Randle Reef Sediment Remediation Project

Comprehensive Study Report

Prepared for:
Environment Canada
Fisheries and Oceans Canada
Transport Canada
Hamilton Port Authority

Prepared by:
The Randle Reef Sediment Remediation Project
Technical Task Group
AECOM

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EXECUTIVE SUMMARY

Introduction

Environment Canada (EC) is leading the development and implementation of a multi-partnered *Randle Reef Sediment Remediation Project* located in Hamilton Harbour, Ontario. Hamilton Harbour is one of 43 "Areas of Concern" (AOCs) identified in the Great Lakes Water Quality Agreement between Canada and the United States. The Hamilton Harbour Remedial Action Plan (commonly called the Hamilton Harbour "RAP") is a detailed strategy to clean up the Harbour, which would result in the "delisting" of the Harbour as an AOC.

Randle Reef is considered to be one of the more complex and highly contaminated sediment sites throughout the Canadian AOCs in the Great Lakes. Randle Reef sediments contain polycyclic aromatic hydrocarbons (PAHs) in very high concentrations in coal tar. This legacy site is a priority for remediation in the Hamilton Harbour RAP and under the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA).

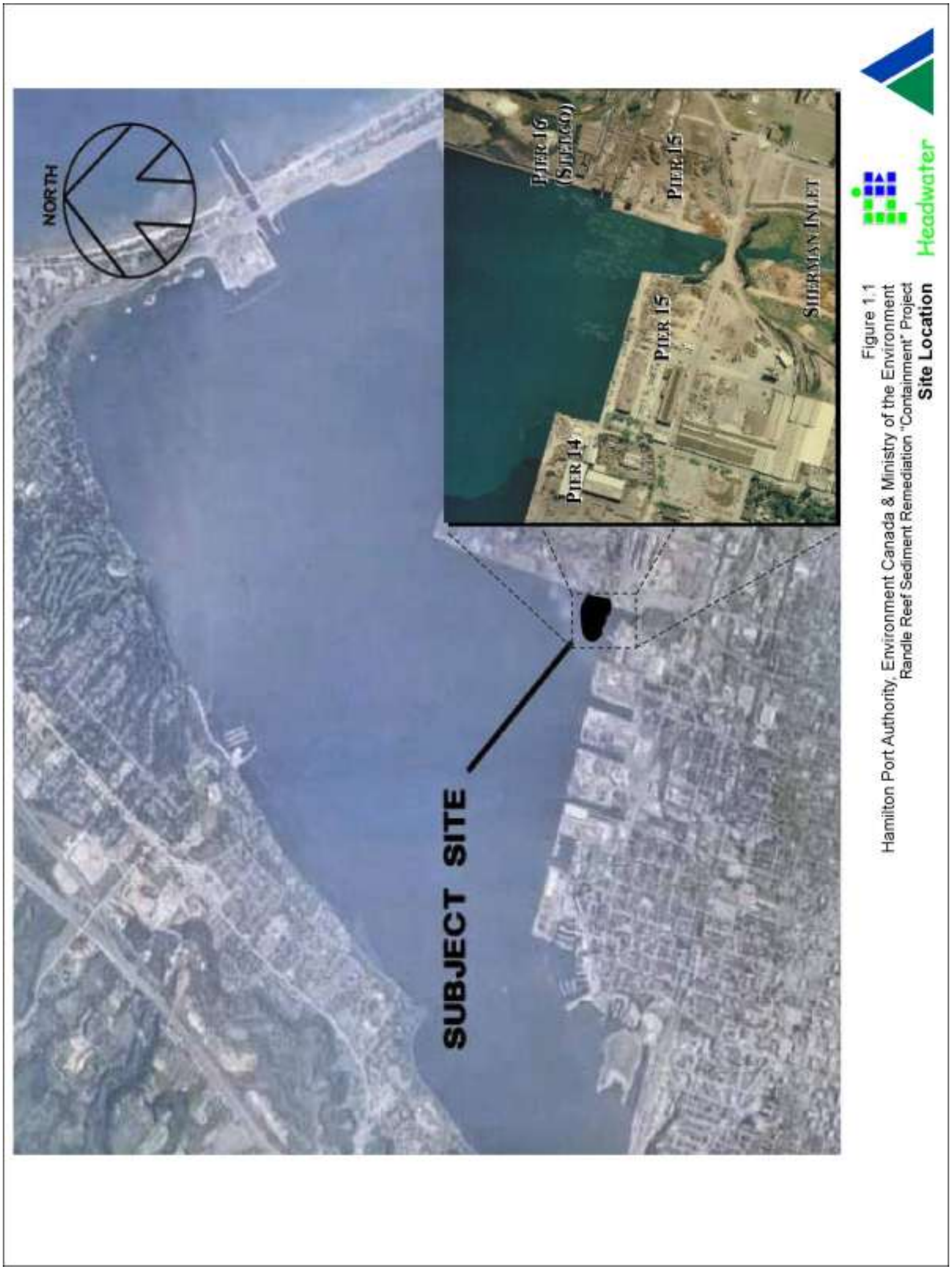
Project Location

Hamilton Harbour is a 2,150 ha embayment located at the west end of Lake Ontario, connected to the lake by a single ship canal across the barrier sandbar that forms the bay. The proposed project is located along the south shore of Hamilton Harbour in the vicinity of Piers 14, 15 and 16. The location of the Randle Reef area within the context of Hamilton Harbour is shown in Figure ES.1.

Purpose of the Project

The purpose of the project is to remediate a number of priority zones of sediments contaminated with high levels of PAHs in the Randle Reef area, with the potential to address other sediments from elsewhere in the Harbour. The project is intended to reduce the exposure of organisms in the Harbour to the most persistent toxic substances in the sediments, and ultimately to reduce the risk of exposure of aquatic and terrestrial biota, including humans, to these same substances.

Figure ES.1 Project Location



The project is intended to substantially diminish the extent to which highly concentrated PAHs found within sediment in the Randle Reef area can move into the water column or across the Harbour, therefore, preventing these sediments from continuing to be a source of contamination within the local ecosystem.

The completed project will result in the creation of new land with a proposed end use of approximately 2/3rds marine terminal and 1/3rd naturalized open space or area surfaced with a suitable aggregate material and used as light industrial space. The proposed marine terminal facility is intended to be suitable for vessels greater than 25,000 DWT and of Seaway draught, with vessels entering and exiting the berths along Pier 15 northwest of Sherman Inlet.

Project Overview

The proposed remediation of Randle Reef involves the construction of a capped engineered containment facility (ECF) of about 7.5 ha in size, consisting of a peninsula attached to Pier 15. The connection point for the containment facility is Pier 16, property owned by the Hamilton Port Authority (HPA), south of the property owned by U.S. Steel (formerly Stelco). The containment facility would cover in-situ about 130,000 m^3 of sediments contaminated with PAHs, and contain about 500,000 m^3 of dredged PAH contaminated sediments from the surrounding areas. The site footprint covers the majority of the most contaminated sediment in the priority zone area (i.e., the area of highest contamination).

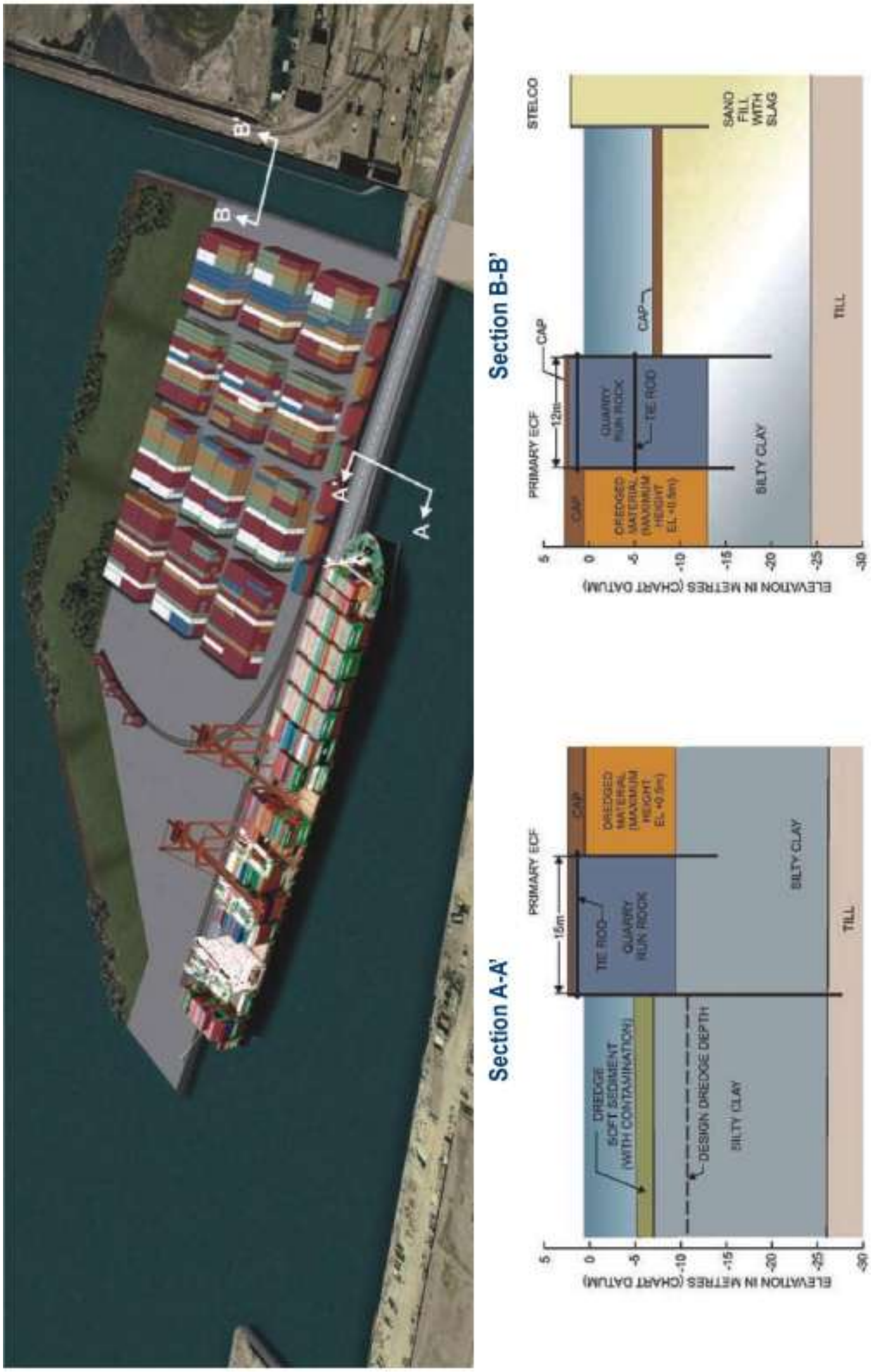
If 1/3 of the ECF is naturalized it could include vegetation that is indigenous to the area to create ecological diversity that may enhance local terrestrial and avian habitat The ECF will also provide approximately 5 ha of the primary site for a marine terminal and operations.

In addition, the ECF design will accommodate ongoing port operations at the Pier 15 berth as well as the U.S. Steel water intake and outfall. A conceptual plan of the proposed project is shown in Figure ES.2.

The construction and dredging required for project completion is expected to take approximately 8 years. The schedule for the *Randle Reef Sediment Remediation Project* includes:

Activity	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2022 and Beyond**
Construction Phase										
Monitoring	■	■	■	■	■	■	■	■	■	
ECF Containment Walls	■	■	■							
In-Water Production Dredging			■	■	■					
U.S. Steel Sediment Cap					■					
ECF Capping						■	■	■		
Post Project Evaluation									■	
Operation Phase										
Long-Term Monitoring										■
Maintenance and Repair										■
Decommissioning Phase										
None Anticipated										

Figure ES.2: Randle Reef Sediment Remediation Project



Canadian Environmental Assessment Act Requirements

The *Canadian Environmental Assessment Act* (CEAA) establishes the federal responsibilities and procedures for the assessment of potential environmental effects of projects. CEAA applies to federal authorities when they contemplate certain actions or decisions in relation to a project that would enable it to proceed in whole or in part.

Four federal agencies have determined that they must exercise one or more of the powers, duties or functions prescribed under section 5 of CEAA. Environment Canada is proposing the construction and operation of the ECF along with associated environmental dredging and containment components. The Hamilton Port Authority (HPA) is proposing marine terminal operations and any future construction related to it. Fisheries and Oceans Canada and Transport Canada have regulatory triggers due to requirements for authorization under the subsection 35(2) of the *Fisheries Act* and section 5 of the *Navigable Waters Protection Act*, respectively. As such Environment Canada, Fisheries and Oceans Canada and Transport Canada are responsible authorities (RAs) for the proposed work. The HPA which is subject to the Canada Port Authorities Environmental Assessment Regulations, is a Prescribed Authority (PA) and has responsibilities similar to those of an RA.

Environment Canada has taken the lead for the environmental assessment of this project as agreed by HPA and the other RAs. The HPA and the RAs agree that since the ECF and the marine terminal are directly linked, it is appropriate that they be assessed together as one project.

The RAs and HPA have determined that the appropriate environmental assessment track for this project is a comprehensive study under CEAA, pursuant to paragraph 28(c) of the *Comprehensive Study List Regulations* which requires a comprehensive study be undertaken for the construction, decommissioning or abandonment of a marine terminal designed to handle vessels larger than 25,000 DWT (dry weight tonnage) that is not planned for lands considered to be routinely and historically used as a marine terminal or designated for use in a land use plan that has been subject to public consultation.

This comprehensive study has been undertaken in accordance with the provisions of CEAA and the *Canada Port Authority Environmental Assessment Regulations*. Since the environmental assessment (EA) for this project commenced on March 7, 2003, this comprehensive study is conducted pursuant to CEAA, Bill C-13 (CEAA 1992) as opposed to the October 2003 Bill C-9 amendments to CEAA(CEAA 2003).

Study Process

The Randle Reef sediment remediation study process involved a number of steps, over a time frame of approximately 13 years (1996 to 2009), including the review of:

- conceptual design alternatives;
- removal/treatment/disposal alternatives;
- sediment removal and containment alternatives (Project Advisory Group);
- conceptual design study for preferred alternative;
- design elements and options; and
- environmental effects, mitigation, monitoring and follow-up measures for the project.

In addition, the use of conditioned dredged material for feedstock for the U.S. Steel's (Stelco's at that time) sinter plant was reviewed. Another assessment involved the re-examination of disposal and reuse alternatives to determine which options were feasible and most likely to be implemented. Further details on the steps in the study process are found in Section 2.4.

The study process progressed from the conceptual design to the detailed evaluation of design elements and options at 30 and 100 percent design levels. The 30 and 100 percent design levels involved more detailed design work and studies (e.g., contaminant fate and transport modelling, geotechnical studies) in order to further develop the preferred options for each design element and better define the project.

The design elements for the Randle Reef project are:

- ECF isolation structures;
- dredging design;
- sediment management;
- ECF capping and closure;
- U.S. Steel intake/outfall (I/O); and
- marine terminal facilities.

Once the project was defined, the environmental effects, mitigation, monitoring and follow-up measures were identified.

The existing environmental conditions within Hamilton Harbour were established and considered in the assessment of environmental effects and in completing the detailed engineering design.

<u>Public, Agency and Aboriginal Engagement and Consultation</u>

Consultation related to the Randle Reef sediment remediation study was initiated in September 1994 when the Bay Area Restoration Council (BARC) organized a public meeting to discuss the need and strategy for sediment remediation in the Harbour. The participants reaffirmed the priority to remediate contaminated sediment and agreed that the project site located near Randle Reef be remediated as a high priority initiative.

Consultation began with stakeholder involvement at the outset of the process of identifying remediation alternatives.

Aboriginal Engagement and Consultation

Aboriginal engagement and consultation initiatives commenced in 2003 and continued through to the present. The following Aboriginal groups were contacted: Six Nations of the Grand River Treaty (Six Nations); Haudenosaunee (Six Nations Traditional Council); Mississaugas of the New Credit; the Huron-Wendat First Nation; and the Métis Nation of Ontario.

In 2003, the Six Nations provided a letter of support for the project to Environment Canada. In subsequent updates, the Six Nations indicated that they had "no apparent indication of any further impacts to traditional use at this time". In 2009 the Métis Nation of Ontario also indicated they were supportive of the project.

Multiple attempts have been made to engage the other Aboriginal groups however no other Aboriginal groups have responded to project notifications and offers to meet to discuss the project.

Project Advisory Group

In fall 2001, a Project Advisory Group (PAG) was formed to assist in identifying and reaching consensus on a preferred remediation alternative. PAG had representatives from 17 participating organizations consisting of scientists, citizens, consultants and government representatives.

The PAG was used to obtain public and agency input at key points in the development of the project.

Project Implementation Team

A Project Implementation Team (PIT) was formed to develop various conceptual design options, as well as to participate in the development of the detailed engineering work for the project. PIT members included the City of Hamilton, Clean Air Hamilton, Fisheries and Oceans Canada, Environment Canada – Great Lakes Sustainability Fund (GLSF) and Hamilton Harbour RAP Coordinator, Hamilton Conservation Authority (HCA), HPA, Ontario Ministry of the Environment (MOE) and U.S. Steel.

Public Open Houses

Two Public Open Houses were held to provide members of the public with an opportunity to learn more about the plans for the clean-up, including: options considered for remediation; what the clean-up involves; engineering design; environmental, social and economic benefits; preliminary EA results; and next steps.

Summary of Issues and Concerns Raised to Date

Issues and concerns have been raised regarding the following: whole Harbour solution; public access; emergency planning; need for provincial EA; requirement for Certificates of Approval (provincial); long term integrity of the structure; service life; ownership and operation; exposure of dredge material to air during dredging process; workers and exposure during dredging; worker and public safety; off-gassing; U.S. Steel water intake; transport of materials through residential community; aquatic resources; birds; cost; monitoring; and provision for future technologies.

Environmental Effects, Mitigation and Residual Effects

Valued ecological and socio-economic components (VECs and VSCs) are those biophysical and socio-economic features that are valued by society and/or can serve as indicators of environmental change. The following VECS and VSCs were examined relative to the potential environmental effects resulting from the *Randle Reef Sediment Remediation Project*:

- Air Quality;
- Ambient Noise;
- Soil Quality;
- Surface Water Quality, Currents and Circulation;
- Aquatic Biota;
- Species at Risk;
- Residential Areas;
- Industrial, Commercial and Municipal Use and Infrastructure;
- Sherman Inlet;
- Public Health and Safety;
- Recreational Uses of the Harbour; and
- Shipping and Navigation.

An assessment of the effects of the project for each of these VECs/VSCs is provided in Section 9. This assessment addresses the baseline environmental conditions, and takes into account construction activities and long-term operation of the facility. It includes all the various aspects related to construction and operation as well as an assessment of potential malfunction and accident scenarios, including the determination of residual environmental effects.

For each VEC/VSC, where an interaction between the project and the environment exists, the potential for adverse environmental effects is identified taking into account the implementation of appropriate mitigation measures.

Effects of the Environment on the Project

The potential effects of severe weather conditions and other environmental events on the condition and function of the project, including climate change, were assessed. The objective was to determine the significance of any such impacts on the environment or to human health and safety.

A series of potential effects are identified, however, all potential adverse effects are predicted to be minor (i.e., non-significant). This conclusion takes into account design standards/features to be incorporated into the project to accommodate for any foreseeable natural events (e.g., extreme weather events, earthquakes) potentially damaging the project and resulting in environmental impacts.

Cumulative Environmental Effects

The evaluation of potential cumulative effects includes a consideration of other past, present and future projects and activities that will/may interact temporally or spatially with the proposed project.

In order to be considered within the cumulative effects assessment the interaction of the environmental effects from the project with the environmental effects of these other projects, or components of these projects, must be cumulative in nature and when combined creates a measurable environmental effect (i.e., temporal or spatial overlap). There must also be sufficient confidence that these other projects or activities have, are or will occur.

It was determined that there is some interaction of the project with some other projects which may result in cumulative effects. Relevant project-inherent effects management measures were reviewed and additional mitigation measures developed, where applicable. Considering these management and mitigation measures, the residual adverse cumulative effects were evaluated and considered to not be significant.

Follow-Up and Monitoring

A follow-up program will be in-place during the implementation of the *Randle Reef Sediment Remediation Project*. This is an essential component of the management and successful completion of project construction and the long-term management of the ECF and marine terminal operations.

Monitoring will be in place in order to measure compliance with applicable regulations, guidelines and standards.

Conclusion on Likelihood of Significant Adverse Environmental Effects

Given the findings presented in this Comprehensive Study Report (CSR), the RAs and HPA conclude that, taking into consideration the implementation of proposed mitigation measures, the project will not likely result in any significant adverse environmental effects. There are many positive benefits from *Randle Reef Sediment Remediation Project*, including achieving the project goals of reducing the source of contamination to the rest of Hamilton Harbour. Any potentially significant negative impacts will be reduced by implementing mitigation measures described in this comprehensive study report. A follow-up program will be implemented to confirm these conclusions and identify additional activities that may be required to protect the environment from any unanticipated adverse environmental effects.

COMMON TERMS AND ABBREVIATIONS

AAQC	ambient air quality criteria
ACDP	acoustic Doppler current profiler
ADMGO	Air Dispersion Modelling Guideline for Ontario
AERMIC	American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee
Agency	Canadian Environmental Assessment Agency
AQI	Air Quality Index
BARC	Bay Area Restoration Council
BBL	Blasland, Bouck & Lee, Inc.
BEAST	benthic assessment of sediment
BMPs	best management practices
BOD	Basis of Design
BTEX	benzene, toluene, ethylbenzene and xylene
BUI	beneficial use impairments
CACs	criteria air contaminants
CCME	Canadian Council of Ministers of the Environment
CEA	cumulative effects assessment
CEAA	*Canadian Environmental Assessment Act*
CEPA	*Canadian Environmental Protection Act, 1999*
CBD	Common Basis for Design
cm/hr	centimetres per hour
CO	carbon monoxide
COA	Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem
C of A	Certificate of Approval
CWS	Canadian Wildlife Service
CWQG	Canadian Water Quality Guidelines
DFO	Department of Fisheries and Oceans
DRET	dredging elutriate test
EA	Environmental Assessment
EAA	Ontario *Environmental Assessment Act*
EC	Environment Canada
ECF	engineered containment facility

EEF	effluent elutriate test
EPA	*Environmental Protection Act*
EPP	environmental protection plan
ESA	Environmentally Significant Area
FML	flexible membrane liner
GAC	granulated active carbon
GCL	geosynthetic clay liner
GHG	greenhouse gases
GLSF	Great Lakes Sustainability Fund
CWS	Canada-Wide Standards
gpm	gallons per minute
GPS	global positioning system
HADD	harmful alteration, disruption or destruction (of fish habitat)
HAMN	Hamilton Air Monitoring Network
HAPs	hazardous air pollutants
HDPE	high density polyethylene
HPA	Hamilton Port Authority
IBI	Index of Biotic Integrity
IGLD	International Great Lakes Datum 1985
I/O	intake/outfall
JTU	Jackson turbidity unit
LSA	local study area
MAL	Maximum Acceptable Level
MDL	Maximum Desirable Level
MET	Raw meteorological
mg/L	milligrams per litre
mitigate	to lessen the impacts
MNR	(Ontario) Ministry of Natural Resources
MOE	(Ontario) Ministry of the Environment
MTL	Maximum Tolerable Level
NAAQOs	National Ambient Air Quality Objectives
NAPL	non-aqueous phase liquid
NAPS	National Air Pollution Surveillance Program
NO	nitrogen oxide

NO2	nitrogen dioxide
NOx	oxides of nitrogen
NTUs	Nephelometric Turbidity Units
NWPA	Navigable Waters Protection Act
NWRI	National Water Research Institute
OMM	operations, maintenance and monitoring
OWRA	*Ontario Water Resources Act*
PA	prescribed authority (i.e., Hamilton Port Authority)
PAG	Project Advisory Group
PAH	polycyclic or polynuclear aromatic hydrocarbons
PAH-N	polycyclic or polynuclear aromatic hydrocarbons less naphthalene
POI	Point of Impingement
PIT	Project Implementation Team
PCB	polychlorinated biphenyls
PCP	pentachlorophenol
PM	particulate matter
ppb	parts per billion (e.g., ng/g, µg/kg, µg/L)
ppm	parts per million (e.g., µg/g, mg/kg, mg/L)
proponent	the party proposing the project (i.e., Environment Canada)
PSQGs	Provincial Sediment Quality Guidelines
PSW	Provincially Significant Wetland
public consultation	discussion with stakeholders, affected property owners and the general public on this remediation project
QEW	Queen Elizabeth Way
PWQO	Provincial Water Quality Objectives
RA	responsible authority
RAP	Hamilton Harbour Remedial Action Plan
RBG	Royal Botanical Gardens
RCM	reactive core mats
remediation	the action of correcting a problem
RTP	Remedial Technologies Program
SAR	Species at Risk
SARA	*Species at Risk Act*
sediment	materials deposited on the lakebed

SEL	severe effects level (i.e., Provincial Sediment Quality Guidelines Severe Effects Level)
SO2	sulphur dioxide
soil	on-shore materials including fill, gravel, sand, silt, clay, organics and sediments
SPL	sound pressure levels
SPU	slurry processing unit
stakeholders	any individual, group or organization that have formalized an interest or concern with respect to a project
TOC	total organic carbon
TRS	total reduced sulphur
TSS	total suspended solids
U.S. EPA	United States Environmental Protection Agency
USSDW	U.S. Steel (formerly Stelco) dock wall
U.S. Steel	U.S. Steel Canada
VEC	valued ecosystem component
VOC	volatile organic compounds
VSCs	valued socio-economic components
WSOC	west side open cut (in reference to U. S. Steel property)
WWTP	wastewater treatment plant

1.0 INTRODUCTION AND BACKGROUND

1.1 Introduction

Environment Canada is leading the development and implementation of a multi-partnered Randle Reef Sediment Remediation Project located in Hamilton Harbour, Ontario. Hamilton Harbour is one of 43 "Areas of Concern" (AOC) identified in the Great Lakes Water Quality Agreement between Canada and the United States. The Hamilton Harbour Remedial Action Plan (commonly called the Hamilton Harbour "RAP") is a detailed strategy to clean up the Harbour, which would result in the "delisting" of the Harbour as an AOC. Remediation of various contaminated sediment sites within the Harbour have been identified as a priority under the Hamilton Harbour RAP.

As part of the RAP "clean up" of Hamilton Harbour, it is proposed to contain in place, the most contaminated sediment found in the area of Randle Reef and possibly other contaminated sediment sites in the Harbour. Randle Reef is considered to be one of the more complex and highly contaminated sediment sites throughout the Canadian AOCs in the Great Lakes. Randle Reef sediments contain polynuclear aromatic hydrocarbons (PAHs) in very high concentrations in coal tar. This legacy site is a priority for remediation in the Hamilton Harbour RAP and under the Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA).

1.2 Project Location

Hamilton Harbour is located at the west end of Lake Ontario. Hamilton Harbour is a 2,150 ha embayment of Lake Ontario, connected to the lake by a single ship canal across the sandbar that forms the bay. The conditions in the Harbour reflect natural inputs, human activities, land uses and drainage from a watershed of 49,400 ha. The Harbour accommodates a commercial port and is considered to be a major shipping centre. The south shore of the Harbour supports the highest concentration of heavy metal industry (primarily iron and steel) in Canada.

The proposed project is located along the south shore of Hamilton Harbour in the vicinity of Piers 14, 15 and 16. The location of the Randle Reef area within the context of Hamilton Harbour is shown in Figure 1.1 while Figure 1.2 illustrates the location of the project site in reference to Piers 14, 15 and 16.

Figure 1.1: Randle Reef Area in Hamilton Harbour

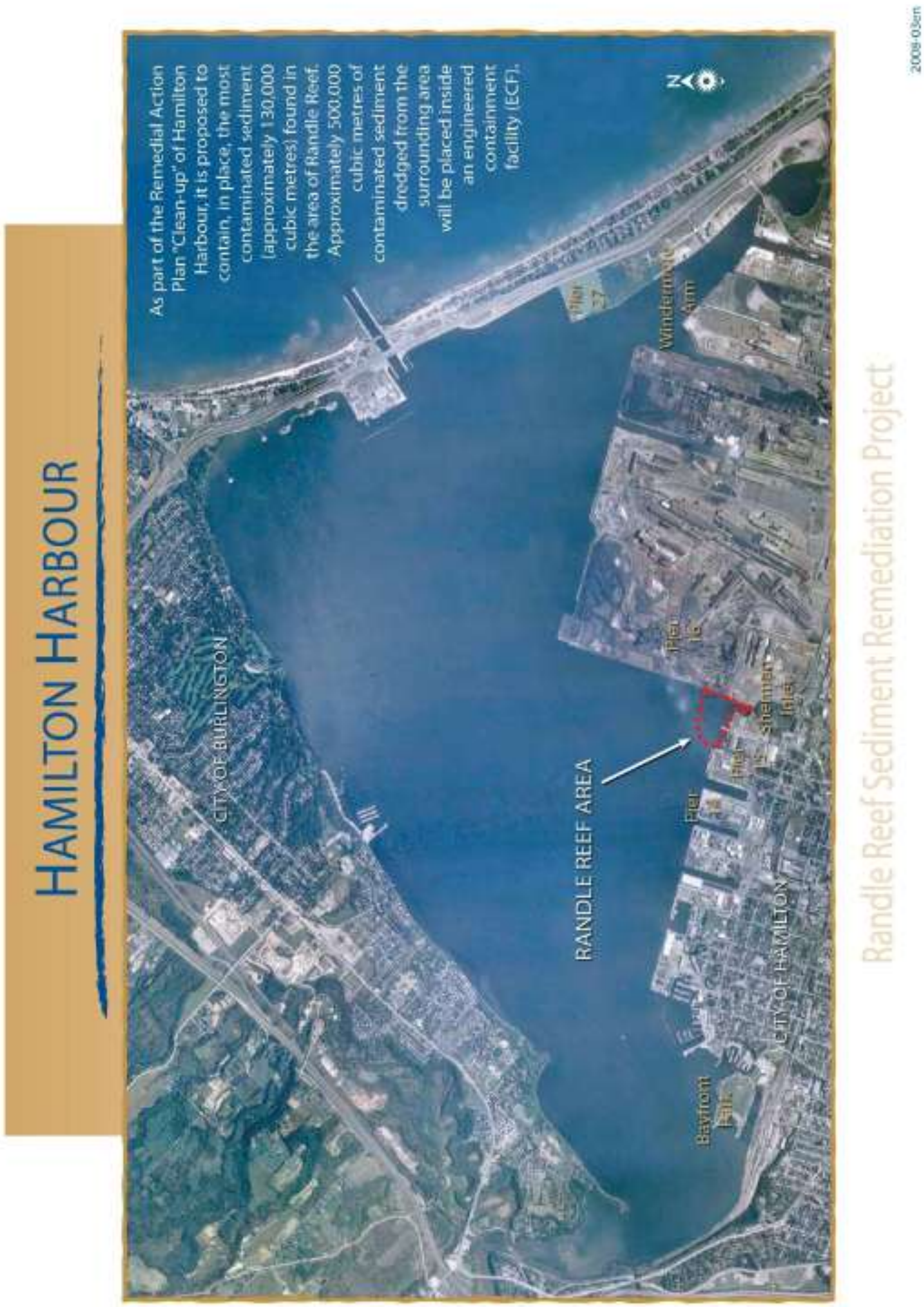
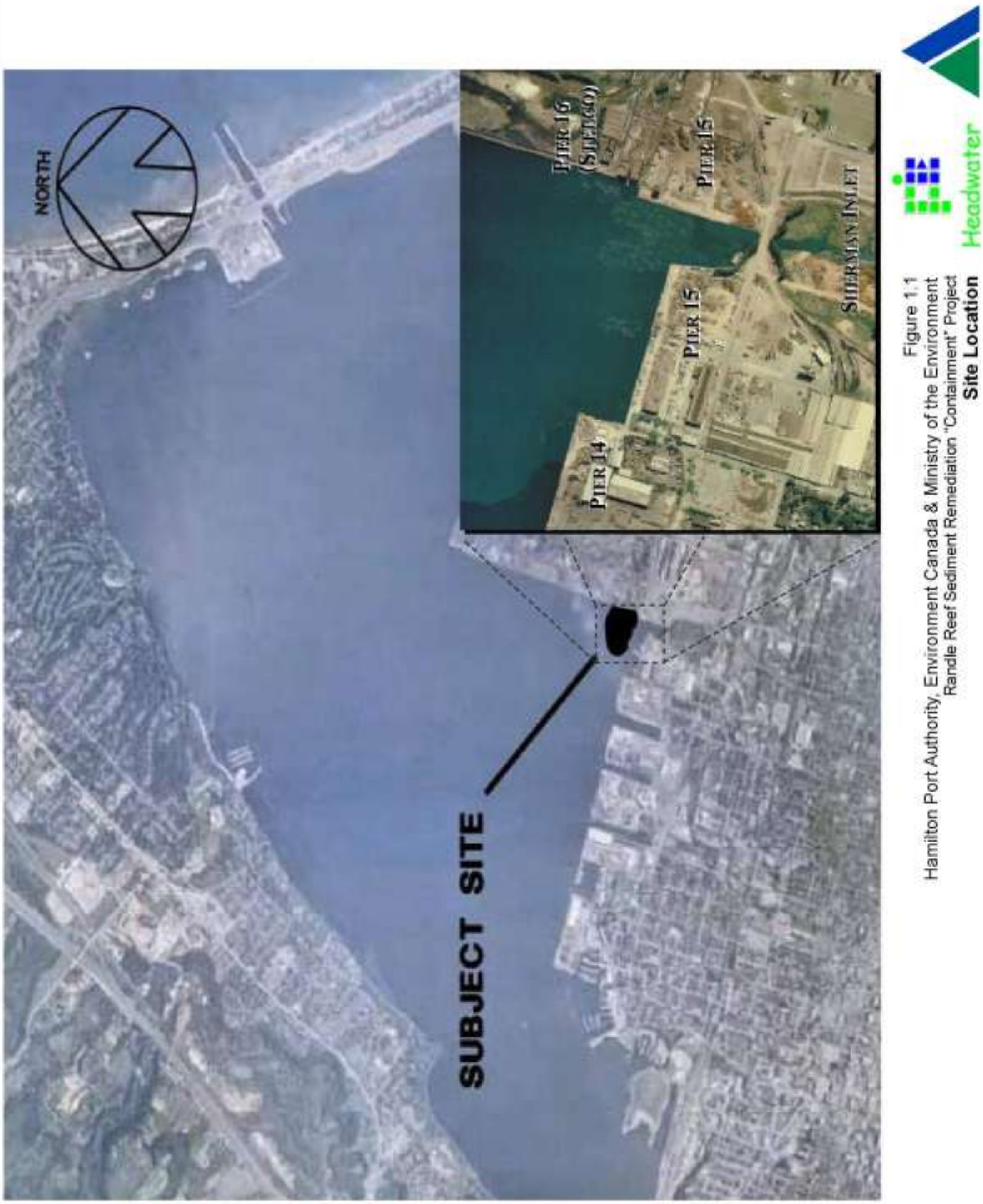


Figure 1.2: Project Location



1.3 Need for and Purpose of the Project

1.3.1 Need for the Project

In 1995, the Hamilton Harbour RAP Strategy for Contaminated Sediment identified an area near Randle Reef as a high priority zone for remedial action. The RAP recommended removal of the highly contaminated sediment, where PAHs were in excessive concentrations.

There is a need to reduce the exposure of organisms in the Harbour to the most persistent toxic substances in the sediments. The physical characteristics of the Randle Reef site are such that it acts as a source, re-circulating contaminants throughout the sediments and water column along the south shore of Hamilton Harbour. As noted in Section 1.1, the site is a priority for remediation in the Hamilton Harbour RAP and under COA.

1.3.2 Purpose of the Project

The purpose of the project is to remediate a priority zone of sediments contaminated with high levels of PAHs in the Randle Reef area, as an initial step to control sources of contamination to the local ecosystem, with the potential to address other sediments from elsewhere in the Harbour.

The project is intended to reduce the exposure of organisms in the Harbour to the most persistent toxic substances in the sediments, and ultimately to reduce the risk of exposure of aquatic and terrestrial biota, including humans, to these same substances.

The project objective is to substantially diminish the extent to which highly concentrated PAHs found within sediment in the Randle Reef area can move into the water column or across the Harbour, therefore, preventing these sediments from continuing to be a source of contamination within the local ecosystem.

The Randle Reef remediation is a high priority project among many projects aimed at achieving the goals and objectives set out in the Hamilton Harbour RAP. Project-specific objectives are consistent with the ultimate long-term objectives of the Hamilton Harbour RAP, as well as the policy framework of the funding organizations.

1.4 Project Overview

The proposed remediation of Randle Reef involves the construction of a dry cap diked containment facility about 7.5 ha in size, consisting of a peninsula attached to Pier 15 [1] The connection point for the containment facility is Pier 15 owned by the Hamilton Port Authority, south of the property owned by U.S. Steel (formerly Stelco). The containment facility would cover in-situ about 130,000 m^3 of sediments contaminated with PAHs, and contain about 500,000 m^3 of dredged PAH contaminated sediments.

The proposed end use of the containment facility is an approximate mix of 2/3 port activities and 1/3 naturalized open space or area surfaced with a suitable aggregate material and used as light industrial space. The proposed marine terminal would be suitable for ships of Great Lakes Seaway draught, with vessels entering and exiting the berths along Pier 15 northwest of Sherman Inlet.

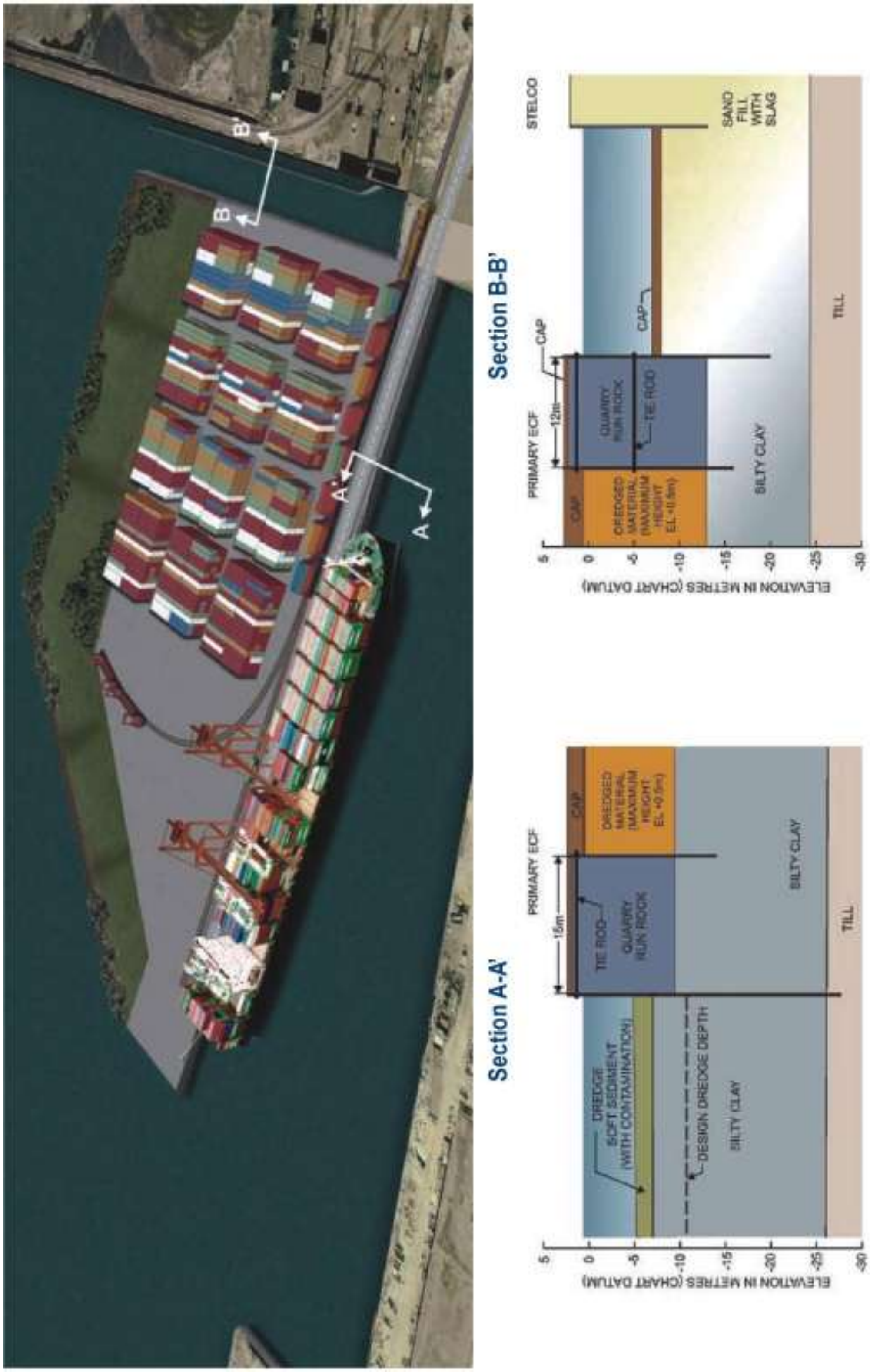
The site footprint covers the majority of the most contaminated sediment in the priority zone area (i.e., the area of highest contamination). The volume of sediment estimated to be contained in-situ is approximately 130,000 m^3. The final elevation of the facility is estimated to be 76.2 m International Great Lakes Datum 1985 (IGLD), which is level with the existing piers. Capping material could come from elsewhere in the Harbour, and/or from sources off-site (i.e., local quarries), provided it meets suitable criteria for capping material. These specifications will be outlined in contract documents as well as in a quality assurance program for incoming materials. The environmental effects related to the use of materials which are sourced off-site are evaluated in Section 9.0.

If 1/3 of the ECF is naturalized it could include vegetation that is indigenous to the area to create ecological diversity that may enhance local terrestrial and avian habitat. The facility will also provide approximately 5 ha of the primary site for a marine terminal.

In addition, the facility will accommodate the ongoing operations of the existing port uses at the Pier 15 berth as well as the U.S. Steel water intake and outfall. A conceptual plan of the proposed project is shown in Figure 1.3.

[1] A secondary facility, consisting of a triangular extension to Pier 15, was originally considered as part of the project. The secondary facility was examined until part way through the 100% design stage, where it was removed from the final design due to technical and cost considerations (see Section 7.0).

Figure 1.3: Randle Reef Sediment Remediation Project



1.5 Project Background

The process to develop a preferred approach to remediate the highly contaminated sediments near Randle Reef has been underway since 1995 and has involved considerable input from a variety of agencies and stakeholders. In November 2001, Environment Canada, as the project lead, formed a multi-stakeholder Project Advisory Group (PAG) [2] consisting of 17 participating organizations to develop a majority opinion around a solution that will satisfy the objectives of the *Randle Reef Sediment Remediation Project* and those of the stakeholders represented.

A range of remediation options were considered by PAG, including: removal and containment; removal and re-use; and in-situ containment. Treatment may or may not have been considered a component of any of the options. Further details on this evaluation are provided in Section 5.1.

In April 2002, after careful consideration of the advantages and disadvantages of each of the remediation options, PAG recommended the in-situ containment option as the preferred remediation approach. This option was selected since it has the potential to address other contaminated sediments in the Harbour (i.e., achieve a larger scale clean-up), involves minimal disturbance of the most highly contaminated sediment, significantly accelerates the time frame to attain RAP goals for addressing contaminated sediment, provides greater opportunity for partnership resources and provides a cost-effective innovative solution for remediating the highly contaminated sediment around Randle Reef.

Subsequently, a Project Implementation Team (PIT) [3] of stakeholders was formed to develop various conceptual design options for review by the PAG.

In September 2002, consultants were contracted to develop a conceptual design study (Acres & Associated, Headwater and PEIL, 2003). The objective of this study was to develop alternative conceptual design options for the containment facility that constraints associated with the project. Three options were developed for all-natural and mixed-use alternatives (i.e., natural/commercial mix). Variations of the multi-use concept were further analyzed.

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[2] The PAG consists of representatives from BARC, Hamilton Harbour RAP Office, Great Lakes United, Clean Air Hamilton, Central North End West Neighbourhood Association, Hamilton Beach Preservation Committee, Hamilton Industrial Environmental Association Citizen Liaison Committee, City of Hamilton, City of Burlington, U.S. Steel (formerly Stelco), Local 1005 (USWA), MOE, Ontario Ministry of Labour, Environment Canada, DFO, HCA and the HPA.

[3] The members of PIT are the City of Hamilton, Clean Air Hamilton, DFO, Environment Canada – GLSF and Hamilton Harbour RAP Coordinator, HCA, HPA, MOE and Stelco

The conceptual design study examined these options by comparing project objectives and key issues within four categories: environmental; technical; socio-economic; and financial.

In December 2002, those in attendance at the PAG meeting recommended a conceptual design for the containment facility. The proposed design involves an engineered containment facility (ECF) that would cover and contain approximately 630,000 m^3 of highly contaminated sediments at the Randle Reef site, and potentially from elsewhere in the Harbour. The PAG recommended that the site optimize the ability to address PAH contaminated sediment greater than 200 parts per million (ppm). The proposed containment facility incorporated some naturalized land use and allowed for future port uses.

In addition, PAG recommended proceeding to undertake the detailed engineering for the proposed facility. In addition, the conceptual design was presented to the public for comment on June 11, 2003. The detailed engineering for the proposed project commenced in the fall of 2003.

1.6 Hamilton Harbour Priority Sediment Sites

Sediments throughout Hamilton Harbour are contaminated with heavy metals and some areas are further contaminated with PCBs, PAHs and oil and grease. The Hamilton Harbour RAP strategy suggests that, with time, contaminants in most areas of the Harbour sediments may weather (as in the case of metals) or degrade (as in the case of organics) or be covered up to such an extent that they might no longer be available to biota. However, the strategy points to three sites as being "highest priority" sites requiring active intervention. Acute toxicity to benthos is highest in those sites. These sites are the area near Randle Reef, the Ottawa Street boat slip, and the Dofasco boat slip. Of the three, the Randle Reef area is the highest priority for sediment remediation. In recent years, there has been concern regarding another area in the Harbour, Windermere Arm, due to elevated levels of PCBs in sediments in this area.

Randle Reef

Randle Reef sediments contain weathered PAHs in high concentrations. The physical characteristics of the site are such that it has the potential for re-circulation of contaminants on the south shore of Hamilton Harbour. Re-circulated PAHs can subsequently move up the food chain.

Ottawa Street Slip

The Ottawa Street Slip has recently been studied to identify whether there is contamination present that would necessitate some remedial management actions. Studies were completed with transects taken from the head to the north end of the slip (Marvin, 2007). Low levels of total PAHs were found that are typical of background in the Harbour and are characteristic of well-weathered PAH profiles, indicating that the contamination is historical and not a result of recent discharges. Metals and PCBs are yet to be analysed but are expected to exhibit similar trends, given the well-weathered sediment profiles. The preliminary conclusion is that no management action is required for the Ottawa Street Slip in relation to the management of PAHs.

Dofasco Boat Slip

ArcelorMittal Dofasco (formerly Dofasco) has undertaken studies to address management options for the Dofasco Boat slip. Studies completed in the area show that the levels of contamination are similar to levels found in the Randle Reef area. ArcelorMittal Dofasco is currently developing management options to address the contamination in the slip.

Windermere Arm

In recent years, concern has been raised with respect to PCB contamination in Windermere Arm. Studies completed to examine the contamination suggest that dredging and removal of this sediment is not recommended as a remediation management option for the sediment in this area. Further work is being done to complete a PCB mass balance study of the Harbour. The Remedial Action Plan Working Group for Windermere Arm is continuing work on examining other inputs (from tributaries, etc.) to validate some of the conclusions in the mass balance study and to further characterize sources that may be contributing to determine if there is a source of ongoing loadings to the Harbour.

1.7 Canada – Ontario Agreement Respecting the Great Lakes Basin Ecosystem and Hamilton Harbour RAP

Under COA, Environment Canada is the lead federal agency responsible for the Hamilton Harbour RAP and the eventual de-listing of this AOC. MOE is the lead provincial agency for the RAP. The Randle Reef site is within the Hamilton Harbour RAP.

The purpose of this Agreement is to "restore, protect and conserve the Great Lakes Basin Ecosystem in order to assist in achieving the vision of a healthy, prosperous and sustainable Basin Ecosystem for present and future generations" (Governments of Canada and Ontario, 2002, p. 11). The revised 2007 agreement supports these objectives.

The Agreement notes that Canada and Ontario will "address historic contamination and degradation [in AOCs] by achieving management strategies for contaminated sediment" (Governments of Canada and Ontario, 2002, p. 13). It is further noted that Canada and Ontario will:

- "*develop a risk-based, decision-making framework;*
- *consult with local communities on the development of management strategies;*
- *provide technical support and/or financial assistance for feasibility studies and remediation activities;*

- *undertake post project and long-term monitoring studies to determine the recovery of beneficial uses; and,*
- *develop publications and web sites and conduct workshops to promote management strategies and technologies for contaminated sediment*" (Governments of Canada and Ontario, 2002, p. 13).

In addition, Canada will *"conduct detailed sediment chemistry and biological assessments in AOCs"* (Governments of Canada and Ontario, 2002, p. 13).

The ultimate goal of the RAP is to delist the AOC. The word "delisting" refers to the removal of Hamilton Harbour from the government held list of AOCs on the Great Lakes, which will occur when all criteria are met. The Hamilton Harbour RAP identified "delisting criteria" or criteria which, when met, signify that a specific beneficial use impairment is no longer present.

Four of the impairments to beneficial uses cited in the Hamilton Harbour RAP are linked to sediment contamination. These impairments are: degradation of benthos (bottom-dwelling organisms); fish tumours and other deformities; degradation of phytoplankton and zooplankton populations; and loss of fish and wildlife habitat.

Sediment remediation is viewed by the Hamilton Harbour RAP as one necessary element in a series of improvements which are interdependent and which will all contribute to removing the current impairments or signs of stress.

The project's contribution to RAP goals takes two forms. The first is its ability to reduce exposure of biota to PAHs, thereby reducing the risk of impairment to their health. The second is the ability to recover lost habitat for bottom-dwelling organisms, and by extension, organisms which feed on them. A net improvement to the health of existing organisms can be expected, as well as an increase in the abundance and diversity of organisms, provided complementary remedial actions are also taken that impact the exposure of biota and recovering lost habitat. An example of one of these actions could be the reduction of combined sewer overflows and various contaminants into the Harbour.

1.8 Contaminants of Concern

Many factors contribute to the toxicity of sediment in Hamilton Harbour, making a direct cause and effect relationship between PAHs and effects on Hamilton Harbour organisms extremely difficult to demonstrate. However, scientists have been able to demonstrate that the acute toxicity of Hamilton Harbour sediments is "significantly correlated" to the concentration of PAHs (Murphy, T.P., H. Brouwer, M.E. Fox, E. Nagy, L. McArdle and A. Moller, 1990).

PAHs are the contaminants of greatest concern in the sediments in the area of Randle Reef because they are known to be persistent and toxic, bioaccumulative to a limited extent, and present in concentrations that are considered very high (Murphy, T.P., H. Brouwer, M.E. Fox, E. Nagy, L. McArdle and A. Moller, 1990). PAHs of sufficient concentrations and exposure periods are carcinogenic and have the potential to harm a wide variety of life forms, including humans. Cautious and safe work routines are required in the handling of these materials.

PAHs are products of incomplete combustion associated with numerous processes and human activities that occur presently or have occurred historically in this region, including steelmaking and coal gasification. PAH contamination is likely a legacy from a variety of past industrial processes and no ongoing sources are known to exist that would re-contaminate the site.

Concentrations of PAHs are very high in this part of the Harbour. The Randle Reef area contains the highest levels of PAH on the Canadian side of the Great Lakes. For purposes of comparison, there is only one location that has been discovered in Canada in which PAH concentrations in sediment exceed those in Hamilton Harbour (this location is Sydney, Nova Scotia) (Environment Canada, 1997, p. 6). Total PAH concentrations in sediments of Randle Reef are comparable to those from Coke Oven Brook, Nova Scotia (maximum 74,860 μg/g, mean 10,761 μg/g). To compare directly to Randle Reef, 1-methyl Naphthalene, 2-methyl Naphthalene and Perylene were not included in the calculation of the total PAH concentration (Borgmann and Santiago, 2004).

In laboratory studies, at concentrations greater than 200 ppm PAH, Hamilton Harbour sediments are acutely toxic to more than 50% of test organisms. At concentrations > 800 ppm, they are acutely toxic to 100% of mayflies, even after corrections have been made for low oxygen levels. Levels above 800 ppm, when re-suspended, act as a source of contamination to the water column and adjacent sediments.

PAH – Within ECF Footprint

Within the proposed engineered containment facility (ECF) and dredged shipping channel footprint, the maximum total PAH concentration in Randle Reef sediment core samples taken in December 1999 was 73,755 μg/g; for these samples, the mean was calculated to be 8,551 μg/g; for samples obtained in December 1996, the mean was 9,721 μg/g (Zeman and Patterson, 2003). The cores containing the highest PAH concentrations were mainly found within the "hot spot" boundaries next to the U.S. Steel dock.

PAH - Outside ECF Footprint

Outside the ECF footprint, total PAH concentrations were found to range from 1 to 9,048 μg/g (median 87 μg/g, mean 320 μg/g) (Milani and Grapentine, 2003b). The Provincial Sediment Quality Guidelines Severe Effects Level (SEL) for PAHs (normalized to Total Organic Carbon (TOC)) is exceeded at seven sites, all located along the U.S. Steel wall. The dominant PAH varies between sites. However, overall the predominant PAHs are fluoranthene, pyrene, naphthalene and phenanthrene.

Trace Metals – Within the ECF Footprint

Metals exceeding the SEL at Randle Reef sites within the ECF footprint include, with average concentrations in brackets: arsenic (As, 26 μg/g); copper (Cu, 78.5 μg/g); mercury (Hg, 0.9 μg/g); manganese (Mn, 1,906 μg/g); lead (Pb, 376 μg/g); and zinc (Zn, 1,710 μg/g) (Milani and Grapentine, 2003a). The Lake Ontario reference medians (where available) were As 6.0 μg/g, Cu 30.0 μg/g, Hg 0.08 μg/g, Pb 55.5 μg/g and Zn 124 μg/g.

Trace Metals – Outside the ECF Footprint

Trace metals in Randle Reef sediments sampled outside the ECF footprint exceeding the SEL at Randle Reef sites include (number of sites in brackets): chromium (3); copper (3); iron (21); lead (8); manganese (63); nickel (2); and zinc (27) (Milani and Grapentine, 2003b). Mn ranges from 742 to 11,019 μg/g (median 1,400 μg/g), Zn ranges from 67 to 2,520 μg/g (median 586 μg/g), Fe ranges from 1.2 to 15.7% (median 3.1%), Pb ranges from 17 to 611 μg/g (median 103 μg/g), and Cu ranges from 17 to 708 μg/g (median 47 μg/g). The highest concentrations of most trace metals occur in the same general location, along the southeastern wall.

Eight Randle Reef sites have two or more trace metals elevated above the SEL and are also higher than at the Lake Ontario reference sites except for Fe, with reference medians (where available) of Zn 124 μg/g, Fe 3.5%, Pb 55.5 μg/g and Cu 30.0 μg/g.

Polychlorinated Biphenyls, PCBs

Total PCB concentrations in Randle Reef sediment outside the ECF footprint range from below detection (20 sites) to 1.4 μg/g (median/mean 0.3 μg/g) (Milani and Grapentine, 2003b). The SEL for PCBs (normalized to TOC) is not exceeded at any site in Randle Reef. PCBs consist primarily of Aroclor-1254 and Aroclor-1260, which are detected at most sites.

Contamination Levels

The Hamilton Harbour RAP plans for sediment clean-up has primarily focused on PAHs, defining three levels of contamination:

“Hot Spots” – High Contamination

- greater than 800 ppm total PAH less naphthalene, and
- other areas of high toxicity such as the Dofasco boat slip (PAHs/PCBs/metals)

Medium Contamination

- between 200 and 800 ppm total PAH less naphthalene

Lower Contamination

- less than 200 ppm total PAH less naphthalene.

Figure 1.4 illustrates the areas of potential contaminant dredging.

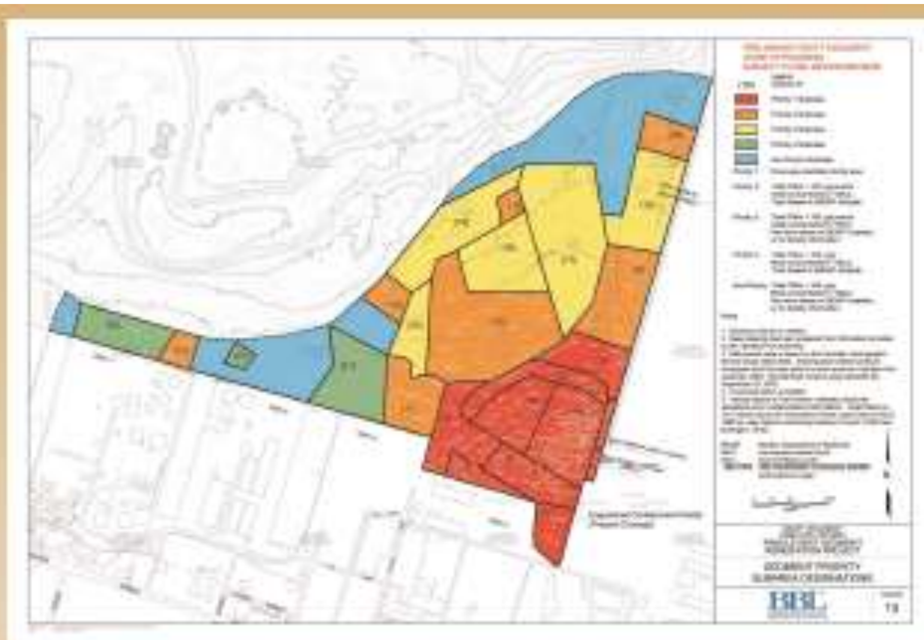
1.9 Project Funding

On August 15, 2007, the Ontario government announced that it is providing $30 million towards the cost of the remediation for Randle Reef. In the news release Ontario Premier Dalton McGuinty indicated that these clean up actions at Randle Reef are part of the province's efforts to improve water quality in the Great Lakes, and will help lead to the delisting of Hamilton Harbour as an Area of Concern on the Great Lakes.

On November 9, 2007, the Honourable John Baird, federal Minister of the Environment, David Sweet, Member of Parliament for Ancaster-Dundas-Flamborough-Westdale and Mike Wallace, Member of Parliament for Burlington, announced that the Government of Canada would invest $30 million towards the clean-up of contaminated sediment in Randle Reef in the Hamilton Harbour Area of Concern in the Great Lakes.

With 2/3 of the funding in place from the federal and provincial governments, the remaining 1/3 is expected to come from stakeholders.

Figure 1.4: Areas of Potential Contaminant Dredging



Contaminated sediment sub-areas will be dredged from priority 1 moving out to priority 4. The sequence and removal of the priority sediments will take into account other considerations for dredging, including the practical limits of dredging equipment, bathymetry of the bottom surface, dredge operations, required environmental controls, and other construction limitations.
The four priority categories are defined as follows:

PRIORITY 1	Priority 1 sediments include the 14.6-hectare (36.5-acre) priority area. These sediments have been previously identified as containing significant concentrations of contaminants (PAHs and metals), as well as showing demonstrated toxicity.
PRIORITY 2	Priority 2 sediments have demonstrated toxicity based on BEAST analysis and elevated concentrations of PAHs and/or metals. Elevated concentrations are defined as total PAH concentrations >100 mg/kg or concentrations of one or more of the metals of interest (arsenic, chromium, copper, iron, lead, nickel, and zinc) that exceed the SELs.
PRIORITY 3	Priority 3 sediments have total PAH concentrations >100 mg/kg or concentrations of one or more metals of interest that exceed the SELs, but do not have demonstrated toxicity. This priority category includes sediments in areas for which no toxicity data are available, as well as areas where the BEAST analysis found no toxicity.
PRIORITY 4	Priority 4 sediments have total PAH concentrations <100 mg/kg, and concentrations of metals of interest below the SELs. However, Priority 4 sediments have demonstrated toxicity based on BEAST analysis.

1.10 Project Schedule

The schedule for the *Randle Reef Sediment Remediation Project* includes:

Date	Project Milestone
December 2012	Submit Comprehensive Study Report to the Canadian Environmental Assessment Agency
February 2013	Public Review of Comprehensive Study Report
After February 2013	Minister's Decision on the Course of Action in Respect of the Project
Fall 2009 to Winter 2012	Secure Funding and Partnerships
To start in 2014 and be completed by 2021.	Construction and Dredging

The construction and dredging required for project completion is expected to take approximately 8 years.

2.0 APPROACH TO DECISION-MAKING

2.1 *The Canadian Environmental Assessment Act*

The *Canadian Environmental Assessment Act* (CEAA) establishes the responsibilities and procedures for the assessment of the potentially significant adverse environmental effects of projects involving the federal government [4]. CEAA applies to federal authorities when they contemplate certain actions or decisions in relation to a project that would enable it to proceed in whole or in part. A federal environmental assessment may be required when a federal authority:

a) is the proponent of a project;
b) provides financial assistance to the proponent;
c) sells, leases or otherwise disposes of federal lands; or
d) issues a permit, licence or any other approval as prescribed in the *Law List Regulations* under CEAA.

The fundamental objectives of CEAA are to:

- ensure that potentially significant adverse environmental effects of projects are considered before irrevocable decisions are made;
- promote the goal of sustainable development;
- ensure that projects undertaken within Canada or on federal lands or waters do not cause significant adverse transboundary environmental effects; and
- ensure the opportunity for meaningful public participation throughout the environmental assessment process.

Four federal agencies have determined that they must exercise one or more of the powers, duties or functions prescribed under section 5 of CEAA. Environment Canada is proposing the construction and operation of the ECF along with associated environmental dredging and containment components. The Hamilton Port Authority (HPA) is proposing marine terminal operations and any future construction related to it. Fisheries and Oceans Canada and Transport Canada have regulatory triggers due to requirements for authorization under the subsection 35(2) of the *Fisheries Act* and section 5 of the *Navigable Waters Protection Act*, respectively. As such Environment Canada, Fisheries and Oceans Canada and Transport Canada are responsible authorities (RAs) for the proposed work. The HPA which is subject to the *Canada Port Authorities Environmental Assessment Regulations* is a Presciribed Authority (Pa) and has responsibilities similar to those of an RA.

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4 Amendments to CEAA came into force on October 30, 2003. These amendments do not apply to the *Randle Reef Sediment Remediation Project* since the comprehensive study for this project was initiated prior to October 30, 2003.

Environment Canada has taken the lead for the environmental assessment of this project as agreed by HPA and the other RAs. The HPA and the RAs agree that since the ECF and the marine terminal are directly linked, it is appropriate that they be assessed together as one project.

The RAs and HPA have determined that the appropriate environmental assessment track for this project is a comprehensive study under CEAA, pursuant to paragraph 28(c) of the Comprehensive Study List Regulations. Paragraph 28(c) of the Comprehensive Study List Regulations requires that a comprehensive study be undertaken for the construction, decommissioning or abandonment of a marine terminal designed to handle vessels larger than 25,000 DWT (dry weight tonnage) that is not planned for lands considered to be routinely and historically used as a marine terminal or designated for use in a land use plan that has been subject to public consultation.

While the HPA and RAs determined that a detailed assessment would be undertaken for the sediment remediation project, it is the end use or port component of the overall project that results in the regulated requirement to undertake a comprehensive study.

This comprehensive study has been undertaken in accordance with the provisions of CEAA and the Canada Port Authority Environmental Assessment Regulations. Since the EA for this project commenced on March 7, 2003, this comprehensive study was conducted pursuant to CEAA, Bill C-13 (CEAA 1992) as opposed to the October 2003 Bill C-9 amendments to CEAA (CEAA 2003).

Scoping is a key initial step in undertaking a CEAA assessment. This involves defining the scope of project, the factors to be considered and the scope of those factors to be considered in the environmental assessment, in accordance with sections 15 and 16 of CEAA. An RA is responsible for defining the scope of the environmental assessment for comprehensive studies.

The scope of project refers to those components of the proposed project that should be considered as part of the project for purposes of environmental assessment.

The scope of factors to be considered for this project addresses the following, in accordance with subsections 16(1) and 16(2) of CEAA 1992:

(a) "the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project …;

(b) the significance of the effects referred to in paragraph (a);

(c) comments from the public …;

(d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;

(e) any other matter relevant to the … comprehensive study … such as the need for the project and alternatives to the project;

(f) the purpose of the project;

(g) alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;

(h) the need for, and the requirements of any follow-up program in respect of the project; and

(i) the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future".

2.2 The Ontario *Environmental Assessment Act*

The Ministry of the Environment (MOE) is providing funding for the project, and has had continuous input to the development of the project design. However, MOE is not a proponent for the project. Therefore, the Ontario Environmental Assessment Act (EAA) does not apply to the Randle Reef Sediment Remediation Project.

2.3 Other Applicable Government Legislation and Regulations

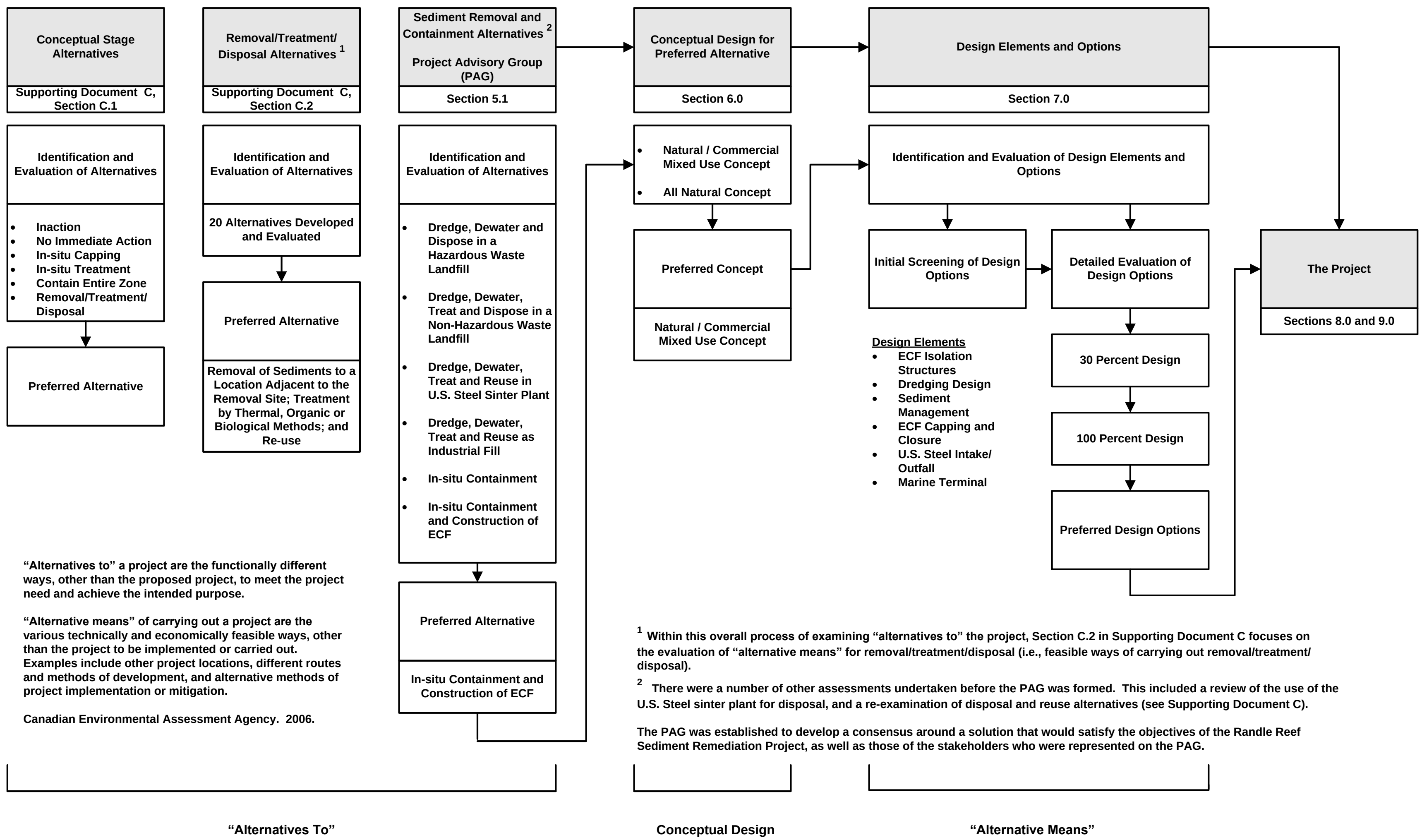
Other government legislation, regulations, guidelines and criteria applicable to the Randle Reef Sediment Remediation Project are described in Supporting Document A.

2.4 Randle Reef Sediment Remediation Project Study Process

The study process is illustrated in Figure 2.1. The assessment of alternatives for the Randle Reef project involved a number of steps, over a time frame of approximately 13 years (1996 to 2009). The main steps in the study process included reviews of:

- conceptual design alternatives (Supporting Document C, Section C.1);
- removal/treatment/disposal alternatives (Supporting Document C, Section C.2);
- sediment removal and containment alternatives – work of the Project Advisory Group (PAG) (Section 5.1).
- conceptual design study for preferred alternative (Section 6.0);
- design elements and options (Section 7.0); and
- environmental effects, mitigation, monitoring and follow-up measures for the project (Section 9.0) (project description is provided in Section 8.0).

Figure 2.1: Randle Reef Sediment Remediation Project Study Process



In addition, before the formation of the PAG, there were a number of other assessments undertaken. These assessments included a review of the use of conditioned dredged material for feedstock for the U.S. Steel's (Stelco at that time) sinter plant (Supporting Document C, Section C.3). This alternative had been developed as a result of discussions among representatives from Environment Canada, MOE, HPA and U.S. Steel. Another assessment involved the re-examination of disposal and reuse alternatives (Supporting Document C, Section C.4) to determine which options were feasible and may be the most likely to be implemented. Further details on the steps in the study process are found in the report sections noted above.

Sections C.1, C.3, C.4 in Supporting Document C and Section 5.1 document the overall evaluation of "alternatives to" the project, as per CEAA. "Alternatives to" the project are: "the functionally different ways, other than the proposed project, to meet the project need and achieve the intended purpose" (Canadian Environmental Assessment Agency, 2006, p. 6). Within this overall process of examining "alternatives to" the project, Section C.2 in Supporting Document C focuses on the evaluation of "alternative means" for removal/treatment/disposal (i.e., feasible ways of carrying out removal/treatment/disposal).

Section 6.0 describes the conceptual design study that was undertaken for the preferred alternative (see Section 5.1).

The alternatives evaluated in Section 7.0 are "alternative means" of carrying out the project, as per CEAA. "Alternative means" of carrying out the project are: "the various technically and economically feasible ways, other than the proposed way, for a project to be implemented or carried out. Examples include other project locations, different routes and methods of development, and alternative methods of project implementation or mitigation" (Canadian Environmental Assessment Agency, 2006, p. 6).

The study process progressed from the conceptual design to the detailed evaluation of design elements and options at the 30 % and 100 % design levels. In Ontario, large scale engineering projects are typically completed to several different class standards of design which represent different stages of completion. While there is no standard definition of 30% design, it is intended to build on the conceptual design and provide a foundation for subsequent more detailed phases. The term "design element" refers to a major category of project activity such as dredging, and the activities associated with it including but not limited to controlling sediment re-suspension during dredging and transporting of the dredged material. "Design options" were examined for all design elements. The term "design option" refers to possible means of executing a component of the design element. For example, mechanical and hydraulic dredging are two options for executing the equipment component of the design element of dredging. A "design alternative" is an assemblage of design options.

The design elements for the Randle Reef project are:

- ECF isolation structures;
- dredging design;
- sediment management;
- ECF capping and closure;
- U.S. Steel intake/outfall (I/O); and
- marine terminal.

Section 7.0 and Supporting Document D document the evaluation of design options and alternatives for each of these six design elements. These options and alternatives are "alternative means" of carrying out the project (as defined above), as per CEAA.

The 30 and 100 percent design levels involved more detailed design work and studies (e.g., contaminant fate and transport modelling, geotechnical studies) in order to further develop the preferred options for each design element and define the project. The design elements function together to accomplish the project goals and objectives (Section 2.5).

Once the preferred project was identified, the potential environmental effects, proposed mitigation, monitoring and follow-up measures were identified. This evaluation is included as Section 9.0 of this report.

2.5 Project Goals and Objectives

The project goals and objectives were developed in 2002 in conjunction with the Project Advisory Group (PAG), as listed in Table A.1 in Supporting Document A. These objectives (which include an overall project objective, project "generic" management objectives and performance objectives) were used to evaluate the various remediation options and were used to select the preferred option. These goals and objectives were refined throughout the development of the conceptual design through to the detailed engineering design for the project.

The PAG goals and objectives were reviewed by the Project Implementation Team (PIT) in the development of the conceptual design. Some goals and objectives were revised at this time in order to be sure the objectives were being met by the proposed project scope and design. Table A.2 in Supporting Document A identifies the environmental, technical, socio-economic and financial objectives that were reviewed as part of the conceptual design study (Section 6.0 provides further details on the conceptual design study). As part of the review of these objectives, the PIT classified the objectives as being "essential" or "desirable". Key issues are also noted in Table A.2.

The project goals and objectives were re-visited as the project design progressed to ensure the environmental, technical, socio-economic and financial objectives were being met.

Based on meeting these project goals and objectives, specific engineering design criteria or requirements were developed (Section 2.6). These design criteria or requirements evolved during the different stages of the engineering work (i.e., initial screening, 30 percent design, 100 percent design) (Section 7.0).

2.6 Design Standards and Requirements

The development of design standards and requirements followed a similar process to the process used for the project goals and objectives – i.e., the design standards and requirements evolved as the project design progressed. The first design standards and requirements were developed by the PIT and the engineering design consultant.

The design standards and requirements were developed based on the project goals and objectives and were consistent with the project goals and objectives. For example, the project objective to minimize risk to worker health and safety during all stages of the project resulted in the adoption of design standards that ensured that all applicable air quality standards and guidelines would be met.

Design standards and requirements were developed for the six design elements and the secondary facility. These standards and requirements were quantitative and qualitative in nature. For example, the design standards for the marine terminal were established in order to meet loading requirements, to accommodate future and long term marine terminal uses and structural needs.

Table A.3 in Supporting Document A provides the design standards that were developed at the 30 percent design stage. Section 7.0 and Supporting document D also provide applicable design standards as they evolved at the 100 percent design stage.

3.0 SCOPE OF PROJECT AND SCOPE OF ASSESSMENT

3.1 Introduction

In accordance with CEAA, responsible authorities (RAs) are required to determine the scope of project and scope of assessment for the proposed project, in conjunction with the expert federal authorities. A *Scoping Document* (Environment Canada, 2003 – revised February 2008) was prepared to document the scope of project and scope of assessment for the comprehensive study for this proposed project. The scoping document served as a guide for federal departments involved in the preparation of this environmental assessment.

Comments received from a June 11, 2003 public open house on the *Randle Reef Sediment Remediation Project* (see Section 10.0 – Public, Agency and Aboriginal Engagement and Consultation) were considered in developing the scoping document.

The scoping document was posted on the HPA and BARC web sites, as well as Environment Canada's Great Lakes Sustainability Fund web site.

The following sections outline the scope of project, the factors to be considered and the scope of the factors to be considered.

3.2 Scope of Project

The scope of the project includes all aspects related to the physical construction and operation of the containment structure, including: the preparation, operation and modification of work sites, including laydown areas; transportation and removal of equipment; dredging and sediment transportation activities; dewatering; capping of containment area; cap naturalization; marine terminal; monitoring; and any ancillary undertakings (e.g., related to temporary on-site treatment and storage facilities, construction or alteration of access roads and rail lines, relocation of affected water intakes and outfalls, shoreline modifications).

Specifically, the scope of the project for the environmental assessment of the *Randle Reef Sediment Remediation Project* is:

- A containment facility consisting of a peninsula adjacent to Pier 15 with an area of approximately 7.5 ha.
- Dredging of areas of contaminated sediments that lie outside the perimeter of the containment facility and between the proposed double walled perimeter, transporting of these sediments and placement of these sediments in the containment facility.
- Future marine terminal navigational dredging of sediment along the south face of the ECF.

- A double berth of length and depth suitable for vessels over 25,000 DWT and of Seaway draught. (This channel also allows vessels to enter or exit the berths along Pier 15 north of Sherman Inlet). Sheet pile walls or similar will be used for the piers on either side of the channel.

- Naturalization of the north and west sides of the ECF. The naturalized land area will be landscaped with appropriate plantings to provide a naturalized feature without focusing on enhancing a specific habitat type. The proposed naturalized area is approximately 2.5 ha.

- Development of 5 ha of the peninsula for marine terminal uses (see Section 8.4).

- Provision of road and rail access to the peninsula from the Hamilton Port Authority's existing property on the eastern part of Pier 15.

- Replacement and/or strengthening of the Pier 15 wall to allow for dredging adjacent to this area.

- Dredging of sediments; The peninsula is located over the majority of sediments with PAH-N > 800 ppm. Dredging or disturbance of these materials will be minimized. Some isolated areas in the channel to the Pier 15 berths north of Sherman Inlet will need to be dredged and placed in the containment facility. Within the containment facility, it was originally envisioned that other contaminated materials could be placed over the sediments that would remain in-situ, however, it is now expected that the containment structure will reach capacity prior to dredging all of the "Priority 3" sediments located in the vicinity of the Randle Reef. The top elevation of these materials would be at elevation 75.0 m International Great Lakses Datum 1985 (IGLD). A total of about 500,000 m^3 of potential volume is provided in the containment facility. Work areas will be managed during dredging.

- Installation of a containment element, for example sealable sheet piling around the perimeter of the containment and keyed into uncontaminated overburden materials underlying the contaminated sediments. The type of containment element eventually selected will depend on a number of engineering, environmental, constructability and cost considerations, some of which will be determined by a risk assessment. Design features will be required along ship berthing areas to prevent impact loads from docking operations acting on the containment element and potentially reducing its integrity.

- The placement of clean fill and an environmental cap (i.e., clay cap or geosynthetic containment material such as a high density polyethylene (HDPE) liner) over the contaminated materials up to the new ground level of elevation 76.2 m, which is the approximate ground level of the existing piers. The requirement for an environmental cap will be determined based on fate and transport modelling of contaminants and groundwater/stormwater transport requirements.

- Fish habitat compensation works through the dredging and remediation of the surrounding substrates to address loss of fish habitat (see Sections 9.2.2.5 and 9.3.2.4).

- Monitoring will include both short-term monitoring during construction and dredging operations, as well as long-term monitoring to ensure the integrity of the facility. Monitoring during construction and dredging operations will be undertaken to ensure that there are no likely significant releases of harmful substances into the air, water or on land. Air quality monitoring will start prior to any remediation activity in the Harbour and will provide detailed background site information. In addition to this baseline monitoring, the Ontario Ministry of the Environment will continue to operate existing ambient air monitoring stations in the vicinity of the project area. The water quality monitoring program will address turbidity, total suspended solids and water chemistry. All applicable federal, provincial and local regulations, guidelines and criteria will be adhered to. Further details on the monitoring program are provided in Section 11.0.

3.3 Factors to be Considered

Subsection 16(1) of CEAA outlines the following factors to be considered in a comprehensive study:

(a) "the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;

(b) the significance of the effects referred to in paragraph (a);

(c) comments from the public that are received in accordance with this Act and the regulations;

(d) measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project; and

(e) any other matter relevant to the … comprehensive study … such as the need for the project and alternatives to the project, that the responsible authority … may require to be considered".

In addition, subsection 16(2) of CEAA requires that every comprehensive study include a consideration of the following:

(a) *"the purpose of the project;*

(b) *alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternative means;*

(c) *the need for, and the requirements of, any follow-up program in respect of the project; and*

(d) *the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future"* [5].

3.4 Scope of Factors to be Considered

The following provides further details on the scope of the factors considered in the environmental assessment.

3.4.1 Scope of Environmental Factors to be Considered

This comprehensive study report includes an assessment of the environmental effects of the project, including cumulative effects. The following environmental factors have been considered in determining and assessing potential adverse environmental effects.

5 The ability of renewable resources to be significantly affected by the project is documented in Section 9.0 and will be addressed in the contract specifications during tendering and bidding for the project, as per the sustainable development analysis completed during the engineering design for the project.

Environmental Factor	Scope of Environmental Factor
Effects on the Biophysical Environment	• fish and fish habitat • water birds and other migratory birds • species at risk • vegetation • wetlands • surface water quality, currents and circulation • groundwater quality and movement • air quality – local and downwind airborne emissions (including greenhouse gases, particulate matter, dust, odours and volatiles) • contamination of soils and/or exposure of potential contaminants
Related Effects on the Socio-Economic and Cultural Environments	• adjacent land uses • local neighbourhood and residents • worker health and safety • public health and safety • noise • aesthetics • residential areas beyond local area site • U.S. Steel operations • City storm sewer and combined sewer outfalls • use of lands and resources for traditional purposes by aboriginal persons • shipping and navigation • recreational uses of the Harbour
Other Considerations	
Cumulative Effects	• cumulative effects on aquatic VECs (e.g., water quality, fish species) • cumulative effects on other VECs
Effects of the Environment on the Project	• seismic activity • wave and current activity * • changes in lake levels * • icing and winter operations * under normal conditions and as a result of climate change
Effects of Accidents and Malfunctions	• failure of safety precautions • spills • containment failure

3.4.2 Spatial and Temporal Boundaries

The spatial boundaries for the assessment are defined in Section 9.0 for each environmental component that is likely to be affected by the project and for each component where a measurable effect is predicted for the cumulative effects assessment.

The time frame over which the potential effects of the project are anticipated to continue is also defined. The definition of this time frame considered potential cumulative effects.

3.4.3 Alternatives to the Project

In exercising their discretion under subsection 16(1)(e) of CEAA to consider alternatives to the project, the RAs have considered alternatives to the proposed solution for remediating the priority zone of contaminants in the Randle Reef area. Further details on the consideration of alternatives to the proposed project are provided in Section 5.0.

3.4.4 Alternative Means of Carrying Out the Project

Alternative means for the design and implementation of the proposed project are examined in Section 7.0. Alternative means were examined for the following project components:

- isolation structures;
- dredging design;
- sediment management/dewatering/water treatment/effluent discharge/air emission controls;
- containment and cover;
- U.S. Steel intake/outfall; and
- marine terminal design.

Each alternative was assessed by considering environmental effects, constraints, costs and schedule. In all cases, a preferred alternative was identified for further consideration, including the identification of mitigation and contingency measures. Alternatives for the phasing of containment construction and filling were also assessed.

3.4.5 Risk Assessment

A risk assessment was carried out to ensure the long-term integrity of containment. The containment design, which has a 200 year lifespan, allows for long-term monitoring of the performance of the facility.

The risk assessment for the project included a site-specific risk assessment that identifies potential receptors and the degree of containment required, and addresses worker health and safety, containment of the contaminants, marine terminal end use and the aquatic environment.

3.4.6 Environmental Enhancement Opportunities

The comprehensive study considers the project's effectiveness in sustaining and enhancing the capacity of renewable resources. Environmental enhancement opportunities were examined in the assessment for: fish habitat compensation (as per Fisheries Act) and wildlife enhancement; terrestrial component of cap naturalization; and associated naturalization projects. Further details on these environmental enhancement opportunities are provided in Section 9.0.

3.4.7 Monitoring and Follow-up

A follow-up program that includes short-term monitoring during project implementation and long-term monitoring post-construction will be required. Future monitoring and maintenance of the containment facility to ensure its long-term performance and security is proposed to be the responsibility of the Hamilton Port Authority. The containment facility design allows for long-term monitoring of the performance of the facility. The design also includes features that allow detection of any reduction in containment integrity before contaminants are released into the environment, and provide measures to be taken if this is detected.

Further details on monitoring and follow-up measures are provided in Section 11.0.

3.4.8 Public, Agency and Aboriginal Engagement and Consultation

Key stakeholders in the development of the proposed project have been involved through the PAG and the PIT. In addition, a range of consultation techniques have been employed including meetings with individual stakeholders and public open houses. First Nations and Metis were advised of the project and meetings were held with the Six Nations Council and Metis Nation of Ontario to discuss the project.

The public has had several opportunities to review and comment on the project prior to the submission of the comprehensive study report to the Canadian Environmental Assessment Agency. Final public and agency consultation will be undertaken through the comprehensive study process which includes: the submission of the comprehensive study report to the Canadian Environmental Assessment Agency for public notification and review; a 30 day public review of the comprehensive study report; and a decision by the federal Minister of the Environment on the course of action in respect of the project.

Further details on public, agency and Aboriginal engagement and consultation are provided in Section 10.0

4.0 EXISTING ENVIRONMENTAL CONDITIONS

4.1 Physical

4.1.1 Surface Water Quality

Hamilton Harbour is a drainage basin for a large urban population and industrial sector. Water quality problems in Hamilton Harbour include excessive ammonia loadings caused primarily through sewage treatment plant effluents, and phosphorus loadings and suspended solids caused by industries along the basin, inflowing streams, sewage treatment plants and sewage overflows. These problems are all related to oxygen depletion and suspended solids.

The highest potential for sediment re-suspension at the proposed site comes from the frequent passing of tug boats over the area. Water depths in this area range between 5 to 8 m. Past dredging activities have occurred in and near this area, with the last recorded operation in 1978.

4.1.2 Wave Activity, Currents and Circulation

The dominant wind direction is WSW (based on 20 years of data from the Hamilton Airport), and the dominant wave direction is approximately WNW (parallel to Piers 11 and 14), with maximum significant wave height about 1.2 to 1.4 m including the effect of partial standing waves due to reflection off Pier 16. The secondary wind direction is from the NNE (parallel to Pier 16). Measured water currents near Randle Reef have been as large as about 0.2 m/s during a period when the maximum winds were about 50 km/hr out of the WSW. The flow is quite variable in direction. Near the surface the larger flows were in southerly directions, but near the bottom (in 13 m depth) the dominant direction was to the NE, in 2000. In 1999, bottom flows were to the NE in response to winds from the NE. The measurement location was some distance off the piers so that the currents were not parallel to the piers as might be expected very close to the piers.

Over a 20 year period maximum winds at Hamilton airport were between 90 and 100 km/hr out of the WSW, so that significantly larger water currents can be expected than the measured currents mentioned in the previous paragraph.

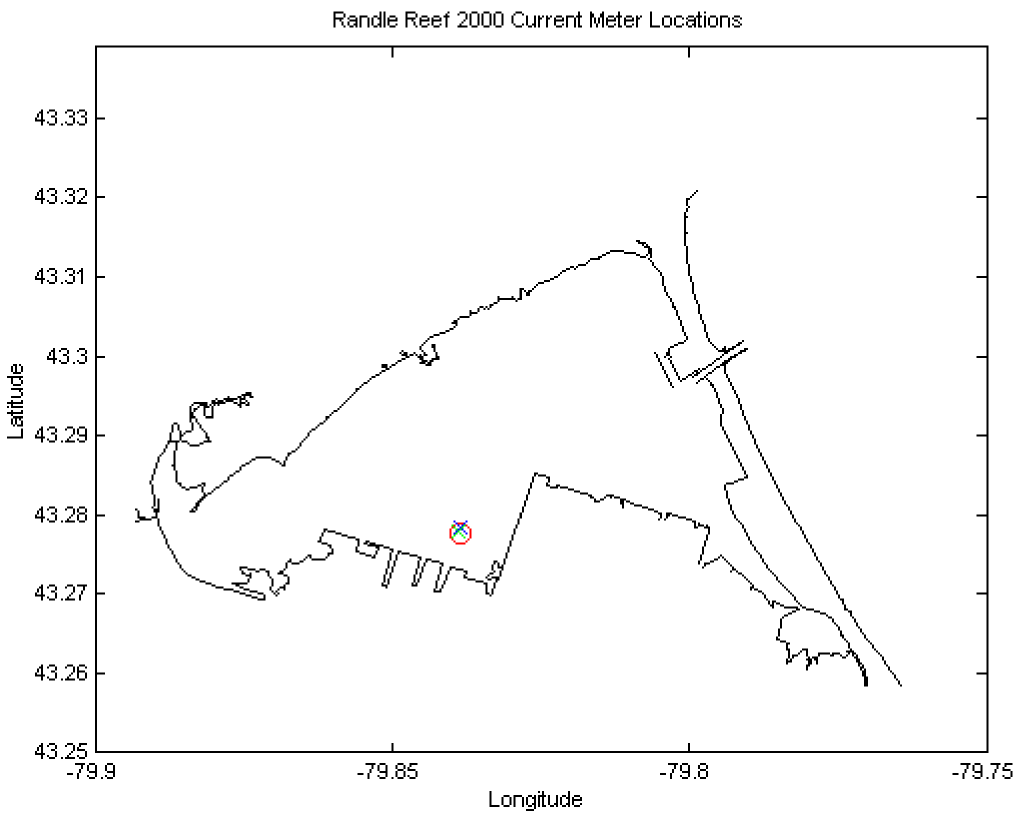
<u>Summary of Currents in 2000</u>

During the summer of 2000 an acoustic Doppler current profiler (ADCP) and a fixed point acoustic current meter (Hydra) were deployed near Randle Reef. The details of the deployments are given in Table 4.1, and the locations are shown in Figure 4.1. The wind rose for Hamilton Airport for the deployment period is shown in Figure 4.2.

Table 4.1: Current Meter Deployment Summary

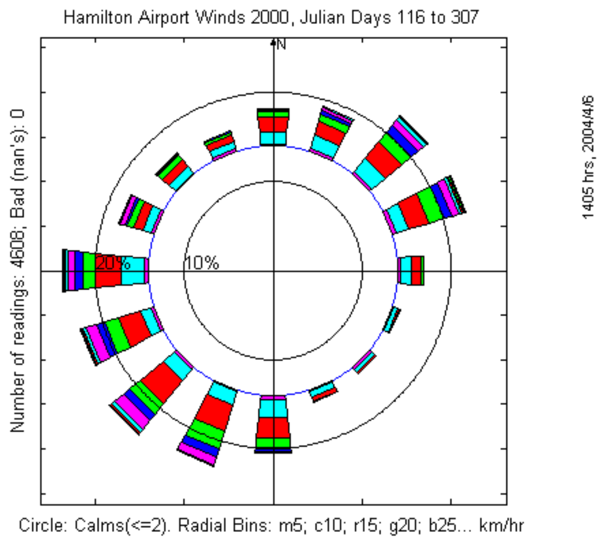
Station ID	Meter Type	Deployment Interval	Water Depth [m]	Latitude UTM, N (NAD83)	Longitude UTM, E	Comments
16A	ADCP	2000-05-02 to 2000-10-31	13	43 16 40 4792345	79 50 18 594251	Just west of Hydra. One metre bins, lowest bin: 11.80 m
07A/B	Hydra	2000-04-25 to 2000-11-02	13.5	43 16 42 4792411	79 50 18 594300	Measurement depth: 12.9 m.

Figure 4.1: Current Meter Locations: ADCP (circle); Hydra (two x's, one for 1999 and one for 2000)



The two current meters took readings every 30 minutes. The ADCP was set up so that it measured the horizontal current at one metre intervals from 1.8 to 11.8 m water depth; the Hydra measured the current at 12.9 m water depth, only the horizontal current is reported here. Current roses are used to summarize the occurrences of the currents in terms of speed and direction intervals.

Figure 4.2: Wind Rose for Hamilton Airport (directions from) for 25 April to 2 November 2000



Currents at 1.8, 2.8, 3.8, and 4.8 m depth are summarized in Figure 4.3 and those at 9.8, 10.8, 11.8 and 12.9 m are in Figure 4.4. The currents were quite variable, with flow in all directions. Near the surface, the currents to the north occur much less frequently than all others (Figure 4.3). In contrast, near the bottom, the current was predominantly towards the northeast or east.

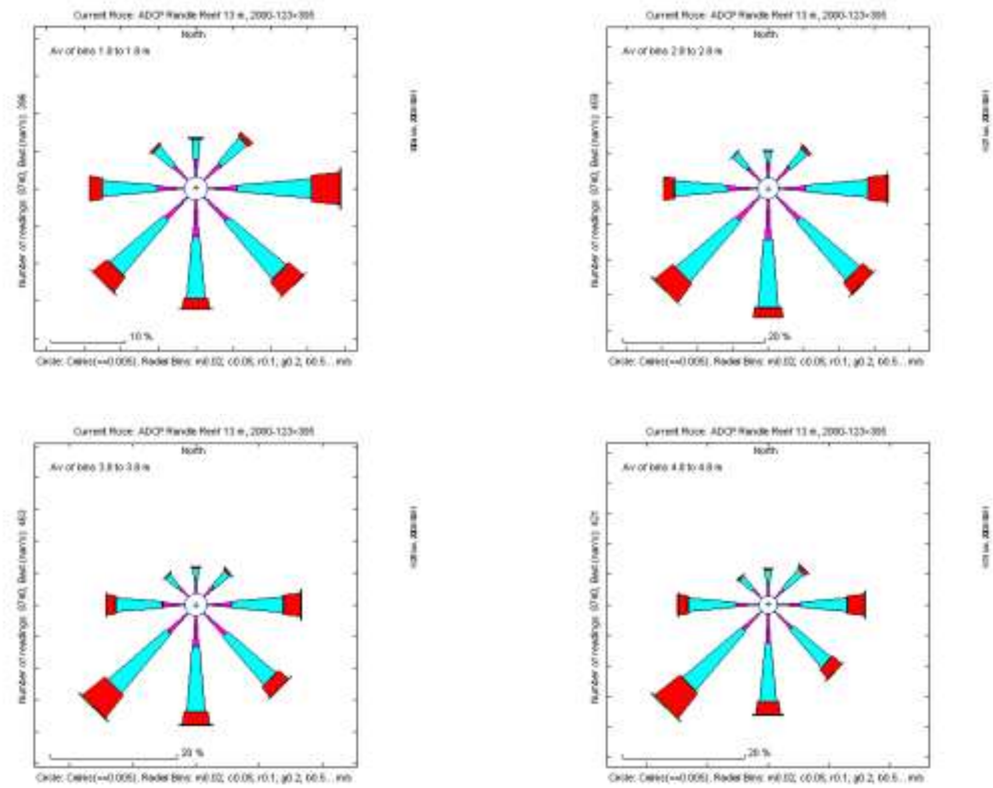
The magnitudes of the flow were relatively small. The most common speed range was from 0.02 to 0.05 m/s. There were a few occasions when the flow was in the 0.1 to 0.2 m/s range. There was a single reading greater than 0.2 m/s, and that was 0.21 m/s (directed towards 20 ° T) at 1.8 m below the water surface. The maximum currents as a function of depth during the deployment are listed in Table 4.2.

Table 4.2: Maximum Currents and Speeds as a Function of Depth

Depth [m]	Speed [m/s]	Direction (to) [°T]
1.8	0.21	20
2.8	0.19	29
3.8	0.20	27
4.8	0.17	28
5.8	0.15	6
6.8	0.14	24
7.8	0.15	201
8.8	0.16	229
9.8	0.17	228
10.8	0.16	226
11.8	0.14	237
12.9	0.14	128

Figure 4.3: Currents Roses for Currents Near Randle Reef, 2000

Depths: top left 1.8 m; top right 2.8 m; bottom left 3.8 m; bottom right 4.8 m. Speed ranges: circle less than 0.05 m/s; magenta 0.02; cyan 0.05; red 0.10; green 0.20; blue 0.50 m/s.



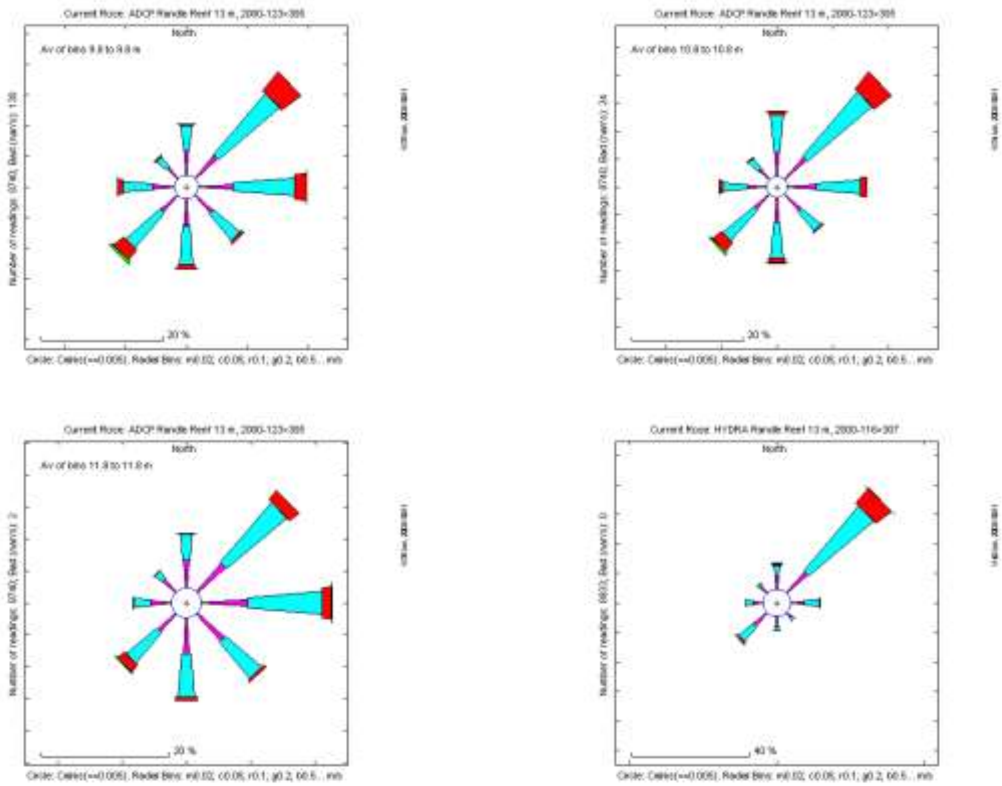
During the deployments of the current meters the maximum winds at the Hamilton Airport were in the 50-55 km/hr speed range and occurred both from the WSW and W directions. By way of comparison, over the 20 year period from 1983 to 2003, the maximum winds at the Hamilton Airport were in the 90-100 km/hr speed range from the WSW. The currents caused by these latter winds would be substantially larger than those recorded during this deployment.

During the deployment maximum easterly winds occurred out of the ENE and were in the 45-50 km/hr speed range. Over the 20 year period the maximum wind speed category out of the east and north was also 65-70 km/hr, from the NE and ENE directions.

Waves caused by 90 km/hr winds from the WSW can be expected to have a height of about 0.8 m and a period of about 3 s and will travel approximately ESE, parallel to piers 11 and 14. For 65 km/hr ENE winds, the wave height would be about 0.7 m and the period about 2.5 s, and the direction would be about SSW, approximately parallel to Pier 16. In both cases the waves will strike near vertical walls and reflect from them resulting in partial standing waves. This will increase the wave height significantly, perhaps by about 50-75%.

Figure 4.4: Currents Roses for Currents Near Randle Reef, 2000

Depths: top left 9.8 m; top right 10.8 m; bottom left 11.8 m; bottom right 12.9 m. Speed ranges: circle less than 0.05 m/s; magenta 0.02; cyan 0.05; red 0.10; green 0.20; blue 0.50 m/s.



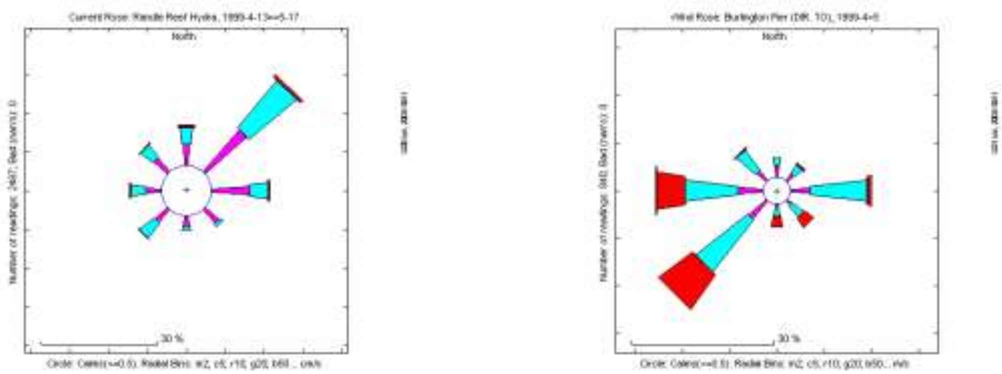
Summary of Currents in 1999

Currents were measured near Randle Reef from 13 April to 17 May at 43 16 39N and 79 50 17W in 13 m depth using the Hydra meter such that the measurement point was at 12.5 m depth. The data were summarized in a data report (Skafel, 2000, NWRI 00-064). The wind rose and the current rose are reproduced in Figure 4.5.

The bottom currents were mainly to the northeast and less than 10 cm/s. The winds were mainly out of the northeast (that is, towards the southwest), and less than 10 m/s (36 km/hr). It appears that the bottom flow was a return flow in response to a surface flow in the direction of the wind.

Figure 4.5: Current (left panel) and Wind (right panel) Roses, April/May 1999

Note: wind direction is reported as direction TOWARDS, to be consistent with the current direction convention.



Summary of Currents in 1994

In 1994, a wave and tide gauge and a smart acoustic current metre (SACM) were operated nearby Randle Reef from November 27 to December 8. A meteorological buoy was located near the sand capping site. Maximum measured flow at the 5m deep SACM for the experiment was 5cm/s to the northeast on November 29 in response to a southwesterly wind event of 15m/s. Significant wave heights and periods were measured in two ways, a wave/tide gauge and by analyses of burst sampled currents from the SACM. Maximum wave height also occurred during the Nov. 29 storm with 10cm by the wave and tide gauge and 57 cm by the orbital flows. It was considered that the current measurements were more likely to be correct as the orifice of the gauge was known to block due to fouling. Both methods yielded periods of 3s. At the 5 m depth of the current meter, these waves generated an orbital flow with amplitude of about 12 cm/s. At the same time a contract was let to Dr. Mario Gagnon who modeled both the wave statistics and the currents with his 3-D finite element model. Poor correspondence between model and observed currents was found at the mesh points closest to the Randle Reef current metre.

Table 4.3 provides summary information on water levels, wave activity and currents.

Table 4.3: Summary Information on Water Levels, Wave Activity and Currents

Characteristic	Summary Information
General	Lake Water Levels (IGLD 85) • 2-year return period = 75.1 m • 100-year return period = 75.6 m • minimum level = 73.8 m (December 1934) • chart datum = 74.2 m • 100-year Regulatory Flood Standard – design guidelines • natural beach = 76.5 m • rip rap revetment = 77.3 m • vertical wall = 77.6 m
Water and Wind Data	• Harbour surge level = 0.5 to 1.0 m • Sig wave height = 1.2 to 1.3 m • wave energy maximum = northeast direction • dominant wind direction = west
Currents	• circulation models suggest current directions of flow at Randle Reef are south and north along Pier 16, depending on wind direction • north flow would likely predominate due to predominant wind direction

Source: Acres & Associated, Headwater and PEIL. 2003. Conceptual Design Study. Volume 2 – Appendices. Appendix A – Common Basis for Design.

Note: The original table located in the above reference also included the sources for the information provided in the table. These sources have not been provided in Table 4.1. The original table should be consulted for this information.

Hydraulic Modeling Study

The National Water Institute Hydraulic Modeling study was completed to better understand the existing hydrodynamic and water quality characteristics of Hamilton Harbour and to evaluate the potential future conditions following construction of the proposed ECF.

A three dimensional hydrodynamic model was used for the study. The model is a general three dimensional free-surface flow model applicable to the simulation of flows, cohesive sediment transport, and water quality and ecology of rivers, lakes, estuaries, and bays. It simulates unsteady flows, taking into account density variation, bathymetry, and external forces arising from meteorology, water elevations, currents and other hydrographic conditions.

The model was calibrated using velocity profiles and water elevations measured by an Acoustic Doppler Current Profiler with 0.5 m vertical resolution in the Randle Reef area. Flow components in the X and Y directions were modeled. The modeling was done to evaluate the effect of the ECF structure on the hydrodynamic regime in the Harbour and to evaluate other components of the design, e.g., impact on the U.S. Steel intake and outfall, the water quality and quantity impacts that may result from the creation of the channel between the dock wall and the ECF, etc. The results of the study are presented in the 100 percent design technical memorandum.

4.1.3 Ground Water Quality and Movement

Generally, the stratigraphy beneath the proposed ECF consists of the following geologic units:

- silt, clayey silt, and silty clay, grey to grey-brown in color with occasional traces of sand ranging in thickness from approximately 7 to 10 m (23 to 33 ft);
- a layer of sand and gravel up to 1 m (3 ft) in thickness; and
- silt till and clayey silt till to shale, reddish-brown, grey-green and grey-brown in colour.

In general, vertical hydraulic groundwater gradients in the vicinity of Randle Reef indicate that very little groundwater is discharging to the Harbour at the location proposed for the ECF. Site specific groundwater investigations were conducted in 2003 and 2004.

2003 Investigation

For the early design-level data collection, a nested set of three groundwater monitoring wells along the McKeil property (which is adjacent to the Sherman outlet at Pier 15) were installed to assess vertical groundwater gradients and groundwater quality (see Figure 4-6 for monitoring well locations). The depths of installation for MW-40A, MW-40 and MW-40B were 4.6, 15.2 and 29 m below ground surface (bgs), respectively.

Groundwater samples were collected from all three wells. The samples were each analyzed for at least one of the following: PAHs, VOCs and/or metals. PAH concentrations in groundwater samples from all three wells were below the method detection limits. VOCs were detected in groundwater samples from MW-40 and MW-40A; VOC concentrations in the MW-40B sample were below detection limits. Metals were detected in groundwater samples from all three wells.

A downward vertical gradient of 0.004 m/m (0.01 ft/ft) was determined for the two shallower monitoring wells whereas a gradient was not determined for the deeper monitoring well. Depth to groundwater in mid-December 2003 was between 1.724 and 1.794 m (5.7 to 5.9 ft) at the two shallower monitoring wells which correspond to groundwater elevations of 75.346 and 75.396 m (247.21 to 247.37 ft) (IGLD 1985) for MW-40 and MW-40A, respectively (AMEC, 2004d).

2004 Investigation

Hydrogeology

The interaction of upland and ECF groundwater had not previously been evaluated. Therefore, four upland monitoring wells were installed adjacent to the proposed ECF. Falling-head permeability tests were conducted in each well, along with groundwater elevation monitoring and the collection of groundwater for chemical analysis. This investigation also included analysis from some of the wells installed in 2003.

The four additional groundwater monitoring wells consisted of three shallow wells (MW-104S, MW-105S, and MW-106S) and one deep well (MW-106D), and were installed on the southern portion of the U.S. Steel property between December 14 and December 23, 2004 (see Figure 4.6 for monitoring well locations).

Depth to groundwater in the shallow wells ranged from 1.28 m (4.2 ft) bgs at MW-104S to 1.57 m (5.2 ft) bgs at MW-106S. Elevations of shallow groundwater ranged from 75.58 to 76.27 m (248 to 250 ft) IGLD 1985, indicating that the coarser-grained materials (e.g., slag, fine sand, and silt) in the upper strata constitute an unconfined shallow groundwater aquifer. The shallow groundwater flow direction was toward the Harbour with a horizontal hydraulic gradient of approximately 0.008 m/m (0.03 ft/ft) (see Figure 4.7 for shallow groundwater elevations and contours).

Depth to groundwater in the deep groundwater monitoring well, MW-106D, was 11.35 m (37 ft), corresponding to a groundwater elevation of 66.5 m (218 ft) IGLD 1985. The vertical hydraulic gradient at the MW-106 monitoring well cluster was 1.2 m/m (4 ft/ft) in a downward direction, indicating that there is a strong downward vertical gradient at this location. These data indicate that the silty clay acts as a barrier to groundwater flow.

Falling-head permeability tests were performed in each of the shallow groundwater monitoring wells to estimate in-situ horizontal hydraulic conductivity in the silt and fine sand layers (MW-40A, MW-104S, and MW-105S) and within the slag material (MW-106S). Geometric mean horizontal hydraulic conductivities in the silt and fine sand ranged from 2.9x10-5 cm/s (9.5x10-7 ft/second) at MW-40A to $8.1x10^{-4}$ cm/s ($2.7x10^{-5}$ ft/second) at MW-105S. The geometric mean horizontal hydraulic conductivities in the coarse slag material was $1.1x10^{-1}$ cm/s ($3.6x10^{-3}$ ft/second).

Laboratory permeability tests were conducted on samples of the silty clay material collected from the MW-106D borehole within the screened interval. The geometric mean vertical hydraulic conductivity was $2.0x10^{-8}$ cm/s ($6.6x10^{-10}$ ft/second). This corresponds to a horizontal hydraulic conductivity of approximately $4.0x10^{-8}$ cm/s ($1.3x10^{-9}$ ft/second) (Freeze and Cherry, 1979).

Figure 4.6: Monitoring Well Locations

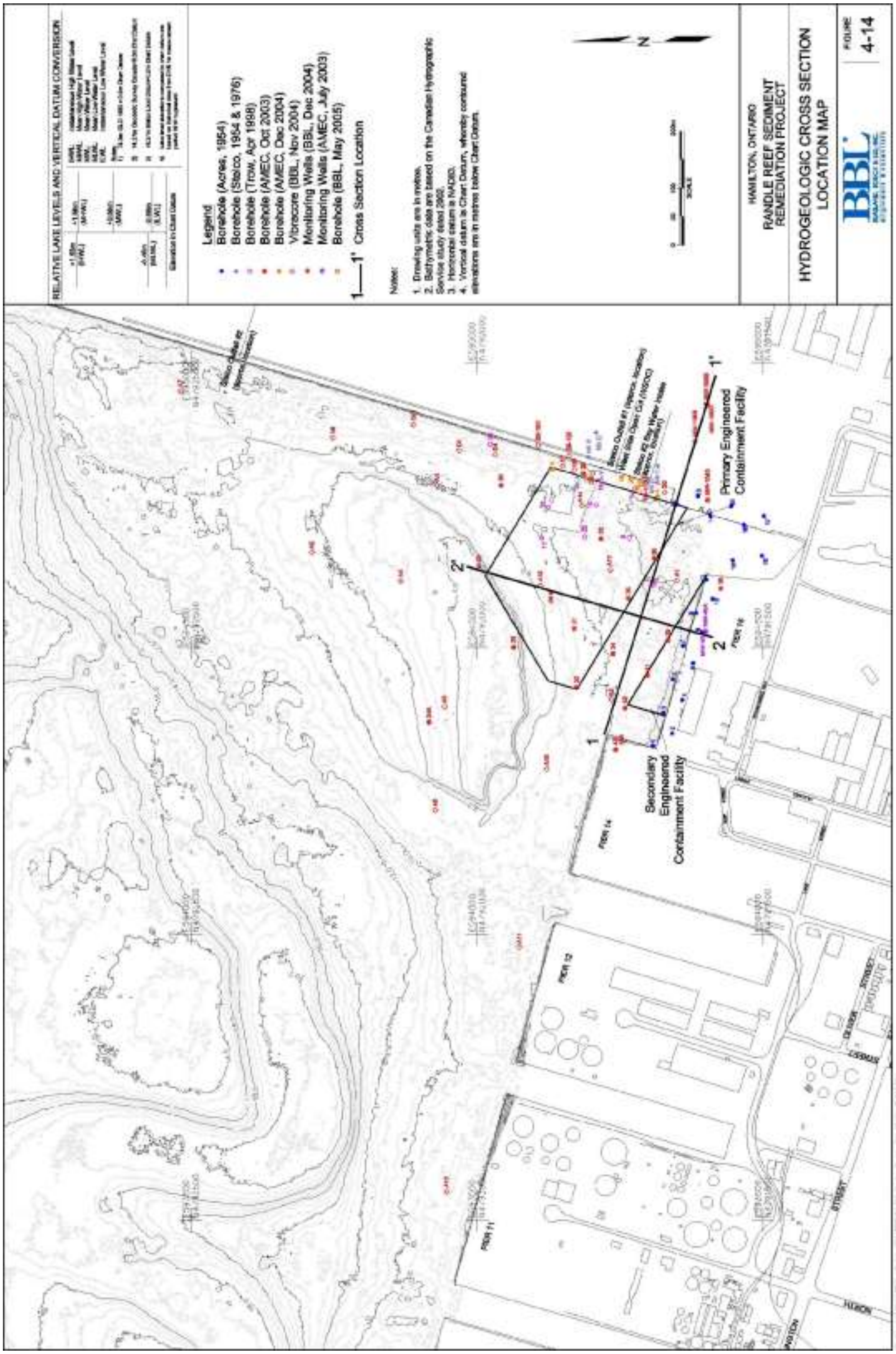
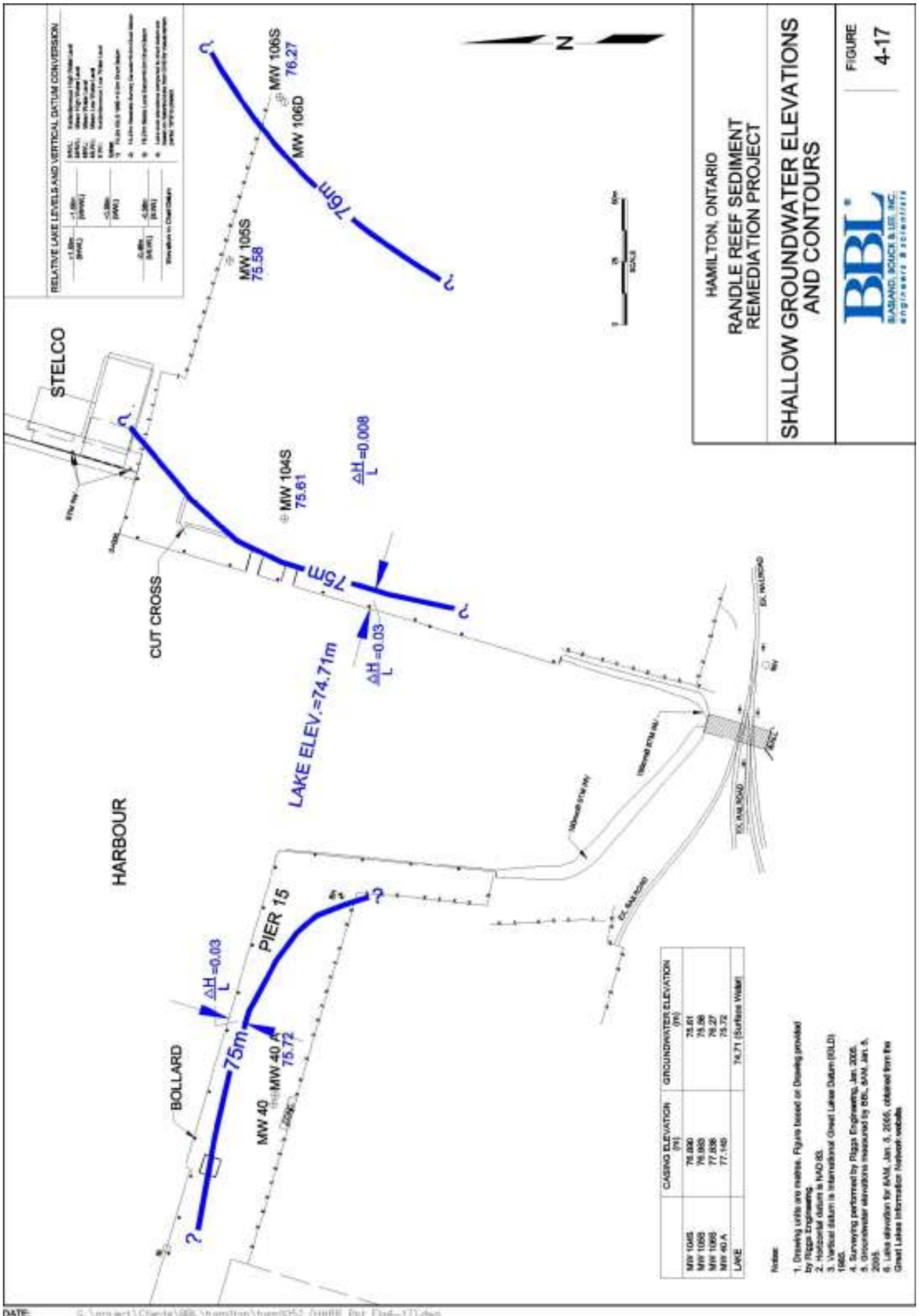


Figure 4.7: Shallow Ground Water Elevations and Contours



Assuming (1) a horizontal gradient of 0.008 m/m (0.08 ft/ft), (2) a porosity of 0.35 and (3) measured horizontal hydraulic conductivities, horizontal groundwater velocities within the shallow groundwater are potentially:

Deposit	Horizontal Hydraulic Conductivity (metres/day)	Horizontal Hydraulic Gradient (ft/ft) [metre/metre]	η – Effective Soil Porosity	Horizontal Groundwater Velocity (metres/day)
Slag (gravel)	95	0.008	0.35	2
Fine sand and silt	0.1	0.008	0.35	0.002

<u>Groundwater Quality</u>

Groundwater samples were collected at monitoring wells MW-40A, MW-104S, MW-105S, MW-106S, and MW-106D on January 5, 2005. The samples were analyzed for PAHs, VOCs, and selected metals. Oxidation-reduction (redox) values ranged from approximately 0 to -100 millivolts, indicating that groundwater is under slightly reducing conditions. Dissolved oxygen varied from less than 1 mg/L in MW-40A to 6 mg/L in MW-106S. Turbidity ranged from 2 to 32 Jackson turbidity units (JTUs) in shallow groundwater and was 1,590 JTU in deep groundwater.

VOCs were not detected in any of the groundwater samples. PAHs were not detected in groundwater samples collected from monitoring wells MW-40A, MW-105S, MW-106S, and MW-106D. The groundwater sample collected from monitoring well MW-104S contained detected concentrations of acenaphthylene, anthracene, biphenyl, dimethylnaphthalene, fluoranthene, fluorene, phenanthrene and pyrene. Concentrations of anthracene, biphenyl, dimethylnaphthalene, fluoranthene, fluorene and phenanthrene exceeded Ontario PWQOs. The Canadian Water Quality Guidelines (CWQG) were also reviewed with respect to water quality criteria and were applied, where appropriate, along with the PWQOs.

Aluminum, arsenic, boron, chromium, cobalt, copper, iron, lead and zinc were detected in shallow groundwater at concentrations above PWQOs (and/or CWQGs). Metals concentrations were generally higher in groundwater samples collected from nearshore monitoring wells (MW-40A and MW-104S) than in samples from monitoring wells farther from the shore (MW-105S and MW-106S). Differences in dissolved and total metals concentrations suggest that the higher turbidity measured for groundwater samples collected at MW-40A and MW-104S may have contributed to the higher metals concentrations observed at these locations, especially concentrations of aluminium, cobalt, copper, lead and zinc. Concentrations of aluminium, cadmium, copper, iron, molybdenum and zinc exceeded PWQOs in the deep groundwater sample from MW-106D. Mercury was not detected in any of the groundwater samples. These results indicate that shallow and deep groundwater discharging to Hamilton Harbour in the vicinity of the proposed ECF is unlikely to adversely impact surface water quality.

4.1.4 Air Quality

Ambient Air Quality Monitoring Program

The state of air quality in Ontario has been measured by the province for 37 years. Over this time period, overall air quality has improved significantly, particularly for nitrogen dioxide (NO2), carbon monoxide (CO) and sulphur dioxide (SO2)(MOE, 2007). However, ozone (O3) and fine particulate matter (PM2.5), which are both components of smog, continue to exceed ambient air quality criteria and set reference levels, and are the pollutants of concern provincially.

The sources of air pollution include both industrial and municipal sources, vehicles and transportation sectors, and natural sources such as forest fires, windblown dust and biogenic emissions from vegetation. Many air pollutants remain in the atmosphere for extended periods of time, and can travel significant distances from the point of origin and affect air quality locally, regionally, nationally and internationally. Pollutant levels are affected by source strengths, sunlight, moisture, clouds, precipitation, geography and local and regional weather conditions.

The Ontario Ministry of the Environment (MOE) collects data at 38 air quality index (AQI) monitoring stations across the province. The data are used to develop and assess air quality initiatives with specific emitters, determine trends, establish the need for policies, programs or regulations, identify sources, provide smog advisories and determine the significance of long-range pollutants, particularly from the United States.

The Technical Support Section in MOE's West Central Region conducts monitoring from point source station locations near the Hamilton industrial area. Figure 4.8 illustrates the locations of the stations. Table 4.4 provides the parameters assessed at the stations.

The data are obtained from some West Central Region sites, the Hamilton Air Monitoring Network (HAMN) (who took over established MOE stations under the Source Emission Monitoring Program in May 2003) and from some provincial AQI stations. Ownership of the data telemetry system, which electronically transmits the data, remains with the MOE. Trends over the past decade (or more) are also analysed. There are two stations south of the proposed site for Randle Reef: 20567 - the Niagara/Land station; and 29160 - the Burlington/Victoria station.

The five HAMN stations are at the following locations:

- 29025 - Barton/Sanford, between downtown and the industrial zone;
- 29102 - Beach Blvd, normally downwind of the industrial zone;
- 29547 - Pier 25 (Beach) industrial zone;
- 29565 - Strathearne Ave. N, industrial zone; and
- 29567 - Niagara/Land, industrial zone.

Figure 4.8: Location of Hamilton Air Quality Monitoring Stations

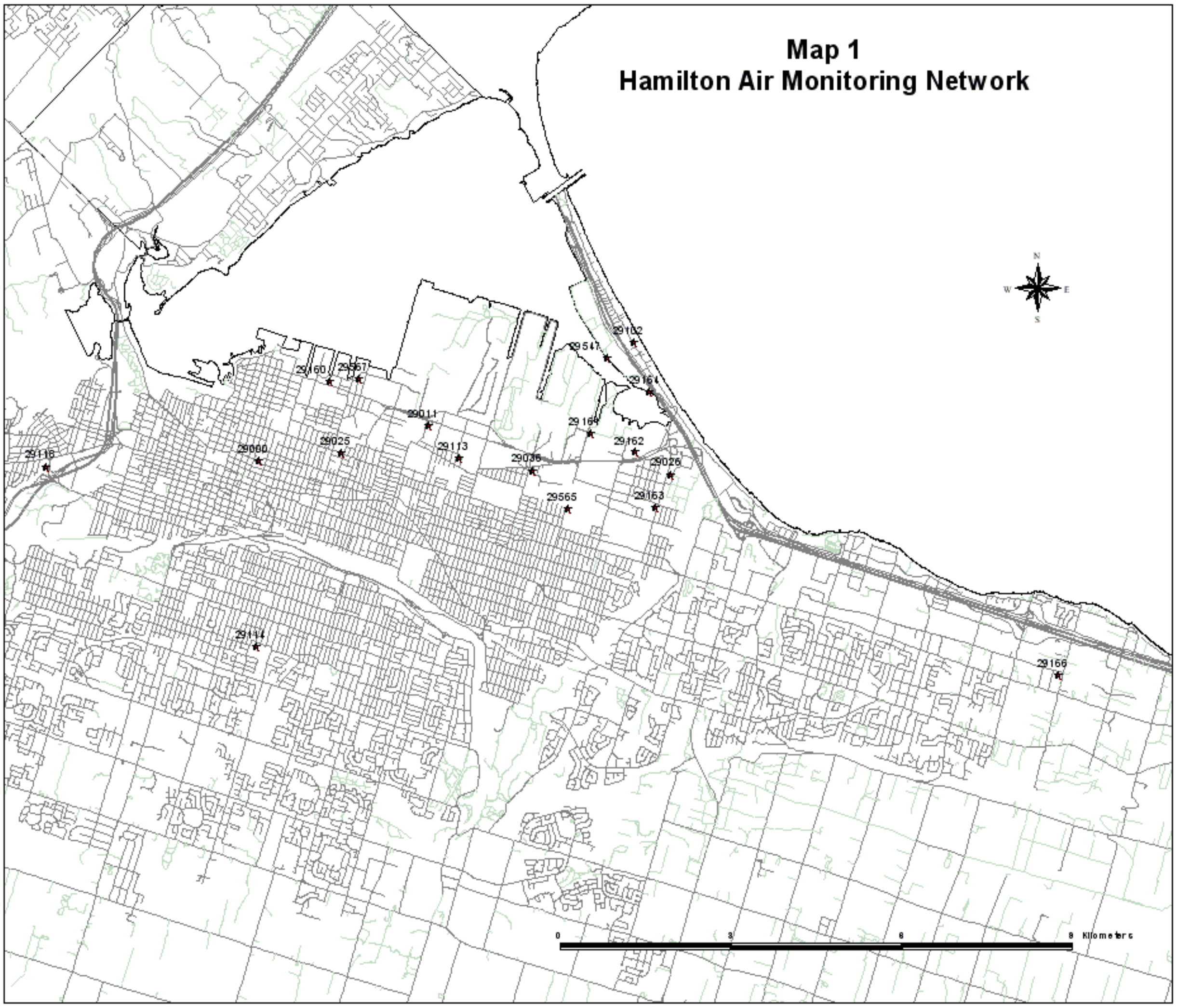


Table 4.4: Hamilton Air Quality Monitoring Stations

STATION NUMBER	LOCATION	AQI C	SO2 C	PM10 C	PM2.5 C	TRS C	O3 C	NOx C	TSP NC	PM10 NC	DF NC	VOC NC	PAH NC	WIND C	TEMP C
29000	Elgin/Kelly	x	X		x	x	x	x	x			x	x		
29300	Elgin/Kelly									x					
29011	Burlington/Leeds										x				
29025	**Barton/Sanford**		X			x			x						
29026	Woodward/Brampton													x	x
29036	Roosevelt/Beach Rd										x				
29102	**Beach Blvd/Towers**		X	x		x		x	x			x			
29113	**Gertrude/Depew**								x			x	x		
29114	Vickers/E 18th	x			x		x		x						
29314	Vickers/E 18th									x					
29118	Main W/Hwy 403	x			x		x								
29160	**Burlington/Victoria**								x						
29163	**Woodward Ave Park**					x									
29164	**Eastport/Windermere**								x						
29166	**Arvin/Jones Stoney Creek**								x						
29547	**Pier 25**												x		
29565	**Strathearne N**			x											
29567	**Niagara/Land**			x		x			x			x	x	x	

AQI - Air Quality Index	TRS - Total Reduced Sulphur	DF - Dustfall
SO2 -Sulphur Dioxide	O3 – Ozone	VOC - Volatile Organics
TSP - Total Suspended Particulate	NOx - Nitrogen Oxides	PAH - Polycyclic Aromatic Hydrocarbons
PM10 C - Continuous Inhalable Particulate	PM10 NC - Non-continuous Inhalable Particulate	TEMP-Temperature
PM2.5 C - Continuous Respirable Particulate	C - Continuous Hourly Measurement	NC - Non-Continuous Measurement

bolded are HAMN

MOE continues to operate a network of ambient air monitors throughout Hamilton centred on three automated AQI stations, including:

- 29000- Elgin/Kelly, downtown AQI;
- 29114- Vickers/East 18th, mountain AQI;
- 29118- Main West/Highway 403, west end AQI; and
- 29026- Woodward Ave. Meteorological station.

The remainder of the network consists of a number of other non-continuous monitors, some of which have been in existence since 1970. A number of these are also part of the provincial and federal toxics monitoring programs and include measurements of VOC and PAH.

Meteorological data (wind speed, wind direction and air temperature) are observed at Station 29026, Woodward Avenue, located on the sewage treatment plant grounds and at the Niagara/Land station 29567.

Environment Canada, through the National Air Pollution Surveillance Program (NAPS) also provides some of the monitoring equipment for Hamilton. The Ministry maintains and operates some of this equipment and reports/receives data to/from Environment Canada.

Trend analysis in the local area over ten (10) plus years shows that:

- inhalable particulates (PM10) have decreased about 20% since the mid 1990s;

- total suspended particulates (TSP) have decreased 15-20% since the mid 1990s; a fugitive dust control program is planned for certain areas in the City; particulate sampling at Pier 12/14 area (near Wentworth) showed elevated TSP and metals due to local fugitive dust sources; manganese levels at this location are improving from dust control efforts by the Federal Marine Terminals Ltd. but criteria exceedances continue;

- respirable particulates (PM22.5) have decreased by 30% downtown and about 15% at the mountain and west end stations since monitoring started in the late 1990s; elevated concentrations above the Canada Wide standard are attributed equally to long range regional smog sources and to local industrial/urban sources as measured at the three AQI stations;

- dustfall has reduced by less than 20% since the late 1990s, with the northeast corner of the city experiencing problematic conditions with dust that is carbonaceous in nature;

- benzene has been reduced in the areas adjacent to the two steel industries; ArcelorMittal Dofasco has reduced benzene by ~84% since 2008, and U.S. Steel Inc. Canada-Hamilton Works has seen an 84% improvement, likely due to the coke oven control plans and other changes at the sites; napthalene, another contaminant associated with coke oven emissions, also showed similar reductions near U.S. Steel and ArcelorMittal Dofasco during this time frame;

- PAHs also showed large decreases in 2007 near the two steel mills; benzo(a) pyrene (B(a)P) has decreased by approximately 70-80% since 1997 near the two plants; even with these improvements, the B(a)P objective was regularly exceeded in the industrial zone;

- sulphur dioxide levels have decreased by 15-40% since 1997; and

- TRS odour exceedances (hours above odour thresholds) have also decreased between 2002-2007 near the steel mills.

Monitoring data specific to the Niagara/Land and the Burlington/Victoria stations are highlighted below for 2007. Data from both of these stations showed impacts from U.S. Steel and from the Federal Marine Terminals. The Burlington/Victoria station showed two exceedances of the manganese criterion, while the Niagara/Land showed no exceedances. This is an improvement from 2006 when there were a total of 6 exceedances. All manganese exceedances coincided with being located downwind of the Federal Marine Terminals and are associated with dust re-entrainment. The company has implemented controls for fugitive dust and materials handling practices which have resulted in an average 50% plus decrease in manganese levels at the two stations since 2003. Special monitoring of ship unloadings revealed more exceedances of the guideline. The TSP daily objective was exceeded in a combined total of 29 samples at the two sites, similar to 2006.

PM_{10} measurements were taken at the Niagara/Land Station and averaged 30 $\mu g/m^3$ (the 24 hour PM_{10} interim criterion is 50 $\mu g/m^3$). This value was lower than 2005/2006 but higher than the levels found between 2001 and 2004. The highest concentrations coincided with winds from the northeast, from the direction of U.S. Steel and nearby dock areas. Inputs from the Federal Marine Terminal property were also noted. A seasonal pattern was noted with higher levels measured in the summer months. This is partly attributed to the local shipping season and summer smog conditions.

For total reduced sulphur (TRS), the Niagara/Land station is primarily affected by the adjacent U.S. Steel plant. There were 31 hours over 10 ppb in 2007, four (4) of which were over 20 ppb. This is similar to the previous few years and a marked improvement to 1998 when 408 hours above 10 ppb were measured.

For VOCs, there has been an 84% decrease in benzene measured at the Niagara/Land Station since 1997. The MOE data suggest that the data may be under-reported compared to MOE and Environment Canada results. No naphthalene guideline exceedances were recorded in 2007, compared to three in 2006.

B(a)P was exceeded in six (6) of 29 samples at the Niagara/Land station and occurred downwind of the City industries.

Meteorological Conditions

Two stations operated by HAMN record local wind speed, wind direction and air temperature. Data from the Niagara/Land Station 29567 (south of the proposed site) and the Woodward Avenue Station 29026 (located at the sewage treatment plant) indicate that the winds from the southwest dominate and account for approximately 40% of the data. Northeast and east winds, the second most prominent directions, which give the city the most industrial impact, occurred approximately 20% of the time.

4.1.5 Climate

General Climate and Weather Patterns

Environment Canada maintains data on climate on a local, provincial and national basis. *Climate normals* or averages are used to summarize or describe the average climatic conditions of a particular location. At the completion of each decade, Environment Canada updates its climate normals for as many locations and as many climatic characteristics as possible. The climate normals and extremes are based on Canadian meteorological stations with at least 15 years of data between 1971 to 2000.

"Climate averages", "climate means" or "climate normals" are all interchangeable terms. These terms refer to arithmetic calculations based on observed climate values for a given location over a specified time period and are used to describe the climatic characteristics of that location. Real-time values, such as daily temperature, are compared to the "climate normal" to determine the variation from the "average".

There are many ways to calculate "climate normals"; the most useful ones adhere to accepted standards. The United Nation's World Meteorological Organization (WMO) considers thirty years long enough to eliminate year-to-year variations. Data collected typically adhere to the WMO standards. The following link http://www.climate.weatheroffice.ec.gc.ca/climate_normals provides the ability to search specific stations for climate normals for a range of parameters. Table B.1 in Supporting Document B provides a summary of the information obtained from the database for the Hamilton A station at Hamilton International Airport in Mount Hope.
Climate Change

One of the most significant impacts of climate change on the Great Lakes, and potentially to the project, is in relation to the possible changes to lake levels, temperatures, shorelines, ice cover and extreme weather events.

Water levels in Lake Ontario are affected by controlled releases of water at the Moses-Saunders Power Generating Station upstream, which in turn impacts the levels in Hamilton Harbour. This significantly impacts any potential changes in water levels for the Harbour.

Studies on the fluctuations in lake levels for the Great Lakes between 1918-1998 showed that the annual mean water level fluctuation for Lake Ontario was 2.0 m (Parlee, 2006). These fluctuations are a result of various regional climate variables such as over-lake precipitation, runoff from the drainage basins and evaporation processes, as well as human factors (water regulation, dredging, diversions and water consumption). Climate change models predict a further decrease in these levels.

Results of climate models vary but most climate change models project higher mean annual air temperatures for the Great Lakes region (Parlee, 2006). Changes in precipitation are less certain but several models suggest increases. Despite more precipitation, the models project that warmer temperatures and increased evaporation will result in lower water levels.

Changes in water levels will have both positive and negative consequences to the shorelines and will result in changes in shipping, impacts to hydroelectric power generation and changes in water quality and quantity.

Changes in the ice cover can impact winter lake evaporation, lake water levels, shoreline erosion, aquatic ecosystems, including winter spawning habitat, aquatic productivity and species composition, weather events, winter recreation and transportation, fisheries and commercial shipping.

The number of climate-related disasters in Ontario shows an increase between 1991-1999, particularly with respect to heavy rainfall and flooding (Parlee, 2006). The frequency of these events is also expected to increase with climate change.

4.1.6 Seismic Activity

The seismicity of the western Lake Ontario region is dominated by shallow (<30 km or 19 miles in depth), local crustal faults. Seismic records for the region indicate the probable existence of several faults in the vicinity of Hamilton Harbour that have historically produced earthquakes with moment magnitudes less than 5.5.

Stability analysis was performed based on the 475 and 975 year return period seismic events, including selection of the seismic parameters used in geotechnical analyses. For liquefaction analyses, amplified peak-ground accelerations and an earthquake magnitude of 5.6 (obtained from the U.S. Geological Survey's de-aggregated hazard plots) were used for both events (USGS, 2002a, 2002b).

Potential seismic-induced geotechnical hazards at the proposed ECF site include surface rupture and liquefaction and subsidence. The potential for surface rupture at this site is considered to be low. Historical data corroborate this low potential (i.e., surface ruptures have not been detected for past earthquakes in the area).

Explorations at the project site revealed a surficial layer of recently deposited soft sediments to depths of approximately 1 m (3 ft) in most areas, but thicker on the south and east sides of the primary ECF. Below this unit, stiff silty clay over very stiff to hard clayey silt/silty clay has been observed. Although the surficial sediment may be susceptible to liquefaction as deposited, this sediment will be compressed during filling, greatly lowering the liquefaction potential. Because of the stiff to hard nature and high fines content of the underlying soils and the region's relatively low seismicity, the foundation system for the proposed ECF is considered not susceptible to significant liquefaction or seismically-induced deformations (i.e., limited strain potential) under the design-level event. Therefore, the hazard associated with liquefaction and subsidence is considered low.

Retaining walls are the primary elements making up the ECF structures and the existing HPA structures. The dynamic behaviour of retaining walls due to seismic activity is complex. The Canadian Foundation Engineering Manual 4th Edition (Canadian Geotechnical Society, 2006) identifies simplified methods for the design of retaining walls including the Mononobe-Okabe method. For the seismic design, the peak ground acceleration for Hamilton of 0.24 was used, and was obtained from the Canadian National Building Code – 2005.

4.1.7 Subsurface Conditions/Stratigraphy

The Lake Ontario basin is characterized by relatively thick (up to 1,500 m (4,900 ft)) Paleozoic carbonate sequences with minor terrigenous units underlain by a southwest-trending Precambrian feature known as the Algonquin-Findlay Arch (Hewitt and Freeman, 1972). Overlying the Paleozoic sedimentary rocks are Quaternary deposits of glacial till, as well as glaciolacustrine clay and silt with minor sand and gravel (Raven et al., 1992). Bedrock in the area is known to be red Queenston shale, which is located approximately 30 m below ground level.

Many reports documenting the subsurface conditions in the Randle Reef area have been completed. Prior to 2003, subsurface data were gathered through a variety of investigations performed to characterize sediments in the Randle Reef area. These investigations are as follows:

- **1954**: Eleven in-water and eight on-land borings drilled to hard pan; borings were located along Pier 15 at the south end of the site (H.G. Acres and Company Ltd., 1954a);

- **1947, 1954, 1976**: Five borings drilled near the I/O structures on the U.S. Steel property (Stelco, 2003);

- **1999**: Nine in-water borings drilled west of the U.S. Steel property within the general footprint of the planned ECF (Trow, 1999); and

- **2004**: Twenty-three borings (21 offshore and 2 upland) and installation of three monitoring wells (AMEC, 2004).

In 2004/2005, additional design-level data were gathered by Arcadis BBL to fill gaps in the information needed to develop the 30 percent design for the ECF. The results are summarized in the Basis of Design Report (Arcadis BBL, 2006).

In 2007, additional geotechnical analyses were performed as part of the Basis of Design Addendum (100% Engineering Design) for the Randle Reef Sediment Remediation Project. The results were presented in a technical memorandum entitled "Task 2.1.1 – Geotechnical Design Analysis" (Arcadis BBL, 2007b).

<u>Summary of Geotechnical Characteristics of Recent Sediment</u>

Recently deposited soft sediments were encountered at the surface within the footprint of the ECF and along the U.S. Steel Dock Wall (USSDW). The thickness of the layer generally ranged from 0.2 to 7.9 m (0.7 to 25.9 ft). The recent sediments consist primarily of very soft to soft low-plasticity silt.

Geotechnical laboratory testing indicates the following sediment properties:

- bulk density ranges from 1.20 to 1.80 g/cm3 (74.9 to 112.4 pcf);
- specific gravity ranges from 2.61 to 2.69;
- natural water content ranges from 25 to 352%; and
- grain size distribution tests indicate that the stratum comprises 17 to 37% sand-size fraction, 53 to 76% silt-size fraction and 6 to 10% clay-size fraction. Several samples from this layer were tested for plasticity index and were reported as non-plastic.

<u>Summary of Geotechnical Characteristics of Geologic and Fill Materials</u>

Figure 4.9 provides the general subsurface profile. Figure 4.10 provides a site plan with cross-section locations. Figures B.1 to B.3 in Supporting Document B provide geotechnical cross sections through the ECF. Figure B.4 also provides a site plan with additional cross-section locations. Figures B.5 and B.6 provide the geotechnical cross sections referred to in Figure B.4.

Fill Materials: Slag (a by-product of steel-making operations) mixed with miscellaneous fill material was encountered along the USSDW. The thickness of the slag fill ranges from about 0 to 15 m (0 to 49.2 ft). The fill material in the Harbour mainly consists of sand with various amounts of fines. In some areas, organic material (peat), slag, cinders, soft ore dust and solidified coal tar pieces are also present. The fill materials are generally very loose or soft in nature; in some boring locations for Pier 15, very soft "silty marl" was encountered overlying older deposits of clay. Based on in-situ and laboratory test results, the saturated unit weight of the fill material is 18.1 kilonewtons per cubic metre (kN/m^3) (115.3 pcf). The natural moisture content of slag fill varies between 10 and 20%.

Figure 4.9: Generalized Subsurface Profile

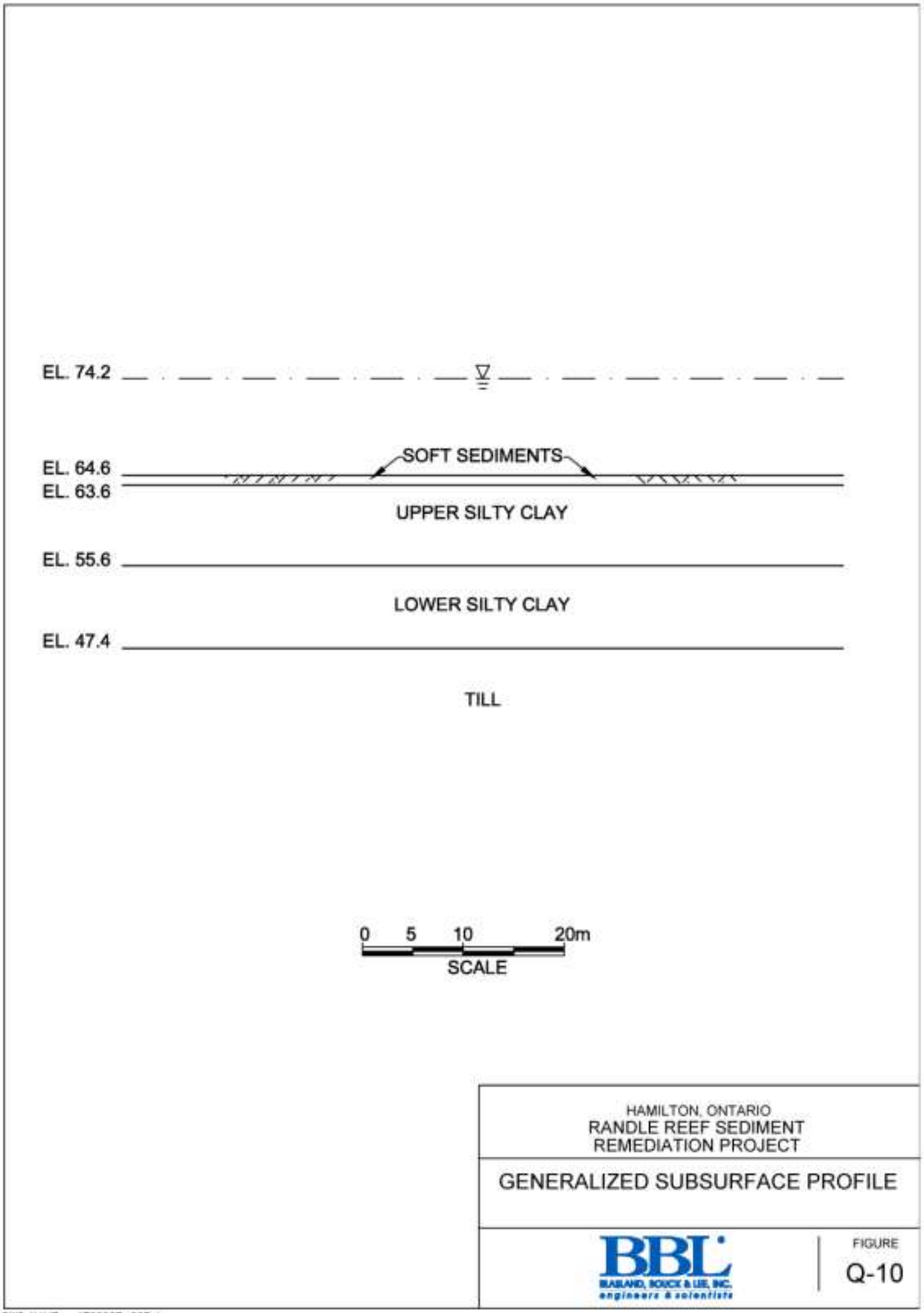
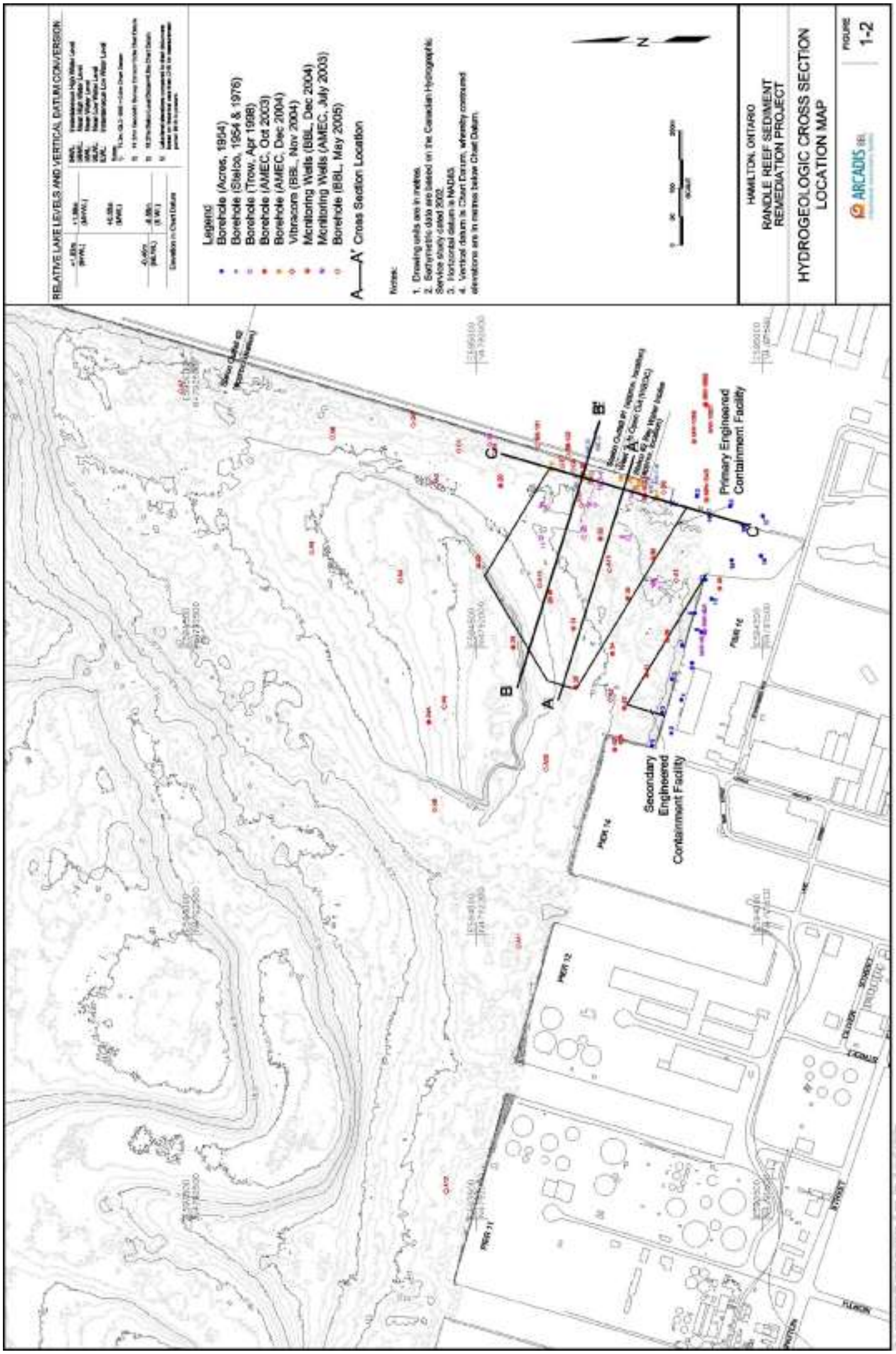


Figure 4.10: Hydrogeologic Cross Section Location Map



The following geologic materials were encountered within the footprint of the ECF:

Silt Deposits: Non-plastic brown silt and grey-black sandy silt were encountered within the ECF footprint underlying the recent soft sediment and also encountered outside the ECF footprint in previously dredged areas, the reef area and at Piers 14 and 15. The material is generally loose to medium dense. The overall thickness of this deposit ranges from 0.3 to 8.1 m (1.0 to 26.6 ft). The water content of composite samples collected within the silt deposits ranges from 16 to 59%. The gradation test results indicate that the non-plastic silt comprises approximately 5% sand-size particles, 77% silt-size particles and 13% clay-size particles. The grey sandy silt comprises approximately 50% sand-size particles, 46% silt-size particles and 4% clay-size particles.

Organics: Several metres of very soft organic material were encountered underlying the recent soft sediment in the middle of the ECF footprint and along the USSDW. The natural moisture content of the organics varies between 208 and 325%.

Upper Silty Clay: The upper silty clay was encountered underlying the recent sediment, slag fill and organic sediment for most of the ECF site. The silty clay layer is about 8 to 12 m (26.2 to 39.4 ft) thick and generally consists of moderately plastic clay (lean clay). Based on in-situ and laboratory test results, the saturated unit weight of the upper silty clay is 19.8 kN/m^3 (126.1 pcf). The results of 19 grain size distribution tests indicate that the stratum comprises a 0 to 12% sand-size fraction, 42 to 69% silt-size fraction and 25 to 58% clay-size fraction. The water content of this layer ranges from 22 to 34%. Results of the Atterberg limits tests indicate the plasticity index of this layer ranges from 8 to 19 (i.e., it is a moderately plastic clay).

Lower Silty Clay: The lower silty clay generally underlies the upper silty clay. The thickness of the deposit ranges from about 3 to 9 m (9.8 to 29.5 ft). The lower silty clay generally consists of moderately plastic clay but is stiffer than the upper silty clay, ranging from very stiff to hard. Based on in-situ and laboratory test results, the saturated unit weight of the lower silty clay is 20.5 kN/m^3 (130.6 pcf). Sieve-hydrometer analysis was performed on one sample; the results indicate a gradation of approximately 16% sand-size particles, 52% silt-size particles and 32% clay-size particles. Results of the Atterberg limits tests indicate the liquid limit, plastic limit and plasticity index of the sample are 25, 17 and 8, respectively. In terms of engineering behavior, this soil is low-plasticity clay despite having higher silt content. The natural moisture content of this layer is 17%.

Sand and Gravel: A relatively continuous gravel layer was encountered in the general vicinity of the proposed marine terminal double walls on the south side of the ECF. Boring logs 33, 34, and 35 indicate the thickness of the geologic unit ranges from 0.5 m (1.6 ft) to 2.5 m (8.2 ft).

Till: Clayey silt till was encountered underlying the upper and lower silty clay deposits. The till contains various amounts of sand, gravel, boulders, and cobbles and is generally very stiff to hard. Gradation analyses on a sample of the till indicate that the layer consists of 17.1% sand-size particles, 42.5% silt-size particles and 34% clay-size particles. Results of the Atterberg limits test indicate the liquid limit, plastic limit and plasticity index of this layer are 32, 18 and 14, respectively.

The natural moisture content of this layer ranges from 3 to 22%. Based on in-situ and laboratory test results, the saturated unit weight of the till is 21.2 kN/m^3 (135 pcf).

Table 4.5 provides a summary of geotechnical information collected within Hamilton Harbour. In addition, geotechnical sampling of sediment west of Pier 16 within the Hamilton Harbour was conducted as part of the Conceptual Design Study (Acres & Associated, Headwater and PEIL, 2003). The Conceptual Design Study (Volume 2 – Appendices) should be consulted for further details. However, the following provides a summary of the results of the geotechnical sampling.

Table 4.5: Summary Geotechnical Information

Characteristic	Summary Information
General	• bedrock in the area is known to be red Queenston shale, which is located approximately 30 m below ground level
Sherman Channel	• eight test pits dug to maximum 2 m depth along channel alignment • primarily black silt muck • petroleum and sewer odours detected
Pier 16/Randle Reef	• nine boreholes advanced through the sediment and into the Harbour floor • clay begins between Elevation 66.5 and 62.5 m, and extends to borehole termination • clay overlain by sediment deposits • clay described as grey with trace silt and sand • shear vane results varied between 41 and 115 kPa, with trend of increasing shear strength with depth • moisture content range 23-98 %
Pier 15	• blue clay begins as high as Elevation 70.7 m and extends to as low as Elevation 47.0 m, changing from soft to stiff with increasing depth • hard pan sand and gravel beginning between Elevation 51.5 and 47.0 m • shale is noted in some of the borehole logs at approximately Elevation 50 m
Pier 14	• brown, very stiff clay extending from Elevation 70.4 m to 68.3 m • blue clay extending from Elevation 68.3 m to 52.7 m, changing from soft to very stiff with increasing depth • as-built drawing indicates that dredged material used to backfill pier extension
Former J. I. Case Property	• north of Burlington St., west of Sherman Ave. and east of McKinstry • 8 boreholes advanced to maximum depth of 12.6 m • silt, foundry sand and slag fill extent ranged from 0.5 to 11.3 m below ground level • fill overlies an organic silt layer ranging from 0.9 to 2.1 m thick • organic silt layer overlies clay layer of unknown thickness

Source: Acres & Associated, Headwater and PEIL, 2003, Volume 2 – Appendices, Appendix A – Common Basis for Design.

Note: The original table located in the above reference also included the sources for the information provided in the table. These sources have not been provided. The original table should be consulted for this information.

4.1.8 Sediment Contamination

EC and MOE conducted numerous surveys between the mid 1980s through to the late 1990s to characterize the sediment in and around Randle Reef. More recent sediment assessment surveys were conducted in the fall of 2000 and 2002 to further quantify the volume of sediments to be dredged and placed within the containment structure. Following the issuance of the Basis of Design (BOD) report (Arcadis BBL, 2006) in early 2006, NWRI Technical Operations collected 46 additional sediment samples in the summer of 2006.

From this large body of data, a comprehensive data base was developed for the project and used for a number of design purposes.

Total PAH concentrations at Randle Reef range from non-detect to 73,000 ppm. While other contaminants are present, and include elevated concentrations of iron, manganese, lead, zinc, chromium and copper, PAHs are the priority for remediation. The concentration ranges of contaminants are presented in Table 4.6, along with the corresponding median contaminant concentrations.

On the basis of available chemistry and toxicity information, four sediment priority categories have been developed. These priority categories were formulated to identify those areas where remediation (by dredging or in-place containment) would be most effective at meeting the following project objectives:

- reduction of PAH mass in site sediments; mass reduction can be accomplished either by removing sediments and placing them in the ECF or by containing them in place;

- reduction of mass of seven selected metals (arsenic, chromium, copper, iron, lead, nickel and zinc) in site sediments; and

- removal/containment of site sediments with demonstrated toxicity.

Table 4.6: Ranges of Contaminant Concentrations in Sediment from Randle Reef

PARAMETER	CONCENTRATION RANGE (mg/kg)
PAHs	
Acenaphthene	ND - 634
Acenaphthylene	ND – 1,740
Anthracene	ND – 1,030
Benzo(a)anthracene	ND - 853
Benzo(a)pyrene	ND - 790
Benzo(b)fluoranthene	ND - 948
Benzo(g,h,i)perylene	ND - 524
Benzo(k)fluoranthene	ND - 320
Chrysene	ND - 794
Dibenzo(a,h)anthracene	ND - 100
Fluoranthene	ND – 3,300
Fluorene	ND – 1,250
Indeno(1,2,3-c,d)pyrene	ND - 538
Naphthalene	ND – 66,800
Phenanthrene	ND – 4,540
Pyrene	ND – 2,370
Total PAHs	ND – 73,755
METALS	
Aluminum	ND – 16,200
Antimony	ND - 2
Arsenic	ND - 57
Beryllium	ND - 5
Cadmium	ND - 40
Chromium	ND – 143.85
Copper	5.4 – 708.14
Iron	5,000 – 350,000
Lead	0.5 – 1,000
Magnesium	700 – 19,300
Manganese	110 – 11,019
Mercury	ND – 4.42
Nickel	ND - 609
Selenium	ND - 4
Silver	ND - 10
Thallium	ND
Zinc	14 – 5,930
All units are mg/kg on a dry weight basis. ND = none detected	

Source: The values are taken from the comprehensive database for Randle Reef which includes studies taken from the 1980s, 1990s and between 2000-2007.

To identify subareas with the highest contaminant concentrations (the remediation of which will result in the greatest contaminant mass reduction), observed total PAH concentrations are compared with the value of 100 mg/kg[6] , and metals concentrations are compared with Ontario Severe Effect Levels (SELs). These comparisons were not selected to meet risk-based goals, but instead to serve as guidelines for identifying the highest-priority areas for remediation. The four priority categories are defined in Table 4.7.

Table 4.7: Priority Categories for Sediment Remediation

Priority Category	Description
Priority 1	Priority 1 sediments include the 14.6 ha (36.5 acre) priority area. These sediments have been previously identified as containing significant concentrations of contaminants (PAHs and metals), as well as showing demonstrated toxicity.
Priority 2	Priority 2 sediments have demonstrated toxicity based on BEAST * analysis (Milani and Grapentine, 2003a, 2003b) and elevated concentrations of PAHs and/or metals. Elevated concentrations are defined as total PAH concentrations >100 mg/kg or concentrations of one or more of the metals of interest (arsenic, chromium, copper, iron, lead, nickel and zinc) that exceed the SELs.
Priority 3	Priority 3 sediments have total PAH concentrations >100 mg/kg or concentrations of one or more metals of interest that exceed the SELs, but do not have demonstrated toxicity. This priority category includes sediments in areas for which no toxicity data are available, as well as areas where the BEAST analysis found no toxicity (Milani and Grapentine, 2003a, 2003b).
Priority 4	Priority 4 sediments have total PAH concentrations <100 mg/kg, and concentrations of metals of interest below the SELs. However, Priority 4 sediments have demonstrated toxicity based on BEAST analysis (Milani and Grapentine, 2003a, 2003b).

* The assessment process (BEnthic Assessment of SedimenT (the BEAST) Reynoldson and Day, 1998) utilizes benthic invertebrates, as these animals are the most exposed and potentially most sensitive to contaminants associated with sediment. Decisions on the spatial extent and severity of contamination is based on the type and number of species present and the response (survival, growth, reproduction) of these animals in standard laboratory tests. Data is compared to the biological guidelines which were developed for both field populations and laboratory responses of benthic invertebrates.

6 An arbitrary value used for organizing the data; this value does not have chemical or biological significance in this context. There is no practical remediation value for an area like Hamilton Harbour which has elevated background levels, however, 100 ppm was developed in consultation with the various technical committees and scientists involved in research work in the Harbour. The studies for PAHs in the Harbour have not demonstrated specific concordance to a specific PAH concentration and effect.

In addition, non-priority areas are defined as those regions for which data are available and demonstrate that the sediments have total PAH concentrations <100 mg/kg, metals concentrations below the SELs and no demonstrated toxicity.

Within the priority areas, 23 priority subareas were identified to further prioritize the relative importance of dredging in a given area. The subareas were determined based on subsets of chemistry or toxicity data, sediment physical characteristics and dredging feasibility. Figure 4.11 presents the priority subareas and their associated priority designations.

Vertical delineation of the contaminant profile in the various areas was examined using the comprehensive data set to develop the approach to dredging and optimizing the mass of contaminants to be dredged and contained. The variability of the contaminant concentrations throughout the sediment cores and the establishment of the clean clay layer led to the determination to dredge to clay in all Priority One and Two areas. In the other priority areas, the depth of contamination was limited to 0.5 m or less (e.g., near the physical reef). Analysis to establish the depth of the clay layer was undertaken as part of the engineering design to establish the depth of contamination, since the clay layer was found be "clean" in the vertical cores. The dredge depths, mass contaminant estimates and volumes were established based on both vertical and horizontal delineation of the contaminants.

Distribution of Contaminant Mass

The approximate mass of total PAH, arsenic, chromium, copper, iron, lead, nickel and zinc within the dredging limits was computed for each of the 23 priority subareas shown on Figure 4.11 using the following assumptions:

- an average concentration for each contaminant was computed as the arithmetic mean of all chemical data for the subarea;
- in the case of Subareas 1 and 7, for which no metals data are available, metals concentrations were estimated as the arithmetic average of the concentrations for the immediately adjacent subareas; the same procedure was used for arsenic in Subareas 1 and 2;
- the mass of each contaminant was computed using a uniform sediment dry density of 1,220 kg/m^3; sediment density was estimated using data obtained during the BOD;
- only the mass of contaminants within the 23 priority subareas was considered (i.e., 100% of the "total" mass is within these subareas); contaminant mass falling outside the horizontal subarea boundaries was not included; and
- for the purposes of the mass removal estimate, dredging was assumed to be completed in Subareas 2 through 5 and Subareas 7 through 18.

Figure 4.11: Sediment Priority Subarea Designations

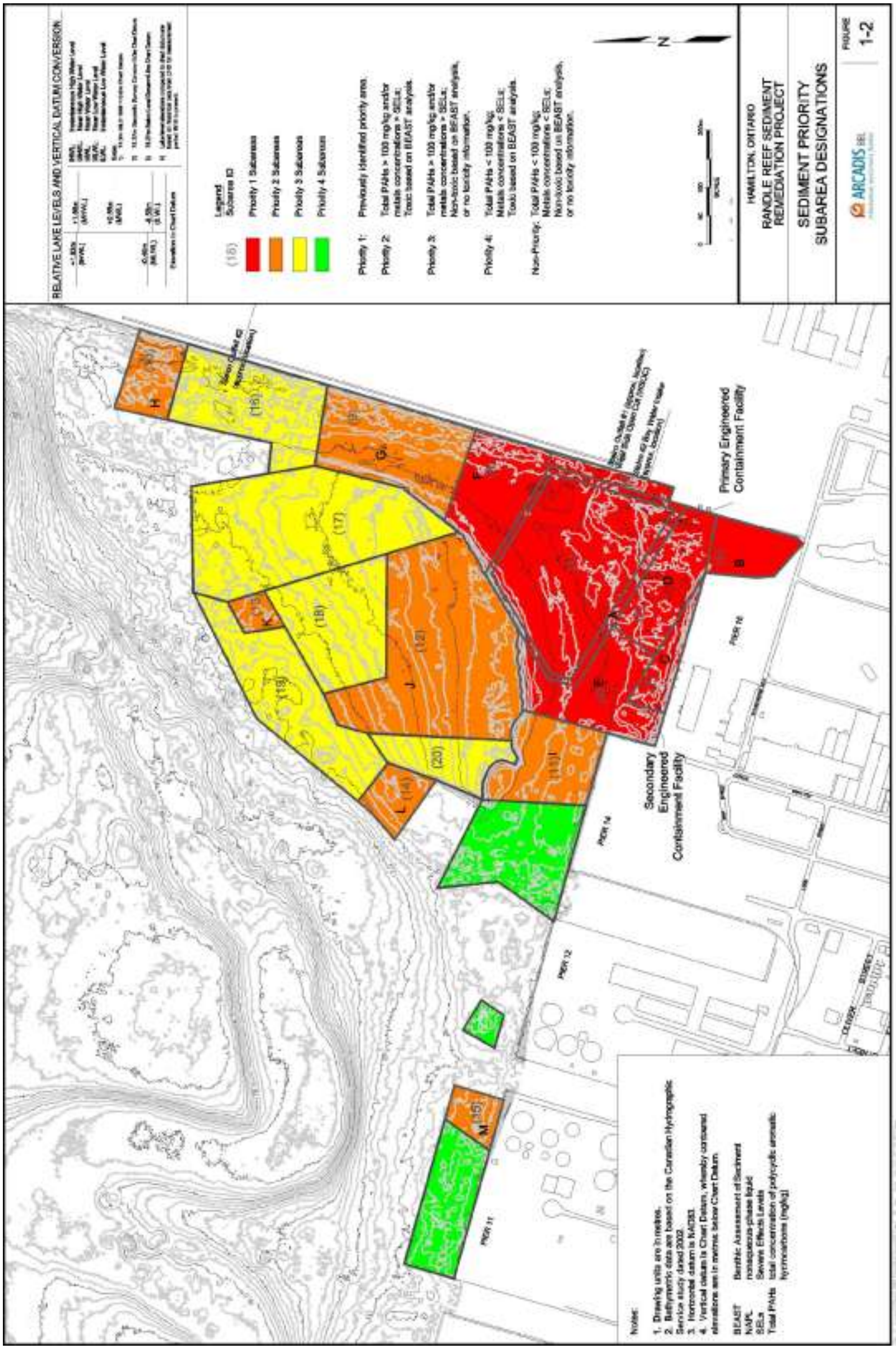


Table B.2 in Supporting Document B shows the total PAH mass distribution by subarea, including the percentage of the total mass found in a given subarea and the cumulative mass for all subareas. Tables B.3 to B.9 provide the same information for each metal.

About 72% of the total PAH mass (within the project boundary) falls within the ECF footprint (Subarea 1). Taken together, the Priority 1 subareas represent about 90% of the total PAH mass within the project boundary. For metals, 37 to 70% of the total mass within the project boundary (depending on the metal) falls within Priority 1 areas, (i.e., Subareas 1 through 8).

The *Randle Reef Sediment Remediation Project* will result in a PAH mass reduction of over 90% when compared to the entire Harbour. The project will also result in an 80% reduction of metals contaminant mass from the Harbour, thus providing a whole Harbour solution.

4.2 Natural Environment

4.2.1 Fish and Fish Habitat

The fishery in Hamilton Harbour is diversified, with 19 families, 42 genera, and 59 species, as represented in Table 4.8. It is important to note that the community structure of the late 1800s was larger with long-lived species. The recent community structure consists of smaller and short-lived species which are characteristic of a eutrophic ecosystem.

These communities show effects of habitat stress. Comparisons of fish data from electrofishing surveys indicate important differences in biomass, species composition and trophic structure between the Harbour and less stressed littoral habitats of the Bay of Quinte and Severn Sound. Although the species composition of the Harbour is comprised of a few less desirable non-native species of fish, current high biomass levels indicate the productivity of the area to be high. This suggests the potential for restoring the habitat and for achieving the desirable fish targets set out by the Hamilton Harbour RAP.

A report on the historical and current fish communities and habitat (i.e., substrate and aquatic vegetation) in Hamilton Harbour was prepared and is included as Supporting Document B. The report includes information on: historical and recent fish surveys; monitoring studies that evaluate the fish community and associated biotic and abiotic factors (conducted pre- and post habitat restoration projects in the Harbour); the current status of beneficial use impairments (BUIs) and their delisting targets for the fish community (based on an Index of Biotic Integrity (IBI)); and current work underway by Fisheries and Oceans Canada on fish and fish habitat in the Harbour.

Table 4.8: Fish Species in Hamilton Harbour and Cootes Paradise, 1984-87

Scientific Name	Common Name	Larvae
Petromyzon marinus	sea lamprey	
Anguilla rostrata	American eel	
Lepisosteus osseus	longnose gar	
Amia calva	bowfin	
Alosa pseudoharengusi	alewife	•
Dorosoma cepedianum	gizzard shad	•
Oncorhynchus kisutch	coho salmon	•
Oncorhynchus tshawytscha	chinook salmon	•
Salmo gairdneri	rainbow trout	
Salmo trutta	brown trout	
Salvelinus namaycush	lake trout	
Coregonus artedii	lake herring	
Couesius plumbeus	lake chub	
Osmerus mordax	American smelt	•
Umbra limi	central mudminnow	•
Esox lucius	northern pike	
Carassius auratus	goldfish	•
Cyprinus carpio	carp	•
Notemigonus crysoleucas	golden shiner	•
Notropis atherinoides	emerald shiner	•
Notropis hudsonius	spottail shiner	•
Notropis heterolepis	blacknose shiner	
Notropis heterodon	blackchin shiner	•
Notropis cornutus	common shiner	•
Notropis chrysocephalus	striped shiner	•
Notropis volucellus	mimic shiner	•
Pimephalus promelus	fathead minnow	•
Pimephalus notatus	bluntnose minnow	•
Semotilus atromaculatus	creek chub	•

Source: Hamilton Harbour RAP et al., 1992.

4.2.2 Aquatic Vegetation

Little or no aquatic vegetation exists within the project area due to the toxic nature of the sediment. Further information on aquatic vegetation is found in Supporting Document B.

4.2.3 Benthic Invertebrates

The health of benthic invertebrates could be considered as another indicator of Harbour health, in addition to chemical measurements, since there is good evidence that benthic species accumulate contaminants through ingestion. Sufficient oxygen content is required at the sediment/water interface for most benthos to survive. Contaminants could continue to limit benthos in-situ, even if hypolimnetic (deep water) oxygen depletion is rectified. This is evident in comparisons to tissue residues in bioassay organisms with those exposed to contaminated sediment (Krantzberg, 1994).

The benthic community in Hamilton Harbour is stressed. In 1964, samples were taken by Johnson and Matheson (1968) which concluded that the Harbour was severely degraded and dominated by pollution-tolerant oligochaetes. Studies undertaken in 1984 documented an increase in biomass throughout the Harbour between 5 and 20 fold, with the community structure composed of more pollution-sensitive species. These findings indicated a shift away from pollution-tolerant species towards more pollution-sensitive species. An additional four genera of chironomids and sphaerids, which were not found in the 1964 study, were identified at 11 sites (Hamilton Harbour RAP et al., 1992).

A Benthic Assessment of Sediment (BEAST) methodology was applied to Randle Reef sediment samples in the fall of 2000. This predictive approach for assessing sediment quality involves an extensive database consisting of information on sediment chemistry, benthic community structure, selected habitat attributes and responses of four benthic invertebrates in laboratory toxicity tests. Near-shore reference sites in the Great Lakes determine the range of normal biological variability so that expected biological conditions at test sites can be predicted by examining the relationships between variability and habitat conditions (Reynoldson and Day, 1998).

Using the BEAST methodology, strong evidence of benthic macroinvertebrate community impairment was observed at the Randle Reef sites. There was a trend of lower taxa diversity and lower abundance of all taxa except pollution tolerant oligochaete worms such as tubificids and naidids (Milani and Grapentine, 2003a). Benthic community alteration was correlated with elevated levels of metals in sediment (copper, mercury, lead and zinc) and increased levels of water nutrients (total phosphorus, nitrites and nitrates).

Toxicity testing at eight sites sampled in the Randle Reef area during the fall of 2000 indicated the sediments were toxic or severely toxic (Milani and Grapentine, 2003a). Although the toxicity was not clearly related to one contaminant or group of contaminants, toxicity among the sampling sites appeared to be related to PAHs and some metals (such as arsenic, cadmium and/or copper).

Since the 2000 sampling coverage in the area of highest sediment contamination was considered to be minimal (only 8 sites), additional sampling locations were deemed necessary to adequately delineate toxicity patterns within the Randle Reef area (Milani and Grapentine, 2003a). The amphipod *(Hyalella azteca)* and mayfly *(Hexagenia spp.)* survival and growth showed the strongest responses to these sediments, thus laboratory toxicity tests were conducted on only these two species in November 2002 at 80 Randle Reef sites (Milani and Grapentine, 2003b).

Strong evidence of toxicity was observed at 31 of the 80 Randle Reef sites and potential toxicity was evident at an additional 19 sites. Toxicity was found to be associated with elevated levels of nitrites and nitrates in the overlying water and one or more trace metals (i.e. copper, iron, lead and zinc) in the sediment. The highest levels of most trace metals occurred along the southeastern wall of U.S. Steel. Metals exceeding the Severe Effects Level (SEL) included 3 sites for copper (17 to 708 ppm; median 47 ppm), 21 sites for iron (1.2 to 15.7%; median 3.1%), 8 sites for lead (17 to 611 ppm; median 103 ppm) and 27 sites for zinc (67 to 2520 ppm; median 5836 ppm) (Milani and Grapentine, 2003b).

In the Randle Reef area, total PAH concentrations in sediment ranged from 1 to 9048 ppm (median 87 ppm, mean 320 ppm); the SEL for PAHs, normalized to total organic carbon, was exceeded at seven sites in the Randle Reef area along the U.S. Steel wall (Milani and Grapentine, 2003b). Seventeen sites had PAHs greater than 100 mg/kg. Because BEAST methodology does not incorporate information on organic contaminants, the relationships between PAHs, as well as metal contaminant concentrations in the sediment, and toxic response were also evaluated using regression analysis. Toxicity to PAHs appears to correlate with metal toxicity (copper, iron and fluorine) and sediment grain size (Milani and Grapentine, 2003b).

4.2.4 Terrestrial Environment

There are six significant areas around the Harbour which support wildlife. These include Cootes Paradise marsh, Hendrie Valley/Carrolls Point, LaSalle Park, Northeastern Shoreline, Fishermans Pier, Windermere Basin and Hamilton Harbour proper. As many as 43 waterbird species are found in the Harbour (Gebauer et al., 1992). The highest number of bird species tend to be found at the west end of the Harbour.

Sparse vegetation occupies the lands where the storage area and sediment preparation site may be erected (i.e., Harbour Port Authority property). Cattail beds fringe the old Sherman Inlet in some areas. Medium sized trees and larger shrubs are also present.

Some nesting of Mallards and Canada Geese likely occurs along the old Sherman Inlet shores. The trees around the Sherman Inlet pond may provide roosting habitat for black-crowned night-herons, which nest in other areas around the Harbour. Common breeding bird species of urbanized areas occur here, such as song sparrow, red-winged blackbird, barn swallow, European starling, house sparrow and rock dove. Other species noted include yellow warbler, eastern kingbird and warbling vireo (extracted from Hamilton Harbour RAP, 1997). Mammals which may inhabit the area would likely include raccoons, muskrat, mice and voles.

4.2.5 Species at Risk

No aquatic or terrestrial fauna or flora at risk are known to inhabit the Randle Reef area. Outside of the Randle Reef area, there are a number of species at risk in the area bounded by Hamilton Harbour and the surrounding watershed, including:

Species	Status (nationally = *Species at Risk Act*)
American eel (*Anguilla rostrata)*	Endangered provincially, Special Concern nationally
Northern brook lamprey (*Ichthyomyzon fosser)*	Special Concern provincially and nationally
Redside dace (*Clinostomus elongates)*	Threatened provincially, Endangered nationally
Gravel chub (*Hybopsis x-punctata*)	Extirpated provincially and nationally
Bigmouth buffalo (*Ictiobus cyprinellus)*	Special Concern provincially and nationally
Shortjaw cisco (*Coregonus zenithicus)*	Threatened provincially and nationally
Eastern spiny softshell (*Apalone spinifera spinifera)*	Threatened provincially and nationally
Common map turtle (G*raptemys geographica)*	Special Concern provincially and nationally
Stinkpot turtle (*Sternotherus odoratus)*	Threatened provincially and nationally
Peregrine falcon (*Falco peregrinus)*	Threatened provincially, Special Concern nationally
Bald eagle (*Haliaeetus leucocephalus)*	Endangered in Southern Ontario, Special Concern in Northern Ontario, Not at Risk nationally
Hoary mountain mint *(Pycnanthemum incanum)*	Endangered provincially and nationally
Few flowered club rush *(Trichophorum planifolium)*	Endangered provincially and nationally
Snapping turtle (*Chelydra serpentinai*)	Special Concern nationally
Blanding's Turtle (*Emydoidia blandingii*)	Threatened provincially and nationally

4.3 Social and Land Use

4.3.1 Land Use

The area surrounding Hamilton Harbour has a mixture of urban, industrial, agricultural and recreational land uses. The City of Burlington is located on the north shore of the Harbour, with the City of Hamilton on the south shore. The Harbour accommodates a commercial port and is considered a major shipping centre for large industries. The highest concentration of heavy metal industry (primarily iron and steel) in Canada is located on the south shore of Hamilton Harbour. A network of highways and railways also surround the Harbour on a number of its shores.

The approximate 42 km shoreline is utilized as follows:

- 46 % - industrial, including proposed developments on existing piers (19.4 km);
- 3 % - transportation (1.4 km);
- 10 % - residential (4.3 km);
- 10 % - institutional (cemeteries, public buildings) (4.0 km);
- 4 % - private open space (private marinas, golf courses) (1.5 km); and
- 27 % - public open space (public marinas, parkland, wildlife habitat) (11.1 km).

The proposed project site is located on and adjacent to the south shores of Hamilton Harbour, west of U.S. Steel Pier 16, northeast of Pier 14 and north of Sherman Inlet and Pier 15. The water lot in which the contaminated sediments are located is owned by the Hamilton Port Authority. The lands adjacent to the site include U.S. Steel along Pier 16, a marine terminal operation on the west side of Pier 15, Hamilton Port Authority lands and a warehouse on the east side of Pier 15 and a backwater embayment named Sherman Inlet. Along the dock face of Pier 16 is U.S. Steel's cooling water outfall pipe. A combined sewer overflow is located in Sherman Inlet. Commercial shipping vessels use the north face of Pier 14 and the northwest face of Pier 16. One of the largest tug boat operations in the Great Lakes operates from Pier 15.

4.3.2 Water Resource Use

Canada's largest port on the Great Lakes is Hamilton Harbour, handling an average of over 12 million tonnes of shipping cargo from 2006-2008. Imports include general cargo, steel slabs, specialty ores, machinery and fertilizers. Exports include steel and general cargo. Bulk shipments of coal, iron ore, sand, scrap metal, petroleum products, tallow, grain, sugar, pelletized slag, mill scale and gypsum are handled.

Recreational activities in the Harbour include boating, sailing, rowing, wind surfing, bird watching and fishing. In the past, a Hamilton Harbour Commissioners by-law prohibited swimming in the Harbour. Due to the improved water quality at the southwest section of the Harbour, swimming is now allowed by the City of Hamilton off Bayfront Park and Pier 4 Parks, which were created in 1992.

Currently, drinking water is drawn from Lake Ontario and municipal waste water is discharged to the Harbour via Red Hill Creek and Windermere Basin. Cooling and treated process water is drawn from the Harbour and discharged into the Harbour from steel manufacturers.

5.0 REVIEW OF ALTERNATIVES TO THE PROJECT

As illustrated in Figure 2.1, there were a number of stages in the overall evaluation of alternatives for the Randle Reef Sediment Remediation Project, including:

- conceptual stage alternatives (Supporting Document C, Section C.1);
- removal/treatment/disposal alternatives (Supporting Document C, Section C.2);
- review of the use of the U.S. Steel (Stelco at the time) sinter plant for disposal (Supporting Document C, Section C.3);
- re-examination of disposal and reuse alternatives (Supporting Document C, Section C.4); and
- sediment removal and containment alternatives – work of the Project Advisory Group (PAG) (Section 5.1).

Further details on each of these stages are provided in Figure 5.1. This figure outlines the timeline for these evaluations, along with the alternatives considered and the conclusions.

Section 5.0 generally documents the identification and evaluation of "alternatives to" the project (see Section 2.4). Within this overall process of examining "alternatives to" the project, Supporting Document C, Section C.2 focuses on the evaluation of "alternative means" for removal / treatment / disposal (i.e., feasible ways of carrying out removal / treatment / disposal).

The historical analyses that preceded the work of the PAG are provided in Supporting Document C, as noted above. The work of PAG was critical in the development of a solution for the remediation of Randle Reef. The PAG was established to develop a consensus around a solution that would satisfy the objectives of the project, as well as those of the stakeholders who were represented on the PAG. At an April 24, 2002 PAG meeting, the majority of the PAG members reached a consensus on recommending containment and the construction of an ECF as the preferred remedial alternative (see Section 5.1.3). Following this recommendation, work on the conceptual design of the project was undertaken (see Section 6.0).

5.1 Sediment Removal and Sediment Containment Alternatives

5.1.1 Description of Alternatives

In November 2001, Environment Canada, as the project lead, formed a multi-stakeholder Project Advisory Group (PAG) consisting of 17 participating organizations to develop a consensus around a solution that will satisfy the objectives of the *Randle Reef Sediment Remediation Project* and those of the stakeholders represented. The PAG consisted of representatives from Bay Area Restoration Council (BARC), Hamilton Harbour RAP Office, Great Lakes United, Clean Air Hamilton, Central North End West Neighbourhood Association, Hamilton Beach Preservation Committee, Hamilton Industrial Environmental Association Citizen Liaison Committee, City of Hamilton, City of Burlington, U.S. Steel, Local 1005 (USWA), Ontario Ministry of Environment (MOE), Ontario Ministry of Labour, Environment Canada, Department of Fisheries and Oceans, Hamilton Conservation Authority (HCA) and the Hamilton Port Authority.

A range of remediation options were considered by PAG, including: removal and disposal; removal and re-use; and in-situ containment. Specifically the alternatives were:

1) dredge, dewater and dispose in a hazardous waste landfill;
2) dredge, dewater, treat and dispose in a non-hazardous waste landfill;
3) dredge, dewater, treat and reuse in U.S. Steel (Stelco at the time) sinter plant;
4) dredge, dewater, treat and reuse as industrial fill;
5a) in-situ containment; and
5b) in-situ containment and construction of an ECF.

These were "alternatives to" the project, as per CEAA (see Section 2.4).

A review of these potential remediation options was carried out by PAG. Background material regarding the various alternatives and the different means for dredging and de-watering sediments, disposal and treatment were presented to PAG in a series of meetings. Information on the various types of disposal facilities and landfills, the various types of PAH treatment technologies (including biological, thermal, chemical and soil washing) and the conditioning and treatment of sediments with these methods for use and handling was reviewed. Information on in-situ options, along with examples of facilities such as the Northern Wood Preservers sediment remediation project in Thunder Bay, was also presented and reviewed.

Figure 5.2 illustrates the sediment remediation options considered by PAG.

Figure 5.1: Process for Evaluating Alternatives

Legend					
Timeline	1996	1997	1999	1999	2001 - 2002
Report Section	Supporting Document C, Section C.1	Supporting Document C, Section C.2	Supporting Document C, Section C.3	Supporting Document C, Section C.4	Section 5.1
Evaluation	Conceptual Design Alternatives	Alternative Means for Removal / Treatment / Disposal	Sinter Plant Alternative	Re-examination of Disposal and Re-use Alternatives	Sediment Removal and Sediment Containment Alternatives - Work of Public Advisory Group (PAG) -
Alternatives Considered	❑ Inaction ❑ No Immediate Action ❑ In-situ Capping ❑ In-situ Treatment ❑ Contain Entire Zone ❑ Removal/ Treatment/ Disposal	❑ Disposal at Hazardous Waste Facility ❑ Biological Treatment, Inorganic Extraction, Placement in ECF ❑ Organic Extraction, Inorganic Extraction, Placement in ECF ❑ Thermal Treatment, Inorganic Extraction, Placement in ECF ❑ Biological Treatment, Disposal in Landfill ❑ Organic Extraction, Disposal in Landfill ❑ Thermal Treatment, Disposal in Landfill ❑ Biological Treatment, Inorganic Extraction, Re-use on Commercial / Industrial Land ❑ Organic Extraction, Inorganic Extraction, Re-use on Commercial / Industrial Land ❑ Thermal Treatment, Inorganic Extraction, Re-use on Commercial / Industrial Land ❑ Thermal Treatment, Inorganic Extraction, Re-use on Residential or Parkland ❑ Organic Extraction, Inorganic Extraction, Re-use on Residential or Parkland ❑ Thermal Treatment, Inorganic Extraction, Disposal in Water ❑ Biological Treatment, Inorganic Extraction, Cap in Area Adjacent to Pier 15 ❑ Organic Extraction, Inorganic Extraction, Cap in Area Adjacent to Pier 15 ❑ Thermal Treatment, Inorganic Extraction, Cap in Area Adjacent to Pier 15 ❑ Thermal Treatment, Inorganic Extraction , Any Land-Based Application ❑ Thermal Treatment, Inorganic Extraction, Re-use as Landfill Cover ❑ Organic Extraction, Inorganic Extraction, Re-use as Landfill Cover ❑ Biological Treatment, Inorganic Extraction, Re-use as Landfill Cover	Based on discussions among Environment Canada, MOE, Hamilton Port Authority and U.S. Steel (Stelco at the time), an alternative which would use the de-watered dredge material for feedstock for the U.S. Steel sinter plant.	Disposal: ❑ Dredge and Dewater the Sediment and Dispose as a Hazardous Waste at an Existing Hazardous Waste Facility ❑ Dredge and Dewater the Sediment, Treat it to Meet Industrial Waste Criteria and Dispose as an Industrial Waste in an Existing Industrial Landfill ❑ Dredge and Dewater the Sediment, Treat it to Meet Industrial Waste Criteria and Dispose in a New Semi-Aquatic Confined Disposal Facility in Hamilton Harbour Re-use: ❑ Dredge and Dewater the Sediment, Treat it to Meet Industrial Land Criteria and Use as Fill at an Industrial Property ❑ Dredge and Dewater the Sediment, Treat it to Meet Residential / Parkland Criteria and Use as Fill at a Residential / Parkland Property	❑ Dredge, Dewater and Dispose in a Hazardous Waste Landfill ❑ Dredge, Dewater, Treat and Dispose in a Non-Hazardous Waste Landfill ❑ Dredge, Dewater, Treat and Re-use in U.S. Steel Sinter Plant ❑ Dredge, Dewater, Treat and Re-use as Industrial Fill ❑ In-situ containment ❑ In-situ containment and construction of an ECF
Conclusions	Removal / treatment / disposal alternative retained for further consideration.	Overall the preferred alternative was: the removal of sediments to a location adjacent to the removal site; treatment by thermal, organic or biological methods; and re-use. However, flexibility was retained since there was a desire to leave room for innovation in order to keep costs down and in finding an end use for the sediments that might avoid taking up limited space in disposal sites.	Given concerns from the public expressed during the consultation undertaken for the sinter plant alternative, it was decided not to proceed with the sinter plant alternative but rather to re-examine some of the other feasible options that had been previously evaluated (Section 5.2 of CSR).	The alternatives were not scored or ranked at this stage. The alternatives were simply presented for discussion and consideration - all alternatives were seen as feasible and none should be excluded from further consideration.	The majority of PAG stakeholder groups reached consensus on recommending containment and the construction of an ECF as the preferred remedial alternative.

5.1.2 Evaluation of Alternatives

Options were assessed against a number of project objectives, as well as a series of stakeholder, management and performance objectives. The key objectives identified by PAG were:

- maximize containment/removal of acutely toxic sediments in the Harbour;
- ensure that the health and safety of workers and citizens are protected during all stages of the project;
- minimize local and downwind airborne emissions during remediation process;
- ensure safe transportation of hazardous materials through residential areas, if disposal to be located in an out of area site;
- avoid high risk alternatives that could result in technology failures, cost overruns and protracted implementation schedules;
- no net loss of fish habitat productive capacity;
- no loss of navigation routes;
- prevent uptake of contaminants by waterfowl;
- partnership opportunities; and
- permanent solution/long-term sustainability.

Table 5.1 outlines the pros and cons of the sediment remediation alternatives assessed by PAG. Table 5.2 provides further information on the comparison of these alternatives.

5.1.3 Conclusions

At the April 24, 2002 PAG meeting, the majority of the PAG stakeholder groups reached consensus on recommending containment and the construction of an ECF as the preferred remedial alternative[7]. It was agreed that engineering and design details would need to be undertaken to optimize containment in the smallest footprint possible. Also, it was clearly stated that the PAG wanted to deal with all PAH contaminated sediment greater than 200 ppm as a whole Harbour solution.

Figure 5.3 illustrates the PAG process for selecting a remedial option. This figure also illustrates the formation of the PIT which was established to move the project forward and to develop various conceptual designs for review by the PAG (see Section 1.4).

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[7] The April 24, 2002 PAG Summary Notes indicate that the Bay Area Restoration Council (BARC) supported the containment approach, although removal was preferred. The City of Burlington was supportive of the preferred alternative as long as habitat work is incorporated in an appropriate location. Great Lakes United could not support the decision due to an earlier resolution against the establishment of confined disposal facilities in the Great Lakes basin. *In situ* containment may, however, be acceptable to Great Lakes United.

The preferred alternative envisaged the following:

- An approximately 5 ha containment structure/system (containment) built around the majority of sediment contaminated with >800 ppm polyaromatic hydrocarbons less naphthalene (PAH-N).

- A 2 ha confined containment structure or facility adjacent to the 5 ha site into which the remainder of Harbour sediment contaminated with >200 ppm PAH-N would be dredged and confined. These sediments would be from contaminated sediments around Randle Reef or possibly from other contaminated areas in Hamilton Harbour.

Figure 5.2: Sediment Remediation Options

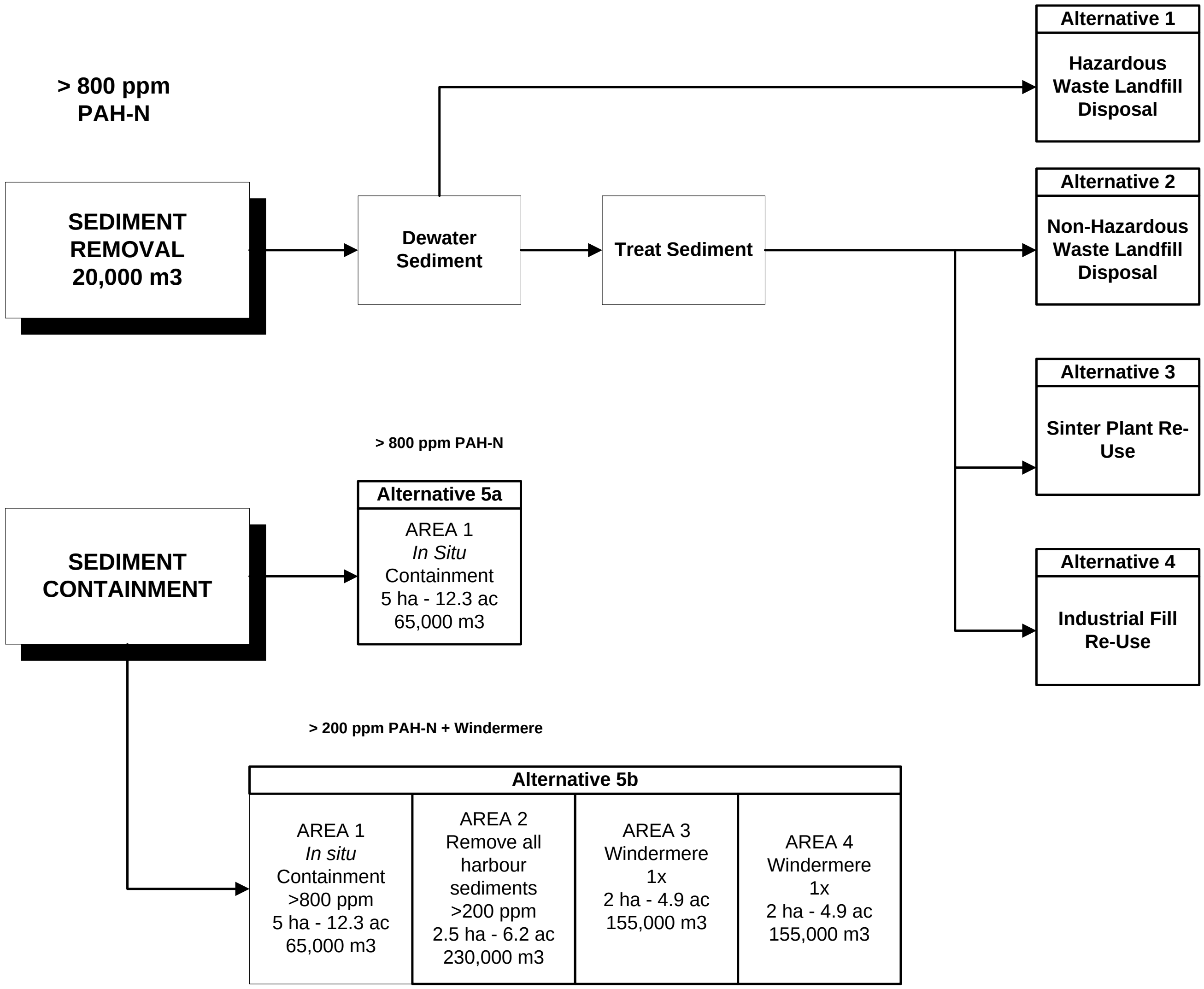


Table 5.1: Pros and Cons of Sediment Remediation Alternatives Assessed by PAG

Remediation Alternative	Pros of Remediation Alternative	Cons of Remediation Alternative
Dredging, Dewatering and Disposal	• removal from the Harbour of most highly contaminated sediment (20,000 m^3) from aquatic environment • commercial application of proven innovative sediment removal technologies • long-term disposal in an approved engineered waste facility • low risk of technological failure and cost overruns during remediation • project completion within 1 year	• potential re-suspension of contaminants into the water column during dredging • potential contaminant loss to the air during mechanical dredging • temporary restrictions on navigation • concerns over handling the material • chance of cost overruns (over dredging) • does not capture 100% of priority zone (>800 ppm total PAHs minus naphthalene) sediments • only addresses the highly contaminated sediment within the Harbour in the navigation channel • potential for re-suspension of remaining contaminated sediment by shipping traffic and storms • concerns over long-term integrity of landfill structure • transportation of contaminated sediment through local neighbourhoods and along provincial highways • short-term increase in truck traffic • limited number of funding partners • potential treatment of sediment required to meet health and safety handling concerns • contingency option required • transfer of contaminants from one site to another
Hazardous Waste Landfill	• long-term disposal in an approved hazardous waste engineered facility • low risk of technological failure and cost overruns during remediation • project completion within 1 year	• concerns over long-term integrity of landfill structure • transportation of hazardous sediments through local neighbourhoods and along provincial highways • short-term increase in truck traffic

Remediation Alternative	Pros of Remediation Alternative	Cons of Remediation Alternative
		• limited number of funding partners • transfer of contaminants from one site to another
Non-Hazardous Waste Landfill	• long-term disposal in an approved non-hazardous, engineered waste facility • low risk of technological failure and cost overruns during remediation • project completion within 1 year • potential reduced transportation costs	• concerns over long-term integrity of landfill structure • transportation of contaminated sediment through local neighbourhoods and along provincial highways • short-term increase in truck traffic • limited number of funding partners • potential treatment of sediment required to meet health and safety handling concerns
Industrial Fill Re-use	• production of industrial fill • project completion within 1 year • potential for re-use of treated material	• high potential for technological failure, cost overruns and delays • need to identify willing recipient to accept the industrial fill • limited number of funding partners • not cost effective • potential short-term increase in truck traffic • untreated sediment may have to be transported and treated off site • potential transportation of contaminated sediment through local neighbourhoods and along provincial highways
Sinter Plant Re-use	• cost effective • re-use of inorganic component of sediments by Stelco (now U.S. Steel) • potential for additional funding partners • sinter plant operation to meet Certificate of Approval and Canada wide standards • significantly reduces off site transport and disposal of contaminated material • in-plant air emissions monitoring • conditioning can be completed in 1 year	• potential health and safety concerns for U.S. Steel workers • conditioned sediment to be used in process over 5 years • potential treatment required to meet health and safety handling concerns

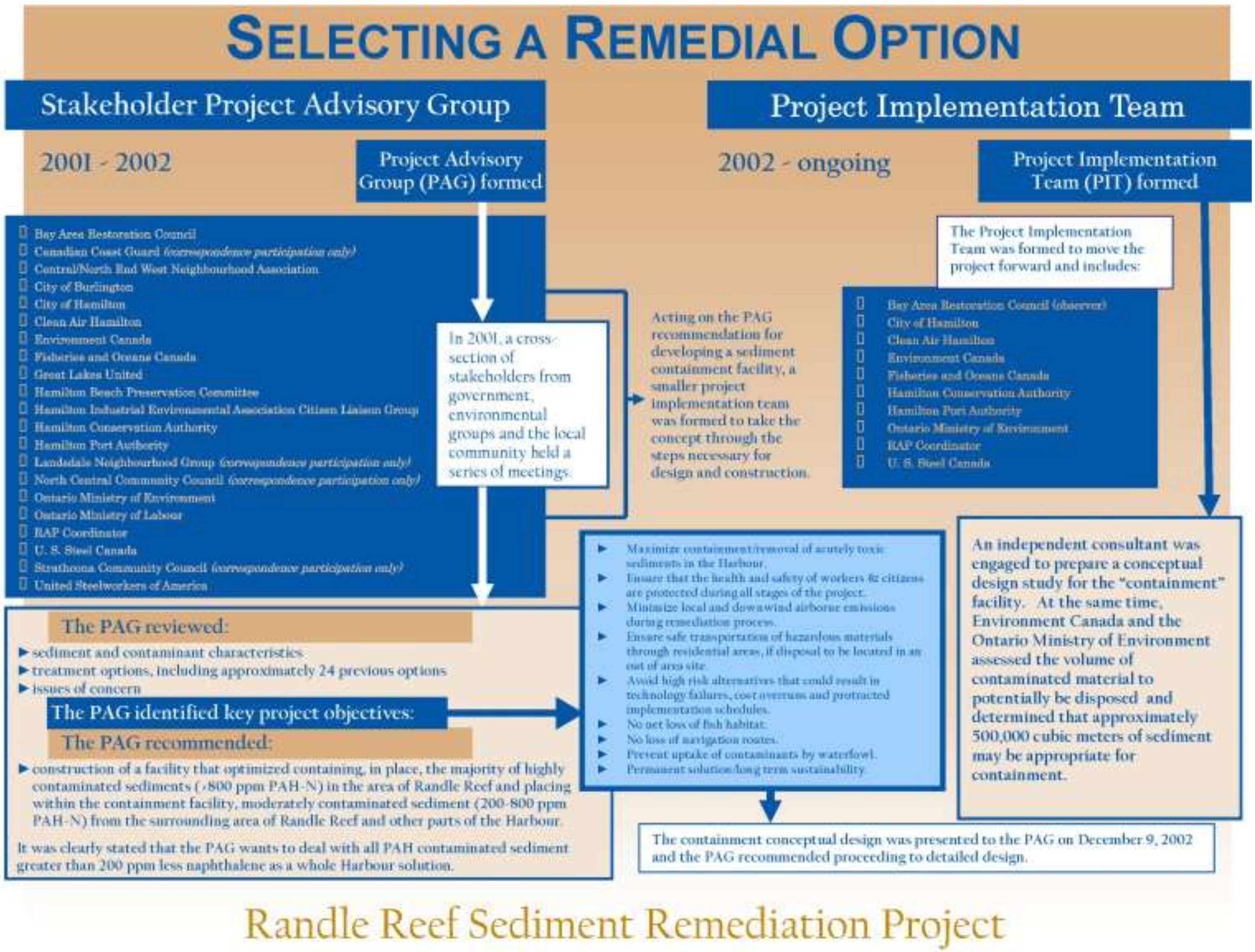
Remediation Alternative	Pros of Remediation Alternative	Cons of Remediation Alternative
In Situ Containment and ECF	• ECF captures 100% of contaminants in the priority zone (approximately 65,000 m^3) plus all of the acutely toxic sediments in the Harbour (approximately 230,000 m^3) • accelerates the process for the delisting of contaminated sediment as an impairment in Hamilton Harbour • low risk of technological failure and cost overruns during remediation • potential for additional funding partners • potential for new green space and other uses • minimized exposure to contaminants in and out of the water • construction of the facility can be completed within 1 year • depending on size, has potential to address a dredging event in Windermere Basin allowing the City of Hamilton to provide funds for the construction of the ECF – Area 3	• concerns over long-term integrity of *in situ* containment structure • long-term monitoring and groundwater control is required for the contained site • concerns over additional in-filling of the Harbour • potential permanent obstruction to navigation • may restrict future use of site • strategy required to prevent potential for contaminant uptake by waterfowl • concern over time frame to fill and close ECF • concerns over ownership of facility

Source: Meeting notes of the Project Advisory Group.

Table 5.2: Comparison of Randle Reef Remediation Options

Option No.	1	2	3	4	5(a)	5(b)	Cost Comparison
Description	Dredge, Dewater & Dispose in a Hazardous Waste Landfill	Dredge, Dewater, Treat & Dispose in a Non - Hazardous Waste Landfill	Dredge, Dewater, Treat & Reuse as Industrial Fill	Dredge, Dewater, Treat & and Reuse in U.S. Steel Sinter Plant	*In Situ* Containment	*In Situ* Containment and Construction of Confined Disposal Facility	Dredge, Dewater & Dispose in a Hazardous Waste Landfill
Total PAHs (-) naphthalene	>800 ppm	>800 ppm	>800 ppm	>800 ppm	>800 ppm	**>200 ppm**	**>200 ppm**
Remediated Quantity (thousands cubic metres)	20	20	20	20	65	295 (*in situ* 95) (dredge 200)	295
Est. Cost Range (millions)	$6.2 to $15.35	$5.85 to $13.8	$13.6 to $27.7	$6.2 to $11.0	$10 to $20	$12 to $25 + Dredging $5 to $10	75 to 150
Best Estimated Cost (millions)	$10	$8.4	$17.1	$7.6	$15	$18 + Dredging $7.5	$90
Best Estimated Cost (cost per metre)	$500	$420	$855	$380	$230	$86 (with dredging)	$305

Figure 5.3: Selecting a Remedial Option



As noted in Section 5.1.2, the alternatives were evaluated against a set of management and performance objectives. Inherent in these objectives was a consideration of potential environmental effects (e.g., no net loss of fish habitat). The level of detail of analysis at the time the evaluation of alternatives was undertaken, did not identify major differences among the alternatives from an environmental effects standpoint. However, there were management and performance objectives that favoured the preferred alternative. The reasons for the PAG selection of containment as the preferred alternative were:

- it is a "whole Harbour" solution;
- there is potential for partnership among a number of stakeholders;
- it has low technological risk;
- it will address contaminated sediment impairment in Hamilton Harbour; and
- it is relatively cost effective.

Subsequently, a Project Implementation Team (PIT) of stakeholders was formed to develop various conceptual design options for review by the PAG. The members of the PIT are the City of Hamilton, Clean Air Hamilton, Fisheries and Oceans Canada, Environment Canada – Great Lakes Sustainability Fund (GLSF) and Hamilton Harbour RAP Coordinator, HCA, Hamilton Port Authority, MOE, BARC and U.S. Steel (Stelco at that time).

The HCA originally did not endorse the mixed use concept. However, on November 5, 2003 they passed a resolution in support of the project. The following has been extracted from this November 5, 2003 letter:

> "The Full Authority passed a resolution at their October 16, 2003 meeting as follows:
>
> > That the Full Authority approves the following recommendation by the Water Management and Environmental Impact Advisory Board.
> >
> > That HCA endorse the modified Option 6[8] for Randle Reef [ECF] that has been agreed to by other partners in this project and which creates a peninsula that is partly green space and partly port facility rather than 100% green space".
>
> This resolution marks a change in the Authority's position on the Randle Reef Remediation project. In April 2002, the Full Authority had supported containment of the contaminated sediments *in situ* and the area capped and turned into a natural area. It should be noted that since 2003 other uses of the green space area have been considered and a final land use decision will be made in the future.

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8 While HCA referred to this as Option 6, Option 6 is equivalent to modified (mixed use) Option 5(b) (see Table 5.5).

> With the ownership proposed by the Hamilton Port Authority as well as financial support for modified Option 6, the Full Authority now supports this solution to a long-standing environmental problem".

Section 6.0 provides further details on the conceptual design work for the preferred alternative.

6.0 CONCEPTUAL DESIGN STUDY FOR THE PREFERRED ALTERNATIVE

6.1 Introduction

In September 2002, a conceptual design study was initiated (Acres & Associated, Headwater and PEIL, 2003) for the preferred alternative (in-situ containment and environmental containment facility (ECF)). The objective of this study was to develop a conceptual design for the containment facility that recognized the environmental, technical and socio-economic requirements and constraints associated with the project.

The study involved: the compilation of existing data and the identification of project objectives and key issues to form a Common Basis for Design (CBD) upon which the conceptual design would be based; and the selection of a preferred conceptual design.

The objectives of the CBD were to:

- assemble the data on which the remainder of the study would be carried out (i.e., the key data on which the conceptual designs were to be based, areal extent of contamination, contaminant concentrations, bathymetry, geotechnical conditions, existing intake and outfalls, etc.); and

- define and confirm the project requirements and issues perceived by each stakeholder in the PIT, and facilitate consensus on these.

An overview of the consultation undertaken during the Conceptual Design Study is provided in Section 10.2.5.

6.2 Conceptual Design Evaluation

Through discussions and meetings with the Project Implementation Team (PIT) and individual stakeholders, a list of "Objectives and Key Issues" was defined under the following categories: environmental; technical; socio-economic; and financial. Resulting from these initial discussions, a number of conceptual design alternatives were developed which were based on two main variations. The two variations were: (1) a fully naturalized island or peninsula; and (2) a mixed use concept. Using the objectives and key issues in the common basis of design, the following conceptual design alternatives were developed:

- an island structure, located either close to Pier 16 over the most contaminated sediments or directly over Randle Reef where it would prove less of an obstruction to shipping;
- a peninsula adjacent to Pier 16 and attached to the eastern part of Pier 15; and
- a peninsula adjacent to Pier 16, north of the U.S. Steel pumphouse, with a possible containment facility attached to Pier 15.

During the review of the conceptual design with the PIT, it became apparent that there were three critical objectives and if the design did not fulfill these objectives, then it was unlikely that the conceptual design alternative would be implemented. These critical objectives were:

1. To maximize the potential for sediment remediation, not just at Randle Reef, but by acting as a facility for contaminated sediment from other areas of Hamilton Harbour (i.e., the "whole Harbour" approach).[9]

2. To contain in-situ the majority of sediments in the Randle Reef area with PAH-N >800 ppm (i.e., the containment facility should be located over the most contaminated sediments so that dredging and disturbance of these materials would not be required).

3. There must be a party willing to consider ownership, long-term maintenance and responsibility for the containment facility.

Taking these factors into account, it became apparent that an island concept should not be considered further since:

- if located on Randle Reef so as not to impede shipping traffic, all the highly contaminated sediments would need to be dredged (i.e., it would not conform to objective 2). Even if located close to Pier 16, it would require more dredging of the contaminated sediments than other options; and

- no party was willing to consider long-term ownership of an island structure (i.e., it did not fulfill objective 3).

The PIT did consider that the concept of a peninsula attached to Pier 16, with a possible extension to Pier 15, had some merit. Accordingly, they directed that this option be developed further.

Two concepts (mixed use concept and all natural concept), which are largely differentiated by the eventual land use, were then developed. The natural/commercial concept (see Figure 6.1) constituted a peninsula attached to Pier 16, with a triangular extension to Pier 15. Approximately 6.4 ha of commercial port space was provided in two areas, with a double berthing area provided between the peninsula and the extended Pier 15. A naturalized shoreline and area was provided along the north and west sides of the peninsula. The total area of this alternative was approximately 9.5 ha.

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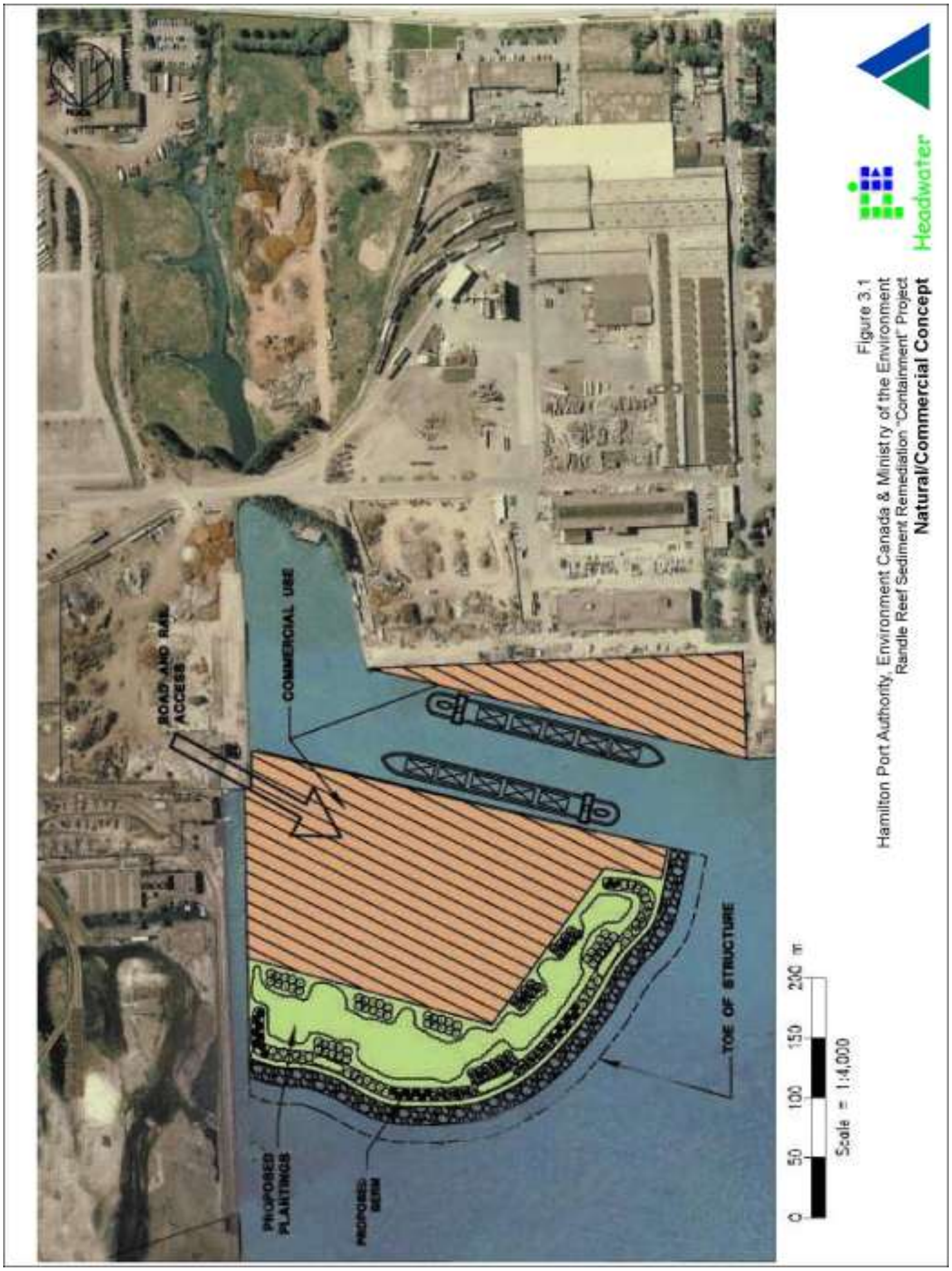
9 During the initial phases of the study, it became apparent that, based on recent sediment sampling results, up to 500,000 m^3 of sediments from areas outside of the Randle Reef area may eventually need to be placed within the containment facility. This was a substantial increase from the approximately 200,000 m^3 of material originally envisaged and had a significant effect on the required size of the containment facility.

Figure 6.1: Natural /Commercial Concept (early conceptual design)



Source: Randle Reef Sediment Remediation "Containment" Project. Conceptual Design Study. Volume 1. March 2003.

The all natural concept (see Figure 6.2) comprised a 9.5 ha peninsula attached to Pier 16, extending approximately 400 m to the west. The complete shoreline and peninsula was naturalized and no commercial port space was provided.

One of the key factors in determining the size of both concepts was the need to contain approximately 500,000 m^3 of contaminated sediments from the Randle Reef area, and possibly from other areas of the Harbour.

The all natural and natural-commercial mix concepts were reviewed with the PIT and compared using the following criteria:

- conformance with the critical objectives; and
- relative benefits and disadvantages of the eventual land uses - all natural or natural/commercial mix.

The ability of the two concepts to meet the critical objectives is shown in Table 6.1. Both had the ability to maximize sediment remediation in Hamilton Harbour and contain in-situ the majority of highly contaminated sediments. However, no party was willing to consider ownership of the all natural peninsula, whereas the Hamilton Port Authority was willing to consider owning and operating the natural/commercial facility, provided 5 ha of commercial port space was provided on the peninsula.

Table 6.1: Conformance to Critical Objectives

Concepts Considered	Maximize Sediment Remediation (Consistent with "Whole Harbour" Approach)	Contain In-situ Majority of Sediments with PAH-N >800 ppm	Party Willing to Consider Ownership, Long-Term Maintenance and Responsibility
Natural/commercial mix	Yes. Containment volume of 525,000 m^3. 115,000 m^3 of sediment contained in-situ.	Yes. Over three-quarters of sediments with PAH-N >800 ppm would be contained in-situ.	Yes. HPA willing to consider ownership if 5 ha of commercial port space is provided on peninsula.
All-natural	Yes. Containment volume of 525,000 m^3. 115,000 m^3 of sediment contained in-situ.	Yes. Over three-quarters of sediments with PAH-N >800 ppm would be contained in-situ.	None.

Figure 6.2: All Natural Concept (early conceptual design)

Source: Randle Reef Sediment Remediation "Containment" Project. Conceptual Design Study. Volume 1. March 2003.

A further comparison of the all natural and natural/commercial mix concepts is presented in Table 6.2. It was concluded that the natural/commercial mix offered the following advantages:

- it minimizes obstruction to Harbour operations;
- there is greater potential for funding and in-kind contributions; and
- the Hamilton Port Authority is willing to consider ownership.

Table 6.2: Further Comparison of Design Concepts

<table>
<tr><th>All Natural</th><th>Natural-Commercial Mix</th></tr>
<tr><td>Configuration
• Peninsula obstructs Harbour operations</td><td>Configuration
• berthing and commercial use on south side
• northern and western sides naturalized</td></tr>
<tr><td>Potential Partners
• Funding
- EC
- MOE
- City

• In-kind
- U.S. Steel - steel for containment, other
- HCA - natural area (design/ implementation/maintenance)</td><td>Potential Partners
• Funding
- EC
- MOE
– City
– HPA

• In-kind
- U.S. Steel - steel for containment, other
- HCA - natural area design/ implementation/maintenance
- HPA - long-term monitoring, maintenance and responsibility
- construction management services</td></tr>
<tr><td>Potential Owner
• None</td><td>Potential Owner
• HPA</td></tr>
</table>

6.3 The Preferred Conceptual Design

Based on a consideration of conformance with the critical objectives and a further comparison of the two end-use concepts, the natural/commercial (mixed use) concept, consisting of a peninsula adjacent to Pier 16 (U.S. Steel) and a triangular extension to the Hamilton Port Authority's Pier 15, was recommended.

This recommendation was accepted by the PIT and was presented to the Project Advisory Group (PAG) on December 9, 2002. PAG endorsed the recommended natural/commercial concept and agreed that it should be carried forward to undergo the necessary environmental assessment process, as well as further public consultation.

As the next steps, the PAG determined that the continuation of the PAG group in an advisory capacity was no longer required, and that the PAG members could continue to participate through the public consultation process. Members would still be kept informed of updates and could meet at appropriate times during the development of the project. It was determined that the PIT would continue until the detailed engineering study was complete.

The Conceptual Design Study outlined further work required in order for the project to proceed, including detailed engineering work which commenced in fall 2003 (see Section 7.0).

7.0 IDENTIFICATION AND EVALUATION OF DESIGN ELEMENTS AND OPTIONS

7.1 Design Elements and Options

The development of the detailed engineering design was carried out by assessing specific design elements for the project. The term "design element" refers to a major category of project activity, such as dredging, and the activities associated with it, such as controlling sediment re-suspension during dredging and transporting the dredged material. The six major design elements were:

- engineered containment facility (ECF) isolation structures [10];
- dredging design;
- sediment management;
- ECF capping and closure (containment and cover);
- U.S. Steel intake/outfall (I/O); and
- marine terminal.

The term "design option" refers to possible means of executing a design element. For example, mechanical and hydraulic dredging are two options for executing the design element of dredging. The term "alternative" refers to an assemblage of design options.

These options and alternatives are "alternative means" of carrying out the project, as per CEAA (see Section 2.4). The evaluation of these options and alternatives is provided in Supporting Document D. This evaluation was based on the considerable detailed engineering design work undertaken for the project.

Several methods were used to evaluate the design options and alternatives. A single method was not applicable or appropriate to evaluate the range of issues associated with the different design options and alternatives at the various stages of design. Where some standardized and criteria and rankings were appropriate to apply, they were used. The evaluation of some design options and alternatives, particularly during the detailed 30 percent and 100 percent design stages, was based on engineering studies, technical studies and technology reviews, rather than comparative evaluation methods. The conclusions from the studies and reviews were applied to develop the details of the design and provided the basis and rationale for the preferred alternative.

The design elements function together to accomplish the project objectives (see Section 2.5). The following sections provide further detail on the design elements and the design options that were evaluated.

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10 As noted in Section 1.5, the scope of project originally included a secondary facility consisting of triangular extension to Pier 15. This secondary facility was examined until part way through the 100% design stage, where it was removed from the final design due to technical and cost considerations (see Supporting Document D, Section D.4.3).

7.2 Process for Identification and Evaluation of Design Elements and Options

The process for the identification and evaluation of design elements and options was undertaken in a number of steps, as illustrated in Figure 7.1.

Within each of the six major design elements, there exists a range of available technologies or options with the potential for application to the Randle Reef project. The initial step was to identify design options for each of the design elements. In some cases, design elements had multiple components. For example, dredging equipment, suspended sediment control and transportation of dredged material were all components of the overall dredging design element. Options for each of these components were examined and alternatives (or an assemblage of options) were developed to further evaluate the overall dredging design component.

The design options and alternatives were evaluated in two steps. The first step was the initial screening of the design options and alternatives (see Section 7.3). This step involved a systematic evaluation of the design options and alternatives in order to determine which options and alternatives had the most merit for carrying forward to the detailed evaluation, the second step in the evaluation process.

The results of the initial screening (i.e., those options and alternatives that were retained for further consideration) were carried forward to the detailed evaluation. The detailed evaluation was undertaken at 30 and 100 percent design levels (see descriptions in Sections 7.4.1 and 7.4.2).

The steps in the process were iterative in nature. For example, options and alternatives that were not carried forward from the initial screening (based on available information at that time) to the detailed evaluation could potentially be re-considered at the 30 percent design level. It was concluded that further refinements to the options and alternatives (including the re-introduction of previously "eliminated" options and alternatives) could be made, subject to the results of the contaminant fate and transport modeling, site-specific geotechnical analyses and other studies that were undertaken as part of the 30 percent design work.

7.3 Initial Screening Process

The initial screening process is illustrated in Figure 7.2.

The intent of the initial screening process was to identify options with the greatest chance of success for the Randle Reef project. In the subsequent stage of design (i.e., detailed evaluation), the preferred option(s) for the design elements were evaluated.

Figure 7.1: Process for Identification and Evaluation of Design Elements and Options

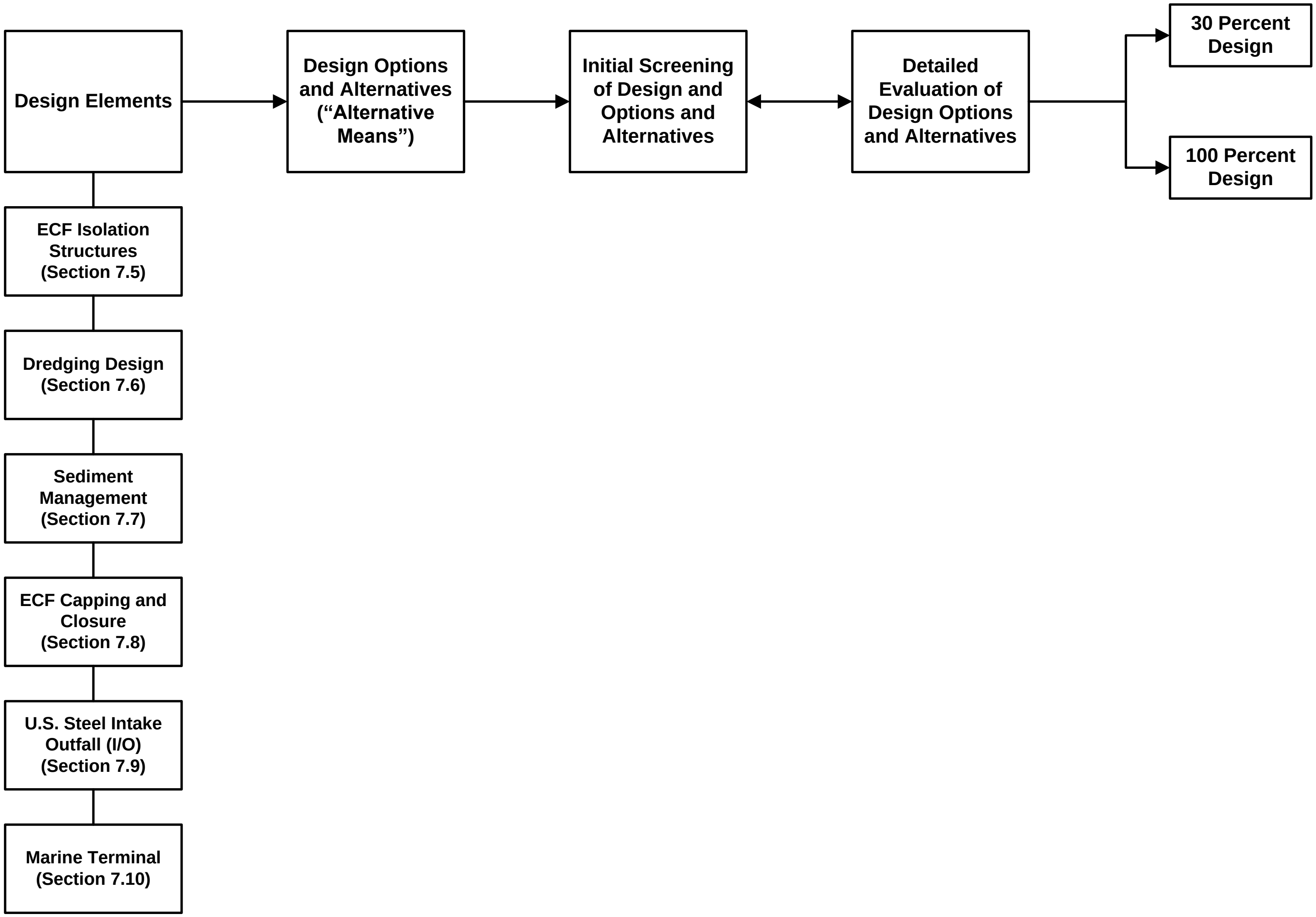
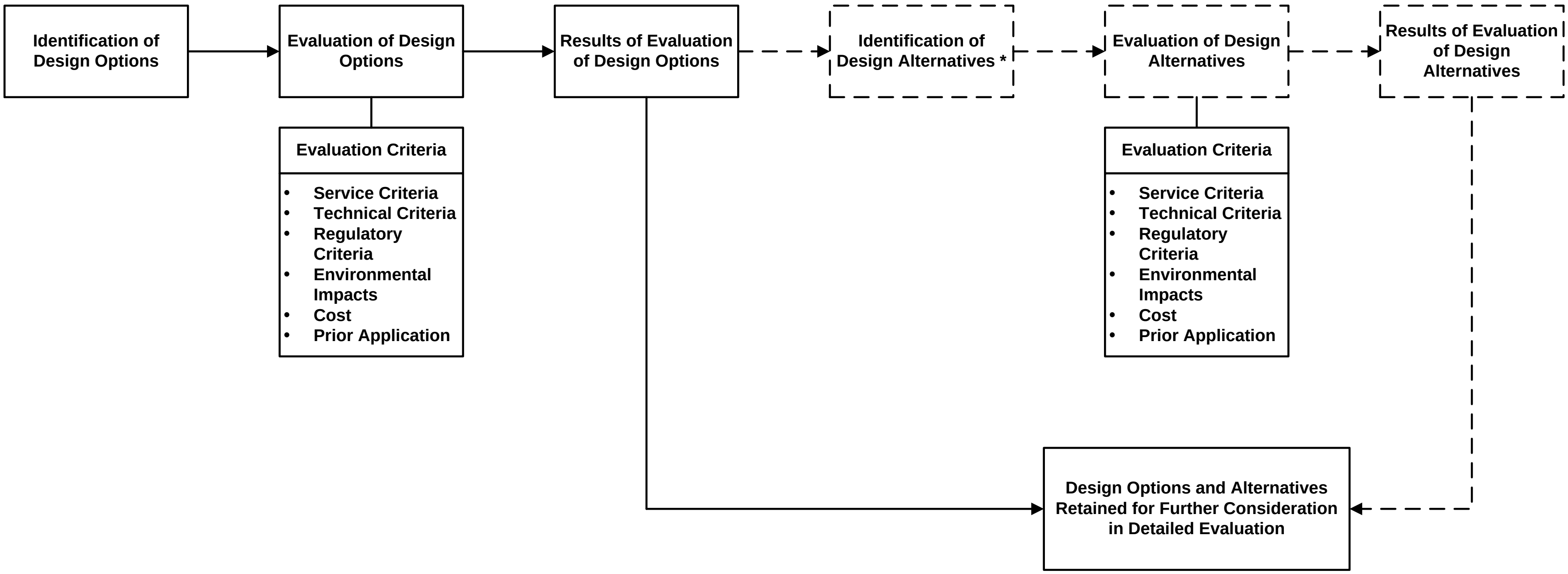


Figure 7.2: Initial Screening Process



*** Design alternatives are an assemblage of design options and were developed after the identification and evaluation of design options. Design alternatives were identified for the dredging and sediment management design elements only.**

The intent of the initial screening was not to necessarily select a final design option but rather to:

- eliminate options with little chance of success for implementation;
- develop an understanding of the issues and challenges, as well as the merits of different design options; and
- identify options with the most merit for carrying forward to the detailed evaluation, where they would be further evaluated.

The identification of options considered at the initial screening stage was based on a review of available technologies, methodologies and systems that are technologically sound, have been used for similar projects or applications, and are available in Ontario. Research from other jurisdictions was also used to identify options.

The criteria that were used in evaluating the design options and alternatives were: service (i.e., effectiveness); technical (feasibility); regulatory; environmental impacts; cost; and prior application. Sub-criteria for these criteria were identified and applied, where appropriate. The criteria and sub-criteria are defined within the context in which they are used for each design element (see Supporting Document D).

7.4 Detailed Evaluation Process

The detailed evaluation process was not necessarily a comparison and evaluation of design options (as was undertaken during the initial screening), although this was true for some design elements. For the most part, the purpose of the detailed evaluation was to examine those options or alternatives carried forward from the initial screening to determine if they were still practical for the Randle Reef project once further detailed design work and studies were undertaken. For example, fate and transport modeling and further geotechnical studies were undertaken, and provided more detailed information on the Randle Reef area, as well as the potential movement of contaminants within the context of the project.

The detailed evaluation was undertaken at 30 and 100 percent design levels. Further details on the 30 and 100 percent design levels are provided in Sections 7.4.1 and 7.4.2.

The main evaluation criteria that were generally applied at the 30 and 100 percent design stages relate to effectiveness, technical feasibility and cost. The level of detail and nature of the evaluation undertaken at these design stages was dependent on the studies and information available for each particular design element. For example, the further evaluation of dredging alternatives at the 30 percent design stage (see Section D.2 in Supporting Document D) consisted of examining the options that had been carried forward from the initial screening against specific design requirements. Much of the further development of the dredging alternatives was deferred to the 100 percent design level when more detailed information was available.

Another important consideration at the 30 and 100 percent design stages was whether a particular option or alternative could be incorporated (i.e., was compatible with) with the other design elements for the project as a whole. In some cases, options that had been considered to be eliminated at the initial screening stage were re-examined in view of more detailed information related to fate and transport modeling and the results of additional studies undertaken for the project.

Engineering complexity and cost were also generally examined in a preliminary manner.

In some cases, at the 30 percent design level, further studies or other parts of the engineering design were required to be completed prior to the selection of a preferred design option. In these instances, the determination of a preferred option was deferred to the 100 percent design stage.

The evaluation that was undertaken at the detailed evaluation stage is a reflection of the amount of detail that was available at the time for each design element, and is consistent with accepted engineering practice where the design progressively evolves to a greater level of detail. The detailed evaluation also reflects some interdependencies among design elements. For example, sediment management may be the limiting factor in how quickly and how much can be dredged. Therefore, the dredging design needed to take into account the results of the 30 percent design of the sediment management design element in order to advance the design for dredging.

7.4.1 30 Percent Design

In Ontario, large-scale engineering projects are typically completed to several different class standards of design which represent different stages of completion of the engineering work (e.g., 30%, 100%). Costs, within a percentage range of overall accuracy, are also developed for these projects.

The 30 percent engineering design for the Randle Reef Sediment Remediation Project (also referred to as the preliminary design) is summarized in the Basis of Design Report (Arcadis BBL, 2006) and was developed using environmental, engineering and geotechnical studies, data, surveys and background information collected during previous investigations conducted for the development of the project. Additional studies to address information gaps were also completed.

This stage of design relates to a level of completion of the studies needed to assess the feasibility of the proposed six design elements (as well as the design of the secondary facility) and to undertake an analysis to recommend the preferred approach for each element.

The main components of the 30 percent design included:

- developing a list of design standards and requirements;
- identifying major design elements;

- identifying and evaluation design options for executing the design elements;
- supplementing environmental information and analysis;
- identifying the project footprint in general terms and the potential for future revisions to the design footprint;
- developing a preliminary ECF construction sequence, including materials and general methodology;
- identifying the preliminary geotechnical stability and foundation requirements;
- developing approaches for accommodating the U.S. Steel facilities, for marine terminal construction and for ECF capping; and
- developing a preliminary overall construction sequence.

The criteria that were used to evaluate the design options at this stage were effectiveness, technical feasibility and cost. Various sub-criteria were identified for each of these criteria, and used in undertaking the more detailed site-specific (compared to the initial screening) evaluation. The findings from various engineering and scientific evaluations were also used in the evaluation of the design options. For example, the bench scale treatability tests and fate and transport modeling was used to analyze whether the option would be effective, considering the site-specific information contained in these studies. For example, the fate and transport modeling demonstrated that the isolation structure selected for containing the sediment would need to be impermeable. Options that could not be engineered to meet this requirement for an impermeable barrier would be eliminated.

Where appropriate, the options were ranked and recommendations were made regarding which options to carry forward to the 100 percent design.

The 30 percent design represents the completion of sufficient engineering/scientific analysis to assess the feasibility of the six major design elements.

7.4.2 100 Percent Design

The final engineering and scientific evaluations related to dredging, sediment management, ECF capping and other aspects of the design were completed during the 100 percent design phase of the engineering design work. The preferred options from the 30 percent design stage were evaluated against their ability: to address issues related to the design elements; to meet objectives for the design elements; and to meet certain design standards or performance criteria.

In addition, a risk assessment, sustainable development analysis, updated cost estimates, a construction monitoring plan, construction sequence and schedule, and a long-term operation, maintenance and monitoring plan for post-construction were prepared. The 100 percent design includes the compilation of all of the information into a report addendum to the Basis of Design (Arcadis BBL, 2007), and the preparation of all the technical specifications and design drawings required for the tendering of the project for construction.

The following design analyses were completed for the 100 percent design:

- geotechnical design analyses;
- structural design calculations for the primary and secondary[11] ECFs;
- dredging design;
- sediment management;
- air emissions control;
- groundwater fate and transport modeling;
- ECF capping and closure;
- ECF grading and drainage;
- stormwater management and utility design;
- U.S. Steel I/O accommodation;
- marine terminal;
- landscape design; and
- hydraulic analysis of ECF impact.

7.5 Summary of Initial Screening Process and Detailed Evaluation Process

Table 7.1 provides a summary of the initial screening process and the detailed evaluation process for the design options. Supporting Document D provides the complete documentation of the initial screening process and the detailed evaluation process.

[11] The secondary ECF was removed from the project part way through the 100% design stage based on technical and cost considerations.

Table 7.1: Summary of Initial Screening Process and Detailed Evaluation Process

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
ECF Isolation Structures		
A. Options Evaluated		

• The following isolation structure options were examined:
 	
• Option 1 – Sheetpile Wall Systems with Sealed Interlocks;
 	
• Option 2 – Standard Sheetpile Wall Systems;
 	
• Option 3 – Concrete Caisson Wall;
 	
• Option 4 – Cellular Steel Sheetpile Wall;
 	
• Option 5 – Earthen Containment Berm;
 	
• Option 6 – Treatment Trenches/Walls; and
 	
• Option 7 – Hybrid Containment Structures.
	• As the results from the contaminant fate and transport modeling and site specific geotechnical analyses became available, refinements to the isolation structure options were made. This resulted in two isolation structure options being eliminated from further consideration for the 30 percent design (see Section D.1.2.4 in Supporting Document D).
	
	• The options that were assessed were:
	
	  • a double steel sheetpile wall;
	  • a standard steel sheetpile wall;
	  • a cellular steel sheetpile wall;
	  • an earthen (sand and gravel) containment berm;
	  • an earthen (sand and gravel) containment berm with sealed steel sheetpile through centre; and
	  • an earthen (sand and gravel) containment berm with reinforced high-density polyethylene (HDPE) liner on side face.
		• The development of the 100 percent design for the isolation structures was largely addressed in conjunction with the 100 percent design development for the marine terminal, as well as through the development of the fate and transport studies work done to support sediment management studies, capping, groundwater and stormwater management. Supporting Document D, Sections D.2.3 (dredging) and D.6.3 (marine terminal) should be referred to for information pertaining to the design for the isolation structures.

B. Results of Evaluation		
• All options were considered suitable for use in constructing	• The options were ranked from most preferred to least	

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
the ECF at Randle Reef. • The following options were considered the most advantageous at this point in the engineering process and were carried forward for further evaluation: • Standard Sheetpile Wall for the eastern side of the ECF; • Standard Sheetpile Wall for the southern side of the ECF; and • Earthen Containment Berm for the northern and western sides of the ECF. • The standard sheetpile wall was selected based on the following main advantages: • compatibility with the HPA facility requirements as well as with the outfall structure and water intake structure along the U.S. Steel property; • the small footprint of the structure is compatible with space requirements associated with the ship channel and maximum capacity of the ECF; • standard sheetpile walls have been used extensively for port facilities and there is a fair amount of engineering and construction experience available; and • sheetpile interlocks can be	preferred as: • double steel sheetpile with sealed interlocks; • earthen (sand and gravel) containment berm with sealed steel sheetpile through centre; and • earthen (sand and gravel) containment berm with reinforced HDPE liner on side face. • Based on the detailed evaluation, it was decided that all three options were feasible and should be retained for further consideration at the 100 percent design level. • It was decided that a greater level of detail (i.e., 100 percent design) was required before a final decision could be made on a preferred option. • Further details on the 30 percent evaluation are provided in Section D.1.2 of Supporting Document D.	

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
sealed, if necessary, to achieve a highly impermeable barrier. • While the sheetpile option is appropriate for the eastern and southern sides of the ECF, an earthen containment berm is better suited for the seaward edges of the ECF because of its more natural appearance in this environment. • The main disadvantage of the berm option is that its relatively large cross section reduces the capacity of the ECF. • Options 1 and 6 were eliminated from further consideration. It was concluded that further consideration of hybrid containment structures was not warranted. Both the sheetpile wall and the earthen berm can be combined with special elements such as treatment trenches to form hybrid containment structures. • Further details on the initial screening evaluation are provided in Section D.1.1 of Supporting Document D.		
Dredging Design		
A. Options Evaluated		
• The following three major components of environmental dredging were evaluated: • environmental dredging equipment; • suspended sediment control; and	• The evaluation for the 30 percent design largely related to the different stages of dredging (i.e., initial dredging, production dredging, and finish/final dredging). Initial dredging involves dredging in the	• Based on a comparison of the dredging techniques in the 30 percent design and an evaluation of the clay surface, the following actions were recommended to be

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
• transportation of dredged material. • Within each of these three components, there exist numerous technologies or options that may be applicable for use for the Randle Reef project. • **Environmental dredging equipment** can generally be classified as mechanical, hydraulic, or pneumatic, depending on the basic method of removing the dredged material from the site. Additionally, numerous specialty dredge technologies have been developed, which combine particular features of the basic dredge methods. Within each of these general categories, numerous technologies are available. Table D.5 describes mechanical, hydraulic and pneumatic or specialty dredges. • Release of **suspended sediments** during dredging, which results in turbidity, is a side effect of nearly all dredging technologies. The following turbidity control technologies were identified for potential use for the *Randle Reef Sediment Remediation Project*: • textile barriers (i.e., "silt screens" and "silt curtains"); • sheetpiles; • moon pools;	footprint of the ECF between the double walls. Production dredging refers to the removal of sediment outside the ECF perimeter and away from sensitive structures such as the U.S. Steel dock wall. Final dredging involves dredging near structures or in areas where access is difficult. In addition, this includes the final dredging required to fill the ECF to the contaminated sediment final grade, which will preferably place sediments with a high solids content to facilitate a more rapid transition to cap construction. • The following options were considered for the dredging design element: • 16 inch hydraulic cutterhead dredge with pipeline; • 14 inch hydraulic cutterhead dredge with pipeline; • enclosed clamshell level cut bucket, large footprint/thin thickness removal; and • high solids pump.	completed for the 100 percent design to confirm the feasibility of the 30 percent options: • re-evaluate the dredge surface to support the objective of dredging to the clay surface in Priority 1 and 2 subareas; • perform more detailed design work to refine and optimize the dredge plan with the available data; and • re-evaluate the overdredge allowance, given the importance of maximizing containment of the contaminants in the ECF.

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
• air (bubble) curtains; and • modifications to dredging rates and equipment. • A description of each of these options is provided in Attachment D.7 in Supporting Document D. • Individual options were combined to form the following environmental dredging alternatives: • Alternative 1 – Closed Clamshell Dredge/Controlled Operations/Barge Transport; • Alternative 2 – Closed Clamshell Dredge/Silt Curtain/Barge Transport; • Alternative 3 – Pneuma Dredge/Controlled Operations/Pipeline Transport; and • Alternative 4 – Cutter Suction Dredge/Controlled Operations/Pipeline Transport. • Table D.6 in Supporting Document D provides a description of these alternatives.		
B. Results of Evaluation		
• The following environmental dredging alternatives were retained for further detailed engineering evaluation: • **Alternative 2** - Closed	• Based on the evaluation and the identification of potential re-suspension and transport controls, a combination that included the 35 cm (14 inch) cutterhead hydraulic dredge	• For initial dredging, it was determined that dredging between the double walls could be performed consistent with design objectives

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
(environmental) clamshell bucket dredge to remove contaminated sediment with transport of those sediments to the ECF by barge or scow for placement in the ECF. It was recommended that silt curtains be employed to control suspended sediments both at the dredge location and at the containment facility (assuming a barge access channel is used). Silt curtains could be configured to encompass the entire site or small excavation cells (i.e., moon pools); and • **Alternative 4** - Cutter suction dredge to remove contaminated sediment with transport of the dredged sediment to the ECF via hydraulic pipeline. It was recommended that silt curtains be employed to control suspended sediments both at the dredge location and at the containment facility. Silt curtains could be configured to encompass the entire site or small excavation cells. • Further details on the initial screening evaluation are provided in Section D.2.1 of Supporting Document D.	with modifications, controlled operations and pipeline transport was preferred. • Based on other evaluations (Herbich, 2000), a 40 cm (16 inch) hydraulic dredge is most compatible with the dredging depths for the Randle Reef project, as well as the pipeline distance. However, discussions with marine contractors in the Hamilton area suggest that a 35 cm (14 inch) cutterhead may also work if the required precision can be attained, and a booster pump may address the pipeline distance required. It was decided that these would be assessed at the 100 percent design stage. • High solids pumps may be suitable for initial dredging between double sheetpile walls while a larger hydraulic dredge may be required within the ECF footprint. Mechanical dredging may be necessary for some aspects of construction, along with engineering controls for air emissions and sediment re-suspension. This may be required for initial dredging between the sheetpile walls, and final/finish dredging, and would be developed during later stages of design. • Further details on the 30 percent evaluation are provided in Section D.2.2 of	using one of two (mechanical or high solids pump) or both approaches. Final dredging may be accomplished by mechanical dredging and will be reviewed during the final stages of design. • For production dredging, the hydraulic cutterhead was evaluated to determine whether the equipment was suitable for the various site conditions. A number of constraints and limitations were identified for consideration in the development of construction specifications, as provided in Section D.2.3.5 of Supporting Document D. • Dredging, transport and filling options will be further developed during the development of drawings and specifications. • The 100 percent design recommended the use of the cutter suction hydraulic dredge or specialized/customized hydraulic dredge. • Further details on the 100 percent design evaluation are provided

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
	Supporting Document D.	in Section D.2.3 of Supporting Document D.
Sediment Management		
A. Options Evaluated		
• The following key facility components were evaluated: • Sediment Management and Handling – Cell Configuration; • Sediment Placement; • Dewatering; • Effluent Treatment; • Effluent Discharge; and • Air Emission Control. • Within each of these components, there exist numerous technologies or options that may be applicable for use for the Randle Reef project. Available options within each component were identified and evaluated relative to their potential use for the Randle Reef project. • Table D.10 in Supporting Document D outlines the options that were examined for the Randle Reef project for the facility components noted above. In addition, Attachment D.12 in Supporting Document D provides a detailed description of the options. • These options were evaluated and the following four alternatives were developed (see Section D.3.1.4 of Supporting Document D): • Alternative 1 - Mechanical dredge/ environmental clamshell out of hopper	• Sediment management options were further developed through the 30 percent design level analysis. • For the ECF subdivision, the following four internal cell configurations were evaluated with respect to the expected effluent water quality and TSS removal (see Figure D.5): • Alternative 1 – two internal cells; • Alternative 2 – three internal cells; • Alternative 3 – four internal cells; and • Alternative 4 – four internal cells. • The options that were retained for the 30 percent design for sediment dewatering were: • in-place dewatering (unaided settling); and • in-place dewatering/sedimentati on via multiple interior cells. • For effluent treatment, the following options were considered: • in-place gravity sedimentation; • polymer-assisted gravity sedimentation in a	• Further evaluation for the 100 percent design for sediment management included completing more detailed design work on the configuration of the ECF and evaluating the flow, placement and treatment of the dredged material and the effluent throughout the initial, production and final dredging stages. The 100 percent design included an analysis of the effluent water quality during the filling and treatment process, an analysis of the conditions and features of the ECF during filling and treatment, and the development of the proposed discharge limitations for discharge from the ECF to Hamilton Harbour. The monitoring requirements associated with sediment management were also outlined for start-up, construction and compliance. • The development of effluent discharge limits was completed and the sequence of dredging and the placement of dredged material were determined in

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
into ECF/ in-place dewatering in the ECF (with or without flocculants)/discharge effluent over a weir with an overflow pipe to an outfall/diffuser in Hamilton Harbour; • Alternative 2 - Mechanical dredge/ environmental clamshell out of hopper into ECF/ in-place dewatering in the ECF (with or without flocculants)/discharge effluent water to the Woodward Avenue Waste Water Treatment Plant; • Alternative 3 - Mechanical dredge/ environmental clamshell out of hopper into ECF/ in-place dewatering in the ECF (with or without flocculants)/pump effluent to a physical/chemical/biological treatment plant on a barge/ discharge effluent to the Harbour; and • Alternative 4 - Hydraulic dredge directly into ECF / in-place dewatering in the ECF (with or without flocculants)/discharge effluent over a weir with an overflow pipe to an outfall/diffuser in Hamilton Harbour. • Air emission control options were incorporated into these alternatives.	polishing cell; • in-place oil adsorbent booms and skimmers; and • mechanical treatment plant (which may consist of one or more of the following process options – oil-water separation, filtration, activated carbon adsorption and chemical precipitation). • For effluent discharge, discharge to sanitary sewer and discharge directly to Hamilton Harbour were reviewed. • For air emissions control, the following were considered: • minimize sediment exposure to air; • minimize TSS in ponded water; • employ an impermeable floating cover; and • employ a temporary vapor-control structure.	conjunction with the development of the dredge plan.

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
B. Results of Evaluation		
• Alternative 1 is probably the least costly approach for handling the dewatering effluent water. However, the discharged water would likely not meet the PWQOs (and/or CWQGs) at the edge of the mixing zone. Therefore, Alternative 1 has a low probability of meeting all the regulatory requirements. However, Alternative 1 is retained for comparison purposes as the lowest cost alternative. • Alternative 2 is probably the second least costly approach for dewatering the dredged sediment. Alternative 2 would have a higher probability of meeting all regulatory requirements than Alternative 1. Under this alternative the discharged water would have to meet the Hamilton sewer use by-law limits. Based on the 95-percentile effluent estimate concentrations, only copper and zinc would exceed the sewer use by-law limits. The magnitude of the exceedences would be less than an order of magnitude. • Alternative 3 is the most costly of the four alternatives presented for dewatering dredged sediment. It is likely that alternative 3 would be selected only if Alternatives 1 and 2 were eliminated due to regulatory, treatability or other concerns.	• For ECF subdivision, an analysis with respect to the expected effluent water quality and TSS removal indicated that the use of internal cells will not have a significant effect on effluent water quality. Segregation and placement of the higher concentration sediments into the ECF first, to maximize settling efficiency and contaminant removal, will be effective at controlling effluent water quality. Based on these results, the following slightly modified design options were retained: • segregate and manage sediments in a single containment cell (similar to Alternative 1) and place Priority 1 and 2 sediments into the ECF first; and • segregate and manage sediments in two internal containment cells (similar to Alternative 2) and place Priority 1 and 2 sediments into the ECF first. • Given the analysis and the above advantages, the preferred design option is to segregate and manage sediments in two internal containment cells (similar to Alternative 2) and to place Priority 1 and 2 sediments into the ECF first.	• Following the placement of Subarea 2 dredged materials into the ECF, Cells 1 and 2 will be filled to the top of the internal cell wall according to contaminant concentrations. Decant water will flow from Cell 1 to Cell 2 or will flow from the influent point of Cell 2 to the final settling cell influent point. Once Cell 2 is filled to the top of the internal wall, dredged material will be placed throughout the ECF, and it will function as one cell. The ECF supernatant will be transferred to the final settling cell using three overflow structures and pumping. The polymer and associated equipment will be located on a small floating platform inside the ECF. The polymer will be mixed with the ECF supernatant using a static mixer. • The final settling cell effluent will flow into an overflow structure and be pumped to the mechanical treatment system via a plastic pipe. The mechanical treatment system will be located on HPA property

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
• Alternative 4 provides a faster production rate than Alternatives 1, 2 and 3. However, dredge and pipeline mobilization and maintenance may increase production costs. Also, due to the large volume of water added to the process via hydraulic dredging, more volumetric capacity is required in the design of the ECF during filling operations. The dredged material tends to have a higher moisture content and, therefore, the treatment of more decant water is expected. • All alternatives were carried forward to the detailed evaluation. • Further details on the initial screening evaluation are provided in Section D.3.1 of Supporting Document D.	• For sediment dewatering, in-place dewatering will be used throughout the production dredging phase. Of the two options retained for the 30 percent design, the in-place dewatering/sedimentation via multiple interior cells is an extension of in-place dewatering (unaided settling) that constrains the discharge flow to improve hydraulic parameters and, therefore, increases TSS removal. This design option is preferred because of the improvement it offers, as well as for reducing the risk that dredge discharge is short-circuited to the effluent discharge point. The preferred design option for sediment dewatering is in-place dewatering/sedimentation via multiple interior cells. • The water quality evaluation shows that in-place gravity sedimentation alone will not achieve the PWQOs (and/or CWQGs) for direct discharge to Hamilton Harbour. All of the design options for effluent treatment were retained for future assessment (i.e., at the 100 percent design stage) since they are all likely to be used at different stages of the process. • The option to discharge effluent to the sanitary sewer was eliminated because the	southwest of the ECF. Effluent from the final settling cell will flow in parallel through sand filters for pre-treatment prior to being treated in parallel carbon vessels. • Further details on the 100 percent design evaluation are provided in Section D.3.3 of Supporting Document D.

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
	flow to the sewer during dredging would be in excess of 5 million gallons per day, which would exceed the sewer capacity. Therefore, direct discharge to Hamilton Harbour was the preferred design option. • For air emissions controls, all of the design options were retained since further modeling studies are required to develop the design standards and criteria, and the associated requirements before an assessment of the air emission control options can be completed. Further consideration of air emission control options was undertaken at the 100 percent design stage. • Further details on the 30 percent evaluation are provided in Section D.3.2 of Supporting Document D.	
ECF Containment and Cover		
A. Options Evaluated		
• Option 1 – Soil Cover; • Option 2 – Concrete Cover; • Option 3 – Synthetic Liner; • Option 4 – Underdrain; • Option 5 – Top Drain; • Option 6 – Top and Bottom Drained; and • Option 7 – Drained, Low Permeability Soil. • These options are described in Table D.14 in Supporting Document D. Illustrations of these options are provided following Attachment D.15 in	• The evaluation of ECF cover and containment options considered the design of both ECF end uses, with approximately two-thirds of the primary ECF (a minimum 5 ha) being designed for marine terminal use and the remaining one-third for a greenway (i.e., soil cover). • For purposes of the 30 percent design, two options which incorporate some or all of the design standards	• The 100 percent design for the containment and cover developed the final design details for the capping system, grading and stormwater management systems. The design of the capping system will accommodate marine terminal loads, limit surface water infiltration and resulting ground water recharge to contaminated sediment,

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
Supporting Document D.	were developed. • Options 1 (Soil Cover) and 2 (Concrete Cover) are similar in design for most components (i.e., combination of greenspace and pavement, presence of a utility corridor, diversion berms, possible granular filter media, etc.). Option 1 includes a channel with a surface grate or equivalent surface collection/conveyance channel sized for a five-year storm. Option 2 omits the channel but includes grading for surface swales in the green space adjacent to the pavement.	and provide effective stormwater drainage. • The 100 percent design included a review of the various standards and guidance for the development of the design for the ECF cap and stormwater management systems, and application of the standards and guidance to the proposed design. Design considerations for the ECF capping system, grading and stormwater management developed during the 30 percent basis of design and during the geotechnical design and the groundwater fate and transport studies completed for the 100 percent design, were applied to the design of the various options for the marine terminal and the greenway.
B. Results of Evaluation		
• Based on the evaluation of the options, Options 1 (Soil Cover) and 2 (Concrete Cover) were preferred (note: Option 1 would only be suitable for green space since it will not meet the marine terminal surface pavement requirements). The main outstanding issue to be resolved with respect to these options was adequate	• A detailed evaluation of the containment and cover options was not completed at the 30 percent design stage. The evaluation of the containment and cover options was largely deferred to the 100 percent design stage. The detailed evaluation of the containment and cover options was dependent on	• The overall design of the ECF capping system is presented in Figure D.10 in Supporting Document D. • The foundation layer will consist of a separation woven geotextile placed directly on the surface of the dredged material,

Initial Screening	Detailed Evaluation	
	30 Percent Design	**100 Percent Design**
environmental performance. It was uncertain if these cover system options combined with the lateral containment options would adequately contain contaminants to acceptable environmental levels. This can only be determined through fate and transport modeling. • If acceptable environmental performance cannot be achieved with these options, then Options 3, 4, 5 and 6 should be considered. The order of preference for the other options was: • Option 3 (Synthetic Liner) (subject to satisfactorily addressing concerns regarding an underlying rise in the ground water level within the ECF); • Option 4 (Underdrain); and • Option 6 (Top and Bottom Drained). • In general, this order represents an increasing level of complexity and cost, and decreasing frequency of prior application with respect to ECFs. • Based on the above, the following was recommended at this stage of the engineering work: • no further work on Option 5 (Top Drain) was recommended because the increased level of complexity and cost does	the more detailed development of the facility design standards and the more detailed technical studies. • Further details on the 30 percent evaluation are provided in Section D.4.2 of Supporting Document D.	followed by placement of a high-strength geogrid. The foundation layer will be placed after self-consolidation of the sediments. Any large depressions on the surface of the dredged material will be smoothed out prior to placement of the geosynthetics. • Modeling results showed that the shear strength in the dredged material must increase to a certain level before the preload is applied. The shear strength will need to be verified during cap construction, using for instance, settlement plates to monitor the conditions or by using pore pressure transducers to monitor deformation behaviour and pore pressure decline. • Further details on the 100 percent design evaluation are provided in Section D.4.3 of Supporting Document D.

<table>
<tr><th rowspan="2">Initial Screening</th><th colspan="2">Detailed Evaluation</th></tr>
<tr><th>30 Percent Design</th><th>100 Percent Design</th></tr>
<tr><td>not appear justified when considering the accompanying increased chance of success;
no further work on Option 7 (Drained, Low Permeability Soil) was recommended because of the volume lost within the ECF; and
fate and transport modeling should be undertaken to determine the required hydraulic regime to provide adequate environmental containment for the contaminants of concern.
Further details on the initial screening evaluation are provided in Section D.4.1 of Supporting Document D.</td><td></td><td></td></tr>
<tr><th colspan="3">U.S. Steel Intake/Outfall (I/O)</th></tr>
<tr><td colspan="3">A. Options Evaluated</td></tr>
<tr><td>Four options were identified, two of which were developed into general concepts. The four options, which are described in Table D.19 in Supporting Document D, were:
Option 1 – Piped I/O;
Option 2 – Open Channel;
Option 3 – Open Channel Wider than Option 2; and
Option 4 - Relocation of Pumphouse Intake Structure.</td><td>Based on the results of the initial screening, two types of design options were developed to accommodate U.S. Steel's I/O. The options were either stand-alone options, in which interactions between the ECF's eastern wall and the U.S. Steel's dock wall were minimized, or options where the ECF's eastern wall and the U.S. Steel's dock wall are attached in order to brace the two structures.
The options examined at the 30 percent design stage were:</td><td>The 100 percent design for the U.S. Steel I/O accommodation addressed the following:
further development of the design for the 25 m wide channel (expanded from 10 m to address U.S. Steel concerns for water quantity and water quality, and back-up flow requirements) between the east side of the primary ECF wall and the</td></tr>
</table>

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
	• Option 1A – Open Channel; • Option 1B – Open Channel with Piped Discharge to South; • Option 2A – Piped Intake; • Option 2B – Pile-supported Culvert; and • Option 2C – Open Channel with Cross-Bracing.	dock wall (Pier 16); • further development of the design for the cap features for the area between the two structures to address isolation of the contaminants, including occasional vessel traffic; • the design/construction features associated with dredging/building adjacent to the dock wall; • the need for a flow separation wall to address intake/outfall water quality and quantity; and • the potential benefits of a hydraulic connection between the channel and the Sherman Inlet area.
B. Results of Evaluation		
• Option 2 (Open Channel) was the preferable option for several reasons. Construction is less complex, thus reducing risk to water quality during the construction activities. Option 2 is less costly to implement and provides less disruption to U.S. Steel's operation of the water intake and outfall than Option 1. Construction would be simpler and would need to be staged in order to maintain acceptable raw water intake	• Based on the preliminary ranking, Option 1A and Option 2C ranked the highest. Both options were retained for consideration during the 100 percent design. However, Option 1A was preferred if further design development indicates that minimizing interactions with the dock wall and mobility of contaminants between the two sites is a significant	• The design basis for the 25 m wide channel was confirmed. • The cap's ability to withstand hydraulic and erosive forces, such as flow and waves, vessel traffic and ice effects was evaluated. The most significant effect was attributed to the occasional vessel traffic, particularly near the

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
quality and possibly protect the stability of the existing Pier 16. • Option 1 would introduce several maintenance issues and annual costs that are undesirable. There is also greater uncertainty regarding environmental approvals for the pipeline option (Option 1) as the design may be considered as a new marine intake because of its location. • However, both options were recommended for further consideration in the more detailed engineering work, especially since Option 1 has the potential to be less harmful to U.S. Steel operations during construction of the ECF. • Further details on the initial screening evaluation are provided in Section D.5.1 of Supporting Document D.	consideration. Considering structural requirements and associated costs for the ECF's eastern wall, Option 2C provides cost savings over Option 1A. Option 1A is the second least expensive design option. • The benefits of Option 1A (Open Channel) included: • reduced potential impacts to U.S. Steel's operations during and after construction; • consistency with project design standards; • long-term reliability; • ability to limit the mobility of contaminants between the ECF and U.S. Steel property; • service life comparable to the ECF (i.e., 200 years), assuming periodic maintenance; • least potential to impact the U.S. Steel dock wall; and • lower risk of impacts to both design and construction schedules. • Further details on the 30 percent evaluation are provided in Section D.5.2 of Supporting Document D.	channel entrance and shipping berths, as well as vessel traffic associated with channel maintenance. • Consolidation and slope stability evaluation indicated that the settlement within the cap due to self-weight is expected to be minimal and to occur during placement. The cap is expected to be relatively stable in the areas adjacent to the dock wall. • The analysis to select either capping or in-situ stabilization/solidification in the dock wall offset area identified that there was limited feasibility for installing and maintaining a cap or completing the in-situ stabilization/solidification. Both were determined to be constrained by navigational requirements, the steep slopes and hard materials that comprise the bottom materials in the area, and the considerations for future repair/replacement for the dock wall. The recommendation for the dock wall offset area, based on it comprising a low percentage of the total potential affected

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
		contaminant mass (less than 1% of the total sediment contaminant mass for all sediment contaminants), is to transition to the dredge areas in adjacent subareas with no active remediation proposed for the offset area. • The presence of the channel is not expected to increase fish habitat compared to existing conditions and, therefore, upgrades to the existing fish screens are not proposed as part of the Randle Reef project. U.S. Steel may chose to utilize the turbidity control structures to support fish impingement screens in the vicinity of the intakes. • Further details on the 100 percent design evaluation are provided in Section D.5.3 of Supporting Document D.
Marine Terminal		
A. Options Evaluated		
• Option 1 - Steel Sheetpile Bulkhead with Kingpiles and Discontinuous Concrete Anchorages; • Option 2 - Steel Sheetpile Bulkhead Reinforced with Plates and Discontinous Concrete Anchorages; • Option 3 - Steel Sheetpile Bulkhead with Angled Tension Anchors to Rock or Till;	• Due to the interaction of the marine terminal design element with the isolations structure design element, the evaluation of the marine terminal design element was completed taking into account the results of the initial phase of the fate and transport modeling completed at the 30 percent	• Further geotechnical analyses were completed to develop the structural requirements and review the site conditions for the design of the walls during the 100 percent design stage. The results of these analyses were then applied to the design for the marine

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
• Option 4 - Double Wall Steel Sheetpile Wall; • Option 5 - Steel Sheetpile Wall with Relieving Platform; • Option 6 - Concrete Caisson Wall; and • Option 7 - Cellular Steel Sheetpile Wall. • These options are described in Table D.23 in Supporting Document D. Illustrations of these options are provided following Attachment D.20 in Supporting Document D.	level of design. This work concluded that the marine terminal walls must provide an effective seal around the contaminants, including sealable interlocks for interior sheetpile walls. • Due to the incompatibility of some of the options with the requirements of the isolation structures, and the findings of the geotechnical studies and the first phase of the fate and transport work, only two of the options from the initial screening were retained and evaluated for the marine terminal walls at the 30 percent design level. The two options were the double steel sheetpile wall with sealed interlocks and the double steel sheetpile wall with sealed interlocks and relieving platform.	terminal walls, for both the primary and secondary facilities. • The objective of the review was to apply the geotechnical parameters and requirements for dredge grade depths and loading requirements to the design option. The design option was also analysed to validate its structural feasibility by conducting a fixed earth analysis and a free earth-undrained analysis. The anchorage capacity of the anchor wall was determined and a finite element analysis of the anchor wall was also completed. An analysis related to the vessel design, berthing and mooring, and corrosion protection of the walls was also undertaken.
B. Results of Evaluation		
• Option 6 has the highest unit cost, even with the cost of the pre-installation dredging excluded from the cost estimate. • Options 1 and 2 have the widest footprint and have high unit costs associated with the wide construction.	• The double steel sheetpile wall with sealed interlocks was somewhat preferred over the double steel sheetpile wall with sealed interlocks and relieving. However, the relieving platform option may be determined to be more cost effective during later stages of design. Both options were,	• The potential steel sheetpiling wall system is shown below in Figure D.21 in Supporting Document D. To address the results of the fate and transport modeling and the requirement for a sealed steel sheetpile wall, the steel sheetpiling will be

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design

• Option 3 has the second lowest per unit cost and the potential for the narrowest footprint. The soil conditions may not support the vertical loads induced by the battered anchors and additional bearing piles may be required.
 	
• Option 5 has high unit costs (based on a conventional anchorage). A relieving platform in combination with the features of Options 3 and 4 may warrant further consideration, depending on soil conditions.
 	
• The environmental constraints related to the method of construction require further investigation (i.e., pile driving and suspended sediment controls, noise, etc.).
 	
• The following options were recommended for further evaluation in the next stage of the engineering work (see Section D.6.2 of Supporting Document D):
 	
  • Option 3 – Steel Sheetpile Wall with Angled Tension Anchors to Rock or Till;
 	
  • Option 4 – Double Wall Steel Sheetpile Wall;
 	
  • Option 5 – Steel Sheetpile Wall with Relieving Platform; and
 	
  • Option 7 – Cellular Steel Sheetpile Wall.
	therefore, retained for further consideration during the 100 percent design level.
	
	• Further details on the 30 percent evaluation are provided in Section D.6.2 of Supporting Document D.
		specified with a low-alloy corrosion resistant steel and will have reserve thickness.
		
		• Two methods were assessed to reduce loads on the south wall: replacement of the weak upper silty clay between the sheetpile walls; and a double tie-rod system. The analysis showed that the two-tie-rod system does not reduce the bending moments as effectively as the clay replacement method. Therefore, the clay replacement method is recommended for the facewalls in those areas where bending moment reduction is required to achieve an economical sheetpile selection.
		
		• The design details for the secondary ECF are similar to those for the south face of the primary ECF.
		
		• Potential means of corrosion protection were evaluated and a steel sheetpile facewall coating system was recommended. This is expected to provide some protection against accelerated corrosion and will likely extend the service life of the facewall in excess of 30 years.

Initial Screening	Detailed Evaluation	
	30 Percent Design	100 Percent Design
• Further details on the initial screening evaluation are provided in Section D.6.1 of Supporting Document D.		• Further details on the 100 percent design evaluation are provided in Section D.6.3 of Supporting Document D.

8.0 PROJECT DESCRIPTION

This section provides an overview of the project description. A more detailed project description is included in Supporting Document F.

8.1 Sediment Remediation Phases and Activities

There are six major design elements that form the sediment remediation plan:

- ECF Isolation Structures;
- Dredging Design;
- Sediment Management;
- Containment and Cover;
- U.S. Steel I/O Accommodation; and
- Marine terminal.

The construction phase encompasses the actual remediation of the contaminated sediments as well as proposed navigational dredging for the marine terminal. All of the design elements listed above are included in the construction phase. The ECF walls will be constructed first, followed by dredging the contaminated sediments and placing them inside the ECF. During this time, contaminated water from the dredging process will be treated before being discharged back into the Harbour. The area in close proximity to the U.S. Steel intake/outfall will be capped under water (i.e. below the invert elevation of the U.S. Steel intake/outfall structures). Once the ECF is filled, it will also be capped. Two thirds of the surface of the ECF will be paved to accommodate future commercial marine terminal activities and the other third of the surface will be landscaped.

The operation of the facility includes use of the paved area for typical marine terminal activities such as loading/unloading. The facility will also support vessel mooring. The landscaped area, if pursued, will be capable of sustaining native growth and providing various types of habitat. The operation phase also includes a long-term monitoring and maintenance plan to ensure the ECF's continued effectiveness.

8.2 Proposed Sediment Remediation

The goal of the *Randle Reef Sediment Remediation Project* is to contain the most severely contaminated sediment in place by constructing an ECF of approximately 7.5 ha in size around it/on top of it. Surrounding contaminated sediment outside the ECF will be dredged, placed in the facility and capped. The final use of the site will include two thirds for a marine terminal and the remaining third for a greenway for naturalization or area surfaced with a suitable aggregate material and used as light industrial space.

8.3 Construction Phase

The construction phase includes the following main activities: sheetpile installation; dredging; ECF effluent treatment; consolidation monitoring; ECF cap placement and construction; U.S. Steel I/O channel capping; and habitat area construction. Construction of the marine terminal will take place after the sediment remediation and ECF construction is complete. Aspects of the marine terminal are discussed in section 8.4.

8.3.1 Debris Removal

The contractor will be required to perform a pre-dredge debris survey over a designated area and to remove debris using mechanical dredging techniques. Debris will be disposed of in accordance with local and provincial regulations.

8.3.2 Turbidity Control Structure at U.S. Steel Intake Pipes

A three-sided turbidity control structure will be installed at the U.S. Steel dock wall in the vicinity of the intakes. The structure will run parallel to the U.S. Steel dock wall and will enclose the intake pipes. The control structure will consist of H-piles that will be used to support turbidity barriers. If needed, the turbidity barriers will be attached to the structure to reduce TSS/turbidity in water flowing to the intakes. The turbidity barrier is proposed to extend from the water surface to the channel bottom.

8.3.3 ECF Containment Walls

The ECF isolation structures are proposed to be constructed prior to any dredging activities. A double steel sheetpile wall (outer wall is primarily a structural wall and the inner wall serves as an impermeable environmental wall and an anchor wall) will form the ECF (Figure 8.1). The primary elements of the structure include (from the inside working outward): the dredged material; the sealed interior sheetpile wall; the quarry rock between the interior and exterior sheetpile walls; and the exterior structural sheetpile wall.

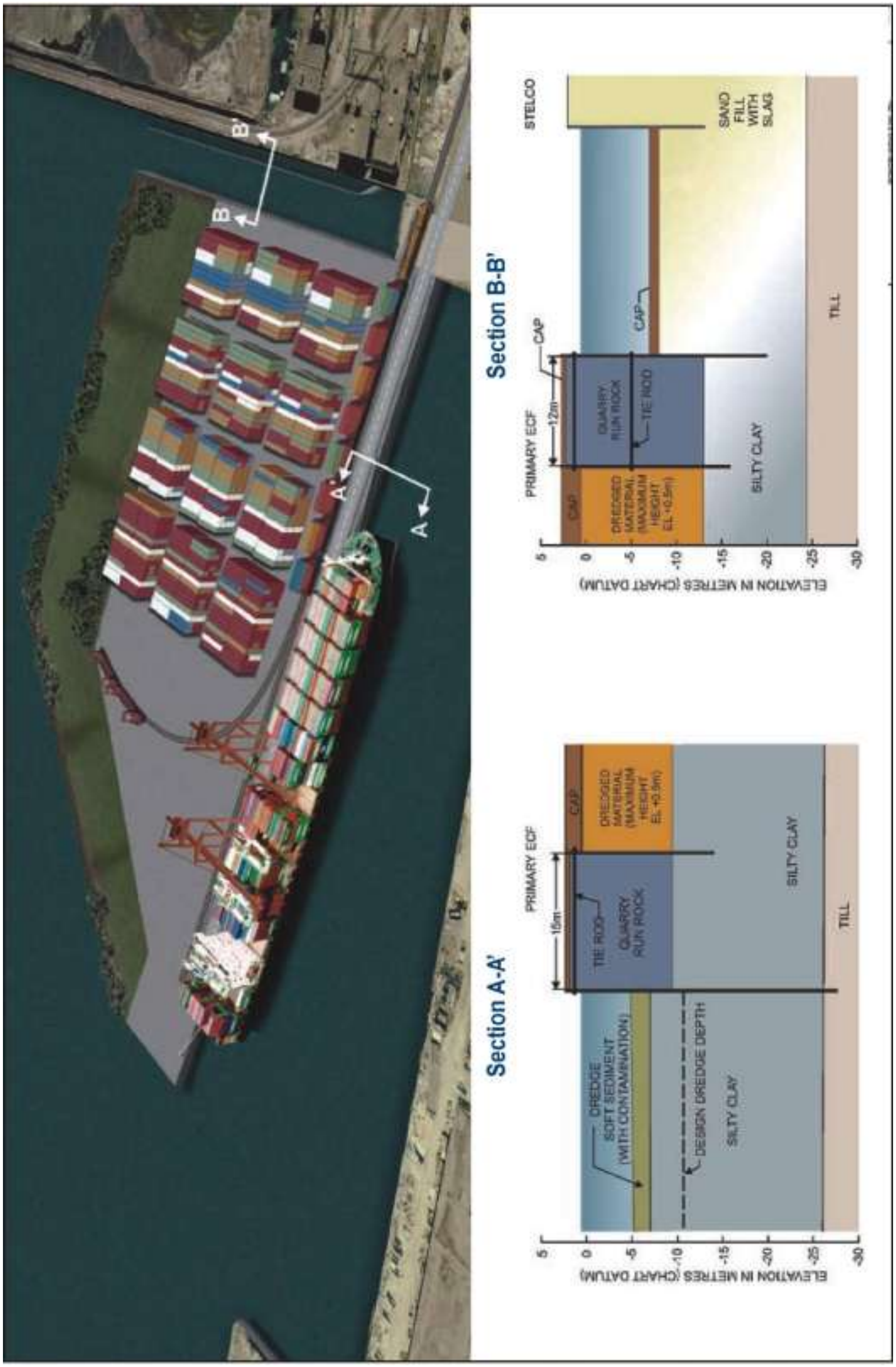
These perimeter structures serve two purposes: (1) to isolate in-situ contaminated sediments, including containment of contaminated dredged material placed inside the ECF; and (2) to provide overall structural support for the ECF and marine terminal walls on the south face of the ECF.

8.3.3.1 Facewall and Anchorwall Construction

The double steel sheetpile wall consists of two parallel sheetpile walls. The exterior wall acts as a facewall. It is anchored with one or more levels of tie-rods connected to the interior wall, which functions as an anchor wall. The facewall and anchor wall will be installed at the same time.

The interior and exterior walls will be separated by backfilled quarry rock.

Figure 8.1: 30 Percent Design Rendering



The anchor wall serves two primary purposes: (1) to provide a wall to isolate the contaminated dredged material; and (2) to stabilize the top of the exterior wall by providing anchorage. The anchor wall interlocks will be sealed to provide a relatively high impermeable barrier.

8.3.3.2 Dredging Between Walls, Backfill and Concrete Parapet

Dredged sediments are to be removed from between the facewall and anchor wall prior to installing the connecting tie-rods. Clean native clay is also to be removed in order to reach the depth necessary for structural stability of the walls. Backfilling between the walls with quarried rock fill will commence after installation of the connecting tie-rods.

Dredging will be accomplished using a combination of a mechanical dredge to "side-cast" sediment into the ECF and a crane-mounted high-solids pump to remove additional materials in proximity to the steel sheetpile walls. As the area being dredged is contained between two sheetpile walls, it is anticipated that there will be no negative environmental effects to the surrounding surface water area. The estimated amount of sediment to be dredged from between the walls is approximately 23,412 m^3 and the estimated amount of clay is 41,723 m^3.

- The area between the walls on the north and west sides of the ECF will be used as a final settling cell where water from the production dredging is treated prior to discharge to the Harbour. Backfilling between the walls on the north side will be conducted such that approximately 3 m of water column will be left above the backfill for final settling. Dredging underneath the final settling cell footprint will be conducted first so that treatment of decant water within the final settling cell can begin as soon as possible.

Further details regarding the final settling cell are provided under Section 8.3.5.2.

A concrete parapet will be included along the south face of the primary ECF. This is the area of the ECF where vessel mooring will take place.

8.3.4 Pier 15 Wall Stability

The existing walls at Pier 15 will require replacement and/or strengthening before dredging in this area can occur. Part of the wall will be encapsulated with a new steel sheetpile wall and part will be strengthened to allow environmental dredging to take place in the area adjacent to the wall. It is proposed to dredge to the depth required for wall replacement/strengthening and subsequently install a post dredging stone mattress, where required, at the base of the wall, up to the design ship draft level.

8.3.5 In-Water Production Dredging

Although the capacity of ECFs can be somewhat altered by how they are constructed, for the most part, ECF capacity is limited by the available area. Because of that limitation, contaminated sediments to be dredged in the vicinity of Randle Reef have been prioritized for dredging and isolation in the ECF according to their chemistry and toxicity (see Figure 8.2). The definition for each priority category is outlined below:

- **Priority** 1: Previously identified as a priority area in earlier studies (identified as containing significant concentrations of PAHs and metals, as well as showing demonstrated toxicity);

- **Priority 2**: Total PAH > 100 mg/kg and/or metals concentrations > Severe Effect Levels (SELs); toxic based on Benthic Assessment of Sediment (BEAST) analysis;

- **Priority 3**: Total PAH > 100 mg/kg and/or metals concentrations > SELs; non-toxic based on BEAST analysis or no toxicity information;

- **Priority 4**: Total PAH < 100 mg/kg; metals concentrations < SELs; toxic based on BEAST analysis; and

- **Non-Priority**: Total PAH < 100 mg/kg; metals concentrations < SELs; non-toxic based on BEAST analysis or no toxicity information.

The dredging design for dredge subunits addresses an in-situ volume of approximately 598,000 m^3. This in-situ volume increases with an overdredge allowance of 0.15 m to approximately 659,000 m^3. The storage capacity for the ECF is estimated to be 500,000 m^3 dependant on consolidation. Dredging will therefore have to end part way through the Priority 3 sediments. The sediment will undergo changes in density and moisture content during dredging and placement that will initially increase the total sediment volume, but will then decrease through consolidation.

Production dredging, estimated to last approximately 28 months, will be conducted using a hydraulic dredge outside the ECF exterior wall and within the limits of dredging.

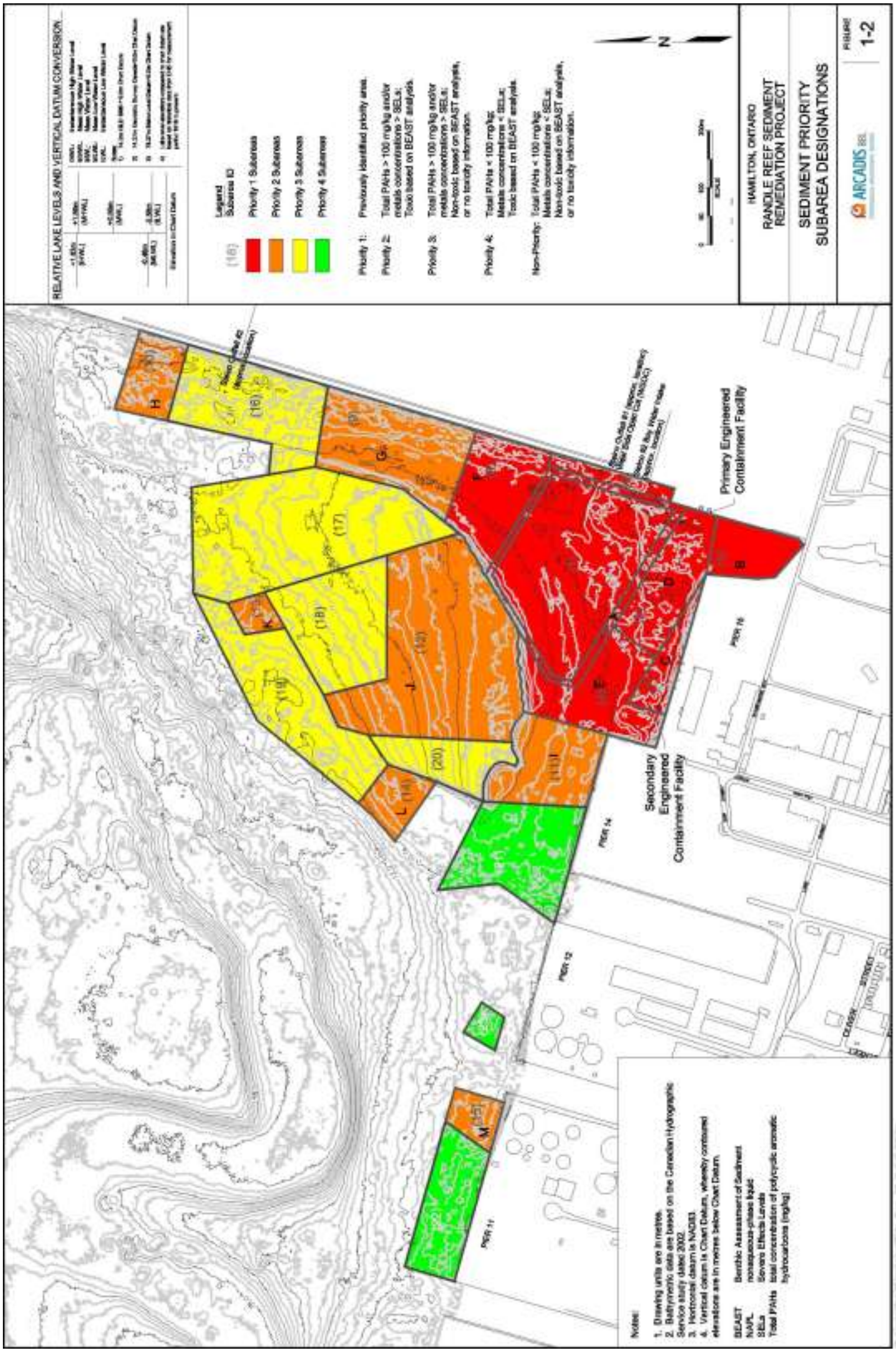
The discharge pipeline will be equipped with floats to facilitate access for moves and to allow inspection for leaks. Typical floating discharge pipelines are made of a flexible plastic material. The discharge pipeline will extend from the dredge pump to the ECF, which will range in direct approximate distances of up to 1,000 m (3,300 ft). The pipeline outlet will be submerged in the ECF to reduce the potential for volatile air emissions. The design of the pipeline outlet will facilitate the movement of the outlet point so that dredged material can be spread throughout the footprint of the ECF.

8.3.5.1 Dredging Sequence

Contaminated sediment from Priority 1 and 2 areas will be fully contained within the ECF, while sediment dredged from Priority 3 areas will be contained as space allows.

The dredging design for activities outside the footprint of the ECF will include the following steps:

Figure 8.2: Sediment Priority Subarea Designations



- dredge Priority 1 and 2 subareas to the clay surface with appropriate offsets from existing structures and dredge as close as is practical to the ECF walls. It is proposed that Priority 1 sediments will be dredged within a physically contained (i.e., steel sheetpile walls) area of the Harbour;

- complete hydrographic surveys to confirm dredging and conduct verification sampling and analysis to identify whether additional focused dredging is necessary in Priority 1 and 2 subareas before dredging in Priority 3 subareas;

- dredge Priority 3 subareas having volumes that can be accommodated within the ECF and fill the facility to an elevation of approximately 1.5 m above Chart Datum. Priority 3 areas will be dredged to the depth of interpreted contamination, which is not necessarily the full depth of the soft sediment layer; and

- place a thin layer cover of sand to backfill areas with PAH concentrations at or above 100 ppm and provide a thin layer cap of approximately 16 cm or less in remaining Priority 3 and 4 subareas to enhance natural recovery within the dredging limits. Capping would occur in two separate layers of approximately 8 cm each.

8.3.5.2 Sediment Management

Sediment management will consist of gravity settling of decant water within the ECF, followed by polymer-assisted settling in a final settling cell (the north and west sides of the ECF, in the space between the double steel sheetpile walls) and additional treatment of effluent using sand filtration and granular activated carbon (GAC) adsorption. Figure 8.3 illustrates the conceptual ECF filling. The sand filtration and GAC units will be located on Pier 15. Treated effluent will be discharged directly to Hamilton Harbour.

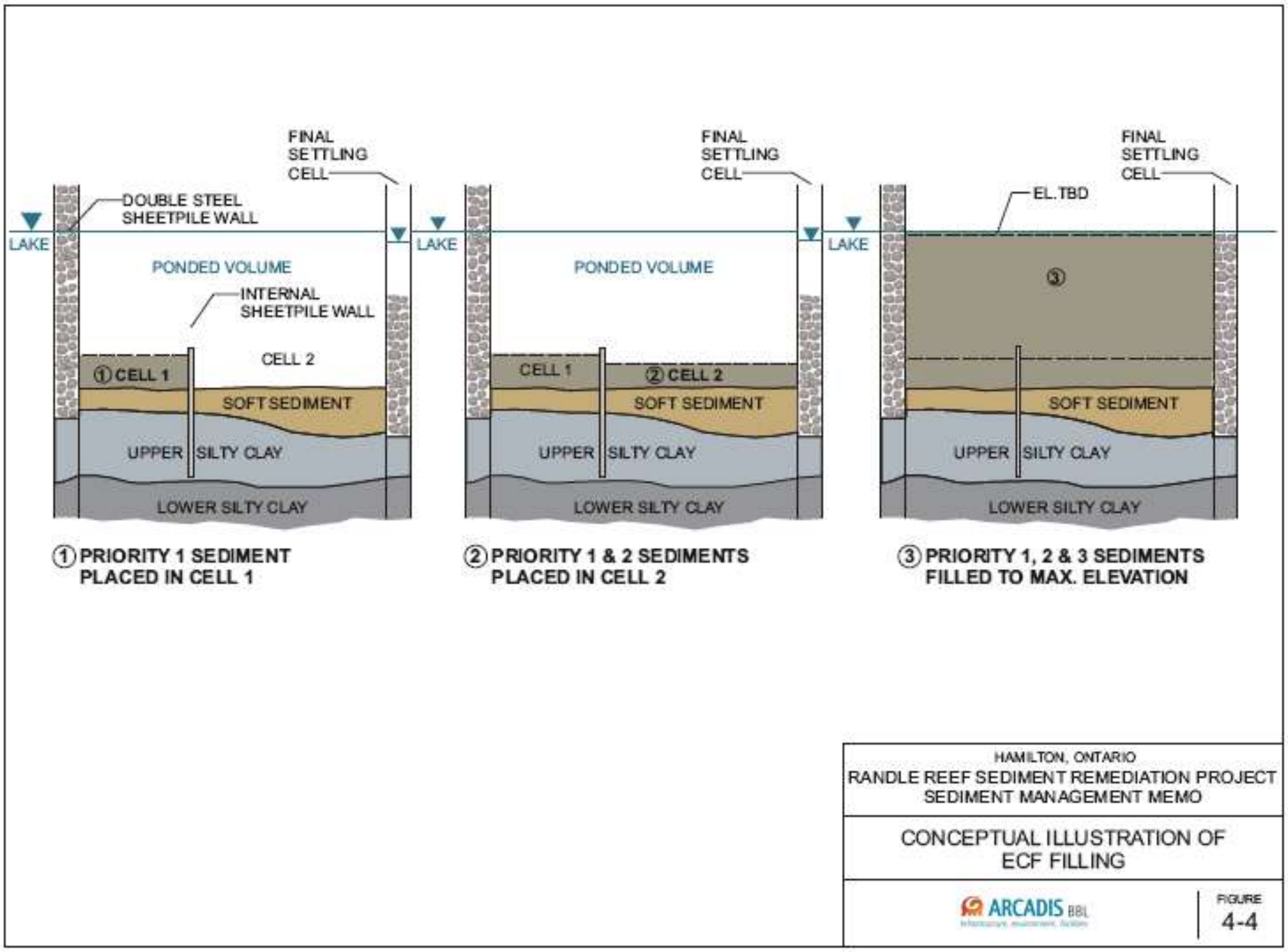
See Figure 8.4 for the location of the final settling cell and the location of the water treatment system on land.

All dredged material will be placed in a submerged condition that allows for a ponded water column above the sediment to control air emissions. The ponded water volume will also allow for settling of solids within the internal cells as dredged material is placed and for the settling of TSS and associated contaminant concentrations in the decant water that passes to the final settling cell.

8.3.5.3 Re-suspension Control

Re-suspension of sediment occurs during hydraulic dredging when the cutterhead and suction action disturb sediments that are not subsequently captured by the dredge. These sediments are then dispersed throughout the surrounding water column. Re-suspension can re-contaminate previously dredged areas or transport contaminated materials to non-priority areas. Re-suspension from hydraulic dredge heads is generally low compared to other dredging methods.

Figure 8.3: Conceptual Illustration of ECF Filling



To mitigate re-suspension and its impacts, engineering controls (such as hydraulic dredge heads with hoods or shrouds) or operational controls (such as dredging from higher to lower elevations and from higher to lower priority areas) can be employed. When re-suspension presents a water quality concern, dredge areas can be segregated with sheetpiles so that the dredging occurs within an enclosed environment.

Silt curtains or screens can be used to reduce turbidity at certain distances from the dredge but they are generally limited in their performance. General experience in the industry indicates that hydraulic dredging produces low turbidity around the dredge head. Because the presence of silt curtains results in reduced dredging rates and increased downtime for the dredging operation (due to repositioning of the silt curtain for each move), these measures would be employed only if necessary.

Preferably, the dredging equipment can be fitted with a hood or shroud to reduce turbidity. This, and other factors such as controlling the rate of dredging and rotation of the cutter, are intended to be the primary methods of managing sediment re-suspension at the dredge head.

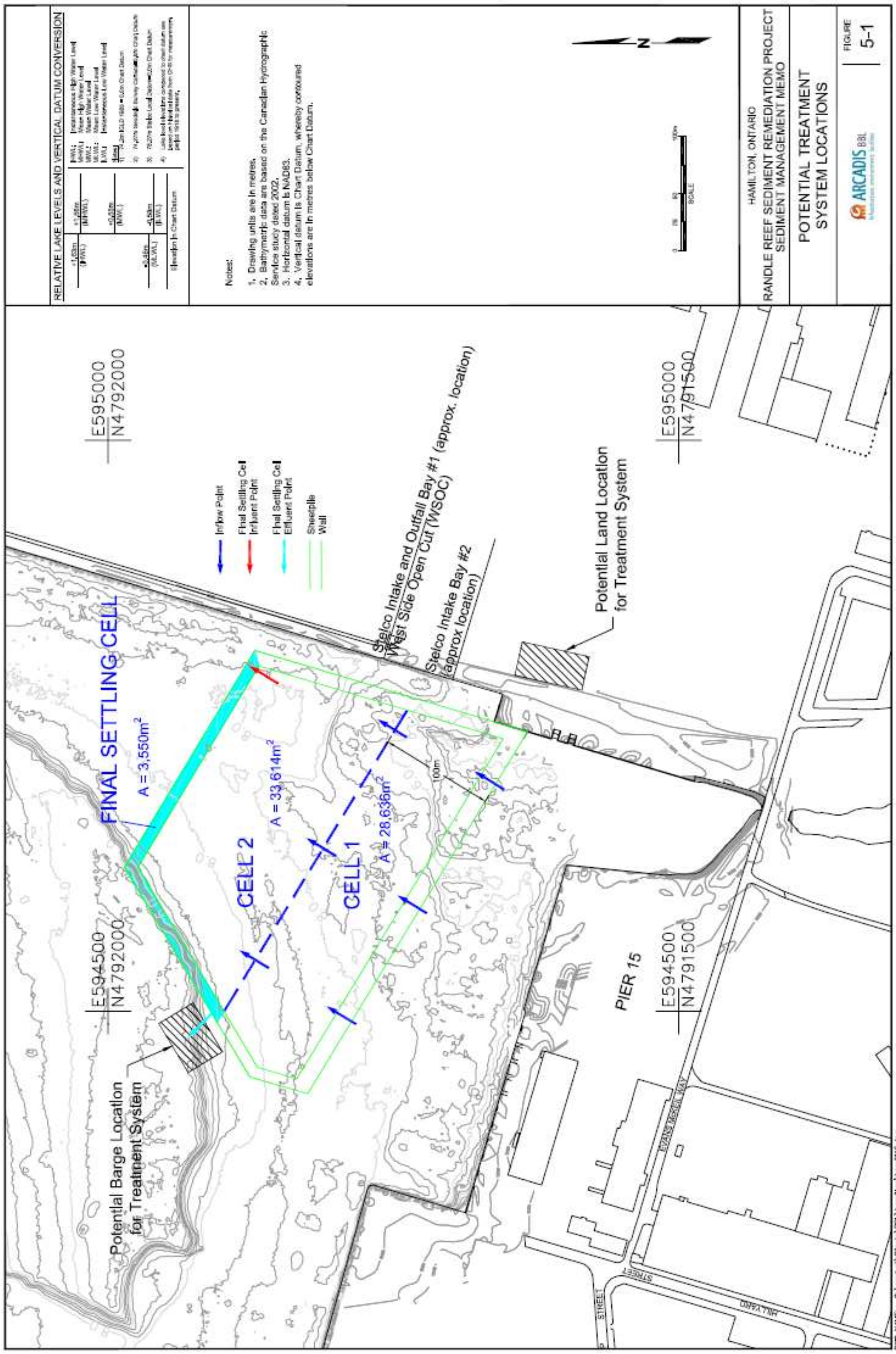
For dredging in areas adjacent to the U.S. Steel intake and the initial dredging on the east side of the ECF between the sheetpile walls, engineering controls such as silt curtains may be needed to prevent suspended sediments from entering the intake.

8.3.5.4 Dredge Verification

Dredging will not remove 100 percent of the contaminant mass, therefore, a certain amount of contaminated sediment will remain in the sediment bed. To address this issue, post-dredging monitoring will be performed to determine whether the dredge criteria were met and additional measures will be taken if they were not.

A combination of hydrographic surveys and verification sampling and analysis will be used to confirm contaminant removal. The amount of residual sediment and residual contaminant mass not removed during dredging will depend on a number of factors. The residual sediment will comprise of either relatively undisturbed sediment or disturbed sediment that has resettled or mixed with clay, slag or other subsurface materials. The former represents sediment that is missed during dredging because of limitations of the dredging design typically associated with data distribution and density, complexity of the stratigraphic conditions and practical limitations inherent in dredging near structures and slopes. The latter is caused by activities at the dredge head that disturb the sediment without capturing it in the dredge pump intake or dredge bucket. Recent studies suggest that residual disturbed sediment can range from 2 to 10% of the dredged mass and is typically 1 to 10 cm (0.4 to 4 inches) in thickness over the surface of the dredge area.

Figure 8.4: Potential Treatment System Locations



Removal accuracy will be monitored during dredging. In addition, dredging progress will be evaluated through hydrographic surveys ("progress surveys") conducted at regular intervals. Dredging completion will be confirmed by hydrographic survey after the first-pass dredging of individual priority areas and again after the second-pass dredging is complete. Verification of the accuracy of dredging to design dredge elevations will be confirmed through these surveys. If design dredge elevations are not met, additional dredging will be performed to complete construction to the design specifications. If verification sampling indicates that additional dredging will be required, a second set of regular hydrographic surveys in conjunction with ongoing second-pass dredging, as well as a final confirmation survey, will be completed.

Two rounds of verification sampling will be conducted: the first will identify residual contaminated sediment remaining after the first-pass dredging is complete; and the second will confirm that residual contaminated sediment and exposed native sediment surfaces meet sediment quality compliance criteria.

First round of verification sampling – Following first-pass dredging and the associated hydrographic survey in each dredge unit, verification sampling will be performed to visually confirm the absence of overlying soft sediments designated for removal and to collect surface sediment samples for laboratory analysis for compliance verification. Results of this interim verification sampling will be used to establish that additional dredging is not needed within the dredge area or to guide design requirements for either second-pass dredging or backfilling.

Second round of verification sampling – A second round of verification sampling will be conducted if second-pass dredging is required. Verification sampling will confirm that contaminated sediments were successfully removed during second-pass dredging and that no additional dredging or backfilling is necessary for exposed surface sediments to meet compliance criteria.

All verification samples will be collected using sediment coring methods. Sediment cores will capture residual surface sediments and must penetrate into the underlying clay layer in order to show the residual sediment thickness and allow for collection of a surface sediment sample for laboratory analysis.

8.3.6 Final Dredging

Final dredging to bring the sediment to grade in the primary ECF will be by mechanical means. Dredged material will be filled above the desired final elevation of approximately +0.5 m Chart Datum in anticipation of consolidation under the weight of the cap and preload.

8.3.7 Backfilling/Thin Layer Cap

Following dredging, backfilling with a sand cover is recommended in two lifts of approximately 8 cm (3 inch) layers for those areas where verification sampling shows PAH concentrations greater than 100 mg/kg, and where an additional dredge pass will not be done. The first lift of the cap will undergo some mixing with the underlying sediment, while the second should provide predominantly a sand cap layer with PAH < 100 mg/kg.

Methods for placing the sand to reduce sediment re-suspension and contaminated sediment entrainment in the cap layer will be specified by the contractor and could include mechanical placement with a bucket, washing sand off a barge, "sand box" vibratory screens, or submerged diffuser placement.

8.3.8 U.S. Steel Channel Sediment Capping

An approximate 25 m wide channel, referred to as the U.S. Steel I/O channel, separates the ECF structure from the U.S. Steel facility. Contaminated sediment is up to an estimated 1.5 m (5 ft) thick in this area and is typically underlain by slag. The channel is designed to limit potential impacts associated with the ECF on water supply for U.S. Steel facilities. The channel will also provide access for maintenance and repairs to the I/O and U.S. Steel dock wall.

The overall design objectives for the U.S. Steel I/O accommodation are to:

- accommodate U.S. Steel's I/O requirements, which include maintaining present water flow rates and water quality properties during and after ECF construction and in the long term following construction;
- reduce disruption to U.S. Steel's Harbour access for shipping; and
- reduce impacts to the U.S. Steel dock wall, which is reportedly nearing the end of its useful service life.

Because of the reportedly deteriorated condition of the U.S. Steel dock wall, dredging was not considered a remedial option for this area, as removing material via dredging could have a destabilizing effect near the base of this dock wall. Additionally, due to the nature of the hard material (presumably slag) in this area, navigation draft requirements and associated propeller/thruster wash, erosional flows and the steep slope beside the dock wall, dredging of this area is considered problematic.

The sediment cap in the U.S. Steel I/O channel will consist of a layer of sand with silt and enriched total organic carbon (TOC). To protect against vessel traffic at the U.S. Steel berths a length of the cap located at the channel entrance near the U.S. Steel berths will be armoured with stone placed over a geotextile and the sand/silt/enriched TOC layer. As there is a restriction on cap thickness in a small area adjacent to the U.S. Steel intake pipes, reactive core mats (RCMs) and armour mats will be used to provide the dual functions of sediment contaminant containment and scour protection. RCMs have a higher capacity to contain contaminants, per unit thickness than a soil-based cap. As a result, a cap with RCMs is thinner than a soil-based cap. A turbidity control structure will be installed around the intakes prior to cap construction.

Cap modeling results indicate that, except for zinc, PWQOs will not be exceeded and Severe Effect Levels (SELs) in the cap will not be exceeded for any of the compounds modeled. Containment of zinc will be expensive and has not been accomplished via full-scale sub-aqueous capping. Additionally, background zinc concentrations are elevated. Accordingly, extraordinary measures to contain zinc are not included in this cap design.

8.3.8.1 Construction Sequencing

Except for the turbidity control structure area, cap construction will commence after the ECF has been constructed and dredging in the priority areas located north of the ECF has been substantially completed. This sequencing is recommended to limit recontamination potential associated with suspension and redeposition of sediment contaminants during dredging. The general sequencing for cap construction is described below:

- construct turbidity control structure around intakes prior to ECF construction or dredging;
- after the ECF has been constructed and dredging in the priority areas located north of the ECF has been substantially completed, construct the sand with silt and enriched TOC cap;
- place armour stone over the sand with silt and enriched TOC cap at U.S. Steel I/O channel entrance; and
- construct the RCM/armour mat cap in the vicinity of the intakes.

8.3.9 ECF Capping

The ECF capping system will consist of a foundation layer, an underliner drainage system, a hydraulic barrier layer, an overliner drainage system, paved surface (in the marine terminal area), vegetative cover (if a greenway), suitable aggregate cover (if light industrial space) and stormwater management systems. The hydraulic barrier will be used in the system to reduce infiltration into the underlying sediments and to reduce upwelling of either pore water or groundwater into the cap materials. The post-consolidated surface of the interface between the top of dredged material fill and the bottom of the ECF cap has a target elevation of approximately +0.5 m Chart Datum. The final thickness of the cap will be approximately 3 m.

Because the ECF is a minimal flow system, most or all of the water that passes through the cap will likely remain within the sealed sheet pile walls. If a sufficient amount of water accumulates under the cap, excessive upward pressure could be exerted on any low-permeability layers in the cap, and cap failure may occur without engineering controls in place. For this reason, a drain system beneath the cap that is capable of providing pressure relief will be installed. The ECF cap design includes perimeter collection trenches that are hydraulically connected to the drainage layer to drain the portion of cap below the geomembrane/geosynthetic clay liner (GCL).

The general ECF cap construction sequence is listed below:

1. Foundation Layer;
2. Underliner Drainage System;
3. Hydraulic Barrier;
4. Overliner Drainage System;
5. Settlement Monitoring System;
6. Subgrade Layer;
7. Preload;
8. Stormwater Drainage System; and
9. Installation of Pavement.

8.3.9.1 Foundation Layer

A foundation layer (layers 2 and 3 on Figure 8.5) will be installed to provide a stable surface on which to begin placement of overlying materials and installation of wick drains. The foundation layer will consist of two layers of geosynthetics: a separation geotextile; and a high-strength geogrid.

8.3.9.2 Underliner Drainage System

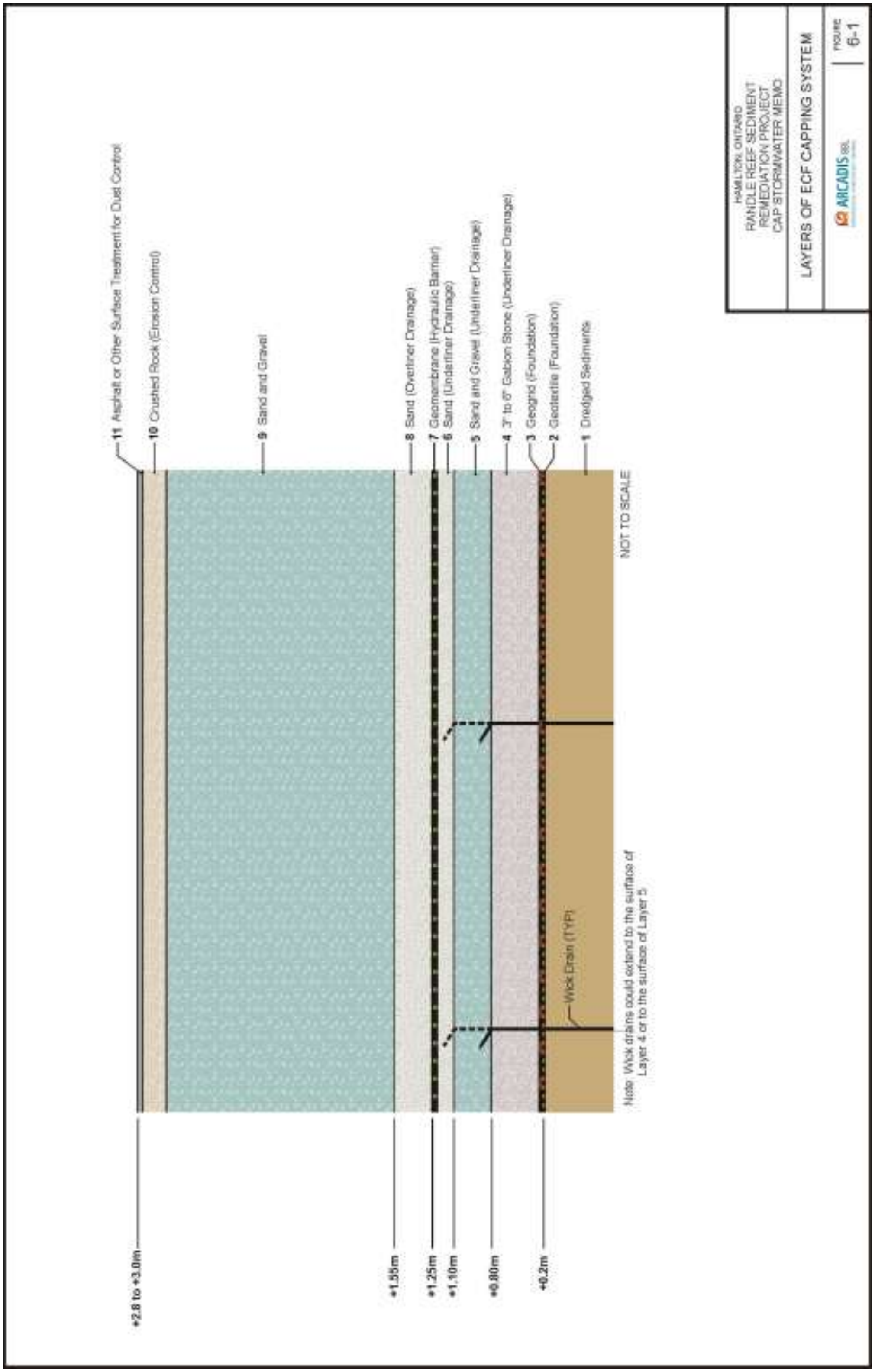
An underliner drainage system (i.e., Layers 4, 5 and 6 on Figure 8.5) will be constructed to manage pore water during consolidation and aid in controlling groundwater upwelling after consolidation. The underliner drainage system consists of gabion stone. The gabion stone will be placed directly on the high-strength geogrid. A perimeter trench system (with horizontal and vertical piping) will be installed around the interior sheetpile wall. Once the gabion stone has been placed, wick drains will be installed to aid in expediting consolidation. A separation geotextile will be used on top of the gabion stone to retain the overlying sand layer that also serves as a cushion to the hydraulic barrier.

8.3.9.3 Installation of Wick Drains

Wick drains will be required in the marine terminal and the marine terminal-to-greenway transition areas to increase the rate of consolidation and shorten the necessary preload duration. Installing wick drains promotes radial consolidation and reduces the length of the drainage path that excess pore water under pressure needs to travel to be removed from the dredged material, thereby accelerating the rate of consolidation. Wick drains are thin strips of composite drainage material wrapped in permeable geosynthetics and driven into the soil using a crawler excavator and hydraulically pressed steel mandrel.

Wick drain spacing with a marine terminal preload is designed to yield 99% consolidation after approximately four months. Approximately 14,770 wick drains are to be installed.

Figure 8.5: Layers of ECF Capping System



8.3.9.4 Hydraulic Barrier Layer

A hydraulic barrier (layer 7 on Figure 8.5) will be used in the system to reduce infiltration into the underlying sediments and to reduce upwelling of either pore water or groundwater into the cap materials. The hydraulic barrier will consist of a linear low-density polyethylene (LLDPE) geomembrane.

8.3.9.5 Overliner Drainage System

An overliner drainage system (Layer 8 on Figure 8.5) will be constructed on the geomembrane and will consist of filter sand combined with horizontal and vertical piping. This system will be used to monitor, analyze, collect, and, if necessary, remove any water that has accumulated on the geomembrane.

8.3.9.6 Subgrade Layer

The subgrade layer (Layer 9 on Figure 8.5) of the marine terminal and greenway areas will be placed directly above the overliner drainage system and will consist of a structural fill material, a sand and gravel mix, placed in lifts and compacted.

8.3.9.7 Preload

The purpose of placing a preload onto the ECF is to allow consolidation to occur within the sediments and foundation soils prior to any future loading of the ECF. It is anticipated that the preload will be in place for twelve to eighteen months.

Once the subgrade layer is in place, the preload will be placed. The preload is anticipated to consist of granular material (i.e., soil, aggregate or taconite).

Once the preload is removed, utilities, final stormwater management systems and the erosion control layers will be constructed.

8.3.9.8 Stormwater Drainage Features

<u>Marine Terminal Portion of the ECF</u>

The primary objectives for stormwater management within the marine terminal area are to:

- develop final grades that accommodate the proposed end use;
- avoid direct runoff from paved surfaces into the lake wherever practical;
- remove runoff from the surface of high-use areas as quickly as possible and practical;
- manage the water quality and quantity in accordance with applicable legislation; and
- reduce, to the extent practical, infiltration of stormwater runoff into underlying capping layers.

Figures 8.6 and 8.7 show the grading and drainage plans, respectively. In general, final grades are laid out to direct stormwater runoff toward the interior of the site in the marine terminal area rather than allow direct discharge to the bay.

Greenway or Light Industrial Area

Stormwater will flow over slopes either directly to the bay or to a French drain system installed between the marine terminal and this area. This French drain will capture clean stormwater running off the back slope before it enters the marine terminal area. Stormwater entering the French drain system will be directed under the greenway / light industrial area through a filter-wrapped pipe, drained to the rock between the interior and exterior sheetpile walls, and then discharged to the bay through the exterior sheetpile.

Because no impervious surfaces are currently proposed for this area, no stormwater quality control practices (other than a vegetated final surface) are proposed at this time.

8.3.9.9 Utilities and Pavement Construction

To support the utility needs of the marine terminal end use, two utility corridors will be installed between the ECF double walls. One utility corridor might be used for electrical and mechanical utilities, while the second corridor might be used for gas utilities.

Once placement of the sub-base and grading is completed, a layer of crushed rock (Layer 10 on Figure 8.5) will be placed. Asphalt pavement (Layer 11 on Figure 8.5) will be placed over the crushed rock.

8.3.9.10 Vegetative Cover/Landscaping

If a green space is created, the desired future condition is a vegetative cover system capable of sustaining native growth and providing various types of habitat as appropriate, providing terrestrial and wildlife opportunities, and improving aesthetics. Landscaping will be based on regional references and include native, non-invasive plant species. Soil types will be based on the native lacustrine plant communities around western Lake Ontario. The higher slopes of the greenway will provide protection from wave action as well as assist in the management of stormwater.

The same sub-grade material used beneath the marine terminal will also be used beneath the greenway as the protection layer; stormwater management features will be installed within this layer. The greenway's erosion control layer will include topsoil and vegetation as well as riprap to serve as wave protection along the northern and northwestern perimeter of the ECF.

Stormwater is intended to be conveyed overland through broad, shallow bioswales to a series of vernal pools located between the inner/outer ECF walls. These pools will provide amphibian habitat and will be planted with a variety of native emergent and wetland fringe species.

The conceptual landform and contouring for the greenway (Figure 8.8) emulate the local, natural character and are intended to provide visual relief and buffering of the industrial and port lands. The creation of the landform provides increased soil depth overtop the protective cap of the ECF, allowing for the installation of larger, native tree species. Figure 8.9 provides a landscape planting concept.

Figure 8.6: ECF Grading Plan

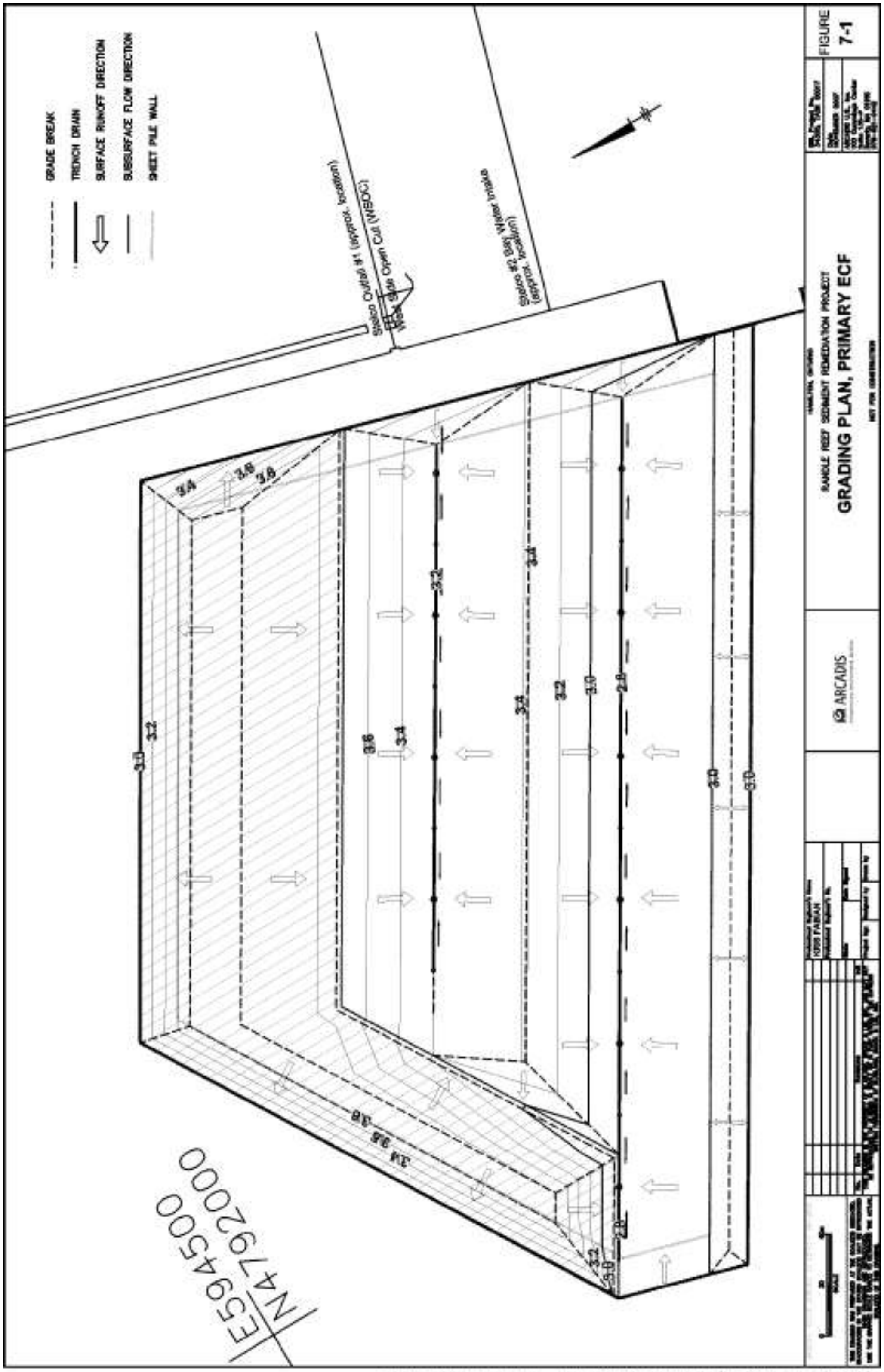
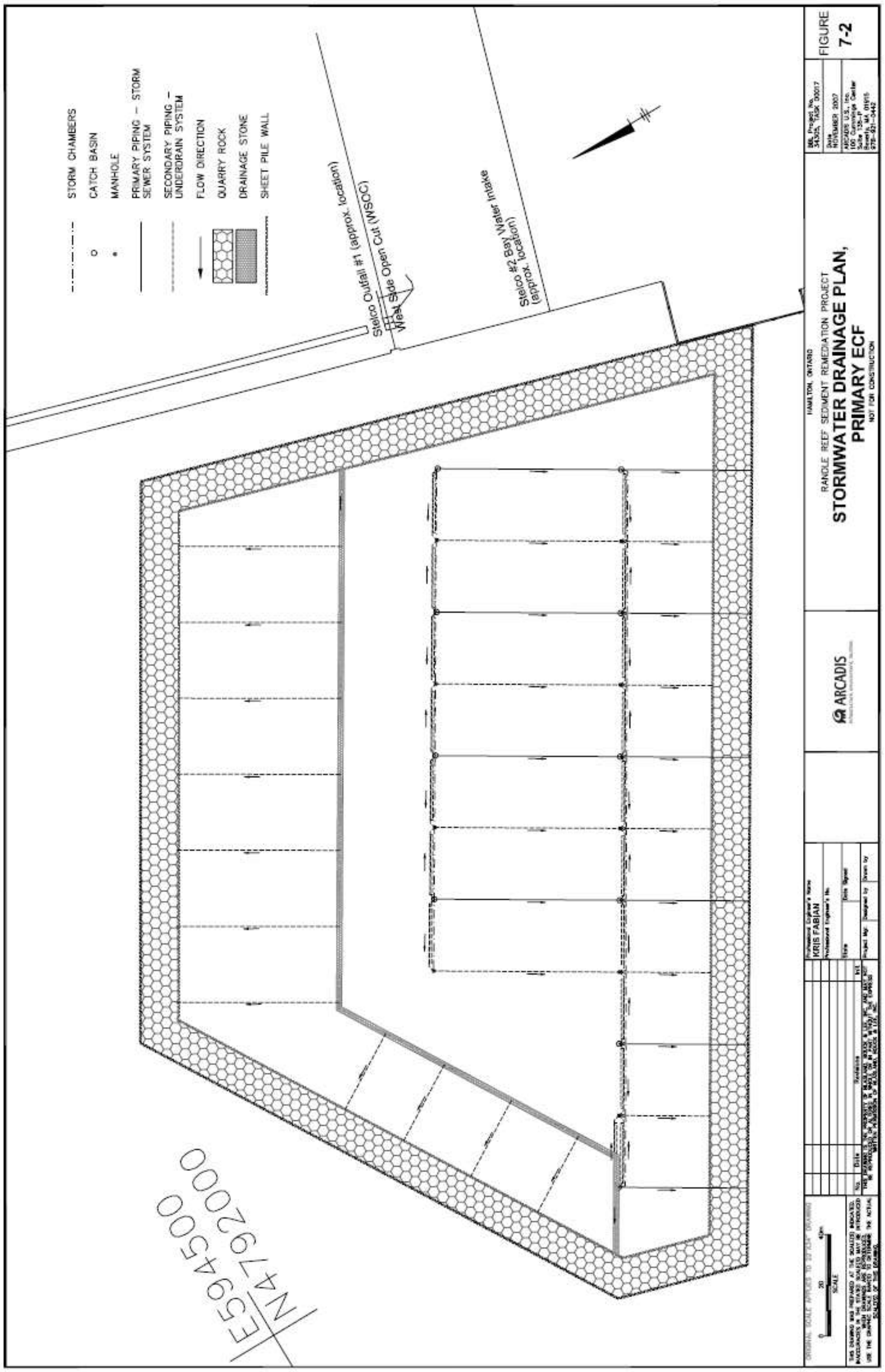


Figure 8.7: ECF Stormwater Drainage Plan



8.4 Operation Phase

Marine Terminal

The detailed end use of the marine terminal is still to be determined beyond its use as an area for loading/unloading vessel cargo. To accommodate possible future uses, the proposed marine terminal portion of the ECF will meet the following minimum specifications:

- Steel sheet pile wall able to accommodate vessel design draft;
- Water services (domestic and fire);
- Sanitary sewer;
- Storm sewer;
- Electrical supply;
- Gas;
- Telephone;
- Lighting along roadway and dock lighting as required;
- Provision for a future 250mm diameter pipeline (liquid product) to site;
- Meet specified dock load limits (50 kPa within 12.2 m of the marine terminal face and 100 kPa beyond 12.2 m);
- Buildings (minimum 7,000 m2 warehouse with office, suitable foundation and 3-4 domes);
- Dock surface (asphalt or concrete throughout);
- Minimum 10 m wide roadway to site;
- One rail siding onto site from HPA's main Pier 15 rail siding; and
- Landscaping to include treatments along access road and entrance features to site.

Figure 8.8: Landscape – Landform Concept

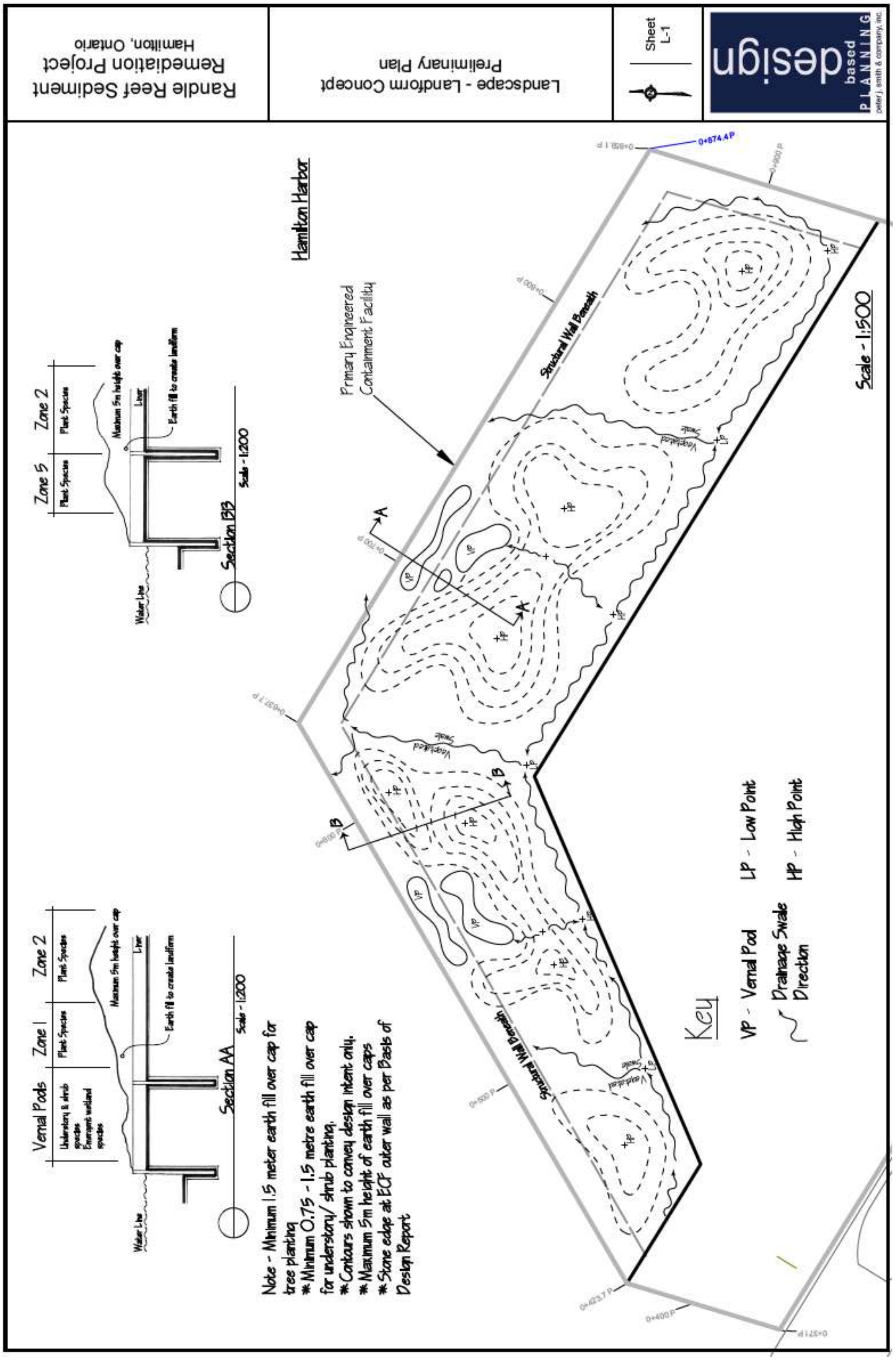
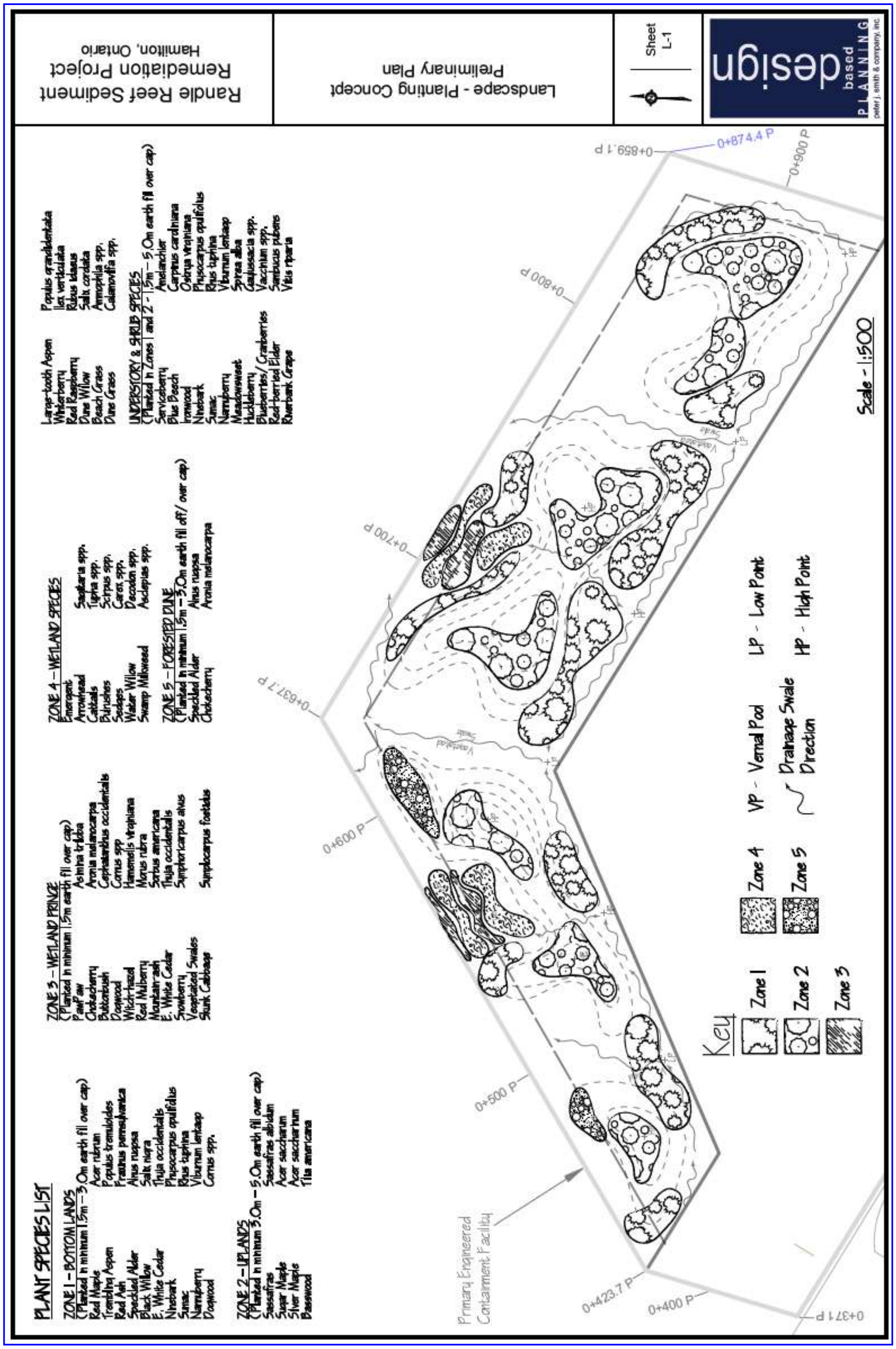


Figure 8.9: Landscape Planting Concept



Greenway or Light Industrial Area

The greenway / light industrial area will not be used for marine terminal operations but may be used for light industrial activities. Equipment within this area will be limited to its design load. For safety, foot traffic will be limited to authorized personnel, and guard rails will be placed along the bayside perimeter at the edge of the vegetative cover to prevent foot traffic onto the riprap.

U.S. Steel I/O Channel

In order to protect the U.S. Steel I/O cap from erosion, as well as further limit potential impacts to water quality by reducing the potential for turbidity associated with vessel traffic and cap erosion, navigation in the channel will be limited as follows:

- only vessels required to maintain the U.S. Steel dock wall, U.S. Steel I/O structures, sediment cap and the ECF will be allowed to enter the channel;
- the channel will be maintained as a low-speed, no-wake zone;
- downward direction of propellers and/or thrusters will be prohibited;
- no spudding or bottom anchoring of vessels will be allowed;
- vessels will be required to fender and tie off to the U.S. Steel dock wall or ECF, depending on their purpose for entering the channel; and
- "no entrance" markers/buoys will be maintained at the entrance to the channel.

8.4.1 Use of the Marine Terminal

HPA has a mandate to develop and maintain the Port of Hamilton for shipping and navigation purposes. It invests in the development of facilities and vessel berths to facilitate cargo movement. The HPA and its tenants need to respond to the dynamic nature of the shipping market, and as a result, port properties are often used for handling/shipping various commodities in the course of any given year. Typical cargo handled on HPA properties includes liquid and dry bulk, various forms of steel (slabs, billets, rod, beams, plate, channels etc.), and project cargo (wind turbine parts, specialty plant equipment, etc.). Future operation of the HPA facility will be guided by the HPA Land Use Plan (2002) and is expected to be compatible with and typical of port operations in Hamilton Harbour. Upon completion of the ECF construction, HPA will operate the ECF as a marine terminal.

The development of the ECF is divided into two areas: (1) 5 ha marine terminal; and (2) 2.5 ha green space or light industrial space. The 5 ha marine terminal portion is intended for one or more of the following potential uses (stand-alone or in combination):

- open storage area for various marine terminal cargo;
- container terminal;
- staging area for railcars, trucks;
- berthing for marine equipment and vessels (tugs, barges, ships, ferries, etc.);

- loading/unloading of marine cargo; and/or
- other uses consistent with the above as may arise from time to time, consistent with the HPA Land Use Plan.

The 2.5 ha, area if used as a green space or light industrial activities, would be limited to activities within the design loading limits. More information on the maintenance and use of this area is provided in Section 8.4.

8.5 Maintenance and Repair

As the facility will be designed for a 200 year lifespan, a maintenance and repair program will be developed and is essential to maintaining the effectiveness of the ECF. An aggressive pavement maintenance and repair schedule, including repairing defects when they occur, will be required to keep the facility pavement from degrading beyond initial surface deflections and from undergoing excessive damage.

8.6 Project Schedule

The construction schedule is estimated to be approximately eight years, from 2014 to 2021. The operational phase will continue indefinitely and it is not anticipated that the facility will be decommissioned.

Table 8.1: Project Schedule

Activity	2014	2015	2016	2017	2018	2019	2020	2021	2022	2022 and Beyond
Construction Phase										
Monitoring	■	■	■	■	■	■	■	■	■	
ECF Containment Walls	■	■	■							
In-Water Production Dredging			■	■	■					
U.S. Steel Sediment Cap					■					
ECF Capping						■	■	■		
Post Project Evaluation									■	
Operation Phase										
Long-Term Monitoring										■
Maintenance and Repair										■
Decommissioning Phase										
None Anticipated										

8.7 Project Cost

The approximate total cost of the project is estimated to be $138.9 million. Table 8.2 provides a breakdown of the estimated cost.

Table 8.2: Project Cost

	APPROXIMATE COST
ECF Containment Structure	$53.5 M
Dredging & Sediment Management	$36.4 M
ECF Capping & Long Term Monitoring	$49 M
APPROXIMATE TOTAL COST	**$138.9 M**

9.0 ENVIRONMENTAL EFFECTS ASSESSMENT

9.1 Introduction

The purpose of this section is to describe the proposed project (with a focus on its environmental interactions), identify its potential environmental effects, identify and propose measures to mitigate these effects and predict the likely significance of the residual environmental effects. An environmental assessment (EA) is a complete process. It begins at the earliest stages of planning and remains in force throughout the life of a project, moving through the following series of stages:

- describing the project and establishing environmental baseline conditions;
- identifying the issues and establishing the spatial and temporal boundaries of the assessment;
- assessing the potential environmental effects of the project, including residual and cumulative effects;
- identifying potential mitigation measures to eliminate or minimize potential adverse effects; and
- conducting environmental effects monitoring and follow-up programs, where required.

The analysis considers all phases of the project including construction, operations, and malfunctions and accidents. Although the specifics of the long-term use of the proposed marine terminal have not been determined, the conceptual and potential future use of the containment structure as a marine terminal have been broadly accounted for by certain requirements within the engineering design, for example, loading requirements for the marine terminal, length of the south wall for navigation, etc.

The assessment of the potential environmental effects associated with the Engineered Containment Facility (ECF) was undertaken at a greater level of detail than that for the marine terminal due to the availability of detailed engineering design drawings and specifications for the ECF. Since the specific end uses of the ECF as a marine terminal are not certain at this time the assessment of the potential effects associated with the marine terminal development and operations was undertaken at a more conceptual level of detail. As a result, the assessment of the potential environmental effects associated with the ECF is documented separately from the potential environmental effects associated with the marine terminal. Sections 9.2 and 9.3 document the environmental assessment of the ECF construction and operation and the marine terminal effects assessment, respectively.

The following sections outline the relevant environmental issues associated with the project, the potential effects and the recommended mitigation required to minimize these effects.

Given the long term duration of the project, it is possible that upcoming innovations and technology may be developed which would increase the efficiency or effectiveness of the project implementation. If in the future, opportunities or circumstances arise that would optimize or otherwise change the implementation of the project, standard engineering design changes could be incorporated, or revised operational practices and best management practices could be utilized to address new or better means for implementation. This will allow for implementation of the up to date project activities and any associated mitigation measures which are required to meet the intent, scope and requirements of this CSR. The environmental assessment implications of these potential future innovations and technologies would be assessed at that time.

9.2 Environmental Assessment of ECF Construction and Operation

9.2.1 Environmental Assessment Scope and Methodology

The approach used in this report for the ECF construction and operation phase of the project has evolved from methods proposed by Beanlands and Duinker (1983), who stress the importance of focusing the assessment on environmental components of greatest concern to society or as indicators of environmental health. In general, the methodology is designed to produce a CSR that:

- focuses on issues of greatest concern;
- addresses regulatory requirements;
- addresses issues raised by Aboriginals, the public and other stakeholders;
- integrates engineering design, mitigation and monitoring programs into a comprehensive environmental management planning process; and
- integrates cumulative effects assessment into the overall assessment of residual environmental effects.

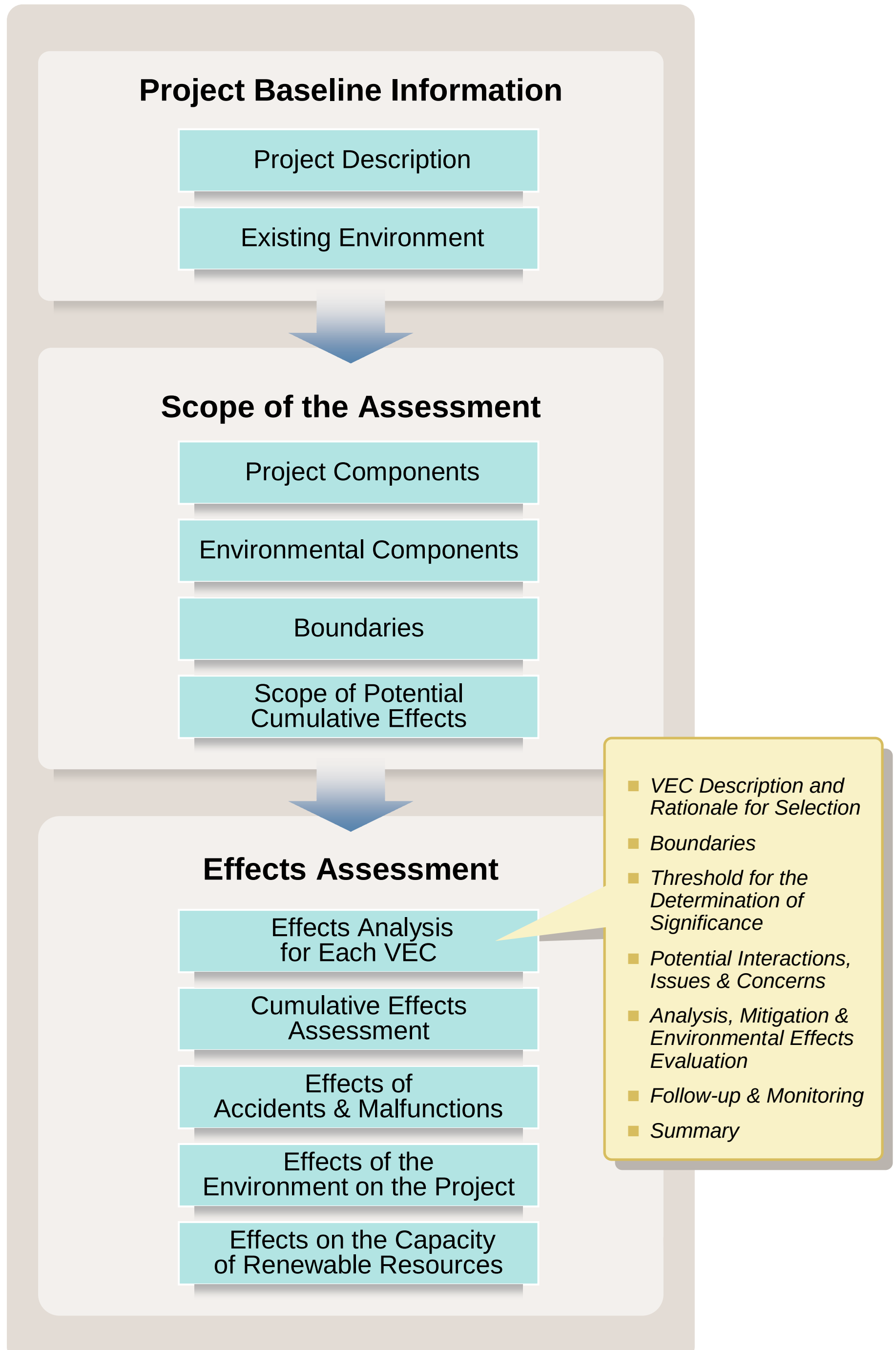
The environmental assessment methodology for the ECF includes an evaluation of the potential effects, including cumulative and residual effects, of each aspect of the ECF (construction, operation, modification) as well as the effects of potential malfunctions and accidents, with regard to valued environmental components (VECs), including valued ecological and socio-economic components. Project-related effects are assessed within the context of boundaries established for the assessment.

Cumulative effects are also assessed. This assessment evaluates the incremental effects of an activity on the environment when the effects are combined with those from other past, existing and future projects which will interact temporally and/or spatially with the proposed project. In addition, effects of the environment on the project are also considered.

The CSR process is illustrated in Figure 9.1 and includes the following steps:

- assembling project baseline information, including a clear description of the proposed project (see Section 8.0) and existing environmental information (see Section 4.0);
- establishing the scope of the project and factors to consider in the environmental assessment (Section 3.0); and
- assessing the potential environmental effects of the ECF including residual and cumulative effects and potential effects of the environment on the project (see Section 9.6).

Figure 9.1: Comprehensive Study Report Process



9.2.1.1 *Valued Environmental Components*

Valued ecological and socio-economic components (VECs and VSCs) are those biophysical and socio-economic features that are valued by society and/or can serve as indicators of environmental change. In accordance with the Beanlands and Duinker (1983) methods, a preliminary set of VECs and VSCs were identified for the ECF, based on issues that had been highlighted through the public consultation process, and regulatory review (Table 9.1). These preliminary components were based on the environmental factors identified in Section 3.4. Potential interactions between the project components and activities and the VECs and VSCs were evaluated using a pathway analysis methodology (see Table 9.1). Pathways for construction, operation, and modification activities and potential accidental events for each of the project components were examined. Table 9.1 summarizes the rationale for exclusion or inclusion of each of the VECs or VSCs in the assessment. Where no project / environment interaction or impact pathway was identified, the issue was deemed to be not relevant to the assessment and eliminated from further consideration. Where potential interactions or pathways between the VECs or VSCs and the project activities were identified, the assessment focused on these and they became the VECs or VSCs on which the assessment is based.

Table 9.1: Issues Scoping/Pathway Analysis Summary Matrix – Valued Environmental Components

Environment/ Resource	Preliminary VECs/ VSCs	Possible Pathways/Project-Environment Interactions	Pathway of Concern/ potential effect on resource		VEC/VSC		Key Rationale for Inclusion/Exclusion as VEC/VSC
			Yes	No	Yes	No	
Atmospheric Environment	Air Quality	• Local and downwind airborne emissions (e.g., dust, exhaust fumes, vapours, odours) during construction phase	X		X		Included: • Protected by statute/regulation • Public concern
	Ambient Noise	• Noise due to construction	X		X		Included: • Public concern
Geology, Soils, Groundwater Resources	Groundwater Quality and Movement	• Groundwater quality - release of additional contaminants into groundwater during construction phase • Change of groundwater flow direction and quantity		X		X	Excluded • No project interaction with resource
	Soil quality	• Contamination of soils and / or exposure of potential contaminants during construction of project elements	X		X		Included: • Potential project-related effects • Identified as concern during project scoping
Surface Water	Surface Water Quality, Currents and Circulation	• Sediment transport (quantity) • Potential changes to wave and current regime • Increased contaminant loading in site runoff during construction phase • Accidental spill of hazardous material during construction phase	X		X		Included: • Protected by statute/regulation • Identified during project scoping • Public concern

Environment/ Resource	Preliminary VECs/ VSCs	Possible Pathways/Project-Environment Interactions	Pathway of Concern/ potential effect on resource		VEC/VSC		Key Rationale for Inclusion/Exclusion as VEC/VSC
			Yes	No	Yes	No	
	Sediment Quality	• Increased contaminant loading in sediments during construction phase		X		X	Excluded: • Contaminated sediment is being removed from aquatic environment • Verification sampling to be conducted during construction
Biota	Terrestrial	• No project interactions with terrestrial biota		X		X	Excluded • No project interaction with resource. Landscaped areas may attract nuisance birds which in this context are not a VEC. The Randle Reef Technical Task Group worked with the Canadian Wildlife Service to ensure the landscape design will discourage/ mitigate the potential for attracting nuisance bird species. Common nuisance bird management techniques, if needed, will be conducted in accordance with the Migratory Bird Regulations.
	Aquatic	Potential effects from: • Sediment transport and re-suspension of contaminated sediments • Harmful alteration, disruption	X	altera tion	X		Included: • Potential project-related effects • Protected by statute/legislation • Identified as concern during project Scoping

Environment/ Resource	Preliminary VECs/ VSCs	Possible Pathways/Project-Environment Interactions	Pathway of Concern/ potential effect on resource		VEC/VSC		Key Rationale for Inclusion/Exclusion as VEC/VSC
			Yes	No	Yes	No	
		or destruction of fish habitat (physical change) • Accidental spill of hazardous material during construction phase • Aquatic birds landing and attempting to feed in the partially filled ECF during down time					
	Species at Risk	Potential effects to aquatic SAR from: Noise, disturbance during construction phase • Direct impacts to SAR specimens	X		X		Included: • Potential project-related effects • Protected by statute/legislation • Identified as concern during Project Scoping
Terrestrial Environment (incl. Wetlands)	Vegetation	• none		X		X	Excluded ▪ No project interaction with resource
	Wetlands	• Potential indirect disturbance of wetland habitat in Sherman Inlet through Project activities that may impact the hydraulic connection between the Inlet and the Harbour		X		X	Excluded ▪ No project interaction with hydraulic or ecological function ▪ Interactions affecting the socio-economic value of upstream Sherman Inlet are addressed (see Sherman Inlet)
Community and Land Use	Residential Areas	• Effects on existing and planned land use • Changes in actual land use and land use designations	X		X		Included as a VSC: • Potential project-related effects • Protected by statute/legislation • Identified as concern during

Environment/ Resource	Preliminary VECs/ VSCs	Possible Pathways/Project-Environment Interactions	Pathway of Concern/ potential effect on resource		VEC/VSC		Key Rationale for Inclusion/Exclusion as VEC/VSC
			Yes	No	Yes	No	
		• Construction effects					project Scoping
	Industrial, Commercial and Municipal Use and Infrastructure	• Effects on existing and planned land use • Changes in actual land use and land use designations • Construction effects	X		X		Included as a VSC: • Potential project-related effects • Protected by statute/legislation • Identified as concern during Project Scoping
	Use of Lands and Resources for Traditional Purposes by Aboriginal Persons	• Potential interaction with traditional land and resource use	X			X	Excluded as a VSC: • Communication with four First Nations indicated that there was no likely interaction with the project. • Final verification will occur after the Agency-led public review
	Sherman Inlet	• Project use of adjacent areas	X		X		Included as a VSC: • Protected by statute/legislation • Public concern
	Archaeology and Heritage Resources	• Potential disturbance of archaeological resources during dredging activities	X			X	Excluded as a VSC: • As per information provided by City of Hamilton and Ministry of Culture, no resources exist in this area
Human Health	Worker Health and Safety	• Potential for emission exposure to workers	X			X	Excluded as a VSC: • Contractor will have a Project Health and Safety Plan to include measures to protect workers (eg., PPE) • Covered under Occupational

Environment/ Resource	Preliminary VECs/ VSCs	Possible Pathways/Project-Environment Interactions	Pathway of Concern/ potential effect on resource		VEC/VSC		Key Rationale for Inclusion/Exclusion as VEC/VSC
			Yes	No	Yes	No	
							Health and Safety regulation
	Public Health and Safety	• Introduction of an element of unsafe conditions due to project activities	X		X		Included as a VSC: • Protected by statute/regulation • Public concern
Recreation and Aesthetics	Recreational Uses of the Harbour	• Potential effects on current and future recreational uses of Harbour during and post construction activities	X		X		Included as a VSC: • Protected by statute/regulation • Public concern
	Aesthetics	• Potential change of existing shoreline may effect existing aesthetics	X			X	Excluded as a VSC: • Sustainable design features such as the naturalization of the north and west sides of the ECF will create a positive effect on aesthetics
Marine Transport	Shipping and Navigation	• Change in configuration of the Harbour. • Potential impact on shipping and navigation from dredging activities and ECF footprint	X		X		Included as a VSC: • Protected by statute/regulation

Notes: VECs/VSCs are based on the environmental factors noted in Section 3.4.1.

Definition of Boundaries

Boundaries provide a meaningful and manageable focus for an environmental assessment and include:

- **ECF phase boundaries** define the extent of the ECF phase, both spatially and temporally. The spatial ECF boundaries are determined based on the maximum zones of influence predicted for the proposed ECF activities and related emissions and discharges, including potential accidents or malfunctions. The spatial ECF boundaries (i.e., ECF "footprints", emissions and discharges and other zones of influence) are described in Section 8.0. Temporal ECF boundaries encompass those periods during which the VECs and VSCs are likely to interact with, or be influenced by, the ECF (see Section 8.0 for a description of the ECF).

- **Ecological boundaries** are determined by the spatial and temporal distributions of the biophysical VECs under consideration. Spatial ecological boundaries may be limited to the immediate project areas, or may extend well beyond the immediate footprints as the distribution and/or movement of an environmental component can be local, regional, national or international in extent. Such factors as population characteristics and migration patterns are important considerations in determining ecological boundaries, and may influence the extent and distribution of an environmental effect. Temporal ecological boundaries consider the relevant characteristics of environmental components or populations, including the natural variation of a population or ecological component, response and recovery times to effects and any sensitive or critical periods of a species' life cycle (e.g., spawning, migration), where applicable. Spatial and temporal ecological boundaries for this assessment are described for each biophysical VEC (see Section 9.2.2 and 9.3.2).

- **Socio-economic boundaries** are determined by the nature of the VSCs under consideration (e.g., the spatial distribution of recreational activity). Temporal socio-economic boundaries also include consideration of natural variation in socio-economic components or systems, response and recovery times, and any particularly important periods (e.g., recreation seasons). Socio-economic spatial and temporal boundaries for this assessment are described for each VSC (see Section 9.2.3 and 9.3.3).

- **Administrative boundaries** are the spatial and temporal dimensions imposed on the environmental assessment for political, socio-cultural or economic reasons. Spatial administrative boundaries can include such elements as property ownership and the way in which natural and/or socio-economic systems are managed. Temporal administrative boundaries may include, for example, fishing seasons regulated by the Ontario Ministry of Natural Resources. Administrative boundaries also include those regulatory requirements that influence the ECF and its implementation. Administrative boundaries are described for each VEC and VSC.

- **Technical boundaries** represent any technical limitations on the ability to assess, evaluate and/or monitor potential environmental effects. For example, insufficient data or data gaps on the abundance, status, and distribution of a fish or wildlife population may limit the ability to predict the potential effects of a proposed development on it. Where such limitations exist, it is important that they be recognized and acknowledged. Technical boundaries for this assessment are described for each VEC and VSC.

Scope of Potential Cumulative Effects

Subsection 16(1)(a) of Canadian *Environmental Assessment Act (CEAA)* requires that every review of a project include an assessment of the "cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out." This assessment considers the regional context for each VEC and VSC to identify potential cumulative effects with other projects and activities in accordance with the Cumulative Effects Assessment Practitioners Guide (CEA Agency 1999).

In order for a VEC/VSC to be considered in the cumulative effects assessment the following must be present:

- there is a measurable environmental effect of the project being proposed;
- the residual environmental effects are demonstrated to interact cumulatively with the environmental effects from other projects or activities (i.e., temporal or spatial overlap); and
- there is sufficient confidence that the other projects or activities have or will likely occur or be carried out and are not hypothetical.

For the purposes of the assessment, it was assumed that the existing status or condition of each VEC incorporated the influence of other past and current projects and activities occurring within or adjacent to the project area. Furthermore, it was also assumed that these existing activities would continue to be carried out in the future and would have similar effects as are currently observed. The cumulative effects assessment focused on the effects of other future projects and activities, as considered and assessed for each VEC/VSC. The cumulative effects assessment, including details on the approach followed have been documented in Section 9.5.

Determination of Significance

Section 16(1)(b) of CEAA requires that the significance of environmental effects be determined. Accepted practice in meeting this requirement involves establishing and applying thresholds for determining the significance of potential adverse effects. Potential thresholds to determine significance were established based on information obtained in issues scoping, available information on the status and characteristics of each VEC, and involved the application of environmental standards, guidelines or objectives, where these are available (e.g., applicable ambient air quality guidelines). Consideration of the carrying capacity, tolerance level or assimilative capacity of the area or VEC is helpful, when it is possible to quantify these characteristics. For each VEC/VSC, thresholds are provided to determine the significance of adverse effects. A decision of significance for each VEC/VSC is made after taking into account the factors in the sections below, that is, after the application of mitigation measures, and in consideration of the following thresholds used to determine significance: magnitude, geographic extent, duration/frequency, reversibility, ecological and socioeconomic context.

Potential Interactions, Issues and Concerns

Potential ECF interactions with VECs/VSCs are described in the effects assessment through a description of the degree to which they are exposed to each ECF activity. Where appropriate, the assessment will include a summary of major concerns regarding the effect of each ECF phase activity on the VECs/VSCs being considered. Existing knowledge in the literature are referred to where possible. Where existing knowledge indicates that an interaction is not likely to result in an effect, certain issues may not warrant further analysis.

Of importance in identifying the potential issues and concerns is input from existing sources of information, including risk assessments, emissions modeling and fate and transport modeling.

Environmental Effects and Mitigation

For each VEC/VSC, the potential interactions are investigated and evaluated based on current scientific knowledge with regard to each interaction. Effects are analyzed using existing knowledge, professional judgment and appropriate qualitative and quantitative analytical tools.

Where applicable, mitigation measures are identified and the significance of the predicted residual environmental effects of the ECF evaluated using thresholds for potential effects specified for each VEC/VSC. The significance evaluation of residual effects for each VEC/VSC is based on thresholds recommended by the CEA (Canadian Environmental Assessment) Agency (1994, 1997), including:

- **Magnitude** – the nature and degree of the predicted environmental effect. The rating depends on the nature of the VEC/VSC and the potential effect.

  For biophysical/ecological VECs the rating system is as follows:

  - *Low* - Affects a specific group or important habitat for one generation or less within natural variation;
  - *Medium* - Affects a portion of a population or critical habitat for one or two generations; temporarily outside the range of natural variability;
  - *High* - Affects a whole stock, population or critical habitat (may be due to the loss of an individual(s) in the case of a species at risk) outside the range of natural variability.

For VSCs the magnitude of potential effect is defined as:

- o *Low* - Does not have a measurable effect on valued socio-economic components;
- o *Medium* - Has an evident measurable but minor effect on socio-economic components;
- o *High* - Has an evident measurable adverse effect on socio-economic components.

- **Geographic extent** – the area over which the particular effect will occur.
- **Frequency** – how often the effect will occur.
- **Duration** – how long the disturbance will occur (i.e., short, medium or long term). The definition of the duration may vary for each VEC/VSC and relates to life cycles processes such as growing seasons, migration or spawning seasons.
- **Reversibility** – the ability of a VEC/VSC to return to an equal or improved condition once the disturbance has ended (for example, reclaiming habitat area equal or superior to that lost). Predicted effects are rated as reversible or irreversible, based on previous research and experience.

Mitigation measures and the need for follow-up and monitoring will be integrated into the analysis of environmental effects, where relevant. Mitigation is defined as the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means. Mitigation measures are consistent with the requirements of all relevant legislation, regulations, guidelines, policies, management plans, specifications, and best management practices. Mitigation measures are identified in a hierarchical manner, with impact avoidance measures identified first, reduction measures second and compensation last.

Significant environmental effects are those adverse effects that will cause a change in the VEC/VSC that will alter its status or integrity beyond an acceptable level. Environmental effects will be evaluated for each VEC/VSC as either significant or not significant, based on consideration of all of the above.

Follow-up and Monitoring

Section 16(2)(c) of CEAA requires consideration of the need for, and requirements of, any follow-up program. Follow-up programs provide essential feedback, in particular with respect to:

- the accuracy of predicted project effects;
- unanticipated effects;
- the necessity and efficacy of project management strategies (e.g., mitigation measures); and
- strengthening the predictive capacity and accuracy in future EAs.

A follow-up program also allows environmental managers to adjust procedures to the situation and implement an adaptive management approach.

Monitoring programs are generally undertaken to verify regulatory or corporate compliance, meet permit or compensation requirements and fulfill commitments to third parties such as non-regulatory stakeholders.

Monitoring and follow-up requirements are evaluated for each VEC and VSC. The likelihood and importance of environmental effects, as well as the level of confidence associated with the adverse residual effects rating, are also taken into consideration.

Residual Environmental Effects Analysis

Adverse residual environmental effects on each VEC and VSC are summarized. This section also addresses the likelihood of predicted potential adverse residual effects for each VEC and VSC.

9.2.2 Biophysical Effects Assessment

9.2.2.1 *Air Quality*

The ECF may result in the discharge of several gaseous and particulate emissions into the atmospheric environment, which in turn may result in possible changes to ambient air quality. The potential effects of the ECF on air quality are assessed in this section.

The air quality assessment includes the following: Hazardous Air Pollutants (HAPs), criteria air contaminants (CACs), greenhouse gases (GHGs) and odour.

VEC Description and Rationale for Selection

Air quality has been selected as a VEC because of its intrinsic importance to the health and well-being of humans, wildlife and vegetation. Emissions to the atmosphere (e.g., particulate matter (PM), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), GHGs, odour, etc.) have the potential to adversely affect human health and other ecosystem elements. Air can be a key pathway for the transport of contaminants to the freshwater, terrestrial and human environments. Several epidemiological studies published over the last few decades have demonstrated the link between poor air quality and negative human health outcomes.

GHGs are also considered in the air quality assessment for the ECF. GHGs are gases that essentially trap the heat of the sun within the earth's atmosphere, which causes the Earth's temperature to rise. GHG emissions are included in the assessment because of their intrinsic importance to climate change as a regional and international issue.

The following boundaries were used to assess potential effects of air emissions from the ECF. Boundaries were divided into four different types: spatial, temporal, administrative, and technical. The effects of the ECF phase on air quality are investigated within these defined boundaries.

Spatial Boundaries

The project area is bounded by Hamilton Harbour to the north, the U.S. Steel property and Ottawa Street to the east, Burlington Street/Industrial Drive to the south and Pier 11 to the west.

The local study area (LSA) for the assessment is the zone of influence of the ECF air emissions, including the sensitive receptors nearest to the remediation site. The spatial extent used for the air quality assessment will be to the point where potential effects of the ECF's routine air emissions fall to near baseline levels. As such, the LSA is a 5 km by 5 km area surrounding the project site, which includes the commercial properties and nearest residential communities.

Temporal Boundaries

Temporal boundaries for the assessment of air quality have been developed in consideration of those time periods during which ECF air emissions have the potential to affect ambient air quality. These include periods of construction and operation. Other considerations for atmospheric emissions include variations in meteorological conditions, which alter conditions for contaminant transport.

It is expected that the majority of the air emissions will occur during the construction . The construction activities for the ECF are expected to have a duration of ten years, starting in 2012. During this time period, emissions from the construction activities are expected to occur up to 20 hours a day, 7 days per week.

The operational phase will occur over the 200 year design life of the facility. Specific future uses of the marine terminal are still unknown at this time and will be established by the future tenant.

Administrative Boundaries

The evaluation of potential ECF effects on air quality typically relies on regulatory standards or objectives with respect to atmospheric concentrations. Although, the Ontario government has the primary responsibility for various aspects of air pollution control, the federal government's objectives for air quality are also commonly integrated into air quality assessments, and are taken into account by federal agencies in a project review.

Air emissions in Ontario are regulated under the provincial Environmental Protection Act (EPA). The EPA provides for a general prohibition against emitting a contaminant into the environment that causes an adverse effect. Ontario Regulation 419/05, Air Pollution-Local Air Quality Regulation, came into effect on November 30, 2005. It was most recently amended on August 31,

2007. The new regulation prescribes requirements for industrial and commercial sources of air pollution to assess, report to the Ontario Ministry of the Environment (MOE), and manage emissions.

Ontario has developed one of the most complete lists of ambient air quality criteria (AAQC) among the Canadian provinces and territories. These criteria are effect-based levels in air, with variable averaging periods appropriate for the effect that they are intended to protect against. The effects considered may be based on health, odour, vegetation, soiling, visibility, corrosion or other effects. AAQC are levels used in environmental assessments, special studies using ambient air monitoring data, and the assessments of general air quality in a community, and for assessing the potential for causing adverse effects.

The Canadian Environmental Protection Act (CEPA) allows for the federal regulation and control of air emissions and concentrations. Two federal tools used to help control air quality pollutants are:

- National Ambient Air Quality Objectives (NAAQOs); and
- Canada-Wide Standards (CWS).

NAAQOs help guide the federal and Ontario governments in making decisions regarding air quality management. The NAAQOs are primarily effects-based but are also reflective of technological, economic and societal information. These objectives are national goals for outdoor air quality for the protection of public health, the environment and aesthetic properties of the environment.

The NAAQOs from the federal government are based on a three-tier structure and are defined as follows:

- the Maximum Desirable Level (MDL) is the long-term goal for air quality and provides a basis for an anti-degradation policy for unpolluted parts of the country and for the continuing development of pollution control technology;
- the Maximum Acceptable Level (MAL) is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well-being; and
- the Maximum Tolerable Level (MTL) denotes time-based concentrations of air contaminants beyond which, because of a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Under CEPA 1999, CWS are considered environmental quality objectives. Ontario has endorsed the CWS for PM and Ozone (O_3) through the Canadian Council of Ministers of the Environment (CCME).

There are no strict regulations with regard to the emission of GHGs in Canada or Ontario but both jurisdictions have set targets for the reduction of GHGs. The Kyoto Protocol is an international accord designed to help reduce the effects of climate change through the reduction of GHG emissions. Canada signed the Kyoto Protocol in 1998, which became legally binding in 2005. Under the terms of the Protocol, Canada is required to reduce emissions to a level of 6% below 1990 levels in the period 2008-2012 (Environment Canada 2008). In March 2008, Environment Canada issued the publication "Turning the Corner, Regulatory Framework for Industrial Greenhouse Gas Emissions". This publication further outlines Canada's initiatives in reducing GHGs. As outlined in the March 2008 publication, Canada's future GHG reduction targets are: 20% reduction from 2006 levels in 2020; and a 60% - 70% reduction by 2050.

Many provinces have also set their own standards for the reduction of GHGs. Ontario has set a target of reducing GHGs to 6% below 1990 levels by 2014, 15% below 1990 levels by 2020, and 80% below 1990 levels by 2050 (MOE: Go Green: Ontario's Action Plan on Climate Change, 2008).

Through the remainder of this report, limits or objectives for air quality will be termed as air criteria. Air criteria from the federal and Ontario governments were used for compounds for which a quantitative assessment was completed.

The applicable federal and provincial criteria relating to ambient air quality criteria are summarized in Table 9.2 for Criteria Air Contaminants and relevant Hazardous Air Pollutants. In the table below, both naphthalene and benzene are considered Hazardous Air Pollutants. Naphthalene is a PAH and benzene is a VOC.

Table 9.2: Federal and Provincial Ambient Air Quality Criteria for Relevant Criteria Air Contaminants and Hazardous Air Pollutants

Pollutant	Averaging Time Period	Ontario[a,b]			Canada			
		Point of Impingement (POI) Guideline	Ambient Air Quality Criteria	Schedule 2 Standards	Canada Wide Standards[c] (Pending)	Ambient Air Quality Objectives[d]		
						Maximum Desirable	Maximum Acceptable	Maximum Tolerable
NO_2 (µg/m³)	½ hour	-	-	500	-	-	-	-
	1 hour	-	400	-	-	-	400	1000
	24 hour	-	200	-	-	-	200	300
	Annual	-	-	-	-	60	100	-
SO_2 (µg/m³)	½ hour	-	-	830	-	-	-	-
	1 hour	-	690	-	-	450	900	-
	24 hour	-	275	-	-	150	300	800
	Annual	-	55	-	-	30	60	-
Total Suspended Particulates (µg/m³)	½ hour	-	-	100				
	24 hour	-	120	-	-	-	120	400
	Annual	-	60	-	-	60	70	-
PM_{10} (µg/m³)	24 hour	-	50	-	-	-	-	-
$PM_{2.5}$ (µg/m³)	24 hour	-	30	-	30	-	-	-
CO (mg/m³)	½ hour	6000	-	-	-	-	-	-
	1 hour	-	36.2	-	-	15	35	-
	8 hour	-	15.7	-	-	6	15	20
Naphthalene (µg/m³)	½ hour	36	-	-	-	-	-	-
	24 hour	-	22.5	-	-	-	-	-
Benzene	-	CARC[e]			-	-	-	-

Notes:
NO_2 –nitrogen oxide
SO_2 – sulphur dioxide
PM - particulate matter
CO - carbon monoxide

Sources:
[a] MOE (2005), Air Quality Objectives and Standards
[b]MOE (2008), Ontario's Ambient Air Quality Criteria
[c]CCME (2000)
[d] CEPA (1999)
[e] CARC In the ONMOE air quality objectives and standards, benzene is outlined as CARC. CARC means that the contaminant is a carcinogen with no assigned standard or guideline. As such, the emissions to the environment are to be limited to the greatest extent possible.

Technical Boundaries

The approach taken in this study is based on a quantitative assessment for potential effects to air quality based on sediment dredging and placement of the dredged material in the ECF. Furthermore, a qualitative assessment for diesel emissions from construction activities, particulate emissions was completed to determine potential ECF effects on air quality.

For the quantitative assessment, air dispersion modelling was used to assess the air quality effects due to the ECF activities. Air dispersion models are important tools that can be used to assess the likelihood of compliance with air quality criteria at a particular location. These dispersion models mathematically predict the behaviour of contaminant emissions by accounting for: emission rates; terrain effects; geometry and location of the sources; receptor locations and meteorology.

The American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee (AERMIC) was formed to introduce state-of-the-art modeling concepts into the EPA's air quality models. Through AERMIC, a modeling system, AERMOD, was introduced that incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain (EPA, 2008).

AERMOD also considers variable urban treatment as a function of city population, and can selectively model sources as rural or urban. Furthermore, air dispersion modelling in Ontario is regulated under Ontario Regulation 419/05: Air Pollution- Local Air Quality (Reg. 419) made under the provincial Environmental Protection Act (EPA). One of the approved dispersion models in Reg. 419 is AERMOD. As such, AERMOD was used as the preferred model.

As per the guidance provided on the MOE website for meteorological (MET) data and dispersion modelling, the MET data for the quantitative assessment was obtained from Environment Canada's meteorological stations that best represent the conditions for project, which are the surface monitoring station at London Airport and the upper air station at White Lake. This MET data is available by licensing agreement on the MOE website http://www.ene.gov.on.ca/envision/air/regulations/metdata/sws.htm)."

As per the "Air Dispersion Modelling Guideline for Ontario, July 2005" (ADMGO), the area within a 3 km radius of the site was examined using aerial photos. It was estimated that the surrounding land use was a mixture of urban and water for use of the meteorological data with AERMET. AERMET is a meteorological data program within the AERMOD suite.

The terrain data was obtained from the MOE website (http://www.ene.gov.on.ca/envision/air/regulations/demdata/dem.html) and the appropriate region was selected based on the UTM coordinates of the site.

Threshold for Determination of Adverse Effects

For the assessment of potential effects on air quality, a significant adverse effect is defined as follows:

- there are frequent or sustained exceedances of an applicable standard or objective;
- odour exposures are frequent and persistent at levels above the odour thresholds outlined by MOE;
- the duration of the adverse effect is long-term (greater than 15 years);
- the effect on air quality will persist during and/or after the ECF is complete; or
- the ecological or social context is substantially affected by air emissions from ECF activities.

A positive effect is one in which there are measurable reductions in the atmospheric contaminant loading as a result of project actions.

Potential Interactions, Issues and Concerns

The proposed project has the potential to affect the local air quality primarily through construction activities related to the proposed remediation works and undertakings. The construction activities involved in the ECF which have the potential to affect the local air quality and contribute to regional air pollution include:

- debris removal using equipment such as a clamshell bucket, barges, and trucks;
- earth moving activities with typical equipment such as dozers, compactors, smooth drum rollers, excavators, dump trucks, water trucks, graders and scrapers;
- ECF and turbidity structure construction and Pier 15 stabilization;
- dredging;
- backfilling and capping of the ECF; and
- sub-aqueous capping of the U.S. Steel channel.

The potential effects during the construction phase will be related to the airborne dust and diesel emissions generated by construction activities. Combustion emissions from vehicle and heavy equipment on the project site have the potential to affect existing GHG, CAC, and HAP levels during the construction phase. Construction activities may also emit airborne PM from road dust and storage piles.

Dredging activities may result in volatile emissions from contaminated sediment. The sources of sediment volatile emissions include the following: the dredging site during active hydraulic dredging operations; dredged material exposed directly to air during mechanical dredging

activities; dewatered dredged material in the ECF prior to capping; the ECF during active placement of dredged material; quiescent ponded material in the ECF; and the capped ECF.
The long-term operational phase of the remediated site has the potential to have some positive effects on the local air quality due to the provision of green space on a portion of the project site and the capping of contaminated sediment. The area is expected to have a net positive change in air quality due to the removal of contaminated water and capping of contaminated sediment.

Table 9.3 summarizes the ECF phase activities and potential issues.

Table 9.3: Summary of Issues, Interactions and Concerns

ECF Activity	Air Quality Parameter	Issue/Interaction/Concerns
• Construction: o Road Traffic o Debris Removal o Earth Moving Activities o Material handling associated with staging and storage areas o Dredging activities o Construction of ECF and Turbidity Structure o Stabilization of Pier 15 o ECF backfilling and capping	• GHGs • Odours • HAPs • CACs • Dust	• Increased diesel combustion emissions from construction equipment and truck traffic will result in GHG emissions • Dredging activities may result in volatilization of contaminants in sediment. This may affect odours and current ambient air concentrations of HAPs • Increased diesel combustion will result in emissions of CACs • Material handling activities, road traffic, earth moving activities and construction activities may result in dust emissions which affect nearby commercial and residential properties.
• Operation: o Reduced fugitive emissions of contaminated sediment and traffic-related dust	• GHGs • Odours • HAPs • Dust	• Increased green space will provide more GHG sinks and as a result will reduce GHG emissions • Emissions of odours and HAPs will be reduced due to the capping of contaminated sediment.

GHGs

GHGs are gases in the earth's atmosphere which prevent the loss of heat into space. While GHGs are essential in maintaining a stable temperature and occur naturally, increase of these gases in the earth's atmosphere largely due to human activity have caused serious concern for climate change trends, particularly over the past few years. Common GHGs include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide.

Project-related sources of GHGs primarily include vehicles, as well as construction equipment exhaust.

CACs

CACs include air quality parameters such as sulphur dioxide (SO_2), oxides of nitrogen (NO_x), carbon monoxide (CO) and PM. Sulphur dioxide (SO_2) is a colourless gas with a distinctive odour similar to that of burnt matches. NO_x are almost entirely made up of nitrogen oxide (NO) and nitrogen dioxide (NO_2).

The levels of NO and NO_2, and the ratio of the two gases, together with the presence of hydrocarbons and sunlight are the most important factors in the formation of ground-level O_3 and other oxidants. NO_x and SO_2 react with other substances in the air to form acidic precipitation. In addition, the largest human health concern associated with NO_x is effects on the respiratory system.

CO is a colourless, odourless, tasteless gas and is produced by the incomplete burning of fossil fuels.

PM is characterized according to size. PM is the general term used for a mixture of solid particles and liquid droplets in the air. The biggest human source of PM is combustion sources, mainly the burning of fuels for motor vehicles and power plants. The types of PM related to the ECF are dust fall, total suspended particulate, particulates less than 10 microns (PM_{10}) and particulates less than 2.5 microns ($PM_{2.5}$).

ECF -related CAC emissions will be released through the combustion of fuels, primarily during the construction phase. This includes emissions from vehicle traffic as well as construction equipment. CAC emissions also may be released during capping and dredging activities.

HAPs

HAPs are substances released into the air by industries, vehicle emissions, agricultural activities and other sources that may threaten human health. Some of these activities include burning waste, burning wood or coal for home heating and motor vehicles. Many organic HAPs are present as vapours, and are classified as VOCs and PAHs.

VOCs include a large group of chemicals containing carbon and hydrogen atoms that can react quickly to form other chemicals in the atmosphere. VOCs can react with oxides of nitrogen in the presence of sunlight to form O3 and photochemical smog and can also be toxic to humans, animals and vegetation.

PAHs are a group of over 100 different chemicals that occur in oil, coal and tar deposits. PAHs are one of the most widespread organic pollutants.

ECF phase-related HAPs emissions will be released from the combustion of fuels and volatilization of contaminated sediment primarily during construction. Sources will include emissions from vehicle traffic, construction equipment diesel emissions and dredging activities.

Analysis, Mitigation, and Environmental Effects Evaluation

Construction

Effects Analysis

The construction activities involved in the ECF phase of the Randle Reef Sediment Remediation Project, which have the potential to affect air quality and contribute to regional air pollution include:

- ECF and Turbidity Structure Construction, and Pier 15 stabilization;
- dredging and capping;
- backfilling and capping of the ECF; and
- sub-aqueous capping of the U.S. Steel channel.

These construction activities will require the use of a number of pieces of heavy construction equipment and vehicles including: pile drivers, dump trucks, concrete trucks, excavators, backhoes, front end loaders and miscellaneous smaller contractor equipment.

The large diesel powered equipment will generate combustion gases including: CO_2, CO, NO_x, N_2O, SO_2, VOCs, PAHs, and PM. The use of construction equipment and trucks will also generate airborne PM from road dust as they travel to and from, as well as on, the construction site. PM will also be generated from the delivery, movement and erosion of material stockpiles, which will be required for aggregate and sand requirements for the ECF.

Dredging operations during the construction of the ECF as well as during production dredging will require the use of large barge operated and or land-based mechanical and hydraulic dredging equipment. Dredging activities during construction (e.g., between the ECF walls) will include mechanical and hydraulic dredging. Production dredging activities will occur outside of the ECF and will only include hydraulic dredging. These large diesel powered units will generate combustion gasses, as well as airborne PM.

Furthermore, dredging activities may potentially release VOCs and PAHs from the disturbed contaminated sediments.

An air dispersion modelling assessment was conducted to determine the potential effects on air quality from the volatilization of contaminated sediment due to dredging operations and the placement of sediment into the ECF. Volatilization is the movement or gaseous emission from a liquid surface to the atmospheric environment.

The modelling assessment focused on assessing scenarios that would represent a maximum emissions scenario from volatilization sources during normal operating conditions. For the remediation activities, five volatilization sources were identified:

- the dredging area during hydraulic dredging operations;
- exposed sediment during mechanical dredging operations for the transport and placement of contaminated sediment in the ECF;
- the ECF during active placement of the dredged material;
- the quiescent, ponded ECF; and
- the dewatered capped ECF due to minor vapour migration through the cap.

It is expected that dredging operations will emit more volatile emissions than quiescent ponded conditions or the capped ECF. Therefore, to capture the effect of maximum emitting operation conditions, the following two scenarios were assessed:

1) mechanical dredging operations for 2 mechanical dredges operating simultaneously; and
2) production dredging operations for 2 hydraulic dredges operating simultaneously.

Mechanical dredging between the ECF walls is scheduled to occur before production dredging outside of the ECF. Currently, it is expected that mechanical dredging and production dredging will not occur simultaneously, therefore, the scenarios assessed do not account for this. In addition, both modelling scenarios assumed operations consist of two (2) ten-hour (10) shifts, seven (7) days a week throughout the year.

During the construction phase, mechanical dredging will remove the sediment in between the ECF walls before backfilling activities occur. The dredged material may be exposed to the air as the mechanical dredge bucket moves through the air and over the sheetpile wall for placement of contaminated sediment into the ECF. The exposure of the dredged material to the air may result in the volatilization of chemicals from the sediment. During mechanical dredging, the ECF itself may also be a volatilization source. This is because mechanical dredging causes increased suspended solids in the near-surface water and increased water turbulence as the mechanical dredge bucket breaks the surface of the water.

Hydraulic dredging will be used during production dredging. Volatilization may occur due to increased suspended solids in the water column and increased water turbulence. The volatile sediment emissions from hydraulic dredging will be lower than mechanical dredging. In hydraulic dredging, the increased suspended solids are limited to the water near the mudline (ARCADIS BBL, 2007).

A modelling exercise was previously completed for Hamilton Port Authority (HPA) by ARCADIS BBL. The modelling exercise was a screening analysis, which assessed the potential for volatilization from dredged material by calculating the maximum flux for PAHs and specified VOCs (benzene, toluene, ethylbenzene and xylene (BTEX)). Based on the maximum flux rates, naphthalene (a PAH) and benzene were screened as the parameters of concern for air dispersion modelling. These compounds are deemed to be reasonable indicators of overall air quality due to their high volatility potential. Emission rates for hydraulic dredging activities and ECF emissions rates previously developed by ARCADIS BBL were used in the modelling assessment. The calculation methodology outlined by ARCADIS BBL for mechanical dredging emission rates was used to predict emission rates from mechanical dredging activities. The emission rates of the identified substances of concern are given below in Table 9.4:

Table 9.4: Source Emission Rates

Parameter		**ECF**	**Production Dredge #1**	**Production Dredge #2**	**Mechanical Dredge #1**	**Mechanical Dredge #2**
Source Type		Area	Area	Area	Volume	Volume
Emission Rates (g/s)	Benzene	2.31E-5	2.12E-6	2.12E-6	1.55E-4	1.55E-4
	Naphthalene	3.17E-3	5.63E-4	5.63E-4	8.13E-3	8.13E-3

The ADMGO was used as a guide for this assessment. As per Section 6.6 in the ADMGO, the modelling results were screened to remove meteorological anomalies. Thus the highest eight (8) 1-hr concentration values and the highest one (1) 24-hr concentration values were removed from each year to determine compliance to the ambient air quality criteria. A conversion factor of 1.2 was used to convert AERMOD 1-hour results to 30-minute results for comparison to 30-minute Point of Impingement (POI) guidelines, outlined in Ontario Regulation 419. With respect to the discharge of air contaminants, Ontario's Reg. 419 defines a POI as any that is not located on the same property as the source of the contaminant. However, the regulation further defines POI as a point located on the same property as the source if that point is located on the following:

- a child care facility; or
- a structure, if the primary purpose of the structure is to serve as a
  - health care facility;
  - a senior citizen's residence or long-term care facility; or
  - and educational facility.

As previously stated, the area of modelling coverage focused on a 5 km by 5 km domain surrounding the project Site.

A tiered receptor grid with variable receptor spacing was used for the dispersion modelling assessment, as outlined in the ADMGO. All receptors situated on water were removed from the assessment. Furthermore, the site plan provided by HPA was used to input the dimensions and location of the project.

Isopleths depicting the maximum point of impingement (POI) location for naphthalene and benzene modelling results are shown in **Figure 9.2, Figure 9.3** and **Figure 9.4**. An isopleth is a contour line on a map representing points of equal value. In this context an isopleth represents points of equal air contaminant concentration on ground level. All areas inside the contour lines represent areas with equal or less air contaminant concentrations.

The maximum predicted ground-level concentrations for naphthalene and benzene for the proposed remediation project are presented in Table 9.5 below:

Table 9.5: Maximum Predicted Ground-Level Concentrations

Contaminant	**Averaging Period**	**Ambient Background Concentration ($\mu g/m^3$)[1]**	**Maximum Predicted Ground Level Concentration ($\mu g/m^3$)**		**Location of Maximum POI**	**Ambient Air Quality Criteria ($\mu g/m^3$)[2]**
			Before Ambient Background Added	After Ambient Background Added		
Naphthalene	½ hour	NA	332.45	NA	East of ECF, on Pier 15	36.5
	Daily	1.26	137.70	138.96	East of ECF, on Pier 15	22.5
Benzene	Daily	1.56	2.63	4.19	Southeast of ECF, on Pier 15	NA

Notes:
1. Ambient background concentration was determined to be an average of five years of data (2003 – 2007) obtained from the Hillyard air monitoring station
2. Air Quality Guidelines from Ontario Regulation 419/05 (MOE, 2005)

Figure 9.2: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

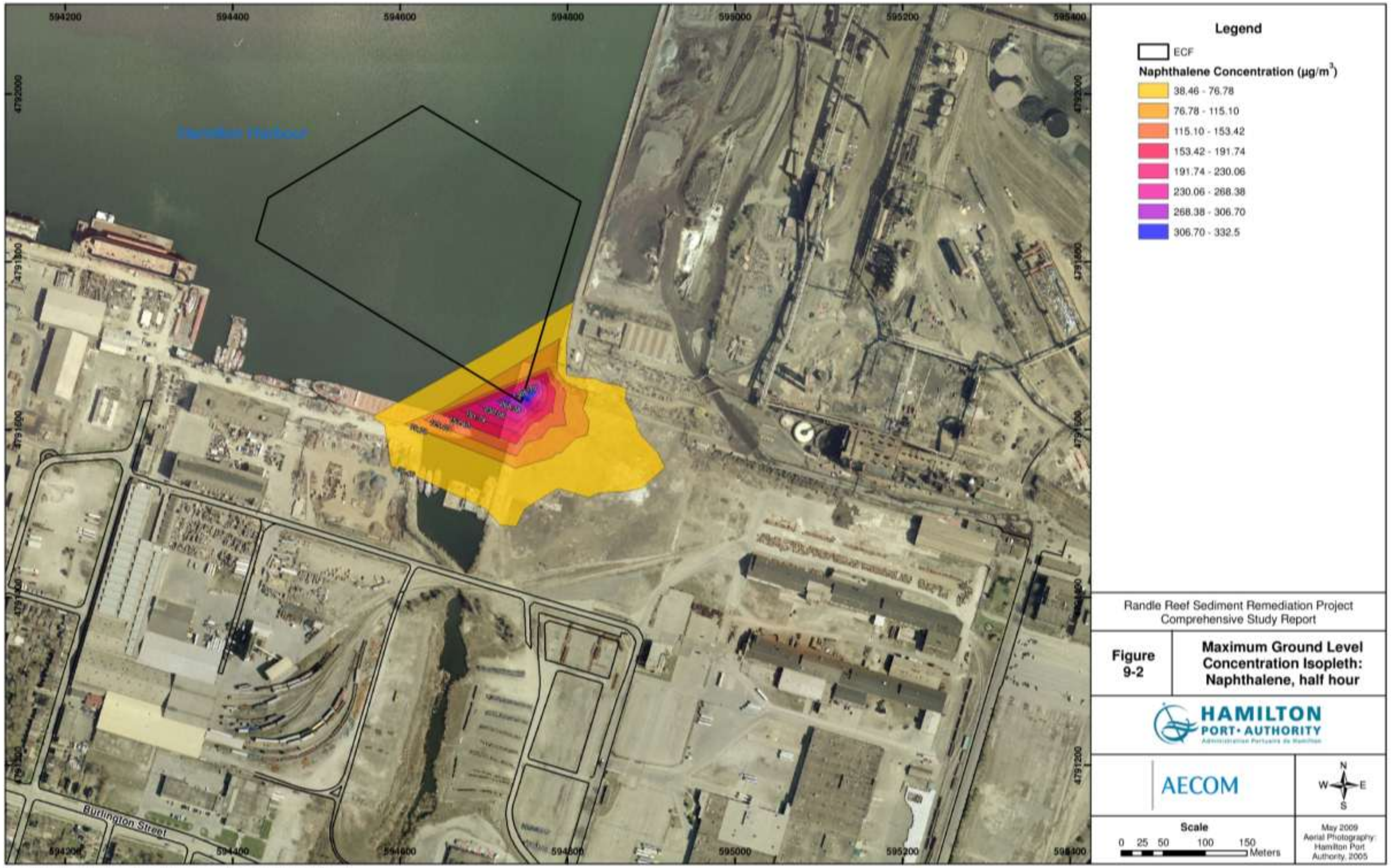


Figure 9.3: Maximum Point of Impingement (POI) Modelling Results (Naphthalene)

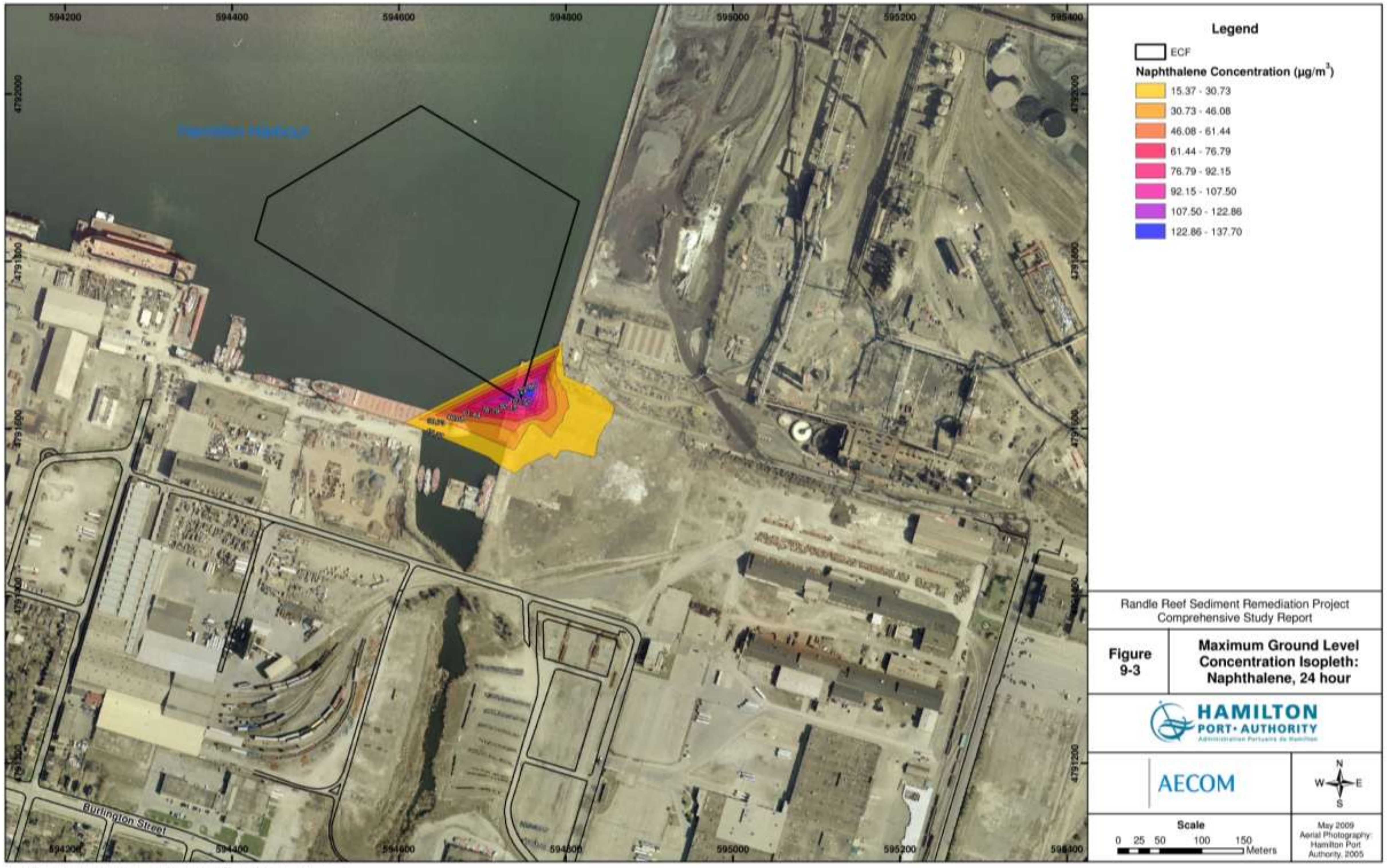
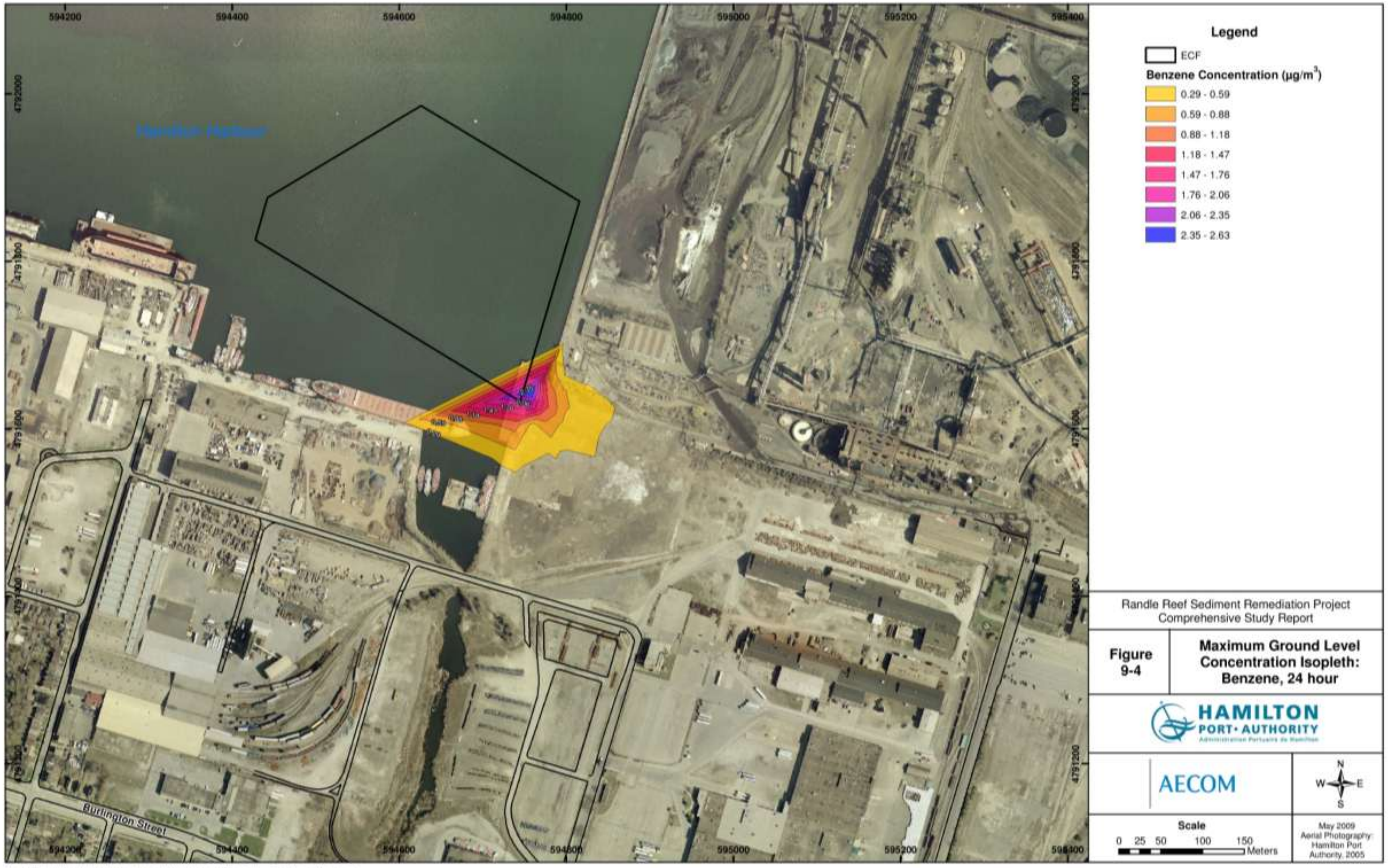


Figure 9.4: Maximum Point of Impingement (POI) Modelling Results (Benzene)



In the five years that air quality was modeled, the predicted naphthalene concentrations were higher than the ambient air quality criteria and POI. These values represent the worst half-hour and worst day predictions. The exceedances occur due to the location of mechanical dredging on the east side of the ECF, closest to land receptors on Pier 15 and U.S. Steel property.

Considering that mechanical dredging will only occur for 80 days, and approximately a quarter of those 80 days will require mechanical dredging on the east side of the ECF, the frequency of predicted exceedance for the 24-hour guideline is 2% over one year. In addition, the frequency of predicted exceedance for the ½-hour guideline is 0.8% over one year. Further evaluation indicates that there are no exceedances of naphthalene air quality criteria in the residential communities. The predicted maximum 24-hour average ground level concentration for naphthalene in the closest residential community is 0.60 $\mu g/m^3$. Therefore, the concentrations of naphthalene are considered to be not significant from an air quality perspective.

For benzene, the maximum daily ground level concentration is 2.63 $\mu g/m^3$. In the residential communities, the maximum 24-hour ground level concentration of benzene is predicted to be 0.02 $\mu g/m^3$. Although there are no ambient air quality criteria guidelines for benzene, the assessment shows that the maximum daily concentration in the residential community is lower than the current benzene air concentrations. As a result of the low magnitude of benzene emissions, these emissions are not considered to be significant to the effects on air quality.

Mitigation

Mitigation of the effect on air quality from the operation of heavy diesel vehicles and equipment includes:

- careful selection of trucking routes to minimize the effect on nearby residential areas,
- on-site speed limits to minimize road dust generation,
- site road house keeping including potentially watering, sweeping and/or vacuuming, to minimize track-out onto local roads,
- truck cleaning/washing stations should be set up at the exit from the site to prevent track-out of dust, debris and potentially contaminated material (during the removal of debris from the ECF footprint and Pier 15 stabilization),
- distance of 250 m between mechanical dredging equipment during operation on the east wall of the ECF;
- the implementation of a "No Idle" policy on site to limit unnecessary combustion emissions;
- the implementation of the contractors Health and Safety Plan for onsite workers;
- development and implementation of a communications protocol for real-time air monitoring exceedances; and

- use of a real-time air monitoring program as a project management tool for implementing appropriate mitigation measures.

Mitigation of any effects from on-site stockpiles will involve consideration of the pile locations, and reasonable timing for delivery to prevent the possibility of having unnecessary open piles on site for extended periods of time. Stockpile management should limit the possibility of dust erosion during high wind events. Other actions including watering, pile shaping and potential covering/tarping as well as the suspension of earth moving and pile dropping operations during extreme high wind events may also be implemented. A dust management plan should be developed and implemented which includes the mitigation measures for staging and storage areas and road traffic.

A project specific air quality monitoring program will be implemented as a project management tool for air quality emissions. Real-time monitoring will be implemented downwind of activities for naphthalene. The monitoring results will be compared to specified action levels and POIs. If monitoring shows any air quality criterion exceedance occurring due to ECF activities, mitigation measures will be implemented and assessed. As well, if complaints occur regarding air quality, additional follow-up and mitigation measures will be implemented. Mitigation measures may include reducing dredging rates, changing location of construction activities, the use of odour suppressants, etc. PAHs and BTEX compounds will also be monitored once a week. The monitoring of PAHs, BTEX compounds and naphthalene will occur at off-site locations downwind of activities. The monitoring will begin at the start of dredging and will continue until capping of the ECF is completed. Further details on the air monitoring measures can be found in Section 11.

Residual Effects

With effective mitigation measures implemented, significant adverse residual effects on air quality from construction activities are unlikely. Due to the distance the effect of ground level concentrations on air quality at nearby residences will be low.

The construction activities will be of short – medium term duration, and affect a local geographical area. Although odour emissions are expected, they are not expected to be frequent and persistently above odour thresholds outlined by MOE. The effect on air quality will also be reversible after the construction phase is complete. Therefore, no significant adverse residual effects on the air quality are likely to occur.

<u>Operation</u>

Effects Analysis

Relatively little air emissions will be generated from the operational phase of the ECF. Maintenance and monitoring activities for the U.S. Steel cap and ECF may create minor air emissions from vehicle traffic. The effect on air quality due to these activities will be short-term and intermittent. The ultimate result of the operational phase of the ECF is expected to be improved air quality for the long-term due to the remediation of the project site. The planted trees and shrubs on the greenway will function as GHG sinks and provide dust suppression for surrounding activities. In addition, it is expected that the operational phase will reduce odours and HAP emissions from contaminated sediment due to the capping of the ECF. This will be a benefit to the health and well-being of the human and ecosystem components.

The specific future uses of this facility as a marine terminal and their effects on air quality will be assessed and managed as required for federal and provincial approvals.

In summary, the adverse effect of the ECF on the existing ambient air quality is expected to be low with some long-term positive effects.

Mitigation

Air emissions associated with the ECF's activities will be monitored. If complaints occur regarding air quality, follow-up and mitigation measures will be implemented. As well, if monitoring shows an air quality criterion exceedance is occuring that is due to ECF activities, mitigation measures will be implemented and assessed.

Residual Effects

No significant adverse residual effects on air quality from the operational phase of the ECF are likely.

Summary of Residual Effects

Table 9.6 provides a summary of the residual environmental effects and recommended mitigation for air quality.

Table 9.6: Residual Environmental Effects Summary for Air Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at US Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, US Steel Channel Capping, Backfilling, Dredging Activities, ECF Final Capping								
Use of construction equipment, daily heavy truck movements, material transfer activities, and sediment dredging may increase ground level concentrations of HAPs, CACs and GHGs	A	• careful selection of trucking routes to minimize the effect on nearby residential areas, • on-site speed limits • on-site road house keeping including potentially watering and / or vacuuming; • truck cleaning / washing stations at the exit from the site • Maintaining a distance of 250 m between mechanical dredging and the east wall of the ECF; and • implement a "No Idle" policy on site • develop and implement dust management plan • real-time air monitoring as a project management tool • communications protocol for any air monitoring results that exceed established action levels and criteria	M – naphthalene emissions from mechanical dredging L – other CAC, HAP, GHG emissions	Local	Short-Medium Term / Intermittent	R	**NA**	NS
OPERATION								
Maintenance and monitoring activities may affect air quality	A	• Air quality complaints will be investigated and mitigation measure plans will be developed as appropriate	L	Local	Long-term/ Intermittent	R	**NA**	NS
The plants and vegetative cover on the greenway will: act as dust barriers; reduce gaseous emissions from contaminated sediment; and provide a GHG sink to help reduce GHG sources	P	• Implementation of restoration/enhancement initiatives within similar environments in Hamilton Harbour	L	Local	Long-term/ Permanent	R	**NA**	NS

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.2.2 *Ambient Noise*

VEC Description and Rationale for Selection

Ambient noise has been selected as a VEC for the Randle Reef Sediment Remediation Project due to the potential for noise from ECF phase activities to negatively impact sensitive receptors and degrade the acoustic environment. Noise is defined as an unwanted sound. Airborne sound is the rapid oscillation of pressure just above and below atmospheric pressure, which creates a sound. Sound is a measure of this pressure referred to as sound pressure levels (SPL) and is measured in units of decibels. To account for individual differences in sound perception, a standard weighting system is used that accounts for the typical hearing response for a human. The standard weighting system is referred to as the "A-weighted scale". A unit of measurement for the "A-weighted scale" is still recorded as a decibel but is denoted as dBA. The "A-weighted scale" has been found to be a good indicator of the annoyance capability of commonly encountered environmental noise and is the best method for monitoring noise.

Furthermore, sound is also listed in the *Ontario Environmental Protection Act* as a contaminant resulting directly or indirectly from human activities that may: impair the quality of the natural environment for any use that can be made of it; cause injury or damage to property or to plant/animal life; cause harm or material discomfort to any person; adversely affect the health or impair the safety of any person; render any property or plan or animal life unfit for use by man; cause loss of enjoyment for normal use of property; or interfere with the normal conduct of business.

The effects of noise on human receptors can include: annoyance; nuisance; dissatisfaction; interference with sleep, speech or learning; and in extreme cases, physiological effects such as startling and hearing loss. As well, excess noise has the potential to disturb wildlife and degrade habitats. The effect of noise on wildlife may include behavioural and physiological responses which have the potential to cause injury, energy loss, decrease in food intake, habitat avoidance and abandonment and reproductive losses (National Park Service, 1994).

The degree of disturbance from ECF noise depends on three items:

- the amount of background sound already present prior to any ECF related noise impacts;
- the working or living activities of the people occupying the area in which the noise is heard; and
- the nature and amount of the noise produced by the ECF.

The environmental assessment of this VEC considers these three items when evaluating the noise impacts on the acoustic environment.

Table 9.7 below identifies the typical SPL experienced for certain activities to put the quantities of the SPL in perspective.

Table 9.7: Typical Sound Pressure Levels for Common Activities

Sound Level	Source of Sound
0 dBA	Least perceivable sound by a human
< 30 dBA	Exceptionally quiet environments
< 40 dBA	Still night in a remote setting
50 – 60 dBA	Conversation
85 dBA	Loud Equipment – Threshold for use of hearing protection

Sound can also be expressed as an equivalent sound level L_{eq} . This is a logarithmic average of sound levels due to all sources of sound in a given area over a stated period of time. The L_{eq} is used to measure steady-state sound or noise and is typically expressed on a one hour basis.
The following boundaries were used to assess potential impacts of noise from the ECF phase. Boundaries were divided into four different types: spatial; temporal; administrative; and technical. The impacts of the ECF on the acoustic environment are investigated within these defined boundaries.

Spatial Boundaries

The spatial boundary encompasses the vicinity of the project area and is extended to include the possible noise sensitive areas. The project area is bounded by Hamilton Harbour to the north, the U.S. Steel property and Ottawa Street to the east, Burlington Street/Industrial Drive to the south and Pier 11 to the west. The assessment area extends 400 m from all ECF activities. It includes the nearest residential community on Land Street. The majority of the ECF's noise will be emitted from the construction area. However, there may also be some noise associated with equipment traveling to and from the project site.

Temporal Boundaries

The temporal boundaries consist of the times, in terms of the time of day and the frequency (week days), for which the construction and operational phases of the ECF phase will be occurring. It is expected that the highest sound levels will be encountered during the ECF construction. The construction phase is expected to be ten (10) years in length.

Administrative Boundaries

The administrative boundaries include applicable guidelines and regulatory framework developed for noise and the protection of the acoustic environment. The following noise guidelines and regulations are applicable for the ECF:

- City of Hamilton *By-Law No. 03-020 to Regulate Noise;*
- Ministry of Environment NPC-115 *"Construction Equipment"*; and
- Health Canada Draft *"Guidance on Noise Assessment for CEA Agency Projects"*.

City of Hamilton Noise By-Law

The City of Hamilton Noise By-law is dependent upon the zoning classification for the location of the source of noise and the noise receptor. The source of noise will primarily be from the project area, which is located in an industrial area as defined in Section 1 of the noise by-law and depicted in Schedule 2 of the noise by-law document.

The noise receptors may be located in the project area which includes an industrial area and residential areas. This distinction is important because if the noise receptor is located in the industrial area all of the provisions in the noise by-law are exempt. However, a more likely and conservative situation is that the noise receptor is located outside of the industrial area. If the noise source is within an industrial area but the receptor is outside of the industrial area, all of the provisions of the noise by-law are exempt except for those provisions outlined in section 11 of the noise by-law document. Section 11 states that at a point of reception, sound levels cannot exceed the Ministry of Environment limits, and is identified in the relevant publication pertinent to this ECF phase assessment:

- Publication - N.P.C. 115 - Construction Equipment.

Ontario Ministry of the Environment Regulations

As mentioned above, the City of Hamilton By-law references the Ontario Ministry of the Environment Regulations. Therefore, the relevant publications will be the consideration of the administrative boundaries for the ECF. The publications presenting sound level limits are discussed below.

Publication - N.P.C. 115 - Construction Equipment

The ECF's construction phase will use typical pieces of construction equipment and may include the following: excavation equipment, loaders, pneumatic tools and pile drivers. The N.P.C. 115 publication presents residential area maximum sound emission standards for specific pieces of construction equipment. The emission standards most applicable for the ECF are presented in Tables 9.8 and 9.9.

Sheet pile drivers are expected to be the ECF noise source with the highest sound pressure level. Pavement breakers and sheet pile drivers are both impact type equipment with similar sound level pressures. As such, the effect of sheet piling on residential sound levels can be appropriately compared to the maximum emission standard for pavement breakers. The equipment outlined in the following tables resembles equipment that may be used during the construction phase.

Table 9.8: Maximum Sound Emission Standards for Excavation Equipment, Dozers, Loaders, Backhoes and Other Similar Equipment for Residential Areas

Date of Manufacture	Power Rating	
	Less than 75 kW	75 kW and Larger
	Maximum Sound Level (dBA)	
Jan. 1 1979 – Dec. 31 1980		88
Jan. 1 1981 and after	83	85

Table 9.9: Maximum Sound Emission Standards for Pneumatic Pavement Breakers for Residential Areas

Date of Manufacture	Power Rating
	Maximum Sound Level (dBA)
Jan. 1 1979 – Dec. 31 1980	90
Jan. 1 1981 and after	85

Typically, the impact of project noise is compared to the existing ambient level due to traffic and surrounding industry. If the noise source has a higher dBA level than the existing background sound level, it may be noticeable to nearby receptors. Generally, sound levels that are less than 5 dBA above the background level are noticeable but not obtrusive. An increase of 10 dBA represents a perceivable doubling of sound levels for a person with average hearing ability.

Technical Boundaries

The assessment approach considers the noise from a receptor position, rather than considering sound levels at the property line. The estimates of noise from construction activities are obtained from published sound levels for specific project sources. The noise impact at the most sensitive receptor was then determined using the inverse square law for sound pressure levels. The inverse square law states that sound pressure levels will decrease by 6 decibels for every doubling of distance from the source of noise.

Threshold for Determination of Adverse Effects

Thresholds for the determination of significant effects on the acoustic environment are defined as follows:

A significant adverse effect is one in which:

- there are frequent exceedances of the administrative boundary; and
- the duration of the noise-emitting operations are long-term.

If the ECF creates continuous noise-emitting operations for greater than 15 years, the effect on the acoustic environment will be considered significant.

The sound level limits, as discussed in the administrative boundary for this assessment are:

- Regulatory criteria defined by Publication N.P.C. 115 Construction Equipment.
- A positive effect is one in which the ambient sound levels are decreased.

Potential Interactions, Issues and Concerns

The majority of the noise will be generated during the construction phase by activities occurring on the project site. Activities likely to produce noise include the following:

- debris removal using equipment such as a clamshell bucket, barges and trucks;
- sheet piling with vibratory pile driver and diesel hammer pile driver;
- earth moving activities with typical equipment such as dozers, compactors, smooth drum rollers, excavators, dump trucks, water trucks, graders and scrapers; and
- hydraulic dredging and mechanical dredging.

As previously mentioned, there will also be noise associated with heavy trucks transporting debris to and from the project site, which can generate noise along the roads traveled.

Analysis, Mitigation and Environmental Effects Evaluation

An ambient noise assessment for existing baseline levels was undertaken as part of a Noise and Vibration Baseline Report in October, 2008. The baseline noise assessment report can be found in the CSR's supporting documents. The baseline noise at the nearest residential receptor was measured during the weekday between 7am to 7pm. This time period, for the baseline condition, is chosen for the environmental effects evaluation as it is the same time period that construction and operational activities are expected to occur. The average Leq reading for this time period was 61 – 62 dBa at the nearest residential receptor location, Hillyard Street and Land Street. The majority of the noise was due to existing industrial sources and local traffic. Noise associated with the ECF's activities will be a new contributor to these background levels.

The following sections discuss the environmental effects of the ECF, interactions and activities and the proposed mitigation.

Construction

Effects Analysis

The construction phase will include debris removal, ECF wall installation, dredging, backfilling and capping activities. These activities will utilize equipment that emits noise. Tables 9.10 and 9.11 list typical sound level outputs of construction machinery commonly used for these activities.

Table 9.11 outlines sound levels at maximum engine power. The sound levels in Table 9.11 assume that the engine exhausts are fitted with manufacturer-installed or approved mufflers. Typically, construction activities do not always operate equipment at full rated speed or power. Reduced speeds and/or power will produce less sound than the levels outlined for maximum engine power.

Table 9.10: Typical Sound Levels from Construction Equipment Dominated by Sound from Diesel Engines

Equipment Type	Range of Sound Levels at 15 metres (dBA)	Approximate Range of Engine Power Rating (kW)
Backhoe	82 – 84	98 – 156
Bulldozer	85 – 90	187 – 522
Compactor	81 – 91	
Excavator	86 – 90	251 – 567
Front End Loaders	86 – 90	224 – 560
Graders	86 – 89	262 – 448
Self – propelled Scrapers	88 – 91	411 – 746
Rubber Tired Rollers	82	90 – 112
Trucks	84 – 97	150 – 300
Cranes (Moveable)	83 – 85	120 – 179
Cranes (Derrick)	82 – 86	90 – 209
Portable Air Compressors	87 – 89	299 – 448
Portable Generators	81 – 87	75 – 300

Table 9.11 outlines range of sound levels for various types of construction equipment not driven by diesel engines.

Table 9.11 : Typical Sound Levels from Construction Equipment Dominated by Sound not from Diesel Engines

Equipment Type	Range of Sound Levels at 15 metres (dBA)
Auxiliary Equipment	
Pumps	68 – 80
Impact Equipment	
Pneumatic Tools	78 – 88
Hammer Sheet Pile Driver	94 – 107
Material Handling Equipment	
Concrete Batch Plant	80 – 85
Concrete Vibrators	68 – 81
Pavers	82 – 92

The following formula for the inverse square law is used to determine the change in sound pressure levels based on the distance from the noise emission source:

$$\triangle D = 10 \log (d1/d2)^2$$

where d1 and d2 are the two distances and △D is the change in sound pressure level in decibels (dBA). Using the above formula, for every doubling of distance, there is a loss of 6 dBA.

The above formula demonstrates that as distance increases, the project impact decreases. Therefore, the impact of the construction phase is assessed for the nearest sensitive receptor. The nearest sensitive receptor is considered to be the residential area on Land and Hillyard Street. This residential area is approximately 350 m south of the project boundary.

The predicted increase in noise at the nearest sensitive receptor was established by assessing the point source with the highest sound pressure level. This source is the sound emission from the hammer sheet pile driver. Using the above formula with a sound range of 94 – 107 dbA and a distance of 350 m from the project boundary, the approximate sound level is predicted to be 43 – 56 dBA.

The baseline condition at the residential properties on Land Street was determined to be 61 – 62 dBA from 7am – 7pm. Typically, construction activities are expected to occur during this time period. As stated previously, the construction activities are predicted to cause a sound level of 43 - 56 dBA at the Land / Hillyard Street residential area. This change is expected to be perceivable, but not obtrusive as the construction activities are predicted create sound levels that are below the existing environment. Also, the predicted sound levels are below all levels outlined in the *N.P.C. 115 Construction Equipment* publication.

The expected sound pressure levels will be transient and intermittent for construction activities. Pile driving is expected to be the largest source of noise. However, the noise from pile driving will not be continuous. The moving and positioning of equipment, placement of jackets and insertion of piles will require a large amount of time for sheet piling. Noise from pile driving will be an intermittent impulse noise, as opposed to a continuous one. Intermittent noise sources can be more difficult to ignore than continuous noise sources. Therefore, intermittent noise may cause more annoyance to human receptors than a continuous noise.

The predicted sound level from the construction activity of 43 – 56 dBA offers an indication of effects on residential receptors in the Land / Hillyard Street residential area. The magnitude of the predicted sound level for the ECF is considered low as it is below all sound levels outlined in the administrative boundary.

Occasional noise from other sources such as the dumping of rock may be louder than operating machinery. However, this type of sound level will attenuate quickly since the duration of the activity is relatively short-term. It is also noted that the level of noise may vary according to the type of construction activity and the number of pieces of equipment in operation at any given time. However, this noise will likely be intermittent and may not occur simultaneously. Also, when more than one piece of equipment is operating in proximity to each other, the sound levels are not additive. As an example, if two impact pile drivers are operating, each with a sound pressure of 100 dBA, the resulting sound pressure level would be 103 dBA at the project site.

Noise from truck traffic may momentarily be higher than 90 dBA for receptors at a distance of 15 m. However, noise from truck traffic will be intermittent and not necessarily simultaneous. It is also unlikely that the sound pressure of approximately 90 dBA from a truck will be for a one hour averaging period. A traffic management plan will be implemented to optimize travel and reduce noise impacts. If noise complaints related to traffic occur, the complaints will be investigated in accordance with the Publication N.P.C 206 *"Sound Levels Due to Road Traffic"* and the Health Canada Draft Publication *"Guidance on Noise Assessment for CEA Agency Projects".*

Mitigation

During construction operations, the following mitigation measures will be implemented:

- all internal combustion engines will be fitted with appropriate muffler systems;
- noise-muffling equipment will be in good working order;
- intensive construction activities will be limited to the hours of 07:00 and 19:00 to reduce the potential impact on receptors;
- nearby residents will be advised of significant noise-causing activities and these activities will be scheduled to cause the least disruption to receptors;
- vibratory pile-driving will be used when possible;

- the public will have contact numbers for appropriate construction and government personnel in the case of any noise issues;
- noise monitoring will be conducted as required at the nearest occupied properties;
- noise complaints from members of the public will be investigated and appropriate responses will be initiated;
- evening and night time operations will be minimized;
- traffic management, which includes limiting traffic in and around the site and modifying speed limits will be implemented; and
- strategic placement of material storage piles to reduce noise associated with loading/unloading will be undertaken.

Residual Effects

With effective mitigation measures implemented, significant residual effects on the acoustic environment from construction activities are unlikely. Due to the distance of the nearby residences, there is substantial attenuation of noise associated with the construction activities.

The construction activities will have a low magnitude, be of a short-medium term duration, and impact a local geographical extent. The impact on the acoustic environment will be low in magnitude and reversible. Therefore, no significant adverse residual effects on the acoustic environment are likely to occur.

Operation

Effects Analysis

Relatively little noise will be generated from the operational phase of the ECF. Maintenance and monitoring activities for the U.S. Steel cap and ECF will create minor noise beyond the immediate vicinity of the ECF. The ECF location offers sufficient buffer distance that the noise should not be audible at the nearest residential community.

The planted trees and shrubs on the greenway will function as noise barriers from both physical and psychological perspectives, and will help reduce ECF noise impacts for the residential communities that are close to the project site.

The impact on existing ambient noise levels is expected to be low.

Mitigation

If noise complaints occur, noise associated with the ECF's activities will be monitored. If a noise exceedance occurs that is due to ECF activities, measures such as noise barriers and traffic management plans can be implemented.

Residual Effects

No significant residual effects on the acoustic environment from the operational phase are likely.

Summary of Residual Environmental Effects

Table 9.12 provides a summary of the residual environmental effects and recommended mitigation for the acoustic environment.

Table 9.12: Environmental Effects Summary for Noise Emissions

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at US Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, US Steel Channel Capping, Backfilling, Dredging Activities, ECF Final Capping								
Use of sheet piling equipment, daily heavy truck movements, and other pieces of construction equipment may increase the noise experienced by human receptors.	A	• Vibrating sheet pile installation; • Use of appropriate muffler systems; • Limit construction activities to the hours of 07:00 – 19:00; • Advise nearby residents of significant noise-causing activities; • Issue contact numbers to Public for any noise issues; • Implement noise monitoring as required; • Investigate and respond to noise complaints; • Minimize evening and night-time operations; • Implement traffic management measures; • Strategic placement of material storage piles	L	Local	Short/ Medium-term	R	**NA**	NS
OPERATION								
Maintenance and monitoring activities may increase noise experienced by human receptors	A	• Investigate noise complaints • Implement traffic management plan and noise barriers as appropriate	L	Local	Long-term/ Intermittent	R	**NA**	NS
The plants and vegetative cover on the greenway will act as noise barriers and will reduce noise experienced by human receptors	P	None	H	Local	Long-term/ Continuous	NR	**NA**	

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.2.3 *Soil Quality*

VEC Description and Rationale for Selection

The soil quality VEC is restricted to the soil within and immediately adjacent to the "staging area", the on-shore portion of the project boundary where debris, clean construction material and impacted soil excavated from Pier 15 will be stockpiled (Figure 9.10). Although this area is partially paved, surface soil appears to consist of a layer of heterogeneous fill (mainly sand and gravel) overlying silt, silty clay, silty clay till, sand and silt till and clayey silt (BBL, 2006). These soils are potentially susceptible to contamination from ECF related activities (spills, storage of contaminated material) and, if eroded during spring runoff or severe stormwater events, may deliver suspended sediments and/or contaminants to the Harbour.

Soil quality is typically identified as a VEC due to its ability to support plant life and its utility to humans. While the terrestrial areas around Randle Reef including the staging areas are industrial and not expected to have much in terms of vegetative cover, exposure to contaminated soil can be harmful to humans and other elements of the ecosystem. Contaminated soil also has the ability to migrate. There may be public concern regarding ECF activities and their impact on soil quality, particularly maintaining or improving soil quality at the marine terminal. Soil quality guidelines associated with industrial land use require that soil quality not be negatively affected above guideline values.

Spatial Boundaries

The VEC spatial boundaries are defined as the boundary of the staging area where construction related material and excavated soil will be stored (in the area of Pier 15 and to the south of Pier 16, see Figure 9.10).

Temporal Boundaries

The temporal boundary of this VEC is defined by the duration of construction and remediation works since these activities have the potential to negatively affect the VEC. The duration of the construction phase (consisting of ECF wall construction, dredging and ECF cap construction) is approximately nine (9) years.

Administrative Boundaries

Ontario Regulation 153/04 (Record of Site Condition under the Environmental Protection Act provides background and generic clean-up standards for various contaminants (e.g., metals and PAHs) and various site conditions (e.g., residential, commercial/industrial). This regulation is administered by the Ministry of the Environment. The current land use of the site is industrial.

Technical Boundaries

Potential soil effects associated with construction and remedial activities (e.g., storage of contaminated material, staging) is expected within the construction phase of the project. The technical boundaries for this VEC are defined by the available soil quality data (Blasland, Bouck and Lee, Inc., 2006; Peto MacCallum, 2008).

Threshold for Determination of Adverse Effects

The thresholds for potential effects are based on the application of O. Reg. 153/04 Standard to soil samples taken in this area after staging activities are completed.

A potential adverse effect on soil quality occurs when contaminants in soil samples exceed applicable O. Reg. 153/04 standards or when contaminants concentrations are elevated relative to pre-project levels.

A positive effect occurs where the project activities decreases levels of surface soil contamination in and adjacent to the staging area.

Potential Interactions, Issues and Concerns

Since the ECF mainly involves dredging and construction within Hamilton Harbour, there are very few ways that project activity may negatively affect the soil quality VEC. These include:

1. stockpiling of potentially contaminated soil from Pier 15 stabilization works and
2. stockpiling/temporary storage of debris retrieved from the Harbour in the staging area.

These activities may result in negative effects to underlying soil from contaminated stormwater runoff or percolation.

Analysis, Mitigation and Environmental Effects Evaluation

Construction

Potential on-Site Stockpiling of Contaminated Debris

To facilitate installation of ECF sheet piles, debris found on the bottom of the Harbour in the general area of the ECF structure (within the contaminated sediment) will be mechanically lifted (i.e., likely utilizing mechanical dredging techniques), transported by barge to the shore and stored in the staging area prior to off-site disposal. The debris will be potentially contaminated with PAHs and heavy metals.

Mitigation measures to prevent or minimize contamination of the site surface soil by potentially contaminated debris will include gently removing the debris from the Harbour. This will be done within an isolated barge work area to minimize the re-suspension and redistribution of contaminated sediments within the harbour (e.g., silt curtains, sealed barge). Potentially contaminated debris will be stored on a paved surface or low permeability geotextile barrier and a stormwater collection system will be used to prevent infiltration to the soil (e.g., dust control measures, properly shape stockpile to avoid steep faces or sides). Any rainwater or snow melt coming into contact with the debris storage pile will be directed to the land-based wastewater treatment plant (WWTP).

The use of these standard construction best management practices will effectively mitigate the relatively low risk of additional soil contamination posed by this activity.

Contaminated Soil Excavation and Removal – Pier 15

Limited excavation of poor quality soil in the area of Pier 15 is required to stabilize Pier 15. The soil in this area exhibits elevated sodium adsorption ratios and electric conductivity in relation to O. Reg. 153/04 Standards. While these parameters are not typically associated with "contaminated soil", they are often observed in soils where road de-icing salts are used or stored.

Considering the minimal amount of excavation and the nature of the contamination, the risk to adjacent soils posed by excavation and temporary storage of this soil is low. If contaminated soil from the Pier 15 east-west wall construction is identified, it will be stockpiled on site and handled in accordance with applicable legislation. Contaminated soil best management practices will be used to mitigate any impact to underlying soils. The stockpiled material will be placed on an impermeable surface and stormwater runoff will be managed to prevent contaminant migration.

The use of standard construction best management practices, as described above, will effectively mitigate the relatively low risk of additional soil contamination posed by this soil storage.

Follow-up and Monitoring

Although some soil remediation activities will occur during ECF construction, the project is designed to focus on the remediation and confinement of contaminated sediment. As such, the monitoring associated with this VEC is limited to the monitoring during construction (excavation and on site stockpiling of potential contaminated material). The monitoring program will include confirmatory sampling and analysis to assess the quality of soil in the on-shore portion of the project boundary pre and post construction activities.

Summary of Residual Environmental Effects

Should follow-up monitoring indicate soil quality has been negatively impacted, the soil can be excavated and transported off-site for disposal. No significant residual effects are anticipated (see Table 9.13).

Table 9.13: Residual Environmental Effects Summary for Soil Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	**Geographic Extent**	**Duration/ Frequency**	**Reversibility (R/NR)**	**Ecological/ Social-Cultural and Economic Context**	
CONSTRUCTION								
Potential on-Site Stockpiling of Contaminated Debris, Contaminated Soil Excavation and Removal – Pier 15								
Stockpiles of contaminated soil from Pier 15 stabilization and debris in the staging area coming into contact with precipitation resulting in the infiltration of contaminated water to underlying soil	Negative effects to underlying soil from stormwater runoff or percolation contaminated with metals, PAHs, etc.; (A)	Storage of potentially contaminated material on a paved surface or low permeability geotextile barrier, use of a stormwater collection system to prevent infiltration to the soil, directing stormwater and snow melt to a land-based wastewater treatment plant	L	Within or beneath the staging area	6 year construction period	R	NA	NS
OPERATION								
NA								

Notes: NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.2.4 *Surface Water Quality, Currents and Circulation*

VEC Description and Rationale for Selection

The surface water VEC has two (2) components - water quality and water circulation within Hamilton Harbour. With the exception of Sherman Inlet (see Section 9.2.3.3), no fresh water streams or creeks enter the Harbour in the project area and so this VEC consists solely of water within the Harbour. Water quality parameters described as part of this VEC include general chemical parameters (e.g., dissolved oxygen and pH), suspended sediments (or turbidity), and dissolved and suspended contaminants (heavy metals, PAHs, PCBs, VOCs, oil and grease, and BTEX). Water circulation includes the magnitude and direction of Harbour water currents.

Surface water has been identified as a VEC because: 1) its quality is protected by statute/regulation; 2) surface water is one of the physical pathways for the potential transport of contaminants to other receptor VECs; and 3) water quality and water circulation have been identified as public concerns.

Spatial Boundaries

The spatial boundary for this VEC is defined by the limits of the Hamilton Harbour although the focus of the VEC is restricted to potential effects in the immediate vicinity of the ECF and dredging areas. The spatial boundary of this VEC also covers the 25 m (82 ft.) wide channel (referred to as the U.S. Steel intake/outfall (I/O) channel) that separates the ECF structure from the U.S. Steel facility.

The U.S. Army Corps of Engineers' DREDGE model [12] was used to predict total suspended solids (TSS) concentrations around the dredge head for a hydraulic dredge used in cutter mode. The DREDGE model predicts that TSS concentrations will range from approximately 1.7 to 5.5 milligrams per litre (mg/L) at about 100 m from the dredge head and at 1 m above the sediment surface (Arcadis BBL, 2007a). This is approximately equal to background water quality within the Harbour (5.0 mg/L– table 2-2: Arcadis BBL, 2007c). This suggests that increased sediment re-suspension will be confined to a zone approximately 100 m downstream from the head of the dredge, depending on the equipment and dredging techniques used. Given this, the spatial boundary of the VEC is defined as the limit of the zone subjected to dredging plus a 100m wide buffer zone downstream from the dredge head.

The spatial boundary for the circulation component of this VEC is Hamilton Harbour (including the U.S. Steel channel) in its entirety since the principal concern is the potential disruption of circulation within the Harbour caused by the presence of the ECF as well as the impact of the ECF on the flow and circulation near the U.S. Steel water I/O.

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12 DREDGE was developed to assist users in making a priori assessments of environmental impacts from proposed dredging operations. DREDGE estimates the mass rate at which bottom sediments become suspended into the water column as the result of hydraulic and mechanical dredging operations and the resulting suspended sediment concentrations. These are combined with information about site conditions to simulate the size and extent of the resulting suspended sediment plume. DREDGE also estimates particulate and dissolved contaminant concentrations in the water column based upon sediment contaminant concentrations and equilibrium partitioning theory.

Temporal Boundaries

The temporal boundary of the water quality aspect of this VEC is defined by the duration of construction and remediation activities. Dredging is expected to require 51 weeks over three (3) dredging seasons to complete (approximately 17 weeks per year). Due to the poor quality of fish habitat within the project area the construction timing window restriction (March 15-July 15) for the protection of fish and fish habitat will not apply to the ECF (Ontario Ministry of Natural Resources).

Construction of the ECF cap will require an additional three (3) years. Monitoring of the quality of ECF seepage water (i.e., groundwater) will continue once construction is complete (see Section 11 – Follow-up and Monitoring). It is expected that seepage water monitoring in groundwater wells installed between the ECF walls will be conducted post construction in Years 1, 2, 5, 10 and 20. Following Year 20, the need for additional monitoring and frequency will be assessed.

The temporal boundary for currents and circulation is considered to be permanent, as the ECF will be a permanent structure within the Hamilton Harbour.

Administrative Boundaries

Surface water quality in Ontario is regulated by the provincial government through MOE. MOE has established provincial water quality objectives (PWQOs) that will be used as the base criteria for this project (MOEE, 1994).

Water circulation within the Harbour is not regulated as such, however, the Hamilton Port Authority and Transport Canada maintain an interest in circulation since changes to circulation and sediment transport may affect shipping and navigation within the Harbour.

Similarly, the water circulation in the area of the U.S. Steel site is not regulated. However, changes to currents due to the construction of ECF and creation of the U.S. Steel channel is a potential concern, as current changes may affect the quality of surface water used by U.S. Steel and navigation near the U.S. Steel site.

Technical Boundaries

The PWQOs/CWQGs contain criteria for all of the critical parameters that will be monitored for the ECF. This includes PAHs, PCBs, VOCs, metals (arsenic, chromium, copper, iron, lead, nickel, and zinc) and total suspended solids. There are no PWQOs for the general chemical parameters (dissolved oxygen, temperature, turbidity) that will also be monitored during the construction of the ECF. However, background water quality within Hamilton Harbour and water quality in the local vicinity of the dredging and construction will be taken into consideration when the monitoring program and water quality thresholds are established. An on-going study is currently being conducted to establish the background surface water quality within the Harbour.

Where a PWQO or a background concentration has not been established for a contaminant, the CWQGs for the Protection of Aquatic Life will be considered.

Past water quality data will be used to establish reference criteria for these parameters. The technical boundaries for this component of the VEC are constrained by the limited amount of existing water quality data for Hamilton Harbour. Water quality data are currently being collected by Environment Canada to supplement the existing database for background water quality and to develop and establish the appropriate monitoring, assessment parameters and effluent discharge criteria for this project.

Threshold for Determination of Adverse Effects

Water Quality

Given the degraded water quality within Hamilton Harbour, the thresholds for potential effects for this VEC during ECF -related activities will be based on project-specific compliance criteria.

A potential adverse effect on water quality may occur when:

- there is an increase in suspended solids and contaminant concentrations (metals, PAHs, PCBs, oil and grease, BTEX) above the ambient water quality, outside of the compliance monitoring boundary during dredging;
- there is a decrease in the water quality compared to baseline (pre-construction) at monitoring points in Hamilton Harbour attributable to ECF -related activities in the Randle Reef area;
- the quality of the water at the U.S. Steel intake point decreases to the degree that the water is no longer usable by U.S. Steel; or
- treated effluent water from the dredged sediment material discharged to Hamilton Harbour does not meet PWQOs or CWQGs for Freshwater Aquatic Life.

A positive effect occurs if water quality in Hamilton Harbour improves due to the removal and containment of contaminated sediments.

Currents and Circulation

A potential adverse effect on currents and circulation within the Harbour occurs if the current regime (magnitude and direction) changes to such a degree that sediment deposition interferes with the normal use of the Harbour by biological resources, recreational boaters or commercial shipping traffic.

A potential adverse effect on currents and circulation within the U.S. Steel channel occurs if the current regime (magnitude and direction) changes to such a degree that it negatively affects the quality of surface water in the vicinity of the U.S. Steel intake pipes, and sediment deposition interferes with the long term normal use of the channel for shipping traffic.

Potential Interactions, Issues and Concerns

The project is designed to remediate PAH and heavy metal contaminated sediment at the bottom of Hamilton Harbour. This will be achieved by dredging the contaminated sediment and confining it within the ECF. The containment of the contaminated sediment and consequent isolation from the water column will result in long term improvements to surface water quality.

The potential interactions, issues and concerns with respect to the surface water VEC include:

- short-term increases in dissolved and suspended contaminant concentrations above existing levels due to re-suspension and dispersion of contaminated sediment during preliminary debris removal, the construction of the ECF walls, Pier 15 stabilization, construction of the U.S. Steel channel turbidity structure, and sediment capping and dredging activities;
- short-term increases in turbidity at the U.S. Steel I/O due to the activities listed above;
- short-term increases in dissolved contaminant concentrations above current levels due to discharge of inadequately treated waste water (dredging decant water) into the Harbour;
- contaminant recirculation to Hamilton Harbour through the migration of contaminated ECF seepage water from the interior of the ECF to the Harbour;
- introduction of contaminated run-off and/or suspended sediments into the Harbour from terrestrial storage of debris, contaminated soil excavated from Pier 15 and clean construction material (armour stone, gravel, sand, etc.) stored on Pier 15 beside the Harbour;
- permanent changes to water circulation patterns (current magnitude and direction) in the vicinity of the ECF due to the presence of the ECF itself; and
- potential accidents or malfunctions resulting in the release of deleterious substances during ECF operations.

Analysis, Mitigation and Environmental Effects Evaluation

Construction

Debris Removal

Debris removal will occur using a grapple or claw type bucket operated from a barge. To minimize substrate disturbance, debris pieces will be gently removed from the bottom. This will be done on calm days within an isolated barge work area to minimize the re-suspension and redistribution of contaminated sediments within the Harbour (e.g., impermeable suspended sediment curtains, sealed barge to contain runoff). Debris removal may increase TSS within the water column. Debris will be transported and stored in the staging area (Figure 9.10) prior to final off-site disposal. Debris will be disposed of in a licensed landfill in accordance with all applicable legislation.

There is no practical method to reduce suspended sediment during these operations. With the application of appropriate mitigation measures and best management practices, the magnitude, duration and geographic extent of potentially adverse effects are expected to be minimal. Since only a small point of the Harbour floor will be disturbed, as each piece of debris is removed the residual environmental effects are expected to be negligible. Should observations indicate that suspended sediments are being transported away from work areas, Fisheries and Oceans Canada (DFO) will be contacted to discuss additional mitigation and management practices to restrict this transport.

ECF Wall Installation, U.S. Steel Turbidity Structure Construction, Pier 15 Stabilization

Localized re-suspension and disturbance of the contaminated sediment (loose sand and silt) is expected during installation and driving of ECF sheet piles and the turbidity structure piles known as "H-piles" for their cross-sectional shape.

The ECF external anchor and internal walls will be constructed of double steel sheet piles installed with vibratory hammers. The sheet piles will be installed over a period of approximately eight (8) months utilizing two (2) pile driving rigs with floating plants. The turbidity structure will be constructed of H-piles for supporting turbidity barriers, to maintain the quality (TSS and turbidity) of water flowing to the U.S. Steel intakes.

Sediment dispersion during these activities will be controlled using a floating silt curtain. These silt curtains are sediment control barriers constructed with a flexible geotextile, providing a controlled area of containment.

The re-suspension of the sediment during piling operations will be short-term and localized. Water quality monitoring during all in-water construction activities at specified sampling frequencies, locations, and depths will be conducted to confirm water quality outside the immediate vicinity of the construction activity. Based on the above, and implementation of appropriate mitigation measures such as silt curtains during the construction period, no adverse effect to the surface water VEC associated with these activities is expected.

Backfilling/Thin Layer Cap and U.S. Steel Sediment Capping

Due to the deteriorated condition of the U.S. Steel dock wall, capping the contaminated sediment in this area has been proposed as an alternative to dredging. The proposed sediment cap will consist of a layer of sand with silt and enriched total organic carbon covering the entire width of the channel between the U.S. Steel dock wall and the ECF. The method used to place the sand cover may include mechanical placement with a bucket, washing sand off a barge, "sand box" vibratory screens, or submerged diffuser placement.

Provided that a turbidity barrier system is utilized, and considering that water quality monitoring will be conducted during these activities, no adverse effect to the surface water VEC is expected.

Dredging

The type and operation of the dredging equipment used and the nature of the material dredged are the determining factors in the generation of turbidity (OMEE, 1994). Hydraulic dredging will be used for the bulk of the dredging operations while mechanical dredging and "side casting" are proposed for the area between the ECF double wall enclosure.

Decant water generated as the dredged sediment settles within the ECF will be piped to a temporary on-land waste-water treatment plant prior to discharge into the Harbour.

Dredging may have short-term, negative effects on water quality due to the re-suspension of contaminated sediments. This will result in increased turbidity and possible increased concentrations of PAHs, VOCs and metals as contaminants desorb from sediment particles and dissolve into the water column.

The Dredging Elutriate Test (DRET) concluded that all PWQOs would be met within a short distance from the dredging location when dredging sediment with relatively low contaminant concentrations (Priority 2 and 4 Subareas) (BBL, 2006). The results also indicated that with the exception of five (5) PAH parameters, all PWQOs would be met within the same distance when dredging sediment with relatively high contaminants concentrations (Priority 1, 2 and 3 Subareas). The contaminant concentrations in a small amount of sediment (approximately 64,000 m^3 from Subareas 1A, 1B and 3) have PAH concentrations higher than the concentrations used for modeling purposes. Larger mixing zones will be required to achieve the PWQOs during the dredging of these areas. (BBL, 2006).

Modeling conducted by Arcadis BBL (2007a) indicates that total suspended solids concentration is expected to return to background levels at 100 m from the dredge head. Arcadis BBL (2007a) indicate that water quality will be measured at the "compliance monitoring boundary" which is given as 91 m from the active dredge location. Monitoring boundaries will be established radially around the dredging area and will migrate with dredging activity. This approach is consistent with recommendations in OMEE (1994). Maximum contaminant concentrations in water samples at the compliance boundary will be established for turbidity, PAHs, PCBs, metals and VOCs.

To mitigate re-suspension and its effects, engineering controls (such as hydraulic dredge heads with hoods or shrouds) or operational controls (such as dredging from higher to lower elevations and from higher to lower priority areas) can be employed. If re-suspension presents a water quality concern, dredge areas can be segregated with sheetpiles so that the dredging occurs within an enclosed environment. If short-term water quality increases above permissible limits are observed, the dredging production rate can be reduced and the operator can monitor the situation until turbidity and other parameters decrease to near ambient conditions. For dredging in areas adjacent to the U.S. Steel intake engineering controls such as silt curtains may be needed to prevent suspended sediments from entering the intake.

Floating silt curtains or screens can be used to reduce turbidity, but these measures are generally limited in their performance in open waters exposed to wind and wave action. Because the presence of silt curtains results in reduced dredging rates and increased downtime for the dredging operation (due to repositioning of the silt curtain for each move), these measures would be employed only if necessary. However, the specifications will place limitations on turbidity resulting from dredging, and the use of silt curtains or screens is one method commonly used for this purpose.

In softer sediments, particulate re-suspension can be reduced by applying suction to remove the majority of the upper sediment surface without activating the cutterhead or by using a low cutter rotation speed. The cutterhead dredge is then activated (or rotation speed is increased) to complete the removal to design elevations as needed.

In summary, potential releases to the water column during dredging will be mitigated by a combination of the following actions:

- dredging within confined areas (e.g., within sheetpile walls and/or silt curtains);
- using controls during dredging operations, including environmental dredging equipment;
- performing monitoring during dredging operations to verify compliance with operational and performance standards;
- all materials and equipment used for the purpose of site preparation and ECF completion will be operated and stored in a manner that prevents any deleterious substance (e.g., petroleum products, silt etc.) from entering the water;
- application of best management practices to prevent spillage of gasoline, diesel fuel and other oil products in to the water;
- contractor will have emergency spill response equipment available onsite to facilitate prompt response to any accidental oil, fuel leaks or spills; and
- use of a cleanup crew with containment/sorbent booms, sorbent pads and skimmers as required primarily for removal of spilled non-aqueous phase liquids (NAPLs) including hydrocarbon fuels, oils and lubricants, and aromatic solvents;

Treated Dredging Effluent Discharge

The decant water generated in the process of sediment settlement and the compaction process within the ECF is transferred to a land-based WWTP for further treatment. The decant water will be treated to achieve applicable water quality criteria/PWQOs prior to discharge into the Hamilton Harbour.

The WWTP consists of parallel sand filters and granular activated carbon vessels. The decant water will be pumped into the sand filters prior to passing through activated carbon vessels. The WWTP effluent water quality is a function of dredge material flow rate and quality (e.g., solids content), ECF configuration and volume, and WWTP performance.

Compliance monitoring will be performed to confirm that treated effluent released into Hamilton Harbour meets PWQOs and/or applicable background concentrations, if appropriate. If breakthrough due to short-circuiting or other unforeseen circumstances is detected, carbon changeout will take place during the granular activated carbon phase of the treatment train. Arrangements will be made with the carbon supply vendor to stockpile and store replacement carbon, or provide timely turnaround, so that the project schedule is not substantially impacted. No residual adverse effect from treated dredging effluent discharge is anticipated.

Terrestrial Storage of Debris, Construction Material and Excavated Soil

Construction material consisting of sand, gravel, and armour stone will be stockpiled on-shore in a staging area during construction of the ECF. The staging area is also expected to contain soil excavated during the stabilization of Pier 15, as well as debris removed from the Harbour prior to dredging. The staging area is approximately 13,000 m^2 in size and is located to the southeast of the ECF.

Stockpiled materials will be covered to reduce stormwater induced runoff from the stockpiles. A stormwater collection and management system is proposed to prevent direct discharge of contaminated water to the Harbour. The stormwater management system will consist of sand filter berms (or a similar system) that filters surface runoff before discharging into the Harbour. Discharge water quality is expected to meet or exceed background values.

<u>Operation</u>

Water Quality Improvements in the Harbour

Dredging operations are expected to remove more than 95% of sediment PAHs and metals from the shallow Randle Reef sediments that contact the surface water column. Placing the dredged material in the ECF will isolate the sediment PAHs and metals from surface water. This project is designed to have a long-term net positive effect on water quality within Hamilton Harbour (BBL, 2006).

Migration of Contaminated ECF Seepage Water

Analytical and numerical groundwater flow and solute transport modeling was performed by BBL (2006) to estimate the long-term quality of ECF seepage water discharging from the ECF to Hamilton Harbour. It also assessed whether additional engineered components would be necessary to supplement the sealed interlocks of the interior sheetpile wall to further limit discharge from the ECF to surface water.

Modeling conducted for the Basis of Design report (BBL, 2006) identified the importance of limiting recharge (precipitation, snowmelt) to the dredged sediments within the ECF and also indicated that recharge, as well as diffusion, are major driving forces for contaminant transport from the ECF to the Harbour. These results underscored the importance of stormwater management at the surface of the ECF. Because the ECF is a minimal flow system, most or all water that passes through the cap will likely remain within the sealed sheetpile walls. As a result, the ECF cap design includes perimeter collection trenches that are hydraulically connected to the drainage layer to drain the portion of cap below the low permeability cover.

Flux calculations predict that the PWQOs will be met between the interior and exterior sheetpile walls and, therefore, are predicted to be met within the Harbour shortly after ECF construction. Rapid natural attenuation of contaminants in the Harbour will further reduce their concentrations in surface water (Arcadis BBL, 2007d).

Groundwater modeling identified the following design requirements to mitigate the potential negative effects of seepage and stormwater associated with the ECF:

- install a drainage system in the ECF cap to limit recharge to dredged material in the ECF;
- perform quality assurance monitoring of the interlock sealing process during construction;
- as an added measure to protect long-term water quality, direct stormwater and/or precipitation to the rock backfill between the double walls, to provide recharge in order to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the sheetpile walls;
- perform long-term monitoring using monitoring wells positioned between the walls; and
- if elevated concentrations of constituents of interest are identified, implement mitigation measures such as water extraction and treatment or addition of sequestering agents.

With these mitigation measures in place, it is expected that effects on water quality within the Harbour will be negligible.

Potential Changes to Currents and Water Circulation in the Harbour

The hydrodynamic behaviour in Hamilton Harbour is largely determined by its morphometry, while circulation is mainly induced by the wind. The wind set-up is caused by the pressure gradient due to the effect of the wind, resulting in a Harbour wide oscillation called a seiche. Due to its shape, there is no dominant travel direction for the seiche, which makes the flow pattern in the Harbour very complex (NWRI, 2007).

Water column currents in the Harbour are mainly wind-induced (Wu et al., 1996). Three-dimensional simulated circulation patterns within Hamilton Harbour under a 3 km/h (2 mph) west wind show negligible induced currents near the Sherman Inlet concrete culvert and along the HPA piers and U.S. Steel dock wall. A west wind induces counter-clockwise currents, with the focal point northwest of the dredge areas. The predicted currents for the majority of the subareas west of the ECF are less than 3 metres per second (m/s). Water currents in the subareas north of the ECF are predicted to be up to 5 m/s.

With regard to the currents and water circulation component of the surface water VEC, hydraulic modeling has shown that the ECF will likely reduce water current speeds in areas to the north, but that it will not significantly interrupt the magnitude or direction of Hamilton Harbour currents (Arcadis BBL, 2007d).

Follow-up and Monitoring

ECF Cap

The project is designed to permanently isolate highly contaminated sediment within the ECF. This will require long-term monitoring of the effectiveness of the ECF as well as monitoring of currents and water quality within Hamilton Harbour.

The engineered cap will be evaluated periodically using both monitoring and modeling programs for an estimated 200 years following construction. Long-term monitoring will include the measurement of ECF sheet pile structures for movement, corrosion, deformation and groundwater / under-drain water quality.

Upon completion of the ECF, a post-monitoring program consisting of ECF cap inspections, ECF perimeter wall inspections, pavement inspection/maintenance and landscaping and groundwater sampling will be initiated.

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Surface water monitoring will continue to occur after the ECF construction is complete to determine if water quality improvements have been achieved and to monitor pore water seepage from the ECF. Contaminants of interest will be determined in consultation with regulatory agencies and RAP groups, and will likely focus on PAHs and arsenic, chromium, copper, iron, lead, nickel and zinc.

The post-construction monitoring program will define monitoring frequencies, locations, depths within the water column, parameters and threshold criteria (alert or action triggers).

Waste-Water Treatment System

Monitoring of the waste-water treatment system is divided into three (3) parts: startup monitoring, performance monitoring and compliance monitoring (BBL, 2006).

Since total metals and PAHs in decant water are directly correlated with TSS, startup sampling results will be compared with the modeled results to "calibrate" the correlation between contaminants and turbidity and quantify the correlation between field-measured turbidity, TSS, total metals and PAHs. This will enable the development of a turbidity criterion for performance monitoring.

Performance monitoring will begin following startup of the treatment system. Turbidity will be continuously measured at the final settling cell effluent point, the sand filter effluent point, and the granular activated carbon (GAC) effluent point using in-line turbidity meters. The ECF and final settling cells will also be observed for presence of films, sheen, and discolouration or odour. In addition to turbidity measurements, during dredging of the most contaminated sediments or during final filling, grab samples may be collected as necessary for laboratory analysis.

The test results will be evaluated and used to adjust construction activities as necessary. Real-time information from performance monitoring will include direct-measured turbidity and visual and olfactory observations.

Compliance sampling will be performed to confirm that treated decant water released into Hamilton Harbour meets water quality requirements during both initial and production dredging. Compliance samples will be collected from the GAC effluent. Compliance samples will be analyzed for pH, TSS, turbidity, total metals (arsenic, cadmium, chromium, copper, lead, nickel, silver, and zinc) and PAHs. Results will be compared to discharge limits based on PWQOs and past water quality data (Arcadis BBL, 2007c)

Summary of Residual Environmental Effects

No significant adverse environmental effects are predicted for the surface water VEC after mitigation has been implemented. In contrast, the project works and activities are expected to have net positive effects on surface quality water (Hamilton Harbour) since the primary source of PAH and metal contamination will be removed from the bottom of the Harbour and isolated from the water column. No significant residual effects are anticipated (Refer to Table 9.14).

Table 9.14: Residual Environmental Effects Summary for Surface Water Quality

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, ECF Wall Installation, U.S. Steel Turbidity Structure Construction, Pier 15 Stabilization, Backfilling/Thin Layer Cap and U.S. Steel Sediment Capping, Backfilling/Thin Layer Cap and U.S. Steel Sediment Capping, Dredging, Treated Dredging Effluent Discharge, Terrestrial Storage of Debris, Construction Material and Excavated Soil								
Debris Removal resulting in increased suspended sediments	A Re-suspension of contaminated sediment leading to increased turbidity and increased mobility of PAHs, metals and other contaminants	None	VL	Within 5 m of each piece of debris	< 1 day per piece of debris	R	Degraded environment	NS
ECF Wall and U.S. Steel turbidity structure construction and Pier 15 stabilization resulting in increased suspended sediments	A Re-suspension of contaminated sediment leading to increased turbidity and increased mobility of PAHs, metals and other contaminants	Restrictions on construction timing, use of turbidity barriers such as silt curtains (as necessary); and controlled unloading of capping material.	L	Proximity of construction zone	Construction period	R	Degraded Environment	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
Backfilling/Thin Layer Cap and U.S. Steel channel sediment capping resulting in increased suspended sediments	A Re-suspension of contaminated sediment leading to increased turbidity and increased mobility of PAHs, metals and other contaminants	Restrictions on construction timing, use of turbidity barriers such as silt curtains; and controlled unloading of capping material.	L	Proximity of pier 15 structure	Constructi on period	R	Degraded Environment	NS
Infiltration of precipitation and snow melt into storage piles of debris, construction material and impacted soil near the Harbour	A Discharge of turbid stormwater from storage piles leading to increased turbidity	Installation of a storm management system surrounding the Site and staging area; use of tarps or geotextiles to cover the piles to reduce contact with stormwater	L	Proximity to the Harbour shoreline	Constructi on period (3 years)	R	Degraded Environment	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
Dredging, causing re-suspension of sediments	A Re-suspension of contaminated sediment leading to increased turbidity and increase mobility of PAHs, metals etc. (Note: The results of re-suspension modelling indicate that TSS concentrations will range from approximately 1.7 to 5.5 milligrams per litre (mg/L) at about 100 m from the dredge head and at 1 m above the sediment surface. Although a maximum of 8 NTU s (Nephelometric Turbidity Units) has been established by EC at Pier 22 dockwall, the measurement unit of mg/L will be maintained in future monitoring given the existing background data and modelling results are reported in mg/L)	Use of engineering controls (hydraulic dredge heads with hoods or shrouds) or operational controls (dredging methods), segregation of dredge areas using sheet piles or silt curtains, or reduction of dredge rate	M	<100 m	3 years	R	Degraded Environment	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
Discharge on non-treated or inadequately treated ECF effluent (decant water) into Hamilton Harbour	A Non-compliant discharge of treated effluent that contributes additional contaminants of concern (metals, PAHs, etc.) to Hamilton Harbour	Regular monitoring combined with standby replacement carbon on site	L	N A	7 years	R	Not Impacted	NS
OPERATION								
Water Quality Improvements in the Harbour, Migration of Contaminated ECF Seepage Water, Potential Changes to Currents and Water Circulation in the Harbour								
Completion of contaminated sediment isolation within ECF	P Decrease in contaminated sediments in the Harbour, water quality improvements in the Harbour after construction completed	NA						

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
Migration of contaminated pore water from the ECF in to the Harbour	A Release or discharge of water containing elevated concentrations of contaminants of concern (metals, PAHs, etc.) to the Harbour	Installation of a low permeability cap and drainage system to limit recharge to the ECF, monitor interlock seals during construction, use stormwater to disperse/degrade contaminants of concern, use monitoring to determine if water extraction to addition of sequestering agents is warranted.	L	Proximity to the ECF	Unknown (long term)	NR	Degraded Environment	NS
ECF-induced changes to magnitude and direction of Harbour currents	A Changes to hydrodynamics and sediment transport	None required	VL	Proximity to ECF	Permanent	NR	NA	NS

Notes: NA- Not Applicable

VL = Very Low, L = Low, M = Moderate, H = High

R = Reversible, NR = Not Reversible

S = Significant, NS = Not Significant

9.2.2.5 *Aquatic Biota*

VEC Description and Rationale for Selection

Freshwater habitat and associated aquatic biota of Hamilton Harbour and Randle Reef have been identified as a VEC due to their nature and the protective status of freshwater habitats provided through different government legislation, including the federal *Fisheries Act.* This VEC focuses on the habitat and aquatic species not identified as conservation priorities due to designations as species at risk (SAR) in Canada. The SAR of Hamilton Harbour are assessed in Section 9.2.2.6. In addition, the stakeholders expressed concern for the aquatic species, their habitats and associated biological features and values.

The remediation of the Randle Reef site is expected to have a positive effect on aquatic habitat and biota by improving the quality of the habitat in Hamilton Harbour in the long-term due to decreased contaminant flux from disturbance of contaminated sediments. However, in the short-term, potential exists for an increase in contamination when the site is disturbed during construction and dredging. Environmental dredging to confine the contaminated sediments from Randle Reef within the ECF is part of the project design and is also the fish habitat mitigation /compensation that will be a component of the DFO Fisheries Act Authorization for the Harbour infilling from the ECF construction.

In Hamilton Harbour, fish habitat is protected under the federal *Fisheries Act*. "Fish" in the *Fisheries Act* is defined as (a) parts of fish, (b) shellfish, crustaceans, aquatic animals and any parts of shellfish, crustaceans or aquatic animals and (c) the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and aquatic animals. "Fish habitat" in the *Fisheries Act* is defined as spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes. This definition includes the quality of those habitats and is not limited to the physical aspects.

Within the *Fisheries Act*, Section 35 (1) states that no one shall carry out any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat, unless it is authorized by the Minister of Fisheries and Oceans. In keeping with the Policy for the Management of Fish Habitat (DFO, 1986), the issuance of a *Fisheries Act* Authorization is conditional on the development of fish habitat compensation and mitigation plans to ensure there will be "No Net Loss" in the productive capacity of fish habitat. It should be noted that fish habitat "compensation" is considered "mitigation" under the CEAA. Section 36(3) of the *Fisheries Act* prohibits the deposit of a deleterious substance in water frequented by fish, unless authorized by regulation. Environment Canada has the responsibility for the administration and enforcement of the Fisheries Act provisions dealing with the deposit of deleterious substances (chemical) into waters frequented by fish through a 1978 Prime Ministerial decision. The exception is that the DFO enforces section 36(3) the *Fisheries Act* regarding sediment as a deleterious substance.

In addition to fish and the associated aquatic biota covered under the *Fisheries Act*, aquatic birds have been identified as a VEC due to their potential exposure to the contaminated sediment during construction as the ECF is filled.

The VECs included in Hamilton Harbour and Randle Reef are linked through various ecosystem pathways and interactions. These linkages include Surface Water Quality, Water Current and Circulation (Section 9.2.2.4) and SAR (Section 9.2.2.6). These features are linked by the movement of aquatic and semi-aquatic species and circulation of water.

Spatial Boundaries

The VEC spatial boundaries include freshwater habitat within the immediate area of Randle Reef up to the limits of the dredging area, as well as the zone of influence within Hamilton Harbour and the surrounding area. The areas for ECF construction and capping (including thin layer capping) activities of the U.S. Steel channel will occur as illustrated in Figure 9.5.

The zone of influence will include aquatic habitat and biota associated with: Spencer Creek; Grindstone Creek; Red Hill Creek; Cootes Paradise Environmentally Significant Area (ESA) and Provincially Significant Wetland (PSW); Van Wagner's Ponds and Marshes Provincially Significant Wetland; Hendrie Valley Provincially Significant Wetland; Sherman Inlet; and open waters of Lake Ontario (as illustrated in Figure 9.5). Each of these represents different components of Hamilton Harbour's watershed and are used by a range of species with varying mobility. These species include amphibians, aquatic mammals, aquatic birds, fish, macro-invertebrates, reptiles and plants. For example, species such as aquatic birds, fish and reptiles can be regarded as highly mobile during most seasons, whereas plants are less mobile. The mobile species are unlikely to spend their life history within the zone of influence of the project and are more likely to enter the Randle Reef site on an irregular, diurnal or seasonal pattern. By contrast, the less mobile species such as benthic macro-invertebrates that occur in the substrate will spend most of their life stages within the zone of influence of the project. Such differences in distribution, migration patterns and life history identifies the ecological spatial boundaries of each species.

Temporal Boundaries

The temporal boundary for VECs within Hamilton Harbour is defined by the construction and operation phases for the remediation of the Randle Reef site and are identical to those established for the overall ECF.

Since habitat is the chief determining factor in population health of most species that use the aquatic habitats of Hamilton Harbour, the temporal boundary includes the yearly twelve-month period during the construction and operation phases of the ECF. At present, the expected duration of the project is approximately 10 years. This includes construction of the ECF containment walls along with dredging in-between, production dredging and filling of the ECF and completing the ECF cap.

Aquatic habitat in Hamilton Harbour is available year round. Particularly sensitive times for fish populations include periods of migration and spawning (e.g., most species spawn during spring and early summer, from April to mid July) and the overwinter period (November to March). Ecological temporal boundaries for aquatic species are linked to movement patterns of highly mobile species that migrate in and out of the Harbour and less mobile species that use the Harbour twelve months a year.

Effects on non-resident migratory species known to utilize the area of influence during migration periods were considered in this analysis.

Figure 9.5: Aquatic Habitat and Biota Zone of Influence

Administrative Boundaries

The following administrative boundaries apply for the remediation of the Randle Reef site:

Fisheries and Oceans Canada– fish habitat is explicitly protected under the federal *Fisheries Act* and authorization from DFO is required for the harmful alteration, disruption and destruction (HADD) of fish habitat. Under the SARA, the Minister of Fisheries and Oceans Canada is the Competent Minister for aquatic species wherever they are found, except those that are in or on federal lands administered by Parks Canada.

Environment Canada – the federal *Species at Risk Act* protects rare or endangered species. The Minister of the Environment (through Parks Canada) is responsible for SAR found in national parks, national historic sites or other federally protected heritage areas. The Minister of the Environment is also responsible for all other SAR not protected by Parks Canada and DFO and for the overall administration of SARA. Environment Canada administers sections of the Fisheries Act prohibiting the introduction of deleterious substances into waters frequented by fish. In addition, Environment Canada administers the Migratory *Birds Convention Act, 1994*, which protects all migratory birds, including aquatic bird species, listed under this Act.

Ontario Ministry of Environment – surface water quality in Ontario is regulated by the provincial government through the new Clean Water Act.

Ontario Ministry of Natural Resources (OMNR) – Section 2.3 of the *Provincial Policy Statement* protects provincially significant wetlands and significant portions of the habitat of endangered and threatened species. OMNR also administers the provincial Endangered Species Act.

Hamilton and Halton Region Conservation Authorities – wetland communities and watercourses associated with Hamilton Harbour are under both the Hamilton and Halton Region Conservation Authorities jurisdictions where development of any kind within/near wetland communities would require their approval according to the *Conservation Authorities Act* Ontario Regulation 161/06.

City of Hamilton Official Plan – protects Environmentally Significant Areas where proposed changes to ESAs require contact with the "Environmentally Significant Areas Impact Evaluation Group".

Technical Boundaries

Numerous studies have been undertaken on the ecology of Hamilton Harbour and the surrounding area (Table 9.15). Field investigations have been undertaken within the Randle Reef area and concluded that little to no aquatic vegetation exists due to the highly toxic nature of the sediment.

Benthic surveys undertaken in 2000 show strong evidence of benthic macroinvertebrate community impairment with a trend of lower species diversity and abundance of pollution tolerant species. Fish sampling was also undertaken in areas near Randle Reef and across Hamilton Harbour by EC, DFO and other researchers such as those located at the Royal Botanical Gardens and McMaster University. These independent studies provide an inventory of fish species in the Harbour, shoreline wetlands and tributary creeks (Table 9.15). Such studies also provide additional context for this project and other details of the biological, chemical and physical feature of these ecosystems.

Table 9.15: Select Studies that Assessed Ecosystem Components Relevant to the 1992 RAP Stage 1 Report for Hamilton Harbour

Theme	**Relevant Studies**
Cootes Paradise	Lougheed *et al.*, 2004; RBG, 2001-2003; Skafel, 2000; Chow-Fraser, 1999
Cyanobacteria	Medeiros and Molot, 2006
Eutrophication analysis	Charlton, 2001; Kellershohn and Tsanis, 1999;
Fish populations	Brousseau *et al.*, 2008; Kövecses, 2007; RBG, 2002, BG, 2002; Minns *et al.*, 1993; Leslie and Timmons, 1992
Fish health	Karrow *et al.*, 2003; Arcand-Hoya and Metcalfe, 2000
Invertebrate toxicity	Bartlett *et al.*, 2005; McCarthy *et al.*, 2004; Marvin *et al.*, 1994; Krantzberg and Boyd, 1992
Management	Zeman and Patterson, 2006; Hill-McKenzie *et al.*, 1993
Native species: birds	Somers *et al.*, 2003; Weseloh et al., 1995; Gebauer *et al.*, 1992
Native species, non-birds	De Solla *et al.*, 2007; Kövecses, 2007; RBG, 2001-2003
Non-native species	Lougheed *et al.*, 2004; Somers *et al.*, 2003; RBG, 2001
Nutrient loading	Medeiros and Molot, 2006;
Organic Contaminants	Ueno *et al.*, 2007; Curran *et al.*, 2000
Other Contaminants	Brassard *et al.*, 1997; Versteeg and Morris, 1996
Paleolimnology	Yang *et al.*, 1993
Sediment chemistry	Ueno et al., 2007; Zeman and Patterson, 2006
Sediment transport	Sofowote *et al.*, 2008; Brassard and Morris, 1997; Versteeg *et al.*, 1995
Submerged macrophytes	Croft and Chow-Fraser, 2007; Theysmeyer and Cleveland, 2001
Water circulation	Chow-Fraser, 2005; Hamblin and He, 2003; Harvey *et al.*, 1997; Lee *et al.*, 1992
Water quality: general	Chow-Fraser, 2005; Charlton and Le Sage, 1996
Water temperature	Wu *et al.*, 1996; Lee *et al.*, 1992

In order to assess the clean up of the Randle Reef site, baseline studies have been completed. These studies were completed over the last 15 years. They were required to characterize the ecosystem prior to dredging of the reef and construction of the ECF to evaluate the risk to ecosystem components and resident species. Such risk evaluation cannot be completed without the consideration of these varied independent studies. Although these studies involve a range of methods, they act to identify the expected pathways for the exposure of contaminants from sediments and water to VECs, the destination for sediments and contaminants and the spatial distribution of mobile and semi- mobile VECs.

The studies and principal contact person(s) were:

- chemical and stable isotope tracers to identify ecosystem linkages among plants, invertebrates, fish and birds – led by Chris Marvin, Environment Canada;
- characterization of sediment toxicity and benthic invertebrate communities – led by Danielle Milani and Lee Grapentine, Environment Canada;
- review and analysis of fish communities and habitats in response to non-native species invasions and restoration efforts – led by Christine Brousseau, DFO;
- review of past and current amphibian, bird, invertebrate, plant and reptile species in Hamilton Harbour – led by staff of Royal Botanical Gardens;
- review of past and current fish communities and habitats of Cootes Paradise – led by staff of Royal Botanical Gardens and Pat Chow-Fraser, McMaster University;
- quantification of aquatic toxicity through analysis of haemocytic leukemia in caged bivalves – led by Jim Sherry, Environment Canada;
- assessment of genetic and reproductive endpoints and embryo-larval deformities in caged and laboratory fish – led by Joanne Parrott, Environment Canada; and
- evaluation of lab and wild fish health, including tumour incidence within Randle Reef – led by Jim Sherry and Mark McMaster, Environment Canada.

Threshold for Determination of Adverse Effects

A potential adverse effect on aquatic habitat and biota from the remediation of the Randle Reef site is one that is likely to cause further impairment of the habitat quality or quantity which in turn may result in a sustained decrease in species richness, diversity and abundance.

A potential positive effect may enhance the habitat quality or quantity, which in turn may result in a sustained increase in species richness, diversity and abundance.

Potential Interactions, Issues and Concerns

The construction phase of the ECF will result in two main environmental effects: loss of aquatic habitat due to construction of the ECF and improved habitat quality in Hamilton Harbour due to a decrease in contaminated sediments.

During the dredging of the Randle Reef site, sediment pore water will be collected and then treated at a dedicated water treatment facility. The discharges are expected to not be acutely lethal or cause any chronic effects in aquatic biota. Specific discharge standards will be developed in conjunction with the appropriate regulatory agencies, such as MOE, prior to the start-up of the remediation project. This treatment of pore water, along with the remediation of the Randle Reef site, will result in a significant decrease in contaminant loading to Hamilton Harbour over the long-term. It is expected that there will be an improvement in the habitat quality of the Hamilton Harbour from these efforts. This will be shown by reduced biological contaminant burdens along with improved biotic diversity and abundance over the long-term.

The proposed duration of the project is approximately 10 years and includes construction of the ECF containment walls along with dredging between the double walls, production dredging and filling of the ECF and completion of the ECF cap. The known or possible effects of these disturbances on aquatic species during the construction phase include:

- potential re-suspension of contaminants in the sediment to surface water during dredging, ECF filling and dewatering;
- direct loss of 7.5 hectares of aquatic habitat;
- potential physical damage/disruption of aquatic habitat;
- potential exposure to toxics by aquatic birds as the ECF is filled with contaminated sediment;
- potential disruption of species lifecycle; and
- potential physical harm or direct mortality to aquatic species.

It is expected that there will be a decreased flux of contaminants to Hamilton Harbour as a result of the containment of contaminated sediments. The treatment of water from the ECF to acceptable standards will result in a discharge of good quality water into the local environment from the treatment process. As well, the long-term effect of remediation of the Randle Reef site will be to isolate the contaminated sediments and reduce the spread of these contaminants via re-suspension in the water column to the rest of Hamilton Harbour, local creeks and the Lake Ontario environment. The expected result will be a net positive effect on the aquatic habitat (water and sediment quality) and biota in each ecosystem, particularly Hamilton Harbour.

Analysis, Mitigation and Environmental Effects Evaluation

Freshwater habitat components and aquatic biota of Hamilton Harbour will interact with ECF activities in several ways. Due to its central position and hydrological and physical linkages, Hamilton Harbour functions as a major ecological node. The Harbour is also the intermediate receiving body for three major stream systems in the City of Hamilton: Spencer Creek (via Cootes Paradise); Grindstone Creek; and Red Hill Creek. The Windermere Basin sub-area in the southeast corner of the Harbour is immediately downstream of the Van Wagner's Ponds and Marshes area on lower Red Hill Creek. Various past studies quantified the features of these areas independent of this study (Table 9.1). The Hendrie Valley ESA encompasses the lower section of Grindstone Creek upstream of the northwest corner of the harbour. Physical linkages exist with the creek mouths, sub-basins, Cootes Paradise and other ESAs and the shoreline. Hydrological and physical links exist with the open waters of Lake Ontario to the east. These habitat components are inter-connected and provide the opportunity for unimpeded migration by aquatic species among different portions of the Harbour, between the Harbour and tributary streams and between the Harbour and Lake Ontario.

A range of studies presented since the 1992 Stage 1 RAP for Hamilton Harbour provide extensive details regarding the complexity of the potential interactions, ecological components and other aspects of this ecosystem. These studies demonstrate the rehabilitation efforts over the last decade and the biological diversity and key habitat features (Table 9.1). Such information has been used in this analysis to identify the potential interactions, issues and concerns and represents a follow-up to a related synthesis that linked environmental contamination to remediation options for Hamilton Harbour (i.e., Zeman and Patterson, 2006).

This complex ecological environment and diversity of potential interactions led to the identification of separate habitat components in Hamilton Harbour. These components include: immediate area of the Randle Reef site; Hamilton Harbour proper; Cootes Paradise; Van Wagner's Ponds and Marshes; Hendrie Valley ESA; open waters of Lake Ontario and watercourses and their associated watersheds that drain into Hamilton Harbour, any of which could potentially be affected by the remediation of the Randle Reef site.

Construction

The Randle Reef Site

The ECF activity will focus on the area directly associated with Randle Reef. Past studies identified that the sediments of the Randle Reef site are the most contaminated sediments in the Harbour. These past studies identify that the sediments contain very high concentrations of metal and organic chemicals that likely cause severe environmental effects on exposed biota in the area near the Randle Reef site. It is for these reasons the remediation activities will involve dredging of contaminated sediments and construction of the ECF.

Dredging may result in the re-suspension of contaminated sediments including organic materials, increased turbidity and TSS which may reduce the total dissolved oxygen concentrations of the water column in the immediate area. These varied stressors may modify the physical environment and interact with any exposed species. However, past benthic surveys in the vicinity of Randle Reef identified a depauperate (i.e. lacking species variety) benthic invertebrate community associated with the contaminated sediments. This community was characterized as dominated by tolerant species such as chironomids and tubifex worms.

It is probable that mobile species, such as fish, will move away from the areas of dredging and ECF construction. It is unlikely that mobile species will experience significant stress from the dredging or construction of the ECF. Similarly, semi-aquatic species such as amphibians, aquatic birds and aquatic mammals are generally expected to readily move away from the area of disturbance and avoid harmful stress. In contrast, the less mobile species, such as benthic macro-invertebrates cannot rapidly move away from the area of dredging and the associated stresses.

However during "downtime" in construction activities, aquatic birds could potentially access the contaminated sediment as the ECF is filled. The ECF structure will act as a discrete accessible section of water during "downtime" in the dredging and filling operation. The ECF at this stage will be a double walled, open top structure slowly being filled with highly contaminated sediments dredged from the surrounding areas. This will result in an area of concentrated contaminated sediments located beneath a layer of water that would progressively become shallower as the volume of sediment increases. This area would be accessible to water birds which dive below the water surface to forage near or in sediments.

Surveys of amphibians and reptiles in the vicinity of Randle Reef revealed low densities so risk to these species will likely be limited.

At present, the expected duration of construction of the ECF is approximately 10 years and includes construction of the ECF containment walls along with dredging in-between, production dredging and filling of the ECF and completion of the ECF cap. Potential releases of PAHs and metals and other materials to surface water may occur during debris removal, dredging, ECF filling and dewatering. Such construction activities will use various mitigation measures to reduce the environmental transfer of materials and stress and include:

- Active sediment containment control methods will be used during all construction activities. Methods may include floating silt curtains and sheet piles. These methods will be deployed as required. Application of best management practices (BMPs) identifies that alternate equipment may be used and will reflect the on-site conditions to overcome any problems.
- During the removal of debris, there is no practical method to eliminate re-suspension of sediments. To minimize substrate disturbance, debris pieces will be gently removed from the bottom. This will be done on calm days within an isolated barge work area to minimize the re-suspension and redistribution of contaminated sediments within the Harbour (e.g., impermeable suspended sediment curtains, sealed barge to contain runoff). As a result, the duration and geographic extent of the disturbance effect(s) is expected to be minimal. The disturbed area will focus only on the Randle Reef site during ECF construction and ECF placement as per the description. Similarly, the removal of debris with the best available techniques will likely have little residual environmental effects.
- Dredging will be mitigated by focusing efforts on small areas that are contained through the use of sediment control methods such as silt curtains, sheet piles and use of specialized dredging equipment. Active monitoring during dredging operations to verify compliance with operational and performance standards and the use of a clean-up crew, as required.
- Routine environmental monitoring of the water quality in areas adjacent to the active work areas will also be conducted during all in-water construction activities. The design of monitoring is identified in the follow up monitoring.
- Direct loss of aquatic habitat will occur during the ECF placement. This effect can be mitigated through the dredging and remediation of the surrounding substrates.

- Potential physical damage or disruption of aquatic habitat during construction works will be contained within sheet pile walls and/or silt curtains. These structures will effectively function as barriers to aquatic species. It is also anticipated that mobile species will be able to avoid construction works (see Section 9.3.6). Removal of any fish stranded by these activities to Hamilton Harbour proper will occur.
- Potential physical harm or killing of aquatic species during construction and dredging activities will be minimized through the use of mitigation measures such as silt curtains and steel sheetpile walls. These or other structures will effectively function as barriers to aquatic species and deter other species such as birds[13] from the construction works. These strategies will reflect BMPs.
- The site activities will generate noise and vibration. However, these effects will be local and only continue for a limited period. No residual environmental effects are expected from these activities.
- Bird scaring devices shall be installed to discourage aquatic birds from landing and foraging in the ECF during down time.

Additional information on mitigation measures are included in Table 9.16 and elsewhere (Surface Water Quality, Currents and Circulation; Section 9.3.4). The possible consequences on species at risk are considered in section 9.3.6.

It is expected the dredging may mobilise sediments, temporarily elevate TSS and increase the re-suspended concentrations of contaminants. If this occurs, the suspended sediments and contaminants may be transported to other portions of Hamilton Harbour. Use of appropriate mitigation measures will effectively minimize the extent of these effects. Nonetheless, it is necessary to consider the potential for interaction between these stressors and other portions of the Harbour. A suite of independent studies have quantified the various facets of the Harbour ecosystem and provide salient insight for this analysis concerning interactions between species and these ecosystems (Table 9.1).

Hamilton Harbour

The Hamilton Harbour is a major deep water industrial port used by large Great Lake- and ocean-going ships to carry cargo. It is also used by smaller boats for recreation, and to receive stormwater and treated wastewater effluent. Because dredging and infilling activities have modified most of the bay, only a small portion of the shoreline exists with natural vegetation primarily in the shallow waters of the western end. Potential interactions include the transport of contaminated sediment, from the Randle Reef site to these adjacent shoreline areas and Lake Ontario proper. Such transport could have negative consequences on different biota during and immediately following the dredging and construction activities. However, these potentially negative interactions are expected

[13] For example, cormorants, a common bird in the Harbour, can swim great distances under water and to great depths.

to occur only over a short-term period and are likely to be less severe compared with the long-term stresses that would occur with no remediation of the Randle Reef site. It is expected that any interactions will result in minimal consequences on local biota given the history of environmental stressors in this bay.

During the construction phase of the ECF, affected water produced during the dredging will be collected and treated at a water treatment facility. The effluent from the facility will not be lethal nor cause any chronic effects in aquatic biota. Specific discharge standards will be developed in conjunction with the appropriate regulatory agencies prior to the start-up of the ECF. The treatment facility will also be able to treat wastewater from ECF activities such as dewatering of the sediments. Other efforts will involve work area isolation and other active sediment control measures.

Cootes Paradise Environmentally Significant Area (ESA) and Provincially Significant Wetland (PSW)

Cootes Paradise is located between the Dundas Valley and Hamilton Harbour, on the northwest fringe of the Hamilton-Ancaster-Dundas urban centre. This ESA is a shallow, flooded basin of open water and marsh habitat created behind the Hamilton Bar landform. The Cootes Paradise PSW is the largest remaining Great Lakes shoreline marsh at the western end of Lake Ontario. It is the receiving body for Spencer Creek, Borer's Creek, Chedoke Creek and a few other small creeks. Water flows from Cootes Paradise into Hamilton Harbour via the cut made in the Hamilton Bar for the Desjardins Canal. The potential interactions between Cootes Paradise and the Randle Reef site dredging and ECF construction are similar to those identified for other areas of Hamilton Harbour, but somewhat limited due to the distance from the Randle Reef area and the net flow of water from Cootes Paradise into the Harbour. Specifically, the transport of contaminated sediment may cause negative interactions on the biota of Cootes Paradise. However, potential interactions are expected to be short-term in nature and will likely be mitigated by the distance and physical separation that exists between the Randle Reef site and Cootes Paradise. For example, the Hamilton Bar will limit the total sediment transported from the Randle Reef site to the Cootes Paradise ESA and likely result in little stress on aquatic biota or aquatic vegetation. The prevailing water current patterns also support this interpretation (Table 9.1)

Other Ecosystems Associated with Hamilton Harbour

A suite of other ecosystems such as wetlands and streams are associated with Hamilton Harbour but occur at relatively large distance from Randle Reef. Because these ecosystems will not receive any large loadings of sediment or water or other materials from activities at Randle Reef, it is reasonable to expect no consequences to the mobile or immobile biota or other features of these ecosystems. These ecosystems are described briefly below.

Van Wagner's Ponds and Marshes Provincially Significant Wetland

The Van Wagner's ponds and marshes are located on the lower reach of Red Hill Creek and are adjacent to Hamilton Harbour and Lake Ontario shoreline. This PSW is bisected by the Queen Elizabeth Way (QEW) and surrounded by intensive industrial and recreational developments. Any potential interactions are expected to be short-term in nature and will likely be mitigated by the distance and physical separation that exists between the pond and marshes of Red Hill Creek and the Randle Reef site area. The prevailing water current patterns also support this interpretation (Table 9.1)

Hendrie Valley Provincially Significant Wetland

Hendrie Valley PSW is located along the northwestern portion of Hamilton Harbour near Cootes Paradise, having both a riverine and lacustrine setting. It is approximately 23 hectares in size and is composed of two wetland types: swamp (13%); and marsh (87%). The disturbances at the Randle Reef site may transport sediment or contaminants, but the effects on the Hendrie Valley area will likely be small in scale and short in duration.

Open Waters of Lake Ontario

Lake Ontario receives all drainage from the Hamilton Harbour ecosystem. Potential interactions from the disturbance of the Randle Reef site may include an increase in the transport of sediment and re-suspended contaminants to the nearshore environment. If such transport occurs, it is unlikely to modify the biological or physical environment in a significant manner. Also, the open shoreline of Lake Ontario near Hamilton Harbour will rapidly dilute any sediments or contaminants that originate from the Randle Reef site (Table 9.16).

Stream Watercourses and their Associated Watersheds

The three major stream systems that drain to Hamilton Harbour include: Spencer Creek; Grindstone Creek; and Red Hill Creek. Because of the downstream flow of water into the Harbour and the distance between the Randle Reef site and each of these creeks, no negative consequences are expected to occur due to the dredging and construction of the ECF.

Operation

The current configurations proposed for the ECFs will result in the filling of approximately 7.5 hectares of Harbour area. At present, the majority of this area includes sediments with high concentrations of contaminants such as metals, PCBs and PAHs. This consideration is also addressed in Zeman and Patterson's review of the Randle Reef area. The sediments are known to be toxic to different sediment-dwelling invertebrates (see Table 9.15). Hence, it is expected these efforts will result in a decreased flux of contaminants from the Randle Reef site to Hamilton Harbour. The long-term consequences of isolated sediments will be a positive effect on the aquatic habitat (water and substrate quality) for Hamilton Harbour.

A potential long-term, adverse effect may be from residual PAHs and metals remaining in sediment after dredging. Data from previous projects (see Table 9.15) suggest that post-dredging residual contaminants can result in a relatively small percentage of the original contaminant mass remaining in shallow sediment. However, post-dredge verification testing of the sediments and placement of a thin-layer cap over areas with remaining residual concentrations above the 100 ppm threshold will reduce the potential for residual contaminant concentrations, as well as expedite recovery of the benthic community in the dredging areas. Constant monitoring during the different phases of the ECF will reduce the risk from the operation of the ECF.

To mitigate surface water impacts and subsequently impacts to aquatic biota, a range of measures will be used to achieve the long-term goals of habitat enhancement, including:

- installation of a drainage system in the ECF cap to limit recharge to material in the ECF;
- conducting quality assurance monitoring of the steel sheetpile interlock sealing process during construction;
- conducting long-term monitoring and physical inspection of the ECF containment;
- conveyance of direct stormwater and/or precipitation to a rock backfill between the double walls, to provide recharge in order to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the steel sheetpile walls;
- conducting long-term monitoring using monitoring wells positioned between the double walls of the ECF to allow for early detection of any potential migration of contaminants; and
- implementation of mitigation measures such as water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.

Further information on mitigation measures is included in Table 9.16 and Section 9.3.4.

Follow-up and Monitoring

Maintenance and monitoring of the site will verify the effectiveness of the Best Management Practices such as sediment control measures during the initial construction of the ECF. For the aquatic environment, the monitoring needs to involve the water and various VEC species, most importantly as this relates to the dredging, ECF construction and capping steps in the construction process.

Similarly, the effective operation of the site following completion of the remediation requires local surface water quality monitoring (see Section 9.3.4). For example, surface water quality monitoring occurs during in-water activities, long term monitoring of ECF operation will likely involve monitoring well sampling.

The collection of local information on biota, habitat features (e.g., sediments) and water quality will identify how the maintenance and monitoring plan is designed. For example, it is necessary to monitor sediments and the benthic macro-invertebrate communities in the Randle Reef site area to quantify the recovery over time. This long term monitoring will document the changes in the aquatic environment directly resulting from the remediation. Such monitoring of the Randle Reef site area will complement other monitoring that is currently conducted across Hamilton Harbour by other agencies (e.g., Environment Canada, refer to Table 9.16). Future monitoring will be conducted by a government agency, to be determined at a later date.

Summary of Residual Environmental Effects Evaluation

The destruction of 7.5 hectares by infilling of the aquatic habitat in the Randle Reef site area is a necessary part of the remediation process. It is expected that the removal and isolation of these contaminated sediments within the ECF will expedite the remediation of the Randle Reef site area sediments. This remediation will likely result in long-term improvements in aquatic habitat features used by biota across Hamilton Harbour and increase the productive capacity of fish, invertebrates and other biota. The net adverse residual environmental effect on the aquatic habitat and biota is not considered to be significant given the likely long-term benefits of the remediation and given the mitigation measures that will be in place to minimize potential shorter-term impacts.

Table 9.16: Residual Environmental Effects Summary for Aquatic Habitat and Biota for different Phases of the ECF phase

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal and Dredging								
• Potential physical damage/disruption of aquatic habitat • Potential release of suspended sediments, metals and sorbed PAHs to surface water • Potential physical harm or mortality of aquatic species (including Aquatic birds)	A	• Use standard sediment control devices (e.g., sheet pile walls, silt curtains). • Equipment configurations and techniques appropriate for harbour location. • Environmental monitoring sufficient for the harbour • Focus period of activity during non-breeding times (e.g., autumn). • Bird scaring techniques as required	H - immobile species (e.g., macrophytes) M - semi-mobile species (e.g., mussels) L - mobile species (e.g., fish)	In-water Nearshore of the Randle Reef site	Project Start up Phase Frequent: duration of dredging	NR	**Aquatic habitat located at the Randle Reef site.** **Aquatic habitat within Hamilton Harbour.**	NS
Removal of contaminated sediments via hydraulic dredging and containment within the ECF	P	NA	H - immobile species L - mobile species.	Hamilton Harbour	Project Start up Phase	NR	**Reduction of contaminants in sediment at The Randle Reef site.**	S
Turbidity Structure Construction at US Steel Intake Pipes								
Potential for transfer of contaminated sediments to Hamilton Harbour.	A	• Use standard sediment control devices.	M	In-water Hamilton Harbour	Frequent: duration of dredging	NR	**Aquatic habitat within Hamilton Harbour**	NS
ECF Walls Construction, Pier 15 Wall Stabilization and Backfilling								
Noise and vibration impacts to aquatic life during construction activities such as sheet pilling and as a result of importing and on-site stock piling of quarry rock.	A	• Time construction activities to avoid breeding times • Use vibratory sheet piling. • Delineate work area.	M	In-water Nearshore Offshore Onshore	Project mid-phase Frequent	NR	• **Aquatic habitat within Hamilton Harbour.** • **All residences in close proximity to Project site.**	NS
Removal (through infilling) of 7.5 ha of fish habitat in harbour area	A	• Implementation of restoration/enhancement initiatives within similar environments in Hamilton Harbour	M	In-water	Permanent	NR	**Habitat to be lost is severely degraded.**	NS

Water treatment								
Pore water from dredged sediments	P	• Treatment of pore water sediments by the water treatment plant	L	• Outfall of water treatment plant	• Project mid-phase • Frequent	**R**	**Release of treated water to Hamilton Harbour**	**NS**
Sediment and Effluent Management and ECF Final Capping								
Potential for sediment and contaminant flux	A	• Sediment control efforts as used in earlier phases (e.g., silt curtain) • Delineate work area	L	• In-water • On-shore	• Project End Phase • Infrequent	**NR**	**Hamilton Harbour**	**NS**
OPERATION								
Potential reduction in contaminant flux	P	NA	H	• In-water	• Operation Phase	**NR**	**Species in Hamilton Harbour**	**S**
Structural failure of the ECF, resulting in leakage of sediment PAHs and metals to surface water.	A	• Installation of drainage system in the ECF cap • Quality assurance monitoring of sheetpile interlock sealing process • Conveyance of direct stormwater and/or precipitation to a rock backfill • Long-term monitoring program between sheetpile walls • Implement water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.	L	• In-water	• Operation Phase	**R**	**Aquatic species within close proximity to the Randle Reef site**	**NS**

Notes: NA- Not Applicable

VL = Very Low, L = Low, M = Moderate, H = High

R = Reversible, NR = Not Reversible

S = Significant, NS = Not Significant

9.2.2.6 *Species at Risk*

VEC Description and Rationale for Selection

Species at risk (SAR) in Hamilton Harbour, which could potentially be found in the Randle Reef area, have been identified as a VEC due to their protected status provided through different government legislation including the federal *Species at Risk Act* (SARA) and Ontario's *Endangered Species Act*. Similarly, the general public and stakeholders have expressed concern for these species.

SARA was created to prevent wildlife species from becoming extinct. It requires Canada to provide for the recovery of species at risk due to human activity and to manage species of Special Concern, to prevent them from becoming Endangered or Threatened. The Act covers all wildlife species at risk nationally, their residences and critical habitats and applies to all lands in Canada. SARA not only prohibits the killing, harming, harassing, capturing or taking of species at risk (Section 32), but also makes it illegal to destroy their residences (Section 33) and critical habitats (Section 58).

The *Endangered Species Act* protects wildlife where no person shall kill, harm, harass, capture or take a living member of a species that is listed on the *Species at Risk in Ontario List* as an extirpated, endangered or threatened species (Section 9 (1)). Section 10 (1) also states that no person shall damage or destroy the habitat of a species that is listed on the *Species at Risk in Ontario List* as an endangered or threatened species or a species that is listed as an extirpated species, if the species is prescribed by the regulations for the purpose of this clause.

There are a total of fourteen (14) SAR located within Hamilton Harbour. The status of all identified SAR within the Harbour is as follows (Table 9.17):

Table 9.17: Species Status

Common Name	Scientific Name	National Status		Provincial Status
		COSEWIC*	SARA**	
American Eel	*Anguilla rostrata*	Special Concern	No status	Endangered
Bald Eagle	*Haliaeetus leucocephalus*	Not at Risk		Endangered (South of French and Mattawa Rivers), Special Concern (North of French and Mattawa Rivers)
Bigmouth Buffalo	*Ictiobus cyprinellus*	Not at Risk		Special Concern
Blanding's Turtle	*Emydoidia blandingii*	Threatened	Threatened	Threatened
Common Snapping turtle	*Chelydra serpentina*	Special Concern	No status	
Eastern Spiny Softshell	*Apalone spinifera spinifera*	Threatened	Threatened	Threatened
Few-flowered Club Rush or Bashful Bulrush	*Trichophorum planifolium*	Endangered	Endangered	Endangered

Gravel Chub	*Hybopsis x-punctata*	Extirpated	Extirpated	Extirpated
Hoary Mountain Mint	*Pycnanthemum incanum*	Endangered	Endangered	Endangered
Northern Brook Lamprey (Great Lakes - Upper St. Lawrence populations)	*Ichthyomyzon fosser*	Special Concern	Special Concern	Special Concern
Northern Map Turtle	*Graptemys geographica*	Special Concern	Special Concern	Special Concern
Peregrine Falcon *(anatum/tundrius* subspecies)	*Falco peregrinus*	Special Concern	No status	Threatened
Redside Dace	*Clinostomus elongates*	Endangered	Special Concern	Endangered
Shortjaw Cisco	*Coregonus zenithicus*	Threatened	Threatened	Threatened
Stinkpot or Common Musk Turtle	*Sternotherus odoratus*	Threatened	Threatened	Threatened

Sources:
*COSEWIC - Committee on the Status of Endangered Wildlife in Canada; an independent body of experts responsible for
identifying and assessing wildlife species considered to be at risk.
**SARA - Species at Risk Act - Wildlife species that have been designated by COSEWIC may then qualify for legal protection and recovery under SARA.
Species at Risk Public Registry. Available at: http:http://www.sararegistry.gc.ca/default_e.cfm
Endangered Species Act, 2007 - O. Reg. 230/08. Consolidation period from February 18 2009 to e-laws currency date May 29 2009. Available at:
http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_07e06_e.htm

SAR unionid mussels have been previously reported in other areas of Hamilton Harbour (e.g., Cootes Paradise). However due to the presence of invasive mussel species, all known populations of SAR mussels in Hamilton Harbour are considered extirpated.

Spatial Boundaries

The ECF spatial boundaries include SAR habitat within the immediate area of Randle Reef including the limits of dredging. The boundary comprises the area where ECF construction and capping activities of the U.S. Steel channel will occur. These activities will modify sediment and water quality within and beyond Randle Reef including Hamilton Harbour as a whole. The exact spatial distribution of SAR at Randle Reef is unknown. If any of the identified SAR bird, fish or reptile species are present, it is expected that they will rapidly migrate away from the area when dredging commences (Table 9.1).

Figure 9.6: Potential SAR Habitat Modification Zone

The likely zone of modification will potentially include SAR habitat associated with Hamilton Harbour, Spencer Creek, Grindstone Creek, Red Hill Creek, Cootes Paradise Environmental Significant Area (ESA) and Provincially Significant Wetland (PSW), Van Wagner's Ponds and Marshes PSW, Hendrie Valley PSW and open waters of Lake Ontario. Figure 9.6 presents the location of these features.

Temporal Boundaries

The temporal boundaries for the SAR VEC within Hamilton Harbour is defined by the construction and operation phases for the remediation of Randle Reef and are identical with those established for the overall ECF.

Habitat is the chief determining factor in population health of most species that use aquatic habitats of Hamilton Harbour, especially SAR. The temporal boundary is considered to include the yearly 12 month period during the construction and operation phases of the ECF. At present, the expected duration of the project is approximately ten years. This includes construction of the ECF containment walls along with dredging in-between, production dredging and filling of the ECF and completion of the ECF cap.

Habitat for aquatic SAR in Hamilton Harbour is available year round. Particularly sensitive times include periods of migration and spawning (e.g., most species spawn during spring and early summer, from April to mid July) and the overwinter starvation period (November to March).

Administrative Boundaries

The following administrative boundaries would apply for the remediation of Randle Reef:

Environment Canada – the federal *Species at Risk Act* protects rare or endangered species. The Minister of the Environment (through the Parks Canada) is responsible for SAR found in national parks, national historic sites or other protected heritage areas. The Minister of the Environment is also responsible for all other SAR not protected by Parks Canada and DFO and for the overall administration of SARA. Environment Canada administers sections of the *Fisheries Act* prohibiting the introduction of deleterious substances into waters frequented by fish.

Fisheries and Oceans Canada (DFO) – fish habitat is explicitly protected under the federal *Fisheries Act* and authorization from DFO is required for the Harmful Alteration Disruption or Destruction (HADD) of fish habitat. Under the SARA, the Minister of Fisheries and Oceans is the Competent Minister for aquatic species wherever they are found, except those that are in or on federal lands administered by Parks Canada.

Ontario Ministry of Natural Resources – Under provincial policies and regulations, the OMNR is responsible for species at risk on private land and provincial Crown lands. The new *Endangered Species Act,* 2007 (ESA) will apply to aquatic species and migratory birds.

The *Provincial Policy Statement* protects provincially significant wetlands and significant portions of the habitat of endangered and threatened species.

Technical Boundaries

All SAR reported by various agencies and groups within Hamilton Harbour's watershed were observed outside of Randle Reef, with the exception of the American eel. One individual was captured in Randle Reef during fish collections conducted by Hamilton Region Conservation Authority staff in 1984. Other SAR have been observed within Carroll's Bay, Spencer Creek, Cootes Paradise, shores of Hamilton Harbour, Burlington Bluffs and the nature sanctuary located at Royal Botanical Gardens.

The habitat requirements of the SAR and their known distribution within Hamilton Harbour is identified in Table 9.18. These habitat requirements will help determine the potential effects of the remediation works on the individual species discussed in the following sections.

Table 9.18: Species at Risk and Their Known Distribution Within Hamilton Harbour

Species	Status	Habitat Requirements/ Lifecycle	Known Distribution within Hamilton Harbour
American eel (*Anguilla rostrata)*	Endangered provincially No SARA status, COSEWIC status special concern and under consideration for SARA listing	All American eel are part of a single breeding population that spawns only in the Sargasso Sea in the Atlantic Ocean. From there, young eels drift with ocean currents and then migrate inland into streams, rivers and lakes. After reaching these freshwater bodies they feed and mature for approximately 10 to 25 years before migrating back to the Sargasso Sea to spawn (Tremblay et al, 2006). They feed on aquatic insects, amphibians and fish.	North and east shores of Hamilton Harbour where muddy, silty substrates occur (Scott and Crossman, 1998). Caught in Randle Reef in 1984 (HRCA). Caught in Hamilton Harbour from 1988 and 1998 (DFO). DFO also reported a dramatic decline in biomass from 1994 to 2002.
Northern brook lamprey (*Ichthyomyzon fosser)*	SARA schedule 1 Special Concern Special Concern provincially and nationally	The northern brook lamprey is non-parasitic, living 3-5 years as a filter feeding larvae (ammocoete) in the bottom sediments of streams before transforming into a non-feeding adult in mid-summer to late fall. The following spring the adult lamprey spawns completing its life cycle.	Course, gravelly warm water streams (Scott and Crossman, 1998). Caught in the Cootes Paradise fishway (HRCA – Cootes Paradise Fishway data)
Redside dace (*Clinostomus elongates)*	SARA schedule 3 special concern, COSEWIC status endangered and under consideration for SARA listing Threatened provincially	Eggs are normally laid in riffles in the gravel nests of other minnows (Cyprinidae). During the spawning period, males leave their resident pools and travel short distances to spawning sites. Prior to spawning, males defend small territories (a few cm in each direction) immediately behind Cyprinidae nests. Eggs are broadcast by females and fertilized by groups of males into the nest (Holm and Dextrase, 2007).	Cool streams with gravel and cobble bottoms and riparian vegetative cover (Scott and Crossman, 1998)(Cootes Paradise tributaries, HRCA) COSEWIC records show occurrence in 2004 within the main branch of Spencer Creek.
Gravel chub (*Hybopsis x-punctata)*	SARA schedule 1 Extirpated Extirpated provincially and nationally	Historically, gravel chub occupied streams with fast currents and sand and gravel substrate (Parker et al, 1988).	Gravel chub was last found in Canada in the Thames River drainage system in 1958 (DFO, 2008)

Species	Status	Habitat Requirements/ Lifecycle	Known Distribution within Hamilton Harbour
Shortjaw cisco (*Coregonus zenithicus)*	No SARA status, COSEWIC reassessing status Threatened provincially and nationally	Shortjaw Ciscoes spawn in either fall or spring in the Great Lakes. Eggs are deposited over the lake bottom and develop over three to four months, depending on water temperature. Shortjaw cisco is an opportunistic feeder and tends to eat only one prey item at a time. It feeds on tiny lake organisms in the water column and at the lake bottom and is itself an important food source for predators such as Lake Trout and Burbot (Todd, 2002).	HRCA records report 1 species caught in 2001 1 km west of Randle Reef. DFO reports species as extirpated from Hamilton Harbour.
Eastern spiny softshell (*Apalone spinifera spinifera)*	Threatened provincially and nationally	Prefers habitat with a soft bottom with some aquatic vegetation with gravelly nesting areas near water (Campbell, 1991).	One female was captured in Carroll's Bay in 2003 by Royal Botanical Gardens staff (Clavering, 2003). Successful nesting occurred in 2008 along Fishermans Pier (HRCA, 2005).
Common map turtle (G*raptemys geographica)*	Special Concern provincially and nationally	Inhabits lakeshores where it basks on rocks and logs in the summer and hibernates on the bottom of deep, slow moving rivers (Roche, 2002).	Sixty-one individuals were captured in Carroll's Bay in 2003 by Royal Botanical Gardens staff (Clavering, 2003).
Stinkpot turtle (*Sternotherus odoratus)*	Threatened provincially and nationally	Shallow weedy areas with mud bottoms (Ontario Ministry of Natural Resources Canada, 2000).	Natural Heritage Information Centre Records show records occurrence in Cootes Paradise dated 2001.
Peregrine falcon (*Falco peregrinus)* Special Concern	Threatened Provincially Special Concern nationally	Nests are usually scrapes made on cliff ledges on steep cliffs, usually near wetlands -- including artificial cliffs such as quarries and buildings. Peregrines prefer open habitats such as wetlands, tundra, savanna, sea coasts and mountain meadows, but will also hunt over open forest.	Attempts to nests on artificial structures (lift bridge) in the area of Fishermans Pier (Fishermans Pier Development Plan – Aquatic and Terrestrial Resources Workshop July 2005; HRCA)
Bald eagle (*Haliaeetus leucocephalus)*	Endangered in Southern Ontario Special Concern in Northern Ontario Not at Risk	Bald eagles live near large bodies of open water such as lakes, marshes, seacoasts and rivers, where there are plenty of fish to eat and tall trees, preferably white pine, for nesting and roosting (Cadman et al, 2007).	Non-nesting visitors observed in Hamilton harbour (HRCA)

Species	Status	Habitat Requirements/ Lifecycle	Known Distribution within Hamilton Harbour
	nationally		
Hoary mountain mint *(Pycnanthemum incanum)*	Endangered provincially and nationally	Requires dry, open, sandy-clay habitats in open-canopied deciduous woods on warmer-than-normal slopes (Crins, 1986).	Occurs on the Burlington Bluffs in Hamilton.
Few flowered club rush *(trichoiphorum planifolium)*	Endangered provincially and nationally	Prefers mesic to dry hardwood forests, usually with oak component, often on hillsides (Flora of North America, 1993)	Only occurs in Royal Botanical Gardens' Cootes Paradise Nature Sanctuary in Hamilton.
Snapping turtle (*Chelydra serpentina*)	Special Concern nationally	Primarily lakes and permanent ponds and marshes, prefers muddy bottoms; can also be found in wide, deep, slow moving rivers with adequate food supply (Natural Resources Canada, 2007); http://scf.rncan.gc.ca/subsite/glfc-amphibians/chelydra-serpentina	Twenty-one individuals were captured in Carroll's Bay in 2003 by Royal Botanical Gardens staff (Clavering, 2003).

Threshold for Determination of Adverse Effects

An adverse effect on SAR biota and their habitat from the remediation of the Randle Reef site is one that is likely to cause any one of the following:

- reduction in the abundance of one or more non-listed species from an existing level, such that recovery of the population is uncertain, or more than one season would be required for a locally depleted population or altered community to be restored to pre-event conditions;
- further impairment of the ecological functioning of the biotic community; and
- an increase in ecological risk to a level that long term effects to the health of SAR within Hamilton Harbour is predicted.

A positive environmental effect for Hamilton Harbour may be the enhancement of the habitat quality, which in turn may result in a sustained increase in species health, richness, diversity and abundance including the identified SAR.

Potential Interactions, Issues and Concerns

Remediation activities have the potential to interact with some of the SAR in Hamilton Harbour. Freshwater habitat components of aquatic SAR of Hamilton Harbour will interact where hydrological and physical links exist between Cootes Paradise, Carroll's Bay, Spencer Creek and the waters of Hamilton Harbour.

There are no potential interactions, issues or concerns with any species which solely rely on terrestrial habitats for lifecycle requirements since all remediation works will occur in water. As such, the following species will not interact with works associated with the remediation of Randle Reef:

- Gravel chub *(Hybopsis x-punctata)* – has been extirpated from Canada since 1958;
- Hoary mountain mint *(Pycnanthemum incanum)* – occurs within terrestrial habitats not linked with Randle Reef and the waters of Hamilton Harbour;
- Few flowered club rush *(Trichophorum planifolium)* – occurs within terrestrial habitats not linked with Randle Reef and the waters of Hamilton Harbour; and
- Peregrine falcon *(Falco peregrinus)* – resides on cliffs/tall buildings and feeds on other birds. No direct interactions are anticipated with this species.

On the other hand, the following species will have potential interactions, issues or concerns associated with the remediation of Randle Reef since all or part of their lifecycle is dependant on aquatic systems. The potential interactions to these species are anticipated to be low, however, should an accident occur, the likelihood of interaction increases. Considering this, DFO and EC's Canadian Wildlife Service will be consulted regarding any necessary measures to avoid harmful interactions and to obtain any permits that may be required under SARA.

- American eel *(Anguilla rostrata)* – American eel has last been observed in the waters of Hamilton Harbour in 1998 (HRCA records) and has been caught in Randle Reef in 1984 (DFO records). American eel is sensitive to low dissolved oxygen levels (Hill 1969, Sheldon 1974) and will be most sensitive during the construction phase when the dredging and ECF construction will occur. Mitigation measures will be put in place to decrease direct access by all aquatic species to the work site during construction. However, it is likely that eel will avoid the Randle Reef area at this time since they are mobile.

- Northern brook lamprey *(Ichthyomyzon fosser)* – northern brook lamprey has been observed in the fishway at the junction of Cootes Paradise and Hamilton Harbour. It prefers warm water gravely streams and backwater areas (Lanteigne, 1991) and most likely inhabits the branches of watercourses which outlet to Hamilton Harbour and Cootes Paradise. Potential interactions with the remediation works might occur if siltation/contaminant fluxes drift beyond the Randle Reef area and into the various watercourses during the construction phase. However, due to flow direction from west to east in the Harbour, this potential interaction appears to be minimal.

- Redside dace *(Clinostomus elongatus)* – redside dace occurs within the main branch of Spencer Creek and is sensitive to sedimentation and changes in water quality and quantity (Parker *et al.*, 1988). Potential interactions with remediation works might occur if siltation/ contaminant fluxes drift beyond the Randle Reef area and into Spencer Creek via Cootes

Paradise during the construction phase. However, due to flow direction from west to east in the Harbour, this potential interaction appears to be minimal.

- Shortjaw cisco *(Coregonus zenithicus)* – shortjaw cisco lives in deep waters of lakes and feeds primarily on insect larvae, crustacean and shrimps. The species is in decline due to overfishing (Todd, 2002) and will most likely be most sensitive during the construction phase when dredging and ECF construction will occur. It is unlikely that shortjaw cisco will occur in the Randle Reef area of Hamilton Harbour, given their life history and habitat preference for deep water, such as depths > 37 m (e.g., Scott and Crossman, 1973). However, if the pelagic eggs of this cisco do occur in the Harbour, despite the shallow nature, it is likely that only a small number of eggs would settle in the vicinity of Randle Reef. If those eggs were lost, it would represent a very small percent of the total eggs released in the water (on the order of less than 0.01%). For this species, it is much more likely to release eggs in Lake Ontario proper and for those eggs to settle on sediments outside of Hamilton Harbour.

- Eastern spiny softshell *(Apalone spinifera spinifera)* – eastern spiny softshell turtle is a highly aquatic turtle associated with lakes and large rivers. It rarely ventures far from shoreline areas. It has been observed in Carroll's Bay and Cootes Paradise and is sensitive to environmental contaminants (Campbell *et al*., 1991). Potential interactions with remediation works might occur if siltation/contaminant fluxes drift beyond the Randle Reef area and into Carroll's Bay and Cootes Paradise during the construction phase.

- Common map turtle *(Graptemys geographica)* – common map turtle is a species of special concern which is particularly sensitive to human activities (Environment Canada, 2003). A population of common map turtles reside along the western shore of Carroll's Bay (Clavering, 2003). This species hibernates in deep waters and would potentially be affected by the remediation works. However, it is likely that common map turtle will avoid the Randle Reef area since they are mobile. Mitigation measures will be put in place to decrease direct access to the work site during construction.

- Stinkpot turtle *(Sternotherus odoratus)* – stinkpot turtle was observed in Cootes Paradise in 2001 (NHIC database). It frequents slow-moving water where it typically walks along the bottom rather than swim. Its diet consists of molluscs and insects and hibernates underwater in mud (Edmonds, 2000). Potential interactions with remediation works might occur if siltation/contaminant fluxes drift beyond the Randle Reef area and into Cootes Paradise during the construction phase. However, due to flow direction from west to east in the Harbour, this potential interaction appears to be minimal.

- Bald eagle *(Haliaeetus leucocephalus)* – bald eagle feed mainly on fish (Cadman et al, 2007). This species would be affected by the remediation works if disturbance of contaminants during the construction phase results in bio-accumulation of heavy metals (Ehrlich, Dobkin and Wheye, 1988) within the local fish populations.

- Snapping turtle *(Chelydra serpentina)* – a population of snapping turtles reside within Carroll's Bay (Clavering, 2003). The common snapping turtle is capable of surviving in significantly polluted habitats, including sewer systems. The population in Carroll's Bay and Cootes Paradise is in decline due to a drop in recruitment. The urban encroachment of the marsh has led to significant amounts of vehicle-related mortality during both the nesting season and the period of hatchling emergence and elevated levels of nest predation (Clavering, 2003).

Analysis, Mitigation and Environmental Effects Evaluation

The remediation of Randle Reef is expected to have a net positive effect on aquatic habitat and biota in general by improving the quality of the habitat in Hamilton Harbour over the long-term due to decreased contaminant flux from disturbance of contaminated sediments. However, in the short-term, the potential exists for an increase in contaminants exposure while the site is disturbed during the remediation effort. The construction of the ECF will result in the loss of approximately 7.5 hectares of aquatic habitat. However, subsequent site activities will provide an opportunity for the reestablishment of clean, usable substrate in the Randle Reef area and Hamilton Harbour. The long-term benefits of these efforts will have a positive effect of the species and their habitats across Hamilton Harbour.

Considering this, the potential environmental effects of the ECF phase fall into two general categories: (1) short-term effects associated primarily with ECF construction and the immediate post-construction period; and (2) long-term effects associated with the duration of ECF operation, maintenance and monitoring.

Construction

During the construction phase of the ECF, water from dredging will be collected and treated at a water treatment facility. The effluent from the facility will not be acutely lethal nor cause any chronic effects in aquatic biota. Specific discharge standards will be developed in conjunction with the appropriate regulatory agencies prior to the start-up of the ECF. The treatment facility will treat wastewater from ECF activities such as dewatering of the sediments.

At present, the expected duration of construction of the ECF is approximately 10 years and includes construction of the ECF containment walls along with dredging in-between, production dredging and filling of the ECF and completion of the ECF cap over 5 years. Potential effects on SAR during the construction phase and appropriate mitigation include:

- Exposure of SAR to potential re-suspension of sediments, metals and sorbed PAHs to surface water during: a. debris removal; b. dredging and c. ECF filling and dewatering:

    a. during debris removal, controlled and careful operation of removal equipment will be employed to help reduce suspended sediment during these operations. However: the magnitude; duration and geographic extent of the adverse effect is expected to be minimal since only a small point of the Harbour floor is disturbed as each piece of debris is removed resulting in an expected negligible residual environmental effect.

b. potential negative effects as a result of dredging will be mitigated by the best available technologies such as a combination of the following: dredging within confined areas (e.g., within sheet pile walls and/or silt curtains); using controls during dredging operations; including environmental dredging equipment; performing environmental monitoring during dredging operations to verify compliance with operational and performance standards and through use of a clean-up crew with containment/sorbent booms, sorbent pads and skimmers as required primarily for removal of spilled NAPLs including hydrocarbon fuels, oils and lubricants and aromatic solvents.

c. sediment/contaminant dispersion during construction activities will be controlled using impermeable floating silt curtains constructed with a flexible geotextile and weight at the bottom. Water quality monitoring will also be conducted during all in-water construction activities. For example, turbidity monitoring during dredging operations will be conducted through establishing stations (near surface, mid-depth and river bottom).

- Direct loss of 7.5 hectares of contaminated aquatic habitat that may have received limited use by some SAR species during part of their life cycle. This effect will be mitigated by the remediation of contaminated sediments following the environmental dredging phase of the ECF.
- Potential physical damage or disruption of SAR habitat during dredging, ECF filling and dewatering during construction activities will be contained within sheet pile walls and/or silt curtains. These structures will function as barriers to aquatic SAR.
- Potential disruption of SAR lifecycle (e.g., feeding, breeding and hibernating) through noise, vibration and light impacts – the existing impacts (e.g., shipways, highway noise, lighting from shoreline industrial facilities) within Hamilton Harbour have had a long-term effect on resident wildlife species where generally species diversity has decreased over the last 50 years. For the most part, SAR occur within Cootes Paradise or Carroll's Bay, areas that are approximately 4 kilometres from Randle Reef. Considering this, construction works, lighting and timing will need to have regard during spawning times of SAR.
- Potential physical harm or mortal loss of SAR during construction activities - during construction works, activities will be contained within sheet pile walls and/or silt curtains. These structures will effectively function as barriers to aquatic SAR.
- For more detail concerning the above mitigation measures, refer to the Surface Water Quality, Currents and Circulation (Section 9.3.4).

Operation

The current proposed configurations for the ECF will result in the filling of approximately 7.5 hectares of aquatic habitat within the Harbour area. The majority of this area represents sediments heavily contaminated by coal tar, PAHs and metals (BBL, 2006). Sediments have been tested for toxicity to organisms and have been demonstrated to be acutely toxic. It is expected that there will be a decreased flux from Randle Reef as a result of the removal and containment of these contaminants. The result will have a positive effect on the aquatic habitat (water and sediment quality) and SAR throughout Hamilton Harbour. Additionally, the ECF design will address the circulation of surface water in the Randle Reef vicinity. Where practical, measures will be incorporated to enhance mixing and oxygenation of surface water that receives storm water flows from municipal sources from Sherman Inlet. Potential long-term adverse effects and their appropriate mitigation include:

- Structural failure of the ECF, resulting in leakage of sediment PAHs and metals from the ECF to surface water – to mitigate surface water impacts and subsequently impacts to SAR, the following measures will be employed:
    a. installation of a drainage system in the ECF cap to limit recharge to dredged material in the ECF;
    b. conducting quality assurance monitoring of the interlock sealing process during and post construction and over the long term;
    c. conveyance of direct storm water and/or precipitation to a rock backfill between the double walls, to provide recharge in order to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the sheet pile walls (if present);
    d. conducting long-term monitoring using monitoring wells positioned between the walls; and
    e. implementation of mitigation measures such as water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.

For more detail on these mitigation measures, refer to the Surface Water Quality, Currents and Circulation (Section9.2.2..4).

A potential long-term, adverse effect may be from residual PAHs and metals remaining in sediment after dredging. Data from previous projects suggest that post-dredging residual contaminants can result in a relatively small percentage of the original contaminant mass remaining in shallow sediment. Post-dredge verification testing of the sediments and placement of a thin-layer cap over areas with remaining residual concentrations above the 100 ppm threshold will minimize the potential for residual contaminant concentrations, as well as expedite recovery of the benthic community in the priority dredging areas.

To mitigate surface water impacts and subsequent impacts to SAR biota, a range of measures will be used to achieve the long-term goals of habitat enhancement, including:

- installation of a drainage system in the ECF cap to limit recharge to dredged material in the ECF;
- conducting quality assurance monitoring of the sheet pile interlock sealing process during construction;
- conveyance of direct storm water and/or precipitation to a rock backfill between the double walls, to provide recharge in order to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the sheet pile walls;
- long-term physical inspection of the ECF containment for early detection of any potential structural failure of the ECF;
- conducting long-term monitoring using monitoring wells positioned between the double walls of the ECF to allow for early detection of any potential migration of contaminants; and
- implementation of mitigation measures such as water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.

Follow-up Maintenance and Monitoring

The removal of contaminated sediment should result in a marked improvement to the sediment quality of Randle Reef and throughout Hamilton Harbour.

Monitoring will need to verify the effectiveness of the management and control measures during the construction phase. Similarly, the effective operation of the site following completion of the remediation will need to be monitored with respect to surface water quality and the ecological integrity of SAR habitat.

Summary of Residual Environmental Effects Evaluation

The infilling of the aquatic habitat in the Randle Reef area is a necessary part of the remediation works. However, this habitat is currently contaminated and is not considered critical. The net adverse residual environmental effect on the aquatic habitat and biota is, therefore, not considered to be significant (Table 9.19). In fact a substantial net gain in aquatic habitat productive capacity is expected as a result of the sediment remediation efforts.

Table 9.19 provides a summary of the residual environmental effects and recommended mitigation measures for SAR.

Table 9.19: Residual Environmental Effects Summary for Species at Risk Habitat and Biota for different Phases of ECF phase.

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal and Dredging								
• Potential physical damage/disruption of species at risk habitat. • Potential SAR exposure to release of suspended sediments, metals and sorbed PAHs to surface water • Potential physical harm or mortal loss of species at risk	A	• Use standard sediment control devices (e.g., sheetpile walls and silt curtains). • Equipment configurations and techniques (e.g., placement of construction lighting only on construction areas), . • Environmental monitoring during construction and post construction to assess the actual affects of the remediation works.	L - mobile species (e.g., American eel, and shortjaw cisco) are able to avoid constructio n area	• In-water • Near shore	• Project Start up Phase • Frequent: duration of dredging	NR	**Species at risk habitat within close proximity to Randle Reef would be affected more.**	NS
Removal of contaminated sediments via hydraulic dredging and containment within the ECF	P	• NA • use of sediment control measures such as air bubblers to limit fish access to work site	H	Hamilton Harbour	Project Start-up Phase	NR	**Decrease of contaminants within sediment and water column**	S
Turbidity Structure Construction at U.S.Steel Intake Pipes								
Potential for transfer of sediments to Hamilton Harbour.	A	Use standard sediment control devices.	M	• In-water • Near shore • Offshore	• Project start-up Phase • Frequent: duration of dredging	NR	**Species at risk habitat within close proximity to Randle Reef**	NS
ECF Walls Construction, Pier 15 Wall Stabilization, Backfilling and U.S. Steel Channel Capping								
Noise and dust impacts to species at risk as a result of importing and on-site stock piling of quarry rock and sheet piling construction.	A	• Time construction activities to avoid breeding times (e.g., spring) • Use standard sediment control devices.	M	• In-water • Nearshore • Onshore • Haul routes	• In-Frequent • Project mid-phase	NR	**Species at risk within close proximity to Randle Reef**	NS
Removal (through infilling) of 7.5 ha of fish habitat from the Harbour area	A	Remediation of contaminated sediments through environmental dredging and subaqueous sand capping.	M	In-water	Permanent	NR	**Habitat lost is within an area that is severely degraded.**	NS
Water treatment								
Pore water from dredged sediments	P	Water treatment of pore water from dredged sediments	L	Outfall of water treatment plant	• Project mid-phase • Frequent	R	**Release of treated water to Hamilton Harbour**	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
Sediment and Effluent Management and ECF Final Capping								
Potential for sediment and contaminant flux	A	Use standard sediment control devices.	L	• In-water • On-shore	• Project End Phase • Infrequent	NR	**Species at risk within close proximity to Randle Reef**	NS
OPERATION								
Potential reduction in contaminant flux	P	• NA	H	In-water	Operation Phase	NR	**Species at risk within Hamilton Harbour**	S
Structural failure of the ECF, resulting in leakage of sediment PAHs and metals to surface water.	A	• Installation of drainage system in the ECF cap • Quality assurance monitoring of interlock sealing process • Conveyance of direct stormwater and/or precipitation to a rock backfill • Long-term monitoring program between sheetpile walls • Implement water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.	L	In-water	Operation Phase	R	**Species at risk within close proximity to Randle Reef**	NS

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3 Socio-Economic Effects Assessment

9.2.3.1 *Residential Areas*

VSC Description and Rationale for Selection

Residential areas are those occupied primarily by private residences. There are two main residential areas of concern included in this VSC. The first includes the residences in proximity to the area of project influence (see Figure 9.7) where the construction of the ECF (e.g., sheet piling and quarry rock fill for the ECF wall and increase heavy truck movements) will take place. The second includes the residences adjacent to the haul route (see Figure 9.8) which will be used to transport materials by truck to and from the project site. The residential area VSC includes existing residential land uses in addition to any residential development proposals planned by the City of Hamilton.

Spatial Boundaries

The VSC spatial boundary includes residential land uses within the area of ECF influence as shown in Figure 9.7. The area of project influence is bounded by Hamilton Harbour to the north, the U.S. Steel property and Ottawa Street North to the east, Burlington Street East/Industrial Drive to the south and Pier 11 to the west.

The spatial boundaries along the haul route presented in Figure 9.8 include the residential land uses adjacent to York Boulevard, Wilson Street/Cannon Street (both one-way streets), Victoria Avenue/Wellington Street (both one-way streets), and Burlington Street East /Industrial Drive in the City of Hamilton.

Temporal Boundaries

The VSC temporal boundary is defined by the construction and operation phases of the ECF and is identical to that established for the overall ECF (see Section 9.2.1). During construction, various peak activity (e.g., deliveries to the staging area) levels will occur.

Administrative Boundaries

The administrative boundaries are defined by private ownership and through the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval) and Zoning By-law. The Official Plan designates specific land use categories while the Zoning By-laws allocate lands in specific zones and prescribes how they are to be used.

Figure 9.7: Existing Residential Land Use in Proximity to the Area of Project Influence

Figure 9.8: Existing Land Use along the Haul Routes

Technical Boundaries

No technical boundaries relevant to the assessment of ECF effects on residential areas have been identified, as trucks will be required to use the selected haul routes along designated truck routes in the City.

Threshold for Determination of Adverse Effects

The thresholds for potential effects of residual effects are used to determine the potential adverse effects and positive effects for each of the socio-economic categories (e.g., residential, industrial, commercial, municipal land use and infrastructure, recreational and shipping and navigation).

The threshold for potential effects of residual effects (e.g., effects after mitigation) for residential areas for the purposes of the ECF is defined below:

A potential adverse effect is one in which:

- there is an increase in noise, vibration and dust caused by the construction of the ECF (e.g., sheet piling, quarry rock fill, and heavy truck movements during peak construction activity) that results in negative effects to residential areas;
- pending the selection of preferred haul route, some residential areas may also be adversely affected by increased truck traffic (e.g., noise, vibration, traffic flow); and
- public health and safety is compromised by increased truck traffic (e.g., accidents in residential areas).

A positive effect is one in which the Harbour clean-up will have a greater potential for delisting it as a Great Lakes Area of Concern with concomitant benefits to recreation, tourism, etc.

Potential Interactions, Issues and Concerns

The ECF will be developed and the contaminated sediments will be removed by dredging the material and depositing it in the ECF, which will be capped. The potential interactions relate to the construction activities that are required to build the ECF including sheet piling and quarry rock fill for the ECF wall. This also includes effects from the construction of the intake turbidity structure at the U.S. Steel I/O, and channel capping, as well as the increased heavy truck movements during peak construction activity.

Area of Project Influence

The potential issues and concerns caused by the construction of the ECF on the existing residential area (approximately 100 single family detached and semi-detached dwelling units) along Oliver Street, Land Street, Wentworth Street, Niagara Street and Hillyard Street within the area of project influence include:

- use of sheet piling equipment and increased heavy truck movements that will enter and exit the project site to transport debris material and quarry rock fill may increase the noise, vibration and dust effects on human receptors (see Section 9.3.2 Ambient Noise).

According to the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval), there are no substantial residential development proposals by the municipality within or adjacent to the area of project influence.

Haul Route

The potential issues and concerns caused by the increased heavy truck movements to transport debris material and quarry rock fill along the haul route include:

- residential land uses along the haul route may be negatively affected by the increase in noise, vibration, and dust (see Section 9.2.2.2 Ambient Noise); and
- residential land uses along the haul route (see Figure 9.8) may be negatively affected by the increased traffic volumes resulting in traffic congestion or increase collision potential at the intersections along York Boulevard, Wilson Street/Cannon Street, Victoria Avenue/Wellington Street, and Burlington Street East, all of which are currently City designated truck routes. This does not apply to the QEW/Burlington Street East alternative haul route which does not include residential areas.

According to the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval), there are no substantial residential development proposals by the municipality along any of the haul routes.

Potential air quality effects caused by the equipment used to construct the ECF as well as the emissions released from the increase in heavy truck are discussed in more detail in Section 9.2.2.1, Air Quality.

Analysis, Mitigation and Environmental Effects Evaluation

The following section outlines the ECF interaction or activity causing the environmental effect and the proposed mitigation.

Construction

Effects Analysis

The duration and the type of equipment to be used for sheet piling and the quarry rock fill for the ECF wall construction is the most important determining factor when considering the potential adverse effects on residential areas within the area of project influence and along the haul route. This specifically pertains to noise, vibration and dust effects.

Dependent on which route is chosen, the number, duration, and the type of construction related vehicles to move during morning and afternoon peak hours on arterial routes is another important determining factor when considering the potential for adverse effects on residential areas along the haul route. This specifically relates to the potential increased traffic volumes, traffic congestion, and potential collisions at the intersections along York Boulevard, Wilson Street/Cannon Street/Victoria Avenue/Wellington Street and Burlington Street East.

Lastly, the overall construction timing of the ECF is a determining factor when considering the potential impact on the market price for residential properties within the area of project influence.

Mitigation

The residential areas located within the area of project influence (residences on Oliver Street, Land Street, Wentworth Street, Niagara Street and Hillyard Street) are located within an industrial zoned area. The prohibition of the existing Noise By-law 03-020 Item 7 (City of Hamilton, January 2009) does not apply to residential areas located in the area of project influence, nor along the potential haul routes: Oliver Street, Land Street, Wentworth Street, Niagara Street, Hillyard Street, York Boulevard, Wilson Street/Cannon Street, Victoria/Wellington Street and Burlington Street East. This has been confirmed through communication with the City's By-Law Enforcement Department.

With respect to the existing residences located on Oliver Street, Land Street, Wentworth Street, Niagara Street and Hillyard Street, the temporary (5 to 8 years) effects caused by the construction of the ECF will be mitigated by using vibrating sheet pile installation. This installation technique produces less noise than the pile driving technique.

Currently, the City of Hamilton does not have a Zoning By-Law for dust emissions in residential or industrial zoned areas. With reference to the Clean Air Hamilton website (www.cleanair.hamilton.ca), industries that handle or store large amounts of particulate-containing materials, such as bulk storage facilities and the aggregate industry are encouraged to implement dust control best management practices and on-site management to reduce the amount of dust dispersed into the air. Therefore, the dust control best practices (e.g., wash bay stations for trucks) will be incorporated into the mitigation plan.

Within the area of project influence, trucks will travel through HPA lands and onto Sherman Avenue North and thus avoid residential areas. For the residential areas along the haul route, roadway level of service or access to a residential property may be compromised by the additional daily heavy truck traffic travelling on the arterial streets and local roads. The mitigation strategies to be used include, but are not limited to, designating and enforcing a haul route so that all truck traffic comes from the east via QEW/Burlington Street East and not through the City (e.g., York Boulevard/Wilson Street/Cannon Street/Victoria Avenue/Wellington Street).

In addition, appropriate methods and approved municipal and provincial haul routes for the transport of the material will be required in the contractor's submission and will be included and adhered to during construction. Haul routes will be selected so that effects to residential neighbourhoods are minimized.

It is also noted that the construction contractor may determine or acquire the various construction materials and use one or more transportation methods, including rail, barge or truck, which will be identified in the bid documents. Methods for the transport of the material will be required in the bidder's submission, and will be adhered to during construction. The transport of materials will be conducted in an environmentally sound manner and in accordance with all applicable legislation.

Residual Effects

Given the above mitigation measures, the construction phase of the ECF is not expected to have any significant residual adverse effects on residential areas.

<u>Operation</u>

Effects Analysis

During the operation phase of the ECF, potential effects to residential land uses will depend on how the ECF lands are to be used. At this time it is proposed that the ECF will be used as a marine terminal. Specific future uses of the marine terminal are still unknown at this time and will be established by the future tenant. The proposed use of the ECF is consistent and compatible with the existing industrial land uses and the HPA Land Use Plan. Furthermore, based on the distance of the ECF from sensitive land uses (e.g., residential) and the nature of existing industrial land uses that surround the residential area and provide a buffer to the proposed ECF, it is unlikely that the operation phase of the project will cause an adverse negative effect to the residential zones within the area of project influence.

Mitigation

During the operation phase of the ECF, the responsible party/owner will verify that all standard operating regulations and local protocols required for a marine terminal by the HPA are met.

Residual Effects

The operation phase of the ECF is not expected to have any significant residual adverse effects on residential areas.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to construction activities (e.g., sheet piling, quarry rock fill and increased heavy truck movements) on existing residential areas within the area of project influence and along the haul route are not considered significant. Any adverse effects would be temporary and minimized through the identified mitigation measures.

Table 9.20 provides a summary of the residual environmental effects and recommended mitigation measures for residential areas.

Table 9.20: Residual Environmental Effects Summary for Residential Areas

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at U.S. Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, U.S. Steel Channel Capping, Backfilling, ECF Final Capping								
Use of sheet piling equipment and increased heavy truck movements that will enter and exit the project site to transport debris material and quarry rock fill may increase the noise, vibration and dust effects on human receptors	A	• Vibrating sheet pile installation; • Delineate the limits of work zones; • Designate and enforce haul route so that all truck traffic uses the designated truck routes (e.g., come from the east via QEW/Burlington Street East and not through the City); • Appropriate methods and approved Municipal and Provincial haul routes for the transport of the material will be required in the contractor's submission and will be included and adhered to during construction; • Haul routes will be selected so that effects to sensitive land uses are minimized; • Construction contractor may determine or acquire the various construction materials and use one or more methods, including rail, barge or truck; and • Transport of materials will be in an environmentally sound manner and in accordance with all applicable legislation;	L	Local	Medium term	R	NA	NS
Public health and safety is severely compromised by increased truck traffic and may increase traffic volumes resulting in traffic congestion, collision potential at the intersections along York Boulevard, Wilson Street (Cannon Street), Victoria Avenue (Wellington Street), and Burlington Street East.	A	• Appropriate methods and approved Municipal and Provincial haul routes for the transport of the material will be required in the contractor's submission and will be included and adhered to during construction; • Haul routes will be selected so that effects to sensitive land uses are minimized; • Construction contractor may determine or acquire the various construction materials and use one or more methods, including rail, barge or truck; and • T ransport of materials will be in an	L	Local	Medium term	R	NA	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
		environmentally sound manner and in accordance with all applicable legislation.						
Dredging Activities, Sediment and Effluent Management								
These activities will be done in water and will not cause an adverse effect on industrial, commercial, and municipal uses.	NA	None	NA	NA	Short-Medium term	NA	NA	NS
OPERATION								
Containment of the Contaminated Sediments within the ECF								
ECF is consistent and compatible with the existing industrial uses. Based on the distance of the ECF from sensitive land uses (e.g., commercial) and nature of existing industrial land uses that surround the proposed ECF, it is unlikely that the operation phase of the project will cause an adverse negative effect on the industrial and commercial land uses within the area of project influence.	NA	Follow standard operating regulations and local protocols as sought out by the HPA.	NA	NA	NA	NA	NA	NS

Notes: NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3.2 *Industrial, Commercial, Municipal Land Use and Infrastructure*

<u>VSC Description and Rationale for Selection</u>

According to the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval):

- industrial land uses include, but are not limited to, manufacturing, warehousing, research and development, motor vehicle service stations, communications establishments (printing and media), etc.;
- commercial land uses include, but are not limited to, retail stores, hotels, offices, medical clinics, etc.; and
- municipal land uses include, but are not limited to, places of worship, parks, community centres, schools, fire stations, libraries, etc.

In addition to the above, the infrastructure component for this ECF includes utility corridors for sewer and water mains, storm water management facilities, hydro, gas, telephone, rail and roads. These corridors will be part of the ECF construction in support of its end use as a marine terminal.

This VSC was identified because the construction and operation of the ECF has the potential to negatively impact industrial, commercial, and municipal land uses, in addition to infrastructure through displacement and/or disruption of these uses. With respect to infrastructure there is also the potential that the current infrastructure is inadequate to support construction and operation of the ECF.

<u>Spatial Boundaries</u>

The VSC spatial boundary includes industrial, commercial and municipal land uses within the area of project influence shown on Figure 9.10. The area of project influence is bounded by Hamilton Harbour to the north, the U.S. Steel property and Ottawa Street to the east, Burlington Street East/Industrial Drive to the south and Pier 11 to the west.

The spatial boundaries along the haul route (see Figure 9.9) include the industrial, commercial and municipal land uses adjacent to York Boulevard, Wilson Street/Cannon Street (both one- way streets), Victoria Avenue/Wellington Street (both one-way streets), and Burlington Street/Industrial Drive in the City of Hamilton.

<u>Temporal Boundaries</u>

The VSC temporal boundary is defined by the construction and operation phases of the ECF and is identical to that established for the overall ECF (see Section 9.2.1). During construction, various peak activity (e.g., deliveries to the staging area) levels will occur.

Administrative Boundaries

The administrative boundaries are defined by private and public ownership in the Bayfront Industrial Area and the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval [14]). The Official Plan designates specific land use categories while the Zoning By-laws allocate lands in specific zones and prescribes how they are to be used.

Technical Boundaries

No technical boundaries relevant to the assessment of ECF effects on industrial, commercial and municipal land use areas have been identified, as trucks will be required to use the selected haul routes along designated truck routes in the City.

Threshold for Determination of Adverse Effects

The thresholds for potential effects of residual effects (e.g., effects after mitigation) for industrial, commercial and municipal land use, in addition to infrastructure for the purposes of the ECF are defined as follows:

A potential adverse effect is one in which:

- there is a sustained change in existing patterns and land uses that adversely affects all or a portion of the industrial, commercial and municipal utilization of the lands for an extended period. This includes the potential to displace established land uses and non-compliance with the City of Hamilton's Official Plan and Zoning By-laws;
- the ECF disrupts the existing infrastructure to the extent that it can no longer serve its intended land use;
- a specific infrastructure deficiency necessary to construct and/or operate the ECF is identified; and
- public health and safety is severely compromised by increased truck traffic (e.g., accidents in commercial and municipal areas).

A positive effect is one in which there would be the provision of increased opportunities for an increase in government tax revenues related to new industrial and other supporting land uses in the Bayfront Industrial Area. This would also include supporting infrastructure improvements.

14 Hamilton's new Urban Official Plan was created to update and consolidate the policies of the seven former Official Plans (the Region and six former municipalities) into one Plan to apply to the entire City and is pending Ministerial approval

Potential Interactions, Issues and Concerns

The ECF will be constructed and the contaminated sediments will be dredged and the material pumped into the ECF, which will be capped. The potential interactions relate to the construction activities that are required to build the ECF including the installation of sheet piling and the use of quarry rock fill for the ECF wall. This also includes effects from the construction of the intake turbidity structure at the U.S. Steel I/O, and channel capping, as well as the increased heavy truck movements during peak construction activity.

The potential issues and concerns caused by the construction of the ECF on the existing land uses and infrastructure within the area of project influence and along the haul route include:

- use of sheet piling equipment combined with the increased heavy truck movements that will enter and exit the project site to transport debris and quarry rock fill may increase the noise, vibration and dust effects on human receptors (see Section 9.3.2 Ambient Noise);
- sensitive land uses (e.g., commercial and municipal) along the haul route may be negatively affected by traffic congestion or increased collisions due to increased traffic volumes and increased traffic may also negatively affect property aesthetics. Depending on which haul route is chosen, fuel or materials spills may also potentially affect sensitive land uses;
- the material staging area will require land from the HPA Pier 16 and , though unlikely, may also require some land from U.S. Steel. There will be a few occasions when Heddle Marine (Pier 14, dry dock and tugs/barges) may have to relocate its activities to other parts of Pier 14 for short periods of time to allow for dredging along the Pier 14 side wall; and
- the staging area and the water treatment plant may potentially conflict with existing infrastructure or there may be requirements to address infrastructure deficiencies.

According to the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval), there are no substantial industrial, commercial and municipal land use development proposals planned by the municipality within the area of project influence or along the haul route. With respect to future land uses, most of the major development areas are proposed in other parts of the City.

Potential air quality effects caused by the equipment used to construct the ECF as well as the emissions released from the increased heavy truck traffic are discussed in more detail under a separate section (see Section 9.2.2.1 Air Quality).

Analysis, Mitigation and Environmental Effects Evaluation

The following section outlines the ECF interaction or activity causing the environmental effect and the mitigation measures proposed to reduce or eliminate the effect.

There are three distinct areas of concern relating to ECF construction:

- industrial, commercial, and municipal land uses within the area of project influence;
- industrial, commercial, and municipal land uses along the haul route; and
- infrastructure conflicts or deficiencies related to construction and facility operation.

For each of these areas, the following section identifies the environmental effects, mitigation, and residual effects (if any).

Construction

Effect Analysis

Along Burlington Street East from Wellington Street North to Sherman Avenue North, the area is comprised of primarily industrial uses (e.g., auto collision and repair shops, processing plants, chemical storage and handling). Several of these industrial uses require waterborne shipping and receiving. Potential effects to shipping and navigation are addressed separately in Section 9.2.3.9.

Commercial land uses are limited to a variety store located on the north east corner of Burlington Street East and Wentworth Street North and a café situated in a commercial plaza located at 601 Burlington Street East between Sherman Avenue North and Hillyard Street. In addition to the café, there are other businesses located in the plaza servicing industrial/commercial land and marine operations (e.g., plumbing, refrigeration and heating).

Existing industrial and commercial land uses within the area of project influence, including the haul route, are shown on Figure 9.9. There are no municipal land uses in the area of project influence.

The Port Map on the HPA website identifies industrial land uses that could potentially be affected by the ECF, including:

- Pier 14 – There are 3 current tenants. Cargo types handled include general and dry bulk cargo while drydock services are also offered.
- Pier 15 – There are 33 current tenants. These businesses provide a wide variety of industrial and commercial services such as warehousing, record management, industrial and construction supply, manufacturing, consulting, etc.
- Pier 16 – U.S. Steel. This business makes raw steel, steel sheet and tubular products for the automotive, appliance, container, industrial machinery, construction and oil and gas industries.

Figure 9.9: Existing Industrial and Commercial Land Uses within the Area of Project Influence

Currently, the proposed staging area is on HPA property on the section of Pier 15 east of Sherman outlet. This area is identified as the preferred location for staging and material storage during dredging and construction of the ECF since it is adjacent to the area of concern and land appears to be more abundant and less utilized compared to other piers. HPA has clarified where locations of long term leases exist on the property. If access to U.S. Steel land is required, appropriate approvals and arrangements will
be made.

The duration of work and the type of equipment used for sheet piling and depositing the quarry rock fill in the ECF wall are the most important factors that determine the potential adverse effects on industrial, municipal and commercial land uses within the area of project influence and along the haul route. Potential adverse effects include noise, vibration and dust effects.

Mitigation

Because this area is located within an industrial zoned area, the Noise By-law 03-020 (City of Hamilton, January 2003) and provisions to regulate sound emissions do not apply. Recognizing the need to address effects from construction, the mitigation strategies that will be employed for the residential area (see Section 9.2.3.1), which covers the same area, will be applied. For instance, the use of vibratory equipment for sheet pile installation produces less noise and impact effects than the pile driving technique.

Should lands from U.S. Steel be required for additional staging space, then consultation with U.S. Steel, combined with careful construction planning will minimize the amount of land required and help avoid interference with surrounding industrial activities. This may also include preparation and negotiation of temporary and permanent easement agreements as required. Other mitigation measures that will help to avoid undue disruption to existing business include advanced notification to Heddle Marine prior to dredging along Pier 14.

Residual Effects

Given the above mitigation measures, the ECF construction is not expected to have any significant residual adverse effects on industrial or commercial land use within the area of project influence.

Construction

Effects Analysis

York Boulevard and Wilson Street/Cannon Street

There are a variety of light industrial and commercial land uses located along York Boulevard and Wilson Street. In addition, there are many municipal land uses and facilities including Hamilton Central Library/Farmers Market, Hamilton City Centre, Copps Coliseum, Wesley Child Care

Centre, Southern Ontario College, Dr. J. Edgar Davey Public School, James St. Alternative Public School and several churches.

York Boulevard and Wilson Street/Cannon Street are four lane one-way arterial roads designated as full time truck routes through the City. According to the City of Hamilton *Road Network Strategy Proposed Road Infrastructure Improvements* (City of Hamilton Road Network Strategy, May 2007) the two-way conversion from one-way on York Boulevard/Wilson Street between Bay Street and Wellington Street is tentatively scheduled as a Municipal Class EA "Schedule C" project, and anticipated construction timing for 2012-2021. Dependent on scheduling, this future improvement may have some impact on this haul route.

Both of these roads are designed to accommodate high traffic volumes (both cars and trucks), however, with an increase in truck traffic through this area the level of service and road capacity may be compromised resulting in negative effects to industrial, commercial and municipal land uses.

Victoria Avenue North/Wellington Street North

There are a variety of commercial establishments and one notable municipal land use, the EMS Ambulance Station at the southwest quadrant of Burlington Street East and Victoria Avenue.

Victoria Avenue/Wellington Street are four lane one-way arterial roads with on-street parking designed to accommodate truck traffic. According to the Road Network Strategy Proposed Road Infrastructure Improvements (2007) there are no plans for infrastructure improvements on this road.

Burlington Street East/Industrial Drive

Land uses along Burlington Street East/Industrial Drive are primarily industrial and commercial. There are no municipal uses along Burlington Street East/Industrial Drive.

Burlington Street East is a six lane two-way arterial road designed to accommodate truck traffic. Industrial Drive is a four-lane one-way arterial road diversion of Burlington Street East starting at Ottawa Street westerly to Birch Avenue where it connects into Burlington Street East. According to the Road Network Strategy Proposed Road Infrastructure Improvements, there are no plans for improvements on these roads.

The number, duration and type of construction-related vehicles moving during morning and afternoon peak hours on arterial streets is an important determining factor when considering the potential for adverse effects on industrial, commercial and municipal land uses along the haul route. This specifically relates to noise, vibration, dust and the potential increase in traffic volumes resulting in traffic congestion and collisions at the intersections along York Boulevard, Wilson Street/Cannon Street, Victoria Avenue/ Wellington Avenue and Burlington Street East.

Mitigation

Within the area of project influence, trucks will travel through HPA lands and onto Sherman Avenue North. The proposed mitigation includes the designation and enforcement of a haul route so that that all truck traffic comes from the east via QEW/Burlington Street East and not through the City (e.g., York Boulevard/Wilson Street/Victoria Avenue). In addition, appropriate methods and approved municipal and provincial haul routes for materials transport will be required in the contractor's submission and will be included and adhered to during construction. Haul routes will be selected so that effects to sensitive land uses are minimized.

Finally, the construction contractor may determine or acquire the various construction materials and use one or more transportation methods, including rail, barge or truck, which will be identified in the bid documents. Methods for the transport of the material will be required in the bidder's submission, and will be adhered to during all phases of construction. The transport of materials will be conducted using generally accepted construction best management practices and will be undertaken in accordance with all applicable legislation.

Residual Effects

Given the above mitigation measures, the construction phase of the ECF is not expected to have any significant residual adverse effects on the industrial, commercial and municipal land uses along the haul route.

<u>Construction</u>

Effects Analysis

CN Railway connects with the Hamilton Port Authority rail spur line (Pier 16 – 24) in the Bayfront Industrial Area. All rail facilities will be maintained during construction and operation. There are no current plans for expansions of these existing railway lines. A rail spur may be extended to the ECF once the final industrial use of the capped ECF is determined. This would accordingly be identified and developed through a separate planning process.

During the construction phase of the ECF, disruption to existing utilities may occur. For example, dependant on the completion of utility locates, the construction of the water treatment plant may require the relocation of some utilities (e.g., gas).

Mitigation

During the detailed design phase of the project, utilities (e.g., gas, hydro, storm sewer and communications) located in proximity to Pier 16 will be identified by the contractor to confirm location, potential conflicts and any planned improvements (e.g., future upgrades) that could potentially be coordinated with this project.

Proposed mitigation strategies include ensuring that the contractor identifies the existing utility services and proposed tie-in locations to the HPA for approval prior to excavations for staging and water treatment areas. Based on this, the contractor may provide supplemental services (e.g., utility relocations), as required, in accordance with contract detailed design specifications. In addition, as required, the contractor will also provide a flag person for any railroad crossings at the internal access road in accordance with contract detailed design specifications. Construction vehicle traffic will be managed in accordance with HPA safety protocols and applicable local requirements.

Residual Effects

Given the mitigation measures proposed above, the construction of the ECF is not expected to have any significant residual adverse effects on the existing infrastructure.

Operation

Effects Analysis

Given the ECF will be created within Hamilton Harbour where currently there is no existing marine terminal, potential interference with existing land and marine operations may occur. These effects will be related to a slight increase in truck, ship and possibly rail traffic to the ECF, depending on what exactly the ECF will be used for once construction is complete.

At this time it is proposed that the ECF will be used as a marine terminal. Specific future uses of the marine terminal are still unknown at this time and will be established by the future tenant. The proposed use of the ECF is consistent and compatible with the existing industrial uses in the area. Based on the distance of the ECF from sensitive land uses (e.g., commercial) and the nature of existing industrial land uses that surround and provide a buffer to the proposed ECF, it is unlikely that the operations phase of the ECF will cause an adverse negative effect on these land uses within the area of project influence.

With respect to the infrastructure that must be extended to the ECF (electricity, water, sewer, etc.), there may be a requirement to extend or establish new infrastructure to support port and industrial activities. This requirement will be determined as the project proceeds but no effects to existing infrastructure are expected.

Mitigation

Early detection of potential interference with existing land and marine operations coupled with early consultation with U.S. Steel and HPA can minimize and/or eliminate this possibility. The ECF owner(s) and HPA will verify that all standard operating regulations and local protocols required for a marine terminal are met. In addition, any infrastructure deficiencies and requirements will be addressed at the appropriate time when the ECF land use is confirmed.

Residual Effects

The operation phase of the ECF is not expected to have any significant residual adverse effects on industrial, commercial and municipal land uses or on existing infrastructure.

Summary of Residual Environmental Effects

The potential for adverse environmental effects from ECF -related construction activities on industrial, commercial and municipal land uses, as well as on infrastructure within the area of project influence and along the haul route are not considered significant. Any adverse effects are expected to be of short duration and will be minimized through the use of standard construction best management practices and project-specific mitigation measures.

Table 9.21 provides a summary of the residual environmental effects and recommended mitigation measures for industrial, commercial, and municipal land uses, as well as infrastructure.

Table 9.21: Residual Environmental Effects Summary for Industrial, Commercial, Municipal Land Use, and Infrastructure

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at U.S. Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, U.S. Steel Channel Capping, Backfilling, ECF Final Capping								
Use of sheet piling equipment and increased heavy truck movements that will enter and exit the project site to transport debris material and quarry rock fill may increase the noise, vibration and dust effects on human receptors.	A	• Vibrating sheet pile installation; • Delineate the limits of work zones; • Designate and enforce haul route so that all truck traffic uses designated truck route (e.g., come from the east via QEW/Burlington Street East and not through the City); • Appropriate methods and approved Municipal and Provincial haul routes for the transport of the material will be required in the contractor's submission and will be included and adhered to during construction; • Haul routes will be selected so that effects to sensitive land uses are minimized; • Construction contractor may determine or acquire the various construction materials and use one or more methods, including rail, barge or truck; and • Transport of materials will be in an environmentally sound manner and in accordance with all applicable; legislation.	L	Local	Medium term	R	NA	NS
Sensitive land uses (e.g., commercial and municipal) along the haul route may be negatively affected by the increased traffic volumes resulting in traffic congestion or increased collision potential.	A	• Delineate the limits of work zones; • Designate and enforce a haul route so that all truck traffic comes from the east via QEW/Burlington Street East and not through the city; • Appropriate methods and approved Municipal and Provincial haul routes for the transport of the material will be required in the contractor's submission and will be included and adhered to during construction; • Haul routes will be selected so that effects to sensitive land uses are minimized; • Construction contractor may determine or acquire the various construction materials and use one or more methods, including rail, barge or truck; and • Transport of materials will be in an environmentally sound manner and in accordance with all applicable legislation. •	L	Local	Medium term	R	NA	NS
Disruption to adjacent industrial land uses, U.S. Steel and Heddle Marine Pier 14 operations, as a result of the material staging area.	A	• Avoid use of U.S. Steel property; • If necessary, minimize the amount of land required for staging and interference with surrounding industrial activities and prepare temporary and permanent easement agreements. Provide advanced notification to Heddle Marine regarding temporary effects to Pier 14	L	Local	Short-term	R	NA	NS

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
		operations						
Disruption to existing utilities (e.g., gas, hydro, communications), water treatment plant, and railroad crossings as a result of the material staging area.	A	• Contractor will be responsible for the protection or relocation of existing site utilities and shall verify the location of such facilities using third party locate services prior to excavations for staging and water treatment areas; • City to comment on potential effects to utilities; • Contractor to provide flag person; and • HPA safety protocols and applicable local requirements.	L	Local	Short- term	R	NA	NS
Dredging Activities, Sediment and Effluent Management								
No project –environment interaction as activities will be completed in-water	NA	• None	NA	NA	Short-Medium term	NA	NA	NS
OPERATION								
Containment of the Contaminated Sediments within the ECF								
Use of the ECF is consistent and compatible with the existing industrial uses. Based on the distance of the ECF from sensitive land uses (e.g., commercial) and nature of existing industrial land uses that surround the proposed ECF, it is unlikely that the operation phase of the project will cause an adverse negative effect on the industrial and commercial land uses within the area of project influence. There may be a requirement to extend or establish new infrastructure to support port and industrial activities related to the ECF.	NA	• Coordinate infrastructure improvements with the City as required.	NA	NA	NA	NA	NA	NS

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3.3 *Sherman Inlet*

VSC Description and Rationale for Selection

Sherman Inlet is a small surface water feature (in fact, a remnant natural wetland or backwater embayment) surrounded by industrial land and bordered by trees and shrubs. It discharges stormwater runoff and combined sewer overflows in a northerly direction into the southeast corner of Hamilton Harbour (Figure 9.10). The inlet is approximately 370 m long and ranges between 4 m and 30 m wide. Sherman Inlet is connected to Hamilton Harbour via a concrete culvert approximately 12 m in diameter.

The Sherman Inlet VSC includes the surface water and sediment quality within the inlet, as well as the inlet's hydrologic flow regime. The rationale for including Sherman Inlet as a VSC is primarily the public concern expressed for maintaining this green space. There is a Sherman Inlet Committee that meets regularly regarding the potential remediation of the area. A Public Open House was held in December 2007 for review of various studies.

Spatial Boundaries

The spatial limits of the Sherman Inlet VSC are shown on Figure 9.8. None of the terrestrial or aquatic ECF activities impinge directly on Sherman Inlet.

Temporal Boundaries

The temporal boundary of this VSC is defined by the duration of construction and remediation works since these activities have the potential to negatively affect the VSC. At present, the expected duration of construction of the ECF is approximately 10 years and includes construction of the ECF containment walls along with dredging in-between, production dredging and filling of the ECF and completion of the ECF cap.

Administrative Boundaries

Sherman Inlet's wetland attributes have not been formally evaluated and so it is not currently covered by the Provincial Policy Statement (PPO, 2005). Sherman Inlet is wholly owned by HPA.

Surface water quality in Ontario is regulated by the provincial government through MOE. MOE has established PWQOs that will be used as the base thresholds for monitoring within the inlet (MOEE, 1994).

The Provincial Sediment Quality Guidelines (PSQGs) are guidelines for use in evaluating the quality of sediments in Ontario. The guidelines establish three levels of effects primarily based on the effect of sediment on the sediment-dwelling organisms. The levels include: 1) the no effect level; 2) the lowest effect level; and 3) the severe effect level.

Water circulation within Sherman Inlet is not regulated. However, the HPA maintains an interest in circulation since changes to circulation may potentially effect the long term surface water and sediment quality within the Inlet.

Technical Boundaries

PWQOs contain criteria for all of the critical parameters that will be monitored within the Inlet. The technical boundaries for this VSC are defined by environmental studies that assess the quality of the surface water and sediment within the Sherman Inlet (Earth Tech Canada Inc., 2005). No technical limitations are expected to constrain this VSC.

The PSQGs provides criteria for all of the primary contaminants of concern that will be assessed following the completion of dredging activities in the vicinity of Sherman Inlet. However, existing background sediment quality within the Inlet will be taken into consideration for the establishment of the sediment quality thresholds.

The available surface water and sediment quality data indicate elevated concentrations of several metal and PAH parameters in the surface water and sediment samples of Sherman Inlet. In addition, elevated concentrations of Total PCBs were detected in the sediment samples obtained within the Sherman Inlet (Earth Tech Canada Inc., 2005).

Threshold for Determination of Adverse Effects

The thresholds for potential effects to this VSC will be determined based on the application of PWQOs to water samples taken within the Inlet.

A potential adverse effect on the Sherman Inlet occurs when the ECF activity in Hamilton Harbour results in:

- a degradation of water quality such that the concentrations of contaminants of concern in water samples do not meet the applicable PWQO or exceed background concentrations established in previous environmental studies;
- a degradation of sediment quality due the deposition of contaminated sediments, exceeding sediment quality thresholds within the Inlet; or
- permanent effect on the circulation pattern, such that long term degradation of surface water and sediment is likely within the Inlet.

Potential Interactions, Issues and Concerns

No ECF activity will be undertaken within Sherman Inlet itself. Construction and dredging activities within Hamilton Harbour have the potential to negatively affect water quality within the inlet should turbid water be allowed to disperse upstream through the concrete culvert into

Sherman Inlet proper. This is considered extremely unlikely as the culvert entrance to Sherman Inlet will be equipped with sediment barriers to restrict the transport of suspended sediment from the Harbour into the Inlet.

Storage of construction material and excavated soil from Pier 15 is slated for Pier 15 approximately 20 m north of the mouth of Sherman Inlet. It is conceivable that stormwater runoff could discharge to Sherman Inlet if no effort is made to prevent this from occurring.

With the implementation of mitigation measures described below, no significant impact to the VSC is expected.

Analysis, Mitigation and Environmental Effects Evaluation

As noted above, construction or dredging activities within Hamilton Harbour have the potential to negatively affect water quality and sediment within Sherman Inlet should turbid water be allowed to disperse upstream through the concrete culvert into Sherman Inlet proper. While this scenario is unlikely, it can be easily prevented by installing silt barriers or other types of sediment traps across the culvert at the mouth of the Inlet. Once this is accomplished, no significant impact to the VSC is expected.

Standard stormwater management techniques can be used where soil and materials are stockpiled. These techniques (use of silt fences, hay bales, sedimentation ponds, infiltration pits, etc.) will prevent uncontrolled stormwater discharge to Sherman Inlet. In addition, a stormwater management system consisting of sand filtration berms (or a similar alternative) is proposed for the staging area.

Summary of Residual Environmental Effects

ECF activities are expected to have net beneficial effects on the surface water in Hamilton Harbour both within and beyond the project boundary as surface water quality is expected to improve where Sherman Inlet discharges to Hamilton Harbour. Given this and the fact that no ECF related activity will occur within Sherman Inlet, no residual negative environmental effects are anticipated (Refer to Table 9.22).

Table 9.22: Residual Environmental Effects Summary for Sherman Inlet

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, ECF Wall Installation, U.S. Steel Turbidity Structure Construction, Pier 15 Stabilization, Backfilling/Thin Layer Cap and U.S. Steel Sediment Capping, Backfilling/Thin Layer Cap and U.S. Steel Sediment Capping, Dredging, Treated Dredging Effluent Discharge, Terrestrial Storage of Debris, Construction Material and Excavated Soil								
Re-suspension of contaminated sediment from preliminary debris removal, the construction of the ECF walls, Pier 15 stabilization, construction of the U.S. Steel turbidity structure, and sediment capping and dredging activities near Sherman Inlet	A Release of contaminated bottom sediment into suspension	• Utilizing silt curtain to isolate the construction zone, installation of a silt curtain or similar barrier at the culvert entrance into Sherman Inlet	L	Proximity of Sherman Outlet	<1 year	R	Degraded water quality and Sediment	NS
Infiltration of precipitation and snow melt into storage piles of debris, construction material and impacted soil near the Harbour	A Discharge of turbid stormwater from storage piles leading to increased turbidity	• Installation of a storm management system surrounding the Site and staging area; use of tarps or geotextiles to cover the piles to reduce contact with stormwater;	L	Proximity to the Harbour shoreline	Constructio n period (6 years)	R	Degraded Environment	NS
Storage of debris, construction and impacted soil material on site	A Increase site run offs contaminants loading	▪ Appropriate storm management system surrounding the Site and staging area; and • Temporary coverage of the material during down pour occurrences.	L	Proximity of HPA shore line and Sherman Outlet	10 years	R	Already impacted	NS
OPERATION								
Migration of Contaminated ECF Seepage Water, Potential Changes to Currents and Water Circulation in the Harbour								
Water quality improvements in Sherman Inlet after construction completed	P Decrease in contaminants entering from the Harbour	• NA	NA	NA	NA	NA	NA	NA

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3.4 *Public Health and Safety*

VEC Description and Rationale for Selection

Human health is included as part of the environmental assessment due to public and regulatory concern that ECF activities may influence the health of individuals in and around the City of Hamilton. In particular, there is concern that there will be health effects from emissions from the project during ECF construction. This VEC is linked directly to the Air Quality VEC (Section 9.2.2.1) and the Residential Area VEC (Section 9.2.3.1).

Spatial Boundaries

The project spatial boundaries include the sites on which construction activities will be occurring, as well as transportation routes through the surrounding neighbourhoods. These boundary areas are represented on Figures 9.7 and 9.8. The boundary areas also encompass the influence of the project air emissions, including the sensitive receptors nearest to the remediation site. As described in the Air Quality section (Section 9.2.2.1) this area is a 5 km by 5 km domain surrounding the project site and includes the commercial properties and nearest residential communities surrounding the project site.

Temporal Boundaries

Temporal boundaries for the assessment of this VEC have been developed in consideration of those time periods during which the ECF may have the potential to affect human health. These include periods of construction and operation. It is expected that the majority of these potential interactions will occur during the construction phase. The construction activities for the ECF are expected to have a duration of approximately 10 years.

The operational phase, which for the purposes of this assessment addresses only the facility's function as an ECF and not its future use as a marine terminal, will continue indefinitely. It is not anticipated that the facility will be decommissioned.

Administrative Boundaries

The regulatory administration of the potential air emissions of the ECF is documented in Section 9.2.2.1. In addition, the City of Hamilton regulates some associated activities through its by-laws. While the scope of this assessment does not specifically include issues related to construction workers' health and safety, it should be noted that their safety will be the responsibility of the contractors, in accordance with the Ontario Occupational Health and Safety Act.

Technical Boundaries

As previously noted, the assessment of ECF activities on Public Health and Safety is highly reliant on Section 9.2.2.1 Air Quality and the quantitative modeling exercises detailed in that Section. The technical boundaries that relate to the assessment of emissions on public health and safety are similar to those outlined in the section for the emissions modeling.

Threshold for Determination of Adverse Effects

The thresholds for potential effects on public health and safety are defined as follows:

A potential adverse effect on public health and safety occurs when there are adverse health effects or serious injury as a result of ECF activities.

A positive effect occurs where the ECF activities remove or decrease any exposure to the public to a current health and safety risk.

Potential Interactions, Issues and Concerns

The ECF will be constructed over some of the most highly contaminated sediment so that disturbance of these sediments will be minimized. The remaining surrounding contaminated sediments will be removed by dredging the material and depositing it in the ECF. The ECF will then be capped. The potential interactions relate to the construction activities that are required to build the ECF, including sheet piling and quarry rock fill for the ECF wall. This also includes effects from the construction of the intake turbidity structure at the U.S. Steel I/O and U.S. Steel channel capping, as well as the increased heavy truck movements during peak construction activity.

The potential issues and concerns caused by the construction of the ECF on the existing residential area (approximately 100 single family detached and semi-detached dwelling units) along Oliver Street, Land Street, Wentworth Street, Niagara Street and Hillyard Street within the area of project influence include:

- use of sheet piling equipment and increased heavy truck movements that will enter and exit the project site to transport debris material and quarry rock fill may increase the noise, vibration and dust effects on human receptors (see Section 9.2.2.1 Air Quality and Section 9.2.2.2 Ambient Noise);
- unauthorized access to the work site by members of the public that could result in injury;
- air emissions related to the release of air contaminants through material handling (see Section 9.2.2.1 Air Quality); and
- spills on the project site as well as public roads as a result of vehicle accidents.

According to the Urban Hamilton Official Plan (City of Hamilton's Urban Area, pending Ministerial approval), there are no substantial residential development proposals within or adjacent to the area of project influence. As a result, the current potential residential receptors, which have been assessed in this CSR, are not expected to substantively change in the near future.

Potential air quality effects caused by the equipment used to construct the ECF as well as the emissions released from the increase in heavy truck traffic are discussed in more detail in Section 9.2.2.1, Air Quality.

The operational phase of the ECF will have limited activities associated with it and it is not expected to have any interaction with the public that would have any potential negative effects on public health and safety.

Analysis, Mitigation and Environmental Effects Evaluation

Construction

Potential Increase of Noise and Dust in Residential Areas

As noted, there is a potential for noise and dust to negatively affect the local residents in the vicinity of the work area. The potential for noise effects on the public has been addressed in Section 9.2.2.2 and the mitigation measures outlined in this section address any concerns as they relate to public health and safety.

Air-borne dust, in the form of particulate matter, has the potential to affect people adjacent to the work areas and along truck routes. The potential negative effects of dust on residential areas have been fully assessed in Section 9.2.3.1. In addition to the mitigation outlined in that section, it is recommended that the following measures be applied if dust related effects are reported during the construction of the ECF:

- trucks carrying loose material either entering or leaving the project site will have boxes covered;
- standard construction procedures and street cleaning will be employed to keep the trucks clean and minimize the accumulation of soils on public roadways;
- particulate matter in air in the project area will be monitored under the project air monitoring program;
- dust suppressants will be used, when necessary; and
- soil and fill will be wetted based upon either air monitoring results or public complaints.

With the proper application of the mitigation measures outlined here, as well as those described in Sections 9.2.2.1 and 9.2.2.2, it is expected that there will be no significant adverse effects on Public

Health and Safety from noise or dust related issues. Any residual environmental effects would not be considered significant.

Unauthorized Access to the Work Site

The ECF may also present short-term risks to public safety in relation to unauthorized access to work areas and an increased level of construction related traffic on the project site. Contractors will be responsible for restricting access only to authorized persons and for ensuring anyone at the work site, including visitors, are provided with appropriate personal protective equipment.

Requirements for site security and site access typical of projects of this nature will be established by the contractors and will likely involve some combination of temporary barriers, flag persons and other measures.

The contractor will be required to develop a Health and Safety Plan for the ECF that outlines the specific measures which will address access to work sites and site security. If there is significant construction equipment traffic on the work site, the contractor will be required to develop a traffic management plan for the project site. In addition, as per the mitigation outlined in Section 9.2.3.1 (Residential Areas), designated haul routes will be identified by the contractor and adhered to by truck drivers hauling material for the ECF phase.

With the proper application of the mitigation measures outlined here, as well as those described in Sections 9.2.3.1, it is expected that there will be no significant adverse effects on public health and safety from unauthorized access to the work site. There are no residual environmental effects predicted.

Air Emissions from Contaminant Handling

As identified in Section 9.2.2.1 (Air Quality), the proposed ECF has the potential to affect the local air quality primarily through construction activities related to the proposed remediation activities. This affect on local air quality has the potential for negative effects on the health of the local residents who are in proximity to the project site. The construction activities involved in the Randle Reef sediment Remediation Project which have the potential to affect the local air quality include:

- debris removal using equipment such as a clamshell bucket, barges, and trucks;
- earth moving activities with typical equipment such as dozers, compactors, smooth drum rollers, excavators, dump trucks, water trucks, graders and scrapers;
- ECF and turbidity structure construction and Pier 15 stabilization;
- dredging; and
- backfilling and capping of the ECF.

These construction activities will require the use of a number of pieces of heavy construction equipment and vehicles including: pile drivers; dump trucks; concrete trucks; excavators; backhoes; front end loaders and miscellaneous smaller contractor equipment.

Detailed dispersion modeling was conducted to determine the potential for these emissions to interact with the surrounding residences. This modeling is described fully in Section 9.2.2.1. The results of this effort were then used to determine the exposure of local residential areas to air emissions from the ECF, and to identify any exceedances to ambient conditions or established health-protective regulatory criteria.

An evaluation of the modeling results indicates that there are no anticipated exceedances of naphthalene air quality criteria in the residential communities. The predicted maximum 24-hour average ground level concentration for naphthalene in the closest residential community is 0.60 $\mu g/m^3$. The ambient air quality for naphthalene in this area, based on current air quality monitoring is 1.26 $\mu g/m^3$. The regulatory ambient air quality criterion for naphthalene, as set out in Air Quality Guidelines from Ontario Regulation 419/05, is 22.5 $\mu g/m^3$. Therefore, as these regulatory criteria are established to be health protective, and the predicted concentrations are low, these emissions are not considered significant from a human health perspective in these residential areas.

Further evaluation of the modeling results indicates that in the residential communities, the maximum 24-hour ground level concentration of benzene was predicted to be 0.02 $\mu g/m^3$. Although there are no ambient air quality criteria guidelines for benzene, the air modeling shows that the predicted maximum daily concentration in the residential community is lower than the current benzene air concentrations (1.56 $\mu g/m^3$). As a result of the low magnitude, benzene emissions are not considered to be significant from a human health perspective.

With the proper application of the mitigation measures described in Section 9.2.2.1, it is expected that there will be no significant adverse effects on public health and safety from ECF related air emissions. Any residual environmental effects would not be significant.

Spills

Uncontrolled spills of regulated materials have the potential to have negative affects on public health and safety. Spills can occur from truck traffic traveling to the project site, from construction equipment kept on-site during this period, or from stored fuels or other liquid materials needed for equipment or construction.

Effects to public health and safety are likely to be related to:

- accidental leaks of petroleum products during equipment fuelling and maintenance;
- navigation accidents, including ship effects with the ECF; and

- traffic accidents along the haul routes.

Such spills are likely to be of small volume and localized, as large quantity storage is not expected during the construction period. Regardless, equipment and materials storage that could result in spills will be located in a secure location, away from high traffic areas and a safe distance from the Harbour. A Spill Control Plan will be developed and implemented by the contractor during construction to provide specific requirements for storage, prevention, and response to spills to minimize any potential effect. The Health and Safety Plan for the ECF will also include measures to ensure the safety of the public in the event of a spill.

With the proper application of the mitigation measures outlined here, as well as those described in Section 9.4, it is expected that there will be no significant adverse effects on Public Health and Safety from ECF related spills. Any residual environmental effects would not be significant.

Follow-up and Monitoring

The monitoring associated with this VEC is limited to the monitoring during ECF construction and operation activities. Ambient air quality monitoring is to be conducted at the project boundaries and in selected residential areas. A program will be implemented that also allows any complaints of excess dust generated by ECF activities in nearby residential areas to be reported and investigated. The Spill Control Plan developed for the project will include confirmatory sampling and analysis to assess the adequacy of any spill clean-up. As well, the contractor Health and Safety plan will cover monitoring of access to the site, training, the use of personal protective equipment required for the site, etc. The details of these monitoring programs will be outlined in the ECF Environmental Protection Plan (EPP) or Environmental Management Plan (EMP) prepared by the contractor.

Summary of Residual Environmental Effects

It is anticipated that with the successful completion of the ECF, there will be net beneficial effects on the Randle Reef area and Hamilton Harbour. While there is some potential for negative effects on Public Health and Safety during the construction phase of the ECF, this assessment demonstrates that there will be no significant adverse residual environmental effects on Public Health and Safety (Refer to Table 9.23).

Table 9.23: Residual Environmental Effects Summary for Public Health and Safety

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Construction of the ECF, placement of contaminated sediments in the ECF, capping of the ECF								
Heavy truck movements that will enter and exit the project site to transport debris material and quarry rock and fill	A May increase the noise, and dust effects on human receptors	See Section 9.3.1 Air Quality and Section 9.3.2 Ambient Noise for detailed mitigation measures. Additional mitigation may include: • trucks carrying loose material either entering or leaving the project site will have boxes covered; • standard construction procedures and street cleaning will be employed to keep the trucks clean and minimize the accumulation of soils on public roadways; • dust suppressants will be used, when necessary; • soil and fill will be wetted when justified by air monitoring results or public complaints, and • particulate matter in air in the project area will be monitored under the project air monitoring program	L	Within the nearby residential areas and along local haul routes	During ECT construction and capping activities	R	May be considered a nuisance issue by local residents.	NS
Unauthorized access to the work site by members of the public	A Accidents with heavy project equipment could result in injury	• Proper site security and site access will be established by the contractors and will likely involve some combination of temporary barriers, flag persons, and other measures; • The contractor will be required to develop a Health and Safety Plan for the project; • The contractor may be required to develop a traffic management plan for the project site; and • See Section 9.4.1 for mitigation measures.	M	Project site boundaries	For the duration of the project construction	R	Safe work sites are required for all projects. Standard construction practices include site security	NS
Air emissions related to the release of air contaminants through material handling (see Section 9.3.1 Air Quality)	A Negative effects on local air quality can have adverse effects on public health in nearby residential areas	• See Section 9.3.1 Air Quality for detailed mitigation measures.	VL	Nearest residential areas	For the duration of the project construction	R	Degraded air quality is a public health and perception issue.	NS
Spills on the project site as well as public roads as a result of vehicle accidents.	A Uncontrolled releases of controlled substances have the potential cause negative effects on public health and safety	• A Spill Control Plan will be developed and implemented by the contractor during construction; • The Health and Safety Plan for the project will also include measures to ensure the safety of the public in the event of a spill.	L	Within project boundaries and haul routes	6 year construction period	R	Spills have the potential for further environmental degradation	NS
OPERATION								
NA								

Notes: NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3.5 *Recreational Uses of the Harbour*

VSC Description and Rationale for Selection

Hamilton Harbour is used for recreational, as well as commercial and industrial purposes. The Harbour is home to several established recreational rowing, sailing and powerboat facilities whose users have the potential to interact with the ECF. The recreational facilities are located in the western and northern part of the Harbour, outside of the Randle Reef area of project influence. Thus, this VSC focuses on recreational activities (e.g., angling, sailing, boating, canoeing, etc.), rather than the facilities themselves.

Recreation was identified as a VSC as there is concern that the dredging and construction of the ECF will negatively affect recreational uses within Hamilton Harbour, and more specifically the body of water that encompasses Randle Reef.

Spatial Boundaries

The VSC spatial boundary is determined by the spatial overlap of recreational boating with ECF activities and installations in the Harbour, including dredging of material and construction of the ECF. The boundaries of dredging and the ECF are illustrated in Figure 9.10.

Temporal Boundaries

The VSC temporal boundary is defined by the construction and operation phases of the ECF. This boundary is identical to that established for the overall ECF (see Section 9.2.1).

Administrative Boundaries

The Canadian Coast Guard is responsible for the monitoring of commercial/industrial and recreational vessel traffic. In addition, Transport Canada will provide administrative support in relation to the project's recognition and adherence to the various acts and regulations as it pertains to marine, shipping, transport activities and safety. Specific shipping regulations under the *Canada Marine Act* that require compliance include:

- Natural and Man-Made Harbour Navigation and Use Regulations;
- Port Authorities Management Regulations;
- Port Authorities Operations Regulations; and
- Public Ports and Public Port Facilities Regulations.

Figure 9.10: Recreational, Shipping and Navigation

In addition, the Canada Marine Act prescribes practices and procedures for public ports to be followed by all ships entering, berthing, departing, maneuvering or anchoring in the waters of all public ports designated by regulation pursuant to Part 2, Section 65 of the *Canada Marine Act*. This includes recreational vessels.

The mission of the HPA is to manage, develop and promote the port for the benefit of its stakeholders and ensure the general security of the port while remaining sensitive to the need for a high degree of safety and environmental responsibility. For this VSC, the HPA is responsible for ensuring safety as it relates to HPA activities that are guided by the above regulations and recreational uses within the area of project influence.

Technical Boundaries

No technical boundaries relevant to the assessment of ECF -effects on recreational uses have been identified. Each regulatory agency involved must act, monitor and advise within their regulatory mandate.

Threshold for Determination of Adverse Effects

The thresholds for potential effects of significance of residual effects (e.g., effects after mitigation) for recreation boating for the purposes of the ECF are defined as follows.

A potential adverse effect occurs when:

- recreational uses within or adjacent to Randle Reef are prevented from occurring for an extended period or permanently excluded such that the temporary or permanent exclusion affects the enjoyment of Hamilton Harbour as a recreational venue; and
- damage and loss of life result due to collisions between recreation boating craft and equipment used for dredging/ECF construction.

A positive effect occurs when ECF activities are beneficial to recreational uses within or adjacent to Randle Reef. This may include overall improvement to Harbour health resulting in improved fishing or a better recreational environment for use and enjoyment.

Potential Interactions, Issues and Concerns

During ECF construction, contaminated sediments will be removed by dredging and the dredged material deposited in the ECF, which will then be capped. Dredging will be accomplished using a combination of: 1) large mechanical dredge to “side cast” sediment into the ECF; and 2) a large crane-mounted high solids pump with suction line/cutter head and a floating discharge line.

Dredging areas will be cordoned (marked with buoys) to provide separation of recreational uses from construction. Potential effects of ECF construction activities (including dredging and activities related to the ECF) include:

- reduced access - closure of recreational boating areas in or near the project site;
- increased traffic, navigational hazards due to increased marine construction traffic; and
- air quality effects on recreational uses in or near the project site (see Section 9.3.1).

During the operational phase, while the ECF will permanently displace an area in Hamilton Harbour that is currently available for recreational activities (e.g., recreational boating), a net positive effect, as discussed in Section 9.2.2.4, is expected. Hamilton Harbour currently occupies approximately 2,150 ha of which the Randle Reef area comprises approximately 60 ha or 2.8% of the Harbour bottom. In total, the entire ECF will cover approximately 7.5 ha which is equivalent to 0.35% of the total Harbour surface area. The remediation of the Randle Reef site is also expected to have a net positive effect on recreational uses (e.g., fishing) in the area of project influence by improving the overall ecological health of Hamilton Harbour in the vicinity of Randle Reef.

Analysis, Mitigation and Environmental Effects Evaluation

Construction

Construction activities of the ECF will restrict recreational boat access to dredging areas in order to ensure the safety of recreational users. Dredging area size will be minimized to the extent possible while also ensuring that construction efficiency levels are maintained. This includes cordoning off dredging areas (marked with buoys) to provide separation of recreational uses from construction. The extent of area restricted from recreational access will be limited to the location of the dredging barge and floating discharge line within the Priority 1, 2 and 3 sediment areas. The approximate total area to be dredged represents less than 5% of the Hamilton Harbour total area. Smaller areas would be sectioned off/isolated and progressively advanced as dredging proceeds within specific dredging time periods, or to address Priority 1 and 2 sediments.

Placement of additional structures/beacons would be placed in appropriate locations in coordination with the Harbour Master of the HPA.

A Notice to Mariners will be issued by the Canadian Coast Guard that communicates the proposed dredging and other in-water activities or obstructions including their location and anticipated duration. In addition, information regarding the ECF, including area of project influence and construction timing will be communicated to Hamilton Harbour recreational facility users and clubs (e.g., Hamilton Waterfront Trust, Harbour-West Marina, Royal Hamilton Yacht Club, Leander Boat Club, Burlington Sailing and Boating Club, etc.).

Some dredging activities and increased vessel traffic may increase the navigational hazards in the area. Standard navigational aids will be applied to ensure safe transportation of materials in and out of the project site (e.g., all dredging vessels in water are to be properly lighted).

Operation

While the ECF will displace a small (7.5 ha) area that could be used for recreational boating, a positive effect will result from the ECF's naturalization area, which will improve fish and wildlife habitat as well as aesthetics.

The technical boundary of the analysis on the future use of this ECF as a marine terminal is limited. The facility is located in an area of heavy industrial use. At this time it is proposed that the ECF will be used as a marine terminal. Specific future uses of the marine terminal are still unknown at this time and will be established by the future tenant.

Summary of Residual Environmental Effects

The potential for adverse environmental effects from ECF -related construction activities on recreational use of Hamilton Harbour will be localized and of short duration. Positive effects are likely to be experienced during the operation phase of the ECF due to the improved environmental health of the Harbour after remediation.

Table 9.24 provides a summary of the residual environmental effects and recommended mitigation measures for recreational uses of the Harbour.

Table 9.24: Residual Environmental Effects Summary for Recreational Uses of the Harbour

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at U.S. Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, Dredging Activities, U.S. Steel Channel Capping, Backfilling, ECF Final Capping, Dredging Activities, Sediment and Effluent Management								
Reduced access to recreational "boater", increased traffic and navigational hazards	A	• Minimize weekly dredging areas; • Contact Canadian Coast Guard Radio Station prior to in-water work activities; • Communicate in-water work activities (e.g., dredging, construction and obstruction), dates, (e.g., notices to mariners, Hamilton Harbour recreational facilities and users; • All vessels (e.g., dredging float) will have proper lighting; • In-water works area (e.g., dredging construction and/or obstruction) area will be marked with cautionary/navigation buoys in compliance with the Private Buoy Regulations of the Canada Shipping Act; and • Placement of additional structures/beacons in coordination with the Harbour Master and HPA.	L	Dredging Area	Medium term	R Once the ECF phase is complete, the Harbour will be reopened	Effects on boaters	NS
OPERATION								
Containment of the Contaminated Sediments within the ECF								
The operation phase of the ECF phase will be consistent and compatible with the existing uses of the Hamilton Harbour. The operation of the ECF will insignificant on recreational users.	A Loss of Hamilton Harbour surface area for recreational boating as ECF will only displace a small area. P improvement to recreational opportunities and overall improvement to Harbour health	• None. • Healthier ecosystem benefits recreational fishing.	NA L	Loss of surface area	NA	NR	NA Effects on boaters	NS

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.2.3.6 *Shipping and Navigation*

VSC Description and Rationale for Selection

Lands surrounding the Randle Reef area are predominantly used for industrial purposes, with shipping playing an important role in the transportation of goods in and out of the area. The Shipping and Navigation VSC focuses on large transportation vessels, including carriers of cargo, bulk materials such as coal and metal concentrates and liquids. Shipping and navigation has been identified as a VSC due to the importance of these activities in providing an essential service for the surrounding industries. There is also potential for the ECF -related activities and installations to interfere with shipping and navigation, through collisions with construction related barges or the potential navigational hazards posed by the ECF structure itself.

Spatial Boundaries

The VSC spatial boundary is determined by the spatial overlap of shipping with ECF activities and installations in the Harbour, including dredging. The boundaries of dredging and the ECF are illustrated in Figure 9.11.

Temporal Boundaries

The VSC temporal boundary is defined by the construction and operation phases of the ECF. This boundary is identical to that established for the overall ECF (see Section 9.2.1).

Administrative Boundaries

The Canadian Coast Guard is responsible for monitoring commercial/industrial and recreational vessel traffic. In addition, Transport Canada administers federal acts and regulations that pertain to marine shipping, transport activities and safety, including potential hazards to navigation. Specific shipping regulations under the *Canada Marine Act* that require compliance include:

- Natural and Man-made Harbour Navigation and Use Regulations;
- Port Authorities Management Regulations;
- Port Authorities Operations Regulations;
- Public Ports and Public Port Facilities Regulations; and
- Collision Regulations.

Figure 9.11: Shipping & Navigation

In addition, the *Canada Marine Act* prescribes practices and procedures required of all ships entering, berthing, departing, manoeuvring or anchoring in the waters of all public ports designated by regulation pursuant to Part 2, Section 65 of the *Canada Marine Act*.

The mission of the HPA is to manage, develop and promote the port for the benefit of its stakeholders and ensure the general security of the port while remaining sensitive to the need for a high degree of safety and environmental responsibility. For this VSC, the HPA is responsible for ensuring safety as it relates to HPA jurisdiction as well as shipping and navigation within the area of project influence.

Technical Boundaries

No technical boundaries relevant to the assessment of ECF effects on shipping and navigation have been identified. Each regulatory agency involved must act, monitor and advise within their regulatory mandate.

Threshold for Determination of Adverse Effects

The thresholds for potential effects of residual effects (e.g., effects after mitigation) for the shipping and navigation VSC are defined as follows:

A potential adverse effect occurs if there is:

- interference with shipping to the extent that smooth operation of the Port is affected;
- interference or compromised safety to navigation;
- a reduction in the economic benefit to the shipping industry; and
- damage and/or loss of life due to collisions.

A positive effect occurs when port facilities are enhanced so as to increase the economic benefits from shipping activities in the Harbour.

Potential Interactions, Issues and Concerns

During ECF construction, contaminated sediments will be dredged, deposited in the ECF and capped. Dredging will be accomplished using barge-mounted mechanical dredges to "side cast" sediment into the ECF combined with a barge and crane-mounted high solids pumps with floating discharge lines to deliver dredged sediment to the ECF. Dredging areas will be cordoned (marked with buoys) to provide separation of shipping from construction activities. The number of barges in operation at any given time will be determined by the construction contractor during tendering and construction and will be planned to meet the technical and scheduling objectives of the ECF.

Potential effects of ECF construction activities (including dredging and activities related to ECF construction) on shipping and navigation include:

- access - closure of shipping areas and piers in or near the ECF; and
- increased traffic - navigational hazards due to increased marine construction traffic and conflict with shipping movements.

It is also possible that the U.S. Steel intake may require protection during the construction phase and that the protection measures may interfere with shipping and navigation. For example, if an in-water silt curtain is required near the intake ship movements near the intake may be restricted for the duration of ECF construction.

It is noted that the ECF will be a new structure located in waters that were once used for shipping. As a result, how ships enter the ECF area and navigate will change from pre-ECF conditions.

Long-term navigational restrictions are proposed with respect to the U.S. Steel I/O channel, including:

- only vessels required to maintain the dock wall, intake/outfall structures, sediment cap and the ECF will be allowed to enter the channel;
- the channel will be maintained as a low-speed, no-wake zone;
- downward direction of propellers and/or thrusters should be limited to reduce the risk of damage to the sediment cap within the U.S. Steel channel;
- no spudding or bottom anchoring of vessels will be allowed;
- vessels will be required to fender and tie off to the dock wall or ECF, depending on their purpose for entering the channel; and
- no entrance markers/buoys will be maintained at the entrance to the channel.

Environmental Effects and Mitigation

Construction

As per HPA communication, for all in water work (e.g., dredging and ECF construction), shipping and navigation will be accommodated around the dredging operation and ECF at all times. This will be specifically captured in the dredging contract specifications. There will be a few occasions where Heddle Marine (Pier 14, dry dock and tugs/barges) may have to temporarily relocate its activities to other parts of Pier 14 to allow for dredging along Pier 14. This will be for a short duration, approximately 2-3 weeks. The extent of the area restricted from shipping will be limited to the location of the dredging barge and floating discharge line within the Priority 1, 2 and 3 sediment areas and/or to areas where isolation for dredging purposes are temporarily in place. Dredging area size will be minimized to the extent possible while also ensuring construction efficiency levels are maintained. This includes cordoning off dredging areas (marked with buoys) to provide separation of shipping from construction. The actual area being dredged on a daily basis will be relatively small. Any containment structures would have to be placed 25 m around (HPA communications) work sites where space permits. Placement of additional structures/beacons would be placed in appropriate locations in coordination with the Harbour Master of the HPA. A Notice to Mariners including shipping companies and Heddle Marine (Pier 14) will be issued by the Canadian Coast Guard that communicates the proposed dredging and other in-water activities or obstructions including location and duration.

Some dredging activities and increased vessel traffic may increase the navigational hazards in the area. Standard navigational aids will be applied to ensure safe transportation of materials in and out of the project site (all dredging vessels in water are to be properly lighted). All dredging platforms and floating equipment should be marked with lights in accordance with Collision Regulation with Canadian Modifications.

Operation

Potential collisions with the ECF itself will be mitigated by design features such as navigation lighting and issuing new port facilities marine chart mapping that recognizes the ECF and how ships will navigate around it.

Summary of Residual Environmental Effects

The potential for adverse environmental effects from ECF–related construction activities on shipping and navigation in Hamilton Harbour will be localized to Pier 14 and the U.S. Steel I/O channel and are of short duration. These effects are not considered to be significant.

Table 9.25 provides a summary of the residual environmental effects and recommended mitigation measures for shipping and navigation.

Table 9.25: Residual Environmental Effects Summary for Shipping and Navigation

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Thresholds for Determining Significance					Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	Ecological/ Social-Cultural and Economic Context	
CONSTRUCTION								
Debris Removal, Turbidity Structure Construction at U.S. Steel Intake Pipes, ECF Wall Construction, Pier 15 Wall Stabilization, U.S. Steel Channel Capping, Backfilling, ECF Final Capping								
Closure of shipping areas and piers in or near the ECF. Navigational hazards due to increased marine construction traffic and conflict with shipping movements.	A Impact from construction and dredging on access to shipping areas and piers. P Overall improvement to Marine Transport Operations	• Shipping and navigation to be accommodated at all times (capture in contract specifications); • Minimize weekly dredging areas; • Contact Canadian Coast Guard Radio Station prior to in-water work activities (e.g., dredging, construction and obstruction), dates (e.g., notice to mariners, U.S. Steel, shipping companies); • All vessels (e.g., dredging float) will have proper lighting; • In-water works area (e.g, dredging construction and/or obstruction) will be marked with cautionary/navigation buoys in compliance with the Private Buoy Regulations of the Canada Shipping Act; • Provide advance notifications to Heddle Marine prior to dredging along Pier 14 and U.S. Steel (intake protection structure); and • Follow specific navigation protocols for area around	L	Local	Long term	R	NA	NS
OPERATION								
Containment of the Contaminated Sediments within the ECF								
The operation phase of the ECF phase will be consistent and compatible with the existing uses of the Hamilton Harbour. The operation of the ECF may cause an adverse effect on marine transport of the Harbour.	P Improvement to Marine Transport Operations A Potential collisions with ECF	• Provide proper navigation lighting on and around ECF. Update port facilities marine chart mapping to reflect ECF. • Follow specific navigation protocols for area around U.S. Steel Intake/Outfall channel (e.g., vessel restrictions, maintain low speed, no wake zone)	NA	NA	NA	NA	NA	NS

Note: NA = Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.3 Marine Terminal Effects Assessment

9.3.1 Environmental Assessment Scope and Methodology

This section describes the potential effects on the environment of typical port operations at the proposed marine terminal. Operations are anticipated to begin following the completion of the proposed ECF project approximately 10 years from the start of construction. As the precise use of the marine terminal is unknown at the present time, this effects assessment for future construction and operation activities of the marine terminal will be conducted in an overview manner by using and extrapolating existing knowledge and experience. There will be a focus on environmental interactions with the marine terminal, the potential environmental effects, the proposed mitigation measures and the significance of the environmental effects.

Although specific long-term uses of the marine terminal are not identified, the conceptual and potential future uses of the ECF as a marine terminal have been broadly accounted for by certain requirements within the engineering design, for example, loading requirements for the marine terminal, length of the south wall for navigational purposes, storm water management, etc. The anticipated future uses of the ECF as a marine terminal are consistent with current marine terminal uses within the Port of Hamilton. The proposed marine terminal will consist of 5 ha for industrial use along with a 2.5 ha green space buffer or area surfaced with a suitable aggregate material and used as light industrial space. The dockwall (371 m) will be able to accommodate one large commercial vessel at a time.

There are two major components of the proposed marine terminal which are expected to take place in the future, and which are assessed at this time. The first is navigational dredging, which is considered a construction project. The second is cargo handling operations on land and on water, in accordance with typical port operations.

The environmental assessment methodology for the proposed marine terminal in this section includes an evaluation of the potential effects, and residual effects with regard to valued environmental components (VECs), including valued ecological and socio-economic components (VSCs) for the proposed marine terminal. Project-related effects are assessed within the context of spatial, temporal and administrative boundaries established for the assessment. Mitigation measures and the need for monitoring and follow-up were integrated into the analysis of environmental effects, where relevant. Mitigation is defined as the elimination, reduction or control of potential adverse environmental effects of the project.

9.3.1.1 *Valued Environmental Components Selection and Assessment*

Valued ecological and socio-economic components (VECs and VSCs) are those biophysical and socio-economic features that are valued by society and/or can serve as indicators of environmental change. The VECs and VSCs identified in Section 9.2 were considered for the assessment of the marine terminal. Those relevant to future navigational dredging and cargo handling activities were selected by the HPA, as listed in Table 9.26 and 9.27.

Where no project/environmental interaction or impact pathway was identified, and based on current knowledge and typical port activities, the issue was deemed to be not relevant to the assessment and eliminated from further consideration. See Tables 9.26 and 9.27 for the scoping matrix.

Table 9.26: VECs for Marine Terminal Biophysical Effects Assessment

VECs	**Construction** (Navigational Dredging)	**Operation** (Cargo Handling)
Air Quality	Yes	Yes
Ambient Noise	Yes	Yes
Surface Water Quality	Yes	No*1
Aquatic Biota	Yes	No*1

*1 Materials/Cargo handling which could result in spills etc. are addressed under accidents and malfunctions.

Table 9.27 VECs for Marine Terminal Socio-Economic Effects Assessment

VSCs	**Construction** (Navigational Dredging)	**Operation** (Cargo Handling)
Residential Areas	No*1	Yes
Sherman Inlet	Yes	No
Recreational Uses of Harbour	Yes	Yes
Shipping and Navigation	Yes	Yes

*1 Not part of the marine terminal scope.

The remainder of this section focuses on the potential interactions between the applicable VECs or VSCs and the marine terminal. The potential interactions and effects are reviewed and evaluated in the context of current knowledge and experience with typical marine terminals, with regard to assessing potential interactions such as magnitude of the effect, the extent, the duration, frequency and reversibility (see Definitions - Marine Terminal 9.3.1.2 for a description of the boundaries).

Environmental effects will be evaluated for each VEC/VSC as either significant or not significant. A decision of significance for each VEC/VSC was made after taking into account appropriate mitigation measures where required. Significant environmental effects are those adverse effects that will cause a change in the VEC/VSC that will alter its status or integrity beyond an acceptable level.

9.3.1.2 *Definitions - Marine Terminal*

To provide a focus for an environmental assessment of the proposed marine terminal the boundaries for the assessment need to be established. These boundaries encompass the geographical location of the terminal and the immediate surrounding area, and those periods of time during which the VECs and VSCs are likely to interact with, or be influenced by, the marine terminal operations including navigational dredging and cargo handling.

Boundaries for future navigational dredging are:

- Spatially, navigational dredging of the bottom sediments will take place adjacent to the commercial dockwall, 250 m or more in length, 20 m to 30 m in width and to a depth of 8.6 m below IGLD (or 10 m below IGLD should a future tenant require vessels of greater than 25,000 DWT to load/unload at the dock). Along with the dredging activities on the water, trucking may or may not be required to transport the dredged material, depending on the selected disposal option. If trucking is required, the potential haul routes are anticipated to be along the established truck routes of Sherman Avenue North and Burlington Street East.
- Temporally, the initial navigational dredging will take place following the completion of the ECF in approximately 10 years, then as needed to maintain or increase the depth. Typical dredging activities occur 12 hours per day, 5 days per week, and the duration varies from one to several weeks depending on the total dredgeate volume.
- Administrative and technical boundaries are considered according to current regulations and practices related to navigational dredging.

Boundaries for future cargo handling are:

- Spatially, cargo handling includes loading and un-loading vessels at the terminal and movements by vehicular traffic, cranes, forklifts, rail and trucks for example. This would take place on the terminal property itself, and off-site along established haul routes. Vessel movements are from the Burlington Canal, through Hamilton Harbour, to the marine terminal and back.
- Temporally, cargo handling operations would begin upon completion of the ECF. As with current and typical Port of Hamilton activities, routine cargo handling and trucking can be 24 hours a day, seven days a week, at a level consistent with the activity at the site. A high volume of truck traffic from a typical pier is 50 trucks per day. The established truck routes include Burlington Street East, where 10,030 vehicles per day were observed in 2006 (City of Hamilton NETMP report, June 2008). Typical vessel transit times within Hamilton Harbour

are 1 to 1 ½ hours from the Burlington Canal to a marine terminal; loading/unloading of the vessel at a terminal typically takes 12 to 24 hours. A typical year sees 700 vessel visits (HPA records). The marine terminal operations, including truck and vessel traffic, are expected to be long term and last the life of the ECF, which is 200 years.

- Administrative and technical boundaries will be considered according to current regulations and practices related to cargo handling.

9.3.2 Biophysical Effects Assessment – Marine Terminal

9.3.2.1 *Air Quality*

The marine terminal operations may result in the discharge of gaseous and particulate emissions into the atmospheric environment, which in turn may result in possible changes to ambient air quality.

Hazardous Air Pollutants (HAPs) and criteria air contaminants (CACs) have the potential to adversely affect human health and other ecosystem elements. Air can be a key pathway for the transport of contaminants to terrestrial and human environments.

Greenhouse gases (GHGs) are also considered because of their intrinsic importance to climate change as a regional and international issue. GHG are addressed specifically under cumulative effects in Section 9.5

Air emissions in Ontario are currently regulated under the provincial Environmental Protection Act (EPA). The EPA provides for a general prohibition against emitting a contaminant into the environment that causes an adverse effect. Ontario Regulation 419/05 Air Pollution-Local Air Quality Regulation was most recently amended on August 31, 2007. Commercial and off-road vehicles exhaust emissions and limits for road dust are not currently regulated, however there are proposed regulations to reduce vessel emissions in Emission Control Areas (ECAs).

The potential effects are related to the airborne dust and diesel emissions. Marine terminal-related HAP and CAC emissions will be released through the combustion of fuels. Sources will include emissions from vehicle traffic and construction equipment diesel emissions. Marine terminal-related sources that affect air quality are primarily vehicles, cargo handling equipment, vessel engine combustion emissions and dust.

Construction – Navigational Dredging

Effects Analysis

The construction activities involved in navigational dredging which have the potential to affect air quality are large diesel powered barge(s) and dredging equipment. These units will generate combustion gasses, as well as, airborne particulate matter. Heavy construction equipment and vehicles including dump trucks, would be used depending on the final destination for the dredged material.

Mitigation

During navigational dredging, the following mitigation measures will be applied as necessary:

- The maintenance of vehicles and dredging equipment to reduce noxious combustion emissions; and
- The implementation of a "No Idle" policy on site to limit unnecessary combustion emissions, should truck transportation of dredged materials be required;

Residual Effects

With effective mitigation measures implemented, the effect of equipment and vehicle exhaust and dust on air quality will be low. Considering that dredging activities will occur for durations of one to several weeks, no significant adverse residual effects on air quality are likely to occur.

Operations – Cargo Handling

Effects Analysis

The activities involved in cargo handling which have the potential to affect air quality include vehicular traffic (cranes, forklifts, trains, and trucks) and vessels that will most likely generate combustion gasses and potentially airborne road and dust from particulate-containing bulk cargos.

The exhaust emissions from truck and rail traffic for the transport of cargo will be intermittent and long term. The predicted increase in truck traffic is expected to be in the order of 50 trucks per day or 0.5% of total volume of traffic along the Burlington Street East corridor, a small percentage of the traffic currently in the area. The increase in vessel traffic in Hamilton Harbour is expected to increase by approximately 2% to 4%. The increase in rail traffic is estimated to be similar to that of vessel traffic.

Loading or unloading particulate-containing bulk cargo from vessels, and handling or storage of these materials could potentially cause dust.

Mitigation

During the operation phase of the marine terminal, the responsible party/tenant will ensure that all regulations are met. Operators will be encouraged to implement best management practices for emissions and dust control.

Mitigation of the effect on air quality from the operation of the marine terminal may include:

- the maintenance of vehicles and equipment to reduce noxious combustion emissions;
- the implementation of a "No Idle" policy on site to limit unnecessary combustion emissions;
- vehicles and cargo handling equipment to be restricted to paved areas where possible to reduce road dust;
- best management practices for vessel cargo loading and unloading to prevent product dust; and
- implementation of a dust management plan that includes the mitigation measures for bulk product staging and storage areas, and road traffic.

Residual Effects

No significant adverse residual effects on air quality from the operational phase of the project are likely.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to navigational dredging and cargo handling on air quality is not considered significant. With effective mitigation measures implemented, the effect of exhaust emissions, road and product dust on air quality will be temporary and low.

Table 9.28 provides a summary of the residual environmental effects and recommended mitigation measures for air quality.

Table 9.28: Residual Environmental Effects Summary for Air Quality – Marine Terminal

Project- Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
Increased vessel and truck traffic, should truck transportation of dredged materials be required	A	• Maintenance of vehicles and equipment • The implementation of a "No Idle" policy	None, short term	NS
OPERATION – Cargo Handling				
Increased vessel and other traffic	A	• The maintenance of vehicles and equipment • The implementation of a "No Idle" policy	Long-term, low volume/ Intermittent	NS
Increased dust	A	• vehicles to be restricted to paved areas where possible • Best management practices for vessel cargo loading and unloading • Dust management plan	Long-term, low volume/ Intermittent	NS

9.3.2.2 *Ambient Noise*

Ambient noise has been selected as a VEC for marine terminal operations due to the potential for noise from project activities to negatively impact sensitive receptors and degrade the acoustic environment. Noise is defined as an unwanted sound.

Excess noise has the potential to disturb wildlife and human receptors. The degree of disturbance from the marine terminal operations depends on the amount of background sound already present, the working or living activities of the people occupying the area in which the noise is heard, and the nature and amount of the noise.

Typically, the impact of project noise is compared to the existing ambient level due to traffic and surrounding industry. The City of Hamilton Noise By-law is dependent upon the zoning classification for the location of the source of noise and the noise receptor. The source of noise will primarily be from the marine terminal location.

An adverse effect is one in which there are frequent exceedances beyond the geographical boundary; and the duration of the noise-emitting operations are long-term.

The following section outlines the project interaction or activity causing the environmental effect and the proposed mitigation.

Construction – Navigational Dredging

Effects Analysis

The dredging activity that takes place on the water is not expected to increase the noise levels in the residential area. In addition, the dredging will be taking place in a working harbour and within an industrialized area of Hamilton. Noise emissions from truck traffic (from the transport of sediment should it be required) will be intermittent and the duration is expected to be from one to several weeks.

Mitigation

During construction the following mitigation measures will be applied as necessary:

- Internal combustion engines will be fitted with appropriate muffler systems in good working order;
- Local noise by-laws will be followed;
- Noise complaints will be investigated and responded to; and
- A traffic management plan will be implemented to facilitate the use of designated haul routes.

Residual Effects

No significant adverse residual effects from noise from the operational phase of the project are expected.

Operations – Cargo Handling

Effects Analysis

Noise from truck and rail traffic for the transport of cargo will be intermittent and long term. The predicted increase in truck traffic is expected to be in the order of 0.5% along the Burlington Street East corridor, a small percentage of the traffic currently in the area. The increase in vessel traffic, which generates a low volume of noise, is expected to increase by approximately 2% to 4%. However the shipping activity that takes place on the water and the cargo handling on port lands is not expected to affect the noise in the residential area.

Mitigation

During operation, the following mitigation measures will be applied as necessary:

- Internal combustion engines will be fitted with appropriate muffler systems in good working order;
- Local noise by-laws will be followed;
- Noise complaints will be investigated and responded to; and
- A traffic management plan will be implemented to facilitate the use of designated haul routes.

Residual Effects

The operational activities are expected to have low impacts in terms of magnitude, and impact a limited local geographical extent for a long duration. The impact on the acoustic environment will be low in magnitude and reversible. Therefore, with effective mitigation measures implemented, no significant adverse residual effects on the acoustic environment are likely to occur.

Summary of Residual Environmental Effects

The potential for adverse noise effects related to navigational dredging and cargo handling is not considered significant. Any adverse effects would be temporary and minimized through the identified mitigation measures.

Table 9.29 provides a summary of the residual environmental effects and recommended mitigation for noise reduction.

Table 9.29: Residual Environmental Effects Summary for Ambient Noise – Marine Terminal

Project-Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
Physical dredging of sediments, and heavy truck movements should truck transportation of dredged materials be required may increase the noise	A	• Use of appropriate muffler systems • Follow local by-laws • Investigate noise and respond to noise complaints • Use existing haul routes	None	NS
OPERATION – Cargo Handling				
Increased truck traffic may increase the noise	A	• Use of appropriate muffler systems • Follow local by-laws • Investigate and respond to noise complaints • Use existing haul routes	None	NS

9.3.2.3 *Surface Water Quality*

Surface water has been identified as a VEC because its quality is protected by statute/regulation and may be impacted by navigational dredging.

Surface water quality in Ontario is regulated by the provincial government through MOE. The provincial water quality objectives (PWQOs) and/or the regulations current at the time of the activity will be used to determine the limits for a potential adverse effect on water quality, such as an increase in suspended solids above the ambient water quality and contaminant concentrations above applicable guidelines.

The following section outlines the project interaction or activity causing the environmental effect and the proposed mitigation.

Construction – Navigational Dredging

Effects Analysis

Dredging is expected to have short-term, negative effects on water quality due to the potential for re-suspension of sediment resulting in increased suspended solids and turbidity. However, the total suspended solids (TSS) concentration and turbidity is expected to quickly return to background levels and the effects are expected to be temporary and short-term.

Mitigation

During construction the following mitigation measures to reduce potential releases to the water column will be applied as necessary:

- using controls during dredging operations, including environmental dredging equipment , silt curtains and a sealed barge to contain runoff;
- performing TSS monitoring during dredging operations to verify compliance with operational and performance standards;
- use of experienced dredge operators; and
- application of best management practices to prevent spillage of gasoline, diesel fuel, oil and other deleterious products in to the water;

Residual Effects

The re-suspension of sediment into the water column during navigational dredging will be short-term and localized. Water quality monitoring during in-water construction activities will be conducted to determine water quality outside the immediate vicinity of the construction activity. Based on the above, and the implementation of appropriate mitigation measures, potential adverse effects are expected to be minimal and no significant residual effects to the surface water VEC are expected.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to navigational dredging on water quality is not considered significant. Any adverse effects would be temporary and minimized through the identified mitigation measures.

Table 9.30 provides a summary of the residual environmental effects and recommended mitigation measures for water quality.

Table 9.30: Residual Environmental Effects Summary for Surface Water Quality – Marine Terminal

Project-Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Marine Terminal				
Dredging, causing re-suspension of sediments	A	• Use of environmental dredging equipment, silt curtains and a sealed barge to contain runoff • TSS monitoring during dredging operations to verify compliance with regulatory standards • Use of experienced dredge operators • Best management practices to be employed to prevent product from entering water	Short term re-suspension of sediments	NS

9.3.2.4 *Aquatic Biota*

Freshwater habitat of Hamilton Harbour has been identified as a VEC due to the protective status of freshwater habitats provided through the federal Fisheries Act.

Section 35(1) of the Fisheries Act, states that no one shall carry out any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat, unless it is authorized by the Minister of Fisheries and Oceans. Section 36(3) of the Fisheries Act prohibits the deposit of a deleterious substance in water frequented by fish, unless authorized by a regulation (see also Surface Water Section 9.3.2.3).

Aquatic habitat in Hamilton Harbour is available year round. Particularly sensitive times for fish populations include periods of migration and spawning during spring and early summer, from April to July.

Additionally, the potential exists for an increase in contamination, noise and vibration when the commercial slip adjacent to the marine facility is disturbed during navigational dredging.

The following section outlines the project interaction or activity causing the environmental effect and the proposed mitigation.

Construction – Navigational Dredging

Effects Analysis

Dredging may result in the re-suspension of contaminated sediments (if present), increased turbidity and TSS which may be hazardous to aquatic life at certain concentrations and which may reduce the total dissolved oxygen concentrations of the water column in the immediate area.

It is probable that mobile species, such as fish, will avoid/move away from the areas of dredging. It is unlikely that mobile species will experience significant stress from the navigational dredging. Similarly, semi-aquatic species such as amphibians, aquatic birds and aquatic mammals are expected to readily move away from the area of disturbance and avoid harmful stress. Less mobile species, such as benthic invertebrates, may be affected. However any effects are not expected to have an impact at the population level.

The site activities will generate noise and vibration. However these effects are expected to be localized and temporary.

Mitigation

Navigational dredging activities will use various mitigation measures to reduce the transfer of sediment to the water column including:

- use of environmental dredging equipment, silt curtains and a sealed barge to contain runoff;
- TSS and turbidity monitoring during dredging operations at specified sampling frequencies, locations, and depths will be performed to verify environmental performance; and
- adherence to OMNR timing restrictions for in-water work and any DFO operational Statements or best management practices, as required.

Residual Effects

Potential physical harm to aquatic species during construction and dredging activities will be minimized through the use of mitigation measures. The net adverse residual environmental effect on the aquatic habitat and biota is not likely to be significant given the short duration of dredging activities, reversibility of effects and mitigation measures that will be in place to minimize potential short-term impacts.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to navigational dredging on water quality is not considered significant. Any adverse effects would be temporary and minimized through the identified mitigation measures.

Table 9.31provides a summary of the residual environmental effects and recommended mitigation measures for aquatic biota.

Table 9.31: Residual Environmental Effects Summary for Aquatic Biota – Marine Terminal

Project-Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
• Potential physical damage/disruption of aquatic habitat • Potential physical harm of species	A	• Use of standard sediment control devices • Equipment configurations and techniques appropriate for harbour location. • Adhere to OMNR timing restrictions for in-water work.	Short term re-suspension of sediments	NS

9.3.3 Socio-Economic Effects Assessment – Marine Terminal

9.3.3.1 *Residential Areas*

Residential areas are those occupied primarily by private residences, and include the residences in proximity to the area of project influence (see Figure 9.7) where the cargo handling related to the proposed marine terminal will take place, noting that trucks will be required to use the selected haul routes along designated truck routes in the City, in accordance with municipal requirements.

Potential adverse effects include an increase in dust and noise caused by navigational dredging, increased traffic during cargo movement to and from the terminal via truck and train and cargo storage (see Air Quality section 9.3.2.1, and Ambient Noise section 9.3.2.2).

The following section outlines the potential operational interaction or activity causing the environmental effect and the proposed mitigation.

Operation – Cargo Handling

Effects Analysis

The operation of the marine terminal will be consistent and compatible with the existing industrial land uses and the HPA Land Use Plan. Furthermore, based on the distance of the proposed marine terminal from residential areas, and the adjacent industrial land uses that surround the residential area which provide a buffer, it is unlikely that the operation phase will cause an adverse negative effect to the residential zones within the area of project influence.

Truck traffic for the potential transport of cargo will be long term. The predicted increase in truck traffic is expected to in the order of 50 trucks per day or an increase of 0.5% more vehicular traffic along the Burlington Street East corridor, a small percentage of the traffic currently in the area. Loading or unloading and handling or storage of particulate-containing bulk cargo from vessels could potentially cause dust.

Mitigation

During the operation phase of the marine terminal, the responsible party/tenant will ensure that all regulations are met. Industries that handle materials, such as bulk storage facilities and/or the aggregate industry will be required to implement dust control best management practices according to the regulations and encouraged to use the best practices. Dust control best practices will be incorporated into the operations plan.

Residual Effects

Any potential adverse effects on existing residential areas as a result of cargo handling would be minimized through the implementation of effective mitigation measures. The operation phase of the marine terminal is not likely to have any significant residual adverse effects on residential areas.

Summary of Residual Environmental Effects

Table 9.32 provides a summary of the residual environmental effects and recommended mitigation measures for residential areas.

Table 9.32: Residual Environmental Effects Summary for Residential Areas – Marine Terminal

Project-Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
OPERATION – Cargo Handling				
Increased truck traffic	A	• Follow regulations • Use existing haul routes	None	NS

9.3.3.2 *Sherman Inlet*

Sherman Inlet is a small surface water feature -a remnant natural wetland or backwater embayment surrounded by industrial land and bordered by trees and shrubs. Currently, it discharges stormwater runoff and combined sewer overflows in a northerly direction into the southeast corner of Hamilton Harbour (Figure 9.10). Sherman Inlet is connected to Hamilton Harbour via a concrete culvert with a span of approximately 12 m.

The Sherman Inlet VSC includes the surface water and sediment quality within the inlet. The rationale for including Sherman Inlet as a VSC is primarily the public concern expressed for maintaining this green space, which makes Sherman Inlet a valued socio-economic component.

A potential adverse effect on the Sherman Inlet would be based on the surface water quality within the Inlet and may occur if navigational dredging results in a degradation of water quality (also see Sediment Quality Section 9.3.2.3 and Surface Water Quality section 9.3.2.4).

The following section outlines the project interaction or activity with potential for causing the environmental effects and the proposed mitigation measures.

<u>Construction – Navigational Dredging</u>

Effects Analysis

No project activity will be undertaken within Sherman Inlet itself. Navigational dredging activities at the marine terminal have the potential to negatively affect water quality within the Inlet should turbid water disperse upstream through the concrete culvert into Sherman Inlet proper. With effective mitigation measures the potential for movement of turbid water should be low.

Mitigation

Navigational dredging activities will use various mitigation measures to reduce the transfer of sediment to the water column into Sherman Inlet, as necessary:

- For the duration of navigational dredging activities at the marine terminal, the installation of a sediment barrier at the culvert entrance to Sherman Inlet to restrict the transport of suspended sediment from the Harbour into the Inlet, as necessary.
- Use of environmental dredging equipment, silt curtains and a sealed barge to contain runoff;
- TSS and turbidity monitoring during dredging operations at specified sampling frequencies, locations, and depths will be performed to verify environmental performance;
- Covering of stockpiled dredgeate material as soon as practical, if required; and
- Timing restrictions for in-water work and any DFO Operational Statements or best management practices at the time will be adhered to.

Residual Effects

With the implementation of mitigation measures (including those for dredging in the previous section) navigational dredging is not expected to have any significant residual adverse effects on the Sherman Inlet.

Summary of Residual Environmental Effects

Table 9.33 provides a summary of the residual environmental effects and recommended mitigation measures for residential areas.

Table 9.33: Residual Environmental Effects Summary for Sherman Inlet – Marine Terminal

Project-Environment Interaction	Potential Positive (P) or Adverse (A) Effect	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
Re-suspension of sediment from navigational dredging near Sherman Inlet	A	• Use turbidity barriers such as silt curtains (as necessary) • Use standard sediment management control devices Equipment configurations and techniques appropriate for harbour location .	None	NS

9.3.3.3 *Recreational Uses of the Harbour*

Hamilton Harbour is used for recreational as well as commercial and industrial purposes. The Harbour is home to several established recreational rowing, sailing and powerboat facilities whose users have the potential to interact with the marine terminal. The recreational facilities are located in the western and northern part of the Harbour, outside of the marine terminal's physical boundaries. Thus, this VSC focuses on recreational activities on the water (e.g. angling, sailing, boating, canoeing, etc.) rather than the terminal itself. Recreation was identified as a VSC as there is concern that the navigational dredging and operation of the marine terminal may negatively affect recreational uses within Hamilton Harbour due to an increase in commercial vessel traffic

The following section outlines the potential operational interaction or activity causing the environmental effect and the proposed mitigation.

Construction – Navigational Dredging

Effects Analysis

Navigational dredging and the associated loading and transport of dredged material will result in a temporary short term increase in vessel traffic and navigational hazards due to increased marine construction traffic which may impact recreational boating.

Mitigation

During construction the following mitigation measures will be applied as necessary:

- all vessels, including barges, to have proper lighting, and dredge areas will be cordoned (marked with buoys) to provide separation of recreational uses from construction in compliance with the Private Buoy Regulations of the Canada Shipping Act in coordination with the Harbour Master;
- a notice to Mariners will be issued by the Canadian Coast Guard that communicates the proposed navigational dredging and/or
- standard navigational aids will be applied to ensure safe transportation of materials.

Residual Effects

With the implementation of mitigation measures described, navigational dredging is not expected to have any significant residual adverse effects on the recreational boating and fishing activity.

Operation – Cargo Handling

Effects Analysis

Increased vessel traffic may affect recreational boating in Hamilton Harbour. The commercial vessel traffic is predicted to permanently increase by about 10 to 30 vessels per year or by approximately 2% to 4%. The typical vessel transit time within Hamilton Harbour is one to one and a half hours, at any time of the day.

Mitigation

No mitigation measures due to increased vessel traffic are recommended.

Residual Effects

The low level of increase in commercial vessel traffic is not expected to have any significant residual adverse effects on the recreational boating as the Hamilton Harbour is a working industrial and recreational harbour and the users are accustomed to such activities.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to navigational dredging and cargo handling on recreational use of Hamilton Harbour is not considered significant. Any adverse effects would be temporary and minimized through the identified mitigation measures.

Table 9.34 provides a summary of the residual environmental effects and recommended mitigation measures for Recreational Uses of Hamilton Harbour.

Table 9.34: Residual Environmental Effects Summary for Recreational Uses – Marine Terminal

Project- Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
Increased vessel traffic	A	• Dredging areas will be marked with buoys • A Notice to Mariners will be issued by the Canadian Coast Guard • Standard navigational aids will be applied to ensure safe transportation of materials	None, short term	NS
OPERATION – Cargo Handling				
Increased vessel traffic	A	None	None	NS

9.3.3.4 *Shipping and Navigation*

Hamilton Harbour is used for commercial and industrial purposes as well as recreational purposes. Lands surrounding the proposed marine terminal are predominantly industrial, with shipping playing an important role in the transportation of goods in and out of the area. The Shipping and Navigation VSC focused on large commercial vessels, and was identified as a VSC due to the importance of these activities in providing an essential service for the surrounding industries. There is potential for the navigational dredging and additional cargo handling related to the marine terminal to interfere with shipping and navigation.

The following section outlines the potential operational interaction or activity causing the environmental effect and the proposed mitigation.

<u>Construction – Navigational Dredging</u>

Effects Analysis

Navigational dredging and the associated loading and transport of dredged material may result in reduced access to the terminal dockwall for loading and unloading activities, increased marine traffic, and navigational hazards due to increased marine construction traffic during the weeks of any navigational dredging activities.

Mitigation

During construction the following mitigation measures will be implemented as required:

- dredging areas will be cordoned (marked with buoys) to provide separation of shipping areas from construction in compliance with the *Private Buoy Regulations* of the *Canada Shipping Act* and in coordination with the Harbour Master of the HPA;
- a notice to Mariners will be issued by the Canadian Coast Guard that communicates the proposed navigational dredging and other in-water activities or obstructions including their location and anticipated duration;
- standard navigational aids will be applied to ensure safe transportation of materials in and out of the project site (e.g., all dredging vessels in water are to be properly lighted); and
- coordination with the terminal operator and other users of the harbour will take place to reduce inconvenience.

Residual Effects

With the implementation of mitigation measures described, navigational dredging is not expected to have any significant residual adverse effects on shipping and navigation.

<u>Operation – Cargo Handling</u>

Effects Analysis

Increased vessel traffic may affect commercial shipping in Hamilton Harbour. The operation of the marine terminal will be consistent and compatible with the existing commercial shipping activities within Hamilton Harbour. The HPA has estimated that the overall permanent increase in the volume of vessel traffic related to this marine terminal is expected to be 10 to 30 vessels per year, representing a 2% to 4% increase. The typical vessel transit time within Hamilton Harbour is one to one and a half hours, at any time of the day.

Mitigation

No adverse effects on shipping and navigation within the Harbour from the operation of the proposed marine terminal are anticipated. No mitigation measures are required.

Residual Effects

The low level of increase in commercial vessel traffic is not expected to result in significant residual adverse effects on shipping and navigation.

Summary of Residual Environmental Effects

The potential for adverse environmental effects related to navigational dredging and cargo handling on shipping and navigation within Hamilton Harbour are not considered significant. Any adverse effects would be temporary or low frequency, and minimized through the identified mitigation measures.

Table 9.35 provides a summary of the residual environmental effects and recommended mitigation measures for Shipping and Navigation.

Table 9.35 : Residual Environmental Effects Summary for Shipping and Navigation – Marine Terminal

Project-Environment Interaction	Potential Effect: Positive (P) or Adverse (A)	Mitigation Measures	Residual Effects	Significance (S/NS)
CONSTRUCTION – Navigational Dredging				
Navigational dredging resulting in partial closure the marine terminal berth	A	• Dredging areas will be marked with buoys • A Notice to Mariners will be issued by the Canadian Coast Guard • Standard navigational aids will be applied to ensure safe transportation of materials • Coordination with terminal operator	None, short term	NS
OPERATION – Marine Terminal				
Increased vessel traffic	A	None	None	NS

9.4 Assessment of Malfunctions and Accidental Events

9.4.1 Introduction

The objectives for the assessment of possible environmental effects from malfunctions and accidental events are to ensure that:

- abnormal events and/or operational upset conditions are considered;
- credible events are identified; and
- the significance of the residual effects (e.g., after mitigation) of such events is determined.

The focus of the assessment is on those events that are considered credible in the context of the project and its environmental setting. It is not the intent to address all conceivable abnormal occurrences, but rather to address those that have a reasonable probability of occurring (considering the specific aspects of site conditions and project design) and that may have an environmental effect or consequence.

Events that have been identified as requiring further assessment include:

- accidental exposure of contaminated sediments to the air during construction;
- accidental discharges of sediment contaminants during construction;
- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges related to cargo handling, during marine terminal operations;
- cap failure of the U.S. Steel I/O channel;
- ECF cap failure;
- sheetpile wall failure;
- accidental spills from the waste water treatment system;
- bottom confining layer failure;
- navigation accidents, including ship impacts with the ECF; and
- traffic accidents along the haul routes.

In addition, the assessment also acknowledges malfunctions and accidents that may be precipitated by external factors, either natural or anthropogenic. In the context of the assessment, external factors that lead to upset conditions are considered “initiating events”. This assessment considers the likelihood of initiating events as well as the consequential effects of such events.

In particular, initiating events that may lead to malfunctions and accidents are identified as follows:

- potential ice damage;
- potential seismic damage;
- wave damage; and
- changing lake levels.

These events, which may be caused by extreme weather conditions, are related to the effects of the environment on the project, which are discussed further in Section 9.6.

9.4.2 Assessment of Malfunctions and Accidents

The objective of this assessment is to determine if any malfunction or accident could be expected to result in a residual environmental effect. The assessment is done in consideration of project-specific features that would be available to either prevent or control the occurrence itself. The mitigation measures for potential effects of an event are also considered in the assessment of malfunctions and accidental events. Project design measures are integrated into the project, as described in Section 8.0. Health, safety and environmental procedures are outlined in the Remedial Action Work Plan. These include measures to mitigate effects of the regular construction and operation activities but also encompass management measures to address malfunctions and accidents (e.g., emergency response plans, spill clean up procedures).

Table 9.36 provides an overview of potential interactions between malfunctions and accidents and project VECs. Short-term, localized effects of any malfunctions and accidents are expected to be more than compensated by the positive effects of the project on these VECs.

Table 9.36: Project VECs and Potential Interaction with Malfunction and Accident Scenarios

	Air Quality	Ambient Noise	Soil Quality	Surface Water Quality, Currents and Circulation	Aquatic Biota	Species at Risk	Residential Areas	Industrial, Commercial and Municipal Use and Infrastructure	Sherman Inlet	Public Health and Safety	Recreational Uses of the Harbour	Shipping and Navigation
Accidental exposure of contaminated sediments to the air during construction	•											
Accidental discharges of contaminants during construction	•			•	•	•			•			
Accidental leaks of petroleum products during equipment fuelling and maintenance	•		•	•	•	•			•	•		
Accidental spills or discharges related to cargo handling, during marine terminal operations	•		•	•	•	•			•			
Cap failure of the U.S. Steel I/O channel				•	•	•			•			
ECF cap failure				•	•	•			•			
Sheetpile wall failure				•	•	•			•			
Accidental spills from waste water treatment system			•									
Bottom confining layer failure				•	•	•			•			
Navigation accidents, including ship effects with the ECF	•	•		•	•	•			•	•	•	•
Traffic accidents along haul routes	•	•	•				•	•		•		
• = Potential for interaction with adverse effects identified												

9.4.3 Air Quality

The possible malfunctions and accidental events that may affect air quality in the area include:

- accidental exposure of contaminated sediments to the air during construction;
- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges related to cargo, during marine terminal operations;
- navigation accidents with the ECF; and
- traffic accidents along haul routes.

9.4.3.1 *Accidental Exposure of Contaminated Sediments to the Air During Construction*

Sediment dredging and transfer to the ECF are conducted "underwater" and air emissions during this process are described in preceding sections. Accidental exposure of contaminated sediment to the air during construction is expected to be rare but may occur as debris is lifted on shore. This exposure has the potential to result in temporary effects on air quality due to the volatilization of contaminated sediment. Exposure of sediments will result in minor emissions of odours and VOCs.

9.4.3.2 *Accidental Leaks of Petroleum Products During Equipment Fuelling and Maintenance*

Accidental leaks of petroleum have the potential to result in temporary effects on air quality. Spills of petroleum products may result in minor emissions of odours and VOCs. The risk of combustible vapour clouds may also be increased. Possible ignition of the vapour clouds could lead to the emission of hydrocarbon combustion by-products.

Prompt clean up procedures will prevent undue exposure and will be facilitated by the development of spill contingency plans in the Remediation Action Work Plan. Given the effective management procedures, these emissions are expected to be minimal. As a result, the air quality effects due to accidental leaks of petroleum products are not expected to be significant.

9.4.3.3 *Accidental Spills or Discharges During Cargo Handling Related to Marine Terminal Operations*

Accidental spills and discharges that are related to cargo handling have the ability to result in temporary effects on air quality, depending on the volatility and nature of the cargo handled.

Prompt clean up procedures will prevent undue exposure and will be facilitated by the development of spill contingency plans in the Remediation Action Work Plan. Given the effective management procedures, these emissions are expected to be minimal. As a result, the air quality effects due to spills and discharges related to cargo are not expected to be significant.

9.4.3.4 *Navigation Accidents*

Although unlikely, navigation accidents may lead to gaseous fuel emissions that include VOCs and hydrocarbons. Navigation accidents could also increase the risk of combustible vapour clouds due to fuel spills. The possible resultant fires could also cause air emissions of fine particles and hydrocarbon combustion by-products. Due to the potential for fires and fuel spills, odours may also be emitted. Emergency response plans will be in place and implemented in the event of navigation accidents.

The likelihood of occurrence for navigation accidents will be significantly reduced by implementing mitigation measures outlined in Section 9.2.3.6 and 9.3.3.4 (Shipping and Navigation). During the ECF construction phase, air monitoring will continue to be implemented as outlined in Section 9.2.2.1. All air quality monitoring exceedances or concerns will be communicated to the public and provincial regulators following the protocols outlined in the Remediation Action Work Plan.

Considering the mitigation measures, the air quality effects due to navigation accidents will be temporary and the occurrence of navigation accidents will have a low likelihood. As a result, the residual effects on air quality will not be significant.

9.4.3.5 *Traffic Accidents Along Haul Routes*

Traffic accidents have the potential to affect air quality. Fuel and material spills due to vehicle accidents along haul routes may cause emissions of fine particulate matter and volatile contaminants. The emissions of volatile contaminants may also lead to odour emissions in the immediate vicinity of the accident.

Spills associated with traffic accidents along haul routes are often difficult to prevent since there are various causes for these accidents (e.g., weather conditions, driver error, etc.). To prevent effects from traffic accidents, regular maintenance and inspections for construction vehicles will be carried out. To minimize the potential of occurrence, a plan for traffic management will also be produced as part of the Remediation Action Work Plan. Prompt action to implement the spill management procedures will avoid undue releases of air emissions.

Given the mitigation measures, the air quality effects due to vehicle accidents along haul routes will be of short duration and are unlikely to be significant.

9.4.4 Ambient Noise

The possible malfunctions and accidental events that may affect noise in the area include:

- navigation accidents, including ship impacts with the ECF; and
- traffic accidents along haul routes.

9.4.4.1 *Navigation Accidents*

Navigation accidents may result in noise in the form of alarms or equipment. This noise may negatively effect the acoustic environment of the surrounding residential receptors. However, it is anticipated that the noise will be for a short duration. The disruptive sounds, such as alarms, are often required for safety reasons. Therefore, mitigation measures for these noise emissions would not be appropriate.

Given that the noise is expected to be infrequent and for a short duration, the potential environmental effects are not considered to be significant.

9.4.4.2 *Traffic Accidents*

Similar to navigation accidents above, traffic accidents may also result in noise in the form of alarms or equipment. The noise resulting from traffic accidents may negatively affect the acoustic environment of the surrounding residential receptors. However, the noise will likely be for a short duration. These disruptive sounds are often required for safety reasons, therefore, mitigation measures would not be appropriate.

Given that the noise is expected to be infrequent and for a short duration, the potential environmental effects are not considered to be significant.

9.4.5 Soil Quality

The possible malfunctions and accidental events that may affect soil quality within the project boundary include:

- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges related to cargo, during marine terminal operations;
- accidental spills from the waste water treatment system near the staging area; and
- traffic accidents along haul routes.

9.4.5.1 *Accidental Leaks of Petroleum Products during Equipment Fuelling and Maintenance*

Accidental spills present a moderate risk to soil quality in equipment storage, staging and refueling areas. Although most of the on-land project area is paved, which reduces the risk to underlying soil, mitigation for unpaved areas will consist of standard construction mitigation measures including preparation of a refueling area (e.g., a gently sloping area with compacted soils and three-sided containment berm) operator training, emergency response planning and equipment maintenance. A refuelling station will be set up within the project area so that any accidental leaks of petroleum products during equipment fuelling and maintenance will be contained and managed within the refuelling area. This station should have a liner/spill containment control features (e.g., collection systems, berms). Residual effects will likely not be significant.

9.4.5.2 *Accidental Spills or Discharges During Cargo Handling, Related to Marine Terminal Operations*

Accidental spills present a minor risk to soil quality in the marine terminal cargo handling area. The cargo handling area will be paved which reduces the risk to underlying soil. With mitigation measures including operator training, emergency response planning and equipment maintenance, residual effects will likely not be significant.

9.4.5.3 *Accidental Spills from Waste Water Treatment System*

Accidental spills and leaks of untreated decant water may result in adverse effects on the soil quality in the vicinity of the treatment system. Mitigation measures to reduce the risk associated with the treatment system leaks include treatment plant operator training and emergency response planning. The use of spill control structures in areas around the treatment plant will also be utilized. Any effects of a spill will likely be of low magnitude and short duration and are not considered to be significant.

9.4.5.4 *Traffic Accidents Along Haul Route*

Traffic accidents along the haul route have the potential to result in soil contamination if hydrocarbons are released.

As indicated above, spills associated with traffic accidents along haul routes are often difficult to prevent. In an effort to prevent traffic accidents involving construction vehicles and equipment associated with the project, regular maintenance and inspections of these vehicles will be carried out. Furthermore, to minimize the potential of occurrence, a plan for traffic management will also be produced as part of the Remediation Action Work Plan.

In the unlikely event of a traffic accident, the primary concern is worker and public safety. When it is safe to do so, mitigation measures will include implementation of emergency response measures such as spill containment and removal of contaminated material for treatment and/or disposal at an approved facility. Prompt action to implement the spill management procedures will minimize the extent of the contamination.

Given the mitigation measures, the environmental effects on soil quality due to traffic accidents along haul routes will be of minimal duration and extent and are unlikely to be significant.

9.4.6 Surface Water Quality, Currents and Circulation

The following malfunctions and accidental events could affect surface water quality in the project area:

- accidental discharges of sediment contaminants during construction;
- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges during cargo handling related to marine terminal operations;
- cap failure of U.S. Steel I/O Channel;
- ECF cap failure;
- sheetpile wall failure;
- migration of contaminants underneath the ECF through the clay layer; and
- navigation accidents, including ship effects with the ECF.

None of the accident and malfunction scenarios are likely to affect currents and circulation in Hamilton Harbour.

9.4.6.1 *Accidental Discharges of Sediment Contaminants During Construction*

Accidental release of contaminated sediment during dredging activities is of concern. These releases will potentially be as a result of dredge line failure (e.g., punctured line, unsecured connections). The risks associated with the release of the contaminated sediment can be reduced by regular inspections of equipment and dredge line, preparation of a contingency plan, and development of an on-site emergency response team equipped with necessary equipment and trained personnel to manage spills and leaks. These spills are likely to be small and of short duration and will likely not have significant adverse effects.

9.4.6.2 *Accidental Leaks of Petroleum Products During Equipment Fuelling and Maintenance*

Accidental on-site spills and leaks of petroleum products may occur due to containment failure or spills caused by mishandling of material. The leaks and spills from construction or operating related equipment fuel or lubricants during fuelling and maintenance of equipment utilized for sheet piling, dredging, and logistic supports are more of a concern. A refuelling station will be set up within the project area so that any accidental leaks of petroleum products during equipment fuelling and maintenance will be contained and managed within the refuelling area. This station should have a liner/spill containment control features (e.g., collection systems, berms). Standard industrial procedures, including employing trained personnel for these activities and implementation of an emergency response plan, will be in place. Given the mitigation measures in place, and the fact that these spills will likely be small and of short duration, residual effects will likely not be significant.

9.4.6.3 *Accidental Spills or Discharges During Cargo Handling Related to Marine Terminal Operations*

Accidental spills or discharges may occur by the mishandling of cargo. Liquid products could be transported by overland flow or storm sewers to surface water. Standard industrial procedures, including employing trained personnel for these activities and implementation of an emergency response plan, will be in place. Given the mitigation measures in place, and the fact that these spills or discharges will likely be relatively small and of short duration, residual effects will likely not be significant.

9.4.6.4 *Cap Failure of the U.S. Steel I/O Channel*

Cap failure of the U.S. Steel I/O channel may occur due to unauthorised navigation in the channel resulting in erosion or scour of cap materials. This, in turn may lead to leakage of contaminants back into the Harbour. If cap failure should occur, emergency procedures will contain migration of contaminants and the cap will be repaired as soon as possible. Release of contaminants will likely be of short duration and effects on surface water quality are not expected to be significant.

9.4.6.5 *ECF Cap Failure*

The infiltration of precipitation into the ECF in the event of cap failure will result in an increase of hydraulic head within the ECF. The increased hydraulic head within the ECF may result in an increased tendency for contaminants to migrate from sediment to surface water. The proposed annual inspection of the ECF cap will reduce the risks associated with the ECF cap failure. If cap failure should occur, emergency procedures (as outlined in the Emergency Response Plan) will contain migration of contaminants and the cap will be repaired as soon as possible. To mitigate potential surface water effects from structural failure of the ECF and subsequently impacts to SAR, the following measures will be employed:

- installation of a drainage system in the ECF cap to limit recharge to dredged material in the ECF;
- conducting quality assurance monitoring of the interlock sealing process during and post construction and over the long term;
- conveyance of direct storm water and/or precipitation to a rock backfill between the double walls, to provide recharge in order to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the sheet pile walls;
- conducting long-term monitoring using monitoring wells positioned between the walls; and

- implementation of mitigation measures such as water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified.

In consideration of the proposed mitigation measures, release of contaminants will likely be of short duration and will not be significant.

9.4.6.6 *Sheetpile Wall Failure*

In the event of the inner sheetpile's seal failure, release of contaminants into the area between the sheetpile walls and eventual migration across the structural wall to surface water may occur. This may be as a result of corrosion or general structural failure due to overloading of ECF walls.

The integrity of the inner sealed sheetpile will be evaluated by monitoring the quality of the groundwater samples collected from between the inner and outer walls. To minimize the risk associated with this failure, periodic visual inspections of the outer structural sheetpile wall will also be undertaken. Furthermore, an emergency response plan will be developed to provide adequate responses to this situation. In consideration of the mitigation measures outlined above, release of contaminants will likely be of short duration and will not be significant.

9.4.6.7 *Migration of Contaminants Underneath the ECF Through the Clay Layer*

There is a potential for the migration of contaminants through breaks/cracks in the clay layer beneath the ECF which may lead to a pathway into the sediment and surface water outside of the ECF. The potential for such movement is low given the low hydraulic gradient that will result from the ECF cap and stormwater management system. The quality of groundwater between the inner and outer sheet walls will be monitored to detect the migration of the contaminants. Harbour water quality immediately adjacent to the ECF will also be monitored. Additionally, a contingency plan for corrective measures (e.g., groundwater pump-and-treat system within the ECF) will be implemented. Residual effects are not expected to be significant.

9.4.6.8 *Navigation Accidents*

The effects of vessels colliding into the ECF will be mainly a function of operators' error or poor weather conditions. Although the ECF structure will be hardened, in the areas where the potential for such accidents may occur, to withstand significant loads and effects, navigational aids will also be installed to minimize the risk of collisions. An emergency response plan will be in place in case of large-scale navigational accidents.

Although unlikely, there is the possibility that a dredge barge or similar vessel will be involved in a navigation accident causing a catastrophic release of contaminated sediment or other contaminants such as petroleum hydrocarbons. This plume from the spill is likely to be of short duration, although it will be larger and will likely travel farther than a small spill. Although the effect may be significant (increased concentration of contaminants above ambient outside the compliance monitoring boundary), it is highly unlikely to occur.

9.4.7 Aquatic Biota

The possible malfunctions and accidental events that may affect aquatic biota, including species at risk in the area include:

- accidental discharges of sediment contaminants during construction;
- ECF cap failure;
- cap failure of the U.S. Steel I/O channel;
- failure of the bottom confining layer failure;
- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges during cargo handling related to marine terminal operations;
- sheetpile wall failure; and
- navigation accidents, including ship effects with the ECF.

9.4.7.1 *Accidental Discharges of Sediment Contaminants During Construction*

Spills of chemical, hazardous, or contaminated materials, regardless of cause or the source, are an issue if the contaminants migrate into Hamilton Harbour during construction. Sources of spills and accidental discharges may include:

- spills or releases during dredging (e.g., failure of the dredgelines);
- failure of the U.S. Steel I/O channel during the construction/operation phase;
- failure of the ECF cap during construction/operation phase; and
- failure of the bottom confining layer during the construction process.

An EPP will be developed and implemented for the ECF construction phase (see Section 9.2.2.5). All remediation activities will observe best management practices. The EPP will follow applicable regulations and will prescribe detailed protocols for management of hazardous materials, particularly in the event of a spill.

Because of the short duration of any unexpected release of contaminated material and the current state of contaminants within the Harbour, the flux is unlikely to adversely affect aquatic habitat and biota over the long-term. Adverse effects will not be significant.

9.4.7.2 *Accidental Leaks of Petroleum Products During Equipment Fuelling and Maintenance*

A refuelling station will be set up within the project area so that any accidental leaks of petroleum products during equipment fuelling and maintenance will be contained and managed within the refuelling area. This station should have a liner/spill containment control features (e.g., collection systems, berms) that prevents surface/ground water from entering Hamilton Harbour waters. If a spill should happen, measures should be undertaken as per the emergency response plan to minimize potential negative effects. Because of the short duration of any unexpected release of petroleum products and the current state of contaminants within the Harbour, it is unlikely that any flux will adversely affect aquatic habitat and biota. Adverse effects will likely be not significant.

9.4.7.3 *Accidental Spills or Discharges During Cargo Handling Related to Marine Terminal Operations*

Accidental spills or discharges may occur by the mishandling of cargo. Liquid products could be transported by overland flow or storm sewers to surface water. If a spill should happen, measures will be undertaken as per the emergency response plan to minimize potential negative effects. Standard industrial procedures, including employing trained personnel for these activities and implementation of an emergency response plan, will be in place. Given the mitigation measures in place, and the fact that these spills or discharges will likely be relatively small and of short duration, residual effects will likely not be significant.

9.4.7.4 *Sheetpile Wall Failure*

Failure of the sheetpile containment during the excavation or the stabilization/solidification process for the Randle Reef site would lead to contaminants entering the aquatic environment. Given the cell-by-cell remediation approach, the volumes of material released would be relatively small. Failure of the cofferdam is highly unlikely given that the design will include engineered safety factors. Monitoring of the stability of the walls will also be ongoing to detect any early changes. An emergency response plan will be developed to provide adequate responses to this situation. Exposure is expected to be temporary and residual effects on aquatic biota and habitat will not likely be significant.

9.4.7.5 *Navigation Accidents*

Small navigation accidents and effects with the ECF are, for the most part, unlikely to release contaminants into Hamilton Harbour. However, there is the possibility that a catastrophic navigational accident will occur. This may cause the release of large quantities of sediment (if a barge is involved) or petroleum hydrocarbons. This plume from the spill is likely to be of short duration, although it will be larger and will likely travel further than a small spill. An emergency response plan will be in place in case of large-scale navigational accidents. However, it is highly unlikely to occur due to standard navigational aids. The effects from such a spill on the aquatic biota are likely to be of short duration and will not be significant.

9.4.8 Species at Risk

The effects of accidents and malfunctions on species at risk are expected to be the same as for aquatic biota, as described in Section 9.4.7, or less, given the infrequency of their occurrence in the vicinity of the project. The effects on the species at risk are likely to be of short duration and will not be significant.

9.4.9 Residential Areas

The only accidental event identified that may affect residential areas is traffic accidents along the haul routes.

During construction, traffic accidents along haul routes may result in disruption to nearby residences including the potential release of hydrocarbon vapours and noise (see Sections 9.4.3 and 9.4.4). Vehicle accidents along the haul routes are more likely due to the higher volume of traffic along these routes. They are often difficult to prevent since they can happen as a function of driver error or poor weather conditions, and may lead to injury of workers and members of the public. To minimize the potential of occurrence, a plan for traffic management will also be produced as part of the Remediation Action Work Plan. A designated haul route will be enforced so that all truck traffic comes from the east via QEW/Burlington Street and not through the City (e.g., York Boulevard/ Wilson Street/Cannon Street/Victoria Avenue/Wellington Avenue). Construction vehicles will be inspected and maintained regularly. During the operation of the marine terminal, the additional increase in truck traffic is expected to be minimal.

In the unlikely event of a traffic accident, the primary concern is worker and public safety. Emergency response measures will be implemented to protect human health and the environment (once it is safe to do so). Although response activities may further disrupt nearby residences, these measures are necessary and their effects cannot be avoided. The potential disruptions will be of short duration.

With implementation of the above mitigation measures, significant environmental effects on residential areas are not likely to occur.

9.4.10 Industrial, Commercial and Municipal Use and Infrastructure

As with residential areas, the only accidental event that may affect industrial, commercial, and municipal land uses and infrastructure is traffic accidents along the haul routes (see Section 9.4.9).

The potential effects on industrial, commercial and municipal use and infrastructure include impacts on users from air and noise and interruption of activities due to traffic disruptions. Mitigation measures related to air and noise are provided in Sections 9.4.3 and 9.4.4.

During construction, the potential for traffic disruptions on industrial, commercial and municipal use and infrastructure from traffic accidents along the haul route will be minimized with implementation of the traffic management plan, which will be produced as part of the Remediation Action Work Plan. Furthermore, a designated haul route will be enforced so that all truck traffic comes from the east via QEW/Burlington Street and not through the City (e.g., York Boulevard/Wilson Street/Cannon Street/Victoria Avenue/Wellington Avenue). During the operation of the marine terminal, the additional increase in truck traffic is expected to be minimal.

In the unlikely event of a traffic accident, emergency response measures will be implemented immediately to protect human health and the environment. Traffic disruption will be minimized to the extent possible.

With implementation of the above mitigation measures, significant environmental effects on industrial, commercial and municipal use and infrastructure are not likely to occur.

9.4.11 Sherman Inlet

The following are the possible malfunctions and accidental events that may affect Sherman Inlet:

- accidental discharges of sediment contaminants during construction;
- accidental leaks of petroleum products during equipment fuelling and maintenance;
- accidental spills or discharges during cargo handling related to marine terminal operations;
- cap failure of U.S. Steel I/O Channel;
- ECF cap failure;
- sheetpile wall failure;
- bottom confining layer failure; and
- navigation accidents, including ship effects with the ECF.

The likely effects on Sherman Inlet are due to effects on surface water quality and aquatic biota within the Inlet, as discussed in Sections 9.4.6 and 9.4.7 respectively. In these instances, the potential for environmental effects are considered to be not significant and/or not likely to occur.

9.4.12 Public Health and Safety

Small spills and releases into the Harbour, such as from dredging activities, ECF cap failure, cap failure of the U.S. Steel I/O channel and failure of the bottom confining layer failure, are unlikely to have effects on public health and safety. Effects to public health and safety are likely to be related to:

- accidental leaks of petroleum products during equipment fuelling and maintenance;
- navigation accidents, including ship effects with the ECF; and
- traffic accidents along the haul routes.

The Health and Safety Plan for the project will include measures to ensure the safety of the public.

9.4.12.1 *Accidental Leaks of Petroleum Products During Equipment Fuelling and Maintenance*

Accidental leaks and spills from construction or using related equipment fuel or lubricants during fuelling and maintenance of equipment may occur during the project. As described in Section 9.4.3, fuel spills have the potential to affect air quality and may result in public health concerns. A refuelling station will be set up within the project area so that any accidental leaks of petroleum products during equipment fuelling and maintenance will be contained and managed within the refuelling area. This station should have a liner/spill containment control features (e.g., collection systems, berms). Standard industrial procedures including employing trained personnel for these activities and implementation of an Emergency Response Plan will be in place. Given the procedures that will be in place, there is unlikely to be an effect on public health from petroleum spills.

9.4.12.2 *Navigation Accidents*

Although unlikely, navigation accidents may lead to injury and loss of life. Navigation accidents will be prevented to the extent possible by:

- communicating in-water work activities and their schedule to the Canadian Coast Guard, HPA and shipping companies;
- ascertaining the schedule of vessel movements in the area that may be affected by ECF Construction;
- marking in-water works areas with cautionary navigation buoys in compliance with the Private Buoy Regulations of the Canada Shipping Act; and
- ensuring proper lighting on all project vessels.

Should a catastrophic navigational accident occur, the effects may be significant. However, given the mitigation measures in place to prevent such accidents, it is highly unlikely to occur.

9.4.12.3 *Traffic Accidents Along Haul Routes*

Vehicle accidents along the haul routes may lead to personal injury or loss of life. In either case, this would be considered a significant effect. Given the mitigation measures described in Sections 9.4.9, they are unlikely to occur, although the probability of occurrence increases with increased traffic loading on the road.

9.4.13 Recreational Uses of the Harbour

The only malfunction or accidental events that could potentially interact with recreational uses of the Harbour are navigation accidents.

Recreational uses of the Harbour are unlikely to be affected by any accidental contaminant spill. However, during construction there is the possibility of recreational marine craft colliding with dredging barges or floating dredging suction and pumping lines. Any personal injury or loss of life would be considered significant. A collision of this nature can be avoided by following the mitigation measures presented in Sections 9.2.3.5 and 9.3.3.3 (Recreational Uses). All in-water works areas will be marked with cautionary navigation buoys in compliance with the Private Buoy Regulations of the *Canada Shipping Act*, and navigation accidents of this type are highly unlikely. During the operation of the marine terminal, there is the possibility of a recreational marine craft colliding with ship traffic associated with the terminal. The additional marine traffic associated with the marine terminal is expected to be minimal (2-4% increase). As a result, navigational accidents of this type are highly unlikely.

9.4.14 Shipping and Navigation

The only malfunction or accidental events that could potentially interact with shipping and navigation are navigation accidents.

During construction there is the potential for large marine transportation vessels to collide with project vessels. This can be best addressed by following the mitigation measures presented in Sections 9.2.3.6 and 9.3.3.4 (Shipping and Navigation) and Section 9.2.3.4 (Public Health and Safety). During the operation of the marine terminal, there is the possibility of a recreational marine craft colliding with ship traffic associated with the terminal. The additional marine traffic associated with the marine terminal is expected to be minimal (2-4% increase).

Although unlikely, navigation accidents may lead to injury and loss of life. The effects of a catastrophic navigational accident may be significant, although, given the mitigation measures in place, it is highly unlikely to occur.

9.4.15 Follow-up and Monitoring Measures

It is essential for the success of the project, that both mitigation measures, maintenance and monitoring are undertaken as outlined in Section 9.0.

The Remedial Action Work Plan will be compiled, communicated, implemented and updated appropriately throughout the course of the project. In addition, the RAs for the project, in conjunction with other appropriate agencies e.g. MOE, will be responsible for determining and implementing follow-up programs.

9.4.16 Significance of Residual Effects from Malfunctions and Accidents

The significance of possible malfunctions and accidents is summarised in Table 9.37. With the implementation of mitigation measures, health and safety provisions, and monitoring programs, effects of the majority of malfunctions and accidents are expected to be small in magnitude, short in duration, localized and reversible. Residual effects are not expected to be significant.

There is the possibility of personal injury or loss of life from either navigational accidents or traffic accidents. In this event, the effect would be considered significant. However, given the mitigation measures in place, there is a high confidence that these events will not occur.

Table 9.37: Summary of Environmental Effects Assessment of Malfunctions and Accidental Events

	Air Quality	Ambient Noise	Soil Quality	Surface Water Quality, Currents and Circulation	Aquatic Biota	Species at Risk	Residential Areas	Industrial, Commercial and Municipal Use and Infrastructure	Sherman Inlet	Public Health and Safety	Recreational Uses of the Harbour	Shipping and Navigation	Likelihood*	Level of Confidence*
Accidental exposure of contaminated sediments to the air during construction	NS													
Accidental discharges of sediment contaminants during construction				NS	NS	NS			NS					
Accidental leaks of petroleum products during equipment fuelling and maintenance	NS		NS	NS	NS	NS			NS	NS				
Accidental spills or discharges during cargo handling related to marine terminal operations	NS		NS	NS	NS	NS			NS					
Cap failure of the U.S. Steel I/O channel				NS	NS	NS			NS					
ECF cap failure				NS	NS	NS			NS					
Sheetpile wall failure				NS	NS	NS			NS					
Accidental spills from waste water treatment system			NS											
Bottom confining layer failure				NS	NS	NS			NS					

	Air Quality	Ambient Noise	Soil Quality	Surface Water Quality, Currents and Circulation	Aquatic Biota	Species at Risk	Residential Areas	Industrial, Commercial and Municipal Use and Infrastructure	Sherman Inlet	Public Health and Safety	Recreational Uses of the Harbour	Shipping and Navigation	Likelihood*	Level of Confidence*
Navigation accidents, including ship impacts with the ECF	NS	NS		S	NS	NS			NS	S	S	S	Highly unlikely	High
Traffic accidents along haul routes	NS	NS	NS				S	S		S			Unlikely	High

NS = Not significant effect

S = Significant effect

* Only addressed for significant effects

9.5 Cumulative Effects Assessment

In accordance with Subsection 16(1) of CEAA, this section assesses the cumulative environmental effects that may result from the project construction or operational phases in combination with other past, present or foreseeable future projects. It should be noted that there is some uncertainly as to predicting effects into the future, especially with components related to operations (Navigational dredging and cargo handling). This uncertainty relates to the fact that there are no clear dates established for when these components will actually be undertaken. This uncertainty has been considered in the assessment of potential cumulative effects.

The proposed project is located in an area that has been subjected to past and current activities including industrial operations and urban development. Although the effects from individual components of a project may be determined to be not significant, the combined effects of other off-site activities with project activities may be significant. The cumulative effects assessment is conducted to ensure the incremental effects resulting from the combined influences of various activities are considered.

9.5.1 Methodology

The methodology used in the cumulative effects assessment incorporates the following key steps, as outlined in the Cumulative Effect Practitioners Guide (Canadian Environmental Assessment Agency, 2006):

- Scoping - identify regional issues of concern, VECs, spatial and temporal boundaries, other unrelated projects and the potential effects of unrelated projects;
- Analysis of Effects - analyze the effects of cumulative interactions/effects on VECs identified during scoping;
- Mitigation - recommend mitigation for effects identified;
- Evaluation of Significance - determine residual cumulative effects and their significance; and
- Follow-up - identify appropriate monitoring.

9.5.2 Scoping

The objective of the cumulative effects assessment scoping exercise is to identify specific VECs and the potential for interaction with other projects and activities. The scoping will:

- identify specific VECs;
- define temporal and spatial boundaries; and
- identify other past, present, and future activities that may influence the VECs identified.

9.5.2.1 *VEC Identification*

Regional issues of concern that may result in cumulative environmental effects include:

- industrial development's contribution to GHG emissions;
- increased industrial development of the area and associated effects;
- increased residential and commercial development of the area and associated effects; and
- changes in the fish species assemblages.

Direct project potential effects on VECs within the scope of the CSR were assessed prior to mitigation in Sections 9.2.2, 9.2.3, 9.3.2 and 9.3.3. Residual effects were then determined after mitigation measures were considered. Since the cumulative effects assessment builds on the assessment of the effects of the project, VECs that have been determined to display residual effects are subject to the cumulative effects assessment.

The following VECs were determined to exhibit residual effects after mitigation and have been identified as VECs that are subject to the cumulative effects assessment:

- Air Quality;
- Ambient Noise;
- Surface Water Quality;
- Aquatic Biota;
- Species at Risk; and
- Public Health and Safety.

9.5.2.2 *Temporal and Spatial Boundaries*

The spatial boundaries for the assessment are defined for each VEC likely to be affected where a measurable effect is predicted for the cumulative effects assessment.

The temporal boundary encompasses past projects and activities which have contributed to the conditions of the existing environment. Certain and reasonably foreseeable future projects that may influence the environmental conditions for the life of the project are also captured within the temporal boundary. The decommissioning phase is not considered in this cumulative effects assessment since the containment facility and marine terminal are expected to be in place indefinitely.

9.5.2.3 *Identification of Other Projects and Activities*

The criteria and rationale used for identifying other projects and activities for the cumulative effects assessment are outlined in Table 9.38.

Table 9.38: Criteria Applied in the Identification of Other Projects and Activities

Criteria	Rationale/ Application of Criterion
Status of other project or activity: • Past and existing; or • Certain/planned; or • Reasonably foreseeable.	For the purposes of this assessment, the cumulative effects assessment does not specifically reference past and present projects and activities. It is assumed that the existing status of each VEC has been influenced by the past and existing projects and the effects have been captured in the baseline study. It is also assumed that the nature of the existing projects or activities will continue to be carried out in the future and they will not have similar effects to what are currently present. As a result, the effects of past and existing projects or activities have been evaluated in the assessment of effects of the project. However, to clearly acknowledge their probable contribution to the baseline conditions, the past and existing projects or activities have been listed under a separate heading in Table 9.42. Planned/certain projects are those that have a high probability of proceeding. The cumulative effects assessment will consider the following as certain/planned projects or activities: • Projects where the intent to proceed is officially announced by the proponent to regulatory agencies; • Projects where submission for regulatory review is imminent; and • Projects that have been approved or are currently under regulatory review for approval. Reasonable foreseeable projects and activities are those that may proceed. These projects and activities typically include those that are identified in approved development plans or those that are in other advanced stages of planning. Hypothetical and speculative projects and activities are not considered as part of the cumulative effects assessment.
Potential for overlap related to **timing** of the project and /or activity: • Other project or activity must be carried out or implemented during the time frame that is relevant to the project.	The project involves the following time frames: Construction: 2012 to 2021 Operation: 2021 onwards In accordance with this time line, the temporal boundary for projects relevant to the cumulative effects assessment will extend from the start of construction phase of the project (2012), continuing through the project construction and operation phases.

Criteria	Rationale/ Application of Criterion
Potential for overlap related to the **type of effect**: • Other projects and activities must exhibit the potential to result in effects on VECs similar to project-related residual effects.	All projects and activities with a "reasonable potential" to exhibit types of environmental effects similar to those anticipated for the project were identified for the cumulative effects assessment.
Potential for a **spatial overlap** of effect: • Other project or activity must influence the project area as defined in the effects analysis for the various VECs.	For the cumulative effects assessment, the regional study area includes areas where possible project interactions with other actions may occur. All projects with a known or expected zone of influence that may overlap with the geographic area likely affected by the project will be identified.

To identify past, existing, and future projects that may result in cumulative effects, various sources of information, including consultations with individuals, agencies and government departments were used. Environmental registries, city plans and environmental approvals were also reviewed for information regarding past, existing and future projects. The following is a list of resources consulted:

- Hamilton Port Authority: Port Map;
- Marilyn Baxter, Environmental Manager, Hamilton Port Authority;
- Hamilton Port Authority Environment Overview;
- City of Hamilton: Planning and Economic Development Department;
- City of Hamilton: Downtown Renewal Division;
- Canadian Environmental Assessment Registry;
- Canada's National Pollutant Release Inventory;
- Infrastructure Ontario and
- Hamilton Air Monitoring Network.

Table 9.39 outlines the initial list of projects that were identified and screened to order to identify a list of other projects and activities to be evaluated in the cumulative effects assessment.

Table 9.39: Identified Other Projects and Activities and Potential for Cumulative Effects

#	Project/Activity	Location	Project Name/Description	Current Status/Time frame	Project Included	Rationale
1	**Past and Present Projects**					
1.1	Industrial Developments	Hamilton	· Stelco Inc. Steel Plant · Dofasco Inc. · Slater Steels · Canadian Drawn Steel · Union Drawn Steel LTD · Lakeport Brewery · Bunge Canada · Aluminous Lighting Products · Attic Mechanical & Maintenance Ltd. · Richards-Wilcox Systems Inc. · Ronsco Inc. · IKO Industries Ltd · Lafarge Canada Inc. · Vopak Terminals of Canada Inc. · Biox Canada Limited · Shell Canada Products · Sylvite Agri-Services Ltd. · Great Lakes Stevedoring Co. Ltd. · Heddle Marine Service Inc. · Fibre Laminations Ltd. · McKeil Marine Ltd. · Universal Handling Equipment Co. Ltd. · VAE Nortrak · Columbian Chemicals · Lakeshore Sand Co. (Ont.) Ltd. · A division of Fairmount Minerals · VFT Canada Inc. · Westway Terminals · Simens-Westinghouse · Orlick Industries · Fell-Fab · Simens-Westinghouse · Canway Equipment Manufacturing · Hamilton Port Authority and Federal Marine Terminals · National Steel Car	In Operation	no	Captured by baseline description through direct effects assessment;
1.2	Water Treatment Plants	Hamilton	· Woodward Avenue Wastewater Treatment Plant	In Operation	no	Captured by baseline description through direct effects assessment;
1.3	Landfills	Hamilton	· Brampton Street Landfill site	Closed	no	Captured by baseline description through

#	Project/Activity	Location	Project Name/Description	Current Status/Time frame	Project Included	Rationale
			· Rennie Street Landfill			direct effects assessment;
1.4	Energy	Hamilton	· Hamilton Community Energy Centre (Hamilton Utilities)	In Operation	no	Captured by baseline description through direct effects assessment;
2	**Planned/Certain Projects**					
2.1	Residential Developments	Hamilton	· 260 King Street East 11 storey building	Under Construction	no	Overlap unlikely due to spatial extents of effects
			· 89 King Street East 5-storey building	Building permits issued		
2.2	Municipal Infrastructure Projects	Hamilton	· Hamilton General Hospital Expansion	In progress, anticipated completion by Spring 2009	no	Overlap unlikely due to spatial extents of effects
2.4	Commercial Developments	Hamilton	· Main,Caroline,George leased parking structure	Planned for construction in 2008	no	Overlap unlikely due to spatial extents of effects
3	**Reasonably Forseeable**					
3.1	Residential Developments	Hamilton	· 12 Mary Street Century Theatre construction/preservation	Site plan stage	no	Overlap unlikely due to spatial extents of effects
			· 150 Main Street West	Property purchased/planning stage		
3.2	Commercial Developments	Hamilton	· King William Street Mixed Use Parking Structure	Phase II ESA 2008	no	Overlap unlikely due to spatial extents of effects
3.3	Remediation Projects	Hamilton	· Sherman Inlet Remediation	EA likely to begin in 2011	**yes**	Overlap likely with respect to Spatial extent of effects; and Temporal occurrence of effects; Type of potential effects (water quality; freshwater biota and habitat; soil quality; air quality; noise; public human health; and species at risk)
3.4	Industrial Developments	Hamilton	· Dofasco Pulverized Coal Injection	Approvals Obtained	**yes**	Overlap with likely with respect to Spatial extent of effects; Temporal occurrence of effects; Type of potential effects (air quality; and public human health)

Past, present and future projects that had an overlap with the proposed project in the geographic extent of potential effects, and the temporal boundary of potential effects were included in the cumulative effects assessment, the type of effect that could potentially occur was alsoconsidered. Projects that did not overlap with the project in these areas were screened out of the cumulative effects assessment.

The past and present projects (as identified in Table 9.39) have been captured in the baseline study. Thus the state of each VEC reflects the influence of past and present projects and activities occurring within or outside of the project area. It is assumed that these activities will proceed into the future and will have similar effects as currently observed. Given this, the focus of this cumulative effects assessment is on future projects and activities and their effects on each VEC.

Reasonably Foreseeable Projects

Dofasco Pulverized Coal Injection:

In August of 2007, Dofasco announced it would consider the construction of a $60 million dollar pulverized coal injection system at its two blast furnaces situated near Hamilton Harbour. Pulverized coal injection involves the addition of crushed coal into the blowpipes of a blast furnace as a substitute for a portion of the coke feed, thereby decreasing coke requirements. Regulatory approval for the construction of the pulverized coal injection system has been obtained.

Key concerns for potential cumulative effects are related to air quality and human health.

Sherman Inlet Remediation Project:

Sherman Inlet is located at Pier 15, near the Randle Reef contaminated site. The area had been identified for remediation in the HPA's 2002 Land Use Plan. Contaminants have been observed in the soil, sediment and surface water of Sherman Inlet.

The remediation plan for Sherman Inlet involves the removal of contaminated soil followed by capping of the area. The remediation also includes fish habitat enhancement and the construction of a public trail. An environmental assessment is planned, and will be followed by project planning and the start of remediation in 2013.

Key concerns for potential cumulative effects are related to air quality, noise, surface water and soils, freshwater habitat and biota, species at risk and public health and safety.

9.5.3 Analysis of Cumulative Effects

The following sections discuss potential cumulative effects on each VEC and VSC. The VECs and VSCs discussed in this cumulative effects assessment are those that have project residual effects that may overlap (geographically and/or temporally) with effects of the reasonable foreseeable projects.

Potentially affected VECs / VSCs include:

- Air Quality;
- Ambient Noise;
- Surface Water Quality;
- Aquatic Biota;
- Species at Risk; and
- Public Health and Safety.

Air Quality

Gaseous emissions generated during construction of the proposed project will consist of PM, HAPs, CACs and GHGs. These emissions have the potential to interact with those created by the Sherman Inlet Remediation project and the Dofasco Pulverized Coal Injection project. The gaseous emissions from these three projects may overlap spatially and temporally in the short term and may result in residual cumulative adverse effects. Air quality levels are currently evaluated using provincial air quality criteria. In consideration of the mitigation measures outlined in Sections 9.2.2.1 and 9.3.2.1, the proposed project contributions during the construction phase are not expected to raise pollutant concentrations above these criteria. In addition, by implementing the mitigation measures outlined in Sections 9.2.2.1 and 9.3.2.1, it is expected that any of the residual cumulative adverse effects on air quality are likely to be low in magnitude, short-term and reversible.

In the long-term, the operational phase of the proposed project is expected to improve local air quality and reduce greenhouse gases. As such, there will be beneficial cumulative effects on air quality.

In consideration of the mitigation measures and potential cumulative effects associated with the proposed project, the Sherman Inlet Remediation project, and the Dofasco Pulverized Coal Injection project, no significant adverse environmental effects are expected. An air monitoring program will be implemented to facilitate any adjustments required for mitigation measures are implemented in a timely manner. Table 9.40 summarizes the potential cumulative effects and mitigation measures required for air quality.

Table 9.40: Cumulative Effects Assessment Summary- Air Quality

Cumulative Project-Environmental Interaction	Residual Project Impact with Mitigation	Mitigating Measures	Thresholds for Determining Significance				Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	
Gaseous emissions from the construction phase of the project may interact with those emitted during construction of the Dofasco Pulverised Coal Injection project and the Sherman Remediation Inlet project	Minimal	• air quality complaints will be investigated and mitigation plans will be developed as appropriate • careful selection of trucking routes to minimize the effect on nearby residential areas • on-site speed limits • on-site road housekeeping best management practices including watering, sweeping or vacuuming as required • truck cleaning / washing stations at the site exit • Maintaining appropriate distance (eg., 250 m) between mechanical dredges during operation on the east wall of the ECF • implement a "No Idle" policy on site • develop and implement dust management plan • real-time air monitoring as a project management tool • communications protocol for any air monitoring results that exceed established action levels and criteria.	L	Local	Short-Term/ Intermittent	R	NS
The remediation of the project site will result in less air emissions in combination with the other projects in the same air shed	Positive	• Implementation of restoration/enhancement initiatives within similar environments in Hamilton Harbour	L	Local	Long-Term/ Permanent	R	

NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

Ambient Noise

Noise from construction and transportation activities associated with the Dofasco Pulverized Coal Injection project may interact with noise from the proposed Randle Reef Remediation project and marine terminal. However, given the distance separating the projects, there is limited opportunity for substantial noise interaction.

The noise from the construction phase of nearby Sherman Inlet may result in short-term, intermittent, and reversible sound quality interactions with the *Randle Reef Sediment Remediation Project.* Given the localized nature and short duration of the construction phase noise, no long-term and/or chronic noise quality impacts are expected. The sound quality interactions between these projects will be readily addressed by the mitigation measures discussed previously. The cumulative effects assessment for ambient noise is summarized in Table 9.41

Table 9.41: Cumulative Effects Assessment Summary- Ambient Noise

Cumulative Project-Environmental Interaction	Residual Project Impact with Mitigation	Mitigating Measures	Thresholds for Determining Significance				Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	
Noise from the construction phase of the Randle Reef project may interact with noise emitted during construction of the Dofasco Pulverized Coal Injection project	Minimal	• Distance between the projects provides a good buffer to minimize noise interaction.	L	Local	Short-Term/ Intermittent	R	NS
Noise from the construction phase of the project may interact the external and internal transportation noise from the Dofasco Pulverized Coal Injection project	None	• Distance between the projects provides a good buffer to minimize noise interaction	L	Local	Short-Term/ Intermittent	R	NS
Noise from the construction activities for the project may interact with noise emissions from the construction phase for the remediation of the Sherman Inlet	None	• See Table 9.12	L	Local	Short-Term/ Intermittent	R	NS

NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

Surface Water Quality

The Sherman Inlet Remediation project has the potential to discharge suspended sediment though a concrete culvert and into Hamilton Harbour in the vicinity of the proposed project.

As previously assessed, the surface water quality within the Harbour may be impacted during the construction phase and operation phase activities as discussed in Sections 9.2.2.4 and 9.3.2.3. These impacts include, but are not limited to, re-suspension of contaminated bottom sediment during dredging and backfilling activities, wastewater treatment plant discharges into the Harbour, migration of contaminated pore water from the ECF into the Harbour, and ECF induced changes to the magnitude and direction of the Harbour currents.

Currently, only very limited hydraulic interaction exists through the concrete culvert between Sherman Inlet and the Harbour. Any surface water interaction between the project activities noted above and the Sherman Inlet Remediation project will occur through this culvert connecting the Inlet to the Harbour. During construction of both projects, a sediment barrier will be installed at the culvert entrance, further restricting hydraulic connectively, and effectively preventing sediment transport upstream into Sherman Inlet or downstream into the Harbour. In addition, no impacts to currents or water circulation within the Harbour are expected during the Sherman Inlet Remediation project.

Given this simple and effective method to restrict re-suspended sediment transport, no cumulative effects are expected and no significant adverse environmental effects on the surface water are predicted, provided that the mitigation measures are implemented. Table 9.42 summarizes the potential cumulative effects and mitigation measures for surface water.

Table 9.42: Cumulative Effects Assessment Summary- Surface Water Quality

Cumulative Project- Environmental Interaction	Residual Project Impact with Mitigation	Mitigating Measures	Thresholds for Determining Significance				Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	
Re-suspension of contaminated sediment from preliminary debris removal, the construction of the ECF walls, Pier 15 stabilization, construction of the U.S. Steel turbidity structure, and sediment capping and dredging activities may interact with the occurrence of suspended sediment from the construction and/or remediation phase of the Sherman Inlet Remediation project	None	• Utilizing sediment barrier (e.g., silt curtain) at the culvert entrance to eliminate the transport of re-suspended sediment upstream and down stream.	L	Local	Short-Term/ Intermittent	R	NS
Infiltration of precipitation and snow melt into storage piles of debris, construction material and impacted soil near the Harbour may interact with the occurrence of suspended sediment from the construction and/or remediation phase of the Sherman Inlet Remediation project	None	• Utilizing sediment barrier (e.g., silt curtain) at the culvert entrance to eliminate the transport of re-suspended sediment upstream and down stream.	L	Local	Short-Term/ Intermittent	R	NS

NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

Aquatic Biota and Species at Risk

With the exception of air quality (mentioned earlier), the geographic extent of the effects from the proposed Randle Reef project and the Dofasco Pulverized Coal Injection project (on land) are not expected to overlap. Therefore, no cumulative effects on aquatic biota and species at risk are anticipated.

In contrast, there may be potential cumulative effects due to the Sherman Inlet Remediation project. The Sherman Inlet Remediation project is located 300 m from the project site. Therefore, the extent of the effects on aquatic and biota and species at risk from the remediation activities for the Sherman Inlet may overlap geographically with the project. Adverse cumulative effects may occur during the construction phase of the project. These include the potential release of suspended sediments, metals and PAHs to surface water during the remediation activities at Sherman Inlet and Randle Reef. The following mitigation measures may be implemented at Sherman Inlet to reduce potential adverse effects:

- use of silt curtains constructed with a flexible geotextile;
- dredging or excavating within sheetpile walls;
- use of environmental dredging equipment;
- application of best management practices for environmental protection;
- construction monitoring to verify compliance with operational and performance standards; and
- use of a clean-up crew with containment/sorbent booms, sorbent pads and skimmers as required.

Due to these mitigation measures and the short term duration of the Sherman Inlet construction phase, the cumulative adverse effects will not be significant. It is anticipated that the operational phase will provide positive impacts as the remediation of the Randle Reef and Sherman Inlet sites will reduce the potential of contaminant migration from these sites. The remediation of both Sherman Inlet and Randle Reef is expected to decrease contaminated flux to the environment as a result of the removal and containment of contaminated sediments, as well as the treatment of waters from the ECF to acceptable standards. The effect of the remediation on the Sherman Inlet and the Randle Reef site is irreversible, with the contaminated sediments being sealed. The result (Table 9.43) will be a positive effect on the aquatic habitat (water quality and quality of the aquatic sediment) and species at risk in Hamilton Harbour watershed. Additionally, the ECF design will address the circulation of surface water in the Randle Reef vicinity. Where practical, measures will be incorporated to enhance mixing and oxygenation of surface water that receives stormwater flows from municipal sources from Sherman Inlet.

Table 9.43: Cumulative Effects Assessment Summary- Aquatic Biota and Species at Risk

Cumulative Project-Environmental Interaction	Residual Project Impact with Mitigation	Mitigating Measures	Thresholds for Determining Significance				Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	
Potential discharge of suspended sediments, metals and PAHs through the culvert and into the surface water of the Harbour during the remediation of Sherman Inlet at the same time that activities at Randle Reef are re-suspending sediment in the Harbour.	Minimal	• Use standard sediment control devices (e.g., sheetpile walls and silt curtains at the culvert separating the Inlet and the Harbour). • Focus period of activity during non-breeding times (e.g., autumn).	L	Local	Frequent	NR	NS

NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

Public Health and Safety

The public human health risks for the construction phase of the project may have cumulative adverse effects with those of the construction phase for the Sherman Inlet Remediation and the Dofasco Coal Injection projects. However, the Randle Reef project assessment has determined that an increase in exposure to gaseous emissions may occur before any unacceptable risks would be experienced. On the positive side, long-term effects associated with the operation of the remediated site are expected to be lower than those of the construction phase.

Potential adverse cumulative effects are also associated with accidents due to the cumulative increased vehicular traffic in the area during the overlapping construction phases of the Randle Reef and Sherman Inlet Remediation and the Dofasco Coal Injection projects. In addition to accidents resulting in injuries, traffic accidents may trigger a hydrocarbon spill event. As a mitigation measure, trucking routes will be carefully selected to minimize effects on nearby residential areas and emergency response planning will be implemented.

Consequently, the residual adverse cumulative effects on public health and safety are anticipated to be not significant.

Table 9.44: Cumulative Effects Assessment Summary- Public Health and Safety

• Cumulative Project-Environmental Interaction	Residual Project Impact with Mitigation	Mitigating Measures	Thresholds for Determining Significance				Significance (S/NS)
			Magnitude (VL/L/M/H)	Geographic Extent	Duration/ Frequency	Reversibility (R/NR)	
Gaseous emissions released during the Randle Reef remediation may interact with gaseous emissions from the Sherman Inlet Remediation and the Dofasco Coal Injection projects	Minor	• See Section 9.3.1 Air Quality for detailed mitigation measures.	VL	Local	Short-Term	R	NS
Spills on the project site as well as public roads as a result of vehicle accidents may interact with gaseous emissions from the Sherman Inlet Remediation project and the Dofasco Coal Injection project.	Minor	• Traffic routes will be selected manage safety and traffic density. • Speed limits will be implemented • A Spill Control Plan will be developed and implemented by the contractor during construction; • The Health and Safety Plan for the project will also include measures to ensure the safety of the public in the event of a spill.	L	Local	Short-Term	R	NS

NA- Not Applicable
VL = Very Low, L = Low, M = Moderate, H = High
R = Reversible, NR = Not Reversible
S = Significant, NS = Not Significant

9.5.4 Mitigation Related to Cumulative Effects

In all those cases where the cumulative effects assessment identified the potential for adverse cumulative effects on a VEC, economically and technically feasible mitigation measures have been developed and the cumulative effects re-evaluated. This was undertaken in the same manner as in the direct effects analysis (Sections 9.2.2, 9.2.3, 9.3.2 and 9.3.3). The difference is that mitigation for cumulative effects may be necessarily more long-term and regionally oriented than those for direct project effects. In addition, where beneficial cumulative effects were identified, enhancement measures have been developed where possible.

The VECs that have the potential for adverse and/or beneficial cumulative effects have been identified and are listed in Table 9.45 together with their corresponding mitigation and enhancement measures.

It is also expected that any accidental spills will be immediately contained or cleaned. Thus, no residual cumulative effects are expected from episodic spill events during the remediation process.

Table 9.45: Cumulative Effects, Mitigation, Residual Effects, Significance

	VEC	Potential Cumulative Effect	Mitigation Measures	Residual Cumulative Effect	Significance
1	Air Quality	• Potential for adverse cumulative effects: • Gaseous emissions from project construction activities and the construction phase of the Sherman Inlet Remediation project may interact. • There is also a potential for adverse cumulative effects due to the gaseous emissions during the Randle Reef construction phase with the gaseous emissions of Dofasco Coal Injection project.	• Air quality complaints will be investigated and mitigation measure plans will be developed as appropriate • Careful selection of trucking routes to minimize the effect on nearby residential areas • The implementation of on-site speed limits • On-site road house keeping including potentially watering, sweeping and / or vacuuming • Truck cleaning / washing stations at the exit from the site • Appropriate distance between mechanical dredges during operation on the east wall of the ECF; and • Implement a "No Idle" policy on site combined with a dust management plan • Real-time air monitoring as a project management tool • Communications protocol for any air monitoring results that exceed established action levels and criteria	Minimal adverse effect (short-term and reversible)	Not Significant
		Potential for beneficial cumulative effects: • The overall reduction in air emissions from contaminated sediment and dust.	• None required	Beneficial effect	Not evaluated
2	Ambient Noise	Potential for adverse cumulative effects due to the following: • Noise emissions from the construction phase of the project may interact with noise emitted from the construction of the Dofasco Pulverized Coal Injection project and the Sherman Inlet Remediation project. • Noise emissions from the construction phase of the project may interact with the external and internal transportation noise for the Dofasco Pulverized Coal Injection project.	• Distance between the project and the Dofasco Coal Injection project provides a good buffer to minimize noise interaction • Vibrating sheet pile installation will be used when possible • Use of appropriate muffler systems for onsite noise sources • Limiting construction activities to the hours of 07:00 – 19:00 • Advising nearby residents of significant noise-causing activities and issuing contact numbers to Public for any noise issues • Investigate and respond to noise complaints • Implement traffic management measures for project traffic.	Minimal adverse effect (localized; effective mitigation available).	Not Significant
3	Surface Water Quality	• Re-suspension of contaminated sediment from preliminary debris removal, the construction of the ECF walls, Pier 15 stabilization, construction of the U.S. Steel turbidity structure, and sediment capping and dredging activities may interact with the occurrence of suspended sediment from the construction and/or remediation phase of the Sherman Inlet Remediation project. • Infiltration of precipitation and snow melt into storage piles of debris, construction material and impacted soil near the Harbour may interact with the occurrence of suspended sediment from the construction and/or remediation phase of the Sherman Inlet Remediation project.	• Utilizing sediment barrier (e.g., silt curtain) at the culvert entrance to eliminate the transport of re-suspended sediment upstream and down stream. • Also See Table 9.14.	None	Not Significant
4	Aquatic Biota and Species at Risk	• Potential discharge of suspended sediments, metals and PAHs through the culvert and into the surface water of the Harbour during the remediation of Sherman Inlet at the same time that activities at Randle Reef are re-suspending sediment in the Harbour.	• Use standard sediment control devices (e.g., sheetpile walls and silt curtains at the culvert separating the Inlet and the Harbour). • Focus activities during non-breeding times (e.g., autumn or winter)	Minor	
5	Public Health and Safety	• Gaseous emissions released during the Randle Reef remediation may interact with gaseous emissions from the Sherman Inlet Remediation and the Dofasco Coal Injection projects	• See Section 9.3.1 Air Quality for detailed mitigation measures	Minimal adverse effect (short-term and localized)	Not Significant
		• Spills on the project site as well as public roads as a result of vehicle accidents may interact with gaseous emissions from the Sherman Inlet Remediation project and the Dofasco Coal Injection project.	• Spill Control Plan • Health and Safety Plan for spills and public management • Traffic routes will be selected to manage safety and traffic density. • Speed limits will be implemented	Minimal adverse effect (short-term, intermittent and localized)	Not Significant

9.5.5 Significance of Residual Cumulative Effects

The residual environmental effects from the project in combination with effects from other identified projects and activities were assessed. Other projects or activities were those that had an overlap with the Randle Reef project effects in spatial extent, temporal boundary and type of effect.

The significance of the residual adverse cumulative effects was determined on the basis of the following thresholds: magnitude; geographic extent; frequency; duration; and reversibility. The significance of cumulative effects was only established for adverse effects.

In most cases where a potential for adverse effects was identified, the adverse effects were considered to be of small magnitude and/or of short duration, affecting a limited local area, or reversible. In addition, some of the interactions between the project and the other project works and activities were considered to be beneficial. In part because the mitigation measures identified for the environmental effects of the Randle Reef project will also mitigate cumulative effects to some degree, no significant cumulative effects were identified for which special or additional mitigation is necessary.

Based on the review of the potential cumulative adverse effects and the mitigation measures, it is unlikely that the project will result in significant adverse environmental effects, including cumulative effects.

9.5.6 Follow-up and Monitoring Measures

Follow-up and monitoring measures relevant to cumulative effects are based on the mitigation measures previously discussed and include:

- Air Quality:

  As per Sections 9.2.2.1 and 9.3.2.1, a project specific air quality monitoring program will be implemented as a project management tool for air quality emissions.

- Ambient Noise

  As per Sections 9.2.2.2 and 9.3.2.2, noise complaints from members of the public will be investigated by noise monitoring at the nearest occupied properties and appropriate responses will be initiated;

- Surface Water Quality

  As per Sections 9.2.2.4 and 9.3.2.3, monitoring at the wastewater treatment system discharge will be conducted and the test results will be evaluated and used to adjust construction activities as necessary. Real-time information from performance monitoring will include direct-measured turbidity and visual and olfactory observations.

- Aquatic Biota and Species at Risk:

  As per Sections 9.2.2.5 and 9.3.2.4, water quality monitoring should be integrated with sediment, benthic invertebrate, and fish sample collections. This integration should include a spatial sample collection design to extend across the open water from the Randle Reef area. No dedicated sample collection for species at risk is warranted, given the view that any such species will be mobile and will move away from the Randle Reef area. An appropriate mitigation and control mechanism (e.g., silt curtain) should be considered at the concrete culvert separating Sherman Inlet from Hamilton Harbour. This installation would remain in place until completion of both Sherman Inlet and Randle Reef remediation projects. Bird control measures will be utilized if needed to prevent aquatic birds from accessing the ECF during dredging and filling.

- Public Health and Safety

  As per Section 9.2.3.4, a Health and Safety Plan for spills and public traffic management, including the implementation and monitoring of speed limits is required to mitigate against the potential for increased traffic accidents causing injury and hydrocarbon or other spills.

9.6 Effects of the Environment on the Project

9.6.1 Introduction

CEAA defines any change to the project that may be caused by the environment as an environmental effect. In accordance with the requirements of CEAA, the potential effects of the environment on the project are assessed using the following steps:

- identification of the potential interactions of the environment with the project;
- description of the project's design components intended to prevent changes to the project as a result of potential effects of the environment;
- identification of potential residual effects and assessment of their significance; and
- description of possible effects on individual VECs as a result of changes to the project.

The thresholds for the determination of significance on the project are defined as one which may cause the following:

- damages to the project's infrastructure such that public health and safety or the environment are at risk;
- substantial delays in the project's construction schedule; and
- damage to the project that is not technically or economically feasible to repair.

As part of the ongoing project pre-design and final design, potential effects of the environment on the project are considered and the project is modified as appropriate. A number of the potential interactions of the environment with the project are discussed in this section and have been considered in the preliminary designs, and will be addressed in the final project design.

9.6.2 Interaction of the Environment with the Project

The following natural environmental issues or events may have an effect on the project during the construction and/or operational phase:

- climate change and associated environmental effects;
- extreme weather such as heavy rain; and
- earthquakes and other seismic events.

Each of these conditions which may interact with the project is described below and is summarized in Table 9.46.

Table 9.46: Potential Interaction of the Environment with the Project

Project Phase	Climate Change	Extreme Weather	Earthquakes and Seismic Events	Potential Interactions (note: mitigation for these effects is presented in the following subsections)
Construction		✓	✓	Extreme weather such as heavy rain fall during excavation activities may result in the release of contaminated materials to the Hamilton Harbour as well as project delays. Extreme weather causing flooding of the Hamilton Harbour may result in flooding of the ECF during the construction phase. This may result in the release of contaminated materials to the waters of the Hamilton Harbour and may increase the turbidity of the water intake at U.S. Steel. Extreme weather such as high winds can have an effect on dredging activities, the transfer of materials for capping, and structural loading on infrastructure. High waves due to high wind speeds may affect the use of barges and result in flooding of the ECF cells. High winds and waves may also result in the formation of ice on the pier and ECF (during colder weather), affect construction activities, and endanger the safety of construction workers. Extreme weather such as dense fog may reduce visibility and may interfere with the operation of construction equipment and vehicles. Shore-line erosion can lead to the erosion of the construction site. This may result in a potential to impact the upper layers of the cap.

Project Phase	Climate Change	Extreme Weather	Earthquakes and Seismic Events	Potential Interactions (note: mitigation for these effects is presented in the following subsections)
				Earthquakes and other seismic activity may: result in damage to construction facilities; affect site stability (i.e., containment of contaminated sediment) and damage storage infrastructure (e.g., fuel storage).
Operation	✓	✓	✓	Climate Change may result in lake level rise and increased storm intensity. These environmental issues may result in shoreline erosion, increased operation disruptions, and elevated potential for accidents or malfunctions of structures if they are not designed to appropriate building standards. Extreme weather such as heavy rainfall could lead to erosion of the topsoil and fill layers of the cover system which may lead to damage to the upper protective layers of the cap. Extreme weather such as high winds can have an effect on carrying out monitoring programs and may increase structural loading on large or tall structures. High waves may result in excess water flowing overtopping the ECF and impacting the U.S. Steel I/O channel and affecting the cover systems on both. The same could be the case for the thin layer cap. Extreme weather such as dense fog may reduce visibility and can interfere with the operation of vehicles. Extreme cold weather may also result in ice hazards. Cold weather will lead to the icing over of Hamilton Harbour which may affect the structure of the sheetpile walls.

Project Phase	Climate Change	Extreme Weather	Earthquakes and Seismic Events	Potential Interactions (note: mitigation for these effects is presented in the following subsections)
				Flooding may occur at work site during extreme precipitation events. Earthquakes and other seismic activity may: result in damage to the operational facilities; affect the site stability (i.e., containment of contaminated sediment); and damage storage infrastructure (e.g., fuel tanks).

9.6.2.1 *Climate Change and Associated Environmental Issues*

Environment Canada identifies climate change as one of the most important environmental issues of our time. It can be caused by the release of greenhouse gases (GHG) into the atmosphere from natural and human sources. The presence of these GHGs may affect local and global weather conditions.

Climate change has the potential to impact the following environmental aspects:

- lake levels;
- temperature;
- shoreline erosion;
- ice cover; and
- extreme weather events (discussed separately below).

Additional details on these effects of the environment on the project are provided below.

Lake level rises are expected to change within Hamilton Harbour since it is located within Lake Ontario. Climate change models predict that increased air temperatures may actually promote increased evaporation and result in lower lake levels (Section 4.1.5) in the long term. Lower water levels may impede the mobility of water vessels used during construction activities; however, it is unlikely that water levels will drop to such an extent in the next 10 years during the construction activities. Shoreline erosion may be affected by lower lake levels; however, again this is not anticipated during the next 10 years.

Climate change may result in warmer ambient temperatures and reduce the duration of ice cover on Hamilton Harbour (Section 4.1.5). In terms of construction activities, this may ease navigational issues for water vessels and allow for an earlier start to construction activities. During the operational phase, reduced ice cover may benefit the structural integrity of the ECF. No detrimental effects from reduced ice cover are expected during the construction or operational phases of the project.

It is possible that climate change may also contribute to increased heavy rainfall events which may result in flooding and shoreline erosion (Section 4.1.5). These weather events would have the potential to delay construction schedules, increase shoreline erosion and damage project facilities during both the construction and operational phases. Extreme weather events will be discussed further in Section 9.6.2.2.

The design components of this project consider the above noted environmental effects and mitigation measures have been incorporated into the engineering design. The mitigation measures specific to climate change are discussed in Section 9.6.3.1.

9.6.2.2 *Extreme Weather*

Extreme weather conditions may result in events such as:

- tornadoes;
- floods;
- droughts;
- lightning;
- heavy precipitation;
- dense fog;
- high winds;
- high waves; and
- icing.

The proposed location of the ECF is partly sheltered from the open water due to the presence of the U.S. Steel site located to the east, and the fact that the Harbour is separated from Lake Ontario by a sandbar barrier. The predominant wind direction is from the south-west, as measured at the Hamilton station during the year 1971 to 2000. The maximum hourly wind speed was recorded at 93 km/hr with a maximum gust speed of 133 km/hr (Section 4.1.5).

Severe weather has the potential to delay construction schedules and damage project facilities. Precipitation and fog may reduce visibility and may interfere with the navigation of construction equipment and vehicles present on the land and water. Decreased visibility also poses a danger to worker safety.

Heavy precipitation may lead to flooding, increased erosion and elevated turbidity affecting water quality. The U. S. Steel I/O located in close proximity to the construction area, draws in water for process use which may be affected by the project. As a result, construction activities may be delayed during these events.

High winds may cause large waves to form in Hamilton Harbour which may delay construction activities. The waves may crash over barriers erected during the construction activities and potentially flood areas near or within the partially constructed ECF. High winds and waves may also result in the formation of ice on the pier and ECF (during colder weather); affect construction activities; and endanger the safety of construction workers. During the operational phase, high winds are expected to have little effect since the majority of the ECF will be below the water surface and the design of the capped surface will mitigate the potential for erosion. If high winds make cargo handling and associated operations dangerous, these operations would be ceased until the weather abates.

Freezing rain, hail, ice and snow may interfere with the operation of vehicles on the construction site, municipal roads and highways as they may limit visibility and create slippery driving conditions. However, these conditions will be no worse than typical driving conditions that are currently experienced in Hamilton. During the operational phase, the ECF will have to be maintained to remove snow and ice and prevent slippery conditions with sand or salting in the interest of safety for the workers and visiting ship personnel. It should be noted that shipping in the Hamilton Harbour does not operate through the winter.

In addition, the Hamilton Harbour ices over during the winter months. The ice cover and resulting freeze thaw may affect the exterior structural sheetpile walls. Extreme snowfall also has the potential to increase structural loadings on the facility.

The mitigation measures specific to extreme weather are discussed in Section 9.6.3.2.

9.6.2.3 *Earthquakes and Other Seismic Activity*

The Hamilton Harbour is located in the western region of Lake Ontario. This region has shallow local crustal faults (<30 km or 19 miles in depth). It is believed that there could be several faults in the vicinity of the Hamilton Harbour and historically, earthquakes with moment magnitudes of less than 5.5 have been recorded.

The design components of this project considered the above noted environmental effects and mitigation measures were incorporated into the engineering design. The mitigation measures specific to earthquakes and other seismic activity are discussed in Section 9.6.3.3.

9.6.3 Project Design Components

Mitigation measures have been included within the design of this project and in the recommendations for future maintenance activities to alleviate any environmental effects that may cause damage, safety concerns or irreparable harm to the ECF and the associated infrastructure.

9.6.3.1 *Climate Change*

Potential changes to the project due to climate change are considered in the section on extreme weather below.

9.6.3.2 *Extreme Weather*

Potential changes to the project due to extreme weather will be mitigated with the following measures: erosion and flood control; structural reinforcement; turbidity barriers; inspections and associated maintenance.

Shoreline erosion will be mitigated during the operational phase by the capping of the ECF. Also, a 2.5 hectare (6.25 acres) area on the ECF, which will consist of green space or light industrial space, will be maintained to prevent erosion. In addition, the ECF will be constructed to minimize overtopping of waves.

In the event of heavy precipitation and increased run-off potential, appropriate erosion and sediment control measures will be implemented to reduce the effect to water quality. During the construction phase, surface water will be diverted away from the construction area and turbidity barriers will be erected around the U.S. Steel I/O. Construction areas will be isolated as appropriate. Additional erosion and sediment control measures will be installed, as needed, in advance of forecasted heavy rain events. A hydraulic connector will be constructed within the ECF to divert increased run-off from flowing over the ECF during heavy precipitation. It will collect the run-off up-gradient from the pier and send it directly to Hamilton Harbour via an underwater outlet.

The ECF cap construction will include a stormwater drainage system which will consist of the following: rough grading of the subbase layer; installation of a stormwater drainage system in the marine terminal area; installation of a stormwater drainage system in the greenway area / light industrial area; installation of a utility corridor trench; final grading of the top subbase layer; and installation of biaxial geogrid layer on top of the subbase. During the operational phase, the stormwater management system will control infiltration of water through the capping system. For the location of the future marine terminal area, mitigation measures will also include laying out final grades to direct stormwater toward the interior of the site, where possible. A filtration system will also be implemented for stormwater management to treat stormwater collected from the proposed marine terminal area. For the operational phase of the future greenway / light industrial area, mitigation measures include stormwater flowing over slopes directly to the lake or to a French drain system. In addition, a second geomembrane layer on the greenway / light industrial area will be installed to inhibit the downward movement of infiltrated stormwater. To the extent practical, the greenway / light industrial area will be graded to convey surface runoff directly into the lake.

Structural reinforcement of the port facilities will mitigate potential damage due to ice or marine vessels and navigational aids will be put in place to guide vessels entering the shipway.

The sheetpile walls have the potential for corrosion based on exposure to the natural elements which may lead to failure of the wall and possible contaminant release. Visual inspections of the sheetpile walls will be performed on an annual basis to check for corrosion and structural integrity. Protective coatings will be used on the sheet pile walls to minimize corrosion and wear on the walls.

Groundwater will be collected from monitoring wells which will be installed within the clean fill between the inner sealed sheetpile wall and the outer structural sheetpile wall to determine if a breach in the wall has occurred. The sampling and analysis will be conducted on an annual basis.

9.6.3.3 *Earthquakes and Other Seismic Activity*

Potential changes to the project due to earthquakes and other seismic activity are to be mitigated through proper design and construction of the facility (i.e., in accordance with all relevant Canadian Codes and design standards (e.g., National Building Code of Canada)).

In the unlikely event of damage to the facility from seismic activity, environmental effects will be identified by the regular sampling from the monitoring wells which will be installed between the double walls around the ECF. Samples will be collected and if contaminants are measured, corrective measures, such as a pump and treat system, will be implemented to mitigate the contaminant migration from the ECF into Hamilton Harbour.

9.6.4 Conclusions

None of the identified interactions between the environment and the project during any of the project phases affect the project to such a degree that the residual adverse effects on any of the VECs are considered significant.

As part of the initial project design stages, numerous works and activities have been undertaken and developed to avoid and/or withstand potential effects on the project due to climate change and extreme weather events. No potential for adverse effects from seismic events has been identified due to the ECF design standards, infrequent occurrence and limited magnitude of any such events in the Hamilton Harbour.

In addition to project features inherent to the design, the operation of the ECF will include regular inspection, monitoring and maintenance. This will ensure that damage to any of the design features or operational aspects will be identified and repaired. Further detail on the incorporation of these features is provided in Section 9.6.3.

9.7 Effects on the Capacity of Renewable Resources

According to subsection 16(2) of CEAA, a CSR shall consider *"the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future"*. This requires that the project meet the definition of sustainable development, which is *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED 1987).

The purpose of the Randle Reef remediation project is to improve the quality of the existing natural environment by reducing the potential for exposure of contaminated sediment to the ecosystem. Therefore, the project is expected to have positive effects on the ecosystem. The following section assesses the project's effects on the capacity of renewable resources.

Effects Assessment

A natural resource qualifies as a renewable resource if it is replenished by natural processes. Not all the VECs identified for the effects assessment (Sections 9.2.2, 9.2.3, 9.3.2 and 9.3.3) are considered to be renewable resources or include renewable resources. VECs that include renewable resources, and the sustainability issues associated with them, are identified by shading in Table 9.47. Only the VECs that include renewable resources are discussed further for the effects on the capacity of renewable resources.

Table 9.47: Renewable Resources and Sustainability Issues by VEC.

VEC	Renewable Resource	Sustainability Issue
Air Quality	Clean air	Long-term air pollution
Ambient Noise	None	None
Soil Quality	Soil	Soil fertility
Surface Water Quality, Currents and Circulation	Freshwater	Surface water quality
Aquatic Biota	Aquatic biota	Ecosystem health, structure and function
Residential Areas	None	None
Industrial, Commercial and Municipal Use and Infrastructure	None	None
Public Health and Safety	None	None
Recreational Use of the Harbour	None	None
Shipping and Navigation	None	None
Notes: Shaded VEC are those identified as requiring further assessment		

In order to be sustainable, a renewable resource must be replenished by natural processes at a rate comparable to or faster than its rate of consumption by humans or other users. Significant adverse effects on renewable resources may result in reduced capacity of these resources to support present and future needs. A significant effect on the sustainability of a renewable resource would occur if the resource is negatively impacted so that its long-term, ongoing use is affected or, in the case of ecosystems, its function and structure are affected.

The project's effects on sustainability of renewable resources were considered for the construction and operation phases of the project. However, sustainability of the resources is considered from a long-term perspective as it implies intergenerational equity (e.g., the same resources or better are available for future generations in 20, 50 or 100 years).

Air Quality

Strictly speaking, air is not a renewable resource, but is rather categorized as a reusable resource. However, air pollution is considered a sustainability issue because of the critical role that air plays in our lives, and the fact that pollutants can remain in the air for long periods (or indefinitely in some cases). Potential air quality effects can be expected from all project construction activities as well as from the operational phase of the marine terminal. However, with mitigation, they are expected to be localized and of short duration. It is not expected that they will affect the air quality of the area in the long-term or affect the sustainability of this resource for future use.

GHG emissions to the atmosphere as a result of the project are expected to have minimal impact to climate change. Climate change has the potential to impact atmospheric temperature and precipitation and as a result may affect the surrounding environment, which includes the following renewable resources: clean air; soils; freshwater quality; and aquatic biota. The construction activities will result in small quantities of direct and indirect GHG emissions. However, the level of the project's GHG emissions compared with the region's existing greenhouse gas emissions will be low. Given the mitigation measures outlined in Sections 9.2.2.1 and 9.3.2.1 (Air Quality) and the short-term duration of the construction phase, the project's emissions of GHGs will not have a significant effect on sustainability in terms of climate change.

Soil Quality

Generally, soil and its ability to support plants and other organisms can be considered a renewable resource. However, the soils that will be affected by the project (see Section 9.2.2.3) are not currently used for agricultural, forestry or ecological purposes due to historical contamination and they are unlikely to be used for these purposes in the foreseeable future. Future uses of soils in the project area are likely to be associated with industrial, commercial or possibly recreational activities. With mitigation, the project is unlikely to have a negative effect on the long-term sustainability of these uses. With the provision of additional green space as part of the final ECF design, it is anticipated that there will be a net positive effect on the sustainability of this resource.

Surface Water Quality, Currents and Circulation

Like air, water is a reusable, not renewable resource. However, the quality of a water resource can influence its current and future use. Ambient water quality in Hamilton Harbour does not currently meet PWQOs and is considered to be impacted by ongoing urban and industrial inputs. The aim of the project is to remediate contaminated sediments in the vicinity of Randle Reef and to remove this source of contamination from influencing water quality. Although there may be some short-term and non-significant effects, as described in Sections 9.2.2.4 and 9.3.2.3, the long term water quality within the Harbour is expected to improve as a result of the project. Thus, there will be an improvement in the sustainability of the water resources in the Harbour.

Aquatic Biota

Aquatic biota are considered to be a renewable resource that supports aquatic and terrestrial life because they continually replace themselves as a food supply for other species. Currently, surface waters and sediments within the Randle Reef site provide pathways for contaminants into freshwater habitats and associated biota. With the containment and in-situ management of contaminant sources and the remediation of the site, the quality of freshwater habitat and biota will inevitably improve over the long-term. It is likely that the aquatic ecosystem in Hamilton Harbour will become more productive and diverse as a result of the proposed sediment remediation, an improvement in the sustainability of aquatic biota.

Summary

Renewable resources identified in the project area include clean air, soil, freshwater, and aquatic biota. The project is expected to have an overall positive effect on the capacity of renewable resources, particularly on freshwater resources and aquatic biota. It is expected that the quality and function of aquatic habitats in the Harbour will improve and that the overall diversity and, thus, sustainability of the ecosystem will improve. Short-term and localized effects on the air and soil will be unlikely to affect the long-term sustainability of these resources.

9.8 Summary and Conclusions

Following consideration of the analysis contained in this CSR, the Responsible Authorities and HPA have determined that the project is not likely to cause significant adverse environmental effects and therefore have decided to support the project implementation (CEAA, Section 37 (1)).

The following sections provide a summary of the assessment of environmental effects as presented in this CSR together with the RAs and the HPAs overall conclusions.

9.8.1 Effects of the Project on the Environment

The effects of the project were assessed for each of the VECs that were established for the project. The assessment took into account all project works and activities associated with the construction, and operation phases, including regular activities as well as malfunction and accident scenarios. Based on plausible project-environment interactions, potentials for numerous adverse effects were identified.

Relevant project design measures were reviewed and additional mitigation measures developed. Considering these design and mitigation measures, the effects were re-assessed and residual effects identified.

The significance of the residual effects was determined. All adverse effects were considered to be minor (i.e., non-significant). As such it was concluded that significant adverse effects on the environment as a result of the project are not likely (see summary tables at the end of the subsections in Section 9).

9.8.2 Effects of the Environment on the Project

The potential effects of climate change, severe weather conditions and other environmental events on the condition and function of the project were assessed. The objective was to determine the significance of any such impacts on the environment or risk to human health and safety.

A series of potential effects were identified, however, all potential adverse effects are predicted to be minor (i.e., non-significant).

This conclusion takes into account standard design features, best management practices and proposed mitigation measures to be incorporated into the project to accommodate for any foreseeable natural events potentially damaging the project and resulting in environmental impacts.

9.8.3 Cumulative Effects

A series of other projects and activities in the surrounding community were identified that will be constructed or operated at the same time as the proposed project. These projects and activities were reviewed to determine if they may result in effects that could act together with the effects of the subject project to create cumulative effects on VECs/VSCs.

In general, cumulative effects can occur if there are spatial and temporal overlaps with those of the project reviewed. It was determined that interaction of the subject project with the other projects may result in cumulative effects. Relevant project-inherent effects management measures were reviewed and additional mitigation measures developed, where applicable. Considering these management and mitigation measures, the residual adverse cumulative effects were considered to be non-significant.

10.0 PUBLIC, AGENCY AND ABORIGINAL ENGAGEMENT AND CONSULTATION

10.1 Consultation on the Hamilton Harbour Remedial Action Plan

This project falls in under the Hamilton Harbour Remediation Action Plan. The *Randle Reef Sediment Remediation Project* is a key element of this plan and this project has been part of the broader consultation process. The Hamilton Harbour RAP was written under the direction of a 42 member stakeholder group which included representatives of a cross-section of the community within the Harbour watershed. Extensive efforts were made by members of this stakeholder group to consult with their networks in the community on the content of the plan. Just prior to its completion in 1992, a two month public awareness and consultation process was conducted. This included contacting households, public service radio spots, open houses and substantial media coverage.

The Hamilton Harbour RAP was updated in 2002 (i.e., Stage 2 Update) by a group of stakeholders representing a cross-section of government, business, environmental and recreational interests. The process of updating the Hamilton Harbour RAP began in 1998 by recalling the RAP stakeholder group under the new name “RAP Forum”. The RAP Forum stakeholders included representation from all the groups known to have an interest in the Harbour and a wish to participate in crafting the Stage 2 Update. Forty groups were represented on the RAP Forum, along with past Bay Area Restoration Council (BARC) presidents and past RAP coordinators. The RAP Forum, along with the RAP Office, prepared the Stage 2 Update report.

The task of receiving public input into the Stage 2 Update and communicating information on the Update involved: ongoing communication with stakeholders and the public by the BARC; direct stakeholder involvement in preparing the Update; and a public review once the draft document was prepared.

The Hamilton Harbour RAP has an ongoing public voice through BARC. BARC is an organization of community stakeholders devoted to revitalizing Hamilton Harbour and its watershed. Formed in 1991 (and incorporated a year later), BARC holds public meetings and community workshops, coordinates volunteers for various remedial actions, provides an annual report “Toward Safe Harbours” on the progress of the RAP, maintains a web site and publishes a quarterly newsletter. BARC was the ongoing conduit to keep specific stakeholders, local leaders and the general public informed about the updating of the Hamilton Harbour RAP. BARC organized on-going information and education initiatives for the general public, stakeholders and school children. Quarterly, BARC circulated over 600 copies of their newsletter “Bringing Back the Bay”, which included a section called “From the RAP Forum” that described the latest activities in updating the Stage 2 Report.

Consultation initiatives involved holding public meetings and providing the draft Stage 2 Update report to the general public for a period of review and comment during the Fall of 2002. Other consultation activities for the Hamilton Harbour RAP update included: a media launch of the draft Stage 2 Update; BARC website information; an updated RAP brochure and fact sheets; public open houses held at locations around the Harbour; municipal Council and Conservation Authority presentations; and public response questionnaires.

Considerable media attention has been given to the Hamilton Harbour RAP and the Randle Reef project, including a series of articles that The Hamilton Spectator released over eight days (November 23 – 30, 2002) entitled "Bringing Back the Bay". Over 30 full pages were devoted to articles ranging from scientific examinations of the restoration efforts to interviews with individuals who use the Harbour in their work. The Hamilton Spectator also held an Open Forum (televised live), and created a Newspapers In Education package to complement the print series.

Further details on the public consultation undertaken for the Hamilton Harbour RAP Stage 2 Update can be found in the document entitled "Remedial Action Plan for Hamilton Harbour: Stage 2 Update 2002" (Hamilton Harbour RAP Stakeholder Forum, 2003), available on the BARC web site (www.hamiltonharbour.ca), the Hamilton Public Library, Burlington Public Library, McMaster Library, CCIW Library and Hamilton Harbour RAP office.

10.2 Consultation on the Randle Reef Sediment Remediation Project

10.2.1 Background

Formal consultation specifically related to the Randle Reef sediment remediation study first occurred in September 1994 when BARC organized a public meeting at which a resolution in favour of action at Randle Reef was passed. Details on the consultation program are provided in the following sections.

10.2.2 Consideration of Alternatives [15]

In September 1994, BARC held a public meeting to discuss the need and strategy for sediment remediation in the Harbour. The participants reaffirmed the priority to remediate contaminated sediment and agreed that the project site located near Randle Reef be remediated as a high priority initiative. Both BARC and the Bay Area Implementation Team (BAIT) were given regular updates on the status of this proposed undertaking.

Consultation began with stakeholder involvement at the outset of the process of identifying remediation alternatives. The Randle Reef Remediation Steering Committee was formed so that stakeholders and potential funding parties participated in selecting the set of acceptable remedial alternatives.

Throughout 1996, the Randle Reef Remediation Steering Committee investigated options to remediate the project site. Committee members included:

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15 "Alternatives" is used as a general term in Section 10.0. The identification and evaluation of "alternatives to" and "alternative means" are documented in Sections 5.0 and 7.0.

- Bay City Restoration Council;
- City of Hamilton;
- Environment Canada;
- Fisheries and Oceans Canada;
- The Hamilton Harbour Commissioners (now Hamilton Port Authority);
- Hamilton Harbour RAP office;
- Hamilton Conservation Authority;
- Ontario Ministry of the Environment and Energy (now Ministry of the Environment (MOE)); and
- Stelco (now U.S. Steel).

In July 1996, public consultation was undertaken on a draft environmental assessment document. This consultation included:

- provision of the full draft document to members of the Randle Reef Remediation Steering Committee and the Hamilton Harbour RAP Technical Committee;
- provision of a project summary to a list of some 300 interested individuals;
- telephone calls directly to over 30 tenants of the HPA located close to the project site;
- public notice in newspapers of the availability of the document at local libraries and the Hamilton Harbour RAP and BARC offices;
- three public open houses at which presentation of the full project was made; and
- posting of project information on the Canadian Environmental Assessment Agency's electronic bulletin board.

The need to involve the public at large was recognized, so a number of methods were used to keep the public and the scientific community informed. BARC's newsletter was used to provide status reports as the assessment was proceeding. A mail-out from the Hamilton Harbour RAP office to stakeholders and interested parties in the scientific community was used to invite comments. A presentation was made to the general membership of BARC in spring 1996 by the Hamilton Harbour RAP co-ordinator. A formal consultation was planned and carried out by BARC on behalf of Environment Canada in the summer of 1996.

Regular updates were provided to the interested public who are members of BARC or BAIT through newsletters, status reports at public meetings, and information items on BAIT agendas.

10.2.3 Project Advisory Group

10.2.3.1 *Identifying the Preferred Remediation Alternative*

In fall 2001, a Project Advisory Group (PAG) was formed to assist in identifying and reaching consensus on a preferred remediation alternative. PAG had representatives from 17 participating organizations and consisted of scientists, citizens, consultants and government representatives from:

- Bay Area Restoration Council;
- Hamilton Harbour RAP Office;
- Great Lakes United;
- Clean Air Hamilton;
- Central North End West Neighbourhood Association;
- Hamilton Beach Preservation Committee;
- Hamilton Industrial Environmental Association Citizen Liaison Committee;
- City of Hamilton;
- City of Burlington;
- Stelco (now U.S. Steel)
- Stelco Local 1005 (USWA);
- Ontario Ministry of Environment;
- Ontario Ministry of Labour;
- Environment Canada;
- Fisheries and Oceans Canada;
- Hamilton Conservation Authority; and
- Hamilton Port Authority.

The PAG was used to obtain public and agency input at key points in the development of the project. The PAG was not a decision-making group but rather an advisory group to the project proponent. The role statement of the PAG was to:

> *"… provide advice to Environment Canada and recommend a socially and environmentally acceptable method(s) to remediate, in a timely and cost effective manner, highly contaminated sediment identified in the area of Randle Reef".*

Members of the PAG were expected to speak on behalf of the group they represented. Further details on the work undertaken by PAG are provided in Section 5.1. In addition, the project, management and performance objectives developed by PAG are provided in Table A.1, Support Document A.

10.2.3.2 *PAG Meetings*

While the PAG was instrumental in identifying the preferred remediation alternative, meetings with PAG have been held throughout the project assessment. Table G.1 in Supporting Document G provides a summary of the PAG meetings. The public consultation for this CSR is considered to have commenced at the PAG meeting held on March 7, 2003.

Table G.2 in Supporting Document G provides the specific questions raised and responses provided at a June 12, 2007 meeting of the PAG and Project Implementation Team (PIT). This meeting occurred at a point where considerable engineering work had been completed for the project. The purpose of this meeting was to provide a project update, as well as an update on the engineering design work, the comprehensive study report and the schedule.

10.2.4 Project Implementation Team Meetings

As noted in Section 1.5, a Project Implementation Team (PIT) was formed to develop various conceptual design options, as well as to participate in the development of the detailed engineering work for the project. PIT members are the City of Hamilton, Clean Air Hamilton, Fisheries and Oceans Canada, Environment Canada – Great Lakes Sustainability Fund (GLSF) and Hamilton Harbour RAP Coordinator, HCA, HPA, MOE and U.S. Steel.

Table G.3 in Supporting Document G provides a summary of the PIT meetings. In addition, combined PIT and PAG meetings were held on June 12, 2007 and September 15, 2008 (see Table G.2 in Supporting Document G).

10.2.5 Conceptual Design Study – Meetings with Key Stakeholders

A Conceptual Design Study was carried out to develop alternative conceptual design options for the containment facility that recognized the environmental, technical and socio-economic requirements and constraints associated with the project.

The study involved:

- the compilation of existing data and the identification of project objectives and key issues to form a Common Basis for Design (CBD) upon which conceptual design options would be based;
- the development of a number of conceptual design options; and
- the selection of a preferred option.

Further details on the Conceptual Design Study are provided in Section 6.1, 6.2 and 6.3.

The first activity undertaken in the study was to hold individual meetings with key stakeholders. The objectives of these meetings were to:

- receive any previous studies and background information relevant to the project that may be available;

- discuss issues or concerns that each stakeholder may have regarding the design, implementation or operation of the project; and

- understand the project objectives from the viewpoint of stakeholders.

Individual meetings were held with: the City of Hamilton; MOE; Hamilton Conservation Authority; Hamilton Port Authority; and Stelco (now U.S. Steel). Information obtained at these meetings was incorporated into the CBD.

During the course of the study, meetings were held with the PIT to solicit their input on study results and the design concepts as they developed. Through discussions and meetings with the PIT and individual stakeholders, a list of "Objectives and Key Issues" for the project was defined. These "Objectives and Key Issues" were initially compiled in draft form. This draft was then circulated to PIT members for comment and then, based on their input, the list was finalized.

Based on reviews with PIT and the recognition of three critical objectives (see Section 6.2), two concepts were developed which were largely differentiated by the eventual land use – (1) a natural/commercial concept and (2) an all natural concept.

The natural/commercial (mixed use) option was identified as the preferred option by PIT and was presented to PAG on December 9, 2002. PAG endorsed the recommended option and agreed that it should be carried forward to undergo the necessary environmental assessment process, as well as further public consultation.

10.2.6 Hamilton Port Authority Client Group Meeting

A meeting with the tenants of the HPA was held on January 21, 2003. The purpose of the meeting was to present the tenants of the HPA with an overview of the conceptual design for the Randle Reef containment structure. HPA organized the meeting and held it at their offices in Hamilton. Representatives from the following were in attendance: Poscor Mill Services; Federal Marine Terminals; McKeil Marine; Heddle Marine Services; Provmar Fuels; Great Lakes Stevedoring; Skid Jim Enterprises; and Simore Transportation. Table 10.1 outlines issues/concerns raised and responses provided at the meeting.

Table 10.1: Summary of Hamilton Port Authority Client Group Meeting Issues/Concerns

Issue/Concern	Response Provided
Public Access	Public access is something not suitable for HPA property due to concerns for public health and safety. There are no plans to incorporate public access to the new structure or triangular expansion to Pier 15, nor to add public access to existing HPA property as part of this proposal.
Concern for worker health and safety due to exposure to contaminants during the construction and dredging process – e.g., transferring contaminated sediments to the containment site, as well as for those working on the newly created lands.	Response included reference to upcoming detailed engineering study that will detail construction details and contingency measures to ensure health and safety during construction, as well as long-term use and exposure issues.
Questioned why naturalized use of the new facility? Should be all port use given location, and the fact the HPA has lost 30 acres [approximately 12 ha] at Pier 8 with the arrival of the Haida and Parks Canada interpretation centre.	Indicated the end use was negotiated with all stakeholders. The naturalized area is for aesthetics, no public use, nor not likely wetlands – more intended as a visual buffer and aesthetics. Not able to comment on what was negotiated between Parks Canada and HPA for the release of those lands.
HPA should own the facility.	That is the present proposal.
Concerns were raised that construction period for the triangle infill at Pier 15 (McKeil and others) will be disruptive to operations. How can we avoid this?	That will be taken into consideration during the detailed engineering phase, and that the consultant will need to meet with the HPA and clients to incorporate these concerns and requests into their construction details. Could be resolved for example by timing the construction when least disruptive.
Concern that new structures will worsen the sedimentation occurring from Sherman Inlet.	Again, something that will need to be addressed with the detailed engineering study.
Question on the long-term integrity of the structure, and it is difficult to understand how this will be accomplished.	Conceptually, the construction will incorporate a sealed steel sheet wall internal to the berm structure that will secure contaminants in place, but detailed engineering will provide the particulars as to how this will be done. The final design will also incorporate monitoring and contingency plans that will allow for effective intervention to avoid any release of the contaminants into the Harbour waters.

10.2.7 June 11, 2003 Public Open House

A Public Open House to discuss the *Randle Reef Sediment Remediation Project* was held on June 11, 2003. The purpose of the open house was to review and discuss the preferred option for the remediation project. Information on the options considered for remediation, conceptual design options, the preferred conceptual design option, environmental enhancement opportunities, the environmental assessment process and next steps was available.

The Public Open House was sponsored by Environment Canada and was held at Liuna Station in Hamilton from 2:00 – 5:00 p.m. and 6:00 – 8:00 p.m. The format for the open house included a presentation by Environment Canada staff and an opportunity to view the display boards (see Supporting Document G) and discuss the project one-on-one with Environment Canada, Hamilton Port Authority and Ministry of the Environment staff in attendance. The open house was attended by 120 people. A Comment Sheet (Supporting Document G) was available and comments were received from 27 members of the public. The majority of the comments (24) were supportive of the project or of a general nature. Table G.4 in Supporting Document G provides a summary of the comments received.

Notices of the open house were published in the Burlington Post (June 8, 2003), The Hamilton Spectator (June 9 and 10, 2003) and the Brabant (now Dundas Star) (June 11, 2003). Articles on the project, along with an announcement of the Public Open House were published in The Hamilton Spectator on June 9 and 12, 2003. Media coverage also included an announcement on 900 CHML (June 5, 2003). In addition, there was 900 CHML radio coverage on the day of the open house and the day after the open house. Mr. John Shaw, Manager at the time of Environment Canada's Great Lakes Sustainability Fund provided information on the project in news slots the evening of June 11, 2003 and the morning of June 12, 2003.

Notices for the open house were also posted on the BARC, HPA and Environment Canada web sites. In addition, 800 copies of a post card notification were printed and distributed by BARC to their contacts, interested parties, public libraries, HPA clients and PAG members. Copies of the post card notification, as well as example public notices are included in Supporting Document G.

10.2.8 November 18, 2008 Public Open House

A second Public Open House to discuss the *Randle Reef Sediment Remediation Project* was held on November 18, 2008. The purpose of the meeting was to provide members of the public with an opportunity to learn more about the plans for the clean-up, including: what the clean-up involves; engineering design; environmental, social and economic benefits; preliminary EA results; and next steps.

The Public Open House was sponsored by Environment Canada and was held at the Hamilton Chamber of Commerce from 1:00 p.m. to 9:00 p.m. Members of the public could view display boards (see Supporting Document G), speak with project team members and submit a Comment

Sheet. This provided an opportunity for one-on-one discussions. A formal presentation was made at 7:00 p.m., followed by a question and answer period.

Notification of the Public Open House were published in the Burlington Post (November 14, 2008), the Bay Observer (weekly edition – week of November 10, 2008) and The Hamilton Spectator (November 12 and 15, 2008). A BARC e-Bulletin also advised those on the BARC mailing list of the open house.

In addition, 76 notices were hand delivered to the neighbourhood adjacent to Randle Reef. This included residences and businesses north of Burlington Street (Oliver St., Wentworth St. N. Niagara St., Land St. and Hillyard St.), including the north side of Burlington Street. HPA tenants in this area received e-mail notification of the Public Open House. A copy of the Public Notice for the meeting is included in Supporting Document G.

In addition, an article entitled "Learn More About the $90M Harbour Cleanup Plan" was published in The Hamilton Spectator on November 15, 2008. The article outlined the purpose, time and location for the public open house.

Copies of the display panels and the presentations were posted on the BARC web site (www.hamiltonharbour.ca). The display boards were also posted on Environment Canada's Great Lakes Sustainability Fund – *Randle Reef Sediment Remediation Project* web site [16] .

Approximately 70 people registered on the sign-in sheet through the course of the public open house. A representative from BARC served as the MC for the presentation portion of the open house, which provided information on: project overview; engineering design; and EA process. The Public Open House was covered by CHCH TV News (Hamilton), with coverage included in the 11:00 p.m. news (November 18, 2008). Table G.5 in Supporting Document G provides a summary of the public comments received.

Subsequent to the public open house, The Hamilton Spectator published another article reporting on the cleanup initiative (November 19, 2008: "Randle Reef Team Seeks $23 Million").

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16 http://sustainabilityfund.gc.ca/Randle_Reef_Sediment_Remediation_Project-WS4F110F61-1_En.htm

10.2.9 Press Coverage

There has been considerable press coverage on the Randle *Reef Sediment Remediation Project*. Newspaper articles have been published in The Hamilton Spectator, as well as the Toronto Star and the Mountain News.

While this press coverage is not a form of public consultation per se, it does indicate another mechanism through which the public have been informed about the project. Supporting Document G contains a listing of newspaper articles that have been published on the project from 1994 to 2010.

10.2.10 Aboriginal Engagement and Consultation

Table 10.2 provides a summary of contacts made with Aboriginal groups. Further details are provided below.

2003 to 2004

Environment Canada provided a background document on the Randle Reef project to the Six Nations of the Grand River Territory (Six Nations) in November 2003, along with an offer to meet with the Six Nations Council at their earliest convenience. Environment Canada staff met with the Six Nations Director of Lands and Resources and several members of the Lands Resources Committee in Oshwegen on December 18, 2003. A general explanation of the project was provided, along with a period of questions and answers. The Director of Lands and Resources and the Committee members present indicated that they would request a presentation to Six Nations Council. Subsequently, Environment Canada was invited by the Six Nations Council to present a brief on the Randle *Reef Sediment Remediation Project*. The presentation took place on March 2, 2004. At this meeting, no issues or land claims were raised.

On May 31, 2004, the Chief, on behalf of the Six Nations Council, provided a submission to Environment Canada noting that:

> *"Issues of environment within our traditional territory are of importance. To that end, Six Nations Council would like to see the maximum amount of contaminants contained by the proposed project reflecting the construction of the 9.5 hectare structure. Six Nations has not identified any other issues relating to the Randle Reef Remediation Project".*

A copy of this letter of support from the Six Nations Council is included in Supporting Document G. Environment Canada acknowledged receipt of this letter and indicated an appreciation for the positive feedback contained in the letter in an e-mail to the Six Nations Director of Lands and Resources on June 7, 2004.

Environment Canada also undertook contacts with the Mississaugas of the New Credit in December 2003 and January 2004, however, no response was received.

2008

In July 2008, the Manager of Six Nations Eco Centre was sent another letter on the project, as a follow-up to a telephone conversation with Environment Canada's consultant (AECOM). The letter provided a project description, an outline of key valued ecosystem components being examined in the project assessment and a request for input. Even though a project endorsement had been previously provided by the Six Nations, considerable work had been undertaken since the prior contacts. A September 3, 2008 e-mail from the Manager of Six Nations Eco Centre indicated that he had reviewed the information package and noted that "this office finds no apparent indication of any further impacts to traditional land use at this time".

In November 2008, further contacts were made with Aboriginal groups to advise them of the project and its current status, as well as to seek comments on the project and any potential effects to traditional land uses. Letters were sent to the Huron Wendat First Nations at Wendake and the Mississaugas of the New Credit First Nation. The letters also provided a description of the project, an outline of key valued ecosystem components being examined in the project assessment and a request for input. Several figures were appended to the letter, including an overview of proposed construction areas and a design rendering for the project. Information on the project background was also provided. Contact information was provided in the event that the letter recipients had questions or concerns or required further information.

In addition to these letters, further telephone contacts were undertaken by Environment Canada to determine if there was interest in arranging for a meeting to discuss the project and its current status. These contacts are as follows:

- August 14, 2008 - Six Nations (519-445-2201) – a voice mail message was left for the Chief 's assistant; there was no response to the call;
- August 14, 2008 - New Credit First Nations (905-768-1133) – Environment Canada spoke with the Chief who expressed interest in arranging a time for a presentation and indicated that he would call back with dates for Council meetings; on November 10, 2008, Environment Canada left a voice mail which referred back to the interest in a presentation noted; there was no response to the call; and
- November 5, 2008 - Six Nations – Environment Canada was advised that there was no interest in a follow up presentation to the March 2, 2004 presentation; representative questioned whether turtles in the area might be affected by the project; e-mail communication from the Manager of Six Nations Eco Centre indicated that there is "no apparent indication of any further impacts to traditional land use at this time". During the November 5, 2008 call, it was noted that some First Nations people had inquired as whether turtles in the area might be affected by the project.

2009

On January 30, 2009 follow up letters (to the November 2008 letters) were sent to the Huron Wendat and the Mississaugas of the New Credit requesting input to the project. No responses have been received to date.

On March 11, 2009, the Confederacy Secretary of Haudenosaunee (Six Nations traditional council) was sent a letter on the project by Environment Canada's consultant (AECOM). The letter provided a project description, an outline of key valued ecosystem components being examined in the project assessment and a request for input. Several figures were appended to the letter, including an overview of proposed construction areas and a design rendering for the project. Information on the project background was also provided. Contact information was provided in the event that the letter recipients had questions or concerns or required further information. No response has been received to date.

In August 2009, Environment Canada undertook further contacts with Aboriginal groups as part of consultation on the draft comprehensive study report, as follows:

- The Chief and Councillors of Six Nations were sent a letter and a copy of the draft comprehensive study report. A copy of the letter was also sent to the Environment Manager of Six Nations, and the Manager of Eco Centre;
- The Chief of the Haudenosaunee Confederacy (Six Nations Traditional Council) was sent a letter and a copy of the draft comprehensive study report. A copy of the letter and the draft report were also sent to the Interim Director of Haudenosaunee Development Institute.
- The Great Chief of Huron-Wendat First Nations was sent a letter and a copy of the draft comprehensive study report;
- The Chief of the New Credit First Nation was sent a letter and a copy of the draft comprehensive study report; and
- The Director of Lands, Resources and Consultation for the Métis Nation of Ontario was sent a letter and a copy of the draft comprehensive study report.

The purpose of these contacts was for Environment Canada to extend the offer to meet with these Aboriginal groups to discuss the project and, in particular, the draft comprehensive study report. The letters requested that these groups provide comments on the draft comprehensive study report, however, the letters also advised of the further opportunity to provide comment on the draft report during the consultation and engagement process to be conducted by the Canadian Environmental Assessment Agency.

2010

In January 2010, Environment Canada undertook further contacts with Aboriginal groups as part of consultation on the draft comprehensive study report, as follows:

- The Chief and Councillors of Six Nations were sent a letter and a copy of the draft comprehensive study report. A copy of the letter was also sent to the Environment Manager of Six Nations, and the Manager of Eco Centre;
- The Chief of the Haudenosaunee Confederacy (Six Nations Traditional Council) was sent a letter and a copy of the draft comprehensive study report. A copy of the letter and the draft report were also sent to the Interim Director of Haudenosaunee Development Institute.
- The Great Chief of Huron-Wendat First Nations was sent a letter and a copy of the draft comprehensive study report;
- The Chief of the New Credit First Nation was sent a letter and a copy of the draft comprehensive study report; and
- The Director of Lands, Resources and Consultation for the Métis Nation of Ontario was sent a letter and a copy of the draft comprehensive study report.

The purpose of these contacts was for Environment Canada was to provide an updated version of the Draft CSR document for review and comment highlighting the sections of the CSR which had undergone recent revision. The letters also advised of the further opportunity to provide comment on the draft report during the consultation and engagement process to be conducted by the Canadian Environmental Assessment Agency.

Table 10.2: Summary of Aboriginal Engagement and Consultation

Aboriginal Group	Consultation	Response
Six Nations of the Grand River Treaty (Six Nations)	<u>2003 to 2004</u> • November 2003 - Environment Canada provided background information, along with an offer to meet with the Six Nations Council • December 18, 2003 – Environment Canada met with Six Nations Director of Lands and Resources and members of the Lands Resources Committee • March 2, 2004 – Environment Canada made a presentation to	<u>2003 to 2004</u> • May 31, 2004 – letter from the Chief noted that "Six Nations Council would like to see the maximum amount of contaminants contained by the proposed project reflecting the construction of the 9.5 ha structure. Six Nations has not identified any other issues relating to the Randle Reef Remediation Project".

Aboriginal Group	Consultation	Response
	Six Nations Council	
	2008 to 2010 • July 23, 2008 telephone contact to discuss the project • July 24, 2008 – letter providing a project description, an outline of the valued environmental components and a request for input was sent to the Six Nations • follow-up phone calls were made on August 8, 13 and 20, 2008 – messages were left • in addition to the above contacts made by AECOM, Environment Canada left a message for the Chief's assistant on August 14, 2008 • in a November 5, 2008 call from Environment Canada to Six Nations, it was indicated that Six Nations was not interested in a presentation by Environment Canada, however, wondered if turtles in the area would be affected • August 2009 - Chief and Councillors were sent a letter and a copy of the draft comprehensive study report; a copy of the letter was also sent to theEnvironment Manager of Six Nations, and the Manager of Eco Centre • January 2010 - Chief and Councillors were sent a letter and an updated copy of the draft comprehensive study report; a copy of the letter was also sent to theEnvironment Manager of Six Nations, and the Manager of Eco Centre	2008 to 2010 • The manager of the Six Nations Eco Centre responded in a September 3, 2008 e-mail, noting that based on the review of the information provided, their office finds "no apparent indication of any further impacts to traditional land use at this time"

Aboriginal Group	Consultation	Response
Haudenosaunee (Six Nations Traditional Council	2009 to 2010 • March 11, 2009 - letter sent to the Confederacy Secretary, providing information on the project and requesting information on potential impacts to the use of lands and resources for traditional purposes by Aboriginal persons • August 2009 -The Chief was sent a letter and a copy of the draft comprehensive study report; a copy of the letter and the draft report were also sent to the Interim Director of Haudenosaunee Development Institute • January 2010 -The Chief was sent a letter and an updated copy of the draft comprehensive study report; a copy of the letter and the draft report were also sent to the Interim Director of Haudenosaunee Development Institute	2009 to 2010 • no response received to date
Mississaugas of the New Credit	2003 to 2004 • December 2003 to January 2004 - Environment Canada undertook contacts 2008 to 2010 • a letter dated November 6, 2008 was sent to the Chief providing a project description, an outline of the valued environmental components, and request for input – if this project will result in any impact to use of lands and traditional purposes by Aboriginal persons	2003 to 2004 • no response received 2008 to 2010 • no response received

Aboriginal Group	Consultation	Response
	• follow-up phone calls to the letter were made on December 17, 2008 and January 9, 2009 – messages were left • a follow up letter to the November 6, 2008 letter (and subsequent phone calls) was sent to the Chief on January 30, 2009 – requesting input to the project • in addition to the above contacts made by AECOM, Environment Canada spoke with the Chief on August 14, 2008 regarding a possible presentation to Council; however, Chief LaForme did not call back with dates for Council meetings, as discussed • on November 10, 2008, Environment Canada contacted the Chief again as a follow-up to the August 14, 2008 conversation – message was left with no response • August 2009 – The Chief of the New Credit First Nation was sent a letter and a copy of the draft comprehensive study report • January 2010 – The Chief of the New Credit First Nation was sent a letter and an updated copy of the draft comprehensive study report	
Huron Wendat	<u>2008 to 2010</u> • A letter dated November 6, 2008 was sent to the Chief providing a project description, an outline of the valued environmental components, and request for input re. if the project will result in any impact to use of lands for	<u>2008 to 2010</u> • no response received

Aboriginal Group	Consultation	Response
	traditional purposes by Aboriginal persons. • Follow-up phone calls to the letter were made on December 17, 2008 and January 9, 2009 – messages were left • A follow up letter to the November 6, 2008 letter (and subsequent phone calls) was sent to the Grand Chief on January 30, 2009-requesting input to the project • August 2009 – the Great Chief of Huron-Wendat First Nations was sent a letter and a copy of the draft comprehensive study report • January 2010 – the Great Chief of Huron-Wendat First Nations was sent a letter and an updated copy of the draft comprehensive study report	
Métis Nation of Ontario	<u>2009 to 2010</u> • August 2009 - The Director of Lands, Resources and Consultation for Métis Nation of Ontario was sent a letter and a copy of the draft comprehensive study report. • January 2010 - The Director of Lands, Resources and Consultation for Métis Nation of Ontario was sent a letter and an updated copy of the draft comprehensive study report.	<u>2009 to</u> • MNO request for a meeting with the project manager to discuss the project • October 2009 – Meeting with the Consultation Assessment Coordinator, to discuss the project overview and environmental assessment • information from the October 2009 meeting provided to the Hamilton-Wentworth Métis Council by the Consultation Assessment Coordinator to determine if they had any interest in additional consultation • to date no interest in

Aboriginal Group	Consultation	Response
		additional consultation has been indicated

10.2.11 Summary of Agency and Public Issues and Concerns

As noted previously, the PAG and PIT, along with the public open houses and meetings with stakeholders, were the principle mechanisms for obtaining agency and public input to the project. Table 10.3 provides a summary of agency and public issues and concerns raised to date, along with a response to the issue or concern.

10.3 Public Notice and Comment Conducted by the Canadian Environmental Assessment Agency

Upon completion, the *Randle Reef Sediment Remediation Project* Comprehensive Study Report is submitted to the Canadian Environmental Assessment Agency which as per subsection 22(1) of CEAA (Bill C-13), publishes a notice advising the public of its submission. This notice is posted on the Agency's web site and published in local newspapers (i.e. the Hamilton Spectator and the Burlington Post). The comprehensive study report will also be made available for viewing at locations noted in the public notice.

A 30 day period is then provided to allow the public to review the report and to submit comments to the Agency. In accordance with subsection 22(2) of CEAA, *"prior to the deadline set out in the notice published by the Agency, any person may file comments with the Agency relating to the conclusions and recommendations and any other aspect of the comprehensive study report".*

Following the deadline for filing of comments, the Agency provides the comments received to the RAs/HPA for consideration *"in determining its course of action and to include the comments in the public registry for the project"* (Canadian Environmental Assessment Agency, 1997). Subsequently, *"after taking into account comments from the public and other stakeholders, and the information contained in the comprehensive study report and other documents submitted by the responsible authority, the Agency recommends a course of action to the Minister"* (Canadian Environmental Assessment Agency, 1997, p. 25).

Table 10.3: Summary of Agency and Public Issues and Concerns Raised to Date

Issue or Concern	Response to Issue or Concern
Whole Harbour Solution It was clearly stated that PAG wants to deal with all materials greater than 200 ppm as a whole Harbour solution.	The project provides a whole Harbour solution.
Public Access Will public access be available and, if so, has security been considered?	Public access is something not suitable for HPA property due to concerns for public health and safety. There are no plans to incorporate public access as part of the project.
Emergency Planning Has an emergency plan been developed?	Yes. An on-going monitoring, maintenance plan and risk management plan have been developed as part of the engineering design to prevent and respond to emergencies.
Need for Provincial EA Why does this project not need a provincial EA?	The process and the project have been reviewed by the Environmental Assessment and Approvals Branch (EAAB) of MOE. There is no legislative requirement for a provincial EA for this project. The project is subject to a federal EA as per *Canadian Environmental Assessment Act* (Bill C-13) requirements.
Requirement for Certificates of Approval Is there a clear step-by-step process for determining what Certificates of Approval are required under provincial legislation?	A review was conducted by the EAAB of MOE to determine whether there is a legislative requirement to issue Certificates of Approval (C of A) under either the *Environmental Protection Act* or the *Ontario Water Resources Act* for various aspects of the project. It does not appear that provincial Certificates of Approval will be required for this project. Environmental monitoring will be undertaken during and after construction to protect air and water quality. It is envisioned that MOE and EC will develop a protocol to manage any identified environmental issues resulting from construction and dredging activities.
Long Term Integrity of the Structure Questions were raised about the long-term integrity of the structure, and that it is difficult to understand how this will be accomplished.	Conceptually, the construction will incorporate a double walled steel sheet pile wall (with the inner wall sealed) that will secure contaminants in place. Detailed engineering will provide the particulars as to how this will be done. The final design will

Issue or Concern	Response to Issue or Concern
	also incorporate monitoring and contingency plans that will allow for effective intervention to avoid any release of the contaminants into the Harbour waters.
Service Life What is the projected service life?	A 200 year service life was identified through the PAG process, which is typically the timeframe desired.
Ownership and Operation After capping, who will own and operate the land?	It is proposed that Hamilton Port Authority will be the long-term owner and manager of the ECF.
Exposure of Dredge Material to Air During Dredging Process Will any of the dredged material be exposed to air during the dredging process?	Dredged material may be exposed to the air for a very brief period of time during mechanical dredging, which accounts for about 4% of the total volume to be dredged. The majority of the dredging will occur through a pumping process underwater (hydraulic dredging). Concerns can be managed. No problems are anticipated with implementation of appropriate mitigation measures.
Workers and Exposure During Dredging With mechanical dredging, there is high potential for exposure, particularly to the people working directly on the dredging process. Exposure cannot be avoided entirely but protective controls and mitigation measures are needed. Proper equipment, protection and procedures must be specified and strictly enforced. Workers must be educated and the site monitored.	Occupational health and safety requirements will be strictly adhered to. Mechanical dredging accounts for approximately 4% of the total material to be dredged. The majority of dredging is being done using a hydraulic dredge.
Worker and Public Safety Concern for worker and public safety.	Air emission modeling, testing and analysis have been conducted to ensure worker and public safety.
Off-gassing Concern expressed related to off-gassing because naphthalene will likely drift to some degree. During mechanical dredging, as the material hits the surface there is potential for off-gassing. Workers in proximity to the site need to be briefed and volatiles need to be monitored. Air borne emission standards must be established and strictly monitored. The process should be suspended, if needed.	Occupational health and safety requirements will be strictly adhered to. Mechanical dredging accounts for approximately 4% of the total material to be dredged. Air quality monitoring will be undertaken (see Section 9).

Issue or Concern	Response to Issue or Concern
U.S. Steel Water Intake Plans and procedures need to be developed to prevent contaminated water and suspended sediment generated during the sediment removal process from entering the U.S. Steel water intake.	The U.S. Steel I/O has been considered in detail (see Support Documents, Section D.5).
Transport of Materials Through Residential Community Residents in proximity to transportation routes need to be briefed and volatiles need to be monitored. A route plan and procedures need to be developed to provide safe transportation through residential communities. Transportation should be suspended, if needed. An emergency plan should be in place.	Transportation routes and potential effects on residential community are addressed in Section 9.
Aquatic Mandate under the *Fisheries Act* is to protect fish and fish habitat. Loss of fish habitat created by the infill raises concern and whether that loss is acceptable needs to be determined. A review of the current status of the existing fish habitat should be part of the assessment.	The potential effects of the project on fish and fish habitat are addressed in Section 9.
Birds During the infilling process, birds will be attracted to the area for a period of time. Management and control strategies can be implemented. More information is needed to address this issue.	There is no interaction between terrestrial birds and the project, therefore terrestrial birds were not considered as a valued ecological component. Mitigation measures related to aquatic birds are included in the aquatic biota VEC (see Section 9. The Randle Reef Technical Task Group worked with the Canadian Wildlife Service to ensure the landscape design will discourage/ mitigate the potential for attracting nuisance bird species. Common nuisance bird management techniques, if needed, will be conducted in accordance with the Migratory Bird Regulations.
Cost The $ 90 million price tag accounts for structural requirements and for stabilizing materials but is the cost dependent on the final use?	Yes, costs differ depending on final use but are not a significant factor.

Issue or Concern	Response to Issue or Concern
Monitoring What monitoring will be in place for the facility?	There will be an extensive monitoring program implemented for the facility. During the construction phase, air quality and water quality monitoring will be undertaken. Monitoring will be performed to confirm that treated effluent released into Hamilton Harbour meets water quality requirements during both initial and production dredging. As this project involves the creation of an ECF, the facility itself will be monitored to ensure it is functioning properly. Similarly, the U.S. Steel cap will also require monitoring over the long term. Any dredged areas where a thin layer sand cap was implemented will also be monitored to confirm natural recovery is taking place.
Provision for Future Technologies In the event that an effective and safe new technology (i.e., a safe way to treat the sediment) arises in the future, can the ECF be opened for the application of this new technology.	Yes, there is provision for the consideration of proven future technologies.

11.0 FOLLOW-UP AND MONITORING PROGRAMS

11.1 Introduction

A follow-up and monitoring program will be in-place during the implementation of the Randle Reef Sediment Remediation Project.

11.1.1 Follow-up Program

The CSR was prepared pursuant to CEAA (1992), under subsection 16(2), and subsection 16(2) of the CPA EA Regulations, and considered the need for, and the requirements of, any follow-up program in respect of the project. To that effect, the RAs for the project and the HPA have determined that a follow-up program will be needed to verify the accuracy of the environmental assessment, and determine the effectiveness of any measures taken to mitigate the adverse environmental effects of the project. Once a course of action decision is taken by the RAs under subsection 38(2) of Bill C-9 or subsection 15(2) of the CPA EA Regulations, the design of the EA follow-up program will be finalized and the RAs and HPA will ensure its implementation.

11.1.2 Monitoring Program

The RAs and HPA will design a monitoring program that will verify whether the required mitigation measures were implemented and meet the objectives of a follow-up program (i.e. assess the accuracy of the conclusions of the environmental assessment and the effectiveness of the mitigation measures).

Table 11.1 provides a preliminary summary of the proposed follow-up and monitoring programs for targeted VECs for pre-construction, construction and operation activities. Descriptions and locations of the activities are also outlined. The design of the follow-up and monitoring programs will be finalized once the course of action decision is taken by the RAs and HPA.

It should be mentioned that although not part of the follow-up and monitoring programs of this CSR, certain survey, compliance inspection, sampling and analysis activities will be conducted during the project implementation in order to confirm the implementation of the project meets all the requirements set out in the drawings and specifications. These activities will include a Sediment Verification Field Sampling Plan (FSP)/Quality Assurance Project Plan (QAPP) which will ensure that the dredging program has met the objectives of the engineering design.

11.2 Follow-up Program

As mentioned above, the follow-up program of this CSR, as defined by CEAA (1992) and CEAA (2003), will help to:

- verify the accuracy of the environmental assessment of a project, and
- determine the effectiveness of any measures taken to mitigate potential adverse environmental effects of the project.

These requirements will include monitoring various aspects of the environment prior to and during the facility's construction and operation, as described below.

Eight studies were undertaken between 2005 and 2009 (pre-construction) to establish the baseline conditions at Randle Reef:

1. Toxicity Identification and Evaluation (TIE)
2. Chemical Monitoring
3. Benthic Invertebrate Assessment
4. Haemocytic Leukemia in Caged Bivalves
5. Fish and Semi-Permeable Membrane Device (SPMD) Responses
6. Genetic and Reproductive Endpoints for Fish
7. Tumours in Wild Fish
8. Wild Fish Health

In order to verify the accuracy of predictions made in the CSR, these baseline studies may be used as a basis for assessing the impact predictions for improvements to aquatic biota and habitat, sediment quality and surface water quality within Hamilton Harbour and the Randle Reef project area.

11.3 Monitoring Programs

In addition to the requirements of the follow-up program, additional monitoring measures will also be in place to ensure;

- that any project activities meet the requirements of applicable environmental legislation, policies and guidelines;
- that the terms and conditions of regulatory approvals are met (e.g. *Fisheries Act and Navigable Waters* Protection Act authorization and approval); and
- that required mitigation and compensation measures are implemented.

A Health and Safety Plan and an Environmental Protection Plan, which will include many aspects of monitoring, will be a required component of the construction contract. These plans will be developed and submitted as part of the construction contract bid for evaluation by the project proponent, contracting authority, and applicable RAs at the time of contract tendering. As an example, the Environmental Protection Plan will include the Fish Salvage Plan and associated monitoring that will be implemented during initial enclosure of the ECF sheet pile wall.

Monitoring will be conducted using a combination of site inspections, sampling, review of records and reports and interviews to ensure terms and conditions of regulatory and operational requirements are met. The schedule for these activities will correspond to the schedule of various elements of the project once they are established.

11.4 Follow-up and Monitoring Programs Framework

The design of the follow-up and monitoring programs will be finalized once the course of action decision is taken by the RAs and HPA.

Upon project implementation the follow-up and monitoring programs will remain subject to review by the project supervision engineer, contracting authority, project steering committee, the RAs, HPA and various stakeholders. If, in the course of the project implementation, it is determined that changes are required to ensure the follow-up and monitoring programs meet the objectives of the project, then these changes will be made in accordance with the intent of the follow-up and monitoring program outlined in this CSR. Supplemental monitoring activities may also be implemented during the construction period to determine the requirement for any additional mitigation measures, adaptive management measures or contingency plan(s) to deal with unexpected or unacceptable outcomes. Such flexibility is a key component to any of the project-related monitoring plans. Alterations to any follow-up or monitoring program will undergo a review by the RAs and HPA and will be appropriately documented in the relevant plan.

11.4.1 Follow-up and Monitoring Programs Schedule and Duration

Pre-construction surveys associated with the eventual follow-up and a monitoring program have been completed in order to establish baseline levels to which the future monitoring programs will be compared. It is anticipated that the follow-up and monitoring programs will adapt throughout their implementation to the evolving nature of the project and the objectives of the programs themselves. The final design of the follow-up and monitoring programs will define elements such as timing, frequency, and trigger(s).

The follow-up and monitoring programs will begin upon the initial implementation of the construction phase of the project, continue through the construction phase, and then on for five years post construction. The five year post construction time period will allow for the completion of the sampling required to verify predictions of the CSR related to construction effects and environmental effects and validate components of the engineering design. The various individual follow-up and monitoring activities will take place over different intervals within this five year post construction time period. To ensure the implementation of the follow-up and monitoring programs, funds have been allocated within the overall project budget.

The commencement and duration of follow-up and monitoring activities will be dictated by the applicable authorities issuing permits and other approvals associated with project activities, and the related mitigation measures stipulated by those permits.

After the completion of the EA follow-up and monitoring programs, which ends five years post construction, the proponents will continue certain survey, inspection and sampling activities for their own purpose, namely the maintenance and safe operation of the facility.

11.4.2 Follow-up and Monitoring Programs Roles and Responsibilities

The RAs and the HPA are committed to working together to ensure that follow-up and monitoring programs are successfully designed and implemented. The follow-up program will, among other things, define the respective roles and responsibilities of the RAs and HPA related to ensuring the implementation of the required mitigation measures. The monitoring program will define the respective roles and responsibilities of the RAs and HPA related to ensuring the implementation of any measures to comply with their individual regulatory and operational requirements.

The RAs and HPA have agreed that Environment Canada will lead and manage the follow-up program, which will clearly define the roles and responsibilities to be assumed by the other RAs and HPA, as agreed by them, in accordance with their specified interests and mandates. In addition, the RAs and HPA will ensure the implementation and monitoring of any measures to comply with their individual regulatory and operational requirements.

Environment Canada is proposing the construction and operation of the ECF. Environment Canada, as the lead RA will co-ordinate the evaluation of whether the mitigation measures and associated follow-up and monitoring programs have been implemented as identified in the CSR for the project.

DFO will review mitigation measures and associated follow-up and monitoring programs as identified in the CSR for the project and provide specialist or expert information or knowledge related to the protection and conservation of fish and fish habitat. DFO will conduct compliance monitoring to ensure that the terms and conditions of any sub-section 35 (2) and / or section 32 *Fisheries Act* authorizations are met.

TC within its mandate and regulatory responsibilities under the *Navigable Waters Protection Act* will ensure the implementation of mitigation measures and associated monitoring programs identified in the CSR for the project. TC will participate, within its mandate and regulatory responsibilities, in the evaluation of whether the mitigation measures and associated monitoring programs identified in the CSR for the project have been followed.

The HPA is proposing marine terminal operations and any future construction related to it. The HPA will ensure the implementation of mitigation measures and associated monitoring programs as they relate to shipping and navigation, on which the HPA has regulatory responsibility through the *Canada Port Authority Environmental Assessment Regulations*. HPA will participate within its corporate mandate and responsibilities under its federal Letters Patent pursuant to the *Canada Marine Act* in the evaluation of whether the implementation of mitigation measures and associated monitoring programs have been met, as identified in the CSR for the project.

Ensuring the implementation of any follow-up and monitoring program components which fall outside of the responsibilities of the other RAs and/or the HPA outlined above will be the responsibility of EC and HPA.

Preliminary information for the EA follow-up and monitoring program is provided in this CSR. A final follow-up program will be developed by the RAs/HPA once they take a course of action decision as required under Section 38(1) of CEAA (1992). This program will specify which of the RAs/HPA is/are responsible for ensuring each of the specific components of the follow-up and monitoring program.

11.5 Information Management and Reporting

On-site monitoring results obtained during construction activities will be either directly downloaded or recorded and compiled by the project supervision engineer on a daily basis. The project supervision engineer will provide monitoring results to the project proponent and contracting authority in weekly reports and monthly summaries.

For each of the follow-up and monitoring programs, a final summary report detailing the data collected and the conclusions will be produced on a frequency as is appropriate. This frequency will be determined by the ultimate use of these finding which along with the requirements of the follow-up and monitoring programs may include; construction management, addressing non-compliance issues, required adjustment for operations (i.e., dredging activities), contract management (payments, etc.), public reporting and overall project oversight These reports will be summarized in overall project status update reports to be produced throughout the various phases of the project.

The public will be advised about the results of the follow-up program. The times at which applicable project status reports are to be made available to the public will be determined based on the final construction schedules, project operations and overall project management needs which will be determined once the associated contracts and project management agreements are established. During the construction phase of the project a reporting system will be in place to receive and address public input. Information pertaining to the follow-up and monitoring program and its implementation will be available to the public for the duration of the program (i. e., during construction and 5 years post construction).

Table 11.1: Preliminary Follow-up and Monitoring Program

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
Air Quality	Air quality will be monitored to confirm the prediction of the CSR that ECF construction activities do not lead to air quality impacts on the local environment, to measure the effectiveness of air quality mitigation measures and if further mitigation efforts are required Background levels will be established on a regular basis before and during construction. Air quality monitoring results will be compared to the Ambient Air Quality Criteria (AAQC) and to confirm that the local air quality is not impacted above the established background levels and/or that emissions do not exceed prescribed limits. Air quality monitoring will be conducted concurrent with construction activities which handle or disturb sediment, such as dredging and sheet pile installation.	Background points outside the active work zone. Off-site points downwind of the construction area. Three specified locations within the work area. A weather station located within or adjacent to the work area.	√	√	

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
Ambient Noise	If complaints are received from residents related to noise and vibration emissions of the project's activities monitoring will be conducted to the confirm the predictions of the CSR, measure the effectiveness of mitigation measures on and off-site and determine if additional mitigation measures are needed to address on or off-site impacts. To confirm that the implementation of various project activities does not exceed applicable regulatory, guideline/guidance or policy requirements.	Monitoring would take place at locations established in the baseline study representing the work area and the nearest residential receptors to the work area.	√	√	√
Soil Quality	Soil quality monitoring and the inspection of the storage/handling of any construction materials will be conducted to confirm the predictions of the CSR, measure the effectiveness of mitigation measures and determine if additional mitigation measures are needed. Monitoring will confirm that soil quality within the on shore portion of the work area does not exceed O. Reg. 153 Standards or the established background soil levels, confirm the successful completion of any soil remediation, and delineate the size and nature of any environmentally impacted soil requiring remediation.	Monitoring/inspections will take place at the on-shore portion of the project boundary.	√	√	
Surface Water Quality, Currents and Circulation	During construction activities surface water quality monitoring, the visual inspection of in water equipment for potential releases and visual inspections for the presence of films, sheen, discoloration /odour, distressed/dying fish/wildlife will be conducted to confirm the predictions of the CSR, to measure the effectiveness of mitigation measures on water quality, currents and circulation and determine if additional mitigation measures are needed to address on or off-site impacts.	Surface water of Hamilton Harbour and the project work area including; • background points outside the active work zone, • sentinel points within the zone of expected construction impact, • compliance points within the	√	√	

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
	Monitoring will confirm the surface water quality meets the prescribed levels during in-water activities.	zone of expected construction and • adjacent to segregated work areas on the outside of barriers (sheet pile, silt curtain).			
	ECF discharge effluent monitoring will be conducted to confirm the predictions of the CSR that the discharged effluent meets the established background criteria for Hamilton Harbour, and the effectiveness of the water treatment plant, and to determine if additional mitigation measures are needed to address on or off-site impacts.	Turbidity will be continuously measured at the final settling cell effluent point, the sand filter effluent point, and the granular activated carbon effluent point. The ECF and final settling cells will also be observed for presence of films, sheen, and discoloration or odour.		√	√
	Groundwater, groundwater pressure, and under drain water monitoring will be conducted to confirm the predictions of the CSR, related to the long term structural integrity of the ECF related to seepage water migration and determine if additional mitigation measures are needed to address on or off-site impacts.	Groundwater sampling via monitoring wells located around the perimeter of the ECF, between the interior and exterior sheet pile walls and via piezometers in dredged material within the inner ECF walls. Pressure transducers installed in the monitoring wells. Under drain water will be collected from under drain sampling points			√

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
		installed in the ECF.			
	Structural monitoring of the ECF will be conducted to confirm the predictions of the CSR and determine if any mitigation measures are needed related to surface water quality. The engineered cap and surface components will be evaluated periodically using both monitoring and modeling programs for an estimated 200 years following construction. Monitoring will also include the measurement of ECF sheet pile structures for movement, corrosion, deformation and groundwater / under-drain water quality.	Inspections of the ECF cap, perimeter wall, pavement, landscaping, sheet piling, support system and quarry rock fill.		√	√
	Monitoring of the hydro graphic topography, cap settling, pore-water and visual assessment of surface water all associated with the U.S. Steel channel cap will be conducted to confirm the predictions of the CSR and determine if any mitigation measures are needed related to surface water quality.	U.S. Steel channel cap.			√
	During navigational dredging activities TSS monitoring will be conducted to confirm the predictions of the CSR, to measure the effectiveness of mitigation measures on water quality, currents and circulation and determine if additional mitigation measures are needed to address on or off-site impacts.	Surface water of Hamilton Harbour adjacent work areas and potentially on the outside of any required barriers (silt curtain).			√
Aquatic Biota	The follow-up and monitoring activities detailed above in the Surface Water Quality, Currents and Circulation section, by extension also contribute to the protection of Aquatic Biota.	See Surface Water Quality, Currents and Circulation.	√	√	√
	Biological monitoring will be conducted to confirm the predictions, including any positive changes to the aquatic environment directly resulting from the completion of the project, of the CSR and determine	The aquatic biota community within Hamilton Harbour and the aquatic portion of the project area (including	√	√	√

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
	if any additional mitigation measures are needed related to the effects of the project on aquatic biota.	Benthic macro-invertebrate)			
	During construction activities the visual inspections to confirm the implementation of mitigation measures such as the installation of segregation barriers where it is deemed they are required and for the presence of distressed/dying fish or other aquatic biota within any such segregation barrier will be conducted to measure the effectiveness of mitigation measures and determine if additional mitigation measures are needed to address potential on or off-site impacts to aquatic biota.	Visual inspections of the segregation barriers such as silt curtains or sheet pile.	√	√	
	Inspection of the ECF for the presence of aquatic birds will be conducted to measure the requirement for or effectiveness of mitigation measures such as bird scaring devices and determine if additional mitigation measures are needed to address potential on or off-site impacts to aquatic biota.	Within the ECF at intervals deemed appropriate after the deposition of dredged sediments and prior to capping.		√	
	Monitoring/inspection of the ecological components of the ECF green space, including the vernal pools, by a qualified biologist/technician to confirm the predictions of the CSR and determine if any additional mitigation measures are needed.	The green space of the ECF.			√
	A fish survey will be conducted upon the initial closure of the ECF walls in order to verify the predictions of the CSR and determine if additional mitigation measures such as fish salvage are required.	Within the ECF walls upon initial completion of enclosure.		√	
Industrial, Commercial and Municipal Use and Infrastructure	The surveying and inspection of existing structures will be conducted to confirm the prediction of the CSR that no settling or horizontal movement of existing structures occurs as a result of project activities, to confirm the effectiveness of mitigation measures and to determine the required mitigation methods if settlement or horizontal movement	Existing structures adjacent to project construction activities.			√

VEC	Description of Follow-up/ Monitoring Activities	Locations	Pre-construction	ECF Construction	ECF & Marine Terminal Operation
	of existing structures is detected, including the modification of project activities.				
	ECF water levels (over liner, under liner) will be monitored to confirm the predictions of the CSR that the ECF design will function effectively and determine if mitigation measures are required.	Within the ECF.			√
	ECF settling will be monitored to confirm the predictions of the CSR that the ECF design will support the effective commercial use of the ECF as a marine terminal and determine if any mitigation measures are required.	ECF cap and paved areas of the ECF cap.			√
	ECF/marine terminal storm water management system monitoring will be conducted in order to confirm the predictions of the CSR that applicable discharge of effluent are met and determine if any mitigation measures are required.	Periodic inspection of catch basins, and maintenance of the system,			√
Public Health and Safety	The follow-up and monitoring activities detailed above in the Air Quality and Ambient Noise sections, by extension also contribute to the protection of Public Health and Safety.	See Air Quality and Ambient Noise.		√	
	Confirmatory sampling as part of a Spill Control Plan will be conducted to assess the effectiveness of any mitigation measures implemented as a result of spills.	In the areas affected by any spill.		√	
Recreational Uses of the Harbour	Habitat area monitoring by a qualified biologist/technician to confirm the predictions of the CSR related to the function of ecological components such as the vernal pools, adequate long term plant growth, survivorship and cover of the ECF green space and determine if any mitigation measures are required.	The green space of the ECF			√

12.0 SUMMARY AND CONCLUSIONS OF THE ASSESSMENT

The following sections provide an overall assessment of the environmental effects of the project and the overall conclusions regarding the project.

12.1 Effects of the Project on the Environment

An assessment of the effects of the project for each of the VECs was completed in Section 9.0 of this comprehensive study report. This evaluation addressed the current environmental conditions, and took into account construction activities and long-term operation of the facility. It included all the various aspects related to construction and operation as well as an assessment of malfunction and accident scenarios.

For each VEC, where an interaction between the project and the environment exists, the potential for adverse effects were identified and where needed, mitigation measures are proposed. An assessment of the significance of the project on the environment, residual effects and cumulative effects was determined for each VEC. Table 12.2 summarizes the mitigation measures, and significance of the environmental effects and cumulative effects for each VEC.

12.2 Effects of the Environment on the Project

The potential effects of the environment on the project are evaluated for both the construction and operational phases. An assessment was done to determine the significance of these effects on the project's effectiveness, the environment and/or to determine the risks to human health and safety.

These potential effects, e.g., lake level effects resulting from climate change, severe effects from wind and wave action, etc. are assessed to determine if there are potential adverse effects and whether they are significant or minor in nature.

Of the potential effects identified, the overall conclusion regarding effects of the environment on the project is that there are no significant effects of the environment on the project given the mitigation measures or design measures that are available to address these potential effects.

12.3 Cumulative Effects

The evaluation of potential cumulative effects includes a consideration of other past, present and future projects and activities that will/may interact temporally or spatially with the proposed project.

In order to be considered within the cumulative effects assessment, the interaction of the environmental effects from the project with the environmental effects of these other projects, or components of these projects, must be cumulative in nature and when combined creates a measurable environmental effect (i.e., temporal or spatial overlap). There must also be sufficient confidence that these other projects or activities have occurred, are occurring or will occur.

As presented in Section 9.5, it was determined that there is some interaction of the project with some other projects which may result in cumulative effects. Relevant project-inherent effects and management measures were reviewed and additional mitigation measures developed, where applicable. Considering these management and mitigation measures, the residual adverse cumulative effects were evaluated and considered to be minor (i.e., non-significant).

12.4 Evaluation of Advantages

The advantages of the project are substantial and fulfil the project's objectives as identified in Section 2.5. The advantages of the *Randle Reef Sediment Remediation Project* are significant with respect to the long-term benefits for Hamilton Harbour, the project stakeholders, and the local community. The overall benefit of the project to Hamilton Harbour is that the sediment remediation will remove a significant source of contamination to the rest of the Harbour, and reduce ecological and human exposure to these contaminants. The project will also provide improvements for the fish and aquatic habitat in the Harbour as a result of the clean-up. The final uses of the facility will provide a social and economic benefit to the local community and project stakeholders. The project will also provide for short-term employment opportunities in the local area during the construction and long-term operation of the facility. The project is also an essential element that must be completed in order to de-list Hamilton Harbour as an Area of Concern.

A number of potential disadvantages have been identified for a number of VECs. They are considered not significant given the localized and temporary nature of the effect and given that they can be effectively prevented or mitigated.

Table 12.1 presents an overall summary of the advantages and disadvantages for each of the project VECs. Specific advantages and disadvantages are provided within the body of the text for each VEC evaluation in Section 9.0.

Table 12.1: Advantages and Disadvantages of Project on VECs

VEC	Advantage	Disadvantage
Air Quality	• Improved long-term air quality related to reducing any emissions resulting from the disturbance of sediments. • Greenway trees and shrubs will act as a greenhouse gas sink and provide dust suppression for surrounding activities. • Operational phase will reduce potential odours and HAP emissions from contaminated sediment due to the capping of the ECF.	• Short term increase in diesel combustion emissions from construction equipment and truck traffic will result in some green house gas emissions. • In the short-term, dredging activities may result in volatilization of contaminants in sediment. This may affect odours and current ambient air concentrations of hazardous air pollutants. • Increased diesel combustion will result in emissions of criteria air contaminants. • Material handling activities, cargo handling, road traffic, earth moving activities and construction activities may result in dust emissions which affect nearby commercial and residential properties.
Ambient Noise	• NA	• Potential for short-term and long term increases in noise levels as a result of construction and dredging activities including debris removal, sheet piling installation, earth moving activities and marine terminal operations. • Potential for increases in noise along haul routes.
Soil Quality	• Long-term reduced potential for re-contamination via surface and groundwater.	• Potentially susceptible to contamination from project related activities (spills, storage of contaminated material). • If erosion occurs during spring runoff or severe stormwater events, may deliver suspended sediments and/or contaminants to the Harbour.
Surface Water Quality, Currents and Circulation	• Containment of the contaminated sediments and consequent isolation from the water column will result in long-term improvements to surface water quality. • Long-term improvement in flow and circulation in the area adjacent to Sherman Outlet.	• Potential short-term increases in dissolved and suspended contaminant concentrations above existing levels due to re-suspension of contaminated sediment during preliminary debris removal, construction of the ECF walls, Pier 15 stabilization, construction of the U.S. Steel turbidity structure, and sediment capping and dredging activities. • Potential short-term increases in turbidity at the U.S. Steel

VEC	Advantage	Disadvantage
		intake/outfall. • Potential short-term increases in dissolved contaminant concentrations due to inadequate process wastewater treatment • Potential contaminated run-off to the Harbour from construction activities (e.g., storage of debris). • Potential to permanently change water circulation patterns in the vicinity of the ECF. • Potential for spills/ discharges from accidents and malfunctions associated with cargo handling
Aquatic Biota	• Long-term improvement to aquatic habitat quality and quantity, which may in turn result in improved species richness, diversity and abundance. • Long term improvement of water quality in Hamilton Harbour. • Shorter-term improvements in local water quality as a result of discharge from the water treatment plant system.	• Loss of 7.5 hectares of habitat (albeit poor quality habitat) due to dredging and construction of the ECF. • Potential releases of contaminants, suspended solids, and contaminants to surface water as a result of dredging, ECF filling and dewatering. • Potential for damage/habitat disruption during dredging, ECF filling and dewatering. • Potential disruption of species lifecycle (e.g., food supply, breeding grounds, hibernating grounds) through noise, vibration and light impacts. • Potential physical harm or direct mortality of non-mobile and semi-mobile species during construction, particularly dredging. • Potential for spills/ discharges from accidents and malfunctions associated with cargo handling
Species at Risk	• Overall positive environmental effect through the enhancement of habitat quality and quantity, which in turn will result in sustained increase in species diversity, abundance, and richness, including the identified species at risk.	• Potential short-term effects associated with releases of suspended sediments and contaminants associated with debris removal, dredging and ECF filling and dewatering. • Direct loss of 7.5 hectares of aquatic habitat which may have provided a food source for certain species at risk. • Potential for disruption/damage of species at risk habitat (e.g. food supply, breeding grounds, hibernating grounds) during dredging, ECF filling and dewatering and other construction activities (e.g., debris removal). • Potential disruption of species at risk lifecycle (e.g.,

VEC	Advantage	Disadvantage
		feeding, breeding, hibernating) through noise, vibration and light impacts. • Potential physical harm or mortal loss of species during construction activities, in particular, during dredging.
Shipping and Navigation	• Long-term improvements for shipping and navigation by improving the berthing facilities in the Harbour. • Long-term improvements in marine terminal facilities and shipping capacity.	• Potential for short-term reduced access due to closure of shipping areas and piers in or near the ECF. • Potential for increased traffic and navigational hazards due to increased marine construction traffic and conflict with shipping movements. • Potential impact to U.S. Steel intake as a result of increased marine construction traffic. • Potential for long-term navigational restrictions related to the U.S. Steel intake and use of suspended sediment control structures (i.e., silt curtains).
Sherman Outlet	• Long-term improvement in water quality in area surrounding Sherman Outlet.	• Potential for short-term impacts to water quality within the outlet if turbid water reaches the outlet and flows/disperses upstream. • Potential for stormwater runoff from adjacent construction areas affecting the Outlet area.
Industrial, Commercial and Municipal Use and Infrastructure	• Long-term potential for increased opportunities for an increase in government tax revenues related to new industrial uses in the Bayfront Industrial areas. • Increased opportunities for shipping and navigation and port related industries/commercial activities. • Increased business opportunities for community.	• Potential short-term increases in noise, vibration and dust as a result of sheet piling equipment, combined with increased truck traffic and other construction activities. • Potential for impacts related to traffic and potential accidents related to fuel or material spills. • Potential to impact adjacent industries (i.e., relocation of marine activities) during periods of dredging and construction. • Potential for conflicts with existing infrastructure in the various staging areas or around the water treatment plant. • Potential for short-term air quality effects due to construction and dredging activities.
Public Health and Safety	• Overall improvement in water quality in the Harbour • Overall improvement of air quality related to potential incidental emissions from exposure to the	• See impacts as per air quality, noise and residential areas VECs.

VEC	Advantage	Disadvantage
	sediments. • See Air Quality and Surface Water Quality, Currents and Circulation for additional advantages.	
Residential Areas	• Overall increase in residential property values from clean-up and delisting of Hamilton Harbour and increase in government tax revenues post construction.	• Potential increase in noise, vibration and dust caused by the construction of the ECF (i.e., sheet piling, quarry rock fill, truck traffic). • Potential increase in truck traffic haul route impacts residential areas (short term for construction activities, long term for cargo handling) • Potential to affect public health and safety due to increased truck traffic (i.e., accidents in residential areas).
Recreational Uses of the Harbour	• Long-term improved aesthetics along the industrial shoreline. • Long-term improvement in water quality related to contaminants in surface water and sediments.	• Potential for reduced access as a result of closure of recreational boating areas in or near the project site. • Potential for increased traffic, navigational hazards due to increased marine construction traffic. • Potential for air quality effects on recreations uses in or near the project site during construction and dredging activities.

12.5 Conclusion of the Responsible Authorities and Hamilton Port Authority

All environmental/socio-economic components of concern are discussed in Section 9.0. Components with potential environmental effects were selected as the VECs. A summary of the evaluation is provided in Table 12.2.

Table 12.2: Significance of Environmental Effects and Cumulative Environmental Effects

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
Air Quality		• Not significant	• Not significant
Air Quality	Mitigation of the effect on air quality from the operation of heavy diesel vehicles and equipment should include: • careful selection of trucking routes to minimize the effect on nearby residential areas, • on-site speed limits to minimize road dust generation, • site road house keeping including potentially watering and/or vacuuming, to minimize track-out onto local roads, • truck cleaning/washing stations should be set up at the exit from the site to prevent track-out of dust, debris and potentially contaminated material (during the removal of debris from the ECF footprint and Pier 15 stabilization), • Distance of 250 m between mechanical dredging equipment during operation on the east wall of the ECF; • the implementation of a “No Idle” policy on site to limit unnecessary	• The construction activities and long-term operations are expected to be of low magnitude and short duration, and will be minimized or mitigated with the implementation of the mitigation measures.	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	combustion emissions; • the implementation of the contractors Health and Safety Plan for onsite workers; • development and implementation of a communications protocol for real-time air monitoring exceedances; and • use of a real-time air monitoring program as a project management tool for implementing appropriate mitigation measures. Mitigation of the effect on air quality from stock piling materials should include: • consideration for location of piles; • reasonable timing for delivery to minimize time piles are exposed; • stockpile management measures such as watering, pile shaping and potential covering/tarping, as well as the suspension of earth moving and pile dropping operations during extreme high wind events ; • having a dust management plan which includes the mitigation measures for staging and storage areas and road traffic; Mitigation measures to control air emissions during various construction activities should include:		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	• having an air quality monitoring program in place that identifies when mitigation measures are required, including: • reducing dredging rates, • changing location of construction activities; • use of odour suppressants, etc.		
Ambient Noise		• Not significant	• Not significant
Construction Activities	• All internal combustion engines will be fitted with appropriate muffler systems; • Noise-muffling equipment will be in good working order; • Intensive construction activities will be limited to the hours of 07:00 and 19:00 to reduce the potential impact on receptors; • Nearby residents will be advised of significant noise-causing activities and these activities will be scheduled to cause the least disruption to receptors; • Vibratory pile-driving will be used when possible; • The public will have contact numbers for appropriate construction and government personnel in the case of	• The construction activities are expected to have a low magnitude effect, be of short-medium term duration and impact a local geographic extent	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	any noise issues; • Noise monitoring will be conducted as required at the nearest occupied properties; • Noise complaints from members of the public will be investigated and appropriate responses will be initiated; • Traffic management, which includes limiting traffic in and around the site and modifying speed limits will be implemented; and • Strategic placement of material storage piles to reduce noise associated with loading/unloading will be undertaken.		
Existing ambient noise	• Ongoing monitoring program will be in-place	• Impact on existing ambient noise levels is expected to be low	
Soil Quality		• Not significant	• Not significant
Soil storage of potentially contaminated soil	• Storage of potentially contaminated material on a paved surface or low permeability geotextile barrier • Use of stormwater collection system to prevent infiltration to the soil		
Stockpiling/temporary storage of debris retrieved from the Harbour in the staging area-potential runoff	• Rinse debris prior to removal from the harbour • Storage of potentially contaminated material on a paved surface or low permeability geotextile barrier		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	• Use of stormwater collection system to prevent infiltration to the soil		
Surface Water Quality, Currents and Circulation		• Not significant	• Not significant
Debris removal	• No practical method to reduce suspended sediment during these operations	• Magnitude, duration and geographic extent of the adverse effect is expected to be minimal. Negligible residual environmental effect	
In-water construction activities	• Dredge within confined areas- use silt curtains or other suspended sediment control measures (e.g. screens, sheetpile wall) • Use engineering controls such as hydraulic dredge heads with hoods or shrouds • Use operational controls such as dredging from higher to lower elevations, or higher to lower priority sediments • Implement water quality monitoring to ensure environmental conditions are being met • In softer sediments, reduce suspension by applying suction to remove the majority of the upper sediments • Have a clean-up crew available on-site with containment/absorbent booms, sorbent pads and skimmers for removal of spilled non-aqueous phase	• No adverse effect is expected as a result of in-water construction activities with the use of mitigation measures (e.g., silt curtain)	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	liquids including hydrocarbon fuels, oils and lubricants, and aromatic solvents • Use of experienced dredge operators		
Capping of U.S. Steel channel	• Use of a turbidity barrier system • Water quality monitoring will be conducted	• No adverse effect is expected as a result of capping of the U.S. Steel channel with the use of a turbidity barrier system and monitoring	
Treating dredged effluent	• Compliance monitoring will be carried out • Carbon changeout will take place if breakthrough due to short-circuiting is detected-arrangements will be made with the carbon supply vendor to either stockpile or store replacement carbon, or provide "just-in-time" turnaround of carbon	• No adverse effect is expected as a result of treating dredged effluent	
Terrestrial storage of debris, construction material and excavated soil	• Cover stockpiled materials to reduce stormwater induced runoff from the stockpiles • Stormwater collection and management system will be in place		
ECF Seepage water	• Install a drainage system in the ECF cap to limit recharge to dredged material in the ECF • Perform quality assurance monitoring of the interlock sealing process during	• Negligible effect is expected as a result of ECF seepage water with the use of water management features at the cap, monitoring and quality assurance of the sealed interlocks on the sheetpile	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	construction • Direct stormwater to the rock backfill between the double walls to facilitate degradation of organic contaminants and dispersion of inorganic contaminants between the sheetpile walls • Perform long-term monitoring using monitoring wells between the walls • Implement measures such as water extraction and treatment, or add sequestering agents if elevated concentrations are identified	walls	
Currents/Circulation		• Will not significantly interrupt or alter the magnitude or direction of currents in Hamilton Harbour	
Aquatic Biota		• Not significant	• Not significant
Construction, debris removal and dredging with potential for the following impacts : • Physical damage/disruption of aquatic habitat (e.g., food supply, breeding grounds and hibernating grounds) • Disruption of aquatic	•Use standard sediment control devices (e.g., sheet pile walls, silt curtains). •Equipment configurations that minimize re-suspension and dredging techniques to minimize turbidity. •Environmental monitoring •Focus period of activity during non-breeding times (e.g., autumn). •Fish salvage plan •Comply with City's noise by-law	• Any interactions are expected to occur only over a short time period and are likely to be less severe than the long-term stresses that would occur if there were no remediation-any interactions that will occur will be short term and will result in minimal consequences on aquatic biota given the history of environmental stressors in the past • Any potential negative interactions are	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
species habitat (e.g., feeding, breeding and hibernating) through noise, vibration and light impacts. • Release of suspended sediments, metals and sorbed PAHs to surface water • Physical harm or mortal loss of species	•Use vibratory sheet piling •Implementation of restoration/enhancement initiatives within similar environments in Hamilton Harbour •Treatment of decanted pore water from the de-watering process by the wastewater treatment plant	expected to be short term and be ameliorated by the distance and physical separation between Randle Reef and will likely result in little stress in the aquatic biota or aquatic vegetation	
Operational impacts- structural failure of the ECF resulting in release of contaminants	• Installation of drainage system in the ECF cap • Quality assurance monitoring of sheetpile interlock sealing process • Conveyance of direct stormwater and/or precipitation to a rock backfill • Long-term monitoring program between sheetpile walls • Implement water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified		
Species at Risk	•Potential impacts considered and determined not applicable to the project	• Not significant. • Given the removal of the aquatic habitat in the Randle Reef area is a necessary part of the remediation	• Not significant

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
		works, and given its current status as contaminated will improve following remediation, and regenerate itself, the net result will be a long-term improvement.	
Construction, debris removal and dredging with potential for the following impacts : • Physical damage/disruption of aquatic habitat (e.g., food supply, breeding grounds and hibernating grounds) • Disruption of aquatic species habitat (e.g., feeding, breeding and hibernating) through noise, vibration and light impacts. • Release of suspended sediments, metals and sorbed PAHs to surface water • Physical harm or mortal loss of species		• Not significant	
Operational impacts- structural failure of the ECF resulting in release of	• Installation of drainage system in the ECF cap		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
contaminants	• Quality assurance monitoring of sheetpile interlock sealing process • Conveyance of direct stormwater and/or precipitation to a rock backfill • Long-term monitoring program between sheetpile walls • Implement water extraction and treatment or addition of sequestering agents if elevated concentrations of constituents are identified		
Residential Areas		• Not significant	• Not significant
Equipment used for sheet piling and quarry rock fill causing noise, vibration and dust	• Vibratory sheet pile installation will reduce pulsation and shaking from equipment • Dust control practices/plans		
Haul Routes- increased traffic volumes, congestion and potential collisions	• Designate and enforce haul routes • Consider other transportation (e.g rail or barge) • Transport of materials will be in an environmentally sound manner and in accordance with all applicable legislation. • Appropriate methods and approved municipal and provincial haul routes for materials transport will be required in the contractor's submission and be included and adhered to during		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	construction • Methods for the transport of the material will be required in the bidder's submission and be adhered to during all phases of construction		
Operations phase of facility	• Ensure all standard operating regulations and local requirements for a marine terminal are met		
Industrial, Commercial and Municipal Use and Infrastructure	• As per mitigation measures for residential	• Not significant	• Not significant
Industrial, commercial and municipal land uses within the area of project influence	• Use of vibratory equipment for sheet pile installation • Use mitigation measures that are applied for residential area • May include preparation and negotiation of temporary and permanent easement agreements • Avoid undue disruption to existing business including advanced notification of activities		
Industrial, commercial and municipal land uses along the haul route	• Designate and enforce haul routes • Appropriate methods and approved municipal and provincial haul routes for materials transport will be required in the contractor's submission and be included and adhered to during construction		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	• Methods for the transport of the material will be required in the bidder's submission and be adhered to during all phases of construction		
Infrastructure conflicts or deficiencies related to construction and facility operation	• Ensure contractor identifies the existing utility services and proposed tie-in locations to the HPA for approval prior to excavations for staging and water treatment areas • Contractor to provide a flag person for any railroad crossings at the internal access road in accordance with contract specifications • Manage construction vehicle traffic in accordance with HPA safety protocols and applicable local requirements		
Sherman Inlet		• Not significant	• Not significant
Water quality and sediment within Sherman Outlet potentially affected by turbid water dispersed upstream as a result of construction or dredging activities	• Install silt barriers or other types of sediment traps across the culvert at the mouth of the outlet • Mitigation practices applicable to surface water quality, aquatic biota, and species at risk all apply for Sherman Inlet.		
Stormwater runoff from storage of materials at Pier 15	• Stormwater management system in staging area along with standard stormwater management techniques (use of silt fences, hay bales, sedimentation ponds, infiltration pits)		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
Public Health and Safety	• See measures identified under Noise, Air Quality, and Industrial, commercial and municipal use and infrastructure, and Recreational Uses of the Harbour	• Not significant	• Not significant
Recreational Uses of the Harbour		• Not significant	• Not significant
Reduced access	• Minimize weekly dredging areas • Contact Canadian Coast Guard Radio Station prior to in-water work • Communications plan for in-water work activities (ie. Notices to mariners, Hamilton Harbour recreational facilities and users)		
Increased traffic, navigational hazards	• All vessels will have proper lighting • In-water work areas will be marked with cautionary/navigation buoys in compliance with Private Buoy Regulations of the Canada Shipping Act		
Air quality effects	• Air quality monitoring • Equipment controls (e.g.hoods, shrouds on dredge equipment) • Operational controls (e.g reduced dredging)		
Shipping and Navigation		• Not significant	• Not significant
Access-closure of shipping	• Shipping and navigation to be		

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
areas or piers during construction	accommodated at all times (capture in contract specifications) • Minimize weekly dredging areas • Contact Canadian Coast Guard Radio Station prior to in-water work activities • All vessels will have proper lighting • In-water work area will be marked with cautionary/navigation buoys in compliance with the Private Buoy Regulations of the Canada Shipping Act • Provide advance notifications to local industries (i.e Heddle Marine, U.S. Steel) prior to dredging • Follow specific navigational protocols		
Increased traffic-navigational hazards	• As per above	• Not significant	
Shipping and Navigation compromised by increased boat traffic	• Construction contractor may determine or acquire the various construction materials and use one or more methods , including barge • Dependent on shipping route selected, complete traffic impact study • Appropriate methods and approved shipping routes will be required in the contractor's bids and adhered to during construction • Shipping routes will be selected so that effects to existing shipping and	• Not significant	

VEC	Mitigation	Significance of Environmental Effects (Significant/Not Significant)	Significance of Cumulative Environmental Effects (Significant/Not Significant)
	navigation are minimized • Transport of materials will be in an environmentally sound manner and in accordance with applicable legislation • Follow specific navigation protocols for area around U.S. Steel intake/outfall channel		
Operational phase of project may cause an adverse effect on marine transport of the Harbour-potential collisions with ECF	• Ensure proper navigation lighting • Update port facilities marine chart mapping to reflect ECF		

Given the findings presented in the comprehensive study report, the RAs and PA(HPA) conclude that taking into consideration the implementation of proposed mitigation measures, the project will not likely result in any significant residual adverse environmental effects. There are many positive benefits of the *Randle Reef Sediment Remediation Project*, including achieving the project goals of reducing the source of contamination to the rest of the Harbour. Any potential negative impacts will be avoided by mitigation measures described within this comprehensive study report. The follow-up and monitoring program, as described in Section 11.0, will be implemented to confirm these conclusions.

GLOSSARY

Alternative Means of Carrying Out a Project — The various technically and economically feasible ways, other than the proposed way, for a project to be implemented or carried out.

Examples include other project locations, different routes and methods of development, and alternative methods of projected implementation or mitigation.

Alternatives to a Project — The functionally different ways, other than the proposed project, to meet the project need and achieve the intended purpose.

For example, if a need for greater power generation has been identified, a proposed project might be to build a new power generation facility. An alternative to that project might be to increase the generation capacity of an existing facility.

CEAA Trigger — An action by a federal authority that triggers or initiates the need for an environmental assessment; that is, one or more of the following duties, powers, or functions in relation to a project:

a) proposes the project;
b) grants money or other financial assistance to a project;
c) grants an interest in land for a project; or
d) exercises a regulatory duty in relation to a project, such as issuing a permit or licence, that is included in the Law List prescribed in the Act's regulations.

Comprehensive Study List — A list of projects, prescribed pursuant to CEAA, which must undergo a comprehensive study.

Design Element — The term "design element" refers to a major category of project activity such as dredging, and the activities associated with it such as controlling sediment re-suspension during dredging and transporting the dredged material.

Design Option — The term "design option" refers to possible means of executing a component of the design element. For example, mechanical and hydraulic dredging are two options for dredging.

Design Alternative — A "design alternative" is an assemblage of design options.

Environment — 'environment' means the components of the Earth, and includes:

a) land, water and air, including all layers of the atmosphere,
b) all organic and inorganic matter and living organisms, and
c) the interacting natural systems that include components referred to in paragraphs (a) and (b)" (Bill C-13).

Environmental Assessment	In respect of a project, an assessment of the environmental effects of the project that is conducted in accordance with the *Canadian Environmental Assessment Act* and the regulations.
Environmental Effect	In respect of a project, a) any change that the project may cause in the environment, including any effect of any such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or on any structure, site or thing that is of historical, paleontological or architectural significance, and b) any change to the project that may be caused by the environment, whether any such change occurs within or outside Canada (Bill C-13).
Residual Environmental Effect	Any change (negative or positive) in the environment that remains after the implementation of mitigation measures (including compensation under the *Fisheries Act* subsection 35(2) Authorization); also explained as the negative and positive net change in the environment after mitigation measures.
Follow-Up Program	A program for: a) verifying the accuracy of the environmental assessment of a project; and b) determining the effectiveness of any measures taken to mitigate the adverse environmental effects of the project (Bill C-13).

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