Conceptual Constraints and Impact Considerations

Final Draft Report
Public Services and Procurement Canada

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Project: 668479

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Executive Summary

This Conceptual Constraints and Impact Considerations (CCIC) document for the proposed Kingston Inner Harbour Sediment Management Project represents an expanded Terms of Reference (TOR) for conducting the Parks Canada Detailed Impact Assessment (DIA), and includes additional information and more details than a traditional TOR to allow a more fulsome engagement with stakeholders and implement a more comprehensive collection of information for the preparation of the DIA. The CCIC provides a preliminary, high-level consideration of Project impacts based on information gathered to date, allowing for early identification of remaining information gaps and potential constraints. The CCIC is based on the sediment management approach outlined in the report "Conceptual Sediment Management Plan for the Kingston Inner Harbour" (Golder, 2021a) and provides:

- a summary of the proposed Sediment Management Project;
- scope of assessment; description of Valued Components (VCs) and existing evidence;
- preliminary consideration of impacts on VCs with desired outcomes, thresholds, and potential design considerations to reduce risk;
- a summary of additional works required to resolve information gaps; and
- potential constraints posed to the Project by VCs and associated desired outcomes and thresholds.

Table of Contents

Figures

Tables

Appendices

D Conceptual Constraints and Impact Considerations – Sediment Quality (WSP, 2023)

E Stage 1 Terrestrial Archaeological Assessment of the Kingston Inner Harbour

F Marine Desktop (Stage 1 Equivalent) Archaeological Assessment of the Kingston Inner Harbour

List of Acronyms

°C	Degrees Celsius
%HA	Percent Highly Annoyed
µg	Microgram
AAQC	Ambient Air Quality Criteria
BMP	Best Management Practice
CAAQS	Canadian Ambient Air Quality Standards
CCIC	Conceptual Constraints and Impact Considerations
CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Act
CEQGs	Canadian Environmental Quality Guidelines
cm	centimetre
CNWA	Canadian Navigable Waters Act
COC	Contaminants of Concern
COPC	Contaminants of Potential Concern
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
COSSARO	Committee on the Status of Species at Risk in Ontario
CRCA	Cataraqui Region Conservation Authority
dB	Decibel
dBA	Decibel “A” weighted
DBH	Diameter at Breast Height
DFO	Fisheries and Oceans Canada
DIA	Detailed Impact Assessment
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
EDDMapS	Early Detection and Distribution Mapping System
EIA	Environmental Impact Assessment
EISS	Environmental Impact Single Scores
ELC	Ecological Land Classification
EMP	Environmental Management Plan
EPO	Environmental Performance Objective
ESA	Endangered Species Act
ESG-RMC	Environmental Sciences Group of the Royal Military College of Canada
FCSAP	Federal Contaminated Sites Action Plan
FQI	Floristic Quality Index
GDP	Gross Domestic Product
GHG	Greenhouse Gases
GLCWMP	Great Lakes Coastal Wetland Monitoring Program
GPS	Geographic Positioning System
ha	Hectares
HDPE	High Density Polyethylene
HEAT	Habitat Ecosystem Assessment Tool
IAA	Impact Assessment Act
IAAC	Impact Assessment Agency of Canada
IBI	Index of Biological Integrity
ICOMOS	International Council on Monuments and Sites
IDS	Integrated Destination Strategy
IJC	International Joint Commission
K3C	Kingston Third Crossing
KIH	Kingston Inner Harbour
km	kilometre

L	Litre
LCA	Life Cycle Assessment
LIO	Land Information Ontario
m	metre
MBCA	Migratory Birds Convention Act
MECP	Ontario Ministry of the Environment, Conservation and Parks
mg	milligram
MHSTCI	Ontario Ministry of Heritage, Sport, Tourism and Culture Industries
mm	millimetre
MNR	Former Ontario Ministry of Natural Resources
MNRF	Ontario Ministry of Natural Resources and Forestry
NHIC	Ontario Natural Heritage Information Centre
N/A	Not Applicable
NO_x	Nitrogen Oxides
O_3	Ozone
PAHs	Polycyclic Aromatic Hydrocarbons
PCA	Parks Canada Agency
PCBs	Polychlorinated Biphenyls
PCOC	Potential Contaminants of Concern
$PM_{2.5}$	Fine Particulate Matter
PSPC	Public Services and Procurement Canada
PSW	Provincially Significant Wetland
PWQO	Provincial Water Quality Objectives
RMC-ESG	Royal Military College Environmental Services Group
ROV	Remote Operated Underwater Vehicle
RSO	Revised Statutes of Ontario
SAR	Species at Risk
SARA	Species at Risk Act
SARO	Species at Risk in Ontario
SJAHCE	Scarlett Janusas Archaeological and Heritage Consulting and Education
SMP	Sediment Management Plan
SO	Statutes of Ontario
SWH	Significant Wildlife Habitat
TC	Transport Canada
TEQ	Toxic Equivalents
TOC	Total Organic Carbon
TSS	Total Suspended Solids
UNESCO	United Nations Educational, Scientific and Cultural Organization
VC	Valued Component
WQMP	Water Quality Management Plan
WSCA	Wildlife Scientific Collector's Authorization

Glossary

Adverse Environmental Effects: a negative change to the environment or to health, social or economic conditions. For Parks Canada, this also includes natural or cultural resources.

Aquatic Wildlife: all wild fish, amphibians, molluscs, and benthic invertebrates and includes any part of such fish, amphibian, mollusc, and benthic invertebrate, including their eggs or young.

Constraint: a limitation to carrying out project activities due to a lack of information or an undesired unmitigated impact.

Cumulative Effects: combined effects (both adverse and positive) from past, present, and reasonably foreseeable future activities and natural processes.

Design Considerations: timing, processes or physical elements that can be considered for incorporation into the detailed design of the sediment management plan (i.e., relating directly to how sediment management is staged and/or carried out) to avoid or minimize adverse environmental effects to valued components.

Desired Outcome: a tangible measure of performance that accurately and precisely relates to the project-Valued Component interaction and predictions of project-induced change.

Detailed Impact Assessment: the impact assessment approach used for a complex project requiring in-depth analysis of project interactions with valued components, as described by Parks Canada's Directive on Impact Assessment.

Environmental Effect: a change to the environment or to health, social or economic conditions and the positive and negative consequences of these changes. For Parks Canada, this also includes natural or cultural resources.

Mitigation: an action that can be taken or a process that can be applied to reduce or eliminate adverse environmental effects that would result from implementation and operation of the project.

Project Impact Area: established to assess the potential, largely direct, and immediate indirect effects of the Project on the local environment.

Project Site: established to identify areas of direct disturbance and represents the physical area required for Project activities to be carried out.

Project Study Area: includes both the Project Impact Area and Project Site.

Qualified Professional: a person who has education, training, licensure, certification, and/or experience to conduct the work and/or make the decision at issue.

Residual Effect: a positive or adverse impact remaining after mitigation has been applied.

Significant Wildlife Habitat: areas in Ontario that are ecologically important in terms of features, functions, representation or amount, and contributing to the quality and diversity of an identifiable geographic area or Natural Heritage System.

Standard of Proof: the quality of scientific evidence that must be met in order to determine if the project-Valued Component interaction will satisfy the desired outcome.

Terrestrial Wildlife: all wild mammals, reptiles and wild birds and includes any part of such mammal, reptile or bird, including their eggs or young.

Threshold: the indicators or measurable conditions used to assess and measure achievement of the desired outcome.

Valued Component: environmental, health, social, economic or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous groups, federal authorities and interested parties.

1 Introduction

SNC-Lavalin Inc. (SNC-Lavalin) was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) and Parks Canada Agency (PCA) to undertake a Detailed Impact Assessment (DIA) for a proposed sediment management project (currently in the conceptual stages) at Kingston Inner Harbour (KIH) in Kingston, Ontario and address the requirements of the *Impact Assessment Act*, 2019 (S.C. 2019, c. 28) (IAA). The DIA has not yet begun and is still in the information-gathering stages.

As a consequence of years of industrial activity in the area, sediments within the KIH are laden with contaminants of varying type, concentration, and extent, as characterized in a number of reports by Golder Associates Ltd. (Golder) (now known as WSP Canada Inc. [WSP]), which has culminated in the development of a Conceptual Sediment Management Plan (SMP) (Golder, 2021a).

PSPC, on behalf of TC and PCA, is facilitating the execution of the DIA for the proposed KIH sediment management works. As a part of the DIA process, two (2) scoping documents were submitted for the project: a Gap Analysis (SNC-Lavalin, 2020a) and Regulatory Summary and Environmental Constraints (SNC-Lavalin, 2020b). These documents were produced under PCA guidance published in 2015 under the former *Canadian Environmental Assessment Act*, 2012 (S.C. 2012, c. 19, s. 52). Since that time, new guidance documents that align with the current IAA were released by PCA, including the Parks Canada Impact Assessment Directive (2019), Parks Canada Impact Assessment Guide (August 2020), and Parks Canada Detailed Impact Assessment Handbook Part 3 (2020 Draft).

This Conceptual Constraints and Impact Considerations (CCIC) document represents an expanded version of a Terms of Reference. It replaces a standard Terms of Reference with a more detailed document for alignment with the IAA, including additional information and details to allow a more fulsome engagement with stakeholders and implement a more comprehensive collection of information for the preparation of the DIA. As such, references to a Terms of Reference document will be replaced by the document title Conceptual Constraints and Impacts Considerations in future iterations of the DIA. The objectives of this CCIC document are to present a preliminary analysis of impacts and potential constraints based on information gathered to date, identify remaining information gaps, and propose additional work required to address the information gaps. This analysis is based on the Conceptual SMP (Golder, 2021a) which will be updated in 2023 to reflect comments received from current stakeholder engagement and Indigenous consultation and engagement, as well as completed biological and ecological surveys. Comments and feedback received, along with new information, will be used alongside the CCIC to inform the first draft of the DIA.

The CCIC will serve as a preliminary analysis of potential high-level impacts associated with the conceptual SMP and will assist in refining the SMP prior to initiating detailed design. In particular, key dominant factors examined in the CCIC will include those considered to have the highest risk, uncertainty, or consequence, such as species at risk turtles, aquatic wildlife and vegetation, sediment quality, surface water quality, and archaeology. It should be noted that the impacts discussed herein are not considered to be exhaustive and will be further evaluated, expanded upon and consulted on as part of the formal DIA process and throughout the detailed design phase. *The CCIC will not draw conclusions regarding impacts of the sediment management plan and is not intended to act as an impact assessment.*

The CCIC development was iterative and relied on input and expertise from the project team to achieve a clear direction on the development and execution of the DIA. Ultimately, the CCIC, as well as feedback and information received from approving authorities, Indigenous groups, local stakeholders and members of the public will inform the DIA, guide the refinement of the SMP to be assessed by the DIA, and inform the detailed design process.

1.1 Project Background

The area surrounding the Kingston Inner Harbour has a history of industrial activity that has resulted in contamination of the sediment lining the harbour bed. Historical industrial activity included a railway, shipyard, fueling, coal gasification, tannery, lead smelter, landfill and other operations. Since 2010, there have been multiple field studies and desktop evaluations conducted in the KIH to characterize the spatial extent and magnitude of contamination, including assessment of the risks of contaminants to humans and aquatic life (ESG-RMC, 2014; Golder, 2011, 2012, 2013, 2014). Assessments were conducted following the Canada-Ontario Decision-Making Framework for the Assessment of Great Lakes Contaminated Sediment (Chapman, 2008; Golder, 2012) and reviewed by the Federal Contaminated Sites Action Plan (FCSAP) Expert Support departments. Despite several decades of time to allow for natural recovery, several areas have not recovered enough to be considered safe for current uses. The result of this work determined that areas of the KIH contain concentrations of contaminated sediments that pose low to very high risks to the environment and human health (Golder, 2016, 2017a, 2019). Therefore, management measures have been recommended to address those risks.

A conceptual remedial options analysis was completed by Golder in 2017 which integrated multiple scientific and logistical factors that influence the risk management decisions for the inner harbour. Consideration was given to balancing many factors, such as chemical risk reduction, feasibility, cost, habitat modification, the potential presence of cultural/archaeological resources or artifacts, and disruption to existing and future water uses.

The Kingston Inner Harbour Sediment Management Project is intended to reduce the risks from sediment contamination to people, fish, and wildlife within the harbour through management of sediment quality. The proposed remediation and management techniques include dredging, capping, sediment amendments, and shoreline modification. The goal of the project is to balance protecting sensitive species, habitats, and valued features while reducing risks associated with contamination.

1.2 Project Summary

The proposed sediment management project of the KIH broadly consists of the following elements, as described in the Conceptual Sediment Management Plan (Golder, 2021a):

- Dredging of contaminated areas within the KIH, including some shoreline, with off-site disposal of contaminated material;
- Placement of a thin engineered cover (potentially including sand, activated carbon, and/or other clean materials) over areas near Anglin Bay, south of the Woolen Mill, and Orchard Street Marsh;
- Placement of a conventional sand cap with activated carbon within Anglin Bay;
- Placement of back-fill materials (with properties similar to the covers described above) in certain individual management units following dredging;
- Shoreline stabilization along the waterfronts at Emma Martin Park, the Woolen Mill, and Douglas Fluhrer Park;
- Temporary facilities and laydown-area(s); and
- Associated site monitoring, restoration, and rehabilitation works.

The sediment management area within the Kingston Inner Harbour is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island/Cataraqui Park to the north and includes an approximate 1.7 km length of the Great Cataraqui River. The total project area including areas requiring physical intervention and monitored natural recovery is approximately 177 ha.

1.3 Regulatory Framework

An assessment of the Regulatory Framework for the Kingston Inner Harbour Sediment Management Project was completed by SNC-Lavalin Inc. (2020b) under the title "Regulatory Summary and Environmental Constraints for Kingston Inner Harbour" (March 2020). While this document was prepared in 2020 and some legislation and/or policies may have been updated in the time since, it should be read in conjunction with this CCIC for a robust characterization of the Regulatory Framework applicable to the Kingston Inner Harbour Sediment Management Project. The Regulatory Framework is briefly summarized below.

1.3.1 Impact Assessment Act, 2019 (IAA 2019) and the Parks Canada Directive on Impact Assessment

The IAA sets out requirements in relation to projects on federal lands. Prior to taking action or making a decision that would enable a project to proceed on federal lands, TC and PCA are required to determine if carrying out the project as proposed (including implementation of identified mitigation measures) has potential to cause significant adverse environmental effects.

PCA's Impact Assessment Directive (2019) outlines PCA's policy framework to ensure compliance with legal regimes for impact assessment and indicates the circumstances in which impact assessment will be undertaken, the general principles that will be respected, the processes and procedures that must be followed, and the associated responsibilities and accountabilities. Parks Canada Impact Assessment Guide (August 2020) describes the impact assessment process developed by PCA to fulfill its requirements as a federal authority under the IAA as well as its legal and mandated obligations to protect Canada's natural and cultural heritage. The purpose of this guide is to provide external proponents, stakeholders, partners, Indigenous groups and the public with an understanding of what PCA's impact assessment requirements are for project proposals within a PCA protected heritage place.

The Impact Assessment process examines how a project may lead to adverse effects on:

- Natural resources – such as species at risk, air, ground and surface water, sediments/soils, habitat features, as well as plants and animals found in the vicinity of a project or otherwise potentially affected by it; and
- Cultural resources – including potential adverse effects on heritage value and character defining elements of known cultural resources, and risks to areas with high potential to contain cultural resources where no inventory has yet been completed.

In addition, the assessment process requires consideration of potential indirect effects of a proposed project; specifically, how the effects of a proposed project on natural resources may in turn cause:

- Adverse effects on characteristics of the environment important to key visitor experience (how the proposal is anticipated to affect activities and/or visitors' enjoyment and connection to place, in relation to defined objectives for the protected heritage place);
- Adverse effects on health and socio-economic conditions of Indigenous and non-Indigenous peoples; and
- Adverse effects on Indigenous Peoples' current use of lands and resources for traditional purposes.

According to PCA's Directive, the appropriate level of impact assessment (i.e., basic or detailed) will vary according to the requirements of each project proposal and will be commensurate with the risk and likelihood of significant adverse environmental effects associated with carrying out the project. Given the scope of work proposed and potential Indigenous and public interest on potential impacts of the Kingston

Inner Harbour Sediment Management Project, it was determined by TC and PCA representatives that the appropriate level of assessment for this project is a Detailed Impact Assessment (DIA). PCA's Detailed Impact Assessment Handbook Part 3 (2020 Draft) provides comprehensive advice for the planning and preparation specifically of DIAs. The DIA is the most comprehensive level of assessment, intended for complex projects that require applied analysis of project interactions with Valued Components[1] (VCs) that may affect a particularly sensitive environmental setting or threaten one or more sensitive VCs. These projects may lead to high levels of interest from public, stakeholders, and Indigenous groups in relation to the potential for adverse environmental effects.

1.3.2 Federal Regulatory Requirements

The Cataraqui River is listed as a navigable waterway in the schedule to the *Canadian Navigable Waters Act* (S.C. 2019, c. 28), administered by TC. Therefore, approval from TC for "works – other than minor works – in, on, over, under, through or across any navigable water that is listed in the schedule" will be required prior to engaging in work that may interfere with navigation. TC is also responsible for administering the *Transportation of Dangerous Goods Act* (S.C. 1992, c. 34) which ensures safety of the public and environment from the transportation of dangerous goods, including hazardous wastes. The transportation of contaminated dredged materials may require an Equivalency Certificate and an Emergency Response Assistance Plan under this Act, which may further activate provincial requirements under the Ontario *Dangerous Goods Transportation Act* (R.S.O. 1990, c. D.1). Likewise, the transportation of these materials may also require a permit for "Equivalent Levels of Environmental Safety" as administered by Environment and Climate Change Canada (ECCC) under the *Canadian Environmental Protection Act* (CEPA) (S.C. 1999, c. 33) if they are categorized as "hazardous waste" and the control and movement of the materials does not comply with division 8, part 7 of CEPA.

KIH is part of the Rideau Canal National Historic Site of Canada (Rideau Canal), which is administered by PCA. Under the Historic Canals Regulations (1993, SOR/93-22; *Department of Transport Act*, R.S.C. 1985, c. T-18), PCA is authorized to administer the regulations as they apply to the management, maintenance, and proper use and protection of historic canals. The project may require authorization under the Historic Canals Regulations. The Rideau Canal is also classified as a cultural UNESCO World Heritage Site, and PCA must consider any potential effects to the identified "Outstanding Universal Value" of the site during the project review to keep in accordance with the 1972 World Heritage Convention.

ECCC is also responsible for the administration of the *Migratory Birds Convention Act* (MBCA) (S.C. 1994, c. 22) which protects and conserves migratory birds, their eggs, and nests. Under the Act, no person is permitted to disturb, destroy, or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird, or have in their possession a live migratory bird, or a carcass, skin, nest, or egg. There are no permits available that allow for incidental take or injury. Best Management Practices, including restricted timing windows, are prioritized in order to reduce the potential for contravention of the MBCA. The active conservative migratory window for the Kingston Area is April 1 to August 31.

The *Species at Risk Act, 2002* (SARA) (S.C. 2002, c. 29) has three purposes: to prevent indigenous species in Canada from disappearing; to provide for the recovery of wildlife species that are extirpated, endangered, or threatened as the result of human activity; and to manage species of special concern to prevent them from becoming endangered or threatened (Government of Canada, 2016). The Act is administered by ECCC, with jurisdiction also granted under certain sections to PCA and Fisheries and Oceans Canada (DFO). Impacted plant, wildlife, and fish species and their habitats, including Species at Risk (SAR) will be assessed in relation to the proposed Project. If it is determined that SAR species may be impacted, a SARA Permit may be required under section 73 of the Act. SARA requires an assessment

[1] Valued Components are environmental, health, social, economic or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous Peoples, federal authorities and interested parties.

of known SAR habitat (including general and critical habitats), consideration of alternatives, development of acceptable mitigations, avoidance opportunities, and compensation when applicable. Approval from DFO in the form of a SARA-compliant *Fisheries Act* Authorization or SARA Permit may be required for impacts to aquatic SAR and their habitats, including fish, shellfish, crustaceans, aquatic animals, and aquatic plants.

The *Fisheries Act* (R.S.C. 1985, c. F-14) is administered by DFO and provides for the management and control of fisheries. The Act prohibits causing the death of fish by means other than fishing, and causing the harmful alteration, disruption, or destruction of fish habitat. A Request for Review is required by DFO if proposed activities are likely to cause impacts to fish and fish habitat. Likewise, if impacts are determined to be probable, a *Fisheries Act* Authorization will be required.

Regulatory permits/approvals required should be confirmed once more information on the SMP is available and prior to the detailed design for the Project being completed. In addition to any potential federal permits and/or approvals that may be required, the DIA will outline TC and PCA policies and directives that will be followed, where applicable.

1.3.3 Provincial Regulatory Requirements

Provincial lands within the Project includes private and Municipal (City of Kingston) lands. Some sediment management activities may be taking place on Municipal and private lands. Additionally, terrestrial staging and access may take place from Municipal and/or private lands. The most stringent environmental requirements among municipal by-laws, provincial Regulations and Acts, and federal Regulations and Acts are recommended for implementation where jurisdictional law is less rigorous or absent. The following is a list of potentially applicable provincial legislation:

- *Invasive Species Act* (S.O. 2015, c. 22)
- *Fish and Wildlife Conservation Act* (S.O. 1997, c. 41)
- *Beds of Navigable Waters Act* (R.S.O. 1990, c. B.4)
- *Lakes and Rivers Improvement Act* (R.S.O. 1990, c. L.3)
- Ontario Fishery Regulations (SOR.2007-237)
- *Public Lands Act* (R.S.O. 1990, c. P.43)
- *Environmental Assessment Act* (R.S.O. 1990, c. E.18)
- *Ontario Water Resources Act* (R.S.O. 1990, c. O.40)
- *Conservation Authorities Act* (R.S.O. 1990, c. C.27)
- Development Interference with Wetlands and Alterations to Shorelines and Watercourses (O. Reg. 148/06)
- *Endangered Species Act* (S.O. 2007, c. 6)
- *Environmental Protection Act* (R.S.O. 1990, c. E.19)
    - Ontario Contaminated Sites Regulation (O. Reg. 163) 1990
- *Clean Water Act* (S.O. 2006, c. 22)
- *Ontario Heritage Act* (R.S.O. 1990, c. O.18)
- *Planning Act* (R.S.O. 1990. C. P.13)
    - Provincial Policy Statement
- *Dangerous Goods Transportation Act* (R.S.O. 1990, c. D.1)

1.3.4 Municipal Regulatory Requirements

The application of municipal by-laws may vary but are largely meant to be applicable on private and municipal (City of Kingston) lands. Staging and access, as well as sediment management activities, may take place from municipal and/or private lands and waters. Some sediment management activities may be taking place on municipal and private lands and waters. The most stringent environmental requirements among municipal by-laws, provincial regulations and acts, and federal regulations and acts are recommended for implementation where jurisdictional law is less rigorous or absent.

- Site Plan Control By-Law 2010-217
- Tree By-Law 2018-15
- Water Supply By-Law 2006-122
- Sewer Use By-Law 2008-192
- Solid Waste Management By-Law 2014-5
- Idling By-Law 2008-95
- Noise By-Law 2004-52
- Cataraqui Region Conservation Authority Guidelines for Erosion and Sediment Control

1.4 DIA Roles and Responsibilities

Public Services and Procurement Canada (Procurement Agency and Technical Expertise)

PSPC is facilitating the completion of the DIA on behalf of proponents TC and PCA. As such, PSPC is responsible for procuring consulting services required to prepare the DIA and facilitating the transfer of information and deliverables between TC, PCA and the consultant.

PSPC is responsible for providing technical expertise related to impact assessment and the management of contaminated sediment, and for working collaboratively with the site custodians (TC and PCA) to scope, assess, and implement DIA measures. Written and verbal guidance will be provided by PSPC to the consultant in support of preparing a draft DIA that will cover the key considerations detailed in this CCIC. This includes participation in meetings and teleconferences, written correspondence, and comments and recommendations on drafts submitted for review.

Transport Canada (Proponent)

TC is a federal custodian responsible for addressing sediment contamination within water lots under its jurisdiction and has additional regulatory responsibilities under the *Canadian Navigable Waters Act* and the *Transportation of Dangerous Goods Act*. TC, like PCA, is responsible for determining the probability of the proposed project to cause adverse environmental impacts under the IAA as well as impacts to navigation and implications for transporting the contaminated dredge materials, should they be considered hazardous waste.

Written and verbal guidance will be provided by TC to PSPC in support of preparing a draft DIA that will cover the key considerations detailed in this CCIC. This includes participation in meetings and teleconferences, written correspondence, and comments and recommendations on drafts submitted for review.

Parks Canada Agency (Proponent)

PCA is a federal custodian responsible for addressing sediment contamination within water lots under its jurisdiction. PCA is the federal land manager in charge of the bed of the Rideau Canal, which includes the Cataraqui River at the southern end of the Canal. Under the PCA Cultural Resource Management Policy (2013), PCA is responsible for assessing the impacts of any proposed intervention that may adversely affect the heritage value of a cultural resource at any protected heritage place. Under SARA, PCA is responsible for any species at risk and their Critical Habitat found exclusively or partly in or on federal lands administered by PCA. In KIH, this includes the water lots that are part of the Rideau Canal. PCA is also responsible for determining the probability of the proposed project to cause adverse environmental impacts under the IAA.

Written and verbal guidance will be provided by PCA to PSPC in support of preparing a draft DIA that will cover all key considerations detailed in this CCIC. This includes participation in meetings and teleconferences, written correspondence, and comments and recommendations on drafts submitted for review.

Expert Federal Authorities (FAs)

Federal authorities in possession of specialist or expert information that may assist with input or advice on the DIA include:

- DFO – if a *Fisheries Act* Authorization is required for the sediment management project, DFO may also be responsible for determining the probability of the proposed project to cause adverse environmental impacts under the IAA
- Environment and Climate Change Canada (ECCC)
- Health Canada

1.5 Federal/Provincial Coordination

Impact assessments that have federal and provincial overlap can be coordinated between the responsible federal and provincial departments. Given current uncertainty regarding the extent of proposed work outside of federally owned water lots or lands, it is not known to what extent the project must address provincial Environmental Assessment requirements. These requirements will be considered as part of any refinements to the SMP and prior to the development of detailed design.

2 Scope of Assessment

2.1 Project Description

2.1.1 Project Objective

The objective of the Kingston Inner Harbour Sediment Management Project is to reduce the risks from sediment contamination to people and wildlife[2] within the harbour through management of sediment quality. Proposed remediation techniques include dredging, capping, sediment amendments, and shoreline modification, while protecting sensitive species, habitats, and valued features. The Project is intended to balance the short and long-term disruptions and risks from multiple stressors and align chemical risk reductions with other values of the Harbour to numerous stakeholders.

2.1.2 Project Location

Kingston Harbour is adjacent to the City of Kingston, at the eastern end of Lake Ontario. The entire Kingston Harbour is approximately 765 hectares (ha) in size and includes an Inner and Outer Harbour. Kingston Inner Harbour (KIH) (the Site) is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Highway 401 to the north and includes a 5 km length of the Great Cataraqui River. The Inner Harbour is further divided into northern and southern sections by Belle Island. The sediment management area within KIH is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island/Cataraqui Park to the north and includes an approximate 1.7 km length of the Great Cataraqui River. The total

[2] In this case, “wildlife” includes birds, mammals, reptiles, amphibians, fish, and benthic invertebrates.

project area including areas requiring physical intervention and monitored natural recovery is approximately 177 ha (**Figure 1**).

Jurisdiction of most of the southern section of the Inner Harbour (i.e., south of Belle Island and Cataraqui Park) is held by TC (**Figure 1**). PCA is the manager of harbour sediments in the portion of the Inner Harbour immediately south of Belle Park (southwest of Belle Island) and in the portion of the Inner Harbour north of Belle Island (**Figure 1**). A small percentage of the southern half of KIH is managed by other parties, including a square water lot managed by the City of Kingston adjacent the former Woolen Mill, a triangular portion of water lot adjacent to the Orchard Street Marsh (jurisdiction for this lot is being determined), small areas of foreshore near the Kingston marina managed by the City of Kingston, a waterlot in the southwestern corner adjacent to Anglin Bay managed by Department of National Defence, and a Military Reserve in the southeastern corner of KIH also managed by the Department of National Defence (**Figure 1**).

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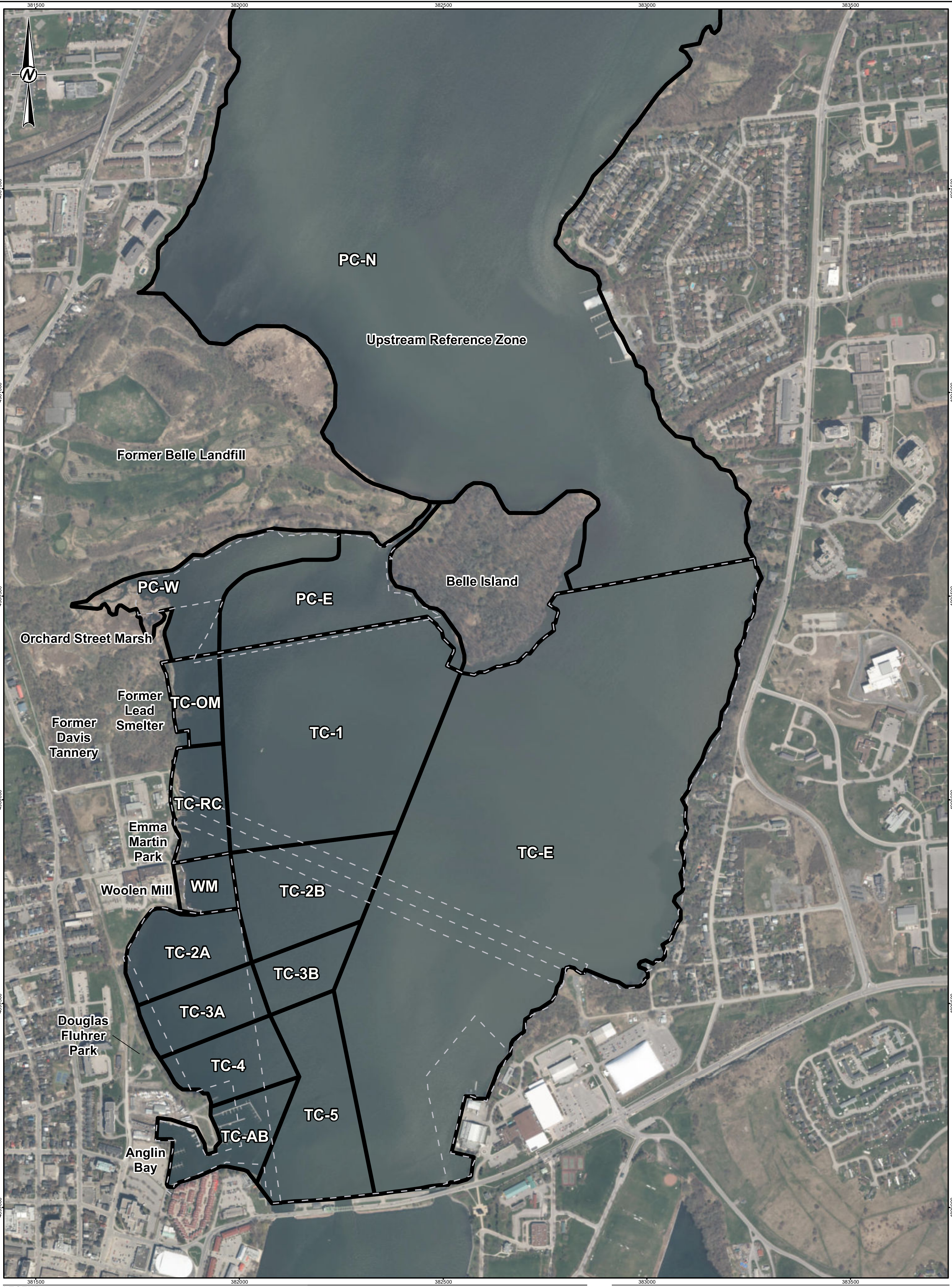

LEGEND

FEDERAL WATER LOT BOUNDARY

MANAGEMENT UNIT

0 200 400

1:9,000 METERS

REFERENCES
1. IMAGERY COPYRIGHT © 20180508 ESRI AND ITS LICENSORS. SOURCE: CITY OF KINGSTON. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. INSET BASE OBTAINED FROM ESRI CANADA.
2. PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SPATIAL DOMAIN OF KIH STUDY AREA AND MANAGEMENT UNITS

CONSULTANT

GOLDER

YYYY-MM-DD	2020-12-10
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
1783886	7000	0	**2**

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2.1.3 Project Phases and Activities

As the Project is currently in the planning stage, the plans for site preparation and mobilization, sediment management activities, demobilization, site restoration, and post-management monitoring have not been specified in detail and are only conceptual (refer to **subsection 1.2**). The Conceptual Sediment Management Plan (Golder, 2021a) will be updated in 2023 to reflect comments received from recent stakeholder engagement and Indigenous engagement and consultation that are currently underway. Following refinement of the Conceptual SMP and the start of detailed design, the DIA will provide a complete description of all components of the Project, which may include the following activities (also see **Figure 2**):

- Site Preparation and Mobilization
    - Vegetation clearing and excavation of soil;
    - Temporary access requirements (roads, offload docks/shoreline equipment access);
    - Temporary facilities and laydown area(s);
    - Installation of Erosion and Sediment Controls; and
    - Site isolation (turbidity curtains, cofferdams, etc.).
        - Aquatic (fish) and semi-aquatic wildlife (reptiles, amphibians) rescue from isolated units.
- Sediment Management Activities
    - Dredging inside turbidity curtain;
        - Methods may include closed clamshell environmental bucket or suction dredge with auger. Other methods may be used at discretion of Contractor due to site conditions and logistical challenges and environmental constraints.
    - Storage, dewatering, treatment, and transportation of contaminated materials (includes sediment treatment facility set up);
    - Disposal of waste materials (including excavated materials, solid non-hazardous construction waste and waste debris from clearing activities);
    - Institutional and Engineering Controls;
        - May include fishing advisories, fencing, and shoreline stabilization.
    - Thin-layer capping (with or without amendments using activated carbon);
    - Conventional sand capping;
    - Wetland management; and
        - Likely be deferred and assessed as separate project under the IA process due to ecological sensitivity and connection to adjacent off-Site property and shoreline development initiatives currently under consideration.
    - Storage of equipment, temporary structures/facilities, and other ancillary project activities.
- Demobilization and Site Restoration
- Post-construction Monitoring and Contingencies
    - Monitored natural recovery;
    - Confirmatory sampling and long-term monitoring; and
    - Adaptive measures (as required)
        - e.g., residuals management cover

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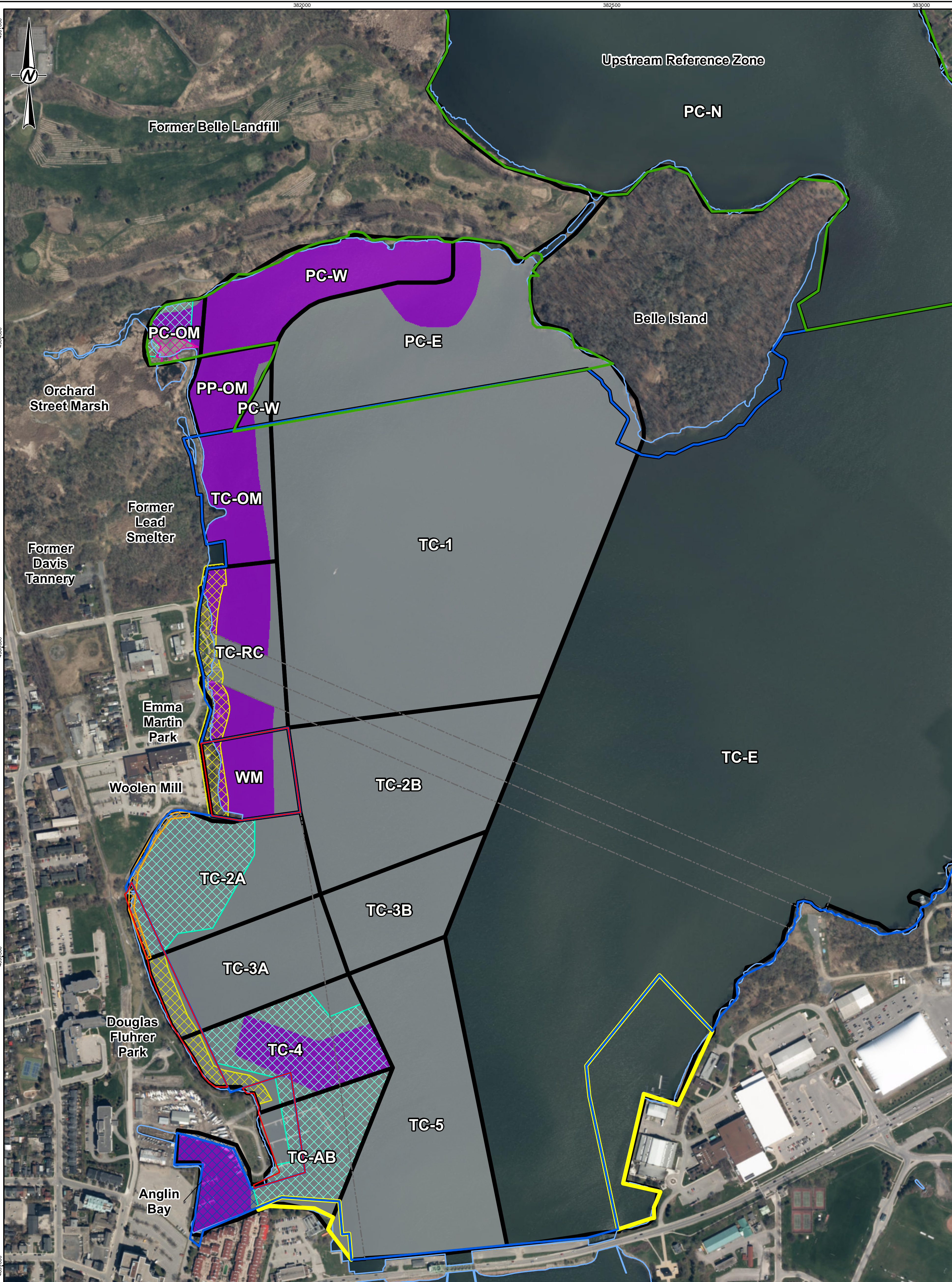

LEGEND

- MANAGEMENT UNIT
- CITY OF KINGSTON JURISDICTION
- PARKS CANADA JURISDICTION
- DEPARTMENT OF NATIONAL DEFENCE JURISDICTION
- TRANSPORT CANADA JURISDICTION
- FEDERAL WATER LOT
- WATERBODY
- WATERCOURSE

MANAGEMENT TECHNIQUE

- CAP (CONVENTIONAL WITH ACTIVATED CARBON)
- THIN CAP WITH ACTIVATED CARBON
- ENGINEERING CONTROL (SHORELINE REVETMENT)
- ENGINEERING CONTROL (BOARDWALK)
- HABITAT MOSAIC (WETLAND REMEDIATION)

INTERVENTION TECHNIQUE

- DREDGED SURFACE SEDIMENT
- MONITORED NATURAL RECOVERY

0 150 300

1:6,000 METERS

REFERENCES

1. IMAGERY COPYRIGHT © 20150414 ESRI AND ITS LICENSORS. SOURCE: CITY OF KINGSTON ONTARIO. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. WATERBODIES AND WATERCIOURSES OBTAINED FROM THE CITY OF KINGSTON ONTARIO.
3. PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PWGSC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SEDIMENT MANAGEMENT PLAN

CONSULTANT
GOLDER

YYYY-MM-DD	2021-03-09
DESIGNED	SS
PREPARED	JP
REVIEWED	SS
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
1783886	7000	0	7

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The project team completed baseline studies from 2020-2023 to gain a better understanding of wildlife presence and habitat use in the Inner Harbour. These studies have been used to facilitate an evaluation of potential effects.

It is expected that the planning stage will be complete by the end of 2024 with the final detailed design. Implementation for the project is planned for 2025 and is expected to take approximately 3 years to complete. A more detailed project schedule will be developed in the detailed design stage and included in the DIA. The current proposed project schedule is included in **Figure 3** below.

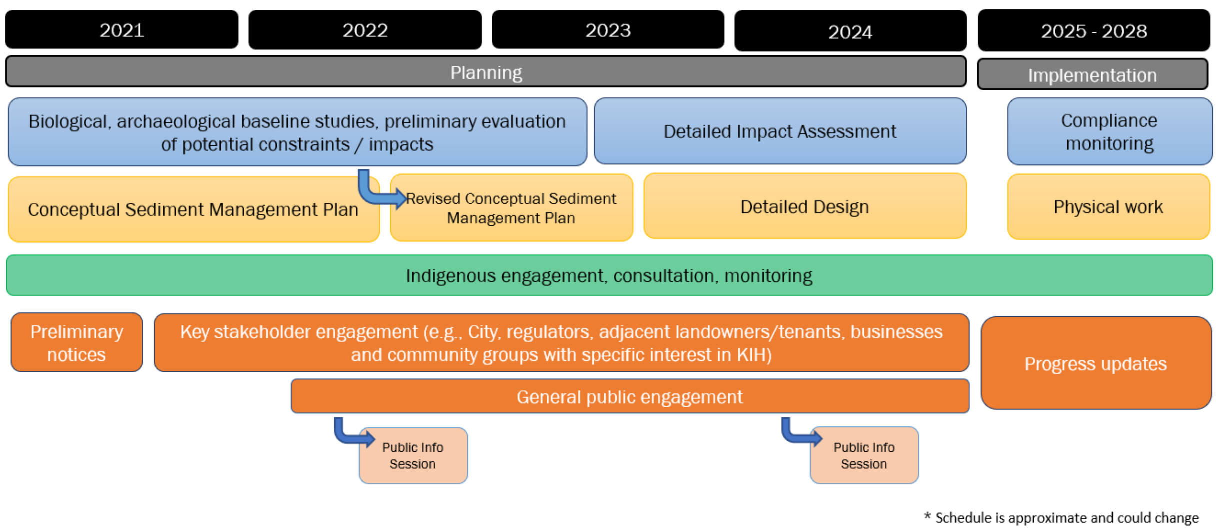


Figure 3: Project Schedule

2.1.3.1 Sediment Management Options

Based on the conceptual SMP (Golder ,2021a), several options for active sediment management are being considered across the water lots, with the potential for multiple options to be applied within each water lot. These options are summarized in general terms below and will be included in the updated SMP currently being prepared by WSP (formerly Golder); as such, they may vary from the sediment management options from the conceptual SMP (Golder, 2021a) presented in **Figure 2** and listed above in **subsection 2.1.3**. The DIA will provide complete descriptions of sediment management options for each water lot.

- Option 1: Dredging Only
  - dredge and leave as excavated without backfilling
- Option 2: Dredging with Cap
  - a thin layer cap (approximately 30 cm) comprised of a sand mixture and/or activated carbon is placed following dredging
- Option 3: Low Intrusion Methods
  - in shallow areas, very thin (3 – 5 cm) placement of an amendment such as pellets or activated carbon
- Option 4: Low Intervention Marsh Restoration
  - a hybrid of monitored natural recovery and wetland remediation
  - using a grid-based method, some areas have low intrusion methods applied and others have contaminated sediments removed, with existing vegetation used for recolonization

2.2 Consideration of Alternatives

The description of alternatives will include details on reasonable, practical, and viable alternatives to the proposed sediment management methods that should be considered and assessed along with the recommended option in the DIA. At this time, based on the current understanding of the project, it is proposed that the alternatives summary will include candidate approaches described under the Conceptual Remedial Options Analysis (Golder, 2017a) and that the preferred alternative be carried from the Recommended Remedial Option for the Kingston Inner Harbour (Golder, 2019). Additionally, the alternatives summary will include options (or refinements of existing candidate options) brought forward from Indigenous engagement and consultation and public engagements.

2.3 Valued Components

The DIA, a framework developed by PCA to ensure compliance with legal regimes for impact assessment, including the IAA, provides the Project Proponents (in this case, TC and PCA) a means to fully consider the potential effects of its decisions on natural and cultural resources prior to approval and implementation of a project so that effects can be avoided, mitigated, and monitored, as required. As part of the initial Scoping Phase of the DIA, Valued Components (VCs) are selected based on scientific evidence and Indigenous knowledge and refined in this case by the management plan for the Rideau Canal and departmental directives and mandates for PCA and TC.

As defined by the Impact Assessment Agency of Canada, VCs are environmental, health, social, economic or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous groups, federal authorities and interested parties. VCs will vary based on the type of project and the location, but all well-defined VCs selected for assessment share several attributes:

- they are representative of the important features of the environment that are affected by the project;
- they are responsive to the effects of the project;
- the project-VC interaction can be described in measurable and monitorable terms so the effect pathway can be clearly understood; and,
- the selected VCs collectively provide a comprehensive overview of the important potential effects of the project.

For the KIH Project, VCs and associated desired outcomes and thresholds were determined in consultation with PSPC, TC, and PCA and were refined as the CCIC was developed to include input received during preliminary consultation and engagement with Indigenous groups and the public. During the selection process, preliminary VCs[3] were evaluated based on peer-reviewed literature, published reports, personal communications, as well as other sources of information. In some cases, broadly defined VCs have subcomponents which aid in structuring the VC assessment. They are categorized in four (4) groupings, listed below:

- Natural Resource Valued Components
  - Aquatic Wildlife and Vegetation[4]

[3] Several of the VCs identified above were evaluated quantitatively or semi-quantitatively in the Ecological Risk Assessment and Risk Synthesis documents (Golder, 2011; Golder, 2016), where they were evaluated as receptors of concern under the Sediment Management Framework (EC and MOE, 2008).

[4] Fish, Molluscs, Amphibians, Benthic Invertebrates, Macrophytes, Algae

- Species at Risk Turtles
    - Species at Risk Birds
    - Species at Risk Bats
    - Terrestrial Vegetation
    - Terrestrial Wildlife[5]
    - Surface Water Quality
    - Lacustrine Processes
    - Sediment Quality
    - Soil and Landform Resources
    - Air Quality
    - Climate Change
- Cultural Resource Valued Components
    - Rideau Canal National Historic Site
    - Rideau Canal UNESCO Outstanding Universal Value
    - Cultural Landscape Features
    - Terrestrial Archaeological Resources
    - Submerged Archaeological Resources
- Indigenous Interests and Rights
- Visitor Experience Valued Components
    - Tourism and Visitor Experience
    - Navigation

The primary purpose of the Description of Valued Components in a DIA document is to provide an overview and introduction to each VC at a variety of scales such as site, local, and landscape scales that are pertinent to the project at hand. The description should provide good reference to the research and evidence backing the description, and assurance to the reviewer or reader that there is sound background information from which to base the assessment process on. The Description of Valued Components is important as the first detailed background information presented in the DIA document. As such, it is important that the information presented is clearly connected and relevant to the project. The Description of Valued Components provides one opportunity wherein a DIA can be adapted to focus and streamline the assessment documentation.

2.3.1 Desired Outcome, Threshold, and Standard of Proof

The potential for the Project to interact with the listed VCs, and the associated level of risk, is currently being determined in this CCIC via preliminary assessment through a variety of means, including:

- Desktop research on the study areas as presented in **subsection 2.5**;
- Discussions with TC and PCA;
- Review of the Project related activities; and
- Professional judgement.

Project interactions with medium- and high-risk[6] VCs will be evaluated based on desired outcomes and associated thresholds held to a standard of proof that must be met to determine if the project-VC interaction will satisfy the desired outcome. Desired outcomes define the measurable conditions related

[5] Birds, Mammals, Reptiles

[6] “What constitutes as high, medium, or low risk depends on the category and type of VC and the circumstances of the interaction. For example, a project-VC interaction with the potential to cause permanent, regional destruction to a natural resource VC would be “high risk” … Project-natural resource VC interactions that are localized, reversible and well understood would be considered “low risk.” (Parks Canada, 2020b).

to Project-VC interactions, while the thresholds define the indicators or measurable conditions used to assess and measure achievement of the desired outcomes. The standard of proof (**Table 1**) dictates the quality of the evidence needed to determine if the desired outcome is achieved and is directly proportional to the nature and magnitude of risk (i.e., as risk increases, so does the necessary standard of proof and the necessary quality and quantity of the associated body of evidence) (Parks Canada, 2020b). Risk can be determined by an understanding of Project-VC interaction outcomes (e.g., well understood or unknown) along with geographic extent and permanence. This CCIC document provides preliminary existing evidence and details the desired outcomes and associated thresholds and standards of proof for each VC (refer to **Section 3**). The preliminary existing evidence information is not considered to be exhaustive as data collection is ongoing and knowledge gaps may be identified. More detailed environmental information will be documented in the DIA including the biological and ecological surveys, Indigenous engagement and consultation, and engagement with the community and stakeholders that will contribute to the scoping, selection, and analysis of VCs.

Table 1: Standard of Proof - Body of Evidence Matrix (Parks Canada, 2020b)

	Standard of Proof		
Body of Evidence	**Low**	**Medium**	**High**
Strength of Evidence	Weak to Medium	Medium to Strong	Strong to Very Strong
Evidence Type	• Precedent/past experience • Expert opinion • Observational studies	• Scientific modelling data – routine and standardized • Quantitative studies from multiple peer-reviewed sources, or Parks Canada grey literature, where the correspondence to project-VC interaction is less precise • Qualitative studies	• Scientific modelling data – specialized to the DIA • Quantitative or studies from multiple peer-reviewed literature sources, or Parks Canada grey literature, with good correspondence to project-VC interaction • Site-specific baseline or follow-up studies adhering to accepted scientific methodologies

2.4 Assessment of Project Impacts

Baseline information and site-specific studies will be used to assess Project interactions with VCs for the proposed Kingston Inner Harbour Sediment Management Project. For this CCIC, baseline information sources and site-specific studies are detailed for each VC in **Section 3**. The CCIC will provide a preliminary assessment of whether the desired outcomes for each VC are met based on the threshold of scientific evidence (standard of proof) and available mitigations; predict impacts; provide preliminary constraints for the SMP design; and identify any additional data gaps.

Once detailed design of the Project is underway, incorporating recommendations from the CCIC, the DIA will determine whether any Project changes to VCs will meet the desired outcomes, taking into consideration the positive influences of mitigations. The DIA will describe the methodology used to identify project interactions with VCs, identify potential effects, select measurable parameters, compile baseline information, predict potential adverse effects, prescribe appropriate mitigation measures, and analyze the significance of residual and cumulative environmental effects. Effects on VCs will be quantified where feasible.

For each VC, the DIA will provide a brief description of methodology used in:

- Background data collection on natural and socioeconomic features and conditions. Data are expected to be collected from the following sources:
  - local government agencies;
  - field investigations;
  - input from the local community and Indigenous groups;
  - published sources (e.g., Ontario Ministry of Natural Resources and Forestry [MNRF], Natural Heritage Information Centre [NHIC], eBird, iNaturalist); and
  - existing documentation provided by PCA and other stakeholders.
- Identification of the effects that are likely to occur on the VCs as a result of implementing the Project based on information obtained on the existing conditions;
- Mitigation measure selection; and
- Analysis of residual and cumulative environmental effects significance.

A detailed description of the existing environment/conditions for each VC in the DIA will allow for an understanding of how the Project may result in positive or negative impacts (refer to **subsection 2.3**). The DIA will assess the impacts of the different proposed sediment management methods (refer to **subsection 2.1.3.1**) for each management unit. The DIA will identify and quantify any predicted interactions between the Project phases (e.g., Site preparation, sediment management activities and post-construction monitoring) and VCs to identify environmental effects. Adverse environmental effects are defined by the IAA as a negative change to the environment or to health, social or economic conditions. Additionally, in the context of PCA's mandate, an adverse environmental effect is a change to natural or cultural resources that impairs the value (Parks Canada, 2020b). The assessment process also requires consideration of potential indirect effects of a proposed project; specifically, how the effects of a proposed project on natural resources may in turn cause:

- Adverse effects on characteristics of the environment important to key visitor experience (how the proposal is anticipated to affect activities and/or visitors' enjoyment and connection to place, in relation to defined objectives for the protected heritage place);
- Adverse effects on health and socio-economic conditions of Indigenous groups and non-Indigenous peoples; and
- Adverse effects on current use of lands and resources by Indigenous groups for traditional purposes.

Following this, the DIA will include a consolidated list of mitigation measures to avoid or lessen adverse environmental effects for each phase of the Project and can be applied to the preparation of Contractor documents and plans (refer to **subsection 2.11**). Residual and cumulative environmental effects after application of mitigation measures are then analysed in the DIA for significance based on the types of evidence, desired outcomes and thresholds established for each Project-VC interaction (refer to **subsections 2.12** and **2.13**). Monitoring and follow-up requirements will also be identified in the DIA (refer to **subsection 2.14**).

2.5 Area of Assessment

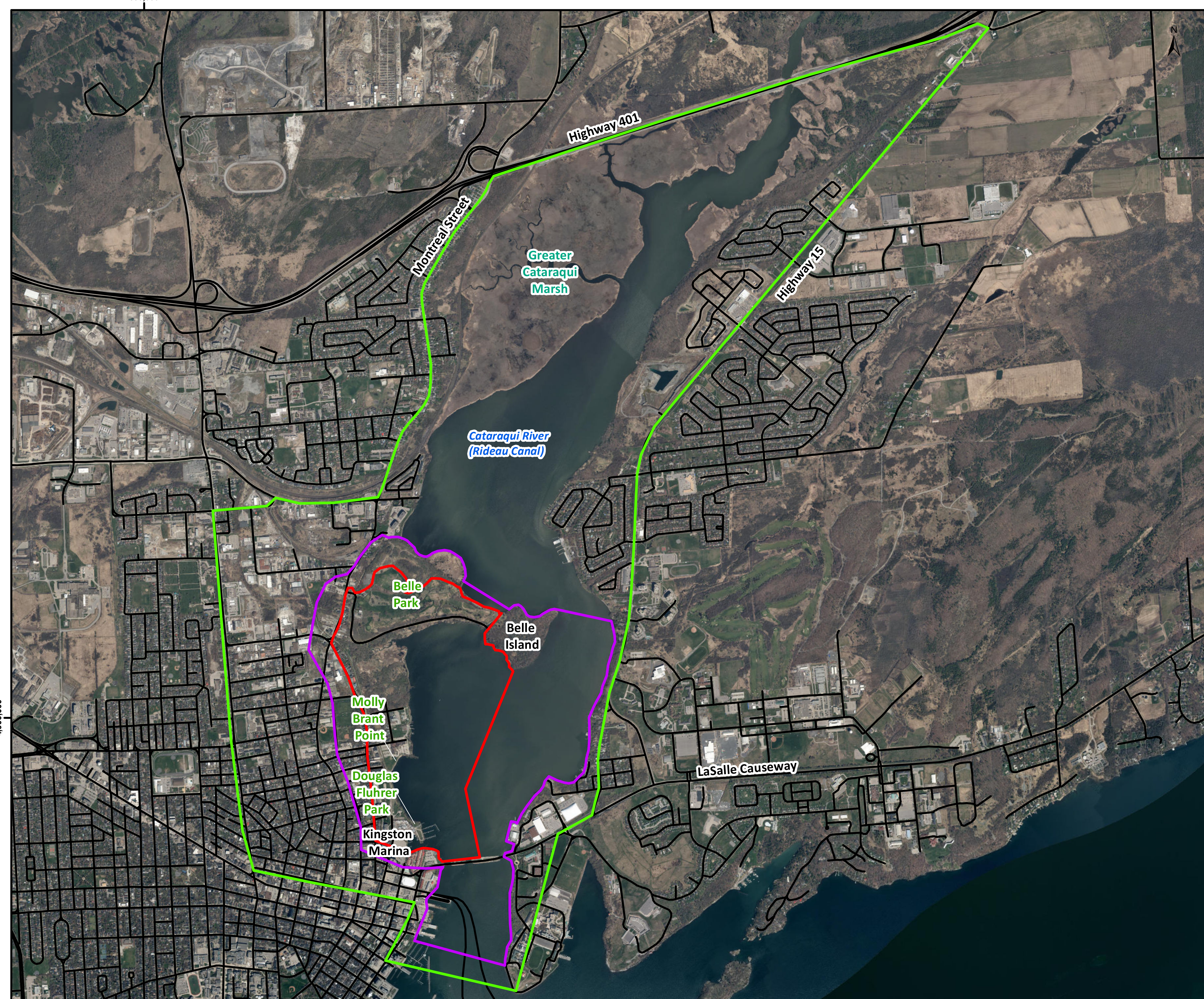
For this report and the DIA, three Project-specific terms regarding spatial boundaries are defined below and depicted in **Figure 4**:

- **Project Site:** The Project Site was established to identify areas of direct disturbance and represents the physical area required for Project activities to be carried out. It includes water lots belonging to TC, PCA, and City of Kingston and associated shoreline along the western Inner Harbour where in-water work and shoreline stabilization will take place, as well as laydown areas, dewatering areas, and temporary access roads. As specific terrestrial sites have yet to be determined, the Project Site currently represents a broad area and will be refined for the DIA. Individual management units as defined by the SMP are included in the Project Site.

- **Project Impact Area:** The Project Impact Area was established to assess the potential, largely direct, and immediate indirect effects of the Project on the local environment and is the focus of the assessment of potential environmental effects (**Section 3**) of this report. The Project Impact Area includes not only in-water activities, but also staging, mobilization, and dewatering or waste handling areas. The Project Impact Area extends along the northern edge of Belle Park and Belle Island south to the confluence of the Cataraqui and St. Lawrence Rivers, as well as to the eastern edge of the Inner Harbour and west to Montreal Street.

- **Project Study Area:** The Project Study Area includes both the Project Impact Area and Project Site. It extends north from the confluence of the Cataraqui and St. Lawrence Rivers to Highway 401, and east from Division Street and Montreal Street to Highway 15. The Project Study Area was established to assess the potential, largely indirect and cumulative effects of the Project in a broader context. It includes the continuous Greater Cataraqui Marsh which is a significant ecological feature throughout the area of assessment.

380,000



4,900,000

380,000

4,900,000

Legend

- Project Study Area
- Project Site
- Project Impact Area
- Transportation Corridors

Kingston Inner Harbour

Area of Assessment

Figure Number:		REV
4		PA
Client: Public Services and Procurement Canada (PSPC)	Project Number: 688479	Date: 2022-02-24

DSC	DRN	CHK	APP
	AD	AF	AF

DRAFT

0 0.15 0.3 0.6 Km

SCALE:1:27,000

Public Services and Procurement Canada

NOTES

1. Coordinate System: NAD 1983 UTM Zone 18N.
2. Cadastral boundaries are for informational purposes only and should not be considered suitable for legal, engineering, or surveying purposes.
3. Datasets obtained from CanVec v12.0 dataset, Natural Resources Canada Earth and Sciences Sector Centre for Topographic Information; Land Information Ontario (LIO) Warehouse Open Data (https://geohub.lio.gov.on.ca/), Ontario Ministry of Natural Resources and Forestry (OMNRF); and Region of Durham Open Data (https://opendata.durham.ca/) Download Date : 2021-02-04

DISCLAIMER

SIZE: 11 X 17 Service Layer Credits: Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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2.6 Indigenous Engagement and Consultation

Indigenous groups with a potential interest in the Project have been identified by TC and PCA. A total of twelve (12) groups have been contacted by TC and PCA:

- Beausoleil First Nation
- The Chippewas of Rama First Nation
- Chippewas of Georgina First Nation
- Mississaugas of Scugog Island First Nation
- Curve Lake First Nation
- Michisaagiig of Hiawatha First Nation
- Alderville First Nation
- Mohawks of the Bay of Quinte
- Mohawk Council of Akwesasne
- Algonquins of Ontario
- Métis Nation of Ontario
- Huron-Wendat Nation

Engagement is also underway with the Mohawk Nation Council of Chiefs.

In partnership, TC and PCA are leading the Indigenous engagement and consultation component of the project. Indigenous consultation requirements of different agencies may also change depending on permit requirements and proposed activities, such as if a DFO *Fisheries Act* Authorization is required. TC and PCA will communicate and produce materials (e.g., Record of Consultation) derived from the process to the consultant (via PSPC) to populate relevant sections of the DIA.

The DIA will incorporate information from the engagement and consultation process into the body of the DIA and will also include a concise summary of the process detailing all Indigenous engagement and consultation that was completed in relation to the proposed project including issues and concerns raised by Indigenous groups, Proponent's responses, and resolutions. It will also include a description of how Indigenous engagement and consultation influenced parts of the DIA including the VCs considered, project alternatives, mitigation or monitoring approaches.

Federal impact assessments are required to include consideration of Indigenous knowledge in impact assessments. The DIA will also discuss how Indigenous knowledge, which may arise as part of the engagement and consultation process, was incorporated into DIA components including scoping of VC's, baseline conditions, desired outcomes and evidence requirements.

2.7 Public Engagement

TC and PCA are responsible and have direct decision-making responsibility regarding the scope of stakeholder and public engagement. PSPC and consultants will provide support to this process.

The plan for the public engagement process is detailed in a document titled Stakeholder Engagement Plan for the Kingston Inner Harbour which was prepared by Golder in 2021. The plan details the purpose of the Public Engagement process, namely presenting the preferred conceptual remedial design to stakeholders to understand concerns from stakeholders in the Project vicinity. The DIA will include a section detailing the outcome of this public engagement process, including how comments and information brought forward were considered in the SMP, detailed design process and DIA and what changes were made as a result.

The goal of the current engagement plan is to obtain feedback regarding the conceptual sediment management plan. Feedback received will be considered in the design and implementation stages of the Project. Engagement activities that will be employed for this process include:

- a series of targeted stakeholder sessions;
- project website;
- virtual information session;
- a public open house; and
- a public comment period whereby stakeholders can submit input via various methods.

All comments obtained from the public will be reviewed and summarized in the "Public Engagement" section of the DIA report. The DIA will organize this section as outlined in the Detailed Impact Assessment Handbook – Part 3 (Parks Canada 2020b), consisting of a concise summary of the engagement process and a description of how the public engagement changed or influenced the DIA.

While Indigenous groups and organizations may have interest and will be welcomed to participate in public engagement activities, the Project Team will be undertaking separate planning for activities to satisfy the duty to engage and consult Indigenous Peoples as detailed in **subsection 2.6**.

2.8 Temporal and Spatial Boundaries

For each VC, the DIA shall describe the timeframe and project phase (temporal scope) when potential effects are likely to occur, as well as the areas where potential effects are expected to occur (spatial/geographic scope). The geographic scope will also identify the extent of the area that cumulative effects could result in as it may be of value to expand the geographic area based on the nature of any known or potential cumulative effects stressors that could apply to a VC.

Spatially, each VC may be affected differently relating to several factors, such as the physical project footprint, proximity to machinery, and/or flow of water, etc. – these should be taken into consideration when defining the spatial boundaries for each VC. Descriptions of temporal and spatial boundaries should include any relevant information from existing assessments (e.g., cultural or natural heritage assessments, identified setbacks.) conducted in the Project Study Area.

2.9 Accidents and Malfunctions

The DIA will describe accidents and malfunctions that have a reasonable probability of occurring during each phase of the Project. The DIA will include the methodology used for assessing the potential risk of an occurrence, specifically the likelihood and consequences. The impact of each potential type of accident or malfunction on specific VCs (physical, biological, and socio-economic), will be discussed. The DIA will include proposed mitigation measures to reduce both the likelihood of an event occurring, and to mitigate the consequences of an event occurring. Residual impacts, which are impacts remaining after mitigation, will be examined and the significance of each residual impact on VCs will be described (refer to **subsection 2.12**).

2.10 Effects of the Environment on the Project

Environmental conditions have the potential to cause work interruptions and/or damage to Project infrastructure. The DIA will assess the effects of geological, climatic and other natural phenomena on the Project, including effects associated with wildfire, drought, flooding, extreme rainfall and any associated geophysical effects (e.g., increased surface flow, erosion potential, changes to bank stability, abnormally elevated/depressed groundwater levels). This will also include consideration for environmental conditions exacerbated or caused by climate change. The DIA will consider the range of potential environmental conditions that can cause potential effects to the Project, emphasis will be placed on environmental conditions that are reasonably plausible but not limited to events that occur on a regular basis.

Federal contaminated sites in Canada are managed in a scientifically sound and nationally-consistent manner through the FSCAP Decision-Making Framework (DMF), which is a 10-step roadmap that outlines specific activities, requirements and key decisions to effectively address contaminated sites (ECCC, 2022). Using the DMF, considerations for climate change are incorporated throughout the 10-step process, including climate change adaptation measures in assessment, remediation/risk management and long-term monitoring activities (ECCC, 2022). The DIA will conduct a climate change risk assessment and consider the impacts of potential climate change hazards on the proposed SMP using this framework. Potential risks or impacts of climate change will also be incorporated into the detailed design process.

2.11 Mitigation Measures

Mitigation measures identified as technically and economically feasible will be developed and described in the DIA to avoid or minimize any identified adverse effects due to implementation and operation of the Project. Recommended measures for mitigating effects on VCs will be based on Best Management Practices as well as recommendations from the Federal Review Team (TC and PCA), DFO, MECP and other organization consultation. The impact analysis will detail how impacts will be avoided or mitigated through project measures including: components of the project design, timing of activities, location of activities, and management.

Recommended mitigation measures will follow a mitigation hierarchy, with primary mitigation methods aimed at avoiding potential negative impacts and secondary mitigation measures aimed at reducing unavoidable residual impacts. Residual impacts are the differences between the desired outcomes and the potential impacts that remain after mitigation measures are applied.

This section will include a consolidated list of mitigation measures to be referenced for integration into the Project tender package and design specifications.

A preliminary review of mitigation measures for select Project-VC interaction scenarios is presented in tables throughout **Section 3**.

2.12 Residual Effects Analysis

The DIA document will include a residual effects analysis that will consider residual impacts on VCs that are likely to occur after mitigation measures have been applied. The analysis will look to determine if the residual effect is positive or adverse, its likelihood to occur, and its significance on each VC. Based on the Parks Canada Directive on Impact Assessment 2019 (Parks Canada, 2019), which includes a comprehensive interpretation of the term “environmental effect”, the residual effects analysis will incorporate the Natural Resources, Cultural Resources, World Heritage Sites, Indigenous Interests and Rights, and Visitor Experience VCs listed in **subsection 2.3** and detailed in **Section 3**, as well as health and socio-economic conditions of Indigenous groups and non-Indigenous peoples.

The residual effects analysis will consider the magnitude, extent, frequency, reversibility, and duration of any residual effects in relation to the VCs. The criteria used to evaluate the residual effects of a Project-VC interaction will relate explicitly to the types of evidence, desired outcomes and thresholds detailed in earlier sections of the DIA. Conclusions drawn from this analysis on the environmental significance of residual effects on VCs will explicitly acknowledge any uncertainties in terms of information gaps or confidence in mitigation measures, and any recommend follow-up monitoring or actions.

2.13 Cumulative Effects Assessment

Within the DIA, cumulative effects will be incorporated into the assessment process through the careful selection of VCs and desired outcomes. The DIA Report will consider any cumulative environmental effects, including any beneficial or positive effects to VCs, that are likely to result from the proposed Project in combination with other projects or activities that have been, or will be, carried out in the Project Study Area. The draft DIA will list all past, present and near-future projects (e.g., projects that have already been proposed or approved) that are part of the cumulative effects assessment, including the Kingston Third Crossing, City of Kingston Waterfront Master Plan, and proposed development of the former Davis Tannery lands. Exact geographic and temporal boundaries will be established for the cumulative effects assessment using VC centered boundaries and using an adaptive approach.

The sources of effects on VCs will be identified and the relative contribution of the proposed Project will be assessed. Consideration will be given to the length of time the environmental effects will occur, as well as other stressors affecting VCs (e.g., climate change, effects of shoreline development). Mitigation measures, both Project-specific and on a regional scale, that diminish cumulative effects will be identified.

2.14 Monitoring and Follow-up

The DIA will detail how residual impacts and mitigation effectiveness will be monitored for the project to inform any future work that may be required. Baseline biological and ecological surveys conducted between 2020 and 2023 were designed such that, in most cases, the same protocols and survey locations can be utilized for post-management monitoring and data collection, allowing for comparisons with data collected pre-remediation (unless otherwise noted throughout **Section 3** as Additional Works Required). Additional data collection to establish baselines for monitoring may also be recommended in the DIA to be completed prior to Project commencement. While detailed methodologies are not required, timing, scope, and objectives of any follow-up or monitoring program should be identified. Additionally, plans and procedures for quality control and quality assurance should be described (e.g., Environmental Protection Plan, emergency plans). Preliminary recommendations and anticipated requirements for Environmental Protection and Management Plans, Monitoring, and Follow-up are summarized in tables for each VC in **Section 3**.

3 Existing Evidence and Potential Environmental Effects

The following subsections detail the selected VCs, the justification for their inclusion and the thresholds that will be used within the CCIC to guide the detailed SMP and for impact analysis in the DIA. The thresholds are provided to meet the requirements of the DIA and should not be interpreted as authorization of the undertaking in accordance with any other federal, provincial, or municipal legislation. The thresholds are intended to minimize or eliminate adverse environmental effects to meet the desired outcomes for each VC and do not relieve the proponent from compliance with applicable legislation.

Scenarios describing potential project interactions with VCs were developed based on the Conceptual Sediment Management Plan (Golder, 2021a). Each scenario and associated desired outcome, threshold, and standard of proof were evaluated using preliminary evidence on existing environmental conditions (detailed for each VC below) and proven mitigation measures to determine whether design considerations to reduce risk can be incorporated into the SMP. Each scenario was also evaluated to determine remaining data gaps to meet each threshold and achieve the desired outcomes. These are provided within each VC section below as tables. The design considerations are options that may be incorporated into the SMP as components of Project design - mitigation measures, typically short-term measures which do not influence design, will be developed in the DIA. These design considerations and constraints will also be provided to the consultant as part of the detailed design. This process is meant to be preliminary to identify constraints that may be addressed early in the conceptual planning stage and identify gaps in information that need to be resolved moving forward into the detailed design stage. Remaining data gaps and risks will also be addressed during the DIA process, along with the development of monitoring plans and follow-up.

3.1 Human Health

Human health was considered as part of the risk assessment refinement and synthesis conducted by Golder (2016) via the following exposure pathways: incidental ingestion and dermal contact with sediment; incidental ingestion and dermal contact with surface water; and fish ingestion. Along with risks to the environment, risks to human health became the drivers for the proposed solutions in the SMP and are detailed in ESG-RMC (2014), Golder (2016) and Golder (2021a). Therefore, the DIA will focus solely on short-term potential impacts to human health as a result of SMP activities during the implementation or construction phase. As the exposure pathways described above are derived from different VCs (e.g., Water Quality, Sediment Quality, Air Quality), human health has not been selected as an individual VC. Instead, these short-term risks will be addressed in each VC. In particular, VC's such as Sediment Quality and Water Quality provide for the additional development of construction related environmental performance objectives to mitigate impacts to human health and the environment during SMP implementation. Long term impacts to human health and the environment and reassessment of the residual risks post SMP implement will be determined through long-term monitoring of the KIH. Further details can be found in individual VC sections below (e.g., **subsection 3.2.7**, **subsection 3.2.9**, and **subsection 3.2.11**).

3.2 Natural Resource Valued Components

The following subsections summarize the existing conditions of Natural Environment VCs within the Project Study Area, including background information and field surveys conducted (where applicable), followed by the thresholds at which each VC will be measured during the DIA. Site specific biological/ecological information to support these VCs were collected from FY 2020-2023 by SNC-Lavalin (SNC-Lavalin, 2023). While these studies focused on the Project Study Area, certain secondary source data, such as faunal atlases and provincial or federal environmental monitoring stations, were used to cover a greater extent of area or provide assessment on a regional scale.

3.2.1 Aquatic Wildlife and Vegetation

3.2.1.1 Fish and Fish Habitat

KIH is classified as warmwater habitat that supports a variety of warmwater fishes with cool or cold -water species that use the Cataraqui River as a migration corridor (Bowfin, 2011). The KIH Project Site has significant overlap with the aquatic study area for Kingston Third Crossing (K3C), which also underwent the DIA process and required environmental surveys over the last decade. As such, data and results obtained from K3C can be applied to the KIH. Detailed fish community sampling and habitat characterization in the Cataraqui River south of Highway 401 was carried out for the K3C, which included: species confirmed or likely to migrate through the K3C study area; potential for mussels to occur in the K3C study area; and detailed mapping for fish spawning habitat in the K3C study area (Hatch, 2019a). MNRF and PCA provided further information on fish assemblage in KIH. Species occurrence data from these sources have been summarized in **Table 2** to assist in determining fish species likely present in the Project Study Area, including spawning habitat.

Notably, two (2) species in **Table 2** are identified as Endangered provincially: American Eel (*Anguilla rostrata*) and Lake Sturgeon *(Acipenser fulvescens*). Both of these species are under consideration for listing under Schedule 1 of SARA as they have each been assessed by COSEWIC as Threatened (for Lake Sturgeon, Great-Lakes Upper St. Lawrence populations). These species are also considered to be important Indigenous harvest species.

Fish habitat within the KIH has been previously identified by Ecological Services as part of the former Davis Tannery property Environmental Impact Assessment. The open water wetland of the Cataraqui River and portions of the northeast Orchard Street Marsh were identified by Ecological Services (2019) as fish habitat; however, details such as habitat characteristics, species detected, and whether the wetlands include spawning, nursery or migratory habitat were not provided.

Detailed fish community sampling was completed by Bowfin Environmental Consulting using an electrofishing boat and seine nets upstream of the KIH Study Area within the K3C study area (Bowfin, 2011). Fish species that were captured tend to prefer slow-moving water, and the majority of fish captured spawn within aquatic vegetation or algae (Bowfin, 2011). [redacted] Bowfin (2011) determined that Lake Chubsucker (*Erimyzon sucetta*) and Channel Darter (*Percina copelandi*) were unlikely to be found within the K3C study area due to lack of suitable habitat characteristics. The fish habitat within the Cataraqui River is not suitable for Lake Sturgeon, and they were not captured during K3C fish community surveys in 2010 (Bowfin, 2011); [redacted] Although the habitat is suitable for Spotted Gar (*Lepisoteus oculatus*), they were also not captured during K3C fish community surveys in 2010 (Bowfin, 2011). As such, Lake Sturgeon and Spotted Gar are unlikely to be found within the KIH Project Study Area. [redacted]; however, none were captured during the K3C 2010 field sampling program (Bowfin, 2011).

Some detail on spawning habitat was included within K3C documents that can be applied to the assessment of proposed sediment management activities in the KIH; however, this mapping was not considered specific enough for the purposes of the proposed sediment management activities and the research conducted was also not specifically targeted to the present KIH Project Impact Area. The Cataraqui River is known to provide spawning habitat for Yellow Perch (*Perca flavescens*), Northern Pike (*Esox lucius*), Muskellunge (*Esox masquinongy*), Pumpkinseed (*Lepomis gibbosus*), Black Crappie, Longnose Gar (*Lepisosteus osseus*), and Largemouth Bass (*Micropterus salmoides*) (Bowfin, 2011). During K3C fish habitat surveys, Yellow Perch were observed spawning in the mid-channel sites (Bowfin, 2011). Young-of-year Pumpkinseed, Bluegill (*Lepomis macrochirus*), Largemouth Bass, Rock Bass (*Ambloplites rupestris*), and Brown Bullhead (*Ameiurus nebulosus*) were sampled during 2010 fish community surveys suggesting that these fish spawn in the K3C study area (Bowfin, 2011). Spawning habitat for Northern Pike has previously been identified in the Area of Natural and Scientific Interest (ANSI) report for the Cataraqui River Marsh (MNR, 2004). [redacted] High quality spawning habitat for Largemouth Bass, Longnose Gar, and forage fish species is located off the southern shoreline of Belle Park, along the western shoreline by Douglas Fluhrer Park and towards the middle of the harbour off Molly Brant Point (Hatch, 2019a).

Table 2: Fish Species Potentially Present in Kingston Inner Harbour

Common Name	Scientific Name	Potential Habitat	Provincial S-Rank[1]	SARA Status	Source[2]
Alewife	*Alosa pseudoharengus*	General	SNA	No Status	1, 3, 4, 7
American Eel	*Anguilla rostrata*	Migratory	S1S2	No Status	1, 7
Banded Killifish	*Fundulus diaphanus*	General	S5	No Status	1, 4, 7
Black Crappie	*Pomoxis nigromaculatus*	Migratory, Spawning	S4	No Status	1, 2, 4, 7
Blackchin Shiner	*Notropis heterodon*	General	S4	No Status	1, 4, 7
Blacknose Shiner	*Notropis heterolepis*	General	S5	No Status	1, 4, 7
Bluegill	*Lepomis macrochirus*	Spawning, Nursery	S5	No Status	1, 2, 4, 7
Bluntnose Minnow	*Pimephales notatus*	General	S5	No Status	1, 4, 7
Bowfin	*Amia calva*	General	S4	No Status	1, 2, 4, 7
Brook Silverside	*Labidesthes sicculus*	General	S4	No Status	1, 4, 7
Brown Bullhead	*Ameiurus nebulosus*	Spawning, Nursery	S5	No Status	1, 2, 4, 7
Brown Trout	*Salmo trutta*	General	SNA	No Status	3, 7
Central Mudminnow	*Umbra limi*	General	S5	No Status	1, 4, 6, 7
Chinook Salmon	*Oncorhynchus tshawytscha*	Migratory	SNA	No Status	2, 3, 7
Coho Salmon	*Onocorhynchus kisutch*	Migratory	SNA	No Status	3, 7
Common Carp	*Cyprinus carpio*	General	SNA	No Status	1, 2, 4, 7
Eastern Silvery Minnow	*Hybognathis regius*	General	S2	No Status	1, 4

Common Name	Scientific Name	Potential Habitat	Provincial S-Rank[1]	SARA Status	Source[2]
Gizzard Shad	*Doro soma cepedianum*	General	S4	No Status	1, 4, 7
Golden Shiner	*Notemigonus crysoleucas*	General	S5	No Status	1, 4, 6, 7
Johnny Darter	*Etheostoma nigrum*	General	S5	No Status	1, 4, 7
Lake Sturgeon	*Acipenser fulvescens*	General	S2	No Status	5, 7
Largemouth Bass	*Micropterus salmoides*	Spawning, Nursery	S5	No Status	1, 2, 4, 7
Logperch	*Percina caprodes*	General	S5	No Status	1, 7
Longnose Gar	*Lepisosteus osseus*	Spawning	S4	No Status	1, 3, 4, 7
Northern Pike	*Esox lucius*	Spawning	S5	No Status	1, 2, 4, 7
Pumpkinseed	*Lepomis gibbosus*	Migratory, Spawning, Nursery	S5	No Status	1, 2, 4, 6, 7
Rock Bass	*Ambloplites rupestris*	Spawning, Nursery	S5	No Status	1, 2, 4, 7
Round Goby	*Neogobius melanostomus*	General	SNA	No Status	1, 3, 4
Sand Shiner	*Notropis stramineus*	General	S4	No Status	1, 7
Smallmouth Bass	*Micropterus dolomieu*	General	S5	No Status	1, 2, 7
Walleye	*Sander vitreus*	General	S5	No Status	3, 7
White Sucker	*Catostomus commersoni*	General	S5	No Status	1, 2, 3, 4, 7
Yellow Bullhead	*Ameirus natalis*	General	S4	No Status	1, 2, 4, 7
Yellow Perch	*Perca flavescens*	Migratory, Spawning, Nursery	S5	No Status	1, 2, 4, 6, 7

[1] Provincial S-Rank (NHIC): S1 – Critically Imperiled; S2 – Imperiled; S3 – Vulnerable; S4 – Common and Apparently Secure; S5 – Secure; SNA – Not Applicable, not suitable target for conservation activities.

[2] Source:

1. MNRF data provided by PCA;
2. MNRF Fish ON-Line (MNRF, 2021);
3. Basic Impact Analysis for Kingston Mills Fixed Bridge Replacement and Swing Bridge Rehabilitation (PCA, 2016);
4. City of Kingston Environmental Assessment for the Third Crossing of the Cataraqui River: Fisheries Results and Impact Analysis (Bowfin, 2011);
5. NHIC Historic Records;
6. Davis Tannery Environmental Impact Assessment (Ecological Services, 2019).
7. DFO HEAT

The fish habitat within the KIH Project Impact Area consists of a slow-moving glide with water levels dictated by Lake Ontario. As reported in K3C studies, the substrate consists of fine sediments with dense submergent vegetation (Bowfin, 2011). Shoreline aquatic vegetation included dense floating and submergent vegetation with some emergent cattails. Offshore, dense submergent vegetation was present in the KIH Project Impact Area during K3C studies (Bowfin, 2011). The benthic community south of Belle Island is relatively low and dominated by pollution tolerant tubifex worm taxa (Hatch, 2019a).

SNC-Lavalin (2023) conducted surveys to characterize fish habitat in the Project Site in 2021 following methods described in Aquatic Habitat Inventory Surveys (Ministry of Natural Resources, 1987) using transects to characterize shoreline, nearshore, and mid-channel habitat. Observational Bass spawning surveys were also conducted in June 2021. Within 50 m of the shoreline, abundant high quality spawning habitat was confirmed for Largemouth Bass, Longnose Gar, and forage fish species, with bass and sunfish nests directly observed in many locations, typically in depths between 0.4 and 0.8 m. Much of the aquatic study area was assessed as possessing high quality habitat for these species, as well as Orchard Street Marsh where high-quality spawning habitat for *Esox* sp. (Northern Pike, Muskellunge) was evaluated. Eight (8) Longnose Gar were noted near the middle of the southwestern shoreline of Belle Island out to approximately 20 metres from shore. High density nesting areas for sunfish and bass were identified along the shoreline by the former Davis Tannery, the Woolen Mill, and south of Molly Brant Point to Douglas Fluhrer Park.

Further from shore, areas were assessed by SNC-Lavalin (2023) as being potential bass spawning habitat. Although it is unlikely for any of the above-mentioned species to spawn in water deeper than 1.2 m, Smallmouth Bass are known to build nests within 0.61 m to 6.1 m water depths within sandy, gravel, or rocky bottoms of lakes or rivers (Scott and Crossman, 1998). As such, they may potentially spawn in the deeper (>1.2 m) areas of KIH within dense submergent vegetation. However, given their preference for using rocks and logs for protection that are abundant throughout shallower areas of KIH, it is unlikely for them to use these deeper vegetated habitats for spawning (Scott and Crossman, 1998).

Within the greater Project Study Area, studies conducted by Bowfin (2011) for K3C characterized much of the aquatic habitat north of Belle Park to Highway 401 as potential spawning habitat for Largemouth Bass, Gar, and forage fish species (all areas apart from navigational channels), while approximately 40% of the aquatic habitat in the same area was characterized as high quality spawning habitat for these species (Hatch, 2019a). High quality spawning habitat was also identified along the eastern shoreline of the Cataraqui River opposite the Project Site (Hatch, 2019a). *Esox* sp. high quality spawning habitat was identified as being significantly more abundant north of Belle Park along the middle of the Cataraqui River where emergent wetland vegetation meets open waters (Hatch, 2019a).

In addition to spawning habitat, KIH likely provides overwintering habitat in the deeper reaches for many fish species (SNC-Lavalin, 2023). The margins of the harbour offer limited fish cover by overhanging grasses, shrubs, and trees. In-water cover consists of dense submergent vegetation, emergent vegetation, downed woody debris, logs, scattered boulders, cobble, shipwrecks, and garbage (i.e., shopping carts and tires), along with the boat slips at the Kingston Marina that provide abundant foraging and rearing habitat for fish.

Data collected by SNC-Lavalin, including 32 fish species likely to be present (refer to **Table 2**), aquatic vegetation type and extent, and substrate cover and extent were scaled using the KIH management units (refer to **Figure 2**) and applied to the DFO Habitat Ecosystem Assessment Tool (HEAT). HEAT provides an accounting framework for assessing losses, gains, and modifications to habitat from development, offset, and restoration activities. Within the tool, fish species were automatically grouped by thermal regime (cold, cool and warm) and vegetation preference (high vegetation and low vegetation), as well as life stages: young of year, spawning, and adult. As a result, approximate percent area of current habitat cover for each life stage and habitat variables was calculated for the ten (10) management units in which sediment management is proposed[7] (see **Tables 3**, **4**, and **5**). The DIA should apply the HEAT model to determine potential habitat losses and gains for young of year habitat, adult habitat, and spawning habitat

[7] The waterlots that compose Orchard Street Marsh (PC-OM and part of PP-OM) have been identified as requiring further studies and individual management plan for less intrusive options. Sediment management of this wetland will likely be deferred and assessed as a separate project under the IA process due to ecological sensitivity and connection to adjacent off-Site property, as well as (private) shoreline development initiatives currently under consideration.

in each management unit based on the proposed sediment management method(s). This information will be used in the DIA to identify high quality habitat to be maintained and/or restored.

Table 3: Percent Area of Young of Year Fish Habitat by Management Unit

Management Unit	Area (m^2)	Cold Water Low Vegetation	Cool Water High Vegetation	Cool Water Low Vegetation	Warm Water High Vegetation	Warm Water Low Vegetation
PC-E	93071	0.0%	25.9%	13.9%	27.2%	0.0%
PC-W	39980	0.0%	26.4%	13.2%	28.6%	0.0%
PP-OM	13520	0.0%	29.2%	10.8%	31.6%	0.0%
TC-OM	22671	0.0%	26.5%	12.8%	28.6%	0.0%
TC-RC	32161	0.6%	26.5%	16.0%	26.7%	4.1%
WM	16123	0.0%	29.9%	14.4%	30.8%	0.0%
TC-2A	50791	0.0%	30.0%	14.6%	30.6%	0.0%
TC-3A	41691	0.0%	30.8%	16.9%	30.4%	0.0%
TC-4	42800	0.0%	31.9%	19.9%	30.0%	0.0%
TC-AB	41907	16.8%	18.6%	25.4%	14.2%	15.5%

Table 4: Percent Area of Spawning Fish Habitat by Management Unit

Management Unit	Area (m^2)	Cold Water Low Vegetation	Cool Water High Vegetation	Cool Water Low Vegetation	Warm Water High Vegetation	Warm Water Low Vegetation
PC-E	93071	0.0%	28.1%	29.7%	27.8%	5.0%
PC-W	39980	0.0%	29.5%	29.6%	28.7%	5.6%
PP-OM	13520	0.0%	31.4%	28.5%	29.9%	0.0%
TC-OM	22671	0.0%	29.5%	29.5%	28.6%	5.0%
TC-RC	32161	0.9%	26.6%	29.2%	25.7%	3.3%
WM	16123	0.0%	31.1%	28.7%	29.7%	1.3%
TC-2A	50791	0.0%	30.8%	28.6%	29.5%	0.7%
TC-3A	41691	0.0%	30.9%	28.7%	29.6%	1.3%
TC-4	42800	0.0%	19.7%	28.7%	25.9%	1.3%
TC-AB	41907	0.0%	2.7%	28.5%	5.3%	0.0%

Table 5: Percent Area of Adult Fish Habitat by Management Unit

Management Unit	Area (m^2)	Cold Water Low Vegetation	Cool Water High Vegetation	Cool Water Low Vegetation	Warm Water High Vegetation	Warm Water Low Vegetation
PC-E	93071	0.0%	28.0%	12.7%	30.1%	8.0%
PC-W	39980	0.0%	28.3%	12.8%	31.0%	7.1%
PP-OM	13520	0.0%	29.2%	12.4%	32.9%	0.0%
TC-OM	22671	0.0%	28.3%	12.7%	31.0%	6.7%
TC-RC	32161	0.0%	27.3%	12.6%	28.0%	5.0%
WM	16123	0.0%	30.0%	12.5%	32.8%	1.3%
TC-2A	50791	0.0%	29.9%	12.5%	32.7%	1.0%
TC-3A	41691	0.0%	30.6%	12.5%	32.9%	1.3%
TC-4	42800	0.0%	31.4%	12.5%	33.0%	1.3%
TC-AB	41907	0.0%	12.0%	12.4%	16.7%	0.0%

The risk assessment (Golder, 2016) found moderate risks to health of bottom fish (e.g., Brown Bullhead) near the shorelines of the north and south end of the KIH due to concentrations of polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in fish habitat in those areas. Additionally, low to moderate health risk in north-central and south-central fish habitats were identified for bottom fish due to the same contaminants at lower concentrations. PAHs are known causal agents for deformities in fish, such as lesions and ulcers, fin and tail erosion, and damaged barbels (Golder, 2016). The objectives of the SMP include reducing or eliminating these risks by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a). Post-implementation of the SMP, total PAH and total PCB sediment concentrations will be reduced to low risk to fish health for all management units (Golder, 2021a).

Fish in the KIH provide recreational opportunities, hold cultural importance, and are an important part of the complex food web that is integral to the functioning of the ecosystem as a whole. The Aquatic Wildlife and Vegetation VC includes Fish and Fish Habitat due to the potential for impacts from the proposed sediment management activities.

3.2.1.1.1 Thresholds

In-water work areas will be isolated by sediment control measures such as turbidity curtains, which can entrap aquatic wildlife. Without mitigation and/or specific Project design considerations, in-water works, particularly dredging, that occur in habitat occupied by aquatic wildlife are likely to result in accidental capture of fish during sediment management activities. Mitigative techniques to safely remove and exclude fish from in-water work areas are anticipated to minimize accidental capture. This Project interaction with Fish and Fish Habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is low and would be based upon observations. The standard of proof would be measured by number of mortalities offish encountered during in-water works, with incidental mortality of small fish (< 5 cm) limited to < 3% of individuals encountered, and incidental mortality limited to < 1% of all other individuals encountered.

Fish species with spawning habitat in the KIH spawn during the period between March 15 and June 30[8]. Without mitigation and/or specific Project design considerations, in-water works such as vegetation removal, dredging, capping, and shoreline stabilization in high-quality fish spawning habitat during the spring spawning period between March 15 and June 30 are likely to result in disturbance to spawning fish during sediment management activities. High-quality fish spawning habitat identified in the Project Site is abundant but largely situated within waterlots where sediment management activities are proposed to occur (SNC-Lavalin, 2023), while additional high quality and potential spawning habitat has been identified east and north of the Project Site (Hatch, 2019a). Consecutive staging of in-water works across the management units that contain high-quality fish spawning habitat, along with habitat restoration post-management, is anticipated to minimize this potential impact. This Project interaction with Fish and Fish Habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low and would be based upon observations. The standard of proof would be measured by the minimum area of fish habitat (identified through the HEAT Model and the DIA) per fish group identified remaining undisturbed during the spawning period between March 15 and June 30

Many of the spawning fish species observed during the KIH spawning surveys were in water depths between 0.4 m and 0.8 m. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that alter or remove the biophysical attributes required for fish to carry out their life processes, such as water depth, substrate composition, and aquatic vegetation, are likely to result in loss of fish habitat post-sediment management. Habitat restoration conducted immediately post-management is anticipated to mitigate habitat loss and potentially

[8] Spawning timing window specific to the Rideau Canal, as identified by PCA.

enhance habitat availability in the Project Site. High-quality fish spawning habitat identified in the Project Site is abundant but largely situated within waterlots where sediment management activities are proposed to occur (SNC-Lavalin, 2023), while additional high quality and potential spawning habitat has been identified east and north of the Project Site (Hatch, 2019a). This Project interaction with Fish and Fish Habitat is considered to be low risk based on a preliminary assessment; however, site-specific follow-up studies adhering to accepted scientific methodologies are required to determine if the desired outcome has been achieved (high level of evidence) and as such the standard of proof is high. The standard of proof would be measured by follow-up studies that assess for continued presence of species found pre-SMP implementation (i.e., Largemouth Bass, Longnose Gar, and forage fish species) in restored spawning habitat following accepted scientific methodologies, using the HEAT model to assess spawning habitat losses and gains.

Table 6: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Aquatic Wildlife and Vegetation: Fish and Fish Habitat

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Aquatic Wildlife and Vegetation: Fish and Fish Habitat							
In-water works such as dredging results in accidental capture of fish.	Temporary: during sediment management activities.	Incidental mortality of small fish (< 5 cm) is limited to <3% of encountered individuals during in-water works. All other incidental harm and mortality is limited to < 1% of individuals encountered during in-water works.	Thorough salvage of fish is conducted by a Qualified Professional(s) in isolated in-water work areas 24 to 48 hours prior to in-water work.	Low	Yes 1, 2, 4, 5, 6, 15, 16	Smaller sub-units isolated by turbidity curtain within Management Unit to be dredged to enhance detectability and capture of aquatic wildlife.	Aquatic Resources Management Plan Dredging and Sediment Removal Plan Surface Water Management and Erosion and Sediment Control Plan
In-water works such as wetland vegetation removal, dredging, capping, and shoreline stabilization during the spring spawning period in high quality spawning habitat where spawning has been confirmed during result in disturbance to spawning fish.	Temporary: during sediment management activities.	High quality spawning habitat where spawning has been confirmed remains secure and effective for fish spawning such that, during the spring spawning period, fish spawn undisturbed and overall fish production remains unchanged as a result of sediment management activities.	Minimum area of fish habitat per fish group identified will remain undisturbed (accessible to fish, turbidity within CCME limits, etc.) during spawning period (to be determined through HEAT Model and DIA)	Low	Yes 1, 2, 4, 6, 15, 22	Timing windows to conduct in-water work in confirmed high quality spawning habitat. Maintain areas of high quality spawning habitat with confirmed spawning during spring spawning period while conducting in-water work in other areas. During March 15 to June 30, avoid conducting in-water work concurrently in Management Units with high quality spawning habitat.	Apply DFO HEAT Model to assist in the determination of fish habitat loss, refinement of thresholds and offsetting plan (should *Fisheries Act* Authorization application be required). Examine species richness comparison to DFO Heat model to determine preferred outcome/threshold. Aquatic Resources Management Plan Vegetation Protection Plan Dredging and Sediment Removal Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Surface Water Management and Erosion and Sediment Control Plan
In-water works such as dredging, capping, and shoreline stabilization in fish spawning habitat result in loss of fish habitat.	Long term: post-sediment management	Habitat remains secure and effective for fish habitat for all life stages such that, at a minimum, species found pre-SMP implementation persist post management. (i.e., Largemouth Bass, Longnose Gar, and forage fish species continue to be observed in spawning habitat)	Biophysical attributes of Largemouth Bass, Longnose Gar, and forage fish species spawning habitat as identified during baseline studies (depth, substrate composition and aquatic vegetation) are restored to confirmed spawning habitat areas.	High	Yes 5, 37, 38	Where possible, avoidance of disturbance to confirmed spawning habitat via exclusion zones. Backfilling dredged area with clean substrate of similar composition to surroundings. Stockpiling and replacement of cover habitat components such as boulders and logs.	Apply DFO HEAT Model to assist in the determination of potential fish habitat loss, refinement of thresholds and an offsetting plan (should a *Fisheries Act* Authorization application be required). Examine species richness comparison to DFO HEAT model to determine preferred outcome/threshold. Aquatic Resources Management Plan Vegetation Protection Plan Dredging and Sediment Removal Plan Surface Water Management and Erosion and Sediment Control Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Site Restoration Plan Follow-up monitoring of restored spawning habitat conducted in accordance with Aquatic Habitat Inventory Surveys (Ministry of Natural Resources, 1987) or other accepted scientific methodology.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.1.2 Amphibians

Amphibian Breeding Habitat within the Orchard Street Marsh was assessed by Ecological Services as part of an Environmental Impact Assessment of the former Davis Tannery property (Ecological Services, 2019). The western portion of the wetland was reported to be absent of amphibians following assessments conducted in 2014, 2018 and 2019, while a “limited amount” of amphibian use was detected in the eastern half of the marsh, closer to the river (Ecological Services, 2019). Green Frog (*Lithobates clamitans*) and American Toad (*Anaxyrus americanus*) were recorded during 2019 surveys (Ecological Services, 2019).

Formal Amphibian Breeding Habitat surveys have not been conducted in the Study Area outside of Orchard Street Marsh or as part of prior environmental assessments that took place in the surrounding area. The Ontario Reptile and Amphibian Atlas (Ontario Nature, 2020) was reviewed to determine amphibian species potentially present in the Study Area based on observations made between 1994 and 2019 within the two 10 km by 10 km atlas grid squares that the Study Area is split between. Within this area, twelve (12) species were identified; however, Eastern Red-backed Salamander, which is a terrestrial species, does not rely upon wetland for life processes and has not been included in this section (refer to **subsection 3.2.5.4**). The eleven (11) remaining species are listed in **Table 7**, including one (1) federal SAR, the Western Chorus Frog (*Pseudacris triseriata*) of the Great Lakes/St. Lawrence - Canadian Shield population (Threatened). Nine (9) of these species are listed as candidates for determining Amphibian Breeding Habitat (Wetland) Significant Wildlife Habitat (SWH). Five (5) of the species in **Table 7** were additionally recorded on iNaturalist (2022) in the Project Site between 2019 and 2021: Northern Leopard Frog (*Lithobates pipiens*), American Bullfrog (*Lithobates catesbeianus*), Green Frog, American Toad, and Blue-spotted Salamander (*Ambystoma laterale*).

Table 7: Amphibian Species Potentially Present in Kingston Inner Harbour

Common Name	Scientific Name	Habitat Preferences[1]	Provincial S-Rank[2]
American Bullfrog	*Lithobates catesbeianus*	Inhabit a wide variety of habitats, especially those with abundant floating, emergent, or submerged vegetation such as ponds, swamps, lakes, reservoirs, marshes, brackish ponds, stream margins, and irrigation ditches.	S4
American Toad	*Anaxyrus americanus*	Live on a wide variety of terrestrial landscapes with sufficient moisture, food, and suitable shallow slow- or non-flowing bodies of water for breeding.	S5
Blue-spotted Salamander	*Ambystoma laterale*	Typically occupy burrows in woodlands, and breed in permanent swamps, temporary ponds, marshes, and roadside ditches.	S4
Gray Treefrog	*Hyla versicolor*	Inhabit various wooded and forested habitats, breeding in shallow woodland ponds and marshes, puddles, ponds in forest clearings, swamps, bogs, and many other	S5

Common Name	Scientific Name	Habitat Preferences[1]	Provincial S-Rank[2]
		permanent or temporary waters lacking significant current.	
Green Frog	*Lithobates clamitans*	Found in virtually any body of permanent or semi-permanent water, breeding in shallow slow- or non-flowing water.	S5
Mudpuppy	*Necturus maculosus*	Lakes, rivers, streams, and other large bodies of water, usually hiding under rocks.	S4
Northern Leopard Frog	*Lithobates pipiens*	Live in the vicinity of springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes. Breed in shallow, still, typically permanent water in areas well exposed to sunlight.	S5
Pickerel Frog	*Lithobates palustris*	Occur in various freshwater aquatic and wetland habitats in wooded regions. Breeding sites include standing water of woodland ponds, bog ponds, impoundments, stream pools, sloughs, and flooded ditches.	S4
Red-spotted Newt	*Notopthalamus viridescens viridescens*	Ponds, lakes, swamps, and slow-moving sections of streams. Eggs are attached to aquatic vegetation or submerged leaves. Juveniles are generally found in forests.	S5
Spring Peeper	*Pseudacris crucifer*	Inhabit moist wooded areas near breeding pools, which include small temporary or permanent ponds, marshes, ditches, and swamps.	S5
Western Chorus Frog (Great Lakes/St. Lawrence – Canadian Shield Population) (SARA: Threatened)	*Pseudacris triseriata*	Inhabit damp meadows, marshes, forest edges, bottomland swamps, and temporary ponds. Breeding sites include quiet, shallow, usually temporary water with submerged and low emergent vegetation.	S4

[1] Source: NatureServe (2022)
[2] Provincial S-Rank (NHIC): S4 – Common and Apparently Secure; S5 – Secure

SNC-Lavalin conducted amphibian Call Count Surveys in 2021 following the protocol from the Marsh Monitoring Program for Surveying Amphibians (Bird Studies Canada, 2009). Survey results, combined with spring incidental observations, resulted in three (3) species of amphibians recorded as occurring within the Study Area: Green Frog, Northern Leopard Frog, and American Bullfrog. Green Frog and Northern Leopard Frog were not recorded at high enough population numbers or Call Level Codes for habitat to be considered SWH (MNRF, 2015a). Male Bullfrogs only call during the breeding period, while females do not call. The occurrence of a male call is a strong indicator that breeding is occurring at the call site. Male American Bullfrogs were recorded calling incidentally in June 2021 and in May 2022 in

Orchard Street Marsh, along the Belle Park shoreline, and in the channel between Belle Park and Belle Island, which confirms breeding by this species in the Study Area. American Bullfrog prefers permanent bodies of water with abundant submerged and emergent vegetation (Harding and Mifsud, 2020). The ELC ecosite wetland area identified in proximity to the American Bullfrogs calling were SAM1-7 (Water Milfoil Mixed Shallow Aquatic) and MASM1-1 (Cattail Mineral Shallow Marsh) which cover parts of Orchard Street Marsh and the Belle Park shoreline. Confirmed SWH includes the ELC ecosite wetland area and the shoreline together (MNRF, 2015a). The shoreline of PC-W is expected to be contained within a 10-metre buffer for exclusion from Project activities, starting from the top of bank, which will protect American Bullfrog breeding habitat from disturbance and alteration, while only a small portion of the PC-E nearshore area is proposed for sediment management.

While Amphibian Movement Corridor SWH is not considered for American Bullfrog (MNRF, 2015a), given the widespread use of the waters along the southern Belle Park shoreline (including Orchard Street Marsh), it is likely that American Bullfrogs take advantage of this continuous aquatic habitat for movement to avoid the risk of travelling terrestrially. A channel between Belle Park and Belle Island connects aquatic habitat to the north and south of these features. Temporary (seasonal) pools are sometimes available in the spring and early summer in the eastern extent of Belle Park (within approximately 250 m of Belle Island), depending on snow melt and spring precipitation, and may be used by American Bullfrogs travelling between the northern and southern shorelines. Temporary pools south of the Belle Park Drive trail may also facilitate east/west movement closer to the southern shoreline. While Erosion and Sediment Control measures will be installed in areas along the shoreline as part of the proposed works, it is not expected to impede the movement of American Bullfrogs given the continuous aquatic habitat available, as such a desired outcome and threshold has not been established for the DIA.

Amphibians in the KIH are exposed to contaminants of concern (COC) in the sediments via multiple pathways, such as incidental ingestion of sediments while foraging; dermal contact with sediments; and through bioaccumulation in food items (e.g., fish, macrobenthos) (Golder, 2021a). In amphibian habitat, elevated concentrations of PAHs, PCBs, and chromium were found in management unit PC-OM, which drains into PC-W (Golder, 2016). Health risks to amphibians were challenging to assess in the risk assessment by Golder (2016) as the literature review could not identify reliable amphibian ecotoxicity benchmarks for chromium or PAHs, and available data were not sufficient to conclude that the population density or developmental health of amphibians was not impaired. The objectives of the SMP include reducing or eliminating potential risks to amphibians by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a).

Amphibians in the KIH are an important part of the complex food web that is integral to the functioning of the ecosystem as a whole. The Aquatic Wildlife and Vegetation VC includes Amphibians due to the potential for impacts from the proposed sediment management activities.

3.2.1.2.1 Thresholds

In-water work areas will be isolated by sediment control measures such as turbidity curtains, which can entrap aquatic wildlife. Without mitigation and/or specific Project design considerations, in-water works, particularly dredging, that occur in habitat occupied by aquatic wildlife are likely to result in accidental capture of amphibians during site preparation and sediment management activities. Mitigative techniques to safely remove and exclude amphibians from in-water work areas are anticipated to minimize accidental capture. This Project interaction with Amphibians is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low and would be based upon observations. The standard of proof would be measured by number of mortalities of and injuries to aquatic wildlife.

Table 8: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Aquatic Wildlife and Vegetation: Amphibians

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Aquatic Wildlife and Vegetation: Amphibians							
In-water works such as dredging results in accidental capture of amphibians.	Temporary: during site preparation and sediment management activities	Incidental harm and mortality to amphibians is limited to < 1% of individuals encountered during in-water works.	During the active season only (April 1 – October 31), thorough salvage of, amphibians is conducted by a Qualified Professional(s) in isolated in-water work areas 24 to 48 hours prior to in-water work.	Low	Yes 1, 2, 4, 5, 6, 15, 16	Smaller sub-units isolated by turbidity curtain within Management Unit to be dredged to enhance detectability and capture of aquatic wildlife.	Aquatic Resources Management Plan Dredging and Sediment Removal Plan Surface Water Management and Erosion and Sediment Control Plan

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[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.1.3 Benthic Invertebrates

Benthic invertebrates are an important component of the food web in aquatic ecosystems. The composition of benthic communities can act as an indicator of pollution or contamination; additionally, benthic invertebrates can contain toxins themselves that bioaccumulate in the aquatic food web, posing risks to humans and ecological receptors (ESG-RMC, 2014).

Benthic communities in the KIH have been investigated and analysed in previous studies by Golder (2011, 2012, 2013, 2016) and in a meta-analysis by ESG-RMC (2014). The federal sediment management frameworks consider resident benthic invertebrate communities in terms of how closely their composition matches reference conditions. The general technical approach by Golder followed the sediment quality triad concept, in which concurrent measurements were made of bulk sediment chemistry, laboratory sediment toxicity, and resident benthic macroinvertebrate community structure. These lines of evidence indicated that the quality of surface sediments was variable across KIH, ranging from equivalent to reference at a minority of stations, to significantly different from reference in some areas (Golder 2012). At multiple stations, particularly in the southern portions of KIH where PAHs were observed at elevated concentrations, the indicators of benthic community health indicated an “overall community pattern” of “possibly different from reference” (Golder 2012, 2016). This category included multiple indications of community condition that were 20% less than the mean reference sediment for the following attributes:

- Total abundance (number of individual organisms);
- Richness (number of unique taxa);
- Simpson’s Diversity Index (SDI); and
- Shannon-Wiener Diversity Index (H’).

The above indications of potential alteration were supported by evidence from sediment chemistry and laboratory toxicity. The chronic toxicity tests in the laboratory relied mainly on protocols for 28-day *Hyalella azteca* (freshwater crustacean) and 20-day *Chironomus dilutus* (a midge). These protocols provided consistency and comparability with earlier testing from the KIH and other Great Lakes sites and provided longer term test durations that may be more sensitive and able to discriminate marginal responses. A tiered program of refined toxicity treatments, called Toxicity Identification Evaluation (TIE), was also applied to the subset of samples that exhibited significant toxicity in the standard testing. Overall, the toxicity program confirmed potential for harm to benthic communities, with a concentration-dependent relationship of adverse effect size versus PAH contamination (Golder, 2016).

It has generally been found that the benthic invertebrate community in KIH is composed of oligochaetes, bivalves, and insect larvae (chironomids, caddisflies), and small percentages of gastropods, amphipods, and isopods. These organisms are variable in densities across the site, which may reflect the variations in nutrient-rich, fine-grained organic sediment substrate (ESG-RMC, 2014) and varying degrees of vegetative cover. As benthic communities are inherently variable, responding to chemical factors, substrate type, and habitat conditions, it can be difficult to discern contaminant-based alterations from other stressors and modifiers of community structure. Nevertheless, low abundance and diversity of benthic taxa (relative to reference) was observed at stations in two TC water lots (TC-4 and TC-AB) which are located at the south end of the Study Area (Golder, 2016). Several other TC water lots south of the Woolen Mill had differences in benthic community structure that may be influenced by natural factors such as macrophyte presence, but sediment contamination could not be ruled out as a cause (Golder, 2016). As stated by ESG-RMC (2014): “While ambiguities in benthic community responses are common in aquatic projects, in cases such as the KIH where contaminant bioaccumulation in the aquatic food web poses unacceptable risks to human and ecological receptors, the benthic community responses do not preclude making remedial decisions.” This approach is also consistent with the federal sediment management framework, which relies on benthic community health assessment as a diagnostic tool for overall environmental health associated with sediment contamination.

Generally, benthic invertebrate species tolerant of organic pollution are dominant throughout impacted areas of KIH (ESG-RMC, 2014). Surveys conducted in 2007 and 2008 identified a total of 114 benthic invertebrate taxa in the KIH, largely represented by chironomids (46 species) and Naidid oligochaetes (11), with a range of 13 to 59 species per station (ESG-RMC, 2014). Macroinvertebrates such as caddisflies, amphipods, and gastropods were represented in the samples as well (ESG-RMC, 2014), broadly matching the findings of Golder (2012, 2016). As part of the ESG-RMC (2014) report, multiple univariate analyses were employed to assess taxa richness, diversity, and evenness between KIH test stations in the northern portion of KIH and reference stations. Reference stations were located upstream of Belle Park, north of the Project Site. Both the ESG-RMC (2014) investigations and the Golder (2012, 2016) investigations indicated that in the northern portion of KIH (i.e., Parks Canada water lot south of Belle Island and some Transport Canada areas), benthic communities were similar to reference. This contrasts with measurements of communities in the southern end of KIH, which were lower in density and more dominated by oligochaetes and chironomids. A list of all 114 benthic invertebrate species sampled from KIH sediments, including sample locations, total individuals sampled and relative abundance, was appended to the ESG-RMC (2014) report.

The risk assessment conducted by Golder (2016) evaluated sediment chemistry, toxicity, and benthos alteration lines of evidence for individual management units to determine potential for adverse effects to the KIH benthic invertebrate community. Management units TC-4 and TC-AB were identified as likely having adverse effects on benthic invertebrates due to historical contamination, while management units TC-5, TC-3B, TC-2A, and TC-2B were identified as potentially having adverse effects. The objectives of the SMP include reducing or eliminating adverse effects to benthic invertebrates by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a). Post-implementation of the SMP, average total PAH sediment concentrations will be reduced to low risk to benthic community health for most management units, and negligible risk for the remainder (TC-OM and TC-2A) (Golder, 2021a).

Overall, benthic invertebrates are an important part of the complex food web that is integral to the functioning of the broader ecosystem. This concern applies both to conditions pre- and post-remediation; the data collected to date indicates that some management units within KIH currently have impaired benthic community health but are not highly depauperate. This means that remediation will need to balance the short-term disruption of these communities in areas where dredging and/or covers are proposed versus the longer-term benefits of contaminant removals in these areas. The Aquatic Wildlife and Vegetation VC includes Benthic Invertebrates due to the potential for impacts from the proposed sediment management activities. Given the interdependence of benthic invertebrate communities and the conditions of substrate, vegetative status, nutrients, and adjacent habitat, it is appropriate to view the biological community at the sediment-water interface as a combined biological component, with both positive and negative effects possible from physical intervention. In most sediment dredging programs, the status of the invertebrate community is used as a monitoring tool to confirm the biological recovery of communities post-remediation.

3.2.1.3.1 Thresholds

Shallow benthic habitats (< 20 m depth) such as those in the KIH more frequently experience natural disturbances due to wave, wind, and current, and are typically represented by low-diversity benthic species assemblages capable of re-colonization when faced with frequent disturbance (Dauer, 1984; Clarke and Miller-Way, 1992; Ray and Clarke, 1999). Following disturbance caused by dredging, there are several physical factors that can affect benthic recovery, including: depth of dredging, habitat type (disturbance history), sediment type, and timing of disturbance (Wilber and Clarke, 2007). Benthic invertebrate recolonization of sand substrates and sediment caps are known to take several years (Newell et al. 1998; Qian et al. 2003). In KIH, it is acknowledged that the current state of the benthic invertebrate community is “impaired” due to sediment contamination and other external stressors. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging and capping that alter benthic biophysical habitat attributes are likely to result in loss of benthic invertebrate communities post-sediment management. Habitat restoration conducted immediately post-management is anticipated to mitigate habitat loss and promote recovery of healthy benthic assemblages; however, due to the previously impaired state it is unlikely the benthic communities will be representative of those typically found in Lake Ontario coastal wetlands and may be dissimilar to reference communities upstream due to other physical factors that precede sediment management. This Project interaction with Benthic Invertebrates is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome is achieved is considered to be high and as such the standard of proof is high. The standard of proof would be measured by follow up studies to assess benthic community composition in comparison to suitable reference sites.

Table 9: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Aquatic Wildlife and Vegetation: Benthic Invertebrates

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Aquatic Wildlife and Vegetation: Benthic Invertebrates							
In-water works such as dredging and capping that alter benthic biophysical habitat attributes result in loss of benthic invertebrate communities.	Long term: post-sediment management	At minimum, benthic invertebrate community diversity is restored to an ecologically compatible community to the habitat in which they are found within 3 years.	Following sediment management, no statistically significant decrease ($p > 0.05$) from baseline biodiversity as established in ESG-RMC (2014) using the Shannon-Wiener Diversity Index.	High	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Translocation of nearby "clean" sediments for benthic re-colonization of dredged areas without capping where the lacustrine clay is left exposed. In locations where dredging has progressed to the stiffer native clay that may require longer time for benthic recolonization, recovery could be assisted by application of a 30 cm thick sand layer mixed with 20% organics (wood pellets). In areas previously noted as having high benthic diversity (or no impairment), instead of dredging, employ lower intrusion methods such as very thin placement (1-2 inches) of material such as activated carbon.	Surface Water Management and Erosion and Sediment Control Plan Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up annual benthic diversity monitoring of restored areas conducted in accordance with methodologies used in ESG-RMC (2014).

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3.2.1.4 Mussels

Mussels can be important indicators of habitat quality, particularly regarding pollution, as they are filter feeders and can accumulate toxins as a result. Some mussels are more tolerant of pollution and disturbance, such as the Eastern Elliptio (*Elliptio complanata*), while others are not, and the abundance or lack thereof may demonstrate water quality issues. Mussel habitat varies from deep to shallow waters; silt, sand, gravel, and cobble; and waters with slow to strong currents. Substrates in the KIH are known to vary between firm with fines and cobbles to soft, unconsolidated muck, but typically described as unconsolidated fines (Bowfin, 2011).

Formal mussel surveys have not been conducted as part of prior environmental assessments that took place in KIH and the surrounding area; however, benthic invertebrate surveys were conducted in the KIH by ESG-RMC (2014) in November of 2007 and 2008. During these surveys, three (3) 8.2 L Ponar grabs of surface sediments were retrieved from seven (7) stations south of Belle Island to the Kingston Rowing Club and two (2) reference stations were positioned upstream of Belle Island (ESG-RMC, 2014). Across all stations, the only bivalve sampled was Zebra Mussel (*Dreissena polymorpha*), an invasive species, found at one (1) station in the inner harbour and at one (1) reference station (ESG-RMC, 2014). Bivalves were also documented in all ten benthic community stations sampled by Golder (2012) across the western KIH. The abundances and proportions of bivalves were variable by location, but there was a tendency for the southern KIH stations to have lower abundances of bivalves relative to the reference area, and relative to the central and northern areas of KIH that were investigated by ESG-RMC (2014).

The Canadian Freshwater Mussel Guide was reviewed to determine mussel species potentially present in the Project Study Area (Area 02MA) based on their known ranges. **Table10** lists these species and their habitat preferences. Two (2) federally listed species at risk, the Eastern Pondmussel (*Ligumia nasuta*) (Special Concern) and the Rainbow Mussel (*Villosa iris*) (Special Concern), were initially included in the list of species potentially occurring in KIH; however, the last recorded occurrences for these species are at distances greater than 25 km from KIH and are unlikely to currently be found in the Project Study Area (DFO, 2018; DFO, 2016). One observation of a species not listed in Area 02MA, the Fatmucket (*Lampsilis siliquoidea*), was reported to iNaturalist (2022) in September 2019 and has been included in the **Table 10**. Two non-native invasive mussels known to the area, Zebra Mussel and Quagga (*Dreissena rostriformis*), are discussed in **subsection 3.2.1.6**.

Table 10: Mussel Species Potentially Present in Kingston Inner Harbour

Common Name	Scientific Name	Habitat Preferences[1]	Provincial S-Rank[2]
Black Sandshell	*Ligumia recta*	Medium to large rivers in locations with strong current and substrates of coarse sand and gravel with cobble. Found at depths between several cm to 2 m or more.	S3
Creek Heelsplitter	*Lasmigona compressa*	Rivers and streams with substrates of gravel, sand, or mud.	S5
Creeper	*Strophitus undulatus*	Habitat generalist; can occupy streams and rivers with a range of flow conditions.	S5
Cylindrical Papershell	*Anodontoides ferussacianus*	Shallow water near shore in silt; also found in small streams, creeks, and lakes in sand or fine gravel.	S4
Eastern Elliptio	*Elliptio complanata*	Habitat generalist; can occupy small streams, large rivers, freshwater tidal waters, ponds and lakes. Tolerates habitat disturbance, pollution, and most substrates except deep semi-liquid silt and rocky bottoms.	S5

Common Name	Scientific Name	Habitat Preferences[1]	Provincial S-Rank[2]
Eastern Floater	*Pyganodon cataracta*	Slow-moving portions of riverine environments in sandy or muddy substrates. It has a high tolerance for silt and can be found in deeper water of lakes and ponds.	S3
Eastern Lampmussel	*Lampsilis radiata*	Prefers sand or gravel substrates in small streams, large rivers, ponds, and lakes.	S4
Elktoe	*Alasmidonta marginata*	Typically found in smaller streams with good current, depths of several cm to 0.6 m, and sand or gravel bottoms.	S3
Fatmucket	*Lampsilis siliquoidea*	Found on a variety of substrates but usually prefers quiet or slow-moving water with a mud bottom, typically avoiding riffles.	S5
Flutedshell	*Lasmigona costata*	Found on gravel, sand or mud bottoms of canals, rivers, and lakes.	S5
Fragile Papershell	*Leptodea fragilis*	Typically found in small streams with strong current and coarse gravel and sand substrates, but also rivers or river-lakes possessing slow currents and a firm substrate composed of sand and mud. Occurs in a variety of depths from shallow embayments down to 6 m.	S4
Giant Floater	*Pyganodon grandis*	Ponds, lakes, and rivers of various sizes, usually on mud but also found on other substrates at depths of 0.2 m and beyond.	S5
Mucket	*Actinonaias ligamentina*	Typically found in large creeks and rivers, where it occurs in gravel and cobble substrates of shoals and runs. Can occur in some areas of large lakes and may also be found in sandy mud or gravel along stream margins.	S4
Pink Heelsplitter	*Potamilus alatus*	Found on a variety of substrates in slow to swiftly flowing water.	S3
Plain Pocketbook	*Lampsilis cardium*	Shallow waters of creeks to big rivers.	S4
Spike	*Eurynia dilatata*	Occurs in medium streams to large rivers in shoal habitat at depths of 4 to 8 m.	S5
Triangle Floater	*Alasmidonta undulata*	Typically occurs in coarse to fine gravel with sand and mud in smaller streams with slow current in the northern part of its range, sometimes sparsely extending into lakes and ponds.	S3

[1] Source: NatureServe (2022)
[2] Provincial S-Rank (2022): S3 – Vulnerable; S4 – Common and Apparently Secure; S5 – Secure

Mussel presence and habitat surveys were initially proposed as part of the 2021 natural heritage investigations conducted by SNC-Lavalin; however, after further discussion with PSPC it was determined that such surveys would pose a human health risk to conduct due to risk of encounter with improperly disposed biomedical sharps, as this type of survey requires in-water work and direct contact with substrates and sediments. Shoreline and nearshore habitats were examined by SNC-Lavalin for mussel shells as an indication of species presence in the harbour, as whole shells or pieces may be deposited following predation by mussel predators known to KIH such as Muskrat, River Otter, Raccoon, diving ducks, and Northern Map Turtles. Only shells of Zebra Mussel (and likely Quagga) were observed, no evidence of native mussel species was found. Additionally, shallow, unvegetated substrates were examined by boat during fish habitat surveys and no mussels were observed on gravel and cobble substrates.

Previously, PCB uptake in caged mussels (Eastern Elliptio, *Elliptio complanata*) at nine locations in KIH was evaluated by Derry et al. (2003). PCB update was highest at locations immediately south of Belle Park and near Emma Martin Park; however, total PCB congener toxic equivalents (TEQs) were well below the Canadian Council of Ministers of the Environment (CCME) PCB tissue residue guideline (Derry et al., 2003). Mussel tissue sampling by Derry et al. (2003) and ESG (2003) in nearby reference locations (e.g., upstream of Belle Park, Outer Harbour) did not find elevated levels of contaminants in those areas. Risks to mussels from PAHs and anticipated post-implementation outcomes are similar to those described for benthic invertebrates in **subsection 3.2.1.3**.

Invasive mussels such as Zebra Mussel and Quagga can kill native freshwater mussels by forming colonies on their shells and also by outcompeting for food (plankton). Due to the contaminated nature of the sediments and the presence of invasive mussels, there is a lower likelihood of native mussel species presence in KIH, and risk of impacts is considered to be very low, thus there is no requirement to conduct further baseline assessment, establish desired outcomes, thresholds, or standard of proof. A complete assessment of impacts to mussels will be conducted as part of the DIA and general mitigation measures may be applied should there be a change regarding the presence of any native mussel species in the Project Impact Area.

3.2.1.5 Aquatic Vegetation

The Orchard Street Marsh in the northwest area of KIH was the predominant wetland feature targeted for wetland community classification, vegetation inventory, and wetland delineation, along with nearshore wetlands and any wetland vegetation occurring along the shoreline.

The MNRF Make a Map tool indicates that much of the Inner Harbour is classified as Provincially Significant Wetland (PSW), part of the Greater Cataraqui Marsh. Portions of the Orchard Street Marsh are included in the designated PSW, while others are not. As part of the former Davis Tannery property Environmental Impact Assessment, Ecological Services explained that Orchard Street Marsh was classified as PSW prior to the knowledge of its heavy contamination and overall lack of biodiversity, and that the area should be downgraded to Non-PSW (Ecological Services, 2019). The majority of the marsh was classified as Cattail Organic Shallow Marsh Type with the adjacent open water wetland classified as Pondweed Submerged Shallow Aquatic Type (SAS1-1) (Ecological Services, 2019). The former Davis Tannery property EIA also did not detect any plant species at risk within the wetland (Ecological Services, 2019). A 2008 botanical inventory documented 54 species, 12 of which were non-native invasives, and no rare or uncommon species (Ecological Services, 2008).

A 2004 desktop update to the Greater Cataraqui Marsh wetland evaluation by the Ministry of Natural Resources (MNR) provides information, largely collected in 1990, on plant species documented within the wetland, including one (1) provincially significant species, five (5) regionally significant species, and one (1) locally significant species (Ontario Ministry of Natural Resources, 2004). The field investigations conducted for this evaluation did not detect any species that were classified as “Endangered” at the time. The plant species list included in the evaluation does not contain any species currently classified as at-risk either federally or provincially.

According to the NHIC database accessed through the Make a Map: Natural Heritage Areas online tool (MNRF), there have been no reported plant SAR or rare species reported in the Study Area.

The Greater Cataraqui Marsh PSW is included in the Great Lakes Coastal Wetland Monitoring Program (GLCWMP) conducted by ECCC and the United States Environmental Protection Agency. As part of this program, coastal wetlands are evaluated for degradation, focusing on coverage and distribution of invasive plants; coverage and diversity of submergent and floating plants; and computing and comparing the Floristic Quality Index (FQI) to regional FQI scores. The GLCWMP Site Mapping Tool (Central Michigan University, 2022) provides Level 1 users with Site Metrics such as the Index of Biological

Integrity (IBI) score for vegetation. The IBI vegetation score is calculated from the following worksheets included in the GLCWMP Vegetation Sampling Standard Operating Procedure (Institute for Great Lakes Research, 2018): a table of wetland quality based on aquatic macrophyte sampling; a flow chart for determining quality rating of submergent marsh zone or submergent component of an emergent marsh zone; a table of species tolerant of nutrient enrichment, sedimentation, or increased turbidity, and; a combined standardized score based on the previous three tables/chart. An IBI vegetation score can range between 0 (very low) and 50 (high). The last timea vegetation evaluation was conducted for the Greater Cataraqui Marsh was in 2011 when it was assigned an IBI vegetation score of 1.7, which is considered to be low quality (Central Michigan University, 2022). Low quality wetlands (score of 1 to 2.9) typically have 25-50% invasive aquatic macrophyte species cover over the entire site and >50% submergent plants that are nutrient-enrichment tolerant species or sediment-and-increased-turbidity tolerant species.

In 2020 and 2021, SNC-Lavalin conducted wetland species inventory and community classification within the Project Site using Ecological Land Classification (ELC) for Southern Ontario (Lee et al., 1998) and Southern Ontario ELC Vegetation Type List (Lee, 2008).) The following aquatic communities were classified within the study area: Water Milfoil (dominant, native and invasive) Submerged Shallow Aquatic (SAS_1-4), Water Milfoil (dominant, native and invasive) Mixed Shallow Aquatic (SAM1-7), Water Lily-Bullhead Lily (White Waterlily dominant) Floating-Leaved Shallow Aquatic (SAF_1-1) and Cattail Mineral (dominant, native and introduced) Shallow Marsh (MASM1-1). Where survey sites overlapped with previous ELC conducted by Ecological Services (2019), results were similar in describing shallow marsh and shallow aquatic sites.

During the 2021 field surveys, species identification was prioritized according to season for each trip. In total 291 plants were identified with 261 identified to species level. Of these, 120 plants were recorded within aquatic/wetland polygons. Seventy-six (76) native species and thirty-six (36) non-native species were identified, with thirteen (13) identified as hybrids. None of the native species are considered to be provincially significant (NHIC, 2020). Aquatic invasive plants are discussed in the following subsection. While community classification is useful in characterizing habitat, additional work is recommended mid-summer prior to commencing sediment management activities to obtain an updated IBI vegetation score based on the GLCWMP Vegetation Sampling Standard Operating Procedure (Institute for Great Lakes Research, 2018).

Aquatic vegetation communities are reflective of the character of KIH wetlands and are the foundation of habitats for the many birds, mammals, reptiles, and amphibians that carry out their life processes there. The Aquatic Wildlife and Vegetation VC includes Aquatic Vegetation due to the potential for impacts from the proposed sediment management activities.

3.2.1.5.1 Thresholds

Dredging of areas with aquatic vegetation directly results in the loss of vegetation along with potential loss of a seed bank. Capping may potentially prevent growth or re-establishment of vegetation remaining in the dredged area. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as vegetation removal, dredging, and capping that remove or alter wetland biophysical attributes are likely to result in degradation of wetland habitat in the Greater Cataraqui Marsh Provincially Significant Wetland post-sediment management. Wetlands that undergo active restoration typically recover within less than 1 year (38%) or between 1 and 10 years (24%); however, they may still suffer from the negative effects of previous disturbances during the recovery period (Pezzati et al. 2018). Great Lakes coastal wetland quality can be evaluated through an assessment of submergent and floating plant species abundance and coverage (Institute for Great Lakes Research, 2018). In 2011, the Great Lakes Coastal Wetland Monitoring Program assigned the Greater Cataraqui Marsh an Index of Biological Integrity vegetation score of 1.7, which is evaluated as being low quality (Central Michigan University, 2022). his Project interaction with Aquatic Vegetation is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome is achieved is considered to be high and as such the standard of proof is high. The standard of proof would be measured by maintaining or improving the Index of Biological Integrity Score as compared to the pre-construction evaluation within10 years following restoration, allowing time for plantings to establish and proliferate; natural recolonization of local flora; and to observe effects of natural processes influencing recovery.

Table 11: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Aquatic Wildlife and Vegetation: Aquatic Vegetation

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Aquatic Wildlife and Vegetation: Aquatic Vegetation							
In-water works such as wetland vegetation removal, dredging, and capping result in biophysical changes that reduce the quality of Greater Cataraqui Marsh Provincially Significant Wetland.	Long term: post-sediment management	At minimum, the assessed quality of wetland vegetation communities identified during baseline is maintained or improves from the pre-construction IBI vegetation score 10 years following in-water works. Areas that were considered ecologically degraded may be restored to an ecologically compatible community to the habitat.	Following restoration of areas disturbed by sediment management activities, wetland vegetation will be assessed using the Index of Biological Integrity score to compare to the pre-construction evaluation. IBI score will be maintained or improved within 10 years post implementation.	High	Yes 1, 2	Stockpiling of removed aquatic vegetation for replanting or translocation of nearby aquatic vegetation from "clean" sediments for re-colonization. Schedule or phase dredging to conclude by spring when water temperatures are more favourable for plant growth to re-establish vegetation.	Mid-summer survey in accordance with Great Lakes Coastal Wetland Monitoring Program Vegetation Sampling Standard Operating Procedure (Institute for Great Lakes Research, 2018) to establish updated IBI vegetation score prior to sediment management activities. Aquatic Resources Management Plan Vegetation Protection Plan Dredging and Sediment Removal Plan Site Restoration Plan Follow-up mid-summer wetland monitoring conducted in accordance with Great Lakes Coastal Wetland Monitoring Program Vegetation Sampling Standard Operating Procedure (Institute for Great Lakes Research, 2018) to obtain post-restoration IBI score Monitoring conducted in years 1, 3, 5, 7, and 10 following restoration.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.1.6 Aquatic Invasive Species

Prior to the present investigation, formal invasive species surveys and mapping had not been completed for the Study Area. Aquatic invasive species, including plants and animals, are often introduced accidentally through pathways such as contaminated recreational equipment (e.g., boats), dumping of bait from other locales, and release of aquaculture (e.g., aquarium trade, live food). Data collected from EDDMapS Ontario (2022) and iNaturalist (2022) indicate that sixteen (16) aquatic invasive species have been reported in Kingston, which includes the Cataraqui River and the Study Area (**Table 12**). Fish community sampling conducted north of the Study Area in support of the Kingston Third Crossing detected Round Goby (*Neogobius melanostomus*) in 2010 (Bowfin, 2011). While Quagga is included in the table below, it has not been detected in the Project Study Area but has been identified to the south along Wolfe Island and may be undetected in Kingston Inner Harbour as it has a similar appearance to Zebra Mussel.

Table 12: Aquatic Invasive Species Potentially Present in Kingston Inner Harbour

Common Name	Scientific Name	Habitat Description[a]	Date Last Reported	Status	Legislation
Curly-leaf Pondweed	*Potamogeton crispus*	Freshwater lakes, rivers, streams, ponds, ditches, and canals. Rooted in silt or clay and sometimes gravel or sand.	08/06/2020[1b]	Not Regulated	N/A
Eurasian Water-milfoil	*Myriophyllum spicatum*	Water 1-3 m deep in lakes, rivers, and ponds, but can occur at depths up to 10 m. Found in acidic or alkaline waters, flourishes in high nutrient environments but also found in nutrient-poor waters.	23/08/2019[2a]	Not Regulated	N/A
European Common Reed	*Phragmites australis ssp. australis*	Found in shallow water habitats including coastland, estuarine, lakes, riparian zones, disturbed areas, urban areas, water courses, and wetlands.	08/06/2020[1b]	Restricted	Invasive Species Act
European Frog-bit	*Hydrocharis morsus-renae*	Areas with limited wave action such as slow- moving water, sheltered inlets, ponds, rivers, and ditches.	29/08/2019[1b]	Not Regulated	N/A

Common Name	Scientific Name	Habitat Description[a]	Date Last Reported	Status	Legislation
European Water Chestnut	*Trapa natans*	Lakes, rivers, streams and ponds with soft substrate, full sun, and nutrient-rich waters. Grows in water 2-4 m deep.	08/04/2020[1b]	Prohibited	Invasive Species Act
Flowering Rush	*Butomus umbetallus*	Shallow water to depth of 2 m in lakes, rivers, marshes, ponds, and wet ditches.	23/08/2021[1b]	Not Regulated	N/A
Hybrid Cattail	*Typha x glauca*	Marshes, wet ditches, and edges of ponds, rivers, and streams.	29/07/2014[3a]	Not Regulated	N/A
Narrow-leaved Cattail	*Typha angustifolia*	Marshes, wet ditches, and edges of ponds, rivers, and streams.	29/07/2014[3a]	Not Regulated	N/A
Purple Loosestrife	*Lythrum salicaria*	Marshes, floodplains, river and stream margins, wet ditches, and fields.	12/07/2020[1b]	Not Regulated	N/A
Quagga	*Dreissena bugensis*	Calm waters of lakes, rivers and reservoirs with hard or soft substrates down to depths of 130 metres.	Not Detected	Federally Prohibited	Fisheries Act
Reed Canary Grass	*Phalaris arundinacea*	Wet soils along lakes, rivers, streams and occasionally in marshes. May also be found in roadside ditches, wet meadows, and gardens.	03/12/2018[1b]	Not Regulated	N/A
Round Goby	*Neogobius melanostromus*	Lakes and middle and lower reaches of rivers; also, in nearshore and deep waters. Cobble, gravel, and sandy substrates, with or without vegetation. Able to withstand low levels of dissolved oxygen.	16/08/2021[1a]	Federally Prohibited	Fisheries Act
Spiny Waterflea	*Bythotrephes longimanus*	Large, deep, clear lakes with low productivity is	31/07/2018[3a]	Not Regulated	N/A

Common Name	Scientific Name	Habitat Description[a]	Date Last Reported	Status	Legislation
		preferred. Lives in water temperatures between 5-28°C. Migrates vertically in water column to deeper, cooler waters during the day and upward to surface waters at night.			
Starry Stonewort	*Nitellopsis obtusa*	Fresh or brackish water, including lakes, ponds, and slow-moving rivers.	30/08/2019[2a]	Not Regulated	N/A
White Perch	*Morone americana*	Lives in both shallow and deep waters that exceed 23°C in summer.	22/04/1984[2a]	Not Regulated	N/A
Yellow Iris	*Iris pseudacorus*	Wetlands and shallow water along streams, rivers, ponds, and lakes.	13/06/2020[1b]	Not Regulated	N/A
Zebra Mussel	*Dreissena polymorpha*	Calm, slow-moving rivers, lakes, reservoirs, ponds, and quarries. Larvae are free-floating, and adults attach to hard surfaces such as rocks, docks, cement, and wood. Water temperatures > 10°C are needed for reproduction.	29/06/1995[2a]	Federally Prohibited	Fisheries Act

[1] Detected in the Project Site
[2] Detected in the Cataraqui River
[3] Detected in Kingston
[a] Information from EDDMapS Ontario (2022)
[b] Information from iNaturalist (2022)

During wetland vegetation surveys conducted by SNC-Lavalin in 2020 and 2021 (refer to **subsection 3.2.1.5**), seven (7) non-native aquatic plant species were recorded in the Project Site: Curly-leaf Pondweed (*Potamogeton crispus*) (rare to occasional), Narrow-leaved Cattail (*Typha angustifolia*) (uncommon to abundant), Purple Loosestrife (*Lythrum salicaria*) (occasional), Eurasian Watermilfoil (*Myriophyllum spicatum*) (occasional to abundant), European Frog-bit (*Hydrocharis morsus-renae*) (occasional), Flowering Rush (*Butomus umbetallus*) (rare to occasional), and European Common Reed (*Phragmites australis ssp. Australis*) (rare to abundant). Additionally, Zebra Mussel shells were observed incidentally in the shallow waters near Belle Island, as well as along the shoreline of Belle Park.

PCA has an active invasive species removal program and conducted removal of European Water Chestnut (*Trapa natans*) in the Project Study Area north of Belle Island and in KIH in the waters surrounding Belle Island and near Orchard Street Marsh in 2020 and 2021. The program is planned to continue in 2023 and future years.

Aquatic invasive species are often introduced or exacerbated by disturbance events, such as construction, or inadvertently transferred on vehicles (e.g., boats) and equipment that enter the water. The Aquatic Wildlife and Vegetation VC includes Aquatic Invasive Species due to the potential for impacts to KIH by introduction or spread of aquatic invasive species, including plants and wildlife.

3.2.1.6.1 Thresholds

Submergent and floating invasive vegetation can be challenging to control and eradicate, as several are already known to the Cataraqui River and can also spread through fragmentation (e.g., Eurasian Watermilfoil). It is difficult to prevent these species from re-establishing in areas with suitable growing conditions, such as recently dredged sites, if it has not been eradicated entirely from surrounding areas. As such, it is also difficult to determine the cause of spread of these species as fragmentation can occur from upstream sources or locally due to recreational water activities or natural causes (e.g., foraging wildlife). Without mitigation, and/or specific Project design considerations, in-water works such as dredging are likely to result in fragmentation and spread of invasive aquatic plants during sediment management activities and post-sediment management. This Project interaction with Aquatic Invasive Species is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by successful containment and removal of plant fragments within dredged units to prevent spread of invasive species.

Equipment and vehicles (e.g., boats) that are transported between aquatic habitats have the potential to transport aquatic wildlife and/or their eggs, as well as certain aquatic vegetation to new areas. Without mitigation and/or specific Project design considerations, in-water works such as vegetation removal, dredging, capping, and shoreline stabilization that does not use clean equipment and materials results in spread of invasive aquatic vegetation and wildlife during sediment management activities and post-sediment management. Once aquatic vegetation and wildlife are introduced, they can quickly become established and difficult to eradicate, such as Zebra Mussels and Eurasian Watermilfoil. This Project interaction with Aquatic Invasive Species is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by qualitative studies to assess the diversity of invasive aquatic vegetation and wildlife species compared to the baseline established by the background review. Due to the challenge of controlling for spread of invasive aquatic vegetation and wildlife already present, only new species not detected prior to sediment remediation will be tracked.

Several invasive emergent aquatic plant species are known to KIH, such as European Common Reed, Hybrid Cattail, and Narrow-leaved Cattail. Emergent aquatic plants such as these often establish and spread in disturbed soils and can be easier to mitigate and control than submergent invasive species such as Eurasian Watermilfoil, which is prevalent throughout KIH and spreads through fragmentation of plants. Without mitigation and/or specific Project design considerations, in-water works such as vegetation removal, dredging, capping, and shoreline remediation that disturb soils and sediments are likely to create conditions that result in introduction or spread of invasive emergent aquatic plant species post-sediment management. This Project interaction with Aquatic Invasive Species is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies to assess changes in the diversity and abundance of invasive emergent aquatic plant species as compared to baseline.

Table 13: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Aquatic Wildlife and Vegetation: Aquatic Invasive Species

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Aquatic Wildlife and Vegetation: Aquatic Invasive Species							
In-water works such as dredging that fragment submergent and floating invasive plants result in spread of invasive aquatic vegetation during sediment management activities and post-sediment management.	Temporary: during sediment management activities	Invasive aquatic plant fragments from dredged units do not spread and establish in KIH or downstream.	Visible fragmented invasive aquatic plants > 1 cm in length are contained within dredged units and removed prior to removal of sediment barriers.	High	Yes 1, 2, 19, 20, 23, 24	Sediment containment design and materials for each management unit that prevent the spread of fragmented aquatic plants (floating and submerged) from spreading at all levels of the water column.	Aquatic Resources Management Plan Invasive Species Management Plan Dredging and Sediment Removal Plan Site Restoration Plan
In-water works such as wetland vegetation removal, dredging, capping, and shoreline stabilization that does not use clean machinery and materials result in spread of invasive aquatic vegetation and wildlife.	Temporary: during sediment management activities And Long term: post-sediment management	Habitat remains secure such that, at a minimum, there is no change in invasive species occurrence.	No statistically significant increase ($p > 0.05$) in diversity of invasive aquatic vegetation and wildlife species in the Project Site as established during the background information review.	High	Yes 1, 2, 19, 20, 23, 24	N/A	Aquatic Resources Management Plan Invasive Species Management Plan Dredging and Sediment Removal Plan Site Restoration Plan Qualitative follow-up studies to be conducted in tandem with fish and benthic surveys.
In-water works such as vegetation removal, dredging, capping, and shoreline stabilization that disturb sediments and transport and operation of vehicles and	Long term: post-sediment management	Habitat remains secure such that, at a minimum, there is no change in invasive species prevalence.	No statistically significant increase ($p > 0.05$) in diversity or abundance of invasive aquatic emergent plant species in the Project Site from levels	High	Yes 1, 2, 19, 20, 23, 24	Stockpiling of removed native emergent aquatic vegetation (e.g., lilies, cattails) for replanting; or, translocation of nearby aquatic vegetation from	Aquatic Resources Management Plan Invasive Species Management Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
equipment result in introduction or spread of invasive emergent aquatic plant species.			established during baseline surveys using Simpson's Index of Diversity.			"clean" sediments for re-colonization. Temporary disturbance areas will be reclaimed as soon as possible after completion of the sediment management activity in that area.	Vegetation Protection Plan Dredging and Sediment Removal Plan Site Restoration Plan Supplementary aquatic wetland vegetation survey (e.g., via drone) to document relative abundance and coverage of vegetation in upper water columns of the Project Site prior to dredging. Follow-up monitoring to be conducted in tandem with seasonal wetland monitoring in years 1, 3, 5, 7, and 10 following restoration.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.2 Species at Risk Turtles

Data from the Ontario Reptile and Amphibian Atlas (Ontario Nature, 2020) indicate that at least five (5) turtle species, all of which are federally classified as at-risk, have been observed in recent years (2014-2019) in the 10 by 10 km atlas square that includes KIH (**Table 14**). The NHIC database, accessed through the online Make a Map: Natural Heritage Areas (MNRF) tool shows records of [redacted] Discussions with Turtles Kingston and Friends of Kingston Inner Harbour have indicated that Blanding's Turtles (*Emydoidea blandingii*) were present at one time in KIH but are now considered extirpated from that location; [redacted]. As a federally Threatened species, Blanding's Turtle has Critical Habitat described in its Recovery Strategy[9] (ECCC, 2018a). In March 2020, PSPC, TC and PCA confirmed with Environment and Climate Change Canada that there is no proposed Critical Habitat for Blanding's Turtle within the Project Site; however, [redacted]

Table 14: Kingston Inner Harbour Species at Risk Turtles

Common Name	Scientific Name	SARO Status[1]	SARA Status[2]	Provincial S-Rank[3,4]
Blanding's Turtle	*Emydoidea blandingii*	Threatened	Endangered	S3
Eastern Musk Turtle	*Sternotherus odoratus*	Special Concern	Special Concern	S3
Midland Painted Turtle	*Chrysemys picta marginata*	No Status	Special Concern	S4
Northern Map Turtle	*Graptemys geographica*	Special Concern	Special Concern	S3
Snapping Turtle	*Chelydra serpentina*	Special Concern	Special Concern	S4

[1] Species at Risk in Ontario List. (2022, February 24). Ministry of the Environment, Conservation and Parks. Retrieved April 5, 2022, from https://www.ontario.ca/page/species-risk-ontario
[2] Species at Risk Public Registry. (2022, March 10). Government of Canada. Retrieved April 5, 2022, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
[3] Natural Heritage Information Centre (NHIC). (2022, February 28). Government of Ontario. Retrieved April 5, 2022, from https://www.ontario.ca/page/get-natural-heritage-information
[4] Provincial S-Rank (NHIC): S3 – Vulnerable; S4 – Common and Apparently Secure

Previous surveys conducted by PCA (2008, 2010) and Friends of Kingston Inner Harbour (2019) recorded observations of Eastern Musk Turtle, Midland Painted Turtle, Northern Map Turtle and Snapping Turtle in KIH, [redacted].

Turtles in KIH are exposed to COC in the sediments via multiple pathways, such as incidental ingestion of sediments while foraging; dermal contact with sediments; through drinking water; and through bioaccumulation in food items (e.g., fish, macrobenthos) (Golder, 2021a). Insufficient data were available

[9] Each species listed on Schedule 1 of SARA as Endangered or Threatened has a Recovery Strategy published, within which Critical Habitat is defined.

to evaluate potential risk to turtles from some primary COC such as PAHs and mercury. Specific toxicity studies have not been carried out and community survey data are inadequate to discern whether soil or sediment contamination has damaged individuals or populations of these species (Golder, 2016). The objectives of the SMP include reducing or eliminating these risks by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a).

Preliminary meetings with Friends of Kingston Inner Harbour, Turtles Kingston, Belle Island Caretakers Circle and Kingston Field Naturalists highlighted the value of turtles and their habitat to the local community. Species at Risk Turtles was selected as a Project VC as proposed sediment management activities may impact Species at Risk Turtles within the Project Impact Area.

3.2.2.1 Overwintering Habitat

Turtle overwintering habitat varies by species, but is generally characterized as permanent water bodies, slow-moving rivers, or large wetlands that are deep enough not to freeze with soft, muddy substrates and adequate Dissolved Oxygen (MNRF, 2015a). The Cataraqui River is several meters deep at its deepest points, has a soft, muddy bottom, and is bordered by areas of wetland suitable for supporting several of Ontario's turtle species throughout their winter brumation period. Knowledge shared by Belle Island Caretakers Circle has identified the entire KIH as cornerstone turtle habitat.

Snapping Turtle overwintering habitat is composed of shallow water that does not freeze to the bottom, with a mud substrate that also includes submerged cover such as floating vegetation mats, logs, or an overhanging bank (ECCC, 2020). They can tolerate low-oxygen environments (ECCC, 2020).

Midland Painted Turtle overwintering habitat occurs in shallow water at depths between 0.24 to 0.40 metres with sediments reaching depths between 0.64 to 0.94 metres (COSEWIC, 2019). They can tolerate low-oxygen environments (COSEWIC, 2019).

Northern Map Turtle overwintering habitat includes well-oxygenated lake or river bottoms sheltered from ice formation at depths from 0.3 to 11.3 metres (ECCC, 2019). Substrate is usually sand or gravel, and also includes features such as boulders, exposed ledges, or tree trunks (ECCC, 2019).

Eastern Musk Turtle overwintering habitat includes well-oxygenated, shallow water to a depth of 3 metres that does not freeze to the bottom, low levels of vegetation, and substrates composed of sand, gravel, and rocks (EC, 2016).

The former Davis Tannery property, which has shoreline in KIH, had an Environmental Impact Assessment conducted by Ecological Services, with fieldwork conducted between 2007 and 2019. While this study did not investigate turtle habitat as part of the fieldwork, [redacted].

Data from a turtle tracking study conducted in KIH in 2019 was provided by Friends of Kingston Inner Harbour. [redacted]

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[redacted]

SNC-Lavalin conducted fall (2020, 2021) and spring (2021) Visual Encounter Surveys[10] for overwintering turtles in KIH according to the survey techniques provided under the "Survey Protocol for Blanding's Turtle (*Emydoidea blandingii*) in Ontario (August 2015)" (MNRF, 2015b) for Open Water Wetlands and Heavily Vegetated, Shallow Wetlands. This protocol was selected to enhance detection probability of Blanding's Turtles within the study area while also allowing for detection or encounter of other turtle species and is one of few standardized protocols available for surveying any of Ontario's freshwater turtle species. In order of abundance, five (5) turtle species were observed: Midland Painted Turtle, Northern Map Turtle, Snapping Turtle, Eastern Musk Turtle, and Red-eared Slider (*Trachemys scripta*; invasive). Blanding's Turtle was not observed during 2020 and 2021 overwintering surveys. [redacted].

Overall, [redacted] (SNC-Lavalin 2023; Keevil et al. unpublished data) which may be more an indication of limiting life history traits (e.g., reproductive age, recruitment) than overwintering habitat availability, given overlap in suitable habitat between [redacted]

This preliminary field survey data indicate that [redacted]; however, exact locations of overwintering individuals and areas with suitable biophysical attributes for each species in the Project Site remain unknown. A Remote Operated Vehicle (ROV) survey was conducted under the ice by SNC-Lavalin in February 2023 to investigate suspected overwintering habitat. [redacted].

Dredging and shoreline stabilization in turtle overwintering areas may result in changes to the biophysical habitat, such as:

- Increased depth between substrate and water surface by up to 1 metre;
- Change in substrate composition and depth;
- Reduced aquatic vegetation and/or changed in species composition; and
- Reduced cover elements such as submerged logs and boulders.

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[10] Visual Encounter Surveys for overwintering turtles take place in early to mid-fall (late September through October) and spring (as soon as ice-off occurs through mid-June) to observe turtles basking in areas they are likely to overwinter.

The depth of the post-remediation surface will vary as a function of several factors that vary across different management units:

- Many areas will not require excavation of one metre because the existing sediment stratigraphy does not require this degree of removal. Several of the sediment cores, especially near shoreline areas, indicate that depths of loosely-consolidated organically rich material are often confined to the upper half-metre of the sediment bed.
- Several areas will have thin layer caps (constructed with either traditional clean materials, or with activated carbon amendments) which will be placed on the post-dredge surface and thereby reduce the change in bathymetry.
- Areas of overwintering turtle habitat (or other life stages) will be considered in the development of the intervention footprint, and dredging discouraged where the net benefit of intervention is reduced due to habitat sensitivity.

3.2.2.2 Basking Requirements

As ectothermic ("cold-blooded") species, turtles bask to regulate their body temperatures (thermoregulation), directly contributing to biological functions such as digestion, egg development, and movement (e.g., swimming or travelling over land). During the active season (April 1 to October 31), turtles may bask more or less often depending on daily or seasonal biological needs as well as ambient water and air temperatures. Critical follicular development periods have been identified for Snapping Turtles and Midland Painted Turtles in Ontario (Rollinson et al. 2012), between May to mid-June and again in late-July to October, which likely overlap with other freshwater species such as Northern Map Turtle (Jain-Schlaepfer et al. 2016) and Eastern Musk Turtle (Mendonca, 1987). Rollinson et al. (2012) summarized that between the end of July to October, approximately 80% of follicular development occurs for Snapping Turtle and 50% for Midland Painted Turtle, and Mendonca (1987) found that temperature effects on follicular development in Eastern Musk Turtles was similar to Midland Painted Turtle. These data indicate that fall is a particularly important basking period for Snapping Turtle reproduction, while both spring and fall are equally important for Midland Painted Turtle and likely also Northern Map Turtle and Eastern Musk Turtle.

Thermoregulation through basking also plays an important role in overall health of freshwater turtles. Selman et al. (2013) found elevated levels of stress indicators in the Yellow-blotched Sawback (*Graptemys flavimaculata*) (a relative of the Northern Map Turtle) when frequently disturbed by human recreation activities, which can result in decreased body condition. Bulté and Blouin-Demers (2010) also found that basking behaviour in Northern Map Turtles is essential for net energy retention and increasing metabolic rate, which in turn affects fitness.

There is some overlap in basking habitat and structures used between species, but differences as well, as detailed below:

Snapping Turtles bask in aquatic habitats at the surface of the water or in shallow water (ECCC, 2020). They are not commonly observed out of water but will also bask near the surface of the water on logs, rocks, beaver or muskrat lodges, and on streambanks (ECCC, 2020).

Midland Painted Turtles demonstrate fidelity to basking sites with logs, fallen trees, and lily tubers among the main structures used (COSEWIC, 2019).

Northern Map Turtles bask on stationary objects such as fallen trees, floating vegetation mats, exposed rocks, or terrestrial areas such as exposed banks (ECCC, 2019).

Eastern Musk Turtles are rarely observed out of the water and typically float just under the surface or beneath floating aquatic vegetation such as lily pads (EC, 2016).

As part of the overwintering and nesting surveys, an inventory of existing basking structures and areas used by turtles in KIH such as fallen trees, logs, floating vegetation, rocks, hummocks, and beaver dams, was compiled by SNC-Lavalin (2023). During data collection, the location of each structure was recorded, photographs were taken, and the number of turtles and species using each structure was noted. [redacted]

3.2.2.3 Nesting Habitat

Freshwater turtle species use terrestrial habitats with a specific set of characteristics for nesting. Typical nesting habitat for Snapping Turtles is in banks composed of sand and gravel along waterways within their habitat (Obbard and Brooks, 1980); however, females may travel distances greater than 1 km over land to find suitable nesting conditions, which may include artificial dam and railway embankments, road shoulders, woodchip piles, garden soil, lawns, and forest clearings (Harding and Mifsud, 2020; Ernst et al. 1994; Congdon et al. 2008b).

Midland Painted Turtles are known to be able to travel hundreds of metres from the water to nest, up to 1,233 m (Christens and Bider, 1987; Congdon and Gatten, 1989; Valenzuela and Janzen, 2001; Rowe et al. 2005; Steen et al. 2012). Long distance travel over land may occur when suitable nesting habitat near the aquatic home range is limited or fragmented by human development (Baldwin et al. 2004). Midland Painted Turtles prefer to nest in areas with an open canopy on a slope with a southern exposure and substrates composed of sand, loam, clay and/or gravel (Christens and Bider, 1987; Ernst and Lovich, 2009; Riley et al. 2014). The degree of canopy cover and abundance of ground vegetation can vary widely (Schwarzkopf and Brooks, 1987; Riley et al. 2014). Similar to Northern Map Turtles, Midland Painted Turtles exhibit high nest site fidelity and will return to nest near (<10 m) past nest site locations (Christens and Bider, 1987; Rowe et al. 2005), and hatchlings may also overwinter in nest, emerging in the spring (Ultsch, 2006; Costanzo et al., 2008; Gibbons, 2013).

Northern Map Turtles typically nest within 35 m of the water (Barrett Beehler, 2007; Bernier and Rouleau, 2010; Rouleau and Bernier, 2011). Nesting microhabitat requirements for this species, beyond proximity to water, include low vegetation density, full sun, low slope (<30°) and a substrate composed of gravel or sand and may also include organic matter and clay (Flaherty and Bider, 1984; Nagle et al. 2004; Barrett Beehler, 2007). Studies have found that Northern Map Turtles exhibit high fidelity to nesting areas and will return to the same nesting site in ensuing seasons, (Carrière, 2007; Nagle and Russel, 2020) and in lotic (river) habitats, adult female Northern Map Turtles have been found to travel up to 5 km to reach their nesting site (Carrière et al., 2009). Northern Map Turtles are also known to produce two clutches within one season in Ontario (Carrière et al. 2006) and second clutches are laid an average of 88.7 m from first clutches (Nagle and Russel, 2020). High nest site fidelity, within and between seasons, and long aquatic distances travelled may be due to low availability of suitable riverine nesting sites. Northern Map Turtle hatchlings will commonly overwinter in their nests, emerging in early spring instead of fall (Baker et al. 2003; Nagle et al. 2004; Ernst and Lovich, 2009; Rudy, 2021).

Nesting habitat of Eastern Musk Turtles in Ontario has not been well studied. Eastern Musk Turtles nest in sand or soil, depositing eggs in shallow excavations (≤10 cm) typically within 10 m of the shoreline (Cagle, 1937; Ernst, 1986; Steen et al. 2012). Nest sites include within shoreline debris, clumps of vegetation, beneath logs, in rotting stumps, or on muskrat lodges (Harding and Mifsud, 2020). Females are known to share nesting locations and may return to the same area to nest each season (Edmonds, 2002; Ernst and Lovich, 2009).

The former Davis Tannery property, which has shoreline in KIH, had an Environmental Impact Assessment conducted by Ecological Services, with fieldwork carried out between 2007 and 2019. While this study did not investigate turtle habitat as part of the fieldwork, it did note the presence of Midland Painted Turtles, Snapping Turtles, and Northern Map Turtles [redacted]

[redacted] There are no known records for Blanding's Turtles nesting in the Project Impact Area.

SNC-Lavalin conducted turtle nesting area surveys between May and early-July of 2021 following the Survey Protocol for Blanding's Turtles (*Emydoidea blandingii*) in Ontario (August 2015) (MNRF, 2015b). Surveys were conducted in areas that may be used for staging, laydown, and dewatering associated with the project, as well as areas immediately abutting the proposed dredging areas. [redacted]

Natural nesting features within the study area, such as riverbanks of sand or gravel, were found to be largely absent. [redacted] In the remaining northern portion of the study area, the shoreline from River Street and along Belle Park is largely forested or otherwise vegetated. South of River Street to the Kingston Marina, shoreline has been engineered with rock revetment and opens up to cultural meadow dominated by grasses (lawn). Human disturbance in this area is high with recreation taking place along the K&P Trail that runs the length of the waterfront from the Kingston Marina to River Street, as well as small watercraft in the water.

3.2.2.4 Foraging

Snapping Turtles are omnivorous, although typically consume larger amounts of plant material than animals, and also consume both live prey and carrion (Lagler, 1940; Schneider, 1998). Along with algae and vascular plants, Snapping Turtles also consume molluscs, arthropods (insects, crayfish), fish (adults and eggs), amphibians, reptiles (including small turtles), birds, and small mammals (Ernst and Lovich, 2009).

Midland Painted Turtles are omnivorous, consuming primarily aquatic insects, crustaceans (e.g., crayfish), algae, duckweed, and rooted plants (Harding and Mifsud, 2020). Hatchlings and juveniles are more carnivorous than adults, with other animal prey including snails, leeches, worms, tadpoles, small fish, and also carrion (Harding and Mifsud, 2020).

Northern Map Turtles are carnivorous, with diet primarily composed of molluscs as well as insects and crayfish (Ernst and Lovich, 2009). Foraging habitat is typically in shallow water, close to shore (Bulté et al., 2008).

Eastern Musk Turtles are omnivorous, moving along the bottom probing the substrate and vegetation for a variety of small animals such as worms, leeches, aquatic insects, snails, crayfish, small fish, and tadpoles (Harding and Mifsud, 2020; Ernst and Lovich, 2009). They also consume aquatic plants, including algae, rooted plants, and seeds, and relatively fresh carrion (Harding and Mifsud, 2020). Eastern Musk Turtles only feed at water temperatures between 13 - 35°C (Mahmoud, 1969).

Foraging habitat and diet composition is unlikely limiting for these species given the breadth of habitat available in the Project Study Area. It is anticipated that design considerations recommended for overwintering habitat and basking habitat in **Table 15** below, as well as for diet components such as fish (**Table 6**), benthic invertebrates (**Table 9**), and aquatic vegetation (**Table 11**) will adequately minimize effects to species at risk turtle food sources and foraging areas in the Project Impact Area.

3.2.2.5 Thresholds

3.2.2.5.1 Species at Risk Turtles Thresholds

Critical follicular development periods in Ontario have been identified for Snapping Turtle and Midland Painted Turtle (Rollinson et al. 2012), which likely overlap with other freshwater species such as Northern Map Turtle (Jain-Schlaepfer et al. 2016). Basking habitat was evaluated and mapped as part of baseline studies. [redacted] Without mitigation, restoration and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that disturb high-quality thermoregulatory habitat from May to mid-June and late-July to October are likely to result in disruption of follicular development in reproductive female Species at Risk Turtles (Rollinson et al. 2012; Jain-Schlaepfer et al., 2016; EC, 2016; ECCC, 2018a) during sediment management activities. [redacted] for the short-term duration of the project or provision of species-suitable alternative basking areas such as those described above, in addition to habitat restoration conducted immediately post-management in disturbed areas, is anticipated to reduce project interactions with these species during critical follicular development periods. This Project interaction with Species at Risk Turtles is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by observation of individual Species at Risk Turtles using newly created and restored basking habitat, including observation of females during critical follicular development periods. Alternative basking and/or enhanced basking habitat provided as compensation should be created at a 2:1 ratio to habitat that is removed or disturbed as a result of Project activities, taking into consideration the type of basking structures composing the habitat (e.g., log, fallen tree/branch, rock, vegetation).

In-water work areas will be isolated by sediment control measures such as turbidity curtains, which can entrap aquatic wildlife, particularly approaching the overwintering period when turtles go dormant. Without mitigation and/or specific Project design considerations, in-water works, particularly dredging, that occur in habitat occupied by aquatic wildlife are likely to result in accidental capture of turtles during sediment management activities. Establishment of secure in-water work areas, movement corridors and rescue and removal of turtles from within isolated in-water work areas prior to the overwintering period (October – April) are anticipated to prevent entrapment of turtles. This Project interaction with Species at Risk Turtles is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low and would be based upon observations. The standard of proof would be measured by number of mortalities of and injuries to turtles within isolated in-water work areas.

All four Species at Risk Turtles in KIH share the same general nesting period between May and mid-July (ECCC, 2020; ECCC, 2018a; EC, 2016; ECCC, 2019; COSEWIC, 2018a). Without mitigation and/or specific Project design considerations, terrestrial and shoreline stabilization works in management units [redacted] during the nesting period from May to mid-July are likely to disturb terrestrial movements of nesting female Species at Risk Turtles during sediment management activities. Project interactions impeding terrestrial movements of nesting turtles are anticipated to be reversed upon completion of sediment management activities by removal of any temporary barriers and structures used. This Project interaction with Species at Risk Turtles is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observation of nesting females travelling to and from their nesting sites.

[redacted] share the same general hatchling emergence periods between April and late June in the spring and between August and late October in the fall (ECCC, 2020; ECCC, 2018a; EC, 2016; ECCC, 2019; COSEWIC, 2018a). Without mitigation and/or specific Project design considerations, terrestrial and shoreline stabilization works in management units [redacted] during the hatchling emergence periods from April to late June and August to late October are likely to disturb terrestrial movements of hatchling Species at Risk Turtles during sediment management activities. Project interactions impeding terrestrial movements of hatchling turtles are anticipated to be reversed upon completion of sediment management activities by removal of any temporary barriers and structures used. This Project interaction with Species at Risk Turtles is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observation of emerging hatchlings travelling to aquatic habitats.

Stockpiled materials such as sand, gravel, soil, and woodchips, as well as gravel roads, can be used by freshwater turtles such as Midland Painted Turtles and Snapping Turtles as nesting sites. Without mitigation and/or specific Project design considerations, unprotected terrestrial works areas, including access roads and stockpiling areas, may present attractive nesting opportunities for turtles which would likely result in harm to species at risk turtles during sediment management activities (MECP, 2020). This Project interaction with Species at Risk Turtles is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by the installation of measures to prevent Species at Risk Turtles from nesting within terrestrial work sites, material stockpiles, and along access roads.

[redacted] share the same general overwintering period between October and April[11] (ECCC, 2020; ECCC, 2018a; EC, 2016; ECCC, 2019; COSEWIC, 2018a). Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization during the overwintering period from October to April are likely to result in

[11] Eastern Musk Turtle overwintering period begins when ambient water temperature dips below 10°C (Ernst and Lovich, 2009) and may therefore begin overwintering earlier than October.

disturbance to overwintering individual Species at Risk Turtles during sediment management activities. Turtles disturbed during the overwintering period typically cannot be immediately returned to their habitat safely and must spend the remainder of the winter at a licenced wildlife care facility. Avoiding in-water work in Management Units where turtles are overwintering between October and April is anticipated to avoid project interactions with overwintering individual Species at Risk Turtles in the Project Site; or, where necessary, install exclusion measures prior to the overwintering period and rescue turtles from enclosed areas. This Project interaction with disturbance of individual Species at Risk Turtles is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by number of overwintering individuals disturbed by project activities.

3.2.2.5.2 Snapping Turtle Thresholds

According to the Management Plan for the Snapping Turtle (ECCC, 2020), Snapping Turtles typically deposit their nests in sand or gravel banks near the water where vegetation is absent or sparse, but also use beaver and muskrat lodges, roadsides, railway embankments, sawdust or mulch piles, gardens, lawns, disturbed soil, forest clearings, and farm fields. Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization in management units [redacted] that traverse Snapping Turtle nests are likely to disturb Snapping Turtle nests and site conditions during site preparation and sediment management activities (ECCC, 2020; Georgian Bay Biosphere Reserve, 2022). Nesting habitat was evaluated and mapped as part of baseline studies, and nesting data were provided by Friends of Kingston Inner Harbour, to understand where avoidance and preservation of habitat access may be possible and allow for detailed restoration planning (SNC-Lavalin, 2023). This Project interaction with Snapping Turtle nesting habitat is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been achieved is considered to be medium and as such the standard of proof is medium. The standard of proof would be measured by qualitative studies assessing the preservation of Snapping Turtle nest site conditions from anthropogenic modification, including substrate, moisture levels and sunlight exposure.

According to the Management Plan for the Snapping Turtle (ECCC, 2020), Snapping Turtle overwintering habitat is composed of shallow water that does not freeze to the bottom, with a mud substrate that also includes submerged cover such as floating vegetation mats, logs, or an overhanging bank. They can tolerate low-oxygen environments. Preliminary field survey data collected by SNC-Lavalin (2023) indicate that Snapping Turtles may overwinter in [redacted] however, exact locations of Snapping Turtle overwintering habitat and areas with suitable biophysical attributes in the Project Site are unknown and therefore Project interactions are not well understood. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that alter the biophysical attributes required for Snapping Turtle to overwinter, such as water depth, substrate composition, and submerged cover objects, are likely to result in destruction of overwintering habitat for Snapping Turtles during sediment management activities and post-sediment management (ECCC, 2020). Without knowledge of the extent of Snapping Turtle overwintering habitat within the Project Site, post-remediation restoration may not succeed in reversing overwintering habitat loss. This Project interaction with biophysical attributes of Snapping Turtle overwintering habitat is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies to assess springtime presence of Snapping Turtles in restored habitat.

According to the Management Plan for the Snapping Turtle (ECCC, 2020), Snapping Turtles bask in aquatic habitats at the surface of the water or in shallow water. They are not commonly observed out of water but will bask near the surface of the water on logs, rocks, beaver or muskrat lodges, and on streambanks. Basking habitat was evaluated and mapped as part of baseline studies to enhance understanding of where avoidance may be possible and allow for detailed mitigation and restoration planning (SNC-Lavalin, 2023). Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that remove or alter habitat features required for Snapping Turtle thermoregulation are likely to result in destruction of thermoregulation habitat for Snapping Turtles during sediment management activities and post-sediment management (ECCC, 2020). This Project interaction with Snapping Turtle basking habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observations of Snapping Turtles using habitat for thermoregulation.

3.2.2.5.3 Midland Painted Turtle Thresholds

According to the COSEWIC Assessment and Status Report for the Midland Painted Turtle (COSEWIC, 2019), Midland Painted Turtles prefer to nest in areas with an open canopy on a slope with a southern exposure and in substrates composed of sand, loam, clay, and/or gravel. The degree of canopy cover and abundance of ground vegetation can vary widely. Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization in management units [redacted] that traverse Midland Painted Turtle nests are likely to disturb Midland Painted Turtle nests and site conditions during site preparation and sediment management activities (COSEWIC, 2018a; Georgian Bay Biosphere Reserve, 2022). Nesting habitat was evaluated and mapped as part of baseline studies, and nesting data were provided by Friends of Kingston Inner Harbour, to understand where avoidance and preservation of habitat access may be possible and allow for detailed restoration planning (SNC-Lavalin, 2023). This Project interaction with Midland Painted Turtle nesting habitat is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been achieved is considered to be medium and as such the standard of proof is medium. The standard of proof would be measured by qualitative studies assessing preservation of Midland Painted Turtle nest site conditions from anthropogenic modification, including substrate, moisture levels and sunlight exposure.

According to the COSEWIC Assessment and Status Report on the Midland Painted Turtle (COSEWIC, 2019), Midland Painted Turtle overwintering habitat occurs in shallow water at depths between 0.24 to 0.40 metres with sediments reaching depths between 0.64 to 0.94 metres. They can tolerate low-oxygen environments. [redacted] exact locations of Midland Painted Turtle overwintering habitat and areas with suitable biophysical attributes in the Project Site are unknown and therefore Project interactions are not well understood. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that alter the biophysical attributes required for Midland Painted Turtle to overwinter, such as water depth and sediment depth, are likely to result in destruction of overwintering habitat for Midland Painted Turtles during sediment management activities and post-sediment management (COSEWIC, 2018a). Without knowledge of the extent of Midland Painted Turtle overwintering habitat within the Project Site, post-remediation restoration may not succeed in reversing overwintering habitat loss. This Project interaction with biophysical attributes of Midland Painted Turtle overwintering habitat is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies to assess springtime presence of Midland Painted Turtles in restored habitat.

According to the COSEWIC Assessment and Status Report on the Midland Painted Turtle (COSEWIC, 2019), Midland Painted Turtles demonstrate fidelity to basking sites with logs, fallen trees, and lily tubers among the main structures used. Basking habitat was evaluated and mapped as part of baseline studies to enhance understanding of where avoidance may be possible and allow for detailed mitigation and restoration planning (SNC-Lavalin, 2023). Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that remove or alter habitat features required for Midland Painted Turtle thermoregulation are likely to result in destruction of thermoregulation habitat for Midland Painted Turtles during sediment management activities and post-sediment management (COSEWIC, 2018a). This Project interaction with Midland Painted Turtle basking habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observations of Midland Painted Turtles using habitat for thermoregulation.

3.2.2.5.4 Northern Map Turtle Thresholds

According to the Management Plan for the Northern Map Turtle (ECCC, 2019), Northern Map Turtles generally nest within 35 metres of the water's edge in areas with low vegetation density, full sun, low slope, and a substrate composed of gravel or sand and may also include organic matter and clay. Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization in management units [redacted] that traverse Northern Map Turtle nests are likely to disturb Northern Map Turtle nests and site conditions during site preparation and sediment management activities (ECCC, 2019; Georgian Bay Biosphere Reserve, 2022). Nesting habitat was evaluated and mapped as part of baseline studies, and nesting data were provided by Friends of Kingston Inner Harbour, to understand where avoidance and preservation of habitat access may be possible and allow for detailed restoration planning (SNC-Lavalin, 2023). This Project interaction with Northern Map Turtle nesting habitat is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been achieved is considered to be medium and as such the standard of proof is medium. The standard of proof would be measured by qualitative studies assessing preservation of Northern Map Turtle nest site conditions from anthropogenic modification, including substrate, moisture levels and sunlight exposure.

According to the Management Plan for the Northern Map Turtle (ECCC, 2019), Northern Map Turtle overwintering habitat includes well-oxygenated lake or river bottoms sheltered from ice formation at depths from 0.3 to 11.3 metres. Substrate is usually sand or gravel, and also includes features such as boulders, exposed ledges, or tree trunks. [redacted] exact locations of Northern Map Turtle overwintering habitat and areas with suitable biophysical attributes in the Project Site are unknown and therefore Project interactions are not well understood. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that alter the biophysical attributes required for Northern Map Turtle to overwinter, such as water depth, dissolved oxygen levels, and submerged cover objects, are likely to result in destruction of overwintering habitat for Northern Map Turtles during sediment management activities and post-sediment management (ECCC, 2019). Without knowledge of the extent of Northern Map Turtle overwintering habitat within the Project Site, post-remediation restoration may not succeed in reversing overwintering habitat loss. This Project interaction with biophysical attributes of Northern Map Turtle overwintering habitat is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies to assess springtime presence of Northern Map Turtles in restored habitat.

According to the Management Plan for the Northern Map Turtle (ECCC, 2019), Northern Map Turtles bask on stationary objects such as fallen trees, floating vegetation mats, exposed rocks, or terrestrial areas such as exposed banks. Basking habitat was evaluated and mapped as part of baseline studies to enhance understanding of where avoidance may be possible and allow for detailed mitigation and restoration planning (SNC-Lavalin, 2023). Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that remove or alter habitat features required for Northern Map Turtle thermoregulation are likely to result in destruction of thermoregulation habitat for Northern Map Turtles during sediment management activities and post-sediment management (ECCC, 2019). This Project interaction with Northern Map Turtle basking habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observations of Northern Map Turtles using habitat for thermoregulation.

3.2.2.5.5 Eastern Musk Turtle Thresholds

According to the Recovery Strategy for the Eastern Musk Turtle (EC, 2016), Eastern Musk Turtles nest close to the shoreline in sunny or partially shaded areas. Nests are shallow, laid in substrates such as rotting wood, leaf litter, a beaver or muskrat lodge, between tufts of grass in beach areas or shallow gravel, and soil-filled rock crevices. Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization in management units [redacted] that traverse Eastern Musk Turtle nests are likely to disturb Eastern Musk Turtle nests and site conditions during site preparation and sediment management (EC, 2016; Georgian Bay Biosphere Reserve, 2022). Nesting habitat was evaluated and mapped as part of baseline studies, and nesting data were provided by Friends of Kingston Inner Harbour, to understand where avoidance and preservation of habitat access may be possible and allow for detailed mitigation and restoration planning (SNC-Lavalin, 2023). This Project interaction with Eastern Musk Turtle nesting habitat is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been achieved is considered to be medium and as such the standard of proof is medium. The standard of proof would be measured by qualitative studies assessing preservation of Eastern Musk Turtle nest site conditions from anthropogenic modification, including substrate, moisture levels and sunlight exposure.

According to the Recovery Strategy for the Eastern Musk Turtle (EC, 2016), Eastern Musk Turtle overwintering habitat includes well-oxygenated, shallow water to a depth of 3 metres that does not freeze to the bottom, low levels of vegetation, and substrates composed of sand, gravel, and rocks. [redacted] however, exact locations of Eastern Musk Turtle overwintering habitat and areas with suitable biophysical attributes in the Project Site are unknown and therefore Project interactions are not well understood. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that alter the biophysical attributes required for Eastern Musk Turtle to overwinter, such as water depth, dissolved oxygen levels, aquatic vegetation abundance, and substrate composition, are likely to result in destruction of overwintering habitat for Eastern Musk Turtles during sediment management activities and post-sediment management (EC, 2016). Without knowledge of the extent of Eastern Musk Turtle overwintering habitat within the Project Site, post-remediation restoration may not succeed in reversing overwintering habitat loss. This Project interaction with biophysical attributes of Eastern Musk Turtle overwintering habitat is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies assessing springtime presence of Eastern Musk Turtles in restored habitat.

According to the Recovery Strategy for the Eastern Musk Turtle (EC, 2016), Eastern Musk Turtles are rarely observed out of the water and typically float just under the surface or beneath floating aquatic vegetation such as lily pads. Without mitigation, restoration, and/or specific Project design considerations, in-water works such as dredging, capping, and shoreline stabilization that remove or alter habitat features required for Eastern Musk Turtle thermoregulation are likely to result in destruction of thermoregulation habitat for Eastern Musk Turtles during sediment management activities and post-sediment management (EC, 2016). Restoration of water lilies and other floating aquatic vegetation immediately post-management is anticipated to mitigate habitat loss. This Project interaction with Eastern Musk Turtle basking habitat is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observational studies. The standard of proof would be measured by continued observations of Eastern Musk Turtles using habitat for thermoregulation.

Table 15: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Species at Risk Turtles

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Species at Risk Turtles							
In-water works such as dredging, capping, and shoreline stabilization that disturb thermoregulatory habitat result in the disruption of follicular development in reproductive female Species at Risk Turtles.	Temporary: during sediment management activities	Thermoregulation habitat remains secure such that during critical follicular development periods, reproductive females bask undisturbed.	During critical follicular development periods from May to mid-June and late-July to October, existing high-quality basking sites in each management unit remain available to reproductive females.	Low	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Timing windows to restrict work in high-quality basking habitat, such as during the spring critical follicular development period (and nesting period) from May through mid-July along the shorelines of Molly Brant Point and Douglas Fluhrer Park; Exclusion zones around high-quality basking habitat; Temporary or permanent (to be determined) provision of alternative and/or enhanced basking habitat in adjacent (undisturbed) area with adequate thermal exposure prior to commencement of in-water works. This should take into consideration the type of basking structures (e.g., log, fallen tree/branch, rock, vegetation) becoming disturbed/inaccessible in the in-water work area and should also consider providing new structures at a 2:1 ratio as practicable. Locations near nesting habitat should be the highest priority; Salvage and replacement of basking logs/structures/floating vegetation in	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring of re-installed and newly installed structures to determine if they provide thermoregulatory habitat as intended by the Site Restoration Plan.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						disturbed areas following completion of sediment management activities.	
In-water works such as dredging results in accidental capture of turtles.	Temporary: during sediment management activities	Incidental harm and mortality to turtles is limited to < 1% of individuals encountered during in-water works.	Isolated work areas are established during the active season only (May1 – September 30), and thorough salvage of turtles is conducted by a Qualified Professional(s) in isolated in-water work areas 24 to 48 hours prior to in-water work.	Low	Yes 1, 2, 4, 5, 6, 15, 16	Smaller sub-units isolated by turbidity curtain within Management Unit to be dredged to enhance detectability and capture of aquatic wildlife. Turbidity curtain designed with large, round floats covered in High Density Polyethylene (HDPE) to exclude turtles from in-water work areas by preventing them from crossing over top. Minimum height is recommended to be 60 cm above water level (MNRF, 2016a). HDPE cover also prevents wildlife such as muskrats from chewing and burrowing into floats; Wildlife exclusion fencing along terrestrial access points to in-water work areas.	Aquatic Resources Management Plan Dredging and Sediment Removal Plan Surface Water Management and Erosion and Sediment Control Plan

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Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial works such as site preparation and mobilization and shoreline stabilization [redacted] result in disturbance to nesting movements of female Species at Risk Turtles.	Temporary: during site preparation and sediment management activities	Terrestrial movement corridors for female Species at Risk Turtles remain available such that, during the nesting period, female Species at Risk Turtles safely and freely move to and from their nesting locations.	In Ontario, the nesting period for turtles approximately spans May to mid July. Terrestrial and shoreline works i[redacted] will monitor for and allow female Species at Risk Turtles to move safely and freely to and from their nesting locations.	Low	Yes 1, 2, 4, 15, 16, 24, 25, 26	Timing windows; Locate mobilization, laydown and stockpile areas away from known nesting habitat; Exclusion zones for terrestrial migration corridors between nesting habitat and aquatic habitat; Prior to the nesting period and under the guidance of a Qualified Biologist, construct temporary (or permanent) artificial nesting mounds or beaches in areas where work is completed or not taking place.	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan
Terrestrial works such as site preparation and mobilization and shoreline stabilization i[redacted] result in disturbance to hatchlings dispersing from nests to aquatic habitats.	Temporary: during site preparation and sediment management activities	Terrestrial movement corridors for dispersing Species at Risk Turtle hatchlings remain available such that, following emergence, hatchling Species at Risk Turtles safely and freely move from their nests to aquatic habitats.	In Ontario, hatchlings emerge from nests in spring between April and late June and in fall from August to late October. Terrestrial and shoreline works i[redacted] will monitor for and allow hatchling Species at Risk Turtles to move safely and freely from their nests to aquatic habitats.	Low	Yes 1, 2, 4, 15, 16, 24, 25, 26	Timing windows; Locate mobilization, laydown and stockpile areas away from known nesting habitat; Exclusion zones for terrestrial migration corridors between nesting habitat and aquatic habitat.	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Species at Risk Turtles are attracted to suitable nesting opportunities within terrestrial work areas associated with site preparation, mobilization and shoreline stabilization.	Temporary: during site preparation and sediment management activities	Species at Risk Turtles are prevented from nesting within terrestrial work sites, material stockpiles and along access roads.	Terrestrial work areas, including access roads, are secured by fencing to prevent Species at Risk Turtles from nesting on work site or in stockpiled materials.	Low	Yes 1, 15, 16, 25, 26	Locate mobilization, laydown and stockpile areas away from known nesting habitat.	Erosion and Sediment Control Plan Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan
In-water works such as dredging, capping, and shoreline stabilization during the turtle overwintering period causes disturbance to overwintering individual Species at Risk Turtles.	Temporary: during sediment management activities	Overwintering individual Species at Risk Turtles remain undisturbed between October and April.	In Ontario, the overwintering period for turtles spans approximately October to April. In-water work in overwintering habitat during this period will be avoided if turtles are present.	Low	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Timing windows; Exclusion zones and movement corridors around and to turtle overwintering habitat; Prior to the turtle overwintering period (e.g., before end of September), isolation of in-water work areas with aquatic wildlife rescue led by a Qualified Biologist. Aquatic wildlife relocated to suitable habitat outside of isolated work areas. In-water work areas remain isolated until completion of remediation work.	Studies identifying locations of turtle overwintering sites within the proposed in-water work areas, which may be achieved through telemetry and/or imagery (e.g., Remote Operated Vehicle with camera; adapted Ground Penetrating Radar paired with high resolution sonar). Clearly mapped Species at Risk Turtle overwintering habitat boundaries. Wildlife Scientific Collector's Authorization (WSCA) from Peterborough District MNRF

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						Turbidity curtain used for isolated in-water work areas designed with large, round floats covered in High Density Polyethylene (HDPE) to exclude turtles from in-water work areas by preventing them from crossing over top. Minimum height is recommended to be 60 cm above water level (MNRF, 2016a). HDPE cover also prevents wildlife such as muskrats from chewing and burrowing into floats; Wildlife exclusion fencing along terrestrial access points to in-water work areas.	with approved Wildlife Animal Care Committee animal care and handling protocols. Parks Canada Research and Collection Permit for ecological work (e.g., turtle rescue) conducted in PC-W and PC-E Species at Risk Protection Plan Species at Risk Contractor Training. Dredging and Sediment Removal Plan Aquatic Resources Management Plan Surface Water Management and Erosion and Sediment Control Plan Monitoring of active project areas for presence of Species at Risk Turtles, including intervention to avoid harm or in the instance of injury.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of overwintering areas.
Snapping Turtles							
Terrestrial works such as site preparation and mobilization and shoreline stabilization [redacted] result in disturbance to Snapping Turtle nests.	Temporary: during site preparation and sediment management activities	Snapping Turtle nests remain secure and effective for egg incubation such that, at a minimum, the nest site conditions are maintained.	Nests discovered within or adjacent to terrestrial work areas, including access routes, are protected until hatchlings have emerged or July 1 of the following year, whichever is sooner. Sites disturbed post-hatchling emergence are restored to attain suitable biophysical attributes for Snapping Turtle.	Medium	Yes 1	N/A	Species at Risk Protection Plan Species at Risk Contractor Training Site Restoration Plan Monitoring of protected nests for signs of disturbance and hatchling emergence.
In-water works such as dredging, capping, and shoreline stabilization that occur in Snapping Turtle overwintering habitat result in destruction of	Temporary: during sediment management activities And	Habitat remains secure and effective for Snapping Turtle overwintering such that, at a minimum, Snapping Turtles continue to be observed in habitat following the	Biophysical attributes of Snapping Turtle overwintering habitat as described in the Management Plan (ECCC, 2020) are restored to disturbed overwintering areas	High	No. Will need to be project-specific, directly influencing sediment management	Where possible, avoidance of disturbance to known overwintering habitat via exclusion zones. Compensation prior to sediment management activities through creation or enhancement of suitable overwintering habitat, including movement corridors, outside of	Studies identifying locations of turtle overwintering sites within the proposed in-water work areas, which may be achieved through telemetry and/or imagery, resulting in clearly mapped Snapping

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Snapping Turtle overwintering habitat.	Long term: post-sediment management	overwintering period (spring).	confirmed for this species.		locations and methods.	Project Impact Area and/or in lesser contaminated locations proposed for natural recovery. Compensation should be conducted at a 2:1 ratio for area of habitat to be removed as creation of overwintering habitat is not a well-established process and may not be successful in providing precise requirements across the entire area.	Turtle overwintering habitat boundaries. Species at Risk Protection Plan Species at Risk Contractor Training Surface Water Management and Erosion and Sediment Control Plan Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of overwintering areas.
Dredging, capping, and shoreline stabilization result in the removal or	Temporary: during sediment	Habitat remains secure and effective for Snapping Turtle thermoregulation such	Where Snapping Turtle basking has previously been observed, thermoregulatory habitat	Low	No. Will need to be project-	Maintenance of existing basking structures in-situ;	Species at Risk Protection Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
alteration of Snapping Turtle habitat features used for thermoregulation.	management activities And Long term: post-sediment management	that, at a minimum, Snapping Turtles continue to be observed using habitat for thermoregulation.	remains comprised of structures similar in size and composition and/or matching the biophysical attributes described in the Management Plan (ECCC, 2020).		specific, directly influencing sediment management locations and methods.	Exclusion zones around high-quality basking habitat; Temporary or permanent (to be determined) provision of alternative and/or enhanced Snapping Turtle basking habitat in adjacent (undisturbed) area with adequate thermal exposure prior to commencement of in-water works. This should take into consideration the type of basking structures (e.g., log, fallen tree/branch, rock, vegetation) becoming disturbed/inaccessible in the in-water work area and should also consider providing new structures at a 2:1 ratio as practicable; Salvage and replacement of basking logs/structures/vegetation in disturbed areas.	Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of basking areas.
Midland Painted Turtles							
Terrestrial and shoreline works such as site preparation and mobilization and shoreline stabilization [redacted] result in disturbance to	Temporary: during site preparation and sediment management activities	Midland Painted Turtle nests remain secure and effective for egg incubation such that, at a minimum, the nest site conditions are maintained.	Nests discovered within or adjacent to terrestrial work areas, including access routes, are protected until hatchlings have emerged or July 1 of the following year, whichever is sooner. Sites disturbed post-	Medium	Yes 1	N/A	Species at Risk Protection Plan Species at Risk Contractor Training Site Restoration Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Midland Painted Turtle nests.			hatchling emergence are restored to attain suitable biophysical attributes for Midland Painted Turtle.				Monitoring of protected nests for signs of disturbance and hatchling emergence.
In-water works such as dredging, capping, and shoreline stabilization that occur in Midland Painted Turtle overwintering habitat result in destruction of Midland Painted Turtle overwintering habitat.	Temporary: during sediment management activities And Long term: post-sediment management	Habitat remains secure and effective for Midland Painted Turtle overwintering such that, at a minimum, Midland Painted Turtles continue to be observed in habitat following the overwintering period (spring).	Biophysical attributes of Midland Painted Turtle overwintering as described in the COSEWIC Assessment and Status Report (COSEWIC, 2019) are restored to disturbed overwintering areas confirmed for this species.	High	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Where possible, avoidance of disturbance to known overwintering habitat via exclusion zones. Compensation prior to sediment management activities through creation or enhancement of suitable overwintering habitat, including movement corridors, outside of Project Impact Area and/or in lesser contaminated locations proposed for natural recovery. Compensation should be conducted at a 2:1 ratio for area of habitat to be removed as creation of overwintering habitat is not a well-established process and may not be successful in providing precise requirements across the entire area.	Studies identifying locations of turtle overwintering sites within the proposed in-water work areas, which may be achieved through telemetry and/or imagery resulting in clearly mapped Midland Painted Turtle overwintering habitat boundaries. Species at Risk Protection Plan Species at Risk Contractor Training Surface Water Management and Erosion and Sediment Control Plan Dredging and Sediment Removal Plan Aquatic Resources Management Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of overwintering areas.
In-water works such as dredging, capping, and shoreline stabilization result in the removal or alteration of Midland Painted Turtle habitat features used for thermoregulation.	Temporary: during sediment management activities And Long term: post-sediment management	Habitat remains secure and effective for Midland Painted Turtle thermoregulation such that, at a minimum, Midland Painted Turtles continue to be observed using habitat for thermoregulation.	Where Midland Painted Turtle basking has previously been observed, thermoregulatory habitat remains comprised of structures similar in size and composition in locations and/or matching the biophysical attributes as described in the COSEWIC Assessment and Status Report (COSEWIC, 2019).	Low	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Maintenance of existing basking structures in-situ; Exclusion zones around high-quality basking habitat; Temporary or permanent (to be determined) provision of alternative and/or enhanced Midland Painted Turtle basking habitat in adjacent (undisturbed) area with adequate thermal exposure prior to commencement of in-water works. This should take into consideration the type of basking structures (e.g., log, fallen tree/branch, rock, vegetation) becoming disturbed/inaccessible in the in-water work area and should also consider providing new structures at a 2:1 ratio as practicable;	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of basking areas.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						Salvage and replacement of basking logs/structures/vegetation in disturbed areas.	
Northern Map Turtles							
Terrestrial and shoreline works such as site preparation and mobilization and shoreline stabilization [redacted] result in disturbance to Northern Map Turtle nests.	Temporary: during site preparation and sediment management activities	Northern Map Turtle nests remain secure and effective for egg incubation such that, at a minimum, the nest site conditions are maintained.	Nests discovered within or adjacent to terrestrial work areas, including access routes, are protected until hatchlings have emerged or July 1 of the following year, whichever is sooner. Sites disturbed post-hatchling emergence are restored to attain suitable biophysical attributes for Northern Map Turtle.	Medium	Yes 1	N/A	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Monitoring of protected nests for signs of disturbance and hatchling emergence.
In-water works such as dredging, capping, and shoreline stabilization that occur in Northern Map Turtle overwintering habitat result in destruction of Northern Map Turtle overwintering habitat.	Temporary: during sediment management activities And	Habitat remains secure and effective for Northern Map Turtle overwintering such that, at a minimum, Northern Map Turtles continue to be observed in habitat following the	Biophysical attributes of Northern Map Turtle overwintering habitat as described in the Management Plan (ECCC, 2019) are restored to disturbed overwintering areas	High	No. Will need to be project-specific, directly influencing sediment management	Where possible, avoidance of disturbance to known overwintering habitat via exclusion zones. Compensation prior to sediment management activities through creation or enhancement of suitable overwintering habitat, including movement corridors, outside of Project Impact Area and/or in lesser	Studies identifying locations of turtle overwintering sites within the proposed in-water work areas, which may be achieved through telemetry and/or imagery resulting in clearly mapped Northern Map Turtle overwintering habitat boundaries.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
	Long term: post-sediment management	overwintering period (spring).	confirmed for this species.		locations and methods.	contaminated locations proposed for natural recovery. Compensation should be conducted at a 2:1 ratio for area of habitat to be removed as creation of overwintering habitat is not a well-established process and may not be successful in providing precise requirements across the entire area.	Species at Risk Protection Plan Species at Risk Contractor Training Surface Water Management and Erosion and Sediment Control Plan Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of overwintering areas.
In-water works such as dredging, capping, and shoreline stabilization result in the removal or alteration of Northern Map Turtle	Temporary: during sediment management activities	Habitat remains secure and effective for Northern Map Turtle thermoregulation such that, at a minimum, Northern Map Turtles	Where Northern Map Turtle basking has previously been observed, thermoregulatory habitat remains comprised of structures similar in size	Low	No. Will need to be project-specific, directly influencing	Maintenance of existing basking structures in-situ; Exclusion zones around high-quality basking habitat;	Species at Risk Protection Plan Species at Risk Contractor Training

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
habitat features used for thermoregulation.	And Long term: post-sediment management	continue to be observed using habitat for thermoregulation.	and composition and/or matching the biophysical attributes described in the Management Plan (ECCC, 2019).		sediment management locations and methods.	Temporary or permanent (to be determined) provision of alternative and/or enhanced Northern Map Turtle basking habitat in adjacent (undisturbed) area with adequate thermal exposure prior to commencement of in-water works This should take into consideration the type of basking structures (e.g., log, fallen tree/branch, rock, vegetation) becoming disturbed/inaccessible in the in-water work area and should also consider providing new structures at a 2:1 ratio as practicable; Salvage and replacement of basking logs/structures/vegetation in disturbed areas.	Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of basking areas.
Eastern Musk Turtles							
Terrestrial and shoreline works such as site preparation and mobilization and shoreline stabilization [redacted] result in disturbance to Eastern Musk Turtle nests.	Temporary: during site preparation and sediment management activities	Eastern Musk Turtle nests remain secure and effective for egg incubation such that, at a minimum, the nest site conditions are maintained.	Nests discovered within or adjacent to terrestrial work areas, including access routes, are protected until hatchlings have emerged or July 1 of the following year, whichever is sooner. Sites disturbed post-hatchling emergence are restored to attain	Medium	Yes 1	N/A	Species at Risk Protection Plan Species at Risk Contractor Training Site Restoration Plan Monitoring of protected nests for signs of disturbance and hatchling emergence.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
			suitable biophysical attributes for Eastern Musk Turtle.				
In-water works such as dredging, capping, and shoreline stabilization that occur in Eastern Musk Turtle overwintering habitat result in destruction of Eastern Musk Turtle overwintering habitat.	Temporary: during sediment management activities And Long term: post-sediment management	Habitat remains secure and effective for Eastern Musk Turtle overwintering such that, at a minimum, Eastern Musk Turtles continue to be observed in habitat following the overwintering period (spring).	Biophysical attributes of Eastern Musk Turtle overwintering habitat as described in the Recovery Strategy (EC, 2016) are restored to disturbed overwintering areas confirmed for this species.	High	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Where possible, avoidance of disturbance to known overwintering habitat via exclusion zones. Compensation prior to sediment management activities through creation or enhancement of suitable overwintering habitat, including movement corridors, outside of Project Impact Area and/or in lesser contaminated locations proposed for natural recovery. Compensation should be conducted at a 2:1 ratio for area of habitat to be removed as creation of overwintering habitat is not a well-established process and may not be successful in providing precise requirements across the entire area.	Studies identifying locations of turtle overwintering sites within the proposed in-water work areas, which may be achieved through telemetry and/or imagery. Clearly mapped Eastern Musk Turtle overwintering habitat boundaries. Species at Risk Protection Plan Species at Risk Contractor Training Surface Water Management and Erosion and Sediment Control Plan Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of overwintering areas.
In-water works such as dredging, capping, and shoreline stabilization result in the removal or alteration of Eastern Musk Turtle habitat features used for thermoregulation.	Temporary: during sediment management activities And Long term: post-sediment management	Habitat remains secure and effective for Eastern Musk Turtle thermoregulation such that, at a minimum, Eastern Musk Turtles continue to be observed using habitat for thermoregulation.	Where Eastern Musk Turtle basking has previously been observed, thermoregulatory habitat remains comprised of structures similar in size and composition and/or matching the biophysical attributes described in the Recovery Strategy (EC, 2016).	Low	No. Will need to be project-specific, directly influencing sediment management locations and methods.	Maintenance of existing basking structures in-situ; Exclusion zones around high-quality basking habitat; Temporary or permanent (to be determined) provision of alternative and/or enhanced Eastern Musk Turtle basking habitat in adjacent (undisturbed) area with adequate thermal exposure prior to commencement of in-water works This should take into consideration the type of basking structures (e.g., log, fallen tree/branch, rock, vegetation) becoming disturbed/inaccessible in the in-water work area and should also consider providing new structures at a 2:1 ratio as practicable; Salvage and restoration of water lily rhizomes in disturbed areas shallower than 1 metre. Possibly	Species at Risk Protection Plan Species at Risk Contractor Training Dredging and Sediment Removal Plan Aquatic Resources Management Plan Site Restoration Plan Follow-up monitoring using the 2015 MNRF Survey Protocol for Blanding's Turtles in Ontario or other approved standardized protocol to assess use of basking areas.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						achieved through stockpiling of removed rhizomes or transplanting from nearby locations.	

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.3 Species at Risk Birds

Data from the OBBA (Cadman et al., 2007) and NHIC database indicate that breeding habitat for nine (9) SAR birds have a moderate to high potential to occur in KIH (**Table 16**). Initial desktop screening also found potential for Black Tern (*Chlidonias niger*; ESA – Special Concern, SARA – No Status) and King Rail (*Rallus elegans*; ESA – Endangered, SARA – Endangered); however, following field investigations by SNC-Lavalin it was determined that potential for occurrence is low due to lack of breeding habitat suitability and availability. [redacted]

Table 16: Kingston Inner Harbour Species at Risk Birds

Common Name	Scientific Name	SARO Status[1]	SARA Status[2]	Provincial S-Rank[3,4]
Barn Swallow	*Hirundo rustica*	Special Concern	Threatened	S4B
Chimney Swift	*Chaetura pelagica*	Threatened	Threatened	S3B
Common Nighthawk	*Chordeiles minor*	Special Concern	Special Concern	S4B
Eastern Whip-poor-will	*Antrostomus vociferus*	Threatened	Threatened	S4B
Eastern Wood-pewee	*Contopus virens*	Special Concern	Special Concern	S4B
Evening Grosbeak	*Coccothraustes vespertinus*	Special Concern	Special Concern	S4
Least Bittern	*Ixobrychus exilis*	Threatened	Threatened	S4B
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Endangered	Endangered	S3
Wood Thrush	*Hylocichla mustelina*	Special Concern	Threatened	S4B

[1] Species at Risk in Ontario List. (2023, January 24). Ministry of the Environment, Conservation and Parks. Retrieved March 27, 2023, from https://www.ontario.ca/page/species-risk-ontario
[2] Species at Risk Public Registry. (2023, March 6). Government of Canada. Retrieved March 27, 2023, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
[3] Natural Heritage Information Centre (NHIC). (2022, December 20). Government of Ontario. Retrieved March 27, 2023, from https://www.ontario.ca/page/get-natural-heritage-information
[4] Provincial S-Rank (NHIC): S3 – Vulnerable; S3B – Vulnerable Breeding; S4 – Apparently Secure; S4B – Apparently Secure Breeding

The Environmental Impact Assessment conducted by Ecological Services (2017, 2019) for the former Davis Tannery property detected [redacted] No other SAR birds were reported from surveys conducted by Ecological Services in 2014, 2018 and 2019, despite targeted surveys for Least Bittern (*Ixobrychus exilis*) and King Rail in 2014.

A Terrestrial Ecological Assessment and Analysis conducted by Ecological Services for the Kingston Third Crossing included bird surveys from 2008 – 2010; however, time of year and survey method were not detailed in the report(Ecological Services, 2011). None of the above listed SAR birds were reported as part of that assessment. Additionally, breeding bird surveys conducted in 2016 for the Kingston Third Crossing did not detect any SAR birds in the KIH Project Impact Area (Golder, 2017b). [redacted]. It was noted that water levels across the survey stations in 2021 were 0.6 m below 2020 levels.

On eBird (2022), breeding season (May-July) observations in the last 10 years have been recorded in the Project Study Area for Barn Swallow (*Hirundo rustica*), Black Tern, Chimney Swift (*Chaetura pelagica*), Eastern Wood-pewee, Least Bittern, Red-headed Woodpecker (*Melanerpes erythrocephalus*), and Wood Thrush (*Hylocichla mustelina*). Both Barn Swallow and Eastern Wood-pewee have likewise been recorded in the iNaturalist (2022) database. [redacted]

In 2021, SNC-Lavalin conducted two types of SAR-targeted breeding bird surveys in KIH: surveys for cryptic marsh species (Least Bittern and King Rail) following the Least Bittern Survey Protocol (Jobin et al., 2011), and surveys for nightjars (Common Nighthawk [*Chordeiles minor*] and Eastern Whip-poor-will) following the Canadian Nightjar Survey Protocol – 2019 (WildResearch, 2019) (SNC-Lavalin, 2023). In both cases, no SAR birds were detected. In 2022, SNC-Lavalin biologists incidentally recorded two (2) Least Bittern [redacted] Following this, three (3) more targeted surveys were conducted according to the Least Bittern Survey Protocol (Jobin et al., 2011); however, no Least Bittern were detected (SNC-Lavalin, 2023).

Least Bittern critical habitat is composed of two factors: habitat suitability and habitat occupancy. The biophysical attributes of suitable Least Bittern breeding habitat include (EC, 2014):

- Permanent wetlands[12] (marshes and shrubby swamps within the boundaries of the high-water mark), and
- Tall and robust emergent and herbaceous and/or woody vegetation interspersed with areas of open water (hemi-marsh conditions), and
- Water level fluctuations close to those of a natural regime.

Least Bittern habitat occupancy can be confirmed by coordinates corresponding to the following minimum breeding activity that occur within a 500 m area of suitable breeding habitat (EC, 2014):

- One (1) record of confirmed[13] breeding since 2001; Or
- Two (2) records of probable breeding in any single year since 2001; Or
- One (1) record of probable breeding in each of two (2) separate years within a 5-year floating window footnote since 2001.

[redacted] Observationally, low water levels such as those experienced in 2021 may temporarily alter habitat suitability on a year-to-year basis. Unless habitat suitability permanently changes, critical habitat status may change at any future time if habitat occupancy criteria are met. Based on the biophysical attributes and potential occupancy, the habitat may qualify as Least Bittern critical

[12] Permanent wetlands include naturally occurring wetlands as well as artificial wetlands managed for conservation purposes.
[13] Refer to Breeding Evidence descriptions provided by Birds Canada for Confirmed breeding evidence and Probable breeding evidence at https://www.birdsontario.org/breeding-codes/

habitat. Critical habitat status, including habitat suitability and occupancy, will be examined as part of the DIA.

Incidentally during other KIH field surveys conducted by SNC-Lavalin (2023), Barn Swallow, Chimney Swift, and Eastern Wood-pewee were detected. [redacted]

According to the Rideau Canal Management Plan (Parks Canada, 2005), "the habitat of flora and fauna species designated as rare, threatened or endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or by the Province of Ontario" must be respected and safeguarded as vital heritage resources. Riparian habitat is the most extensive habitat type throughout the Project Study Area and is used by many species for breeding and feeding. Eastern Wood-pewee is a species associated with forest edges, while Barn Swallow are associated with anthropogenic structures and open habitats. Both can be found along river shorelines to nest and forage for insects. Least Bittern is a species that relies on marshes surrounded by open water and is known to nest in the Area of Assessment, north of the Inner Harbour. The breadth of habitats occupied by these three species is representative of the other six potentially occurring bird species at risk.

The Project Impact Area includes a broad range of breeding habitats, including wetlands, meadow, shoreline, forest, and built structures upon or within which birds may nest. Species at Risk Birds are of particular concern as they are protected by several measures under the federal *Migratory Birds Convention Act*, 1994 (S.C. 1994, c. 22) and also the *Species at Risk Act* (S.C. 2002, c. 29). Species at Risk Birds was selected as a Project VC as proposed sediment management activities have potential to impact Species at Risk Birds and their habitats within the Project Site.

3.2.3.1 Thresholds

A background information review and incidental observations during field surveys indicate that several species at risk birds are known to occur in the vicinity of the Project Site and may forage in this area and establish breeding habitat. Without mitigation and/or specific Project design considerations, sediment management and intervention activities that generate noise exceeding 50 decibels are likely to result in disturbance of breeding Species at Risk Birds during site preparation and sediment management activities (ECCC, 2021). This Project interaction with Species at Risk Birds is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by sediment management activity-related exceedances of the noise limit within Species at Risk Bird breeding habitat between April 1 and August 31.

A background information review and incidental observations during field surveys indicate that several species at risk birds are known to occur in the vicinity of the Project Site and may forage in this area and establish breeding habitat. Without mitigation, restoration, and/or specific Project design considerations, in-water and terrestrial works that remove vegetation between April 1 and August 31 are likely to result in destruction of breeding and foraging habitat for Species at Risk Birds during sediment management activities and post-sediment management (ECCC, 2018b). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. The waterlots that compose Orchard Street Marsh (PC-OM and PP-OM) have been identified as requiring further studies and individual management plan for less intrusive options, and as such the marsh will not have any vegetation removed as part of the present SMP. This Project interaction with Species at Risk Birds is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by any destruction of or harm to Species at Risk Birds and their nests caused by vegetation removal.

Barn Swallow have been recorded incidentally [redacted] Without mitigation, restoration, and/or specific Project design considerations, terrestrial works that remove vegetation with 5 metres of a Barn Swallow nest are likely to result in destruction of Barn Swallow breeding and foraging habitat during sediment management activities and post-sediment management (MECP, 2021b). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. This Project interaction with Species at Risk Birds: Barn Swallow is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by any vegetation removal occurring within 5 metres of a Barn Swallow nest.

Individual Least Bittern have been recorded infrequently [redacted] There is potential for this species to occupy suitable habitat in the Project Impact Area, in which case the habitat would meet the criteria for critical habitat. The waterlots that compose Orchard Street Marsh (PC-OM and PP-OM) have been identified as requiring further studies and individual management plan for less intrusive options, and as such the marsh will not have any vegetation or sediments removed as part of the present SMP. Without mitigation, restoration, and/or specific Project design considerations, sediment management and intervention activities occurring within Least Bittern critical habitat are likely to result in destruction of Least Bittern breeding habitat during sediment management activities and post-sediment management (MNRF, 2016b). Currently, critical habitat has not been confirmed in the Project Impact Area, and areas of suitable habitat [redacted] are not anticipated to be disturbed by sediment management activities. This Project interaction with Species at Risk Birds: Least Bittern is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by monitoring for Least Bittern occupancy as described by the Recovery Strategy (EC, 2014) and protection of suitable habitat (as defined by the Recovery Strategy [EC, 2014]) within 500 metres of any confirmed or probable breeding observation intersecting with the Project Site during the sediment management phase of the Project.

Table 17: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Species at Risk Birds

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Species at Risk Birds							
Noise from terrestrial and in-water works such as site preparation and mobilization, dredging, and capping result in the disturbance of breeding Species at Risk Birds.	Temporary: during site preparation and sediment management activities	Noise levels remain at or below levels known to cause disturbance to breeding Species at Risk Birds.	Between April 1 and August 31, noise levels in proximity to Species at Risk Birds breeding habitat are limited to 50 decibels as per the federal Guidelines to Reduce Risk to Migratory Birds.	Low	Yes 1, 12, 13, 15, 17, 33, 39	Timing windows for work that exceeds noise level threshold. Noise abatement. Staging noisy equipment away from breeding bird habitat features such that noise diminishes to 50 dB or below at the habitat edge.	Breeding Bird Surveys on Belle Island to determine presence/no detection for species at risk birds within the Project Impact Area. Noise, Vibration and Ambient Light Management Plan. Species at Risk Protection Plan Species at Risk Contractor Training Monitoring for noise levels
Terrestrial and in-water works such as site preparation and mobilization, dredging, capping, and wetland remediation that remove vegetation result in destruction of undetected breeding and foraging habitat for Species at Risk Birds.	Temporary: during site preparation and sediment management activities And Long term: post-sediment management	Habitat remains secure such that, during the breeding season, potentially suitable breeding and foraging habitats are maintained.	Avoidance of vegetation removal during the Species at Risk Birds breeding season between April 1 and August 31.	Low	Yes 1, 2, 12, 13, 15, 17, 28	Timing windows.	Breeding Bird Surveys on Belle Island to determine presence/no detection for species at risk birds within the Project Impact Area. Vegetation Protection Plan Species at Risk Protection Plan Species at Risk Contractor Training Monitoring of active project areas for presence of bird nests.
Terrestrial works involved in site preparation and mobilization that remove	Temporary: during sediment	Habitat remains secure and effective for Barn Swallow such that, at a	Avoidance of vegetation removal from within 5 metres of	Low	Yes	Exclusion zones established surrounding confirmed Barn Swallow	Breeding Bird Surveys on Belle Island to determine presence/no

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
vegetation in proximity to nesting Barn Swallows result in destruction of breeding and foraging habitat for Barn Swallow.	management activities And Long term: post-sediment management	minimum, existing breeding and foraging sites are maintained.	any Barn Swallow nest during the breeding season as per the Barn Swallow General Habitat Description (MECP, 2021b).		1, 18, 27	habitat, including the Barn Swallow artificial nesting structure.	detection for species at risk birds within the Project Impact Area. Clearly mapped breeding and foraging areas for Barn Swallow (e.g., Barn Swallow Roosting Structure).Vegetation Protection Plan Species at Risk Protection Plan Species at Risk Contractor Training Monitoring of active project areas for presence of Barn Swallow nests.
Terrestrial and in-water works in wetlands such as site preparation and mobilization, dredging, capping, and wetland remediation that remove vegetation result in destruction of Least Bittern breeding habitat.	Temporary: during sediment management activities And Long term: post-sediment management	If Least Bittern is detected prior to or during sediment management activities, habitat remains secure and effective such that, at a minimum, existing breeding habitat is maintained.	Avoidance of vegetation removal in suitable Least Bittern breeding habitat within 500 metres of a confirmed or probable breeding record as per the Recovery Strategy (EC, 2014).	Medium	Yes 36	If habitat is confirmed prior to commencement of works: Exclusion zones around confirmed Least Bittern breeding habitat.	Least Bittern critical habitat has been partially detected as Orchard Street Marsh meets habitat suitability criteria. At any point in the future, occupancy criteria can be confirmed by coordinates corresponding to the following minimum breeding activity: • One (1) record of confirmed breeding since 2001; Or • Two (2) records of probable breeding in any single year since 2001; Or • One (1) record of probable breeding in each of two (2) separate years within a 5-year

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							floating window footnote since 2001. Species at Risk Protection Plan Species at Risk Contractor Training Monitoring for Least Bittern in suitable habitat within 500 metres of project activities during breeding season using Least Bittern Survey Protocol (Jobin et al., 2011).

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.4 Species at Risk Bats

Bats in Ontario are small and secretive, often only visible in the fading light of the evening sky as they emerge from their roosts in trees and other structures. As they are difficult to view and also to identify without close-up inspection, they tend to be underreported in citizen science databases such as iNaturalist. The Mammal Atlas of Ontario (Dobbyn, 1994) identifies the following four (4) species, listed as SAR, with ranges that include the Project Study Area: Little Brown Myotis (*Myotis lucifugus*), Northern Myotis (*Myotis septentrionalis*), Eastern Small-footed Myotis (*Myotis leibii*), and Tri-colored Bat (*Perimyotis subflavus*) (**Table 18**).

Table 18: Kingston Inner Harbour Species at Risk Bats

Common Name	Scientific Name	SARO Status[1]	SARA Status[2]	Provincial S-Rank[3,4]
Eastern Small-footed Myotis	*Myotis leibii*	Endangered	No Status	S2S3
Little Brown Myotis	*Myotis lucifugus*	Endangered	Endangered	S3
Northern Myotis	*Myotis septentrionalis*	Endangered	Endangered	S3
Tricolored Bat	*Perimyotis subflavus*	Endangered	Endangered	S3?

[1] Species at Risk in Ontario List. (2022, February 24). Ministry of the Environment, Conservation and Parks. Retrieved April 5, 2022, from https://www.ontario.ca/page/species-risk-ontario
[2] Species at Risk Public Registry. (2022, March 10). Government of Canada. Retrieved April 5, 2022, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
[3] Natural Heritage Information Centre (NHIC). (2022, February 28). Government of Ontario. Retrieved April 5, 2022, from https://www.ontario.ca/page/get-natural-heritage-information
[4] Provincial S-Rank (NHIC): S2S3 – Imperiled to Vulnerable; S3 – Vulnerable; ? – denotes inexact numeric rank

Eastern Small-footed Myotis is a non-migratory species that roosts in a variety of habitats, primarily in open, sunny rocky habitats and occasionally in buildings. During the winter, this species hibernates in caves and abandoned mines (Humphrey, 2017). Summer habitat is still poorly understood for the Eastern Small-footed Myotis, meaning that it is not currently possible to identify specific areas of foraging habitat used by this species (Humphrey, 2017). In Ontario, females give birth to one young per year between mid-May and the end of July, roosting alone or in small maternity colonies in a variety of habitats (e.g., old barn, rocky habitats) (Humphrey, 2017).

Little Brown Myotis is a non-migratory species that is commonly found roosting in anthropogenic structures (e.g., bat boxes, bridges, and barns) but also uses cavities of canopy trees, foliage, tree bark, crevices on cliffs, and other structures (Fenton and Barclay, 1980; Slough, 2009; Coleman and Barclay, 2011; Randall et al. 2014). Overwintering can occur in a variety of underground sites including caves, abandoned mines, wells, and tunnels, with bats typically hibernating in clusters when temperatures are cooler (ECCC, 2018c; Kurta and Smith, 2014). Little Brown Myotis are most often associated with open habitats, including ponds, roads, and open canopy forest (Segers and Broders, 2014). Females prefer large-diameter trees for maternity roosting, but also exhibit high site fidelity to anthropogenic structures (Olson & Barclay, 2013; Randall et al. 2014).

Northern Myotis is a non-migratory species that can be found roosting individually or in small groups in trees, but also in anthropogenic structures (Sasse and Perkins, 1996; Foster and Kurta, 1999; Caceres and Barclay, 2000; Carter and Feldhammer, 2005). This species forages along forest edges, within forests, and along forest-covered creeks and roadsides (Caceres and Barclay, 2000; Ratcliffe and Dawson, 2003; Henderson and Broders, 2008; Owen et al. 2003). Northern Myotis will hibernate in cool sections of mines and caves, typically individually (Barbour and Davis, 1969; Kurta and Smith, 2014). Little is known about maternity habitat use by Northern Myotis in Ontario (Humphrey and Fotherby, 2019).

Tri-colored Bat is a non-migratory species that roost in live and dead deciduous foliage, particularly in dead leaf clusters on living trees (MNRF, 2017). In the spring and summer, this species primarily forages in forested riparian areas, over water, and in open areas (Ethier and Fahrig, 2011). Overwintering habitat for hibernation is strictly limited to deep caves or mines where temperatures are stable and there is high humidity (ECCC, 2018c).

The greatest threat posed to all four (4) SAR bats is white-nose syndrome, a fungus that kills these species at their hibernacula by disrupting the hibernation cycle and exhausting fat supplies during the winter (Warnecke et al. 2012; Humphrey, 2017; ECCC, 2018c).

Critical Habitat for Little Brown Myotis, Northern Myotis and Tri-colored Bat has been partially identified regarding hibernacula (ECCC, 2018c). Currently, maternity roosts, migration routes, swarming sites, and male roosting sites are not identified as Critical Habitat as they warrant further study to determine biophysical attributes and importance (ECCC, 2018c). On land under provincial jurisdiction in Ontario, general habitat protections for these four (4) species apply to roosting habitat, maternity roosting habitat, foraging habitat, and hibernacula and swarming sites as regulated habitat has not yet been fully defined. No known hibernacula habitat features exist within the Project Study Area, but anthropogenic structures and treed habitats have the potential to provide maternity roosts. In March 2020, PSPC, TC and PCA confirmed with Environment and Climate Change Canada that there is no Critical Habitat for any bat species within or close to the Project Site.

During the spring and early summer, most Ontario bat species rely on forest habitat that supports a healthy density of large-diameter cavity trees. Females form maternity colonies in tree cavities that provide a warm, humid microclimate that optimizes gestation and postnatal growth of offspring (Kunz and Anthony, 1982). [redacted]

A bat habitat assessment and acoustic monitoring surveys were conducted by Ecological Services in 2019 in support of the former Davis Tannery property Environmental Impact Assessment. [redacted] The methods of the former Davis Tannery property EIA (Ecological Services, 2019) do not describe whether acoustic recordings were manually identified or auto-identified by software – manual identification is often regarded as having higher accuracy if conducted by an experienced individual. It is possible these passes were mis-identified as belonging to SAR bats, given the low number of passes detected. These surveys were also overwhelmingly conducted during the months of July and August which is outside of the recommended survey period for bats (June 1st to June 30th) (MNRF, 2017; MNR, 2011).

The Kingston Third Crossing Natural Environment Assessment (Golder, 2017b) did not include acoustic surveys but did identify candidate maternity roost trees within the study area for that project. The Species at Risk Bat Survey (Hatch, 2019a) indicated Golder conducted Bat Surveys in 2018. A Species at Risk review was conducted on the East and West Approaches and Snag Surveys took place near these locations. Acoustic monitoring confirmed Little Brown Myotis and Northern Myotis within the study area. However, the Species at Risk Bat Survey is not available publicly, and details of survey methodology and results are unknown.

In 2021, SNC-Lavalin conducted bat maternity roost surveys in accordance with Bats and Bat Habitats: Guidelines for Wind Power Projects (MNR, 2011). Forty-one (41) plots were assessed during the leaf-off period within the Project Impact Area, excluding the former Davis Tannery lands and Belle Island. Bat maternity roost surveys were completed within deciduous and mixedwood forests in the Project Impact

Area. Each plot survey consisted of searching a fixed area 12.6 m radius plot (=0.05 ha) for candidate trees. All snag and cavity trees >25 cm DBH (diameter at breast height) were photographed, identified to species, measured (dbh), bat habitat characteristics noted, and had GPS coordinates recorded. The snag/cavity tree density per hectare of trees was calculated to determine if the site was a candidate for bat maternity colony roosts.

In total, 60 trees across the 41 survey plots were identified as candidates for maternity roost habitat, each found to have a cavity and/or loose bark and/or crack, among other snag attributes identified within the protocol. Most of the candidate trees had a dense canopy cover (>70%) and were either Poplar species or Crack Willow that do not provide good cavity habitat (MNR, 2011). Three (3) trees were considered high quality potential maternity roosting habitat and were further assessed for bat activity with exit surveys paired with acoustic monitoring following the same MNR protocol. Bats were not detected exiting any of the snag attributes and no SAR bats were detected by acoustic monitoring.

While foraging habitat was not surveyed or assessed directly, it is not expected to be limiting as these species use a variety of edge, open, wetland, forest, and riparian habitats to forage. In the case of Little Brown Myotis, this species has been recorded travelling 1 km to 5 km from their maternity roost to foraging sites, demonstrating their ability to seek foraging sites over a broad area (Henry et al., 2002; Randall et al., 2014).

Species at Risk Bats was selected as a Project VC as treed portions of the Project Site have potential to host SAR bat maternity roosts, which are integral to the recovery of SAR bats, and may be impacted by proposed sediment management activities.

3.2.4.1 Thresholds

Bat maternity habitat assessments were conducted as part of the baseline studies and species at risk bats were not detected (SNC-Lavalin, 2023). [redacted] Without mitigation and/or specific Project design considerations, terrestrial works that remove vegetation in treed habitat with suitable maternity roost characteristics between April 1 and September 30 are likely to result in harm to undetected maternity roosting Species at Risk Bats during site preparation and sediment management activities (Humphrey and Fotherby, 2019). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. This Project interaction with Species at Risk Bats is considered to be medium risk based on preliminary assessment, and as such the standard of proof is also medium. The standard of proof would be measured by any destruction of or harm to bat maternity roosts caused by vegetation removal in treed habitat with suitable maternity roost characteristics.

Bat maternity habitat assessments were conducted as part of the baseline studies and species at risk bats were not detected (SNC-Lavalin, 2023). [redacted] Currently, it has not been determined which locations and attributes of maternity roosts are necessary for the survival or recovery of species at risk bats. While maternity roosts critical for survival have not yet been identified, proposed criteria to identify roosts include species, number of individuals using the roost, whether the roost is in a White Nose Syndrome-affected area, and the number of other known maternity roosts in the vicinity (ECCC, 2018c). Species at risk bat population numbers and use or availability of maternity roosting habitat in the Project Study Area is unknown. There is potential for tree conditions to change between years and provide suitable maternity roost characteristics where before there were none, and also that use of randomized plots resulted in missed suitable candidate roost trees in the Project Impact Area. Given the low number of suitable trees evaluated during baseline studies by SNC-Lavalin (2023, and lack of detected maternity roosts, any future roost detected would likely be significant to the area, potentially contributing to the recovery of the species. Without mitigation, restoration, and/or specific

Project design considerations, terrestrial works that remove or alter trees in Species at Risk Bat maternity roosting habitat are likely to result in destruction of Species at Risk Bat maternity roosting habitat during site preparation, sediment management activities, and post-sediment management (Humphrey and Fotherby, 2019). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. This Project interaction with Species at Risk Bats is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by vegetation removal from known maternity roosting habitat.

Table 19: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Species at Risk Bats

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Species at Risk Bats							
Terrestrial works involved in site preparation and mobilization that remove vegetation result in destruction of undetected maternity roosting habitat for Species at Risk Bats during site preparation and sediment management activities.	Temporary: during site preparation and sediment management activities	Habitat remains secure such that, during the active season, potentially suitable maternity roosting habitats are maintained.	Avoidance of vegetation removal in treed habitat with suitable snag characteristics during the Species at Risk Bats active season between April 1 and September 30.	Low	Yes 1, 29	Timing windows	Exit tree surveys paired with acoustic monitoring should take place at suitable snags on Belle Island to determine presence/no detection for species at risk bats within the Project Impact Area. If it should be found to occur, clearly mapped maternity roosting habitat with inventory of snag trees, including location, species, snag attributes, decay class, diameter at breast height (DBH), and photographs. Species at Risk Protection Plan Species at Risk Contractor Training Vegetation Protection Plan Monitoring of vegetation clearing areas for presence of Species at Risk Bats.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial works involved in site preparation and mobilization that remove or alter trees in Species at Risk Bat maternity roosting habitat result in the destruction of Species at Risk Bat maternity roosting habitat.	Temporary: during site preparation and sediment management activities And Long term: post-sediment management	Habitat remains secure and effective for Species at Risk Bats such that, at a minimum, existing maternity roosting habitat is maintained.	Avoidance of vegetation removal from known maternity roosting habitat.	Medium	Yes 1	If habitat is confirmed prior to commencement of works: Exclusion zones for confirmed maternity roosting habitat. Potential for compensation of Little Brown Myotis habitat under ESA approval or permit if removal of roost(s) is required by installation of bat house(s) in nearby suitable habitat under the direction of a Qualified Biologist. Any roosting habitat removed will be replaced with suitable tree species to the bat species affected (and local soils/climate): • Little Brown Myotis: Trembling Aspen (*Populus tremuloides*), Red Oak (*Quercus rubra*), Large-tooth Aspen (*Populus grandidentata*), and Red Maple (*Acer rubrum*). • Northern Myotis: Red Maple, Red Oak • Tri-colored Bat: White Oak (*Quercus alba*), Red Oak	Exit tree surveys paired with acoustic monitoring should take place at suitable snags on Belle Island to determine presence/no detection for species at risk bats within the Project Impact Area. If it should be found to occur, clearly mapped maternity roosting habitat with inventory of snag trees, including location, species, snag attributes, decay class, diameter at breast height (DBH), and photographs. If Tri-colored Bat habitat is identified in an area where vegetation removal is required, further work will need to be done to determine appropriate compensation actions. Species at Risk Protection Plan

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						• Eastern Small-footed Myotis: not applicable (roosts in rocky habitats).	Species at Risk Contractor Training. Vegetation Protection Plan Monitoring of vegetation clearing areas for presence of Species at Risk Bats.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.5 Terrestrial Wildlife

3.2.5.1 Migratory Birds

Data from the Ontario Breeding Bird Atlas (Cadman et al., 2007; Birds Canada, 2022b) indicate that 132 bird species with recorded breeding evidence have been observed within the two (2) 10 km by 10 km atlas squares that contain the Project Study Area, including twenty-three (23) species at risk (refer to **subsection 3.2.3**). The DIA for the Kingston Third Crossing (Hatch, 2019a) documented 66 bird species during field investigations, most of which were also listed in the OBBA results; however, this number includes species observed outside of the breeding bird season. A Terrestrial Ecological Assessment and Analysis conducted by Ecological Services for the Kingston Third Crossing included bird surveys from 2008 – 2010; however, time of year and survey method were not detailed in the report (Ecological Services, 2011). Their report noted, however, that the western shoreline of the Cataraqui River, particularly within 100 m of shore, is important to breeding waterfowl. Breeding bird surveys associated with Kingston Third Crossing were carried out in June and July of 2016, identifying 43 bird species; no species at risk were documented (Golder, 2017b).

A 2004 desktop update to the Greater Cataraqui Marsh wetland evaluation by the MNR (now MNRF) indicated that the area was scored as “Nationally Significant” for Waterfowl Staging and/or Moulting based on data provided by Kingston Field Naturalists and Ducks Unlimited (MNR, 2004). It was noted that flocks of Canvasbacks (*Aythya valisineria*) numbering over 5,000 had been observed (MNR, 2004). Other species noted as part of the original evaluation in 1990 included Greater Scaup (*Aythya marila*) and Blue-winged Teal (*Spatula discors*). Additionally, the Greater Cataraqui Marsh wetland evaluation indicated that the area was scored as “Regionally Significant” for Waterfowl Breeding based on data provided by MNR Napanee in 1990 (MNR, 2004). Species noted as being present as part of the original assessment include Mallard (*Anas platyrhynchos*) and Wood Duck (*Aix sponsa*).

Two separate breeding bird surveys targeting non-SAR migratory birds were conducted twice each by SNC-Lavalin in the KIH in 2021: one for all species following protocols from Ontario Breeding Bird Atlas: Guide for Participants (Ontario Breeding Bird Atlas, 2001), and the second specifically targeting nesting waterfowl using the protocols from Birds and Bird Habitats: Guidelines for Wind Power Projects (MNR, 2011). In total, 39 species were documented as possibly breeding in the Project Impact Area (**Table 20**) (SNC-Lavalin, 2023). Across all surveys, Canada Goose (*Branta canadensis*) was the most abundant species, followed by Mallard, Song Sparrow (*Melospiza melodia*), and Yellow Warbler (*Setophaga petechia*). Notably, a pair of Osprey (*Pandion haliaetus*) nested on a purpose-built platform close to the water’s edge of Belle Park, near Orchard Street Marsh. Results of surveys that targeted species at risk are described in **subsection 3.2.3**.

Table 20: 2021 Breeding Bird Survey Results from Kingston Inner Harbour

Common Name	Scientific Name	SARA Status	Provincial S-Rank[1,2]
American Crow	*Corvus brachyrhynchos*	No Status	S5
American Goldfinch	*Carduelis tristis*	No Status	S5
American Redstart	*Setophaga ruticilla*	No Status	S5B
American Robin	*Turdus migratorius*	No Status	S5
Baltimore Oriole	*Icterus galbula*	No Status	S4B
Barn Swallow	*Hirundo rustica*	Threatened	S4B
Belted Kingfisher	*Megaceryle alcyon*	No Status	S5B, S4N
Black-capped Chickadee	*Poecile atricapillus*	No Status	S5
Blue Jay	*Cyanocitta cristata*	No Status	S5
Canada Goose	*Branta canadensis*	No Status	S5

Common Name	Scientific Name	SARA Status	Provincial S-Rank[1,2]
Chestnut-sided Warbler	*Dendroica pensylvanica*	No Status	S5B
Common Grackle	*Quiscalus quiscula*	No Status	S5
Common Tern	*Sterna hirundo*	No Status	S4B
Common Yellowthroat	*Geothlypis trichas*	No Status	S5B, S3N
Downy Woodpecker	*Picoides pubescens*	No Status	S5
Eastern Kingbird	*Tyrannus tyrannus*	No Status	S4B
European Starling	*Sturnus vulgaris*	No Status	SNA
Great Blue Heron	*Ardea herodias*	No Status	S4
Great Crested Flycatcher	*Myiarchus crinitus*	No Status	S5B
House Finch	*Carpodacus mexicanus*	No Status	SNA
House Sparrow	*Passer domesticus*	No Status	SNA
House Wren	*Troglodytes aedon*	No Status	S5B
Indigo Bunting	*Passerina cyanea*	No Status	S5B
Killdeer	*Charadrius vociferus*	No Status	S5
Mallard	*Anas platyrhynchos*	No Status	S5
Mute Swan	*Cygnus olor*	No Status	SNA
Northern Cardinal	*Cardinalis cardinalis*	No Status	S5
Osprey	*Pandion haliaetus*	No Status	S5B
Red-eyed Vireo	*Vireo olivaceus*	No Status	S5B
Red-winged Blackbird	*Agelaius phoeniceus*	No Status	S5
Ring-billed Gull	*Larus delawarensis*	No Status	S5
Rock Pigeon	*Columba livia*	No Status	SNA
Savannah Sparrow	*Passerculus sandwichensis*	No Status	S5B, S3N
Song Sparrow	*Melospiza melodia*	No Status	S5
Virginia Rail	*Rallus limicola*	No Status	S4S5B
Warbling Vireo	*Vireo gilvus*	No Status	S5B
White-breasted Nuthatch	*Sitta carolinensis*	No Status	S5
Wood Duck	*Aix sponsa*	No Status	S5B, S3N
Yellow Warbler	*Dendroica petechia*	No Status	S5B

[1] Natural Heritage Information Centre (NHIC). (2022, February 28). Government of Ontario. Retrieved February 28, 2022, from https://www.ontario.ca/page/get-natural-heritage-information
[2] S3N – Vulnerable Non-breeding; S4 – Apparently Secure; S4B – Apparently Secure Breeding; S4N – Apparently Secure Non-breeding; S4S5B – Apparently Secure to Secure Breeding; S5 - Secure; S5B – Secure Breeding; SNA – Not Applicable

Several migratory bird species were considered under the risk assessment by Golder (2016), including Mallard, Marsh Wren (*Cistothorus palustris*), Great Blue Heron, and Osprey. Exposure to PCBs, chromium, and other COC were assessed as negligible health risks for Great Blue Heron and Osprey across the individual management units (Golder, 2016). In management units PC-E, PC-W, and TC-OM (refer to **Figure 2**), chromium was found to be a moderate health risk to Marsh Wren, while "other" COC were considered to be low risk to this species in the same areas, and PCB was low risk in PC-W (Golder, 2016). Chromium was assessed as a moderate risk to Mallard in PC-W and TC-OM, and as low risk in PC-E, TC-RC, and TC-1 (Golder, 2016). These risks were characterized as being located close to the shoreline (Golder, 2021a). The objectives of the SMP include reducing or eliminating these risks by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021). Post-implementation of the SMP, chromium sediment concentrations will be reduced to negligible risk to Mallard health for all management units (Golder, 2021a). For Marsh Wren, total PCBs will be reduced to negligible risk in PC-W; chromium will be reduced to low risk in PC-E and TC-OM and very low risk in PC-W; and lead will be reduced to very low risk in PC-E, PC-W, and TC-OM (Golder, 2021a).

The Project Impact Area and greater Project Study Area include a broad range of breeding habitats, including wetlands, meadow, shoreline, forest, and built structures upon or within which birds may nest. Migratory birds are of particular concern as they are protected by several measures under the federal *Migratory Birds Convention Act*, 1994 (S.C. 1994, c. 22). The Terrestrial Wildlife VC includes Migratory Birds due to the potential for impacts from the proposed sediment management activities.

3.2.5.1.1 Thresholds

Without mitigation and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation during the bird breeding period between April 1 and August 31 are likely to result in harm to nesting migratory birds, as it poses the potential for active nesting sites to be destroyed during site preparation and sediment management activities (ECCC, 2018b). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. This Project interaction with Migratory Birds is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by any destruction of or harm to migratory birds and their nests caused by vegetation removal.

Migratory bird habitat can be found throughout terrestrial habitats in the Project Impact Area, primarily concentrated in the north end including the former Davis Tannery property, Orchard Street Marsh, Belle Park, and Belle Island (assumed). Without mitigation and/or specific Project design considerations, terrestrial and in-water works such as site preparation and mobilization and sediment management and intervention using heavy equipment that generate noise exceeding 50 decibels (dB) between April 1 and August 31 are likely to result in disturbance of breeding migratory birds during site preparation and sediment management activities (ECCC, 2021). The level of noise generated by sediment management activities is currently unknown; however, a crane generates 78 – 103 dBA at the operator’s position (MLTSD, 2022). Noise abatement and mitigation are common practices in the construction industry. This Project interaction with Migratory Birds is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low as it would be based on observations. The standard of proof would be measured by sediment management activity-related exceedances of the noise limit within migratory bird breeding habitat between April 1 and August 31.

Table 21: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Migratory Birds

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial Wildlife: Migratory Birds							
Terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation during the breeding bird season result in harm to nesting migratory birds.	Temporary: during site preparation and sediment management activities	Habitat remains secure such that, during the breeding season, migratory birds and their nests are unharmed.	During the bird breeding period between April 1 and August 31, avoidance of harm to migratory birds and their nests from vegetation removal.	Low	Yes 1, 11, 12, 13, 15, 17	Timing windows for terrestrial vegetation removal. Minimize need for vegetation removal by situating staging areas and access routes in existing open areas (e.g., parking lot, trails).	Breeding Bird Surveys on Belle Island to determine presence/no detection for breeding migratory birds. Vegetation Protection Plan Wildlife Protection and Management Plan Site Restoration Plan
Noise from heavy equipment used for terrestrial and in-water works such as site preparation and mobilization and sediment management and intervention activities result in the disturbance of breeding migratory birds.	Temporary: during site preparation and sediment management activities	Noise levels in migratory bird breeding habitat remain at or below levels known to cause disturbance to breeding migratory birds.	Between April 1 and August 31, noise levels in proximity to breeding bird habitat are limited to 50 decibels or below as per the federal Guidelines to Reduce Risk to Migratory Birds.	Low	Yes 1, 12, 13, 15, 17, 33, 39	Timing windows for work that exceeds noise level threshold. Noise abatement. Staging noisy equipment away from breeding bird habitat features such that noise diminishes to 50 dB or below at the habitat edge.	Breeding Bird Surveys on Belle Island to determine presence/no detection for breeding migratory birds. Wildlife Protection and Management Plan Noise, Vibration and Ambient Light Management Plan

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.5.2 Snakes

Five (5) species of snake potentially occur within the Project Study Area, including and Eastern Milksnake, Gray Ratsnake (*Pantherophis spiloides*), Eastern Gartersnake (*Thamnophis sirtalis sirtalis*), Dekay's Brownsnake (*Storeria dekayi*) and Northern Watersnake (*Nerodia sipedon sipedon*) (iNaturalist, 2022; Ontario Nature, 2020). Gray Ratsnake in the Kingston region is listed as Threatened both provincially and federally and typically prefers a mosaic of forest and open habitat that includes fields and bedrock outcrops which is generally unavailable in the Project Impact Area. Three (3) Gray Ratsnake observations recorded in the Ontario Reptile and Amphibian Atlas, as recent as 2019, within the 10 km by 10 km grid square that overlaps with the Project Study Area were confirmed by Ontario Nature to occur outside of the Project Study Area (Brittney Vezina, Ontario Nature, *pers. comm.*, September 20, 2022).

The former Davis Tannery property, which has shoreline in the KIH, had an Environmental Impact Assessment conducted by Ecological Services, with fieldwork conducted between 2007 and 2019. In May 2014, snake surveys were conducted on the former Davis Tannery property by Ecological Services by visual encounter, examining potential habitat features (Ecological Services, 2017). [redacted] Ecological Services also documented three (3) Eastern Gartersnakes on the property (Ecological Services, 2019).

Whereas habitat during the active season (April – October) is more generalized, suitable overwintering habitat is crucial to surviving freezing temperatures in northern climates. Many reptiles, such as Northern Watersnakes, express a high rate of fidelity to habitat sites (Pattishall and Cundall, 2008) and do not have the option to seek more suitable habitat once cold weather and the overwintering period (October – April) has arrived (Reinert, 1993). As such, overwintering hibernacula features for reptiles can be a limiting factor for habitat occupancy.

During the active season, Northern Watersnakes generally remain in close proximity (< 5m) to aquatic habitats and seasonally increase the size of their home range in response to increased emergent aquatic vegetation cover, typically peaking in July and August (Roth and Greene, 2006). Given this larger flexibility in home range in the summer months, Northern Watersnakes may be more adaptable to habitat disturbance during this timeframe. While Northern Watersnakes have been found to exhibit very high site fidelity, typically being found within 1 metre of previously occupied sites (e.g., in a hole, under a rock, on a log), they have also demonstrated the ability to shift locations by at least 100m following disturbance such as a high-water event (Pattishall and Cundall, 2008). Northern Watersnakes in the KIH likely demonstrate a certain amount of adaptability in habitat use due to within-year fluctuations of water levels influenced by Lake Ontario that can vary by as much as 0.939 m during the active season (as in 2017) (Government of Canada, 2022).

[redacted] No other snake species were recorded in this location; however, Dekay's Brownsnake and Eastern Gartersnake were observed in Belle Park, although not in aggregations or congregations to suggest the presence of any other snake overwintering habitat feature.

Basking habitat composition for Northern Watersnakes is the same as basking habitat described for turtles in **subsection 3.2.2.2**. The shoreline of PC-W is expected to be contained within a 10-metre buffer for exclusion from Project activities, starting from the top of bank, which will protect Northern Watersnake basking and foraging habitat from disturbance and alteration, while only a small portion of the PC-E nearshore area is proposed for sediment management. Project design considerations recommended for creating or compensating turtle basking habitat disturbed by Project activities will likewise benefit Northern Watersnakes.

Snake overwintering habitat is generally limited in availability due to specific microhabitat and microclimatic conditions (MNRF, 2014). The Terrestrial Wildlife VC includes Snakes due to the potential for impacts from proposed sediment management activities.

3.2.5.2.1 Thresholds

[redacted] No other hibernaculum feature is known to the area. Changes to structural microhabitat features of a hibernaculum may directly influence the microclimatic conditions required for over-winter survival of reptiles (Rosen, 1991; Howes and Lougheed, 2004). It can take many years of habitat management to effectively create an artificial hibernaculum to replace one that is destroyed (MNRF, 2018). Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization in management unit [redacted] that alter or remove the snake hibernaculum without suitable nearby overwintering habitat alternatives are likely to result in destruction of overwintering snake habitat and harm to the local snake population during site preparation, sediment management activities, and post-sediment management (MNRF, 2014; MNRF, 2015). This Project interaction with Snakes is considered to be high risk based on preliminary assessment, and as such the standard of proof is also high and would be based on follow-up studies adhering to accepted scientific methodologies. The standard of proof would be measured by observations of Northern Watersnakes near the hibernaculum entrance before and after the overwintering period.

Table 22: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Snakes

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial Wildlife: Snakes							
Terrestrial works such as site preparation and mobilization and shoreline stabilization in management unit [redacted] that alter or remove the snake hibernaculum result in the destruction of snake overwintering habitat and disturbance to overwintering snakes.	Temporary: during site preparation and sediment management activities And Long term: post-sediment management	Suitable snake overwintering habitat remains available such that, at a minimum, Northern Watersnakes are observed basking near the hibernaculum feature(s) during the spring and fall across all Project phases.	Northern Watersnakes and other snake species in the KIH have access to suitable overwintering habitat across all Project phases.	High	Yes 1, 11, 15	Work exclusion zone around snake hibernaculum that does not impede snake access and egress. Timing windows for terrestrial work near hibernaculum (avoided between October 1 and March 31). If existing hibernaculum feature is to be altered or removed, in compensation construct a minimum of 3 hibernacula as close as possible to the existing hibernacula feature in suitable habitat (as determined by a Qualified Biologist) prior to Project commencement and ahead of the overwintering period (MNRF, 2018). This option would also require the existing hibernaculum feature to have measures put in place to prevent snakes from entering it prior to the overwintering period to protect snakes from harm during Project terrestrial works that affect the feature. If altered during terrestrial works, consider restoration of existing hibernaculum as part of shoreline stabilization to enhance habitat availability post-remediation.	Wildlife Protection and Management Plan Dredging and Sediment Removal Plan During sediment management activities, Visual Encounter Surveys for snakes at the hibernaculum between late-August and October 31 and also between April 1 and May 31 according to the Survey Protocol for Ontario's Species at Risk Snakes (MNRF, 2016c). Overwintering habitat constructed according to Best Management Practices for Identifying, Managing and Creating Habitat for Ontario's Species at Risk Snakes (MNRF, 2018). Follow-up monitoring detailed in the same BMP, recommended for at least 2 winters.

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.5.3 Non-SAR Bats

Bats in Ontario are small and secretive, often only visible in the fading light of the evening sky as they emerge from their roosts in trees and other structures. As they are difficult to view and also to identify without close-up inspection, they tend to be underreported in citizen science databases such as iNaturalist. Species which may be present include Big Brown Bat (*Eptesicus fuscus*), Silver-haired Bat (*Lasionycteris notivagans*), Eastern Red Bat (*Lasiurus borealis*), and Hoary Bat (*Lasiurus cinereus*) (Thorne, 2017). Species at risk (SAR) Bats are addressed in **subsection 3.2.4**. No known hibernacula habitat features exist within the Area of Assessment, but anthropogenic structures and treed habitats have the potential to provide maternity roosts.

During the spring and early summer, most Ontario bat species rely on forest habitat that supports a healthy density of large-diameter cavity trees. Females form maternity colonies in tree cavities that provide a warm, humid microclimate that optimizes gestation and postnatal growth of offspring (Kunz and Anthony, 1982). Treed areas within the Study Area are largely confined to the north section from the former Davis Tannery property to Belle Park and Belle Island, as seen on recent satellite imagery (Google Earth, 2021); however, a narrow strip of trees also runs intermittently from the former Davis Tannery property south to Douglas Fluhrer Park.

A bat habitat assessment and acoustic monitoring surveys were conducted by Ecological Services in 2019 in support of the former Davis Tannery property Environmental Impact Assessment. These surveys identified four candidate roost trees on the former Davis Tannery property and detected four (4) non-SAR bat species via acoustic monitoring: Big Brown Bat, Hoary Bat, Silver-haired Bat and Eastern Red Bat. Activity, as indicated by passes recorded per hour, tended to be higher further from the shoreline at the western edge of the former Davis Tannery property (Ecological Services, 2019).

The Kingston Third Crossing Natural Environment Assessment (Golder, 2017b) did not include acoustic surveys but did identify candidate maternity roost trees within the study area for that project, [redacted] Extensive woodland mapping conducted by Cataraqui Region Conservation Authority (CRCA) identified numerous and large tracts of significant woodland [redacted] within the Project Study Area, as well as nearby areas beyond the Project limits (CRCA, 2006) which may provide suitable bat maternity roosting habitat.

In 2021, SNC-Lavalin conducted bat maternity roost habitat surveys in accordance with Bats and Bat Habitats: Guidelines for Wind Power Projects (MNR, 2011). Forty-one (41) plots were assessed during the leaf-off period within the Project Impact Area, excluding the former Davis Tannery lands and Belle Island. Bat maternity roost surveys were completed within deciduous and mixedwood forests in the Project Impact Area. Each plot survey consisted of searching a fixed area 12.6 m radius plot (=0.05 ha) for candidate trees. All snag and cavity trees >25 cm DBH (diameter at breast height) were photographed, identified to species, measured (DBH), bat habitat characteristics noted, and had GPS coordinates recorded. The snag/cavity tree density per hectare of trees was calculated to determine if the site was a candidate for bat maternity colony roosts.

In total, 60 trees across the 41 survey plots were identified as candidates for maternity roost habitat, each found to have a cavity and/or loose bark and/or crack, among other snag attributes identified within the protocol. Most of the candidate trees had a dense canopy cover (>70%) and were either Poplar species or Crack Willow that do not provide good cavity habitat (MNR, 2011). Three (3) trees were considered high quality potential maternity colony habitat and were further assessed for bat activity with exit surveys paired with acoustic monitoring following the same MNR protocol. Bats were not detected exiting any of the snag attributes; however, acoustic monitoring detected the presence of Big Brown Bat and Hoary Bat.

The Terrestrial Wildlife VC includes Non-SAR Bats as treed portions of the Project Site have potential to host bat maternity colonies and may be impacted by proposed sediment management activities.

3.2.5.3.1 Thresholds

Bat maternity habitat assessments were conducted as part of the baseline studies and did not detect maternity colonies. Bats have been detected on the former Davis Tannery property in previous investigations identified during the background information review, but maternity colonies were not identified. Bats prefer trees with snag characteristics (e.g., crack, crevice, loose bark, knot hole) that are in early stages of decay (MNRF, 2015a). There is potential for tree conditions to change between years and provide suitable maternity colony characteristics where before there were none, and that use of randomized plots resulted in missed suitable candidate roost trees in the Project Impact Area. Given the low number of suitable trees evaluated during baseline studies by SNC-Lavalin (2023), and lack of detected maternity colonies, any future colony detected would likely be significant to the area. Without mitigation and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation in treed habitat with suitable snag characteristics between April 1 and September 30 may result in destruction of unidentified bat maternity colonies which may result in harm to actively roosting females and their offspring during site preparation and sediment management activities (MNR, 1984). This Project interaction with Non-SAR Bats is considered to be medium risk based on preliminary assessment, and as such the standard of proof is also medium. The standard of proof would be measured by any destruction of or harm to bat maternity colonies caused by vegetation removal in treed habitat with suitable snag characteristics.

Table 23: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Non-SAR Bats

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial Wildlife: Non-SAR Bats							
Terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation result in destruction of undetected Big Brown Bat and Silver-haired Bat maternity colonies.	Temporary: during site preparation and sediment management activities	Habitat remains secure such that, during the active season, potentially suitable maternity colony habitats are maintained.	Avoidance of vegetation removal in treed habitat with suitable snag characteristics during the bat active season between April 1 and September 30. If removal is to occur during active season, vegetation clearing area is to be inspected by a Qualified Biologist for roosting bats and confirm habitat suitability prior to vegetation removal.	Medium	Yes 1, 11, 14, 15, 29	Timing windows for terrestrial vegetation removal. Minimize need for vegetation removal by situating staging areas and access routes in existing open areas (e.g., parking lot, trails).	To understand potential presence of Bat SAR in the Project Impact Area, exit tree surveys paired with acoustic monitoring are recommended to take place at suitable snags on Belle Island to determine presence/no detection for bat maternity colonies. Vegetation Protection Plan Wildlife Protection and Management Plan Site Restoration Plan

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.5.4 Other Terrestrial Wildlife

At least 16 mammal species, other than bats, have been observed in the KIH either by the project team (denoted by *) or confirmed through observations submitted to iNaturalist (2022) are listed below. None of these species are considered to be rare or at-risk provincially or federally; however, certain species may have local or Indigenous cultural significance, such as Canadian Beaver and White-tailed Deer.

- American Mink (*Neogale vison*)
- American Red Squirrel (*Tamiasciurus hudsonicus*)
- Canadian Beaver (*Castor canadensis*)*
- Coyote (*Canis latrans*)*
- Eastern Chipmunk (*Tamias striatus*)*
- Eastern Cottontail (*Sylvilagus floridanus*)*
- Eastern Grey Squirrel (*Sciurus carolinensis*)*
- Groundhog (*Marmota monax*)*
- Short-tailed Weasel (*Mustela richardsonii*)*
- Meadow Vole (*Microtus pennsylvanicus*)*
- Muskrat (*Ondata zibethicus*)*
- North American River Otter (*Lontra canadensis*)*
- Raccoon (*Procyon lotor*)
- Striped Skunk (*Mephitis mephitis*)
- White-footed Mouse (*Peromyscus leucopus*)
- White-tailed Deer (*Odocoileus virginianus*)*

Both iNaturalist (2022) records and observations by SNC-Lavalin biologists were predominantly located north of River Street, in Belle Park, Belle Island, and along the former Davis Tannery property. South of River Street, observations were largely restricted to the shoreline and included rodents (Canadian Beaver, Eastern Chipmunk, Eastern Gray Squirrel, Groundhog, Muskrat), weasels (American Mink, Short-tailed Weasel), and Eastern Cottontail.

Eastern Red-backed Salamander (*Plethodon cinereus*) (not at risk) is a terrestrial-dwelling and reproducing amphibian that may be found in the KIH as indicated by the Ontario Reptile and Amphibian Atlas (Ontario Nature, 2020). It has not been detected in any previous site investigation within the Project Study Area; however, targeted surveys were not conducted.

Terrestrial works are anticipated to be limited to site preparation and mobilization, as well as shoreline stabilization. The degree of risk posed by the Project to this group of terrestrial wildlife by Project activities is considered to be very low, thus there is no requirement to conduct further baseline assessment, establish desired outcomes, thresholds, or standard of proof. It is anticipated that standard wildlife mitigation measures such as exclusion fencing, environmental monitoring, worker awareness training, stopping work activities if any species enters the active work area, and other measures developed in the DIA and described in the Contractor's Site-specific Wildlife Protection and Management Plan will be sufficient to prevent negative impacts to terrestrial wildlife species and their habitat. Project design considerations are not necessary to mitigate risk. A complete assessment of impacts to terrestrial wildlife will be conducted as part of the DIA.

Semi-aquatic mammals were considered under the risk assessment by Golder (2016), including American Mink and Muskrat. In management units PC-W and TC-OM (refer to **Figure 2**), PCBs were found to be a moderate health risk to American Mink, and negligible risk from chromium and other COC in those areas as well as PC-E (Golder, 2016). Chromium was assessed as a low risk to Muskrat in PC-E, PC-W, and TC-OM, while PCBs and other COCs were assessed as having negligible risk to Muskrat in those areas (Golder, 2016). These risks were characterized as being located close to the shoreline (Golder, 2021a). Incidentally, dead Muskrats, each without signs of trauma, were observed by SNC-Lavalin biologists on three (3) occasions between 2020 and 2022 in Orchard Street Marsh and Belle Park (PC-OM[14] and PC-W). The objectives of the SMP include reducing or eliminating these risks by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a). Post-implementation of the SMP, total PCBs concentration in sediments will be reduced to negligible risk for American Mink in PC-W and TC-OM (Golder, 2021a). For Muskrat, chromium will be reduced to very low risk in PC-E and TC-OM, and negligible risk in PC-W (Golder, 2021a).

3.2.5.4.1 Arthropods

Five (5) arthropods listed as at-risk either provincially or federally have ranges that overlap with the Project Study Area (see **Table 24**). Monarch (*Danaus plexippus*) has been recorded in KIH on iNaturalist (2022) in 2021 and was also observed by SNC-Lavalin biologists in 2021. None of the other three (3) species have been recorded in iNaturalist (2022) or the NHIC database.

Table 24: Arthropods Potentially Present in Kingston Inner Harbour

Common Name	Scientific Name	SARO Status[1]	SARA Status[2]	Provincial S-Rank[3,4]
American Bumble Bee	*Bombus pensylvanicus*	Special Concern	Special Concern	S3S4
Monarch	*Danaus plexippus*	Special Concern	Special Concern	S2N, S4B
Nine-spotted Lady Beetle	*Coccinella novemnotata*	Endangered	Endangered	S1
Transverse Lady Beetle	*Coccinella transversoguttata*	Endangered	Special Concern	S1
Yellow-banded Bumble Bee	*Bombus terricola*	Special Concern	Special Concern	S3S5

[1] Species at Risk in Ontario List. (2023, January 24). Ministry of the Environment, Conservation and Parks. Retrieved March 27, 2023, from https://www.ontario.ca/page/species-risk-ontario
[2] Species at Risk Public Registry. (2023, March 6). Government of Canada. Retrieved March 27, 2023, from https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html
[3] Natural Heritage Information Centre (NHIC). (2022, December 20). Government of Ontario. Retrieved March 27, 2023, from https://www.ontario.ca/page/get-natural-heritage-information
[4] S1 – Critically Imperilled; S2N – Imperiled Non-breeding; S4B – Apparently Secure Breeding; S3S5 – Vulnerable to Secure range rank

American Bumble Bees forage on flowers for pollen and nectar, and nest above ground in dense mats of long grass or abandoned bird nests, or sometimes in abandoned rodent burrows (COSEWIC, 2018b). It is thought that pesticide use and habitat fragmentation, as well as low genetic diversity, have caused American Bumble Bee to decline (COSEWIC, 2018b). As a species of Special Concern, under both the *Endangered Species Act* (ESA) and SARA, there is no regulated habitat or Critical Habitat defined for this species. American Bumble Bee is potentially present in the KIH Project Study Area. [redacted]

The Monarch requires four types of habitat throughout its lifecycle: breeding, nectaring, staging and overwintering (COSEWIC, 2016a). As a species of Special Concern, under both the *Endangered Species Act* (ESA) and SARA, there is no regulated habitat or Critical Habitat defined for this species. Overwintering habitat occurs outside of Ontario, while the other three types can be found within. The

[14] In the Risk Assessment Refinement (Golder, 2016), PC-OM is included in the PC-W waterlot.

primary requirement of breeding habitat is the presence of Milkweed (*Asclepias* sp.), which typically grows in open wetlands, dry sandy areas, short grass and tall grass prairie, agricultural areas, riverbanks, irrigation ditches, arid valleys, south-facing hillsides, and along roadsides and in roadside ditches (ECCC, 2016). Nectaring habitat similarly occurs in a wide range of environments from native grasslands to residential gardens and road medians that contain a variety of wildflowers (e.g., *Solidago* sp., *Symphotrichum* sp., *Asclepias* sp., etc.; ECCC, 2016). Staging habitat, also known as stopover habitat, consists of field and forest habitat at least 10 ha in size within 10 km of Lake Ontario and hosts an average of 100 Monarchs per day for 50 days during fall migration (August-October) for >5000 "Monarch Use Days" (MUD), or >3000 MUD with significant presence of Painted Ladies (*Vanessa cardui*) and Red Admirals (*Vanessa atalanta*) (MNRF, 2015a). Stopover habitat has not been detected during the background information review process or during field investigations by SNC-Lavalin in 2020 and 2021; however, there remains some potential for breeding and nectaring habitat in the Project Site as the vegetation inventory included plant species belonging to the *Asclepias*, *Solidago*, and *Symphotrichum* genera. [redacted]

Nine-spotted Lady Beetles have been found in a variety of habitats including agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas, and isolated natural areas. It is most often associated with areas of shrubs or small trees interspersed with open grassy areas, such as old fields (COSEWIC, 2016b). This species is a generalist predator on various soft-bodied insects. The Nine-spotted Lady Beetle has not been observed in Ontario since the mid-1990s (COSSARO, 2016a), and the decline is likely due to the introduction of invasive lady beetle species and pathogens, disease, and parasites transferred from those species (COSEWIC, 2016b). As Nine-spotted Lady Beetle has not been observed in nearly 30 years, it is unlikely to be present in the KIH Project Study Area and is not recommended to be carried forward for assessment.

Transverse Lady Beetles are habitat generalists, including agricultural areas, suburban gardens, parks, coniferous forests, deciduous forests, prairie grasslands, meadows, riparian areas and other natural areas. This species primarily preys on aphids and their distribution is largely driven by prey availability rather than habitat type (Hagen 1962). Despite being so widespread, this species is now either absent or below detection levels across much of its range, with no new provincial records since 1990 (COSSARO, 2017). The decline of the Transverse Lady Beetle is largely attributed to the introduction of invasive lady beetle species, as well as pathogens and pesticide exposure, but may also be due to land use changes and habitat loss (COSSARO, 2017). As Transverse Lady Beetle has not been observed since 1990, it is unlikely to be present in the KIH Project Study Area and is not recommended to be carried forward for assessment.

Yellow-banded Bumble Bees are habitat generalists, found in mixed woodlands and a variety of open habitat including native grasslands, farmlands, and urban areas. Queens overwinter in loose soil or rotting trees (Benton 2006). This species emerges early in the spring and reproduces at the end of summer, making it susceptible to phenological shifts in key forage plants, spring storms and other climate-related factors that can alter access to food resources (COSSARO, 2016b). This species nests in colonies underground at depths of 15 to 45cm, often in abandoned rodent burrows with downward sloping entrances (Hobbs 1968; Plath 1927). An observed decline in Yellow-banded Bumble Bee populations in Ontario is due to a combination of factors including pathogens from managed bumble bees and honeybees, habitat loss, competition with invasive bee species, pesticide exposure, and climate change (COSSARO, 2016b). [redacted]

Terrestrial works are anticipated to be limited to site preparation and mobilization, as well as shoreline stabilization and will not likely interact with significant foraging, breeding or nectaring habitat [redacted]

[redacted] The degree of risk posed by the Project to arthropods is considered to be very low, thus there is no requirement to conduct further baseline assessment, establish desired outcomes, thresholds, or standard of proof. It is anticipated that standard mitigation measures such as vegetation protection zones, environmental monitoring, worker awareness training, and other measures developed in the DIA and described in the Contractor's Site-specific Species at Risk Protection Plan will be sufficient to prevent negative impacts to Monarch and other SAR insects and their habitats. Project design considerations are not necessary to mitigate risk. A complete assessment of impacts to arthropods will be conducted as part of the DIA and general mitigation measures may be applied should there be a change regarding the presence of at-risk arthropods in the Project Impact Area.

3.2.6 Terrestrial Vegetation

Much of the western terrestrial areas of KIH are landscaped parkland or have commercial developments; the exceptions to this are Belle Park and Belle Island at the northern extent, and the former Davis Tannery lands in the northwest corner, immediately south of Orchard Street Marsh. Belle Island, a portion of Belle Park along its southwest edge, and the former Davis Tannery lands all contain wooded areas considered to be Significant Woodland according to the City of Kingston Official Plan Schedule 8A (City of Kingston, 2019).

The former Davis Tannery property was subject to an Environmental Impact Assessment with work carried out by Ecological Services between 2007 and 2014 (Ecological Services, 2019). Land cover determined by Ecological Land Classification (ELC) in this study, which spanned the former Davis Tannery, Orchard Street Marsh, and Belle Park, included Cultural Meadow (CUM), Cultural Woodland (CUW), Cultural Thicket (CUT), Cattail Organic Shallow Marsh Type (MAS3-1a and MAS3-1b), and Pondweed Submerged Shallow Aquatic Type (SAS1-1) (Ecological Services, 2019). The assessment noted that there were no records of Butternut on the property. The assessment also confirmed that the woodland on the property meets MNR (2010) criteria to be considered a significant woodland due to its proximity to the Greater Cataraqui Marsh Provincially Significant Wetland (PSW) and location adjacent to a watercourse (Cataraqui River); however, it was also detailed that the woodland is dominated by non-native species and is below the City of Kingston significant size threshold of 50 ha (Ecological Services, 2019). Guidelines developed by the MNR (1999) suggest that, within a watershed, woodlands greater than 4 ha should be considered for significance in areas where forest cover is between 10-15%, while CRCA identifies all riparian woodlands within 30 metres of a waterbody or watercourse to be significant (CRCA, 2006). Within the Project Impact Area, CRCA identified the forested areas on Belle Island and the former Davis Tannery property as significant (CRCA, 2006). Additional significant tracts of riparian forest are located upstream of the Project Impact Area, within the Project Study Area, particularly along the eastern side of the river (CRCA, 2006).

The long history of cultural influences on the KIH terrestrial areas likely precludes them from containing terrestrial-based rare plant communities listed in the Significant Wildlife Habitat Criteria Schedules for Ecoregion 6E (MNRF, 2015a), which requires the presence of provincially rare S1, S2 and S3 vegetation communities. Two plant SAR, Butternut (*Juglans cinerea*) and White Wood Aster (*Eurybia divaricata*) have ranges that overlap with the Project Study Area and are potentially present. but have not been detected in previous local site investigations.

According to the NHIC database accessed through the Make A Map: Natural Heritage Areas online tool (MNRF), there have been no reported plant SAR or rare species reported in the Project Impact Area.

Terrestrial vegetation surveys were conducted by SNC-Lavalin in 2020 and 2021 in accordance with Ecological Land Classification (ELC) for Southern Ontario (Lee et al., 1998) and Southern Ontario ELC Vegetation Type List (Lee, 2008) to identify and classify vegetative communities in the Project Site. Community classifications include: Graminoid Meadow (MEGM3-4), Dry-Fresh Deciduous Forest (FODM2-4), Fresh-Moist Lowland Deciduous Forest (FODM7-3/7), Fresh-Moist Deciduous Forest

(FODM 8/9), Deciduous Plantation (FODM12), and Deciduous Swamp (SWDM3-4). In addition, five (5) constructed ecosites were identified: Parkland and Recreational areas (CGL_2/4), Transportation (CVI_1), High Density Residential (CVR_2) and Light Industry (CVC_2).

In addition to the ELC sampling process, a concerted effort was also made to identify any plants observed outside of the designated sample locations during the execution of the program. In total 293 plants were identified with 258 identified to species level. An additional 30 plants were identified to genus level and will be revisited to refine identification for the final report. During 2021 field surveys, species identification was prioritized according to season for each trip. Of the identified taxa, 229 plants were identified in terrestrial polygons, 104 were native species, 99 non-native, and 26 plants were identified as hybrids. None of the native species are provincially significant (NHIC, 2020) or Species at Risk. Five (5) of the non-native species are considered significant terrestrial invasive species whose extent will be further assessed and mapped as surveys progress: Wild Parsnip (*Pastinacea sativa*), European Buckthorn (*Rhamnus cathartica*), Dog-strangling Vine (*Vincetoxicum rossicum*), Garlic Mustard (*Alliaria petiolata*), and Japanese Knotweed (*Reynoutria japonica*).

Vegetation communities are reflective of the character of KIH and are the foundation of habitats for the many birds, mammals, reptiles, and amphibians that carry out their life processes there. Terrestrial Vegetation was selected as a Project VC as proposed sediment management activities may impact Terrestrial Vegetation within the Project Site.

3.2.6.1 Thresholds

Plant communities that are disturbed by partial or complete removal of vegetation undergo succession, which is the process of change in species structure of an ecological community over time. Two forests within the Project Impact Area, on Belle Island and the former Davis Tannery lands, have been identified by CRCA as significant due to their proximity to the water (within 30 m) (CRCA, 2006) and overall low forest cover in the surrounding area. Without mitigation, restoration, and/or specific Project design considerations, terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation are likely to result in changes to vegetation community classification post-sediment management (Lee et al., 1998). Areas of vegetation removal for the Project have not yet been identified; however, terrestrial vegetation removal requirements for the Project are unlikely to be considered extensive. This Project interaction with Terrestrial Vegetation is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been achieved is considered to be high and as such the standard of proof is high. The standard of proof would be measured by follow-up studies on lands under Project control and/or as per lease agreements to assess ecological community classification compared to baseline ecological community classification of disturbed areas or, in ecologically degraded areas at baseline, restoring habitat to an ecologically compatible community. Areas selected for environmental compensation will be reflective of the ecological community classification of the removed vegetated area and equivalent in size or greater. In the event that vegetation removal is required on private property that was not included as part of baseline investigations (e.g., former Davis Tannery lands) the DIA should further assess implications of habitat loss in those areas with input from CRCA regarding significant woodland classification and consider potential for compensation in suitable nearby location(s) or forming conservation agreements with property custodians to carry out restoration.

Invasive plant species degrade natural areas by impacting species diversity which in turn can disrupt ecosystem linkages within the habitat. Soil disturbance is a well-known factor in facilitating establishment of invasive plant species to an area. Without mitigation, restoration, and/or specific Project design considerations, terrestrial and shoreline stabilization works that disturb soil are likely to result in introduction or spread of terrestrial invasive plant species during site preparation, sediment management activities, and post-sediment management (Sherman, 2015). This Project interaction with Terrestrial Vegetation is considered to be low risk based on preliminary assessment; however, the evidence required to determine if the desired outcome has been satisfied is considered to be high and as such the standard of proof is high. The standard of proof would be measured by follow-up studies of disturbed terrestrial sites to assess whether the occurrence of invasive terrestrial plant species as established at baseline has been maintained or increased, unless the site was classified as a Cultural ecosite, which is prone to invasive species colonization.

Table 25: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Terrestrial Vegetation

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial Vegetation							
Terrestrial works such as site preparation and mobilization and shoreline stabilization that remove vegetation result in changes to vegetation community classification.	Long term: post-sediment management	On lands under Project control and/or as per lease agreements, at minimum, and according to land use planning, vegetation communities identified achieve the same ecological community classification after five years following sediment management activities. Areas that were considered ecologically degraded or under anthropogenic influence may be restored to an ecologically compatible community to the habitat. Areas selected for environmental compensation will be reflective of the ecological community classification of the removed vegetated area and equivalent in size or greater.	Vegetation restoration maintains, improves or re-establishes ecological community classification of each disturbed area.	High	Yes 1, 2, 20, 21	Minimize areas of vegetation removal.	Spring terrestrial vegetation survey and botanical inventory for Belle Island to assess impacts within the Project Impact Area. Vegetation Protection Plan Site Restoration Plan Follow-up seasonal vegetation monitoring (spring, summer, fall) including Ecological Land Classification (Lee et al., 1998) for 5 years evaluating re-establishment of vegetation in replanted areas with recommendations should re-establishment fail.
Terrestrial works such as site preparation and mobilization and shoreline stabilization that disturb soil, and transport and operation of vehicles and equipment result in introduction or spread of	Temporary: during site preparation and sediment management activities And	Habitat remains secure such that, at a minimum, there is no change in invasive species occurrence.	No statistically significant increase ($p > 0.05$) in number of invasive terrestrial plant species in the Project Site at the ecosite level, unless the area was classified as a Cultural ecosite type during baseline	High	Yes 1, 2, 19, 20, 21, 23, 24	N/A	Pre-construction survey following the methods for “Monitoring impacts on native vegetation” in Guide to Monitoring Exotic and Invasive Plants (Environment Canada, 1997). An a priori power analysis should be conducted to determine the appropriate number of monitoring

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
terrestrial invasive plant species.	Long term: post-sediment management		investigations (e.g., Constructed, Agriculture).				quadrats needed to achieve sufficient power. Spring terrestrial vegetation survey and botanical inventory for Belle Island to assess impacts within the Project Impact Area. Vegetation Protection Plan Invasive Species Management Plan Site Restoration Plan Follow-up seasonal vegetation monitoring (spring, summer, fall) for 3 years, with annual recommendations should control of invasive species be required, following the methods for “Monitoring impacts on native vegetation” in Guide to Monitoring Exotic and Invasive Plants (Environment Canada, 1997) using the same monitoring quadrats established during the pre-construction survey.

[1] “The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] “The standard of proof will be expressed as “high,” “medium,” or “low,” depending upon the circumstances of the project-VC interaction.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standard

3.2.7 Surface Water Quality

3.2.7.1 Current Water Quality Profiles

The text within this subsection was prepared by WSP (formerly Golder), the full technical memorandum can be found in **Appendix B**.

The Environmental Services Group at the Royal Military College (ESG-RMC, 2014) provides a detailed review of historical surface water quality studies for areas near KIH undertaken between 1971 to 2010. Their assessment relied on surface water quality data collected from 2003 to 2010, as summarized in **Table 26**. The surface water quality data collected since 2003 reflects water quality conditions following the implementation of several source control measures to reduce contaminant inputs from the Belle Island Landfill (further discussed in Section 2.3 of **Appendix B**). Based on these studies, it was concluded that the Great Cataraqui River is a eutrophic and alkaline system, with generally good water quality that, with few exceptions, met the provincial and federal water quality criteria (ESG-RMC, 2014).

WSP (formerly Golder) re-screened the data relied upon by ESG against current water quality criteria, including the Ontario Provincial Water Quality Objectives (PWQOs) and the CCME Water Quality Guidelines (WQGs) for the Protection of Aquatic Life (1999/2022). The updated screening indicated that chromium, copper, lead, zinc, PCBs, and several PAHs exceeded the current water quality criteria. Federal Environmental Quality Guidelines (FEQGs) have recently been established for chromium, copper, lead, and zinc that are based on recent scientific evaluations and allow for water quality parameters that influence bioavailability to be considered for the derivation of site-specific water quality guidelines. However, site-specific water quality parameters necessary to derive FEQGs, including pH, temperature, hardness, and dissolved organic carbon (DOC) were not reported by ESG-RMC (2014) and therefore the FEQGs were not further considered. The exclusion of these toxicity modifying factors means that generic (and conservative) guidelines were relied upon for screening, potentially screening through substances that would otherwise be eliminated with updated and/or site-specific guidelines.

Table 26: Summary of Water Quality Data for the Kingston Inner Harbour (ESG 2014)

Study	Surface Water Sampling Locations	Parameters Assessed	Results
ESG (2003) Sampling completed in 2002	Two locations in KIH (upstream and downstream of Belle Park Landfill) Two locations in Outer Harbour (Fort Frontenac water lot and near Wolfe Island Ferry Dock)	Inorganic elements (total) PAHs PCBs	Concentrations were mostly below analytical detection limits ESG concluded that copper was marginally above generic criteria at an upstream site. Copper and zinc exceed generic criteria at the upstream site
Tinney (2006) Sampling completed in 2004 and 2005	13 locations across KIH across seasons (November, June, September), including three reference locations	Conventional water quality parameters PCBs PAHs Inorganic elements (total)	Alkaline waters at all locations with elevated conductivities Eutrophic waters at all locations, but nutrient concentrations were below PWQOs and CCME WQGs PAHs and PCBs were below analytical detection

Study	Surface Water Sampling Locations	Parameters Assessed	Results
			limits; however, detection limits applied were high and above PWQOs. Based on Tinney (2006) data, ESG concluded that inorganics exceeded generic criteria for aluminum (seven locations), iron (three locations), and chromium (one location) within the KIH Chromium and copper remain above generic criteria within the KIH locations and were not detected in reference locations.
Benoit and Burniston (2010) Sampling completed in 2006	Seven stations in the southwest portion of KIH south of Belle Park, and one reference location	PCBs PAHs Inorganic elements (total) TSS Organochloride pesticides	Based on Benoit and Burniston (2010) data, ESG concluded that most chemicals were present in trace quantities or below analytical detection limits and PWQOs/CCME WQGs. Elevated concentrations correlated with TSS, suggesting chemicals were primarily bound to particulates. Elevated PCBs in one sample near Belle Island Landfill was not correlated with TSS and may indicate a nearby input. Chromium, copper, lead, zinc, PCBs, and PAHs exceed generic criteria within the KIH and reference locations, but only total chromium, zinc, and PCB concentrations were greater within the KIH relative to reference.
ESG (2009) Sampling completed in 2009	Eight locations in KIH, and two reference stations	Total and dissolved metals (Cu, Pb, Zn, Cr, As)	Total concentrations of chromium, copper, lead, and zinc exceed generic criteria in KIH locations, concentrations within reference locations were

Study	Surface Water Sampling Locations	Parameters Assessed	Results
			below analytical detection limits. Based on e-mail correspondence with ESG on 12 December2022, the samples were collected as part of a larger study to investigate potential transport of contaminants from the former Davis Tannery property into the river, with emphasis on high flow conditions. The study targeted storm events and spring meltwater runoff periods, and sampling locations were selected to be within drainage channels from the site and in areas downstream of the Kingscourt storm sewer. Therefore, ESG concluded that the elevated total concentrations likely reflect transient conditions of elevated TSS in the water column due to erosion and surface water runoff during storm events. Dissolved concentrations of copper and zinc remain above generic criteria; however, these criteria are conservative. The recent FEQGs (Canada 2022) could not be applied as there was no site-specific information on hardness, pH, DOC, and temperature required to derive site-specific guidelines.

A recent study examined the water quality in Anglin Bay located within the southern portion of the KIH (ESG 2017). One surface water sample was collected at the mouth of Anglin Bay and analyzed for inorganic elements, PCBs, PAHs, petroleum hydrocarbons (PHCs), benzene, toluene, ethylbenzene, and xylenes (BTEX), tributyltin (TBT), and TSS. PCBs, PAHs, PHCs, BTEX, and TBT were below the analytical detection limits. No inorganic parameters in these data exceeded the CCME WQGs or the PWQOs.

The City of Kingston was contacted by WSP (formerly Golder) to see if they had any additional surface water quality data available from the past 10 years (personal correspondence with Paul MacLatchy on 30 November 2022). The City of Kingston informed WSP of studies completed by Malroz Engineering Inc. (Malroz 2021) and Kiewit (2020 and 2021), which are summarized below.

Semi-annual surface water sampling is undertaken in the KIH as part of the Belle Park Landfill monitoring program (Malroz 2021). The sampling locations include a reference location upstream of the landfill and three locations within the KIH. The surface water samples are analyzed for conventional water quality parameters and metals (cadmium, cobalt, copper, iron, lead, zinc). The surface water quality data from the most recent sampling program were screened against current PWQOs and CCME WQGs. Concentrations of copper, and zinc exceeded the water quality criteria at the reference site and within the KIH. The concentrations were higher within the surface water samples collected within the KIH but were correlated with higher TSS as a result of sediment disturbance. Nitrate and nitrite also exceeded the CCME WQGs at the reference site and within the KIH; however, the concentrations were comparable to background conditions (Malroz 2021).

Ambient Cataraqui River surface water quality data were recently collected as part of the Kingston Third Crossing Project located north of Belle Park (Kiewit 2020 and 2021). These activities were undertaken in a portion of the Cataraqui River previously identified by both RMC-ESG (2014) and Golder (2017a) as being representative of local reference conditions. In-situ monitors were used to measure dissolved oxygen, turbidity, pH, temperature, and conductivity 150 m upstream and 150 to 200 m downstream of the project during in-water works (defined as background levels). The cumulative 30-day background levels for turbidity ranged from 0.48 nephelometric turbidity unit (NTU) (June to July) to 5.34 NTU (November to December) in 2020. In 2021, the cumulative 30-day background levels ranged from 0.81 NTU (June to July) to 12.91 NTU (August to September)[15]. As part of the project, a site-specific TSS: turbidity relationship (i.e., regression) was derived to define site-specific NTU thresholds for monitoring that equated to the CCME WQGs for TSS (Kiewit 2020 and 2021).

The closest surface water quality data available from the Ontario Provincial (Stream) Water Quality Monitoring Network (PWQMN) is the Kingston Mills station (#12000400202), located approximately 5.5 km upstream of the KIH. However, this location may be too distant from the Site to be able to establish local reference conditions as it does not account for the diffuse contaminant inputs from the urban areas of Kingston. It also may have different hydrological conditions from the area south of the Great Cataraqui Marsh.

3.2.7.2 Potential Environmental Effects

The Surface Water Quality VC represents the quality of the waters in KIH, specific to the Project Study Area. The purpose of including the Surface Water VC in the DIA is to assess the reduction of risk to sensitive receptors and to ensure project activities do not impact KIH surface waters. If managed correctly, the proposed project activities should not result in the significant release of contaminants into KIH waters, through the resuspension of contaminants in harbour sediments, or due to sedimentation from disturbances along the shoreline land area. The DIA will form the basis of a site-specific plan to mitigate and monitor the potential release of contaminants, and ensure that immediate, downstream and pathway impacts of contaminant release are reduced or eliminated.

[15] During the Kiewit 2021 study, Sondes may have been interacting with bottom sediments in low water/wavy conditions during August/September and the 12.91 NTU measurement may not be representative due to data interference.

To assess these possible effects and improvements an understanding of current conditions in KIH is required. A detailed memorandum report was completed by WSP (formerly Golder) entitled "*Conceptual Constraints and Impact Considerations - Water Quality"* dated February 2, 2023, provided in **Appendix B**. The memo was completed to support the water quality component of this CCIC document by providing preliminary, high-level considerations of potential Project impacts based on information gathered to date. Assessments of sediment and surface water have previously been completed in the Project Study Area, and a high level summary is provided in **Appendix B**. Based on the information available to date, the overall goal for water quality management during the Project is to maintain current conditions of water quality. Additional assessment of KIH surface water is required as part of the DIA to establish current baseline conditions within the context of previous studies.

The baseline data collected prior to commencing the project should be used to assist in setting reference values along with historical data and, applicable guidelines and regulations for protection of aquatic life that can be used for monitoring purposes during the work activities (i.e., dredging). Regular water quality monitoring of parameters such as temperature, pH, dissolved oxygen and turbidity with an in-situ water quality meter will provide continuous information on conditions at the site and confirm the effectiveness of mitigation measures. If thresholds are exceeded at background/reference locations (i.e., far-field and near-field reference), additional monitoring may be required to determine spatial and temporal extents of the turbidity plume. Additional sampling of Potential Contaminants of Concern (PCOC) may be warranted based on the level of concern, which should be outlined in the water quality management plan (WQMP). PCOCs may be analyzed via laboratory analysis at key points throughout the Project and before it commences.

An Environmental Management Plan (EMP) for the Project Site should be completed along with a Site-specific WQMP for the Project which should include details for water quality monitoring throughout the SMP process, including site-preparation, construction, and post-construction. This would include identifying background (near field and far field sampling locations) and down-current locations (assessment and compliance points) and requirements for sampling (i.e., depths, parameters). Similar processes can be used to monitor the success of the Project, assessing the water quality in the Project area against specific background (up current) monitoring locations.

3.2.7.3 Thresholds

The scenarios presented in **Table 27** provided by WSP (formerly Golder) (**Appendix B**) illustrate the risk to KIH surface waters during sediment management activities. Given the nature of remedial project activities, sediment release from in-water works is likely unavoidable, but efforts will be made to contain these releases close to their point of origin, and within environmental limits to be specified in an EMP. Such procedures have effectively been applied at other federal sediment remediation projects to provide confidence that sediment remobilization is limited to the extent practicable, and water quality (including turbidity and related chemical measurements) maintained. Accidental release of chemical contaminants from regular heavy equipment use, equipment failure, accidental spillage, or any other release pathway (i.e., introduction of substances not currently in the study area) will be managed through following BMP and a Site-specific EMP. Sediment and turbidity release from terrestrial works (from staging areas, for instance) are also likely to occur but can be mitigated through environmental monitoring and management (e.g., sediment control). While there is some potential for downstream impacts to Lake Ontario and upstream impacts due to inflows from Lake Ontario, with improvements on historical management practices and regulation, the likely small magnitude and spatial extent of these impacts render them equally localized and reversible. These Project interactions with Surface Water Quality are considered to be low risk based on preliminary assessment and have manageable outcomes; however, the evidence required to determine if the desired outcome has been achieved is considered to be medium, and as such the standard of proof is medium. The standard of proof would be measured by monitoring and follow-up studies to assess surface water quality compared to baseline and/or background, which should be defined in a site-specific water quality management plan as part of the DIA process.

These scenarios can be monitored via the same mechanism, such as a site-specific Environmental Performance Objective (EPO). An EPO is used during project activities as a threshold to trigger remedial or preventative actions. It can be further detailed in a site-specific water quality management plan regarding stringency of the water quality objectives in relation to background data, guidelines and regulatory requirements. Site specific EPOs would be developed based on results of the DIA would consider the historical and background information in **Appendix B**.

Table 27: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Surface Water Quality

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Surface Water Quality							
Pre-Remediation within the Kingston Inner Harbour							
Baseline water quality present within the KIH prior to remediation should not reflect on-going sources of contamination.	Temporary: pre-remediation	Surface water quality with respect to COCs[4] and CECs[5] is maintained at a level to protect aquatic life from long-term and chronic effects.	Surface water quality will be assessed using the PWQOs, CCME WQGs, and FEQGs. Where available, the FEQGs will take precedence[6]. Where criteria are exceeded, concentrations will be compared to reference locations to understand the source of elevated contaminants.	High	Yes F	Implementation of mitigation measures at identified sources, if identified from proposed monitoring (see additional works to right). Design engineer to work with City of Kingston to align shoreline works with current understanding of upgradient sources (e.g., storm sewer outfalls, soil erosion controls for shoreline areas). Enhancement of existing upgradient municipal source control initiatives, including public education, if ongoing sources of COCs or CECs	A baseline surface water quality monitoring program should be completed prior to the Project, that includes surface water analysis within each management unit, at reference locations, and immediately downgradient of major contaminant sources along the shoreline (e.g., Belle Park Landfill, storm sewers during dry outfalls, Emma Martin Park, Rowing Club, Former Davis Tannery). The baseline surface water quality monitoring program should address data daps identified in Section 3.1 in order to fully capture pre-remediation levels.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
						identified at levels of concern.	
During Remediation at the Point of Discharge/Compliance Point ***Regulatory compliance with Section 36 of the Fisheries Act is typically evaluated at the point at which an operator no longer exercises control over a discharge (referred to as the Point of Discharge [POD]). In the case of a sediment remediation project, control ends at the point at which turbidity is no longer controlled and the point of regulatory compliance may include the edge of a turbidity curtain, a safety buffer around dredging auger where the closest samples can be safely collected from, or the end of pipe during dewatering (referred to as Compliance Point).***							
In-water works involving dredging, dewatering and/or capping resulting in the re-suspension of sediments and associated contaminants at the POD.	Temporary: during sediment management activities	Surface water quality with respect to TSS, COCs and dissolved oxygen is maintained at a level to protect aquatic life from short-term and acute lethality.	An EPO linked to TSS will be developed as part of the WQMP for the POD (as outlined in **Appendix B** Section 3.2) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Suggested EPOs include the short-term CCME WQG for TSS (25 mg/L above background) or the DFO (1992) threshold (75 mg/L irrespective of background). Monitoring during in-water works would include: continuous in-situ monitoring of turbidity (to infer TSS concentrations) at reference locations and	High	Yes A, B, C	EMP will detail project requirements following BMPs, which may include the use of a turbidity curtain during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance, and additional filtration during dewatering	A site-specific WQMP is required prior to commencement of the Project that will define the EPOs, outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring, and identify high level management actions to address water quality that is found to exceed the EPO. Prior to implementation of the WQMP, a site-specific TSS:Turbidity relationship should be determined (Section 3.1 of **Appendix B**). EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce turbidity.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
			at the Compliance Point to ensure the EPO is met; in-situ monitoring of other water quality indicators that may impact toxicity, including: pH, dissolved oxygen, and temperature; and intermittent sampling for COCs to confirm that the turbidity-based EPO is protective of contaminant exposures.				
During Remediation at the Receiving Environment/Assessment Point ***Considers potential exposures within the receiving environment outside the work area, at the edge of the initial dilution zone (referred to as the Assessment Point). The Assessment Point is typically defined as approximately 100 m away from the Compliance Point.***							
In-water works involving dredging, dewatering and/or capping resulting in the re-suspension of sediments and associated contaminants within the Receiving Environment.	Temporary: during sediment management activities	Surface water quality with respect to TSS, COCs and dissolved oxygen is maintained at a level to protect aquatic life from long-term and chronic toxicity	An EPO linked to TSS will be developed as part of the WQMP for the Receiving Environment (as outlined in Section 3.2 of **Appendix B**) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Suggested EPO includes the long-term CCME WQG for TSS	High	Yes A, B, C	An EMP will detail project requirements following BMPs, which may include the use of a turbidity curtain during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance, and additional filtration during dewatering	A site-specific WQMP is required prior to commencement of the Project that will define the EPOs, outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring, and identify high level management actions to address water quality that is found to exceed the EPO. Prior to implementation of the WQMP, a site-specific TSS:Turbidity relationship

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
			(5 mg/L above background). Monitoring during in-water works would include: continuous in-situ monitoring of turbidity (to infer TSS concentrations) at reference locations and at the Assessment Point to ensure EPO is met; in-situ monitoring of other water quality indicators that may impact toxicity, including: pH, dissolved oxygen, and temperature; and intermittent sampling for COCs to confirm that the turbidity-based EPO is protective of contaminant exposures.				should be determined (Section 3.1 of **Appendix B**). EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce turbidity.
Post Remediation within the Kingston Inner Harbour							
Long-term impacts of sediment re-suspension following in-water works	Long-term: post-sediment management	Remediation activities have not negatively impacted water quality at the Site	COCs meet the PWQOs, CCME WQGs, and FEQGs. Where available, the FEQGs will take precedence[6] OR Where water quality criteria are exceeded, the COCs are within	Moderate	Yes F	If it is determined that the elevated COCs are the result of the Project and not other sources, additional remedial measures may be considered (e.g., capping	A baseline surface water quality monitoring program should be completed prior to the Project, that includes surface water analysis within each management unit, at reference locations, and immediately downgradient of major contaminant sources along

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
			the range of pre-remediation baseline conditions. Post-remedial monitoring should be completed over 5 years and include locations adjacent to other contaminant sources along the KIH before inferences of Project related impacts are made.			within sediment management units that have elevated COCs).	the shoreline (e.g., Belle Park Landfill, storm sewers during dry outfalls, Emma Martin Park, Rowing Club, Former Davis Tannery). The baseline surface water quality monitoring program should address data daps identified in Section 3.1 of **Appendix B**.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)

[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)

[3] Proven Mitigation Measures, Best Management Practices, Guidelines and Standards include:

[A] PCA. 2017. Ontario Waterways Environmental Standards and Guidelines Document, Part 2.

[B] PCA. 2017. Parks Canada National Best Management Practices: Works In and Around Waterbodies.

[C] Evaluating Construction Activities Impacting on Water Resources Part III B: Handbook for Dredging. 2011. Ontario Ministry of the Environment.

[D] Erosion and Sediment Control Guide for Urban Construction. 2019. Toronto and Region Conservation Authority.

[E] Construction Specification for Temporary Erosion Control. 2021. Ontario Provincial Standard Specification.

[F] Canada. 2021. Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours under the Federal Contaminated Sites Action Plan (FCSAP). Version 1.1. Fisheries and Oceans Canada, Ottawa ON, Canada. November 2021.

[4] COCs represent chemical parameters that are known to be elevated within sediments and/or surface water within the KIH, including nutrients, metals, PAHs, PCBs

[5] CECs represent chemical parameters that are increasing being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders are endocrine disrupters, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and polybrominated diphenyl ethers (PBDE)

[6] FEQGs (Canada, 2022) have recently been established that are based on recent scientific evaluations and allow for site-specific water quality guidelines to be developed based on pH, temperature, hardness, and/or dissolved organic carbon (DOC).

3.2.8 Lacustrine Processes

The Lacustrine Processes VC refers to the hydrodynamic and geomorphologic process within KIH. Due to the relatively shallow depths of KIH, the proposed project activities are unlikely to result in significant impacts. However, this cannot be confirmed until SMP and DIA finalization, when pre-development and post-development conditions can be compared. The purpose of including Lacustrine Processes as a VC is to mitigate and monitor the potential changes to, and impacts due to, KIH hydrodynamics and geomorphology.

- The KIH is a basin at the mouth of the 910 km^2 Cataraqui River watershed draining into Lake Ontario. The harbour is approximately 1.7 km long and 1 km wide. Harbour bathymetry can be categorized based on the following areas: South: The area south of Anglin Bay and Kingston Marina (includes management unit TC-AB, and parts of TC-5, and TC-E) is approximately 15 m to 23 m in depth, shallow sharply at the shorelines;
- East: The navigation channel connecting the Outer Harbour to the Rideau Canal (includes parts of management unit TC-E) with depths of 8 m to 10 m along its centre, shallowing sharply to the east and west.
- Northwest: The rest of the harbour (including remaining management units) which shallows more gradually north and west.

The hydrodynamics within KIH are controlled by the regional hydrodynamics of Lake Ontario and are not greatly influenced by upstream inputs apart from extreme precipitation events. Water levels in Lake Ontario are controlled to a certain extent by hydroelectric dams, with output managed by the International Joint Commission (IJC) between the Canadian and United States governments. The area has generally low energy with small changes in water levels, low current velocities and low wave heights due to short fetches and shallow water depths (Golder, 2019a).

Winds and waves from Lake Ontario can cause unique localized conditions within the Study Area, such as increased water levels and even reverse flows (e.g., seiche waves) for short periods (Hatch, 2019a); however, overall, Lake Ontario wave energy is largely absorbed by the LaSalle Causeway structure, therefore wave energy passing into the basin is low and sporadic and does not have a pronounced effect on water levels (CRCA, 1976). Southerly and southwesterly winds, combined with downstream flow, generate a clockwise circulation cell, which would dominate suspended sediment transport, particularly in water depths of less than 2 m found over much of the Study Area, and sediment is transport both to the north and south, as found with the long-term historical dispersal of contaminants within the harbour (Golder, 2019a). Wave action due to wind is insignificant due to low water levels and aquatic vegetation along the shorelines (CRCA, 1976). Previous sediment transport (Golder, 2017a) and sediment stability (SNC-Lavalin, 2020) studies concluded that hydrodynamic changes will have a limited impact on project and environment.

These studies also confirmed very low sedimentation rates within KIH. The harbour was classified as a quiescent environment, promoting sediment settlement with a stabilizing presence of aquatic vegetation. Appendix A of the Recommended Remedial Option for the Kingston Inner Harbour (Golder, 2019a) summarizes the key KIH sedimentation processes as follows:

- bioturbation causes sediment re-suspension to a maximum depth of 0.15 m ; and
- the estimated rate of sedimentation ranges from approximately 0.11 – 0.72 mm/year within the harbour indicating a sediment-limited environment. These low rates of sedimentation are unlikely to be adequate for burial or dilution of contaminated sediments.

WSP (formerly Golder) has prepared a technical memorandum entitled “Conceptual Constraints and Impact Considerations-Lacustrine Processes” dated February 15, 2023, that provides discussion on baseline hydrodynamics and sediment processes, potential environmental effects (including thresholds and VCs) and summary of constraints. The document is intended to support the DIA by providing preliminary high-level information and is provided in **Appendix C**.

The development of the DIA can use publicly available continuously collected data and previous studies to establish a baseline hydrological process regime for KIH. Processes to be analyzed include currents, water levels, wind generated waves, storm surges and seiches, ice cover and harbour bathymetry. A list of applicable background sources was produced in 2020 during the Gap Analysis phase of the DIA process. Background information may include:

- Lake Ontario water levels and surge quantities at Kingston
- Ontario Flow Assessment Tool
- HCCL. 2011. Hydrotechnical Analysis in Support of Environmental. Assessment for Third Crossing of Cataraqui River. Kingston, Ontario
- Canadian Hydrographic Service
- Government of Canada – Environment and natural resources (e.g., historical weather data)
- Any other local and publicly available monitoring data.

3.2.8.1 Thresholds

The scenarios presented in **Table 28** provided by WSP (formerly Golder) (**Appendix C**) illustrate the risk to KIH surface waters during sediment management activities. Water levels throughout KIH are relatively shallow, with much of the Inner Harbour measured at less than 2 m, only reaching a depth of 4 m near the La Salle Causeway where significant boating activity occurs approaching the Kingston Marina (Golder, 2019a). Without mitigation and/or specific Project design considerations, in-water works such as dredging, capping, and site isolation methods (e.g., large cofferdams)may impact lacustrine processes at the local scale. However, the design of the overall remediation plan will limit these alterations, and the remaining changes will be both minor in magnitude and addressed through design of shoreline elements and other techniques. Lacustrine processes generally do not have quantified criteria or thresholds similar to Environmental Performance Objectives (EPOs) but rather consider the potential for undesirable or desirable changes to the baseline condition. In general, minimizing or selectively limiting changes (e.g., maintaining bathymetry and shoreline geometry where appropriate) and implementing appropriate mitigation (e.g., designing slopes, depths, and geotechnical features to maintain desired properties of sediment resuspension, erosion potential, and habitat value) helps meet Sediment Quality and Water Quality threshold targets. These Project interactions with the Lacustrine Processes VC is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The following thresholds were identified by WSP (**Appendix C**) to measure the standard of proof:

- **Conditions during active works**—Thresholds for this stage relate primarily to managing changes in lacustrine processes due to mechanical sediment disturbance, and through appropriate controls on the release or generation of suspended sediments during works.

- **Conditions following completion of works**—Thresholds relate to management of parameters that affect lacustrine processes such as restoring depth parameters, slopes, and substrate type to agreed upon limits and the restoration of submerged aquatic vegetation.

- **Long-term stabilized conditions**—Thresholds relate to functional green engineered solutions that meet shore protection requirements and habitat enhancement expectations.

Table 28 29: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Lacustrine Processes

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Lacustrine Processes							
Site preparation and removal of existing shore infrastructure and shore protection may result in temporary changes in the stability of the shoreline and substrate with the potential to alter sediment transport processes in Kingston Inner Harbour.	Temporary: during sediment management activities	Water levels, wind generated waves, and currents in the sediment management areas continue to fluctuate within natural ranges and broad circulation patterns are not disturbed. Shorelines and riverbed remain stable during remediation.	Changes to shorelines and sediment movement within the project area will be monitored during remediation within acceptable limits.	Medium	Yes	Structures such as docks and shore protection will be replaced with like structures in the event of temporary removal. Design of dredge prisms will consider slopes and stability of sediment in each management unit. The environmental management plan (EMP) will detail project monitoring requirements, which will include measures to avoid excessive sediment disturbance.	Conduct lacustrine process and sediment transport modelling to compare remediation with baseline conditions. Monitoring plans should include procedures for corrective actions to be taken in the event of significant alteration to baseline processes.
In-water works such as dredging, capping, and shoreline stabilization will result in changes in local depths resulting in alteration of SAV. Temporary or permanent loss of SAV may result in increased frequency of the potential resuspension (increase in TSS/turbidity) by wind waves and currents	Temporary: during sediment management activities OR Long-term: post-sediment management.	Detailed design will account for hydrodynamic and ecological factors that influence restoration of SAV. Restoration of SAV will consider both plantings of native materials and generation of substrate conditions (depths, particle sizes, and flow conditions) to facilitate redevelopment of SAV communities.	SAV within management units is eventually restored to acceptable limits.	Medium	Yes	N/A	SAV restoration plan. Hydrodynamic (wave and current modelling) and related assessment of sediment transport potential is recommended to compare the existing condition to the post-project (dredged) condition. Evaluate whether risks from temporary loss of SAV are significant in terms of changes to sediment transport potential, and develop mitigations as appropriate.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
In-water works such as dredging, capping, and shoreline stabilization will result in changes in local depths resulting in changes to local hydrodynamics and sediment transport	Long-term: post-sediment management	Water levels, wind generated waves, and currents in the sediment management areas continue to fluctuate naturally and circulation patterns are not disturbed.	Bathymetry of management units is restored within set depth parameters.	Medium	Yes	In some cases, dredge cuts will be partially backfilled with engineered covers to restore the bed elevation to balance exposure reduction with navigational depth considerations (e.g., Anglin Bay).	Hydrodynamic (wave and current modelling) and related assessment of sediment transport potential is recommended to compare the existing condition to the post-project (dredged) condition to evaluate if dredging related changes in depth are significant in terms of changes to sediment transport potential.
Excavation of contaminated material in the upland and riparian zones may contribute to loss of shoreline protection function (e.g., stability) and temporary loss and degradation of habitat.	Long-term: post-sediment management	Functional green engineered solutions that meet shore protection requirements and habitat enhancement expectations. Green-engineered solutions may include beach nourishment and re-planting of riparian vegetations and nearshore (SAV).	Monitoring of shoreline position and shoreline profile within acceptable limits.	Medium to High	Yes	SMP and detailed designs to consider appropriate site-specific solutions to minimize losses of function.	SAV restoration plan. Shoreline protection and restoration designs.

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.9 Sediment Quality

3.2.9.1 Current Sediment Profiles

The text within this subsection was prepared by WSP (formerly Golder), the full technical memorandum can be found in **Appendix D**.

Extensive sediment quality characterization has been completed over KIH, including upstream reference areas, over multiple decades. The early conceptual planning stages of the Project (Golder 2016, 2017c, 2019, 2021) relied mainly on sediment quality data collected between 2008 and 2013, a period over which the greatest densities of surface sediment quality samples were collected. Many of the data, including historical collections from several independent organizations, were collated by ESG-RMC (2014), and additional collections were conducted and summarized by Golder (2011, 2012, 2013a, 2014, 2016). All those data, following screening for relevance (e.g., removal of data for dredged sediment), were summarized in Golder (2016) as part of the synthesis of environmental quality and risk information.

To distinguish sediment quality in the upstream reference area from the contaminated portions of the PCA and Transport Canada water lots south of Belle Island, sediment quality profiles for reference areas were calculated using the following methods:

- Surface grab samples from the years 2004 to 2011 were identified in ESRI ArcGIS (10.8)
- The upstream sampling area was constrained to the area marked on Figure A-1 of **Appendix D** as Parks Canada (Upstream Reference Zone), which has the management unit code of PC-N. The reference zone also aligns with Cataraqui River north of management unit TC-E on Figure A-2 of **Appendix D**. This upstream area was identified by both ESG-RMC (2014) and Golder (2016, 2017a) as an appropriate harbour reference condition. The sediment quality in PC-N includes diffuse regional background inputs of anthropogenic substances but is not influenced by Project-related point sources, and also has similar sediment substrate. Ecological effects in this area were negligible in magnitude based on the screening risk assessment (Golder 2016).
- The Spatial Analyst Inverse Distance Weight (IDW) tool was applied in ArcGIS software ArcMap to calculate the surfaces for contaminants in PC-N. Within the IDW tool the optional/selectable variables included:
    - The input barrier was used to prevent the tool for interpolating across the land of Belle Park and Belle Island Park.
    - For chromium outliers 2011-M and SE36 were excluded.
- With the surfaces created, the ArcGIS Pro Zonal Statistics tool (Zonal Statistics within Spatial Analyst) was used to calculate the arithmetic mean and 90th percentile value for PC-N.

The above procedures yielded a spatially weighted and site relevant characterization of local reference conditions, with summary statistics summarized in **Table 29**.

Table 30: Summary of Reference Area Sediment Contamination

Constituent	Sample Size for Reference Area (excluding outliers)	Mean Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [Mean]	90^{th} percentile Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [90^{th} percentile]
Antimony	15	0.06	<0.2	0.18	<0.2
Arsenic	15	2.46	<ISQG (5.9)	2.99	<ISQG (5.9)

Constituent	Sample Size for Reference Area (excluding outliers)	Mean Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [Mean]	90th percentile Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [90th percentile]
Chromium	13	54.18	<PEL (90.0)	80.38.0	<PEL (90.0)
Copper	15	29.92	<ISQG	33.54	<ISQG
Lead	15	41.59	<PEL (91.3)	55.64	<PEL (91.3)
Mercury	15	0.079	<ISQG	0.22	<PEL (0.49)
Silver	15	0.21	<LAET (0.5)	0.50	<LAET (0.5)
Zinc	15	108.83	<ISQG (123)	126.88	<PEL (315)
Total PAHs	15	1.66	<LEL (4.0)	3.82	<LEL (4.0)
Total PCBs	15	0.064	<LEL (0.07)	0.17	<PEL (0.28)

(1) Sediment quality category shown is the category as depicted in the legend of corresponding figure in Appendix A of **Appendix D**, with cool colours (blue and green) representing the lowest level of contamination, yellow indicating moderate contamination, and hot colours (orange through red) representing the highest levels of bulk sediment contamination. Colour categories do not necessarily indicate potential for ecological risk, but rather overall magnitude of sediment contamination. Cell entry indicates the federal sediment quality guideline (mg/kg dw) or concentration threshold at upper end of interval.
ISQG = Interim Sediment Quality Guideline (Canadian Council of Ministers of the Environment)
PEL = Probable Effect Level (Canadian Council of Ministers of the Environment)
LAET = Low Apparent Effect Threshold (Avocet 2003)
LEL = Lowest Effect Level (Ontario Ministry of Environment 2008)

For all contaminants of interest, reference sediment concentrations are lower than probable effect level or equivalent, including both mean and upper tail (90th percentile) estimates (**Table 29**). These conditions, although not pristine, reflect low magnitude of urban influence and acceptable sediment quality for working harbours (FCSAP 2021). For most substances, average reference sediment quality is below the Interim Sediment Quality Guideline (ISQG), which is a highly conservative screening value for sediment quality screening.

During early consultation stages, several stakeholders raised the question of whether the contaminant distributions in KIH sediment remain stable over periods of a decade or more. To address this question, and to provide additional delineation data for advancing the conceptual design, PSPC contracted Golder Associates Ltd. (now known as WSP Canada Inc.; WSP) to lead a supplemental sampling program in Fall 2021, emphasizing the water lot sections within and adjacent to areas proposed for active intervention. These data were combined with sediment chemistry data from within the past decade[16] to produce an updated sediment chemistry surface. Golder (2022) describes the methods and factual results from this supplemental sampling program. Updated sediment chemistry distributions for the primary and secondary COCs are summarized in Appendix A (Figures A-3 through A-12 of **Appendix D**). These figures depict surface weighted averaged (smoothed) distributions of COCs identified in the detailed risk assessment. Surface sediment distributions in Appendix A of this report were compared against the historical surfaces found in Appendix A of Golder (2017a) to identify similarities and differences.

Some general conclusions from the updated sediment quality profiling included:

[16] Although data from prior to 2021 were included in the updated chemistry surfaces, most results depicted in Appendix A of **Appendix D** plots are from Fall 2021 sampling. The figures in Appendix A of **Appendix D** distinguish between the most recent results (Fall 2021 depicted as square symbols) and prior decade (2011–2020 inclusive depicted as circular symbols)

- The spatial distribution and magnitude of contamination in Fall 2021 remained broadly consistent with earlier profiling. There was no widespread evidence of significant recovery or deterioration of sediment quality over the past decade, with concentrations of inorganic and organic substances remaining well above sediment quality guidelines, and at similar magnitude and spatial distribution to earlier characterizations.

- Numerous substances remain elevated relative to both upstream reference conditions and relative to the eastern half of KIH. The gradient of improving sediment quality moving from west to east was confirmed, in accordance with proximity to legacy sources along the western shoreline.

- Substantial portions of KIH, including the central areas (e.g., TC-1, TC-2B) have elevated bulk sediment concentrations relative to background and relative to conservative generic sediment quality criteria, but not at concentrations that yield unacceptable risks based on the results of a quantitative risk assessment (Golder 2016). Because the remedial objective is to reduce only the substances that cause moderate or greater risks, leaving such low-level concentrations in place within the central harbour is acceptable, and the updated concentration profiles indicate that this approach remains appropriate.

- For some constituents, which previously exhibited isolated pockets of elevated sediment chemistry in the central KIH (relative to surrounding areas within the same management unit), such localized areas did not appear as heterogeneous in 2021. In is unclear whether this finding relates to standardization of collection and analytical methods in recent data collections (i.e., earlier compilations reflected multiple distinct investigations with differences in collection methods and analytical techniques), or to a more homogenous field condition. Antimony, mercury, and PCBs are examples of COCs that exhibited smoother distributions in 2021 relative to the patchier profiles evident in earlier data compilations.

The updated contamination distributions for key COPCs are summarized below, with comparisons made to the earlier profiles summarized in Golder (2017a).

Metals/Metalloids

Antimony (Figure A-3 of **Appendix D**)—The updated sediment quality profile indicates that antimony remains at a stable magnitude of harbour-wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines developed for freshwater sediments. Most sediment concentrations in KIH fall below the 2LAET (second Lowest Apparent Effects Threshold) guideline, a value calculated by Avocet (2003) using statistical analysis of co-occurring freshwater sediment chemistry and toxicological endpoint data. The main difference in the 2021 dataset is that the localized exceedances of the 2LAET guideline are now limited to the nearshore areas along the western shoreline, particularly adjacent to the Woolen Mill (WM) and Parks Canada (PC-W) shorelines. Earlier characterizations indicated occasional anomalous elevated antimony concentrations in the central harbour (TC-1, TC-2B), but these hotspots have not been confirmed in recent sampling. Overall, antimony indicates similar, but smoother (i.e., fewer localized areas that deviate from the broad spatial gradient), concentration distributions in recent sampling. Furthermore, because antimony is highly coincident with other COCs, including other metals/metalloids, the remediation design for other constituents will address antimony contamination of interest.

Arsenic (Figure A-4 of **Appendix D**)—The updated sediment quality profile indicates that arsenic remains at a stable magnitude of harbour-wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines for freshwater sediments. Both historical and recent chemistry distributions indicate that several management units exceed the CCME Probable Effect Level (PEL) for freshwater sediment, although such exceedances of the PEL are small in magnitude in most locations. Exceedances of the 2LAET guideline from Avocet (2003) are restricted to two management units (WM, RC), and this spatial profile has remained generally consistent over time. The main difference in the sediment profile for arsenic is that the conditions in the northern half of the RC management unit (along the submerged utilities corridor) have improved in the last decade, and this may reflect the positive effect of historical dredging in the affected area. Overall, distribution of arsenic at levels of concern remains localized in this one area of western shoreline sediment. The cooccurrence of these peak arsenic levels with other COCs, including other metals/metalloids, means that remediation design targeted to other constituents will address arsenic contamination of interest.

Chromium (Figure A-5 of **Appendix D**)—Chromium remains the single COC with the highest overall magnitude of exceedance of generic sediment quality guidelines and background Cataraqui River sediment concentrations. Over a century of tannery activities were conducted in the Davis Tannery lands beside the Orchard Street Marsh. Although the tannery closed in the 1970s, the proximity to the marsh, which was used for discharge of industrial waste until 1974, has left a clear profile of chromium contamination in sediment. Nearly all sediment within a 500-metre radius of the brownfield (former tannery) site continues to have total chromium concentrations in sediment that exceed 500 mg/kg, a value well above the CCME PEL, the provincial Severe Effect Level (SEL) and the 2LAET. Much of the sediment contamination in the northwestern corner of KIH adjacent to the drainage from the brownfield zone exceeds 1,000 mg/kg chromium. These spatial gradients and overall magnitude of contamination remain consistent with the historical data distribution for chromium. The use of generic guidelines overstates the ecological hazard associated with chromium, as most chromium in surface KIH sediments is in the trivalent form, which is lower in toxic potency relative to the hexavalent form. Nevertheless, the chromium patterns identified in earlier delineations have been confirmed, and with no meaningful improvement in chromium concentrations over time. Chromium concentrations above 1,000 mg/kg remain common within several management units (PC-W, PP-OM PC-OM, TC-OM) in the vicinity of Orchard Marsh, and these concentrations continue to support the rationale for physical intervention in these maximally exposed areas.

Copper (Figure A-6 of **Appendix D**)—Sediment copper remains a highly localized COC in KIH, with nearly the entire harbour exhibiting copper below the CCME PEL. Although the western half of KIH exhibits copper at concentrations higher than upstream reference conditions, the level of exceedance remains modest. Per FCSAP (2021) guidance for working harbours, such conditions below PEL do not, on their own, warrant remedial actions. The only area in KIH with copper contamination at levels of concern is in the head of Anglin Bay, adjacent to the shipyard operations. The innermost half of Anglin Bay contains copper at concentrations above the CCME PEL, the provincial SEL, and the Avocet (2003) apparent effect thresholds (including the 2LAET at the maximally exposed areas). These findings confirm that copper distributions have remained very stable over the past decade and continue to identify Anglin Bay as an area of elevated metals contamination. As the entire inner portion of Anglin Bay has also been identified by intervention based on legacy PAH contamination, the recent findings for copper do not change the designation of management unit TC-AB.

Lead (Figure A-7 of **Appendix D**)—The distribution of lead in sediment remains fundamentally unchanged relative to the previous decade. Most of the western half of KIH exhibits lead at concentrations above the PEL, and above upstream reference concentrations, but with only localized areas exceeding the LAET from Avocet (2003). Despite these exceedances of generic guidelines and background, the detailed risk assessment indicated the risk from sedimentary lead was low, in part due to presence of local modifying factors (such as acid volatile sulphides that bind divalent metal cations). Furthermore, the few areas of maximum lead contamination are coincident with other metals and organics, such that intervention for other COCs will address any minor risk from lead.

Mercury (Figure A-8 of **Appendix D**)— The distribution of mercury in sediment also remains fundamentally unchanged relative to the previous decade. The only difference in the recent data collections is that the chemical distributions follow smoother gradients from the legacy shoreline source. Most of KIH, in both historical and recent sampling, remains below the CCME PEL of 0.49 mg/kg. However, contiguous areas of sediment mercury contamination above the PEL remain along the west-central shoreline in KIH, and approximately half of that contiguous area includes concentrations above the SEL of 2 mg/kg. The areas that exceed the PEL remain of interest for two reasons: 1) the areas of contiguous sediment contamination that approach, and sometimes exceed, the SEL result in average concentrations of total mercury across multiple management units that could result in bioaccumulation of mercury to levels of concern; 2) the sediment quality guidelines do not explicitly incorporate biomagnification pathways, such that mercury contamination in KIH fish tissues confirms the bioavailability of sediment mercury, validates previous identification as an environmental concern, and is reflected in the development of local fish consumption advisories for the harbour. These confirmed mercury exposure levels, which have not ameliorated with time, remain a consideration in the conceptual remedial design.

Silver (Figure A-9 of **Appendix D**)— The updated sediment quality profile indicates that silver remains at a stable magnitude of harbour wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines developed for freshwater sediments. Both historical and recent sampling indicate a pattern of moderate silver exceedances extending from the legacy industrial activities at the Woolen Mill. Sediment concentrations in KIH are currently below the 2LAET guideline over the vast majority of locations, and no link between silver concentration and adverse effects was identified in the detailed risk assessment. Overall, silver indicates similar, but smoother, concentration distributions in recent sampling. Furthermore, because silver is highly coincident with other COCs, including other metals/metalloids, the remediation design for other constituents will address any silver contamination of interest

Zinc (Figure A-10 of **Appendix D**)—The distribution of zinc in sediment remains fundamentally unchanged relative to the previous decade. Most of the western half of KIH exhibits zinc at concentrations below the PEL, and with no localized areas exceeding the LAET from Avocet (2003). The detailed risk assessment indicated the risk from sedimentary zinc was low, in part due to presence of local modifying factors (such as acid volatile sulphides that bind divalent metal cations). Furthermore, the few areas of zinc contamination above the PEL are coincident with other metals and organics, such that intervention for other COCs will address any minor risk from zinc.

Organics

Polycyclic aromatic hydrocarbons (PAHs; Figure A-11 of **Appendix D**)—Broadly, the magnitude of PAH contamination remains similar to the previous decade. Several regions of elevated PAH contamination have been identified through the western KIH; these concentrations of total PAHs provide a synthesis of the numerous individual parent PAHs and are a useful indicator of both spatial exposure gradient and temporal trend for PAH mixtures that are stable in composition. Both historical and recent sampling indicates three main regions of total PAH contamination that exceed the Probable Effect Concentration (MacDonald et al. 2000):

- Northwestern KIH water lot adjacent to former Belle landfill and Orchard Marsh
- West central nearshore area adjacent to the Woolen Mill
- Southern shoreline area within and adjacent to Anglin Bay

These zones are delineated more clearly in the recent sampling relative to historical sampling and depict a clearer linkage to historical contamination sources. Sediment PAH concentrations observed within KIH in the vicinity of Anglin Bay and the Douglas Fluhrer Park area are likely the result of historical contamination from a former rail yard and coal gasification plant (Golder 2013b). Although the overall contribution of PAHs from the rail yard area is unknown, the spatial extent of contamination, PAH composition and type of industrial activity all suggest that rail yard activities played a significant role in contaminating the adjacent water lots of KIH. Within Anglin Bay, migration of PAHs from the large deposits of weathered coal tar historically transported via storm sewers are expected to be responsible for the PAH concentrations found in nearby sediments. These historical contributions are expected to represent the bulk of the observed PAH contamination, with ongoing sources (i.e., storm water discharges, vessel traffic, hydrocarbon spills) representing only a minor component. The legacy PAH concentrations are heterogenous in distribution at depth, with some areas exhibiting shallow PAH contamination (i.e., within upper 1 m of sediment bed) that exceeds typical surface concentrations.

The central and eastern areas of KIH, although elevated relative to reference conditions, do not indicate PAH contamination at levels of concern for a working harbour.

Polychlorinated biphenyls (PCBs; Figure A-12 of **Appendix D**)—Of all COC evaluated in KIH, the distributions of sediment PCB contamination exhibit the largest changes in distribution pattern over the last decade. However, the changes do not appear to indicate transport or degradation of PCBs in sediment (particularly as PCBs are highly persistent in the environment), but rather uncertainties in the sediment chemistry surfaces. In the recent sediment delineation, the contamination surface for total PCBs is more consistent with expected sources and gradients; the PCB contamination is focussed along shoreline sediments close to the former Belle landfill, and in some hot spots toward the southeastern portion of KIH. The pattern over much of KIH is consistent with landfill leachate as the primary source. Two former demolition/scrap yard properties may have also contributed to the PCBs found in the KIH sediment, although historical poor PCB handling practices may have led to the discharge of PCBs through the storm sewer system from the Kingscourt outfall and in the vicinity of Douglas Fluhrer Park (MacLatchy 2013, pers. comm.). These are the only contiguous areas in recently sampling that exceed 1 mg/kg dry weight total PCB. Remaining PCB measurements, all below 1 mg/kg total PCB, occur at concentrations higher than reference conditions, and above the PEL, through the entire western KIH. In historical chemistry, there was increased spatial distribution of moderate PCB concentrations in the range of 0.6 to 1.0 mg/kg dry weight total PCB, particularly in the central KIH. It is unknown whether these differences in the central harbour result from analytical variability, heterogeneity in sediments, or other cause; nevertheless, the concentrations below 1 mg/kg are unlikely to warrant intrusive management to achieve acceptable risk. Instead, emphasis on the nearshore hotspots, which overlap the contamination distributions for other primary COCs, would provide the most effective way to manage PCB exposures. PCBs cause adverse effects primarily through broad biomagnification pathways rather than localized direct effects, meaning that management should emphasize weighted average conditions in management units rather than specific locations representing small PCB mass.

3.2.9.2 Potential Environmental Effects

The overall aim of the SMP is to reduce levels of contamination in surface sediments. The focus of the SMP is in areas that yield moderate or higher risk to receptors and where physical intervention, and deliberately modifying of the sediment quality profile is required for chemical risk reduction. WSP (formerly Golder) has prepared a technical memorandum entitled "*Conceptual Constraints and Impact Considerations-Sediment Quality*" dated February 6, 2023, that provides discussion on current sediment quality, potential environmental effects (including thresholds and VCs) and summary of constraints. The document is intended to support the DIA by providing preliminary high-level information and is provided in **Appendix D**.

The Sediment Quality VC refers to the physical and chemical properties of the sediment underlying the waters of KIH and in its riparian areas. If managed appropriately, the proposed project activities will result in safe removals of contaminated sediments, resulting in improvements of both localized and broad-scale sediment quality without unacceptable resuspension or mobilization of sediments. The purpose of including Sediment Quality as a VC is to mitigate and monitor the potential release of contaminants into unimpacted or low-contaminated KIH sediments, and through appropriate environmental controls provide confidence that immediate, downstream and pathway impacts of contaminant release are reduced or eliminated.

The development of the DIA can use previous studies on sediment quality in KIH and available information on the project methodologies to determine potential impacts. A list of applicable background sources was produced in 2020 during the Gap Analysis phase of the DIA process, with studies related to sediments identified as applicable to the former VC heading "Terrain, Geology, and Soils" (SNC-Lavalin, 2020a). The list of sources for the DIA should be updated to encompass newly available information to ensure an up to date and accurate baseline of Sediment Quality in KIH.

The current state of KIH sediment contamination, as assessed by Golder (2013, 2014, 2016, 2021a), poses human health risks above acceptable levels, with moderate risk from exposure via dermal contact throughout most of the management units and also a low risk from fish ingestion. The objectives of the SMP include reducing or eliminating these risks by removing or reducing the contamination; preserving sensitive habitats, particularly where contamination risks are marginal; modifying or limiting site use by receptors; and intercepting or removing the exposure pathways (Golder, 2021a). Post-implementation of the SMP, significant risk pathways for most recreational users will be reduced through physical removal or isolation of contaminated nearshore sediments (Golder, 2021a).

3.2.9.3 Thresholds

Sediment contaminant mapping produced by Golder (2021c) identified concentrations of total PAH, total PCB, antimony, arsenic, chromium, copper, lead, mercury, silver, and zinc for each waterlot in KIH. Without mitigation and/or specific Project design considerations, in-water works such as staging, dredging, and capping may adversely impact quality of unimpacted or low-contaminated KIH sediments post-sediment management. Design elements and appropriate environmental controls for limiting the mobility of resuspended contaminated sediments should be considered (i.e., turbidity and suspended solids management). Containment of suspended solids during dredging is the most important risk factor for construction and remediation stages, and turbidity controls are commonly included in EMPs for dredging projects, including use of physical controls (e.g., silt curtains), shoreline filter materials, and application of threshold TSS and/or turbidity objectives to prevent unacceptable redistribution of sediments and reduce the effect of dredge residuals. Construction staging and planning should include the deployment of mitigations to prevent the introduction of new contaminants to KIH sediments, such as spill containment areas, designated spill kit locations, and a filter bag for dredging waters.

The scenarios presented in **Table 30** below provided by WSP (formerly Golder) in **Appendix DD** illustrate the risk to KIH sediment, during the sediment management activities and outlines narrative thresholds and highlights that Site specific numerical thresholds will need to be developed as part of detailed design. The memo recommends implementation of EPOs based on TSS and/or turbidity, and states EPOs for water quality are applicable to both water quality and sediment quality thresholds and can be maintained simultaneously. Using water quality data to assess possible impacts to sediment quality before they occur. Further discussion on EPO (including details on monitoring water quality i.e., “points of compliance”) are provided in **Appendix D** entitled “Conceptual Constraints and Impact Considerations – Water Quality”.

Table 31: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Sediment Quality

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Sediment Quality							
Pre-Remediation within the Kingston Inner Harbour							
Baseline sediment quality within the KIH prior to remediation may be influenced by on-going sources of contamination.	Long term: post-sediment management	Surface sediment concentrations of COCs are stable (not increasing over broad areas), and without unacceptable active sources of non-legacy COCs or CECs from upgradient areas.	Sediment quality for new samples (such as particulates from storm sewers, or additional sediment delineations in marsh areas) will be evaluated relative to site-specific risk-based concentrations, where available.	High	Yes	Implementation of mitigation measures at identified sources, if identified. Continuation of municipal source control initiatives, including public education, if ongoing sources of COCs identified at levels of concern.	Storm sewer outflows into the KIH that lack end of pipe controls should be monitored for potential particulate inputs that may be associated with contaminants. This program could be harmonized with water quality monitoring under dry-weather and wet-weather conditions. Design of soil erosion and sedimentation controls for any proposed redevelopment of Orchard Steet Marsh and surrounding riparian areas. Need to be determined based on additional baseline monitoring and property redevelopment plans.
Baseline sediment quality characterization within the KIH identifies gaps in spatial extent of contamination of relevance to remedial design	Temporary: prior to sediment management activities	Surface sediment concentrations of COCs are delineated adequately to identify localized areas within management areas that present source zones for sediment transport to outlying areas.	Sediment quality (at both surface and depth) will be evaluated relative to site-specific risk-based concentrations, where available. When no quantitative benchmarks are available for a specific COC, the data will be screened based on the categories of risk indicated in the detailed risk assessment and risk synthesis documents.	Moderate	Yes	Consideration of engineered covers or activated carbon where sediment quality is heterogeneous or with potential for free-product coal tar presence.	Additional vertical profiling of Anglin Bay and vicinity to address heterogeneity in coal-tar influenced sediments. Sediment stratigraphy analysis to refine estimates of depth to native lacustrine clay (to bound maximum vertical extent of contamination).
During Remediation in Zone of Dredging							

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
In-water works such as dredging, capping, and shoreline stabilization result in an alteration to existing sediment quality in Kingston Inner Harbour.	Temporary: during sediment management activities	Sediment quality in managed areas is improved within performance objectives for primary COCs. Sediment quality in unmanaged areas is maintained at the baseline established prior to sediment management.	Sediment quality will be assessed for reductions of primary COPCs evaluated by risk-based performance objectives set prior to sediment management activities. Performance objectives will be established on a management unit specific basis.	High	Yes A, B, C, E, G	Filter bag for dredging waters, with effectiveness confirmed through bench testing prior to use. Thin layer capping (residuals management covers) incorporated proactively in design to reduce exposures (i.e., base design elements) or to improve recolonization potential (environmental contingency).	For each Management Unit, establish performance objectives for sediment quality for priority COPCs. Follow-up should include contingencies where post-confirmation monitoring indicates lower efficacy of removals relative to the design. Monitoring plans should include procedures for corrective actions to be taken in the event of excessive turbidity or sediment dispersion during sediment management activities.
Equipment associated with in-water works that could result in chemical spill into KIH waters.	Temporary: during sediment management activities	BMP are followed; no incidents involving chemical release; events managed in such a way to avoid damage to aquatic life or water quality.	Site inspections and implementation of EMP procedures following BMPs. Environmental monitors to record spills, monitor clean up, and complete follow up monitoring and sampling of COCs in sediment and surface water as required.	High	Yes A, B, C, D, E	EMP will detail project requirements following BMPs (e.g., water booms around equipment, spill kit on Site, spill response plan).	EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce spill occurrence and limit potential impacts to aquatic life.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
In-water works involving dredging, dewatering and/or capping result in the re-suspension of sediments and associated contaminants at the point of discharge.	Temporary: during sediment management activities	Surface water quality with respect to total suspended solids (TSS), COCs and dissolved oxygen is maintained at a level to protect aquatic life from short-term and acute lethality.	An EPO linked to TSS will be developed as part of the WQMP for the POD (as outlined in the CCIC elements for water quality) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Monitoring of turbidity during in-water works, plus in-situ monitoring of other WQ indicators that may impact toxicity.	High	Yes A, B, C	EMP will detail project requirements, which may include the use of turbidity curtains during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance.	Site-specific WQMP is required prior to commencement of the Project that will define the EPOs, monitoring needs, and management actions to address water quality that is found to exceed the EPO. Prior to commencement of the WQMP, site-specific TSS:Turbidity relationship(s) should be determined, potentially varying by management unit.
Post Remediation in Zone of Dredging							

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
In-water works involving dredging, dewatering and/or capping result do not meet project objectives for contaminant mass removal or isolation.	Long-term: post-sediment management	Remediation achieves the required dredge elevations or depths based on post-construction survey. Dredge residuals and/or engineered cover yields surface sediment quality that satisfies performance objectives for primary COCs.	Post-construction survey results will be compared to bathymetry targets. Confirmatory sampling to evaluate post-dredging sediment quality is required after the contractor has achieved the required dredge elevations or depths. Data evaluated for possible missed inventory (i.e., contaminated sediments that are not removed as part of dredging) and/or dredge residuals (i.e., contaminated sediment suspended during dredging activities that settle to the surface of the seabed).	High	Yes A, B, C	Contingency re-dredging may be required if unacceptable dredge residuals or missed inventory. Additional thin layer capping (residuals management covers) as contingency.	Develop Confirmatory Sampling, Analysis, and Evaluation Plan as part of detailed design stage.
Long-term Post Remediation within the Kingston Inner Harbour							
Long-term barriers to recolonization following in-water works	Long-term: post-sediment management	Remediation activities have yielded confirmed sediment quality improvements, with negligible to low risk across KIH. Benthic communities, including benthic invertebrates, forage fish, and macrophytes	Surface sediment quality evaluated relative to site-specific risk-based concentrations, where available. Biological investigations of ecological recovery. Post-remedial monitoring of sediment should be completed over 5 years, and tissue monitoring completed over 10 years.	Moderate	Yes F	Contingency measures may be considered (e.g., thin-layer capping or activated carbon within sediment management units that have persistent elevated COCs). Incorporation of natural organic carbon sources and mixed particle sizes in capping materials to provide nutrient sources	Pilot stage assessment of thin layer cap options, including (a) incorporation of activated carbon or (b) mixing with particle sizes and organic carbon content to enhance recovery. Pilot studies should simulate field conditions of physical and biological mixing and confirm lack of toxicity to invertebrates under controlled conditions.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
		have successfully re-established.				and substrate for recolonization. Incorporation of natural-based (i.e., ecosystem-based) approaches, such as Green Shores methods for shoreline management to enhance recovery	Design of long-term monitoring program for fish tissues, limited to biomagnifying substances.

Notes: KIH = Kingston Inner Harbour; COC = contaminant of concern; CEC = contaminant of emerging concern; POD = point of discharge; TSS = total suspended solids; EPO = Environmental Performance Objective; WQMP = Water Quality Management Plan; EMP = Environmental Management Plan; BMP = Best Management Practice

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[3] Proven Mitigation Measures, Best Management Practices, Guidelines and Standards include:

- [A] PCA. 2017. Ontario Waterways Environmental Standards and Guidelines Document, Part 2.
- [B] PCA. 2017. Parks Canada National Best Management Practices: Works In and Around Waterbodies.
- [C] Ontario Ministry of the Environment. 2011. Evaluating Construction Activities Impacting on Water Resources Part III B: Handbook for Dredging.
- [D] Toronto and Region Conservation Authority. 2019. Erosion and Sediment Control Guide for Urban Construction.
- [E] Province of Ontario. 2021. Construction Specification for Temporary Erosion Control. Ontario Provincial Standard Specification.
- [F] Canada. 2021. Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours under the Federal Contaminated Sites Action Plan (FCSAP). Version 1.1. Fisheries and Oceans Canada, Ottawa ON, Canada. November 2021.

[4] COCs represent chemical parameters that are known to be elevated within sediments and/or surface water within the KIH, including nutrients, metals, PAHs, PCBs

[5] CECs represent chemical parameters that are increasing being detected in water bodies but are not typically monitored or regulated. Of particular interest to stakeholders are endocrine disrupters, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and polybrominated diphenyl ethers (PBDEs).

3.2.10 Soil and Landform Resources

KIH is located in the Napanee Plain physiographic region of Southern Ontario. The Napanee Plain is relatively flat and characterized by shallow soil deposits overlying limestone/dolostone bedrock. The terrain of the Napanee Plain includes many bedrock outcrops and karst formations, including caves, sinkholes and gorges (Nature Conservancy of Canada, 2022).

The Kingston Area on the western shores of KIH is dominated by Lansdowne Clay, which is typically seen at lower elevations of a limestone plain such as the Napanee. It generally consists of shallow bedrock with glaciolacustrine clay overburden, matching the deeper layers of sediment in KIH and likely originating in the glacial Lake Iroquois (Dalrymple and Carey, 1990). Clay soils are generally rated low on the spectrum of soil erodibility, but they have long suspension times in water and are difficult to remove with sediment treatment system. A more detailed assessment of soil erodibility at each staging site will be useful for the DIA. Data-based thresholds for the Project Study Area will include those found in the CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health and Agriculture Canada's Soil Erodibility Indicator.

The federal water lots at KIH share boundaries with publicly and privately owned lands, some of which are brownfield sites with contaminated soils. The prevention of soil mobilization and sloughing across these boundaries and into KIH is a key mitigative consideration. The design and implementation of these measures will need to incorporate the regulatory requirements for the various jurisdictions of bordering properties.

The Soil and Landform Resources VC refers to existing soils, sediment, landforms, terrain, and geologic features in the Project Site If managed incorrectly, the proposed project activities may result in soil contamination and increases from natural rates of erosion and sedimentation of terrestrial soils into the aquatic environment, leading to downstream impacts on water quality and aquatic life. The purpose of including the Soil and Landform Resources VC is to identify and mitigate potential erosion and sedimentation issues arising from the proposed project activities.

3.2.10.1 Thresholds

Dredging activities will likely involve mechanically moving sediment between different areas of the Project and eventually offsite for disposal. Without mitigation, restoration, and/or specific Project design considerations, terrestrial and in-water activities involving the transportation of contaminated sediment may result in the unintended spillage of contaminated soils, as well as changes to sediment composition impacting plant growth and benthic life processes, during sediment management activities. This Project interaction with Soil and Landform Resources is considered to be medium risk based on preliminary assessment, and as such the standard of proof is also medium. The standard of proof would be based upon the development and adequate implementation of controls, monitoring procedures and management responses in an Environmental Management Plan for the project.

Terrestrial works such as vegetation removal and shoreline stabilization will likely result in soil disturbance which can alter erosional processes. Without mitigation, restoration, and/or specific Project design considerations, terrestrial activities involving clearing and grubbing, soil storage on site could result in increases in erosion and sedimentation rates post-sediment management. This Project interaction with Soil and Landform Resources is considered to be low risk based on preliminary assessment, and as such the standard of proof is also low. The standard of proof would be based upon installation, maintenance and monitoring of effective erosion control structures and sediment discharge (including sediment-laden runoff).

Table 32: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Soil and Landform Resources

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Soil and Landform Resources							
In-water and terrestrial works involving the transportation of contaminated sediment result in contamination of soils .	Temporary: during sediment management activities	All spilled contaminated sediments removed from harbour waters are removed from site.	No spilled contaminated sediment removed from the harbour remains within the terrestrial environment in the Study Area.	Medium	Yes 1,2,3,5,7	Adequate space is provided for hauling vehicle and turning radius requirements to ensure smooth transfer of contaminated sediments.	Soil sampling to establish existing conditions during the monitoring phase to confirm contamination status. Dredging and Sediment Removal Plan Sediment transfer processes should undergo risk analysis and proper mitigations are applied to determine proper mitigations.
Terrestrial activities involving clearing and grubbing, soil storage on site result in changes to natural rates of erosion and sedimentation.	Long term: post-sediment management	Erosion, sedimentation and sediment input into surface water is controlled and minimized on site.	Erosion and sedimentation are controlled on site, and rates do not increase beyond background levels.	Low	Yes 1,2,3,4,5,6	Shoreline and near-shore works are staged to minimize Project effects on erosion and sedimentation.	Soil sampling to establish existing conditions. Dredging and Sediment Removal Plan Surface Water Management and Erosion and Sediment Control Plan

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.11 Air Quality

Air quality in the Study Area is generally good, similar to most urban and suburban communities along the northern shore of Lake Ontario. Significant potential sources of air contaminants in the vicinity of the Study Area include Highway 401 to the north and the industrial areas of Kingston. In the analysis below, air quality data from Air Quality Ontario's (MECP) Kingston Ambient Air Monitoring Site from 2017 to 2020 is compared with the Canadian Ambient Air Quality Standards (CAAQS) for fine particulate matter ($PM_{2.5}$), ozone (O_3) and nitrogen oxides (NO_x).

Fine Particulate Matter

The ambient fine particulate matter measured at the MECP air quality monitoring station in Kingston between 2017 and 2020 shows no exceedances of the CAAQS, as shown in **Table 33** below.

Table 33: $PM_{2.5}$ Averages for the MECP air quality monitoring station in Kingston Compared to CAAQS

	CAAQS	The 3-year average of the annual 98th percentile of the daily 24-hour average concentrations.		The 3-year average of the annual average of the daily 24-hour average concentrations	
		27 µg/m³		8.8 µg/m³	
$PM_{2.5}$	2017				
	2018	17.56		5.38	
	2019		17.01		5.45
	2020				

Ozone

Ozone is formed when heat and sunlight cause chemical reactions between nitrogen oxides (NOx) and volatile organic compounds (VOCs). In warm, sunny conditions, ozone may be produced from the emissions of construction equipment, such as nonroad diesel equipment (Lewis et al. 2015). The ambient ozone measured at the MECP air quality monitoring station in Kingston between 2017 and 2020 shows a marginal exceedance of the CAAQS between 2017 and 2019. Between 2018 and 2020, ozone levels were very close to exceeding the CAAQS. To summarize, ambient ozone layers are high in the region, as shown in **Table 34** below.

Table 34: Ozone Averages for the MECP air quality monitoring station in Kingston Compared to CAAQS

	CAAQS	The 3-year average of the annual 4th highest of the daily maximum 8-hour average ozone concentrations	
		62 ppb	
O_3	2017		
	2018	63.25	
	2019		61.67
	2020		

Nitrogen Oxides

The ambient nitrogen oxides measured at the MECP air quality monitoring station in Kingston between 2017 and 2020 shows an exceedance of the CAAQS between 2017 and 2019 and between 2018 and 2020. However, the 1-hour average concentrations of NO_x do not exceed the CAAQS in any year. To summarize, long-term nitrogen oxides concentrations are high in the Study Area, while short-term concentrations are low, as shown in **Table 35** below.

Table 35: Nitrogen Oxides Averages for the MECP air quality monitoring station in Kingston Compared to CAAQS

NO_x	CAAQS	The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentrations		The average over a single calendar year of all 1-hour average concentrations
		60 ppb		17.0 ppb
	2017			4.87
	2018	63.6		4.69
	2019		64.00	4.50
	2020			4.04

Overall, the data above show the air quality in the Kingston area is generally good, however the airshed receives high levels of long-term ozone and nitrogen oxide contamination which exceed the CAAQS. The descriptor "generally good" is defensible because the long-term exceedances often barely exceed the CAAQS, and the short-term and annual average values for $PM_{2.5}$ and NO_x comfortably meet the CAAQS.

While the complete extent of area to be dredged, volume of dredge, and type of dredging equipment to be used has not been finalized, there are some known differences between mechanical bucket dredge and cutterhead pipeline dredge, which both produce emissions from burning diesel fuel. When comparing Environmental Impact Single Scores (EISS) (considers environmental impacts, including air pollutants such as nitrogen oxide and VOCs) for a dredged volume of 100,000 cubic yards (76,455 m^3), mechanical bucket dredging has a lower (better) EISS when transporting dredged materials 12,000 and 16,000 feet, while cutterhead pipeline dredge has a lower EISS when transporting dredged materials 8,000 feet (Anderson, 2008). In all cases, the EISS score, and therefore emissions, rises with greater volumes dredged and for transporting dredged materials greater distances (Anderson, 2008).

The Air Quality VC refers to physical and chemical properties of the Project Study Area airshed. Without mitigation measures in place, the proposed project activities involve potential for the release of contaminants into the airshed. The purpose of including Air Quality as a VC is to identify and mitigate potential air quality issues arising from the proposed project activities.

The development of the DIA can use previous studies on air quality in KIH and available information on the project methodologies to determine potential impacts. A list of applicable background sources was produced in 2020 during the Gap Analysis phase of the DIA. The list should be updated in the DIA to encompass newly available information to ensure an up to date and accurate baseline of air quality in KIH. To determine potential emissions due to project activity, the DIA should include a review of publicly available emissions information on commonly used and advanced equipment for carrying out the proposed project. The DIA should also include an air dispersion model to determine the spatial distribution of potential impacts. The goal will be to generate potential mitigations for inclusion in a future Air Quality and Dust Management Plan, or similar, for the project.

It is anticipated that standard mitigation measures such as fencing, site access controls, signage, environmental monitoring, and other measures developed in the DIA and described in the Contractor's Dust and Air Quality Management Plan will be sufficient to prevent negative impacts to humans. Project design considerations are not necessary to mitigate risk. A complete assessment of impacts to human health due to Project air emissions will be conducted as part of the DIA.

3.2.11.1 Thresholds

Three scenarios were developed to illustrate potential project-related Air Quality impacts, as shown in **Table 36**.

The first scenario involves terrestrial and in-water sediment management activities such as sediment dewatering and sediment stabilization that may cause excessive release of contaminated dust. A desktop study to determine best-case and worst-case scenarios for contaminated sediments being released as dust contamination should be conducted. This analysis should be used to develop thresholds related potential effects on human health and the environment.

The second involves the release of dust, regardless of contamination status, into the airshed surrounding KIH during sediment management activities. A desktop study to calculate best-case and worst-case air dustfall/dust-release scenarios should be undertaken to inform the development of a site air quality plan, or similar. A preliminary threshold of dustfall not exceeding exceed 7 g/m^2 over a 30-day average, as per the Ontario Ambient Air Quality Criteria (AAQC) has been proposed. This threshold may be made more stringent based on the results of the above-mentioned desktop study or based on potential pathway effects to other VCs and should be confirmed in the DIA. This Project interaction with Air Quality is considered to below risk based on preliminary assessment, and as such the standard of proof is low. The standard of proof is low would be based on observation of successful implementation of mitigations and planned remedial actions.

The third scenario involves the direct release of chemical contaminants into the airshed surrounding KIH (i.e., release of fumes or hydrocarbon derivatives from site equipment). during sediment management activities The DIA should include a desktop study to calculate contaminant emissions from construction equipment required to execute the proposed Sediment Management Plan, and to develop applicable mitigations., as well as determine local sensitive receptors to air pollution Design considerations to reduce risk may include green procurement incentivization via the incorporation design elements that green-minded subcontractors would have the unique capacity to implement. As this Project interaction with Air Quality is considered to be low risk based on preliminary assessment, and as such the standard of proof is low. The standard of proof would be measured by observation that the equipment used on site is comparable to those modelled in the desktop study in terms of expected contaminant release.

Table 36: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Air Quality

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Air Quality							
Terrestrial and in-water works such as sediment dewatering and sediment stabilization cause excessive release of contaminated dust.	Temporary: during sediment management activities.	Release of contaminated dust is limited to the greatest degree practicable.	Workers and public should be adequately protected from the worst-case contaminated dust release scenario.	Low	N/A	Wet methods for dust control are likely the only practicable solution. Elements of dredging process may be outfitted with impermeable barriers. Respirators may be required for workers.	Determine dust threshold of contaminated sediments in relation to potential dispersal and its effects on human health and the environment.
Terrestrial works such as site preparation and mobilization and shoreline stabilization cause excessive release of dust.	Temporary: during sediment management activities	Construction activities do not impact sensitive receptors due to reductions in air quality.	Dustfall should not exceed 7 g/m^2 over a 30-day average as per the Ontario Ambient Air Quality Criteria (AAQC).	Low	Yes **9**	**Staging areas, dust control planning.**	**Desktop study to calculate best-case and worst-case air dustfall/dust-release scenarios**[17].
Terrestrial and in-water works such as site preparation and sediment management, including shoreline stabilization release airborne contamination.	**Temporary: during sediment management activities**	**Release of machine generated air contamination is limited to the greatest practical degree and does not impact sensitive receptors** due to a reduction in air quality.	Practical approaches to limit air contaminant release are used and do not significantly impact the compliance of the continuous air quality values Kingston Ambient Air Monitoring Site with the CAAQs.	Low	N/A	Green procurement incentivization, design elements that green-minded subcontractors would have the unique capacity to implement.	**Desktop study of contaminant emissions from construction equipment required to execute the proposed Sediment Management Plan, comparing equipment types, scheduling, etc.** **Identify sensitive receptors in the local airshed.**

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)

[17] This scenario may change if staging area/terrestrial sites also contain contaminated soils and additional mitigation measures need to be considered.

[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.2.12 Climate Change

Kingston, ON is situated within a large area with a Köppen climate classification of Dfb, stretching from the maritime provinces of Canada to the Rocky Mountains in British Columbia (PlantMaps, 2023). The Dfb classification refers to a warm, humid, continental climate, characterized by four distinct seasons and a relative even distribution of precipitation throughout the year. The Environment Canada climate normal station data from the Kingston Pumping Station (Climate ID: 6104175) presented in **Table 37** below aligns with this classification, showing a relatively even distribution of precipitation days and four distinct seasons in terms of temperature and depth of precipitation. The most recent precipitation event (prior to 2010) in which the amount of precipitation in a 24-hour period exceeded the monthly climate normal occurred on October 1, 1974, where 79.5 mm of rain fell in a 24-hour period.

Table 37: 1981 to 2010 Canadian Climate Normals station data - Kingston WPCP

Station Information - Climate ID: 6104175; Elevation: 76.5 m; Latitude: 44°14'38.052" N; Longitude: 76°28'50.040" W; Temperatures in Celsius													
Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily Average Temperature (°C)	-7.0	-5.5	-0.7	6.6	13.2	18.4	21.5	20.6	16.2	9.6	3.7	-2.6	7.8
Daily Maximum (°C)	-2.6	-1.0	3.6	11.1	17.8	22.9	25.9	24.9	20.4	13.5	7.4	1.2	12.1
Daily Minimum (°C)	-11.4	-10.0	-5.1	2.1	8.6	13.9	17.1	16.3	12.0	5.6	0.1	-6.4	3.6
Precipitation (mm)	2.1	65.9	64.6	78.1	78.4	73.0	64.3	78.7	95.4	90.4	98.1	82.5	951
Extreme Daily Precipitation (mm)	39.6	37.0	46.2	51.6	58.7	49.0	72.2	52.2	66.2	**79.5**	64.6	45.0	-
Days with >25mm Precipitation	0.12	0.19	0.19	0.31	0.32	0.50	0.62	0.73	0.85	0.50	0.65	0.31	5.3

In the City of Kingston's 2014 plan, Kingston Climate Action Plan, the predicted increase in daily average temperature for the Whitby, ON area by 2050 is 3.3 ± 0.7 °C, bringing the yearly average to 11.1 ± 0.7 °C. The yearly amount of precipitation is predicted to increase by 73 ± 39 mm, bringing the yearly precipitation amount to 1024 ± 39 mm from the current value of 951 mm. The predicted number of days with precipitation greater than 25 mm is predicted to increase by eight (10) to a total of thirteen (13) (Kingston, 2014).

The Climate Change VC refers to the potential impacts of project activities on climate change, the potential impact of climate change on the project, and the effect of climate on the natural resources interacting with the project (Parks Canada, 2020). The desired outcome is to not exacerbate the effects of climate change on the shoreline and harbour dynamics.

The proposed project activities will likely result in the release of Greenhouse Gases (GHG) and may also disturb existing carbon sinks within the Project Impact Area. Great Lakes coastal wetlands are a potentially extensive reservoir of carbon, yet site-specific quantifications of the Great Lakes coastal wetlands are limited (Braun et al., 2020). Freshwater wetlands are also variable in their carbon balance as they can store large amounts of carbon due to low rates of decomposition but are simultaneously large sources of methane (Loder and Finkelstein, 2019). Dredging affects the carbon balance in two ways, firstly it eliminates vegetation which sequester the carbon through plant biomass and accumulation in sediments. Secondly the disposal of contaminated sediments will result in gas production from aerobic and anaerobic degradation of the disposed sediments (Gerbert et al., 2018). Terrestrial carbon pools will also be affected as removal of vegetation though clearing and grubbing activities, especially the tree canopy layer, will decrease carbon storage within the project footprint while at the same time reducing carbon sequestration levels due to lower photosynthetic rates.

For the CCIC, SNC-Lavalin will the rely on project plans and documentation of the methodologies and equipment to be used to carry out the work to determine the resulting GHG emissions and the disturbance of existing carbon sinks, and to explore options for mitigation such as green construction practices.

The intensity and frequency of extreme weather events are expected to increase in the coming years and decades due to climate change. This has the potential to impact project activities and outcomes, including the alteration of flow rates, flow patterns and rates of erosion and sedimentation. Changes to water levels and temperatures are also expected to impact wetland extent, composition, and habitat availability in the KIH area.

By including the Climate Change VC, these potential impacts can be assessed in the DIA, and appropriate mitigations can be applied to detailed design. Design elements of the dredging program should also incorporate how they can promote resiliency for sensitive VC receptors. For example, preferred overwintering habitat varies between SAR turtles. with species varying in their preferred water depths and bottom conditions. Creating variability in water depth following dredging can build in resiliency to fluctuating water levels as both Lake Ontario and waterflow along the Rideau may change as a result of climate change. For the DIA, the consultant will rely on previously completed local or regional climate change projections.

The DIA should include a Life Cycle Assessment (LCA) using an applicable tool or methodology, such as the U.S. Federal Highway Administration's Infrastructure Carbon Estimator, to approximate energy use and carbon emissions throughout all project phases and to identify appropriate mitigations. If climate change is expected to have a significant impact on the project, VC-specific climate projections at various Representative Concentration Pathways, as adopted by the Intergovernmental Panel on Climate Change, may be required.

3.2.12.1 Thresholds

Heavy equipment use associated with site preparation and mobilization as well as sediment management activities will result in the release of GHG emissions and are likely to impact on climate change. This Project interaction with Climate Change is considered to be low risk based on preliminary assessment, and as such the standard of proof is low. The standard of proof would be measured by the use of a carbon accounting tool to quantify the greenhouse gas emissions from the project due to construction practices and/or mitigations through green infrastructure or climate adaptive design elements.

Terrestrial and in-water works such as dredging, vegetation clearing, and excavation of soil during site preparation and sediment management activities will result in the release of GHG emissions and are likely to impact on climate change. This Project interaction with Climate Change is considered to be low risk based on preliminary assessment, and as such the standard of proof is low. The standard of proof would be measured by the use of a carbon accounting tool to quantify the carbon balance from the project and use of climate adaptive design elements that minimize carbon loss.

Project works such as dredging, vegetation clearing, and excavation of soil may result in the increase in vulnerability of sensitive receptors (for example adjacent wetlands, traditional use sites, SAR wildlife) to extreme weather events in the Study Area and are likely to impact on climate change post-sediment management. This Project interaction with Climate Change is considered to be low risk based on preliminary assessment, and as such the standard of proof is low. The standard of proof would be measured by selection of areas which are less vulnerable to extreme weather events and application of appropriate erosion control structures and revegetation techniques that minimize vulnerability to extreme events.

Table 38: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Climate Change

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Climate Change							
Heavy equipment use associated with site preparation and mobilization as well as sediment management activities result in the release of GHG emissions.	Temporary: during site preparation and sediment management activities	Sediment management activities do not disproportionally impact climate change.	The GHG emissions of construction equipment and methodologies is documented and considered in the formulation of the work plan and the procurement process.	Low	N/A	Green procurement incentivization, design elements that give an edge to green-minded subcontractors.	Desktop study of GHG emissions from construction equipment required to execute the proposed Sediment Management Plan.
Terrestrial work and in-water work such as dredging, vegetation clearing, and excavation of soil result in the release of GHG emissions.	Temporary: during site preparation and sediment management activities	Sediment management activities do not disproportionally impact climate change.	The GHG emissions from disturbed terrestrial and wetland communities is documented and considered in the formulation of the work plan.	Low	N/A	Timing of vegetation removal, selection of areas of disturbance to lessen carbon stock removal.	Desktop study of GHG emissions due to Project activities
Project works result in increased vulnerability of sensitive receptors to extreme weather events post-sediment management.	Long term: post-sediment management	Project design, such as shoreline stabilization, does not increase the vulnerability of sensitive receptors to extreme weather events.	Sensitive climate receptors are protected or undisturbed.	Low	Yes 10	Selection of areas of disturbance.	Review of potential carbon sinks and sensitive climate receptors.

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.3 Cultural Heritage Valued Components

The following two sections discuss the Project Interactions with these Heritage Values in the context of the Rideau Canal National Historic Site and World Heritage Site VCs.

3.3.1 Rideau Canal National Historic Site

The Rideau Canal was designated a national historic site of Canada in 1925 and declared a heritage river in 2002. Its reasons for designation were most recently updated in 2011 to recognize its cutting edge design; it is the best preserved from the great canal-building era in North America; its construction through more than 200 kilometers was a monumental feat; its importance in the context of the aftermath of the War of 1812; and it contributed significantly to the social and economic development of Upper Canada. In relation to the main elements for historical designation (canal, engineering works, and associated buildings) the Project is removed from their locations and has no direct impact on them. However, the heritage value of the Rideau Canal lies in the health and wholeness of its cultural landscape, as a witness of the early 19th-century forms, materials, and technologies of the waterway, and as a dynamic reflection of the longstanding human and ecological inter-relationships between the canal and its corridor (Parks Canada, 2022). The Canadian Heritage Rivers System (CHRS) aims to manage heritage rivers in order to conserve their natural, cultural and recreational values. The Rideau Waterway was declared a heritage river for its outstanding historical and recreational values including its unique assemblage of working historical buildings and engineering structures. Part of the Rideau Waterway Plaque text states “Along the Rideau, one finds a unique blend of wildlife, city life and country life, of past and present, nature and culture.”

In 2011 PCA produced the document Heritage Values and Guiding Principles for the Cataraqui River Sector of the Rideau Canal. One of the primary purposes of the document was to review the Rideau Canal National Historic Site of Canada and World Heritage Site designations and to examine the specific values ascribed to them that are reflected in the Cataraqui River sector of the canal. The document identified key heritage values for the Cataraqui sector of the Rideau Canal, namely:

- the historic, ecological and visual associations with the certain shore lands and communities along the waterway which contributes to the unique historical environment of the canal system;
- through-navigation of the canal system which helps to assure the preservation of the unique historical environment; and
- the extensive wetlands and lakes of the Canal which reveal the relationship between canal construction and the natural environment, and which are an integral part of the unique historical environment of the waterway.

The report also stated that the natural ecosystem elements within the Cataraqui sector are valued because:

- of their contribution to the health and wholeness of the ecosystem within the corridor;
- they are vital parts of the landscape character and history of the corridor;
- of their contribution to the enjoyment and quality of life along the corridor. (CIS, 2000, sect. 11.0)

The study area for the KIH, which includes the Cataraqui Wetlands, is one of the few areas where the landscape was not altered by canal construction. For this section of the canal, PCA cultural resource management priorities are the preservation of the natural character and managing modern interventions on the landscape (Parks Canada, 2011)

For National Historic Sites the designated place is the area which was designated by the Minister as the national historic site on the recommendation of the Historic Sites and Monuments Board of Canada. For the Rideau Canal it consists of the lands and waters under the jurisdiction of Parks Canada including the bed of the Rideau Canal to the upper controlled water elevation (high water mark) (Parks Canada, 2005). In terms of the Project Impact Area for KIH this encompasses the area around Belle Isle and Belle Park (**Figure 4**).

As stated in the Rideau Canal National Historic Site Management Plan (2005), Parks Canada's primary interest in land uses adjacent to the Canal and Canal lands (the designated place) is the retention and enhancement of the natural, cultural and scenic values. The CIS also identifies key strategies to determine if the designated place would be impaired or put under threat by a development or use. For the KIH project area the three (3) strategies that are applicable are:

- through navigation of the Canal system is maintained to help assure the preservation of the unique historical environment and safeguard the level one cultural resources;

- the heritage character of corridor shore-lands are safeguarded from inappropriate development or uses;

- the landmarks, viewscapes and natural ecosystem features of the Canal's islands, shore-lands and wetlands that are related to the construction of the Canal and which are part of the Canal's unique historical environment are safeguarded

In relation to the designated place, the Commemorative Integrity Statement notes that there are important historic values of the Canal system and its environment that extend beyond the administered Canal lands and waters, including view sheds, visual linkages and associative values encompass a variety of urban, rural and natural areas adjacent to the Canal (Parks Canada, 2005).

3.3.1.1 Thresholds

There is not an anticipated direct impact on the main cultural resources directly related to the reasons for designation. The engineering works, buildings, and Lockstation landscapes are outside of the KIH project areas. While the main cultural resources for the canal are not impacted by the Project, the Project is within the Rideau Canal's designated place and impacts on heritage values that have been articulated for the Rideau Canal National Historic Site.

Similarly, while proposed in-water works will not have a direct impact to the main navigation channel of the Rideau Canal, there is a small potential for equipment or management activities to interact with through navigation. Protection of navigation of the canal system including desired outcomes, standards of proof, and additional works required are discussed in detail in **subsection 3.5.2** and therefore no additional thresholds were developed in this section.

Terrestrial and in-water works including vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), placement of hording and fencing, staging and shoreline stabilization, and installation of Erosion and Sediment Controls that remove vegetation or alter the shoreline may temporarily or permanently alter the heritage character of corridor shore-lands and modify natural ecosystem elements that results in loss of landscape character, potentially impairing the Rideau Canal's designated place. Protection of heritage character and landscape character including desired outcomes, standards of proof, and additional works required are discussed in detail in the cultural landscape features **subsection 3.3.3** and therefore no additional thresholds were developed in this section.

Proposed sediment management activities have the potential for short-term and long-term changes to viewscapes of KIH during sediment management activities and post-sediment management, potentially impairing the Rideau Canal's designated place. Viewscapes and the visual setting are also highlighted as part of the value underlying the Rideau Canal World Heritage Site as highlighted in the ICOMOS review. Protection of viewscapes and the visual setting including desired outcomes, standards of proof, and additional works required are discussed in detail in **subsection 3.3.2** discussing the Rideau Canal UNESCO World Heritage Site and therefore no additional thresholds were developed in this section.

As archaeological resources represent cultural resources associated with the national significance of the site-part of the nominated property, these are discussed in **subsection 3.3.4** and **subsection 3.3.5**, therefore no additional thresholds were developed in this section.

3.3.2 Rideau Canal UNESCO World Heritage Site

The Project lies within both the Rideau Canal National Historic Site, which has its southern terminus at Belle Island and the World Heritage Site which extends to the Lasalle Causeway and includes the Kingston Fortifications National Historic Sites. The Rideau Canal National Historic Site and the Kingston Fortifications National Historic Sites were inscribed on the World Heritage List in 2007 on the basis two criteria and adopted the following Statement of Outstanding Universal Value:

"The Rideau Canal is a large strategic canal constructed for military purposes which played a crucial contributory role in allowing British forces to defend the colony of Canada against the United States of America, leading to the development of two distinct political and cultural entities in the north of the American continent, which can be seen as a significant stage in human history.

Criterion (i): The Rideau Canal remains the best preserved example of a slackwater canal in North America demonstrating the use of European slackwater technology in North America on a large scale. It is the only canal dating from the great North American canal-building era of the early 19th century that remains operational along its original line with most of its original structures intact.

Criterion (iv): The Rideau Canal is an extensive, well preserved and significant example of a canal which was used for a military purpose linked to a significant stage in human history - that of the fight to control the north of the American continent.

The nominated property includes all the main elements of the original canal together with relevant later changes in the shape of watercourses, dams, bridges, fortifications, lock stations and related archaeological resources. The original plan of the canal, as well as the form of the channels, has remained intact. The Rideau Canal has fulfilled its original dynamic function as an operating waterway without interruption since its construction. Most of its lock gates and sluice valves are still operated by hand-powered winches.'

The 2005 Rideau Canal World Heritage Site Management Plan (Parks Canada, 2005) specifies how the world heritage values of the UNESCO property would be protected. In terms of the project specific actions mentioned in the plan include working with municipalities, landowners, the Province of Ontario and other stakeholders to ensure that suitable land use policies for adjacent lands are in place to protect the property and to intervene in proposed development applications should the agency believe that the development would negatively affect the world heritage values or resources of the inscribed property.

DIAs conducted on projects with the potential to affect World Heritage sites are required to study the impact of the proposed project on the Outstanding Universal Value for that site. It is not anticipated that the Project will affect the operation and existing structures of the Rideau Canal and sufficient evidence exists to demonstrate the Conceptual Sediment Management Plan will not interact with the operation and existing structures of the Rideau Canal. While the engineering works, fortifications, and other built resources are the primary drivers for the Outstanding Universal Value of the Rideau Canal, per the *Operational Guidelines for the Implementation of the World Heritage Convention*, effective management of a world heritage site goes beyond the property to include any buffer zone(s), as well as the broader setting.

When the Rideau Canal was inscribed on the World Heritage List in 2007, the World Heritage Committee recognized a 30-metre buffer zone surrounding the inscribed property. In this sector of the Canal the buffer zone extends back from the high water mark of the Cataraqui River. Lands within the buffer zone are not under the jurisdiction of the PCA; however, the measurement is consistent with the minimum 30m development setback from water required by all 13 municipalities along the length of the canal, including Kingston. The World Heritage Committee also recommended that consideration be given to strengthening the canal's visual protection outside the buffer zone, in order to ensure that the visual values of the setting are protected alongside environmental values.

To meet this recommendation PCA, on behalf of the Rideau Corridor Landscape Strategy (multi-jurisdictional working group) undertook a landscape character assessment of the Rideau Corridor, in order to identify key features and values along the waterway, and to support more effective planning and management of the landscape. This process resulted in the Rideau Corridor Landscape Strategy: Landscape Character Assessment and Planning & Management Recommendations (Dillon, 2012). For the area around the KIH the report identified the following landscape values: the Cataraqui Marsh, Belle Island, and views across Cataraqui Bay and to Lake Ontario framed by downtown Kingston. A Visual Preference Survey was also undertaken as a component of the landscape character assessment. Identification of the most-valued and least-valued photographs help to identify key features and values of the Rideau Corridor to support more effective planning and management of the Rideau Corridor's landscape. High scoring photos all represented natural features along the Canal, with limited riparian vegetation along the shoreline a common theme in all negative views.

3.3.2.1 Thresholds

There is not an anticipated direct impact on the main drivers of Outstanding Universal Value for the canal (engineering works, fortifications, and other built resources) as they are outside of the Project area.

While the OUV of the canal is not impacted by the Project, part of the heritage value lies in the human and ecological inter-relationships between the Canal and its environment, particularly the visual setting as highlighted in the ICOMOS review. Proposed sediment management activities have the potential for short-term and long-term changes to viewscapes of KIH during sediment management activities and post-sediment management. Maintaining or improving the Project area's visual setting, including the buffer zone, will require establishment of a baseline assessment of the immediate landscape setting of the KIH, followed by an analysis of proposed changes to the waterfront through a Visual Impact Assessment. This Project interaction with the visual setting is considered to be medium based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by protection/restoration/enhancement of the buffer zone and landscape setting via use of selective placement of hording and fencing, avoidance of vegetation removal and restoration/enhancement of removed vegetation, such that the landscape character/viewscapes of the KIH are not impaired.

Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls may temporarily alter or obscure features of the landscape during sediment management activities. This project interaction with the landscape character is localized, partly reversable in the long-term, and well understood, it is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by preservation or restoration of the historical, architectural or contextual significance of landscape features in the KIH.

Table 39: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Rideau Canal UNESCO Outstanding Universal Values

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Rideau Canal National Historic Site and UNESCO World Heritage Site							
Terrestrial and in-water works such as mobilization, wetland vegetation removal, dredging, capping, and shoreline stabilization, may create temporary or permanent changes in landscape character.	Temporary: during sediment management activities And Long term: post-sediment management	Maintenance/enhancement of natural ecosystem features, buffer zone and landscape character of the KIH.	Natural ecosystem features, buffer zone and landscape character/viewscapes of the KIH are not impaired.	Medium	Yes 40, 43	Design temporary works so that no permanent alteration occurs to the features of the affected cultural landscape Design shoreline stabilization and site restoration to be compatible with the features of the affected cultural landscape	Baseline assessment of shorelines/landscape character of Project Study Area, followed by a visual impact assessment of proposed changes, as part of a Cultural Heritage Impact Statement; mitigation measures; restoration/enhancement plans Document important viewscapes (e.g., Landscape Character Assessment [Dillon, 2012] and City of Kingston Official Plan).
Terrestrial and in-water works such as shoreline stabilization that modify natural ecosystem elements result in loss of landscape character.	Temporary: during sediment management activities And Long term: post-sediment management	At minimum, valued natural shoreline landscape features are restored.	The historical, architectural or contextual significance of landscape features are preserved or restored.	Medium	Yes 40, 43	Design shoreline stabilization and site restoration to be compatible with valued landscape features.	Document and understand the affected landscape.

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.3.3 Cultural Landscape Features

KIH, or portions of the site, hold various culturally significant designations including a National Historic Site (Rideau Canal) and UNESCO World Heritage Site (see **subsections 3.3.1** and **3.3.2**). As defined in Standards and Guidelines for the Conservation of Historic Places in Canada (Parks Canada, 2010), cultural landscapes are "any geographical area that has been modified, influenced or given special cultural meaning by people", and speaks to not allowing cultural landscapes to be altered or lost through incompatible development. The guidelines for cultural landscapes are divided into 11 subsections evidence of land use; evidence of traditional practices; land patterns; spatial organizations; visual relationships; circulation; ecological features; vegetation; landforms; water features; and built features. Applied to the KIH area a number of elements are present:

- Belle Island in terms of evidence of traditional practices as it has been designated as a site of significant Aboriginal cultural heritage.

- The Greater Cataraqui Marsh is a defining ecological feature which extends into the north end of the Project Area and is a distinguishing feature of Kingston sector of the Rideau Canal. The vegetation is significant as it largely has remained unchanged since pre-canal construction.

- the Rideau Canal is a water feature which is also an important transportation system providing watercraft navigation between Ottawa and Kingston, in the project area it is characterized by the navigable channel and Inner Harbour; and

- the visual relationships between the natural and built features on-land and the waterway.

The importance of Cultural Landscapes, otherwise known as Cultural Heritage Landscapes, is also recognized by the Province in the Provincial Policy Statement 2020 which states "Significant built heritage resources and significant cultural heritage landscapes shall be conserved". Examples include parks, trailways, viewsheds, natural areas, industrial complexes of heritage significance, and areas recognized by federal or international designation authorities.

The City of Kingston conducted a Cultural Heritage Study in 2019 titled North King's Town Secondary Plan Cultural Heritage Study (Bray Heritage, 2019) which is included the Project Study Area. The study identified a number of significant environmental, archaeological and built heritage resources in the project area including: Wildlife habitats, former industrial buildings, offshore marine archaeological resources, "the Willows" tree grouping, and marine recreation. The studies description of the Inner Harbour stated, "The area has significant archaeological and built heritage resources from centuries of occupation and use." It also stated "The former and current dockyard is a continuing (and rare) traditional industry on the waterfront while the fishing spots along the shore also continue an enduring, though evolving, relationship to the water. Additionally, within the Kingston Official Plan (2021), the Rideau Canal is recognized as a Cultural Heritage Landscape.

3.3.3.1 Thresholds

A background information review indicates the KIH has significant environmental resources in the Project Study Area, including natural areas, wildlife habitats and visual associations, which contribute to the cultural landscape. Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls that remove vegetation or alter the shoreline are likely to modify natural ecosystem elements of the Cultural Landscape during sediment management activities and post-sediment management. This project interaction with the Cultural Landscape is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by the retention or restoration of valued Cultural Landscape features.

Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls may temporarily alter or obscure features of the Cultural Landscape during sediment management activities. This project interaction with the Landscape Features is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by documenting whether alterations to the shoreline and adjacent vegetation are compatible with the existing cultural landscape and landscape features and assessing whether valued natural shoreline landscape features are maintained or restored.

Table 40: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Cultural Landscape and Landscape Features

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Cultural Landscape Features							
Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls that alter or obscure built features result in alteration of the cultural landscape.	Temporary: during sediment management activities	Features of the cultural landscape are retained and not permanently altered.	The historical, architectural or contextual significance of cultural landscape elements are not altered or lost.	Medium	Yes 40, 43	Design temporary works so that no permanent alteration occurs to the features of the affected cultural landscape Design shoreline stabilization and site restoration to be compatible with the features of the affected cultural landscape	Consultation with the local community and stakeholders regarding important cultural landscapes. Document and understand the affected cultural landscape
Terrestrial and in-water works such as shoreline stabilization that modify natural ecosystem elements result in loss of landscape character.	Temporary: during sediment management activities And Long term: post-sediment management	At minimum, valued natural shoreline landscape features are restored.	The historical, architectural or contextual significance of landscape features are preserved or restored.	Medium	Yes 40, 43	Design shoreline stabilization and site restoration to be compatible with valued landscape features.	Consultation with the local community and stakeholders regarding important landscape features. Document and understand the affected cultural landscape

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[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.3.4 Terrestrial Archaeological Resources

The known anthropogenic history of KIH spans back to the post-glacial period approximately 13,500 years ago and includes Indigenous land use and post-Contact European settlement of the area. The potential for archaeological resources in KIH and surrounding area is high due to this rich history of Indigenous and early-European use and settlement. This history is highly valued by the City of Kingston, community members, and Indigenous peoples with connections to the land. The City of Kingston adopted an Archaeological Master Plan in 2010 that details known archaeological sites and resources and provides a management strategy for such sites and resources.

As part of the City of Kingston Third Crossing of the Cataraqui River Environmental Assessment (J.L. Richards, 2012), in 2009, a Stage 1 Archaeological Assessment was completed by Nicholas Adams of Adams Heritage for the proposed bridge crossing including multiple potential route options for the project (Adams, 2009). The report concluded that all areas within the proposed project area contained archaeological potential and should undergo assessment prior to any site activities, including areas within KIH. Additional archaeological assessments (stage 2) for the proposed bridge project were completed in 2010 but they were conducted in areas to the north of the KIH project area.

In 2011 as part of the Review and Data Gap Assessment for Parks Canada Waterlot, Kingston Inner Harbour (Golder, 2011) a list of archeological resources was compiled for KIH. The list included both underwater and terrestrial reports from archaeological assessments conducted in or adjacent to the study area in the KIH. This report only compiled a list of potential archeological resources as a review of the individual reports including study area maps was beyond the scope of the study.

Kingston Inner Harbour: A Cultural Heritage Landscape Pilot Study (Holthof, 2015) list the following significant heritage attributes of the KIH that relate to terrestrial archeological resources:

- The Rideau Canal;
- Fort Frontenac (ruins and contemporary);
- The Tête du Pont Barracks;
- H.M.C.S. Cataraqui;
- Davis Dry Dock;
- Historic industrial buildings on the western shore including,
    - 9 North St.;
    - Metalcraft Marine 347 Wellington St.;
    - The Woolen Mill, Cataraqui St.;
- Artifacts from the Inner Harbours industrial and maritime past including,
    - Bollards at the entrance to Anglin Bay
    - Oil Pipes at the entrance to Anglin Bay
    - Angrove's manhole cover in Douglas Fluhrer Park

The report titled “Chronology of North King’s Town, Kingston” (Mckendry 2018) details the history of the area to the west of the KIH study area but also includes the shoreline of the project area. The report is a chronology from pre-European contact to 2017 based on historical sources. The document includes a large section detailing historical sources and archeological reports from the KIH area.

A Stage 1 terrestrial archaeological assessment of the KIH was conducted by Past Recovery Archeology Services in 2020 (**Appendix E**). The study found the terrestrial portion of the subject property had limited archaeological potential for land-based archaeological resources, but had potential for deeply buried archaeological resources, both pre-Contact and early historic marine resources including wrecks, lost cargo, boat houses, wharves, etc., that may be located under reclaimed land from the Cataraqui River. The report concluded that any below-grade excavations the study area should be the subject of Stage 2 archaeological monitoring undertaken by a licensed consultant archaeologist. It also concluded no further archaeological assessment of the Orchard Street Marsh or Belle Park is required as these areas have low archaeological potential, and the portions of the study area that overlap the former Davis Tannery property require no further archaeological assessment as they have been previously subject to Stage 1 and 2 archaeological assessments.

3.3.4.1 Thresholds

Sediment management and intervention activities that remove terrestrial vegetation, remove or alter built features and or alter the shoreline are likely to alter elements of Terrestrial Archeological Resources. This project interaction with Terrestrial Archaeological Resources is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by the use of protective mitigations and any destruction of or damage to Terrestrial Archaeological Resources caused by sediment management activities.

Table 41: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Terrestrial Archaeological Resources

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Terrestrial Archaeological Resources							
Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation of soil, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls result in damage or destruction of buried archaeological resources.	Temporary: during sediment management activities.	No damage to archaeological resources.	Compliance with PCA Guidelines for the Management of Archaeological Resources and the City of Kingston Archaeological Master Plan.	High	Yes 30, 31, 40	Exclusion zones around archeological resources or identification of resources that may require recovery. Works conducted under guidance from licensed consultant archaeologist.	Stage 2 monitoring for potential archaeological resources along the shoreline between Douglas Fluhrer Park and Molly Brant Point and also near the Kingston Rowing Club where the original topsoil and shoreline may still be present. Clearly mapped areas of known or high archaeological potential and identification of exclusion, recovery or monitored zones. Archaeological monitoring of relevant terrestrial work undertaken by a licensed consultant archaeologist.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.3.5 Submerged Archaeological Resources

Submerged Archaeological Resources was selected as Project VC as it was identified by TC and PCA as important and required for the assessment. The potential for submerged archaeological resources in the KIH is high due to its rich history of early-European use and settlement. In its role as federal lead for heritage conservation and archaeology, the objective of the PCA is to protect and manage archaeological resources as they are key to ensuring commemorative integrity of National Historic Sites. The Commemorative Integrity Statement for the Rideau Canal NHSC states that Level 1 archaeological sites will be unimpaired and not under threat when:

- underwater resources are safeguarded through the encouragement of and cooperation with municipalities or other levels of government, and
- all operational projects involving below ground disturbance and/or underwater disturbance are reviewed to ascertain potential impact on resources. (CIS, 2000, section 6.4)

This history is also highly valued by the City of Kingston and community members. The City of Kingston adopted an Archaeological Master Plan in 2010 that details known archaeological sites and resources and provides a management strategy for such sites and resources.

[redacted]

As part of the City of Kingston Third Crossing of the Cataraqui River Environmental Assessment (J.L. Richards, 2012), in 2009 a Stage 1 Background Research Underwater Archaeological Assessment of the Cataraqui River was completed by Scarlett Janusas Archaeological and Heritage Consulting and Education (SJAHCE). [redacted]

As stated in the previous section, in 2011 as part of the Review and Data Gap Assessment for Parks Canada Waterlot, Kingston Inner Harbour (Golder, 2011) a list of archeological resources was compiled for the KIH. Beyond the compiled list of existing archaeological assessments, the report made specific recommendations in terms of submerged archaeological resources. Firstly, as the location of the shoreline has been altered significantly there is potential for locating shipwrecks within the land surrounding the harbour and for locating pre-contact sites within the water. Secondly, the report recognized that the potential for submerged archaeological and cultural resources is a data gap which needs to be addressed. Finally, the report recommended an archaeological assessment take place prior to any work be conducted in the KIH including dredging, construction, remediation or staging activities. The report also recommends that the PCA Underwater Archaeology Services should be contacted regarding any proposed remediation or archaeological works.

A marine desktop (stage 1 equivalent) archaeological assessment of the KIH was conducted by Past Recovery Archeology Services in 2020 (**Appendix F**). The majority of the marine component of the study area retains high archaeological potential for post-Contact archaeological resources, mainly wrecks. It noted that 10 registered wrecks were within the areas of proposed impacts. The report concluded that the study area should be subject to additional marine archaeological assessment. It recommended investigations should consist of a geophysical survey encompassing multi-beam sonar and marine magnetometer surveys to identify anomalies which may represent significant archaeological features or deposits.

In October 2021, a partial Stage 2 marine archaeological assessment was conducted in KIH, which included geophysical surveys using multi-beam echo sounding, marine magnetometer, side-scan sonar and sub-bottom profiler. A visual inspection of known and potential cultural resources was also completed using a remotely operated vehicle (ROV). The Stage 2 marine archaeological assessment continued in May 2022 with additional geophysical surveys using single-beam bathymetry and marine magnetometer surveys in specific areas originally surveyed in 2021 as well as areas that were not accessible in 2021. A ROV survey was planned for December 2022 to assess anomalies identified in May 2022; however, thick ice cover in the KIH prevented the survey from being carried out and it has been rescheduled for open water conditions in spring 2023 The results of this assessment are pending and will be included as part of the DIA.

3.3.5.1 Thresholds

Aquatic works such as dredging, construction, dewatering or remediation activities in the harbour or alteration the shoreline are likely to alter elements of large Submerged Archeological Resources, such as known shipwrecks. Damage from sediment management and intervention activities could result in partial or full loss of these Submerged Archeological Resources during sediment management activities. This project interaction with Submerged Archaeological Resources is considered to be high risk based on preliminary assessment, and as such the standard of proof is high. The standard of proof would be measured by the effectiveness of protective mitigations and the absence of any destruction of or damage to Submerged Archaeological Resources caused by sediment management activities.

Protective mitigations for Submerged Archeological Resources will likely be dependant on the size and importance of the resource. For large Submerged Archeological Resources, including wrecks, avoidance is considered the preferred option. These large Submerged Archeological Resources are largely known, or will likely be identified, during the Stage 2 Archeological Survey. Other smaller Archeological Resources may be found the Stage 2 Archeological Survey or during sediment management activities. While avoidance should be considered, it may not be possible depending on location and timing of discovery. In these cases, recovery and preservation could be conducted based on guidance from a licensed archaeologist.

Table 42: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Submerged Archaeological Resources

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Submerged Archaeological Resources							
In-water sediment management activities such as dredging and shoreline stabilization result in disturbance to sediments which contain wrecks and other large submerged archaeological resources.	Temporary: during sediment management activities	No damage to submerged large archaeological resources.	Compliance with PCA Guidelines for the Management of Archaeological Resources	High	Yes 30,31,40,45, 47	Exclusion zones around archeological resources or identification of resources that may require recovery. Capping but no dredging at site of archaeological resources. Works conducted under guidance from licensed consultant archaeologist.	Stage 2 Marine Archaeological Assessment report with updated mapping of submerged archaeological resources and additional details on archaeological potential in KIH. Archaeological monitoring of relevant work undertaken by a licensed consultant archaeologist.
In-water sediment management activities such as dredging and shoreline stabilization result in disturbance to sediments which contain smaller submerged archaeological resources.	Temporary: during sediment management activities	If avoidance is not possible recovery and preservation of submerged archaeological resources.	Compliance with PCA Guidelines for the Management of Archaeological Resources	High	Yes 30,31,40,45, 47	Survey and removal of archaeological resources prior to dredging activities. Works conducted under guidance from licensed consultant archaeologist.	Stage 2 Marine Archaeological Assessment report with updated mapping of submerged archaeological resources and additional details on archaeological potential in KIH. Archaeological monitoring of relevant work undertaken by a licensed consultant archaeologist.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.4 Indigenous Interests and Rights

Indigenous Interests and Rights are included as a VC as Indigenous peoples have inhabited KIH and the surrounding regions for thousands of years and a number of separate First Nations have lived in and near what is now known as Kingston. The identification of potentially affected Indigenous groups has been carried out by TC and PCA. A total of twelve (12) groups have been contacted:

- Beausoleil First Nation
- The Chippewas of Rama First Nation
- Chippewas of Georgina Island First Nation
- Mississaugas of Scugog Island First Nation
- Curve Lake First Nation
- Michisaagiig of Hiawatha First Nation
- Alderville First Nation
- Mohawks of the Bay of Quinte
- Mohawk Council of Akwesasne
- Algonquins of Ontario
- Metis Nation of Ontario
- Huron-Wendat Nation

Engagement is also underway with the Mohawk Nation Council of Chiefs.

The Government of Canada consults with Indigenous Peoples for many reasons, including: statutory and contractual; policy and good governance; and the common law duty to consult. The duty to consult is based on obligations of the Crown in relation to potential or established Aboriginal or Treaty rights of the Aboriginal peoples of Canada, recognized and affirmed in section 35 of the *Constitution Act, 1982*.

The IAA includes provisions to ensure impact assessments respect the rights of Indigenous Peoples and the rights outlined in section 35 of the *Constitution Act, 1982*, and aims to promote communication and cooperation with Indigenous peoples of Canada with respect to impact assessments.

Under section84 of the IAA, an authority's determination regarding whether the carrying out of the project is likely to cause significant adverse environmental effects must be based on a consideration of factors including any adverse impact that the project may have on the rights of the Indigenous Peoples of Canada recognized and affirmed by section 35 of the Constitution Act, 1982; and any Indigenous knowledge provided with respect to the project.

While projects undertaken on federal land or waterlots are not subject to provincial legislation, consideration of and general alignment with provincial requirements should be take into account for the duration of the project. Access to the project works may also take place on non-federal land and may require permits from other jurisdictions.

The Ontario Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) was consulted as it has an interest in undertakings such as KIH under its mandate to develop policies and programs for the conservation of Ontario's cultural heritage, including indigenous cultural heritage. Under the Ontario Heritage Act (1990), and as part of its Standards and Guidelines for Consultant Archaeologists, consultant archaeologists practising in Ontario must engage Indigenous groups in certain stages of archaeological assessments. When engagement occurs archeologist must include documentation of the engagement process in the project report package. Additionally, the City of Kingston, through its Official Plan (Kingston, 2019), recognizes the importance of Indigenous Peoples, and the need to engage with Indigenous Peoples when dealing with issues that involve Cultural Landscapes, archaeology, or Cultural Heritage. The Official Plan specifically states a need for specific efforts to engage Indigenous Peoples for specific planning processes.

3.4.1 Thresholds

. Potential impacts on Indigenous rights and interest cannot be determined without input and involvement of Indigenous Peoples. TC and PCA continue to consult with Indigenous groups to gather feedback and traditional knowledge to incorporate into the DIA process and Project design. Scenarios describing potential project impacts on Indigenous Interests and Rights and associated thresholds will be developed as part of the consulting process (**Table 43**). At the end of the consultation process a refinement of the DIA will take place as necessary.

Table 43: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Indigenous Interests and Rights

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Indigenous Interests and Rights							
To be determined with input and involvement of Indigenous groups.	To be determined.	To be determined with input and involvement of Indigenous groups.	To be based on Indigenous knowledge, derived through engagement and consultation.	High	To be determined.	To be determined.	Completion of engagement and consultation with Indigenous groups.

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.5 Visitor Experience Valued Components

3.5.1 Tourism and Visitor Experience

Tourism and Visitor Experience was selected as Project VC as it was identified by TC and PCA as important and required for the assessment. From the perspective of PCA, the visitor experience values can be found in the Rideau Canal Management Plan which states the Rideau Canal is a valuable tourism and recreational resource contributing substantially to the economy of eastern Ontario (Parks Canada, 2005). At the time of its writing in 2005, the plan stated the Canal contributed over $24 million to national GDP and sustains over 600 full-time jobs. In terms of guiding principles, the plan states decision making should:

- Recognize that the Rideau Canal contributes to tourism and recreation as a major component of the corridor economy.
- Respect the historic values, natural features, scenic beauty and diversity of cultural landscapes of the Canal corridor
- Development of the shore-land and on lands adjoining Canal lands should respect the historic and scenic character of the Canal landscape and be environmentally sustainable and not conflict with navigation.

As stated in the draft Detailed Impact Assessment Handbook (Parks Canada, 2020), maintaining the visitor experience is a key element of the Parks Canada mandate, and changes to the environment affecting visitor experience should be considered as part of the scope for DIA. The handbook also states how changes to development and use, even those with intended benefits, have the potential to alter or disturb visitor use.

In the Rideau Canal Draft Management Plan (Parks Canada, 2020), the first key strategy for the management of the canal is to recognize the full potential of the canal for visitors stating, “While recreational boating use of the Rideau Canal remains a key focus, there are also increasing opportunities to encourage land-based visitors to explore new locations along the Canal and to attract new and different types of users to the waterway.”

For KIH area the PCA visitor experience relates to two components. Firstly, to the views of the natural and urban environment along with public pathways with views of the Rideau Canal. Secondly, to the use of the navigable channel. Historical structures such as the Kingston Mills Blockhouse and the Kingston fortifications are outside of the study area.

While there is no formal Parks Canada visitor centre in the KIH, the areas around the Inner Harbour provide opportunities for visitors through activities such as: the park system and trails, dining along the shoreline with viewscapes of the harbour, and the navigable channel which provides access to watersports and boating. Navigation is also considered separately under the Navigation VC, **subsection 3.5.2**, and includes navigation outside of the Rideau Canal. Project actions have the potential to impact on the enjoyment of these activities.

In 2019 the City of Kingston, in partnership with Tourism Kingston, initiated the development of an Integrated Destination Strategy (IDS) with the intention of establishing tourism priorities for the next five (5) years. One of the key initiatives was to integrate the waterfront into the downtown tourism experience. The strategy stated that the variety of water-based activities, sailing, islands/cruises, Kingston Harbour, Indigenous and eco-tourism experiences are the key means for visitors to develop a connection to the water. Additionally, the city should continue efforts to ensure development is focussed on pedestrians and active transportation, using built heritage and cultural resources, to provide new experiences.

Kingston has planned several waterfront improvement projects in the downtown area including Douglas Fluhrer Park, which is located within the KIH Project Site.

A large percentage of the KIH Project Impact Area is parkland, including Belle Park, Emma Martin Park, Molly Brant Point and Douglas Fluhrer Park, which are also connected by the waterfront K&P Trail. The City of Kingston Parks and Recreation Master Plan (2021) states the importance of the trail system and passive parks that preserve natural areas and open space. The plan recommends enhancement of waterfront trails to maximize their aesthetic and functional value, expand upon the existing natural parks and trail systems as a means to develop corridors that serve ecological, passive recreational and active transportation purposes and ensure that accessibility and safety concerns do not become a barrier to park usage.

While the conceptual Sediment Management Plan (Golder, 2021a) aims to increase the safety related to the use and enjoyment of the Inner Harbour, in the short-term, the presence of construction equipment may also cause high levels of anthropogenic noise which has been shown to negatively impact on the perception of aesthetic values, especially in natural areas and areas of high scenic value (Benfield, 2010). Research conducted by the U.S. Environmental Protection Agency indicates that a 5 dB change in sound levels is required to trigger a change in large-scale community response to noise. The MECP Noise Publication NPC-300 states that the outdoor daytime limit for noise sensitive receptors is 55 decibels or the ambient background noise, whichever is higher. Noise Sensitive land uses include hotels, schools, daycares and residential dwellings. These have yet to be identified within the Project area. The DIA should refer to Health Canada guidance once sensitive receptors have been identified and estimate the percentage of highly annoyed (%HA) in the community.

3.5.1.1 Thresholds

Public amenities including Belle Park, Emma Martin Park, Molly Brant Point, Douglas Fluhrer Park, and the K&P Trail are located adjacent to the water lots proposed to undergo sediment management and shoreline stabilization, including the southern extent of the Rideau Canal. Terrestrial works such as site preparation and mobilization that require vegetation clearing, excavation of soil, temporary access roads, temporary facilities and laydown areas, and installation of Erosion and Sediment Controls that block access to waterfront trails and parks are likely to alter tourism and visitor experience to the waterfront during site preparation and sediment management activities. Details pertaining to extent and location(s) of vegetation clearing, excavation of soil, temporary access roads, and temporary facilities and laydown areas are currently unknown. This Project interaction with Tourism and Visitor Experience is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof would be measured by provision of alternative access in combination with notice of disruption to access to waterfront areas such as the parks and trails.

Proposed sediment management activities have the potential for short-term changes to the soundscape and of KIH. A variety of dredging and construction equipment and vehicles are anticipated to be used to conduct the proposed sediment management activities. The presence and use of this equipment are likely to negatively impact Tourism and Visitor Experience of the KIH during sediment management activities. Short term acoustic impacts on Tourism and Visitor Experience will be assessed by compliance with local noise bylaws and by maintaining construction noise levels below provincial daytime limits for noise sensitive receptors. This Project interaction with Tourism and Visitor Experience Values is considered to be low based on preliminary assessment, and as such the standard of proof is low. The standard of proof would be measured by protection of the project area via use of project timing, noise abatement and mitigation for heavy equipment.

Heavy equipment and vehicles in motion or with moving parts can pose dangers such as pinch-points and can cause serious injury if not properly isolated and safety controls implemented. Terrestrial works involving vehicles and heavy equipment that are in uncontrolled areas are likely to present safety hazards that impact visitors during site preparation and sediment management activities. This Project interaction with Tourism and Visitor Experience is considered to be low risk based on preliminary assessment, and as such the standard of proof is low as it would be based on observations. The standard of proof would be measured by use of site control measures to protect visitors from heavy equipment and vehicles.

Table 44: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Tourism and Visitor Experience

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Tourism and Visitor Experience							
Terrestrial works involved in site preparation and mobilization such as vegetation clearing, excavation, temporary access requirements, temporary facilities and laydown area(s), and installation of Erosion and Sediment Controls that, in the City of Kingston, alter waterfront park(s) and K&P trail use result in a negative experience for visitors and tourists.	Temporary: during site preparation and sediment management activities	Waterfront Parks (Belle Park, Emma Martin Park, Molly Brant Point, and Douglas Fluhrer Park) and K&P Trail access and use are maintained to the extent possible.	Public notice provided in areas that will be disturbed prior to commencement of terrestrial works describing service disruption, works being completed, and a timeline to restoration of access.	Medium	To be determined.	To be determined.	Engagement with the local community and stakeholders regarding potential effects to access and use.
Heavy equipment use associated with site preparation and mobilization as well as sediment management activities result in sensory disturbance which reduces enjoyment of soundscapes in Kingston Inner Harbour by visitors.	Temporary: during sediment management activities	Noise levels are maintained such that the effect on aesthetics is minimized to the extent possible.	Compliance with MECP noise levels for sensitive land uses (55db) Compliance with City of Kingston noise and construction bylaws and federal Historic Canals Regulations.	Low	Yes 46	Noise abatement.	Noise, Vibration, Management Plan Identification of noise sensitive land uses
Heavy equipment and vehicle use associated with site preparation and mobilization as well as sediment management activities present safety hazards to visitors to Kingston Inner Harbour.	Temporary: during sediment management activities	Facilities, access roads and work sites are secure and have control measures in place to protect workers and members of the public.	No safety incidents involving members of the public.	Low	Yes 1	Fencing/Hoarding installed. Road restrictions. Traffic control plan.	Access Management Plan should be developed. Consultation with Kingston Bylaw enforcement and Parks Canada Visitor Safety and

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
							Prevention Coordinator

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)

[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

3.5.2 Navigation

The Project Area is located on the Rideau Canal and Cataraqui River, which is designated under the *Canadian Navigable Waters Act* (CNWA) as a scheduled waterway. The Rideau Canal is also regulated under *Historic Canal Regulations* which address the management, use and protection of the canal including ensuring the safe navigation of vessels. For these reasons, Navigation was selected as a Project VC. It is also a VC due to the potential impact on community groups, and ultimately all users of the waterway that rely on the KIH for navigation and aquatic recreational resources including boating, rowing, and canoeing clubs. Protecting and facilitating the public right to navigation is a key part of Transport Canada's Navigation Protection Program, and Parks Canada's management of the Trent-Severn Waterway. The Rideau Canal Draft Management Plan (Parks Canada, 2020) recognizes recreational boating is still a key focus of the canal. This VC considers both the impacts to navigation on the main navigation channel as it relates to the Rideau Canal, but also the Inner Harbour as a whole as it relates to navigation within the Inner Harbour itself.

The Inner Harbour can be accessed through a number of locations. The Project area is accessible through the navigation channel entering the Inner Harbour from Lake Ontario through the LaSalle Causeway or locking down from the Kingston Mills Lockstation and the Rideau Canal system into the lower Cataraqui. A boat launch is located within Emma Martin Park and is used extensively by local fishers and boaters to launch small vessels. The Cataraqui Canoe Club and the Kingston Rowing Club are located in Emma Martin Park in the centre of the Project Site. A rowing course is located adjacent to the navigable channel with additional rowing areas within the Inner Harbour. Kingston Marina is located at the south end of the Project Site and provides slips for up to 150 vessels. Metalcraft Marine operates out of the same area, constructing and repairing commercial vessels. The harbour gradually slopes from the Belle Park southern shoreline to a depth of two (2) metres in the middle of the harbour in front of Doug Fluhrer Park. Many areas within the Inner Harbour are less than one (1) meter. The harbour area close to Kingston Marina is the deepest area and has been measured at approximately 5 m deep. Water depth in the navigable channel is maintained at a minimum of 1.5m during the navigation season.

Any impacts to navigation will require assessment and approval by TC and PCA prior to engaging in work that may interfere with navigation. Impacts to navigation from sediment management activities could include a temporary limit on available navigable areas, reduction in the available draft, delays in access to both marinas and the navigable channel, surface and subsurface hazards from dredging equipment and uncharted alterations to bathymetry. Under the CNWA, a public notice will also be required to be published prior to issuance of any approval.

This section will be completed for the DIA following stakeholder consultation led by TC and PCA. The Stakeholder Engagement Plan for the Kingston Inner Harbour (Golder, 2021b) lists water-based recreation associations as part of the community stakeholder groups that are scheduled to be contacted as part of the engagement process. Specific groups that would be specifically interested in navigational issues and are scheduled to be contacted include Kingston Yacht Club, Dolphin Scuba Club, Kingston Recreational Divers, Kingston Rowing Club, Cataraqui Canoe Club, CORK Sail Kingston, St. Lawrence Cruise Lines, Kingston 1000 Island Cruises, and Ahoy Rentals.

3.5.2.1 Thresholds

Aquatic works that physically limit access to the Inner Harbour, limit movement between different areas of the harbour or movement between the Inner Harbour and the navigable channel are likely to have impacts on the navigability of the Inner Harbour during sediment management activities. The Project is not expected to interfere with the main navigable channel of the Cataraqui River, but access points may be restricted depending on Project timing and staging during sediment management activities. This project interaction with navigation is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof will be measured by provision of access to the main navigable channel of the Cataraqui River by recreational watercraft from the Inner Harbour.

Concerns of inner harbour users over access to the area for recreational and commercial activities are known to exist. Stakeholder consultation with groups specifically interested in navigational issues has yet to occur. Terrestrial and in-water works that physically limit access to the boat launch and marina are likely to have impacts on the navigability of the Inner Harbour during sediment management activities. This project interaction with Navigation is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof will be measured through the development of access measures that arise from the consultation process and their successful implementation.

Aquatic works such as dredging, and capping will result in the alteration of bathymetry within the Inner Harbour. Altered bathymetry is likely to have impacts on the navigability of the Inner Harbour during sediment management activities and post sediment management and could result in altered navigation channels and prevent Inner Harbour access to some vessels depend on their draft. This project interaction with navigation is considered to be medium risk based on preliminary assessment, and as such the standard of proof is medium. The standard of proof will be measured through the development of target elevations and from the consultation process and their successful implementation.

Table 45: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Navigation

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Navigation							
In-water works such as equipment access, wetland vegetation removal, dredging, capping, and shoreline stabilization alter access to and use of navigational channel.	Temporary: during sediment management activities	Access to the main navigable channel by watercraft accessing the Inner Harbour (including the main navigation channel, marina, boat launch and rowing club) is maintained to the extent possible.	Compliance with the Canadian Navigable Waters Act (S.C. 2019, c.28) legislation and permits.	Medium	To be determined.	To be determined.	Consultation with Transport Canada in compliance with the Canadian Navigable Waters Act including a review of works by TC and publication of a notice, including any information specified by TC. Engagement with the local nautical community and stakeholders regarding potential access and use effects.
Terrestrial and in-water works such as mobilization, wetland vegetation removal, dredging, capping, and shoreline stabilization alter access to boat launch and marina	Temporary: during sediment management activities	Disruptions to public access and use of the public boat launch and marina are minimized.	Boat launch and marina access and use is maintained during active season (April – November). Clear notice of service disruptions provided at point of service and to community ahead of time.	Medium	To be determined.	To be determined.	Engagement with the local nautical community and stakeholders regarding potential access and use effects.
In-water works such as dredging, capping, alter bathymetry changing navigational channel and harbour access.	Temporary: during sediment management activities And	Bathymetry maintained at elevations that continue to permit access by vessels of current draft	Target elevations to be determined	Medium	To be determined.	Target elevations for bathymetry	Consultation with Transport Canada to determine targets. Engagement with the local nautical community and stakeholders regarding potential access and use effects.

Scenario	Impact Timeframe	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
	Long term: post-sediment management						

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[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, Parks Canada, 2020b)
[3] Refer to **Appendix A** for list of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

4 Approach to Assessment and Evaluation of Potential Effects

The processes described in **subsections 2.11** through **2.13** will be carried out for all project-VC interactions presented in **Section 3**, incorporating information and recommendations brought forward during the engagement and consultation processes. This CCIC is based on the Conceptual SMP (Golder, 2021a) and the Project effects on and interactions with VCs may change when more details are available in the detailed design process. The assessment will take into consideration any residual and cumulative impacts that are likely to occur after mitigations have been applied. In some circumstances, unique mitigations may be developed using evidence-based decision-making, Indigenous knowledge, Indigenous engagement and consultation, and public engagement, which may occur during the DIA process or be developed post-DIA as part of environmental protection plans. The criteria used to evaluate the residual and cumulative effects will relate explicitly to the types of evidence, desired outcomes, and thresholds presented for each VC in **Section 3**. The residual impacts will be compared to the desired outcomes and threshold measures for each VC.

Certain high-risk project-VC interactions may require monitoring during Project activities or as follow-up (refer to VC tables in **Section 3**). The processes described in **subsection 2.14** will be carried out for such project-VC interactions to ensure that mitigations and restoration are meeting the desired outcomes. Additionally, monitoring may be described in site-specific plans developed prior to commencement of works and will be the responsibility of the contractor and/or other parties as determined by PSPC and the Project Proponents. Site-specific plans are listed under “Additional Works Required” for certain VCs in **Section 3** but are not listed under data gaps below as they are considered standard practice for Projects such as this and are developed after the DIA is complete.

4.1 Summary of Data Gaps

Gaps in information and data required to meet the thresholds and achieve the desired outcomes of various project-VCs under assessment are listed in the individual tables for each VC in **Section 3**. The following subsections expand on how this information may be collected and any other anticipated requirements to complete the DIA.

4.1.1 Aquatic Wildlife and Vegetation

4.1.1.1 Fish and Fish Habitat

Application for a request for review from DFO related to the *Fisheries Act* may be required due to the potential of the Project in causing a harmful alteration, disruption or destruction of fish habitat. The application must include a detailed description of the extent and type of fish habitat that is likely to be affected. DFO’s HEAT model (www.habitatassessment.ca) assists in the calculation of fish habitat area affected, providing an accounting framework for assessing losses, gains, and modifications to habitat. This tool should be used to assist in the determination of potential fish habitat loss, refinement of thresholds and an offsetting plan (should a *Fisheries Act* Authorization application be required). The pre- and post- species richness should be compared using the DFO HEAT model to determine preferred outcomes and thresholds.

4.1.1.2 Aquatic Vegetation

Ecological Land Classification conducted collected data on species abundance but not cover, as percent cover is not an element of ELC. Additional work is recommended to be conducted mid-summer prior to commencing sediment management activities to obtain an updated IBI vegetation score based on the

GLCWMP Vegetation Sampling Standard Operating Procedure (Institute for Great Lakes Research, 2018). This will allow for direct comparison with post-management monitoring.

4.1.2 Species at Risk Turtles

Turtle overwintering habitat cannot be further refined without telemetry studies to understand where individuals go to overwinter either within or outside of the Project Site, and still may not reveal all overwintering locations without widespread effort in the form of many replicates both within and across species, sexes, and age classes. A ROV survey was conducted under the ice in February 2023 by SNC-Lavalin to investigate suspected overwintering habitat but was unable to complete a thorough survey of the KIH due to shallow depths, dense vegetation, and obstacles encountered under the ice (e.g., wrecks) posing navigational challenges (refer to **subsection 3.2.2.1**). Additional studies to investigate and confirm overwintering habitat are recommended, which could include ROV surveys immediately following the ice melt on KIH, potentially allowing for turtles to be observed in shallower depths prior to their spring emergence.

Prior to sediment management, suitable habitat qualities during the overwintering period should be quantified and mapped, such as water depth, sediment depth, substrate composition, oxygen levels, aquatic vegetation composition and density, and availability of submerged shelter objects (e.g., boulders, logs).

4.1.3 Species at Risk Birds

Additional surveys for breeding birds are recommended in order to account for species [redacted], such as Eastern Wood-pewee and Red-headed Woodpecker. While Barn Swallows have not been observed [redacted], it should continue to be observed for nesting activity; if nesting occurs, foraging areas and any other breeding sites within the Project Impact Area should be clearly mapped.

Continued monitoring for Least Bittern [redacted] is recommended as criteria for federal critical habitat identification has been partially detected and Least Bittern were present in the area in 2022.

4.1.4 Species at Risk Bats

Bat maternity roosting habitat surveys were conducted [redacted] At these locations, presence of bats should be determined via exit surveys and acoustic monitoring. Should any bat maternity roost be confirmed, the habitat should be clearly delineated and include an inventory of snag trees that identifies location, species, snag attributes, decay class, diameter at breast height, and photographs.

4.1.5 Terrestrial Wildlife

Additional surveys for breeding birds are recommended to account for species present on Belle Island, which is within the Project Impact Area, and contribute to the DIA. Likewise, surveys are recommended for Belle Island at suitable snags to assess for bat maternity colony presence within the Project Impact Area via exit surveys and acoustic monitoring. Should any bat maternity colony be identified, the habitat should be clearly delineated and include an inventory of snag trees that identifies location, species, snag attributes, decay class, diameter at breast height, and photographs.

4.1.6 Terrestrial Vegetation

A spring terrestrial vegetation survey and botanical inventory of Belle Island is recommended as only fall and summer data have been collected to date (SNC-Lavalin, 2023). This information can be used to verify and update plant lists and Ecological Land Classification mapping within the Project Impact Area and contribute to the DIA.

To establish monitoring that can be compared post-sediment management, a pre-construction survey should be conducted following the methods for “Monitoring impacts on native vegetation” in Guide to Monitoring Exotic and Invasive Plants (Environment Canada, 1997). An a priori power analysis should be conducted to determine the appropriate number of monitoring quadrats needed to achieve sufficient power.

4.1.7 Surface Water Quality

A surface water quality baseline of the sediment management areas is required prior to commencement of works to ensure the sediment disruption does not cause negative environmental effects. Several data gaps related to the current understanding of surface water quality within KIH were identified by WSP (formerly Golder) (**Appendix B**), listed below:

- **Updated Water Chemistry**—The majority of data available for the KIH were collected between 2002 and 2009 (ESG 2014). However, several source control measures have been implemented since that time that have likely improved surface water quality conditions (Section 2.3 of **Appendix B**). Current baseline conditions within the Project area (i.e., between Belle Island and the Kingston LaSalle Causeway) should be established with new surface water quality data, building upon historical sampling nodes, and collected for each COC group associated with sediment (metals, PAHs, and PCBs) plus nutrients and toxicity modifying factors.
- **Chromium analysis**—The surface water data collected for the Site to date includes only total chromium analysis. However, water quality criteria are only available for the hexavalent and trivalent forms of chromium, and the form of chromium can influence toxicity in the environment. Analysis of these chromium species should be completed when assessing surface water quality.
- **Diffuse inputs of other COCs**—The Great Cataraqui River is characterized as a eutrophic system that is subject to diffuse nutrient inputs from agricultural activities upgradient of the Site (ESG-RMC 2014). Nutrients should also be included as a regional stressor group as part of the surface water quality assessment.
- **Suitable reference locations**—Surface water quality data from reference locations should be collected for COCs to help understand the source of any elevated parameters identified within the KIH. The reference location should be upgradient from the Project area but also within the urban areas of Kingston to reflect similar diffuse inputs. The historical sampling network provides options for this sampling to provide consistency over time.
- **Detection limits**—The detection limits for many of the surface water samples previously collected within the KIH and from reference locations were elevated above current PWQOs or CCME WQGs. The laboratory should be consulted ahead of completing any surface water quality monitoring to develop analytical detection limits that meet the applicable criteria.
- **Understanding site-specific ancillary parameters that affect bioavailability**—Several of the PWQOs and CCME WQGs are hardness dependent (cadmium, copper, lead, nickel, zinc) or pH dependent (aluminum and ammonia total). Further, FEQGs have recently been established for aluminum, cobalt, copper, lead, and zinc that are based on recent scientific evaluations and allow for site-specific water quality guidelines to be developed based on pH, temperature, hardness, and/or DOC (Canada 2022). The surface water quality assessments should include analysis of these parameters.
- **Dissolved metal and TSS concentrations**—Previous studies have shown that the total concentrations of metals within the water column of KIH are strongly correlated with particulates (ESG 2009; Benoit and Burniston 2010; Malroz 2021). Dissolved metal concentrations and TSSs should be sampled, along with total metal concentrations, to help understand the form of any elevated metals, which strongly influences bioavailability.

- **Dissolved oxygen**—The re-suspension of anoxic sediments can reduce the dissolved oxygen concentration in the water column to potentially harmful levels. However, dissolved oxygen concentrations are also influenced seasonally by temperature and processes such as photosynthesis by algal blooms. The Great Cataraqui River is also more susceptible to reduced oxygen levels as it is a eutrophic system, particularly during the summer. Baseline conditions of dissolved oxygen levels within the KIH should be established that includes seasonal variability.

WSP (formerly Golder) (**Appendix B**) also note that it is important to confirm that the established baseline conditions do not reflect ongoing contamination from major sources along the KIH. Although there have been several source control measures implemented along the shoreline of the KIH to decrease the potential for re-contamination (**Appendix B**), there are several data gaps related to the current understanding and quantification of effectiveness for these controls, including:

- **Effectiveness of storm sewer management**—The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), such that particulate inputs may be discharged that are associated with contaminants. Metals and PAHs have not been sampled within these storm sewers since the early 2000s, where concentrations of PAHs, aluminum, copper, phosphorous and silicon exceeded PWQOs and/or CCME WQGs. Recent improvements in the City of Kingston sewer system have likely decreased the potential for contamination to enter the KIH via storm sewers, but this has not been formally assessed. Storm sewers along the KIH should be sampled during dry outfall events to understand if they represent a major source of on-going contaminant loading. Further, it is suggested that aqueous and sediment material from the storm sewer outflows during flowing conditions (i.e., wet periods) are sampled and analyzed for COCs to establish time-weighted averages of contaminant loading.
- **Contaminants of emerging concern (CECs)**—There have been several CECs identified over the past decade in urban environments that are increasingly being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders could be endocrine disrupters which are known to be harmful to aquatic receptors, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS), and polybrominated diphenyl ethers (PBDE). None of these substances would be linked to historical sources in federal water lots but would reflect municipal sources. It is hypothesized that the concentrations of CECs within the KIH is low because the major source of CECs would be wastewater entering the sanitary system from residences and businesses, which is directed to the City of Kingston water treatment plants located downgradient of the KIH. To verify this, CECs could be collected from storm sewer outflows during both dry outflow and CSO events, to confirm the presence of CECs.

Finally, WSP (formerly Golder) (**Appendix B**) identify the following data gap needs to be addressed to establish EPOs:

- **TSS:Turbidity relationship**—It is expected that a TSS threshold can be used to prevent potential environmental effects from in-water works (refer to Section 3.2 for further details). The TSS18 threshold can then be correlated to a turbidity19 value, which can be measured on a "real-time" (i.e., operational) basis with an in-situ field meter to manage water quality during in-

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[18] TSS encompasses both inorganic solids such as clay, silt, and sand, and organic solids such as algae and detritus and is a gravimetric measurement of the dry weight of suspended particulate material (solids) per unit volume of water. The measurement of TSS requires the collection of a sample and submission of that sample to the laboratory. Analysis is done by filtering the sample onto a glass fibre filter and drying the sample at a specified temperature. Data for this analysis are typically available on a 24-h turnaround.

[19] Turbidity is a measure of the optical properties (e.g., scattering of light) of particulates suspended in water. Turbidity is often used for the day-to-day management of dredging activities as the results are available in real time. Turbidity is measured using an instrument that measures the passage of light through the sample as well as the scattered light that is reflected from the sediment particles and reports values in units such as nephelometric turbidity units (NTU).

water works. This approach circumvents costs or delays associated with laboratory analysis and turnaround time. This allows for more measurements to be collected at a greater frequency and across a greater spatial scale and allows for immediate implementation of mitigation measures to prevent harmful environmental effects. TSS is a gravimetric measurement (mass per volume) whereas turbidity is an optical measurement which can be influenced by particle size, shape, color, and reflectivity. As a result, two materials occurring at the same TSS concentration in a given waterbody may result in different turbidity values. A site-specific TSS:turbidity relationship should therefore be established prior to any in-water works. The TSS:turbidity relationship would have to be specific to the type of sediment being disturbed; therefore, the different sediment types (i.e., particle sizes) throughout the sediment management area should be confirmed to determine if different TSS:turbidity relationships are required for different areas. Additional bench-scale testing of clean remedial management cover to be placed within the remediation area is also recommended to confirm whether the TSS:turbidity relationship developed for dredging needs to be revised for placement of clean material.

4.1.8 Lacustrine Processes

WSP's (formerly Golder) Lacustrine Processes memorandum, in **Appendix C**, listed the following information gaps to be addressed prior to beginning water works:

- Analysis of spatial and temporal sediment transport dynamics for KIH based on the proposed combined configuration of remedial activities for each Management Unit. If required, the latter should include 2D modelling of the potential effects of the proposed remedial activities (dredging, cap thickness, changes in depth and SAV) on currents, waves, and sediment transport potential.
- Development of dredge prism configurations (limits for level of increase or decrease in water depth, slopes between adjacent management units) to maintain existing lacustrine processes within acceptable limits based on potential changes in sediment transport identified by the recommended modelling as described above.
- Measurement and analysis (e.g., modelling) of water level fluctuations in KIH at various timescales (e.g., monthly, annually) and effects on local currents and sediment transport potential in KIH.
- Analysis of extreme weather events and their affect on the riverbed within the Project Area. This would include the intensity and frequency of storm surges and hazard wave effects in KIH, as well as potential climate impacts during all Project phases. This analysis should include measurement and modelling as described above.
- Ice thickness and movement may be the key design consideration for shallow water capping and shore protection design; site specific ice thickness and mobility data are not available at this time.

Additionally, the intensity and frequency of storm surges and hazard wave effects in KIH should be reviewed, as well as potential climate impacts during all construction phases to generate appropriate mitigations.

4.1.9 Sediment Quality

The following data gaps related to sediment quality within KIH were identified by WSP (formerly Golder) and are also listed in **Appendix D**.

A reliable baseline for sediment quality within the Project area is required before starting any in-water works; such will maximize effectiveness of dredging and provide confidence that sediment disruption does not cause negative environmental effects. The recent sediment sampling in Fall 2021 provides good coverage of the management units of greatest interest, and provides data collected using highly standardized field sampling and analytical methods. As such, remaining data gaps in sediment quality are limited, localized, and could be addressed as part of detailed design, or in conjunction with proposed baseline surface water sampling programs, which are described in the accompanying WSP (2023) memorandum entitled "Conceptual Constraints and Impact Considerations – Water Quality" (**Appendix B**).

The following bullets summarize the few remaining data gaps of greatest significance.

- **Stream sediment conditions in Orchard Street Marsh**—Because the headwaters of the unnamed creek that drains the Orchard Street Marsh falls outside federal ownership, the recent sediment sampling (Fall 2021) excluded the evaluation of sediment quality in the wetland (marsh) areas adjacent to the PC-OM management unit. This area includes flows from the Kingscourt storm sewer catchment and intersects the area of historical tannery waste deposits. This portion of the KIH study area is complex and challenging for several reasons:
    - The land ownership is complicated, with adjacent land areas owned by the City of Kingston, PCA, Transport Canada, and a private landowner. Development plans have been in progress in recent years, but to date no final development plan has been approved by the City.
    - The environmental setting is complex, with areas of cattail marsh, degraded riparian zones that nevertheless remain part of Provincially Significant Wetland habitat, and adjacent vegetated areas that may be altered as part of municipal or private development plans for the waterfront.
    - The hydrological environment makes it difficult to infer sediment quality over some zones of sediment. The flows from Kingscourt storm sewer, and the accompanying solids, have entwined with historical contaminated sediment, resulting in a complex pattern of sediment quality. The heterogeneity of sediments in this area is evident from historical sediment quality sampling.

  The complexity and sensitivity of this area makes routine sediment delineation and remediation design challenging to implement. It may be prudent to defer the detailed assessment of this zone pending resolution of numerous land ownership, development, and permitting issues related to the wetland areas.

- **Depth profiling near Anglin Bay**—The depth of contaminated sediments is greatest in areas within and adjacent to Anglin Bay, where the longest depositional sediment cores have been obtained in historical vibracore sampling (Golder 2014a). Also, the distribution of PAHs in subsurface sediments is heterogeneous. The sediment horizons with higher PAH concentrations within and among the management units surrounding Anglin Bay, reflect a complex pattern of historical contamination related to former coal gasification plant releases. In various cores, peak PAH concentrations have been measured at several depths, including mid-depth (e.g., Cores 1 and 10 at depths from 40 to 100 cm); deeper intervals (e.g., Core 3 at depths from 100 to 130 cm); and shallower intervals (e.g., Cores 8, 11, and 12 at depths from 10 to 40 cm). Given this heterogeneity, it is recommended that PSPC characterize the vertical contamination profile with additional precision prior to undertaking detailed design. This portion of the KIH has the greatest potential to uncover significant contamination at depth, due to the association of free product with historical coal tar-containing wastes. Additional cores would not provide precise delineation of sediment but would be valuable in identifying the recommended depths of excavation prior to detailed design stage; such would assist in refining sediment volumes and development of specifications for cover depth, thickness, and composition in the vicinity of Anglin Bay.

- **Sediment stratigraphy**—For some areas of the harbour, dredge volume requirements could be refined through use of sediment stratigraphy analysis. The current estimates of volumes have been assigned based on the results of coring studies, which have identified horizons of sediment materials with distinguishing properties. For example, most KIH sediment profiles contain a layer of loosely consolidated material, composed of sand, silt and organics, which exists at the surface of sites up to depths of 5 to 20 cm, with material becoming more consolidated silt and/or clay with increasing depth. The lower limit (maximum depth) of legacy contamination could be inferred from the depth of the native lacustrine clay that underlies the depositional layers described above. Such layers provide a stratigraphic and physical barrier to sediment contamination at depth. Rather than rely on discrete coring logs, sub-bottom profiling systems such as Ground-Penetrating Radar (GPR) could be applied to identify and measure various sediment layers that exist below the sediment/water interface. Such systems, which could also be verified or calibrated using additional physical cores, would augment existing bathymetry and sidescan sonar profiles previous used to evaluate archaeological values. This information (GPR and/or additional physical tests) would provide a surface of sediment layer depths, helping inform the design of dredge prisms for detailed remedial design.

Aside from the above, the main information gaps for sediment management under current conditions relate to issues of source control, which have also been described in the accompanying WSP memorandum entitled “Conceptual Constraints and Impact Considerations – Water Quality” (**Appendix B**). Although there have been several source control measures implemented along the shoreline of the KIH to decrease the potential for re-contamination (Section 2.3 of **Appendix D**), there are several data gaps related to the current understanding and quantification of effectiveness for these controls, including:

- **Effectiveness of storm sewer management**—The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), such that particulate inputs may be discharged that are associated with contaminants. Recent improvements in the City of Kingston sewer system have likely decreased the potential for contamination to enter the KIH via storm sewers, but this has not been formally assessed. Storm sewers along the KIH should be sampled during dry outfall events to understand if they represent a major source of on-going contaminant loading. Further, it is suggested that aqueous and sediment material from the storm sewer outflows during flowing conditions (i.e., wet periods) are sampled and analyzed for COCs to establish time-weighted averages of contaminant loading.
- **Confirmation of Former Davis Tannery erosion controls**—To validate effectiveness of historical (and potential additional) contaminant transport controls near the former Davis Tannery, the storm sewer monitoring program described above should be expanded to include aqueous and suspended sediment material draining from the western shoreline into KIH during wet-weather events. No dry-weather component would be required for this pathway.
- **Contaminants of emerging concern (CECs)**—There have been several CECs identified over the past decade in urban environments that are increasingly being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders could be endocrine disrupters which are known to be harmful to aquatic receptors, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS), and polybrominated diphenyl ethers (PBDE). None of these substances would be linked to historical sources in federal water lots, but rather would reflect municipal sources. Samples could be collected from storm sewer outflows during both dry outflow and CSO events, to confirm the presence of CECs.

4.1.10 Soil and Landform Resources

Soil sampling should be conducted prior to Project commencement to establish existing conditions. The sediment transfer process should undergo a risk analysis for potential to spill into the terrestrial environment to determine applicable mitigation measures.

4.1.11 Air Quality

Sensitive receptors in the local airshed should be identified. A desktop analysis calculating best-case and worst-case scenarios for air dustfall/dust-release and air contaminants should be completed for the DIA, as well as a desktop study of contaminant emissions from construction equipment required to execute the proposed Sediment Management Plan, comparing equipment types, scheduling, and other applicable elements. Options for implementation of control methods, or Best Management Practices, should be assessed. The dust threshold of contaminated sediment should be determined in relation to potential dispersal and its effects on human health and the environment.

4.1.12 Climate Change

A desktop study of Greenhouse Gas emissions from construction equipment and from Project-related activities should be completed for the DIA once the Conceptual SMP has undergone further refinement. Additionally, the DIA should include a review of potential carbon sinks and sensitive climate receptors.

4.1.13 Rideau Canal National Historical Site

No data gaps for specifically for the Rideau Canal National Historical Site have been identified. Engagement regarding shoreline character and the visual setting is discussed as part of the Rideau Canal UNESCO Outstanding Universal Value in **section 4.1.14**. Engagement with the local community and stakeholders regarding important cultural landscapes is discussed in **section 4.1.15**. Engagement with the local community and stakeholders regarding Navigation is discussed in **section 4.1.20**.

4.1.14 Rideau Canal UNESCO Outstanding Universal Value

Baseline assessment of shorelines/landscape character of Project Study Area, followed by a visual impact assessment of proposed changes, as part of a Cultural Heritage Impact Statement, including mitigation measures and restoration/enhancement plans. Documentation of important viewscapes/soundscapes collected from Landscape Character Assessment (Dillon, 2012) and the City of Kingston Official Plan.

4.1.15 Cultural Landscape Features

Engagement with the local community and stakeholders regarding important cultural landscape features is required, with work to be conducted to document and understand the affected cultural landscape. This may include developing a State of the Site Assessment.

4.1.16 Terrestrial Archaeological Resources

Stage 2 monitoring is recommended for potential archaeological resources [redacted]. Clearly mapped areas of known or high archaeological potential and identification of exclusion, recovery, or monitored zones will allow for a better understanding where impacts from sediment management activities may occur. Until completed, undocumented areas of high archaeological potential could be located with the KIH.

4.1.17 Submerged Archaeological Resources

A Stage 2 Marine Archaeological Assessment report with updated mapping of submerged archaeological resources and additional details on archaeological potential in KIH is currently underway. Until completed undocumented areas of high archaeological potential could be located with the KIH. Once known, areas of known or high archaeological potential should be identified and mapped as areas of exclusion, recovery, or monitoring.

4.1.18 Indigenous Interests and Rights

Potential Project interactions with Indigenous Interests and Rights cannot be assessed without Indigenous engagement and consultation, which will be conducted by TC and PCA. The engagement and consultation process is ongoing, and the DIA will include details on Indigenous interests and rights that arise from this process.

4.1.19 Tourism and Visitor Experience

Engagement with the local community and stakeholders regarding potential effects to access and use is required, with consultation to be conducted with Kingston Bylaw enforcement and PCA Visitor Safety and Prevention Coordinator.

4.1.20 Navigation

In compliance with the *Canadian Navigable Waters Act*, an assessment and approval of the Project by TC will be required. Engagement with the local nautical community and stakeholders regarding potential effects on access and use is also required.

5 Summary of Constraints

In certain cases, closure of data gaps was not sufficient to eliminate significant Project constraints for VCs, as identified in **Section 3**. Below, these constraints are summarized as applicable for each VC. Where data gaps remain, or should new information or data become available, additional constraints may arise with provision of new information. Site-specific plans and monitoring identified in the VC tables in **Section 3** are not considered to be constraints and are not listed below. They will be carried forward to the DIA.

5.1 Aquatic Wildlife and Vegetation

High quality spawning habitat for Largemouth Bass, Longnose Gar, and other forage fish species has been identified throughout the Project Site. The timing window for spawning fish is expected to present a significant Project constraint regarding aquatic wildlife, which determines when in-water work can occur, general permitted between July 1 and March 14.

5.2 Species at Risk Turtles

Without further information regarding turtle species overwintering locations within the Project Site, at minimum, turtle overwintering habitat should be protected during the overwintering period between October and April, which would place constraints on the timing of in-water works such as dredging, capping, and shoreline stabilization. If overwintering habitat is not further refined, this would include all aquatic habitat in the Inner Harbour.

Terrestrial areas abutting the Inner Harbour water lots are largely under provincial jurisdiction regarding SAR and wildlife in general. As such, turtle nesting habitat is protected in Ontario as Significant Wildlife Habitat under the Provincial Policy Statement (2020) of the *Planning Act* (R.S.O. 1990, c. P.13), which typically requires significant (30 – 100 m) setbacks from nesting areas, plus travel routes. [redacted] Nesting habitat and turtle travel corridors may present a significant constraint to terrestrial access for sediment management and shoreline stabilization.

Exclusion zones around high-quality basking habitat has been recommended as a design consideration to reduce risk; however, a significant portion of high-quality basking habitat along PC-W and PC-E would likely be protected by the City's 10 metre setback from top of bank. The threshold to protect high-quality basking sites during critical follicular development periods presents a timing window constraint on in-water and shoreline work.

5.3 Species at Risk Birds

While the Barn Swallow nesting structure has not demonstrated signs of use by Barn Swallow (as of 2022), it is recommended to be treated as an active site with a 5-metre buffer established around the structure to maintain site conditions. This may place constraints on shoreline stabilization and vegetation removal in that area of the WM management unit.

[redacted] Should this occur, a 500-metre setback within suitable habitat would be required from the origin of observation.

5.4 Species at Risk Bats

Species at Risk Bats are known to occur in KIH. While no maternity roosting habitat has been identified during field investigations by SNC-Lavalin (2023) [redacted], there is potential for Species at Risk Bats to establish maternity roosting habitat in suitable trees of the Project Impact Area. The timing window for SAR bats is expected to present a significant Project constraint, which determines when vegetation can be removed, generally permitted between October 1 and March 31.

5.5 Terrestrial Wildlife

The timing window for migratory birds is expected to present a significant Project constraint regarding wildlife, which determines when vegetation can be removed, generally permitted between September 1 and March 31.

While reptile hibernacula are protected in Ontario as Significant Wildlife Habitat under the Provincial Policy Statement (2020) of the *Planning Act* (R.S.O. 1990, c. P.13), [redacted] Habitat features such as this are rare and have not been detected elsewhere during field investigations (SNC-Lavalin, 2023). Snakes typically exhibit high fidelity to overwintering habitat and the loss of a hibernaculum can be detrimental to the local population that uses the feature. It is recommended that efforts be made to protect the overwintering habitat feature from alteration, which would require shoreline stabilization design considerations to be made in proximity of the feature, or to compensate any predicted changes to the feature by installing artificial overwintering habitat nearby prior to commencement of sediment management activities.

The timing window for non-SAR bats is expected to present a significant Project constraint regarding wildlife, which determines when vegetation can be removed, generally permitted between October 1 and March 31.

5.6 Terrestrial Vegetation

Terrestrial vegetation removal may be constrained by timing windows due to terrestrial wildlife, birds, and bats (refer to **subsections 5.3, 5.4** and **5.5**).

5.7 Surface Water Quality

According to WSP (formerly Golder) (**Appendix B**), it is expected that the EPOs will be approximately:

- 25 mg/L above background to 75 mg/L irrespective of background at the POD (Compliance Point)
- 5 mg/L above background within the Receiving Environment (Assessment Point)

Even if EPOs deviate from the above approximations, there are known methods for engineering design, operational controls, and contingency measures that should mitigate risks while still allowing for flexibility in design within each management unit. Additional Project constraints may be identified once the data gaps identified in **subsection 4.1.7** are addressed.

5.8 Lacustrine Processes

WSP's (formerly Golder) Lacustrine Processes memorandum, in **Appendix C**, listed the following lacustrine process constraints pertaining to project activities:

- Ship mooring infrastructure and geotechnical constraints in some management units (e.g., TC_AB) could be a constraint to the dredging activities and would limit the proximity of dredging to the margins of the management unit and/or necessitate slopes to dredge cuts that reduce the volumes of sediment that can be safely excavated.
- Existing shoreline elements in some areas include large diameter materials used to armour shorelines and provide bank stability. Nature-based shorelines can provide creative solutions to isolate the sediments and stabilize the shoreline from present or future erosion. However, as these shoreline elements would require modifications to shorelines owned by the City of Kingston, agreements would be required to preserve shoreline features that accommodate geotechnical, contamination, recreational, and ecological/biological objectives for the shorelines.
- The existing bathymetry within the enclosed portion of Anglin Bay is assumed to be satisfactory for the long-term operation of the bay as both a recreational and industrial resource. If required, any future maintenance dredging of the bay should avoid significant disruption of the proposed capping.
- The time lag between dredging, capping and re-establishment of sub-aquatic vegetation (whether planted or through natural recolonization of substrate) may constrain sediment cap performance criteria; cap design and riverbed substrate needs to be resilient to erosion without SAV present in post project condition. In addition, surface sediment substrate type needs to be amenable to plant community recolonization.
- Ice thickness and movement may be a key design consideration for shallow water capping and shore protection design in addition to, or over and above wave action. Site-specific ice thickness and mobility information should be developed using synthetic methods (such as modelling) and any observational data that may be available.

5.9 Sediment Quality

The Sediment Quality memorandum prepared by WSP (formerly Golder) (**Appendix D**), listed the following design related constraints:

WSP did not identify any design-related constraints beyond those already discussed in **subsection 4.1.9** that would result in outright failure of the broad remediation objectives specified in Section 1.2 of **Appendix D**. There are known methods for engineering design, operational controls, and contingency measures that should mitigate risks while still allowing for flexibility in design within each management unit. However, there are some factors beyond the exclusive control of the federal government that may influence the timing, details, or effectiveness of the remedial design(s). These include:

- **Geotechnical considerations**—Some portions of the shoreline, most notably along the southern shoreline of Anglin Bay, have highly engineered features, including vertical walls and steep banks. In these areas, it is not possible to dredge to the wall; design rather requires a slope to maintain structural integrity of the shoreline.

- **Navigation and mechanical disturbance of sediment in Anglin Bay**—The design of the dredging program for Anglin Bay must allow for sufficient navigational draft for watercraft, including not only small vessels, but also larger vessels destined for the shipyard. The dredge prism and depth of post-dredge cap material must provide room for navigational draft and afford protection against prop scour.

- **Property redevelopment in brownfield**—There are small areas of shoreline sediment that are owned by a private property developer, and although such areas would ideally be co-managed for consistency and efficiency, such cannot be guaranteed at this stage of the project, particularly given uncertainty regarding the approvals, timing, and design features for potential brownfield redevelopment. This constrains the design options for management unit TC-OM.

- **Municipal shoreline areas**—There are small areas of shoreline sediment adjacent to Woolen Mill (near Molly Brant Point) and along the shore of Douglas Fluhrer Park that are owned by the

City of Kingston. Although preliminary discussions have been held between federal and municipal land managers, with opportunities identified for synergy and co-operative management, uncertainty remains in the degree of collaboration and design of shoreline features that overlap property boundaries.

- **Permitting for Provincially Significant Wetland (PSW)**—The management of the cattail marsh and other wetland types at the mouth of the creek discharging from the Orchard Street Marsh is complex. Multiple parties own and manage properties adjacent to or within the wetland areas that have been designated as PSW habitats. The requirement for permits and agreements among various regulators, site owners, and other stakeholders is more onerous than for other parts of the KIH shoreline.
- **Linkage to Off-Site Sediment Management**—There are other areas of contaminated sediment in downtown Kingston (e.g., near or south of the LaSalle Causeway) for which contaminant profiles resemble portions of KIH. For substances that could be managed on a regional scale, such as PAHs in shoreline sediments, it may be advisable to combine management of KIH sediments with adjacent parcels.

Additional Project constraints may be identified once the data gaps identified in **subsection 4.1.9** are addressed.

5.10 Soil and Landform Resources

There were no Project constraints identified for Soil and Landform Resources.

5.11 Air Quality

Air quality impacts are expected to be limited with proper implementation of BMPs. A protocol for investigating and responding to complaints related to air quality impacts of project works should be established.

5.12 Climate Change

Any sensitive climate receptors determined during the DIA process should be protected. The dredging program should incorporate elements that aid in resiliency of identified sensitive elements.

5.13 Rideau Canal National Historic Site

Currently no Project constraints have been identified for Rideau Canal National Historic Site; however, constraints may arise from an assessment of the landscape character and proposed changes.

5.14 Rideau Canal UNESCO Outstanding Universal Value

Currently no Project constraints have been identified for Rideau Canal UNESCO Outstanding Universal Value; however, constraints may arise from an assessment of the landscape character and proposed changes.

5.15 Cultural Landscape Features

Currently no Project constraints have been identified for Cultural Landscape Features; however, constraints may arise from the public engagement process.

5.16 Terrestrial Archaeological Resources

Currently no Project constraints have been identified for Terrestrial Archeological Resources; however, pending the results of the Stage 2 monitoring for potential archaeological resources, exclusion, recovery or monitoring zones around archeological resources may be put in place.

5.17 Submerged Archaeological Resources

Marine areas of known or high archaeological potential are likely to result in the creation of an exclusion, recovery or monitoring zones where dredge work will be limited or completely excluded. Alternative dredging methods may also need to be considered.

5.18 Indigenous Interests and Rights

Potential Project interactions with Indigenous Interests and Rights cannot be assessed without the completion of Indigenous engagement and consultation, which will be conducted by TC and PCA. It is currently unknown what Project constraints may arise from the process resulting from the information and knowledge to be documented.

5.19 Tourism and Visitor Experience

Currently no Project constraints have been identified for Tourism and Visitor Experience; however, constraints may arise from the public engagement process.

5.20 Navigation

Design constraints related to maintaining access to the marina and access to the boat launch will need to be considered and additional constraints may be identified during the public engagement process.

6 Closure

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APPENDIX A

List of Proven Mitigation Measures, Best Management Practices, Guidelines and Standards

Appendix A: **Proven Mitigation Measures, Best Management Practices, Guidelines and Standards**

#	Document Title	Source
1	Ontario Waterways Environmental Standards and Guidelines Document, Part 2. 2017. Parks Canada.	https://buyandsell.gc.ca/cds/public/2019/08/29/6c12d43844068e47eab71d9d99e6b88/209.40404.01_esg_-_ontario_waterways_july_2017.pdf
2	Parks Canada National Best Management Practices: Works In and Around Waterbodies. 2017. Parks Canada.	https://buyandsell.gc.ca/cds/public/2018/05/30/b251fef54705e09fd611687456767e6e/app_a-works_in_and_around_waterbodies_bmp-draft_april_04.pdf
3	Evaluating Construction Activities Impacting on Water Resources Part III B: Handbook for Dredging. 2011. Ontario Ministry of the Environment.	https://www.ontario.ca/page/evaluating-construction-activities-impacting-water-resources-part-iii-b-handbook-dredging
4	Erosion and Sediment Control Guide for Urban Construction. 2019. Toronto and Region Conservation Authority.	https://s3-ca-central-1.amazonaws.com/trcaca/app/uploads/2020/01/30145157/ESC-Guide-for-Urban-Construction_FINAL.pdf
5	General Specification for Environmental Protection for Construction in and Around Waterbodies and on Waterbody Banks. 2021. Ontario Provincial Standard Specification.	https://www.roadauthority.com/Standards/Home/FileDownload?standardFileId=12eae353-fd7f-41b3-824c-65e458a54ac4
6	Construction Specification for Temporary Sediment Control. 2020. Ontario Provincial Standard Specification.	https://www.roadauthority.com/Standards/Home/FileDownload?standardFileId=25122ede-3b99-4117-a65e-785383e953fc
7	Management of Excess Soil – A Guide for Best Management Practices. Published 2016. Ontario Ministry of the Environment, Conservation and Parks	https://www.ontario.ca/page/management-excess-soil-guide-best-management-practices
8	Construction Specification for Temporary Erosion Control. 2021. Ontario Provincial Standard Specification.	https://www.roadauthority.com/Standards/Home/FileDownload?standardFileId=654ccb07-6605-4390-a413-37df0085097c
9	Technical Bulletin: Management Approaches for Industrial Fugitive Dust Sources. 2017. Ontario Ministry of Environment, Conservation and Parks.	https://www.ontario.ca/page/technical-bulletin-management-approaches-industrial-fugitive-dust-sources
10	Best Practices and Resources on Climate Resilient Natural Infrastructure. 2018. Prepared for Canadian Council of Ministers of the Environment.	https://ccme.ca/en/res/natural_infrastructure_report_en.pdf
11	Significant Wildlife Habitat Mitigation Support Tool, Version 2014. Ontario Ministry of Natural Resources and Forestry.	https://dr6j45jk9xcmk.cloudfront.net/documents/4773/mnr-swhmist-accessible-2015-03-10.pdf
12	Ontario Breeding Bird Atlas-3 Breeding Season/Safe Date Guide. 2021. Birds Canada.	https://www.birdsontario.org/wp-content/uploads/Atlas-3-Safe-Dates-English-chronological-2021-04-03.pdf
13	Nesting calendars in zone C3, technical information for planning purposes covering Lower Great Lakes/St. Lawrence Plain (Bird Conservation Region 13). 2018. Environment and Climate Change Canada.	https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/general-nesting-periods/nesting-periods.html
14	Bats in Buildings: A Guide to Safe and Humane Exclusions. 2011. Bat Conservation International.	http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_bat_exclu_enfr.pdf

#	Document Title	Source
15	Protocol for Wildlife Protection during Construction. 2015. City of Ottawa.	https://documents.ottawa.ca/sites/documents/files/documents/construction_en.pdf
16	Ontario Species at Risk Handling Manual: For Endangered Species Act Authorization Holders. 2011. Ontario Ministry of Natural Resources.	http://files.ontario.ca/environment-and-energy/species-at-risk/mnr_sar_tx_sar_hnd_mnl_en.pdf
17	Guidelines to Reduce Risk to Migratory Birds. 2021. Environment and Climate Change Canada.	https://www.canada.ca/en/environment-climate-change/services/avoiding-harm-migratory-birds/reduce-risk-migratory-birds.html
18	Barn Swallow General Habitat Description. 2018. Ontario Ministry of the Environment, Conservation and Parks.	https://www.ontario.ca/page/barn-swallow-general-habitat-description#section-0
19	Ontario Invasive Plant Council Best Management Practices Series.	https://www.ontarioinvasiveplants.ca/resources/best-management-practices/
20	Construction Specification for Vegetative Cover. 2020. Ontario Provincial Standard Specification.	https://www.roadauthority.com/Standards/Home/FileDownload?standardFileId=b3f0af3e-6384-42cc-b671-adb01cb31212
21	Vegetation Removal and Restoration/Reclamation Guidelines. 2018. Parks Canada.	https://buyandsell.gc.ca/cds/public/2018/12/13/3055eca4db59f07b14739714557142b8/annex_4-vegetation_removal_reclamation_guidelines_draft_29082018_en.pdf
22	In-water Work Timing Window Guidelines. 2013. Ontario Ministry of Natural Resources.	https://docs.ontario.ca/documents/2579/stdprod-109170.pdf
23	Invasive Phragmites – Best Management Practices. 2011. Ontario Ministry of Natural Resources.	https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Phragmites_BMP_FINAL.pdf
24	Clean Equipment Protocol for Industry. 2013. Peterborough Stewardship Council and Ontario Invasive Plant Council.	https://www.ontarioinvasiveplants.ca/wp-content/uploads/2016/07/Clean-Equipment-Protocol_June2016_D3_WEB-1.pdf
25	Best Management Practices for Mitigating the Effects of Roads on Amphibian and Reptile Species at Risk in Ontario. 2016. Ontario Ministry of Natural Resources and Forestry.	https://files.ontario.ca/bmp_herp_2016_final_final_resized.pdf
26	Reptile and Amphibian Exclusion Fencing: Best Practices. Published 2020. Ontario Ministry of the Environment, Conservation and Parks.	https://www.ontario.ca/page/reptile-and-amphibian-exclusion-fencing
27	Best Management Practices for Excluding Barn Swallows and Chimney Swifts from Buildings and Structures. 2017. Ontario Ministry of Natural Resources and Forestry.	https://files.ontario.ca/barschswbmpenpdffinalv.1.017ja241.pdf
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29	Habitat Management Guidelines for Bats in Ontario. 1984. Ontario Ministry of Natural Resources.	https://dr6j45jk9xcmk.cloudfront.net/documents/2790/guide-bats.pdf

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32	Parks Canada National Best Management Practices: Trail Maintenance and Modification. 2016. Parks Canada.	https://buyandsell.gc.ca/cds/public/2017/05/04/e3c17bf78a8937721363a5d4c20c0f9f/pca_-_trailsbmp.pdf
33	Environmental Noise Guideline – Stationary and Transportation Sources – Approval and Planning. 2013. Ontario Ministry of the Environment and Climate Change.	https://www.ontario.ca/page/environmental-noise-guideline-stationary-and-transportation-sources-approval-and-planning
34	Canadian Guidelines for Outdoor Lighting (Low-impact Lighting) for Dark-Sky Protection Programs.	https://csbg.ca/articles/CGOL.PDF
35	Technical Guidance for Assessment and Mitigation of the Effects of Traffic Noise and Road Construction Noise on Bats. 2016. California Department of Transportation.	https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/noise-effects-on-bats-jul2016-a11y.pdf
36	Recovery Strategy for the Least Bittern (Ixobrychus exilis) in Canada. Species at Risk Act Recovery Strategy Series. 2014. Environment Canada.	https://www.ontario.ca/page/recovery-strategy-least-bittern
37	Rehabilitation and Enhancement of Aquatic Habitat Guide. V1.0. Fisheries and Oceans Canada.	https://sustainabletechnologies.ca/app/uploads/2016/05/Rehabilitation-Guide-1.0.pdf
38	Fish Habitat Enhancement Toolkit: In-water Brush Piles (woody debris) Enhancement. Lanark County Stewardship Council & Watersheds Canada.	https://watersheds.ca/wp-content/uploads/2021/03/In-water-Structures-Brush-Protocols.pdf
39	Commonly Applied Construction Noise Mitigation Measures and Considerations for Noise Reduction. Government of British Columbia. Adapted from New South Wales Construction Noise Guideline (August 2008 draft for consultation), Department of Environment and Climate Change, New South Wales, Australia.	https://projects.eao.gov.bc.ca/api/document/5887e0f2f64627133ae5b28e/fetch#:~:text=Maximize%20Shielding&text=Use%20full%20enclosures%2C%20such%20as,barriers%20as%20early%20as%20possible.
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41	PROMISING PATHWAYS: strengthening engagement and relationships with Aboriginal peoples in Parks Canada heritage places. Parks Canada.	https://www.pc.gc.ca/en/agence-agency/aa-ia/parcours-pathways
42	World Heritage Cultural Landscapes. A Handbook for Conservation and Management. UNESCO	https://unesdoc.unesco.org/ark:/48223/pf0000187044
43	A Handbook for Managers of Cultural Landscapes with Natural Resource Values. Conservation and Stewardship Publication No. 5. Conservation Study Institute.	https://www.nps.gov/orgs/1412/upload/handbook-508.pdf

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44	Parks Canada Guidelines for the Management of Archaeological Resources. Parks Canada	https://www.pc.gc.ca/en/docs/pc/guide/gra-mar/~/media/FC605DCDBC2744E29F6AE6AFEC892417.ashx
45	Underwater Archaeology: The NAS Guide to Principles and Practice	https://www.nauticalarchaeologysociety.org/underwater-archaeology-the-nas-guide
46	City Of Kingston Ontario By-Law Number 2004-52, A By-Law to Regulate Noise	https://www.cityofkingston.ca/documents/10180/16904/Noise+Bylaw/015b9303-2db7-4e26-8b03-4c17ba1e59cb
47	Archaeological Damage from Offshore Dredging: Recommendations for Pre-Operational Surveys and Mitigation During Dredging to Avoid Adverse Impacts	https://www.boem.gov/sites/default/files/mm-research/2022-03/2004-005.pdf
48	Technical Bulletin: management approaches for industrial fugitive dust sources	https://www.ontario.ca/page/technical-bulletin-management-approaches-industrial-fugitive-dust-sources

APPENDIX B

Conceptual Constraints and Impact Considerations – Water Quality (WSP, 2023)

TECHNICAL MEMORANDUM

DATE 02 February 2023 **Reference No.** 22523199-006-TM-Rev0

TO [redacted]
Public Services and Procurement Canada

CC

FROM Gary Lawrence **EMAIL** [redacted]

CONCEPTUAL CONSTRAINTS AND IMPACT CONSIDERATIONS – WATER QUALITY

1.0 INTRODUCTION

Golder Associated Ltd (amalgamated under WSP Canada Inc. in January 2023), was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) and Parks Canada Agency (PCA) to identify conceptual constraints and impact considerations related to water quality for the proposed Sediment Management Project (the Project) at the Kingston Inner Harbour (KIH) in Kingston, Ontario (the Site). The memo was completed to support the water quality component of the Conceptual Constraints and Impact Considerations (CCIC) document for the Project being completed by SNC-Lavalin Inc. (SNC-Lavalin). The CCIC is intended to support a Detailed Impact Assessment (DIA) by providing preliminary, high-level considerations of potential Project impacts based on information gathered to date. The CCIC provides early identification of remaining information gaps and additional works required to address the information gaps, and identifies any Project constraints that are known at this time (SNC-Lavalin 2022).

The KIH is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island to the north and includes an approximate 1.7-kilometre (km) length of the Great Cataraqui River. TC is responsible for the management of most sediment areas in the southern section of the KIH (i.e., south of Belle Island). PCA is responsible for sediments in the portion of the KIH immediately north and southwest of Belle Island. A small percentage of the southern half of KIH is owned by other parties, including a square water lot adjacent to the former Woolen Mill, small areas of foreshore near the Kingston Marina, and a Military Reserve in the southeastern corner of KIH. The KIH study area is divided into management units that reflect the risk potential from sediment contamination (Figure 1).

The primary contaminants of concern (COCs) in sediment include chromium, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs); these COCs are the risk drivers for chemical management within the KIH. The Project is currently in the conceptual stages, but is expected to include remediation of the bedded sediments in areas of the KIH with the highest concentration of primary COCs. Other elevated COCs in the proposed remedial areas include antimony, arsenic, lead, mercury, silver, and zinc (Golder 2017).

Based on historical assessments, the Great Cataraqui River is considered a eutrophic and alkaline system with generally good water quality that meets most provincial and federal water quality criteria (ESG 2014). The high flushing rate of water through the river system has contributed to the favourable water quality because the current promotes the dilution of contaminants within surface water. Historical (legacy) sources, rather than ongoing sources, are primarily responsible for the sediment contamination within KIH (Golder 2013). The City of Kingston also has implemented several source control measures and environmental programs to reduce ongoing inputs of contaminants from the shoreline into the KIH. Studies have shown that the contaminant inputs are generally associated with particulates rather than the aqueous and dissolved phases (ESG 2014 and Malroz 2021). The primary sources of elevated COCs within surface water will likely be the result of sediment resuspension or sediment loadings from surface water run-off events, rather than chemical diffusion into the water column. Therefore, provided that source control measures are maintained from surrounding runoff sources, and water quality is managed during Project activities, acceptable conditions of water quality are expected to be maintained during and after the Project. However, pre-construction water quality sampling will be required to enable verification.

Based on the information available to date, the overall goal for water quality management during the Project is to maintain current conditions of water quality. It is not necessary to make quantifiable improvements to water quality post-remediation but rather to 1) limit and/or minimize potential environmental effects from sediment disruption caused by in-water works, and 2) confirm that sediment resuspension does not deteriorate surface water quality relative to existing (or baseline) conditions in KIH.

The sediment remediation components of the Project will involve in-water works, such as dredging and capping material placement, that will temporarily result in the re-suspension of particulate-bound contaminants into the KIH. As such, water quality management is needed during remediation to protect aquatic life from direct toxicity associated with COCs that may be released into suspension (and potentially desorb into solution) as sediments are disturbed, as well as to protect aquatic life from any physical effects associated with the suspended sediments themselves. Managing unacceptable exposures within the water column during remediation will be accomplished through Environmental Performance Objectives (EPOs). EPOs are defined as numerical objectives for water quality that can be applied during remediation to provide suitable protection of the environment, while also providing ability to meet the broader remediation objectives for sediment. During in-water works, the EPOs should act as trigger-levels that can be easily monitored to confirm environmental controls are working, inform the need for mitigation measures as needed, and thereby prevent potential environmental effects from surface water exposures before they occur.

The primary regulatory drivers for establishing EPOs are related to Section 36 of the *Fisheries Act* (Canada 1985 and amendments) and provincial statutes such as the Ontario *Environmental Protection Act* and *Water Resources Act* (Ontario 1990a,b and amendments). These acts have a shared goal of preventing the discharge of “contaminants” or “pollutants” into the natural environment that may cause an “adverse effect”, which includes impairment of the natural environment, injury to plants or animals, or harm to people. Under federal jurisdictions, the Canadian Council of Ministers of the Environment (CCME) Water Quality Guidelines (WQGs) for the Protection of Freshwater Aquatic Life (CCME 1999/2022) can provide a starting point for evaluating the potential for adverse effects. The Provincial Water Quality Objectives (PWQOs) are applicable to areas under Ontario jurisdictions (Ontario 2016). However, these criteria are generic and conservative concentrations that are best used as a screening tool to identify COCs that may require further assessment. Recent federal guidance has recognized that there are ongoing diffuse inputs from anthropogenic sources into harbours and emphasizes comparisons to local harbour ambient background (Canada 2021). Given the association of contaminants with bedded sediments and the diffuse inputs of contaminants from the urban and agricultural activities in the surrounding area, it is expected that management of total suspended solid (TSS) concentrations, specifically with respect to changes above baseline (or existing) conditions, can form the basis of the EPOs during active works. Post-remediation, it is expected that the Project success related to water quality can be evaluated based on the ambient water quality criteria (e.g., PWQOs or CCME WQGs) and the pre-remediation baseline concentrations.

To address any conceptual constraints and impact considerations related to surface water quality prior to, during, and after the Project, the following information is presented in this memo:

- **Existing Conditions (Section 2.0)** – Summarizes the available information related to the existing water quality within the KIH, as well as reference conditions (Section 2.1). The cause of any elevated parameters previously identified within the KIH is also evaluated (Section 2.2), along with source control measures that have been implemented to minimize inputs of COCs along the KIH (Section 2.3). Overall, this section evaluates whether water quality data within KIH are sufficient to provide a baseline against which changes during and after in-water works can be compared to, and if terrestrial sources of COCs have been effectively controlled to prevent re-contamination into the KIH.

- **Potential Environmental Effects (Section 3.0) –** Provides an overview of the potential environmental effects that may result if water quality is not managed during the Project. Data gaps related to the current understanding of surface water quality within the KIH are identified; these will need to be addressed to establish baseline conditions and EPOs (Section 3.1). An overview of the approach used to establish EPOs is also provided (Section 3.2). Finally, the findings are summarized with respect to preliminary considerations of potential impacts to water quality from the Project (i.e., the Valued Components), the desired outcomes, thresholds for meeting the desired outcomes, potential design considerations to reduce risk, and additional works required to resolve information gaps (Section 3.3). It is expected that these summary findings will be incorporated in an updated version of the CCIC document.

- **Summary of Constraints (Section 4.0) –** Identifies any known Project constraints based on the conceptual design that may impact surface water quality and cause potential environmental effects if not accounted for. These Project constraints will be used to inform the detailed design.

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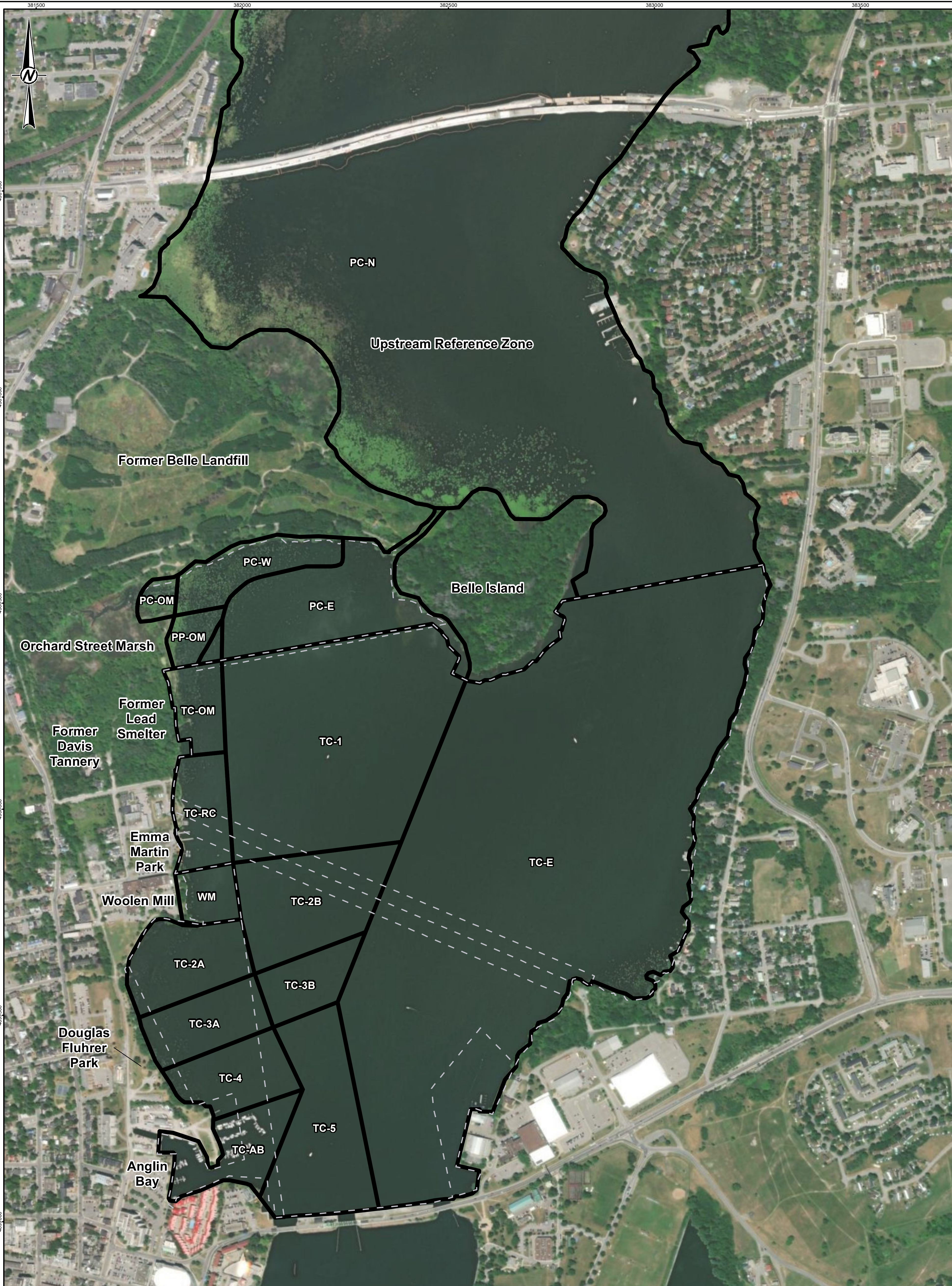

LEGEND

FEDERAL WATER LOT BOUNDARY

MANAGEMENT UNIT

0 200 400

1:9,000 METERS

REFERENCES

1. IMAGERY COPYRIGHT © 20220711 ESRI AND ITS LICENSORS. SOURCE: MAXAR. USED UNDER LICENSE, ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT

PSPC

PROJECT

KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE

SPATIAL DOMAIN OF KIH STUDY AREA AND MANAGEMENT UNITS

CONSULTANT

WSP GOLDER

YYYY-MM-DD	2022-12-08
DESIGNED	LF
PREPARED	JP
REVIEWED	
APPROVED	

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2.0 EXISTING CONDITIONS

Understanding existing water quality conditions within the KIH is important for providing confidence that the Project does not result in the release of contaminants above baseline conditions. Guidance for managing federal aquatic contaminated sites in working harbours has recently been published to provide guidance to federal custodians of FCSAP sites in urban or multi-source environments (Canada 2021). The FCSAP *Guidance for Working Harbours* recognizes that there are ongoing diffuse inputs from anthropogenic sources into harbours. The guidance acknowledges that the comparison of contaminant concentrations to pristine natural background conditions is not appropriate for working harbour sites, and instead emphasizes comparisons to local harbour ambient background (i.e., baseline). Therefore, the available data within and upstream of the KIH were reviewed to identify potential data gaps with respect to establishing baseline conditions, against which any changes following the implementation of the Project can be compared (Section 2.1).

Another important prerequisite to remedial planning is to provide confidence that ongoing sources of contamination are appropriately controlled to achieve acceptable protection levels before taking remedial action involving physical works (Canada 2021). Therefore, the environmental controls put in place to prevent additional contaminant inputs along the KIH were also reviewed (Section 2.2).

2.1 Current Water Quality Profiles

The Environmental Services Group at the Royal Military College (ESG 2014) provides a detailed review of historical surface water quality studies for areas near KIH undertaken between 1971 to 2010. Their assessment relied on surface water quality data collected from 2003 to 2010, as summarized in Table 1. The surface water quality data collected since 2003 reflects water quality conditions following the implementation of several source control measures to reduce contaminant inputs from the Belle Island Landfill (further discussed in Section 2.3). Based on these studies, it was concluded that the Great Cataraqui River is a eutrophic and alkaline system, with generally good water quality that, with few exceptions, met the provincial and federal water quality criteria (ESG 2014).

WSP Golder re-screened the data relied upon by ESG against current water quality criteria, including the Ontario PWQOs (Ontario 2016) and the CCME WQGs for the Protection of Aquatic Life (1999/2022). The updated screening indicated that chromium, copper, lead, zinc, PCBs, and several PAHs exceeded the current water quality criteria. Federal Environmental Quality Guidelines (FEQGs) have recently been established for chromium, copper, lead, and zinc that are based on recent scientific evaluations and allow for water quality parameters that influence bioavailability to be considered for the derivation of site-specific water quality guidelines. However, site-specific water quality parameters necessary to derive FEQGs, including pH, temperature, hardness, and dissolved organic carbon (DOC) were not reported by ESG (2014) and therefore the FEQGs were not further considered. The exclusion of these toxicity modifying factors means that generic (and conservative) guidelines were relied upon for screening, potentially screening through substances that would otherwise be eliminated with updated and/or site-specific guidelines.

Table 1: Summary of Water Quality Data for the Kingston Inner Harbour (ESG 2014)

Study	Surface Water Sampling Locations	Parameters Assessed	Results
■ ESG (2003) ■ Sampling completed in 2002	■ Two locations in KIH (upstream and downstream of Belle Park Landfill) ■ Two locations in Outer Harbour (Fort Frontenac water lot and near Wolfe Island Ferry Dock)	■ Inorganic elements (total) ■ PAHs ■ PCBs	■ Concentrations were mostly below analytical detection limits ■ ESG concluded that copper was marginally above generic criteria at an upstream site. ■ Copper and zinc exceed generic criteria at the upstream site
■ Tinney (2006) ■ Sampling completed in 2004 and 2005	■ 13 locations across KIH across seasons (November, June, September), including three reference locations	■ Conventional water quality parameters ■ PCBs ■ PAHs ■ Inorganic elements (total)	■ Alkaline waters at all locations with elevated conductivities ■ Eutrophic waters at all locations, but nutrient concentrations were below PWQOs and CCME WQGs ■ PAHs and PCBs were below analytical detection limits; however, detection limits applied were high and above PWQOs. ■ Based on Tinney (2006) data, ESG concluded that inorganics exceeded generic criteria for aluminum (seven locations), iron (three locations), and chromium (one location) within the KIH ■ Chromium and copper remain above generic criteria within the KIH locations, and were not detected in reference locations.
■ Benoit and Burniston (2010) ■ Sampling completed in 2006	■ Seven stations in the southwest portion of KIH south of Belle Park, and one reference location	■ PCBs ■ PAHs ■ Inorganic elements (total) ■ TSS ■ Organochloride pesticides	■ Based on Benoit and Burniston (2010) data, ESG concluded that most chemicals were present in trace quantities or below analytical detection limits and PWQOs/CCME WQGs. Elevated concentrations correlated with TSS, suggesting chemicals were primarily bound to particulates. Elevated PCBs in one sample near Belle Island Landfill was not correlated with TSS and may indicate a nearby input. ■ Chromium, copper, lead, zinc, PCBs, and PAHs exceed generic criteria within the KIH and reference locations, but only total chromium, zinc, and PCB concentrations were greater within the KIH relative to reference.

Study	Surface Water Sampling Locations	Parameters Assessed	Results
▪ ESG (2009) ▪ Sampling completed in 2009	▪ Eight locations in KIH, and two reference stations	▪ Total and dissolved metals (Cu, Pb, Zn, Cr, As)	▪ Total concentrations of chromium, copper, lead, and zinc exceed generic criteria in KIH locations, concentrations within reference locations were below analytical detection limits. Based on e-mail correspondence with ESG on 12 December 2022, the samples were collected as part of a larger study to investigate potential transport of contaminants from the Davis Tannery property into the river, with emphasis on high flow conditions. The study targeted storm events and spring meltwater runoff periods, and sampling locations were selected to be within drainage channels from the site and in areas downstream of the Kingscourt storm sewer. Therefore, ESG concluded that the elevated total concentrations likely reflect transient conditions of elevated TSS in the water column due to erosion and surface water runoff during storm events. ▪ Dissolved concentrations of copper and zinc remain above generic criteria; however, these criteria are conservative. The recent FEQGs (Canada 2022) could not be applied as there was no site-specific information on hardness, pH, DOC, and temperature required to derive site-specific guidelines.

A recent study examined the water quality in Anglin Bay located within the southern portion of the KIH (ESG 2017). One surface water sample was collected at the mouth of Anglin Bay and analyzed for inorganic elements, PCBs, PAHs, petroleum hydrocarbons (PHCs), benzene, toluene, ethylbenzene, and xylenes (BTEX), tributyltin (TBT), and TSS. PCBs, PAHs, PHCs, BTEX, and TBT were below the analytical detection limits. No inorganic parameters in these data exceeded the CCME WQGs or the PWQOs.

The City of Kingston was contacted to see if they had any additional surface water quality data available from the past 10 years (personal correspondence with Paul MacLatchy on 30 November 2022). The City of Kingston informed WSP Golder of studies completed by Malroz Engineering Inc. (Malroz 2021) and Kiewit (2020 and 2021), which are summarized below.

Semi-annual surface water sampling is undertaken in the KIH as part of the Belle Park Landfill monitoring program (Malroz 2021). The sampling locations include a reference location upstream of the landfill and three locations within the KIH. The surface water samples are analyzed for conventional water quality parameters and metals (cadmium, cobalt, copper, iron, lead, zinc). The surface water quality data from the most recent sampling program were screened against current PWQOs and CCME WQGs. Concentrations of copper, and zinc exceeded the water quality criteria at the reference site and within the KIH. The concentrations were higher within the surface water samples collected within the KIH, but were correlated with higher TSS as a result of sediment disturbance. Nitrate and nitrite also exceeded the CCME WQGs at the reference site and within the KIH; however, the concentrations were comparable to background conditions (Malroz 2021).

Ambient Cataraqui River surface water quality data were recently collected as part of the Kingston Third Crossing Project located north of Belle Park (Kiewit 2020 and 2021). These activities were undertaken in a portion of the Cataraqui River previously identified by both RMC-ESG (2014) and Golder (2017) as being representative of local reference conditions. In-situ monitors were used to measure dissolved oxygen, turbidity, pH, temperature, and conductivity 150 m upstream and 150 to 200 m downstream of the project during in-water works (defined as background levels). The cumulative 30-day background levels for turbidity ranged from 0.48 nephelometric turbidity unit (NTU) (June to July) to 5.34 NTU (November to December) in 2020. In 2021, the cumulative 30-day background levels ranged from 0.81 NTU (June to July) to 12.91 NTU (August to September)[1]. As part of the project, a site-specific TSS:turbidity relationship (i.e., regression) was derived to define site-specific NTU thresholds for monitoring that equated to the CCME WQGs for TSS (Kiewit 2020 and 2021).

The closest surface water quality data available from the Ontario Provincial (Stream) Water Quality Monitoring Network (PWQMN) is the Kingston Mills station (#12000400202), located approximately 5.5 km upstream of the KIH. However, this location may be too distant from the Site to be able to establish local reference conditions as it does not account for the diffuse contaminant inputs from the urban areas of Kingston. It also may have different hydrological conditions from the area south of the Great Cataraqui Marsh.

2.2 Causation

The historical water quality data presented in Section 2.1 indicate that concentrations of nitrate, nitrite, chromium, copper, lead, zinc, PCBs, and PAHs have historically exceeded the CCME WQGs and/or PWQOs, and that chromium, copper, lead, zinc, PCBs, and PAHs have been elevated within the KIH relative to upstream reference conditions. The specific sources of the elevated parameters are often uncertain, although several of these constituents are known to be associated with legacy sources of soil and sediment contamination in KIH:

- Lead and Zinc—Historically, there were two major smelting operations east of Orchard Street along KIH, including Frontenac Smelting Works, a lead smelter that ceased operations in 1916. These smelters used nearby railway sidings and the nearby waterfront, and discharged waste into the harbour. The signature of metals contamination remains from these sources, although it has been dispersed widely across the harbour, rather than concentrated in localized areas.
- Chromium—Over a century of tannery activities were conducted in the Davis Tannery lands beside the Orchard Street Marsh. Although the tannery closed in the 1970s, the proximity to the marsh, which was used for discharge of waste until 1974, has left a clear profile of chromium contamination in sediment.
- PCBs—Project Trackdown (Benoit et al. 2016) is an investigative environmental program aimed at tracking sources of PCB contamination in Great Lakes tributaries, and has included the Cataraqui River and KIH as one of three tributaries to Lake Ontario. The program applied a multi-media weight of evidence approach for identifying sources of PCBs to the environment. In KIH, the source of PCB contamination was identified to be localized “hot spots” in inner harbour sediments, particularly along the western shoreline adjacent to commercial and historical industrial activity. Some localized remediation was undertaken in these areas, although other areas of elevated PCBs remain in western KIH.

[1] During the Kiewit 2021 study, Sondes may have been interacting with bottom sediments in low water/wavy conditions during August/September and the 12.91 NTU measurement may not be representative due to data interference.

- PAHs—PAHs are a ubiquitous group of substances in urban areas, but there are localized areas of elevated PAHs in portions of KIH. The areas of highest contamination tend to be in shoreline areas, adjacent to historical deposits of leachate and coal gasification byproducts:
  - North KIH—Shoreline deposits of elevated PAHs are observed adjacent to the former municipal landfill on Belle Park (Golder 2017, 2022). Although municipal source control actions have reduced inputs from legacy sources, the historical deposits remain in near shore sediment.
  - South KIH—Kingston's coal gasification plant operated within the downtown area of Kingston from the mid 1800s through to the 1950s. This plant processed coal to produce coal gas, and by-product of the coal gasification process was coal tar. Historical discharges (prior to municipal remediation of large quantities of contaminated soil and groundwater) resulted in accumulation of concentrated coal tar deposits in and around Anglin Bay. These deposits are heterogenous, and often found at depth below the sediment-water interface, but are also found in patches at the current sediment surface (Golder 2017, 2022).

The Project plans to remediate sediment management units with the highest concentrations of COCs, including chromium, lead, zinc, PAHs, and PCBs, which are resulting in unacceptable risks to human health and the environment through sediment exposure pathways (Golder 2017). Historical water quality assessments suggest that contamination in solid phases (sediment and suspended particulates) are more important exposure pathways to receptors than aqueous phases. In water quality monitoring, elevated concentrations of surface water quality parameters are associated with particulate rather than aqueous phases given the strong association of the COCs with TSS. ESG (2009) measured total surface water concentrations of chromium, copper, lead, and zinc within the KIH above current PWQOs and CCME WQGs, but these exceedances were correlated strongly with the particulate fraction of metals; in contrast, dissolved surface water concentrations were generally below analytical detection limits. Benoit and Burniston (2010) also found elevated concentrations of COCs were correlated with TSS. Malroz (2021) concluded that metal concentrations measured within the water column of the KIH were correlated with particulates as a result of sediment disturbance. The source of elevated COCs within surface water may therefore be the result of sediment resuspension, rather than chemical diffusion into the water column. Natural variations in total metals concentrations are expected due to changes in natural energy levels in the water column, and could also occur through human physical disturbance of the sediments during sampling under shallow water conditions (Malroz 2021).

The Project plans to remediate sediment management units with the highest concentrations of chromium, lead, zinc, PAHs, and PCBs, which are resulting in unacceptable risks to human health and the environment through sediment exposure pathways (Golder 2017). Based on the historical water quality assessments, management of TSS will be key to protecting water quality within the KIH.

In addition to legacy sources, which have been identified to be the drivers for most contamination of KIH media in both TC and PCA water lots, there is potential for smaller loadings from ongoing land-based sources, as discussed in Section 2.3.

2.3 Source Controls

To prevent the continued input of contaminants into the KIH from major land-based sources along the shoreline (Figure 2), environmental controls have been put in place to reduce the contaminant flux and/or to intercept contamination prior to entering the KIH. These include:

- Belle Park Landfill leachate collection system
- Emma Martin Park passive reaction barrier
- Rowing Club storm water run-off upgrades
- Former Davis Tannery clay berm
- Municipal initiatives to reduce contaminant and particulate inputs into storm sewers
- Municipal septic upgrades and any capacity upgrades to limit combined sewer overflow (CSO) events

The effectiveness of these controls to prevent ongoing sources of contamination into the KIH is further discussed below. The City of Kingston has indicated that their source control initiatives will be aligned with the remediation plan for KIH sediments (once finalized).

2.3.1 Belle Park Landfill

Leachate from the Belle Park Landfill historically provided a major source of PCBs into the KIH. A number of measures have been implemented since 1997 to contain and treat the leachate, including installation of barriers and extraction wells to intercept groundwater, off-site groundwater treatment, and the use of trees to sequester metals. Follow-up studies between 2003 and 2011 concluded that the Belle Park Landfill was no longer a significant source of PCBs into the KIH (ESG 2014). Since then, groundwater has been assessed semi-annually for site-specific indicators of landfill leachate, including ammonia (N) total, chloride, iron, pH, and TSS. The results from the most recent groundwater assessment (2019–2020) were within historically established concentration ranges; however, ammonia total and iron remain above the PWQOs (Malroz 2021).

The Belle Park Landfill monitoring program includes surface water sampling at strategic locations within the Great Cataraqui River to monitor the effectiveness of the groundwater remedial measures that have been implemented. Surface water sampling is also undertaken at a reference station upstream of the landfill and in a stream to the west of the landfill to characterize ambient water quality at locations outside the influence of the landfill. The surface water samples are analyzed for conventional water quality parameters and metals. Several locations exceeded the PWQOs for metals (cadmium, cobalt, copper, iron, lead, zinc) within surface water downstream of the landfill during the most recent monitoring events (2019–2020), however, it was concluded that the exceedances were consistent with historical results (1997–2018). The yearly variability in reported metals concentrations was attributed to the degree of entrained particulate matter; this would be strongly linked to sediment disturbance caused by a change in natural energy levels in the water column and/or human disturbance of sediments during sampling (as supported by elevated turbidity values). The west stream (reference location draining into the Great Cataraqui River) also had metal concentrations above the PWQOs identifying other sources of contaminants that are influencing water quality in the local region (Malroz 2021).

2.3.2 Emma Martin Park

In 2011, discharge of arsenic in groundwater was identified as a major contaminant source into the KIH. The City of Kingston installed a passive reaction barrier to address the issue, which has been successful in reducing the arsenic concentrations. The City of Kingston is continually monitoring groundwater discharge from this area to ensure the effective remediation of arsenic (personal correspondence, Paul MacLatchy on 30 November 2022). Historical reports have not identified arsenic as a surface water concern (Section 2.1). The distribution of historically sourced arsenic in sediment along the KIH waterfront is also spatially limited relative to other metals in the harbour (Golder 2017, 2022).

2.3.3 Rowing Club

In 2007, discharge of particulate bound mercury in surface runoff from the Rowing Club was identified as a potential source of contamination into the KIH. A follow up study by the City of Kingston identified elevated mercury within the surface soil surrounding the Rowing Club. The City of Kingston subsequently implemented improvements and modifications to prevent stormwater runoff that could cause erosion of mercury contaminated soils; confirmatory monitoring during high precipitation events confirmed that unacceptable surface soil erosion was no longer occurring (ESG 2014).

2.3.4 Former Davis Tannery

The former Davis Tannery historically discharged liquid waste containing chromium into a wetland north of the tannery (known as the Orchard Street Marsh). A clay berm was installed in the 1980s to prevent groundwater discharge of contaminants into the KIH. Studies completed in 2010 indicated that inorganic metals were only detected within the particulate phase in groundwater and were undetected within the dissolved phase. Similarly, contaminant concentrations within surface water runoff from the former Davis Tannery were also not contained in the dissolved phase. During high precipitation events, it is possible that particulate matter with elevated COCs may be transported into the KIH through surface water runoff (ESG 2014).

2.3.5 Storm Sewers

Storm sewers are a potential source for urban contaminants such as metals and PAHs captured from stormwater flow. ESG (2014) summarizes historical water quality studies related to storm sewer inputs along the KIH. The most recent study was completed by Derry et al. (2003), who collected integrated water samples from six storm sewer outflows on the western side of the KIH where all samples exceeded the PWQOs for PAHs (metals were not analyzed).

The Kingscourt storm sewer (discharges to the Orchard Street Marsh) and the Dufferin storm sewer (north end of Douglas Fluhrer Park) drains the majority of the catchment area along the western shore of the KIH. The last time outflows from these storm sewers (under dry weather conditions) were sampled for metals was in 2005 (personal correspondence, Paul MacLatchy on 30 November 2022). Metals with detected concentrations above analytical reporting limits included aluminum, barium, bismuth, boron, calcium, copper, iron, magnesium, manganese, phosphorous, potassium, silicon, sodium, strontium, and zinc. Metals with concentrations above current PWQOs and CCME WQGs included aluminum, copper, phosphorus, and silicon.

The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), which means that particulate inputs that may be associated with contaminants are conveyed with water flows. The City of Kingston has adopted several source control measures to reduce particulate loading to storm sewers since 2005 (personal correspondence, Paul MacLatchy on 6 December 2022), including street sweeping programs and catchment basin clean-up. The City of Kingston also engages in educational programs to raise awareness of the importance of reducing inputs of storm-water pollutants and reducing the dumping of waste materials into storm drains (e.g., Fish and Frogs Forever Program). These recent improvements have likely decreased the potential for contamination to enter the KIH via storm sewers, including relative to the Derry et al. (2003) results, but this has not been formally assessed.

2.3.6 Combined Sewer Overflows (CSO)

CSOs consist of large pulses of nutrients and coliform bacteria associated with raw sewage that is discharged during and after heavy rainfall. These events are not planned but rather occur through temporary capacity exceedances of the sanitary sewers during high precipitation episodes. The City of Kingston has completed several upgrades to control frequency and magnitude of CSO events, specifically around the KIH (Utilities Kingston 2022), including:

- Emma Martin Park CSO storage tank installation (2006) to reduce overflows from the River Street Pumping station and upstream CSOs.
- Harbourfront Trunk Sewer twinning (2005) and refurbishment (2008).
- Replacement of CSO sections with separated sanitary and storm sewers within the Kingscourt and Dufferin sewer sheds (2001 - ongoing).

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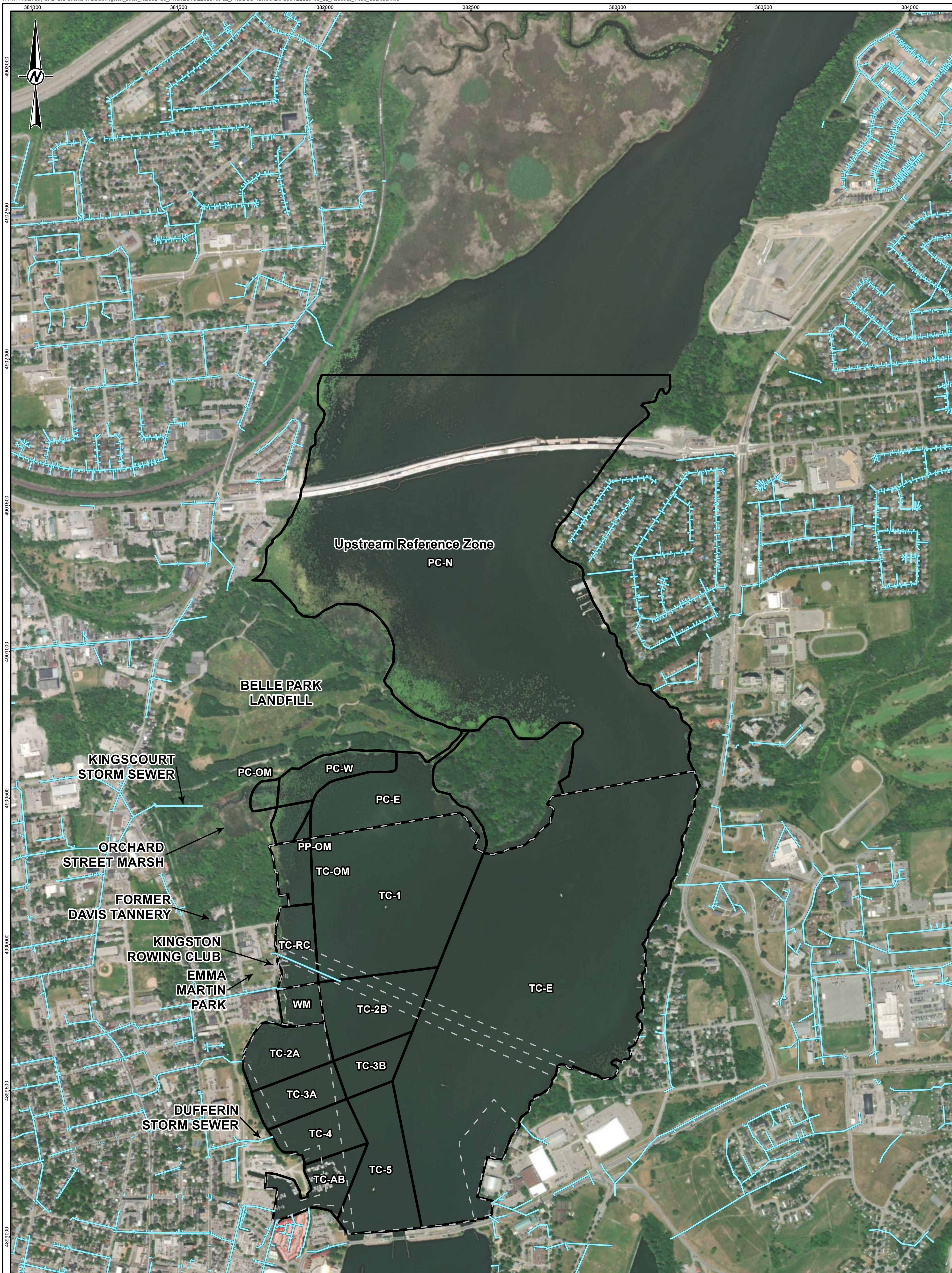

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- STORM SEWER

0 250 500

1:12,500 METERS

REFERENCE(S)

1. IMAGERY COPYRIGHT © 20220711 ESRI AND ITS LICENSORS. SOURCE: MAXAR. USED UNDER LICENSE, ALL RIGHTS RESERVED.

PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
MAJOR CONTAMINANT SOURCES FOR KINGSTON INNER HARBOUR

CONSULTANT

wsp GOLDER

YYYY-MM-DD	2022-12-08
DESIGNED	LF
PREPARED	JP
REVIEWED	
APPROVED	

PROJECT NO.	PHASE	REV.	FIGURE
22523199	4000	0	2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

3.0 POTENTIAL ENVIRONMENTAL EFFECTS

Water quality within KIH may be affected by the Project through the following:

- Induced suspension of solids / turbidity during in-water works (e.g., during dredging, dewatering of dredged material (if applied), and placement of capped material);
- Re-suspension of contaminated sediments during in-water works;
- Reduction of dissolved oxygen levels from the release of anoxic sediments; and,
- Fuel and hydraulic spills from equipment.

The water quality changes may cause the following environmental effects:

- The suspension of sediments into the water column can have physical effects on fish and other organisms and cause behavioural changes. The effects of excessive suspended particulate matter have been well documented and include: habitat disturbances, physical smothering, reduced photosynthesis, gill abrasion and decreased ability to capture food or avoid predation (CCME 2002).
- The suspension of contaminated sediments into the water column can cause direct toxicity to aquatic organisms.
- The re-suspension of sediments that may be in an anoxic state can also reduce the dissolved oxygen concentration in the water column to potentially harmful levels.
- Contaminants released from fuel and hydraulic spills can be toxic to aquatic life (e.g., BTEX and phthalates).

The release of contaminates from suspended particulates into the aqueous phase is unlikely to be a driver for environmental effects, as the historical water quality assessments completed within the KIH have shown that the COCs have a strong association with TSS (Section 2.2).

As such, water quality management is needed during in-water works to 1) reduce potential impacts to the environment from sediment disruption, and 2) provide confidence that sediment resuspension does not deteriorate surface water quality. The latter objective is evaluated in comparison to existing (or baseline) conditions present within KIH prior to remediation. To meet these objectives, the following are required:

- An understanding of the existing surface water quality to establish baseline conditions against which any changes caused by the Project can be compared—The data requirements for establishing reliable baseline conditions are further discussed in Section 3.1.
- Defining threshold levels for water quality indicators that can be implemented during and after remediation to prevent potential environmental effects—Given the strong association of contaminants with sediments (Section 2.2) and the diffuse inputs of contaminants from urban and agricultural activities in the surrounding area, it is expected that TSS management with respect to changes above baseline (or existing) conditions can form the basis of the EPOs to be implemented during remediation. The approach for identifying threshold levels to prevent potential environmental effects is further discussed in Section 3.2.

3.1 Data Gaps

A baseline for surface water quality within the Project area is required before starting any in-water works to ensure that sediment disruption does not cause negative environmental effects. There are several data gaps related to the current understanding of surface water quality within the KIH (Section 2.1) that will need to be addressed to establish baseline conditions, including:

- **Updated Water Chemistry**—The majority of data available for the KIH were collected between 2002 and 2009 (ESG 2014). However, several source control measures have been implemented since that time that have likely improved surface water quality conditions (Section 2.3). Current baseline conditions within the Project area (i.e., between Belle Island and the Kingston LaSalle Causeway) should be established with new surface water quality data, building upon historical sampling nodes, and collected for each COC group associated with sediment (metals, PAHs, and PCBs) plus nutrients and toxicity modifying factors.

- **Chromium analysis**—The surface water data collected for the Site to date includes only total chromium analysis. However, water quality criteria are only available for the hexavalent and trivalent forms of chromium, and the form of chromium can influence toxicity in the environment. Analysis of these chromium species should be completed when assessing surface water quality.

- **Diffuse inputs of other COCs**—The Great Cataraqui River is characterized as a eutrophic system that is subject to diffuse nutrient inputs from agricultural activities upgradient of the Site (ESG 2014). Nutrients should also be included as a regional stressor group as part of the surface water quality assessment.

- **Suitable reference locations**—Surface water quality data from reference locations should be collected for COCs to help understand the source of any elevated parameters identified within the KIH. The reference location should be upgradient from the Project area but also within the urban areas of Kingston to reflect similar diffuse inputs. The historical sampling network provides options for this sampling to provide consistency over time.

- **Detection limits**—The detection limits for many of the surface water samples previously collected within the KIH and from reference locations were elevated above current PWQOs or CCME WQGs. The laboratory should be consulted ahead of completing any surface water quality monitoring to develop analytical detection limits that meet the applicable criteria.

- **Understanding site-specific ancillary parameters that affect bioavailability**—Several of the PWQOs and CCME WQGs are hardness dependent (cadmium, copper, lead, nickel, zinc) or pH dependent (aluminum and ammonia total). Further, FEQGs have recently been established for aluminum, cobalt, copper, lead, and zinc that are based on recent scientific evaluations and allow for site-specific water quality guidelines to be developed based on pH, temperature, hardness, and/or DOC (Canada 2022). The surface water quality assessments should include analysis of these parameters.

- **Dissolved metal and TSS concentrations**—Previous studies have shown that the total concentrations of metals within the water column of KIH are strongly correlated with particulates (ESG 2009; Benoit and Burniston 2010; Malroz 2021). Dissolved metal concentrations and TSSs should be sampled, along with total metal concentrations, to help understand the form of any elevated metals, which strongly influences bioavailability.

- **Dissolved oxygen**—The re-suspension of anoxic sediments can reduce the dissolved oxygen concentration in the water column to potentially harmful levels. However, dissolved oxygen concentrations are also influenced seasonally by temperature and processes such as photosynthesis by algal blooms. The Great Cataraqui River is also more susceptible to reduced oxygen levels as it is a eutrophic system, particularly during the summer. Baseline conditions of dissolved oxygen levels within the KIH should be established that includes seasonal variability.

It is also important to confirm that the established baseline conditions do not reflect ongoing contamination from major sources along the KIH. Although there have been several source control measures implemented along the shoreline of the KIH to decrease the potential for re-contamination (Section 2.3), there are several data gaps related to the current understanding and quantification of effectiveness for these controls, including:

- **Effectiveness of storm sewer management**—The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), such that particulate inputs may be discharged that are associated with contaminants. Metals and PAHs have not been sampled within these storm sewers since the early 2000s, where concentrations of PAHs, aluminum, copper, phosphorous and silicon exceeded PWQOs and/or CCME WQGs. Recent improvements in the City of Kingston sewer system have likely decreased the potential for contamination to enter the KIH via storm sewers, but this has not been formally assessed. Storm sewers along the KIH should be sampled during dry outfall events to understand if they represent a major source of on-going contaminant loading. Further, it is suggested that aqueous and sediment material from the storm sewer outflows during flowing conditions (i.e., wet periods) are sampled and analyzed for COCs to establish time-weighted averages of contaminant loading.
- **Contaminants of emerging concern (CECs)**—There have been several CECs identified over the past decade in urban environments that are increasingly being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders could be endocrine disrupters which are known to be harmful to aquatic receptors, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS), and polybrominated diphenyl ethers (PBDE). None of these substances would be linked to historical sources in federal water lots, but would reflect municipal sources. It is hypothesized that the concentrations of CECs within the KIH is low because the major source of CECs would be wastewater entering the sanitary system from residences and businesses, which is directed to the City of Kingston water treatment plants located downgradient of the KIH. To verify this, CECs could be collected from storm sewer outflows during both dry outflow and CSO events, to confirm the presence of CECs.

Finally, the following data gap will need to be addressed to establish EPOs:

- **TSS:Turbidity relationship**—It is expected that a TSS threshold can be used to prevent potential environmental effects from in-water works (refer to Section 3.2 for further details). The TSS[2] threshold can then be correlated to a turbidity[3] value, which can be measured on a "real-time" (i.e., operational) basis with an in-situ field meter to manage water quality during in-water works. This approach circumvents costs or delays associated with laboratory analysis and turnaround time. This allows for more measurements to be collected at a greater frequency and across a greater spatial scale and allows for immediate implementation of mitigation measures to prevent harmful environmental effects. TSS is a gravimetric measurement (mass per volume) whereas turbidity is an optical measurement which can be influenced by particle size, shape, color, and reflectivity. As a result, two materials occurring at the same TSS concentration in a given waterbody may result in different turbidity values. A site-specific TSS:turbidity relationship should therefore be established prior to any in-water works. The TSS:turbidity relationship would have to be specific to the type of sediment being disturbed; therefore, the different sediment types (i.e., particle sizes) throughout the sediment management area should be confirmed to determine if different TSS:turbidity relationships are required for different areas. Additional bench-scale testing of clean remedial management cover to be placed within the remediation area is also recommended to confirm whether the TSS:turbidity relationship developed for dredging needs to be revised for placement of clean material.

3.2 Thresholds

To prevent the potential for adverse effects from sediment resuspension during in-water works, implementation of EPOs based on TSS:Turbidity is recommended.

There are presently no specific regulations nor discharge standards (either federal or provincial) pertaining to discharge from dredging projects. The specific parameters and points of compliance are generally determined by agreement at the project level through the process of environmental review and consultation with the responsible regulatory agencies such to meet the general provisions of the environmental statutes.

Regulatory compliance with Section 36 of the *Fisheries Act* is typically evaluated at the point at which an operator no longer exercises control over a discharge[4], referred to as the "point of discharge (POD)". In the case of a sediment remediation project, control ends at the point at which turbidity is no longer controlled and the point of regulatory compliance may include the edge of a silt curtain, a safety buffer around the dredging auger where the

[2] TSS encompasses both inorganic solids such as clay, silt, and sand, and organic solids such as algae and detritus and is a gravimetric measurement of the dry weight of suspended particulate material (solids) per unit volume of water. The measurement of TSS requires the collection of a sample and submission of that sample to the laboratory. Analysis is done by filtering the sample onto a glass fibre filter and drying the sample at a specified temperature. Data for this analysis are typically available on a 24-h turnaround.

[3] Turbidity is a measure of the optical properties (e.g., scattering of light) of particulates suspended in water. Turbidity is often used for the day-to-day management of dredging activities as the results are available in real time. Turbidity is measured using an instrument that measures the passage of light through the sample as well as the scattered light that is reflected from the sediment particles and reports values in units such as nephelometric turbidity units (NTU).

[4] This reasonable operational concept is adapted from the *Metal and Diamond Mining Effluent Regulation* (MDMER), a regulation made pursuant to the *Fisheries Act*. Although the remedial dredging project is obviously not a metal mine and the regulations do therefore not directly apply, the definition of a discharge point contained in the MDMER is a contemporary workable definition for the present purpose and one intended to have conformity with the parent legislation, the *Fisheries Act*. The MDMER defines a discharge point as being the point at which the operator ceases to have control over the effluent. This definition provides a workable parallel to prevailing environmental statutes and enables an assessment of ecological risks within the context of federal and provincial regulatory requirements.

closest samples can be safely collected from, or the end of pipe during dewatering (referred to as the Compliance Point). The EPO for the Compliance Point aims to protect against short-term and acute lethality (to fish).

EPOs are also established for the receiving environment outside the work area, at the edge of the initial dilution zone (referred to as the Assessment Point). The Assessment Point is typically defined as approximately 100 m away from the Compliance Point. The EPO for the Assessment Point aims to protect against chronic and sub-lethal effects (to fish).

Figures 3 and 4 illustrate the Compliance Point and the Assessment Point for a typical dredging and sediment dewatering project.

Additionally, large turbidity events can occur as short-duration (i.e., hours long) transient events, for example from activities such as a boat passage or during CSOs. Thus, an EPO that represents an increase over background and the operational characterization of background (i.e., during in-water works) will be important because it will aid in deciding if turbidity measurements are of concern or if turbidity measurements are simply normal, transient events associated with other activities.

Following the completion of in-water works, long-term monitoring will also be required to ensure that the remediation activities have not negatively impacted water quality with respect to the KIH baseline conditions.

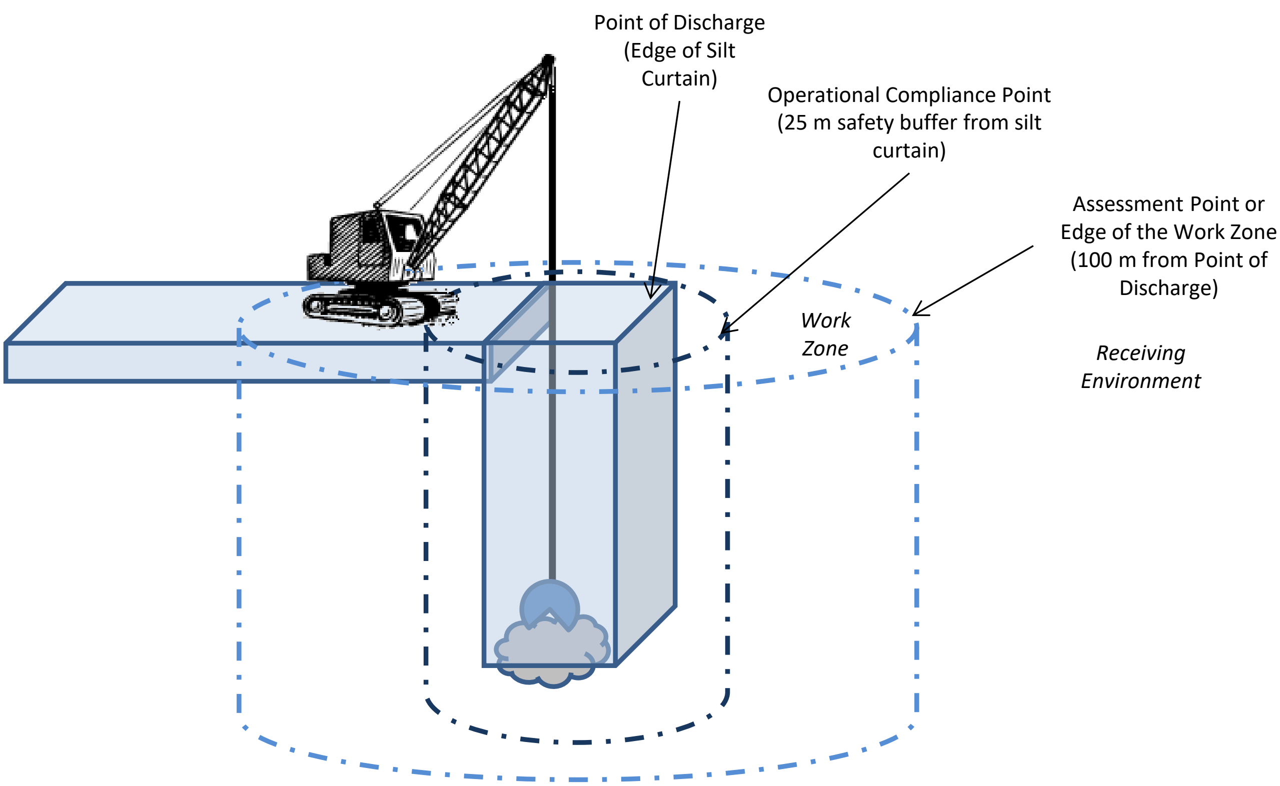

Figure 3: Schematic of the Compliance Point and the Assessment Point for Dredging

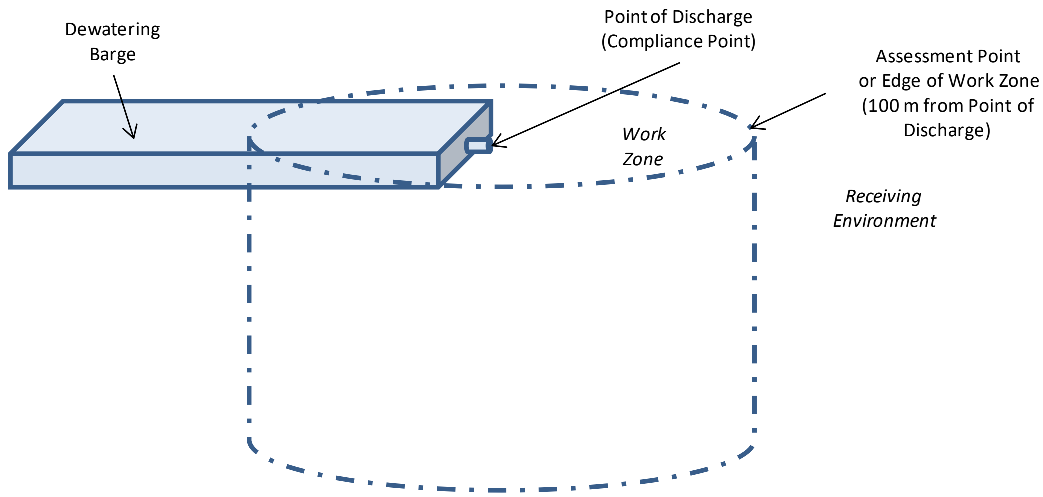

Figure 4: Schematic of the Compliance Point and the Assessment Point for Dewatered Aqueous Output

A step-wise approach is recommended for establishing EPOs, as follows:

1) Individual contaminant concentrations in water will be predicted for each management unit using a mass balance model based on sediment chemistry data from the recent sampling program in Fall 2021 (Golder 2022). The potential for physical effects to aquatic organisms and habitat from suspended sediments can be incorporated into the mass balance model through the selection of the range of TSS concentrations from 5 to 100 mg/L. The lower value is the CCME long-term exposure WQG for TSS (CCME 2002) and the upper value is provided as a potential TSS concentration during an uncontrolled release as a result of Project activities to provide an indication of the potential risks associated with such a release. A maximum TSS concentration of 75 mg/L (as an absolute concentration rather than as induced above background) would be expected for discharges from a construction site during wet weather to protect fish from the physical effects of suspended particles (DFO 1992).

2) Predicted water concentrations of contaminants based on the mass balance modelling in Step 1 can then be screened against CCME WQGs (CCME 1999/2022). Long-term (chronic) WQGs for the protection of freshwater aquatic life are to be used for this screening because they are conservative and where they are met, aquatic life as well as human uses (e.g., recreation) are also expected to be protected. For contaminants with FEQGs, it is recommended that these be used for contaminant screening instead of outdated CCME WQGs that do not reflect the current state of science and do consider multiple ancillary parameters that impact bioavailability, such as pH, hardness, DOC, and temperature (Canada 2022). The collection of data for such modifying factors (described in Section 3.1) would allow for FEQGs to be applied on a site-specific basis.

3) Where chronic CCME WQGs (or FEQGs) are exceeded, the safety factor incorporated into the guideline will be reviewed and where the predicted aqueous concentration is within the safety factor, the exceedance will not be considered to represent an environmentally relevant risk of adverse effects at the POD (or Compliance Point).

4) The interpretation of potential guideline exceedances will also need to consider the potential for guidelines to already be exceeded upstream of the Site or to already be exceeded under baseline conditions. For example, diffuse inputs of metals and PAHs may enter the waterway via surface water runoff from roadways or from poorly maintained boats travelling through the waterway. There are also diffuse inputs of nutrients from upgradient agricultural areas. In these cases, changes to water quality should be measured against the concentrations found within the upstream reference areas or under baseline conditions.

5) The potential for mixture toxicity will be evaluated for the sediment management units with the highest sediment concentrations using an additivity model and fish acute toxicity benchmarks. Acute toxicity benchmarks will be obtained from readily available sources such as guideline derivation documents.

6) Following completion of Steps 1 to 5, the use of either the CCME short-term exposure WQG for TSS (25 mg/L above background) or the DFO discharge limit for TSS (75 mg/L irrespective of background) as the EPO for application at the POD (or Compliance Point) can be confirmed, based on the assumption that by controlling the particulates in water discharged from a given work area, the concentration of contaminants present will also be controlled.

7) The use of the CCME long-term exposure WQG for TSS (5 mg/L above background) as the EPO for application within the Receiving Environment (or Assessment Point) can also be confirmed based on the results from the previous steps.

8) A turbidity level associated with the TSS thresholds selected as the EPOs can then be determined based on a site-specific TSS:Turbidity relationship (Section 3.1). The turbidity-based EPOs can be monitored in-situ and allows for “real-time” water quality management, where the need for additional mitigation measures during in-water works is informed immediately before potential environmental effects occur.

9) An evaluation of the uncertainty associated with the derivation of the EPOs will also be undertaken and mitigations will be developed to help address these potential uncertainties.

The EPOs will be developed as part of a site-specific Water Quality Management Plan (WQMP) for the Project. To monitor compliance with the EPOs, the site-specific WQMP should include background (near field and far field sampling locations) and down-current locations (assessment points) across multiple sampling depths.

The following are also recommended to monitor the effectiveness of the turbidity-based EPOs during in-water works:

- In-situ monitoring of other water quality indicators during in-water works that may impact toxicity, including: pH, dissolved oxygen, and temperature.
- Intermittent laboratory analysis of samples for general chemistry, total metals, PAHs, and PCBs to confirm that the turbidity-based EPOs are being protective of contaminant exposures.

Following the remedial program, long-term monitoring of COCs should be completed to confirm that the remediation activities have not negatively impacted water quality at the Site. The results of which should be compared against chronic WQGs protective of aquatic life, pre-remediation baseline concentrations, and upstream reference concentrations to assess the success of the Project.

3.3 Valued Components

Valued Components are environmental, health, social, economic, or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous peoples, federal authorities and interested parties. Table 2 summarizes the potential impacts to Valued Components related to surface water quality during different scenarios over the course of the Project. Under each scenario the desired outcomes, the thresholds for meeting the desired outcomes, the potential design considerations to reduce risks to surface water quality, and the additional works required to resolve information gaps are discussed.

Table 2 includes evaluation of valued components for pre-remediation stage due to the importance of confirming appropriate source controls prior to implementation of remedial works. This requirement is specific to issues around chemical contamination, and is not required for physical or biological valued components.

Table 2: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Surface Water Quality

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Pre-Remediation within the Kingston Inner Harbour						
Baseline water quality present within the KIH prior to remediation should not reflect on-going sources of contamination.	Surface water quality with respect to COCs[4] and CECs[5] is maintained at a level to protect aquatic life from long-term and chronic effects.	Surface water quality will be assessed using the PWQOs, CCME WQGs, and FEQGs. Where available, the FEQGs will take precedence[6]. Where criteria are exceeded, concentrations will be compared to reference locations to understand the source of elevated contaminants.	High	Yes F	Implementation of mitigation measures at identified sources, if identified from proposed monitoring (see additional works to right). Design engineer to work with City of Kingston to align shoreline works with current understanding of upgradient sources (e.g., storm sewer outfalls, soil erosion controls for shoreline areas). Enhancement of existing upgradient municipal source control initiatives, including public education, if ongoing sources of COCs or CECs identified at levels of concern.	A baseline surface water quality monitoring program should be completed prior to the Project, that includes surface water analysis within each management unit, at reference locations, and immediately downgradient of major contaminant sources along the shoreline (e.g., Belle Park Landfill, storm sewers during dry outfalls, Emma Martin Park, Rowing Club, Former Davis Tannery). The baseline surface water quality monitoring program should address data daps identified in Section 3.1 in order to fully capture pre-remediation levels.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
During Remediation at the Point of Discharge/Compliance Point *Regulatory compliance with Section 36 of the Fisheries Act is typically evaluated at the point at which an operator no longer exercises control over a discharge (referred to as the Point of Discharge [POD]). In the case of a sediment remediation project, control ends at the point at which turbidity is no longer controlled and the point of regulatory compliance may include the edge of a turbidity curtain, a safety buffer around dredging auger where the closest samples can be safely collected from, or the end of pipe during dewatering (referred to as Compliance Point).*						
In-water works involving dredging, dewatering and/or capping resulting in the re-suspension of sediments and associated contaminants at the POD.	Surface water quality with respect to TSS, COCs and dissolved oxygen is maintained at a level to protect aquatic life from short-term and acute lethality.	An EPO linked to TSS will be developed as part of the WQMP for the POD (as outlined in Section 3.2) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Suggested EPOs include the short-term CCME WQG for TSS (25 mg/L above background) or the DFO (1992) threshold (75 mg/L irrespective of background). Monitoring during in-water works would include: continuous in-situ monitoring of turbidity (to infer TSS concentrations) at reference locations and at the Compliance Point to ensure the EPO is met; in-situ monitoring of other water quality indicators that may impact toxicity, including: pH, dissolved oxygen, and temperature; and intermittent sampling for COCs to confirm that the turbidity-based EPO is protective of contaminant exposures.	High	Yes A, B, C	EMP will detail project requirements following BMPs, which may include the use of a turbidity curtain during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance, and additional filtration during dewatering	A site-specific WQMP is required prior to commencement of the Project that will define the EPOs, outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring, and identify high level management actions to address water quality that is found to exceed the EPO. Prior to implementation of the WQMP, a site-specific TSS:Turbidity relationship should be determined (Section 3.1). EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce turbidity.
Equipment associated with in-water works that could result in chemical spill into KIH waters.	BMP are followed; no incidents involving chemical release; events managed in such a way to avoid damage to aquatic life or water quality.	Environmental monitors to record and report spills, monitor clean up, and complete follow up monitoring and sampling of COCs in sediment and surface water as required.	High	Yes A, B, C, D, E	EMP will detail project requirements following BMPs (e.g., water booms around equipment, spill kit on Site, spill response plan).	EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce spill occurrence and limit potential impacts to aquatic life.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
During Remediation at the Receiving Environment/Assessment Point *Considers potential exposures within the receiving environment outside the work area, at the edge of the initial dilution zone (referred to as the Assessment Point). The Assessment Point is typically defined as approximately 100 m away from the Compliance Point.*						
In-water works involving dredging, dewatering and/or capping resulting in the re-suspension of sediments and associated contaminants within the Receiving Environment.	Surface water quality with respect to TSS, COCs and dissolved oxygen is maintained at a level to protect aquatic life from long-term and chronic toxicity	An EPO linked to TSS will be developed as part of the WQMP for the Receiving Environment (as outlined in Section 3.2) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Suggested EPO includes the long-term CCME WQG for TSS (5 mg/L above background). Monitoring during in-water works would include: continuous in-situ monitoring of turbidity (to infer TSS concentrations) at reference locations and at the Assessment Point to ensure EPO is met; in-situ monitoring of other water quality indicators that may impact toxicity, including: pH, dissolved oxygen, and temperature; and intermittent sampling for COCs to confirm that the turbidity-based EPO is protective of contaminant exposures.	High	Yes A, B, C	An EMP will detail project requirements following BMPs, which may include the use of a turbidity curtain during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance, and additional filtration during dewatering	A site-specific WQMP is required prior to commencement of the Project that will define the EPOs, outline the scope of water quality monitoring that will be undertaken during Project activities including location and frequency of monitoring, and identify high level management actions to address water quality that is found to exceed the EPO. Prior to implementation of the WQMP, a site-specific TSS:Turbidity relationship should be determined (Section 3.1). EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce turbidity.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required
Post Remediation within the Kingston Inner Harbour						
Long-term impacts of sediment re-suspension following in-water works	Remediation activities have not negatively impacted water quality at the Site	COCs meet the PWQOs, CCME WQGs, and FEQGs. Where available, the FEQGs will take precedence[6] OR Where water quality criteria are exceeded, the COCs are within the range of pre-remediation baseline conditions. Post-remedial monitoring should be completed over 5 years and include locations adjacent to other contaminant sources along the KIH before inferences of Project related impacts are made.	Moderate	Yes F	If it is determined that the elevated COCs are the result of the Project and not other sources, additional remedial measures may be considered (e.g., capping within sediment management units that have elevated COCs).	A baseline surface water quality monitoring program should be completed prior to the Project, that includes surface water analysis within each management unit, at reference locations, and immediately downgradient of major contaminant sources along the shoreline (e.g., Belle Park Landfill, storm sewers during dry outfalls, Emma Martin Park, Rowing Club, Former Davis Tannery). The baseline surface water quality monitoring program should address data daps identified in Section 3.1.

Notes: KIH = Kingston Inner Harbour; COC = contaminant of concern; CEC = contaminant of emerging concern; PWQO = provincial water quality objective; CCME WQG = Canadian Council of Ministers of the Environment Water Quality Guideline for the Protection of Freshwater Aquatic Life; FEQG = Federal Environmental Quality Guideline; POD = point of discharge; TSS = total suspended solids; EPO = Environmental Performance Objective; WQMP = Water Quality Management Plan; EMP = Environmental Management Plan; BMP = Best Management Practice

[1] “The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[2] “The standard of proof will be expressed as “high,” “medium,” or “low,” depending upon the circumstances of the project-VC interaction.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[3] Proven Mitigation Measures, Best Management Practices, Guidelines and Standards include:

- [A] PCA. 2017. Ontario Waterways Environmental Standards and Guidelines Document, Part 2.
- [B] PCA. 2017. Parks Canada National Best Management Practices: Works In and Around Waterbodies.
- [C] Evaluating Construction Activities Impacting on Water Resources Part III B: Handbook for Dredging. 2011. Ontario Ministry of the Environment.
- [D] Erosion and Sediment Control Guide for Urban Construction. 2019. Toronto and Region Conservation Authority.
- [E] Construction Specification for Temporary Erosion Control. 2021. Ontario Provincial Standard Specification.
- [F] Canada. 2021. Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours under the Federal Contaminated Sites Action Plan (FCSAP). Version 1.1. Fisheries and Oceans Canada, Ottawa ON, Canada. November 2021.

[4] COCs represent chemical parameters that are known to be elevated within sediments and/or surface water within the KIH, including nutrients, metals, PAHs, PCBs

[5] CECs represent chemical parameters that are increasing being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders are endocrine disrupters, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and polybrominated diphenyl ethers (PBDE)

[6] FEQGs (Canada 2022) have recently been established that are based on recent scientific evaluations and allow for site-specific water quality guidelines to be developed based on pH, temperature, hardness, and/or dissolved organic carbon (DOC).

4.0 SUMMARY OF DESIGN-RELATED CONSTRAINTS

The remedial design for the Project should be able to maintain TSS levels that meet the EPOs at the POD (Compliance Point) and within the Receiving Environment (Assessment Point) (Section 3.2). The EPOs will be developed as part of a site-specific WQMP. We have not identified any specific design-related constraints beyond those already discussed in Section 3.3.

Based on previous experience with similar projects it is expected that the EPOs will be approximately:

- 25 mg/L above background to 75 mg/L irrespective of background at the POD (Compliance Point)
- 5 mg/L above background within the Receiving Environment (Assessment Point)

Even if EPOs deviate from the above approximations, there are known methods for engineering design, operational controls, and contingency measures that should mitigate risks while still allowing for flexibility in design within each management unit. Additional Project constraints may be identified once the data gaps identified in Section 3.1 are addressed.

5.0 CLOSURE

We trust this information is sufficient for your needs at this this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned

WSP CANADA INC.

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https://golderassociates.sharepoint.com/sites/162644/project files/6 deliverables/3.0_issued/22523199-006-tm-rev0/22523199-006-tm-rev0-water quality 02feb_23.docx

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APPENDIX C

Conceptual Constraints and Impact Considerations – Lacustrine Processes (WSP, 2023)

TECHNICAL MEMORANDUM

DATE 15 February 2023 **Reference No.** 22523199-004-TM-Rev0

TO [redacted]
Public Services and Procurement Canada

CC

FROM Phil Osborne **EMAIL** [redacted]

CONCEPTUAL CONSTRAINTS AND IMPACT CONSIDERATIONS – LACUSTRINE PROCESSES

1.0 INTRODUCTION

Golder Associated Ltd (amalgamated under WSP Canada Inc. in January 2023), was retained by Public Services and Procurement Canada (PSPC) on behalf of Transport Canada (TC) and Parks Canada Agency (PCA) to identify the conceptual constraints and impact considerations related to lacustrine processes for the proposed Sediment Management Project (the Project) at the Kingston Inner Harbour (KIH) in Kingston, Ontario (the Site). Lacustrine processes may include hydrodynamic processes (e.g., river processes, currents), sediment processes (transport, sources, sinks of sediment) and the geomorphology, which is the interaction of the physical processes at the sediment and water interface. The memo was completed to support the lacustrine processes component of the Conceptual Constraints and Impact Considerations (CCIC) document for the Project being completed by SNC-Lavalin Inc. (SNC-Lavalin). The CCIC is intended to support a Detailed Impact Assessment (DIA) by providing preliminary, high-level considerations of potential Project impacts based on information gathered to date. The CCIC provides early identification of remaining information gaps and additional works required to address the information gaps and identifies any Project constraints that are known at this time (SNC-Lavalin 2022).

The KIH is bounded by Highway 2 (La Salle Causeway Bridge) to the south and Belle Island to the north. TC is responsible for the management of most sediment areas in the southern section of the KIH (i.e., south of Belle Island). PCA is responsible for sediments in the portion of the KIH immediately north and southwest of Belle Island. A small percentage of the southern half of KIH is owned by other parties, including a square water lot adjacent the former Woolen Mill (WM), small areas of foreshore near the Kingston Marina, and a Military Reserve in the southeastern corner of KIH. The KIH study area is divided into management units that reflect the risk potential from sediment contamination (Figure 1).

Figure 1: Spatial Domain of KIH Study Area and Water Lot Boundaries

The primary contaminants of concern (COCs) in sediment include metals (e.g., chromium), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs), all of which are associated with legacy contamination from historical industrial activities, and which are the risk drivers for chemical management within the KIH. These contaminant groups are bound, complexed, or sorbed to particulate matter, including fine grained sediment particles and associated organic matter, which influences their fate and partitioning in the environment. The Project is currently in the conceptual stages but is expected to include remediation of the bedded sediments in areas of the KIH with the highest concentration of primary COCs. Other elevated COCs in the proposed remedial areas include antimony, arsenic, lead, mercury, silver, and zinc (Golder 2017b).

1.1 Memo Organization

To support the CCIC related to lacustrine processes the following information is presented in this memo:

- Existing Conditions (Section 2.0)—Summarizes the available information related to the baseline hydrodynamics and sediment processes within the KIH.
- Proposed Sediment Management Overview (Section 3.0)—Provides a brief overview of proposed sediment management for KIH as described in the Conceptual Sediment Management Plan (SMP) and describes some of the lower-intrusion approach being considered in updates to the SMP; these are expected to include nature based (green-engineered) shoreline solutions and thin layer amendments to the surface sediment in some management units within KIH.
- Potential Environmental Effects (Section 4.0)—Provides an overview of the potential environmental effects from Project activities that may result in changes to sediment processes, river currents, and/or geomorphology if not properly managed. Data gaps related to the current understanding of lacustrine processes within the KIH are identified. The findings are summarized with respect to preliminary considerations of potential impacts to lacustrine processes from the Project (i.e., the Valued Components), the desired outcomes, thresholds for meeting the desired outcomes, potential design considerations to reduce risk, and additional works required to resolve information gaps.
- Summary of Constraints (Section 5.0)—Identifies Project constraints specific to the conceptual design that may impact lacustrine processes and cause potential environmental effects if not accounted for. These Project constraints will be used to inform the detailed design.

2.0 EXISTING CONDITIONS

Sediments, which are the solid materials at the bottom of the harbour waters, behave differently in the environment than land-based soils. Understanding sediment movement is important because many contaminants bind closely with the solids found in the sediment bed, and because lacustrine processes can influence physical properties of interest in KIH, including shoreline stability and resuspension/redistribution of sediment. KIH is a relatively wide and shallow basin feature at the mouth of the Cataraqui River, where it flows into Lake Ontario. Figure 2 shows bathymetry elevations within the Site Boundary range from approximately 75.5 m to 67.5 m (a range of 8 m). The water depths are shallow (approximately 1.5 metre or less) across most of KIH with the exception of the navigational channel along the eastern and southern ends of the harbour.

Figure 2: Bathymetric survey of the Kingston Inner Harbour

The broad environmental features of the region resulted from the receding and melting of glaciers, which caused water levels to rise and flood low-lying river mouths by lake shores at the end of the last ice age. The present-day river mouth area includes a navigation channel with approximately three metres of navigational draft depth that has been maintained by dredging in the past. The water flows are therefore deeper and faster moving on the eastern side of the harbour (Figure 3). However, much of the harbour is shallower and with low water velocities, including the western half where most legacy sediment contamination has accumulated. This results in a low-energy and primarily depositional environment, in which fine-grained surface sediments accumulate and redistribute slowly over time.

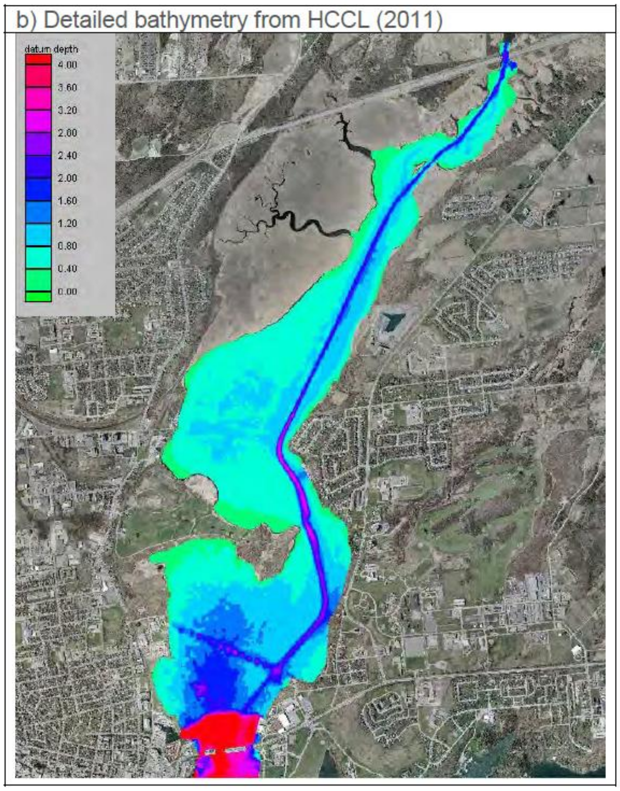


Figure 3: Bathymetry of the wider Cataraqui River from HCCL (2011). Source: SNC Lavalin (2020b)

One important property of harbour sediments is that they are mobile, and they mix over time. This includes movements up and down (vertically) in the sediment bed, and sideways (laterally). These movements are governed by both physical and biological processes. The sediment bed can be described as an evolving surface of solid matter, which can be altered in the short term (large storm events), or over the longer term with the gradual movement of sediment. Biological communities can either enhance mixing (e.g., through bioturbation of surface sediments by microorganisms) or constrain mixing (e.g., presence of aquatic plants and root mats that stabilize sediments).

The broad natural processes that affect how water and sediments move within the environment are important for understanding how sediment contamination could change in response to a clean-up project. Such understanding can be linked to the remedial design to provide confidence that the Project will not result in undesirable changes to these processes.

2.1 Baseline Hydrodynamics

The existing hydrodynamics (physical processes) of KIH were studied in previous reports such as the Sediment Transport Study (Golder 2017a) and Sediment Stability Study (SNC-Lavalin 2020b). These reports provided a basis for developing a conceptual understanding of sediment processes discussed in the conceptual SMP (Golder 2021).

Several physical hydrodynamic processes control currents and circulation within KIH and have the potential to influence sediment and contaminant transport within KIH and the adjacent Cataraqui River. These processes are discussed in the following sections:

- Cataraqui River hydrology
- Lake Ontario water levels including the effects of lake seiches and storm surges
- Wind generated currents
- Wind generated waves
- Vessel wakes
- Ice cover

2.1.1 KIH Bathymetry and Dredging

The KIH consists of a shallow U-shaped basin and is approximately 1.7 kilometres (km) long and 1 km wide. At the southern end of the harbour, the La Salle Causeway divides the inner harbour from the outer harbour. The outer harbour is approximately 900 metres (m) long and terminates at the mouth of the Cataraqui River, into Lake Ontario. The KIH basin shallows from its deepest point (adjacent to the La Salle Causeway) to approximately 1 m depth in areas just south of Belle Island. A very shallow marsh (depths typically < 1.5 m) extends from the south end of Belle Island (Figure 2).

According to Canadian Hydrographic Services (CHS 2007), the southern end of the harbour was dredged as recently as 1965 to a depth of 5.5 m. The dredge cut runs from the mouth of Anglin Bay on the west side, to the Cataraqui River /Rideau Canal navigation channel to the east (Figure 2). The navigation channel runs approximately south to north, connecting the lock system of the Rideau Canal to Lake Ontario. A smaller channel area runs perpendicular to the navigational channel (Figures 3); this localized deepening coincides with the municipal infrastructure corridor connecting the west and east shores of the harbour.

2.1.2 Cataraqui River Hydrology

The harbour is located at the mouth of the Cataraqui River which is part of the Rideau Canal system. The Cataraqui River watershed is within the Great Lakes Lowlands and drains an area of approximately 910 km^2 (Acres 1977). The Cataraqui River discharge regime is dominated by a spring (February-March) increase in flows due to snowmelt and modulated by periods of precipitation. Cataraqui River flows range from 4 m^3/s to 17 m^3/s up to a maximum estimated flow of 50 m^3/s recorded during an extreme storm (HCCL 2011). These flows cause the KIH to flush out approximately 76 times per year (Golder 2017a).

Water levels at the mouth of the Cataraqui River are controlled primarily by the hydrologic and hydrodynamic regime of Lake Ontario (see Section 2.1.3). Construction of several major infrastructure projects have also significantly impacted hydrologic processes in KIH including:

- St. Lawrence seaway (late 1840s)
- Rideau Canal and lock system (1832)
- La Salle Causeway (1916)
- Lake Ontario Management Plan (1960s)
- Upgrades to sanitary sewer (including dredging across central KIH)

These projects have mainly resulted in a dampening of water level fluctuations and restriction of flows into and out of the harbour. This reduces the speed of currents and strength of circulation which have resulted in a reduction in sediment transport potential.

In KIH the dominant Cataraqui River currents align with the navigation channel with most of the river discharge occurring along the eastern portions of the harbour. Belle Island has a sheltering effect on the western side of the harbour and results in a slight recirculation effect (Figure 3). Minor inputs of surface water flow also occur on the western side of the harbour and have some influence on overall water movement. Smaller discharges enter the harbour through storm sewer outfalls, including at the north end of the brownfield area at the Orchard Street Marsh, which is fed by the Kingscourt storm sewer flows.

2.1.3 Lake Ontario Water Levels

Water levels in KIH are generally consistent with Lake Ontario levels (Dalrymple and Carey 1990). The minimum, mean and maximum historic water levels in Lake Ontario were 73.8, 74.8 and 75.7 (overall range 1.9) respectively. These calculations were based on the monthly lakewide average water levels from January 1960 through December 2016. Water supplies to Lake Ontario surpassed the historical maximum during Spring 2017 and water levels remained high throughout the summer. In 2018, peak Lake Ontario water levels decreased to approximately the 1960–2016 seasonal average but spiked again in spring 2019 (new maximum of 75.9m) and remained high through late summer. These record setting levels were followed by recent stable water levels that have remained near historical seasonal averages from January 2021 to January 2023.

The location of KIH at the eastern end of Lake Ontario, combined with southwesterly dominant wind directions, make the site prone to lake seiche-induced water level fluctuations and wind set-up. Lake seiches are standing waves caused when wind forcing and atmospheric pressure changes force water from one end of the water body to another resulting in set-up. When the forcing changes or reduces water level set-down occurs and oscillations occur that may persist for several hours or days.

Magnitudes of seiche at the eastern end of Lake Ontario are typically in the range of 0.25 to 0.5 m, but potentially reaching 0.7 m (HCCL 2011). Seiches can create tide-like currents as water is forced northward through La Salle Causeway openings. Golder (2017a) estimated current speeds at the Causeway of up to 0.15 m/s associated with a 0.5 m surge draining in two hours have the potential to re-suspend sediment in the harbour entrance area transporting them into KIH during the rising surge and potentially transporting fine sediment out of the harbour during the falling limb of the surge.

2.1.4 Wind Generated Currents

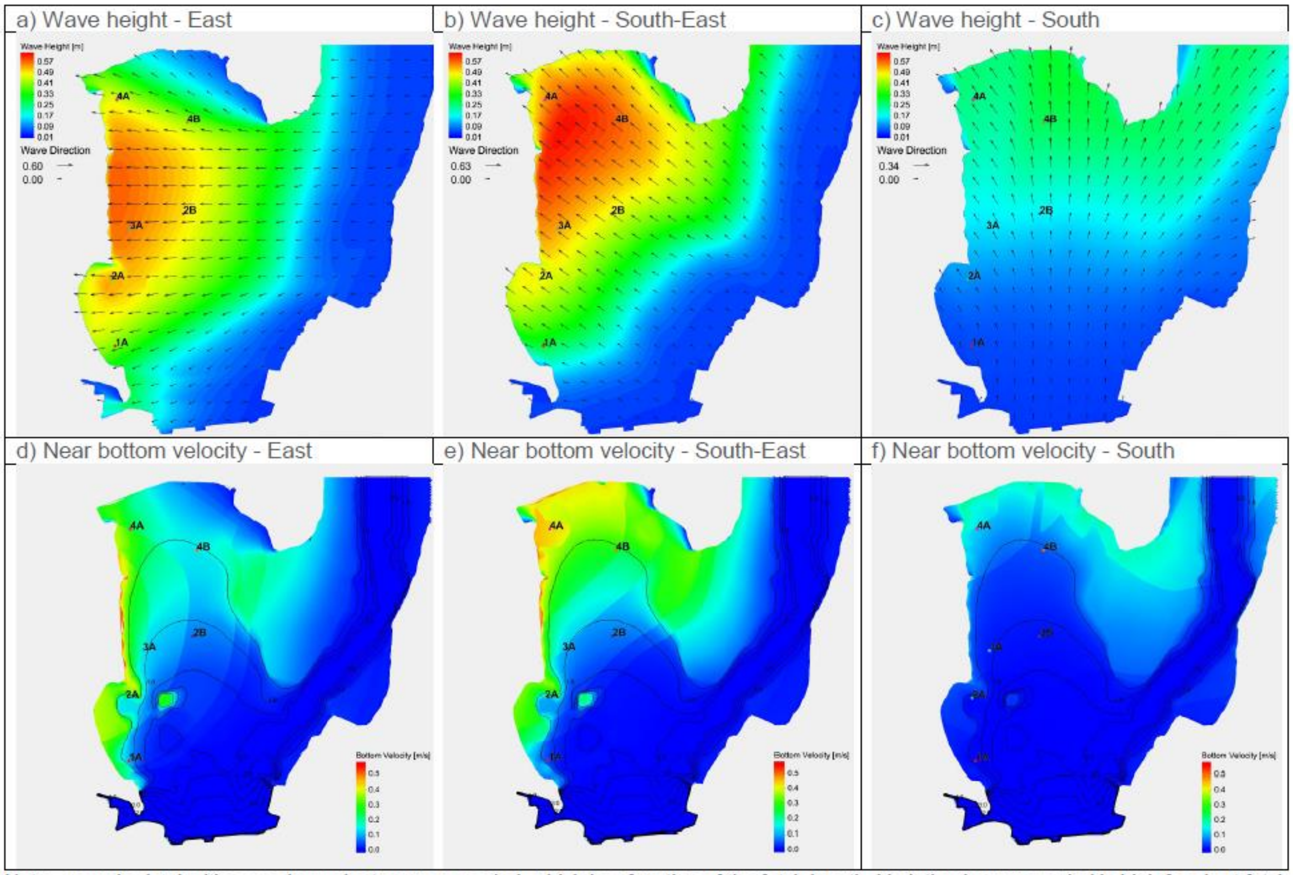
Wind patterns also influence currents in the harbour. Dominant winter wind conditions within KIH are from the West, with less frequent winds coming from the South and the Northeast. Summer wind conditions are predominantly from the South, with less frequent winds from the Southwest. These winds create localized wind generated currents and small waves (Figure 4 and Figure 5).

Winds combined with River currents generally create a clockwise circulation cell in KIH with dominant flows being southward along the eastern shore; the La Salle Causeway deflects a certain amount of flow to the west and northward along the western shore. Wind and recirculation deflect flow eastward at Belle Island (Figure 5).

2.1.5 Wind Generated Waves

Although the dominant wave direction in Lake Ontario is from the southwest, the effect of these waves is reduced by the La Salle Causeway across the mouth of the harbour (Figure 4). Water and sediment movement are influenced more by local conditions inside the harbour, and the modest dimensions of the harbour limit the strength of wave action inside the harbour. For example, the limited fetch (distance of open water over which the wind can blow) limits the size of wind generated waves in KIH.

Wind waves on the west side of KIH have been estimated to range from 0.2 to 0.5 m for annual storms to extreme winter storms respectively with wave periods ranging from 1.6 to 2.3 seconds (Golder 2017a). SNC (2020b) applied a two-dimensional wave growth and transformation model to predict wind waves within KIH for three directions (East, South-East and South) for 1, 10, and 50-year return periods. An example of significant wave height and associated near bottom wave orbital velocities is shown in Figure 4. The results indicated the waves may reach 0.5 m or higher on the western and northwest shoreline during east and south-east winds with 50-year return periods with corresponding bottom velocities of 0.2 to 0.5 m/s. However, the model did not include the attenuation effect of submerged aquatic vegetation on wave growth and transformation in KIH so the results for wave height and bottom velocity are likely to be over-conservative.



Note: near-bed velocities are dependent on wave period, which is a function of the fetch length. Variation in wave period is high for short fetch length. The abrupt changes in near-bed velocities apparent on figures d, e and f are a result of this and show the limitations of numerical modelling for short fetch areas.

Figure 4: Significant wave height for winds with 50-year return period for the (a) East; (b) South-East; (c) South directions and the associated near bottom water velocities for (d) East (e) South-East (f) South directions. Source: SNC 2020b

2.1.6 Vessel Wakes and Propeller Wash

Propeller scour from vessel movements within the water lot may resuspend and transport materials within the harbour, although dense vessel traffic is limited to the vicinity of La Salle Causeway and Anglin Bay. In these areas sediments are primarily silts (fine-grained) and the water depth is shallow (i.e., <1.5 m). Vessel speeds and wakes are restricted for the remainder of the water lot, where boating consists mainly of rowing and kayaking; sediment resuspension from propeller action and vessel traffic is not expected to contribute to resuspension in areas outside of the navigation routes (Golder 2017a). There was limited vessel activity identified north of the harbour limit and west of the navigation channel in the available historical imagery. SNC (2020b) also reported difficulties in navigating the study area west of the navigational channel, with repetitive clogging and fouling of the propeller by submerged aquatic vegetation (SAV). It is unlikely that either wakes or propeller action contribute significantly to resuspension in the study area due to speed restrictions imposed by navigation requirements and the presence of SAV.

2.1.7 Seasonal Ice Cover

Seasonal ice cover occurs typically from mid to late December until mid to late April depending on severity of winter conditions. Ice cover reduces the effects of wind on currents and circulation and reduces the effects of wave action. Ice formation occurs most often along the shoreline and may freeze from the surface to the sediment bed in shallow water. The latter process may result in ice-related transport of sediments from shallow water areas. Ice thickness and movement may be a key design consideration for shallow water capping and shore protection design

The DIA for Kingston Third Crossing concluded that the potential for ice jam flooding during either the temporary works or post-construction (bridge in place) was extremely low. This was related to the low velocities within the Project area and lack of supply ice due to Kingston Mills upstream (Hatch 2019).

Ice processes are expected to have a small to negligible effect on sedimentary processes in KIH and similarly, the implementation of the SMP is unlikely to result in significant changes to the ice cover and ice dynamics in the project area. However, there is a lack of quantitative ice thickness and ice movement data for KIH. This may be potentially resolved by synthetic data obtained from models and observations.

2.1.8 Summary of Currents and Circulation

Currents and circulation within KIH are influenced by Cataraqui River hydrology as well as Lake Ontario water levels including the effects of lake seiches and storm surges, wind generated currents, wind generated waves, vessel wakes, and seasonal ice cover (Figure 5).

Factors that cause movement of sediment, and water that may contain suspended sediment in KIH, include:

- Cataraqui River flows, which are strongest on the eastern side of the harbour and drives a clockwise circulation of water and sediment in the inner harbour between the La Salle Causeway and Belle Island.
- Surface water runoff from land to the KIH basin.
- Wind generated waves and vessel generated wake effects which have potential to disturb and mix sediments in the shallow areas along the western shoreline.
- Changes in regional water levels in Lake Ontario, which can periodically result in a reversal in flow, or backwater effect through the LaSalle Causeway into KIH.

Factors that inhibit or reduce the movement of sediment and water in KIH include:

- Dense submerged aquatic vegetation (SAV) occurs over large parts of the western half of the harbour and particularly the northern embayment to the south of Belle Island in water depths less than approximately 1.7 m. SAV reduces currents, traps sediments, and increases local deposition of sediment on the harbour bed (See Section 2.2).

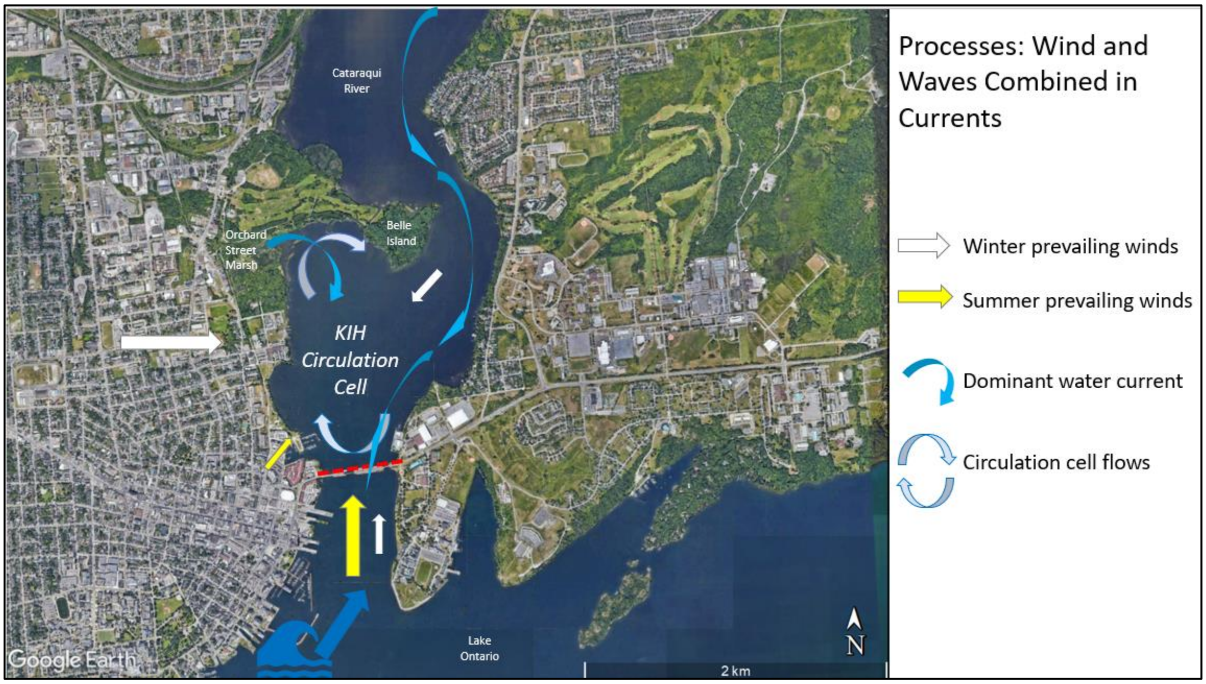


Figure 5: Conceptual overview of wind and wave processes in Kingston Inner Harbour

The La Salle Causeway structure restricts the flow of water and sediment from the harbour into Lake Ontario. River flows through three 40-meter gaps in the Causeway representing 30% of the cross-sectional area of the original opening with as much as 70% blocked by the Causeway.

A modelling-based assessment of the relative influence of environmental factors on water velocities and levels for the Kingston Third Crossing project north of Belle Island revealed that wind is the primary driver of water movement in the study area with lake surge having a significant but secondary influence (Hatch 2019). Wind from the south was the main environmental factor adopted for analysis of average water movement conditions, and the design.

2.2 Submerged Aquatic Vegetation

The impact of SAV and broader aquatic vegetation on reducing current speeds and wave energy has been well documented and can significantly increase sediment deposition and bed stability due to increased friction and root binding. Golder (2011) reported presence of the following primary SAV types in KIH: Eurasian watermilfoil, coontail, pondweeds, and eelgrass. The increased presence of cattails and Eurasian watermilfoil are associated with the accumulation of sediments related to human-induced hydrological changes. Dalrymple and Carey (1990) indicate that portions of KIH deeper than 1.7 m water depth are typically devoid of vegetation. Based on the bathymetry shown in Figures 2 and 3, and observations from historical air photos, the northern two thirds of the harbour (north of the harbour limits), and east of the navigation channel are well covered with aquatic vegetation and not significantly affected by physical disturbance through vessel activity (Golder 2017a).

SNC (2020b) report observations of SAV during the open water season in 2018 and reported significant difficulties in navigating the study area west of the navigational channel, with repetitive clogging and fouling of the propeller by SAV. SNC (2020b) further classified a September 2015 aerial image for floating, submerged and mixed (floating and submerged) vegetation types (Figure 6).

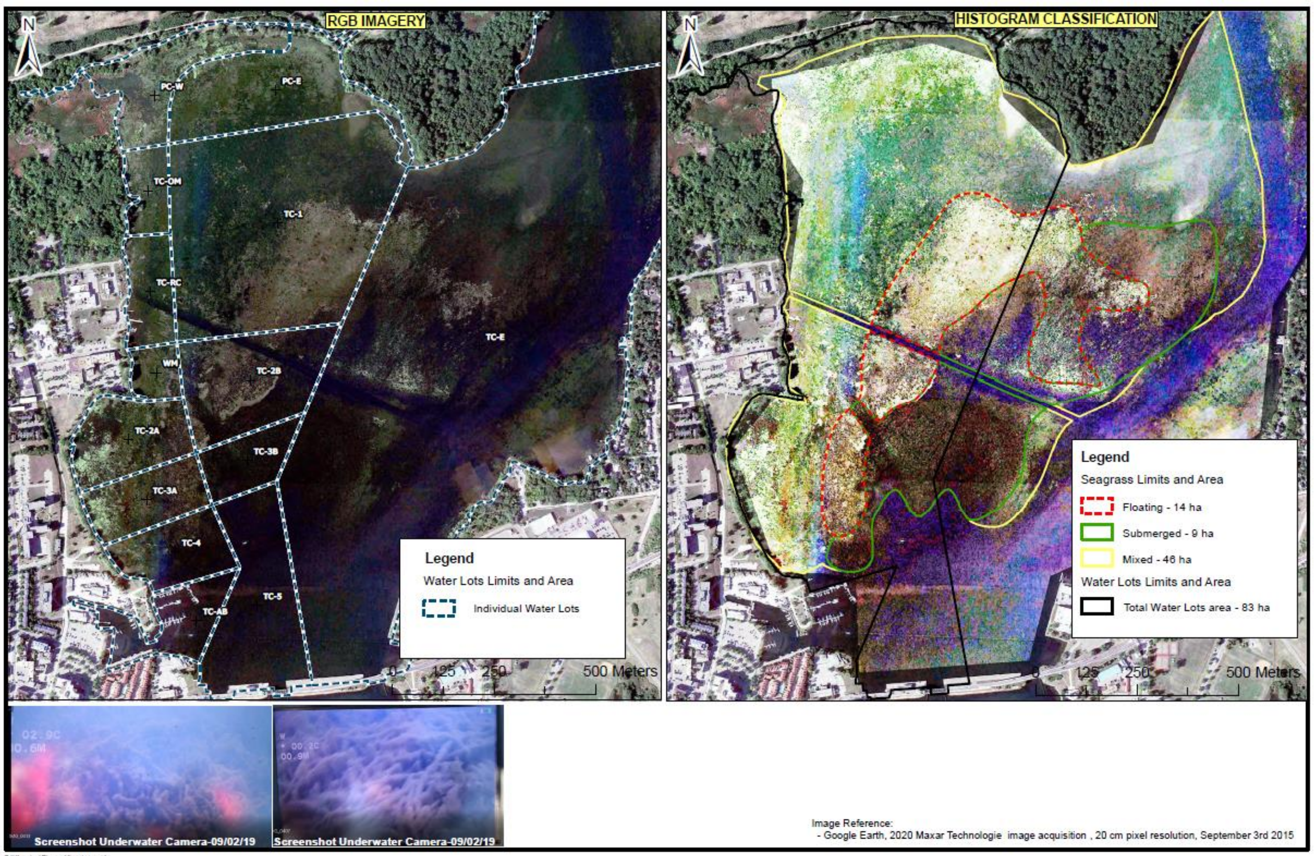


Figure 6: Macrophyte beds in the KIH basin using delimitation from satellite imagery (September 2015) and underwater camera imagery (February 2019) Source: SNC 2020

Based on SNC (2020b) analysis of satellite images, the northern two-thirds of KIH and the area west of the navigation channel were well covered with aquatic vegetation. The water lots in KIH cover a total surface area of 83 ha. Of this, 83 % (69 ha) is covered by extensive macrophyte beds (floating: 14 ha, submerged: 9 ha; mixed: 46 ha). The water lot management units with limited presence of vegetation are located in the deeper reaches at the south end of KIH (TC-5, TC-AB, and part of TC-4).

2.3 Baseline Sediment Processes

The geology in KIH consists of surficial deposits of quaternary and Holocene sediments overlying limestone bedrock (Gull River formation) (Golder 2009). Depth to bedrock ranges from 3 m on the western side of the harbour to 22 m on the eastern side (Golder 2009, 2017a).

Older sediments overlying bedrock are interpreted as being glaciolacustrine clays deposited in glacial Lake Iroquis (Dalrymple and Carey 1990). Alternating layers of peat and gyttja overlying the clay suggest cyclical variations in water levels of Lake Ontario over time where peat is formed in shallower waters, and gyttja accumulates in deeper waters. Most KIH sediment profiles contain a layer of loosely consolidated material, composed of sand, silt and organics, which exists at the surface of sites up to depths of 5 to 20 cm, with material becoming more consolidated silt and/or clay with increasing depth. Peat and gyttja accumulation are indicative of a low energy, sediment sink environment. The gyttjas are soft, water rich (generally >>80%), with fine particle sizes (muds) and with a wide range of organic contents (20–70%). Gyttjas with high organic content contain abundant root material and commonly have a mottled appearance due to bioturbation. The inorganic content of the peat is silt and clay with mean grain sizes of 0.0155 mm to 0.0055 mm. These fine soft sediments occur over most of KIH with the mostly organic peats mainly in the shallow areas along the west shoreline (Dalrymple and Carey 1990; Golder 2017a, SNCL 2020b).

The process of bioturbation (mechanical disturbance of sedimentary deposits by living organisms) can contribute to the resuspension and/or redistribution of previously buried contaminated sediments (Golder 2017a). Although a detailed analysis of species-specific bioturbation was outside the scope of Golder (2017a), reference values of 0.13 m (5 inches) and 0.15 m (6 inches) of bioturbation depth (below the sediment bed) was considered appropriate for KIH based on studies in the Great Lakes region (Avista Utilities 2015) and maximum depths observed in highly depositional environments (White and Miller 2008).

A relatively recent distribution of fine-grained surface sediments occurs across KIH (Golder 2014). The latter shows a fining of material from the western side of KIH to the east (Figure 7). An area of silty sand is present offshore of Douglas Fluhrer Park north towards the rowing club. Sandy silt occupies the area east of the silty sand followed by the dominant surface sediment deposit of silty clay as well as a smaller area south east of Belle Island covering part of the navigation channel. Silty clay surface sediment covers approximately 60% of the bed within KIH. Fine grained material is indicative of low-energy areas of deposition and coarser materials are indicative of higher-energy conditions. The slightly sandier sediment on the west side of the harbour reflects influence of higher wave energy in the shallow water.

Figure 7: Distribution of Fine-Grained Surface Sediment in Kingston Inner Harbour

A sediment plume from the Cataraqui River visible from the air photo imagery (Golder 2017a) suggests that the river sediments delivered to KIH are primarily deposited within the harbour while a smaller fraction are flushed out into Lake Ontario where they likely settle offshore. The lack of observable dynamic sedimentary features (e.g., flow induced bedforms) in KIH and in the vicinity of the mouth of Cataraqui River, supports the hypothesis that this is a low energy environment from a sediment transport perspective. It is likely that the local sediment regime within KIH is dominated by a combination of fine-grained sediments delivered via the Cataraqui River, resuspension of local bed sediments by local wind waves and contributions from local storm water outfalls.

A sediment transport study was undertaken by Golder (2017a) that examined hydrology, bathymetry, topography, geology, wind and wave action, vessel-related sediment disturbance, presence of aquatic vegetation, and potential for bioturbation. These processes were examined in relation to the distribution of contaminants within the sediments to conceptually model the physical processes governing transport and fate. It was determined that a complex sediment transport regime exists within the KIH water lot. Distributions of contaminated sediments within the harbour were influenced by a clockwise gyre in the north and east portion of the KIH water lot. The trajectory of the suspended sediments carried by the Cataraqui River is influenced by the La Salle Causeway, with some discharges to Lake Ontario and the remaining sediment redirected toward Anglin Bay (Golder 2017a; Figure 8). The low degree of flushing of sediments through the La Salle Causeway is confirmed by the continued presence of high concentrations of contaminants from historical sources at or near the surface of sediments. The study concluded that the La Salle Causeway is acting as a partial sediment trap during transport. The dominant source of sediments to KIH is a combination of fine-grained sediments delivered via Cataraqui River flows and resuspension of localized bed sediments through wave/winds, currents, and contributions from local stormwater flows (Golder 2017a). SNC-Lavalin (2020b) completed a KIH sediment stability study in 2019 to gain a better understanding of the hydraulic circulation dynamics in KIH. Water velocities within the KIH basin were assessed as low in magnitude, with no strong circulation pattern. Suspended sediment loads and turbidity were also assessed as low in magnitude, and peak turbidity was observed during wind-induced wave action originating from southeasterly winds. Water levels within the KIH basin were shown to align with fluctuations in water level within Lake Ontario (SNC 2020b).

Figure 8: Shoreline processes

As observed in previous studies, very low sedimentation rates were confirmed, with the northern portion of the water lot (PC-W and TC-1) having slightly higher rates (SNC-Lavalin 2020b). Erodibility experiments showed low near bottom water velocities, reaching critical water velocity for resuspension under easterly or southeasterly wind conditions. The generally low rates of accumulation, low magnitudes of resuspension, and physical mixing from bioturbation, combine to result in slow changes to surface sediment quality over time.

SNC-Lavalin (2020b) summarize the wind wave directions and return period at which sediment may be potentially resuspended for selected locations in KIH as follows:

- In water lot PC-W, resuspension of bottom sediment is expected from easterly and south westerly winds with a 1-year return period and from southerly winds with a 10-year return period.
- In water lot TC-2A, resuspension is more likely to occur from easterly winds with a 1-year return period, less often from south easterly winds with a 10-year return period and rarely from southerly winds with a 50-year return period.
- In water lots TC-4 and TC-RC, resuspension events from wave activity are unlikely as such events require winds with a return period of 50 years or more.

SNC-Lavalin (2020b) did not include the attenuation effect of SAV on either waves or bottom orbital velocity in KIH, therefore the recurrence of resuspension for the existing condition is likely to be significantly over-estimated by this method. The recurrence used for the baseline assessment is likely more representative of the post-remediated condition (which is expected to have lower density of vegetation, at least until recolonization occurs)

The hydraulic influence on water velocities and subsequent sediment resuspension from the Cataraqui River is limited. Overall, KIH is classified as a quiescent environment which promotes sediment settling with the presence of aquatic plants that have a stabilizing effect on the fine organic sediments. Risks associated with large sediment resuspension events were determined to be unlikely due to the low mean water velocities and extensive macrophyte bed coverage. The process of bioturbation may contribute to the resuspension and/or redistribution of previously buried contaminated sediments. Bioturbation may rework sediment to depths up to 0.15 m below the sediment bed level in KIH.

The processes affecting how sediments interact with both shorelines and the different habitat types found in the harbour may be summarized as follows:

- Coarse sediments enter the harbour from the Cataraqui River, mainly during peak flows associated with storm surges.
- Additional fine-grained sediments enter the harbour from the Cataraqui River. Because particles are smaller in size, they can be transported during both low and high flows.
- Sediment may be resuspended through forces of wind-generated waves, boat wake, propeller wash, and currents as well as bioturbation.
- Sediment movement, either towards or away from the shoreline is affected by wind, waves, and boat wake. Eroded sediment may be redistributed by currents generally moving into deeper water on the east side of the harbor or into the marshes south of Belle Island.

- The extensive presence of aquatic vegetation throughout KIH significantly reduces the sediment transport potential (sediment mobility) in most areas of the KIH study area.
- Additional inputs of coarse and fine sediments come from upland sources such as eroded soils; they are flushed in the harbour by small creeks and storm water systems.
- Fine-grained sediments are transported from the river to the marshes during storms and floods.
- Coarser sediments are trapped by vegetation and accumulate in the outer marshes.
- Fine-grained sediment, including silts and muds, are trapped and accumulate within the inner marshes.

3.0 PROPOSED SEDIMENT MANAGEMENT

A conceptual remedial options analysis (CROA) was completed in 2017; the CROA integrated multiple scientific and logistical factors that could influence the risk management decisions for the KIH, as well as a variety of remedial strategies and multiple levels of physical intervention (e.g., high, moderate, and low levels of physical intrusion). This supported a conceptual remedial design that described an overall level of intervention that is intermediate between the low and moderate intervention levels identified in the CROA (Golder 2017b), reflecting assumptions regarding the practicality, cost, proportional risk reduction, site constraints, and a subset of considerations that were anticipated to be raised by stakeholders (Golder 2019). In 2020, a preliminary remedial action plan (RAP), later renamed the Conceptual Sediment Management Plan (Conceptual SMP; Golder 2021) was prepared. The document provided an analysis of the scientific issues, estimates of indicative liability costs, alternatives evaluation, and a recommended approach for sediment management within the aquatic portions of the harbour.

3.1 Preliminary Conceptual Design

As described in the Conceptual SMP (Golder 2021) and summarized in the CCIC Project Summary (SNC-Lavalin 2022), the proposed sediment management project of KIH broadly consisted of the following elements:

- Dredging of contaminated areas in selected management units within the KIH, including some shoreline areas, with off-site disposal of contaminated material.
- Placement of a thin engineered cover (potentially including sand, activated carbon, and/or other clean materials) over areas near Anglin Bay, south of the Woolen Mill, and Orchard Street Marsh.
- Placement of a conventional sand cap with activated carbon within Anglin Bay.
- Placement of back-fill materials (with properties similar to the covers described above, or potentially with lower intervention options) in certain individual management units following dredging.
- Shoreline stabilization along the waterfronts at Emma Martin Park, the Woolen Mill, and Douglas Fluhrer Park.
- Temporary facilities and laydown-area(s).
- Associated site monitoring, restoration, and rehabilitation works.

Since the Conceptual SMP was released, an updated sediment sampling program was completed, as well as ongoing biological and archeological assessments and surveys. Stakeholder engagement, public information sessions and Indigenous Community consultations have also been underway. An amendment to the SMP is expected in Summer 2023 that will include updates to the proposed approach. These refinements are expected to include the refinement of the areas of physical intervention based on updated data, Indigenous and stakeholder engagement, consideration of environmentally sensitive habitats or areas of archaeological significance, and constraints identified in the CCIC. The amendment to the SMP will also include updates to the proposed intervention techniques across management units but will not provide detailed design features in individual management units. For example, based on stakeholder feedback regarding the proposed shore protection options, which originally included an engineered revetment structure placed over a sediment cap, it was recognized that further consideration should be given to nature-based approaches for shoreline restoration. The benefits of nature-based approaches are discussed in the following section (Section 3.1).

3.2 Nature-Based Shoreline Restoration

There is growing recognition that the development of sustainable and resilient coastal restoration and protection infrastructure presents an opportunity to make intentional use of processes and functions found in natural systems (e.g., nature-based solutions), to strengthen the overall performance and expand the coastal infrastructure value (Bridges et al. 2021).

Nature-based (green-engineered) shore protection features can include several components of plant systems such as uplands, wetlands, and submerged aquatic vegetation. These plant systems are an important component of the harbour, providing benefits to improve shoreline resilience and stability and can be used to reduce wave and current action to protect the riverbed and the shorelines from erosion. For example, upland plants can reduce wind energy, stabilize land surfaces and shelter shorelines from winds that produce waves and currents. They also provide habitat for many species and adapt to changing water levels. Submerged aquatic vegetation provides direct attenuation of waves and currents reducing the potential for riverbed erosion and sediment transport. A nature-based approach is well suited for the KIH given the sheltered nature of the harbour, as the lower wave action limits shoreline stress, making it easier for shoreline plants to establish. Some of the opportunities within of a nature-based approach for the KIH include:

- Providing habitat improvement for already impacted or hardened shorelines, especially the enhancement of turtle habitat and the establishment of aquatic coastal and riparian vegetation.
- Beautifying the shorelines while also limiting the potential for human access to the water to reduce human exposure to COCs.
- Replacement of invasive species with native species.

The existing western shoreline of KIH includes habitat features that are potential constraints to remediation (e.g., sensitive habitats for turtles and other animals that require protection against unacceptable disruptions) but also potential opportunities for improvements (e.g., naturalization of coarse-material armored shorelines, contouring of slopes for animal migration to riparian areas, native plantings to support desired ecological and hydrological properties). Specifically, the TC-RC management unit near Emma Martin Park, the WM management unit in front of the Woolen Mill along with TC-3A and TC-4 management units along Douglas Fluhrer Park appear to offer the greatest potential for habitat improvements and shoreline restoration after nearshore contamination

(Figure 1). Although pockets of quasi-natural habitat existing in these areas, including emergent aquatic vegetation and basking logs for reptiles, some of the shoreline areas have large diameter rocks and retaining structures that are less suited to the local ecology. Several shoreline areas in the harbour, such as the Orchard Street Marsh and shoreline vegetation in the vicinity of Molly Brant Point, remain important habitat for turtles and wildlife, and will require special care and delicate remediation methods. Based on the identification of critical habitats from the Detailed Impact Assessment, some of these areas may require incorporation of natural recovery approaches.

Based on early feedback from stakeholders, four guiding principles were proposed in designing nature-based (green-engineered) shorelines to be applied to future updates of the SMP and into the detailed design phases. These principles are currently as follows:

1) Develop turtle-friendly habitat to support their shoreline uses; this may include shoreline planting, use of natural shoreline stabilization like large woody debris, and intermittent but selective use of large rock.

2) Balance human and recreational values with ecosystem, habitat, and aesthetic values. Examples include re-naturalized shorelines, hidden erosion protection, and increasing shoreline planting. Human access to water may need to be limited in some areas to protect against trampling of habitat.

3) Where possible, use the natural shoreline features of KIH including small size materials or rocks, aquatic plants, and contouring of shoreline to increase project benefits.

4) Separation of sensitive aquatic habitat features from human recreational access to prevent trampling or disturbance of natural habitat features, while still allowing for paths for human use of the upland that consider aesthetics, isolation from contact with contaminated sediments, and compatibility with the City of Kingston's Master Plan.

In selected areas of KIH where the implementation of nature-based shorelines is appropriate, these principles will help to preserve or restore physical processes, maintain, or enhance the habitat and function of the shoreline, prevent or reduce contamination and protect the shorelines from erosion. Where localized interventions are required to access highly contaminated sediments, activities will be timed, sequenced, and managed to limit habitat disruptions, and where needed, compensated for in other areas of KIH shoreline and wetland habitats.

4.0 POTENTIAL ENVIRONMENTAL EFFECTS

Lacustrine processes within the KIH may be affected by Project activities. Effects of most activities are expected to be minor in terms of degree of influence on long-term or broad scale hydrological and limnological processes. Most disruptions will be short term, associated with construction activities, and will be managed with controls. Minor to moderate longer-term changes in hydrodynamic and sediment processes may occur from project activities that directly modify the harbour bathymetry and substrate type, such as dredging and capping. The thickness of dredging in most areas will be confined to approximately 1.0 m below current grade, and even in these areas various options for backfilling with an environmental substrate are being considered.

Overall, the implementation of the broad design in the Conceptual SMP will result in an increase in water depths (lowering of sediment bed elevation) over portions of the western KIH. For example, dredging to a net depth of 0.5 metres below existing bed level will result in a small but potentially measurable reduction in near-bed wave orbital velocities with a commensurate reduction in local sediment transport potential. Such changes would potentially be offset by an increase in wave energy elsewhere or by an increase in sediment transport potential due to reduction in SAV. The use of dredging combined with selective capping means that some changes in water and sediment transport dynamics will occur. However, their influence is not expected to be sufficient to cause major changes to the baseline condition described in Section 2.3; rather the influences would be localized depending on the configuration of the final dredging prisms, design of slopes between adjacent areas, and geotechnical properties of the post-remediation sediment substrate. The net effect of the lacustrine processes, including in terms of resuspension potential, shoreline erosion, and flood control could be evaluated by a model comparison of existing conditions compared with the dredged and capped condition (see Section 4.1). The purpose of this section is to identify, at a preliminary level, the potential for unintended consequences, such that appropriate measures can be adopted to reduce or eliminate potential for their occurrence.

4.1 Summary of Data Gaps

There is a good baseline understanding of the existing lacustrine processes within the Project area. However, there are some information gaps that should be addressed prior to beginning in water works:

- Analysis of spatial and temporal sediment transport dynamics for KIH based on the proposed combined configuration of remedial activities for each Management Unit. If required, the latter should include 2D modelling of the potential effects of the proposed remedial activities (dredging, cap thickness, changes in depth and SAV) on currents, waves, and sediment transport potential.
- Development of dredge prism configurations (limits for level of increase or decrease in water depth, slopes between adjacent management units) to maintain existing lacustrine processes within acceptable limits based on potential changes in sediment transport identified by the recommended modelling as described above.
- Measurement and analysis (e.g., modelling) of water level fluctuations in KIH at various timescales (e.g., monthly, annually) and effects on local currents and sediment transport potential in KIH.
- Analysis of extreme weather events and their affect on the riverbed within the Project Area. This would include the intensity and frequency of storm surges and hazard wave effects in KIH, as well as potential climate impacts during all Project phases. This analysis should include measurement and modelling as described above.
- Ice thickness and movement may be the key design consideration for shallow water capping and shore protection design; site specific ice thickness and mobility data are not available at this time.

4.2 Thresholds

Without mitigation and/or specific Project design considerations, in-water works such as staging, dredging, and capping could adversely impact some lacustrine processes at the local scale. However, the design of the overall remediation plan will limit these alterations, and the remaining changes will be both minor in magnitude and addressed through design of shoreline elements and other techniques. Table 1 summarizes the project scenarios, desired outcomes, and associated thresholds associated with lacustrine processes at the three future milestone stages of the Project. Lacustrine processes generally do not have quantified criteria or thresholds similar to Environmental Performance Objectives (EPOs) but rather consider the potential for undesirable or desirable changes to the baseline condition. In general, minimizing or selectively limiting changes (e.g., maintaining bathymetry and shoreline geometry where appropriate) and implementing appropriate mitigation (e.g., designing slopes, depths, and geotechnical features to maintain desired properties of sediment resuspension, erosion potential, and habitat value) helps meet Sediment Quality and Water Quality threshold targets.

The key thresholds identified for each stage of the Project are listed below and described further in Table 1:

- **Baseline (existing) condition**—No thresholds applicable for this stage relate to lacustrine processes.
- **Conditions during active works**—Thresholds for this stage relate primarily to managing changes in lacustrine processes due to mechanical sediment disturbance, and through appropriate controls on the release or generation of suspended sediments during works.
- **Conditions following completion of works**—Thresholds relate to management of parameters that affect lacustrine processes such as restoring depth parameters, slopes, and substrate type to agreed upon limits and the restoration of submerged aquatic vegetation.
- **Long-term stabilized conditions**—Thresholds relate to functional green engineered solutions that meet shore protection requirements and habitat enhancement expectations.

4.2.1 Valued Components

Valued Components (VCs) are environmental, health, social, economic, or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous peoples, federal authorities and interested parties. Table 1 summarizes the potential impacts to Valued Components related to lacustrine processes during different scenarios over the course of the Project. Under each scenario the desired outcomes, the thresholds for meeting the desired outcomes, the potential design considerations to reduce risks to lacustrine processes, and the additional works required to resolve information gaps are discussed.

Table 1: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Lacustrine Processes

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required or Recommended
1. During Remediation in Zone of Dredging						
Site preparation and removal of existing shore infrastructure and shore protection may result in temporary changes in the stability of the shoreline and substrate with the potential to alter sediment transport processes in Kingston Inner Harbour.	Water levels, wind generated waves, and currents in the sediment management areas continue to fluctuate within natural ranges and broad circulation patterns are not disturbed. Shorelines and river bed remain stable during remediation.	Changes to shorelines and sediment movement within the project area will be monitored during remediation within acceptable limits.	Medium	Yes	Structures such as docks and shore protection will be replaced with like structures in the event of temporary removal. Design of dredge prisms will consider slopes and stability of sediment in each management unit. The environmental management plan (EMP) will detail project monitoring requirements, which will include measures to avoid excessive sediment disturbance.	Conduct lacustrine process and sediment transport modelling to compare remediation with baseline conditions. Monitoring plans should include procedures for corrective actions to be taken in the event of significant alteration to baseline processes.
2. Post Remediation in Zone of Dredging						
In-water works such as dredging, capping, and shoreline stabilization will result in changes in local depths resulting in alteration of SAV. Temporary or permanent loss of SAV may result in increased frequency of the potential resuspension (increase in TSS/turbidity) by wind waves and currents	Detailed design will account for hydrodynamic and ecological factors that influence restoration of SAV. Restoration of SAV will consider both plantings of native materials and generation of substrate conditions (depths, particle sizes, and flow conditions) to facilitate redevelopment of SAV communities.	SAV within management units is eventually restored to acceptable limits.	Medium	Yes	N/A	SAV restoration plan. Hydrodynamic (wave and current modelling) and related assessment of sediment transport potential is recommended to compare the existing condition to the post-project (dredged) condition. Evaluate whether risks from temporary loss of SAV are significant in terms of changes to sediment transport potential, and develop mitigations as appropriate.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required or Recommended
In-water works such as dredging, capping, and shoreline stabilization will result in changes in local depths resulting in changes to local hydrodynamics and sediment transport	Water levels, wind generated waves, and currents in the sediment management areas continue to fluctuate naturally and circulation patterns are not disturbed.	Bathymetry of management units is restored within set depth parameters.	Medium	Yes	In some cases, dredge cuts will be partially backfilled with engineered covers to restore the bed elevation to balance exposure reduction with navigational depth considerations (e.g., Anglin Bay).	Hydrodynamic (wave and current modelling) and related assessment of sediment transport potential is recommended to compare the existing condition to the post-project (dredged) condition to evaluate if dredging related changes in depth are significant in terms of changes to sediment transport potential.
3. Long-Term Post Remediation within the Kingston Inner Harbour						
Excavation of contaminated material in the upland and riparian zones may contribute to loss of shoreline protection function (e.g., stability) and temporary loss and degradation of habitat.	Functional green engineered solutions that meet shore protection requirements and habitat enhancement expectations. Green-engineered solutions may include beach nourishment and re-planting of riparian vegetations and nearshore (SAV).	Monitoring of shoreline position and shoreline profile within acceptable limits.	Medium to High	Yes	SMP and detailed designs to consider appropriate site-specific solutions to minimize losses of function.	SAV restoration plan. Shoreline protection and restoration designs.

Notes:
KIH = Kingston Inner Harbour; SAV = submerged aquatic vegetation; TSS = total suspended solids; EPO = Environmental Performance Objective; WQMP = Water Quality Management Plan; SMP = Sediment Management Plan.

[1] “The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[2] “The standard of proof will be expressed as “high,” “medium,” or “low,” depending upon the circumstances of the project-VC interaction.” (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[3] Proven Mitigation Measures, Best Management Practices, Guidelines and Standards available (see CCIC 2023 Appendix C)

5.0 SUMMARY OF CONSTRAINTS

Potential constraints for lacustrine processes in relation to Project activities include:

- Ship mooring infrastructure and geotechnical constraints in some management units [redacted] could be a constraint to the dredging activities and would limit the proximity of dredging to the margins of the management unit and/or necessitate slopes to dredge cuts that reduce the volumes of sediment that can be safely excavated.
- Existing shoreline elements in some areas include large diameter materials used to armour shorelines and provide bank stability. Nature-based shorelines can provide creative solutions to isolate the sediments and stabilize the shoreline from present or future erosion. However, as these shoreline elements would require modifications to shorelines owned by the City of Kingston, agreements would be required to preserve shoreline features that accommodate geotechnical, contamination, recreational, and ecological/biological objectives for the shorelines.
- The existing bathymetry within the enclosed portion of Anglin Bay is assumed to be satisfactory for the long-term operation of the bay as both a recreational and industrial resource. If required, any future maintenance dredging of the bay should avoid significant disruption of the proposed capping.
- The time lag between dredging, capping and re-establishment of sub-aquatic vegetation (whether planted or through natural recolonization of substrate) may constrain sediment cap performance criteria; cap design and riverbed substrate needs to be resilient to erosion without SAV present in post project condition. In addition, surface sediment substrate type needs to be amenable to plant community recolonization.
- Ice thickness and movement may be a key design consideration for shallow water capping and shore protection design in addition to, or over and above wave action. Site-specific ice thickness and mobility information should be developed using synthetic methods (such as modelling) and any observational data that may be available.

As several of the above constraints relate to stakeholder preferences, and sometimes require trade-offs among desired features, specific Project design considerations should incorporate input from ongoing stakeholder consultation. This is particularly important where physical works overlap property boundaries, requiring agreements and authorizations to modify physical and biological features of shoreline areas.

6.0 CLOSURE

We trust this information is sufficient for your needs at this this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

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https://golderassociates.sharepoint.com/sites/162644/project files/6 deliverables/3.0_issued/22523199-004-tm-rev0/22523199-004-tm-rev0-lacustrine processes 15feb_23.docx

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APPENDIX D

Conceptual Constraints and Impact Considerations – Sediment Quality (WSP, 2023)

TECHNICAL MEMORANDUM

DATE 6 February 2023 **Reference No.** 22523199-005-TM-Rev0

TO [redacted]
Public Services and Procurement Canada

CC

FROM Gary Lawrence **EMAIL** [redacted]

CONCEPTUAL CONSTRAINTS AND IMPACT CONSIDERATIONS – SEDIMENT QUALITY

1.0 INTRODUCTION

Golder Associated Ltd (amalgamated under WSP Canada Inc. in January 2023), was retained by Public Services and Procurement Canada (PSPC), on behalf of Transport Canada (TC) and Parks Canada Agency (PCA), to identify conceptual constraints and impact considerations related to sediment quality for the proposed Sediment Management Project (the Project) at Kingston Inner Harbour (KIH) in Kingston, Ontario (the Site). The memo was completed to support the sediment quality component of the Conceptual Constraints and Impact Considerations (CCIC) document for the Project being completed by SNC-Lavalin Inc. (SNC-Lavalin). The CCIC is intended to support a Detailed Impact Assessment (DIA) by providing preliminary, high-level considerations of potential Project impacts based on information gathered to date. The CCIC provides early identification of remaining information gaps and additional works required to address the information gaps and identifies any Project constraints that are known at this time (SNC-Lavalin 2022).

1.1 Project Setting

The KIH is bounded by Highway 2 (LaSalle Causeway Bridge) to the south and Belle Island to the north and includes an approximate 1.7-kilometre (km) length of the Great Cataraqui River. TC is responsible for the management of most sediment areas in the southern section of the KIH (i.e., south of Belle Island). PCA is responsible for sediments in the portion of the KIH immediately north and southwest of Belle Island. A small percentage of the southern half of KIH is owned by other parties, including a square water lot adjacent the former Woolen Mill, small areas of foreshore near the Kingston Marina, and a Military Reserve in the southeastern corner of KIH (Figure A-1).

The primary contaminants of concern (COCs) in sediment include chromium, polycyclic aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs); these COCs are the risk drivers for chemical management within the KIH. The Project is currently in the conceptual stage, but is expected to include remediation of the bedded sediments in areas of the KIH with the highest concentration of primary COCs. Other elevated COCs in the proposed remedial areas include antimony, arsenic, lead, mercury, silver, and zinc (Golder 2017). These secondary COCs are highly correlated with the primary COCs and do not require quantitative remedial objectives because they will be addressed jointly with primary COCs.

1.2 Objectives

Based on the information available to date, the overall goal for sediment quality management during the Project is to provide reductions of primary COCs in the surface sediments of KIH, with chemical removals focussed on areas that current yield moderate (or greater) levels of risk to primary producers, fish, wildlife, and/or human health. Due to the cooccurrence of elevated concentrations of several substances in sediment contamination from legacy sources, remediation will also result in reductions of secondary COCs even where quantitative remedial targets for the latter are not defined.

Because improvement in sediment quality is a primary objective of the Project, the considerations that apply to sediment chemistry are different from those that apply to other components of the project evaluated in the DIA. The sediment remediation components of the Project necessarily involve in-water works, such as dredging and capping material placement. As described in the Risk Synthesis (Golder 2016), Conceptual Remedial Options Assessment (Golder 2017a), and the Sediment Management Plan (SMP; Golder 2021), the levels of chemical contamination (and associated health risk) exceed safe levels for multiple types of organisms and in multiple management units within KIH. Appendix A (Figure A-2) presents the layout of the various sediment management units in KIH, and depicts the draft layout of the conceptual remedial design, including areas of proposed sediment excavation (dredging) and surrounding areas of lower intervention remedial methods.

Although the degree and details of physical intervention will incorporate flexibility and customization as the Project progresses toward detailed design, requirement for physical intervention exists for several management areas, particularly along the western shoreline of KIH. Therefore, unlike several other natural resource components, where the objective is to avoid alterations to the extent possible, the SMP is focussed on deliberately modifying the sediment quality profile to result in chemical risk reduction.

Broadly, the Project is intended to implement targeted removals and/or isolation of contamination in a manner that will:

- Provide both localized and broad (harbour-wide) reductions of primary COCs to reduce ecological and human health risks;
- Provide high efficiency of chemical removals per unit of effort spent, such that the positives of chemical risk reduction outweigh short-term disruptions;
- Rely on natural recovery processes in areas of the harbour that currently have risks that are low to negligible;
- Prevent or limit the degree of habitat disruption during project works, particularly for sensitive ecological components;
- Provide potential for recolonization and restoration of affected areas and;
- Prevent unacceptable resuspension or release of contaminants during project works, thereby preventing impairment of water quality.

Based on output from the Conceptual Remedial Options Assessment (Golder 2017a), and the draft SMP (Golder 2021), there are substantial areas in the central and eastern portions of KIH that have been confidently assigned as suitable for no-action or monitored natural recovery. Although concentrations of several COCs exceed background levels in these areas, the magnitude of contamination and corresponding risk to aquatic life and human health is low. This means that these areas can be excluded from further consideration in the SMP and CCIC.

The CCIC is intended to support a Detailed Impact Assessment (DIA) by providing preliminary, high-level considerations of potential Project impacts based on information gathered to date. Several of these considerations have been articulated in the conceptual planning stages of the Project (Golder 2016, 2017a, 2019, 2021), including consideration of chemical, ecological, archaeological, administrative, infrastructure-related, and other constraints to the remedial strategy. During early stages of conceptual remedial options evaluation, management units were identified to customize candidate management options to specific portions of the water lot; the overall Site-wide intensity of physical intervention was categorized into high, moderate, and low levels. Multiple risk management strategies and technologies were identified, including both conventional intrusive options (e.g., capping, dredging) and lower intrusion options (e.g., thin-layer capping with active layers, monitored natural recovery). Such strategies were focussed on long-term project objectives, and evaluations were conducted prior to initiation of DIA activities, stakeholder consultation, or detailed study design for any management unit. As such, this memorandum emphasizes recent updates to our understanding of these considerations, distinguishes between potential short-term and long-term effects, and summarizes the information in a manner suitable for incorporation in the CCIC.

Due to the nature of physical interventions in contaminated sediment, there are four temporal periods of relevance to remedial planning:

- **Baseline (existing) condition**—This condition describes the sediment quality prior to the implementation of intrusive remediation. It affects the remedial design through prioritization of areas for physical removals, specification of depths requiring removals, and selection of appropriate remedial tools for each area requiring physical management.
- **Conditions during active works**—The condition describes the temporary changes in sediment quality resulting from sediment disturbance. Although methods are available to limit the degree of disturbance, including sediment resuspension and erosion controls, sediment quality can change from baseline as part of physical works, including mobilizing the remediation equipment, processing bed sediments, and managing dredge residuals.
- **Conditions immediately following completion of works**—Following completion of the initial remediation phase, it is necessary to confirm the post-remediation sediment quality, and develop contingency measures as necessary.
- **Long-term stabilized conditions**—Following completion of all engineering measures, and after sufficient time has passed for the sediment bed to stabilize (e.g., mixing of surface layers and reestablishment of plant and animal communities on the post-dredge surface). This condition describes the long-term state of sediment quality, and is used to gauge the long-term success of the project.

In addition to the Project objectives summarized above, there are additional prerequisites to remedial planning directly from FCSAP Aquatic Sites Framework (DFO 2019):

1) It is important to determine causation before taking remedial action(s) involving physical works (discussed in Section 2.2 below).

2) It is important that on-going sources of contamination are controlled before taking remedial action(s) involving physical works (discussed in Section 2.3 below).

3) It is important that remedial actions not cause more environmental damage than they remedy (discussed in Section 3 below).

1.3 Regulatory Context

Section 3.0 of the SMP (Golder 2021) specifies regulatory requirements and guidelines that could influence the development of the Project design for KIH. Such included several components of federal legislation *Fisheries Act*, *Species at Risk Act*, *Migratory Birds Convention Act*, *Canadian Navigable Waters Act*, the *Impact Assessment Act*, Historic Canals Regulations, and *Parks Canada Act*. Under provincial jurisdiction, the *Ontario Endangered Species Act*, *Ontario Environmental Protection Act*, *Ontario Water Resources Act*, Ontario Contaminated Sites Regulation (O. Reg. 163), *Ontario Heritage Act*, and the *Planning Act* may all apply to the Project design. Finally, municipal planning documents also regulate the development of shoreline areas that may be influenced by the project, including 1) the Official Plan (Kingston 2019) that identifies natural heritage features, Provincially Significant Wetland and Riparian Corridor, Environmental Impact Assessment requirements, and other environmental policy considerations, and 2) Cataraqui Region Conservation Authority regulations of flood potential and natural heritage features in the Cataraqui River watershed.

A common aspect of the regulatory documents summarized above is that, although disturbances associated with the project are not necessarily prohibited, there are several environmental considerations that must be formally evaluated, and that may trigger the need for specific environmental investigations, permits, and other authorizations. Another common aspect of the above acts and regulations is that multiple jurisdictions apply along the shoreline of KIH, in part related to the complexity of land ownership, whereby parcels of water lot are owned by different parties (e.g., federal custodians, City of Kingston, and private landowners). The management plan also includes some shoreline areas under provincial jurisdiction, where combinations of federal, provincial, and municipal statues may apply.

1.4 Document Organization

To address conceptual constraints and impact considerations related to sediment quality prior to, during, and after the Project, the following information is presented in this memo:

- **Existing Conditions (Section 2.0)**—Summarizes the available information related to the existing sediment within the KIH, as well as reference conditions (Section 2.1). The causes of elevated risk related to sediment chemistry within the KIH are summarized (Section 2.2), along with source control measures that have been implemented to minimize inputs of COCs along the KIH (Section 2.3). Overall, this section evaluates whether available sediment quality data are sufficient to provide a baseline against which changes during and after in-works can be compared, and if terrestrial sources of COCs have been effectively controlled to prevent re-contamination into the KIH.

- **Potential Environmental Effects (Section 3.0)**—Provides an overview of the potential environmental effects that may result if sediment quality is not managed during the Project. Data gaps related to the current understanding of surface sediment quality within the KIH are identified. An overview of the approach used to establish environmental performance objectives is also provided (Section 3.2). Finally, the findings are summarized with respect to preliminary considerations of potential impacts to sediment quality from the Project (i.e., the Valued Components), the desired outcomes, thresholds for meeting the desired outcomes, potential design considerations to reduce risk, and additional works required to resolve information gaps (Section 3.3). It is expected that these summary findings will be incorporated in an updated version of the CCIC document.
- **Summary of Constraints (Section 4.0)**—Identifies any known Project constraints specific to the detailed design that may impact surface sediment quality and cause potential environmental effects if not accounted for.

2.0 EXISTING CONDITIONS

The current conditions of sediment quality provide a baseline against which the performance of the project can be gauged. The exposure parameters of greatest interest include sediment concentrations of metals (particularly chromium, but also antimony, arsenic, copper, lead, mercury, silver, and zinc) and select organic contaminants (primarily polycyclic aromatic hydrocarbons [PAHs] and polychlorinated biphenyls [PCBs]). Other chemical contaminants (e.g., other metals, nutrients, organotins) have been screened against background and conservative sediment quality guidelines and determined not to meaningfully influence sediment quality during any stage of the Project. Similarly, the area of interest within KIH is the western half only, as the eastern half of KIH has been evaluated in detail and determined to exhibit negligible to low risk to all receptors (Golder 2016).

The characterization of current conditions described below emphasizes the key chemical characteristics that drive health risks. Additional details of the distributions of these and other parameters are provided in Golder (2016, 2022), including depictions of conventional parameters (e.g., total organic carbon, particle size distributions).

2.1 Current Sediment Profiles

Extensive sediment quality characterization has been completed over KIH, including upstream reference areas, over multiple decades. The early conceptual planning stages of the Project (Golder 2016, 2017a, 2019, 2021) relied mainly on sediment quality data collected between 2008 and 2013, a period over which the greatest densities of surface sediment quality samples were collected. Many of the data, including historical collections from several independent organizations, were collated by ESG (2014), and additional collections were conducted and summarized by Golder (2011, 2012, 2013b, 2014a, 2016). All those data, following screening for relevance (e.g., removal of data for dredged sediment), were summarized in Golder (2016) as part of the synthesis of environmental quality and risk information.

To distinguish sediment quality in the upstream reference area from the contaminated portions of the PCA and Transport Canada water lots south of Belle Island, sediment quality profiles for reference areas were calculated using the following methods:

- Surface grab samples from the years 2004 to 2011 were identified in ESRI ArcGIS (10.8)

- The upstream sampling area was constrained to the area marked on Figure A-1 as Parks Canada (Upstream Reference Zone), which has the management unit code of PC-N. The reference zone also aligns with Cataraqui River north of management unit TC-E on Figure A-2. This upstream area was identified by both ESG (2014) and Golder (2016, 2017a) as an appropriate harbour reference condition. The sediment quality in PC-N includes diffuse regional background inputs of anthropogenic substances but is not influenced by Project-related point sources, and also has similar sediment substrate. Ecological effects in this area were negligible in magnitude based on the screening risk assessment (Golder 2016).
- The Spatial Analyst Inverse Distance Weight (IDW) tool was applied in ArcGIS software ArcMap to calculate the surfaces for contaminants in PC-N . Within the IDW tool the optional/selectable variables included:
  - The input barrier was used to prevent the tool for interpolating across the land of Belle Park and Belle Island Park.
  - For chromium outliers 2011-M and SE36 were excluded.
- With the surfaces created, the ArcGIS Pro Zonal Statistics tool (Zonal Statistics within Spatial Analyst) was used to calculate the arithmetic mean and 90th percentile value for PC-N.

The above procedures yielded a spatially weighted and site relevant characterization of local reference conditions, with summary statistics summarized in Table 1.

Table 1: Summary of Reference Area Sediment Contamination

Constituent	Sample Size for Reference Area (excluding outliers)	Mean Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [Mean]	90th percentile Surface Concentration (mg/kg dry weight)	Sediment Quality Category(1) [90th percentile]
Antimony	15	0.06	<0.2	0.18	<0.2
Arsenic	15	2.46	<ISQG (5.9)	2.99	<ISQG (5.9)
Chromium	13	54.18	<PEL (90.0)	80.38.0	<PEL (90.0)
Copper	15	29.92	<ISQG (35.7)	33.54	<ISQG (35.7)
Lead	15	41.59	<PEL (91.3)	55.64	<PEL (91.3)
Mercury	15	0.079	<ISQG (0.17)	0.22	<PEL (0.49)
Silver	15	0.21	<LAET (0.5)	0.50	<LAET (0.5)
Zinc	15	108.83	<ISQG (123)	126.88	<PEL (315)
Total PAHs	15	1.66	<LEL (4.0)	3.82	<LEL (4.0)
Total PCBs	15	0.064	<LEL (0.07)	0.17	<PEL (0.28)

(1) Sediment quality category shown is the category as depicted in the legend of corresponding figure in Appendix A, with cool colours (blue and green) representing the lowest level of contamination, yellow indicating moderate contamination, and hot colours (orange through red) representing the highest levels of bulk sediment contamination. Colour categories do not necessarily indicate potential for ecological risk, but rather overall magnitude of sediment contamination. Cell entry indicates the federal sediment quality guideline (mg/kg dw) or concentration threshold at upper end of interval.
ISQG = Interim Sediment Quality Guideline (Canadian Council of Ministers of the Environment)
PEL = Probable Effect Level (Canadian Council of Ministers of the Environment)
LAET = Low Apparent Effect Threshold (Avocet 2003)
LEL = Lowest Effect Level (Ontario Ministry of Environment 2008)

For all contaminants of interest, reference sediment concentrations are lower than probable effect level or equivalent, including both mean and upper tail (90th percentile) estimates (Table 1). These conditions, although not pristine, reflect low magnitude of urban influence and acceptable sediment quality for working harbours (FCSAP 2021). For most substances, average reference sediment quality is below the Interim Sediment Quality Guideline (ISQG), which is a highly conservative screening value for sediment quality screening.

During early consultation stages, several stakeholders raised the question of whether the contaminant distributions in KIH sediment remain stable over periods of a decade or more. To address this question, and to provide additional delineation data for advancing the conceptual design, PSPC contracted Golder Associates Ltd. (now known as WSP Canada Inc.; WSP) to lead a supplemental sampling program in Fall 2021, emphasizing the water lot sections within and adjacent to areas proposed for active intervention. These data were combined with sediment chemistry data from within the past decade[1] to produce an updated sediment chemistry surface. Golder (2022) describes the methods and factual results from this supplemental sampling program. Updated sediment chemistry distributions for the primary and secondary COCs are summarized in Appendix A (Figures A-3 through A-12). These figures depict surface weighted averaged (smoothed) distributions of COCs identified in the detailed risk assessment. Surface sediment distributions in Appendix A of this report were compared against the historical surfaces found in Appendix A of Golder (2017a) to identify similarities and differences.

Some general conclusions from the updated sediment quality profiling included:

- The spatial distribution and magnitude of contamination in Fall 2021 remained broadly consistent with earlier profiling. There was no widespread evidence of significant recovery or deterioration of sediment quality over the past decade, with concentrations of inorganic and organic substances remaining well above sediment quality guidelines, and at similar magnitude and spatial distribution to earlier characterizations.
- Numerous substances remain elevated relative to both upstream reference conditions and relative to the eastern half of KIH. The gradient of improving sediment quality moving from west to east was confirmed, in accordance with proximity to legacy sources along the western shoreline.
- Substantial portions of KIH, including the central areas (e.g., TC-1, TC-2B) have elevated bulk sediment concentrations relative to background and relative to conservative generic sediment quality criteria, but not at concentrations that yield unacceptable risks based on the results of a quantitative risk assessment (Golder 2016). Because the remedial objective is to reduce only the substances that cause moderate or greater risks, leaving such low-level concentrations in place within the central harbour is acceptable, and the updated concentration profiles indicate that this approach remains appropriate.
- For some constituents, which previously exhibited isolated pockets of elevated sediment chemistry in the central KIH (relative to surrounding areas within the same management unit), such localized areas did not appear as heterogeneous in 2021. In is unclear whether this finding relates to standardization of collection and analytical methods in recent data collections (i.e., earlier compilations reflected multiple distinct investigations with differences in collection methods and analytical techniques), or to a more homogenous

[1] Although data from prior to 2021 were included in the updated chemistry surfaces, most results depicted in Appendix A plots are from Fall 2021 sampling. The figures in Appendix A distinguish between the most recent results (Fall 2021 depicted as square symbols) and prior decade (2011–2020 inclusive depicted as circular symbols)

field condition. Antimony, mercury, and PCBs are examples of COCs that exhibited smoother distributions in 2021 relative to the patchier profiles evident in earlier data compilations.

The updated contamination distributions for key COPCs are summarized below, with comparisons made to the earlier profiles summarized in Golder (2017a).

Metals/Metalloids

- **Antimony** (Figure A-3)—The updated sediment quality profile indicates that antimony remains at a stable magnitude of harbour-wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines developed for freshwater sediments. Most sediment concentrations in KIH fall below the 2LAET (second Lowest Apparent Effects Threshold) guideline, a value calculated by Avocet (2003) using statistical analysis of co-occurring freshwater sediment chemistry and toxicological endpoint data. The main difference in the 2021 dataset is that the localized exceedances of the 2LAET guideline are now limited to the nearshore areas along the western shoreline, particularly adjacent to the Woolen Mill (WM) and Parks Canada (PC-W) shorelines. Earlier characterizations indicated occasional anomalous elevated antimony concentrations in the central harbour (TC-1, TC-2B), but these hotspots have not been confirmed in recent sampling. Overall, antimony indicates similar, but smoother (i.e., fewer localized areas that deviate from the broad spatial gradient), concentration distributions in recent sampling. Furthermore, because antimony is highly coincident with other COCs, including other metals/metalloids, the remediation design for other constituents will address antimony contamination of interest.

- **Arsenic** (Figure A-4)—The updated sediment quality profile indicates that arsenic remains at a stable magnitude of harbour-wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines for freshwater sediments. Both historical and recent chemistry distributions indicate that several management units exceed the CCME Probable Effect Level (PEL) for freshwater sediment, although such exceedances of the PEL are small in magnitude in most locations. Exceedances of the 2LAET guideline from Avocet (2003) are restricted to two management units (WM, RC), and this spatial profile has remained generally consistent over time. The main difference in the sediment profile for arsenic is that the conditions in the northern half of the RC management unit (along the submerged utilities corridor) have improved in the last decade, and this may reflect the positive effect of historical dredging in the affected area. Overall, distribution of arsenic at levels of concern remains localized in this one area of western shoreline sediment. The cooccurrence of these peak arsenic levels with other COCs, including other metals/metalloids, means that remediation design targeted to other constituents will address arsenic contamination of interest.

- **Chromium** (Figure A-5)—Chromium remains the single COC with the highest overall magnitude of exceedance of generic sediment quality guidelines and background Cataraqui River sediment concentrations. Over a century of tannery activities were conducted in the Davis Tannery lands beside the Orchard Street Marsh. Although the tannery closed in the 1970s, the proximity to the marsh, which was used for discharge of industrial waste until 1974, has left a clear profile of chromium contamination in sediment. Nearly all sediment within a 500-metre radius of the brownfield (former tannery) site continues to have total chromium concentrations in sediment that exceed 500 mg/kg, a value well above the CCME PEL, the provincial Severe Effect Level (SEL) and the 2LAET. Much of the sediment contamination in the northwestern corner of KIH adjacent to the drainage from the brownfield zone exceeds 1,000 mg/kg chromium. These spatial gradients and overall magnitude of contamination remain consistent with the historical data distribution for chromium.

The use of generic guidelines overstates the ecological hazard associated with chromium, as most chromium in surface KIH sediments is in the trivalent form, which is lower in toxic potency relative to the hexavalent form. Nevertheless, the chromium patterns identified in earlier delineations have been confirmed, and with no meaningful improvement in chromium concentrations over time. Chromium concentrations above 1,000 mg/kg remain common within several management units (PC-W, PP-OM PC-OM, TC-OM) in the vicinity of Orchard Marsh, and these concentrations continue to support the rationale for physical intervention in these maximally exposed areas.

- **Copper** (Figure A-6)—Sediment copper remains a highly localized COC in KIH, with nearly the entire harbour exhibiting copper below the CCME PEL. Although the western half of KIH exhibits copper at concentrations higher than upstream reference conditions, the level of exceedance remains modest. Per FCSAP (2021) guidance for working harbours, such conditions below PEL do not, on their own, warrant remedial actions. The only area in KIH with copper contamination at levels of concern is in the head of Anglin Bay, adjacent to the shipyard operations. The innermost half of Anglin Bay contains copper at concentrations above the CCME PEL, the provincial SEL, and the Avocet (2003) apparent effect thresholds (including the 2LAET at the maximally exposed areas). These findings confirm that copper distributions have remained very stable over the past decade, and continue to identify Anglin Bay as an area of elevated metals contamination. As the entire inner portion of Anglin Bay has also been identified by intervention based on legacy PAH contamination, the recent findings for copper do not change the designation of management unit TC-AB.

- **Lead** (Figure A-7)—The distribution of lead in sediment remains fundamentally unchanged relative to the previous decade. Most of the western half of KIH exhibits lead at concentrations above the PEL, and above upstream reference concentrations, but with only localized areas exceeding the LAET from Avocet (2003). Despite these exceedances of generic guidelines and background, the detailed risk assessment indicated the risk from sedimentary lead was low, in part due to presence of local modifying factors (such as acid volatile sulphides that bind divalent metal cations). Furthermore, the few areas of maximum lead contamination are coincident with other metals and organics, such that intervention for other COCs will address any minor risk from lead.

- **Mercury** (Figure A-8)— The distribution of mercury in sediment also remains fundamentally unchanged relative to the previous decade. The only difference in the recent data collections is that the chemical distributions follow smoother gradients from the legacy shoreline source. Most of KIH, in both historical and recent sampling, remains below the CCME PEL of 0.49 mg/kg. However, contiguous areas of sediment mercury contamination above the PEL remain along the west-central shoreline in KIH, and approximately half of that contiguous area includes concentrations above the SEL of 2 mg/kg. The areas that exceed the PEL remain of interest for two reasons: 1) the areas of contiguous sediment contamination that approach, and sometimes exceed, the SEL result in average concentrations of total mercury across multiple management units that could result in bioaccumulation of mercury to levels of concern; 2) the sediment quality guidelines do not explicitly incorporate biomagnification pathways, such that mercury contamination in KIH fish tissues confirms the bioavailability of sediment mercury, validates previous identification as an environmental concern, and is reflected in the development of local fish consumption advisories for the harbour. These confirmed mercury exposure levels, which have not ameliorated with time, remain a consideration in the conceptual remedial design.

- **Silver** (Figure A-9)— The updated sediment quality profile indicates that silver remains at a stable magnitude of harbour wide contamination, with most KIH sediment falling between lower and upper sediment quality guidelines developed for freshwater sediments. Both historical and recent sampling indicate a pattern of moderate silver exceedances extending from the legacy industrial activities at the Woolen Mill. Sediment concentrations in KIH are currently below the 2LAET guideline over the vast majority of locations, and no link between silver concentration and adverse effects was identified in the detailed risk assessment. Overall, silver indicates similar, but smoother, concentration distributions in recent sampling. Furthermore, because silver is highly coincident with other COCs, including other metals/metalloids, the remediation design for other constituents will address any silver contamination of interest

- **Zinc** (Figure A-10)—The distribution of zinc in sediment remains fundamentally unchanged relative to the previous decade. Most of the western half of KIH exhibits zinc at concentrations below the PEL, and with no localized areas exceeding the LAET from Avocet (2003). The detailed risk assessment indicated the risk from sedimentary zinc was low, in part due to presence of local modifying factors (such as acid volatile sulphides that bind divalent metal cations). Furthermore, the few areas of zinc contamination above the PEL are coincident with other metals and organics, such that intervention for other COCs will address any minor risk from zinc.

Organics

- Polycyclic aromatic hydrocarbons (PAHs; Figure A-11)—Broadly, the magnitude of PAH contamination remains similar to the previous decade. Several regions of elevated PAH contamination have been identified through the western KIH; these concentrations of total PAHs provide a synthesis of the numerous individual parent PAHs and are a useful indicator of both spatial exposure gradient and temporal trend for PAH mixtures that are stable in composition. Both historical and recent sampling indicates three main regions of total PAH contamination that exceed the Probable Effect Concentration (MacDonald et al. 2000):

  - Northwestern KIH water lot adjacent to former Belle landfill and Orchard Marsh
  - West central nearshore area adjacent to the Woolen Mill
  - Southern shoreline area within and adjacent to Anglin Bay

  These zones are delineated more clearly in the recent sampling relative to historical sampling and depict a clearer linkage to historical contamination sources. Sediment PAH concentrations observed within KIH in the vicinity of Anglin Bay and the Douglas Fluhrer Park area are likely the result of historical contamination from a former rail yard and coal gasification plant (Golder 2013a). Although the overall contribution of PAHs from the rail yard area is unknown, the spatial extent of contamination, PAH composition and type of industrial activity all suggest that rail yard activities played a significant role in contaminating the adjacent water lots of KIH. Within Anglin Bay, migration of PAHs from the large deposits of weathered coal tar historically transported via storm sewers are expected to be responsible for the PAH concentrations found in nearby sediments. These historical contributions are expected to represent the bulk of the observed PAH contamination, with ongoing sources (i.e., storm water discharges, vessel traffic, hydrocarbon spills) representing only a minor component. The legacy PAH concentrations are heterogenous in distribution at depth, with some areas exhibiting shallow PAH contamination (i.e., within upper 1 m of sediment bed) that exceeds typical surface concentrations.

The central and eastern areas of KIH, although elevated relative to reference conditions, do not indicate PAH contamination at levels of concern for a working harbour.

- Polychlorinated biphenyls (PCBs; Figure A-12)—Of all COC evaluated in KIH, the distributions of sediment PCB contamination exhibit the largest changes in distribution pattern over the last decade. However, the changes do not appear to indicate transport or degradation of PCBs in sediment (particularly as PCBs are highly persistent in the environment), but rather uncertainties in the sediment chemistry surfaces. In the recent sediment delineation, the contamination surface for total PCBs is more consistent with expected sources and gradients; the PCB contamination is focussed along shoreline sediments close to the former Belle landfill, and in some hot spots toward the southeastern portion of KIH. The pattern over much of KIH is consistent with landfill leachate as the primary source. Two former demolition/scrap yard properties may have also contributed to the PCBs found in the KIH sediment, although historical poor PCB handling practices may have led to the discharge of PCBs through the storm sewer system from the Kingscourt outfall and in the vicinity of Douglas Fluhrer Park (MacLatchy 2013, pers. comm.). These are the only contiguous areas in recently sampling that exceed 1 mg/kg dry weight total PCB. Remaining PCB measurements, all below 1 mg/kg total PCB, occur at concentrations higher than reference conditions, and above the PEL, through the entire western KIH. In historical chemistry, there was increased spatial distribution of moderate PCB concentrations in the range of 0.6 to 1.0 mg/kg dry weight total PCB, particularly in the central KIH. It is unknown whether these differences in the central harbour result from analytical variability, heterogeneity in sediments, or other cause; nevertheless, the concentrations below 1 mg/kg are unlikely to warrant intrusive management to achieve acceptable risk. Instead, emphasis on the nearshore hotspots, which overlap the contamination distributions for other primary COCs, would provide the most effective way to manage PCB exposures. PCBs cause adverse effects primarily through broad biomagnification pathways rather than localized direct effects, meaning that management should emphasize weighted average conditions in management units rather than specific locations representing small PCB mass.

2.2 Causation

The historical and recent sediment quality data presented in Section 2.1 indicate that concentrations of several metals/metalloids, PCBs, and PAHs have historically exceeded sediment quality guidelines, and also exceed concentrations in far-field areas (e.g., eastern KIH) and upstream reference locations. Although the specific sources of the elevated parameters are sometimes uncertain, there are known linkages of these contaminant profiles to legacy sources of soil and sediment contamination in KIH shoreline areas. Golder (2013a) summarizes the historical linkages between urban activities and the sediment contamination profiles described above.

Adverse effects have been observed, or predicted using risk-based exposure models, for the above COC groups. The presence of elevated contaminants coincident with the observation of adverse effects is necessary, but not sufficient, to provide evidence of causation. Golder (2012) summarizes evidence for causation, concluding that there is evidence that PAHs have contributed to the toxicity of sediments. A weight of evidence approach was applied to evaluate linkages among components of the Sediment Quality Triad (sediment chemistry, laboratory toxicity, and benthic invertebrate community composition), with an emphasis on identifying statistical associations between effects-based endpoints and sediment contamination. Several lines of evidence supported a linkage between sediment contamination and ecological responses, including:

- *Chironomus dilutus* toxicity endpoint—Significant negative relationships ($p < 0.05$) were identified between toxicity to a midge in a laboratory exposure and sediment contamination. Most PAHs (with the exception of 1-methylnaphthalene, acenaphthalene, anthracene, and fluorene) were observed to have a significant negative correlation with *C. dilutus* survival, including total PAHs.
- *Hyalella azteca* toxicity endpoint—Although effects on *H. azteca* survival and growth were not evident in toxicity testing (relative to the negative control performance), significant negative relationships ($p < 0.05$) were identified between the growth endpoint and several physiochemical parameters. Again, significant correlations were observed for several parameters that exceeded upper-bound sediment quality guidelines and that are not bound to AVS, consisting almost entirely of PAHs.
- Biological Community Responses—Significant negative correlations identified between benthic invertebrate community metrics and physicochemical parameters in sediment for sampling stations in KIH. Significant negative correlations with benthic invertebrate metrics (richness, diversity, and dominance indicators) were observed, with most negative correlations being for PAH constituents. The above findings suggest that the associations between concentration and response that were observed in toxicity test endpoints are also translating into biological responses in the field.
- Toxicity Identification Evaluation—A series of focused sediment experiments was conducted in response to the laboratory toxicity results mentioned above. The TIE showed that the increase in toxicity associated with UV exposure was substantial, providing a strong line of evidence that photo-activated organic toxicants were present.
- Fish Deformities—A literature review (Golder 2014b) summarized the linkage between sediment PAH exposures and the prevalence of anomalies, including liver lesions and external deformities. The above information suggests that observed patterns in fish deformity rates, if not caused by viruses, may be caused by PAHs, particularly for sediment concentrations of 10 mg/kg total PAH and higher. PAHs have been identified as potential causal agents for the observed field deformities; sedimentary PAH concentrations were explored in more detail through the acquisition of additional chemistry data and correspondence to field-based evidence for tumour incidence in brown bullhead. Although definitive confirmation of causation would require histopathology, virology, and tissue and bile analysis, the review concluded that PAH contamination in sediment was a plausible explanation for observed anomalies in locally caught bullhead.

For risk predictions made for wildlife (mammals, birds, reptiles) and humans, it is not possible to conduct a rigorous causation assessment with the information currently available. Such studies of causation, which could include epidemiology studies, controlled laboratory bioassays (feeding studies), or detailed controlled field experiments, suffer from high uncertainty, ethical issues, potential for destructive sampling, and technical complexity. As such, potential risk must be inferred from concentration-response information gleaned from published sources, including toxicity reference values for dose-based chemical exposure.

2.3 Source Controls

Source removal or control is a pre-requisite to remediation of the aquatic environment so that the disturbance associated with remedial measures will not need to be repeated. More specifically, FCSAP risk management funding is only available for contaminated sites where the activity that caused the contamination took place prior to 1 April 1998 and where on-going sources of contamination are sufficiently controlled.

Evidence for source control as it relates to sediment contamination in KIH comes from three main types of information:

- **Historical trend evaluation**—The long-term temporal trend of contamination in harbour sediments provides a broad indication of existing source controls. If elevated concentrations of primary COCs are increasing over time, or being observed in new, previously uncontaminated locations, there is evidence that sources are not being effectively controlled. Demonstration of stable or decreasing concentrations does not provide definitive evidence for adequate source controls, as inputs could be degraded or buried over time, but trend assessment is a useful screening step. The profiles of sediment chemistry described in Section 2.1, particularly in relation to older historical samples, provides useful confirmation that the surface sediment contamination remains stable, without exacerbation by ongoing sources.
- **Evaluation of known legacy sources of upgradient contamination**—PSPC engaged WSP to undertake reviews of several known legacy contamination sources along the Kingston waterfront to confirm that they have been controlled. These evaluations have considered demonstrated source control actions, mainly by City of Kingston, including engineering measures to control ongoing releases, fingerprinting of hydrocarbon signatures to document sources, and municipal programmes including public education to reduce contaminant inputs at the source.
- **Environmental monitoring of media potentially entering KIH** (surface water, groundwater, sewer discharges, soil, sediment)—PSPC and other federal custodians (PCA and Transport Canada) have contracted Golder to collect chemistry data along the shoreline to characterize sources and assess implications for management. In addition, the City of Kingston had used such monitoring programs to inform management of contaminant pathways to KIH and has implemented remediation programs to address identified issues.

For the most part, source control measures have been successfully implemented in KIH, such that remedial options can emphasize the legacy contamination sources (Golder 2017). Information on ongoing source control initiative is detailed in the accompanying WSP memorandum entitled “Conceptual Constraints and Impact Considerations – Water Quality.” As these initiatives simultaneously control for sediment and water quality pathways, only a summary is provided below.

The City of Kingston has documented the following municipal controls undertaken to limit contaminant transport to the KIH:

- **Belle Park Landfill leachate collection system**—Leachate control system at the closed Belle Park Landfill to prevent point source discharge of leachate-impacted shallow groundwater to KIH. These systems consist of conventional perimeter collection wells, off-site groundwater treatment, and plantings of hybrid poplar phreatophytes. The Belle Park Landfill monitoring program also includes surface water sampling at strategic locations within the Great Cataraqui River to monitor the effectiveness of the groundwater remedial measures that have been implemented. Follow-up studies between 2003 and 2011 concluded that the Belle Park Landfill was no longer a significant source of PCBs into the KIH (ESG 2014). Since then, groundwater has been assessed semi-annually for site-specific indicators of landfill leachate, including ammonia (N) total, chloride, iron, pH, and TSS. The results from the most recent groundwater assessment (2019–2020) were within historically established concentration ranges; however, ammonia (N) total and iron remain above the PWQOs (Malroz 2021).

- **Emma Martin Park passive reaction barrier**—Investment in controls to contaminated groundwater flow from Emma Martin Park to the KIH. Controls consist of funnel and gate system with a reactive wall designed to reduce dissolved arsenic loading from shallow groundwater flow; the City intends to continue to operate this system. The City of Kingston monitors groundwater discharge from this area to ensure the effective remediation of arsenic (personal correspondence, Paul MacLatchy on 30 November, 2022). The distribution of historically sourced arsenic in sediment along the KIH waterfront is also spatially limited relative to other metals in the harbour (Golder 2017, 2022).
- **Rowing Club storm water run-off upgrades**—In 2007, discharge of particulate bound mercury in surface runoff from the Rowing Club was identified as a potential source of contamination into the KIH. A follow up study by the City of Kingston identified elevated mercury within the surface soil surrounding the Rowing Club. The City of Kingston subsequently implemented improvements and modifications to prevent stormwater runoff that could cause erosion of mercury contaminated soils; confirmatory monitoring during high precipitation events confirmed that unacceptable surface soil erosion was no longer occurring (ESG 2014). A hydrogeological assessment was completed in 2011 for Emma Martin Park and the Rowing Club that concluded that these areas are not a continuing source of chromium or PCBs into the KIH (ESG 2014).
- **Former Davis Tannery clay berm**—The former Davis Tannery historically discharged liquid waste containing chromium into a wetland north of the tannery (known as the Orchard Street Marsh). A clay berm was installed in the 1980s to prevent groundwater discharge of contaminants into the KIH. During high precipitation events, it is possible that particulate matter with elevated COCs may be transported into the KIH through surface water runoff (ESG 2014). Potential for soil erosion and slumping into the Orchard Street Marsh will continue to be evaluated in conjunction with property redevelopment proposals in the brownfield area, including landscaping controls to prevent erosion and sediment movement to the KIH. Supplemental water quality studies have been recommended in the accompanying WSP (2023) memorandum entitled “Conceptual Constraints and Impact Considerations – Water Quality” to address potential point sources of suspended sediment and particulate matter. An extension of that program to encompass the Davis Tannery surface discharges is described in Section 3.1, below.
- **Storm sewers**—Storm sewers are a potential ongoing source for urban contaminants such as metals and PAHs captured from stormwater flow. The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), which means that particulate inputs that may be associated with contaminants are conveyed with water flows. The City of Kingston has adopted several source control measures to reduce particulate loading to storm sewers since 2005 (personal correspondence, Paul MacLatchy on 6 December 2022), including street sweeping programs and catchment basin clean-up. The City of Kingston also engages in educational programs to raise awareness of the importance of reducing inputs of storm-water pollutants and reducing the dumping of waste materials into storm drains (e.g., Fish and Frogs Forever Program).
- **Combined sewer overflows**—CSOs consist of large pulses of nutrients and coliform bacteria associated with raw sewage that is discharged during and after heavy rainfall. The City of Kingston has completed several upgrades to control frequency and magnitude of CSO events, specifically around the KIH (Utilities Kingston 2022), including Emma Martin Park CSO storage tank installation (2006) to reduce overflows from the River Street Pumping station. Harbourfront Trunk Sewer twinning (2005) and refurbishment (2008), and

replacement of CSO sections with separated sanitary and storm sewers within the Kingscourt and Dufferin sewer sheds (2001–ongoing).

Federal investigations and programs have further limited sources of potential contamination:

- **Western shoreline dredging**—Project Trackdown (Benoit and Burniston 2010, Benoit et al. 2016) was established as an investigative environmental program to track sources of PCB contamination in Great Lakes tributaries. In KIH, the source of PCB contamination was identified to be localized "hot spots" in inner harbour sediments, particularly along the western shoreline adjacent to commercial and historical industrial activity. Some localized remediation was undertaken in these areas, which resulted in PCB removals, along with co-located contaminants (e.g., arsenic and mercury).
- **Organotin regulations**—The spatial profiling of tributyltin (TBT) in 2010 and 2011 (Golder 2011; 2012) indicated that exceedances of screening criteria for TBT were observed within portions of Anglin Bay. This is expected due to the close association of TBT contamination with the historical usage of TBT as an antifoulant, and the prevalence of ship repair and moorage within Anglin Bay (i.e., residual contamination of harbours can occur in areas of extensive ship moorage, particularly where scraping or blasting of ship hulls is conducted near open water). TBT is now a restricted substance in antifouling paints, and in June 2011 the federal government added tributyltins and tetrabuytltins to Schedule 1 to the *Canadian Environmental Protection Act, 1999*. Although legacy sources of TBT, at moderate levels, remain in Anglin Bay, ongoing sources have been controlled through environmental regulation of sources.

Given the above source controls (municipal and federal), the fate and transport linkages of greatest relevance to remedial options analysis relate to the effect of remedial design features (whether positive or negative) on the existing situation. For example, sediment management options along the south shore of Belle Park must take into consideration how removal of sediment or alteration of shorelines may impact shallow groundwater flow (and associated leachate), while management options adjacent to the Orchard Street Marsh must consider the potential for alteration of sediment movements (e.g., bank slumping, sediment erosion control during storm events).

3.0 POTENTIAL ENVIRONMENTAL EFFECTS

As described in Section 1.2, the broad purpose of the Project is to address unacceptable levels of contaminants in KIH, requiring physical intervention to achieve this goal. Provided that the remediation program is conducted responsibly, with consideration given to managing short-term habitat disturbances to the sediment substrate, the long-term condition of sediment quality (including status of benthic community, and provision of food and habitat for other trophic levels) will be improved. The potential environmental effects discussed in this section relate to unintended consequences of the proposed interventions, which would either hinder the effectiveness of the Project, or exacerbate the short-term disruptions. The nature of these potential unintended consequences varies depending on the project stage considered within the remediation program.

- **Baseline (existing) condition**—Unintended consequences for baseline conditions could include lack of accuracy or precision around the current spatial extent of contamination, including both horizontal and vertical dimensions. The underlying risk of this scenario is that, should the baseline conditions not be characterized adequately, the effectiveness of the remediation could be compromised, either by missing important areas of contamination or by assigning undue priority to respective parcels of sediment.

- **Conditions during active works**—Unintended consequences during active works consist primarily of uncontrolled sediment disturbances, resulting in undesirable sediment resuspension and/or bank erosion. Such sediment disturbances, if not effectively controlled, could have direct adverse effects to aquatic life, or could result in redistribution of contaminated sediments into adjacent areas of the waterlot. The effects of excessive suspended particulate matter have been well documented and include habitat disturbances, physical smothering, reduced photosynthesis, gill abrasion and decreased ability to capture food or avoid predation (CCME 2002).
- **Conditions immediately following completion of works**—Unintended consequences following competition of the initial remediation phase consist of unacceptable levels of dredge residuals or leaving a new surface sediment profile that is prone to slumping, scour, or bed instability.
- **Long-term stabilized conditions**—Unintended consequences for long-term conditions relate to failure to meet the long-term management goals articulated in Section 1.2. Such could occur through incomplete or ineffective sediment removals, or through inability of the new sediment surface to effectively recolonize following remedial works.

The above unintended consequences could occur if the environmental management plan does not provide appropriate mitigations and contingencies. The purpose of the section, therefore, is to identify the potential for unintended consequences, such that appropriate measures can be adopted to reduce or eliminate potential for their occurrence. Accordingly, the following are required:

- An understanding of the existing sediment quality to establish baseline conditions against which any changes caused by the Project can be compared—The data gaps for establishing reliable baseline conditions are further discussed in Section 3.1.
- Defining threshold levels for sediment quality indicators (i.e., chemical benchmarks in sediment used to define need for removals and to define acceptable post-remediation conditions) that can be implemented during and after remediation to prevent potential environmental effects—The approach for identifying threshold levels (performance objectives or other criteria) to prevent potential environmental effects is further discussed in Section 3.2.

3.1 Data Gaps

A reliable baseline for sediment quality within the Project area is required before starting any in-water works; such will maximize effectiveness of dredging and provide confidence that sediment disruption does not cause negative environmental effects. The recent sediment sampling in Fall 2021 provides solid coverage of the management units of greatest interest, and provides data collected using highly standardized field sampling and analytical methods. As such, remaining data gaps in sediment quality are limited, localized, and could be addressed as part of detailed design, or in conjunction with proposed baseline surface water sampling programs, which are described in the accompanying WSP (2023) memorandum entitled “Conceptual Constraints and Impact Considerations – Water Quality.”

The following bullets summarize the few remaining data gaps of greatest significance.

- **Stream sediment conditions in Orchard Street Marsh**—Because the headwaters of the unnamed creek that drains the Orchard Street Marsh falls outside federal ownership, the recent sediment sampling (Fall 2021) excluded the evaluation of sediment quality in the wetland (marsh) areas adjacent to the PC-OM management unit. This area includes flows from the Kingscourt storm sewer catchment and intersects the area of historical tannery waste deposits. This portion of the KIH study area is complex and challenging for several reasons:

- The land ownership is complicated, with adjacent land areas owned by the City of Kingston, PCA, Transport Canada, and a private landowner. Development plans have been in progress in recent years, but to date no final development plan has been approved by the City.
- The environmental setting is complex, with areas of cattail marsh, degraded riparian zones that nevertheless remain part of Provincially Significant Wetland habitat, and adjacent vegetated areas that may be altered as part of municipal or private development plans for the waterfront.
- The hydrological environment makes it difficult to infer sediment quality over some zones of sediment. The flows from Kingscourt storm sewer, and the accompanying solids, have entwined with historical contaminated sediment, resulting in a complex pattern of sediment quality. The heterogeneity of sediments in this area is evident from historical sediment quality sampling.

The complexity and sensitivity of this area makes routine sediment delineation and remediation design challenging to implement. It may be prudent to defer the detailed assessment of this zone pending resolution of numerous land ownership, development, and permitting issues related to the wetland areas.

- **Depth profiling near Anglin Bay**—The depth of contaminated sediments is greatest in areas within and adjacent to Anglin Bay, where the longest depositional sediment cores have been obtained in historical vibracore sampling (Golder 2014a). Also, the distribution of PAHs in subsurface sediments is heterogeneous. The sediment horizons with higher PAH concentrations within and among the management units surrounding Anglin Bay, reflect a complex pattern of historical contamination related to former coal gasification plant releases. In various cores, peak PAH concentrations have been measured at several depths, including mid-depth (e.g., Cores 1 and 10 at depths from 40 to 100 cm); deeper intervals (e.g., Core 3 at depths from 100 to 130 cm); and shallower intervals (e.g., Cores 8, 11, and 12 at depths from 10 to 40 cm). Given this heterogeneity, it is recommended that PSPC characterize the vertical contamination profile with additional precision prior to undertaking detailed design. This portion of the KIH has the greatest potential to uncover significant contamination at depth, due to the association of free product with historical coal tar-containing wastes. Additional cores would not provide precise delineation of sediment but would be valuable in identifying the recommended depths of excavation prior to detailed design stage; such would assist in refining sediment volumes and development of specifications for cover depth, thickness, and composition in the vicinity of Anglin Bay.
- **Sediment stratigraphy**—For some areas of the harbour, dredge volume requirements could be refined through use of sediment stratigraphy analysis. The current estimates of volumes have been assigned based on the results of coring studies, which have identified horizons of sediment materials with distinguishing properties. For example, most KIH sediment profiles contain a layer of loosely consolidated material, composed of sand, silt and organics, which exists at the surface of sites up to depths of 5 to 20 cm, with material becoming more consolidated silt and/or clay with increasing depth. The lower limit (maximum depth) of legacy contamination could be inferred from the depth of the native lacustrine clay that underlies the depositional layers described above. Such layers provide a stratigraphic and physical barrier to sediment contamination at depth. Rather than rely on discrete coring logs, sub-bottom profiling systems such as

Ground-Penetrating Radar (GPR) could be applied to identify and measure various sediment layers that exist below the sediment/water interface. Such systems, which could also be verified or calibrated using additional physical cores, would augment existing bathymetry and sidescan sonar profiles previous used to evaluate archaeological values. This information (GPR and/or additional physical tests) would provide a surface of sediment layer depths, helping inform the design of dredge prisms for detailed remedial design.

Aside from the above, the main information gaps for sediment management under current conditions relate to issues of source control, which have also been described in the accompanying WSP memorandum entitled "Conceptual Constraints and Impact Considerations – Water Quality." Although there have been several source control measures implemented along the shoreline of the KIH to decrease the potential for re-contamination (Section 2.3), there are several data gaps related to the current understanding and quantification of effectiveness for these controls, including:

- **Effectiveness of storm sewer management**—The storm sewer outflows into the KIH have no end of pipe controls (e.g., settling ponds), such that particulate inputs may be discharged that are associated with contaminants. Recent improvements in the City of Kingston sewer system have likely decreased the potential for contamination to enter the KIH via storm sewers, but this has not been formally assessed. Storm sewers along the KIH should be sampled during dry outfall events to understand if they represent a major source of on-going contaminant loading. Further, it is suggested that aqueous and sediment material from the storm sewer outflows during flowing conditions (i.e., wet periods) are sampled and analyzed for COCs to establish time-weighted averages of contaminant loading.
- **Confirmation of Former Davis Tannery erosion controls**—To validate effectiveness of historical (and potential additional) contaminant transport controls near the former Davis Tannery, the storm sewer monitoring program described above should be expanded to include aqueous and suspended sediment material draining from the western shoreline into KIH during wet-weather events. No dry-weather component would be required for this pathway.
- **Contaminants of emerging concern (CECs)**—There have been several CECs identified over the past decade in urban environments that are increasingly being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders could be endocrine disrupters which are known to be harmful to aquatic receptors, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS), and polybrominated diphenyl ethers (PBDE). None of these substances would be linked to historical sources in federal water lots, but rather would reflect municipal sources. CECs could be collected from storm sewer outflows during both dry outflow and CSO events, to confirm the presence of CECs.

3.2 Thresholds

Sediment contaminant mapping, as described in Section 2.1 and detailed in Golder (2021), identified distributions of organic contaminants (total PAH, total PCB) and metals/metalloids (antimony, arsenic, chromium, copper, lead, mercury, silver, and zinc). Without mitigation and/or specific Project design considerations, in-water works such as staging, dredging, and capping may adversely impact quality of unimpacted or low-contaminated KIH sediments. Design elements and appropriate environmental controls for limiting the mobility of resuspended contaminated sediments must be considered (i.e., turbidity and suspended solids management). Containment of suspended solids during dredging is the most important risk factor for construction and remediation stages, and turbidity controls are commonly included in Environmental Management Plans (EMPs) for dredging projects, including use of physical controls (e.g., turbidity curtains), shoreline filter materials, and application of TSS and/or turbidity objectives to prevent unacceptable redistribution of sediments and reduce the effect of dredge residuals. Construction staging and planning should include the deployment of mitigations to prevent the introduction of new contaminants to KIH sediments, such as spill containment areas, designated spill kit locations, and a filter bag for dredging waters.

To prevent the potential for adverse effects from sediment resuspension during in-water works, implementation of Environmental Performance Objectives (EPOs) based on TSS and/or turbidity are recommended. In this manner, both water quality and sediment quality thresholds are maintained simultaneously. The accompanying WSP-memorandum entitled “Conceptual Constraints and Impact Considerations – Water Quality” provides a detailed discussion of how specific parameters and points of compliance are generally determined, how EPOs may be established at compliance points (including point of discharge and the receiving environment outside the work area), and how EPOs are linked to background turbidity levels. In addition, a step-wise approach is recommended for calculating and establishing EPOs, including application of mass-balance models, water quality predictions, comparisons to environmental quality guidelines, and application to “real-time” water quality management. Using this approach, the need for additional mitigation measures during in-water works can be informed rapidly before potential environmental effects occur.

3.2.1 Narrative Thresholds

Table 1 summarizes the project scenarios, desired outcomes, and associated thresholds associated with sediment quality at the four milestone stages of the Project. As this Project interaction with Sediment Quality is primarily localized, well understood, and with proven mitigation measures, it is classified as low risk for all stages of the Project, subject to the implementation of the Environmental Management Plan with associated Environmental Performance Objectives (EPOs). The Project is expected to significantly improve sediment quality conditions in KIH overall, but there is the potential for negative impacts to localized areas where: (1) dredge residuals could mix with adjacent low contamination areas outside the excavation area; or (2) sediments at depth are mobilized and allowed to mix with the post-remediation surface sediment layer. The evidence required to determine satisfaction or dissatisfaction with the desired outcome is generally high, and as such the standard of proof is high. The standard of proof would be measured by follow-up studies to assess sediment quality compared to baseline during project implementation monitoring of EPOs.

The key thresholds identified for each stage of the Project are listed below and described further in Table 1:

- **Baseline (existing) condition**—Thresholds for this stage relate to adequate delineation of present-day contamination profiles. Baseline assessment evaluation of valued components for pre-remediation stage due to the importance of confirming appropriate source controls prior to implementation of remedial works. This requirement is specific to issues around chemical contamination, and is not required for physical or biological valued components.
- **Conditions during active works**—Thresholds for this stage relate primarily to managing changes in sediment quality due to mechanical sediment disturbance, and through appropriate spill controls during works.
- **Conditions immediately following completion of works**—Thresholds for this stage relate to confirmation of dredging effectiveness and associated contingency measures to manage dredge residuals.

- **Long-term stabilized conditions**—Thresholds relate to rehabilitation and recolonization of disturbed areas, and monitoring of strongly bioaccumulative substances for long-term reductions in tissue concentrations.

3.2.2 Numerical Thresholds

Site-specific (or management unit-specific) numerical thresholds have not yet been developed for individual constituents. However, such numerical thresholds, which are sometimes called site-specific target levels or site - specific performance objectives, will need to be developed as part of detailed design.

Some principles that will apply to the development of these numerical thresholds are:

- Numerical thresholds will reflect site-specific and risk-based values. The generic sediment quality criteria, including CCME PEL, are not appropriate for making remedial decisions or specifying performance objectives.
- Numerical thresholds will reflect the transition from low to moderate risk magnitude, to remain consistent with the conceptual framework for sediment management in KIH.
- In all cases, numerical thresholds for individual substances will be maintained at concentrations (in dry weight sediment units) equal to or greater than the reference sediment quality (Table 1). Reduction of COC concentrations to below local background would be neither practical nor effective, as long-term sediment movements from resuspension and deposition of sediments from adjacent management units will gradually blend surface sediment quality, such that long-term sediment quality in remediated areas will resemble the reference and low-risk conditions left outside the dredging footprint.
- The scale at which numerical thresholds apply may vary depending on the type of contaminant, and the pathway driving risk for that contaminant. For example, PCBs should be managed on a broader spatial scale than PAHs, because the former exert their effects primarily through biomagnification pathways rather than direct toxicity.
- The selection of receptor and endpoint used to develop numerical thresholds may be informed by stakeholder consultation. For example, the sediment PAH exposure concentration causing minor adverse effects to fish (e.g., increased incidence of liver and/or external lesions) is lower than the concentration expected to cause significant toxicity and/or community impairment to freshwater invertebrates
- Numerical thresholds may vary among management units. Because sediment contamination is being managed as a complex mixture, it is sometimes necessary to adapt the threshold for an individual substance to provide protection against mixture effects from multiple substances. Furthermore, some substances have toxicity modified by sediment properties such as organic carbon or particle size, which are not consistent across the entire KIH.

Numerical thresholds will be developed for total concentrations of PAHs and PCBs, but not for individual congeners or compounds within these groups.

Table 2: Valued Components, Scenarios, Desired Outcomes, Thresholds, and Standard of Proof for Sediment Quality

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required or Recommended
1. Pre-Remediation within the Kingston Inner Harbour						
Baseline sediment quality within the KIH prior to remediation may be influenced by on-going sources of contamination.	Surface sediment concentrations of COCs are stable (not increasing over broad areas), and without unacceptable active sources of non-legacy COCs or CECs from upgradient areas.	Sediment quality for new samples (such as particulates from storm sewers, or additional sediment delineations in marsh areas) will be evaluated relative to site-specific risk-based concentrations, where available.	High	Yes	Implementation of mitigation measures at identified sources, if identified. Continuation of municipal source control initiatives, including public education, if ongoing sources of COCs identified at levels of concern.	Storm sewer outflows into the KIH that lack end of pipe controls should be monitored for potential particulate inputs that may be associated with contaminants. This program could be harmonized with water quality monitoring under dry-weather and wet-weather conditions. Design of soil erosion and sedimentation controls for any proposed redevelopment of Orchard Steet Marsh and surrounding riparian areas. Need to be determined based on additional baseline monitoring and property redevelopment plans.
Baseline sediment quality characterization within the KIH identifies gaps in spatial extent of contamination of relevance to remedial design.	Surface sediment concentrations of COCs are delineated adequately to identify localized areas within management areas that present source zones for sediment transport to outlying areas.	Sediment quality (at both surface and depth) will be evaluated relative to site-specific risk-based concentrations, where available. When no quantitative benchmarks are available for a specific COC, the data will be screened based on the categories of risk indicated in the detailed risk assessment and risk synthesis documents.	Moderate	Yes	Consideration of engineered covers or activated carbon where sediment quality is heterogeneous or with potential for free-product coal tar presence.	Additional vertical profiling of Anglin Bay and vicinity to address heterogeneity in coal-tar influenced sediments. Sediment stratigraphy analysis to refine estimates of depth to native lacustrine clay (to bound maximum vertical extent of contamination).
2. During Remediation in Zone of Dredging						
In-water works such as dredging, capping, and shoreline stabilization result in an alteration to existing sediment quality in Kingston Inner Harbour.	Sediment quality in managed areas is improved within performance objectives for primary COCs. Sediment quality in unmanaged areas is maintained at the baseline established prior to sediment management.	Sediment quality will be assessed for reductions of primary COPCs evaluated by risk-based performance objectives set prior to sediment management activities. Performance objectives will be established on a management unit specific basis.	High	Yes A, B, C, E, G	Filter bag for dredging waters, with effectiveness confirmed through bench testing prior to use. Thin layer capping (residuals management covers) incorporated proactively in design to reduce exposures (i.e., base design elements) or to improve	For each Management Unit, establish performance objectives for sediment quality for priority COPCs. Follow-up should include contingencies where post-confirmation monitoring indicates lower efficacy of removals relative to the design. Monitoring plans should include procedures for corrective actions to be taken in the event of excessive turbidity or sediment dispersion during sediment management activities.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required or Recommended
					recolonization potential (environmental contingency).	
Equipment associated with in-water works that could result in chemical spill into KIH waters.	BMP are followed; no incidents involving chemical release; events managed in such a way to avoid damage to aquatic life or water quality.	Site inspections and implementation of EMP procedures following BMPs. Environmental monitors to record spills, monitor clean up, and complete follow up monitoring and sampling of COCs in sediment and surface water as required.	High	Yes A, B, C, D, E	EMP will detail project requirements following BMPs (e.g., water booms around equipment, spill kit on Site, spill response plan).	EMP will need to be completed outlining contractor requirements and environmental protection measures to reduce spill occurrence and limit potential impacts to aquatic life.
In-water works involving dredging, dewatering and/or capping result in the re-suspension of sediments and associated contaminants at the point of discharge.	Surface water quality with respect to total suspended solids (TSS), COCs and dissolved oxygen is maintained at a level to protect aquatic life from short-term and acute lethality.	An EPO linked to TSS will be developed as part of the WQMP for the POD (as outlined in the CCIC elements for water quality) that will be protective of direct, acute toxicity from contaminants associated with re-suspended sediment, as well as the physical effects related to TSS itself. Monitoring of turbidity during in-water works, plus in-situ monitoring of other WQ indicators that may impact toxicity.	High	Yes A, B, C	EMP will detail project requirements, which may include the use of turbidity curtains during dredging, positioning of equipment to avoid propeller wash, placement of barge spuds to avoid sediment disturbance.	Site-specific WQMP is required prior to commencement of the Project that will define the EPOs, monitoring needs, and management actions to address water quality that is found to exceed the EPO. Prior to commencement of the WQMP, site-specific TSS:Turbidity relationship(s) should be determined, potentially varying by management unit.
3. Post Remediation in Zone of Dredging						
In-water works involving dredging, dewatering and/or capping result do not meet project objectives for contaminant mass removal or isolation.	Remediation achieves the required dredge elevations or depths based on post-construction survey. Dredge residuals and/or engineered cover yields surface sediment quality that satisfies performance objectives for primary COCs.	Post-construction survey results will be compared to bathymetry targets. Confirmatory sampling to evaluate post-dredging sediment quality is required after the contractor has achieved the required dredge elevations or depths. Data evaluated for possible missed inventory (i.e., contaminated sediments that are not removed as part of dredging) and/or dredge residuals (i.e., contaminated sediment suspended during dredging activities that settle to the surface of the seabed).	High	Yes A, B, C	Contingency re-dredging may be required if unacceptable dredge residuals or missed inventory. Additional thin layer capping (residuals management covers) as contingency.	Develop Confirmatory Sampling, Analysis, and Evaluation Plan as part of detailed design stage.

Scenario	Desired Outcome	Threshold	Standard of Proof[1] (L/M/H)[2]	Proven Mitigation Measures Exist[3] (Y/N)	Design Considerations to Reduce Risk	Additional Works Required or Recommended
4. Long-Term Post Remediation within the Kingston Inner Harbour						
Long-term barriers to recolonization following in-water works	Remediation activities have yielded confirmed sediment quality improvements, with negligible to low risk across KIH. Benthic communities, including benthic invertebrates, forage fish, and macrophytes have successfully re-established.	Surface sediment quality evaluated relative to site-specific risk-based concentrations, where available. Biological investigations of ecological recovery. Post-remedial monitoring of sediment should be completed over 5 years, and tissue monitoring completed over 10 years.	Moderate	Yes F	Contingency measures may be considered (e.g., thin-layer capping or activated carbon within sediment management units that have persistent elevated COCs). Incorporation of natural organic carbon sources and mixed particle sizes in capping materials to provide nutrient sources and substrate for recolonization. Incorporation of natural-based (i.e., ecosystem-based) approaches, such as Green Shores methods for shoreline management to enhance recovery	Pilot stage assessment of thin layer cap options, including (a) incorporation of activated carbon or (b) mixing with particle sizes and organic carbon content to enhance recovery. Pilot studies should simulate field conditions of physical and biological mixing, and confirm lack of toxicity to invertebrates under controlled conditions. Design of long-term monitoring program for fish tissues, limited to biomagnifying substances.

Notes: KIH = Kingston Inner Harbour; COC = contaminant of concern; CEC = contaminant of emerging concern; POD = point of discharge; TSS = total suspended solids; EPO = Environmental Performance Objective; WQMP = Water Quality Management Plan; EMP = Environmental Management Plan; BMP = Best Management Practice

[1] "The standard of proof dictates the quality of evidence; that is, project-VC interactions requiring a high standard of proof necessitate convincing evidence to determine satisfaction or dissatisfaction with the desired outcome." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[2] "The standard of proof will be expressed as "high," "medium," or "low," depending upon the circumstances of the project-VC interaction." (Detailed Impact Assessment Handbook Part 3 – 2020 Draft, PCA 2020)

[3] Proven Mitigation Measures, Best Management Practices, Guidelines and Standards include:

[A] PCA. 2017. Ontario Waterways Environmental Standards and Guidelines Document, Part 2.
[B] PCA. 2017. Parks Canada National Best Management Practices: Works In and Around Waterbodies.
[C] Ontario Ministry of the Environment. 2011. Evaluating Construction Activities Impacting on Water Resources Part III B: Handbook for Dredging.
[D] Toronto and Region Conservation Authority. 2019. Erosion and Sediment Control Guide for Urban Construction.
[E] Province of Ontario. 2021. Construction Specification for Temporary Erosion Control. Ontario Provincial Standard Specification.
[F] Canada. 2021. Guidance for Assessing and Managing Aquatic Contaminated Sites in Working Harbours under the Federal Contaminated Sites Action Plan (FCSAP). Version 1.1. Fisheries and Oceans Canada, Ottawa ON, Canada. November 2021.

[4] COCs represent chemical parameters that are known to be elevated within sediments and/or surface water within the KIH, including nutrients, metals, PAHs, PCBs

[5] CECs represent chemical parameters that are increasing being detected in water bodies but are not typically monitored or regulated. Of particulate interest to stakeholders are endocrine disrupters, such as bisphenol A (BPA), perfluoroalkyl and polyfluoroalkyl substances (PFAS) and polybrominated diphenyl ethers (PBDEs).

3.3 Valued Components

Valued Components (VCs) are environmental, health, social, economic, or additional elements or conditions of the natural and human environment that may be impacted by a proposed project and are of concern or value to the public, Indigenous peoples, federal authorities and interested parties. Table 2 summarizes the potential impacts to Valued Components related to sediment quality during different scenarios over the course of the Project. Under each scenario the desired outcomes, the thresholds for meeting the desired outcomes, the potential design considerations to reduce risks to surface water quality, and the additional works required to resolve information gaps are discussed.

If managed appropriately, the proposed project activities will result in safe removals of contaminated sediments, resulting in improvements of both localized and broad-scale sediment quality without unacceptable resuspension or mobilization of sediments. The purpose of including Sediment Quality as a VC is to mitigate and monitor the potential release of contaminants into unimpacted or low-contaminated KIH sediments, and through appropriate environmental controls provide confidence that immediate, downstream and pathway impacts of contaminant release are reduced or eliminated.

The development of the DIA can use previous studies on sediment quality in KIH and available information on the project methodologies to determine potential impacts. A list of applicable background sources was produced in 2020 during the Gap Analysis phase of the DIA process, with studies related to sediments identified as applicable to the former VC heading “Terrain, Geology, and Soils” (SNC-Lavalin 2020a, b; 2021). The list of sources for the DIA should be updated to encompass newly available information to ensure an up to date and accurate baseline of Sediment Quality in KIH.

4.0 SUMMARY OF DESIGN-RELATED CONSTRAINTS

This section is intended to address whether there are additional known constraints specific to detailed design. In other words, given our current level of understanding, and assuming the “additional works” outlined in Table 1 are completed:

- Are there design/project constraints that can be identified now that would cause adverse environmental effects that cannot be mitigated?
- Are there potential constraints that have uncertainty in terms of mitigation potential, but require project tracking and later resolution?

We have not identified any design-related constraints beyond those already discussed in Section 3.3 that would result in outright failure of the broad remediation objectives specified in Section 1.2. There are known methods for engineering design, operational controls, and contingency measures that should mitigate risks while still allowing for flexibility in design within each management unit. However, there are some factors beyond the exclusive control of the federal government that may influence the timing, details, or effectiveness of the remedial design(s). These include:

- **Geotechnical considerations**—Some portions of the shoreline, most notably along the southern shoreline of Anglin Bay, have highly engineered features, including vertical walls and steep banks. In these areas, it is not possible to dredge to the wall; design rather requires a slope to maintain structural integrity of the shoreline.

- **Navigation and mechanical disturbance of sediment in Anglin Bay**—The design of the dredging program for Anglin Bay must allow for sufficient navigational draft for watercraft, including not only small vessels, but also larger vessels destined for the shipyard. The dredge prism and depth of post-dredge cap material must provide room for navigational draft and afford protection against prop scour.
- **Property redevelopment in brownfield**—There are small areas of shoreline sediment that are owned by a private property developer, and although such areas would ideally be co-managed for consistency and efficiency, such cannot be guaranteed at this stage of the project, particularly given uncertainty regarding the approvals, timing, and design features for potential brownfield redevelopment. This constrains the approaches for management unit TC-OM.
- **Municipal shoreline areas**—There are small areas of shoreline sediment adjacent to Woolen Mill (near Molly Brant Point) and along the shore of Douglas Fluhrer Park that are owned by the City of Kingston. Although preliminary discussions have been held between federal and municipal land managers, with opportunities identified for synergy and co-operative management, uncertainty remains in the degree of collaboration and design of shoreline features that overlap property boundaries.
- **Permitting for Provincially Significant Wetland (PSW)**—The management of the cattail marsh and other wetland types at the mouth of the creek discharging from the Orchard Street Marsh is complex. Multiple parties own and manage properties adjacent to or within the wetland areas that have been designated as PSW habitats. The requirement for permits and agreements among various regulators, site owners, and other stakeholders is more onerous than for other parts of the KIH shoreline.
- **Linkage to Off-Site Sediment Management**—There are other areas of contaminated sediment in downtown Kingston (e.g., near or south of the LaSalle Causeway) for which contaminant profiles resemble portions of KIH. For substances that could be managed on a regional scale, such as PAHs in shoreline sediments, it may be advisable to combine management of KIH sediments with adjacent parcels.

Additional Project constraints may be identified once the data gaps identified in Section 3.1 are addressed.

5.0 CLOSURE

We trust this information is sufficient for your needs at this this time. Should you have any questions or concerns, please do not hesitate to contact the undersigned.

WSP Canada Inc.

[redacted]

Jennifer Daley, PhD
Senior Environmental Scientist

[redacted]

Gary Lawrence, RPBio
Environmental Scientist, Principal

JD/GSL/asd

Attachments: Appendix A – KIH Sediment Quality Profiles from Recent Sampling (2011–2021)

https://golderassociates.sharepoint.com/sites/162644/project files/6 deliverables/3.0_issued/22523199-005-tm-rev0/22523199-005-tm-rev0-sediment quality 06feb_23.docx

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APPENDIX A

KIH Sediment Quality Profiles from Recent Sampling (2011–2021)

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LEGEND

- FEDERAL WATER LOT BOUNDARY
- PRIVATE PROPERTY
- KINGSTON MUNICIPAL PARK
- FEDERAL PARK

0 150 300

1:7,000 METERS

REFERENCE(S)
1. IMAGERY COPYRIGHT © 20220711 ESRI AND ITS LICENSORS. SOURCE: MAXAR VIVID WV02. USED UNDER LICENSE, ALL RIGHTS RESERVED.
2. INSET BASE OBTAINED FROM ESRI CANADA.
3. PARKS OBTAINED FROM THE CITY OF KINGSTON
4. PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SPATIAL DOMAIN OF KIH STUDY AREA AND WATER LOT BOUNDARIES

CONSULTANT

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
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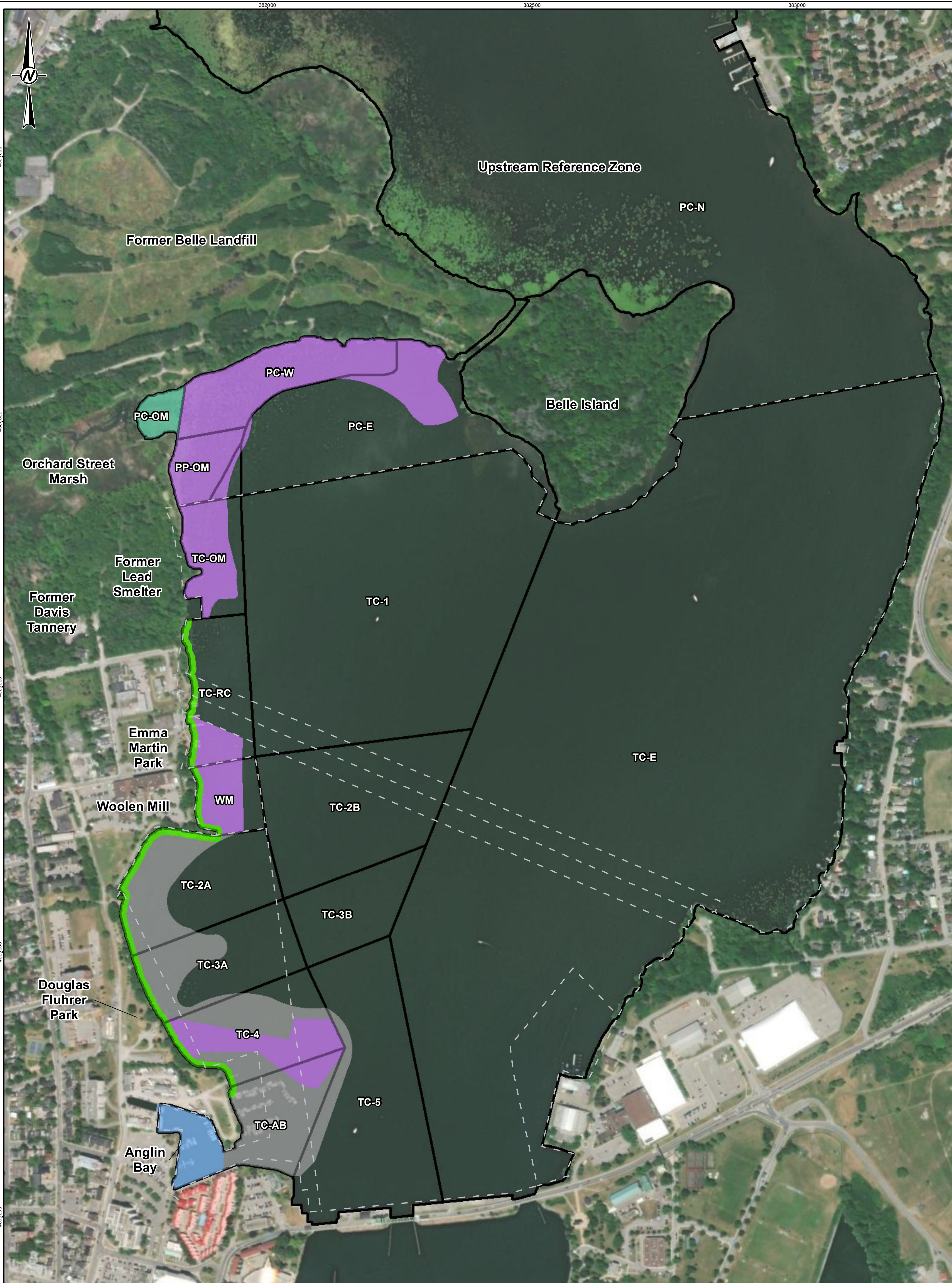

LEGEND

- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

0 150 300

1:7,000 METERS

REFERENCES

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SPATIAL DOMAIN OF KIH STUDY AREA, WITH UPDATES TO CONCEPTUAL REMEDIAL DESIGN

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-2

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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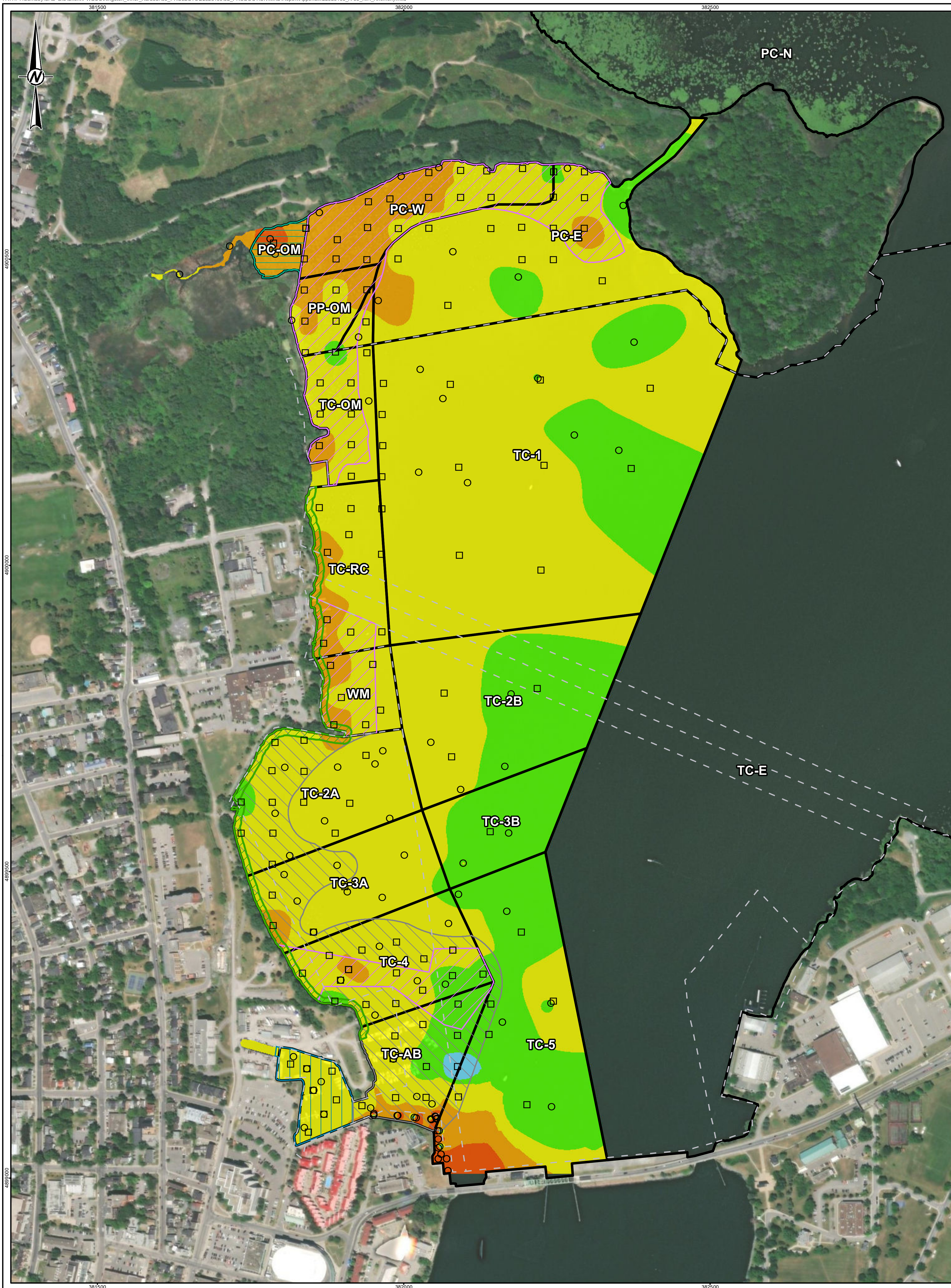

LEGEND

- □ 2021 SURFACE GRAB LOCATION
- ○ 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

ANTIMONY

- 0 - 0.2 mg/kg
- 0.2 - 0.6 mg/kg (<LAET)
- 0.6 - 1.9 mg/kg (<2LAET)
- 1.9 - 6 mg/kg
- 6 - 20 mg/kg
- > 20 mg/kg

0 120 240

1:6,000 METERS

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
ANTIMONY BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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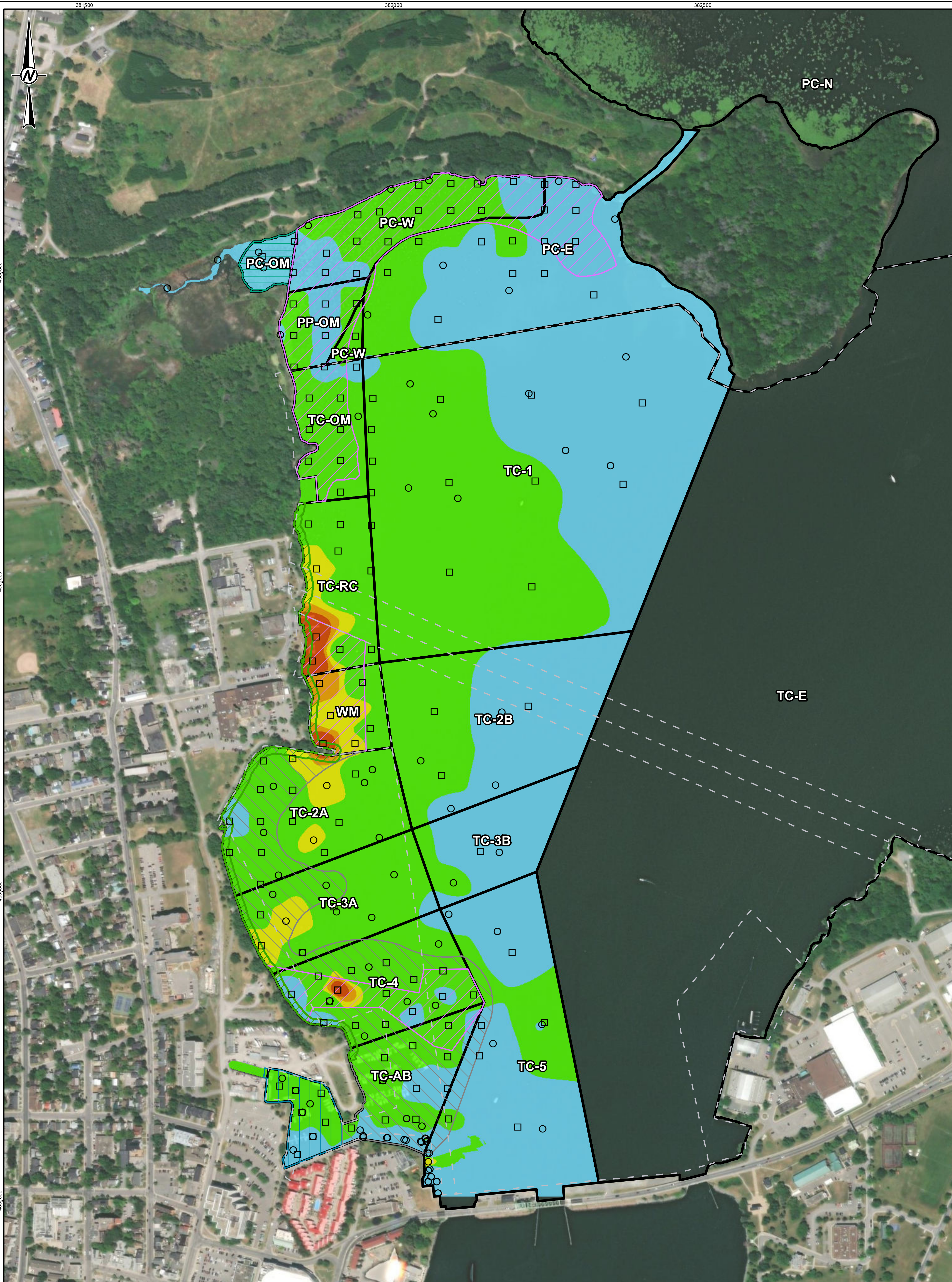

LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

ARSENIC

- 0 - 5.9 mg/kg (<ISQG)
- 5.9 - 17 mg/kg (<PEL)
- 17- 33 mg/kg (<SEL)
- 33 - 50.9 mg/kg (<2LAET)
- 50.9 - 100 mg/kg
- > 100 mg/kg

0 120 240

1:6,000 METERS

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
ARSENIC BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	**A-4**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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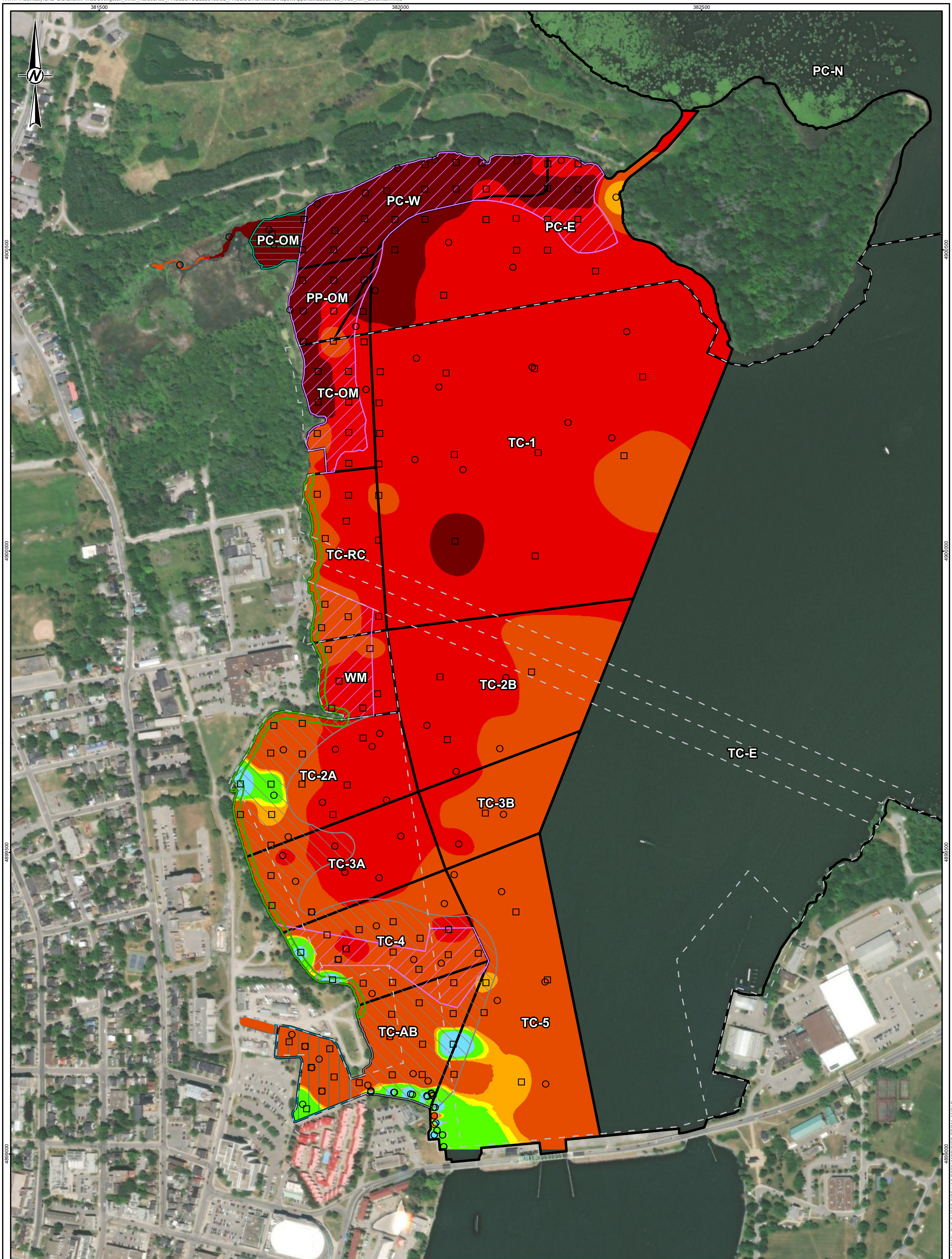

LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

CHROMIUM

- 0 - 37.3 mg/kg (<ISQG)
- 37.3 - 90 mg/kg (<PEL)
- 90 - 110 mg/kg (<SEL)
- 110 - 133 mg/kg (<2LAET)
- 133 - 500 mg/kg
- 500 - 1,000 mg/kg
- > 1,000 mg/kg

0 120 240

1:6,000 METERS

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
CHROMIUM BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-5

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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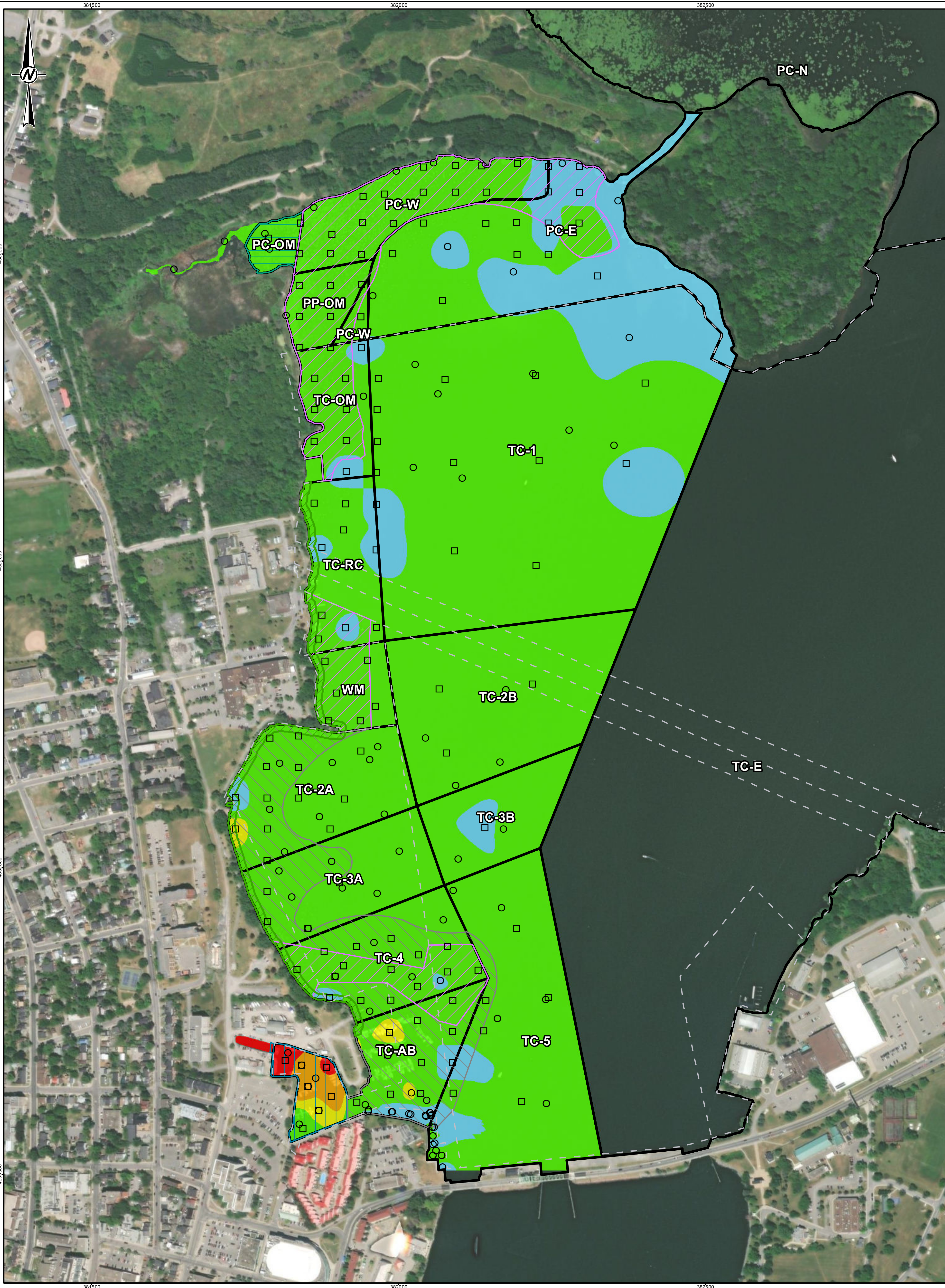

LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

COPPER

- 0 - 35.7 mg/kg (<ISQG)
- 35.7 - 110 mg/kg (<SEL)
- 110 - 197 mg.kg (<PEL)
- 197 - 619 mg/kg (<LAET)
- 619 - 829 mg/kg (<2LAET)

0 120 240

1:6,000 METERS

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
COPPER BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-6

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

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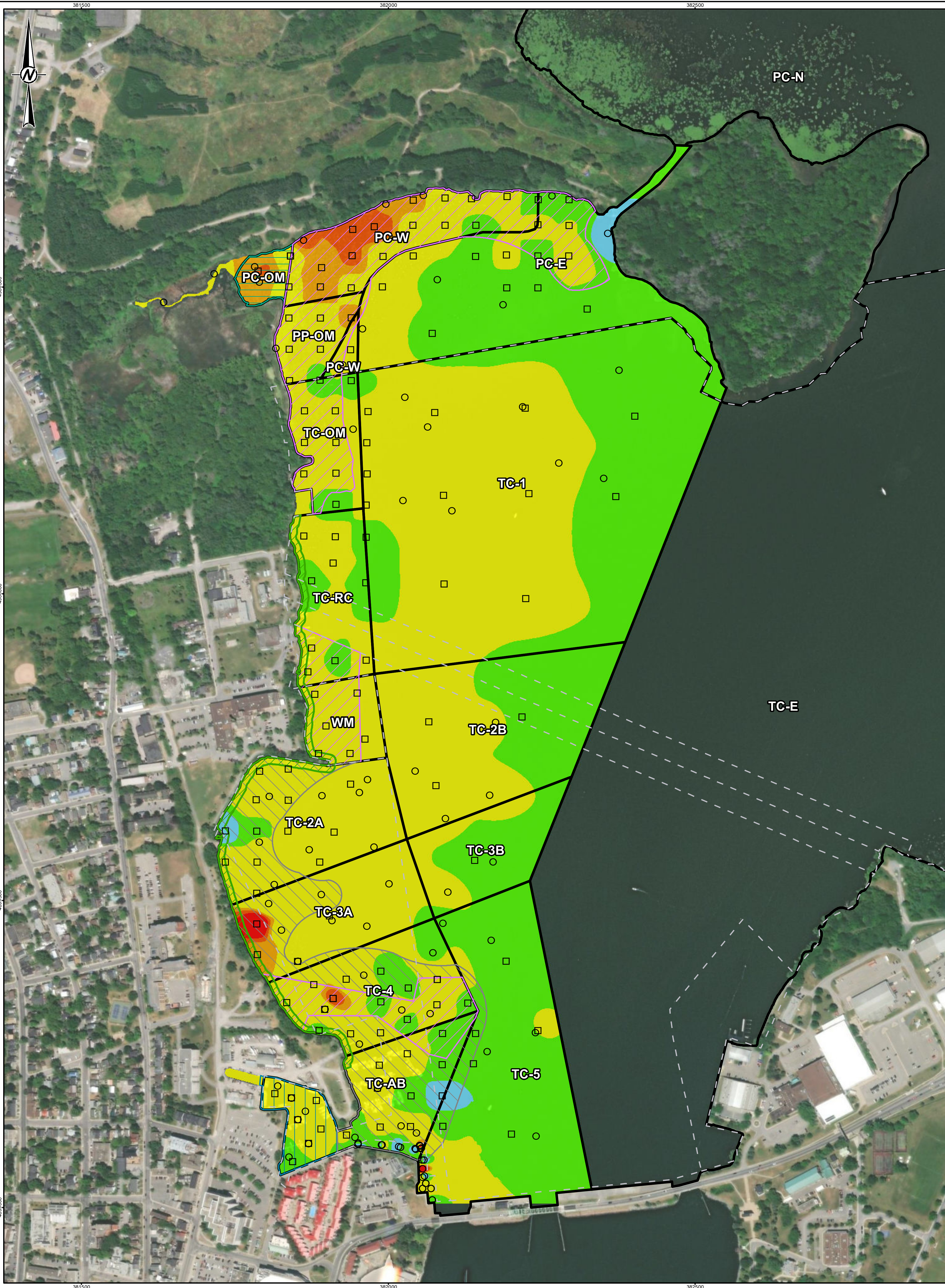

LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

LEAD

- 0 - 35 mg/kg (<ISQG)
- 35 - 91.3 mg/kg (<PEL)
- 91.3 - 250 mg/kg
- 250 - 335 mg/kg (<LAET)
- 335 - 431 mg/kg (<2LAET)
- >431 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
LEAD BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-7

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

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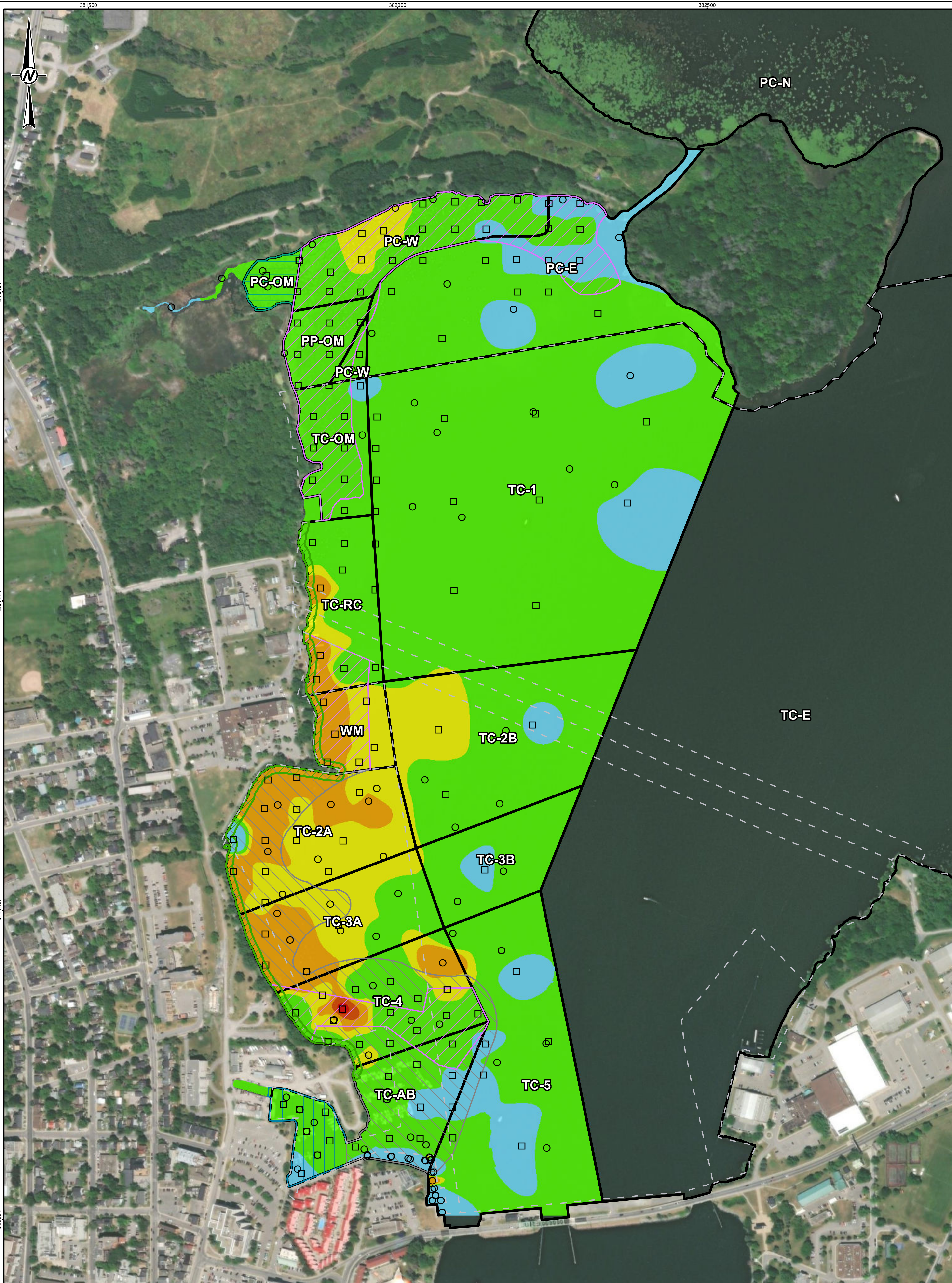

LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

MERCURY

- 0 - 0.17 mg/kg (<ISQG)
- 0.17 - 0.486 mg/kg (<PEL)
- 0.486 - 0.8 mg/kg (<LAET)
- 0.8 - 2 mg/kg (<SEL)
- 2 - 3.04 mg/kg (<2LAET)
- > 3.04 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
MERCURY BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

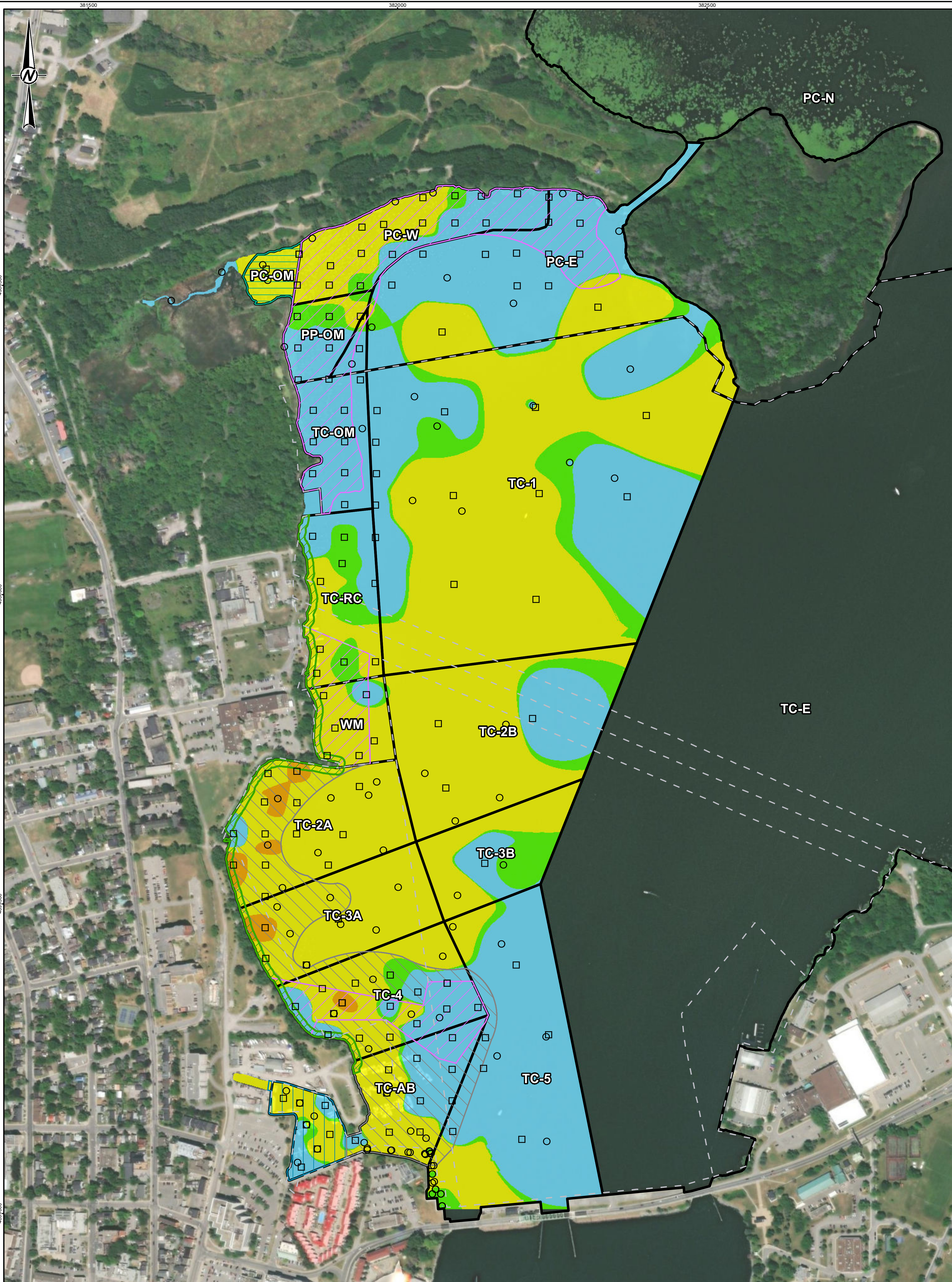
YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-8

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

PATH: Y:\burnaby\CAD-GIS\Client\PWGSC\Kingston_Inner_Harbour\99_PROJECTS\22523199\02_PRODUCTION\MXD\Report\Appendix\22523199_A-09_KIH_Silver.mxd



LEGEND

- □ 2021 SURFACE GRAB LOCATION
- ○ 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

SILVER

- 0 - 0.5 mg/kg
- 0.5 - 0.545 mg/kg (<LAET)
- 0.545 - 2 mg/kg
- 2 - 3.5 mg/kg (<2LAET)
- 3.5 - 4.5 mg/kg
- > 4.5 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)
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2. INSET BASE OBTAINED FROM ESRI CANADA.
PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
SILVER BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

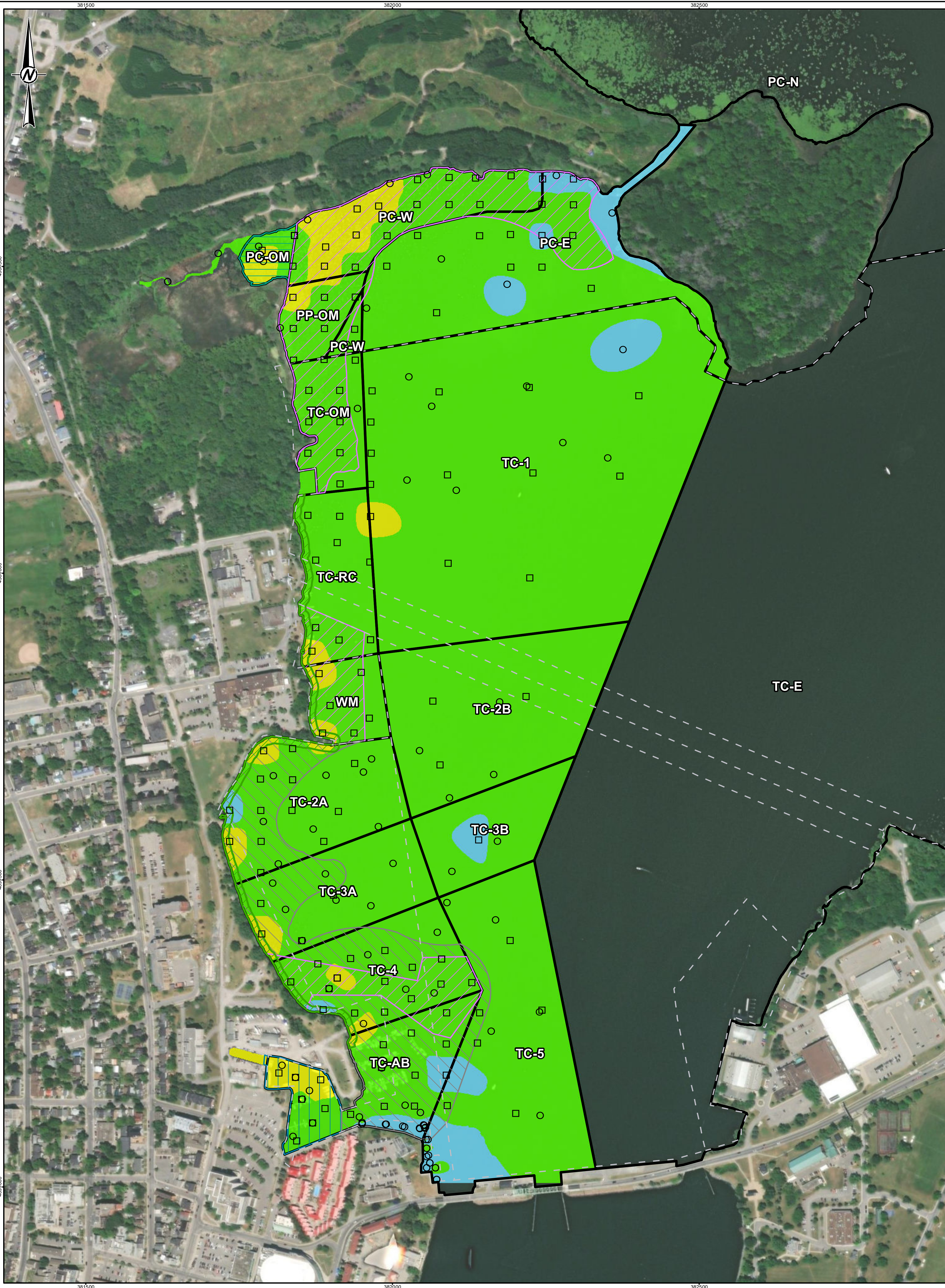
YYYY-MM-DD	2022-02-06
DESIGNED	CP
PREPARED	JP/MH
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	8007	0	A-9

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: Y:\burnaby\CAD-GIS\Client\PWGSC\Kingston_Inner_Harbour\99_PROJECTS\22523199\02_PRODUCTION\MXD\Report\Appendix\22523199_A-10_KIH_Zinc.mxd



LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

ZINC

- 0 - 123 mg/kg (<ISQG)
- 123 - 315 mg/kg (<PEL)
- 315 - 683 mg/kg (<LAET)
- 683 - 820 mg/kg (<SEL)
- 820 - 1080 mg/kg (<2LAET)
- > 1080 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT

PSPC

PROJECT

KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE

ZINC BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

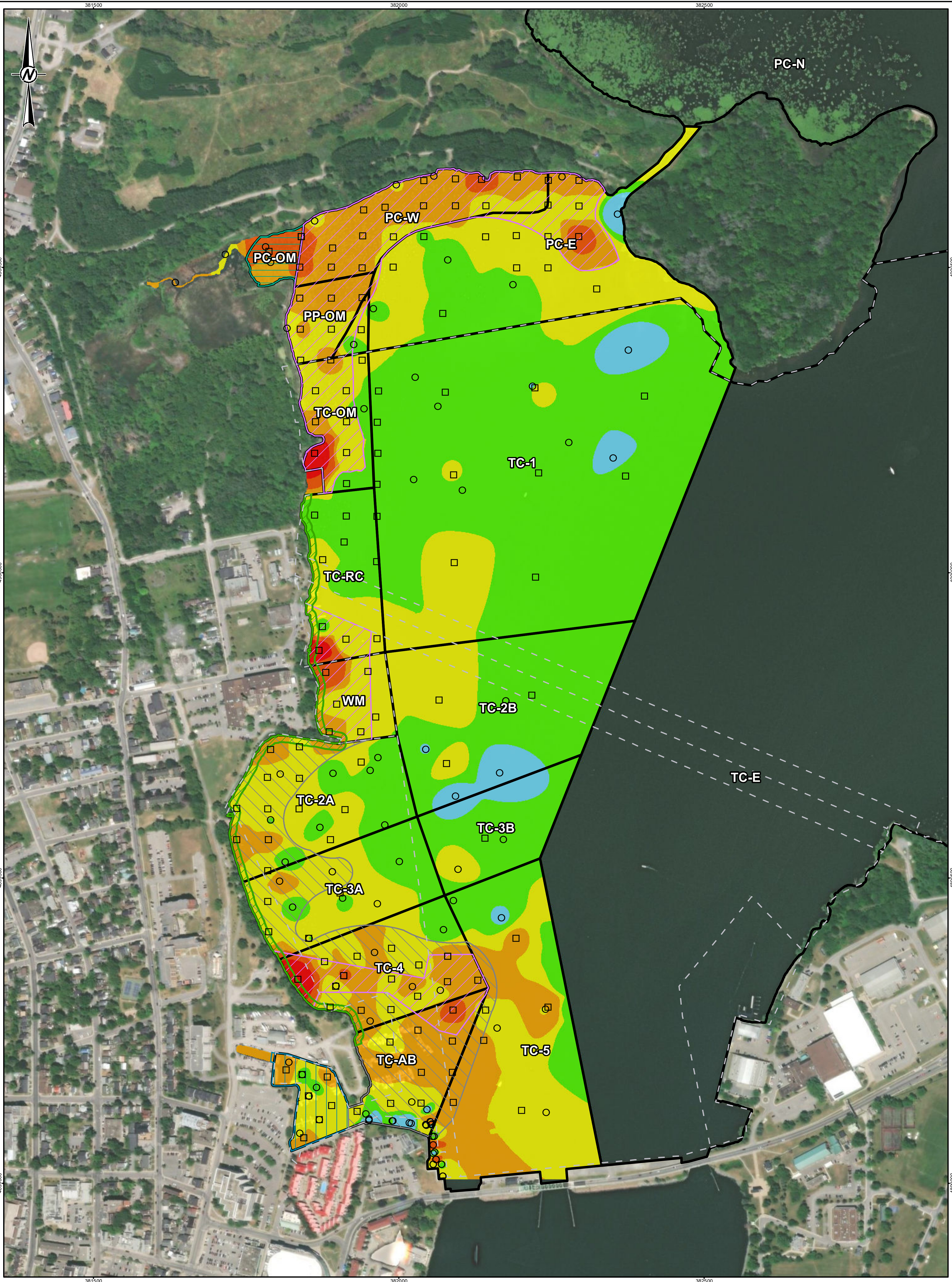
PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-10

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

0

PATH: Y:\burnaby\CAD-GIS\Client\PWGSC\Kingston_Inner_Harbour\99_PROJECTS\22523199\02_PRODUCTION\MXD\Report\Appendix\22523199_A-11_KIH_Total_PAH.mxd



LEGEND

- □ 2021 SURFACE GRAB LOCATION
- ○ 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

TOTAL PAH

- 0 - 1.61 mg/kg (<TEC)
- 1.61 - 4 mg/kg (<LEL)
- 4 - 10 mg/kg
- 10 - 22.8 mg/kg (<PEC)
- 22.8 - 100 mg/kg
- 100 - 750 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
TOTAL PAH BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

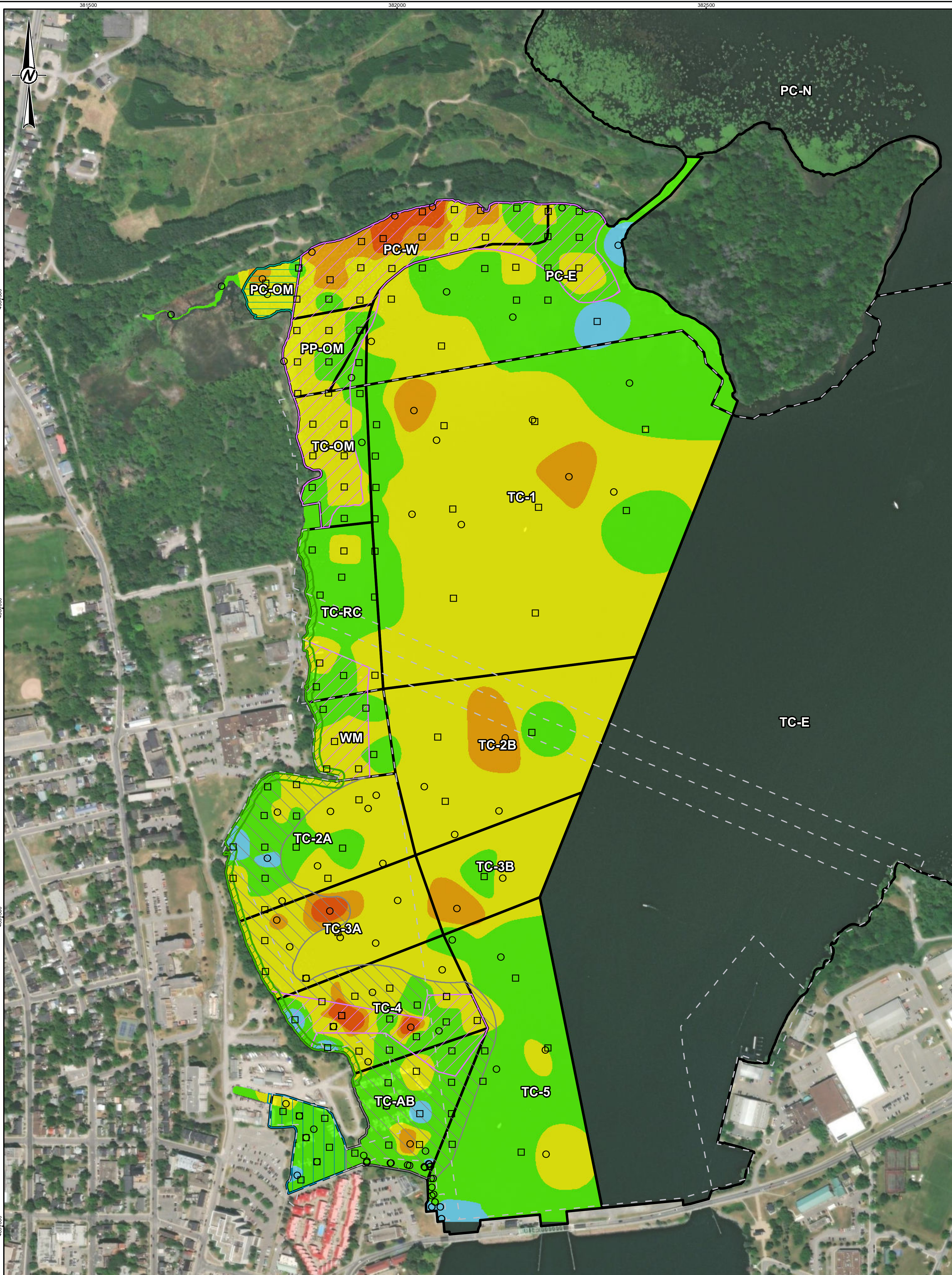
YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	**A-11**

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

0 25mm

PATH: Y:\burnaby\CAD-GIS\Client\PWGSC\Kingston_Inner_Harbour\99_PROJECTS\22523199\02_PRODUCTION\MXD\Report\Appendix\22523199_A-12_KIH_Total_PCB.mxd



LEGEND

- 2021 SURFACE GRAB LOCATION
- 2011 - 2020 SURFACE GRAB LOCATION
- FEDERAL WATER LOT BOUNDARY
- MANAGEMENT UNIT
- DREDGE BOUNDARY WITH THIN LAYER (0.3m) CAP/COVER
- DREDGE BOUNDARY WITH CONVENTIONAL (1.0m) CAP WITH ACTIVATED CARBON OR REACTIVE BARRIER
- THIN LOW-INTERVENTION CAP - ACTIVATED CARBON
- GREEN SHORELINE MANAGEMENT
- FUTURE WETLAND MANAGEMENT OR OFFSETTING

TOTAL PCB

- 0 - 0.07 mg/kg (<LEL)
- 0.07 - 0.3 mg/kg (<PEL)
- 0.3 - 0.6 mg/kg (<LAET)
- 0.6 - 1 mg/kg
- 1 - 5.3 mg/kg (<SEL)
- > 5.3 mg/kg

0 120 240

1:6,000 METERS

REFERENCE(S)

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PROJECTION: UTM ZONE 18 DATUM: NAD 83

CLIENT
PSPC

PROJECT
KINGSTON INNER HARBOUR
KINGSTON, ONTARIO

TITLE
TOTAL PCB BULK SEDIMENT CHEMISTRY AND INVERSE WEIGHTED DISTANCE SURFACE (2011 - 2021)

CONSULTANT

wsp

YYYY-MM-DD	2023-02-06
DESIGNED	JD
PREPARED	JP
REVIEWED	JD
APPROVED	GL

PROJECT NO.	PHASE	REV.	FIGURE
22523199	3000	0	A-12

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

25mm

APPENDIX E

Stage 1 Terrestrial Archaeological Assessment of the Kingston Inner Harbour

APPENDIX F

Marine Desktop (Stage 1 Equivalent) Archaeological Assessment of the Kingston Inner Harbour