

APPENDIX A
PROBABLE EFFECTS DETERMINATION REPORT (CEAA)
AND REGULATORY APPROVALS

**FISHERIES AND OCEANS
CANADIAN ENVIRONMENTAL ASSESSMENT ACT (CEAA) 2012
PROJECT EFFECTS DETERMINATION REPORT**

GENERAL INFORMATION

1. Project Title: Search and Rescue Station Construction – Twillingate (Boehner Site), NL	
2 Proponent: Fisheries and Oceans Canada, Real Property, Safety, and Security (DFO RPSS)	
3. Other Contacts (Other Proponent, Consultant or Contractor): Public Service and Procurement Canada (PSPC)	4. Role: OGD Consultant
5. Source of Project Information: Dave Bursey, Project Manager, PSPC	
6. Project Review Start Date: May 30 th , 2018	
7. DFO File No.: 18-HNFL-00196	8. PSPC File No: R.089926.001
9. TC File No.: NPP #2018-200069/NEATS	

BACKGROUND

<p>10. Background about Proposed Development (including a description of the proposed development):</p> <p>A new Search and Rescue facility will be established adjacent to an existing DFO Small Craft Harbour facility at the Boehner Site in Twillingate, NL. Approximately 6000 cubic metres of sediment will be dredged from an approximately 2500 square metre area. A 3150 square metre area of the waterlot will be infilled utilizing the dredge spoils, imported fill and rock ballast. The new service area will be surrounded with timber cribbing. A new marginal wharf and floating docks will also be constructed on the seaward end of the service area. As part of the project, an existing RCMP facility (located in the uplands) will be demolished and a new SAR station constructed. This component of the work will occur entirely within the uplands and will be assessed under a separate report.</p>
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PROJECT REVIEW

<p>11. DFO's rationale for the project review:</p> <p>Project is on federal land <input checked="" type="checkbox"/> <u>and</u>;</p> <p><input checked="" type="checkbox"/> DFO is the proponent</p> <p><input type="checkbox"/> DFO to issue <i>Fisheries Act</i> Authorization or <i>Species at Risk Act</i> Permit</p> <p><input type="checkbox"/> DFO to provide financial assistance to another party to enable the Project to proceed</p> <p><input type="checkbox"/> DFO to lease or sell federal land to enable the Project to proceed</p> <p><input type="checkbox"/> Other</p>
<p>12. Fisheries Act Sections (if applicable): n/a</p>

<p>13. Other Authorities</p> <p>Transport Canada – Navigation Protection Program and Environmental Affairs and Aboriginal Consultation Unit (TC NPP and TCEA)</p>	<p>14. Other Authorities rationale for involvement:</p> <p><i>Navigation Protection Act</i></p>
<p>15. Other Jurisdiction:</p> <p>Newfoundland and Labrador – Department of Municipal Affairs and Environment, Water Resources Division (NLDMAE-WR)</p> <p>Newfoundland and Labrador – Service NL (SNL)</p>	
<p>16. Other Expert Departments Providing Advice:</p> <p>Fisheries and Oceans Canada, Fisheries Protection Program (DFO FPP)</p>	<p>17. Areas of Interest of Expert Departments:</p> <p><i>Fisheries Act</i></p>
<p>18. Other Contacts and Responses: N/A</p>	
<p>19. Scope of Project (details of the Project subject to review):</p> <p><u>Construction/Installation:</u></p> <p>A new Search and Rescue facility will be established adjacent to an existing DFO Small Craft Harbour facility at the Boehner Site in Twillingate, NL. Approximately 6000 cubic metres of sediment will be dredged from an approximately 2500 square metre area. It should be noted that this area has been dredged regularly (most recently in 2016) as part of on-going maintenance dredging associated with the adjacent and active DFO SCH site. A 3150 square metre area of the waterlot will be infilled utilizing the dredge spoils, imported fill and rock ballast. The new service area will be surrounded with timber cribbing. A new marginal wharf and floating docks will also be constructed on the seaward end of the service area.</p> <p>In-water work will require the dredging and re-deposition of marine sediments. Dredging will be completed using either a temporary gravel access road built within the boundaries of the proposed infill/dredge area and or use of a floating barge. Dredged materials will be moved using heavy equipment such as excavators and dump trucks. Gravel fill will also be imported to the site from an approved source and placed within the boundaries of the infill area. Dredge spoils and infill will be end dumped, shaped and compacted using heavy equipment. Timber cribbing will be placed around the perimeter of the service area to allow for maximum available berthage. The service area/infill will be capped with clean fill and asphalt. Cribbing material will be assembled on-site and floated into position. Ballast will be added to the cribbing sinking the blocks into place. Floating docks will be assembled in an upland area and floated into position.</p> <p><u>Operation</u></p> <p>DFO RPSS's Environmental Management System, with an integrated Environmental Management Plan, will cover operational aspects of environmental management at the harbour (fuelling, waste disposal, activities on the property and water).</p> <p><u>Decommissioning</u></p> <p>This facility is not presently planned to be decommissioned. At the time of decommissioning, DFO RPSS will develop a site-specific re-use or reclamation plan that is appropriate for the applicable environmental legislation and DFO policies.</p> <p><u>Scheduling</u></p> <p>Subject to regulatory approval and DFO RPSS operational priorities and funding, this Project will likely commence during the 2018 – 2019 fiscal year.</p>	

20. Location of Project:

The project site is located in Twillingate (49°38'56.93" N, 54°46'10.07" W) located approximately 76 km north of the community of Gander on the northeast coast of Newfoundland. The site is accessible via local roads from provincial route 340.

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21. Environment Description:

Bio-Physical Environment

The project site is located on an exposed point of land in relatively shallow water. There are several residential dwellings in close proximity to the project site and an active, commercial Small Craft harbour property immediately the north of the site which contains a large paved service area and several floating docks. The main Twillingate SCH site is located approximately 300 metres to the northwest and contains a large rubblemound breakwater, several finger pier wharves and an active fish plant.

The immediate project site is characterized by the SCH Boehner site to the north, small private fishing wharves to the south, Twillingate Harbour to the east and a mixed substrate (boulder, pebble-cobble material) shoreline to the west. Water depths range between 1.0 - 1.5 metres. The uplands is characterized by a gravel parking area surrounded by grass vegetation and Main Street.

The general project site is a flat and exposed coastal area with a moderate cover of grass, native shrub, and coniferous vegetation. The immediate project site is a developed SCH site and is largely paved. Twillingate falls within the North Shore ecoregion. This ecoregion represents a narrow coastal zone 20-25km in width extending from Bonavista Bay to the Baie Verte Peninsula. Black Spruce and Balsam Fir form a continuous forest except where barrens dominate on the coastal headlands.

The general area is a flat and exposed coastal area with a moderate cover of grass, native shrub, and coniferous vegetation. Various types of flora are known to be present in the immediate project area, including sourweed, sea lettuce, and bacterial mats. Various species of cnidaria, finfish, and porifera are known to utilize the immediate project site. According to Fisheries and Oceans' Traditional Ecological Maps of the area, lumpfish, cod, seal, Capelin and lobster may be found within or near the project area.

Species at Risk (Aquatic and Terrestrial)

A search of the Atlantic Canada Conservation Data Centre (ACDC) database was conducted which produced a list of rare/unique species (i.e. plants and animals) within a 5 km buffer zone (standard ACDC procedure) of the site of the proposed work. All species were cross-referenced with Schedule 1 of the Species At Risk Act (SARA) and none were found to be listed as extirpated, endangered, threatened or of special concern.

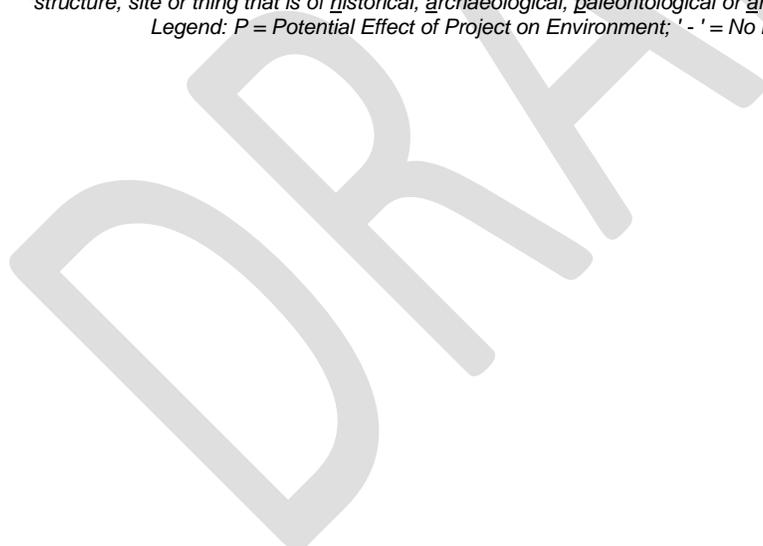
22. Scope of Effects Considered (sections 5(1) and 5(2)):

Table 1: Potential Project / Environment Interactions Matrix

Project Phase / Physical Work/Activity	As per Section 5(1)			Section 5(1c)				Section 5(2)			Due Diligence			
	Fish (Fisheries Act)	Aquatic Species (SARA)	Birds (MBCA)	Health and Socio-economic	Physical and cultural heritage	Land use	*HAPA Significance	Health and Socio-economic	Physical and cultural heritage	*HAPA Significance	Water (ground, surface, drainage, etc.)	Terrestrial / Aquatic Species	Soil/Marine Sediment	Air Quality
Construction / Installation														
Dredging and disposal	P	-	-	P	-	-	-	P	-	-	P	P	P	P
Infilling/service area construction	P	-	-	P	-	P	-	P	-	-	P	P	P	P
Wharf construction/floating docks	P	-	-	P	-	P	-	P	-	-	P	P	-	P
Operation / Maintenance	P	-	-	-	-	-	-	-	-	-	P	-	-	-
Decommissioning / Abandonment														

**structure, site or thing that is of historical, archaeological, paleontological or architectural significance.*

Legend: P = Potential Effect of Project on Environment; '-' = No Interaction



23. Environmental Effects of Project:

Potential Project / Environmental Interactions and their effects are outlined below:

Fish:

- Sedimentation as a result of infilling, wharf construction and dredging may temporarily disrupt and/or negatively impact fish and quality of potential fish habitat at the immediate project site.
- Accidental discharge of heavy machinery fuel/fluids or hazardous substances could negatively impact fish and potential fish habitat.
- Improperly disposed of dredge spoils may erode and result in sedimentation of surface water, negatively impacting fish and fish habitat.

Health and Socio economic:

- Potential for safety hazards to workers and site users during construction activities.
- Intake lines for fishplant and/or lobster holding pens may be negatively impacted by potential sedimentation of waterbody, resulting in negative impacts to fish plant/lobster fishers.

Water

- Sedimentation as a result of infilling, wharf construction and dredging may temporarily disrupt and/or negatively impact fish and quality of potential fish habitat at the immediate project site.
- Construction related refuse may be deposited in water-body, decreasing marine water quality.
- Accidental discharge of heavy machinery fuel/fluids or hazardous substances may result in a decrease of marine water quality.
- Construction activities taking place near the shoreline may result in erosion.
- Improperly disposed of dredge spoils have the potential to contaminate surface, ground and potable water resources.

Aquatic Species

- Sedimentation as a result of infilling, wharf construction and dredging may temporarily disrupt and/or negatively impact fish and quality of potential fish habitat at the immediate project site.
- Accidental discharge of heavy machinery fuel/fluids or hazardous substances could negatively impact aquatic species.
- Improperly disposed of dredge spoils may erode and result in sedimentation of surface water, negatively impacting aquatic species.

Soil / Marine Sediments

- Improperly disposed dredge spoils may result in contamination of surrounding soils.
- Accidental discharge of heavy machinery fuel/fluids or hazardous substances may result in contamination of soils.
- Construction activities at site or natural events (e.g. rainfalls) could result in erosion/ sedimentation events.
- Operational phase of site may result in degradation of quality/increase of contaminants of marine sediments at immediate project.
- Marine sediments are impacted with elevated levels of metals (i.e. arsenic, copper, selenium) and polyaromatic hydrocarbons (i.e. naphthalene and phenanthrene).

Air quality

- Improper storage/disposal of dredge spoils may result in unpleasant odours and provide annoyance to facility users and nearby residents.

- Construction activities may result in nuisance impacts due to an increase in noise and dust and the use of heavy equipment.

Navigation Consideration:

- Environmental effects of the project on navigation are taken into consideration as part of the Project Effects Determination (PED) only when the effects are indirect, i.e. resulting from a change in the environment affecting navigation. Direct effects on navigation are not considered in the PED, but any measures necessary to mitigate direct effects will be included as terms and conditions associated with the work approved or permitted pursuant to the *Navigation Protection Act*.

24. Mitigation Measures for Project (including Habitat Compensation):

- Reduce duration of in-water work wherever possible.
- Construction activities that involve in-water work will be conducted during periods of low flow, or at low tide, to further reduce the potential for effects on fish / fish habitat and water quality.
- Schedule work to avoid wet, windy, and rainy periods that may increase erosion and sedimentation into the marine environment. Weather conditions should be checked daily to manage / prepare the site for these events.
- Project activities involving in-water work will be suspended, and/or additional mitigation measures will be implemented if ocean conditions cause sediment or turbidity within the marine environment, outside the immediate vicinity of the Project.
- Develop and implement an Erosion and Sediment Control Plan for the site that reduces risk of sedimentation of the marine environment during the Project. Erosion and sediment control measures should be maintained until disturbed ground has been permanently stabilized, suspended sediment has resettled, or settling basin and runoff water is clear.
- Develop a response plan that is to be implemented immediately in the event of an accidental sediment release or spill of a deleterious substance, and keep an emergency spill kit on site with staff trained in its use. This oil spill response plan must be reviewed and approved by the proponent (DFO-RPSS) prior to commencing Project-related activities.
- Oil spill response equipment, such as adsorbents and open-ended barrels, should be available on-site in case of a spill or leak. Spills or leaks must be promptly contained, cleaned up and reported to the 24-hour environmental emergencies report system (1-800-563-2444).
- Marine sediments are impacted with elevated levels of metals (i.e. arsenic, copper, selenium) and polycyclic aromatic hydrocarbons (i.e. naphthalene and phenanthrene). A qualitative risk screening completed by AMEC (Appendix D) in 2018 indicated that dredged sediments are suitable for re-use on-site, as fill for the new service area, provided the material is capped with clean fill and asphalt. As such, all dredged/excavated sediments must be utilized as fill to construct the service area located behind the proposed marginal wharf. This material is to be capped with clean fill and/or asphalt. Any excess material is to be trucked to the Norris Arm Regional Waste Facility for disposal. Disposal and/or re-use in any other location is not permitted.
- Trucks transporting dredge spoils must be secured against spillage. Any potential release of dredge spoils must be immediately cleaned.
- Construction materials used in a watercourse will be handled and treated in a manner to prevent the release or leaching of substances into the water that may be harmful to fish.
- Construction materials associated with the Project will be removed from site upon Project completion.

- Make a reasonable effort to confirm that machinery arriving on site is inspected and in clean condition, and is maintained free of fluid leaks.
- Whenever possible, operate machinery on land above the high-water mark in a manner that reduces disturbance to the banks and bed of the waterbody.
- Machinery will be checked for leakage of lubricants or fuel and must be in good working order. Refuelling will be done at least 100 m from a water body and on a level surface to reduce the potential for spills or leaks into the marine environment.
- Cribbing ballast material should be, to the greatest extent possible, free of fine-grained materials to help reduce sedimentation of the waterbody and must not be obtained from below the highwater mark.
- Pre-treated wood for the crib blocks should be thoroughly dried before used in construction and placed in the marine environment. Additional application of preservatives should be take place at a reasonable distance away from a waterbody, to reduce the potential of leaching deleterious substances into the marine environment.
- Rock material will be moved and installed into the marine environment in a manner that reduces the potential for sedimentation or turbidity to occur. This includes using an excavator to place rocks in their locations instead of end dumping from a truck.
- Food waste from Project staff can increase the potential for human-wildlife encounters, and increases the chance for effects to wildlife and worker safety. As a result, food scraps and litter should be properly contained in approved storage containers and not left on site by staff. Food and other non-hazardous wastes will be disposed of at an approved facility.
- If encountered, Project staff should not approach concentrations of seabirds, sea ducks, or shorebirds. Interacting with wildlife, including feeding, is prohibited.
- Machinery used for the Project will be well muffled to reduce noise for local residents, and local municipality construction by-laws will be adhered to.
- Where feasible, mitigation measures such as dust suppressors will be implemented to reduce the potential for increased dust during Project activities.
- Project employees will be equipped with the proper Personal Protective Equipment for Project tasks, and work will comply with provincial occupational health and safety regulations.
- Consultation with local fishers should be conducted prior to the start of the project and if necessary work completed outside of the lobsters fishing season in Lobster Fishing Area 4B (i.e. May 12 to July 6), to avoid conflict.
- Fuel storage tanks located on federal property must be installed/maintained in accordance with the requirements and recommendations outlined in the federal Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations and the Environmental Code of Practice for Aboveground and Underground Storage Tank Systems Containing Petroleum and Allied Petroleum Products.

25. Significance of Adverse Environmental Effects of Project:

Taking into account the proposed mitigation measures for the Project, significant adverse environmental effects from Project activities are not anticipated.

26. Other Considerations (Public Consultation, Aboriginal Consultation, Follow-up)

Public Consultation

The Project will provide safer and more secure access for vessels using this facility. No negative public concern is expected as a result of this Project. A Ministerial announcement was made on May 14, 2018, indicating that this project would increase the Coast Guard's maritime search and rescue capacity on the northeast coast of Newfoundland (<https://www.canada.ca/en/canadian-coast-guard/news/2018/05/twillingate-nl-home-to-new-search-and-rescue-lifeboat-station.html>). Consultation with local fishers will also be conducted prior to the start of the project should it be determined that the project may impact the local lobster fishery (May 12 to July 6).

Indigenous Engagement

Indigenous fishers do not utilize this facility. As such, Indigenous engagement was not deemed necessary as part of this determination.

Government Consultation

Federal and provincial authorities likely to have an interest in the Project were consulted by Public Services and Procurement Canada, Environmental Services, during the course of this assessment. A Project description was distributed to the following authorities:

- DFO FPP
- TC NPP
- TCEA
- NLDEMA WR
- SNL

DFO FPP determined that 'Serious Harm' to fish could be avoided by following standard mitigations as described within Appendix C. These mitigation measures will be factored into the Project in addition to the mitigation measures described above.

TC NPP determined that an approval for the Project would be required under the *Navigation Protection Act*.

NLDMAE-WR are currently in the process of issuing an infilling and dredging approval for the Project.

SNL has provided an approval for the landfill disposal of excess dredge spoils.

Expert advice/specialist information provided by the above noted departments has been incorporated into this document.

Accuracy and Compliance Monitoring

A follow-up program (as defined in S. 2(1) and as applicable to non-designated projects on federal lands) is a program for determining the effectiveness of mitigation measures. Site monitoring (accuracy and compliance monitoring) may be conducted to verify whether required mitigation measures were implemented. The proponent must provide site access to Responsible Authority officials and/or its agents upon request.

27. Other Monitoring and Compliance Requirements (e.g. *Fisheries Act* or *Species at Risk Act* requirements)

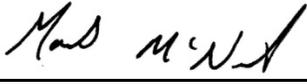
N/A

CONCLUSION

28. Conclusion on Significance of Adverse Environmental Effects:

The Federal Authorities have evaluated the Project in accordance with Section 67 of *Canadian Environmental Assessment Act (CEAA), 2012*. On the basis of this evaluation, the departments have determined that the Project is not likely to cause significant adverse environmental effects with mitigation and therefore can proceed using mitigative measures as outlined.

29. Prepared by:



32. Date: May 31, 2018

33. Name:

Mark McNeil

34. Title:

Environmental Specialist, PSPC-ES

35. Decision Taken

- DFO may exercise its power, duty or function, i.e. may issue the authorization - where the Project is not likely to cause significant adverse environmental effects. Confirm below the specific power, duty or function that may be exercised.
- DFO to issue *Fisheries Act* Authorization or *Species at Risk Act* Permit
 - DFO to proceed with Project (as proponent)
 - DFO to provide financial assistance for Project to proceed
 - DFO to provide federal land for Project to proceed
- DFO has decided not to exercise its power, duty or function because the Project is likely to cause significant adverse environmental effects.
- DFO to ask the Governor in Council to determine if the significant adverse environmental effects are justified in the circumstances

36. Approved by:

37. Date:

38. Name:

Taryn Baker

39. Title:

Regional Director, DFO-RPSS, NL

40. TRANSPORT CANADA RECOMMENDATION	
Project Title:	Twillingate (Boehner Site), NL – Search and Rescue Station Construction
TC File No.:	NEATS:
NPP File No.:	NPP # 2018-200069
Environmental Review Decision:	Taking into account the implementation of any mitigation measures that Transport Canada considers appropriate, the project is not likely to cause significant adverse environmental effects and, as such, Transport Canada may exercise any power or perform any duty or function that would permit the project to be carried out in whole or in part.
Prepared by:	Melissa Ginn Environmental Officer Environmental Affairs and Aboriginal Consultation Unit
Signature:	Date:
Mailing Address:	10 Barter's Hill, St. John', NL
Tel:	709-772-3088
Fax:	709-772-3072
Email:	melissa.ginn@tc.gc.ca
Recommended by:	J. Jason Flanagan Senior Environmental Assessment Officer Environmental Affairs and Aboriginal Consultation Unit
Signature:	Date:
Approved by:	Kevin LeBlanc Regional Manager Environmental Affairs and Aboriginal Consultation Unit
Signature:	Date:

List of Appendices:

Appendix A: Topographic map and photos of project site

Appendix B: Site drawings

Appendix C: Regulatory Approvals/Responses

Appendix D: Qualitative Risk Screening Dredge Spoils Re-use

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APPENDIX A

Topographic map and photos of project site



Description

Figure 1: Topographic Map of Proposed Site Location: Twillingate (Boehner Site)





Figure 2: Project site highlighted in yellow.
WGS84 Coordinates: 49°38'56.93"N, - 54°46'10.071"W

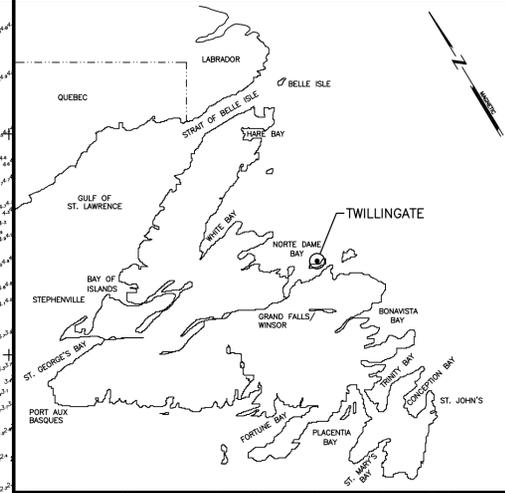


Figure 3. Street view of project site (Google Earth).

APPENDIX B

Site drawings

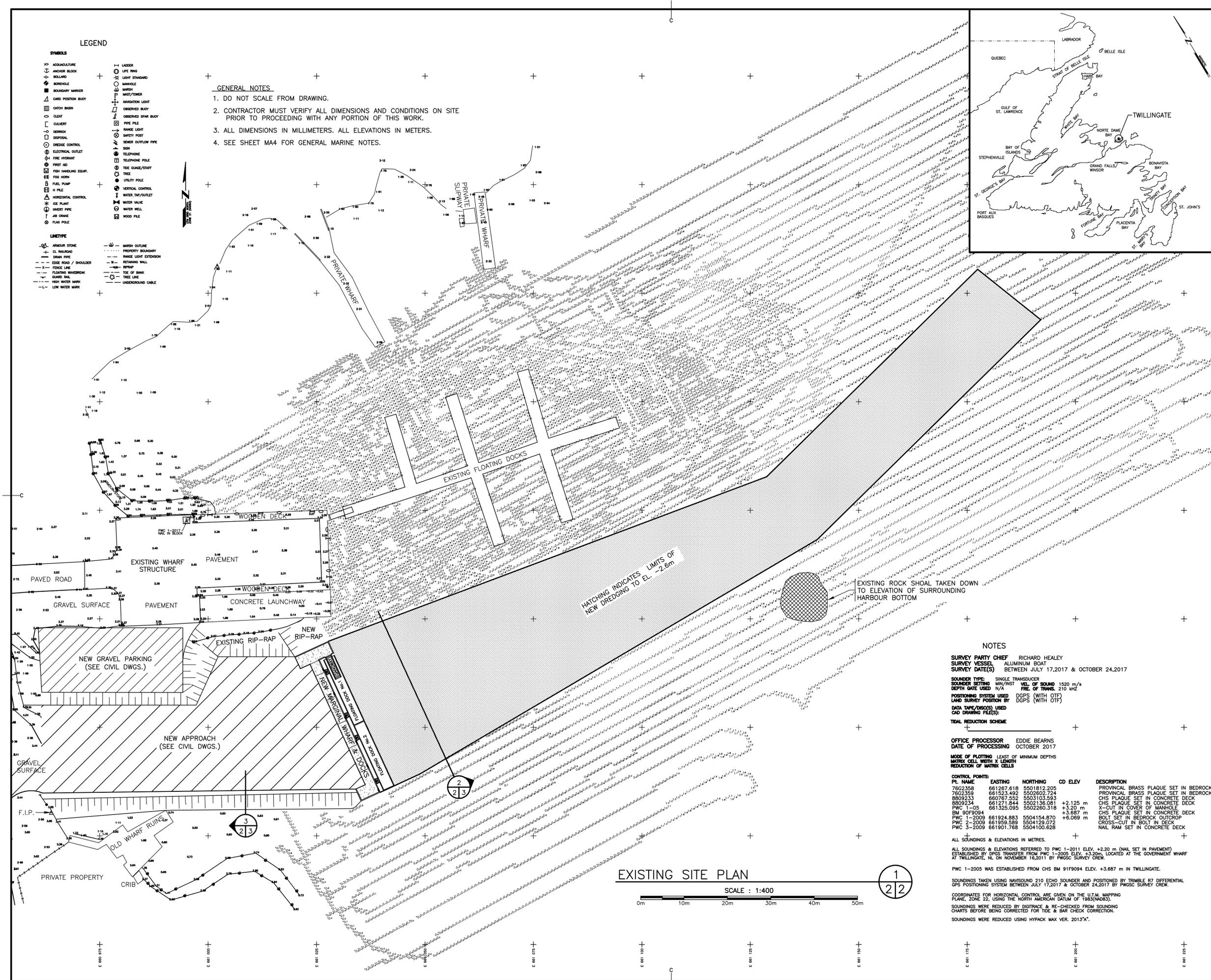
PROVINCE OF NEWFOUNDLAND AND LABRADOR
PEGNL PERMIT HOLDER
 This Permit Allows
DILLON CONSULTING LIMITED
 To Practice Professional Engineering
 in Newfoundland and Labrador.
 Permit No. as issued by PEGNL D0161
 which is valid for the year 2018



LEGEND

- SYMBOLS**
- ANCHOR BLOCK
 - BOLLARD
 - BOREHOLE
 - BOUNDARY MARKER
 - CARD POSITION BUOY
 - CATCH BASIN
 - CLEAT
 - CLUBNET
 - DERIVICK
 - DISPOSAL
 - DREDGE CONTROL
 - ELECTRICAL OUTLET
 - FIRE HYDRANT
 - FIRST AID
 - FISH HANDLING EQUIP.
 - FOG HORN
 - FUEL PUMP
 - H PILE
 - HORIZONTAL CONTROL
 - ICE PLANT
 - IMBERT PIPE
 - JIB CRANE
 - FLAD POLE
 - LADDER
 - LIFE RING
 - LIGHT STANDARD
 - MANHOLE
 - MARSH
 - MAST/TOWER
 - NAVIGATION LIGHT
 - OBSERVED BUOY
 - OBSERVED SPAR BUOY
 - PIPE PILE
 - RANGE LIGHT
 - SAFETY POST
 - SEWER OUTFLOW PIPE
 - SON
 - TELEPHONE
 - TELEPHONE POLE
 - TIDE GAUGE/STAFF
 - TREE
 - UTILITY POLE
 - VERTICAL CONTROL
 - WATER TAP/OUTLET
 - WATER VALVE
 - WATER WELL
 - WOOD PILE
- LINE TYPE**
- ANCHOR STONE
 - CL. ROAD
 - DRAIN PIPE
 - EDGE ROAD / SHOULDER
 - FENCE LINE
 - FLOATING WHARF/BREAK
 - GAUGE PILE
 - HIGH WATER MARK
 - LOW WATER MARK
 - MARSH OUTLINE
 - PROPERTY BOUNDARY
 - RANGE LIGHT EXTENSION
 - RETAINING WALL
 - RIP-RAP
 - TIDE OF BANK
 - TREE LINE
 - UNDERGROUND CABLE

- GENERAL NOTES**
- DO NOT SCALE FROM DRAWING.
 - CONTRACTOR MUST VERIFY ALL DIMENSIONS AND CONDITIONS ON SITE PRIOR TO PROCEEDING WITH ANY PORTION OF THIS WORK.
 - ALL DIMENSIONS IN MILLIMETERS. ALL ELEVATIONS IN METERS.
 - SEE SHEET MA4 FOR GENERAL MARINE NOTES.



HATCHING INDICATES LIMITS OF NEW DREDGING TO EL. -2.6m

EXISTING ROCK SHOAL TAKEN DOWN TO ELEVATION OF SURROUNDING HARBOUR BOTTOM

NOTES

SURVEY PARTY CHIEF RICHARD HEALEY
SURVEY VESSEL ALUMINUM BOAT
SURVEY DATE(S) BETWEEN JULY 17, 2017 & OCTOBER 24, 2017

SOUNDER TYPE: SINGLE TRANSDUCER
SOUNDER SETTING: HW/NST VEL. OF SOUND 1520 m/s
DEPTH GATE USED: N/A FREQ. OF TRANS. 210 kHz

POSITIONING SYSTEM USED: DGPS (WITH OTF)
LAND SURVEY POSITION BY: DGPS (WITH OTF)

DATA TAPE(DISC(S)) USED:
CAD DRAWING FILE(S):

TIDAL REDUCTION SCHEME:

OFFICE PROCESSOR EDDIE BEARNS
DATE OF PROCESSING OCTOBER 2017

MODE OF PLOTTING: LEAST OF MINIMUM DEPTHS
MATRIX CELL WIDTH X LENGTH:
REDUCTION OF MATRIX CELLS:

CONTROL POINTS:	PL. NAME	EASTING	NORTHING	CD ELEV	DESCRIPTION
762358	661267.618	5501812.205			PROVINCIAL BRASS PLAQUE SET IN BEDROCK
762359	661523.492	5502602.724			PROVINCIAL BRASS PLAQUE SET IN BEDROCK
8809233	660767.552	5503103.934			CHS PLAQUE SET IN CONCRETE DECK
8809234	661271.844	5502136.081	+2.125 m		CHS PLAQUE SET IN CONCRETE DECK
PWC 1-2005	661325.095	5502260.318	+3.20 m		X-CUT IN COVER OF MANHOLE
BM 90F9094			+3.687 m		CHS PLAQUE SET IN CONCRETE DECK
PWC 1-2009	661924.883	5504154.870	+6.069 m		BOLT SET IN BEDROCK OUTCROP
PWC 2-2009	661959.589	5504129.072			CROSS-CUT IN BOLT IN DECK
PWC 3-2009	661901.768	5504100.628			NAIL RAIL SET IN CONCRETE DECK

ALL SOUNDINGS & ELEVATIONS IN METRES.

ALL SOUNDINGS & ELEVATIONS REFERRED TO PWC 1-2011 ELEV. +2.20 m (NAIL SET IN PAVEMENT) ESTABLISHED BY DGPS TRANSFER FROM PWC 1-2005 ELEV. +3.20m, LOCATED AT THE GOVERNMENT WHARF AT TWILLINGATE, NL ON NOVEMBER 16, 2011 BY PWGSC SURVEY CREW.

PWC 1-2005 WAS ESTABLISHED FROM CHS BM 91F9094 ELEV. +3.687 m IN TWILLINGATE.

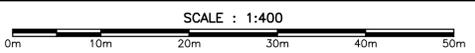
SOUNDINGS TAKEN USING NAVSOUND 210 ECHO SOUNDER AND POSITIONED BY TRIMBLE R7 DIFFERENTIAL GPS POSITIONING SYSTEM BETWEEN JULY 17, 2017 & OCTOBER 24, 2017 BY PWGSC SURVEY CREW.

COORDINATES FOR HORIZONTAL CONTROL ARE GIVEN ON THE U.T.M. MAPPING PLANE, ZONE 22, USING THE NORTH AMERICAN DATUM OF 1983(NAD83).

SOUNDINGS WERE REDUCED BY DIGITRACE & RE-CHECKED FROM SOUNDING CHARTS BEFORE BEING CORRECTED FOR TIDE & BAR CHECK CORRECTION.

SOUNDINGS WERE REDUCED USING HYPACK MAX VER. 2013A*.

EXISTING SITE PLAN



1/212

B	ISSUED FOR 90% REVIEW	MAY.18 2018
A	ISSUED FOR 50% REVIEW	APR.24 2018
revisions		date

CP1-MARINE PHASE DFO FACILITY SAR STATION
TWILLINGATE, NL

NEW SITE PLAN

designed	S.PEARCE	conçu
date	APRIL, 2018	
drawn	B. SCAPLEN	dessiné
date	APRIL, 2018	
approved		approuvé
date		
Tender		Soumission
PWGSC Project Manager	Administrateur de projets TPSGC	
project number	no. du projet	
R.089926.001		
drawing no.	no. du dessin	
MA2 OF 9		

APPENDIX C

Regulatory Approvals



P.O. Box 5667
St. John's, NL A1C 5X1

May 10, 2018

Your file Votre référence

Our file Notre référence

18-HNFL-00196

Mr. Craig Hogan
DFO - Real Property Safety and Security (RPSS)
P.O. Box 5667
St. John's, NL
A1C 5X1

Subject: Construction of New Search and Rescue Station Twillingate Harbour, Twillingate, NL – Implementation of Measures to Avoid and Mitigate Serious Harm to Fish and Prohibited Effects on Listed Aquatic Species at Risk

Dear Mr. Hogan:

The Fisheries Protection Program (the Program) of Fisheries and Oceans Canada (DFO) received your proposal on April 13, 2018. We understand that you propose to:

- Dredge an area approximately 36.6 m to 18.6 m wide x 185 m in the seaward direction to 2.5 m depth using either a temporary gravel access road built within the boundaries of the project footprint or use of a floating barge. Dredged materials will be re-deposited within the boundaries of the proposed infill area. The total area to be dredged is ~ 4,435 m².
- Infill an area ~ 43.2 m wide and 72 m in the seaward direction to accommodate a new parking area and approach. The approach will be surrounded with timber cribbing. The total footprint will be ~ 3,110 m².
- Construct a new timber crib marginal wharf 36.6 m (L) by 4.877 m (W) with an adjoining L-shaped crib block 3.048 m (W) by 3.66 m (L) with gangway to new floating docks along the seaward face of the new approach. The total footprint will be 190 m².

Our review considered the following information:

- Request for Review received April 13, 2018;
- Received engineering drawings from Mark McNeil (PSPC) April 27, 2018;
- Email correspondence with Fishery Officer on May 2, 2018; and
- Habitat characterization and prior dredging program for Twillingate Harbour from Mark McNeil (PSPC) on May 7, 2018.

Your proposal has been reviewed to determine whether it is likely to result in serious harm to fish which is prohibited under subsection 35(1) of the *Fisheries Act* unless authorized. Your proposal has also been reviewed to determine whether it is likely to affect listed aquatic species at risk, any part of their critical habitat or the residences of their individuals in a manner which is prohibited under sections 32, 33 and subsection 58(1) of the *Species at Risk Act*, unless authorized.

To avoid and mitigate the potential for serious harm to fish, we recommend implementing the measures listed below:

- Duration of in-water works should be minimized.
- The project should be carried out in a manner that minimizes the release of sediment and/or other project related material into the waters of Twillingate Harbour or any other adjacent water body.
- The in-water use of heavy equipment is not permitted. The operation of such equipment must be confined to dry stable areas, i.e temporary access road or barge.
- To the extent possible, project related activity should be carried out during low tide and low wind/wave conditions.
- Project related activity should be suspended, and/or additional mitigation measures taken (i.e. deployment of a floating sediment boom/curtain) if wind or tide conditions cause sediment/turbid water to be visible outside the immediate project area.
- Shoreline disturbance should be restricted to the immediate work area. Any shoreline areas disturbed by project activities should be stabilized as soon as possible to prevent erosion.
- Rock material for infill should be reclaimed dredge material and clean rock free of fine erodible material and sized to resist displacement during storm and/or flood events.
- Rock material should not be end dumped; rather it should be dumped on land and placed on station using an excavator or similar equipment.
- Consultation with local fishers should be conducted prior to start of the project and if necessary work completed outside of the lobster fishing season in Lobster Fishing Area 4B (i.e. May 12 to July 6), to avoid conflict.

Provided that you incorporate these measures into your plans, the Program is of the view that your proposal will not result in serious harm to fish or prohibited effects on listed

aquatic species at risk. As such, an authorization under the *Fisheries Act* or a permit under the *Species at Risk Act* is not required.

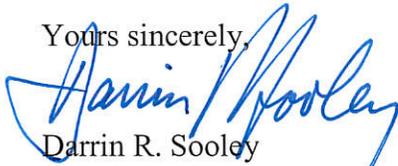
Should your plans change or if you have omitted some information in your proposal, further review by the Program may be required. Consult our website (<http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html>) or consult with a qualified environmental consultant to determine if further review may be necessary. It remains your responsibility to avoid causing serious harm to fish and avoid prohibited effects on listed aquatic species at risk, any part of their critical habitat or the residences of their individuals.

It is also your *Duty to Notify* DFO if you have caused, or are about to cause, serious harm to fish that are part of or support a commercial, recreational or Aboriginal fishery. Such notifications should be directed to <http://www.dfo-mpo.gc.ca/pnw-ppe/violation-infraction/index-eng.html>.

Please notify this office at least 10 days before starting your project. A copy of this letter should be kept on site while the work is in progress. It remains your responsibility to meet all other federal, provincial and municipal requirements that apply to your proposal.

If you have any questions in this regard please do not hesitate to contact me by phone at (709) 772-3521 or by email at darrin.sooley@dfo-mpo.gc.ca. Please refer to the file number referenced above when corresponding with the Program.

Yours sincerely,



Darrin R. Sooley
Senior Biologist, Coastal, Marine Oil & Gas Development
Fisheries Protection Program – Regulatory Reviews
Ecosystems Management Branch, NL Region

CC: Mark McNeil (PSPC)

File No. 38935

May 7, 2018

Public Works and Government Services Canada
P. O. Box 4600
St. John's, NL
A1C 5T2

Attention: Mark McNeil

Dear Mr. McNeil:

RE: Disposal of Marine Sediment from Dredging, Twilling (Boehner Site) NL

With reference to the above-noted project, the Government Service Centre has received and reviewed your proposal. Based on the results of chemical analysis provided and information contained in the documentation submitted we would have no objections provided the following stipulations and recommendations are adhered to:

1. As per your proposal, the disposal of dredge material (approximately 4500 cubic meters) at an approved Waste Disposal Site with approval of the site owner/operator. Waste material is to be disposed on site as directed by the site owner/operator. Currently the only approved operating site in the region is the Norris Arm Regional Waste Management Facility. To obtain the approval to use this site please contact the site manager, Mr. Edward Evans at 709-653-2900.
2. All other waste material generated during this project and operation of the facility shall be considered, prior to disposal, for reuse, resale or recycling.
3. During operations any floating debris, at the project site, is to be secured and retrieved on a daily basis for disposal.
4. Any on-site fuel storage tank system installations other than those connected to a heating appliance of a capacity of 2,500 litres or less are subject to the Storage and Handling of Gasoline and Associated Products Regulations and will require approval by the Government Service Centre prior to installation.
5. All fuel storage tank systems connected to a heating appliance of a capacity of 2,500 litres or less must comply with the *Heating Oil Storage Tank System Regulations*.
6. The storage, handling and disposal of used oil and lubricants must comply with the *Used Oil Control Regulations, NLR 82/02*.
7. All vehicles and heavy equipment must be in good repair and inspected regularly to ensure there are no oil or fuel leaks.

8. Re-fueling, maintenance activities and the storage of gasoline and other associated products such as oil, grease, diesel, hydraulic and transmission fluids should take place far as practically possible from any body of water and on level terrain.
9. In order to ensure that a quick and effective response to a spill event is possible, spill response equipment should be readily available on-site. Response equipment, such as absorbents and open-ended barrels for collection of cleanup debris, should be stored in an accessible location on-site. Personnel working on the project should be knowledgeable about response procedures. The proponent should consider developing a contingency plan specific to the proposed undertaking to enable a quick and effective response to a spill event.
10. Should site work reveal any actual or suspected site contamination the proponent shall contact the Department at 292-4367 or by calling the twenty-four hour Environmental Emergency Line at 722-2083 or 1-800-563-9089.
11. This approval does not release the proponent from the obligation to obtain appropriate approvals from other concerned provincial, federal and municipal agencies.
12. Dredge spoils are to be transported in water tight trucks or containers to prevent leakage during transport.
13. Dredge material may be redistributed or used on site as per the requirements of section 7.5 and 8.0 of the guidance document below.

http://www.mae.gov.nl.ca/env_protection/waste/guidancedocs/ExcSoilsConcreteRubbleDredgedMaterials.pdf

14. Dredge spoils must be visually checked for possible contamination (i.e. fuel oil, sewage and organic contaminants of concern).

Should you have any questions or comments, please contact me at the address above or by telephoning (709) 292-4367.

Yours truly,



Karl Boone
Environmental Protection Officer

KB:tc

cc: Town of Twillingate

APPENDIX D

Qualitative Risk Screening Dredge Spoils Re-use



-FINAL-

**QUALITATIVE RISK SCREENING
SEDIMENT DREDGEATE RE-USE
CANADIAN COAST GUARD SEARCH AND RESCUE STATION
TWILLINGATE
NEWFOUNDLAND AND LABRADOR**

Submitted to:

Public Services and Procurement Canada
Environmental Services
10 Barters Hill
St. John's, NL
PO Box 4600
A1C 5T2

Submitted by:

Amec Foster Wheeler
Environment & Infrastructure
133 Crosbie Road
P.O. Box 13216
St. John's, NL
A1B 4A5

March 2018

TF18076779



IMPORTANT NOTICE

This report was prepared exclusively for PSPC and DFO by Amec Foster Wheeler Environment & Infrastructure, a Division of Amec Foster Wheeler Americas Limited. The quality of information, conclusions and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler Environment & Infrastructure's services and based on: i) information available at the time of preparation, ii) data supplied by outside sources and iii) the assumptions, conditions and qualifications set forth in this report. This report is for use by PSPC and DFO only, subject to the terms and conditions of its contract with Amec Foster Wheeler Environment & Infrastructure. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

EXECUTIVE SUMMARY

Amec Foster Wheeler Environment & Infrastructure, a division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), was retained by Public Services and Procurement Canada (PSPC), on behalf of Fisheries and Oceans Canada (DFO), to conduct a risk assessment for the placement of dredged sediment at a new Canadian Coast Guard (CCG) Search and Rescue (SAR) station in Twillingate, Newfoundland and Labrador (NL) herein referred to as “the site.” Based on discussions with PSPC, it is understood that CCG is proposing to create a permanent wharf approach to a new marginal wharf at the site, which will require infilling of an existing boat basin. It is proposed to place approximately 3,000 m³ of dredged marine sediment in the new approach area to the marginal wharf. It is understood that the approach will be capped with clean fill and asphalt.

Based on discussions with PSPC, the scope of work included the following:

- Complete a human health and ecological risk assessment at the site to assess whether or not the levels of contaminants of potential concern (CoPC) in marine sediment could pose a potential unacceptable risk to human and ecological receptors at the site. Following review of the analytical data for the site, only a qualitative risk screening was required.
- Preparing a technical report with an assessment of findings, conclusions, and recommendations for future actions, where warranted.

PSPC collected sediment marine samples from the waterlot in November and December 2017 to assess the environmental quality of the sediment to be dredged. A total of 26 marine sediment samples were collected and analysed for petroleum hydrocarbons (PHCs), metals, cyanide, pH, polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs). The findings were as follows:

- PHCs and PCBs were either not detected or detected at concentrations below the applicable screening guidelines, in all of the sediment samples analysed.
- Arsenic, copper, selenium and pH were detected in sediment samples at concentrations above the Canadian Council of Ministers of the Environment (CCME) Canadian Soil Quality Guidelines (CSQG) for commercial sites.
- Naphthalene and phenanthrene were detected at concentrations above the applicable CCME CSQG for environmental health for the protection of freshwater aquatic life.
- Metals leachate concentrations were below the screening guidelines in the marine sediment samples analysed; however, the reportable detection limits (RDL) for cadmium and silver were above the 2011 Ontario Ministry of Environment (MOE) Generic Site Condition Standards (SCS) for Use within 30 m of a Water Body in a Non-Potable Ground Water Condition (Table 9).

Based on the findings of the risk screening, unacceptable risks to human and ecological receptors on or in the vicinity of the site are not expected from the metals and PAH impacts identified in marine sediment to be dredged from the waterlot and used as fill for the approach to the new marginal wharf, assuming that the area is to be capped with clean fill and asphalt.

If the proposed plan for the area is altered (i.e., will not be paved), further assessment may be required.

Please note that this assessment did not assess the applicability of the marine sediment for backfill material from a material suitability and geotechnical perspective.

This assessment also did not assess management of any excess soils. If there is excess soil, further assessment/analysis may be required and disposal options will have to be assessed to ensure it is disposed of properly.

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APPENDICES

Appendix A	Figures (Provided by PSPC)
Appendix B	Laboratory Data Tables
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1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, a division of Amec Foster Wheeler Americas Limited (Amec Foster Wheeler), was retained by Public Services and Procurement Canada (PSPC), on behalf of Fisheries and Oceans Canada (DFO), to conduct a risk assessment for the placement of approximately 3000 cubic meters (m³) of dredge spoils at a new Canadian Coast Guard (CCG) Search and Rescue (SAR) station in the community of Twillingate, Newfoundland and Labrador (NL) herein referred to as “the site.”

2.0 BACKGROUND INFORMATION

CCG is proposing to create a permanent wharf approach to a new marginal wharf being constructed at a SAR station site, which will require infilling of an existing boat basin. Approximately 4,500 m³ of marine sediment will be dredged from the harbour adjacent to the site. Of this dredged material, it is proposed to place 3,000 m³ of material in the new approach area to the marginal wharf (refer to PSPC figures in Appendix A). It is understood that the approach will be capped with clean imported fill material and asphalt.

PSPC collected marine sediment samples from the water lot in November 2017 and December 2017 for analysis of petroleum hydrocarbons (PHCs), metals, cyanide, pH, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and metals leachate to assess the environmental quality of the marine sediment to be dredged from the harbour. The results of the sampling program are discussed further in Section 4.0. The analytical data assessed will be used in the qualitative human health and ecological risk screenings presented in Section 5.0 and 6.0, respectively.

3.0 SCOPE OF WORK

Based on discussions with PSPC, the scope of work for the current assessment included the completion of the following tasks:

- Complete a human health risk assessment (HHRA) and screening level ecological risk assessment (ESA) in marine sediment to assess whether or not the levels of contaminants of potential concern (COPCs) at the site pose a potential unacceptable risk to human and ecological receptors at the site for its intended use as backfill material during upcoming site renovations. Note that following review of the analytical data for the site, only a qualitative risk screening was required for both human and ecological receptors.
- Prepare a technical report to include assessment of findings, conclusions, and recommendations for future actions, where warranted.

4.0 MARINE SEDIMENT SAMPLING PROGRAM (PSPC)

PSPC collected marine sediment samples from the waterlot in November 2017 and December 2017 for analysis of PHCs, metals, cyanide, pH, PAHs and metals leachate to assess the environmental quality of the marine sediment to be dredged from the harbour.

On November 20, 2017, a total of 12 marine sediment samples (Sample 1 to Sample 12) were collected from the waterlot at the locations shown on the Sediment Sampling Plan, in Appendix A. Divers were contracted to collect the sediment samples from the uppermost 30 cm of sediment.

On December 12, 2017, six boreholes were advanced in the area to be excavated (3116-BH1 to 3116-BH6) to facilitate the collection of marine sediment samples at various depths. Boreholes 3116-BH1 and 3116-BH2 were advanced to a depth of 2 m below the top of the sediment, and three samples were collected. The remaining boreholes were advanced to 1 m below the top of the sediment, and two samples were collected. Sample depths are indicated in Table 1, Appendix B, and in the sample IDs (i.e. 0Z indicates 0 m).

In total, 26 marine sediment samples were submitted to AGAT Laboratories (AGAT) for analyses of benzene, toluene, ethylbenzene, xylenes (BTEX), total petroleum hydrocarbons (TPH), metals, cyanide, pH, PAHs and PCBs. In addition, 12 samples were also analysed for metals leachate (Sample 1, Sample 2, Sample 4, Sample 8 to Sample 11, 3116-BH1-MS1-0Z, 3116-BH2-MS1-0Z, 3116-BH4-MS1-0Z, 3116-BH5-MS1-0Z and 3116-BH6-MS1-0Z).

4.1 Site Classification/Guidelines

Applicable regulatory assessment guidelines are determined, in part, by features of the site such as land use, presence of potable water supplies and distance to other possible receptors. According to PSPC, the marine sediment dredge spoils will be used to infill a former boat basin to build an approach to a new marginal wharf planned to be constructed at the site. As such, the marine sediment data was compared to soil quality guidelines. The site is considered to be commercial based on past and anticipated future land use activities (SAR station and wharf). Site soils are considered to be coarse-grained and groundwater in the area is not expected to be used for human consumption (non-potable). The waterlot is adjacent to the east side of the proposed marginal wharf.

TPH concentrations in marine sediment were compared to the Canadian Council of Ministers of the Environment (CCME) Canada Wide Standards (CWS) Soil Quality Guidelines for Petroleum Hydrocarbons for a commercial site with coarse grained soils for the protection of aquatic life. BTEX/TPH concentrations in soil on the site are also compared to the 2012 Atlantic Partnership in RBCA [Risk-Based Corrective Action] Implementation (PIRI) Tier I Risk-Based Screening Levels (RBSLs) (Table 4a) for the protection of human health for a commercial property with coarse-grained soil and non-potable groundwater and fuel oil and lube oil impacts (revised 2015). Even though the dredge sediment is to be capped with clean soil and asphalt, as a conservative approach, the data was also compared to Tier I Ecological Screening Levels (ESLs) (Table 1a) for the protection of plants and soil invertebrates with direct soil contact for a commercial property with coarse grained soil.

BTEX, metals, pH, cyanide, and PCBs were compared to the CCME Canadian Soil Quality Guidelines (CSQG) for a commercial site.

PAH concentrations in soil were compared to the CCME CSQGs for the protection of environmental health and human health (direct contact, based on carcinogenic effects of PAHs) for a commercial property with coarse-grained soil. Based on the proximity to the aquatic habitat, the freshwater aquatic life guidelines are used, where they exist for ecological receptors. Note that there are no aquatic life guidelines for protection of marine aquatic life. Non-carcinogenic PAH concentrations in soil are also compared to the Alberta Environment (AENV) Surface Soil Remediation Guideline Values (Table A-4) for the protection of human health (direct soil contact) for a commercial property with coarse-grained soil (AENV 2010).

Groundwater at the site is not expected to be used as a source of potable water. Therefore, metals leachate concentrations will be compared to the 2011 Ontario Ministry of Environment (MOE) Generic Site Condition Standards (SCS) for Use within 30 m of a Water Body in a Non-Potable Ground Water Condition (Table 9).

4.2 Analytical Results

This section provides a summary of the laboratory analytical results marine sediment (soil) samples collected from the harbour (waterlot) by PSPC. Laboratory summary analytical data tables are presented Tables 1 to 5 (Appendix B) and the laboratory CoA are presented in Appendix C. Sample locations are illustrated on the Sediment Sampling Plan, provided by PSPC, in Appendix A. Results of the sediment analyses indicated the following:

- BTEX/TPH were either not detected or detected at concentrations below the applicable CCME CSQGs, CCME CWS, Atlantic PIRI Tier I RBSLs and Tier I ESLs, in all of the marine sediment samples analysed.
- Arsenic was detected in nine marine sediment samples at concentrations above the CCME CSQG of 12 mg/kg. The maximum arsenic concentration detected was 28 mg/kg (Sample 11).
- Copper was detected in five marine sediment samples at concentrations above the CCME CSQG of 91 mg/kg. The maximum copper concentration detected was 120 mg/kg (3116-BH6-MS1-0Z).
- Selenium was detected in 11 marine sediment samples at concentrations above the CCME CSQG of 2.9 mg/kg. The highest detected concentration detected was 5 mg/kg (Sample 1 and Sample 2).
- pH levels in 10 marine sediment samples collected were above of the CCME CSQG (acceptable range) of 6 – 8. The highest pH detected was 8.37 (3116-BH5-MS2-0.3-1Z).
- Naphthalene and phenanthrene (PAHs) were detected at concentrations above the applicable CCME CSQG for environmental health for the protection of freshwater aquatic life. Remaining PAHs were either not detected or detected at concentrations below applicable guidelines.
- PCBs were not detected in any of the marine sediment samples analysed.

- Metals leachate concentrations were below the MOE SCSs in all of the samples analysed. However, the reportable detection limits (RDL) for cadmium and silver (0.003 mg/L and 0.005 mg/L, respectively) were above the MOE SCS (0.002 mg/L and 0.005 mg/L, respectively).

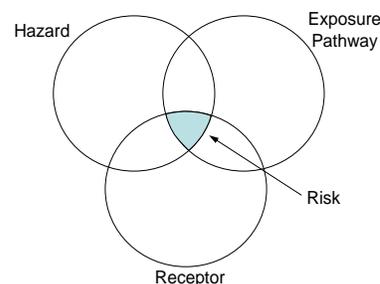
5.0 HUMAN HEALTH RISK SCREENING

In order to assess the potential risks resulting from contaminants identified in the marine sediment (metals and PAHs) a human health risk screening has been completed, incorporating the information obtained from the PSPC marine sediment sampling programs completed at the site waterlot in 2017. The screening has been conducted in accordance with CCME and Health Canada guidance and assumes that the marine sediment will be dredged, used as backfill for the approach to the new marginal wharf and subsequently capped with clean soil and asphalt.

5.1 Methodology Overview

For a potential unacceptable risk to exist at a site, three components must be present to contribute a risk to human health. As indicated in the diagram to the right, these are:

- An elevated chemical concentration (hazard).
- A receptor to come in contact with the chemical.
- An exposure pathway to facilitate contact between the receptor and the chemical.



The standard risk assessment approach includes the following four-step paradigm:

1. Problem Formulation
2. Toxicity (Hazard) Assessment
3. Exposure Assessment
4. Risk Characterization

The scope and requirements for Steps 2 to 4 are dependent on the conceptual site model (CSM) developed in Step 1.

5.2 Problem Formulation for the HHRA

The problem formulation step is an important information gathering and interpretation stage, which serves to plan and focus the approach of an HHRA. The data gathered and evaluated in this stage provides information regarding the physical and geographic features of the site, identification of potential human receptors, possible exposure pathways, and any other specific areas or issues of concern to be addressed.

For the current assessment, key tasks requiring evaluation within the Problem Formulation Step included the following:

- Site Characterization.
- Determine the chemicals of concern.
- Human receptor selection and characterization.
- Selection of exposure pathways and scenarios based on the chemicals of concern.

The outcome of these tasks forms the basis of the approach taken in the current assessment. A more detailed methodology for each of these tasks is described in the sections that follow.

5.2.1 Site Characterization

Based on discussions with PSPC, the CCG is proposing to create a permanent wharf approach to a new marginal wharf being constructed at the site. This will require infilling of an existing boat basin. Approximately 4,500 m³ of marine sediment will be dredged from the harbour adjacent to the site. It is proposed to place 3,000 m³ of the dredged material in the new approach area. It is understood that the new approach to the marginal wharf will be capped with clean fill and asphalt. The site is considered to be commercial based on past and anticipated future land use activities (SAR station and wharf). Groundwater at the site and surrounding areas is not expected to be used as a source of potable water.

5.2.2 COPC Screening

COPC are determined by comparing the maximum concentrations identified at the site to appropriate screening benchmarks. If the maximum concentration is less than the benchmark then no further action is required; however, if the maximum concentration is greater than the screening benchmark, this does not necessarily mean that there is a risk, it simply means that further assessment is warranted. Parameters that did not exceed the applicable screening benchmarks in the previous investigations are not included in the below discussion.

Marine sediment/Soil

The maximum arsenic, copper, selenium concentrations and pH values exceed the guidelines listed in Section 4.1. Analytical results for metals and pH in sediment were initially compared to the CCME CSQGs for a commercial site. However, for the human health risk screening, human health specific screening guidelines can be used. The CCME SQG for arsenic (12 mg/kg) was developed based on an incremental lifetime cancer risk (ILCR) of 10⁻⁶. Health Canada has subsequently approved an ILCR of 10⁻⁵ for management of contaminated sites. The CCME CSQG for arsenic corresponding to an ILCR of 10⁻⁵ is 31 mg/kg, and this value has been accepted by Health Canada as a screening value for arsenic in soil in Atlantic Canada.

There is no human health specific guideline for pH. The CCME CSQG was an interim soil quality guideline from 1991. It is understood that it is also based on ecological concerns.

Alberta Environment a pH guideline of 6-8.5 (AENV, 2016), which is based on ecological direct contact. All pH levels detected in the marine sediment were below 8.5. This elevated pH is not considered to be a potential human health concern.

The maximum concentrations identified in the marine sediment samples exceeding the screening guidelines were carried forward for further assessment as presented in Table 5.1.

Table 5.1: Human Health Screening of CoPCs in Marine sediment/Soil

COPC	Maximum Concentration	Applicable Human Health Guideline (Commercial) ¹	Further Assessment Required?
Arsenic	28 mg/kg	31 mg/kg	No
Copper	120 mg/kg	4000 mg/kg	No
Selenium	5 mg/kg	125 mg/kg	No

Note:

1) CCME Soil Quality Guideline for human health for soil contact at a commercial site.

As shown in Table 5.1, the maximum arsenic, copper and selenium concentrations detected in the marine sediment samples are below the human health screening guidelines for a commercial site indicating that no unacceptable risks to human receptors are expected if the dredged material is used as fill material at the site. In addition, the dredge material to be used as fill material is to be capped with clean soil and asphalt, thus eliminating the exposure pathway.

Leachate

Metals leachate concentrations were below the MOE SCSs in all of the samples analysed. However, the reportable detection limits (RDL) for cadmium and silver were above the MOE SCS for cadmium and silver. These guidelines are protective of discharge to a water body. Since groundwater at the site is not used for potable purposes, metals are not volatile, and the area is going to be capped with clean fill and asphalt, human exposure to potentially impacted groundwater is not expected. Further assessment is not required.

5.3 Human Health Risk Screening Conclusions

Based on the Human Health Risk Screening, unacceptable risks to human receptors at the site are not expected from exposure to the CoPCs identified in the dredged marine sediments from the waterlot.

6.0 ECOLOGICAL RISK SCREENING

A permanent wharf approach to a new marginal wharf is being constructed at a SAR station site. Approximately 3000 m³ of dredged will be placed in the new approach area, and will subsequently be capped with clean fill and asphalt. Concentrations of arsenic, copper, selenium pH, naphthalene and phenanthrene in soil were greater than applicable screening guidelines and RDLs for cadmium and silver in leachate exceeded the applicable screening guidelines. As

such, an evaluation of potential unacceptable risks to ecological receptors is required for the marine sediment to be dredged and used as fill material at the site.

Since the approach will be covered with fill and asphalt, the approach is not considered to be a viable ecological habitat (terrestrial). As such, no further assessment of terrestrial ecological receptors is recommended, as adverse effects are not expected.

The harbour (waterlot) is located directly adjacent to the site. Concentrations of naphthalene and phenanthrene in marine sediment/soil exceeded the guidelines protective of freshwater aquatic life, and RDLs for cadmium and silver concentration in leachate were greater than the MOE SCS for protection of aquatic life within 30 m of the site. Adverse effects are not expected due to the following reasons:

- The leachate analysis completed by the laboratory used the Synthetic Precipitation Leaching Procedure (SPLP) approach, which simulate material sitting in or on top of the ground surface exposed to rainfall. The dredged material will be covered with clean fill and asphalt, decreasing potential for impacts leaching to groundwater. It is not likely that the concentrations in groundwater, if some leaching were to occur, would pose an adverse effect to nearby aquatic habitat. In addition, silver was not detected in the marine sediment, except for two low detections and only low levels of cadmium were detected, below guidelines.
- The soil guidelines for protection of freshwater aquatic life are back-calculated from the CCME water quality guidelines for the protection of freshwater aquatic life. The calculation does not include any biodegradation of PAHs in the subsurface environment, which is a highly conservative assumption. Based on the low levels of PAHs in the soil, and since the material will be capped with clean fill and asphalt, adverse effects to the aquatic habitat are not expected.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the results of the marine sediment sampling program and findings of the risk screening, unacceptable risks to human and ecological receptors on or in the vicinity of the site are not expected from the metals and PAH impacts identified in marine sediment to be dredged and used as fill for the approach to the new marginal wharf, assuming that the area is to be capped with clean fill and asphalt.

Based on the findings of the current and previous environmental investigations, the following recommendations have been provided for consideration:

- If the proposed plan for the area is altered (i.e., will not be paved), further assessment may be required.
- Please note that this assessment did not assess the applicability of the marine sediment for backfill material from a material suitability and geotechnical perspective.

- This assessment also did not assess management of any excess soils. If there is excess soil, further assessment/analysis may be required and disposal options will have to be assessed to ensure it is disposed of properly.

8.0 CLOSURE

This report has been prepared for the exclusive use of DFO and PSPC. No further warranty, expressed or implied, is made. The conclusions presented herein are based solely upon the scope of services and time and budgetary limitations described in our contract. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Amec Foster Wheeler accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. The limitations of this report are attached in Appendix D.

Respectfully Submitted,

**Amec Foster Wheeler Environment & Infrastructure,
a Division of Amec Foster Wheeler Americas Limited**

Prepared by:



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9.0 REFERENCES

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Canadian Council of Ministers of the Environment (1999). Canadian Environmental Quality Guidelines (Updated September 2007). Updated subsequently (Accessed online September 2017 <http://ceqg-rcqe.ccme.ca/>).

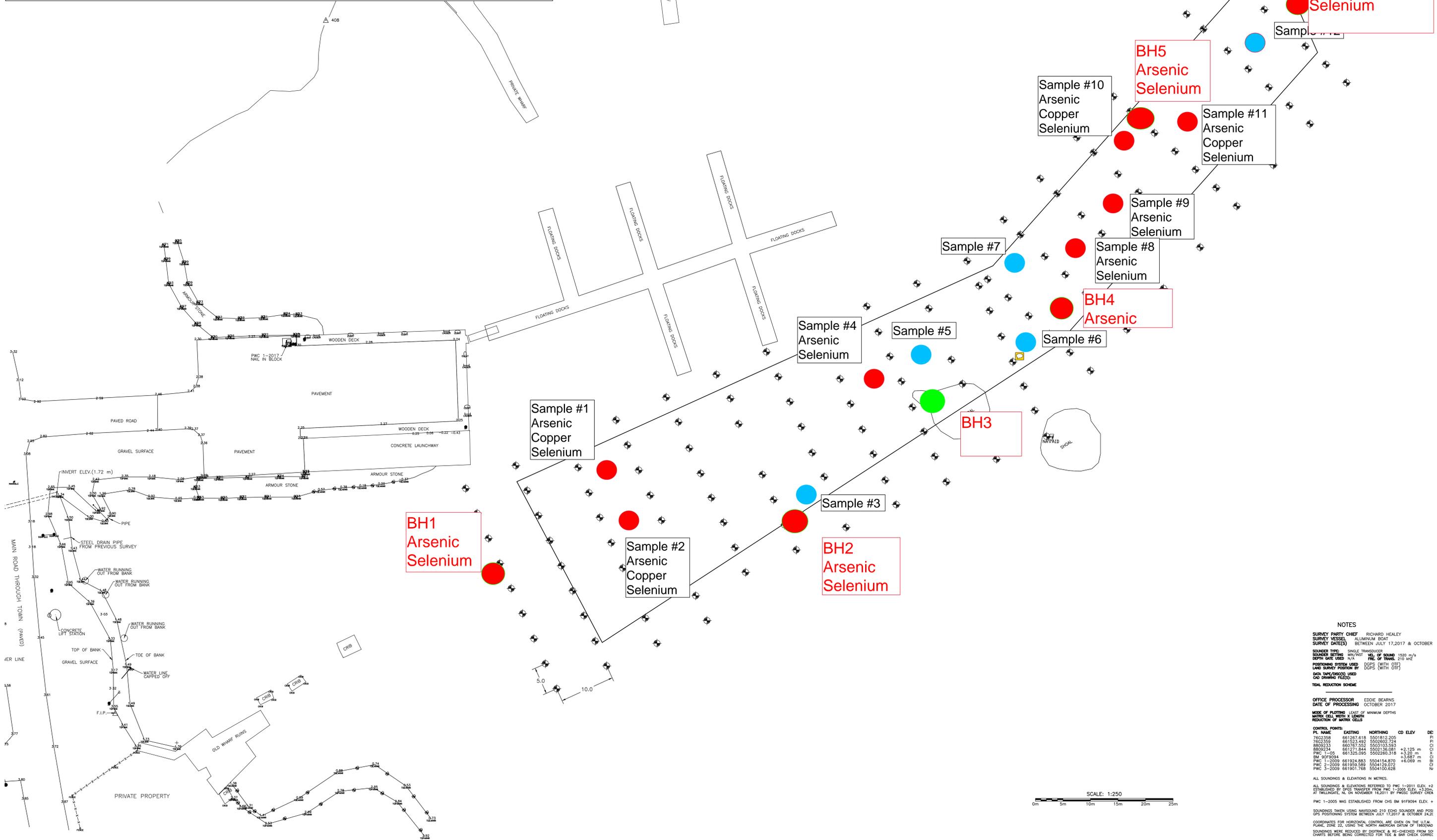
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APPENDIX A

Figures (Provided by PSPC)

Twillingate (Boehner Site) SAR - sediment sampling plan
 AGAT call-up #16-55
 Project number R.089926.002



NOTES

SURVEY PARTY CHIEF: RICHARD HEALEY
SURVEY VESSEL: ALUMINUM BOAT
SURVEY DATE(S): BETWEEN JULY 17, 2017 & OCTOBER 2017

SONDAGE TYPE: SINGLE TRANSDUCER
SONDAGE SETTING: MIN/INST VEL. OF SOUND 1520 m/s
DEPTH GATE USED: N/A **TIME OF TRAVEL:** 210 ms

POSITIONING SYSTEM USED: DGPS (WITH ODP)
LAND SURVEY POSITION BY: DGPS (WITH ODP)

DATA TAPE/FILES USED:
CAD DRAWING FILE(S):
TIDAL REDUCTION SCHEME:

OFFICE PROCESSOR: EDDIE BEARNS
DATE OF PROCESSING: OCTOBER 2017

MODE OF PLOTTING: LEAST OF MINIMUM DEPTHS
MATRIX CELL WITH A LENGTH:
REDUCTION OF MATRIX CELLS:

PL. NAME	EASTING	NORTHING	CD ELEV	DE
7622358	661271.618	5501812.205		PI
7622359	661523.492	5502902.724		PI
8802923	660767.552	5503103.883		CI
8802924	661271.844	5502136.081	+2.125 m	X
PWC 1-2009	661362.055	5502263.318	+3.200 m	X
BM 90F9094			+3.687 m	CI
PWC 1-2009	661924.883	5504154.870	+6.069 m	CI
PWC 2-2009	661959.589	5504129.072	+6.069 m	CI
PWC 3-2009	661901.768	5504100.628		NV

ALL SOUNDINGS & ELEVATIONS IN METRES.
 ALL SOUNDINGS & ELEVATIONS REFERRED TO PWC 1-2011 ELEV. +2 ESTABLISHED BY GPS TRANSFER FROM PWC 1-2005 ELEV. +3.20m, AT TWILLINGATE, N.S. ON NOVEMBER 16, 2011 BY PROSS SURVEY CREW.
 PWC 1-2005 WAS ESTABLISHED FROM CHS BM 91F9094 ELEV. +3.687 m.
 SOUNDINGS TAKEN USING HANSON 210 ECHO SOUNDER AND POS GPS POSITIONING SYSTEM BETWEEN JULY 17, 2017 & OCTOBER 24, 2017.
 COORDINATES FOR HORIZONTAL CONTROL ARE GIVEN ON THE U.T.M. PLANE ZONE 22, USING THE NORTH AMERICAN DATUM OF 1983 AND SOUNDINGS WERE REDUCED BY DIGITRACK & RE-CHECKED FROM SOU CHARTS BEFORE BEING CORRECTED FOR TIDE & BAR CHECK CORRECT. SOUNDINGS WERE REDUCED USING HYPOACK MAX VER. 2013.1*.

APPENDIX B

Laboratory Data Tables

Table 1: Petroleum Hydrocarbon (PHC) Concentrations in Sediment (to be dredged)

Lab ID	Sample ID	Sample Depth (mbgs)	Sampling Date	BTEX Parameters (mg/kg)				Petroleum Hydrocarbons (mg/kg)					Resemblance
				Benzene	Toluene	Ethyl-Benzene	Xylenes	C ₆ -C ₁₀	>C ₁₀ -C ₁₆	>C ₁₆ -C ₂₁	>C ₂₁ -C ₃₂	Modified TPH	
8931841	Sample 1	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	73	130	203	Unidentified compound(s)
8931843	Sample 2	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	36	66	102	Unidentified compound(s)
8931844	Sample 3	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	27	27	Unidentified compound(s)
8931845	Sample 4	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	22	41	63	Unidentified compound(s)
8931846	Sample 5	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	31	73	104	Unidentified compound(s)
8931847	Sample 6	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	26	26	Unidentified compound(s)
8931848	Sample 7	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	16	41	57	Unidentified compound(s)
8931849	Sample 8	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	31	70	101	Unidentified compound(s)
8931850	Sample 9	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	70	127	197	Unidentified compound(s)
8931851	Sample 10	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	62	145	207	Unidentified compound(s)
8931852	Sample 11	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	75	153	228	Unidentified compound(s)
8931853	Sample 12	-	20-Nov-17	<0.03	<0.04	<0.03	<0.05	<3	<15	30	67	97	Unidentified compound(s)
8983827	3116-BH1-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	40	129	169	Unidentified compound(s)
8983830	3116-BH1-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	33	82	115	Unidentified compound(s)
8983835	3116-BH2-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	38	131	169	Unidentified compound(s)
8983836	3116-BH2-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	28	64	92	Unidentified compound(s)
8983839	3116-BH2-MS3-1-2Z	1-2	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	<15	<20	No Resemblance
8983845	3116-BH3-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	25	87	112	Unidentified compound(s)
8983848	3116-BH3-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	37	37	Unidentified compound(s)
8983849	3116-BH3-MS3-1-2Z	1-2	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	<15	<20	No Resemblance
8983851	3116-BH4-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	23	73	96	Unidentified compound(s)
8983861	3116-BH4-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	17	<20	Unidentified compound(s)
8983863	3116-BH5-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	52	146	198	Unidentified compound(s)
8983864	3116-BH5-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	<15	<20	No Resemblance
8983870	3116-BH6-MS1-0Z	0	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	44	186	230	Unidentified compound(s)
8983871	3116-BH6-MS2-0.3-1Z	0.3-1	12-Dec-17	<0.03	<0.04	<0.03	<0.05	<3	<15	<15	<15	<20	No Resemblance
RDL (mg/kg)				0.025	0.025	0.025	0.050	2.5	10	10	15	15	-
CWS Protection of Aquatic Life (commercial / coarse grained soil)				-	-	-	-	970	380	-	-	-	-
Atlantic PIRI Tier I ESLs for Soil (commercial / coarse grained soil)				180	250	300	350	320	260	1,700 ¹		-	-
Atlantic PIRI Tier I RBSLs (commercial/ coarse grained soil / non-potable)				2.5	10,000	10,000	110	-	-	-	-	4,000 / 10,000	Fuel Oil / Lube Oil

Notes:

BTEX: Benzene, Toluene, Ethylbenzene, Xylenes

TPH: Total Petroleum Hydrocarbons

RDL: Reportable Detection Limit

Modified TPH: TPH minus BTEX

<X: Concentration below the RDL

- : Parameter not analyzed or no guideline, or not applicable or not known

mbgs: Meters below ground surface

PIRI: Partners in [Risk Based Corrective Action] Implementation

ESLs: Ecological Screening Levels for plants and soil invertebrates and direct soil contact (0-1.5 m)

Canada Wide Standards for Petroleum Hydrocarbons. For protection of aquatic life (10 m from waterbody)

RBSLs: Risk Based Screening Levels

¹: The guideline is for the PHC fraction C16-C34.

Concentration exceeds the Atlantic PIRI ESLs for PHCs in soil at a commercial / industrial site

Concentration exceeds the Atlantic PIRI Tier I RBSLs for PHCs in soil at a commercial site

Table 2: Metal Concentrations in Sediment (to be dredged)

		DATA												GUIDELINES
Lab ID		8931841	8931843	8931844	8931845	8931846	8931847	8931848	8931849	8931850	8931851	8931852	8931853	CCME CSQG
Sample ID		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	
Sampling Date		20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	20-Nov-17	Commercial
Parameters	RDL (mg/kg)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	(mg/kg)	mg/kg	mg/kg
Aluminum (Al)	10	8190	7870	7660	8360	7090	6130	7170	7560	7550	7320	7630	6780	-
Antimony (Sb)	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	40
Arsenic (As)	1	23	24	7	20	11	3	8	18	19	24	28	10	12
Barium (Ba)	5	59	61	25	51	31	7	30	41	36	54	59	19	2,000
Beryllium (Be)	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	8
Boron (B)	2	205	162	77	105	91	12	60	63	50	59	61	21	-
Cadmium (Cd)	0.3	2.2	2.3	0.7	1.8	1.4	<0.3	0.8	1.6	1.7	2.9	2.4	0.6	22
Chromium (Cr)	2	46	50	33	45	35	21	30	39	40	45	47	31	87
Cobalt (Co)	1	9	9	7	8	6	5	6	7	7	7	7	5	300
Copper (Cu)	2	97	105	39	91	53	13	37	71	76	108	104	35	91
Iron (Fe)	50	26200	23600	19100	21400	16100	12700	16500	17700	17200	18400	19200	14700	-
Lead (Pb)	0.5	49.6	56.7	16.5	43	30.8	6.1	16.7	33.4	34.5	57	43.9	14.4	260
Manganese (Mn)	2	364	353	365	366	254	248	318	292	283	300	309	243	-
Mercury (Hg)	0.05	0.14	0.12	0.05	0.23	0.09	<0.05	0.06	0.13	0.14	0.19	0.19	0.05	24
Molybdenum (Mo)	2	16	17	7	11	12	<2	6	8	7	10	9	3	40
Nickel (Ni)	2	25	26	17	24	18	10	15	19	19	23	23	14	89
Selenium (Se)	1	5	5	2	3	2	<1	1	3	3	4	3	1	2.9
Silver (Ag)	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.6	0.5	<0.5	40
Strontium (Sr)	5	79	89	40	63	40	14	33	48	41	65	56	16	-
Thallium (Tl)	0.1	0.1	0.2	<0.1	0.1	0.1	<0.1	<0.1	0.1	0.1	0.2	0.2	<0.1	1
Tin (Sn)	2	11	12	6	10	10	4	5	9	9	11	10	5	300
Uranium (U)	0.1	3.7	4	2	2.9	4	0.6	1.8	2.5	1.9	2.6	2.1	0.8	33
Vanadium (V)	2	58	62	45	55	45	28	38	48	46	57	51	32	130
Zinc (Zn)	5	125	142	60	120	92	32	62	142	104	161	140	55	360
Cyanide	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	8
pH	-	7.97	8.16	8.38	8.01	7.96	8.03	7.87	7.75	7.75	8.14	7.92	7.49	6-8

Notes:

RDL: Reportable Detection Limit

<X: Concentration below the RDL

CCME: Canadian Council of Ministers of the Environment

CSQG: Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health

-: Value Not Established

Concentration exceeds the CCME CSQGs for metals in soil at a commercial site

Table 2: Metal Concentrations in Sediment (to be dredged), Cont'd

		DATA														GUIDELINES
Lab ID		8983827	8983830	8983835	8983836	8983839	8983845	8983848	8983849	8983851	8983861	8983863	8983864	8983870	8983871	CCME CSQG
Sample ID		3116-BH1-MS1-0Z	3116-BH1-MS2-0.3-1Z	3116-BH2-MS1-0Z	3116-BH2-MS2-0.3-1Z	3116-BH2-MS3-1-2Z	3116-BH3-MS1-0Z	3116-BH3-MS2-0.3-1Z	3116-BH3-MS3-1-2Z	3116-BH4-MS1-0Z	3116-BH4-MS2-0.3-1Z	3116-BH5-MS1-0Z	3116-BH5-MS2-0.3-1Z	3116-BH6-MS1-0Z	3116-BH6-MS2-0.3-1Z	
Sampling Date		12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	Commercial
Parameters	RDL (mg/kg)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Aluminum (Al)	10	8520	6380	8460	5930	6290	8030	6570	6490	7770	6650	7890	7430	8110	7270	-
Antimony (Sb)	1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	40
Arsenic (As)	1	14	5	17	4	4	12	5	5	13	5	26	5	25	5	12
Barium (Ba)	5	38	35	41	17	7	32	9	6	23	9	69	50	35	17	2,000
Beryllium (Be)	2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	8
Boron (B)	2	182	56	169	32	23	75	48	33	53	25	66	20	45	19	-
Cadmium (Cd)	0.3	2	0.5	1.6	<0.3	<0.3	0.9	0.6	0.6	0.7	0.3	1.6	<0.3	1.9	<0.3	22
Chromium (Cr)	2	49	30	48	26	33	39	31	40	38	27	47	27	48	33	87
Cobalt (Co)	1	9	4	9	4	5	7	4	5	6	4	7	5	7	5	300
Copper (Cu)	2	75	26	77	20	19	52	18	18	43	11	76	16	120	17	91
Iron (Fe)	50	23400	13700	24000	12100	12400	19700	13800	21700	16800	12200	17300	14400	17900	15000	-
Lead (Pb)	0.5	35.7	41.5	31.2	22.4	7.4	22	11.3	5.4	17.2	9.9	34.7	43	58.6	13.7	260
Manganese (Mn)	2	380	213	391	197	225	348	214	311	283	204	281	243	293	235	-
Mercury (Hg)	0.05	0.14	0.33	0.11	0.05	0.05	0.17	0.09	<0.05	0.11	<0.05	0.13	<0.05	0.16	0.06	24
Molybdenum (Mo)	2	19	10	14	5	4	7	9	8	4	4	8	4	5	4	40
Nickel (Ni)	2	25	13	24	11	12	19	14	20	17	12	19	11	21	14	89
Selenium (Se)	1	3	1	3	<1	<1	2	1	<1	2	<1	3	<1	3	<1	2.9
Silver (Ag)	0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	40
Strontium (Sr)	5	75	186	70	13	12	37	17	14	26	13	47	11	38	9	-
Thallium (Tl)	0.1	0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	0.1	<0.1	0.2	<0.1	1
Tin (Sn)	2	9	10	8	8	4	7	7	4	6	4	8	5	25	6	300
Uranium (U)	0.1	5.2	6.7	3.3	1.5	1.1	2	3.2	2.4	1.2	1.9	2	1.3	1.4	1.6	33
Vanadium (V)	2	64	34	59	30	33	49	36	32	42	33	46	36	48	37	130
Zinc (Zn)	5	100	60	97	42	38	75	44	58	69	37	104	45	124	35	360
Cyanide	0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	8
pH	-	7.47	7.8	7.38	7.77	8.28	7.48	7.91	8.16	7.39	8.24	7.26	8.34	7.25	8.37	6-8

Notes:

RDL: Reportable Detection Limit

<X: Concentration below the RDL

CCME: Canadian Council of Ministers of the Environment

CSQG: Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health

-: Value Not Established

Concentration exceeds the CCME CSQGs for metals in soil at a commercial site

Table 3: Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Sediment (to be dredged)

		DATA												GUIDELINES	
Lab ID		8931841	8931843	8931844	8931845	8931846	8931847	8931848	8931849	8931850	8931851	8931852	8931853	Environmental Health Guidelines ⁽¹⁾	Human Health Commercial
Sample ID		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12		
Sampling Date (D/M/Y)		20-Nov-17													
Parameter	RDL (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	
1-Methylnaphthalene	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.11	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-
2-Methylnaphthalene	0.02	0.02	0.02	<0.02	0.02	0.03	0.11	0.02	0.02	0.02	0.02	0.05	<0.02	-	-
Acenaphthene	0.00671	0.0341	0.035	0.0228	0.0366	0.0667	0.0888	0.0538	0.0351	0.032	0.0281	0.0646	0.0343	0.28*	8000
Acenaphthylene	0.005	0.067	0.08	0.049	0.08	0.116	0.066	0.055	0.065	0.086	0.067	0.115	0.053	320*	-
Anthracene	0.03	0.18	0.18	0.14	0.18	0.29	0.16	0.15	0.18	0.2	0.19	0.32	0.15	32	37000
Benzo(a)anthracene	0.01	0.56	0.5	0.29	0.5	0.64	0.23	0.36	0.45	0.56	0.77	0.85	0.31	10^a	-
Benzo(a)pyrene	0.01	0.43	0.41	0.23	0.42	0.51	0.15	0.27	0.38	0.44	0.49	0.66	0.21	72	-
Benzo(b)fluoranthene	0.05	0.43	0.38	0.18	0.32	0.4	0.12	0.22	0.3	0.36	0.42	0.55	0.17	10^a	-
Benzo(j,k)fluoranthene	0.05	0.38	0.24	0.14	0.3	0.39	0.14	0.22	0.28	0.36	0.47	0.57	0.13	10^a	-
Benzo(ghi)perylene	0.01	0.32	0.24	0.13	0.22	0.28	0.09	0.16	0.24	0.23	0.26	0.37	0.11	-	-
Chrysene	0.01	0.57	0.56	0.3	0.53	0.68	0.26	0.48	0.49	0.56	0.79	0.93	0.27	-	-
Dibenzo(a,h)anthracene	0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	10^a	-
Fluoranthene	0.05	0.98	0.98	0.63	0.94	1.49	0.58	0.96	1.04	1.09	0.99	1.88	0.57	-	-
Fluorene	0.01	0.05	0.07	0.05	0.07	0.12	0.14	0.08	0.07	0.07	0.06	0.15	0.09	0.25*	-
Indeno(1,2,3)pyrene	0.01	0.44	0.22	0.12	0.23	0.28	0.08	0.14	0.24	0.24	0.26	0.38	0.11	10^a	5300
Naphthalene	0.01	0.04	0.05	0.03	0.05	0.06	0.22	0.03	0.05	0.05	0.04	0.09	0.02	0.013*	4100
Perylene	0.05	0.1	0.09	<0.05	0.09	0.1	<0.05	0.05	0.09	0.09	0.11	0.15	<0.05	-	-
Phenanthrene	0.03	0.46	0.48	0.38	0.51	0.95	0.62	0.63	0.6	0.6	0.46	1.34	0.5	0.046*	-
Pyrene	0.05	0.83	0.87	0.53	0.86	1.26	0.53	0.85	0.81	0.92	0.81	1.5	0.47	100^a	3200

Application of Benzo(a)pyrene Potency Equivalency Factors

Parameter	Units	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	B(a)P Potency Equivalency Factors (PEF)	CCME, 2012 ⁴ Human Health Direct Contact Commercial
Benzo(a)anthracene	mg/kg	0.0560	0.0500	0.0290	0.0500	0.0640	0.0230	0.0360	0.0450	0.0560	0.0770	0.0850	0.0310	0.1	-
Benzo(a)pyrene	mg/kg	0.4300	0.4100	0.2300	0.4200	0.5100	0.1500	0.2700	0.3800	0.4400	0.4900	0.6600	0.2100	1	-
Benzo(b+j+k)fluoranthene	mg/kg	0.0810	0.0620	0.0320	0.0620	0.0790	0.0260	0.0440	0.0580	0.0720	0.0890	0.1120	0.0300	0.1	-
Benzo(ghi)perylene	mg/kg	0.0032	0.0024	0.0013	0.0022	0.0028	0.0009	0.0016	0.0024	0.0023	0.0026	0.0037	0.0011	0.01	-
Chrysene	mg/kg	0.0057	0.0056	0.0030	0.0053	0.0068	0.0026	0.0048	0.0049	0.0056	0.0079	0.0093	0.0027	0.01	-
Dibenzo(a,h)anthracene	mg/kg	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	1	-
Indeno(1,2,3-cd)pyrene	mg/kg	0.0440	0.0220	0.0120	0.0230	0.0280	0.0080	0.0140	0.0240	0.0240	0.0260	0.0380	0.0110	0.1	-
Application of UF ³	-	3	3	3	3	3	3	3	3	3	3	3	3	-	5.3
Benzo(a)pyrene TPE (10⁻⁵)	mg/kg	1.88	1.67	0.94	1.71	2.09	0.65	1.13	1.56	1.82	2.10	2.74	0.88	-	-

Notes:

< indicates that parameter was not detected above the reportable detection limit (RDL)

- : Not analyzed or no guideline exists

CCME: Canadian Council of Ministers of the Environment

CSQG: Canadian Soil Quality Guidelines

B(a)P: Benzo(a)pyrene

TPE: Total Potency Equivalent

PEF: Potency Equivalence Factor

⁽¹⁾ CCME CSQGs for commercial land use, protection of environmental health, based on non-carcinogenic effects of PAHs, 1999 (2010 update)

a: 1991 CCME Interim Soil Quality Guideline (ISQG)

* Protection of freshwater aquatic life guideline (applied where exists)

⁽²⁾ Alberta Environment (AENV) surface soil remediation guideline values for commercial land use (Table A-4), protection of human health, direct soil contact (2010)

⁽³⁾ UF: Uncertainty Factor, added in the instance that the source of PAHs is Creosote.

⁽⁴⁾ CCME CSQGs for commercial land use, protection of human health, direct contact, based on carcinogenic effects of PAHs, 1999 (2010 update)

Bold and underlined data exceed the environmental health guideline, commercial land use

Bold and shaded data exceeds the human health guideline (direct contact), commercial land use

Table 3: Polycyclic Aromatic Hydrocarbon (PAH) Concentrations in Sediment (to be dredged) Cont'd

Lab ID	DATA															GUIDELINES	
	8983827 3116-BH1-MS1-0Z	8983830 3116-BH1-MS2-0.3-1Z	8983835 3116-BH2-MS1-0Z	8983836 3116-BH2-MS2-0.3-1Z	8983839 3116-BH2-MS3-1-2Z	8983845 3116-BH3-MS1-0Z	8983848 3116-BH3-MS2-0.3-1Z	8983849 3116-BH3-MS3-1-2Z	8983851 3116-BH4-MS1-0Z	8983861 3116-BH4-MS2-0.3-1Z	8983863 3116-BH5-MS1-0Z	8983864 3116-BH5-MS2-0.3-1Z	8983870 3116-BH6-MS1-0Z	8983871 3116-BH6-MS2-0.3-1Z	Environmental Health Guidelines ⁽¹⁾	Human Health Commercial	
Sample ID	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17			
Sampling Date (D/M/Y)																	
Parameter	RDL (mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
1-Methylnaphthalene	0.05	<0.05	0.06	<0.05	<0.05	0.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	-	-
2-Methylnaphthalene	0.02	0.04	0.05	0.03	0.02	0.08	0.04	<0.02	<0.02	<0.02	<0.02	0.02	0.07	0.03	<0.02	-	-
Acenaphthene	0.00671	0.049	0.0735	0.0278	0.0627	0.0377	0.0214	0.00882	<0.00671	0.0117	0.0214	0.0319	0.0767	0.109	0.00948	0.28*	8000
Acenaphthylene	0.005	0.12	0.117	0.071	0.088	0.092	0.049	0.027	<0.005	0.027	0.028	0.048	0.109	0.061	0.012	320*	-
Anthracene	0.03	0.16	0.29	0.14	0.39	0.15	0.07	0.05	<0.03	0.05	0.07	0.1	0.2	0.59	<0.03	32	37000
Benzo(a)anthracene	0.01	0.64	0.67	0.34	0.74	0.16	0.19	0.09	<0.01	0.13	0.14	0.31	0.26	1.01	0.06	10^a	-
Benzo(a)pyrene	0.01	0.47	0.72	0.37	0.69	0.17	0.22	0.1	<0.01	0.14	0.15	0.35	0.28	0.92	0.07	72	-
Benzo(b)fluoranthene	0.05	0.59	0.72	0.32	0.51	0.11	0.17	0.09	<0.05	0.12	0.12	0.33	0.19	0.92	0.06	10^a	-
Benzo(j,k)fluoranthene	0.05	0.6	0.55	0.36	0.83	0.15	0.22	0.06	<0.05	0.12	0.15	0.19	0.21	0.79	0.06	10^a	-
Benzo(ghi)perylene	0.01	0.46	0.43	0.23	0.32	0.11	0.14	0.08	<0.01	0.08	0.11	0.2	0.18	0.42	0.05	-	-
Chrysene	0.01	0.83	0.81	0.44	0.73	0.17	0.23	0.1	<0.01	0.15	0.17	0.36	0.31	1.06	0.09	-	-
Dibenzo(a,h)anthracene	0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	10^a	-
Fluoranthene	0.05	1.07	1.51	0.71	1.51	0.37	0.42	0.23	<0.05	0.25	0.38	0.63	0.62	1.75	0.15	-	-
Fluorene	0.01	0.1	0.14	0.05	0.14	0.14	0.05	0.02	<0.01	0.02	0.04	0.05	0.17	0.16	0.01	0.25*	-
Indeno(1,2,3)pyrene	0.01	0.45	0.57	0.27	0.41	0.13	0.19	0.08	<0.01	0.11	0.13	0.21	0.18	0.58	0.06	10^a	5300
Naphthalene	0.01	0.06	0.09	0.05	0.04	0.08	0.07	<0.01	<0.01	0.02	0.02	0.03	0.06	0.05	<0.01	0.013*	4100
Perylene	0.05	0.17	0.17	0.08	0.16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	0.05	0.23	<0.05	-	-
Phenanthrene	0.03	0.83	1.06	0.47	0.88	0.57	0.38	0.2	<0.03	0.16	0.33	0.39	0.86	1.15	0.11	0.046*	-
Pyrene	0.05	0.96	1.38	0.6	1.23	0.4	0.38	0.22	<0.05	0.21	0.33	0.54	0.67	1.34	0.14	100^a	3200

Parameter	Units	3116-BH1-MS1-0Z	3116-BH1-MS2-0.3-1Z	3116-BH2-MS1-0Z	3116-BH2-MS2-0.3-1Z	3116-BH2-MS3-1-2Z	3116-BH3-MS1-0Z	3116-BH3-MS2-0.3-1Z	3116-BH3-MS3-1-2Z	3116-BH4-MS1-0Z	3116-BH4-MS2-0.3-1Z	3116-BH5-MS1-0Z	3116-BH5-MS2-0.3-1Z	3116-BH6-MS1-0Z	3116-BH6-MS2-0.3-1Z	B(a)P Potency Equivalency Factors (PEF)	CCME, 2012 ⁴ Human Health Direct Contact Commercial
Benz[a]anthracene	mg/kg	0.0640	0.0670	0.0340	0.0740	0.0160	0.0190	0.0090	0.0010	0.0130	0.0140	0.0310	0.0260	0.1010	0.0060	0.1	-
Benzo[a]pyrene	mg/kg	0.4700	0.7200	0.3700	0.6900	0.1700	0.2200	0.1000	0.0100	0.1400	0.1500	0.3500	0.2800	0.9200	0.0700	1	-
Benzo[b+j+k]fluoranthene	mg/kg	0.1190	0.1270	0.0680	0.1340	0.0260	0.0390	0.0150	0.0100	0.0240	0.0270	0.0520	0.0400	0.1710	0.0120	0.1	-
Benzo[ghi]perylene	mg/kg	0.0046	0.0043	0.0023	0.0032	0.0011	0.0014	0.0008	0.0001	0.0008	0.0011	0.0020	0.0018	0.0042	0.0005	0.01	-
Chrysene	mg/kg	0.0083	0.0081	0.0044	0.0073	0.0017	0.0023	0.0010	0.0001	0.0015	0.0017	0.0036	0.0031	0.0106	0.0009	0.01	-
Dibenzo[a,h]anthracene	mg/kg	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	0.0060	1	-
Indeno[1,2,3-cd]pyrene	mg/kg	0.0450	0.0570	0.0270	0.0410	0.0130	0.0190	0.0080	0.0010	0.0110	0.0130	0.0210	0.0180	0.0580	0.0060	0.1	-
Application of UF ³	-	3	3	3	4	5	3	3	3	3	3	3	3	3	3	-	5.3
Benzo(a)pyrene TPE (10 ⁻⁵)	mg/kg	2.15	2.97	1.54	3.82	1.17	0.92	0.42	0.08	0.59	0.64	1.40	1.12	3.81	0.30	-	-

Notes:

< indicates that parameter was not detected above the reportable detection limit (RDL)

- : Not analyzed or no guideline exists

CCME: Canadian Council of Ministers of the Environment

CSQG: Canadian Soil Quality Guidelines

B[a]P: Benzo[a]pyrene

TPE: Total Potency Equivalent

PEF: Potency Equivalence Factor

⁽¹⁾ CCME CSQGs for commercial land use, protection of environmental health, based on non-carcinogenic effects of PAHs, 1999 (2010 update)

a: 1991 CCME Interim Soil Quality Guideline (ISQG)

* Protection of freshwater aquatic life guideline (applied where exists)

⁽²⁾ Alberta Environment (AENV) surface soil remediation guideline values for commercial land use (Table A-4), protection of human health, direct soil contact (2010)

⁽³⁾ UF: Uncertainty Factor, added in the instance that the source of PAHs is Creosote.

⁽⁴⁾ CCME CSQGs for commercial land use, protection of human health, direct contact, based on carcinogenic effects of PAHs, 1999 (2010 update)

Bold and underlined data exceed the environmental health guideline, commercial land use

Bold and shaded data exceeds the human health guideline (direct contact), commercial land use

Table 4: Polychlorinated Biphenyl (PCB) Concentrations in Sediment (to be dredged)

		DATA												GUIDELINES
Lab ID		8931841	8931843	8931844	8931845	8931846	8931847	8931848	8931849	8931850	8931851	8931852	8931853	CCME CSQG
Sample ID		Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8	Sample 9	Sample 10	Sample 11	Sample 12	
Sampling Date		20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	20/11/2017	Commercial
Parameters	RDL (mg/kg)	mg/kg												
Total PCB	0.020	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	33

		DATA													GUIDELINES	
Lab ID		8983827	8983830	8983835	8983836	8983839	8983845	8983848	8983849	8983851	8983861	8983863	8983864	8983870	8983871	CCME CSQG
Sample ID		3116-BH1-MS1-OZ	3116-BH1-MS2-0.3-1Z	3116-BH2-MS1-OZ	3116-BH2-MS2-0.3-1Z	3116-BH2-MS3-1-2Z	3116-BH3-MS1-OZ	3116-BH3-MS2-0.3-1Z	3116-BH3-MS3-1-2Z	3116-BH4-MS1-OZ	3116-BH4-MS2-0.3-1Z	3116-BH5-MS1-OZ	3116-BH5-MS2-0.3-1Z	3116-BH6-MS1-OZ	3116-BH6-MS2-0.3-1Z	
Sampling Date		12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	12-Dec-17	Commercial
Parameters	RDL (mg/kg)	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Total PCB	0.020	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	33

Notes:

RDL: Reportable Detection Limit

<X: Concentration below the RDL

CCME: Canadian Council of Ministers of the Environment

CSQG: Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health

Concentration exceeds the CCME CSQGs for PCBs in soil at a commercial / industrial site

Table 5: Metal SPLP Concentrations in Sediment

		Data												
Lab ID		8931841	8931843	8931845	8931849	8931850	8931851	8931852	8983827	8983835	8983851	8983863	8983870	MOE ¹
Sample ID		Sample 1	Sample 2	Sample 4	Sample 8	Sample 9	Sample 10	Sample 11	3116-BH1-MS1-0Z	3116-BH2-MS1-0Z	3116-BH4-MS1-0Z	3116-BH5-MS1-0Z	3116-BH6-MS1-0Z	
Sampling Date		20-Nov-17	8-Dec-17	8-Dec-17	8-Dec-17	8-Dec-17	12/08/17							
Parameters	RDL (mg/L)	mg/L					mg/L	mg/L						
Aluminum Leachate	0.02	0.10	0.05	0.07	0.08	0.05	0.06	0.05	0.09	0.07	0.06	0.04	0	-
Antimony Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	16
Arsenic Leachate	0.02	0.02	0.04	0.02	0.03	0.06	0.08	0.04	<0.02	<0.02	0.07	0.07	0	1.5
Barium Leachate	0.02	<0.02	0.04	0.03	<0.02	0.03	0.04	0.05	<0.02	<0.02	<0.02	0.02	0	23
Beryllium Leachate	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.053
Bismuth Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
Boron Leachate	0.05	1.50	1.48	1.40	0.91	0.87	1.12	1.03	0.96	0.86	0.36	0.74	1	36
Cadmium Leachate	0.003	<0.003	0.0021											
Chromium Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.640
Cobalt Leachate	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.052
Copper Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.069
Iron Leachate	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.60	0.70	0.60	1.00	1	-
Lead Leachate	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.020
Lithium Leachate	0.02	0.03	0.03	0.03	0.02	0.02	0.03	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	-
Manganese Leachate	0.02	0.03	0.05	0.05	0.04	<0.02	<0.02	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	-
Molybdenum Leachate	0.02	0.14	0.15	0.16	0.12	0.11	0.17	0.16	0.13	0.10	0.03	0.10	0.04	7.300
Nickel Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.390
Selenium Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.050
Silver Leachate	0.005	<0.005	0.0012											
Strontium Leachate	0.02	0.68	0.71	0.63	0.45	0.43	0.51	0.67	0.45	0.48	0.22	0.30	0.26	-
Thallium Leachate	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.400
Tin Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-
Uranium Leachate	0.001	0.007	0.007	0.006	0.003	<0.001	0.001	0.002	0.004	0.003	<0.001	<0.001	<0.001	0.330
Vanadium Leachate	0.02	<0.02	0.020	0.020	0.030	0.080	0.160	0.040	0.030	0.020	0.060	0.080	0.090	0.200
Zinc Leachate	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.890

Notes:

RDL: Reportable detection limit

MOECC: Ontario Ministry of the Environment and Climate Change

1: MOECC Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act, April 15, 2011. Table 9

- : Parameter not analyzed or no guideline, or not applicable.

Bold, Underlined and Shaded: concentration exceeds MOE Table 9 Non-potable Groundwater Standards for use within 30 m of a waterbody.

Bold: Detection limit exceeds the guideline