APPENDIX 1:

BEAR ISLAND
NUNAVUT WATER BOARD
EXPLORATION/REMOTE CAMP
SUPPLEMENTARY QUESTIONNAIRE

P.O. Box 119
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kNK5 wmoEp5 vtmpq
NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

EXPLORATION/ REMOTE CAMP SUPPLEMENTARY QUESTIONNAIRE

Applicant: **Indian and Northern Affairs Canada** **Licence No:** ____________________
(For NWB Use Only)

ADMINISTRATIVE INFORMATION

1. Environment Manager: **Matt McElwaine** Tel: **(780) 497-6288** Fax: **(780) 497-3842**
   E-mail: **Matthew.McElwaine@pwgsc.gc.ca**

2. Project Manager: **Mark Yetman** Tel: **(867) 975-4733** Fax: **(867) 975-4736** E-mail: **yetmanm@inac-ainc.gc.ca**

3. Does the applicant hold the necessary property rights? **Yes**

4. Is the applicant an 'operator' for another company (i.e., the holder of the property rights)? **No**
   If so, please provide letter of authorization.

5. Duration of the Project
   - ☐ One year or less Start and completion dates: ____________________
   - ☑ Multi Year:

   If Multi-Year indicate proposed schedule of on site activities
   Start: **May 1, 2009** Completion: **December 1, 2011**

CAMP CLASSIFICATION

6. Type of Camp
   - ☐ Mobile (self-propelled)
   - ☐ Temporary
   - ☑ Seasonally Occupied: **June 15 to September 15**
   - ☐ Permanent
   - ☐ Other: ____________________

7. What is the design, maximum and expected average population of the camp?

The contractor will mobilize the camp in the summer of 2009 and demobilize in the summer of 2010 or 2011. The camp will be occupied from June 15 to September 15 (maximum ~90 days per year). The expected average population of the camp is 35 people (maximum of 50).

8. Provide history of the site if it has been used in the past.

See attached Executive Summary in English and Inuktitut (Appendix 3 & 4)

CAMP LOCATION

9. Please describe proposed camp location in relation to biogeographical and geomorphological features, and water bodies.

Bear Island is located approximately 160 km northwest of Chisasibi, Quebec and 300 km south of Sanikiluaq, Nunavut, see attached Site Maps (Appendix 6). The island is approximately 5 km long, north to south, by 1.5 km wide. It is a low lying black basalt outcrop, covered with small lakes and ponds, which were created by glacial scouring. Typical plants found in this region include ground cover of dwarf birch, willow, cotton grass, lichen and moss. Seabird activity and bear and fox evidence was noted in the 1995 investigation. The wildlife typically found in this region includes black and polar bears, wolf, red fox, snowshoe hare, raven, osprey, shorebirds, seabirds, waterfowl, seal, walrus and whale.

The proposed location of the camp is indicated on Figure 2.1A in the Remedial Action Plan (Appendix 5).

10. How was the location of the camp selected? Was the site previously used? Was assistance from the Regional Inuit Association Land Manager sought? Include maps and/or aerial photographs.

The Camp will be sited in a previously disturbed area. Existing buildings will not be used as camp facilities as they may contain contaminants and are not suitable for occupation during the project. The exact location of the camp will be determined upon awarding of project contract (see Appendix 12), however, EarthTech has recommended a location in the Phase III Environmental Assessment and Remedial Action Plan (Appendix 5).

11. Is the camp or any aspect of the project located on:

- ☑ Crown Lands — Permit Number (s)/Expiry Date: **INAC Land Use Permit application has been submitted concurrently with this application**
- ☐ Commissioners Lands — Permit Number (s)/Expiry Date: **n/a**
- ☐ Inuit Owned Lands — Permit Number (s)/Expiry Date: **n/a**

12. Closest Communities (direction and distance in km):

The Bear Island Mid-Canada Line Radar Station is located approximately 160 km northwest of Chisasibi, Quebec, and 300 km south of Sanikiluaq, Nunavut (Appendix 6).

13. Has the proponent notified and consulted the nearby communities and potentially interested parties about the proposed work?

Consultations were completed during the Phase III Environmental Site Assessment and the development of the Remedial Action Plan. In addition, community consultations with the Hamlet Council, Hunters and Trappers Organization and community residents were completed in February 2008 in Chissasibi. The results of the assessment and the various remediation options being considered for the site were presented. These meetings were used to solicit input as to the community's preferred remedial option. Please see attached public consultation records appended to the Bear Island Mid-Canada Line Radar Station Remedial Action Plan (Appendix 5) for additional details.

14. Will the project have impacts on traditional water use areas used by the nearby communities? Will the project have impacts on local fish and wildlife habitats?

The project is not expected to have negative impacts on traditional water use areas or local fish and wildlife habitats. See attached Environmental Screening of the remediation activities at Bear Island (Appendix 7).

PURPOSE OF THE CAMP

15. ☐ Mining (includes exploration drilling)
☐ Tourism (hunting, fishing, wildlife observation, adventure/expedition, etc.) (Omit questions # 16 to 21)
☑ Other **Site Remediation (Omit questions #16 to 22)**

16. Activities (check all applicable)

☐ Preliminary site visit
☐ Prospecting
☐ Geological mapping
☐ Geophysical survey
☐ Diamond drilling
☐ Reverse circulation drilling
☐ Evaluation Drilling/Bulk Sampling (also complete separate questionnaire)
☐ Other: ______________________________

17. Type of deposit (exploration focus):

☐ Lead Zinc
☐ Diamond
☐ Gold
☐ Uranium
☐ Other: ____________________

DRILLING INFORMATION

18. Drilling Activities

☐ Land Based drilling
☐ Drilling on ice

19. Describe what will be done with drill cuttings?

20. Describe what will be done with drill water?

21. List the brand names and constituents of the drill additives to be used? Includes MSDS sheets and provide confirmation that the additives are non-toxic and biodegradable.

22. Will any core testing be done on site? Describe.

SPILL CONTINGENCY PLANNING

23. The proponent is required to have a site specific Spill Contingency Plan prepared and submitted with the application This Plan should be prepared in accordance with the *NWT Environmental Protection Act, Spill Contingency Planning and Reporting Regulations, July 22, 1998* and *A Guide to the Spill Contingency Planning and Reporting Regulations, June 2002*. Please include for review.

See attached Preliminary Spill Contingency Plan (Appendix 8). The Contractor will be responsible for providing a more detailed spill contingency plan following contract award and prior to mobilization to site (see Appendix 12).

24. How many spill kits will be on site and where will they be located?

See attached Preliminary Spill Contingency Plan (Appendix 8). The Contractor will be responsible for providing a more detailed spill contingency plan following the contract award and prior to mobilization to site (see Appendix 12).

25. Please describe the types, quantities, and method of storage of fuel and chemicals on site, and provide MSDS sheets.

Handling, storage and use of flammable liquids will be governed by the current National Fire Code of Canada. Flammable liquids such as gasoline, kerosene and naphtha will be kept for ready use in quantities not exceeding 45 litres, provided they are stored in approved safety cans bearing the Underwriter's Laboratory of Canada or Factory Mutual seal of approval. Contractor will comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding employee training, use, handling, storage and disposal of hazardous materials, and regarding labelling and provision of Material Safety Data Sheets (MSDS) as required by WHMIS legislation. Upon award of contract and prior to mobilization, the Contractor will provide types, quantities, and method of storage for all fuel and chemicals on site (Appendix 12).

WATER SUPPLY AND TREATMENT

26. Describe the location of water sources.

Potential water sources are the Freshwater Reservoir constructed during site operation (See Figure 2.1A in the Remedial Action Plan, Appendix 5) as well as several other small shallow lakes in the vicinity of the camp location.

27. Estimated water use (in cubic metres/day):

- ☑ Domestic Use: **20** Water Source: **Freshwater Resovoir**
- ☐ Drilling: ______ Water Source: ______
- ☐ Other: ______ Water Source: ______

28. Describe water intake for camp operations? Is the water intake equipped with a mesh screen to prevent entrapment of fish? (see *DFO 1995, Freshwater Intake End-of-Pipe Fish Screen Guideline*) Describe:

Water will be pumped to site (or via truck) via a small horsepower pump and equipped with a small mesh screen. The pump will be placed at least 30 m from any water body and a spill kit will be sited near the pump.

29. Will drinking water quality be monitored? What parameters will be analyzed and at what frequency?

Commercially bottled water that meets Health Canada Guidelines for Canadian Drinking Water Quality (GCDWQ) will be used as drinking water until it is demonstrated that the local source meets the Health Canada GCDWQ. Water will be sampled at the water supply sources and at the distribution source and submitted for laboratory analysis. Prior to consumption, at least two consecutive sets of analytical test results will demonstrate that the water source meets the Health

Canada GCDWQ. Water will be sampled and analyzed weekly as long as the camp is operational.

30. Will drinking water be treated? How?

If on-site water in its current state does not meet Health Canada GCDWQ, it will be treated to meet the Health Canada GCDWQ. The contractor will determine the appropriate equipment, supplies and materials required to treat the water in accordance with the Health Canada GCDWQ. This information will be forwarded after contract award and prior to mobilization (see Appendix 12).

31. Will water be stored on site?

Following award of contract, the Contractor will determine the method of water storage on site. This information will be forwarded after contract award and prior to mobilization (see Appendix 12).

WASTE TREATMENT AND DISPOSAL

32. Describe the characteristics, quantities, treatment and disposal methods for:

☑ Camp Sewage (blackwater)

Two independently operated temporary lagoons will be installed. Each lagoon will have an individual capacity for 45 days of wastewater storage or one half of the duration of the construction season, whichever is more. Maximum fluid depth will not exceed one metre. The location of the lagoons will be a minimum of 100 m from the construction camp or other temporary facilities and drainage paths, and downwind of the construction camp (based on the prevailing wind direction). Discharge criteria will be as follows: 1) oil and grease – none visible, 2) pH – 6 to 9, 3) TSS – 180 mg/L, 4) BOD – 120 mg/L, 5) fecal coliforms – 100,000 CFU/100 ml. See Appendix 6 for additional details on the sewage lagoons.

☑ Camp Greywater

The camp greywater will consist primarily of wastewater generated from the kitchen and bathroom sinks and showers. The estimated flow from this wastewater stream is 75 L/day per person. This waste will be directed to the sewage lagoons mentioned above (same disposal location as camp sewage).

☑ Solid Waste

Non-hazardous, combustible solid waste will be incinerated on-site in an enclosed container. Non-combustible solid waste generated from the camp operations will be stored in a secure waste disposal bin. The contents of the waste disposal bin will be transported and disposed of in the on-site non-hazardous waste landfill on an as required basis.

☑ Bulky Items/Scrap Metal

Any bulky items or scrap metal waste at the site will be disposed of in one of the on-site non hazardous waste landfill.

☑ Waste Oil/Hazardous Waste

Waste oil and/or hazardous waste generated at the site will either be incinerated on-site (eg. some fuels) or removed from the site and disposed of at the appropriate off-site licensed hazardous

material treatment/disposal facility. The hazardous materials will be removed by Cat train and sea lift in accordance with the Transportation of Dangerous Goods Act.

☑ Empty Barrels/Fuel Drums

Barrel contents comprising water only (less than 2% glycols or alcohols) shall be transferred to an open vessel such as a utility tub or half-barrel and any organic material removed by agitation with a pillow or segment of oil absorbent material. The water may then be discarded onto ground that is a minimum of 30 m distant from natural drainage courses. Used oil absorbent material shall be treated as described in the following sections.

Barrel contents, which are comprised of water with glycols and/or alcohols or organic phases, and which contain less than 2 mg/L PCBs, 100 mg/L chlorine, 2 mg/L cadmium, 10 mg/L chromium, and 100 mg/L lead, will be disposed of by on-site incineration (alternatively, these contents may be disposed of off-site at a licensed facility). The solid residual material resulting from incineration will be subjected to a leachate extraction test. Material found to be nonleachate toxic shall be disposed of as contaminated soil. Leachate toxic material will be treated as hazardous waste and disposed of off-site at a licensed disposal facility.

Barrel contents, which contain greater than 2 mg/L PCBs, 1,000 mg/L chlorine, 2 mg/L cadmium, 10 mg/L chromium or 100 mg/L lead will be disposed of off-site at a licensed disposal facility. Used oil absorbent material will be treated as hazardous waste and disposed of off-site at a licensed disposal facility. If it is shown to be uncontaminated with PCBs (<2 mg/L), chlorine (<1,000 mg/L), cadmium (<2 mg/L), chromium (<10 mg/L), and lead (<100 mg/L), it may be incinerated on-site.

Empty barrels will be crushed or shredded and landfilled as non-hazardous waste after they have been cleaned in an appropriate manner. The barrels shall be crushed in such a manner so as to reduce their volume by a minimum of 80%. Shredded barrels may be disposed of in the non hazardous waste landfill or off-site as recycled metals.

☐ Other: **Not applicable.**

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33. Please describe incineration system if used on site. What types of wastes will be incinerated?
The types of waste that will be incinerated at the site consist primarily of domestic solid waste including food, paper and unpainted wood waste. Upon award of contract, the Contractor will identify the incineration system to be used on-site. The details regarding this incineration system will be provided for approval prior to mobilization (see Appendix 12).

The contents of all unsealed barrels with incomplete or inadequate labelling (ie: barrels with unknown contents) will be sampled and submitted for laboratory analysis prior to their classification as either waste that can be incinerated on-site or hazardous waste that must be transported off-site for disposal at an approved facility.

34. Where and how will non-combustible waste be disposed of? If in a municipality in Nunavut, has authorization been granted?

Non-combustible solid waste generated from the camp operations will be stored in a secure waste disposal bin. The contents of the waste disposal bin will be transported and disposed of in the on-site non hazardous waste (NHW) landfill on an as required basis.

35. Describe location (relative to water bodies and camp facilities) dimensions and volume, and freeboard for all sumps (if applicable).

This information and information supplementing the discussion of water bodies and camp facilities in Section 32 will be provided as it becomes available (see Appendix 12).

36. Will leachate monitoring be done? What parameters will be sampled and analyzed, and at what frequency?

Groundwater monitoring wells will be installed around the perimeter of the landfill to facilitate long term leachate monitoring. Monitoring will occur at least annually for the first five years and periodically thereafter for a total of 25 years. The monitoring requirements of the landfill will be reassessed at that time. For further details on the long term monitoring see the Bear Island Mid-Canada Line Radar Station Remedial Action Plan (Appendix 5).

OPERATION AND MAINTENANCE

37. Have the water supply and waste treatment and disposal methods been used and proven in cold climate? What known O&M problems may occur? What contingency plans are in place?

The contract specifications will require the Contractor to utilize water supply and waste treatment and disposal methods that have been used and proven effective in cold climates. All on-site activities are scheduled for the summer field season when the average daily temperature is above freezing. The water and wastewater systems are basic so it is unlikely that any O&M problems will occur as a result of the climate. These systems will meet all federal guidelines. Further information will be provided as it becomes available (see Appendix 12).

The Contractor will be responsible for identifying potential O & M problems that may occur and ensuring contingency plans are in place to deal with them. The Contractor will provide a Health and Safety Plan and Onsite Contingency Emergency Response Plan.

ABANDONMENT AND RESTORATION

38. Provide a detailed description of progressive and final abandonment and restoration activities at the site.

The camp will be decommissioned and all equipment removed from the site during the summer of 2010 or 2011. Restoration of the site will be in accordance with the Bear Island Mid-Canada Line Radar Station Remedial Action Plan (Appendix 5).

BASELINE DATA

39. Has or will any baseline information be collected as part of this project? Provide bibliography.

- ☑ Physical Environment (Landscape and Terrain, Air, Water, etc.)
- ☑ Biological Environment (Vegetation, Wildlife, Birds, Fish and Other Aquatic Organisms, etc.)
- ☑ Socio-Economic Environment (Archaeology, Land and Resources Use, Demographics, Social and Culture Patterns, etc.)
- ☐ Other: ________________________________

Bibliography:

Please see the "List of Additional Documents" provided in Appendix 11.

REGULATORY INFORMATION

40. At a minimum, you should ensure you have a copy of and consult the documents below for compliance with existing regulatory requirements:

- ✓ ARTICLE 13 – *NCLA -Nunavut Land Claims Agreement*
- ✓ NWNSRTA – *The Nunavut Waters and Nunavut Surface Rights Tribunal Act, 2002*
- ✓ *Northwest Territories Waters Regulations, 1993*
- ✓ NWB - Water Licensing in Nunavut - Interim Procedures and Information Guide for Applicants
- ✓ NWB - Interim Rules of Practice and Procedure for Public Hearings
- ✓ RWED – *Environmental Protection Act, R-068-93- Spill Contingency Planning and Reporting Regulations, 1993*
- ✓ RWED A Guide to the Spill Contingency Planning and Reporting Regulations, 2002
- ✓ NWTWB - Guidelines for Contingency Planning
- ✓ *Canadian Environmental Protection Act, 1999 (CEPA)*
- ✓ *Fisheries Act, RS 1985* - s.34, 35, 36 and 37
- ✓ DFO - Freshwater Intake End of Pipe Fish Screen Guideline
- ✓ NWTWB - Guidelines for the Discharge of Treated Municipal Wastewater in the NWT
- ✓ Canadian Council for Ministers of the Environment (CCME); Canadian Drinking Water Quality Guidelines, 1987
- ✓ Public Health Act - Camp Sanitation Regulations
- ✓ Public Health Act - Water Supply Regulations
- ✓ *Territorial Lands Act* and *Territorial Land Use Regulations*; Updated 2000

APPENDIX 2:

LETTER TO NUNAVUT IMPACT REVIEW BOARD REGARDING BEAR ISLAND JURISDICTION

November 3, 2008

Nunavut Impact Review Board
PO Box 1360
Cambridge Bay NU
X0B 0C0

RE: BEAR ISLAND MID-CANADA LINE RADAR STATION REMEDIATION PROJECT – NUNAVUT IMPACT REVIEW BOARD JURISTICTION

To Whom It May Concern:

Indian and Northern Affairs Canada (INAC) is in the process of applying for permits and licences required for the Bear Island Mid-Canada Line Radar Station Remediation Project.

As part of this process it has been determined that the Nunavut Impact Review Board (NIRB) does not have jurisdiction over Bear Island and as such a NIRB review will not be required for the project. As such, INAC has not included "NIRB Form Part 1 - Project Proposal Information Requirements" with this application package.

If you have any questions or require additional information please contact the Project Manager, Mark Yetman, at (867) 975-4733 or via e-mail at yetmanm@inac-ainc.gc.ca.

Sincerely,

Natalie Plato

Natalie Plato
Director, Contaminated Sites
Nunavut Regional Office

APPENDIX 3:

BEAR ISLAND
EXECUTIVE SUMMARY (ENGLISH)

EXECUTIVE SUMMARY

1. PROJECT BACKGROUND & LOCATION

The Government of Canada has initiated the Federal Contaminated Sites Action Plan (FCSAP) to clean up federally owned contaminated sites and to address the environmental liabilities associated with each site. The FCSAP program provides funding for the remediation of contaminated sites posing risks to human health and/or the environment. Indian and Northern Affairs Canada (INAC) has applied for, and secured, funds under this program for the investigation and remediation of two abandoned Mid-Canada Line Radar Stations (Sites 412 and 413) located on Bear Island (54°20'N, 81°05'W) in the central northern portion of James Bay, Nunavut. Bear Island is approximately 160 km northwest of Chisasibi, Quebec and 300 km south of Sanikiluaq, Nunavut. Site maps and drawings are included in this submission (See Appendix B, C and E).

Bear Island is approximately 5 km long, north to south, by 1.5 km wide. It is a low lying black basalt outcrop, covered with small lakes and ponds, which were created by glacial scouring. Typical plants found in this region include ground cover of dwarf birch, willow, cotton grass, lichen and moss. Seabird activity and bear and fox evidence was noted in the 1995 investigation. The wildlife typically found in this region includes black and polar bears, wolf, red fox, snowshoe hare, raven, osprey, shorebirds, seabirds, waterfowl, seal, walrus and whale.

The two Doppler radar stations operated on Bear Island from the 1950s to 1965 as part of the former Mid-Canada Early Warning Line. They were abandoned in 1965 without any cleanup operations although the majority of the buildings were removed to their foundations. The environmental issues at Bear Island include former landfills and site buildings, as well as abandoned hazardous materials (lead acid batteries, petroleum products, asbestos), barrels and scrap metal.

At Site 413 there is a toppled radar tower and only the building foundation and most of the floor remains. The petroleum, oils and lubricants (POL) tanks have been removed but some piping is still present. The buildings appear to have been equipped with sanitary toilet systems, where the waste was discharged into a deep tank under the building. A partially covered landfill and a surface dump are present at the site, northeast of Site 412. In addition, there is a 3,300 m long pipeline and 2,850 m long electrical cable, which runs through the sites and physical debris is scattered throughout the island. A 1,500 m airstrip (abandoned) is located on the west side of the island, between the two stations; the roads between the two sites are connected via the airstrip. There is a beaching area on the east side of the island in a natural bay, approximately 1 km north of Site 412 and connected to the site by road. The beach area is believed to be where supplies were unloaded for the island and consists of a storage and hut area with a POL site to the south. There is very little of the POL site remaining with the exception of some petroleum piping.

A preliminary environmental assessment of Bear Island was conducted in 1995 by the Environmental Sciences Group (ESG) of Royal Roads Military College. Surface soil, vegetation and water samples, were collected, from various locations on the island to investigate possible contamination. Chemical contamination at Bear Island was reported to be minimal and mostly confined to localized areas. Physical debris, however, is ubiquitous and abundant.

An environmental site delineation and material inventory was completed over two days in 2001 by Earth Tech Canada, using the ESG report as a template for gathering and compiling more specific information on Bear Island. Soils contaminated with arsenic, cadmium, copper, chromium, lead, selenium and zinc were identified in a number of areas at the Main Doppler Detection Building Site 412, Barrel Cache Area, Beach Area and Northern Doppler Detection Building Site 413. Earth Tech reported an estimated 354 m^3 of soil contaminated with metals, which exceeds the CCME Environmental Soil Quality Guidelines for residential/parkland use. The volume of hydrocarbon-contamination on site, according to the Canada Wide Standards for Petroleum Hydrocarbons in Soil, is approximately 85 m^3 located around the landfill site northeast of the main site. Although PCBs were detected in a stained area at the eastern edge of the garage foundation at Site 412 and at a low area at the base of the dumpsite during the 1995 ESG assessment, the 2001 delineation analysis results reported all PCB levels were below the laboratory's detection limit. Volumes for the reported contaminated soils were calculated based on depth to the black shale bedrock as permafrost is not an issue at this site.

Debris is scattered throughout the island, although there was a neatly stacked pile at the beach. A dump is located in a small area 150 m north of Site 412 where a concentrated pile of debris is found and the toe of this dump is in a small pond which is connected to a large lake. There are approximately 4,000 barrels at the site. The Barrel Cache area has approximately 3,000 barrels stockpiled on the ground surface in an area halfway between Site 412 and the Beaching area. There is approximately 1,000 m^3 of non-hazardous debris that can be landfilled on site. An estimated 35 m^3 of hazardous materials such as batteries, various liquid products in barrels, asbestos board and lead sheathing were also identified and inventoried. Only one landfill was identified during the 1995 and 2001 assessments, located near the stack of barrels halfway between Site 412 and the beaching area. No detectable concentrations of PCBs or inorganic elements were detected in the landfill area besides the reported hydrocarbon soil contamination.

INAC augmented the work carried out in previous years with a detailed site investigation in the summer of 2007. At the same time, a geotechnical investigation was completed to identify suitable borrow source material and potential locations for non hazardous landfills. An archaeological assessment was also completed to identify areas of potential cultural or historical significance.

Based on the results of these investigations, as well as information gathered during the public consultation process, INAC has finalized the Bear Island Mid-Canada Line Radar Station Remedial Action Plan (RAP) in accordance with the *Abandoned Military Sites Remediation Protocol* and proposes initiating this work in the summer of 2009.

2. PROJECT ACTIVITIES & SCHEDULE

Site investigation and site characterization phases were completed in the summer of 2007. A Remedial Action Plan (RAP) for the proposed activities was prepared and is included in this submission package. Project work is to be started in the summer 2009 with the mobilization of equipment to the site via sealift/barge. A detailed project schedule is also included in this submission (see Appendix G).

All existing site infrastructure will be demolished and the material will be segregated into hazardous and non hazardous waste streams. Hazardous wastes will be packaged and transported south for disposal. Non hazardous building debris and other non hazardous wastes identified at the site will be put into the on-site non hazardous landfill that will be constructed as part of the clean up activities.

Waste consolidation activities will be primarily focused on the removal of contaminated soils and surface debris. There are also small amounts of POL fluids, lead paint/cables, batteries, and asbestos to remediate. The soils are contaminated with hydrocarbons and some metals.

Barrels can be found throughout the site; these will be handled and disposed of in accordance with the INAC *DEW Line Barrel Protocol*. The barrels assessed during the site investigation were empty but it is anticipated that some containing product may be found. Subsurface soil conditions below the barrels will be determined following their removal. All barrels will be consolidated, crushed and buried at the site.

INAC formally adopted the *Abandoned Military Sites Remediation Protocol* for use at all INAC controlled military sites in the north in March of 2005. This document identifies how INAC will handle most aspects of the site clean up including cleanup criteria, landfill establishment and closure, hazardous materials and wastes handling and disposal, barrel protocol, building demolition and disposal, borrow source development and final site reclamation. Site Specific Risk Assessments (SSRAs) will be used to augment CCME and other previously identified criteria where criteria are not available for the contaminant(s) of concern, based on site-specific issues.

A temporary camp and associated sewage treatment lagoons will be constructed. This facility will allow for a maximum of 50 personnel to reside on site for the duration of the construction season, which is anticipated to take up to 90 days during the 2009 and 2010 field seasons. Following the proposed site remediation work the temporary camp will be demobilized.

Personnel will normally be mobilized to site by air using the on-site airstrip. At completion of the project in 2010, the site surface will be restored based on the detailed remediation work plan that is also included in this submission.

3. SOCIAL IMPACT OF THE PROJECT

Wherever possible, the project has adopted solutions tailored to the northern environment and its inhabitants by using local knowledge and including the unique needs of northerners and their environments in the remediation work plan.

Consultations were completed during the Phase III Environmental Site Assessment and are presented in the final report (see Appendix E). In addition, community consultations with the Hamlet Council, Hunters and Trappers Organization and community residents were completed in February 2008 in Chisasibi, Quebec. The results of the assessment and the various remediation options being considered for the site were presented. These meetings were used to solicit input as to the community's preferred remedial option. Please see attached public consultation records appended to the Bear Island Mid-Canada Line Radar Station Remedial Action Plan (Appendix B) for additional details. The community presentations were used to complete the following objectives:

- To share information on the project with the community;
- To hear site-specific concerns from local people who are familiar with current conditions at the site or were familiar with on-site activities during facility operation;
- To identify the issues and concerns the communities had with the site and the proposed work;
- To identify resources (labour and equipment) in the community that would be able to assist in the execution of the project; and
- To develop a better remediation plan.

APPENDIX 4:

BEAR ISLAND
EXECUTIVE SUMMARY (INUKTITUT)

ᐊᐅᓚᑦᑎᔾᓄᐊᒐᒃᓴᐃᑦ ᓇᐃᓈᖅᑕᐅᓯᒪᔪᑦ

1. ᐱᓕᕆᐊᑦ ᖃᓄᖅ ᐱᕙᓪᓕᐊᓕᓚᐅᖅᓯᒪᙱᓚᑦ ᓇᓃᒻᒪᙱᓚᓗ

ᑲᓇᑕᐅᑉ ᒐᕙᒪᒃᑯᖏᑦ ᐱᒋᐊᖅᑎᑦᑎᓯᒪᓕᕐᒪᑕ ᑲᓇᑕᒥ ᓱᕈᖅᑕᐅᓯᒪᔪᓂᒃ ᓄᓇᓂᒃ ᓴᓗᒻᒪᖅᓴᐃᔾᔪᑎᒃᓴᓂᒃ (ᖃᓘᑎᑐᑦ ᓇᐃᓈᖅᓯᒪᔪᑦ FCSAP-ᒥᒃ), ᓴᓗᒻᒪᖅᓴᖅᑕᐅᓂᐊᕐᒪᑕ ᑲᓇᑕᒥ ᐱᕋᑎᕆᔭᐅᔪᑦ ᓄᓇᐃᑦ ᓱᕈᖅᑕᐅᓯᒪᔪᑦ ᐊᒻᒪᓗ ᑐᑭᓯᑦᑎᐊᕈᒪᓪᓗᒋᑦ ᐊᕙᑎᖏᓐᓂᒃ ᐅᓗᕆᐊᓇᖅᑐᕐᑲᕐᓂᖏᑦ ᐊᑐᓂ ᓄᓇᓂ. ᑖᒃᑯᐊ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᐊᑐᖅᑕᐅᓲᑦ ᑆᓇᐅᔭᕐᑲᖅᑎᑦᑎᓲᑦ ᐋᕿᒋᐊᖅᑕᐅᑦᑎᐊᕐᓂᖏᓐᓄᑦ ᓱᕈᖅᓯᒪᔪᐃᑦ ᓄᓇᐃᑦ ᐅᓗᕆᐊᓇᖅᓯᓯᒪᓪᓗᑎᒃ located on Bear Island ᐃᓄᐃᑦ ᖃᓄᐃᓐᓂᖏᓐᓄᑦ ᐊᒻᒪᓗ/ᐅᕝᕙᓗᓐᓂᑦ ᐊᕙᑎᒧᑦ. ᐃᓄᓕᕆᔾᔪᕐᑲᒃᑯᑦ (INAC-ᑯᑦ) ᐆᒃᑐᖅᓯᒪᔪᑦ, ᑐᓂᔭᐅᓯᒪᓪᓗᑎᒡᓗ ᑆᓇᐅᔭᓂᒃ ᑖᒃᑯᓇᖓᑦ ᑆᓇᐅᔭᖅᑖᕐᕿᐅᕙᒃᑐᓂᒃ ᖃᐅᔾᓴᖅᑕᐅᔾᔪᑎᒃᓴᖏᓐᓄᑦ ᐊᒻᒪᓗ ᓴᓗᒻᒪᖅᑕᐅᓂᖏᓐᓄᑦ ᕿᒪᒃᑕᐅᓂᑯᐃᑦ ᑲᓇᑕᒥ ᐃᓂᕕᓂᕆᔭᐅᔪᑦ ᐅᖓᓯᒃᑐᒥᒃ ᖃᖓᑕᔪᓂᒃ ᖃᐅᔾᔭᕐᕕᕕᓐᓂᑦ (ᐃᓂᖏᑦ ᓇᓴᐅᑎᓖᒃ 412 ᐊᒻᒪᓗ 413). (54°20' ᐅᐊᖕᓇᕐᒥ, 81°05'ᐱᖓᖕᓇᕐᒥ) . ᕿᑎᐊᓃᑦᑐᖅ ᐃᒪᖓᑕ ᔾᐃᒥᓯ ᐲᑉ, ᓄᓇᕗᒻᒥ. Bear Island ᕿᑭᖅᑕᖓ ᐅᖓᓯᖕᓂᖅᑲᖅᑐᖅ 160 ᑭᓖᒥᑦᑐᓂᒃ, ᐅᐊᖕᓇᖓᑕ ᐱᖓᖕᓇᖅᐸᓯᐊᓂ ᓲᓴᐱᒥᒃ (Chisasibi) ᑯᐸᐃᖕᒥᒃ ᐊᒻᒪᓗ 300 ᑭᓖᒥᑕᐃᑦ ᓂᒋᐊᓂ ᑭᓖᒥᑕᓂᒃ ᐅᖓᓯᖕᓂᒃ ᓴᓂᑭᓪᓗᐊᕐᒥᒃ. ᓄᓇᕗᒻᒥ ᑕᑯᕚᑦ ᓄᓇᖑᐊᕐᓂᒃ ᑎᑎᕋᐅᔭᖅᑕᐅᓯᒪᔪᓪᓗ ᐃᓚᒋᔭᐅᔪᑦ ᑖᒃᑯᓇᓂ ᑐᓂᕈᑕᐅᔪᓂ. (ᑕᑯᓗᒋᑦ ᑎᑎᕐᑲᐃᑦ ᐃᓚᒃᑲᓂᖕᒋᑦ B, C ᐊᒻᒪᓗ E).

ᑕᑭᓂᖅᑲᖅᑐᖅ 5 ᑭᓖᒥᑕᓂᒃ, ᐅᐊᖕᓇᕐᒥᒃ ᓂᒋᐊᕐᒧᑦ, ᐊᒻᒪᓗ 1.5 ᑭᓖᒥᑕᓂᒃ ᓂᕈᑐᓂᖅᑲᖅᓱᓂ. ᐊᑦᑎᖕᓂᐅᔪᖅ ᕿᕐᓂᖅᑕᒥᒃ ᐅᔭᕋᓪᓛᓂᖅᑲᖅᑐᖅ, ᑕᓯᖅᑲᐅᖅᓱᓂ, ᑕᓯᕋᓚᓪᓗ, ᓯᕐᒥᕕᓂᕐᓄᑦ ᓯᑐᕕᐅᖅᑲᑦᑕᕐᓂᑰᓪᓗᑎᒃ. ᐱᕈᖅᕕᐅᕙᒃᑐᖅ ᒥᑭᔪᓂᒃ ᓇᐹᖅᑐᒃᓴᔭᐅᔭᖅᑐᓂᒃ, ᐃᕕᖕᓂᒃ, ᒪᓂᕐᓂᒃ, ᑎᖓᐅᔭᓂᒡᓗ. ᑎᖕᒥᐊᖅᑲᐅᖅᑐᑦ ᑕᕆᐅᕐᒥᐅᑕᓂᒃ ᐊᒻᒪᓗ ᓇᓄᖅᑲᑦᑕᖅᓯᒪᔪᖅ ᑕᕆᒐᓂᐊᖅᑲᕐᓂᖓᓗ ᖃᐅᔾᔭᐅᓚᐅᖅᑐᖅ 1995-ᒥ ᖃᐅᔾᓴᖅᑕᐅᒐᒥ. ᐆᒪᔪᐃᑦ ᑕᐅᑐᕙᓂᓲᑦ ᕿᕐᓂᖅᑐᐃᑦ ᓇᓄᐃᑦ ᐊᒻᒪᓗ ᓇᓄᐃᑦ, ᐊᒪᕈᐃᑦ, ᐊᐅᐸᓗᒃᑐᑦ ᑎᕆᒐᓂᐊᑦ, ᐅᖃᓖᑦ, ᑐᓗᒐᐃᑦ, ᑭᒡᒐᕖᑦ, ᓯᒡᔭᕆᐊᕐᔪᐃᑦ, ᑕᕆᐅᕐᒥᐅᑕᐃᑦ ᑎᖕᒥᐊᑦ, ᒥᑏᑦ, ᑐᑦᑕᓖᕐᔪᐃᑦ, ᓇᑦᑏᑦ, ᐊᐃᕖᑦ ᕿᓇᓗᒐᐃᑦᑐ.

ᒪᕿᐑᒃ ᖃᖓᑕᔪᓂᒃ ᖃᐅᔨᐅᓴᕿᕖᒃ ᐊᐅᓚᑕᐅᓚᐅᖅᓯᒪᔪᑦ Bear Island-ᒥ 1950-ᖏᓐᓂᒃ 1965-ᒧᑦ ᐃᓚᒋᔭᐅᓪᓗᑎᒃ ᑲᓇᑕᒥ ᖃᐅᔾᓵᓕᔾᔪᑕᐅᕙᓚᐅᖅᑐᓂᒃ ᐅᓇᑕᖅᑐᒃᓴᓄᑦ ᖃᐅᔾᓴᕿᕕᐅᓪᓗᑎᒃ. ᕿᒪᒃᑕᐅᑐᐃᓐᓇᕐᓂᑰᕗᑦ 1965-ᒥ ᓴᓗᒻᒪᖅᓴᑕᐅᓇᓱᐊᖅᓯᒪᖏᑦᑎᐊᖅᓱᑎᒃ, ᑭᓯᐊᓂ ᑕᒪᕐᒥᒃᓴᐃᑦ ᐃᒡᓗᕐᔪᐊᑦ ᐲᔭᖅᑕᐅᓯᒪᒐᓗᐊᖅᓱᑎᒃ ᑐᖓᕕᖏᓐᓂᒃ. ᐊᕙᑎᓕᕆᓪᓗᓂ ᐃᓱᒪᕝᑖᐅᔪᑦ Bear Island-ᒥ ᐃᓚᖅᑐᑦ ᐊᑦᓯᕕᕕᓂᕐᓂᒃ ᐊᒻᒪᓗ ᐃᒡᓗᕐᔪᐊᖅᕿᕕᕕᓂᕐᓂᒡᓗ, ᐊᒻᒪᓗ ᕿᒪᒃᑕᐅᓯᒪᑐᐃᓐᓇᖅᑐᓂᒃ ᐅᓗᕆᐊᓇᖅᑐᓕᖕᓂᒃ ᐱᕐᑯᑎᕕᓂᕐᓂᒃ (ᑐᕐᑯᓇᖅᑐᓖᑦ

ᐆᑕᕐᓇᖅᑐᓂᒃ ᐹᑐᓖᕕᓃᑦ, ᐅᖅᓱᐊᓗᓕᕕᓃᑦ, ᓄᖑᔪᐃᑦᑐᖅᑕᓖᑦ, ᖃᑦᑕᐅᔭᕕᓃᑦ ᐊᒻᒪᓗ ᓴᕕᕋᔭᕕᓃᑦ).

ᐃᓂᖓᓂ 413-ᒥ, ᑲᑕᒃᓯᒪᔪᕐᑲᓚᐅᖅᑐᖅ ᓇᐸᔪᕕᓂᕐᒥᒃ ᓈᓚᐅᑎᕐᑲᕐᕕᕕᓂᕐᒥᒃ ᐊᒻᒪᓗ ᐃᒡᓗᕐᔪᐊᑉ ᑐᖓᕕᕕᓂᖓ ᓇᑎᕕᓂᖓᓗ ᐊᒥᐊᒃᑯᑐᐊᖑᓪᓗᑎᒃ. ᐅᖅᓱᐊᓗᕕᓃᑦ, ᐅᖅᓯᖅᑎᕈᐱᑦ ᐊᒻᒪᓗ ᒥᖑᐊᓖᑦ ᐅᖅᓱᒥᒃ ᖃᑦᑕᐅᔭᕐᔪᐊᑦ ᐲᔭᖅᑕᐅᓯᒪᔫᖓᓗᐊᑦ ᑭᓯᐊᓂ ᓱᓕ ᓱᓪᓗᓕᕕᓂᖏᑦ ᐱᑕᕐᑲᖅᐳᑦ. ᐃᒡᓗᕐᔪᐊᕕᓃᑦ ᑯᕕᔪᓂᒃ ᕐᑯᕐᕕᕐᑲᖅᓯᒪᔪᕕᓂᐅᔮᖅᑐᑦ, ᐃᑎᕈᐃᓪᓗ ᑯᕕᕐᑲᑦᑕᕐᓂᖅᓱᑎᒃ ᐃᑎᔪᒧᑦ ᖃᑦᑕᐅᔭᕐᔪᐊᕐᒧᑦ, ᐃᒡᓗᕐᔪᐊᑦ ᐊᑕᓃᑦᑐᓂ. ᐃᓚᖓᓂᒃ ᑕᑖᖅᑐᒥᒃ ᐊᑦᓯᕕᕐᑲᓚᐅᖅᑐᑦ (ᐊᒃᑕᕐᕕᖕᒥᒃ) ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᖄᖓᓃᑦᑐᖅ ᐊᑦᑕᒧ ᑕᐅᕙᓃᓚᐅᖅᑐᖅ, ᐅᐊᖕᓇᖓᑕ ᑲᓇᖕᓇᖅᐸᓯᐊᓂ ᐃᓂᕆᕕᓂᕐᒥ 412-ᒥ. ᐊᒻᒪᓗ, ᓱᓪᓗᓕᕐᑲᓚᐅᖅᑐᖅ 3,300 ᒦᑕᓂᒃ ᑕᑭᓂᓕᖕᒥᒃ ᑕᐅᕘᓇᓕᒫᖅ ᐃᒡᓗᕐᔪᐊᕐᑲᕐᕕᕆᓚᐅᖅᑕᓕᒫᖓᓂ, ᐊᒻᒪᓗ ᐊᒃᑕᑯᐃᑦ ᓇᓂᑐᐃᓈᑦᑎᐊᖅᑐᑦ ᕿᑭᖅᑕᒥ. ᒥᑦᑕᕐᕕᕕᓂᕐᑲᖅᑐᑦ 1,500 ᒦᑕᓂᒃ ᑕᑭᓂᓕᒃ ᐱᖓᖕᓇᖅᐸᓯᐊᓂ ᕿᑭᖅᑕᐅᑉ, ᐊᑯᓐᓂᖏᓐᓂ ᒪᕐᕉᒃ ᖃᐅᔨᓴᕐᕕᕕᓂᖅ; ᐊᕐᑯᑎᖏᑦ ᐊᑯᓐᓂᖏᓐᓃᑦᑐᐃᑦ ᖃᐅᔨᓴᕐᕕᕕᓃᑦ ᐊᑕᔪᑦ ᒥᑦᑕᕐᕕᖑᕐᒧᑦ. ᓄᓈᓇᐊᖅᑐᕐᕕᕐᑲᖅᑐᖅ ᑐᓚᒃᑕᕐᕕᖕᒥᒃ ᑕᐅᕙᓂ ᑲᓇᖕᓇᖓᓂ ᕿᑭᖅᑕᐅᑉ, ᑲᖏᖅᖢᐊᓛᕐᒥ, ᐅᖓᓯᖕᓂᕐᑲᖅᑐᖅ 1 ᑭᓛᒥᑕᒥᒃ ᐅᐊᖕᓇᖓᓂ ᐃᓂᕆᔭᐅᔪᕕᓂᐅᑉ 412, ᐊᒻᒪᓗ ᑎᑭᑕᐅᔪᓐᓇᖅᓱᓂ ᐃᓂᕕᓂᖓ ᐊᖅᑯᑎᒃᑯᑦ. ᓄᓈᕐᕕᒃ ᐃᓱᒪᓇᖅᑐᖅ ᐱᕐᑯᑏᑦ ᑎᑭᓴᖅᑕᐅᓯᒪᔪᑦ ᓂᐅᔭᐅᕙᓚᐅᖅᑐᑦ ᑕᐅᕙᓂ, ᐱᕐᑯᑏᑦ ᑕᐅᕙᓃᓪᒪᑎ ᓱᕐᓗᐊᑦ ᐊᒻᒪᓗ ᐅᖅᑯᐊᖅ ᑕᐅᕙᓂ ᓂᕆᐊᓂ. ᒥᑭᑦᑐᓪᒪᕆᐅᓕᖅᑐᖅ ᐅᖅᓱᐊᓗᕐᑲᐅᑎᕐᑲᕐᕕᕕᓃᑦ ᐊᒥᐊᒃᑯᑦ ᓱᓪᓗᓕᕕᓂᐅᖓᓗᐊᑦ ᑭᓯᐊᓂᐅᓕᖅᑐᑦ.

ᓯᕗᓪᓕᖅᐹᖅᓯᐅᑏᑦ ᐊᕙᑎᒥᒃ ᖃᐅᔨᓴᖅᑕᐅᓂᖓ Bear Island ᕿᑭᖅᑕᖓ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᓯᒪᔪᖅ 1995-ᒥ ᐊᕙᑎᓕᕆᔨᒃᑯᑦ ᖃᐅᔨᓴᖅᑎᖏᑦᑕ ᑎᒥᕐᑯᑎᖏᓐᓄᑦ, Royal Roads Military College-ᑯᑦ ᐃᓕᓐᓂᐊᕐᕕᖓᓄᑦ. ᖃᖓᓂᑦᑐᑦ ᓄᓇᐃᑦ, ᐱᕐᑯᖅᑐᑦ, ᐃᒪᐃᓪᓗ ᐲᖅᓯᕙᐅᓚᐅᖅᑐᑦ ᓇᑭᑐᐃᓐᓇᖅ ᕿᑭᖅᑕᖓᓂᒃ, ᖃᐅᔨᓴᖅᑕᐅᓪᓗᑎᒃ ᓱᕈᕐᓇᖅᑐᕐᑲᑐᐃᓐᓇᕆᐊᕐᑲᕐᒪᖔᑕ. ᓱᕈᕐᓇᖅᑐᓂᒃ ᓱᕈᖅᑕᐅᓯᒪᓚᐅᖅᑐᖅ Bear Island ᕿᑭᖅᑕᖓ ᐊᖏᔫᖏᑦᑐᒥᒃ ᐊᒻᒪᓗ ᐃᓂᕕᓃᓐᓇᖕᓇᖏᓐᓂᓯᑎᒃ. ᐊᒃᑕᑯᓪᓚᓇᑦ ᐱᕐᑯᑎᕕᓃᑦ, ᑭᓯᐊᓂ ᐊᒥᓲᒪᓇᐊᓗᐃᑦ ᐊᒻᒪᓗ ᑕᑯᒃᓴᐅᑦᑎᐊᖅᓱᑎᒃ.

ᐊᕙᑎᐊᓃᑦᑐᑦ ᐊᖏᓂᖏᑦ ᐊᒻᒪᓗ ᓱᓇᕐᑲᕐᓂᖏᑦ ᐱᔭᕇᖅᑕᐅᓚᐅᖅᑐᑦ ᒪᕐᕉᖕᓂᒃ ᐅᓪᓘᖕᓂᒃ 2001-ᖑᑎᓪᓗᒍ, Earth Canada Tech-ᑯᓐᓄᑦ ᐊᑐᖅᓱᑎᒃ ESG-ᑯᑦ ᐅᓂᒃᖄᓕᐅᕈᑎᖏᓐᓂᒃ ᐃᔾᔪᐊᖅᓯᓂᔾᔪᒃ ᑲᑎᖅᓱᐃᓂᕐᒧᑦ ᐊᒻᒪᓗ ᐃᓕᐅᕐᑲᐃᓂᕐᒧᑦ ᖃᐅᔨᔭᐅᔪᒪᓯᒪᔪᓂᒃ ᑕᐃᑲᓂ Bear Island ᕿᑭᖅᑕᖓᓂ. ᓄᓇᐃᑦ ᓱᕈᖅᑕᐅᓯᒪᔪᑦ ᑐᕐᑯᓇᖅᑐᒧᑦ, ᐹᑐᓖᒃᓴᔭᕐᓄᑦ, ᓱᓪᓗᓕᐅᕈᑎᒃᓴᓄᑦ, ᑐᕐᑯᓇᖅᑐᓕᖕᓂᒃ ᓴᕕᕋᔭᒃᓴᓂᒃ, ᓄᖑᔪᐃᑦᑐᓕᖕᓂᒃ ᐊᒻᒪᓗ ᓴᕕᕋᔭᓪᓚᑦᑖᕐᓂᒃ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᑐᑦ ᑕᐅᑲᓂ ᐃᕐᑲᓇᐃᔭᕕᕕᓂᕐᒥ ᓈᓴᐅᑎᓕᖕᒥ 412-ᒥ, ᖃᑦᑕᐅᔭᕐᔪᐊᕐᑲᕐᕕᕕᓂᕐᒥᒃ ᓄᓇᒥ, ᓂᐅᕋᐃᕕᖕᒥ ᓯᒡᔭᒥ, ᐊᒻᒪᓗ ᐃᒡᓗᕐᔪᐊᕐᑲᕐᕕᖕᒥ ᓇᓴᐅᑎᓕᖕᒥ 4123-ᒥ.Earth Tech-ᑯᑦ

ᐅᓂᒃᑳᓚᐅᖅᑐᑦ ᖃᓂᒋᔾᖏᓃᓐᓂᖏᓐᓂᒃ m^3 ᓄᓇᐃᑦ ᓱᕈᖅᑕᐅᓯᒪᓂᖏᓐᓂᒃ ᓴᕕᕋᔾᖕᓂᒃ, ᐅᖓᑕᐅᔾᔮᓯᒪᓪᓗᑎᒃ ᑲᓇᑕᓕᒫᒥ ᐊᕙᑎᓕᕆᔾᕚᐊᒃᑯᑦ ᓄᓇᒥᒃ ᐱᐅᓹᔭᕆᐊᕐᑲᕐᓂᖏᓐᓄᑦ ᓇᓗᓇᐃᒃᑯᑕᕆᔭᐅᔪᓂ ᐊᖏᕐᕋᕐᑲᕐᕕᐅᕙᒃᑐᓂ/ᒥᖑᐃᖅᓯᕐᕕᕐᑲᖅᑐᓂᓗ. ᐊᖏᓂᖏᑦ ᐅᖅᓱᐊᓗᒃᓴᔭᕐᕕᓂᕐᓂᒃ ᓱᕈᖅᑕᐅᓯᒪᔪᑦ, ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᑲᓇᑕᓕᒫᒥ ᐊᔾᔮᒋᔭᐅᔪᑦ ᒪᓕᒃᑕᐅᓲᑦ ᐅᖅᓱᐊᓗᕐᑲᕐᓂᖏᓐᓂᒃ ᓄᓇᐃᑦ, ᖃᓂᒋᔾᖏᑦᓃᑦᑐᑦ 85 m^3 ᓄᓇᐃᑦ ᐊᕙᓗᐊᓂ ᐊᒃᑕᕐᕖᑦ ᐅᐊᖕᓇᖓᓂ ᑲᓇᖕᓇᖅᐸᓯᐊᓃᑦᑐᓂ ᐃᒡᓗᕐᔪᐊᕐᑲᐅᓂᖅᓴᕕᓂᐅᔪᓂ. ᖃᐅᔨᔭᐅᒐᓗᐊᖅᓱᑎᒃ PCB-ᓃᒃ ᓱᕈᕐᓇᖅᑐᕐᑲᕐᑎᓪᓗᒋᑦ ᑯᕕᕕᐅᓯᒪᔪᓂ ᑲᓇᖕᓇᖅᐸᓯᐊᓂ ᐊᒃᑕᑯᐃᑦ ᑐᖓᕕᖓᓂ ᐃᓂᖓᓂ ᓈᓴᐅᑎᓕᐅᑉ 412, ᐊᑦᑎᖕᓂᕐᒦᑦᑐᑦ ᐊᒃᑕᕐᕕᖕᒥ 1995-ᒥ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᓂ, 2001-ᒥ ᐊᖏᓂᖏᓐᓂᒃ ᖃᐅᔨᓴᖅᑕᐅᒐᒥᒃ ᖃᐅᔨᔭᐅᓂᕋᖅᑕᐅᓯᒪᓚᐅᖅᑐᑦ ᑕᒪᕐᒥᒃ PCB-ᓂᒃ ᓱᕈᕐᓇᖅᑐᓖᑦ ᐊᑖᓃᑦᓚᐅᖅᑐᑦ ᖃᐅᔨᓴᕐᕕᐅᑉ ᖃᐅᔨᔪᓐᓇᕐᓂᖏᓐᓂᒃ. ᐊᖏᓂᖏᑦ ᓱᕈᖅᑕᐅᓯᒪᓂᕋᖅᑕᐅᔪᓂ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᑦ ᐆᒃᑐᕋᖅᑕᐅᓪᓗᑎᒃ ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᐃᑎᓂᖏᑦ ᐅᔭᕋᖕᓄᑦ ᑎᑭᐅᒪᔪᑦ ᓄᓇᐅᑉ ᐊᑖᓂ, ᐱᔾᔪᑕᐅᓪᓗᑎᒃ ᓄᓇᐅᑉ ᖁᐊᖑᓂᖓ ᐊᑖᓂ ᒫᓐᓇᐅᔪᖅ ᐃᓱᒪᓘᑕᐅᖏᓪᒪᑦ ᑕᐅᕙᓂ ᐃᓂᕕᓂᐅᔪᓂ.

ᓇᓂᑐᐃᓐᓇᑦᑎᐊᖅ ᐱᖁᑎᕕᓂᖃᖅᑐᖅ ᐃᒋᑕᐅᓯᒪᔪᓂᒃ ᕿᑭᖅᑕᓕᒫᒥ, ᖁᓕᕇᓕᖅᑎᖅᑕᐅᓯᒪᔪᖃᑦᑎᐊᕋᓗᐊᖅᓱᓂ ᓯᓪᕙᒥ. ᐊᒃᑕᕐᕕᖃᖅᑐᑦ ᒥᑭᔪᑯᓗᖕᒥᒃ 150 ᒦᑕᓂᒃ ᐅᖓᓯᖕᓂᒃ ᐅᐊᖕᓇᖓᓂ ᐃᓂᕕᓂᐊᓂ ᓈᓴᐅᑎᓕᐅᑉ 412, ᐊᒃᑯᖃᕐᓂᖅᐹᖑᓪᓗᓂ, ᐊᒻᒪᓗ ᐃᓱᐊᓃᑦᑐᖃᖅᓱᓂ ᐊᒃᑕᑯᐃᑦ ᒥᑭᔪᒥᒃ ᑕᓯᐊᕐᔪᖕᒥᒃ, ᐊᑕᓪᓗᓂ ᐊᖏᓂᖅᓴᒍᑦ ᑕᓯᕐᒍᑦ. 4,000-ᖑᓃᑦᑐᑦ ᖃᑦᑕᐅᔭᕕᓂᐊᓗᐃᑦ ᑕᐅᕙᓃᑦᑐᑦ. ᖃᑦᑕᐅᔭᕐᑲᕐᕕᕕᓂᖅ ᖃᑦᑕᐅᔭᕐᑲᕐᒥᔪᖅᒪ 3,000-ᓂᒃ ᖁᓕᕇᓕᖅᑎᖅᓯᒪᓪᓗᑎᒃ ᓄᓇᐅ ᖄᖓᓂ ᐊᑯᓐᓂᖏᓐᓂᒃ ᐃᒡᓗᕐᔪᐊᑉ 412 ᐊᒻᒪᓗ ᓯᒃᔭᒥ ᓂᐅᕋᐃᕕᕕᓂᕐᒥ. There is approximately 1,000 ᖃᓂᒋᔾᖏᓐᓂᒃ 1,000-ᖑᔪᑦ m^3 ᐊᔾᔮᒌᖏᑦᑑᑎᓂᒃ ᐊᒃᑯᐃᑦ ᐃᓗᓕᓖᑦ ᖃᑦᑕᐅᔭᕐᕕᓂᕐᓃᑦᑐᑦ, ᓴᓂᕋᒃᓴᕕᓂᕐᓂᒃ ᓄᖑᔪᐃᑦᑐᓕᖕᓂᒃ ᑐᕐᑯᓇᖅᑐᓕ ᐊᒻᒪᓗ ᓴᕕᕋᔭᓕᖕᓂᒃ ᕿᔪᖕᓂᒃ ᖃᐅᔨᔭᐅᔪᕐᑲᓚᐅᕐᒥᔪᖅ ᓈᓴᖅᑕᐅᓪᓗᑎᒡᓗ. ᐊᑕᐅᓲᓐᓇᑯᓗᒃ ᐊᒃᑯᕐᑲᕐᕕᒃ ᓇᓗᓇᐃᖅᑕᐅᓚᐅᖅᓯᒪᔪᖅ 1995-ᒥ ᐊᒻᒪᓗ 2001-ᒥ ᖃᐅᔨᓴᖅᑕᐅᔪᓂ, ᓴᓂᐊᓃᑦᑐᑦ ᖁᕆᓖᖅᓯᒪᔪᐃᑦ ᖃᑦᑕᐅᔭᕐᔪᐊᑦ ᐊᑯᓐᓂᖏᓐᓂᒃ 412 ᐊᒻᒪᓗ ᓂᐅᕋᐃᕕᖕᒥ ᓯᒃᔭᒥ. PCB-ᒥᒃ ᓄᖑᔪᐃᑦᑐᖅᑕᓕᖕᓂᒃ ᓇᓂᓯᔪᕐᑲᓚᐅᖏᑦᑐᖅ ᐅᕙᓗᓐᓃ ᓄᖑᑦᑐᓐᓇᖏᑦᑐᓂᒃ ᑕᐃᑲᓂ ᐊᒃᑕᕐᕕᖕᒥ, ᓴᓂᐊᓂ ᐅᖅᓱᓗᓕᕕᕐᓂᒃ ᓱᕈᖅᑕᐅᓯᒪᔪᓂᒃ.

ᐃᓄᓕᕆᔨᑐᕐᑲᒃᑯᑦ ᐱᓕᕆᐊᒃᑲᓐᓂᓕᓚᐅᖅᑐᑦ ᓯᕗᓂᐊᓂ ᒪᕐᐹᖕᓂ ᐊᕐᕋᔫᖕᓂᒃ ᐱᓕᕆᐊᕆᓚᐅᖅᑕᖏᓐᓂᒃ ᓇᓗᓇᐃᔭᖅᓯᒪᑦᑎᐊᓕᖅᓱᑎᒃ ᖃᐅᔨᓴᖅᑕᐅᒃᑲᓐᓂᕐᒪᑕ 2007-ᒥ. ᑕᐃᔅᓱᒪᓂᑦᓴᐃᓐᓇᖅ, ᓄᓇᖏᑦ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᔪᒪᓪᓗᑎᒃ ᓯᐅᕋᖅᑕᖅᕕᐅᔪᓐᓇᕋᔭᖅᑐᑦ ᐊᒻᒪᓗ ᐃᓂᒃᓴᓂᒃᑕᐅᔪᓐᓇᕋᔭᖅᑐᑦ ᓄᖑᔪᐃᑦᑐᓕᖕᓂᒃ ᐊᒃᑕᑯᓄᑦ. ᓄᓇᐃᑦ ᐱᖁᑎᕕᓂᖃᕐᒪᖖᑕ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᕐᒥᔪᑦ ᓇᓗᓇᐃᖅᑕᐅᓂᐊᕐᒪᑕ

ᐃᓕᖅᑯᓯᑐᖃᕐᓄᑦ ᐊᓐᓂᕐᓇᖅᑐᖃᖏᒻᒪᖔᑕ ᐅᕙᓗᓐᓃᑦ ᑕᐃᔅᓯᒪᓂᓂᑕᕐᓂᒃ ᐱᒻᒪᕆᐅᓇᔭᖅᑐᓂᒃ.

ᑐᖓᕕᐅᓪᓗᑎᒃ ᑐᑭᓯᔭᐅᓯᒪᓕᖅᑐᑦ ᑕᐃᒃᑯᓇᖓ ᖃᐅᔨᓴᖅᑕᐅᓚᐅᖅᑐᓄᑦ, ᐊᒻᒪᓗ ᑲᑎᖅᓱᖅᑕᐅᓯᒪᓂᖏᓐᓄᑦ ᐃᓄᐃᑦ ᑐᑭᓯᓂᐊᕐᕕᐅᓚᐅᖅᑐᓂᒃ, ᐃᓄᓕᕆᔨᑐᖃᒃᑯᑦ ᐱᔭᕇᖅᓯᓚᐅᖅᑐᑦ Bear Island-ᒥ ᕿᑭᖅᑕᓂᒃ ᓈᓚᐅᑎᖃᕐᕕᕕᓂᖏᓐᓂᒃ ᐅᓇᑕᖅᑐᒃᓴᕕᓃᑦ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᔾᔪᑎᒃᓴᖏᓐᓄᑦ ᐸᕐᓇᐅᑎᓂᒃ ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᕿᒪᒃᑕᐅᓯᒪᔪᕕᓃᑦ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ ᐃᓂᕕᓂᖏᓐᓂᒃ ᓴᓗᒻᒪᖅᓴᐃᓂᕐᒧᑦ ᐊᖏᕈᑏᑦ ᐊᒻᒪᓗ ᐱᕆᐊᖅᑎᑦᑎᔪᒪᓕᖅᑐᑦ ᐱᓕᕆᐊᒃᓴᐅᓂᐊᖅᑐᓂᒃ ᐊᕐᕋᒎᓂᐊᖅᑐᒥ 2009-ᒥ.

2. ᓴᓇᔭᐅᔪᒃᓴᐃᑦ ᐱᓕᕆᐊᒃᓴᖏᑦ ᐊᒻᒪᓗ ᖃᖓᒃᑰᖓᓂᐊᕐᓂᖏᑦ

ᓄᓇᐃᑦ ᖃᐅᔨᓴᖅᑕᐅᒐᒥᒃ ᐊᒻᒪᓗ ᖃᓄᐃᑦᑑᖕᒪᖔᑕ ᓄᓇᐃᑦ ᐱᔭᕇᖅᑕᐅᓚᐅᖅᑐᑦ ᐊᐅᔭᒃᑯᑦ 2007-ᒥ. ᐋᖅᑭᒋᐊᖅᑕᐅᔾᔪᑎᒃᓴᖏᓐᓄᑦ ᐸᕐᓇᐅᑎᑦ ᐱᓕᕆᐊᖑᕆᐊᕈᒪᔪᓄᑦ ᓴᓇᔭᐅᓚᐅᖅᑐᑦ ᐃᓚᒋᔭᐅᖅᑕᐅᓪᓗᑎᒡᓗ ᑖᒃᑯᓇᓂ ᑐᓂᕐᕈᑎᒃᓴᓕᐊᖑᔪᓯᒪᔪᓂ. ᐱᓕᕆᐊᒃᓴᐃᑦ ᓴᓇᔭᐅᕆᐊᕋᔭᖅᑐᑦ ᐊᐅᔭᒃᑯᑦ 2009-ᒥ ᐱᕐᑯᑏᑦ ᑎᑭᑎᑕᐅᕆᐊᓂᐊᖅᓯᑎᒃ ᐅᒥᐊᕐᔪᐊᒃᑯᑦ. ᓇᓗᓇᐃᖅᑕᐅᓯᒪᑦᑎᐊᖅᑐᑦ ᓴᓇᔭᒃᓴᐃᑦ ᖃᖓᒃᑰᖓᓂᖏᑦ ᐃᓚᒋᔭᐅᒋᕗᑦ ᑖᒃᑯᓄᖓ ᑎᑎᖅᑲᓄᒃ ᑐᓂᔭᒃᓴᓄᑦ (ᑕᑯᓗᒋᑦ ᑎᑎᖅᑲᐃᑦ ᐃᓚᒃᑲᓐᓂᖏᑦ G-ᒦᑦᑐᑦ).

ᑕᒪᕐᒥᒃ ᓄᓇᒦᑦᑐᑦ ᐃᒡᓗᕐᕝᐊᕕᓃᑦ ᐱᕐᑯᑎᕕᓃᓐᓗ ᓱᕋᖅᑎᖅᑕᐅᓂᐊᖅᑐᑦ ᐱᕐᑯᑏᓐᓗ ᐊᕝᕙᖅᑐᖅᑕᐅᓗᑎᒃ ᐅᓗᕆᐊᓇᖅᑐᓄᑦ ᐅᓗᕆᐊᓇᖏᑦᑐᓄᓪᓗ ᐊᒃᑕᑯᖅᑕᐅᓂᐊᖅᑐᓄᑦ. ᐅᓗᕆᐊᓇᖅᑐᓖᑦ ᐳᖅᑲᖅᑕᐅᑦᑎᐊᕐᓂᐊᖅᑐᑦ ᐊᐅᓪᓚᖅᑎᑕᐅᓗᑎᒡᓗ ᖃᓪᓗᓈᑦ ᓄᓇᖓᓄᑦ ᐃᒋᑕᐅᑦᑎᐊᓂᐊᕐᒪᑕ. ᐅᓗᕆᐊᓇᖅᑐᒐᓛᖅᑐᑦ ᐃᓗᐃᓪᓗ ᐱᕐᑯᑏᑦ ᓱᕋᖅᑎᑕᐅᓂᐊᖅᑐᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᔪᓂ ᓄᓇᒥ ᐃᓗᐊᖅᑲᓇᖅᑐᓂ ᑕᐅᕙᓂ ᓄᓇᒥ ᐅᓗᕆᐊᓇᖅᑐᒐᓛᖅᑐᑦ ᐊᒃᑕᕐᕕᒃᓴᖅ, ᓴᓇᔭᐅᓯᒪᓂᐊᕐᒥᒪᑦ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᔪᓂ ᐱᓕᕆᐊᖑᖅᑕᐅᓗᑎᒃ.

ᐊᒃᑕᑯᐃᑦ ᑲᑎᖅᓱᖅᑕᐅᓂᖏᑦ ᐱᓕᕆᐊᖑᓗᐊᕐᓂᐊᖅᑐᑦ ᐄᔭᖅᑕᐅᓗᑎᒃ ᓱᕈᖅᑕᐅᓯᒪᔪᑦ ᓄᓇᐃᑦ ᐊᒻᒪᓗ ᓄᓇᐅᑉ ᖄᖓᓂᑦᑐᑦ ᐊᒃᑕᑯᐃᑦ. ᐅᖅᓱᐊᓗᕕᓂᖅᑲᖅᑐᕐᒥᒪᑦ, ᒥᖑᐊᕕᓂᖅᓯᖅᑎᓪᓗ (ᐊᒥᐊᕕᓂᕐᓂᒃ), ᐹᑐᓚᕕᓂᕐᓂᒃ, ᓄᖑᔪᐃᑦᑐᓕᖕᓂ ᐃᓗᐹᕈᑎᓂᒃ, ᐋᖅᑭᒃᑕᐅᑦᑎᐊᓂᐊᖅᓯᐊᕐᒥᔪ. ᓄᓇᐃᑦ ᓱᕈᖅᓯᒪᔪᖃᖅᑐᑦ ᐅᖅᓱᐊᓗᕕᓂᖅᓯᑎᒃ ᐊᒻᒪᓗ ᐃᓚᖏᓐᓂᒃ ᓴᕕᕋᔭᖕᓂᒃ.

ᖃᑦᑕᐅᔭᕐᔪᐊᑦ ᓇᓂᔭᐅᔪᓐᓇᖅᑐᑦ ᓇᓂᑐᐃᓐᓇᖅ ᐃᓂᕕᓂᖓᓂ; ᑖᒃᑯᐊ ᐊᐅᓚᑕᐅᓂᐊᖅᑐᑦ ᐃᒋᐅᖅᑲᖅᑕᐅᓪᓗᑎᒃ ᒪᓕᒃᑕᐅᓪᓗᑎᒃ ᐃᓄᓕᕆᔨᑐᖃᒃᑯᑦ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ ᐃᓂᕕᓂᖏᓐᓂᒃ ᖃᑦᑕᐅᔭᕐᔪᐊᓕᕆᓂᕐᒧᑦ ᐊᖏᕈᑎᓂᒃ. ᖃᑦᑕᐅᔭᕐᔪᐊᕕᓃᑦ ᖃᐅᔨᓴᖅᑕᐅᔪᑦ ᐃᓗᓕᖅᑲᖅᑕᐅᓚᐅᖅᑐᓄᑦ ᑭᓯᐊᓂ ᓂᕈᐊᖅᑕᐅᔪᑦ ᐃᓕᖅᑲᖅᑐᑦ

Canada

ᐃᓗᓕᖅᑲᑐᐃᓐᓇᓇᐊᖅᑲᖅᓂᖏᓐᓂᒃ. ᓄᓇᐃᑦ ᐃᓗᐊ ᐊᑖᓂᑦᑐᑦ ᖃᑦᑕᐅᔭᖅᔪᐊᑦ ᑐᑭᓯᔭᐅᓯᒪᓂᐊᖅᑐᑦ ᖃᓄᐃᑦᑑᓂᖏᑦ ᐲᔭᖅᑕᐅᓚᐅᖅᑐᑎᒃ ᖃᑦᑕᐅᔭᖅᔪᐊᑦ. ᑕᒪᖅᒥᒃ ᖃᑦᑕᐅᔭᕝᕚᑦ ᑲᑎᖅᓱᖅᑕᐅᓂᐊᖅᑐᑦ, ᓯᖃᓕᖅᑎᑕᐅᔪᑎᒡᔪ ᐊᒻᒪᓗ ᓴᐳᔭᐅᔪᑎᒃ ᑕᐃᑲᓂ ᐃᓂᒃᓴᖕᒐᓂ.

ᐃᓄᓕᓇᔾᑐᖅᑲᒃᑯᑦ ᐊᖏᕈᑎᖃᓕᖅᑐᑦ ᕿᒪᒃᑕᐅᑐᐃᓇᖅᓯᒪᔪᓂᒃ ᐅᓇᑕᖅᑐᒃᓴᐃᑦ ᐃᓂᕙᓂᖏᓐᓄᑦ ᐋᖅᑭᒋᐊᕈᑏᑦ ᐊᖏᕈᑎᖏᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᑐᑦ ᑕᒪᐃᓐᓂ ᐃᓄᓕᓇᔾᑐᖅᑲᒃᑯᓐᓄᑦ ᐊᐅᓚᑕᐅᔪᓂ ᐅᓇᑕᖅᑐᒃᓴᓄᑦ ᐃᓂᕙᓂᓇᔭᐅᔪᓂ ᐅᑭᐅᖅᑕᖅᑐᒥ ᒫᔾᔨ 2005-ᒥᒃ ᐱᒋᐊᓚᐅᖅᑐᓂᒃ. ᑕᐃᒃᑯᐊ ᑎᑎᖅᑲᖏᑦ ᓇᓗᓇᐃᖅᓯᓯᒪᔪᑦ ᖃᓄᖅ ᐃᓄᓕᓇᔾᑐᖅᑲᒃᑯᑦ ᐊᐅᓚᑦᑎᖃᑦᑕᖅᓂᐊᖅᒪᖔᑦ ᑕᒪᐃᓐᓂᒃ ᐃᓂᕙᓂᖅᓂᒃ ᓴᓗᒻᒪᖅᓴᖅᑕᐅᔪᓂᒃ ᓲᖅᓗ ᓴᓗᒻᒪᖅᓴᐃᔭᓇᐊᖅᑲᖅᓂᖅᒧᑦ ᒪᓕᒍᖅᓂᒃ, ᐊᒃᑕᖅᕚᑦ ᓴᓇᔭᐅᖅᑲᑦᑕᖅᓂᖏᓐᓂ ᐊᒻᒪᓗ ᒪᑐᔭᐅᖅᑲᑦᑕᖅᓂᖏᓐᓂ ᐅᓗᓇᐊᓇᖅᑐᓕᖕᓂᒃ ᐃᓚᓖᑦ, ᐊᒻᒪᓗ ᐊᐅᓚᑕᐅᓂᖏᓐᓂᒃ ᐃᒋᐅᖅᑲᖅᑕᐅᖅᑲᑦᑕᖅᓂᖏᓐᓂᓗ, ᖃᑦᑕᐅᔭᖅᔪᐊᓕᓇᓂᖅᒧᑦ ᐊᖏᕈᑎᓂᒃ, ᐃᒡᓗᖅᔪᐊᖅᓂᒃ ᑲᑕᒍᐃᑎᑦᑎᓂᖅᒧᑦ, ᓴᐅᖅᕋᖅᑕᖅᕝᕕᒃᓴᓂᒃ ᐊᒻᒪᓗ ᑭᖑᓪᓕᖅᐹᖅᒥᒃ ᓴᓗᒻᒪᖅᓴᐃᓂᖅ ᐋᖅᑭᒃᓯᐃᑦᑎᐊᖅᓂᖅᓗ. ᓄᓇᐃᑦ ᓇᓗᓇᐃᖅᑕᐅᓯᒪᓂᖏᓐᓄᑦ ᐅᓗᓇᐊᓇᖅᑐᑦ ᖃᐅᔨᓴᕈᑏᑦ ᐊᑐᖅᑕᐅᖅᑲᑦᑕᖅᓂᐊᖅᑐᑦ ᐊᑐᖅᑕᐅᓂᐊᖅᒥᔪᑦ ᐊᓯᖏᓐᓄᑦ ᓴᓗᒻᒪᖅᓴᐃᔾᔪᑎᐅᕙᒃᑐᓄᑦ ᐊᒻᒪᓗ ᐊᓯᖏᑦ ᒪᓕᒐᐃᑦ, ᒪᓕᒐᖅᖁᑎᑕᐅᖏᑦᑐᓄᑦ ᓴᓗᒻᒪᖅᑕᐅᔭᓇᐊᖅᑲᖅᒥᔪᓄᑦ, ᐃᓯᒪᑑᑕᐅᔪᓂ ᒪᓕᒃᑕᐅᔪᑎᒃ ᓇᓪᓕᐊᖑᓂᖏᑦ ᓄᓇᐃᑦ ᐃᓯᒪᑑᑕᐅᔪᑦ.

ᓄᓇᓕᕋᑮᖅᑲᑲᐃᓇᖅᓂᐊᖅᑐᑦ ᐊᒻᒪᓗ ᐃᑎᕈᖅᓂᒃ ᐊᒃᑕᖅᕝᕕᖅᑲᖅᓂᐊᖅᑐᑦ ᓴᓇᔭᐅᓂᐊᖅᒪᑕ. ᑖᓐᓇ ᓄᓇᓕᕋᑮᒃᓴᖅ ᐃᓄᖅᑲᕈᓐᓇᖅᓂᐊᖅᑐᖅ 50 ᐃᖅᑲᓇᐃᔭᖅᑎᓂᒃ ᑕᐅᕗᓐᓂᐊᖅᒪᑕ ᓴᓇᔪᖅᑲᖅᓂᓕᒫᖏᓐᓂ, ᓂᕆᐅᕐᓇᖅᑐᖅ ᐱᓕᕆᓂᐊᖅᓂᖏᓐᓂᒃ 90-ᓂᒃ ᐅᑦᑐᓂᒃ 2009-ᒥ ᐊᒻᒪᓗ 2010-ᒥ ᓴᓐᓇᐅᔪᓐᓇᖅᓂᐊᖅᑐᓂ. ᓴᓗᒻᒪᖅᓴᖅᑕᐅᕚᓂᑦᑎᐊᖅᐸᑦ ᐲᔭᖅᑕᐅᓇᔭᖅᑐᖅ ᓄᓇᓕᕋᑮᖅᑲᖅᕝᕙᖓ ᓄᒃᑎᖅᑐᑎᒡᔪ ᑕᐃᑲᓐᖓᑦ.

ᐃᖅᑲᓇᐃᔭᖅᑎᒃᓴᐃᑦ ᑎᑭᑎᑕᐅᓯᐊᓂᐊᖅᑐᑦ ᓄᓇᒧᑦ ᑕᐅᕗᖓ ᖃᖓᑕᓲᒃᑯᑦ ᐊᑐᖅᑕᐅᓗᓂ ᑕᐃᑲᓃᕈᓂᒃᑐᖅ ᒥᑦᑕᕝᕕᒃ. ᓴᓇᔪᕈᓂᒃᐸᑦ 2010-ᒥ ᐃᓂᕆᔭᖓᑦ ᐋᖅᑭᒃᓱᖅᑕᐅᑦᑎᐊᖅᓂᐊᖅᑐᖅ ᒪᓕᒃᑕᐅᔪᑎᒃ ᐋᖅᑭᒃᓯᐃᑦᑎᐊᕈᑎᓄᑦ ᐸᖅᓇᐅᑏᑦ, ᑖᒃᑯᓇᓂ ᑎᑎᖅᑲᓃᖅᑲᑕᐅᔪᑦ ᑐᓂᖅᑯᑎᒃᓴᓂ.

3. ᐃᓅᓯᖅᒧᑦ ᐊᒃᑐᐊᓂᖅᑲᖅᓂᖏᑦ ᓴᓇᔭᐅᔪᑦ

ᖃᖓᑐᐃᓐᓇᖅ ᐊᔪᖅᓇᖏᓂᓕᒫᖓᓂ, ᓴᓇᔪᑦ ᐋᖅᕿᐅᒪᑦᑎᐊᕋᓯᐊᖅᓂᐊᖅᑐᑦ ᐅᑭᐅᖅᑕᖅᑑᑉ ᐊᕙᑎᖓᓄᑦ, ᐃᓄᖁᑎᖏᓐᓄᓪᓗ, ᐊᑐᖅᑕᐅᔪᑎᒃ ᐃᓄᐃᑦ ᖃᐅᔨᒪᔭᑐᖅᑲᖏᑦ ᐊᒻᒪᓗ ᐊᔾᔨᐅᖏᑦᑐᒥᒃ ᐱᔭᕆᐊᖅᑲᖅᓂᖏᑦ ᐅᑭᐅᖅᑕᖅᑐᒥᐅᑦ ᐊᕙᑎᖏᓪᓗ ᐋᖅᑭᒃᓱᖅᑕᐅᑦᑎᐊᓇᐊᓕᖅᑎᓪᓗᒋᑦ.

ᑐᑭᓯᓂᐊᕐᕕᐅᓯᒪᔪᑦ ᐱᔾᔪᑏᕐᑕᐅᒪᐅᕐᑐᑦ ᐱᖓᔪᕆᔾᐅᔪᓂ ᐊᕙᑎᓕᕆᓂᕐᒥᒃ ᖃᐅᔨᓴᕐᑕᐅᓂᖏᓐᓂ ᐊᒻᒪᓗ ᑐᓂᔾᐅᑦᓗᑎᒃ ᑭᖑᓪᓕᕐᐹᕐᓂ ᐅᓂᒃᑳᓕᐊᖑᓪᓗᑎᒃ (ᑕᑯᓗᒋᑦ ᑎᑎᕐᑲᐃᑦ ᐃᓚᒃᑲᓂᖏᑦ E). ᐊᒻᒪᓗ, ᓄᓇᓕᖕᓂ ᑐᑭᓯᓂᐊᕐᕕᐅᓚᐅᕐᑐᑦ Hᐊᒻᒪᓚᖁᑦ ᑲᑎᒪᔩᖏᑦ, ᐊᖑᓇᓱᒃᑏᑦ ᒥᑭᒋᐊᕐᓂᐊᕐᑏᓪᓗ ᑲᑐᔾᔩᕐᑲᑎᒋᖏᑦ ᐊᒻᒪᓗ ᓄᓇᓕᖕᒥᐅᑦ ᐱᔾᔪᑏᕐᑕᐅᓪᓗᑎᓪᓗ ᕕᕗᐊᕆ 2008-ᒥ, ᓰᓵᐱᒥ (Chisasibi) ᑯᐸᐃᖕᒥ. ᓴᕿᓚᐅᕐᑐᑦ ᖃᐅᔨᓴᕐᑕᐅᔪᓂᒃ ᐊᒻᒪᓗ ᐊᑐᕐᑕᐅᔪᓐᓇᕐᑐᓂ ᓇᓪᓕᕐᖄᕈᑎᒃ ᐊᔾᔨᒌᖏᑦᑑᑏᑦ ᓴᓗᒻᒪᕐᑕᓂᐅᖏᓐᓄᑦ ᐃᓱᒪᒃᓴᕐᓯᐅᕈᑕᐅᓚᐅᕐᑐᑦ ᓄᓇᒥ ᐊᑐᕐᑕᐅᓂᐊᕐᑐᑦ. ᑲᑎᒪᔪᓂ ᑐᓴᕐᕕᐅᔪᐊᓚᐅᕐᑐᑦ ᓄᓈᑦ ᐊᑐᕐᑕᐅᖖᕈᕐᑯᔾᔭᖏᑦ ᓴᓗᒻᒪᕐᓴᐃᓂᕐᔪᑦ. ᐊᑏ ᑕᑯᓂᐊᕐᐸᑎᑦ ᑖᒃᑯᓇᓃᕐᑲᑕᐅᔪᑦ ᐃᓄᓕᒫᑦ ᑐᑭᓯᓂᐊᕐᕕᐅᓯᒪᓂᖏᑦᑕ ᑎᑎᕐᑲᖏᑦ, ᐃᓚᔭᐅᓯᒪᔪᑦ Bear Island-ᒥ ᕿᑭᕐᑕᒥ ᑲᓴᑕᒥ ᖃᐅᔨᓴᕐᕕᕕᓃᑦ ᐋᕿᒋᐊᕐᑕᐅᓂᖏᓐᓄᑦ ᐸᕐᓇᐅᑎᓂ (ᑎᑎᕐᑲᐃᑦ ᐃᓚᒃᑲᓂᖏᑦ B) ᑐᑭᓯᓂᐊᒃᑲᓂᕈᒪᒍᕕᑦ. ᓄᓇᓕᖕᓂ ᐅᕐᑲᐅᓯᐅᓚᐅᕐᑐᑦ ᐊᑐᕐᑕᐅᓚᐅᕐᑐᑦ ᐱᔾᔪᑏᕐᑕᐅᓂᖏᓐᓄᑦ ᐅᑯᐊ ᐊᑖᓃᑦᑐᑦ ᑐᕋᖓᓇᔭᐅᔪᑦ:

- ᖃᐅᔨᒪᔭᐅᔪᓂᒃ ᑐᓂᓯᕐᑲᑦᑕᕐᓂᕐᒃ ᓴᓇᔭᐅᓂᐊᕐᑐᓂᒃ ᓄᓇᓕᖕᒥᐅᓄᑦ;
- ᑐᓴᕈᒪᓂᕐᒃ ᓄᓇᐃᑦ ᒥᒃᓵᓄᑦ ᐃᓱᒪᓘᑕᐅᔪᓂᒃ ᓄᓇᓕᖕᒥᐅᓄᑦ ᖃᐅᔨᒪᔪᓂᒃ ᖃᓄᐃᑦᑑᓂᖏᓐᓂᒃ ᑕᐃᑲᓂ ᓄᓇᒥ ᐅᕙᓗᓐᓃᑦ ᖃᐅᔨᒪᓚᐅᕐᑐᑦ ᓄᓇᖓᓂ ᑕᐅᕙᓂ ᐃᕐᑲᓇᐃᔩᓇᔭᐅᕙᓚᐅᕐᑐᓂᒃ ᑕᐃᔅᓱᒪᓂ ᓱᓕ ᐊᐅᓚᑕᐅᓂᖏᓐᓂ;
- ᓇᓗᓇᐃᕐᑕᐅᕐᑯᓪᓗᒋᑦ ᐃᓱᒪᓘᑕᐅᔪᑦ ᓄᓇᓕᖕᒥᐅᓄᑦ ᑕᐃᑲᓂ ᓄᓇᒥ ᐊᒻᒪᓗ ᐱᓕᕆᐊᖑᔪᒪᔪᓂᒃ;
- ᓇᓗᓇᐃᕐᑕᐅᕐᑯᓪᓗᒋᑦ ᐊᑐᖓᒃᓴᐃᑦ (ᓴᓇᐟᓯᑦ ᐱᕐᑯᑏᓪᓗ) ᓄᓇᓕᖕᓂ ᐃᑲᔪᕈᓐᓇᕐᑐᑦ ᐱᓕᕆᐊᖑᔪᒪᔪᓂᒃ; ᐊᒻᒪᓗ
- ᓴᕿᑦᑎᔪᒪᓂᕐᒃ ᐱᐅᓂᕐᒃᓴᓂᒃ ᐋᕿᓯᑦᑎᐊᕈᑎᒃᓴᓄᑦ ᐸᕐᓇᐅᑎᓂᒃ.

Canada

APPENDIX 5:

BEAR ISLAND
REMEDIAL ACTION PLAN

Bear Island Mid-Canada Line Radar Station

Remedial Action Plan Revised Sept. 2008

Bear Island, Nunavut

EARTH TECH | AECOM

Remedial Action Plan

Bear Island Mid-Canada Line Radar Station
Bear Island, Nunavut

Revised September 2008

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September 2008

Project No.: 101610-03

Remedial Action Plan

Bear Island Mid-Canada Line Radar Site,

Bear Island, Nunavut

Reviewed by:

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Executive Summary

As the caretaker of federal lands in Canada's north, Indian and Northern Affairs Canada (INAC) is responsible for the care and management of sites that are no longer maintained by the original owner/operator. These sites are often contaminated as a result of mining, oil and gas activities, as well as from government military activities, which took place before environmental impacts were understood. Through the Contaminated Sites Program (CSP), INAC has made it a priority to assess, prioritize and mitigate/remediate the environmental impacts of contaminated sites in Canada's North. As a result, INAC is required to develop a Remedial Action Plan (RAP) for the former Bear Island Mid-Canada Line Radar Station, located at Bear Island, Nunavut.

In support of the Remedial Action Plan, Earth Tech AECOM (Earth Tech), on behalf of Public Works and Government Services Canada (PWGSC) and INAC, has prepared this report which identifies remediation options, critiques potential remediation methods, and provides recommendations for site restoration, as well as a cost estimate to undertake the remedial work.

This RAP for the former Bear Island Mid-Canada Line Radar Station was designed in accordance with the INAC Abandoned Military Site Remediation Protocol (April 2008). This Protocol is designed to address legal requirements, health and safety issues, INAC's Contaminated Sites Management Policy requirements and standard environmental issues. The Protocol identifies financially prudent methodologies that address all the requirements listed above while maintaining a cost effective remediation project.

The table below provides a summary of the environmental issues identified at Bear Island and the proposed remedial action for each.

Environmental Concern	Site Assessment Findings	Recommended Remediation Method
DCC Tier I Contaminated Soils	12.0 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and PCBs which exceed the DCC Tier I criteria were identified onsite.	Dispose of soils that exceed DCC Tier I soils (12.0 m^3) in an onsite landfill.
DCC Tier II Contaminated Soils	82.3 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and PCBs which exceed the DCC Tier I criteria were identified onsite. This volume includes 0.8 m^3 of material that is co-contaminated with Tier I metals and 3.5 m^3 of Tier I PCBs.	Excavate, containerize and label soils that exceed DCC Tier II criteria (82.3 m^3) and dispose offsite.
Petroleum Hydrocarbon Contaminated Soils	Approximately 109.8 m^3 of hydrocarbon impacted soil in exceedance of the INAC Abandoned Military Site Remediation Protocol for PHC Soils.	Excavate 77.9 m^3 contaminated soils and place into containers, and ship off site to a licensed disposal facility. Scarify 31.9 m^3 of PHC stained soil.
Surface Debris	Approximately 622.5 m^3 of non-hazardous debris consisting of heavy equipment, barrels, scrap metal, scrap wood, concrete, electrical equipment and plumbing parts, and any remaining buildings.	Consolidate and dispose in a non hazardous landfill constructed onsite.

Environmental Concern	Site Assessment Findings	Recommended Remediation Method
Existing Landfills	Landfill North of Site 413 is considered a Class A landfill and was found to contain hazardous materials. Also, the surrounding soils are being impacted from contaminants located within the landfill. North Landfill is considered to be a Class C landfill and there is no evidence that the surrounding soils are being impacted.	Consolidate and dispose waste debris (14.7 m^3) accordingly. Remediate PHC contaminated soils as described above. Consolidate surface debris, as well as the partially buried debris located on the exposed southwest toe of the landfill, (approx 41.7 m^3 total) and dispose accordingly.
POL Fluids	There are approximately 1.05 m^3 (1,050 L) of Petroleum, Oil and Lubricant fluids.	Incinerate POL fluids that meet incineration criteria (<2 ppm PCBs and Cd and <10 ppm Cr and <100 ppm lead and <1000 ppm Chlorine), otherwise treat as Hazardous Waste.
Water in barrels	With the exception of five barrels, all barrels inspected were found to be empty or rusted through. This fact does not ensure that all barrels on site are empty or contain just rusty water as all (approximately 4300 barrels) were not inspected.	During clean-up, all barrels must be approached using the DLCU barrel protocol.
Lead Painted Products	Approximately 27.0 m^3 of lead amended paint materials were discovered on site	Dismantle lead painted items and ship off site to an appropriate disposal facility.
Hazardous Materials	Approximately 18.0 m^3 of hazardous materials were identified at the site. These materials consisted of lead acid batteries (3 m^3), asbestos containing materials (12.5 m^3), and lead cable and zinc conduit (2.5 m^3).	Asbestos waste to be collected, bagged and disposed of in an on-site landfill. All hazardous materials (such as batteries and hazardous cable/conduit) will be containerized, labeled and shipped to be disposed at a licensed southern facility.
Compressed Gas Cylinders	Approximately 8 compressed gas cylinders were identified onsite.	Vent and dispose of cylinders according to the INAC AMSRP in the non-hazardous landfill.

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LIST OF APPENDICES

1.0 INTRODUCTION

Bear Island, Nunavut is home to two former Mid-Canada Line Radar Stations, which include the main station Site 412 (situated near the south end of the island) and Site 413 (situated near the north end of the island). The island is located toward the central northern end of James Bay and approximately 160 km northwest of Chisasibi, Quebec (**Figure 1.0, Appendix A**). The sites were in operation from the mid-1950s to 1965, after which the site was vacated and left abandoned.

Indian and Northern Affairs Canada (INAC), as the caretaker of federal lands in Canada's north is responsible for the care and management of contaminated sites that are no longer maintained by the original owner/operator. Consequently, in approximately 1965 the site, including all structures, equipment, debris and environmental disturbances, became the responsibility of INAC.

There are four main areas at Bear Island, which include the South Doppler Area (Site 412), North Doppler Area (Site 413), the Beach Area, and the Airstrip Area. Facilities at Site 412 consisted of a Doppler detection building, emergency shelter and garage, as well as a radar tower. Also, located slightly north of Site 412 are the landfill and barrel cache areas. Similar to Site 412, Site 413 consisted of a Doppler detection building and radar tower. After the site was abandoned, facilities at both Site 412 and Site 413 were demolished to their foundations. While the facilities were in operation, the Beach Area was believed to be the area used as the staging area to unload supplies for the operations on the island. Currently there is a large amount of debris stockpiled at the Beach Area, thought to be brought here from Sites 412 and 413 with the intention of removing it from the island.

In 1996, the Environmental Sciences Group (ESG) of the Royal Roads Military College (RRMC) was requested by INAC to conduct a scientific investigation and determine cleanup requirements using the DND DEW Line Cleanup Protocol. The investigation was concentrated on soil, water and plant media to investigate the presence of chemical contamination resulting from previous site activities and the potential for negative impacts on the environment. It was concluded that chemical contamination at Bear Island was minimal and mostly confined to localized areas. On the other hand, physical debris was said to be "ubiquitous and abundant" and "collecting it all will be the main challenge of cleaning up the site". Areas of concern were identified and qualified, however estimates for volume of impacted material was not obtained. In addition, the scope of work of the ESG investigation did not include the assessment of hydrocarbon contamination. The cleanup recommendations included placing non-hazardous debris and DCC Tier I PCBs or Lead contaminated soil in properly designed landfills on site; shipping DCC Tier II contaminated soil to an off-site to an industrial landfill; and crushing and burying the empty barrels with the non-hazardous debris or recycling off-site.

In 2001, Earth Tech conducted an investigation program aimed to delineate soil contamination, inventory materials remaining on the site, locate potential landfill and borrow sites, and generate a topographic survey of the site. Based on the findings, it was estimated that 354 m^3 of soil was contaminated with heavy metals (including all facilities at Site 412, barrel cache area, beach areas, and Site 413) and 86 m^3 of hydrocarbon contaminated soil (at the landfill area). It was also estimated that 1,000 m^3 of non-hazardous material and 35 m^3 of hazardous material exists on site. Also, potential locations for non-hazardous landfills on Bear Island were identified.

Based on information gained from the 1996 and 2001 investigations, and through the Contaminated Sites Program (CSP), INAC has made it a priority to assess, prioritize and mitigate/remediate the environmental impacts of contaminated Sites in Canada's North. Bear Island was classified as a high priority site, which required an additional assessment to accurately quantify the volumes of contaminated soil, as well as identification and assessment of hazardous and non-hazardous materials remaining on site. Earth Tech completed the site investigation activities in late July/early August 2007, which provided the necessary information to complete this Remedial Action Plan (RAP). This RAP was prepared to provide a conceptual remediation design and preliminary specifications for cleanup of the Bear Island Mid-Canada Line Radar Station.

2.0 OBJECTIVES

The main purpose of this Remedial Action Plan was to identify remediation options, critique potential remediation methods, and provide recommendations for site restoration. Based on assessment activities completed by Earth Tech in July/August 2007, a comprehensive site remediation work plan was developed. Remediation options were developed for each waste stream identified at the site, and were critically evaluated to discuss potential risks, advantages, and disadvantages of each remediation option. Based on a number of factors, outlined below, recommendations were made as to the preferred remediation approach. Also, community meetings with PWGSC and INAC in Chisasibi were conducted in February 2008 to incorporate community contribution in selecting the remedial option for each waste stream.

The RAP was designed to meet the following cleanup objectives in accordance with the Indian and Northern Affairs Canada Abandoned Military Site remediation Protocol (April 2008):

1. Restore the site to an environmentally safe condition;
2. Prevent the migration of contaminants into the Arctic ecosystem;
3. Remove physical hazards for the protection of human health and safety; and
4. Implement a cost effective remediation solution.

3.0 SITE DESCRIPTION

As previously shown in **Figure 1.0**, the former Bear Island Mid-Canada Line Radar Station (Sites 412 and 413) is located in the north central portion of James Bay, Nunavut, at 54°20' N, 81°05' W. The communities nearest to Bear Island are Chisasibi, Quebec, which is approximately 160 km southeast, and Sanikiluaq, Nunavut, which is located approximately 300 km north of Bear Island.

The Mid-Canada Line Radar Station was constructed in the mid-1950s and operated until approximately 1965 at which point it was abandoned. In 1965, responsibility for the site was assumed by INAC. The site consists of two Doppler Stations (Sites 412 and 413), a Beach Area and an Airstrip Area, as shown in **Figure 2.0**. Facilities located in each of the main areas are also illustrated in **Figure 2.0**.

The South Doppler Area – Site 412 is located on a hill approximately 17 m above and approximately 300 m west of James Bay. The facilities in the area included; a Doppler detection building, emergency shelter, garage, sewage outfall, one large and two small radar antenna towers, a network of utility poles, as well as numerous waste debris piles. The majority of the facilities at Site 412 have been demolished to their foundations. The concrete garage foundation, wooden timber Doppler detection building foundation and the concrete bunker near the emergency shelter are all that remain in place. Also located in this general vicinity are an existing landfill (approximately 200 m north), and the barrel cache and disturbed area (approximately 400 m north and northwest). It appears that the building construction materials from this area were placed in sorted piles, partially buried or stockpiled at the Beach Area.

The Beach Area is located in a small bay on the east side of Bear Island, approximately 1 km north of the South Doppler Station – Site 412. This area was likely used as the barge staging area when the site was in operation. There is a large amount of stockpiled construction materials and debris in this area (heavy equipment, wooden huts, barrels, etc.), thought to be brought to the beach with the intention of removing it from the island.

Site 413 was the northern, smaller radar facility on Bear Island. Facilities in this area consisted of a control building, an antenna and a set of POL tanks. Like the South Doppler Area, the building has been demolished to its wood frame foundation and the building materials are piled around the area. Also, the antenna was down and the POL tanks were removed.

The airstrip, located on the west side of the island, has a north-south orientation and is approximately 1500 m in length. There is one main debris area at the airstrip, which is located on the east side near the south end of the airstrip. In this area there was a wooden hut, wooden frames of three other huts, as well as domestic debris such as glass bottles, pots and pans, and a few empty barrels. There was also one partially full barrel found lying on its side, which was leaking and causing a small surface stain.

Potential granular borrow source areas were identified at the south end of the island (1.2 km south of Site 412), 0.5 km south of Site 412 and 0.2 km southeast of Site 413, and contain all necessary granular fill types, except Type 4 which is required for the construction of low permeability containment berms.

4.0 BIOPHYSICAL ENVIRONMENT

4.1 Physiographic Description

Bear Island is approximately 1.5 km wide and 5 km long and is located at the northern end of James Bay, approximately 80 km from the nearest shore (Ontario). Bear Island is a low lying black basalt outcrop, covered with small lakes and ponds. Where the surface is not exposed bedrock or covered by water, the surficial materials consists of coarse gravel up to approximately 1.5 m thick. It is understood that Bear Island is located is an area of sporadic discontinuous permafrost (NRC, 1995).

4.2 Climate

The closest weather stations with climate data are the airports at La Grande Riviere, Quebec and Kuujjuarapik, Quebec, which are 240 km east-southeast and 250 km northeast of Bear Island, respectively. Both locations have similar climate normals; however, of the two locations Kuujjuarapik is considered to be in an environment most similar to Bear Island. The daily mean temperatures in the area varies from approximately -23.4ºC in January to approximately 11.4ºC in August, and the average annual temperature is approximately -4.4ºC. The average annual precipitation is approximately 415 mm of rainfall and 241 cm of snow.

4.3 Flora and Fauna

Bear Island is located in the Hudson Bay Lowland ecological region, one of the Earth's largest wetland landscapes. The vast majority of vegetation communities are rich in lichens and mosses, which make up fen wetland types. Because of exposure to wind and wave action, the vegetation communities are all low-lying vegetation and are mostly constrained to the interior areas of the Island around the glacial lakes and ponds. Flora observed on the island includes various species of lichens, willows, berry bushes, grasses, mosses and wildflowers.

General observations regarding wildlife inhabiting Bear Island during the 2007 field program was noted by Earth Tech. Fauna observed in the area includes Polar Bears, arctic foxes, Canada geese, snowy owls (no direct observation, only an abandoned nest), red-throated loons and arctic terns. On July 28, 2007 during preliminary visits to Bear Island to mobilize equipment and supplies to the site in preparation for field activities, approximately nine polar bears were observed on and in the vicinity of Bear Island. The community of polar bears consisted of approximately three mothers with one or more young cubs, and approximately three solo males. Upon returning to the site the following day, there were two sets of mothers with one or more young cub(s), as well as one lone male polar bear. The single male remained in the area for only a short period of time, before leaving the island off the southwest shore; whereas the two sets of mother with cub(s) remained on the island for the duration of the field program. The resident mothers with cubs remained in well sheltered locations on the extreme north portion of the island, which is several hundred metres from the nearest radar site infrastructure. Consequently, interaction and sitings were limited when arriving and departing the island in the airplane. That being said, logistical and work challenges for the future remediation program may prove difficult if bears are present in the work area.

In addition to polar bears, arctic terns and Canadian geese were also found to be nesting on Bear Island during the 2007 field program. A significant arctic tern nesting area was noted on the sandy expanse at the south tip of Bear Island. The terns became highly agitated when field personnel entered this area, and eggs were noted in the sandy soils. Therefore, restricted access to this breeding and nesting area is recommended. The Canadian geese were found to be more widespread than the arctic terns on Bear Island. It should be noted that the young goslings were flightless during the period when the field team was on site. Future remediation activities should consider and respect all wildlife residing on Bear Island.

5.0 INAC SITE REMEDIATION PROTOCOL

5.1 General

Numerous factors affect the suitability of site remediation plans, and must be considered when determining a site specific remediation plan. For this reason, INAC has created the Abandoned Military Site Remediation Protocol (AMSRP, April 2008) to provide a consistent approach for designing RAPs for abandoned military sites. This protocol is designed to address all legal requirements, health and safety issues, INAC's Contaminated Sites Management Policy requirements and standard environmental issues. The protocol identifies financially prudent methodologies that address all the requirements listed above while maintaining a cost effective remediation project. This Remedial Action Plan for the former Bear Island Mid-Canada Line Radar Station was designed in accordance to the INAC Protocol.

The following sections provide an outline of typical environmental issues and their remedial action procedures addressed by the Protocol. These technical aspects are described in greater detail in the INAC Abandoned Military Site Remediation Protocol (**Appendix B**). The following considerations (as outlined in the INAC Protocol) need to be considered in the development and implementation of the remedial action plan for the Bear Island site:

- Respect all historical agreements and obligations in a fair and reasonable manner;
- Ensure consistency with federal guidelines for the management of contaminated sites;
- Apply the Canadian Council of Ministers of the Environment (CCME) environmental protection and management approaches (CCME 1996, 1997, 1999, 2001);
- Apply simple, practical remedial solutions wherever possible, with flexibility as necessary to adjust to site-specific conditions when they are identified;
- Establish cost effective solutions through the use of best practices to ensure appropriate levels of environmental protection for all sites;
- Recognize the concerns of global warming in an Arctic setting; and
- Ensure the long-term effectiveness of the environmental remedial measures.

5.2 Landfills

5.2.1 Landfill Closure

Landfills on INAC abandoned military sites are classified as Class A, Class B or Class C. A Class A landfill is a landfill located in an unstable, high erosion location. These landfills require relocation. If during the relocation process, hazardous materials are noted, the hazardous materials are segregated and disposed of off site. A Class B landfill is a landfill located in a suitable, stable location but there is contaminated leachate being released from the landfill. These landfills require the contaminated leachate to be contained within an engineered containment system. If this is not feasible, the landfill must be relocated to an engineered landfill or the waste must be disposed of off site. Lastly, a Class C landfill is a landfill located in a suitable and stable location with no contaminated leachate being released. These landfills can be left in place and additional granular material can be placed to prevent erosion and promote proper drainage if required.

5.2.2 Landfill Development

The design of landfills at abandoned military sites must give consideration to the type of waste that is to be stored in the landfill, proximity to drainage courses and distance to borrow sources required for landfill construction. Only non hazardous materials and/or non regulated contaminated soils are to be stored in newly constructed on site landfills. All hazardous waste is to be disposed of off site.

Capping of the landfills must include a minimum 0.6 m granular cover, promote run-off, prevent infiltration and minimize erosion. Visual inspection monitoring must be conducted to confirm the integrity of the landfill.

5.3 Physical Debris

Debris throughout the site must be collected and segregated into hazardous and non hazardous waste streams. To reduce volumes, non hazardous material shall be crushed, shredded and/or incinerated prior to placement in the on site landfill. Hazardous materials shall be disposed of off site in accordance applicable guidelines and regulations.

5.4 Contaminated Soils

Soil conditions at Bear Island were assessed using the INAC Abandoned Military Site Remediation Protocol (revised April 2008) as the governing criteria. Heavy metal and PCB concentrations in soils were compared to the DEW Line Cleanup Criteria, which was developed for the Department of National Defence. Petroleum hydrocarbons were evaluated using the process currently utilized on DND DEW Line sites, which was adopted by the INAC AMSRP (revised April 2008).

Heavy metal and PCB contaminated soils identified will be categorized as regulated, hazardous, or contaminated but not hazardous. Soils that are identified as being regulated will be remediated and/or disposed of following applicable regulations. Hazardous soils will be disposed of off-site. Contaminated but not hazardous soils must be remediated to meet DCC DEW Line Clean Up (DLCU) Criteria. Soils classified as contaminated, but not hazardous, are to be remediated based on one of three primary contaminated soil types. Firstly, metal contaminated soils must be disposed off site or encapsulated on site. Secondly, hydrocarbon contaminated soil will be assessed using the evaluation process outlined in the INAC AMSRP. Lastly, PCB contaminated soil must be either disposed off site or encapsulated on site. In cases where co-contamination of soils is present, the most conservative remedial option that addresses both contaminants must be applied.

5.5 Contaminated Water

Surface waters with heavy metal contamination (in exceedance of the CCME Freshwater Aquatic Life Criteria) were observed at Bear Island near the main barrel cache area. It should be noted that considering the shallow depth of the surface water it is unlikely that the pond is fish bearing. It is expected that removal of the source contamination (zinc contaminated soils at the barrel cache) would address the problem and therefore no remedial options for contaminated water are discussed in this remedial action plan.

5.6 Hazardous Materials

In general, all hazardous materials will be shipped off site to a licensed hazardous waste disposal facility. Exceptions include asbestos, which is to be double bagged and disposed in an engineered landfill onsite, in accordance to local regulations. Petroleum products, free of chlorine, PCBs, heavy metals, etc, are to be incinerated. Heavier petroleum products are to be mixed and burned on site, or shipped off site. Compressed gas cylinders, with known contents, are to be vented and subsequently placed in engineered landfills on site. Timbers found suspected to be treated with creosote are to be wrapped in polyethylene and disposed of in an on site landfill. It should be noted that wood samples from the Doppler building framework did not indicate elevated creosote parameters. Lead-based paint considered to be hazardous (leachable lead >5 mg/L) will be collected and transported offsite, whereas painted components not considered hazardous will be disposed in on site landfills. Also, a small volume of zinc coated conduit and lead cable is located on site, which are being classified as hazardous since soil data indicates that both materials have generated soils that are DCC Tier II, hazardous soil.

5.7 Barrels

Barrels located at the site will be addressed in accordance with the DEW Line Cleanup Barrel Protocol (**Appendix B**). With the exception of four barrels located slightly southwest Barrel Cache area, all barrels inspected were found to be empty or contained rusty water. In fact most barrels were rusted right through. In general, empty barrels will be crushed and disposed in on site landfills. This fact does not ensure that all barrels on site are empty or contain just rusty water as all (approximately 4300 barrels) were not inspected. During cleanup activities all barrels must be approached using the DLCU barrel protocol. The contents of filled barrels will inspected and tested, and either be incinerated on site or shipped off site for disposal. The now empty barrels will then be rinsed, crushed and disposed in on site landfills. Depending on the results, the contents will either be incinerated on site or shipped off site for disposal.

5.8 Buildings and Infrastructure

All existing buildings and infrastructure shall be demolished to their foundations. All hazardous material is to be removed prior to or during demolition activities. All removed hazardous material is to be disposed of in accordance with protocol outlined in Section 5.4. Under special circumstances, some buildings may be left place once clear ownership of the building has been outlined.

5.9 Borrow Sources

Borrow sources for granular material will be required for the construction of new landfills and for general site grading purposes. Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources. Upon completing remedial activities, all borrow areas will be recontoured to restore natural drainage and to match surrounding topography. Borrow sources at the south end of the island will be carefully managed to ensure that the arctic tern nesting habitat, as well as the archaeological site, are not impacted by remediation activities.

5.10 Site Grading

Disturbed areas on the site will be graded and shaped to blend in with the natural contours and to eliminate potential hazards for wildlife and humans accessing the site in the future. The disturbed areas include contaminated soils excavations, existing and new landfills, debris areas, disturbed areas resulting from demolition activities; borrow areas, and any areas disturbed as a result of remediation activities.

5.11 Contractor Support Activities

For the completion of remedial activities, a camp will be established on site and will be situated in a previously disturbed location to minimize the extent of new disturbances. Waste generated by the camp will be incinerated and disposed of in on site landfills. Sewage will be treated using an appropriately sized treatment system, and effluent quality will adhere to applicable licenses. Potable water located on site will be tested and used in accordance with the applicable water license. Contingencies for water supply will include filters, and a supply of bottled water. Fuel required to operate the camp and to complete remedial activities will be stored on site in accordance with applicable legislation and licenses.

6.0 COMMUNITY MEETINGS

A community meeting open to the public, was hosted by INAC in Chisasibi, Quebec on February 20, 2008. A copy of the meeting minutes is located in **Appendix C**. To date, no concerns were raised by any of the community members specifically with the proposed Remedial Action Plan for Bear Island. Other historical information was obtained during the community meeting. Several community members present at the meeting expressed a great concern for the radar site at Cape Jones, rather than the Bear Island site. Cape Jones is located in an area frequented by the Cree people for hunting and recreational purposes, whereas Bear Island is not frequently used because of its remote location. That being said, there were community members that visited Bear Island in approximately 1964, after the site was abandoned. Billy Martin Hunter and Billy Weetaltuk reportedly visited Bear Island with members of the Roman Catholic Church, to salvage building materials (metal, wood, etc) to be used in Fort George (former location of Chisasibi). The one time visit to Bear Island was accomplished using a Hudson Bay Barge and took approximately 11 hours (one way). While onsite they noted punctured fuel drums and fuel spills that were impacting the soil. Shore birds were also reportedly contaminated with oil. It was also noted that Eider ducks were breeding on the island, and that polar bears were present. Another community member, William Chiskamish reported that the landfill on the island was constructed by people from Chisasibi and that debris buried included new equipment.

7.0 EVALUATION OF REMEDIAL OPTIONS

7.1 Cleanup Objectives

The following remedial objectives are based on guidance provided from Northern Contaminated Sites, Public Works and Government Services Canada and the Indian and Northern Affairs Canada Abandoned Military Site Remediation Protocol, April 2008.

- Restore the site to an environmentally safe condition;
- Prevent the migration of contaminants into the Arctic ecosystem;
- Remove physical hazards for the protection of human health and safety; and
- Implement a cost effective remediation solution.

7.2 Site Issues

The following sections present a summary of the contaminant and waste disposal issues, as well as the potential remedial methods, for site issues identified from past site assessments. In the cases where more than one remedial method is identified, the options will be evaluated based on the remedial objectives and a recommendation for the favourable remedial method will be provided. Specific issues that need to be addressed at the Bear Island site include;

- Disposal of contaminated soils (PHCs, metals, PCBs),
- Collection and disposal of hazardous materials (POL liquids, asbestos containing materials, lead and zinc materials, batteries),
- Collection and disposal of products coated with lead amended paint,
- Proper disposal for the partially buried debris located near the former Garage, Landfill North of Site 412 and North Landfill Area, and
- Collection and disposal of non-hazardous surface debris piles and dumps (located at Site 412, Beach Area, Site 413, Airstrip Area, Barrel Cache, along roadways and scattered in other areas of the site).

7.3 Contaminated Soils

The following table presents a summary of the contaminated soils and remedial methods recommended to address the contaminated soils at the identified at the Bear Island Mid-Canada Radar Station.

Table 1: Summary of Contaminated Soils at Bear Island

Location	Contaminant Exceeding Criteria (Max ppm)	DCC I m^3	DCC II m^3	PHC Evaluation m^3	Comments
South Doppler Detection Building	**Metals**		1.0		
South Outfall	**Metals** **PCBs**		0.8		Impacted area is co-contaminated
Emergency Shelter	**Metals**		15.8		
Garage	**Metals** **PCBs** **PHC**		24.6	28.8	Impacted area is co-contaminated PHC stained soil requiring scarification to 0.3 m
Landfill North of Site 412	**PHCs**			5.3	PHC contaminated soil requiring excavation to 0.15 m
Main Barrel Cache	**Metals**		5.0		
Small Barrel Cache	**PHCs**			27.3	PHC contaminated soil requiring excavation to bedrock (approximately 0.5m)
POL Storage Area	**Metals** **PHCs**	5.2		40.5	PHC contaminated soil requiring excavation to bedrock (approximately 1.0 m)

Location	Contaminant Exceeding Criteria (Max ppm)	DCC I m^3	DCC II m^3	PHC Evaluation m^3	Comments
Beach Bulldozer	**Metals** **PHCs**		1.7	3.1	PHC stained soil requiring scarification to 0.3 m
Beach Electrical Hut	**Metals**		1.5		
Beach Building Panels	**Metals**		3.2		
Beach Barrel Cache	**Metals**	6.8			
North Doppler Area – ESG-244	**Metals**		4.6		
North Doppler Area – ESG-243	**Metals**		10.9		
Airstrip Area	**PHCs**			4.8	PHC contaminated soil requiring excavation to bedrock (approximately 0.5 m)
Electrical Cable	**Metals**		13.2		Additional sampling along the cable is recommended to confirm impacted areas
TOTAL ESTIMATED VOLUMES		**12.0**	**82.3**	**109.8**	

In accordance with the Indian and Northern Affairs Canada Abandoned Military Site Remediation Protocol, April 2008, the following remedial options are presented for consideration. Bear Island is an abandoned and remote site; therefore the remedial plan must be designed accordingly. Solutions that achieve remedial objectives and minimize site remediation costs will be deemed favourable.

Despite the fact that in-situ technologies reduce contaminant exposure to humans and the environment, in-situ remediation technologies were not researched in detail. In situ remedial technologies are care and maintenance intensive and have not generally proven to be pragmatic technologies for remote, northern site remediation. For this reason in situ technologies were not explored in great detail.

7.3.1 PCB Contaminated Soils

7.3.1.1 Contaminant Issue

The Phase III ESA identified approximately 4.3 m^3 of PCB contaminated soils at the South Outfall and the Garage, as shown in **Figures 4.0** and **6.1** of **Appendix A**. In both cases the PCB contamination plumes identified provide the lateral extent of DCC Tier I contamination for PCBs; however, the soil within these plume areas is also co-contaminated with heavy metals (cadmium, copper, lead and/or zinc) in exceedance of the DCC Tier II criteria. Therefore due to the metal concentrations all PCB contaminated soils are classified as exceeding DCC Tier II.

7.3.1.2 Remedial Method

Due to the limited quantities delineated, the soil shall be excavated, containerized, labelled in accordance with the Transportation of Dangerous Goods Act and shipped off site to a disposal facility that is licensed to accept PCB contaminated soils co-contaminated with heavy metals.

7.3.2 Metal Contaminated Soils

7.3.2.1 Contaminant Issue

The assessment identified a total of 94.3 m^3 of metal contaminated soil at the South Doppler Detection Building (**Figure 3.1**), the South Outfall (**Figure 4.0**), the Emergency Shelter (**Figures 5.1**), the Garage (**Figure 6.1**), the Barrel Cache (**Figure 8.1**), the POL Storage Area (**Figure 10.1**), the Beach Area (**Figure 11.0**), and the North Doppler Area (**Figure 12.0**). As previously indicated in **Table 1**, these soils exceed either DCC Tier I or Tier II criteria. Of the 94.3 m^3, there is approximately 12.0 m^3 of DCC Tier I metal contaminated soil, which includes 4.3 m^3 co-contaminated with DCC Tier I PCB contaminated soil as described in Section 7.3.1.1 above. The other 82.3 m^3 of metal contaminated soil exceeds the DCC Tier II criteria.

7.3.2.2 Remedial Method

Due to the small amounts of metal contaminated soils on site and the large operational and maintenance costs of metal contaminated soil remedial technologies as well as the high costs to construct a hazardous waste landfill, on site remediation or disposal of the soils on site is not recommended. All metal contaminated soils that exceed the DCC Tier I criteria, but are less than DCC Tier II criteria (12.0 m^2) should be buried in the non-hazardous landfill. The metal contaminated soils that exceed the DCC Tier II criteria (82.3 m^3) should be excavated, containerized, labelled in accordance with the Transportation of Dangerous Goods Act and shipped off site to a disposal facility that is licensed to accept metals contaminated soils co-contaminated with PCBs.

7.3.3 Hydrocarbon Contaminated Soils

7.3.3.1 Contaminant Issue

The Phase III site investigation identified approximately 109.8 m^3 of PHC contaminated soil that exceed the INAC Abandoned Military Sites Remediation protocol (DND DEW Line PHC Evaluation Process), which consists of 77.9 m^3 requiring excavation and 31.9 m^3 requiring scarification. It should be noted that soil volumes are likely to increase as a result of bulking during excavation; therefore a 25% contingency should be applied to the total volume of PHC contaminated soil. The hydrocarbon contaminated soils are located at the Landfill North of Site 412 (**Figure 7.1**), the Small Barrel Cache (**Figure 8.1**), the POL Storage Area (**Figure 10.1**), the Beach Bulldozer Area (**Figure 11.0**), and the Airstrip Area (**Figure 13.1**).

7.3.3.2 Remedial Options

<u>Excavation and Off-Site Disposal</u>

The first potential remedial option for the hydrocarbon soils at Bear Island is to excavate the PHC contaminated soils ship them south to a facility licensed to accept hydrocarbon contaminated soils. Since the contamination is completely removed from the site, it meets all of the remedial objectives; however, the major disadvantage of this method is the cost for shipping the material off site and the associated landfill tipping fee.

Bear Island is located in the middle of James Bay, which means that barging to the closest community (i.e. Chisasibi) is the most practical option for removing the contaminated soil. Barging is typically expensive; however, due to the relatively small volume of PHC contaminated soil (81 m^3), this option is favourable because it removes the material from the site, thus prohibiting future site visits for landfarming or monitoring purposes. It is anticipated that the cost of removing the material via sea lift is more cost effective than building, operating and monitoring a landfarm cell or landfill. Also, this remedial option would meet all INAC clean up objectives.

<u>On Site Land Farming</u>

Option 2 for handling the petroleum contaminated soils is the use of a land farm. Land farming is a remediation technique used to reduce the hydrocarbon levels in soil via volatilization, biodegradation and photo degradation. The hydrocarbon soils are spread out on a self contained, lined land farm cell in a lift approximately 0.3 m thick. Chemical amendments (fertilizer) and water are added to the soil to promote biodegradation of the hydrocarbons. The soil is scarified or "turned" using heavy equipment to break up the soil, add oxygen and promote volatilization. Microbes in the soil, (bacteria and fungi) breakdown the hydrocarbon chains converting them into biomass.

Advantages of land farming are that the contamination is eventually eliminated. This eliminates the need for long term inspections and monitoring, and removes any long term liability of the site. Notable disadvantages include the time and effort required for the construction of the land farm cell and the remediation process, as well as monitoring the activity and ensuring the material is remediated to the applicable criteria.

In a northern climate, a minimum of two to three years is required for remediation depending on temperatures, moisture, soil contaminants and fertilizer application/soil turning. Land farming also requires a work crew to visit the site to scarify the contaminated soil, add the chemical fertilizer and monitor the soil contamination levels. Once the soil has been remediated below the applicable criteria, the land farm cell will be decommissioned in place and contoured into natural topography. Due to the time requirement for this method, additional site trips are required after the initial remedial program has been completed.

Land farming of the contaminated soils would meet the INAC Cleanup Objectives one, two and three. Due to the small volume of impacted soils and the cost associated with building, operating and monitoring a landfarm cell, it is not cost effective to landfarm the hydrocarbon contaminated soil.

<u>Landfill On Site</u>

A secure landfill was evaluated as a third option. A landfill containing contaminated soils shall have an engineered clay/synthetic liner to ensure the contaminants within the soil are not allowed to become mobile. Proper design of the landfill will also ensure that permafrost is developed within the landfill to further decrease the mobility potential of the contaminants. The geotechnical evaluation, completed by EBA, identified that Type 4 granular material (well-graded sand and gravel with some fines) which is required for the low permeability containment berms was not found on the island. Consequently, it would necessary to either import suitable material or use a synthetic liner system to meet the containment requirements of a hazardous/PHC landfill.

Advantages of the landfill are that the remedial work can be completed in one season. Disadvantages for this option are similar to the capping option (described below). The main disadvantages of land filling the PHC contaminated soils are that the contamination will remain on site. This requires long term inspections and monitoring of the landfill at a significant extra capital and labour cost to ensure the contamination is contained within the landfill. Also, a synthetic liner or engineered clay must be imported to meet the containment requirements, which would make this option even more costly.

The landfill option meets INAC Cleanup Objectives one, two and three, however long term monitoring and inspections of the landfill are required as the contamination will remain on site. Consequently, the cost for building and monitoring a landfill is likely offset by the cost to excavate the material and dispose of it off site.

Engineered Cap in Place

Option 4 for dealing with the hydrocarbon contamination at the Bear Island site is to grade and cover the contaminated areas with an engineered cap. The cap would consist of a 1.0 m thick layer of compacted engineered fill, graded to promote drainage.

A cap would reduce the amount of rain and surface water coming into contact with the contamination and prevent further dispersion of the hydrocarbon contamination. The cap would also eliminate the possibility of humans and/or fauna from coming into contact with the contamination. This remedial option has a relatively low cost and a minimal level of effort. The capping of the hydrocarbon contaminated soils could easily take place during other site remedial activities.

In addition to the engineered cap a chemical amendment can be added to the contaminated soil. The chemical amendment (fertilizers, nutrients, nitrogen etc.) promote biodegradation of the hydrocarbons by providing the necessary chemicals and nutrients required by the microbes for the degradation to occur. The hydrocarbon impacted soils are excavated and the chemical amendment would be mixed into the soils and the soils would be replaced and capped as noted above. The additional costs for the chemical amendment include the costs for the excavation of the impacted areas; the addition of the amendment, the amendment itself and the cost to replace and compact the soils after the amendment is added.

The main disadvantage of this option is that the engineered fill must be imported. Other disadvantages associated with this remedial option are that it would require further monitoring events to ensure the capping system remains in good condition (no erosion, frost heaving) and that the hydrocarbons do not become mobile. The capping would also greatly reduce the natural occurring bioremediation of the soils by limiting the amount of oxygen reaching the contaminated soil. Less oxygen reduces the rate of aerobic degradation of the hydrocarbons. There would be little to no control over the bioremediation process and ongoing monitoring of the contaminated area would be required.

In Situ Soil Vapour Extraction

Vapour extraction is a remedial method used to remediate hydrocarbon contaminated soils. Air is pushed or drawn through the contaminated soils and the lighter end hydrocarbons volatilize into the air. The air is then released into the atmosphere or run through carbon filters to remove the hydrocarbons. Contamination favouring this option is light end hydrocarbons (F1 Fractions). Heavier fractions of hydrocarbons are less likely to volatilize and require different remediation methods. The soils must also be porous, freely allowing the air to move through the soil and volatilize the hydrocarbons. Poorly graded dry sands and gravels are ideal for vapour extraction. Saturated well graded soils are not favourable for Soil Vapour Extraction.

Vapour Extraction systems rely on powered blowers and require frequent adjustments and maintenance during the extraction process. Since Bear Island is a remote unmanned site the cost of instituting this remedial measure is not cost effective. The soils and type of hydrocarbon contamination at Bear Island are not compatible with vapour extraction remediation methods. The contamination at the Bear Island site is the larger fractions of hydrocarbons (F2 and F3). Vapour extraction will not be explored further as a remedial option.

Biopile

A biopile is a remediation technology used to remediate hydrocarbon contaminated soils. The PHC contaminated soils are collected into piles and wrapped in synthetic liners to promote anaerobic degradation of the hydrocarbons and retain heat to promote the bioactivity. Temperatures measured within an active biopile are often much higher than ambient temperatures. Biopiling has had limited success as an effective remediation technique at remote and unmanned northern sites due to low ambient temperatures and the care and maintenance involved with operating the biopile system. Biopiles will not be explored further as a remedial option.

Scarification

In accordance with the DND Evaluation process, Type A (non-mobile) hydrocarbon impacted soil with TPH concentrations less than 20,000 mg/kg and located a localized area with a slope less than 10% must be scarified to a depth of 0.3 m.

7.3.3.3 Recommendation

Based on the evaluation of the remedial options in the context of the remedial objectives, it is recommended that the 77.9 m^3 of hydrocarbon contaminated soils be excavated and shipped off site for disposal. Also, it is recommended that the 3.1 m^3 of Type A impacted soil at the Beach Bulldozer be scarified (area of 10.4 m^2 to a depth of 0.3 m) to address hydrocarbon stained soils in that area.

7.4 Site Materials

7.4.1 Non-Hazardous Materials

Approximately 727 m^3 of non-hazardous materials are estimated to be left on site at Bear Island, which includes 622.5 m^3 of surface debris, 14.7 m^3 at the existing landfill, and 41.7 m^3 in the west toe of Landfill A. The following table presents a summary of the non-hazardous materials. It should be noted that 48 m^3 of concrete structures, such as antenna bases and the emergency shelter, are not included in the **Table 2** because it is likely the surrounding soil will be re-contoured and the concrete structures will be left in place. A detailed inventory of the non-hazardous materials is provided in **Table D1** (**Appendix D**).

The 2007 Phase III ESA included the collection and analysis of a concrete sample collected from the Garage foundation. As reported, the analysis indicated PCBs concentrations less than 50 ppm in all the samples. Consequently, concrete products are classified as non-hazardous waste.

All buildings/infrastructure shall be demolished to their foundations in accordance with the INAC, Abandoned Military Site Remediation Protocol, April 2008. All barrels shall be addressed using the Department of National Defence (DND) DEW Line Clean up Barrel Protocol (**Appendix B**). A detailed summary of the non-hazardous materials located at the Bear Island site is provided in **Table D1** (**Appendix D**). Remedial options for non-hazardous materials are described below.

Table 2 – Summary of Non-Hazardous Materials

Location	Volume (m3)	Weight (tonnes)	Percentage of Total (% by weight)	Comments
South Doppler Area	446.8	1413.7	69.0	Includes barrels in the west toe of the North Landfill Area, as well as assumes concrete emergency vault and antenna bases will remain in place
Beach Area	104.3	311.9	15.2	Located on ground surface
North Doppler Area	101.7	263.6	12.9	Located on ground surface, and assumes concrete antenna bases will remain in place
Airstrip Area	26.1	59.3	2.9	Located on ground surface
Total	**678.9**	**2048.5**		

7.4.1.1 Remedial Options

Buried in Place

Once all the structures have been demolished to their foundations, the site materials can be buried in place. The debris would be flattened and covered with compacted engineered fill or placed in a nearby excavation or low spot in the surrounding terrain and then covered with compacted fill. The cover of compacted fill must be engineered to promote positive drainage and the cap must also be graded to match surrounding terrain. Advantage of this method is that it is less expensive as the contractor does not have to remove, transport and place material in a landfill some distance away. The disadvantages of this method is that the material is not placed in a secure engineered landfill and that a large contractor effort would be required to move fill to cover the debris piles that are scattered around the site. In the event that additional debris is discovered on site, the debris shall be addressed using the INAC Abandoned Military Site Remediation Protocol, April 2008. In the event that the materials are buried onsite, future monitoring would be required.

Consolidate Wastes and Place in On Site Non Hazardous Waste Landfill

Once all the structures have been demolished to their foundations, the demolished materials as well as the non-hazardous materials from the surface debris piles that are scattered around the site would be transported to an engineered landfill. This option is more cost intensive, but it gathers all the site material into one secure area reducing future monitoring inspection efforts. Placing the non hazardous demolition waste in an on-site engineered landfill is in accordance with the INAC Abandoned Military Site Protocol, April 2008.

Off Site Disposal

Once all the structures have been demolished to their foundations, the demolished material can be collected and transported off site. As Bear Island is located 140 km off-shore from the nearest community of Chisasibi, a sea lift would be required to deliver the material for disposal at another location. Due to the large costs associated with hauling demolition material via barging, off site disposal is deemed too expensive and not cost effective.

7.4.1.2 Recommendation

It is recommended that an engineered non-hazardous waste landfill be constructed on site using the available borrow sources. It is recommended that all non-hazardous waste materials be collected, consolidated and deposited in one central landfill. This landfill should be large enough to place all of the non-hazardous debris plus the disposable Tier I soils, as well as the bagged asbestos waste and vented compressed gas cylinders.

Since the debris piles that are scattered around the site are located on the ground surface and are not buried the collection of these materials and disposal in a common landfill is recommended over burial in-place as the remedial option. Although the North Landfill Area is classified as a Class C Landfill (located in a suitable, stable location with no evidence of contaminated leachate), it is also recommended that all non-hazardous wastes be recovered from the exposed toe along the southwest perimeter of the North Landfill Area (**Figure 9.0**). This material should also be placed into the common landfill. All non-hazardous material on site is to be placed in the landfill and compacted and capped in accordance with the landfill design. Taking the results of the Ecological Site assessment, as well as the location of the majority of the debris onsite, it is recommended to use landfill location #1, as identified in the EBA Geophysical and Geotechnical report (Figure 1 in the EBA report).

7.4.2 Hazardous Materials

Hazardous materials are known to be present at the former Bear Island Mid-Canada Line Radar Station based on assessment work completed in 2007, and previously in 2001. A detailed inventory of hazardous waste is provided in **Table D2** (**Appendix D**). All hazardous materials (with the exception of Asbestos Containing Materials and empty compressed gas cylinders) will be containerized and labelled in accordance with the Transportation of Dangerous Goods act in Accordance with the INAC Abandoned Military Sites Remediation protocol and disposed of offsite.

Approximately 27.0 m^3 of Lead painted materials and 18.8 m^3 of hazardous materials (asbestos materials and lead-acid batteries, gas cylinders) were identified during the 2007 Earth Tech site assessment. A detailed description of the hazardous / non-hazardous samples is provided in **Table D3** (**Appendix D**). It should be noted that additional paint samples from the materials where the paint was applied to a metal substrate (i.e. electrical cabinets at the Beach Area) should be collected at the commencement of remediation activities to avoid any uncertainties with the proper method to handle these paint products. The paint samples must include the substrate as well as the paint, and are to be submitted for leachable lead analysis. Also, paint samples collected during the 2007 investigation program were only analyzed for lead consequently it is recommended that the painted media be resampled and analyzed for PCB content. It should be noted however that the only paint product not found to be hazardous (i.e. lead contaminated) was the white and orange antenna paint. If the antennas (two large and three small) are found to contain PCB contaminated paint the volume of hazardous materials will increase by as much as 75 m^3.

According to the AMSRP the Landfill North of Site 412 is classified as a Class A Landfill (unstable, high erosion location with contaminated soil downgradient) and consequently debris within this landfill must be sorted and disposed of accordingly.

Remedial options for hazardous materials are described below.

7.4.2.1 Petroleum Oil and Lubrication (POL) Fluids and Collected Water

Incinerate on Site

Preliminary results for barrel samples found to contain product at Bear Island is provided in **Table D4** (**Appendix D**). Some of the product samples collected during the 2007 investigation were compromised during transport to the lab; consequently results for chlorine and chromium were not available for some of the barrel samples. These barrels at the small barrel cache must be re-sampled and analyzed for chlorine and chromium content. The fluids can be burned if the levels of the previously listed parameters are below the criteria for incineration as listed in the Department of Defence DEW Line Clean up Barrel Protocol (the POL fluid contains <1000 ppm Cl and <10 ppm Cr; **Appendix B**). If the POL fluid analysis indicates any of these contaminant levels have been exceeded, the fluid will be classified as a hazardous material and must be treated in accordance with Section 7.4.2 (Hazardous Material) of this document. There is approximately 1.05 m^3 of POL liquids stored onsite.

Disposal on Ground

As a general note, all barrels inspected at Bear Island were found to be empty or rusted through, with the exception of approximately four barrels at the Small Barrel Cache and one at the Airstrip (described above). This fact does not ensure that all barrels on site are empty or contain just rusty water as all (approximately 4300 barrels) were not inspected. During cleanup activities all barrels must be approached using the DLCU barrel protocol. A copy of the DEW Line Clean-up protocol is provided in **Appendix B**.

7.4.2.2 Asbestos

Asbestos Containing Materials (ACM) at the Bear Island site includes to green and brown 9"x9" floor tiles and asbestos cement board, which were found at both the South and North Doppler Areas, as well as at the Beach Area. A detailed description of the asbestos samples in provided in **Table D4** (**Appendix D**). Asbestos is located throughout the remaining structures, within the surface debris piles and scattered in the region of the above mentioned areas. All asbestos is to be properly abated, in accordance with applicable Federal and Territorial Asbestos regulations, prior to any demolition activities.

Asbestos Abatement, Place in On Site Landfill

All asbestos is to be abated in accordance with applicable Federal and Territorial Asbestos regulations and guidelines. All asbestos debris shall be abated and placed in a sealed, airtight container, clearly labelled "ASBESTOS". The asbestos is then placed in the engineered landfill constructed onsite. The location of the asbestos material located within the landfill should be noted for future reference. This method is in accordance with the INAC Abandoned Military Site Remediation Protocol. Due to the transport costs associated with transport of materials from the Bear Island site, off site disposal is not recommended for the asbestos waste.

7.4.2.3 Lead Contaminated Paint

Paint Removal, Off Site Disposal

Paint abatement consists of physically removing the lead contaminated paint from the substrate. This is accomplished by physical scrapping, chemical stripping, sand blasting and various other abrasive physical removal techniques. As the paint being removed contains lead, abatement methods must be conducted in a manner that protects the worker and the environment from lead contamination. Abatement methods generating dust must be conducted in a sealed, negative pressure environment with the area exhaust filtered with a certified High Efficiency Particulate Air (HEPA) Filter. Misted water is also used to control the paint dust, requiring the waste water to be filtered to remove the contaminated paint or collected and treated as hazardous waste. These required mitigation measures increase costs dramatically. This option would meet the INAC cleanup objectives for restoring the site to an environmentally safe condition and preventing the migration of the contaminants as all of the lead containing paint would be removed from site. The abatement process; however, is involved and costly. The abatement costs combined with the disposal costs make this option less cost effective.

Remove Painted Materials, Off Site Disposal

As an alternative to paint abatement, building materials painted with contaminated paint can be dismantled and disposed of as hazardous materials, bypassing the requirement for the paint to be abated. The transport and disposal costs are higher due to the fact that the painted building materials are disposed of along with the paint; however these additional costs are smaller than the additional costs of paint abatement. As there is minimal scrapping and abrasion during the dismantling activities, negative air enclosures and filtration systems are not required. Dismantled material volumes can be minimized by cutting and compacting. This option meets the INAC Abandoned Military Site Clean up Protocol Cleanup Objectives one, two and three. This option is also less expensive than the abatement options making it more cost effective than the other options proposed.

7.4.2.4 Recommendations

During cleanup activities all barrels must be approached using the DEW Line Clean-up barrel protocol (**Appendix B**). If the petroleum products meet the incineration guidelines, the waste products may be incinerated adhering to an approved method, otherwise POL fluids must be shipped off-site and disposed of accordingly. Rusty barrels found to contain water must be handled according to the barrel protocol.

It is recommended that all compressed gas cylinders (after they are vented), as well as asbestos waste, be disposed in the constructed landfill.

It is recommended that the lead amended paint materials be dismantled and disposed off site. This remedial method is in accordance with the INAC Abandoned Military Site Remediation Protocol, April 2008. Care is to be taken during the dismantling to prevent dust and paint chips from being released into the environment and to protect the workers that are conducting the dismantling from PCB and lead contamination. All dismantled lead contaminated paint material shall be packaged, transported and disposed of in accordance with the current regulations governing the handling and disposal of hazardous materials.

7.5 Recommended Remediation Methods

The following table presents a summary of the recommended remedial methods.

Table 3: Summary of Recommended Remediation Methods

Environmental Concern	Site Assessment Findings	Recommended Remediation Method
DCC Tier I Contaminated Soils	12.0 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and PCBs which exceed the DCC Tier I criteria were identified onsite.	Dispose of soils that exceed DCC Tier I soils (12.0 m^3) in an onsite landfill.
DCC Tier II Contaminated Soils	82.3 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and PCBs which exceed the DCC Tier I criteria were identified onsite. This volume includes 4.3 m^3 of material that is co-contaminated with Tier I PCBs.	Excavate, containerize and label soils that exceed DCC Tier II criteria (82.3 m^3) and dispose offsite.
Petroleum Hydrocarbon Contaminated Soils	Approximately 109.8 m^3 of hydrocarbon contaminated soil in exceedance of the INAC Abandoned Military Site Remediation Protocol for PHC Soils.	Excavate 77.9 m^3 contaminated soils and place into containers, and ship off site to a licensed disposal facility. Scarify 31.9 m^3 of PHC stained soil.
Surface Debris	Approximately 622.5 m^3 of non-hazardous debris consisting of heavy equipment, barrels, scrap metal, scrap wood, concrete, electrical equipment and plumbing parts, and any remaining buildings.	Consolidate and dispose in a non hazardous landfill constructed onsite.
Existing Landfills	Landfill North of Site 413 is considered a Class A landfill and was found to contain hazardous materials. The surrounding soils are being impacted from debris located within the landfill. North Landfill is considered to be a Class C and there is no evidence that surrounding soils are being impacted.	Consolidate and dispose waste debris (14.7 m^3) accordingly. Remediate PHC contaminated soils as described above. Consolidate surface debris, as well as the partially buried debris located on the exposed southwest toe of the landfill, (approx 41.7 m^3 total) and dispose accordingly.
POL Fluids	There are approximately 1.05 m^3 (1,050 L) of Petroleum, Oil and Lubricant fluids.	Incinerate POL fluids that meet incineration criteria (< 2 ppm PCBs and Cd and < 10 ppm Cr and <100 ppm lead and <1000 ppm Chlorine), otherwise treat as Hazardous Waste (**Appendix C**)

Environmental Concern	Site Assessment Findings	Recommended Remediation Method
Water in barrels	With the exception of five barrels, all barrels inspected were found to be empty or rusted through. This fact does not ensure that all barrels on site are empty or contain just rusty water as all (approximately 4300 barrels) were not inspected.	During clean-up, all barrels must be approached using the DLCU barrel protocol (**Appendix C**).
Lead Painted Products	Approximately 27.0 m^3 of lead amended paint materials were discovered on site.	Dismantle contaminated paint items and ship off site to an appropriate disposal facility.
PCB Painted Products	If the orange and white painted antennas are found to contain PCB contaminated paint, there is potentially an additional 75 m^3 of hazardous materials on site.	Dismantle contaminated paint items and ship off site to an appropriate disposal facility.
Hazardous Materials	Approximately 18.0 m^3 of hazardous materials were identified at the site. These materials consisted of lead acid batteries (3 m^3), asbestos containing materials (12.5 m^3), and lead cable and zinc conduit (2.5 m^3).	Asbestos waste to be collected, bagged and disposed of in an on-site landfill. All hazardous materials (such as batteries and hazardous cable/conduit) will be containerized, labeled and shipped to be disposed at a licensed southern facility.
Compressed Gas Cylinders	Approximately 8 compressed gas cylinders were identified onsite.	Vent and dispose of cylinders according to the INAC AMSRP in the non-hazardous landfill.

8.0 REMEDIAL DESIGN AND IMPLEMENTATION

8.1 Remedial Objectives

The remedial design for the Bear Island Mid-Canada Line Radar Station has been developed in accordance with the Indian Affairs and Northern Development, Abandoned Military Site Protocol, April 2008. The following section outlines the general design and implementation of the preliminary draft Bear Island Remedial Action Plan (RAP).

Remedial Design and Implementation Objectives:

1. Ensure safety of workers on site;
2. Prevent further contamination at the Bear Island Mid-Canada Line Radar Station;
3. Minimize impact to environment, fauna, flora and
4. Achieve remedial objectives.

The contractor shall have a site specific, Health and Safety Plan (HASP) in place and understood by all involved workers prior to work starting on the site. Contractor shall also have a spill contingency plan in place to deal with any unforeseen and accidental releases of contaminants.

8.2 Camp/Contractor support

Due to the high costs for a contractor to commute to the site on a daily basis, and due to the potential that the contractor may not be able to access the site during poor weather, it is recommended that an onsite construction camp be utilized. The camp must be large enough to support approximately 30 site workers and approximately 3-5 camp staff. If possible, the camp will be located in a previously disturbed area, such as the disturbed area west of the Barrel Cache (**Figure 2.1A**), to minimize any new disturbances in accordance with applicable licenses.

The camp shall include a potable water source, sewage collection and treatment in accordance with all applicable guidelines and regulations, bear safety measures, emergency rations and an emergency rescue contingency plan. A water sample was collected by Earth Tech from the water reservoir, located south of the north of Site 412 (as shown in **Figure 2.1A**). Although the results for total metals, PCBs, PHCs and PAHs are below the CCME Guideline for Canadian Drinking Water Quality, the sample was not analyzed for routine water potability. Consequently, the water reservoir should be resampled prior to setting up the camp to determine if the water source can be used to support the camp requirements. It should also be noted that additional testing would be required on an on-going basis for potable use during remediation.

Domestic waste generated by the camp will either be disposed off-site or incinerated on-site with the ash placed in the on-site landfill or shipped off-site. Sewage will be treated using an approved sewage treatment system, in accordance with applicable legislation and licenses.

It is recommended that mobilization to the site be achieved using sealift rather than airlift. It should be noted that the proposed barge landing area, located at the Beach Area in a bay on the east side of the island, has not been inspected by a sealift contractor. It is recommended that an inspection be completed to ensure the sealift can be land on the island. In the event that the sealift can be landed on Bear Island, it is recommended that consideration be given to truck all the contractor equipment and supplies to the James Bay community of Chisasibi. Potentially a sealift contractor would be able to load up in Chisasibi and transfer the materials to Bear Island. The other option for mobilization is to sealift the entire contractor's equipment from Montreal via sealift. It is also recommended that the contractor charter aircraft in the community of La Grande or Chisasibi in order to re-supply the camp and move personnel.

As described in Section 4.3 above, Polar Bears were residing on Bear Island. It is likely that Polar Bear are commonly observed on the island in the summer season. Due to terrain and topographic features of the island, there are numerous locations where bears could approach the camp and work areas without being noticed. Due to the high potential for bear encounters, it is recommended that a safety plan be developed by the contractor to maximize the protection of all workers onsite. The plan should provide guidance on how to respond in a manner that is safe to both humans and polar bears. The plan should also outline methods of deterrents, waste disposal requirements as well as the proper procedures to follow should a bear be encountered. During the field season activities, numerous polar bear wildlife monitors should be used to provide 24 hour surveillance for the camp and crew members. To add an additional level of protection, the main camp should be surrounded with a 2 m high, 10,000 volt electrical fence. Each of the wildlife monitors should be equipped with rifles as well as two-way radios to allow them to be in continual communication with all field and camp staff. It is recommended that a wildlife specialist be involved in the design and follow through of the contractors Polar Bear mitigation plan.

In addition to mitigation measures being in place during the field activities, measures must be taken during the off-season to minimize Polar Bears being attracted to infrastructure associated with clean-up activities. It will be necessary to leave heavy equipment and tools, as well as potentially hard-sided camp infrastructure, over the winter. It is recommended to remove all kitchen supplies (stoves, fridges, food, etc.) and other infrastructure that can be removed from the site during the winter/off-season to reduce the attraction of Polar Bears and other wildlife.

8.3 Infrastructure/Roads

8.3.1 Airstrip

As was presented in the EBA report, the airstrip is susceptible to becoming oversaturated during spring thaw or during periods of heavy rain. If contractors are preparing to use the airstrip at Bear Island, it is recommended that the contractor evaluate the runway condition prior to use. The contractor shall utilize the airstrip at its own risk. The airstrip must be continually evaluated by the operational pilots and staff at the Bear Island site. If and when excessive erosion and/or rutting are noted, the airstrip shall be repaired immediately as required and to the satisfaction of the operational pilots. Further assessments and the use of a Boeing Penetrometer shall be employed before larger aircraft are taken under consideration for landing on the airstrip at Bear Island. It is recommended that the contractor maintain the airstrip on a regular basis to allow for camp resupply and personnel transfer. Once remediation activities have been completed it is recommended that the airstrip be left in place. This practice is consistent with most other site clean-up programs (DEW Line and otherwise), because the airstrip is currently referenced on aviation maps and is available to be used in the event of an emergency. Removing the airstrip is therefore considered to be a safety hazard.

8.3.2 Existing Roads

Due to lack of upkeep and erosion, some of the existing roads to be utilized during remedial activities will require minor repair and upgrading. The settlements and washout areas shall be patched and compacted using borrow material from the most suitable borrow source (identified in the EBA report). Upon completing the remediation program, with the exception of removing culverts and any other fabricated materials, it is recommended that the existing roads will be left in place. The only amendments recommended are slight modifications to allow natural drainage patterns to continue.

8.4 Borrow Source Development

Borrow sources shall be developed in accordance with the Indian and Northern Affairs Canada Abandoned Military Site Remediation Protocol. Required borrow material shall be drawn from one of the three borrow sources identified in the EBA report. It should be noted that the tern nesting habitat and archaeological sites located at the south borrow source should be identified and remain undisturbed during site activities.

Once the borrow source requirements for the Bear Island remediation have been satisfied all borrow sources will be recontoured to restore natural drainage and to match surrounding topography and minimize changes to the existing permafrost.

8.5 Non-Hazardous Waste Landfill Engineering and Construction

The landfill location was selected based on the required landfill size, distance to material to be landfilled and distance to borrow sources. The landfill location (shown in **Figure 2.1A**) just north of Site 412 requires the least amount of transportation for the majority of the waste and it is on the crest of a hill, minimizing the probability of erosion and infiltration. It was identified in an Ecological Assessment, completed by Earth Tech in 2007, that this area provides an important vegetation resource. It should be noted that other areas on the island provide equal vegetation resources and more importantly, it is recommended that the landfill design includes planting native vegetation to re-establish the vegetation resource currently located in this area. Another suitable location for the non-hazardous landfill is within the disturbed area, although this option was not investigated by EBA during the 2007 investigation. Other potential landfill areas were identified south of Site 412; however, Landfill Area #3 was located in close proximity to the sensitive arctic tern nesting area at the south end of Bear Island, and Landfill Area #2 was sited near fox dens. Therefore, it is not recommended to use either Landfill Areas #2 or #3.

The landfill shall be constructed in a controlled manner with minimal lifts to control compaction and settlement. Surface water run-on and run-off will be controlled through proper grading to positively shed water and to prevent ponding and seepage into the landfill. Consideration to the landfill cap angles must be designed as to not to encourage erosion of capping material.

Leachate control should be accomplished by control measures (rather than containment and collection such as synthetic liner cover). Control measures include placing only dry and stable material in the landfill and preventing water infiltration into the landfill to prevent leachate generation. Fill material shall be "frost stable" and placement outside of high groundwater or constant surface water area recharge area. Settling of the landfill surface shall be avoided by placing thin lifts (0.15 m) and compacting/vibrating to fill voids.

Outside berms shall be constructed at 3H:1V and inside berms at 1.5H:1V. The top of the berm should have a minimum width of 2 m. Since the berm material will be erodible, the berms should have a minimum 0.5 m thick cover of gravel and cobbles.

The reduction of surface settlement over the landfill should be completed by ensuring all debris voids are filled in and the total debris thickness in the landfill does not exceed 3 m. The landfill cap shall be compacted to 95% of the maximum density.

8.6 Waste Handling Facility Construction

A Waste Handling Facility (WHF) will be required at the Bear Island site to receive and sort various waste items. The fluids handling area within the WHF shall be lined with an engineered clay/synthetic liner to prevent the migration of contaminants resulting from any accidental spills. The fluids handling area is to be bermed and the engineered liner should have some fill cover to protect the liner integrity. The waste handling facility shall have applicable safety items and PPE which include but are not limited to; fire extinguisher, first aid kit, eye wash station, emergency spill kit etc. Materials to be received and sorted at the WHF include but are not limited to:

- Barrels (Barrel Protocol)
  - Empty
  - Unknown fluids
  - POLs
  - Cleaning, rinsate, crushing

- Batteries
- Compressed Gas Cylinders
- Items painted with Lead Paint
- Soils for off Site Removal
- Creosote Treated timbers (wrap in poly, on site landfill).

The WHF area shall be located near the proposed landfill location (**Figure 2.1A**) and it is recommended that the WHF be surrounded by a temporary road to provide access to vehicles and equipment required in the delivery, sorting and transport of the site waste. Upon decommissioning of the WHF the area beneath the facility shall be sampled for confirmatory purposes.

8.7 Schedule

8.7.1 Schedule

Based on the scope of work of the project, it is assumed that one complete construction season would be needed to complete the project; however due to the delay in the arrival of the sealift to this site (approximately late July) and the time required to construct an onsite camp, it is expected that 2 field seasons will be required to complete all onsite activities. It is assumed that remedial activities would not commence until mid-August and would continue until the end of September of the first construction year.

Assuming the project is tendered in the Fall 2008, the following is a proposed schedule for the remediation of this site:

- Community meetings (Spring 2008)
- Permitting (Summer/Fall 2008)
- Bidders site meeting (Fall 2008)
- Contract tender (Winter 2008)
- Contract award (Spring 2009)
- Mobilization (Summer 2009)
- Year 1 Remedial Activities (Summer 2009)
- Year 2 Remedial Activities (Summer 2010)
- Demobilization (Fall 2010).

9.0 PROJECT AND LONG TERM MONITORING

The purpose of project and long term monitoring is to confirm compliance of the remedial activities with the specified clean up objectives and clean up criteria. During the remedial program, quantities of all site materials should be estimated, tracked and measured. Contaminated areas that have been excavated shall be confirmed clean by field screening methods and then samples shall be taken for laboratory confirmation.

As all dumps are recommended to be excavated, long term monitoring of these areas will not be required. However, any newly constructed non-hazardous landfill will be inspected visually. This visual inspection will look for any settling, ponding, erosion or frost action that may have occurred. If there are signs of instability at these landfills such that buried material becomes exposed, then remedial action will be implemented. Visual monitoring will be conducted at all constructed landfills in approximately mid-August. The frequency of the program will be on an annual basis for the first five years, then if no problems area encountered year 7, 10, 15 and 25. A full review of data will be completed in the fifth year.

10.0 REFERENCES

Abandoned Military Site Remediation Protocol, Indian and Northern Affairs Canada, April 2008.

An Environmental Assessment of Two Mid-Canada Line Sites at Bear Island, Environmental Sciences Group, Royal Roads Military College, March 1996.

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A Federal Approach to Contaminated Sites, Contaminated Sites Management Working Group, November 1999.

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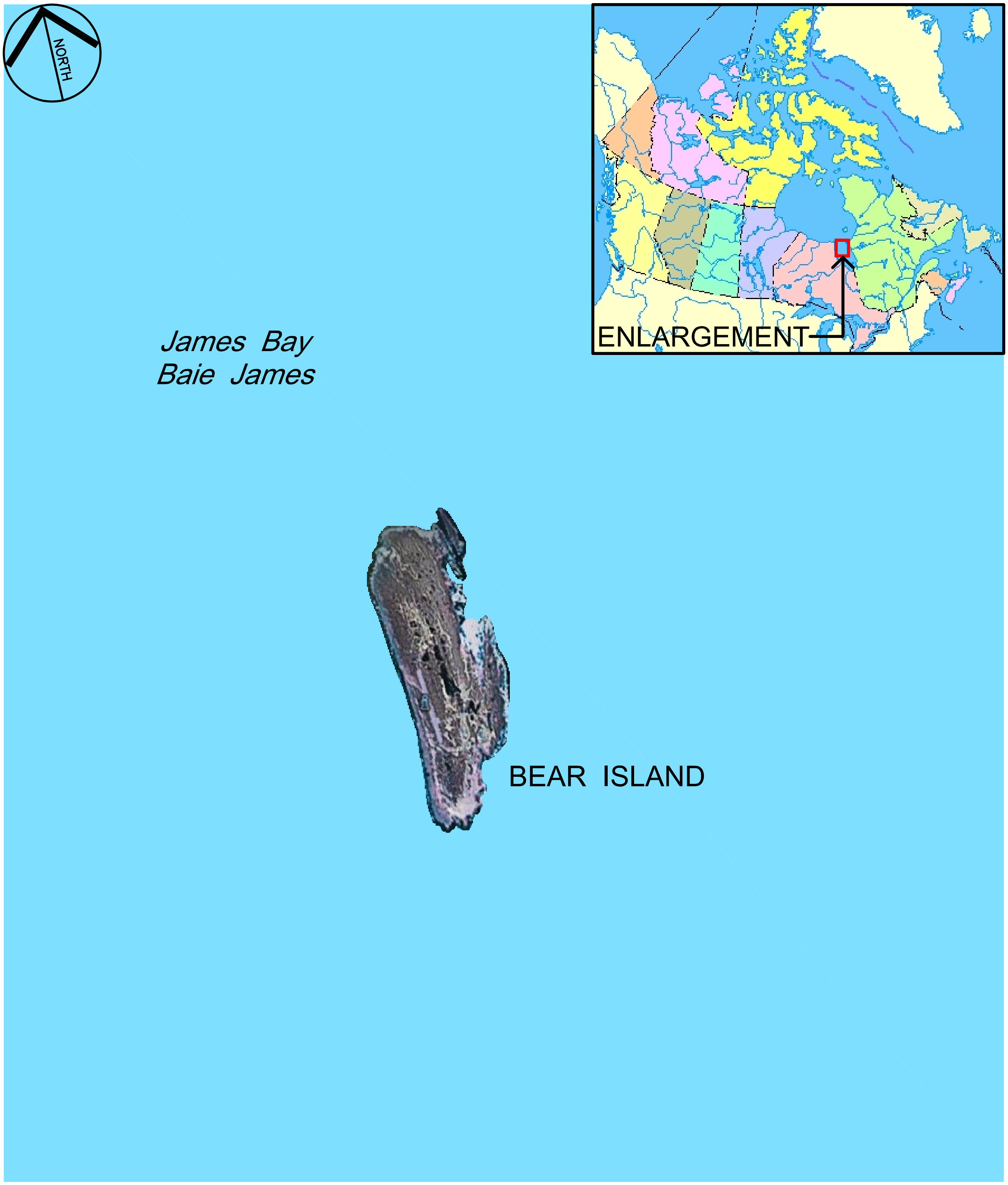
APPENDIX A

FIGURES



0 1 2 3 4 5km
Scale 1:100,000

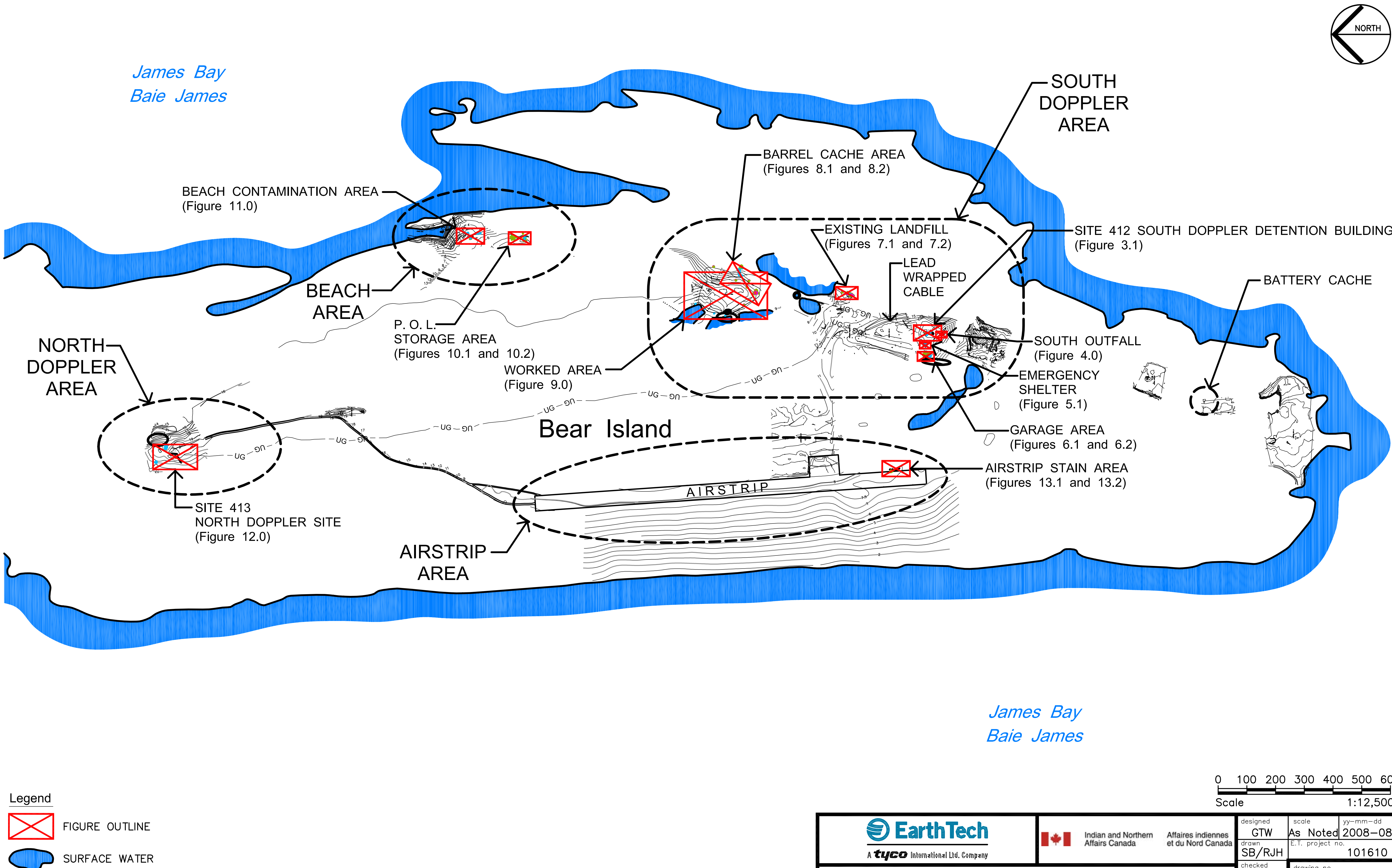
EarthTech
A tyco International Ltd. Company

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

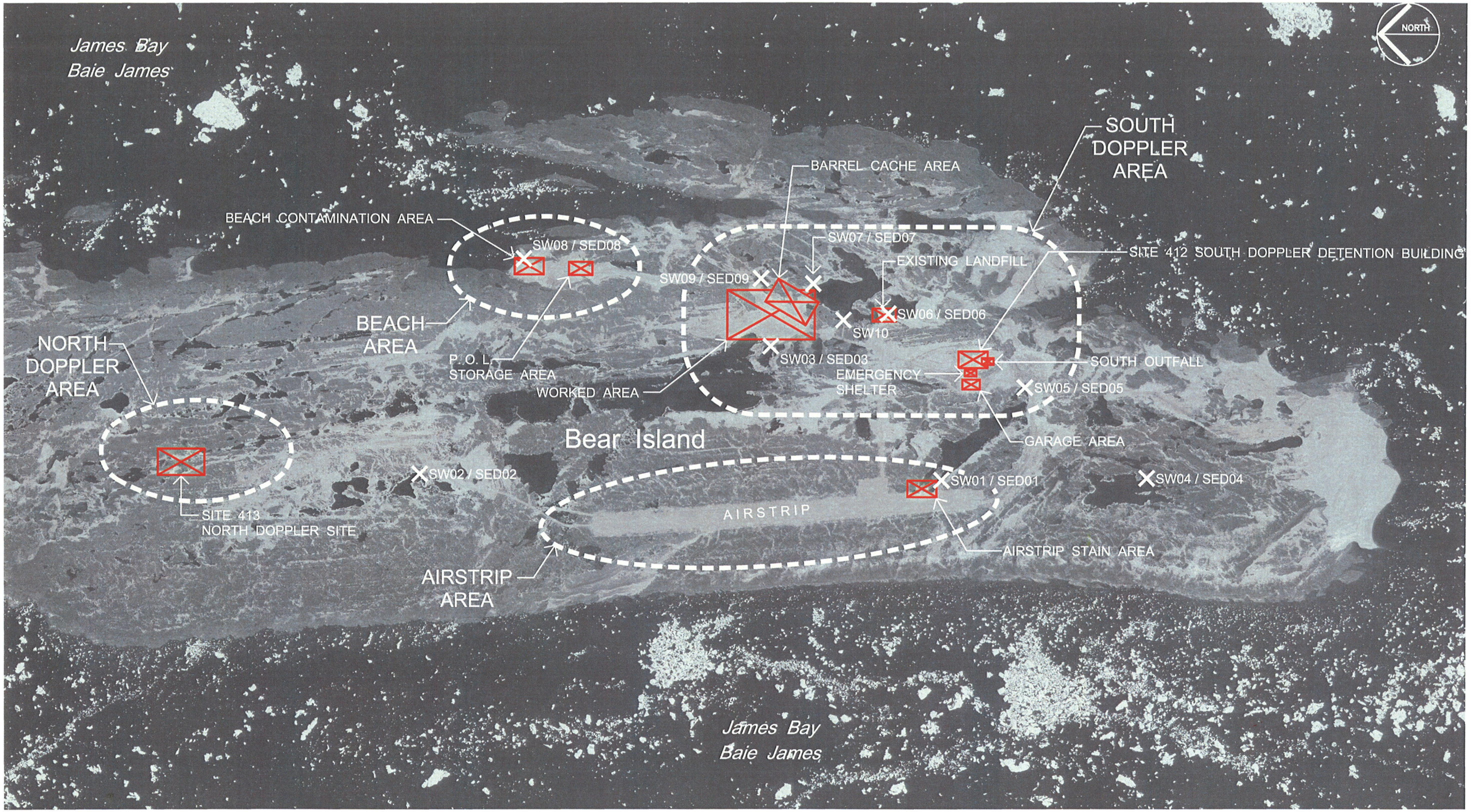
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
SITE LOCATION

designed GTW	scale As Noted	yy-mm-dd 2008-08-15
drawn SB/RJH	E.T. project no. 101610	
checked GTW	drawing no. FIGURE 1.0	
approved		

L:\WORK\101000\101610\02A-CAD\ENV\DRAWINGS\Cadd File:101610_FIGURE 1.0.dwg\Last Edit: 2008-08-15 (10:00)\Plot Scale: 1:1 (A4)



EarthTech A tyco International Ltd. Company	Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada	designed GTW	scale As Noted	yy-mm-dd 2008-08-15
		drawn SB/RJH	E.T. project no. 101610	
BEAR ISLAND MID - CANADA LINE SITE Remedial Action Plan SITE LAYOUT		checked GTW approved	drawing no. FIGURE 2.0	



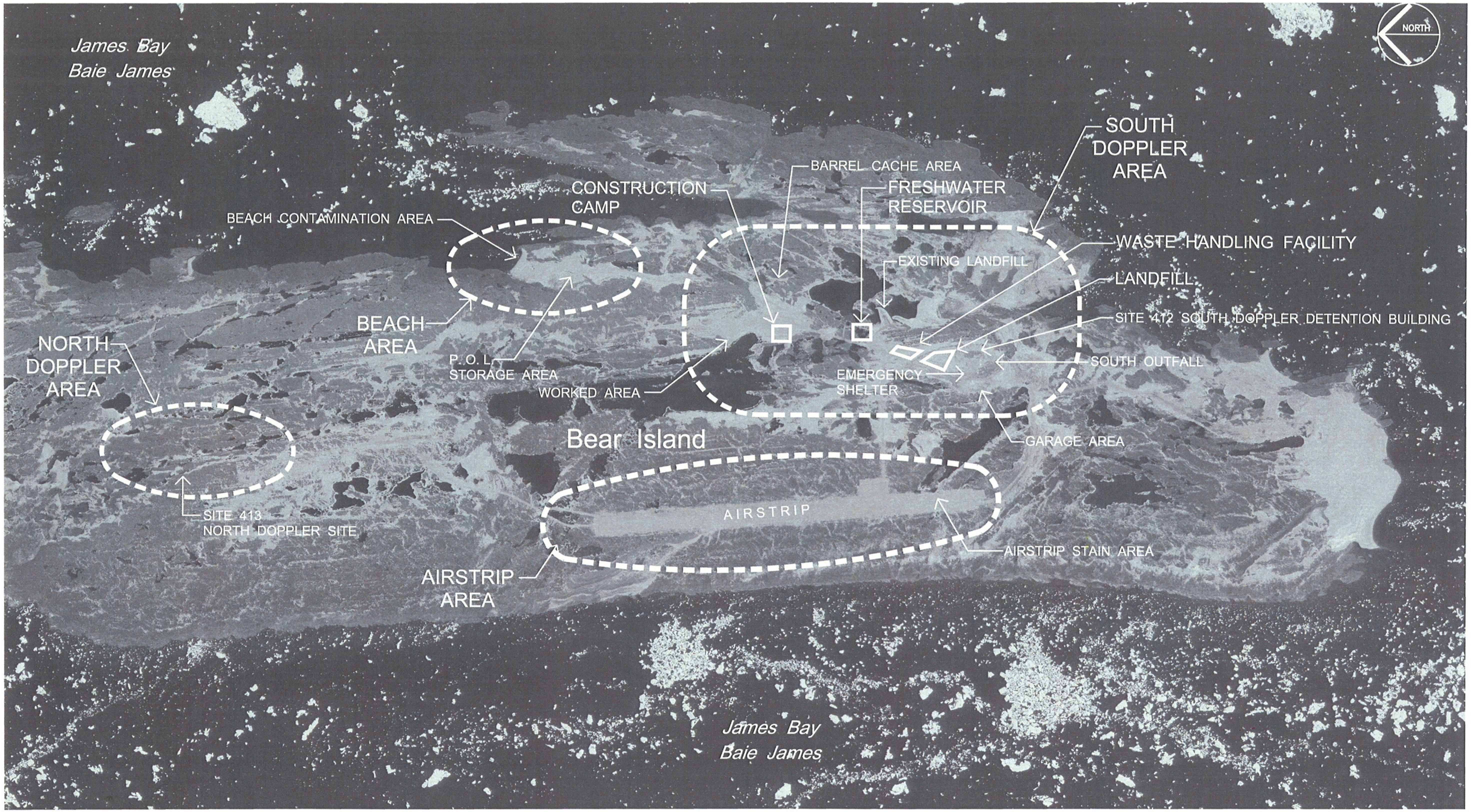
Legend

- FIGURE OUTLINE
- SAMPLE LOCATION
- SW04 WATER SAMPLE
- SED04 SEDIMENT SAMPLE

0 100 200 300 400 500 600m

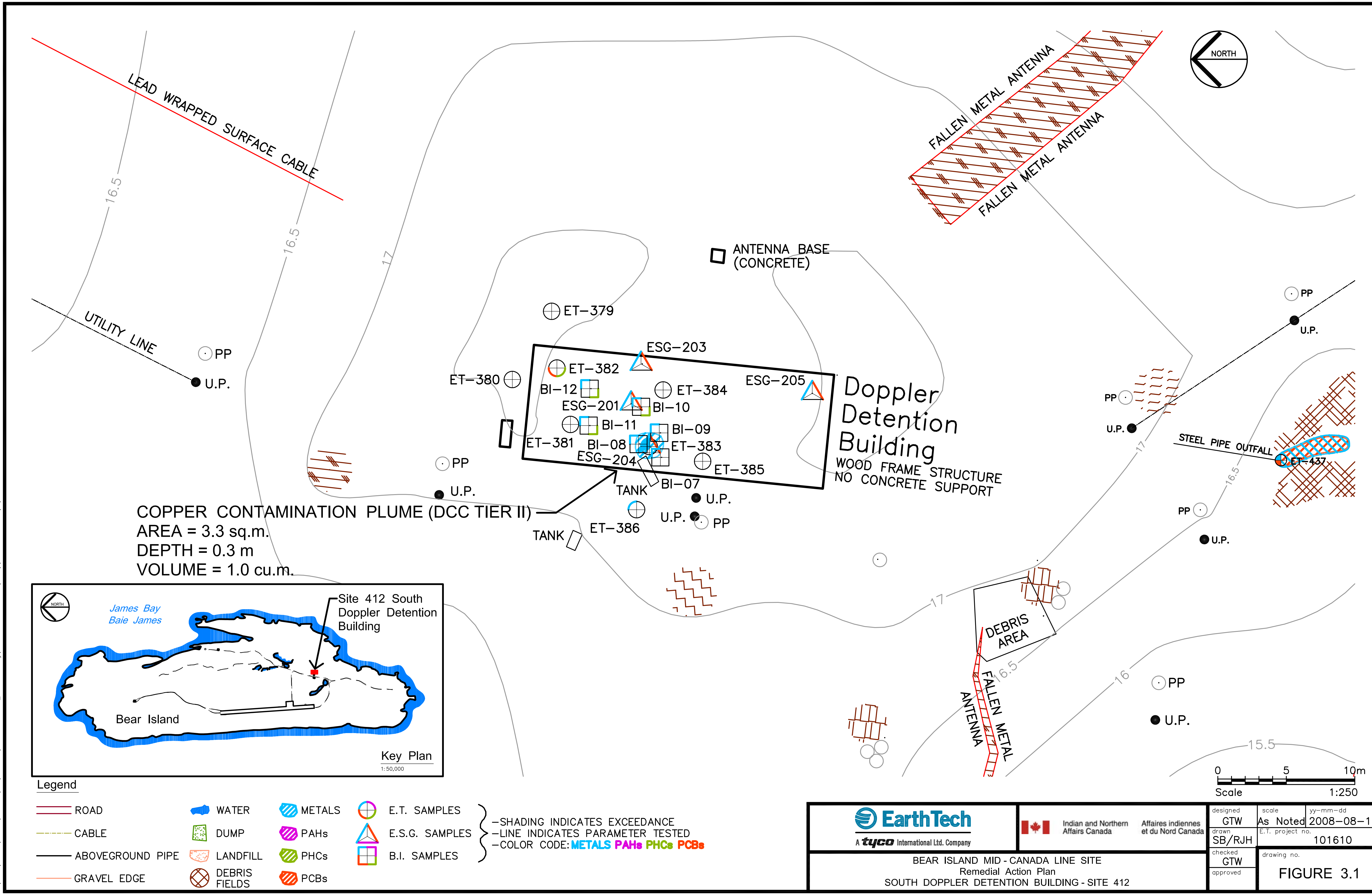
Scale 1:12,500

EARTH TECH AECOM	Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada	designed GTW drawn SB/RJH	scale As Noted yy-mm-dd 2008–08–15 E.T. project no. 101610
BEAR ISLAND MID - CANADA LINE SITE Remedial Action Plan SITE LAYOUT - SURFACE WATER and SEDIMENT SAMPLE LOCATIONS		checked GTW approved	drawing no. FIGURE 2.1

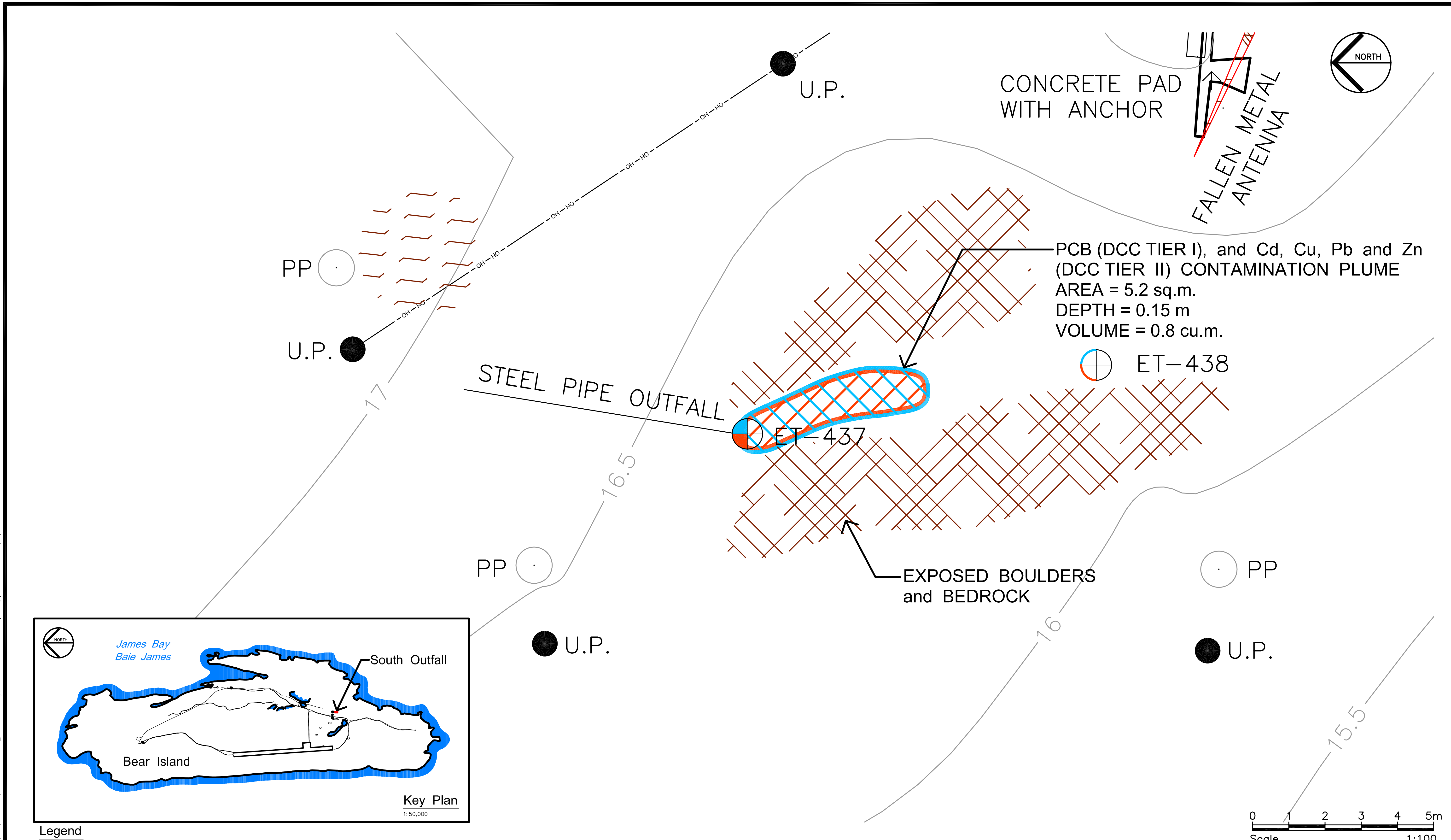


0 100 200 300 400 500 600m
Scale 1:12,500

EARTH TECH | AECOM	Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada	designed GTW	scale As Noted; yy-mm-dd 2008-03-14
		drawn SB/RJH	E.T. project no. 101610
BEAR ISLAND MID-CANADA LINE SITE Phase III Environmental Site Assessment and Materials Audit SITE LAYOUT		checked GTW approved	drawing no. FIGURE 2.1A



LEAD WRAPPED SURFACE CABLE
UTILITY LINE
FALLEN METAL ANTENNA
NORTH
ANTENNA BASE (CONCRETE)
PP
U.P.
ET–379
ESG–203
ET–382
ET–380
BI–12
ET–384
ESG–205
ESG–201
BI–10
BI–11
BI–09
ET–381
BI–08
ET–383
ESG–204
ET–385
TANK
BI–07
Doppler Detention Building
WOOD FRAME STRUCTURE
NO CONCRETE SUPPORT
STEEL PIPE OUTFALL
ET–437
COPPER CONTAMINATION PLUME (DCC TIER II)
AREA = 3.3 sq.m.
DEPTH = 0.3 m
VOLUME = 1.0 cu.m.
ET–386
DEBRIS AREA
16.5
17
16
15.5
Scale 1:250
0 5 10m
James Bay
Baie James
Site 412 South Doppler Detention Building
Bear Island
Key Plan
1:50,000
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy–mm–dd 2008–08–15
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no.
FIGURE 3.1
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
SOUTH DOPPLER DETENTION BUILDING - SITE 412



Legend

ROAD	WATER	METALS	E.T. SAMPLES		
CABLE	DUMP	PAHs	E.S.G. SAMPLES		
ABOVEGROUND PIPE	LANDFILL	PHCs	B.I. SAMPLES		
GRAVEL EDGE	DEBRIS FIELDS	PCBs			

–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs

EarthTech
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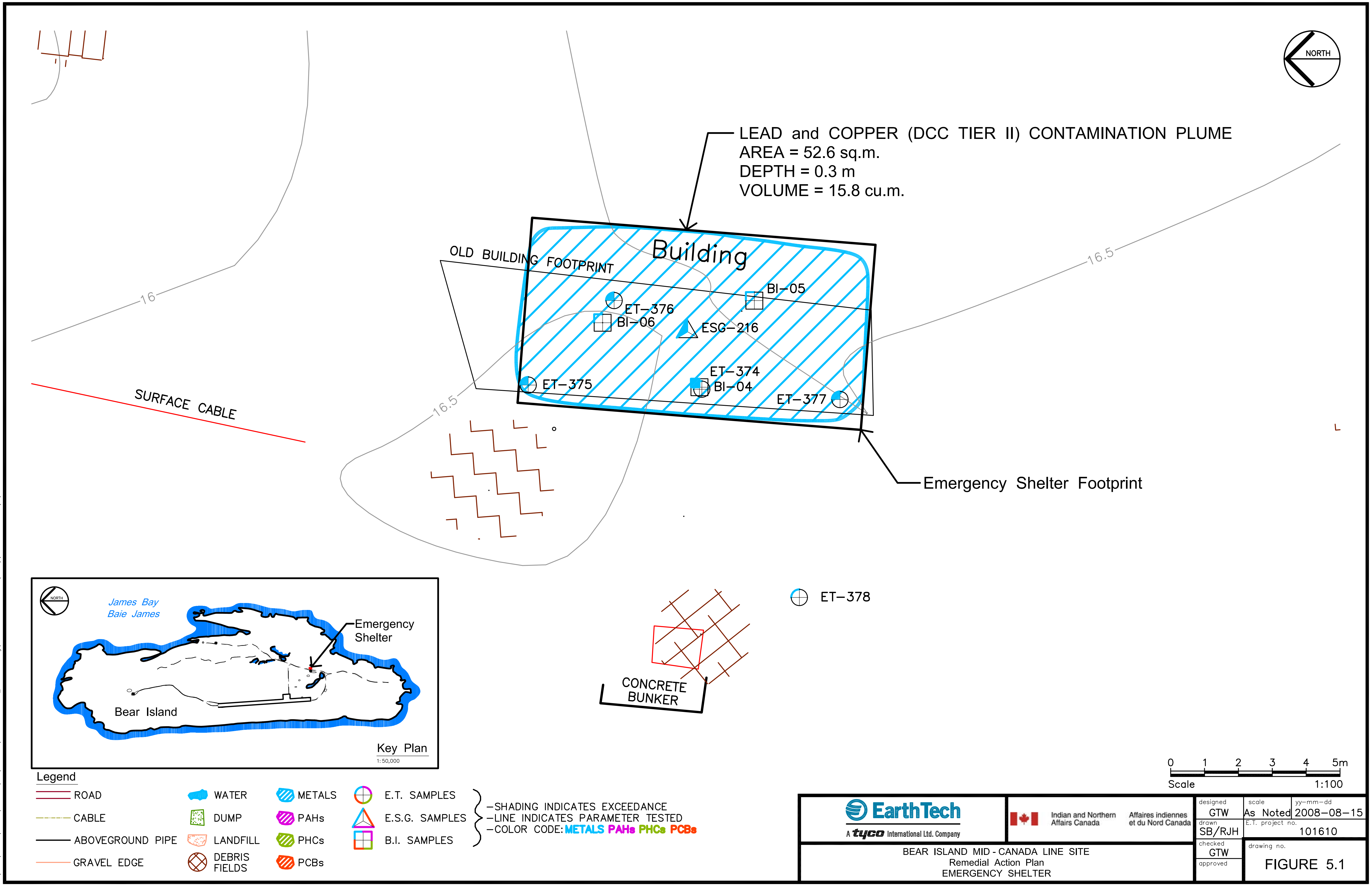
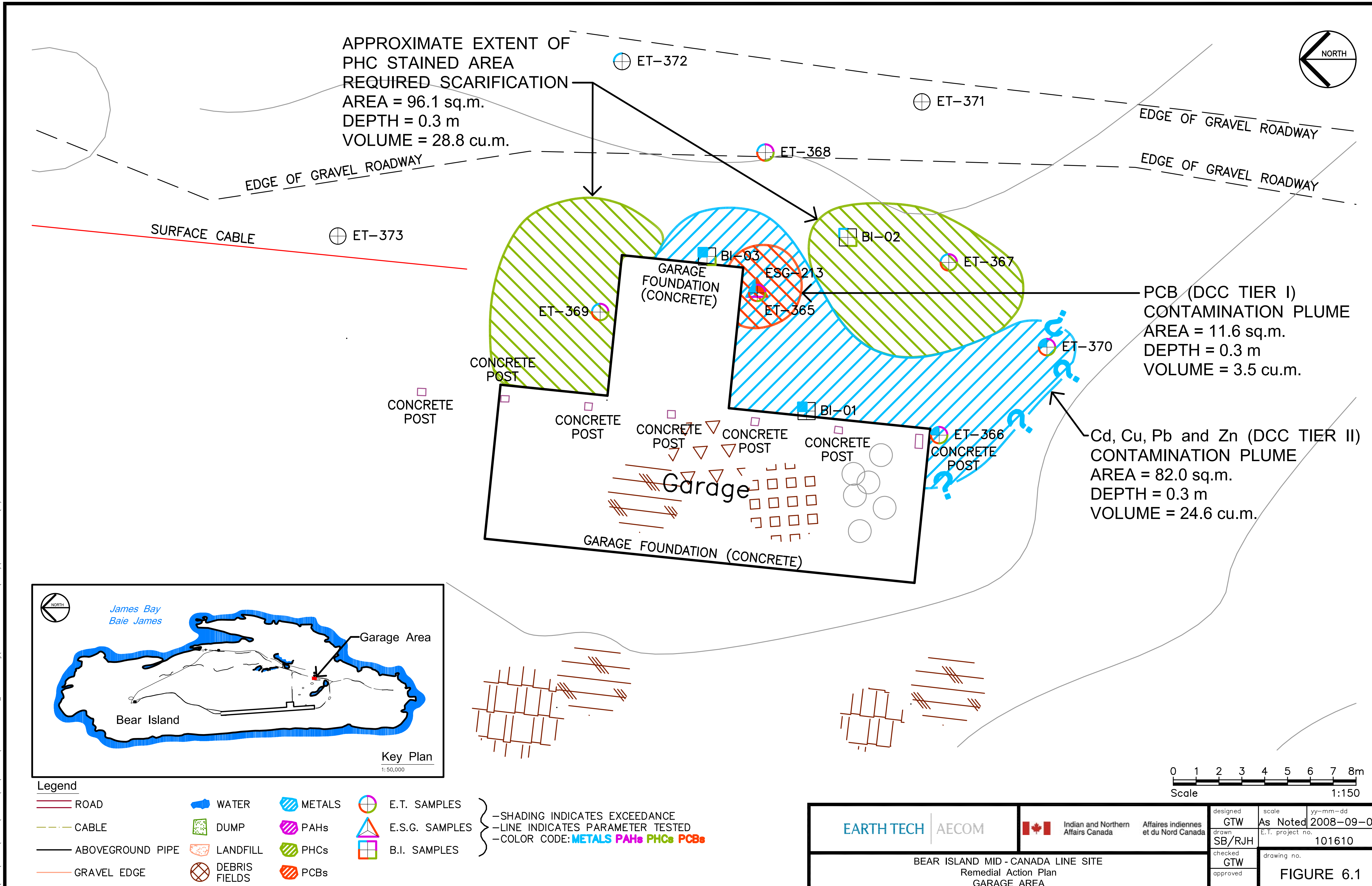
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

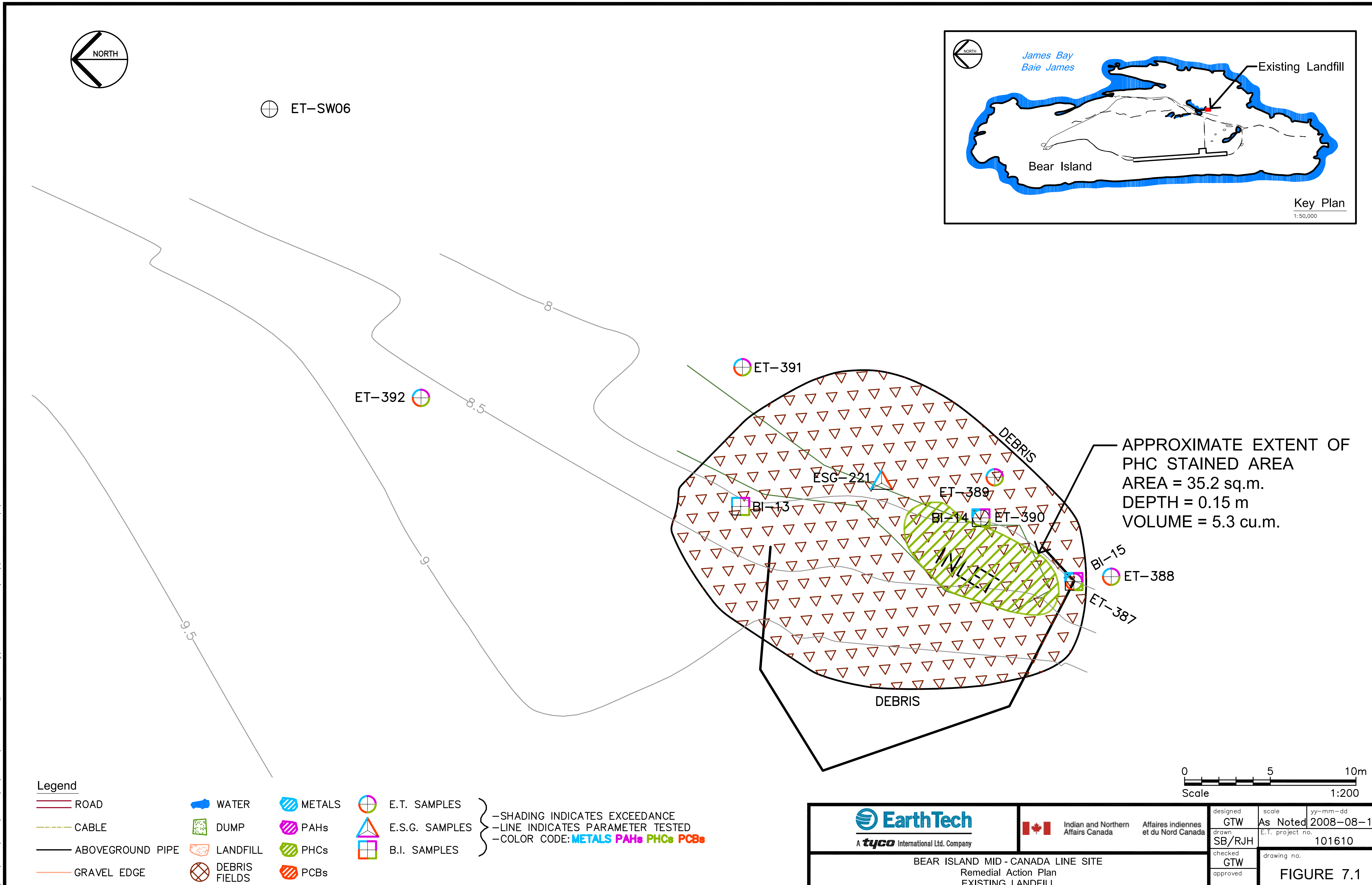
designed GTW	scale As Noted	yy–mm–dd 2008–08–15
drawn SB/RJH	E.T. project no. 101610	
checked GTW	drawing no. FIGURE 4.0	
approved		

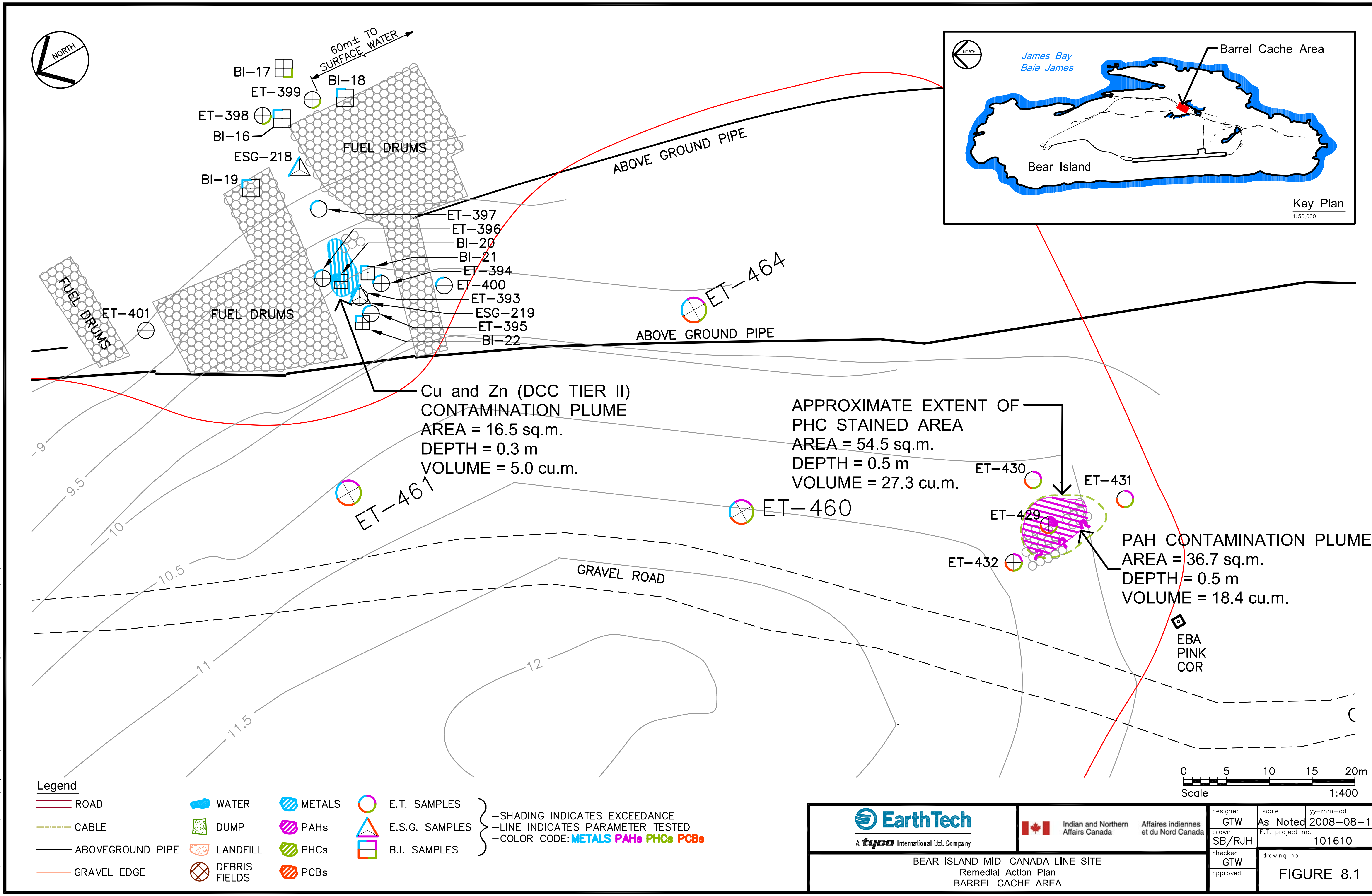
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
SOUTH OUTFALL

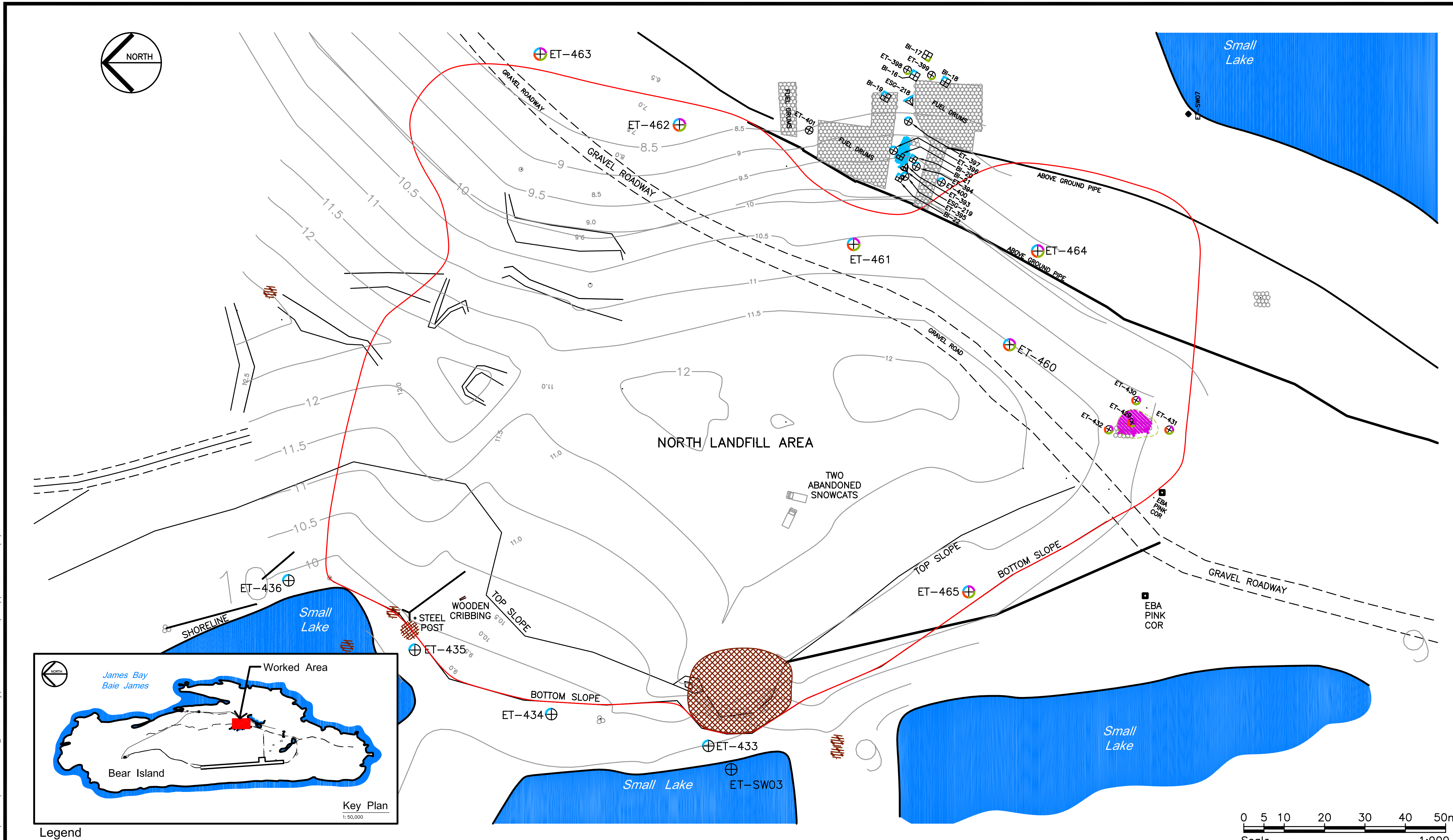


NORTH
LEAD and COPPER (DCC TIER II) CONTAMINATION PLUME
AREA = 52.6 sq.m.
DEPTH = 0.3 m
VOLUME = 15.8 cu.m.
OLD BUILDING FOOTPRINT
Building
ET–376
BI–06
BI–05
ESG–216
ET–375
ET–374
BI–04
ET–377
16
16.5
16.5
SURFACE CABLE
Emergency Shelter Footprint
ET–378
CONCRETE BUNKER
James Bay
Baie James
Emergency Shelter
Bear Island
Key Plan
1:50,000
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs
0 1 2 3 4 5m
Scale 1:100
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy–mm–dd 2008–08–15
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no.
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
EMERGENCY SHELTER
FIGURE 5.1


APPROXIMATE EXTENT OF
PHC STAINED AREA
REQUIRED SCARIFICATION
AREA = 96.1 sq.m.
DEPTH = 0.3 m
VOLUME = 28.8 cu.m.
ET–372
ET–371
ET–368
ET–373
ET–369
ET–367
ET–365
ET–370
ET–366
ESG–213
BI–01
BI–02
BI–03
EDGE OF GRAVEL ROADWAY
EDGE OF GRAVEL ROADWAY
EDGE OF GRAVEL ROADWAY
SURFACE CABLE
NORTH
GARAGE FOUNDATION (CONCRETE)
CONCRETE POST
Garage
GARAGE FOUNDATION (CONCRETE)
PCB (DCC TIER I)
CONTAMINATION PLUME
AREA = 11.6 sq.m.
DEPTH = 0.3 m
VOLUME = 3.5 cu.m.
Cd, Cu, Pb and Zn (DCC TIER II)
CONTAMINATION PLUME
AREA = 82.0 sq.m.
DEPTH = 0.3 m
VOLUME = 24.6 cu.m.
James Bay
Baie James
Garage Area
Bear Island
Key Plan
1:50,000
0 1 2 3 4 5 6 7 8m
Scale 1:150
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs
EARTH TECH AECOM
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy–mm–dd 2008–09–08
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no. FIGURE 6.1
BEAR ISLAND MID-CANADA LINE SITE
Remedial Action Plan
GARAGE AREA


NORTH
ET–SW06
ET–392
ET–391
8
8.5
9
9.5
ESG–221
ET–389
ET–390
BI–13
BI–14
BI–15
ET–388
ET–387
INLET
DEBRIS
DEBRIS
APPROXIMATE EXTENT OF
PHC STAINED AREA
AREA = 35.2 sq.m.
DEPTH = 0.15 m
VOLUME = 5.3 cu.m.
James Bay
Baie James
Existing Landfill
Bear Island
Key Plan
1:50,000
0
5
10m
Scale
1:200
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy–mm–dd 2008–08–15
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no.
FIGURE 7.1
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
EXISTING LANDFILL


NORTH
60m± TO SURFACE WATER
BI-17
BI-18
ET-399
ET-398
BI-16
ESG-218
BI-19
FUEL DRUMS
FUEL DRUMS
FUEL DRUMS
ABOVE GROUND PIPE
ABOVE GROUND PIPE
ET-397
ET-396
BI-20
BI-21
ET-394
ET-400
ET-393
ESG-219
ET-395
BI-22
ET-401
ET-464
Cu and Zn (DCC TIER II)
CONTAMINATION PLUME
AREA = 16.5 sq.m.
DEPTH = 0.3 m
VOLUME = 5.0 cu.m.
APPROXIMATE EXTENT OF
PHC STAINED AREA
AREA = 54.5 sq.m.
DEPTH = 0.5 m
VOLUME = 27.3 cu.m.
ET-430
ET-431
ET-429
ET-432
ET-461
ET-460
PAH CONTAMINATION PLUME
AREA = 36.7 sq.m.
DEPTH = 0.5 m
VOLUME = 18.4 cu.m.
EBA
PINK
COR
GRAVEL ROAD
9
9.5
10
10.5
11
11.5
12
James Bay
Baie James
Barrel Cache Area
Bear Island
Key Plan
1:50,000
0
5
10
15
20m
Scale
1:400
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
-SHADING INDICATES EXCEEDANCE
-LINE INDICATES PARAMETER TESTED
-COLOR CODE: METALS PAHs PHCs PCBs
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed
GTW
scale
As Noted
yy-mm-dd
2008-08-15
drawn
SB/RJH
E.T. project no.
101610
checked
GTW
approved
drawing no.
FIGURE 8.1
BEAR ISLAND MID - CANADA LINE SITE
Remedial Action Plan
BARREL CACHE AREA



Legend

ROAD	WATER	METALS	E.T. SAMPLES
CABLE	DUMP	PAHs	E.S.G. SAMPLES
ABOVEGROUND PIPE	LANDFILL	PHCs	B.I. SAMPLES
EXTENT OF LANDFILL	DEBRIS FIELDS	PCBs	

–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs

EarthTech
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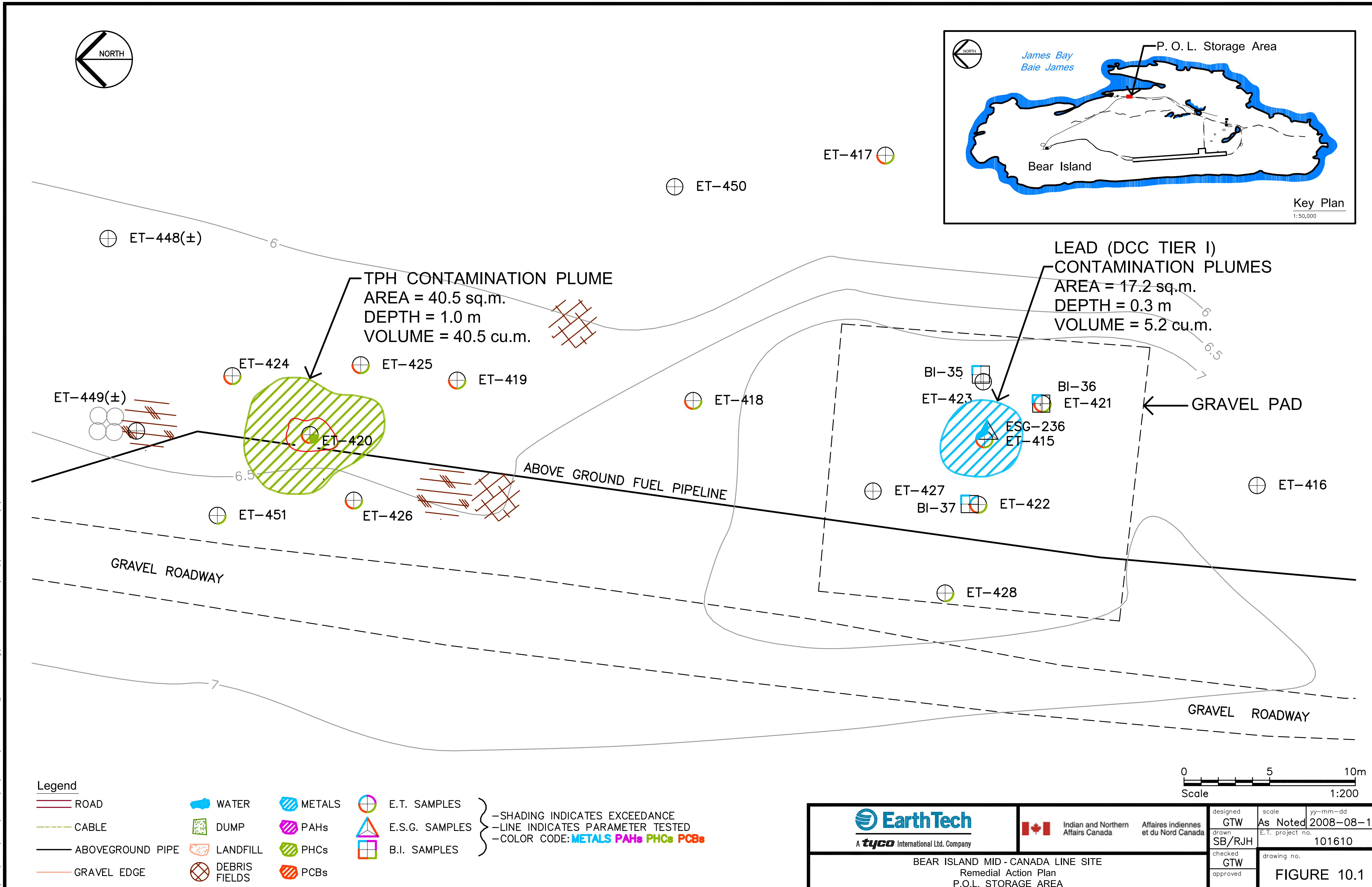
Indian and Northern Affairs Canada — Affaires indiennes et du Nord Canada

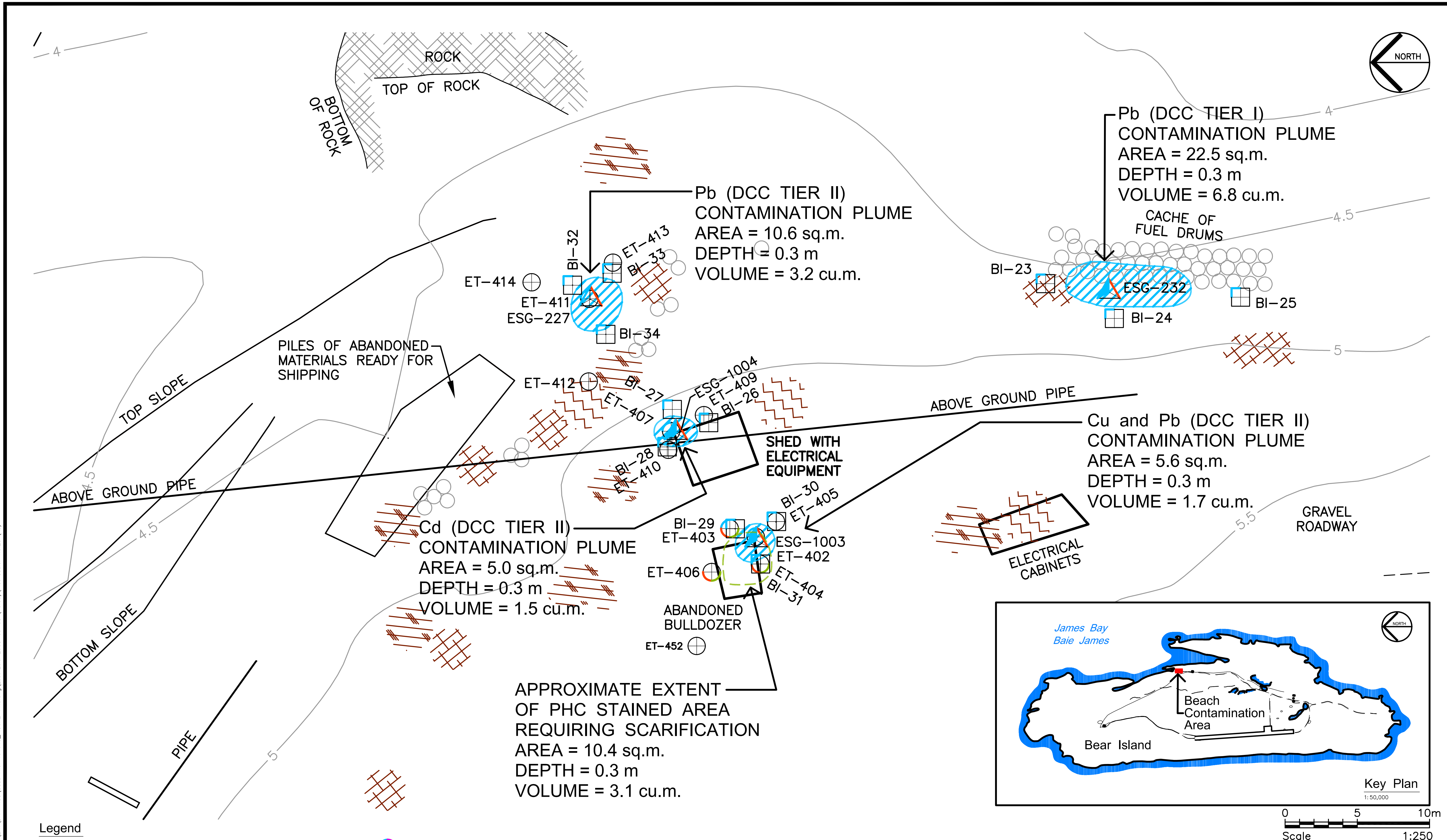
designed GTW	scale As Noted	yy-mm-dd 2008-08-15
drawn SB/RJH	E.T. project no. 101610	
checked GTW	drawing no.	
approved	FIGURE 9.0	

BEAR ISLAND MID-CANADA LINE SITE
Remedial Action Plan
NORTH LANDFILL AREA

L:\WORK\101000\101610\02A-CAD\ENV\DRAWINGS\Cadd File: 101610_FIGURE 9.0.dwg\Last Edit: 2008-08-15 (15:00)\Plot Scale: 1:0.9 (A3)



NORTH
P. O. L. Storage Area
James Bay
Baie James
Bear Island
Key Plan
ET-417
ET-450
ET-448(±)
6
TPH CONTAMINATION PLUME
AREA = 40.5 sq.m.
DEPTH = 1.0 m
VOLUME = 40.5 cu.m.
LEAD (DCC TIER I)
CONTAMINATION PLUMES
AREA = 17.2 sq.m.
DEPTH = 0.3 m
VOLUME = 5.2 cu.m.
6.5
7
ET-424
ET-425
ET-419
ET-449(±)
ET-420
ET-418
BI-35
ET-423
BI-36
ET-421
GRAVEL PAD
ESG-236
ET-415
ABOVE GROUND FUEL PIPELINE
ET-451
ET-426
ET-427
BI-37
ET-422
ET-416
GRAVEL ROADWAY
ET-428
GRAVEL ROADWAY
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
-SHADING INDICATES EXCEEDANCE
-LINE INDICATES PARAMETER TESTED
-COLOR CODE: METALS PAHs PHCs PCBs
0
5
10m
Scale
1:200
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy-mm-dd 2008-08-15
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no.
BEAR ISLAND MID-CANADA LINE SITE
Remedial Action Plan
P.O.L. STORAGE AREA
FIGURE 10.1



Legend

ROAD	WATER	METALS	E.T. SAMPLES
CABLE	DUMP	PAHs	E.S.G. SAMPLES
ABOVEGROUND PIPE	LANDFILL	PHCs	B.I. SAMPLES
GRAVEL EDGE	DEBRIS FIELDS	PCBs	

- SHADING INDICATES EXCEEDANCE
- LINE INDICATES PARAMETER TESTED
- COLOR CODE: METALS PAHs PHCs PCBs

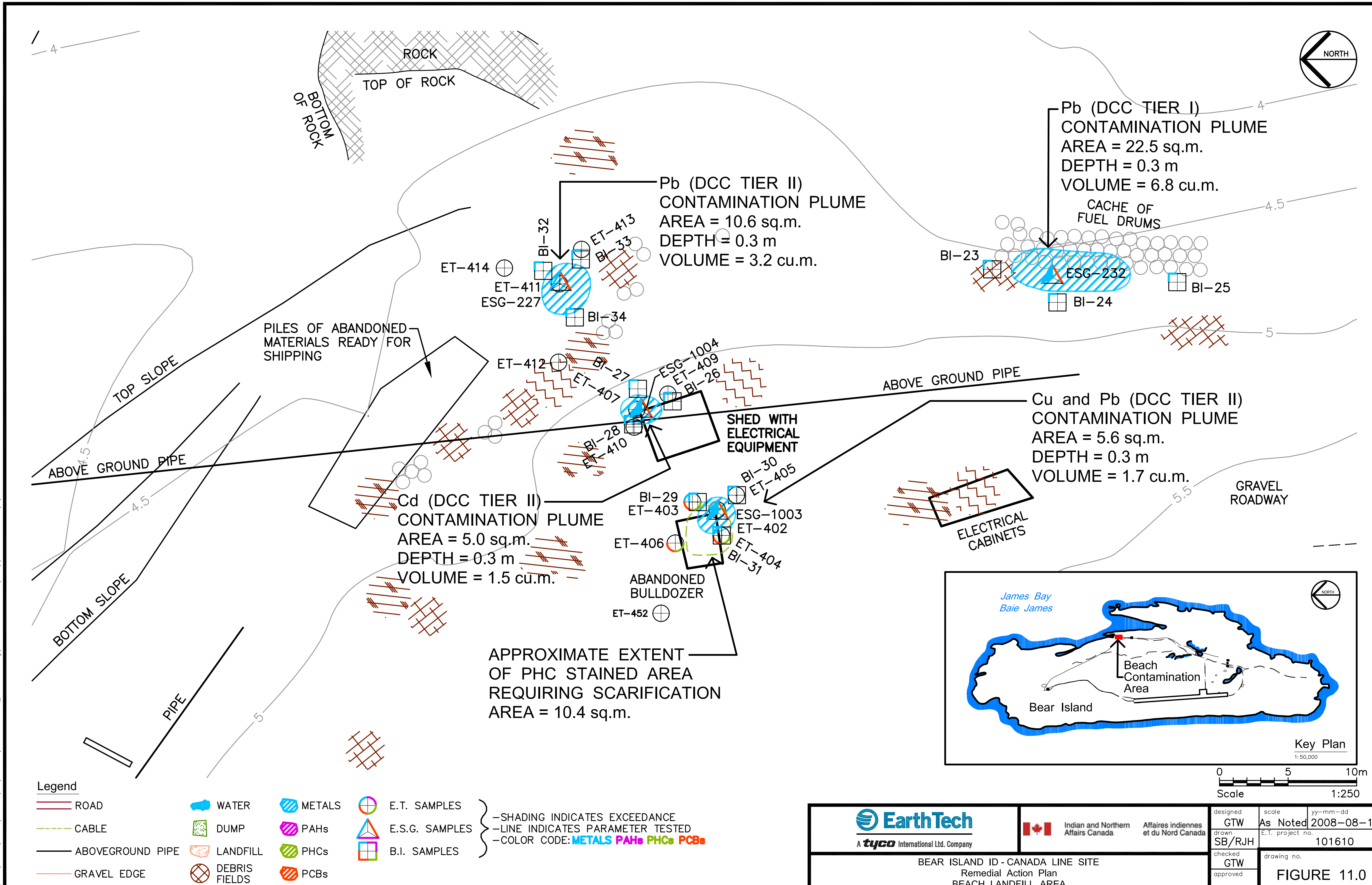
EARTH TECH | AECOM

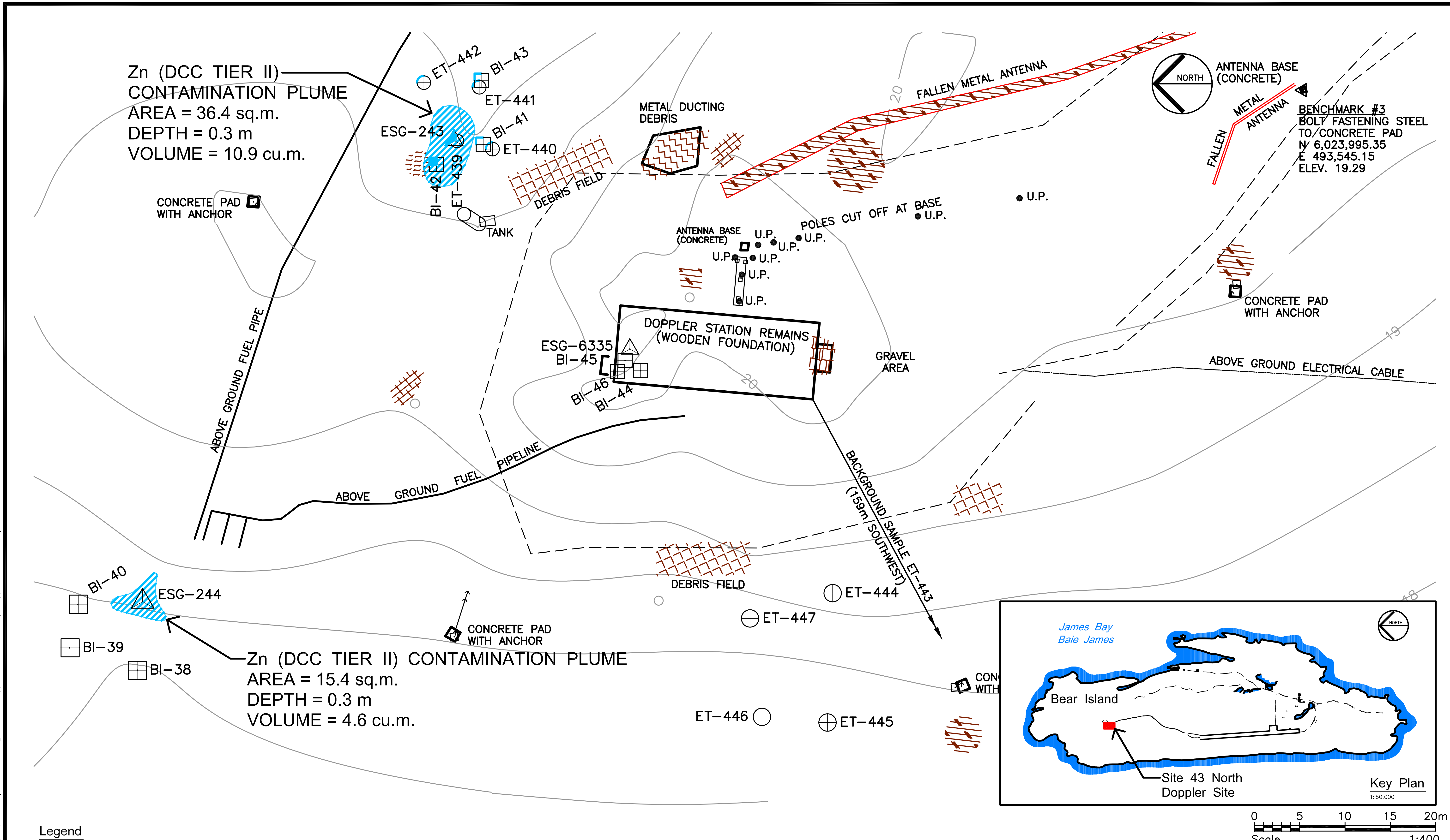
Indian and Northern Affairs Canada — Affaires indiennes et du Nord Canada

BEAR ISLAND ID - CANADA LINE SITE
Remedial Action Plan
BEACH LANDFILL AREA

designed GTW	scale As Noted	yy-mm-dd 2008-09-08
drawn SB/RJH	E.T. project no. 101610	
checked GTW	drawing no.	FIGURE 11.0
approved		

L:\WORK\101000\101610\02A-CAD\ENV\DRAWINGS\Cadd File: 101610_FIGURE 11.0.dwg\Last Edit: 2008-09-08 (15:00)\Plot Scale: 1:0.25 (A3)


ROCK
TOP OF ROCK
BOTTOM OF ROCK
NORTH
Pb (DCC TIER I)
CONTAMINATION PLUME
AREA = 22.5 sq.m.
DEPTH = 0.3 m
VOLUME = 6.8 cu.m.
CACHE OF FUEL DRUMS
BI–23
ESG–232
BI–24
BI–25
Pb (DCC TIER II)
CONTAMINATION PLUME
AREA = 10.6 sq.m.
DEPTH = 0.3 m
VOLUME = 3.2 cu.m.
BI–32
ET–413
BI–33
ET–414
ET–411
ESG–227
BI–34
PILES OF ABANDONED MATERIALS READY FOR SHIPPING
TOP SLOPE
ET–412
BI–27
ET–407
ESG–1004
ET–409
BI–26
BI–28
ET–410
SHED WITH ELECTRICAL EQUIPMENT
ABOVE GROUND PIPE
Cu and Pb (DCC TIER II)
CONTAMINATION PLUME
AREA = 5.6 sq.m.
DEPTH = 0.3 m
VOLUME = 1.7 cu.m.
BI–30
ET–405
BI–29
ET–403
ESG–1003
ET–402
ET–406
ET–404
BI–31
ELECTRICAL CABINETS
GRAVEL ROADWAY
Cd (DCC TIER II)
CONTAMINATION PLUME
AREA = 5.0 sq.m.
DEPTH = 0.3 m
VOLUME = 1.5 cu.m.
ABANDONED BULLDOZER
ET–452
BOTTOM SLOPE
PIPE
APPROXIMATE EXTENT
OF PHC STAINED AREA
REQUIRING SCARIFICATION
AREA = 10.4 sq.m.
4
4.5
5
5.5
James Bay
Baie James
Beach Contamination Area
Bear Island
Key Plan
1:50,000
0
5
10m
Scale
1:250
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
–SHADING INDICATES EXCEEDANCE
–LINE INDICATES PARAMETER TESTED
–COLOR CODE: METALS PAHs PHCs PCBs
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy–mm–dd 2008–08–15
drawn SB/RJH
E.T. project no. 101610
checked GTW
approved
drawing no.
FIGURE 11.0
BEAR ISLAND ID - CANADA LINE SITE
Remedial Action Plan
BEACH LANDFILL AREA



Legend

ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES

-SHADING INDICATES EXCEEDANCE
-LINE INDICATES PARAMETER TESTED
-COLOR CODE: METALS PAHs PHCs PCBs

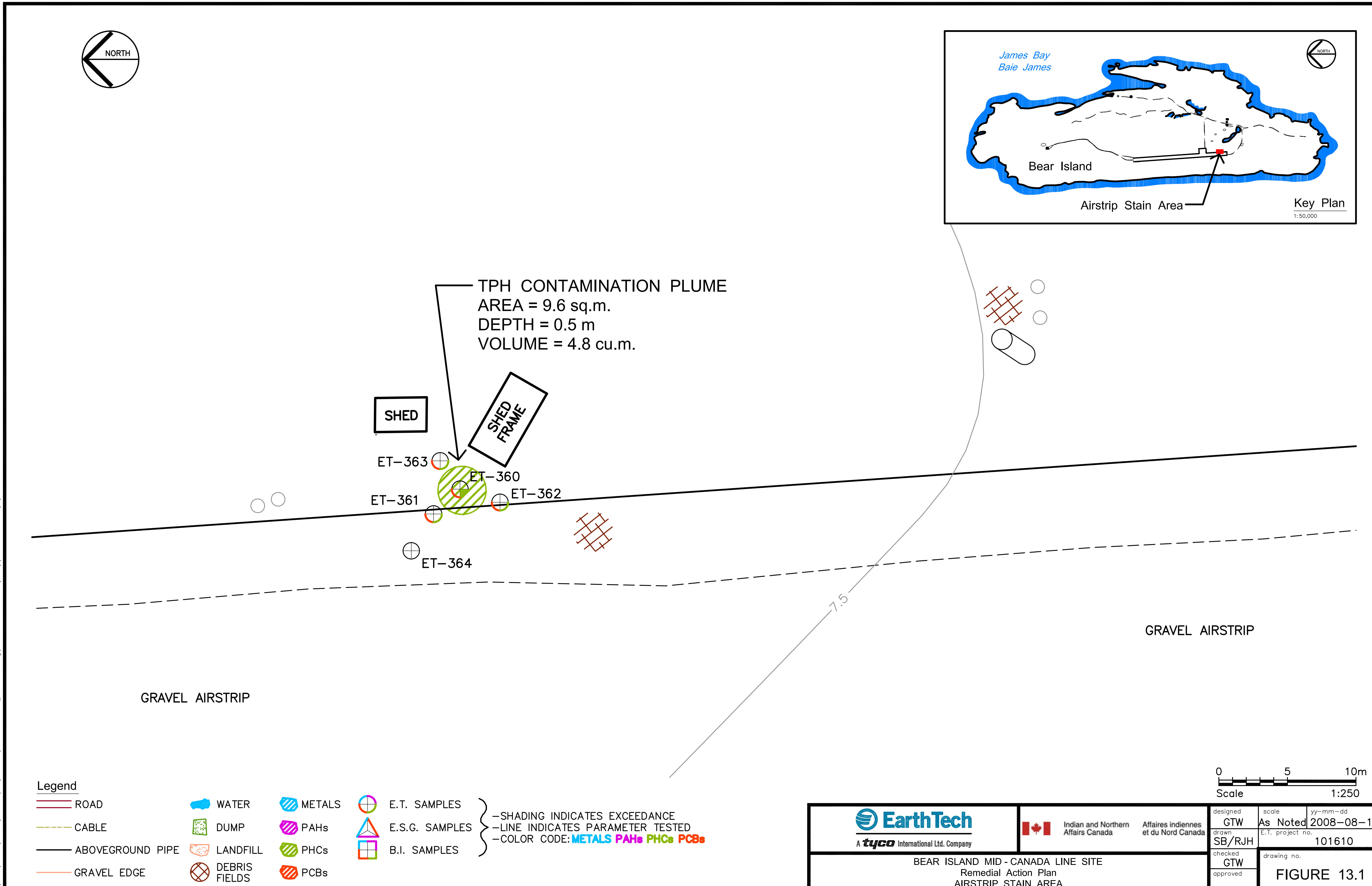
EarthTech
A tyco International Ltd. Company

Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada

designed GTW	scale As Noted	yy-mm-dd 2008-08-15
drawn SB/RJH	E.T. project no. 101610	
checked GTW	drawing no.	
approved	FIGURE 12.0	

BEAR ISLAND MID-CANADA LINE SITE
Remedial Action Plan
SITE 413 - NORTH DOPPLER SITE

FIGURE 12.0


NORTH
TPH CONTAMINATION PLUME
AREA = 9.6 sq.m.
DEPTH = 0.5 m
VOLUME = 4.8 cu.m.
SHED
SHED FRAME
ET-363
ET-360
ET-361
ET-362
ET-364
7.5
GRAVEL AIRSTRIP
GRAVEL AIRSTRIP
James Bay
Baie James
Bear Island
Airstrip Stain Area
Key Plan
1:50,000
Legend
ROAD
CABLE
ABOVEGROUND PIPE
GRAVEL EDGE
WATER
DUMP
LANDFILL
DEBRIS FIELDS
METALS
PAHs
PHCs
PCBs
E.T. SAMPLES
E.S.G. SAMPLES
B.I. SAMPLES
-SHADING INDICATES EXCEEDANCE
-LINE INDICATES PARAMETER TESTED
-COLOR CODE: METALS PAHs PHCs PCBs
0
5
10m
Scale
1:250
EarthTech
A tyco International Ltd. Company
Indian and Northern Affairs Canada
Affaires indiennes et du Nord Canada
designed GTW
scale As Noted
yy-mm-dd 2008-08-15
drawn SB/RJH
E.T. project no. 101610
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approved
drawing no.
FIGURE 13.1
BEAR ISLAND MID-CANADA LINE SITE
Remedial Action Plan
AIRSTRIP STAIN AREA

APPENDIX B

INAC ABANDONED MILITARY SITE REMEDIATION PROTOCOL

Indian and Northern Affairs Canada Affaires indiennes et du Nord Canada

Abandoned Military Site Remediation Protocol

April 2008

Indian and Northern Affairs Canada

Abandoned Military Site Remediation Protocol

November 2007

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1 INTRODUCTION

In the 1950s, at the height of the Cold War, the Distant Early Warning (DEW) Line, a series of radar stations, was constructed across the Canadian Arctic and Alaska to provide surveillance of northern approaches to the continent. In total, 63 stations were constructed of which 42 were located in Canada. In 1963, due to advances in technology, installations at 21 of the sites were considered redundant and these Intermediate or I-Sites were abandoned. All buildings, vehicles, Petroleum Oil Lubricant (POL) storage tanks and miscellaneous debris were left in place. The administration of these sites was transferred to Indian and Northern Affairs Canada (INAC) (Fletcher 1989; INAC 2002). The locations of the INAC military sites in the Canadian Arctic are indicated on Figure 1. The remainder of the installations on the DEW Line continued to operate until the early 1990s, at which point most of them were converted to the North Warning System (NWS). Decommissioning and cleanup of these 21 sites, excluding facilities that are required for the operation of the NWS, is the responsibility of the Department of National Defence (DND).

Several environmental issues have been identified at DEW Line sites, based on previous preliminary and detailed assessments at the INAC and DND sites (ESG 1991, 1993). These issues include physical hazards related to unconsolidated debris and aged structures, as well as environmental impacts associated with soil contamination. In 1996, DND initiated remediation of the DEW Line sites under its jurisdiction, and cleanup of these sites is on-going. The cleanup follows the conditions of the DEW Line Cleanup Protocol (ESG, 1993 and ESG/UMA, 1995) and the co-operation agreements between DND and Nunavut Tunngavik Inc. (NTI) (DGE 1998) and DND and the Inuvialuit Regional Corporation (IRC) (DGE 1996).

INAC has completed the remediation of a number of sites across the Canadian Arctic namely Iqaluit Upper Base, Resolution Island (BAF-5), Horton River (BAR-E), Sarcpa Lake (CAM-F), and Pearce Point (PIN-A). The approach adopted for the remediation of these sites has generally been consistent with the methodology applied at the DND DEW sites (PWGSC references here). Due to the Federal Governments commitment to future funding of contaminated site clean up, INAC recognizes the need for a consistent protocol for abandoned military site cleanup (INAC 2002).

A number of factors must be considered when determining the most suitable approach to site remediation for remote sites in the Arctic environment. The Abandoned Military Site Remediation Protocol is based on an approach that addresses legal requirements, INAC's Contaminated Sites Policy (including risk management requirements) and standard environmental management practices (INAC 2002). This Protocol also takes into consideration financially prudent methodologies that address the site environmental issues while striking a balance with remedial cost. An over-arching principle has been to balance the environmental benefits of remediation activities with potential negative physical impacts to the Arctic environment.

The primary objectives of this document are to provide sufficient background information to understand the environmental issues present at these sites, and to describe the guiding principles for their assessment and remediation. Additional supporting technical information is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008).

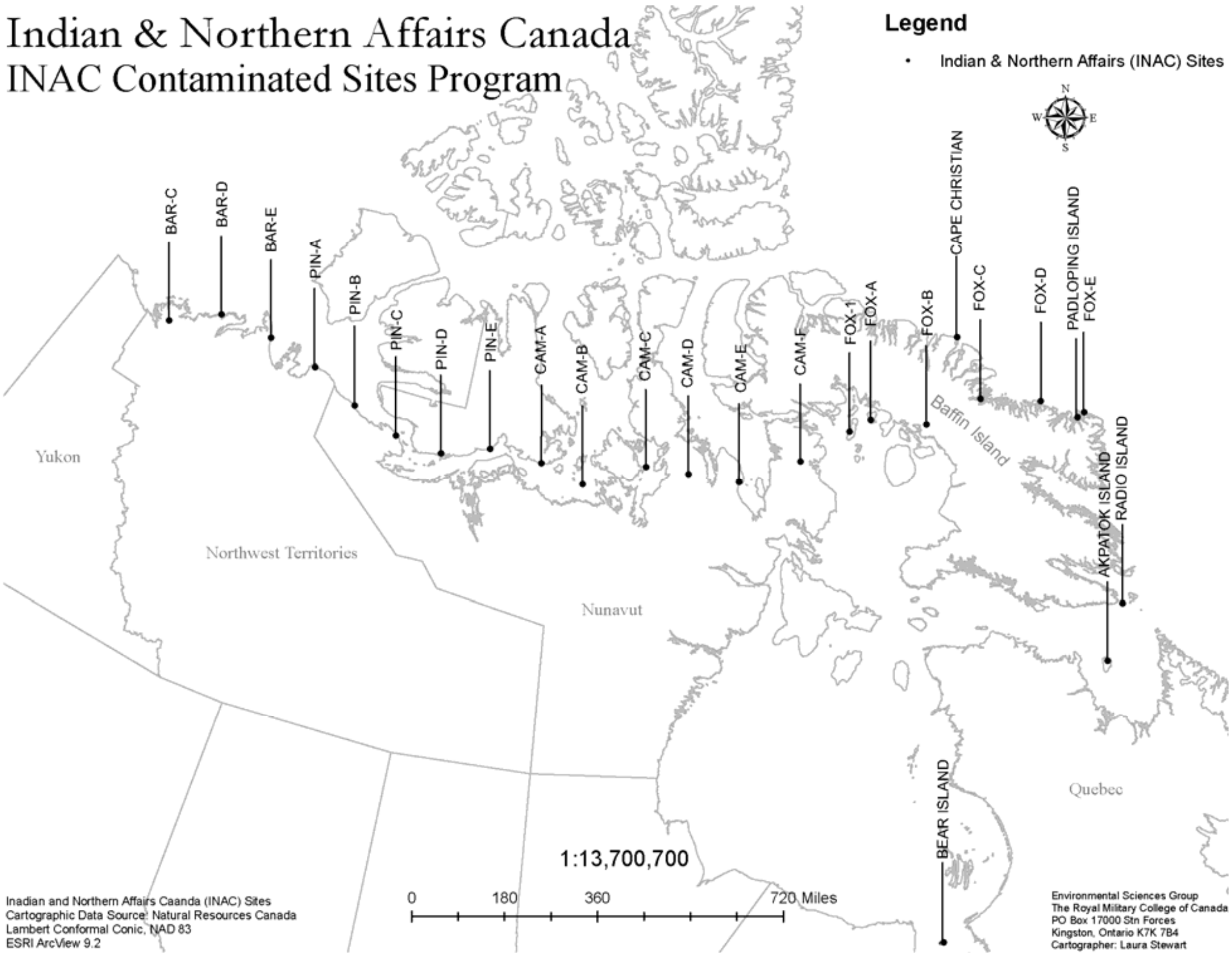


Figure 1 Location of INAC Military Sites

1.1 *Scope of Document*

This document has been structured in a manner generally consistent with the steps outlined in the Federal Contaminated Sites Action Plan (Figure 1 (sic)) as shown in Figure 2. As previously indicated, issues of environmental concern have been identified at the INAC DEW Lines (Step 1). Extensive historical data (Steps 2 and 3) from initial environmental assessments, as well as detailed information collected through the assessment of the DEW sites under the jurisdiction of DND, has been used to develop the requirements for the detailed assessment of the INAC sites (Step 5), as described in Section 4 of this document – Assessment Protocol. Guidelines for the development of a remediation strategy (Step 7) are provided in Section 5 of this document. Implementation related issues, such as confirmatory sampling, waste manifesting, construction quality assurance/quality control measures (Step 9) are described in Section 6. Post-implementation monitoring requirements are described in Section 7 (Step 10).

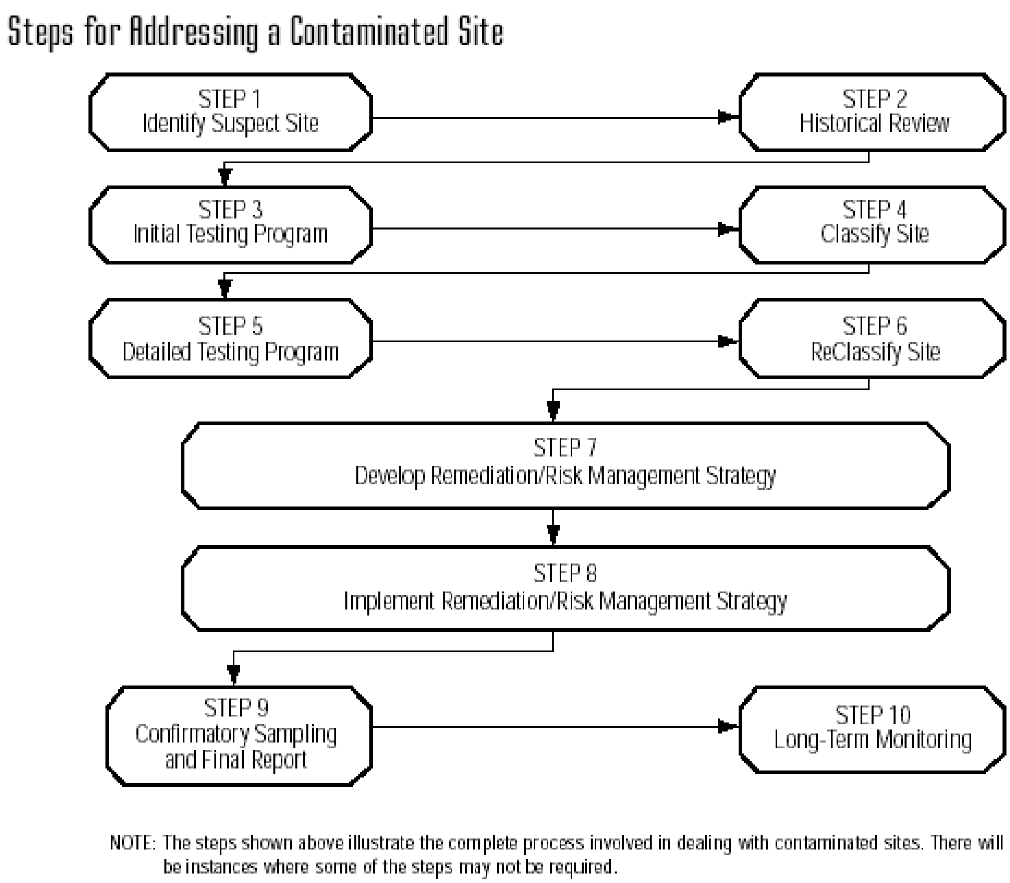


Figure 2 Steps for Addressing a Contaminated Site

2 BACKGROUND

2.1 CCME Environmental Quality Guidelines

Where remediation of federal real property is undertaken, departments and agencies are to set remediation objectives in accordance with the most applicable of the three methods developed by the Canadian Council of Ministers of the Environment (CCME) (CCME 1997):

CCME Tier 1: Follow CCME Environmental Quality Guidelines (CCME 1997, 1999), as amended from time to time, and, where applicable, the *Canada-wide Standard for Petroleum Hydrocarbons in Soil* (CCME 2001), as amended from time to time. To the extent that such guidelines do not exist for a particular type of contamination, or are technically or economically inappropriate for a particular situation, departments and agencies may follow equivalent guidelines or standards (e.g. provincial);

CCME Tier 2: Follow modified CCME Environmental Quality Guidelines where site conditions, land use, receptors, or exposure pathways differ only slightly from the protocols used in the development of the guidelines; and

CCME Tier 3: Develop site-specific remediation objectives based on a site-specific risk assessment, as outlined by the CCME, or equivalent, where site conditions are unique or particularly sensitive.

Although the CCME Environmental Quality Guidelines are broad in application and address a wide variety of land uses and potential contaminants from diverse sources, they do not necessarily address the environmental conditions representative of the Arctic.

2.2 Department of National Defence (DND) DEW Line Cleanup (DLCU) Protocol

The initial environmental assessment of the DEW Line sites under the jurisdiction of DND was one of the first major contaminant investigations in the Arctic related to point source contaminants. Following these assessments in the early 1990s, a remedial protocol was developed by DND in consultation with other government agencies and stakeholders (ESG 1991, 1993), and is referred to as the DEW Line Cleanup (DLCU) Protocol. This Protocol was developed at a time when no remediation standards and criteria specific to the Canadian Arctic existed but remedial criteria for contaminants were developed using a contaminant source and pathway targeted approach, consistent with CCME's Tier 3 method. A broad suite of chemicals was investigated and the contaminants of concern at DEW Line sites were identified as those contaminants that were consistently elevated relative to the site background levels and the available Canadian federal or provincial guidelines (CCME 1991). The rationale for selection of contaminants of concern is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008). Engineering input with respect to remediation strategies was used to refine the cleanup protocol (ESG/UMA 1995), prior to its implementation at the first DND sites in 1996.

The cleanup of Arctic sites presents a number of unique challenges, including but not limited to:

- Remote site location, with access limited to sea-lift and small aircraft during the summer months, and over-land during winter;
- Short construction season, typically from July to September, which may limit the technical feasibility of remedial options;
- Lack of centralized waste disposal facilities;
- High costs associated with mobilization of equipment and personnel to the sites, both during the site assessment and remedial phases; and
- Sensitivity of the Arctic ecosystem to changes in the physical habitat.

Experience gained since 1996 at the DND sites has been reviewed annually to evaluate lessons learned and to incorporate new information and methodologies as they become available. The DLCU protocol therefore is the culmination of scientific and engineering expertise that has been applied across the Arctic at the DND sites.

Although there are many similarities between INAC and DND DEW sites, the INAC sites were in operation for a significantly shorter period of time, and environmental issues tend to differ in scale. In addition, there may have been other land use subsequent to the DEW Line activities. INAC sites and known land uses are summarized in Table 1.

Table 1 Summary of INAC Military Sites and Historic Land Use

Site Designation/Name	Location	Other Historic Land Use/ or Issues
BAR-C Tununuk Camp	NWT	Imperial Oil as Lessee
BAR-D, Atkinson Point	NWT	Canadian Marine Drilling (CANMAR) Canadian Reindeer Ltd. (note: cleanup on-going)
BAR-E Horton River	NWT	SRR, (note: cleanup completed, monitoring on-going)
PIN-A Pearce Point	NWT	Biological Research Station (note: cleanup completed, monitoring ongoing)
PIN-B Clifton Point	Nunavut/Kitikmeot	
PIN-C Bernard Harbour	Nunavut/Kitikmeot	
PIN-D Ross Point	Nunavut/Kitikmeot	
PIN-E Cape Peel	Nunavut/Kitikmeot	
CAM-A Sturt Point	Nunavut/Kitikmeot	
CAM-B Hat Island	Nunavut/Kitikmeot	Short Range Radar (SRR) as part of North Warning System
CAM-C Matheson Point	Nunavut/Kitikmeot	
CAM-D Simpson Lake	Nunavut/Kitikmeot	SRR (module train gone)
CAM-E Keith Bay	Nunavut/Qikiqtaaluk	Module train gone/some evidence of burning
CAM-F Sarcpa Lake	Nunavut/ Qikiqtaaluk	Research Station (note: cleanup completed, monitoring ongoing)
FOX-1 Rowley Island	Nunavut/Qikiqtaaluk	SRR (large burn area, module train gone)
FOX-A Bray Island	Nunavut/Qikiqtaaluk	SRR (module train gone)
FOX-B Nudluardjuk Lake	Nunavut/Qikiqtaaluk	SRR
FOX-C Ekalugad Fiord	Nunavut/Qikiqtaaluk	
FOX-D Kivitoo	Nunavut/Qikiqtaaluk	Fire destroyed main building train in 1963
FOX-E Durban Island	Nunavut/Qikiqtaaluk	Partially burned building
Cape Christian	Nunavut/Qikiqtaaluk	LORAN Site
Padloping Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station
Radio Island	Nunavut/Qikiqtaaluk	Navigational aid and weather station (note: cleanup completed, monitoring ongoing)
Akpatok Island	Nunavut/Qikiqtaaluk	Exploratory oil well drilling in the 1970s
Bear Island	Nunavut/Qikiqtaaluk	Mid-Canada site
BAF-5 Resolution Island	Nunavut/Qikiqtaaluk	Pole-Vault site (note: cleanup completed, monitoring ongoing)

Based on these cleanup objectives were set for the INAC sites, and the INAC protocol was developed as outlined in the following sections.

3 CLEANUP OBJECTIVES

Cleanup objectives, which are consistent with the Federal Contaminated Sites Management Working Group (CSMWG) objective to "integrate sustainable development and pollution prevention principles while meeting environmental regulations and protecting public health" (CSMWG, 2000, TB 1998, 2000, 2002), have been identified as follows:

- To restore sites to meet the environmental objectives established for the northern sites;
- To prevent migration of contaminants into the Arctic ecosystem;
- To remove physical hazards for the protection of human health and safety; and
- To implement a cost effective remediation solution.

These objectives are consistent with those applied in the remediation of DEW Line sites under the jurisdiction of DND (DGE 1996, 1998). The following considerations need to be taken into account when developing and implementing a Remedial Action Plan for the INAC sites:

- Respect all historical agreements and obligations in a fair and reasonable manner;
- Ensure consistency with federal guidelines for the management of contaminated sites;
- Apply the Canadian Council of Ministers of the Environment (CCME) environmental protection and management approaches (CCME 1996, 1997, 1999, 2001) as applicable;
- Apply simple, practical remedial solutions wherever possible, with flexibility as necessary to adjust to site-specific conditions when they are identified;
- Establish cost effective solutions through the use of best practices to ensure appropriate levels of environmental protection for all sites;
- Recognize the concerns of climate change in an Arctic setting; and
- Ensure the long-term effectiveness of the environmental remedial measures.

It is Canadian government policy that all federal departments and agencies ensure sound environmental stewardship with respect to property in their care by avoiding contamination and managing contaminated sites in a consistent and systematic manner that recognizes the principle of risk management and results in the best value for the Canadian taxpayer (TBRP 1998, 2000, 2002). The following section identifies the primary factors that have been taken into consideration in developing a remediation approach.

3.1 *Biophysical Environment*

The INAC abandoned military sites are located across the Arctic in the Southern Arctic Ecozone in the western Arctic, in the Northern Arctic Ecozone in the central and eastern Arctic and Arctic Cordillera along the east coast of Baffin Island. The majority of the sites are located along the coastline.

Mean annual temperatures are in the range of -11^{0}C in the western Arctic and tend to be colder in the central and eastern Arctic. Accordingly, all of the sites are located within the zone of continuous permafrost. Much of the Arctic region is classified as polar desert as annual precipitation, predominantly as snow, is generally within the range of 100 to 300 mm. One exception is the eastern coastline of Baffin Island near Cumberland Peninsula, where precipitation can be in the order of 400 to 600 mm annually.

As indicated, the Arctic ecosystem is characterized by extreme environmental conditions, including cold temperatures, large seasonal fluctuations in incoming solar radiation, extensive snow and ice cover, and short growing seasons. These conditions affect the productivity, species diversity, wildlife behaviour (e.g., migration), and food chain characteristics of Arctic ecozones. For example, productivity in terrestrial, freshwater, and marine environments is reduced due to limited nutrient availability, low light, low temperatures, ice cover, and short growing seasons. Compared to most other ecosystems, the Arctic is characterized by relatively low reproductivity, organisms that are slower to reach sexual maturity and are generally longer lived, lower species diversity; and distinctive sub-ice biological communities. Relatively short food chains, which are characteristically known for their dominance of marine mammals and birds, are associated with simple predator-prey relationships (e.g. phytoplankton-zooplankton-fish-seal-polar bear or phytoplankton-zooplankton-whale). The combination of all these physical factors affect the sparse distribution and number of Arctic biological communities and makes them very sensitive to physical disturbances such as habitat destruction (AMAP 1998, CACAR 2003).

The assessment and remedial protocols that have been developed are cognizant of striking a balance between the physical disturbances of existing impacted areas versus the physical disturbances of developing new areas required to support remediation activities.

4 ASSESSMENT PROTOCOL

The elements of the assessment protocol have been developed through the review of previous work at related sites (eg. PWGSC 2001, 2001b, 2001c, 2002, 2002b, 2002c, 2002d, 2002e, 2002f, 2003, IEG 2001, EWG 1998 & 1999, UMA 1994) and taking into consideration information of particular relevance to the unique character of the INAC sites. Typical environmental issues at abandoned military sites include:

- Contaminated Soils
- Existing landfills/dump sites
- Debris on surface and in waters near the sites
- Debris associated with the demolition of structures/facilities
- Hazardous waste

The objective of the environmental assessment of these sites is to collect sufficient information to allow the development of a Remedial Action Plan.

Issues related to implementation, including but not limited to: environmental screening, permitting, and construction, also require information to be collected at the assessment stage. These information requirements include:

- Geotechnical site information relating to potential development areas for landfills and/or hydrocarbon contaminated soil treatment area, available borrow sources;
- Site access, such as condition of roadways, the airstrip, barge landing areas, requirements for winter roads or CAT train routes;
- Potable water supply and seasonal fluctuations of potable water supply;
- Siting of camp facilities and temporary storage areas;
- Natural Environment Assessment;
- Traditional Knowledge Surveys/Assessment; and
- Archaeological Assessment

This section of the protocol provides guidance related to conducting an environmental site assessment that meets the requirements of the INAC cleanup objectives.

4.1 Background Geo-Chemical Assessment

Application of remedial criteria must take into account background concentrations of inorganic elements, as naturally elevated concentrations of a select number of inorganic elements may impact assessment and subsequent remedial activities. High natural variability in concentrations of inorganic elements on the local scale has been observed at several DND DEW Line sites (PIN-1, DYE-M, FOX-2, FOX-3). Based on a desk-top study of the geochemistry and surficial and bedrock geology, a detailed investigation of background concentrations is required in conjunction with the environmental site assessment of the following sites:

- Nadluarjuk Lake (FOX-B),
- Kivitoo (FOX-D),
- Durban Island (FOX-E) and
- Padloping Island.

A statistically valid approach must be used to design a sampling program for the collection of representative samples from background areas. Guidance for the background geochemistry investigation is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008).

4.2 Contaminated Soils

4.2.1 Inorganic Elements and PCBs – DCC Criteria

The contaminants of concern for INAC abandoned military sites, where historic land use is limited to former DEW Line operations, is based on a detailed review of data collected to date from DND and INAC site assessment and delineation programs. The DEW Line Cleanup (DLCU) Protocol, that includes criteria for a specific, limited set of contaminants, is considered appropriate for the INAC sites. Supporting documentation for selection of these criteria is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008).

This provides a consistent approach across all sites, and is generally considered protective of the Arctic ecosystem as described in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008). The parameters and criteria are identified in Table 2.

Table 2   DEW LINE CLEANUP CRITERIA (DCC) FOR SOIL (see Note a)

Parameter in Soil	**CRITERIA[b]** mg/kg	
Inorganic Elements	*DCC Tier I [c]*	*DCC Tier II[d]*
Arsenic (As)		30
Cadmium		5.0
Chromium		250
Cobalt		50
Copper	-	100
Lead	200	500
Mercury	-	2.0
Nickel		100
Zinc		500
Polychlorinated biphenyls		
PCBs	*1.0*	*5.0*

a. These criteria were adopted specifically for the cleanup of Arctic DEW Line Sites from the 1991 versions of the Quebec Soil Contamination Indicators and the Canadian Council of Ministers of the Environment Interim Canadian Environmental Criteria for Contaminated Sites. They were validated by an assessment of the soil concentration at which the substance was taken up by vascular plants and thereby constituted an input to the Arctic ecosystem.

b. Soil criteria are given in parts per million, ppm.

c. Soils containing lead and/or PCBs at concentrations in excess of DCC Tier I, but less than DCC Tier II, may be landfilled in an Inert Waste Landfill,

d. Soils containing one or more substrates in excess of DCC Tier II are to be treated/disposed of in a manner that precludes contact with the Arctic ecosystem.

A review of data collected on INAC sites with land use other than DEW Line activities indicated that the likelihood of other parameters occurring systematically in concentrations exceeding applicable criteria in the absence of other contaminants of concern is low (INAC 2008).

Based on historic patterns of waste disposal and contamination observed at other former DEW Line sites, soils contaminated in excess of the DCC criteria are typically found in the following locations:

- In the vicinity of buildings;
- Former sewage discharge areas;
- Former open storage areas;
- In areas, where surface debris is present;
- Landfill or dump areas; and
- Petroleum, Oil, Lubricant (POL) bulk storage areas and along fuel lines and transfer locations.

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a Remedial Action Plan and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and shall include the following information:

- Description of the objective for each potential area of concern
- Sampling locations
- Sampling methods
- Proposed number of samples and media
- Parameters for analyses,
- Sampling methodology, analytical requirements, Quality Assurance/Quality Control measures.

Delineation shall be achieved by sampling in a grid pattern over the affected area. The grid spacing is determined by the estimated size of the area: the larger the estimated area, the larger the grid spacing. A number of test pits shall be excavated to determine the depth of contamination. Test pits shall also be excavated outside the area of surface contamination, to evaluate whether sub-surface migration of the contaminants has occurred. Greater sample density may be warranted based on site specific conditions; in particular in areas where soils contaminated with PCB concentrations in excess of 50 ppm are suspected; such as at garages and module trains. Consideration shall be given to the cost-benefit of the cost for analyses versus the cost of disposal of contaminated soils. It is recommended that over-sampling and an iterative approach to analyses be employed to provide greater confidence that closure is achieved during the assessment phase.

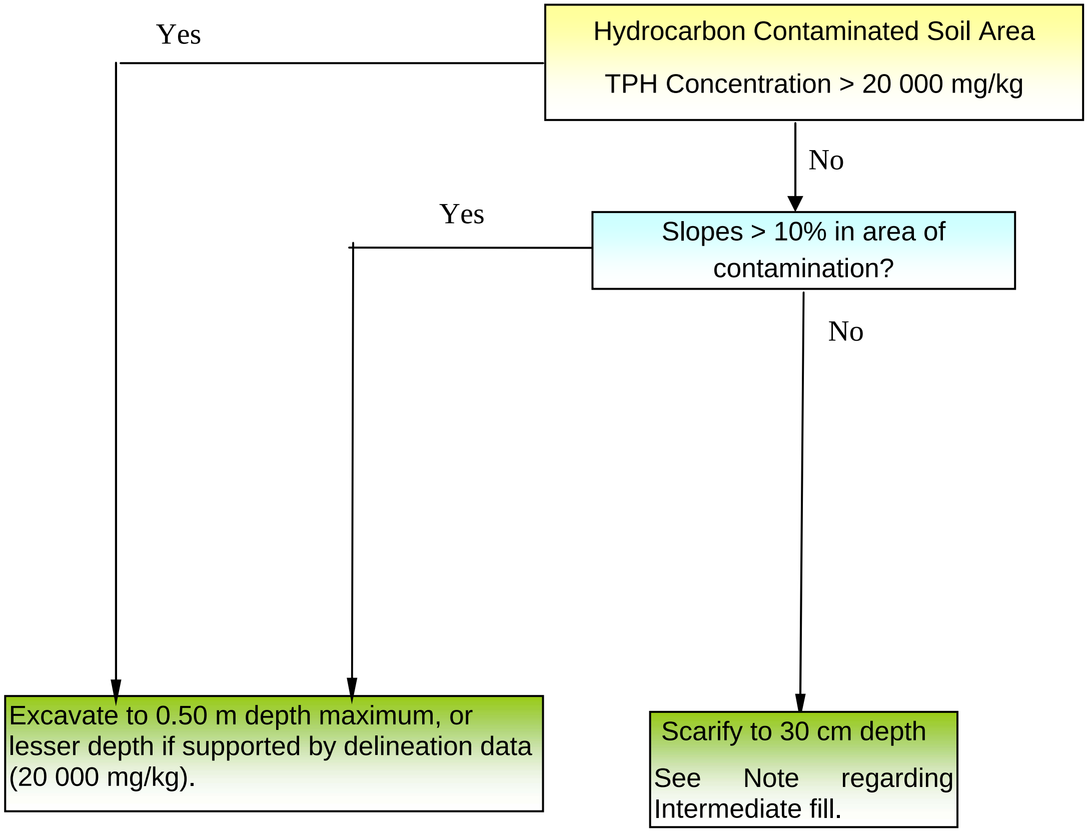
Additional samples shall be collected and analysed to determine transport and disposal requirements should off-site disposal of contaminated soils be required.

4.2.2 Hydrocarbon Contaminated Soils

Where free product is encountered, the free phase liquid will be addressed prior to the application of a qualitative risk assessment method for establishing remediation requirements.

A review of the assumptions used for the derivation of the CCME CWS for Petroleum Hydrocarbons, as well as the need to minimize physical disturbance suggests that direct application of criteria for the protection of all receptors may not be appropriate at the INAC sites (INAC 2008). Therefore, based on a review of the CCME Method, the process currently utilized on DND DEW Lines sites, and the quantitative risk assessments carried out to date, a revised set of criteria are provided, as summarized in the following flowcharts. Supporting documentation is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008)

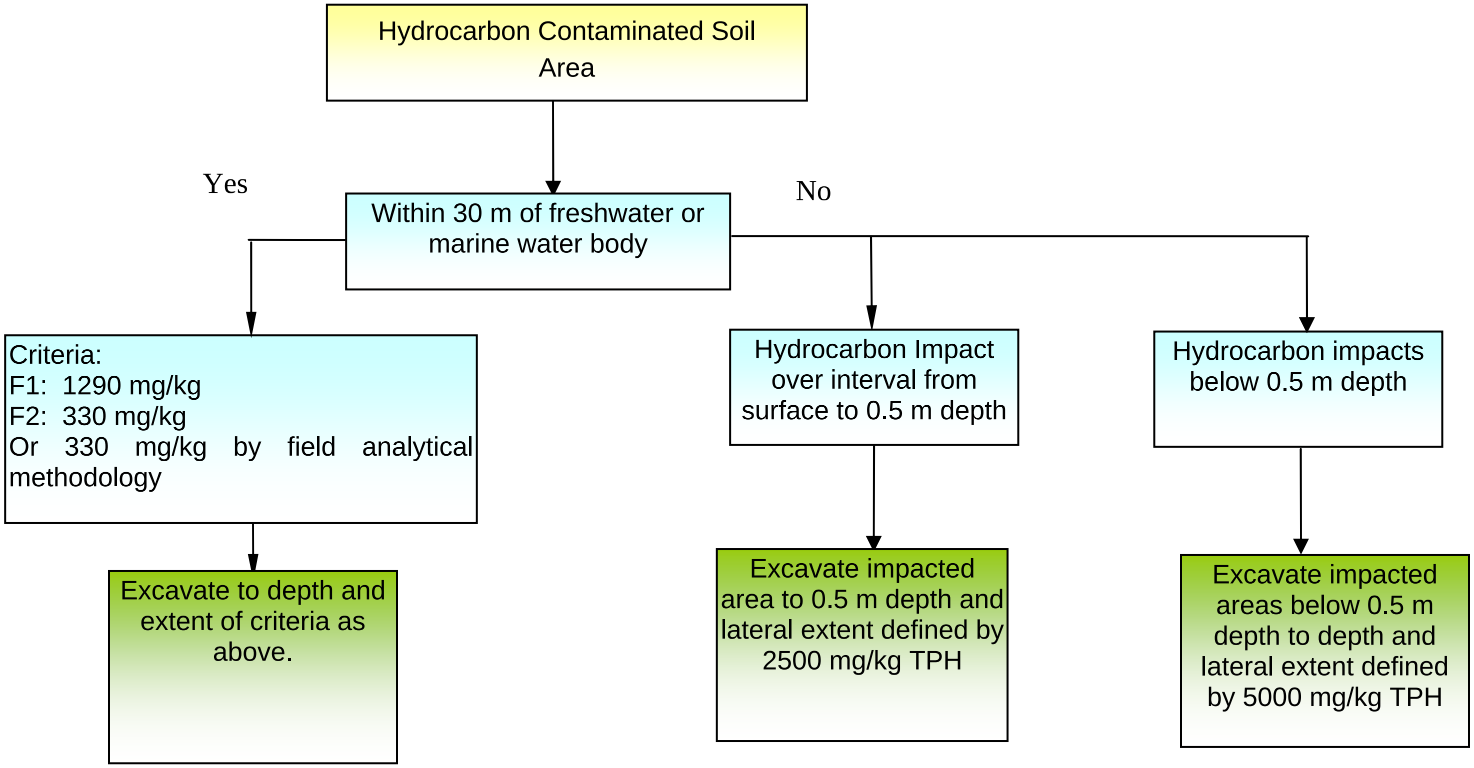
Figure 3 **Type A (Non-Mobile) Hydrocarbon Contaminated Soil – Evaluation Process**



Notes:

Type A is defined as the sum of F3 and F4
20 000 mg/kg criterion based on residual formation.
Presence of co-contaminants to be confirmed or disproved. Most stringent requirements apply.
F3 and F4 are essentially insoluble and migration of dissolved phase in active layer groundwater is not applicable.
Criteria for topography to mitigate against sediment/contaminant transport through surface water run-off.

Figure 4 **Type B (Mobile) Hydrocarbon Contaminated Soil – Evaluation Process**



Based on historic patterns of contamination observed at other former DEW Line sites, soils contaminated with hydrocarbons are typically found in the following locations:

- In the vicinity of buildings near fuel distribution lines, fuel dispensing tanks;
- Former open storage areas and/or debris areas where barrels may be present;
- Petroleum, Oil, Lubricant (POL) bulk storage areas; and
- Landfill or dump areas

Delineation of the lateral extent and depth of contamination is required to determine quantities of sufficient accuracy to develop a Remedial Action Plan and the subsequent Contractual Drawings and Specifications. A detailed sampling plan shall be developed for each potential area of concern identified as part of historic review, and must include the following information:

- Description of the objective for each potential area of concern;
- Sampling locations;
- Proposed sampling methods for shallow and depth samples, where the depth sampling should achieve a depth consistent with the estimated active layer thickness;
- Proposed number of samples and media;
- Parameters for analyses in accordance with Table 3;
- Sampling methodology, analytical requirements, Quality Assurance/Quality Control measures.

At minimum, the information requirements as outlined in Table 3 shall be incorporated into the Sampling Plan.

Table 3 Hydrocarbon Contaminated Soil Information Requirements

Item	Comments
Hydrocarbon Contaminated Soils – Stained Soils (F3/F4 fraction) – Type A	
Areal Extent -Visible surface staining	Topographic survey and location/coordinates of stained areas and sample locations Provide sketches with measurements
Topography	Provide survey of area to confirm slopes, Examine for evidence of erosion (drainage channels)
Soil Description	Include description of grain size distribution Fine grained, coarse grained, maximum particle size Well graded or poorly graded.
Sampling	Collect soil samples for analyses of F1 to F4 fractions to characterize contamination, analyses for presence of co-contaminants such as PCBs.
Confirm Depth of Staining	Testpit to extent of stain, collect soil sample for PHC analyses at 0.5 m depth.
In areas of multiple staining	Identify and survey extent of stains Collect individual samples from most visibly stained areas to represent "worst" case. Focus on stained areas larger than 4 m^2
Evidence of residual or free product	
Hydrocarbon Contaminated Soils – Near Fuel Storage, Distribution or Dispensing Areas (F1-F3 fraction) Type B	
Within 30 m of **water body supporting aquatic life**	
Describe surrounding environment	Confirm fish bearing waters if possible, differentiate from tundra ponds. Consulting locals and elders who use the area may prove to be useful.
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 330 mg/kg as per on-site analytical capabilities Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results. Oversampling and iterative analyses may be required where there is poor correlation with test-kits (organic materials)
Sample groundwater in Testpit excavation in source zone.	Collect groundwater samples and analyze for dissolved hydrocarbons (F1, F2) and wastewater discharge criteria (Section 6). Measure water levels, and presence of free product, if applicable
Greater than 30 m distant of water body supporting aquatic life	
Sampling – Hydrocarbons	Delineate **laterally and at depth** to 2500 mg/kg as per on-site analytical capabilities. Collect sufficient samples for laboratory analyses of hydrocarbon fractions to confirm correlation with on-site analytical results For the purposes of comparison, use the summation of F1 to F3 concentrations.
Collect soil samples for grain size distribution	Representative samples should be taken of soils within and downgradient of the source zone for determination of grain size distribution, and water content.
All Hydrocarbon Contaminated Soil Areas	
Topography	Survey sample locations and topography of source zone and surrounding area. Include min. 25 m buffer zone around contaminated areas. Document seepage zones (toe of embankments), if applicable. Evidence of erosion
Evidence of impacted vegetation	Note presence and extent of vegetation; identify areas of stressed vegetation if applicable.
Wildlife	Note presence or evidence of wildlife (nests, burrows, etc.) within impacted and surrounding area area. Review in context with overall Natural Environment Survey (Section 4.9)

Additional representative samples shall be collected and analysed to assist in the determination of treatment requirements. These analyses shall include, but not be limited to:

- Water content
- Total Available Nutrients
- Total Organic Carbon
- Treatability tests to assess bioremediation potential

4.3 *Landfills*

Landfills on INAC abandoned military sites are generally smaller in extent than those located on DND DEW Line sites, and in some cases, may be more appropriately referred to as buried debris areas or dumps. As part of the historic review, areas of ground disturbance/landfill activity will be identified for further investigation. A detailed investigation/sampling plan shall be developed for each area, and must include the following information:

- Description of the objective for each potential area of concern
- Methodology for determining extent of buried debris using non-intrusive geophysical surveys, such as Electro-Magnetic Surveys (EM) or Ground Penetrating Radar (GPR), and associated ground-truthing.
- Identification of sampling locations both up- and down-gradient of the landfill or dump.
- Proposed sampling methods for shallow and depth samples, where the depth sampling should achieve a depth consistent with the estimated active layer thickness.
- Proposed number of samples and media
- Parameters for analyses
- Sampling methodology, analytical requirements, and Quality Assurance/Quality Control measures.

In addition, general site information shall be collected as outlined in Section 4.9 and 4.10, as well as landfill/dump specific information as described below to support the evaluation of the potential environmental risk associated with the landfill (Annex A).

Physical Characteristics:

- Landfill/Dump Extent
- Landfill/Dump Depth
- Contaminant Characterization (concentrations/extent)
- Volume and extent of exposed debris, where exposed debris is defined as surface and/or partially buried debris within 0.5 meters of the surface.

Pathway/Transport Mechanisms

Surface expressions of contaminated soil and/or leachate.

- Grades/Topography
- Surface cover materials type and depth
- Evidence of erosion
- Precipitation
- Distance to downgradient perennial surface water bodies

Receptor Characteristics

- Distance to freshwater/marine habitat and habitat usage.
- Terrestrial Habitat
- Traditional Land Use

The evaluation matrix prepared by the DND/NTI Environmental Working Group (EWG 1998), was adopted for this protocol with minor modifications for the assessment of potential environmental risk (Annex A). These modifications included:

- Addressing remedial requirements for debris areas (generally smaller in size than landfills)
- Modifying contaminant characterization to include leachate migration and the presence of contaminants as one category.
- Including consideration of snow pack as well as annual precipitation.

Additional detail regarding the evaluation of landfills/dumps is provided in Annex A.

4.4 Surface Debris

Surface debris is present on many of the sites, and may consist of a variety of waste materials including:

- Scrap metal and wood wastes (painted/unpainted);
- Barrels, potentially containing product; and
- Asbestos, batteries, electrical equipment.

All areas of debris shall be inventoried to the extent possible to provide volume estimates and characterization of waste materials. Site debris shall be classified as inert, non-hazardous wastes or hazardous wastes in accordance with the following regulations.

- Federal Transportation of Dangerous Goods Act and Regulations
- The Canadian Environmental Protection Act

- The Nunavut or Northwest Territories Environmental Protection Act

The number of barrels containing product shall be inventoried where it is safe to do so. However, it is impractical to sample and analyse contents of all barrels on site during the assessment phase. To provide information required for the Remedial Action Plan, a statistically relevant number of barrels shall be sampled and analysed for parameters in accordance with the barrel protocol, and as summarized below:

Organic Phase: Total Chlorine, PCBs, Cadmium, Chromium, Lead

Aqueous Phase: % Alcohols and Glycols, Total Chlorine, Cadmium, Chromium, Lead

If the aqueous phase is less than 2% alcohols or glycols, water shall be analysed in accordance with waste water discharge criteria. See Annex B for further information on the Barrel Protocol.

4.5 *Submerged Debris*

Debris may be present in the near shore marine environment and/or lakes that are present on the site. Observations of debris in water shall be recorded to the extent possible and supplemented with local and anecdotal knowledge. Previous studies have confirmed that such debris is primarily a risk to navigation in shallow waters (INAC 2008).

4.6 *Buildings/Structure Inventory*

The existing buildings and infrastructure at a site will be demolished to their foundations as part of the cleanup. To assist in the development of the Remedial Action Plan, an inventory of building contents and building/structure construction materials and dimensions is required. Building contents, where present, shall be inventoried and classified as non-hazardous or hazardous wastes. Hazardous building materials may include, but not be limited to: PCB and lead-amended paint, asbestos containing materials (ACMs), fluorescent lights, and mercury containing switches.

Painted building materials shall be tested for total lead and PCBs, and leachable lead and PCBs in order to determine disposal requirements. Samples of concrete, excluding paint, shall be collected and analysed for PCBs. As part of the assessment, a detailed waste inventory shall be prepared that includes: dimensions, building materials, foundation materials (concrete slab, timber piles, timber crib), estimated volume and mass of wastes, and the basis of any assumptions used in the estimate. Painted materials must be specifically identified and the extent of paint coverage and adherence quantified.

4.7 *Geotechnical Requirements*

4.7.1 Potential Development Areas

New engineered landfills and hydrocarbon treatment areas may be required during cleanup. Potential locations shall be identified and surveyed during the site assessment phase. Guidelines for the siting of potential development areas include:

- Avoidance of permafrost sensitive areas, vegetated areas and archaeological features.

- Avoidance of contaminated areas.
- Maintain a distance of 300 m or more from downgradient permanent water features
- Ground surface topography with grades of 6% or less.
- Proximity to borrow sources, waste materials.

The INAC sites are all located within the zone of continuous permafrost. The sensitivity of permafrost to climate warming consists of two components, the thermal response to warming and the impact of thaw (physical response) (Smith, Burgess, 2004) as cited in EBA (2007). The physical response of the terrain to permafrost degradation is mainly dependent on the ice content of the frozen material (Dyke et al., 1997). Warming of ice-rich perennially frozen ground would eventually lead to its thawing and the resultant thaw settlement, slope instability, thaw slumping, thermokarst, and other permafrost degradation-related processes. Excess ground ice can be identified by landforms at surface, such as patterned ground. An evaluation of the potential for impacts due to climate change is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008).

Potential development areas shall be surveyed to provide detailed topographic information to allow generation of ground contours. In previously disturbed areas, soil sampling and analyses shall be carried out to confirm or disprove the presence of any historic contamination using a targeted approach. Additional sampling should be carried out over a grid with spacing of approximately 50 m x 50 m.

4.7.2 Borrow Sources

Borrow material is required during cleanup for the construction of new landfills, development of treatment areas, backfilling of contaminated soil excavation, closure of existing landfills, regrading of areas disturbed during cleanup and for road construction.

Available existing sources of borrow material should be exhausted before exploiting new areas. Areas of excess ground ice or of biophysical significance (denning/nesting areas) should be avoided. Use of abandoned gravel pads and road infrastructure as granular source material is preferable, wherever possible. Given the potential for impacts due to historic activities, existing gravel pads shall be screened for the presence of contaminants during the assessment phase.

Borrow sources shall be identified and characterized and estimated quantities developed. Test-pits shall be excavated to confirm subsurface stratigraphy, seepage, depth to permafrost table or bedrock, and ground ice conditions. Select soil samples shall be retained for geotechnical laboratory testing to assist in the development of Specifications. Testing shall include, but not be limited to water content, grain size distribution, and moisture density relationships. At sites where background inorganic element concentrations are elevated, additional samples shall be taken to characterize the borrow material.

4.7.3 Site Access

Access to the sites is typically by barge/ship and aircraft and on the sites by existing access roads. A limited number of sites are land-locked. The use of the airstrip is essential to mobilize materials and equipment required for site activities. An inspection and sampling of the airstrip fill materials shall be completed during the assessment phase to determine the load capacity to support a variety of aircraft. Drainage and erosion features shall be documented.

As heavy equipment will be required for the site restoration, potential CAT Train and/or other equipment mobilization options shall be investigated. The suitability of the beach for barge landing/sea lift access shall also be assessed. Local knowledge and TK may prove useful in evaluating potential CAT train routes as well as suitable barge landing sites.

4.7.4 Siting of Camp Facilities and Temporary Storage areas.

Laydown areas are required for temporary camp structures, equipment and storage during the cleanup. Potential locations shall be identified during the site assessment phase. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances.

4.8 Potable Water Supply

A suitable water supply shall be identified during the site assessment phase. Consideration shall be given to the flow rates at the time of the site assessment, as water withdrawal rates may not exceed 10% of the flow volume. Water samples shall be collected and analysed for criteria in accordance with the latest edition of the CCME Guidelines for Drinking Water Quality.

4.9 Natural Environment Assessment

A thorough assessment of the natural environment of the site and surrounding area shall be conducted as part of the detailed environmental site assessment. This assessment shall be carried out mainly by a biologist with input from a local traditional knowledge (TK) consultant, where appropriate. This study shall consist of describing the regional and local setting, local ecosystems, species assemblage as well as potential impacts to vegetation and wildlife from cleanup activities and proposed mitigation measures. Additional information requirements are outlined in the following subsections.

4.9.1 Regional and Local Setting

The report should address the following information requirements.

- Location (site coordinates, main natural and man-made features present);
- Ecosetting (ecozones and ecoregions);
- Climate (mean temperature and precipitation data);
- Vegetation;
- Landforms and soils (main land features, soil types, general topography);
- Human usage and disturbance (TK input will be valuable to assess human usage of the area).

4.9.2 Local Ecosystems

This subsection should describe 1) the various inland ecosystems; 2) the ecosystems present in the former operational areas (*i.e.*, disturbed areas and areas with infrastructure); as well as, if applicable, 3) the shore/coastline ecosystem; and the 4) open ocean ecosystem.

Each identified ecosystem should be described in terms of the various terrestrial and freshwater habitats, the vegetation and wildlife species present in those habitats, as well as past and current impacts and disturbances to habitats. Local and traditional knowledge from people who use these areas for hunting and fishing may provide useful information on plant and wildlife species present as well as ecosystem health.

4.9.3 Species Assemblage

This subsection should describe the various species at risk (*i.e.*, extirpated, endangered, threatened, or special concern) according to the Species at Risk Act (SARA) that occur in the general vicinity of the site.

All species (*i.e.*, birds, mammals, fish, and plants) observed or known to use the site and surrounding areas should be documented. Observations should be described in terms of numbers and behaviour during sighting (*e.g.*, migrating, nesting/breeding, feeding, etc.). Species not observed on site but known to use the area may be documented by consulting local TK holders as well as various studies and reports.

4.9.4 Impacts and Mitigation

Potential impacts to vegetation and wildlife from site investigation and remediation activities should be clearly identified. Proposed mitigation measures and other recommendations should also be presented as part of the Natural Environment Assessment.

4.10 Traditional Knowledge Surveys/Assessment

Traditional Knowledge (TK) forms an integral part of the development of the Remedial Action Plan. Incorporating TK during the assessment phase can provide guidance on targeting specific areas of concern to local residents. The qualitative knowledge provided by local residents can be used to complement and enhance the largely quantitative information provided by the physical studies completed during the site assessments.

TK can be efficiently obtained through a local community representative (*i.e.*, local TK consultant) who can liaise between the Consultant and the various TK holders in the community. The local TK consultant may either be an Elder or someone else who knows the site well (*e.g.*, hunter, ranger). The ideal local TK consultant possesses some TK, but more importantly knows who to consult in the community to obtain relevant site information and TK.

4.10.1 Typical TK and Local Knowledge

TK gathered on site may be grouped in four (4) main categories:

1. Historical and Archaeological Features
2. Wildlife Use
3. Land Use
4. Site Specific Information

Historical and archaeological features provide information on traditional land use of the area. These features, often hidden from the untrained eye, will be identified by local TK holders as to their use and relative age, and can complement the work of the archaeological assessment.

Wildlife use of the land in and around the site includes migration routes, mating and calving grounds, as well as summer and winter-feeding areas of large land mammals. Nesting, moulting, and summer feeding grounds of migratory birds such as geese and ducks, as well as migration routes and feeding areas of sea mammals must also be identified.

Land use relates to traditional usage of the land and sea for hunting, fishing, camping, and harvesting products on land (*e.g.*, berries, eggs, medicine, tea, drinking water), and harvesting of sea products (*e.g.*, clams, kelp).

Site-specific information about the military site while it was under construction or in operation, including events (spills, accidents), waste management practices (storage, dumping), as well as natural occurrences, should also be documented.

4.11 *Archaeological Assessment*

The overall purpose of the archaeological assessment is to obtain the necessary archaeological regulatory approval at the assessment stage as required to implement the remediation program. The scope of the archaeological assessment shall include:

- Preparation and submission of permit applications to the Department of Culture, Language, Elders and Youth.
- Completion of an Overview for each site, which would include file searches to determine the number, nature and terrain associations of previously recorded sites.
- Completion of a field inventory and assessment of each site;
- Completion of a heritage features or structures evaluation for consideration of heritage value;
- Provision of a heritage resource impact assessment for each site
- Implementation of more detailed investigations at key sites and appropriate mitigation at significant sites affected by proposed projects (if required); and
- Preparation of a final permit report for each site and, if required, provides a summary of these results suitable for inclusion in a screening document.

Areas of high and moderate archaeological potential for containing cultural material will require detailed examination during the assessment phase, to ensure the protection and if required, development of mitigation measures to be implemented prior to or during cleanup.

5 REMEDIATION PROTOCOL

The elements of the remediation protocol have been developed through the review of previous work at related sites by DND and INAC, and take into consideration information of particular relevance to the unique character of the INAC sites.

The primary components of cleanup on the INAC abandoned military sites includes:

- Treatment/Disposal of Contaminated Soil
- Disposal of Debris/Demolition Waste
- Closure of Existing Landfills or Dumps
- Construction of New Landfills
- Development of Borrow Sources and Site Grading Activities

The goals of a Remedial Action Plan are to reduce the environmental liabilities present at the site, maximize benefits to local communities and ensure good value to the Crown. More specifically, the Remedial Action Plan is to identify and evaluate options applicable to the treatment and/or disposal of waste materials present at a site. These waste materials typically include:

- Soil contaminated with inorganic elements, PCBs and/or petroleum hydrocarbons;
- Non-hazardous and hazardous wastes associated with building/facility demolition;
- Visible/accessible debris including barrel contents; and
- Buried debris/landfills as identified by geophysical surveys

The estimated volume of waste materials in each stream shall be determined and options evaluated on the basis of effectiveness to reduce and/or mitigate environmental risks in the short and long term, long term liability or residual risks, relative costs, monitoring costs and community acceptance. The costs associated with implementing remedial solutions include, but are not limited to: resources, such as materials, equipment, and human resources, and site logistics. Mobilization and site access constitute a significant cost for remote site cleanups, and can have significant impact on selection of the preferred remedial option. The evaluations shall be summarized and preferred remedial options identified for each waste stream. Options shall be integrated to finalize the recommended approach for site remediation.

During remediation planning public community consultations are conducted in surrounding communities to obtain feedback on the draft Remedial Action Plan.

5.1 *Contaminated Soils*

Contaminated soils are considered in three primary categories; soils that are regulated, soils that are classified as hazardous and soils that are classified as contaminated but not hazardous waste. Contaminated soils that are regulated shall be remediated and/or disposed of in compliance with the applicable regulations. Volumes of contaminated soil that are not regulated or hazardous shall be excavated to the depth and extent to meet the DCC (see section 4.2.1). Hydrocarbon contaminated soil remediation levels shall be established through the application of the Petroleum Hydrocarbon (PHC) Evaluation Process.

Three primary contaminated soil types have been identified; inorganic element contaminated soil, PCB contaminated soil and hydrocarbon contaminated soil (Type A and Type B, see section 4.2.2). Where multiple contaminants are present in the soils, the most conservative remedial option that addresses all contaminant types shall be applied. A summary of remedial options for contaminated soils is presented in Table 4.

Table 4 Summary of Remedial Options – Contaminated Soil

Contaminated Soil	Remedial Options
DCC Tier I	• Excavate and place in an on-site engineered landfill or • Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II	• Excavate and dispose of in an on-site Tier II facility or • Containerize for off-site disposal[1]
Inorganic Elements Leaching	• Transport in accordance with the TDGA for disposal at an off-site facility
PCB Contaminated Soil in excess of CEPA	• Store in accordance with Storage of PCB Material Regulations pending a decision regarding disposal
Type A TPH (Non-Mobile Hydrocarbon Contaminated Soil)	• Excavate and place in an on-site engineered landfill • Scarify surficial stains that meet PHC criteria.
DCC Tier I -Type A TPH	• Excavate and place in an on-site engineered landfill or • Cap in place under 0.3 m of clean fill if in a stable location
DCC Tier II -Type A TPH	• Excavate and place in an on-site Tier II disposal facility or • Containerize for off-site disposal[1]
Type B TPH (Mobile Hydrocarbon Contaminated Soil)	• *In-situ* or *ex-situ* treatment to reduce environmental risk to meet guidelines
DCC Tier I -Type B TPH	• Ex-situ treatment to meet guidelines and place in an on-site engineered landfill or cap under 0.3 m of clean fill in a stable location after treatment. • Small areas of contamination may be excavated and disposed of in a Tier II disposal facility
DCC Tier II -Type B TPH	• Excavate and place in an on-site Tier II Facility or • Containerize for off-site disposal[1]
Hazardous Soil	• Dispose in compliance with applicable regulations

[1] Decision of whether to dispose of on or off-site is based on cost analyses (see section 5.2.6, Table 6).

5.2 *Debris – Site Debris and Demolition Wastes*

Site debris shall be collected and segregated into hazardous and non-hazardous waste streams for disposal:

Non hazardous waste: The volume of the non-hazardous materials shall be minimized through crushing, shredding, or incineration, prior to their placement in an on-site engineered landfill. If there is no existing landfill on-site, and no suitable location for a new engineered landfill, the non-hazardous materials shall be disposed of off-site; and

Hazardous waste: These materials shall be disposed of off-site, in accordance with the current regulations governing the handling and disposal of hazardous materials.

Hazardous materials referred to in this section are defined as any materials, which are, designated "hazardous" or "dangerous goods" under Territorial or Federal legislation. Generally, all hazardous materials identified at the site shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act (TC 2002), to a licensed hazardous waste disposal facility.

Some hazardous materials that are typical of abandoned military sites and require special consideration include the following:

PCB Contaminated Concrete: PCB contaminated concrete (excluding paint) with concentrations in excess of 50 ppm is regulated under the CEPA, and shall be collected and transported off-site, in accordance with the Transportation of Dangerous Goods Act and CEPA to a licensed hazardous waste disposal facility.

PCB Paint on Building Components: PCB paint and PCB painted components that are regulated under the CEPA, shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act and CEPA, to a licensed hazardous waste disposal facility. PCB painted materials are considered regulated under CEPA when the component, (paint and substrate) contain greater than 50 ppm PCBs total. Accordingly, knowledge of the thickness and density of the paint, and substrate material is required to calculate total PCB concentrations. Loose paint materials/paint chips are regulated under CEPA when PCB concentrations in the paint are greater than 50 ppm.

Lead-Based Paint on Building Components: Lead-based painted components that are classified as hazardous material shall be collected and transported off site, in accordance with the Transportation of Dangerous Goods Act to a licensed hazardous waste disposal facility. Painted components that exceed the relevant federal or Territorial criteria but are not considered hazardous shall be collected and disposed in an on-site engineered landfill. Lead-based painted materials are considered hazardous when the lead leachate concentrations from a test of the component (paint and substrate) exceed 5 mg/L or the concentration as provided in the latest schedule of the TDGA.

Additional discussion related to the classification of painted material is provided in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008).

There are also a few exceptions, which are described below:

Asbestos: Asbestos waste shall be collected, double bagged and disposed of in an on-site engineered landfill, in accordance with the appropriate legislation. Where no on-site facility is available, asbestos waste shall be shipped off-site for disposal. Where asbestos materials are painted, disposal requirements shall be based on paint analyses.

Petroleum Products: Petroleum products, such as gasoline or diesel, which do not contain other hazardous products (chlorine, PCB, metals, etc.) will be incinerated on-site under appropriate emissions controls. Heavier petroleum products such as lubricating oil will be disposed of off-site or mixed with lighter petroleum products and incinerated on-site under appropriate emissions controls in accordance with the Barrel Protocol provided in Annex B.

Compressed Gas Cylinders: Compressed gas cylinders with known contents shall be vented. Once empty, the metal cylinder shall be disposed on-site in an engineered landfill. . Where no on-site facility is available, compressed gas cylinders shall be shipped off-site for disposal.

Creosote Treated Timbers: Timbers shall be wrapped in polyethylene sheets and disposed on-site in an engineered landfill. Where no on-site facility is available, creosote treated timbers shall be shipped off-site for disposal.

5.2.1 Submerged Debris

Submerged debris shall be removed from the near-shore environment to a depth of 2 metres or 30 metres off-shore, whichever is encountered first. Work in marine and freshwater environments shall be in accordance with all stipulations as provided by the Department of Fisheries and Oceans. Debris, once removed shall be classified as hazardous or non-hazardous and disposed of as indicated in the previous sub-section.

5.2.2 Barrels

Barrels identified at the site shall be handled according to the Barrel Protocol (see Annex B) and as outlined below:

Empty Barrels: Empty barrels shall be crushed and disposed in an on-site engineered landfill;

Filled or Partially Filled Barrels: Barrel contents shall be inspected and tested if necessary and disposed of appropriately (off-site or incinerated). The empty barrel shall be rinsed, crushed and disposed on-site in an engineered landfill. The spent rinse liquid shall be tested and disposed of appropriately. Absorbent materials used as part of this process shall be disposed as hazardous material, as required; and

Buried Empty Barrels: Areas containing buried empty barrels will be inspected to determine if any of the barrels contain material and characterized through a geophysical survey. If the barrels are found to be empty the area will be stabilized through compaction to crush any corroded barrels. A cover of borrow material shall be placed over the area and compacted.

The criteria used to determine the acceptability of product for on-site incineration are summarized in Table 5 as follows:

Table 5 Barrel Protocol Criteria and Disposal Summary

Phase	% Alcohol or Glycols	PCBs	Chlorine ppm	Cadmium ppm	Chromium ppm	Lead ppm	Disposal
Organic		<2	<1000	<2	<10	<100	On-Site Incineration
Organic		>2	>1000	>2	>10	>100	Ship South
Aqueous	>2		>1000	>2	>10	>100	Ship South
Aqueous	>2		<1000	<2	<10	<100	On-Site Incineration
Aqueous	<2						Discard in accordance with wastewater discharge criteria

5.2.3 Buildings and Infrastructure

The existing buildings and infrastructure at a site shall be demolished to concrete foundations. Above-grade timber foundations shall be removed. Exposed timber piles shall be removed to 0.3 m below ground surface. All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. Hazardous demolition materials shall be disposed off-site.

PCB amended painted material shall be containerized in accordance with the Transportation of Dangerous Goods Act, and transported off-site to a licensed treatment disposal facility.

Only in exceptional circumstances will existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters once clear transfer of ownership has been established.

5.3 *Landfill Closure*

The following section will apply to landfills, dumps and debris areas. For ease of reading the term ‘landfill’ will be used throughout this section. Using the landfill/dump and debris area evaluation matrix (Annex A), landfills can be classified into one of three broad categories. Actions associated with each category of landfill have been identified. Where a landfill exists on INAC abandoned military sites, the condition of the landfill shall be evaluated to determine the most appropriate action;

If the landfill is located in an unstable, high erosion location, it shall be relocated to a properly engineered landfill. During the relocation process, any identified hazardous materials shall be segregated for off-site disposal (Class A landfill);

If the landfill is located in a suitable, stable location, but there is evidence of contaminant migration, potential remedial solutions include excavation or provision of a suitably engineered containment system.

The remedial solution selected shall be based on a cost-benefit analyses that includes consideration of construction costs and long-term monitoring costs. (Class B).

If the landfill is located in a suitable, stable location, with no evidence of contaminant migration it may be left in place. If required, additional granular fill shall be placed to ensure erosion protection and proper drainage (Class C Landfill). Consideration must be given to surrounding topography (to blend into existing terrain) and long term monitoring costs.

5.4 *Landfill Development*

New engineered landfills may be required for the disposal of non-regulated contaminated soils and non-hazardous debris collected or generated during cleanup. Two classes of landfills are provided:

- Inert Waste Landfill.
- Tier II Contaminated Soil Landfill

5.4.1 Inert Waste Landfill

An Inert Waste Landfill is a new landfill constructed for the disposal of non-hazardous debris and building demolition waste. Tier I contaminated soils may also be disposed of in these landfills. The landfills constructed to date at the DND DEW sites are predominately above ground facilities. The landfills do not rely on permafrost for containment nor do they include a geosynthetic liner.

The general design parameters include a perimeter berm and landfill cover constructed of a well graded sand and gravel. Clay is generally not available at the abandoned military sites. The sand and gravel should have a minimum of 8% fines (<0.08 mm) and be compacted to a minimum of 95% maximum dry density (ASTM D698). The landfill should have a maximum debris thickness of 3 m and minimum cover thickness of 1.0 m.

To reduce settlement and ground subsidence, the debris should be placed in maximum 0.5 m thick lifts with a granular intermediate graded over each lift of debris to fill the voids. The intermediate fill should be a minimum of 0.15 m thick and worked into the underlying debris. The final landfill surface must be graded such that water ponding does not occur. Ponding and infiltration could increase the seasonal thaw depth or contribute to leachate generation. The landfill surface must not be so steep that it promotes erosion of the cover materials that could expose debris.

The fill material for landfill cap should a well-graded material that is relatively erosion resistant and will have moderate water infiltration. Alternative designs or surface treatments are required if erosion resistant materials are not present on site. The alternatives include importing coarser gravels and cobbles, vegetation covers at sites where it is possible to vegetate the sites, roller compacted concrete or other synthetic surfaces.

The final landfill design parameters including granular fill specifications, side slopes, cover thickness, and maximum height of landfill are dependent on site specific ground conditions and borrow availability. Designs must be reviewed by a geotechnical engineer with permafrost experience.

5.4.2 Tier II Contaminated Soil Landfill

As outlined below and as detailed in Abandoned Military Site Remediation Protocol, Technical Supporting Documentation (INAC 2008) the decision as to whether to construct a Tier II Contaminated Soil Landfill on site is based on a number of factors. The decision criteria related to volumes of contaminated soil were based on relative cost estimates and may not accurately reflect site specific conditions and are provided as a guideline only.

Table 6 Decision Criteria Tier II Contaminated Soil Landfill

▪ Is the site landlocked?	▪ For landlocked sites, off-site transport costs increase significantly. ▪ Consideration should be given to on-site disposal facility.
▪ Is landfill excavation required.	▪ Landfill excavations pose contracting risks due to unknown quantities of waste material. To mitigate risks, an on-site Tier II disposal facility should be considered.
▪ Are known contaminated soil volumes less than 300 to 500 m^3.	▪ If yes, evaluate contingency factors and potential over-runs. If significant risk of quantity overrun is present, construct landfill on-site. ▪ If volume of contaminated soil estimated to be below these values, ship off-site for disposal.
▪ Are known volumes of contaminated soil between 500 and 1000 m^3	▪ Evaluate site specific conditions, and develop preliminary design and cost estimate for an on-site disposal facility using site specific information. ▪ Confirm availability and quality of borrow material.
▪ Are known volumes of contaminated soil greater than 1000 m^3.	▪ If yes, confirm availability and quality of granular borrow. ▪ If granular borrow sufficient, develop preliminary design and cost estimate for an on-site disposal facility, using site specific conditions. ▪ Re-evaluate on-site disposal costs versus off-site disposal and confirm cost-benefit.

The Tier II Contaminated Soil Landfill design is based on the containment of contaminated soil with a lined landfill provided with sufficient granular fill cover to maintain the contaminated soil in a frozen condition. The required fill thickness is a function of the climatic conditions selected as the design criteria.

Geothermal analyses are required to substantiate the use of permafrost as a means of containment for the landfills. Analyses are carried out to predict the short-term and long-term ground temperatures for the Tier II Contaminated Soil Landfill to determine:

- Length of time for landfill freezeback;
- Short-term and long-term thermal regime in the landfill; and
- Depth of annual thaw (active layer) in the cover material.

Geothermal analyses should be carried out for the landfills using two-dimensional finite element computer models. The models simulate transient, two-dimensional heat conduction with a change of phase for a variety of boundary conditions. The heat exchange at the ground surface should be modeled with an energy balance equation considering air temperatures, wind velocity, snow depth, and solar radiation. The models should include the temperature phase change relationships for saline soils, such that freezing depression and unfrozen water content variations can be explicitly modeled.

The soil thermal properties required to carry out geothermal analyses include: porewater composition, latent heat, specific heat (frozen and unfrozen), and thermal conductivity (frozen and unfrozen). These properties are determined indirectly from well-established correlations with soil index properties, moisture content, grain size distribution, bulk density, salinity, etc. (Farouki, 1986; Johnston, 1981). Soil index properties are based on information collected during the site investigations.

Climatic data required for the thermal model include monthly mean air temperature, wind speed, solar radiation, and snow cover. The thermal analysis should be calibrated to measured temperatures and/or observed active layers thicknesses. The landfill designs include analyses for mean temperature conditions, warm conditions and long-term climate change. Statistical analyses are carried out to determine mean monthly temperatures representative of a 1 in 100 warm year. The freezing index and thawing index for each year are calculated from the recorded air temperature data. The index for each year is ranked in ascending order and plotted. A “best-fit” line is drawn through the set of points to estimate the 1 in 100 warm year index. Mean monthly air temperatures are increased by the ratio of the 1 in 100 warm year freezing or thawing index to the mean year freezing or thawing index to estimate the mean monthly temperatures of a 1 in 100 warm year. The influence of climate change should be evaluated by similar methods presented in ACIA 2005. This includes the average estimated of season temperature changes by various Global Circulation models.

Given the uncertainties in climate change and the cost of returning to a site at a future date, it is recommended that the Soil Disposal Facility be designed for 100 years of long-term climate warming (average of four GCMs) as a minimum. With this design condition, the active layer could penetrate the contaminated soil if a warm year occurred. Containment during this condition would be provided by the thick soil cover and the geomembrane liner. Additional factors of safety can also be applied to account for uncertainties in the geothermal model, soil input parameters, and climate input parameters, or the facilities can be design for climate change plus one 1 in 100 warm year. Some modifications to this section may be made following the FMEA.

5.5 *Borrow Source Development*

Granular borrow material will be required for the development of new landfills and general site grading purposes.

5.5.1 Site Grading

Grading operations generally consist of the shaping and regrading of disturbed areas to blend in with the natural contours, in accordance with all applicable licenses. The disturbed areas may include:

- contaminated soil excavation areas,
- existing and new landfill areas,

- debris areas,
- areas disturbed during demolition activities,
- granular borrow areas, and
- any area disturbed during the establishment and operation of the camp, equipment storage and maintenance activities.

5.6 *Contractor Support Activities*

For the implementation of the remedial activities, a Contractor will establish a camp and storage areas on-site, where required. Where possible, these will be located in previously disturbed areas such as borrow or storage areas, to minimize any new disturbances, in accordance with all applicable licenses.

Domestic refuse generated by the camp shall be incinerated and disposed of on-site in an engineered landfill. Sewage shall be handled by an appropriately sized sewage treatment system, in accordance with applicable legislation and all applicable licenses.

Potable water supplies at the site will be tested and used, only if they meet the Canadian Drinking Water Quality Standards (CCME 2002), in accordance with all applicable licenses.

Fuel required for the operation of the camp will be stored on-site in accordance with applicable legislation and licenses.

All hazardous materials shall be segregated prior to or during demolition. Non-hazardous demolition materials and asbestos shall be collected and disposed in an on-site engineered landfill. Hazardous demolition materials shall be disposed off-site.

Only in exceptional circumstances shall existing buildings remain intact on site following the remediation program. These structures may remain as emergency shelters once clear transfer of ownership has been established.

6 CONSTRUCTION RELATED IMPLEMENTATION REQUIREMENTS

Consistent with Step 9 of the Federal Contaminated Sites Action Plan, confirmation that the objectives of the Remedial Plan have been met is required. Based on the issues typically associated with the remediation of the INAC sites, confirmatory testing encompasses a wider range of activities. These include, but are not necessarily limited to:

- Confirmatory testing of contaminated soils;
- Quality Assurance testing of earthworks associated with the remediation and construction of landfills;
- Testing as required for waste manifesting to allow for shipment and disposal of materials off-site; and
- Testing as required to meet the requirements of Land Use Permits, and/or other Licences/Permits issued for the cleanup program.

The requirements and/or guidelines for these testing programs are outlined in the following sub-sections.

6.1 *Confirmatory Testing Contaminated Soils*

Following excavation of contaminated material confirmatory samples shall be collected and analyzed to ensure that cleanup objectives have been met. Sampling will be conducted by a third party qualified to carry out such work. A detailed sampling plan shall be developed for each area of concern identified for excavation in the Remedial Action Plan, and must include the following information:

- Description of the objective for each potential area of concern
- Sampling locations
- Sampling methods
- Proposed number of samples and media
- Parameters for analyses
- Sampling methodology, analytical requirements, and Quality Assurance/Quality Control measures.

6.1.1 Tier I contaminated soils:

Tier I criteria were developed to address aerial transport of contaminants; excavation and backfilling precludes this pathway. If, during the site assessment, sufficient evidence has been collected to demonstrate that soils at depths of greater than 0.3 m below surface do not exceed Tier II levels for inorganic elements or PCBs, confirmatory sampling will not be required.

6.1.2 Tier II contaminated soils:

Confirmatory sampling shall be carried out using a systematic grid sampling design following the DND DLCU Confirmatory Sampling Protocol as summarized in Table 7. This design provides a practical and simple method for designating sample locations and ensures uniform coverage of a site. Discrete samples should be collected at every point on the grid. For small areas, all samples shall be analyzed, whereas for larger areas only a fraction of the interior grid samples shall be analyzed. When choosing sample locations for analysis, consideration shall be given to areas of previously high concentrations. No single sample result or the mean of a duplicate/replicate sample shall exceed the cleanup objectives. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

Table 7 Confirmatory Testing Grid Sizes

Size of area	Grid size	# Perimeter samples analyzed	# Interior grid samples analyzed
<100 m^2	3x3 m	all	all
>100 m^2, <2500 m^2	6x6 m	50%	40%
>2500 m^2	12x12 m	50%	40%

6.1.3 Hazardous Soils

Confirmatory sampling following excavation of soils considered hazardous according to CEPA (PCBs >50 ppm) or the TDGA may require a more closely spaced grid than outlined in Table 7 to minimize the overall volume of materials requiring off-site disposal.

6.1.4 Type B TPH (Fractions F1 to F3)

Confirmatory sampling following excavation of petroleum hydrocarbon impacted soils within 30 m of a water body supporting aquatic life will follow the confirmatory sampling protocol outlined in section 6.1.2. The remedial solution for petroleum hydrocarbon impacted soils further removed from surface water bodies involves excavation of source areas. In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes. For comparison purposes, total petroleum hydrocarbons (TPH) data obtained by hexane extraction can be compared to data generated using the CCME analytical procedure for PHC in soils by summing fractions F1 to F3. The presence of residual petroleum hydrocarbon contamination is expected following excavation to design limits as outlined in the Remedial Action Plan. Representative samples from the base of the excavation will be collected and analyzed for record keeping purposes using the CCME analytical procedure for PHC in soils.

6.1.5 Ex-situ Confirmatory Sampling

Soils excavated from landfills and dumps will be classified ex-situ. The excavated soils will be placed in windrows or stockpiles with a maximum stockpile size of 20 m^3 (B.C. Environment, 1995. Contaminated Site Statistical Applications. March, 1995). Debris is separated from the soil and sorted as potentially hazardous and non-hazardous under the supervision of the Hazardous Materials Specialist. Stained soil and soil associated with potentially contaminated debris such as battery waste or barrels must be stockpiled separately from other soil to prevent dilution and facilitate disposal.

As part of the sampling protocol, two types of soil samples shall be collected from stockpiles: discrete and composite. Sample locations are selected at various surface and depth locations at each stockpile to obtain samples that are representative of the entire pile. Five discrete samples are collected and analyzed for the first 20 stockpiles and every 20th stockpile thereafter. Composite samples shall be collected and analyzed at all stockpiles. Composite samples consist of approximately equal volumes of soil collected from the five discrete sample locations.

The standard deviation for each stockpile shall be calculated based on discrete sample results. These standard deviations are then used to calculate the average standard error for all stockpiles (Equation 1). Twice the average standard error is added to the analytical result for the composite sample to provide a 95% upper confidence limit (Equation 2).

$$SE_{avg} = \frac{\sum_{1}^{m}\left(\frac{SD}{\sqrt{n}}\right)}{m} \qquad \textbf{(Equation 1)}$$

$$UCL = \left[Composite_x\right] + 2\left(SE_{avg}\right) \qquad \textbf{(Equation 2)}$$

n represents the number of sample values,

SE_{avg} represents the average standard error,

SD represents the standard deviation of the sample values,

m represents the number of stockpiles,

UCL represents the upper confidence limit and

x represents the stockpile number.

Classification of stockpiles for disposal is based on a comparison of the 95% upper confidence limit values and the relevant clean up objectives.

The first 20 stockpiles shall be analyzed for the nine inorganic elements for which the DCC criteria are applicable and PCBs. Analysis for petroleum hydrocarbon will be based on visual and/or olfactory evidence. This process shall be repeated for every 20th stockpile thereafter. All the remaining stockpiles will be tested for copper, lead and zinc and any other analyte that exceeded the DCC criterion previously until it is no longer present (Table 8). Field analysis can provide adequate detection limits for statistical classification of certain contaminants (PCBs and PHC), while others (inorganic elements) must be analyzed in CAEAL accredited laboratories for more precise results.

Table 8 Analytical Requirements for Stockpile Sampling

Stockpile No.	Samples Collected	Analytical Suite	Samples for Analyses
1 through 20	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed for first 20 stockpiles
Every 20th thereafter	**5 discrete** 1 composite	**PCBs, Cu, Ni, Co, Cd, Pb, Zn, Cr, As** PHC and Hg where evident	All discrete and all composite samples are analyzed
Remaining stockpiles	**1 composite**	**PCBs, Cu, Pb, Zn** PHC, Hg and other inorganic elements where evident	Every composite sample is analysed.

Once the excavation is complete, the base of the landfill excavation must be sampled in accordance with confirmatory sampling protocol for Tier II soils.

6.1.6 Confirmatory Sampling of Material Processing Areas

Residual contamination may be present at barrel processing areas, hazardous materials processing areas, and stockpile lay down areas after clean up activities are complete. Once an area is no longer in use, a detailed inspection for evidence of staining and other indicators of contamination such as visible debris or paint flakes shall be carried out. Samples must be collected in these areas in a grid pattern based on the size of the area (see Table 7). In cases where field analytical methodology is used, 10-20% of the samples analyzed in the field should also be analyzed in the laboratory for quality control purposes.

6.2 Quality Assurance Testing of Earthworks

At most sites, earthworks will be carried out as part of the construction of new landfills, remediation of existing landfills, and/or development of hydrocarbon contaminated soil treatment areas. Contract Specifications developed for the project will identify specific requirements for fill gradation and compaction standards. As part of the testing to be carried out during cleanup, quality assurance (QA) testing is required to confirm that the earthworks are in conformance with the Specifications. The number and type of testing will be dependent on the volume of fill to be placed and the number of different material types employed in the cleanup. A QA program shall be developed in conjunction with the design engineer to determine the optimal number of tests required.

6.3 *Testing Related to Permits/Regulatory Requirements*

in progress

7 LANDFILL MONITORING

Under review

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A Annex A – Landfill / Dump And Debris Area Evaluation Process

A.1 Introduction

In 1997, the DEW Line Cleanup Environmental Working Group (EWG), comprised of members representing Nunavut Tungaavik Inc. (NTI) and the Department of National Defence (DND) / Defence Construction Canada (DCC), was formed to address environmental issues associated with the DEW Line sites under the jurisdiction of DND. One of their tasks was the development of a matrix to assess potential environmental risk associated with existing landfills at the DEW Line sites. The evaluation matrix considered three primary categories, contaminant source, exposure pathways and potential receptors. In the development of the matrix, landfills typical of the DND DEW Line sites were considered. The DND DEW Line sites were in operation for nearly 40 years, and landfill activity was generally extensive. By comparison, the INAC DEW Line sites or I-sites, were only operational for a period of approximately five to six years. Accordingly, waste disposal practices were different. At many sites, waste materials were not consolidated in a single area, and isolated areas of partially buried debris are common.

This current document presents a Landfill/Debris Area Evaluation Matrix that considers conditions more specific to INAC DEW Line and other northern abandoned military sites.

A.2 Background

To address the varied nature of DEW Line landfills, a consistent method for the assessment of their potential risk to the arctic environment, in the form of a risk evaluation matrix, was developed by the DND/NTI EWG in 1997. Since that time, the matrix has been utilized to develop recommendations for landfill remediation at DND DEW Line sites. This document provides a modified evaluation matrix to address the landfills/buried debris areas more typical of the DEW Line and other abandoned military sites under the jurisdiction of INAC.

The DND/NTI evaluation matrix was based on the CCME National Classification System for Contaminated Sites, and adapted to address the particular concerns of the Arctic environment. This revised version also references the Federal Contaminated Site Action Plan (FCSAP) Contaminated Site Classification Guidance Document. The matrix is divided into three categories of equal weight: contaminated source, pathways, and receptors. The interaction of these three elements results in environmental risk. Each category is assigned 50 points, which are distributed among several factors. Each of these factors has been made as specific as possible in order to reduce the subjectivity of the matrix to a minimum. In addition, each of the three main categories is assigned a highly subjective "special considerations" factor according to the method described in the CCME Classification System. As it is unlikely that any classification system could address all possible factors, a special considerations factor allows the user to increase or decrease the score "to emphasize important concerns about a site and should be used as an **exception rather than as a rule**" (CCME 1992, p.6-7).

The intended purpose of the matrix is to evaluate the potential environmental risk posed by landfills in their current condition. It is not considered suitable for assessing environmental risk posed by a landfill post-closure. Specific elements of the landfill closure design that mitigate against the potential risk posed by the landfill are not considered in the matrix evaluation process.

Two conservative assumptions are made during the evaluation of all landfills/buried debris areas.

- The contents of landfills/buried debris areas are unknown and all potential contaminants may be present.
- If contaminants come into contact with receptors, they could have adverse effects on the receptors.

A.3 MATRIX FACTORS

A. Contaminant Source

Four factors were considered under Contaminant Source to describe specific landfills/debris areas as follows:

A.1 Landfill Extent

A.2 Estimated Depth of Landfill

A.3 Contaminant Characteristics – combined presence of leachate and surface contaminated soil.

A.4 Presence of Surface Debris

Contaminant characteristics were assigned the greatest weighting in this category as it is a strong indicator of potential environmental risk associated with the landfill. The volume of a landfill is considered to be related to its potential to be contaminated – the greater the volume, the greater the risk that the landfill contains contaminants. The volume of the landfill is divided into two parameters, area and depth. The area is relatively easy to measure; the estimated depth of the landfill is given less weight in the matrix as it is difficult to measure using non-intrusive techniques.

A.1: Landfill Extent

The larger the area of the landfill, the greater the potential for contaminants to be present exists. Landfill areas are based on the results of geotechnical/geophysical site surveys and visual observations. The value of 10 000 m^2 is an area approaching the size of the largest landfills on the DEW Line; scoring for all other landfills is prorated based on their areal extent relative to 10000 m^2. Areas less than 1000 m^2 are referred to as debris areas.

Scores are provided for all landfills/debris areas following the detailed field investigations that are carried out prior to cleanup/construction. The objectives of these investigations are to delineate the extent of known contamination, and confirm existing site and landfill conditions.

A.2: Estimated Depth

The depth of a landfill/debris area is estimated by visual inspection of surrounding topographic features. The average depth of the active layer is used as a qualifier for the description of landfill depth, as this is generally the maximum depth of investigation. The depth of the active layer may range from one to two meters at these sites, depending on material type; therefore an average depth of 1.5 meters was used in the rating. Landfills with estimated depths of greater than 1.5 meters were scored higher than those with estimated depths of less than 1.5 meters. For the majority of INAC DEW Line landfills, it is anticipated that the depth of buried waste is 1.5 metres or less based on the relatively short duration of operation. Exceptions to this may include dumping within ravine areas or other natural depressions.

A.3: Contaminant Characteristics

Contamination associated with landfills and/or debris areas may be elevated with respect to background concentrations, but less than applicable criteria. In this case, elevated concentrations may be indicative of chronic low levels of contaminants leaching from the landfill, as a result of infiltration and percolation of surface water, or flow of active layer groundwater through the landfill. In some cases, contamination on the surface or near the toe of the landfill may exceed applicable criteria as a result of direct spills or leaking containers.

With consideration of the FSCAP Hazard Ranking of contaminants and the DEW Line Cleanup Criteria, all contaminants included in the DEW Line Cleanup Criteria are considered high concern, with the exception Petroleum Hydrocarbon Fractions F3 and F4. In the scoring of this category, four categories are provided:

- Concentrations not elevated with respect to background; however, the potential for contamination is considered possible.

- Concentrations elevated with respect to background; but less than DEW Line Cleanup guidelines. Elevated with respect to background refers to a concentration in excess of the three times the mean background concentration.

- Concentrations in excess of Tier I guidelines.
- Concentrations in excess of Tier II guidelines.

A.4: Presence of surface debris

At some landfills, surface debris is very extensive, while at others there is almost no debris. Scoring needs to be quantitative; therefore the percentage of the surface area of the landfill that is covered with debris is used as the basis for scoring. A landfill that has surface debris covering more than 50% of its surface receives a full score. Debris areas, as implied by the designation, generally receive full score for this category.

B. Pathways

The primary transport mechanisms for contaminants from the DEW Line landfills are considered to be:

- Aerial transport of fine particles; and
- Dissolved phase and/or colloidal transport in water, both as surface water run-off or subsurface water flow.

B.1: Aerial Transport of Contaminants

All contaminants can be transported as particles. Windblown debris is not considered in this category, as debris pickup is inherent in any cleanup. Surface contamination or surface expressions of leachate impacted soils imply the potential for aerial transport. This factor is given a low weight because the quantity of contaminated soil on the surface of a landfill is generally low relative to the quantity of contaminated soil at the site as a whole. In addition, it is anticipated that relative to the effect of water movement, aerial transport contributes less to the transport of contaminants away from a landfill.

B.2: Water Movement

Dissolved phase and/or colloidal transport in water includes movement of surface water and subsurface water within the active layer. "Groundwater" is not addressed as an issue separate from surface water, as the movement of water within the active layer is subject to the same driving forces or gradients as surface water. The intent of this sub-category is to examine factors that affect migration away from the landfill – slope, runoff, extent and type of cover on the landfill, annual precipitation and distance to surface water. Among these factors, topography, runoff potential and proximity to surface water are given the greatest weight.

B.2.1 Topography

The degree of the slope on which the landfill is located is one of the major factors contributing to transport of contaminants. Scoring is carried out on a progressive scale. In cases where there are different slopes across the landfill, a weighted average is used.

B.2.2 Cover Material – Depth

The extent to which contaminants are available for transport is also dependent on the depth and type of cover material. The potential for leachate generation and correspondingly, leachate migration, is related to the infiltration of water into the landfill. Cover over the landfill helps mitigate infiltration of water into the landfill contents. As the thickness of the landfill cover increases, the likelihood that potential contaminants will be released from the landfill decreases. If the active layer is contained in the cover material above the debris, then the potential for surface water infiltration into the landfill is small; this circumstance is assigned the lowest score.

B.2.3 Cover Material – Type

The erosion potential of a landfill is partly based on the type of cover material. Erosion can eventually lead to the exposure of the landfill contents. Some cover materials are more susceptible to erosion than others; well graded gravels are the least susceptible, and silty materials are the most susceptible. In cases where there is no cover, this factor is assigned the highest score. Where the cover materials consist of a combination of soil types, the scoring should reflect the more conservative or higher score.

B.2.4 Surface Water/Run-Off Potential

This factor aims to describe the destructive potential of water action on the landfill, which could take the form of waves; streams, rivers or lakes; or seasonal drainage. Where there is significant seasonal drainage, the run-off potential is high. "Significant seasonal drainage" is defined as run-off that has the potential to transport large quantities and concentrations of contaminants to surface water courses over a short period of time (CCME 1992, p.23). Significant seasonal drainage also includes consideration of major snow drifting on a landfill.

B.2.5 Precipitation

The amount of precipitation received, either as rain or snow fall, affects the amount of surface water infiltration or run-off, and potentially erosion. The majority of the DEW Line sites receive less than 500 mm of precipitation annually, with the exception of sites on the lower east coast of Baffin Island. Typically, the amount of precipitation at any site is relatively low. Any given rainfall event is unlikely to generate major run-off; however, spring thaw and corresponding run-off may be significant at some sites. Detailed precipitation data is not available for the INAC sites; therefore data was interpolated from the Hydrological Atlas of Canada Maps, as summarized below.

Sites	Annual Precipitation (mm)	Annual Snowfall (cm)	Average Maximum Snow Pack depth (cm)
PIN-B	100-200	100	30
PIN-C, D, E, CAM-A, B, C	100-200	80	30
CAM-D, E, F	150-200	100	50
FOX-1,A,	150-200	100	60
FOX-B	200-300	100	60
FOX-C	200-300	200	70
FOX-D	350	240	100
FOX-E	+400	240	100

As spring run-off likely represents the maximum precipitation event, scoring is provided relative to the maximum snow pack depth, with a score of 4 allotted to snow pack depth of 100 cm. If site specific factors, such as drifting in the landfill area are present, the score may be increased to 5, the maximum allotted to this category.

B.2.6 Distance to Down-gradient Perennial Surface Water/Seasonal Drainage Channel

The distance to surface water will affect the probability of contaminants reaching the watercourse. This factor can include streams, seasonal or perennial, running directly through the landfill or streams and lakes downgradient from the landfill, but it is intended to exclude small ponds with no outflow. On very steep slopes, this distance should consider the horizontal distance to the water body rather than the vertical drop. The impact of drainage with respect to contaminant exposure is not considered in this category (it is considered under Receptors); this factor determines whether there is a drainage pathway from the landfill.

C. Receptors

This section addresses the potential for impact on receptors, specifically, aquatic and terrestrial habitats, as well as human exposure. Impact on humans is the primary consideration; however, it should be recognized that impact on humans is implicit in the scoring of factors addressing ecosystem impact. The scoring within each category is to be based on recorded data, as well as local knowledge of the land use in the area, and therefore requires local input.

C.1: Potential Impact on Receiving Freshwater/Marine Habitat

Selection of the water body in this category is based on potential effects on the receiving habitat. Consideration must be given to the regional drainage patterns. For example, where the drainage from a landfill is overland (i.e. there is no direct connection between the landfill and the downgradient water body), water bodies beyond two kilometers should not be used in the evaluation. This is based on the premise that natural attenuation of any potential contamination will occur with overland flow. Where a direct connection between a landfill and a downgradient water body exists, via a stream or interconnected ponds, the two-kilometre limit should not be used.

C.1.1 Proximity to Receiving Freshwater/Marine Habitat

"Receiving habitat" is considered to be a significant body of water near the toe of the landfill where contaminants are likely to have an impact. The water body may support freshwater or marine life and/or may be used by avifauna and/or terrestrial mammals as a water source. It is not necessarily the seasonal drainage course or perennial water body closest to the landfill toe. **The objective is to select a habitat that supports receptors rather than identify the closest body of water.** It is assumed that only habitat downgradient from the landfill is to be considered (given that aerial transport of contaminants to habitat upgradient from the landfill will be addressed by the remediation of contaminated soil).

C.1.2 Estimated Habitat Usage – Freshwater/Marine

The score within this category is based on the frequency of usage within the selected receiving environment and considers the level of biodiversity and the occurrence of calving/spawning grounds. Freshwater and/or marine wildlife are potentially more at risk compared with terrestrial wildlife or avifauna, the latter which are exposed through water ingestion. Thus, when terrestrial wildlife or avifauna are the primary receptor, the score for this factor should fall into the moderate or low category based on the potential frequency of usage. Otherwise, when the selected water body sustains freshwater and/or marine wildlife, the level of biodiversity should be used to evaluate the score. It should be noted that the most conservative approach - in the selection of the receiving water body - must be used when scores from section C.1.1 and C.1.2 are combined. Finally, "Biologically sensitive" areas such as bird sanctuaries and/or endangered, threatened or vulnerable populations should be considered as "special considerations".

C.2: Potential Impact on Receiving Terrestrial Habitat

C.2.1 Extent of Vegetation

The extent of vegetation considers the area within 300 metres downgradient of the landfill. Within this distance, vegetation is expected to be most susceptible to uptake of contaminants if they are leaching from the landfill. However, topography and the potential for run-off must be considered and a greater or lesser distance could be considered.

C.2.2 Estimated Habitat Usage – Terrestrial/Avifauna

The same criteria as for usage of aquatic habitat are to be applied.

C.3: Potential Human Exposure Through Land Use

C.3.1 Presence/Occupation

This factor addresses strictly dermal exposure and inhalation; consumption of food and water from the area are dealt with in subsequent factors. The risk of dermal exposure or inhalation is much lower when soil is frozen; therefore winter occupation of the site is assigned a low risk. “Summer” in this factor is intended to include the spring, summer and fall periods when the ground surface is not frozen. Within this factor, the scoring takes into account the likelihood and the duration of contact. Using this method, proximity to a community is considered (high likelihood of contact), although proximity to a community does not necessarily trigger a high score if visits are infrequent (low duration of contact).

The likelihood of contact considers proximity to community or to a camp, as well as proximity to “travel routes”. The duration of contact considers full time residences (i.e. permanent community for high, summer camp for moderate, winter camp or travel routes as low). Scores may be interpolated between the allocated points, according to Table 1-1 below.

Table 1-1 Scoring Guide for Section C.3.1

	High Likelihood of Contact	Moderate Likelihood of Contact	Low Likelihood of Contact
High Duration of Contact	8	6	4
Moderate Duration of Contact	6	4	2
Low Duration of Contact	4	2	1

Different landfills on a site may need to be considered individually.

C.3.2 Proximity to Drinking Water Source

Regardless of whether the source is seasonal or perennial, an established community or a summer camp water source located downgradient of the landfill is to be considered in this factor.

C.3.3 Food Consumption

Sedentary organisms are more susceptible to local inputs as their exposure is greater if they are downgradient from the landfill. These organisms can include bottom-dwellers such as sculpins, mussels, sea urchins etc., as well as terrestrial vegetation, which can be used for medicinal purposes. This kind of contamination "is quite localized when considered on a broad regional scale" (DIAND 1997, pg. 5). Migratory marine animals may have body burdens of contaminants; these are not directly attributable to local contaminant sources, as the vast majority of organochlorines, for instance, arrive in the Arctic via long range transport. Caribou living in the general area of DEW Line sites do not have elevated levels of contaminants, as they feed over a very wide area. The Canadian Arctic Contaminant Assessment Report (DIAND, 1997) describes these results in more detail.

It is recognized, however, that sources such as DEW Line sites do contribute contaminants to the Arctic ecosystem. For the purpose of scoring the matrix, therefore, a high consumption of animals from the area surrounding the DEW Line sites has the potential to pose a higher risk than a low consumption, **although in general the risk remains low.**

This factor is divided into two sub-sections, and the score is the sum of the score for each of the two sub-sections.

Special Considerations

As indicated in the introduction to the matrix, each of the three main categories includes a "*special considerations*" factor. The proposed value of the special considerations factor is a maximum of ten percent of the overall score for each category. It is intended that no circumstance will allow a user to assign a special considerations score that will cause the score for that category to exceed the maximum allotted. To avoid undue bias, it is also suggested that the user should complete the entire evaluation form and score a site before addressing special considerations in the total score.

The Environmental Working Group (EWG) based the landfill risk evaluation matrix on the CCME model which defines three categories: contaminant source, pathways and receptors. Within those three categories, the EWG tried to address all of the possible factors contributing to risk. Recognizing that even a thorough matrix could never address all possible risk factors, special considerations were included to address specific risk factors that are not general to all of the DEW Line sites.

As noted in the CCME document, the special considerations factor is not intended to be applied on a regular basis, as it addresses very site-specific risk factors. In fact, if the special consideration factor was being consistently applied in the scoring of landfills, it would indicate that the matrix itself was incomplete. Special considerations should be site-specific characteristics that can be documented.

Three examples of how special considerations could be applied are provided to clarify the use of such a classification:

Example 1. Wildlife on site

It may be that "special considerations" points would be assigned to the Receptors category when endangered, threatened and/or vulnerable species (COSEWIC, 1997) are known to visit the DEW Line landfill.

Example 2. Drinking water

The risk associated with landfill impact on a drinking water source is addressed in section C.3.2. In that section, the distance from a landfill to a known drinking water source, permanent or seasonal, is used as an indicator of the risk that the contaminants in the landfill could have an impact on the drinking water source. If a landfill is close to a drinking water source, then section C.3.2 would be assigned the maximum score (8 points). In the case of Pelly Bay, however, where the landfills are far from the drinking water source and therefore receive a relatively low score in section C.3.2, "special considerations" points may be added to address concerns that the landfills are located in the watershed for the community drinking water supply.

Example 3. Proximity to a community

In the landfill risk evaluation matrix, human exposure to a landfill is measured in the following way: people can spend time at the landfill (potential dermal exposure), they can drink water from an area near the landfill (potential ingestion), they could live very close to landfills (potential exposure through aerial transport) or they could eat animals that feed near the landfill (potential ingestion). These considerations form section C.3 of the risk evaluation matrix. If a landfill is located near a community, there is a greater likelihood that people will spend time at the landfill than there is for landfills far from a community. It is not necessarily the case, however, that landfills near communities receive frequent visits; therefore, instead of creating a special section addressing proximity to a community, the risk of human exposure (see Table 1-1) is more accurately evaluated by measuring time spent at a landfill. In these cases, however, "special considerations" points may be added to the Receptors category to address a community's specific concerns.

A.4 Traditional Knowledge

The matrix for the evaluation of potential environmental risk associated with landfills was developed recognizing that local input would be relied upon in the scoring of landfills. Additional guidance on the collection of Traditional Knowledge is provided in of the protocol.

A.5 Interpretation of Scores

The score obtained through the application of the matrix is intended to represent the potential environmental risk posed by a given landfill in its current state. The objective of landfill remediation is to mitigate the risk associated with a landfill by preventing the migration of contaminants that may be present in the landfill.

Landfills scoring 105 points or more are classified as potentially high risk (Class A) and require excavation. The high score accorded to these landfills is generally a result of the ecological sensitivity of the area and the geometry and surrounding topography of the landfill, which precludes the development of a cost-effective and long-term design solution such as pathway intervention and/or stabilization of the landfill. Landfills with a score of 100-104 points must be considered on a case by case basis – some may require complete excavation while others may be considered Class B landfills.

Landfills with a score in the range 75 to 99 points are classified as moderate potential environmental risk (Class B). An engineered leachate containment system will be provided for these landfills to mitigate against potential environmental risks. In specific cases where an engineered leachate containment system cannot be constructed, an evaluation of excavation will be carried out with the objective of determining whether complete excavation or partial excavation with a leachate containment system is required.

Landfills with scores of 75 or less are classified as low potential environmental risk (Class C). In general, the remediation approach for these landfills includes placement of an engineered cover, following collection, sorting, and appropriate disposal of debris from the surface, and excavation and disposal of any surface contaminated soils from the area. Some of the factors to be considered in the design of the cover include: thickness and type of the existing cover materials; slopes on the landfill; surrounding topography and available granular fills.. The cover is designed to promote surface water run-off (i.e. no areas of standing water), prevent erosion, and mitigate against settlement. Where required, the slope of the landfill may be modified and/or geotextiles may be incorporated into the granular cover to provide a long-term solution. Generally, the final thickness of cover material is approximately 0.75 metres, and may be greater dependent on site specific conditions. The granular cover material is to be placed in layers and compacted before the placement of the next layer of granular fill, until the design thickness is reached.

Debris areas scoring a total of 89 points or more are classified as potentially high risk and require excavation to the full extent/depth of the debris. In addition, if a debris area scores greater than 23 points in the contaminant source category, complete excavation of the debris area is recommended.

For debris areas scoring less than 89 points, it is considered unlikely that leachate containment will be cost-effective when compared to excavation and removal of debris. Consideration must therefore be given to the level of contamination present. If contaminants are present in excess of criteria, it is recommended that the debris area be excavated to its full extent. If contamination does not exceed criteria, debris should be cut-off and removed within the upper 0.5 metres of the ground surface.

Debris areas are classified as being of low environmental risk if the overall score is less than 63. These areas may be covered in place once surface accessible debris is removed. However, consideration must be given to surrounding topography, such that the cover must blend in with existing grades.

Overall, it is to be stressed that the matrix is to be used in the assessment of potential environmental risks associated with a specific landfill. It is not intended to be used as the sole criterion in determining the remediation solution for a landfill. The results of the matrix, both total score and the score from each major category, are to be considered in conjunction with the engineering evaluation of site conditions, to determine appropriate design solutions. Review of the individual category scores relative to the total score will highlight particular areas of concern that are to be addressed during the design process.

The potential impacts of climate change are also to be considered in evaluating remedial solutions.

It should be emphasized that the total score has an error associated with it of approximately 5 points; there is inevitable subjectivity in the scoring process and scores that fall near decision points should be considered on a case by case basis.

A.6 References

BC Environment. June 1996. Guideline #1 Contaminated Sites: Site Characterization and Confirmation Testing. Draft.

CCME. 1992 National Classification System for Contaminated Sites.

COSEWIC, 1997, Categories of the Committee on the Status of Endangered Wildlife in Canada, Canadian Wildlife Service, Environment Canada.

DIAND, 1997. Canadian Arctic Contaminants Assessment Report.

B Annex B – Barrel Protocol

B.1 Introduction

In order to determine the correct disposal method for barrels and their contents, the contents must first be identified. All barrel contents should be sampled and analyzed according to DND DEW Line Cleanup standard procedures, as described in this section.

Analytical data obtained for the samples collected from barrels located at the site should be compared to the criteria included in Table 1, below. Barrel contents are identified as organic or aqueous and the concentrations of glycols, alcohols, PCBs, chlorine, cadmium, chromium and lead are determined. The flash point of organic waste and aqueous waste (> 2% glycols/alcohols) must also be determined. Uncontaminated aqueous phases can be disposed of on the land according to the discharge criteria; uncontaminated organic phases can be incinerated; contaminated aqueous material should be scrubbed free of organic material; and contaminated organic material should be disposed of as hazardous material.

During the delineation phase of the site investigation, an inventory of the number and locations of barrels at the site is to be compiled. This inventory should include buried or partially buried barrels that will be taken out of the landfills during excavation. Where significant numbers of barrels are present on a site, and if safe to do so, representative samples shall be collected to provide a preliminary indication of whether on-site incineration is a viable alternative. Otherwise, barrels are only sampled during the cleanup phase and as such, the handling, transportation and opening of barrels is the responsibility of the site Contractor.

Other waste fuels and oils are also sampled according to this protocol. These may come from a variety of sources including, but not necessarily limited to, old generators, fuel tanks and pipelines, and transformers.

B.2 Inspection

All barrels are to be inspected to address the following items which shall be recorded and used as a guide prior to opening barrels.

- Symbols, words, or other marks on the barrel that identify its contents, and/or that its contents are hazardous: e.g. radioactive, explosive, corrosive, toxic, flammable.
- Symbols, words, or other marks on the barrel that indicate that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume containers.
- Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves, or signs that the barrel is under pressure such as bulging and swelling.
- Spillage or discoloration on the top and sides of the barrel.

B.3 Sampling

Barrels shall not be transported until it has been determined that they are not under pressure, do not leak, and are sufficiently sound for transport.

Barrels to be sampled should be set in an upright position, provided that this does not cause them to leak and that it is physically possible.

Barrels should only be opened according to accepted procedures and under qualified supervision, preferably using remotely operated, non-sparking equipment.

Once open, barrels will be sampled by personnel wearing proper personal protective equipment as described below (B.7). Samples of the contents of all barrels shall be extracted using a drum thief and placed into a pre-labelled glass vial. The number and type of liquid phases, and their respective thickness, and the size of each barrel are to be recorded.

In instances where there are a large number of barrels with obviously similar contents, these can be grouped together and 30 to 40% of the barrels in the group sampled. Barrels containing less than 50 mm of liquid may be combined with compatible material prior to sampling; samples inferred to contain only water on a visual examination shall be tested prior to this consolidation. Barrel contents, which consist of black oil, shall not be consolidated.

All barrels shall be clearly numbered using spray paint or other suitable paint marker. The number on this label should be the only sample coding provided to the laboratory.

The barrel locations and barrel sample descriptions should be recorded.

Samples should be kept at ambient temperatures and shipped by guaranteed freight to laboratories where they should be kept cold pending analysis.

B.4 Testing

Liquid samples shall be inspected and classified as either containing water or organic materials. Samples thought to contain water shall be analyzed to confirm that they are indeed water, and contain less than 2% glycols or alcohols.

The contents of barrels containing organic materials, including aqueous samples which contain more than 2% glycols or alcohols, shall be tested for flash point, PCBs, total chlorine, cadmium, chromium and lead following the targeted barrel testing approach presented in Figure 1. Analyses will be conducted on a rush basis where indicated. In addition, major organic components should be identified e.g. fuel oil, lubricating oil.

If on site incineration of waste is not planned, waste samples need only be tested for flash point, PCB, and pH (at regular turnaround time) in order to classify the waste for transport and disposal options.

Contents of barrels which contain two or more phases shall have all phases analyzed; the organic phases as described above and the aqueous phase to ascertain whether it contains less than 2% organic substances. In addition, the aqueous phase shall be tested for any components found in the organic phases above the criteria provided in the protocol.

B.5 Disposal of Barrel Contents

Barrels containing only rust and sediment shall be treated as empty barrels.

Barrel contents comprising water only (less than 2% glycols or alcohols) shall be transferred to an open vessel such as a utility tub or half-barrel and any organic material removed by agitation with a pillow or segment of oil absorbent material. The water shall be tested prior to discharge in accordance with wastewater discharge criteria. Where water meets criteria, it may be discharged to the ground a minimum of 30 meters distance from natural drainage courses. Used oil absorbent material shall be treated as described in the following subsection.

Barrel contents which are composed of water with glycols and/or alcohols or organic phases, and which contain less than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium, 100 ppm lead, and that have a flash point between 25°C and 225°C, may be disposed of by incineration. Alternatively these contents may be disposed of off-site at a licensed disposal facility. The solid residual material resulting from incineration shall be subjected to a leachate extraction test. Material found to not be leachable shall be disposed of as DCC Tier II contaminated soil. Leachable material shall be treated as hazardous waste and disposed of off-site at a licensed disposal facility.

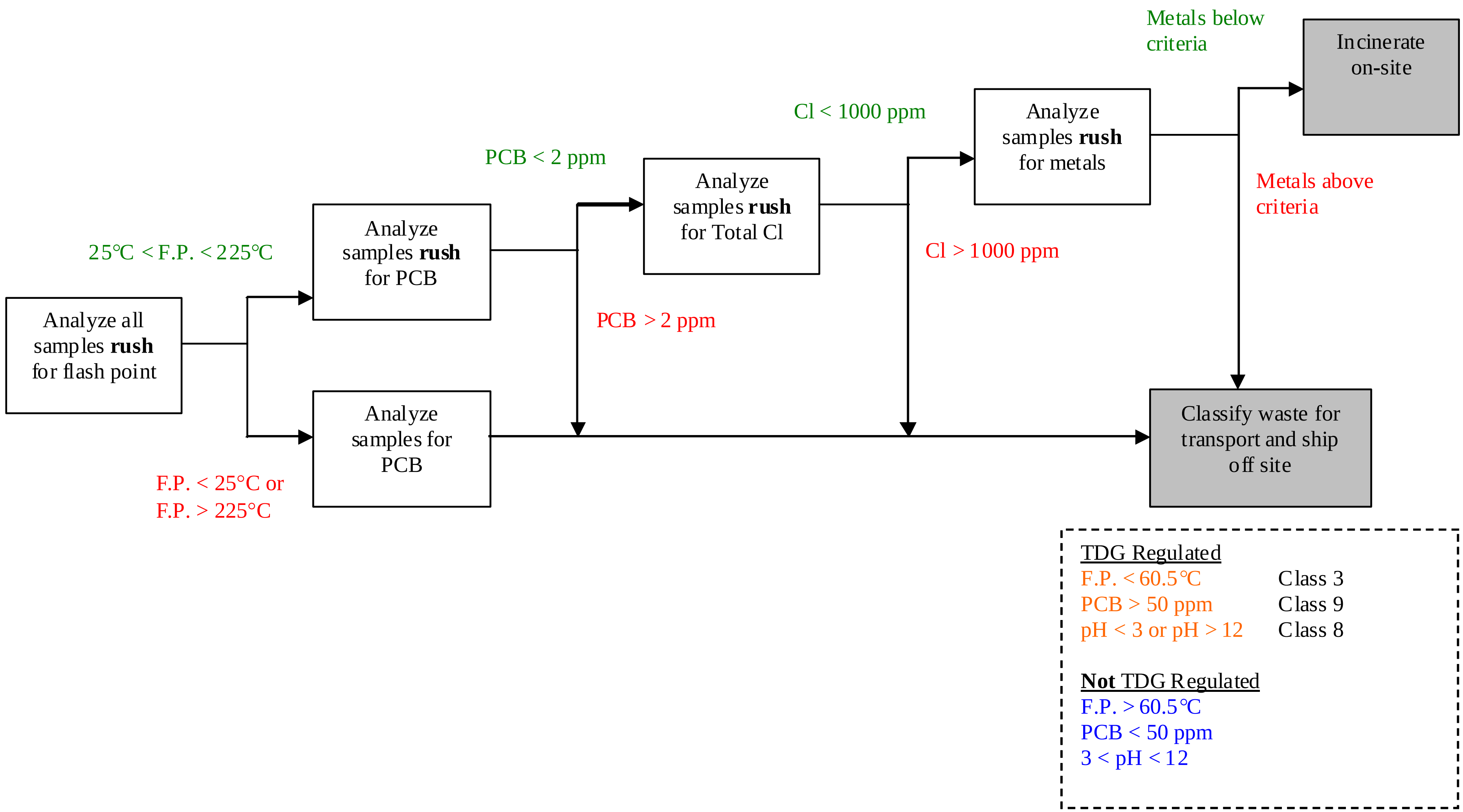

Figure 1 Targeted Barrel Testing Approach

Barrel contents, which contain greater than 2 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead, or that have a flash point below 25°C or greater than 225°C shall be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes.

Used oil absorbent material should be treated as hazardous waste and disposed of off-site at a licensed disposal facility. If it is shown to be uncontaminated with PCBs (< 2 ppm), chlorine (< 1000 ppm), cadmium (< 2 ppm), chromium (< 10 ppm) and lead (< 100 ppm), it may be incinerated on-site.

B.6 Disposal of Barrels

Empty barrels may be crushed or shredded and landfilled on-site as non-hazardous waste after they have been cleaned in an appropriate manner. The barrels shall be crushed in such a manner so as to reduce their volume by a minimum of 75%. Shredded barrels may be disposed of off-site as recycled metals.

B.7 Personnel Protective Equipment

Safety equipment required includes a respirator with organic vapour cartridges, safety glasses, a hard hat, rubber safety boots, double gloves (chemically resistant on the outside, and latex or vinyl on the inside) and disposable Syranex-coated coveralls.

A decontamination procedure should be established at the barrel sampling area(s) to prevent tracking potentially contaminated liquids outside of the sampling area(s).

It is advisable to have one person outside of the sampling area to observe the sampler(s) in case of unexpected hazards, and also to record the samplers’ observations.

APPENDIX C

MEETING MINUTES

Bear Island Mid-Canada Radar Site
2008 Community Consultation regarding the draft Remedial Action Plan

Chisasibi, Quebec
February 20, 2008
7:00 – 9:00 pm (presentation)
9:00 – 10:00 (questions)

Introductions:
Sonia Nobrega (INAC)
Lisa Dyer (PWGSC/TPSGC)
Greg Wright (Earth Tech

Presentation:
Sonia – draft Remedial Action Plan

Attendees: 46 (Eddie Rupert, Translator)

Sonia made a presentation about the work completed at Bear Island.

- Bear Island was a Mid-Canada Line Radar Station
- The purpose of this meeting is to share information, communicate plans and to seek community input
- Objectives for Bear Island
    - Minimize environmental impact
    - Comply with legal requirements
    - Follows all Federal policies
    - Increase public awareness about remediation activities
    - To provide employment opportunities to local work force
- Bear Island is located 160 km Northwest of Chisasibi
- Site includes the North and South Dopler Stations, an airstrip, roads and Beach Area
- The radar sites were built in the 1950s
- Workers lived at the North Dopler station
- Most of the buildings have been demolished
- 2 radio towers have collapsed on site
- Roads connect all the areas
- History
    - 1950 to 1965 Radar Stations
    - 1965 to present under the care of INAC
    - 1996 Environmental Site Assessment
    - 2001 Environmental Site Delineation
    - 2007 Phase 3 Environmental Site Assessment, Archaeological Impact Assessment and Remedial Action Plan
- Bear Island Clean Up Objectives

- Protect human health and safety
- Protect the environment
- Employ proven Northern Technologies
- Use long term solutions
- Minimize the environmental impact of clean up activities
- Minimize time spent on site
- Minimize long term monitoring requirements
- Employ cost effective solutions

- Bear Island Non-Hazardous Wastes
    - o Heavy equipment, radar towers, metal waste, concrete, empty barrels, wood
    - o Approximately 730 m^3 or 91 dump trucks

- Clean Up Options for Non Hazardous Wastes
    - o Leave waste where it is and cover with gravel
    - o Ship Material Off site
    - o Build a new secured landfill and place waste inside
- Bear Island Hazardous Waste
    - o Includes batteries, lead amended paint, asbestos, lead cable and zinc conduit and gas cylinders
    - o Petroleum Product volume is around 1,500 litres
- Options for cleaning up Hazardous Waste
    - o Build a hazardous waste landfill and place material inside
    - o Place in a non hazardous landfill
    - o Ship off site
- Asbestos
    - o Place in plastic bags and dispose of in an engineered landfill
- Lead Amended Paint, Batteries, Lead Cable and Zinc Conduit
    - o Remove off site for disposal at a licensed facility
- Petroleum Product
    - o Incinerate on site if possible
- Compressed Gas Cylinders
    - o Vent and dispose of in the site landfill

- Contaminated Soils at Bear Island
    - o Comes from batteries, paint, electrical equipment
    - o Heavy metals such as cadmium, copper, lead and zinc found on site
    - o Approximately 92 m^3
    - o Enough to fill 11 dump trucks
    - o Clean Up Options
        - ▪ Place material in a non hazardous landfill on site
        - ▪ Ship off site
        - ▪ Build a new hazardous waste landfill and place material inside
    - o Recommendation
        - ▪ Low level contaminated soils to be placed in a non hazardous landfill on site
        - ▪ 13 m^3 or 1.5 dump trucks
        - ▪ High level contaminated soils to be put in containers and disposed of off site
        - ▪ 79 m^3 or 9.5 dump trucks

- PCB Contaminated Soils
  - PCBs used in transformers, capacitors, hydraulic fluids, flame retardants and paints
  - High level contaminated soils – $4m^3$
  - Low level contaminated soils – $1m^3$
  - Clean Up Options
    - Place waste in a non hazardous landfill
    - Ship material off site
    - Build a new hazardous waste landfill and place material inside
  - High level contaminated soils are to be removed from site – $4m^3$
  - Low level contaminated soils to be placed in an engineered landfill on site – $1m^3$

- Hydrocarbon contaminated soils
  - 295 m^3 of contaminated soil
  - Same as 37 dump trucks
  - 102 m^3 of non mobile contamination
  - 193 m^3 of diesel fuel contaminated soils
  - Clean Up Options
    - On site land farming
    - Place a gravel cap on top
    - In situ soil vapour extraction
  - Non mobile contamination to be placed in a secure landfill
  - Diesel contaminated soils to be removed from site

- Archaeological Impact Assessment
  - A single heritage resource site was identified at Bear Island
  - A 20 m buffer has been created around the site to protect it

- Remediation Schedule
  - Summer 2008 – bidders tour
  - Fall 2008 – permitting
  - Winter 2008 – contract tender
  - Spring 2009 – Contract Award and Community Consultation
  - Summer 2009 – Mob equipment to site
  - Summer 2009 & 2010 – Clean up activities
  - Spring 2010 – Community Consultation
  - Fall 2010 – Demob from site

- Future consultations and monitoring
    - During remediation – one meeting per year
    - After remediation – one meeting during monitoring years
    - Annual inspections of landfill for first five years after construction
    - Then once every 5 years until 2030
    - The monitoring requirements will be reevaluated in 2035

- Potential Aboriginal Involvement
    - Business opportunities
    - Sub contractors
        - Camp supply
        - Provision of equipment
    - Labour opportunities
        - Equipment operators
        - Mechanics
        - Surveyors
        - Trades
        - Labourers
        - Cook/Housekeepers
        - Wildlife Monitors
        - Interpreters
        - Health and Safety Officer
        - Opportunities for Sampling Scientist

- Project Procurement
    - Bidder's conference
    - Use of a request for proposal
    - Posted on MERX the government electronic tendering service
    - www.merx.com
    - The proposals are evaluated for socio economic benefit, technical content and cost
    - If the proposal is technically sound the contract can be awarded for the higher cost as long as it is no more than 15 percent higher
    - Training – funding will be made available
    - Incentive/Penalty Clause
        - Aboriginal commitment must be met by the contractor
        - There is a bonus for contractors that exceed the guaranteed aboriginal employment commitment
    - Work could also be contracted through Standing Offer Agreements with the government or through Contribution Agreements

- Contacts
    - Sonia Nobrega/Mark Yetman from INAC (867) 975-4733
    - Lisa Dyer from PWGSC at (867) 766-8377

Comments & Questions and Answers:

Comment: (Jimmie Neacappo) These sites have been around for many years. The contamination may have spread over the years. The oil drums started to leak and ended up in wider spread contamination.

Question: Joint effort between the US and Canadian Armies. There were no regulations that forced the Military to clean up the site. Were there any rules for clean up? Why did it take so long to clean up the site?
Answer: (Sonia Nobrega) Does not know the history behind why the site was not cleaned up sooner. However, funding is available now and the site will be cleaned up.

Question: (Samson Snowboy) Wanted to know about the clean up for Cape Jones
Answer (Sonia Nobrega) This site is outside the Nunavut Territory and Sonia believes that DND is responsible for this site along with Grey Goose Island. Sonia will find out who is responsible for Cape Jones and the schedule for clean up of this site.

Question: (James Stewart) Venting of gas cylinders. Why are you not burning the gas cylinders? Why vent?
Answer: (Sonia Nobrega) Venting is safer than burning for health and safety reasons

Question: (Daisy House) How far away is Sanikiluaq away and are they being consulted?
Answer :(Sonia Nobrega) Sanikiluaq is 300 km away. Bear Island is not part of the land claim agreement but part of Nunavut. Authorities in Nunavut were contacted to determine who should be consulted.

Question: (Samson Snowboy) Cape Jones probably has the same types and concentration of contaminates as Bear Island
Answer: (Sonia Nobrega) Not familiar with the site. Contamination issues can be similar at Military sites.

Comment: (Jimmie Neacappo) Bear Island might be part of the Cree Land Claims Negotiations
Comment: (Sonia Nobrega) Is aware of the Land Claims Negotiations and all parties are aware of the activities on Bear Island.

Comment: (Harry Scipio) The reason why radar sites were put on the island was the threat from the Russians. This Elder worked at the site. The Radar stations were not very effective and only were in place for a short period of time.
Comment: (Sonia Nobrega) – The Bear Island station was operated for less than 10 years to monitor for Russian activity.

Comment: (Harry Scipio) The work that is to be done on Bear Island is not important to the Cree people as they do not frequent the area. They are more concerned about the site at Cape Jones because this area is used for hunting. Would like to see efforts put into cleaning up Cape Jones.

Comment: There were some people that went to the Island. Billy visited the island.
Comment: (Sonia Nobrega) Sonia will try and find information regarding Cape Jones.

Comment: (Billy Martin Hunter) Went to site in 1964 after the site was abandoned. The Roman Catholic Church gathered material from the site. The material from site was brought back to Fort George and used to build the residential school. It took 11 hours to get there by boat.
When they were on site they saw that the soil was damaged, punctured fuel drums and fuel spills. Eider Ducks were breading on the island and there were polar bears. It would be a very good idea to clean up the island. It is a beautiful spot and could be used for tourism in the future.

Comment: (Billy Weetaltuk) Also went to the Island with Billy Martin Hunter. Saw the contamination and saw that shore birds were contaminated with oil. The material salvaged included metal, wood and what ever was useful. They only went there once. A Hudson Bay Barge bought back materials to Fort George.

Comment: (Sonia Nobrega) Earth Tech conducted the most recent environmental investigation of the Island. The cost to clean up the site is estimated to be 8 to 15 million. Are interested in learning from people about what the best route to Bear Island would be. The contractor will determine how to access the site.

Question: (William Chiskamish) The landfill on the island was constructed by some people from Chisasibi. Brand new equipment was buried on site. Will the landfill be removed from site?
Answer: (Sonia Nobrega) The landfill at site and the area around it was tested and no contamination was found to be migrating from the landfill. Greg Wright from Earth Tech tested the site and it has been determined that the best option is not to dig up the site.

Question: (Moses Snowboy) Is this the only site being worked on? Are any sites on the Quebec mainland being remediated?.
Answer: (Sonia Nobrega) Not aware of what sites are being remediated in Quebec.

Comment: (Moses Snowboy) The material from sites found on the main land has had a great affect on hunting and wildlife. He wants to talk about the radar station at Cape Jones and the Point. Believes there are impacts from this site affecting wildlife. At Cape Jones they found the carcass of a polar bear soon after they dismantled the buildings. Feels that the death was related to contamination at the site.

Comment: (Sonia Nobrega) Greg and Lisa are taking notes and recording your questions. Sonia will find out what is happening at Cape Jones.

Comment: (Moses Snowboy) Wants to see the area around Cape Jones cleaned up because this area is visited by Elders and youth. Material was buried on site and they don't know what it is.

Question: (Sonia Nobrega) How far is Cape Jones from Chisasibi?
Answer: (Moses Snowboy) The site is 80 miles North of Chisasibi. Can travel there by boat in the summer and snowmobile in winter. Cape Jones was abandoned in 1962, 1963.

Question: (Sonia Nobrega) Is Chisasibi the main user of Cape Jones?
Answer: (Eddie Rupert) Yes, there are three radar stations at Cape Jones

Sonia thanked everyone for coming out and asking good questions. The meeting was closed.

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APPENDIX D

SUMMARY TABLES

Table D1: Detailed Summary of Non-Hazardous Materials

Location		Items	Material	Quantity	Comments	In Situ Volume[1] (m^3)	Crushed or Cut Volume[2] (m^3)	Weight[3] (tonnes)[4]	Percentage of Total Non-Hazardous Materials (by weight)
South Doppler Area - Site 412	Doppler Detection Building (DDB)	Wooden structure	Wood	lump sum	165 linear m of 0.3x0.3 beams, joists and flooring	15	15.0	3.6	0.17
		Concrete foudation pillars	Concrete	40	approx 1.5x0.3x0.3 (m)	5.5	5.5	9.9	0.46
		Power poles	Wood	20	approx 5 m tall 0.3 m diameter	7	7.0	1.7	0.08
		Antenna bases	Concrete	7	approx 3 m^3 each	21	21.0	37.8	1.77
		Antennas	Steel	3	1 large, 2 small		40.0	157.0	7.35
		HVAC ducting	Steel/Iron	lump sum	east of building	10	5.0	19.6	0.92
		Scrap metal	Steel/Iron	lump sum	wire, cable, piping, scrap metal scattered in vicinity of DDB		25.0	98.1	4.60
		Scrap wood	Wood	lump sum	scattered in vicinity of DDB		8.0	1.9	0.09
		Domestic debris	Tin	lump sum	domestic debris south of DDB		0.5	0.3	0.01
		Glass Products	Glass	lump sum	domestic debris south of DDB		0.5	0.4	0.02
		Barrels	Steel/Iron	10		1.6	0.5	1.9	0.09
		Fuel/Water/Sewage Tanks	Steel/iron	2		4	2.0	7.8	0.37
	Emergency Shelter (ES)	Emergency vault	Concrete	1		20	7.0	12.6	0.59
		Barrels	Steel/Iron	5	within and surrounding ES	0.8	0.2	0.9	0.04
		Scrap metal	Steel/Iron	lump sum	bed frames, rubber-wrapped cables, nails, piping, misc metal		6.0	23.5	1.10
		Scrap wood	Wood	lump sum	lumber and misc wood within and surrounding ES footprint		4.0	1.0	0.05
	Garage	Foudation	Concrete	lump sum	approx 165 m^2 and 0.3 m thick		50.0	90.1	4.22
		Concrete pillars	Concrete	15	2.0x0.5x0.5 (m) with rebar		7.5	13.5	0.63
		Barrels	Steel/Iron	20		3.2	1.0	3.8	0.18
		Scrap metal	Steel/Iron	lump sum	vehicle parts, ducting, piping, snow removal blade, wires, misc metal		15.0	58.9	2.76
		Scrap wood	Wood	lump sum	lumber and misc wood scattered in vicinity of garage		6.0	1.4	0.07
	Road to south end of Island	Barrels	Steel/Iron	8		1.28	0.4	1.5	0.07
		Glass Products	Glass	lump sum	bottles, jars, etc	2	0.5	0.4	0.02
		Domestic debris	Tin	lump sum	cans	2	0.5	0.3	0.01
		Scrap wood	Wood	lump sum		2	2.0	0.5	0.02
		Scrap metal	Steel/Iron	lump sum	vehicle parts, piping, scrap metal	3	3.0	11.8	0.55
	Landfill North of Site 412	Barrels	Steel/Iron	50		8	2.4	9.4	0.44
		Scrap metal	Steel/Iron	lump sum	metal strapping, ducting, vehicle parts, wires, misc metal	10	10.0	39.2	1.84
		Scrap wood	Wood	lump sum		2	2.0	0.5	0.02
		Glass Products	Glass	lump sum	bottles, jars, etc	0.5	0.3	0.2	0.01
	Barrel Cache	Barrels	Steel/Iron	3800	also includes barrels at the small barrel cache area which contain product requiring disposal	608	182.4	715.9	33.53
		Scrap metal	Steel/Iron	lump sum	wires, misc metal	1	1.0	3.9	0.18
		Scrap wood	Wood	lump sum	misc lumber and wood	2	2.0	0.5	0.02
	North Landfill Area	Barrels	Steel	35		5.6	1.7	6.6	0.31
		Snow vehicles	Steel	2		35	20.0	78.5	3.68
		Scrap Wood	Wood	lump sum	lumber and misc wood	8	8.0	1.9	0.09
		Scrap Metal	Steel	lump sum	vehicle parts (incl rubber tracks for snow vehicles), piping, pumping equipment, scrap metal	12	12.0	47.1	2.21
Beach Area	Beach Area	Heavy Equipment	Steel/Iron	lump sum	bulldozer	10	8.0	31.4	1.47
		Fire Fighting Carts	Steel/Iron	lump sum		4	2.0	7.8	0.37
		Fire Fighting Hose	Rubber	lump sum		0.5	0.5	0.2	0.01
		Barrels	Steel/Iron	140		22.4	6.7	26.4	1.24
		Machinery Parts	Steel/Iron	lump sum	heavy equipment parts, snow removal blade	4	3.0	11.8	0.55
		Scrap Metal	Steel/Iron	lump sum	metal strapping, nails, wiring, piping, misc scrap metal	15	15.0	58.9	2.76
		Scrap wood	Wood	lump sum	misc lumber and wood (not incl drift wood)	9	9.0	2.2	0.10
		Electrical Building	Wood	lump sum	includes building skeleton and wood framing of electrical cabinets	40	5.0	1.2	0.06
	POL Area	Wood	Wood	550	wood supports along pipeline (approx two 0.15x0.15x0.4 wood support every 6 m)	9.9	10.0	2.4	0.11
		Barrels	Steel/Iron	45	including 30 barrels east of POL pad area	7.2	2.2	8.5	0.40
		Pipeline	Steel/Iron	lump sum	pipe extends from POL pad to North and South Doppler Areas (approx 3,300 m total)	40	40.0	157.0	7.35
	Road to Beach Area	Barrels	Steel/Iron	20		3.2	1.0	3.8	0.18
		Wood	Wood	lump sum	misc scrap wood	2	2.0	0.5	0.02

Table D1: Detailed Summary of Non-Hazardous Materials

Location		Items	Material	Quantity	Comments	In Situ Volume[1] (m^3)	Crushed or Cut Volume[2] (m^3)	Weight[3] (tonnes)[4]	Percentage of Total Non-Hazardous Materials (by weight)
North Doppler Area - Site 413	North Doppler Detection Building	Wooden structure	Wood	lump sum		30	30.0	7.2	0.34
		Building foundation/pads	Concrete	lump sum		4	4.0	7.2	0.34
		Power poles	Wood	7	approx 5 m tall 0.3 m diameter	2.5	2.5	0.6	0.03
		Antennas	Steel/Iron	2	1 large, 1 small		35.0	137.4	6.43
		Antenna bases	Concrete	8	approx 2.5 m^3 each	20	20.0	36.0	1.69
		Scrap Metal	Steel/Iron	lump sum	ducting, wire, piping, cables, metal strapping, misc metal	10	10.0	39.2	1.84
		HVAC ducting	Steel/Iron	lump sum	west and north of the building	6	6.0	23.5	1.10
		Steel wrapped Cable	Steel/Iron	lump sum	2,880 m length from Site 413 to Site 412	10	10.0	39.2	1.84
		Barrels	Steel/Iron	25	including barrels along road from airstrip	4	1.2	4.7	0.22
		Fuel/Water/Sewage Tanks	Steel/iron	1		2	1.0	3.9	0.18
		Scrap Wood	Wood	lump sum		2	2.0	0.5	0.02
Airstrip Area	Airstrip Area	Terminal buildings	Wood	3	1 complete, 2 partial huts	50	6.0	1.4	0.07
		Fiberglass insulation	Fiberglass	lump sum	in walls of terminal hut	0.5	0.1	0.1	0.00
		Shingles	Tar/Asphalt	lump sum	roof of former terminal hut	0.25	0.3	0.2	0.01
		Glass Products	Glass	lump sum	bottles, jars, etc	0.25	0.3	0.2	0.01
		Domestic debris	Tin	lump sum	tin cans, pots and pans, etc	0.25	0.3	0.1	0.01
		Barrels	Steel/Iron	120		19.2	5.8	22.6	1.06
		Antenna	Steel/Iron	1		0.5	0.5	2.0	0.09
		Machinery Parts	Steel/Iron	lump sum	airstrip grading equipment, snow removal blade	4	3.0	11.8	0.55
		Fuel/Water/Sewage Tanks	Steel/iron	2		4	2.0	7.8	0.37
		Scrap Metal	Steel/Iron	lump sum	cable, wire, wind sock support, misc scrap metal	3	3.0	11.8	0.55
		Scrap Wood	Wood	lump sum		5	5.0	1.2	0.06
	Totals						**726.9**	**2135**	

Notes: 1 - volume of each material was determined based on field measurements and observations
2 - crushed volume based on volume reduction from crushing with excavator bucket or crushing in landfill with bull dozer; cut volume reduction based on torch cutting scrap metal and sawing scrap wood to manageable sizes
3 - weights of materials obtained from *Pocket Ref* (T.J.Glover, 2005) and *Standard Volume to Weight Conversion Factors* (USEPA, 2008)
Wood (based on average of soft woods and assuming 50% voids when cut/crushed/stacked) = 480.6 kg/m^3
Scrap metal (based on weight of steel and assuming 50% voids when crushed) = 3924.9 kg/m^3
Concrete (based on gravel type concrete and 25% voids when crushed) = 1802.1 kg/m^3
Rubber (based on ground scrap and assuming 25% voids when cut/ground) = 480.6 kg/m^3
Glass (based on semicrushed) = 889.1 kg/m^3
Tin cans (based on manual compaction) = 503.8 kg/m^3
Fibreglass (assumed to be saturated with water, therefore weight of water was used for calculation) = 999.6 kg/m^3
Asphalt shingles (based on weight of tar and assuming 25% voids) = 861.4 kg/m^3
4 - tonnes = 10^3 kg

Table D2: Detailed Summary of Hazardous Materials

Location		Items	Material	Quantity	Comments	Material Volume[1] (m^3)	Weight[2] (tonnes)[3]	Percentage of Total Hazardous Materials (by weight)
South Doppler Area Site 412	Site 412 Area	Brown floor tile	Asbestos	lump sum	5-10 % Chrysotile; piled south of DDB and scattered around the South Doppler Area	1	0.6	1.4
		Green floor tile	Asbestos	lump sum	5-10 % Chrysotile; piled south of DDB and scattered around the South Doppler Area	1	0.6	1.4
		Asbestos cement board	Asbestos	lump sum	25-50 % Chrysotile; piled south of DDB and scattered around the South Doppler Area	8	8.7	18.6
		Lead acid batteries	Lead	14	piled at Garage (6) and on road (8) approx 300 m south of Site 412	1.5	0.3	0.7
	Landfill North of Site 412	Lead acid batteries	Lead	10	piled at the existing landfill	1	0.2	0.5
	Barrel Cache and North Landfill Area	Barrels with Product	Waste Oil	800 L	approx 4 partially full barrels at the Small Barrel Cache (may require shipment to a disposal facility)	0.8	0.7	1.5
		Lead cable	Lead	lump sum	373 m length from Site 412 to water reservoir, and stockpiled at the Disturbed Area	2	11.3	24.2
Beach Area		Building Panels	lead in paint	lump sum	70.2 mg/L leachable lead	7	1.7	3.6
		Electrical Cabinets	lead in paint	lump sum	15.2 mg/L leachable lead	10	39.2	83.8
		Brown floor tile	Asbestos	lump sum	5-10 % Chrysotile; scattered around the Beach Area	0.5	0.3	0.7
		Green floor tile	Asbestos	lump sum	5-10 % Chrysotile; scattered around the Beach Area	0.5	0.3	0.7
		Lead acid batteries	Lead	3	piled near bulldozer	0.5	0.1	0.2
		Compressed Gas Cylinders	Compressed Gas	8	compressed gas cylinders for fire fighting equipment	0.8	1.6	3.4
		Boat	lead in paint	lump sum	9.9 mg/L leachable lead	10	2.4	5.1
North Doppler Area Site 413		Brown floor tile	Asbestos	lump sum	5-10 % Chrysotile; scattered around the North Doppler Area	0.6	0.4	0.8
		Green floor tile	Asbestos	lump sum	5-10 % Chrysotile; scattered around the North Doppler Area	0.2	0.1	0.3
		Asbestos cement board	Asbestos	lump sum	5-10 % Chrysotile; scattered around the North Doppler Area	0.2	0.2	0.5
		Zinc coated conduit	Zinc	lump sum	stockpiled north of the building	0.5	1.8	3.8
Airstrip Area		Asbestos cement board	Asbestos	lump sum	25-50 % Chrysotile; scattered near the terminal huts	0.5	0.5	1.2
		Barrel with Product	Fuel	250 L	1 partially full barrel which requires shipment to a disposal facility	0.25	0.2	0.4
Totals						**47**	**71.5**	

1 - volume of each material was determined based on field measurements and observations

2 - weights of materials obtained from *Pocket Ref* (T.J.Glover, 2005) and *Standard Volume to Weight Conversion Factors* (USEPA, 2008)
Floor Tiles (no weight found in reference material, used asphalt shingles to approximate) = 861.4 kg/m ^{3}
Asbestos Cement Board (based on lightlweight concrete with expanded clay aggregate) = 1089 kg/m ^{3}
Batteries = 24.18 kg/battery
Waste Oil (lube oil = 910 km/m^3; petroleum oil = 881 kg/m^3; transformer oil = 880 kg/m^3) = 900 kg/m^3
Lead cable (based on cast lead and 50% voids when compressed) = 5670 kg/m ^{3}
Lead paint (based on weight of substrate) = 480.6 kg/m ^{3} (wood) and 3924.9 kg/m^3 (metal)
Zinc conduit (based on cast zinc and 50% voids when compressed/cut) = 3524.1 kg/m ^{3}

4 - tonnes = 10^3 kg

Table D3: Inventory of Asbestos, Paint, Concrete and Wood Samples

Sample ID	Item	Description	Location	Lead Leachate	Total PCBs	Asbestos Content	Color	Substrate	Condition	Comments
Building Panels	paint	buidling panels stockpiled	Beach Area	**70.2**		-	yellow/green	wood	flakey	ET 2007 investigation
Electrical Cabinet	paint	electrical cabinets in hut	Beach Area	**15.2**		-	blue	steel	good	ET 2007 investigation
Brown 9x9 Tile	ACM	brown 9x9 floor tile	Site 412, 413 and Beach Area	-		**5-10 %**	light brown	chrysotile	good	ET 2007 investigation
Garage Foundation	concrete	southeast corner of foundation	Garage	-	< 0.05	-	grey	concrete	fair	ET 2007 investigation
Orange Tower	paint	orange paint from radar antenna	Site 412	<0.5			orange	steel	weathered	ET 2007 investigation
White Tower	paint	white paint from radar antenna	Site 412	<0.5			white	steel	weathered	ET 2007 investigation
Green Tile	ACM	green 9x9 floor tile	Site 412, 413 and Beach Area	-		**5-10 %**	green	chrysotile	good	ET 2007 investigation
Asbestos Board	ACM	asbestos cement board	Site 412, 413, Beach Area and Airstrip	-		**25-50 %**	grey	chrysotile	good	ET 2007 investigation
Boat Paint	paint	hull of boat near beach area	Beach Area	**9.9**	-		white	wood	flakey	ET 2007 investigation
N Doppler Floor	wood	treated lumber from Site 413	Site 413	non-detect for PAHs and metals			brownish grey	wood	weathered	ET 2007 investigation

Notes: ACM indicates potential asbestos containing material

Criteria: 5 mg/L Lead leachate in paint
50 ppm PCBs
1% Asbestos content

Table D4: Summary of Barrel Analysis

Identifier	Location	Estimated Volume	Aqueous or Organic	PCB (ppm)	Cl (ppm)	Cd (ppm)	Cr (ppm)	Pb (ppm)	Disposal Method	Comments
				>2 ppm?	>1000 ppm?	>2 ppm?	>10 ppm?	>100 ppm?		
BAR-01	Small Barrel Cache	200 L	Organic	<1		<1	**<50**	8	refer to comment	Confirm Cl and Cr concentrations. If < 1000 and < 10, suitable for incineration. Otherwise ship south for disposal
BAR-02	Small Barrel Cache	200 L	Organic	<0.05	2	<1	**<50**	5	refer to comment	Confirm Cr concentrations. If < 1000, suitable for incineration. Otherwise ship south for disposal
BAR-03	Small Barrel Cache	200 L	Organic	<1		<1	**<50**	21	refer to comment	Confirm Cl and Cr concentrations. If < 1000 and < 10, suitable for incineration. Otherwise ship south for disposal
BAR-04	Small Barrel Cache	200 L	Organic	<1		<1	**<50**	16	refer to comment	Confirm Cl and Cr concentrations. If < 1000 and < 10, suitable for incineration. Otherwise ship south for disposal
BAR-05	Airstrip Area	250 L	Organic	<0.3	32	**6**	**220**	**540**	ship south for disposal	

APPENDIX 6:

BEAR ISLAND
SITE MAPS & DRAWINGS

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
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Indian and Northern Affairs Canada
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Canada

REMEDIATION PROJECT

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SHEET INDEX	
Sheet No.	TITLE
CIVIL	
421391 C01	SITE LOCATION PLAN
421391 C02	OVERALL SITE PLAN
421391 C03	AREAS 1 AND 5 NORTH DOPPLER SITE AREA AND AIRSTRIP AREA
421391 C04	AREA 2 BEACH AND POL AREAS
421391 C05	AREA 3 BARREL CACHE AND NORTH LANDFILL AREA
421391 C06	AREA 4 SOUTH DOPPLER SITE AREA
421391 C07	NON-HAZARDOUS WASTE LANDFILL - PLAN
421391 C08	NON-HAZARDOUS WASTE LANDFILL - SECTIONS
421391 C09	GENERAL DETAILS
STRUCTURAL	
421391 S01	DEMOLITION PLAN AREAS 1 AND 5
421391 S02	DEMOLITION PLAN AREAS 2 AND 4

BEAR ISLAND, NUNAVUT
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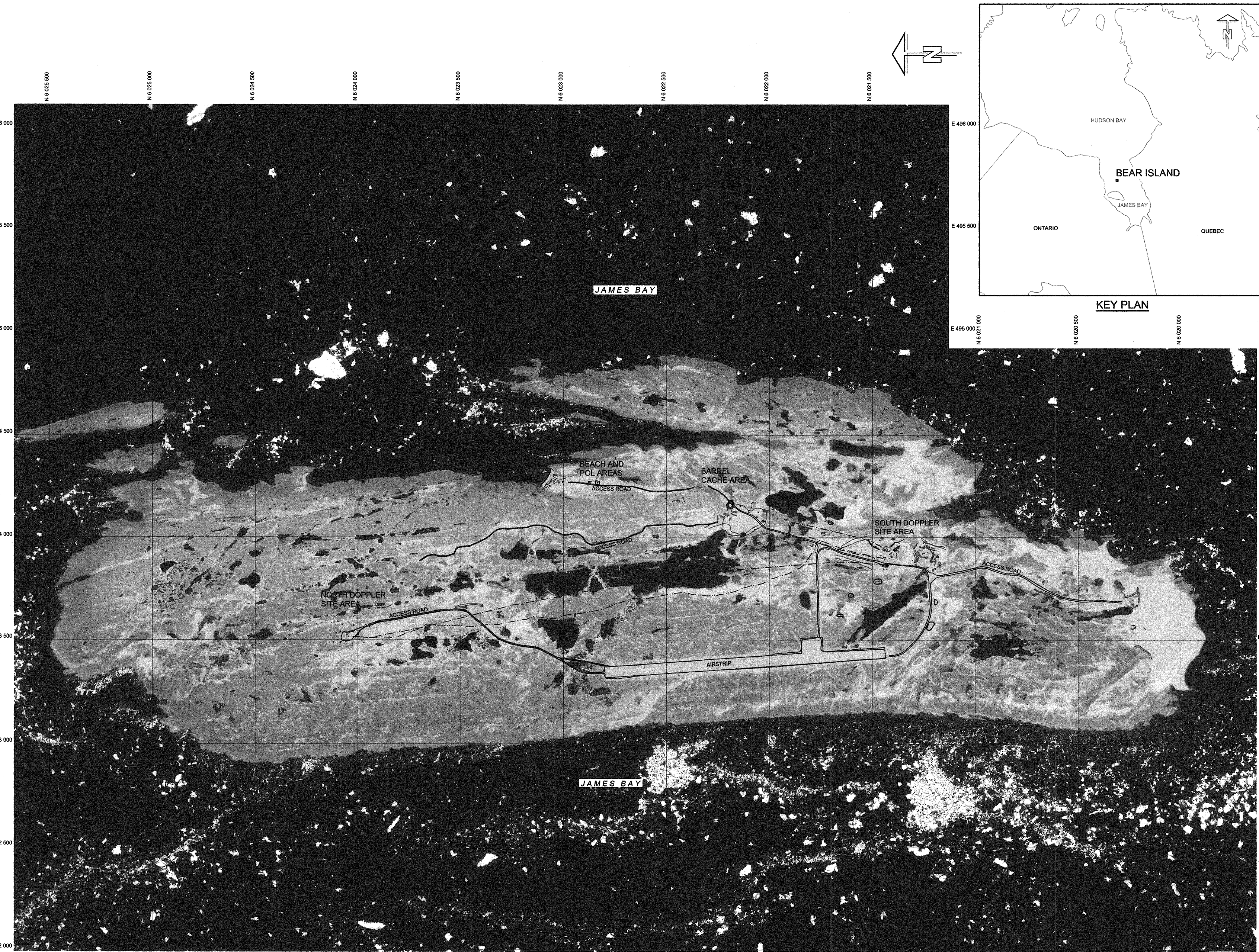

KEY PLAN

Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

REAL PROPERTY SERVICES
Western Region

Client: Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada

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2. SITE PLANS AND TOPOGRAPHIC INFORMATION ARE BASED ON AIR PHOTOS AND SURVEY PROVIDED BY EARTH TECH AND INAC. CURRENT CONDITIONS MAY NOT BE EXACTLY AS SHOWN.

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C	ISSUED FOR TENDER	08/10/06
B	ISSUED FOR 99% REVIEW	08/07/30
A	ISSUED FOR 90% REVIEW	08/06/18

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C detail on drawing no. / detail sur dessin no.

project title / titre du projet: **BEAR ISLAND REMEDIATION PROJECT**

drawing title / titre du dessin: **SITE LOCATION PLAN**

designed by / concu par	T. ESHPETER
drawn by / dessine par	B. CHAO
approved by / approuve par	B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC	L. DYER
scale / echelle	1:7500
project no. / projet no.	421391
date / date	SEPTEMBER, 2008
sheet / feuille	C01 OF 09

421391-C01

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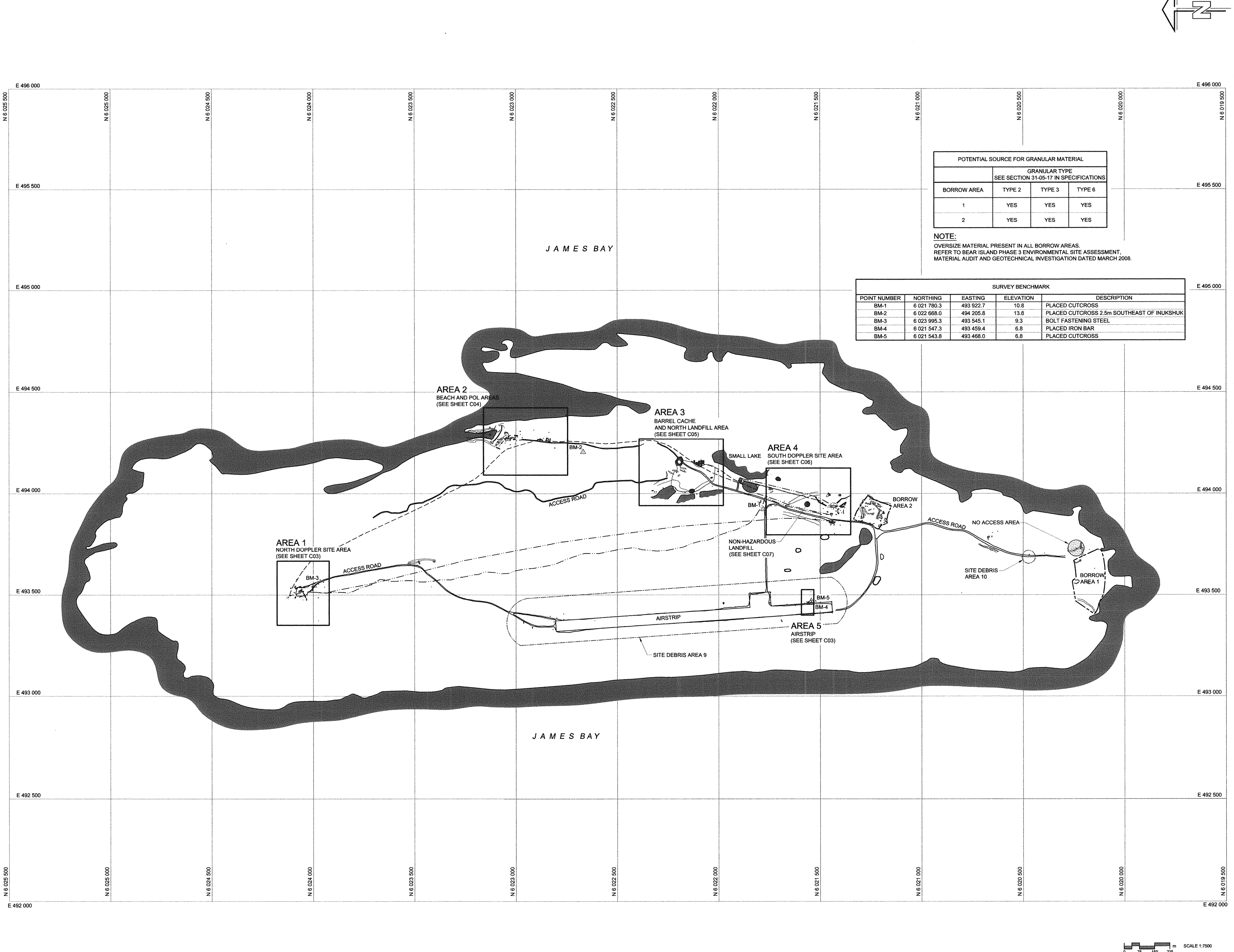

POTENTIAL SOURCE FOR GRANULAR MATERIAL			
	GRANULAR TYPE SEE SECTION 31-05-17 IN SPECIFICATIONS		
BORROW AREA	TYPE 2	TYPE 3	TYPE 6
1	YES	YES	YES
2	YES	YES	YES

NOTE:

OVERSIZE MATERIAL PRESENT IN ALL BORROW AREAS.
REFER TO BEAR ISLAND PHASE 3 ENVIRONMENTAL SITE ASSESSMENT, MATERIAL AUDIT AND GEOTECHNICAL INVESTIGATION DATED MARCH 2008.

SURVEY BENCHMARK				
POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM-1	6 021 780.3	493 922.7	10.8	PLACED CUTCROSS
BM-2	6 022 668.0	494 205.8	13.8	PLACED CUTCROSS 2.5m SOUTHEAST OF INUKSHUK
BM-3	6 023 995.3	493 545.1	9.3	BOLT FASTENING STEEL
BM-4	6 021 547.3	493 459.4	6.8	PLACED IRON BAR
BM-5	6 021 543.8	493 468.0	6.8	PLACED CUTCROSS

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3. ALL COORDINATES ARE SITE COORDINATES AND ALL ELEVATIONS ARE BASED ON SITE DATUM.
4. ACCESS ROADS REQUIRE REPAIRS OR UPGRADE PRIOR TO USE.
5. REFER TO TABLE 024123-1 IN APPENDIX B OF SPECIFICATIONS FOR DESCRIPTION OF DEBRIS AREA.
6. ALL NON-HAZARDOUS DEBRIS TO BE PLACED IN NON-HAZARDOUS WASTE LANDFILL.

LEGEND:

- BODY OF WATER
- APPROXIMATE EXTENT OF BORROW AREAS
- SURVEY BENCHMARK
- NO ACCESS AREA
- POL LINES
- ELECTRICAL CABLE
- SITE DEBRIS AREAS

R. MERKOSKY NWT/NU 2008-10-03

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drawing title / titre du dessin

OVERALL SITE PLAN

designed by / concu par: T. ESHPETER

drawn by / dessine par: B. CHAO

approved by / approuve par: B. FEDORAK

PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER

scale / echelle: 1:7500

project no. / projet no.: 421391

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421391-C02

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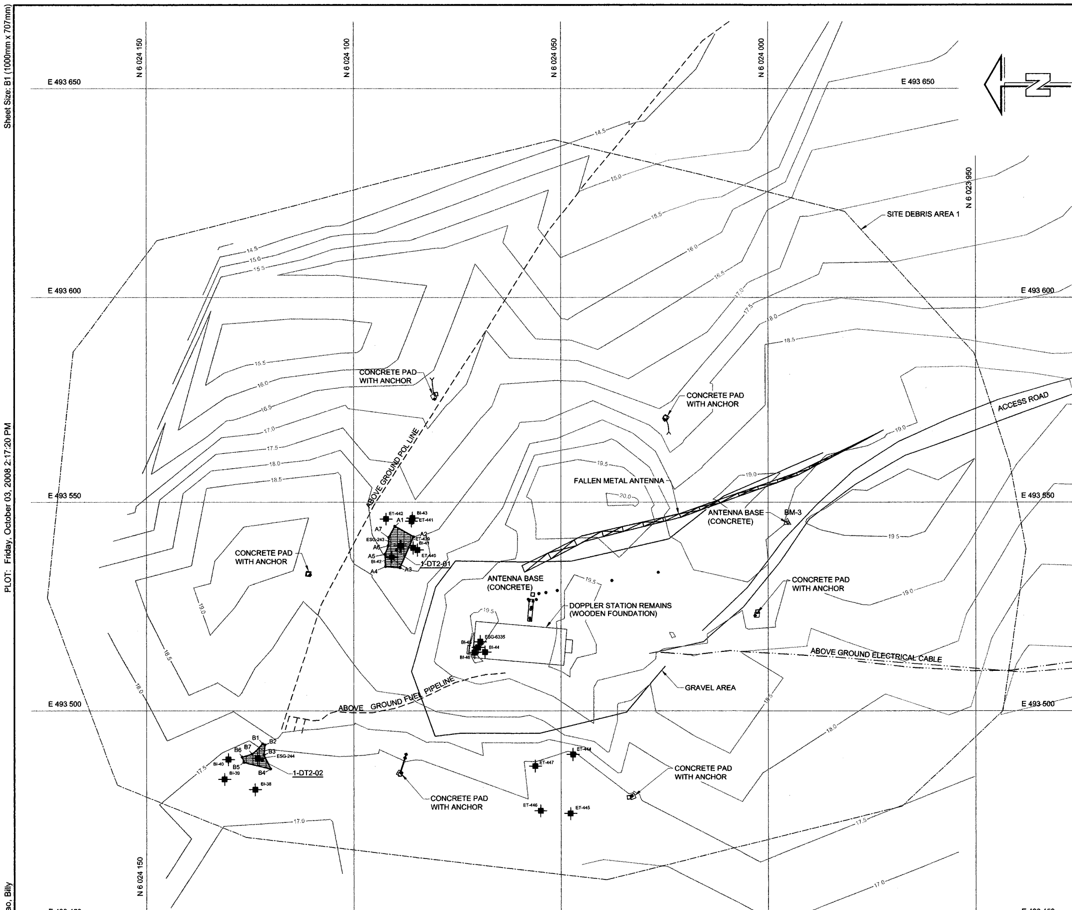


CONTAMINATED SOIL TO BE EXCAVATED						
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	COMMENTS	REFERENCE POINTS N	REFERENCE POINTS E
TIER II CONTAMINATED SOIL						
1-DT2-01	42.7	0.3	12.8	CONTAINERIZE AND SHIP OFF-SITE.	6 024 090	493 539
1-DT2-02	18.4	0.3	5.5	CONTAINERIZE AND SHIP OFF-SITE.	6 024 122	493 488

AREA 1-DT2-01 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION

NO.	COORDINATES NORTHING	COORDINATES EASTING
A1	6 024 090.1	493 544.2
A2	6 024 085.5	493 541.7
A3	6 024 088.8	493 534.3
A4	6 024 092.3	493 534.6
A5	6 024 092.4	493 537.6
A6	6 024 091.6	493 539.7
A7	6 024 091.5	493 541.6

AREA 1-DT2-02 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION

NO.	COORDINATES NORTHING	COORDINATES EASTING
B1	6 024 122.0	493 492.1
B2	6 024 121.4	493 491.9
B3	6 024 121.7	493 489.6
B4	6 024 120.0	493 486.2
B5	6 024 126.5	493 487.8
B6	6 024 126.9	493 489.0
B7	6 024 124.6	493 489.7

SURVEY BENCHMARK

POINT NUMBER	NORTHING	EASTING	ELEVATION
BM-3	6 023 995.3	493 545.1	9.3
DESCRIPTION: BOLT FASTENING STEEL			

AREA 1 - NORTH DOPPLER SITE AREA

SCALE 1:500

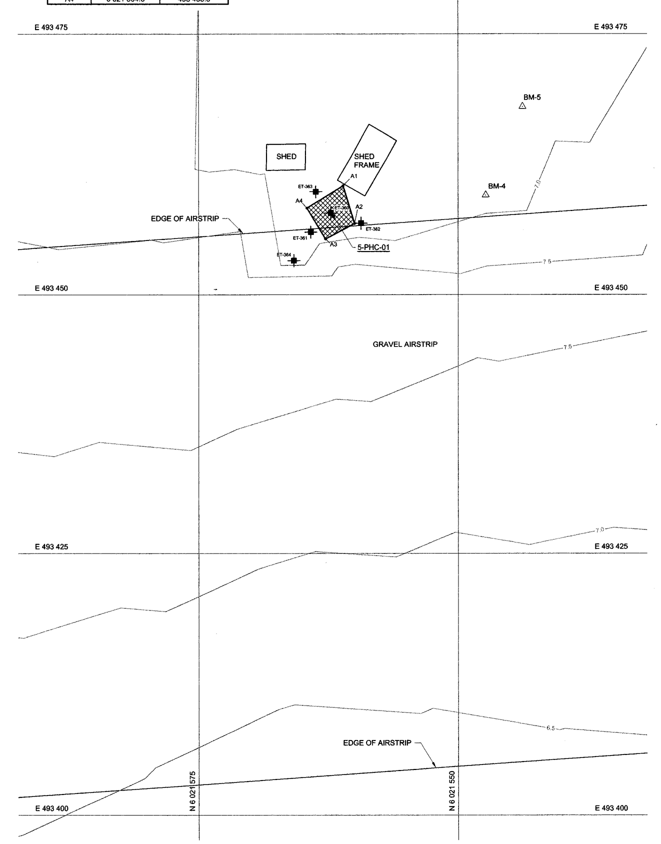
CONTAMINATED SOIL TO BE EXCAVATED						
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	COMMENTS	REFERENCE POINTS N	REFERENCE POINTS E
F1/F2 HYDROCARBON CONTAMINATED SOIL						
5-PHC-01	12.9	0.5	6.5	CONTAINERIZE AND SHIP OFF-SITE.	6 021 562	493 457

AREA 5-PHC-01 COORDINATE POINTS F1/F2 HYDROCARBON CONTAMINATED SOIL EXCAVATION

NO.	COORDINATES NORTHING	COORDINATES EASTING
A1	6 021 561.1	493 460.4
A2	6 021 560.0	493 456.8
A3	6 021 562.8	493 455.4
A4	6 021 564.6	493 458.3

SURVEY BENCHMARK

POINT NUMBER	NORTHING	EASTING	ELEVATION	DESCRIPTION
BM-4	6 021 547.3	493 459.4	6.8	PLACED IRON BAR
BM-5	6 021 543.8	493 468.0	6.8	PLACED CUTCROSS



AREA 5 - AIRSTRIP

SCALE 1:200

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3. CONTOURS SHOWN REPRESENT APPROXIMATE EXISTING GROUND AT INTERVAL OF 0.5m.

LEGEND:

- TEST PIT LOCATION
- COORDINATE POINT
- SURVEY BENCHMARK
- UTILITY POLE
- TIER II CONTAMINATED SOIL
- HYDROCARBON CONTAMINATED SOIL
- POL LINES
- ELECTRICAL CABLE
- SITE DEBRIS AREA

REGISTERED PROFESSIONAL ENGINEER R. MERKOSKY LICENSEE NWT/NU 2008-10-03

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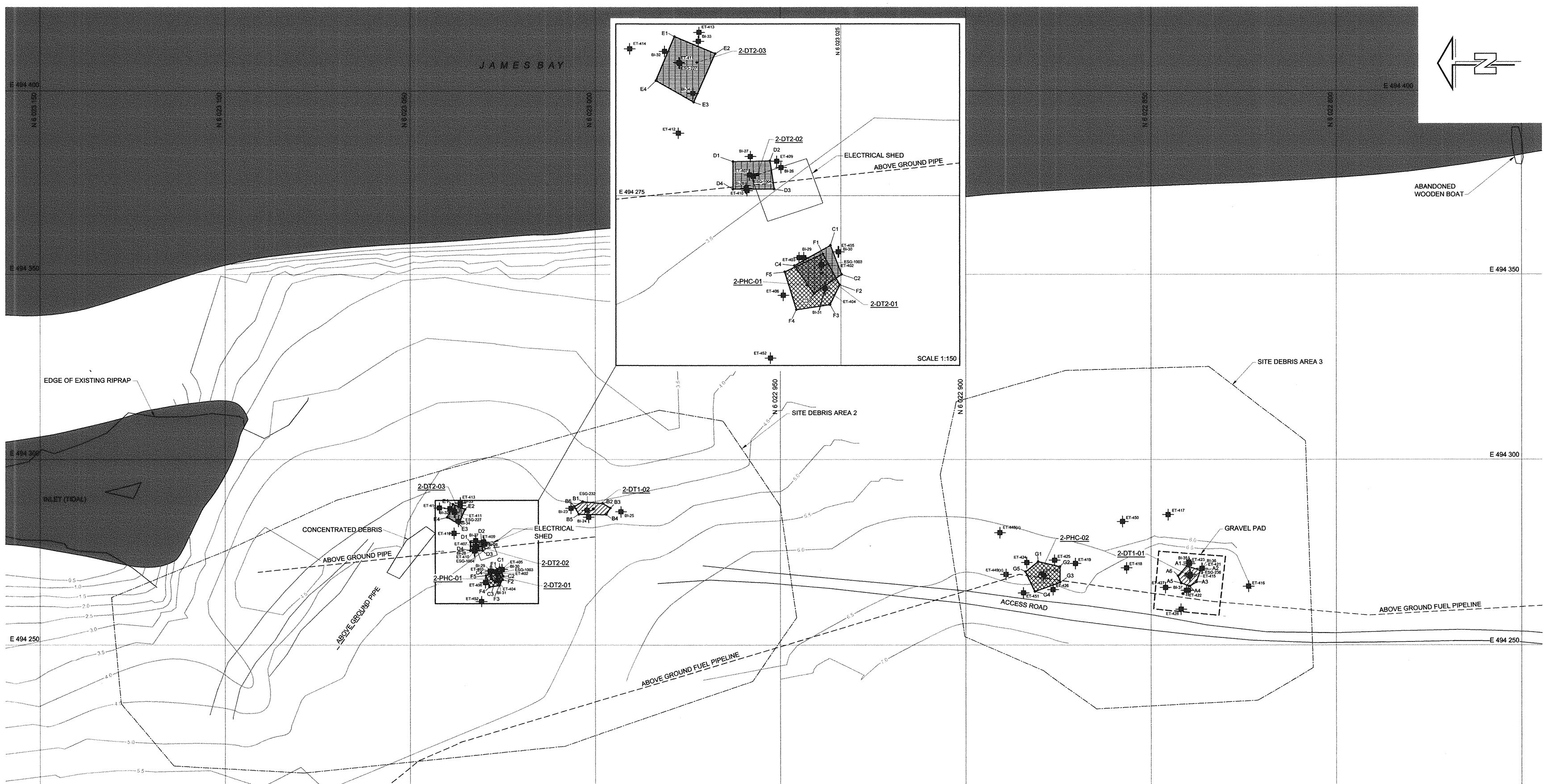
drawing title / titre du dessin: **AREAS 1 AND 5 NORTH DOPPLER SITE AREA AND AIRSTRIP AREA**

designed by / concu par: T. ESHPETER
drawn by / dessine par: B. CHAO
approved by / approuve par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER
scale / echelle: AS SHOWN
project no. / projet no.: 421391
date / date: SEPTEMBER, 2008
sheet / feuille: C03 OF 09

421391-C03

B1 1000 x 707



AREA 2-DT1-01 COORDINATE POINTS TIER I CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
A1	6 022 840.3	494 271.4
A2	6 022 836.7	494 270.1
A3	6 022 837.7	494 267.1
A4	6 022 839.5	494 266.0
A5	6 022 841.9	494 266.8
A6	6 022 842.7	494 268.7

AREA 2-DT1-02 COORDINATE POINTS TIER I CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
B1	6 023 003.4	494 288.7
B2	6 022 998.0	494 288.2
B3	6 022 995.9	494 287.0
B4	6 022 997.0	494 285.2
B5	6 023 004.5	494 285.2
B6	6 023 005.7	494 287.4

AREA 2-DT2-01 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
C1	6 023 025.8	494 270.9
C2	6 023 024.9	494 268.6
C3	6 023 027.2	494 267.0
C4	6 023 028.7	494 269.3

AREA 2-DT2-02 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
D1	6 023 033.8	494 277.8
D2	6 023 030.7	494 277.8
D3	6 023 030.4	494 275.5
D4	6 023 033.7	494 275.5

AREA 2-DT2-03 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
E1	6 023 038.5	494 288.0
E2	6 023 035.2	494 286.6
E3	6 023 036.9	494 282.7
E4	6 023 040.0	494 284.4

AREA 2-PHC-01 COORDINATE POINTS F1/F2 HYDROCARBON CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
F1	6 023 026.5	494 270.3
F2	6 023 025.1	494 267.8
F3	6 023 025.9	494 266.2
F4	6 023 028.6	494 265.8
F5	6 023 029.5	494 268.8

AREA 2-PHC-02 COORDINATE POINTS F1/F2 HYDROCARBON CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
G1	6 022 880.4	494 272.5
G2	6 022 874.6	494 271.2
G3	6 022 874.6	494 267.0
G4	6 022 881.3	494 264.5
G5	6 022 883.9	494 269.8

CONTAMINATED SOIL TO BE EXCAVATED						
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	COMMENTS	REFERENCE POINTS	
					N	E
F1/F2 HYDROCARBON CONTAMINATED SOIL						
2-PHC-01	50.8	1.0	50.8	CONTAINERIZE AND SHIP OFF-SITE.	6 023 028	494 268
TIER I CONTAMINATED SOIL						
2-DT1-01	20.7	0.3	6.2	USE AS INTERMEDIATE FILL AT NON-HAZARDOUS LANDFILL.	6 022 841	494 269
2-DT1-02	26.7	0.3	8.0	USE AS INTERMEDIATE FILL AT NON-HAZARDOUS LANDFILL.	6 023 027	494 269
TIER II CONTAMINATED SOIL						
2-DT2-01	7.9	0.3	2.4	CONTAINERIZE AND SHIP OFF-SITE.	6 023 027	494 269
2-DT2-02	7.2	0.3	2.2	CONTAINERIZE AND SHIP OFF-SITE.	6 023 032	494 277
2-DT2-03	14.5	0.3	4.3	CONTAINERIZE AND SHIP OFF-SITE.	6 023 037	494 286

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3. CONTOURS SHOWN REPRESENT APPROXIMATE EXISTING GROUND AT INTERVAL OF 0.5m.

LEGEND:

- TEST PIT LOCATION
- SURVEY BENCHMARK
- COORDINATE POINT
- TIER I CONTAMINATED SOIL
- TIER II CONTAMINATED SOIL
- HYDROCARBON CONTAMINATED SOIL
- POL LINES
- SITE DEBRIS AREA

REGISTERED PROFESSIONAL ENGINEER
R. MERKOSKY
LICENSEE
NWT/NU
2008-10-03

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PERMIT NUMBER
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UMA ENGINEERING LTD.

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A	ISSUED FOR 90% REVIEW	08/06/18

A detail number / number du detail
B source drawing no. / de dessin no.
C detail on drawing no. / detail sur dessin no.

project title / titre du projet

BEAR ISLAND REMEDIATION PROJECT

drawing title / titre du dessin

AREA 2 BEACH AND POL AREAS

designed by / concu par: T. ESHPETER
drawn by / dessine par: B. CHAO
approved by / approuve par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER
scale / echelle: 1:500
project no. / projet no.: 421391
date / date: SEPTEMBER, 2008
sheet / feuille: C04 OF 09

421391-C04

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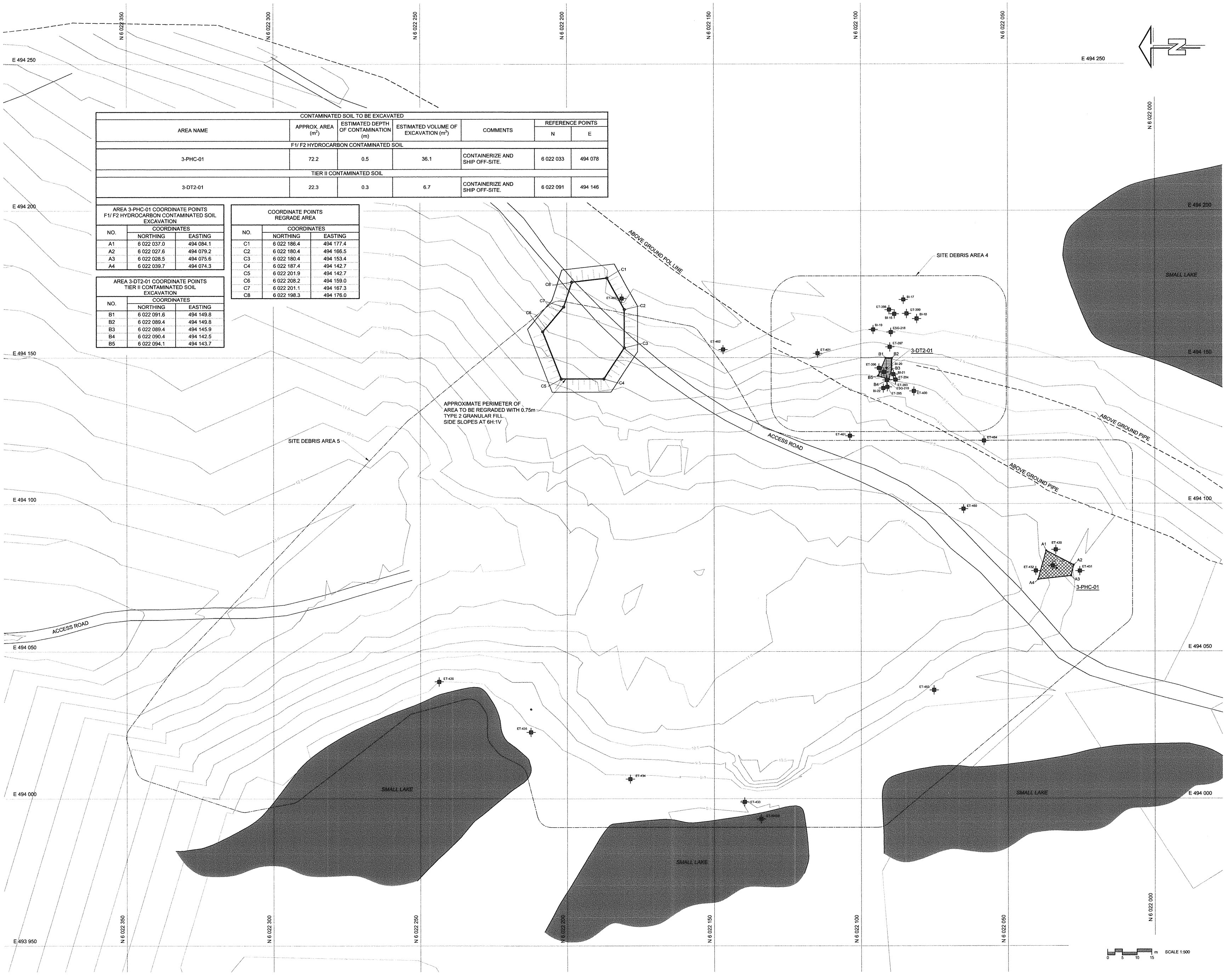
Saved by: Chao, Billy
UMA FILE NO.: 2977-365-00_00-B-0004_RX.DWG
B1 1000 x 707



CONTAMINATED SOIL TO BE EXCAVATED						
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	COMMENTS	REFERENCE POINTS N	REFERENCE POINTS E
F1/ F2 HYDROCARBON CONTAMINATED SOIL						
3-PHC-01	72.2	0.5	36.1	CONTAINERIZE AND SHIP OFF-SITE.	6 022 033	494 078
TIER II CONTAMINATED SOIL						
3-DT2-01	22.3	0.3	6.7	CONTAINERIZE AND SHIP OFF-SITE.	6 022 091	494 146

AREA 3-PHC-01 COORDINATE POINTS
F1/ F2 HYDROCARBON CONTAMINATED SOIL EXCAVATION

NO.	COORDINATES NORTHING	COORDINATES EASTING
A1	6 022 037.0	494 084.1
A2	6 022 027.6	494 079.2
A3	6 022 028.5	494 075.6
A4	6 022 039.7	494 074.3

AREA 3-DT2-01 COORDINATE POINTS
TIER II CONTAMINATED SOIL EXCAVATION

NO.	COORDINATES NORTHING	COORDINATES EASTING
B1	6 022 091.6	494 149.8
B2	6 022 089.4	494 149.8
B3	6 022 089.4	494 145.9
B4	6 022 090.4	494 142.5
B5	6 022 094.1	494 143.7

COORDINATE POINTS
REGRADE AREA

NO.	COORDINATES NORTHING	COORDINATES EASTING
C1	6 022 186.4	494 177.4
C2	6 022 180.4	494 166.5
C3	6 022 180.4	494 153.4
C4	6 022 187.4	494 142.7
C5	6 022 201.9	494 142.7
C6	6 022 208.2	494 159.0
C7	6 022 201.1	494 167.3
C8	6 022 198.3	494 176.0

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3. CONTOURS SHOWN REPRESENT APPROXIMATE EXISTING GROUND AT INTERVAL OF 0.5m.
4. REGRADED SIDES SLOPES 6H:1V MAXIMUM UNLESS NOTED OTHERWISE.

LEGEND:

- BODY OF WATER
- TEST PIT LOCATION
- UTILITY POLE
- COORDINATE POINT
- TIER II CONTAMINATED SOIL
- HYDROCARBON CONTAMINATED SOIL
- POL LINES
- SITE DEBRIS AREA

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2008-10-03

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A	ISSUED FOR 90% REVIEW	08/06/18

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C detail on drawing no. / detail sur dessin no.

project title / titre du projet

BEAR ISLAND REMEDIATION PROJECT

drawing title / titre du dessin

AREA 3
BARREL CACHE
AND NORTH LANDFILL AREA

designed by / concu par: T. ESHPETER

drawn by / dessine par: B. CHAO

approved by / approuve par: B. FEDORAK

PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER

scale / echelle: 1:500

project no. / projet no.: 421391

date / date: SEPTEMBER, 2008

sheet / feuille: C05 OF 09

421391-C05

PLOT: Friday, October 03, 2008 2:18:50 PM

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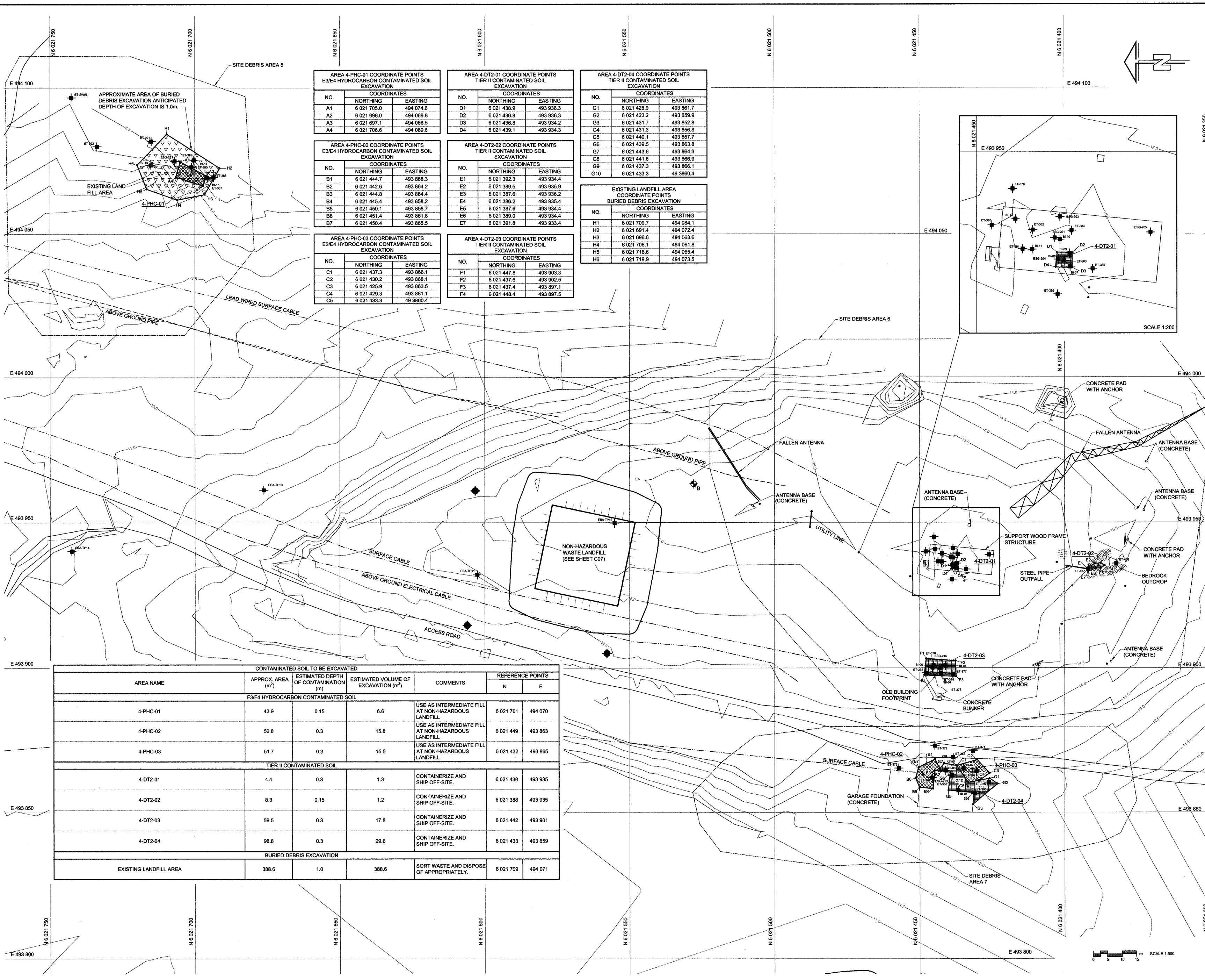

AREA 4-PHC-01 COORDINATE POINTS E3/E4 HYDROCARBON CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
A1	6 021 705.0	494 074.6
A2	6 021 696.0	494 069.8
A3	6 021 697.1	494 066.5
A4	6 021 706.6	494 069.6

AREA 4-PHC-02 COORDINATE POINTS E3/E4 HYDROCARBON CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
B1	6 021 444.7	493 868.3
B2	6 021 442.6	493 864.2
B3	6 021 444.8	493 864.4
B4	6 021 445.4	493 858.2
B5	6 021 450.1	493 858.7
B6	6 021 451.4	493 861.8
B7	6 021 450.4	493 865.5

AREA 4-PHC-03 COORDINATE POINTS E3/E4 HYDROCARBON CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
C1	6 021 437.3	493 866.1
C2	6 021 430.2	493 868.1
C3	6 021 425.9	493 863.5
C4	6 021 429.3	493 861.1
C5	6 021 433.3	49 3860.4

AREA 4-DT2-01 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
D1	6 021 438.9	493 936.3
D2	6 021 436.8	493 936.3
D3	6 021 436.8	493 934.2
D4	6 021 439.1	493 934.3

AREA 4-DT2-02 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
E1	6 021 392.3	493 934.4
E2	6 021 389.5	493 935.9
E3	6 021 387.6	493 936.2
E4	6 021 386.2	493 935.4
E5	6 021 387.6	493 934.4
E6	6 021 389.0	493 934.4
E7	6 021 391.8	493 933.4

AREA 4-DT2-03 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
F1	6 021 447.8	493 903.3
F2	6 021 437.6	493 902.5
F3	6 021 437.4	493 897.1
F4	6 021 448.4	493 897.5

AREA 4-DT2-04 COORDINATE POINTS TIER II CONTAMINATED SOIL EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
G1	6 021 425.9	493 861.7
G2	6 021 423.2	493 859.9
G3	6 021 431.7	493 852.8
G4	6 021 431.3	493 856.8
G5	6 021 440.1	493 857.7
G6	6 021 439.5	493 863.8
G7	6 021 443.6	493 864.3
G8	6 021 441.6	493 866.9
G9	6 021 437.3	493 866.1
G10	6 021 433.3	49 3860.4

EXISTING LANDFILL AREA COORDINATE POINTS BURIED DEBRIS EXCAVATION		
NO.	COORDINATES	
	NORTHING	EASTING
H1	6 021 709.7	494 084.1
H2	6 021 691.4	494 072.4
H3	6 021 696.6	494 063.6
H4	6 021 706.1	494 061.8
H5	6 021 716.6	494 065.4
H6	6 021 719.9	494 073.5

CONTAMINATED SOIL TO BE EXCAVATED						
AREA NAME	APPROX. AREA (m^2)	ESTIMATED DEPTH OF CONTAMINATION (m)	ESTIMATED VOLUME OF EXCAVATION (m^3)	COMMENTS	REFERENCE POINTS	
					N	E
F3/F4 HYDROCARBON CONTAMINATED SOIL						
4-PHC-01	43.9	0.15	6.6	USE AS INTERMEDIATE FILL AT NON-HAZARDOUS LANDFILL	6 021 701	494 070
4-PHC-02	52.8	0.3	15.8	USE AS INTERMEDIATE FILL AT NON-HAZARDOUS LANDFILL	6 021 449	493 863
4-PHC-03	51.7	0.3	15.5	USE AS INTERMEDIATE FILL AT NON-HAZARDOUS LANDFILL	6 021 432	493 865
TIER II CONTAMINATED SOIL						
4-DT2-01	4.4	0.3	1.3	CONTAINERIZE AND SHIP OFF-SITE.	6 021 438	493 935
4-DT2-02	8.3	0.15	1.2	CONTAINERIZE AND SHIP OFF-SITE.	6 021 388	493 935
4-DT2-03	59.5	0.3	17.8	CONTAINERIZE AND SHIP OFF-SITE.	6 021 442	493 901
4-DT2-04	98.8	0.3	29.6	CONTAINERIZE AND SHIP OFF-SITE.	6 021 433	493 859
BURIED DEBRIS EXCAVATION						
EXISTING LANDFILL AREA	388.6	1.0	388.6	SORT WASTE AND DISPOSE OF APPROPRIATELY.	6 021 709	494 071

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4. ALL SURFACE DEBRIS TO BE REMOVED FROM CONTAMINATED SOILS ARE NEW LANDFILL AREA AND BURIED DEBRIS AREAS PRIOR TO ANY FILL PLACEMENT OR EXCAVATION.

LEGEND:

- TEST PIT LOCATION
- UTILITY POLE
- A1 COORDINATE POINT
- TIER II CONTAMINATED SOIL
- HYDROCARBON CONTAMINATED SOIL
- BURIED DEBRIS
- POL LINES
- ELECTRICAL CABLE
- SITE DEBRIS AREA
- PROPOSED MONITORING WELL LOCATION
- B PROPOSED BACKGROUND MONITORING WELL LOCATION

REGISTERED PROFESSIONAL ENGINEER R.R. MERKOSKY LICENSEE NWT/NU
2008-10-03

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C detail on drawing no. / detail sur dessin no.

project title — titre du projet
BEAR ISLAND REMEDIATION PROJECT

drawing title — titre du dessin
AREA 4
SOUTH DOPPLER SITE AREA

designed by — concu par: T. ESHPETER
drawn by — dessine par: B. CHAO
approved by — approuve par: B. FEDORAK
PWGSC Project Manager — Administrateur de Projets TPSGC: L. DYER

scale — echelle: 1:500
project no. — projet no.: 421391
date — date: SEPTEMBER, 2008
sheet — feuille: C06 OF 09

421391-C06

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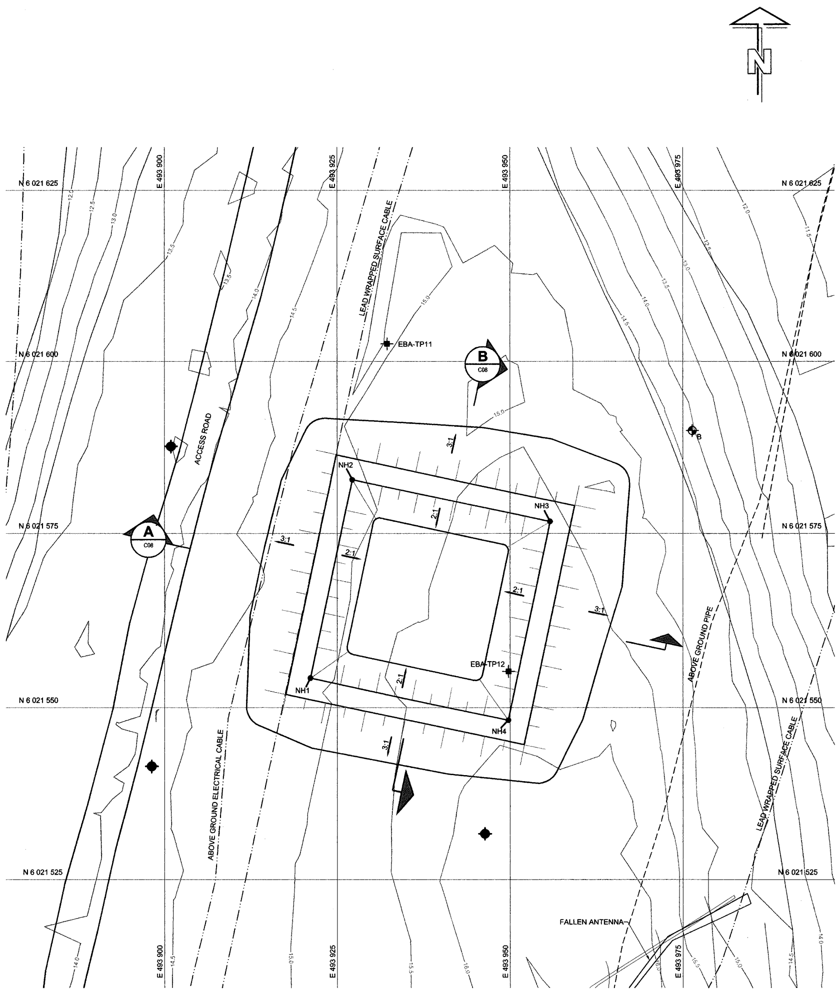
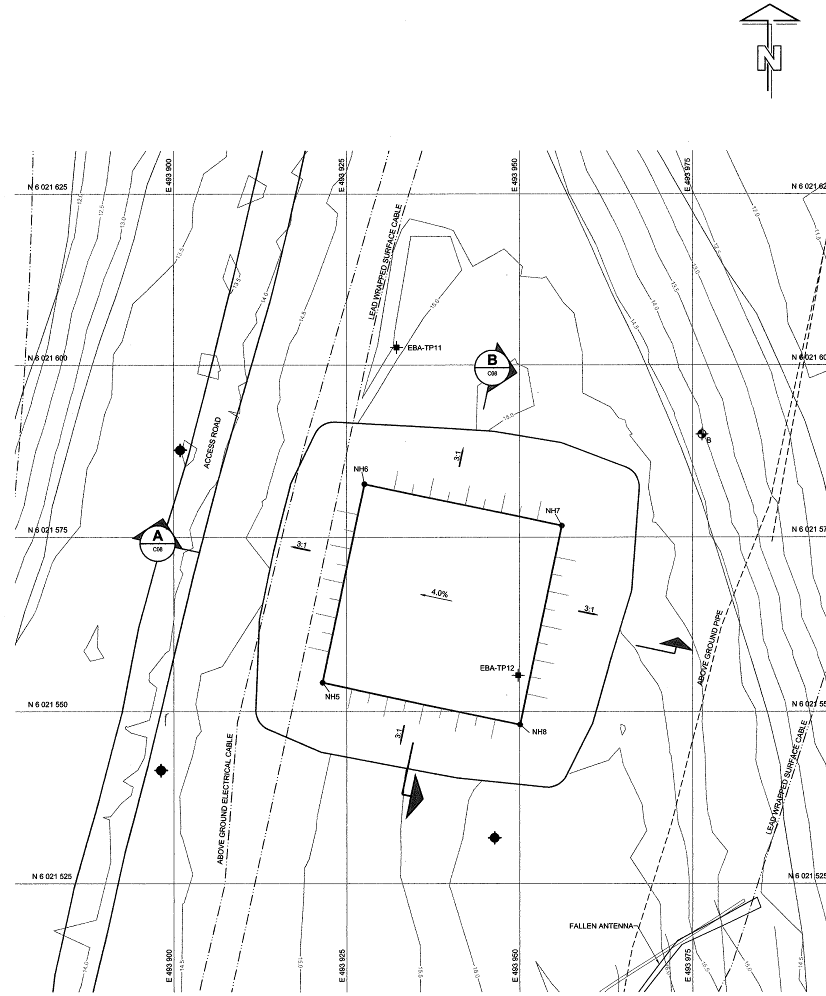


BERM PLAN

SCALE 1:300

COORDINATE POINTS NON-HAZARDOUS WASTE LANDFILL BERM			
No.	NORTHING	EASTING	ELEVATION
NH1	6 021 554.22	493 921.13	17.13
NH2	6 021 582.78	493 927.19	17.13
NH3	6 021 576.71	493 955.81	18.30
NH4	6 021 548.14	493 949.75	18.30



FINAL COVER PLAN

SCALE 1:300

COORDINATE POINTS NON-HAZARDOUS WASTE LANDFILL SURFACE			
No.	NORTHING	EASTING	ELEVATION
NH5	6 021 554.13	493 921.53	18.15
NH6	6 021 582.70	493 927.59	18.15
NH7	6 021 576.64	493 956.12	19.31
NH8	6 021 548.07	493 950.06	19.31

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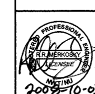
3. CONTOURS SHOWN REPRESENT EXISTING GROUND AT INTERVAL OF 0.5m.
4. ALL COORDINATES ARE SITE COORDINATES AND ALL ELEVATIONS ARE BASED ON SITE DATUM.
5. FOR MONITORING WELL INSTALLATION DETAILS SEE SHEET C09. ALL LOCATIONS TO BE FIELD APPROVED BY THE DEPARTMENTAL REPRESENTATIVE.

LEGEND:

- NH1 — COORDINATE POINT
- EBA-TP11 — TEST PIT LOCATION
- POL LINES
- ELECTRICAL CABLE
- PROPOSED MONITORING WELL LOCATION
- PROPOSED BACKGROUND MONITORING WELL LOCATION



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project title / titre du projet: **BEAR ISLAND REMEDIATION PROJECT**

drawing title / titre du dessin: **NON-HAZARDOUS WASTE LANDFILL PLAN**

designed by / concu par: T. ESHPETER
drawn by / dessine par: B. CHAO
approved by / approuve par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER
scale / echelle: 1:300
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PLOT: Friday, October 03, 2008 2:19:44 PM

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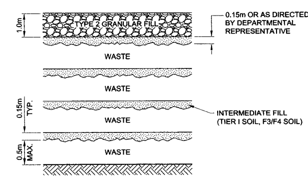
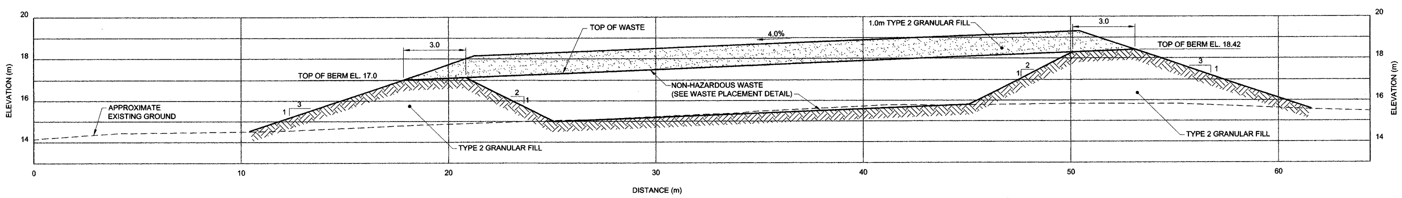
ADD ADDITIONAL WASTE LAYERS, AS REQUIRED, TO ACHIEVE THE NON-HAZARDOUS WASTE LANDFILL DESIGN ELEVATIONS.



WASTE PLACEMENT DETAIL

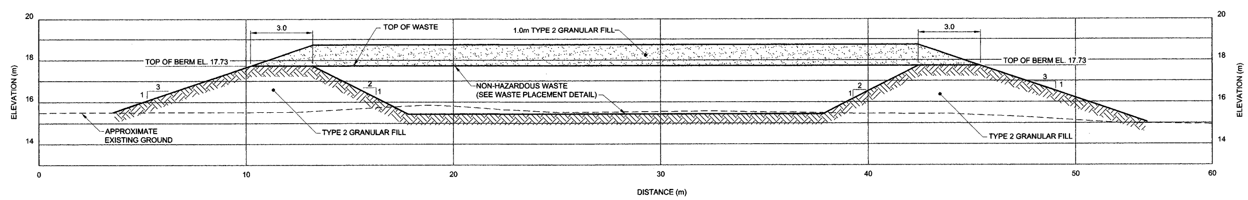
SCALE: N.T.S.



SECTION A

C07

SCALE 1:100



SECTION B

C07

SCALE 1:100

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2. ALL COORDINATES ARE SITE COORDINATES AND ALL ELEVATIONS ARE BASED ON SITE DATUM.

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B source drawing no. / de dessin no.
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project title / titre du projet

BEAR ISLAND REMEDIATION PROJECT

drawing title / titre du dessin

NON-HAZARDOUS WASTE LANDFILL SECTIONS

designed by / conçu par: T. ESHPETER
drawn by / dessiné par: B.CHAO
approved by / approuvé par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER
scale / échelle: AS SHOWN
sheet / feuille: C08 OF 09
project no. / projet no.: 421391
date / date: SEPTEMBER, 2008

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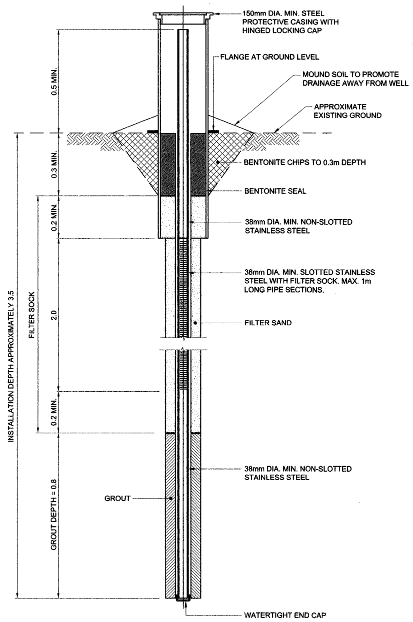
421391-C08



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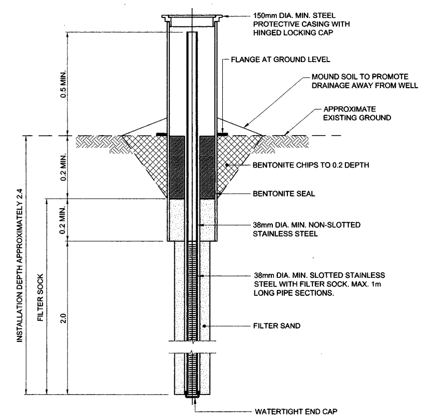

TYPICAL MONITORING WELL/BACKGROUND MONITORING WELL
(FOR BEDROCK DEPTH < 0.7m)
SCALE: N.T.S.

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drawing title / titre du dessin
GENERAL DETAILS

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drawn by / dessine par: B. CHAO
approved by / approuve par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER
scale / echelle: NOT TO SCALE
project no. / projet no.: 421391
date / date: SEPTEMBER, 2008
sheet / feuille: C09 OF 09

421391-C09

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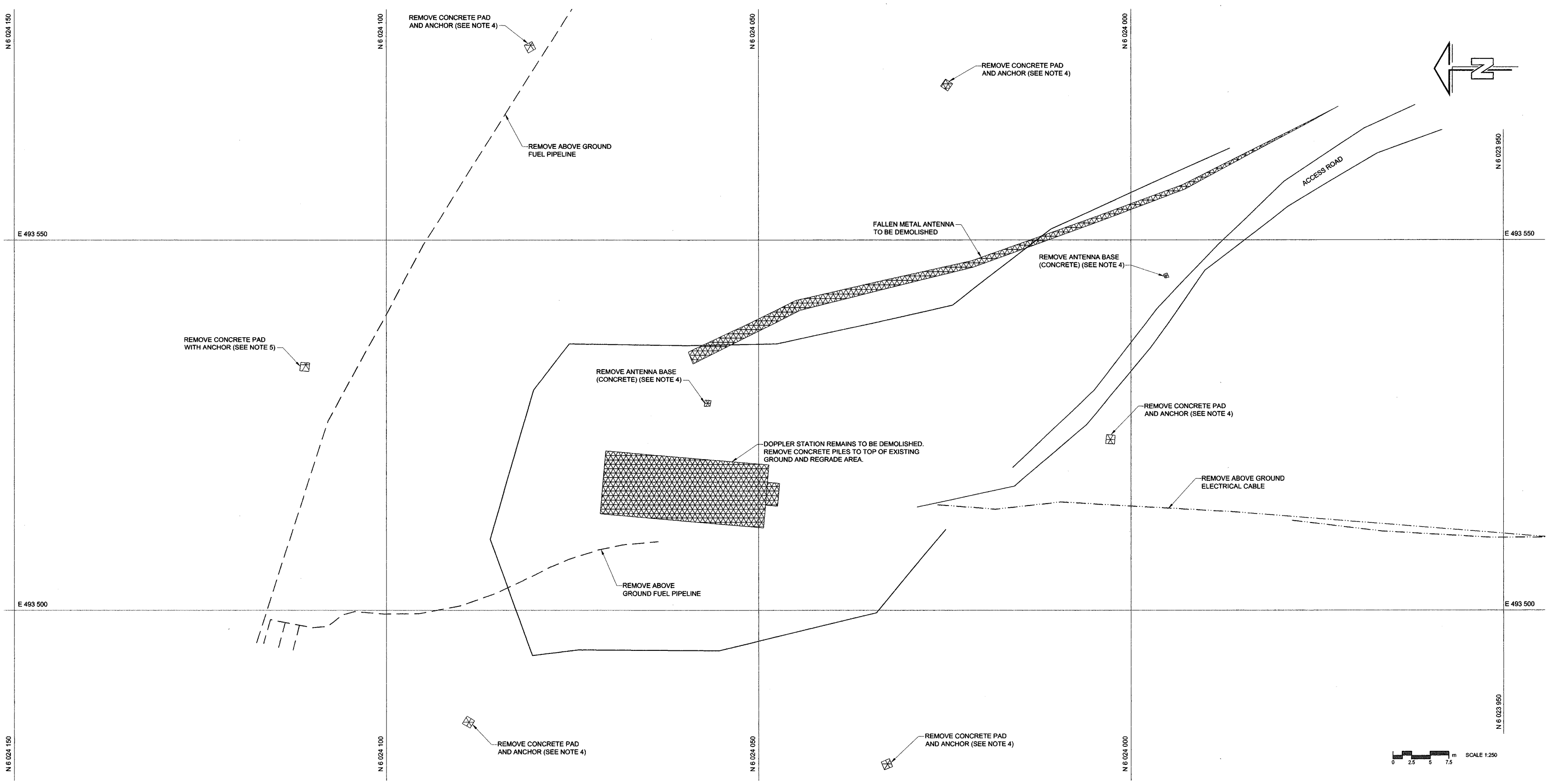
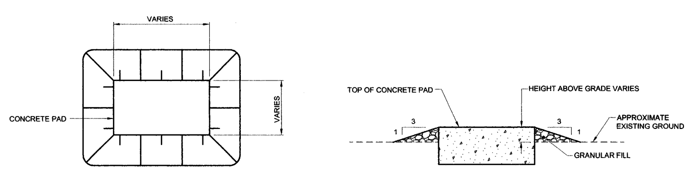


AREA 1 - NORTH DOPPLER AREA



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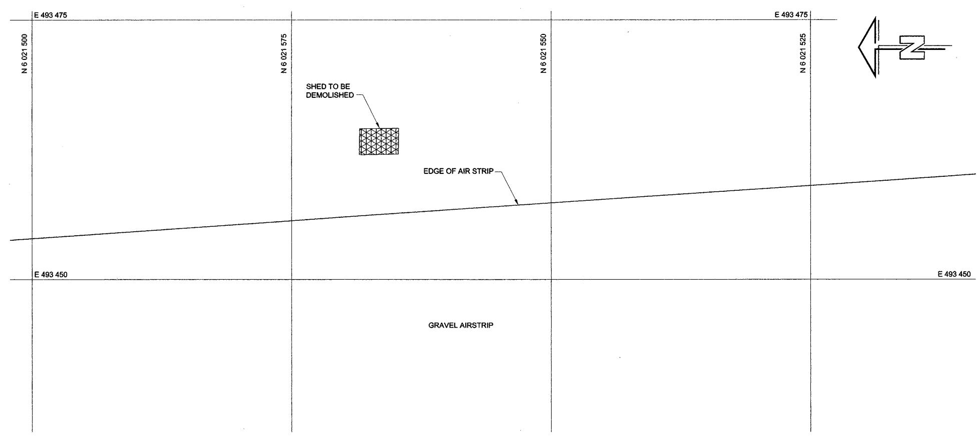

AREA 5 - AIRSTRIP

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3. ALL STRUCTURES DESIGNATED FOR DEMOLITION TO BE DEMOLISHED TO TOP OF CONCRETE FOUNDATIONS UNLESS NOTED OTHERWISE.
4. REMOVE CONCRETE PAD AND ANCHOR, AND PLACE IN NON-HAZARDOUS WASTE LANDFILL
5. LOCATION OF POL LINES AND ELECTRICAL CABLES SHOULD BE CONSIDERED APPROXIMATE.
6. ALL DEMOLITION ITEMS ARE TO BE PLACED IN THE NON-HAZARDOUS WASTE LANDFILL, UNLESS NOTED OTHERWISE.

LEGEND:

- STRUCTURES TO BE DEMOLISHED
- POL LINES
- ELECTRICAL CABLE

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C detail on drawing no. / detail sur dessin no.

project title / titre du projet: **BEAR ISLAND REMEDIATION PROJECT**

drawing title / titre du dessin: **DEMOLITION PLAN AREAS 1 AND 5**

designed by / concu par: T. ESHPETER
drawn by / dessine par: B. CHAO
approved by / approuve par: B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC: L. DYER

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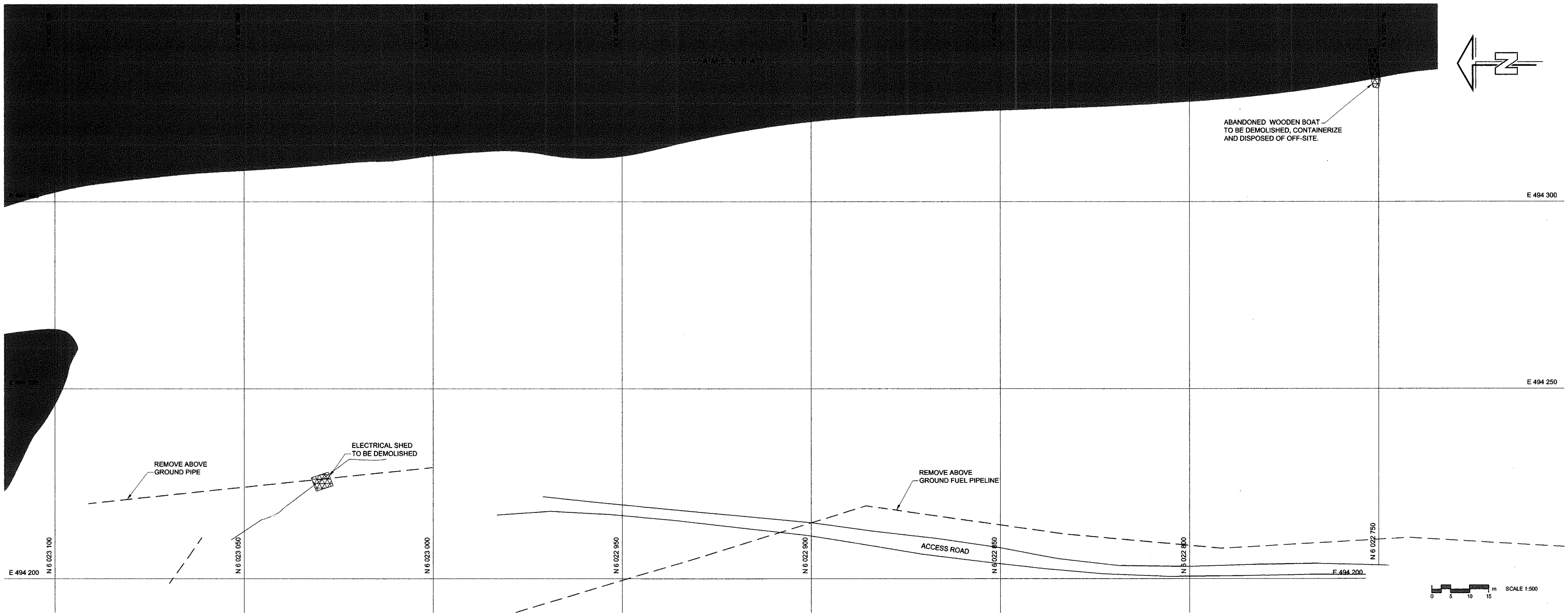
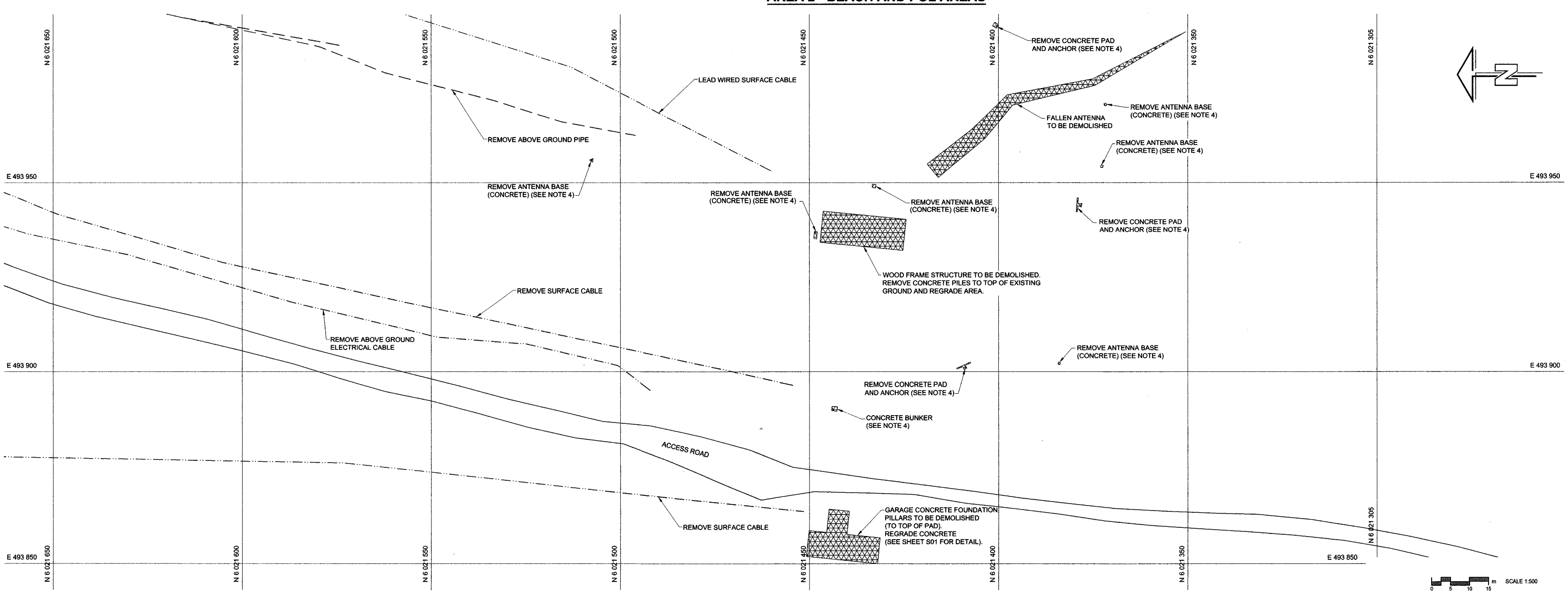


AREA 2 - BEACH AND POL AREAS



AREA 4 - SOUTH DOPPLER AREA

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6. ALL DEMOLITION ITEMS ARE TO BE PLACED IN THE NON-HAZARDOUS WASTE LANDFILL, UNLESS NOTED OTHERWISE.

LEGEND:

- STRUCTURES TO BE DEMOLISHED
- POL LINES TO BE REMOVED
- ELECTRICAL CABLE TO BE REMOVED

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project title / titre du projet: BEAR ISLAND REMEDIATION PROJECT

drawing title / titre du dessin: DEMOLITION PLAN AREAS 2 AND 4

designed by / conçu par	T. ESHPETER
drawn by / dessiné par	B. CHAO
approved by / approuvé par	B. FEDORAK
PWGSC Project Manager / Administrateur de Projets TPSGC	L. DYER
scale / échelle	1:500
project no. / projet no.	421391
date	SEPTEMBER, 2008
sheet / feuille	S02 OF 02

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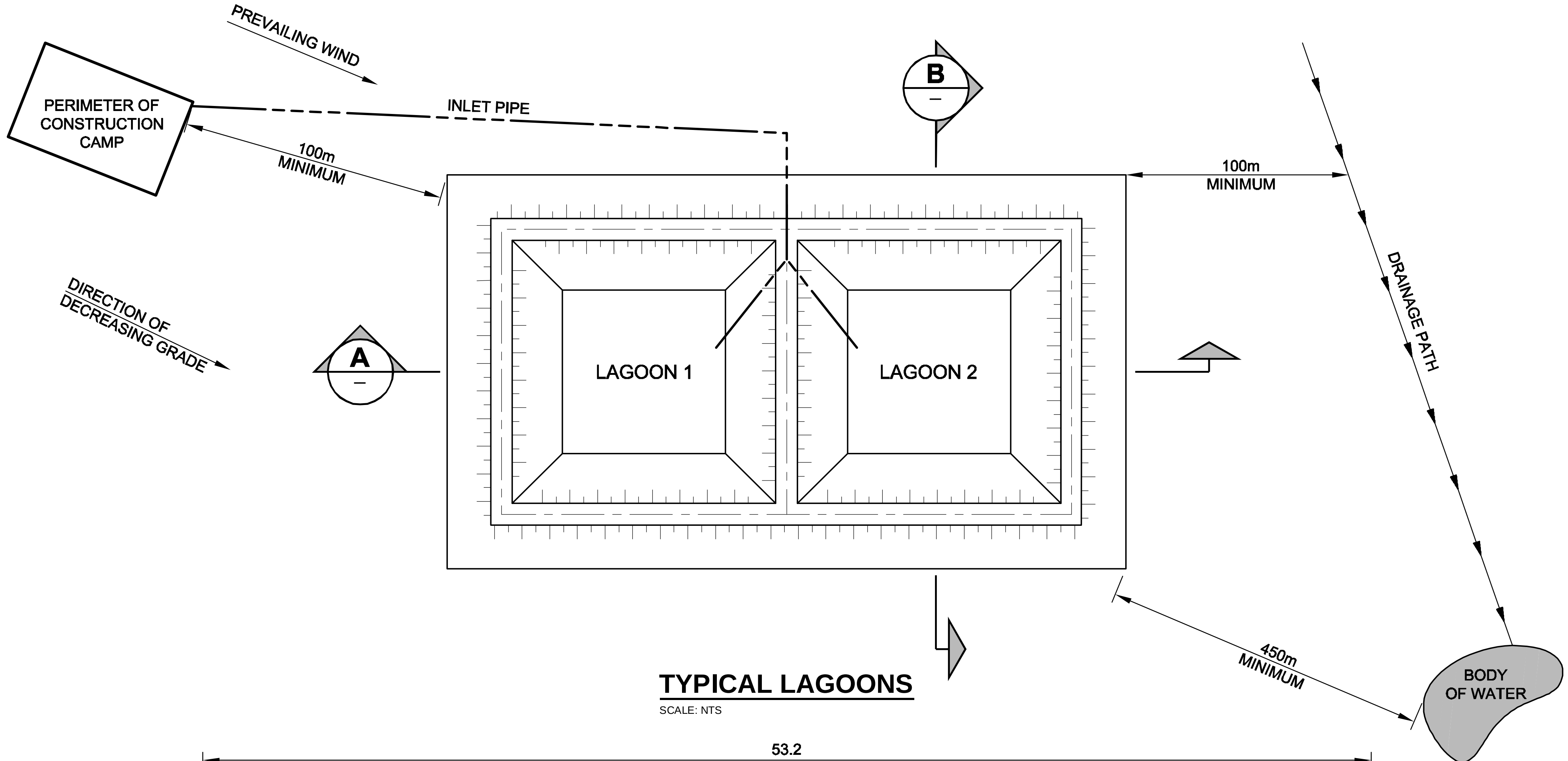
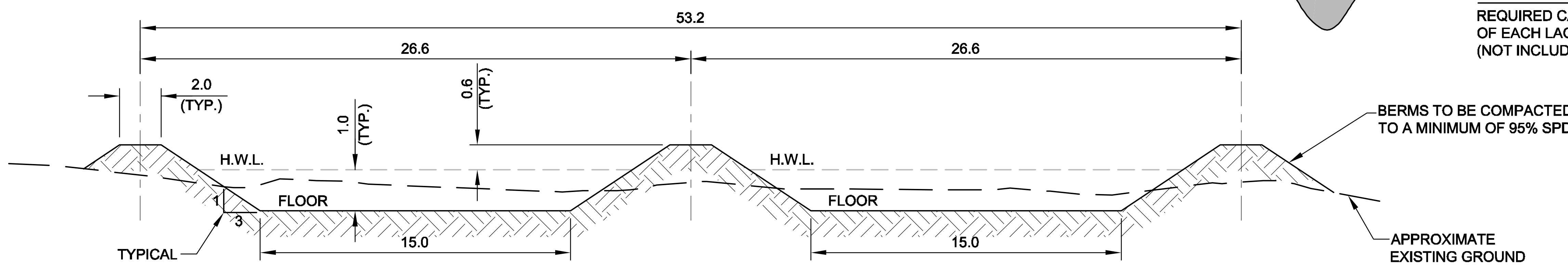


TYPICAL LAGOONS

SCALE: NTS



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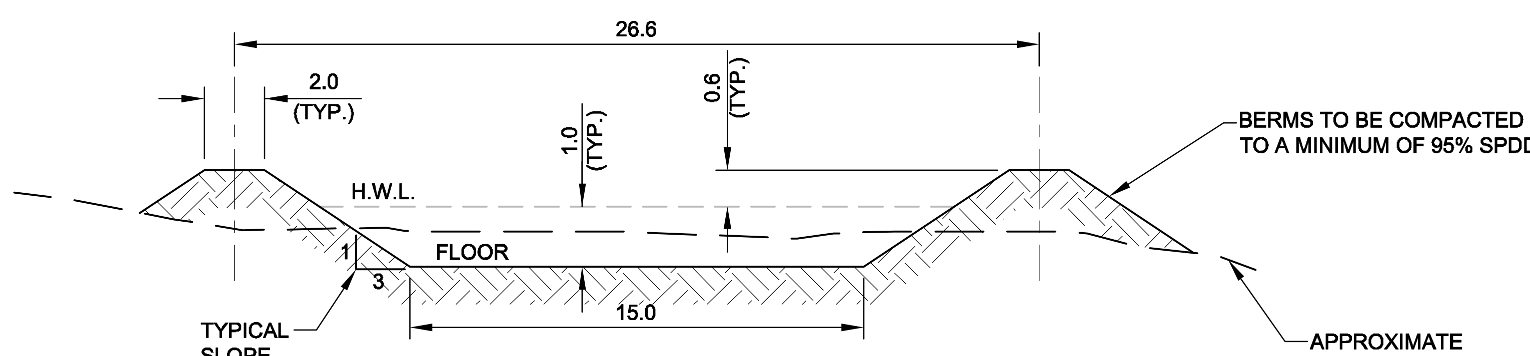
SCALE: NTS



SECTION B

SCALE: NTS

GENERAL NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. IN THE EVENT OF SHALLOW BEDROCK, WHERE FLOOR OF THE LAGOON IS JUST BELOW ORIGINAL GROUND, USE 3m WIDE TOP OF BERM.
3. COMPACTED BERMS TO 95% OF STANDARD PROCTOR DRY DENSITY (SPDD), AT OPTIMUM MOISTURE CONTENT.
4. DISCHARGE WASTEWATER FROM CORNER OPPOSITE OF INLET.

ASSUMPTIONS AND DETAILS:

1. CAPACITY OF EACH LAGOON = 50 DAYS
2. AVERAGE CAMP SIZE = 35 PERSONS
3. MAXIMUM FLUID DEPTH = NOT TO EXCEED 1m
4. FREEBOARD = 0.6m
5. LAGOON TO BE LOCATED 100m FROM CAMP AND DOWNWIND, BASED ON PREVAILING WINDS.
6. ASSUME GROUND SLOPES AWAY FROM CAMP.
7. LOADING = 0.175m^3/PERSON/DAY

CALCULATIONS:

LOADING	0.175m^3/PERSON/DAY
CAMP SIZE	x 35 PERSONS
CONSTRUCTION SEASON	x 50 DAYS
REQUIRED CAPACITY OF EACH LAGOON (NOT INCLUDING FREEBOARD)	= 307m^3

Public Works and Government Services Canada
Bear Island Remediation
Provision of Drawings and Specs - Bear Island, NU

Typical Lagoon Plan and Sections

Figure 1.0

AECOM

APPENDIX 7:

BEAR ISLAND
ENVIRONMENTAL SCREENING

ENVIRONMENTAL SCREENING OF THE PROPOSED INVESTIGATION AND REMEDIATION OF BEAR ISLAND MID-CANADA LINE RADAR SITE UNDER THE NUNAVUT IMPACT REVIEW PROCESS

Submitted to:

Public Works and Government Services Canada
Suite 1650, 635-8th Avenue SW
Calgary, Alberta
T2P 3M3

Submitted by:

AMEC Earth & Environmental
5681-70 Street
Edmonton, Alberta
T6B 3P6

September 4, 2008

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LIST OF APPENDICES

LIST OF ACRONYMS

AIA	Archaeological Impact Assessment
ABP	Aboriginal benefits package
ACM	Asbestos Containing Materials
AMSRP	Abandoned Military Site Remediation Protocol
ASU	Analytical Services Unit
BMPs	Best Management Practices
CAC	Criteria Air Contaminants
CCME	Canadian Council of Ministers of Environment
CEAA	Canadian Environmental Assessment Act
CEPA	Canadian Environmental Protection Act
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO	carbon monoxide
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSP	Contaminated Sites Program
CWF	Canadian Wildlife Federation
CWS	Canadian Wildlife Service
DCC	Defense Construction Canada
DDT	dichlorodiphenyltrichloroethane
DEW	Distant Early Warning
DLCU	DEW Line Clean-Up
DFO	Department of Fisheries and Oceans
DND	Department of National Defense
EA	Environmental Assessment
EC	Environment Canada
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
ESA	Environmental Site Assessment
ESCP	Erosion and Sediment Control Plan
EPP	Environmental Protection Plan
ERP	Environmental Response Plan
FCR	Federal Coordination Regulation
FCSAAP	Federal Contaminated Sites Accelerated Action Plan

TABLE OF CONTENTS (CONT'D)

LIST OF ACRONYMS (CONT'D)

GN	Government of Nunavut
HASP	Health and Safety Plan
HTO	Hunters and Trappers Organization
INAC	Indian and Northern Affairs Canada
IUCN	International Union for Conservation of Nature and Natural Resources
LME	Large Marine Ecosystem
MBCA	Migratory Bird Convention Act
NIRB	Nunavut Impact Review Board
NILCA	Nunavik Land Claim Agreement
NLCA	Nunavut Land Claims Agreement
NOx	nitrogen oxides
NPC	Nunavut Planning Commission
NPRI	National Pollution Release Inventory
NRCAN	Natural Resources Canada
NSA	Nunavut Settlement Area
NTI	Nunavut Tunngavik Incorporated
NWPA	Navigable Waters Protection Act
NWB	Nunavut Water Board
NWMB	Nunavut Wildlife Management Board
NWNSRTA	Nunavut Waters and Nunavut Surface Rights Tribunal Act
PCBs	polychlorinated biphenyls
PHC	petroleum hydrocarbon
PM	particulate matter
POL	petroleum, oil and lubricant fluids
POPs	persistent organic pollutants
PWGSC	Public Works and Government Services Canada
RA	Responsible Authority
RAP	Remedial Action Plan
SARA	Species at Risk Act
SO_2	sulphur dioxide
TC	Transport Canada
WHF	Waste Handling Facility
VEC	Valued Ecosystem Component

1.0 INTRODUCTION

Indian and Northern Affairs Canada (INAC), as the caretaker of federal lands in Canada's north, is responsible for the care and management of contaminated sites that are no longer maintained by the original owner/operator (PWGSC, 2008). These sites are often a result of mining, oil and gas activities, as well as government military activities. Through the Contaminated Sites Program (CSP), INAC has made it a priority to assess, prioritize and mitigate/remediate the environmental impacts of contaminated sites in Canada's north (Earth Tech, 2008a). Included in the list of contaminated sites are the former Mid-Canada Line Radar Stations on Bear Island (the Site).

1.1 PURPOSE

The purpose of this project is to conduct an environmental screening assessment for the proposed investigation and remediation of the former Bear Island Mid-Canada Line Radar Station, located on Bear Island, Nunavut consistent with the assessment requirements of both the *Canadian Environmental Assessment Act* (CEAA) and the *Nunavut Land Claims Agreement* (NLCA).

The main objective is to assess the environmental, social, economic and cultural effects of the proposed investigation and remediation of the former Bear Island Mid-Canada Line Radar Station including identification of potential impacts and development of mitigation plans where necessary.

Specific objectives required to achieve the general objective include:

- Identification and effect of project components and development activities which may affect the receiving environment;
- Identification of existing conditions within the project area, including existing uses of land, resources and other activities which have the potential, in combination with proposed remediation activities, to affect the environment;
- Assess cumulative effects associated with this project and other past, present or proposed projects in the area; and
- Determine any follow-up requirements.

1.2 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

1.2.1 Scope of the Project

The trigger for an environmental assessment (EA) under Article 12.5.2 of the NLCA is a project proposal, as defined under Article 1 of the NLCA, requiring one or more authorizations from the Territorial Government, Federal Government or a Designated Inuit Organization. In scoping the project, clean up activities requiring such authorizations were identified. Furthermore, according to guidance from the Canadian Environmental Assessment Agency (2007) the scope of project will also include the following:

- any component of the development proposal directly related to a regulatory trigger(s) (trigger components); and
- any other components of the development proposal that should be included in the scope of the project in consideration of their potential to cause adverse environmental effects related to matters within federal jurisdiction (non-trigger components).

A trigger component can generally be described as the physical work or activity for which one or more regulatory approvals is/are required. It should usually be defined to include elements physically linked together.

In addition to principle project elements, non-trigger components and accessory components of the project can also be included in the project scope. The decision to include them is based on potential for adverse environmental effects, public concerns and the extent of federal jurisdiction.

As such the scope of the project is defined in Table 1.

Table 1. Summary of Project Scope

Project	Description
CEAA and Nunavut Impact Review Board (NIRB) EA Triggers	• Funding from INAC • Federal permits required for land use • Water License required from Nunavut Water Board
Scope of the project – principal project	Physical clean up of the Site, including: • Delineation of all impacted environmental media • Demolition and disposal of site structures and tanks and landfill on site • Removal of waste materials (including hazardous wastes) • Excavation and transportation south of all contaminated soil except for Tier 1 soils which will be used as intermittent fill in the landfill • Collection and disposal of miscellaneous debris • Collection, cleaning (if necessary), crushing and landfilling of empty barrels
Accessory physical works	• Mobilization and demobilization of contractor's equipment • Temporary personnel construction camp • Upgrading of roadways where required
Other undertakings in relation to the physical work	None

The project activities are described in further detail in Section 2.3.

1.2.2 Scope of the Assessment

In accordance with Article 12.5.2 of the NLCA, this environmental assessment includes a consideration of the following factors:

- project description, including the purpose and need for the project;
- anticipated ecosystemic and socio-economic impacts of the project;
- anticipated effects of the environment on the project;
- steps which the proponent proposes to take including any contingency plans, to avoid and mitigate adverse impacts;
- steps which the proponent proposes to take to optimize benefits of the project, with specific consideration being given to expressed community and regional preferences as to benefits;
- steps which the proponent proposes to take to compensate interests adversely affected by the project;
- the monitoring program that the proponent proposes to establish with respect to ecosystemic and socio-economic impacts;
- the interests in lands and waters which the proponent has secured, or seeks to secure;
- options for implementing the proposal; and
- any other matters that NIRB considers relevant.

Consultation with NIRB resulted in no further identification of other relevant matters.

Furthermore Sections 16(1) and 16(2) of CEAA identifies the following screening requirements which have also been incorporated in this review:

- the environmental effects of the project, including the environmental effects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- the significance of the effects;
- comments from the public that are received in accordance with CEAA and its regulations;
- measures that are technically and economically feasible and that would mitigate any significant adverse environmental effects of the project;
- the purpose of the project;
- alternative means of carrying out the project that are technically and economically feasible and the environmental effects of any such alternatives; and
- the need for, and the requirements of, any follow-up program in respect of the project; and the capacity of renewable resources that are likely to be significantly affected by the project to meet the needs of the present and those of the future.

1.2.3 Scope of the Factors

This assessment will consider the potential effects of the proposed project on identified components of the environment within spatial and temporal boundaries that encompass the area and the time period for which the proposed project will occur.

For most impacts the spatial extent of the assessment is limited to the footprint and duration of the project as described in Section 2.0 of the Project Description. For the consideration of cumulative impacts a regional assessment has been undertaken where there is potential for overlapping impacts from other projects and activities.

2.0 PROJECT DESCRIPTION

2.1 BACKGROUND

The Mid-Canada Line was a line of radar stations and military sites that stretched across Canada's 55th parallel of latitude from Labrador to British Columbia. The stations were meant to provide air defense and early warning using Doppler Radar Systems. Doppler Radar Systems determine aircraft velocity relative to the Earth's surface and are generally used with navigation computers (PWGSC, 2008).

There are two former (abandoned) Mid-Canada Line Radar Stations on Bear Island located at approximately 55^{o}N: Site 412 (the main station) and Site 413 (situated near the north end of the Island). The stations were constructed between 1954 and 1957 and were in operation from the mid-1950's to 1965 (Earth Tech 2008a). The Site was then vacated and left abandoned. The Site, including all structures, equipment, debris, and environmental disturbances, became the responsibility of INAC around 1965.

There are four main areas of activity at Bear Island:

1. South Doppler Area (Site 412).
2. North Doppler Area (Site 413).
3. Beach area.
4. Airstrip area.

After the Site was abandoned, facilities at both Site 412 and Site 413 were demolished to the foundations. Currently, much of the debris, buildings and building components, and machinery from Site 412 and Site 413 are stockpiled at the beach area (Earth Tech, 2008a).

Earth Tech (2008a) completed a classification of the Bear Island site (Sites 412 and 413) using the Federal Contaminated Sites Accelerated Action Plan (FCSAAP) classification system based on the findings of previous investigations. In summary, the FCSAAP score was determined to be 73.8, which classifies the site as a *Class 1: Action Required.* By definition, this classification indicates that the action (e.g. further site characterization, risk management, remediation, etc) is required to address existing concerns. Typically, Class 1 sites show a propensity for high concern due to several factors, and that measured or observed impacts have been documented (Earth Tech, 2008a).

This high priority classification of Bear Island led to the development of a Remedial Action Plan (RAP) to provide a conceptual remediation design and preliminary specifications for clean up of the Site. The RAP was designed to meet the following clean up objectives in accordance with the INAC Abandoned Military Site Remediation Protocol (Earth Tech 2008b):

1. Restore the site to an environmentally safe condition.
2. Prevent the migration of contaminants into the Arctic ecosystem.
3. Remove physical hazards for the protection of human health and safety.
4. Implement a cost effective remediation solution.

Past investigations completed at the Site are summarized in the following table:

Table 2. Summary of Previous Investigations

Investigation	Purpose	Issues and Conclusions
An EA of 2 Mid-Canada Line Sites at Bear Island (*Environmental Sciences Group, Royal Roads Military College, March 1996)*	To determine cleanup requirements using the Department of National Defense (DND) Distant Early Warning (DEW) Line Cleanup (LCU) Protocol The investigation focused on the presence of contamination resulting from previous site activities	• chemical contamination was minimal and confined to localized areas • physical debris was excessive • assessment of hydrocarbon contamination not included in scope Recommendations included: • managing the non-hazardous waste on-site (in designated landfills) • shipping Defense Construction Canada (DCC) Tier II Contaminated soil to off-site industrial landfills
Former Mid-Canada Line Radar Station, Bear Island, Nunavut – Environmental Site Delineation and Material Inventory, *(Earth Tech Canada, November 2001)*	To delineate soil contamination, inventory materials remaining on the site, locate potential landfill and borrow sites, and generate a topographic survey of the Site	• soil was found to be contaminated with heavy metals and hydrocarbons • identified an estimated 1,000 m^3 of non-hazardous material and 35 m^3 of hazardous material on site

Table 2. Summary of Previous Investigations

Investigation	Purpose	Issues and Conclusions
RAP Bear Island Mid-Canada Line Radar Station Bear Island, Nunavut, March 2008	To identify remediation options, assess potential remediation methods and to provide recommendations for site restoration	• soil was found to be contaminated with heavy metals and hydrocarbons • there is an estimated 700 m^3 of non-hazardous material and 20 m^3 of hazardous material on site • there is one Class A landfill on site containing petroleum hydrocarbon (PHC) contaminated soil and one Class C landfill on site containing partially buried debris • there are 4300 barrels on site with unknown contents that should be assessed and disposed of according to the DLCU barrel protocol • approximately 27 m^3 of lead amended paint materials are present (recommended to be dismantled and disposed of off-site) • approximately 8 compressed cylinders, present on site, should be vented and disposed of in a non-hazardous landfill
Archaeological Impact Assessment (AIA) of the Former Mid-Canada Line Radar Site, Bear Island Nunavut	To identify the potential for impacts to heritage resources through the remedial reclamation of the former Mid-Canada Line Radar Station at Bear Island	One single global heritage site was identified. It was recommended that the area be avoided during the remediation process

Source: Terms of Reference (PWGSC, 2008)

2.2 SITE DESCRIPTION

Bear Island (the Island) is located at 54°20' N, 81°05' W, toward the central northern end of James Bay (Figure 1). The closest communities to Bear Island include Chisasibi, Quebec on the James Bay coastline approximately 160 km to the southeast, and Sanikiluaq, Nunavut located on the north end of the Belcher Islands, approximately 300km to the north (Figure 1). Additional information regarding the biophysical environment is provided in Section 3.0.

As noted in Section 2.1 there were four main areas of activity including two station sites on the Island; the Southern Station, Site 412 (South Doppler Area) and the North Station, Site 413 (North Doppler Area) (Figure 2). In addition, potential granular borrow source areas were identified at the south end of the island (1.2 km south of Site 412), 0.5 km south of Site 412 and 0.2 km southeast of Site 413, and contain all necessary granular fill types, except Type 4 which is required for the construction of low permeability containment berms (Earth Tech 2008b).

2.2.1 South Doppler Area – Site 412

The Southern Station (Site 412) is located on a hill approximately 17 m above and approximately 300 m west of James Bay (Figure 2). The facilities in the area included a Doppler detection building, emergency shelter, garage, sewage outfall, one large and two small radar antenna towers, a network of utility poles, and numerous waste debris piles. The majority of the facilities at Site 412 have been demolished to the foundations. The concrete garage foundation, wooden timber Doppler detection building foundation and the concrete bunker near the emergency shelter are all that remain in place. It is understood that the Doppler detection building was the operations centre as well as living quarters for the site employees while the radar station was in operation (Earth Tech, 2008a).

Also located in this general vicinity are an existing landfill (approximately 200 m north), and the barrel cache and disturbed area (approximately 400 m north and northwest). It appears that the building construction materials from this area were placed in sorted piles, partially buried or stockpiled at the Beach Area (Earth Tech, 2008a). Environmental concerns in the south Doppler area include: contaminated soils in the vicinity of the facilities, surface stains, surface water drainage and contaminant migration from impacted areas as well as the hazardous materials scattered and piled in the area (Earth Tech, 2008a). Furthermore, studies around the Doppler Detection building identified hydrocarbon and metal contamination in the soils.

2.2.2 North Doppler Area – Site 413

This area was the northern, smaller radar facility on the Island (Figure 2). Facilities in this area consisted of a control building, an antenna and a set of petroleum, oil and lubricant fluids (POL) tanks. Like the South Doppler Area, the building has been demolished to its wood frame foundation and the building materials are piled around the area. Also, the antenna was down and the POL tanks were removed (Earth Tech, 2008b). Previous investigations have identified heavy metal contamination in two areas north of the building, in the vicinity of where the POL tanks once stood and near a pile of zinc coated electrical conduit (Earth Tech, 2008a).

2.2.3 Beach Area

The Beach Area is located in a small bay on the east side of Bear Island, approximately 1 km north of the South Doppler Station – Site 412 (Figure 2). This area was likely used as the barge staging area when the site was in operation. There is a large amount of stockpiled construction materials and debris in this area (heavy equipment, wooden huts, barrels, etc.), thought to be brought to the beach with the intention of removing it from the island (Earth Tech, 2008b). Environmental concerns in this area include heavy metal and/or hydrocarbon contaminated soil identified in the vicinity of electrical equipment and components, heavy machinery, and on the former POL storage pad (Earth Tech, 2008a).

2.2.4 Airstrip

The airstrip, located on the west side of the island, has a north-south orientation and is approximately 1500 m in length (Figure 2). There is one main debris area at the airstrip, which is located on the east side near the south end of the airstrip. In this area there was a wooden hut, wooden frames of three other huts, as well as domestic debris such as glass bottles, pots and pans, and a few empty barrels. There was also one partially full barrel found lying on its side, which was leaking and causing a small surface stain (Earth Tech 2008b).

2.3 DESCRIPTION OF PROJECT ACTIVITIES

The RAP includes the following tasks:

- delineation of all impacted environmental media (particularly soils and building wastes);
- excavation and removal of contaminated soils;
- demolition of all site structures & tanks and burial on site;
- collection of miscellaneous debris;
- disposal of all previously containerised hazardous liquid and solid (soil) wastes; and
- collection and crushing of empty barrels.

There are a number of project tasks that have not been determined or are yet to be finalized. This screening report covers only the elements currently established but is structured so that additional project elements and tasks may be incorporated into the assessment as they are defined by Public Works and Government Services Canada (PWGSC) and INAC.

2.3.1 Project Schedule

Based on an anticipated project tendering date of fall 2008, the proposed schedule for site remediation is as follows:

- Contract tendering (Winter 2008)
- Contract award (Spring 2009)
- Mobilization (Summer 2009)
- Year 1 remedial activities (Summer 2009)
- Year 2 remedial activities (Summer 2010)
- Demobilization (Fall 2010)

2.3.2 Project Activities

Environmental issues at Bear Island requiring remediation are related to:

- contaminated soils;
- areas of surface and partially buried debris;

- existing landfills;
- hazardous materials;
- petroleum products; and
- abandoned barrels.

Contaminated soils will be excavated, classified and either buried in an on-site non-hazardous landfill or shipped to a licensed facility for proper disposal. Existing areas containing landfill materials will be excavated and materials will be consolidated and disposed of accordingly. A new landfill will be constructed to contain only non-hazardous materials and non-regulated contaminated soils.

In accordance with protocols established by INAC, all hazardous materials, excluding asbestos and some compressed gas cylinders, with unknown content, will be shipped off-site to a licensed facility for proper disposal. Asbestos will be disposed of in an on-site landfill, and compressed gas cylinders with known contents will be vented and land filled on-site. Barrels containing fluids will be excavated and tested, and treated according to the DND DEW Line Cleanup Barrel Protocol (INAC, 2008).

A summary of the main environmental concerns and associated remedial methods are presented in Table 3 (adapted from Earth Tech 2008b).

Table 3. Summary of Bear Island Environmental Concerns and Recommended Remedial Actions

Environmental Concern	Site Assessment Findings	Remediation Method
DCC Tier I Contaminated Soils	12.0 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and polychlorinated biphenyls (PCBs) which exceed the DCC Tier I criteria were identified onsite	Dispose of soils that exceed DCC Tier I soils (12.0 m3) in an onsite landfill
DCC Tier II Contaminated Soils	82.3 m^3 of soils with concentrations of heavy metals (Cd, Cu, Pb and Zn) and PCBs which exceed the DCC Tier II criteria were identified onsite. This volume includes 0.8 m^3 of material that is co-contaminated with Tier II metals and 3.5 m^3 of Tier II PCBs	Excavate, containerize and label soils that exceed DCC Tier II criteria (82.3 m^3) and dispose offsite
Petroleum Hydrocarbon Contaminated Soils	Approximately 81.0 m^3 of hydrocarbon contaminated soil in exceedance of the Tier I Canada Wide Standards for Petroleum Hydrocarbons (Eco Soil Contact/Protection of Groundwater for Aquatic Life)	Excavate contaminated soils and place into containers, and ship off site to a licensed disposal facility
Surface Debris	Approximately 670.6 m^3 of non-hazardous debris consisting of heavy equipment, barrels, scrap metal, scrap wood, concrete, electrical equipment and plumbing parts, and any remaining buildings	Consolidate and dispose in a non-hazardous landfill constructed onsite
Existing Landfills	Landfill North of Site 413 is considered a Class A landfill and was found to contain hazardous materials. Also, the surrounding soils are being impacted from contaminants located within the landfill North Landfill is considered to be a Class C landfill and there is no evidence that the surrounding soils are being impacted	Consolidate and dispose waste debris (14.7 m^3) accordingly. Remediate PHC contaminated soils as described above Consolidate surface debris as well as the partially buried debris located on the exposed southwest toe of the landfill, (approx 41.7 m^3 total) and dispose accordingly

Table 3. Summary of Bear Island Environmental Concerns and Recommended Remedial Actions

Environmental Concern	Site Assessment Findings	Remediation Method
POL Fluids	There are approximately 1.05 m^3 (1,050 L) of POL fluids	Incinerate POL fluids that meet incineration criteria (< 2 ppm PCBs and Cd and < 10 ppm Cr and <100 ppm lead and <1000 ppm Chlorine), otherwise treat as Hazardous Waste
Water in barrels	With the exception of five barrels, all barrels inspected were found to be empty or rusted through. This fact does not ensure that all barrels on site are empty or contain just rusty water as all (approximately 4300 barrels) were not inspected	During clean-up, all barrels must be approached using the DLCU barrel protocol
Lead Painted Products	Approximately 27.0 m^3 of lead amended paint materials were discovered on site	Dismantle lead painted items and ship off site to an appropriate disposal facility
Hazardous Materials	Approximately 18.0 m^3 of hazardous materials were identified at the site. These materials consisted of lead acid batteries (3 m^3), asbestos containing materials (12.5 m^3), and lead cable and zinc conduit (2.5 m^3)	Asbestos waste to be collected, bagged and disposed of in an on-site landfill. All hazardous materials (such as batteries and hazardous cable/conduit) will be containerized, labeled and shipped to be disposed at a licensed southern facility
Compressed Gas Cylinders	Approximately 8 compressed gas cylinders were identified on-site	Vent and dispose of cylinders according to the AMSRP (April 2008) (INAC, 2008) in the non-hazardous landfill

It should also be noted that the Contractor and Client will be required to develop an Environmental Protection Plan (EPP) and Environmental Management Plan to support project activities by providing mitigative measures (refer to Section 4.3). In addition to this, and in the event of an environmental incident (i.e. oil spill) or emergency situation, an Emergency Response Plan (ERP) will also be required. Development of these plans will be done prior to the start of the project and implemented when needed.

The detailed project description outlining the remediation and related support activities described in the RAP (Earth Tech 2008b) are outlined below.

2.3.3 Contractor Support Activities

2.3.3.1 Mobilization

Mobilization to the site is anticipated to be conducted via sealift, with the proposed barge landing area located at the beach area on the east side of the Island. Prior to use, the landing area will be inspected by a sealift contractor to ensure that barging can be utilized. Depending on the contractor, the sealift may be mobilized from a James Bay community or from Montreal. Aircraft from the community of La Grande or Chisasibi will be chartered to re-supply the camp and move personnel as required during remediation activities.

2.3.3.2 Contractor Camp

To support the remedial activities, an onsite construction camp will be situated in a previously disturbed location (e.g., west of the barrel cache) to minimize the extent of new disturbance. The camp will be large enough to support approximately 30 site workers and approximately 3-5 camp staff. The camp will include a potable water source, sewage collection and treatment in accordance with all applicable guidelines and regulations, bear safety measures, emergency rations, and an emergency rescue contingency plan. The existing water reservoir will be re-sampled prior to setting up the camp to determine if the water source can be used to support the camp requirements. Additional testing will be required on an on-going basis for potable use during remediation. Contingencies for water supply will include filters and a supply of bottled water.

Waste generated by the camp will either be disposed off-site or incinerated on-site with the ash placed in the constructed landfill or shipped off-site, as appropriate. Sewage will be treated using an appropriately sized treatment system, and effluent quality will adhere to applicable licenses. Fuel required to operate the camp and to complete remedial activities will be stored on site in accordance with applicable legislation and licenses.

Measures will be taken during the off-season (i.e., winter 2009/2010) to reduce the potential for polar bears and other wildlife to be attracted to infrastructure associated with clean-up activities. Although it will be necessary to leave heavy equipment, tools, and hard-sided camp infrastructure over the winter, all kitchen supplies (food, utensils, etc.) and other mobile infrastructure will be removed from the site during the winter.

2.3.3.3 Existing Infrastructure

Where the contractor plans to utilize the airstrip at the Island, the contractor and operational pilots will evaluate the runway condition prior to and continually during use. If excessive erosion and/or rutting are noted, the airstrip will be repaired immediately to the satisfaction of the operational pilots. Further assessments and the use of a Boeing Penetrometer will be employed before considering the use of larger aircraft. Once remediation activities have been completed, the airstrip will be left in place, as the airstrip is currently referenced on aviation maps and is available to be used in the event of an emergency.

Due to lack of maintenance and erosion, some of the existing roads to be utilized during remedial activities will require minor repair and upgrading with borrow material. Upon completion of the remediation program, with the exception of removing any fabricated materials and re-grading to re-establish natural drainage patterns, the existing roads will be left in place.

2.3.3.4 Waste Handling Facility Construction

A Waste Handling Facility (WHF) will be located on the Island to receive and sort various waste items located on the island. This facility will be located near the proposed landfill location and be surrounded by a temporary road to provide access to vehicles and equipment required for the delivery, sorting and transport of site waste. The fluids handling area within the WHF will be bermed and lined with an engineered liner to prevent the migration of contaminants resulting from any accidental spills. Materials to be received and sorted at the WHF will include but not limited to:

- barrels;
- batteries;
- compressed gas cylinders;
- items painted with lead paint;
- items painted with PCB amended paint;
- soils for off site removal; and/or
- creosote treated timbers.

Upon completion of remediation activities and decommissioning of the WHF, soils in and around the WHF will be sampled to assess the presence of contamination as a result of the works and remedial measures implemented, as required.

2.3.4 Other Activities

2.3.4.1 Borrow Sources

Borrow sources for granular material will be required for the construction of the new landfill and for general site grading purposes. Borrow sources will be developed in accordance with the Abandoned Military Site Remediation Protocol (AMSRP) (revised April 2008) (INAC, 2008). Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources identified by EBA Consulting Ltd in 2007.

Upon completion of remedial activities, all borrow areas will be re-contoured to restore natural drainage, match surrounding topography and minimize changes to the existing permafrost. Borrow sources at the south end of the island will be carefully managed to ensure that the arctic tern nesting habitat, as well as the archaeological site, are not impacted by remediation activities.

2.3.4.2 Landfill Development

A new landfill is required at Bear Island for the proper disposal of non-hazardous materials and/or non-regulated contaminated soils. All hazardous waste will be disposed of off-site. The proposed landfill identified in the RAP is just north of Site 412, as this location requires the least amount of transportation for the majority of the waste and it is on the crest of a hill, minimizing the probability of erosion and infiltration.

The landfill will be constructed in a controlled manner with minimal lifts to control compaction and settlement. Surface water run-on and run-off will be controlled through proper grading to positively shed water and to prevent ponding and seepage into the landfill. Consideration to the landfill cap angles will be designed as to not to encourage erosion of capping material.

Leachate control will be accomplished by control measures (rather than containment and collection), including placement of only dry and stable material in the landfill and prevention of water infiltration into the landfill to avoid leachate generation. Fill material will be “frost stable” and will be placed outside of high groundwater and/or the constant surface water area recharge area. Settling of the landfill surface will be avoided by placing thin lifts (0.15 m) and compacting/vibrating to fill voids.

Outside berms will be constructed at 3H:1V and inside berms at 1.5H:1V. The top of the berm will have a minimum width of 2 m. Since the berm material will be erodible, the berms will have a minimum 0.5 m thick cover of gravel and cobbles. The reduction of surface settlement over the landfill will be completed by ensuring all debris voids are filled in and the total debris thickness in the landfill does not exceed 3 m. The landfill cap will be compacted to 95% of the maximum density. There are no plans to re-vegetate the cover.

2.3.4.3 Physical Debris

Debris throughout the site will be collected and segregated into hazardous and non-hazardous waste streams at the WHF. Where feasible, non-hazardous material will be crushed, shredded and/or incinerated prior to placement in the on-site landfill. Hazardous materials will be disposed of off-site in accordance applicable guidelines and regulations.

Non-Hazardous Materials

Approximately 727 m^3 of non-hazardous materials are estimated to be left on site at Bear Island. This volume does not include approximately 48 m^3 of concrete structures, such as antenna bases and the emergency shelter, because it is likely the surrounding soil will be re-contoured and the concrete structures will be left in place. Table 4 presents a summary of Bear Island non-hazardous materials.

Table 4. Summary of Non-Hazardous Materials by Volume and Weight

Location	Volume (m^3)	Weight (tonnes)	Percentage of Total (% by weight)	Comments
South Doppler Area	446.8	1413.7	69.0	Includes barrels in the west toe of the North Landfill Area, as well as assumes concrete emergency vault and antenna bases will remain in place
Beach Area	104.3	311.9	15.2	Located on ground surface
North Doppler Area	101.7	263.6	12.9	Located on ground surface, and assumes concrete antenna bases will remain in place
Airstrip Area	26.1	59.3	2.9	Located on ground surface
Totals	**678.9**	**2048.5**	**100**	

Remedial measures for non-hazardous materials will involve:

1. All buildings/infrastructure will be demolished to the foundations in accordance with the INAC AMSRP. The Phase III Environmental Site Assessment (ESA) (Earth Tech 2008a) included the collection and analysis of a concrete sample collected from the garage foundation. The analysis indicated PCBs concentrations less than 50 ppm in all the samples. Consequently, concrete products are classified as non-hazardous waste and will be disposed of in the landfill.

2. Since the debris piles that are scattered around the site are located on the ground surface and are not buried, these materials will be collected and disposed of in the landfill. According to the AMSRP, the Landfill North of Site 412 is classified as a Class A Landfill (unstable, high erosion location with contaminated soil down-gradient) and consequently debris within this landfill will be sorted and disposed of accordingly.

3. All barrels will be disposed of in accordance with the DEW Line Clean-Up Barrel Protocol. Empty barrels will be crushed and disposed in the on site landfill. The contents of filled barrels will inspected and tested, and either be incinerated on site or shipped off-site for disposal as appropriate. Empty barrels will then be rinsed, crushed and disposed in the on-site landfill.

2.3.4.4 Contaminated Soils

Soil conditions at Bear Island were assessed by Earth Tech (2008a) using the AMSRP (revised April 2008) as the governing criteria.

A total estimated volume of contaminated soils is 175.3 m^3 (Table 5) (Earth Tech, 2008b). Of this total, approximately 12.0 m^3 is considered DCC I, 82.3 m^3 DCC II, and 81.0 m^3 PHC. These soils will either be:

- buried in the on-site non-hazardous landfill (DCC Tier I contaminated soil);

- excavated, containerized, labeled in accordance with the *Transportation of Dangerous Goods Act* and shipped off-site to a disposal facility that is licensed to accept PCB and heavy metal co-contaminated soils (soils that exceed the DCC Tier II criteria); or
- excavated and shipped off-site for disposal (hydrocarbon contaminated soils).

Table 5 presents a summary of the contaminated soils identified in the RAP (Earth Tech 2008b).

Table 5. Summary of Contaminated Soils at Bear Island

Location	Contaminant Exceeding Criteria	DCC I (m^3)	DCC II (m^3)	PHC Evaluation (m^3)	Comments
South Doppler Detection Building	Metals	-	1.0	-	
South Outfall	Metals PCBs	-	0.8	-	Impacted area is co-contaminated
Emergency Shelter	Metals	-	15.8	-	
Garage	Metals PCBs	-	24.6	-	Impacted area is co-contaminated
Landfill North of Site 412	PHCs	-	-	5.3	PHC contaminated soil requiring excavation to 0.15 m
Main Barrel Cache	Metals	-	5.0	-	
Small Barrel Cache	PHCs	-	-	27.3	PHC contaminated soil requiring excavation to bedrock (approximately 0.5 m)
POL Storage Area	Metals PHCs	5.2	-	40.5	PHC contaminated soil requiring excavation to bedrock (approximately 1.0 m)
Beach Bulldozer	Metals PHCs	-	1.7	3.1	PHC contaminated soil requiring scarification to 0.3 m
Beach Electrical Hut	Metals	-	1.5	-	
Beach Building Panels	Metals	-	3.2	-	
Beach Barrel Cache	Metals	6.8	-	-	
North Doppler Area-ESG-244	Metals	-	4.6	-	
North Doppler Area-ESG-243	Metals	-	10.9	-	
Airstrip Area	PHCs	-	-	4.8	PHC contaminated soil requiring excavation to bedrock (approximately 0.5 m)
Electrical Cable	Metals	-	13.2	-	Additional sampling along the cable is recommended to confirm impacted areas
Total Estimated Volumes		**12.0**	**82.3**	**81.0**	-

Due to the limited quantities of PCB contaminated soils delineated, these soils will be excavated, containerized, labeled in accordance with the *Transportation of Dangerous Goods Act* and shipped off-site to a disposal facility that is licensed to accept PCB contaminated soils co-contaminated with heavy metals.

Due to the small amounts of metal contaminated soils on site and the large operational and maintenance costs of metal contaminated soil remedial technologies as well as the high costs to construct a hazardous waste landfill, all metal contaminated soils that exceed the DCC Tier I criteria, but are less than DCC Tier II criteria (12.0 m^2) will be buried in the landfill. The metal contaminated soils that exceed the DCC Tier II criteria (82.3 m^3) will be excavated, containerized, labeled in accordance with the *Transportation of Dangerous Goods Act* and shipped off-site to a disposal facility that is licensed to accept metals contaminated soils co-contaminated with PCBs.

Based on the evaluation of the remedial options in the context of the remedial objectives, 77.9 m^3 of hydrocarbon contaminated soils will be excavated and shipped off-site for disposal, and 3.1 m^3 will be scarified.

2.3.4.5 Hazardous Materials

In general, all hazardous materials will be shipped off-site to a licensed hazardous waste disposal facility. Petroleum products, free of chlorine, PCBs and heavy metals will be incinerated. Heavier petroleum products will be mixed and burned on site, or shipped off-site. Hazardous material remedial measures are as follows:

- Barrels at the small barrel cache containing fluids will be excavated and tested, and treated according to the DEW Line Cleanup Barrel Protocol. If the petroleum products meet the incineration guidelines, the waste products may be incinerated adhering to an approved method, otherwise POL fluids must be shipped off-site and disposed of accordingly. Rusty barrels found to contain water will be handled according to the barrel protocol.

- Asbestos Containing Materials (ACM) at the Island includes green and brown floor tiles and asbestos cement board, which were found at both the South and North Doppler Areas, as well as at the Beach Area. Asbestos is located throughout the remaining structures, within the surface debris piles and scattered in the region of the above mentioned areas. Asbestos debris will be abated and placed in a sealed, airtight container, clearly labeled “ASBESTOS”. The asbestos is then placed in the constructed landfill. The location of the asbestos material located within the landfill will be noted for future reference.

- Lead-based paint materials considered to be hazardous (leachable lead greater than 5 mg/L) will be dismantled and disposed off-site. Care will be taken during the dismantling to prevent dust and paint chips from being released into the environment and to protect the workers that are conducting the dismantling from PCB and lead contamination. All dismantled lead contaminated paint material will be packaged, transported and disposed of in accordance with the current regulations governing the handling and disposal of hazardous materials. Painted components considered non-hazardous will be disposed in the on-site landfill.

- Compressed gas cylinders, with known contents, will be vented and subsequently placed in the constructed landfill.

- Timbers found suspected to be treated with creosote will be wrapped in polyethylene and disposed of in an on site landfill.

- Zinc coated conduit and lead cable is located on site, which are being classified as hazardous since soil data indicates that both materials have generated soils that are DCC Tier II, hazardous soil.

2.3.4.6 Site Grading

After remediation activities are complete, disturbed areas will be graded and contoured to blend in with the natural contours and to eliminate potential hazards for wildlife and humans accessing the site in the future. Disturbed areas will include contaminated soils excavations, existing and new landfills, debris areas, disturbed areas resulting from demolition activities, borrow areas, and any areas disturbed as a result of remediation activities.

2.3.5 Closure

Closure activities will involve a demobilization of equipment and project associated structures (e.g. camp and waste handling facility). Final site grading will take place.

2.4 REGULATORY AND PERMIT REQUIREMENTS

INAC projects in this part of Nunavut are subject to both the territorial and federal environmental impact review processes. Territorial assessment requirements are set out in the NLCA, while federal requirements are set out in CEAA. The requirements of both processes will be met through a single screening level assessment CEAA applies when the following key components are present:

- there is a project, defined as an undertaking in relation to a physical work or a physical activity as listed in the CEAA Inclusion List Regulations;
- there is a Responsible Authority (RA) with a trigger in respect of the project;
- a federal department or agency is the proponent, contributes financially to the project, disposes of an interest in the land (sale, lease or other) to enable the project, or issues a permit, licence or approval under one or more of the provisions of the CEAA Law List Regulations); and
- the project is not included on the CEAA Exclusion List Regulations.

No other responsible or other federal authorities have been identified to date although this project has not yet been referred through the Federal Coordination Regulation (FCR) process. INAC will be a RA with respect to this project.
Section 12.2.4 of the NLCA requires that the NIRB screen project proposals based on defined

criteria. Project proposals are provided to NIRB by other regulatory agencies as part of the overall project approval process (i.e. Nunavut Water Board; Nunavut Land Use Board).

2.4.1 The Land Claim Context

Nunavut was officially created by the passing of the *Nunavut Act* in 1993, with the transition to Canada's newest territory completed in 1999. The Territory as defined under the *Nunavut Act* included the islands of the Hudson and James Bay's including Bear Island. Also in 1993 the federal government passed the *Nunavut Land Claims Agreement Act* that ratified the NLCA, an agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen of Canada. Under the NLCA, Inuit received certain rights and benefits in exchange for surrender of any claims, rights and title and interests.

The framework for Nunavut's regulatory system is derived from the NLCA. The NLCA establishes Inuit/government co-management boards for land use planning (Nunavut Planning Commission (NPC), environmental assessment and monitoring (NIRB), water use and waste disposal (Nunavut Water Board (NWB), and wildlife management (Nunavut Wildlife Management Board (NWMB). However, the NLCA applies only to the Nunavut Settlement Area (NSA) as defined in Article 3, and the co-management boards only have jurisdiction within the NSA. The borders between Nunavut, as defined in the *Nunavut Act* and the NSA as defined in the NLCA do not overlap exactly. Islands in the James Bay such as Bear Island fall within Nunavut but are outside the NSA. This means that much of the legislation passed by the Nunavut Legislature, or inherited from the Northwest Territories, applies to Bear Island, for example the *Environment Protection Act*, and the *Wildlife Act,* but strictly speaking the Nunavut Planning Commission, NIRB, and NWB have no jurisdiction.

2.4.2 Nunavut Impact Review Board (NIRB)

NIRB was established in 1996, under Article 12.2.1 of the NLCA, as an institution of public government with responsibilities for environmental assessment. Article 12 of the NLCA establishes processes for the screening and review of project proposals on land and marine areas within the NSA (including Inuit Owned Lands, Commissioners lands, and Crown lands) and to the Outer Land Fast Ice Zone. The functions of NIRB are to:

- screen project proposals to determine whether or not a review is required;
- review the ecosystemic and socio-economic impacts of proposed projects;
- measure and define the extent to which regions and communities will be impacted;
- determine, on the basis of its review, whether project proposals should proceed, and if so, under what terms and conditions, and then report its determination to the Minister; and
- monitor projects in order to collect and analyze information on the long term state and health of the ecosystem and socio-economic environment of the Nunavut Settlement Area.

The initial steps of the screening involve notification of the proponent and authorizing agencies, establishment of a timeline for a screening determination and distribution of the project proposal to appropriate stakeholders. NIRB then reviews the potential effects of the project and the level of public concern about and/or in support of the proposed project. Once the screening has been completed, NIRB will produce a Screening Decision Report that documents its determination as to whether the project proposal should be approved without further review, abandoned or modified by the proponent, or subject to review under Part 5 or 6 of the NLCA.

It is anticipated that the assessment of the site remediation at Bear Island would only be subject to screening level of assessment under the NIRB process.

2.4.3 Nunavut Water Board (NWB)

The NWB was created pursuant to Article 13 of the NLCA and came into existence on July 9, 1996. The NWB has responsibilities and powers over the use, management and regulation of inland water in Nunavut and with objectives to provide for the conservation and utilization of waters in Nunavut in a manner that will provide the optimum benefits for the residents of Nunavut in particular, and Canadians in general.

The powers and responsibilities of the NWB have been defined further by the implementing legislation of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA). The NWNSRTA states that no person may use water or dispose of waste into water without the approval of the NWB. Once a license is issued by the NWB, the jurisdiction of the NWB ceases. Compliance and enforcement of water licenses and provisions of the NWNSRTA fall under the jurisdiction of INAC, who's Minister appoints Inspectors for that purpose. Water use at the site and disposal of waste into water will require a license from NWB. The type of license will depend on the volumes of water used and the amounts of waste.

2.4.4 Federal and Territorial Legislation

In addition to the regulatory context provided by the NLCA, both the federal and territorial governments have their own jurisdictions and legislative requirements related to this project. Notably, the Site is located on federal lands that are regulated by INAC. As the RA, INAC requires that an environmental screening be conducted in accordance with CEAA, which is triggered by Federal involvement in a project. CEAA applies when a Federal department or agency is required to make a decision on a proposed project. In accordance with (Section 5(1)), of CEAA, an EA is required if a Federal Authority exercises or performs one or more of the following powers, duties, or functions relating to a project:

- proposing the project (known as the "proponent trigger");
- granting money or any other form of financial assistance to the proponent (the "funding trigger");
- granting an interest in land to enable a project to be carried out (e.g., sell, lease, or otherwise transfer control of land) (the "land trigger"); and/or

- exercising a regulatory duty in relation to a project, such as issuing a permit or license, that is included in the Law List prescribed in CEAA's regulations (the "Law List trigger"); this would include such items as permits under Section 35(2) of the *Fisheries Act* or Section 8 of the *Territorial Lands Act*.

Remediation of the Bear Island Mid-Canada Line Radar Site is being proposed by INAC, funding for the project will be from the Federal government, and permit for land use under the *Territorial Land Act* will be required. As such completion of a CEAA screening-level EA report is required for this project.

In addition to CEAA requirements there are a number of other Federal and Territorial regulatory requirements that must be met. The relevance of some of these to the project will depend on the final specification for remediation activities, but a list of the most relevant are contained in Table 6.

Bear Island itself falls within the 'overlapping interest zone' of the Cree and Nunavik Inuit as identified in Article 27 of the Nunavik Land Claim Agreement (NILCA). It is anticipated that boards for land use planning, impact assessment and water use will eventually be established under the NILCA and the yet to be settled Cree of Eejou Istchee Claim. These boards will work cooperatively in the overlap area. However, in the meantime, in the absence of another land claim based EA process, screening of the project by NIRB, would give interests within Nunavut and Nunavik the opportunity participate in the EA process. Similarly, a license for water use and waste disposal adjacent to water will be issued by the NWB.

Table 6. Key Regulatory Organizations and Permit Requirements for the Bear Island Remediation Project

Issuing/ Lead Agency Details		Contact
Federal		
INAC	Permits required for land access, camp construction, lay-down and borrow sources under the *Nunavut Land Claims Settlement Act, Territorial Lands Act* and Regulations and *Federal Real Property Act* and Regulations **Notes:** Permits for land use and borrow sources will be required based on current project description and discussions with INAC contact	Spencer Dewar Manager of Lands. PO Box 100 Building 918 Iqaluit Nunavut Tel 867 975 4280
Department of Fisheries and Oceans (DFO)	*Fisheries Act* for authorizations, permits, or letter of advice for works or undertaking affecting fish habitat (i.e. temporary facilities that may be required on the shoreline/nearshore zone for the barge landings) **Notes:** Authorizations from DFO will not be required based on the current project description and discussions with DFO contact	Amy Liu Habitat Biologist PO Box 358 Iqaluit Nunavut X0A 0H0 Tel 867 979 8007 Amy.liu@dfo.gc.ca

Table 6. Key Regulatory Organizations and Permit Requirements for the Bear Island Remediation Project

Issuing/ Lead Agency Details		Contact
Transport Canada (TC)	*Navigable Water Protection Act* (NWPA) authorizations (for structures built in, on or over navigable waters) **Notes:** Authorizations from Transport Canada will not be required based on the current project description	Jim Morrell Environment Officer 344 Edmonton Street Winnipeg Manitoba Canada R3C 0P6 Tel 204 983 5857 morrejp@tc.gc.ca
Environment Canada (EC)	*Species at Risk Act* (SARA), *Migratory Birds Convention Act* (MBCA) and Regulations, Section 36(3) of the *Fisheries Act*, *Canadian Environmental Protection Act* (CEPA) **Notes***:* No authorizations are required from EC; however, based on discussions with the EC contact, inventories of Species at Risk should be compiled for the project area using the mapping function on the EC website	Siu-Ling Han Section Head Northern Conservation Qimugjuk Building Box 1870 Iqaluit Nunavut X0A 0H0 Tel 867 975 4633 Savana Levenson Environmental Assessment Specialist 5204-50th Avenue, Suite 301 Yellowknife Northwest Territories X1A1E2 Tel 867 669 4772 Amy Sparks Contaminated Sites Officer 4999-98 Avenue Edmonton, Alberta T6B 2X3 Tel 780 951 8746
Natural Resources Canada (NRCAN)	Explosive Storage, Explosive Handling, Magazine Permits and permit for transportation of explosives under the *Explosive Act* and Regulations **Notes:** Authorizations from Natural Resources Canada will not be required based on the current project description	Andrew McAllister Senior Environmental Assessment Officer 580 Booth Street Ottawa Ontario K1A 0E4 Tel 613 995 3153 amcallis@nrcan.gc.ca
NWB	Water License required for use of water and deposit of waste into water under the NWNSRTA **Notes:** A water license for the project will be required, based on discussions with the Nunavut Water Board	Dionne Filiatraut Executive Director Nunavut Water Board PO Box 119 Gjoa Haven Nunavut XOB 1JO Tel 867 360 6338 Email:Dionne@nunavutwaterboard.org
Territorial		

Table 6. Key Regulatory Organizations and Permit Requirements for the Bear Island Remediation Project

Issuing/ Lead Agency Details		Contact
Government of Nunavut (GN) Department of Environment	*Environmental Protection Act* (spill response plans, waste management guidelines) *Transportation of Dangerous Goods Act,* requirement for Waste Manifests Regulatory Requirements related to land use and disturbance of wildlife also exists in the *Wildlife Act* **Notes:** Waste Manifest documents are required for hazardous waste movements. Wildlife species have been included in this assessment based on discussions with GN biologists	Helen Yeh Manager of Environmental Assessment and Land Use PO Box 1000 Iqaluit Nunavut X0A 0H0 Tel 867 975 7733 Email: hyeh@gov.nu.ca
GN Department of Economic Development and Transportation	Registration for use of vehicles in Nunavut under the *Motor Vehicles Act* **Notes:** Vehicles for project use will need to be registered. No contact made with regulator	Lorna Gee Director PO Box 10 NCC Building Gjoa Haven X0B 1J0 Tel: (867) 360-4614 Fax: (867) 360-4619 Email: lgee@gov.nu.ca
GN Department of Culture Language Elders and Youth	Permit required to disturb an archeological site under the *Nunavut Archaeological and Paleontological Site Regulations* **Notes:** Based on discussions with the contact and the current project description, no permits are required	Julie Ross Chief Archeologist Box 310, Igloolik, Nunavut, X0A 0L0 Tel 867 934 2040 Email:jross@gov.nu.ca
GN Department of Health and Social Services	*Public Health Act* and Regulations, contains criteria for camp sanitation, refuse disposal drinking water and medical facilities **Notes:** Criteria within the regulations will have to be met. No contact made with regulator	Isaac Sobel Chief Medical Officer PO Box1000 Building 11076 Iqaluit Tel 867 975 5774 Email: Isobel@gov.nu.ca

3.0 ENVIRONMENTAL DESCRIPTION

3.1 SITE LOCATION AND DIMENSIONS

Bear Island is located at 54^{o}20' N, 81^{o}05' W, toward the central northern end of James Bay.

The Island is approximately 1.5 km wide and 5 km long and is part of the Hudson Bay Lowland ecological region, one of the Earth's largest wetland landscapes (Earth Tech 2007). The Island is a low lying black basalt outcrop, covered with small lakes and ponds created by glacial scouring from the last deglaciation of the Laurentide Ice Sheet, and where the surface is not exposed bedrock or covered by water, the surficial materials consists of coarse gravel up to approximately 1.5 m thick (Earth Tech 2007; Earth Tech 2008b). It is understood that Bear Island is located is an area of sporadic discontinuous permafrost (NRC, 1995; Earth Tech, 2008a).

3.2 CLIMATE AND AIR QUALITY

3.2.1 Climate

The closest weather stations with climate data are the airports at La Grande Riviere, Quebec and Kuujjuarapik, Quebec, which are 240 km east-southeast and 250 km northeast of Bear Island, respectively. Both locations have similar climate normals; however, of the two locations Kuujjuarapik is considered to be in an environment most similar to Bear Island. The daily mean temperatures in the area varies from approximately -23.4ºC in January to approximately 11.4ºC in August, and the average annual temperature is approximately -4.4ºC (Earth Tech 2008b). The average annual precipitation is approximately 415 mm of rainfall and 241 cm of snow (Earth Tech 2008b).

3.2.2 Air Quality

Indications of air quality can be gleaned from the National Pollution Release Inventory (NPRI) that summarizes releases of Criteria Air Contaminants (CAC) for Nunavut and allows comparisons with Canada as a whole. It is evident from Table 7 that emissions of contaminants in Nunavut are a small fraction of those in Canada and are unlikely to influence air quality regionally.

Table 7. NPRI 2006 CAC Emissions for Nunavut

Category	TPM	PM_{10}	$PM_{2.5}$	SOx	NOx	VOC	CO	NH_3
Industrial Sources	190	41	24	20	216	11	46	0
Non-industrial Fuel combustion	257	214	214	93	3105	135	626	0
Transportation	90	90	85	50	1256	1141	7743	5
Open Sources	7542	2162	381	0	3	24	37	0
Natural	0	0	0	0	12,048	505,151	0	0
Miscellaneous	8	8	8			239	3	2
Total Nunavut	**8087**	**2515**	**711**	**164**	**16628**	**506701**	**8455**	**7**
Total Canada	**18,377,707**	**6,082,953**	**1,333,894**	**1,972,042**	**2,550,728**	**31,785,247**	**11,732,202**	**555,477**

TPM=Total Particulate Matter
PM10 = Any particulate matter with a diameter less than or equal to 10 microns
PM 2.5= Any particulate matter with a diameter less than or equal to 10 microns
SO_X= Refers to all gaseous oxides of sulphur
NO_X=Consists of nitric oxide (NO) and nitrogen dioxide (NO_2)
VOC = Volatile Organic Compounds refer to photochemically reactive hydrocarbons, excluding compounds such as methane, ethane, acetone, methylene chloride, methyl chloroform and several chlorinated organics
CO=Carbon Monoxide
NH_3=Ammonia

Because of the small, very dispersed population and the low level of industrialization, the Northern areas of Canada generally have good air quality and few pollution sources (Commoner et. al., 2006; EC, 2008) (Table 7). There are however local air quality issues including emissions from diesel engines used for electrical power generation, motor vehicle emissions, dust from gravel roads, smoke, and odorous compounds (EC, 2008; Weather Network, 2008). Additional concerns are related to human health as a result of air quality impacts from other parts of the globe.

During the winter months, atmospheric inversions can trap vehicle exhaust and wood smoke from home heating near the ground, leading to elevated levels of particulate matter (PM) in some communities (EC, 2008). Many communities in the North produce the electricity they require using diesel generators. This burning of diesel fuel causes emissions of PM, nitrogen oxides and sulfur dioxide (EC, 2008). Road dust in communities is an issue primarily in the spring, when dry conditions create loose dust on unpaved roads, and in summer treatment with calcium chloride, which acts as a dust suppressant by attracting and holding moisture, is required (EC, 2008). In addition, smoke from large forest fires in summer months can also affect air quality, leading to elevated levels of PM (EC, 2008).

In Nunavut, air quality is also affected by the long-range transportation of persistent organic pollutants (POPs) such as PCBs, and dichlorodiphenyltrichloroethane (DDT), trace metals such as mercury, and dioxins, that originate from many sources including fossil fuels, smelters, pesticides/herbicides, industrial chemicals, and waste incineration, and are carried up into the region via air currents from around the world (Commoner et. al., 2006; EC, 2008; Weather Network, 2008). Most of these contaminants come from sources in North and Central America, Eastern Europe, and Southeast Asia (EC, 2008). The movement of air currents in the Northern Hemisphere is such that the air gravitates towards the Arctic and eventually carries pollutants into Northern Canada. Subsequently, these pollutants become trapped in the cold temperatures and, due to the resulting low evaporation rates, settle out and enter the food chain (EC, 2008; Weather Network, 2008). Those in Nunavut that pursue a subsistence lifestyle are exposed to higher levels of POPs and mercury compared to people who live in southern Canada because of the increased exposure of northern wildlife that make up an indigenous diet (caribou, fish, marine mammals) (Commoner et. al., 2006; EC, 2008). These studies have also shown that breast milk of some Inuit women has been found to contain levels of POPs four to five times higher than in women who live in southern Canada (EC, 2008), and twice the levels of dioxin concentrations (Commoner et. al., 2006)

With increasing activity in mining and oil and gas production air quality is likely to be a growing concern in the North (EC, 2008).

The Bear Island site is currently inactive and no emissions are being generated.

3.3 GEOLOGY, GEOMORPHOLOGY AND HYDROGEOLOGY

Bear Island is characterized by low- and flat-lying extensively exposed bedrock covered with small lakes and ponds created by glacial scouring from the last deglaciation of the Laurentide Ice Sheet (Earth Tech, 2008a). The bedrock is represented by competent magnetic black shale, which may have undergone some weak metamorphism that has strengthened the rock (EBA, 2008). The magnetic nature of the shale could be explained by the occurrence of either magnetite, or illmenite or pyrrhotite.

Where the surface is not exposed bedrock or covered by water, the bedrock is partially covered by a blanket of recent marine sediment surficial materials consisting predominantly of sand, gravel and cobbles with variable content of boulders of coarse gravel up to approximately 1.5 m thick. Geophysical evaluations found that the bedrock possesses ferric properties (Earth Tech, 2008a).

Bear Island is located is an area of sporadic discontinuous permafrost, with 10% to 50% of land area underlain by permafrost (NRC 1995). However, during field investigations by Earth Tech in 2007, (Earth Tech, 2008a) there was no evidence of the occurrence of perennially frozen ground or permafrost-related geomorphic processes and landforms on the Island.

No groundwater-specific studies were conducted as part of the 2007 field investigations (Dyer, pers. com., 2008). Test pits excavated at proposed landfill and borrow source locations did not encounter the groundwater table, although moist to wet granular material was encountered in some pits at excavation termination between 0.6 m and 0.9 m (Earth Tech, 2008a). Water is expected to move rapidly through the coarse-grained subsurface materials to the bedrock layer, and generally flow in the same direction as surface flow (e.g., downslope towards waterbodies or James Bay).

3.4 HYDROLOGY

The hydrographic system of the Quebec slope of James Bay is made up of great rivers with few tributaries, in which flow almost directly the great lakes of the intermediary plateau (Municipalite de Baie-James, 2008).

The area is well-watered. All the rivers are fed by the rains and snows. After the strong spring flood created by snow melting, come the summer low waters, higher during some years. The fall flood, caused by rains, is characterized by the swelling of waters. At the beginning of November, however, the water level begins to drop (Municipalite de Baie-James, 2008).

An ecological assessment on Bear Island in 2007 (Earth Tech, 2008a) did not include a hydrological survey, however, there is note of numerous, shallow waterbodies and associated fen wetlands (refer to Section 3.5.2).

3.5 TERRESTRIAL ENVIRONMENT

It is important to note that due to the relative isolation of Bear Island, comprehensive species surveys have not been completed. The information below has been collected from surveys related to this project, past reports, and from species lists created for James Bay, Hudson Bay, and Nunavut in general.

General mitigative measures for dealing with wildlife, including flora, throughout the project, are provided in Section 4.3.

3.5.1 Flora

Riley (2003) approximated that, since the last deglaciation, terrestrial flora and fauna have had less than 7000 years to occupy the Island's lowland's margins and uplands, and have had much less time to colonize lower elevations which appears to be the case for as the vast majority of vegetation communities are rich in lichens and mosses; typical species found in early succession. Furthermore, the Island is also continually exposed to extreme elements, wind and wave action making it difficult for any plant species to root and colonize (Earth Tech, 2007). The resulting low-lying vegetation is therefore an adaptation of these extreme conditions (Earth Tech, 2007).

The vast majority of the Island consists of communities rich in lichens, a typical species found in early succession. Because of exposure to wind and wave action, developed vegetation communities are constrained to the interior areas of the Island, especially around the glacial lakes and ponds (Earth Tech, 2007). The Ecological Assessment by Earth Tech (2007) identified six (6) major vegetative communities summarized in the table below. Flora observed includes various species of lichens, willows, berry bushes, grasses, mosses and wildflowers.

Common shrubs in the area include black crowberry, cranberry and blueberry (Earth Tech, 2008a).

Table 8. Description of Major Vegetative Communities on Bear Island

Vegetative Community		Description	Physical Characteristics and Species
V1	Sparse-lichen dominated stand	• major vegetation community covering approximately 80% of the Island • generally following the shoreline • dominated by lichens as habitat is mostly exposed to extreme wind/wave action • some vascular plants in sheltered niches of the bedrock	• 80% exposed bedrock • black basalt • 20-30% lichen species • vascular species include three-toothed saxifrage • (*Saxifraga tricuspida*) and mountain avens (*Dryas integrifolia*)
V2	Sparse–open willow and lichen dominated stand	• located within those areas which have been historically disturbed, particularly along the airstrip, Site 412 and Site 413 • substrate consists of rounded to sub-angular gravel (transported from a borrowing source)	• vascular species cover approximately 25% of this community and includes mountain avens (*Dryas octopetala.*), lime willow (*Salix lanata*), and net-veined willow (*Salix reticulata*)
V3	Closed crowberry stand	• occurs near the proposed landfill areas • consists mainly of berry species and a variety of lichen species	• occurs over glacial till consisting of large rounded to subangular gravel and cobble • berry species include black crowberry (*Empetrum nigrum*) with low-lying cranberry (*Vaccinium vitis-idaea*)
V4	Open wildflower and lichen dominated stand	• occurs near the inland ponds/lakes • contains a mixture of lichen and wildflower species with some low-lying • shrubs • soils are very shallow, only about 2-5 centimetres deep, and have a very high percentage of decomposed roots	• approximately 40% exposed rock consisting of large angular to sub-angular cobble • vascular species include mountain avens, three-toothed (prickley) saxifrage (*Saxifraga tricuspidata*), a variety of lichen species with • some black crowberry, net-veined willow (*Salix reticulata*), Canada buffalo-berry (*Shepherdia canadensis*) and club-moss (*Lycopodium annotinumi*)

Table 8. Description of Major Vegetative Communities on Bear Island

Vegetative Community		Description	Physical Characteristics and Species
V5	Closed willow fen	• occurs near inland ponds/lakes and contains a high abundance of shrub and moss species that prefer wet, acidic conditions • moss and lichen species dominate the sub-stratum and willow /berry bearing shrubs constitute the low-lying canopy	• organic soils occur over bedrock and are up to 40 centimetres deep consisting of decomposed roots and moss • wildflower species include large-flowered wintergreen (*Pyrola grandiflora*), buckbean (*Menyanthes trifoliate*), common mare's tail (*Hippuris vulgaris*), bog rosemary (*Andromeda glaucophylla*) and butterwort (*Pinguicula vulgaris*) • bog rosemary and buckbean are species that only occur in fen habitats
V6	Aquatic fen	• found within the inland standing pools/lakes	• two main species occur; buckbean and common mare's tail

3.5.2 Wetlands

Fen wetland types occur along the edges of the numerous inland waterbodies (Figure 2) (Earth Tech, 2008a). This type of wetland is fed by surface and/or groundwater (minerotrophic) and is characterized by the neutral or alkaline water, often containing high concentrations of calcium and magnesium carbonates, high specific conductivity, cool temperature, and a clear color resulting from low levels of dissolved organic matter but high in nutrients (Bedford et. al., 1999; Haslam, 2003; EC, 2008). Fen wetlands are persistent, usually relatively small, and maintain an existence that is dependent on the availability of water (Haslam, 2003; EC, 2008). As important sites of groundwater discharge, fens are also good indicators of shallow aquifers (Haslam, 2003). Furthermore, because groundwater is the primary source of water input, the water table of fens is stable, with surface peat soils saturated but seldom flooded (Bedford et. al., 1999). Additional information on surface water and water quality is provided in Section 3.6.

Flora species often include rich herbaceous layer dominated by graminoids, a patchy to continuous moss carpet with brown mosses (Amblystegiaceae) more prevalent than sphagnum mosses (Sphagnaceae), and low shrubs (Bedford et. al., 1999). Other typical fen species include sedges (*Carex* sp.), spike-rush (*Eleocharis* sp.), and grasses (Bedford et. al., 1999; EC, 2008).

Too many nutrients or other chemicals can irreparably damage fens and can therefore be good indicators of environmental quality (Haslam, 2003).

3.5.3 Birds

The James Bay coastal areas offer a large variety of habitats favourable to migratory birds (islands, battures, coastal wetlands, peatlands). However, the interior region has few welcoming areas for wild birds (Municipalite de Baie-James, 2008). Common coastal species include Canada goose (*Branta canadensis*), greater white-fronted goose (*Anser albifrons*), mallard duck (*Anas platyrhynchos*), black duck (*Anas rubripe*s), tufted duck (*Aythya fuligula*), common goldeneye (*Bucephala clangula*), red-breasted merganser (*Mergus serrator*), common eider (*Somateria mollissima*), scaups () and scoters (*Melanitta* sp.) (Municipalite de Baie-James, 2008).

During the Earth Tech 2007 (Earth Tech, 2008a) field study Canada goose, red-throated loons (*Gavia stellata*) and arctic tern (*Sterna paradisaea*) were noted on the Island (Earth Tech, 2008b). A significant arctic tern nesting area was identified on the sandy expanse at the south tip of Bear Island (Earth Tech 2008b). Canada geese utilize the Island during fall/spring migrations as it is an easily accessible stop-over and ideal due to the presence of inland ponds and vegetation (Earth Tech, 2008a). Geese were observed in a variety of spots but mainly in areas containing berry producing shrubs (Earth Tech, 2008a). In addition to a migratory stop-over and feeding area, Canada geese were also observed to be nesting (goslings were sighted), although more widespread than the Arctic terns (Earth Tech, 20008b). On the breeding grounds, adult pairs wait until the snow and ice melt before they begin nesting and goslings are able to fly at eight to nine weeks old (Chesapeake Bay Field Office, 2008).An abandoned snowy owl (*Nyctea scandiaca*) nest with egg shells and a remnant wing was also noted (Earth Tech, 2008b). This species utilizes the area for its winter range (Robbins et. al., 1983).

At community meetings in Chisasibi on February 20, 2008, community members that visited Bear Island in 1964 reported observations of breeding eider ducks on the Island (Earth Tech, 2008a).

Other marine/water birds/ducks that have the potential to occur in this area include:

- Black guillemot (*Cepphus grylle*);
- Herring gull (*Larus argentatus*);
- Red phalarope (*Phalaropus fulicaria*);
- Red-necked phalarope (*Phalaropus lobatus*);
- Common snipe (*Gallinago gallinago*);
- Short-billed dowitcher (*Limnodromus griseus*);
- American bittern (*Botaurus lentiginosus*);
- Green-winged teal (*Anas crecca*);
- Northern pintail (*Anas acuta*);

The white-rumped sandpiper (*Calidris fuscicollis*), pectoral sandpiper (*Calidris melanotos*), red knot (*Calidris canutus*), black-bellied plover (*Pluvialis sauatarola*), ruddy turnstone (*Arenaria interpres*), dunlin (*Calidris alpina*) and sanderling (*Calidris alba*) all pass the area during fall and spring migrations, and the least sandpiper (*Calidris minutilla*), spotted sandpiper (*Actitis macularia*), solitary sandpiper (*Tringa solitaria*), semipalmated plover (*Charadrius semipalmatus*), and the semipalmated sandpiper (*Calidris pusilla*) utilize the area as a summer and/or breeding ranges (Robbins et. al., 1983; Municipalite de Baie-James, 2008). The greater yellowlegs (*Tringa meanoleuca*) and lesser yellowlegs (*Tringa flavipes*) are less likely to appear, but still have potential (Robbins et. al., 1983).

Small terrestrial bird species in the area include horned lark (*Eremophila alpestris*) which is often joined in mixed flocks with lapland longspurs (*Calcarius lapponicus*), snow bunting (*Plectrophenax nivalis*), and American pipit (*Anthus rubescens*) (Bird Web, 2008). Rock ptarmigan (*Lagopus muta*) and willow ptarmigan (*Lagopus lagopus*) are likely the only larger terrestrial bird species found on Bear Island.

The gyrfalcon (*Falco rusticolus*), is found in this area for its winter range, and the merlin (*Falco columbarius*), northern harrier (*Circus cyaneus*), northern goshawk (*Accipiter gentilis*), and golden eagle (*Aquila chrysaetos*) use the area for summer/breeding ranges. Rough-legged hawks (*Buteo lagopus*) pass over Bear Island during spring and fall migrations (Robbins et. al., 1983). The gray jay (*Perisoreus canadensis*) is present all year in this area as is the common raven (*Corvus corax*) (Robbins et. al., 1983). Other passerine species that include this area in summer/breeding ranges and could therefore have the potential to occur on Bear Island include:

- Dark eyed junco (slate coloured race) (*Junco hyemalis*);
- Northern shrike (*Lanius excubitor*);
- Tennessee warbler (*Vermivora peregrina*);
- Orange-crowned warbler (*Vermivora celata*);
- Yellow warbler (*Dendorica petechia*);
- Yellow-rumped warbler (*Dendroica coronata*);
- Blackpoll warbler (*Dendroica striata*);
- Northern waterthrush (*Seiurus noveboracensis*);
- Wilson's warbler (*Wilsonia pusilla*);
- Savannah sparrow (*Passerculus sandwichensis*);
- American tree sparrow (*Spizella arborea*);
- White-crowned sparrow (*Zonotrichia leucophrys*);
- White-throated sparrow (*Zonotrichia albicollis*);
- Fox sparrow (*Passerella iliaca*);
- Lincoln's sparrow (*Melospiza lincolnii*);
- Swamp sparrow (*melospiza georgiana*);
- Water pipit (*Anthus spinoletta*);
- Ruby-crowned kinglet (*Regulus calendula*);
- Gray-cheeked thrush (*Catharus minimus*);

- American robin (*Turdus migratorius*); and
- Common flicker (*Colaptes auratus*).

3.5.4 Wildlife

Fauna observed in the area includes polar bear (*Ursus maritimus*), including females with cubs and solo males, and arctic fox (*Alopex lagopus*). It should be noted that a female with cubs remained in the vicinity during the Earth Tech 2007 field studies (2008b) occupying well sheltered locations on the extreme north portion of the island, approximately several hundred metres from the nearest radar site infrastructure.

Other terrestrial mammalian species that could inhabit the area include red fox (*Vulpes vulpes*), ermine (*Mustela erminea*), and arctic hare (*Lepus arcticus*) (Anand-Wheeler, 2002).

Although no information regarding small rodents inhabiting Bear Island was found, the presence of arctic fox and possibly red fox and ermine, suggest that small rodents would exist as a food source for these small mammals. This would include mice, ground squirrel (*Spermophilus parryii*) /red squirrel (*Tamiasciurus hudsonicus*), lemmings, voles, shrews, snowshoe hare (*Lepus americanus*) and pocket gophers. Additional food species for the Arctic fox includes ptarmigan (rock ptarmigan) (when/where available) (Anand-Wheeler, 2002).

3.5.5 Species at Risk - Fauna

An ecological assessment in 2007 (Earth Tech, 2008b) did not observe any significant/sensitive wildlife (fauna) species on the Island. It should be noted, however, that during the ecological assessment an arctic tern nesting area was identified at the south end of the island, and that the island as a whole provides nesting habitat for migratory and arctic avifauna, as well as habitat for small mammals and polar bears (Earth Tech, 2008a).

An index search of the SARA website (SARA, 2008a) for listed species (under both SARA and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC)) located in Nunavut, identified forty-seven (47) species, including sub-species (Appendix A, Table A1). Those species listed as "*not at risk*" by COSEWIC (COSEWIC 2008) were removed. Ranges for the remaining species were confirmed and only those with ranges inclusive of James Bay and/or the southern reaches of Hudson Bay, were kept as species that could <u>potentially</u> occur on or around (i.e. marine species) Bear Island. Additionally, identified species were cross checked using the mapping feature available on the SARA website. This process identified one additional species; the Barrow's goldeneye (*Bucephala islandica*) that has been included due to its possible presence on the Belcher Islands (refer to Section 3.5.5.1).

Information on this final list of species (8) with the potential to occur on Bear Island, including status/global ranking, is provided in Table 9. Explanation for inclusion is provided below in Sections 3.5.5.1 – 3.5.5.8. Descriptions of the status/ranking categories are also provided in Appendix A.

As shown below, there is suitable habitat on Bear Island and the surrounding waters so that there does exist a possibility that any of these species may be present at the time of the remediation project. The potential presence of any one of these species will be determined by a number of factors including weather conditions, population dynamics, annual variations in migratory and feeding patterns etc. Mitigative measures to deal with this possibility are provided in Section 4.3.

Table 9. Listed Species with Potential to Occur on Bear Island

Species (Common Name)	Species (Latin Name)	Population	COSEWIC Status[3]	SARA Status[4]	IUCN Status[5]	Global Ranking[6]
Barrow's Goldeneye	*Bucephala islandica*	Eastern Canada	Special Concern	Special Concern	Least Concern	G5
Beluga Whale	*Delphinapterus leucas*	Western Hudson Bay population	Special Concern	No Status	Vulnerable[1]	G5
Harlequin Duck	*Histrionicus histrionicus*	Eastern population	Special Concern	Special Concern	Least Concern	G4
Peregrine Falcon (anatum subspecies)	*Falco peregrinus anatum*		Non-active	Threatened	Least Concern	G4
Polar Bear	*Ursus maritimus*		Special Concern	No Status[2]	Vulnerable	G3/G4
Rusty Blackbird	*Euphagus carolinus*		Special Concern	No Status	Vulnerable	G4
Short-eared Owl	*Asio flammeus*		Special Concern	Special Concern	Least Concern	G5
Yellow Rail	*Coturnicops noveboracensis*			Special Concern	Least Concern	G4

[1] These species require an updated evaluation
[2] COSEWIC recommended in April 2008 that the polar bear be assessed as a *species of special concern* under SARA. This review remains pending.
[3] COSEWIC, 2008
[4] SARA, 2008a
[5] IUCN (International Union for Conservation of Nature and Natural Resources), 2008
[6] NatureServe Explorer, 2008

3.5.5.1 Barrow's Goldeneye (Eastern Canada population)

This diving duck primarily breeds and winters in Canada (SARA, 2008b). The limits of the range of the eastern population of Barrow's goldeneye are still unknown but data indicate that it breeds only in Canada prefering high elevation lakes that do not contain fish (SARA, 2008b). Although the species has the potential to occur on the Belcher Islands (Figure 3), the only confirmed breeding records are from Quebec (SARA, 2008b). Specific population trends are unknown but it is believed that the eastern population of the species declined during the twentieth Century and that it may still be declining (SARA, 2008b). In eastern Canada, there has been a significant reduction in the amount of suitable breeding habitat due to logging and fish introduction, and hunting is an additional threat (SARA, 2008b).

The Barrow's Goldeneye, Eastern population, is protected under SARA and by the federal *Migratory Birds Convention Act* (MBCA). The species is also protected under the Newfoundland and Labrador *Endangered Species Act*.

3.5.5.2 Harlequin Duck

Harlequin Ducks of the eastern population mostly breed throughout much of Labrador, along eastern Hudson Bay, and the Great Northern Peninsula of the island of Newfoundland along in-land fast-flowing turbulent rivers (Figure 4). Most individuals spend winters in coastal marine environments on offshore islands, headlands, and rocky coastlines (SARA, 2008b).
The eastern North American wintering population has declined from historical estimates, but numbers appear to be increasing in North America over the last ten years. The primary cause of the decline is not clearly known, however, over-hunting could be an important cause (SARA, 2008b). Although hunting of this population has not been permitted in recent years, the birds remain extremely vulnerable to hunters because of their tameness, their tendency to feed close to shore, and the resemblance of the female and immatures to ducks of other species which may be legally hunted (SARA, 2008b). In addition, the contamination, destruction, and alteration of habitat are considered important factors for the decline including oil spills and chronic oil pollution which are major threats to the duck's wintering habitat (SARA, 2008b).

The Harlequin Duck, Eastern population, is protected under SARA and by the federal MBCA. Harlequin Ducks are also protected in New Brunswick, Nova Scotia, and Newfoundland and Labrador under the provincial Endangered Species Acts.

3.5.5.3 Perigrine Falcon (*anatum* subspecies)

The Peregrine Falcon (*anatum* subspecies) (American peregrine), breeds south of the tree line in Alaska and Canada (Figure 5), throughout most of the U.S.A., and from central to south Mexico (SARA, 2008b).

Peregrines prefer open habitats such as wetlands, tundra, savannah, sea coasts and mountain meadows, for home ranges but will also hunt over open forest (SARA, 2008b).

Precipitous declines in peregrine populations were associated with the usage of DDT (SARA, 2008b).

The Peregrine Falcon is listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

3.5.5.4 Yellow Rail

There are thought to be roughly a few thousand pairs of Yellow Rails breeding in the Hudson/James Bay region (Figure 6) (Alvo and Robert, 1999; SARA, 2008b). The species does not winter in Canada (Alvo and Robert, 1999).

Nesting habitat is usually in marshes dominated by sedges, true grasses, and rushes, where there is little or no standing water and where the substrate remains saturated throughout the summer, including damp fields and meadows, on the floodplains of rivers and streams, in the herbaceous vegetation of bogs, and at the upper levels (drier margins) of estuarine and salt marshes (SARA, 2008b). A greater diversity of habitat types is used during migration and winter when the rails are known to use coastal wetlands and rice fields (SARA, 2008b).

Habitat availability has declined and is still declining throughout the species' southern breeding range and relatively small wintering range and in certain parts of the Hudson/James Bay region, habitat may be declining as a result of habitat degradation by snow goose (*Chen caerulescens*) (SARA, 2008b). Loss and degradation of wetlands is the greatest threat to this species throughout its breeding range and on wintering grounds, habitat loss has been so extensive that the wintering range may no longer be contiguous, forcing rails to become restricted to a narrow band of coastline (Alvo and Robert, 1999; SARA, 2008b).

The Yellow Rail is protected by the federal MBCA and accompanying regulations pertaining to hunting (it is illegal to hunt rails anywhere in Canada, except in Ontario and in the Yukon).

3.5.5.5 Polar Bear

Polar bears are found on ice covered waters throughout the circumpolar Arctic but are most common along coastal areas and in the channels between islands and archipelagos, where distribution is closely tied to the distribution and abundance of ringed seals (*Pusa hispida*), a preferred prey (Figure 7) (CWS/CWF 2008; SARA, 2008b). During the summer some populations of polar bears remain on the sea ice as it melts and retreats northward (SARA, 2008b). However for other populations, the sea ice melts completely and the bears are forced to spend the summer on land where they live off stored body fat, returning to sea ice when it reforms in the fall (SARA, 2008b). Polar bears may also catch bearded (*Erignathus barbatus*), harp (*Phoca groenlandica*), hooded (*Cystophora cristata*), and harbour (*Phoca vitulina*) seals, and occasionally, young Atlantic walruses (*Odobenus rosmarus rosmarus*), beluga whales, and narwhals (*Monodon monoceros*) (depending upon distribution) and during the summer, will also consume grasses, lichens, mosses, and berries (SARA, 2008b).
Most maternity denning occurs on land, although some may occur out on the multi-year ice, where dens are excavated in snowdrifts on south-facing slopes of hills or valleys or, for southerly populations, dug into the banks of creeks and lakes (SARA, 2008b).

Maternity denning areas and spring feeding areas are two of the most critical components of polar bear habitat.

Polar bears are vulnerable to over-harvesting, as adult females have low reproductive rates, and to pollutants that may interfere with hormone regulation, immune system function, and possibly reproduction (COSEWIC, 2002; SARA, 2008b). At the population level, reproductive and survival rates may be affected (SARA, 2008b). Increased human activity in the Arctic also puts valuable denning and spring feeding habitats at greater risk of disturbance (COSEWIC, 2002; SARA, 2008b).

The management of polar bears in Canada is the responsibility of the provincial and territorial governments in which they occur. COSEWIC is currently re-assessing the status of polar bears in Canada. Polar bears are included in Appendix II of CITES as a "*species which, although not necessarily now threatened with extinction, may become so unless trade in specimens of such species is subject to strict regulation to avoid utilization incompatible with their survival*".

3.5.5.6 Short-eared Owl

The Short-eared Owl breeds or winters in North, South and Middle America, Europe, Asia and Africa, for a nearly global range (SARA, 2008b). In Canada, it breeds in every province and territory, from the southern border to the low Arctic but is absent from the Boreal Forest and other heavily forested areas (SARA, 2008b).

The species prefers extensive stretches of open habitats and marshlands and is primarily a bird of marshland and deep grass fields (SARA, 2008b). Short-eared owls will hunt and roost in abandoned pastures, fields, hay meadows, grain stubble, airports, young conifer plantations and marshes in the winter, and frequents prairies, grassy plains or tundra in the summer (SARA, 2008b).

Habitat loss has contributed to the species' decline. Additionally, short-eared owls are exposed to danger from predators and machinery as the species nests on the ground (SARA, 2008b). Effects of environmental contamination are not known (SARA, 2008b).

The Short-eared Owl is not protected by the federal MBCA, but provincial legislation in most provinces protects the species from hunting, possession and selling.

3.5.5.7 Beluga Whale (Western Hudson Bay population)

Belugas aggregate in the Churchill, Nelson and Seal River estuaries on the southwest coast of Hudson Bay arriving in the area in mid-June and building in numbers in the estuaries until late July (Figure 8) (COSEWIC, 2004). From here the species moves northward along the coast as far as Repulse Bay (Figure 8) (COSEWIC, 2004). The Inuit of Hudson Bay have long known the timing and coastal routes of belugas, and believe that there are one or two other populations that remain in both southern Hudson Bay and James Bay, and perhaps in the northwestern Hudson Bay area throughout the winter (COSEWIC, 2004).

The population appears to be relatively abundant, but is subject to substantial removals by hunting in parts of its range, and is potentially threatened by shipping and hydroelectric dams (COSEWIC, 2004).

3.5.5.8 Rusty Blackbird

The Rusty Blackbird habitat for breeding/nesting corresponds closely to the boreal forest and taiga terrestrial ecozones (Figure 9) (COSEWIC, 2006). The species favours the shores of conifer forest wetlands such as slow-moving streams, peat bogs, marshes, swamps, beaver ponds and pasture edges (COSEWIC, 2006; SARA, 2008b) and is generally absent from wetlands in regions above the tree line, such as the alpine tundra and Arctic tundra, and it is not abundant in high mountain wetlands (COSEWIC, 2006).

In Canada, the conversion of wetlands into farmland or land suitable for human habitation is the primary cause of habitat loss and consequently threats to population numbers (SARA, 2008b). In addition, it is quite likely that Rusty Blackbird populations are affected by bird control programs designed to reduce populations of birds that ravage crops (COSEWIC, 2006) and the species may also be affected by the degradation of wetlands (COSEWIC, 2006) and the invasion of dominant species, such as the Red-winged Blackbird, in these wetlands (SARA, 2008b).

In Canada, the Rusty Blackbird is not protected under the MBCA. However, on American soil, the species is protected by the United States' *Migratory Bird Treaty Act* of 1918, which prohibits the capture, destruction, and possession of this bird.

3.5.6 Species at Risk – Flora

An ecological assessment in 2007 (Earth Tech, 2008b) did not observe any significant/sensitive flora species on the Island.

The same methodology was employed for at risk flora species as was used for faunal species in Section 3.5.5. No flora species at risk were identified for Bear Island.

3.6 AQUATIC ENVIRONMENT

3.6.1 Freshwater Environment

There are numerous small freshwater bodies (glacial lakes and ponds) present on Bear Island; the largest of which is located in the center part of the Island (Figure 2). Other substantial waterbodies are located mostly in the southern and south-eastern areas of the Island, including what was once the water supply reservoir, and several smaller areas located in the northern area of the island. The pond near the main barrel cache area (east) was found to be heavily contaminated with metals but due to shallow depths it is unlikely that the pond is fish bearing (Earth Tech, 2008b).

Additional information on water quality is provided in Section 3.6.2.

3.6.2 Fish Species

No fishery surveys were performed on the Island, however, the more abundant freshwater species to be found in the James Bay area include; red longnose sucker (*Catostomus catostomus*), white sucker (*Catostomus commersoni*), whitefish (Coregonus sp.), lake whitefish (*Coregonus clupeaformis*), northern pike (*Esox reicherti*), lake char (*Salvelinus namaycush*), walleye (*Stizostedion vitreum*), and brook trout *Salvelinus fontinalis*) (Municipalite de Baie-James, 2008). The number of species diminishes from South to North and from West to East (Municipalite de Baie-James, 2008).

Although there were no fishery surveys/assessments carried out, the waterbodies present on the Island are shallow enough that freezing would be complete and therefore uninhabited by fish species (Dyer, Pers. com., 2008)

3.6.3 Water Quality

The most recent and most comprehensive assessment of water quality at Bear Island was completed in August 2007 (Earth Tech, 2008a).

A total of ten (10) surface water samples were obtained from various locations. Surface water samples were retrieved from drainage courses down-gradient of areas with known or potential contamination, as well as from background locations. The main study areas from which surface water samples were collected include west of the South Doppler area, east of the Landfill North of Site 412, north and south of the Barrel Cache, west of the Disturbed area, east of the Airstrip area, and along the shoreline at the Beach Area. Background surface water samples were collected from ponds southeast of the airstrip and west of the road going to the North Doppler area. Also, a surface water sample was collected from the drinking water reservoir. Samples were analyzed for heavy metals, PCB and PHC, and compared to the latest version of the Canadian Council of Ministers of Environment (CCME) Canadian Environmental Quality Guidelines Freshwater Aquatic Life Criteria and Drinking Water Quality Guidelines.

No exceedances of the CCME Guidelines were detected in surface water samples analyzed for PCBs, PHCs and PAHs. Exceedances of zinc were identified in surface water samples from ponds located south and north of the Main Barrel Cache. The elevated zinc concentrations may be attributed to the zinc contamination located in the soils at the Barrel Cache area.

Additionally, with the exception of the drinking water reservoir, sediment samples were taken from locations corresponding to the water samples. The PCB and PAH concentrations were below detection limits. The analysis for hydrocarbons indicated that elevated concentrations were recorded in sediment samples collected from the pond located east of the airstrip and from a background sample located from a pond located west of the road to Site 413. The cause of the elevated levels at the background pond west of the road to Site 413 is unknown at this time.

3.6.4 Marine Environment

3.6.4.1 Characteristics

The Hudson Bay Large Marine Ecosystem (LME) is characterized by the Arctic climate. It is a shallow, inland sea connected to the Atlantic Ocean by the Hudson Strait and the Labrador Sea, and to the Arctic Ocean by the Foxe Basin and the Fury and Hecla Strait, and includes the James Bay to the South (Canadian Arctic Resources Committee, 2008; NOAA, 2008). Cold saline water enters the Hudson Bay and James Bay from the northwest and the currents in this LME are strongly influenced by influxes of fresh water from rivers and, during the open-water season, by wind stress (NOAA, 2008; Parks Canada, 2008). The LME is characterized by long, cold winters and short, cool summers and Hudson Bay is the largest body of water in the world that seasonally freezes over each winter and becomes ice-free each summer, with James Bay becoming ice-free by the end of July (NOAA, 2008).

The James Bay region is very shallow, averaging less than 50 m, with depths of less than 6 m rimming the coasts for up to 15 km offshore, and an average tidal range of 1-2 m (Parks Canada, 2008). Extensive shore leads develop throughout the region, and are kept open by the constantly blowing wind (Parks Canada, 2008).

Polynyas (open water areas in the ice which are known to be important biologically throughout the Arctic) are found predominantly along the north-west and east coasts, in the James Bay and in the vicinity of the Belcher Islands, situated in the Southeast Hudson Bay (Canadian Arctic Resources Committee, 2008; NOAA, 2008). Some beluga whales use the polynya of north-west Hudson Bay and James Bay in the winter (Canadian Arctic Resources Committee, 2008; NOAA, 2008).

3.6.4.2 Fish Species

In general, the Hudson Bay LME has relatively poor marine biological productivity and a relative absence of commercial fisheries, however, approximately 60 species of fish are known to inhabit the estuarine communities of Hudson Bay and James Bay (NOAA, 2008). The more significant marine resources are to be found in Foxe Basin, where there is saltwater inflow into the Bay from the Arctic Ocean (NOAA, 2008). Marine fish species of major importance in the LME are Arctic char (*Salvelinus alpinus*), whitefish (*Coregonus* sp.), and Arctic cod (Polar cod) (*Boreogadus saida*) (NOAA, 2008).

Freshwater and anadromous fish species dominate the James Bay fish fauna, in addition to the 22 marine species found in the region (Parks Canada, 2008). Brook trout, lake cisco (lake herring) (*Coregonus artedii*), lake whitefish, capelin (*Mallotus villosus*), Arctic char and sculpin (*Cottus* sp.) are some of the more common species (Parks Canada, 2008).

3.6.4.3 Mammals

Ringed seals are found on all coasts of James Bay and Hudson Bay, with populations estimated at 61,000 and 455,000 respectively (Canadian Arctic Resources Committee, 2008; NOAA, 2008). Harbor seals occur in small numbers at isolated localities along all coasts and harp seals are found as far south as the Belcher Islands in the summer (NOAA, 2008; Parks Canada, 2008).

The most southerly subpopulation of polar bears, many summering on the large islands in James Bay, depend on these seal species as a food source (refer to Section 3.5.5.5) (Parks Canada, 2008).

The eastern Hudson Bay beluga population concentrates around the many islands in the region (refer to Section 3.5.5.8) but other whales are rare (Parks Canada, 2008).

Field studies in 2007 (Earth Tech, 2008a) identified the presence of seal bones near the Arctic tern nesting grounds. No additional evidence of seal communities was observed.

3.6.4.4 Marine Birds

The Hudson Bay and James Bay coasts provide a major migration pathway and a breeding ground for many species of geese and ducks, as well as sea birds (refer to Section 3.5.3). The Hudson Bay subspecies of the common eider breeds on the Belcher and Ottawa islands and winters in the shore leads around the islands (Parks Canada, 2008). Snow goose (*Chen caerulescens*), Canada goose, brant (*Branta bernicla*) and a variety of diving and dabbling ducks are found along the coasts of James Bay, particularly during the migratory period and the west coast is critical to migrating shorebirds; a large portion of the central Arctic population of the red knot and the entire central Arctic population of the hudsonian godwit (*Limosa haemastica*) funnel through this area every year on southern migrations (Canadian Arctic Resources Committee, 2008; Parks Canada, 2008). Other waterfowl species that utilize inshore, intertidal and brackish coastal habitats in the James Bay bioregion include black duck, northern pintail (*Anas acuta*), mallard, American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), and greater scaup (*Aythya marila*). Mergansers and loons make extensive use of offshore water for feeding (Canadian Arctic Resources Committee, 2008). Important shorebird species include dunlin (*Alnus glutinosa*), blackbellied plover (*Pluvialis squatarola*), golden plover (*Pluvialis apricaria*), semi-palmated plover (*Charadrius semipalmatus*), greater and lesser yellowlegs (*Tringa solitaria* and *Tringa melanoleuca*), sanderling and sandpiper (*Calidris* sp.), whimbrel (*Numenius phaeopus*), and marbled godwit (*Limosa fedoa*) (Canadian Arctic Resources Committee, 2008).

3.7 SITE SPECIFIC LAND USE HISTORY (PAST AND PRESENT)

Bear Island's location in the northernmost end of James Bay, at the mouth of Hudson Bay, is in an area accessible to Inuit peoples to the north and the Cree peoples residing in the Hudson Bay area of Ontario and Quebec. However, the Island is not used for hunting or fishing purposes, and has rarely been visited by from people the nearby Wemindji and Chisasibi communities (Earth Tech, 2008a). According to the AIA, there is no recorded habitation of the Island.

The Mid-Canada Line Radar Site was built in the 1950s, and with it, a survival hut. In late 1964 or early 1965, the site was no longer needed and the survival hut was also closed and abandoned.

The Island provides habitat for various wildlife species (refer to Section 3.5) but there is no known use of the island by the nearest communities of Chisasibi, Quebec and Sanikiluaq, Nunavut.

3.8 CULTURAL FEATURES

3.8.1 Cultural Feature/Heritage Resources and Special Places

The spatial boundary of the AIA (2007) focused on previously disturbed sites and those that could potentially be disturbed during the proposed remediation activities. The assessment team discovered one previously unrecorded heritage resource site (noted as GbHg 1 in the AIA) and identified as a tent ring comprised of roughly 35 to 50 rocks (Golder Associates Ltd., 2008). The structure is situated approximately one metre from the edge of the gravel pit that was previously used in conjunction with the radar sites on the island. No other cultural materials were found at the site (Golder Associates Ltd., 2008).

Other findings of the AIA include a "prehistoric house foundation", an Inukshuk, and a beached boat (Golder Associates Ltd., 2008). Although these findings are not classified as heritage resources, it was recommended that a 20 m buffer be designated around each of them for avoidance by any remediation activities. Each of these findings is evidence of more recent activity, and as such, can still be classified as cultural markers (Golder Associates Ltd., 2008). Although the beached boat was considered "interesting" during the AIA, the RAP identifies the paint on the boat as potentially hazardous due to the lead content and as such the boat has been slated for remediation (Golder Associates Ltd., 2008, Earth Tech 2008a).

There are no designated special places on Bear Island. No burial grounds were noted during the AIA or any site visits (Earth Tech 2008a).

3.8.2 Aesthetic Value

Aesthetic value is low. At present, Bear Island is littered with scattered debris. There are no remaining structures on the Island; however, debris and refuse such as snowmobile remains and rusted barrels are present.

3.9 Socioeconomic Environment

Bear Island is unpopulated and the closest community is that of Chisasibi, Quebec, located along the James Bay coastline. The closest Nunauvt community is that of Sanikiluaq, approximately 300km north of Bear Island.

Chisasibi is a Cree community with a 2006 population of 3,972, of whom 95.5% are Aboriginal (Statistics Canada, 2006). Nearly 7% of the community's population is Inuit (Cree Nation of Chisasibi, 2006). Chisasibi's population is young, with a median age of 23 and has a high unemployment rate (16.0%) (Statistics Canada, 2006). The community was relocated in the early 1980s from its original location on the island of Fort George.

Sanikiluaq, Nunavut's closest community to Bear Island had a recorded population of 744 in 2006, of which nearly 95% were Inuit (Statistics Canada, 2006). Currently, the population is young, with a median age of 19.6 and roughly 40% of the population under the age of 15 (Statistics Canada, 2006). Participation rates and employment rates are low at 52.4 and 41.7 percent, respectively, and unemployment in Sanikiluaq is high at 22.7% (Statistics Canada, 2006). Sanikiluaq's economy is largely based on traditional subsistence activities as well as arts and crafts production and some tourism. Bear Island is not traditionally visited by people from Sanikiluaq (Arragutainuq, pers.com., 2008).

The community of Wemindji is located on the James Bay coast approximately 100km south of Chisasibi. In 2006, the population of Wemindji was 1,215, 97.5% of whom are Aboriginal (Statistics Canada, 2006). Information about Wemindji's potential use of the island is limited, however, one individual from the community was employed as a bear monitor and assisted in the identification and recording of sites during the AIA.

4.0 PROJECT/ENVIRONMENT INTERACTIONS

4.1 ASSESSMENT METHODOLOGY

This screening level environmental assessment has been prepared in a manner that is consistent with both NIRB and CEAA requirements.

Information that must be submitted to NIRB as part of a screening, includes:

- proponent information;

- project proposal description including purpose, scope, timing, authorizations and alternatives;
- description of the existing environment (biophysical and socio-economic);
- description of public participation (informing, consulting, participation); and
- identification of potential environmental and socio-economic effects.

Incorporating these information requirements and the requirements of CEAA, the following general approach was used for the preparation of this screening:

- review of relevant information pertaining to the site, including past reports and site assessments commissioned and completed by INAC, and PWGSC;
- review of environmental and socio-economic information relevant to the site and the adjacent areas, obtained from government departments, literature searches, and public consultations;
- review of similar assessments;
- identification and analysis of potential project environmental interactions;
- assessment of project impacts on the environment;
- identification of proposed mitigation measures to reduce and/or eliminate project related impacts;
- assessment of residual project effects and the significance;
- consideration of the effects of the environment on the project along with accidents and malfunctions;
- identification and assessment of cumulative effects assessment;
- the identification of management and monitoring plans; and
- the use of professional judgment and experience.

4.1.1 Valued Ecosystem Component Identification and Selection

The basis for environmental impact assessment is the identification of environment and socio-economic components of concern that have potential to be impacted by the project. Beanlands and Duinker (1983) introduced the term Valued Ecosystem Components (VECs) and its use in now common place in EA practice. Both NIRB and CEAA use the term VEC in guidance documents. NIRB defines VECs as follows:

> *'VECs are those aspects of the environment considered to be of vital importance to a particular region or community, including:*
>
> *a) Resources that are either legally, politically, publicly or professionally recognized as important, such as parks, land selections, and historical sites.*
> *b) Resources that have ecological importance.*
> *c) Resources that have social importance'.*

For this project a four stage process was implemented to identify potential VECs. Firstly, a review of government regulatory responsibilities was undertaken, followed by direct communication with those regulators. Secondly, VECs were identified through the careful review of other remediation projects and complemented with results from public consultations. Finally, the professional judgment of EA practitioners and remediation experts was used to identify any potential gaps in the list of VECs.

As a result of this tiered VEC selection process, a comprehensive list was developed of eight (8) VECs. Table 10 lists the VECs and the means by which they were identified.

Table 10. List of VECs and Selection Rationale

VEC	VEC Selection Rationale			
	Regulatory	Identified in other EA Projects	Public/Inuit	Professional Judgment
Air Quality	√	√		√
Wildlife	√	√	√	√
Vegetation	√	√	√	√
Landforms	√	√		√
Aquatic Resources (including Water Quality)	√	√	√	√
Marine Environment	√			√
Socioeconomic Environment	√	√	√	√
Cultural/Archeological Features	√	√	√	√

4.1.2 Interactions and Potential Effects Assessment Methodology

Following a review of available baseline information and expert judgment the interactions between the project and the environment have been identified for each VEC by answering the following questions.

- How do interactions occur?
- Where do interactions occur?
- When do interactions occur?

As a tool for achieving this, matrices have been utilized as recommended by NIRB in the Screening Part 2 Form, Project Specific Information Requirements. The potential for each project component to interact with each VEC is identified.

Following the identification of potential project/VEC interactions an assessment of the impact has been undertaken. This assessment identifies the specific nature and extent of the interactions between the project and the VECs. Where appropriate, the assessment includes a summary of major concerns or hypotheses of relevance regarding the effect of each activity on the VECs being considered.

Where existing knowledge or the application of standard mitigation indicates that an interaction is not likely to result in an impact, certain issues may warrant only limited analysis.

4.1.3 Mitigation

For each VEC, mitigation measures are suggested that are designed to minimize the potential environmental impacts of the remediation activities. Impact mitigation focuses on design elements, alternative construction techniques and long-term operational practices with the avoidance of impacts as the preferred option.

4.1.4 Determining the Significance of Residual Impacts

Residual effects are those impacts remaining after all appropriate mitigation measures have been implemented. It is usual practice within an EA to determine the significance of environmental impacts after mitigation has been considered. Guidance on the determination of significance of residual impacts is provided by NIRB as follows:

> *'Significance is a consideration of the context of the project and the intensity of adverse effects, by giving particular regard to the following:*
>
> *a. the environmental sensitivity of the geographic area likely to be affected by the project;*
> *b. the historical, cultural and archeological significance of the geographic area likely to be affected by the project;*
> *c. the extent of the effects of the project, including the geographical area that will be affected, the size of the affected human populations, and the size of the affected wildlife populations and related habitat;*
> *d. the extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit Harvesting activities;*
> *e. the magnitude and complexity of adverse effects;*
> *f. the probability of adverse effects occurring;*
> *g. the frequency and duration of adverse effects;*
> *h. the reversibility or irreversibility of adverse effects;*
> *i. the potential for cumulative adverse effects given past, present and future relevant events.'*

Incorporating this determination and the guidance provided by CEAA, the following criteria (Table 11) have been used to determine the significance of residual impacts for this proposed project.

Table 11. Residual Impact Rating Criteria

Attribute	Options	Definition
Sensitivity of Area	Low	The sensitivity of the environment from the impact is considered low
	Medium	The environment is considered fairly sensitive to the impact
	High	The environment is considered very sensitive to the impact
Direction	Positive	Beneficial impact to population or resource
	Neutral	No change to population or resource
	Negative	Adverse impact to population or resource
Scope	Local	Impact restricted to area within 1km of the Project Site
	Regional	Impact extends up to several kilometers from the Project Site
	Territorial	Impact extends throughout Nunavut
Duration	Short-term	Impacts are significant for less than a year before population or resource returns to it's previous state; or for a species, less than one generation
	Medium-term	Impacts are significant for 1 to 10 years; or for a species, for one generation
	Long-term	Impacts are significant for greater than 10 years; or for a species, significant for more than one generation
Frequency	Once	Occurs only once
	Intermittent	Occurs occasionally at irregular intervals
	Continuous	Occurs on a regular basis and regular intervals
Magnitude	Negligible	No measurable change from background in the population or resource; or in the case of air, soil or water quality, if the parameter remains less than the standard, guideline or objective
	Low	Impact causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms)
	Moderate	Impact causes 1 to 10% change in the population or resource
	High	Impact causes >10% in population in resource
Probability	Low	The impact is unlikely to occur
	Medium	The impact is fairly likely to occur
	High	There is a high probability of the impact occurring
Significance	Insignificant	Minimal or no measurable change from background conditions that may last over a long-term period
	Significant	Measurable change from background conditions that may last over a long-term period
	Unknown	Insufficient data available to make a professional judgment, more study required.

4.1.5 Considering Cumulative Effects

Cumulative effects will occur when two or more concurrent project activities interact either additively or synergistically to further exacerbate the effect on a VEC. Other activities that have or are likely to take place in the foreseeable future (i.e., projects currently planned and scheduled) can also lead to cumulative effects on VECs.
The analysis of the cumulative effects of the proposed project includes the following steps:

- identification of other activities that may overlap cumulatively with the project;
- analysis of residual effects of proposed project;
- mitigation measures; and
- determination of significance of cumulative effects.

4.2 IDENTIFICATION OF PROJECT INTERACTIONS

The environmental assessment process involves evaluation of the likely interactions between the project activities and the environment (specifically the VECs). Table 12 summarizes the potential project interactions between the main project components and the VECs.

Table 12. Identification of Project Interactions

Project Activities	Site Preparation Activities					Remediation Activities					Closure Activities	
	Mobilization	Construction of Contractor Camp and WHF	Upgrading of roads and airstrip	Borrow Source Development	Landfill Construction	Clean-Up of Physical Debris/Demolition	Contaminated Soil Removal/Disposal	Hazardous Materials Removal/Disposal	Camp Waste Disposal	Site Grading	Site Grading	Demobilization
VECs												
Air Quality	X	X	X	X	X	X	X	X		X	X	X
Wildlife	X	X	X	X	X	X	X	X	X	X	X	X
Vegetation		X	X	X	X	X	X	X	X	X	X	
Landforms	X	X	X	X	X	X	X	X		X	X	X
Aquatic Resources (including Water Quality)			X		X	X	X	X	X	X	X	
Marine Environment	X				X							X
Cultural Features	X	X	X	X	X	X	X	X	X	X	X	X
Socio-economics	X	X	X	X	X	X	X	X	X	X	X	X

4.3 ASSESSMENT OF PROJECT INTERACTIONS

An assessment of all project interactions with identified VECs is provided in the following tables. A brief summary for each VEC is also included. Only those residual impacts considered to be significant will be further analyzed.

4.3.1 Air Quality

Table 13. Assessment of Impacts and Effects on Air Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
All site preparation and closure activities including mobilization and demobilization	• Dust and green house gas emissions from traffic and heavy equipment	• Dust control measures will be implemented (i.e. water will be used for dust suppression, exposed soil piles will be covered etc.) • Development of EPPs and EMPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: high Significance: insignificant
Remediation				
• *Excavation/removal and disposal of contaminated soils and hazardous material*	• Dust/exhaust emissions from traffic and construction equipment	• Dust control measures will be implemented (i.e. water will be used for dust suppression, exposed soil piles will be covered etc.) • Development of EPPs and EMPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: high Significance: insignificant
• *Excavation/removal and disposal of contaminated soils and hazardous material*	• Removal of the contaminated soil from the environment will reduce the risk of effects on air quality	• N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local Duration: long-term Frequency: intermittent Magnitude: negligible Probability: high Significance: beneficial, not evaluated

Table 13. Assessment of Impacts and Effects on Air Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site grading	• Dust/exhaust emissions from traffic and construction equipment	• Dust control measures will be implemented (i.e. water will be used for dust suppression, exposed soil piles will be covered etc.) • Development of EPPs and EMPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: high Significance: insignificant
Upset Conditions				
Extreme precipitation events and high wind events	• High precipitation events, coupled with project activities may result in erosion, slumping or sliding of surficial materials • High wind events will lead to decreased air quality as surficial materials become air borne	• Avoiding work with equipment during extreme precipitation events and during associated adverse ground conditions • Implementation ERPs (Refer also to Section 5.1.4)	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: medium Significance: insignificant

Summary of Air Quality Related Issues:

Adverse potential impacts to air quality are associated with all phases of the project, including mobilization/demobilization, remediation and in the event of extreme precipitation and high wind events. In order to complete the proposed project, heavy machinery will be utilized. Consequently, there will be low emissions of greenhouse gases, nitrogen oxides (NOx), sulphur dioxide (SO_2) particulate matter, and carbon monoxide (CO) due to combustion of diesel fuel or gasoline and burning of non-hazardous waste. Emissions from vehicles and construction equipment however will be short term and intermittent and will not have a significant residual effect on air quality within the local study area or regionally. Dust generation is expected to also be low in volume and infrequent. Overall positive effects are expected as a result of removal of contaminated soils and hazardous materials.

A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to: dust suppression/control measures, implementation of good practice measures, and avoidance of work during extreme weather events. Additionally, the amount of soil exposed and disturbed will be limited to the areas requiring remediation and the movement of soils will be minimized whenever possible. Exposed soil piles will be covered. EMPs and EPPs are also important along with a general ERP.

Following implementation of mitigation measures, adverse effects associated with project activities to air quality will be local, short-term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects and it is expected that the Project will have long-term beneficial effects on air quality.

4.3.2 Wildlife

Table 14. Assessment of Impacts and Effects on Wildlife

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
All site preparation and closure activities including mobilization and demobilization	• Increased noise and human presence could disturb nesting and/or breeding activities of birds, denning female polar bears and cubs etc. • Direct mortalities caused by traffic and heavy equipment • Alteration of migratory patterns due to humans and/or traffic and equipment • Human encounters with wildlife	• Avoidance of all nesting and breeding areas (terns and Canada geese) • Situate activities to avoid effects on wildlife receptors • Restricted access to personnel (required distances from avian colonies, and polar bears) • Make information available to personnel regarding flora, fauna and sensitive habitats • Schedule activities during non-breeding/nesting seasons for birds and polar bears • Avoidance of all animals, when possible • Development of an information pamphlet on working in polar bear habitat • Design project so that nests are not disturbed or destroyed (i.e. include pre-construction surveys prior to project activities) • Management of food waste at camps and throughout the site • Implement EPPs and EMPs that include noise abatement measures and wildlife management plan that include wildlife awareness training	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible - low Probability: high Significance: insignificant

Table 14. Assessment of Impacts and Effects on Wildlife

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Remediation				
All remediation activities	• Increased noise and human presence could disturb nesting and/or breeding activities of birds, denning female polar bears and cubs etc. • Human encounters with wildlife • Demolition of structures that may be presently used by wildlife (i.e. nests)	• Refer to above mitigative measures • Inspect structures prior to demolition	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible - low Probability: high Significance: insignificant
	• Improve wildlife habitat • Decreased potential for harm (direct and indirect) to wildlife	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local - regional Duration: long-term Frequency: once Magnitude: medium - high Probability: high Significance: beneficial, not evaluated
Camp waste disposal (and general operation)	• Attraction of polar bears to the site resulting in defence kills and impacting already low population levels	• Bear safety awareness training will be provided • Containers for domestic waste and incinerators will be located in enclosed bear-proof structures • All camp personnel will be familiar with 'Safety in Polar Bear Country' literature produced by GN Department of Environment • Garbage will be incinerated daily • Bear deterrents (cracker shells, thunder flashes and rubber bullets) will be on site • The use of electric fencing within the camp design, especially around sleeping quarters will be considered	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short – long-term Frequency: intermittent Magnitude: moderate Probability: low Significance: insignificant

Table 14. Assessment of Impacts and Effects on Wildlife

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Upset Conditions				
Potential for oil spills	• Loss of wildlife including vegetation • Impacts to sensitive environments (i.e. fen wetlands) • Degradation of land, surface and ground water	• Develop and implement EPPs and EMPs • Develop and implement ERPs that include an oil spill contingency plan to deal with oil spills effectively (Refer also to Section 5.1.4) • Use of berms, booms, and sediment controls should be considered to protect surface water from excessive sediment loading and to prevent deleterious substances from entering surface and ground waters • Educate personnel on the potential impacts of the spills and contingency plans	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: medium-term Frequency: once Magnitude: moderate - high depending on size and location of the spill Probability: low Significance: insignificant

Summary of Wildlife Related Issues:

Impact on the terrestrial wildlife community has already occurred due to the historical activities and associated site contamination, and it is expected that the remediation of the site will improve wildlife habitat.

The primary sources of sound from the remediation activities will be associated with the camps, vehicles, and equipment/machinery. Noise associated with these sources will be short-term and restricted to the main sites/landfills, airstrip, and roads. General mitigation measures for the noise that will be generated during remediation activities will include but not be limited to: maintaining equipment in good working condition, turning equipment off when not in use (where practicable). Wildlife and employees working on the remediation project are expected to be the only receptors exposed to the elevated noise levels. Wildlife, in most cases will instinctively move away from the intermittent noise and employees will implement appropriate hearing protection measures.

In the event that remediation activities can not be completed without disturbing/destroying habitat/nests associated with migratory bird species, a permit authorizing the removal of nests or disruption of habitat will be obtained as required by the MBCA.

There is potential for human and wildlife interaction during the life of the project, however, it is expected that such encounters will be insignificant and minimal. It is likely that most species will avoid the area where people are working and machinery is operating. Example mitigation measures that could be included in a Wildlife Management Plan are provided in Appendix B. Facilities will not be demolished in the immediate vicinity of nests while birds are nesting and the responsible wildlife officer will be contacted for additional guidance to ensure disturbance of wildlife is minimized. Field studies in 2007 (Earth Tech, 2008a) noted that adult terns were seen exhibiting highly agitated behaviour when field personnel entered the nesting area, and eggs were noted in the sandy soils. Restricted access to this breeding and nesting area is recommended. The Ontario Breeding Bird Atlas defines the period during which Arctic tern nesting can be expected to occur as late to mid-June to late July. Additionally, adult pairs of Canadian geese breed/nest after the snow and ice melt and goslings require 8-9 weeks before being able to fly. Physical works/activities will be scheduled around these breeding and nesting times or situated to avoid effects on wildlife receptors including breeding birds.

Polar bears are an unlikely but possible occurrence at the site during remediation activities. Polar bears are naturally inquisitive and are often attracted to odors and sounds from camp facilities. Polar bears will usually not attack humans except to protect cubs or because they are starving. (CWS/CWF, 2008).Considering the status of some of the populations close to the site any defense kill of a polar bear could have population level impacts. Consequently, preparedness for the occurrence of polar bears is vital in camp design, operation, and equipment.

All disturbed areas will be re-graded and reshaped to match the existing terrain to facilitate the recovery of the ecosystem components. A contingency plan will be prepared that address spills of hazardous materials as well as other potential accident scenarios that may adversely affect wildlife and wildlife habitat. This plan will be consistent with the GN Spill Contingency Planning and Reporting Regulations and guidance issued by NWB related to contingency planning. EMPs and EPPs are also important along with a general ERP.

Following implementation of mitigation measures, adverse effects associated with project activities to wildlife will be local, short-term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects and it is expected that the Project will have long-term beneficial effects on wildlife.

Refer also to tables 17 and 18 for impacts associated with aquatic resources and water quality, and the marine environment, respectively.

4.3.3 Vegetation

Table 15. Assessment of Impacts and Effects on Vegetation

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
Site preparation and closure activities not including mobilization and demobilization	• Disturbed/destroyed habitat • Direct mortality of some vegetative species • Impacts from dust	• Where possible, remedial works will occur within the footprints of disturbed sites and existing paths to limit the impact on the existing vegetation • Unless required for drainage purposes, smoothing and contouring of disturbed surfaces will be minimized in order to create microsites that will encourage future vegetation growth • Refer to air quality impacts (Table 13) for mitigative measures to deal with dust suppression	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term to long-term Frequency: once Magnitude: medium Probability: high Significance: insignificant
Landfill construction	• Loss of berry-bearing shrub species resulting in a loss of a food source for resident/migrating wildlife	• Transplant shrubs to an alternative area	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term to long-term if species are destroyed Frequency: once Magnitude: low – high depending if species are destroyed Probability: high unless Landfill Area #1 is avoided Significance: insignificant

Table 15. Assessment of Impacts and Effects on Vegetation

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Remediation				
All remediation activities	• Disturbed/destroyed habitat • Direct mortality of some vegetative species • Hindrance of re-colonization • Impacts from dust	• Where possible, remedial works will occur within the footprints of disturbed sites and existing paths to limit the impact on the existing vegetation • Unless required for drainage purposes, smoothing and contouring of disturbed surfaces will be minimized in order to create microsites that will encourage future vegetation growth • Refer to air quality impacts (Table 13) for mitigative measures to deal with dust suppression	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible - low Probability: high Significance: insignificant
	• Improved habitat for growing conditions • Decreased potential for harm from contaminated surface and ground waters, and soil	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local Duration: long-term Frequency: once Magnitude: medium - high Probability: high Significance: beneficial, not evaluated
Upset Conditions				
Potential for oil spills	• Loss of vegetation • Impacts to sensitive environments (i.e. fen wetlands) • Degradation of land, surface and ground water	• Develop and implement EPPs and EMPs • Develop and implement ERPs that include an oil spill contingency plan to deal with oil spills effectively (Refer also to Section 5.1.4) • Use of berms, booms, and sediment controls should be considered to protect surface water from excessive sediment loading and to prevent deleterious substances from entering surface and ground waters • Educate personnel on the potential impacts of the spills and contingency plans	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: medium-term Frequency: once Magnitude: moderate - high depending on size and location of the spill Probability: low Significance: insignificant

Summary of Vegetation Related Issues:

Impacts to vegetation will be associated with the remediation activities and with potential upset conditions such as oil spills. A Contingency Plan for oil spills will be part of the ERP. This plan will be consistent with the GN Spill Contingency Planning and Reporting Regulations and guidance issued by NWB related to contingency planning. The development of EMPs and EPPs are important to avoid these events.

Due to the slow growing nature of the vegetation community in the area, it is likely that the remediation works will hinder the vegetative re-colonization of the site in the short term. Local vegetation may also be affected by fugitive dust during remediation activities but removal of contaminated soils will aid in the overall natural re-vegetation of the site.

Some site preparation activities and remediation activities will have short term, minor residual effects on vegetation while natural re-vegetation occurs. However, the removal of contaminated soils and hazardous material will likely improve the soil conditions and re-vegetation success by reducing the amount of area with elevated levels of contamination. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.3.4 Landforms

Table 16. Assessment of Impacts and Effects on Landforms

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
Mobilization and demobilization including site grading	• Movement of equipment and personnel may disturb or degrade soils and landforms	• Existing roads and pathways will be utilized as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: low Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance: insignificant
Contractor Camp and WHF Construction	• Establishment of camp facilities and the WHF may disturb or degrade surficial materials and landforms	• The camp and WHF will be located on previously disturbed areas.	• No cumulative adverse effects identified	Sensitivity of the Area: low Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance: insignificant
Upgrading of Site Roads/Airstrip	• Drainage to be improved during grading of roads and airstrips, and re-grading of site at completion	• N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance beneficial, not evaluated
Borrow Source Development	• Granular material extraction will result in alteration of landforms in the immediate vicinity of the borrows	• Upon completion, borrow areas will be re-contoured and graded to match adjacent areas as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low Probability: high Significance: insignificant

Table 16. Assessment of Impacts and Effects on Landforms

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Landfill Construction	• Excavation for new landfill construction and closure of existing landfills may degrade permafrost and existing land contours • Alteration of existing terrain	• Surface area and time of permafrost exposure will be minimized. • Land surface will be re-contoured to match pre-remediation conditions as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low Probability: high Significance: insignificant
Remediation				
Clean-up of physical debris/demolition	• Remediation of old dumps and general clean-up and movement of equipment and personnel may disturb or degrade soils and landforms	• Existing roads and pathways will be utilized as much as possible. • Land surface will be re-contoured to match pre-remediation conditions as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low Probability: high Significance: insignificant
Excavation/removal and disposal of contaminated soils and hazardous material	• Excavation and removal of contaminated soil may degrade permafrost and existing land contours • Alteration of existing terrain	• Surface area and time of permafrost exposure will be minimized. • Land surface will be re-contoured to match pre-remediation conditions as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low Probability: high Significance: insignificant
Site grading	• Grading activities may disturb or degrade soils and landforms • Alteration of existing terrain	• Existing roads and pathways will be utilized as much as possible.	• No cumulative adverse effects identified	Sensitivity of the Area: low Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance: insignificant

Table 16. Assessment of Impacts and Effects on Landforms

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Upset Conditions				
Extreme precipitation events	• High precipitation events, coupled with project activities may result in erosion, slumping or sliding of surficial materials	• Avoiding work with equipment during extreme precipitation events and during associated adverse ground conditions	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: medium Significance: insignificant

Summary of Landforms Related Issues:

Adverse potential impacts to landforms are associated with all phases of the project, including mobilization/demobilization, remediation and in the event of extreme precipitation. Adverse effects may include degradation of surficial materials (including permafrost) and landforms through establishment of support facilities, general movement of equipment around the site, excavation of materials for remediation or borrow, and general clean up of materials The excavation and movement of contaminated soils is likely to alter the existing terrain. However, the existing terrain is currently not in its natural form. As such the effects of further excavation would be minimal. Adverse effects associated with extreme precipitation events include erosion, slumping or sliding of surficial materials, which may be exacerbated by project activities.

A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to: locating access routes and camp facilities on previously disturbed areas, limiting the area and time that permafrost is exposed, re-contouring and grading to ensure that landforms match remediation conditions as much as possible, and avoiding working with equipment during extreme precipitation events and associated adverse ground conditions.

Overall, the removal of abandoned site infrastructure will improve the visual aesthetics of the local terrain, drainage will be improved with grading of the site and historically disturbed areas will be blended into the landscape.

Following implementation of mitigation measures, adverse effects associated with project activities to landforms will be local, short-term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.3.5 Aquatic Resources and Water Quality

Table 17. Assessment of Impacts and Effects on Aquatic Resources and Water Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
Upgrading of roads and airstrip	• Sediment in run-off from re-graded roads and surfaces has the potential to impact water quality	• Development of EMPs and EPPs • Development and implementation of temporary (during construction) and permanent erosion and sediment control measures (i.e. berms, silt fences)	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low - moderate Probability: low Significance: insignificant
Landfill Construction	• Landfill surface runoff, leachate generation and seepage may have an effect on surface and ground water quality, and sediment and could affect local aquatic environments	• New landfills will be sited away from natural drainages • Upon closure, existing landfills will be graded to promote surface runoff • The design cover of land fills should extend below the active permafrost zone and study to estimate the active zone thickness is important for landfill cover design • Landfill cover must be resistant to erosion, slope failures and freeze/thaw creep • Landfill cover thickness will be designed so that the waste materials are below the active layer • Development of EMPs and EPPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible - low Probability: low Significance: insignificant

Table 17. Assessment of Impacts and Effects on Aquatic Resources and Water Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Grading	• Extraction of granular material and grading adjacent to waterbodies has the potential to impact aquatic habitat, including sensitive habitats (i.e. fen wetlands) and thereby affect aquatic animals, due to sediment entering the water	• Development and implementation of temporary (during construction) and permanent erosion and sediment control measures (i.e. berms, silt fences) • Equipment will not be operated within the wetted perimeter • Disturbed areas adjacent to water will be stabilized, if required • Erosion protection of excavated and fill slopes will be important to prevent sediment • Borrow development, remedial excavation and landfill slope designs should provide for proper drainage and consider soil strength when saturated in slope stability analysis • Environmental monitoring should take place during remedial activities to ensure compliance and functioning of drainage and sediment controls structures • Development and implementation of EPPs and EMPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible - low Probability: low Significance: insignificant

Table 17. Assessment of Impacts and Effects on Aquatic Resources and Water Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Remediation				
Excavation/removal and disposal of contaminated soils and hazardous material	• During disposal activities, hazardous materials have potential to impact local water quality, invertebrate, wildlife and water fowl using aquatic resources	• Transportation procedures in accordance with *Transportation of Dangerous Goods Act* will be implemented • All workers will be trained in proper handling procedures for all hazardous materials on-site • Hazardous materials will be stored at least 30m away from the high water mark of any water body • Spill contingency plans have been developed and will be implemented as necessary (Refer also to Section 5.1.4) • Contingency plans related to all materials and equipment will be available on-site (Refer also to Section 5.1.4) • Development of EMPs and EPPs	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible Probability: low Significance: insignificant
	• Improved wildlife habitat • Decreased potential for harm (direct and indirect) to wildlife	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local - regional Duration: long-term Frequency: once Magnitude: medium - high Probability: high Significance: beneficial, not evaluated
	• Removal of the contaminated soil and hazardous materials from the environment will reduce the risk of contamination of active layer water	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local Duration: long-term Frequency: once Magnitude: negligible Probability: high Significance: beneficial, not evaluated

Table 17. Assessment of Impacts and Effects on Aquatic Resources and Water Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Camp waste disposal	• The operation of the work camp will include disposal of camp sewage, grey water, garbage and other non-hazardous wastes that could impact water quality	• Camp sewage and grey water will be diverted to sumps that are located a minimum of 100m from a drainage course or a water course • Sumps will be closed off at the end of remediation activities • All other camp waste will be disposed of in one of the new landfills or removed off-site on completion of the remediation activities	• No cumulative adverse effects identified	Sensitivity of the Area: low - medium Direction: negative Scope: local Duration: short-term Frequency: intermittent Magnitude: negligible - low Probability: low Significance: insignificant
Site Grading	Refer to site grading activities done under site prep and closure phase			
Upset Conditions				
Extreme rainfall	• Increased erosion of exposed surfaces and engineered landfill caps, resulting in sediment and contaminant laden runoff, and possible failure of facilities	• Engineer landfills to take account of extreme rainfall events • Borrow development, remedial excavation and landfill slope designs should provide for proper drainage and consider soil strength when saturated in slope stability analysis • Ensure capping materials has sufficient strength and are graded to promote run-off	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local - regional Duration: medium-term Frequency: once Magnitude: low - moderate Probability: low Significance: insignificant
Climate change	• Warming of wastes within landfills could increase leachate production and potential for impacts on aquatic resources	• Ensure appropriate engineering of landfills to account for possible climate change scenarios. • Monitor long-term integrity of landfills and potential for leachate migration into the aquatic environment	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local - regional Duration: long-term Frequency: N/A Magnitude: moderate - high Probability: high Significance: unknown, could be significant

Table 17. Assessment of Impacts and Effects on Aquatic Resources and Water Quality

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Potential for silt events	• Impacts to sensitive environments (i.e. fen wetlands) • Degradation of land, surface and ground water	• Develop and implement EPPs and EMPs • Develop and implement ERPs that include an contingency plans to deal with events effectively (Refer also to Section 5.1.4) • Development and implementation of temporary (during construction) and permanent erosion and sediment control measures (i.e. berms, silt fences) • Educate personnel on the potential impacts	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: short - medium-term Frequency: once Magnitude: low - moderate Probability: low Significance: insignificant
Potential for oil spills	• Impacts to sensitive environments (i.e. fen wetlands) • Degradation of land, surface and ground water	• Refer to above listed mitigative measures • Fuel storage and refuelling must occur at least 30m from the high water mark of any waterbody, in a natural depression or bermed area • All fuel storage containers will be situated in a manner that allows easy access and removal of containers in the event of leaks or spills. Fuel caches in excess of 20 drums should be inspected daily • All fuel will be handled in accordance with the Contingency Plan (Refer also to Section 5.1.4)	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: medium-term Frequency: once Magnitude: moderate - high depending on size and location of the spill Probability: low Significance: insignificant

Summary of Aquatic Resources and Water Quality Related Issues:

Adverse potential impacts to aquatic resources and water quality on Bear Island are possible during all phases of the project as well as upset conditions that pertain to spills and sediment events, and extreme rainfall events, and climate change.

Silt generated by the use of heavy equipment, excavation of landfills/and borrow source and erosion of slopes and ditches, along with fugitive dust emissions and the potential for landfill leachate may have an effect on surface water quality and sediment, and could impact local aquatic environments and, through habitat usage, aquatic flora and fauna. Furthermore, possible fuel spills from general use of heavy equipment and from fuel storage areas are also a possibility. A number of common practice environmental protection measures will be incorporated to reduce this likelihood including, appropriate engineering design, following good practice in handling materials and developing and implementing a Spill Contingency Plan that complies with GN Spill Contingency Planning and Reporting Regulations. EMPs and EPPs are also important along with a general ERP. Erosion and sediment control can occur at any time during construction. The highest potential for erosion occurs during clearing, grading and during activities in or near wetlands and watercourses. Specific mitigation measures for the protection of the topsoil resource and water quality from erosion and sedimentation will be outlined in the EPP under an erosion and sediment control plan (ESCP). This ESCP will be developed and implemented on-site to protect aquatic resources and water quality.

It is also presumed that the operation of the temporary work camp will include treatment and disposal of waste, which has the potential to impact water quality. This waste will be handled in a manner that complies with guidelines issued by territorial and federal governments or the NWB. This will include placing sewage and wastewater collection sumps a minimum of 100 m from any drainage course or water course, and complying with GN guidelines for General Management of Hazardous Wastes.

It should be noted that other northern sites have demonstrated, on occasion, that the granular overburden material can be potentially acid generating or can leach metals, affecting the water quality of adjacent rivers and lakes. Measures will be taken on-site to ensure that appropriate material is used.

Extreme weather conditions such as heavy rainfall have the potential to exacerbate impacts on aquatic resources and water quality. Knowledge of extreme event occurrence and subsequent sitting and design of facilities is the key mitigation in this regard.

Long term global warming could reduce the effectiveness of the remediation activities. Landfill designs must take account of this likelihood and ensure permafrost is maintained within the wastes. Monitoring of landfill freeze-back is also recommended.

Overall the remediation activities are expected to have positive impact on aquatic resources through the removal and isolation of contaminants from the environment. Following implementation of mitigation measures, adverse effects associated with project activities to aquatic resources and water quality will be local, short-term and insignificant. A monitoring program for water quality will be put in place to track this VEC (refer to Section 8.0). Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.3.6 Marine Environment

Table 18. Assessment of Impacts and Effects on Marine Environment

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
All mobilization and demobilization activities	• Noise issues to marine mammals • Impacts to seal pupping activities and to seal behaviour (use of shore/beaches) • Potential boat collisions with marine mammals (belugas)	• Schedule activities during times when marine mammals are not likely to be in the area (refer to Section 3.5.5.7) • Boat monitors to watch for beluga pods • Use of barges to maintain straight courses and low speeds • Shipping scheduled during the normal open water season thus avoiding sensitive seal pupping season (March-June) • Make information available to personnel regarding marine habitat/fauna • Avoidance of all animals • Restricted access to personnel	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local - regional Duration: short – medium-term Frequency: once Magnitude: negligible – medium Probability: low Significance: insignificant
Landfill construction	• Proximity of the beach landfills to the marine environment has the potential to impact marine habitat, and marine flora and fauna through sediment or hazardous materials entering the water	• Surface water should be diverted away from landfills during excavation • Berms, booms, and sediment controls should be considered to protect surface water from excessive sediment loading and to prevent deleterious substances from entering the marine environment • Development of EMPs and EPPs • Development of ERP with Spill Contingency Plan (Refer also to Section 5.1.4)	• No cumulative adverse effects identified	Sensitivity of the Area: medium Direction: negative Scope: local Duration: short-term Frequency: once Magnitude: low - medium Probability: low Significance: insignificant

Table 18. Assessment of Impacts and Effects on Marine Environment

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Remediation				
General remediation activities (not including site grading)	• Long-term reductions in contaminant levels to the marine environment	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: local - regional Duration: long-term Frequency: intermittent/continuous Magnitude: low - high Probability: high Significance: beneficial, not evaluated
Upset Conditions				
Extreme rainfall	• Increased erosion of exposed surfaces and engineered landfill caps, resulting in sediment and contaminant laden runoff entering the marine environment	• Engineer landfills to take account of extreme rainfall events • Borrow development, remedial excavation and landfill slope designs should provide for proper drainage and consider soil strength when saturated in slope stability analysis • Ensure capping materials has sufficient strength and are graded to promote run-off	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local - regional Duration: short-term Frequency: intermittent Magnitude: negligible Probability: low Significance: insignificant
Climate change	• Warming of wastes within landfills could increase leachate production and potential for impacts on aquatic resources	• Ensure appropriate engineering of landfills to account for possible climate change scenarios. • Monitor long-term integrity of landfills and potential for leachate migration into the aquatic environment	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local Duration: long-term Frequency: continuous Magnitude: negligible Probability: high Significance: unknown, could be significant

Table 18. Assessment of Impacts and Effects on Marine Environment

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Potential for oil spills	• Loss of wildlife • Degradation of marine and shoreline habitat if the spill occurs in water • Degradation of land, surface and ground water if the spill occurs on land	• Develop and implement EPPs and EMPs • Develop and implement ERPs that include an oil spill contingency plan to deal with oil spills effectively and that includes a <u>marine specific component</u> that will include reconnaissance surveys to find marine birds and mammals near spills, and use of deterrents to keep animals away from spills • Educate personnel on the potential impacts of the spills and contingency plans	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local – regional depending on size and location of spill Duration: medium-term Frequency: once Magnitude: moderate - high depending on size and location of the spill Probability: low Significance: insignificant

Summary of Marine Environment Related Issues:

Potential impacts to marine mammals and the marine environment in general, are mainly limited to mobilization and demobilization operations during the limited open water season. The sensitivity of marine mammals to shipping operations is not fully understood but is thought to be influenced by timing, location (i.e. avoidance of sensitive life history times and locations), and size, speed and number of the vessels involved. The avoidance of seal denning areas and times could be achieved by shipping during the months of August and September. Additionally, belugas pass through the southern part of Hudson Bay during both spring and fall migrations and aggregate in the estuaries on the southwest coast of Hudson Bay arriving in the area in mid-June and building in numbers in the estuaries until late July (refer to Section 3.5.5.7). Avoidance of the waters around Bear Island until August will jeopardize the schedule of the project. When possible shipping activities should be restricted or limited during June and July, however those vessels that do utilize the waters during this time should ensure that other mitigative measures are implemented (i.e. decreased speeds, straight courses, visual monitoring for wildlife, and avoidance of detected wildlife. It is important to note also, that the barges to be used in this operation will be small, slow moving and limited in number making marine mammal collisions less likely to occur. Impacts are therefore expected to be low.

The greatest risk is posed by the accidental release of existing on-site contaminants or spills of fuels. As described for the Aquatic Resources assessment (Table 17) a number of environmental protection measures will be implemented during all phases of the project. These measures should minimize the chances of accidental release of contaminants into the marine environment and, consequently, the marine food chain. Furthermore, a spill contingency plan will be developed dealing with spills of hazardous materials into the environment, including the marine environment. This plan will be consistent with the GN Spill Contingency Planning and Reporting Regulations and guidance issued by NWB related to contingency planning.

Generally the impact on the marine environment is expected to be positive with reduced likelihood of contaminant migrating from the site into the surrounding waters and potentially impacting the ecosystem on a broader level. Following implementation of mitigation measures, adverse effects associated with project activities to the marine environment will be local, short-term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.3.7 Cultural Features/Heritage Resources and Aesthetic Values

Table 19. Assessment of Impacts and Effects on Cultural Features/Heritage Resources and Aesthetic Value

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impacts
Cultural Features/Heritage Resources				
Site Preparation/Closure Activities				
All Activities	• Potential to disturb the identified tent ring site (GbHg 1) or other identified cultural features	• A 20 metre buffer will be created around GbHg 1 and the other known cultural features (Inukshuk and prehistoric house foundation) to ensure avoidance by remediation crews	• No cumulative adverse effects identified.	Sensitivity of the Area: high Direction: negative Scope: local (at gravel pit site) Duration: short-term Frequency: once Magnitude: medium - high Probability: low Significance: insignificant
	• Disturbance or destruction of new or unanticipated heritage resource or cultural sites	• No artifacts or other associated objects will be removed from the site unless their integrity is threatened in any way. • The site's visible boundaries will be marked and the area avoided. • A report of the discovery of the site will be made to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute as per the Nunavik Land Claims Act. • The discovery will be documented.	• No cumulative adverse effects identified.	Sensitivity of the Area: medium to high Direction: negative Scope: local (across the Island) Duration: short-term Frequency: once Magnitude: unknown Probability: low Significance: insignificant
	• Discovery and documentation of new heritage resource sites or cultural features as a result of site disturbance or excavation during remediation activities	• No artifacts or other associated objects will be removed from the site unless their integrity is threatened in any way. • The site's visible boundaries will be marked and the area avoided. • A report of the discovery of the site will be made to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute as per the Nunavik Land Claims Act. • The discovery will be documented.	• No cumulative adverse effects identified.	Sensitivity of the Area: medium to high Direction: positive Scope: local (across the Island) Duration: short-term Frequency: unknown Magnitude: unknown Probability: low Significance: insignificant / beneficial

Table 19. Assessment of Impacts and Effects on Cultural Features/Heritage Resources and Aesthetic Value

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impacts
Remediation				
All Activities	• Potential to disturb the identified tent ring site (GbHg 1) due to its proximity to the gravel pit	• A 20 metre buffer will be created around GbHg 1 and the other known cultural features (Inukshuk and prehistoric house foundation) to ensure avoidance by remediation crews	• No cumulative adverse effects identified.	Sensitivity of the Area: high Direction: negative Scope: local (at gravel pit site) Duration: short-term Frequency: once Magnitude: medium - high Probability: low Significance: insignificant
	• Disturbance of destruction of new or unanticipated heritage resource or cultural sites	• No artifacts or other associated objects will be removed from the site unless their integrity is threatened in any way. • The site's visible boundaries will be marked and the area avoided. • A report of the discovery of the site will be made to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute as per the Nunavik Land Claims Act. • The discovery will be documented.	• No cumulative adverse effects identified.	Sensitivity of the Area: medium to high Direction: negative Scope: local (across the Island) Duration: short-term Frequency: once Magnitude: unknown Probability: low Significance: insignificant
	• Discovery and documentation of new heritage resource sites or cultural features as a result of site disturbance or excavation during remediation activities	• No artifacts or other associated objects will be removed from the site unless their integrity is threatened in any way. • The site's visible boundaries will be marked and the area avoided. • A report of the discovery of the site will be made to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute as per the Nunavik Land Claims Act. • The discovery will be documented.	• No cumulative adverse effects identified.	Sensitivity of the Area: medium to high Direction: positive Scope: local (across the Island) Duration: short-term Frequency: unknown Magnitude: unknown Probability: low Significance: insignificant / beneficial
Upset Conditions				
None				

Table 19. Assessment of Impacts and Effects on Cultural Features/Heritage Resources and Aesthetic Value

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impacts
Aesthetic Value				
Site Preparation/Closure Activities				
All Activities	• Personnel and all associated equipment and buildings for the set up/demobilization of the RAP	N/A	• No cumulative adverse effects identified.	Sensitivity of the Area: low Direction: neutral Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance: insignificant
Remediation				
All Activities	• Personnel and all associated equipment and buildings for the duration of the RAP	N/A	• No cumulative adverse effects identified.	Sensitivity of the Area: low Direction: neutral Scope: local Duration: short-term Frequency: once Magnitude: negligible Probability: high Significance: insignificant
Upset Conditions				
None				

Summary of Cultural Features/Heritage Resources and Aesthetic Value Related Issues:

It is possible that the proposed remediation work will affect the known heritage and cultural resources on Bear Island and that there is also the potential to disturb unrecorded heritage resources and potentially expose and/or damage new sites. Effects on culture features/heritage resources are generally classified as negative, permanent and irreversible. However, given the knowledge of the existing heritage resource site and cultural features on Bear Island, and the mitigative measures provided, these locations can be avoided and/or protected. The residual impacts are therefore considered local, short-term and insignificant. The disturbance of unknown cultural features or heritage resource sites can also be positive in that it can provide the opportunity to record and investigate new sites that can add to the knowledge of the region's history.

In the event that any heritage resources including fossils, artifacts, and archeological remains are encountered during site remediation activities the following rules will apply:

1. no artifacts or other associated objects will be removed from the site unless the integrity of the object is threatened in any way.
2. visible boundaries will be marked and the area avoided.
3. a report of the discovery of the site will be made to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute as per the Nunavik Land Claim Agreement.
4. the discovery will be documented.

The creation of a 20 m buffer surrounding any known/discovered archaeological resource and cultural sites will protect these areas/objects from possible impact resulting from remediation activities on Bear Island.

During the mobilization/demobilization and remediation activities, the required personnel and equipment will cause a minor decrease in aesthetics, however, the remediation of the island will improve overall aesthetics of the island and will lead to improved habitat for the wildlife.

Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.3.8 Socio-Economics

Table 20. Assessment of Impacts and Effects on Socio-Economics

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Site Preparation/Closure Activities				
All Activities	• Employment opportunities • Procurement opportunities for camp and equipment supply	N/A	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: positive Scope: territorial/provincial Duration: short-term Frequency: once Magnitude: unknown Probability: high Significance: beneficial, not evaluated
Remediation				
All Activities	• Accidental release of fuels or hazardous materials	• ERPs • EPPs and EMPs • Refer also Section 5.1.4	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local to regional depending on spill size and location Duration: short to long-term depending on spill size and location Frequency: N/A Magnitude: low to high depending on spill size and location Probability: low Significance: insignificant
	• Training and employment opportunities • Procurement opportunities for camp and equipment supply	• Funding for training will be available. • Aboriginal benefits package will award bonus points to companies that propose higher levels of Aboriginal employment and sub-contracting opportunities. • Minimum Aboriginal employment content provisions • Minimum Aboriginal contracting content provisions	• No cumulative adverse effects identified.	Sensitivity of the Area: high Direction: positive Scope: territorial/provincial Duration: short-term Frequency: once Magnitude: unknown Probability: high Significance: could be significant, beneficial, not evaluated further

Table 20. Assessment of Impacts and Effects on Socio-Economics

Project Component/Activity	Potential Impact	Mitigation	Cumulative Effects	Residual Impact
Upset Conditions				
Potential for spills	• Accidental release of fuels or hazardous materials	• ERPs • EPPS and EMPs • Refer also to Section 5.1.4	• No cumulative adverse effects identified	Sensitivity of the Area: high Direction: negative Scope: local - regional depending on spill size and location Duration: short - long-term depending on spill size and location Frequency: N/A Magnitude: low - high depending on spill size and location Probability: low Significance: insignificant

Summary of Socio-Economic Related Issues:

The proposed remediation activities will result in benefits for Aboriginal people through training, employment and procurement opportunities. INAC's contracting provisions allow for up to 2% of the value of the contract to be used for training purposes. In addition, INAC uses and Aboriginal benefits package during the proposal evaluation process which awards bonus points to companies that propose higher levels of Aboriginal employment and sub-contracting (PWGSC, pers.comm., 2008).

The proposed remediation activities will not affect any land use activities as there are no individuals or groups that currently use the island from the closest communities of Chisasibi and Sanikiluaq. Remediation activities on Bear Island will provide economic development opportunities through training, employment and procurement. Employment opportunities provide positive economic benefit through skills acquisition and work experience. Some of the possible employment opportunities that were highlighted during the public meeting in Chisasibi, Quebec on February 20, 2008 included:

- Equipment operators;
- Mechanics;
- Surveyors;
- Trades;
- Labourers;

- Cooks/Housekeepers;
- Wildlife Monitors;
- Interpreters;
- Health and Safety Officer; and
- Sampling Scientist.

Potential business opportunities that may arise from the project will exist primarily in the areas of camp and equipment supply. Overall, the proposed remediation activities will result in positive benefits to the communities which are involved in the remediation activities through the supply of personnel as well as goods and services required during the project. Individuals in the communities of Chisasibi, Quebec and Sanikiluaq, Nunavut will likely benefit through training, employment and procurement opportunities and related economic benefits.

Issues related to impacts from potential spills will be dealt with by ERPs (refer also to Section 5.0), and EPPs and EMPs. Nearby communities will be made aware of the remediation activities and potential spills if there is an occurrence.

Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.4 MITIGATION AND RESIDUAL EFFECTS SUMMARY

The majority of mitigative measures can be achieved through the development and implementation of the following documents:

- EPPs;
- EMPs that will provide Best Management Practices (BMPs);
- ERPs that include Spill Contingency Plans; and
- supplementary documents (i.e. Safety in Polar Bear Country)

With the implementation of mitigation measures and project design strategies, potential adverse effects of the proposed project will be adequately managed and adverse residual effects are not expected to occur. Considerations of potential sensitive environments that have been identified will also be incorporated into the design of the future remedial program for the site to ensure that potential landfills or borrow areas are not sited in sensitive environments.

Residual environmental effects are those that remain after mitigation measures have been factored into the analysis. A significant residual effect is defined as any permanent, non-mitigable change in an identified VEC. The Impact Assessment completed in Section 4.3 resulted the following conclusions:

1. There are no cumulative adverse affects for any of the VECs.
2. There were no significant residual impacts for any of the VECs.
3. There were two instances where significance was unknown and both were related to climate change for aquatic resources and water quality, and the marine environment.
4. There were a number of beneficial impacts identified.

After implementation of the remediation plan, long-term monitoring requirements are expected to be minimal. Overall, the project will result in a positive impact to Bear Island and the project VECs.

5.0 MALFUNCTIONS AND ACCIDENTS

Malfunctions and accidents are of concern for the remediation project as they may result in adverse effects. Malfunctions and accidents for this project are related to the following:

- worker health and safety;
- wildlife;
- weather; and
- accidental spills of contaminants to the environment.

5.1 MITIGATIVE MEASURES

5.1.1 Worker Health and Safety

A Health and Safely Plan (HASP) will be prepared by the contractor for the project. Under government contracting policies and guidelines, contractors must abide by health and safety regulations and ensure the safety of their employees through adequate training and awareness programs, and by providing appropriate safety equipment and safe working conditions. The HASP will include bear safety training, archaeological awareness training, and training on working in potentially adverse weather conditions. Consideration will also be given for ensuring that site personnel have appropriate provisions and fuel supplies in the event of prolonged blizzard conditions. Proper handling procedures will be implemented and hazardous materials are to be containerized for shipment off-site. Implementation and adherence to an appropriate HASP should result in no residual effects to worker health and safety.

5.1.2 Wildlife

Refer to Section 5.4.

5.1.3 Weather

As part of the Project design a number of features will be considered to minimize the potential for adverse effects of weather on the Project. These measures include:

5.1.3.1 Extreme Weather Conditions

- Dimensioning stormwater management systems for low frequency storm events (1 in 100 year, 24 hour (hr), and rain events. This measure will consider information provided by Environment Canada http://climate.weatheroffice.ec.gc.ca/prods_servs/index_e.html) as well as the latest research on the potential for the increased frequency of such events.
- Consideration of additional storm water volumes.
- Implementation of ESCP during all phases.
- Proper scheduling of Project activities, i.e., ensuring surface water management infrastructure is in place before the start of large excavation and earth works.
- Development and implementation of an Operations Plan that defines weather conditions during which land–based project activities (e.g., crane operation for loading and unloading) will be restricted or no longer permitted.

5.1.3.2 Extreme Marine Conditions

- Monitoring of site-specific (i.e. beach loading/unloading area) oceanographic conditions to generate site-specific design parameters that may be required.
- Detailed design of marine activities on the basis of existing marine data and modeling of potential (extreme) oceanographic conditions (wave height, currents, water levels, ice pressure).
- Development and implementation of Operations Plan that defines weather conditions at which marine project activities will no longer be permitted and vessels will be required to vacate.
- Monitoring of weather and marine conditions.
- Routine communication between approaching vessels and land personnel including briefing on site-specific weather / marine conditions.

5.1.4 Accidental Spills

Spills are generally short term events that may result during re-fuelling of equipment or due to vehicle accidents (equipment spills). Soil, vegetation, the aquatic environment, and wildlife habitat have the potential to be impacted at the spill site. Liquids may coat the leaves of herbaceous plants and mosses, preventing photosynthesis and temporarily resulting in reduced plant health or mortality, and/or may directly burn or have immediate toxic effects on plants. Contaminants may also adversely affect soil quality, reducing the potential for plant growth. Changes in vegetation characteristics in turn may reduce the affected area's value as wildlife habitat. However, in terrestrial areas, spills are likely to be very localized in extent and associated with remediation areas.

Spills may occur near waterways or along slopes, and enter the aquatic environment affecting water quality, aquatic vegetation, invertebrates and other wildlife at the immediate site and to downstream areas. Impacts to the aquatic environment would largely depend on the type and volume of contaminants involved, flow conditions of the watercourse.

Spill containment and remediation will occur in accordance with a Spill Contingency Plan (the Plan) prepared by the contractor for the project. The Plan will include all measures designed to mitigate accidental releases of contaminants during remediation activities. Overall, the potential effects of spills are likely negligible in the long term due to the low probability of occurrence, the small area involved, containment of most spills following implementation of the Plan, the temporary nature of impact, and the high potential for remediation.

5.2 CONCLUSION

Following implementation of the mitigation measures discussed above, there are no anticipated residual effects.

5.3 GENERAL EMERGENCY RESPONSE PLAN (ERP)

An ERP, including a spill contingency plan, has been developed and included in Appendix C. These plans provide a prescribed course of action to be followed in the case of unanticipated events during the RAP and include:

1. Fuel or chemical spills.
2. Potentially dangerous wildlife encounters.
3. Discovery of heritage resources.

The plans will enable persons in a particular contingency situation to maximize the effectiveness of the environmental response and meet all regulatory requirements for reporting to the appropriate authorities. The plans also describe the locations where hydrocarbons (fuel) and spill response equipment will be stored at the site.

6.0 IMPACTS OF THE ENVIRONMENT ON THE PROJECT

6.1 EXTREME WEATHER

The implementation of a remediation project in a remote southern Arctic environment such as at Bear Island presents unique logistical issues. The seasonal work conditions limit the time allowed for winter and summer remediation activities.

Extreme weather, such as rainfall events, early or late snowfall events, high winds and fog can impede construction progress through work stoppages and difficult working conditions. These delays may include work stoppage on-site or delays in the transportation of personnel and supplies to and from the island. Ice may delay marine transport to and from the site. Conditions related to the Arctic climate, such as ice and frozen ground may also delay clean up activities. Clean up activities which are best completed at maximum thaw may be delayed depending on seasonal climate changes.

Although adverse weather conditions are relatively common in this northern environment, it is expected that the selected remediation contractor will be familiar with the site specific conditions and adequately prepared to perform the required measures to ensure the proposed project proceeds, including construction scheduling incorporating allowances for adverse weather. However, due to the relatively short duration of the project there is minimal potential for adverse environmental conditions to affect the proposed remediation activities.

6.2 LANDFORM INSTABILITY

Unstable lands in the Bear Island study area are generally infrequent and lacking in severity compared to projects which occur on landscapes with steeper terrains. However, the potential for small slides or subsidence to disrupt remediation activities in areas of greater relief still exists.

Mitigation of the potential for landslides and subsidence includes route selection to avoid areas of greater landslide risk, and implementation of engineering and design BMPs. Instability will be identified during remediation and a geotechnical engineering specialist will be consulted to recommend any monitoring or remedial action.

The occurrence of landslides has the potential to induce additional erosion and/or sediment releases into aquatic environments. Geotechnical input and constraint-based design will be required during detail design to address potential issues with the project as it relates to landform instability.

7.0 CUMULATIVE IMPACTS

7.1 IDENTIFICATION OF CUMULATIVE ENVIRONMENTAL EFFECTS

Cumulative effects, the combined effect of unrelated existing, proposed, and foreseeable future activities, were assessed for the project, as required under CEAA. Cumulative effects can occur as interactions between project components (either from the same or more than one site) and/or between environmental components. Effects can occur in one of four ways:

- physical or chemical transport mechanisms;
- nibbling loss (i.e., gradual disturbance);
- special or temporal crowding; and
- growth induction initiated by the project.

Effects considered in the cumulative effects assessment were based largely on the results of the residual impact assessment for each biophysical resource and socio-economic factors and the potential for spatial and/or temporal overlap with other projects. Residual impacts constituted project-related effects remaining following mitigation (where required, and where feasible) of identified project impacts. Residual impacts that were neutral or negligible were considered not to contribute to cumulative effects, and therefore were not included in the assessment. Potential cumulative effects are assessed only for those environmental components likely to sustain an adverse residual effect as a result of the proposed project.

7.2 SCOPING

The proposed remediation of the Bear Island site includes the remaining infrastructure, non-hazardous waste, hazardous waste, and contaminated soils. Additionally, a landfill will be constructed, and sealift will be used to transport hazardous waste and hydrocarbon and metal contaminated soil off-site. A temporary camp and waste handling facility will also be established on the Island to facilitate the identification and separation of waste streams.

At the time of report preparation, the proposed physical remediation program was estimated to take approximately 6 months over an 18-month period, which includes mobilization, remediation, demobilization as well as the disposal of hazardous materials off-site.

7.3 ASSESSMENT

The remediation activities will initially disturb the existing terrain and environmental conditions of the Island. However, given the limited environmental footprint of the sites and the removal and disposal of contaminated soil and hazardous waste, it is expected that the overall impact of the remediation works will be positive. In the long term the remediation project facilitates the return of soil, water and vegetation and wildlife habitat to natural conditions.

Due to the limited time frame of the project it is not expected that it will contribute significantly to the cumulative environmental effects of other land use activities in the local area.

Remediation of the Bear Island site will have an overall positive affect on the environment and mitigation strategies will be implemented to avoid and/or reduce potential project-related impacts.

7.4 MITIGATION

The remediation works will be implemented by following the mitigation measures contained within this report and BMPs that, when implemented, will effectively mitigate potential impacts on the environment.

Due to the remoteness and isolated location of Bear Island and the sensitivity of the surrounding environment, care will be taken to ensure that the project does not impact or alter the landscape or marine environment outside of the remediation areas.

7.5 RESIDUAL EFFECTS AND SIGNIFICANCE

The remediation of the Bear Island sites is not expected to result in any negative residual or cumulative effects expected with respect to the current and foreseeable activities in the project area. The remediation will have a positive effect on the environment through the demolition of deteriorating buildings, the removal of hazardous materials, the land filling of non-hazardous debris, the contouring of the site to mitigate erosion, and the long term restoration of the site to restore habitat to one that is similar to what was present before site construction.

The contribution of the effects of the remediation activities at the site are therefore assessed as being positive and not significant.

8.0 MONITORING AND FOLLOW-UP

Project and long term monitoring of remediation activities will be conducted to confirm compliance with the remediation objectives and criteria. During the remedial activities, quantities of all site materials will be estimated, tracked and measured. Excavated areas of contamination will be confirmed clean by field screening methods and samples will be taken for laboratory confirmation.

It will be necessary to ensure that an appropriate water quality monitoring program is developed and executed. If future monitoring reveals exceedances, it will be necessary for contingency measures to be implemented. These contingency measures should be considered in this plan and could include the appropriately treatment of any discharges to ensure compliance. As the existing dumps will be excavated, long term monitoring of these areas will not be required. However, the newly constructed non-hazardous landfill will be inspected visually (see below).

During the first five years after remediation, visual monitoring at all constructed landfills will be conducted at least once a year, preferably in mid-August. This visual inspection will look for any settling, ponding, erosion or frost action that may have occurred. The performance of the landfill cover, if any, should also be monitored over time. Climate change, increased precipitation and wind erosion may cause degradation and limit effectiveness. If there are signs of instability such that buried material becomes exposed, then remedial action will be implemented. Finally, the establishment of vegetation and the impacts on the integrity of the cover material should be monitored.

After five full years post-remediation monitoring a summary of all of the monitoring data collected will be prepared and a comprehensive assessment of the performance of the remediation work against the objectives, and a recommendation for an on-going monitoring program, be made at that time. If no additional issues are identified during this initial monitoring, the frequency of the program frequency will be reduced, with monitoring occurring in post-remediation years 7, 10, 15 and 25. The monitoring program will be re-evaluated after 25 years.

9.0 CONSULTATION

9.1 PUBLIC CONSULTATION

A community meeting was held in Chisasibi, Quebec on February 20, 2008. The purpose of the meeting was to introduce the community to the proposed remediation project and the draft RAP (Earth Tech, 2008a). The presentation also included an overview of the AIA and potential employment and procurement opportunities likely to be associated with the project. Forty-six (46) people attended the meeting and translation services were provided.

Key issues raised during the community meeting focused on:

- site contamination from leaking oil drums;
- proposed venting of gas cylinders;
- length of time it has taken to have the site cleaned up;
- Sanikiluaq's involvement;
- potential for Bear Island to be part of the Cree Land claims negotiations;
- knowledge of Cree usage of the Island limited to a visit to the island in 1964 to gather materials to build the residential school at Fort George (former location of Chisasibi); and
- remediation of other sites in Quebec, in particular, that at Cape Jones.

Overall, there were no key concerns raised related to the draft RAP or the project in general (Earth Tech, 2008a).

9.2 AGENCY CONSULTATION

Officials from various agencies government departments were contacted in an effort to introduce the project and to discuss VEC selection as well as potential concerns and approval requirements. The following agencies and Federal and Territorial Government Departments were contacted:

- Nunavut Impact Review Board;
- Nunavut Water Board;
- Government of Nunavut, Department of the Executive and Intergovernmental Affairs;
- Government of Nunavut, Department of the Environment;
- Indian and Northern Affairs Canada;
- Fisheries and Oceans Canada;
- Environment Canada; and
- Sanikiluaq Hunters and Trappers Organization.

The Hunters and Trappers Organization (HTO) was contacted in Sanikiluaq to determine whether or not the community had any information on traditional land use or information about wildlife on Bear Island. No additional information was obtained, however, according to the Chair of the HTO, the community is very interested in future employment opportunities as machinery operators, labourers and wildlife monitors.

10.0 CONCLUSIONS

This proposed project for the abandoned Bear River Mid-Canada Line Radar Station, located on Bear Island, Nunavut will result in the remediation of a current contaminated site. Project activities will include the removal of contaminated soils and hazardous waste, and demolition and removal of site infrastructure and non-hazardous waste resulting in restoration of the site to near pre-disturbance conditions.

The effects of the project activities on the identified VECs have been assessed as not significant or as positive. Positive effects of project activities are outcomes from both environmental and socio-economic perspectives. Overall, the resulting restoration will improve the environment and consequently a potentially important culture feature of this area.

11.0 REFERENCES

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11.1 Record of Contacts

11.1.1 Government and Wildlife Agencies

Lucassie Arragutainuq, Chair of Sanikiluaq HTO and Chair Nunavut Impact Review Board. By phone July 30, 2008. Subject: Traditional Land Use by people from Sanikiluaq, information on wildlife, and employment (the community would be very interested in future employment opportunities as machinery operators, labourers and wildlife monitors).

Spencer Dewar, Manager of Lands INAC, Nunavut Regional Office - by phone on 24 June. Subject: VEC selection, regulatory environment

Lisa Dyer, Environmental Specialist, Indian and Northern Affairs Canada. By e-mail September 2, 2008. Subject: groundwater information.

Dionne Filiatrault, Executive Director, Nunavut Water Board. By e-mail June 27, 2008, Subject: Water Licensing.

Gregor Hope, Wildlife Technician, Government of Nunavut, Pond Inlet tel 867 899 8876. By Phone on 23 June 2008. Subject: Wildlife baseline data.

Amy Liu, Habitat Biologist, DFO.By phone July 2, 2008. Subject: Permit requirements, VEC selection and baseline data.

Savana Levenson, EA Specialist, Environment Canada. By phone July 15, 2008. Subject: VEC and issue identification

William Mackay, Legal Counsel, GN Executive and Intergovernmental Affairs. By email on 12, 24 & 25 June. Subject: Regulatory environment.

Leslie Payette, Nunavut Impact Review Board- By phone on June 25. Subject: VEC selection, EA format/requirements

Elizabeth Peacock, Polar Bear Biologist, Government of Nunavut –By phone on June 25. Subject: Possible knowledge on bear populations

Julie Ross, Chief Archaeologist, Government of Nunavut Department of Culture Language Elders and Youth. By phone August 28, 2008. Subject: Reporting requirements for archaeological and heritage resource finds of Nunavik Land Claim Agreement.

Amy Sparks, Contaminated Sites Officer, Environment Canada. By phone July 30, 2008. Subject: VEC Selection, Species at Risk , and environment protection issues.

Mark Yetman, Contaminated Sites Project Manager, Indian and Northern Affairs Canada. By email 19, 24 June & July 21. Subject: Issues surrounding land claims and the regulatory environment.

11.1.2 Socio-Economic

Agency	Contact	Date	Type of Contact	Issues Discussed
Government of Nunavut	G. Hope, Wildlife Technician	June 23, 2008	Telephone	Wildlife baseline data
Indian and Northern Affairs Canada	M. Yetman, Contaminated Sites Project Manager	June 19 & 24, 2008 July 21, 2008	E-mail	Issues surrounding land claims, regulatory environment
Indian and Northern Affairs Canada	S, Dewar, Manager of Lands	June 24, 2008	Telephone	VEC selection, regulatory environment
Nunavut Impact Review Board	L. Payette	June 25, 2008	Telephone	VEC Selection, EA format/requirements
Government of Nunavut	E. Peacock, Polar Bear Biologist	June 25, 2008	Telephone	Polar bear populations
Government of Nunavut	W. Mackay, Legal Counsel	June 12, 24 & 25, 2008	E-mail	Regulatory environment
Department of Fisheries and Oceans	A. Liu, Habitat Biologist	July 2, 2008	Telephone	Permit requirements, VEC selection, baseline data
Environment Canada	S. Levenson, EA Specialist	July 15, 2008	Telephone	VEC and issue identification
Sanikiluaq Hunters and Trappers Organization	L. Arragutainaq	July 30, 2008	Telephone	Traditional land use, wildlife, employment opportunities
Government of Nunavut	J. Ross, Chief Archeologist	August 28, 2008	Telephone	Heritage resource reporting requirements of Nunavik Land Claim Agreement

FIGURES

Source:
PWGSC, 2001

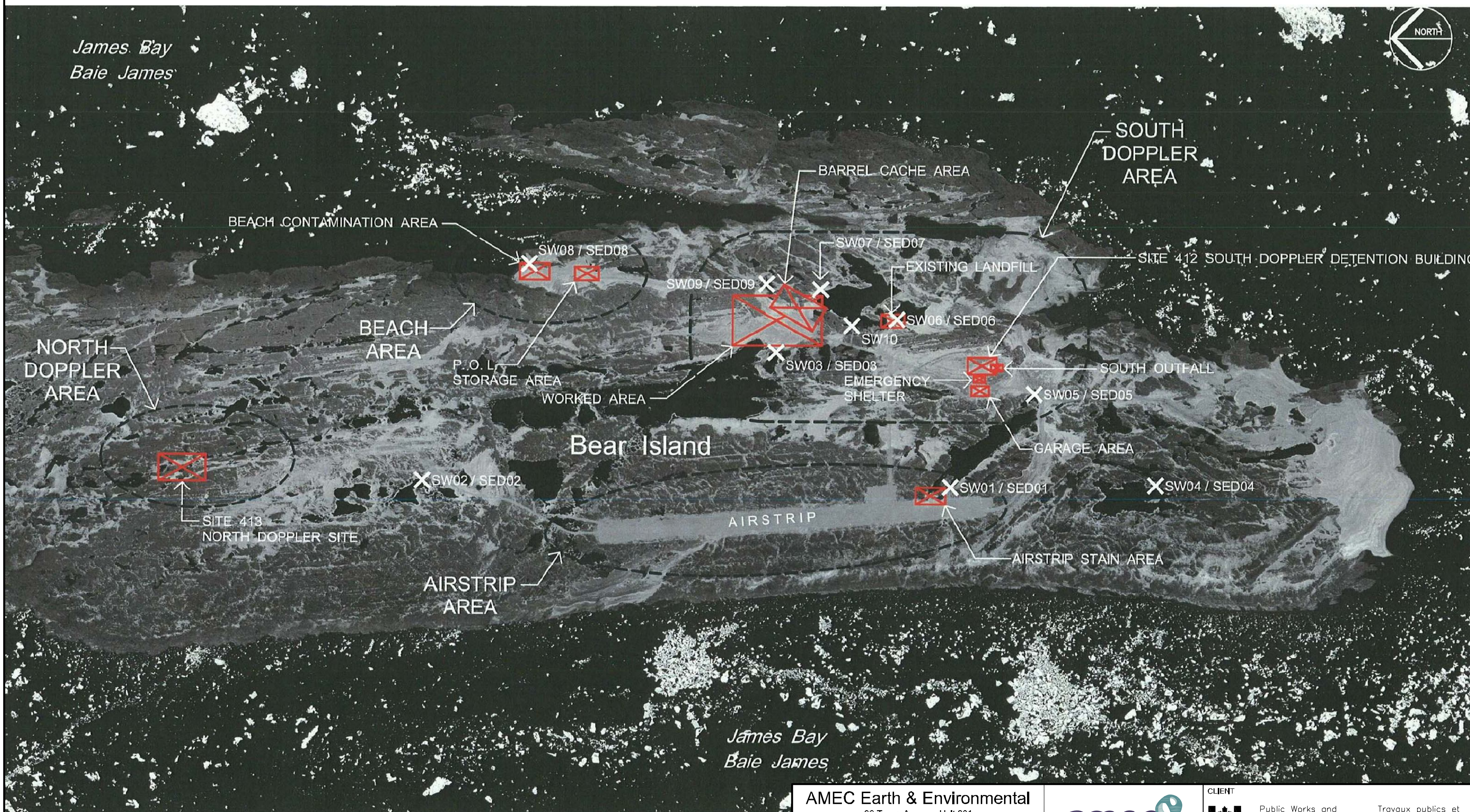
AMEC Earth & Environmental
32 Troop Avenue, Unit 301
Dartmouth Ns B3B 1Z1
(P)902-468-2848 (F) 902-468-1314

CLIENT

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

PROJECT Bear Island Remedial Action Plan Assessment	DWN BY: DS	DATUM: N/A	DATE: August 2008
	CHK'D BY: N/A	REV. No.: 0	PROJECT No. EE26279
TITLE Bear Island General Location	PROJECTION: N/A	SCALE: NTS	FIGURE No. Figure 1



Source:
Earth Tech, 2008b

AMEC Earth & Environmental 32 Troop Avenue, Unit 301 Dartmouth Ns B3B 1Z1 (P)902-468-2848 (F) 902-468-1314	amec	CLIENT Public Works and Government Services Canada / Travaux publics et Services gouvernementaux Canada

PROJECT	DWN BY:	DATUM:	DATE:
Bear Island Remedial Action Plan Assessment	N/A	N/A	August 2008
	CHK'D BY: N/A	REV. NO.: 0	PROJECT NO: EE26279
TITLE: Bear Island Site Layout	PROJECTION: N/A	SCALE: N.T.S.	FIGURE No. Figure 2

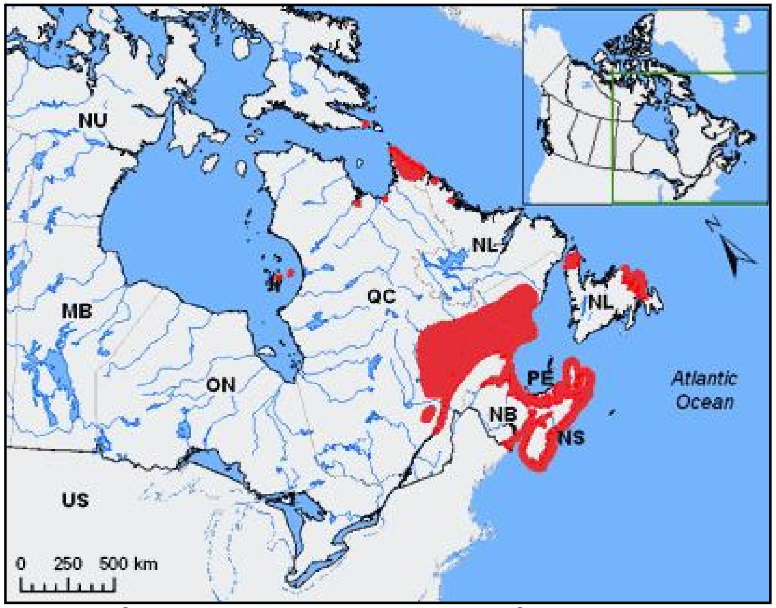


Figure 3. Canadian Distribution of Barrow's Goldeneye (Eastern population)
Source: SARA, 2008b

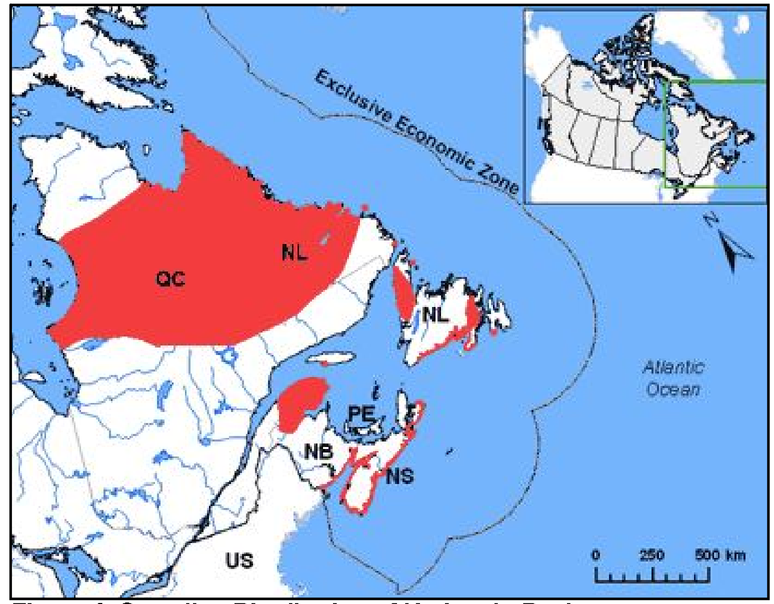


Figure 4. Canadian Distribution of Harlequin Duck (Eastern population)
Source: SARA, 2008b

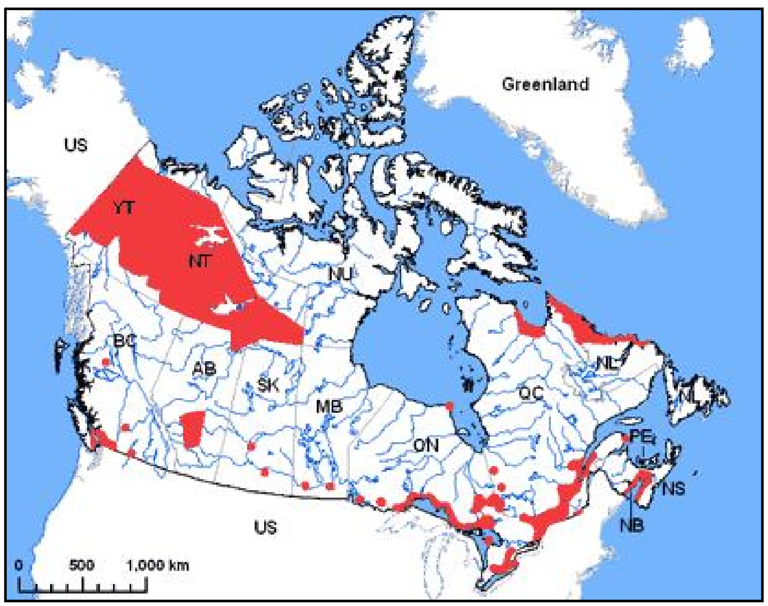


Figure 5. Distribution of Perigrine Falcon
Source: SARA, 2008b

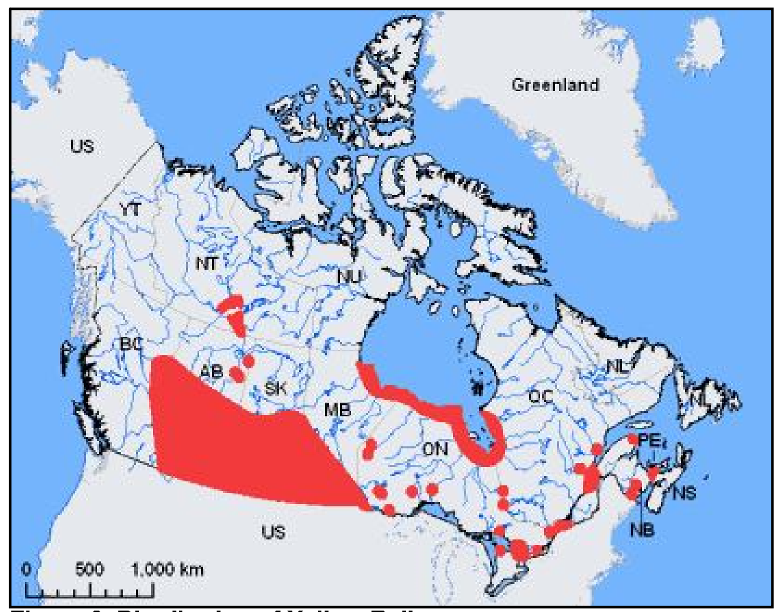


Figure 6. Distribution of Yellow Rail
Source: SARA, 2008b

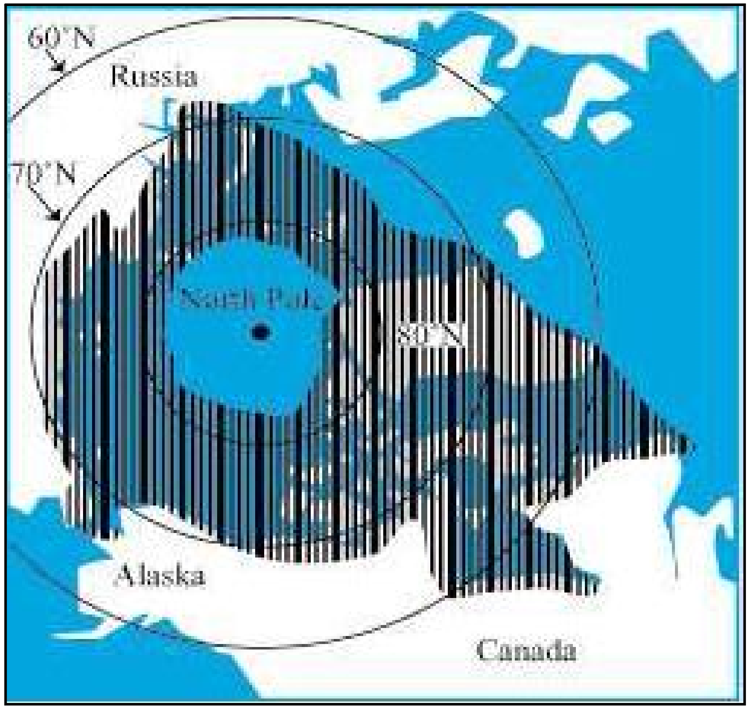


Figure 7. Distribution of Polar Bear
Source: CWS/CWF, 2008

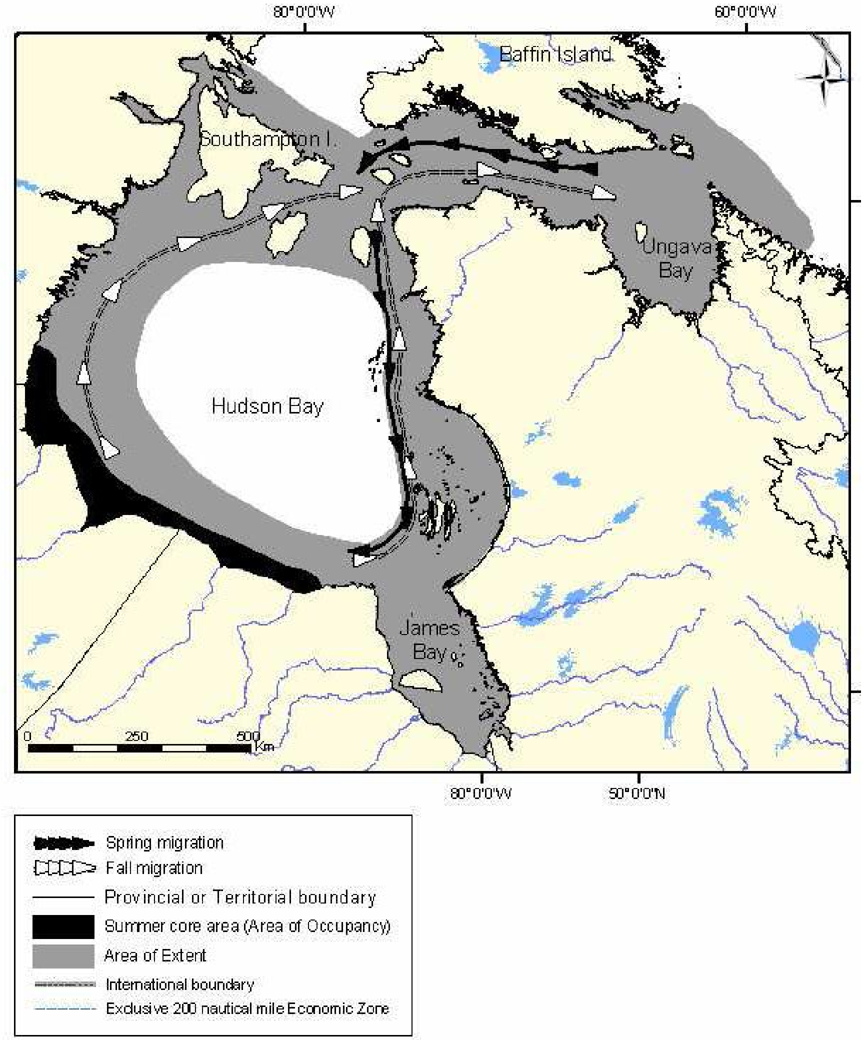


Figure 8. Distribution of Beluga Whale (Western Hudson Bay population)
Source: COSEWIC, 2004

Figure 9. North American distribution of Rusty Blackbird during breeding (light grey) and wintering (dark grey) seasons.
Source: COSEWIC, 2006
Note: The species also winters regularly within the dotted area.

APPENDIX A

COSEWIC and SARA Listed Species for Nunavut
and
Category Descriptions for IUCN Red List, SARA, COSEWIC and Global Rankings

1 – IUCN RED LIST CATEGORIES

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the

possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

2 – SARA CATEGORIES

ENDANGERED: a wildlife species that is facing imminent extirpation or extinction.

EXTIRPATED: a wildlife species that no longer exists in the wild in Canada, but exists elsewhere in the wild.

SPECIES OF SPECIAL CONCERN: a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.

THREATENED: a wildlife species that is likely to become an endangered species if nothing is done to reverse the factors leading to its extirpation or extinction.

NOT AT RISK: determined to be not at risk

NO STATUS: insufficient information to determine a status category

3 – COSEWIC CATEGORIES

EXTINCT: Species that no longer exists

ENDANGERED: Species is facing imminent extirpation or extinction

EXTIRPATED: Species that no longer exists in the wild in Canada, but occurs elsewhere

THREATENED: Species is likely to become endangered if limiting factors are not reversed

SPECIAL CONCERN: Species has characteristics that make it particularly sensitive to human activities or natural events

NOT AT RISK: Species that has been evaluated and found to be not at risk

DATA DEFICIENT: Species for which there is insufficient information to designate a status

4 – GLOBAL RANKINGS

G1: *Critically* Imperiled - At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2: *Imperiled* - At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3: *Vulnerable* - At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.

G4: *Apparently Secure* - Uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5: *Secure* - Common; widespread and abundant.

Table A1. COSEWIC and SARA Listed Species for Nunavut

Common Name	*Latin Name*	Population	COSEWIC Status	SARA Schedule[1]	SARA Status
American Black Bear	*Ursus americanus*		Not at Risk		
American Coot	*Fulica americana*		Not at Risk		
Atlantic Walrus	*Odobenus rosmarus rosmarus*		Special Concern	No schedule	No Status
Bald Eagle	*Haliaeetus leucocephalus*		Not at Risk		
Barren-ground Caribou	*Rangifer tarandus groenlandicus*	Dolphin and Union population	Special Concern	No schedule	No Status
Beluga Whale	*Delphinapterus leucas*	Cumberland Sound population	Threatened	No schedule	No Status
Beluga Whale	*Delphinapterus leucas*	Eastern Hudson Bay population	Endangered	No schedule	No Status
Beluga Whale	*Delphinapterus leucas*	Eastern High Arctic - Baffin Bay population	Special Concern	No schedule	No Status
Beluga Whale	*Delphinapterus leucas*	Western Hudson Bay population	Special Concern	No schedule	No Status
Beluga Whale	*Delphinapterus leucas*	Southeast Baffin Island-Cumberland Sound population	Non-active	Schedule 2	Endangered
Boreal Owl	*Aegolius funereus*		Not at Risk		
Canada Lynx	*Lynx canadensis*		Not at Risk		
Common Loon	*Gavia immer*		Not at Risk		
Eskimo Curlew	*Numenius borealis*		Endangered	Schedule 1	Endangered
Felt-leaf Willow	*Salix silicicola*		Special Concern	Schedule 1	Special Concern
Fourhorn Sculpin	*Myoxocephalus quadricornis*	Freshwater form	Data Deficient	Schedule 3	Special Concern
Golden Eagle	*Aquila chrysaetos*		Not at Risk		
Grizzly Bear	*Ursus arctos*	Northwestern population	Special Concern	No schedule	No Status
Gyrfalcon	*Falco rusticolus*		Not at Risk		
Harbour Seal Atlantic and Eastern Arctic subspecies	*Phoca vitulina concolor*		Not at Risk		
Harlequin Duck	*Histrionicus histrionicus*	Eastern population	Special Concern	Schedule 1	Special Concern
Ivory Gull	*Pagophila eburnea*		Endangered	Schedule 1	Special Concern
Merlin	*Falco columbarius*		Not at Risk		
Northern Goshawk *atricapillus* subspecies	*Accipiter gentilis atricapillus*		Not at Risk		
Northern Grey Wolf	*Canis lupus occidentalis*		Not at Risk		
Northern Harrier	*Circus cyaneus*		Not at Risk		
Peary Caribou	*Rangifer tarandus pearyi*	High Arctic population	Non-active	Schedule 2	Endangered
Peary Caribou	*Rangifer tarandus pearyi*	Low Arctic population	Non-active	Schedule 2	Threatened
Peary Caribou	*Rangifer tarandus pearyi*		Endangered	No schedule	No Status
Peregrine Falcon anatum subspecies	*Falco peregrinus anatum*		Non-active	Schedule 1	Threatened

Table A1. COSEWIC and SARA Listed Species for Nunavut

Common Name	*Latin Name*	Population	COSEWIC Status	SARA Schedule[1]	SARA Status
Peregrine Falcon anatum/tundrius	*Falco peregrinus anatum/tundrius*		Special Concern	No schedule	No Status
Peregrine Falcon tundrius subspecies	*Falco peregrinus tundrius*		Non-active	Schedule 3	Special Concern
Polar Bear	*Ursus maritimus*		Special Concern	No schedule	No Status
Porsild's Bryum	*Mielichhoferia macrocarpa*		Threatened	No schedule	No Status
Red Knot islandica subspecies	*Calidris canutus islandica*		Special Concern	No schedule	No Status
Red Knot rufa subspecies	*Calidris canutus rufa*		Endangered	No schedule	No Status
Red-necked Grebe	*Podiceps grisegena*		Not at Risk		
Red-tailed Hawk	*Buteo jamaicensis*		Not at Risk		
Ross's Gull	*Rhodostethia rosea*		Threatened	Schedule 1	Threatened
Rough-legged Hawk	*Buteo lagopus*		Not at Risk		
Rusty Blackbird	*Euphagus carolinus*		Special Concern	No schedule	No Status
Sharp-shinned Hawk	*Accipiter striatus*		Not at Risk		
Short-eared Owl	*Asio flammeus*		Special Concern	Schedule 3	Special Concern
Snowy Owl	*Bubo scandiaca*		Not at Risk		
Tyrrell's Willow	*Salix tyrrellii*		Not at Risk		
Wolverine	*Gulo gulo*	Western population	Special Concern	No schedule	No Status
Yellow-billed Loon	*Gavia adamsii*		Not at Risk		

Source: SARA Website

Notes:

[1] The Act establishes Schedule 1, as the official list of wildlife species at risk. Schedule 1 classifies those species as being extirpated, endangered, threatened, or a special concern. Once listed, the measures to protect and recover a listed wildlife species are implemented. Species that were designated at risk by COSEWIC prior to October 1999, must be reassessed using revised criteria before they can be considered for addition to Schedule 1 of SARA. These species are listed on Schedules 2 and 3, or are not listed on any schedule, and are not yet officially protected under SARA.

APPENDIX B

Wildlife Management Plan

Implementation of a Wildlife Management Plan would ensure wildlife awareness training of the remediation work crew which would decrease the risk of disturbing local wildlife migration behaviour.

Example mitigation measures that should be considered for inclusion in such a plan are as follows:

Traffic and Equipment Management

- minimize the amount of disturbed area;
- reduce noise by use of muffled exhaust systems;
- a requirement that all diesel powered equipment meet emission guidelines;
- enforce a minimum flying altitude of 300 m above ground level for any project aircraft outside of the Project area;
- restrict vehicles to designated roads and prepared work areas (i.e., recreational use of off-road vehicles prohibited);
- establish and enforce speed limits;
- give wildlife the right-of-way;
- implement non-chemical dust suppression methods (i.e., spraying with water) on roads during the snow/ice free period;
- prohibit hunting at the site;
- minimize grading where possible;
- conduct pre-project surveys to identify wildlife sensitive locations (i.e. birds nests) and develop plans to ensure avoidance;
- promote natural vegetation regeneration following remedial activities; and
- incorporate wildlife awareness and sensitivity training for on-site personnel.

Waste Management

- educate and reinforce proper waste management practices to all workers and visitors to the site;
- implement appropriate waste management protocols, which may include burning all food wastes in an oil-fired incinerator and/or weatherproof and wildlife-resistant containers;
- eliminate attractants (e.g. food waste, oil products) at the landfill site;
- separate food waste and non-food waste at source;
- consider appropriate fencing around the landfill area;
- burn waste oil in waste-oil furnaces or take off-site for recycling;
- designate appropriate areas for worker lunch and coffee breaks;
- educate people on the risk associated with feeding wildlife and careless disposal of food garbage; and
- initiate an ongoing review of the efficacy of the waste management program and adaptive improvement.

APPENDIX C

General Emergency Response and Contingency Plan

These plans provide a prescribed course of action to be followed in the case of unanticipated events and include:

1. Fuel or chemical spills.
2. Potentially dangerous wildlife encounters.
3. Discovery of heritage resources.

1.0 SPILL CONTINGENCY PLANNING

Spills of petroleum products and other hazardous materials cannot be entirely prevented; however, the impacts can be minimized by establishing a predetermined line of response and action plan. The Government of Nunavut, Department of Environment in the document *A Guide to Spill Contingency Planning & Reporting* identifies the following requirements for spill contingency plans:

- date the contingency plan was prepared;
- name and address of the person in charge, management or control;
- name and address of the owner if different from the person in charge;
- name, job title and 24 hour telephone number for the persons responsible for activating the contingency plan;
- description of the facility including the location, size and storage capacity;
- site map that is intended to illustrate the facility's relationship to other areas that may be affected by the spill;
- description of the type and amount of fuels and chemicals normally stored on site;
- steps to be taken to report, contain, and clean up and dispose of a contaminant in the case of a spill;
- means by which the contingency plan is activated;
- description of the training provided to employees to respond to a spill; and
- an inventory and the location of response and clean up equipment available to implement the plan.

Detailed plans containing all of the above information will be required by the Nunavut Water Board as part of the water license application. These will be subject to review by regulatory agencies. The following points provide an overview of these requirements.

1.1 PLAN OBJECTIVE

The objective of a spill contingency plan is to protect the environment and human health by minimizing the impacts of spill events through clear and concise instructions to all personnel.

1.2 SITE CONTACTS

The name and contact information of the person in charge of the site and responsible for activating the spill response will be provided with the final detailed plans. However, the project manager within INAC is:

Mark Yetman
Contaminated Sites Project Manager,
Indian and Northern Affairs Canada
PO Box 2200 Iqaluit NU
X0A 0H0
Phone: (867) 975-4733
Fax: (867) 975-4736
E-mail: yetmanm@inac-ainc.gc.ca

1.3 HAZARDOUS MATERIALS STORAGE ON-SITE

A variety of fuels (diesel, gasoline and lubricating oils) may be used during the site remediation. Fuels are usually stored in either barrels of 205 liters or smaller capacity, or in double walled tanks. For either storage option it is anticipated that any spill quantity would likely be small. Transportation of fuels must comply with the *Transportation of Dangerous Goods Act* and Regulations. To prevent spreading in the event of a spill, fuel stored in drums will be located, whenever practical, in a natural depression a minimum distance of 90 feet from all streams, preferably in an area of low permeability. All fuel storage containers will be situated in a manner that allows easy access and removal of containers in the event of leaks or spills. A material safety data sheet (MSDS) will be provided for each fuel in a central location to allow for easy access in the event of a spill. Large fuel caches in excess of 20 drums should be inspected daily.

All chemicals stored on site will be stored in a safe and chemically-compatible manner a minimum of 90 feet from all bodies of water. An MSDS should be provided for each chemical and be posted in a central location; accessible by all camp personnel. Camp personnel should be conversant in the handling of these chemicals as well as able to deal with any accidents or spills.

Hazardous materials stored on-site should be marked so they will be visible under all conditions, in all seasons. This is intended to help prevent possible injuries to camp personnel and/or damage to the containers.

Site maps showing the location of storage facilities relative to areas potentially impacted by the spills will be provided in the detailed spill plans.

1.4 LOCATION OF SPILL KITS

Spill kits will be located at all fuel storage areas once determined. Kits will include a shovel, pick-axe, drums, booms, absorbent pad/sheet, disposable protective gloves/coveralls, and disposal bags. In addition other equipment commonly used during remediation projects will be available for spill response such as:

- pickup trucks;
- fuel truck;
- excavators;
- bulldozers;
- loaders;
- rock trucks and haul units;
- compaction equipment;
- large spill kits; and
- small spill kits.

Used spill clean-up materials and recovered fuels will be contained in drums and removed off-site to an appropriate disposal facility. Waste manifest documents for transportation and disposal will be obtained from the Government of Nunavut, Department of Environment.

1.5 IN THE EVENT OF A SPILL

The most common pollution incidents would probably involve spills of diesel or gasoline onto land resulting from: human error during transfer, rupture of barrels from deterioration or damage, seepage from fittings or valves, or equipment failure. Daily checking of equipment and preventative maintenance would also identify damage to the fuel system and reduce the risk of spills or leaks.

In the event of a spill, protection of human health and safety is paramount. Contamination of personnel involved in clean up is a real possibility as is contamination of the surrounding workplace and environment. The individual responding to a spill shall:

1. Ensure personnel are appropriately trained.

All employees working on the Bear Island remediation Project, including contractors and sub-contractors, will be trained in the handling of materials to help prevent and respond to hazardous material spills in a timely and effective manner. All employees on site will also be trained for initial spill response in the event of a spill. The recommended training for these purposes consists initially of the 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) course offered by various environmental firms and the 8-Hour HAZWOPER refresher course every two (2) years thereafter. The training must place special emphasis on spill response in remote arctic locations.

2. Activate the spill response team.

3. Make use of materials and equipment available for adequate response to fuel spills, such as excavators for creating earthen dykes and hydrocarbon absorbent booms.

4. Warn people in the immediate vicinity of spill occurrence.

5. Wear protective clothing as required for handling spills.

6. Shut of potential ignition sources if safe to do so.

7. Identify the spilled material if possible, and take all safety precautions before approaching it.

8. Stop the spill at source if it is safe to do so.

9. Contain the spill, if safe to do so, by implementing the Spill Response Actions summarized below taken from the INAC *Guidelines for Spill Contingency Planning*.

1.6 SPILL RESPONSE ACTIONS

Reporting

Report the spill to the Spill Report Line (see below) and follow up with a written spill report. This report shall contain the following information.

- date and time of the spill;
- location of the spill and direction the spill may be moving;
- name and phone number of a contact person close to the location of the spill;
- type of contaminant spilled and quantity spilled;
- cause of the spill;
- whether the spill is continuing or has stopped;
- description of the existing containment;
- action taken to contain, recover, clean up and dispose of spilled material;
- name, address and phone number of the person reporting the spill; and
- name of owner or person in charge, management or control of the contaminants at the time of the spill.

Refer to the following attached documents for additional information:

1. Instructions for Completing the NT-NU Spill Report Form.
2. NT-NU Spill Report Form.

Containment of Spills on Land

These types of spills generally occur during late spring, summer and fall. All measures should be taken to avoid spills reaching open water bodies. Dykes can be created using soil surrounding a spill. A plastic tarp should be placed on or at the base of the dyke to pool spilled material for removal with sorbent materials.

Trenches can also be dug provide to contain spills provided the soil is thawed. Trenches should be dug to bedrock or to permafrost which will then provide a containment layer. Spilled material can be removed using a pump or sorbent materials.

Containment of Spills on Water (Marine or Freshwater)

Spills on water are again likely to occur during the warmer months of the year. Booms should be used, released from shore, to contain the spill. A boat may be needed to contain spills away from the shore. Fuel contained within the boom must be recovered using sorbent material or pumps and placed in bags or barrels.

In streams temporary weirs can be considered made from plywood. Fuels will float on the water surface and be retained and water can pass under the weir.

For spills in the sea, immediately mobilize additional containment and clean up equipment in consultation with the Coast Guard, Environment Canada, and Fisheries and Oceans Canada if on-site equipment is inadequate. Close isolation valves to stop fuel flow, if required. Deploy lightweight booms and oil absorbent materials to protect environmental resources along the coastline, as applicable. Track the progress of the spill, if of unknown origin.

Containment of Spills on Ice

Sorbent materials should be used to soak up the spilled materials. Remaining contaminate ice can be scraped and shoveled into plastic bags.

Dykes can be used to retain spills on ice. Surrounding snow can be compacted and molded down slope from the spill. Again, traps can be used to collect the spilled liquid ant the base of the dyke and pumped into barrels or collected with sorbent materials.

For large spills where little snow is available for dyke construction, trenches can be cut into the ice down slope and around the spill.

Containment of Spills on Snow

Snow is a natural sorbent and spills can be easily recovered by raking and shoveling contaminated snow into bags or barrels. Again dykes and tarps can be used to contain large spills on snow.

1.7 KEY CONTACTS IN THE EVENT OF A SPILL

In the event of a spill, contact the 24-Hour Spill Report Line and provide all relevant details. A Nunavut/NWT Spill Report (attached) should be filled out and faxed to the spill line: **24-Hour Spill Report Line: (867) 920-8130 Fax: (867) 873-6924**

Environment Canada, as lead agency, shall then be contacted by officials to ensure the appropriate response. The lines are staffed 24 hours a day and can also be used to co-ordinate a response in the event of a non-spill emergency outside of normal working hours.

The **Environment Canada 24-hour pager (867-920-5131),** operated by Environmental Emergencies Officers should also be contacted.

Other useful contacts are listed in Table 1 below:

Table C1. Contacts in the Event of a Spill

Department	Contact	Fax and Phone Number
Nunavut/NWT Spill Line	Nunavut/NWT	867 920-8130(p) 867 873-6924 (f)
Government of Nunavut Department of Environment Environmental Protection Division	Robert Eno Manger Pollution Control Iqaluit Nunavut	867 975-7748 (p) 867 975-5990 (f)
Indian and Northern Affairs Canada – Contaminated Sites Directorate (Project Proponent)	Mark Yetman Contaminated Sites Project Manager, Indian and Northern Affairs Canada PO Box 2200 Iqaluit Nunavut	867 975-4733 (p) 867 975-4736 (f)
Indian and Northern Affairs Canada – Water Division	Kevin Buck Manager of Waters Building 918 Iqaluit Nunavut	867 975-4550 (p) 867 975-4585 (f)
Public Works and Government Services Canada	Lisa Dyer Project Manager PWGSC Yellowknife, NWT	867 766-8337(p) 867 873-5885 (f)
Environment Canada, Enforcement Branch	Curtis Didham, Environment/Emergencies Enforcement Officer, Iqaluit, NT	867 669-4700 (p)
*Canadian Coast Guard Environmental Response	Central and Arctic Region	1 800 265-0237 (p)

** For Marine spills only.*

A contingency plan check-list is attached (Attachment 3).

2.0 WILDLIFE ENCOUNTERS

2.1 BEAR-PEOPLE CONFLICTS

The RAP is in an area where polar bears may be encountered. The contactor will follow procedures outlined in the *Safety in Bear Country Manual*, and should contact the Regional Manager of Wildlife or Regional Biologist indicated below for information and advice on measures that should be taken to minimize the possibility of bear-people conflicts. Any bear sighting or interaction will be reported as soon as possible to the nearest Conservation Officer or the Regional Wildlife Biologist contacts listed in Table 2.

Table C2. Contacts for Wildlife Encounters

Name	Position	Fax and Phone Number
Seeglook Akeeagok	Regional Manager	867-979-7800 (p) 867-979-8809 (f)
Kimball Nogier	Conservation Officer (Sanikiluaq)	867-266-8098 (p) 867-266-8095 (f)
Debbie Jenkins	Regional Biologist (Pond Inlet)	867-899-8876 (p) 867-899-8024 (f)

2.2 WILDLIFE ENCOUNTER MITIGATION MEASURES

The following measures will be undertaken to avoid problematic wildlife encounters:

- Proper food handling and garbage disposal procedures will be followed to reduce the likelihood that wildlife will be attracted to the operation. Careful planning and attention to details of camp design and maintenance will decrease the attraction wildlife to the camp. The contractor will take every effort to minimize odors that potentially attract carnivores through timely housekeeping.
- Chemicals containing salts, which may attract wildlife to the site, should be stored so that they are inaccessible to wildlife.
- Operators of vehicles and equipment shall make every effort to avoid encounters with large mammals. If wildlife is present in a work area, operation of heavy equipment will be suspended until wildlife has moved away. Vehicles and noisemakers may be used if necessary to frighten the persistent problem bears away from the site.
- The killing of wildlife for any reason at variance with the *Wildlife Act* and regulations is an offence. The contractors will co-ordinate procedures for handling wildlife problems and incidents with the Government of Nunavut -Department of Environment (GN DOE) wildlife office in Iqaluit.
- Bear deterrents (cracker shells, thunder flashes and rubber bullets) will be on site.
- The shooting of problem bears will be considered an absolute last resort and will only be undertaken in consultation with GN DOE or if a bear threatens human safety. Bears will only be shot by a person familiar with and competent with the camp firearm. Wounded or otherwise aggravated bears can be extremely dangerous.
- Contractor staff will report death of a bear or any wildlife to the Field Team Leader and the appropriate wildlife officer who will issue instructions as to the disposal of the carcass, samples to be collected and the formal reporting procedures to be followed.
- Due to the possibility of rabies, any animal that bites a human will be shot and the carcass retained intact pending instructions from the appropriate wildlife officer. If possible, notify the wildlife officer before any drastic action is taken. Seek medical advice from the appropriate medical facility for treatment of animal inflicted wounds.
- Dedicated wildlife monitors should be employed at all times.
- The use of electric fences, especially around sleeping quarters will be considered.

3.0 HERITAGE RESOURCES

Archaeological investigations have confirmed the presence of heritage resources/sites on Bear Island. In Nunavut such sites are protected by law. Section 5 of the Nunavut Archeological and Paleontological Site Regulations state that:

> "No *person shall excavate, alter or otherwise disturb an archaeological site, or remove an archaeological artifact from an archaeological site, without a Class 2 permit*."

Consequently, all site personnel are prohibited from knowingly disturbing any archaeological or other heritage site or collecting any artifacts. Removing artifacts is also a criminal offence under Section 3 of these regulations.

In the event of finding any heritage resources including fossils, artifacts, archeological remains the following rules will apply:

- do NOT remove any artifacts or other associated objects from the site unless the integrity of the object/artifact is threatened in any way;
- mark the site's visible boundaries and avoid the area; and
- report the discovery of the site to the Archaeology Division of the Government of Nunavut Department of Culture Language Elders and Youth and the Avataq Cultural Institute to the following contacts:

  Julie Ross
  Chief Archeologist
  Box 310, Igloolik,
  Nunavut, X0A 0L0
  Tel 867 934 2040
  Email:jross@gov.nu.ca

  Daniele Jendron
  Avataq Cultural Institute
  215 Redfern Street, Suite 400
  Westmount, Quebec H3Z 3LS
  Tel 514 274 1166 ext. 266

Reports of all archaeological finds shall include:

- the identity of the person making the discovery;
- a description of the site location, including topography, landmarks, etc.;
- the nature of the activity resulting in the discovery;
- a description of the archaeological site, including size, features, or visible details, supplemented by sketches or photographs;
- actions currently undertaken to protect the archaeological features; and
- any extenuating circumstances.

3.1 Human Remains

In the event of a discovery of human remains:

- advise the nearest detachment of the RCMP of the discovery. The RCMP will make the decision as to whether the territorial coroner or archaeological department should be contacted;
- halt all activities around the area of discovery. Until determined otherwise, the remains should be treated as evidence in a criminal investigation. If the remains are found in the bucket of heavy equipment, the bucket should not be emptied, as physical evidence may be destroyed;
- secure the area and designate it as out of bounds to all personnel;
- depending on weather conditions, the human remains should be provided with non-intrusive protection such as a cloth or canvas tarp (non-plastic preferred);

- document the discovery; and
- do not resume activities in the vicinity of the find until confirmations and direction from the Department of Culture Language Elders and Youth and Avataq Cultural Institute is received.

ATTACHMENT 1

Instructions for Completing the NT-NU Spill Report Form

This form can be filled out electronically and e-mailed as an attachment to spills@gov.nt.ca. Until further notice, please verify receipt of e-mail transmissions with a follow-up telephone call to the spill line. Forms can also be printed and faxed to the spill line at 867-873-6924. Spills can still be phoned in by calling collect at 867-920-8130.

Section		Required Information
A	Report Date/Time	The actual date and time that the spill was reported to the spill line. If the spill is phoned in, the Spill Line will fill this out. **Please do not fill in the Report Number**: the spill line will assign a number after the spill is reported.
B	Occurrence Date/Time	Indicate, to the best of your knowledge, the exact date and time that the spill occurred. Not to be confused with the report date and time (see above).
C	Land Use Permit No./Water License No.	This only needs to be filled in if the activity has been licensed by the Nunavut Water Board and/or if a Land Use Permit has been issued. Applies primarily to mines and mineral exploration sites.
D	Geographic Place Name	In most cases, this will be the name of the city or town in which the spill occurred. For remote locations – outside of human habitations – identify the most prominent geographic feature, such as a lake or mountain and/or the distance and direction from the nearest population center. **You must include the geographic coordinates** (Refer to Section E).
E	Geographic Co-ordinates	This only needs to be filled out if the spill occurred outside of an established community such as a mine site. Please note that the location should be stated in degrees, minutes and seconds of Latitude and Longitude.
F	Responsible Party or Vessel Name	This is the person who was in management/control/ownership of the substance at the time that it was spilled. In the case of a spill from a ship/vessel, include the name of the ship/vessel. Please include full address, telephone number and email. Use box K if there is insufficient space. **Please note that, the owner of the spilled substance is ultimately responsible for any spills of that substance, regardless of who may have actually caused the spill.**
G	Contractor Involved?	Were there any other parties/contractors involved? An example would be a construction company who is undertaking work on behalf of the owner of the spilled substance and who may have contributed to, or directly caused the spill and/or is responding to the spill.
H	Product Spilled	Identify the product spilled; most commonly, it is gasoline, diesel fuel or sewage. For other substances, avoid trade names. Wherever possible, use the chemical name of the substance and further, identify the product using the four digit UN number (eg: UN1203 for gasoline; UN1202 for diesel fuel; UN1863 for Jet A & B)
I	Spill Source	Identify the source of the spill: truck, ship, home heating fuel tank and, if known, the cause (eg: fuel tank overfill, vandalism, storm, etc.). Provide an estimate of the extent of the contaminated/impacted area (eg: 10 m^2)
J	Factors Affecting Spill	Any factors which might make it difficult to clean up the spill: rough terrain, bad weather, remote location, lack of equipment. Do you require advice and/or assistance with the cleanup operation? Identify any hazards to persons, property or environment: for example, a gasoline spill beside a daycare centre would pose a safety hazard to children. Use box K if there is insufficient space.

Section		Required Information
K	Additional Information	Provide any additional, pertinent details about the spill, such as any peculiar/unique hazards associated with the spilled material. State what action is being taken towards cleaning up the spill; disposal of spilled material; notification of affected parties. If necessary, append additional sheets to the spill report. Number the pages in the same format found in the lower right hand corner of the spill form: eg. "Page 1 of 2", "Page 2 of 2" etc. **Please number the pages to ensure that recipients can be certain that they received all pertinent documents.** If only the spill report form was filled out, number the form as "Page 1 of 1".
L	Reported to Spill Line by:	Include your full name, employer, contact number and the location from which you are reporting the spill. Use box K if there is insufficient space.
M	Alternate Contact	Identify any alternate contacts. This information assists regulatory agencies to obtain additional information if they cannot reach the individual who reported the spill.
N	Report Line Use	(leave blank)

ATTACHMENT 2

NT-NU Spill Report

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR	REPORT NUMBER -
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME	☐ UPDATE # TO THE ORIGINAL SPILL REPORT	
C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)		
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM THE NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR		
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS		
F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION		
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION		
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER	
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES	
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT	
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS			

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION **Station operator**	EMPLOYER	LOCATION CALLED **Yellowknife, NT**	REPORT LINE NUMBER **(867) 920-8130**

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC | SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN | FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

ATTACHMENT 3

Contingency Plan Checklist

Contingency Planning and Spill Reporting in Nunavut:
Contingency Plan Check List

- ❑ ***The date the contingency plan was prepared.***

- ❑ ***The name and address of the person in charge, management or control.*** This is an on-site person responsible for managing the facility. This person would be initially responsible for clean up activities.

- ❑ ***The name and address of the owner if different from the person in charge.*** This is the person ultimately responsible for the facility, usually the owner.

- ❑ ***The name, job title and 24 hour telephone number for the persons responsible for activating the contingency plan.*** This ensures the employee discovering the spill can activate a response and provides a 24 hour point of contact for the authority investigating the spill.

- ❑ ***A description of the facility including the location, size and storage capacity.*** This is important if persons are unfamiliar with the facility or area. The description could include a map and/or diagrams.

- ❑ ***A site map that is intended to illustrate the facilities relationship to other areas that may be affected by the spill.*** The map should be to scale and be large enough to include the location of your facility, nearby <u>buildings</u> or facilities, <u>roads</u>, <u>culverts</u>, <u>drainage patters</u>, and any nearby bodies of <u>water</u>.

- ❑ ***A description of the type and amount of fuels and chemicals normally stored on site.***

  <u>FUEL STORAGE</u>
  -This would include chemical names, volumes, and weights of the contaminants, and storage methods.
  - To prevent spreading in the event of a spill, fuel stored in drums should be located, whenever practical, in a natural depression a minimum distance of 90 feet from all streams, preferably in an area of low permeability.
  -All fuel storage containers should be situated in a manner that allows easy access and removal of containers in the event of leaks or spills. Large fuel caches in excess of 20 drums should be inspected daily.

  <u>CHEMICAL STORAGE</u>
  -All chemicals should be stored in a safe and chemically-compatible manner a minimum of 90 feet from all bodies of water.
  -Material safety data sheets (MSDS) should be provided for each chemical and be posted in a central location; accessible by all camp personnel. Camp personnel should be conversant in the handling of these chemicals as well as able to deal with any accidents or spills.

- ***The steps to be taken to report, contain, and clean up and dispose of a contaminant in the case of a spill***.
    a) ***Reporting***: Notification of all parties involved. This can include internal and external reporting procedures as well as a copy of the spill report.
    b) ***Clean up***: Removal of the contaminant from the environment, a detailed of actual containment and clean up techniques. (2 steps: contain and remediate; be aware of fire)
    c) ***Disposal*****:** Is the treatment of the contaminant such that it is no longer a threat to the environment. Plans may include location of disposal sites approved to accept wastes, means of storage prior to disposal and other approvals required. (Waste Manifest doc)

- ***The means by which the contingency plan is activated.*** This should outline internal company procedures to activate appropriate response equipment and personnel.

- ***A description of the training provided to employees to respond to a spill.*** A sound training program is necessary when dealing with an emergency situation

- ***An inventory and the location of response and clean up equipment available to implement the plan.*** This includes your equipment as well as any to be used by another person responding to the spill on your behalf.
  SPILL KIT (FUEL)
  Shovel, pick-axe, drums, booms, absorbent pad/sheet, disposable protective gloves/coveralls, sorbent, containment, disposal bags etc.

Also: A list of local contractors or clean up specialists who may be called upon to assist in responding to spills. A list of emergency numbers such as fire, ambulance and police.

APPENDIX 8:

BEAR ISLAND
PRELIMINARY SPILL CONTINGENCY PLAN

PRELIMINARY CONTINGENCY PLANS

Bear Island
Mid-Canada Line Radar Station
Remediation Project

Submitted by:	Department of Indian Affairs and Northern Development Northern Affairs Program Nunavut Regional Office
Prepared by:	Public Works and Government Services Canada Real Property Services Architectural & Engineering Services Environmental Services Western Region

June, 2008

1 GENERAL

1.1 The following contingency plans present the prescribed course of action to be followed in the case of unanticipated events during the site remediation such as fuel or chemical spills, potentially dangerous wildlife encounters, and the discovery of heritage resources. The plans will enable persons in a particular contingency situation to maximize the effectiveness of the environmental response and meet all regulatory requirements for reporting to the appropriate authorities. The plans also describe the locations where hydrocarbons (fuel) and spill response equipment will be stored at the site.

1.2 In addition, measures will be implemented, within the Contractor's Site Specific Contingency Plans, to prevent spill events. This includes, but is not limited to, the use of preventative measures such as secondary containment for all fuel storage areas and the use of designated fuelling areas to minimize impact to the surrounding region.

1.3 Spill contingency plans for the site will be included in the Contractor's Site Specific Contingency Plans and will be posted on-site during the remediation. The following information will be included:

1. a description of pre-emergency planning;
2. personnel roles, lines of authority and communication;
3. emergency alerting and response procedures;
4. evacuation routes and procedures, safe distances and places of refuge;
5. emergency alerting and response procedures;
6. directions/methods of getting to the nearest medical facility;
7. emergency decontamination procedure;
8. emergency medical treatment and first aid;
9. emergency equipment and materials;
10. emergency protective equipment;
11. procedures for reporting incidents; and
12. spill response and containment plans for all materials that could potentially be spilled.

2 FUEL AND HAZARDOUS MATERIAL SPILLS

2.1 The objective of the fuel-related contingency plan is to protect the environment and human health by minimizing the impacts of spill events through clear and concise instructions to all personnel.

2.2 A variety of fuels (diesel, gasoline and lubricating oils) may be used during remediation activities on-site. As fuels are usually stored and transferred in barrels of 205 litres or smaller capacity, any quantity spilled would likely be small.

2.3 Transportation of fuels must comply with the *Transportation of Dangerous Goods Act and Regulations.*

2.4 The most common pollution incidents would probably involve spills of diesel or gasoline onto land resulting from: human error during transfer, rupture of barrels from deterioration or damage, seepage from fittings or valves, or equipment failure. Daily checking of equipment and preventative maintenance would also identify damage to the fuel system and reduce the risk of spills or leaks.

2.5 In the event of a spill, protection of human health and safety is paramount. The potential for employees to come in contact with contamination is a real possibility as is contamination of the surrounding workplace and environment.

The individual responding to a spill shall:

1. Ensure personnel are appropriately trained.
    a. All employees working on the Bear Island Mid-Canada Line Radar Station Remediation Project, including contractors and sub-contractors, will be trained in the safe operation of all machinery and tools, as well as in the handling of materials to help prevent and respond to hazardous material spills in a timely and effective manner. In addition employees will be trained in the proper fuelling, oiling and greasing protocols to minimize the chance of a spill occurrence. All employees on site will also be trained for initial spill response in the event of a spill.
2. Make use of materials and equipment available for adequate response to fuel spills, such as excavators for creating earthen dykes and hydrocarbon absorbent booms.
3. Warn people in the immediate vicinity and evacuate the area if necessary.
4. Wear protective clothing as required for handling spills.
5. Isolate and eliminate all ignition sources.
6. Identify the spilled material if possible, and take all safety precautions before approaching it.
7. Attempt to immediately stop the leakage and contain the spill, if safe to do so, by implementing the Spill Response Actions summarized on the following page.
8. Report to the Field Team Leader the spill location, type of material, volume and extent, status of spill (direction of movement), and prevailing meteorological conditions.
9. Follow all applicable federal/territorial regulations and guidelines or the disposal of spill materials.
10. Document all events and actions taken. Include information required by applicable regulations and guidelines.
11. Notify appropriate government agencies using the contact list. Report spills immediately on the 24-Hour Spill Report Line (867) 920-8130.

Petroleum Hydrocarbon
- SPILL RESPONSE ACTIONS –

ON LAND
- Do not flush into ditches or drainage systems.
- Block entry into waterways and contain with earth, snow or other barrier.
- Remove small spills with sorbent pads.
- On tundra use peat moss and leave in place to degrade, if practical.

ON SNOW & ICE
- Block entry into waterways and contain with snow or other barrier.
- Remove minor spills with sorbent pads and/or snow.
- Use ice augers and pump to recover diesel under ice.
- Slots in ice can be cut over slow moving water to contain oil.
- Burn accumulated diesel from the surface using Tiger Torches if feasible and safe to do so.

ON MUSKEG
- Do not deploy personnel and equipment on marsh or vegetation.
- Remove pooled diesel with pumps and skimmers.
- Flush with low pressure water to herd diesel to collection point.
- Burn only in localized areas, e.g., trenches, piles or windrows.
- Do not burn if root systems can be damaged (low water table).
- Minimize damage caused by equipment and excavation.

ON WATER
- Contain spill as close to release point as possible.
- Use spill containment boom to concentrate slicks for recovery.
- On small spills, use sorbent pads to pick up contained oil.
- On larger spills, use skimmer on contained slicks.
- Do not deploy personnel and equipment onto mudflats or into wetlands

RIVERS & STREAMS
- Prevent entry into water, if possible, by building berm or trench.
- Intercept moving slicks in quiet areas using (sorbent) booms.
- Do not use sorbent booms/pads in fast currents and turbulent water.

3 WILDLIFE ENCOUNTER

3.1 Preventative measures will be implemented to minimize probability of encounters. This includes, but is not limited to, keeping the site clean through the incineration, encapsulation or removal of wastes from site as soon as possible following generation.

3.2 Bears are a potential hazard to workers at all times and the situation can be exacerbated by the presence of any substance that a bear perceives to be food.

3.3 Employ dedicated wildlife monitors at all times during Remediation operations.

3.4 Be familiar with bear deterrent procedures. Be familiar with the GNWT "Safety in Bear Country" manual and make available a reference copy at the site.

3.5 Operators of vehicles and equipment shall make every effort to avoid encounters with large mammals. Congregations of animals near food or garbage are a potential problem, which can be overcome by proper disposal of food wastes. Concentrations of scavenging animals, such as wolves, foxes and bears, increase the risk of diseases, particularly rabies, and danger to personnel. The following precautions and actions are to be taken at each site:

1. The killing of wildlife for any reason at variance with the Wildlife Act and regulations is an offence. Co-ordinate procedures for handling wildlife problems and incidents with the regional Nunavut wildlife office.
2. Use vehicle, noisemakers and, if necessary, a firearm to frighten the bear away from the site.
3. Shoot the bear only if the bear returns repeatedly, refuses to leave or directly threatens human safety. Killing is considered a last resort and, if at all possible, the appropriate wildlife officer should be contacted to alert them of the problem. If a bear is to be shot, assign the task only to a person familiar with and competent with the camp firearm. Wounded or otherwise aggravated bears can be extremely dangerous.
4. Report the death of a bear to the Field Team Leader and the appropriate wildlife officer who will issue instructions as to the disposal of the carcass and the formal reporting procedures to be followed.
5. Due to the possibility of rabies, shoot any animal that bites a human and retain the carcass intact pending instructions from the appropriate wildlife officer. If possible, notify the wildlife officer before any drastic action is taken. Seek medical advice from the appropriate medical facility for treatment of animal inflicted wounds.

4 HERITAGE RESOURCES

4.1 All site personnel are prohibited from knowingly disturbing any archaeological or other heritage site or collecting any artefacts. Removing artefacts is a criminal offence.

4.2 In the event of finding heritage resources:

1. Do NOT remove any artefacts or other associated objects from the site unless their integrity is threatened in any way.
2. Mark the site's visible boundaries and avoid the area.
3. Report the discovery of the site to the appropriate regulatory agency.
4. Document the discovery.

4.3 In the event of a discovery of human remains:

1. Advise the PMO of the discovery and they will contact the nearest detachment of the RCMP. The RCMP will make the decision as to whether the territorial coroner or archaeological department should be contacted.
2. Halt all activities around the area of discovery. Until determined otherwise, the remains should be treated as evidence in a criminal investigation. If the remains are found in the bucket of heavy equipment, the bucket should not be emptied, as physical evidence may be destroyed.
3. Secure the area and designate it as out of bounds to all personnel.
4. Depending on weather conditions, the human remains should be provided with non-intrusive protection such as a cloth or canvas tarp (non-plastic preferred).
5. Document the discovery.

5 KEY CONTACT LIST

5.1 24-Hour Spill Report Line

1. In the event of a spill, contact the 24-Hour Spill Report Line and provide them with all the relevant details.
   Telephone: (867) 920-8130
   Fax: (867) 873-6924
2. Environment Canada, as lead agency, shall then be contacted by officials to ensure the appropriate response. The lines are staffed 24 hours a day and can also be used to co-ordinate a response in the event of a non-spill emergency outside of normal working hours.

5.2 Other Contacts

1. In the event of a non-spill emergency (e.g. related to wildlife, fisheries, heritage resource, etc.), contacts are provided in Table 1.

Table 1: Contact List

Internal Resource	Contact	Phone Number Fax Number
Indian and Northern Affairs Canada	Mark Yetman Contaminated Sites Project Manager Iqaluit, Nunavut	(867) 975-4733 (867) 975-4736
Public Works & Government Services Canada	Lisa Dyer Project Manager Yellowknife, Northwest Territories	(867) 766-8377 (867) 873-5885

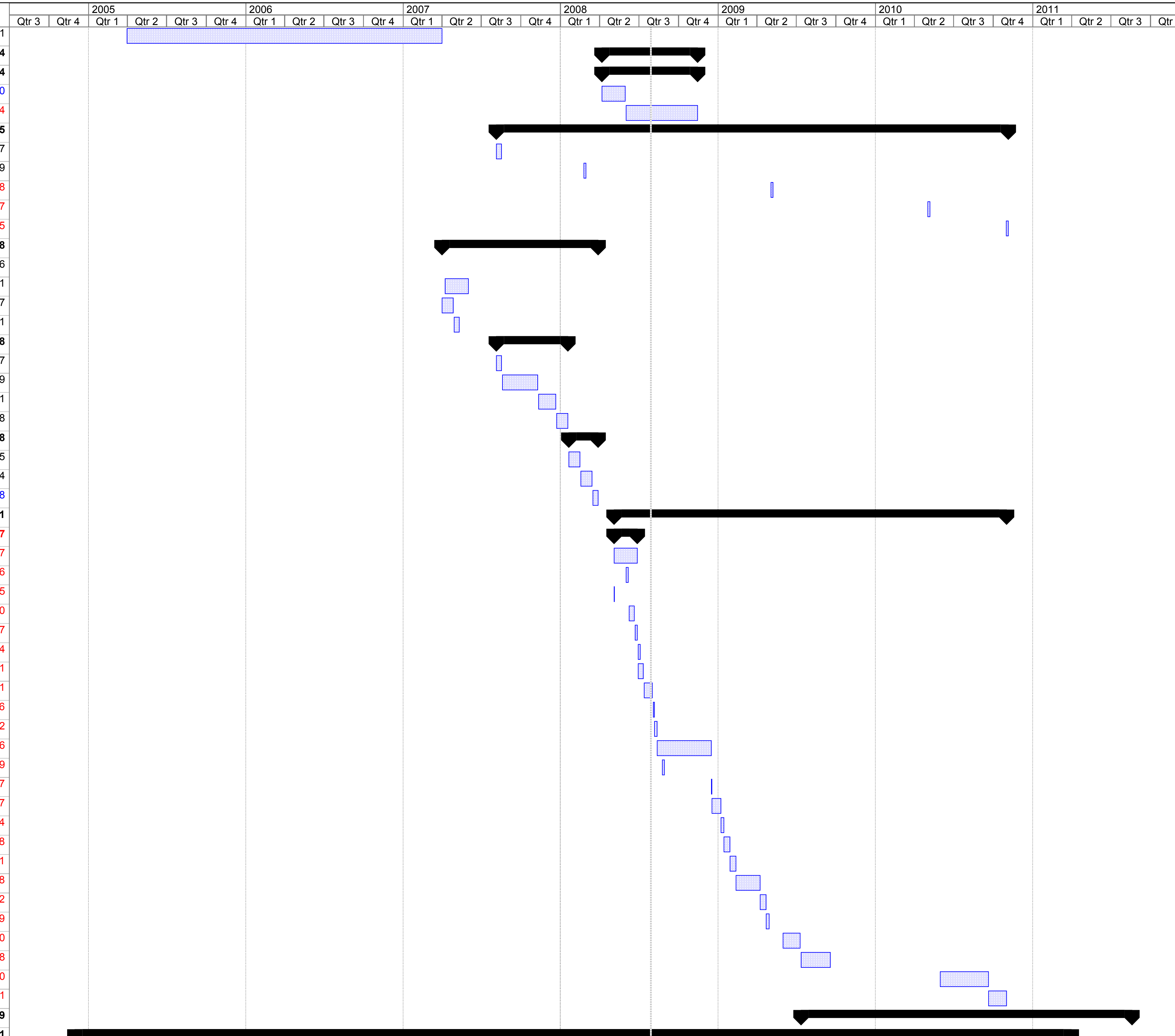
External Resource	Contact	Phone Number Fax Number
24 Hour Spill Line	NWT/Nunavut Spills Report	(867) 920-8130 (867) 873-6924
Iqaluit Fire Department	Tim Hinds Fire Marshall Iqaluit, Nunavut	(867) 975-5310 (867) 979-4221
Environment Canada	Curtis Didham Enforcement Officer Iqaluit, Nunavut	(867) 975-4644 (867) 975-4594
Indian and Northern Affairs Canada	Carl McLean Director, Operations Iqaluit, Nunavut	(867) 975-4546 (867) 975-4560
Government of Nunavut	Rob Eno Manager, Pollution Prevention Iqaluit, Nunavut	(867) 975-7748 (867) 975-5990

APPENDIX 9:

BEAR ISLAND
PROJECT SCHEDULE

BEAR ISLAND MID-CANADA LINE RADAR STATION REMEDIATION PROJECT

ID	Task Name	Duration	Start	Finish
1	**1 Care and Maintenance**	521 days	Fri 05-04-01	Sun 07-04-01
2	**2 Regulatory Approvals**	**160 days**	**Mon 08-04-07**	**Fri 08-11-14**
3	**2.1 Land and Water Use Permit for Site Restoration**	**160 days**	**Mon 08-04-07**	**Fri 08-11-14**
4	2.1.1 Prepare documents	40 days	Mon 08-04-07	Fri 08-05-30
5	2.1.2 Regulatory Review	120 days	Mon 08-06-02	Fri 08-11-14
6	**3 Consultation**	**850 days**	**Mon 07-08-06**	**Fri 10-11-05**
7	3.1 During Phase III ESA	10 days	Mon 07-08-06	Fri 07-08-17
8	3.2 Presentation of Phase III Results & Draft RAP	5 days	Mon 08-02-25	Fri 08-02-29
9	3.3 Pre-Construction Community Meeting	5 days	Mon 09-05-04	Fri 09-05-08
10	3.4 Mid-Construction Community Meeting	5 days	Mon 10-05-03	Fri 10-05-07
11	3.7 Post-Construction Community Meeting	5 days	Mon 10-11-01	Fri 10-11-05
12	**4 Site Investigation and Assessment**	**260 days**	**Mon 07-04-02**	**Fri 08-03-28**
13	4.1 Background Review	5 days	Mon 07-04-02	Fri 07-04-06
14	4.2 Gap Analysis for Phase III ESA and Engineering	40 days	Mon 07-04-09	Fri 07-06-01
15	4.3 Develop TOR for all site assessment	20 days	Mon 07-04-02	Fri 07-04-27
16	4.4 Obtain Contracts for Site Assessment	10 days	Mon 07-04-30	Fri 07-05-11
17	**4.5 Site Assessment**	**120 days**	**Mon 07-08-06**	**Fri 08-01-18**
18	4.5.1 Conduct Site Assessment	10 days	Mon 07-08-06	Fri 07-08-17
19	4.5.2 Complete Draft Repor	60 days	Mon 07-08-20	Fri 07-11-09
20	4.5.3 Report Review	30 days	Mon 07-11-12	Fri 07-12-21
21	4.5.4 Finalize Reporting	20 days	Mon 07-12-24	Fri 08-01-18
22	**4.6 RAP Development and Cost Estimates**	**50 days**	**Mon 08-01-21**	**Fri 08-03-28**
23	4.6.1 RAP Development	20 days	Mon 08-01-21	Fri 08-02-15
24	4.6.2 Internal Review	20 days	Mon 08-02-18	Fri 08-03-14
25	4.6.3 Finalize RAP	10 days	Mon 08-03-17	Fri 08-03-28
26	**5 Site Remediation**	**651 days**	**Mon 08-05-05**	**Mon 10-11-01**
27	**5.1 Prepare Site Remediation Tender documents for site restoration**	**40 days**	**Mon 08-05-05**	**Fri 08-06-27**
28	5.1.1Retain Consultant to prepare spec documents	40 days	Mon 08-05-05	Fri 08-06-27
29	5.1.2 Have Contracting review 66% spec documents	5 days	Mon 08-06-02	Fri 08-06-06
30	5.1.3 Submit Form 9200	1 day	Mon 08-05-05	Mon 08-05-05
31	5.2 DIAND Review of tender documents	10 days	Mon 08-06-09	Fri 08-06-20
32	5.3 Tender document edits	5 days	Mon 08-06-23	Fri 08-06-27
33	5.4 Prepare and submit RMP and PAAA	5 days	Mon 08-06-30	Fri 08-07-04
34	5.5 Procurement Plan Review and Approval	10 days	Mon 08-06-30	Fri 08-07-11
35	5.6 Contracting Services Procurement Plan	15 days	Mon 08-07-14	Fri 08-08-01
36	5.6 Provide Advanced Notification to Land Claims Offices	3 days	Mon 08-08-04	Wed 08-08-06
37	5.7 Post RFP on MERX	4 days	Thu 08-08-07	Tue 08-08-12
38	5.8 Tender Period	90 days	Wed 08-08-13	Tue 08-12-16
39	5.9 Bidder's Conference / Site Visit	5 days	Mon 08-08-25	Fri 08-08-29
40	5.10 Tender close	1 day	Wed 08-12-17	Wed 08-12-17
41	5.11 Bid Evaluation	15 days	Thu 08-12-18	Wed 09-01-07
42	5.12 Make Recommendation to INAC to Award	5 days	Thu 09-01-08	Wed 09-01-14
43	5.13Clarification and negotiation with proposed Contractor	10 days	Thu 09-01-15	Wed 09-01-28
44	5.14 Prepare contract request and regional approval documents	10 days	Thu 09-01-29	Wed 09-02-11
45	5.15 Approval to award (over $10 million with PAAA & GST)	40 days	Thu 09-02-12	Wed 09-04-08
46	5.16 Obtain documents from Contractor	10 days	Thu 09-04-09	Wed 09-04-22
47	5.17 Contract Award	5 days	Thu 09-04-23	Wed 09-04-29
48	5.18 Mobilization	30 days	Mon 09-06-01	Fri 09-07-10
49	5.19 Construction Activities (Year 1)	50 days	Mon 09-07-13	Fri 09-09-18
50	5.20 Construction Activities (Year 2)	80 days	Tue 10-06-01	Mon 10-09-20
51	5.21 Demobilization	30 days	Tue 10-09-21	Mon 10-11-01
52	**6 Monitoring Activities**	**550 days**	**Mon 09-07-13**	**Fri 11-08-19**
57	**7 Project Management**	**1652 days**	**Wed 04-12-01**	**Thu 11-03-31**



Project: Work Program Schedule
Date: Mon 08-07-28

Task	Milestone	Rolled Up Task	Rolled Up Progress	External Tasks	Group By Summary
Progress	Summary	Rolled Up Milestone	Split	Project Summary	

APPENDIX 10:

BEAR ISLAND
ARCHAEOLOGICAL IMPACT ASSESSMENT

Golder Associates Ltd.

1000, 940 6th Avenue S.W.
Calgary, Alberta, Canada T2P 3T1
Telephone (403) 299-5600
Fax (403) 299-5606

FINAL REPORT

ARCHAEOLOGICAL IMPACT ASSESSMENT (AIA) OF THE FORMER MID-CANADA LINE RADAR SITE, BEAR ISLAND, NUNAVUT (SUPPLY ARRANGEMENT EO211-054107/006/NCS)

Submitted to:

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
Nunavut Permit No. 2007-035A

DISTRIBUTION:

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March 2008 **07-1328-0011**

CREDITS

Project Director	Grant Clarke, M.A.
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Senior Review	D'Arcy Green, M.A.
Client Contacts	Lisa Dyer Project Support Officer Public Works and Government Services Canada 5th Floor, Telus Plaza North 10025 Jasper Avenue Edmonton, AB. T5J 1S6

EXECUTIVE SUMMARY

During August of 2007, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) on behalf of Public Works and Government Services Canada (PWGSC/INAC) for the Former Mid-Canada Line Radar Site Project on Bear Island, Nunavut. All required fieldwork was completed under an Archaeological Permit (2007-035A) issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut, to David Blower of Golder.

The former Mid-Canada Line Radar Station is located on Bear Island at the mouth of James Bay. The remote location is of interest as it may have served as a strategic stop-off point during prehistoric times as well as a critical radar station during more recent times. Low-level aerial reconnaissance of the island was conducted in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential.

Lack of vegetation and sedimentation on the island enabled surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not fully examined, but several areas had been previously identified by the project team for confirmation of their status as heritage resources. Upon closer examination, each of the aforementioned locations proved to be of insufficient age to be deemed archaeological in nature. However, a single heritage resource site was identified during the program, and is documented as per the Nunavut Archaeological and Palaeontological Sites Regulations.

By conducting this AIA, it is recommended that PWGSC/INAC has fulfilled the requirements of the current program in their attempts to identify the potential for impact to heritage resources through the remedial reclamation of the former Mid-Canada Line Radar Station at Bear Island. The AIA of Bear Island included the participation of William Atsynia from the local community of Wemindji, who acted as bear monitor and participated in the identification and recordation of the heritage resource site.

As the investigations of the AIA identified a heritage resource, GbHg 1, it is recommended that avoidance of that resource be required during the remediation process. All other suspected heritage resources have been refuted as described in this report. However, while not meeting the technical requirements to be classified as heritage resources, they are cultural markers of a recent occupation as described in this report, which do not affect the remediation process and as such, it is also recommended that efforts to avoid interfering with them be considered if possible.

Additionally, a community meeting was held in Chisasibi, Quebec, on February 20, 2008 which resulted in very little discussion on the heritage resources of Bear Island. Community members were informed that a buffer of 20 m had been placed around one new site identified on the island.

It is recommended that PWGSC/INAC have met their obligations to assess the potential for impact to heritage resources on Bear Island due to the remediation of the former Mid-Canada Line Radar Site. It is also recommended that, with the avoidance of the newly identified site, GbHg 1, no impacts will occur to the heritage resources of Bear Island through implementation of this program.

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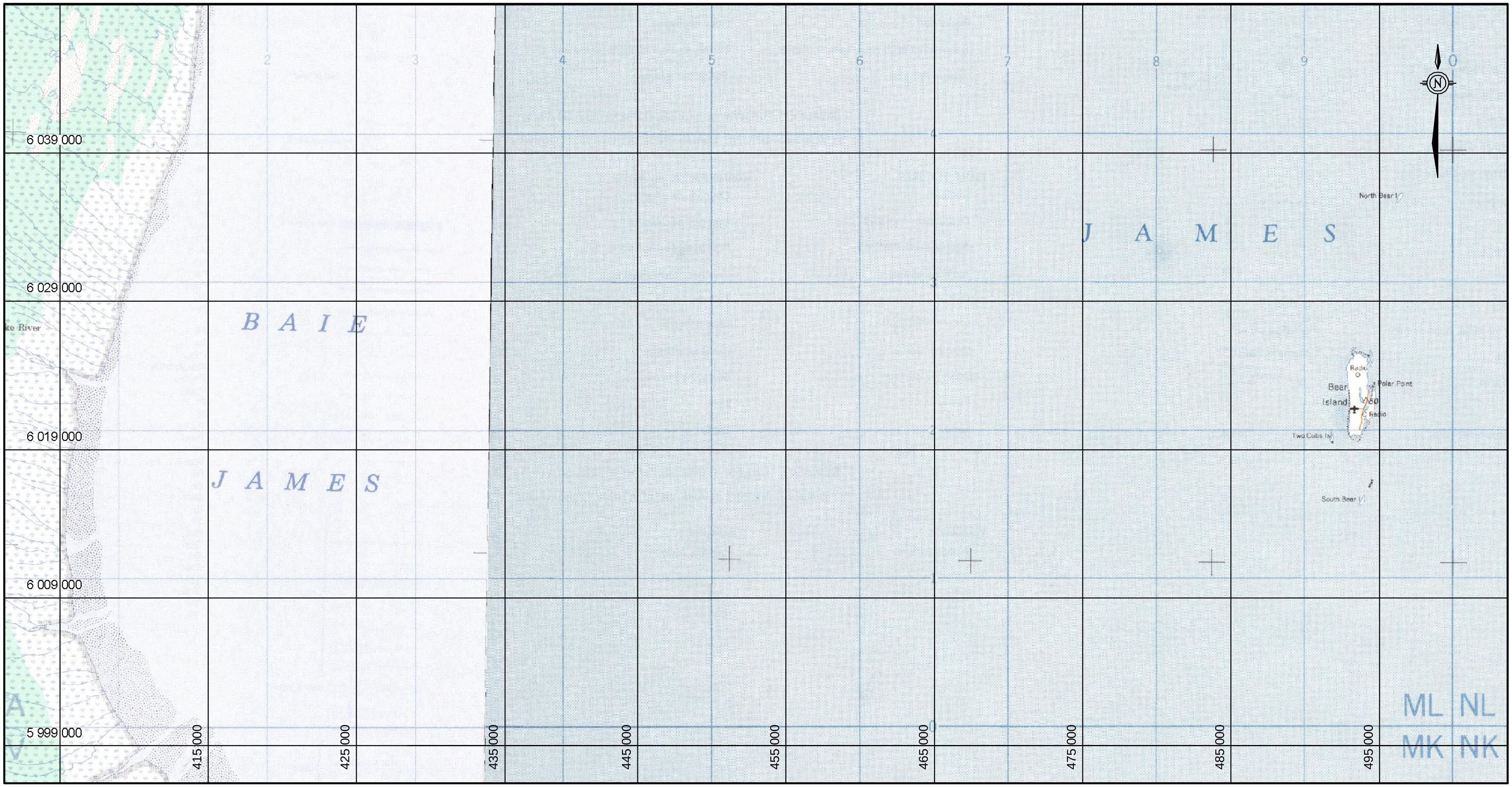
1. INTRODUCTION

In August of 2007, Golder Associates Ltd. (Golder) conducted an Archaeological Impact Assessment (AIA) on behalf of Public Works and Government Services Canada and Indian and Northern Affairs Canada (PWGSC/INAC), for the Former Mid-Canada Line Radar Site Project on Bear Island, Nunavut (Figures 1 and 2). All required fieldwork was completed under Archaeological Permit 2007-035A issued by the Department of Culture, Language, Elders and Youth (CLEY), Nunavut to David Blower.

Low-level aerial reconnaissance of the island was initially flown in order to assess the locations of all structures and debris requiring further investigation and to identify areas of archaeological potential. Additional information on potential heritage features was provided by Lisa Dyer and the PWGSC/INAC team that had been working on the island for several days prior to the arrival of the archaeologists.

The AIA was intended to identify any artifacts or heritage resource areas that might be impacted by a remediation program and, as such, only those areas of previous and potential disturbance were assessed. The intent of this program was not to conduct a full AIA of Bear Island. However, during traverse of the island to reach potential areas, other landscapes were noted, and any suspected features considered. The northern area of the island, beyond the northernmost facility, was not assessed as no further structures exist in that location and avoidance of the area prevented unwarranted exposure to the polar bears residing in that vicinity. In addition, the eastern side of the island contains a rocky ridge that was not assessed as no part of the Mid-Canada Line Radar Site was located there and no remediation is scheduled to be conducted in that locale. The remaining areas of Bear Island were investigated and considered for the presence of heritage resources.

L:\2007\1328 YKnife\07-1328-0011\4000\Fig 1 Bear Island Location.dwg   Mar 10, 2008 - 10:30am



NOTE

UTM GRID IS NAD 83, ZONE 17.

REFERENCE

TOPOGRAPHIC MAP 43/I AND 43/J SCANNED BY SOFTMAP. © 1983 HER MAJESTY THE QUEEN IN RIGHT OF CANADA. DEPARTMENT OF ENERGY, MINES AND RESOURCES. PROJECTION : TRANSVERSE MERCATOR DATUM : NAD83 COORDINATE SYSTEM : UTM ZONE 1 7.

PROJECT

BEAR ISLAND MID - CANADA RADAR SITE PROJECT

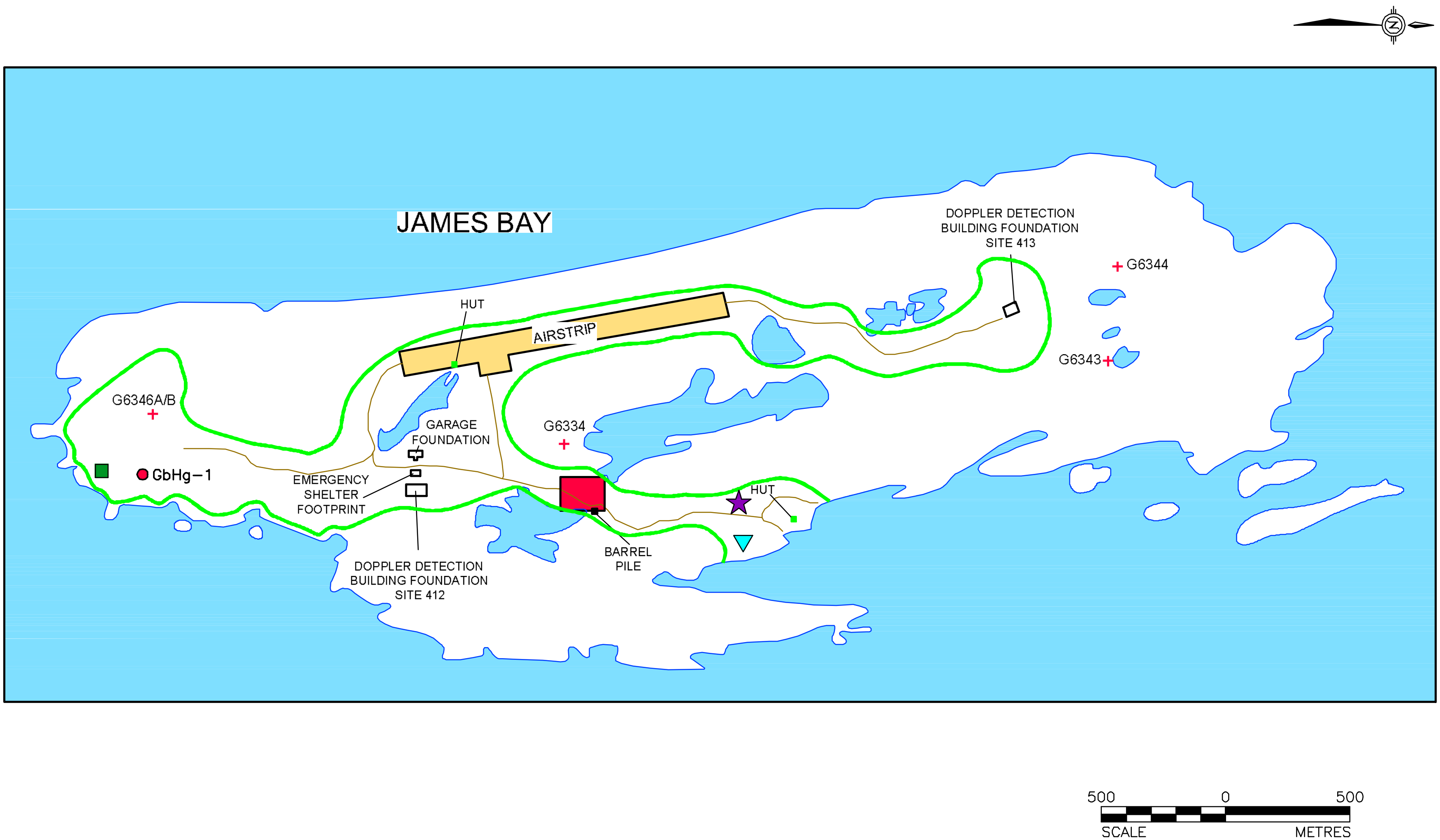
TITLE

BEAR ISLAND LOCATION

Golder Associates
Calgary, Alberta

PROJECT	07.1328.0011.4000		FILE No. Bear Island Location	
DESIGN	DB	10/09/07	SCALE AS SHOWN	REV. 0
CADD	MM	04/10/07	FIGURE: 1	
CHECK	DB	10/03/08		
REVIEW	DB	10/03/08		

L:\2007\1328 YKnife\07-1328-0011\4000\Fig 2 Bear Island DEW Station.dwg Mar 10, 2008 – 10:33am



LEGEND

- BACKGROUND SAMPLE LOCATIONS
- STACKED BARRELS
- WORKED AREA
- HERITAGE RESOURCE SITE
- BOAT
- AIA STUDY AREA
- MARKER
- SIGN

REFERENCE

DIGITIZED FROM DRAWING MAP 1-2 GENERAL SITE LAYOUT OBTAINED FROM THE CLIENT (SEP. 07, 2007)

PROJECT

BEAR ISLAND MID - CANADA RADAR SITE PROJECT

TITLE

BEAR ISLAND

Golder Associates
Calgary, Alberta

PROJECT	07.1328.0011.4000		FILE No. Bear Island	
DESIGN	DB	10/09/07	SCALE AS SHOWN	REV. 0
CADD	FN	23/10/09		
CHECK	DB	10/03/08		
REVIEW	DB	10/03/08		

FIGURE: 2

The predominance of low-lying basalt rock contributed to a lack of vegetation which facilitated assessment of the facility areas and increased visual assessment for the presence and/or absence of cultural materials. As requested, areas which will not be impacted during remediation were not fully examined. Several features were identified by the project team, prior to the arrival of the archaeologist, which required confirmation as to their status as heritage resources. One previously unrecorded heritage resource site was identified by the archaeologist during the program, which was documented as per the *Nunavut Archaeological and Palaeontological Sites Regulations*.

2. LOCATION, POTENTIAL IMPACTS, AND OBJECTIVES

2.1 Location

The former Mid-Canada Line Radar Station is located on Bear Island at the north end of James Bay and operated from the late 1950’s until late 1965 or early 1966. The remote location is of heritage interest as it may have served as a strategic stop-off point during prehistoric times as well as a critical radar station during more recent times. Its position on the southern boundary of Hudson Bay places it in an area of overlapping use by the Inuit to the north, West Cree of Ontario, and the East Cree of Quebec. Currently no 1:50,000 NTS topographic maps exist for this location, but a 1:250,000 map showing Bear Island is available (Figure 1).

Bear Island is a low-lying black basalt outcrop, covered with small lakes, ponds, gravel beaches and exposed rock. In 1995, it was noted that none of the radar station buildings were left standing, their locations only recognized by foundations, but that a large amount of debris had been scattered over the island (INAC 1996).

2.2 Potential Impacts

The potential impacts to heritage resources at Bear Island are dependent upon the proximity of those resources to the remediation activities that will be conducted to remove the remnants of the former Mid-Canada Line Radar Station. Heritage resource sites are non-renewable resources that may be located at or near ground level or may be deeply buried. Prehistoric or precontact archaeological sites are those sites which contain features, artifacts or ecofacts reflecting the use of a given land base by people prior to European influences and technologies. Features are non-portable articles that indicate a human modification of the local environment such as hearths, pits, tent rings, stone cairns and Inuksuit. Artifacts are portable items that have been modified by people at some time in the past. These include such items as projectile points, stone flaking debris, and cut and modified bone. Ecofacts are naturally occurring items such as preserved plant remains or pollen that can aid in the interpretation of archaeological sites. Historic archaeological sites include the features, artifacts and ecofacts relating to the past few hundred years of human occupation. These sites are typically identified by the presence of buildings or structural remains, but may include any site that has evidence of historic use of the landscape.

Alteration of the landscape can result in the damage or complete destruction of all or portions of historic resource sites. These alterations often involve the displacement of artifacts resulting in the loss of valuable contextual information or may involve the destruction of the artifacts and features themselves resulting in complete information loss. These losses are permanent and irreversible. Primary, secondary and tertiary impacts are possible with any new development. Remediation can be considered a new development in this context if it impacts previously undisturbed areas during operation.

Primary impacts include those disturbances resulting immediately from project. The primary impact zone is the area within the remediation footprint including access roads and temporary work zones. Individual sites are likely to be affected to varying degrees if they are located within the development area. Artifact context is fundamental to interpretation of archaeological sites. By disturbing the context in which artifacts and features are recovered, interpretations of heritage resources sites and, ultimately, past lifeways are affected negatively.

Secondary impacts can occur when the support services or additional access required by development adversely affects heritage resources outside the primary target areas. The remediation project should have no secondary effect on heritage resources.

Tertiary impacts are the results of project induced changes in demography and land use patterns. Increased rates of intentional and unintentional impacts can be expected as a result of increased visitation to an area if the project were large enough to affect regional population bases. Tertiary impacts are anticipated to be very low for this project, especially because changes to the island through remediation will not affect the visitation rates for use of the island due to its isolated location and lack of a desirable resource base.

The study detailed in this report is intended to identify areas of possible impact and to determine whether the current proposed project will disturb those heritage resources located in proximity to the development.

2.3 Project Objectives

The objective of the 2007 study at the former Mid-Canada Line Radar Station located on Bear Island is to ensure that heritage resources are not inadvertently impacted by the proposed clean-up and remediation project. The purpose of this AIA is to:

- conduct a pre-impact assessment of the proposed remediation areas;
- identify any archaeological sites within those areas (if present);
- make recommendations to CLEY and PWGSC/INAC to mitigate or avoid those sites;
- make recommendations on surveillance and monitoring;
- provide a cost estimate on implementing the recommendations during the construction phase; and
- prepare a draft Final Report to be reviewed by PWGSC/INAC, followed by a Final Report for distribution as required and submission to CLEY.

3. PHYSICAL AND CULTURAL SETTING

3.1 Environmental Context

An understanding of past environmental conditions and the environmental factors that shape human approaches to subsistence and settlement patterns enable archaeologists to not only locate sites, but also to provide more accurate interpretations of individual sites. The physical aspects of the environs (topography, drainage, climate and soils) as well as resource availability (flora, fauna, lithic materials and water) are prime criteria for the identification of site location and function. Assessments of the universal cultural activities of site location, travel within and through the area, and resource exploitation are key components of any archaeological site analysis.

The anthropological theory of environmental determinism suggests that, to a great extent, environmental factors condition human behavioural and cultural adaptations, or patterns of behaviour. The environment has likely influenced many of the activities that contribute to the character of the regional prehistoric record. All available environmental variables must be considered as indicators of prehistoric use of the landscape.

The regional environment influences where specific activities and occupation are located in a pattern of seasonal movements according to the availability of resources: a seasonal round. The variables of archaeological site distribution can be identified and combined into useful criteria for suggesting the potential of an environment to hold heritage resources that includes a wide variety of landforms frequently associated with coastlines and lake shores, river banks, eskers and kames, and bedrock knolls in Arctic environs. Distribution patterns partially reflect environmental opportunities presented to human groups as well as cultural preferences demonstrated by site location. Topography influences much human activity including travel, communication, resource catchments, dwelling locations and eventually constrains human activity areas to defined localities. Based on existing heritage resources, the environment is a key factor in human settlement patterns.

3.2 Regional Environment

Prior to European contact, the people of North America developed economies that were intimately linked with the landscapes in which they lived. Changes in the vegetation communities have occurred throughout the region over time and the productivity of the landscape and how it was culturally manipulated in the past has changed.

Bear Island is predominantly flat with very little topography on its western side. There are rocky outcrops on the eastern edge of the island with a high ridge running along the northeast coastal area. A small change in elevation in the centre of the island and on the northern half of the island provides some relief. There is a sheltered cove on the eastern central side of the island where beach landings were conducted during the operation of the radar station. Overlooking the sheltered cove are rocky outcrops and hills on the east and west.

3.3 Heritage Resources

Archaeology is the study of human history through the material remains of culture, now known as heritage resources. The ultimate goal in archaeology is to describe the cultures and events responsible for the creation and deposition of the remains at a given archaeological site. As such, archaeologists use material remains to determine the nature and age of cultural occupations at a site. Artifacts, ecofacts and features deposited into the natural environment, along with their inter-relationships, are the integral parts that make up an archaeological site. The Nunavut Archaeological and Palaeontological Sites Regulations (2003) define heritage resources as: “but not limited to, archaeological and historical sites, burial grounds, palaeontological sites, historical buildings and cairns.”

Predating the arrival of Europeans, precontact archaeological sites are comprised of artifacts, features and residues of native origin typically characterized by modified bone and stone, and stone structures. Historic sites are those structures, features, and objects of European influence that date back to contact with the Europeans but can also represent more recent activity of more than 50 years. Depending on the context, sites less than 50 years old may be considered to represent traditional land use and are identified to document continued use and occupation of an area to the present time. A key component of the historic period record are the sites, artifacts and affiliated resources relating to post-contact Aboriginal people's use of the landscape. These include both archaeological sites and objects such as standing and collapsed cabins, campsites, graves, and traditional sites and resources, such as special places, hunting and plant collecting areas, traplines and their associated remains, oral traditions and various documents. These latter resources are usually identified through consultation procedures such as Traditional Use Studies (TUS) or community consultations.

Additionally, heritage resources include, as well as the sites where events took place in the past, all of the objects that they contain and any of the contextual information that may be associated with them and will aid in their interpretation, including natural specimens and documents or verbal accounts.

Heritage resources are non-renewable and are susceptible to alteration, damage, and destruction by construction and development activities. The value of heritage resources cannot be measured in terms of individual artifacts or biological specimens, rather the value of these resources lies in the integrated information which is derived from the relationship of the individual artifacts and fossil specimens, associated features, spatial relationships (distribution), and contextual situations. Interpretation of heritage resource materials, and the ability to interpret the significance of particular sites in a landscape, is based on an understanding of the nature of the relationship between individual archaeological and palaeontological materials as well as the sediments and strata within which they are contained. As such, removal or mixing of cultural or fossil bearing sediments results in the permanent loss of information basic to the understanding of these resources. As a result, heritage resources are increasingly susceptible to destruction and depletion through disturbance.

Similarly, tundra areas north of the tree line are characterized by extremely slow rates of soil development and sediment accumulation. Accordingly, at repeatedly occupied sites, there is little chance of distinguishing occupations relating to different periods within the 10,000-year record of human occupation in the region without recovering a diagnostic indicator. Some areas of high sediment deposition rates are present along the length of the study area, but these are not the typical scenario.

The lack of temporally diagnostic artifacts, the absence of materials suitable for radiocarbon dating, and the natural mixing of shallow archaeological deposits serve to limit the definition of the recognized prehistory for the region. In contrast, extant documents, records, and oral testimony provide a firmer basis for understanding the historic period of the region.

3.3.1 Cultural Chronology

The culture history of the northern James Bay area is complex as it straddles two ecological zones demarcated by the tree line. To the south, people adopted a boreal subsistence pattern, while to the north, a pattern based on existence on the harsh tundra of the interior and a coastal existence down either side of Hudson’s Bay. Just as climatic changes through time resulted in movement of the tree line either to the north or to the south, so too did these changes influence settlement patterns among the inhabitants of either zone. Although there is a lack of physical evidence, it is quite probable that inhabitants from either ecological zone settled in the James Bay area at one time or another. An abbreviated outline of cultural development for the north and the study area is included below.

3.3.1.1 Shield Culture (8,000 to 1,500 BP)

The early cultural development most applicable to the study area is the Shield Culture. Shield Culture encompassed the boreal forest of the northern Canadian Shield including the southeastern Northwest Territories, southern Nunavut, most of Manitoba, northern

Ontario, northern Quebec and Labrador from approximately 8,000 years ago to 1,500 years ago (Wright 1995). Due to the relatively recent recession of the Laurentide ice sheet, it does not appear that the Hudson Bay Lowlands were occupied prior to 4,000 years ago (Wright 1995).

Shield Culture materials can typically be distinguished from earlier cultures by the introduction of the atlatl dart, signalled by the presence of notched projectile point styles. This was not, however, a replacement for the previously utilised lanceolate points, as both side-notched and lanceolate points appear together in Shield Culture sites (Wright 1995). Other tools associated with Shield Culture include large bifacially flaked knives, scrapers, chipped adzes and unmodified flakes, but few ground stone tools.

Shield Culture is based on technology, subsistence and settlement patterns that show very little change over an extended temporal period and is considered to have led to the northern Algonquian-speaking people who still occupy the territory today, including the Cree of the James Bay area (Wright 1995).

Originally the Shield Archaic populations occupied the Thelon River drainage in Keewatin District, but sometime between 1500 and 1000 BC, abandoned the region due to a deteriorating climate that may have forced the tree line too far south to permit the Shield Archaic hunters to commute from the forest to their old lands in the Thelon drainage. In its place the Arctic Small Tool tradition (ASTt) appears.

3.3.1.2 Arctic Small Tool Tradition (4,200 to 2,800 BP)

There is presently little evidence to link earlier Palaeo-Arctic tradition occupations to the Arctic Small Tool tradition (ASTt) occupations that succeed them. The ASTt represents a widespread cultural manifestation that covers all of the Canadian Arctic as well as parts of Alaska and Greenland and is typically thought to date between approximately 4,200 and 2,800 BP (McGhee 1990). It includes the Denbigh Flint complex in northern Alaska, the Independence I culture of the Canadian High Arctic, the Inuvik Phase and the

Pre-Dorset culture in Arctic Canada, and the Sarqaq culture in Greenland (Dumond 1987). It is possible that the ASTt relates to a separate migration of peoples from Siberia and does not appear to be related to the preceding Palaeo-Arctic tradition. As the name implies, the toolkit of the ASTt is comprised of lithic artifacts that are finely made and smaller than tools of similar function and age from elsewhere in North America. These include microblades and microcores, burins, gravers, small side and end scrapers, side and end blades, and bipointed (arrow) and triangular (harpoon) projectile points (Wright 1995). In Alaska, it appears to have developed into the cultures of the Norton tradition, while in Canada, it developed into the Dorset culture.

Around 3,500 BP, the High Arctic appears to have depopulated as Pre-Dorset groups shifted their range into the Barren Grounds of the Northwest Territories and adjacent portions of the boreal forest. Although a more complex model has been assumed (McGhee 1996), a correlation with general climatic trends becomes apparent.

The Canadian Tundra Tradition (3,300 to 2,600 BP) has been described as a local variant of the ASTt which focused on caribou exploitation (Noble 1981). Sites of this cultural tradition are widespread, being represented in sites on Great Slave and Great Bear Lakes eastward to North Henik Lake near Hudson Bay. Characterized by large lenticular and oval bifaces, small triangular and side notched points, side blades, burin and microblade technology, these assemblages are most commonly associated with orange/pink and white quartzites. Native copper appears in some sites toward the end of this period.

3.3.1.3 Taltheilei Shale Tradition (2,500 to 100 BP)

Following the ASTt, is the Taltheilei Shale Tradition (2,500 to 100 BP), seen as ancestral to development of the Athapaskan people (Noble 1981). Artifacts of siliceous shale originating on the eastern arm of Great Slave Lake are characteristic; although Taltheilei artifacts have also been identified in the Barrens south of Kugluktuk at Itchen Lake (Blower 2003) and range as far south as Christina Lake in Alberta where late phase variants have been recovered (Blower 2007). Lanceolate projectile points continue to be important in the tool assemblage but small corner and side notched points occur in the latter half of the tradition. The prominent biface and burin and microblade technologies of the preceding phase are notably absent.

3.3.1.4 Dorset Culture (2,500 to 1,000 BP)

The Dorset culture occupied the Canadian Arctic from 2,500 BP until at least 1,000 BP. (McGhee 1990). Best known for miniature carvings, Dorset appears to have been a more successful adaptation to the conditions of the north than the preceding ASTt cultures from which it developed. This is demonstrated by the huge area occupied by Dorset groups and by evidence that they had perfected winter hunting on the sea ice. Cooler conditions in the northern hemisphere around 3,000 years ago resulted in expansion of the sea ice and a shift away from terrestrial hunting of caribou and hunting of sea mammals from boats in open water to a procurement of sea mammals from coastal edges and sea ice. This is evidenced in the archaeological record with a shift away from bow hunting to harpoon and spear hunting (McGhee 1996). Artifacts recovered from sites representing this period are more diverse and “reflect a richer and more secure way of life than that of earlier Palaeo-Eskimos.” including the establishment of permanent winter villages (McGhee 1996).

However, when the people of the Thule culture arrived in the Canadian Arctic approximately 1,000 years ago, the Dorset culture had largely or entirely disappeared for reasons that are not well understood (McGhee 2001; Wright 1999).

3.3.1.5 Thule (1,000 to 400 BP)

The Thule tradition dates from approximately 1,000 to 400 BP and is derived from the Norton tradition in northern Alaska. More specifically, Thule grows out of the Old Bering Sea and Punuk traditions, which have numerous similarities to Thule cultural assemblages. These assemblages suggest subsistence based on maritime resources such as seals and whales that were hunted from kayaks or umiaks as identified by harpoon floats. Thule represented a new kind of adaptation to the Arctic environment, based on the hunting of large sea mammals in open water through the use of drag floats attached to the harpoon line. Large skin boats and the use of dogs to pull large sleds were other Thule innovations. Winters were spent in sometimes large communities of semi-subterranean houses, subsisting on a stored surplus obtained most typically by hunting bowhead whales. The introduction of Thule into the Canadian Arctic is noted by a distinct change in a number of cultural markers from the Dorset culture. The earliest Thule occupations currently recognized are on islands in the Bering Strait and exhibit an almost complete reliance on maritime resources; however, later sites demonstrate that both maritime and terrestrial resources were utilized (McGhee 1990). Climatic changes following the thirteenth century likely caused the Thule to modify their way of life into that of the various historic Inuit groups.

3.3.2 Historic Inhabitants

Historical use of the project area is identified with the James Bay Cree in Quebec, the Moose Cree in Ontario and Inuit groups, some of whom eventually moved into the Chisasibi (Fort George) area on the Quebec side of James Bay (Lovisek 2002; Nutall 2005). Bear Island falls into an overlap area between all three groups, positioned as it is, near the centre of the mouth of James Bay and Hudson Bay. Many of the Cree moved into former trading post areas and represent two regional groups: the coasters, who were dependant on maritime sea mammals and later worked with fur traders; and the inland Cree, who were more caribou-oriented until the establishment of fur trade posts in the nineteenth century (Preston 1981; Honigmann 1981). The Inuit of Northern Quebec spent summers inland hunting caribou, returning to the coast in winter when ice and snow facilitated the use of dog sleds. It is during the sixteenth century that sustained European contact began with hostilities recorded until the early eighteenth century (Lovisek 2002). Magee (2005) notes that Henry Hudson and his crew spent several weeks navigating James Bay in 1610, before hauling their ship, the *Discovery*, ashore to spend the winter. Interestingly, only a single encounter with a native was recorded for the entire stay. The crew of the *Discovery* mutinied the following year and Hudson, his son and several loyal crew members were set adrift in James Bay in 1611 and never heard from again (McGhee 2005). Afterwards, the dominance of the Hudson's Bay Company on the fur trade created a reliance on the company by Inuit groups. Many of these groups remained semi-nomadic into the early twentieth century.

Beyond the knowledge that Bear Island existed on maps as far back as the seventeenth century, there is little information on any habitation of the site in historic times. On a map produced in 1762, Bear Island is noted along with its outlying smaller rocky islands known then as the "Cubs". In all later maps, it is known continuously as Bear Island or a variation of it. This designation is certainly supported today as a large number of polar bears and cubs have been identified on the northern sections of the island and adjoining isles, and were present during this AIA.

It was not until the 1950's, when the Mid-Canada Early Warning Line was built, that habitation of the island was recorded; albeit temporarily. The station on Bear Island had two Doppler antennae at the top of guyed towers, an equipment building, a survival hut and fuel tanks which were closed sometime between late 1964 and the spring of 1965 when jet aircraft rendered the Mid-Canada Early Warning Line defence system redundant.

3.3.3 Heritage Studies

Prior to the current study of the former Mid-Canada Line Radar Site on Bear Island, no heritage resources sites were recorded in the Nunavut or Canadian Museum of Civilization database for this location.

4. METHODOLOGY

4.1 Field Inventory and Assessment

All field work was conducted under a valid Class II Archaeological Permit issued by CLEY. The field program focused on assessment of all areas of high and moderate archaeological potential, and considered other areas of low potential as the survey was conducted and opportunities arose. During the course of the field investigations, all heritage resource sites that were identified were to be evaluated with respect to: site significance; potential effects to the sites that may occur during remediation; the significance of these potential effects; and then, recommendations were to be made regarding any mitigation warranted to offset effects caused by the remediation program. Field results were to be communicated to the client while in the field to take advantage of time and cost savings to the project. Inventory and assessment techniques followed established practices and consisted of the following:

- visual examination of the identified areas to determine the presence of such surficial features such as standing or collapsed buildings, dumps, cache pits, cabin foundations, etc. and exposed precontact cultural materials such as stone tool making debris and tools;
- visual examination of the identified areas to determine the presence of items of historical military interest;
- excavation of shovel tests (ca. 40 x 40 cm) to varying depths to determine the potential for subsurface precontact cultural remains if deposition is present;
- visual examination of bedrock exposures (if any) or gravels for Quaternary palaeontological fossils as well as precontact quarrying activity;
- excavation of either additional shovel tests or 1 x 1 m units for the purpose of identifying the distribution, density, and nature of cultural remains associated with sites identified through inventory procedures;

- documentation of the location (GPS coordinates), nature, size, and complexity of each identified site; and
- documentation of individual site features to record content, context, potential identity, and to provide information required to develop a mitigation program.

These results, along with updates and recommendations will be included in written submissions to CLEY as required by the Permit to conduct the AIA, and discussed with the Chief Archaeologist of Nunavut.

4.2 Heritage Feature / Structure Evaluation

Evaluations of heritage features and standing structures were to be completed for features/structures that are observed during the investigations. These evaluations would consider perceived heritage resource value and community cultural value as well as the predicted impact from the proposed program. In general, disturbed sites with limited cultural remains would be assigned lower archaeological resource values than undisturbed sites, large sites with large amounts of cultural material, complex sites, and multicomponent sites. Undisturbed multicomponent sites would generally be assigned the highest heritage resource value.

Community input will play a role in the evaluation of site value, and the inclusion of a member of the local community on the field crew aided in the in-field discussions regarding site significance.

4.3 Detailed Archaeological Site Investigations / Mitigation

If required, mitigation of significant heritage resources sites may include a number of different options. Prior to evaluation of these mitigative options, the perceived value of the identified archaeological sites will be discussed with the PWGSC/INAC Project team to determine the feasibility of avoiding important sites. Only if site avoidance is not possible, will other mitigative measures such as collection and documentation, and controlled mapping/excavation be considered. In areas of no sediment deposition surface collection and mapping of artifacts and features may satisfy regulatory requirements for mitigation. Recommendations for excavation may include a controlled excavation mitigative plan and will specify the number of square metres and suggest locations for excavation units/blocks.

Overall mitigative options may be summarized by:

- collection and documentation undertaken at the time of the field assessment at all sites with low archaeological resource value;
- avoidance if feasible at all sites assigned high archaeological resource value;
- mitigative excavations which will be recommended at those sites assigned high archaeological resource value that could not be avoided by borrow source relocation; and
- a management plan for required mitigation relative to the proposed construction schedule will be discussed with the site project team.

4.4 Reporting

Analysis of collected artifacts includes cleaning, cataloguing, identification, inventory, and description of each individual piece for inclusion in the final report. Both stone material and technological identification and descriptions of all artifacts will be undertaken. GPS site information would be provided for mapping relative to the former site structures at the site and to CLEY, but not included in the final versions of the report. Archaeological site maps, photographs, and artifact scans will be prepared as digital files. Based on the cultural material collected, a recommendation regarding final site disposition relative to future projects is to be made.

Upon completion of the field components and the required artifact curation, a draft report will be prepared. A final permit report on the archaeological studies will be prepared for

CLEY on behalf of PWGSC/INAC, for review by CLEY. This report will include a project description, the environmental setting, the historical and archaeological context for the project area, field methodology, and the results of the field reconnaissance. The report will include both descriptive, as well as mapped data on the sites, artifacts, and features identified, as well as detailed information on the nature, content, and significance of the artifacts and features identified. Cultural material recovered will be inventoried, described, and discussed within the report text to aid in evaluation of scientific and interpretive value. All identified sites will be documented on appropriate site inventory forms.

If required, a summary of the findings will be prepared for inclusion in a screening document.

In general, the following workplan is followed:

- Avoidance will be recommended if feasible at all sites assigned high archaeological resource value (this to include all constructed features: burials, tent rings, caches, hunting blinds, hearths).
- Collection and documentation will be undertaken as a mitigative option of sites with low archaeological resource value, or isolated artifacts, as a method of protecting the heritage resource from future undocumented impacts due to increased personnel activity in the vicinity.
- Mitigative excavations, including mapping, collection and test excavations, will be recommended at those sites assigned high archaeological resource value that could not be avoided by facility relocation, and discussed with CLEY and the Chief Archaeologist as to the acceptable methods of mitigation.

A management plan for required mitigation, monitoring or surveillance relative to the proposed remediation will be developed as part of the contracted services deliverable to PWGSC/INAC. This could include site mitigation, additional survey of any project relocates required due to site avoidance, and verification of those heritage sites located outside the proposed development activity area that should remain outside re-located areas.

4.5 Community Consultation

Consultation regarding the remedial options for Bear Island between PWGSC/INAC and the community of Chisasibi, Quebec, took place on February 20, 2008. Community review and input on heritage resources is normally sought for incorporation into site interpretation, archaeological resource value, and appropriate mitigation options prior to submission of the Final Report. Heritage resources were not an issue during this consultation and the community members were informed that a 20 m buffer has been created around the single newly identified heritage site GbHg 1 (see Results Section 5.3.1).

5. RESULTS

A search of the Canadian Museum of Civilization database yielded no information on previously recorded heritage resources sites on Bear Island prior to conducting the AIA. As such, no revisits or information updates to existing sites was required.

On arrival at the former Mid-Canada Line Radar Site it was noted that previous work removing the structures and support facilities had already been conducted. Where buildings and support structures had been located, only refuse remained. Crumbling concrete foundations, guy wire support blocks, decayed wooden floors, fallen metal radio towers, bottle dumps, vehicle parts, damaged electronic equipment and other remains of the stations occupation and operation are all that it is left. No standing structures of significance or heritage concern remain for study. Roadways, facility remains, and areas of PWCGS concern were investigated for heritage resources that may not be apparent to the untrained observer.

Four areas of concern were identified by the PWCGS team already on Bear Island as possible heritage resources. This brings a total of six areas of assessment that included:

- roadways linking the former facilities with the southern and northern end of the island and the beach landing area;
- station foundations and telecommunications refuse and building remains;
- a “prehistoric house foundation”;
- a beached boat near the beach landing area;
- an Inukshuk; and
- a possible semi-subterranean house.

These were all investigated and are reported on below.

5.1 Former Mid-Canada Line Radar Site Areas of Investigation

5.1.1 Roadways and Airstrip

All connecting roadways, airstrip and adjoining areas were assessed for heritage resources with negative results. In most cases, the road beds had been made with gravel fill from another location, most likely a source at the southeast end of the island where gravel extraction is evident from a large area (Plate 1). This borrow source is located in the south eastern side of the island and is the highest point of land in this location.

Plate 1 View south of gravel pit at southeast end of island overlooking GbHg 1.

Additional materials located near to the roads include the remains of old Bombardier snowmobiles that will be cleared away (Plate 2).

Plate 2 View east of snowmobile remains.

5.1.2 Infrastructure Areas

As mentioned above, the structures on Bear Island have been removed, scavenged, or deteriorated into a state of disrepair with only debris and refuse still present (Plate 3). In all such areas, assessment ground inspection was conducted to identify possible heritage resources but with negative results. This includes the hut at the beach landing area (Plate 4), the barrel storage area, and water storage areas (Plate 5). The condition of the station facilities can be seen from these photographs. No areas of prehistoric use could be identified, and no historic remains of significance recorded.

Plate 3 View north of Doppler detection building foundation (Site 412) remains.

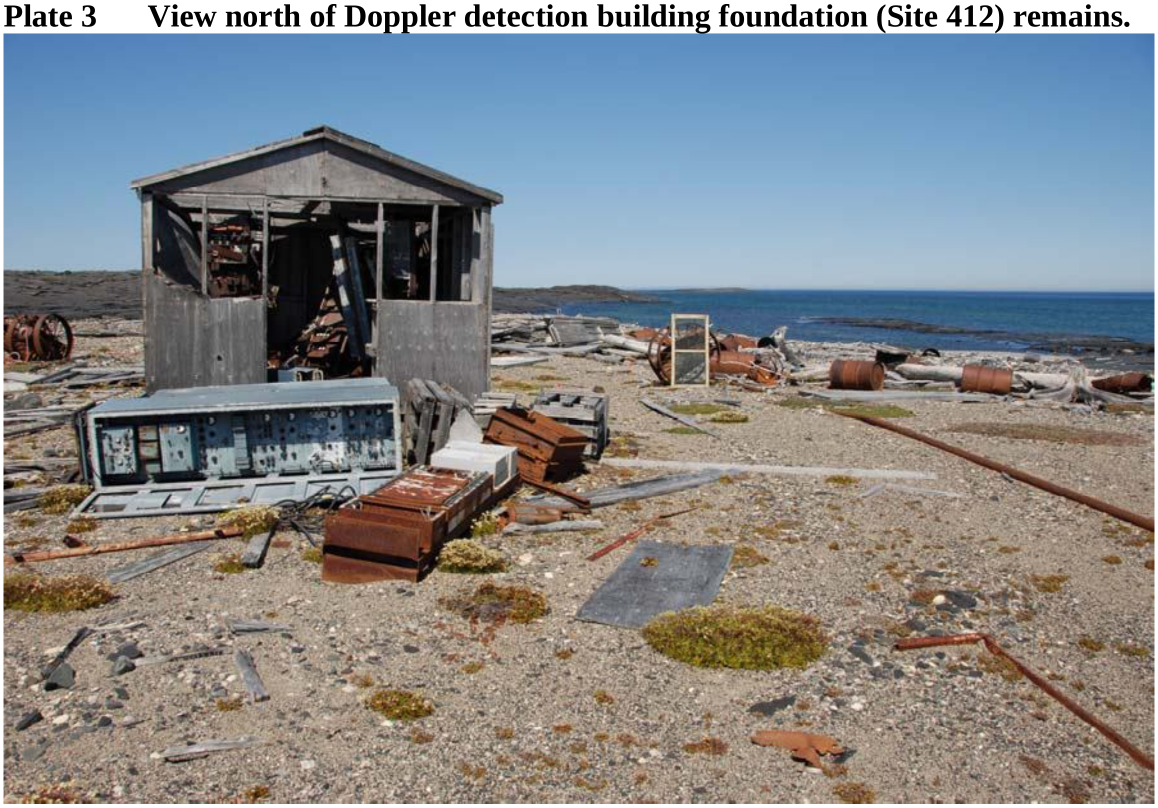


Plate 4 View north of beach landing area.

Plate 5 View northwest of water storage pond.

5.2 Potential Heritage Resource Sites

5.2.1 "House Foundation"

Several team members had identified this site variously as a house foundation, or a cross (Plate 6). Upon examination it was identified that the base rocks were possibly used to hold down lumber and boards which appear to be remnants of a sign post structure. Planks of wood with wire nails in them are still present and the structure direction faces out into the bay at the southern tip of the island as if it were a sign for approaching water craft. The stones used to hold down the cross piece do not have matching lichen growth on them and it is apparent that they were placed there from a mixed context with black, orange and grey lichen present. Their juxtaposition appears recent enough that no new lichen growth has occurred between the points of contact between rocks and the lichen colours do not match up. It is thought that this was possibly the support structure for a Station Identification sign.

Plate 6 View southeast of sign structure and rocks.

5.2.2 Marooned Boat

On the east side of the island on a sheltered beach a boat has been beached (Plate 7). The boat has been there for an unknown period of time. It is in poor condition and based on its present location was beached during a very considerable storm, or hauled out of the water for storage. The cabin still contains evidence of electrical wiring and canvass/vinyl style wood covering on the outer shell. While the boat is interesting, it is not a heritage site.

Plate 7 View northeast of marooned boat showing rocky terrain.

5.2.3 "Inukshuk"

An Inukshuk was reported on the rocky outcrop overlooking the beach landing area and marooned boat (Plate 8). The feature appeared to be an Inukshuk from a distance, but upon closer inspection it appeared to be a marker, possibly for navigation, due to its position above the cove. Assessment of the feature resulted in the identification of a wrench or iron bar inside the structure which is placed in sight of the beach and harbour entrance. The feature is approximately 2 m in height with a base of 95 by 130 cm.

Prior to the AIA, one of the pilots for the 2007 Bear island assessment team recovered a rifle stock from the "Inukshuk" area with syllabic writing etched on one side of the butt (Plate 9). The rifle stock was not old, although the wood was weathered and the finish stripped away. The stock was presented for inspection and photography as an item of interest only. The rifle stock is not considered a heritage resource and its origin and the circumstances to it's presence on the island is not currently known.

Plate 8 View northeast of Inukshuk/marker overlooking cove.

Plate 9 Rifle stock with syllabic writing.

While on an unrelated visit to Baker Lake several days later, an Inuit Elder translated the syllabics into the following:

Lucassie Atutukai

Seeme Uninnalaatujaq

Charlie Ilujaatsiaq

James Uitaluk

Tommy Ittujaatsiapik

Utaaluktuq Qasalluaq

Noah Akuliaq

People of Inukjuaq (Port Harrison)

Sept. 2002

Inukjuaq is 493 km (straight line) north east of Bear Island on the Quebec (Nunavik) shoreline. It is not known whether this group of people was on Bear Island, or what the circumstances of the rifle stock were.

5.2.4 “Semi-Subterranean House”

The possible semi-subterranean house was brought to our attention by the project Geotechnical Engineer (Plate 10). The possible feature was located in the north/central part of the island at the end of a small esker where evidence of bulldozer activity was still visible. A cut through the esker was made by the bulldozer at a 90° angle, and then it tracked across the spine of the esker. At the south end of the esker gravel had been pushed up to form a ridge behind a scooped out area that had disturbed the surrounding rock plates. There were no cultural materials located at the “site” and it is believed that it was in the process of being used as a gravel source at the north end of the island.

Plate 10 View northwest of "semi-subterranean house."

5.3 Newly Identified Heritage Resource Site

5.3.1 GbHg 1

During the investigation of the southern section of the island and the area surrounding the previously used gravel pit, a tent ring was identified (Plates 11 and 12) approximately one metre away from the edge of the gravel pit. Borden Number GbHg 1 was received from the Canadian Museum of Civilization designating the site location, and in this case identifying it as the first site identified in this Borden Block. The ring is constructed of raised rocks and is incomplete, with several rocks missing from the east end, and an apparent entrance opening on the southeast side. The ring appears quite old and settled in place, on a surface of numerous other rocks. It was revisited later in the day for observation under an increased oblique angle of sunlight which supported the identification.

Plate 11 View south of GbHg 1, tent ring.

Plate 12 View north of GbHg 1, with doorway in foreground.

The ring has approximately 35 to 50 rocks and is on the highest point of land in the southern sector which is now the gravel pit. It measures approximately 3.5 by 3 m. There is no evidence of cultural materials in the vicinity of the ring. While the ring is identifiable it does not hold enough information to assign it to a particular architectural Type (*cf.* Ryan 2003). It could be suggested that it is a Late structure based on Ryan's typology, but there is no substantial information present to support that conjecture. There are no cultural materials present around the rocks. Because of this, and the incomplete nature of the ring, with little potential for the presence of further information, its significance is rated as low.

Should the gravel pit be used during the remediation activity it is possible that this site would be impacted. A 20 m buffer zone around the site will ensure that its integrity is not compromised.

6. SUMMARY AND RECOMMENDATIONS

The AIA of the Bear Island radar station conducted under Nunavut Permit 2007-035A produced the results as discussed in Section 5 and outlined in Table 1. The predominance of bedrock and nearly complete lack of vegetation and sedimentation on the island enabled a high visibility surface examination of the facility areas to adequately assess for the presence of cultural materials. As requested, areas which will not be impacted during remediation were not fully examined. In addition, four areas were identified prior to the AIA by the project team for confirmation of their status as heritage resources. Each of these was determined to be of recent origin and do not meet the requirements of a heritage resource. Nonetheless, a single heritage resource site, GbHg 1, was identified during the program, and is documented as per the *Guidelines for Applicants and Holders of Nunavut Territory Archaeology and Palaeontology Permits* (Government of Nunavut 2003). This site is considered to be of low significance due to a lack of cultural materials, or evidence of additional cultural activity, and its less than complete state.

Table 1 Heritage Site Recommendations

Site	Type	Significance	Recommendations
GbHg 1	tent ring	low	20 m buffer zone; continued avoidance

On arrival at the former Mid-Canada Line Radar Site it was observed that all areas of the main facility had been removed although foundations remain in a state of disrepair and decay. Because of this, the assessment of individual structures became redundant. An assessment of small areas of possibly undisturbed land throughout this area was conducted but with negative results. Site GbHg 1 will not be impacted by remediation and a 20 m buffer zone has been placed around the site should any remediation activity take place in its vicinity.

It is recommended that remediation of the former Mid-Canada Line Radar Site should be allowed to continue with no impact to heritage resources if continued avoidance of GbHg 1 is practiced.

By conducting this AIA and taking part in a community consultation at Chisasibi on February 20, 2008, it is recommended that PWGSC/INAC has fulfilled the requirements of the current program to identify the potential for impact to heritage resources through the remedial reclamation of the former Mid–Canada Line Radar Station at Bear Island. The AIA of Bear Island included the participation of a member of the local community at Wemindji, William Atsynia, who acted as bear monitor and participated in the identification and recordation of sites.

As the investigations of the AIA identified heritage resource site, GbHg 1, it is recommended that avoidance of that resource be required during the remediation process. While a buffer zone of 20 m would protect this site, it is currently only one metre from the edge of the gravel pit on its northwest side. Care will need to be taken to ensure that site integrity is maintained should the gravel pit be used during remediation.

All other suspected heritage resources have been refuted as described in this report. However, while not meeting the technical requirements to be classified as heritage resources, they are cultural markers of a recent occupation and cultural activity as described in this report, but which do not affect the remediation process. As such, avoidance is recommended to prevent interfering with the “prehistoric house foundation” on the southern tip of the island, and, the beached boat and Inukshuk at the beach landing area, through the designation f of a 20 m buffer zone.

7. CLOSURE

We trust the above meets your present requirements. If you have any questions or require additional details, please contact the undersigned.

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APPENDIX I

PHOTOGRAPH LOG

Former Mid-Canada Line Radar Site Photo Log

No.	Direction	Site	Comment
1-62	all	n/a	aerial photographs of Bear Island
63-66		n/a	airstrip landing area
67-72	all	WP 003	signpost (house foundation/cross)
73-82	all	n/a	misc. photos of south east side of island
83-88	W	GbHg 1	tent ring
89-90	NW	n/a	recent faunal
91-94	all	n/a	misc. photos west side of island
95-107	all	n/a	marooned boat on the beach, east side of island
108-116	all	n/a	beach landing area and cove
117-123	all	n/a	crew on overlook above cove
124-125	S	n/a	rock upland overlooking cove
126-138	NE	n/a	"Inukshuk" above cove
139-144	NE	n/a	rusted out snowmobiles
145-146	NW	n/a	one water storage area
147	S	n/a	pipeline
148-152	all	n/a	Doppler detection foundation Site 412
153-159	NW	n/a	south end of esker in north half of island
160-168	all	n/a	Doppler detection foundation Site 413
169-175	all	n/a	misc. photos near Doppler detection foundation Site 413
176-187	N	n/a	photos of north end of island (white specs are polar bears)
188-192	S / SW	n/a	central west side of island
193-201	SE	n/a	south central, east side of island
202-204	SW	GbHg 1	tent ring
205-207	SW	n/a	signpost stand
208-211	SW	n/a	southern tip of island
212-214	NE	GbHg 1	gravel pit with GbHg 1 on right edge
215-218	NW	n/a	storm clouds
219-223	n/a	n/a	rifle stock with syllabic writing
224-230	all	n/a	staging area

APPENDIX 11:

BEAR ISLAND
LIST OF ADDITIONAL DOCUMENTS

BEAR ISLAND MID-CANADA LINE RADAR STATION REMEDIATION PROJECT
- List of Additional Documents -

DATE	TITLE	AUTHOR	LOCATION
1996	Environmental Assessment of Two Mid-Canada Line Sites at Bear Island, NWT	Environmental Sciences Group, Royal Roads Miliary College	Will be provided upon request
2002	Former Mid-Canada Line Radar Station, Bear Island, Nunavut. Environmental Site Delineation and Material Recovery	Earth Tech	Will be provided upon request
2008	Bear Island Mid-Canada Line Radar Station Phase III Environmental Site Assessment, Materials Audit and Geotechnical Evaluation	Earth Tech	Will be provided upon request
2008	Archaeological Impact Assessment of the Former Mid-Canada Line Radar Site, Bear Island, Nunavut	Golder Associates	Appendix 9
2008	Environmental Screening of the Proposed Investigation and Remediation of Bear Island Mid-Canada Line Radar Site Under the Nunavut Impact Review Board Process	AMEC Earth & Environmental	Appendix 6

APPENDIX 12:

BEAR ISLAND
SUPPLEMENTAL INFORMATION

SUPPLEMENTARY INFORMATION

The information listed below will be provided following award of the Contract and prior to mobilization to site:

1. Contractor Work Methodology Plan; including
    a. camp operation, including wastewater treatment unit specifications;
    b. details, including incinerator specifications and contaminated water treatment unit specifications;
    c. project drawings, including final location of camp, staging area, containerization area and any potential sumps; and
    d. a detailed work schedule
2. Environmental Protection Plan
3. Spill Contingency Plan, including
    a. site specific spill response plans;
    b. spill kit quantities and locations;
    c. training; and
    d. key contacts
4. Emergency Response Plan, including
    a. site specific response plans;
    b. roles and responsibilities;
    c. training; and
    d. key contacts