Indigenous and Northern Affairs Canada | Affaires autochtones et du Nord Canada

ROBERTS BAY
LONG TERM MONITORING PLAN

Revised March 29, 2017

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Appendices

1.0 Introduction

Roberts Bay and Ida Bay are abandoned silver mine sites. Explorations for silver at Roberts Bay and for silver and gold at Ida Bay were carried out at the sites between 1965 and 1972. Mining activities took place at the sites from 1972 to 1975. Further explorations continued at the leases throughout the 1980s and 1990s. In 1997 the Roberts Mining Lease was surrendered and the area covered by the lease was opened and subsequently re-staked as the ORO 5 claim in 1998.

INAC completed the site assessment of the site, developed a Remediation Action Plan (RAP), and carried out the remediation of the site between 2008 and 2010. The remediation involved the demolition and disposal of buildings, structures and other debris; the clean up of hazardous materials; and the excavation and disposal of metals and petroleum hydrocarbon contaminated soils.

1.1 Location

Roberts Bay and Ida Bay sites are located approximately 115 kilometres southwest of Cambridge Bay on the north coast of mainland Nunavut. The Roberts Bay site is located approximately 1 km north of Roberts Lake while the Ida Bay mine site is located adjacent to Melville Sound about 6 km north of the Roberts Bay site (Figure 1).

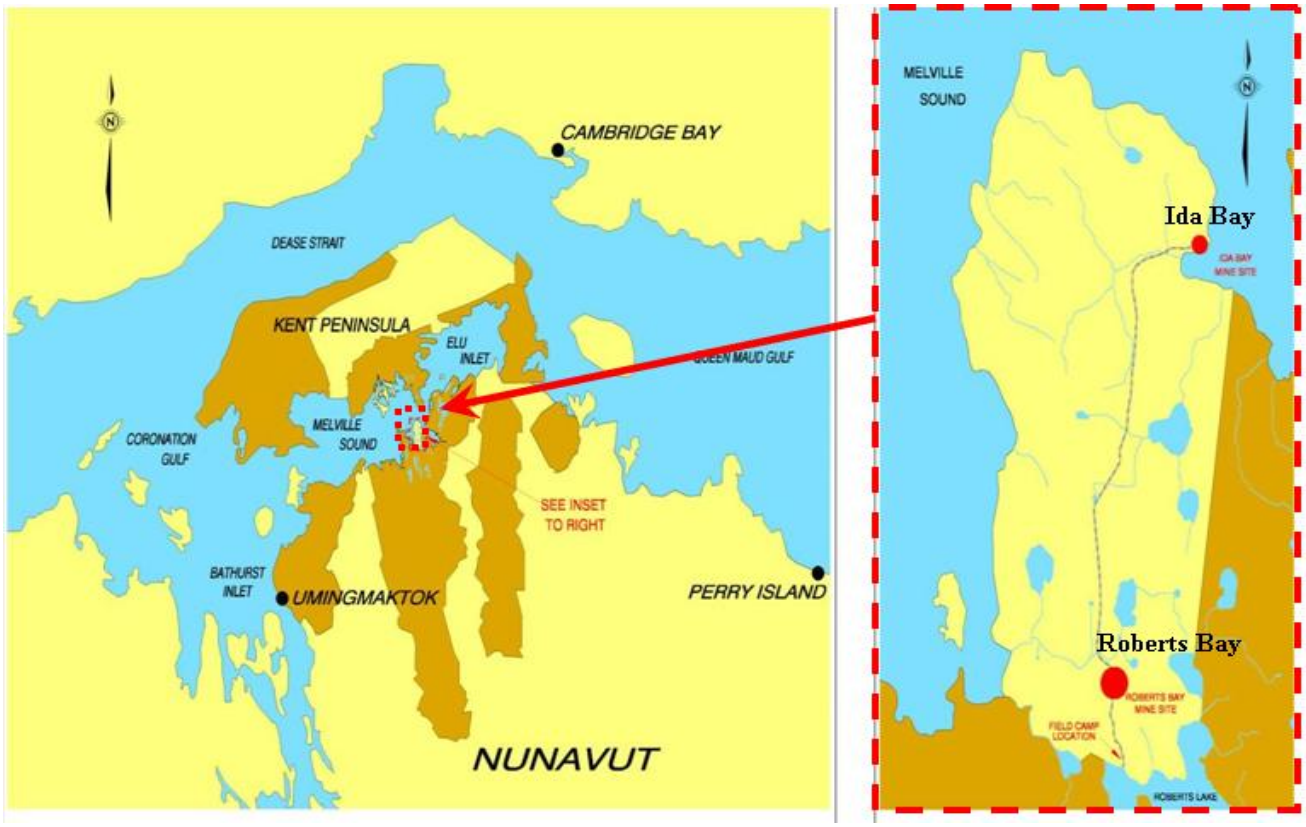


Figure 1: Roberts Bay and Ida Bay Location

1.2 Site Characteristics

1.2.1 Roberts Bay Site

The Roberts Bay mine site has been in a state of abandonment for nearly 30 years. It contained residual infrastructure; tailings pond; waste rock; abandoned equipment; non-hazardous wastes and debris (e.g. scrap metal, wood, mill equipment, appliances and burlap bags); hazardous wastes (e.g. petroleum products, batteries, propane tanks, assay lab reagents and some unknown chemicals); petroleum and metals impacted soil.

The site also contained two mine openings (1 adit and 1 vertical shaft) and a capped vent raise. The adit was surrounded by a chain-link fence meant to prevent accidental access to it, but had deteriorated over time. The adit was fully flooded. The vertical shaft was located on the side of a basaltic ridge and was accessible by climbing the ridge. The shaft was open and the walls looked partially caved in. There was a fence surrounding 2/3 of the perimeter of the shaft, allowing access to the shaft opening. There were stability problems surrounding the collar. The vent raise had been capped with concrete.

Geochemical assessment conducted on the waste rock and the tailings at the site suggest that these materials were potentially non-acid generating.

1.2.2 Ida Bay Site

Similar to Roberts Bay, Ida Bay mine site had been in a state of abandonment for nearly 30 years. The site consisted of one adit; a partially covered vent raise; three waste rock piles; three exploration trenches; and a small amount of non-hazardous debris (scrap wood and metal). The adit was in poor condition and fully flooded. There was no physical barrier to the adit entrance with the exception of the water preventing access. The vent raise was covered with plywood and was flooded. The three exploration trenches found on the site were open.

Waste rock piles were located adjacent to the adit. The smallest of the three piles was located immediately north of the adit and extended from land into the ocean. The second pile was located west of the adit while the third large elongated pile was located to the west of the second pile.

Geochemical assessments conducted at the site suggest that the waste rocks were potentially non-acid generating.

1.3 Climate

No weather station was available at Roberts/Ida Bay. The closest weather station is the Cambridge Bay Airport station, operated by Environment Canada, which is about 115 Km Northeast of Roberts Bay. At this station, the average annual total precipitation is 138.8 mm, consisting of 69.6 mm rainfall and 821 mm snowfall. The mean daily high

temperature for July is 12.3°C and low of 4.6°C. The January mean daily high temperature is -29.3°C and low of -36.3°C. The fluctuation between highs and lows for daily temperature averages 7.0°C.

Local climate data, in association with the near-by Doris North Project, has been collected at the Windy Lake and Boston mineral exploration camps since 1993. The project area has a low Arctic ecoclimate with a mean annual temperature of –12.1°C with winter (October to May) and summer (June to September) mean daily temperature ranges of -50°C to +11°C and -14°C to +30°C, respectively. The mean annual total precipitation ranges from 94 mm to 207.3 mm. Annual lake evaporation (typically occurring between June and September) is estimated to be 220 mm.

1.4 Geology

The Roberts Bay/Ida Bay project area (the project area) is coastal lowland with numerous lakes and ponds separated by glacial landforms and parallel running geological intrusions of diabase dykes and sills. The drainage basins are generally long and narrow and predominantly oriented along the north-south axis. Low lying areas at the site are saturated and marshy and underlain by clayey silt with permafrost detected at depths of 0.3 to 0.6 m. The dominant soils are Turbic and Static Cyrosols. Elevated areas are typically underlain by a silty, gravelly sand till, saturated if poorly drained with permafrost at approximately 0.6 m below grade. Occasional granular deposits are found in the vicinity of the site at surface and are typically well graded sands and gravels with 1 to 2% silt/clay.

The project area is found within the Hope Bay Volcanic Belt in the north of the Slave geological province; a geological sub-province of the Canadian Shield. The rocks within the region are primarily Archean in age and within the Yellowknife Supergroup. The region is underlain by the late Archean Hope Bay Greenstone Belt. This geological formation ranges from 7 to 20 km in width and over 80 km in length, orientated in a north-south direction. The late Archean Hope Bay Greenstone Belt lies entirely within the faulted Bathurst Block forming the northeast portion of the Slave Structural Province. The rocks in this belt are dominantly mafic to felsic lavas and tuffs, namely basalts and andesites that have undergone metamorphism to greenschist facies. Inclusions of granite, granodiorite and quartz veins are common throughout the volcanic belt. Along the margins, at the contact of the volcanics with granite, there are both structural and metamorphic deformations. Both the Roberts Bay and Ida Bay silver mineralization are found within vein structures. The structures of the deposits are generally controlled along a fault, and economic ore minerals included silver, copper, lead and zinc.

2.0 Monitoring Program

After completion of remediation at the Roberts Bay and Ida Bay sites, the only structure that remains is the non-hazardous waste landfill (landfill) at the Roberts Bay Site. No landfill was required at the Ida Bay site. The non-hazardous wastes/debris from Ida Bay

was co-managed with the non-hazardous wastes from Roberts Bay at the Roberts Bay site's landfill. Due to the small amounts of metals and PCB contaminated (TIER II) soils at the site, there will not be any need for a Secure Soil Disposal Facility (SSDF).

2.1 Details of the Non-Hazardous Waste Landfill

The landfill was constructed at Roberts Bay in July 2009. The location of the landfill is at the tailings pond (Appendix B).

The landfill was constructed by first stabilizing the existing four perimeter tailings pond berms. Tailings spilled over existing berms was consolidated and managed in the pond. Standing water in the tailings pond was drained, treated and discharged appropriately. A woven geotextile was laid on the tailings followed by about 0.3 metre thick granular material for stabilization of the surface. The non-hazardous waste was placed in the landfill in layers consisting of 0.5 metre lifts of waste covered by 0.15 metres of granular fill. Once all the layers were completed a final cover of granular fill was used to cap the landfill.

The final construction steps included grading to promote drainage and the installation of the thermistors to monitor freezeback. No monitoring wells were installed as the zone is a permafrost zone and the wells were not likely produce any additional information.

The landfill at Roberts Bay will contain: non-hazardous demolition debris, such as timbers, plywood, and sheet metals; non-hazardous site debris, such as scrap metal and wood; non-hazardous debris/soil excavated from site dumps; creosote timbers; and asbestos (double-bagged).

2.2 Monitoring Requirements

The monitoring procedures for the Roberts Bay site are similar to those defined in the INAC's Abandoned Military Site Remediation Protocol, AMSRP (2008), with some modifications as applicable to mine sites. The protocol recommends three categories of monitoring: pre-construction baseline monitoring, post-construction monitoring, and natural environment monitoring.

2.2.1 Baseline Monitoring

The baseline monitoring procedure recommended by INAC AMSRP (2008) involves soil monitoring and groundwater monitoring. Groundwater monitoring will not be required at this site as the zone is a permafrost region and the well may not yield any water.

- Soil Monitoring:

  INAC AMSRP (2008) specifies that, for baseline monitoring, soil samples will be taken at a grid spacing of 50 m x 50 m. In 2010, 7 samples were collected within the

vicinity of the landfill (taking into consideration, the site topography) and 4 samples were collected a minimum of 200 m from the landfill for background.

The samples were analyzed for:

- Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc
- Polychlorinated biphenyls (PCBs)
- Hydrocarbon Fractions, F1, F2, F3 and F4

These data supplemented the soil information collected during the assessment phase of the site and will be used as the baseline soil data to which subsequent monitoring data would be compared.

- Water (Runoff) Monitoring:

Water samples were collected (following spring melt) from the channel running towards Roberts Lake and other channels surrounding the landfill area that could hold water during spring melt. This includes ROB-6 to ROB-10 monitoring locations identified in Table 1.

Table 1: Summary of Surface Water Sampling Locations

Sample	Description
ROB-06	Surface water to southeast of SWMF that may at times flow South to Roberts Lake
ROB-07	Southwest of the SWMF
ROB-08	Northeast of SWMF (to detect possible leachate and runoff)
ROB-09	Roberts Lake (for background and control)
ROB-10	Southeast of SWMF (to detect possible leachate and runoff)

Water samples were analyzed for:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals
- Major ions, hardness, total dissolved solids, total suspended solids
- pH and conductivity
- PCBs

These data supplemented the surface water information collected during the assessment phase of the site and will be used as the baseline surface water data to which subsequent monitoring data would be compared.

2.2.2 Post-Construction Monitoring

The INAC AMSRP (2008) recommends a landfill monitoring procedure which involves visual monitoring; soil monitoring and groundwater monitoring. Thermal monitoring is only required if the landfill being monitored is either a Tier II facility or a leachate containing landfill.

Since the Roberts Bay site is a mine site (not military) and because the landfill is being built on top of the tailings, the INAC AMSRP (2008) was modified whereby thermal monitoring will be used to monitor the permafrost aggradation in the landfill to ensure that the tailings and other content of the landfill are immobilized. Also, no groundwater monitoring will be required because the zone is a permafrost zone and groundwater wells will not likely produce any additional information. Similar to the baseline monitoring, surface water samples will be collected, during flow, from the channels surrounding the landfill.

The long term monitoring program at Roberts Bay is as follows:

- Visual Monitoring
    - This will check the physical integrity of the landfill and look for evidence of erosion, ponding, frost action, settlement and lateral movement (Appendix D contains a Visual Monitoring Checklist).
    - Photographs will be taken to document the condition of the landfill and substantiate the recorded observations.

- Soil Monitoring

  Soil samples will be taken at the toe of the landfill (and locations where seepage or staining has been identified as part of the visual inspection) and towards the down gradient and along the channel that runs towards Roberts Lake. These samples will be analysed and the results will be compared to baseline/background samples. The parameters that will be analysed include:

    - Inorganic elements: arsenic, cadmium, chromium, cobalt, copper, lead, nickel, and zinc
    - Polychlorinated biphenyls (PCBs)
    - Total Petroleum Hydrocarbons (TPH)

- Surface Water Monitoring

  Water samples will be collected (following spring melt) from the channel running towards Roberts Lake and other streams surrounding the landfill area. This will include ROB-6 to ROB-10 monitoring locations identified in Table 1. These samples will be analysed and the results will be compared to baseline/background samples.

Water samples will be analyzed for:

- Petroleum Hydrocarbon Fractions, F1 and F2
- Total and dissolved metals
- Major ions, hardness, total dissolved solids, total suspended solids.
- pH and conductivity
- PCBs

- Thermal Monitoring
  - In 2009, three (3) sets of thermistor strings were installed at selected intervals to provide ground temperature profiles at various locations within the landfill. Automatic data loggers attached to the thermistors allow remote data collection. The data from this system will be collected and analysed to confirm permafrost re-establishment of the landfill.

2.2.3 Natural Environment Monitoring

The natural environment was assessed after site remediation and during subsequent site visits. Both site specific and regional information are collected. For full details of the site specific data and regional data that are required, reference can be made to the INAC AMSRP (2008). For the Roberts Bay site, the required natural environment monitoring data is incorporated into Appendix D – the Visual Monitoring Checklist.

2.3 Monitoring Frequency

The post construction monitoring frequency will follow the schedule recommended in the INAC AMSRP (2008). The three phases recommended by the protocol are:

- Phase I: years 1, 3 and 5
- Phase II: years 7, 10, 15 and 25
- Phase III: beyond 25 years

Monitoring at the Roberts Bay began in 2010. Phase I monitoring took place in 2010, 2012, and 2014. Each of the four monitoring events discussed above (i.e. visual monitoring, soil monitoring, surface water monitoring, thermal monitoring, and natural environment monitoring) will be conducted during each site visit. The visits will be carried out between the months of July to September. An evaluation of Phase I monitoring data was carried out at the end of the 2014 program and additional (phase II) monitoring was required.

Phase II monitoring will be carried out during the years 2016, 2019, 2024 and 2034. At the completion of the 25 year monitoring program a review will take place and the need for continued monitoring (phase III) will be assessed.

Table 2, below, outlines the monitoring schedule.

Table 2: Monitoring Schedule

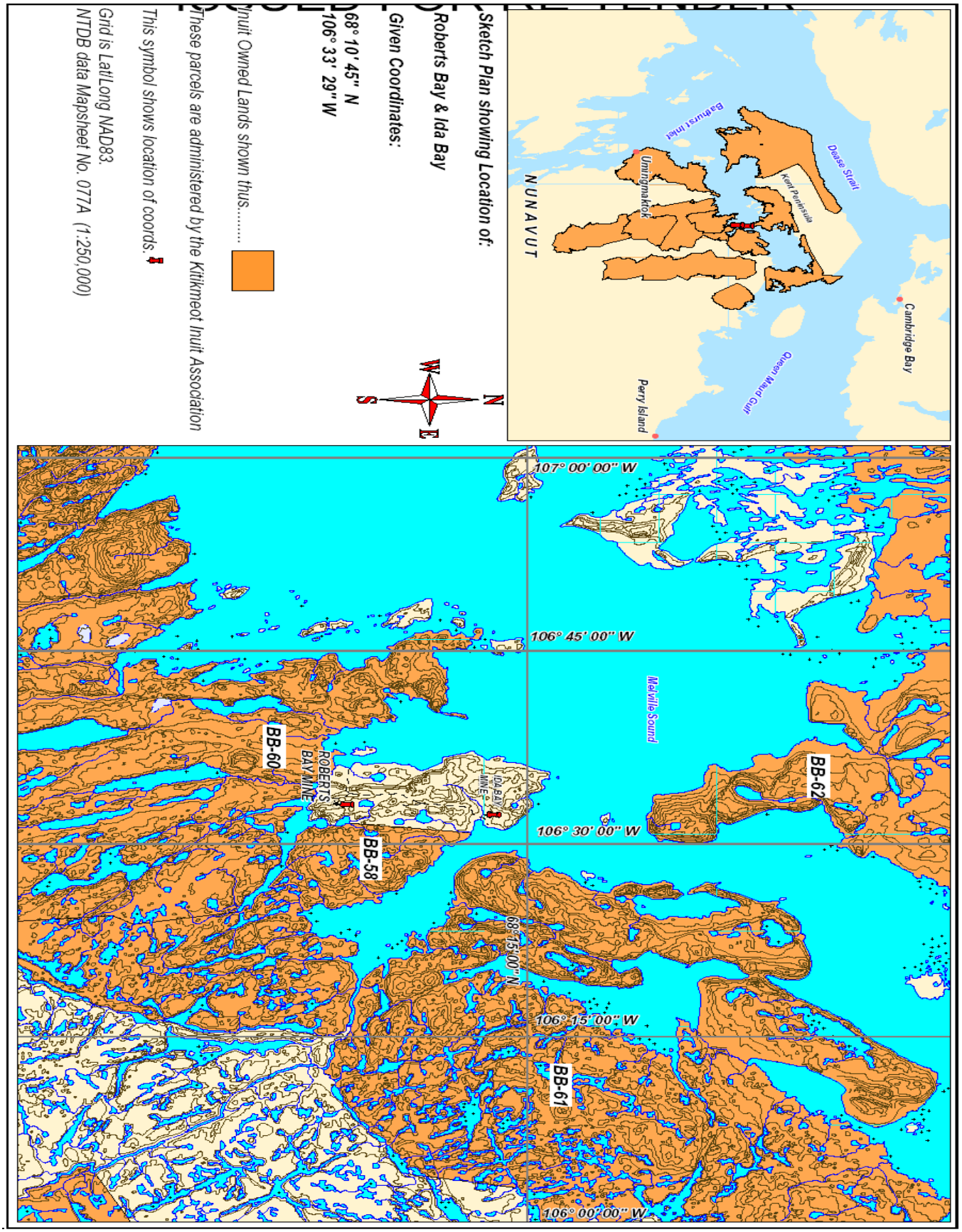
Year	Site Monitoring Scheduled (X)
2010	X
2011	
2012	X
2013	
2014	X
2015	
2016	X
2017	
2018	
2019	X
2020	
2021	
2022	
2023	
2024	X
2025	
2026	
2027	
2028	
2029	
2030	
2031	
2032	
2033	
2034	X
2035	

3.0 Quality Assurance/Quality Control

All sampling, sample preservation and analyses will be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater". All analysis will be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Accredited Laboratory.

Quality Assurance/Quality Control (QA/QC) will be consistent with CAEAL regulations and guidelines. At least 20% of samples will be taken and analyzed in duplicate and all appropriate QA/QC data will be generated and reported.

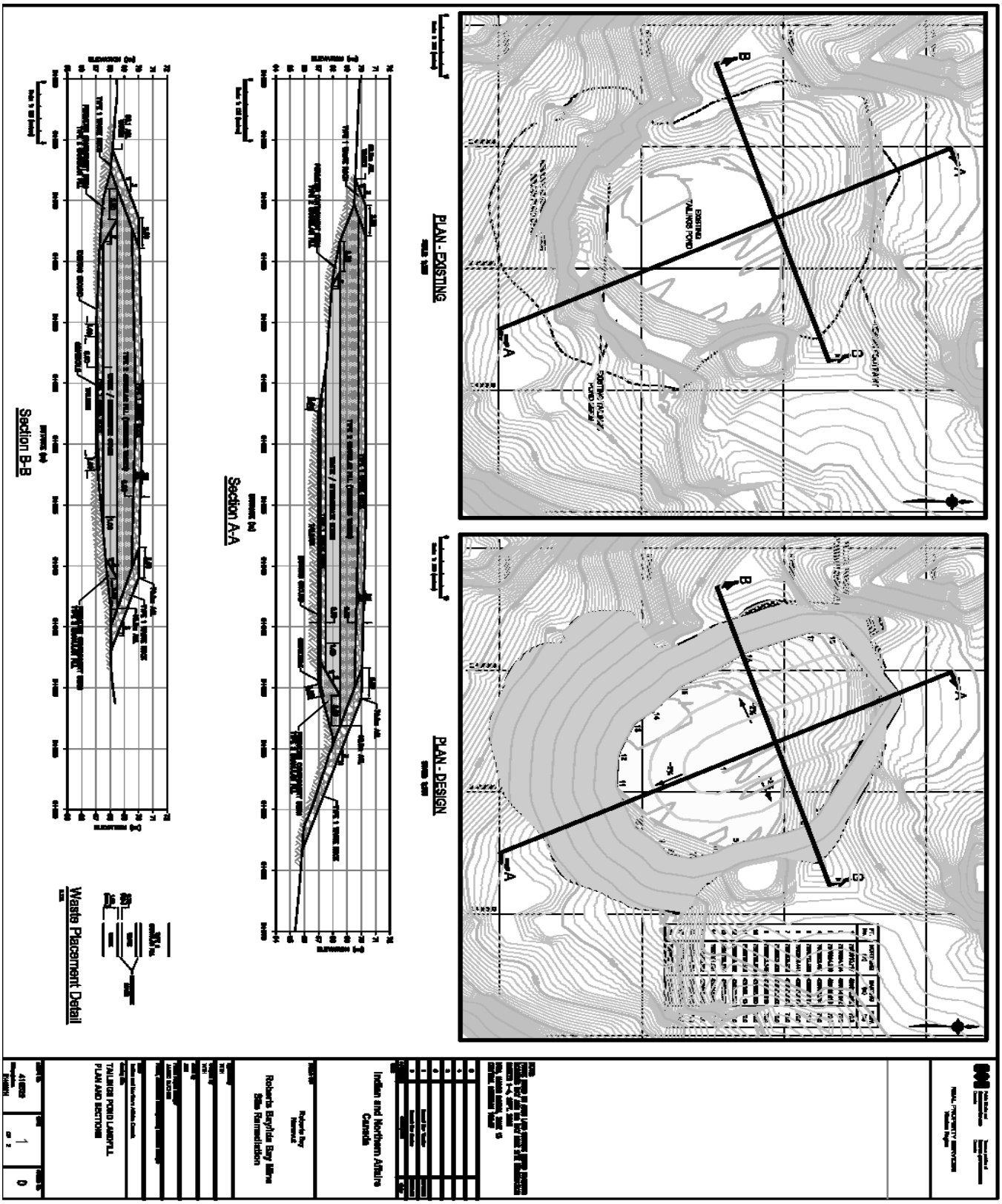
Appendix A: Roberts Bay and Ida Bay Map

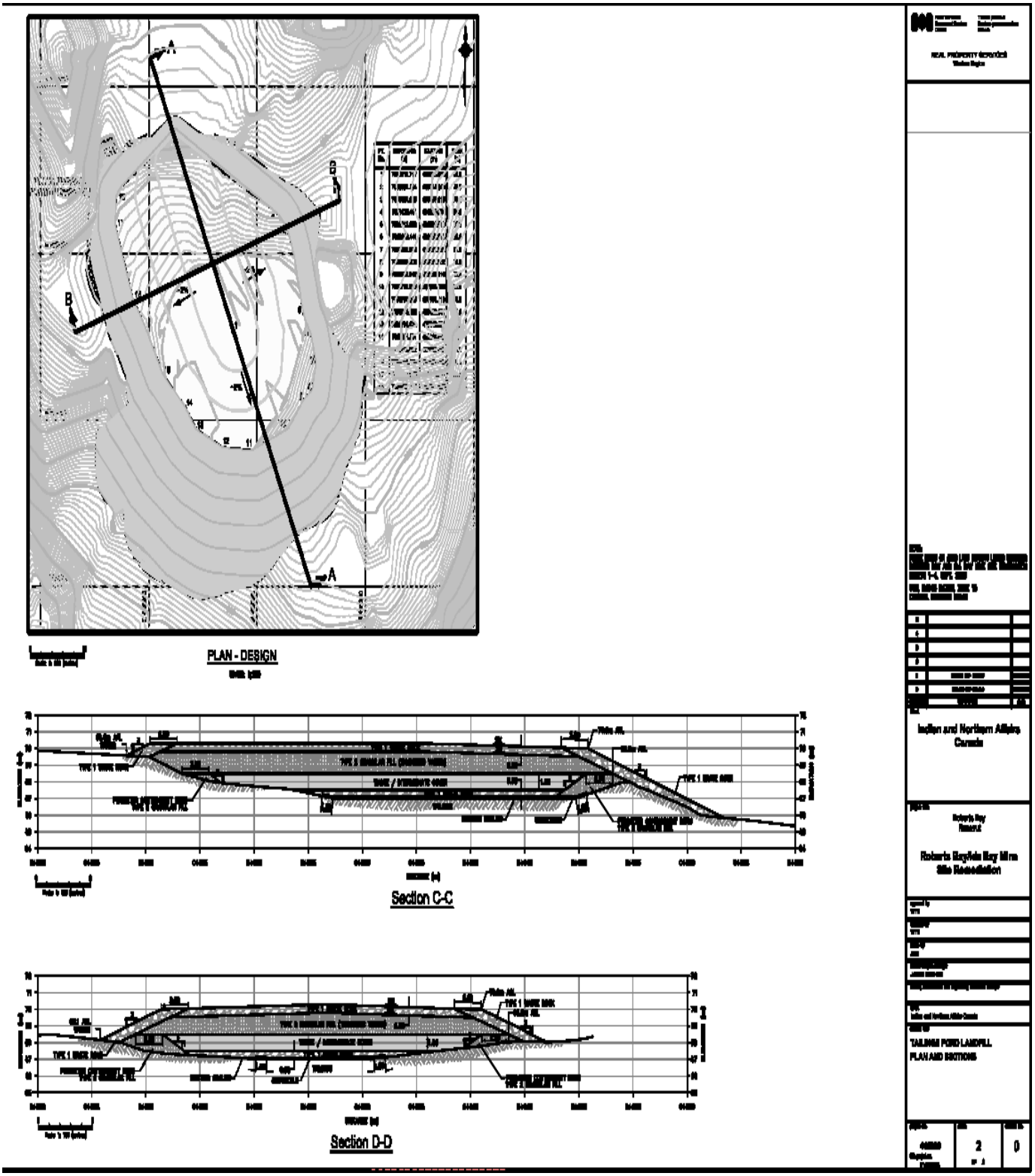

Sketch Plan showing Location of:
Roberts Bay & Ida Bay
Given Coordinates:
68° 10' 45" N
106° 33' 29" W
Inuit Owned Lands shown thus.....
These parcels are administered by the Kitikmeot Inuit Association
This symbol shows location of coords.
Grid is Lat/Long NAD83.
NTDB data Mapsheet No. 077A (1:250,000)
N
W
E
S
NUNAVUT
Umingmaktok
Bathurst Inlet
Dease Strait
Kent Peninsula
Cambridge Bay
Queen Maud Gulf
Pery Island
107° 00' 00" W
106° 45' 00" W
106° 30' 00" W
106° 15' 00" W
106° 00' 00" W
68° 15' 00" N
Melville Sound
BB-60
BB-58
BB-62
BB-61
ROBERTS BAY MINE
IDA BAY MINE

Appendix B: Non-Hazardous Waste Landfill Location Map (Tailings Pond Area)


N
Scale
0 10 20 30 m
To Exploration Camp
Old campsite with debris
Road to landing at Roberts Lake
Tailings pond
Mill building
Mine adit and vestibule
To Background Lake (RBSM-4)
To Ida Bay site
Beach
Till berm
Stained soil
Fine ore hopper
Coarse ore hopper
Conveyor belt
Assay lab
Hazmat storage
Fine ore pad
Cone crusher
Stained soil and drums
Drums
Ridge
Waste rock piles
Waste rock berm
Waste rock pad
Fuel bladder
Quartz rich berm materials
Stained soil
Old waste rock pad scrap metal storage
Metal debris
Garage
Waste rock piles
Old explosives magazine
Covered vent raise, concrete cover
Mine shaft/Adit
Waste rock berm for camp landfill
Scrap metal debris
Outhouse
Wood debris
Wood debris
Old appliances
Scrap metal debris
Wood debris
Core
Burlap sacks
RBSM-1
RBSM-MILL-1
RBSM-MILL-HAZ1
RBSM-GAR PRODUCT-1
RBSM-GAR PRODUCT-2
RBSM-GAR-1
RBSM-GAR-2
RBSM-GAR-W-1
RBSM-TF-1
RBSM-TF-2
RBSM-TF-3
RBSM-TF-4
RBSM-TF-5
RBSM-TF-6
RBSM-TF-7
RBSM-TF-8
RBSM-2
RBSM-3
RBSM-CAMP-1
RBSM-VAL-1
1,2
3
4
5
6
7
9
10
LEGEND:
Road/Fill Materials
Waste Rock Berms
Bedrock Outcrop
Till
Tundra
Waste Rock Sample
Tailings Sample
Water Sample
Hazmat Sample
Soil Sample

Appendix C: Non-Hazardous Waste Landfill As-Built Drawings


PLAN - EXISTING
PLAN - DESIGN
Section A-A
Section B-B
Waste Placement Detail
Indian and Northern Affairs Canada
Roberts Bay
Roberts Bay Mine Site Remediation
TAILINGS POND LANDFILL
PLAN AND SECTIONS


A
B
B
A
PLAN - DESIGN
Section C-C
Section D-D
Indian and Northern Affairs Canada
Roberts Bay
Site Remediation
TAILINGS POND LANDFILL
PLAN AND SECTIONS
2
0

Appendix D: Visual Monitoring / Natural Monitoring Checklist

Roberts Bay and Ida Bay
VISUAL MONITORING CHECKLIST

Date:	
Landfill:	

Visually assess the landfill for the following items & provide a photograph record

1. Erosion	Answer
a) Is erosion occurring on the surface or berms of the landfill?	
i) Are there preferred drainage channels?	
ii) Is there sloughing of material?	
b) What is the extent of the erosion? *(percentage of surface area)*	
i) Is it localized or continuous?	
c) Where is the erosion occurring? *(i.e. along the toe, on the surface, through the berms)*	
d) Explanation: *(i.e. evidence of significant surface water run-off, poor material)*	

2. Settlement	Answer
a) Is there differential settlement occurring on the surface?	
i) Are there low areas or depressions?	
ii) Are voids forming?	
b) What is the extent of the settlement? *(percentage of surface area)*	
i) Is it localized or continuous?	
ii) How deep is it?	
c) Where is the settlement occurring? *(i.e. near berms, near the centre of the facility)*	
d) Explanation: *(i.e. evidence of significant surface infiltration, water ponding, snow drifting)*	

3. Frost Action	Answer
a) Is there frost action/damage to the landfill?	
i) Is there exposed debris due to uplift?	
ii) Is there tension cracking along the berms?	
iii) Is there sorting of granular fill?	
b) What is the extent of the frost action? *(percentage of surface area)*	
i) Is it localized or continuous?	
c) Where is the heaving/cracking occurring? *(i.e. along the toe, on the surface, through the berms)*	
d) Explanation: *(i.e. poor material, poor compaction, high water/silt content in cover material)*	

4. Monitoring Instruments
a) What is the condition of the monitoring wells and thermistor strings*(if applicable)*?
5. Others - Confirm presence or absence, extent and description of the following
Animal Burrows: Vegetation: Staining: Vegetation Stress: Seepage Points: Exposed Debris: Other observed features:

6. Sketch

7. General Comments