

10.0 Abandonment and Decommissioning Plan

The contractor is required to complete the clean up and remediate all of the areas in which their activities took place, as described in this Project Description. Following completion of the clean up activities, all vehicles and equipment, remaining fuel, supplies and construction camp are to be removed from the site by the contractor, which typically coincides with the annual sea-lift

The following sections provide a summary of the closure activities that will occur at the completion of the clean up at the CAM-5 site.

Contractor Demobilization: Contractor demobilization includes the dismantling and removal from the site of all vehicles and equipment, remaining fuel, supplies and construction camp, clean up of the site, and transportation of labour from the site. Upon removal of the construction camp, the contractor is to grade the area to match the surrounding terrain and to ensure positive drainage.

Demolition: Upon the completion of the demolition work, the contractor is to remove any remaining debris and leave the work site clean. Building sites and all areas affected by demolition work are graded. The areas surrounding remaining concrete and timber foundations are reshaped so that the top of the gravel is flush with the top of the foundation. Any voids or holes in the surface of the foundation are filled with gravel.

Contaminated Soil Excavation: In areas of contaminated soil excavation, the excavations are filled with granular material, compacted and graded to match the existing ground surface.

Landfarm Closure: At the conclusion of landfarm operations, additional granular material is placed to provide a compacted cover. The surface area is graded to a minimum slope of 2-4% to promote surface water run-off. Groundwater wells installed around the perimeter of the landfarm are decommissioned, including backfill with grout.

Non-Hazardous Waste Landfill: A final lift of granular material will be placed, compacted and the surface graded to avoid water ponding and minimize infiltration at the completion of landfill operations. Following completion of the landfill closure, groundwater monitoring wells are installed to facilitate monitoring of the landfill performance.

Tier II Soil Disposal Facility: Placement and compaction of the final cover of the landfill also includes grading to promote drainage away from the landfill. Following closure of the Tier II Soil Disposal Facility, groundwater monitoring wells and thermistor strings are installed to facilitate monitoring of the facility's performance.

11.0 Monitoring and Maintenance Plans

11.1 Monitoring in Relation to the Environmental Assessment

Monitoring involves a continual on-site review of impact predictions made during the environmental assessment process. The purpose of the monitoring is two fold:

- To confirm the accuracy of impact predictions made if, and when, they occur on-site and to ensure that mitigative action taken is appropriate; and
- To be able to identify impacts that occur on-site that may not have been identified during the assessment process, but require an appropriate mitigative measure.

The results of this on-site assessment will be reviewed on an annual basis as part of the project quality assurance program. Any assessment and impact predictions requiring adjustment or re-evaluation will be identified at this time.

11.2 Monitoring in Relation to Environmental Objectives

As part of the overall DLCU program, the DND will undertake an extensive multiple year post clean up monitoring program at the CAM-5 site. The purpose of the program is to ensure that environmental objectives, particularly those related to landfill remediation, continue to be met. The specific tasks related to the monitoring of each landfill are based on the associated risk. A site specific monitoring plan will be developed upon completion of the clean up.

The Environmental Working Group will review the results of each monitoring event and provide recommendations to the Steering Committee. In those cases where remediation standards are not being maintained, engineering and/or other solutions will be developed and implemented to rectify the situation.

The following table outlines the monitoring requirements for the landfills at CAM-5.

Table 16: Landfill Monitoring Requirements

Landfill Designation	Visual Inspection	Soil Sampling	Groundwater Sampling	Thermal Monitoring
Covered Landfills	Yes	No	No	No
Upper Site Landfill (Leachate contained)	Yes	Yes	Yes	Yes
Tier II Soil Disposal Facility	Yes	Yes	Yes	Yes
Non-Hazardous Waste Landfill	Yes	Yes	Yes	No

The proposed locations of the groundwater monitoring wells and soil sample locations are shown on the drawings provided in Appendix A. These locations are approximate and will be ground-truthed during construction and the GPS coordinates of the locations will be collected.

11.3 Construction Monitoring Program

The program during the construction phase of the project addresses the requirement for effluent monitoring of the sewage lagoon.

Table 17: Monitoring Requirements During the Construction Phase

Location	Sample Type	Frequency	Parameters
C5-1	Sewage Effluent (water)	Twice. Once at 30 days after establishment and once prior to discharge.	Mineral oil & grease
			Total suspended solids
			Biological oxygen demand
			Faecal coliforms
			pH

GPS Coordinates will be collected after establishment of the sewage lagoon.

11.4 Post-Construction Monitoring Program

11.4.1 Introduction

The following summary is being provided for the post-construction landfill monitoring program as described in the DND/NTI Environmental Cooperation Agreement for the former CAM-5, Mackar Inlet DEW Line site (see Appendix B). Information on both the development and review process for the program, as well as the specific components of the program are included.

11.4.2 Background

The DND, in cooperation with the NTI, developed a landfill monitoring plan to address post closure monitoring requirements for the landfills at the DEW Line sites. DCC is managing the cleanup and monitoring programs on behalf of the DND.

The objective of the landfill monitoring program is to collect sufficient information to assess the performance of the landfills from a geotechnical and environmental perspective. The landfill monitoring plan specifies the requirements for visual inspection, and chemical and thermal monitoring of landfills at the DEW Line sites under DND's jurisdiction

11.4.3 Program Components

The post-construction landfill monitoring program consists of four main components to measure the performance of the landfills, which depend on the remediation plan for each landfill. These components are visual, soil, groundwater, and thermal monitoring. Details on each of the monitoring components are provided below.

Visual Monitoring: The physical integrity of the landfill is inspected and reported. Documented observations include:

- Evidence of settlement, ponding, frost action, erosion, and lateral movement.
- Sloughing of berms/covering layers, thermal contraction cracks, etc.

Photographic records are to be provided to document the general condition of the landfill and to substantiate all recorded observations. The location of all photographic viewpoints will be referenced to existing monuments.

Soil and Groundwater Monitoring: The soil and groundwater monitoring program consists of baseline/background assessment and contaminant evaluation. Background conditions represent soil and water quality from an area not impacted by the landfill. Background (naturally occurring) values are obtained from samples collected from areas that were not directly influenced by activities at the DEW Line

site, but are indicative of the prevailing geochemistry. These samples are taken hydraulically upgradient and at some distance from the landfill area, prior to any remediation and/or construction work being carried out. These samples are generally collected from areas both up and downgradient of the landfill.

Soil and groundwater samples (where required) are collected prior to construction/closure of a landfill, to represent background as well as baseline conditions. The results of subsequent landfill monitoring events are compared to these baseline and background values to evaluate any potential changes in environmental conditions

In general, one monitoring well is installed upgradient and two to three wells are installed downgradient of the landfill during the construction phase. Using water elevation data from a minimum of three wells allows assessment of the hydraulic gradient and flow velocities. Review of analytical data from water samples collected from wells up and down gradient allows evaluation of potential impacts associated with the landfill. Soil samples are collected from the toe of the landfill, generally from the same locations as the monitoring wells. Contamination in soil samples at the toe of the landfill reflects chronic input from water that may have infiltrated the landfill, and is an important factor of contaminated leachate

Prior to collection of samples from a monitoring well, the well is purged and allowed to reach equilibrium. Physical measurements are collected prior to and after purging and are referenced to the top of the monitoring well pipe. The measured physical parameters include:

- Water elevation;
- Total depth of water;
- Presence of hydrocarbons;
- Hydrocarbon layer thickness (if appropriate);
- Colour, odour;
- pH;
- Conductivity; and
- Temperature.

Thermal Monitoring: Geothermal analysis were carried out as part of the design to predict the length of time required for permafrost aggradation through landfills requiring leachate containment, including the Upper Site Landfill and the Tier II Soil Disposal Facility. These analyses also provided information on the long and short term thermal regime in the ground, and the depth of the active layer in the cover material.

A thermal monitoring system provides measurement of sub-surface ground temperatures, which allows comparison to and verification of the predicted ground temperatures. The thermal monitoring system consists of installation of thermistor strings, with thermistor beads at selected intervals to provide ground temperature profiles at various locations within the landfill. The thermistor strings are attached to automated data-loggers that allow for remote data collection. In general, a minimum of three thermistors are installed at each landfill where permafrost aggradation through the landfill contents in an integral part of the design.

11.4.4 Frequency

The landfill monitoring program consists of three phases, as described in detail below.

11.4.4.1 Phase I

Phase I involves monitoring of conditions to confirm that equilibrium is achieved. The frequency of monitoring events during Phase I is dependent on the closure or remediation design at specific landfills. The Upper Site Landfill and Tier II Soil Disposal Facility will be monitored on an annual basis for the first

five years. The five-year term was selected on the basis that ground temperature thermal regimes at these landfills will require three to five years to reach equilibrium.

The Non-Hazardous Waste Landfill, Lower Site Landfill – South and the USAF Closure Landfill will be monitored over a reduced frequency in the first, third and fifth years following construction in Phase I. The Airstrip Landfill and Lower Site Landfill – North are being excavated and therefore do not require any monitoring.

An evaluation of all Phase I data will be carried out at the end of five years to confirm that thermal and chemical equilibrium is achieved, and that no stability issues are identified. The Phase I monitoring program may be extended, if required, to provide sufficient data to establish equilibrium conditions.

The first year of the Phase I post-construction monitoring is completed by the ESG of the Royal Military College of Canada, who are part of the DLCU Project Team. Subsequent landfill monitoring events are carried out by independent contractors, who successfully win the competitive tender.

11.4.4.2 Phase II

Phase II monitoring is the verification of equilibrium conditions established in Phase I. The monitoring frequency in Phase II is downgraded from Phase I and will be carried out according to the following schedule: year 7, year 10, year 15 and year 25

11.4.4.3 Phase III

Phase III involves the monitoring for long-term issues such as liner integrity, permafrost stability and significant storm events. At the end of the Phase II program, a re-evaluation of the landfill monitoring program will be carried out prior to initiating any Phase III program. The scope of the Phase III monitoring program is not included here, but is anticipated to be based on a 10-year monitoring interval,

11.4.5 Review and Evaluation Process

An Environmental Working Group (EWG) was established to provide a technical report and to support the DLCU Steering Committee. The working group is comprised of qualified engineering and environmental scientists with expertise in environmental remediation and clean up in northern climates. The EWG has four designated representatives, two from each of the Owner (DND) and the Inuit (through the NTI), respectively.

During the monitoring program, the EWG reviews the results of the monitoring program in accordance with the methodology as described previously. The results of the review and any recommendations regarding changes to the monitoring plan and/or remediation requirements are reported to the DND/NTI Steering Committee

The requirement for further monitoring after 25 years is evaluated. Monitoring may be terminated if the performance of the landfill was satisfactory over the period of monitoring from an environmental and geotechnical perspective, as appropriate. The assessment of satisfactory performance is carried out jointly by the NTI and DND.

11.5 Detailed Landfill Monitoring Requirements

The following sections provide a summary of the detailed monitoring requirements for each landfill at CAM-5. Drawings showing the landfill areas are in Appendix A.

11.5.1 Tier II Soil Disposal Facility

A Tier II Soil Disposal Facility is being constructed at the CAM-5 site for the disposal of Tier II contaminated soils excavated during the clean up. Consistent with the Environmental Provisions of the Cooperation Agreement, monitoring of the facility consists of visual monitoring for evidence of settlement, erosion, differential movement, collection of soil and groundwater samples from around the facility to monitor the effectiveness of the containment system, and monitoring of sub-surface ground temperatures in the berms and in the main body of the disposal facility. Table 18 provides the detailed monitoring requirements at the Tier II Soil Disposal Facility. See Drawings H-M27/1-9101-108 and 117 for details. The drawings will be updated upon construction completion.

Table 18: Detailed Monitoring Requirements at the Tier II Soil Disposal Facility

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	N/A
TBD	Groundwater	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	Total Arsenic Total Cadmium Total Chromium Total Cobalt Total Copper Total Lead Total Nickel Total Zinc Total Mercury PCBs Total Petroleum Hydrocarbons (C ₆ -C ₃₂)
TBD	Soil	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	PCBs TPH as F1 (C ₆ -C ₁₀) TPH as F2 (C ₁₀ -C ₁₆) TPH as F3 (C ₁₆ -C ₃₄) Arsenic Cadmium Chromium Cobalt Copper Lead Nickel Zinc Mercury
TBD	Thermal	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	Temperature

11.5.2 Non-Hazardous Waste Landfill

The Non-Hazardous Waste (NHW) Landfill is being constructed at CAM-5 for the disposal of non-hazardous debris, demolition material and Tier I contaminated soils that are a result of cleanup activities.

Monitoring of the NHW Landfills includes visual monitoring for evidence of settlement, erosion, differential movement, and periodic collection of soil and groundwater samples from around the facility to monitor for the presence of leachate. Table 19 provides the detailed monitoring requirements at the NHW Landfill. See drawings H-M27/1-9101-108 for more information. The drawings will be updated upon construction completion.

Table 19: Detailed Monitoring Requirements at the Non-Hazardous Waste Landfill

Location	Sample Type	Frequency	Parameters
Determined on-site	Visual	Once per year in years 1, 3, 5, 7, 10, 15, 25 post-construction	N/A
TBD	Groundwater	Once per year in years 1, 3, 5, 7, 10, 15, 25 post-construction	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C ₆ -C ₃₂)
TBD	Soil	Once per year in years 1, 3, 5, 7, 10, 15, 25 post-construction	PCBs
			TPH as F1 (C ₆ -C ₁₀)
			TPH as F2 (C ₁₀ -C ₁₆)
			TPH as F3 (C ₁₆ -C ₃₄)
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

11.5.3 Upper Site Landfill

The Upper Site Landfill was used for the disposal of a variety of wastes and debris from the construction and operation of the site. Based on the environmental and engineering investigations, it was determined this landfill posed a moderate potential environmental risk. Therefore, the remediation plan for this landfill is to install a leachate containment system. Monitoring will include visual monitoring for evidence of settlement, erosion, differential movement, collection of soil and groundwater samples from around the facility to monitor the effectiveness of the containment system, and monitoring of subsurface ground temperatures in the berms and in the main body of the landfill. Table 20 provides the detailed monitoring requirements at the Upper Site Landfill. See Drawings H-M27/1-9101-104 and 109 for details on the proposed monitoring locations. The drawings will be updated upon construction completion.

Table 20: Detailed Monitoring Requirements at the Upper Site Landfill

Location	Sample Type	Frequency	Parameters
Determined on site	Visual	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	N/A
TBD	Groundwater	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	Total Arsenic
			Total Cadmium
			Total Chromium
			Total Cobalt
			Total Copper
			Total Lead
			Total Nickel
			Total Zinc
			Total Mercury
			PCBs
			Total Petroleum Hydrocarbons (C ₆ -C ₃₂)
TBD	Soil	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	PCBs
			TPH as F1 (C ₆ -C ₁₀)
			TPH as F2 (C ₁₀ -C ₁₆)
			TPH as F3 (C ₁₆ -C ₃₄)
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
TBD	Thermal	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	Zinc
			Mercury
TBD	Thermal	Once per year in years 1, 2, 3, 4, 5, 7, 10, 15, 25 post-construction	Temperature

11.5.4 USAF Landfill, Asbestos Landfill and Lower Site Landfill South

Based on the environmental and engineering investigations, it was determined these landfills pose a low environmental risk. The remediation plan for these landfills is to remove surface contamination and surface debris and regrade the landfills. The monitoring plan includes visual monitoring, and the periodic collection of soil samples to monitor for potential leachate. The monitoring stations for these landfills are not yet available. Table 22 provides the detailed monitoring requirements at these landfills. See drawings H-M27/1-9101-102, 106 and 108 for further details. The drawings will be updated upon construction completion.

Location	Sample Type	Frequency	Parameters
Determined on-site	Visual	Once per year in years 1, 3, 5, 7, 10, 15, 25 post-construction	N/A
TBD	Soil	Once per year in years 1, 3, 5, 7, 10, 15, 25 post-construction	PCBs
			TPH as F1 (C ₆ -C ₁₀)
			TPH as F2 (C ₁₀ -C ₁₆)
			TPH as F3 (C ₁₆ -C ₃₄)
			Arsenic
			Cadmium
			Chromium
			Cobalt
			Copper
			Lead
			Nickel
			Zinc
			Mercury

12.0 Information Sources

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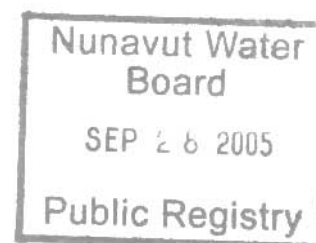
UMA, *Specifications for the Clean Up of the CAM-5, Mackar Inlet DEW Line Site – Draft*. UMA Engineering Ltd., in association with SGE Acres, 2005.

EBA, *DEW Line Clean Up Project CAM-5 (Mackar Inlet) DEW Line Site Geotechnical Investigations and Preliminary Landfills Designs*. EBA Engineering Consultants Ltd., 2003.

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APPENDIX A

Drawings





LANDS - WATER LOTS OUTSIDE OF THE
BOUNDARIES ARE UNDER DIAND
JURISDICTION

Custodian : DIAND
Reserve requested by DND 56/08/10
Established by DIAND 56/08/29,
Privy Council



CAM-5

MACKAR INLET

FINAL

Reserved for DND /
Réservé pour le MDN

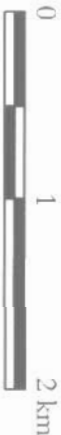
Inuit Owned Lands/
Terres en propriété Inuit

The original reserve boundary was created using the I/SAR notes and bounds description
This description has inherent limitations (as demonstrated where it extends into the water).
The anomalies have been left on the map as the notes and bounds description
was used to originally reserve the land for DND

Carte de base : carte topographique 47B/7 / Échelle 1 : 50 000, Zone LTM 16.
Publié par la Direction des levés et de la cartographie
Ministère de l'énergie, des mines et des ressources, Ottawa, 1975.
Background information : Topographic map 47 B/7 (Scale 1: 50 000, LTM Zone 16,
Produced by the Surveys and Mapping Branch
Department of Energy, Mines and Resources, Ottawa, 1975.



Scale / Échelle : 1 : 40 500



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DEW LINE CLEAN UP PROJECT

DRAWING INDEX					
DRAWING No.	TITLE	DRAWING No.	TITLE	DRAWING No.	TITLE
SITING		SITING		STRUCTURAL	
H-W27/1-9101-101	OVERALL SITE PLAN	H-W27/1-9101-114	LANDFILL CROSS SECTION AND DETAILS	H-W27/1-9101-205	MODULE TRAIN UNITS 1A-25 PLAN
H-W27/1-9101-102	PROJECT LAYOUT	H-W27/1-9101-115	ARSTRIP LANDFILL PLAN AND CROSS SECTION	H-W27/1-9101-206	MODULE TRAIN UNITS 1A-25 ELEVATIONS
H-W27/1-9101-103	STATION AREA SITE PLAN	H-W27/1-9101-116	NON-HAZARDOUS WASTE LANDFILL CROSS SECTION	H-W27/1-9101-207	UNHEATED VEHICLE STORAGE PLAN AND ELEVATIONS
H-W27/1-9101-104	STATION AREA NORTH AND SOUTH SITE PLANS	H-W27/1-9101-117	TER II DISPOSAL FACILITY KEY TRENCH EXCAVATION PLAN & GRADING/INSTRUMENTATION PLAN	H-W27/1-9101-208	OIL STORAGE SHED AND POL. PLUMHOUSE PLANS, SECTION AND ELEVATIONS
H-W27/1-9101-105	LOWER SITE AREA SITE PLAN SH. 1	H-W27/1-9101-118	TER II DISPOSAL FACILITY CROSS SECTION AND DETAIL	H-W27/1-9101-209	RADAR TOWER/RADOME PLAN AND SECTION
H-W27/1-9101-106	LOWER SITE AREA SITE PLAN SH. 2	H-W27/1-9101-119	MISCELLANEOUS DETAILS SH. 1	H-W27/1-9101-210	COMMUNICATION DISH ELEVATIONS
H-W27/1-9101-107	ARSTRIP AREA SITE PLANS	H-W27/1-9101-120	MISCELLANEOUS DETAILS SH. 2	H-W27/1-9101-211	COMMUNICATION BILLBOARD, EQUIPMENT AND ELECTRICAL PLANS, SECTIONS AND ELEVATIONS
H-W27/1-9101-108	MIDDLE SITE LANDFILL AREA SITE PLAN			H-W27/1-9101-212	FUEL TANKS PLAN AND ELEVATIONS
H-W27/1-9101-109	UPPER SITE LANDFILL KEY TRENCH EXCAVATION PLAN & GRADING/INSTRUMENTATION PLAN	STRUCTURAL		H-W27/1-9101-213	ARSTRIP AUXILIARY FACILITIES STANDARD DETAILS
H-W27/1-9101-110	UPPER SITE LANDFILL CROSS SECTION	H-W27/1-9101-201	STATION AREA DEMOLITION SITE PLAN		
H-W27/1-9101-111	LOWER SITE LANDFILL - NORTH EXCAVATION PLAN	H-W27/1-9101-202	ARSTRIP AREA DEMOLITION SITE PLANS		
H-W27/1-9101-112	LOWER SITE LANDFILL - SOUTH PLAN AND CROSS SECTION	H-W27/1-9101-203	WAREHOUSE PLAN, SECTION AND ELEVATION		
H-W27/1-9101-113	LOWER SITE LANDFILL - SOUTH CROSS SECTION	H-W27/1-9101-204	GARAGE PLAN AND SECTION		

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