All contact water in the perimeter collection system is to be collected and tested to ensure it meets the wastewater discharge criteria prior to the end of each operation season. If the contact water does not meet these guidelines, it may be treated so that it does meet the criteria or it will be treated as hazardous material and disposed of off-site.

At the conclusion of the third treatment season, the following tasks are to be completed to close the landfarm:

- Confirmatory testing of the soils to ensure the remediation objectives have been met;
- Place and compact granular material from the perimeter berms to provide a cover over the remediated hydrocarbon co-contaminated with Tier I contaminated soils area. Additional cover material is to be placed to provide a 300 mm minimum depth of compacted granular fill as cover over this soil area. All granular fill is to be compacted to 95% Maximum Dry Density;
- Grade the surface of the area, as required, to promote surface water runoff;
- Decommission the groundwater monitoring wells, including backfilling with appropriate grout, removal of the protective casing, lockable cap and well pipe to within 300 mm from the ground surface, and backfill and compact all voids with granular fill material.

Further details on the design of the landfarm facilities are on Drawings 104, 111 and 116 in Appendix I.

5.5 Landfill Closure and Grading

There are five landfills at CAM-3 that will be closed. The following work will be completed as part of the closure:

- Removal of surface debris and compaction of the surface;

- Removal of source contamination at the Northeast Landfill;
- Supply and installation of geomembranes and geotextiles at the USAF Landfill;
- Supply, placement and compaction of additional gravel over the landfills;
- Grading to promote surface water run off from the landfills; and,
- Supply and installation of groundwater monitoring wells and thermistor strings (if required).

5.6 Description of Existing Landfills

5.6.1 Station Landfill

The Station Landfill is located approximately 200 m south of the module train along an elevated u-shaped ridge on the south side of the access road between the station and airstrip. The surface area of the landfill is 10,000 square metres, and the depth is estimated to be greater than 1.5 metre. The geophysical survey conducted at the landfill indicated that the debris was spread over five discrete areas. One area, containing a buried radar dish, was located outside of the main landfill area on the tundra. Debris was present over approximately 15% of the landfill surface, with some debris partially buried within the landfill. There are some debris and gravel piles near the toe of the landfill slope and further out in the wet low-lying area beyond the toe of the slope. The surface of the landfill is graded down to the southwest with side slopes ranging from 4.5 horizontal to 1 vertical (4.5H:1V) to 6.5H:1V. Despite the incline at the edge of the landfill (approximately 12-15% grade), no erosion was evident.

Drainage from the landfill accumulates in small depressions downgradient of the landfill, which drain intermittently along poorly defined channels towards a pond 200 m to the south. There are no marine or freshwater environments within 10 km of the landfill area. The small ponds in the vicinity of the landfill are not anticipated to support aquatic life. No drinking water sources are located within 1 km of the landfill.

There is approximately 60-80% vegetation cover in the undisturbed areas downgradient of the landfill. The habitat usage is moderate, with sightings of migratory animals such as caribou noted in the general area.

Residents of Taloyoak and Gjoa Haven may visit the area, and the likelihood and duration of contact are considered moderate and low, respectively, due to the considerable distance from the shoreline. Food consumption of migratory organisms is considered moderate and no sedentary organisms are harvested from this area.

The analytical data showed there was no evidence of contaminated leachate or leachate migration from the landfill. There was contaminated soil identified at one location covering approximately 9 m^2 on the surface of the landfill where battery fragments were located.

Based on the information collected, the results of the environmental screening of this landfill indicate a low to moderate risk to the surrounding environment. Therefore, the remediation option for this landfill is to cover it with granular material and grade it to promote surface runoff, minimize erosion, and stabilize the slope. The battery fragments and associated contaminated soil will be removed, as will all surface debris.

Further details on the remediation of this landfill are provided on drawings 104 and 109 in Appendix I.

5.6.2 Beach Landfill

The Beach Landfill is located approximately 100 m south of the Beach POL pad and about 50 m from the ocean. It is a large, relatively flat, disturbed area that was identified by geophysical survey as containing a significant amount of buried debris. The landfill consists of two pockets of debris and is approximately 2500 m^2 and between 1.0 and 1.5 m deep, based on the surrounding topography. Limited surface debris was present at the time of the site investigation. The average

landfill slope is less than 5%. The landfill cover consists of sand and gravel beach deposits that range in thickness from 0.1 to 0.5 m thick.

Drainage from the landfill is generally to the southeast towards Shepherd Bay, less than 100 m downgradient. There are no drinking water sources within 1 km of the landfill.

Vegetative cover is sparse over the landfill and downgradient due to the sand/gravel beach deposits. Habitat usage is considered low to moderate based on the general presence of caribou in the area. The potential impact on terrestrial organisms is considered low, given the absence of vegetation.

Residents of Taloyoak and Gjoa Haven may visit the site; however, the likelihood and duration of contact are considered moderate. Food consumption is low for migratory organisms. No sedentary organisms are harvested from the area.

Some minor areas of hydrocarbon contamination were identified at the landfill, but not at concentrations that are considered a risk to the environment. Leachate was not identified at this landfill. Based on the information collected, the landfill is considered a low environmental risk. Therefore, the recommended remediation option is placement of additional cover and grading.

For further details see Section 5.5 and Drawings 102 and 106.

5.6.3 USAF Landfill

The United States Air Force (USAF) Landfill is located approximately 2.6 km northeast of the main station. The landfill area is elevated approximately 1.0 m to 2.5 m above the surrounding tundra, extending out from the former beach ridge and road area, approximately 400 m south of the winter water supply lake. The area encompassed by the landfill is based on geophysical surveys which indicate the landfill consists largely of buried metal debris covering an area approximately 7,000 m^2, with an estimated depth of greater than 1.5 m. The surface of the landfill is relatively flat, with

slopes of 5%. The landfill slopes to the southeast. Geophysical surveys indicate the landfill consists largely of buried metal debris covering an area approximately 7,000 m2. Scattered surface debris covers approximately 20% of the area.

The landfill is covered with sand and gravel with a small amount of vegetation. Off the edge of the landfill, the terrain changes to poorly drained tundra consisting of a thick organic mat overlying dense silt or clay. The water table in the tundra is close to or at ground surface with standing water visible along portions of the landfill toe.

In general, the site drains to the southeast. Some leachate was observed on the southwest and northwest slopes. Surface water runoff is considered low due to the slope. There are no major drainage courses in the area. Drainage from the landfill accumulates in small depressions downgradient of the landfill, which drain intermittently along poorly defined channels towards a pond to the east. This pond is the primary aquatic receiving environment, approximately 750 east of the landfill. The summer water supply lake is 600 m west and upgradient of the landfill. The landfill is not anticipated to have an impact on the water supply.

Estimated habitat usage is moderate to high. Snowy owls were noted nesting downgradient of the landfill and caribou are known to frequent the area. Residents of Taloyoak and Gjoa Haven may visit the area, but the likelihood and duration of contact are considered low to moderate due to the distance from the shore. Food consumption is considered moderate for migratory organisms.

Localized soil contamination was detected on the surface of the landfill. It is apparent that some migration of contaminants has occurred; however, contaminants were not detected in any of the groundwater or surface water samples collected. The contaminant migration appears to be restricted by the surrounding low-permability soils. Analytical data suggests that elevated contaminant levels are present at the surface of the landfill, as opposed to at depth, showing that the primary migration pathway is more likely surface water runoff rather than leachate migration from within the landfill.

The results of the environmental screening found that there is a moderate risk to the surrounding environment, therefore a modified leachate containment (partial containment) design is recommended to prevent further infiltration into the landfill. A full containment system is not considered necessary because the migration from the landfill is not widespread. Surface debris will also be removed.

Details on the remediation of this landfill are in Section 5.5 and Drawings 104, 112, and 118-120 in Appendix I

5.6.4 North Warning System (NWS) Landfill

The NWS Landfill is located immediately adjacent to the northwest edge of the USAF Landfill and was in reportedly limited use after the 1989 and 1990 site assessment. The surface of the landfill has been capped with granular fill and graded, such that no debris is visible. An erosion channel runs through the length of the landfill. Results of the geophysical surveys and visual observations indicate the landfill contains a limited amount of debris in an area approximately 1,500 m^2. The depth of the landfill is estimated to be 1.0 m, based on the topography. Vegetation cover is sparse over the landfill, but is extensive in the area downgradient of the landfill.

In general, the site drains to the southeast. Surface water runoff is considered low due to the slope (5%). There are no major drainage courses in the area. Drainage from the landfill accumulates in small depressions downgradient of the landfill, which drain intermittently along poorly defined channels towards a pond to the east. This pond is approximately 750 m east of the landfill and is the primary aquatic receiving environment. The summer water supply lake is 600 m west and upgradient of the landfill.

Estimated habitat usage is moderate to high, given the presence of caribou and the nesting snowy owls. Residents of Taloyoak and Gjoa Haven may visit the area, but the likelihood and duration of contact are considered low to moderate because of the distance to the shore. Food consumption is

considered moderate for migratory organisms. No sedentary organisms are harvested from this area.

The results of the environmental screening show that there is a low risk to the surrounding environment. Therefore, the remediation option for this landfill is to cover it with granular material and grade it to promote surface runoff, minimize erosion, and stabilize the slope.

Additional details are provided on Drawings 104 and 112 in Appendix I.

5.6.5 Northeast Landfill

The Northeast Landfill is located approximately 1 km north of the module train. The centre portion of the landfill is a local topographic high, the east portion is relatively flat and the western portion slopes down to a wet low-lying area. Based on geophysical surveys and surface exposures, it appears that debris is buried in several isolated locations covering a large area approximately 60,000 m^2. The depth of the landfill is estimated to be 1.0 to 1.5 m, based on the topography. The average landfill slope is 7%. Debris is present along the toe of the landfill, consisting primarily of partially buried drums, equipment parts and domestic debris observed over 25% of the area. The cover material consists of gravely, cobbly soil and silty gravel with a trace of clay. Existing cover ranges from none to 0.5 m thick.

Drainage from the landfill is generally to the west. The drainage accumulates in small depressions downgradient of the landfill, which in turn drain intermittently along poorly defined channels towards a small pond. There is some potential for settlement of debris and/or minor erosion, and exposed debris. The primary aquatic receiving environment is a small pond, approximately 150 m west of the landfill. The north lobe of this landfill is approximately 600 m downgradient and southwest of the water supply lake.

Vegetative cover is sparse within the landfill, but extensive in the area downgradient of the landfill. Habitat usage is considered moderate, based on the presence of caribou in the area. Residents of Taloyoak and Gjoa Haven may visit the site, however, the likelihood and duration of contact are considered low to moderate, based on the considerable distance to the shoreline. Food consumption is considered moderate for migratory organisms. No sedentary organisms are harvested from this area.

Based on the results of the engineering and environmental investigations, there are two areas of surface contamination to be excavated on the landfill surface covering an area of approximately 140 m^3. The contaminated soil areas are associated with areas of debris. Investigations completed downgradient of these areas and along the perimeter of the landfill identified no discernable contaminant levels. In addition, water samples collected from the standing water along the western toe of the landfill identified no elevated contaminant levels, suggesting contaminant migration (leaching) is not occurring at the landfill.

The results of the environmental screening found that there is a low risk to the surrounding environment. Therefore, the remediation option for this landfill is to cover it with granular material and grade it to promote surface runoff, minimize erosion, and stabilize the slope. The contaminated soil areas and associated debris, as well as any other surface debris, will also be removed.

Additional details are provided in Section 5.5 and on Drawing 110 in Appendix I.

5.6.6 Asbestos Landfill

The Asbestos Landfill is located along the beach road 3.4 km west of the station along a till ridge within a former borrow area. The area is approximately 325 m^2 (13 m x 25 m). There is a small amount of scattered surface debris in the area. The landfill is well covered with granular material although there is some evidence of subsidence. See Drawing 103 for further details.

The EWG has determined that there is no risk posed by the landfill providing there is adequate cover. Therefore, the remediation option for this landfill is to cover it with granular material and regrade to compensate for minor settlement observed in the existing cover.

5.7 Disposal of Site Debris

All site debris is to be disposed of in accordance with the DND/NTI Agreement. All debris will be sorted and classified as hazardous and non-hazardous debris. Hazardous materials will be shipped off-site for disposal, non-hazardous materials will be placed in the NHW landfill.

Creosote treated timbers will be wrapped in plastic and asbestos double-bagged and disposed of in the NHW landfill. PCB painted material will be segregated and disposed of off site at a disposal facility

Where scattered or embedded debris is removed, the area will be reshaped if necessary and any voids left by removal of debris will be backfilled with granular material.

5.8 Barrel Disposal Requirements

In order to determine the correct disposal method for barrels and their contents, the contents must first be identified. All barrel contents are sampled and analyzed.

Analytical data obtained for the samples collected from barrels located at the site will be compared to the criteria included in Table 5-4, below. Barrel contents are identified as organic or aqueous and the concentrations of glycols, alcohols, PCBs, chlorine, cadmium, chromium and lead are determined. Uncontaminated aqueous phases can be disposed of on the land; 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.

Table 5-4: Barrel Protocol Criteria and Disposal Summary

Phase	% glycols or alcohols	PCB	Cl	Cd	Cr	Pb	Disposal
Organic	-	<2	<1000	<2	<10	<100	Incineration
Organic	-	>2	>1000	>2	>10	>100	Ship south
Aqueous	>2%	>2	>1000	>2	>10	>100	Ship south
Aqueous	>2%	<2	<1000	<2	<10	<100	Incineration
Aqueous	<2%						Scrub & discard

5.8.1 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: i.e., radioactive, explosive, corrosive, toxic, flammable.
- Symbols, words or other marks on the barrel that indicate that it contains discarded laboratory chemicals, reagents, or other possibly dangerous materials in small-volume containers.
- Signs of deterioration or damage such as corrosion, rust, or leaks at seams, rims, and V grooves.
- Spillage or discolouration on the top and sides of the barrel.
- Signs that the barrel is under pressure such as bulging and swelling.

5.8.2 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. Prior to sampling, barrels 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 using heavy equipment, according to accepted procedures and under qualified supervision. Once open, barrels will be sampled by personnel wearing proper personal protective gear. Samples of the contents of all barrels shall be extracted using a drum thief.

In instances where there are a large number of barrels with obviously similar contents, these can be grouped together and 30-40% 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 marker. The number on this label should be the only sample coding provided to the laboratory. The barrel locations and barrel sample description 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.

5.8.3 Testing

Liquid samples shall be inspected and classified as either containing water or organic materials. Samples thought to contain water shall be analysed 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 PCBs, total chlorine, cadmium, chromium, and lead, in addition to identification of the major components, i.e., fuel oil, lubricating oil.

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 described below.

5.8.4 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 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 ppm PCBs, 100 ppm chlorine, 2 ppm cadmium, 10 ppm chromium, and 100 ppm lead, may be disposed of by incineration. Alternatively, these contents may be disposed of off-site at a licensed facility. The solid residual material resulting from incineration shall be subjected to a leachate extraction test. Material found to be non-leachate toxic shall be disposed of as DCC Tier II 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 ppm PCBs, 1000 ppm chlorine, 2 ppm cadmium, 10 ppm chromium or 100 ppm lead will be disposed of off-site at a licensed disposal facility. Contents may be combined with compatible materials for shipping purposes. Flash points may be required to be determined if they cannot be inferred from the product identification.

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 (<2ppm), chromium (<10ppm), and lead (<100 ppm), it may be incinerated on-site.

5.8.5 Disposal of Barrels

Empty barrels may 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 75%. Shredded barrels may be disposed of in the NHW Landfill or off-site as recycled metals.

5.9 Demolition of Facilities

The work to be conducted at the CAM-3 site includes the demolition, removal and disposal or containerization of all structures and utilities as shown on the demolition drawings (see Drawings 201-204) and includes the following:

- Removal and disposal of all contents of buildings identified for demolition, including storage tanks. Tanks and pipes containing fuel must be pumped out or drained prior to cleaning and disposal.

- Removal, segregation and containerization of building facility components coated with PCB amended paint at PCB concentrations in excess of 50 ppm.

- Removal and disposal of asbestos material in accordance with the asbestos abatement program. Asbestos must be removed and disposed of in a method that eliminates the risk of exposure to friable asbestos. Proper personal protective equipment and specialized equipment is required when removing asbestos. Asbestos materials are bagged in polyethylene prior to placement in a NHW landfill.

- Removal and disposal of concrete contaminated with PCBs at concentrations in excess of 1 ppm and less that 50 ppm.
- Removal and containerization of concrete contaminated with PCBs at concentrations in excess of 50 ppm.
- Removal and placement of hazardous demolition waste material in containers in accordance with the Hazardous Waste regulations. Hazardous demolition waste is segregated and disposed of according to CEPA guidelines.
- Removal, wrapping in plastic, and disposal of creosote treated timbers. Creosote treated timbers must be wrapped in polyethylene sheets before being placed in a NHW landfill. Creosote coated power poles or foundations are to be cut off 300 mm below ground level.
- Removal and disposal of drainage culverts.
- Disconnecting and capping of services, as required.
- Non-hazardous materials require no special treatment and can be crushed and placed in the NHW Landfill.

Demolition debris to be disposed of on-site will be cut into shapes and sizes which will minimize void space when landfilled. Concrete foundations are largely left intact except where coated with PCB paints. Following the removal of site structures, demolition areas are reshaped or backfilled with granular fill to a height flush with the remaining foundations. All voids or holes that are left by foundation or structure removal are filled with gravel.

5.10 Removal of Hazardous Material

"Hazardous" waste materials are defined as waste materials that are designated as 'hazardous' under Nunavut Territorial or Federal legislation; or as 'dangerous goods' under the Transportation *of*

Dangerous Goods Act (TDGA). The Canadian Environmental Protection Act (CEPA) regulates material containing PCBs at greater that 50 ppm. Specifically identified hazardous materials include: batteries, asbestos, fuel tank bottom sludges, solvents, PCB-containing liquids, fuels and lubricating oils, alcohols and glycols, and heavy metal contaminated liquids. Disposal requirements of these hazardous waste materials are presented in Table 5-5.

Table 5-5: Hazardous Waste Material Disposal Requirements

Hazardous Waste Material	Disposal Requirement
• Batteries • Heavy-metal contaminated organic liquids Cadmium > 2 ppm Chromium >10 ppm Lead >100 ppm • Liquids containing organic compounds with chlorine concentrations >1000 ppm • Liquids containing organic compounds with PCB concentrations > 2 ppm and < 50 ppm • Liquids containing organic compounds other than those described above	Off-site licensed treatment/disposal facility (by separate contract).
• Fuel tank bottom sludges • Fuels, lubricating oils, alcohols and glycols	Off-site licensed treatment/disposal facility (by separate contract) OR On-site incineration in accordance with Sections 02090 of the contract specifications
• Liquids and solids containing organic compounds with PCB concentration > 50 ppm	Off-site licensed treatment and disposal facility

All hazardous materials are to be shipped off-site to a licensed hazardous material disposal facility. The exceptions to this are asbestos and creosote treated wood. Asbestos will be double-bagged and creosote-treated timbers will be wrapped in plastic and placed in the NHW Landfill. The locations these materials within the landfill will be marked on "as-built" drawings.

The paint on many of the building materials contains PCBs in excess of 50 ppm. These construction materials will be collected using suitable equipment for the task, containerized and

transported off site for disposal. Temporary storage of these materials on-site will be in accordance with the Temporary Storage of PCB Waste Regulations under CEPA.

5.11 Transportation of Hazardous Materials Off-site

Hazardous materials to be placed in environmental suitable containers at an approved containment facility on-site. A storage area is established as per Environment Canada guidelines. The hazardous materials are removed by sea lift in accordance with Transportation of Dangerous Goods Act.

5.12 Grading and Addition of Granular Materials

There were numerous areas identified that require grading and possibly addition of granular materials. These areas generally consist of piles of buried or partially buried, non-hazardous debris that will be covered with additional granular material and shaped to blend in with the natural terrain and promote positive drainage. These areas are identified in the drawings provided in Appendix I.

5.13 Contractor Support Activities

The following activities will occur on-site to support clean up work:

- Use of existing beach landing area, airstrip and roads at site for equipment transport, movement and access to work areas.
- Set-up of site for camp and equipment storage.
- Sewage from the camp will be handled with, at minimum, primary treatment (settling tank and lagoon) and discharged to ground surface. Sewage treatment and disposal will be in accordance with the Land Use Permit and Water Use License.
- Domestic waste to be disposed (as is, or incinerated as specified by the Land Use Permit) in the new Non-hazardous Waste Landfill.

- Demobilization of cleanup camp following end of project.
- Vehicle traffic to work areas is to be supported by the existing access roads that traverse the site.
- Labour and equipment requirements are anticipated to include 35- 50 personnel, 20 pieces of heavy construction equipment and 6 support vehicles.
- Duration of work is anticipated to be approximately 4 months, not including winter shutdown period, over a period of four years.

5.14 Future Activities

The site is a North Warning System Long Range Radar Site, and there are no current plans to change this land use. In addition, an on-going landfill monitoring program was agreed to in the DND-NTI Environmental Cooperation Agreement.