7.0 FACILITY DECOMMISSIONING AND CLEAN-UP OPTIONS

7.1 OVERVIEW

CAM-5, MacKar Inlet was an auxiliary station within the original DEW Station System. It will be decommissioned and totally abandoned. The DEW site will be restored under the DND/DIAND MOU, as discussed in Volume 2, Section 1.0.

As described in Volume 2, Section 6.2, the USAF removes and disposes of all the identifiable and recoverable hazardous materials as part of the normal site shut-down procedure. Hazardous materials, such as asbestos, which are integral to the structure of the facilities, are generally left in place. The "swept clean" facilities then become the responsibility of DND. Under the MOU, DIAND and DND will investigate the salvage potential of the various assets.

In the following sections, the decommissioning of CAM-5 MacKar Inlet is described and includes a summary of salvage options, demolition procedures, disposal of debris from demolition and the remedial action alternatives for the various facilities and features encountered at CAM-5.

7.2 DEMOLITION PROCEDURES

In Table 7.1, the facilities and features at CAM-5 are listed and the applicable demolition procedures are briefly described. Also included in the table are the salvage options for each facility. Hazardous materials integral to the structure are identified and the implications of these on the demolition procedure are discussed in the following sections. The column designated "Demolition Procedures" in Table 7.1, lists the actions required to demolish the remainder of the structure for the specific facility which has been shut-down, "swept clean" of recoverable hazardous materials and those components to be salvaged have been removed.

Three landfill sites were identified at CAM-5 during the site investigation in 1990 and are described in Section 6.3 of this report. These sites were not considered suitable for additional landfill activity due to their proximity to water sources and or drainage channels. A new landfill site should be engineered and developed for the disposal of debris from demolition.

7.2.1 ASBESTOS

Based on the previous surveys and sampling results presented in Section 5 of this report, it is evident that a significant amount of asbestos is present on site. Typically, the asbestos is in the form of pipe insulation for water heating lines and flue/exhaust stacks. Sheet asbestos was generally used in the fire barrier. As-built drawings also identified vinyl asbestos floor tiles in the module train. Analysis of floor tiles obtained at CAM-5 indicate an asbestos content of less than 1 percent. The asbestos content of all floor tiles at CAM-5 should be determined prior to demolition so that the proper procedures for demolition and disposal may be followed (Regulation 7/82).

These materials will have to be removed prior to demolition of the facilities following the guidelines presented in Table 6.7 in Volume 2. Properly packaged asbestos containing materials may be landfilled on site. The regulatory authorities, governing disposal of these materials are listed in Table 6.7 of Volume 2.

7.2.2 CREOSOTE TREATED TIMBER

Creosote treated timber was present in the wood foundations of the module train, storage sheds and shelter huts (FAC No's 1, 3009, 3010 and 3013). The preserved wood foundations are considered hazardous combustibles and should be landfilled as is.

7.2.3 PAINT

The paint samples obtained from CAM-5 contained moderate concentrations of the metals analyzed, and were generally considered to be typical of industrial oil based paints. Elevated levels of barium were detected in two samples. During demolition, all workers must be protected from the potential dust hazard.

Painted combustible materials, with the exception of wooden structures which have been treated with creosote, may be burned. Due to the heavy metals in the paint, ashes and residue must be collected and landfilled in a secure manner, such that the potential for generation of hazardous leachate is mitigated.

A Toxicity Characteristic Leaching Procedure (TCLP) was carried out on three paint samples taken from the exterior and interior of facilities at BAR-3. These results are considered typical for paint samples obtained at other sites. The test determines whether metals can leach from solids under acidic conditions in landfills. The results of the tests performed on the paint samples obtained from BAR-3, showed that the leachate was hazardous due to high lead concentrations. Additional leachate testing should be conducted using pH values typical of water in the Arctic. Surface water in the Arctic is generally alkaline, which would likely limit the leaching of metals from paint.

7.3 REMEDIAL ACTION ALTERNATIVES

7.3.1 APPROACH

Methods for restoring landfills and remediating contaminated soil were presented in Section 6.5.2 of Volume 2. The methods were described and evaluated for effectiveness, reduction of risk, implementability, cost and compliance with regulatory standards. Preferred options for landfill restoration and clean up of soils were discussed.

In this site volume, each facility (landfill, POL, outfall, pallet line and stained area) was assessed and problem areas defined for clean up action. In this section, the problems identified in Section 6.0, Site Assessment are summarized, and recommended action presented.

For each facility, the following information is presented in Table 7.2

- area potentially affected, based on the area used for the risk assessment and defined on the contaminant maps;
- indicator chemical of concern;
- level found, based on the Quebec Guidelines;
- a rating of environmental risk due to migration potential;
- number of samples required to further delineate an area of contamination;
- a rating of the physical hazards on the site;
- preferred action for remediation and restoration;
- soil remediation options;
- comments and other considerations.

7.3.2 SUMMARY OF PROBLEMS IDENTIFIED AND RECOMMENDED ACTION

This discusses the problems which have been identified at each location investigated on this site. On the basis of the evaluation, recommended actions have been instituted to reduce the risks present at these locations. These recommendations are given based upon the information available from the site visit. Additional information in the form of further laboratory analysis or more historical information may change the bias of the recommendation. Definitions of the main procedures used throughout this section are given in Volume 2.

7.3.2.1 Landfill A

PROBLEMS IDENTIFIED

- Metallic and other debris at this site represents a physical hazard.
- Staining was noted at the toe of landfill.
- TPH above Level B was found in one soil sample.
- PCBs and PAHs were noted in some of the soil samples.

RECOMMENDED ACTION

- Metallic surface debris should be removed and buried in an engineered landfill.
- As part of the clean-up procedure, the extent of soil contamination should be confirmed by field sampling and analysis prior to determining remediation options.
- The landfill should be restored in place to prevent erosion and eliminate drainage that could cause leachate production and migration of contaminants.
- To restore in place, the landfill should be capped with an impermeable liner constructed of soil or a synthetic material and local drainage restored.
- The landfill should be monitored for leachate production by testing surface water and soils biannually.

7.3.2.2 Landfill B

PROBLEMS IDENTIFIED

- Metallic and other debris represents a physical hazard.
- The disturbed area is extensive.
- There is potential erosion of the site along steeply sloping topography.
- The proximity to lake represents an environmental risk from long term leachate production if no action is taken.

RECOMMENDED ACTION

- Metallic surface debris should be removed and buried in an engineered landfill.
- As part of the clean-up procedure, potential soil contamination should be confirmed by field sampling and analysis prior to determining remediation options.
- The landfill should be restored in place to prevent erosion and eliminate drainage that could cause leachate production and migration of contaminants to the lake.
- To restore in place, the landfill should be capped with an impermeable liner constructed of soil or a synthetic material and the drainage rerouted.

- The landfill should be monitored for leachate production by testing surface water and soils biannually.

7.3.2.3 Landfill C

PROBLEMS IDENTIFIED

- Metallic and other debris represents a physical hazard.

RECOMMENDED ACTION

- Metallic surface debris should be removed and buried in an engineered landfill.
- As part of the clean-up procedure, soil contamination should be confirmed by field sampling and analysis prior to determining remediation options.
- The landfill should be restored in place to prevent erosion and eliminate drainage that could cause leachate production and migration of contaminants.
- To restore in place, the landfill should be capped with an impermeable liner constructed of soil or a synthetic material and local drainage restored.
- The landfill should be monitored for leachate production by testing surface water and soils biannually.

7.3.2.4 POL 1

PROBLEMS IDENTIFIED

- No visual indications of problems.
- No samples analyzed.

RECOMMENDED ACTION

- As part of the clean-up procedure, the extent of soil contamination should be confirmed by field sampling and analysis.
- The area should be restored by removing dykes, and regrading and covering with clean fill.

7.3.2.5 POL 2

PROBLEMS IDENTIFIED

- Some soil staining was evident and hydrocarbon odours were detected.
- Samples at the outside area of the berm contained TPH above Level B and trace levels of lead.
- There was some PCB contamination of soils in the outer dyke area.

RECOMMENDED ACTION

- Sampling should be carried out to determine the extent of lead, PCB and hydrocarbon contamination in soil including further subsurface regions.
- As part of the clean-up procedure, the extent of soil contamination should be confirmed by field sampling and analysis.
- PCB contaminated soils may be remediated by solvent extraction or placement in a secure landfill.

- Hydrocarbon contaminated soil may be remediated by incineration or placement in a secure landfill. The presence of PCBs requires that higher temperature be used if incineration is the remediation option.
- Lead contaminated soils may be remediated by either burying in a new engineered landfill or by solidification.
- The area should be restored by removing dykes, and regrading and covering with clean fill.

7.3.2.6 POL 3

PROBLEMS IDENTIFIED

- Hydrocarbons are migrating towards the lake, TPH concentrations exceeding Level C were found inside the dyke area.
- Some PAHs were detected.

RECOMMENDED ACTION

- As part of the clean-up procedure, the extent of soil contamination should be confirmed by field sampling and analysis.
- Hydrocarbon contaminated soil should be remediated by incineration or placement in a secure landfill.
- The area should be restored by removing dykes, and regrading and covering with clean fill.

7.3.2.7 POL 4

PROBLEMS IDENTIFIED

- Some soil staining is evident.
- Some evidence of hydrocarbon contamination was observed.
- Hydrocarbon films were observed on adjacent ponds within the dyke.
- Hydrocarbon and PCB contamination was found inside the dyke area, lead was detected above Level B.

RECOMMENDED ACTIONS

- As part of clean-up procedure, the extent of soil contamination should be confirmed by field sampling and analysis.
- Hydrocarbon contaminated soil may be remediated by incineration or placement in a secure landfill.
- As low-level PCBs are also present, incineration of the contaminated soil must occur at temperatures higher than those required for soils contaminated by hydrocarbons only.
- Ponded water with hydrocarbon sheens should be treated with sorbants.
- The area should be restored by removing dykes, and regrading and covering with clean fill.

7.3.2.8 Pallet Line 1

PROBLEMS IDENTIFIED

- Metallic surface debris should be removed and buried in an engineered landfill.
- Soil stains were not evident.

- PL-1 is a former landfill site with unknown buried materials.

RECOMMENDED ACTIONS

- Metallic surface debris should be removed and buried in an engineered landfill.
- As part of the clean-up procedure, soil contamination should be confirmed by field sampling and analysis prior to determining remediation options.
- The old landfill area should be capped with an impermeable liner constructed of soil or a synthetic material and local drainage restored.
- The old landfill should be monitored for leachate production by testing surface water and soils biannually.

7.3.2.9 Sewage Outfall A

PROBLEMS IDENTIFIED

- Volatile compounds detected in the pond 1.1 km north of the Main Module Train.
- PCB contamination above Level B was found in two soil samples.

RECOMMENDED ACTION

- As part of the clean-up procedure, the levels and extent of contamination should be confirmed by field sampling and analysis prior to soil remediation.
- After the extent of contamination has been determined, the appropriate soil remediation technique can be identified.
- PCB contaminated soils may be remediated by solvent extraction or placement in a secure landfill.
- The area should be restored by regrading and covering with clean fill.

7.3.2.10 Stain Area 1: Airstrip

PROBLEMS IDENTIFIED

- TPH was identified in a large stain area 50 metres northeast of the storage shed.
- PCBs in excess of Level A were present at this site.

RECOMMENDED ACTION

- As part of the clean-up procedure, the levels and extent of soil contamination should be confirmed by field sampling and analysis prior to soil remediation.
- Hydrocarbon contaminated soils may be remediated by incineration or placement in a secure landfill.
- As low level PCBs are present, incineration of hydrocarbon contaminated soil will require higher temperatures.

7.3.2.11 Stain Area 2: Main Module

PROBLEMS IDENTIFIED

- Several small stain areas were observed.
- A hydrocarbon film was noted on a small stream downslope from the Main Module Train.
- TPH and PCBs were detected in excess of Level A.

RECOMMENDED ACTION

- As part of the clean-up procedure, the levels and extent of soil contamination should be confirmed by field sampling and analysis prior to soil remediation.
- Hydrocarbon contaminated soil may be remediated using incineration or placement in a secure landfill.
- PCB contaminated soil should be remediated by solvent extraction or placement in a secure landfill.
- Due to the presence of PCBs in the soil, higher temperatures must be used for incineration of the hydrocarbon contaminated soils than if the soils were contaminated by hydrocarbons only.

TABLE 7.1: CAM-5, MACKAR INLET: FACILITY DESCRIPTION AND DEMOLITION PROCEDURES

Component	Description/Hazardous Materials	Salvage Potential	Demolition Procedures
Buildings			
a) Wood Frame Modular Buildings • Module Train FAC 1	• prefabricated modular units • wood frame with insulated plywood panels • exterior metal or plywood sheathing ■ asbestos insulating material ■ metals in paint	• system components for heating, plumbing, and electrical • salvage units intact for reuse • furnishings	■ remove/package/label asbestos insulation • remove metal cladding/cut into manageable sections ■ separate hazardous combustibles for disposal • burn non-hazardous combustibles
b) Insulated Steel Buildings • Garage FAC 2 • Warehouse FAC 3 • Vehicle Storage FAC 13	• steel frame with insulated metal panels • typical "pre-engineered structure" ■ asbestos insulation material ■ metals in paint	• system components for heating, plumbing, electrical • superstructure components may be dismantled for re-erection elsewhere • salvage of structural steel for scrap metal • furnishings	■ remove/package/label asbestos insulation • dismantle superstructure components/cut into manageable sections
c) Uninsulated Steel Buildings • POL Pumphouse FAC 11	• steel frame with exterior metal panels ■ metals in paint	• salvage of structural steel for scrap metal	• dismantle structure/cut into manageable sections
d) Insulated Wood Buildings • Shelter Hut FAC 3009 • Airstrip Hut FAC 3013 • Storage Shed FAC 3010	• timber frame - insulated plywood and/or canvas exterior	• heating system components	■ separate hazardous combustibles for disposal • burn non-hazardous combustibles
Foundation			
a)	• timber sill/skid ■ possible creosote in wood	• none	■ separate hazardous combustibles for disposal • burn non-hazardous combustibles
b)	• concrete slab/footings	• none	• drill holes in concrete slabs or footings and backfill • demolish concrete using mechanical means down to grade
c)	• concrete filled steel pipe	• none	• cut off at grade using mechanical means

TABLE 7.1 CONTINUED

Component	Description/Hazardous Materials	Salvage Potential	Demolition Procedures
External Utilities Facilities			
a) Sewage Lines • FAC 33	• steel pipe 106 m, 75 mm Ø ■ purge prior to salvage/disposal	• scrap metal	• purge, crush and cut into manageable sections ■ retain purged fluids for testing/ disposal
Communication Facilities			
a) Billboard Antenna • FAC 6 • FAC 7	• approximately 18 meters square reflector on steel truss structure • wave guide supported on plywood structure ■ metals in paint	• possible salvage of structural steel for scrap value • possible salvage of copper cable	• dismantle and cut into manageable sections • bundle copper cable
b) Dish Antenna • FAC 4 • FAC 5 • TVRO	• approximately 8 meter diameter dish on structural steel tower ■ metals in paint	• possible salvage of structural steel for scrap value	• dismantle and cut into manageable sections
c) Surface/Suspended Communication/Power Cable • FAC 26	• copper conducting wire sheathed in aluminum, or lead and encased in polyvinyl ■ lead casing	• possible salvage of copper cable	■ collect and separate hazardous from non-hazardous materials • bundle for disposal
POL Facilities			
a) Fuel Tanks • Diesel Tanks FAC 8, FAC 9, FAC 10 and Two (2) Additional Tanks • Mogas Tanks - Two Tanks	• steel construction - 3 tanks at 246 m^3 ea. - 2 tanks at 69 m^3 ea. - 2 tanks at 23 m^3 ea. ■ metals in paint	• possible salvage of tank for reuse or scrap metal	• purge, crush and cut into manageable sections ■ retain purged fluids for testing/ disposal
b) POL Lines • FAC 14	• steel construction - 50 mm Ø - 6,812 m ■ metals in paint	• exposed pipe may be salvaged for scrap value	• purge, crush and cut into manageable sections ■ retain purged fluids for testing/ disposal

TABLE 7.2: CAM-5, MACKAR INLET: SUMMARY OF CLEAN-UP OPTIONS

Location	Area Potential Affected (m^2)	Chemical Indicator	Level	Environ. Risk/ Migration Potential	No. of Sample Required	Physical Hazards	Preferred Action Required	Remediation Options	Comments
Landfill A	23360	TPH	B-C	Moderate	--	Moderate	Restore/Monitor		
Landfill B	72142	--	--	High	--	High	Restore/Monitor		
Landfill C	20800	--	--	High	--	Moderate	Restore/Monitor		
POL-1	--	--	--	Low	--	Low	Restore		
POL-2	4630	TPH/PCB	B-C	Low	10	Low	Further Evaluation Remediation if required Restore	TPH: Incineration/secure landfill PCB: Solvent extraction/ secure landfill	Subsurface delineation of TPH and lead.
POL-3	5334	TPH/PCB	C/A-B	High	20	Low	Further Evaluation Remediate Restore	TPH: Incineration/secure landfill	Delineation of degree and extent of TPH migration and impact to lake.
POL-4	5600	Lead/PCB TPH	B-C/A-B A-B	Low	--	Low	Remediate Restore	Lead: Secure landfill/ solidification TPH: Incineration/secure landfill	Confirmatory sampling for PCB, lead and TPH.
PL1	23100	--	--	Low	--	Low	Restore as per landfill/monitor		
Outfall	106200	PCB	B-C	Low	--	Low	Restore	PCBs: Solvent extraction/ secure landfill	Confirmatory sampling for PCBs.
Airstrip	--	--	--	Low	--	Low	Remediate, if required Restore	TPH: Secure landfill	Delineation of hydrocarbon contamination.
Main Module	120820	PCB/TPH	A-B/ A-B	Low	--	Low	Remediate, if required Restore	TPH: Incineration/secure landfill PCBs: Solvent extraction/ secure landfill	Landfill stained soils Stain characterization confirmatory sampling.

8.0 COST ESTIMATES

This section summarizes the estimated costs for the clean-up and decommissioning of CAM-5. It includes clean-up of contaminated soils, restoration of the site and facility demolition and disposal. As well, an overall cost for engineering and contract management is estimated. All costs are in 1991 Canadian Dollars.

8.1 CLEAN-UP OF CONTAMINATED SOILS

A cost estimate of the clean-up of contaminated soils at CAM-5 has been prepared based on the available analytical results, and the recommended remediation options discussed in Section 7.3. Details of the estimate are given in a separate document (UMA, 1991b). Where additional sampling is recommended in Section 7.3 (POL-2 and POL-3) the estimate assumes the worst case, that a portion of the area will require remediation.

The estimate assumes that all landfilling will be done on site and all borrow sources will be on site.

The estimated costs for remediation are summarized in Table 8.1. The estimate is preliminary and is intended for budget allocation purposes only. It can be expected to have an accuracy in the range of +/- 40 percent.

8.2 RESTORATION OF SITE FEATURES

The cost estimate for the restoration of the site is summarized in Table 8.1. The components of and assumptions for restoration are given in Section 7.3 and the detailed estimate in a separate document (UMA, 1991b). This estimate is expected to be in the range of +/- 40 percent.

8.3 FACILITY DEMOLITION AND DISPOSAL

The cost of demolition and disposal of the facilities as recommended in Sections 7.1 and 7.2 is given in Table 8.1. This cost estimate is intended for budgeting purposes only, based on the assumptions given in Volume 2, Section 7. The estimate is expected to be accurate to +/-25 percent.

8.4 ENGINEERING, CONTRACT MANAGEMENT, TESTING AND MONITORING COSTS

Table 8.1 includes an allowance of 15 percent for Engineering and Contract Management plus 5 percent for confirmatory testing, plus CN$100,000 for future monitoring. The rationale for this is discussed in Volume 2, Section 7.

The "Engineering" portion includes implementation planning and preparation of plans specifications and contract documents for the restoration work. The first step in the implementation planning involves the additional testing recommended in Section 7.3 and Table 7.2, plus surveying to locate the samples and prepare site base plans. This is estimated (UMA, 1991b) to cost CN$102,000 and is included as part of the 15 percent Engineering and Contract Management allowance.

The contract management portion of the allowance covers the administration of the contracts, on-site inspection of the work and technical support to the contract manager. An allowance of CN$100,000 is included for future monitoring (based on 4 monitoring visits to a typical site). In this case, the allowance is provided to account for unknowns related monitoring of the landfill.

The 5 percent testing allowance covers the confirmatory testing recommended as Phase VI of the site clean-up process described in the National Guidelines for Decommissioning Industrial Site (Monenco, 1989). This testing would be performed in each area to be restored.

8.5 SUMMARY

The total estimated cost for this site, including the allowance for engineering, management and testing is CN$13,208,000 based on the recommendations presented in Section 7 of this volume.

The rank of CAM-5 (with respect to the other 20 DEW Line sites), which may be used to determine the priority for budget allocation, is discussed in Volume 2, Section 7 and summarized in Volume 1, the Executive Summary.

TABLE 8.1

CAM-5, MACKAR INLET SUMMARY OF RECOMMENDED ACTIONS AND ESTIMATED COST

Location	Area (m2) Potentially Affected	Recommended Action	Estimated Remediation Cost	Estimated Restoration Cost
LANDFILL A	23,360	1. Restore area. 2. Monitor.		$701,000
LANDFILL B	72,142	1. Restore area. 2. Monitor.		$2,164,000
LANDFILL C	20,000	1. Restore area. 2. Monitor.		$600,000
POL 1	2,500	1. Restore area.		$19,000
POL 2	4,630	1. Determine extent of lead, PCB and hydrocarbon contamination. 2. Treat high contaminant concentrations. 3. Restore area.	$417,000	$35,000
POL 3	5,334	1. Determine extent of hydrocarbon and PCB concentration 2. Treat high hydrocarbon concentrations in soil. 3. Restore area.	$320,000	$40,000
POL 4	5,600	1. Treat high hydrocarbon concentrations in soil. 2. Treat hydrocarbon sheen on pond water. 3. Restore area.	$336,000 $50,000	$28,000
PALLET P-1	23,100	1. Restore area. 2. Monitor.		$693,000
OUTFALL A	106,200	1. Treat contaminants. 2. Restore area.	$319,000	$1,328,000

TABLE 8.1

CAM-5, MACKAR INLET SUMMARY OF RECOMMENDED ACTIONS AND ESTIMATED COST

Location	Area (m2) Potentially Affected	Recommended Action	Estimated Remediation Cost	Estimated Restoration Cost
BUILDING PROXIMITIES AND AIRSTRIP	123,500	1. Treat high hydrocarbon and PCB concentrations.	$2,223,000	
		2. Restore area.		$500,000
FACILITY DEMOLITION AND DISPOSAL				$1,150,000
SUBTOTALS			$3,665,000	$7,258,000
ESTIMATED TOTAL FOR SITE RESTORATION				$10,923,000
ESTIMATED ENGINEERING, CONTRACT MANAGEMENT, TESTING AND MONITORING COST				$2,285,000
ESTIMATED TOTAL				$13,208,000

PLATE 1 - AERIAL VIEW FROM EAST

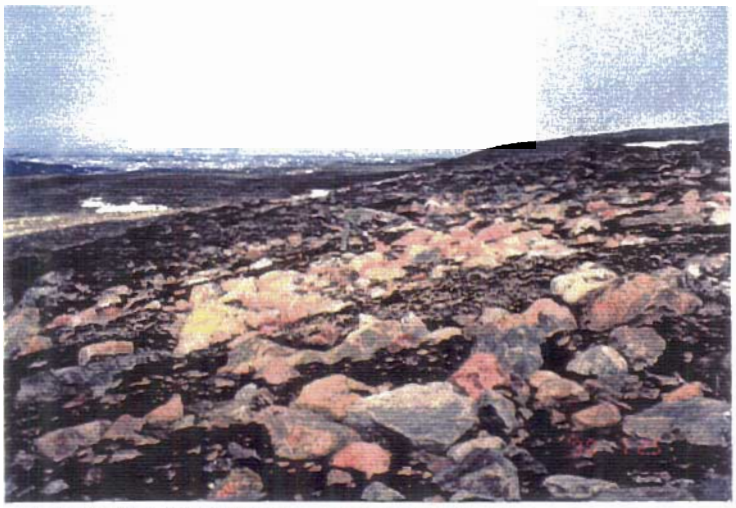
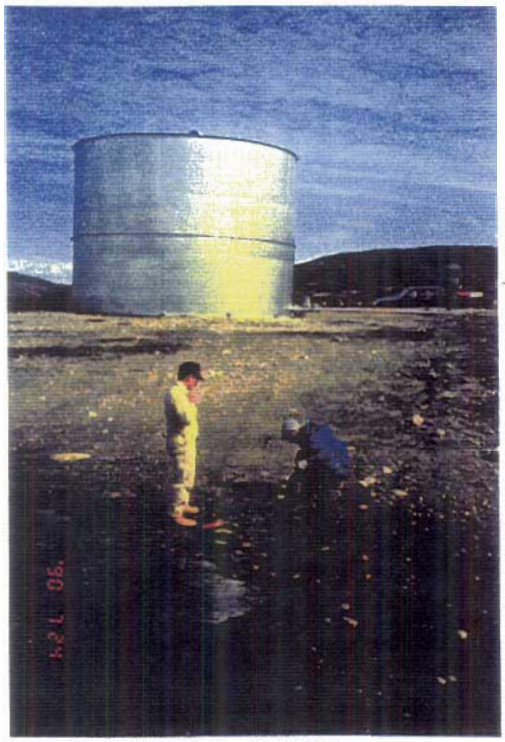


PLATE 2

SEWAGE OUTFALL-UPPER BASE
VIEW TOWARDS EAST

PLATE 3



AIRSTRIP POL TANK
STORAGE FACILITY
VIEW TOWARDS EAST

PLATE 4

STAGING/STORAGE AREA
NEAR AIRSTRIP

CAM-5 MACKAR INLET

PLATE 5

LANDFILL AT LOWER BASE
VIEW TO SOUTHWEST

PLATE 6

LANDFILL AT LOWER BASE
EASTERN EDGE OF LANDFILL

PLATE 7

SOIL STAINING ON GARAGE EMBANKMENT
VIEW TO NORTH