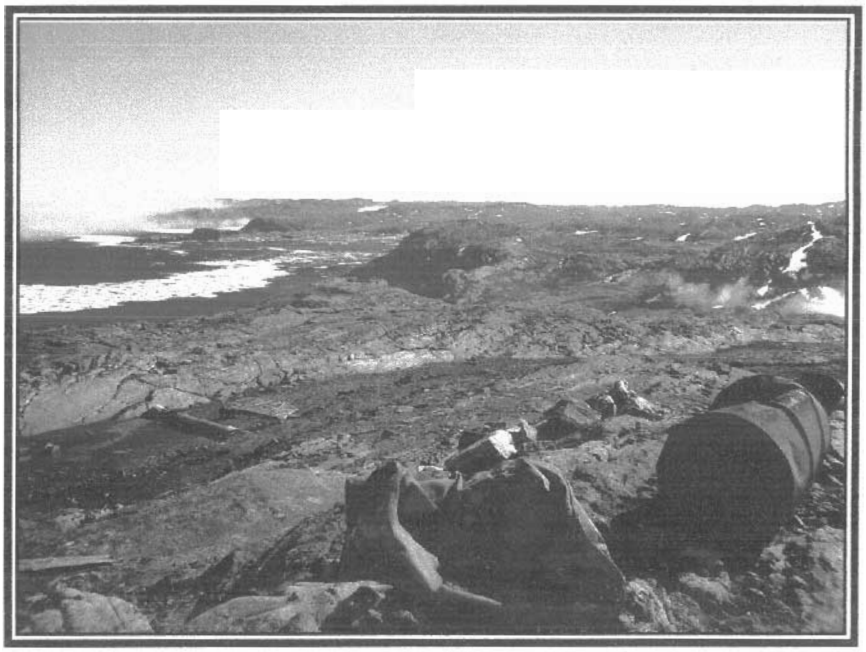
INDIAN AND NORTHERN AFFAIRS CANADA
NUNAVUT REGIONAL OFFICE

ENVIRONMENTAL SCREENING REPORT
for the
RESOLUTION ISLAND PROJECT
BAF-5 : ABANDONED POLE VAULT MILITARY RADAR STATION



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QIKIQTAALUK CORPORATION

March 1998
revision 1 - February 2003

EXECUTIVE SUMMARY

The proposed project to clean up the abandoned military radar station located at Resolution Island in the Canadian Arctic has been screened pursuant to the Canadian Environmental Assessment Act (CEAA). The lead responsible Authority has been identified as Indian and Northern Affairs Canada.

The general objective of the project is to reduce the negative environmental impacts from past occupation that has contributed to soil contamination, in violation of the Canadian Environmental Protection Act (CEPA), as well as to unstable waste dumps. The Project started in 1998 and has been on-going ever since. Revisions to the initial screening report were deemed necessary based on the planning of new clean up activities.

The project involves the removal, containerization and temporary storage of CEPA soils (PCB levels > 50 ppm) for off-site shipping and disposal as well as management of other contaminated soils exceeding generic criteria and remaining drum contents (waste petroleum products). A remote construction camp is operated and managed to accommodate the work crew. For the purpose of assessing socio-economical and environmental impacts, the project has been divided into its major activities. The impacts and recommended mitigative measures are summarized in Table 1.

Community consultations were not conducted as part of the screening but were carried out in Kimmirut in May 1998, prior to the beginning of the clean up activities, as well as in Iqaluit and Kimmirut in September 2000. Various interested parties participated in these consultations.

Based on the information given in this screening report, the proposed project is not likely to cause significant adverse environmental effects and the project may proceed with the assurance that mitigating measures will be implemented.

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
7.1 Site Access	
Rutting and Erosion Heavy equipment and vehicles can damage soil integrity.	*Vehicles or heavy equipment shall not be operated off-roads after heavy rain or melting snow conditions. Such restrictions shall apply until the soil has dried sufficiently so that excessive rutting can be prevented.*
Habitat Disturbances Seabirds are known to be vulnerable during their nesting period. Some species may be affected by low-flying aircraft and close approaches by marine vessels.	*Pilots shall be advised to maintain an altitude of at least 500 metres above ground or water when passing over areas where birds are concentrated. Pilots shall not be permitted to do low-level flights to observe and/or photograph wildlife.*
Habitat Degradation Large volumes of fuel will be required at the site to run both equipment and generators. The fuel is expected to be transported to the site on a barge or supplied by tanker ships. There is the possibility of accidental spillage at the site which would result in the contamination of soils and/or water in the surrounding environment.	*Transportation of fuel, as well as any other hazardous materials brought to the site, shall be done in compliance with the Transportation of Dangerous Goods Act and Regulations requirements. Fuel will be kept in double walled steel tanks. Valves on fuel tanks should have receptacles placed beneath them to catch any leaked fuel.*
7.2 Construction Camp	
Aesthetic and Safety Solid waste produced at the camp may cause both an aesthetic and safety concern at the site. Animals are attracted to solid waste disposal sites and have the possibility of becoming a nuisance as well as a safety concerns to personnel.	*Waste bins used at the site shall be animal proof and emptied on a frequent basis. Non-hazardous combustible wastes are to be burned daily, in a forced air fuel-fired incinerator. Ash and non-combustible non-hazardous wastes should be buried within the upper non-hazardous landfill. Hazardous wastes shall be stored in a proper manner and transported from the site in accordance with the Transportation of Dangerous Goods Act and Regulations.*
Health Sewage disposal from the camp may cause a health problem for both humans and wildlife.	*A sewage lagoon located near the camp shall be used for the disposal of sewage water. Hazardous materials shall not be discharged in this lagoon. A warning sign shall be posted near the lagoon, and the lagoon shall be fenced off to prevent accidents.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
Habitat Degradation Fuel used in equipment and camp generators is needed in large quantities and must be transported to the site via sealift, and then trucked to the upper site. Fuel spillage can result in both soil and surface water contamination.	*A spill contingency plan was prepared for fuel storage as well as any other hazardous liquids used at the site. Fuel storage is to be located at least 12 metres above the high water mark of the nearest water body, on flat stable terrain or in a natural depression and is to be stored and dispensed in accordance with the CCME Environmental Code of Practice for Above ground Storage Tank Systems and fire code requirements. Secondary containment is required for any fuel storage container with a capacity of 4,000 litres or more. Any contamination created at the site should be remediated. Fuel spills shall be reported and cleaned up immediately.*
Fire There is the possibility of a fire occurring at the site as a result of camp related activities.	*Adequate attention to fire safety and prevention is required by the camp operator and workers. Fire alarms and fire fighting equipment suitable for the size of the camp are maintained on-site. A Fire Emergency Plan is in place.*
7.3 Fuel Handling and Storage	
Habitat Loss/Alteration Some habitat loss or alteration may occur if a fuel spill occurs.	*Emergency spill equipment including fuel pumps, empty drums, containment booms and other sorbent materials are available on site. Enough equipment are on-site to clean up a 1,000 litre spill at the fuel tank farm or any other fuel storage locations.*
Fire There is the possibility of a fire occurring at the site as a result of accidents (*i.e.*, ignition sources).	*Smoking is prohibited within 5 metres of the fuel storage facilities. Appropriate signs are posted. Fire-fighting equipment are available for immediate access near the tank farm and at all fuel storage locations.*
7.4 Heavy Machinery and Vehicle Management	
Wildlife Stress Wildlife can be affected by vehicle movements although it is expected that this will have a minimal impact.	*Mobile equipment and vehicle operators shall not operate vehicles in a manner to disturb any wildlife species.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
Habitat Alteration Some habitat alteration may occur if a spill of maintenance fluids occur.	*Vehicle and equipment maintenance and servicing shall be conducted only in designated areas on gravel pads, where special procedures can be implemented to manage fluids, waste, and contain potential spills. Maintenance, fuelling and lubrication of machinery shall be conducted in such a way as to avoid fluid spills. Used fluids (e.g., oils, antifreeze) and filters (e.g., oil, fuel) shall be containerized in separate and appropriately identified drums (or other appropriate containers) and shall be treated as hazardous materials. All storage containers shall be properly sealed after use. Waste fluids shall not be used for dust control.*
Health and Safety Because of the topography of the site, there is a concern for accidents involving vehicles on roads.	*A speed limit shall be established (tentatively 30 km/hour or less) and enforced by the site superintendent..*
7.5 Water Supply	
Fish Habitat Alteration There is a potential for fish habitat alteration from freshwater withdrawal activities.	*Water usage shall respect all conditions of the water permits delivered by the Nunavut Water Board.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
7.6 Asbestos Abatement	
Health and Safety The buildings contain friable asbestos. The removal of such materials creates a health risk for personnel involved in the asbestos abatement activities.	*The removal of the asbestos from any locations is to be treated as an asbestos project and all of the related health and safety requirements adhered to. This will include the removal of all visible asbestos. The Safety Act and Occupational Health Regulations (Nunavut) require that workers handling asbestos material wear respiratory equipment approved by the Canada Standards Association, as well as other safety equipment including coveralls, gloves, eye protection and head gear. All personnel who work on the asbestos material must be trained for the use of protective equipment and safe handling and disposal of the asbestos. Warning signs should be posted at the site informing staff that asbestos removal is occurring and ensure that personnel not working with the asbestos should not be near the working site.*
7.7 Demolition of Work	
Health and Safety There is a safety concern for workers involved in demolition activities.	*A health and safety program that meets the standards and requirements of applicable regulatory agencies shall be implemented. The construction safety measures of the National Building Code shall be respected and enforced.*
7.8 Construction and Maintenance of Roads	
Permafrost Degradation Cut and fill operations required to provide the sub-granular base for the road access to the S1/S4 beach area may disrupt the permafrost.	*Disturbed soil that disrupts natural drainage patterns or exposes permafrost in ice rich soils shall be repaired.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
Habitat Degradation Installation of culverts in the stream and subsequent covering by gravel might, or installation of a boulder layercause stirring of bottom sediments and generate an increase in water turbidity downstream. This could cause impacts to the stream aquatic habitats as well as fish habitats in the ocean downstream.	*These impacts should be temporary (i.e., only during the construction and removal of the road and culverts), however, during these activities, a silt fence shall be installed to limit the spreading of sediments and turbidity downstream. The use of a bridge would eliminate the need for mitigation measures.*
7.9 Excavation of Contaminated Soil	
Rutting and Erosion Unstable areas such as steep slopes and streams may be encountered during the excavation phase. These areas are more prone to rutting, erosion and environmental damage.	*Excavation work shall be minimized in the vicinity of watercourses. Heavy machinery, vehicles and equipment shall not be operated in waterways. Waste, excavated fill and/or debris shall not be disposed in waterways. Suitable barriers such as silt fences shall be installed if required to separate work areas from waterways. All unstable areas requiring excavation shall be identified and procedures shall be implemented to minimize surface rutting.*
Contamination of "Clean" Areas There is a risk that excavation activities contribute to the contamination of non-contaminated areas including fish habitat. Furthermore, equipment and machinery used during contaminated soil excavation and handling will require cleaning, and this will produce hazardous materials (solids and fluids) that can have a negative environmental impact if not managed properly.	*Hazardous material management areas shall be located at a minimum distance of 30 metres from the nearest water body. CEPA soils screening procedures shall be implemented in such a way as to prevent the spreading of contaminated dust. Movement of heavy machinery, vehicles and equipment within the hazardous material management areas shall be controlled to prevent the dispersion of potentially hazardous dust and materials into the environment. Wash water resulting from the cleaning (i.e., decontamination) of equipment and heavy machinery used in the hazardous waste management areas shall be recovered and treated as per regulations.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
Permafrost Degradation Material and equipment will have to be stored temporarily within each hazardous material management area for the duration of the excavation activities.	*Storage areas shall be sited in locations where the natural surface drainage will not be affected and where ponding can be avoided. Materials shall not be stored on unprotected ground. Gravel pads or other appropriate methods shall be constructed to protect ice-rich soil from damages.*
7.10 Construction of Engineered Landfills	
Rutting and Erosion Use of heavy equipment and machinery can damage soil integrity, especially in unstable areas.	*Heavy equipment operations shall be limited to pre-determined work areas. Activities outside these areas shall be minimized, and conducted only when the soil is sufficiently dry so that excessive rutting can be prevented.*
Surface Water Runoff/Sediment Movement Heavy equipment traffic and large movements of granular material may generate high sediment loads in surface water runoff.	*Landfill sites shall be located at a minimum distance of 30 metres from the nearest water body. Silt fences shall be installed in drainage ditches in order to prevent migration of sediments to streams and water bodies.*
Habitat Loss/Alteration Habitat will be lost and altered through the excavation and removal of top soil, as well as by backfilling over vegetated areas.	*Upon landfill closure, the area shall be covered with granular material, graded and reshaped to match the surrounding topography and minimize erosion. Vegetation will eventually colonize this new surface area.*
7.11 On-site Treatment of Hydrocarbon Contaminated Soils	
Contamination of "Clean" Areas Treatment activities may potentially contribute to the contamination of non-contaminated areas. Dry contaminated soil particles and dust may be spread by wind. Furthermore, runoff water draining from the soil may be contaminated.	*The landfarming treatment pad shall be located at a minimum distance of 30 metres from the nearest water body. The soil moisture level shall be kept at an optimal level to promote biodegradation, therefore this soil moisture will minimize loss of particles to wind. Drainage ditches located around the treatment pad will recover potentially contaminated water. The water will then be tested, and treated if required, before being discharged.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
7.12 Disposal of Hazardous Materials	
Health and Safety There is a safety concern for workers involved in the handling of hazardous waste.	*Every possible precaution shall be taken when hazardous materials and contaminated soils are handled, hauled or transported to ensure that such materials do not come into contact with site personnel. Protective clothing shall always be used by site workers when hazardous materials including contaminated soils are handled. All clean up personnel shall be informed and shall comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) program and the Hazardous Waste Operations and Emergency Response (HAZWOPER) program.*
Habitat Degradation Spill of hazardous materials during off site shipping could cause severe impacts to terrestrial and/or fish habitats.	*Any unknown waste that may require off-site shipping shall be characterized to determine whether it must be considered as a transport hazard according to regulations. All provisions from the Transportation of Dangerous Goods Act (TDGA), the International Maritime Dangerous Goods (IMDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulations shall be respected.*
7.13 Temporary Storage of CEPA Soils	
Contamination of "Clean" Areas There is a environmental concern with the release of contaminated soils in non-contaminated areas during transportation to storage facilities.	*Spillage of material during transportation between the excavation site and the storage/stockpile location shall be minimized, if not avoided.*
7.14 Disposal of Non-hazardous Materials	
Aesthetic and Safety Non-hazardous waste may cause both an aesthetic and safety concern at the site if not managed properly. Non-hazardous waste can be scattered by wind or animals and thereby becoming a safety concern to personnel as well as wildlife.	*Waste to be placed in non-hazardous landfills shall be compacted and rapidly covered with a layer of granular fill.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
7.15 Landfill Closure	
Safety and Health Because of the nature of work involved and potential hazardous material exposure, there is a concern for the health and safety of workers.	*The impact of these operations is similar to that of the section 7.12 and 7.14 and the mitigative measures identified in these sections apply.*
7.16 Development of Granular Borrow Areas	
Wildlife Avoidance Blasting rock produces a high decibel noise which may alarm wildlife causing some avoidance and resident bird populations may be vulnerable to noise during their nesting period in May and June. This operation will only be required over short periods during the project. Therefore, avoidance by wildlife should not be permanent.	*Blasting shall be limited to the time of the season when nesting is mostly over (i.e., July and August).*
Safety Hazard The transportation and handling of explosives is a safety concern for workers.	*Handling, storage and transportation of explosives shall be conducted according to applicable laws and regulations. The handling of explosives shall be restricted to authorized and licensed personnel. Blasting shall be conducted in such a way as to minimize dispersal of material, and prevent dispersed materials from reaching fuel or hazardous material storage locations. A buffer zone of 300 metres shall be respected.*
Habitat Loss/Alteration Habitat may be lost through the removal of vegetation from blasting operations. However, the bedrock areas to be blasted are relatively free of vegetation.	*No mitigative measures were considered necessary.*

Table 1: Summary of Activities, Impacts and Mitigative Measures

Impacts	Mitigative Measures
Environmental Disturbances Quarrying activities may create environmental impacts to the immediate surroundings of the borrow pits.	*A quarry permit issued under the INAC Territorial Quarrying Regulations shall be obtained. The permit shall have site-specific provisions for environmental protection. These conditions are provided to minimize the extraction process impacts on water quality, drainage, erosion and ecosystems. All terms and conditions of the quarry permit shall be respected, including borrow area recontouring and clean up before abandonment.*
Disruption of Drainage Drainage may be impacted during excavation of the borrow areas. Sediments may be deposited into streams, thereby disrupting natural drainage of the area.	*Borrow pits shall be protected from erosion and ponding by proper grading.*
Permafrost Degradation Excavation of the borrow areas will remove the insulating ground cover and expose the sides and the bottom of the excavations to direct sunlight. This may result in erosion and slumping of the pit side walls. Damage to permafrost in the immediate vicinity of the pits is unavoidable. The areas are, however, surrounded by bedrock outcrops and it is likely underlain by bedrock as well. The excavations may therefore extend to surface bedrock in some areas, eliminating the concern for permafrost degradation.	*Final grading of any non-bedrock side walls will be required to address slumping and erosion of the pits the following summer.*
7.17 Migration Barriers	
Safety and Health Because of the nature of the work involved to remove existing containment booms, there is a concern that workers may be exposed to potentially hazardous materials.	*The impact of these operations is similar to that of the section 7.12 and 7.14 and the mitigative measures identified in these sections apply.*
Habitat Loss/Alteration Habitat will be lost through the removal of vegetation from excavation of trenches. However, the surface of land to be excavated to construct migration barrier is relatively small.	*No mitigative measures were considered necessary except that movement of heavy machinery required to excavate trenches shall be restricted to the close vicinity of excavation areas.*

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ASU	Queen's University Analytical Services Unit
CACAR	Canadian Arctic Contaminants Assessment Report
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
CEPA	Canadian Environmental Protection Act
CSO	Contaminated Sites Office
DCC	DEW Line Clean Up Criteria
DEW Line	Distant Early Warning Line
DIAND	Department of Indian Affairs and Northern Development ("Owner")
DND	Department of National Defence
EPP	Environmental Protection Plan
ERP	Emergency Response Plan
ESG	Environmental Sciences Group
GNWT	Government of Northwest Territories
HAZWOPER	Hazardous Waste Operations and Emergency Response
HTA	Hunters and Trappers Association
IATA	International Air Transport Association
IMDGC	International Marine Dangerous Goods Code
INAC	Indian and Northern Affairs Canada
LDS	Legault Desjardins Simon Consultants Inc.
LRR	Long Range Radar
LSS	Logistic Support Site or Station
MOU	Memorandum of Understanding
MSDS	Material Safety Data Sheet
NFC	National Fire Code
NH	Non Hazardous
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claims Agreement
NPC	Nunavut Planning Commission
NTI	Nunavut Tunngavik Inc.
NWB	Nunavut Water Board
NWS	North Warning System
NWT	Northwest Territories
PCB	Polychlorinated Biphenyls
POL	Petroleum Oil and Lubricant
QC	Qikiqtaaluk Corporation
QIA	Qikiqtani Inuit Association
SRR	Short Range Radar
RMC	Royal Military College
RRMC	Royal Roads Military College
TDGA	Transportation of Dangerous Goods Act
USAF	United States Air Force
WHMIS	Workplace Hazardous Materials Information System

1.0 BACKGROUND INFORMATION

After the second world war, a defence detection and communication system consisting of main, auxiliary, and intermediate stations (named BAR-*, PIN-*, CAM-*, FOX-*, and DYE-M)[1] emerged in the Canadian Arctic; these were the Distant Early Warning (DEW) Line Sites. These communication facilities were part of the American military response strategy to prevent a Russian invasion from the North during the cold war. Apart from this DEW Line, other sites were constructed along the eastern part of Baffin Island and Labrador to transmit intercepted northern signals to southern military stations: these sites were part of the Pole Vault Line (named BAF-*)[1]. The surveillance and communication station installed at Resolution Island (RI) was one of the major Pole Vault sites (BAF-5).

In March 1985, Canada and the United States signed a Memorandum of Understanding (MOU), an agreement to modernize the North American Air Defence System. The memorandum sets out the requirements for replacement of the Distant Early Warning (DEW) Line with an automated system called the North Warning System (NWS). The Resolution Island site now hosts a Short Range Radar (SRR) station as part of this new radar system.

The SRR sites, including BAF-5, are remotely operated and personnel are no longer required on a full-time basis (on site staff is only required for short periods: maintenance and inspection). Obsolete radar stations such as Resolution Island were abandoned in poor environmental conditions. It should be mentioned that approximately 200 persons occupied this station that was operated from 1956 to 1972.

Environmental assessments of the DEW Line sites were conducted to identify the principal contaminants and determine the impact of these contaminants on the arctic ecosystem (1,2,3). Most of these studies were conducted by the Environmental Sciences Group (ESG) from the Royal Military College (RMC) and the Analytical Services Unit (ASU) from Queen's University in Kingston. Generally, these studies have revealed past waste disposal practices, confirmed contamination sources, and illustrated potential for contaminant migration. Furthermore, the major pollution problems usually found on these old radar sites have been targeted.

Among these studies, many environmental investigations were conducted at Resolution Island (9).

[1] The symbol * refers either to a letter (A to E) or a number (1 to 5) which corresponds to a radar site location.

Most of the site-specific problems were characterized through an extensive monitoring program performed by ESG and ASU (4,5,6,7). These environmental studies were predominantly carried out during summer seasons from 1993 to 1997 and they documented the implications for clean up activities.

An engineering site investigation was also conducted to collect the information required to complete clean up design drawings and specifications. This investigation included the establishment of temporary benchmarks, surveys of contaminated areas and proposed landfill areas for non-hazardous (NH) materials, identification of requirements for the Canadian Environmental Protection Act (CEPA) soil storage facilities and granular borrow areas. The engineering site survey and investigation was carried out during the summer of 1997 with the objectives of more accurately determining soil volumes from known contaminated areas and verifying overall site conditions. The need for extended monitoring and for previously proposed project activity modifications was also identified.

Since then, clean up activities were carried out every summer season. Works conducted to date have been reported elsewhere[2] and are summarized in section 4.22. A revision to the initial Environmental Screening Report submitted in February 1998 was required since more stringent clean up criteria that generates additional clean up activities are to be implemented by INAC.

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[2] Resolution Island 2001 Scientific Investigations, prepared by Queen's University ASU for DIAND, March 2002.

Resolution Island 2000 Scientific Investigations, prepared by Queen's University ASU for DIAND, November 2000.

Resolution Island 1999 Scientific Investigations, prepared by Queen's University ASU for DIAND, March 2000.

Resolution Island 1998 Scientific Investigations, prepared by Queen's University ASU for DIAND, January 1999.

Resolution Island 1997 Scientific Investigations, prepared by Queen's University ASU for DIAND, March 1998.

Summary of 2002 Activities Resolution Island Project, prepared by Sinanni Inc. and Qikiqtaaluk Corporation for Indian and Northern Affairs Canada (INAC), November 2002.

Summary of 2001 Activities Resolution Island Project, prepared by Sinanni Inc. and Qikiqtaaluk Corporation for INAC, December 2001.

Summary of 2000 Activities Resolution Island Project, prepared by LDS Consultants Inc. and Qikiqtaaluk Corporation for DIAND, November 2000.

Summary of 1999 Activities Resolution Island Project, prepared by LDS Consultants Inc. and Qikiqtaaluk Corporation for DIAND, December 1999.

Summary of 1998 Activities Clean up of Resolution Island, prepared by LDS Consultants Inc. and Qikiqtaaluk Corporation for DIAND, November 2000.

2.0 PROJECT RATIONALE

Previous studies have shown that approximately 5,000 m^3 of soils are contaminated with polychlorinated biphenyls (PCB) exceeding the CEPA criteria (concentrations > 50 ppm). These soils are mainly located in the S1/S4 valley, the S1/S4 beach area and the Furniture dump. Part of the floor from two buildings (S1-A and S3-A) were also found to exceed the CEPA criteria for PCBs: at one sampling location, concentration was as high as 60,000 ppm. Furthermore, approximately 10,000 m^3 of soil exceed the Canadian Council of Ministers of the Environment (CCME) for Residential/Parkland land use. Apart from PCBs, other contaminants of concerns are mainly mercury, cobalt, copper, lead and petroleum hydrocarbons. Some of these contaminated soils are located near the ocean and pose a more direct threat to marine habitats.

Furthermore, most buildings contain asbestos. Approximately 2500 linear metres of pipe insulation (< 150 mm outside diameter) and 500 m^2 of tiles were found in buildings at the upper site. Some of the buildings are in poor conditions and pose a health and safety problem for workers and visitors.

Approximately 4,000 drums are present on site, some of which still contain their original contents. Finally, some landfills are still leaching contaminants, thus requiring excavation and sorting to remove the sources.

The primary clean up requirements for the Resolution Island site (BAF-5) are as follows:

- asbestos abatement (completed);
- demolition work (on-going);
- road construction to contaminated areas (on-going);
- excavation and containerization of CEPA soils and other contaminated soils (on-going);
- construction of permanent migration barriers (to do);
- drum collection, handling and shredding (on-going);
- POL incineration (on-going);
- collection and disposal of debris (on-going); and
- closure of existing landfills (on-going).

3.0 SITE DESCRIPTION

Resolution Island, BAF-5 (Inuit name: Tujjaat - "place where birds land") is situated at the southeastern tip of Baffin Island approximately 310 km southeast of Iqaluit and just outside of Frobisher Bay (61° 35' N and 64° 40' W). The radar site occupies a surface of approximately 3 square kilometres (km^2). Figure 3.1 illustrates the general location of the Island where BAF-5 was constructed.

The main station is located on the summit of Cape Warwick, 360 m above sea level, at the northeastern end of the Island overlooking Brewer Bay. This area is where the construction camp and the new SRR station are found. The upper site also contains areas of environmental concerns such as the S1/S4 valley, the furniture dump (completed) and the PCL dump. The S1/S4 beach area, another important site of environmental concern, is situated down gradient from the S1/S4 valley, at the bottom of the cliff near the ocean.

From the upper site, a gravel road leads to the airstrip and to the former freshwater lake. For the clean up project at Resolution Island, this area, including the remote antenna hill, does contain some areas of environmental concerns: the airstrip dump, the northslope dump, the maintenance dump and petroleum hydrocarbon contaminated soil. The road goes further to the beaching area and gives access to beach landfills which contain areas of lead and mercury contamination. Furthermore, a new road constructed to provide access to the S1/S4 beach area still need to be completed. Figure 3.2 gives a general layout of the abandoned military radar station found at Resolution Island.

Access to the Island is by sea via Brewer Bay, by air using a helicopter or a Twin Otter aircraft via the runway located northwest of the summit.

Figure 3.1: Location of the abandoned military radar site (BAF-5) at Resolution Island.

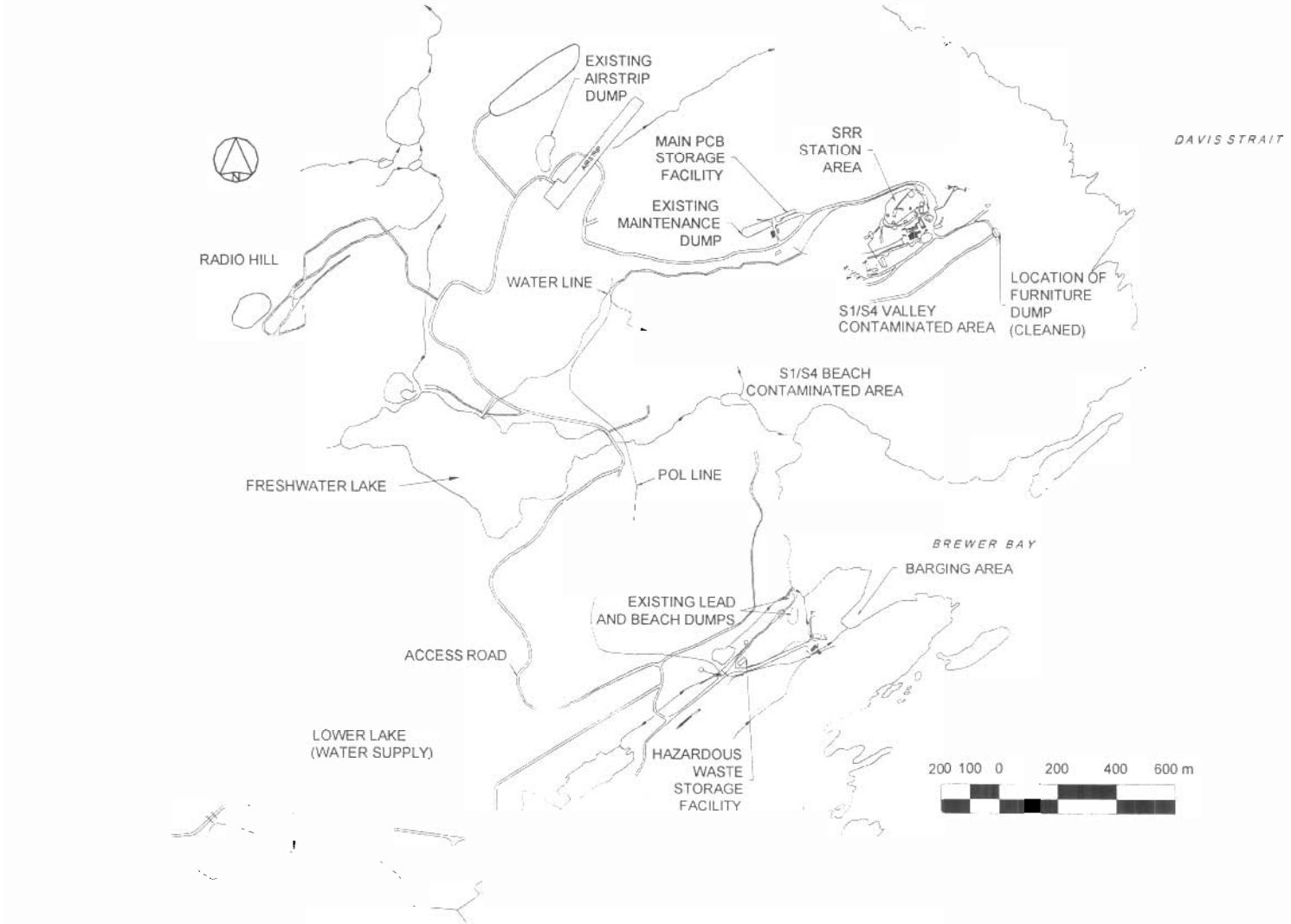

Figure 3.2: General layout of the Resolution Island abandoned military radar site.

4.0 PROJECT ACTIVITIES

The activities at BAF-5 were initially based on the decision by Indian and Northern Affairs Canada (INAC) to clean up the site according to a risk-based approach. This decision was taken following the evaluation of recent studies: site assessments conducted by ESG and ASU, risk assessment performed by Golder Associates (8), and clean up options submitted by Qikiqtaaluk Corporation (QC) and Legault, Desjardins, Simon Consultants Inc. (LDS) (10). Since 2002, this approach has been changed towards a criteria based approach using the CCME Canadian Environmental Quality Guidelines. Based on this new approach, the clean up activities at Resolution Island will include the removal, containerization and off-site shipment of all CEPA soils, as well as the removal and on-site disposal of other contaminated soils. The following sections describe the major activities to be performed during the clean up of the Resolution Island site. Remediation work carried out thus far (*i.e.*, between 1997 and 2002) is presented at the end of this section.

The major clean up activities include the following:

- site access;
- operation of a construction camp;
- fuel handling and storage;
- equipment and vehicle use, storage and maintenance;
- water supply;
- waste management;
- asbestos abatement;
- demolition work;
- construction and maintenance of roads;
- excavation of contaminated soil;
- construction of engineered non-hazardous waste landfill;
- construction of engineered lined landfill;
- on site treatment of hydrocarbon contaminated soils;
- disposal of hazardous material;
- temporary storage of CEPA soils
- disposal of non-hazardous materials;
- POL incineration
- landfill closure;
- development of granular borrow areas;
- installation of migration barriers;
- site grading; and

- winterization and demobilization.

4.1 Site Access

Access to the Resolution Island site is to be by helicopter, chartered aircraft and/or via sealift. Iqaluit is one of the closest communities to the site and the most convenient centre to organize logistics. On site, local access to construction, demolition, clean up and other work areas is to be through the existing road network. Graded areas, located near the beach landing area and storage facility, the maintenance buildings and airstrip areas and/or in the vicinity of the summit area, is to be used for temporary storage of materials.

4.2 Construction Camp

A remote construction camp will have to be operated during clean up activities. The existing camp, repaired and operated during the 1997 season and which can accommodate approximately 50 persons, will have to be used to meet the needs of workers, other personnel, and visitors.

4.3 Fuel Handling and Storage

Fuel will is transported to the site and stored in approved facilities to supply all equipment required for clean up activities including camp generators, heavy equipment, vehicles, and a helicopter. A tank farm was set up to store fuel on-site.

4.4 Heavy Machinery and Vehicle Management

Equipment and vehicles were and/or are to be transported to the site, stored in approved locations and used only for contracted work. All heavy equipment, machinery, and vehicles will have to be maintained and operated as suggested by warranties given by manufacturers.

4.5 Water Supply

At the beach area, a water supply lake is used as a potable water source. Drinking water is provided to the camp tank using a truck (pumping). As a contingency measure, potable water could be provided to the camp using a helicopter system.

4.6 Camp Waste Management

Appropriate waste management procedures is implemented for all facilities and operations at all times during the clean up activities at Resolution Island. Domestic wastewater is discharged in the dedicated lagoon located approximately 140 metres away from the camp.

Non-hazardous solid wastes generated as part of the operation of the construction camp are incinerated and/or disposed on site in an existing non-hazardous landfill. Domestic non-hazardous waste are incinerated and ashes are disposed of as described above. Refuse which are not to be landfilled or incinerated includes waste oil and liquids containing hazardous materials.

4.7 Asbestos Abatement

Asbestos material (mainly pipe insulation) was removed from remaining buildings located at the upper site. Asbestos was double-bagged and landfilled on-site within a non-hazardous waste disposal site. A separate cell within the non-hazardous landfill site was used to dispose asbestos containing materials. The location of this cell was surveyed and the coordinates recorded. Asbestos abatement was completed in the buildings that are being used and in those that were demolished. Asbestos may still be present (in waste site to be excavated, in outdoor water pipes and in cladding panels of the troposcanner).

4.8 Demolition Work

The Main PCB storage building will need to be demolished to make way for the construction of the Tier II landfill. Demolition work shall include the removal and disposal of structural steel, sheet metal cladding, fibreglass insulation, and concrete. Hazardous materials shall be removed from the building prior to demolition. Workers will have to wear appropriate personal protective equipment when handling these materials. Non-hazardous materials will have to be disposed in a suitable on-site non-hazardous landfill. Granular material will have to be placed over the waste and compacted within the non-hazardous landfills to minimize settlement.

4.9 Construction and Maintenance of Roads

A new road will have to be constructed (completed) to provide heavy machinery access to the S1/S4 beach area. This road will have to cross a small creek which does not sustain fish habitat and culverts will have to be installed. A temporary road will need to be constructed to access the

contaminated soil areas in the S1/S4 valley. Another road to access the lower airstrip borrow area will also be needed. Other roads and the airstrip will have to be maintained operational by repairing seasonal damage caused by spring run-off.

4.10 Excavation of Contaminated Soil

For this project, the establishment of contaminated soil levels were recently revised and are now based on the DEW Line Clean Up Criteria (DCC). These generic criteria used to clean up other DEW line sites managed by the Department of National Defence (DND) are listed in Table 4.1.

Table 4.1: Dew Line Clean up Criteria (DCC) for Contaminated Soil

Contaminant	Soil Concentration (ppm)	
	Tier I	Tier II
Arsenic (As)	---	30
Cadmium (Cd)	---	5
Chromium (Cr)	---	250
Cobalt (Co)	---	50
Copper (Cu)	---	100
Lead (Pb)	200	500
Mercury (Hg)	---	2
Nickel (Ni)	---	100
Zinc (Zn)	---	500
Polychlorinated Biphenyls (PCBs)	1	5

At Resolution Island, all soils exceeding the CEPA criteria (> 50 ppm PCBs) are to be containerized and temporarily stored on-site for future off-site shipment. All Tier II contaminated soils (PCB, lead, mercury, and cobalt) are to be excavated and disposed on site in an engineered lined landfill. The Tier I contaminated soils (PCB, lead) will also be excavated and disposed in an engineered non-hazardous landfill. Soils contaminated by petroleum hydrocarbons (HC) will be excavated and treated or disposed on site depending on type of HC contamination.

4.11 Construction of Engineered NH Waste Landfills

Engineered unlined landfills were constructed on site and will continue to be operated for the disposal on non-hazardous waste materials such as demolition debris, empty and clean drums, bagged creosote-treated timbers and Tier I contaminated soils. At the end of the project these sites will be covered by granular material and graded to promote surface water runoff. Monitoring wells will be installed around the site to monitor groundwater quality.

4.12 Construction of an Engineered Lined Landfill

An engineered lined landfill will be constructed and operated on site for the disposal of Tier II contaminated soils and debris and soils contaminated by heavy hydrocarbons such as lubricating oils and grease (*i.e.*, which are not easily biodegradable). A bottom geomembrane liner will be installed to prevent leachate migration to underlying soils. At the end of the project this site will be covered by a geomembrane liner and sufficient granular material to promote freezeback and to prevent water infiltration into the waste material and thereby promote surface water runoff. Thermistors will be installed in the site to monitor freeze back and monitoring wells will be installed around the site to monitor groundwater quality.

4.13 On-site Treatment of Hydrocarbon Contaminated Soils

The soils contaminated by light hydrocarbons, such as gasoline and diesel fuel, will be excavated and treated on site by bioremediation. Landfarming will likely be used as the biotreatment method. The excavated soils will be placed on a treatment pad, amended with nutrients and moisture, and tilled on a regular basis to introduce oxygen and thereby promote biodegradation. The runoff and drainage water will be recovered, tested, and treated (if required) prior to discharge.

4.14 Disposal of Hazardous Materials

Hazardous materials are defined as follows: Hazardous materials are wastes or 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 than 50 parts per million (ppm). Specifically identified hazardous materials at Resolution Island include: batteries; asbestos; fuel tank bottom sludges; solvents; PCB containing liquids; fuels and lubricating oils; alcohols and glycols; and heavy metal-contaminated liquids. The requirements for disposal of these hazardous

materials are presented in Table 4.2.

Table 4.2: Hazardous Material Requirements for Disposal

Hazardous Material	Disposal Requirement
• liquids containing organic compounds with chlorine concentration > 1,000 ppm • liquids containing organic compounds with heavy metal contamination such as: - Cadmium (Cd) > 2 ppm - Chromium (Cr) > 10 ppm - Lead (Pb) > 100 ppm • liquids containing PCB concentrations > 2 ppm and < 50 ppm • batteries	Temporary on-site storage and off-site shipment to a licensed treatment/disposal facility.
• asbestos	Double bagged and landfilled on site.
• fuels • lubricating oils • alcohols and glycols • fuel tank bottom sludges	On-site incineration.
• explosives	Removed and disposed off-site by a permitted explosives contractor.
• liquids containing PCBs > 50 ppm	Temporary on-site storage and off-site shipment to a licensed treatment/disposal facility

Hazardous materials may be encountered during sorting of landfill contents and demolition debris. Hazardous materials will have to be collected and sorted using protective clothes, materials and equipment suitable for this task.

4.15 Temporary Storage of CEPA Soils

CEPA soil was and will have to be excavated, screened (if required), containerized and/or stored in a dedicated temporary storage facility at Resolution Island. Excavation will be conducted using either heavy machinery when access is possible or manually with hand excavation tools. CEPA soils are/will be stored in steel containers according to Environmental Impact Statement (EIS)

requirements[3]. Storage containers will be identified, labelled, and staged on a platform at the beach area prior to off-site shipment.

4.16 Disposal of Non-Hazardous Materials

Non-hazardous materials expected to be encountered include demolished building materials, metal, empty drums (shredded), creosote treated timbers, concrete, and other debris. These materials are to be disposed on site in one of the non-hazardous engineered landfills. If required, creosote treated timbers may have to be bagged before disposal.

4.17 Landfill Closure

The Resolution Island site has 8 identified landfill areas that were previously used for the disposal of domestic waste, abandoned machinery and equipment, structural remains, drums and other material (3 beach dumps, furniture dump, northslope dump, PCL dump, maintenance and airstrip dumps). For those landfills requiring closure, surface debris (*i.e.*, drums and scrap metal) will have to be shredded prior to closure. Closure of the existing landfills will include placement of granular fill over the landfill and grading of the landfill area to restore natural drainage. Three (3) new non-hazardous landfills were created to accommodate the disposal of non-hazardous waste, demolition debris and asbestos; two near the summit area and one at the lower site.

4.18 Development of Granular Borrow Areas

Several sources of granular borrow material were identified. Whenever possible, existing sources of borrow material are used during clean up. Use of alternate sources will be minimized. After site clean up, all borrow areas will have to be re-graded to match surrounding topography.

4.19 Migration Barriers

Migration barriers will have to be constructed to prevent movement of residual contaminated soils into the ocean. These barriers will have to be installed at the S1/S4 valley, the S1/S4 beach area and the furniture dump. They will consist of silt fences, followed by trenches filled with sorbent booms.

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[3] Resolution Island Removal and Disposal of PCB-Contaminated Soils Project - Environmental Impact Statement, prepared by the Department of Indian and Northern Affairs, September 2000.

4.20 Site Grading

Site grading operations will have to focus on shaping and grading disturbed areas to blend in with natural contours. Disturbed areas include:

- contaminated soil excavation areas;
- existing and new landfill areas;
- debris areas;
- areas disturbed during demolition operations;
- granular borrow and road construction areas; and
- any area disturbed during the construction and operation of the construction camp, equipment storage and maintenance facilities.

During grading operations, natural drainage will have to be restored if such operation is possible. This will apply to areas which can be restored by excavation or placement of fill material. It should be recognized that Resolution Island is deficient in fill material, therefore granular fill material will be saved for priority tasks. Areas not to be disturbed include:

- the operating SRR facilities which comprise helipad, satellite ground terminals and fuel storage tanks;
- areas susceptible to permafrost degradation.

4.21 Winterization and Demobilization

After each clean up season, heavy equipment, materials and the construction camp is/will be winterized to prevent deterioration from harsh weather conditions that occur during non-operational seasons. Following the completion of clean up activities, most equipment, remaining fuel and supplies will have to be removed from the Resolution Island site. Some supplies will have to be kept on site and the construction camp may have to be kept operational for further post-construction monitoring activities.

4.22 Summary of Remedial Work Carried Out

A summary of the remediation activities carried out every year since the beginning of the project (*i.e.*, between 1997 and 2002) is as follows:

1997: Initial equipment mobilisation from Iqaluit to RI. QC sends a 20 person crew to RI for sea lift operations and basic core camp renovations. QC also provides technical support to Queen's

University ASU, and LDS (*i.e.*, currently Sinanni) for their respective field work.

1998: QC sends a 40 person crew to RI to complete camp renovations, to receive and handle new material and equipment sea lifted from Montreal to RI, to assemble a 290,000 litre fuel tank farm, to remove asbestos from abandoned buildings, to repair roads, and to provide training to Inuit in trades related to the scope of work.

1999: QC sends a 50 person crew to RI to proceed with scheduled clean up and training activities from June 15 to September 15. Activities include beach lead dump excavation and waste sorting, removal and containerization of mercury contaminated soils; off-site shipment of PCBs and other hazardous waste, furniture dump excavation, building demolition, construction/operation of a NH waste landfill, shredding and disposal of empty drums, incineration of POL products, structural steel construction to join the two maintenance buildings, roof and wall cladding, garage door installation on the joined buildings, and aluminium recycling.

2000: QC sends a 50 person crew to RI to proceed with scheduled clean up and training activities from July 5 to September 15. The main tasks accomplished include: camp renovations following polar bear damages, excavation of the furniture dump, demolition of PCB contaminated buildings and containerisation of CEPA material, removal of CEPA soil from S1/S4 building area, set up and operation of a drum staging/sorting/pumping/washing station, operation of an oil separator / water treatment system, waste oil incineration, construction of a road to Lower Lake borrow pit, relocation of the sewage line and lagoon.

2001: QC sends a 50 person crew to RI to proceed with scheduled clean up and training activities from July 4 to September 3. Activities include: excavation of CEPA PCB soil from S1/S4 building and drainage area, excavation of waste from Old Beach Dump and New Beach Dump, drainage and treatment of phenol contaminated water from beach POL tanks, clean up of the Battery Dump, installation of trial silt fence in drainage path of former Furniture Dump, drainage of fuel from beach POL tank, management and incineration of waste POL products, construction of a new road to Radio Hill, operation of a new borrow pit located behind Radio Hill.

2002: QC sends a 50 person crew to RI to proceed with scheduled clean up and training activities from July 12 to August 28. The main tasks accomplished include: excavation of CEPA PCB soil from the upper S1/S4 valley and from the PCL dump, containerisation of PCB CEPA soil from the Main PCB storage building using conveyor system (234 containers filled, hauled and staged at the lower site), removal of waste debris from Lead Beach Dump and New Beach Dump, operation of

the grease thinning and mixing system, incineration of grease and other waste POL products.

More details on the various tasks conducted at Resolution Island since 1998 can be found in Summary of Activities reports prepared by Qikiqtaaluk Corporation and Sinanni Inc. and in Scientific Investigation reports prepared by Queen's University Analytical Services Units, all submitted to Indian and Northern Affairs Canada (INAC).

5.0 REGULATORY OVERVIEW

5.1 General

Except for the locations of SRR installations which are under the control of the Department of National Defence (DND), the Resolution Island site is situated on Crown Land and not on Inuit Owned Lands as defined in the Nunavut Land Claims Agreement (NCLA). Thus, the site is under the control of the Ministry of Indian and Northern Affairs.

5.2 Federal Jurisdictions

Several federal acts, regulations, and guidelines shall affect project activities to be conducted at Resolution Island. These federal jurisdictions are applicable all across Canada. In relation to the clean up of this abandoned military radar station, the most relevant ones are described as follows:

- The *Canadian Environmental Protection Act* controls hazardous substances from their production and/or import to their use, storage and/or disposal. Furthermore, this act also includes procedures to handle specified levels of PCB contaminated materials, and requirements for PCB storage facilities.
- The *Fisheries Act* protects fish and their habitat from pollution and disturbance. Fisheries and Oceans Canada is responsible for reviewing permit applications or restoration plans submitted by other agencies.
- The *Transportation of Dangerous Goods Act* and *Regulations* describe the procedures and measures for the safe transportation of dangerous goods. The act applies to all handling of dangerous goods by any means of transport whether or not the goods originate from or are destined for any place in Canada.
- The *Department of Indian Affairs and Northern Development Act* gives provisions for undertaking, promoting and recommending policies and programs for, among others, the economical development of Nunavut.
- The *Constitution Act* recognizes and affirms the existing aboriginal and treaty rights of aboriginal peoples, including Inuit of Canada. It also enables legislation for the Nunavut Land Claims Agreement (NLCA). The NLCA in turn describes the terms and conditions for the developments of a territorial government within the Nunavut Settlement Area.
- The *Nunavut Act* establishes a territory known as Nunavut and it gives provisions for its government, legislature, and administrating and jurisdiction power.
- The *Arctic Waters Pollution Prevention Act* and *Regulations* control shipping activities in

Arctic waters adjacent to lands and islands. These were developed to ensure the welfare of the residents of Arctic communities, and to protect the ecological balance in water, ice, and land areas.

- The *Territorial Lands Act* gives authority to administer and protect Crown lands under the direct control of the Indian and Northern Affairs Canada (INAC). The following regulations are pursuant to this act:

  The *Territorial Land Use Regulations* define regulatory measures to maintain appropriate environmental practices for any land use activities on territorial lands. These regulations require that land use permits be issued for such operations as the clean up work to be conducted at Resolution Island (use of heavy machinery, camp operation, use of explosives, construction of access roads, etc.).

  The *Territorial Quarrying Regulations* describe fee schedule and procedures for extracting Crown owned gravel, sand, limestone, marble, gypsum, granite, clay, stone and/or other materials from territorial lands. The regulations specify applications, dimensions of quarries and requirements for permits.

- The *Canada Wildlife Act* ensures that the Government of Canada will collaborate in research and management of wildlife species normally under the responsibility of provinces and/or territories. This is particularly relevant for threatened, endangered and/or vulnerable species such as polar bear which seasonally move across various regulatory boundaries.
- The *Migratory Birds Convention Act* gives protection to designated migratory avian and their habitats. This act also regulates harvesting of certain species.
- The *Canada Shipping Act* and *Regulations* provide safety standards and/or pollution prevention and controls procedures for shipping activities in Canadian waters.
- The *Navigable Waters Protection Act* relates to all facilities required for navigation in Canadian waters.
- The *Canada Labour Act* and *Regulations* is the labour code which governs all federal employees or activities on Canadian owned or controlled land. Private provincial or territory employees are always submitted to such jurisdictions. The labour act governs minimum wages, statutory holidays, and maximum work hours.
- The *National Fire Code* (NFC) describes requirements for fire prevention, safety in buildings, fire fighting and maintenance of fire safety equipment including fire extinguishers. Furthermore, the NFC establishes the procedures for prevention, containment and fighting of fires originating outside buildings. The NFC also defines sets of standards for the storage and handling of dangerous goods, flammable liquids and combustible liquids.
- The *Atomic Energy Control Act* and *Regulations* define the packaging requirements and approval requirements for the transportation of radioactive materials.

- The *Explosives Act* and *Regulations* define explosive types, permitting, packaging, handling, transporting, and safety requirements.

Apart from these acts and respective regulations, the following guidelines and/or reports shall be used as references for the clean up work to be conducted at Resolution. These are defined, but not limited to the following:

- The *Canadian Arctic Contaminants Assessment Report* (CACAR) describes recent findings on the presence and transport of contaminants into the Canadian Arctic.
- The *Second Report from the Environmental Working Group* compiles achievements and agreements between NTI and DND on standards and requirements for the clean up of DEW Line sites located within the Nunavut settlement area.
- The *Guidelines for Preparation of Hazardous Material Spill Contingency Plans* describe parameters that should be considered in the development of hazardous material spill emergency plans. They also define the information that should be incorporated into a comprehensive contingency plan.
- The *Code of Good Practice on Dump Closing or Conversion to Sanitary Landfill at Federal Establishments* describes the requirements to improve operation and closing of existing dumps. It is used to give a consistent approach for the clean up of existing dumps in order to prevent contamination of water, air and soil. It also ensures that the best available control technologies are used.
- The *Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments* specify the level of treatment and effluent quality that shall be applicable to all wastewater discharged from existing and proposed federal installations.
- The *Code of Practice for Used Oil Management* defines appropriate environmental options for handling, storage, collection, recycling, transportation, reuse and/or disposal of used oils in Canada. It also helps regulatory authorities to formulate provincial and/or regional strategies for used oil management.
- The *Canadian Environmental Quality Criteria for Contaminated Sites* as determined by the CCME gives generic criteria for contaminants in soil and water (groundwater). These guidelines were defined to maintain, improve, and/or protect environmental quality and human health at contaminated sites. These criteria were developed to offer technical and scientific guidance to provincial, federal, territorial, and non-governmental agencies in the evaluation and/or clean up of contaminated sites. They shall serve as bench marks on which the degree of contamination at a site can be assessed.
- The *Canadian Drinking Water Guidelines* were also defined by the CCME for specified uses

of water.

5.3 Nunavut Territory Jurisdictions

In addition to the federal acts and regulations summerized in Section 5.2, the clean up of the Resolution Island site located in Nunavut shall comply with the following:

- The *Environmental Protection Act (Nunavut)* governs the protection of the environment from contaminants. The act defines offenses and penalties as well as the powers of environmental inspectors.
- The *Public Health Act (Nunavut)* was established to protect the general health and well-being of the communities in Nunavut.
- The *Nunavut Wildlife Act* governs the protection of wildlife and their habitats, and specifies harvesting criteria for selected species.
- The *Fire Prevention Act (Nunavut)* describes requirements for fire prevention. Among other things, the act provides procedures for the removal of fuel tanks and/or lines.
- The *Explosives Use Act and Regulations (Nunavut)* controls surface drilling and blasting to be conducted for purposes other than for mining.
- The *Safety Act* and *Occupational Health Regulations (Nunavut)* define the health and safety standards to be complied with in occupational environments to ensure the health and safety of the workers.
- The *Spill Contingency Planning and Reporting Regulations (Nunavut)* describe requirements for spill reporting and emergency planning.
- The *Guidelines for Discharge of Treated Municipal Wastewater (NWT)* define generic criteria for water quality effluent discharges from facilities such as the Resolution Island construction camp.
- The *Guidelines for Removal of Materials Containing Friable Asbestos* define procedures to be used when friable asbestos such as pipe insulation shall be removed.
- The *Northwest Territories Archaeological Sites Regulations* were developed to protect and conserve archaeological sites. The regulations prohibit site disturbances and removal of artifacts, and define provisions for site investigations by a certified archaeologist.

Activities associated with the clean up of Resolution Island (BAF-5) in the Nunavut Settlement Area require the provision of a Land Use Permit, a Water Licence, and Quarry Permits through the Nunavut Water Board (NWB) and INAC. The off-site shipping and disposal project was screened and public hearings were conducted by the Nunavut Impact Review Board (NIRB). The following legislation shall be complied with:

- The *Nunavut Waters Act* and *Regulations* specify standards for the conservation, development and use of the water resources within the Territory of Nunavut. Under this jurisdiction, the established Water Board shall provide licenses for all water usage and waste disposal activities.
- The *Nunavut Land Claims Agreement* (NLCA) defines titles and rights on the Nunavut settlement area based on their traditional and current use and occupation of the lands, waters and land-fast ice therein in accordance with their own customs and usages. The agreement gives provision for wildlife, outpost camps, parks and conservation areas. The NLCA also describes requirements for land, water and resource management and planning, for developmental impacts and for the establishment of a political system.

5.4 Permits

All necessary permits, authorizations, certificates and approvals related to site operations, handling, transport and disposal of hazardous material must be obtained by INAC and/or Qikiqtaaluk Corporation, the Contractor. Table 5.1 presents a partial list of these requirements where the delay corresponds to the approximate time required to obtain the said permits, certificates, licenses or authorizations after the application has been appropriately submitted.

Table 5.1: Applicable Permits and Authorizations for the Clean Up of Resolution Island			
Authorizations or Permits	**Regulatory Authorities**	**Activities**	**Permitting Agencies**
Work affecting fish habitat authorization	Fisheries Act	Culvert installation, stream crossing, erosion control, drainage, effluent discharge	Fisheries and Oceans Canada (Nunavut)
Water License	Northern Inland Water Act	Water use and wastewater disposal	Indian and Northern Affairs Canada
Land Use Permit	Territorial Lands Act, Territorial Land Use Regulations	Camp operation, heavy equipment use, fuel storage and use, waste disposal	Indian and Northern Affairs Canada
Transportation Permit	Transport of Dangerous Goods Act, IATA Dangerous Goods Act	Sea lifting, air transport of hazardous wastes	Transport Canada
Quarrying Permit	Territorial Lands Act, Territorial Land Use Regulations, Territorial Quarrying Regulations.	Extracting granular resources	Indian and Northern Affairs Canada
Explosives Permit	Explosives Use Act (Nunavut)	Quarrying activities	Natural Resources, Nunavut

6.0 BIOPHYSICAL ENVIRONMENT

6.1 Physiographic Description

6.1.1 Geology

The Short Range Radar Station, BAF-5 is located near Brewer Bay on the northeastern side of Resolution Island (Inuit name: Tujjaat - "a place where birds land"). The Island is located on the southeastern tip of Baffin Island, just outside of Frobisher Bay (61°35'N, 60°40'W). The Island is part of the Canadian Shield and therefore consists of barren gneiss bedrock. A few minor till deposits occur on the site (4). The Baffin Island soils can be mainly classified as cyric regosolic in nature (11). This class of soil is defined as imperfectly drained mineral soil with lack of profile development.

6.1.2 Hydrology

Within the immediate area of the abandoned military site, there are three (3) lakes which are in close proximity to the main road that links the upper site to the beach area. The former Freshwater Lake (900m long by 350m wide), formerly used as the water supply lake, is located approximately half way between the upper site and the beach area, southwest of the airstrip. The former Freshwater Lake discharges into Brewer Bay through a small creek. The second closest lake (280 m long by 80 m wide) is located at the lower site, southwest of the beach POL tanks. It drains towards the south into another lake and then into the ocean. Furthermore, a small man-made pond (80 m long by 60 m wide), located between the 2 beach POL tanks, discharges into the Brewer Bay. Finally, Lower Lake, currently used as the water supply lake, is located in a relatively undisturbed area (*i.e.*, Lower Lake borrow pit nearby was used from 2000 to 2001) at approximately 3.2 km (in a straight line) from camp and 1.6 km from the nearest traffic and construction activities. It drains towards the east and discharges into the ocean through a small stream. All three (3) lakes and the pond show no signs of aquatic life.

6.1.3 Topography

The topography of Resolution Island is rugged, and consists of slopes on the summit averaging 10%. Steep cliffs are situated along the south and southwest sides of the summit with elevations over 200 m ASL. The vegetation is limited to the location of the gullies and other low-lying valleys where soil is present and rooting possible. The summit of the Island consists of tilted bedrock with

parallel rock ridges, knolls, and shallow gullies forming a series of ledges. These are particularly prominent on the north and south slopes.

6.1.3 Meteorology

Climate at Resolution Island ranges from long cold winters to short mild summers. The daily annual mean temperature is -8.1°C. The daily mean maximum temperature from July to September is 5.3°C (12). Wind speeds reach a mean average of 27 km/hr over the year, predominantly from the northwest. The average wind speed is 22 km/hr during the months of July to September (13). The mean average precipitation is 73.5 mm and the maximum daily rainfall mean is 24.1 mm for the months of July to September. The annual mean precipitation is 372.0 mm and the majority falls as snow (12).

6.2 Biological Description

Resolution Island is located within the Northern Arctic Ecozone. The bio-diversity in the area is quite low in comparison to other regions. While there is variability of species with respect to specific habitats, many species range over large areas of the ecozone.

6.2.1 Terrestrial Flora

Because of the harsh environment and rocky areas with little soil development present on the Island, the flora is limited to a few species. In the areas where the soil is sufficient (4), the following species were identified:

Species	Common Name
Lichens	
Rhizocarpon geographicum (L.) DC.	map lichen
Thamnolia subuliformis	worm lichen
Cladonia rangifernia Web.	reindeer lichen
Umbilicaria sp.	rock tripe
Xanthoria elegans	jewel lichen

Species (continued)	**Common Name** (continued)
Mosses	
Distichium sp.	
Drepanocladous aduncus (Hedw.) Warnst.	
Polytrichum juniperinum Hedw. var.alpestre BSG	
Polytrichum piliferum Hedw.	
Sphagnum sp.	
Poaceae (Grass Family)	
Phippsia algida (Sol.) R.Br.	
Cyperaceae (Sedge Family)	
Carex Bigelowii Torr.	
Eriophorum scheuchzeri Hoppe	cotton grass
Eriophorum russeolum	
Juncaceae (Rush Family)	
Luzula confusa Lindebl.	wood rush
Salicaceae (Willow Family)	
Salix arctica Pall. S.lat	Arctic willow
Salix herbacea L.	least willow
Caryophyllaceae (Pink Family)	
Cerastium alpinum L. s.lat	mouse-ear willow
Silene acaulis L. ssp. Acaulis	moss-campion
Minuarta sp.	sandwort
Brassicaceae (Mustard Family)	
Eutrema edwardsii.R.Br.	

Species (continued)	**Common Name** (continued)
Saxifragaceae (Saxifrage Family)	
Saxifraga aizoides L.	yellow mountain saxifrage
Saxifraga stellaris L. var. comosa Retz.	
Saxifraga uniflora	
Saxifraga tricuspidata	prickly saxifrage
Empetraceae (Crowberry Family)	
Emperum nigrum L.ssp. Hermaphroditum (Lge.) Bocher	crowberry
Ericaceae	
Cassiope hypnoides (L) D.Don	moss heather
Cassiope tetragona (L.) D.Don ssp. tetragona	Arctic white heather
Ledum decumbens (Ait.) Lodd.	Labrador tea
Vaccinium uliginosum L.ssp. pubescens (wormsk.) Young	blueberry
Diapensiaceae (Diapensia Family)	
Diapensia lapponica L.	

6.2.2 Fauna

Polar bears are frequently seen at Resolution Island and tracks are constantly sited in the area. Arctic foxes have been sighted on Resolution Island. The surrounding area is also a migration route for whales. There are a few different species of seals in the area, along with walruses that are attracted to the 49 different species of fish occurring in the nearby marine waters.

The cliff along Brewer Bay also attracts water fowl such as the thick-billed murre and black-legged kittiwake for nesting. There have been sightings of snow buntings, glaucous gulls, ptarmigans, peregrine falcons, and ravens on the Island.

7.0 POTENTIAL PROJECT IMPACTS AND MITIGATIVE MEASURES

The project, as a whole, has and will provide a substantial amount of employment and training opportunities for the Inuit of the Baffin Region and positive economic impacts on the local economy are expected. To date, approximately 18,000 person-days were employed as part of this project (12,000 for laborers and supervisors, 4,000 for trainees, and 2,000 for other personnel: camp operation, catering, bear monitoring, laboratory testing, and engineering). The project created positive social and economical opportunities and it is expected that final activities will also have positive social and economical impacts.

In the following section, the potential environmental impacts of remaining project activities of the Resolution Island Project are identified and assessed. Where impacts are deemed to be significant, mitigative measures are recommended.

7.1 Site Access

Transportation of work crews, small equipment and camp supplies will be carried out with a helicopter and with occasional Twin Otter chartered aircraft flights. Fuel supply and large equipment will be shipped by marine vessels. Furthermore, on-site access to construction locations will be conducted through the existing road network with heavy equipment and other vehicles including pick-ups and ATVs.

Impact: Rutting and Erosion Heavy equipment and vehicles can damage soil integrity.

Mitigation: *Vehicles or heavy equipment shall not be operated off-roads after heavy rain or melting snow conditions. Such restrictions shall apply until the soil has dried sufficiently so that excessive rutting can be prevented.*

Impact: Habitat Disturbances Seabirds are known to be vulnerable during their nesting period. Some species may be affected by low-flying aircraft and close approaches by marine vessels.

Mitigation: *Pilots shall be advised to maintain an altitude of at least 500 metres above ground or water when passing over areas where birds are concentrated. Pilots shall not be permitted to do low-level flights to observe and/or photograph wildlife.*

Impact: Habitat Degradation Large volumes of fuel are required at the site to run both equipment and generators. The fuel is to be transported to the site on a barge or supplied by tanker ships. There is the possibility of accidental spillage at the site which would result in the contamination of soils and/or water in the surrounding environment.

Mitigation: *Transportation of fuel, as well as any other hazardous materials brought to the site, shall be done in compliance with the Transportation of Dangerous Goods Act and Regulations requirements. Fuel will be kept in double walled steel tanks. Valves on fuel tanks should have receptacles placed beneath them to catch any leaked fuel.*

7.2 Construction Camp

A single camp that can accommodate approximately 50 persons will be operated for the duration of the project.

Impact: Aesthetic and Safety Solid waste produced at the camp may cause both an aesthetic and safety concern at the site. Animals are attracted to solid waste disposal sites and have the possibility of becoming a nuisance as well as a safety concerns to personnel.

Mitigation: *Waste bins used at the site shall be animal proof and emptied on a frequent basis. Non-hazardous combustible wastes are to be burned daily, in a forced air fuel-fired incinerator. Ash and non-combustible non-hazardous wastes should be buried within the upper non-hazardous landfill. Hazardous wastes shall be stored in a proper manner and transported from the site in accordance with the Transportation of Dangerous Goods Act and Regulations.*

Impact: Health Sewage disposal from the camp may cause a health problem for both humans and wildlife.

Mitigation: *A sewage lagoon located away from the camp shall be used for the disposal of sewage water. Hazardous materials shall not be discharged in the lagoon. A warning sign shall be posted near the lagoon, and the lagoon shall be secured to prevent accidents.*

Impact: Habitat Degradation Fuel used in equipment and camp generators is needed in large quantities and must be transported to the site via sealift, and then trucked to the upper site. Fuel spillage can result in both soil and surface water contamination.

Mitigation: *A spill contingency plan was prepared for fuel storage as well as any other hazardous liquids used at the site. Fuel storage is to be located at least 12 metres above the high water mark of the nearest water body, on flat stable terrain or in a natural depression and is to be stored and dispensed in accordance with the CCME Environmental Code of Practice for Above ground Storage Tank Systems and fire code requirements. Secondary containment is required for any fuel storage container with a capacity of 4,000 litres or more. Any contamination created at the site should be remediated. Fuel spills shall be reported and cleaned up immediately.*

Impact: Fire There is the possibility of a fire occurring at the site as a result of camp related activities.

Mitigation: *Adequate attention to fire safety and prevention is required by the camp operator and workers. Fire alarms and fire fighting equipment suitable for the size of the camp are maintained on-site. A Fire Emergency Plan is in place.*

7.3 Fuel Handling and Storage

Approximately 300,000 litres of Jet A1 diesel fuel are stored on-site for a 2-year project requirement. Nine (9) self-contained fuel tanks (32,000 litres each) are used for on-site fuel storage.

Impact: Habitat Loss/Alteration Some habitat loss or alteration may occur if a fuel spill occurs.

Mitigation: *Emergency spill equipment including fuel pumps, empty drums, containment booms and other sorbent materials are available on site. Enough equipment are on-site to clean up a 1,000 litre spill at the fuel tank farm or any other fuel storage locations.*

Impact: Fire There is the possibility of a fire occurring at the site as a result of accidents (*i.e.*, ignition sources).

Mitigation: *Smoking is prohibited within 5 metres of the fuel storage facilities. Appropriate signs was posted. Fire-fighting equipment are available for immediate access near the tank farm and at all fuel storage locations.*

7.4 Heavy Machinery and Vehicle Management

Heavy equipment and vehicles such as excavators, bulldozers and trucks are required to conduct and support clean up activities. These vehicles will require routine maintenance and lubrication.

Impact: Wildlife Stress Wildlife can be affected by vehicle movements although it is expected that this will have a minimal impact.

Mitigation: *Mobile equipment and vehicle operators shall not operate vehicles in a manner to disturb any wildlife species.*

Impact: Habitat Alteration Some habitat alteration may occur if a spill of maintenance fluids occur.

Mitigation: *Vehicle and equipment maintenance and servicing shall be conducted only in designated areas on gravel pads, where special procedures can be implemented to manage fluids, waste, and contain potential spills. Maintenance, fuelling and lubrication of machinery shall be conducted in such a way as to avoid fluid spills. Used fluids (e.g., oils, antifreeze) and filters (e.g., oil, fuel) shall be containerized in separate and appropriately identified drums (or other appropriate containers) and shall be treated as hazardous materials. All storage containers shall be properly sealed after use. Waste fluids shall not be used for dust control.*

Impact: Health and Safety Because of the topography of the site, there is a concern for accidents involving vehicles on roads.

Mitigation: *A speed limit shall be established (tentatively 30 km/hour or less) and enforced by the site superintendent.*

7.5 Water Supply

Water from Lower Lake, located near Lower Lake borrow pit, shall be used as a water supply

source providing such use does not adversely affect fish habitats. It should be mentioned that no signs of aquatic life were recorded in Lower Lake. Therefore, minimal impacts are expected.

Impact: Fish Habitat Alteration There is a potential for fish habitat alteration from freshwater withdrawal activities.

Mitigation: *Water usage shall respect all conditions of the water permits delivered by the Nunavut Water Board.*

7.6 Asbestos Abatement

Asbestos pipe insulation and tiles were removed from all buildings located at the summit area. Remaining asbestos material shall be double-bagged and disposed in a separate cell of the non-hazardous landfill.

Impact: Health and Safety The removal of friable asbestos creates a health risk for personnel involved in the asbestos abatement activities.

Mitigation: *The removal of the asbestos from any locations is to be treated as an asbestos project and all of the related health and safety requirements adhered to. This will include the removal of all visible asbestos. The Safety Act and Occupational Health Regulations (Nunavut) require that workers handling asbestos material wear respiratory equipment approved by the Canada Standards Association, as well as other safety equipment including coveralls, gloves, eye protection and head gear. All personnel who work on the asbestos material must be trained for the use of protective equipment and safe handling and disposal of the asbestos. Warning signs should be posted at the site informing staff that asbestos removal is occurring and ensure that personnel not working with the asbestos should not be near the working site.*

7.7 Demolition Work

The Main PCB storage building will be demolished to make way for the construction of the Tier II landfill. Demolition work shall include the removal and disposal of structural steel, sheet metal cladding, fibreglass insulation, and concrete.

Impact: Health and Safety There is a safety concern for workers involved in demolition activities.

Mitigation: *A health and safety program that meets the standards and requirements of applicable regulatory agencies shall be implemented. The construction safety measures of the National Building Code shall be respected and enforced.*

7.8 Construction and Maintenance of Roads

Apart from the existing roads that will require routine maintenance, a temporary road will be constructed to gain access to the S1/S4 valley contaminated area. Another road will be constructed from the lower site to the S1/S4 beach area. In order to reach the S1/S4 beach area, a small stream will have to be crossed. This will be achieved either by installing culverts underneath the gravel road, or by installing a layer of small boulders through which water could continue to flow.

Impact: Permafrost Degradation Cut and fill operations required to provide the sub-granular base for the road access to the S1/S4 beach area may disrupt the permafrost.

Mitigation: *Disturbed soil that disrupts natural drainage patterns or exposes permafrost in ice rich soils shall be repaired.*

Impact: Habitat Degradation Installation of culverts in the stream and subsequent covering by gravel might, or installation of a boulder layercause stirring of bottom sediments and generate an increase in water turbidity downstream. This could cause impacts to the stream aquatic habitats as well as fish habitats in the ocean downstream.

Mitigation: *These impacts should be temporary (i.e., only during the construction and removal of the road and culverts), however, during these activities, a silt fence shall be installed to limit the spreading of sediments and turbidity downstream. The use of a bridge would eliminate the need for mitigation measures.*

7.9 Excavation of Contaminated Soil

Approximately 5,000 m^3 of CEPA PCB soils will be excavated using heavy machinery or manually. Soil will be screened to remove large boulders and containerized. Other contaminated soils, such as Tier I and Tier II soils (lead, cobalt, mercury, or PCBs), as well as hydrocarbon contaminated

soils will also be excavated and managed according to their level of contamination. Hazardous material management areas will be set up for the processing of CEPA soils to prevent the contamination of "clean" areas.

Impact: Rutting and Erosion Unstable areas such as steep slopes and streams may be encountered during the excavation phase. These areas are more prone to rutting, erosion and environmental damage.

Mitigation: *Excavation work shall be minimized in the vicinity of watercourses. Heavy machinery, vehicles and equipment shall not be operated in waterways. Waste, excavated fill and/or debris shall not be disposed in waterways. Suitable barriers such as silt fences shall be installed if required to separate work areas from waterways. All unstable areas requiring excavation shall be identified and procedures shall be implemented to minimize surface rutting.*

Impact: Contamination of "Clean" Areas There is a risk that excavation activities contribute to the contamination of non-contaminated areas including fish habitat. Furthermore, equipment and machinery used during contaminated soil excavation and handling will require cleaning, and this will produce hazardous materials (solids and fluids) that can have a negative environmental impact if not managed properly.

Mitigation: *Hazardous material management areas shall be located at a minimum distance of 30 metres from the nearest water body. CEPA soils screening procedures shall be implemented in such a way as to prevent the spreading of contaminated dust. Movement of heavy machinery, vehicles and equipment within the hazardous material management areas shall be controlled to prevent the dispersion of potentially hazardous dust and materials into the environment. Wash water resulting from the cleaning (i.e., decontamination) of equipment and heavy machinery used in the hazardous waste management areas shall be recovered and treated as per regulations.*

Impact: Permafrost Degradation Material and equipment will have to be stored temporarily within each hazardous material management area for the duration of the excavation activities.

Mitigation: *Storage areas shall be sited in locations where the natural surface drainage will not*

be affected and where ponding can be avoided. Materials shall not be stored on unprotected ground. Gravel pads or other appropriate methods shall be constructed to protect ice-rich soil from damages.

7.10 Construction of Engineered Landfills

Engineered unlined landfills were constructed and operated on site for the disposal on non-hazardous waste materials. Engineered lined landfills were constructed and are operated on site for the disposal of Tier II contaminated soils and debris, creosote-treated timbers, and soils contaminated by heavy hydrocarbons such as lubricating oils and grease.

Impact: Rutting and Erosion Use of heavy equipment and machinery can damage soil integrity, especially in unstable areas.

Mitigation: *Heavy equipment operations shall be limited to pre-determined work areas. Activities outside these areas shall be minimized, and conducted only when the soil is sufficiently dry so that excessive rutting can be prevented.*

Impact: Surface Water Runoff/Sediment Movement Heavy equipment traffic and large movements of granular material may generate high sediment loads in surface water runoff.

Mitigation: *Landfill sites shall be located at a minimum distance of 30 metres from the nearest water body. Silt fences shall be installed in drainage ditches in order to prevent migration of sediments to streams and water bodies.*

Impact: Habitat Loss/Alteration Habitat will be lost and altered through the excavation and removal of top soil, as well as by backfilling over vegetated areas.

Mitigation: *Upon landfill closure, the area shall be covered with granular material, graded and reshaped to match the surrounding topography and minimize erosion. Vegetation will eventually colonize this new surface area.*

7.11 On-site Treatment of Hydrocarbon Contaminated Soils

The soils contaminated by light hydrocarbons, such as gasoline and diesel fuel, will be excavated

and bio-treated on site, most likely by landfarming.

Impact: Contamination of "Clean" Areas Treatment activities may potentially contribute to the contamination of non-contaminated areas. Dry contaminated soil particles and dust may be spread by wind. Furthermore, runoff water draining from the soil may be contaminated.

Mitigation: *The landfarming treatment pad shall be located at a minimum distance of 30 meters from the nearest water body. The soil moisture level shall be kept at an optimal level to promote biodegradation, therefore this soil moisture will minimize loss of particles to wind. Drainage ditches located around the treatment pad will recover potentially contaminated water. The water will then be tested, and treated if required, before being discharged.*

7.12 Disposal of Hazardous Materials

PCB contaminated electrical equipment (*e.g.*, transformers, capacitors, and ballasts) and old batteries have been found on site. Furthermore, hazardous materials may be encountered during the sorting of waste in landfills and the testing of drum contents. Sorting of waste was carried out at the furniture dump, is on-going at the beach dumps, and will be required at the cobalt dump and the airstrip dump, with partial sorting for the latter. Hazardous material management areas will be set up for the processing of hazardous waste to prevent the contamination of "clean" areas. Hazardous materials will be temporarily stored on site and shipped off site to an authorized hazardous waste disposal facility.

Impact: Health and Safety There is a safety concern for workers involved in the handling of hazardous waste.

Mitigation: *Every possible precaution shall be taken when hazardous materials and contaminated soils are handled, hauled or transported to ensure that such materials do not come into contact with site personnel. Protective clothing shall always be used by site workers when hazardous materials including contaminated soils are handled. All clean up personnel shall be informed and shall comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) program and the Hazardous Waste Operations and Emergency Response (HAZWOPER) program.*

Impact: Habitat Degradation Spill of hazardous materials during off site shipping could cause severe impacts to terrestrial and/or fish habitats

Mitigation: *Any unknown waste that may require off-site shipping shall be characterized to determine whether it must be considered as a transport hazard according to regulations. All provisions from the Transportation of Dangerous Goods Act (TDGA), the International Maritime Dangerous Goods (IMDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulations shall be respected.*

7.13 Temporary Storage of CEPA Soils

CEPA soils will be containerized at the excavation and the bulk storage locations. Bulk soils and soil filled containers will be transported to the PCB storage facilities. The soil-filled steel containers meeting EIS specifications will be appropriately staged. Some soils may need to be stockpiled in bulk form inside a lined building, with access restricted to authorized and trained personnel.

Impact: Contamination of "Clean" Areas There is a environmental concern with the release of contaminated soils in non-contaminated areas during transportation to storage facilities.

Mitigation: *Spillage of material during transportation between the excavation site and the storage/stockpile location shall be minimized, if not avoided.*

7.14 Disposal of Non-hazardous Materials

Non-hazardous materials such as kitchen and camp rubbish, shredded drums and demolished building structures will be landfilled on site.

Impact: Aesthetic and Safety Non-hazardous waste may cause both an aesthetic and safety concern at the site if not managed properly. Non-hazardous waste can be scattered by wind or animals and thereby becoming a safety concern to personnel as well as wildlife.

Mitigation: *Waste to be placed in non-hazardous landfills shall be compacted and rapidly covered with a layer of granular fill.*

7.15 Landfill Closure

Some existing dumps will be excavated and waste will be sorted to separate hazardous from non-hazardous material. These include the furniture dump, the maintenance dump and the beach dumps.

Impact: Safety and Health Because of the nature of work involved and potential hazardous material exposure, there is a concern for the health and safety of workers.

Mitigation: *The impact of these operations is similar to that of the section 7.12 and 7.14 and the mitigative measures identified in these sections apply.*

7.16 Development of Granular Borrow Areas

Granular material shall mainly be used for road construction, Tier II landfill construction and non-hazardous landfill covers. Resolution Island is very limited in granular material. Specific locations were identified as borrow areas. Blasting of bedrock may be required to increase the volume of granular material.

Impact: Wildlife Avoidance Blasting rock produces a high decibel noise which may alarm wildlife causing some avoidance and resident bird populations may be vulnerable to noise during their nesting period in May and June. This operation will only be required over short periods during the project. Therefore, avoidance by wildlife should not be permanent.

Mitigation: *Blasting shall be limited to the time of the season when nesting is mostly over (i.e., July and August).*

Impact: Safety Hazard The transportation and handling of explosives is a safety concern for workers.

Mitigation: *Handling, storage and transportation of explosives shall be conducted according to applicable laws and regulations. The handling of explosives shall be restricted to authorized and licensed personnel. Blasting shall be conducted in such a way as to minimize dispersal of material, and prevent dispersed materials from reaching fuel or hazardous material storage locations. A buffer zone of 300 metres shall be*

respected.

Impact: Habitat Loss/Alteration Habitat may be lost through the removal of vegetation from blasting operations. However, the bedrock areas to be blasted are relatively free of vegetation.

Mitigation: *No mitigative measures were considered necessary.*

Impact: Environmental Disturbances Quarrying activities may create environmental impacts to the immediate surroundings of the borrow pits.

Mitigation: *Quarry permits issued under the INAC Territorial Quarrying Regulations shall be obtained. The permits shall have site-specific provisions for environmental protection. These conditions are provided to minimize the extraction process impacts on water quality, drainage, erosion and ecosystems. All terms and conditions of the quarry permit shall be respected, including borrow area recontouring and clean up before abandonment.*

Impact: Disruption of Drainage Drainage may be impacted during excavation of the borrow areas. Sediments may be deposited into streams, thereby disrupting natural drainage of the area.

Mitigation: *Borrow pits shall be protected from erosion and ponding by proper grading.*

Impact: Permafrost Degradation Excavation of the borrow areas will remove the insulating ground cover and expose the sides and the bottom of the excavations to direct sunlight. This may result in erosion and slumping of the pit side walls. Damage to permafrost in the immediate vicinity of the pits is unavoidable. The areas are, however, surrounded by bedrock outcrops and it is likely underlain by bedrock as well. The excavations may therefore extend to surface bedrock in some areas, eliminating the concern for permafrost degradation.

Mitigation: *Final grading of any non-bedrock side walls will be required to address slumping and erosion of the pits the following summer.*

7.17 Migration Barriers

Migration barriers consisting of erosion control mats and trenches filled with containment booms will be installed at three (3) different locations to prevent the migration of contaminants (mainly fine particles transported with run-off) from reaching the ocean.

Impact: Safety and Health Because of the nature of the work involved to remove existing containment booms, there is a concern that workers may be exposed to potentially hazardous materials.

Mitigation: *The impact of these operations is similar to that of the section 7.12 and 7.14 and the mitigative measures identified in these sections apply.*

Impact: Habitat Loss/Alteration Habitat will be lost through the removal of vegetation from excavation of trenches. However, the surface of land to be excavated to construct migration barrier is relatively small.

Mitigation: *No mitigative measures were considered necessary except that movement of heavy machinery required to excavate trenches shall be restricted to the close vicinity of excavation areas.*

7.18 Cumulative Effects

Cumulative effects are defined in the Canadian Environmental Assessment Act as "any cumulative environmental effects that are likely to result in combination with other projects or activities that have or will be carried out."

The Clean up of Resolution Island has been assessed for cumulative environmental effects. While past human occupation of the site must be considered in this assessment, the actual effects of past operations of the radar installation are not assessed in this report.

The project is to take place over a fixed period of time (summer seasons over three to five remaining years) in an area where no human occupation and development has occurred in the past apart from military operations. There is no reported human activity within 200 kilometres of the site.

Cumulative environmental effects of the project are expected to be negligible:

no current traditional land usage, and no industrial or commercial activities have been reported in the immediate area and surroundings;

- the site has been previously occupied by the military and much of the project areas remain marginal for use by wildlife; and
- the project is to occur over a relatively short period of time.

8.0 MONITORING PROGRAM

8.1 Rationale

In order to monitor the efficiency and impact of clean-up activities, it will be necessary to establish a system of long-term monitoring stations in areas most likely affected by contamination from the site. By determining conditions at these sites both before and after remediation of the site, the success of the clean up effort can be assessed and, if required, further measures taken.

Numerous studies conducted prior to clean up of this abandoned military radar site have shown that contaminants were leaching from the site into the surrounding environment. Soil and plant samples have shown high levels of contamination.

8.2 Objectives

A long-term monitoring program shall be implemented at Resolution Island to verify the general conditions of PCB storage facilities (visual inspection) and to evaluate the performance of migration barriers (containment dams and erosion control devices) and landfills. The monitoring program shall have the following objectives:

.1 Establish monitoring areas and determine the location of sampling points for the required media (*i.e.*, soil, water, sorbent material) likely impacted by contaminants;

.2 Establish the baseline concentration data of known contaminant parameters in soil and groundwater; and

.3 Implement a long-term monitoring schedule.

8.3 Methods

The long-term monitoring program shall combine visual inspection, sampling and analysis. The physical integrity of the PCB storage facilities and landfills should be inspected and reported using photographs (from the air as well as from ground level) and drawings. Documented observations should include signs of damage from settling, pounding, frost action, erosion, lateral movement and other potential causes.

The technique used for monitoring changes in the ecosystem shall be the "bottom up" method. In this method, soil and water samples are collected and analyzed to indicate potential for plant and animal intake. The advantages of using this method is that it is site specific, it is not damaging to

the environment, and it can detect problems before contaminants reach higher organisms in the food chain. As for the containment barriers, the monitoring program shall also include provisions for the collection and analysis of sorbent material within containment barriers to verify that they are not saturated.

In the monitoring program, considerations shall be given to contaminant movement in water and soil. Factors affecting the monitoring methodology include, sampled media, temporal and spatial considerations, and site selection.

8.3.1 Sampling Methods

Both soil and groundwater shall be sampled to provide data on the transport and presence of contaminants resulting from landfill leachate migration and movement of surficial contaminated soil particles through surface water run-off.

8.3.2 Temporal Considerations

The monitoring program will not only be used to characterize the surrounding environment in terms of contamination, but shall also measure how the level of contamination changes over time.

After establishing the baseline values, samples should be taken on a yearly basis for the first five (5) years after completion of the remediation work. Afterwards, sampling should be carried out at a less intense frequency until stable conditions are observed.

8.3.3 Spatial Considerations

Depending of the surface area of the site to be monitored, at least three (3) sampling locations shall be used. Typically, a monitoring well will be installed at each sampling location. Groundwater shall be sampled from each well and analyzed for all the required parameters. Results from groundwater samples will indicate the lateral distribution of contamination. Furthermore, both surface (0 - 10 cm) and subsurface (40 - 50 cm) soils shall be sampled in the vicinity of each sampling location (*i.e.*, near monitoring wells when present). Results from soil samples will indicate both the lateral and vertical distribution of contamination.

8.3.4 Site Selection

Reproducibility is considered an important factor in the monitoring program. This is primarily due to temporal and spatial variations. The following rationale shall be used in selecting monitoring sites:

The site should represent a probable contaminant distribution route;
Sampling plots should be relatively uniform but large enough that sufficient unaffected areas are available for future sampling;
Sites should be easily identifiable;
Sites should be typical of the surrounding area in terms of soil (sediment) and vegetation type.

8.4 Recommendations

The areas where PCB soils are containerized shall be inspected as required by regulations arising from CEPA. Furthermore, it is recommended that soil and water samples be taken for the analysis of PCBs up and down gradient of migration barriers at the S1/S4 valley, the S1/S4 beach area, the furniture dump, and around the PCB storage areas. In addition, sorbent materials shall be collected from booms in containment barriers and shall be replaced before they become saturated. Soil samples shall also be taken in the pathways leaching from the summit (North Slope, PCL dump, etc.) and analyzed for PCBs although less frequently than for other locations.

It is also recommended that soil samples be taken for the analysis of heavy metals in the leachate pathway of the lead dump (beach landfill) and the cobalt dump (maintenance area), and that remote soil and water background samples be collected and analyzed for targeted contaminants as references.

9.0 Screening Recommendation

Subject to review and public consultations, the findings of this screening report are that the proposed clean up project at Resolution Island is not likely to cause adverse effects. The project may continue/proceed with the assurance that the mitigating measures identified in this report will be implemented.

10.0 REFERENCES

1-Dew Line Cleanup, Environmental Workshop, Royal Roads Military College Environmental Sciences Group, October 1991.

2-Dew Line Cleanup, 2nd Environmental Workshop, Royal Roads Military College Environmental Sciences Group, April 1993.

3-Dew Line Cleanup: Scientific and Engineering Summary Report, prepared by Royal Roads Military College Environmental Sciences Group and UMA Engineering Ltd. for the Department of National Defence, 1995.

4-Environmental Study of a Military Installation at Resolution Island, BAF-5, prepared by Royal Roads Military College Environmental Sciences Group for the Department Indian Affairs and Northern Development, March 1994.

5-Environmental Study of a Military Installation at Resolution Island, BAF-5-Volume Two, prepared by Queen's University Analytical Services Unit for the Department of Indian Affairs and Northern Development, March 1995.

6-Environmental Study of a Military Installation at Resolution Island, BAF-5-Volume Three, prepared by Royal Military College Environmental Sciences Group for the Department of Indian Affairs and Northern Development, RMC-CCE-ES-96-10, March 1996.

7-Environmental Study of a Military Installation at Resolution Island, BAF-5-Volume Four, prepared by Queen's University Analytical Services Unit for the Department of Indian Affairs and Northern Development, March 1997.

8-Environmental Risk Assessment for Resolution Island, Northwest Territories, prepared by Golder Associates Ltd and Royal Roads University for the Department of Indian Affairs and Northern Development, May 1997.

9-PCB Testing Program: BAF-5 - Resolution Island, prepared by Bond Architects & Engineers Ltd. for the Department of National Defence, September 1988.

10-Clean up Options for Resolution Island, prepared by Qikiqtaaluk Corporation and Legault, Desjardins, Simon Consultants Inc. for the Department of Indian Affairs and Northern Development, December 1997.

11- Soils in Canada, Clayton, J.S. W.A Ehrlich, D.B. Cann, J.H. Day and I.B. Marshall., Research Branch, Department of Agriculture, Ottawa (In 2 Volumes), 1977.

12-Canadian Climate Data, Resolution Island, NWT, User Calculated Means for (1962-1993), Environment Canada, 1994.

13-Canadian Climate Data, Resolution Island, NWT, User Calculated Means for (1929-1961), Environment Canada, 1994.