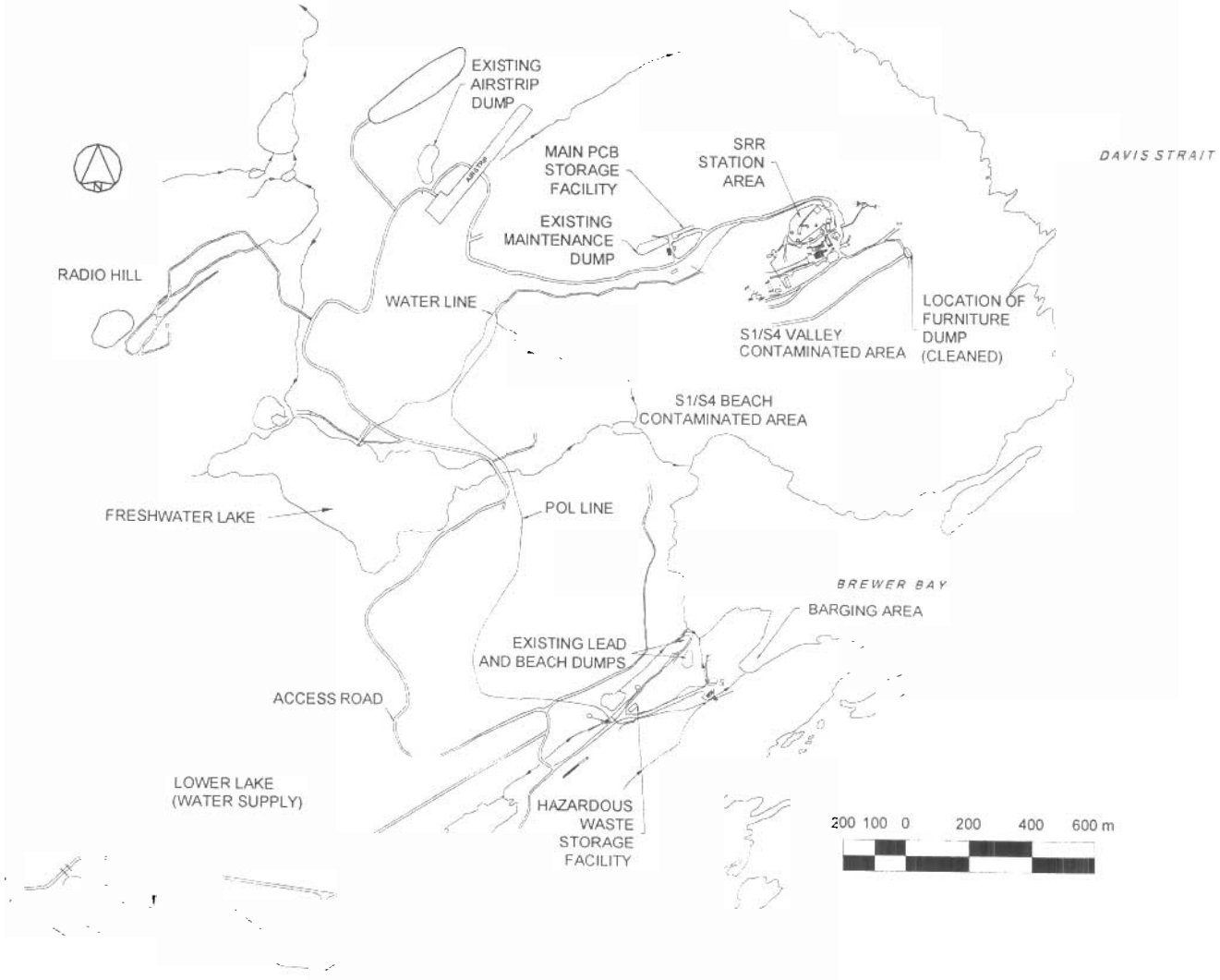

Figure 3.2: General layout of the Resolution Island abandoned military radar site.

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.