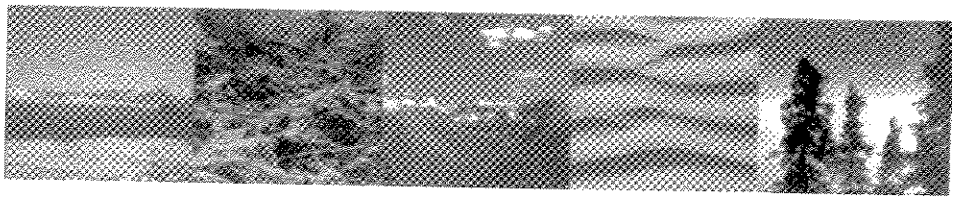
Environmental Assessment of the Site Remediation of the Former U.S. Coast Guard LORAN Station, Cape Christian, Nunavut



Prepared for
Public Works and Government Services Canada
Western Region

Submitted by
Gartner Lee Limited

April 2007

Gartner Lee

Environmental Assessment of the Site Remediation of the Former U.S. Coast Guard LORAN Station, Cape Christian, Nunavut

Prepared for
Public Works and Government Services Canada, Western Region

April 2007

Reference: **GLL 70088**

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April 9, 2007

Alison Dourado, P.Biol.
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Dear Ms. Dourado::

Re: 70088 – Environmental Assessment of the Site Remediation of the Former U.S. Coast Guard Station, Cape Christian, Nunavut

Please find attached the revised final report identifying potential impacts which may result from the proposed remediation of the Cape Christian site. The report presents mitigation measures along with potential residual and cumulative effects. On the basis of our review, monitoring programs are recommended.

Yours very truly,
GARTNER LEE LIMITED

Arlene Laudrum, P.Geol.
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Executive Summary

The Cape Christian site is a former U.S. Coast Guard Long Range Navigation (LORAN) Station located approximately 16 km northeast of the Hamlet of Clyde River, on the northeast coast of Baffin Island. Environmental assessment and remediation planning and design have been ongoing since 1974. The site will be fully remediated in the near future. Activities related to the project include: dismantling of infrastructure and segregation of wastes; remediation and disposal of non-hazardous waste; and remediation and disposal of petroleum and metals impacted soil. Hazardous materials will be containerized and shipped off-site for disposal in the South, with the exception of asbestos material (not painted with lead/PCB paint), which will be bagged and disposed of in the on-site landfill.

As required under the *Nunavut Land Claim Agreement* (NLCA) and the *Canadian Environmental Assessment Act* (CEAA), the remediation activities proposed for the Cape Christian site must undergo an Environmental Impact Assessment (EIA). Under the NLCA a screening of the proposed project is required as 1) the project is proposed by Indian and Northern Affairs Canada (INAC) as the agent of the federal government or the Crown; and 2) the federal government funds the project.

Gartner Lee was retained by Public Works and Government Services Canada (PWGSC) on behalf of INAC to prepare the EIA for the proposed remediation of the Cape Christian Site.

The remediation will follow the 2007 Remediation Action Plan (RAP) prepared by Earth Tech Canada Inc. The EIA will guide Public Works and Government Services Canada in their mandated attempts to fully remediate this site in accordance with all applicable territorial and federal legislation.

The following is a proposed schedule for the remediation of the Cape Christian site according to the RAP (Earth Tech, 2007):

- Contractor barges to Clyde River (Fall Year 1);
- Contractor cat trains to Cape Christian (Winter Year 1);
- Contractor completes first season of work at Cape Christian (Summer Year 2);
- Equipment remains on-site (Winter Year 2);
- Contractor completes 2nd season of work (Summer Year 3);
- Contractor cat trains back to Clyde River (Winter Year 3); and
- Contractor barges equipment to South from Clyde River (Fall Year 4).

The following remedial objectives were outlined in the RAP (Earth Tech, 2007) and are based on the INAC's *Abandoned Military Site Remediation Protocol*, March 2005:

1. Restore the Cape Christian site to an environmentally safe condition;
2. Prevent the migration of contaminants into the Arctic ecosystem;
3. Remove physical hazards for the protection of human health and safety; and
4. Implement a cost effective remediation solution.

The remediation of the Cape Christian site will have a positive effect on the environment through the demolition of deteriorating buildings, the removal and disposal of hazardous materials and the land filling of non-hazardous debris and ultimately, the contouring of the site to mitigate erosion. Through the implementation of the proposed mitigation measures and project design, potential adverse effects of the proposed project will be minimized and no adverse residual effects are expected to occur.

Post-remediation monitoring is recommended once every year for the first five years followed by monitoring every five years for the following 20 years in order to determine the effectiveness of remediation.

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1. Introduction

Public Works and Government Services Canada (PWGSC), on behalf of Indian and Northern Affairs Canada (INAC) engaged Gartner Lee Limited to prepare an Environmental Impact Assessment (EIA) for the proposed remediation of the former U.S. Coast Guard Long Range Navigation (LORAN) Station, Cape Christian, Nunavut (the Cape Christian site). This EIA will be submitted to the Department of Community and Government Services, Government of Nunavut (CSG-GN), Nunavut Impact Review Board (NIRB) and the federal regulators in Nunavut.

1.1 Background

As the custodian of federal lands in the North, INAC has responsibility through the Northern Contaminated Sites Program (CSP) to manage a number of contaminated properties that are no longer maintained by the original occupant. INAC's portfolio of contaminated sites in the North originated from private sector mining, oil and gas activities and government military activity dating back over half a century. The Cape Christian site is one of these sites.

Cape Christian is located on the northeast coast of Baffin Island, Nunavut, as shown on Figure 1, LORAN Station, Cape Christian, Nunavut. The site is located approximately 16 km northeast of the Hamlet of Clyde River at 70°31'17"N Latitude and 68°17'56"W Longitude. The site is located within the municipal boundaries and block land transfer of Clyde River. Access to the site is either by water, land or air (e.g., boat, ATV or fixed wing aircraft equipped with tundra tires) (Earth Tech, 2007).

The U.S. Coast Guard constructed the LORAN station in 1954 and operated it until 1974, when it was returned to Canadian control. The station was abandoned with all of the infrastructure and equipment essential to the operation of the site intact. The station has remained closed. It was visited regularly by local hunters and the site has been used as a resource for supplies and equipment (Environmental Services Group [ESG], 1995). The Government of Nunavut administers the Land and is responsible for the buildings on the Cape Christian site.

The site currently consists of five deteriorating buildings: The Main Station, Garage, Hazmat Building, Terminal Building and Survival Hut as shown on Figure 2, Site Plan. Seven Above-ground Storage Tanks (AST) are located on the site: five (5) 102,000L tanks by the Main Station building, one (1) 102,000L tank by the airstrip and one (1) 2,000 L heating oil tank between the Main Station and the former Royal Canadian Mounted Police (RCMP) site. A former freshwater reservoir is located east of the Main Station and there are eight worked areas that contain landfill materials along the beach.

Gartner Lee referred to a number of reports and minutes of meetings in finalizing the EIA report. These included:

- Environmental Services (OGGO), Western Region, *Terms of Reference for the Environmental Assessment of the Site Remediation of the Former Cape Christina Military Site*, January 2007;
- Earth Tech Canada Inc., *Former U.S. Coast Guard Loran Station, Cape Christian, Nunavut, Remediation Action Plan*, January 2007;
- Indian and Northern Affairs, Cape Christian Site Remediation Project, *Community Meetings at Clyde River*, November 2006;
- FMA Heritage Resources Consultants Inc., *Archaeological Impact Assessment, U.S. Coast Guard LORAN Station, Cape Christian Site Remediation Program*, October 2006;
- Earth Tech Canada Inc., *Cape Christian LORAN Station Supplemental Environmental Site Assessment, Materials Audit, and Geotechnical Evaluation* (DRAFT REPORT), October 2006;
- Earth Tech Canada Inc., *Former U.S. Coast Guard Loran Station, Cape Christian, Nunavut, Environmental Site Delineation and Material Inventory*, February 2002;
- Indian and Northern Affairs, *Community Meeting*, Clyde River, March 2006; and
- Environmental Sciences Group, Royal Military College, Kingston, Ontario, A*n Environmental Assessment of a U.S. Coast Guard Loran Station at Cape Christian*, NWT, March 1996.

The previously identified environmental issues at Cape Christian include contaminated soils, areas of buried debris, site buildings, hazardous materials (e.g., lead paint, asbestos, Polychlorinated Biphenyl [PCB] paint), fuel and petroleum products, fuel storage tanks, and abandoned barrels. INAC has approved the Remediation Action Plan (RAP) that identifies remediation options, critiques potential remediation methods, and provides recommendations for site restoration (Earth Tech, 2007). Gartner Lee has prepared the following EIA to identify potential environmental effects and mitigative measures for the remediation of the Cape Christian site. Once the EIA has been completed and has received appropriate regulatory approvals, PWGSC will tender the site remediation work to a qualified contractor. Under the direction of PWGSC, the contractor will complete the cleanup in accordance with the RAP, and any direction and terms and conditions resulting from the completed EIA and regulatory processes.

1.2 Scope of Work

The assessment identifies potential impacts to the existing conditions surrounding the Cape Christian site, which may result from project activities during and after site remediation. This includes the environmental effects of any malfunction or accident that may occur in connection with the project. Mitigation measures are identified to prevent or minimize any potential environmental impacts.

Residual impacts, those impacts remaining after all appropriate mitigations have been implemented, are discussed. Monitoring and follow-up programs are outlined to determine the success of mitigation methods and assess the project's impacts.

Cumulative effects that are likely to result from the remediation of the Cape Christian site in combination with other projects or activities in the surrounding area are also assessed.

2. Regulatory Overview

2.1 North Baffin Regional Land Use Plan

The North Baffin Regional Land Use Plan (NBRLUP) is a revision of the original *Lancaster Sound Regional Land Use Plan* approved by the federal government in 1990. The NBRLUP was developed following the signing of the *Nunavut Land Claim Agreement* (NLCA) in 1993 and the establishment of the Nunavut Planning Commission (NPC) in 1995. The NBRLUP presents a framework of principles, objectives and terms directing land use, regulation and decision making in the region. It was developed in order to conform to the NLCA principles, and was approved in June 2000. Some of the primary principles included are to protect and restore the environmental integrity in the Nunavut settlement area and to protect and promote the present and future well being of the residents of Nunavut while taking into account the interests of all Canadians. Projects are required to conform to these principles which are meant to protect the land and people.

The NPC believes that all land use within the region should be subject to three basic principles (NBRLUP, 2000):

- **Conservation** –all renewable and non-renewable resources should be used wisely;
- **Communication** – there must be continual and effective communication between all parties to ensure balanced development and to resolve conflicts between land users;
- **Development** – all approved development should proceed in a sustainable manner, which is defined generally as the management of human relationships to the natural environment in such a way that economic, social and cultural needs are met and ecological processes and natural diversity are maintained.

To meet these basic principles and the broader principles and objectives of the NBRLUP, this remediation project proposal will:

- meet the *Conformity Requirements for Cleanup and Monitoring of Waste Sites*, identified in section 3 of the NBRLUP (and summarized in Appendix C of the NBRLUP); and
- be conducted in accordance with the *Code of Good Conduct for Land Users*, identified in Appendix H of the NBRLUP.

2.2 Environmental Assessment Process in Nunavut

The NLCA, which was passed in June 1993, provides title to the Nunavut Inuit of 350,000 km^2 of land in the eastern Arctic. The agreement establishes clear rules of ownership and control over land and resources. *The Nunavut Land Claim Settlement Act and Nunavut Act* enable the implementation of the

provisions of the NLCA. Article 12 of the NLCA establishes the processes for the screening and review of project proposals on land and marine areas within the Nunavut Settlement Area and the Outer Land Fast Ice Zone. Environmental assessment in Nunavut involves the following three processes:

- The NPC, established under Chapter 11 of the *NLCA*, is responsible for reviewing project proposals to ensure they comply with any applicable approved land use plans. A regional land use plan is in place for the Cape Christian Site. Where a project proposal conforms to land use plan, the NPC forwards the project proposal application to the NIRB for screening;
- NIRB is responsible for implementing Chapter 12 of the *NLCA*, which deals with Development Impact. This includes conducting environmental and socio-economic assessments, using Inuit Qaujimajatuqangit (IQ) and recognized scientific methods to gauge and monitor potential impacts of project proposals on the Nunavut Settlement Area (NIRB, 2006b). The Nunavut Settlement Area includes Inuit Owned Lands (IOL), Commissioner's Lands and Crown Land; and
- *The Canadian Environmental Assessment Act (CEAA)* prescribes an environmental assessment process designed to integrate environmental considerations in projects which require a Responsible Authority (RA) to make a decision or take on a responsibility, whether as a proponent, land administrator, source of funding or regulator (e.g., issuance of a permit or licence).

Within Nunavut, INAC regulates land use on Crown Lands, whereas Nunavut Tungavik Incorporated (NTI) and the regional Inuit associations regulate subsurface and surface land use on IOL. The Government of Nunavut regulates Commissioner's Land. All site activities for the Cape Christian remediation project will be carried out on Commissioner's Land.

Through the Northern Contaminated Sites Program, INAC has custodial responsibility for the management of a number of contaminated abandoned military sites, including the Cape Christian site. As the RA, INAC requires that an environmental screening be conducted in accordance with CEAA, as the remediation activities proposed for the site are identified on the *Inclusion List Regulation* of the CEAA. Where a proposed project in Nunavut involves a CEAA trigger, federal and territorial governments and the NIRB work together to harmonize the environmental screening process. As such, this EIA has been conducted in a manner that is consistent with the NLCA and CEAA and the guidance documentation of the NIRB, the Canadian Environmental Assessment Agency and INAC.

2.2.1 Nunavut Planning Commission

The NPC was established under the *NLCA* to administer the regional land use planning processes and various aspects of environmental reporting and management in Nunavut. Their main function is to develop land use plans, policies and objectives that guide resource use and development throughout Nunavut, with an emphasis on protecting and promoting the existing and future well-being of the residents and communities of the Nunavut Settlement Area. Land use includes water, wildlife and the

offshore. The expectation is that the land use plan will be environmentally sound and reflect the values and interests of the region's residents.

Project proposals are first submitted by proponents to the authorizing agency responsible for issuing a permit, licence, lease or approval. Where a regional land use plan is in place, the application is forwarded by the authorizing agency to the NPC to determine if the project proposal is in conformity with the approved regional land use plan.

Conformity with the NBRLUP

Section 12.3 of the *NLCA* describes the relationship between the NIRB process and Land Use Planning provisions where an approved Land Use Plan is in place. The NPC will determine, pursuant to Section 11.5.10 of the *NLCA*, that a project proposal is in conformity with the land use plans, or a variance has been approved, and shall forward the project proposal with its determination and recommendations to NIRB and other authorizing agencies. At the same time, the NPC may make recommendations to the agencies as a result of issues or concerns that arose during the conformity determination. Once the proposal has been reviewed by the NPC, the NIRB and other authorizing agencies can complete their assessments. Previously identified environmental issues at Cape Christian include contaminated soils, areas of buried debris, site buildings, hazardous materials (e.g., lead paint, asbestos, PCB paint), fuel and petroleum products, fuel storage tanks, and abandoned barrels (Earth Tech, 2002, 2006), and can be considered a Waste Site under the NBRLUP definition. Table 1 identifies the conformity requirements that would apply and how the proposed project meets them.

Table 1. Cape Christian Reclamation Project Proposal conformity with the NBRLUP Conformity Requirements for Cleanup and Monitoring of Waste Sites

Conformity Number	Conformity Requirement	How Conformity is Met by the Cape Christian Reclamation Project Proposal
3.13.1	All users of the land shall follow the *Code of Good Conduct* in Appendix H [of the NBRLUP] to ensure that no new waste sites are created.	• All contractors working on the site shall be made aware of this Code and will be required to conform to it.
3.13.2	The principle of "the polluter pays" shall apply to a strategy for cleaning up the environment. Where it is possible to identify the person, company or agency responsible for creating an abandoned or inactive waste site, they shall be made responsible for site cleanup and restoration.	• The cleanup of this site has become the responsibility and priority of the federal government.
3.13.3	When identification is not possible, the government agency (or its successor) that had regulatory responsibility for the site at	• INAC, through PWGSC, will oversee the cleanup of the site in accordance with the RAP and mitigation measures

Conformity Number	Conformity Requirement	How Conformity is Met by the Cape Christian Reclamation Project Proposal
	the time it was active shall be responsible for site cleanup and restoration.	identified in the EIA.
3.13.4a	The NPC shall work with communities, Qikigtani Inuit Association (QIA), government, industry and other interested parties to develop an inventory of waste sites and a short list of cleanup priorities in keeping with the NPC's responsibilities assigned in *NLCA* Section 11.9.1.	• This site has been identified as a priority cleanup site, and is identified as such in the NBRLUP.
3.13.4b	Community residents in particular, and all land users in general, shall be actively involved in planning and conducting cleanup operations, whenever possible and practicable.	• The NPC in developing the NBRLUP has consulted extensively with residents and communities in the region. • INAC has consulted with the communities and residents of the area in its investigations of the site over the years, and in developing the approved Remediation Action Plan (RAP) for cleanup of the site (Earth Tech, 2007). • There are plans to hire Inuit by having in place an Inuit Benefits Package. The positions available for Inuit would include labourers, heavy equipment operators, and camp support staff.
3.13.4c	Refuse, such as fuel drums and scrap metal, shall be recycled where possible.	• Through ongoing site assessments, and the identification of contaminates of concern, there are no recycling opportunities identified.
3.13.4d	Sites containing toxic materials shall be given priority for cleanup, and the location of these sites shall be widely publicized to warn residents.	• With the approval of the RAP for cleanup and reclamation of the site, and the preparation, submission and approval of this EIA, cleanup of the site can begin in 2007. • The site has been previously identified as containing contaminants of concern.
3.13.4e	Sites within or near caribou calving grounds, near water and near communities shall also be given priority for cleanup.	• With the approval of the RAP for cleanup and reclamation of the site, and the preparation, submission and

Conformity Number	Conformity Requirement	How Conformity is Met by the Cape Christian Reclamation Project Proposal
		approval of this EIA, cleanup of the site can begin in 2007.
3.13.8	New occurrences of pollution, garbage and contamination caused by anyone shall be prevented. Land users shall ensure that all drums are safely recovered.	• This is a cleanup and reclamation project that will remove all contaminated materials and bury all inert materials, and restore the land. • Any contamination caused during the cleanup and reclamation, such as accidental spills of fuel or oil, shall be cleaned up in accordance with the approved Spill Response Plan.

2.2.2 Nunavut Impact Review Board

NIRB was established on July 9, 1996 as an institution of public government with responsibilities for the environmental assessment of projects in the Nunavut Settlement Area. Article 12 of the *NLCA*, which establishes NIRB, provides for the screening of project proposals to determine whether they should be subject to further review. There are two types of review processes for the environmental assessment of projects: a Part 5 review and a Part 6 review. A Part 5 review is conducted by NIRB and a Part 6 review is conducted by a federal Environmental Assessment Panel.

The functions of NIRB are to:

- Screen project proposals to determine whether or not a review is required;
- Review the ecosystemic and socio-economic impacts of proposed projects;
- Measure and define the extent to which regions and communities will be impacted;
- Determine, on the basis of its review, whether project proposals should proceed, and if so, under what terms and conditions, and then report its determination to the Minister; and
- Monitor projects in order to collect and analyze information on the long term state and health of the ecosystem and socio-economic environment of the Nunavut Settlement Area.

It is anticipated that the assessment of the site remediation of the Cape Christian site would only be subject to screening level of assessment under the NIRB process.

The initial steps of the screening involve notification of the proponent and authorizing agencies, establishment of a timeline for a screening determination and distribution of the project proposal application to appropriate stakeholders. NIRB then reviews the potential effects of the project and the

level of public concern about and/or in support of the proposed project. Once the screening has been completed, NIRB will produce a Screening Decision Report that documents its determination as to whether the project proposal should be approved without further review, abandoned or modified by the proponent, or subject to review under Part 5 or 6 of the NLCA.

2.2.3 Canadian Environmental Assessment Act

The *CEAA* is the federal environmental assessment legislation designed to integrate environmental considerations in projects which require a RA to make a decision or take on a responsibility, whether as a proponent, land administrator, source of funding or regulator (issuance of a permit or licence). The RA is required to ensure that an environmental assessment of the project is carried out prior to making its decision or taking action.

There are four assessment streams under *CEAA*: Screening, Comprehensive Study, Panel Review and Mediation. The first three represent different levels and complexities of assessment. Mediation is intended to focus on issues that typically are difficult to resolve in an assessment.

The Cape Christian site remediation project will be addressed at the screening level. The requirements for a screening under *CEAA* are generally met through the NIRB process.

2.3 Land Tenure and Regulatory Authorizations

2.3.1 Land Tenure

The Cape Christian site is located on Commissioner's Lands, within the municipal boundary and block land transfer of the community of Clyde River (Figure 2.4-1). There are no IOL that will be affected by the project, and all land based activities will take place within the municipal boundary. Within Nunavut, Commissioner's Lands are administered by the Government of Nunavut.

2.3.2 Authorizations Required for the Project

The key authorizations required to complete the project would be a Land Use Permit, a Quarrying Permit, and a Water Licence. The project is located on Commissioner's Land, therefore the land use and quarrying authorizations would be issued by the Department of Community and Government Services, Government of Nunavut (CGS-GN). A Water Licence is required and must be issued by the Nunavut Water Board. Table 2 identifies key EA and Regulatory organizations for projects occurring in Nunavut. It should be noted that not all of the authorizations in the table would be required for this project.

Table 2. Key EA and Regulatory Organizations for Projects in Nunavut

Stream	Issuing/Lead Organization	Location	Key Details
EA	Nunavut Impact Review Board (NIRB)	Cambridge Bay	NIRB Screening, Part 5 Review, Part 6 Panel Review
	CEAA (in addition to those federal RA that issue a licence, permit or authorization for the project)	Iqaluit, Ottawa and various southern Canada locations.	CEAA Screening, Comprehensive Study, Panel Review (including Part 6 Panel Review under the NLCA)
Regulatory	Transport Canada (TC)	Sarnia, Winnipeg	*Navigable Water Protection Act* authorizations (for structures built in, on or over navigable waters)
	CGS-GN	Iqaluit	Crown Land Use Permits
			Crown Land Quarry Permits
	Fisheries and Oceans Canada (DFO)	Iqaluit (with support from Winnipeg)	*Fisheries Act* (authorizations or letter of advice for works or undertaking affecting fish habitat)
	Nunavut Department of Economic Development and Transportation	Iqaluit	*Motor Vehicles Act*, Vehicle Registration
	TC/Nunavut Department of Sustainable Development	Sarnia/Iqaluit	*Transportation of Dangerous Goods Act*
	Natural Resources Canada (NRCAN)	Ottawa	Blasting Permits
			Explosives Magazine Permit
			Radio Licence
	Environment Canada (EC)	Iqaluit	*Species at Risk Act*
			Migratory Birds Act and Regulations
			Section 36(3) of the *Fisheries Act*
			Canadian Environmental Protection Act
	Nunavut Water Board (NWB)	Gjoa Haven, Yellowknife	*Nunavut Waters Act* (water licences)
	Nunavut Department of Health and Social Services	Iqaluit	*Public Health Act* (for permit/criteria related to sewage disposal, food premises, sanitation, etc.
	Health Canada	Ottawa	Issues related to public and worker health.

Stream	Issuing/Lead Organization	Location	Key Details
	Department of Environment (DoE), GN	Iqaluit	*Environmental Protection Act* (spill response plans, waste management guidelines)
Consultation	Department of Culture, Language, Elders and Youth (CLEY), GN	Iqaluit	General requirement

3. Environmental Setting

Cape Christian is located near the mouth of the Clyde River, approximately 16 km northeast of the Hamlet of Clyde River, on the northeast coast of Baffin Island.

The site resides in the Baffin Coastal Lowland and consists of discontinuous segments of Quaternary and potentially late Tertiary deposits of glacial, marine and terrestrial origin behind which steep bedrock slopes occur (Andrews, 1989). The project area consists of primarily flat, undulating terrain which supports discontinuous low shrub tundra complex vegetation (FMA Heritage Resources Consultants Inc, 2006). This ecoregion is classified as having a high arctic ecoclimate characterized by being humid and cold with short summers and long winters. The annual precipitation measured at Clyde River is 225.6 mm with the majority (87%) coming from snow. The mean daily temperatures vary from –28° Celsius to 4.2° Celsius with an average of -12.4°.

3.1 Biophysical Environment

Terrain, Vegetation and Wetlands

The ecoregion is geologically composed of crystalline Precambrian massive rocks that occur as isolated outliers from peninsulas and fjords that extend out from the Davis Highlands. The terrain is rolling with some bedrock outcrops. A well-developed lowland slopes from the base of the mountains to sand and gravel beaches backed by low coastal bluffs, marine terraces and raised beaches (Sempels, 1982). Lowland drainage is poor and small lakes, marshes and swamps are frequent. The surface drainage of the site is generally to the east towards Baffin Bay. The dominant soils are turbic cryosols on sandy colluvial, morainal, and marine deposits. Depending on the season, permafrost is encountered between 0.5 meters and 0.75 meters below ground surface. The site has been previously and extensively disturbed and contaminated. There are also no community surface water sources at Cape Christian.

The variety of landforms, from the flat Arctic lowlands in the west to the mountains and deep fjords of the eastern coasts, provides diverse habitat, including well-vegetated lowlands, sheltered bays, steep cliffs and tidewater glaciers. This ecoregion has a sparse vegetative cover of mixed low-growing herbs and shrubs, consisting of moss, purple saxifrage (*Saxifraga oppositifolia*), avens (*Dryas)*, arctic willow (*Salix arctica*), kobresia (*Kobresia* spp.), sedge (*Carex* spp.), and arctic poppy (*Papaver radicadum*). There are currently no Species At Risk Act (SARA) listed plant species in Nunavut due to a deficiency of data.

The presence of permafrost at shallow depths creates a barrier of frozen earth on which melting snow and ice pools create wetlands. Wet sites can develop up to 60% cover of wood rush (*Luzula* spp.), wire rush (*Juncus* spp.), and saxifrage (*Saxifraga* spp.), along with a nearly continuous cover of mosses.

Wildlife and Birds

The region's marine habitat is essential to the survival of several million seabirds, which occur in concentrations not found elsewhere in the Arctic. Twenty key habitat sites for king eider (*Somateria spectabilis*), northern fulmar (*Fulmaris glacialis*), black-legged kittiwake (*Rissa tridactyla*), thick-billed murre (*Uria lomvia*) and black guillemot (*Cepphus grylle*), as well as glaucous (*Larus hyperboreus*), Ross's (*Rhodostethia rosea*) and ivory gulls (*Pagophila eburnean*), rock ptarmigan (*Lagopus mutus*), and snow goose (*Chen caerulescens*) are found across the region (Latour *et al.,* 2006, Mallory and Fontaine, 2004). Wetlands also provide habitat for the migratory birds. The site supports the common ringed plover (*Charadrius hiaticula*) and, while not a SARA listed species, this is one of two areas (the other is Ellesmere Island) that the species occurs in all of North America.

The wetlands of the region with their enriched growth of vegetation also support wolves (*Canis lupus*), arctic fox (*Alopex lagopus*), barren-ground caribou (*Rangifer tarandus groenlandicus*) arctic hare (*Lepus arcticus*), brown (*Lemmus sibiricus*) and collared (*Dicrostonyx groenlandicus*) lemmings.

The Baffin Island tundra wolf, *(C. l. manningi)* is known only from Baffin Island. No wolves were seen during 186 field-weeks of collective field activities on the northern half of Baffin Island (55 field-weeks) suggesting that wolves are rare (Miller and Reintjes, 1995). However, wolves were observed on a regular basis over a 6 year period on the southern half of Baffin Island (Miller and Reintjes, 1995). The distribution of wolves in the high Arctic is related to the relative abundance of their prey. Arctic-island wolves tend to investigate everything that is new to them, including field camps or field party members that they encounter in their environment (Miller and Reintjes, 1995).

Barren-ground caribou migrate in a limited range from northern and mid - Baffin island down to the southern part in winter, and migrate back north in the summer. Based on ear tags and satellite telemetry, caribou are found in 3 distinct subpopulations on the island: North, South and Northeastern Baffin populations. The South Baffin population occupies approximately half of Baffin Island and was estimated

at 60,000 – 180,000 animals in the late 1980s. The North and Northeast Baffin populations were estimated at 50,000-150,000 and >10,000, respectively (Ferguson and Gauthier, 1992). Most calving takes place on high plateaus in west central Baffin. Some females calve on or near their wintering areas in June without reaching a specific calving ground. In summer (May-September), caribou eat the leaves of willows, sedges, flowering tundra plants, and mushrooms. They switch to lichens (reindeer moss), dried sedges (grasslike plants), and small shrubs (like blueberry) in September.

Arctic hares seem to prefer drier areas, avoiding wet meadows on the tundra and survive best in areas without deep snow cover which allows for easier access to forage (Gray, 1993). Their main food is the Arctic willow, however, the flowers of purple saxifrage are a favourite food in late spring and early summer (Parker, 1977). Brown lemmings inhabit open tundra areas, and the collared lemming frequents dry, sandy, or gravelly areas. Lemmings feed mostly on leaves and shoots, grass, and sedge and remain active through the harsh northern winter, finding food by burrowing through the snow and utilising grasses clipped and stored in advance. Arctic fox are scavengers and can usually be found where polar bears venture on the fast ice close to land in their search for seals. Arctic hares and lemmings are a primary food source for arctic foxes and arctic wolves.

3.2 Marine Environment

The North Baffin area is one of the most important marine mammal habitats in the eastern Arctic. Eighty-five percent of North America's narwhal (*Monodon monoceros*), and 40% of its beluga whales (*Delphinapterus leucas*) are found here. The narwhal is designated as "Special Concern" by the Committee of the Status of Endangered Wildlife in Canada (COSEWIC, 2004) and is not listed under the *Species At Risk Act* (SARA). However, it is being considered for addition to Schedule 1 under SARA. Aerial surveys of the pack ice of western Baffin Bay provided surface estimates of 14,437 – 34,363 narwhals in the Baffin Bay population (COSEWIC, 2004a). Little is known of actual habitat requirements of narwhal. However, the quality of the ice habitat, i.e., the presence of leads in fast ice and the density of broken pack ice, appears to be a key aspect of habitat selection (COSEWIC, 2004). In summer, they show preference for coastal areas that offer deep water and shelter from the wind (Kingsley *et al.*, 1994). During their fall migrations, and in the winter, narwhals show preference for deep fjords and the continental slope, where depths range from 1000 to 1500 m (Dietz *et al.*, 2001).

The Baffin Bay beluga population is designated as Special Concern (COSEWIC, 2005) and is listed under Schedule 3 of SARA as "Special Concern". Recent aerial surveys of the Baffin Bay beluga population yield an estimate of 21,213 (COSEWIC, 2004b). The habitat used by beluga whales varies seasonally. As the fast ice breaks up in late spring, beluga whales mass along the ice edges and penetrate the leads (Stirling, 1980). During the summer when the fast ice has broken up or completely disappeared, belugas are found along the coastlines and in relatively shallow waters (Smith and Martin, 1994).

Small colonies of walrus (*Odobenus rosmarus rosmarus*) are present, in the region. Canadian walrus populations have been designated "Not at Risk" by COSEWIC (2004), and are not listed under SARA. A preliminary estimate of the Baffin Bay walrus population suggests approximately 350 animals in the region (COSEWIC, 2006). Atlantic walruses require large areas of shallow water (80 m or less) with bottom substrates that support a productive bivalve community, and suitable ice or land nearby upon which to haul out (COSEWIC, 2006). Arctic char are found in inland and coastal waters.

The endangered bowhead whale (*Balaena mysticetus*) summers in the southern part of the region. The Davis Strait-Baffin Bay bowhead population is designated "Threatened" by COSEWIC, and is not listed under SARA but is under consideration for addition to Schedule 1, with a present population estimated to be less than 3,000 animals (COSEWIC, 2005). Adult and adolescent bowhead whales remain off the east coast of Baffin Island for the summer and autumn (Finley, 1990). Habitat requirements depends on distribution of their primary food source (zooplankton). Whales congregate in Isabella Bay, where food is most concentrated and possibly because it offers protection from killer whales and shelter from heavy seas (Finley, 1990). Bowhead habitat is protected by the *Fisheries Act*, which prohibits the destruction of any fish habitat. A marine protected area is being developed for Igaliqtuuq, near Clyde River, through the proposed *Igaliqtuuq Bowhead Conservation Plan* (Moshenko *et al.* 2003).

This region also supports populations of polar bear (*Ursus maritimus*), ringed (*Phoca hispida*), harp (*Phoca groenlandica*) and bearded (*Erignathus barbatus*) seals. The polar bear is designated as "Special Concern" by COSEWIC (2002) and is not listed under SARA. A preliminary estimate of 2200 animals for the Baffin Bay polar bear population, based on 1993-95 mark-recapture data, is considered to be conservative (COSEWIC, 2004). The distribution of polar bears is influenced primarily by the type and distribution of sea ice, and the density and distribution of seals. Maternity denning sites and spring feeding areas are two of the most critical components of their habitat (Harington, 1968; Stirling *et al.*, 1984; Stirling, 1990). Most maternity denning takes place on land (within 8 km of the coast; Harington, 1968, Messier et al., 1994) and individual females show fidelity to general denning areas (Ramsay and Stirling, 1990). In the low-lying areas, most dens are concentrated along relatively low coastal and river banks and ridges. Polar bear dens are thought to represent the "core areas" of their ranges (Harington, 1968). The habitats most used by polar bears when hunting seals in spring are stable shore-fast ice with deep snowdrifts along pressure ridges which are suitable for ringed seal birth lairs and breathing holes, the floe edge where leads are wide (> 1 km), and areas of moving ice with seven-eighths or more of ice cover (Stirling *et al.*, 1993). Polar bears, because of their highly investigative behaviour, are attracted to and may consume foreign substances that can be harmful or even cause death (Lunn and Stirling, 1985; Stirling 1988b; Amstrup *et al.*, 1989).

Sealing continues to be important for its nutritional and cultural values to northerners. Ringed seals are the most abundant marine mammal in the Canadian Arctic with estimates of 90,000 in the Canadian High Arctic (Kingsley, 1985, 1990). Ringed seals preferred habitat consists of the leads, pressure ridges and polynyas in the land-fast ice of the Arctic Ocean. The offshore pack ice is used irregularly. Bearded seals

are sparsely distributed throughout the central High Arctic, primarily in coastal areas, and are most abundant where water depths are less than 100 m (Kingsley, 1985). Bearded seal estimates in eastern Lancaster Sound and western Baffin Bay ranged from 7400 to 9500 (Koski and Davis, 1980). Numbers of harp seals occurring in various parts of the Canadian Arctic in summer are poorly known (Davis et al., 1980). A steady movement of harp seals occurs along the northeastern coast of Baffin Island from mid June to late August with stragglers noted as late as mid September (Koski and Davis 1979).

3.3 Air Quality, Noise and Climate

The Cape Christian site is currently inactive and no emissions or noise are being generated.

Climate change could have potential effects on the area. The term climate change refers to changes in weather patterns (temperature, precipitation and wind patterns) that are observed over several decades. These changes are projected to have diverse impacts on the world and its various systems, whether natural or man made. From a Canadian Arctic perspective, any changes in climate can have serious and long-term consequences. Rising temperatures, rising river flows and sea levels, declining snow cover, increasing precipitation, timing of lake and river freeze-up/break-up and thawing permafrost, may impact natural ecosystems and societies that live within these marginal regions. These changes can have a direct impact on the Cape Christian remediation project, particularly on the long term stability of landfarm and landfill containment that relies on permafrost.

3.4 Human Environment

Overall Regional Profile

Clyde River is located in the regional district of Qikiqtaaluk Region or Qikiqtani region (formerly Baffin Region). The region covers 1,040,417.90 km^2 and is comprised of the following areas; Baffin Island, the Belcher Islands, Akmiski Island, Mansel Island, Prince Charles Island, Bylot Island, Devon Island, Cornwallis Island, Bathurst Island, Amund Ringness Island, Ellef Ringness Island, Axel Heiberg Island, Ellesmere Island, the Melville Peninsula, the eastern part of Melville Island, and the northern parts of Prince Whales Island and Somerset Islands. It also includes the smaller islands in between these larger islands and landmasses.

The population for the region of Qikiqtaaluk was 15,765 in 2006 according to Census Canada. The population has increased since 2000 by 9.7%. The regional seat of Qikiqtaaluk is Iqaluit (population 6,184 people in 2006). Other key hamlets in the region include the following; Arctic Bay, Cape Dorset, Grise Fiord, Hall Beach, Igloolik, Kimmirut, Pangnirtung, Pond Inlet, Qukiqtarjuaq, Resolute, Sanikiluaq, and the settlement of Nanisivik.

Demographics

Clyde River or Kanngiqtugaapik, as it is known in Inuktitut, is a small hamlet located on the shores of Baffin Island and on the Davis Strait off of Clyde Inlet.

The population of Clyde River according to the 2006 Canada Census is 820 people (Table 3.). This is a substantial increase from 2001 where there was a population of 785 people, indicating a 4.5% increase.

Table 3. Population Trends from 1991-2001

Year	Census Counts for Clyde River
2006	820
2001	785
1996	708

(Statistics Canada 1996 to 2006)

There is no disaggregated information available for the 2006 Statistics Canada Census. According to the 2001 statistics there are more males than females in Clyde River and the majority of people are under the age of 19 years of age (Table 4). This follows the territorial trend as Nunavut has the largest growing population of Canada.

Table 4. Age Characteristics of the Population 2001

Total – All Persons	Total	Male	Female
All Total Persons	785	405	380
Age 0-19	415	210	195
Age 20 -44	265	135	130
Age 45 - 64	95	45	45
Age 65-84	10	10	10
Age 85 over	5	0	0

(Statistics Canada 1996 to 2006) - note: total population provided by Statistics Canada is not always an exact addition of male and female

Statistics Canada reveals that the majority of residents in Clyde River have lived at their same residence for more than five years (Statistics Canada, 2001). This is the result of strong cultural values that focused on family relationships and to the land. Travel costs are also expensive and few people can afford to live outside of their community. Some 5% of the population has lived outside of Nunavut in another province or territory in the last year (Statistics Canada, 2001). Census Canada (2001) indicates that the majority of the population in Clyde River is Inuit with 3.8% that are identified as non-aboriginal.

Economics and Labour Force

Major economic activities in Clyde River are based on government, tourism, hunting and trapping as well as arts and crafts.

The Government of Nunavut has developed an outlook strategy that promotes economic development and sustainability. To promote this as dictated by the Land Claims agreement the Baffin Region Inuit Association (now called the Qikiqtani Inuit Association) created the Qikiqtaaluk Corporation which is a wholly Inuit owned birthright development corporation. It aims to provide direct opportunities such as training and employment for Inuit inside the region and outside. Qikiqtaaluk Corporation owns and has stake in a variety of businesses that range form environmental, shipping, fisheries and gas companies, and construction.

Employment

Clyde River has a 52.7% participation rate (Statistics Canada, 2001) in the work force. Employment was at 39.6% in 2001 with an unemployment rate of 25%. The unemployment rate is very high and can be linked with poor training opportunities, lack of economic opportunities and seasonal or traditional economies (land-based activities).

Culture and Natural Heritage

Since 2001 the hamlet of Clyde River and the Department of Environment, Parks and Special Places Division (Government of Nunavut) started working towards the identification of cultural and natural heritage sites of significance and the conservation and protection of the land area of Clyde River. This area contains significant archaeological and cultural heritage sites, as well as unique wildlife habitats. In 2003, residents of Clyde River recommended further study of the area to determine the feasibility of a territorial park.

The proposed plan is aimed at creating a territorial park approximately 40 km Northwest of Cape Christian which covers approximately 16,179 square kilometres, of which approximately one third of the land mass is rugged, glacier-covered mountain landscapes and deep coastal fjords. The plan includes territorial coastlines along Baffin Bay west to the Barnes Ice Cap, and encompasses: Eglinton Fjord, Sam Ford Fjord and Walker Arm, Gibbs and Clark Fjords as well as the Barnes Plateau, Ayr Lake and Scott Inlet. The next step in the park feasibility process is to better understand the existing cultural heritage resources contained within the proposed park area.

Archaeological Resources

Cape Christian was built in 1954 and at that time no consideration was given to the potential environmental effects of construction and operation of the site. No archaeological studies were completed prior to construction, so pre-existing archaeological and cultural resources at the site are unknown. In a recent Archaeological Impact Assessment completed for the site (Figure 5, FMA Heritage Resources

Consultants Inc., 2006) one archaeological site was identified in an area of proposed activity. The site is located in the vicinity of the flag poles and antenna platform north of the Main Station Facilities (0526278E 7824720N, UTM 19, NAD 83). The site is adjacent to the base of the knoll on which the flagpoles are located and extends northward along the ridge adjacent the ocean.

4. Project Description

4.1 Project Objectives

The following remedial objectives were outlined in the RAP and are based on the INAC *Abandoned Military Site Remediation Protocol (INAC Protocol)* (Earth Tech, 2007):

- Restore the Cape Christian site to an environmentally safe condition;
- Prevent the migration of contaminants into the Arctic ecosystem;
- Remove physical hazards for the protection of human health and safety; and
- Implement a cost effective remediation solution.

4.2 Project Schedule

The following is a proposed schedule for the remediation of the Cape Christian site according to the RAP (Earth Tech, 2007):

- Contractor barges to Clyde River (Fall Year 1)
- Contractor cat trains to Cape Christian (Winter Year 1)
- Contractor completes first season of work at Cape Christian (Summer Year 2)
- Equipment remains on-site (Winter Year 2)
- Contractor completes 2nd season of work (Summer Year 3)
- Contractor cat trains back to Clyde River (Winter Year 3)
- Contractor barges equipment from Clyde River (Fall Year 4)

4.3 Project Activities

The project encompasses the remediation of the Cape Christian site. The project will be the culmination of several years of investigative work consisting of a number of site assessments and investigations and minor clean up programs. Activities related to the project include: dismantling of infrastructure and segregation of wastes; remediation and disposal of non-hazardous waste; and remediation and disposal of petroleum and metals impacted soil. The site currently consists of five deteriorating buildings: The Main Station, Garage, Hazmat Building, Terminal Building and Survival Hut. Seven Above-ground Storage

Tanks (AST) are located on the site: five (5) 102,000L tanks by the Main Station building, one (1) 102,000L tank by the airstrip and one (1) 2,000L heating oil tank between the Main Station and the former RCMP site. A former freshwater water reservoir was located east of the Main Station and there were eight worked areas that contain landfill materials along the beach as shown on Figure 2.

Environmental issues at Cape Christian requiring remediation are related to: contaminated soils, areas of buried debris, site buildings, hazardous materials, petroleum products, fuel storage tanks, and abandoned barrels. Contaminated soils will be excavated, classified and either buried in an on-site non-hazardous landfill or shipped to a licensed facility for proper disposal. Existing areas containing landfill materials will either be upgraded and improved to ensure containment, or excavated and relocated. A new landfill will be constructed to contain only non-hazardous materials and non-regulated contaminated soils. A landfarm will be constructed to remediate PHC contaminated soils. All existing buildings and infrastructure at Cape Christian will be demolished. The project may utilize a barge to transport material to and from site. In accordance with protocols established by INAC, all hazardous materials, excluding asbestos, will be shipped off-site to a licensed facility for proper disposal. Asbestos will be double-bagged and disposed of in an on-site landfill. All hazardous material including heavier petroleum products are to be shipped off-site to a licensed disposal facility except compressed gas cylinders with known contents, which will be vented and land filled on-site. Barrels containing fluids are to be excavated and tested, and treated according to the Distant Early Warning (DEW) Line Cleanup Barrel Protocol (Earth Tech, 2007).

Table 5 provides a summary of the proposed abandonment methods, materials and equipment to be used during the remedial activity as per the RAP (Earth Tech, 2007):

Table 5. Abandonment Methods for each Environmental Issue

Issue	Remediation Option	Required equipment
Site Debris: ~2800m^3 of non-hazardous debris (heavy equipment, buildings, building foundations, tanks, etc.)	Material to be crushed, shredded and/or incinerated prior to placement in the on-site landfill	Excavators, bulldozer, loaders, dump trucks, water truck, grader, pick-up trucks, and All Terrain Vehicles (ATVs)
Worked Areas 2 through 8: 7 areas of land filled material (barrels, building material, etc.)	Excavate land fill and consolidate buried material in the on-site non-hazardous waste landfill	Excavators, bulldozer, loaders, dump trucks, water truck, grader, pick-up trucks, and ATVs
Tier 1 Soils: ~66 m^3 of soils with contaminant concentrations of metals or PCBs that exceed Tier 1, but not Tier 2 INAC Abandoned Military Site Remediation Protocol soil criteria.	Excavate and place in on-site non- hazardous waste landfill	Excavators, bulldozer, loaders, dump trucks, water truck, grader, pick-up trucks, and ATVs
Tier 2 Soils: ~395 m^3 of soils with higher contaminant concentrations of metals or PCBs that exceed Tier 2 INAC Abandoned Military Site	Excavate contaminated soils and place into containers, and ship off-site to a licensed disposal facility	Excavators, bulldozer, loaders, dump trucks, water truck, grader, pick-up trucks, ATVs and containers

Issue	Remediation Option	Required equipment
Remediation Protocol soil criteria.		
Petroleum Hydrocarbon Contaminated Soils: ~1700 m^3 of soil in exceedance of the Canadian Council of Minsters of the Environment (CCME) Canada Wide Standards (CWS) for Petroleum Hydrocarbon (PHC) criteria.	Excavate and treat in an on-site land farm cell	Excavators, bulldozer, loaders, dump trucks, water truck, grader, pick-up trucks, and ATVs
Petroleum, Oil and Lubricant (POL) Fluids: ~6,800 L	Place POL fluids into containers, and ship off-site to a licensed disposal facility.	Loaders, dump trucks, pick-up trucks, ATVs, pumps and containers
Compressed gas cylinders:	Compressed gas cylinders with known contents will be vented and land filled on-site. Cylinders of unknown contents will be shipped off-site to a licensed disposal facility	Loaders, dump trucks, pick-up trucks, ATVs, and containers
PCB Contaminated Paint Items: ~12 m^3 of PCB painted materials	Dismantle contaminated paint items, containerize and ship off-site to a licensed disposal facility	Excavators, loaders, dump trucks, pick-up trucks, ATVs and containers
Lead Contaminated Paint Items: ~113 m^3 of lead painted materials	Dismantle contaminated paint items, containerize and ship off-site to a licensed disposal facility	Excavators, loaders, dump trucks, pick-up trucks, ATVs and containers
Hazardous Materials: ~30 m^3 of hazardous materials, including lead acid batteries, pressurized cylinders, paints and chemicals	Containerize and dispose of all hazardous materials in accordance with INAC Protocol	Excavators, loaders, dump trucks, water truck, grader, pick-up trucks, ATVs and containers
Asbestos: ~21 m^3 of asbestos containing materials (pipe insulation, transite board and matted insulation) – Some of the transite board is painted with Lead/PCB and will have to be shipped off-site for disposal	Abate asbestos not painted with Lead/PCB paint (~10 m^3) in accordance with the appropriate legislation – double bag and place in on-site landfill Transite board painted with Lead/PCB paint (~10 m^3) shall be abated and disposed of off-site at a licensed disposal facility	Excavators, bulldozer, loaders, dump trucks, grader, pick-up trucks, ATVs, bags and containers
Barrels	Empty barrels will be crushed and disposed in an on-site landfill Barrels containing fluids will be inspected and treated according to the DEW Line Cleanup Barrel Protocol	Excavator, bulldozer, loader, dump trucks, pick-up trucks, containers, and ATVs
Archaeological Site	Ensure the historic archaeological site is not disturbed during remediation activities	Equipment use is to avoid this area
Creosote Treated Timber	Timbers to be wrapped in	Loader, dump-truck, pick-up

Issue	Remediation Option	Required equipment
	polyethylene and disposed of in an on-site landfill	trucks, and ATVs

The Cape Christian site will require a Waste Handling Facility to receive and sort various waste streams. Materials to be received and sorted include; barrels, batteries, compressed gas cylinders, items with PCB/Lead paint, soils and creosote treated timber (Earth Tech, 2007).

Once all the structures have been demolished to their foundations, the remaining site foundation materials can be buried in place. Disturbed areas on the site (i.e. excavated areas) will be graded and shaped to blend in with the natural contours and to eliminate potential hazards for wildlife and humans accessing the site in the future and to inhibit erosion.

4.3.1 Contaminated Soils

It is estimated that there is approximately 2,160 m^3 of contaminated soils identified at the Cape Christian site. Contaminated soils will be excavated, classified and either buried in an on-site non-hazardous landfill (Defence Construction Canada Tier 1 [DCC I]), or containerized and shipped to an off-site licenced disposal facility (Defence Construction Canada Tier 2 [DCC II]). It is recommended that PHC contaminated soils be excavated and placed into an on-site land farm. Table 6 outlines the contaminated soils identified according to the RAP (Earth Tech, 2007).

Table 6. Summary of Contaminated Soils

Location	Contaminant Exceeding Criteria (Max Concentration ppm)	DCC I m^3	DCC II m^3	CWS PHC m^3	Comments
Main Station Area ASTs	PHCs (F2: 12100)			381	Additional sampling during remedial activities required to further delineate contamination
Main Station Building North of West Wing	Metals (Lead: 723)		10		
Main Station East of East Wing	PHCs (F2: 9370)			287	
Main Station Building East of East Wing	PCBs (PCB: 1.7)	18			Plume associated with ESG sample G6516
Main Station East of East Wing	Metals (Cadmium: 6.9, Zinc: 1200)		2		Plume associated with ESG sample G6512 and delineated in previous Earth Tech Report, 2001
Main Station Building East of East Wing	Metals (Lead: 290, Zinc: 4500)		1		Plume associated with ESG sample G6508 and

Location	Contaminant Exceeding Criteria (Max Concentration ppm)	DCC I m^3	DCC II m^3	CWS PHC m^3	Comments
					delineated in previous Earth Tech Report, 2001
Main Station Building East of East Wing	Metals (Cadmium: 7.4, Zinc: 7350)		55		Plume associated with samples in floor sumps
Main Station Building East of East Wing	Metals (Lead: 210)	41			Plume associated with ESG sample G6576
Main Station Area Maintenance Garage	Metals (Cadmium: 5.9)		126		
Main Station Area Maintenance Garage	PHCs (F3: 41100)			160	
Main Station Area Disaster Hut	Metals (Cadmium: 5.9)		1		Plume associated with ESG sample G6593 and delineated in previous Earth Tech Report, 2001
Beach Area, Outfall	Metals (Copper: 273)		207		Plume associated with Earth Tech 2001 samples CC43 and CC40
Beach Area, Worked Area #1	PHCs (F2: 8450)			871	
	Total Estimated Volumes	59	402	1699	Total = 2160 M^3

4.3.2 Infrastructure Requirements

In order to successfully complete remedial activities some site construction and upgrades will occur. Borrow sources will be developed to make this site activity feasible. Borrow sources will be recontoured to match surrounding topography (Earth Tech, 2007).

Camp Requirements

Camp construction is necessary in order to support the Contractor staff, camp staff and 3 to 5 visitors during remediation. Site roads and the airstrip may be upgraded in order to facilitate site access and transportation. The RAP recommends a camp be established on-site and situated in one of two areas identified in Figure 2.0 in Appendix A of the RAP. The camp will also have safety measures (particularly as they relate to polar bears), emergency rations and an emergency rescue contingency plan in place. The work camp, including its facilities, utilities, services, location and operation will be operated in accordance with applicable federal, territorial and local codes, regulations and requirements governing camps, including environmental regulatory requirements, Land Use Permit and Water Use Licence.

Following remediation activities, the camp will be removed and the ground surface will be prepared to facilitate vegetation establishment where possible. Compacted surfaces such as all-season roads; building, AST, and garage gravel pads; and airstrips will be loosened or scarified. Where available, overburden suitable for revegetation will be distributed on disturbed surfaces.

Access to Site

Site mobilization and demobilization will require the shipment of materials, supplies and equipment. Barge access is an option for getting heavy equipment and required materials to the Cape Christian site for the remediation program. The barge landing may be at Cape Christian or it may be at Clyde River. Should the shipments be to Clyde River then a winter road access will be required to deliver supplies to the area of activity. Current plans suggest the existing trail between Clyde River and Cape Christian will be used to transport supplies. Some of the existing roads to be utilized during remedial activities will require repair and upgrading before heavy equipment can use these roads. The airstrip will also be upgraded, including recontouring and resurfacing. The transportation of equipment and supplies to Cape Christian from Clyde River would occur in the Fall Year 1; and the backhaul of equipment and containerized wastes from Cape Christian to Clyde River would occur in the Winter Year 3.

Water Supply

To service the work camp, potable water can be brought to the site or supplied from the freshwater reservoir on-site, providing the reservoir water meets the Canadian Drinking Water Quality Guidelines. Non potable water can be obtained from the ocean or the freshwater reservoir when required. Only non-contaminated freshwater would be used for dust suppression, as required.

Waste Disposal

Sewage and grey water from the site will be treated and disposed of in accordance with applicable regulations. Solid waste will be collected and disposed of with other non-hazardous materials in the on-site landfill. PHC contaminated soils will be deposited into an on-site landfarm. The landfarm will be constructed with a synthetic liner. All camp waste will be disposed of in accordance with the Land Use Permit. All sewage will be located a minimum of 60 m away from any water body and main camp buildings, in accordance with the Land Use Permit.

Excavation Requirements

Approximately 14,200 m^3 of fill material is required for site clean up. Fill is required for upgrading the airstrip and site roads during remediation, backfilling contaminated soil areas and general site grading purposes. Additional fill is required for the development of a non-hazardous waste landfill and landfarm. Sufficient borrow areas were identified in the Earth Tech Cape Christian LORAN Station Supplementary Environmental Site Assessment, Materials Audit and Geotechnical Investigation (Earth Tech, 2007).

Table 7 identifies excavation requirements and borrow sources as outlined in the RAP (Earth Tech, 2007). A Quarry Permit will likely be required from CGS-GN.

Table 7. Excavation Requirements and Borrow Sources

Material Required	Estimated Amount Required m^3	Source	Site Activity
Well graded gravel	3,600	Well graded gravel not available on-site; existing borrow material must be screened and/or crushed to produce well graded material or imported from the Clyde River airstrip gravel source	Airstrip upgrade
Fairly well graded gravel	1,300	Borrow Source 4	Land Farm Construction
Fairly well graded gravelly sand or fairly well graded gravel	3,500	Borrow Sources 7, 5 and 4	Landfill Cap
Poorly graded gravelly sand, fairly well graded gravelly sand or fairly well graded gravel	5,000	Borrow Sources 7, 6, 5 and 4	Road Improvements
Poorly graded gravelly sand, fairly well graded gravelly sand or fairly well graded gravel	800	Borrow Sources 7, 6, 5 and 4	Campsite pad

4.3.3 Borrow Sources

Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources. Table 8 identifies borrow sources proposed by Earth Tech (2007) in the RAP to facilitate remediation at the Cape Christian site.

Table 8. Proposed Borrow Source Locations and Material Type

Borrow Source	Location	Type of Material	Estimated Amount of Material Available m^3
Borrow Source #1	Freshwater Reservoir Embankment	Poorly graded sand	9,000
Borrow Source #2	Berms of Proposed Landfill #2	Poorly graded silty sand	1,000
Borrow Source #3	Main Approach Road before River Crossing	Poorly graded sand	10,000
Borrow Source #4	Building, AST and Garage Gravel Pads	Fairly well graded gravel	3,300
Borrow Source #5	End of Road Past	Fairly well graded gravelly	1,700

Borrow Source	Location	Type of Material	Estimated Amount of Material Available m^3
	Equipment Dump	sand	
Borrow Source #6	Near South Beach Barrel Cache	Poorly graded gravelly sand	5,250
Borrow Source #7	750 m Northeast of Main Station Building	Fairly well graded gravelly sand	4,000

5. Impact Assessment Methodology

The methodology followed to complete this environmental impact assessment (EIA) was a desk-top exercise that consisted of the following steps:

- Identification and review of relevant information pertaining to the site, including past reports and site assessments commissioned and completed by INAC, and PWGSC;
- Identification and review of environmental and socio-economic information relevant to the site and the adjacent area;
- Identification and review of similar EIAs completed for similar sites in Nunavut;
- Identification and review of the requirements of the approvals processes for proposed projects in Nunavut, including review of the NBRLUP;
- The identification and analysis of potential project effects;
- The identification of proposed mitigation measures to reduce and/or eliminate project related impacts;
- The identification of potential residual project effects and a cumulative effects assessment;
- The identification of management and monitoring plans; and
- The use of professional judgement and experience in the completion of the EIA.

EIA is generally focused on ecological and human environment attributes that have scientific, social, cultural, economic, historical, archaeological, or aesthetic value, or are of local or regional concern and/or significance. The most important and/or sensitive of these attributes are usually chosen as representative indicators of change, and are referred to as Valued Ecosystem Components (VECs). For the purposes of this EIA, because the Cape Christian site is an existing disturbed and contaminated site, VECs were not identified. Rather, an issues based approach was taken where the potential impacts resulting from the remediation activities were identified and assessed. Mitigation measures were applied, impacts were predicted, the likelihood of the impact was also predicted, and any residual effects were identified. Based on the identified residual effects, cumulative effects were also assessed.

5.1 Potential Project Effects

The Cape Christian site is an existing disturbed and contaminated site that continues to pose significant environmental and human health risks (Earth Tech, 2002). The site has been identified as a priority site for remediation due to these potential risks. The remediation activities will cause disturbance to the site, but will ultimately result in reclamation of the site. The long term environmental and human health risks will also be reduced or eliminated through the remediation activities and mitigation measures.

The potential impacts resulting from the remediation activities were identified and assessed. In section 7 of this report, each potential impact is identified, a description of the impact is given, additional background information is provided where required, appropriate mitigation measures are identified, and any residual effects are described.

5.2 Mitigation Measures

The EIA identifies potential impacts to existing conditions at the site that may result from remediation activities. Mitigation measures are identified that may prevent or minimize the potential environmental impacts. Mitigation is addressed under two categories:

- **Mitigation by Design:** this describes mitigation measures which have been built into the project design; and
- **Mitigation of identified project effects:** this describes mitigation measures applied during the remediation activities.

Monitoring and follow-up programs may be recommended as a means to determine the effectiveness of the mitigation of the project effects. Essentially, the remediation program can be considered mitigation measures of the existing disturbed and contaminated site. Monitoring programs may be recommended in order to determine the effectiveness of the remediation.

5.3 Residual Effects and Cumulative Effects

Residual effects are those impacts remaining after all appropriate mitigation measures have been implemented. Cumulative effects can occur when the project residual impacts combine with past, existing and potential future effects from other activities in a cumulative manner. Cumulative effects can be positive or negative. Based on the identified residual effects, cumulative effects were assessed. Any residual effects identified with the Project will be described (Table 9) and rated for each impact statement where appropriate.

Direction

The direction of a residual impact once mitigation is applied describes the long-term change of the environmental component relative to baseline conditions as negative, neutral or positive.

Geographic Extent

The geographic extent is described as local if the predicted effect does not extend beyond the Local Study Area (LSA), which includes the area within a 1 km wide buffer around Project facilities, infrastructure and road corridor. The geographic extent is described as regional if it extends into the Regional Study Area (RSA), which includes the area within a 30 km wide buffer around Project facilities, infrastructure and road corridors, and Extra-regional if the effect reaches beyond the RSA. The Extra-regional Study Area (ESA) would include the shipping lane in the Baffin Bay and Davis Strait. For most of the year, much of the RSA and ESA are icebound. The proposed shipping period is during the mostly ice-free period of the year in the Arctic—July, August, and September. However, even during that period, the entire RSA and ESA is rarely ice-free. The distribution and abundance of marine mammals in the RSA is highly dependent on the extent and nature of the ice cover.

Table 9. Residual Impact Rating Criteria

Criteria	Rating Term	Definition
Direction	Positive	Beneficial change.
	Neutral	No change.
	Negative	Adverse change.
Geographic Extent	Local	Effect is limited to the Local Study Area.
	Regional	Effect extends to the Regional Study Area.
	Extra-regional	Effect extends beyond the Regional Study Area.
Duration[1]	Short-term	Effect lasts <2 years.
	Medium-term	Effect continues from 2 to 9 years.
	Long-term	Effect continues from 10 to 50 years.
	Permanent	Effect is permanent beyond 50 years.
Frequency	Once	Effect occurs once during construction, operations or closure.
	Intermittent	Effect occurs occasionally or periodically.
	Continuous	Effect occurs continuously during all or any phase.
Reversibility	Reversible	Effect is reversed after the activity ceases.
	Non-Reversible	Effect will not be reversed when activity ceases.
Magnitude	None	Magnitude is relative and assigned based on professional judgement. Magnitude combines the overall impact of the project activities, combining the ratings of the above criteria, measured against the threshold for the indicator.
	Negligible	
	Low	
	Medium	
	High	

Criteria	Rating Term	Definition
Note: 1. Duration identified in this table is generalized. This criterion is re-defined for each environmental component in the environmental assessment related to that component.		

Duration

Duration is defined as the length of time a predicted impact will last. Duration is defined as short-term, medium-term, long-term or permanent.

Frequency

Frequency describes how often an impact occurs and is defined as once, intermittent or continuous.

Reversibility

Reversibility is an indicator of the potential of recovery from a predicted impact and is defined as reversible or non-reversible.

Magnitude

Magnitude describes the overall impact of Project activities on the environmental component, combining the ratings of all criteria measured against the threshold for the indicator. To assign magnitude, some element of professional judgement is needed. Magnitude is ranked as negligible, low, medium or high.

6. Public Participation

Community meetings have been held in Clyde River to discuss the remediation of the Cape Christian site. On March 25, 2002 representatives of PWGSC, INAC, the Government of Nunavut and the Nunavut Research Institute held a meeting with the public. Concerns raised at that meeting were incorporated into the Remedial Action Plan. On November 29, 2006 another community meeting was held in Clyde River to discuss the proposed remediation project. Representatives from INAC, PWGSC, the Government of Nunavut and Earth Tech Canada were present to answer questions raised in the meeting.

7. Environmental Impact Assessment

This section identifies the potential major impacts from the proposed remediation activities outlined in the RAP (Earth Tech, 2007) for the Cape Christian site. Each potential impact is uniquely identified (e.g., IS-1) and described in an impact statement. Where appropriate, additional background information is also provided to give the proper context to the identified potential impact. Appropriate mitigation measures are

identified for each potential impact, and any residual effects are also identified. Table 10 lists the potential impacts decribed.

Table 10. Impact Statement (IS) Index

Impact Statement (IS)Index	Potential Impact
IS-1	Landforms and Associated Soils
IS-2	Vegetation Distribution
IS-3	Invasive Species
IS-4	Vegetation Health
IS-5	Wetlands
IS-6	Wildlife Habitat
IS-7	Aquatic Habitat
IS-8	Marine Mammals
IS-9	Noise and Air Quality
IS-10	Local Community
IS-11	Archaeological Resources
IS-12	Permafrost/Thermal Regime
IS-13	Malfunctions and Accidents

7.1 IS-1: Landforms and Associated Soils

Surface disturbance activities during remedial activities may affect the quantity (abundance and distribution) and quality of landforms and associated soils within the LSA.

Background Information

Previously identified environmental issues at Cape Christian include contaminated soils, buried debris, site buildings, hazardous materials (e.g., lead paint, asbestos, PCB paint), fuel and petroleum products, fuel storage tanks, and abandoned barrels. Surface disturbance, including grading, contouring, and excavation will be required to level construction-sites and storage areas, excavate borrow material, excavate buried debris, develop the landfarm cell, and landfill site and build temporary roads for use during the two year remediation project. Gravel or fill pads will be put in place to support the development of the temporary roads, building foundations, and airstrip upgrades if it is to be used during the project. Any surface affected by removal, levelling or burial will result in a loss of landform surface and associated soil and can have direct or indirect effects on the quantity and quality of surface available for growth of vegetation and wildlife habitat, and thus affect biodiversity. Dust generated during remedial activities will affect vegetation and is discussed in IS-4

There are approximately 2,160 m3 of contaminated soils at the site. These soils will be excavated, thus causing a surface disturbance. However, these contaminated soils will be removed and properly disposed of depending on the type of contamination. Buildings, equipment and site debris will also be removed potentially causing a surface disturbance. Final reclamation will involve contouring the Cape Christian

site to restore natural drainage patterns of surface water, to reduce disturbance to the existing permafrost, and to direct surface water away from the capped landfill and landfarm sites in order to prevent leachate generation, ponding and pooling, and erosion.

Mitigation Measures

Remediation activities should be restricted to the existing disturbed and contaminated footprint of the Cape Christian site as much as possible to reduce new surface disturbances. The camp should be located on previously disturbed lands. Upon camp decommission, disturbed areas should be regraded and reshaped to match existing terrain and drainage paths.

Removal of contaminated soils will prevent long term leaching of contaminants into surrounding soils, and will eliminate contamination sources, thus improving the long term quality of the remaining soils.

Following remediation activities, the ground surface will be prepared to facilitate vegetation establishment where possible. Compacted surfaces such as all-season roads; building, AST, garage and gravel pads; and airstrips will be loosened and scarified. Where available, overburden suitable for revegetation will be distributed on disturbed surfaces. Final grading of land surfaces will be consistent with the surrounding topography and will be compatible with grading requirements to restore natural drainage patterns as much as possible, and to prevent surface water pooling at critical locations (e.g., landfarm, landfills).

The landfarm will be designed with contingency to treat potential additional contaminated soil. Post-remediation procedure of the landfarm will include monitoring once every year for the first five years followed by monitoring every five years for the following 20 years. The monitoring program will be revaluated after the 25 years.

Residual Effects

The only identified residual effects will be a change to the existing landform topography and the quality of the soils at the site.

Landform Topography:
Direction = Positive
Geographic Extent = Local
Duration = Permanent
Frequency = Once
Reversibility = Non-Reversible
Magnitude = Negligible

Soil Quality:
Direction = Positive
Geographic Extent = Local
Duration = Permanent
Frequency = Once
Reversibility = Non-Reversible
Magnitude = Negligible

7.2 IS-2: Vegetation Distribution

Surface disturbance activities during remediation activities may affect the abundance and distribution of vegetation within the LSA.

Background

Terrestrial vegetation is an important indicator of soil quality, since the root systems are in constant contact with soil particles and associated chemicals. Uptake of chemicals through the roots can affect vegetation health. Surface disturbance and vegetation loss, burial and compaction will all impact vegetation directly. Importing vehicles and materials from outside the Project area may introduce weeds to the region. Air emissions and dust may affect plant health and the composition of vegetation communities.

Direct loss of vegetation will occur through surface disturbance or burial, as a result of Project activities. Surface disturbance will result in loss of existing living vegetation, propagules and seed on or near the ground surface. Soils required for plant growth may also be lost and substrate quality, moisture levels and temperature may change.

Project activities that will result in surface disturbance or burial include: grading, and excavation; and construction, infrastructure and storage areas. Clean-up activities including excavation and disposal of waste material will also result in direct losses to surface vegetation. Development of planned borrow sources for temporary road and airstrip (if required) development will result in losses of vegetation and the substrates beneath. Road construction will result in permanent burial of surface vegetation. Loss of vegetation due to surface disturbance is long-term in duration due to extremely slow growing conditions in the region, including cold, nutrient poor substrates and generally thin soils.

Where contaminated soils are removed, any vegetation associated with those soils would also likely be contaminated, and would therefore be removed and properly disposed of with the soil. Removal of hazardous materials will improve soil conditions and revegetation success.

Mitigation Measures

Remediation activities should be restricted to the existing disturbed and contaminated footprint of the Cape Christian LORAN Station as much as possible to reduce disturbance, and a decline in the abundance and distribution of vegetation in non-disturbed and contaminated areas of the site. Removal of contaminated soils will prevent long term leaching of contaminants into surrounding soils, and will eliminate contamination sources, thus removing the potential for vegetation contamination through uptake of contaminants from the soil. Fuel spills from vehicles and other equipment are expected to be minor and as part of the spill response plan, will be cleaned up immediately.

All vehicles and equipment transported from other areas into the site will be thoroughly washed of all soil and debris prior to arrival at the site to reduce the potential for introduction of weed species. It is unknown if seed mixes will be used to promote revegetation of remediated soils and replacement of removed vegetation. If seed mixes are used, only arctic seed mixes appropriate for the eastern arctic should be used.

Vehicular traffic will be restricted to designated all-season road alignments to limit areas of dust deposition.

Drills equipped with dust suppressors will be used during quarrying activities, and non-contaminated freshwater will be put on the roads to suppress dust.

Following remediation activities, the ground surface will be prepared to facilitate vegetation establishment where possible. Compacted surfaces such as all-season roads; building, AST, and garage gravel pads; and airstrips will be loosened or scarified. Where available, overburden suitable for revegetation will be distributed on disturbed surfaces.

Residual Effects

The only residual effect identified will be the removal of existing vegetation from contaminated and disturbed locations at the Cape Christian site.

Vegetation Removal:
Direction = Positive
Geographic Extent = Local
Duration = Short-Term
Frequency = Once
Reversibility = Non-Reversible
Magnitude = Negligible

7.3 IS-3: Invasive Species

Transportation of equipment and vehicles to the Project area and use of reclamation seed may introduce exotic invasive plants to the region, and may have an effect on vegetation diversity.

Background

Vehicles and equipment and materials transported from other areas have the potential to introduce weed species to new locations on tires or cavities in the undercarriage. Seed mixes can also include quantities of weed species.

Mitigation Measures

All vehicles and equipment transported from other areas into the site will be thoroughly washed of all soil and debris prior to arrival at the site. It is unknown if seed mixes will be used to promote revegetation of remediated soils and replacement of removed vegetation. It is recognized that some form of soil stabilization is required to prevent wind and surface water erosion. If seed mixes are used, only arctic seed mixes appropriate for the eastern arctic should be used. Recognizing that vegetation growth is very slow in the arctic, a combination of seeding with an appropriate arctic seed mix and other forms of soil/surface stabilization should be considered.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.4 IS-4: Vegetation Health

Dust and air emissions from Project activities (e.g., clearing, grading, excavating, vehicle traffic, demolition of buildings and other structures) may have an effect on vegetation health.

Background

Gaseous and particulate emissions that will be generated during the reclamation accumulate in plants, soils and water and can result in vegetation damage and changes in vegetation species diversity (Materna, 1984). Dust will also be generated at borrow sources and on road surfaces, and any barge landing site and the airstrip (if it is activated). Dust deposition can influence vegetation hardiness, snowmelt rates and changes in vegetation community structure.

Mitigation Measures

During the design phase of the remediation project, there has been a conscious attempt to minimize the Project disturbance footprint by grouping facilities as closely as possible, to avoid unnecessary road development and unnecessary foundation placement, thereby limiting dust generation and deposition.

Vehicular traffic will be restricted to designated all-season road alignments to limit areas of dust deposition.

Drills equipped with dust suppressors will be used during quarrying activities, and non-contaminated freshwater will be put on the roads to suppress dust.

Residual Effects

Dust effects from remedial activities are predicted to be local in extent for the road, airstrip, pits and borrow sources. Effects are expected to persist for 10- 50 years and are therefore long term.

Vegetation health:
Direction = Negative
Geographic Extent = Local
Duration = Permanent
Frequency = Once
Reversibility = Non-Reversible
Magnitude = Low

7.5 IS-5: Wetlands

Surface disturbance activities during remedial activities may affect the abundance and distribution of wetlands within the LSA.

Background

Wetlands are generally associated with low temperatures and short growing seasons where ample precipitation and high humidity cause excessive moisture to accumulate. Wetlands provide important benefits in a watershed, including preventing or reducing the risk of floods, improving water quality, and providing habitat for unique plant and animal communities. Characteristic plant species include mosses, sedges, and cottongrass. Characteristic wildlife include king eiders, snow geese, shorebirds and dabbling ducks.

Mitigation Measures

During the design phase of the Project, there has been a conscious attempt to minimize the Project disturbance footprint by grouping facilities as closely as possible, to avoid unnecessary road development and unnecessary foundation placement.

Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources.

Disturbance to riparian areas will be minimized. The Project site and immediate area will be checked for nesting birds prior to and during remediation activities, and if species are within the area during the sensitive periods, a wildlife officer will be contacted for guidance to ensure disturbance is minimized. Any nests discovered will not be destroyed.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.6 IS-6: Wildlife Habitat

Presence of infrastructure and sensory disturbance (e.g., auditory, olfactory, visual) during reclamation activities may cause direct and indirect (functional) loss of habitat available for wildlife in the Project area, which may have an effect on their behaviour, distribution, and abundance.

Background

Direct habitat loss is through loss of vegetation through surface disturbance, burial, or compaction, or the introduction of exotic invasive plants resulting in changes in abundance and diversity of vegetation. This loss of habitat will result in decreased foraging ability, availability of denning/nesting sites, and shelter for wildlife.

Wildlife may be using existing facilities as habitat (e.g., nesting) and demolition may result in loss of habitat.

The Project will result in an increase in sound levels within the LSA remedial activities through blasting, clean up operations, vehicles, and low-flying aircraft which may disturb wildlife and result in reduced use of an area and therefore indirect (functional) habitat loss. Some carnivores, including bears, may be attracted to sensory stimuli from developments (such as food smells).

Mitigation Measures

Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources.

Following remediation activities, the ground surface will be prepared to facilitate vegetation establishment where possible. Compacted surfaces such as all-season roads; building, AST, and garage gravel pads; and airstrips will be loosened or scarified. Where available, overburden suitable for revegetation will be distributed on disturbed surfaces.

All vehicles and equipment transported from other areas into the site will be thoroughly washed of all soil and debris prior to arrival at the site to reduce the potential for introduction of weed species. It is unknown if seed mixes will be used to promote revegetation of remediated soils and replacement of removed vegetation. If seed mixes are used, only arctic seed mixes appropriate for the eastern arctic should be used.

The Project site and immediate area will be checked for nesting birds and denning wolves or polar bears prior to and during remediation activities, and if species are within the area during the sensitive periods, a wildlife officer will be contacted for guidance to ensure disturbance is minimized. Any nests discovered

will not be destroyed. Bear safety awareness training will be provided and there will no feeding or harassing of wildlife.

Containers for domestic waste and incinerators will be located in enclosed bear-proof structures. Garbage will be incinerated daily.

Speed limits will be set on all roads and signage and radios will be used to warn drivers of wildlife in the area.

Noisy events (e.g., blasting) during remediation activities will be scheduled, based on recommendations from wildlife and fisheries experts, to minimize potential disturbance of sensitive species and/or periods.

If used for the project, aircraft approach and departure flight paths will be developed for the Cape Christian airstrip. A minimum general flying altitude of 610 m (2000 ft) above ground level for nesting migratory birds and known raptor nesting sites, and 1100 m (3600 ft) where birds are known to concentrate (moulting/brooding areas) and identified caribou calving and post-calving areas will be implemented.

Residual Effects

The only residual effect identified will be the direct loss of habitat from the removal of existing vegetation from contaminated and disturbed locations at the Cape Christian site.

Direct habitat loss:
Direction = Negative
Geographic Extent = Local
Duration = Long-term
Frequency = Once
Reversibility = Non-Reversible
Magnitude = Negligible

7.7 IS-7: Aquatic Habitat

Silt from erosion of slopes and ditches, organic and inorganic contaminants from fugitive dust emissions during remedial excavations and general vehicle traffic at the site, and the potential for landfill leachate generation may have an effect on surface water quality and sediment, and could affect local aquatic environments, fish and fish habitat, and marine mammals.

Background

The surface drainage of the site is ephemeral and generally to the east towards Baffin Bay. Observations recorded in 1995 state that an outlet in the water supply dam flowed into a pooling area east of the reservoir (ESG, 1996). Drainage from three of the eight worked areas also pooled east of the reservoir. Drainage from this area then flowed north under the fuel line into the "Outfall" drainage channel and then east into the ocean (ESG, 1996). Surface water that runs onto the landfill surface (i.e., not diverted) will infiltrate and generate leachate. A large ephemeral stream also exists at the southern end of the former Cape Christian Airstrip. While fisheries data is lacking for the Cape Christian site, any contaminated surface run-off could adversely affect potential fish and fish habitat. There are no sport fisheries in or around the Cape Christian site (B. Wooley, pers. comm.).

Excavated and backfilled slopes including berm slopes and landfill cover will be highly susceptible to erosion if constructed or consisting of silty sand. Erosion of excavated slopes, ditches and landfill cover will load surface water with sediment and potentially contaminants. Suitable erosion protection will be important to prevent sediment loading in surface water.

Frost heave of materials could result in localized steepened slopes and ice rich backfill could result in excessive settlement with the potential for localized slope failures and/or ponding of surface water. Cover and backfill materials should be frost stable and ice free (note this conflicts with low-permeability soil requirement for landfill cover)

Negative impacts on surface water quality (e.g., silt from erosion of slopes and ditches, organic and inorganic contaminants from remedial excavations and potentially landfill leachate). Generation and seepage of leachate from the landfill to shallow groundwater and surface water is a potential long-term risk if the landfill cover is not designed to be stable and resistant to erosion in long-term. Silty sand has a very low shear strength when saturated and could be subject to creep during spring thaw periods when the underlying soil is frozen.

Investigation indicates that most borrow sources at the site consist of fine silty sand (Earth Tech, 2007). The site does not appear to have a large source of borrow material suitable for erosion protection. However, excavation of gravel and cobbles from nearby riverbeds is proposed. Borrow of aggregate from riverbeds could negatively impact the surface water quality and result in significant sediment loading.

Borrow areas and excavated slopes will be susceptible to erosion until suitable permanent erosion protection is placed.

Mitigation Measures

The landfill should be located on relatively high, flat ground and surface water should be diverted away from the area.

Suitable erosion protection of excavated and fill slopes will be important to prevent sediment loading in surface water. Alternative erosion control products (i.e., geosynthetic erosion control mats) could be considered for ditches and temporary steep slopes highly susceptible to erosion located near surface water bodies. However, it may be undesirable to import manufactured products and preferable to use natural erosion protection. So identifying a source of suitable gravel/cobble erosion protection is critical.

The use of silt and sediment controls (i.e., silt fencing) should be considered to protect surface water from excessive sediment loading during construction and remedial activities and for preventing deleterious substances from entering the aquatic environment.

Use of low-permeability soils (i.e., locally available silty material) in the active zone for the landfill cover could be susceptible to freeze/thaw creep (if poorly drained or saturated soil is placed on a slope), frost heave (if placed with high water content), or excessive settlement (if placed with ice). Borrow development, remedial excavation and landfill slope designs should provide for proper drainage and consider soil strength when saturated in slope stability analysis. Alternative geosynthetic low-permeabilty landfill covers (e.g. a geomembrane formulated for arctic conditions) could be considered. The design cover should extend below the active permafrost zone. Studies of climate (existing and future predications) to estimate the active zone thickness with a high degree of confidence is important for proper landfill cover design. A low-permeability landfill cover is important to prevent infiltration of precipitation and surface water and minimize leachate generation. Landfill cover must be resistant to erosion, slope failures and freeze/thaw creep.

Remedial excavation and landfill slope designs should provide for proper drainage and consider saturated soil strength in slope stability analysis. Flatter slopes could be considered to reduce susceptibility to erosion and slope creep/failure. Steeper slopes (e.g., 3H:1V sideslopes proposed for landfill berms) could be more susceptible to surficial sloughing/slumping and progressive creep. Landfill cover stability and resistance to erosion should be monitored to ensure the final cover design is stable and continues to minimize infiltration in the long-term. Landfill cover thickness should also be designed so that the waste materials are below the active layer (i.e., annual freeze/thaw zone). These measures will prevent future infiltration of precipitation into the waste and the long term generation of leachate.

Provide environmental monitoring during remediation activities to ensure compliance and functioning of drainage and sediment controls structures.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.8 IS-8: Marine Mammals

Project activities at Cape Christian (e.g., construction; equipment, vehicle and potential aircraft use; potential ship movements, docking, loading/unloading, and accidental spills) may cause mortality, injury, or altered marine mammal distribution in the Cape Christian LSA.

Background

Most potential impacts to marine mammals in the LSA are limited to the vicinity of the barge landing site or the vessels between the shipping route and the barge landing site. The sensitive periods of birth, pup dependence, and adult moult for seals in the Canadian High Arctic occur from late March through mid June. During that period, most seals are in the zone of landfast ice. During the open-water season (July to September), seals generally are widely scattered in low densities. Equipment and vehicle activities are predicted to have little impact on ringed seals. Project activities in the vicinity of the barge landing dock site are likely to disturb seals and perhaps cause them to move away from or avoid those sources of disturbance. Shipping operation within the LSA will occur annually from July through October, during the open-water period. Most potential impacts to seals, walrus and whales would be disturbance-related and result in avoidance reactions. Belugas are known to be sensitive when approached by fast, erratically-moving small boats, and when exposed to noise from ships and icebreakers in deep channels of the Canadian High Arctic in spring (Richardson *et al.* 1995). Thus, the type of vessel traffic that would be encountered in the LSA likely would cause only mild, transitory disturbance.

Polar bears, because of their highly investigative behaviour, may be attracted to the Cape Christian site during remediation activities and may be destroyed as defence kills, or may consume foreign substances that can be harmful or even cause death (Lunn and Stirling, 1985; Stirling 1988b; Amstrup *et al.*, 1989). The size of a population could decline quickly as a result of direct mortality due to increased access or defense kills, or indirect mortality caused by environmental damage to their habitat or prey.

Mitigation Measures

Monitor area around the barge landing site for marine birds and mammals prior to and during remedial activities. Work will be scheduled around seasonal restrictions, e.g., seal pupping (April to mid-June).

Reduce number of aircraft flights during spring ringed seal pupping and moulting (April to mid-June). Fly at or above 600 m altitude and follow designated flight corridors.

Shipping is scheduled during the normal open water season. Vessels will steer a straight course, maintain constant speed, and avoid sudden changes in speed/direction.

There will be a spill response plan, including reconnaissance surveys to find marine birds and mammals near spills, and use of deterrents to keep animals away from spills.

Bear safety awareness training will be provided and there will no feeding or harassing of wildlife. Containers for domestic waste and incinerators will be located in enclosed bear-proof structures. Garbage will be incinerated daily.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.9 IS-9: Noise and Air Quality

Remediation activities could cause an increase in noise levels and a decrease in air quality over the length of the project.

Background

The coastal area is influenced greatly by the marine environment (Maxwell 1981). In winter, mean temperatures are not as low as in regions of similar latitudes due to milder air associated with cyclonic systems, and numerous water inlets along the coast. In summer, the cold current of Baffin Bay and heavy concentrations of sea ice that persist until late summer, has a cooling effect on summer temperatures. Cloudiness persists throughout the winter and summer periods due to the maritime influence.

Climate data is available for Clyde River from 1971-2000 at
http://climate.weatheroffice.ec.gc.ca/climateData/canada_e.html

Mitigation Measures

Ultra-low sulphur diesel fuel will be used in trucks and equipment to reduce the level of gaseous emissions and potential acid input (PAI).

Drills equipped with dust suppressors will be used during quarrying activities, and water or liquid calcium chloride will be used on the roads to suppress dust. Speed limits will be established on the roads.

Use and maintain noise abatement equipment.

Noisy events during remedial activities will be scheduled, based on recommendations from wildlife and fisheries experts, to minimize potential disturbance of sensitive species and/or periods.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.10 IS-10: Local Community

Remediation activities at Cape Christian could affect the residents and community of Clyde River.

Background

The Cape Christian site is located within the Municipal boundary and block land transfer of Clyde River, and is a previously disturbed and contaminated site that poses significant risk to human health and the environment. Community residents can travel to and through the site on ATVs and snowmobiles. Any human contact with the site poses health risk from contamination and injury from existing buildings and debris on the site. The Cape Christian site has been inactive for many years, and does not generate employment or economic benefit for the residents. However, the various studies of the site carried out over the years by the federal government have likely generated some economic development opportunities and temporary employment for local residents.

Mitigation Measures

Removal of site contamination, buildings and debris will make the site safer for residents to visit and pass through in their travels on the land. Local residents and local businesses in Clyde River will be given the opportunity to participate in the remediation and to benefit economically from the Project through the Inuit Impact Benefits Package.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.11 IS-11: Archaeological Resources

Remediation activities could impact on archaeological resources at the Cape Christian site.

Background

Occupation and use of the Cape Christian site has resulted in extensive disturbance. Numerous beach and tundra locations associated with borrow areas were disturbed by grading and other vehicular traffic as well as borrow activities. Existing borrow areas have been largely disturbed surficially by grading; areas of additional borrow activity will not impact previously undisturbed areas. The remaining areas surrounding the station, seasonal drainages and roads are all associated with disturbances.

It is strongly recommended that all traffic and remediation activities avoid the site area. In the event that avoidance is not feasible further study is recommended. Because of the good potential for undisturbed artifacts and features in the site area and the high likelihood of disturbance during remedial activities, it is recommended that mitigative excavations be undertaken in these areas. Of particular concern are remediation activities that would involve removal of the flag poles and the antennae platform as both of these areas are associated with undisturbed soil and cultural deposits. Similarly, potential features incorporating both fireplaces and bone materials were observed east of the flag pole locality. Mitigation of these features is also recommended prior to any further remediation work. Depending on the final remediation plan, detailed site mapping may also be warranted (FMA Heritage Resource Consultants, 2006).

Mitigation Measures

The existing archaeological site that is at the Cape Christian site is located in an area that can easily be avoided during reclamation activities. Erecting barriers and/or establishing buffer zones will ensure protection of the site. The archaeological site will be clearly marked with a temporary fence and flagging material in order to facilitate avoidance of the site. Contractors working at the site will also be given archaeological awareness training during normal health and safety training at the beginning of the work season, or each rotation. This training will reinforce the importance of archaeological resources and assist workers in identifying potential archaeological sites and how to avoid them. Avoidance measures will be in accordance with *Archaeological and Palaeontological Resources Terms and Conditions for Land Use Permit Holders* (Appendix A).

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.12 IS-12: Permafrost/Thermal Regime

Effects of theProject on the thermal environment.

Background

Climate change is the only environmental effect that could significantly affect the Project. Climate change is an on-going phenomena that will continue to impact air temperature, precipitation, snow and ice cover, and will continue to affect aquatic and terrestrial ecology and anthropogenic infrastructure on a worldwide basis. Inclement weather, as well as ice and frozen ground may delay remediation clean up activities and ice may delay marine transport. It is for these reasons that climate change factors are considered for development projects to ensure that predictions related to engineering design and environmental impacts have integrity and credibility over the long term.

Smith and Burgess (2004) predict that, in areas where permafrost is thinner and ground temperatures are warmer than -2^0C, there is the potential for significant loss of permafrost over the long term. In areas of thicker permafrost where ground temperatures are at or below -5^0C, the main result from global warming will be a thicker active layer (the uppermost layer of frozen ground), and a gradual overall thinning of permafrost. As permafrost warms, groundwater storage capacity will increase through a thickening of the active layer and infiltration into underlying sediments. Increased water in the active layer may result in other impacts such as increased frost heave, due to the availability of unfrozen water, resulting in cryogenic features such as frost blisters. Icing activity may also become a more common occurrence, particularly during spring break-up. There may also be an impact on surface water quality and ultimately on fish and aquatic life, due to increased dissolved solids from the interaction between shallow groundwater and surface water. Other potential impacts of degrading permafrost in ice-rich sediments will be general soil or slope instability due to excess water and loss of soil strength (Smith and Burgess, 2004). The sensitivity of permafrost depends on the potential for thaw, and the impact of thaw. Another long-term change is the potential development of unfrozen zones or taliks below an active layer that allows for shallow subsurface water flow during winter months (Smith and Burgess, 2004).

Mitigation Measures

The biggest concern for the reclamation activities is the effects of climate change on ground thermal regimes and the reliance on permafrost as an impermeable barrier to contaminant movement and for terrain stability over the long term. The average daily temperature at Cape Christian over the year is -12C. As climate change occurs over a very long period of time, once ground thermal regimes are re-established after disturbance and particularly in the landfarm and landfill sites, they should remain stable for a long period of time providing additional disturbance and proper terrain stability measures are implemented. Cap design for the landfarm and landfills should extend below the surrounding permafrost level to promote re-establishment of permafrost in these facilities. Proper cap thicknesses and appropriate ground

moisture content should be ensured when reclaiming these facilities. And, surface contouring to prevent surface water from draining into these facilities should be ensured.

Although not a mitigation measure, monitoring of ground thermal regimes in the landfill and landfarm should occur to ensure re-establishment of permafrost.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.13 IS-13: Malfunction and Accidents

Malfunctions and accidents could adversely affect the project.

Background

Malfunctions and accidents of concern for the reclamation project relate to worker health and safety, and accidental spills of contaminants (e.g., oil, grease, fuel, contaminated soils being relocated/removed).

Under government contracting policies and guidelines, contractors must abide by health and safety regulations and ensure the safety of their employees through adequate training and awareness programs, and by providing appropriate safety equipment and safe working conditions.

Mitigation Measures

- A *Health and Safety Plan* and a *Spill Contingency Plan* should be prepared for this project and contractors should implement and abide by these Plans. The Health and Safety Plan should include bear safety training, archaeological awareness training, and training on working in potentially adverse weather conditions. Proper handling procedures will be implemented and hazardous materials are to be containerized for shipment off-site.

Residual Effects

No residual effects are identified with this impact once mitigation measures have been applied.

7.14 Mitigation Measures

The following table summarizes the mitigation measures presented in the previous sub-sections.

Table 11. Summary of Potential Impacts and Mitigation Measures

Impact Statement	Mitigation Measure
IS-1: Landforms and Associated Soils *Surface disturbance activities during remedial activities may affect the quantity (abundance and distribution) and quality of landforms and associated soils within the LSA.*	• Restrict activity to existing disturbed and contaminated footprint • Disturbed areas to be regraded and shaped to match existing terrain • Monitoring once every year for the first five years followed by monitoring every five years for the following 20 years • Design landfarms with contingency to treat potential additional contaminated soil

	• Ground surfaces will be prepared to facilitate vegetation establishment following remediation activities
IS-2: Vegetation Distribution *Surface disturbance activities during remediation activities may affect the abundance and distribution of vegetation within the LSA.*	• Restrict activity to the existing disturbed and contaminated footprint • Fuel spills will be cleaned up immediately • All vehicles and equipment transported from other areas into the site will be thoroughly washed of all soil and debris prior to arrival at the site to reduce the potential for introduction of weed species • If seed mixes are used to promote revegetation of remediated soils and replacement of removed vegetation, only arctic seed mixes appropriate for the eastern arctic should be used • Vehicular traffic will be restricted to designated all-season road alignments to limit areas of dust deposition • Drills equipped with dust suppressors will be used during quarrying activities, and non-contaminated freshwater will be put on the roads to suppress dust • Ground surfaces will be prepared to facilitate vegetation establishment following remediation activities
IS-3: Invasive Species *Transportation of equipment and vehicles to the Project area and use of reclamation seed may introduce exotic invasive plants to the region, and may have an effect on vegetation diversity.*	• Vehicles and equipment transported into the site will be thoroughly washed of all soils and debris prior to arrival • Some form of soil stabilization is required to prevent wind and surface water erosion • Only seed mixes appropriate for the eastern arctic should be used

IS-4: Vegetation Health *Dust and air emissions from Project activities (e.g., clearing, grading, excavating, vehicle traffic, demolition of buildings and other structures) may have an effect on vegetation health.*	• Minimize project disturbance by grouping facilities close together, avoiding unnecessary road development and foundation placement during design • Restrict vehicle traffic to designated all-season road alignments • Non-contaminated freshwater to be put on roads to suppress dust • Drills equipped with dust suppressors will be used during quarrying activities
IS-5: Wetlands *Surface disturbance activities during remedial activities may affect the abundance and distribution of wetlands within the LSA.*	• Minimize project disturbance by grouping facilities close together, avoid unnecessary road development and foundation placement • Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources • The project site and existing area will be checked for nesting birds before and during remediation activity and no nests will be destroyed • A wildlife officer will be consulted to ensure disturbance is minimized if species are discovered within the area
IS-6: Wildlife Habitat *Presence of infrastructure and sensory disturbance (e.g., auditory, olfactory, visual) during reclamation activities may cause direct and indirect (functional) loss of habitat available for wildlife in the Project area, which may have an effect on their behaviour, distribution, and abundance.*	• Existing borrow sources, including abandoned gravel pads and road infrastructure, will be fully exhausted prior to exploiting new sources • Vehicles and equipment transported into the site will be thoroughly washed of all soils and debris prior to arrival • Ground surfaces will be prepared to

	facilitate vegetation establishment following remediation activities • The area will be checked for nesting birds and denning wolves or polar bears before and during remediation activity • If species are found within the area a wildlife officer will be contacted for guidance to ensure minimal disturbance • • Noisy events (e.g., blasting) during remediation activities will be scheduled, based on recommendations from wildlife and fisheries experts, to minimize potential disturbance of sensitive species and/or periods • There will be no harassing or feeding wildlife • Garbage will be incinerated daily and containers for domestic waste and incinerators will be bear-proof • Speed limits will be set on all roads and signage and radio will warn drivers of wildlife in the area • Aircraft approach and departure flight paths will be developed for the Cape Christian airstrip
IS-7: Aquatic Habitat *Silt from erosion of slopes and ditches, organic and inorganic contaminants from fugitive dust emissions during remedial excavations and general vehicle traffic at the site, and the potential for landfill leachate generation may have an effect on surface water quality and sediment, and could affect local aquatic environments, fish and fish habitat, and marine mammals.*	• Surface water should be diverted away from landfill • Erosion protection of excavated and fill slopes will be important to prevent sediment loading in surface water • Erosion control products could be considered for ditches and temporary steep slopes highly susceptible to erosion located near surface water bodies • Silt and sediment controls should be considered to protect surface water from

	excessive sediment loading and to prevent deleterious substances from entering the aquatic environment • Borrow development, remedial excavation and landfill slope designs should provide for proper drainage and consider soil strength when saturated in slope stability analysis • Alternative geosynthetic low-permeability landfill covers could be considered • The design cover should extend below the active permafrost zone and study to estimate the active zone thickness is important for landfill cover design • Landfill cover must be resistant to erosion, slope failures and freeze/thaw creep • Landfill cover stability and resistance to erosion should be monitored to ensure the final cover design is stable and continues to minimize long-term infiltration • Landfill cover thickness should be designed so that the waste materials are below the active layer • Environmental monitoring should take place during remedial activities to ensure compliance and functioning of drainage and sediment controls structures
IS-8: Marine Mammals *Project activities at Cape Christian (e.g., construction; equipment, vehicle and potential aircraft use; potential ship movements, docking, loading/unloading, and accidental spills) may cause mortality, injury, or altered marine mammal distribution in the Cape Christian LSA.*	• Monitor area around the barge landing site for marine birds and mammals prior to and during remediation activities • Work will be scheduled around seasonal restrictions • Reduce number of aircraft flights during spring ringed seal pupping and moulting (April to mid-June) • Fly at or above 600 m altitude and follow designated flight corridors • Shipping is scheduled during the normal

	open water season. Vessels will steer a straight course, maintain constant speed, and avoid sudden changes in speed/direction • There will be a spill response plan, including reconnaissance surveys to find marine birds and mammals near spills, and use of deterrents to keep animals away from spills • Bear safety awareness training will be provided and there will no feeding or harassing of wildlife • Containers for domestic waste and incinerators will be located in enclosed bear-proof structures • Garbage will be incinerated daily
IS-9: Noise and Air Quality *Remediation activities could cause an increase in noise levels and a decrease in air quality over the length of the project.*	• Ultra-low sulphur diesel fuel will be used in trucks and equipment to reduce the level of gaseous emissions and potential acid input (PAI) • Drills equipped with dust suppressors will be used during quarrying activities, and water or liquid calcium chloride will be used on the roads to suppress dust • Speed limits will be established on the roads • Use and maintain noise abatement equipment • Noisy events during remediation activities will be scheduled, based on recommendations from wildlife and fisheries experts, to minimize potential disturbance of sensitive species and/or periods

IS-10: Local Community *Remediation activities at Cape Christian could affect the residents and community of Clyde River.*	• Removal of site contamination, buildings and debris will make the site safer for residents to visit and pass through in their travels on the land • Local residents and local businesses in Clyde River will be given the opportunity to participate in the remediation and to benefit economically from the Project through the Inuit Impact Benefits Package
IS-11: Archaeological Resources *Remediation activities could impact on archaeological resources at the Cape Christian site.*	• The existing archaeological site that is at the Cape Christian site is located in an area that can easily be avoided during reclamation activities • Erecting barriers and/or establishing buffer zones will ensure protection of the site. The archaeological site will be clearly marked with a temporary fence and flagging material in order to facilitate avoidance of the site • Contractors working at the site will be given archaeological awareness training during normal health and safety training at the beginning of the work season, or each rotation • Avoidance measures will be in accordance with *Archaeological and Palaeontological Resources Terms and Conditions for Land Use Permit Holders* (Appendix A)
IS-12: Permafrost/Thermal Regime *Effects of the Project on the thermal environment.*	• Once ground thermal regimes are re-established after disturbance and particularly in the landfarm and landfill sites, they should remain stable for a long period of time providing additional disturbance and proper terrain stability measures are implemented

	• Cap design for the landfarm and landfills should extend below the surrounding permafrost level to promote re-establishment of permafrost in these facilities • Proper cap thicknesses and appropriate ground moisture content should be ensured when reclaiming these facilities • Surface contouring to prevent surface water from draining into these facilities should be ensured. • Monitoring of ground thermal regimes in the landfill and landfarm should occur to ensure re-establishment of permafrost
IS-13: Malfunctions and Accidents	• Implementation of a site specific Health and Safety Plan • Implemention of a site specific spill contingency plan

8. Residual Effects

The effect of surface disturbance on landforms and soils abundance and distribution is low during remedial operation and there is no effect at closure or at the regional scale. Therefore, it can be concluded that the effects of the Cape Christian remediation action plan on the landforms and soils in the LSA and RSA are considered to be not significant.

The impact on vegetation is local in extent, long-term in duration, and reversible over time if drainage and substrate characteristics are restored. Given mitigation and re-vegetation monitoring efforts and growth conditions at northern latitudes, the magnitude of the effect on vegetation diversity is predicted to be negligible. Effects of weed establishment on particular vegetation cannot be made with confidence. Dust effects from remedial activities are predicted to be local in extent for the road, airstrip, pits and borrow sources. Effects are expected to persist from 10 to 50 years and are therefore long term.

Direct and indirect habitat losses are predicted to result in minor effects on distribution, abundance, and behaviour of wildlife. Direct mortality as a result of the Cape Christian site remediation project may occur

from accidental and problem kills, and through enhanced access and human presence leading to increased harvesting. Accidental mortalities are predicted to occur infrequently. Problem kills primarily involve carnivores, and generally result from inadequate waste management and behavioural attraction to infrastructure. Given careful attention to mitigation, the residual effects are predicted to be minor, reversible post-closure, and pose little increased risk to populations.

Most potential impacts to ringed seals would be short-term disturbance and limited to the vicinity of the barge landing site or the vessels on the shipping route; they would be neutral or negative in direction, because effects may be experienced along the shipping route, short-term, intermittent and reversible. Consequently, the residual effects associated with Impact Statement IS-8(Marine Mammals) are considered not significant.

9. Cumulative Effects

The remediation of the Cape Christian site is not expected to result in any cumulative effects. The purpose of the remediation program is to repair the environmental effects of the abandoned site. The remediation program may interfere with traditional land use during the project. However, this is not considered a cumulative effect and residents of Clyde River will be notified of the remediation schedule.

The remediation of the Cape Christian site will have a positive effect on the environment through the demolition of deteriorating buildings, the removal of hazardous materials, the land filling of non-hazardous debris, the contouring of the site to mitigate erosion, and the long term restoration of the site. The contribution of the effects of the remediation activities at the site are assessed as being positive and not significant.

10. Management and Monitoring Plans

Surveillance monitoring of the Cape Christian site following the completion of the remediation work will serve two fundamental purposes:

1. Performance Monitoring: measuring the prescribed reclamation indicators to provide for an assessment of environmental conditions against the prescribed reclamation criteria (such as "the concentration of hydrocarbons in monitoring wells surrounding the land farm shall be less than the INAC Protocol, for example); and
2. Triggers Monitoring: measuring environmental conditions against various prescribed triggers that would initiate maintenance or contingency actions (such as the initial erosion of a newly constructed cover on a landfill).

The following activities are recommended:

- Confirmatory soil sampling of contaminated soil remediated areas is recommended to verify that the soil quality objectives outlined in the INAC Protocol have been met.
- Annual visual inspection of the land farm to confirm cell and liner integrity.
- Monitoring wells installed around the land farm are to be monitored annually during its operation and at least once following decommissioning to confirm that leachate is not negatively affecting the receiving environment.
- Upon decommissioning of the land farm confirmatory soil sampling is required.
- Annual inspection of the landfill cover is recommended to confirm that the cover is intact and waste is not exposed.
- Climate and ground temperature monitoring is recommended to confirm the landfill cover thickness is sufficient and that waste is below the active zone.
- Surface water quality monitoring of the receptor downstream of the landfill and large remedial excavation area(s) is recommended to confirm that leachate, residual contaminants or sediment are not negatively affecting surface water quality. The site is to be monitored a minimum of five years.
- Soil sampling around the landfill area is recommended to be conducted in conjunction with the surface water sampling program.
- After five full years post-remediation monitoring at Cape Christian it is recommended that a summary of all of the monitoring data collected be prepared and that a comprehensive assessment of the performance of the remediation work against the objectives, and a recommendation for an on-going monitoring program, be made at that time (including inspection once every five years for the next twenty years). INAC's post-remediation procedure includes monitoring once every year for the first five years followed by monitoring every five years for the following 20 years. The monitoring program is revaluated after the 25 years.

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12. Glossary and Acronyms

12.1 Acronyms

AST	Above Ground Storage Tank
ATV	All Terrain Vehicle
CCME	Canadian Council of Ministers of the Environment
CEAA	Canadian Environmental Assessment Act
CGS-GN	Department of Community and Government Services, Government of Nunavut
CLEY	Department of Culture, Language, Elders and Youth
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSP	Northern Contaminated Sites Program
CWS	Canada Wide Standards
DCC I	Defence Construction Canada Tier 1
DCC II	Defence Construction Canada Tier 2
DEW Line	Distant Early Warning Line
DFO	Department of Fisheries and Oceans
DIAND	Department of Indian Affairs and Northern Development
DoE	Department of Environment
EA	Environmental Assessment
EC	Environment Canada
EIA	Environmental Impact Assessment
ESG	Environmental Services Group, Royal Military College, Kingston, Ontario
FA	Federal Authority
FWAL	Freshwater Aquatic Life
GN	Government of Nunavut
INAC	Indian and Northern Affairs Canada
INAC Protocol	INAC Abandoned Military Site Remediation Protocol
IOL	Inuit Owned Land
IQ	Inuit Qaujimajatuqangit
LORAN	Long Range Navigation
LSA	Local Study Area
NBRLUP	North Baffin Regional Land Use Plan
NIRB	Nunavut Impact Review Board
NLCA	Nunavut Land Claim Agreement
NPC	Nunavut Planning Commission
NRCAN	Natural Resources Canada
NRI	Nunavut Research Institute

NTI	Nunavut Tungavik Incorporated
NWB	Nunavut Water Board
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated Biphenyl
PHC	Petroleum Hydrocarbon
POL	Petroleum, Oil and Lubricant
PWGSC	Public Works and Government Services Canada
QIA	Qikiqtani Inuit Association
RA	Responsible Authority
RAP	Remediation Action Plan
RCMP	Royal Canadian Mounted Police
SARA	Species at Risk Act
TC	Transport Canada
VEC	Valued Ecosystem Components

12.2 Glossary

The following glossary was obtained from the NIRB guide F: Terminology and Definitions found on the NIRB ftp site at: http://ftp.nunavut.ca/nirb/

Authorization

Any approval, permit, license, lease, certificate, or other written communication that is required to allow a project or a component of a project to proceed.

Authorizing Agency (AA)

Any government agency, Designated Inuit Organization (DIO) or any other body that has the authority to issue a permit, lease, license or grant approval to a Proponent to conduct some physical work or physical activity in relation to a project proposal. These authorizations may trigger the NIRB screening process.

Best Environmental Practices

The application of the most appropriate combination of measures, including the most economically feasible, the best available technology, and the best scientific information available, to all stages of the project for the goal of attaining sustainable development.

Cumulative Environmental Assessment (CEA)

The assessment of impacts on the biophysical and socio-economic environment that results from the incremental effects of a development when added to other past, present, and reasonably foreseeable future

developments, regardless of what agency or person undertakes such other developments. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

Designated Inuit Organization (DIO)

The Nunavut Tunngavik Incorporated (NTI), or in respect of a function under the NLCA, any of the organizations that has been designated under NLCA, Section 39.1.3 as responsible for that function the Regional Inuit Association (RIA) (Kitikmeot Inuit Association, Kivalliq Inuit Association and Qikiqtani Inuit Association).

Distribution List

A list compiled, on a project-by-project basis, to which information and correspondence is forwarded relating to any developments in the process of a specific project proposal application.

Document

Includes anything in printed form, and telecommunication or electronic transmission capable of being reduced to a printed format, and video or audiotapes.

Ecosystem

A community of living (biotic) organisms interacting with each other and with non-living (abiotic) support elements, such as solar energy, air, water and soil.

Ecosystemic

Relating to the complex of a natural community of living and nonliving organisms and its environment functioning as an ecological unit in nature.

Elder

Any member of the community recognized as such in accordance with local culture, customs and traditions or someone recognized for their experience in Inuit culture, customs and knowledge.

Environment

The components of the Earth including (a) land, water and air, including all layers of the atmosphere; (b) all organic and inorganic matter and living organisms; and (c) the interacting natural systems that include components referred to in (a) and (b). It also includes the complex web of inter0relationships between biotic and abiotic components which sustain all life on earth, including the social/health aspects of human group existence.

Environmental Effect/Impact

Any positive or negative change in the biophysical and/or socioeconomic environment caused by, or directly related to, a former, ongoing or proposed activity. There are 3 types of effects:

1. **Direct Effects** - refer to changes in the environmental components that result from direct cause-effect consequences of interactions between the project activities and the environment.
2. **Indirect Effects** - result from cause-effect consequences of interactions between the environment and direct impacts. For example, the effect of pollution may not only be seen directly in the loss of local vegetation, but indirectly as a degradation of the health, culture and social structure of the local people.
3. **Cumulative Effects** - refer to the accumulation of changes to the environment caused by human activities (e.g. past, existing and proposed activities, including activities associated with the project under assessment). These changes occur over space and time and can be brought about by environmental effects that are additive or interactive. For example hunting, oil spills, loss of habitat, commercial fishing pressure on prey species, can all affect marine mammals in the Arctic.

Environmental Assessment (EA)

Any of the following definitions could apply:

a) The identification, description, assessment, and mitigation of the direct and indirect effects on: human beings, fauna, flora, soil, water, air, climate and the landscape; the interaction of these factors; and on material assets, and the cultural heritage.
b) A process for identifying, predicting, evaluating, and mitigating the relevant effects of proposed projects and physical activities prior to major decisions and commitments being made.
c) A tool to use in integrated planning of development proposals, policies and programs.
d) An activity designed to identify, predict, interpret and communicate information about impacts and mitigation measures of a proposed activity on human health and the well being of the ecosystem

Environmental Impact Statement (EIS)

Termed "Impact Statement" under the NLCA, an EIS refers to a documented assessment of the environmental and socio-economic consequences and recommended mitigative actions of any project proposal expected to have significant environmental consequences, which is prepared by the Proponent in accordance with guidelines established by NIRB.

Hearing

Includes a hearing on an application, the hearing of a motion, a pre-hearing conference, or a written hearing.

Industrial Activity

An activity in which a structure or building, land, water, or equipment is utilized for a commercial use as opposed to a private or traditional use, and includes the manufacture and production of goods and the operation of any licensed or regulated services or activities that generate sales or revenue.

Information Request (IR)

A written request for information or particulars made by the Board, or from one party to another.

Intervener

Any interested party intending to participate in a Board hearing and to play a role regarding any issues raised by the application, either by questioning other Parties or by bringing forward their own evidence.

Inuit Qaujimajatuqangit (IQ)

Guiding principles of Inuit social values including: respecting other, relationships, and caring for people; development of skills through practice, effort and action; working together for a common cause; fostering good spirit by being open, welcoming, and inclusive; serving and providing for family and/or community; decision making through discussion and consensus; being innovative and resourceful; and respect and care for the land, animals and the environment.

Minister

Unless otherwise specified, means the federal or territorial Minister having the jurisdictional responsibility for authorizing a project to proceed; however, the Government of Canada and Territorial Government may, within their respective jurisdictions, designate a single Minister to be responsible for NIRB and to perform all functions assigned to the Minister.

Mitigation

The actions taken including design, construction, schedule, and restorative measures, to control, reduce or eliminate a potential adverse environmental effect of a proposed activity or project.

Monitoring

The systematic observation or tracking of an activity to determine whether it is proceeding or functioning as expected. Through monitoring, the accuracy of environmental impact predictions is assessed. A number of different monitoring activities are identified below:

a) Effects monitoring is the process of measuring and interpreting changes to environmental and socio-economic parameters to identify relevant project effects, and may involve assessing the accuracy of impact predictions contained in the project impact statements;

b) Compliance monitoring is the process of determining whether and to what extent the land or resource use in question is carried out according to regulatory requirements, including terms and conditions contained in NIRB project certificates.

Nunavut Settlement Area (NSA)

Please refer to Article 3 in the NLCA and the map attached in Guide 1 – The Nunavut Impact Review Board.

Nunavut Land Claims Agreement (NLCA)

The land claims agreement signed on May 25, 1993, between the Inuit of the Nunavut Settlement Area and the Queen in Right of Canada, based on and reflecting the following objectives:

a) to provide for certainty and clarity of rights to ownership and use of lands and resources, and of rights for Inuit to participate in decision-making concerning the use, management and conservation of land, water and resources, including the offshore;
b) to provide Inuit with wildlife harvesting rights and rights to participate in decision making concerning wildlife harvesting;
c) to provide Inuit with financial compensation and means of participating in economic opportunities; and
d) to encourage self-reliance and the cultural and social well-being of Inuit.

Party

The applicant or Proponent involved in the review process, and includes any DIO's, Interveners, or the Public.

Precautionary Principle

If there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental and/or socioeconomic degradation.

Project Certificate

Refers to a certificate of approval issued by NIRB pursuant to Sections 12.5.12 and 12.6.17 of the NLCA. Such a certificate authorizes a project, or a component of a project to proceed and contains specific terms and conditions which must be implemented.

Project Description

Refers to one of the required elements of a project proposal that all aspects of the planning, designing, construction, operation, ongoing restoration activities, decommissioning, and post-decommissioning phases of a project proposal.

Project Proposal

This definition in the NLCA applies to any physical work that a Proponent proposes to construct, operate, modify, decommission, abandon or otherwise carry out, or a physical activity that a Proponent proposes to undertake or otherwise carry out; such work or activity being within the NSA.

Proponent

In respect of a project proposal, means the person, body or government authority that proposes the project.

Public

Any potentially affected person in potentially affected communities, which includes individual members of an affected community, as well as organized community interest groups.

Public Registry

The place where records are kept, which are accessible to the public. NIRB maintains hardcopies of records in the Cambridge Bay, NU office, and also electronic records on an ftp site (http://ftp.nunavut.ca/nirb/)

Reasonably Foreseeable Future Developments

Those future projects or activities which are currently under regulatory review or will be submitted for regulatory review in the near future, as determined by the existence of a proposed project description, letter of intent, or any regulatory application filed with an Authorizing Agency.

Regulation

Includes an order, regulation, order in council, order prescribing regulations, rule, rule of court, form, tariff of costs or fees, letters patent, commission, warrant proclamation, by-law, resolution or other instrument issued, made or established in the execution of a power conferred by or under the authority of a statute, or by or under the authority of the Governor in Council or Commissioner-in-Executive Council.

Screening

An evaluation of a project proposal conducted to determine if a review is required and, if so, what type of review is required (Part 5 or Part 6).

Scoping

A process that begins early in the environmental assessment, involving all affected parties that pinpoints significant issues warranting study and analysis. An activity which aims to identify those components of the biophysical and social environment which may be impacted by the project and for which there is public and/or professional concern. These components will then become the focus of the ensuing investigations.

Significance

Significance is a consideration of the context of the project and the intensity of adverse effects, by giving particular regard to the following:

a) the environmental sensitivity of the geographic area likely to be affected by the project;
b) the historical, cultural and archeological significance of the geographic area likely to be affected by the project;
c) the extent of the effects of the project, including the geographical area that will be affected, the size of the affected human populations, and the size of the affected wildlife populations and related habitat;
d) the extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit Harvesting activities;
e) the magnitude and complexity of adverse effects;
f) the probability of adverse effects occurring;
g) the frequency and duration of adverse effects;
h) the reversibility or irreversibility of adverse effects;
i) the potential for cumulative adverse effects given past, present and future relevant events; and
j) any other factors NIRB considers relevant to assessing significance.

Socio-Economic Effects

Refers to any of a variety of social and economic effects, including impacts upon the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and local and regional government organizations.

Standing

Refers to a party's right to participate, make a legal claim, or seek judicial enforcement of a duty or right.

Sustainable Development

Development that meets the needs of the present generation without compromising the ability of future generations to meet their needs.

Traditional Knowledge (TK)

A cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission. Specific Inuit Traditional Knowledge is referred to as Inuit Qaujimajatuqangit.

Transboundary Impacts

Environmental effects/impacts which occur across provincial, territorial, or international boundaries.

Translation

Written communication transcribed from one language to another. Translation may include Inuktitut, Inuinnaqtun, other Inuit dialects, Canadian official languages, or any other languages deemed relevant for the purposes of the Board.

Valued Ecosystem Components (VECs)

Those aspects of the environment considered to be of vital importance to a particular region or community, including:

a) Resources that are either legally, politically, publicly or professionally recognized as important, such as parks, land selections, and historical sites.

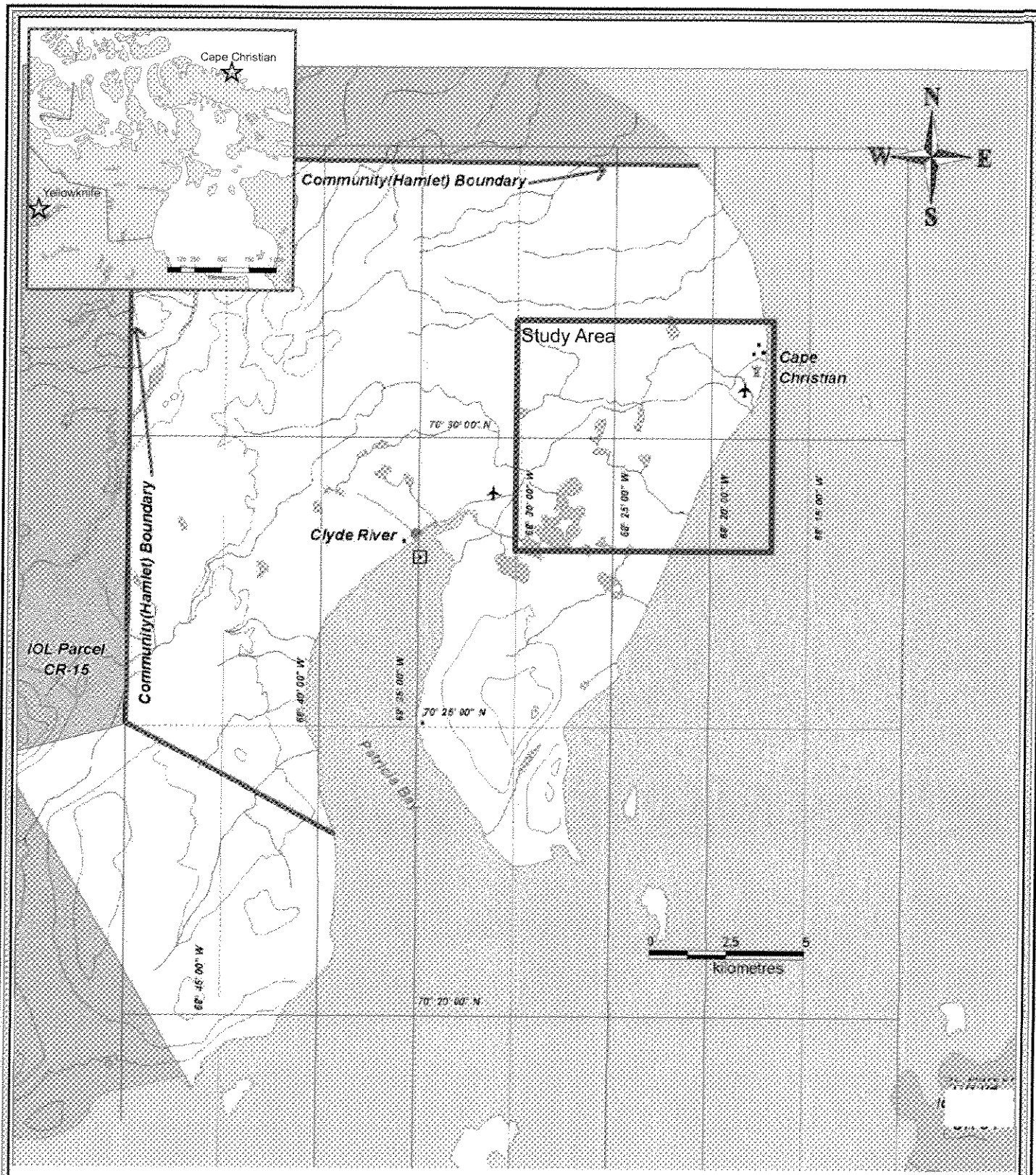
b) Resources that have ecological importance.

c) Resources that have social importance.

Valued Socio-Economic Components (VSECs)

Those aspects of the socio-economic environment considered to be of vital importance to a particular region or community, including components relating to the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and community and local government organizations

Figures



Map Sources/Notes:

Cape Christian image acquired from:

Former U.S Coast Guard LORAN Station, Cape Christian, Nunavut Remediation Action Plan (Figure 2 page 33).

Prepared by: Earth Tech Canada Inc., January 2007.

Inset map data acquired from

Digital Chart of the World at 1:2 million scale

Public Works and Government Services Canada, Western Region

Environmental Assessment of the Remediation of the former U.S Coast Guard LORAN Station

LORAN Station Cape Christian, Nunavut

Gartner Lee

Figure 1
Version 1

Date Revised: March 14, 2007
Date Plotted: March 14, 2007
Revision: 0
File Location: S:\GIS_Proj\Y2007\p70088\mxd\70088_fig1_Clyde_ov_mar2007.mxd

Map Sources/Notes:

Image of Site plan acquired from:
Former U.S Coast Guard LORAN Station, Cape Christian, Nunavut Remediation Action Plan (Figure 2 page 33).

Prepared by: Earth Tech Canada Inc., January 2007.

0 250
Metres

UTM Zone 12N, NAD 83

File Name: 70088_fig2_Clyde_rtv_apr2007.mxd
Reviewed By: AL
Date Issued: April 2007
Prepared By: GS
Project Number: 70088

Public Works and Government Services Canada, Western Region

Environmental Assessment of the Remediation of the former U.S Coast Guard LORAN Station

Site Plan

Gartner Lee

Figure 2
Version 1