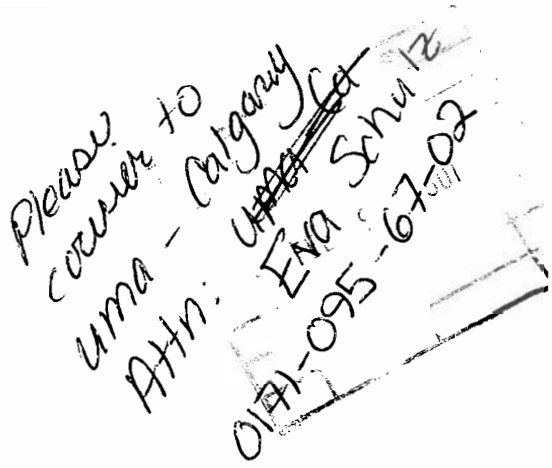
APPENDIX E:

PROJECT DEXCRIPTION FOR NUNAVUT IMPACT REVIEW BOARD CLEAN UP OF FIFTEEN DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA

Defence Construction Canada

Construction de Défense Canada



PROJECT MANAGEMENT OFFICE DEW LINE CLEAN UP

DEFENCE CONSTRUCTION CANADA

PROJECT DESCRIPTION FOR NUNAVUT IMPACT REVIEW BOARD

CLEAN UP OF FIFTEEN DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA

June 1998

Defence Construction Canada | Construction de Défense Canada

0171-095-Law-814 – N.I.R.B.

cc letters only to ~~ASD~~ ~~TMS~~ ~~SMS~~ ~~Purdy~~ ~~Roland~~ ~~NAP~~ ~~EBA~~ ~~SBE~~ for info only

DL PMO – ENV

June 8, 1998

Refer to file number / Mentionner le dossier

Regarding to file

Mr. Larry Pokok Aknavigak
Chair, Nunavut Impact Review Board
PO Box 2379
Cambridge Bay, NT X0E 0C0

Dear Sir:

Please find enclosed, on behalf of the Department of National Defence, ten copies of our submission to the Nunavut Impact Review Board for the decommissioning of fourteen Distant Early Warning (DEW Line) radar sites in the Nunavut Settlement Area. This submission is being forwarded to you, as we are required to apply for land use permits pursuant to the *Territorial Land Use Act* and *Regulations*. I would appreciate if the Board could review this at your next session. Our current planning has the clean up of the first of the fourteen sites, Cambridge Bay, beginning on or about July 1, 1998.

The overall project plan has been the result of several initiatives that have taken place since 1989, including:

- Initial site investigations at all of these sites between 1989 and 1994;
- The development of a baseline protocol for the clean up of these sites designed to preclude the migration of contaminants from the sites into the Arctic food chain and to leave the sites in an environmentally safe condition;
- A comprehensive public consultation program that has been undertaken for the past 6 years in a number of Nunavut communities. This program will continue throughout the implementation phase of the project;
- An extensive environmental assessment program pursuant to the *Environmental Assessment and Review Process Guidelines Order*, which I have included ten copies of the report with this submission. This program examined possible impacts that the clean up itself may have on biophysical, socio-economic and cultural/heritage components of the environment. In those cases where possible impacts were predicted, appropriate mitigation actions were proposed and have been or will be incorporated into site specific Environmental Protection Plans; and
- Most recently, extensive consultation with Nunavut Tunngavik Incorporated (NTI) on the environmental provisions for the clean up. This has resulted in the promulgation of an agreement between the Department of National Defence (DND) and the Inuit, which I have included with this submission. It is important to note that this agreement has not yet been signed by either DND or NTI but this is the version submitted to the Minister of National Defence and 1st Vice President of NTI for approval. We expect that this agreement will be signed in the near future and will inform you as soon as this final step is complete.

Place de Ville, Tower B
112 Kent Street, 17th Floor
Ottawa, Ontario K1A 0K3
Fax: 998-1061

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Canada

We are currently awaiting the delivery of our 1:50,000 scale topographic maps and will forward them to you as soon as they arrive.

I trust that we have provided the information you require in accordance with the Board's current procedures. I remain available to you or the board to clarify any issue related to this submission at any time. If you have any questions, please feel free to telephone me at (613) 998-9524. Alternatively, I may be reached by facsimile at (613) 998-1061 or by e-mail at *dccenv@smtp.gc.ca.*

I wish to thank you and the Board, in advance, for your consideration of our submission.

Yours truly,

Shawn D. Bindon, M.Sc., P.Biol.
Environmental Services Division

Enclosures.

cc. Mr. Art Washuta, P.Eng., UMA Engineering Limited
Dr. Ken Reimer, Royal Military College of Canada
Mr. Tony Downs, P.Eng., Department of National Defence
Annette McRobert, Department of Indian and Northern Affairs

Defence Construction Canada
Construction de Défense Canada

DL PMO – ENV

June 8, 1998

Refer to file number *Mentionner le dossier*

Annette McRobert
Manager, Land Administration
Department of Indian and Northern Affairs
PO Box 1500
Yellowknife, NT X1A 2R3

Dear Annette:

As we discussed during may last trip to Yellowknife, please find enclosed, on behalf of the Department of National Defence, land use permit and quarry applications and supporting documentation for the clean up of fourteen Distant Early Warning (DEW Line) sites in the Nunavut Settlement Area. The first of these sites to undergo clean up, Cambridge Bay, is scheduled to start on or about July 1, 1998.

For your information, we have concurrently provided a submission to the Nunavut Impact Review Board providing the details of this project. I have included a copy of this submission. An environmental assessment of the clean up of these sites has also been completed and enclosed.

I trust that we have provided all of the required documentation required to allow your Department to issue these permits. I remain available to you or your staff to clarify any issue related to these applications. If you have any questions, please feel free to telephone me at (613) 998-9524. Alternatively, I may be reached by facsimile at (613) 998-1061 or by e-mail at *dccenv@smtp.gc.ca*.

Yours truly,

Shawn D. Bindon, M.Sc., P.Biol.
Environmental Services Division

Enclosures.

cc. Mr. Art Washuta, P.Eng., UMA Engineering Limited
Dr. Ken Reimer, Royal Military College of Canada
Mr. Tony Downs, P.Eng., Department of National Defence

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Canada

PROJECT DESCRIPTION FOR NUNAVUT IMPACT REVIEW BOARD
CLEAN UP OF FIFTEEN DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA

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LIST OF ANNEXES

PROJECT DESCRIPTION FOR NUNAVUT IMPACT REVIEW BOARD
CLEAN UP OF FIFTEEN DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA

PART 1 - PROPONENT IDENTIFICATION INFORMATION

Defence Construction Canada
(on behalf of the Director General Environment, Department of National Defence)
Place de Ville, Tower B
112 Kent Street, 17th Floor
Ottawa, ON K1A 0K3

Phone: 613-998-9524
Fax: 613-998-1061

Contact Regarding this Submission: Shawn Bindon, 613-998-9524
DEW Line Clean Up Project Manager: Rob Martel, 613-998-9523
DEW Line Clean Up Contract Manager (Field Supervisor): John Graham, 613-998-9529

Lead Authorising Agencies
List Of Approvals, Permits And Licences Required

The lead agency for this project is the Department of National Defence, represented by the Director General Environment. The management of this project is being provided by Defence Construction Canada. These agencies will be responsible for obtaining permits except in those cases where the clean up contractor is required to do so by legislation.

The types of approvals, permits and licences will vary for each DEW Line site, depending on several factors, including:

- Control of land (i.e. DND versus DIAND; no work is to take place on Inuit owned land);
- Types of materials being transported or stored;
- Location/source of mineral resources (i.e., gravel) that is not located on DND reserves; and
- Proximity of work locations to sensitive environmental components such as migratory bird sanctuaries and fish habitat.

It is anticipated that the permits, licences or approvals listed in Annex A may be required at some or all of the DEW Line sites. In addition, a number of permits or licences may be required by the successful contractor at each site. These permits or licences pertain to the operation and maintenance of the contractors camp or owing to his/her status as an employer. Examples of these permits include those related to the possession of firearms, day to day camp operation and federal/territorial labour codes.

There is no requirement anticipated for either the project management office nor the contractor to obtain the following permits or licences:

- Quarry permits for existing DND gravel sources located within the existing DND reserves;
- Water licences, as existing on-site or commercial sources will be used; and
- Research or archaeological permits, as scientific or archaeological research activities in support of the clean up requiring such permits has been completed.

Legislative Framework affecting the project

During the implementation of the DEW Line Clean Up Project, all applicable environmental laws, regulations and requirements of federal, territorial and other authorities, will be adhered to. The contractors effecting the work will acquire and comply with those permits, approvals and authorisations as may be required. Annex A is a list of those permits that may be required. The Contractor will be subject to and must comply with those permits and approvals obtained on behalf of and by DND to conduct this work. The Contractor, through all project phases, will work in close cooperation with regulatory authorities and DND to ensure compliance.

Federal Regulatory Overview

- The *Canadian Environmental Protection Act* regulates toxic substances from their production or import, to consumption, storage and disposal. Key Regulations associated with this *Act* are the *Chlorobiphenyl Regulations* and the *Storage of PCB Regulations*.

- The *Transportation of Dangerous Goods Act* and *Regulations* promote public safety in the transportation of dangerous goods. The Act applies to all handling, offering for transport and transporting of dangerous goods by any means of transport whether or not the goods originate from or are destined for any place or places in Canada.

- The *Fisheries Act* protects fish and fish habitat from pollution, negative alteration or disturbance, or impediments to fish movement. Fisheries and Oceans Canada will be given the opportunity to review permit applications or restoration plans.

- The *Arctic Waters Pollution Prevention Act* and *Regulations* govern development and shipping activity in Arctic waters adjacent to the mainland and islands of the Canadian Arctic, to ensure the continuing welfare of the residents of the areas, and to protect the ecological balance in water, ice and land areas.

- The *Migratory Birds Convention Act* provides for the protection of designated migratory species, including birds of prey, their habitats, and the regulated harvest of certain species.

- The *Canada Wildlife Act* provides for the involvement of the Government of Canada in cooperative research and management programs involving wildlife species normally the responsibility of provinces or territories. This is particularly relevant to rare and endangered species or species such as caribou which seasonally move across regulatory boundaries.

- The *Canada Shipping Act* regulates shipping activities under the jurisdiction of Canada. Regulations cover technical standards of operation safety and pollution aspects related to shipping activities in Canadian waters.

- The *Constitution Act* is the enabling legislation for the Nunavut Land Claims Agreement. The Nunavut Land Claims Agreement in turn details the terms and conditions for developments and other uses of lands within the Nunavut Settlement Area.

- The *Navigable Waters Protection Act* pertains to the erection of structures or facilities used to enhance or impede navigation in waters under the jurisdiction of Canada.

- The *Territorial Lands Act* provides the authority for administering and protecting lands under the direct control of the Minister of Department of Indian Affairs and Northern Development (DIAND) (Territorial Lands). The following regulations are pursuant to this act:

    - *The Territorial Land Use Regulations* provide regulatory control for maintaining sound environmental practices for any land use activities on Territorial lands. These regulations require that land use permits be issued for such operations as work involving the use of heavy equipment, establishment of camps, use of explosives, and clearing of lines, trails and rights-of-way, including construction of access roads.

    - *The Territorial Quarrying Regulations* establish the fee schedule and procedures for extracting Crown-owned limestone, granite, slate, marble, gypsum, loam, marl, gravel, sand, clay or stone from Territorial Lands. The regulations specify permits, applications, staking and dimensions of quarries.

- The *Northwest Territories Waters Act* and *Regulations* provide for the conservation, development and use of the water resources of the Northwest Territories and for the establishment of a Water Board to license all such water usage and waste disposal activities.

- *Atomic Energy Control Act* and *Regulations* describe the packaging requirements and approvals needed for the transportation of radioactive materials.

- *Explosives Act* and *Regulations* define explosives, the permitting requirements needed to use explosive substances, packaging, handling and transporting requirements, and safety requirements.

- *National Fire Code (NFC)* establishes the standard for fire prevention, fire fighting and life safety in buildings in use, including standards for the conduct of activities causing fire hazards, maintenance of fire safety equipment and egress facilities, standards for fire extinguishers, etc. In addition, the NFC establishes the standard for prevention, containment and fighting of fires originating outside buildings which may present a hazard to a nearby

community and sets the standards for the storage and handling of dangerous goods, flammable liquids and combustible liquids.

Northwest Territories Regulatory Overview

The Territorial Government and DIAND jointly administer the part of the NWT that contains DEW Line sites. The Territorial seat of government and the DIAND regional office are in Yellowknife. DIAND regional offices within the Nunavut Settlement Area are present in Yellowknife and Iqaluit.

In addition to the Federal and Territorial Acts and Regulations above, the clean up of the DEW Line sites in the NWT is also governed by:

- The Explosive Use Act provides controls for surface blasting other than for mining purposes.
- The NWT Wildlife Act provides for the protection of wildlife and wildlife habitats as well as regulated harvest of selected species.
- The NWT Environmental Protection Act provides for protection of the environment from the discharge of contaminants, clean up of contaminants and unsightly premises. In addition, the powers of inspectors as well as offences and penalties are defined. The Act applies only to situations not authorised by other Canadian Acts in the NWT.
- The *Spill Contingency Planning and Reporting Regulation* outline requirements for filing of a contingency plan and for reporting of spills.
- The *Northwest Territories Archaeological Sites Regulations*, pursuant to the *Northwest Territories Act*, protects archaeological sites in the Northwest Territories from disturbance and prohibits the removal of archaeological specimens, except under permit.
- *Occupational Health Regulations* outline the health and safety standards to be maintained at workplaces to ensure the health and safety of persons.

Environmental Guidelines

- *National Guidelines for Decommissioning Industrial Sites* provides the recommended process for undertaking site assessment studies.
- *Guidelines for Effluent Quality and Wastewater Treatment at Federal Establishments* indicate the degree of treatment and effluent quality that will be applicable to all wastewater discharged from existing and proposed Federal installations.
- *National Guidelines for the Landfilling of Hazardous Waste* (CCME Report, April 1991) are to be used by regulators, designers, owners, and operators of hazardous waste facilities. They

cover site selection, design, construction, closure and post-closure care, monitoring, and operation. They are intended for new, not existing facilities.

- *Guidelines for Preparation of Hazardous Material Spill Contingency Plans* identify factors that should be considered in the development of hazardous material spill contingency plans and the information that should be incorporated into a comprehensive contingency plan.

- *Code of Good Practice on Dump Closing or Conversion to Sanitary Landfill (1977)* outlines the guidelines to improve operation and properly close existing dumps. It is intended to promote a consistent approach to the clean up of existing dumps to prevent contamination of water, air and land and to ensure that the best particular control technology is used.

- *Code of Practice for Used Oil Management in Canada* describes environmentally sound options for the handling, storage, collection, transportation, recycling, reuse and disposal of used oils in Canada. It is intended to provide guidance for used oil generators and to regulatory authorities in the formulation of provincial or regional used oil management strategies.

- *Canadian Drinking Water Guidelines* are compiled by CCME for Canadian Drinking Water Quality for specified uses of water likely of concern at contaminated sites.

- *NWT Guidelines for Removal of Materials Containing Friable Asbestos* outline guidelines to be used to remove friable asbestos.

- *NWT Guidelines for Municipal Type Wastewater Discharges* outline requirements for water quality effluent from these facilities.

- *NWT Guidelines for Discharge of Treated Municipal Wastewater* outline requirements for water quality effluent from these facilities.

List Of Previous Environmental Assessments

As a federal proponent, the Department of National Defence is required to conduct an environmental assessment for the clean up of each DEW Line site. As an early planning tool, these assessments were drafted in 1991 by the Department of National Defence under the auspices of the *Environmental Review Process Guidelines Order*. Subsequent changes to overall project planning have been assessed from time to time and the assessment document updated.

A similar environmental assessment was completed in 1996 for the clean up of the six DEW Line sites in the Inuvialuit Settlement Region. Through an ongoing project program of quality assurance and post assessment/implementation monitoring, conclusions and predictions have been validated or modified from the lessons learned in the ISR sites and incorporated into the assessment for the Nunavut sites.

These assessments have been preceded by extensive on-site environmental and engineering investigations completed by the Environmental Sciences Group at Royal Military College and UMA Engineering Limited. The initial investigations, which took place from 1989 to 1994 were used to provide a baseline study of the existing environment (both biological and physical) and ecological pathways and possible transport mechanisms that will exist during the clean up. Detailed socio-economic analysis, including a detailed archaeological survey of the sites, were completed during this time. Since 1996, DND has conducted a series of further site investigations in order to update the original information and to address further data and analysis requirements.

Environmental Assessment Process

The environmental assessment undertaken in support of this project has used a process in which potential environmental impacts have been assessed on Valued Ecosystem Components identified during an initial scoping exercise.

The following sections provide a summary of the activities that were undertaken in conducting this environmental assessment:

Scoping

As a self directed environmental assessment, the initial step taken was to conduct a series of social and ecological scoping exercises designed to:

- Determine the temporal and spatial boundaries of the assessment; and

- Focus the analysis on the environmental issues directly related to the clean up project itself (i.e. identification of Valued Ecosystem Components).

In scoping the project, clean up activities to be assessed were identified. Possible additional activities were examined using the Canadian Environmental Assessment Agency's "Principal Project/Accessory" test, which is used to determine if other activities demonstrate an interdependence, linkage and/or geographical/ecological proximity with the primary clean up.

The assessment scope included a determination of the environmental effects to be assessed and the effects that are to be considered in making decisions regarding the project. The following chart outline the scope of the project and of the assessment:

Scope of the Project: **Project:** Clean Up of 15 DEW Line sites in the Nunavut Settlement Area **EA Trigger:** Funding from Department of National Defence **Scope of the project:** Principal Project: physical clean up of the 15 DEW Line sites within the Nunavut Settlement Area. Accessory physical works: Transportation of waste (including hazardous) materials, debris disposal, mobilisation and demobilisation of contractors equipment and personnel Other undertakings in relation to the physical work: None.
Scope of the Assessment: **Project:** Clean Up of 15 DEW Line sites in the Nunavut Settlement Area **EA Trigger:** Funding from Department of National Defence **Scope of the assessment:** The environmental assessment is to consider the effects of all project related activities (i.e. those related to the clean up of the site) and associated physical works on both biophysical (terrestrial, aquatic) and socio-economic assessment factors.

As a result of scoping, the following factors were identified for assessment:

- The need to evaluate environmental effects of the project, including those relating to cumulative effects that are likely to result from carrying out this project.
- Project undertakings performed in conjunction with other off site projects/activities that have been or will be carried out.
- The relative levels of significance.
- Public comments.
- Mitigation measures deemed to be technically and economically feasible.

Interested parties were identified and consulted during the assessment process including:

- 'Expert' federal departments (Environment Canada, GNWT Natural Resources, GNWT Health, DIAND);
- 'Other' federal departments (DND, Defence Construction Canada, Parks Canada);
- Aboriginal organisations (Nunavut Tunngavik Incorporated, Nunavut Planning Commission); and

- The community leadership of the various eastern Arctic hamlets and the general public.

Assessment of Environmental Effects

The initial step following the scoping exercise was to undertake a determination of the possible environmental effects of the project. This assessment involves providing a detailed overview of the project, a description of the existing environment (including inventories and ecological processes) and, finally, the identification of project-environment interactions.

The aim of describing the project was to clearly outline the constituent components and activities that were to occur on each of the DEW Line sites. Activities include mobilisation, project layout and design, plans and scheduling, specifics related to each of the activities (i.e., how would contaminated soil be identified, excavated, transported and disposed of), operating procedures, control procedures and demobilisation plans. Detailed data concerning each of the activities (i.e., material volumes) was included with this description.

During the scientific studies described above, the site teams collected all relevant information concerning the existing environment components of the study area. This information included a description of the physical, biological and social characteristics of the study area.

Using the information that was obtained on the project and the existing environmental setting, the assessment study determined interactive links between these two components. Particular concern was focused on the location, sensitivity, seasonal presence and abundance of these components. In general, these interactions were shown using a matrix table which are shown in the environmental assessment reports that accompany this submission.

Also included in the assessment of environmental effects were possible impacts relating to socio-economic factors (heritage, culture, archaeological, employment and business opportunities), land use and human health.

During the assessment stage, conclusions were made as to the type of impact (i.e. level of adversity) and its level of significance, based on comments received during public consultation sessions.

Identification of mitigation options

The third stage of the assessment process was to undertake the identification of mitigation measures that would result in a reduction or elimination of likely environmental effects associated with the clean up of each of the sites. In the case of this project, all potential adverse effects were addressed and not simply those deemed to be significantly adverse, the minimum required by assessment legislation. Mitigative actions now form part of the overall project design and planning documentation, which resulted in the Environmental Protection Plan. The requirement for on-site personnel to adhere to these mitigative measures is contractual in nature as the Environmental Protection Plan forms part of the clean up contract.

PART 2 - PROJECT IDENTIFICATION INFORMATION

Project Title

DEW Line Clean Up in the Nunavut Settlement Area

Type of Activity

Construction activities in support of the environmental clean up of 15 DND DEW Line sites in the Nunavut Settlement Area.

Summary of Operation

Scope

The physical and environmental restoration of the DEW sites requires the removal of structures and debris including hazardous material such as batteries, waste oils, asbestos and inorganic elements (principally copper, lead, and zinc) and polychlorinated biphenyls (PCBs). An environmental monitoring program will also be undertaken following the clean up activities.

Background

From 1955 to 1993, the Distant Early Warning System - the DEW Line - provided radar surveillance of the northern approaches to the North American continent. This now inactive chain of radar stations, at approximately 70 degrees latitude, stretches several thousand kilometres across the breadth of the Arctic. The DEW Line originally consisted, in Canada, of 42 sites but was reduced to half this number in 1963. The 21 sites (6 in the Inuvialuit Settlement Region and 15 in the Nunavut Settlement Area), which were decommissioned in the 1960's, are now the responsibility of the Department of Indian Affairs and Northern Development (DIAND).

In March 1985, Canada and the United States agreed to modernise the North American Air Defence System by closing the remaining 21 DND DEW sites and building the North Warning System (NWS). The DEW Line Clean Up (DLCU) focuses on closing out the former DEW Line sites, including the remediation of chemically contaminated soils, the stabilisation of landfill areas and the demolition/burial of surplus infrastructure and debris.

In 1996, the clean up of the FOX-4 Cape Hooper site was the first Nunavut based site to be started and is expected to be completed in the summer of 1998.

Rationale for the project and primary goals

The process of biomagnification, which is defined as positively sloped variation in concentrations through increasingly higher tropic levels of the food chain, is a well-documented phenomenon. The process of biomagnification is a particularly important phenomenon in Arctic

organisms, where, as a result of their dependency on a high fat content in their diets, are extremely sensitive to contamination inputs, especially chlorinated contaminants such as PCBs. In some cases, top carnivore levels of the Arctic food chain (i.e. Polar Bears) may experience a contaminant (i.e. PCB) biomagnification factor in excess of 3×10^9 times when compared to the first order (primary) source of these contaminants, namely sediment and adjacent waters.

The aim of the DEW Line Clean Up Project is to decommission those facilities used by the former DEW Line which have been declared surplus to the requirements of the new North Warning System and to restore the sites to an environmentally safe condition. Environmental restoration includes the setting of remediation objectives that are designed to preclude the continued migration of contamination (and hence biomagnification) into the Arctic ecosystem/food chain. To accomplish this, remediation will include:

- The excavation of soils in cases where parameters exceed those that have been set for the project (i.e. believed to cause significant input into the lower levels of the food chain, for example, higher plants and detritus); and

- The remediation of landfills which may serve as a source of water contamination and may enter the lower levels of the marine food chain (i.e. algae).

Given the fragile nature of the highly sensitive Arctic ecosystems, it is important that past anthropogenic activities, such as the operation of the DEW Line, not causes any significantly adverse affects on any one of the trophic levels of the Arctic food chain. The limited availability of species at any given trophic level leaves little opportunity for another species to negate the effects of the loss of another. In addition, negative biological effects (i.e. plant loss) may lead to physical disturbances, such as damage to permafrost.

In anticipation of the close out of the existing DEW Line system, DND sponsored a five year environmental and engineering study of the 15 DND DEW Line sites in Nunavut. The purpose of this study was to ascertain the baseline condition and to propose realistic clean up objectives and strategies. The protection of the food chain from DEW Line contaminants was established as the aim of the clean up. These studies confirmed that physical restoration would involve considerable quantities of materials, including limited quantities of hazardous materials such as waste oil, batteries and asbestos. Conclusions reached by independent analyses indicated that inorganic elements (principally copper, lead and zinc) and polychlorinated biphenyls (PCB's) pose the greatest threat to the biophysical environment.

Project Location

The location of each DEW Line site in the Nunavut Settlement Area is shown in Annex B and listed in Annex C. There is no requirement to select alternative sites. There is no special land status that has been designated for this site.

Enclosed with this submission are the 1:50000 NTS topographical maps for each site.

Project Components and Alternatives

Evaluation of Alternatives to the Project

The capability deficiency that has been identified is that DEW Line facilities at these locations no longer required by the Department of National Defence. These facilities therefore pose both a safety hazard and a potential long term source of contaminant input to the sensitive Arctic environment and, as such, must undergo a clean up process that will preclude further input into the environment, in general, and, specifically, the food chain.

As a project strictly dedicated to the clean up of these military establishments, the range of *alternatives to* this project are limited in nature. Two alternatives to the clean up of these sites that can be identified have been rejected or implemented in a limited fashion based on either military operational requirements and/or environmental reasons. These two alternatives were as follows:

Commercial or other Government use of the facilities. This alternative involves the sale of those facilities no longer required by the Department of National Defence to commercial interests. Two possibilities are present, namely on-site commercial development or sale of these capital assets themselves and movement off-site. The federal government, as facility managers, and continuing operational requirements of the se sites (i.e. most sites remain part of the North Warning System) preclude the on-site option from being followed. The Department of National Defence has, however, put up all facilities that can be safely reused up for sale through the federal Crown Assets Disposal Corporation. The transactions of those facilities sold to local or regional interests and subsequent removal off-site have been completed.

No clean up action (*Null alternative*). The second alternative involved examining the environmental impact of maintaining the *status quo* at the sites. It was quickly realised that failure to address the environmental problems identified during the site investigations could lead to the following:

- Placing the Arctic environment/food chain at risk;
- Possible future legal liabilities for the federal government; and
- Greater clean up costs in the future.

Description of Planning, Designing, Operation, decommissioning and post-decommissioning phases of the project

As discussed in the section immediately above, DND initiated this project with a number of scientific and engineering investigations to examine the current baseline conditions of the site. The objectives of these studies were as follows:

- to identify the nature and extent of chemical contamination at the sites;
- to determine the possible impact of these contaminants on the Arctic ecosystem in general and the food chain in particular; and
- to develop practical environmental clean up strategies appropriate for the Arctic.

The results of these two studies resulted in the identification of the baseline conditions, principal contaminants and possible impact pathways/effects hypotheses. As a result of these studies, DND has acquired a detailed physical and chemical inventory of all of the DEW Line sites and, in fact, the largest Arctic contaminant database available.

During the radar upgrade program in the early 1990's, a Canadian consultant consortium was initially contracted to carry out an initial environmental clean up study of the DEW Line sites in Canada. The objectives set for this study were to identify and investigate areas impacted by past waste disposal practices and spills. Additionally, the study determined and evaluated remedial action alternatives for these waste disposal and spill areas and for debris arising from the demolition of excess facilities.

This initial study was carried out in accordance with the Canadian Council of Ministers of the Environment's *National Guidelines for Decommissioning Industrial Sites* which uses a six phase approach:

Phase I	Site information assessment
Phase II	Reconnaissance testing program
Phase III	Detailed testing program
Phase IV	Preparation of decommissioning and clean up plans
Phase V	Implementation of decommissioning and clean up plans
Phase VI	Confirmatory sampling and completion reporting

The scope of this initial study was to conduct a screening using Phases I to III and a recommendation of the decommissioning alternatives for Phase IV. Phases V and VI are in the process of being implemented.

The objective of the Phase I review was to familiarise the study team with past site operations and practices. In particular, the review was used to identify the types of chemicals commonly used on the sites, possible spill locations and waste disposal methodologies and locations.

During Phase I a review of the available documentation pertaining to each site was undertaken. Included in these documents were asbestos, PCB, and hazardous materials inventories for each of the sites as well as spill reports and retrograde histories for hazardous wastes. Subsequent to this initial record search, the study team undertook a literature search with the goal of providing background information on the environmental setting within each particular ecoclimatic region. The scope of this environmental overview included descriptions of the physiography, geology, hydrology, vegetation, wildlife, fisheries and marine mammals, heritage resources and land use. In addition, an initial examination and evaluation into available clean up technologies and methodologies were carried out. The final part of this review included an overview of the then present Canadian Federal and Provincial clean up standards, criteria, guidelines and regulatory framework.

The following outlines the results of this initial study:

- Hazardous materials (as defined by the Canadian *Transportation of Dangerous Goods Act*) that were identified on the sites included Class 1 (explosives), Class 2 (compressed gas cylinders), Class 3 (flammable liquids), Class 5 (oxidizing substances), Class 6 (poisonous and infectious substances), and Class 8 (corrosives).

- Various materials were identified that are not classified as hazardous but may be considered as a cause for concern includes diesel, grease, oil, lubricants, and hydraulic fluids.

- There was very little information available on fuel spills at each of the sites.

- A detailed survey of the biophysical environment (i.e. climate, geology, hydrology, flora and fauna survey, heritage resources, and land use) was obtained.

Phases II and III were combined into a field investigation program in accordance with the *Guidelines* referenced above. Field and laboratory work was carried out by the study team to:

- Collect and analyse soil, water, cooling oil, asbestos and paint samples;

- To determine site specific environmental parameters for a baseline risk assessment;

- To note sites of historical and archaeological significance; and

- To locate and determine the extent of contamination associated with landfills.

The results of the Phase II/III study are summarised below:

- Facilities overview: The design of the structures (including buildings and miscellaneous towers) for each of the 15 sites is essentially the same. Facility layout, however, is site specific. All sites were constructed on granular pads over the natural ground. All site activity centred around the main building, referred to as the 'modular train', which housed the majority of activities, including radar and communications operations, offices, workshops,

power generation, and accommodation of personnel. Other facilities included vehicle and equipment maintenance/storage areas, petroleum facilities, communication dishes and ancillary facilities (i.e. storage, weather stations, etc). Each site also had an airstrip and, in some cases, a hangar. The types and quantities of facilities being demolished as part of this project varies for each site as there are varying requirements for these facilities as part of the new North Warning System.

- Asbestos surveys found that asbestos was located at all 15 sites in sheet and pipe forms. Analysis found that the typical samples were chrysolite.

- Paint samples identified several heavy metals (lead was of greatest concern) and PCB's.

- PCB's were also found in a variety of equipment, including communications and lighting equipment.

- Analytical results from laboratory testing were reviewed and compared with applicable soil and drinking water guidelines as well as background values from both literature and off site samples. Analysis was carried out in two stages. In most cases, a first round of samples was analysed for a full suite of compounds. The results of the first round were reviewed and, in sample locations where the results exceeded the guidelines, a second round of down gradient (or below) samples were taken. Contaminants that were analysed include inorganic (i.e. metals) and organic (i.e. PCB's) compounds.

- Landfills were assessed for contents and leachate potential. Landfills were found to contain a variety of materials and, in some cases, are the source of contaminated leachate. In addition, many open dump sites were found at each location. These dumps contained scrap metals (i.e. barrels), wire, and paper remains. In some cases, old equipment was found around the site. The majority of waste materials were, however, either located within landfills or in pallet lines awaiting disposal.

At the same time as this initial study, the Canadian Department of National Defence conducted a second, parallel study of the sites. In 1989/90, an environmental study of ten of the 21 sites provided a detailed physical and chemical inventory of the stations and considered the impact of chemical contaminants on the Arctic ecosystem. This first part also presented a basis for the general approach to the clean up of the DEW Line, as well as specific clean up recommendations for each station. This was followed up, in 1992, by an assessment program, including the provision of recommendations for clean up, for the remaining eleven sites. In conjunction with these studies, an overview document discussing the environmental impact of the DEW Line on the Arctic. This report proposed the major migration pathways by which chemical contamination from these sites was distributed throughout the Arctic ecosystem.

In conjunction with the station assessments, several Canadian government departments conducted two studies in 1993/1994 designed to assess the impact of the historically common practice of disposing debris into the ocean through the ice. The first study, which took place in

the waters of Cambridge Bay and the second study, which took place along the east coast of Baffin Island, included assessing the marine environment adjacent to three DEW Line sites, including the Cambridge Bay site. The first of these ocean disposal studies concluded that there was a large variety and amount of debris on the ocean floor but that there were no significant chemical effects arising from its presence (i.e. it was concluded that PCB contamination emanated from anthropogenic sources near the study site and not the ocean disposed equipment). The second historic ocean disposal study reported that very little debris in each of the study areas were present and that there is no evidence that historic ocean disposal activities have contributed to contamination of the near shore marine environment.

Given the small amount of historical data on contaminant disposal for the study teams for both studies, this second scientific study of the DEW Line sites sampled all areas of the sites and analysed for a wide suite of contaminants. During the initial stages of this study, patterns of waste disposal common to all of the sites became evident. This was supported by the following observations:

- Debris in varying quantities were found scattered over the sites and often included hazardous materials (i.e. batteries, waste oils, and asbestos);

- The contents of some landfills were exposed, the result of erosion and spring runoff;

- Fuel handling and storage facilities were often the sites of spills. In addition, contamination was consistently found at less obvious locations (i.e. PCBs that were found in older household products which were believed to have been dumped outside buildings or down drains);

- Chemical analyses showed the following patterns of contaminant dispersal:

  (1) PCBs and inorganic elements such as copper, lead and zinc were found to be the contaminants of primary concern in soil and water. Pesticides, polyaromatic hydrocarbons, phthalates and chlorinated compounds were either absent or in low concentrations,

  (2) Inorganic element contamination was, in general, confined to outfalls and landfills, and in the case of lead, to fuel spills,

  (3) PCBs were present in elevated levels around outfalls and, to a lesser degree, in landfills and stained areas near pallet lines and buildings,

  (4) Leachate waters and soils collected at the base of some landfills contained detectable concentrations of contaminants, indicating a more concentrated source within the landfill, and

(5) The remaining contamination appeared to be restricted to isolated spills within the station area.

Future sampling was based on the knowledge gained from the initial sampling and the distribution parameters discussed above.

Evidence was found at many of these sites that showed the migration of contaminants (primarily copper, lead, zinc and PCBs) along adjacent water systems or, in the case of PCBs, by aerial transport. Point sources for such migration were identified for remediation action.

While the DEW Line sites were operational, barrels (i.e. 45/55 gallon drums) were used extensively to transport petroleum products. As a result, some sites have up to several thousand barrels remaining, many of which were simply discarded onto the surrounding landscape. In most cases these barrels are empty but some contain unidentified residues. In addition, initial studies indicate that barrels are buried in landfills. The status of these barrels is unknown but information can be extrapolated from the analytical results of the surface barrels (i.e. types of contaminants, etc). Random sampling of barrels at the stations showed the following:

- Most of the discarded barrels were empty but some contain waste oil, water, or remnants of the original contents (or a combination of these three);
- A small proportion of the barrels contain glycols, fuel and lubricants, waste oils or PCBs; and
- In most cases barrel contents can be incinerated on-site, but some contain substances (i.e. cadmium, chromium, lead, chlorine and/or PCBs) in excess of regulations and, as such, must be disposed of in southern disposal facilities.

The results that were obtained from both DEW Line Clean Up scientific assessment studies were subsequently reviewed using an impact, or risk, assessment philosophy. The mere presence, or input, of a chemical contaminant is not alone cause for concern; an impact on the ecosystem must be assessed. Chemical contaminants are considered to have an adverse effect on the environment if a negative impact can be demonstrated (i.e. levels of chemical contamination that may affect reproductive success). Specifically, an adverse effect was defined as the significant introduction of a chemical contaminant into the terrestrial or marine food chains. The initial part of the risk assessment evaluated contaminant persistence and mobility and determined the circumstances under which they would be a potential threat to the environment.

As part of the ecological risk assessment process, both terrestrial and marine impacts were examined. In examining terrestrial impact, the study team used plants (a primary food source in the Arctic ecosystem) as an indicator to determine to what extent contaminants had entered the food chain. As a result of these studies, the study team was able to determine the maximum concentration of contaminants that could be present in soils without posing a significant effect on higher levels of the food chain. This evaluation was a key assessment factor in determining the Arctic soil remediation criteria for contaminants found on the DEW Line sites. In determining

marine impact, the results of a historic ocean disposal studies concluded that evidence for biomagnification of PCBs in bottom dwelling marine organisms, which act as food sources for larger organisms such as birds and marine mammals, suggest that low level inputs have a significant impact on the ecosystem. As a result of this conclusion, it was determined that it is important that contaminants be prevented from entering the ocean, even at low concentrations. As such, contaminant flow must be contained at the source. Furthermore, assessment of the underwater debris found during this study concluded that, despite the extensive nature of the debris, chemical contamination was insignificant when compared to shoreline runoff and, as such, clean up actions should be restricted to the land and foreshore areas and not deep waters unless there is evidence to the contrary.

As a result of these studies, three reports were completed which presented the conclusions that arose from these investigations along with practical recommendations for remediation strategies appropriate to the Arctic. Supporting information was provided through other reports, including a specific study on archaeological resources. These reports were supplied to a number of libraries throughout Canada (including a number throughout the Northwest Territories).

Environmental Working Group

In 1997, the Department of National Defence and Nunavut Tunngavik Incorporated (NTI) agreed to form an **Environmental Working Group** (EWG). The EWG is comprised of scientific and technical experts representing both the Inuit (NTI) and DND. The purpose of the EWG is to examine environmental issues related to the DEW Line Clean Up project and to provide recommendations to a joint DND/NTI core group consisting of senior management from both organisations. Specific tasks that have been assigned to the EWG included:

- Development of a landfill risk evaluation matrix;
- Evaluation of, and recommendations for, a post-construction/remediation landfill monitoring program;
- Identification of hydrocarbon clean up requirements;
- Establishment of confirmatory testing protocols; and
- Preparation of a list of items suitable for landfilling at the DEW Line sites.

Pre-clean up Activities

Prior to the clean up of each site, the Department of National Defence undertakes a final site assessment. The aim of these site visits is several-fold, including:

- To fully delineate the extent of contaminated areas in order to prepare accurate construction drawings;

- To confirm the structural and environmental status for buildings and other facilities that are to be demolished;

- To re-confirm the baseline environment of the site prior to implementation; and

- To examine landfills, where required, to confirm details pertaining to the remediation of these areas.

PCB's in Paint

During the final site investigations conducted in 1996 at Tuktoyaktuk and Cape Parry, the DND investigation team discovered that the paint on many of the buildings contained PCBs in excess of 50 ppm. Materials containing such concentrations of PCBs are currently regulated under the *Canadian Environmental Protection Act*. Painted materials containing PCB levels higher than 50 ppm constitute a PCB solid waste and must be disposed of in accordance with the existing legislation. It is not permissible under Canadian law to landfill solid PCB waste.

The PCBs in the paint is chemically bound in the paint itself and, in tests conducted to date by scientists at the Royal Military College of Canada and the University of British Columbia, there is evidence that PCBs do not leach out of the paint to escape into the environment. If PCBs do not leach out, it is probable that there would be no risk to the environment or to public health and safety, if these waste construction materials are isolated in a suitably engineered and monitored landfill.

Further study has revealed that PCBs in paint are common throughout the world, including Canada. DND has therefore requested that Environment Canada review these scientific studies and consider revising the regulatory definition of a PCB solid in order to permit the landfilling of construction debris that contains PCB paint. Environment Canada is examining the issue and will make a decision in due course. In June, 1998, there will be a scientific and technical conference on this issue. The NTI, on behalf of the Inuit, are being kept up to date on developments related to this issue.

Until a decision on the PCB in paint issue is rendered, construction materials containing PCBs in excess of 50 ppm will not be landfilled. At some sites, the material may be containerised and stored in accordance with the *PCB Waste Storage Regulations*.

Inclusion of Traditional Knowledge

One of the guiding principles of the DEW Line Clean Up project is to ensure the meaningful participation of local residents in both the planning and execution phases. One way of ensuring this is to incorporate traditional knowledge into site specific planning. Traditional and local knowledge is being collected as part of the site-specific pre-construction phase (described immediately above) of the project. An Inuit representative who is familiar with both the DEW

Line site and traditional use of the area will be chosen by the relevant Regional Inuit Association to be on-site during the pre-construction delineation phase of each clean up. The Inuit representative will work closely with the EWG to identify Inuit use of the area, wildlife patterns and past activities and occurrences that may have impacted on landfills (i.e., dumping, hazardous waste storage, natural occurrences). This information will be used in order to assist in the scoring of the landfill matrix (the scoring methodology is described in the EWG reports included with this submission).

Additionally, DND and the NTI will attempt to establish a community DEW Line Clean Up committee which will facilitate the flow of local knowledge to the EWG prior to and during each site visit. To effect this, the EWG will visit local communities most affected by each DEW Line site and conduct one on one interviews with a number of residents, the Hamlet Administrative Officer and/or Mayor, the local HTA and other relevant community organizations.

Project Design - Development of the DEW Line Clean Up Criteria and Protocol and DND/NTI Agreement on the Environmental Provisions for the project

The purpose of the DEW Line Clean Up project is to:

- Demolish and remove existing facilities that are not required for the operation of the North Warning System;
- Remove contaminated soils from the sensitive Arctic food chain;
- Clean up surface debris; and
- Physically restore the unused portion of the site to as natural a state as possible.

In cooperation with several federal departments (Environment Canada, Fisheries and Oceans, Indian and Northern Affairs) and the Government of the Northwest Territories (Renewable Resources and Health departments), DND initially drafted the *General Protocol for DEW Line Clean Up*. This protocol served as the basis for the DND/NTI Agreement on environmental provisions for the clean up of these sites (Annex D). As there are no established standards for the Arctic, existing federal guidelines, such as the Interim Canadian Environmental Quality Criteria for Contaminated Sites, have been modified to account for the unique northern environment. These adjustments to existing guidelines reflect both the sensitivity of the Arctic food chain to ecological processes such as biomagnification and the close dependence of the Inuit on the land for food. In addition, a secondary, barrel specific, protocol has been promulgated. The barrel protocol outlines the process for dealing with barrels and barrel contents found on the DEW Line sites.

The protocol outlined in the DND/NTI Agreement (Annex D), was developed from the conclusions and recommendations resulting from the biophysical, socio-economic, and engineering site assessments (mediated through the DND/NTI EWG). The end result of the

protocol development process is the documenting of contaminant clean up criteria and specific physical actions that are to be undertaken, if required at a particular site. These criteria have been developed based on existing federal and provincial criteria in conjunction with studies that show the functional relationships and/or pathways for biological uptake from soil. The resulting protocol defines two concentration tiers of soil contamination (see Appendix E of Annex D). Soil substrates containing Tier I concentrations may be placed in appropriate on-site landfills while those soils in excess of the Tier II standard are to be disposed of in a manner that provides additional measures to permanently segregate these contaminants from the Arctic ecosystem. Soils exceeding federal legislative limits (i.e., *Canadian Environmental Protection Act* and *Chlorobiphenyl Regulations*) will be disposed of off-site at a licensed disposal or destruction facility. On-site containment measures are discussed below.

Project Design – Engineering

The elements of the engineering design are directly related to specific clean up requirements as established by the DND/NTI Agreement.

Visible debris in the vicinity of each station will be removed and sorted. Non-hazardous debris will be placed in an on-site engineered landfill. Hazardous materials will be removed from the site and disposed of at a licensed hazardous material disposal facility. All facilities at the site which are not required for the operation of the North Warning System will be wither sold (where building conditions permit and if a suitable buyer can be identified) demolished and placed on-site in suitable landfills (in accordance with the limitations placed by federal legislation). Portions of the previously disturbed areas of the site will also be recontoured to establish natural drainage patterns.

Specific activities for the 15 DEW Line sites include the following:

Landfill Development

- Landfills will be developed at this site to accommodate non-hazardous site and demolition debris. Where available, existing landfills are to be used.

Landfill Closure

- Closure of all former DEW Line landfills not being used by the North Warning System will be in accordance with Section 6.0 and Appendix B of the DND/NTI Agreement (Annex D).

Disposal of Site Debris

- All visible debris will be collected and sorted. Non-hazardous debris will be placed in an engineered landfill on-site provided a suitable location and sufficient borrow materials can be found. Materials suitable for landfill have been examined by the EWG and are shown in the

DND/NTI Agreement. This listing is summarised in Appendix C of Annex D. Hazardous debris will be shipped disposed of in accordance with federal legislation.

- All debris which is attributable to the operation of each DEW Line site and is within two metres of the surface at low tide or within tow meters of the surface on an inland water body will be removed by DND.

- Where there is reasonable evidence of additional off site contamination and/or debris which is solely attributable to the operation of the DEW site, DND will undertake testing to determine the extent of contamination in consultation with the NTI and remediate the site in accordance with the DND/NTI Agreement.

Disposition of Contaminated Soils

- Soils containing DCC-I and DCC-II contamination are present at all DEW Line sites within the Nunavut Settlement Area. They will be disposed of in accordance with the DND/NTI Agreement.

Removal of Hazardous Materials

- Materials identified in the DND/NTI Agreement as not suitable for landfill **or** are otherwise designated as hazardous (see Appendix C of Annex D of this submission) are to be disposed of in an appropriate (licensed if required) disposal facility off-site.

Demolition of Facilities

- All structures not required for the operation of the North Warning System are to be demolished and /or removed to the top of their concrete foundations, sorted into non-hazardous and hazardous components and treated as described in subsections above (Disposal of Site Debris and Removal of Hazardous Materials).

- Prior to demolition, DND will attempt to sell or otherwise transfer ownership of certain facilities through the Crown Assets Disposal Corporation (CADC). These transactions will occur in accordance with existing legislation or CADC policies governing these activities. Normally, other federal government departments, followed by territorial and municipal governments are offered these facilities before they are put up for sale to private individuals or organisations.

Transportation of Hazardous Materials Off Site

- Hazardous materials are to be removed by air or sealift in compliance with the *Transportation of Dangerous Goods Act* and the *Transportation of Dangerous Goods Regulations*. These materials may be temporarily stored in order to transport them in

conjunction with other material. Storage will meet the requirements of applicable legislation, such as the *Storage of PCB Materials Regulation*.

General Site Grading

- The purpose of site grading is to restore the natural landscape of areas that have been disturbed as a result of either previous DEW Line operations or the clean up itself. Site grading will serve to restore the natural contours of the area in order to re-establish driainage.
- Areas to be graded include:
  - Landfills that are to be closed.
  - All areas disturbed by demolition activities.
  - Debris and contaminated soil excavation areas.
  - Borrow areas for granular material.
  - Locations disturbed by the contractor during on-site operations.

Development of Borrow Sources

- Existing on-site gravel sources are to be used where sufficient gravel of the proper quality is available. Otherwise, off-site or commercial sources will be used. Where required, the project will obtain appropriate land use and/or quarrying permits in order to use off site sources.

Contractor Support Activities

- Beach landing areas, roads and existing airstrips/airports will be used for equipment and personnel transport, as well as on-site movement between work areas.
- Potential equipment storage areas are to be shown on the contract drawings, accounting for sensitive biophysical, social and/or cultural sensitivities.
- All labour and equipment will be demobilised from the site following the termination of the project.
- Potential construction camp areas are shown on the site plans included with this submission (Annex D).

Decommissioning Activities

Site decommissioning activities will involve the demobilisation of all contractor equipment, camp infrastructure (if used) and materials no longer required at the site. The requirement for the contractor to undertake these decommissioning activities will be a contractual obligation written into the project specifications.

Timetable of Activities

The expected timetable for effecting the clean up, is provided for in the DND/NTI Agreement (Appendix A of Annex D).

It is expected that the clean up of this site will occur during the summer construction period (June - October) each year. Decommissioning of the clean up camp/crew/etc., is expected to occur in the second half of the last construction season.

Off site activities

Off site activities in support of this project will be in the form of transportation (sea and air) associated with the transport of materials, equipment and personnel to the site. These two activities are described below:

- Air transport - most transportation by air is expected to utilise existing commercial and charter services in and out of each site . Depending on the contractor's schedule, minimal use of chartered aircraft will occur at remote sites (i.e., one flight per week using Twin Otter). No rotary wing flying activity directly to the site by the clean up contractor is anticipated.

- Sealift transport - it is anticipated that contractors will utilise sea lift support to transport bulk materials and equipment (vehicles, heavy equipment, etc) to the sealift beach. This would potentially result in the increase in sealift traffic by one or two sailings per year (one early and one late summer), only if a specific, dedicated trip is made for DEW Line Clean Up purposes. Otherwise, no additional vessel traffic is anticipated.

Number of personnel on-site

The total anticipated number of personnel on-site will vary with the size and scope of the clean up. The estimated average number of personnel on-site is 40 personnel. At times these numbers may be increased owing to existing North Warning System requirements.

New technology and methods to be utilised

Development of Tier II Soil Disposal Facilities

Based on engineering field surveys conducted at the sites in 1992 and 1993, it became apparent that a potentially large volume of Tier II contaminated soil (estimated at 30,000 m^3) would require segregation in a manner which precludes their continued contact with (and thereby

protecting) the Arctic ecosystem. A number of disposal options/technologies were considered by the DEW Line Cleanup Project team; of these, the most environmentally and economically viable was determined to be the development of engineered Tier II soil disposal facilities at specific sites. These facilities utilise a double containment system, consisting of permafrost and synthetic liners which limit leachate generation and prevent contaminant migration.

The Tier II soil disposal facilities are designed to provide a contained facility for the disposal of Tier II contaminated soil. One of the major concerns with respect to the facilities is the possible leakage of contaminants from soils placed in the facility and the potential impact on the surrounding ecosystem and nearby communities. The double containment system developed for the Tier II soil disposal facilities is designed to prevent contents from leaking and migrating into the surrounding environment. The design has been based on the characterisation of the contaminants in the soils and the geothermal properties of the permafrost. Permafrost will provide the primary containment barrier in which the frozen substrate will advance (freeze-back) and encapsulate the contents in the facility. Extensive geothermal analysis on the time required for freeze-back, thermal regime in the ground surrounding the facilities and the depth of the active layer in the cover material, has been used to determine the thickness of both the cover and base as well as the time required to provide adequate permafrost encapsulation. Synthetic liners provide secondary containment. A PVC (polyvinyl chloride) liner will be placed at the base and side slopes of the facility; this liner is chemically compatible with the contaminated soils (i.e. not adversely affected by exposure to hydrocarbons), and will prevent the potential movement of moisture during the period required for permafrost aggradation. The second liner, a geocomposite clay liner (GCL), is to be installed in the cover of the facility, which will prevent drainage from percolating down through the cover fill which might otherwise impact the time required for permafrost freeze-back. The geocomposite clay liner provides the required flexibility for accommodating settlement or disturbance. The GCL consists of a sandwiched composite of geotextiles and bentonite clay.

Careful consideration has also been given to the characterization of waste soils being placed in the Tier II soil disposal facilities. Contaminated soils, which contain levels of contaminants in violation of the *Canadian Environmental Protection Act* (CEPA) and associated regulations, are considered hazardous material and will not be placed in the Tier II soil disposal facilities. These materials are to be removed from the site to a licensed disposal facility along with other hazardous wastes. Some of the soils may also contain petroleum hydrocarbons - often where lead and PCB contamination have occurred as a result of waste oil and/or fuel spills. These hydrocarbons will be contained within the soil matrix and will not exist as free liquids which could potentially leach. Leachate testing has also been conducted on most of the more highly contaminated soil samples as set forth in *Ontario Regulation 347*.

Another environmental concern during the development of these facilities is the possible requirement of explosives for use in some excavation activities. In addition to the obvious danger to human health, other possible impacts could include damage to surrounding areas (including waterbodies, environmentally sensitive areas and hazardous material storage facilities) from shock waves and blasting scatter, and the disturbance of nearby wildlife by sudden peak noise

levels. Blasting, where required, will be conducted by authorised personnel in accordance with all required permits, licenses and applicable laws and regulations, and as dictated by regulatory authorities.

Selection of the areas for Tier II soil disposal facility development is based on a number of technical factors including:

- Topography, drainage and geology;
- Minimisation of disturbance to natural drainage patterns;
- Appropriate distances from marine and freshwater systems and communities, as well as other biologically-sensitive areas;
- Ensure drainage away from ocean and domestic water supplies, distances from beaching areas and locations of contaminated soil, and accessibility.

Future activities

As an environmental clean up project, there are no future uses/activities associated with this project, outside of the ongoing environmental monitoring program agreed to in the DND/NTI Agreement (Appendix H and I of Annex D).

Emergency Response Plan

Contingency plans associated with the clean up of each site are to be outlined in site- specific Environmental Protection Plans (see Annex E for Cambridge Bay). One section of these plans outline generic contingency plans for the prescribed course of action to be followed in the event of fuel or chemical spills, potentially dangerous wildlife encounter and the discovery of heritage resources. These plans will enable persons that encounter a particular contingency situation to maximise the effectiveness of the environmental protection response and meet regulatory requirements for reporting to the appropriate agencies. Associated with this document is the detailed spill response plan for the North Warning System, which has operational control of the site. This spill response plan also forms part of the contractual obligations of the successful contractor.

Contingency Plan for Alternative Transportation

Given the geographical location of these sites (i.e. no regional road access but, in some cases (Hall Beach, Pelly Bay, Cambridge Bay, Broughton Island) still accessible to a community and airport), the number of technically and economically feasible transportation alternatives becomes limited. The two primary access alternatives, namely sealift and air, are already being utilised.

For two sites (Mackar Inlet and Dewar Lakes, sealift will likely be replaced by Cat trains as these sites are land-locked.

Pollution Control Systems and Environmental Management Procedures

The main focus of the project environmental management program during the clean up is based upon-site specific Environmental Protection Plans (sample in Annex E) and the associated North Warning System spill response plan (Annex F). The requirements outlined in these plans have been the end result of the environmental assessment process and includes those mitigative measures designed to reduce or eliminate potential effects. Disposal methods for solid, liquid or gaseous wastes are shown in this plan.

For the purposes of this project, monitoring is being conducted for two reasons:

Monitoring in relation to the environmental assessment. This monitoring involves a continual on-site review of impact predictions made during the environmental assessment process. The purpose of this monitoring is two fold:

- to confirm the accuracy of impact predictions made if, and when, they occur on-site and to ensure that mitigative action taken is appropriate; and

- to be able to identify impacts that occur on-site that may not have been identified during the assessment process but, none the less, require an appropriate mitigative response.

The results of on-site this assessment of will be reviewed on an annual basis as part of the project quality assurance program. Assessment areas and impact predictions requiring adjustment or re-evaluation are identified at this point and an action plan promulgated.

Monitoring in relation to environmental objectives. As part of the overall DEW Line Clean Up program, DND will undertake an extensive multiple year post clean up monitoring program at each site. This monitoring program is contained in the DND/NTI Agreement (Appendix H and I of Annex D). The purpose of this program will be to ensure that environmental objectives, particularly those related to landfill remediation, continue to be met. The results of this program will be provided to stakeholder organisations. In those cases where agreed to remediation standards are not being maintained, an engineering and/or other solution will be implemented to rectifying the situation.

Project Financing

The clean up of the DEW Line sites in the Nunavut Settlement Area is being financed by the Department of National Defence.

PART 3 - DESCRIPTION OF THE EXISTING ENVIRONMENT SURROUNDING DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA

As discussed in the section entitled 'Project Components and Alternatives' above, much of the existing environmental conditions along the DEW Line has been based on the studies undertaken by the Environmental Sciences Group (Royal Roads Military College) and the United States Air Force. The purpose of these studies was to provide an overview of the baseline condition of each of the 21 DND DEW Line sites.

This section of the submission will provide an overview of the existing biophysical and socio-economic/cultural environments of the regions surrounding these sites. This section is supplemental to the specific information provided in the environmental assessment reports that accompany this submission.

Description of the Biophysical Environment

Area Ecology

Arctic Archipelago Ecozone

The 15 DEW Line sites in the Nunavut Settlement Area are located within the Arctic Archipelago ecozone. This ecozone, which covers the northern mainland coast of Nunavut (including Boothia Peninsula) as well as the islands to the north of the mainland (i.e., Victoria Island, Jenny Lind Island, King William Island). Biologically, this ecozone is further subdivided into two ecoprovinces, five ecoregions and 21 ecodistricts.

Terrestrial Environment

Flora

Most sites are characterised by undulating hills which are typically well drained and sustain 100 percent vegetation cover. The sloped areas are dominated by *Dryas* spp., grasses, *Salix* spp., and *Cassiope* spp., with lesser amounts of sedges, *Saxifrage* spp., *Empetrum nigrum* and lichens. Low lying organic terrain between hilly areas are dominated by sedges and *Equisetum* spp., with lesser amounts of grasses, *Dryas* spp., and *Salix* spp.

Flat areas are often caharacterized by organic terrain with numerous small pools of water. The vegetative cover in this area is typically 100 percent and comprised of grasses, sedges, *Salix* spp., *Vaccinium vitis-idaea, Ledum palustre, Dryas* spp., and *Betula* spp.

Disturbed areas at these sites have variable degrees of vegetative cover consisting of grasses, *Dryas* spp., and *Salix* spp. Areas down-gradient from the sewage outfall areas are dominated by sedges with incidental occurrences of *Dryas* spp., *Salix* spp. and *Senecio congestus.*

Endangered Plant Species. A review of the most recently published 'Canadian Species at Risk' by COSEWIC (1997 edition) shows that there are no plants present on the sites that are currently listed as at risk.

Mammals

The primary terrestrial animal species of concern in the Eastern Arctic are foxes, bears, muskoxen and caribou.

The Arctic Fox is present throughout the Arctic year-round. Its diet consists of lemmings, the eggs and young of many different species of birds and carrion. In some cases, foxes will dig young Ringed Seals out of their dens for food. These foxes are solitary except when breeding. Foxes are usually found on land but can go out on the sea ice, following polar bears and scavenging off of seal carcasses.

Polar Bears are the largest carnivorous land animals, although they spend much of their time at sea. These bears are permanent residents of the areas along the DEW Line. Migrations are localised in conjunction with the migration of food sources. Young are born in snow dens either on land or (rarely) at sea. Their diet mainly consists of Ringed Seals, Bearded Seals and Walrus. Occasionally, Beluga Whales and Arctic Cod will be consumed. An important facet of their feeding behaviour is that they often eat the blubber of their prey, leaving the carrion for other species of mammals.

Caribou spend winters in the more southern boreal forest and migrate to Arctic tundra in summer to bear young and forage. They travel in large herds, sometimes across to islands. Often, they will cross open water.

Muskoxen remain in Arctic tundra throughout the year. In summer, they congregate in grassy river valleys, lakeshores and meadows where sedges, grasses, willows and heath plants are found. In winter, muskox inhabitat wind-swept hilltops and slopes where vegetation (woody plants) is exposed. Muskoxen can be found around DEW Line sites, especially on the more southern islands of the Arctic archipelago. Muskox travel in closely packed herds up to 100 individuals. Migration is localized.

Marine Environment

In undertaking development activities in the Nunavut Settlement Area, it is important to note the complexity of the regions ecosystem. This complex system results in a number of relationships between species of the Arctic. The major focus of these relationships is the need for all species to consume others within the ecosystem. Given the complex food web that is present, most mammals and birds have a varied diet.

Primary producers in the region along the DEW Line include phytoplankton and macroalgae both rooted on ocean bottoms and floating in the water column. These primary producers result in a large amount of biomass that feeds an assortment of animals.

Plants in the region are consumed by herbivores, including small invertebrates in zooplankton. These animals are primarly eaten by crusteaceans (amphipods and copepods) and molluscs (benthic bivalves and pelagic pteropods).

Primary carnivores in the Nunavut region include a large number of species of zooplankton that feed on herbivorous crustaceans. The main groups of zooplankton include two types of crustaceans (pelagic euphausids (or krill) and decapods (shrimps and crabs). Secondary carnivores consume small carnivorous and herbivorous invertebrates. Species in this category include all large pelagic invertebrates (fish, birds and mammals). The most abundant fish in the region of the DEW Line sites are Arctic Cod, Arctic Char, Cisco and Whitefish. Prevalent bird species include a number of ducks, geese, auks and loons.

Top carnivores at the top of the food web include Polar Bears, baleen whales, large toothed whales and birds of prey (i.e., Peregrine falcon and Snowy Owls). These predators consume a variety of organisms from lower levels, including fish, birds and smaller mammals (i.e., seals). Polar Bears catch seals when the opportunity permits (i.e., in shallow waters and shallow pools on the surface of ice floes. In rare cases, beluga whales are also a source of food for Polar Bears. Some birds become prey to certain mammals, such as the Arctic Fox and whales (which consume them when feeding on surface plankton). In many cases, birds eat other birds (young and eggs).

At the highest end of the food chain, humans consume food from many levels of the food chain, including fish, birds and mammals.

Biological Seasons

For the most part, biological seasons and associated activities are closely linked to ice conditions. It is these conditions that determine animal distribution and behaviour. The following section provides an outline of biological change that occurs immediately before and during the clean up of these sites.

Spring

For this period, ice occupies coastal areas and offshore areas. In the western areas of the Nunavut Settlement Area, bowhead and beluga whales migrate eastward in offshore waters. Marine mammals and birds start to accumulate along ice edges to feed and await breakup in order to migrate towards summer ranges. During this period, seal pups are born and caribou migrate northward towards the Coronation Gulf area.

Summer

In summer, marine mammals have access to and are found at traditional summering areas. Belugas are found in estauaries in Hudson Bay. Walruses spend a great deal of time at traditional haul out sites. Narwhal and harp seals are found throughout their range. Along the north coast around DEW Line sites, seabirds and waterfowl eggs hatch and the young are reared.

Fall

The onset of this period is characterised by the southward migration of waterfowl and shorebirds, the movement of marine mammals to wintering areas. Caribou migrate southward across sea ice in Coronation Gulf.

Overview of the Socio-economic Environment

Demographics

Approximately 19,500 (1991) people live in the Nunavut Settlement Area. Communities that are in close proximity to the DEW Line sites are shown in the following table:

Community (Local Name)	1991 Population
Qikiqtani Region	
Broughton Island (Qikiqtarjuaq)	461
Clyde River (Kangiqlugaapik)	565
Hall Beach (Sanirajak)	526
Igloolik (Igulik)	936
Iqaluit	3552
Kivalliq Region	
Rankin Inlet	1706
Kitikmeot Region	
Cambridge Bay (Ikaluktutiak)	1116
Kugluktuk	1059
Gjoa Haven (Ursuqtuq)	783
Pelly Bay (Arviliqtuq)	409
Taloyoak	580

Each site may have a number of outpost camps, traditional use areas, camps or other areas of interest. During the community meetings to be held prior to the clean up of each site, the project management office will endeavor to identify these areas with local residents. Where required, applicable mitigation measures (i.e., timing restrictions, etc.) will be included in the site specific environmental protection plan in order to prevent interruption of these activities.

Approximately 80% of the population in this area is Inuit. Non-native populations are concentrated in centres of regional government (Iqaluit, Cambridge Bay and Rankin Inlet). Unemployment among the Inuit population is high compared to the non-native population of the area (30% versus 2%). The cost of living is approximately 1.5 to 2 times that in southern cities, while the average household income is approximately two-thirds of that in the rest of Canada.

Area Economy

Much of the area within close proximity of the DEW Line is currently based on renewable resource harvesting, non-renewable resource extraction and energy development. Additionally, service industries such as tourism and government are becoming increasingly more important facets of the economy, particularly given the imminent formation of the new territorial government in 1999. Wage employment is often available in the mining, oil and gas, construction, tourism and government sectors. Trapping, fishing and traditional arts also provide a portion of the population with regular wage employment. Demand for wage employment still outweighs supply, however. This has resulted in an increased importance for the subsistence economy which supplies food, clothing and raw materials.

Renewable Resource Harvesting

Owing to the high levels of unemployment and the expense of food from southern sources, country foods play an important role in the area's economy. Five out of six households hunt and fish at least part-time. Approximately 60% of households rely on country food for a large proportion of their meat. The main types of country foods are seal, narwhal, caribou, fish and walrus. Additionally, the Inuit use a variety of plants for food and medicinal purposes. In addition to providing food, renewable resource harvesting also satisfies other needs, including clothing.

The DEW Line Clean Up project recognises the need to protect these resources.

Native Land Use

Hunting

It is recognised that hunting and the relationship to the land are of profound cultural and spiritual importance to the Inuit. Hunting itself provides a means for linking modern day lifestyles and culture with the past. Hunting is valued by the Inuit as it contributes to both independence and community well-being.

The harvesting of marine mammals is the foundation of the Inuit subsistence economy and much of the marine mammal harvesting is done from sea ice. There are a large number of routes linking hunting areas, outpost camps and other communities. Of all marine mammals hunted, the ringed seal is the most important. This mammal provides a year round source of food as well as

a cash income. During the clean up of the DEW Line sites (July – October annually), it is expected that these seals will exist on fast ice and open water.

The main terrestrial mammals used for food and other applications are polar bears, caribou and muskoxen. In some communities, these mammals (especially caribou) are a more important source for food than marine mammals. Caribou are hunted year round but most intensely in September when the animal congregate in large herds prior to migrating south. Caribou are shot both on land and from boats as they are crossing water bodies.

Wage Economy

Since the 1950's, an important source of income has been based on waged employment, whether from individual activities or more traditional forms of wage employment (i.e., construction work, oil and gas industry, etc.). Tourism is becoming an increasing important facet of the economy.

It is expected that, for the short term in particular communities and the longer term (i.e., approximately 20 years), a significant number of person-years of employment will be generated as a result of this project. Additionally, further enhancement of the areas' economy is expected resulting from increased local purchases and use of local businesses.

Valued Ecosystem Components

Valued Ecosystem Components (VEC's) for each site are outlined in the individual site environmental screening reports included with this submission. This section outlines those VEC's common to each of the 15 sites in the Nunavut Settlement Area.

Physical

- Protection of Permafrost soils
- Surface water, particularly related to the drinking water supply

Biological

- Wetland habitats (lakes and ponds) used by birds for feeding and nesting
- Tundra habitat including:
    1. Feeding and nesting areas for birds
    2. Feeding areas for herbivores
    3. Feeding and calving areas for caribou, bears and muskoxen
- Local vegetation
- Marine mammals off coasts

Socio-economic

- regional employment opportunities
- regional business opportunities
- regional training opportunities
- hunting and fishing in local area

Archaeological, Historical and Cultural

- archaeological sites identified around the station

Land Use

Each of the DEW Line sites has been or is, in general, used exclusively for the purposes of operating a military radar station, which includes on-site operation and maintenance of infrastructure and off-site transportation by air and sealift. Limited local use of the immediate site area occurs (i.e., for hunting and fishing, etc.). In some cases, there are regularly used fishing and hunting areas immediately adjacent to the sites (i.e., Cambridge Bay).

PART 4 - DESCRIPTION OF THE PUBLIC CONSULTATION PROCESS

As part of the DEW Line Clean Up project, a public consultation program has been carried out in communities across the north since August of 1992. In 1992 and 1993 teams from the Department of National Defence and other federal departments conducted a broad range public consultation sessions to consult the local residents about the project and to obtain input regarding specific concerns about the work.

During the public consultation process, meetings were held in those communities in the vicinity of DEW Line sites as well as briefings to government officials in Iqaluit, Cambridge Bay and Yellowknife. Advertisements, information packages and translation services were provided in English as well as Inuktitut. Minutes were recorded at each of the meetings and action items passed on to the responsible agencies.

The purpose of these meetings were several fold, including:

- inform the community of the status and schedule for the project;
- provide information regarding the process for the closure and clean up of the sites as well as providing information for providing socio-economic opportunities (business and employment);
- present information concerning the DEW Line Clean Up protocol which has been adopted for the project;
- provide general information regarding the demolition and disposal of facilities;
- obtain information regarding public concerns through discussions at the meetings and questionnaires; and
- Obtain information regarding local labour and contracting capabilities to assist in developing implementation strategies.

For the DEW Line Clean Up project, DND has sought to integrate the views of all interested stakeholders, including individuals or groups, into the decision making process undertaken by the Department of National Defence. For this project, the approach to public involvement in environmental assessments includes two major elements:

- adequate public notification; and
- appropriate public consultation.

For DEW Line Clean Up, public notification has been used as a secondary source of public consultation, using a one-way exchange of information with the public. The purpose of this particular process is to provide notification of report preparation, decisions that are made and actions that have been or are planned to be taken. For this project, this particular methodology has not been considered 'participation'. Public notification has been used mainly for notifying the public of the results of previous environmental assessments.

Public consultation has been used to involve the public in the environmental assessment process through dialogue between northern residents and the project representatives. This dialogue has proved useful in identifying public concerns, needs and values before final decisions on courses of action were made.

1992 Program

Nine communities were visited in 1992:

- Broughton Island
- Clyde River
- Igloolik
- Hall Beach
- Taloyoak (Spence Bay)
- Pelly Bay
- Gjoa Haven
- Kugluktuk (Coppermine)
- Cambridge Bay

The main goals in 1992 were to present the base clean up protocol and plan as well as hear suggestions and ideas from the public. The objectives of the initial meetings included the following:

a. Provide general information to the community regarding the status and schedule for the project;

b. Provide information regarding the process for closure and cleanup of the DEW Line;

c. Present environmental information regarding the DEW Line Clean Up (DLCU) Protocol adopted for the project;

d. Provide general information regarding the demolition/disposal of facilities;

e. Obtain information regarding public concerns through discussions at the meetings and through questionnaires; and

f. Obtain information regarding local labour and contracting capabilities to assist in developing implementation strategies.

A report prepared by the project management team outlined the information provided to the public and summarised questions/concerns which arose during the meetings.

Many questions and concerns were raised regarding various aspects of the project and almost half of these dealt with two main areas: employment opportunities and environmental impact protection. There is a serious desire among the people in the communities to obtain training and to be involved in the clean up of the sites. The second major issue of environmental impact and protection was expressed as concern about the short and long-term impact on the food chain. Perhaps the most serious concerns expressed centred on previous disposal practices, particularly ocean dumping.

The appearance of the sites, particularly those adjacent to communities, was a concern. The proposed cleanup protocol was generally accepted to be the most practical. Some details related to performance of long term monitoring were yet to be worked out. This will be addressed with the new monitoring plan.

In general, the meetings were well attended, the project team was well received and discussions were wide ranging and lively. People seemed to appreciate the initiative taken by DND to inform the communities regarding DLCU and the public provided valuable insights into the project. In some cases people have unrealistic expectations regarding the project and it was important to correct these. In this region of high unemployment it is important to be truthful and not be too optimistic concerning the economic impact of a one time project such as this clean up.

1993 Program

The same nine communities in the Nunavut Settlement Area were visited in May and June 1993. The objectives for this second round of meetings were as follows:

a. Update the communities on the current status of the project;

b. Present information on the site investigations and the 80% Design Submission for the ten sites studied in 1992;

c. Provide clean up protocol information on the 11 DND sites surveyed in 1993;

d. Present information on the plans for the 21 DIAND sites; and

e. Request suggestions and ideas regarding community concerns with the cleanup plans.

Questions and concerns were raised by the public regarding a variety of aspects of this project. While the majority of concerns were in regards to socio-economic effects and benefits (employment opportunities) there was also a concern over the environmental protection measures that were to be employed during the clean up. The residents of these communites have expressed a desire to obtain job training and to be involved with the clean up of these sites. With respect to environmental protection, concern was expressed as to how the clean up of these sites would impact the food chain over the short and long terms. There were a number of concerns over how previous disposal practices, particularly ocean dumping, was conducted and what the effects have and will be. Another aspect of environmental protection raised by the public was that of aesthetics. Questions were asked about how the sites would look like at the end of the clean up. No major concerns about the effect of the clean up operations were raised.

The issues outlined above were addressed through discussions during the meetings and concerns were alleviated through these consultation sessions.

1994 Program

In 1994, public consultation focused on involvement of both the territorial (GNWT) government and recently formed Inuit organisations. Two meetings were held in late 1994 with Nunavut officials in Cambridge Bay (Kitikmeot Inuit Association/Nunavut Tunngavik Incorporated joint meeting and Nunavut Planning Commission).

1996 Program

In 1996, the DEW Line Clean Up project resumed its public consultation program by holding public meetings at those communities that would be closest to those sites undergoing clean up in 1996. Within the Nunavut Settlement Area, the communities of Broughton Island and Clyde River were invited to participate in a public meeting discussing upcoming DEW Line Clean Up activities.

1997 Program

The DEW Line Clean Up project office followed up on the 1996 community visits in cases where there is local interest to do so. Both Clyde River and Broughton Island hosted a public information session. These meetings focused on providing planning details as to the upcoming work at the site. Community interest continued to be high, especially in the area of employment opportunities, environmental protection and salvage opportunities.

Future Public Involvement Activities Starting in 1998

As the project enters the implementation phase, public involvement will focus on providing communities with an update on clean up activities within their local area. Several community specific activities will be undertaken:

- The project management office will hold a community information briefing in the community or communities closest to each DEW line site just prior to the start of clean up (i.e., 1 to 2 months in advance). The aim of these meetings will be to provide community residents with an overview of final details concerning the start of work at each site. The first such meeting will take place in Cambridge Bay in May, 1998.

- The community closest to each DEW Line site will be invited to form a joint advisory committee with DND. The purpose of this committee, which is expected to typically include the community mayor and another resident plus the on-site representatives from the project, is to serve as a forum for addressing local concerns and questions about the clean up during the period when actual activity is taking place. It is expected that this committee will meet monthly during the summer periods.

- As part of the pre-clean up site delineation work, local communities will be asked to provide traditional local knowledge about the DEW Line site area, particularly related to landfills. Typical questions to be posed are shown in the DND/NTI Agreement (Annex D) and are summarised in Annex M.

DND/NTI Project Review Committee

As part of the Agreement between the Department of National Defence and Nunavut Tunngavik Incorporated (Annex D), there are to be regularly scheduled meetings between these two organisations. These meetings, which will involve senior management from both organisations, are designed to provide a regular forum to discuss the clean up program within the Nunavut Settlement Area and to bring up concerns relating to environmental and/or socio-economic concerns.

PART 5 - IDENTIFICATION OF ENVIRONMENTAL EFFECTS

There has been extensive evaluation of predicted environmental impacts related to the clean up operation. Additionally, mitigation measures have been introduced for both those impacts that are both general and site specific in nature.

The following table summarizes those impacts that have been identified for the DND DEW Line sites and mitigative actions outlined in the Environmental Screening Report for the Cleanup of the DEW Line sites in the Nunavut Settlement Area.

Description	Significance	Monitoring/Mitigation Requirements
Impacts of Landfill Development and Closure		
Potential risks to soils, surface water, terrestrial and aquatic habitat from development and closure of landfills	Potentially significant	• design of landfill development and closure to prevent leachate • landfills to be contoured to match existing drainage patterns
Impacts of Demolition/Regrading Activities		
Potential risk to existing habitat from demolition and regrading activities	Potentially significant in previously unimpacted areas	• demolition areas to be recontoured to match existing drainage patterns • regrading to be limited to specified areas
Impacts of Removal and Transport of Hazardous Materials/Fuel/Contaminated Soil		
Potential risks to soils, surface water, terrestrial and aquatic habitat and species and human safety from accidental events such as fuel or hazardous materials spills	Potentially significant in the worst case (i.e. large spill volume)	• development of a contingency plan outlining procedures to follow in the event of an accidental spill • training and education of employees in emergency procedures • storage of fuel in dyked tanks • proper fuel handling techniques, particularly when refuelling equipment
Hazards to human health and safety during clean up, especially during asbestos abatement and facility demolition where PCB paint is present.	Significant due to contaminated nature of material on site	• proper procedures for handling hazardous materials • removal of hazardous materials from site

Impacts of General Clean Up Activities		
Elimination of potential hazards and sources of contaminants through remediation of existing landfills, removal of physical debris, discontinued use of sewage outfalls, and removal of contaminated soil	Improvement of overall environmental conditions	• compliance and monitoring requirements for engineering performance are detailed in contract specifications
Disruption of heritage sites due to new development, regrading, and/or activities of contractors' personnel	Potentially significant (prior to mitigation) at sites with high potential for archaeological resources	• report and record any features of potential interest, ensure areas are clearly marked • avoidance of controlled excavation of features • monitor excavations for additional features • all personnel to be discouraged from visiting archaeological and other heritage sites
Degradation of permafrost due to clean up operations	Potentially significant in excavations in ice rich ground	• avoid patterned ground and ice rich areas when siting new facilities or borrow sources • if possible, backfill excavations as soon as practical • replace vegetation cover or topsoil as soon as possible after excavation • exploit existing borrow sources to minimize disturbed areas • monitor for evidence of soil erosion, subsidence, or development of thermokarst
Effect of contractors activities (e.g. noise or disturbance) and/or personnel on terrestrial wildlife species	Potentially significant (prior to mitigation) on sites where wildlife is noted	• minimize activity in sensitive areas • scheduling of work activities to avoid nesting, calving, or migration periods • education of employees to prevent on site personnel from harassing wildlife
Effect of contractors activities (e.g. noise or disturbance) on marine wildlife species	Potentially significant (prior to mitigation) on sites where marine wildlife is known to occupy off shore waters	• scheduling of shipping to minimize disturbance to marine environment • sea mammals to be avoided by all shipping • vessel traffic to be restricted to traditional shipping lanes

Effect of clean up operations and contractor's activities on terrestrial habitat, vegetation	Potentially significant, at sites where vegetation covers a major portion of the site, for example in the Low Arctic Ecoclimatic Region	• siting of clean up camps or new development (landfills) to be on disturbed ground, wherever possible • vehicle and equipment traffic is to be combined to existing access roads
Effect of clean up activities on appearance of site	Improvement. Surface debris will be collected and disturbed areas regraded	• none required (Note: some sites may have more extensive clean up)
Other Environmental Impacts		
Use of local services and northern residents during implementation of clean up plans	Positive impact on northern socio-economic development	• tender documents for DEW Line Clean Up contracts will include clauses requiring Contractors to maximize employment and business opportunities in the North
Disruption of heritage sites due to new development, regrading, and/or activities of contractors' personnel	Potentially significant (prior to mitigation) at sites with high potential for archaeological resources	• report and record any features of potential interest, ensure areas are clearly marked • avoidance of controlled excavation of features • monitor excavations for additional features • all personnel to be discouraged from visiting archaeological and other heritage sites
Effect of cleanup operations on local resource use	Potentially significant (prior to mitigation) at sites near year round communities or seasonal camps	• consultation with local communities to minimize conflicts • scheduling of activities to avoid hunting and fishing activities

PART 6 – CUMULATIVE ENVIRONMENTAL EFFECTS

For the purposes of the DEW Line Clean Up Project, cumulative effects have been defined as changes to the biophysical, social, cultural or economic environments caused by a project component in combination with any on-going, past or future activities. In undertaking environmental assessments, the project management office has included an evaluation of possible cumulative effects, including:

- Impacts over a larger (regional) area including the crossing of jurisdictional boundaries;
- Temporal boundaries beyond the time frame required to complete the clean up work;
- Interactions with Valued Ecosystem Components (both biophysical and socio-economic); and/or
- With other past, ongoing (i.e., operation of the North Warning System, mining activities, existing hamlet operations) or known future (i.e., construction related to the build up of the Nunavut government infrastructure) activities.

This evaluation also included an evaluation of levels of significance.

Cumulative effects arising from the DEW Line Clean Up Project can occur as interactions between project components (either from the same or more than one site) and/or between environmental components. Effects can occur in one of four ways:

- Physical or chemical transport mechanisms;
- "Nibbling loss" (i.e., gradual disturbance);
- Spatial or temporal crowding;
- Growth induction initiated by the project.

An analysis of cumulative environmental effects has been undertaken for this project. In doing so, four steps have been undertaken to date:

1. Scoping, including identifying issues of potential concern, VEC;s that could be affected and boundary setting;
2. Analysis of effects, including an evaluation of baseline data and possible effects on VEC's. Methods could include the use of overlays to identify where the geographic and temporal extent of various projects' effects may interact;
3. Identification of mitigation options and recommending measures to be undertaken; and

4. Evaluating significance of these effects, after mitigation actions have been applied.

As a result of this analysis, it can be concluded that, for the most part, both the clean up of each site and the individual components will not lead to significantly adverse cumulative impacts. As a result of initial overlay studies, the clean up of each site can be considered as a short term, distinct individual event that will not have any form of additive effect with past, existing or known future activities.

PART 7 – MITIGATION

Part 5 (above) identifies mitigation measures that are to implemented for this project.

PART 8 – ABANDONMENT AND DECOMMISSIONING PLAN

The contract documents for the DEW Line Clean Up Project will require that the contractor clean up and remediate the area in which their activities took place. Following the completion of clean up activities, all vehicles and equipment, remaining fuel, supplies, personnel, and the construction camp are to be removed from the site by the contractor. The construction specifications provide for a percentage of the payment for mobilisation/demobilisation to be withheld pending a satisfactory withdrawal from the site.

Demobilisation will coincide with the annual sealift. The contractor will be required to arrange for this sealift. All provisions of the Environmental Protection Plan (Annex E) will be strictly adhered to until the demobilisation is complete.

PART 9 – MONITORING AND MAINTENANCE PLANS

For the purposes of this project, monitoring is being conducted for two reasons:

Monitoring in relation to the environmental assessment

This monitoring involves a continual on-site review of impact predictions made during the environmental assessment process. The purpose of this monitoring is two fold:

- to confirm the accuracy of impact predictions made if, and when, they occur on-site and to ensure that mitigative action taken is appropriate; and

- to be able to identify impacts that occur on-site that may not have been identified during the assessment process but, none the less, require an appropriate mitigative response.

The results of on-site this assessment of will be reviewed on an annual basis as part of the project quality assurance program. Assessment areas and impact predictions requiring adjustment or re-evaluation are identified at this point and an action plan promulgated.

Monitoring in relation to environmental objectives

As part of the overall DEW Line Clean Up program, DND will undertake an extensive multiple year post clean up monitoring program at each site. This monitoring program is contained in the DND/NTI Agreement (Appendix H of Annex D). The purpose of this program will be to ensure that environmental objectives, particularly those related to landfill remediation, continue to be met. The results of this program will be provided to stakeholder organisations. In those cases where agreed to remediation standards are not being maintained, an engineering and/or other solution will be implemented to rectifying the situation.

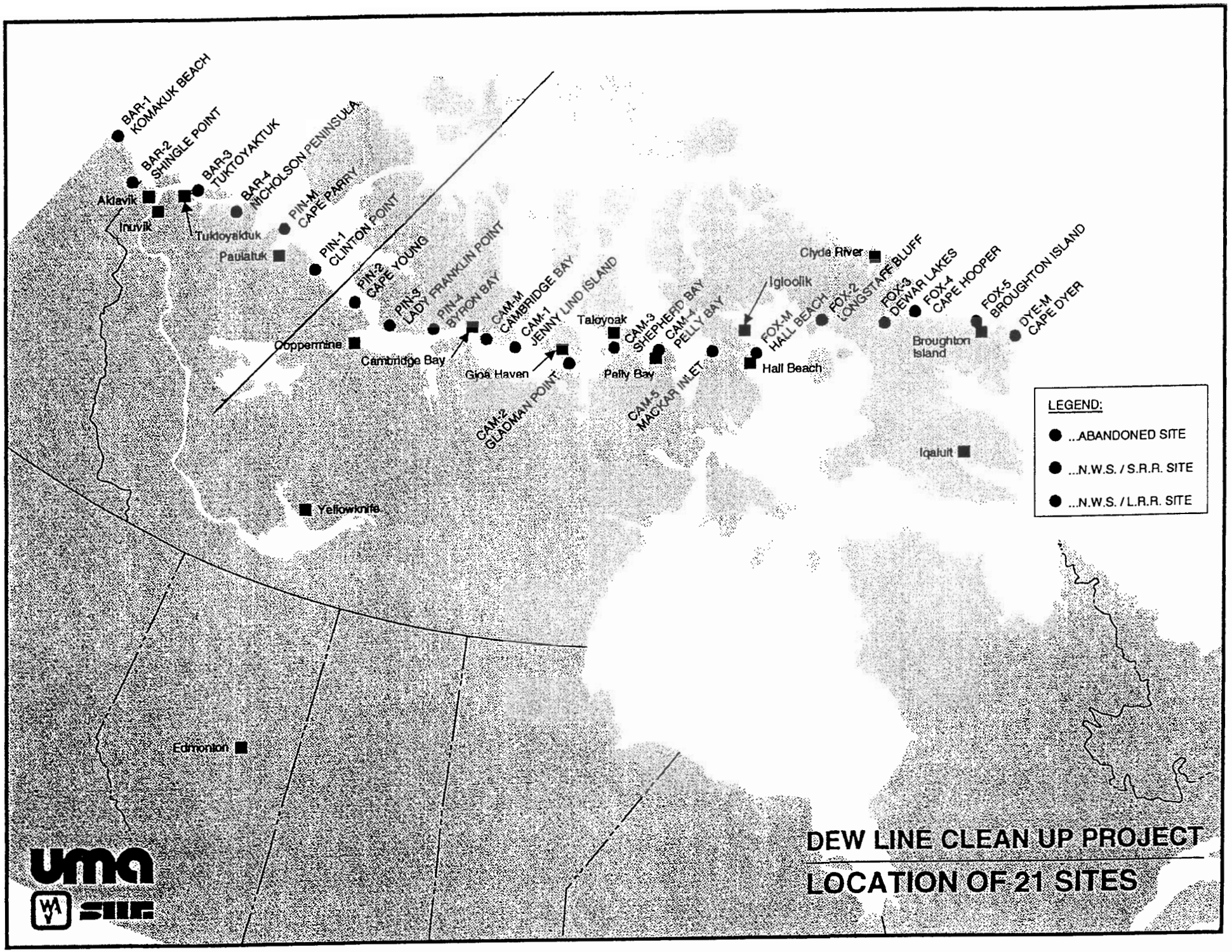
Annex A
To NIRB Submission

LIST OF PERMITS ATTRIBUTABLE TO DEW LINE CLEAN UP[1]

TYPE OF PERMIT/ AUTHORIZATION OR LICENCE	DESCRIPTION	CONTACT
Land Use Permit	Required for certain activities that take place on Crown Lands in accordance with the *Territorial Land Use Act* and *Territorial Land Use Regulations*	Department of Indian and Northern Affairs Land Administration Yellowknife, NT
Quarry Permit	Required for certain quarrying activities that take place on Crown Lands in accordance with the *Territorial Land Use Act* and *Territorial Quarrying Regulations*	Department of Indian and Northern Affairs Land Administration Yellowknife, NT
Authorization for Works or undertaking affecting fish or fish habitat	Required for certain activities that may impact on fish or fish habitat in accordance with the *Fisheries Act*. Pertains to stream crossings, culverts, siltation and erosion control and effluent discharge.	Department of Fisheries and Oceans Yellowknife or Iqaluit
Permit to undertake work in a migratory bird sanctuary	Required for certain activities that occur within migratory bird sanctuary regulations in accordance with the *Migratory Bird Sanctuary Regulations*	Canadian Wildlife Service
Explosives permits	Required for activities requiring the use explosives in accordance with the federal *Explosives Act*	Natural Resources Canada

[1] This list provides a comprehensive listing of possible permit requirements for each of the fifteen DEW Line sites in the Nunavut Settlement Area. Not all nor necessarily any of these permits may be required at a particular site.

TYPE OF PERMIT/ AUTHORIZATION OR LICENCE	DESCRIPTION	CONTACT
Authorization for annual inspection of PCB storage areas	Required when a proponent requests authority to inspect PCB storage areas annually vice monthly	Environment Canada
Marine transportation permits	As required by the *Transportation of Dangerous Goods Act*	
Air transportation permits	As required by the International Air Transport Association Dangerous Goods Regulations	


BAR-1 KOMAKUK BEACH
BAR-2 SHINGLE POINT
BAR-3 TUKTOYAKTUK
BAR-4 NICHOLSON PENINSULA
PIN-M CAPE PARRY
PIN-1 CLINTON POINT
PIN-2 CAPE YOUNG
PIN-3 LADY FRANKLIN POINT
PIN-4 BYRON BAY
CAM-M CAMBRIDGE BAY
CAM-1 JENNY LIND ISLAND
CAM-2 GLADMAN POINT
CAM-3 SHEPHERD BAY
CAM-4 PELLY BAY
CAM-5 MACKAR INLET
FOX-M HALL BEACH
FOX-2 LONGSTAFF BLUFF
FOX-3 DEWAR LAKES
FOX-4 CAPE HOOPER
FOX-5 BROUGHTON ISLAND
DYE-M CAPE DYER
Aklavik
Inuvik
Tuktoyaktuk
Paulatuk
Coppermine
Cambridge Bay
Gjoa Haven
Taloyoak
Pelly Bay
Igloolik
Hall Beach
Clyde River
Broughton Island
Iqaluit
Yellowknife
Edmonton
LEGEND:
...ABANDONED SITE
...N.W.S. / S.R.R. SITE
...N.W.S. / L.R.R. SITE
DEW LINE CLEAN UP PROJECT
LOCATION OF 21 SITES

Annex C
To NIRB Submission

DND DEW LINE SITES IN THE NUNAVUT SETTLEMENT AREA -
LOCATIONS AND PRESENT STATUS

LOCATION	SITE	COORDINATES	REGION	STATUS
Cape Young	PIN-2	68°56'N 116°55'W	Kitikmeot	CLOSED
Lady Franklin Point	PIN-3	68°28'N 113°13'W	Kitikmeot	LRR
Byron Bay	PIN-4	68°45'N 109°04'W	Kitikmeot	CLOSED
Cambridge Bay	CAM-M	69°06'N 105°07'W	Kitikmeot	LRR/LSS
Jenny Lind Island	CAM-1	68°40'N 101°43'W	Kitikmeot	CLOSED
Gladman Point	CAM-2	68°40'N 97°48'W	Kitikmeot	SRR
Sheperd Bay	CAM-3	68°48'N 96°26'W	Kitikmeot	LRR
Pelly Bay	CAM-4	68°27'N 89°45'W	Kitikmeot	SRR
Mackar Inlet	CAM-5	68°17'N 85°07'W	Qikiqtani	CLOSED
Hall Beach	FOX-M	68°45'N 81°11'W	Qikiqtani	LRR/LSS
Longstaff Bluff	FOX-2	68°54'N 75°10'W	Qikiqtani	SRR
Dewar Lakes	FOX-3	68°45'N 109°04'W	Qikiqtani	LRR
Cape Hooper	FOX-4	68°26'N 66°44'W	Qikiqtani	SRR
Broughton Island	FOX-5	67°33'N 63°39'W	Qikiqtani	SRR
Cape Dyer	DYE-M	66°39'N 61°21'W	Qikiqtani	LRR

LRR = Long Range Radar; SRR = Short Range Radar; LSS = Logistics Support Site