APPENDIX 6

CONTWOYTO LAKE
REMEDIATION PROJECT

ENVIRONMENTAL SCREENING REPORT (ESR)

ENVIRONMENTAL SCREENING ASSESSMENT OF THE PROPOSED REMEDIATION OF THE CONTWOYTO LAKE FORMER WEATHER STATION CONTWOYTO LAKE, NUNAVUT

Prepared for:

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PWGSC Project No.: R.057569

March 2013
(Revised 15 October 2013)

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29 March 2013 *(Revised 15 October 2013)*

Public Works and Government Services Canada
5101 - 50th Avenue
PO Box 518
Yellowknife, Northwest Territories X1A 2N4

Attention: Ms. Janice Lee

Re: **Environmental Screening Assessment of the Proposed Remediation of the Contwoyto Lake Former Weather Station Contwoyto Lake, Nunavut**

Dear Ms. Lee:

SENES Consultants Limited (SENES) is pleased to provide the following environmental screening assessment of the proposed remediation of the former weather station located at Contwoyto Lake, Nunavut.

As per Task 8 in the Terms of Reference (TOR) dated May 2012 for the Contwoyto Lake Former Weather Station, *the consultant shall conduct an environmental screening assessment for the final RAP in accordance with the Nunavut Land Claims Agreement as outlined in Appendix C of the TOR.*

We trust that the enclosed report is suitable for your current requirements. If you have any questions or require further information, please do not hesitate to contact us.

Yours very truly,

SENES CONSULTANTS

Jason D. Mauchan, M.Eng.
Environmental Specialist

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Encl.

EXECUTIVE SUMMARY

ES1 FORWARD

SENES Consultants (SENES) was retained by Public Works and Government Services Canada (PWGSC) to complete a Phase III Environmental Site Assessment (ESA), a Remedial Action Plan (RAP), and an Environmental Screening Assessment Report (ESAR) for the Contwoyto Lake former Weather Station (WS) Remediation Project. The majority of the hazardous waste, non-hazardous debris, and impacted soils are due to past activities associated with the site being operated as a weather station from the 1950s to the 1980s.

This ESAR has been completed to identify potential impacts of the RAP on the environment and propose actions to mitigate such impacts so that the project can proceed through the licensing, contracting, and remediation phases.

The instigation for the submission of this ESAR is that the proposed RAP for the project is defined as a "project proposal" under the Nunavut Land Claims Agreement and therefore must be screened by the Nunavut Impact Review Board.

To complete the remediation of the former WS, the RAP proposes that unpainted wood, liquids, and hydrocarbon contaminated soils be treated on site; whereas hazardous and non-hazardous materials and metals impacted soils would be removed off-site to an appropriate licensed disposal facility for disposal. Mobilization and demobilization would be by a purpose built ice road. On-site remediation work is expected to take one summer.

ES2 BACKGROUND

The Contwoyto Lake former WS is located on the northwestern shore of an unnamed island approximately one third of the way northbound on Contwoyto Lake in the Kitikmeot Region of Nunavut (Figure 1). The site is approximately 190 km southwest of Bathurst Inlet, Nunavut, about 330 km southeast of Kugluktuk, Nunavut and 400 km northeast of Yellowknife, Northwest Territories.

The Contwoyto Lake Weather Station site was originally a small camp built and operated by Pacific Western Airlines (PWA) during the Distant Early Warning (DEW) Line Site construction c. 1956. PWA built the existing buildings which included the Quonset living quarters, power house, beacon building and airstrip and installed the communications equipment that existed at the site. In 1978, Transport Canada acquired the site to establish a telecommunications and navigational aid station. By 1980, Transport Canada was looking into abandoning the site, for the more economical option of establishing a non-directional beacon (NDB) air navigation aid at

the nearby Echo Bay Mines - Lupin Site. In 1984, the Coppermine Hunters and Trappers Organization (HTO) took over responsibility for the site buildings and established it as an outpost camp (WESA, 2011).

ES3 REMEDIATION AREA

For the purposes of this Environmental Screening Report (ESR), the site has been divided into five areas (Figure 2) corresponding to the areas of environmental concern (AEC). The five AECs are:

1. Peninsular Pond Area
2. Camp Area
3. Radio Tower Area
4. Airstrip Area
5. Former Inuit Camp Area [part of Inuit Owned Land (IOL) Area]

E4 ENVIRONMENTAL IMPACT FINDINGS

A summary of environmental impacts at the former WS site is based on the results of the Phase I/II and Phase III ESA presented below in Table ES-1.

Table ES-1 Summary of Environmental Impact

Component	Quantity
Hazardous waste	13.5 m^3
Non-hazardous waste	122.5 m^3
No. of drums	279
Volume of drum contents to ship south	400 litres
Volume of drum contents to treat on-site	2,100 litres
Metals-impacted soils(1)	46.2 m^3
Tier II metals-impacted soils(2)	36.1 m^3
PHC-impacted soils(3)	1142.2 m^3
PHC Type B impacted soils(4)	1142.1 m^3

(1) Metals data compared to Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health for an agricultural land use.

(2) Metals data compared to DEW Line Cleanup Criteria (DCC) for Soil as stated in the AMSRP.

(3) PHC data compared to 2008 Tier 1 coarse grained F1 to F4 for an agricultural land use. Metals data compared to Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health for an agricultural land use.

(4) PHC data compared to AMSRP Remedial Objectives for Hydrocarbon Contaminated Soil

E5 REMEDIATION TIMELINE

The following general project activities and milestones are anticipated for the design and implementation of the RAP:

- April 2014 - Mobilize to site.
- June to October 2014 & 2015 – Remedial activities.
- March 2016 – Demobilize from the site.

The schedule may change depending on procurement approach, contract award, and regulatory approval.

E6 PVEC AND VSEC

Potential Valued Ecosystem Components (VECs) and Valued Socio-Economic Components (VSECs) were identified for the project. Initially, a review of the regulatory responsibilities of government agencies was completed, and then VECs and VSECs identified in other projects of a similar nature were reviewed. Once these VECs and VSECs were identified, they were confirmed during the community meeting, and finally, based on the RAP, the professional judgement of environmental practitioners and remediation specialists identified any potential gaps in the identified VECs and VSECs. Identified VECs and VSECs included climate, air quality, terrain, soils, hydrology, wildlife, cultural features, and traditional land use.

To determine the potential impacts to the various VECs or VSECs, the environmental baseline information and specific RAP activities were reviewed, and using professional judgement, project activities (site preparation and camp operation, remediation and closure) that would impact/interact with a specific VEC or VSEC were identified.

By far the most common potential impacts to VECs were contamination from spills during refuelling or servicing equipment used in project activities, from remediation activities themselves (such as incinerating waste or transporting drums), or direct physical disturbance to the VEC during project activities (such as camp construction). Important impacts to wildlife range from direct mortality to sensory disturbances. The most important mitigation measures are those that will prevent or limit contamination, such as developing a spill contingency best management practice, or those that prevent or limit physical disturbances, such as using the natural esker for camp construction.

Residual impacts are defined as impacts that remain after mitigation has been applied. Implementation of the mitigation strategies outlined for the remediation of the former WS are

predicted to result in no negative residual impacts, and overall, the remediation will have a positive effect on the environment by removing contaminated soil and hazardous material from the site. Cumulative environmental impacts occur when impacts, in particular residual impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. Given that the project will have a positive impact on the environment and has no residual impacts, the remediation of the former WS will not add to the cumulative environmental effects of other land use activities in the local area.

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1.0 PROJECT RATIONALE

The goal of the project is to remediate the Contwoyto Lake former Weather Station (WS).

The following site objectives for the remediation of the Contwoyto Lake WS were developed in accordance with applicable Federal Policies, the principles of the Nunavut Land Claims Agreement (NLCA), remediation best practices and the remediation protocols outlined in the Abandoned Military Site Remediation Protocol (AMSRP).

- Minimize human health and safety risks at the Contwoyto Lake WS;
- Protect fish, wildlife and vegetation;
- Protect the water quality of Contwoyto Lake;
- Minimize environmental impacts during remediation;
- Increase public awareness about remediation activities;
- Minimize long-term care and maintenance;
- Return the site to its original condition where possible;
- Be cost-effective; and
- Provide employment opportunities for the local work force.

2.0 BACKGROUND INFORMATION

2.1 SITE LOCATION

The Contwoyto Lake former WS is located in Nunavut (NU) within the West Kitikmeot region and is situated on the western limit of an unnamed remote island on the lower third of Contwoyto Lake.

Table 2-1 Co-ordinates of the Contwoyto Lake Former Weather Station

	Northing	Easting
UTM (Zone 12W)	7262678 m	528831
	Latitude	Longitude
Degrees	65.48501°	-110.37634°

The nearest community to the Contwoyto Lake former WS is Kugluktuk which is 330 km northwest of the site (see Figure 1). Yellowknife is approximately 400 km to the southwest.

2.2 LAND USE HISTORY

Prior to the development of the Contwoyto Lake WS there was little evidence that the area was used on a permanent basis by the local Aboriginal peoples; however, summer camps may have been used for centuries (Golder, 2013). The site is surrounded by Inuit Owned Lands (IOL) and lies fully within Nunavut.

The Contwoyto Lake WS was built and operated by Pacific Western Airlines (PWA) during the Distant Early Warning (DEW) Line Site construction c. 1956. The site was converted to a weather station outpost in 1978 and operated as a manned and then remote weather station until its closure in 1981 (WESA, 2011).

In 1984, the Kugluktuk (then Coppermine) Hunters and Trappers Association took over responsibility for the site buildings, establishing it as an outpost camp.

Residents from the Kugluktuk, continue to hunt, trap and gather traditional foods throughout the region. In addition to traditional land use, the area is frequented by non-aboriginal hunters.

During August 2012 Golder Associates Limited (Golder) conducted and Archaeological Impact Assessment (AIA) for the Contwoyto Lake former WS. The field work was conducted under Nunavut Archaeologists Permit 2012-008A issued by the Department of Culture and Heritage, Government of Nunavut (Culture and Heritage) to Julie Ross of Golder.

During the survey of the island on which the former WS is situated no previously unrecorded archaeological sites were recorded. The location of a previously identified site of interest was revisited and three land use sites were documented. The previously recorded site, NiLt-1, was identified as an indigenous historic campsite 60 m from the former radio tower (Golder, 2013). The recommendation was to avoid this area. The three land use sites documented were described as recent and no further archaeological work was recommended.

2.3 INFRASTRUCTURE

During its operation as a weather station, various generations of radio communication and weather equipment were housed at the site. At the time operations ceased, infrastructure consisted of a main communications camp building, a generator building, two ham radio sheds, a collapsed radio tower, multiple debris areas and fuel caches, as well as an underground meat locker. A drum-lined emergency airstrip suitable for smaller fixed wing aircraft was also located at the site.

The majority of site infrastructure was located on a coarse overburden esker which is the predominant geologic feature in the area.

In addition to the existing dilapidated infrastructure related to the former weather station, there is an active Inuit hunting camp (operated by the Kugluktuk Hunters and Trappers Association) and a former Inuit camp that operated when the weather station was in operation. The existing hunting camp (Structure 01) is located approximately 300 m west of the weather station on a peninsula that extends from the western shoreline of the island while the former Inuit camp was located along the shoreline in the IOL south of the former weather station and east of the former radio tower location (see Figure 2). The HTA were consulted with regards to their hunting camp on the peninsula (Structure 01). All associated debris from the weather station that is in the vicinity of the HTA cabin, will be cleaned up. The HTA hunting cabin will be left intact for further use.

2.4 SITE ACCESS

Summer access to the site is currently by fixed-wing aircraft on floats or tundra tires or helicopter with boat access from the Lupin Mine would be possible. Float planes can dock on both the north and south side of the peninsula (see Figure 2). Fixed wing twin otters can land on the unmaintained airstrip along the esker. Winter access to the site is by ice road or ice airstrip or using the nearby airstrip at the Lupin Mine. During the winters when the ice road to the Lupin Mine has been constructed it has passed within a few hundred metres of the former WS. During the winters when the ice road to the Lupin Mine is not active a dedicated ice road could be constructed from the Ekati turn off which is approximately 130 km to the southwest of the site.

The major landform at the site is the esker which was reportedly used as an emergency airstrip during the WS operation. In 2012, pilots reported that a twin otter with tundra tires could land on the unused airstrip. The remediation program will likely use parts of the natural feature of the esker which created the airstrip to house a temporary camp, a temporary treatment area for PHC-impacted soils, and a temporary drum wash area. Note that on either side of the esker are marshlands and ponds. Ultimately, after the remedial works are complete, the natural features of the esker are expected to remain relatively similar through re-grading activities and hence the viability of the esker as an emergency airstrip will continue.

2.5 SITE DIMENSIONS

The Contwoyto Lake former weather station site is 37 ha and is located fully within NU. The site is situated on an unnamed island measuring approximately 4 km^2. The site is surrounded on two sides (south and east) by IOL lands and Contwoyto Lake on the balance.

2.6 CLIMATE

Temperatures in the Contwoyto Lake area are summarized as follows (based on Canadian Environment Canada – Canadian Climate Normals 1961-1990):

- Average daily highs ranging from 14.9 ˚C (July) to -27.9˚C (January);
- Average daily lows ranging from 5.2 ˚C (August) to -35.1˚C (January); and
- Extreme temperature records of -53.9 ˚C to 27.2 ˚C.

Due to the exposed nature of the site, extreme cold temperatures are exacerbated by wind chill. Contwoyto Lake itself is anticipated to partially moderate temperature fluctuations, particularly during the relatively brief open water season (July to August/September).

With total annual precipitation of 246.6 mm, the Contwoyto Lake area is technically classified as a desert. Approximately 55% of precipitation falls during the four months when average daily temperatures exceed 0˚C (i.e., June to September). Nonetheless, precipitation in the form of snow can occur at any time throughout the year.

2.7 HYDROLOGY, GEOLOGY AND HYDROGEOLOGY

2.7.1 Hydrology

Contwoyto Lake is the dominant hydrologic feature in this area of Nunavut, with a surface area of 1,034 km^2. The lake is the primary outflow of the Burnside River, which eventually drains into Bathurst Inlet and then the Arctic Ocean. The hydrologic conditions at the weather station are governed by the coarse esker material on the highlands and the permafrost underlying the entire site. The small surface water bodies inland from Contwoyto Lake are shallow and interconnected through low-lying marshlands, all of which ultimately discharge to Contwoyto Lake. From the topography of the site the surface water drainage on site would be towards the low-lying areas of the site to the north and south of the esker with the water migrating towards Contwoyto Lake.

2.7.2 Geology

Based on the site-specific information from test pits and boreholes, the site geology is described according to the following stratigraphic units:

Surficial Topsoil - The surficial topsoil consists of sand, gravel with organic rich peat material typical for this region located in the low lying areas. Within the limits of the esker, the surficial soils are exclusively coarse grained materials. In the low lying areas, this horizon comprises a thin veneer of dark brown to black topsoil containing some organic debris (e.g. wood and root debris). The topsoil horizon is loose, and ranges from moist to wet.

Native Soils – The native soils within the limits of the on-site esker are a mix of sands and gravels with cobbles and boulders in evidence from visual observations along the shoreline. The basement of the native soils was not defined during the course of the environmental site assessment work in 2011 or 2012; however, permafrost was encountered across the site at depths

ranging from 0.5 to 1.2 m below grade.

In the low lying areas, the topsoil is underlain by a mix of finer grained silts and sands with some cobble and gravel present. Permafrost was encountered in locations where site conditions allowed for deeper overburden sampling. The basement of the native soils within this area of the site was not encountered during the recent site assessment work.

Bedrock – No bedrock was encountered within the limits of the weather station site.

2.7.3 Hydrogeology

It is presumed that the permafrost at the bottom of the active layer acts as a barrier below the groundwater table, and the movement of groundwater and infiltrating surface water at this site would be expected to follow the local contours of any permafrost (and/or bedrock in areas of shallow overburden) toward low-lying areas. Drainage paths are generally determined by local topography, which drains toward Contwoyto Lake.

2.8 VEGETATION

The vegetation in the area of the site is low-lying shrubs, grass and bushes with patches of berry bearing vegetation.

From direct observations in August 2012, the vegetation at the former WS includes: Dwarf birch, blueberries, cloudberries, bakeapple berries, cranberries, Labrador tea, sphagnum moss, lichen, grasses, and various other low lying bushes (including other berry bearing plants).

2.9 WILDLIFE

The region surrounding the site is known to support a diversity of terrestrial species. Animals seasonally present in the area are known to include barren-ground caribou and other mammals such as black bears and wolf. Hundreds of bird species have been observed throughout the region including waterfowl, shorebirds as well as predatory birds.

From direct observations in August 2012, a Golden Eagle, Gulls and Geese are known to frequent the site.

The Department of Fisheries and Oceans (DFO) reports that Contwoyto Lake supports populations of the following fish species: lake trout, Arctic char, round whitefish, lake cisco,

Arctic grayling and burbot (DFO 1986). Observations at the weather station indicate that the small inland ponds are devoid of fish.

As part of the Phase III ESA a review of the Natural Resources Canada Ecozone maps was completed. The former weather station on Contwoyto Lake is located within the Southern Arctic Ecozone. From the Government of Northwest Territories (GNWT) Environmental and Natural Resources literature (no equivalent yet established in Nunavut) the status of the NWT Species at Risk Index for mammals and birds within this Ecozone are as noted below:

Table 2-2 Summary of Species at Risk in Southern Arctic Ecozone

Species	Status
Mammals	
Peary Caribou	Endangered
Grizzly	Special Concern
Wolverine	Special Concern
Northern Mountain Caribou	Special Concern
Birds	
Eskimo Curlew	Endangered
Ivory Gull	Endangered
Olive-sided Flycatcher	Threatened
Red Knot	Threatened
Peregrine Falcon (Tundra-type)	Special Concern

From the GNWT literature it was been reported that none of the above noted species are in immediate risk of extinction in the GNWT and as such we have inferred the same situation exists in NU. With the exception of the caribou none of the species listed above were observed on the site. This is likely due to the lack of food and remote nature of the island on which the site is situated.

2.10 SUMMARY OF SITE CONDITIONS

During the Phase III ESA the Contwoyto Lake site was sub-divided into five Areas of Environmental Concern (AECs) depending on their setting, historical use and potential for contamination. The different areas were as follows and are shown on Figure 2:

- AEC 1: Peninsular Pond Area
- AEC 2: Camp Area
- AEC 3: Radio Tower Area

- AEC 4: Airstrip Area
- AEC 5: Former Inuit Camp Area [part of Inuit Owned Land (IOL) Area]

Information on environmental conditions and historic activities at the Contwoyto Lake WS has been obtained through the following:

- Integrated Phase I and Phase II Environmental Site Assessment, WK117- Contwoyto Lake Weather Station, Nunavut – WESA Inc. (WESA), 2011.
- Phase III Environmental Site Assessment Final Report for the Contwoyto Lake Remediation Program, Former Weather Station, NU – SENES Consultants (SENES), October 2013.
- Archaeological Impact Assessment, Contwoyto Lake Weather Station, Golder Associates, February 2013.
- Aboriginal Affairs and Northern Development Canada Community Meeting, Contwoyto Lake Weather Station Remedial Action Plan (RAP), Kugluktuk, Nunavut, Jan 15th, 2013.
- State of Knowledge Report, West Kitikmeot/Slave Study area (Sly et al., 1999)

A total of 230 samples have been analyzed as part of the two ESA programs. The laboratory work has comprised analyses of soil, surface water, sediment, building materials, paint, vegetation, and drum contents as shown below in Table 2-3.

Table 2-3 Laboratory Analysis

Sample Description	Phase I/II	Phase III	Total
Soil – chemical	33	101	134
Soil - geotechnical	0	4	4
Surface Water	5	12	17
Sediment	2	12	14
Building Materials	9	6	15
Paint	10	5	15
Vegetation	0	4	4
Drum Contents	0	27	27
Total	**59**	**171**	**230**

Based on the laboratory data, a quantitative summary of the key components for the remediation of the Contwoyto Lake former WS is provided below in Table 2-4, Table 2-5, and Table 2-6 for

impacted soil by AEC, discrete impact zones, hazardous/non-hazardous wastes, and drums/drum contents, respectively.

The volume of impacted media was calculated using laboratory data, site observations and comparison to CCME and AMSRP guidelines. Table 2-4 summarizes the impacted soil by AEC.

Table 2-4 Volume of Impacted Soils

Area	CCME(1)			AMSRP(2)	
	Volume			Volume	
	Metals-impacted sediment	PHC-impacted soils	Metals-impacted soils	Type B PHC-impacted soils	Tier II Metals-impacted soils
AEC 1	<0.05 m^3	0.2 m^3	0.1 m^3	0.1 m^3	0.1 m^3
AEC 2	0 m^3	1142 m^3	46.1 m^3	1142 m^3	36 m^3
AEC 3	0 m^3	0 m^3	0 m^3	0 m^3	0 m^3
AEC 4	0 m^3	0 m^3	0 m^3	0 m^3	0 m^3
AEC 5	0 m^3	0 m^3	0 m^3	0 m^3	0 m^3
Total	**<0.05 m^3**	**1142.2 m^3**	**46.2 m^3**	**1142.1 m^3**	**36.1 m^3**

(1) PHC data compared to 2008 Tier 1 coarse grained F1 to F4 for an agricultural land use. Metals data compared to Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health for an agricultural land use.

(2) PHC data compared to AMSRP Remedial Objectives for Hydrocarbon Contaminated Soil. Metals data compared to AMSRP DEW Line Cleanup Criteria (DCC) for Soil.

The majority of PHC-impacted soils are on the esker in the vicinity of the main communications camp building and the generator building. PHC impacts in these areas were reported to a maximum depth of 1.5 m below grade and were associated with above ground storage tanks (ASTs). In isolated areas in the old camp dump (debris area) the PHC impacts were reported to a maximum depth of 0.3 m below grade and were associated with old drums.

Soils impacted with metals were typically associated with debris in the old camp dump to a depth of 0.3 m below grade. Note that the majority of the metals-impacted soils are co-contaminated with PHCs.

Surface water impacts by anthropogenic activities were not identified at the former WS. One sediment impact from mercury was reported in the Phase II ESA. This result was not reproduced during the Phase III and therefore the sediment impact is considered isolated.

Hazardous waste identified at the site included wood with PCB-amended paint applications, wood and metal with Pb-amended paint applications, compressed gas cylinders, old batteries, old paint cans, jerry cans, and an old radiator. The volume of hazardous and non-hazardous waste and debris is summarized below in Table 2-5.

Table 2-5 Volume of Hazardous and Non-Hazardous Waste and Debris

Description of Hazardous Waste	Volume (m3)	Volume (m3)	Description of Non-Hazardous Waste
Wood with PCB-Amended Paint (PAP)	5.8	11.1	Plastics, ceramics, flooring, insulation, roofing
Compressed gas cylinders	0.5	85.3	Metal[(1)]
Old Radiator	0.01	14.0	Concrete
Decaying Batteries, paint cans	<0.01	12.1	Non-painted wood (burnable[2])
Jerry cans with residual contents	<0.01	**122.5**	**Non-hazardous Waste Total**
Freon from fridge, freezer	<0.01	**110.4 m^3**	**Non-hazardous Waste Total to Transport South (lower volume assumes untreated wood is burnt)**
Wood with Pb-amended paint	5.2		
Painted metal	1.9		
Hazardous Waste Total	**13.5 m^3**		

(1) Assumes a 30% reduction of drum volumes by crushing.

(2) Assumes approval from authorities having jurisdiction.

(3) This total does not include metals impacted soils to be shipped off-site. This total does not include 200 litres of petroleum based product and 200 litres of unknown product contained within drums to be shipped off site.

There were 279 drums identified on the site. The drum and drum contents overview is provided in Table 2-8.

Table 2-8 Drum and Drum Contents Overview

Detail	Quantity
No. of drums with liquid contents	99 drums
No. of empty drums	180 drums
Total No. of drums on-site	**279 drums**
Volume of water or oily water	1,700 litres
Volume of petroleum based product	200 litres
Total Volume of drum contents	**2,100 litres**
Volume of drum contents to treat on-site	**1,700 litres**
Volume of liquid to ship south[(1)]	**400 litres**

[(1)] Includes 200 litres of unknown product contained within 1 drum and 200 litres of petroleum based contained within multiple drums.

2.11 SOCIO-ECONOMIC

The nearest permanent community is Kugluktuk, which has a population of approximately 1,450 people with a total of 448 private dwellings (Statistics Canada, 2011). The median age of the population is 24.3 with 68.1% over the age of 15. According to Statistics Canada 2007 data the unemployment rate in Kugluktuk was 22%.

The Hamlet of Kugluktuk has a wide variety of community services and organizations. The community has two schools that provide education from kindergarten to Grade 12. Robert Hornal and Associates (RHA, 2002) reports that Nunavut Arctic College in Kugluktuk offers high school upgrading, as well as university and other special courses and programs. Outside agencies and employers have also provided training in the areas of geological sciences, construction trades, heavy equipment mechanics, kimberlite processing, and Inuit culture and language (Inuinnaqtun is the most common aboriginal language in Kugluktuk), especially since 89% of the inhabitants of Kugluktuk are of aboriginal descent (RHA, 2002). The hamlet also has a community health centre, elder's centre, youth centre, recreation centre, and wellness centre. Municipal services include electrical power generation, an airport, two retail stores, a hotel, a RCMP detachment, water and sewage collection, and a volunteer fire department (RHA, 2002).

3.0 REMEDIATION PROJECT DESCRIPTION

3.1 PROJECT ACTIVITIES

The scope of work planned for the Contwoyto Lake former weather station includes:

i) Remediation; and
ii) Observation.

The scope of work planned for the remediation project is summarized below in Table 3-1.

Table 3-1 Summary of Preliminary Preferred Remedial Options

Site Component	Preliminary Preferred Option
Physical Risks - Buildings	• Remove all hazardous building materials, consolidate and transfer to an appropriately licensed off-site facility. • Demolish all structures, there is 12.1 m^3 untreated wood on site, which will be open burned (assuming approval by AHJ) and ashes will be tested, classified as Hazardous or Non- Hazardous waste and removed off-site accordingly. Any remaining residual materials will be transferred to an appropriately licensed off-site facility.
Hazardous Materials	• Transfer 13.5 m^3 Hazardous Material to an appropriately licensed off-site facility.
Non-Hazardous Waste & Debris	• Consolidate and ship 110.4 m^3 of non-hazardous material off-site to an appropriate licensed off-site disposal facility.
Soils Impacted by Metals	• Consolidate and ship 36.1 m^3 of Tier II metal contaminated soil to an appropriately licensed off-site facility.
Soils Impacted by Petroleum Hydrocarbons	• Treat PHC-impacted soil (~1142.1 m^3) on site.
Drums and drum contents	• Consolidate the ~200 litres of fuels on-site and transfer to an appropriately licensed off-site facility. Transfer the 200 litres of unknown product to an appropriately licensed off-site facility. • On-site treatment of the ~1,700 litres of water and oily water contained within the drums. • Clean the 279 drums on-site, crush the drums to reduce their volume, transfer the crushed drums an appropriately licensed off-site facility.

3.2 SCHEDULE

Remediation work would be completed over the summer months and all equipment and waste materials, not managed on site, would be brought out at the end of the program on the next season's winter road. The following general project activities and milestones are anticipated:

- April 2014 - Mobilize to site.
- June to October 2014 & 2015 – Remedial activities.
- March 2016 – Demobilize from the site.

The schedule may change depending on procurement approach, contract award, regulatory approval and weather.

3.3 REMEDIAL ACTIVITIES

The remedial activities for the overall clean-up of the former WS are described in the following sections. Note that method, materials and equipment used to remediate the former WS will depend on the approach proposed by the contractor selected to perform the remediation. The details described below are based on our experience with remediation works of similar scope and remoteness such as the remediation works at the Roberts Bay/Ida Bay, Hidden Lake, Port Radium, Contact Lake and El Bonanza/Bonanza mine sites, as well as the Sawmill Bay drum clean-up and PIN-B Clifton Point DEW Line site remediation program.

For all remedial activities, it has been assumed that the protection of wildlife concerns and sensitive receptors will be addressed, as appropriate, as detailed in the Remedial Action Plan.

3.3.1 Mobilization and Demobilization

Mobilization and demobilization of material and equipment would occur during winter. A proper ice road would be constructed so tractor trailers could be used. It is assumed that ten flatbed trailers would be used. The winter site access is dependent on the availability of the Lupin Mine ice road. Assuming the construction of the winter road to Lupin Mine has occurred, the routing takes it within a few hundred metres of the former weather station and as such a spur line approximately 500 m long would be required to connect the site to the winter road. If the construction of the winter road to Lupin Mine is not constructed, a winter road of 130 km, from the Ekati Mine turn-off, would be required. Table 3-2 summarizes the winter road construction requirements based on the two scenarios.

Table 3-2 Winter Ice Road

Scenario	Length of Winter Road Construction Required
Lupin Mine ice road built	500 metres
Lupin Mine ice road not built	130 km

It has been reported that the Lupin Mine ice road will not be constructed in the subsequent years. Therefore the winter mobilization/demobilization of material and equipment would take up to a week per winter road season to complete. As part of the demobilization, the waste material would be transported via trailer to disposal facilities in Southern Canada via the winter ice road.

Another option would be the construction of an ice Airstrip. Hercules aircrafts have landed on Contwoyto Lake in the past without incident. April would be the optimum time to mobilize with the Hercules onto the ice, as the ice is at its maximum thickness (usually 59" of ice exists in the spring, on the lake) and also there will be more daylight hours for mobilization activities. An ice airstrip could be constructed that is about 5500 feet in length and 200 feet in width.

Ice thickness will be monitored and ice flooding techniques can be utilized to build up the airstrip ice thickness, if required. Snow accumulation and temperatures would also need to be closely monitored. This could be possible with the use of the weather station at Lupin, to identify any unseasonably warm trends that may require earlier flooding to increase ice thickness to complete the airstrip.

Should thin ice and/or heavy snowfall prevent an ice airstrip mobilization option, a contingency plan of using a Hercules for air mobilization to the Lupin mine airstrip would be another option. Lupin has a 6000 foot airstrip and the Hercules has landed on this strip in the summer of 2013, so the grade is acceptable to accommodate the aircraft. Lupin has a site road that leads to the edge of Contwoyto Lake. This would allow the mobilization crew to cross the ice on Contwoyto Lake, in order to reach the Contwoyto Lake Remediation Site.

3.3.2 Work Camp

During the summer field season, a soft camp could be used and situated atop the esker format that was used as an emergency airstrip when the weather station was in operation. The camp would be seasonal.

During the winter mobilization of the fleet, crews would be housed in mobile trailer units.

The number of on-site personnel will be determined by the selected remediation contractor. It is assumed that a minimal crew of six to eight workers (including wildlife monitor) would be used to consolidate the hazardous waste materials, demolish the structures and consolidate waste while another field crew of up to four workers would be used to consolidate the drums on site. Subsequently, a crew of six workers (including the wildlife monitor) would be used to prepare the contaminated soil treatment area, excavate and treat the petroleum hydrocarbon impacted materials, and excavate and consolidate the metal impacted soils for off-site transport.

The camp to accommodate the on-site personnel would consist of the appropriate number of tents, a cooking area and a waste disposal area. The camp will have to abide by the water license and land use permit.

3.3.3 Site Vehicles

There are no roads on site and given the terrain all-wheel drive vehicle or track machines would be required for the remediation program unless some surface improvements are made to allow for heavier wheeled equipment (e.g. geoweb geosynthetic reinforcement).

Depending on the final remedial strategy and the option selected a combination of excavators, dump trucks and/or bulldozers, pickup trucks, and ATVs will be required. The equipment fleet for the site remediation is projected to include an excavator, bulldozer, loader, packer, two rock trucks, two pickup trucks, and four ATVs with trailers. Ultimately, the selected fleet will be dependent on the remediation contractor. The use of the vehicles will be as site conditions allow.

Considerations for site vehicles are as follows:

- All personnel will have the appropriate license required to operate the vehicles.
- Vehicles will be operated in accordance with the Government of Nunavut (GN) Motor Vehicles Act.

- All occupants within vehicles must wear seatbelts at all times.
- Vehicles will not be driven in excess of posted speed limits. Road and traffic conditions may dictate lower maximum allowable speeds.
- Vehicles must be maintained in clean condition.
- All personnel will be responsible for conducting maintenance checks of fuel, all fluids and tire pressure, and for ensuring that required safety/emergency equipment is present prior to departure.
- All operators will conduct a thorough walk-around of vehicles prior to departure. Windows and mirrors are to be kept clean and free of obstruction.

The use of motor vehicles will be consistent with the following Acts, policies, or directives:

- Motor Vehicles Act
- All-Terrain Vehicle Act
- Vehicle Use Guidelines

It is presumed that snowmobiles and watercraft will not be used for the remediation project.

3.3.4 Hazardous Material Abatement

Considering the relatively low volumes of hazardous waste, the preferred remedial option for these materials is off-site disposal. Hazardous materials would be consolidated at the site and placed into a temporary staging area using appropriate methods pursuant to off-site disposal either via aircraft or winter road during the demobilization from the site. Likely, the off-site disposal of hazardous materials will be via aircraft and then shipped to an appropriate off-site licensed disposal facility.

3.3.5 Building Demolition and Debris Clean-up

All structures would be demolished and residual non-hazardous debris from across the site will be consolidated and transferred via aircraft during demobilization to an off-site licensed disposal facility.

The untreated wood from the demolition of the existing structures would be burned and the ash tested and then classified as hazardous or non-hazardous and then transferred off-site for disposal accordingly. There is an estimated 12.1 m^3 of untreated/ unpainted wood.

The sections of the radio tower will be consolidated and transferred off-site to an appropriate off-site disposal facility.

3.3.6 Drum Contents Consolidation and Cleaning

Liquid residual in drums would be consolidated into two basic streams: residual organic liquids totalling an estimated 400 litres; and, residual water and oily water, totalling an estimated 1,700 litres. The organic liquids would be transferred off-site to an appropriate licensed facility for disposal. The water would be treated on-site using a system likely comprising of an oil-water separator and carbon filtration with discharge criteria set in accordance with the water license. The emptied drums would be cleaned and subsequently crushed along with the empty drums on-site. The crushed drums would be transferred off-site for disposal to appropriate licensed facility. It is assumed that a 30% reduction of drum volumes can be achieved by on-site crushing. The selected contractor will have to abide by the discharge criteria in the site specific water license. The discharge criteria will be applied to the treated liquid in the drums as well as the process water used to clean the drums. Discharge locations will have to be approved by the land use inspector. It is anticipated that a diffuser will be used to minimize the potential for erosion.

3.3.7 Soil Excavation

Soil excavations will include transferring PHC-impacted soils to the treatment area, excavating metal-impacted soils for transfer off-site to an appropriate licensed facility and gathering borrow material from the esker.

A borrow source examination was completed as part of the Phase III ESA. The results of the soil index testing which was part of the Phase III ESA are summarized in the table below.

Table 3-3 Summary of Soil Index Testing of Potential Borrow Material

Sample Location	Proctor Value (kg/m3)	Optimum Moisture Content (%)	Soil Classification
Airstrip	1972	8.5	Sandy Gravel (coarse to medium) with trace fines
Airstrip	1874	12.5	Coarse sand and Gravel some medium to fine sand, trace silt
Airstrip	1811	12.5	Coarse sand and Gravel some medium to fine sand, trace silt
Peninsula	1791	10.5	Gravelly coarse to medium sand with trace fines

In general the potential borrow sources are a mix of coarser sands and gravels with variable amounts of cobble and fines. This material would be free draining soil.

On the basis of the survey work completed during the Phase III ESA program the volume of available borrow from the Peninsula esker would be on the order of 12,000 m^3 however given its proximity to Contwoyto Lake a variance under the quarry permit terms and conditions would be required to allow this material to be used as a borrow source. The volume of borrow available from the airstrip borrow area, assuming that the former emergency airstrip is to be decommissioned, would be on the order of 90,000 m^3. This volume does not include for the parts of the esker that are currently occupied by the former weather station. The only limiting factor on the available borrow is the amount of permafrost within the upper 5 m of the esker. This may result in the available borrow volumes being reduced to a quarter of the maximum available borrow noted above, however, the nature of the aggregate within the borrow areas is such that the ice would readily melt and the water drain from this material once exposed at surface.

The borrow requirement will include backfilling the impact zones and capping the soil treatment area with clean fill. The volume of required borrow is estimated to be less than 5,000 m^3.

3.3.8 Soil Treatment

Construction of a soil treatment area for land farming of PHC impacts is a viable remedial option at this site. The light fraction petroleum hydrocarbons are expected to be treated within one summer field season provide the work starts by mid-June. On-site soil treatment requires the

PHC impacts to be managed in accordance with the AANDC Abandoned Military Site Remediation Protocol (AMSRP). PHC Impacted Soils will be treated on-site until they meet the applicable AMSRP clean-up standards. After the treatment of the light fraction hydrocarbon impacted soil, the treated soil will be used to backfill the remediation excavations. There are no Type B (as defined by the AMSRP) impacts.

The estimated time of 16 weeks for the treatment of the PHC impacted soils is based on our recent work at the Polar Continental Shelf Facility clean-up in Tuktoyaktuk where PHC impacted soils were treated in a manner consistent with what is anticipated for the Contwoyto Lake program. For the Tuktoyaktuk program two short seasons were required due to the late start to the remediation work. It is anticipated that the same number of weeks of work will be required as the volume of impacted soil, the nature of the soil and the impacts therein are similar.

3.3.9 Winterization

Winterization for the equipment and materials on-site will likely involve a nine month winterization period.

4.0 PROJECT/ENVIRONMENT INTERACTIONS

4.1 IDENTIFICATION

The environmental work to date has identified impacted media including PHC-impacted soils, metals impacted soils, hazardous debris, non-hazardous debris, and liquid contents within drums. The following subsections identify components of the environment which will be of consideration during the remediation project.

4.1.1 The Esker

On the basis of the site reconnaissance program undertaken during the Phase III ESA the esker material on site was observed to comprise mainly sands and gravels with variable amounts of cobble and boulder.

The results of the test pit work within the airstrip identified fine to coarse sand and gravels over the upper 500 mm. The cobble and boulder content increased the further east one was relative to the former weather station camp. Field observations indicated that the sidewalls of the test pits continued to collapse, thus suggesting that there was minimal moisture and little to no silt or clay within the airstrip esker material.

The results of the test pit sampling within the esker on the Peninsula confirmed that the material at this location was primarily fine to coarse sand and gravel at depths greater than 500 mm. A field observation of note was that the sidewalls of the test pit continued to collapse, thus suggesting that there was minimal moisture and little to no silt or clay within the Peninsula esker material.

4.1.2 Marshlands

The overburden within the marshland located to the north and south of the airstrip portion of the esker on site has a surficial cover of organic material, such as peat and mosses, approximately 50 mm to 200 mm thick underlain by fine grained sands and silts. The overburden material in this part of the site is generally wet to saturated

4.1.3 Permafrost

A permafrost assessment was completed in 2012 as part of the Phase III ESA.

The site is located in an area of continuous permafrost (90-100%) (NRCan, 1995). Summer active layer depths above the permafrost depend on vegetation cover, subsurface material type, and moisture conditions, but typically range from about 15 cm depth in areas supporting a thick organic mat to more than 120 cm in areas where vegetation cover is thin (Dredge et al. 1999).

Due to the coarse grained characteristics of the surficial materials and the moderately continuous vegetative cover at the site, the local active layer is shallow in poorly drained areas and deeper in areas with well-drained soil conditions (i.e. in areas of sand deposits such as the on-site esker).

During the course of the Phase III ESA program the active zone of permafrost was encountered only at locations where soil sampling extended to depths greater than a metre and as such permafrost conditions were only observed within the esker material located within the vicinity of the former weather station.

During the course of the borehole sampling at the Camp Area it was observed that the top of the permafrost (active layer) was encountered approximately 0.5 to 1.0 m below grade with the base of the active layer approximately 1.21 to 1.48 m below grade.

4.1.4 Groundwater

No groundwater was encountered during the Phase III ESA borehole program however approximately 25 to 50 mm of saturated soil was reported in isolated locations around the former weather station buildings. There was no evidence of seepage zones along the esker slopes and as such it was inferred that the active zone of the permafrost mirrors the topography of the site with little to no groundwater being generated given the depth of the active zone. In other words there is insufficient thermal energy to allow sufficient ice to melt within the active zone to create a measurable groundwater condition. The groundwater that could be available is effectively frozen all year round.

It is expected that infiltrating surface water at this site would follow the local contours of any permafrost (and/or bedrock in areas of shallow overburden) toward low-lying areas and that any permafrost at the bottom of the active layer would act as a barrier below the groundwater table.

4.1.5 Vegetation

Plant species identified at the site through direct observation are listed above in Section 2.8.

4.1.6 Wildlife

Wildlife species identified at the site through direct observation as well as those possible to habitat the site are identified above in Section 2.9

4.1.7 Fresh Water

4.1.7.1 *Contwoyto Lake*

Contwoyto Lake is approximately 1000 km2. Contwoyto Lake drains both north and south through two rivers: the Burnside and the Back. The Burnside River flows from the northern end of the lake into Bathurst Inlet. At its southern end, Contwoyto Lake drains into Pellatt Lake, which in turn flows via the Contwoyto River into Back River and then on to Chantry Inlet. No surface water impacts were identified for the Contwoyto Lake waters surrounding the former WS site.

4.1.7.2 *Inland waters*

The inland waters in the vicinity of the site are of varying size and fluctuate seasonally. No surface water impacts within the inland waters were reported in the Phase I/II ESA or the Phase III ESA.

4.1.8 Noise

Noise pollution is defined as displeasing or excessive noise that may disrupt the activity or balance of human or animal life. The source of noise during the remedial works will be mainly caused by machines, motor vehicles, and aircrafts arriving at site.

4.1.9 Air

Although site-specific measurements are not available for the Contwoyto Lake WS, air sampling at other northern abandoned mine sites has found excellent air quality well below the Ambient

Air Quality Standard (AAQS) for the Northwest Territories, Nunavut, and other jurisdictions. The concentrations of conventional pollutants (i.e. total suspended particulate - TSP, sulphur dioxide - SO_2, nitrogen oxides - NO_x) at the Contwoyto Lake WS Site are expected to be similar, as there are no significant sources of these pollutants in the local study area. Furthermore, the site is small with a limited footprint of historically disturbed area, has been inactive for many years, and contains only limited features that are potentially subject to wind disturbance/erosion.

4.2 IDENTIFICATION OF VALUED ENVIRONMENTAL AND SOCIO-ECONOMIC COMPONENTS

This ESAR has been prepared in a manner that is consistent with NIRB requirements as outlined in the Article 12 of the NCLA and the Guide 3: Guide to Filing Project Proposals and the Screening Process (NIRB, 2007a). In order to determine project and environment interactions, it is necessary to identify relevant ecosystem components (biological and anthropogenic), determine potential impacts to those components based on the scope of work, and the possible mitigation strategies available to reduce or eliminate those impacts. The sections below outline the process to identify and determine the interactions

The NIRB (NIRB, 2007b) defines valued ecosystem components (VECs) as "those aspects of the environment considered to be of vital importance to a particular region or community, including:

- Resources that are either legally, politically, publicly or professionally recognized as important, such as parks, land selections, and historical sites;
- Resources that have ecological importance; and
- Resources that have social importance."

Valued Socio-Economic Components (VSECs) are defined by the NIRB (NIRB, 2007b) as "those aspects of the socio-economic environment considered to be of vital importance to a particular region or community, including components relating to the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and community and local government organizations."

Potential VECs and VSECs were identified in a four-stage process. Initially, a review of the regulatory responsibilities of applicable Nunavut and other government agencies was completed, including the NIRB. Also, VECs and VSECs identified in northern projects of similar scope were reviewed, such as the the remediation works at the Roberts Bay/Ida Bay, Hidden Lake, Port

Radium, Contact Lake and El Bonanza/Bonanza mine sites, as well as the Sawmill Bay drum clean-up and PIN-B Clifton Point DEW Line site remediation program. Once these VECs and VSECs are identified, they are confirmed during the public consultation process and in discussions with local government; in this case the Kitikmeot Inuit Association (KIA). Finally, based on the activities in the proposed RAP, professional judgement of environmental practitioners and remediation specialists identified any potential gaps in the VECs and VSECs previously identified.

In keeping with the above policies, community representatives from the Inuit community of Kugluktuk participated in consultations regarding the RAP for the Contwoyto Lake Remediation Project. A community meeting was held on January 15th, 2013. The community consultation meeting minutes are attached within the Phase III ESA. As a result of this selection process, a comprehensive list and selection rationale was developed and is outlined below in Table 4-1.

Table 4-1 List of VECs and VSECs

VEC or VSEC	VEC Selection Process			
	Regulatory Requirement	Identified in other ESRs	Public / Inuit Input	Professional Judgement
Climate and Air Quality	✓	✓		✓
Terrain and Geology		✓	✓	✓
Soils	✓	✓		✓
Hydrology and Hydrogeology	✓	✓		✓
Vegetation	✓	✓	✓	✓
Wildlife (Terrestrial Species)	✓	✓	✓	✓
Wildlife (Aquatic Species)	✓	✓	✓	✓
Cultural Features and Special Places	✓	✓	✓	✓
Job Opportunities	✓	✓	✓	✓
Current Employers	✓		✓	✓
Traditional Land Use	✓	✓	✓	✓
Community Services	✓	✓		✓
Aesthetics	✓	✓	✓	✓

4.3 IDENTIFICATION OF PROJECT IMPACTS AND MITIGATION

To determine the potential impacts to the various VECs or VSECs, the baseline information along with specific project activities outlined in the RAP were reviewed, and using professional judgement, project activities that would impact/interact with a specific VEC or VSEC were identified. As recommended by the NIRB (2010b) in *Screening Part 2Form Project Specific Information Requirements (PSIR)* this process was completed using a matrix of project activities versus VECs and VSECs. This matrix and the results of the process are included in Table 4-2.

Table 4-2 Identification of Project Impacts on VECs and VSECs

VEC or VSEC	Remediation Project Activities											
	Site Preparation and Camp Operations			Remediation[1]							Closure	
	Mobilization and Transportation of Personnel and Equipment to Site	Temporary Site Requirements[1] – Camp, Hazardous Material Storage Area, Drum Wash Station	Camp Operation[1]– Waste Treatment and Water Use	Structure Demolition and Debris Removal	On-Site Burning of Non-Hazardous Wood Waste	On-Site Consolidation of Hazardous Waste	On-site Treatment of Liquid Waste within Drums	Removal of Contaminated Soils	Construction and Operation of Landfarm	Off-Site Transportation of Waste to Disposal Facility via Winter Road to Yellowknife[2]	Impact Zone Regrading and Natural Re-vegetation of Disturbances	Demobilization and Transportation of Personnel and Equipment Off-Site
Climate and Air Quality	√	√	√	√	√	√	√	√	√	√	√	√
Terrain and Geology	√	√		√				√	√	√	√	
Soils	√	√	√	√	√	√	√	√	√	√	√	√
Hydrology and Hydrogeology	√	√	√	√			√	√	√	√	√	√
Vegetation	√	√	√	√			√	√	√	√	√	√
Wildlife (Terrestrial Species)	√	√	√	√		√	√	√	√	√	√	√
Wildlife(Marine Species)		√								√		
Cultural Features and Special Places		√		√				√	√	√	√	
Job Opportunities	√	√	√	√	√	√	√	√	√	√	√	√
Current Employers	√	√	√	√	√	√	√	√	√	√	√	√
Traditional Land Use		√	√	√	√	√	√	√	√	√	√	
Community Impacts	√	√	√								√	√
Aesthetics		√	√					√	√		√	

Notes:

1 – Stipulated by conditions within Land Use Permit/Water License

2 – Materials to be shipped off-site to appropriate licensed disposal facilities: metals, crushed drums; hazardous waste such pressurized cylinders, batteries, materials with lead paint and PCB paint applications, and non-hazardous waste such as metal, plastic and glass.

In NIRB (2007c) Guide 4: Guide to Project Proposals Exempt from Screening significance is defined as "…a consideration of the context of the project and the intensity of adverse effects, by giving particular regard to the following:

- The environmental sensitivity of the geographic area likely to be affected by the project;
- The historical, cultural and archaeological significance of the geographic area likely to be affected by the project;
- The extent of the effects of the project, including the geographical area that will be affected, the size of the affected human populations, and the size of the affected wildlife populations and related habitat;
- The extent of the effects of the project on other regional human populations and wildlife populations, including the extent of the effects on Inuit harvesting activities;
- The magnitude and complexity of adverse effects;
- The probability of adverse effects occurring;
- The frequency and duration of adverse effects;
- The reversibility or irreversibility of adverse effects; and
- The potential for cumulative adverse effects given past, present and future relevant events."

Environmental effects are defined as "any positive or negative change in the biophysical and/or socio-economic environment caused by, or directly related to, a former, ongoing or proposed activity (NIRB, 2007b). There are two types of effects:

- Direct effects - refer to changes in the environmental components that result from direct cause-effect consequences of interactions between the project activities and the environment.
- Indirect effects - result from cause-effect consequences of interactions between the environment and direct impacts. For example, the effect of pollution may not only be seen directly in the loss of local vegetation, but indirectly as a degradation of the health, culture and social structure of the local people."

Socio-economic effects are defined as "…any of a variety of social and economic effects, including impacts upon the local economy, health, demographics, traditional way of life, cultural well-being, social life, archaeological resources, existing services and infrastructure, and local and regional government organizations" (NIRB, 2007b).

Once an impact to a particular VEC or VSEC was identified, the impact was rated using the system outlined in Table 12. This system is based on Smardon et al. (1976) and Leopold et al. (1971). This system was used by AMEC (2008) for a screening report for the PIN-B Clifton Point DEW Line site remediation program, by EBA for a screening report for the Hope Lake Sites (2011) and has been advocated by Canadian Environmental Assessment Agency (EBA, 2011).

This rating system has been modified so that the definitions provided by NIRB have been considered and to make it suitable for this project.

Table 4-3 Impact Rating Criteria

Attribute	Options	Definition
Direction	Positive	Beneficial impact to population or resource.
	Neutral	No change to population or resource.
	Negative	Adverse impact to population or resource.
Scope	Local	Impact restricted to area within 1 km of the Project site.
	Regional	Impact extends up to several kilometers from the Project site.
	Territorial	Impact extends throughout Nunavut.
Duration	Short-Term	Impacts are significant for less than a year before population or resource returns to its previous state; or for a species, less than one generation.
	Medium-Term	Impacts are significant for 1 to 10 years; or for a species, for one generation.
	Long-Term	Impacts are significant for greater than 10 years; or for a species, significant for than one generation.
Frequency	Once	Occurs only once.
	Intermittent	Occurs occasionally at irregular intervals.
	Continuous	Occurs on a regular basis and regular intervals.
Magnitude	Negligible	No measurable change from background in the population or resource; or in the case of air, soil or water quality, if the parameter remains less than the standard, guideline or objective.
	Low	Impact causes <1% change in the population or resource (where possible the population or resource base is defined in quantitative terms).
	Moderate	Impact causes 1 to 10% change in the population or resource.
	High	Impact causes >10% in population in resource.
Probability	Low	The impact is unlikely to occur.
	Medium	The impact is fairly likely to occur.
	High	There is a high probability of the impact occurring.

Attribute	Options	Definition
Significance	Insignificant	Minimal or no measurable change from background conditions that may last over a long- term period.
	Significant	Measurable change from background conditions that may last over a long-term period.
	Unknown	Insufficient data available to make a professional judgement, more study required.

Different project activities have similar impacts and impact ratings and consequently similar mitigation strategies; therefore, in the following sections, project activities with analogous impacts, impact ratings, and mitigation have been grouped together for each of VECs and VSECs. The following tables provide an assessment of project interactions, potential impacts and ratings, and mitigation strategies. A brief summary for each VEC is also included. A discussion, rather than a table format, is provided for VSECs and project interactions later in the report. Only residual impacts, those impacts that cannot be mitigated and that are also considered significant, are discussed later in the ESAR.

4.4 PROJECT IMPACTS AND MITIGATION

4.4.1 Climate and Air Quality Impacts

Table 4-4 Assessment of Impact on Climate

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Greenhouse gas emissions from this project are insignificant so mitigation is not required
Mobilization and transportation of personnel and equipment to sites (winter road to mobilize equipment and demobilize equipment and waste, twin otter to mobilize/demobilize personnel during summer remedial works.	Greenhouse gas emissions from equipment operation, camp waste incineration, and transportation events.		
Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station			
Camp Operation – Waste Treatment and Water Use			
Remediation			
On-site burning of non-hazardous wood waste Structure demolition and debris removal On-site consolidation of Hazardous Waste On-site treatment of liquid waste within drums Treatment and Removal of contaminated soils Construction and Operation of landfarm Off-site transportation of waste to disposal facility via winter Road to Yellowknife	Greenhouse gas emissions from wood waste, incineration equipment, and from equipment operation.		
Closure			
Impact zone regrading and natural revegetation of disturbances, long-term monitoring Demobilization and Transportation of Personnel and Equipment Off-Site	Greenhouse gas emissions from equipment operation and transportation events.		
Summary: Adverse potential impacts to air quality with respect to climate are associated with all phases at all project areas, including mobilization, remediation and demobilization. As a result emissions of greenhouse gases, nitrogen oxides (NOx), sulphur dioxide (SO2) particulate matter, and carbon monoxide (CO) due to combustion of aviation fuel, diesel fuel and gasoline; burning of non-hazardous wood waste will increase. Emissions from construction equipment, however, will be short term and intermittent and will not have a significant residual effect on the climate within the local study area, regionally, or nationally.			

Table 4-5 Assessment of Impacts on Air Quality

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control Best Management Practices (BMP), such as using water for controlling dust and limiting remediation activities during high wind periods Exhaust emissions for project are insignificant so mitigation is not required
Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station	Dust from development of temporary remedial requirements, borrow pit, and transport on-site. Exhaust emissions from equipment operation		
Remediation		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: Low (hazardous emissions) High (particulate matter) Significance: Insignificant	Proper segregation of wood from other material so only wood is burned Proper training of burning operators to ensure high temperatures to limit particulate emissions
On-site burning of non-hazardous wood waste	Potentially hazardous air emissions if hazardous material is burned with wood Potentially increased emissions of particulate matter		
On-site treatment of drum contents	Exhaust emissions from equipment operation	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Exhaust emissions for project are insignificant so mitigation is not required
Structure demolition and debris removal On-site consolidation of hazardous waste Treatment and Removal of contaminated soil Potential construction and operation of landfarm Off-site transportation of waste to an appropriately licensed disposal facility	Potential emissions of hazardous waste particles and dust while completing remediation activities and the potential construction and operation of landfarm Exhaust emissions will result from equipment operation	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: Medium Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods Careful segregation and transportation of hazardous waste Exhaust emissions for project are insignificant so mitigation is not required
Closure		Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods Exhaust emissions for project are insignificant so mitigation is not required
Site regrading and natural revegetation of disturbances Demobilization of camp and construction equipment	Potential dust emissions while regrading disturbed areas Exhaust emissions from equipment operation		
Summary: Adverse potential impacts to air quality are associated with all phases at all project areas, including mobilization, remediation and demobilization. In order to complete the proposed remediation, heavy equipment, liquid waste treatment, and incineration equipment will be used and wood and camp waste will be burned. As a result emissions will increase due to combustion of aviation fuel, diesel fuel and gasoline, and burning of wood waste. Emissions from vehicles and construction equipment however will be short term and intermittent and will not have a significant residual effect on air quality within the local study area, regionally or nationally. Dust generation is expected to also be low in volume and infrequent. A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to: dust suppression/control measures, implementation of good practice measures and avoidance of work during extreme wind events. There is potential for emissions of dioxins and furans through the inadvertent burning of hazardous wastes, but these will be managed by ensuring on-site diversion and segregation of waste, thus ensuring only the unpainted wood waste stream is burned. Additionally, the amount of soil exposed and disturbed will be limited to the areas requiring remediation and the movement of soils will be minimized whenever possible. Exposed soil piles will be covered, including the landfarm subsequent to remediation. A BMP for Dust Control will be developed and implemented and will contain these and other measures. Following implementation of mitigation measures, adverse impacts associated with project activities to air quality will be local, short term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.			

4.4.2 Terrain and Geological Impacts and Mitigation

Table 4-6 Assessment of Impacts on Terrain and Geology

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Once Magnitude: Low Probability: High Significance: Insignificant	
Mobilization and transportation of personnel and equipment to sites Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station	Site preparation and construction activities could disturb the terrain and potentially damage permafrost. Winter road construction could disturb terrain.		The winter road construction is scheduled to use the same routing as the Lupin Mine Ice Road using the same company that has previously constructed the route. The on–site use of the existing esker (previously used as an airstrip) as a roadway and to limit creation of new disturbed areas Disturbed areas will be recontoured to match pre-disturbance conditions to the fullest extent possible
Remediation			Proper operation of the landfarm to ensure impact is contained within the landfarm Limit exposure time of the permafrost
Potential construction and operation of landfarm	Disruption of surficial geology may provide a potential pathway for impact to subsoils. Permafrost may be damaged		
Structure demolition and debris removal On-site burning of non-hazardous wood waste Treatment and Removal of contaminated soil Off-site transportation of waste to Yellowknife and then to a disposal facility	Remediation activities could disturb the terrain and potentially damage permafrost		Minimize disturbance to the terrain Ensure incineration areas are properly constructed to avoid impact to permafrost Recontour disturbed area quickly to match pre-disturbance conditions Use of low pressure equipment while transporting untreated waste to Kugluktuk
Closure		Direction: Negative Scope: Local Duration: Short-term Frequency: Once Magnitude: Low Probability: Moderate Significance: Insignificant	
Site recontouring and natural revegetation of disturbances	Activities could disturb the terrain and potentially damage permafrost		Land surface will be recontoured to match pre-disturbance conditions to the fullest extent possible Surface area and time of permafrost exposure will be minimized
Summary: Adverse potential impacts to geology are associated with the construction of a landfarm and the potential for impact of the underlying geology. However, if proper construction and maintenance techniques are followed no impacts are expected and the construction of a landfarm is not expected to contribute to any adverse cumulative effects. It is expected that the Project will have long-term beneficial effects on the geology at the sites due to the removal or treatment of hazardous waste and removal and treatment contaminated soil as these sources of impact will have been removed. No residual or cumulative impacts to geologic resources are expected. It is expected that the esker will remain as an emergency airstrip once remedial works are complete.			

4.4.3 Soil Impacts and Mitigation

Table 4-7 Assessment of Impacts on Soil

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the Transportation of Dangerous Goods Act and Regulations (Government of Canada 1992) Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from water bodies
Mobilization and transportation of personnel and equipment to site. Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station. Camp Operation – Waste Treatment and Water Use	Potential impact of soil from spills when refuelling and servicing equipment and during transportation events on ice road Degradation (erosion, compaction, admixing) of soil during site preparation activities		
Camp construction and potential development of borrow pit(s)	Degradation (erosion, compaction, admixing) of soil during site preparation activities	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Use of existing esker as a road and previously disturbed areas to the fullest extent possible Soil will not be disturbed during extreme windy conditions
Remediation		Direction: Negative (beneficial once non-hazardous and hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies. All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site consolidation of hazardous solid waste. On-site treatment of aqueous liquid waste Treatment and Removal of contaminated soil. Potential construction and operation of landfarm. Off-site transportation of waste to appropriate licensed disposal facility via winter road or via aircraft	Potential impact of soil from spills when refuelling and servicing equipment Potential soil impact while removing, transporting, burning or incinerating remediation materials, and potential landfarm construction		
Structure demolition and debris removal Treatment and Removal of contaminated soil Potential landfarm construction and operation Off-site transportation of waste to an appropriately licensed disposal facility	Degradation (erosion, compaction, admixing) of soil during remediation activities such as removing waste, contaminated soil or potential landfarm construction	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Use existing roads, pathways and previously disturbed areas to the fullest extent possible Topsoil and subsoil will be handled and stored separately Soil will not be disturbed or handled during wet and / or windy conditions
Closure		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill. Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies. Hazardous waste and fuel storage areas (including drums) will be inspected daily. Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act and Regulations* (Government of Canada, 1992)
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Potential impact of soil from spills when refuelling and servicing equipment		

Table 4-7 Assessment of Impacts on Soil (cont`d)

Project Activity	Potential Impact	Impact Rating	Mitigation
Site recontouring and natural revegetation of disturbances	Degradation of soil (erosion, compaction, admixing) during recontouring	Direction: Negative Scope: Local Duration: Short-term Frequency: Once Magnitude: Low Probability:Moderate Significance: Insignificant	A Soil Management BMP will be developed and implemented Topsoil and subsoil will be handled and stored separately Soil will not be disturbed or handled during wet and / or windy conditions

Summary:

Adverse potential impacts to soils are associated with all phases of the Project, including mobilization, remediation and demobilization, especially in the event of extreme precipitation. Adverse effects may include degradation of soil through compaction and/or admixing of topsoil and subsoil. Potential soil impact can occur from improper storage, transportation and use of fuel and hazardous waste.

Adverse effects associated with extreme precipitation events include erosion, slumping or sliding of surficial materials (especially during landfarm construction and operation, if required). A number of measures will be implemented to mitigate the potential adverse effects associated with project activities. These will include, though not be limited to, locating access routes and storage areas on previously disturbed areas, limiting the area and time that permafrost is exposed, re-contouring and grading to ensure that landforms match pre- disturbance conditions as much as possible. Other measures include avoiding working with equipment during extreme precipitation events, and if required separating topsoil and subsoil during construction activities. A soil handling protocol will be developed prior to construction activities.

To mitigate the impacts of potential soil impact, fuel and hazardous material will be stored in an easily accessible bermed area, hazardous waste and fuel storage areas (including drums) will be inspected daily. Fuel and hazardous material containers will be stored in a manner that allows easy removal in case of a leak or spill. A Spill Contingency BMP will be developed and implemented, and along with spill containment equipment, be available to all workers on-site.

Overall, the removal of abandoned site infrastructure and debris, removal or treatment of hazardous and non-hazardous waste, and removal or treatment of contaminated soil will be beneficial to soil resources as sources of impact will be removed. Following implementation of mitigation measures, adverse effects associated with project activities to landforms and soils will be local, short term and insignificant. Additionally, these impacts are not expected to contribute to any adverse cumulative effects.

4.4.4 Hydrology and Hydrogeology Impacts and Mitigation

Table 4-8 Assessment of Impacts on Hydrology and Hydrogeology

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations			
Mobilization and transportation of personnel and equipment to site. Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station.	Potential impact of surface water and groundwater from spills when refuelling servicing equipment and during transportation events.	Direction: Negative Scope: Local Duration: Short-Term Frequency:Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies. Transportation procedures on-site and off-site will be in accordance with the Transportation of Dangerous Goods Act and Regulations (Government of Canada 1992)
Camp construction and potential development of borrow pit(s)	Sedimentation or damage to riparian areas can occur during site activities	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	Development and implementation of a Sediment Control BMP. Placement of temporary (during remediation) and permanent erosion control measures (i.e., berms, silt fences) Limit disturbance of any new areas Borrow area will be away from the slopes of the esker. Disturbed areas adjacent to water bodies will be stabilized if necessary. Environmental monitoring will occur during construction activities to ensure erosion control measures are implemented and adequate
Camp Operation – Waste Treatment and Water Use	The operation of the work camp will include disposal of camp sewage, grey water, garbage and other non-hazardous wastes which could impact water quality	Direction: Negative Scope: Local Duration: Short-term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Camp sewage and grey water will be diverted to sumps that are located at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Sumps will be closed off at the end of remediation activities All other camp waste will be disposed of off-site on completion of the remediation activities
Remediation			
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site consolidation of hazardous solid waste On-site treatment of aqueous liquid waste Treatment and Removal of contaminated soil Potential landfarm construction and operation Off-site transportation of waste via aircraft and then to appropriate licensed disposal facility	Potential impact of surface water and groundwater from spills when refuelling and servicing equipment Potential surface water and groundwater impact while removing, transporting, burning or incinerating waste materials, and potential landfarm construction	Direction: Negative (beneficial once non-hazardous, but especially hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily Hazardous materials and contaminated soil will be exposed for as short time as possible All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Landfarm will be constructed to ensure leachate will not impact the surrounding environment

Table 4-8 Assessment of Impacts on Hydrology and Hydrogeology (cont`d)

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal Removal of contaminated soil Potential construction and operation of landfarm	Sedimentation or damage to riparian areas can occur during remediation activities that disturb the land surface	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	Development and implementation of a Sediment Control BMP. Placement of temporary (during remediation or landfarm construction) erosion control measures (i.e., berms, silt fences) Limit disturbance of any new areas Disturbed areas near adjacent to water bodies will be stabilized Remedial excavations or landfarm design should provide for proper drainage and soil stability Environmental monitoring will occur during remediation activities to ensure erosion control measures are implemented and adequate
Closure		Direction: Negative (beneficial once non- hazardous, but especially hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and
Demobilization and transportation of personnel and equipment off-site Site recontouring and natural revegetation of disturbances	Potential impact of surface water and groundwater from spills when refuelling and servicing equipment		
Site recontouring and natural revegetation of disturbances	Sedimentation or damage to riparian areas can occur during site recontouring	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Moderate Significance: Insignificant	Development and implementation of a Sediment Control BMP. Disturbed areas near adjacent to water bodies will be stabilized Recontouring site to match natural terrain after infrastructure, hazardous and non-hazardous waste, and contaminated soil removal

Summary:

Adverse potential impacts to aquatic resources and water quality at the site are possible during all phases of the Project due to potential spills and sedimentation events (especially during extreme rainfall events). Silt generated by the use and movement of heavy equipment and remediation equipment across the site, the excavation of contaminated soil, the potential construction of the landfarm, the operation of the landfarm, along with fugitive dust emissions may have an effect on surface water quality and could impact local aquatic environments. Surface and groundwater impacts could occur from improperly storing and transporting fuel and hazardous waste, refuelling equipment, incinerating and / or burning of hazardous and non-hazardous waste, and from potential landfarm leachate.

A number of environmental protection measures will be incorporated to reduce the likelihood of surface and groundwater impacts such as developing and implementing a Spill Contingency BMP which will include measures such as having containment equipment available, storing fuel and hazardous material and refuelling of equipment at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. and proper treatment of waste water. Construction design of the landfarm must ensure that leaching to surrounding surface water or groundwater will not occur. Erosion and sediment release can occur at any time but especially at the beginning of construction (therefore sedimentation control barriers should be placed as soon as possible), and during precipitation events or during snowmelt. The highest potential for sedimentation occurs during clearing, grading and during activities in or near wetlands and watercourses. Specific mitigation measures for the protection of the topsoil resource and water quality from sedimentation will be in the Sedimentation Control BMP and will include limiting the disturbance of any new areas and placing temporary sedimentation control barriers.

Overall the remediation activities are expected to have positive impact on the hydrology and hydrogeology of the three sites with removal of hazardous and non-hazardous materials, and contaminated soil. Following implementation of mitigation measures, adverse effects associated with project activities to the hydrology and hydrogeology of the project areas will be local, short-term and insignificant. These impacts are not expected to contribute to any adverse cumulative effects.

4.4.5 Vegetation Impacts and Mitigation

Table 4-9 Assessment of Impacts on Vegetation

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Temporary Site Requirements – Camp, Hazardous Material Storage Area, Drum Wash Station; Potential development of borrow pit(s) and upgrading of airstrip	Dust from development of borrow pit(s) and camp construction could impact vegetation		
Mobilization and transportation of personnel and equipment to sites Camp construction; potential development of borrow pit(s) and upgrading of airstrip Camp operation – waste treatment and water use	Potential impact to vegetation from spills when refuelling and servicing equipment	Direction: Negative Scope: Local Duration: Medium Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible. Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with *the Transportation of Dangerous Goods Act* and *Regulations (Government of Canada 1992)*
Camp construction; potential development of borrow pit(s)	Loss or alteration of vegetative cover can occur when completing site preparation and camp construction	Direction: Negative Scope: Local Duration: Long-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing esker, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Use equipment with low pressure tires
Remediation		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Structure demolition and debris removal Removal of contaminated soil Potential construction and operation of landfarm Off-site transportation of waste to an appropriately licensed disposal facility	Dust from remediation activities, such as removing debris and burning waste, and the potential construction and operation of landfarm could impact vegetation		
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site compaction of hazardous solid waste On-site treatment of aqueous liquid waste Treatment and Removal of contaminated soil Potential landfarm construction and operation Off-site transportation of waste to an appropriately licensed disposal facility	Potential impact to vegetation from spills when refuelling and servicing equipment Potential vegetation impact from wastes while removing, transporting, burning or incinerating waste materials, and potential landfarm construction	Direction: Negative (beneficial once non-hazardous, but especially hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Medium-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible Landfarm will be constructed to ensure leachate will not impact the surrounding environment

Table 4-9 Assessment of Impacts on Vegetation (cont`d)

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal Removal of contaminated soil Potential construction and operation of landfarm Off-site transportation of waste to appropriate disposal facility via aircraft	Physical disturbance, loss or alteration of vegetative cover can occur when completing remediation activities such as removing debris or hazardous soil and the potential construction and operation of the landfarm	Direction: Negative Scope: Local Duration: Long-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing esker, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Limit creation of new disturbed areas while completing remediation Use equipment with low pressure tires
Closure		Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: High Significance: Insignificant	Development and implementation of a Dust Control BMP, such as using water for controlling dust and limiting remediation activities during high wind periods
Site recontouring and natural revegetation of disturbances	Dust from recontouring could impact vegetation		
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Potential impact to vegetation from spills when refuelling and servicing equipment	Direction: Negative Scope: Local Duration: Medium-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Hazardous waste and fuel storage areas (including drums) will be inspected daily Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Site recontouring and natural revegetation of disturbances	Loss or alteration of vegetative cover can occur when completing recontouring activities	Direction: Negative Scope: Local Duration: Long-term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Use existing esker, pathways and previously disturbed areas to the fullest extent possible Ensure natural drainages are recreated to limit water ponding and foster revegetation Land surface will be recontoured in to match pre-disturbance conditions to the fullest extent possible but with the minimal equipment use to foster natural revegetation Use equipment with low pressure tires
Summary: Adverse potential impacts to vegetation are associated with all phases of the Project. The movement of heavy equipment, transportation equipment and remediation equipment across to the site, potential construction and operation of the landfarm removing waste and debris, camp construction, borrow pit development and recontouring the site will result in fugitive dust emissions. Dust suppression and control measures will be implemented, thus dust is not expected to have a significant effect on adjacent vegetation. Remediation at the site will significantly remove contaminants in local soils and remove the long-term potential for vegetation damage. Longer term impacts on vegetation are expected from disturbance during infrastructure and debris removal; hazardous and non- hazardous waste removal, storage and transport; and potential landfarm construction (including stockpiles); potential borrow pit development; and camp construction. To minimize the potential for direct loss and / or alteration of vegetation, remediation activities will be limited to the footprint of previously disturbed areas as much as possible. Extreme windy conditions may exacerbate fugitive dust, extreme rainfall may exacerbate erosion, and accidental hydrocarbon spills have the potential to adversely affect vegetation, with appropriate mitigation, such as proper fuel storage, erosion control and dust control measures the probability of significant adverse effects is anticipated to be low. Residual effects on vegetation may result from some site preparation and remedial activities until natural revegetation occurs. These impacts are not expected to contribute to any adverse cumulative effects. Overall, remediation of the site will have a positive impact on vegetation communities.			

4.4.6 Wildlife Impacts and Mitigation

Table 4-10 Assessment of Impacts on Terrestrial Wildlife

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations			
Mobilization and transportation of personnel and equipment to site Camp construction; potential development of borrow pit(s) Camp operation – waste treatment and water use	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused during transportation of materials, site preparation, and camp operations	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Conduct pre-disturbance nest surveys; avoid active nesting structures when present; if habituated by a bird species of special concern remove structure when nesting complete Inspect all structures and debris to for wildlife use prior to remediation Suspend activities during the caribou calving season(May-July) if caribou cows are present Suspend activities if large numbers (>100) caribou are migrating through the site Restrict wildlife access to disturbed areas Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing Containers for domestic waste will be located in enclosed bear-proof structures Garbage will be removed or incinerated from sites daily Bear safety awareness training will be provided as will information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites The use of electric fencing will be considered for the camp
Mobilization and transportation of personnel and equipment to sites Camp construction; potential development of borrow pit(s) and Camp operation – waste treatment and water use	Potential impact to wildlife habitat from spills when refuelling and servicing camp, construction, and transportation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily. Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Remediation			
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site consolidation of hazardous solid waste On-site treatment of aqueous liquid waste Treatment and removal of contaminated soil Potential construction and operation of landfarm Off-site transportation of waste via aircraft and then to an appropriate licensed disposal facility	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused by remediation activities like removing debris and demolishing infrastructure using heavy equipment	Direction: Negative (beneficial once non-hazardous, but especially hazardous materials and contaminated soil have been treated or removed from the sites) Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Conduct pre-disturbance nest surveys; avoid active nesting structures if habituated by a bird species of special concern, remove structure when nesting completed Inspect all structures and debris for wildlife use prior to remediation Suspend activities during the caribou calving season(May-July) if caribou cows are present Suspend activities if large numbers (>100) caribou are migrating through the site Restrict wildlife access to disturbed areas Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing Bear safety awareness training will be provided as will information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites

Table 4-10 Assessment of Impacts on Terrestrial Wildlife (cont`d)

Project Activity	Potential Impact	Impact Rating	Mitigation
Structure demolition and debris removal On-site burning of non-hazardous wood waste On-site consolidation of hazardous solid waste On-site treatment of aqueous liquid waste Removal of contaminated soil Potential landfarm construction and operation Off-site transportation of waste via aircraft and then to an approved licensed disposal facility	Potential impact of wildlife from spills when refuelling and servicing remediation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in and easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily All workers will be trained in proper handling of non-hazardous and hazardous materials and contaminated soil Hazardous materials and contaminated soil will be exposed for as short time as possible
Closure			
Site recontouring and natural revegetation of disturbances Demobilization and transportation of personnel and equipment off-site	Direct mortality, sensory impairment, disruption of movement patterns and indirect mortality produced by wildlife/human interactions potentially caused during transportation of materials by aircraft and construction equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: High Significance: Insignificant	Implement Wildlife BMP that includes noise abatement measures Suspend activities if large numbers (>100) caribou are migrating through the site Restrict wildlife access to disturbed areas Aircraft flights will maintain a minimum altitude of 610 m above ground level except for takeoff and landing Bear safety awareness training will be provided as will information on other wildlife encounters All personnel will be familiar with current 'Safety in Bear/Polar Bear Country' literature produced by Nunavut Department of Environment Bear deterrents will be kept at all sites
Site recontouring and natural revegetation of disturbances Demobilization & transportation of personnel and equipment off-site	Potential impact of wildlife habitat from spills from when refuelling and servicing construction and transportation equipment	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Low Probability: Low Significance: Insignificant	A Spill Contingency BMP will be developed and implemented, and be available to all workers on-site Fuel and hazardous material will be stored in an easily accessible bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill Fuel storage, hazardous material storage and refueling of equipment will occur at the greatest reasonable distance from waterbodies and in accordance with the land use inspector and permits/license. Hazardous waste and fuel storage areas (including drums) will be inspected daily. Transportation procedures on-site and off-site will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)

Summary: Potential adverse impacts to terrestrial wildlife are associated with all phases of the Project at the site. Adverse effects may include sensory disturbance, disruption of wildlife movement, direct and indirect wildlife mortality as a result of project activities and wildlife/human interactions. Noise from transportation equipment, heavy equipment and remediation equipment and human activity will likely result in the temporary avoidance of the area by most wildlife, and may result in changes in local movement patterns of wildlife. The impacts from noise are considered to be of negligible-low magnitude based on the potential species present and number of individuals recorded in the area during fieldwork for this project. Maintaining equipment in good working condition, turning equipment off when not in use, and use of mufflers will reduce the effects of noise on wildlife. Nest sites and / or burrows maybe disturbed during the demolishment of infrastructure and the removal of non-hazardous waste, hazardous waste (including containers) and debris. Infrastructure should be checked for all wildlife species but especially species of concern. In the event that remediation activities cannot be completed without disturbing/destroying nests or burrows associated with migratory birds or species of special concern a wildlife officer from the Government of Nunavut should be contacted for additional guidance and/or to obtain a permit authorizing the removal of nests or disruption of habitat. Small mammals with ground colonies should also be avoided, where possible. The potential for wildlife and human interactions during the Project is possible, especially at the campsite; however, it is expected that such encounters will be infrequent and insignificant. Longer term contact is possible if the landfarm is constructed. Grizzly bear, wolverine, foxes, wolves, and ravens may also be attracted to the three sites. Proper containment and disposal of wastes/garbage, such as removal or incineration at the end of every day, and training of workers in wildlife interactions and bear safety will reduce the probability of adverse wildlife encounters. Leaks or spills of stored hazardous waste or fuel are possible and could impact wildlife. Previous measures outlined for preventing or dealing with spills and leak will be implemented. The development and implementation of a Wildlife Management BMP will assist in minimizing project impacts on wildlife and could include measures such as aircraft maintaining minimum altitudes and providing bear proof structures for containers for domestic waste. Overall, the removal of abandoned site infrastructure and remediation of contaminated soils will improve habitat quality and thus, have long-term benefits for wildlife. Following implementation of mitigation measures, adverse effects associated with project activities to wildlife will be local, short-term, and insignificant. These impacts are not expected to contribute to any adverse cumulative effects.

Table 4-20 Assessment of Impacts on Marine Wildlife

Project Activity	Potential Impact	Impact Rating	Mitigation
Site Preparation and Camp Operations			
Mobilization of equipment to site via the winter road	Transport of materials from site via the winter road could cause noise issues for marine mammals A winter road failure or fuel leak could impact fish populations in the fresh water lakes	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: Low Significance: Insignificant	Develop and implement a Spill Contingency BMP and ensure personnel are appropriately trained Have Spill Contingency BMP available to all workers A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies. Transportation procedures will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Mobilization of personnel to site via twin otter on floats	A fuel spill or leak could occur when twin otter on floats is docked	Direction: Negative Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: Low Significance: Insignificant	Develop and implement a Spill Contingency BMP and ensure personnel are appropriately trained Have Spill Contingency BMP available to all workers A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies. Transportation procedures will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Remediation		Direction: Negative	
Removal of contaminated soil	Potential impact to fish habitat from spills when refuelling twin otters during transportation of personnel to and from site	Scope: Local Duration: Short-Term Frequency: Intermittent Magnitude: Negligible Probability: Low Significance: Insignificant	Develop and implement a Spill Contingency BMP and ensure personnel are appropriately trained Have Spill Contingency BMP available to all workers A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies. Transportation procedures will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Potential landfarm construction and operation Off-site transportation of waste via aircraft and then to an appropriate licensed disposal facility	Transport of materials from site via the winter road could cause noise issues for marine mammals A winter road failure or fuel leak could impact fish populations in the fresh water lakes While refueling or transporting material on the flatbed a fuel spill or leak could occur Hazardous material being transported could spill or leak	Direction: Negative Scope: Local Duration: Short-Term Frequency: Once Magnitude: Negligible Probability: Low Significance: Insignificant	Develop and implement a Spill Contingency BMP and ensure personnel are appropriately trained Have Spill Contingency BMP available to all workers A Spill Contingency BMP will be developed and implemented, and be available on-site for all workers Contain spill as close to release point as possible Proper containment and removal of fuels from any waterbodies Transportation procedures will be in accordance with the *Transportation of Dangerous Goods Act* and *Regulations* (Government of Canada 1992)
Summary: Potential impacts to marine mammals are generally limited to the winter road transportation and refuelling of the twin otter. The inland ponds at the former WS did not contain fish. The sensitivity of marine mammals to the ice road is seen as insignificant as only one mobilization event and one demobilization event on the ice road is planned. No water craft are expected to be used during remedial activities. The flatbed trucks on the ice road will haul the hazardous material. If there was a spill, the fresh water lakes may be impacted. The hazardous material shipment will be limited in volume. The greatest risk to marine wildlife and marine resources is the accidental release of fuels during refuelling the twin otter and the accidental release of shipped hazardous materials and/or a spill of fuel during winter ice road transport, which could directly impact marine wildlife or marine wildlife habitat. A Spill Contingency BMP will include measures for dealing with a spill on marine waters. The Spill Contingency BMP will minimize the potential of an accidental release of contaminants into the marine environment. Overall, remediation of the site will have a positive impact on the marine environment as waste debris from the site will be consolidated and removed from site. Although no negative impacts on surface water were reported in the Phase III ESA, the potential for the surface water of Contwoyto Lake to be impacted will be reduced with the removal of the debris from the site.			

4.5 CULTURAL FEATURES AND SPECIAL PLACES IMPACTS AND MITIGATION

It was not until the 1980s that archaeological sites were recorded near Contwoyto Lake (Golder, 2013). Tent rings and lithic scatters are the most common site types, however, cabins, cairns, hearths, inuksuit, and hunting blinds have also been recorded. On the same unnamed island that the former WS site is on there has only been on archaeological site recorded, namely, Lit-1. The site was originally recorded by David Blower and is described as a large gathering place and campsite used by Inuit families at Christmas and in the spring (Golder, 2013).

The structure (Structure 01) on the peninsula is operated by the Kugluktuk Hunters and Trappers Association. Structure 01 is scheduled to remain at the site. Current mobilization, remediation, and demobilization activities planned for the project areas will not impact Lit-1 or the three land use sites identified in the AIA. To protect the cultural features on the island where the former WS was located, it was recommended that the Lit-1 site be avoided. No remedial activities are scheduled for the Lit-1 area, however, its location will be identified to ensure it is not affected.

If any new cultural features are discovered, especially in areas slated for remediation, their location and boundary, including a buffer, will be marked and the area avoided. The discovery will be reported to the Archaeology Division of the Department of Culture, Language Elders and Youth of the Government of Nunavut. If a cultural feature or features need to be impacted to complete the remediation, no disturbance of the feature will occur until advice from the Archaeology Division is received. This may require hiring an outside consultant to complete an AIA and make recommendations for the treatment of the cultural feature or features. Impacts to the current cultural features/special places or any discovery of any cultural features/special places can be mitigated, and no adverse cumulative effects are expected.

4.6 SOCIO-ECONOMIC IMPACTS AND MITIGATION

Two of the projects goals have a direct positive socio-economic impact. These two goals are: to increase public awareness about remediation activities; and, to provide employment opportunities for the local work force.

It is understood that Aboriginal participation in the remediation program is an important consideration for AANDC.

4.6.1 Traditional Land Use

It is possible that summer camps may have been used for centuries on the Contwoyto Lake WS island. It is expected that the Kugluktuk Hunters and Trappers Association will continue to maintain a camp at the former WS.

In 1998, RHA (2002) reported that 58% of the workforce hunted and fished and 10% trapped. The Kugluktuk HTO operate the cabin at the former WS, which is used by local hunters and non-aboriginal hunters. This is the only current land use at the project site.

The mobilization, remediation, and demobilization activities will only affect traditional land use in the project areas as well as along the winter access route while activities are being completed. A preliminary schedule of activities is presented in Section 3.2, however, if schedule changes the HTO and the KIA. Impacts to the traditional land uses in the project areas can be mitigated and positive residual impacts are expected. Positive residual impacts are expected with the removal of non-hazardous and hazardous waste and clean-up of contaminated soil at the sites, which will improve wildlife habitat and therefore potentially increase traditional land use activities

4.6.2 Job Opportunities

The remediation contractor will be selected based in part on Aboriginal Opportunity Considerations which will include: socioeconomic benefits for the community such as subcontracting (goods, services, etc.), employment, and training opportunities.

The Project will result in positive socio-economic benefits to the community of Kugluktuk. The NCLA (Nunavut Tunngavik Inc., 1993) serves as a guide for the mitigation of socio- economic impacts, for example, it provides for the creation of procurement policies by federal and territorial governments for Inuit-owned firms. An Aboriginal Opportunities Considerations (AOC) section will be included in the contract for the remedial work. The AOC will guarantee minimum levels of Inuit employment and Inuit sub-contracting. Project procurement proposals will be evaluated based on criteria such as socio-economic benefit, technical content and cost. Individuals and businesses will be able to benefit through employment and procurement opportunities and related economic benefits. Employment opportunities could provide positive economic benefit through skills acquisition and work experience. Some of the possible employment opportunities could include:
Camp staff;

- Equipment operators;
- Mechanics;
- Surveyors;
- Trades;
- Labourers;
- Wildlife monitors;
- Interpreters;
- Health and safety officer; and
- Sampling scientist.

The estimate for work assumes that a single crew, supplemented by additional labourers as required, would be carrying out the separate categories of remedial works in a linear fashion with the majority of the clean-up tasks being completed in series (i.e. hazardous materials abatement, demolition then soil clean-up).

The hours of work, for both the winter and summer seasons, would likely conform to the typical northern practice of working a minimum of ten hours a day with longer days worked during period of mobilization and demobilization.

Potential business opportunities that may arise from the project will exist primarily in the areas of logistical support, heavy equipment and supply. A range of Inuit- owned businesses located in Kugluktuk provide goods and services in the areas of food services, expediting, contracting and equipment supply, and transportation and shipping (RHA 2002). No negative job opportunities are expected, and therefore, no residual impacts are expected.

4.6.2.1 *Training Opportunities*

Federal, Provincial and Territorial legislation stipulates mandatory certification training requirements for operations under their specific jurisdiction. The following outlines requirements for Transportation of Dangerous Goods (TDG) and Workplace Hazardous Materials Information System (WHMIS) training.

All employees have the legal right to know about the hazards of their workplace. As an employer, the selected remediation contractor has a legal obligation to fully train their employees in all of the hazards of the job those same employees are expected to perform and how to avoid those same risks from having an adverse effect on them.

In all Canadian provinces, territories and in the federal jurisdiction, workers are protected by the Workplace Hazardous Materials Information System.

This WHMIS law requires the employer to: label containers of hazardous materials; provide Material Safety Data Sheets (MSDSs) with additional information; and, provide education and training so that employees understand. It is expected that all personnel at the Contwoyto Lake former WS will receive WHMIS training.

Personnel required to handle or package Dangerous Goods for shipping will be TDG certified. The selected remediation contractor may provide this training in the field as required.

All personnel working at the former Contwoyto Lake former WS will have received the Site Specific Worker Orientation Seminar, will have received WHMIS training and any training required for their particular tasks at the site.

4.6.3 Community Impacts

The Hamlet of Kugluktuk has a wide variety of community services and organizations. An impact to community services would be the use of the community health centre in the case of an accident during the project activities. This impact would be of short duration but could be significant depending on the accident. It would not have residual impacts on the community.

Hazardous and non-hazardous materials will be packaged and transported via aircraft to Yellowknife for eventual shipment to an approved licensed disposal facility. The storage of these materials will be in accordance with all territory and federal regulations. As such, potential impacts, such as exposure of hazardous material to the community members, are considered unlikely and insignificant. There are no expected residual impacts.

While many of the staff required to complete the remedial activities at the former WS may be from Kugluktuk, a number of individuals from outside the community will likely be needed for the duration of the remedial activities. The employment opportunities are expected for two mobilizations/demobilization seasons and two summer remediation seasons.

4.7 AESTHETIC IMPACTS

The construction of the weather station in the DEW Line era caused anthropogenic disturbances at the site. The remediation activities will be beneficial to the aesthetics of the area as buildings will be demolished and all debris will be removed. The only short-term aesthetic impact will be the potential construction of the landfarm, but once soil in the landfarm meets regulatory criteria this area will be revegetated. All aesthetic impacts can be mitigated, and no residual impacts are expected. The esker has been used as an emergency airstrip. It is expected that once remedial works are completed, the esker will return to its viability as an emergency airstrip.

4.8 RESIDUAL IMPACTS

Residual impacts are defined as impacts that remain after mitigation has been applied (CEAA 1999). The remediation of the former Contwoyto Lake WS sites is not expected to result in any negative residual impacts, and the remediation of the site will have a positive effect on the environment.

5.0 CUMULATIVE ENVIRONMENTAL IMPACTS

Cumulative environmental impacts occur when impacts, in particular residual impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. The NIRB (2007b) defines cumulative impacts as "…the accumulation of changes to the environment caused by human activities (e.g., past, existing and proposed activities, including activities associated with the Project under assessment). These changes occur over space and time and can be brought about by environmental effects that are additive or interactive. For example, hunting, oil spills, loss of habitat, and commercial fishing pressure on prey species, can affect marine mammals in the Arctic".

The amount of mining and exploration activity in the Kitikmeot region of Nunavut has been quite high according to Nunavut Overview 2007: Mineral Exploration, Mining and Geoscience (INAC et al., 2007). The Lupin Mine is located 50 km northwest of the former WS.

Also, within the region, a number of other former exploration, mining, and military sites are currently being remediated or have remediation schedules that may overlap with the Contwotyto Lake former WS Remediation Program.

The remediation program at the site will initially disturb the existing terrain and environmental conditions of the study area. However, given the limited environmental footprint of the site and the removal, containment and/or disposal of contaminated soil and hazardous and non-hazardous waste, it is expected that the overall impact of the remediation project will be positive. In the long term, the remediation project will facilitate the return of soil, water, and vegetation and wildlife habitat to natural conditions.

Given that the Project will have a positive impact on the environment and has no residual impacts, the remediation of the site will not add to the cumulative environmental effects of other land use activities in the local area.

5.1.1 Accidental Release

By far the most common potential impacts to VECs were contamination from spills during refuelling or servicing equipment used in project activities. A Spill Contingency BMP

will be developed and implemented, and be available to all workers on-site. Fuel and hazardous material will be stored in easily accessible and bermed area, which will act as a spill barrier and allow for easy removal in case of a leak or spill.

In instances when a spill does occur, the person responsible for the discharge of a prohibited contaminant into the environment, and the owner or the person in control of the contaminant before it is discharged, must immediately report the spill. The responsible person must also take reasonable measures to stop the discharge and to notify all persons who might be adversely affected by the discharge. An inspector may also order that person to repair or remedy any injury or damage to the environment that results from the discharge.

If a person voluntarily provides detailed information obtained through an environmental audit or site assessment concerning his non-compliance with the Act, the Chief Environmental Protection Officer may negotiate an agreement with that person to address any damage to the environment.

In Nunavut, responsibility for management of water remains with the federal government, managed by the department of Aboriginal Affairs and Northern Development Canada. More locally, authority to issue licenses has been delegated to several water boards. The Nunavut Water Board issues environmental management objectives for sewage discharges and sets site-specific requirements for water licences. The Environmental Guideline for Industrial Waste Discharges (GWD) establishes standards for the discharge of waste from an industrial operation on Commissioner's Land or lands administered by municipal governments in Nunavut. It addresses the discharge of effluent and process residuals resulting from industrial operations.

6.0 MONITORING PROGRAM

Project monitoring has two objectives:

- Monitor implementation of the Project to confirm compliance with the remediation objectives and accuracy of impact predictions; and
- Monitor the long-term success of the Project if required; measuring environmental conditions against triggers and thresholds that would initiate adaptive management and contingency plans.

The NIRB (2007b) defines monitoring as the systematic observation or tracking of an activity to determine whether it is proceeding or functioning as expected. Through monitoring, the accuracy of environmental impact predictions is assessed. Two different monitoring activities that will be incorporated into this Project are identified below:

- Effects monitoring is the process of measuring and interpreting changes to environmental and socio-economic parameters to identify relevant project effects, and may involve assessing the accuracy of impact predictions contained in the Project impact statements.
- Compliance monitoring is the process of determining whether and to what extent the activity is carried out according to regulatory requirements, including terms and conditions contained in NIRB project certificates.

Based on the NIRB definition and the monitoring objectives, compliance monitoring will be completed for the duration of the remedial activities. This will include such actions as adherence to safety standards, sampling protocols, and reporting schedules. An environmental management plan (EMP) will be completed prior to the work being conducted that will outline requirements of compliance monitoring based on regulatory and industry standards. If a landfarm is created on-site for remediation of the hydrocarbon-contaminated soil, the monitoring of this facility would be identified within the EMP. It should be noted that at the site in question there is no operable groundwater table within the esker where the treatment of the PHC impacted soils would take place. From observations made during the ESA field work the amount of free water within the active zone underlying the site was not thick enough (less than 50 mm) and did not have sufficient water to generate a gradient that would induce the movement of water a top the active permafrost layer. On the basis of our experience the installation of monitoring wells within the esker would not generate a sufficient volume of water to allow for PHC testing. For

this reason the installation of monitoring wells around the proposed landfarm are not deemed necessary as no groundwater information would be gathered from the respective wells.

Based on the recommended remedial options, long-term monitoring may be required. All impacts will be removed to regulatory criteria with the exception of an isolated impact of sediment (<0.1 m^3) within the peninsula pond. Once soil remediation and removal of waste has been completed, impacts to sediment should be mitigated. Potential impacts to surface water will be reduced once remedial activities have occurred as the site debris will be collected and transported off-site. Monitoring of the contaminant treatment area may be required to confirm that impacts have been mitigated.

7.0 PROJECT APPROVAL AND PERMIT REQUIREMENTS

The NLCA provides the regulatory context for completing this ESAR for the proposed project for the NIRB. However, both the federal and Nunavut governments have other necessary or potential legislative requirements related to this project. Table 7-1 and 7-2 provides a list of other Federal and Territorial agencies, and associated legislation.

Table 7-1 Federal Regulatory Agencies and Legislative Requirements

Agency	Legislative Requirements
Aboriginal Affiars and Northern Development Canada (AANDC) and Public Works and Government Services Canada	*Land Claims Settlement Act* *Federal Real Property Act* and *Regulations* Notes: Permits for land use and potential borrow sources may be required based on the Project as proposed.
Fisheries and Oceans Canada (DFO)	*Fisheries Act* Notes: Authorizations or letter of advice may be required if project impacts fish habitat. Based on the current project, no authorization requirements are expected.
Transport Canada (TC)	*Navigable Waters Protection Act* Notes: Authorization may be required if any structures are built within or on navigable waters. Based on the current project proposal, no authorization requirements are expected.
Environment Canada (EC)	*Species at Risk Act* *Migratory Birds Act* and *Regulations* *Fisheries Act* [Section 36(3)] *Canadian Environmental Protection Act* Notes: Authorizations not anticipated, but a list of species at risk and migratory birds, potential impacts to these species and mitigation strategies has been compiled as part of the ESAR.
Natural Resources Canada (NRC)	*Explosives Act* and *Regulations* Notes: Permits required if explosives stored, handled or transported. Based on current project description, permits are not required.

Table 7-2 Territorial Agencies and Legislative Requirements

Agency	Legislative Requirements
Nunavut Water Board	*Nunavut Waters Act* *Nunavut Surface Rights Tribunal Act* Notes: Authorizations for water use and deposit of waste into water. Based on the current project description, a water licence will be required.
Department of Environment (Government of Nunavut)	*Environmental Protection Act Transportation of Dangerous Goods Act Wildlife Act* Notes: Based on the current project proposal, spill response plans and waste management guidelines must be followed and waste manifest documents will required for moving hazardous waste. Regulatory requirements related to land use and disturbing wildlife must also be met. Authorizations related to *Wildlife Act* requirement are not anticipated, but a list of wildlife species, potential impacts to these species, and mitigation strategies has been compiled.
Department of Culture, Language, Elders and Youth (Government of Nunavut)	*Nunavut Act (Nunavut Archaeological and Palaeontological Sites Regulations)* Notes: The archaeological site Lit-1 identified in the Archaeological Impact Assessment for this project will be avoided. Excavation of contaminated soils within 1 m of an archaeological site will require a permit; this is not expected for this project as proposed. If any new sites are identified, the Department will be contacted.
Department of Health and Social Services (Government of Nunavut)	*Public Health Act* and *Regulations* Notes: The criteria outlined in the Act and Regulations for any camps associated with the Project must meet requirement for sanitation, waste disposal, drinking water quality and medical facilities.

During the remedial works, the following documents will be required on-site.

- Contract drawings.
- Specifications.
- Requests for Clarification and responses.
- Addenda.
- Task Authorizations.
- Change Orders.
- Reviewed shop drawings.
- Other modifications to Contract.

- Field test reports.
- Copy of approved Work Schedule.
- Manufacturers' installation and application instructions.
- Material and Safety Data Sheets Specifications.
- Site Specific Health and Safety Plan.
- Response Plan.
- Spill Contingency Plan.
- Fire Safety Plan.
- Emergency Response Plan.
- Waste Disposal Work Plan.
- Contaminated Soil Treatment Plan.
- Land Use Permit and Water License.
- Site Medic Credentials.
- Labour conditions and wage Schedules.
- Up-to-date record drawings.
- License for Radio Communication.
- All applicable Territorial permits and licenses.
- All applicable Federal permits and licenses.
- Copies of manifests and bills of lading.
- Demolition Plan.
- Hazardous Material Audit
- Worker Training Program.
- WSCC Notification of Project.
- Letter of Good Standing with WSCC.

7.1 EXCAVATION REQUIREMENTS

7.1.1 Excavating Contaminated Soils

7.1.1.1 *Metals*

The preliminary preferred remedial option for soils contaminated with metals is to remove from site to an appropriate licensed disposal facility.

7.1.1.2 *Hydrocarbons*

The preliminary preferred remedial option for soils contaminated with hydrocarbons is to treat on site to meet AMSRP criteria. Once the hydrocarbon impacted soil is treated and meets criteria the soil will be reused as backfill within the remediated portions of the site.

7.1.2 Potential Borrow Sources

The esker which extends beyond the Contwoyto Lake former WS has been identified as a potential borrow source. In general this potential borrow source is a mix of coarser sands and gravels with variable amounts of cobble and fines. This material would be free draining soil.

7.2 ON-SITE MATERIAL MANAGEMENT

The on-site material management during the remediation of the Contwoyto Lake WS will depend on the approach proposed by the contractor selected to perform the remediation.

All toxic/hazardous materials to be used, including fuels, will be managed by the contractor selected to perform the remediation work. The contractor is expected to provide spill contingency plans, emergency procedures, and a site specific health and safety plan etc. for review prior to remedial works commencing.

The selected contractor will outline the collection, storage and disposal methods for waste including garbage, human waste, and trade waste. Remediation activities will be subject to the land use inspector.

7.3 OFF-SITE LAND USES

There is a potential that off-site land use will only be required for site access by land. In particular, an access road would likely be constructed which would extend from the Lupin Mine ice road should a winter road be constructed.

8.0 KNOWLEDGE DEFICIENCIES

Information on the environmental conditions at the site was collected during previous field studies. While this information is adequate for the scope of this work, there are some knowledge deficiencies with respect to remediation work in the arctic that are not specific to this project.

The International Panel on Climate Change (IPCC) reports that average global temperatures could increase by up to 6°C by the end of the century (IPCC, 2007), and this increase could result in an increased frequency of extreme weather events including increased precipitation. Much uncertainty remains regarding climate change predictions and how these changes will affect Arctic regions. However, likely alterations include changes in the range and depth of permafrost occurrences, all of which have a bearing on impact predictions related to soil stability, erosion control, and drainage. These should not have a bearing on the Project as a landfill is not scheduled to be constructed on-site and no impacted materials are remaining on-site apart from treated hydrocarbon-contaminated soils.

9.0 PUBLIC INPUT AND CONCERNS

To collect public input and to receive public concerns regarding the Project, a community meeting was held in Kugluktuk on January 15th, 2013, to discuss the draft RAP. Approximately 60 members of the local community attended the meeting. The primary concerns of the community were impacts of the Project on traditional land use and employment opportunities directly working on the Project.

The people have expressed concerns regarding abandoned sites on traditional lands. Although the Contwoyto Lake WS is small relative to other regional developments (e.g., the Lupin mine, Jericho mine and the like), there remains a general concern associated with historic activities on these lands. The potential contamination of water and soils, as well as impacts to fish, wildlife and vegetation, are commonly cited as the top priorities for attention. Physical hazards such as collapsing and/or unsound buildings, residual drums and debris have also been identified as concerns with respect to human and wildlife health.

10.0 CONCLUSION

The mitigation strategies outlined for the remediation of the Contwoyto Lake former WS site are predicted to result in no negative residual impacts, and overall, the remediation of site will have a positive effect on the environment by removing contaminated soil and hazardous material from the site. Cumulative environmental impacts occur when impacts, in particular residual impacts, from two or more concurrent project activities combine either additively or synergistically to further exacerbate the impact on a VEC or VSEC. Given that the project will have a positive impact on the environment and has no residual impacts, the remediation of the site will not add to the cumulative environmental effects of other land use activities in the local area.

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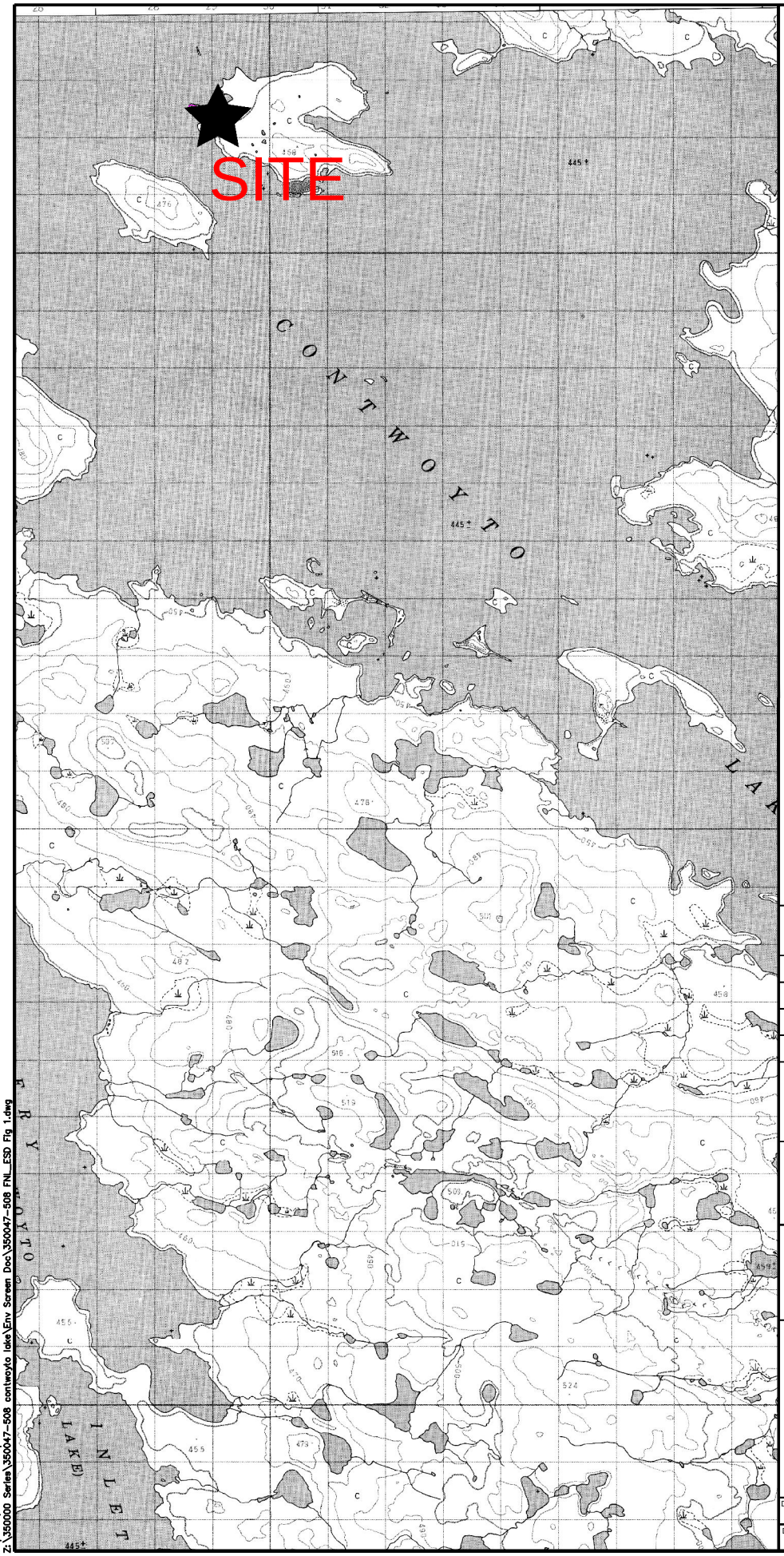
APPENDIX A

FIGURES



N

REVISIONS:

No.	Date:	By:	Revisions

REFERENCE:

1. DEPARTMENT OF ENERGY AND MINES (1980) 76 E/8
2. NATURAL ATLAS OF CANADA SERIES

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

SENES Consultants

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

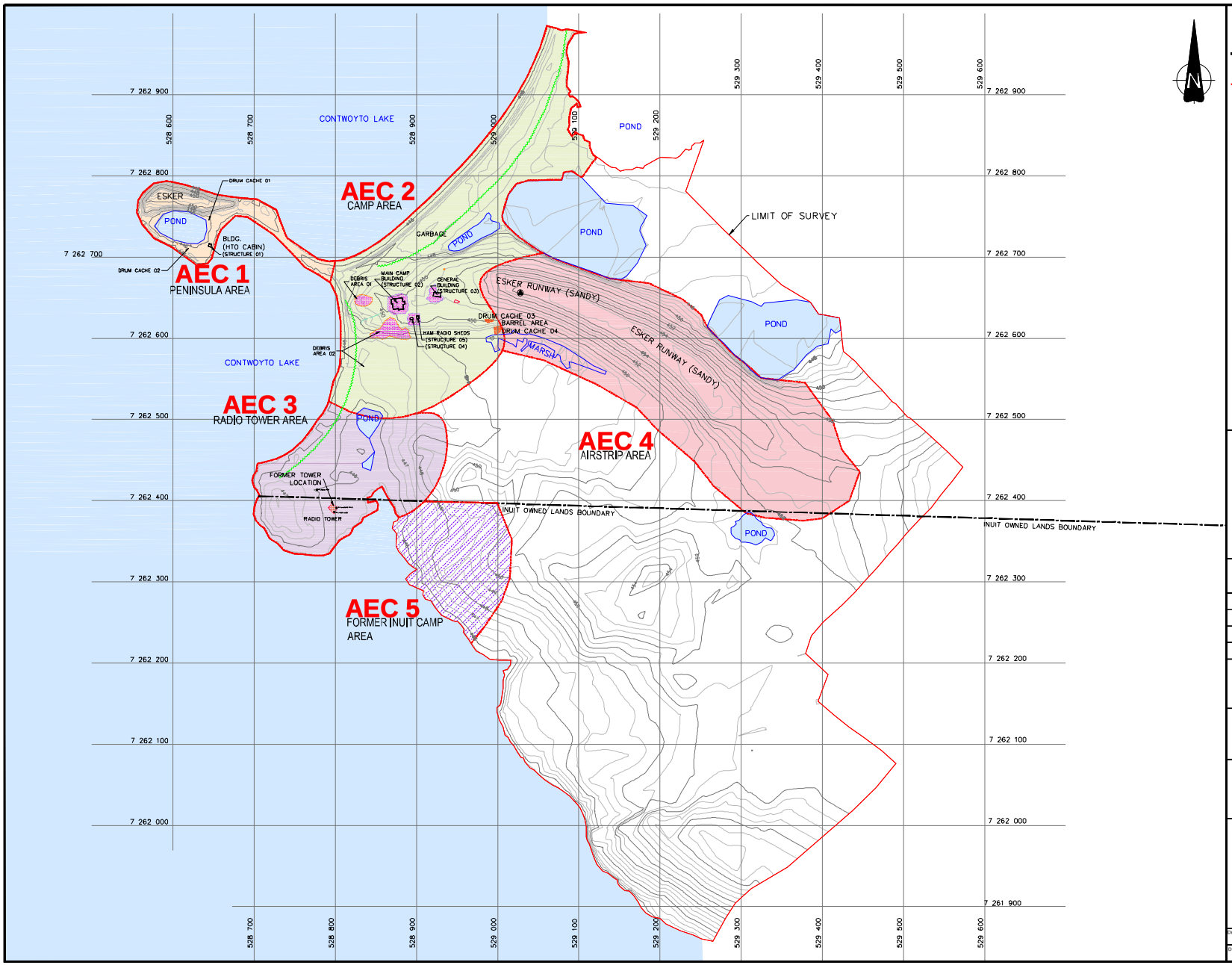
CONTWOYTO REMEDIATION PROJECT

FORMER WEATHER STATION (WK17)

KEY PLAN

Drawn By:	P.A.F.	Approved By:	C.F.G.	Project No:	350047-508
Date:	MARCH 2013	Scale:	1:100000±		FIGURE 1

Apr 08, 2013 - 3:57pm - USER Izba
Z:\350000 Series\350047-508 contwoyto lake\Env Screen Doc\350047-508 FNL_ESD Fig 1.dwg



LEGEND:

- INUIT OWNED LANDS BOUNDARY
- AREA OF ENVIRONMENTAL CONCERN (AEC) BOUNDARY LINE
- AEC 1 – AREA OF ENVIRONMENTAL CONCERN 1 PENINSULA AREA
- AEC 2 – AREA OF ENVIRONMENTAL CONCERN 2 CAMP AREA
- AEC 3 – AREA OF ENVIRONMENTAL CONCERN 3 RADIO TOWER AREA
- AEC 4 – AREA OF ENVIRONMENTAL CONCERN 4 AIRSTRIP AREA
- AEC 5 – AREA OF ENVIRONMENTAL CONCERN 5 FORMER INUIT CAMP AREA
- AREAS OF CONCENTRATED WASTE/DEBRIS AREA

NOTES:

UTM COORDINATES ARE REFERRED TO THE CENTRAL MERIDIAN OF UTM ZONE 12 (111° WEST LONGITUDE). ELEVATIONS WERE DERIVED FROM PPP NAD83-CSRS (CANADIAN SPATIAL REFERENCE SYSTEM). ELEVATION SHOWN ARE IN METRES AND ARE ORTHOMETRIC.
CONTOUR INTERVAL IS 0.50m.

CONTROL STATION
N. 7262655.59, E.529028.15, ELEV. 454.21m

REVISIONS:

No.	Date:	By:	Revisions

REFERENCE:

1. TOPOGRAPHIC SURVEY BY OLLERHEAD & ASSOCIATES LTD, DATED AUGUST 2012

Public Works and Government Services Canada
Travaux publics et Services gouvernementaux Canada

SENES Consultants

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA

CONTWOYTO REMEDIATION PROJECT
FORMER WEATHER STATION (WK17)

SITE PLAN

Drawn By:	J.B.S.	Approved By:	C.F.G.	Project No	350047-508
Date:	MARCH 2013	Scale:	1:4500±		FIGURE 2

APPENDIX B

SITE PHOTOGRAPHS

PHOTOGRAPHIC RECORD

Client: PWGSC/AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508
Photo No. 1		
Date: 8/6/2012		
Direction Photo taken: North aerial view		
Description: The Contwoyto Lake former weather station is located east of the Peninsula, south of the two large inland ponds, and on the esker which is seen extending to the east from the Peninsula. The Peninsula is seen extending into Contwoyto Lake to the west.		

Client: PWGSC/ AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508
Photo No. 2		
Date: 8/6/2012		
Direction Photo taken: South aerial view		
Description: The Peninsula. The structure on the south part of the Peninsula is operated by the Kugluktuk Hunters and Trappers Association.		

Client: PWGSC/ AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508
Photo No. 3 **Date: 8/8/2012** **Direction Photo taken: North west** **Description: Former weather station camp – the power building. The section of the building that is standing is the north half of the structure. The south half has been demolished. Note the large fuel tank. There are two more large tanks inside the building.**		

Client: PWGSC/ AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508
Photo No. 4 **Date: 8/8/2012** **Direction Photo taken: East** **Description: Weather station camp – the two small buildings were used to house electronics. Typical wood frame construction with plywood interior and exterior sheathing. The exterior has tarpaper sheeting as cover. Scattered debris visible in the surrounds.**		

PHOTOGRAPHIC RECORD

Client: PWGSC/ AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508

Photo No. 5

Date: 8/8/2012

Direction Photo taken: South west

Description:
Former weather station camp debris (domestic and skidoo parts). Drums located to the west and south of the former weather station buildings.

Client: PWGSC/ AANDC-CARD	CONTWOYTO LAKE FORMER WEATHER STATION	Project No. 350047-508

Photo No. 6

Date: 8/8/2012

Direction Photo taken: South east

Description:
Former weather station radio tower in sections. Former weather station buildings seen in the distance on the esker.