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WorleyParsons Komex

resources & energy

SHELL CANADA LIMITED

Interim Abandonment and Restoration Plan

Camp Farewell, NT

C52360300

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PROJECT C52360300 - INTERIM ABANDONMENT AND RESTORATION PLAN

FILE LOC.: CALGARY

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CONTENTS

Tables within Text

Tables

Figures

Photographs

Appendices

1. INTRODUCTION

1.1 Overview

WorleyParsons Komex was retained by Shell Canada Ltd. (Shell) to provide an updated Interim Abandonment and Restoration Plan (Plan) for Shell's Camp Farewell (Site) located at 69° 12' 30" N latitude, 135° 06' 04" W longitude, approximately 95 km northwest of Inuvik in the Northwest Territories (Figure 1). This site is leased from the federal government. The Plan has been completed in partial fulfillment of the requirements outlined in the Northwest Territories Water Board (the Board) licence #N7L1-1762 Renewal dated November 1, 2005 (Appendix I).

The Plan addresses the camp as a whole (Figure 2), but segregates out restoration requirements associated with the plant water systems. Restoration activities outlined in this plan include decommissioning (dismantling), remediation and reclamation.

1.2 Purpose and Scope

The purpose of this Plan is to summarize existing information pertaining to the restoration of Camp Farewell and has been prepared to:

- address the Board's reporting requirements for reclamation of the water systems (collection, distribution and discharge facilities); and,
- provide Shell with an overview of the restoration requirements associated with the entire Site.

The following tasks have been undertaken to address the objectives of the Plan:

- review of the 2006 Phase II Environmental Site Assessment (WorleyParsons Komex, 2006);
- evaluation of subsequent land use alternatives and selection of a base case for subsequent land use;
- selection of remediation guidelines;
- determination of reclamation objectives for the Site;
- development of a plan for dismantling facilities and removing Site inventory;
- development of conceptual remedial programs to address areas of impact that exceed the assumed criteria; and,
- development of a reclamation plan for the developed area to return the land to a condition suitable for subsequent land use.

1.3 Organisation of Report

The Restoration Plan is organized as follows.

- Introduction – overview, purpose and scope of project;
- Regional setting – climatic data, surface geology and land use information;
- Site history – background and general use, 1981 spill, current operations and previous environmental investigations;
- Restoration criteria – decommissioning, remediation and reclamation criteria;
- Nature and extent of impact – soil and groundwater impact associated with the site;
- Restoration plan – for the water systems, including the camp facilities; and,
- Restoration plan – for the remainder of the site, including materials stored on the Site, power generation and work areas, as well as the airstrip and areas of off-Site impact.

1.4 Water Board Restoration Requirements

The Restoration Plan satisfies Item 1 of Part G of Licence No. N7L1-1762 (Appendix I) granted to Shell Canada by the Northwest Territories Water Board (Board) in accordance with the *Northwest Territories Waters Act*. Item 1 of Part G of the Licence states:

The Licensee shall submit to the Board for approval within one (1) year of issuance of this Licence, an updated Interim Abandonment and Restoration Plan including a complete Phase II Environmental Assessment of Camp Farewell.

The 2006 Phase II Environmental Assessment has been submitted under a separate cover (WorleyParsons Komex, 2006), but where relevant, is summarized in this report.

The "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (NWTWB, 1990) is the latest published literature associated with abandonment and restoration in the Northwest Territories and is therefore applied in this case. The approach, outlined in the Guidelines, has been tailored to address the unique characteristics of Camp Farewell. It is possible that Camp Farewell will continue to be used as a staging and storage area after the camp operations have been discontinued and decommissioned. For this reason, restoration of the camp facilities and storage area has been presented separately.

1.5 Scope and Requirements of Site Restoration

Requirements for restoration of the entire Site provide Shell with a better understanding of final Site abandonment and reclamation requirements. Where available, restoration options have been provided to allow Shell to better plan these activities. Implementation of the preferred restoration option will require review and consent by various regulatory bodies.

Lease No. 107 C/4-2-10 and Lease No. 107 C/4-1-7 (Appendix II) outline the general requirements regarding restoration of the Site and the airstrip, respectively. Both Leases state in Termination – Part 11

Upon the termination or expiration of this lease, the lessee shall deliver up possession of the land in a condition satisfactory to the Minister.

and in Restoration – Part 13

Where the lessee fails to restore the land as required and within the time allowed by the Regulations or by the Minister, the Minister may order the restoration of all or any part of such land and any expenses thus incurred by the Minister shall be recoverable from the lessee as a debt due to Her Majesty.

2. REGIONAL SETTING

2.1 Climatic Data

Climatic data is available for Inuvik which is located approximately 95 km southeast of Camp Farewell. Over the period from 1971 to 2000, the mean daily temperature at Inuvik was -8.8° C with the temperature exceeding 0° C on average 156 days a year. Average annual precipitation for this period is 248.4 mm, consisting of 117 mm of rainfall and 167.9 cm of snowfall (Environment Canada, 2006).

Climatic data is also available for Tuktoyaktuk which is located approximately 75 km northeast of Camp Farewell and is situated on the Beaufort Sea coast. Over the period from 1971 to 2000 the mean daily temperature at Tuktoyaktuk was -10.6° C with the temperature exceeding 0° C on average 137 days a year. Average annual precipitation for this period was 167.8 mm, consisting of 75.3 mm of rainfall and 95.3 cm of snowfall (Environment Canada, 2006). The ice free period on the Mackenzie River is approximately four to five months (June to October). The active layer is similarly governed by this period of time.

2.2 Surface Geology and Permafrost

Camp Farewell is located in the Mackenzie Delta on an outwash plain bordered to the west and southwest by the Mackenzie River and to the east, north, and south by shallow lakes and intermittent ponds (Figure 2). The distance from Camp Farewell's lease boundaries to these water bodies varies from 20 m (southwest to the Mackenzie River) to a maximum of approximately 360 m north and 660 m east to several unnamed lakes. Drainage from the lease is predominantly to the south and southwest (Figure 2).

Surficial geology (Figures 3, 4A and 4B) near the site consists of silty sand overlying sand and interbedded sand and gravel deposits associated with the Toker Member, Melloch Till, or those deposited during the Buckland Glaciation (Rampton, 1987). These glaciofluvial sediments are overlain by organic deposits. The outwash plains and valley trains encountered in the Mackenzie Delta and along the Tuktoyaktuk Coastlands are generally 3 to 30 m thick and include the Cape Dalhousie Sands, North Star Outwash, Garry Island Member and, probably, Turnabout Member. Visual observation at Camp Farewell indicates that the outwash plain upon which the camp is situated is approximately 15 m thick.

The region surrounding Camp Farewell is underlain by extensive discontinuous permafrost with a low to moderate ice content (<10% to 20%) that extends to a depth of approximately 95 m below ground surface (bgs). The region is characterized by sparse ice wedges, no massive ground ice, and sparse pingo ice (Heginbottom, 1995). The depth to the active layer (i.e., the layer of soil subject to seasonal thaw) is typically less than 1.0 m bgs and can be as little as 0.28 m below the surface. The active layer is typically the zone of highest groundwater flow. WorleyParsons Komex (2006) reported groundwater above permafrost at depths ranging from 0.26 m to 0.83 m bgs (with depth increasing to the south) and generally dependent on the amount of gravel overburden. As a result of the organic rich soils, the groundwater is light brown in colour.

The area to the north and west of Camp Farewell demonstrates these ice wedges in the form of polygon-shaped depressions. These depressions provide favourable conditions for the establishment of both willow (*Salix* spp.) and alder (*Alnus*). The surrounding area is characterized by dwarf shrubs and ground cover such as mosses and lichens.

2.3 Sensitive Land Use Information

Camp Farewell is located within the Kendall Island Bird Sanctuary (KIBS), near its southern boundary. Shell is required to hold and meet the conditions set out in a permit (Permit # NWT-MBS-06-02) that allows its personnel and/or delegates to enter and conduct activities in the sanctuary. This sanctuary was established in 1961 to protect the staging and breeding grounds of over 100 species of shorebirds, songbirds, and waterfowl, especially the Lesser Snow Goose (Canadian Wildlife Service, 2000). This sanctuary includes over 600 km^2 of the Mackenzie River Delta and is bounded to the north by the Beaufort Sea. The habitat provided by the Mackenzie delta-estuary (which houses KIBS) consists of seasonal flats, wet meadows and, coastal marshes. Seasonally up to 7,500 Lesser Snow Geese, 5,000 Greater White-fronted Geese, 1,000 Brant, and 1,200 Tundra Swans nest, moult and stage in the sanctuary. An estimated 60,000 pairs of shorebirds nest in the outer Mackenzie Delta (Canadian Wildlife Service, 2000).

KIBS is adjacent to the migration and summering area of many marine mammals. The waters north of the sanctuary (downstream of Camp Farewell) are thought to be the calving habitat for at least 2,000 beluga whales (Canadian Wildlife Service, 2000). Barren-ground grizzly bears are also indigenous to the outer islands of the sanctuary.

2.4 Present and Past Land Use and Adjacent Land Use

The Mackenzie Delta is a traditional hunting and trapping area for both of the region's indigenous populations, the Gwich'in and the Inuvialuit. The area surrounding Camp Farewell is protected and managed by the Canadian Wildlife Service (CWS) and has been since the establishment of the KIBS in 1961. Given the protected status of the lands surrounding Camp Farewell, there are and have been no industrial settlements within several kilometres of the site. Industrial activity in the form of seismic exploration and exploratory drilling have been ongoing, albeit intermittently, throughout the region since the 1960's.

Due to the presence of permafrost throughout the region, the inhabitants of the Mackenzie Delta draw their water from either freshwater lakes or the Mackenzie River and its tributaries. This is also the case with Camp Farewell (Komex International Ltd. (Komex), 2001).

3. SITE HISTORY

3.1 Background and General Use

The Camp Farewell site was established in the winter of 1970 and the camp housing was brought to site during the summer of 1971. The main purpose of the camp was to act as a staging and storage site for Shell's Delta Drilling Program. The camp was operated fulltime until 1978 with crew accommodations consisting of a single story building accommodating up to 60 – 70 people. Camp Farewell has since operated periodically until the present (primarily between 1978 and 1994). In the mid-1970's, several large capacity fuel tanks were moved onto the site including two 5,000 bbl tanks, one 3,000 bbl tank, and three 2,000 bbl tanks. In the mid 1980's, the original crew accommodations (camp) were replaced with the current facility. This operational camp facility has a capacity of 32 men. Storage activities included fuel storage for up to 6.8 million litres of fuel (including aviation fuel, diesel, and gasoline), material storage (including building material and drilling mats), pipe storage and drilling materials storage (including barite, caustic soda, and Aqua Seal). Shell also holds a second lease with the Federal government for the adjacent airstrip.

During construction of the site, either 50 mm of polyurethane foam or polyurethane pads were lain over the tundra across the entire lease site (Komex, 2001). Urethane foam has been tested as an effective impermeable liner to prevent contamination of underlying soils and groundwater (EPS, 1977). These pads along with 450 mm of compacted gravel were used as a thermal barrier to protect the underlying permafrost. During test pitting conducted in 2006 (WorleyParsons Komex, 2006), this liner was generally encountered in the central portion of the gravel pad area at depths between 0.38 m and 0.62 m bgs. The liner was not, however, encountered in all test pits thereby suggesting that while a liner was used, the gravel pad was extended beyond the perimeter of the liner, possibly after the initial establishment of the facility. The pad fill material generally comprises sand and gravel to depths down to 0.47 m – 0.9 m bgs (the deepest areas of gravel were encountered at the burn pit and the day tank area).

It has also been noted that drilling mud products (bentonite) were mixed with the gravel that was used on the lease in order establish good gravel adhesion and compaction (Komex, 2001).

3.2 1981 Dome/CanMar Spill

A search of the Government of the Northwest Territories (GNWT's) Hazardous Spills Database (Komex, 2001) confirmed a major spill (approximately 800,000 litres) of water contaminated diesel fuel from the tank farm in 1981. This fuel was stored at Camp Farewell by Canadian Marine Drilling (CanMar), a subsidiary of Dome Petroleum, in the two 5,000 barrel tanks in Camp Farewell's tank farm. Based on personnel interviews conducted in 2000 (Komex, 2001), the spill was attributed to an act of vandalism/theft and that the tanks were likely tampered with during the winter of 1980-81 and the spill occurred in the spring. It was reported on May 24, 1981.

The spill was released into the berm, overtopped the berm and travelled through the berm onto the lease site from where it followed the site topography south-west over the steep banks to the frozen Mackenzie

River. Initial spill cleanup consisted of collecting any free fuel within the berm and camp area. This fuel was pumped into various holding tanks. Residual fuel was collected using sorbent pads. Over the 4 to 6 week clean-up effort a Sacke Portable Burner was used 24 hours/day to burn the recovered fuel. Fuel spilled onto the river was collected using sorbents or burned in situ. All collected sorbents and other spill-related debris on-site were incinerated. Other than the collection of free oil, no soil/water remediation was conducted. Further details of correspondence related to the spill and clean up can be found in Komex (2001).

3.3 Current Operations

The Camp Farewell lease (Figure 3; Photos 1 and 2) is under the stewardship of Shell. Currently, the camp is used as a staging site for various activities such seismic operations, preliminary development assessment work, and drilling operations. Aside from providing crew accommodations, the site is used for seismic vehicle maintenance, seasonal storage, and as a fuel depot. In 1999, E. Gruben's Transport placed a temporary one-story modular accommodations building for 30 plus persons and an exterior transformer approximately 20 m to the east of the main accommodations building (Komex, 2001).

The primary water related facilities at the site include:

- Water intake system;
- Storage system – storage tank inside the crew accommodations;
- Distribution system;
- Water use facilities – toilets, sinks, showers and associated piping;
- Gravity collection system;
- Lift station tank and pump;
- Primary treatment system;
- UV disinfection unit and chlorine dosing system; and,
- Final transport tank, pump and piping.

In addition to the camp and water facilities, the lease area includes:

- a bermed Tank Farm with five tanks;
- a Lagoon;
- a Fuel Trailer;
- storage Sheds 1, 2 and 3;
- metal Storage Tanks (believed to be empty);
- a number of storage racks with metal sleds and pipes;

- two stockpiles of crates containing drilling mud additives (bentonite, potash, barite, caustic soda etc.); and,
- a Burn Pit area containing an open top metal bin for incineration of construction debris.

A more detailed audit of materials and structures at the site should be repeated prior to implementing decommissioning and dismantling activities to ensure an accurate and current inventory.

The northeast corner of the Camp lease, adjacent to the airstrip, is currently used for temporary storage of aviation fuel for regional helicopter operations.

3.4 Previous Environmental Investigations

Several environmental investigations have been conducted at the site previously and are referenced throughout this report. These include the following:

Table A Summary of Previous Environmental Programs

Environmental Program	Summary
Baseline Environmental Site Assessment, Camp Farewell, Mackenzie Delta, Northwest Territories (Golder, 2000).	Golder (2000) summarizes baseline sampling results conducted for Geco-Prakla, a division of Schlumberger Canada Limited, prior to sub-leasing a portion of the site from Shell. The area of the sub lease included the main camp accommodations, associated accommodation trailers, the lagoon area, the area south of the storage crates and racks (including Shed #1) and extended to the east of the lease (Golder, 2000). It is not believed that the sub-lease area included the burn pit.
Phase I and Phase II Environmental Site Assessment of the Shell Farewell Stockpile and Campsite (Komex, 2001)	A Phase 1 and Phase 2 study of the entire site was conducted in September 2000 (Komex, 2001). Key issues of concern identified in this study included: • Total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs) and selected trace metals on and down gradient of the burn pit; • Xylene and TPH in the area of and around the Tank Farm and the spill area of the historical tank release; • TPH concentrations related to surface staining throughout various areas of the gravel base pad; • Total barium concentrations throughout various areas of the base pad; and, • EC and pH on the base pad in the areas where

Environmental Program	Summary
	drilling mud additives had historically been stored.
Interim Abandonment and Restoration Plan (Komex, 2002)	Following completion of the Phase I and II Environmental Site Assessment (Komex, 2001), an abandonment and restoration plan was submitted to the Northwest Territories Water Board.
Phase II Environmental Site Assessment, Camp Farewell, N.W.T. (WorleyParsons Komex, 2006)	A more detailed Phase II was conducted to delineate soil and groundwater contamination at the site. Key issues of concern identified by this study are discussed in Section 5 of this report.

4. RESTORATION CRITERIA

4.1 Decommissioning Requirements

Decommissioning (i.e., dismantling and removal) requirements, for the purpose Site restoration, are outlined in "Guidelines for Abandonment and Restoration Planning for Mines in the Northwest Territories" (NWTWB, 1990) and "Environmental Code of Practice for Aboveground Storage Tank Systems Containing Petroleum Products" (CCME, 1994).

The Guidelines for Abandonment and Restoration include information regarding decommissioning the following on-Site items.

- Fuel and Chemical Storage Areas;
- Airstrips and Other Drainage Inhibitors;
- Solid waste; and,
- Buildings and Other Structures.

The Environmental Code of Practice for Aboveground Storage Tank Systems includes additional requirements which will be addressed during tank decommissioning, as outlined in Sections 6.4 and 6.5 of the Code.

It is assumed that all materials and facilities will be removed from the Site as part of the restoration process. In general, the facilities to be dismantled can be divided into the following generalized categories:

- facilities and components that remain operable and can be re-used directly;
- materials that can be treated and/or recycled for beneficial re-use;
- waste materials that must be managed and disposed of in accordance with Northwest Territories Regulations and Guidelines; and,
- contaminated materials that must be managed, treated and/or disposed of in accordance with Northwest Territories Regulations and Guidelines.

4.2 Remediation Guidelines

4.2.1 Soil

For the purposes of developing this plan, remediation guidelines for soil are based on background soil conditions and the Northwest Territories Environmental Tier I Guidelines for Contaminated Site Remediation (NWT, 2003) as outlined below.

Background Soil Chemistry

Background soil chemistry from WorleyParsons Komex (2006) was assessed to evaluate the effect of textural differences in the soil (i.e., organic versus mineral soil) on soil chemistry, and the influence of organic matter in the organic rich soils on measured middle to heavy end hydrocarbon concentrations (typically petroleum hydrocarbon fractions (PHC) F_2, F_3 and F_4). This allowed for the comparison of results to background samples of similar textural class (organic or mineral).

A 95% confidence interval was calculated based on measured background PHC F_2, PHC F_3, PHC F_4 results.

Table B Upper Limit of the 95% Confidence Interval, Background Organic Rich Soils

PHC F2	PHC F3	PHC F4
176 mg/kg	3127 mg/kg	2061 mg/kg

The hydrocarbon soil chemistry of organic rich soil samples taken from locations adjacent to or beneath the gravel base pad was then compared to the calculated background hydrocarbon ranges listed above. Chromatograms were also used to identify particular background "signatures" in order to distinguish between natural occurring hydrocarbons and hydrocarbons related to historical site activities. As detectable PHC F_1 and BTEX concentrations are not anticipated in background soils samples, these parameters were not compared to background conditions but rather to the regulatory guidelines outlined below. Where samples were taken from soil of dominantly mineral composition, results were also only compared to the reference guidelines outlined below.

Regulatory Guidelines

It is recognised that the selection and approval of appropriate remediation guidelines will need to be re-visited and formally approved at the time of actual facility restoration. More detailed site specific (i.e., Tier 2) or risk based (i.e., Tier 3) standards may eventually be applied, in accordance with the Northwest Territories Environmental Tier I Guidelines for Contaminated Site Remediation (NWT, 2003). If base pad material (sandy gravel) is slated for removal, reuse or resale as an industrial substrate following on-site remediation, it is assumed that industrial guidelines would be applied for this material. For the purpose of developing this plan, the following regulatory remediation guidelines for soil have been used.

Table C Applicable NWT Guidelines

Parameter	Guideline
Hydrocarbons (BTEX and PHCs)	NWT Environmental Guideline for Site Remediation (NWT, 2003); Tier I levels for PHCs, Industrial and Residential / Parkland land use, coarse surface soils, Eco Soil contact pathway.

Parameter	Guideline
Salinity, metals and PAHs	NWT Environmental Guideline for Site Remediation (NWT, 2003); Industrial and Residential / Parkland land use, coarse surface soils.
Barium (total and extractable)	Alberta Environment Soil Quality Guidelines for Barite (AENV, 2004).

Should a Tier 3 Risk Based approach be selected, relevant CCME guidelines will be utilized (CCME, 1996a, 1996b, 1997, 2001 and 2003).

Land Use

The NWT Tier I guidelines are generally considered to be protective of human and environmental health for specified uses of soil at contaminated sites based on the intended future use of the land. Under NWT (2003) guidelines, current and likely future land use is classified as Industrial and Residential / Parkland, respectively.

Relevant portions of the Industrial land use definition (NWT, 2003) include "land uses in which the primary activity is related to the production, manufacture or storage of materials" and "The public does not usually have uncontrolled access to this type of land". Although, access to the Camp Farewell site is not controlled, the relative remoteness of the site limits public access to the site.

Relevant portions of the Residential / Parkland land use definition (NWT, 2003) include "the activity that is recreational in nature, and requires the natural or human designed capability of the land to sustain that activity. Residential / Parkland is often readily accessible to the public". By utilizing the Residential / Parkland land use definition it is believed that traditional access and aboriginal harvesting activities are considered.

Based on current land use definitions, Industrial land use guidelines are the most applicable for the site at this time. However, eventual restoration of the site will require application of Residential / Parkland land use guidelines. As such, Residential / Parkland land use guidelines are the primary regulatory guidelines referred to in this Plan.

Exposure Pathways

Key exposure pathways (CCME, 2001) for the Camp Farewell site are protection of groundwater for aquatic life and ecological soil contact. For coarse grained soil in both land uses, these exposure pathways are the most restrictive and have been used for the comparison of hydrocarbon results.

4.2.2 Surface and Groundwater

At present, no specific water quality guidelines exist for the Northwest Territories. As a conservative measure, the CCME guidelines for freshwater and marine aquatic life (CCME, 1999 and updates) were used for surface and groundwater for the purposes of developing this plan. The abbreviations "FWAL" and

"MAL" in the text refer to Freshwater Aquatic Life and Marine Aquatic Life, respectively. Exceedences of the CCME FWAL or MAL values do not necessarily indicate a facility-related source, and may reflect natural conditions.

4.3 Reclamation Guidelines

Reclamation criteria for the Site will parallel those outlined in "Reclamation Guidelines for Northern Canada" (INAC, 1987) and "Mine Site Reclamation Policy for the Northwest Territories" (INAC, 2002). Information from these Guidelines will be supplemented with current reclamation literature and Site specific information. Site specific information will be used to restore the site to a state compatible with the original undisturbed conditions, in a manner consistent with the present Licence that is protective of human health and the environment.

5. NATURE AND EXTENT OF IMPACT

5.1 Water Related Facilities

5.1.1 Lagoon Water and Sediments

Lagoon water is managed in accordance to Part D "Conditions Applying to Waste Disposal" of the water licence (Appendix I). As per Part B "General Conditions", annual reporting, including that of all discharged waste and analytical results, is required by March 31st of the following calendar year. As such, reporting related to Part B "General Conditions" will be provided under a separate cover.

Following final draining of the lagoon for abandonment, sediment sampling and lagoon sidewall sampling (and analyses) should be undertaken prior to decommissioning and backfilling. In particular, previous environmental investigations (Komex, 2001), reported a toluene concentration of 0.94 mg/kg that exceeds the NWT residential/parkland guideline of 0.8 mg/kg. Additional sampling is recommended to confirm or refute the presence of toluene.

5.2 Gravel Base Pad and Surrounding Land

5.2.1 2006 Environmental Site Assessment

A detailed Phase II Environmental Assessment (WorleyParsons Komex, 2006) was conducted in August 2006 to evaluate soil, surface water and groundwater conditions at the Camp Farewell site, and to identify the nature and extent of contamination resulting from historical or current operations at the site in support Shell's asset management activities. The assessment program included: a geophysical survey (EM31 and EM38), soil sampling, surface water sampling and the installation and sampling of groundwater monitoring wells among specified Areas of Assessment (AOAs; Figure 5).

A summary of findings from the 2006 Phase II is provided below. Results from previous investigations are included where relevant. 2006 analytical results and piezometer details are summarised in Tables 1 to 6. Figures 6 and 7 depict sample locations and interpreted areas exceeding reference guidelines or background baseline concentrations (see Section 5.2).

5.2.2 Burn Pit

Eight soil locations, one piezometer and two surface water locations were sampled within and down-gradient of the burn pit area. A summary of findings for this AOA is provided below:

- Facility related hydrocarbon impact was identified within (S06-56) and down gradient of (S06-55 and S06-62 located in a depression running to the south / southwest) of the burn pit. Other PHC concentrations down gradient of the burn pit were attributed to natural organic material. Elevated pH and concentrations of copper, lead and zinc within the burn pit, and detectable concentrations of PAHs within and down gradient (S06-10, S06-55 and P06-3) of the burn pit were also reported, confirming the disposal of hydrocarbon contaminated material and scrap metal in the burn pit. These results are consistent with the analytical results from previous investigations (Komex, 2001). The reported elevated total barium concentration may be due to the incineration of empty bags of drilling mud additives (barite) in the burn pit.

- Detectable concentrations of BTEX (ethylbenzene above CCME MAL guidelines) and PHC were identified in shallow groundwater down gradient of the burn pit.
- No detectable hydrocarbon concentrations were measured in the two surface water bodies located down gradient of the burn pit and site. Metals concentrations above CCME MAL and / or FWAL guidelines (cadmium, copper and iron) are likely attributed to background water conditions.
- An area of hydrocarbon stained soil adjacent to the burn pit was sampled (S06-43) following excavation by Shell personnel. Concentrations of all hydrocarbon parameters were below reference guidelines or laboratory detection limits indicating that adequate excavation of this hydrocarbon impacted gravel has been accomplished.

5.2.3 Tank Farm/Historical Tank Spill Area

Twenty seven soil borehole and two piezometer locations were sampled in the west and southwest (down gradient) sides of the site to assess soil conditions on and off the gravel base pad. A summary of findings for this AOA is provided below:

- Soil samples were taken at the location of the historical tanks to assess "worst case" conditions and along the spill path from the tank area to the base of the embankment where the spill flowed onto the frozen Mackenzie River. The "worst case" sample (S06-23) was advanced in the source area zone where the spill originated. Results suggested that impact associated with the tank farm and historical spill is characterized by hydrocarbon fractions of PHC F3 and lighter, and not PHC F4 concentrations.
- An area with BTEX and PHC concentrations above reference guidelines for residential / parkland and industrial land use and established background concentrations has been identified. The area of impact incorporates the historical tanks and spill area on the gravel pad (S06-23, S06-37, S06-38, S06-39, S06-40), an area off the gravel pad extending into the adjacent tundra to the north (S06-15, S06-16, S06-44 and S06-66) and an area extending into the adjacent tundra to the west / southwest (S06-20 and P06-7). The area around locations S06-23 and S06-44 reported the highest concentrations of facility related hydrocarbons. These results are consistent with the main direction of spill flow as described in Komex (2001). The area of impact does not appear to extend to P06-6.
- Piezometers were installed down gradient of the Tank Farm area and along the flow path of the 1981 spill to assess, and if necessary, monitor potential migration of contamination. Detectable but below regulatory guideline concentrations of xylenes and PHC F2 were identified in one piezometer down-gradient of the historical tank spill area.

5.2.4 Gravel Pad

Ten soil locations were sampled across the gravel pad, targeting storage areas and providing general coverage across the site or EM anomalies. A summary of findings for this AOA is provided below:

- A liner between the natural tundra and the gravel fill was encountered in the central portion of the pad area but not at all test pit locations. This suggests that while a liner was used, the gravel pad was extended beyond the perimeter of the liner, possibly after the initial establishment of the facility.
- Total barium concentrations measured on the gravel pad were generally consistent with previous analytical results. However, based on the measured extractable barium concentrations and the application of Barite guidelines (AENV, 2004) all samples except S06-3 reported total barium concentrations below AENV (2004) residential / parkland criteria. The elevated total barium concentration at S06-3 appears to be localized.
- Hydrocarbon impact was identified in gravel fill material at one location near storage racks in the central portion of the pad area (S06-6). These results are consistent with Komex (2001) which also reported elevated TPH concentrations in this area. The extent of facility related impact across the gravel pad appears to be limited to areas of localized drips and spills as part of refuelling and other operational activities.
- Slightly elevated terrain conductivity values were measured by EM31 and EM38 surveys at the center of the gravel pad, covering an area approximately 25 m by 30 m, centered at 495997 E, 7677661 N. Locations S06-63 and S06-68 were selected based on the geophysical anomaly reported to the northeast of Storage Shed #1 and intersected extremely hard concrete like material. This material reported EC, pH and molybdenum values above residential / parkland criteria, soluble salt concentrations elevated above background concentrations and a nickel concentration above industrial guidelines.
- A large conductivity anomaly was measured by the EM31 and EM38 surveys, covering an area approximately 65 m by 50 m, centered at 496185 E, 7677738 N. The nature of the anomaly may be attributed to buried metals in the area. Location S06-45 was advanced to assess this EM anomaly. Soil chemistry measured in this location was consistent with that of other locations on the pad. Although no buried metal was intersected during sampling, it is believed that buried metal is the source of this EM anomaly.
- Small, discrete anomalies were measured throughout the site by the EM31 and EM38 surveys. Their nature can also be attributed to the high number of buried and surface metal debris throughout the gravel pad.

5.2.5 Above Ground Fuel Storage Tanks

Ten soil locations were sampled within three identified Above Ground Storage Tank (AST) areas, excluding the Tank Farm. A summary of findings for this AOA is provided below:

- A localized PHC F2 concentration above the residential / parkland guideline was measured in gravel adjacent to the Day Tank (S06-48; 0.2-0.65 m bgs). PHC F2, PHC F3 and PHC F4 concentrations in the underlying organic horizon at this sample location were below background concentrations. Surrounding test pits (S06-47, S06-49 and S06-50) reported detectable but below guideline PHC concentrations in the gravel pad and below background PHC F2, PHC F3 and PHC F4 concentrations in the underlying buried organic horizon thereby suggesting that PHC F2 impact is limited to the gravel pad at S06-48.
- Four samples were taken in areas of limited vegetation growth near the fuel storage tanks where drips and spills were believed to have occurred during fuelling. Two locations (S06-34 and S06-42) reported BTEX and / or PHC concentrations above Residential / Parkland and / or Industrial land use criteria thereby supporting visual indications of surface fuel spills. The remaining sample locations in this area reported detectable PHC concentrations below Residential / Parkland guidelines. Depth of impact likely extends to the base of the gravel pad.
- PHC F2 and / or PHC F3 concentrations above background or residential / parkland guidelines were reported adjacent to the Heating Oil AST. S06-60 reported elevated PHC F3 concentrations in the gravel pad. S06-61 reported elevated PHC F2 concentrations in the underlying organic layer, but not in the overlying gravel cover.

5.2.6 Perimeter of the Gravel Pad

Eight soil locations (five along the northeast perimeter and three along the east perimeter) and two piezometer locations (along the south perimeter) were sampled at the perimeter of the site. A summary of findings for this AOA is provided below:

- Hydrocarbon concentrations identified off the gravel pad at the north-east perimeter were generally attributed to natural organic material. Potential facility related hydrocarbon impact was evidenced by PHC F2, F3 and F4 concentrations above background concentrations at S06-31 and S06-57. Detectable PHC F1 values in samples from S06-32 and S06-33 may suggest facility related impact, however, measured hydrocarbon concentrations are below the established background values for organic rich soils.
- Perimeter samples taken to the east and south of the site reported no concentrations of parameters exceeding reference guidelines or background concentrations.
- Two piezometers (P06-4 and P06-5) were installed to the south of the site. These piezometers were dry at the initial time of sampling. A groundwater sample was collected approximately one month after installation from P06-5, however; only sufficient water for hydrocarbon analysis was obtained. P06-4 was still dry and unable to be sampled. No facility related hydrocarbon impact was identified in groundwater to the south (down-gradient) of the gravel pad area.

6. RESTORATION OF WATER-RELATED FACILITIES

6.1 Overview

The restoration plan to be implemented for the water related facilities, including the accommodation facilities consists of the following:

- decommissioning (i.e., dismantling and removal) of facilities associated with water collection, distribution, use, treatment and disposal;
- treatment (i.e., dewatering and remediation, if required) of lagoon sediments/sludge following lagoon decommissioning; and,
- management of waste generated by these activities.

Reclamation of these areas is included in the scope of work for reclamation of the site as a whole.

6.2 Decommissioning and Dismantling Activities

All facilities located in the camp accommodation area, including water systems (Figure 2) will be dismantled in support of restoration. An audit of the materials and structures in the camp area will be repeated prior to implementing decommissioning and dismantling activities to ensure an accurate inventory is available at that time.

In general, efforts will be made to re-use and recycle materials where practical. At this point, it is reasonable to plan for the following program.

- The current camp facilities would have little salvage value given their age. It is reasonable to assume that a survey would be completed to identify any potentially hazardous materials such as mercury switches, asbestos, and lead paints. Because the camp is relatively new (1985) there is low risk that any of these materials are present. These materials along with the remaining facilities in the camp accommodation area would be removed and either partially recycled or disposed at a local municipal landfill. Based on the results of the Phase 1 assessment (Komex, 2001), no significant quantities of potentially hazardous materials are suspected to be present.
- Water collection, transfer and treatment facilities likely have residual value and would be sold for subsequent application elsewhere.
- Miscellaneous metals and piping would be segregated from the facilities and likely shipped south for recycling. It is possible that a small portion of the metals will be in sufficiently good condition for re-use.

The primary costs associated with the dismantling phase would be associated with the physical dismantling in such a remote location, as well as transportation of materials either south, or to an alternate location in the Arctic.

6.3 Remediation Activities

The lagoon will be decommissioned once it is no longer required in the sewage treatment process. If analytical data indicates, treatment of the sediment that has accumulated in the lagoon may be required to comply with remedial standards. Prior to remediation, effluent from the lagoon will be required to meet discharge criteria set out in Northwest Territories Water Board Licence # N7L1-1762 Renewal, Part D before discharging to the Mackenzie River.

Following lagoon decanting, dewatering of the sludge will be performed using natural air-drying potentially coupled with mixing of absorbents. The depth of the sludge is not expected to exceed 0.5 m and should be mixed in thin lifts to increase drying efficiency. The sludge can be dried in the lagoon and may require mechanical mixing to enhance the drying process.

Air drying is expected to require approximately 3 months with at least 2 of the 3 months having an average daily temperature above 0°C, which occurs from June to September. Treatment of the lagoon sediment / sludge in this manner negates the need for off-site transport and disposal. Air drying the digested sludge / sediments in this manner constitutes a Process to Significantly Reduce Pathogens (PSRP) as designated by the Environmental Protection Agency (EPA, 1989). Treatment of lagoon sediment / sludge meets Item 6 of Part D of the Water Board Licence. The process of air drying will also serve to reduce hydrocarbon compounds that are present. As such, the dried sediments are expected to be suitable for subsequent reuse as fill following the drying and treatment process. They could also be beneficially reused as a topsoil amendment as part of site reclamation.

6.4 Reclamation Activities

Reclamation of the camp accommodation area is addressed with the remainder of the camp storage facilities. It is possible that the Site will continue to be used as a material storage facility after the accommodation component has been removed.

The sewage lagoon should be reclaimed by backfilling the lagoon using the dykes and treated sediments to conform to the surrounding landscape. It may be beneficial to spread alluvial sediments over the prepared grade to approximate the surrounding topsoil conditions. At this point, the surface material would be fertilized and seeded with native species (see Section 2.2). The final reclamation plan will be chosen based on feedback from the local Government Land Use Inspector.

7. RESTORATION OF BASE PAD AND SURROUNDING LAND

7.1 Overview

It is suggested that the restoration plan for the site be conducted in several phases, with near term, preliminary remediation and monitoring initiated in response to areas of impact defined in Komex (2006) with a longer term plan detailing final (site end of life) restoration plans. As such the following section is organized as follows:

- near-term remediation and monitoring of areas of previously identified impact;
- decommissioning (i.e., dismantling and removal) of structures and materials;
- additional treatment (e.g., remediation or disposal) of contaminated soils, if necessary;
- management of waste generated by these activities; and,
- final reclamation of the area to a condition compatible with undisturbed conditions and surrounding land use.

7.2 Near Term Site Remediation and Monitoring

7.2.1 General

Environmental site assessments undertaken at the site have identified several areas requiring remediation (Figures 6 and 7). A general summary of proposed remediation strategy is as follows:

- source removal of hydrocarbon impacted soil / gravel located within the gravel base pad area;
- off-site disposal or on-site treatment of excavated soil;
- restoration of excavated areas.
- monitoring and management of hydrocarbon impacted natural tundra; and,
- groundwater monitoring.

7.2.2 Impacted Gravel (Source) Removal - Gravel Base Pad Area

The estimated volume of hydrocarbon impacted soil requiring excavation within the gravel pad area is 2,495 m^3. This soil is located in several of the 2006 AOAs of the site:

- Tank farm/historical fuel spill area – 2,000 m^3: the gravel fill requires excavation until the intersection of the liner or the underlying organic soil, at an average depth of 0.5 m bgs;
- Fuel Storage AST – 30 m^3: two additional spot areas east of the main impacted area requiring excavation of gravel fill material until the intersection of the liner or the underlying organic soil, at an approximate depth of 0.6 m bgs;

- Fuel tank Area – 370 m^3: the gravel fill material and the underlying natural soil requires excavation, to an approximate depth of 1.2 m bgs;
- Burn Pit – 75 m^3: the gravel fill material requires excavation until the intersection of the liner or the underlying organic material, at an approximate depth of at least 0.5 m bgs;
- Gravel Pad – 20 m^3: the gravel fill material in a spot area near the storage racks requires excavation until the intersection of the liner or the underlying organic soil, at an approximate depth of 0.65 m bgs.

Excavation would be conducted with heavy equipment transported to the site by barge (summer) or by winter road. Validation samples will be collected from the completed excavation to ensure that the remediation objectives have been met.

7.2.3 Treatment Options

Options for the management of excavated base pad gravel / soil include:

- on-site *ex-situ* treatment of hydrocarbon impacted material and reuse as backfill; and,
- off-site disposal – transportation of excavated soil to an appropriate landfill facility.

Given the limited supply of gravel in the Mackenzie Delta, the preferred option is to excavate, treat and reuse the impacted gravel for industrial purposes, wherever and whenever gravel is removed from the Site.

On-site Treatment

On-site *ex-situ* treatment will be implemented to reduce BTEX and PHC F1-F3 concentrations in the sandy gravel base pad material to less than NWT guideline levels for the pre-determined land use (Residential/Parkland or Industrial). On-site treatment options include thermal desorption, chemical oxidation or bioremediation.

Ex-situ biological treatment has been applied successfully at similar project locations and for similar contaminant conditions. Komex International (now WorleyParsons Komex) has been involved in two similar projects on behalf of Amoco Canada with Canmar's former Tuk Base and with the Government of the Northwest Territories' (NWT) Department of Transportation at the Tuk airport. The characteristics of the soils and contaminants at the Site are very similar to those at the Tuk airport and Canmar's Base, as is evidenced in the underlying summary of the projects.

Table D Comparison of Hydrocarbon Contamination

Parameter	Tuk Airport	Canmar Tuk Base	Camp Farewell
Contaminant	diesel, gasoline and jet fuel	diesel and jet fuel	gasoline and diesel
Contaminated media	Sandy gravel	Sandy gravel	Sandy gravel
Volume of soil (m^3)	2,000	2,000	2,495
Before Treatment			
primary carbon chain length range	C8 to C60	C10 to C20	C10 to C34
primary hydrocarbon concentration (mg/kg)	TPH range from 2,500 to 10,000	TPH range from 3,000 to 20,000	PHC F1 - <293 PHC F2 - <4,220 PHC F3 - <3,980
After Treatment			
primary carbon chain length range	C10 to C34+	C10 to C34	C10 to C34
primary TPH concentration (mg/kg)	600 to 1950	300 to 2,200	NWT, 2003

It is important to note that Komex's previous experience involved sites that continued to be used for industrial purposes. The addition of nutrients and oxygen, in conjunction with moisture amendments similar to that used at the Tuk sites, will act as a more aggressive approach to meet the desired criteria. More than one field season may be required. These modifications are based on successful treatment methods applied at similar projects in northern latitudes (Ramert and Eberhardt, 1996 and Reynolds et al. 1998).

Given the generally gravel material to be excavated, thermal desorption or chemical oxidation are considered to be the more time efficient of these options. Thermal desorption equipment or chemical oxidizer would require transport to site.

Treatment cells (with the design and number of cells dependent on the remediation method employed, volumes and time constraints) could be constructed on a portion of the storage base pad area or the adjacent air strip.

Off-Site Disposal

The majority of the proposed material to be excavated appears to be impacted only with hydrocarbons, and therefore should be able to be re-used as backfill after treatment and confirmatory sampling to ensure successful treatment. *In-situ* volumes of base pad soils containing salts, basic materials (elevated pH) or barite above Site criteria and / or industrial guidelines are estimated to be localized on the order of < 150 m^3. In particular, material from the burn pit contains trace metals above reference guidelines and therefore treatment and reuse of this soil is limited and alternative remedial options will be required.

A risk assessment should be considered to evaluate potential reuse options for these materials. Alternately, these materials would be transferred to Alberta or British Colombia for disposal unless a suitable facility is constructed in the area as an alternative. Material for off-site disposal will be sampled for classification prior to transportation for evaluation against the Transportation of Dangerous Goods and Landfilling Regulations. All materials would generally be classified as non-hazardous and non-dangerous in accordance with accepted transportation and disposal criteria.

7.2.4 Restoration of Excavated Areas

The completed excavation will need to be backfilled, either with treated soil (in the case of on-site treatment) or with imported backfill material (in the case of off-site disposal), to return the excavated areas to a level compatible with the remaining gravel pad area. Fill material will be sampled prior to backfilling to ensure that all parameter guideline concentrations are met.

7.2.5 Hydrocarbon Impacted Natural Tundra

Identified hydrocarbon impact appears to extend beyond the gravel pad in several areas as listed below:

- Tank farm / historical fuel spill area – 700 m^3: the area of hydrocarbon impacted soil extends beyond the gravel pad to the north and west;
- Burn pit area – 395 m^3: the area of hydrocarbon impacted soil extends beyond the gravel pad to the south and south-east; and
- North-east perimeter – 60 m^3: an area of hydrocarbon impacted soil is located off the gravel pad at the north-east perimeter.

Limited ground and vegetation disturbance is an important variable in considering remediation methods for these areas. Currently, the vegetation in these areas is healthy and appears to be unaffected by the presence hydrocarbons (Komex, 2001 and 2006). The fragile nature of the local vegetation and difficulties associated with re-vegetation in northern climates are reasons to discourage such disturbance. In short, the extensive ground and vegetation disturbance that would result from excavation would cause excessive damage to the fragile tundra environment and the underlying permafrost. Excavation of the natural tundra is not considered to be a beneficial option.

In-situ treatment options, such as soil vapour extraction (SVE), have also been considered. However, source removal of hydrocarbon impacted soil / sandy gravel from the base pad should alleviate the identified soil and groundwater impacts in the natural tundra surrounding the site. As such, although *in-situ* remediation is potentially a viable option, given the health of the vegetation, the limited lateral movement of contaminants over time, the physical limitations (including shallow permafrost) and the remote location of the site, *in-situ* treatment is not considered the best option at this time. Following removal of the hydrocarbon impacted material on the gravel pad, the vegetation in the natural tundra surrounding the gravel pad will be monitored for signs of stress which may be related to the identified presence of hydrocarbons in the soil. Additional soil sampling will be undertaken to monitor and assess attenuation of hydrocarbons off-site.

7.2.6 Groundwater Management and Monitoring Programs

Facility related hydrocarbon impact, including detectable concentrations of BTEX and PHC, identified in soil at the burn pit appears to have impacted the shallow groundwater down-gradient of the burn pit area. Detectable but below regulatory guideline concentrations of xylenes and PHC F2 were also reported in one piezometer down-gradient of the historical tank spill area.

Continued soil, vegetation and groundwater monitoring will be undertaken to reassess conditions following completion of excavation and remediation activities. A timeline of one, two and five years after the completion of excavation and reclamation activities is suggested (this would be reassessed based on the results of each monitoring event). Monitoring will include:

a) Groundwater monitoring at all piezometer locations to assess groundwater conditions on an annual basis (for the above mentioned timeline) after the completion of excavation and reclamation activities. Analysis of groundwater samples would include BTEX, PHC F1-F4 and routine water chemistry parameters.

b) Annual soil and vegetation monitoring following source removal will be undertaken in the natural tundra surrounding the gravel pad in AOAs with identified facility related impact. Soil samples will be obtained and submitted for laboratory analyses and vegetation will be monitored for signs of stress which may be related to the identified presence of hydrocarbons in the soil.

The analytical schedule for soil samples would be consistent with contaminants identified during previous environmental assessments (Komex, 2001, WorleyParsons Komex, 2006) and would consist of some or all of the following:

- BTEX;
- PHC F1, F2, F3, F4 and F4G;
- Soil salinity: pH, EC, soluble anions and cations;
- Total Metals (CCME Metals); and,
- Polycyclic Aromatic Hydrocarbons (PAHs).

Additional options for the management of soil and groundwater in the native tundra will be considered following review of annual soil, vegetation and groundwater monitoring data.

7.3 Decommissioning and Dismantling Activities

An up to date audit of the materials and structures in the storage area of the Site should be completed prior to implementing decommissioning activities to ensure an accurate inventory. This ensures that decommissioning is completed in a safe manner and that appropriate measures are implemented to deal with the materials that are present at that time.

In general, efforts will be made to re-use and recycle materials where practical. At this point, it is reasonable to plan for the following program.

- Drilling materials such as pipe that are still in operable condition would be sold for subsequent re-use in exploration or production projects being completed in the area. Worn materials or drilling materials that are no longer functional would be recycled or disposed.
- Fuels would be removed from their storage facilities and beneficially reused locally. Fuel storage tanks would be reused or recycled.
- Miscellaneous construction materials remaining on the Site likely have adequate function for beneficial reuse in the local market place. It is assumed that these materials would either be recycled or disposed locally in a municipal landfill.
- The current camp support facilities would have little salvage value given their age and present condition. It is reasonable to assume that a survey would be completed to identify any potentially hazardous materials such as mercury switches, asbestos, and lead paints. These materials would be removed, if present. Given the age of the camp (1985), there is low risk of these materials being present. The remaining facilities would be removed and either partially recycled or disposed at a local municipal landfill. Based on the results of the Phase 1 assessment, no significant quantities of potentially hazardous materials are suspected to be present.
- Miscellaneous metals and piping would be segregated from the facilities and recycled or disposed. It is possible that a small portion of the metals will be in sufficiently good condition for re-use in the Arctic.

The primary costs associated with the Site decommissioning and dismantling phase would be associated with the physical dismantling in such a remote location, as well as transportation of materials either south, or to an alternate location in the Arctic.

7.4 Additional Remediation Activities

It is anticipated that remediation of areas of impacted soil identified by environmental site assessments conducted to date (see Section 7.2) will have been undertaken before the final restoration of the site. However, other remediation requirements may be present which will need to be addressed at the time of final site restoration. The remediation strategy for any such requirements will be based on the type and location of contamination, and is likely to follow the same general principles as outlined in Section 7.2.

7.5 Reclamation and Re-Vegetation Activities

7.5.1 Reclamation Activities

Reclamation of the site will focus on returning the gravel pad area to a level compatible with the surrounding undisturbed land.

The Reclamation Plan involves leaving the current urethane and gravel layers of the base pad in place. Permanently removing these layers would expose the pre-camp natural surface, which has experienced subsidence due to static loading and melting caused by the Site base. The depressed exposed surface would likely be void of plant material, which acts as an insulative layer. The dark colour and lack of vegetation will lead to ground thawing. Due to the depression created by removal of the Site base excavation, compaction of soils and elevated ground temperatures, ponding in the depression is a strong possibility if the Site base material is removed. If base materials are left in place, topography of the Site will remain relatively unchanged. Reclamation focus would be on re-vegetation of the Site. A summary of Reclamation Plan consists of:

- grading to match Site topography;
- rip area to loosen compacted soil and scarify with machinery to enhance micro-topography for vegetation;
- cover with a thin lift of natural alluvial soils to match the surrounding soil conditions; and
- re-vegetate Site with an appropriate mixture of plant species.

Removing this liner may result in deeper penetration of contaminants into soils and groundwater due to removal of the impermeable layer and / or deepening the active zone and allowing for an increased area for contaminant migration. Complete breakdown of Urethane Foam into soluble components proceeds very slowly and therefore it is unlikely that products deleterious to the environment would be released into the soil or groundwater at significant rates (EPS, 1977). Freeze-thaw cycles and exposure to the elements are probably the largest contributor to urethane degradation.

Given the relative scarcity of gravel materials in the area, it may be beneficial to remove some of the gravel from the base pad for beneficial re-use off-site.

7.5.2 Re-Vegetation

A native seed mixture combined with amendments (e.g., fertilizer) is proposed for the Site. The final seed mix and application rate will be developed with input from the local Government Land Use Inspector. The objectives of the seed mix are to:

- stabilize Site soils;
- provide habitat equivalent to the surrounding landscape;
- allow the for natural succession of vegetation and minimize maintenance; and

- utilize a seed mixture compatible with the local vegetation.

7.5.3 Monitoring Programs

Vegetation/Reclamation Monitoring

The Site will be assessed for reclamation success, likely on an annual basis for the first five years following remediation, restoration and abandonment activities, until vegetation is established. The progress and extent of growth of all desirable and non-desirable species will be identified and documented. Any unusual soil conditions, such as erosion, bare areas, etc., would be identified and addressed. Maintenance would be undertaken as required, until reclamation is accepted as complete and sustainable.

8. CLOSURE

We trust that this report satisfies your current requirements and provides suitable documentation for your records. If you have any questions or require further details, please contact the undersigned at any time.

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Signature
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PERMIT NUMBER: P 409
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

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Tables

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resources & energy

Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth	Date	Physical: Moisture Content	Clay	Silt	Sand	Texture Class	Theor. Gypsum Reqmt.	Salinity / Sodicity: EC	pH	Sodium Adsorption Ratio	Saturation %	Soluble Ca	Soluble Cl	Soluble CO_3	Soluble HCO_3	Hydroxide	Soluble K	Soluble Mg	Soluble Na	Soluble SO_4	Sulphur: Sulphur	Sulphur-T	Hydrocarbons: Benzene	Toluene	Ethylbenzene	Xylenes-total	PHC F_1 (C_6-C_{10})	PHC F_2 (C_{10}-C_{16})	PHC F_3 (C_{16}-C_{34})	PHC F_4 (C_{34}-C_{50}+)	F_4SG (Heavy HC-silicagel)	Reached baseline at C_{50}
	(m)	(d-m-y)	(%)	(%)	(%)	(%)	(units)	(tons/ac)	(us/cm)	(units)	(ratio)	(%)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(Yes/No)
NWT Industrial, Coarse surface			—	—	—	—	—	—	4,000	6 - 8	12	—	—	—	—	—		—	—	—	—	—	—	5	0.8	20	20	330	760	1,700	3,300	—	—
NWT Residential/Parkland Coarse Surface			—	—	—	—	—	—	2,000	6 - 8	5	—	—	—	—	—		—	—	—	—	—	—	0.5	0.8	1.2	1	130	150	400	2,800	—	—
Background Chemistry (Organic rich soils, PHCs only) - 85% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<10	176	3,127	2,061	—	—
Background																																	
S06-1	(0.0-0.20)	03-Aug-06	66.5	7	58	34	Silt Loam	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	64	1,150	585	4,900	NO
	(0.20-0.40)	03-Aug-06	68.5	23	57	20	Silt Loam	<0.1	251	6.7	0.6	180	30	15	<10	102	—	<5	14	17	<10	—	1,100	<0.0050	<0.020	<0.010	<0.045	<10	164	2,850	1,880	12,000	NO
S06-2	(0.0-0.20)	03-Aug-06	81.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	89	1,760	975	5,300	NO
	(0.20-0.40)	03-Aug-06	69.9	5	66	30	Organic	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	91	1,580	1,020	4,700	NO
P06-1	(0.85-1.35)	05-Aug-06	17.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	<10	<10	—	YES
P06-2	(0.15-0.35)	06-Aug-06	46.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	64	1,000	614	4,700	NO
Burn Pit Area																																	
S06-9	(0.15-0.45)	04-Aug-06	14.1	—	—	—	—	<0.1	1,370	7.9	3.8	34	31	75	<10	367	<10	329	8	93	187	<200	84	<0.0050	<0.020	<0.010	<0.045	<10	<10	47	31	—	YES
	(0.45-0.65)	04-Aug-06	17.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-10	(0.15-0.45)	04-Aug-06	55.2	—	—	—	—	<0.1	1,120	6.7	1	160	87	44	<10	130	<10	177	29	41	278	—	—	<0.0050	<0.020	<0.010	<0.045	16	147	1,460	1,020	6,600	NO
S06-11	(0.0-0.15)	04-Aug-06	64.1	—	—	—	—	<0.1	1,630	7.6	5	260	55	147	<10	576	<10	278	17	166	94	<200	1,590	<0.0050	<0.020	<0.010	<0.045	12	54	744	661	3,200	NO
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-12	(0-0.15)	04-Aug-06	54.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.45)	04-Aug-06	18	5	11	84	Loamy Sand	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-43	(0.2-0.9)	07-Aug-06	5.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.020	<10	29	86	32	—	YES
S06-65	(0.2-0.6)	11-Aug-06	52.6	—	—	—	—	<0.1	459	6.6	0.7	100	37	10	<10	82	—	54	16	21	90	<200	717	<0.0050	<0.020	<0.010	<0.040	128	1,740	1,770	861	6,500	NO
S06-66	(0.2-0.5)	11-Aug-06	6.7	—	—	—	—	<0.1	1,230	8.3	4.6	19	56	50	<10	725	—	273	9	142	158	<200	1,360	<0.0050	0.077	<0.010	0.26	293	3,460	356	88	—	YES
S06-62	(0.15-0.63)	14-Sep-06	66	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	18	[illegible]	1520	685	6300	NO
P06-3	(0.7-0.85)	06-Aug-06	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	<10	<10	—	YES
Historical Tank Spill Area																																	
S06-14	(0-0.2)	04-Aug-06	33.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	116	841	520	3,000	NO
S06-15	(0.2-0.42)	04-Aug-06	44.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.068	0.05	0.095	16	292	3,470	2,100	12,000	NO
S06-16	(0.20-0.44)	04-Aug-06	70.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.22	<0.010	<0.020	19	441	6,710	2,810	—	NO
S06-17	(0.2-0.46)	04-Aug-06	31.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	11	170	1,820	1,380	6,100	NO
S06-19	(0.20-0.60)	04-Aug-06	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.020	<10	16	37	12	—	—
S06-20	(0.2-0.6)	04-Aug-06	42.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.021	0.35	0.42	5.8	140	506	1,490	1,190	5,200	NO
S06-23	(0.15-0.45)	07-Aug-06	5.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	59	4,220	3,900	52	—	YES
	(0.45-0.75)	07-Aug-06	6.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.087	0.095	1.9	109	3,400	2,790	63	—	YES
	(0.75-1.15)	07-Aug-06	58.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	5.7	0.062	0.58	88	310	6,930	3,770	24,000	NO
	(1.15-1.35)	07-Aug-06	57.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	2.8	<0.010	<0.045	27	182	3,500	1,640	13,000	NO
S06-27	(0.2-0.5)	06-Aug-06	35.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.020	<10	26	503	394	—	YES

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

			Physical						Salinity / Sodicity													Sulphur		Hydrocarbons									
Sampling Location	Soil Depth (m)	Date (d-m-y)	Moisture Content (%)	Clay (%)	Silt (%)	Sand (%)	Texture Class (units)	Theor. Gypsum Reqmt. (tons/ac)	EC (uS/cm)	pH (units)	Sodium Adsorption Ratio (ratio)	Saturation % (%)	Soluble Ca (mg/L)	Soluble Cl (mg/L)	Soluble CO_3 (mg/L)	Soluble HCO_3 (mg/L)	Hydroxide (mg/L)	Soluble K (mg/L)	Soluble Mg (mg/L)	Soluble Na (mg/L)	Soluble SO_4 (mg/L)	Sulphur (mg/kg)	Sulphur-T (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes-total (mg/kg)	PHC F_1 (C_6-C_{10}) (mg/kg)	PHC F_2 (C_{10}-C_{16}) (mg/kg)	PHC F_3 (C_{16}-C_{34}) (mg/kg)	PHC F_4 (C_{34}-C_{50}+) (mg/kg)	F_4SG (Heavy HC-Silicagel) (mg/kg)	Reached baseline at C_{50} (Yes/No)
NWT Industrial, Coarse surface			—	—	—	—	—	—	4,000	6 - 8	12	—	—	—	—	—		—	—	—	—	—	—	5	0.8	20	20	330	760	1,700	3,300	—	—
NWT Residential/Parkland Coarse Surface			—	—	—	—	—	—	2,000	6 - 8	5	—	—	—	—	—		—	—	—	—	—	—	0.5	0.8	1.2	1	130	150	400	2,800	—	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<10	178	3,127	2,061	—	—
Historical Tank Spill Area continued																																	
S06-28	(0.2-0.7)	06-Aug-06	20.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.020	<10	15	241	183	—	YES
S06-29	(0.2-0.7)	06-Aug-06	33.6	—	—	—	—	<0.1	491	7.1	0.8	82	70	20	<10	280	<10	<5	32	33	15	—	521	<0.0050	<0.020	<0.010	<0.045	<10	48	647	377	—	YES
S06-30	(0.2-0.76)	06-Aug-06	48.8	—	—	—	—	<0.1	473	6.7	0.9	120	67	12	<10	171	<10	<5	30	36	48	—	736	<0.0050	<0.020	<0.010	<0.045	<10	106	1,490	935	—	NO
S06-37	(0.5-0.7)	07-Aug-06	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	178	112	<10	—	YES
	(0.7-1.0)	07-Aug-06	55.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.034	9.9	<0.010	0.29	16	309	2,090	1,010	9,100	NO
	(1.0-1.3)	07-Aug-06	21.7	5	16	80	Loamy Sand	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-38	(0-0.35)	07-Aug-06	6.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	12	53	—	YES
	(0.35-0.55)	07-Aug-06	32.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.015	5.2	0.035	0.25	<10	60	657	394	2,900	NO
S06-39	(0.65-0.95)	07-Aug-06	44.5	13	45	42	Loam	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	3	<0.010	<0.045	<10	152	2,080	1,010	9,000	NO
	(0.95-1.4)	07-Aug-06	14	6	7	87	Loamy Sand	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.1	<0.010	<0.045	<10	<10	25	99	—	YES
S06-40	(0.15-0.5)	07-Aug-06	6.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.037	<0.010	<0.045	<10	92	205	45	—	YES
	(0.5-0.7)	07-Aug-06	5.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.24	0.033	0.2	28	787	754	36	—	YES
S06-41	(0.15-0.6)	07-Aug-06	3.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	25	16	—	YES
	(0.95-1.4)	07-Aug-06	17.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.11	<0.010	<0.045	<10	<10	83	52	—	YES
S06-44	(0-0.15)	07-Aug-06	58.9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.21	<0.010	0.59	34	1,330	6,890	3,010	23,000	NO
	(0.15-0.5)	07-Aug-06	60.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	4.9	<0.010	<0.045	37	990	9,490	6,320	37,000	NO
S06-62	(0.5-1.0)	09-Aug-06	10.9	—	—	—	—	<0.1	394	7.4	0.6	30	57	16	<10	247	—	6	18	22	74	—	288	<0.0050	<0.020	<0.010	<0.040	<10	12	109	54	—	YES
S06-64	(0.0-0.15)	14-Sep-06	58.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	16	56	576	209	—	YES
	(0.15-0.33)	14-Sep-06	62.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	47	919	421	3900	NO
S06-65	(0.15-0.39)	14-Sep-06	63.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	60	148	1820	968	6800	NO
S06-66	(0.15-0.58)	14-Sep-06	65.3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.54	<0.010	<0.040	195	343	8290	2910	19,000	NO
S06-67	(0.00-0.15)	14-Sep-06	57.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	16	173	943	231	—	YES
	(0.15-0.47)	14-Sep-06	41.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	47	53	523	421	1900	NO
P06-6	(0.15-0.3)	06-Aug-06	48.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.020	<10	21	323	211	—	YES
	(0.5-1.1)	06-Aug-06	21.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	27	276	201	—	YES
	(1.1-1.25)	06-Aug-06	14.8	7	11	82	Loamy Sand	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	76	79	—	YES
P06-7	(0.15-0.45)	07-Aug-06	54.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.071	0.31	2.5	14	79	1,520	986	6,200	NO
Gravel Pad																																	
S06-3	(0.0-0.20)	03-Aug-06	6.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,630	—	—	—	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	5.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	757	—	—	—	—	—	—	—	—	—	—
	(0.40-0.60)	03-Aug-06	—	—	—	—	—	<0.1	286	7	1.4	17	15	22	<10	53	—	12	6	26	40	—	—	—	—	—	—	—	—	—	—	—	—
S06-4	(0-0.20)	04-Aug-06	5.3	—	—	—	—	—	—	—	—	24	—	—	—	—	—	—	—	—	—	<200	246	—	—	—	—	—	—	—	—	—	—
S06-5	(0.2-0.4)	04-Aug-06	5	—	—	—	—	—	—	—	—	25	—	—	—	—	—	—	—	—	—	<200	397	—	—	—	—	—	—	—	—	—	—
S06-6	(0.2-0.40)	04-Aug-06	5.4	—	—	—	—	—	—	—	—	22	—	—	—	—	—	—	—	—	—	<200	645	<0.0050	<0.020	<0.010	<0.045	<10	53	880	184	—	YES
S06-7	(0.2-0.5)	06-Aug-06	3.8	—	—	—	—	<0.1	208	7.9	<0.1	23	30	<10	<10	148	<10	9	6	<10	27	—	311	—	—	—	—	—	—	—	—	—	—
S06-8	(0.2-0.5)	07-Aug-06	3.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	491	<0.0050	<0.020	<0.010	<0.045	<10	—	—	—	—	—

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360000
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth (m)	Date (d-m-y)	Physical: Moisture Content (%)	Clay (%)	Silt (%)	Sand (%)	Texture Class (units)	Theor. Gypsum Reqmt. (tons/ac)	Salinity / Sodicity: EC (uS/cm)	pH (units)	Sodium Adsorption Ratio (ratio)	Saturation % (%)	Soluble Ca (mg/L)	Soluble Cl (mg/L)	Soluble CO_3 (mg/L)	Soluble HCO_3 (mg/L)	Hydroxide (mg/L)	Soluble K (mg/L)	Soluble Mg (mg/L)	Soluble Na (mg/L)	Soluble SO_4 (mg/L)	Sulphur: Sulphur (mg/kg)	Sulphur-T (mg/kg)	Hydrocarbons: Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes-total (mg/kg)	PHC F_1 (C_6-C_{10}) (mg/kg)	PHC F_2 (C_{10}-C_{16}) (mg/kg)	PHC F_3 (C_{16}-C_{34}) (mg/kg)	PHC F_4 (C_{34}-C_{50+}) (mg/kg)	F_4G (Heavy HC-Silicagel) (mg/kg)	Reached baseline at C_{50} (Yes/No)
NWT Industrial, Coarse surface			—	—	—	—	—	—	4,000	6 - 8	12	—	—	—	—	—		—	—	—	—	—	—	5	0.8	20	20	330	760	1,700	3,300	—	—
NWT Residential/Parkland Coarse Surface			—	—	—	—	—	—	2,000	6 - 8	5	—	—	—	—	—		—	—	—	—	—	—	0.5	0.8	1.2	1	130	150	400	2,800	—	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<10	176	3,127	2,061	—	—
Gravel Pad continued																																	
506-45	(0.6-0.95)	09-Aug-06	47.1	—	—	—	—	<0.1	394	6.4	<0.1	180	22	14	<10	29	—	57	8	<10	109	—	—	—	—	—	—	—	—	—	—	—	—
	(0.9-1.4)	09-Aug-06	—	—	—	—	—	<0.1	382	7.6	0.7	27	65	20	<10	1,370	—	51	14	23	23	—	—	—	—	—	—	—	—	—	—	—	—
	(1.4-1.8)	09-Aug-06	13.3	—	—	—	—	<0.1	457	7.5	0.7	23	67	33	<10	907	—	41	15	25	21	—	—	<0.0050	<0.020	<0.010	<0.040	<10	<10	<10	<10	—	YES
506-46	(0.2-0.6)	09-Aug-06	—	—	—	—	—	<0.1	261	7.4	1.3	16	13	28	<10	75	—	<5	7	24	30	—	—	—	—	—	—	—	—	—	—	—	—
506-53	(0.1-0.2)	14-Sep-06	—	—	—	—	—	<0.1	570	8.76	2.1	29.5	19	<5	<2	487	<2	141	4	39	51	—	—	—	—	—	—	—	—	—	—	—	—
	(0.2-0.3)	14-Sep-06	6.7	—	—	—	—	<0.1	4,090	12.3	2	42.1	333	913	434	<2	9	592	<1	131	16	—	—	—	—	—	—	—	—	—	—	—	—
506-55	(0.2-1.0)	14-Sep-06	6.7	—	—	—	—	<0.1	650	9.6	1.5	22.5	60	18	97	283	<10	67	9	45	178	—	—	—	—	—	—	—	—	—	—	—	—
Fuel Storage Tank Area (South of Tank Farm)																																	
506-34	(0.2-0.5)	07-Aug-06	4.4	—	—	—	—	<0.1	219	7.2	0.9	17	20	<10	<10	137	<10	7	10	20	24	—	155	0.23	33	5.8	180	897	812	522	38	—	YES
506-35	(0.2-0.5)	07-Aug-06	4.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.027	<0.010	<0.045	<10	<10	21	15	—	YES
506-36	(0-0.2)	07-Aug-06	7.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	48	142	39	—	YES
506-42	(0-0.2)	07-Aug-06	12.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1,080	<0.0050	<0.020	<0.010	<0.045	<10	78	743	130	—	YES
Day Tank Area																																	
506-47	(0.6-0.75)	09-Aug-06	49.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	60	777	424	1,400	NO
506-48	(0.2-0.65)	09-Aug-06	5.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	19	882	306	20	—	YES
	(0.65-1.0)	09-Aug-06	34.3	—	—	—	—	—	—	—	—	150	—	—	—	—	—	—	—	—	—	—	827	<0.0050	<0.020	<0.010	<0.040	<10	129	706	415	1,600	NO
506-49	(0.85-1.05)	09-Aug-06	6.8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	71	813	506	3,100	NO
506-50	(0.3-0.85)	09-Aug-06	3.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	13	<10	<10	—	YES
	(0.85-1.05)	09-Aug-06	36.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	62	889	603	1,900	NO
Heating Oil AST / Fuel Trailer																																	
506-60	(0.35-0.65)	11-Aug-06	62.6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	0.54	<0.010	<0.040	<10	92	986	610	—	YES
506-61	(0.2-0.7)	11-Aug-06	11.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	11	36	44	—	YES
	(0.7-1.2)	11-Aug-06	34.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	0.093	30	594	1,920	1,120	7,500	NO
NE Perimeter of Gravel Pad																																	
506-31	(0-0.2)	07-Aug-06	54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	258	3,540	2,840	16,000	NO
506-32	(0.2-0.5)	07-Aug-06	27.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	32	138	2,120	1,520	9,100	NO
506-33	(0.2-0.5)	07-Aug-06	59.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	13	92	1,740	1,150	7,200	NO
506-57	(0.0-0.15)	14-Sep-06	65.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	11	110	1,500	666	—	YES
	(0.15-0.56)	14-Sep-06	72.5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	6.3	<0.010	<0.040	<10	237	5,630	2,440	21,000	NO
506-58	(0.2-0.35)	11-Aug-06	36.7	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	135	1,580	874	6,100	NO
East Perimeter of Gravel Pad																																	
506-63	(0-0.2)	09-Aug-06	7.2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.040	<10	13	120	41	—	YES
506-64	(0.2-0.4)	09-Aug-06	7.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	0.033	0.2	111	90	87	27	—	YES
South Perimeter of Gravel Pad																																	
P06-4	(0.65-0.85)	06-Aug-06	41.7	—	—	—	—	<0.1	524	7.1	0.7	140	68	14	<10	—	—	<5	32	27	80	—	909	—	—	—	—	—	—	—	—	—	—
	(1.8-2.0)	06-Aug-06	19.1	—	—	—	—	<0.1	711	7.3	0.7	28	81	84	<10	—	—	7	31	28	48	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	<10	<10	—	YES
P06-6	(0-0.15)	06-Aug-06	22.1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	11	341	74	—	YES
	(0.5-1.0)	06-Aug-06	18.4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	<0.0050	<0.020	<0.010	<0.045	<10	<10	<10	<10	—	YES

NOTES:

1. — in guideline row(s) denotes no criteria for that parameter.
2. — in detail data row(s) denotes parameter not analyzed.
3. Denotes values exceeding NWT Industrial coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
4. Denotes values exceeding NWT Residential/Parkland coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
5. For organic rich soils only, denotes PHCs F2 - F4 values exceeding the upper limit of the 95% confidence interval of established background hydrocarbon ranges

* Barium and extractable barium concentrations have been compared to AENV (2004) Natural Area and / or Industrial soil quality guidelines for Barite

WorleyParsons Komex
resources & energy

Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth (m)	Date (d-m-y)	Metals: Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium* (mg/kg)	Barium:E* (mg/kg)	Beryllium (mg/kg)	Bismuth (mg/kg)	Hot Water Soluble Boron (mg/kg)	Bromide (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Fluoride (mg/kg)	Hex Chromium (mg/kg)	Iron (mg/kg)	Magnesium (mg/kg)	Lead (mg/kg)	Potassium (mg/kg)	Lithium:D (mg/kg)	Manganese (mg/kg)	Sodium (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Phosphorus (mg/kg)	Phosphorus:D (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Strontium (mg/kg)
NWT Industrial, Coarse surface			—	40	12	41,000	440	8	—	—	—	22	—	87	300	91	—	1.4	—	—	600	—	—	—	—	50	40	50	—	—	3.9	40	—
NWT Residential/Parkland Coarse Surface			—	20	12	3,300	260	4	—	—	—	10	—	64	50	63	—	0.4	—	—	140	—	—	—	—	6.6	10	50	—	—	1	20	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Background																																	
S06-1	(0.0-0.20)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	4,030	<2	4	208	63	0.3	<10	0.6	—	0.5	11,600	7	6.1	6	—	<0.3	13,000	1,640	<10	184	2.4	75.8	68	0.12	<0.5	18	—	365	1.8	<1	35.5
S06-2	(0.0-0.20)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-1	(0.85-1.35)	05-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-2	(0.15-0.35)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Burn Pit Area																																	
S06-9	(0.15-0.45)	04-Aug-06	—	—	3	84.3	35	<0.1	—	<0.1	—	<0.2	—	5	0.7	<2	167	<0.3	—	—	<10	—	—	—	—	<0.05	<0.5	<4	—	—	<0.5	—	—
	(0.45-0.65)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-10	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-11	(0.0-0.15)	04-Aug-06	—	—	2	361	30	0.2	—	1.3	—	<0.2	—	5	0.7	6	131	<0.3	—	—	<10	—	—	—	—	<0.05	1.1	8	—	—	0.7	—	—
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-12	(0-0.15)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-43	(0.2-0.9)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-65	(0.2-0.6)	11-Aug-06	3,500	<2	4	206	42	0.2	<10	0.8	<10	0.3	4,410	7	4.4	6	120	<0.3	5,320	1,330	<10	732	4.8	227	58	0.06	<0.5	15	—	385	<0.5	<1	16.6
S06-66	(0.2-0.5)	11-Aug-06	4,280	<2	5	5,300	98	0.2	<10	2.2	<10	1.4	8,290	18	2.5	83	196	<0.3	14,500	1,090	336	1,970	2.7	473	935	<0.05	1.8	11	—	444	<0.5	<1	138
S06-62	(0.15-0.63)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-3	(0.7-0.85)	05-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Historical Tank Spill Area																																	
S06-14	(0-0.2)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-15	(0.2-0.42)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-16	(0.20-0.44)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-17	(0.2-0.46)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-19	(0.20-0.60)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-20	(0.2-0.6)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-23	(0.15-0.45)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.45-0.75)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.75-1.15)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.15-1.35)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-27	(0.2-0.5)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth (m)	Date (d-m-y)	Aluminum (mg/kg)	Antimony (mg/kg)	Arsenic (mg/kg)	Barium* (mg/kg)	Barium:E* (mg/kg)	Beryllium (mg/kg)	Bismuth (mg/kg)	Hot Water Soluble Boron (mg/kg)	Bromide (mg/kg)	Cadmium (mg/kg)	Calcium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Fluoride (mg/kg)	Hex Chromium (mg/kg)	Iron (mg/kg)	Magnesium (mg/kg)	Lead (mg/kg)	Potassium (mg/kg)	Lithium:D (mg/kg)	Manganese (mg/kg)	Sodium (mg/kg)	Mercury (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Phosphorus (mg/kg)	Phosphorus:D (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Strontium (mg/kg)
			Metals																														
NWT Industrial, Coarse surface			—	40	12	41,000	440	8	—	—	—	22	—	87	300	91	—	1.4	—	—	600	—	—	—	—	50	40	50	—	—	3.9	40	—
NWT Residential/Parkland Coarse Surface			—	20	12	3,300	260	4	—	—	—	10	—	64	50	63	—	0.4	—	—	140	—	—	—	—	6.6	10	50	—	—	1	20	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Historical Tank Spill Area continued																																	
S06-28	(0.2-0.7)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-29	(0.2-0.7)	06-Aug-06	3,610	<2	4	196	39	0.2	<10	0.3	—	<0.2	10,000	6	4.3	4	—	<0.3	10,200	2,920	<10	262	4.5	75	102	<0.05	<0.5	15	—	443	<0.5	<1	27.8
S06-30	(0.2-0.76)	06-Aug-06	4,200	<2	4	220	83	0.2	<10	0.3	—	<0.2	11,500	7	5	4	—	<0.3	9,190	4,210	<10	360	5.2	104	126	<0.05	<0.5	13	—	469	0.8	<1	27.9
S06-37	(0.5-0.7)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.7-1.0)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.0-1.3)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-38	(0-0.35)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.35-0.55)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-39	(0.65-0.95)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.95-1.4)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-40	(0.15-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.5-0.7)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-41	(0.15-0.6)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.95-1.4)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-44	(0-0.15)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-52	(0.5-1.0)	09-Aug-06	3,080	<2	6	100	16	0.2	<10	0.2	—	<0.2	12,000	6	2.9	4	—	<0.3	9,870	3,380	<10	347	5.7	155	53	<0.05	0.6	11	—	487	<0.5	<1	34.3
S06-64	(0.0-0.15)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.33)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-65	(0.15-0.39)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-66	(0.15-0.58)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-67	(0.00-0.15)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.47)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-6	(0.15-0.3)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.5-1.1)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.1-1.25)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-7	(0.15-0.45)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gravel Pad																																	
S06-3	(0.0-0.20)	03-Aug-06	2,310	<2	6	8,040	44	0.2	<10	0.6	—	0.2	2,820	7	1.9	8	—	<0.3	6,860	679	38	443	2.3	223	<10	0.11	1	7	—	367	<0.5	<1	105
	(0.20-0.40)	03-Aug-06	2,080	<2	6	2,660	33	0.2	<10	0.2	—	<0.2	1,320	6	1.6	5	—	<0.3	6,050	708	13	365	1.8	380	<10	0.06	0.6	6	—	274	<0.5	<1	61.4
	(0.40-0.60)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-4	(0-0.20)	04-Aug-06	—	—	5	944	14	0.2	—	0.2	—	<0.2	—	6	1.2	6	250	<0.3	—	—	15	—	—	—	—	0.1	<0.5	6	—	—	<0.5	—	—
S06-5	(0.2-0.4)	04-Aug-06	—	—	6	1,120	32	0.2	—	0.4	—	0.2	—	29	4	6	310	<0.3	—	—	16	—	—	—	—	0.05	0.6	11	—	—	<0.5	—	—
S06-6	(0.2-0.40)	04-Aug-06	—	—	5	1,910	46	0.2	—	0.3	—	<0.2	—	16	1.8	7	267	<0.3	—	—	17	—	—	—	—	0.09	<0.5	6	—	—	<0.5	—	—
S06-7	(0.2-0.5)	05-Aug-06	1,390	<2	3	1,050	40	0.2	<10	<0.1	—	<0.2	810	4	1.6	5	—	<0.3	3,840	382	10	234	0.9	1,710	<10	0.06	<0.5	7	—	314	<0.5	<1	37.7
S06-8	(0.2-0.5)	07-Aug-06	1,410	<2	5	603	21	0.2	<10	0.1	—	<0.2	1,070	4	1	5	—	<0.3	7,020	457	<10	196	1.3	584	32	0.06	0.5	6	—	289	<0.5	<1	22.8

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth	Date	Metals																														
			Aluminum	Antimony	Arsenic	Barium*	Barium:E*	Beryllium	Bismuth	Hot Water Soluble Boron	Bromide	Cadmium	Calcium	Chromium	Cobalt	Copper	Fluoride	Hex Chromium	Iron	Magnesium	Lead	Potassium	Lithium:D	Manganese	Sodium	Mercury	Molybdenum	Nickel	Phosphorus	Phosphorus:D	Selenium	Silver	Strontium
	(m)	(d-m-y)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
NWT Industrial, Coarse surface			—	40	12	41,000	440	8	—	—	—	22	—	87	300	91	—	1.4	—	—	600	—	—	—	—	50	40	50	—	—	3.9	40	—
NWT Residential/Parkland Coarse Surface			—	20	12	3,300	260	4	—	—	—	10	—	64	50	63	—	0.4	—	—	140	—	—	—	—	6.6	10	50	—	—	1	20	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gravel Pad continued																																	
S06-45	(0.6-0.85)	09-Aug-06	3460	<1	4	240	—	<0.4	—	0.5	—	0.2	7080	31	3	<5	—	<0.2	6360	1390	6	938	—	73	52	—	<0.4	9	343	—	0.7	<1	19
	(0.9-1.4)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.4-1.8)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-46	(0.2-0.6)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-63	(0.1-0.2)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.2-0.3)	14-Sep-06	5100	<1	7	627	—	<0.4	—	6	—	0.4	56,900	[illegible]	5	7	—	<0.2	7710	3690	5	1,040	<10	192	152	—	[illegible]	[illegible]	264	—	<0.5	<1	24
S06-68	(0.2-1.0)	14-Sep-06	2270	<1	7	749	—	<0.4	—	<2	—	0.2	9,550	57	6	5	—	<0.2	7920	847	5	692	<10	615	75	—	8.1	49	291	—	<0.5	<1	27
Fuel Storage Tank Area (South of Tank Farm)																																	
S06-34	(0.2-0.5)	07-Aug-06	1,480	<2	4	416	22	0.2	<10	0.1	—	<0.2	692	5	0.8	5	—	<0.3	4,300	455	<10	172	1.5	118	20	<0.05	<0.5	4	—	197	<0.5	<1	16.9
S06-35	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-36	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-42	(0-0.2)	07-Aug-06	2,000	<2	5	[illegible]	—	0.2	<10	0.1	—	<0.2	1,530	5	1.6	6	—	<0.3	5,790	622	<10	229	2.2	169	31	0.06	<0.5	7	—	300	<0.5	<1	35.8
Day Tank Area																																	
S06-47	(0.6-0.75)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-48	(0.2-0.65)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.65-1.0)	09-Aug-06	4,410	<2	4	303	—	0.3	<10	1.3	—	<0.2	10,600	8	4.9	7	—	<0.3	10,800	2,450	<10	318	6	134	60	<0.05	0.6	17	—	639	<0.5	<1	26.6
S06-49	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-50	(0.0-0.85)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Heating Oil AST / Fuel Trailer																																	
S06-60	(0.35-0.65)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-61	(0.2-0.7)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.7-1.2)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NE Perimeter of Gravel Pad																																	
S06-31	(0-0.2)	07-Aug-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-32	(0.2-0.5)	07-Aug-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-33	(0.2-0.5)	07-Aug-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-67	(0.0-0.15)	14-Sep-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.56)	14-Sep-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-68	(0.2-0.35)	11-Aug-05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
East Perimeter of Gravel Pad																																	
S06-53	(0-0.2)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-54	(0.2-0.4)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
South Perimeter of Gravel Pad																																	
P06-4	(0.65-0.85)	06-Aug-06	3,210	<2	4	225	18	0.2	<10	0.2	—	<0.2	14,500	6	4.2	6	—	<0.3	6,820	3,540	<10	301	4.5	120	109	<0.05	0.6	14	596	—	0.6	<1	29.3
	(1.6-2.0)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-6	(0-0.15)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.5-1.0)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

NOTES:

1. — in guideline row(s) denotes no criteria for that parameter.
2. — in detail data row(s) denotes parameter not analyzed.
3. Denotes values exceeding NWT Industrial coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
4. Denotes values exceeding NWT Residential/Parkland coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
5. For organic rich soils only, denotes PHCs F2 - F4 values exceeding the upper limit of the 95% confidence interval of established background hydrocarbon ranges

* Barium and extractable barium concentrations have been compared to AENV (2004) Natural Area and / or Industrial soil quality guidelines for Barite

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360000
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth	Date	Metals (Cont.) Thallium	Tin	Titanium	Uranium	Vanadium	Zinc	Zirconium
	(m)	(d-m-y)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
NWT Industrial, Coarse surface			1	300	—	—	130	360	—
NWT Residential/Parkland Coarse Surface			1	50	—	—	130	200	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—
Background									
S06-1	(0.0-0.20)	03-Aug-06	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	<1	<2	24.9	0.5	14	13	1
S06-2	(0.0-0.20)	03-Aug-06	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	—	—	—	—	—	—	—
P06-1	(0.85-1.35)	05-Aug-06	—	—	—	—	—	—	—
P06-2	(0.15-0.35)	06-Aug-06	—	—	—	—	—	—	—
Burn Pit Area									
S06-9	(0.15-0.45)	04-Aug-06	<1	—	—	—	11	11	—
	(0.45-0.65)	04-Aug-06	—	—	—	—	—	—	—
S06-10	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—
S06-11	(0.0-0.15)	04-Aug-06	<1	—	—	—	9	28	—
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—
S06-12	(0-0.15)	04-Aug-06	—	—	—	—	—	—	—
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—
S06-43	(0.2-0.9)	07-Aug-06	—	—	—	—	—	—	—
S06-65	(0.2-0.6)	11-Aug-06	<1	<2	43	0.7	14	25	<1
S06-66	(0.2-0.5)	11-Aug-06	<1	<2	71	0.4	15	218	1
S06-62	(0.15-0.63)	14-Sep-06	—	—	—	—	—	—	—
P06-3	(0.7-0.85)	06-Aug-06	—	—	—	—	—	—	—
Historical Tank Spill Area									
S06-14	(0-0.2)	04-Aug-06	—	—	—	—	—	—	—
S06-15	(0.2-0.42)	04-Aug-06	—	—	—	—	—	—	—
S06-16	(0.20-0.44)	04-Aug-06	—	—	—	—	—	—	—
S06-17	(0.2-0.46)	04-Aug-06	—	—	—	—	—	—	—
S06-19	(0.20-0.60)	04-Aug-06	—	—	—	—	—	—	—
S06-20	(0.2-0.6)	04-Aug-06	—	—	—	—	—	—	—
S06-23	(0.15-0.45)	07-Aug-06	—	—	—	—	—	—	—
	(0.45-0.75)	07-Aug-06	—	—	—	—	—	—	—
	(0.75-1.15)	07-Aug-06	—	—	—	—	—	—	—
	(1.15-1.35)	07-Aug-06	—	—	—	—	—	—	—
S06-27	(0.2-0.5)	06-Aug-06	—	—	—	—	—	—	—

Sampling Location	Soil Depth	Date	PAHs 2-Methylnaphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a)-anthracene	Benzo(a)-pyrene	Benzo(b&j)fluoranthene	Benzo(g,h,i)-perylene	Benzo(k)fluoranthene	Chrysene	Dibenzo(a,h)-anthracene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene
	(m)	(d-m-y)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
NWT Industrial, Coarse surface			—	—	—	—	10	—	—	—	10	—	—	—	—	10	22	50	100
NWT Residential/Parkland Coarse Surface			—	—	—	—	1	—	—	—	1	—	—	—	—	1	0.6	5	10
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Background																			
S06-1	(0.0-0.20)	03-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	(0.20-0.40)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-2	(0.0-0.20)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.20-0.40)	03-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-1	(0.85-1.35)	05-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-2	(0.15-0.35)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Burn Pit Area																			
S06-9	(0.15-0.45)	04-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	(0.45-0.65)	04-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S06-10	(0.15-0.45)	04-Aug-06	0.55	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	1.1	<0.05	<0.05
S06-11	(0.0-0.15)	04-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	(0.15-0.45)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-12	(0-0.15)	04-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	(0.15-0.45)	04-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S06-43	(0.2-0.9)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-65	(0.2-0.6)	11-Aug-06	3.9	0.11	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.13	0.05
S06-66	(0.2-0.5)	11-Aug-06	<0.05	0.2	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.1	0.05
S06-62	(0.15-0.63)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-3	(0.7-0.85)	06-Aug-06	0.46	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.13	0.25	<0.05
Historical Tank Spill Area																			
S06-14	(0-0.2)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-15	(0.2-0.42)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-16	(0.20-0.44)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-17	(0.2-0.46)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-19	(0.20-0.60)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-20	(0.2-0.6)	04-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-23	(0.15-0.45)	07-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.49	<0.05	<0.05	<0.05	1
	(0.45-0.75)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.75-1.15)	07-Aug-06	1.1	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.32	<0.05	0.08
	(1.15-1.35)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-27	(0.2-0.5)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth (m)	Date (d-m-y)	Metals (Cont.) Thallium (mg/kg)	Tin (mg/kg)	Titanium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zirconium (mg/kg)
NWT Industrial, Coarse surface			1	300	---	---	130	360	---
NWT Residential/Parkland Coarse Surface			1	50	---	---	130	200	---
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int			---	---	---	---	---	---	---
Historical Tank Spill Area continued									
S06-28	(0.2-0.7)	06-Aug-06	---	---	---	---	---	---	---
S06-29	(0.2-0.7)	06-Aug-06	<1	<2	30.4	0.4	13	18	<1
S06-30	(0.2-0.76)	06-Aug-06	<1	<2	38.3	0.4	14	22	<1
S06-37	(0.5-0.7)	07-Aug-06	---	---	---	---	---	---	---
	(0.7-1.0)	07-Aug-06	---	---	---	---	---	---	---
	(1.0-1.3)	07-Aug-06	---	---	---	---	---	---	---
S06-38	(0-0.35)	07-Aug-06	---	---	---	---	---	---	---
	(0.35-0.55)	07-Aug-06	---	---	---	---	---	---	---
S06-39	(0.65-0.95)	07-Aug-06	---	---	---	---	---	---	---
	(0.95-1.4)	07-Aug-06	---	---	---	---	---	---	---
S06-40	(0.15-0.5)	07-Aug-06	---	---	---	---	---	---	---
	(0.5-0.7)	07-Aug-06	---	---	---	---	---	---	---
S06-41	(0.15-0.6)	07-Aug-06	---	---	---	---	---	---	---
	(0.95-1.4)	07-Aug-06	---	---	---	---	---	---	---
S06-44	(0-0.15)	07-Aug-06	---	---	---	---	---	---	---
	(0.15-0.5)	07-Aug-06	---	---	---	---	---	---	---
S06-62	(0.5-1.0)	09-Aug-06	<1	<2	29.1	0.5	12	30	<1
S06-64	(0.0-0.15)	14-Sep-06	---	---	---	---	---	---	---
	(0.15-0.33)	14-Sep-06	---	---	---	---	---	---	---
S06-65	(0.15-0.39)	14-Sep-06	---	---	---	---	---	---	---
S06-66	(0.15-0.58)	14-Sep-06	---	---	---	---	---	---	---
S06-67	(0.00-0.15)	14-Sep-06	---	---	---	---	---	---	---
	(0.15-0.47)	14-Sep-06	---	---	---	---	---	---	---
P06-6	(0.15-0.3)	06-Aug-06	---	---	---	---	---	---	---
	(0.5-1.1)	06-Aug-06	---	---	---	---	---	---	---
	(1.1-1.25)	06-Aug-06	---	---	---	---	---	---	---
P06-7	(0.15-0.45)	07-Aug-06	---	---	---	---	---	---	---
Gravel Pad									
S06-3	(0.0-0.20)	03-Aug-06	<1	<2	25.8	0.5	16	54	<1
	(0.20-0.40)	03-Aug-06	<1	<2	23	0.4	15	23	<1
	(0.40-0.60)	03-Aug-06	---	---	---	---	---	---	---
S06-4	(0-0.20)	04-Aug-06	<1	---	---	---	14	19	---
S06-5	(0.2-0.4)	04-Aug-06	<1	---	---	---	15	28	---
S06-6	(0.2-0.40)	04-Aug-06	<1	---	---	---	15	29	---
S06-7	(0.2-0.5)	06-Aug-06	<1	<2	18.8	0.3	10	14	<1
S06-8	(0.2-0.5)	07-Aug-06	<1	<2	9.6	0.4	9	15	<1

Sampling Location	Soil Depth (m)	Date (d-m-y)	PAHs 2-Methylnaphthalene (mg/kg)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)-anthracene (mg/kg)	Benzo(a)-pyrene (mg/kg)	Benzo(b&j)fluoranthene (mg/kg)	Benzo(g,h,i)-perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)-anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
NWT Industrial, Coarse surface			---	---	---	---	10	---	---	---	10	---	---	---	---	10	22	50	100
NWT Residential/Parkland Coarse Surface			---	---	---	---	1	---	---	---	1	---	---	---	---	1	0.6	5	10
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int			---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Historical Tank Spill Area continued																			
S06-28	(0.2-0.7)	06-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-29	(0.2-0.7)	06-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S06-30	(0.2-0.76)	06-Aug-06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
S06-37	(0.5-0.7)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.7-1.0)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(1.0-1.3)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-38	(0-0.35)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.35-0.55)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-39	(0.65-0.95)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.95-1.4)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-40	(0.15-0.5)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.5-0.7)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-41	(0.15-0.6)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.95-1.4)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-44	(0-0.15)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.15-0.5)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-62	(0.5-1.0)	09-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-64	(0.0-0.15)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.15-0.33)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-65	(0.15-0.39)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-66	(0.15-0.58)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-67	(0.00-0.15)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.15-0.47)	14-Sep-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P06-6	(0.15-0.3)	06-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.5-1.1)	06-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(1.1-1.25)	06-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
P06-7	(0.15-0.45)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Gravel Pad																			
S06-3	(0.0-0.20)	03-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.20-0.40)	03-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	(0.40-0.60)	03-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-4	(0-0.20)	04-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-5	(0.2-0.4)	04-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-6	(0.2-0.40)	04-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-7	(0.2-0.5)	06-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S06-8	(0.2-0.5)	07-Aug-06	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

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Table 1

2006 Soil Analytical Results

CLIENT: Shell Canada Limited
PROJECT NO.: C52360300
PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Sampling Location	Soil Depth (m)	Date (d-m-y)	Metals (Cont.) Thallium (mg/kg)	Tin (mg/kg)	Titanium (mg/kg)	Uranium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Zirconium (mg/kg)
NWT Industrial, Coarse surface			1	300	—	—	130	360	—
NWT Residential/Parkland Coarse Surface			1	50	—	—	130	200	—
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—
Gravel Pad continued									
S06-45	(0.6-0.95)	09-Aug-06	<0.3	<1	—	<1	16	14	—
	(0.9-1.4)	09-Aug-06	—	—	—	—	—	—	—
	(1.4-1.8)	09-Aug-06	—	—	—	—	—	—	—
S06-46	(0.2-0.8)	09-Aug-06	—	—	—	—	—	—	—
S06-63	(0.1-0.2)	14-Sep-06	—	—	—	—	—	—	—
	(0.2-0.3)	14-Sep-06	<0.3	<1	—	<1	25	35	—
S06-68	(0.2-1.0)	14-Sep-06	<0.3	<1	—	<1	14	26	—
Fuel Storage Tank Area (South of Tank Farm)									
S06-34	(0.2-0.5)	07-Aug-06	<1	<2	11.2	0.3	10	13	<1
S06-35	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—
S06-36	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—
S06-42	(0-0.2)	07-Aug-06	<1	<2	17.9	0.3	10	22	<1
Day Tank Area									
S06-47	(0.6-0.75)	09-Aug-06	—	—	—	—	—	—	—
S06-48	(0.2-0.65)	09-Aug-06	—	—	—	—	—	—	—
	(0.65-1.0)	09-Aug-06	<1	<2	24.5	0.5	17	26	1
S06-49	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—
S06-50	(0.3-0.85)	09-Aug-06	—	—	—	—	—	—	—
	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—
Heating Oil AST / Fuel Trailer									
S06-60	(0.35-0.65)	11-Aug-06	—	—	—	—	—	—	—
S06-61	(0.2-0.7)	11-Aug-06	—	—	—	—	—	—	—
	(0.7-1.2)	11-Aug-06	—	—	—	—	—	—	—
NE Perimeter of Gravel Pad									
S06-31	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—
S06-32	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—
S06-33	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—
S06-67	(0.0-0.15)	14-Sep-06	—	—	—	—	—	—	—
	(0.15-0.56)	14-Sep-06	—	—	—	—	—	—	—
S06-68	(0.2-0.35)	11-Aug-06	—	—	—	—	—	—	—
East Perimeter of Gravel Pad									
S06-63	(0-0.2)	09-Aug-06	—	—	—	—	—	—	—
S06-64	(0.2-0.4)	09-Aug-06	—	—	—	—	—	—	—
South Perimeter of Gravel Pad									
P06-4	(0.65-0.85)	06-Aug-06	<1	<2	32.2	0.5	13	46	1
	(1.6-2.0)	06-Aug-06	—	—	—	—	—	—	—
P06-6	(0-0.15)	06-Aug-06	—	—	—	—	—	—	—
	(0.5-1.0)	06-Aug-06	—	—	—	—	—	—	—

Sampling Location	Soil Depth (m)	Date (d-m-y)	PAHs 2-Methylnaphthalene (mg/kg)	Acenaphthene (mg/kg)	Acenaphthylene (mg/kg)	Anthracene (mg/kg)	Benzo(a)anthracene (mg/kg)	Benzo(a)pyrene (mg/kg)	Benzo(b&j)fluoranthene (mg/kg)	Benzo(g,h,i)-perylene (mg/kg)	Benzo(k)fluoranthene (mg/kg)	Chrysene (mg/kg)	Dibenzo(a,h)-anthracene (mg/kg)	Fluoranthene (mg/kg)	Fluorene (mg/kg)	Indeno(1,2,3-cd)pyrene (mg/kg)	Naphthalene (mg/kg)	Phenanthrene (mg/kg)	Pyrene (mg/kg)
NWT Industrial, Coarse surface			—	—	—	—	10	—	—	—	10	—	—	—	—	10	22	50	100
NWT Residential/Parkland Coarse Surface			—	—	—	—	1	—	—	—	1	—	—	—	—	1	0.6	5	10
Background Chemistry (Organic rich soils, PHCs only) - 95% Conf. Int.			—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gravel Pad continued																			
S06-45	(0.6-0.95)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.9-1.4)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.4-1.8)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-46	(0.2-0.8)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-63	(0.1-0.2)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.2-0.3)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-68	(0.2-1.0)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fuel Storage Tank Area (South of Tank Farm)																			
S06-34	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-35	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-36	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-42	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Day Tank Area																			
S06-47	(0.6-0.75)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-48	(0.2-0.65)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.65-1.0)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-49	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-50	(0.3-0.85)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.85-1.05)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Heating Oil AST / Fuel Trailer																			
S06-60	(0.35-0.65)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-61	(0.2-0.7)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.7-1.2)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
NE Perimeter of Gravel Pad																			
S06-31	(0-0.2)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-32	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-33	(0.2-0.5)	07-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-67	(0.0-0.15)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.15-0.56)	14-Sep-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-68	(0.2-0.35)	11-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
East Perimeter of Gravel Pad																			
S06-63	(0-0.2)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S06-64	(0.2-0.4)	09-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
South Perimeter of Gravel Pad																			
P06-4	(0.65-0.85)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(1.6-2.0)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P06-6	(0-0.15)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	(0.5-1.0)	06-Aug-06	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

NOTES:

1. — in guideline row(s) denotes no criteria for that parameter.
2. — in detail data row(s) denotes parameter not analyzed.
3. Denotes values exceeding NWT Industrial coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
4. Denotes values exceeding NWT Residential/Parkland coarse surface guidelines. For BTEX and PHC F1 parameters (all soils) and PHCs F2-F4 fractions (mineral soil only, see note 5), the most conservative of the eco soil contact or protection of groundwater for aquatic life pathways have been used.
5. For organic rich soils only, denotes PHCs F2 - F4 values exceeding the upper limit of the 95% confidence interval of established background hydrocarbon ranges
** Barium and extractable barium concentrations have been compared to AENV (2004) Natural Area and / or Industrial soil quality guidelines for Barite*

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Table 2

Piezometer Installation Details, Datum/Groundwater Surface Elevations And Hydraulic Conductivities

CLIENT: Shell Canada

PROJECT NO.: C52360300

PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Monitoring Station	Ground Elevation	Datum Elevation (Top of PVC)	Stickup (PVC)	Total Depth of Piezometer	Depth Interval of Screen	Date Measured	Depth To Groundwater	Depth To Groundwater	Depth To Permafrost	Groundwater Surface Elevation	Hydraulic Conductivity	Lithology
	(masl)	(masl)	(m)	(mbgs)	(mbgs)	(d-m-y)	(mbtoc)	(mbgs)	(mbgs)	(masl)	(m/s)	
C52360300 - Water - Year 2006												
P06-1	**13.57**	14.35	0.78	1.01	0.56 - 0.15	9-Aug-06	1.04	0.26	0.40	13.31	N/M	Silt Loam
P06-2	**12.56**	13.36	0.80	1.10	0.65 - 0.24	9-Aug-06	1.14	0.34	0.35	12.22	N/M	Silt Loam and Organic
P06-3	**10.21**	11.01	0.80	1.30	0.80 - 0.39	9-Aug-06	1.57	0.77	0.70	9.44	N/M	Sandy Loam and Organic
P06-4	**10.45**	11.25	0.80	1.80	1.8 - 1.07	9-Aug-06	Dry	Dry	2.00	Dry	N/M	Loamy Sand
P06-5	**9.63**	10.43	0.80	1.05	0.7 - 0.29	9-Aug-06	1.53	0.73	0.60	8.90	N/M	Loamy Sand and Organic
P06-6	**13.52**	14.32	0.80	1.50	0.93 - 0.2	9-Aug-06	1.63	0.83	1.10	12.69	N/M	Loamy Sand and Organic
P06-7	**13.93**	14.73	0.80	0.77	0.56 - 0.15	9-Aug-06	1.17	0.37	0.50	13.56	N/M	Organic

NOTES:

1. *Data may be entered to the nearest mm, but are reported above to the nearest cm.*
   Apparent rounding errors may occasionally occur in calculated fields (e.g., Groundwater Surface Elevation).
2. *N/M - Denotes not measured.*
3. *masl - Denotes Metres Above Sea Level.*
4. *mbgs - Denotes metres below ground surface.*
5. *mbtoc - Denotes metres below top of PVC casing.*
6. Piezometer survey elevation data taken on September 14, 2006 by Klohn Crippen Berger personnel

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Table 3

Water Quality: Field Measured Parameters

CLIENT: Shell Canada

PROJECT NO.: C52360300

PROJECT NAME: Abandonment and Restoration Plan, Camp Farewell, NT

Monitoring Station	Date (d-m-y)	Temperature (°C)	Electrical Conductivity (at 25°C) (µS/cm)	pH (units)	Comments
C52360300 - Water - Year 2006					
Surface Water					
WS06-1	3-Aug-06	20.9	315	9.6	Surface water
WS06-2	3-Aug-06	22.2	869	7.65	Surface water
Piezometers					
P06-1	9-Aug-06	9.4	615	6.97	Purged dry
P06-2	9-Aug-06	9.2	849	7.09	Purged dry
P06-3	9-Aug-06	9.8	2260	7.21	Purged dry
P06-4	9-Aug-06	---	---	---	Dry
	14-Sep-06	---	---	---	Dry
P06-5	9-Aug-06	---	---	---	Dry
	14-Sep-06	---	---	---	Insufficient sample for field parameters
P06-6	9-Aug-06	10.0	1149	6.87	Purged, did not go dry
Duplicate	9-Aug-06	9.8	1084	7.01	
P06-7	9-Aug-06	9.8	980	6.9	Purged dry

NOTES:

1. ***Electrical conductivity values standardized to 25°C.***
2. ***--- Denotes parameter not measured.***