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10 March 2023

Bijaya Adhikari, Ph.D., Science and Regulatory Coordinator
Inuvialuit Water Board
151 Mackenzie Road
Mack Travel Building – 2nd Floor
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Inuvik, NT X0E 0T0

Dear Dr. Adhikari,

Camp Farewell Annual Report

Please find attached the annual report for activities completed at Camp Farewell, prepared by WSP Canada Inc. on behalf of Shell Canada Limited. The report meets the Inuvialuit Water Board Licence (N7L1-1834) reporting requirement and provides a summary of the Phase II Environmental Site Assessment completed in 2022, in response to an Environmental Impact Screening Committee information request dated July 18, 2022.

Should you have any querries, please contact Kyle Thompson.

Sincerely,

Kyle Thompson
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REPORT

2022 Annual Report

Camp Farewell, Inuvialuit Settlement Region, Northwest Territories

Submitted to:

Shell Canada Limited

400 - 4 Avenue SW, PO Box 100, Station M, Calgary, Alberta T2P 2H5

Submitted by:

WSP Canada Inc.

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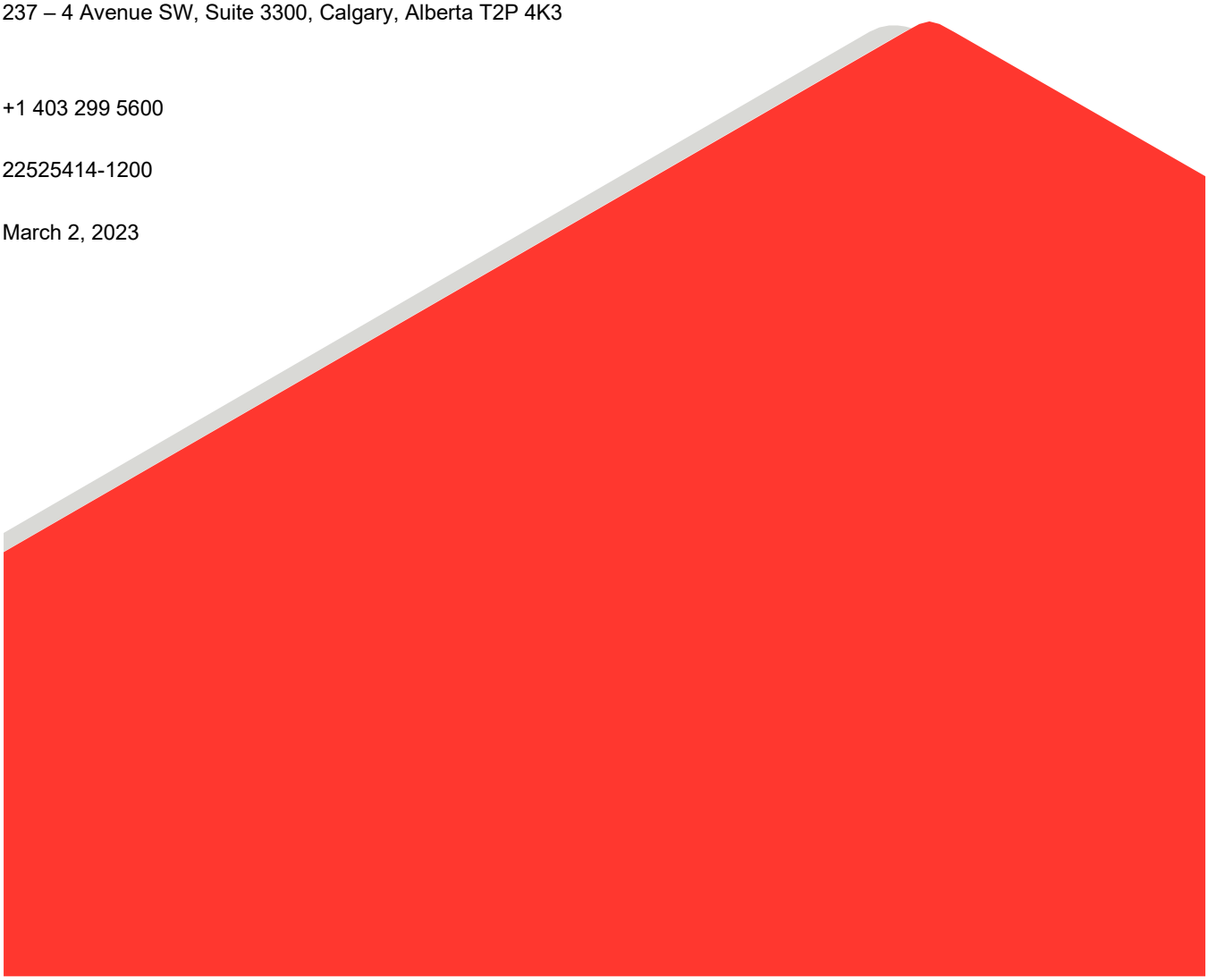
March 2, 2023



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APPENDICES

1.0 INTRODUCTION

The 2022 Annual Report provides the required information in fulfillment of Water Licence N7L1-1834 granted by the Inuvialuit Water Board (IWB) to Shell Canada Energy (Shell). The Water Licence is associated with the remediation, reclamation and monitoring activities at Camp Farewell (the Site). The Site is approximately 125 kilometres north of Inuvik, within the Kendall Island Bird Sanctuary of the Mackenzie Delta, Northwest Territories (NT). The Site location is presented in Figure 1 of the appended 2022 Supplemental Phase II Environmental Site Assessment (ESA) (Appendix A).

The 2022 Scope of Work included the Supplemental Phase II ESA investigation and associated activities conducted between August 3 and 29, 2022. This report documents the activities completed in 2022 at the Site as per the requirements outlined in the IWB Water Licence N7L1-1834 Part B: General Conditions Section 1, items A through M. A copy of the IWB licence is provided in Appendix B.

2.0 SUMMARY OF WORK COMPLETED IN 2022

Field crews were on-site between August 3 and 29, 2022. Environmental sampling was completed at the Site between August 6 and 26, 2022. The 2022 Camp Farewell program was completed as part of an overall 2022 summer program which included the assessment of similar sites throughout the Inuvialuit Settlement Region, NT using the same personnel and similar equipment. The following list provides a summary of the activities completed at the Site:

- mobilized and demobilized two barges to and from the Site (crew quarters and spacer barge with equipment);
- completed daily wildlife sweeps;
- advanced a total of 70 boreholes at the Site as described below:
  - advanced 67 boreholes for delineation and/or assessment of petroleum hydrocarbons (PHC), polycyclic aromatic hydrocarbons (PAH) or metal exceedances in soil;
  - advanced three boreholes to assess the vertical extent of PHCs within permafrost in locations where elevated concentrations of multiple parameters were detected with no vertical delineation; and
  - completed and developed eight boreholes as monitoring wells;
- completed one groundwater monitoring and sampling event for laboratory analysis of benzene, toluene, ethylbenzene, xylenes, PHC Fractions F1 to F4, PAH, salinity and dissolved metals pending sufficient water;
- collected surface water samples from three background locations for analysis of PHCs, salinity, total metals and dissolved organic carbon;
- completed a survey of the borehole and monitoring well locations;
- completed a habitat assessment for terrestrial and aquatic receptors;
- conducted quality assurance/quality control (QA/QC) sampling; and
- prepared a Supplemental Phase II ESA report documenting and detailing the methods and results of the investigation activities.

In addition to the activities listed above, the Site also operated as a staging area for environmental assessments and as a refuelling area for a helicopter program located at nearby sites. The activities detailed within this report pertain to the Camp Farewell program only and does not include the results of the environmental assessments at any of the nearby sites.

2.1 Summary of Results of the 2022 Program

Below is a summary of the results for the Supplemental Phase II ESA at the Site:

- Sand and gravel fill were observed at surface on the Site footprint, extending up to 4.50 metres below ground surface (mbgs), the maximum depth investigated. Outside of the Site footprint, peat was observed at surface to between 0.1 and 0.5 mbgs, where silty sand or permafrost was encountered.
- Depth to permafrost ranged from 0.2 to 0.7 mbgs in the undisturbed areas to the east, west and north of the Site footprint. Depth to permafrost in previously disturbed areas (Site footprint, former airstrip and former access road) ranged from 1.2 to greater than 3.15 mbgs.
- Light non-aqueous phase liquid was not identified in any of the wells monitored.
- The depth to groundwater during this investigation ranged from 0.36 to 0.95 mbgs. Nine of the groundwater monitoring wells were dry. These monitoring wells were located off-site to the west, north and east of the Site footprint.
- Soil samples with concentrations of PHCs exceeding the applied guidelines were identified in the former above ground storage tank area, former fuel storage area, two former burn pit areas, on the former access road, on and adjacent to the former airstrip and off the Site footprint to the north and east.
- Based on chromatogram and biogenic toluene analysis, naturally occurring PHCs were identified in locations off the Site footprint. Petrogenic hydrocarbons were identified in the former burn pit areas, off-site north of the Site footprint and adjacent to the former airstrip.
- Soil samples from one borehole on the former access road exceeded the applied guideline for naphthalene.
- Soil samples from one borehole were below the pH guideline range off-site east of the Site footprint.
- Soil samples from four boreholes exceeded the applied guidelines and background concentration ranges for one or more of the following: barium (true total), chromium (total), nickel and selenium. The metal exceedances were identified in the two former burn pits, the former access road and east of the Site footprint. The chromium, nickel and copper impacts identified in 2021 were laterally delineated. Soil in the vicinity of barium exceedances in two locations, identified in 2021, were resampled for barium (true total) and did not exceed the applied guideline.
- Due to lack of sufficient water in the monitoring wells to sample and logistical issues, only two groundwater monitoring wells were sampled in 2022. One groundwater sample collected from the monitoring well in the former burn pit area exceeded the applicable guideline for naphthalene.
- A surface water sample collected in 2021 in a water body adjacent to the former access road exceeded the applied guidelines for aluminum, copper and iron. The concentrations were similar to the background surface water samples collected in 2022, suggesting that the elevated concentrations of these parameters from 2021 are likely consistent with background conditions.

- Soil with exceedances of the applied guidelines for PHCs have been vertically delineated but have not been laterally delineated to the east of the former storage yard. The naphthalene exceedance is vertically delineated in soil and has been laterally delineated except to the northeast. Metal exceedances have not been delineated in soil on the access road and off-site to the east.
- Based on the review of the QA/QC results, the data presented in this report are considered to be reliable.
- The shack on-site is an emergency shelter used by local communities.
- The 2022 investigation better characterized the current Site conditions and the extents of the remaining Site impacts above applied guidelines and background concentrations are well defined.

A copy of the Supplemental Phase II ESA report outlining the methods and results of the investigation is provided in Appendix A.

2.2 Future Work to be Completed

Based on the findings of the Supplemental Phase II ESA, it is recommended that a Remedial Action Plan (RAP) be completed to potentially provide: a conceptual site model; a discussion of the chromatogram analysis; further interpretation of the 2021 and 2022 results; and recommendations for steps to move toward Site closure, including, but not limited to, remediation options and risk assessment. A RAP will be provided to the Inuvialuit Water Board for review and approval.

3.0 WATER LICENCE REPORTING

3.1 Part B 1a – Freshwater Usage

Water was not obtained from any water body in 2022. A total of 65,000 litres (L) of water was sourced from Inuvik for potable/domestic purposes.

3.2 Part B 1b and 1c – Waste Discharge

The sewage lagoon is no longer on-site; therefore, no discharges of waste occurred in 2022. Waste was managed at approved off-site facilities.

3.3 Part B 1d – Summary of Waste

Waste produced during the 2022 program included domestic waste, oily waste, grey water and sewage. The soil sampling activities created some disposable sampling equipment waste (nitrile gloves and disposable Terra Core™ soil sampling devices) and limited soil waste (<1 cubic metre [m^3]) which was stored in a designated soil waste bag prior to being transported and disposed of off-site at an approved facility. Boreholes were backfilled with soil cuttings, sand and/or bentonite immediately following the soil sampling. Oily waste was generated as part of the concurrent helicopter program staged at the Camp Farewell site.

3.3.1 Stored On-site

Waste was stored on the barge on-site prior to being disposed of off-site. Domestic waste was stored in secured garbage bins and 51,289-L of wastewater (sewage, grey water) was stored in 4,000- and 45,000-L holding tanks respectively. Purge water from groundwater sampling was stored in a 205-L barrel. Oily waste was stored in a different 205-L barrel. All waste was removed at the end of the program and disposed of at approved facilities.

3.3.2 Transported Off-site

Non-hazardous domestic waste (396 kilograms) and soil cuttings (<1 m^3) were removed from the Site and disposed of at the Inuvik solid waste facility. Recyclable beverage containers were taken to the Inuvik bottle depot for recycling. Liquid waste (52,000 L of sewage and grey water) was disposed of at the Inuvik sewage lagoon. The oily waste and purge water drums (approximately 50 L of purge water collected from groundwater monitoring wells at Camp Farewell and two other sties that were part of the overall summer 2022 program) remained in secure storage in Inuvik, NT until being disposed of at the KBL Environmental disposal facility in Yellowknife, NT in 2023. Documents pertaining to the waste disposal are found in Appendix C.

3.4 Part B 1e – Surveillance Network Sampling Program Results

The surveillance network program applied to the sewage lagoon, which was remediated in 2013. Therefore, no sampling was conducted under the surveillance network program.

3.5 Part B 1f – Modifications of Water Supply or Sewage Treatment Facilities

There are no water supply or sewage treatment facilities on-site.

3.6 Part B 1g – Spills and Discharges

Two spills occurred at the Site in 2022. The first spill occurred on August 5, 2022. Approximately 2 L of Jet A-1 fuel leaked from the fueling nozzle of the fuel truck during refueling of the helicopter. A second spill occurred on August 11, 2022, when a minor drip leak of Jet A-1 fuel (<1 L) from a flange bolt on the fuel truck was identified during an equipment inspection. The spills were cleaned up as per the Spill Contingency Plan and corrective actions were taken to avoid further releases. Waste generated from the spill cleanup was disposed of off-site at an approved facility as per the description in Section 3.3.2. Further details are provided in the spill investigation report found in Appendix D. No other spills or discharges occurred.

3.7 Part B 1h – Sump restorations

No sump restorations were completed in 2022.

3.8 Part B 1i – Abandonment and Restoration Work

No abandonment or restoration work was completed in 2022 and none is planned for 2023.

3.9 Part B 1j – Summary of Studies

No studies were completed in 2022. No studies are planned for 2023.

3.10 Part B 1k – Updates to Plans and Operations

The 2022 Waste Management Plan, Spill Contingency Plan and the Emergency Response Plan were submitted to the IWB on July 11, 2022. The Site is not operational; therefore, there are no operations, maintenance or sewage treatment plans.

3.11 Part B 1l – Spill Training and Communications

Daily meetings were conducted prior to work to discuss environmental health and safety issues, including the identification of hazards for both workers and the environment. Inspections of facilities and equipment were completed daily. Weekly meetings were also conducted to address any issues on-site. Orientations were

completed for all workers on-site which included the review of the Waste Management Plan, Spill Contingency Plan and the Emergency Response Plan.

Emergency response drills were completed in July as part of the overall 2022 summer program which included the assessment of similar sites throughout the NT. The equipment and personnel involved in the spill and fire response drills were consistent throughout the program and the sites were similar in remoteness and region.

A spill response drill was completed on July 16, 2022. The drill involved a hypothetical hydraulic fluid spill from the drill rig. Personnel took the following steps during the drill:

- Equipment was immediately shut down.
- Spill pads were used on the equipment and placed under the hypothetical spill area.
- Drillers had a shovel and bucket available on-hand to clean up soils that were impacted by the hypothetical spill.
- Since the equipment was shut off promptly, the hypothetical spill was concluded to be less than 1 L.
- The Site Supervisor notified the first point of contact on the Emergency Response Plan of the spill response drill who then notified the Client.

A drill was also conducted for fire emergency response. A medical emergency response drill was not conducted, as a medical emergency, including the evacuation of personnel, occurred prior to the drill being scheduled. Records of the spill response drill and fire drill and are provided in Appendix E.

3.12 Part B 1m – Other Details (if any)

No further details have been requested by the IWB.

4.0 STATEMENT OF LIMITATIONS

This report was prepared for the exclusive use of Shell Canada Limited. The report, which specifically includes all tables and figures, is based on data and information collected during the Site investigation activities conducted by WSP Canada Inc. and is based solely on the conditions of the property at the time of the field investigations, supplemented by historical information and data obtained by WSP Canada Inc. as described in this report. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site may be contaminated and remain undetected.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services.

Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. WSP Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The content of this report is based on information collected during our investigation, our present understanding of the Site conditions, and our professional judgment in light of such information at the time of this report. This report provides a professional opinion and therefore no warranty is expressed, implied, or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statues are subject to change. The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, WSP Canada Inc. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

Signature Page

WSP Canada Inc.

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Environmental Technologist

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WSP Canada Inc.
Signature M. Jillian Mitton
Date March 9, 2023
PERMIT NUMBER: P407
NT/NU Association of Professional Engineers and Geoscientists

APPENDIX A

2022 Supplemental Phase II Environmental Site Assessment

REPORT

Supplemental Phase II Environmental Site Assessment

Camp Farewell
Inuvialuit Settlement Region, Northwest Territories

Submitted to:

Shell Canada Limited

400 - 4 Avenue SW, PO Box 100, Station M, Calgary, Alberta, T2P 2H5

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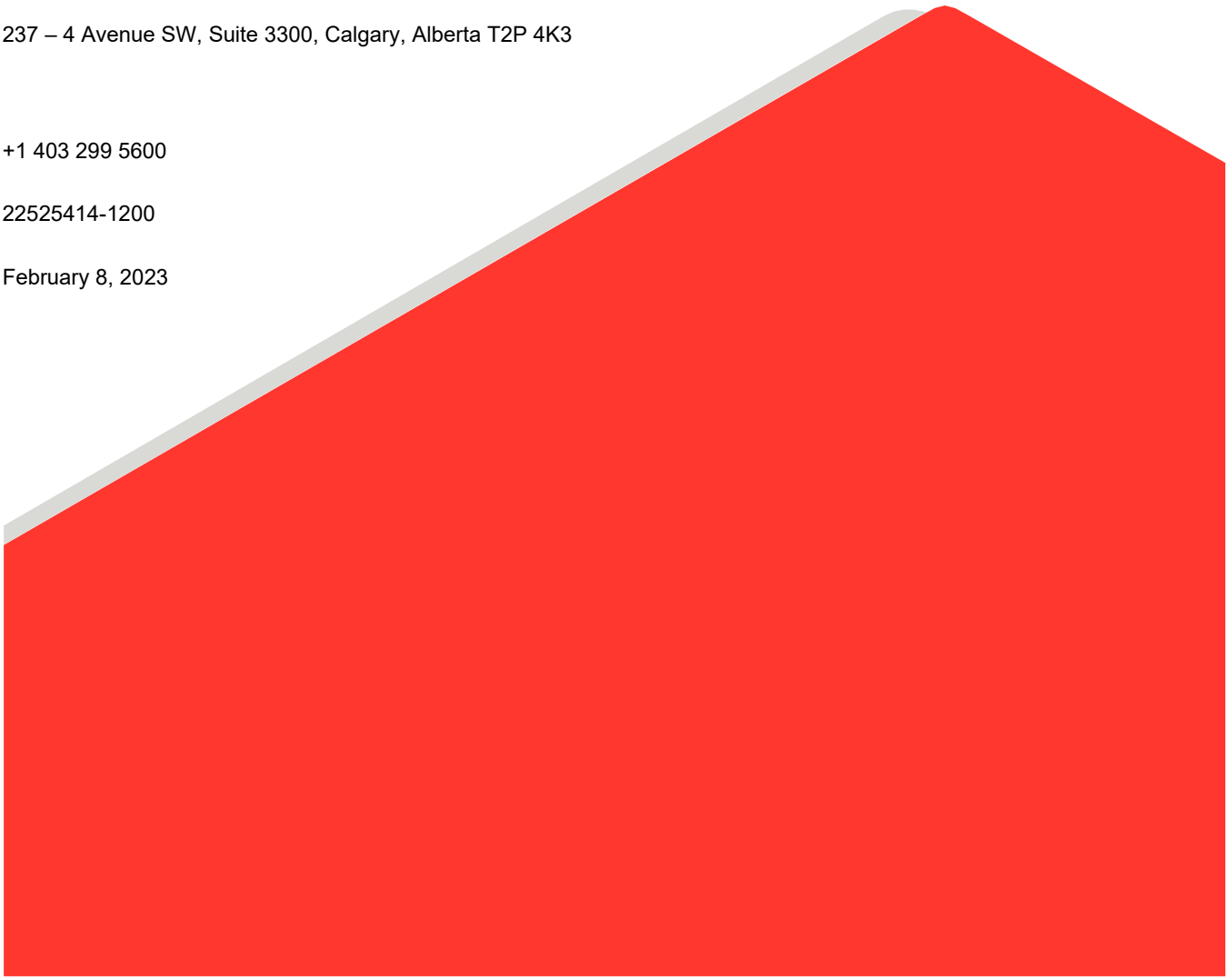
February 8, 2023



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Executive Summary

Site Background

Site location	69°12'30.0"N 135°06'04.4"W
Type of facility	Former staging and storage site for approved oil and gas research, oil and gas exploration and development activities
Current land use	Parkland, in the Kendall Island Bird Sanctuary
Adjacent land use	North – Tundra, Kendall Island Bird Sanctuary, former airstrip East – Tundra, Kendall Island Bird Sanctuary South – MacKenzie River and tundra West – MacKenzie River and tundra

Field Work

Dates of field work	August 3 to 29, 2022
Number of boreholes / monitoring wells soil sampled	70 (BH22-01, BH22-03 to BH22-08, BH22-10 to BH22-12, BH22-14 to BH22-15, BH22-17 to BH22-21, BH22-24 to BH22-42, BH22-44 to BH22-49, BH22-51 to BH22-70, MW22-02, MW22-09, MW22-13, MW22-16, MW22-22, MW22-23, MW22-43, MW22-50)
Number of monitoring wells sampled	2 (P19-5, P19-06)
Number of surface water samples	3 (SW22-01 to SW22-03)

Site Stratigraphy and Hydrogeology

Predominant soil type	Coarse-grained
Depth to groundwater	From 0.36 to 0.95 mbgs
Light non-aqueous phase liquid	Not detected

Nearby Receptors

Groundwater use within 500 m	None
Surface water body within 500 m	The Site is adjacent to the MacKenzie River.

Selected Guidelines

PHC, PAHs, salinity and metals	▪ GNWT Guideline for Contaminated Site Remediation ▪ Soil analytical results for PHC Fractions F1 to F3 at depths greater than 0.5 mbgs were also compared to the management limit of 5,000 milligrams per kilogram recommended for soils at depths greater than 0.5 mbgs in the AMSRP for additional context (INAC 2008).

	▪ Soil analytical results for PHC Fractions F1 to F3 applied for locations <30 m from a freshwater body were also compared to the AMSRP guideline (INAC 2008). ▪ CCME soil and surface water quality guidelines ▪ Alberta Soil Remediation Guidelines for Barite ▪ Alberta Environmental Quality Guidelines for Surface Waters ▪ FCSAP Groundwater Quality Guidelines for Federal Contaminated Sites Where applicable, Tier 1 remediation guidelines for residential/parkland land use and fine-grained soils were applied.

Soil Analytical Results

PHC	Soil samples collected from 13 sampling locations exceeded the GNWT guidelines for one or more PHC parameters. Four of these sampling locations also exceeded the AMSRP guideline for Type B hydrocarbons. Exceedances were identified in the two former burn pit areas, on the former access road, on and adjacent to the former airstrip, the former AST area and off the Site footprint to the north and east. Samples from 28 locations were shown to be of biogenic origin (i.e., peat) and were therefore not considered exceedances of the applied criteria.
PAH	A naphthalene exceedance was identified in one borehole on the former access road; however, this may not be representative of actual conditions given the data quality issues identified during the laboratory analysis and data quality review.
Salinity	The pH result from one borehole was below the pH guideline range off the Site footprint to the east.
Metals	Exceedances were identified in four locations in the two former burn pits, the former access road and east of the Site footprint.

Groundwater Analytical Results

PHC	No exceedances were identified.
PAH	A naphthalene exceedance was identified in one monitoring well in the former burn pit area.
Salinity	No exceedances were identified.
Dissolved metals	Insufficient water to sample for dissolved metals

Surface Water Analytical Results

PHC	No exceedances were identified.
PAH	No exceedances were identified.
Salinity	No exceedances were identified.
Total metals	Exceedances of total aluminum, copper, iron and zinc was identified at one surface water sampling location. The surface water body is considered to be representative of background conditions.

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List of Abbreviations

°C	degree Celsius
AENV	Alberta Environment
AEP	Alberta Environment and Parks
AMSRP	Abandoned Military Site Remediation Protocol
APEC	Area of Potential Environmental Concern
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BTEX	benzene, toluene, ethylbenzene, xylenes
BVL	Bureau Veritas Laboratories
CCME	Canadian Council of Ministers of the Environment
DOC	dissolved organic carbon
EC	electrical conductivity
ESA	environmental site assessment
FCSAP	Federal Contaminated Sites Action Plan
GoC	Government of Canada
Golder	Golder Associates Ltd.
GNWT	Government of Northwest Territories
HDPE	high density polyethylene
IEG	IEG Consultants Ltd.
INAC	Indian and Northern Affairs Canada
IWB	Inuvialuit Water Board
km	kilometre
L	litre
LNAPL	light non-aqueous phase liquid
m	metre
mbgs	metre below ground surface

NWT	Northwest Territories
OVM	organic vapour monitor
PAH	polycyclic aromatic hydrocarbon
PHC	petroleum hydrocarbon
QA/QC	quality assurance/quality control
Shell	Shell Canada Limited
SOW	Scope of Work
WorleyParsons	WorleyParsons Komex Resources and Energy
WSP	WSP Canada Inc.

1.0 INTRODUCTION

WSP (WSP Canada Inc., formerly Golder) was retained by Shell to complete a Supplemental Phase II ESA at Camp Farewell (the Site). The Site is approximately 125 km north of Inuvik, in the Kendall Island Bird Sanctuary of the Mackenzie Delta, NWT. The Site location is presented in Figure 1.

This report documents the methods and results of the Supplemental Phase II ESA investigation conducted from August 3 to 29, 2022.

1.1 Objective

The objective of the 2022 SOW was to delineate soil impacts at the Site identified during the 2021 field program, to further assess groundwater and to characterize background conditions in soil, groundwater and surface water.

A Site plan including historical remediation excavation boundaries is presented on Figure 2. The program meets the IWB Water License (N7L1-1834) requirement.

1.2 Scope of Work

The scope of work for this Supplemental Phase II ESA program consisted of the following activities:

The work on-site included:

- drilling a total of 70 boreholes as described below:
  - drilling 40 boreholes to permafrost for lateral delineation of PHC, PAH or metal exceedances in soil;
  - drilling three boreholes to assess the vertical extent of PHCs within permafrost in locations where maximally elevated concentrations were detected of multiple parameters with no vertical delineation;
  - drilling two boreholes to permafrost to confirm barium results in soil at two locations with barium exceedances (TP21-129 and TP21-117) (to be analyzed for true total barium);
  - drilling five boreholes to permafrost for assessment of metal concentrations in background areas;
  - drilling 20 additional boreholes (added to the original SOW) to assess other areas and delineate PHC exceedances in soil; and
  - completing eight of the boreholes as monitoring wells;
- developing all newly installed wells on-site;
- completing one groundwater monitoring event and collecting groundwater samples from the newly installed and existing monitoring wells for laboratory analysis of BTEX, PHC Fractions F1 to F4, PAH, salinity and dissolved metals pending sufficient water;
- collecting surface water samples background locations to be analyzed for PHCs, salinity, total metals and DOC;
- completing a survey of the borehole and monitoring well locations;
- completing a habitat assessment;
- conducting QA/QC sampling; and
- preparing a report documenting and detailing the methods and results of the investigation activities.

2.0 SITE BACKGROUND

2.1 Site Description

The Site is approximately 125 km north of Inuvik, in the Kendall Island Bird Sanctuary of the Mackenzie Delta, NWT. The Site activities are regulated by Canadian Wildlife Services permit MM-NR-2021-NT-004, DOL lease number 107C/04-002 and IWB Water Licence N7L1-1834.

Beginning in 1970, Camp Farewell was used as a staging ground and storage site for approved research, oil and gas exploration, and development activities. The Site was constructed on permafrost, and layers of polyurethane and compacted gravel were installed as a thermal and contamination barrier. The Site consisted of camp buildings for worker habitation, ASTs, burn pits, sewage lagoon and storage areas for various materials and equipment. Substances stored on-site included aviation fuel, gasoline, diesel and drilling additives (including barite and salt-based additives). An air strip (land lease 107 C/4-1-8) was northeast of the Site. An 800,000-L spill of diesel impacted water occurred in 1981 from a tank farm on-site. Decommissioning of the Site was completed between 2008 and 2019.

Various environmental sampling and remediation programs have occurred at the Site beginning in 2000, as described in Section 2.3. A review of previous investigations indicated that impacted soil was left on-site following remediation efforts.

The general features of the Site are illustrated in Figure 2. Site photographs are presented in Appendix A.

2.2 Land Use

The Site is on tundra, adjacent to a channel of the Mackenzie River in the Mackenzie River Delta within the Kendall Island Bird Sanctuary. The Site is currently vacant except for existing monitoring wells, an emergency shack, woody debris from the wood pilings removal and a dock at a lake north of the Site. The ground cover is a mix of tundra and gravel. The Site has importance to the community and habitat. Its community importance includes hunting, trapping and fishing. Its habitat importance includes being a denning area for polar bears and grizzly bears, nesting and breading habitat for birds, and habitat for fish. Land use classification for contaminant interpretation, as outlined by the CCME, is defined as parkland.

2.3 Summary of Previous Work

Previous environmental assessments were reviewed by WSP to assess the Site conditions and as a source of information for reporting (Golder 2022a/b). Soils impacted by PHC, PAH and/or metals were identified on-site in the former AST tank farm and spill areas, former burn pit, the sewage lagoon and camp area, and in the storage area near the centre of the Site. Hydrocarbon exceedances in soil were also identified off-site to the north, between the Site and the off-site air strip. Elevated EC, pH and PHC and barium concentrations in soil were identified previously (2001, report not available) in the area where drilling additives had been stored (WorleyParsons 2006).

The sewage lagoon was decommissioned in 2013 and impacted soil was removed and disposed of off-site. Remediation activities for hydrocarbon-impacted soils in other areas was completed in 2009, 2016, 2018 and 2019. Remediation activities included in-situ and ex-situ treatment of hydrocarbon-impacted soils on-site. The treated soil was backfilled on-site following each remediation program. The majority of the Site footprint has been excavated as illustrated on Figure 2, which provides the excavation boundaries for the remedial excavations completed between 2013 and 2019. The remediation programs included the removal of polyurethane foam and

other debris. The most recent remediation report indicated that treated soil, which remained impacted with PHCs, had been backfilled into the 2019 excavations and that PHC impacts in soil were likely present outside of 2019 remediation area (IEG 2020).

In 2021, a Phase II ESA was completed by WSP which identified concentrations of PHC, PAH and/or metal parameters in exceedance of the applied guidelines in soil. PHC exceedances were present across the Site. PAHs exceeded in a possible burn pit identified during the fieldwork. Metals exceeded in the two former burn pits and in four other locations on the plant footprint.

Groundwater wells were installed in 2006 and 2019 in the former spill area, burn pit area and on the periphery of the Site. Groundwater has historically exceeded the applicable guidelines for PHCs, salinity and metal parameters. The wells which have had PHC concentrations above the guidelines were in the former spill area, burn pit area and off-site to the north and east.

3.0 REGULATORY FRAMEWORK AND APPLIED GUIDELINES

The regulatory framework for GNWT is detailed in the Environmental Guideline for Contaminated Site Remediation (GNWT 2003). For parameters that do not have guidelines under the GNWT, guidelines were provided by other regulatory bodies, including CCME and AENV.

The ASMRP Remedial Objectives for Hydrocarbon-Contaminated Soils framework was also used to inform the application of hydrocarbon guidelines use at the Site. The AMSRP has used CCME criteria and quantitative risk assessment to develop PHC guidelines which protected receptors and minimize the physical disturbance of remediation activities in the Arctic ecosystem.

Additional details related to the choice of guidelines are presented in Appendix B.

3.1 Applied Guidelines

3.1.1 Soil

- Soil analytical results for BTEX, PHC Fractions F1 to F4, salinity and metals were compared to the Tier 1 GNWT Guideline for Contaminated Site Remediation for coarse-grained soil and residential/parkland land use (GNWT 2003).
- Soil analytical results for PHC Fractions F1 to F4 (as calculated concentrations of Type A or Type B hydrocarbons) were also compared to the ASMRP Remedial Objectives for Hydrocarbon-Contaminated Soils (INAC 2008).
- Select samples were submitted for laboratory analysis of PHC Fractions F1 to F4 chromatograms and biogenic toluene. Samples which were found to be biogenic as opposed to petrogenic in origin were not considered exceedances of the applicable guidelines.
- Soil analytical results for PAH were compared to the Tier 1 GNWT Guideline for Contaminated Site Remediation for coarse-grained soil and residential/parkland land use (GNWT 2003) and the CCME soil quality guidelines for residential/parkland land use.
- Soil analytical results for barium were compared to the Alberta Soil Remediation Guidelines for Barite for residential/parkland land use (AENV 2009).

Eight off-site boreholes (BH22-42, BH22-44, BH22-45, BH22-46, BH22-53, BH22-54, BH22-54 and MW22-43) are likely representative of background conditions as they were advanced off-Site, away from on-Site APECs and upgradient of the interpreted groundwater flow. The encountered soil lithology was generally consistent between the background locations (peat, underlain by silty sand or sand). Soil analytical results are compared to the background analytical results to provide additional context when guidelines exceedances are identified.

3.1.2 Groundwater

Groundwater analytical results were compared to the FCSAP Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (GoC 2016a,b). The Tier 1 criteria for coarse-grained soil in a residential/parkland land use were selected.

There are no background groundwater monitoring wells at the Site.

3.1.3 Surface Water

Surface water analytical results were compared to the CCME Water Quality Guidelines for the protection of aquatic life (freshwater) (CCME 1999 and updates) and the Environmental Quality Guidelines for Alberta Surface Waters (freshwater aquatic life) (AEP 2018).

Two surface water locations (SW22-01 and SW22-02) are likely representative of background conditions as they were collected off-Site, away from on-Site APECs and up-gradient of the interpreted groundwater flow. Surface water analytical results are compared to SW22-01 and SW22-02 analytical results to provide additional context when guideline exceedances are identified.

4.0 FIELD WORK AND METHODS

The following sections outline the field work completed at the Site.

4.1 Pre-Investigation Activities

Between August 3 and 6, 2022, a base of operations was established, including: a barge with crew quarters and kitchen; an emergency boat; communication infrastructure; and a spacer barge to store equipment and tanks for water and sewage. The barges were anchored to the shoreline.

4.1.1 Site Survey

Prior to drilling, the Site boundaries and the proposed borehole locations were surveyed. After the drilling program was completed, the new monitoring wells were surveyed using a real-time kinematic survey system. A vertical and horizontal survey of the newly installed monitoring well locations was also completed. A copy of the Site survey is in Appendix C.

4.2 Borehole Drilling

A M5T track-mounted drill rig equipped with direct push tooling and solid stem augers, operated by Mobil Augers and Research Ltd., was used for the assessment. The solid stem auger was specifically considered for boreholes proposed that extend into permafrost.

The borehole and monitoring well locations are presented in Figure 2. Boreholes logs and well completion details are presented in Appendix D.

4.2.1 Monitoring Well Installation

The monitoring wells were constructed of 50-millimetre diameter, Schedule 40 polyvinyl chloride screen and solid riser. All well completion zones consisted of 0.010-inch slot screens, and 10-20 silica sand was placed below, around and above the screen. Well annuli above the sand pack was sealed with hydrated bentonite chips. All monitoring wells were completed with lockable aboveground steel casings set in concrete.

4.3 Soil Sampling

The soil conditions identified during the subsurface investigations were recorded on WSP's standard field logs. The soil was logged consistently with the Unified Soil Classification System (ASTM 2009). Soil samples were collected at intervals of approximately 0.15 m for the top 0.50 mbgs of soil, and at intervals of 0.3 to 0.5 m to the maximum depth following the methodology described below.

Each soil sample collected was split, with half being placed in laboratory-supplied sample jars for analysis and half placed into re-sealable plastic bags for organic vapour measurements using an RKI Eagle Portable Gas Monitor. EC was also measured during sampling as a soil quality indicator parameter using a Hanna Instruments® EC meter. Calibration of the EC meter was completed as per the manufacturer's instructions.

Organic vapour measurements were completed by allowing a quarter-filled soil bag to equilibrate for about 30 minutes at a temperature at or above 15°C. Soil in the bag was broken apart and the probe of the RKI Eagle with methane elimination was inserted into the bag and the peak headspace reading recorded for each sample. As per the manufacturer's instructions, the OVM was bump tested daily to 15% lower explosive limit using a hexane standard. If the bump test differed more than 10% from the known concentration, the OVM was adjusted to match the exact concentration of the calibration gas. Calibrations were logged at the start of each day.

Soil samples for laboratory analysis were selected based on physical observations (e.g., evidence of staining, soil colour and/or texture, evidence of odours), field screening results (e.g., highest EC/OVM readings) or at the target depth outlined in the SOW. A minimum of one soil sample was submitted for analysis from between ground surface and less than 0.5 mbgs (surface soil), a second from greater than 0.5 mbgs (subsurface soil as defined by ASMRP) and a third from the maximum depth of the investigation (targeting undisturbed native soil). Additional samples were submitted from above and below any major changes in physical observations or field screening results that were observed.

Soil samples were placed in laboratory-supplied containers suitable for the analytes: BTEX, PHC Fractions F1 to F4, PAHs, salinity or various metals. Where applicable, the appropriate laboratory-supplied preservative was added to the samples. Samples were kept in ice-filled coolers and submitted under chain-of-custody protocols.

Soil sample transportation was scheduled multiple times each week by direct subcontractors from Inuvik to BVL in Yellowknife by scheduled flights and then to BVL in Calgary by scheduled flights managed by BVL. All samples destined for analysis of volatile constituents were preserved using methanol on the Site prior to packaging so that the extended transportation hold time of five days (rather than two days for unpreserved samples) could be achieved. Sampling crews had appropriate International Air Transport Association Transportation of Dangerous Goods training to allow for transportation of limited quantities of methanol by air.

4.4 Groundwater Monitoring Well Development

Following drilling and prior to groundwater sampling, each newly installed well was developed by removing the equivalent of three well volumes of water from the well. HDPE tubing was used to develop the monitoring wells until dry. Purged water was retained on-site in a 205-L barrel. Once the field program was completed, the barrel was transported off-site and properly disposed at an approved facility.

4.5 Groundwater Monitoring and Sampling

One round of groundwater monitoring and sampling of the newly installed and existing wells was to be completed at the Site during the 2022 field program. However, nine of the fifteen wells were dry and due to logistical challenges, only two of the six wells could be sampled in 2022.

Groundwater monitoring activities consisted of measuring depth to groundwater and, if present, the thickness of LNAPL using a Heron oil/water interface probe. LNAPL was not detected in any well monitored. Prior to use in each well, the interface probe was cleaned using a phosphate-free detergent and water solution and rinsed with distilled water to minimize the potential for cross-contamination. Depth measurements were taken from the top of casing.

Groundwater samples were collected using the grab sampling method using a disposable bailer or HDPE tubing as there was limited water and low-flow sampling or pumping could not be completed. Routine water quality indicator parameters were measured during sampling using a Hanna Instruments® EC meter. The parameters measured included EC, pH and temperature. Calibration of the EC meter was completed as per the manufacturer's instructions.

Groundwater samples were submitted for analysis of BTEX, PHC Fractions F1 and F2, PAH, dissolved salinity parameters and dissolved metals. The groundwater samples were placed in laboratory-supplied bottles. Where applicable, the appropriate laboratory-supplied preservative was added to the samples.

Groundwater samples were kept in ice-filled coolers and submitted under chain-of-custody protocols to BVL following the same transportation method as the soil samples.

4.6 Surface Water

Four sampling locations to assess background surface water chemistry were proposed. However, only three locations could be sampled in 2022. Surface water pH, temperature and EC were measured in the field at each sampling location using a Hanna Instruments® multiparameter sensor. Sampling equipment and sensor probes were decontaminated between sampling locations using a phosphate-free detergent and water solution and rinsed with distilled water to minimize the potential for cross-contamination Surface water samples were collected and placed in laboratory-supplied bottles. Where applicable, the appropriate laboratory-supplied preservative were added to the samples.

Surface water samples were submitted for analysis of BTEX, PHC Fractions F1 and F2, salinity parameters, total metals and DOC. Surface water samples were kept in ice-filled coolers and submitted under chain-of-custody protocols to BVL following the same transportation method as the soil samples.

4.7 Habitat Assessment

A qualitative habitat assessment was carried out at the Site and included the following objectives:

- summary of general terrestrial and aquatic habitat characteristics and quality at the Site and surrounding area;
- determination of whether the river and ponds are likely to support aquatic receptors (i.e., fish, aquatic vegetation, pelagic and benthic invertebrates);
- characterization of the ponds to determine whether they will fully freeze in winter and are expected to be present throughout the year;
- identification of potential terrestrial and aquatic receptors through incidental observations, visual evidence (e.g., scat) and presence of suitable habitat; and
- identification of species-at-risk through a desktop survey, with any results to be confirmed in the field with visual observations.

5.0 RESULTS

The following section outlines the results of the Supplemental Phase II ESA. Figure 3 provides a visual representation of the inferred groundwater flow and Figure 4 provides a visual representation of all soil, groundwater and surface water analytical results.

5.1 Site Stratigraphy

A description of the stratigraphy for the 70 boreholes advanced at the Site are presented on the field logs in Appendix D.

The stratigraphy at the Site generally consists of the following:

- Sand and gravel fill were observed at surface on the Site footprint, extending up to 4.50 mbgs, the maximum depth investigated.
- Outside of the Site footprint, peat was observed at surface extending to between 0.1 and 0.5 mbgs, where silty sand or permafrost was encountered.
- Depth to frozen soil, representative of permafrost, ranged from 0.2 to 0.7 mbgs in the undisturbed areas to the east, west and north of the Site footprint. Depth to permafrost in previously disturbed areas (Site footprint, former airstrip and former access road) ranged from 1.2 to >3.15 mbgs (at BH22-24).

Based on field observations, predominantly coarse-grained soils are on-site. This is consistent with historical observations and grain-size analysis.

5.2 Site Hydrogeology

The 2022 groundwater monitoring results are presented in Table 1 and Figure 3, and summarized below.

Field Parameters	Minimum	Maximum
LNAPL (mm)	Not detected	Not detected
Depth to groundwater (mbgs)	0.36	0.95

Monitoring wells P06-4, P06-6, P19-4, MW22-02, MW22-09, MW22-13, MW22-16, MW22-43 and MW22-50 were dry during the 2022 monitoring event. Groundwater flow is interpreted to the southeast, towards the Mackenzie River.

5.3 Soil Analytical Results

The soil analytical results are illustrated in Figures 4 to 7 and summarized in Tables 2 to 5. Copies of the laboratory certificates of analysis are included in Appendix E.

5.3.1 Petroleum Hydrocarbons

Soil samples collected from 14 sampling locations exceeded the GNWT guidelines for one or more of the following parameters: BTEX and PHC Fractions F1 to F4. Four of these samples also exceeded the AMSRP guideline for Type B hydrocarbons.

Samples with concentrations of PHCs exceeding the GNWT guidelines were identified in the two former burn pit areas, on the former access road, on the former airstrip and off the Site footprint to the north and east.

Samples with concentrations of PHCs exceeding the GWNT and the AMSRP guidelines were in the former AST area and adjacent to the former airstrip and a former fuel storage area on the northeast portion of the Site (on and off the Site footprint).

GNWT exceedances have been vertically delineated but have not been delineated to the east of the former storage yard. AMSRP exceedances have been vertically and laterally delineated.

PHC analytical results compared to GNWT guidelines are presented on Table 2A and are compared to AMSRP guidelines on Table 2B. All results are presented on Figure 5.

5.3.1.1 Biogenic PHCs

Analysis was completed on selected samples which exceeded the applied guidelines for PHC fractions or toluene to ascertain the origin of the hydrocarbons. Samples from 26 locations were shown to be of biogenic origin (i.e., peat) and were, therefore, not considered exceedances of the applied criteria. The hydrocarbons in samples from four locations were found to be petrogenic (light and middle distillate). The hydrocarbons in two of these four locations were found to be a combination of biogenic and petrogenic origin. The hydrocarbons in samples from seven locations were inconclusive. Biogenic PHCs were identified in locations off the Site footprint. Petrogenic hydrocarbons were identified in the former burn pit areas, off Site north of the Site footprint and adjacent to the former airstrip.

A summary of the results of the biogenic PHC assessments and laboratory reports are provided in Appendix F.

5.3.2 Polycyclic Aromatic Hydrocarbons

A soil sample from one borehole (MW22-22) on the former access road exceeded the applied guidelines and background concentration range for naphthalene. A data quality issue was identified, resulting in a discrepancy between a field duplicate (DUP K) and parent sample (MW22-22-03) exceeding or meeting the guideline for naphthalene; however, both results were greater than five times the reportable detection limit. As a conservative measure, the exceedance was used to represent the sample's result. Naphthalene is vertically delineated and has been laterally delineated except to the northeast. PAH analytical results are presented on Tables 3A and 3B, and on Figure 5.

5.3.3 Salinity

Concentrations of salinity parameters did not exceed the applied guidelines and background concentration ranges in any soil sample, except for pH at MW22-13. Salinity analytical results are presented on Tables 4A and 4B, and on Figure 6.

5.3.4 Metals

Soil samples from four boreholes exceeded the applied guidelines and background concentration ranges for one or more of the following: barium (true total), chromium (total), nickel and selenium. The metal exceedances were identified in the two former burn pits, the former access road and east of the Site footprint.

The chromium, nickel and copper impacts identified in 2021 were laterally delineated. Soil in the vicinity of barium exceedances in two locations, identified in 2021, were resampled for barium (true total) and did not exceed the applied guideline.

Metal exceedances have not been delineated on the access road or off-site to the east. Metal analytical results are presented on Tables 5A and 5B, and on Figure 7.

5.4 Groundwater Analytical Results

Monitoring wells P06-4, P06-6, P19-4, MW22-02, MW22-09, MW22-13, MW22-16, MW22-43 and MW22-50 were dry during the 2022 monitoring and sampling event. Due to lack of sufficient water and logistical challenges, P19-5 and P19-6 were the only wells sampled in 2022. Groundwater samples for field parameters and dissolved metals were not collected as there was limited water to sample.

One groundwater sample collected from one monitoring well (P19-5 in the former burn pit area) exceeded the applicable guideline for naphthalene. PHC concentrations did not exceed the guidelines in the sample from P19-6 which had exceeded the guideline for benzene during the previous groundwater sampling event (2019). No other exceedances were identified.

The groundwater analytical results are illustrated in Figures 8 to 10 and summarized in Tables 6 to 8. Copies of the laboratory certificates of analysis are included in Appendix E.

5.5 Surface Water Analytical Results

There are no applied guideline values for DOC. The DOC results presented in Table 10 were used during the guideline value determination of select parameters.

Concentrations of total metals parameters did not exceed the applied guidelines in the 2022 surface water sample. A surface water sample collected in 2021 in a water body adjacent to the former access road exceeded the applied guidelines for aluminum, copper and iron. The 2022 analytical results suggest that the elevated concentrations of these parameters from 2021 are likely consistent with background conditions.

The surface water analytical results are illustrated in Figures 8 to 11 and summarized in Tables 9 to 14. Copies of the laboratory certificates of analysis are included in Appendix E.

6.0 HABITAT ASSESSMENT

Habitat assessments were completed on August 14 and 15, 2022. The table below provides a summary of wildlife observed during the assessment.

Date	Species observed	Notes
August 14, 2022	Sandhill crane (*Antigone canadensis*)	Vocalization heard and viewed flying overhead
	Unknown small ground-dwelling mammal	Small hole observed in bank of slope potentially home to rodent or other small mammal, and brief sighting in grasses
	Sparrow (unknown species)	Observed flying
	Moose (*Alces alces*)	Tracks viewed
	Snow geese (*Anser caerulescens)*	Observed flying
	Bear (unknown species)	Scat observed
	Wasp (unknown species)	Remnants of a nest observed
August 15, 2022	Snow geese (*Anser caerulescens)*	Observed flying
	Sandhill crane (*Antigone canadensis*)	Observed landing
	Grizzly bear (*Ursus arctos horribilis*)	Tracks observed
	Willow ptarmigan (*Lagopus lagopus*)	Vocalization heard, scat and bird flying observed
	Red throated loon (*Gavia stellata*)	Observed flying
	Sparrow (unknown species)	Observed flying and feathers found
	Fox (species unknown)	Scat observed

In addition to the habitat assessment, bear tracks were observed near the shoreline of the Site, an arctic fox was observed on the Site access road, and sandhill cranes were observed flying at the Site. The results of the habitat assessment are presented in Appendix G.

7.0 FIELD AND LABORATORY QUALITY ASSURANCE/ QUALITY CONTROL

A QA/QC program was followed to manage and quantify the quality of the investigation results. The program included field procedures, laboratory procedures and the use of QC samples to quantify the results of the program. Eleven field duplicate soil samples were submitted as part of this program. All soil, groundwater and surface water samples are placed in laboratory-supplied containers suitable for the analytes, and, where applicable, the appropriate laboratory-supplied preservative is added to the samples, as outlined Appendix H which provides a discussion of the QA/QC program.

Fifty-seven data quality issues were identified. No data quality issues resulted in the associated data being considered suspect as further explained in Appendix H.

The analytical results of the soil, surface water and groundwater samples collected by WSP field staff between August 3 and 29, as part of the Supplemental Phase II ESA, are considered reliable.

8.0 CONCLUSIONS

Below is a summary of the results for the Supplemental Phase II ESA:

- Sand and gravel fill were observed at surface on the Site footprint, extending up to 4.50 mbgs, the maximum depth investigated. Outside of the Site footprint, peat was observed at surface extending to between 0.1 and 0.5 mbgs, where silty sand or permafrost was encountered.
- Depth to permafrost ranged from 0.2 to 0.7 mbgs in the undisturbed areas to the east, west and north of the Site footprint. Depth to permafrost in previously disturbed areas (Site footprint, former airstrip and former access road) ranged from 1.2 to >3.15 mbgs (at BH22-24).
- LNAPL was not identified in any of the wells monitored.
- The depth to groundwater for this investigation ranged from 0.36 to 0.95 mbgs.
- Soil samples with concentrations of PHCs exceeding the GNWT guidelines only were identified in the two former burn pit areas, on the former access road, on the former airstrip and off the Site footprint to the north and east. Soil samples with concentrations of PHCs exceeding the GWNT and the AMSRP guidelines were in the former AST area and adjacent to the former airstrip and a former fuel storage area on the northeast portion of the Site (on and off the Site footprint).
- Based on chromatogram and biogenic toluene analysis, biogenic PHCs were identified in locations off the Site footprint, consistent with the peat occurrences in the boreholes. Petrogenic hydrocarbons were identified in the former burn pit areas, off Site north of the Site footprint and adjacent to the former airstrip.
- Soil samples from one borehole (MW22-22) on the former access road exceeded the applied guideline for naphthalene.
- Soil samples from one borehole (MW22-13) were below the pH guideline range off the Site footprint to the east.
- Soil samples from four boreholes exceeded the applied guidelines and background concentration ranges for one or more of the following: barium (true total), chromium (total), nickel and selenium. The metal exceedances were identified in the two former burn pits, the former access road and east of the Site footprint. The chromium, nickel and copper impacts identified in 2021 were laterally delineated. Soil in the vicinity of barium exceedances in two locations, identified in 2021, were resampled for barium (true total) and did not exceed the applied guideline.
- Due to lack of sufficient water and logistical issues, P19-5 and P19-6 were the only wells sampled in 2022. One groundwater sample collected from one monitoring well (P19-5 in the former burn pit area) exceeded the applicable guideline for naphthalene.
- Concentrations of total metals parameters did not exceed the applied guidelines in the 2022 surface water sample. A surface water sample collected in 2021 in a water body adjacent to the former access road exceeded the applied guidelines for aluminum, copper and iron. The 2022 analytical results suggest that the elevated concentrations of these parameters from 2021 are likely consistent with background conditions.
- Soil with GNWT exceedances for PHCs have been vertically delineated but have not been delineated to the east of the former storage yard. Soil PHC exceedances have been vertically and laterally delineated using AMSRP guidelines. Naphthalene is vertically delineated in soil and has been laterally delineated except to the northeast. Metal exceedances have not been delineated in soil on the access road and off-site to the east.

- Naphthalene impacts in groundwater are not delineated.
- Based on the review of the QA/QC results, the data presented in this report are considered to be reliable.
- The 2022 investigation better characterized the current Site conditions and the extents of the remaining Site impacts above applied guidelines and background concentrations are well defined.

9.0 RECOMMENDATIONS

Based on the findings of the Supplemental Phase II ESA, it is recommended that:

- A Remedial Action Plan be completed to provide: a conceptual site model; a discussion of the chromatogram analysis; further interpretation of the 2021 and 2022 results; and recommendations for steps to move toward Site closure, including, but not limited, to additional Site investigations, remediation options and risk assessment.

10.0 REFERENCES

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11.0 STATEMENT OF LIMITATIONS

This report was prepared for the exclusive use of Shell Canada Limited. The report, which specifically includes all tables and figures, is based on data and information collected during the Site investigation activities conducted by WSP Canada Inc. and is based solely on the conditions of the property at the time of the field investigations, supplemented by historical information and data obtained by WSP Canada Inc. as described in this report. However, it is never possible, even with exhaustive sampling and testing, to dismiss the possibility that part of a site may be contaminated and remain undetected.

The services performed as described in this report were conducted in a manner consistent with that level of care and skill normally exercised by other members of the engineering and science professions currently practicing under similar conditions, subject to the time limits and financial and physical constraints applicable to the services. Any use which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibilities of such third parties. WSP Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

The content of this report is based on information collected during our investigation, our present understanding of the Site conditions, and our professional judgment in light of such information at the time of this report. This report provides a professional opinion and therefore no warranty is expressed, implied, or made as to the conclusions, advice and recommendations offered in this report. This report does not provide a legal opinion regarding compliance with applicable laws. With respect to regulatory compliance issues, it should be noted that regulatory statutes and the interpretation of regulatory statues are subject to change. The findings and conclusions of this report are valid only as of the date of this report. If new information is discovered in future work, including excavations, borings, or other studies, WSP Canada Inc. should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

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