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PROTECTING OUR ARCTIC ENVIRONMENT

MONITORING PLAN

PPD BAKER LAKE LANDFARM

February 27, 2026

Nunatta Environmental Services Project 25-29

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1 INTRODUCTION

Nunatta Environmental Services Inc. has prepared this monitoring plan on behalf of the Petroleum Products Division (PPD) of Transportation and Infrastructure Nunavut. This plan addresses regular planned monitoring at the Baker Lake Landfarm in Baker Lake, Nunavut.

PPD is responsible for the management of the landfarm.

1.1 Effective Date

This monitoring plan is effective June 1, 2026.

This is the first version of the plan.

1.2 Distribution List

The plan and the most recent revisions have been distributed to:

- The Nunavut Impact Review Board,
- The Nunavut Water Board, and
- The Hamlet of Baker Lake.

1.3 Purpose

The purpose of this plan is to describe the monitoring requirements for the landfarm, including soil, water and groundwater sampling methods. The plan identifies key personnel and their roles and responsibilities, available equipment, and resources available.

1.4 Project Background

PPD is responsible for the purchase, transportation, storage and distribution of all petroleum products in Nunavut. PPD's headquarters is in Rankin Inlet, where it also maintains the tank farm and other fuel infrastructure.

After a spill at the Baker Lake Tank Farm in 2021, Nunatta and others excavated and segregated impacted soil in a lined containment cell south of the Tank Farm. Since the time of the spill, some soil has been bioremediated and is ready for re-use, but it is likely that some soil remains impacted with petroleum hydrocarbons.

PPD has proposed to construct a landfarm to treat this remaining soil and possibly other impacted soil in the community. The Hamlet of Baker Lake has selected an area northwest of the built-up area and north of the airport for the landfarm.

The landfarm will be constructed from gravel and sand with an impermeable membrane that limits the transmission of impacts from the landfarm to the surrounding area. The plan is for the landfarm to accept only soil contaminated with hydrocarbons in which the primary petroleum is fuel oil and/or diesel fuel and/or gasoline.

2 EXISTING CONDITIONS

2.1 Site Description

A parcel of land (Lot 454, Plan 4945) has been surveyed to use as the landfarm site.

The proposed landfarm is located northwest of the hamlet of Baker Lake, in the Kivalliq Region of Nunavut. The geographical coordinates of the centre of the site are

Latitude	Longitude
64.321680° N	96.092068°W

The site is relatively flat, with a slight slope towards the southeast.

2.2 Instrumentation

The landfarm will have four monitoring wells installed, one on each side. The monitoring wells will be installed to permafrost, approximately. The wells will be completed with stick-up casings.

2.3 Copies of the Plan

A copy of this plan will be kept on site during all active operations: turning the soil, adding amendments, etc.

PPD will retain a copy of this plan at all times in its Headquarters office in Rankin Inlet.

3 ORGANIZATION AND RESPONSIBILITIES

3.1 Management

PPD will be responsible for the management of the landfarm.

Day to day management may be contracted to an environmental consultant or contractor, depending on the work required.

Field personnel from PPD, the consultant and the contractor or any of these in combination may fulfill the requirements of this plan.

3.2 Laboratory

PPD will ensure that its consultants and contractors use laboratories certified by the Canadian Association for Laboratory Accreditation Inc. (CALA). CALA accreditation is a formal recognition that laboratories are competent, impartial and independent.

For an environmental laboratory to attain accreditation, it must meet both the management and technical requirements of ISO/IEC 17025. Specific application of requirements in ISO/IEC 17025 as they relate to the area of environmental testing are detailed in CALA's requirements. These include specific requirements for resources, processes, management systems and structures.

Laboratories are reassessed every two years to ensure their continued conformance with requirements. Laboratories accredited by CALA are also required to participate in proficiency testing programs between reassessments.

4 HEALTH AND SAFETY

A standalone Health and Safety Plan (HASP) will be prepared by the consultant or contractor before maintaining, sampling or otherwise operating the landfarm. Employees of PPD, the consultant and/or contractor will receive appropriate training before work at the site. Because the landfarm site is away from the hamlet of Baker Lake and will be fenced, PPD does not expect that members of the public will be exposed to impacts from site operations.

The HASP will include consideration of relevant exposure pathways and appropriate mitigations for site workers, including:

- Inhalation,
- Ingestion, and
- Direct contact with impacted soils.

The HASP will also include consideration of potential migration of contaminants via dust or water runoff, and include plans for mitigation. Such plans may include limitations on work in high-wind conditions.

The HASP will also include requirements for personal protective equipment at the site.

5 SAMPLING PLAN

Sampling at the site will include soil, landfarm water and groundwater sampling.

5.1 Soil Sampling

To assess the performance of the landfarm, PPD will sample soils twice annually: in the spring and again before freeze up.

Samples will be collected from each stockpile/area in the landfarm. In general, samples will be analyzed for the same contaminants as the site restoration criteria shown in Table 1.

Sample locations will be chosen to ensure uniformly distributed and representative sampling collection throughout the stockpile or area.

Samples will not be collected from the surface of a stockpile. Instead, a hole will be excavated to at least 30 cm below the surface to ensure that conditions are representative.

Sample frequency will be based on the volume of soil estimated to be in the landfarm. Frequency is shown in Table 1 below.

Table 1: Samples Indicated for Landfarm

Landfarm Soil Volume (m^3)	Number of Samples
≤ 130	3
> 130 to 220	4
> 220 to 320	5
> 320 to 430	6
> 430 to 550	7
> 550 to 670	8
> 670 to 800	9
> 800 to 950	10
> 950 to 1100	11
> 1100 to 1250	12
> 1250 to 1400	13
> 1400 to 1550	14
> 1550 to 1700	15

Landfarm Soil Volume (m^3)	Number of Samples
> 1700 to 1850	16
> 1850 to 2050	17
> 2050 to 2200	18
> 2200 to 2350	19
> 2350 to 2500	20
> 2500 to 2700	21
> 2700 to 2900	22
> 2900 to 3100	23
> 3100 to 3300	24
> 3300 to 3500	25
> 3501 to 3700	26
> 3700 to 3900	27
> 3900 to 4100	28
> 4100 to 4300	29
> 4300 to 4500	30
> 4500 to 4700	31
> 4700 to 5000	32
> 5000	N = 32 + (V − 5000) ÷ 300 where N is the minimum number of samples, and V is the volume of soil in the landfarm.

Samples will be analyzed for BTEX, PHCs, PAHs and lead. Samples may also be analyzed for other parameters to fine-tune nutrient addition.

PPD will use the guidelines from Nunavut's Environmental Guideline for the Management of Contaminated Sites ("EGMCS", GN Department of Environment, 2014) to determine when the soil is ready for reuse. The EGMCS focuses on the management of PHC contaminated soil, because "[m]ost contaminated sites in Nunavut are the result of petroleum hydrocarbon spills (i.e. gasoline, jet fuel, diesel, bunker fuel)."

The EGMCS incorporates values for contaminants developed by the Canadian Council of Ministers of the Environment (CCME) that "may be adopted de facto as the site-specific remediation criteria and

incorporated directly into the Remedial Action Plan or modified within certain limits," according to the Guideline. As a result, PPD will refer directly to the CCME source guidelines where relevant.

For re-use as road base material, the relevant guidelines are commercial, and soil is expected to be coarse. Guidelines are shown in Table 2, below. Because groundwater is not used for drinking water, that pathway is excluded. Coarse soil is assumed based on historical observations, but will be confirmed during monitoring. The aquatic life pathway is retained as roads may be constructed near Baker Lake or other water bodies.

Table 2: Soil Re-use Guidelines

Analyte	Guideline Value (µg/g)	Controlling Pathway
Benzene	0.30	Vapour intrusion, slab on grade
Toluene	0.10	Groundwater check (aquatic life)
Ethylbenzene	50	Groundwater check (aquatic life)
Xylenes	37	Groundwater check (aquatic life)
Petroleum Hydrocarbon F1	320	Eco soil contact/Vapour intrusion
Petroleum Hydrocarbon F2	260	Eco soil contact
Petroleum Hydrocarbon F3	1,700	Eco soil contact
Petroleum Hydrocarbon F4	3,300	Eco soil contact
Lead	82	Not applicable

PAHs will be assessed according to the CCME's Canadian Environmental Quality Guideline for PAHs (CCME, 2010).

5.2 Landfarm Water Sampling

The perimeter berms of the landfarm will allow for rain and snowmelt to be contained inside the landfarm. PPD will allow a minimum of 0.5 metres of freeboard at the downgradient end of the landfarm to ensure that impacted water does not overtop the berms.

Accumulated water typically evaporates under sun and wind action. Water in the cells also aids in the bioremediation process and controls dust. It has been found that contaminated water can be stripped of hydrocarbons by pumping it into holes in the soil pile

If water exceeds the freeboard level, PPD will ensure that water in the landfarm is pumped to temporary storage (e.g., in totes, drums or temporary tanks). PPD will sample the temporary water storage and assess the potential for on-land disposal of water.

Where water concentrations are above CCME freshwater aquatic life guidelines or other relevant guideline (see below), PPD will filter and treat the water before disposal. Typically, this process will include a sand filter and activated carbon. Water will be re-tested for hydrocarbons and when acceptable levels are reached, PPD will consult with the Nunavut Department of Environment and/or Water Board representatives at Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) at least 15 days in advance to obtain permission for on-land disposal.

Table 3: Site Restoration Criteria

Analyte	Concentration (µg/L)
Benzene	370
Toluene	2
Ethylbenzene	90
Xylenes	30
PHC F1	150
PHC F2	110
Lead	1

These criteria are obtained from CCME Water Quality Guidelines (benzene, toluene, ethylbenzene) or Alberta's Environmental Quality Guidelines for Alberta Surface Waters (all others).

Environment and Climate Change Canada has developed a hazard index approach for benzene, toluene, ethylbenzene and xylenes (BTEX) contaminants that will also be considered when disposing of water. (ECCC, 2024).

5.3 Groundwater Sampling

Four groundwater wells are planned to be installed during the construction of the landfarm.

Previous experience indicates that monitoring wells are likely to remain frozen until very late in the season in Baker Lake. As a result, a single annual monitoring round is planned, for late summer.

The monitoring round will include water samples collected from each well.

Analytical results will be compared to guideline values as shown in Table 4 for contaminants of concern, i.e., PHCs, BTEX and lead.

Table 4: Groundwater Guidelines

Analyte	Concentration (µg/L)
Benzene	690
Toluene	8.3
Ethylbenzene	11,000
Xylenes	18,000
PHC F1	9,100
PHC F2	1,300
Lead	1 (see note below)

The Table 4 guidelines are obtained from the Federal Interim Groundwater Quality Guidelines for commercial/industrial sites (Table 3 from FCSAP, 2016 stipulating coarse soils). While these guidelines are useful for assessing risks to human health and the environment, any changes over time will be more useful in assessing landfarm performance.

Because acceptable concentrations of lead in water vary with hardness, the conservative approach is taken here to address potential risks. That is, the lowest guideline value is selected.

6 SAMPLING METHODOLOGY

6.1 Soil Sampling

Samples will be collected by advancing test pits or with a sampling probe to ensure that samples of the proper depth are collected.

Samples will be collected using methanol preservation to collect volatile in accordance with the CCME's guidance manual for site assessment (CCME, 2016).

The field assessor will record soil observations during excavation, including approximate grain size, colour, moisture content, stratigraphy, and nature and extent of apparent contamination. Test pits (if advanced) will be logged and provided in reports.

Equipment may be used to collect samples at appropriate depths, including trowels and probes. These re-usable implements will be decontaminated with detergent and water between locations.

6.2 Landfarm Water Samples

Landfarm water samples will be collected directly from the landfarm, or from temporary storage containers such as totes or tanks before disposal. Samples will be collected by submerging the bottle under the surface of the water, removing the cap and allowing the bottle to fill, then recapping the bottle.

6.3 Groundwater Samples

A groundwater sample will be collected from each monitoring well.

Before sampling, static ground water levels will be measured with a water level tape. Volatile components in air will be measured with a photoionization detector.

Each monitoring well will be purged using a foot valve and sample tubing. Water will be collected in a pail and transported to the landfarm for disposal/re-use in adding moisture to the soil. Where possible, three monitoring well volumes will be purged before sampling; however, slow recharge may make this difficult. Where samples are collected before three well volumes are removed, it will be noted in the report.

Samples will be collected in laboratory-prepared containers appropriate for each analysis.

Reusable equipment (e.g., water level tapes) will be decontaminated between each well using sample detergent and a distilled water rinse.

6.4 Sample Handling

All samples will be identified on laboratory-provided labels indicating sample ID, date, and analysis.

Samples will be placed into coolers with ice for preservation until shipment to the lab. Samples will be shipped to the lab accompanied by chain of custody forms identifying samples, volumes, dates, and other pertinent information.

7 QUALITY

Quality planning is an essential part of a sampling and analysis plan. This section identifies elements of the monitoring plan that may influence data quality. The discussion below is based on the CCME's characterization guidance (CCME, 2016).

7.1 Laboratory Quality

PPD will ensure that its consultants and contractors use laboratories certified by the Canadian Association for Laboratory Accreditation Inc. (CALA). CALA accreditation is a formal recognition that laboratories are competent, impartial and independent.

For an environmental laboratory to attain accreditation, it must meet both the management and technical requirements of ISO/IEC 17025. Specific application of requirements in ISO/IEC 17025 as they relate to the area of environmental testing are detailed in CALA's requirements. These include specific requirements for resources, processes, management systems and structures.

Laboratories are reassessed every two years to ensure their continued conformance with requirements. Laboratories accredited by CALA are also required to participate in proficiency testing programs between reassessments.

Laboratory internal quality control will be reviewed as part of annual reporting and will include:

The main laboratory quality control activities and check samples are as follows:

- **Method blanks**, where a clean sample is processed simultaneously with and under the same conditions as samples being analyzed.
- **Laboratory duplicates**. The lab compares two aliquots obtained from the same sample container.
- **Spiked Samples**. A known mass of compound with similar characteristics but not found in nature is added to a sample at a known concentration.
- **Matrix Spikes**. A known mass of target analyte is added to a matrix sample with known concentrations.

7.2 Field Quality

The field program will include the following elements.

7.2.1 Field Duplicates

Field duplicates will be evaluated with the Relative Percent Difference (RPD). The RPD is calculated as follows:

$$RPD = \frac{|parent - duplicate|}{\left(\frac{parent + duplicate}{2}\right)}$$

Field and laboratory quality will be compared to guidelines laid out in Table 5. These evaluation methods are derived from CCME guidance (CCME, 2016).

Duplicate samples will be collected at a rate of approximately one per ten parent samples per matrix. At least one duplicate sample will be taken for every matrix in every year, regardless of overall sample numbers.

7.2.2 Trip Blanks

A trip blank is a clean sample of water that is prepared by the lab. The trip blank accompanies the field technician to the site and throughout the sampling program. When the program is complete, the blank is transported to the laboratory for analysis in the same method as other samples (i.e., via air transport). The trip blank is used to document any contamination of samples that results from preparation, shipping or field handling. In general, these samples are limited to the analytes that are most likely to be impacted by contamination during the field program, i.e., volatiles.

A trip blank is typically a water sample, which can represent all matrices sampled.

Where any concentrations of analytes are measured in the blank, potential causes of detections should be assessed and evaluated. The results of this evaluation may mean that further discussion, analysis or re-sampling is required for other elements of the field program.

7.3 Targets

The data quality targets for the program are shown in Table 5, below.

Table 5: Data Quality Targets

Quality Control Measure	Evaluation
Field duplicate	Relative percent difference between the primary and duplicate sample should be less than 60 percent for soil.
Laboratory duplicate	Per laboratory quality program, but generally less than 30 percent for soil.
Laboratory blank	Per laboratory quality program but should generally be non-detect.
Matrix spike	Per laboratory quality program.

Samples where primary or duplicate analyte are not detected are evaluated as “acceptable.”

Where one sample in a duplicate pair contains detectable concentrations of an analyte but the other sample does not, samples pairs will be deemed acceptable when the detected concentration is less than twice the detection limit.

8 REFERENCES

Canadian Council of Ministers of the Environment (CCME), 2023. Canadian Environmental Quality Guidelines. Updates to December 2023. Link.

Canadian Council of Ministers of the Environment (CCME), 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment. Volume 1: Guidance Manual. Link.

Canadian Council of Ministers of the Environment (CCME), 2010. Canadian Environmental Quality Guidelines: Polycyclic Aromatic Hydrocarbons 2010. Link.

Environment and Climate Change Canada, 2024. Canadian Environmental Protection Act, 1999 - Federal Environmental Quality Guidelines - Benzene, Toluene, Ethylbenzene, Xylene (BTEX). Link.

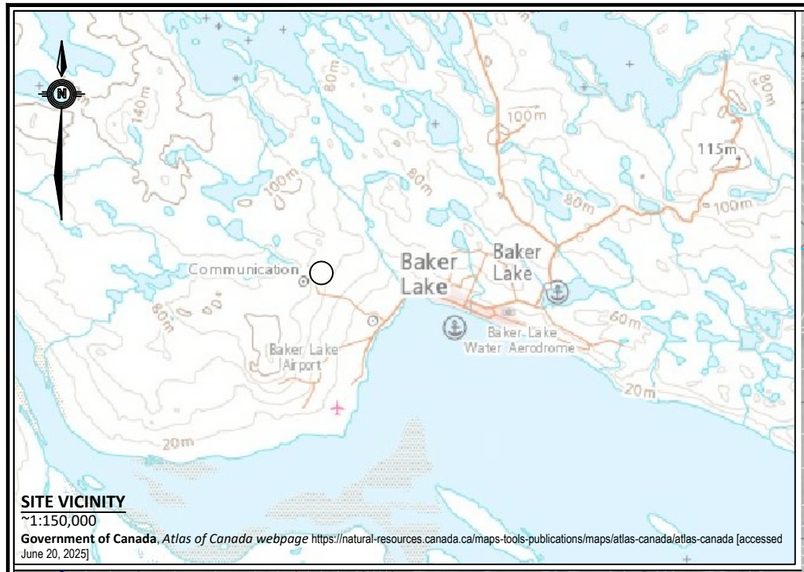
Federal Contaminated Sites Action Plan, 2016. Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites. Link.

Government of Alberta, 2018. Environmental Quality Guidelines for Alberta Surface Waters. Water Policy Branch, Alberta Environment and Parks. Edmonton, Alberta. Link.

Government of Nunavut Department of Environment, 2014. Environmental Guideline for the Management of Contaminated Sites. Most recent revision: December 2014. Link.

FIGURE

FILE: 25-29-v4-r0.dwg



SITE VICINITY
~1:150,000
Government of Canada, *Atlas of Canada webpage* https://natural-resources.canada.ca/maps-tools-publications/maps/atlas-canada/atlas-canada [accessed June 20, 2025]

LEGEND

SUBJECT PROPERTY BOUNDARY

SCALE 1:5000

50 0 50 100 200m

REFERENCES:

1. Government of Nunavut Department of Community Services Panning and Lands Division website: https://cs-pals.ca/downloads/baker-lake/ [accessed June 27, 2025]
2. Sub-Arctic Geomatics, "Compiled Plan of Lots 454 to 456, and Road R45 and Field Notes of Survey Baker Lake, Nunavut" Canada Lands Surveys Records 114003 Dated 2025-04-10, Filed in the Land Titles Office for Nunavut as 4945.
3. Google Earth V 7.3.6.10201. (6/20/2023) Baker Lake, NU 14W 639835.58 m E 7136064.65 m N, eye alt 2.90 km 2025 Airbus 2025 CNES / Airbus [accessed June 10, 2025]

SEAL

REGISTERED PROFESSIONAL ENGINEER
A.D. HENDERSON
LICENSEE
2026·1·26
NT/NU

PERMIT TO PRACTICE P1328

VERSIONS

NO	DESCRIPTION	DATE
1	90% SUBMISSION	2025-06-30
2	99% SUBMISSION	2026-01-16
3	ISSUED FOR CLIENT REVIEW	2026-01-18
4	ISSUED FOR TENDER	2026-01-26

CLIENT

COMMUNITY AND GOVERNMENT SERVICES PETROLEUM PRODUCTS DIVISION

Yedoma

PROJECT

BAKER LAKE LANDFARM

TITLE

CIVIL SITE PLAN

PROJECT NO.	DWN	CKD	DATE	
25-29	SG	AH	June 27, 2025	C-01