Drainage/Seepage Monitoring and Management Plan
Hamlet of Pangnirtung, Pangnirtung, Nunavut

Project Name:
Water Licence Compliance – Hamlet of Pangnirtung

Type of Document:
Final

Project Number:
FRE-00232735-A5

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Date Submitted:
November 8, 2024

Hamlet of Pangnirtung

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Date Submitted:
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Appendices

1 Introduction

The Hamlet of Pangnirtung, NU operates a Solid Waste Disposal Facility and a separate Metals/ Hazardous Waste Management Facility that serve the community of approximately 1,600 residents. Approval to operate these facilities is permitted under the Hamlet's Water Licence No. 3AM-PAN1828 issued May 4, 2018 by the Nunavut Water Board (NWB) and effective until May 3, 2028. The Water Licence governs water use and waste disposal within the Hamlet. A copy of the Class A Water Licence can be found in Appendix A of the QA/QC plan (EXP, 2018) prepared to address the Water Licence monitoring requirements.

The Water License *Part E: Conditions Applying to the Deposit of Waste and Waste Management of the Water Licence, item 9* stipulates:

> *The Licensee shall submit to the Board, for approval, a standalone Drainage / Seepage Monitoring and Management Plan with the 2018 Annual Report to address intervener's comments and recommendations made during the 2017-2018 licensing process and public hearing, including, at a minimum, a list of parameters of concern, targeted concentrations limits and monitoring details*.

Background, rationale and the intervener's comments and recommendations made during the 2017-2018 licensing process and public hearing for the requested Plan were provided in the NWB's document entitled *Nunavut Water Board Water Licence No: 3AM-PAN1828 Reasons for Decision Including Record of Proceedings* dated May 4, 2018.

During 2024, the Hamlet requested EXP Services Inc. (EXP) to review the status of their compliance with Water Licence Part E: item 9), and to update and provide the standalone *Drainage/ Seepage Monitoring and Management Plan* for the facilities. The Drainage/Seepage Monitoring and Management Plan documented herein is a supplement to the document entitled Quality Assurance and Quality Monitoring Plan (QA/QC Monitoring Plan) prepared by EXP (2018) to address the Hamlet's monitoring requirements as stipulated in the NWB Water Licence.

2 Existing Conditions

2.1 Water Licence Requirements and Drainage/ Seepage Plan Status

The Water Licence in effect for the facility stipulates (Part E, item 9) that the standalone *Drainage/Seepage Monitoring and Management Plan* was to be submitted with the 2018 Annual Report, with the sampling outlined in the Plan conducted during open water 2018 (Part H, item 2) conditions (i.e., to capture the spring freshet). It is EXP's understanding that although a formal standalone Drainage/Seepage Monitoring and Management Plan was not submitted with the 2018 Annual Report that the Hamlet has completed several key elements of the Plan. These elements/activities have included:

- Completion of site survey and development of a drainage plan indicating surface water drainage controls and key culvert information including culvert coordinates. Results of the survey and drainage plan development were provided in an EXP memo report entitled "*Pangnirtung Drainage Plan Topographic Survey*" EXP file FRE-00253815-A0 dated June 18th, 2019. A copy of key drainage plan figures from this work which indicate the locations of the three Water Licence specified Drainage/Seepage monitoring stations is provided in Appendix A;
- Development of the report entitled *Quality Assurance/Quality Control Plan Hamlet of Pangnirtung, Pangnirtung, Nunavut* (EXP file FRE-00232735-A0, May 24th, 2018) outlining the Water Licence monitoring program requirements and QA/QC program to ensure reliable results. The 2018 QA/QC plan outlines leachate seep sample requirements including locations, frequency, sampling and analytical suites which are reiterated in this standalone plan;
- A memo report dated February 11th, 2021, and entitled *Pangnirtung Leachate Sample Summary* (EXP file FRE-00232735-A0) provided a summary of results of drainage/seepage samples collected on June 21, 2020 from the three drainage/seepage monitoring stations specified in the Water Licence. A copy of this report is provided in Appendix B.

Collectively, these reports provide the background and framework for the standalone *Drainage/Seepage Monitoring and Maintenance Plan* provided herein.

2.2 2024 Site Visit

To provide for a Drainage/Seepage Plan relevant to current conditions, a Site Visit by a representative of EXP was made to the Pangnirtung Solid Waste Disposal Facility and the Metals and Hazardous Waste Management Facility during September 2024. Approximate locations of each of these waste management areas and the construction and demolition (C&D) management area are indicated on a figure included in Appendix A. (The Site Visit was completed in conjunction with 2024 Pangnirtung Airfield Rehabilitation work, EXP file FRN-24007043-A0). The purpose of the 2024 Site Visit was to complete a walkover of the facility areas including (as practical) the entire perimeter of the containment berms to assess current drainage conditions and evidence (if any) of seepage around the toe of the berms and observe conditions and seepage (if any) at or near the Water Licence specified drainage/seepage sampling locations (PAN-4, PAN-5 and PAN-6).

A Field Report and accompanying photographs of the Water Licence specified drainage/ seepage monitoring stations and respective culverts/drainage features and site conditions observed at the time of the 2024 Site Visit is provided in Appendix C. Results of the Site Visit were used to develop implementation aspects for the maintenance portion of this standalone *Drainage/Seepage Monitoring and Maintenance Plan*.

3 Drainage/ Seepage Monitoring Plan

This section is adapted from the EXP QA/QC Plan (EXP, 2018) which should be referred to if further clarification of sampling requirements, method and procedures is required.

3.1 Sampling Locations

The Hamlet's Water Licence specifies six (6) monitoring locations, three of which are related to Drainage/Seepage Monitoring Plan requirements. Table 3.1 provides a description of the sampling points, along with their coordinates; the Drainage/Seepage sampling locations are indicated in bold.

Table 3.1 – Water Licence Monitoring Locations (source: EXP, 2018)

Monitoring Program Station Number and Coordinates	Description	Status
PAN-1 N66° 08.80', W65° 41.03'	Raw water supply intake at the Duval River	Active (Volume)
PAN-2 N66° 09.31', W65° 40.48'	Raw sewage from the pump-out truck	Active (Volume)
PAN-3 N66° 09.31', W65° 40.52'	Effluent from Wastewater Treatment Plant	Active (Quality)
PAN-4 N66° 09.48', W65° 39.98'	**Run-off from Sludge Disposal Area**	**Active (Quality)**
PAN-5 N66° 09.45', W65° 40.16'	**Run-off from the Solid Waste Disposal Facility**	**Active (Quality)**
PAN-6 N66° 09.49', W65° 39.67'	**Run-off from Metals and Hazardous Waste Storage Area**	**Active (Quality)**

3.2 Drainage/Seepage Location Sampling Frequency

Water Licence monitoring frequency is provided in the QA/QC Monitoring Plan (EXP, 2018). The Water Licence Sampling Testing and Compliance requirements for the Drainage/Seepage monitoring locations are indicated in Table 3.2. Note that sampling frequency is required to be coordinated with the spring freshet, as follows:

> ***….The campaign (sampling) shall consist of sampling three times (at the beginning, middle and near the end of discharge/run-off) during the spring freshet and once per every subsequent month until freezing.*** **(Water Licence Part H, item 2).**

Note that Part H (item 2) further stipulates that additional sampling is required after every rainfall event. For practical purposes, it is EXP's opinion that sampling "after every rainfall event" would only be completed where there is adequate flow at the sampling locations (see below). It is understood that any other additional sampling during the year for the Drainage/Seepage Monitoring program would be at the discretion and request of the regulatory agencies. After completion of a one-year monitoring period it is understood the results of the program would be submitted with the Annual Report for that year, and the requirements for sampling during subsequent years would be pending review by the NWB (this should be confirmed in writing with the NWB).

Table 3.2 – Drainage/Seepage Monitoring Sampling Frequency (source: EXP, 2018)

Monitoring Program Station Number	Description	Frequency
PAN-4	Run-off from Sludge Disposal Area	Beginning, middle and near the end of discharge/run-off observed; once per every subsequent month until freezing.
PAN-5	Run-off from the Solid Waste Disposal Facility	Beginning, middle and near the end of discharge/run-off observed; once per every subsequent month until freezing.
PAN-6	Run-off from Metals Storage Area	Beginning, middle and near the end of discharge/run-off observed; once per every subsequent month until freezing.

3.3 Drainage/ Seepage Leachate Sampling Parameters

The requirements for monitoring and analytical testing of drainage/seepage samples is identified in Schedule H (Table 1 and Table 2) of the Water Licence. Samples collected from the Drainage/Seepage Monitoring Stations PAN-4, PAN-5, and PAN-6 shall be analyzed for the following parameters.

- Biochemical Oxygen Demand – BOD_5
- pH
- Total Suspended Solids
- Nitrate-Nitrite
- Chloride
- Sodium
- Magnesium
- Total Hardness
- Total Phenols
- Total Arsenic
- Total Cadmium
- Faecal Coliforms
- Conductivity
- Ammonia Nitrogen
- Sulphate
- Potassium
- Calcium
- Total Alkalinity
- Total Aluminum
- Total Cobalt

- Total Copper
- Total Iron
- Total Mercury
- Total Zinc
- Total Chromium
- Total Lead
- Total Nickel
- Total Organic Carbon – TOC

3.4 Compliance Criteria (Part E.9) for Drainage/Seepage Samples - Current Water Licence # 3AM-PAN1828

The water licence requires that the Drainage/Seepage Monitoring and Management Plan address the "…*intervener's comments and recommendations made during the 2017-2018 licensing process and public hearing, including at a minimum, a list of parameters of concern, targeted concentrations limits and monitoring details*.

For the initial assessment of sample results, it is suggested that CCME guideline criteria for aquatic marine life be used.

3.5 Sampling Procedures

All sampling, sample preservation and analyses are to be conducted in accordance with methods described in the current edition of *Standard Methods for the Examination of Water and Wastewater* (American Public Health Association, American Water Works Association, and Water Environment Federation, most current edition). Also, additional guidance can be obtained from the contract laboratory (accredited by the Canadian Association for Laboratory Accreditation).

To obtain meaningful results from the analyses, the following six factors are of particular importance:

- Sample collection as per schedule and location.
- Correct usage of container/sample bottle for parameter being tested.
- Correct labelling of sample bottles and filling out record/field sheet.
- Correct procedure for sampling.
- Proper and timely shipment of samples to the laboratory.
- Timely delivery of samples to the laboratory from the air cargo facility.

3.6 Sampling Collection

Sampling staff are required to wear appropriate PPE during field sampling. This will include eye protection.

3.6.1 Sampling Equipment

Dedicated latex or nitrile gloves (i.e., one pair per sample) are to be used during sample collection and sample handling. Monitoring program samples collected for analysis of selected chemical parameters are to be placed directly into new pre-cleaned, laboratory-supplied sample bottles as outlined in Appendix D.

All monitoring samples are to be placed in clean coolers for transportation to the subcontract laboratory. The samples are transported/submitted under Chain of Custody documentation. Included on a Chain of Custody form is the client information, the sample information, the analyses requested, the relevant regulations, the turnaround time for the analytical results, comments, and temperature of the samples at the time they arrived in the laboratory. An example of a completed Chain of Custody form can be found in Appendix E.

3.6.2 Sampling Containers

Sample containers for drainage/seepage samples have their own set of containers. The following photographs indicate the containers for leachate sampling; specific sample bottle requirements are presented in Appendix D.

LEACHATE

3.6.3 Sampling Methods

All monitoring program samples will be collected by suitably-trained Hamlet Public Works staff. The following techniques are to be used (when possible) whenever grab samples are collected:

- Inspect/prepare/maintain each of the three drainage/seepage monitoring stations such that monitoring and sampling can be collected (see Section 4 for existing conditions and recommendations for preparing and maintaining sampling locations).
- If practical, measure flow rate at the respective sampling coordinate location. In the event monitoring and sample collection is not practical at the monitoring station coordinate location, one option would be to collect the sample from the nearby “upstream” culvert (where present, e.g., PAN-4, PAN-5) near the location. Use of a bucket/pail (e.g. 20 L capacity) placed at or near the culvert discharge location could be considered to assist in meeting monitoring objectives.

- To the extent practical, the samples will be collected from a location where there is good mixing and the sample will be representative. In the event it is necessary to collect a sample from an area of ponded water/leachate seepage, the sample is not to be skimmed from the surface, taken very close to the bottom, or near any sidewalls. The sample is to be taken from a middle zone, if possible, where there is good mixing and the geometry of the surface water channel/culvert or sump will not affect the quality of the sample.
- The monitoring program samples need to be shipped to the analytical laboratory for analysis immediately or as soon as practical after collecting the sample.
- Samples should always be collected into new, pre-cleaned, laboratory-supplied sample bottles.

3.7 Sample Handling

All monitoring program samples are to be collected into new, pre-cleaned laboratory-supplied containers with the proper preservative, where applicable. A complete list of parameter handling and preservatives can be found in Appendix D.

All sample containers are to be tightly sealed and properly labelled with the sample ID, date and time of sample collection, location of sample collection and parameters to be analyzed. The outside of the bottles are to be cleaned with soap and water after sampling and dried off prior to placing the samples in the cooler. The samples are to be stored on ice in a cooler until delivery to the laboratory. A Chain of Custody form, used to track the samples, is to be filled out completely, placed in a Ziplock bag and placed in the cooler with the samples. Keep the last page of the Chain of Custody and give it to the Hamlet Foreman for their records.

The following checks are generally performed by the laboratory upon receipt:

- Verification of the integrity and condition of all sample coolers.
- Verification of the integrity and condition of all sample containers.
- Checks for leakage, cracked or broken closures or containers, evidence of grossly contaminated container exteriors or shipping cooler interiors, and obvious odours, etc.
- Verification of receipt of complete documentation for each container.
- Verification that sample identification numbers on sample transmittal forms corresponds to sample identification numbers on the sample containers.
- Verifications that holding times were met and samples were kept cool during transit.

3.8 Quality Assurance and Quality Control Program

Cross contamination is a common source of error in sampling procedures. QC samples help identify when and how contamination might occur. There are various types of QC samples. EXP recommends the following number of quality control samples based on the number of samples collected:

- One field blank per cooler.
- 10% blind duplicates.

If the total number of samples collected is less than five, include at a minimum, one blind duplicate.

It is essential to request extra bottle sets from the contract laboratory when placing the bottle order to allow the collection of field blanks and blind duplicate samples.

3.9 Laboratory Analytical Program

3.9.1 Laboratory Accreditation

The Hamlet uses an analytical laboratory accredited by the Canadian Association for Laboratory Accreditation (CALA); formally known as the Canadian Association for Environmental Analytical Laboratories (CAEAL) for the Water Licence monitoring program. Refer to Appendix D of the EXP 2018 QA/QC plan for a copy of the laboratory's CALA accreditation certificate and a list of the parameters for which they are certified. (It is understood that the Hamlet uses Caduceon Laboratories for drainage/ seepage sample analysis; a separate laboratory (ALS) is used in the event fish toxicity testing is required).

It is understood that the GN-DOH does bacteria testing in their own lab in Iqaluit following their own guidelines.

3.9.2 Method Detection Limits

The method detection limits (MDLs) are provided on the contract laboratory's Certificates of Analysis.

3.9.3 Methodology

As indicated above, the contract laboratory is accredited by CALA for specific tests and complies with the requirements of ISO/IEC Standard 17025.

4 Drainage/ Seepage Maintenance Plan

4.1 Drainage Improvements – Existing Conditions

Based on the September 2024 Site Visit (refer to Field Report and related photos, Appendix C) and the Hamlet's public works ongoing activities, it is understood that the site in general, and the Water Licence specified drainage/seepage sampling locations will warrant ongoing clean-up, maintenance and upgrading as part of ongoing operations. Ongoing/ recommended work includes:

1) In some areas there is notable amounts of windblown and misplaced/displaced debris and litter in ditching, drainage swales and most culverts at both the Solid Waste Disposal Site and the Metals Management Site. As part of the Hamlet's regular maintenance activities, the windblown litter and debris should be removed from the ditches, swales and culverts and placed within the footprint and inside the containment berm perimeters of the respective facility (Solid Waste Disposal and Metals/Hazardous Waste facilities).

2) Mitigative measures to improve drainage of the existing surface water control works should continue to be completed as part of the regular maintenance activities. This will include cleaning ditches and "micro-grading" where warranted along the ditch alignments such that there is positive drainage with minimal potential for accumulation of ponded water. The upgradient ditches around both facilities, and the upslope ditch around the Metals containment area warrant particular attention such that "clean" unimpacted surface water from upslope of the facilities drains away and there is no potential for ponded water outside the containment berms to infiltrate over time.

3) Observations during the 2024 Site Visit indicated that the drainage ditch around the toe of slope on the upslope side of the Metals/Hazardous Waste Management site is intersected by a southeast trending aggregate berm/road base. It is possible this feature may result in flow being blocked or more potential for ponding along the upslope drainage ditch. This upslope ditch should be inspected and mitigative measures taken (e.g. clean out culvert if present or install a culvert; regrade the drainage ditch on each side of the aggregate berm/roadway base).

4) Concerning items 3) and 4), if needed, the services of a qualified stormwater/drainage professional could be retained to inspect the existing drainage works and to develop a grading plan for the facilities such that ponded water does not accumulate within the drainage swales and ditches.

5) At each of the three drainage/seepage monitoring stations, establish appropriate conditions to allow for monitoring and sampling requirements to be completed and collection of representative samples. Based on the 2024 Site Visit, suggested measures to implement for each location are as follows:

    a) PAN-4: the 2024 Site Visit observations and photographs taken at and near this station's coordinate location indicate that the "upstream" culvert near PAN-4 daylights and discharges above grade. In the event a sample cannot be collected from the PAN-4 coordinate location, it is anticipated sampling requirements could be met by sampling at this upstream culvert;

    b) PAN-5: the 2024 Site Visit observations and photographs taken at and near this station's coordinate location indicate that the culvert immediately upslope of PAN-5 is partially buried but could likely be cleaned out such that it daylights and discharges above grade. In the event a sample cannot be collected from the PAN-5 coordinate location, it is anticipated sampling requirements could be met by sampling at this

upstream culvert. It may be necessary to dig a shallow drainage sump at the culvert outlet to provide for adequate conditions to allow monitoring and sampling requirements to be completed;

c) PAN-6: the 2024 Site Visit observations indicated that there was no culvert observable near this location, only a drainage swale exiting the containment berm. Notable and steady flow was observed coming directly from the point where the swale exited the berm, then through a culvert under the roadway. Along its drainage course before the roadway, there is an elevation drop at PAN-6 (see PAN-6 sign location photo, Appendix C). At the PAN-6 monitoring location it is expected that monitoring and sampling requirements can be met (e.g., as practical capture and time sample collection using a pail/ bucket);

d) Repair/reinstate, as necessary, the sample location ID signs (PAN-4, PAN5, and PAN-6) to assist in ensuring that samples are collected and labelled accordingly in the field. At the time of the 2024 Site Visit, signs were located at each station (see photos attached).

6) At the northwest corner of the Metals Dump and inside the berm, significant ponded water was observed with several residential sized fuel oil tanks present and/or floating on the ponded water. The ponded water may indicate a low point from which incident precipitation ponding within the Metals containment area cannot drain to the PAN-6 outlet swale. It is recommended that the ponded water be pumped and dispersed as practical toward the eastern side of the metals containment area. It would likely be impractical to expose the floor of the Metals containment area and regrade the footprint such that the potential for ponded water is eliminated. Therefore, it will likely be necessary to monitor for ponded water on an ongoing basis (particularly at the northwest corner of the Metals area), and to take maintenance/ mitigative actions such that the potential for overtopping the containment berm is eliminated.

7) Inspect the integrity of the containment berms (and fencing, where present) along their entire perimeters and complete mitigative work to establish consistent height and thickness along the berms, and to repair any existing areas of erosion (e.g. rills).

4.2 Annual Inspection and Maintenance

In conjunction with the “baseline” drainage/seepage monitoring work to be completed in the “year one” sampling round (i.e., the sampling round completed in the first year in accordance to the Water Licence stipulation to capture spring freshet runoff conditions and subsequent rainfall events), inspect the perimeter berms for potential leachate seeps (no seepage flow other than that observed at location PAN-6 was observed by EXP during the September 2024 Site Visit suggesting that although some berm maintenance/ repair work is warranted, there are no significant active areas of leachate seepage (other than PAN-6)).

Following the completion of the “year-one” monitoring to capture the spring freshet and, where practical, subsequent rainfall events in that year, annual inspections of the containment berms should be completed. If seepage/erosion is observed, it should be reported in the Annual Monitoring report and mitigative actions identified and completed. Representative maintenance activities would include repair of berm erosion and increasing containment berm height if warranted. Any areas of ponded water (e.g., the ponded water observed inside containment berm northwest corner of the Metal containment area during the 2024 Site Visit) should be photographed and documented, and appropriate mitigative measures identified and implemented.

Regular inspection of drainage ditches, swales and culverts for each facility including the drainage/seepage sampling stations and related upslope drainage control and roadway culverts should be completed as routine activities during site visits by facility maintenance staff. Any areas of ponded water or obstructions should be mitigated, and misplaced and windblown litter and debris should be relocated to within the containment berm areas of the respective facilities.

Maintain the drainage/seepage station ID signage.

5 Reporting Requirements

As a condition of NWB Licence 3AM-PAN1828, the Hamlet is required to submit an Annual Report to the NWB, no later than March 31st of the year following the calendar year reported. Among other requirements, the annual report is required to include tabular summaries of all analytical data generated under the Monitoring Program. Results for drainage/seepage monitoring samples should be compared to appropriate guideline/compliance criteria identified in consultation with the NWB (tentative comparative criteria are identified in Section 3.4, above).

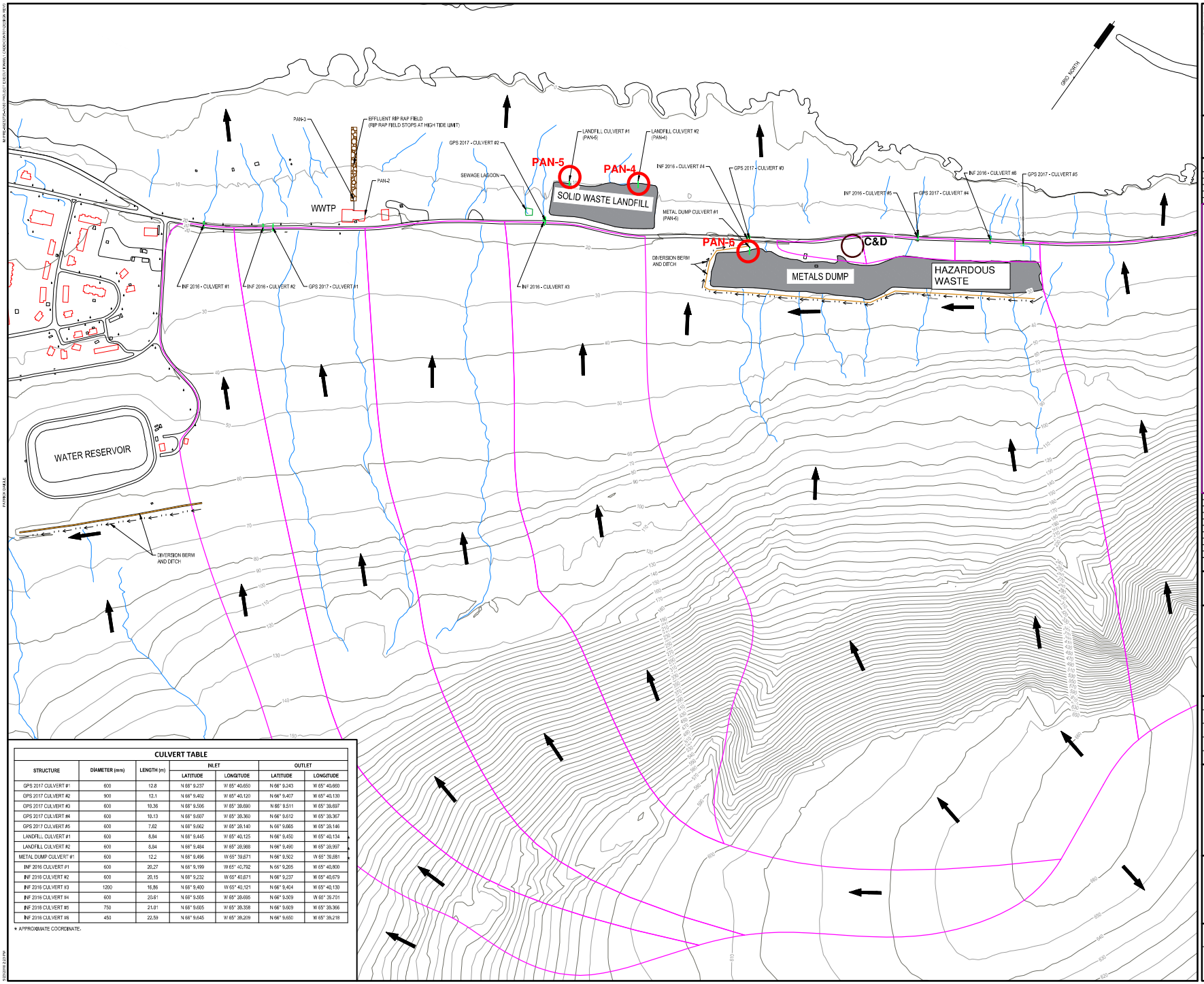
6 References

Quality Assurance/ Quality Control Plan Hamlet of Pangnirtung, Pangnirtung, Nunavut, Water Licence Compliance, EXP Services Inc. file FRE-00232735-A0, May 24, 2018.

Standard Methods for the Examination of Water and Wastewater, American Public Health Association, American Water Works Association, and Water Environment Federation, Latest Edition.

Appendix A:
Site Location and Drainage Plan Figures


Hamlet of Pangnirtung, NU
Solid Waste Landfill
Metal Dump
Wastewater Treatment
Sewage Lagoon
Fish Plant
Water Treatment / Reservoir
Google Earth
© 2017 Google
Image © 2017 DigitalGlobe
N
1 km



CULVERT TABLE

STRUCTURE	DIAMETER (mm)	LENGTH (m)	INLET		OUTLET	
			LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
GPS 2017 CULVERT #1	600	12.8	N 66° 9.237	W 65° 40.650	N 66° 9.243	W 65° 40.660
GPS 2017 CULVERT #2	900	12.1	N 66° 9.402	W 65° 40.120	N 66° 9.407	W 65° 40.130
GPS 2017 CULVERT #3	600	10.36	N 66° 9.506	W 65° 39.690	N 66° 9.511	W 65° 39.697
GPS 2017 CULVERT #4	600	10.13	N 66° 9.607	W 65° 39.360	N 66° 9.612	W 65° 39.367
GPS 2017 CULVERT #5	600	7.62	N 66° 9.662	W 65° 39.140	N 66° 9.665	W 65° 39.146
LANDFILL CULVERT #1	600	8.84	N 66° 9.445	W 65° 40.125	N 66° 9.450	W 65° 40.134
LANDFILL CULVERT #2	600	8.84	N 66° 9.484	W 65° 39.988	N 66° 9.490	W 65° 39.997
METAL DUMP CULVERT #1	600	12.2	N 66° 9.496	W 65° 39.671	N 66° 9.502	W 65° 39.681
INF 2016 CULVERT #1	600	20.27	N 66° 9.199	W 65° 40.792	N 66° 9.205	W 65° 40.800
INF 2016 CULVERT #2	600	20.15	N 66° 9.232	W 65° 40.671	N 66° 9.237	W 65° 40.679
INF 2016 CULVERT #3	1200	16.86	N 66° 9.400	W 65° 40.121	N 66° 9.404	W 65° 40.130
INF 2016 CULVERT #4	600	20.61	N 66° 9.505	W 65° 39.695	N 66° 9.509	W 65° 39.701
INF 2016 CULVERT #5	750	21.01	N 66° 9.605	W 65° 39.358	N 66° 9.609	W 65° 39.366
INF 2016 CULVERT #6	450	22.59	N 66° 9.645	W 65° 39.209	N 66° 9.650	W 65° 39.218

* APPROXIMATE COORDINATE.

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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

No.	Issue	Date
A	ISSUED TO CLIENT FOR REVIEW	2018 APR 10
B	ISSUED TO CLIENT	2018 APR 19
	ISSUED TO CLIENT	2018 APR 26

LEGEND

- WATERCOURSE
- CULVERT DRAINAGE AREA
- EFFLUENT RIP RAP FIELD
- BUILDING
- INFRASTRUCTURE 2016 CULVERT
- GPS DATA 2017 CULVERT
- WWTP — WASTEWATER TREATMENT PLANT
- SURFACE WATER FLOW DIRECTION
- DIVERSION BERM
- DIVERSION DITCH

MONITORING STATIONS

PAN-2 RAW SEWAGE (TRUCK DISCHARGE)
PAN-3 TREATED WWTP EFFLUENT
PAN-4 RUN-OFF FROM SLUDGE DISPOSAL AREA
PAN-5 RUN-OFF FROM SOLID WASTE DISPOSAL FACILITY
PAN-6 RUN-OFF FROM METALS STORAGE AREA

No.	Revision	Date
0	FOR INFORMATION ONLY	2018 APR 19

FOR INFORMATION ONLY

Professional Seal(s)

Drawn By:	SAL/PD
Dwg Standards Ckd By:	
Designed By:	SAL
Design Checked By:	
Scale:	NOT TO SCALE

Project Title

HAMLET OF
PANGNIRTUNG, NU

Dwg. Title

EXISTING DRAINAGE PATTERN

Project No. FRE-00232735-A0

Dwg. No. **C-101** Rev. No. 0

Appendix B:
Leachate Sample Report

Memorandum

Project Name: Hamlet of Pangnirtung – Solid Waste Leachate Sample Summary	Project #: FRE-00232735-A0 /File No: 60.2
To: Jamie Evic	From: Daryl Burke
Date: February 11, 2021	
Subject: Pangnirtung Leachate Sample Summary	
Prepared By: Jack Piercy	
Distribution: Bhabesh Roy (GN), Daryl Burke (EXP)	

Background

In the Hamlet of Pangnirtung solid waste is deposited in two facilities, the Solid Waste Management Facility and the Metal and Hazardous Waste Storage Area. The Solid Waste Management Facility is divided into an area for domestic solid waste and another area for Geotube bags filled with sludge from the Wastewater Treatment Facility. As part of the Hamlet's water license, a monitoring program of the leachate from these facilities has been developed and the results must be reported annually. The monitoring program identifies three stations where leachate and run-off samples are to be taken and analyzed for the parameters listed in Schedule H of the Nunavut Water Board Type "A" Water Licence No. 3AM-PAN1828. The sample station PAN-4 is to monitor the sludge dumping area. Sample station PAN-5 is to monitor the domestic solid waste dumping area. Lastly, sample station PAN-6 is to monitor the Metal and Hazardous Waste Storage Area.

Purpose

The Hamlet of Pangnirtung has asked EXP services to review the quality of the runoff samples from the sludge disposal area, Solid Waste Management Facility, and Metal and Hazardous Waste Storage Area from monitoring stations PAN-4, PAN-5, and PAN-6, respectively. Analyzed sample results were provided and were compared to CCME water quality guidelines for the protection of aquatic marine life.

Discussion

Quality of the runoff from the sludge disposal area PAN-4, Solid Waste Management Facility PAN-5 and Metal and Hazardous Waste Storage Area PAN-6 can be found attached to this memo.

The pH is noted to be 6.51 and 6.47 for PAN-4 and 5 respectively. These are below the CCME guideline for the protection of Marine Aquatic life. The CCME narrative states that "*The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes.".* There is not enough data to comment on weather or not this pH level is a result of a natural process and as such must be considered to be outside the acceptable range recommended by CCME.

Cadmium levels in PAN-6's sample were found to be 0.000194 mg/L. This is above the CCME guideline for the protection of Marine Aquatic life of 0.00012mg/L.

Although the analysis for mercury for each site was less than the method detection limit (M.D.L), it should be noted that the CCME recommended limit is below that detectable amount of mercury. As such, no comment can be made on whether the three sampled mercury levels are above or below the CCME guidelines.

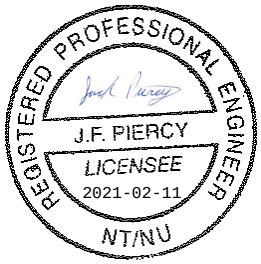
Phosphorus-Total was noted at all three sample locations. CCME does not have a numerical limit for Phosphorus, rather it references a guidance framework for the management of nutrients in nearshore marine systems. In the CCME guidance framework, fjords are a special case because of the greater variability in assimilation capacity among fjords and they recommend that *"likely most appropriate method for setting nutrient criteria for a fjord would be to use the historical data approach which does not require that a classification system be developed."* Historical data was not provided and as such no comment can be made on whether the three samples Phosphorus-Total levels are above or below the CCME guidelines.

Conclusion

The analyzed sample results of PAN-4, PAN-5 and PAN-6 were reviewed and compared with the CCME water quality guidelines for the protection of marine aquatic life. It was noted that the samples taken at PAN-4 and PAN-5 had PH Levels below the CCME guidelines. Additionally, the PAN-6 sample Cadmium levels were above the CCME guidelines limit.

Prepared by:

Jack Piercy, P.Eng.
Design Engineer
EXP Services Inc.



Certificate of Analysis
Final Report

Report To: **REPORT No. B20-22356**

Hamlet of Pangnirtung
P.O. Box 253,
Pangnirtung Nunavut X0A 0R0 Canada
Attention: Nancy Anilniliak
DATE SUBMITTED: 31/Jul/20
DATE REPORTED: 17/Aug/20
SAMPLE MATRIX: Leachate
Station Code: PAN-4

2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244
P.O. NUMBER:
WATERWORKS NO.:

			Client ID: **Sample ID:** **Date Collected:**		Sludge B20-22356-1 21-Jul-20	CCME Water Quality Guidelines for the Protection of Marine Aquatic Life	
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**			**Units**
Hardness (as CaCO3)	mg/L	1	SM 3120	04-Aug-20/O	7	-	
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	31-Jul-20/O	< 5	-	
pH @25°C	pH Units		SM 4500H	31-Jul-20/O	6.51	7-8.7 and Narrative*	
Conductivity @25°C	µmho/cm	1	SM 2510B	31-Jul-20/O	27	No Data	
Total Suspended Solids	mg/L	3	SM2540D	06-Aug-20/K	< 3	-	
Chloride	mg/L	0.5	SM4110C	04-Aug-20/O	3.8	NRG	
Nitrite (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	No Data	
Nitrate (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	200	mg/L
Sulphate	mg/L	1	SM4110C	04-Aug-20/O	1	No Data	
Aluminum	mg/L	0.01	SM 3120	04-Aug-20/O	0.16	No Data	
Arsenic	mg/L	0.0005	EPA 200.8	05-Aug-20/O	< 0.0005	0.0125	mg/L
Cadmium	mg/L	0.00007	EPA 200.8	05-Aug-20/O	< 0.000070	0.00012	mg/L
Calcium	mg/L	0.02	SM 3120	04-Aug-20/O	1.62	No Data	
Chromium	mg/L	0.002	SM 3120	04-Aug-20/O	0.002	No Data	
Cobalt	mg/L	0.005	SM 3120	04-Aug-20/O	< 0.005	No Data	
Copper	mg/L	0.002	SM 3120	04-Aug-20/O	0.005	No Data	
Iron	mg/L	0.005	SM 3120	04-Aug-20/O	0.29	No Data	
Lead	mg/L	0.0001	EPA 200.8	05-Aug-20/O	0.0002	No Data	
Manganese	mg/L	0.001	SM 3120	04-Aug-20/O	0.01	No Data	
Mercury	mg/L	0.00002	SM 3112 B	05-Aug-20/O	< 0.00002	0.000016	mg/L
Nickel	mg/L	0.01	SM 3120	04-Aug-20/O	< 0.01	No Data	
Potassium	mg/L	0.1	SM 3120	04-Aug-20/O	< 0.1	-	
Zinc	mg/L	0.005	SM 3120	04-Aug-20/O	0.017	Not assessed	
Ammonia (N)-Total	mg/L	0.01	NH3-H	05-Aug-20/K	< 0.01	No Data	
Phosphorus-Total	mg/L	0.01	E3199A.1	05-Aug-20/K	0.01	Guidnece Framework	
Phenolics	mg/L	0.002	MOEE 3179	06-Aug-20/K	< 0.002	No Data	
BOD(5 day)	mg/L	3	SM 5210B	05-Aug-20/K	< 3	-	
Total Organic Carbon	mg/L	0.2	EPA 415.2	31-Jul-20/O	6.8	-	
Oil & Grease-Total	mg/L	1	SM 5520	07-Aug-20/K	3.1	-	
Fecal Coliform	cfu/100mL	1	MOE E3371	31-Jul-20/O	47	No Data	
Benzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	110	µg/L
Toluene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	215	µg/L
Ethylbenzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	25	µg/L
Xylene, m,p-	µg/L	1	EPA 8260	05-Aug-20/R	< 1.0	No Data	
Xylene, o-	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	No Data	
Xylene, m,p,o-	µg/L	1.1	EPA 8260	05-Aug-20/R	< 1.1	No Data	
Toluene-d8 (SS)	% rec.		EPA 8260	05-Aug-20/R	96.2	-	
PHC F1 (C6-C10)	µg/L	50	MOE E3421	05-Aug-20/R	< 50	-	
PHC F2 (>C10-C16)	µg/L	50	MOE E3421	05-Aug-20/K	< 50	-	
PHC F3 (>C16-C34)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-	
PHC F4 (>C34-C50)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-	
Acenaphthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Acenaphthylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(a)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(a)pyrene	µg/L	0.01	EPA 8270	06-Aug-20/K	< 0.01	No Data	
Benzo(b)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(b+k)fluoranthene	µg/L	0.1	EPA 8270	06-Aug-20/K	< 0.1	-	
Benzo(g,h,i)perylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Benzo(k)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Chrysene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Dibenzo(a,h)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Fluorene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Methylnaphthalene,1-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Methylnaphthalene,2-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Naphthalene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	1.4	µg/L
Phenanthrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Terphenyl-d14 (SS)	% rec.	10	EPA 8270	06-Aug-20/K	110	-	

Notes:
* - CCME Narrative -The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

NRG = No recommended guideline.
- = Not on list of Canadian water quality guidelines for the protection of aquatic life.

Certificate of Analysis
Final Report

Report To: **REPORT No. B20-22369**

Hamlet of Pangnirtung

P.O. Box 253,
Pangnirtung Nunavut X0A 0R0 Canada
Attention: Nancy Anilniliak
DATE SUBMITTED: 31/Jul/20
DATE REPORTED: 17/Aug/20
SAMPLE MATRIX: Leachate
Station Code: PAN-5

2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244
P.O. NUMBER:
WATERWORKS NO.:

					Client ID:	Dump	CCME Water Quality Guidelines for the Protection of Marine Aquatic Life	
					Sample ID:	B20-22369-1		
					Date Collected:	21-Jul-20		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**				**Units**
Hardness (as CaCO3)	mg/L	1	SM 3120	05-Aug-20/O	7	-		
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	04-Aug-20/O	< 5	-		
pH @25°C	pH Units		SM 4500H	04-Aug-20/O	6.47	7-8.7 and Narrative*		
Conductivity @25°C	µmho/cm	1	SM 2510B	04-Aug-20/O	25	No Data		
Total Suspended Solids	mg/L	3	SM2540D	05-Aug-20/K	< 3	-		
Chloride	mg/L	0.5	SM4110C	04-Aug-20/O	3.6	NRG		
Nitrite (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	No Data		
Nitrate (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	200	mg/L	
Sulphate	mg/L	1	SM4110C	04-Aug-20/O	< 1	No Data		
Aluminum	mg/L	0.01	SM 3120	05-Aug-20/O	0.17	No Data		
Arsenic	mg/L	0.0005	EPA 200.8	05-Aug-20/O	< 0.0005	0.0125	mg/L	
Cadmium	mg/L	0.00007	EPA 200.8	05-Aug-20/O	< 0.000070	0.00012	mg/L	
Calcium	mg/L	0.02	SM 3120	05-Aug-20/O	1.92	No Data		
Chromium	mg/L	0.002	SM 3120	05-Aug-20/O	< 0.002	No Data		
Cobalt	mg/L	0.005	SM 3120	05-Aug-20/O	< 0.005	No Data		
Copper	mg/L	0.002	SM 3120	05-Aug-20/O	0.006	No Data		
Iron	mg/L	0.005	SM 3120	05-Aug-20/O	0.319	No Data		
Lead	mg/L	0.0001	EPA 200.8	05-Aug-20/O	0.0003	No Data		
Manganese	mg/L	0.001	SM 3120	05-Aug-20/O	0.013	No Data		
Mercury	mg/L	0.00002	SM 3112 B	06-Aug-20/O	< 0.00002	0.000016	mg/L	
Nickel	mg/L	0.01	SM 3120	05-Aug-20/O	< 0.01	No Data		
Potassium	mg/L	0.1	SM 3120	05-Aug-20/O	< 0.1	-		
Zinc	mg/L	0.005	SM 3120	05-Aug-20/O	0.027	Not		
Ammonia (N)-Total	mg/L	0.01	H	05-Aug-20/K	0.06	No Data		
Phosphorus-Total	mg/L	0.01	E3199A.1	05-Aug-20/K	0.01	Guidnece Framework		
Phenolics	mg/L	0.002	MOEE 3179	06-Aug-20/K	< 0.002	No Data		
BOD(5 day)	mg/L	3	SM 5210B	05-Aug-20/K	< 3	-		
Total Organic Carbon	mg/L	0.2	EPA 415.2	04-Aug-20/O	6.8	-		
Oil & Grease-Total	mg/L	1	SM 5520	07-Aug-20/K	1.5	-		
Fecal Coliform	cfu/100mL	1	MOE E3371	31-Jul-20/O	43	No Data		
Benzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	110	µg/L	
Toluene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	215	µg/L	
Ethylbenzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	25	µg/L	
Xylene, m,p-	µg/L	1	EPA 8260	05-Aug-20/R	< 1.0	No Data		
Xylene, o-	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	No Data		
Xylene, m,p,o-	µg/L	1.1	EPA 8260	05-Aug-20/R	< 1.1	No Data		
Toluene-d8 (SS)	% rec.		EPA 8260	05-Aug-20/R	95.5	-		
PHC F1 (C6-C10)	µg/L	50	MOE E3421	05-Aug-20/R	< 50	-		
PHC F2 (>C10-C16)	µg/L	50	MOE E3421	05-Aug-20/K	< 50	-		
PHC F3 (>C16-C34)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-		
PHC F4 (>C34-C50)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-		
Acenaphthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Acenaphthylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Benzo(a)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Benzo(a)pyrene	µg/L	0.01	EPA 8270	06-Aug-20/K	< 0.01	No Data		
Benzo(b)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Benzo(b+k)fluoranthene	µg/L	0.1	EPA 8270	06-Aug-20/K	< 0.1	-		
Benzo(g,h,i)perylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-		
Benzo(k)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-		
Chrysene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Dibenzo(a,h)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Fluorene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Methylnaphthalene,1-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-		
Methylnaphthalene,2-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-		
Naphthalene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	1.4	µg/L	
Phenanthrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data		
Terphenyl-d14 (SS)	% rec.	10	EPA 8270	06-Aug-20/K	109	-		

Notes:

* - CCME Narrative -The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

NRG = No recommended guideline.
- = Not on list of Canadian water quality guidelines for the protection of aquatic life.

Certificate of Analysis
Final Report

Report To: **REPORT No. B20-22368**

Hamlet of Pangnirtung
P.O. Box 253,
Pangnirtung Nunavut X0A 0R0 Canada
Attention: Nancy Anilniliak
DATE SUBMITTED: 31/Jul/20
DATE REPORTED: 17/Aug/20
SAMPLE MATRIX: Leachate
Station Code: PAN-6

2378 Holly Lane
Ottawa Ontario K1V 7P1
Tel: 613-526-0123
Fax: 613-526-1244
P.O. NUMBER:
WATERWORKS NO.:

			Client ID:		Metal Dump B20-22368-1	CCME Water Quality Guidelines for the Protection of Marine Aquatic Life	
			Sample ID:				
			Date Collected:		21-Jul-20		
Parameter	**Units**	**M.D.L.**	**Reference Method**	**Date/Site Analyzed**			**Units**
Hardness (as CaCO3)	mg/L	1	SM 3120	04-Aug-20/O	24	-	
Alkalinity(CaCO3) to pH4.5	mg/L	5	SM 2320B	31-Jul-20/O	26	-	
pH @25°C	pH Units		SM 4500H	31-Jul-20/O	7.3	7-8.7 and Narrative*	
Conductivity @25°C	µmho/cm	1	SM 2510B	31-Jul-20/O	73	No Data	
Total Suspended Solids	mg/L	3	SM2540D	06-Aug-20/K	< 3	-	
Chloride	mg/L	0.5	SM4110C	04-Aug-20/O	5.3	NRG	
Nitrite (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	No Data	
Nitrate (N)	mg/L	0.1	SM4110C	04-Aug-20/O	< 0.1	200	mg/L
Sulphate	mg/L	1	SM4110C	04-Aug-20/O	5	No Data	
Aluminum	mg/L	0.01	SM 3120	04-Aug-20/O	0.08	No Data	
Arsenic	mg/L	0.0005	EPA 200.8	05-Aug-20/O	< 0.0005	0.0125	mg/L
Cadmium	mg/L	0.00007	EPA 200.8	05-Aug-20/O	0.000194	0.00012	mg/L
Calcium	mg/L	0.02	SM 3120	04-Aug-20/O	7.79	No Data	
Chromium	mg/L	0.002	SM 3120	04-Aug-20/O	< 0.002	No Data	
Cobalt	mg/L	0.005	SM 3120	04-Aug-20/O	< 0.005	No Data	
Copper	mg/L	0.002	SM 3120	04-Aug-20/O	0.005	No Data	
Iron	mg/L	0.005	SM 3120	04-Aug-20/O	1.49	No Data	
Lead	mg/L	0.0001	EPA 200.8	05-Aug-20/O	0.0012	No Data	
Manganese	mg/L	0.001	SM 3120	04-Aug-20/O	0.065	No Data	
Mercury	mg/L	0.00002	SM 3112 B	05-Aug-20/O	< 0.00002	0.000016	mg/L
Nickel	mg/L	0.01	SM 3120	04-Aug-20/O	< 0.01	No Data	
Potassium	mg/L	0.1	SM 3120	04-Aug-20/O	0.4	-	
Zinc	mg/L	0.005	SM 3120	04-Aug-20/O	0.221	Not assessed	
Ammonia (N)-Total	mg/L	0.01	H	05-Aug-20/K	0.11	No Data	
Phosphorus-Total	mg/L	0.01	E3199A.1	05-Aug-20/K	0.03	Guidnece Framework	
Phenolics	mg/L	0.002	MOEE 3179	06-Aug-20/K	< 0.002	No Data	
BOD(5 day)	mg/L	3	SM 5210B	05-Aug-20/K	< 3	-	
Total Organic Carbon	mg/L	0.2	EPA 415.2	31-Jul-20/O	5.1	-	
Oil & Grease-Total	mg/L	1	SM 5520	07-Aug-20/K	2	-	
Fecal Coliform	cfu/100mL	1	MOE E3371	31-Jul-20/O	0	No Data	
Benzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	110	µg/L
Toluene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	215	µg/L
Ethylbenzene	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	25	µg/L
Xylene, m,p-	µg/L	1	EPA 8260	05-Aug-20/R	< 1.0	No Data	
Xylene, o-	µg/L	0.5	EPA 8260	05-Aug-20/R	< 0.5	No Data	
Xylene, m,p,o-	µg/L	1.1	EPA 8260	05-Aug-20/R	< 1.1	No Data	
Toluene-d8 (SS)	% rec.		EPA 8260	05-Aug-20/R	96.6	-	
PHC F1 (C6-C10)	µg/L	50	MOE E3421	05-Aug-20/R	< 50	-	
PHC F2 (>C10-C16)	µg/L	50	MOE E3421	05-Aug-20/K	< 50	-	
PHC F3 (>C16-C34)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-	
PHC F4 (>C34-C50)	µg/L	400	MOE E3421	05-Aug-20/K	< 400	-	
Acenaphthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Acenaphthylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(a)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(a)pyrene	µg/L	0.01	EPA 8270	06-Aug-20/K	< 0.01	No Data	
Benzo(b)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Benzo(b+k)fluoranthene	µg/L	0.1	EPA 8270	06-Aug-20/K	< 0.1	-	
Benzo(g,h,i)perylene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Benzo(k)fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Chrysene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Dibenzo(a,h)anthracene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Fluoranthene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Fluorene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Indeno(1,2,3,-cd)pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Methylnaphthalene,1-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Methylnaphthalene,2-	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	-	
Naphthalene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	1.4	µg/L
Phenanthrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Pyrene	µg/L	0.05	EPA 8270	06-Aug-20/K	< 0.05	No Data	
Terphenyl-d14 (SS)	% rec.	10	EPA 8270	06-Aug-20/K	107	-	

Notes:
* - CCME Narrative -The pH of marine and estuarine waters should fall within the range of 7.0 – 8.7 units unless it can be demonstrated that such a pH is a result of natural processes. Within this range, pH should not vary by more than 0.2 pH units from the natural pH expected at that time. Where pH is naturally outside this range, human activities should not cause pH to change by more than 0.2 pH units from the natural pH expected at that time, and any change should tend towards the recommended range.

NRG = No recommended guideline.
- = Not on list of Canadian water quality guidelines for the protection of aquatic life.

Appendix C:
EXP 2024 Site Visit Field Report and related Photographs

Field Report

2024 Site Visit re: Pangnirtung Drainage/ Seepage Monitoring and Maintenance Plan

Client:	**Government of Nunavut**	**Project No.:**	~~**FRN 24007043-A0**~~ FRE-00232735-A5
Project:	**Pangnirtung Airfield Rehabilitation**	**Date:**	**Sep 26, 2024**
Inspector:	**sebastien.brun**	**Weather:**	**Foggy / 6oC**

EXP was on site to document the current conditions at drainage/seepage monitoring locations PAN 4, 5 and 6, as well as the culverts bridging both sides of the roadway on September 26, 2024. The existing drainage plan is attached for reference. Photographs of the drainage/ seepage monitoring stations and signage are also attached.

INF 2016 CUL 3 was observed to have lots of garbage upstream and downstream of the culvert with water flowing through. The culvert seemed to be in good condition and no visible dip was noted in the roadway.

PAN-5 was located on the northwest side of the solid waste landfill, as per the signage on site. The culvert outlet was in good condition. Some garbage was seen downstream as well as an old steel culvert/pipe. The pipe inlet was buried in the landfill. No flow was seen coming out of the outlet.

PAN-4 was located on the northeast side of the solid waste landfill, as per the signage on site. The culvert outlet was in good condition. It is assumed that the inlet of the pipe was also buried in the landfill. The outlet was observed to be dry with some garbage downstream.

The PAN-6 culvert signage was located on the northwest side of the metals dump. EXP noted that there was no culvert at this location, only a swale in the berm of the metals dump. Significant flow was coming directly from the metals dump using the swale, then through a culvert under the roadway west of PAN-6, and downhill into the Fjord. Little amounts of garbage were observed downstream.

Another culvert was located east of the PAN-6 signage under the roadway. Lots of garbage was accumulated at the pipe inlet, possibly blocking potential flow. No dip was observed in the roadway.

INF 2016 Culvert #6 had some flow going through. Little to no garbage was observed at this location. The culvert itself was damaged at both the inlet and outlet.

Drone shots were taken of both the solid waste landfill and the metals dump. Ponded water was observed in the Metals dump at the northwest corner and on the south side.

Recommendations

EXP recommends that ongoing site maintenance include regular inspections and clearing of garbage from ditches and relocation to the respective landfill and metals dump disposal areas. The fence on the east side of the landfill is broken and could be a source of some of the windblown garbage and should be repaired. If required, ditches should be regraded to eliminate the potential for water pooling in perimeter drainage ditches.

Signature of Site Inspector

EXP Services Inc 555 Mapleton Road Moncton, NB 506.857.8889
• www.exp.com

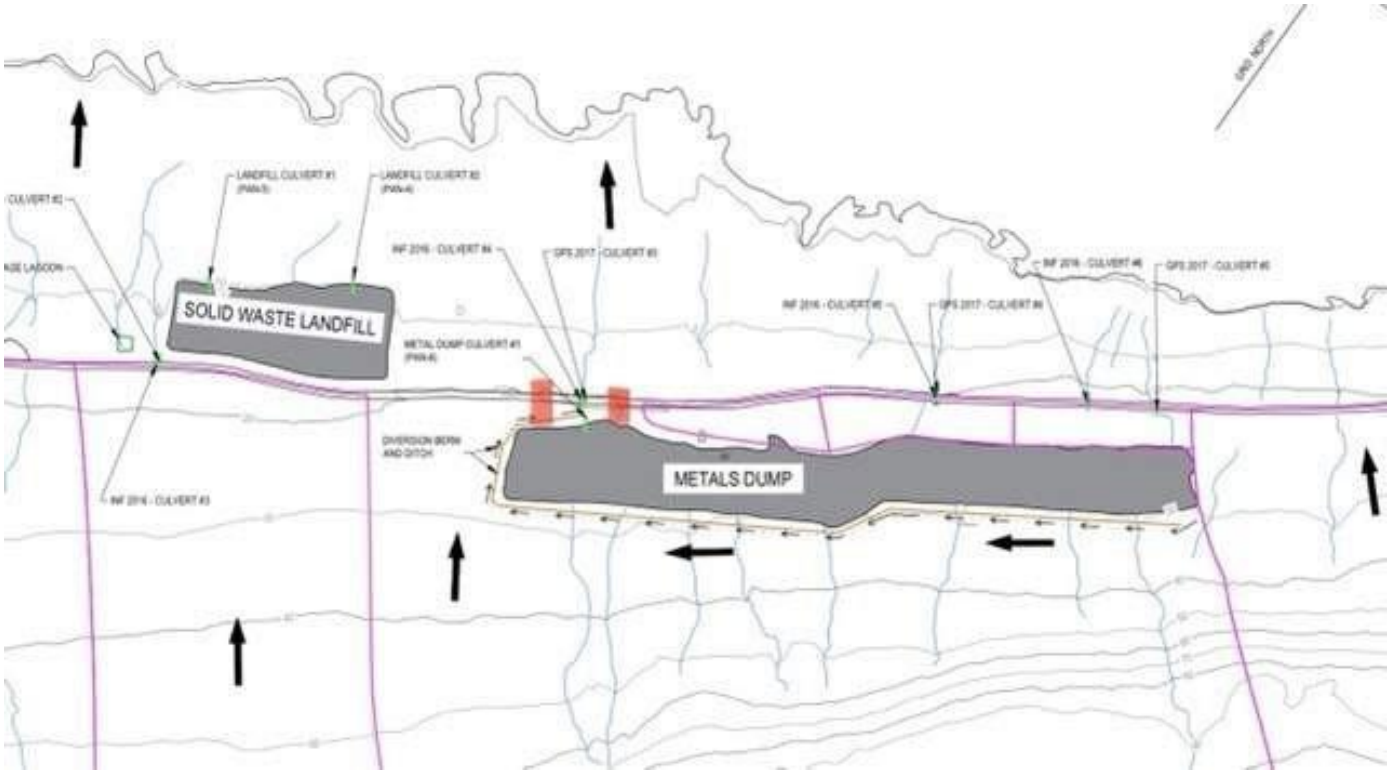


Photo 1: Existing Drainage Plan

Photo 2: PAN-4 Outlet

Photo 3: PAN-5 Outlet

Photo 4: PAN-6 (downstream)

PAN-4 Sign

PAN-5 Sign

PAN-6
Sign

Appendix D:
Drainage/ Seepage Sample Bottle Requirements

Drainage/ Seepage Leachate Sample Bottles

Leachate Samples Bottles Include:

1. Red cap for Metals bottle, HNO_3 Nitric Acid preservative
2. 125 mL amber for Phenolics, H_2SO_4 Sulphuric Acid preservative
3. Round 250 mL plastic for Bacteria, $Na_2S_2O_3$ Sodium thiosulfate preservative to offset effects of chlorination
4. 2 x 500 mL clear plastic (for BOD and TSS and rest of general chemistry), no preservative
5. 2 Yellow cap (one for ammonia and the second for TOC), H_2SO_4 Sulphuric Acid preservative

Appendix E:
Chain of Custody Example

GENERAL SAMPLE SUBMISSION FORM

CADUCEON ENVIRONMENTAL LABORATORIES
Client committed. Quality assured. Proudly Canadian.

SAMPLES SUBMITTED TO:

Kingston	
Ottawa	X
Richmond Hill	
Barrie	
Windsor	

TESTING REQUIREMENTS

	O'Reg 153/04	Table (1 - 9)		Record of Site	
	O'Reg 406/19	Table (1 - 9.1)		SPLP Table (1-9.1)	
	RPI		ICC		Agricultural
	Coarse		Medium/Fine		O'Reg 558 TCLP
	MISA		PWQO		Landfill Monitoring
	Other:				

REPORT NUMBER (Lab Use)

Are any samples to be submitted intended for Human Consumption under any Drinking Water Regulations? ☐ Yes ☐ No (If yes, submit all Drinking Water Samples on a Drinking Water Chain of Custody)

Organization: Munnicipality og Pangnirtung	Address: PO Boc 253 Pangnirtung X0A 0R0	Invoicing Address (if different):
Contact: SOA Jack Hicks		
Tel: 867-473-8953 / Fax:		
Email:	Quote #: Q4370	Project Name or #:
Additional Info (email, cell, etc): sao@pangnirtung.ca	P.O. #:	Additional Info:

ANALYSES REQUESTED

Leachate Package | Suspected Highly Contaminated

TURNAROUND SERVICE REQUESTED (see back page)

*Must be arranged in advance

	Platinum*	200% Surcharge
	Gold*	100% Surcharge
	Silver	50% Surcharge
	Bronze	25% Surcharge
X	Standard	
	Specific Date:	

* Sample Matrix Legend: WW=Waste Water, SW=Surface Water, GW=Groundwater, LS=Liquid Sludge, SS=Solid Sludge, S=Soil, Sed=Sediment, PC=Paint Chips, F=Filter, Oil = Oil

Lab No.	Sample Source and/or Sample Identification	WaterTrax (SPL)	Sample Matrix *	Date Collected (yy-mm-dd)	Time Collected	Indicate Test For Each Sample By Using A Check Mark In The Box Provided	X	Field pH	Field Temp.	# Bottles/ Sample	Field Filtered Y/N
	PAN-4		Leachate			X					
	PAN-5		Leachate			X					
	PAN-6		Leachate			X					

SAMPLE SUBMISSION INFORMATION

	Sampled by:	Submitted by:
Print:		
Sign:		
	Date (yy-mm-dd)/Time:	Date (yy-mm-dd)/Time:

SHIPPING INFORMATION

After Hours Drop Off		Drop Off	
Courier (Client account)			
Courier (Caduceon account)		# of Pieces	
Caduceon (Pick-up)			

REPORTING

XLSX	
XLSX / CofA Guideline	
CSV	
ESdat	

SAMPLE RECEIVING INFORMATION (LABORATORY USE ONLY)

Received By (print):		Signature:	
Date Received (yy-mm-dd):		Time Received:	
Laboratory Prepared Bottles: ☐ Yes ☐ No			
Sample Temperature °C:		Labeled by:	

Comments:

Page ____ of ____

G

Nunavut Water Board Licence No: 3AM-PAN1828 Leachate Package Includes:

Effluent (E):

- pH
- Conductivity (uS/cm)
- Temperature (deg. C)
- Total Suspended Solids (TSS) (mg/L)
- Biochemical Oxygen Demand (mg/L)
- Fecal Coliform (CFU/100 mL)
- Nitrate-Nitrite (mg/L)
- Ammonia Nitrogen (mg/L)
- Sulphate (mg/L)
- Chloride (mg/L)
- Total Hardness (mg/L)
- Total Alkalinity (mg/L)
- Total Phenols (mg/L)
- Total Organic Carbon - TOC (mg/L)

ICP Metals Scan (Total) (Me):

- Aluminum (Al) - mg/L
- Arsenic (As) - mg/L
- Calcium (Ca) - mg/L
- Cadmium (Cd) - mg/L
- Cobalt (Co) - mg/L
- Chromium (Cr) - mg/L
- Copper (Cu) - mg/L
- Iron (Fe) - mg/l
- Mercury (Hg) - mg/L
- Potassium (K) - mg/L
- Magnesium (Mg) - mg/L
- Sodium (Na) - mg/L
- Nickel (Ni) - mg/L
- Lead (Pb) - mg/L
- Zinc (Zn) - mg/L