MEMO

TO:	City of Iqaluit, CO Alan Rustom, Colliers Project Leaders
FROM:	Keith Barnes, P.Eng.
cc:	Scott Kyle, P.Eng., Kyle MacIntyre, P.Eng., Matt Balcombe, P.Eng.,Christopher Shortall, P.Eng., Helen Langille, P.Eng.
DATE:	October 2, 2020
SUBJECT:	July 2020 Regulator (ECCC/CIRNAC) Comments - Responses
OUR FILE:	19-9543

Dillon Consulting (Dillon) is currently engaged to provide detailed design services to the City of Iqaluit (the City) for a new landfill facility as well as a waste transfer station and leachate treatment system.

This memo is a response to comments received September 17, 2020 from Environment and Climate Change Canada (ECCC), Crown-Indigenous Relations and Northern Affairs Canada (CIRNAC) regarding Nunavut Water Board (NWB) water license application #3AM-IQA1626 design package as submitted in January 2020.

A table summarizing the commitments status as of September 17 are attached in **Addendum A – Regulator Commitments Status, 2 October 2020**.

The commitment response document is attached in **Appendix B – Regulator Commitments Response Package, 2 October 2020**.

APPENDIX A
Regulator Commitments Status
2 October 2020

October 2, 2020 List of Commitments Response to

Technical Meeting (TM) September 17, 2020 Held in Relation to

An Application to Amend Water Licence No. 3AM-IQA1626

Commitment #	Document/Topic Category	Party Responsible for Commitment	Party(s) who raise item	Comment # in Letter	Recommendations	City of Iqaluit Response	Intervener Reply and Follow-Up Questions	Suggested Form of Submission	Timeline for Submission	Status (October 2)	Location in Appendix B
ECCC											
1	Baseline Monitoring	City of Iqaluit	ECCC	1	ECCC recommends that the proponent: Provide raw and summarized data (including field results, laboratory reports, a tabulated summary, and a comparison of monitored parameters to relevant guidelines) for the baseline conditions assessment of the Waste Transfer Station and landfill conducted by Dillon Consulting in 2019; and Show how the baseline information has been used and incorporated into design/mitigation as needed.	The City of Iqaluit's response indicates that information will be included in the 100 % submission.	ECCC requests that the City provide the outstanding information (see column 1) for review.	Updated Facility Monitoring Plan Document	Document update provided by October 2, 2020	Complete	Pages 1 - 146
2	Unbaled Waste	City of Iqaluit	ECCC	2	ECCC recommends that: The proponent identify measures to ensure the containment of unbaled C&D debris and any unbaled MSW within the landfill cell. Contingency measures, such as potential cover sources, should be available to ensure containment of unbaled waste in the event of any extended or	The City of Iqaluit's response document indicates that text reflecting this comment has been added to Sections 8.3.1 and 9.1 of the Operations & Maintenance Manual.	ECCC requests that the City provide the updated Sections 8.3.1 and 9.1 of the Operations and Maintenance Manual for review.	Provide updated Sections 8.3.1 and 9.1 of the Operations and Maintenance Manual	Document update provided by October 2, 2020	Complete	Pages 147 – 149

					recurring operational issues at the Waste Transfer Station. The proponent conduct an evaluation of the durability of the baled wastes’ plastic cover, which should include a discussion of alternative cover methods.						
3	Acid Rock Drainage/Metal Leaching (ARD/ML)	City of Iqaluit	ECCC	3	ECCC recommends that the proponent sample project borrow source locations in order to identify any Acid Rock Drainage/Metal Leaching potential that could affect water quality. Testing should be completed using static and kinetic methods to characterize representative units. ECCC recommends that the proponent should avoid quarry/units that are determined to have ARD/ML potential.	N/A	ECCC suggests this recommendation could be resolved by a license condition, or by inclusion of this item in a quarry plan.	City of Iqaluit to request license condition	Commitment to be provided by City of Iqaluit	License Condition to be requested	Referenced on Page 149
4	Leachate treatment – Landfill	City of Iqaluit	ECCC	4	ECCC recommends that the proponent identify treatment options beyond the existing system, and determine the lead-time needed to install and commission the treatment system.	N/A	ECCC suggests this recommendation could be resolved by inclusion of a licence condition that requires the City of Iqaluit to (1) characterize the leachate and (2) submit a treatment plan for Board approval.	City of Iqaluit to request license condition	Commitment to be provided by City of Iqaluit	Complete	Page 150 - 152
5	Leachate retention ponds	City of Iqaluit	ECCC	5	ECCC requests that the City describe how volumes of effluent and precipitation would be managed under a potential high precipitation scenario (i.e., annual increase of 9 percent over baseline climate) during the first 2 years of operations.	The City of Iqaluit’s response document states that to account for a 9% increase over baseline conditions [i.e., the upper range precipitation projection scenario], storage volume of the [leachate retention] lagoons will have to be increased from 11,000m3 to 14,000m3.	ECCC requests that the City provide the outstanding information (see column 1) for review.	Provide updated lagoon detail drawing	Provide updated drawing by October 9	Drawing to be provided by October 9	Referenced on Page 153
6	Groundwater	City of Iqaluit	ECCC	6	ECCC recommends that the proponent revise the Environmental Protection Plans [i.e., EPP-Construction Phase; and EPP-Operations, Closure and Post-Closure Phases] to	The City of Iqaluit’s response indicates that this information will be included in the 100 % submission.	ECCC requests that the City provide the outstanding information (see column 1) for review.	Provide updated EPP-Construction Phase, EPP-Operations,	Provide updated documents by October 2	Complete	Page 154-157

					include groundwater as an environmental consideration for this project.			Closure, and Post-Closure Documents			
7	Environmental Protection Plans, Section 4.0 – Mitigation measures tables	City of Iqaluit	ECCC	7	ECCC recommends that the mitigation measures tables located in Section 4.0 of both Environmental Protection Plans (EPPs) each include a measure specifying that erosion and sediment control activities be conducted in accordance with the Erosion and Sediment Control Plan.	The City of Iqaluit's response document indicates that Section 4.0 of both Environmental Protection Plans (EPP-C, EPP-O) have been updated as requested.	ECCC requests that the City provide the updated Section 4.0 for both Environmental Protection Plans (i.e., EPP-Construction Phase; and EPP-Operations, Closure and Post-Closure Phases) for review.	Provide updated Section 4.0 of EPP-C and Section 4.0 of EPP-O documents	Provide updated documents by October 2	Complete	Page 158-172
8	Environmental Protection Plans, Section 5.0 (Monitoring and Inspection)	City of Iqaluit	ECCC	8	ECCC recommends that the proponent submit the monitoring and inspection sections of the Environmental Protection Plans [i.e., EPP-Construction Phase; and EPP-Operations, Closure and Post-Closure Phases] prior to commencement of construction.	The City of Iqaluit's response document indicates that the Monitoring and Inspection section of the Construction Phase EPP document has been updated accordingly. The intent of Recommendation 8 is that the monitoring and inspection sections (i.e., Section 5.0) of both Environmental Protection Plans (i.e., EPP-Construction Phase; and EPP-Operations, Closure and Post-Closure Phases) be submitted prior to commencement of construction. The City's response indicates that only the Construction Phase EPP document has been updated.	ECCC requests that the City: Submit the updated monitoring and inspection section (i.e., Section 5.0) of the Environmental Protection Plan – Construction Phase document for review; and Update and submit the monitoring and inspection section (i.e., Section 5.0) of the Environmental Protection Plan – Operations, Closure and Post-Closure Phases document for review.	Provide updated Section 5.0 of the EPP-C and Section 5.0 of the EPP-O documents	Provide updated documents by October 2	Complete	Page 154-157
9	Total Suspended Solids	City of Iqaluit	ECCC	9	ECCC recommends that the proponent: Conduct sediment monitoring in relation to any project disturbances in or near water (e.g., in-stream construction); and Conduct TSS/turbidity monitoring routinely during in-stream works, and identify thresholds and accompanying management actions in advance of such in-stream works.	The City of Iqaluit's response document indicates that Section 4.3 of the Erosion and Sediment Control Plan document has been updated accordingly.	ECCC requests that the City provide the updated Section 4.3 of the Erosion and Sediment Control Plan for review.	Provide updated Section 4.3 of the Erosion and Sediment Control	Provide updated documents by October 2	Complete	Page 173-174

10	Visual Monitoring	City of Iqaluit	ECCC	10	ECCC recommends that the proponent increase the frequency of visual monitoring during and following freshet and major rainfall events, particularly with respect to monitoring for signs of erosion and	The City of Iqaluit's response document indicates that this will be included in the 100 % submission.	ECCC requests that the City provide the outstanding information (see column 1) for review.	Provide updated Facility Monitoring Plan	Provide updated documents by October 2	Complete	Page 175
11	Landfill surface monitoring	City of Iqaluit	ECCC	11	ECCC recommends that the proponent add TSS and phenols to the surface water monitoring parameters listed in Section 3.5.1 (Surface Water Monitoring Plan) of the Facility Monitoring Plan.	The City of Iqaluit's response document indicates that this will be included in the 100 % submission	ECCC requests that the City provide the outstanding information (see column 1) for review.	add TSS and phenols to the surface water monitoring parameters listed in Section 3.5.1 of the Facility Monitoring Plan	Provide updated document by October 2	Complete. Now Section 3.4.1 due to editing.	Page 176-177
12	Groundwater Monitoring	City of Iqaluit	ECCC	12	ECCC recommends that the proponent: Include the monitoring of dissolved metals, in addition to total metals, for groundwater samples; and Incorporate a description of how the groundwater monitoring results will be assessed (for example, compare results to baseline sample concentrations, applicable license requirements and recognized groundwater guidelines) into Section 3.7 (Active Layer Groundwater Monitoring) of the Facility Monitoring Plan.	The City of Iqaluit's response document indicates that this will be included in the 100 % submission.	ECCC requests that the City provide the outstanding information (see column 1) for review.	Provide updated Section 3.7 of the Facility Monitoring Plan	Provide updated documents by October 2	Complete Now Section 3.6 due to editing.	Page 178-179
13	Effluent discharge	City of Iqaluit	ECCC	13	ECCC recommends that the proponent characterize the effluent to determine compatibility with the wastewater treatment process prior to transporting effluent to the City's Waste Water Treatment Plant (WWTP). The proponent may need to implement alternative small-scale treatment if effluent quality would render the options	The City of Iqaluit's response document indicates that Section 12.2 of the Operations and Maintenance Manual and Section 3.9 of the Facility Monitoring Plan have been updated accordingly.	ECCC requests that the City provide the updated Section 12.2 of the Operations and Maintenance Manual and the updated Section 3.9 of the Facility Monitoring Plan for review.	provide updated Section 12.2 of the Operations and Maintenance Manual and updated Section 3.9 of the Facility Monitoring Plan	Provide updated documents by October 2	Complete. Due to revisions the relevant section is now 3.7.	Page 150 – 152 and Page 180-181

					discussed unacceptable.						
14	Leachate Management – Landfill	City of Iqaluit	ECCC	14	ECCC recommends that the proponent: Provide details for assessing landfill leachate/effluent characteristics; and Include a summary in the annual report of the landfill leachate management system, including leachate generation rates, leachate/effluent characteristics, holding pond capacity, and an update on leachate management/treatment.	The City of Iqaluit's response document indicates that Section 12.2 of the Operations and Maintenance Manual has been updated accordingly.	ECCC requests that the City provide the updated Section 12.2 of the Operations and Maintenance Manual for review.	provide updated Section 12.2 of the Operations and Maintenance Manual	Provide updated document by October 2	Complete	Page 150 – 152 and Page 182-184
15	Leachate Management – Waste Transfer Station	City of Iqaluit	ECCC	15	ECCC recommends that the proponent: Provide secondary containment for the leachate holding tank; Characterise the WTS leachate to determine compatibility with the wastewater treatment process prior to transporting leachate to the City's WWTP; Track the WTS leachate generation rates/volumes and treatment/disposal details; and Report the WTS leachate generation rates/volumes, treatment/disposal details, and characterization results in the annual report.	The City of Iqaluit's response document indicates that Section 12.1 and Section 14.0, item 10 of the Operations and Maintenance Manual have been updated accordingly.	ECCC requests that the City provide the updated Sections 12.1 and 14.0 of the Operations and Maintenance Manual for review.	Provide updated Section 12.1 and Section 14.0 of the Operations and Maintenance Manual	Provide updated document by October 2	Complete	Page 150 – 152 and Page 185-187
16	Liner installation timing and planning	City of Iqaluit	ECCC	16	ECCC recommends that the proponent provide in the Annual Report: An update on the capacity of the landfill cell currently in use, including the installation timing calculation (inputs and result); and Discuss the required actions/schedule for the design	The City of Iqaluit's response to this recommendation states "Refer to Section 14.0, item 7 of the Operations and Maintenance Manual". ECCC notes that, although Section 14.0, item 7 of the O&M manual discusses the landfill cell liner installation, it does not indicate whether the items listed in this	ECCC suggests that the licence include a condition under the annual reporting requirements for (1) an update as outlined in the first bullet of the recommendation [i.e., an update on the capacity of the landfill cell currently in use, including the installation timing	City of Iqaluit to request license condition	City of Iqaluit to request license condition	License condition to be requested by City of Iqaluit	Referenced on Page 188

					and installation of the next lined disposal area in the sequence.	recommendation will be included in the annual report.	calculation (inputs and result)], and (2) a brief status report on the requirements for the next disposal area in the sequence.				
17	New Technology/ Lessons Learned	City of Iqaluit	ECCC	17	ECCC recommends that the proponent: • Identify and describe measures to prevent/mitigate the challenges described (i.e., substantial volumes of poor quality leachate, and down time during mechanical breakdowns and for maintenance), and discuss their anticipated effectiveness; • Describe how the effectiveness of these prevention/mitigation measures will be monitored; and • Document lessons-learned to inform subsequent stages of construction and operation.	As baling of municipal solid waste is not a proven technology for Canada's arctic environment, it is important to proactively identify and address potential new challenges/ issues at the outset of the project, to the extent possible. ECCC notes that the baling facility located in Yellowknife has been experiencing ongoing challenges, including generation of substantial quantities of poor quality leachate, management and disposal of leachate, and challenges with operation of the machinery including down time for repairs and maintenance. It would be prudent to consider whether such issues could occur at the City of Iqaluit's planned baling operations.	ECCC requests that the City provide the outstanding information (see column 1) for review. ECCC suggests that the Proponent contact the City of Yellowknife to see if there are common elements in the proposed system that may lead to problems. ECCC can provide the City of Iqaluit with contact information for the City of Yellowknife's Manager of Sustainability and Solid Waste.	Provide updated Operations and Maintenance Manual Section Provide notes from City of Yellowknife to be provided by the City of Iqaluit	Provide updated OMM by October 2 City of Iqaluit to commit to providing notes of meeting with City of Yellowknife	Updated OMM completed. Currently working on scheduling with involved parties.	Page 185-187 and Page 189-250 and 251-252
CIRNAC											
18	Reclamation of the West 40 Landfill	City of Iqaluit	CIRNAC	1	CIRNAC recommends the City provide an update on plans for reclaiming the West 40 landfill including: ▪ An estimated schedule for reclamation work; and ▪ details on site drainage, including where all the ditches would be on the decommissioned site, their drainage directions and how they connect with the offsite retention pond	This is outside the scope of the detailed design process and will be addressed by the City of Iqaluit and/or AECOM. AECOM Response: The date of closure of the West 40 Landfill is dependent on the schedule for the new landfill. The West 40 Landfill will not be closed until the new landfill and transfer Station are commissioned and fully operational. The landfill is currently filling to a proposed final design elevation that has been developed to provide the City with disposal capacity until the new facilities are operational. As of the 2019 projections it appears that the landfill has capacity until sometime in 2022/23. The landfill has just completed a 2020 survey and is	OK – Resolved. CIRNAC recommends that an amended licence include a condition for the applicant to provide the final closure design report one year prior to reclamation work being undertaken. Additionally, we suggest the plan be provided within one year of closure of the West 40 landfill.	OK – Resolved.	OK – Resolved.	N/A	Referenced on Page 253

						in the process of evaluating the remaining airspace and therefore determining site life. As is the normal practice, a final closure design and closure report will not be developed until the landfill is in fact closed. A final design cannot be developed until the final fill elevations and contours are realized. The final closure report and design will address final landform shape, final slopes, final cover design, surface water drainage and controls, and long term monitoring and maintenance requirements.					
19	OMM	City of Iqaluit	CIRNAC	2	CIRNAC recommends the applicant provide rationale for not controlling leachate and contact water from the bale storage area at the waste transfer station.	Drawings will be revised to include asphalt pad, asphalt curbing to control runon and runoff, and the sump.	CIRNAC to confirm this is included in 100% drawings – request timeline for submission.	Provide updated drawings of proposed bale storage area changes	Provide updated drawings by October 9	Updated drawings to be provided by October 9	Referenced on Page 253
20	OMM	City of Iqaluit	CIRNAC	2	Additionally, they should explain how they will ensure proper drainage at the waste transfer treatment site with such small grades.	See comment 45.		Provide updated drawings of site drainage changes	Provide updated drawings by October 9	Updated drawings to be provided by October 9	Referenced on Page 253
21	Landfill Leachate Treatment	City of Iqaluit	CIRNAC	3	CIRNAC recommends the applicant clarify what the current position is for treating landfill leachate, their plan for collecting the necessary data for an informed decision, and the factors that will control their decision.	As outlined in the Operations and Maintenance Manual, the approach to leachate management will be to hold it for up to two years in new engineered lagoons. Routine samples will be taken by the City and the data reviewed by Dillon. If untreated leachate at the outlet of the second holding pond is found to exceed discharge limits set by the NWB, then additional treatment will be designed and installed. The nature of additional treatment technology will depend on the parameters in exceedance, but are expected to be met with the addition of aeration to the lagoons, metal precipitation and filtration.	Three options are discussed for discharging the ponds: · Transporting effluent to the West 40 landfill; · Transporting effluent to the City's wastewater treatment plant; and · Controlled release of effluent to a gravel bed diffuser or treatment in a wetland. Based on the response and discussions in the Technical Meeting, it is still not clear: **Which leachate treatment option was chosen? Will leachate be discharged to the environment?** CIRNAC recommends the applicant monitor and report on the leachate, before the	Original comment included in response document on Page 254	City of Iqaluit to request license condition	Comment provided in response.	Page 254

							ponds become full. This could be included in a management plan or as a licence condition. Monitoring of both quantity and quality should be done throughout the open water season, with results reported and analyzed every year for at least the first 5 years. If results indicate the need for water treatment, choice of methodologies and their implementation should occur within one year.			
22	Landfill leachate collection, Design Drawings (90%)	City of Iqaluit	CIRNAC	4.1	provide more detail on leachate collection pipes including: ▪ Showing leachate piping intended for Cell 1 in detail and providing conceptual layout for piping for the remaining cells; ▪ Providing details in the drawings for piping diameter, perforation and clean out/inspection access (if any); ▪ Providing details on whether leachate piping would be placed on cell floor or within leachate collection trenches; and ▪ Providing evidence to demonstrate how the leachate pipe will not be deformed under waste loading	The leachate collection piping in the cells has been removed due to the assumption that the waste mass and underlying granulars will freeze along with any piping in the granulars. An 8 m wide strip, reduced to 4 m for the 100% submission will allow leachate to run off of or percolate through the baled material and exist into the 4 m strip. The leachate can then flow to the leachate collection sump for pumping out to the leachate lagoons.	The explanation is hard to interpret without a drawing showing new concept of leachate collection. The responses seem to indicate leachate will still flow to sumps from cells far away from those sumps, and it is unclear: **How will this work once landfill is closed?** CIRNAC to confirm this is included in 100% drawings – request timeline for submission.	Provide updated drawings of leachate system	Updated drawings to be provided by October 9	Updated drawings to be provided by October 9	Referenced on Page 254
23	Landfill leachate collection, Design Drawings (90%)	City of Iqaluit	CIRNAC	4.2	provide information on the leachate sumps including: ▪ More detail on design intent for leachate sump in each cell once the cells are at capacity; and ▪ An explanation on the choice of manholes to lower pumps into the sump.	The sump in Cell 1 will be removed and the berm between Cell 1 and 4 removed so leachate from Cells 1 to 6 will flow to the Cell 4 sump. When a cell that has a sump is closed the manhole in the sump will be extended through the cap allowing for leachate to be removed via pumping from the sumps in subsequent cells.	The key concern is a low point in which leachate can accumulate remaining after sump or manhole removal. The concept of Cell 1 connection into Cell 4 is clear from the answer provided, but it is unclear: H**ow will the sump be “removed”?**	Provide updated drawings of the leachate sumps	Provide updated drawings by October 9	Updated drawings to be provided by October 9	Referenced on Page 254

							CIRNAC to confirm this is included in 100% drawings – request timeline for submission.				
24	Landfill leachate collection, Design Drawings (90%)	City of Iqaluit	CIRNAC	4.3	provide more information on the liner system including: ▪ Thermal or settlement slack in the geomembrane placement requirements; and ▪ Details on the proposed geotextile.	Technical Specifications Section 33 47 14 Geomembranes, Clause 3.4 requires the Contractor to prepare and submit a thermal compensation plan. Technical Specifications Section 31 32 21 provides minimum requirement details for proposed geotextiles Type A, Type B, and Type C.	The Technical Specifications referred to in the response are not available for review. The response for thermal slack is satisfactory, but without the specifications, the department cannot comment on the geotextile. The department recommends that the thermal compensation plan be submitted for approval prior to construction.	Provide updated Technical Specifications Section 33 47 14 and Section 31 32 21	Provide updated documents by October 2	Completed	Page 255-278
25	Landfill leachate collection, Design Drawings (90%)	City of Iqaluit	CIRNAC	4.4	CIRNAC recommends the applicant provide clarification in design intent for Cell 10 leachate collection to ensure all leachate from Cells 10, 11 and 12 can be removed.	Grades have been reviewed.	The grades been reviewed. **Have they been revised? If so, how?** CIRNAC to confirm this is included in 100% drawings – request timeline for submission.	Provide updated grading drawings	Provide updated drawings by October 9	Updated drawings to be provided by October 9	Referenced on Page 279
26	Surface water management at landfill, Design Drawings (90%)	City of Iqaluit	CIRNAC	5.1	CIRNAC recommends the applicant provide details on surface water ditching on north side of Cell 1 to convey drainage around the bermed area.	A profile section of this ditch has been added to drawing C08.	CIRNAC to confirm this is included in 100% drawings – request timeline for submission.	Provide updated detail drawings of the Cell 1 drainage around the bermed area	Provide updated drawings by October 9	Updated drawings to be provided by October 9	Referenced on Page 279
27	Surface water management at landfill, Design Drawings (90%)	City of Iqaluit	CIRNAC	5.2	CIRNAC recommends the applicant provide information on the stormwater berm in Cell 1. Specifically, if the berm is temporary, information should be provided in the drawings on the design intent for removal of the berm. If the berm is permanent, then information should be provided on how filling of bales should occur at the berm location.	A note has been added to the relevant drawings indicating the berm is temporary and to be removed by the Owner prior to waste being placed in that location.	OK – Resolved.	Resolved.	Resolved.	Resolved	Referenced on Page 279
28	Surface water management at	City of Iqaluit	CIRNAC	5.3	CIRNAC recommends the applicant provide rationale for why erosion control features were not deemed necessary in the following areas:	On the west side of the west road the grade slopes to the west, and the northern most sediment trap on the east side would capture that	The applicant provided sufficient rationale regarding	Provide updated surface water	Provide updated drawings by October 9	Updated drawings to be	Referenced on Page 279

	landfill, Design Drawings (90%)				▪ Sediment traps along west side of west access road and along south side of south access road; and ▪ Fibre rolls and silt fence on both sides of Leachate lagoon road.	flow. The area to the south of the south road is higher than the ground to the north. Two sediment traps will be added to the south side of the road.	the sediment traps. Please clarify: **Rationale for why erosion control features were not deemed necessary in the fibre rolls and silt fence on both sides of Leachate lagoon road.** **Whether flow from west ditch on west access road is designed to flow into northernmost sediment trap.**	management drawing		provided by October 9	
29	Fencing, Design Drawings (90%)	City of Iqaluit	CIRNAC	6	CIRNAC recommends the applicant provide clarification on where fencing and gates are to be installed and, if no fencing is planned around the landfill site, provide details on how wildlife and general public will be restricted from access.	Fencing is to be installed at the toe of the leachate lagoons berms. Fencing is to be installed initially around Cell 1, and will be moved and extended as the landfill expands. A gate is located on the western side connecting to the berm that separates the two lagoons.	The response provided by the applicant indicates where fencing will be installed, but does not fully address the question of site security and wildlife deterrents. CIRNAC recommends that site access be addressed in the Operation and Maintenance Plan or Manual, specifically: **What are the procedures for gate closures?** **How will wildlife and general public be restricted from access?** **What will be the response procedures if public/wildlife accesses the site?**	Provide updated Operation and Maintenance Manual Section 2.1.2 – Site Security	Provide updated documents by October 2	Complete	Page 280-281
30	Permafrost, MSC, FMP, OMM	City of Iqaluit	CIRNAC	7.1	CIRNAC recommends the applicant describe what construction methodologies will be used to minimize impact on permafrost of construction activities. Additionally, they should provide a basis for the design approach recognizing the geotechnical and permafrost conditions that exist at the landfill site.	This is documented in the Wood Geothermal Modelling and Geotechnical Recommendations report dated May 2019 and is included in the 100% package.	CIRNAC to confirm this is included in 100% drawings – request timeline for submission. The Wood report does not describe the construction methodologies that will be used to minimize impact on permafrost (mitigate	Provide comment by October 2	Provide comment by October 2	Complete	Page 282

							permafrost degradation) due to proposed construction activities at the WTS, Landfill and Access Road. The Wood report is entirely silent on the design, construction, and approach for mitigating permafrost degradation along the Access Road. So, the reviewer referred to The Method Statement of Construction Report which 31also does not address design basis, co32nstruction methodology and activities to mitig33ate permafrost degradation. The entire Method34 Statement of Construction Report only refers to P35ermafrost 3 times in 2 sections – Section 4.2.536 referring to CSA Standard S500 - Thermosyphon 37foundations for buildings in permafrost regions and a thermal analysis, and Section 5.2.15 proposing a monitoring network. **What construction methodologies will be used to minimize impact on permafrost of construction activities?**				
31	Permafrost, MSC, FMP, OMM	City of Iqaluit	CIRNAC	7.2	CIRNAC recommends the applicant describe permafrost conditions at the proposed leachate pond location and explain how permafrost conditions have been addressed in the design, construction and operation of the ponds.	This is documented in the Wood Geothermal Modelling and Geotechnical Recommendations report dated May 2019 and is included in the 100% package.	The requested information was not found in the Wood Report, and the 100% submission is still unavailable for review. It is unclear : **How have permafrost conditions at the proposed leachate pond location been addressed in the design,**	Provide comment by October 2	Provide comment by October 2	Complete	Page 282

							construction and operation of the ponds?			
32	Permafrost, MSC, FMP, OMM	City of Iqaluit	CIRNAC	7.3	CIRNAC recommends the applicant describe the rationale for thermistor locations and how they will monitor ground temperature changes within and below the facilities.	Grading has been revisited and approved by Wood (project geotechnical consultant). No changes to the current grading plan design are proposed.	The requested information was not found in the Wood Report, and the 100% submission is still unavailable for review. It is unclear : **What is the rationale for thermistor locations?** **How will the thermistors monitor ground temperature changes within and below the facilities, including the WTS, Landfill and Access Road?**	Provide comment by October 2	Drawings will be provided by October 9	Thermistor locations response Complete. Grading drawings will be provided by October 9	Page 282
33	Permafrost, MSC, FMP, OMM	City of Iqaluit	CIRNAC	7.4	CIRNAC recommends the applicant explain why it was not deemed necessary to consider heat generation from decomposing municipal waste in the thermal modelling of the landfill.	This is documented in the Wood Geothermal Modelling and Geotechnical Recommendations report dated May 2019 and is included in the 100% package.	The requested information was not found in the Wood Report, and the 100% submission is still unavailable for review. It is unclear : **Why was heat generation from decomposing municipal waste not considered in the thermal modeling of the landfill?**	Provide comment by October 2	Provide comment by October 2	Complete	Page 282
34	Waste transfer station geotechnical report	City of Iqaluit	CIRNAC	8	CIRNAC recommends the applicant identify where this report can be found.	This is outside the scope of the detailed design process and will be addressed by the City of Iqaluit and/or EXP. EXP Response: EXP completed the geotechnical report for the TS in 2018 I believe and provided Colliers with a copy of the report for the 2019 Landfill Site and TS Design RFP.	CIRNAC to confirm this is included in this Geotechnical Report – request timeline for submission. **When will this be available for review/reference?**	City of Iqaluit to Provide Geotechnical Report	City of Iqaluit to Provide Geotechnical Report	City of Iqaluit to Provide Geotechnical Report	City of Iqaluit to Provide Geotechnical Report
35	Design Drawings (90%)	City of Iqaluit	CIRNAC	9	CIRNAC recommends the applicant clarify the construction methodology for cuts and ditches at the landfill.	Specific construction methods are determined by the contractor, not the designer. This is outside the scope of the detailed design process.	The Designer is obliged to provide construction direction to the Contractor regarding what will be	Provide comment by October 2	Provide comment by October 2	Complete	Page 282

							permitted and what will not be permitted construction practices specific to mitigation permafrost degradation and environmental impacts. **What is the proposed strategy to protect permafrost during cutting and digging?** CIRNAC is seeking a commitment from the applicant to provide this methodology for review at least 60 days prior to work being undertaken.				
36	OMM	City of Iqaluit	CIRNAC	10.1	CIRNAC recommends the applicant describe if non-baled waste in the landfill will be compacted, and how solid waste will be handled at the landfill in event of a mechanical breakdown of the baling or shredding equipment.	Text has been added to Section 8.3.1 of the Operations and Maintenance Manual.	CIRNAC to confirm this is included in revised O&M manual – request timeline for submission.	Provide updated Operations and Maintenance Manual	Provide updated documents by October 2	Complete	Page 283-284
37	OMM	City of Iqaluit	CIRNAC	10.2	CIRNAC recommends the applicant clarify what household hazardous wastes will be accepted and if the hazardous waste storage area includes secondary containment.	Household Hazardous Wastes will be collected according to the regulatory environment in the City of Iqaluit and the Government of Nunavut, and are therefore subject to change. Hazardous waste storage does include secondary containment (Loraday Building Model No: LEP/L73-4012 Built in Accordance to FM 6049 Standard/Non-Combustible/40ft. Storage Building or equivalent). Section 4.1.5 and Section 4.1.6 of the Operations and Maintenance Manual have been updated accordingly.	Please clarify: **What are the acceptable and non-acceptable household hazardous wastes?** CIRNAC recommends that the Operation and Maintenance Manual include the list of acceptable and non-acceptable wastes upon commissioning of the facility to provide guidance to the operating staff, and that the Manual be updated as required as the regulatory environment changes. CIRNAC to confirm this is included in revised O&M	Provide recommended HHW list for Operations and Maintenance Manual	Provide updated documents by October 2	Complete	Page 285-286

							manual – request timeline for submission.				
38	OMM	City of Iqaluit	CIRNAC	10.3	CIRNAC recommends the applicant provide additional detail on leachate pumping including: objective criteria for when pumping is required (e.g. maximum allowable leachate head); method to be used to measure the leachate head and the level in the sump; and requirements for monitoring of pond levels and hoses for leaks during pumping operations.	The leachate head in the landfill sumps will be measured by a staff gauge bolted to the interior of the manhole. Hoses would not be used for leachate pumping - flanged and bolted solid wall HDPE piping would be installed at the start of the season and removed and stored at the end of the pumping season. Given the slope and the HDPE lining of the lagoons a HDPE staff gauge will be welded to the lagoon liner. The pump will be controlled by floats in the cell sumps, with the allowable head equal to the depth of the sump of 1.0 m or approximately 300 mm over the floor of the cell.	The applicant provided additional details which generated more questions: **- How will the bolts be protected from corrosion?** **- How will personnel respond if the staff gauge is dislodged by ice?** **- The extraction pipe will be removed for winter. Will the float system also be removed?** **- The response seems to indicate an automated system, while the Operation and Maintenance Manual indicates a manual operation - which is correct?** CIRNAC to confirm details included in revised O&M manual and 100% submission – request timeline for submission.	Provide updated Operations and Maintenance Manual	Provide Updated documents by October 2	Complete	Page 189-250 (Complete updated OMM provided)
39	OMM	City of Iqaluit	CIRNAC	10.4	CIRNAC recommends a water license condition be developed to require additional cover if nuisances occur.	Ok.	OK – Resolved.	Resolved	Resolved	Resolved	Referenced Page 287
NWB											
40	Regulatory Advice	ECCC	NWB				Provide regulatory advice on the applicable regulation or guideline, including limits/parameters that could be included within the licence with respect to the potential discharge of treated effluent (treated leachate) into the environment.	Refer to ECCC Commitment 12.	October 2, 2020	Complete	Page 178-179

							Provide regulatory advice on the applicable regulation or guideline including limits/parameters that could be included within the licence and/or used to compare groundwater monitoring results to (referred to in ECCC Comment 12).				
41	Operational Costs	City of Iqaluit	NWB				Provide operational cost for hydraulic bailer and annual operational cost of landfill, including WTS. Cost difference between feasibility stage and estimated now.			Request extension to October 23 respond to this commitment.	Page 287

APPENDIX B
Regulator Commitments Response Package
2 October 2020

Appendix A

Baseline Environmental Data Collection Report (Dillon Consulting Limited, 2019)

DILLON CONSULTING

75 YEARS

DILLON
CONSULTING

CITY OF IQALUIT

Baseline Environmental Data Collection

Future Landfill and Waste Transfer Station

October 2019 | 19-9543

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Figures

Tables

Tables (appended to this report)

Appendices

References

Acronyms, Abbreviations, Definitions

– B –

BTEX, benzene, toluene, ethylbenzene and xylenes

– C –

C&D, Construction and Demolition
CALA, Canadian Association of Laboratory Accreditation Inc.
CCME, Canadian Council of the Ministers of the Environment
CSQG, Canadian Soil Quality Guideline
CWS, Canada Wide Standards
CWQG, Canadian Water Quality Guideline

– D –

DO, Dissolved Oxygen

– E –

EXP, EXP Services Inc.

– N –

NWB, Nunavut Water Board

– O –

ORP, oxidation reduction potential

– P –

PAHs, polycyclic aromatic hydrocarbons
PFAS, per- and polyfluoroalkyl substances
PHCs, petroleum hydrocarbons

– Q –

QA/QC, Quality Assurance/Quality Control

– R –

RDL, Reportable Detection Limit
RPD, Relative Percent Difference

– V –

VOCs, volatile organic compounds

– W –

WTS, Waste Transfer Station

Executive Summary

Soil and/or groundwater investigations were conducted at the proposed waste transfer station (WTS) and landfill site (Landfill) locations in July and September 2019, respectively. At the WTS, five drive-point monitoring wells were installed, four of which into test pit excavations and one by manual means. Sixteen surface soil samples were collected from various areas of potential environmental concern (APECs) across the WTS area. Groundwater samples were collected from newly installed monitoring wells hosting groundwater. Surface water sampling was conducted at a water course running adjacent to the WTS boundaries to the north, northeast and east. At the Landfill, five existing monitoring wells and three nearby surface water bodies were sampled. Soil and water samples were submitted to Bureau Veritas for laboratory analyses.

Waste Transfer Station

WTS soil results indicated petroleum hydrocarbon (PHC) F3 and select polycyclic aromatic hydrocarbons (PAHs) exceeded referenced guidelines in 2019. Impacts were observed across the WTS area, including the Fire Fighting Training Area (FFTA) and the City's yards.

Groundwater samples were collected at monitoring wells 19MW-02, 19MW-03 and 19MW-04 in July 2019. Depth to groundwater ranged from 1.21 m below top of casing (m btoc) to 2.28 m btoc. Groundwater flow direction could not be determined as no survey of the well network was conducted. No measureable light non-aqueous phase liquid (LNAPL) was recorded in any of the monitoring wells in July 2019. Results for groundwater sampling indicated select PAHs and per- and polyfluoroalkyl substances compounds, as well as dissolved copper, exceeded referenced guidelines from the City's yards and boundaries of the FFTA.

Surface water samples were also collected from three locations along the adjacent water course in July 2019. Surface water results were below the applicable guidelines.

WTS soil and groundwater analytical results appear to be the result of historical operations, activities, and chemical or debris storage in this area.

Landfill

Dissolved and total metals, nitrite (as N) and sulphate concentrations in groundwater were observed to exceed the referenced guidelines for one or more parameters at each monitoring well location. Sedimentation in collected groundwater samples as a result of limited available groundwater for sampling may have influenced (i.e., biased high) the analytical results in groundwater.

Surface water samples were collected from three locations (WS-100 to WS-102) from nearby water bodies in September 2019. Surface water results were below the applicable guidelines.

The Landfill groundwater results, while exceeding referenced guidelines, are considered to represent background geological conditions: elevated concentrations in soil and surrounding bedrock, and limited buffering capacity in the surrounding geological materials.

1.0 Introduction

1.1 Background

The City of Iqaluit (the City) is in the process of implementing its Solid Waste Management Strategy to service their near and long-term (75 years) municipal solid waste disposal requirements. Founded on a previously-completed conceptual design and facility siting exercise, key elements of the project include a solid WTS within the immediate urban area of the City, where residential and commercial waste will be hauled to, processed, and compacted in bales with the objective of using wood and corrugated cardboard as a fuel source for an on-site biomass boiler. Tires, metal, and some construction and demolition (C&D) wastes will also be shredded and or baled for landfilling or transported south for recycling. The resulting solid waste bales and possibly a smaller amount of unbaled C&D waste will be trucked to an engineered balefill landfill site located approximately 6 km from the WTS. Vehicles transferring the waste bales will access the road leading to the Landfill from the waste transfer station to avoid having the transfer vehicle travel through the City. Development of the proposed facilities is scheduled to commence in 2020 with facility commissioning occurring in 2022.

Iqaluit is located at the south end of Baffin Island, on Frobisher Bay at 64° 44’ N latitude and 68° 31’ E longitude. Access to the City is limited, with the only year-round access provided by commercial aircraft; sealift can also be utilized during the summer months. The Landfill is located approximately 6 km northwest of the City and occupies an approximate area of 22 ha (Figure 1). The WTS is located at the end of Kakivak Court (Figure 2). The WTS occupies an area of approximately 2.4 ha and comprises an office building, scale house, transfer station, and contaminant storage area.

1.2 Objective and Scope of Work

The objective of the 2019 baseline environmental data collection program was to characterize baseline conditions at the WTS and Landfill, including soil and/or groundwater quality assessment.

The following activities were completed as part of the 2019 scope of work for the WTS and Landfill:

WTS

- Preparation of a site-specific Health and Safety Plan;
- Soil sampling at various areas of potential environmental concern (APECs);
- Advancement of test pits to facilitate well installations;
- Installation of drive-point groundwater monitoring wells;
- Groundwater monitoring and collection of groundwater and surface water samples; and
- Preparation of a report summarizing the 2019 baseline data collection program.

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Landfill

- Preparation of a site-specific Health and Safety Plan;
- Groundwater monitoring at existing monitoring wells;
- Groundwater and surface water sampling of monitoring wells and nearby surface water bodies; and,
- Preparation of a report summarizing the 2019 baseline data collection program.

2.0 Regulatory Framework

Canadian Council of Ministers of the Environment (CCME) Health Canada guidelines were used for reference purposes in the selection of soil and groundwater guideline values for potential parameters of concern at the site. Given the site settings, current land use and dominant soil particle size, the following guideline documents were used for comparison to laboratory results:

Soil

- CCME Tier 1 Soil Quality Guidelines, Commercial Land Use, Coarse-Grained Soil (1999);
- CCME Canadian Soil Quality Guidelines, Commercial Land Use, Coarse-Grained Soil (1999);
- CCME Canada-Wide Standards (CWS) for Petroleum Hydrocarbons, Commercial Land Use, Coarse-Grained Soil (potable and non-potable water) (2008);
- Draft Federal Soil and Groundwater Quality Guideline for PFOS based on a commercial land use scenario as presented in the Government of Canada's "Interim Advice to Federal Custodian Departments for the Management of Federal Contaminated Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per- and Polyfluoroalkyl Substances (PFAS)", Version 1.4.1, (2018); and
- Updates to Health Canada Soil Screening Values for Perfluoroalkylated Substances (PFAS) for Commercial/Industrial land use (2019).

Groundwater and Surface Water

- Draft Federal Soil and Groundwater Quality Guideline for PFOS based on a commercial land use scenario as presented in the Government of Canada's "Interim Advice to Federal Custodian Departments for the Management of Federal Contaminated Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per- and Polyfluoroalkyl Substances (PFAS)", Version 1.4.1, (2018);
- Health Canada Water Screening Values for Perfluoroalkylated Substances (2018);
- Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (2016), Tier 1 Guidelines for Commercial/Industrial land use and coarse and fine textured soils; and,
- CCME Canada Water Quality Guidelines (CWQGs) for the Protection of Freshwater Aquatic Life, 1999.

Commercial land use was selected as the baseline conditions screening criteria. Groundwater, for the purposes of this report, refers to active layer groundwater. Active layer groundwater is not used for potable use in the City of Iqaluit. The Health Canada Water Screening Values for Perfluoroalkylated Substances will be used for screening, in lieu of available guidelines protective of environmental receptors.

3.0 Field Program

3.1 Waste Transfer Station

The field program at the WTS was conducted between July 16 and 18, 2019, and consisted of shallow soil sampling, installation of drive-point monitoring wells, groundwater monitoring, and groundwater and surface water sampling.

3.1.1 Soil Sampling and Drive Point Installation

On July 16 and 17, 2019, shallow soil sampling was conducted at the WTS. Three areas were targeted: The Fire Fighting Training Area (FFTA) and two City yards, one northwest of the FFTA and one south of the FFTA. The investigation areas and associated sampling locations are shown on Figure 3.

Soil samples were collected from the upper 10 to 15 cm of soil at each sampling location, placed in laboratory-supplied jars and stored in an ice-filled cooler pending submission. A total of 16 soil samples were collected from the three areas and submitted for laboratory analysis of one or more of: benzene, toluene, ethylbenzene, and xylenes (collectively known as BTEX), petroleum hydrocarbon (PHC) fractions F1 to F4, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), glycols, PFAS, and particle size.

On July 18, 2019, drive-point monitoring wells were installed at five locations at the WTS (19MW-01 to 19MW-05; Figure 3). Attempts were made to install the monitoring wells by hand; however, refusal was encountered at depths of less than 30 cm at several locations. Consequently, Nunavut Excavating was contracted to advance test pit excavations to facilitate installation of the drive-point wells.

Soil samples were collected from the base of two test pits (TP-1 and TP-4), placed in laboratory-supplied jars and stored in an ice-filled cooler. Samples were analyzed for BTEX, PHC F1 to F4 and PAHs. Soil samples were submitted to Bureau Veritas Laboratories (Bureau Veritas; formerly Maxxam Analytics Inc.) of Ottawa, Ontario. Soil samples were analyzed within specified laboratory hold times. Chain of Custody documentation, provided by Bureau Veritas, was completed by Dillon field technicians and accompanied the laboratory submissions.

3.1.2 Groundwater and Surface Water Monitoring and Sampling

Newly installed monitoring wells were monitored and sampled on July 18, 2019. Drive-point wells were monitored and sampled using the following procedure:

- Measuring depth to light non-aqueous phase liquid (LNAPL; if present), depth to groundwater and depth to well bottom, using a Heron oil/water interface probe. Measurements were recorded relative to the surveyed top of PVC casing.

- Monitoring equipment was decontaminated using a Liquinox® solution, organic-free water rinse and clean paper towel, upon removal from the monitoring well.

Groundwater samples were collected by Dillon personnel using low-flow sampling techniques. Of the five groundwater monitoring wells installed, only three hosted water (19MW-02 to 19MW-04). While groundwater was present at 19MW-05, insufficient water was available to permit sample collection after purging. Sample collection included the following activities:

- Clean ¼" (6 mm) low density polyethylene (LDPE) tubing was installed in the monitoring well with the intake point placed approximately 0.25 m above the bottom of the well within the screened zone.
- The ¼" LDPE tubing was connected above ground to MasterFlex silicone tubing that was fit to a flow-rate adjustable peristaltic pump. Pumped groundwater was directed through a flow-through cell that was connected to a calibrated YSI 556 multi-parameter meter for the measurement of the following field parameters: pH, electrical conductivity, temperature, dissolved oxygen, oxygen reduction potential and turbidity.
- The monitoring well was purged using a peristaltic pump at a low-flow rate (less than 500 mL/min).
- Field parameters were monitored and recorded at regular intervals during purging until the values stabilized.
- Upon achieving stabilization, the field parameters were recorded and the flow-through cell was disconnected. Groundwater samples were collected in clean, laboratory-supplied containers for one or more of BTEX, PHC F1 to F2, VOCs, glycols, dissolved metals and PFAS.
- Samples were placed in ice-filled coolers and placed in cold storage pending submission to Bureau Veritas in Ottawa, Ontario.

Surface water samples were collected from three locations (SW-1 to SW-3) along the water course adjacent to the north and east boundaries of the investigation areas (Figure 3). Sample collection consisted of placement of clean, laboratory-supplied containers in a flowing portion of the stream for analysis of BTEX, PHC F1 to F2 and total metals. Samples were placed in ice-filled coolers and placed in cold storage pending submission to Bureau Veritas in Ottawa, Ontario.

Groundwater and surface water samples were analyzed within specified laboratory hold times. Chain of Custody documentation, provided by Bureau Veritas, was completed by Dillon field technicians and accompanied the laboratory submissions.

3.2 Landfill

The field program at the Landfill was conducted between September 5 and 6, 2019 and consisted of groundwater monitoring and surface water sampling.

3.2.1 Groundwater and Surface Water Monitoring and Sampling

Five previously existing monitoring wells (W-107 to W-111) were monitored and sampled on September 5-6, 2019. Monitoring well locations are presented on Figure 4. Wells were monitored using the following procedure:

- Removing the monitoring well cap and measuring standpipe organic vapour readings using a RKI Eagle portable gas detector, calibrated to a hexane standard and operated in "methane elimination" response mode;
- Measuring depth to light non-aqueous phase liquid (LNAPL; if present), depth to groundwater, and depth to well bottom using a Heron oil/water interface probe. Measurements were recorded relative to the surveyed top of PVC casing; and
- Monitoring equipment was decontaminated using a Liquinox® solution, organic-free water rinse and clean paper towel upon removal from the monitoring well.

Groundwater samples were collected by Dillon personnel using low-flow sampling techniques. Sample collection included the following activities:

- Clean ¼" (6 mm) low density polyethylene (LDPE) tubing was installed in the monitoring well with the intake point placed approximately 0.25 m above the bottom of the well within the screened zone.
- The ¼" LDPE tubing was connected above ground to MasterFlex silicone tubing that was fit to a flow-rate adjustable peristaltic pump. Pumped groundwater was directed through a flow-through cell that was connected to a calibrated YSI Pro DSS multi-parameter water quality meter for the measurement of the following field parameters: pH, electrical conductivity (EC), temperature, dissolved oxygen (DO), oxygen reduction potential (ORP) and turbidity;
- The monitoring well was purged using a peristaltic pump at a low-flow rate (less than 150 mL/min). Due to slow recharge rates, a full purge and/or stabilization of field parameters could not be obtained prior to sampling. Groundwater samples were collected to enable data collection.
- Field parameters were recorded and the flow-through cell was disconnected. Groundwater samples were collected in clean, laboratory-supplied containers for one or more of routine water quality, ammonia-nitrogen (NH_4-N), total Kjeldahl nitrogen (TKN), and dissolved metals and trace elements (including low-level cadmium).
- Samples were placed in ice-filled coolers and placed in cold storage pending submission to Bureau Veritas Laboratories (Bureau Veritas; formerly Maxxam Analytics Inc.) of Yellowknife, Northwest Territories.

Surface water samples were collected from three locations (WS-100 to WS-102) in water bodies to the east, west and northwest of the proposed Landfill (Figure 4). Field parameters were measured (pH, EC, temperature, DO, ORP and turbidity) and samples were collected in clean, laboratory-supplied containers from beneath the surface at the shores of the water bodies for analysis of one or more of routine water quality, NH_4-N, TKN and total metals and trace elements (including low-level cadmium).

Samples were placed in ice-filled coolers pending submission to Bureau Veritas in Yellowknife, Northwest Territories.

Chain of Custody documentation, provided by Bureau Veritas, was completed by Dillon field technicians and accompanied all laboratory submissions.

4.0 Results

4.1 Waste Transfer Station

4.1.1 Soil Quality

Results from sampling of shallow soil and test pit locations are presented in Tables 1 and 2 (attached). Specific sample locations and soil results are presented on Figure 5a. Borehole logs are presented in Appendix A and Laboratory Certificates of Analyses for July 2019 soil sampling are included as Appendix B.

Soil samples were collected from two test pits and 16 surface locations within the proposed WTS boundaries. Surface soil sample locations were selected based on potential for environmental impact resulting from current and/or former materials storage, operations, or other activities.

Results are summarized as follows:

- Headspace organic vapour readings ranged from non-detectable to 30 parts per million (ppm);
- Concentrations in soil for BTEX and PHC parameters were below the referenced guidelines, except for PHC fraction F3 at SS08;
- VOC concentrations were less than laboratory reportable detection limits (RDLs) and referenced guidelines – the RDL for trichloroethene exceeded the referenced guideline;
- Glycols concentrations were below laboratory RDLs and the referenced guidelines;
- PFAS concentrations were below the referenced guidelines; and,
- Select PAH parameter concentrations exceeded the referenced guidelines.

Exceedances observed in soil at the WTS are summarized below in Table 4-1.

Table 4-1: Soil Analytical Exceedances at the Waste Transfer Station

Parameter	Sample Location		SS03	SS04	SS05	SS06	SS07	SS08	SS13	SS14	TP4
	CWS for PHCs	CCME CSQG									3.0 mbgs
PHC fraction F3	1700	n.v.	n.e.	n.e.	n.e.	n.e.		2400	n.e.	n.e.	n.e.
Acenaphthene	n.v.	0.28	3.4	2.1	n.e.	n.e.	0.61	n.e.	n.e.	n.e.	n.e.
Benzo (a) pyrene	n.v.	1.4	5.1	4.5	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.	n.e.
Fluorene	n.v.	0.25	4.6	2.8	n.e.	n.e.	0.78	n.e.	n.e.	n.e.	n.e.
Naphthalene	n.v.	0.013	1.3	0.6	n.e.	n.e.	0.14	n.e.	n.e.	n.e.	n.e.
Phenanthrene	n.v.	0.046	22	15	0.068	0.94	4.1	n.e.	0.062	0.056	0.082

Table Notes:
Concentrations presented in mg/kg.
SS Soil samples taken at 0.1 – 0.2 metres below ground surface.
TP Soil samples taken at variable depths as noted in Table.
CWS for PHCs denotes Canada Wide Standards for PHCs in Soil, Commercial land use, non-potable groundwater, coarse-grained (2008)
CCME CSQG denotes CCME Canadian Soil Quality Guidelines, Commercial Land Use, Coarse-Grained Soil (1999)
n.e. denotes no exceedance.
n.m. denotes not measured
n.v. denotes no value

Soil exceeding referenced guidelines was observed across the WTS area, including the FFTA and the City yards. These exceedances appear to be the result of historical operations, activities and storage in these areas (as reported in the Phase II Environmental Site Assessment by EXP Consulting Ltd. in 2018).

4.1.2 Groundwater Monitoring

Groundwater monitoring data collected from drive point monitoring wells in July 2019 is presented in Table 3 (attached). Depth to groundwater ranged from 1.21 m below top of casing (m btoc) to 2.28 m btoc. Groundwater flow direction could not be determined as no survey of the well network was conducted.

No measureable LNAPL was recorded in any of the monitoring wells in July 2019.

4.1.3 Groundwater and Surface Water Quality

Groundwater samples were collected at monitoring wells 19MW-02, 19MW-03 and 19MW-04 in July 2019. Surface water samples were also collected from three locations along the adjacent water course in July 2019. Groundwater analytical results are presented in Table 4 and 5, (attached), and on Figure 5b. Surface water analytical results are presented in Table 6 (attached), and on Figure 5b. Laboratory Certificates of Analysis are included as Appendix B.

Results are summarized as follows:

- Concentrations for BTEX and PHC fractions F1 and F2 in groundwater were less than RDLs and/or referenced guidelines;
- VOC and glycols concentrations in groundwater were less than laboratory reportable detection limits (RDLs) and referenced guidelines;
- Metals concentrations in groundwater were below the referenced guidelines with the exception of copper, which exceeded at each sampled monitoring well location;
- Select PFAS concentrations in groundwater exceeded the referenced guidelines at 19MW-02;
- Multiple PAH RDLs were observed to exceed the referenced guidelines;
- Select PAH parameter concentrations in groundwater exceeded the referenced guidelines at 19MW-04; and,
- Surface water results for each parameter analyzed was below the referenced guidelines.

Groundwater exceedances were observed within the City yards and along the boundaries of the former FFTA and are summarized below in Table 4-2.

Table 4-2: Groundwater Analytical Exceedances at the Waste Transfer Station

Parameter	Sample Location		19MW-02	19MW-03	19MW-04
	FIGQG	HC SV			
Benzo (a) pyrene	0.000015	n.v.	n.e.	n.e.	0.000026
Fluoranthene	0.00004	n.v.			0.000066
Pyrene	0.000025	n.v.			0.000051
Dissolved Copper	0.002	n.v.	0.01	0.0062	0.0032
PFHpA	n.v.	0.0002	0.00037	n.e.	n.m.
PFHxA	n.v.	0.0002	0.00055	n.e.	n.m.
PFNA	n.v.	0.00002	0.00012	n.e.	n.m.
PFPeA	n.v.	0.0002	0.00099	n.e.	n.m.
6:2 FtS	n.v.	0.0002	0.0016	n.e.	n.m.

Table Notes:
Concentrations presented in mg/L.
FIGQG denotes Federal Interim Groundwater Quality Guidelines (mg/L)
HC SV denotes Health Canada Screening Values for PFAS
n.e. denotes no exceedance.
n.m. denotes not measured
n.v. denotes no value
PFHpA denotes Perfluoroheptanoic Acid
PFHxA denotes Perfluorohexanoic Acid
PFNA denotes Perfluorononanoic Acid
PFPeA denotes Perfluoropentanoic Acid
6:2 FtS denotes 6:2 Fluorotelomer Sulfonate

4.2 Landfill

4.2.1 Groundwater and Surface Water Quality

Groundwater samples were collected at monitoring wells W-107 to W-111 in September 2019. Surface water samples were also collected from three locations (WS-100 to WS-102) from nearby water bodies in September 2019. Groundwater and surface water analytical results are presented in Table 7 and Table 8, respectively (attached), and on Figure 6. The Laboratory Certificate of Analysis is included as Appendix B. Results are summarized as follows:

- Concentrations for routine water quality parameters were below the referenced guidelines for parameters analyzed, with the exception of nitrate (as N) and sulphate at W-107;
- Select dissolved and/or total metals concentrations in groundwater exceeded referenced guidelines at each monitoring well location; and
- Surface water results for each parameter analyzed was below the referenced guidelines.

Groundwater exceedances are summarized in Tables 4-3 below.

Table 4-3: Groundwater Analytical Exceedances at the Landfill

Parameter	Sample Location FIGQG	W-107	W-108	W-109	W-110	W-111
Nitrite as N	0.06	0.15	n.e.	n.e.	n.e.	n.e.
Dissolved Sulphate	100	1400	n.e.	n.e.	n.e.	n.e.
Dissolved Aluminum	0.005	n.e.	0.0083	0.015	0.014	0.014
Dissolved Cadmium	0.00009	0.00014	n.e.	0.007	n.e.	n.e.
Dissolved Copper	0.002	0.0047	0.0039	0.0074	0.0039	0.004
Dissolved Iron	0.3	0.63	n.e.	n.e.	n.e.	n.e.

Table Notes:
Concentrations presented in mg/L.
FIGQG denotes Federal Interim Groundwater Quality Guidelines (mg/L)
n.e. denotes no exceedance.

Due to slow recharge rates, opportunistic sampling was performed at each monitoring well. As a result, some sediment was present in groundwater samples despite being field-filtered prior to submission. It is possible that the exceedances of referenced guidelines observed in 2019 resulted, in part, from the presence of sediment in the samples.

Considering that no significant development or anthropogenic activity is expected to have occurred in this area prior to sampling, it is reasonable to assume that groundwater and surface water results observed in 2019 are the reflection of background water quality, as well as potential influence from the presence of sediment in the samples.

4.3 Quality Assurance/Quality Control

The results of the field quality assurance/quality control (QA/QC) program are summarized in Table 9 and Table 10 (attached), which includes laboratory analytical results for blank samples (i.e., equipment and field), blind field duplicates, and relative percent difference (RPD).
A QA/QC note was provided in the laboratory certificate of analysis (COA) and a summary is provided as follows:

- Samples submitted to the lab met temperature requirements;
- Sample hold times were exceeded for W109, W110 and W111; and
- Detection limits were raised during the analysis of metals (for the September samples submitted), PAHs (SS03, SS04, SS06 and SS07) and PFAS for 19MW-02 due to the sample matrix; samples required dilution.

Analyzed field duplicates had results suitable for quantitative calculation of RPD. The RPD was not calculated for those parameters where one or both of the results associated with the original and/or field duplicate sample exhibited concentrations less than five times the RDL. The acceptable criteria were based on the laboratory RPD acceptance criteria, as provided in the COAs and are provided in their respective analytical tables.

Overall laboratory data quality is considered acceptable and the results representative with no identification of significant quality issues requiring further investigation or resampling.

5.0 Summary

Soil and/or groundwater investigations were conducted at the proposed WTS and Landfill locations in July and September 2019, respectively. At the WTS, five drive-point monitoring wells were installed, four of which into test pit excavations and one by manual means. Sixteen surface soil samples were collected from various APECs across the WTS area. Groundwater samples were collected from newly installed monitoring wells hosting groundwater. Surface water sampling was conducted at a water course running adjacent to the WTS boundaries to the north, northeast and east. At the Landfill, five existing monitoring wells and three nearby surface water bodies were sampled. Soil and water samples were submitted to Bureau Veritas for laboratory analyses.

5.1 Waste Transfer Station

WTS soil results indicated PHC F3 and select PAHs exceeded referenced guidelines in 2019. Impacts were observed across the WTS area, including the FFTA and City yards.

Groundwater samples were collected at monitoring wells 19MW-02, 19MW-03 and 19MW-04 in July 2019. Depth to groundwater ranged from 1.21 m below top of casing (m btoc) to 2.28 m btoc. Groundwater flow direction could not be determined as no survey of the well network was conducted. No measureable LNAPL was recorded in any of the monitoring wells in July 2019. Results for groundwater sampling indicated select PAH and PFAS compounds, as well as dissolved copper, exceeded referenced guidelines from the City yards and boundaries of the FFTA.

Surface water samples were also collected from three locations along the adjacent water course in July 2019. Surface water results were below the applicable guidelines.

WTS soil and groundwater analytical results appear to be the result of historical operations, activities, and chemical or debris storage in this area.

5.2 Landfill

Dissolved and total metals, nitrite (as N) and sulphate concentrations in groundwater were observed to exceed the referenced guidelines for one or more parameters at each monitoring well location. Sedimentation in collected groundwater samples as a result of limited available groundwater for sampling may have influenced (i.e., biased high) the analytical results in groundwater.

Surface water samples were collected from three locations (WS-100 to WS-102) from nearby water bodies in September 2019. Surface water results were below the applicable guidelines.

The Landfill groundwater and surface water results, while exceeding referenced guidelines, are considered to represent background geological conditions: elevated concentrations in soil and surrounding bedrock, and limited buffering capacity in the surrounding geological materials.

6.0 Closure

This report was prepared exclusively for the purposes, project and Site location outlined in the report. The report is based on information provided to, or obtained by Dillon as indicated in the report, and applies solely to site conditions existing at the time of the Site investigation. Although a reasonable investigation was conducted by Dillon, Dillon's investigation was by no means exhaustive and cannot be construed as a certification of the absence of all potential impacts at the Site. Rather, Dillon's report represents a reasonable review of available information within an agreed work scope, schedule and budget. It is therefore possible that currently unrecognized areas of concern may exist at the Site, and that the levels of potential impact may vary across the Site. Further review and updating of the report may be required as local and Site conditions, and the regulatory and planning frameworks, change over time.

This report was prepared by Dillon for the sole benefit of our Client, The City of Iqaluit. The material in it reflects Dillon's best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

Respectfully submitted,

DILLON CONSULTING LIMITED

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Keith Barnes, P.Eng.
Project Manager

DIGITAL NOT SIGNED

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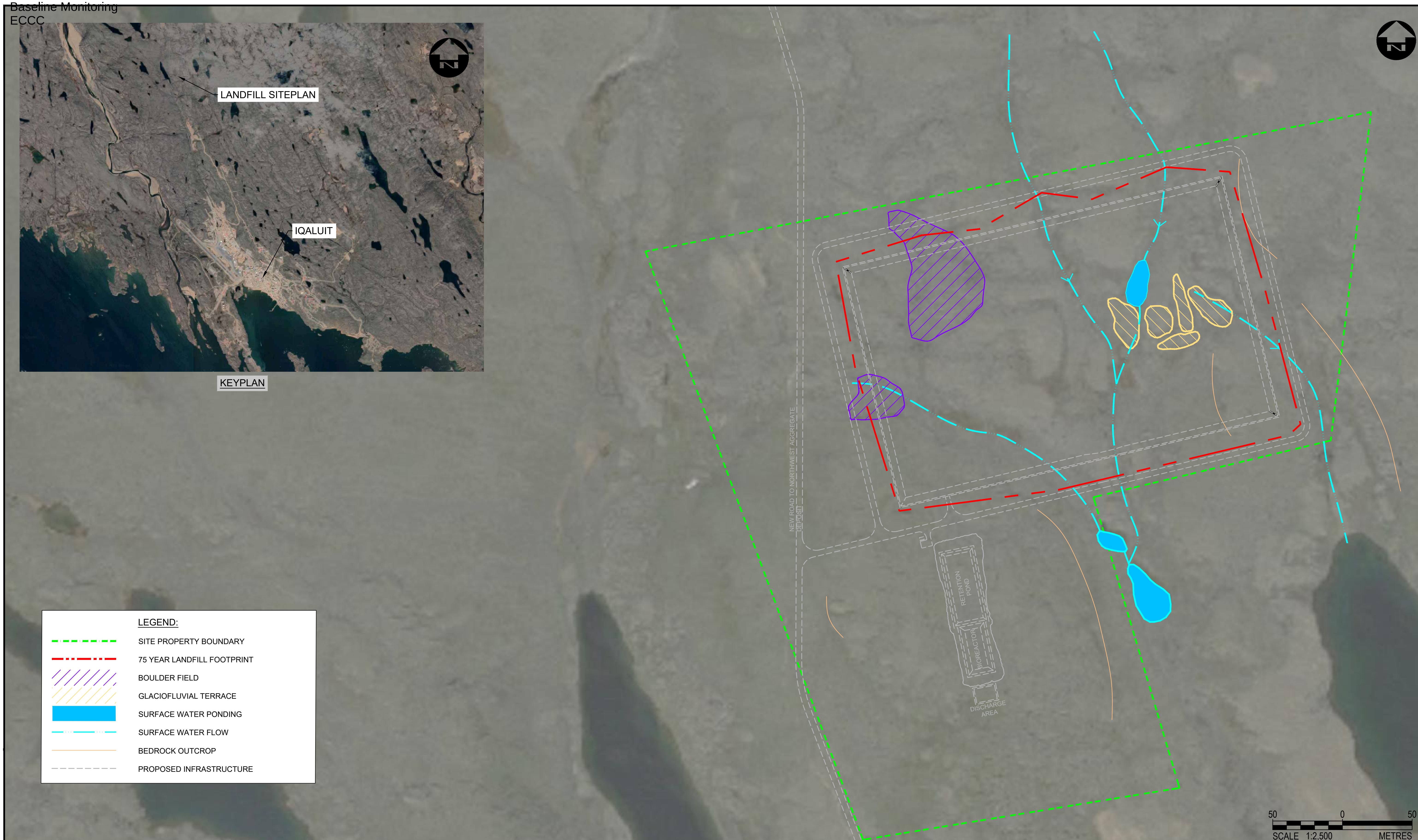
Senior Technical Reviewer

CMR:slg

Figures



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CITY OF IQALUIT

SOLID WASTE LANDFILL
PROPOSED FACILITY LAYOUT

PROJECT NO. 19-9543

FIGURE NO. 1

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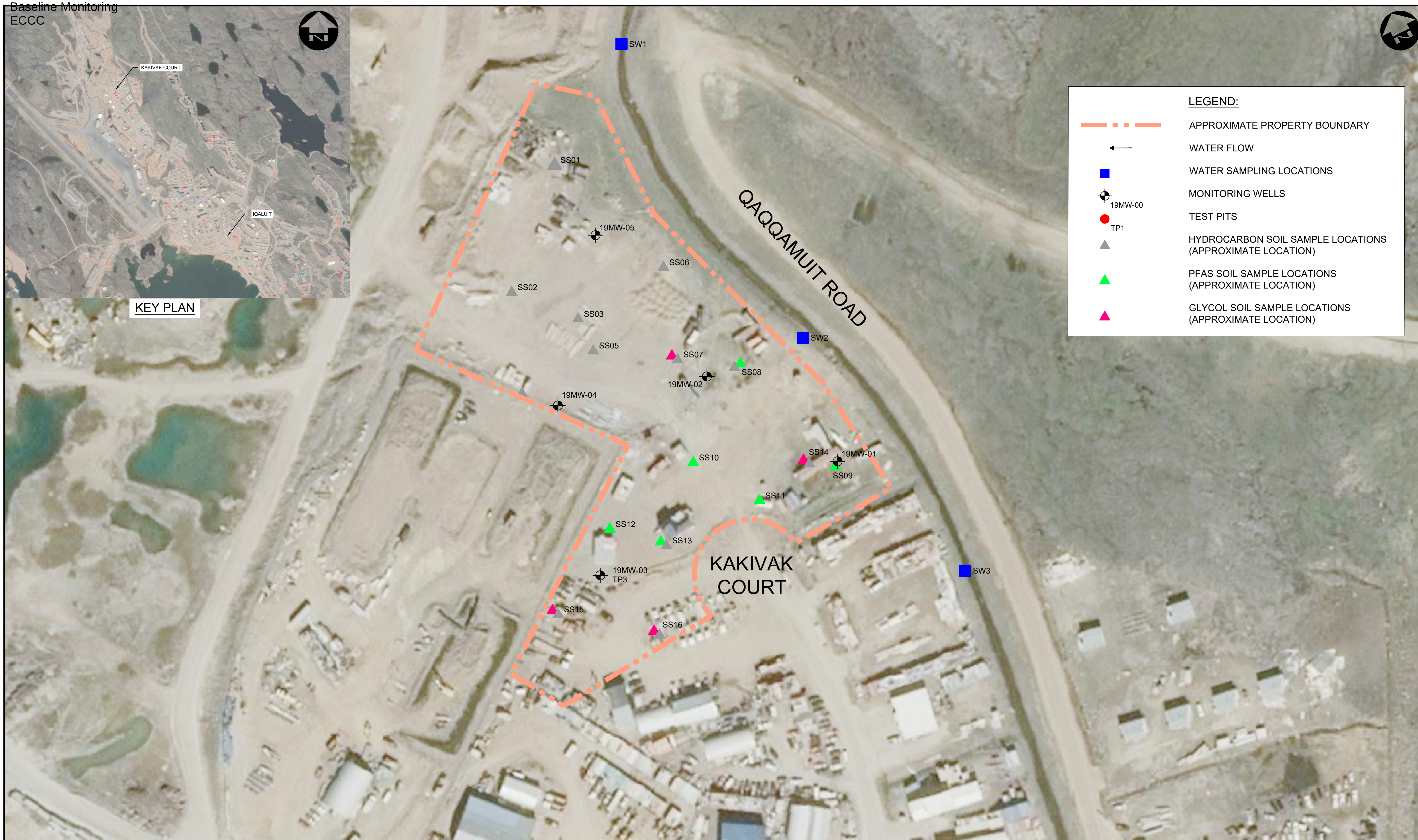
CITY OF IQALUIT

WASTE TRANSFER STATION
PROPOSED FACILITY LAYOUT

PROJECT NO. 19-9543

FIGURE NO. 2



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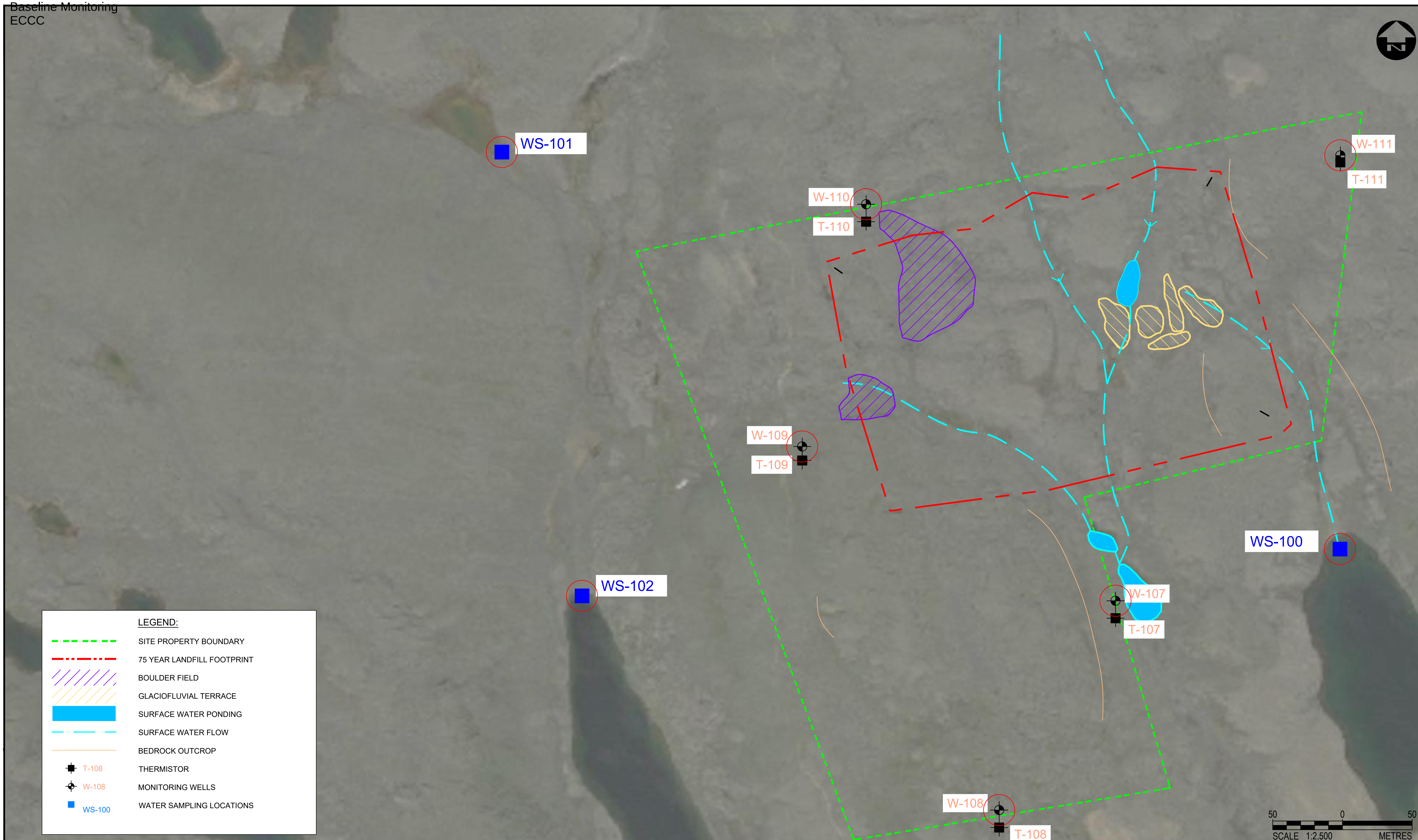
WASTE TRANSFER STATION
ENVIRONMENTAL SAMPLING LOCATIONS

PROJECT NO. 19-9543

FIGURE NO. 3



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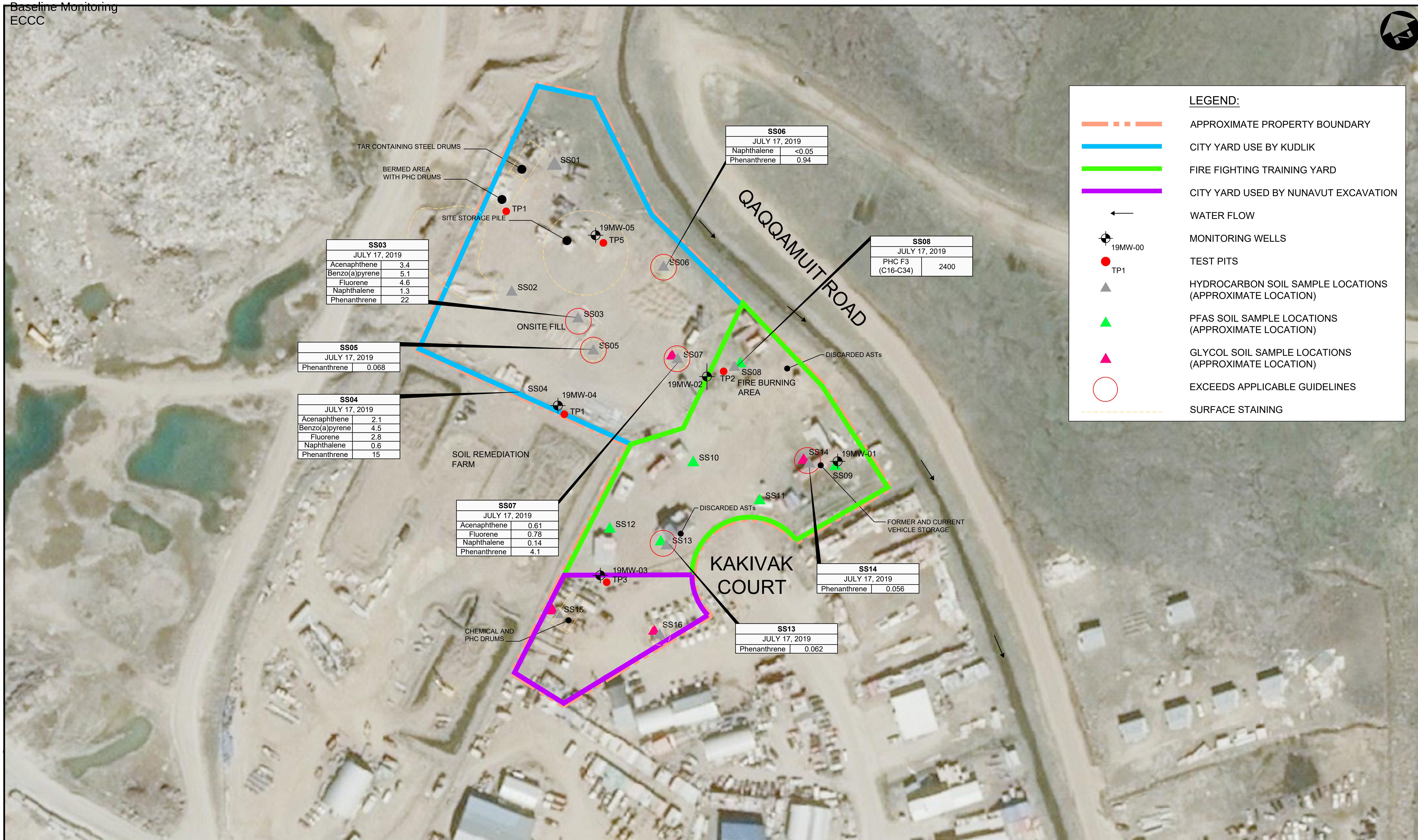
SOLID WASTE LANDFILL
ENVIRONMENTAL SAMPLING LOCATIONS

PROJECT NO. 19-9543

FIGURE NO. 4



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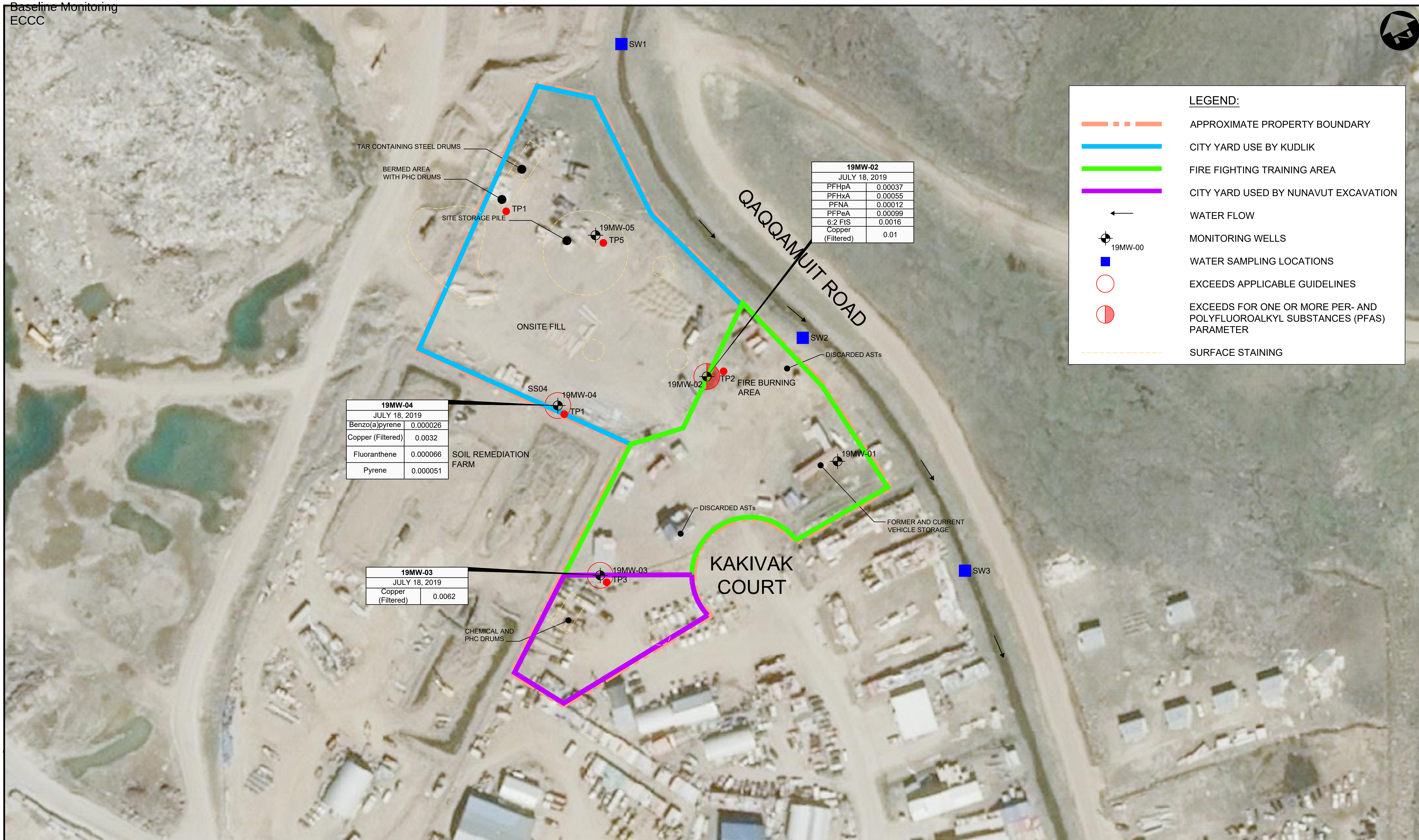
WASTE TRANSFER STATION
2019 SOIL ANALYTICAL RESULTS

PROJECT NO. 19-9543

FIGURE NO. 5a



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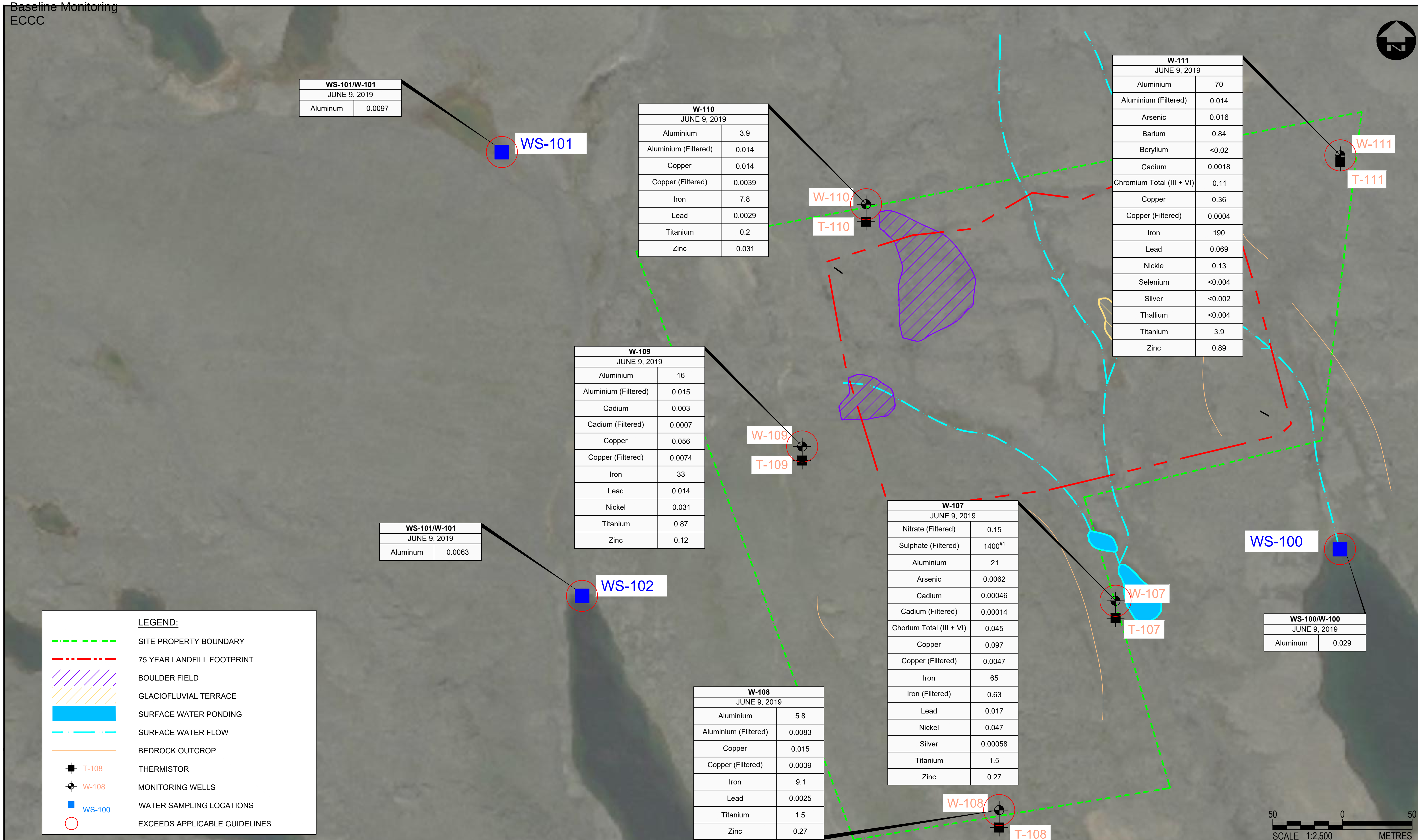
WASTE TRANSFER STATION
2019 GROUNDWATER ANALYTICAL RESULTS

PROJECT NO. 19-9543

FIGURE NO. 5b



WS-101/W-101	
JUNE 9, 2019	
Aluminum	0.0097

W-110	
JUNE 9, 2019	
Aluminium	3.9
Aluminium (Filtered)	0.014
Copper	0.014
Copper (Filtered)	0.0039
Iron	7.8
Lead	0.0029
Titanium	0.2
Zinc	0.031

W-111	
JUNE 9, 2019	
Aluminium	70
Aluminium (Filtered)	0.014
Arsenic	0.016
Barium	0.84
Berylium	<0.02
Cadium	0.0018
Chromium Total (III + VI)	0.11
Copper	0.36
Copper (Filtered)	0.0004
Iron	190
Lead	0.069
Nickle	0.13
Selenium	<0.004
Silver	<0.002
Thallium	<0.004
Titanium	3.9
Zinc	0.89

W-109	
JUNE 9, 2019	
Aluminium	16
Aluminium (Filtered)	0.015
Cadium	0.003
Cadium (Filtered)	0.0007
Copper	0.056
Copper (Filtered)	0.0074
Iron	33
Lead	0.014
Nickel	0.031
Titanium	0.87
Zinc	0.12

WS-101/W-101	
JUNE 9, 2019	
Aluminum	0.0063

W-107	
JUNE 9, 2019	
Nitrate (Filtered)	0.15
Sulphate (Filtered)	1400[#1]
Aluminium	21
Arsenic	0.0062
Cadium	0.00046
Cadium (Filtered)	0.00014
Chorium Total (III + VI)	0.045
Copper	0.097
Copper (Filtered)	0.0047
Iron	65
Iron (Filtered)	0.63
Lead	0.017
Nickel	0.047
Silver	0.00058
Titanium	1.5
Zinc	0.27

WS-100/W-100	
JUNE 9, 2019	
Aluminum	0.029

W-108	
JUNE 9, 2019	
Aluminium	5.8
Aluminium (Filtered)	0.0083
Copper	0.015
Copper (Filtered)	0.0039
Iron	9.1
Lead	0.0025
Titanium	1.5
Zinc	0.27

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CITY OF IQALUIT

SOLID WASTE LANDFILL
2019 GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS

PROJECT NO. 19-9543

FIGURE NO. 6

Tables

Table 1: Analytical Results for Soils at the Waste Transfer Station

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	Parameter	Units	EQL	CCME SQGL Tier 1 - Commercial (Coarse)	CSQG Commercial Use (Coarse Grained)	CWS for PHC - Commercial, Coarse (Non-Potable GW)	CWS for PHC - Commercial, Coarse (Potable GW)	SS01	SS02	SS03	SS04	SS04	SS05	SS06	SS07	SS08	SS09	SS10	SS12	SS13	SS14	SS15	SS16	TP1	TP4
							Sample Date	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-18	2019-07-18
Particle Size	% >75um	%	1	-	-	-	-	-	-	-	-	90	-	-	-	-	-	-	-	-	-	-	-	-	-
	Sieve - #200 (<0.075mm)	%	1	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons (PHCs)	Reached Baseline at C50	-	-	-	-	-	-	1[#1]	0[#2]	0[#2]	0[#2]	-	1[#1]	0[#2]	0[#2]	1[#1]	-	-	-	0[#2]	1[#1]	1[#1]	1[#1]	1[#1]	1[#1]
	PHC F1 (C6-C10)	mg/kg	10	240	-	-	-	<10	<10	<10	<10	-	<10	<10	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10
	PHC F1 (C6-C10) - BTEX	mg/kg	10	240	-	320	240	<10	<10	<10	<10	-	<10	<10	<10	<10	-	-	-	<10	<10	<10	<10	<10	<10
	PHC F2 (C10-C16)	mg/kg	10	260	-	260	260	<10	<10	17	29	-	<10	17	11	130	-	-	-	<10	<10	<10	<10	<10	<10
	PHC F3 (C16-C34)	mg/kg	50	1700	-	1700	1700	540	140	280	720	-	<50	140	210	2400	-	-	-	120	75	370	96	<50	<50
	PHC F4 (C34-C50)	mg/kg	50	3300	-	3300	3300	<50	77	180	450	-	<50	170	140	150	-	-	-	59	<50	160	<50	<50	<50
Sample Preparation	Moisture Content (dried @ 103°C)	mg/kg	1000					2900	2400	2900	4400	-	2100	5700	3400	6700	17,000	2000	1700	3600	14,000	4200	2400	5100	6300
Volatile Organic Compounds (VOCs)	1,1,1,2-tetrachloroethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,1,1-trichloroethane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,1,2,2-tetrachloroethane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,1,2-trichloroethane	mg/kg	0.05	0.01|50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,1-dichloroethane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,1-dichloroethene	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,2-dibromoethane (Ethylene dibromide)	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,2-dichloroethane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,2-dichloropropane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,3-Dichloropropene	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Acetone	mg/kg	0.5	-	-	-	-	<0.5	-	-	<0.5	-	-	-	-	-	-	-	-	-	-	<0.5	-	-	-
	Bromoform	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Carbon tetrachloride	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Bromodichloroethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Bromoethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Chlorobenzene	mg/kg	0.05	10	10	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Chlorodibromomethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Chloroform	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	cis-1,2-dichloroethene	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	cis-1,3-dichloropropene	mg/kg	0.03	-	-	-	-	<0.03	-	-	<0.03	-	-	-	-	-	-	-	-	-	-	<0.03	-	-	-
	Dichlorodifluoromethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Dichloromethane	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Hexane	mg/kg	0.05	-	6.5	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Methyl Ethyl Ketone (MEK)	mg/kg	0.5	-	-	-	-	<0.5	-	-	<0.5	-	-	-	-	-	-	-	-	-	-	<0.5	-	-	-
	Methyl tert-Butyl Ether (MTBE)	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Styrene	mg/kg	0.05	50	50	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Trichloroethene	mg/kg	0.05	-	0.01	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Tetrachloroethene	mg/kg	0.05	0.5|50	0.5	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	trans-1,2-dichloroethene	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	trans-1,3-dichloropropene	mg/kg	0.04	-	-	-	-	<0.04	-	-	<0.04	-	-	-	-	-	-	-	-	-	-	<0.04	-	-	-
	Trichlorofluoromethane	mg/kg	0.05	-	-	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	Vinyl chloride	mg/kg	0.02	-	-	-	-	<0.02	-	-	<0.02	-	-	-	-	-	-	-	-	-	-	<0.02	-	-	-
BTEX	Benzene	mg/kg	0.02	0.03	0.03	-	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Toluene	mg/kg	0.02	0.37	0.37	-	-	0.042	<0.02	<0.02	0.028	-	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	0.098	0.034	<0.02	<0.02	<0.02
	Ethylbenzene	mg/kg	0.02	0.082	0.082	-	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Xylene (m & p)	mg/kg	0.02	-	-	-	-	<0.02	<0.04	<0.04	<0.02	-	<0.04	<0.04	<0.04	<0.04	-	-	-	<0.04	0.056	<0.02	<0.04	<0.04	<0.04
	Xylene (o)	mg/kg	0.02	-	-	-	-	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.02	<0.02	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Xylenes Total	mg/kg	0.02	11	11	-	-	<0.02	<0.04	<0.04	<0.02	-	<0.04	<0.04	<0.04	<0.04	-	-	-	<0.04	0.056	<0.02	<0.04	<0.04	<0.04
Polycyclic Aromatic Hydrocarbons (PAHs)	1-Methylnaphthalene	mg/kg	0.005	-	-	-	-	<0.005	<0.005	0.58	0.36	-	<0.005	<0.05	0.089	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	2-Methylnaphthalene	mg/kg	0.005	-	-	-	-	<0.005	<0.005	0.83	0.41	-	<0.005	<0.05	0.099	<0.005	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	1 & 2 Methylnaphthalene	mg/kg	0.0071	-	-	-	-	<0.0071	<0.0071	1.4	0.77	-	<0.0071	<0.071	0.19	<0.0071	-	-	-	<0.0071	<0.0071	<0.0071	<0.0071	<0.0071	<0.0071
	Acenaphthene	mg/kg	0.005	0.28	0.28	-	-	<0.005	0.0056	3.4	2.1	-	0.0091	0.14	0.61	<0.005	-	-	-	0.01	0.0089	<0.005	<0.005	<0.005	0.011
	Acenaphthylene	mg/kg	0.005	320	320	-	-	<0.005	<0.005	<0.05	<0.05	-	<0.005	<0.05	<0.05	<0.005	-	-	-	<0.005	<0.005	0.013	<0.005	<0.005	<0.005
	Anthracene	mg/kg	0.005	32	32	-	-	<0.005	0.013	7.2	5	-	0.022	0.34	1.4	<0.005	-	-	-	0.021	0.02	0.023	<0.005	<0.005	0.029
	Benzo(a)anthracene	mg/kg	0.005	10	10	-	-	<0.005	0.026	7.2	6	-	0.04	0.38	1.6	<0.005	-	-	-	0.059	0.018	0.02	<0.005	<0.005	0.048
	Benzo(a) pyrene	mg/kg	0.005	1.4	1.4	-	-	<0.005	0.029	5.1	4.5	-	0.035	0.31	1.2	<0.005	-	-	-	0.059	0.013	0.024	<0.005	<0.005	0.04
	Benzo(b & k)fluoranthene	mg/kg	0.005	-	-	-	-	<0.005	0.03	6	5.2	-	0.044	0.35	1.4	<0.005	-	-	-	0.073	0.017	0.038	<0.005	<0.005	0.048
	Benzo(g,h,i)perylene	mg/kg	0.005	-	-	-	-	<0.005	0.061	2.4	2.2	-	0.023	0.21	0.63	0.0063	-	-	-	0.057	0.0082	0.044	<0.005	<0.005	0.027
	Benzo(k)fluoranthene	mg/kg	0.005	10	10	-	-	<0.005	0.011	2.5	2.2	-	0.017	0.13	0.56	<0.005	-	-	-	0.026	0.0064	0.011	<0.005	<0.005	0.019
	Chrysene	mg/kg	0.005	-	-	-	-	0.012	0.019	5	4.2	-	0.029	0.3	1.1	<0.005	-	-	-	0.045	0.013	0.012	<0.005	<0.005	0.033
	Dibenz(a,h)anthracene	mg/kg	0.005	10	10	-	-	<0.005	<0.005	0.84	0.75	-	0.0062	<0.05	0.19	<0.005	-	-	-	0.011	<0.005	0.0057	<0.005	<0.005	0.0073
	Fluoranthene	mg/kg	0.005	180	180	-	-	<0.005	0.062	20	15	-	0.098	0.98	4.2	0.0061	-	-	-	0.1	0.05	0.037	<0.005	<0.005	0.11
	Fluorene	mg/kg	0.005	0.25	0.25	-	-	<0.005	0.0065	4.6	2.8	-	0.0094	0.18	0.78	<0.005	-	-	-	0.011	0.011	<0.005	<0.005	<0.005	0.012
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.005	10	10	-	-	<0.005	0.022	2.7	2.5	-	0.023	0.17	0.66	<0.005	-	-	-	0.043	0.0079	0.037	<0.005	<0.005	0.027
	Naphthalene	mg/kg	0.005	0.013	0.013	-	-	<0.005	<0.005	1.3	0.6	-	<0.005	<0.05	0.14	<0.005	-	-	-	0.0071	<0.005	<0.005	<0.005	<0.005	<0.005
	Phenanthrene	mg/kg	0.005	0.046	0.046	-	-	<0.005	0.044	22	15	-	0.068	0.94	4.1	<0.005	-	-	-	0.062	0.056	0.014	<0.005	<0.005	0.082
	Pyrene	mg/kg	0.005	100	100	-	-	0.0056	0.047	13	10	-	0.07	0.7	2.9	0.007	-	-	-	0.077	0.034	0.035	<0.005	<0.005	0.08
SVOCs	1,2-Dichlorobenzene	mg/kg	0.05	10	10	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,3-dichlorobenzene	mg/kg	0.05	10	10	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
	1,4-dichlorobenzene	mg/kg	0.05	10	10	-	-	<0.05	-	-	<0.05	-	-	-	-	-	-	-	-	-	-	<0.05	-	-	-
Solvents	Methyl Isobutyl Ketone (MIK)	mg/kg	0.5	-	-	-	-	<0.5	-	-	<0.5	-	-	-	-	-	-	-	-	-	-	<0.5	-	-	-
Glycols	Total Glycol	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	<10	-	-	-	-	-	<10	<10	<10	-	-
	Diethylene glycol	mg/kg	10	-	-	-	-	-	-	-	-	-	-	-	<10	-	-	-	-	-	<10	<10	<10	-	-
	Ethylene glycol	mg/kg	10	960	960	-	-	-	-	-	-	-	-	-	<10	-	-	-	-	-	<10	<10	<10	-	-
	Propylene glycol	mg/kg	10	-	6210	-	-	-	-	-	-	-	-	-	<10	-	-	-	-	-	<10	<10	<10	-	-

Notes:
#1 YES
#2 NO
mg/kg - milligrams per kilogram
EQL - estimated quantitation limit

Table 2: Soil Analytical Results (PFAS) - Waste Transfer Station

				Sample Name	SS08	SS09	SS10	SS12	SS13
				Sample Date	2019-07-17	2019-07-17	2019-07-17	2019-07-17	2019-07-17
			Draft FSQG for PFOS - Comm/Ind - Coarse	HC Soil Screening Value for PFAS - Commercial	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2	0.1-0.2
Parameter	Units	EQL			(m)	(m)	(m)	(m)	(m)
8:2 Fluorotelomer Sulfonate (8:2 FtS)	mg/g	0.000001	-	0.00121	<0.000001	<0.000001	0.000001	<0.000001	<0.000001
N-Et-FOSA	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
N-Et-FOSE	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
N-Ethyl perfluorooctane sulfonamidoacetic acid	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
N-Me-FOSA	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
N-Methyl perfluorooctane sulfonamidoacetic acid	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorobutane Sulfonate (PFBS)	mg/g	0.000001	-	0.092	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorobutanoic acid	mg/g	0.000001	-	0.173	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorodecane Sulfonate	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorodecanoic Acid (PFDA)	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorododecanoic Acid (PFDoA)	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluoroheptane sulfonate	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluoroheptanoic Acid (PFHpA)	mg/g	0.000001	-	0.00121	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorohexane Sulfonate (PFHxS)	mg/g	0.000001	-	0.0035	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorohexanoic Acid (PFHxA)	mg/g	0.000001	-	0.00121	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorononanoic Acid (PFNA)	mg/g	0.000001	-	0.00013	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorooctane Sulfonamide (PFOSA)	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorooctane Sulfonate (PFOS)	mg/g	0.000001	0.00014	0.0032	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorooctanoic Acid (PFOA)	mg/g	0.000001	-	0.00105	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluoropentanoic Acid (PFPeA)	mg/g	0.000001	-	0.00121	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorotetradecanoic Acid	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluorotridecanoic Acid	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
Perfluoroundecanoic Acid (PFUnA)	mg/g	0.000001	-	-	<0.000001	<0.000001	<0.000001	<0.000001	<0.000001
6:2 Fluorotelomer Sulfonate (6:2 FtS)	mg/g	0.000001	-	0.00121	0.0000037	<0.000001	<0.000001	<0.000001	<0.000001

Notes:
mg/g - milligrams per gram
EQL - estimated quantitation limit
Draft Federal Soil and Groundwater Quality Guideline for PFOS based on a commercial land use scenario as presented in the Government of Canada's "Interim Advice to Federal Custodian Departments for the management of Federal Contaminated Sites Contaioning Perfluorooctane Sulfonate (PFOS) and other Per- and Polyfluoroalkyl Substances (PFAS)", Version 1.4.1, 2018.
Updates to Health Canada Soil Screening Values for Perfluoroalkylated Substances (PFAS) for Commerical/Industrial land use, 2019.

Table 3: Groundwater Monitoring Results
Baseline Environmental Sampling

Monitoring Well ID	Monitoring Date (dd-mmm-yy)	Depth to Well Bottom (m btoc)	Geology within Screened Interval	Depth to Water (m btoc)	Standpipe Organic Vapour Reading (ppm)	Stick-up Height (m ags)	Top of Casing Elevation (m)	Water Elevation (m asl)
Waste Transfer Station - Monitoring Wells Installed by Dillon (2019)								
19MW-01	18-Jul-19	2.14	Gravel Fill	Dry	-	0.56	-	-
19MW-02	18-Jul-19	2.55	Gravel Fill	2.43	-	1.22	-	-
19MW-03	18-Jul-19	2.54	Gravel Fill	2.26	-	1.05	-	-
19MW-04	18-Jul-19	3.47	Gravel Fill	3.26	-	1.33	-	-
19MW-05	18-Jul-19	3.47	Gravel Fill	2.38	-	1.19	-	-
Landfill - Monitoring Wells Installed by Others								
W-107	06-Sep-19	2.76	-	1.56	210	1.27	-	-
W-108	06-Sep-19	3.37	-	2.15	110	1.21	-	-
W-109	05-Sep-19	3.02	-	1.675	85	1.257	-	-
W-110	05-Sep-19	3.67	-	1.799	110	1.09	-	-
W-111	05-Sep-19	3.38	-	2.53	130	1.705	-	-

Notes:
(-) - No Data
Dry - Well was dry at time of sampling
m - meters
m btoc - meters below top of casing
m asl - meters above sea level
m ags - meters above ground surface
Survey - Not conducted

Table 4: Groundwater Analytical Results - Waste Transfer Station

				Sample Name	19MW-02	19MW-03	19MW-04
				Sample Date	2019-07-18	2019-07-18	2019-07-18
				Fed Interim GWQG - Tier 1, Commercial/Industrial, Coarse			
	Parameter	Units	EQL	mg/L			
Petroleum Hydrocarbons (PHCs)	Reached Baseline at C50	-	-	-	YES	YES	YES
	PHC F1 (C6-C10)	mg/L	0.025	9.1	<0.025	<0.025	<0.025
	PHC F1 (C6-C10) - BTEX	mg/L	0.025	9.1	<0.025	<0.025	<0.025
	PHC F2 (C10-C16)	mg/L	0.1	1.3	0.17	<0.1	<0.1
	PHC F3 (C16-C34)	mg/L	0.2	-	<0.2	<0.2	<0.2
	PHC F4 (C34-C50)	mg/L	0.2	-	<0.2	<0.2	<0.2
Volatile Organic Compounds (VOCs)	1,1,1,2-tetrachloroethane	mg/L	0.0005	0.066	-	<0.0005	<0.0005
	1,1,1-trichloroethane	mg/L	0.0002	1.1	-	<0.0002	<0.0002
	1,1,2,2-tetrachloroethane	mg/L	0.0005	0.063	-	<0.0005	<0.0005
	1,1,2-trichloroethane	mg/L	0.0005	0.091	-	<0.0005	<0.0005
	1,1-dichloroethane	mg/L	0.0002	6.6	-	<0.0002	<0.0002
	1,1-dichloroethene	mg/L	0.0002	0.49	-	<0.0002	<0.0002
	1,2-dibromoethane (Ethylene dibromide)	mg/L	0.0002	0.0051	-	<0.0002	<0.0002
	1,2-dichloroethane	mg/L	0.0005	0.1	-	<0.0005	<0.0005
	1,2-dichloropropane	mg/L	0.0002	0.33	-	<0.0002	<0.0002
	1,3-Dichloropropene	mg/L	0.0005	0.1	-	<0.0005	<0.0005
	Acetone	mg/L	0.01	13	-	<0.01	<0.01
	Bromoform	mg/L	0.001	3.7	-	<0.001	<0.001
	Carbon tetrachloride	mg/L	0.0002	0.0068	-	<0.0002	<0.0002
	Bromodichloroethane	mg/L	0.0005	-	-	<0.0005	<0.0005
	Bromoethane	mg/L	0.0005	-	-	<0.0005	<0.0005
	Chlorobenzene	mg/L	0.0002	0.0013	-	<0.0002	<0.0002
	Chlorodibromomethane	mg/L	0.0005	10	-	<0.0005	<0.0005
	Chloroform	mg/L	0.0002	0.0018	-	<0.0002	<0.0002
	cis-1,2-dichloroethene	mg/L	0.0005	0.03	-	<0.0005	<0.0005
	cis-1,3-dichloropropene	mg/L	0.0003	-	-	<0.0003	<0.0003
	Dichlorodifluoromethane	mg/L	0.001	-	-	<0.001	<0.001
	Dichloromethane	mg/L	0.002	0.098	-	<0.002	<0.002
	Hexane	mg/L	0.001	-	-	<0.001	<0.001
	Methyl Ethyl Ketone (MEK)	mg/L	0.01	150	-	<0.01	<0.01
	Methyl tert-Butyl Ether (MTBE)	mg/L	0.0005	4.3	-	<0.0005	<0.0005
	Styrene	mg/L	0.0005	0.072	-	<0.0005	<0.0005
	Trichloroethene	mg/L	0.0002	0.029	-	<0.0002	<0.0002
	Tetrachloroethene	mg/L	0.0002	0.11	-	<0.0002	<0.0002
	trans-1,2-dichloroethene	mg/L	0.0005	0.03	-	<0.0005	<0.0005
	trans-1,3-dichloropropene	mg/L	0.0004	-	-	<0.0004	<0.0004
	Trichlorofluoromethane	mg/L	0.0005	-	-	<0.0005	<0.0005
	Vinyl chloride	mg/L	0.0002	0.013	-	<0.0002	<0.0002
BTEX	Benzene	mg/L	0.0002	0.69	<0.0002	<0.0002	<0.0002
	Toluene	mg/L	0.0002	0.083	<0.0002	<0.0002	<0.0002
	Ethylbenzene	mg/L	0.0002	11	<0.0002	<0.0002	<0.0002
	Xylene (m & p)	mg/L	0.0002	-	<0.0004	<0.0002	<0.0002
	Xylene (o)	mg/L	0.0002	-	<0.0002	<0.0002	<0.0002
	Xylenes Total	mg/L	0.0002	18	<0.0004	<0.0002	<0.0002
Polycyclic Aromatic Hydrocarbons (PAHs)	1-Methylnaphthalene	mg/L	0.00005	-	0.000057	<0.00005	<0.00005
	2-Methylnaphthalene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	1 & 2 Methylnaphthalene	mg/L	0.000071	0.18	<0.000071	<0.000071	<0.000071
	Acenaphthene	mg/L	0.00005	0.0058	<0.00005	<0.00005	<0.00005
	Acenaphthylene	mg/L	0.00005	0.046	<0.00005	<0.00005	<0.00005
	Anthracene	mg/L	0.00005	0.000012	<0.00005	<0.00005	<0.00005
	Benzo(a)anthracene	mg/L	0.00005	0.000018	<0.00005	<0.00005	<0.00005
	Benzo(a) pyrene	mg/L	0.00001	0.000015	<0.00001	<0.00001	0.000026
	Benzo(b & k)fluoranthene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Benzo(g,h,i)perylene	mg/L	0.00005	0.00017	<0.00005	<0.00005	<0.00005
	Benzo(k)fluoranthene	mg/L	0.00005	0.00048	<0.00005	<0.00005	<0.00005
	Chrysene	mg/L	0.00005	0.0014	<0.00005	<0.00005	<0.00005
	Dibenz(a,h)anthracene	mg/L	0.00005	0.00026	<0.00005	<0.00005	<0.00005
	Fluoranthene	mg/L	0.00005	0.00004	<0.00005	<0.00005	0.000066
	Fluorene	mg/L	0.00005	0.003	<0.00005	<0.00005	<0.00005
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00005	0.00021	<0.00005	<0.00005	<0.00005
	Naphthalene	mg/L	0.00005	0.0011	<0.00005	<0.00005	<0.00005
	Phenanthrene	mg/L	0.00003	0.0004	<0.00003	<0.00003	0.000065
	Pyrene	mg/L	0.00005	0.000025	<0.00005	<0.00005	0.000051
SVOCs	1,2-Dichlorobenzene	mg/L	0.0005	0.0007	-	<0.0005	<0.0005
	1,3-dichlorobenzene	mg/L	0.0005	0.042	-	<0.0005	<0.0005
	1,4-dichlorobenzene	mg/L	0.0005	0.026	-	<0.0005	<0.0005
Solvents	Methyl Isobutyl Ketone (MIK)	mg/L	0.005	58	-	<0.005	<0.005
Glycols	Total Glycol	mg/L	5	-	<5	<5	-
	Diethylene glycol	mg/L	5	-	<5	<5	-
	Ethylene glycol	mg/L	5	190	<5	<5	-
	Propylene glycol	mg/L	5	500	<5	<5	-
Metals	Antimony (Filtered)	mg/L	0.0005	2	<0.0005	<0.0005	<0.0005
	Arsenic (Filtered)	mg/L	0.001	0.005	0.0014	<0.001	<0.001
	Barium (Filtered)	mg/L	0.002	2.9	0.013	0.0057	0.0043
	Beryllium (Filtered)	mg/L	0.0005	0.0053	<0.0005	<0.0005	<0.0005
	Boron (Filtered)	mg/L	0.01	1.5	0.047	0.076	0.063
	Cadmium (Filtered)	mg/L	0.0001	0.00009	<0.0001	<0.0001	<0.0001
	Chromium (6+)	mg/L	0.0005	-	<0.0005	<0.0005	<0.0005
	Chromium Total (III+VI) (Filtered)	mg/L	0.005	0.0089	<0.005	<0.005	<0.005
	Cobalt (Filtered)	mg/L	0.0005	-	0.00052	<0.0005	<0.0005
	Copper (Filtered)	mg/L	0.001	0.002	0.01	0.0062	0.0032
	Lead (Filtered)	mg/L	0.0005	0.001	0.00084	<0.0005	0.00075
	Mercury	mg/L	0.0001	0.000016	<0.0001	<0.0001	<0.0001
	Molybdenum (Filtered)	mg/L	0.0005	0.073	0.0012	0.0016	0.001
	Nickel (Filtered)	mg/L	0.001	0.025	0.0026	<0.001	<0.001
	Selenium (Filtered)	mg/L	0.002	0.001	<0.002	<0.002	<0.002
	Silver (Filtered)	mg/L	0.0001	0.00025	<0.0001	<0.0001	<0.0001
	Sodium (Filtered)	mg/L	0.1	-	5.6	6.5	5.1
	Thallium (Filtered)	mg/L	0.00005	0.0008	<0.00005	<0.00005	<0.00005
	Uranium (Filtered)	mg/L	0.0001	0.015	0.00078	0.0013	0.00079
	Vanadium (Filtered)	mg/L	0.0005	-	0.0016	<0.0005	<0.0005
	Zinc (Filtered)	mg/L	0.005	0.03	0.0097	<0.005	<0.005

Notes:
Grey shaded cells - exceedance of Federal Interim Groundwater Quality Guidelines - Tier 1, Commercial/Industrial, Coarse
EQL - estimated quantitation limit
mg/L - milligrams per litre
Underline - EQL exceeds guideline
Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (2016), Tier 1 Guidelines (Commercial/Indu

Table 5: Groundwater Analytical Results (PFAS) - Waste Transfer Station

	Parameter	Units	EQL	Draft FEQG for PFOS - GW Final (Ecological Receptors)	Draft FEQG for PFOS - Surface Water	HC Drinking Water Screening Value for PFAS	19MW-02	19MW-03
						Sample Date	2019-07-18	2019-07-18
Perfluoroalkyl Substances	8:2 Fluorotelomer Sulfonate (8:2 FtS)	mg/L	0.00002	-	-	0.0002	0.00016	<0.00002
	N-Et-FOSA	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	N-Et-FOSE	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	N-Ethyl perfluorooctane sulfonamidoacetic acid	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	N-Me-FOSA	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	N-Methyl perfluorooctane sulfonamidoacetic acid	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluorobutane Sulfonate (PFBS)	mg/L	0.00002	-	-	0.015	<0.00002	<0.00002
	Perfluorobutanoic acid	mg/L	0.00002	-	-	0.03	0.00012	0.00003
	Perfluorodecane Sulfonate	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluorodecanoic Acid (PFDA)	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluorododecanoic Acid (PFDoA)	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluoroheptane sulfonate	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluoroheptanoic Acid (PFHpA)	mg/L	0.00002	-	-	0.0002	0.00037	0.000042
	Perfluorohexane Sulfonate (PFHxS)	mg/L	0.00002	-	-	0.0006	<0.00002	0.000036
	Perfluorohexanoic Acid (PFHxA)	mg/L	0.00002	-	-	0.0002	0.00055	0.000055
	Perfluorononanoic Acid (PFNA)	mg/L	0.00002	-	-	0.00002	0.00012	<0.00002
	Perfluorooctane Sulfonamide (PFOSA)	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluorooctane Sulfonate (PFOS)	mg/L	0.00002	0.0068	0.0068	-	0.00004	0.00026
	Perfluorooctanoic Acid (PFOA)	mg/L	0.00002	-	-	-	0.00032	0.000059
	Perfluoropentanoic Acid (PFPeA)	mg/L	0.00002	-	-	0.0002	0.00099	0.000086
	Perfluorotetradecanoic Acid	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluorotridecanoic Acid	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	Perfluoroundecanoic Acid (PFUnA)	mg/L	0.00002	-	-	-	<0.00002	<0.00002
	N-Methylperfluorooctanesulfonamidoethanol (N-MeFOSE)	ug/L	0.02	-	-	-	<0.02	<0.02
	Perfluorononanesulfonic acid (PFNS)	ug/L	0.02	-	-	-	<0.02	<0.02
	Perfluoropentansulfonic acid (PFPeS)	ug/L	0.02	-	-	-	<0.02	<0.02
	6:2 Fluorotelomer Sulfonate (6:2 FtS)	mg/L	0.00002	-	-	0.0002	0.0016	0.000046

Notes:
mg/L - milligrams per litre
EQL - estimated quantitation limit
Draft Federal Soil and Groundwater Quality Guideline for PFOS based on a commercial land use scenario as presented in the Government of Canada's "Interim Advice to Federal Custodian Departments for the management of Federal Contaminated Sites Containing Perfluorooctane Sulfonate (PFOS) and other Per- and Polyfluoroalkyl Substances (PFAS)", Version 1.4.1, 2018.
Health Canada Water Screening Values for Perfluoroalkylated Substances, 2018.

Table 6: Surface Water Analytical Results - Waste Transfer Station

DILLON CONSULTING

	Parameter	Units	EQL	CCME CWQG for the Protection of Freshwater Aquatic Life - Long Term	SW1	SW2	SW3
				Sample Name	SW1	SW2	SW3
				Sample Date	2019-07-16	2019-07-16	2019-07-16
				mg/L			
Petroleum Hydrocarbons (PHCs)	Reached Baseline at C50	-	-	-	YES	YES	YES
	PHC F1 (C6-C10)	mg/L	0.025	-	<0.025	<0.025	<0.025
	PHC F1 (C6-C10) - BTEX	mg/L	0.025	-	<0.025	<0.025	<0.025
	PHC F2 (C10-C16)	mg/L	0.1	-	<0.1	<0.1	<0.1
	PHC F3 (C16-C34)	mg/L	0.2	-	<0.2	<0.2	<0.2
	PHC F4 (C34-C50)	mg/L	0.2	-	<0.2	<0.2	<0.2
BTEX	Benzene	mg/L	0.0002	0.37	<0.0002	<0.0002	<0.0002
	Toluene	mg/L	0.0002	0.002	<0.0002	<0.0002	<0.0002
	Ethylbenzene	mg/L	0.0002	0.09	<0.0002	<0.0002	<0.0002
	Xylene (m & p)	mg/L	0.0002	-	<0.0004	<0.0004	<0.0004
	Xylene (o)	mg/L	0.0002	-	<0.0002	<0.0002	<0.0002
	Xylenes Total	mg/L	0.0002	-	<0.0004	<0.0004	<0.0004
Polycyclic Aromatic Hydrocarbons (PAHs)	1-Methylnaphthalene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	2-Methylnaphthalene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	1 & 2 Methylnaphthalene	mg/L	0.000071	-	<0.000071	<0.000071	<0.000071
	Acenaphthene	mg/L	0.00005	0.0058	<0.00005	<0.00005	<0.00005
	Acenaphthylene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Anthracene	mg/L	0.00005	0.000012	<u><0.00005</u>	<u><0.00005</u>	<u><0.00005</u>
	Benzo(a)anthracene	mg/L	0.00005	0.000018	<u><0.00005</u>	<u><0.00005</u>	<u><0.00005</u>
	Benzo(a) pyrene	mg/L	0.00001	0.000015	<0.00001	<0.00001	<0.00001
	Benzo(b & k)fluoranthene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Benzo(g,h,i)perylene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Benzo(k)fluoranthene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Chrysene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Dibenz(a,h)anthracene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Fluoranthene	mg/L	0.00005	0.00004	<u><0.00005</u>	<u><0.00005</u>	<u><0.00005</u>
	Fluorene	mg/L	0.00005	0.003	<0.00005	<0.00005	<0.00005
	Indeno(1,2,3-c,d)pyrene	mg/L	0.00005	-	<0.00005	<0.00005	<0.00005
	Naphthalene	mg/L	0.00005	0.0011	<0.00005	<0.00005	<0.00005
	Phenanthrene	mg/L	0.00003	0.0004	<0.00003	<0.00003	<0.00003
	Pyrene	mg/L	0.00005	0.000025	<u><0.00005</u>	<u><0.00005</u>	<u><0.00005</u>
Metals	Antimony	mg/L	0.0005	-	<0.0005	<0.0005	<0.0005
	Arsenic	mg/L	0.001	0.005	<0.001	<0.001	<0.001
	Barium	mg/L	0.002	-	0.0028	0.0028	0.0029
	Beryllium	mg/L	0.0005	0.0053	<0.0005	<0.0005	<0.0005
	Boron	mg/L	0.01	1.5	<0.01	<0.01	<0.01
	Cadmium	mg/L	0.0001	0.00009	<u><0.0001</u>	<u><0.0001</u>	<u><0.0001</u>
	Chromium (6+)	mg/L	0.0005	-	<0.0005	<0.0005	<0.0005
	Chromium Total (III+VI) (Filtered)	mg/L	0.005	-	<0.005	<0.005	<0.005
	Cobalt	mg/L	0.0005	-	<0.0005	<0.0005	<0.0005
	Copper	mg/L	0.001	See footnote 1	<0.001	<0.001	<0.001
	Lead	mg/L	0.0005	See footnote 1	<0.0005	<0.0005	<0.0005
	Mercury	mg/L	0.0001	0.000016	<u><0.0001</u>	<u><0.0001</u>	<u><0.0001</u>
	Molybdenum	mg/L	0.0005	0.073	<0.0005	<0.0005	<0.0005
	Nickel	mg/L	0.001	See footnote 1	<0.001	<0.001	<0.001
	Selenium	mg/L	0.002	0.001	<u><0.002</u>	<u><0.002</u>	<u><0.002</u>
	Silver	mg/L	0.0001	0.00025	<0.0001	<0.0001	<0.0001
	Sodium	mg/L	0.1	-	1	1	1.1
	Thallium	mg/L	0.00005	0.0008	<0.00005	<0.00005	<0.00005
	Uranium	mg/L	0.0001	0.015	<0.0001	<0.0001	<0.0001
	Vanadium	mg/L	0.0005	-	<0.0005	<0.0005	<0.0005
	Zinc	mg/L	0.005	0.007	<0.005	<0.005	<0.005

Notes:
1 - Copper, lead, and nickel guidelines vary with hardness. See CCME CWQG
Grey shaded cells - exceedance of CCME Canadian Water Quality Guideline for the Protection of Freshwater Aquatic Life
EQL - estimated quantitation limit
mg/L - milligrams per litre
<u>Underline</u> - EQL exceeds guideline
Federal Contaminated Sites Action Plan (FCSAP) Guidance Document on Federal Interim Groundwater Quality Guidelines for Federal Contaminated Sites (2016), Tier 1 Guidelines (Commercial/Indu

Table 7: Analytical Results for Groundwater at the Landfill

	Parameter	Units	EQL	Fed Interim GWQG - Tier 1, Commercial/Industrial, Coarse	W-107	W-108	W-109	W-110
				Sample Date	2019-09-06	2019-09-06	2019-09-05	2019-09-05
				mg/L				
General Chemistry	Bicarbonate	mg/L	1	-	570	77	160	47
	Carbonate	mg/L	1	-	<1	<1	<1	<1
	Hydroxide	mg/L	1	-	<1	<1	<1	<1
	Alkalinity (total) as CaCO3	mg/L	1	-	460	63	130	39
	Phenolphthalein Alkalinity	mg/L	1	-	<1	<1	<1	<1
	Ammonia (as N)	mg/L	0.015	-	0.26	0.023	0.016	0.019
	Kjeldahl Nitrogen Total	mg/L	0.05	-	2.3[1]	0.17	3.4[1]	0.24
	Nitrate (as N) (Filtered)	mg/L	0.01	-	0.018	0.064	<0.01	0.083
	Nitrate (as NO3-) (Filtered)	mg/L	0.044	13	0.08	0.29	<0.044	0.37
	Nitrate + Nitrite (as N)	mg/L	0.014	-	0.17	0.064	<0.014	0.083
	Nitrite (as N) (Filtered)	mg/L	0.01	0.06	0.15	<0.01	<0.01	<0.01
	Nitrite (as NO2-) (Filtered)	mg/L	0.033	-	0.5	<0.033	<0.033	<0.033
	Phosphorus	mg/L	0.1	-	2.3	0.15	0.67	<0.1
	Phosphorus (Filtered)	mg/L	0.1	-	<0.1	<0.1	<0.1	<0.1
	Electrical conductivity (lab)	µS/cm	2	-	3000	140	250	89
	Chloride (Filtered)	mg/L	1	120	80	2	2.3	1.9
	pH (Lab)	pH Unit	-	6.5-9	7.55	7.67	7.88	7.71
	Sulphate (SO4) (Filtered)	mg/L	1	100	1400[1]	4.5	<1	3.8
Calculated Parameters	Hardness (as CaCO3)	mg/L	0.5	-	1900	64	110	40
	Ionic Balance	%	-	-	1.6	2.3	7.2	4.8
	Total Dissolved Solids (TDS) - Calculated	mg/L	10	-	2400	70	120	45
	Anions Total	meq/L	-	-	41	1.4	2.6	0.91
	Cations Total	meq/L	-	-	40	1.4	2.3	0.83
Metals	Aluminium (Filtered)	mg/L	0.003	0.005	0.0044	0.0083	0.015	0.014
	Antimony (Filtered)	mg/L	0.0006	2	0.0023	<0.0006	0.00087	<0.0006
	Arsenic (Filtered)	mg/L	0.0002	0.005	0.00036	<0.0002	<0.0002	<0.0002
	Barium (Filtered)	mg/L	0.01	2.9	0.059	<0.01	0.017	<0.01
	Beryllium (Filtered)	mg/L	0.001	0.0053	<0.001	<0.001	<0.001	<0.001
	Boron (Filtered)	mg/L	0.02	1.5	<0.02	<0.02	<0.02	<0.02
	Cadmium (Filtered)	mg/L	0.00002	0.00009	0.00014	0.000025	0.0007	<0.00002
	Calcium (Filtered)	mg/L	0.3	-	260	21	40	12
	Chromium Total (III+VI) (Filtered)	mg/L	0.001	0.0089	<0.001	<0.001	<0.001	<0.001
	Cobalt (Filtered)	mg/L	0.0003	-	0.011	<0.0003	<0.0003	<0.0003
	Copper (Filtered)	mg/L	0.0002	0.002	0.0047	0.0039	0.0074	0.0039
	Iron (Filtered)	mg/L	0.06	0.3	0.63	<0.06	<0.06	<0.06
	Lead (Filtered)	mg/L	0.0002	0.001	0.00023	<0.0002	<0.0002	<0.0002
	Lithium (Filtered)	mg/L	0.02	-	<0.02	<0.02	<0.02	<0.02
	Magnesium (Filtered)	mg/L	0.2	-	310	2.7	2.8	2.3
	Manganese (Filtered)	mg/L	0.004	-	8.1	0.009	0.014	0.012
	Molybdenum (Filtered)	mg/L	0.0002	0.073	0.003	0.0005	0.00081	0.00038
	Nickel (Filtered)	mg/L	0.0005	0.025	0.0094	0.0048	0.0011	<0.0005
	Potassium (Filtered)	mg/L	0.3	-	4.3	0.44	0.6	<0.3
	Selenium (Filtered)	mg/L	0.0002	0.001	<0.0002	<0.0002	<0.0002	<0.0002
	Silicon (Filtered)	mg/L	0.1	-	7.7	2.8	2.3	2.1
	Silver (Filtered)	mg/L	0.0001	0.00025	<0.0001	<0.0001	<0.0001	<0.0001
	Sodium (Filtered)	mg/L	0.5	-	22	1.3	1.1	0.83
	Strontium (Filtered)	mg/L	0.02	-	0.54	0.043	0.055	0.02
	Sulphur (as S) (Filtered)	mg/L	0.2	-	470	1.5	0.53	1.1
	Thallium (Filtered)	mg/L	0.0002	0.0008	<0.0002	<0.0002	<0.0002	<0.0002
	Tin (Filtered)	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001
	Titanium (Filtered)	mg/L	0.001	0.1	<0.001	<0.001	<0.001	<0.001
	Uranium (Filtered)	mg/L	0.0001	0.015	0.012	<0.0001	0.00024	<0.0001
	Vanadium (Filtered)	mg/L	0.001	-	<0.001	<0.001	<0.001	<0.001
	Zinc (Filtered)	mg/L	0.003	0.03	0.0072	0.0039	0.0043	0.0036

Notes:
[1] Detection limits raised due to dilution to bring analyte within the calibrated range.
Grey shaded cells - exceedance of Federal Interim Groundwater Quality Guidelines - Tier 1, Commercial/Industrial, Coarse
mg/L - milligrams per litre
EQL - estimated quantitation limit
Underline - EQL exceeds guideline

Table 7: Analytical Results for Groundwater at the Landfill

				Sample Name	W-111
				Sample Date	2019-09-05
				Fed Interim GWQG - Tier 1, Commercial/Industrial, Coarse	
	Parameter	Units	EQL	mg/L	
General Chemistry	Bicarbonate	mg/L	1	-	73
	Carbonate	mg/L	1	-	<1
	Hydroxide	mg/L	1	-	<1
	Alkalinity (total) as CaCO3	mg/L	1	-	60
	Phenolphthalein Alkalinity	mg/L	1	-	<1
	Ammonia (as N)	mg/L	0.015	-	0.03
	Kjeldahl Nitrogen Total	mg/L	0.05	-	14[1]
	Nitrate (as N) (Filtered)	mg/L	0.01	-	0.044
	Nitrate (as NO3-) (Filtered)	mg/L	0.044	13	0.2
	Nitrate + Nitrite (as N)	mg/L	0.014	-	0.044
	Nitrite (as N) (Filtered)	mg/L	0.01	0.06	<0.01
	Nitrite (as NO2-) (Filtered)	mg/L	0.033	-	<0.033
	Phosphorus	mg/L	0.1	-	5.1
	Phosphorus (Filtered)	mg/L	0.1	-	<0.1
	Electrical conductivity (lab)	µS/cm	2	-	130
	Chloride (Filtered)	mg/L	1	120	1.3
	pH (Lab)	pH Unit	-	6.5-9	8.11
	Sulphate (SO4) (Filtered)	mg/L	1	100	3.3
Calculated Parameters	Hardness (as CaCO3)	mg/L	0.5	-	56
	Ionic Balance	%	-	-	5.1
	Total Dissolved Solids (TDS) - Calculated	mg/L	10	-	63
	Anions Total	meq/L	-	-	1.3
	Cations Total	meq/L	-	-	1.2
Metals	Aluminium (Filtered)	mg/L	0.003	0.005	0.014
	Antimony (Filtered)	mg/L	0.0006	2	<0.0006
	Arsenic (Filtered)	mg/L	0.0002	0.005	<0.0002
	Barium (Filtered)	mg/L	0.01	2.9	<0.01
	Beryllium (Filtered)	mg/L	0.001	0.0053	<0.001
	Boron (Filtered)	mg/L	0.02	1.5	<0.02
	Cadmium (Filtered)	mg/L	0.00002	0.00009	0.00003
	Calcium (Filtered)	mg/L	0.3	-	20
	Chromium Total (III+VI) (Filtered)	mg/L	0.001	0.0089	<0.001
	Cobalt (Filtered)	mg/L	0.0003	-	<0.0003
	Copper (Filtered)	mg/L	0.0002	0.002	0.004
	Iron (Filtered)	mg/L	0.06	0.3	<0.06
	Lead (Filtered)	mg/L	0.0002	0.001	<0.0002
	Lithium (Filtered)	mg/L	0.02	-	<0.02
	Magnesium (Filtered)	mg/L	0.2	-	1.4
	Manganese (Filtered)	mg/L	0.004	-	0.011
	Molybdenum (Filtered)	mg/L	0.0002	0.073	0.0013
	Nickel (Filtered)	mg/L	0.0005	0.025	<0.0005
	Potassium (Filtered)	mg/L	0.3	-	0.37
	Selenium (Filtered)	mg/L	0.0002	0.001	<0.0002
	Silicon (Filtered)	mg/L	0.1	-	3.4
	Silver (Filtered)	mg/L	0.0001	0.00025	<0.0001
	Sodium (Filtered)	mg/L	0.5	-	1.1
	Strontium (Filtered)	mg/L	0.02	-	0.029
	Sulphur (as S) (Filtered)	mg/L	0.2	-	1.2
	Thallium (Filtered)	mg/L	0.0002	0.0008	<0.0002
	Tin (Filtered)	mg/L	0.001	-	<0.001
	Titanium (Filtered)	mg/L	0.001	0.1	<0.001
	Uranium (Filtered)	mg/L	0.0001	0.015	0.00019
	Vanadium (Filtered)	mg/L	0.001	-	<0.001
	Zinc (Filtered)	mg/L	0.003	0.03	0.0032

Notes:
[1] Detection limits raised due to dilution to bring analyte within the calibrated range.
Grey shaded cells - exceedance of Federal Interim Groundwater Quality Guidelines - Tier 1, Commercial/Industrial, Coarse
mg/L - milligrams per litre
EQL - estimated quantitation limit
Underline - EQL exceeds guideline

Table 8: Analytical Results for Surface Water at the Landfill

	Parameter	Units	EQL	CCME CWQG for the Protection of Freshwater Aquatic Life - Long Term (mg/L)	WS-100 (2019-09-06)	WS-101 (2019-09-06)	WS-102 (2019-09-06)
General Chemistry	Bicarbonate	mg/L	1	-	33	84	53
	Carbonate	mg/L	1	-	<1	<1	<1
	Hydroxide	mg/L	1	-	<1	<1	<1
	Alkalinity (total) as CaCO3	mg/L	1	-	27	69	44
	Phenolphthalein Alkalinity	mg/L	1	-	<1	<1	<1
	Ammonia (as N)	mg/L	0.015	See footnote 1	0.023	0.022	<0.015
	Kjeldahl Nitrogen Total	mg/L	0.05	-	0.13	0.3	0.1
	Nitrate (as N) (Filtered)	mg/L	0.01	-	<0.01	<0.01	<0.01
	Nitrate (as NO3-) (Filtered)	mg/L	0.044	13	<0.044	<0.044	<0.044
	Nitrate + Nitrite (as N)	mg/L	0.014	-	<0.014	<0.014	<0.014
	Nitrite (as N) (Filtered)	mg/L	0.01		<0.01	<0.01	<0.01
	Nitrite (as NO2-) (Filtered)	mg/L	0.033		<0.033	<0.033	<0.033
	Phosphorus	mg/L	0.1	-	<0.1	<0.1	<0.1
	Phosphorus (Filtered)	mg/L	0.1	-	-	-	-
	Electrical conductivity (lab)	µS/cm	2	-	61	160	96
	Chloride (Filtered)	mg/L	1	120	1.9	2.3	<1
	pH (Lab)	pH Unit	-		7.72	8.03	7.77
	Sulphate (SO4) (Filtered)	mg/L	1		2.8	8.5	4
Calculated Parameters	Hardness (as CaCO3)	mg/L	0.5	-	27	75	46
	Ionic Balance	%	-	-	6.6	2	0.83
	Total Dissolved Solids (TDS) - Calculated	mg/L	10	-	32	83	48
	Anions Total	meq/L	-	-	0.65	1.6	0.96
	Cations Total	meq/L	-	-	0.57	1.6	0.94
Metals	Aluminium	mg/L	0.003	0.1 (see footnote 2)	0.029	0.0097	0.0063
	Antimony	mg/L	0.0006	-	<0.0006	<0.0006	<0.0006
	Arsenic	mg/L	0.0002	0.005	<0.0002	<0.0002	<0.0002
	Barium	mg/L	0.01	-	<0.01	<0.01	<0.01
	Beryllium	mg/L	0.001	-	<0.001	<0.001	<0.001
	Boron	mg/L	0.02	1.5	<0.02	<0.02	<0.02
	Cadmium	mg/L	0.00002	0.00009	<0.00002	<0.00002	<0.00002
	Calcium	mg/L	0.3	-	8.4	25	15
	Chromium Total (III+VI)	mg/L	0.001	-	<0.001	<0.001	<0.001
	Cobalt	mg/L	0.0003	-	<0.0003	<0.0003	<0.0003
	Copper	mg/L	0.0002	See footnote 3	0.00044	0.00064	0.00069
	Iron	mg/L	0.06	0.3	<0.06	0.097	<0.06
	Lead	mg/L	0.0002	See footnote 3	<0.0002	<0.0002	<0.0002
	Lithium	mg/L	0.02	-	<0.02	<0.02	<0.02
	Magnesium	mg/L	0.2	-	0.78	1.8	1.4
	Manganese	mg/L	0.004	-	<0.004	<0.004	<0.004
	Molybdenum	mg/L	0.0002	0.073	<0.0002	0.00023	0.00023
	Nickel	mg/L	0.0005	See footnote 3	<0.0005	<0.0005	<0.0005
	Potassium	mg/L	0.3	-	<0.3	0.3	<0.3
	Selenium	mg/L	0.0002	0.001	<0.0002	<0.0002	<0.0002
	Silicon	mg/L	0.1	-	1.1	2.1	1.3
	Silver	mg/L	0.0001	0.00025	<0.0001	<0.0001	<0.0001
	Sodium	mg/L	0.5	-	0.59	1.2	0.75
	Strontium	mg/L	0.02	-	<0.02	0.035	0.021
	Sulphur (as S)	mg/L	0.2	-	0.85	2.7	1.3
	Thallium	mg/L	0.0002	0.0008	<0.0002	<0.0002	<0.0002
	Tin	mg/L	0.001	-	<0.001	<0.001	<0.001
	Titanium	mg/L	0.001	-	<0.001	<0.001	<0.001
	Uranium	mg/L	0.0001	0.015	<0.0001	<0.0001	<0.0001
	Vanadium	mg/L	0.001	-	<0.001	<0.001	<0.001
	Zinc	mg/L	0.003	0.007	<0.003	<0.003	<0.003

Notes:
1 - Ammonia guideline varies with pH and temperature. See Ammonia Factsheet (CCME CWQG)
2 - Aluminum guideline varies with pH. See CCME CWQG
3 - Copper, lead, and nickel guidelines vary with hardness. See CCME CWQG
Grey shaded cells - exceedance of CCME Canadian Water Quality Guideline for the Protection of Freshwater Aquatic Life
mg/L - milligrams per litre
EQL - estimated quantitation limit
Underline - EQL exceeds guideline

Table 9: Soil QA/QC Results

			SDG	B9K5175	B9K5175	
			Field ID	TP1	QAQC01	**RPD**
			Sampled Date/Time	2019-07-18 14:25	2019-07-18 14:25	
Chem_Group	**ChemName**	**Units**	**EQL**			
Petroleum Hydrocarbons (PHCs)	Reached Baseline at C50	-		1	1	0
	PHC F1 (C6-C10)	mg/kg	10	<10	<10	0
	PHC F1 (C6-C10) - BTEX	mg/kg	10	<10	<10	0
	PHC F2 (C10-C16)	mg/kg	10	<10	<10	0
	PHC F3 (C16-C34)	mg/kg	50	<50	<50	0
	PHC F4 (C34-C50)	mg/kg	50	<50	<50	0
Sample Preparation	Moisture Content (dried @ 103°C)	mg/kg	1000	5100	5400	6
BTEX	Benzene	mg/kg	0.02	<0.02	<0.02	0
	Toluene	mg/kg	0.02	<0.02	<0.02	0
	Ethylbenzene	mg/kg	0.02	<0.02	<0.02	0
	Xylene (m & p)	mg/kg	0.04	<0.04	<0.04	0
	Xylene (o)	mg/kg	0.02	<0.02	<0.02	0
	Xylenes Total	mg/kg	0.04	<0.04	<0.04	0
Polycyclic Aromatic Hydrocarbons (PAHs)	1-Methylnaphthalene	mg/kg	0.005	<0.005	<0.005	0
	2-Methylnaphthalene	mg/kg	0.005	<0.005	<0.005	0
	1 & 2 Methylnaphthalene	mg/kg	0.0071	<0.0071	<0.0071	0
	Acenaphthene	mg/kg	0.005	<0.005	<0.005	0
	Acenaphthylene	mg/kg	0.005	<0.005	<0.005	0
	Anthracene	mg/kg	0.005	<0.005	<0.005	0
	Benzo(a)anthracene	mg/kg	0.005	<0.005	<0.005	0
	Benzo(a) pyrene	mg/kg	0.005	<0.005	<0.005	0
	Benzo(b & k)fluoranthene	mg/kg	0.005	<0.005	<0.005	0
	Benzo(g,h,i)perylene	mg/kg	0.005	<0.005	<0.005	0
	Benzo(k)fluoranthene	mg/kg	0.005	<0.005	<0.005	0
	Chrysene	mg/kg	0.005	<0.005	<0.005	0
	Dibenz(a,h)anthracene	mg/kg	0.005	<0.005	<0.005	0
	Fluoranthene	mg/kg	0.005	<0.005	<0.005	0
	Fluorene	mg/kg	0.005	<0.005	<0.005	0
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.005	<0.005	<0.005	0
	Naphthalene	mg/kg	0.005	<0.005	<0.005	0
	Phenanthrene	mg/kg	0.005	<0.005	<0.005	0
	Pyrene	mg/kg	0.005	<0.005	<0.005	0

*RPDs have only been considered where a concentration is greater than 1 times the EQL.

**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 80 (1-10 x EQL); 50 (10-30 x EQL); 30 (> 30 x EQL))

***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laborat

Table 10: Water QA/QC Results

			SDG	M086514,M046197	M086514,M046197		M086514,M046197	M086514,M046197		M086514,M046197	M086514,M046197	
			Field ID	W-110	QA/QC 2	**RPD**	WS-100	QA/QC 3	**RPD**	WS-102	QA/QC 4	**RPD**
			Sampled Date/Time	2019-09-05	2019-09-05		2019-09-06 10:00	2019-09-06 10:00		2019-09-06	2019-09-06	
Chem_Group	**ChemName**	**Units**	**EQL**									
General Chemistry	Bicarbonate	mg/l	1	47	48	2	**33**	**<1**	**188**	53	55	4
	Carbonate	mg/l	1	<1	<1	0	<1	<1	0	<1	<1	0
	Hydroxide	mg/l	1	<1	<1	0	<1	<1	0	<1	<1	0
	Alkalinity (total) as CaCO3	mg/l	1	39	39	0	**27**	**<1**	**186**	44	45	2
	Phenolphthalein Alkalinity	mg/l	1	<1	<1	0	<1	<1	0	<1	<1	0
	Ammonia (as N)	mg/l	0.015	0.019	0.016	17	0.023	0.022	4	**<0.015**	**0.046**	**102**
	Kjeldahl Nitrogen Total	mg/l	0.05	0.24	0.19	23	**0.13**	**<0.05**	**89**	0.1	0.1	0
	Nitrate (as N) (Filtered)	mg/l	0.01	0.083	0.082	1	<0.01	<0.01	0	<0.01	<0.01	0
	Nitrate (as NO3-) (Filtered)	mg/l	0.044	0.37	0.36	3	<0.044	<0.044	0	<0.044	<0.044	0
	Nitrate + Nitrite (as N)	mg/l	0.014	0.083	0.082	1	<0.014	<0.014	0	<0.014	<0.014	0
	Nitrite (as N) (Filtered)	mg/l	0.01	<0.01	<0.01	0	<0.01	<0.01	0	<0.01	<0.01	0
	Nitrite (as NO2-) (Filtered)	mg/l	0.033	<0.033	<0.033	0	<0.033	<0.033	0	<0.033	<0.033	0
	Phosphorus	mg/l	0.1	<0.1	0.1	0	<0.1	<0.1	0	<0.1	<0.1	0
	Phosphorus (Filtered)	mg/l	0.1	<0.1	<0.1	0						
	Electrical conductivity (lab)	µS/cm	2	89	87	2	**61**	**<2**	**187**	96	100	4
	Chloride (Filtered)	mg/l	1	1.9	1.4	30	1.9	<1	62	<1	1.3	26
	pH (Lab)	pH Unit		7.71	7.7	0	7.72	5.74	29	7.77	7.87	1
	Sulphate (SO4) (Filtered)	mg/l	1	3.8	3.8	0	**2.8**	**<1**	**95**	4	4	0
Calculated Parameters	Hardness (as CaCO3)	mg/l	0.5	40	40	0	**27**	**<0.5**	**193**	46	46	0
	Ionic Balance	%		4.8	4.1	16				0.83	3.5	123
	Total Dissolved Solids (TDS) - Calculated	mg/l	10	45	44	2	**32**	**<10**	**105**	48	50	4
	Anions Total	meq/L		0.91	0.91	0	0.65	0.0E0	200	0.96	1	4
	Cations Total	meq/L		0.83	0.84	1	0.57	0.003	198	0.94	0.95	1
Metals	Aluminium	mg/l	0.003	3.9	4	3	**0.029**	**0.0041**	**150**	0.0063	0.0081	25
	Aluminium (Filtered)	mg/l	0.003	0.014	0.014	0						
	Antimony	mg/l	0.0006	<0.0006	<0.0006	0	<0.0006	<0.0006	0	<0.0006	<0.0006	0
	Antimony (Filtered)	mg/l	0.0006	<0.0006	<0.0006	0						
	Arsenic	mg/l	0.0002	0.00073	0.00064	13	<0.0002	<0.0002	0	<0.0002	<0.0002	0
	Arsenic (Filtered)	mg/l	0.0002	<0.0002	<0.0002	0						
	Barium	mg/l	0.01	0.035	0.036	3	<0.01	<0.01	0	<0.01	<0.01	0
	Barium (Filtered)	mg/l	0.01	<0.01	<0.01	0						
	Beryllium	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Beryllium (Filtered)	mg/l	0.001	<0.001	<0.001	0						
	Boron	mg/l	0.02	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0
	Boron (Filtered)	mg/l	0.02	<0.02	<0.02	0						
	Cadmium	mg/l	2e-005	0.000054	0.000056	4	<0.00002	<0.00002	0	<0.00002	<0.00002	0
	Cadmium (Filtered)	mg/l	2e-005	<0.00002	<0.00002	0						
	Calcium	mg/l	0.3	13	13	0	**8.4**	**<0.3**	**186**	15	15	0
	Calcium (Filtered)	mg/l	0.3	12	12	0	**9.4**	**<0.3**	**188**	16	16	0
	Chromium Total (III+VI)	mg/l	0.001	0.0058	0.0062	7	<0.001	<0.001	0	<0.001	<0.001	0
	Chromium Total (III+VI) (Filtered)	mg/l	0.001	<0.001	<0.001	0						
	Cobalt	mg/l	0.0003	0.0031	0.003	3	<0.0003	<0.0003	0	<0.0003	<0.0003	0
	Cobalt (Filtered)	mg/l	0.0003	<0.0003	<0.0003	0						
	Copper	mg/l	0.0002	0.014	0.014	0	0.00044	0.00023	63	0.00069	0.00074	7
	Copper (Filtered)	mg/l	0.0002	**0.0039**	**0.0011**	**112**						
	Iron	mg/l	0.06	7.8	7.8	0	<0.06	<0.06	0	<0.06	<0.06	0
	Iron (Filtered)	mg/l	0.06	<0.06	<0.06	0	<0.06	<0.06	0	<0.06	<0.06	0

Table 10: Water QA/QC Results

			SDG	M086514,M046197	M086514,M046197		M086514,M046197	M086514,M046197		M086514,M046197	M086514,M046197	
			Field ID	W-110	QA/QC 2	**RPD**	WS-100	QA/QC 3	**RPD**	WS-102	QA/QC 4	**RPD**
			Sampled Date/Time	2019-09-05	2019-09-05		2019-09-06 10:00	2019-09-06 10:00		2019-09-06	2019-09-06	
	Lead	mg/l	0.0002	0.0029	0.003	3	<0.0002	<0.0002	0	<0.0002	<0.0002	0
	Lead (Filtered)	mg/l	0.0002	<0.0002	<0.0002	0						
	Lithium	mg/l	0.02	<0.02	<0.02	0	<0.02	<0.02	0	<0.02	<0.02	0
	Lithium (Filtered)	mg/l	0.02	<0.02	<0.02	0						
	Magnesium	mg/l	0.2	4.2	4.2	0	**0.78**	**<0.2**	**118**	1.4	1.4	0
	Magnesium (Filtered)	mg/l	0.2	2.3	2.3	0	**0.87**	**<0.2**	**125**	1.4	1.5	7
	Manganese	mg/l	0.004	0.18	0.18	0	<0.004	<0.004	0	<0.004	<0.004	0
	Manganese (Filtered)	mg/l	0.004	0.012	0.012	0	<0.004	<0.004	0	<0.004	<0.004	0
	Molybdenum	mg/l	0.0002	0.00047	0.00048	2	<0.0002	<0.0002	0	0.00023	0.00025	8
	Molybdenum (Filtered)	mg/l	0.0002	0.00038	0.00032	17						
	Nickel	mg/l	0.0005	0.0064	0.0064	0	<0.0005	<0.0005	0	<0.0005	<0.0005	0
	Nickel (Filtered)	mg/l	0.0005	<0.0005	<0.0005	0						
	Potassium	mg/l	0.3	0.88	0.87	1	<0.3	<0.3	0	<0.3	<0.3	0
	Potassium (Filtered)	mg/l	0.3	<0.3	<0.3	0	<0.3	<0.3	0	<0.3	<0.3	0
	Selenium	mg/l	0.0002	<0.0002	<0.0002	0	<0.0002	<0.0002	0	<0.0002	<0.0002	0
	Selenium (Filtered)	mg/l	0.0002	<0.0002	<0.0002	0						
	Silicon	mg/l	0.1	8.4	8.3	1	**1.1**	**<0.1**	**167**	1.3	1.3	0
	Silicon (Filtered)	mg/l	0.1	2.1	2.1	0						
	Silver	mg/l	0.0001	<0.0001	<0.0001	0	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Silver (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0						
	Sodium	mg/l	0.5	1	1	0	0.59	<0.5	17	0.75	0.74	1
	Sodium (Filtered)	mg/l	0.5	0.83	0.84	1	0.66	<0.5	28	0.8	0.8	0
	Strontium	mg/l	0.02	0.026	0.026	0	<0.02	<0.02	0	0.021	0.021	0
	Strontium (Filtered)	mg/l	0.02	0.02	<0.02	0						
	Sulphur (as S)	mg/l	0.2	1.2	1.1	9	**0.85**	**<0.2**	**124**	1.3	1.3	0
	Sulphur (as S) (Filtered)	mg/l	0.2	1.1	1.1	0						
	Thallium	mg/l	0.0002	<0.0002	<0.0002	0	<0.0002	<0.0002	0	<0.0002	<0.0002	0
	Thallium (Filtered)	mg/l	0.0002	<0.0002	<0.0002	0						
	Tin	mg/l	0.001	<0.001	<0.001	0	<0.001	<0.001	0	<0.001	<0.001	0
	Tin (Filtered)	mg/l	0.001	<0.001	<0.001	0						
	Titanium	mg/l	0.001	0.2	0.19	5	<0.001	0.0012	18	<0.001	<0.001	0
	Titanium (Filtered)	mg/l	0.001	<0.001	0.0012	18						
	Uranium	mg/l	0.0001	0.00014	0.00026	60	<0.0001	<0.0001	0	<0.0001	<0.0001	0
	Uranium (Filtered)	mg/l	0.0001	<0.0001	<0.0001	0						
	Vanadium	mg/l	0.001	0.007	0.0067	4	<0.001	<0.001	0	<0.001	<0.001	0
	Vanadium (Filtered)	mg/l	0.001	<0.001	<0.001	0						
	Zinc	mg/l	0.003	0.031	0.032	3	<0.003	<0.003	0	<0.003	<0.003	0
	Zinc (Filtered)	mg/l	0.003	0.0036	<0.003	18						

*RPDs have only been considered where a concentration is greater than 1 times the EQL.
**High RPDs are in bold (Acceptable RPDs for each EQL multiplier range are: 80 (1-10 x EQL); 50 (10-30 x EQL); 30 (> 30 x EQL))
***Interlab Duplicates are matched on a per compound basis as methods vary between laboratories. Any methods in the row header relate to those used in the primary laboratory

Appendix A

Borehole Logs

DILLON CONSULTING

Dillon Consulting Limited
200 - 334 11 Ave SE
Calgary, Alberta, T2G 0Y2
Telephone: 403.215.8880
Fax: 403.215.8889

19MW-01

Client: City of Iqaluit

Project No.: 19-9543

Drilling Co.: Nunavut Excavating

Supervised by: A.Hounsell

Project: Iqaluit WTS and Landfill Design

Location: City of Iqaluit

Drilling Method: Test Pitting

Date Started: 18-Jul-19

Date Completed: 18-Jul-19

Depth Scale (m)	Stratigraphic Description	Lithology	Depth (m)	Well Construction (Stick-up (m): 0.56)	Sample: Method	Sample: Number	Sample: VOC	Depth Scale (m)
	Gravel fill with large cobbles mixed throughout from surface to test pit completion or rejection.	Gravel		Below ground riser.				
1.0								1.0
				Screened section.				
			1.58					

LITHOLOGY SYMBOLS: Gravel

METHOD SYMBOLS

DILLON CONSULTING

Dillon Consulting Limited
200 - 334 11 Ave SE
Calgary, Alberta, T2G 0Y2
Telephone: 403.215.8880
Fax: 403.215.8889

19MW-02

Client: City of Iqaluit
Project No.: 19-9543
Drilling Co.: Nunavut Excavating
Supervised by: A.Hounsell

Project: Iqaluit WTS and Landfill Design
Location: City of Iqaluit
Drilling Method: Test Pitting
Date Started: 18-Jul-19
Date Completed: 18-Jul-19

Depth Scale (m)	Stratigraphic Description	Lithology	Depth (m)	Well Construction	Sample: Method	Sample: Number	Sample: VOC	Depth Scale (m)
	Gravel fill with large cobbles mixed throughout from surface to test pit completion or rejection.	Gravel		Stick-up (m): 1.22; Below ground riser.; Screened section.				
1.0								1.0
			1.33					

LITHOLOGY SYMBOLS: Gravel

METHOD SYMBOLS

Dillon Consulting Limited
200 - 334 11 Ave SE
Calgary, Alberta, T2G 0Y2
Telephone: 403.215.8880
Fax: 403.215.8889

19MW-03

Client: City of Iqaluit
Project No.: 19-9543
Drilling Co.: Nunavut Excavating
Supervised by: A.Hounsell

Project: Iqaluit WTS and Landfill Design
Location: City of Iqaluit
Drilling Method: Test Pitting
Date Started: 18-Jul-19 Date Completed: 18-Jul-19

Depth Scale (m)	Stratigraphic Description	Lithology	Depth (m)	Well Construction (Stick-up (m): 1.05)	Sample: Method	Sample: Number	Sample: VOC	Depth Scale (m)
	Gravel fill with large cobbles mixed throughout from surface to test pit completion or rejection.			Below ground riser.				
1.0				Screened section.				1.0
			1.49					

LITHOLOGY SYMBOLS: Gravel

METHOD SYMBOLS

DILLON CONSULTING

Dillon Consulting Limited
200 - 334 11 Ave SE
Calgary, Alberta, T2G 0Y2
Telephone: 403.215.8880
Fax: 403.215.8889

19MW-04

Client: City of Iqaluit
Project No.: 19-9543
Drilling Co.: Nunavut Excavating
Supervised by: A.Hounsell

Project: Iqaluit WTS and Landfill Design
Location: City of Iqaluit
Drilling Method: Test Pitting
Date Started: 18-Jul-19
Date Completed: 18-Jul-19

Depth Scale (m)	Stratigraphic Description	Lithology	Depth (m)	Well Construction (Stick-up (m): 1.33)	Sample: Method	Sample: Number	Sample: VOC	Depth Scale (m)
	Gravel fill with large cobbles mixed throughout from surface to test pit completion or rejection.	Gravel		Below ground riser.				
1.0								1.0
				Screened section.				
2.0			2.14					2.0

LITHOLOGY SYMBOLS: Gravel

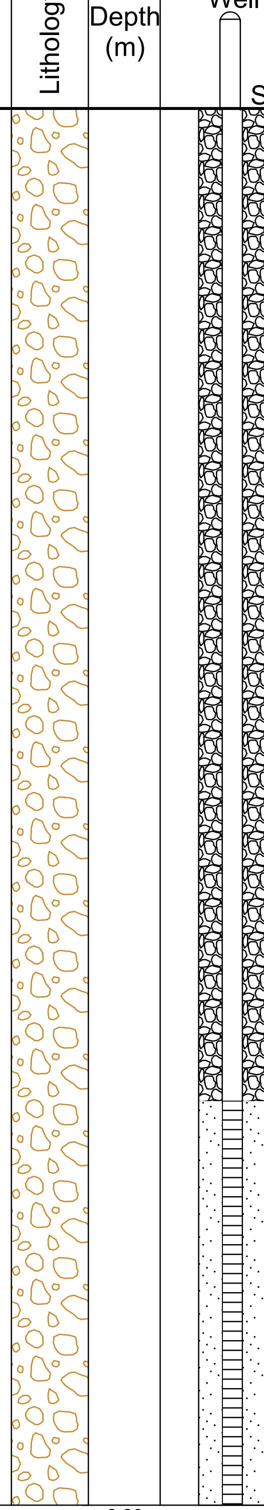
METHOD SYMBOLS

Dillon Consulting Limited
200 - 334 11 Ave SE
Calgary, Alberta, T2G 0Y2
Telephone: 403.215.8880
Fax: 403.215.8889

19MW-05

Client: City of Iqaluit	Project: Iqaluit WTS and Landfill Design
Project No.: 19-9543	Location: City of Iqaluit
Drilling Co.: Nunavut Excavating	Drilling Method: Test Pitting
Supervised by: A.Hounsell	Date Started: 18-Jul-19 Date Completed: 18-Jul-19

Depth Scale (m)	Stratigraphic Description	Lithology	Depth (m)	Well Construction (Stick-up (m): 1.19)	Sample Method	Sample Number	VOC	Depth Scale (m)
	Gravel fill with large cobbles mixed throughout from surface to test pit completion or rejection.			Below ground riser.				
1.0								1.0
2.0				Screened section.				2.0
			2.28					



LITHOLOGY SYMBOLS: Gravel

METHOD SYMBOLS

Appendix B

Laboratory Certificate of Analyses

BUREAU VERITAS

Your Project #: 19-9543
Your C.O.C. #: 727706-01-01

Attention: Andrew Hounsell

Dillon Consulting Limited
334 - 11th Ave SE
Suite 200
Calgary, AB
CANADA T2G 0Y2

Report Date: 2019/08/09
Report #: R5831866
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9K5175
Received: 2019/07/24, 11:45

Sample Matrix: Soil
Samples Received: 18

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum (1)	15	N/A	2019/07/31	CAM SOP-00301	EPA 8270D m
1,3-Dichloropropene Sum (1)	3	N/A	2019/07/30		EPA 8260C m
Petroleum Hydro. CCME F1 & BTEX in Soil (1, 2)	1	N/A	2019/07/29	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydro. CCME F1 & BTEX in Soil (1, 2)	11	N/A	2019/07/30	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Soil (1, 3)	15	2019/07/29	2019/07/30	CAM SOP-00316	CCME CWS m
Glycols in Soil by GC-FID (1)	4	N/A	2019/07/29	CAM SOP-00322	EPA 8015 m
Moisture (1)	3	N/A	2019/07/26	CAM SOP-00445	Carter 2nd ed 51.2 m
Moisture (1)	15	N/A	2019/07/27	CAM SOP-00445	Carter 2nd ed 51.2 m
PAH Compounds in Soil by GC/MS (SIM) (1)	15	2019/07/30	2019/07/31	CAM SOP-00318	EPA 8270D m
PFAS in soil by SPE/LCMS (1, 4)	5	2019/08/02	2019/08/04	CAM SOP-00894	ASTM D7968-17a m
Volatile Organic Compounds and F1 PHCs (1)	2	N/A	2019/07/27	CAM SOP-00230	EPA 8260C m
Volatile Organic Compounds and F1 PHCs (1)	1	N/A	2019/07/29	CAM SOP-00230	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
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Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

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Your Project #: 19-9543
Your C.O.C. #: 727706-01-01

Attention: Andrew Hounsell

Dillon Consulting Limited
334 - 11th Ave SE
Suite 200
Calgary, AB
CANADA T2G 0Y2

Report Date: 2019/08/09
Report #: R5831866
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9K5175

Received: 2019/07/24, 11:45

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Laboratories Mississauga
(2) No lab extraction date is given for F1BTEX & VOC samples that are field preserved with methanol. Extraction date is the date sampled unless otherwise stated.
(3) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following "Alberta Environment's Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003". Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.
(4) Per- and polyfluoroalkyl substances (PFAS) identified as surrogates on the certificate of analysis represent the extracted internal standard.

Encryption Key

Christine Gripton
Senior Project Manager
09 Aug 2019 13:31:48

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (SOIL)

BV Labs ID		KIY529			KIY530		KIY531		
Sampling Date		2019/07/17 10:05			2019/07/17 10:30		2019/07/17 10:50		
COC Number		727706-01-01			727706-01-01		727706-01-01		
	UNITS	SS01	RDL	QC Batch	SS02	RDL	SS03	RDL	QC Batch
Inorganics									
Moisture	%				2.4	1.0	2.9	1.0	6250990
Calculated Parameters									
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	0.0071	6248794	<0.0071	0.0071	1.4	0.071	6248794
Polyaromatic Hydrocarbons									
Acenaphthene	ug/g	<0.0050	0.0050	6255270	0.0056	0.0050	3.4	0.050	6255270
Acenaphthylene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	<0.050	0.050	6255270
Anthracene	ug/g	<0.0050	0.0050	6255270	0.013	0.0050	7.2	0.050	6255270
Benzo(a)anthracene	ug/g	<0.0050	0.0050	6255270	0.026	0.0050	7.2	0.050	6255270
Benzo(a)pyrene	ug/g	<0.0050	0.0050	6255270	0.029	0.0050	5.1	0.050	6255270
Benzo(b/j)fluoranthene	ug/g	<0.0050	0.0050	6255270	0.030	0.0050	6.0	0.050	6255270
Benzo(g,h,i)perylene	ug/g	<0.0050	0.0050	6255270	0.061	0.0050	2.4	0.050	6255270
Benzo(k)fluoranthene	ug/g	<0.0050	0.0050	6255270	0.011	0.0050	2.5	0.050	6255270
Chrysene	ug/g	0.012	0.0050	6255270	0.019	0.0050	5.0	0.050	6255270
Dibenz(a,h)anthracene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	0.84	0.050	6255270
Fluoranthene	ug/g	<0.0050	0.0050	6255270	0.062	0.0050	20	0.050	6255270
Fluorene	ug/g	<0.0050	0.0050	6255270	0.0065	0.0050	4.6	0.050	6255270
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	0.0050	6255270	0.022	0.0050	2.7	0.050	6255270
1-Methylnaphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	0.58	0.050	6255270
2-Methylnaphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	0.83	0.050	6255270
Naphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	1.3	0.050	6255270
Phenanthrene	ug/g	<0.0050	0.0050	6255270	0.044	0.0050	22	0.050	6255270
Pyrene	ug/g	0.0056	0.0050	6255270	0.047	0.0050	13	0.050	6255270
Surrogate Recovery (%)									
D10-Anthracene	%	97		6255270	99		114		6255270
D14-Terphenyl (FS)	%	106		6255270	109		127		6255270
D8-Acenaphthylene	%	90		6255270	91		106		6255270

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (SOIL)

BV Labs ID		KIY532			KIY533		KIY534	KIY535		
Sampling Date		2019/07/17 11:20			2019/07/17 12:00		2019/07/17 12:10	2019/07/17 12:35		
COC Number		727706-01-01			727706-01-01		727706-01-01	727706-01-01		
	UNITS	SS04	RDL	QC Batch	SS05	RDL	SS06	SS07	RDL	QC Batch
Inorganics										
Moisture	%				2.1	1.0	5.7	3.4	1.0	6250990
Calculated Parameters										
Methylnaphthalene, 2-(1-)	ug/g	0.77	0.071	6248794	<0.0071	0.0071	<0.071	0.19	0.071	6248794
Polyaromatic Hydrocarbons										
Acenaphthene	ug/g	2.1	0.050	6255270	0.0091	0.0050	0.14	0.61	0.050	6255270
Acenaphthylene	ug/g	<0.050	0.050	6255270	<0.0050	0.0050	<0.050	<0.050	0.050	6255270
Anthracene	ug/g	5.0	0.050	6255270	0.022	0.0050	0.34	1.4	0.050	6255270
Benzo(a)anthracene	ug/g	6.0	0.050	6255270	0.040	0.0050	0.38	1.6	0.050	6255270
Benzo(a)pyrene	ug/g	4.5	0.050	6255270	0.035	0.0050	0.31	1.2	0.050	6255270
Benzo(b/j)fluoranthene	ug/g	5.2	0.050	6255270	0.044	0.0050	0.35	1.4	0.050	6255270
Benzo(g,h,i)perylene	ug/g	2.2	0.050	6255270	0.023	0.0050	0.21	0.63	0.050	6255270
Benzo(k)fluoranthene	ug/g	2.2	0.050	6255270	0.017	0.0050	0.13	0.56	0.050	6255270
Chrysene	ug/g	4.2	0.050	6255270	0.029	0.0050	0.30	1.1	0.050	6255270
Dibenz(a,h)anthracene	ug/g	0.75	0.050	6255270	0.0062	0.0050	<0.050	0.19	0.050	6255270
Fluoranthene	ug/g	15	0.050	6255270	0.098	0.0050	0.98	4.2	0.050	6255270
Fluorene	ug/g	2.8	0.050	6255270	0.0094	0.0050	0.18	0.78	0.050	6255270
Indeno(1,2,3-cd)pyrene	ug/g	2.5	0.050	6255270	0.023	0.0050	0.17	0.66	0.050	6255270
1-Methylnaphthalene	ug/g	0.36	0.050	6255270	<0.0050	0.0050	<0.050	0.089	0.050	6255270
2-Methylnaphthalene	ug/g	0.41	0.050	6255270	<0.0050	0.0050	<0.050	0.099	0.050	6255270
Naphthalene	ug/g	0.60	0.050	6255270	<0.0050	0.0050	<0.050	0.14	0.050	6255270
Phenanthrene	ug/g	15	0.050	6255270	0.068	0.0050	0.94	4.1	0.050	6255270
Pyrene	ug/g	10	0.050	6255270	0.070	0.0050	0.70	2.9	0.050	6255270
Surrogate Recovery (%)										
D10-Anthracene	%	108		6255270	105		110	101		6255270
D14-Terphenyl (FS)	%	123		6255270	113		114	104		6255270
D8-Acenaphthylene	%	105		6255270	96		100	91		6255270

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (SOIL)

BV Labs ID		KIY536	KIY541			KIY541		
Sampling Date		2019/07/17 13:50	2019/07/17 14:55			2019/07/17 14:55		
COC Number		727706-01-01	727706-01-01			727706-01-01		
	UNITS	SS08	SS13	RDL	QC Batch	SS13 Lab-Dup	RDL	QC Batch
Inorganics								
Moisture	%	6.7	3.6	1.0	6250990			
Calculated Parameters								
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	<0.0071	0.0071	6248794			
Polyaromatic Hydrocarbons								
Acenaphthene	ug/g	<0.0050	0.010	0.0050	6255270	0.014	0.0050	6255270
Acenaphthylene	ug/g	<0.0050	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
Anthracene	ug/g	<0.0050	0.021	0.0050	6255270	0.022	0.0050	6255270
Benzo(a)anthracene	ug/g	<0.0050	0.059	0.0050	6255270	0.059	0.0050	6255270
Benzo(a)pyrene	ug/g	<0.0050	0.059	0.0050	6255270	0.061	0.0050	6255270
Benzo(b/j)fluoranthene	ug/g	<0.0050	0.073	0.0050	6255270	0.076	0.0050	6255270
Benzo(g,h,i)perylene	ug/g	0.0063	0.057	0.0050	6255270	0.060	0.0050	6255270
Benzo(k)fluoranthene	ug/g	<0.0050	0.026	0.0050	6255270	0.028	0.0050	6255270
Chrysene	ug/g	<0.0050	0.045	0.0050	6255270	0.046	0.0050	6255270
Dibenz(a,h)anthracene	ug/g	<0.0050	0.011	0.0050	6255270	0.012	0.0050	6255270
Fluoranthene	ug/g	0.0061	0.10	0.0050	6255270	0.11	0.0050	6255270
Fluorene	ug/g	<0.0050	0.011	0.0050	6255270	0.013	0.0050	6255270
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	0.043	0.0050	6255270	0.045	0.0050	6255270
1-Methylnaphthalene	ug/g	<0.0050	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
2-Methylnaphthalene	ug/g	<0.0050	<0.0050	0.0050	6255270	0.0050	0.0050	6255270
Naphthalene	ug/g	<0.0050	0.0071	0.0050	6255270	0.012	0.0050	6255270
Phenanthrene	ug/g	<0.0050	0.062	0.0050	6255270	0.073	0.0050	6255270
Pyrene	ug/g	0.0070	0.077	0.0050	6255270	0.086	0.0050	6255270
Surrogate Recovery (%)								
D10-Anthracene	%	86	94		6255270	99		6255270
D14-Terphenyl (FS)	%	108	101		6255270	110		6255270
D8-Acenaphthylene	%	97	86		6255270	93		6255270

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (SOIL)

BV Labs ID		KIY542			KIY543			KIY544		
Sampling Date		2019/07/17 16:30			2019/07/17 17:30			2019/07/17 17:45		
COC Number		727706-01-01			727706-01-01			727706-01-01		
	UNITS	SS14	RDL	QC Batch	SS15	RDL	QC Batch	SS16	RDL	QC Batch
Inorganics										
Moisture	%	14	1.0	6250990				2.4	1.0	6250990
Calculated Parameters										
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	0.0071	6248794	<0.0071	0.0071	6249634	<0.0071	0.0071	6249634
Polyaromatic Hydrocarbons										
Acenaphthene	ug/g	0.0089	0.0050	6255270	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
Acenaphthylene	ug/g	<0.0050	0.0050	6255270	0.013	0.0050	6255270	<0.0050	0.0050	6255270
Anthracene	ug/g	0.020	0.0050	6255270	0.023	0.0050	6255270	<0.0050	0.0050	6255270
Benzo(a)anthracene	ug/g	0.018	0.0050	6255270	0.020	0.0050	6255270	<0.0050	0.0050	6255270
Benzo(a)pyrene	ug/g	0.013	0.0050	6255270	0.024	0.0050	6255270	<0.0050	0.0050	6255270
Benzo(b/j)fluoranthene	ug/g	0.017	0.0050	6255270	0.038	0.0050	6255270	<0.0050	0.0050	6255270
Benzo(g,h,i)perylene	ug/g	0.0082	0.0050	6255270	0.044	0.0050	6255270	<0.0050	0.0050	6255270
Benzo(k)fluoranthene	ug/g	0.0064	0.0050	6255270	0.011	0.0050	6255270	<0.0050	0.0050	6255270
Chrysene	ug/g	0.013	0.0050	6255270	0.012	0.0050	6255270	<0.0050	0.0050	6255270
Dibenz(a,h)anthracene	ug/g	<0.0050	0.0050	6255270	0.0057	0.0050	6255270	<0.0050	0.0050	6255270
Fluoranthene	ug/g	0.050	0.0050	6255270	0.037	0.0050	6255270	<0.0050	0.0050	6255270
Fluorene	ug/g	0.011	0.0050	6255270	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
Indeno(1,2,3-cd)pyrene	ug/g	0.0079	0.0050	6255270	0.037	0.0050	6255270	<0.0050	0.0050	6255270
1-Methylnaphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
2-Methylnaphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
Naphthalene	ug/g	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270	<0.0050	0.0050	6255270
Phenanthrene	ug/g	0.056	0.0050	6255270	0.014	0.0050	6255270	<0.0050	0.0050	6255270
Pyrene	ug/g	0.034	0.0050	6255270	0.035	0.0050	6255270	<0.0050	0.0050	6255270
Surrogate Recovery (%)										
D10-Anthracene	%	92		6255270	96		6255270	97		6255270
D14-Terphenyl (FS)	%	102		6255270	113		6255270	105		6255270
D8-Acenaphthylene	%	90		6255270	91		6255270	88		6255270

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (SOIL)

BV Labs ID		KIY545	KIY546	KIY548		
Sampling Date		2019/07/18 14:25	2019/07/18 14:25	2019/07/18 15:45		
COC Number		727706-01-01	727706-01-01	727706-01-01		
	UNITS	TP1	QAQC01	TP4	RDL	QC Batch
Inorganics						
Moisture	%	5.1	5.4	6.3	1.0	6250990
Calculated Parameters						
Methylnaphthalene, 2-(1-)	ug/g	<0.0071	<0.0071	<0.0071	0.0071	6249634
Polyaromatic Hydrocarbons						
Acenaphthene	ug/g	<0.0050	<0.0050	0.011	0.0050	6255270
Acenaphthylene	ug/g	<0.0050	<0.0050	<0.0050	0.0050	6255270
Anthracene	ug/g	<0.0050	<0.0050	0.029	0.0050	6255270
Benzo(a)anthracene	ug/g	<0.0050	<0.0050	0.048	0.0050	6255270
Benzo(a)pyrene	ug/g	<0.0050	<0.0050	0.040	0.0050	6255270
Benzo(b/j)fluoranthene	ug/g	<0.0050	<0.0050	0.048	0.0050	6255270
Benzo(g,h,i)perylene	ug/g	<0.0050	<0.0050	0.027	0.0050	6255270
Benzo(k)fluoranthene	ug/g	<0.0050	<0.0050	0.019	0.0050	6255270
Chrysene	ug/g	<0.0050	<0.0050	0.033	0.0050	6255270
Dibenz(a,h)anthracene	ug/g	<0.0050	<0.0050	0.0073	0.0050	6255270
Fluoranthene	ug/g	<0.0050	<0.0050	0.11	0.0050	6255270
Fluorene	ug/g	<0.0050	<0.0050	0.012	0.0050	6255270
Indeno(1,2,3-cd)pyrene	ug/g	<0.0050	<0.0050	0.027	0.0050	6255270
1-Methylnaphthalene	ug/g	<0.0050	<0.0050	<0.0050	0.0050	6255270
2-Methylnaphthalene	ug/g	<0.0050	<0.0050	<0.0050	0.0050	6255270
Naphthalene	ug/g	<0.0050	<0.0050	<0.0050	0.0050	6255270
Phenanthrene	ug/g	<0.0050	<0.0050	0.082	0.0050	6255270
Pyrene	ug/g	<0.0050	<0.0050	0.080	0.0050	6255270
Surrogate Recovery (%)						
D10-Anthracene	%	100	99	98		6255270
D14-Terphenyl (FS)	%	108	107	107		6255270
D8-Acenaphthylene	%	93	91	91		6255270

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KIY530	KIY531	KIY533	KIY534	KIY535	KIY536		
Sampling Date		2019/07/17 10:30	2019/07/17 10:50	2019/07/17 12:00	2019/07/17 12:10	2019/07/17 12:35	2019/07/17 13:50		
COC Number		727706-01-01	727706-01-01	727706-01-01	727706-01-01	727706-01-01	727706-01-01		
	UNITS	**SS02**	**SS03**	**SS05**	**SS06**	**SS07**	**SS08**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons									
Benzene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
Toluene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
Ethylbenzene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
o-Xylene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
p+m-Xylene	ug/g	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	6252645
Total Xylenes	ug/g	<0.040	<0.040	<0.040	<0.040	<0.040	<0.040	0.040	6252645
F1 (C6-C10)	ug/g	<10	<10	<10	<10	<10	<10	10	6252645
F1 (C6-C10) - BTEX	ug/g	<10	<10	<10	<10	<10	<10	10	6252645
F2-F4 Hydrocarbons									
F2 (C10-C16 Hydrocarbons)	ug/g	<10	17	<10	17	11	130	10	6252122
F3 (C16-C34 Hydrocarbons)	ug/g	140	280	<50	140	210	2400	50	6252122
F4 (C34-C50 Hydrocarbons)	ug/g	77	180	<50	170	140	150	50	6252122
Reached Baseline at C50	ug/g	No	No	Yes	No	No	Yes		6252122
Surrogate Recovery (%)									
1,4-Difluorobenzene	%	104	104	104	103	103	105		6252645
4-Bromofluorobenzene	%	98	98	97	96	98	98		6252645
D10-Ethylbenzene	%	91	89	89	89	94	93		6252645
D4-1,2-Dichloroethane	%	98	98	97	97	97	97		6252645
o-Terphenyl	%	89	89	89	91	87	104		6252122

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KIY536			KIY541			KIY541		
Sampling Date		2019/07/17 13:50			2019/07/17 14:55			2019/07/17 14:55		
COC Number		727706-01-01			727706-01-01			727706-01-01		
	UNITS	**SS08 Lab-Dup**	**RDL**	**QC Batch**	**SS13**	**RDL**	**QC Batch**	**SS13 Lab-Dup**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons										
Benzene	ug/g	<0.020	0.020	6252645	<0.020	0.020	6252645			
Toluene	ug/g	<0.020	0.020	6252645	<0.020	0.020	6252645			
Ethylbenzene	ug/g	<0.020	0.020	6252645	<0.020	0.020	6252645			
o-Xylene	ug/g	<0.020	0.020	6252645	<0.020	0.020	6252645			
p+m-Xylene	ug/g	<0.040	0.040	6252645	<0.040	0.040	6252645			
Total Xylenes	ug/g	<0.040	0.040	6252645	<0.040	0.040	6252645			
F1 (C6-C10)	ug/g	<10	10	6252645	<10	10	6252645			
F1 (C6-C10) - BTEX	ug/g	<10	10	6252645	<10	10	6252645			
F2-F4 Hydrocarbons										
F2 (C10-C16 Hydrocarbons)	ug/g				<10	10	6252122	<10	10	6252122
F3 (C16-C34 Hydrocarbons)	ug/g				120	50	6252122	120	50	6252122
F4 (C34-C50 Hydrocarbons)	ug/g				59	50	6252122	71	50	6252122
Reached Baseline at C50	ug/g				No		6252122	No		6252122
Surrogate Recovery (%)										
1,4-Difluorobenzene	%	104		6252645	103		6252645			
4-Bromofluorobenzene	%	99		6252645	98		6252645			
D10-Ethylbenzene	%	90		6252645	90		6252645			
D4-1,2-Dichloroethane	%	96		6252645	97		6252645			
o-Terphenyl	%				91		6252122	94		6252122

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PETROLEUM HYDROCARBONS (SOIL)

BV Labs ID		KIY542	KIY544	KIY545	KIY546	KIY548		
Sampling Date		2019/07/17 16:30	2019/07/17 17:45	2019/07/18 14:25	2019/07/18 14:25	2019/07/18 15:45		
COC Number		727706-01-01	727706-01-01	727706-01-01	727706-01-01	727706-01-01		
	UNITS	**SS14**	**SS16**	**TP1**	**QAQC01**	**TP4**	**RDL**	**QC Batch**
BTEX & F1 Hydrocarbons								
Benzene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
Toluene	ug/g	0.098	<0.020	<0.020	<0.020	<0.020	0.020	6252645
Ethylbenzene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
o-Xylene	ug/g	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	6252645
p+m-Xylene	ug/g	0.056	<0.040	<0.040	<0.040	<0.040	0.040	6252645
Total Xylenes	ug/g	0.056	<0.040	<0.040	<0.040	<0.040	0.040	6252645
F1 (C6-C10)	ug/g	<10	<10	<10	<10	<10	10	6252645
F1 (C6-C10) - BTEX	ug/g	<10	<10	<10	<10	<10	10	6252645
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	<10	<10	<10	<10	<10	10	6252122
F3 (C16-C34 Hydrocarbons)	ug/g	75	96	<50	<50	<50	50	6252122
F4 (C34-C50 Hydrocarbons)	ug/g	<50	<50	<50	<50	<50	50	6252122
Reached Baseline at C50	ug/g	Yes	Yes	Yes	Yes	Yes		6252122
Surrogate Recovery (%)								
1,4-Difluorobenzene	%	104	105	105	103	104		6252645
4-Bromofluorobenzene	%	96	96	98	96	98		6252645
D10-Ethylbenzene	%	95	87	91	84	87		6252645
D4-1,2-Dichloroethane	%	97	99	98	99	99		6252645
o-Terphenyl	%	94	93	95	96	90		6252122

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

BV Labs ID		KIY529	KIY532			KIY532		
Sampling Date		2019/07/17 10:05	2019/07/17 11:20			2019/07/17 11:20		
COC Number		727706-01-01	727706-01-01			727706-01-01		
	UNITS	SS01	SS04	RDL	QC Batch	SS04 Lab-Dup	RDL	QC Batch
Inorganics								
Moisture	%	2.9	4.4	1.0	6250990			
Calculated Parameters								
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	<0.050	0.050	6248943			
Volatile Organics								
Acetone (2-Propanone)	ug/g	<0.50	<0.50	0.50	6250043	<0.50	0.50	6250043
Benzene	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
Bromodichloromethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Bromoform	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Bromomethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Carbon Tetrachloride	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Chlorobenzene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Chloroform	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Dibromochloromethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,2-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,3-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,4-Dichlorobenzene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,1-Dichloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,2-Dichloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,1-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
cis-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
trans-1,2-Dichloroethylene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,2-Dichloropropane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
cis-1,3-Dichloropropene	ug/g	<0.030	<0.030	0.030	6250043	<0.030	0.030	6250043
trans-1,3-Dichloropropene	ug/g	<0.040	<0.040	0.040	6250043	<0.040	0.040	6250043
Ethylbenzene	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
Ethylene Dibromide	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Hexane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Methylene Chloride(Dichloromethane)	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	<0.50	0.50	6250043	<0.50	0.50	6250043
Methyl Isobutyl Ketone	ug/g	<0.50	<0.50	0.50	6250043	<0.50	0.50	6250043
Methyl t-butyl ether (MTBE)	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Styrene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,1,1,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

BV Labs ID		KIY529	KIY532			KIY532		
Sampling Date		2019/07/17 10:05	2019/07/17 11:20			2019/07/17 11:20		
COC Number		727706-01-01	727706-01-01			727706-01-01		
	UNITS	SS01	SS04	RDL	QC Batch	SS04 Lab-Dup	RDL	QC Batch
1,1,2,2-Tetrachloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Tetrachloroethylene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Toluene	ug/g	0.042	0.028	0.020	6250043	0.032	0.020	6250043
1,1,1-Trichloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
1,1,2-Trichloroethane	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Trichloroethylene	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	<0.050	0.050	6250043	<0.050	0.050	6250043
Vinyl Chloride	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
p+m-Xylene	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
o-Xylene	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
Total Xylenes	ug/g	<0.020	<0.020	0.020	6250043	<0.020	0.020	6250043
F1 (C6-C10)	ug/g	<10	<10	10	6250043	<10	10	6250043
F1 (C6-C10) - BTEX	ug/g	<10	<10	10	6250043	<10	10	6250043
F2-F4 Hydrocarbons								
F2 (C10-C16 Hydrocarbons)	ug/g	<10	29	10	6252122			
F3 (C16-C34 Hydrocarbons)	ug/g	540	720	50	6252122			
F4 (C34-C50 Hydrocarbons)	ug/g	<50	450	50	6252122			
Reached Baseline at C50	ug/g	Yes	No		6252122			
Surrogate Recovery (%)								
o-Terphenyl	%	92	90		6252122			
4-Bromofluorobenzene	%	93	93		6250043	93		6250043
D10-o-Xylene	%	97	105		6250043	108		6250043
D4-1,2-Dichloroethane	%	100	100		6250043	102		6250043
D8-Toluene	%	101	101		6250043	102		6250043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

BV Labs ID		KIY543		
Sampling Date		2019/07/17 17:30		
COC Number		727706-01-01		
	UNITS	SS15	RDL	QC Batch
Inorganics				
Moisture	%	4.2	1.0	6250990
Calculated Parameters				
1,3-Dichloropropene (cis+trans)	ug/g	<0.050	0.050	6248943
Volatile Organics				
Acetone (2-Propanone)	ug/g	<0.50	0.50	6250043
Benzene	ug/g	<0.020	0.020	6250043
Bromodichloromethane	ug/g	<0.050	0.050	6250043
Bromoform	ug/g	<0.050	0.050	6250043
Bromomethane	ug/g	<0.050	0.050	6250043
Carbon Tetrachloride	ug/g	<0.050	0.050	6250043
Chlorobenzene	ug/g	<0.050	0.050	6250043
Chloroform	ug/g	<0.050	0.050	6250043
Dibromochloromethane	ug/g	<0.050	0.050	6250043
1,2-Dichlorobenzene	ug/g	<0.050	0.050	6250043
1,3-Dichlorobenzene	ug/g	<0.050	0.050	6250043
1,4-Dichlorobenzene	ug/g	<0.050	0.050	6250043
Dichlorodifluoromethane (FREON 12)	ug/g	<0.050	0.050	6250043
1,1-Dichloroethane	ug/g	<0.050	0.050	6250043
1,2-Dichloroethane	ug/g	<0.050	0.050	6250043
1,1-Dichloroethylene	ug/g	<0.050	0.050	6250043
cis-1,2-Dichloroethylene	ug/g	<0.050	0.050	6250043
trans-1,2-Dichloroethylene	ug/g	<0.050	0.050	6250043
1,2-Dichloropropane	ug/g	<0.050	0.050	6250043
cis-1,3-Dichloropropene	ug/g	<0.030	0.030	6250043
trans-1,3-Dichloropropene	ug/g	<0.040	0.040	6250043
Ethylbenzene	ug/g	<0.020	0.020	6250043
Ethylene Dibromide	ug/g	<0.050	0.050	6250043
Hexane	ug/g	<0.050	0.050	6250043
Methylene Chloride(Dichloromethane)	ug/g	<0.050	0.050	6250043
Methyl Ethyl Ketone (2-Butanone)	ug/g	<0.50	0.50	6250043
Methyl Isobutyl Ketone	ug/g	<0.50	0.50	6250043
Methyl t-butyl ether (MTBE)	ug/g	<0.050	0.050	6250043
Styrene	ug/g	<0.050	0.050	6250043
1,1,1,2-Tetrachloroethane	ug/g	<0.050	0.050	6250043
1,1,2,2-Tetrachloroethane	ug/g	<0.050	0.050	6250043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (SOIL)

BV Labs ID		KIY543		
Sampling Date		2019/07/17 17:30		
COC Number		727706-01-01		
	UNITS	SS15	RDL	QC Batch
Tetrachloroethylene	ug/g	<0.050	0.050	6250043
Toluene	ug/g	0.034	0.020	6250043
1,1,1-Trichloroethane	ug/g	<0.050	0.050	6250043
1,1,2-Trichloroethane	ug/g	<0.050	0.050	6250043
Trichloroethylene	ug/g	<0.050	0.050	6250043
Trichlorofluoromethane (FREON 11)	ug/g	<0.050	0.050	6250043
Vinyl Chloride	ug/g	<0.020	0.020	6250043
p+m-Xylene	ug/g	<0.020	0.020	6250043
o-Xylene	ug/g	<0.020	0.020	6250043
Total Xylenes	ug/g	<0.020	0.020	6250043
F1 (C6-C10)	ug/g	<10	10	6250043
F1 (C6-C10) - BTEX	ug/g	<10	10	6250043
F2-F4 Hydrocarbons				
F2 (C10-C16 Hydrocarbons)	ug/g	<10	10	6252122
F3 (C16-C34 Hydrocarbons)	ug/g	370	50	6252122
F4 (C34-C50 Hydrocarbons)	ug/g	160	50	6252122
Reached Baseline at C50	ug/g	Yes		6252122
Surrogate Recovery (%)				
o-Terphenyl	%	92		6252122
4-Bromofluorobenzene	%	91		6250043
D10-o-Xylene	%	101		6250043
D4-1,2-Dichloroethane	%	101		6250043
D8-Toluene	%	103		6250043

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KIY536			KIY537	KIY538	KIY540		
Sampling Date		2019/07/17 13:50			2019/07/17 14:10	2019/07/17 14:20	2019/07/17 14:45		
COC Number		727706-01-01			727706-01-01	727706-01-01	727706-01-01		
	UNITS	**SS08**	**RDL**	**QC Batch**	**SS09**	**SS10**	**SS12**	**RDL**	**QC Batch**
Inorganics									
Moisture	%				17	2.0	1.7	1.0	6250464
Perfluorinated Compounds									
Perfluorobutanoic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluoropentanoic Acid (PFPeA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorohexanoic Acid (PFHxA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluoroheptanoic Acid (PFHpA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorooctanoic Acid (PFOA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorononanoic Acid (PFNA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorodecanoic Acid (PFDA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluoroundecanoic Acid (PFUnA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorododecanoic Acid (PFDoA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorotridecanoic Acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorotetradecanoic Acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorobutanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluoropentanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorohexanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluoroheptanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorooctanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorononanesulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorodecanesulfonic acid (PFDS)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
Perfluorooctane Sulfonamide (PFOSA)	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
EtFOSA	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
MeFOSA	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
EtFOSE	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
MeFOSE	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
EtFOSAA	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
MeFOSAA	ug/kg	<1.0	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
6:2 Fluorotelomer sulfonic acid	ug/kg	3.7	1.0	6262247	<1.0	<1.0	<1.0	1.0	6262247
8:2 Fluorotelomer sulfonic acid	ug/kg	<1.0	1.0	6262247	<1.0	1.0	<1.0	1.0	6262247
Surrogate Recovery (%)									
13C2-6:2-Fluorotelomersulfonic Acid	%	98		6262247	89	100	101		6262247
13C2-8:2-Fluorotelomersulfonic Acid	%	98		6262247	85	93	92		6262247
13C2-Perfluorodecanoic acid	%	95		6262247	78	91	94		6262247
13C2-Perfluorododecanoic acid	%	93		6262247	71	84	86		6262247
13C2-Perfluorohexanoic acid	%	101		6262247	93	103	105		6262247

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KIY536			KIY537	KIY538	KIY540		
Sampling Date		2019/07/17 13:50			2019/07/17 14:10	2019/07/17 14:20	2019/07/17 14:45		
COC Number		727706-01-01			727706-01-01	727706-01-01	727706-01-01		
	UNITS	SS08	RDL	QC Batch	SS09	SS10	SS12	RDL	QC Batch
13C2-perfluorotetradecanoic acid	%	90		6262247	60	68	76		6262247
13C2-Perfluoroundecanoic acid	%	94		6262247	76	88	91		6262247
13C3-Perfluorobutanesulfonic acid	%	100		6262247	87	99	101		6262247
13C4-Perfluorobutanoic acid	%	97		6262247	89	99	100		6262247
13C4-Perfluoroheptanoic acid	%	99		6262247	88	100	102		6262247
13C4-Perfluorooctanesulfonic acid	%	95		6262247	80	92	93		6262247
13C4-Perfluorooctanoic acid	%	96		6262247	85	96	99		6262247
13C5-Perfluorononanoic acid	%	99		6262247	85	96	99		6262247
13C5-Perfluoropentanoic acid	%	96		6262247	88	98	100		6262247
13C8-Perfluorooctane Sulfonamide	%	84		6262247	58	83	82		6262247
18O2-Perfluorohexanesulfonic acid	%	97		6262247	85	96	94		6262247
D3-MeFOSA	%	66		6262247	60	65	55		6262247
D3-MeFOSAA	%	98		6262247	81	88	92		6262247
D5-EtFOSA	%	71		6262247	67	72	55		6262247
D5-EtFOSAA	%	89		6262247	69	87	85		6262247
D7-MeFOSE	%	75		6262247	67	81	76		6262247
D9-EtFOSE	%	77		6262247	62	81	70		6262247

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BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KIY541		
Sampling Date		2019/07/17 14:55		
COC Number		727706-01-01		
	UNITS	SS13	RDL	QC Batch
Perfluorinated Compounds				
Perfluorobutanoic acid	ug/kg	<1.0	1.0	6262247
Perfluoropentanoic Acid (PFPeA)	ug/kg	<1.0	1.0	6262247
Perfluorohexanoic Acid (PFHxA)	ug/kg	<1.0	1.0	6262247
Perfluoroheptanoic Acid (PFHpA)	ug/kg	<1.0	1.0	6262247
Perfluorooctanoic Acid (PFOA)	ug/kg	<1.0	1.0	6262247
Perfluorononanoic Acid (PFNA)	ug/kg	<1.0	1.0	6262247
Perfluorodecanoic Acid (PFDA)	ug/kg	<1.0	1.0	6262247
Perfluoroundecanoic Acid (PFUnA)	ug/kg	<1.0	1.0	6262247
Perfluorododecanoic Acid (PFDoA)	ug/kg	<1.0	1.0	6262247
Perfluorotridecanoic Acid	ug/kg	<1.0	1.0	6262247
Perfluorotetradecanoic Acid	ug/kg	<1.0	1.0	6262247
Perfluorobutanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluoropentanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluorohexanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluoroheptanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluorooctanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluorononanesulfonic acid	ug/kg	<1.0	1.0	6262247
Perfluorodecanesulfonic acid (PFDS)	ug/kg	<1.0	1.0	6262247
Perfluorooctane Sulfonamide (PFOSA)	ug/kg	<1.0	1.0	6262247
EtFOSA	ug/kg	<1.0	1.0	6262247
MeFOSA	ug/kg	<1.0	1.0	6262247
EtFOSE	ug/kg	<1.0	1.0	6262247
MeFOSE	ug/kg	<1.0	1.0	6262247
EtFOSAA	ug/kg	<1.0	1.0	6262247
MeFOSAA	ug/kg	<1.0	1.0	6262247
6:2 Fluorotelomer sulfonic acid	ug/kg	<1.0	1.0	6262247
8:2 Fluorotelomer sulfonic acid	ug/kg	<1.0	1.0	6262247
Surrogate Recovery (%)				
13C2-6:2-Fluorotelomersulfonic Acid	%	102		6262247
13C2-8:2-Fluorotelomersulfonic Acid	%	92		6262247
13C2-Perfluorodecanoic acid	%	93		6262247
13C2-Perfluorododecanoic acid	%	89		6262247
13C2-Perfluorohexanoic acid	%	106		6262247
13C2-perfluorotetradecanoic acid	%	90		6262247

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KIY541		
Sampling Date		2019/07/17 14:55		
COC Number		727706-01-01		
	UNITS	**SS13**	**RDL**	**QC Batch**
13C2-Perfluoroundecanoic acid	%	91		6262247
13C3-Perfluorobutanesulfonic acid	%	99		6262247
13C4-Perfluorobutanoic acid	%	101		6262247
13C4-Perfluoroheptanoic acid	%	102		6262247
13C4-Perfluorooctanesulfonic acid	%	93		6262247
13C4-Perfluorooctanoic acid	%	98		6262247
13C5-Perfluorononanoic acid	%	97		6262247
13C5-Perfluoropentanoic acid	%	102		6262247
13C8-Perfluorooctane Sulfonamide	%	85		6262247
18O2-Perfluorohexanesulfonic acid	%	99		6262247
D3-MeFOSA	%	65		6262247
D3-MeFOSAA	%	90		6262247
D5-EtFOSA	%	67		6262247
D5-EtFOSAA	%	91		6262247
D7-MeFOSE	%	82		6262247
D9-EtFOSE	%	76		6262247

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

GLYCOLS BY GC-FID (SOIL)

BV Labs ID		KIY535	KIY542	KIY542	KIY543	KIY544		
Sampling Date		2019/07/17 12:35	2019/07/17 16:30	2019/07/17 16:30	2019/07/17 17:30	2019/07/17 17:45		
COC Number		727706-01-01	727706-01-01	727706-01-01	727706-01-01	727706-01-01		
	UNITS	SS07	SS14	SS14 Lab-Dup	SS15	SS16	RDL	QC Batch
Glycols								
Propylene Glycol	mg/kg	<10	<10	<10	<10	<10	10	6252918
Ethylene Glycol	mg/kg	<10	<10	<10	<10	<10	10	6252918
Diethylene Glycol	mg/kg	<10	<10	<10	<10	<10	10	6252918
Total Glycol	mg/kg	<10	<10	<10	<10	<10	10	6252918

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

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Client Project #: 19-9543
Sampler Initials: AH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C

Sample KIY531 [SS03] : PAH analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Sample KIY532 [SS04] : PAH analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Sample KIY534 [SS06] : PAH analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Sample KIY535 [SS07] : PAH analysis: Due to the sample matrix, sample required dilution. Detection limits were adjusted accordingly.

Results relate only to the items tested.

BUREAU VERITAS

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6250043	AYA	Matrix Spike [KIY532-02]	4-Bromofluorobenzene	2019/07/27		96	%	60 - 140
			D10-o-Xylene	2019/07/27		105	%	60 - 130
			D4-1,2-Dichloroethane	2019/07/27		100	%	60 - 140
			D8-Toluene	2019/07/27		106	%	60 - 140
			Acetone (2-Propanone)	2019/07/27		89	%	60 - 140
			Benzene	2019/07/27		98	%	60 - 140
			Bromodichloromethane	2019/07/27		93	%	60 - 140
			Bromoform	2019/07/27		96	%	60 - 140
			Bromomethane	2019/07/27		134	%	60 - 140
			Carbon Tetrachloride	2019/07/27		96	%	60 - 140
			Chlorobenzene	2019/07/27		96	%	60 - 140
			Chloroform	2019/07/27		92	%	60 - 140
			Dibromochloromethane	2019/07/27		100	%	60 - 140
			1,2-Dichlorobenzene	2019/07/27		95	%	60 - 140
			1,3-Dichlorobenzene	2019/07/27		100	%	60 - 140
			1,4-Dichlorobenzene	2019/07/27		104	%	60 - 140
			Dichlorodifluoromethane (FREON 12)	2019/07/27		109	%	60 - 140
			1,1-Dichloroethane	2019/07/27		94	%	60 - 140
			1,2-Dichloroethane	2019/07/27		97	%	60 - 140
			1,1-Dichloroethylene	2019/07/27		104	%	60 - 140
			cis-1,2-Dichloroethylene	2019/07/27		91	%	60 - 140
			trans-1,2-Dichloroethylene	2019/07/27		99	%	60 - 140
			1,2-Dichloropropane	2019/07/27		90	%	60 - 140
			cis-1,3-Dichloropropene	2019/07/27		88	%	60 - 140
			trans-1,3-Dichloropropene	2019/07/27		93	%	60 - 140
			Ethylbenzene	2019/07/27		94	%	60 - 140
			Ethylene Dibromide	2019/07/27		96	%	60 - 140
			Hexane	2019/07/27		101	%	60 - 140
			Methylene Chloride(Dichloromethane)	2019/07/27		95	%	60 - 140
			Methyl Ethyl Ketone (2-Butanone)	2019/07/27		93	%	60 - 140
			Methyl Isobutyl Ketone	2019/07/27		95	%	60 - 140
			Methyl t-butyl ether (MTBE)	2019/07/27		83	%	60 - 140
			Styrene	2019/07/27		97	%	60 - 140
			1,1,1,2-Tetrachloroethane	2019/07/27		103	%	60 - 140
			1,1,2,2-Tetrachloroethane	2019/07/27		96	%	60 - 140
			Tetrachloroethylene	2019/07/27		94	%	60 - 140
			Toluene	2019/07/27		91	%	60 - 140
			1,1,1-Trichloroethane	2019/07/27		96	%	60 - 140
			1,1,2-Trichloroethane	2019/07/27		101	%	60 - 140
			Trichloroethylene	2019/07/27		99	%	60 - 140
			Trichlorofluoromethane (FREON 11)	2019/07/27		113	%	60 - 140
			Vinyl Chloride	2019/07/27		108	%	60 - 140
			p+m-Xylene	2019/07/27		99	%	60 - 140
			o-Xylene	2019/07/27		95	%	60 - 140
			F1 (C6-C10)	2019/07/27		91	%	60 - 140
6250043	AYA	Spiked Blank	4-Bromofluorobenzene	2019/07/27		97	%	60 - 140
			D10-o-Xylene	2019/07/27		86	%	60 - 130
			D4-1,2-Dichloroethane	2019/07/27		103	%	60 - 140
			D8-Toluene	2019/07/27		104	%	60 - 140
			Acetone (2-Propanone)	2019/07/27		95	%	60 - 140
			Benzene	2019/07/27		104	%	60 - 130
			Bromodichloromethane	2019/07/27		99	%	60 - 130
			Bromoform	2019/07/27		101	%	60 - 130
			Bromomethane	2019/07/27		143 (1)	%	60 - 140

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Dillon Consulting Limited
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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Carbon Tetrachloride	2019/07/27		103	%	60 - 130
			Chlorobenzene	2019/07/27		100	%	60 - 130
			Chloroform	2019/07/27		98	%	60 - 130
			Dibromochloromethane	2019/07/27		104	%	60 - 130
			1,2-Dichlorobenzene	2019/07/27		98	%	60 - 130
			1,3-Dichlorobenzene	2019/07/27		102	%	60 - 130
			1,4-Dichlorobenzene	2019/07/27		107	%	60 - 130
			Dichlorodifluoromethane (FREON 12)	2019/07/27		116	%	60 - 140
			1,1-Dichloroethane	2019/07/27		100	%	60 - 130
			1,2-Dichloroethane	2019/07/27		103	%	60 - 130
			1,1-Dichloroethylene	2019/07/27		111	%	60 - 130
			cis-1,2-Dichloroethylene	2019/07/27		96	%	60 - 130
			trans-1,2-Dichloroethylene	2019/07/27		105	%	60 - 130
			1,2-Dichloropropane	2019/07/27		96	%	60 - 130
			cis-1,3-Dichloropropene	2019/07/27		95	%	60 - 130
			trans-1,3-Dichloropropene	2019/07/27		97	%	60 - 130
			Ethylbenzene	2019/07/27		99	%	60 - 130
			Ethylene Dibromide	2019/07/27		101	%	60 - 130
			Hexane	2019/07/27		109	%	60 - 130
			Methylene Chloride(Dichloromethane)	2019/07/27		101	%	60 - 130
			Methyl Ethyl Ketone (2-Butanone)	2019/07/27		99	%	60 - 140
			Methyl Isobutyl Ketone	2019/07/27		102	%	60 - 130
			Methyl t-butyl ether (MTBE)	2019/07/27		89	%	60 - 130
			Styrene	2019/07/27		102	%	60 - 130
			1,1,1,2-Tetrachloroethane	2019/07/27		108	%	60 - 130
			1,1,2,2-Tetrachloroethane	2019/07/27		101	%	60 - 130
			Tetrachloroethylene	2019/07/27		100	%	60 - 130
			Toluene	2019/07/27		96	%	60 - 130
			1,1,1-Trichloroethane	2019/07/27		104	%	60 - 130
			1,1,2-Trichloroethane	2019/07/27		106	%	60 - 130
			Trichloroethylene	2019/07/27		106	%	60 - 130
			Trichlorofluoromethane (FREON 11)	2019/07/27		122	%	60 - 130
			Vinyl Chloride	2019/07/27		115	%	60 - 130
			p+m-Xylene	2019/07/27		104	%	60 - 130
			o-Xylene	2019/07/27		101	%	60 - 130
			F1 (C6-C10)	2019/07/27		94	%	80 - 120
6250043	AYA	Method Blank	4-Bromofluorobenzene	2019/07/27		93	%	60 - 140
			D10-o-Xylene	2019/07/27		97	%	60 - 130
			D4-1,2-Dichloroethane	2019/07/27		100	%	60 - 140
			D8-Toluene	2019/07/27		102	%	60 - 140
			Acetone (2-Propanone)	2019/07/27	<0.50		ug/g	
			Benzene	2019/07/27	<0.020		ug/g	
			Bromodichloromethane	2019/07/27	<0.050		ug/g	
			Bromoform	2019/07/27	<0.050		ug/g	
			Bromomethane	2019/07/27	<0.050		ug/g	
			Carbon Tetrachloride	2019/07/27	<0.050		ug/g	
			Chlorobenzene	2019/07/27	<0.050		ug/g	
			Chloroform	2019/07/27	<0.050		ug/g	
			Dibromochloromethane	2019/07/27	<0.050		ug/g	
			1,2-Dichlorobenzene	2019/07/27	<0.050		ug/g	
			1,3-Dichlorobenzene	2019/07/27	<0.050		ug/g	
			1,4-Dichlorobenzene	2019/07/27	<0.050		ug/g	
			Dichlorodifluoromethane (FREON 12)	2019/07/27	<0.050		ug/g	
			1,1-Dichloroethane	2019/07/27	<0.050		ug/g	

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Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			1,2-Dichloroethane	2019/07/27	<0.050		ug/g	
			1,1-Dichloroethylene	2019/07/27	<0.050		ug/g	
			cis-1,2-Dichloroethylene	2019/07/27	<0.050		ug/g	
			trans-1,2-Dichloroethylene	2019/07/27	<0.050		ug/g	
			1,2-Dichloropropane	2019/07/27	<0.050		ug/g	
			cis-1,3-Dichloropropene	2019/07/27	<0.030		ug/g	
			trans-1,3-Dichloropropene	2019/07/27	<0.040		ug/g	
			Ethylbenzene	2019/07/27	<0.020		ug/g	
			Ethylene Dibromide	2019/07/27	<0.050		ug/g	
			Hexane	2019/07/27	<0.050		ug/g	
			Methylene Chloride(Dichloromethane)	2019/07/27	<0.050		ug/g	
			Methyl Ethyl Ketone (2-Butanone)	2019/07/27	<0.50		ug/g	
			Methyl Isobutyl Ketone	2019/07/27	<0.50		ug/g	
			Methyl t-butyl ether (MTBE)	2019/07/27	<0.050		ug/g	
			Styrene	2019/07/27	<0.050		ug/g	
			1,1,1,2-Tetrachloroethane	2019/07/27	<0.050		ug/g	
			1,1,2,2-Tetrachloroethane	2019/07/27	<0.050		ug/g	
			Tetrachloroethylene	2019/07/27	<0.050		ug/g	
			Toluene	2019/07/27	<0.020		ug/g	
			1,1,1-Trichloroethane	2019/07/27	<0.050		ug/g	
			1,1,2-Trichloroethane	2019/07/27	<0.050		ug/g	
			Trichloroethylene	2019/07/27	<0.050		ug/g	
			Trichlorofluoromethane (FREON 11)	2019/07/27	<0.050		ug/g	
			Vinyl Chloride	2019/07/27	<0.020		ug/g	
			p+m-Xylene	2019/07/27	<0.020		ug/g	
			o-Xylene	2019/07/27	<0.020		ug/g	
			Total Xylenes	2019/07/27	<0.020		ug/g	
			F1 (C6-C10)	2019/07/27	<10		ug/g	
			F1 (C6-C10) - BTEX	2019/07/27	<10		ug/g	
6250043	AYA	RPD [KIY532-02]	Acetone (2-Propanone)	2019/07/27	NC		%	50
			Benzene	2019/07/27	NC		%	50
			Bromodichloromethane	2019/07/27	NC		%	50
			Bromoform	2019/07/27	NC		%	50
			Bromomethane	2019/07/27	NC		%	50
			Carbon Tetrachloride	2019/07/27	NC		%	50
			Chlorobenzene	2019/07/27	NC		%	50
			Chloroform	2019/07/27	NC		%	50
			Dibromochloromethane	2019/07/27	NC		%	50
			1,2-Dichlorobenzene	2019/07/27	NC		%	50
			1,3-Dichlorobenzene	2019/07/27	NC		%	50
			1,4-Dichlorobenzene	2019/07/27	NC		%	50
			Dichlorodifluoromethane (FREON 12)	2019/07/27	NC		%	50
			1,1-Dichloroethane	2019/07/27	NC		%	50
			1,2-Dichloroethane	2019/07/27	NC		%	50
			1,1-Dichloroethylene	2019/07/27	NC		%	50
			cis-1,2-Dichloroethylene	2019/07/27	NC		%	50
			trans-1,2-Dichloroethylene	2019/07/27	NC		%	50
			1,2-Dichloropropane	2019/07/27	NC		%	50
			cis-1,3-Dichloropropene	2019/07/27	NC		%	50
			trans-1,3-Dichloropropene	2019/07/27	NC		%	50
			Ethylbenzene	2019/07/27	NC		%	50
			Ethylene Dibromide	2019/07/27	NC		%	50
			Hexane	2019/07/27	NC		%	50
			Methylene Chloride(Dichloromethane)	2019/07/27	NC		%	50

BV Labs Job #: B9K5175
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Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Methyl Ethyl Ketone (2-Butanone)	2019/07/27	NC		%	50
			Methyl Isobutyl Ketone	2019/07/27	NC		%	50
			Methyl t-butyl ether (MTBE)	2019/07/27	NC		%	50
			Styrene	2019/07/27	NC		%	50
			1,1,1,2-Tetrachloroethane	2019/07/27	NC		%	50
			1,1,2,2-Tetrachloroethane	2019/07/27	NC		%	50
			Tetrachloroethylene	2019/07/27	NC		%	50
			Toluene	2019/07/27	13		%	50
			1,1,1-Trichloroethane	2019/07/27	NC		%	50
			1,1,2-Trichloroethane	2019/07/27	NC		%	50
			Trichloroethylene	2019/07/27	NC		%	50
			Trichlorofluoromethane (FREON 11)	2019/07/27	NC		%	50
			Vinyl Chloride	2019/07/27	NC		%	50
			p+m-Xylene	2019/07/27	NC		%	50
			o-Xylene	2019/07/27	NC		%	50
			Total Xylenes	2019/07/27	NC		%	50
			F1 (C6-C10)	2019/07/27	NC		%	30
			F1 (C6-C10) - BTEX	2019/07/27	NC		%	30
6250464	JMP	RPD	Moisture	2019/07/26	0.80		%	20
6250990	JMP	RPD	Moisture	2019/07/27	1.4		%	20
6252122	GUL	Matrix Spike [KIY541-01]	o-Terphenyl	2019/07/30		100	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/30		103	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2019/07/30		87	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2019/07/30		86	%	50 - 130
6252122	GUL	Spiked Blank	o-Terphenyl	2019/07/30		95	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/30		97	%	80 - 120
			F3 (C16-C34 Hydrocarbons)	2019/07/30		85	%	80 - 120
			F4 (C34-C50 Hydrocarbons)	2019/07/30		85	%	80 - 120
6252122	GUL	Method Blank	o-Terphenyl	2019/07/30		93	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/30	<10		ug/g	
			F3 (C16-C34 Hydrocarbons)	2019/07/30	<50		ug/g	
			F4 (C34-C50 Hydrocarbons)	2019/07/30	<50		ug/g	
6252122	GUL	RPD [KIY541-01]	F2 (C10-C16 Hydrocarbons)	2019/07/30	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2019/07/30	1.4		%	30
			F4 (C34-C50 Hydrocarbons)	2019/07/30	18		%	30
6252645	JP5	Matrix Spike [KIY536-03]	1,4-Difluorobenzene	2019/07/29		104	%	60 - 140
			4-Bromofluorobenzene	2019/07/29		98	%	60 - 140
			D10-Ethylbenzene	2019/07/29		91	%	60 - 140
			D4-1,2-Dichloroethane	2019/07/29		97	%	60 - 140
			Benzene	2019/07/29		88	%	60 - 140
			Toluene	2019/07/29		92	%	60 - 140
			Ethylbenzene	2019/07/29		92	%	60 - 140
			o-Xylene	2019/07/29		88	%	60 - 140
			p+m-Xylene	2019/07/29		90	%	60 - 140
			F1 (C6-C10)	2019/07/29		94	%	60 - 140
6252645	JP5	Spiked Blank	1,4-Difluorobenzene	2019/07/29		105	%	60 - 140
			4-Bromofluorobenzene	2019/07/29		99	%	60 - 140
			D10-Ethylbenzene	2019/07/29		87	%	60 - 140
			D4-1,2-Dichloroethane	2019/07/29		98	%	60 - 140
			Benzene	2019/07/29		88	%	60 - 140
			Toluene	2019/07/29		90	%	60 - 140
			Ethylbenzene	2019/07/29		91	%	60 - 140
			o-Xylene	2019/07/29		88	%	60 - 140
			p+m-Xylene	2019/07/29		92	%	60 - 140

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			F1 (C6-C10)	2019/07/29		92	%	80 - 120
6252645	JP5	Method Blank	1,4-Difluorobenzene	2019/07/29		104	%	60 - 140
			4-Bromofluorobenzene	2019/07/29		98	%	60 - 140
			D10-Ethylbenzene	2019/07/29		88	%	60 - 140
			D4-1,2-Dichloroethane	2019/07/29		98	%	60 - 140
			Benzene	2019/07/29	<0.020		ug/g	
			Toluene	2019/07/29	<0.020		ug/g	
			Ethylbenzene	2019/07/29	<0.020		ug/g	
			o-Xylene	2019/07/29	<0.020		ug/g	
			p+m-Xylene	2019/07/29	<0.040		ug/g	
			Total Xylenes	2019/07/29	<0.040		ug/g	
			F1 (C6-C10)	2019/07/29	<10		ug/g	
			F1 (C6-C10) - BTEX	2019/07/29	<10		ug/g	
6252645	JP5	RPD [KIY536-03]	Benzene	2019/07/29	NC		%	50
			Toluene	2019/07/29	NC		%	50
			Ethylbenzene	2019/07/29	NC		%	50
			o-Xylene	2019/07/29	NC		%	50
			p+m-Xylene	2019/07/29	NC		%	50
			Total Xylenes	2019/07/29	NC		%	50
			F1 (C6-C10)	2019/07/29	NC		%	30
			F1 (C6-C10) - BTEX	2019/07/29	NC		%	30
6252918	GUL	Matrix Spike [KIY542-02]	Propylene Glycol	2019/07/29		94	%	60 - 140
			Ethylene Glycol	2019/07/29		84	%	60 - 140
			Diethylene Glycol	2019/07/29		77	%	60 - 140
6252918	GUL	Spiked Blank	Propylene Glycol	2019/07/29		100	%	60 - 140
			Ethylene Glycol	2019/07/29		86	%	60 - 140
			Diethylene Glycol	2019/07/29		80	%	60 - 140
6252918	GUL	Method Blank	Propylene Glycol	2019/07/29	<10		mg/kg	
			Ethylene Glycol	2019/07/29	<10		mg/kg	
			Diethylene Glycol	2019/07/29	<10		mg/kg	
			Total Glycol	2019/07/29	<10		mg/kg	
6252918	GUL	RPD [KIY542-02]	Propylene Glycol	2019/07/29	NC		%	50
			Ethylene Glycol	2019/07/29	NC		%	50
			Diethylene Glycol	2019/07/29	NC		%	50
			Total Glycol	2019/07/29	NC		%	50
6255270	RAJ	Matrix Spike [KIY541-01]	D10-Anthracene	2019/07/31		87	%	50 - 130
			D14-Terphenyl (FS)	2019/07/31		95	%	50 - 130
			D8-Acenaphthylene	2019/07/31		83	%	50 - 130
			Acenaphthene	2019/07/31		93	%	50 - 130
			Acenaphthylene	2019/07/31		91	%	50 - 130
			Anthracene	2019/07/31		90	%	50 - 130
			Benzo(a)anthracene	2019/07/31		105	%	50 - 130
			Benzo(a)pyrene	2019/07/31		97	%	50 - 130
			Benzo(b/j)fluoranthene	2019/07/31		90	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/31		100	%	50 - 130
			Benzo(k)fluoranthene	2019/07/31		90	%	50 - 130
			Chrysene	2019/07/31		101	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/31		110	%	50 - 130
			Fluoranthene	2019/07/31		109	%	50 - 130
			Fluorene	2019/07/31		96	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/31		98	%	50 - 130
			1-Methylnaphthalene	2019/07/31		102	%	50 - 130
			2-Methylnaphthalene	2019/07/31		92	%	50 - 130
			Naphthalene	2019/07/31		86	%	50 - 130

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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Phenanthrene	2019/07/31		91	%	50 - 130
			Pyrene	2019/07/31		110	%	50 - 130
6255270	RAJ	Spiked Blank	D10-Anthracene	2019/07/31		99	%	50 - 130
			D14-Terphenyl (FS)	2019/07/31		104	%	50 - 130
			D8-Acenaphthylene	2019/07/31		91	%	50 - 130
			Acenaphthene	2019/07/31		100	%	50 - 130
			Acenaphthylene	2019/07/31		97	%	50 - 130
			Anthracene	2019/07/31		98	%	50 - 130
			Benzo(a)anthracene	2019/07/31		110	%	50 - 130
			Benzo(a)pyrene	2019/07/31		100	%	50 - 130
			Benzo(b/j)fluoranthene	2019/07/31		95	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/31		102	%	50 - 130
			Benzo(k)fluoranthene	2019/07/31		104	%	50 - 130
			Chrysene	2019/07/31		100	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/31		108	%	50 - 130
			Fluoranthene	2019/07/31		114	%	50 - 130
			Fluorene	2019/07/31		102	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/31		105	%	50 - 130
			1-Methylnaphthalene	2019/07/31		109	%	50 - 130
			2-Methylnaphthalene	2019/07/31		99	%	50 - 130
			Naphthalene	2019/07/31		93	%	50 - 130
			Phenanthrene	2019/07/31		95	%	50 - 130
			Pyrene	2019/07/31		109	%	50 - 130
6255270	RAJ	Method Blank	D10-Anthracene	2019/07/31		100	%	50 - 130
			D14-Terphenyl (FS)	2019/07/31		107	%	50 - 130
			D8-Acenaphthylene	2019/07/31		88	%	50 - 130
			Acenaphthene	2019/07/31	<0.0050		ug/g	
			Acenaphthylene	2019/07/31	<0.0050		ug/g	
			Anthracene	2019/07/31	<0.0050		ug/g	
			Benzo(a)anthracene	2019/07/31	<0.0050		ug/g	
			Benzo(a)pyrene	2019/07/31	<0.0050		ug/g	
			Benzo(b/j)fluoranthene	2019/07/31	<0.0050		ug/g	
			Benzo(g,h,i)perylene	2019/07/31	<0.0050		ug/g	
			Benzo(k)fluoranthene	2019/07/31	<0.0050		ug/g	
			Chrysene	2019/07/31	<0.0050		ug/g	
			Dibenz(a,h)anthracene	2019/07/31	<0.0050		ug/g	
			Fluoranthene	2019/07/31	<0.0050		ug/g	
			Fluorene	2019/07/31	<0.0050		ug/g	
			Indeno(1,2,3-cd)pyrene	2019/07/31	<0.0050		ug/g	
			1-Methylnaphthalene	2019/07/31	<0.0050		ug/g	
			2-Methylnaphthalene	2019/07/31	<0.0050		ug/g	
			Naphthalene	2019/07/31	<0.0050		ug/g	
			Phenanthrene	2019/07/31	<0.0050		ug/g	
			Pyrene	2019/07/31	<0.0050		ug/g	
6255270	RAJ	RPD [KIY541-01]	Acenaphthene	2019/07/31	28		%	40
			Acenaphthylene	2019/07/31	NC		%	40
			Anthracene	2019/07/31	2.4		%	40
			Benzo(a)anthracene	2019/07/31	0.72		%	40
			Benzo(a)pyrene	2019/07/31	2.2		%	40
			Benzo(b/j)fluoranthene	2019/07/31	4.8		%	40
			Benzo(g,h,i)perylene	2019/07/31	5.1		%	40
			Benzo(k)fluoranthene	2019/07/31	4.5		%	40
			Chrysene	2019/07/31	1.8		%	40
			Dibenz(a,h)anthracene	2019/07/31	1.6		%	40

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QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Fluoranthene	2019/07/31	8.4		%	40
			Fluorene	2019/07/31	21		%	40
			Indeno(1,2,3-cd)pyrene	2019/07/31	5.4		%	40
			1-Methylnaphthalene	2019/07/31	NC		%	40
			2-Methylnaphthalene	2019/07/31	0.50		%	40
			Naphthalene	2019/07/31	NC		%	40
			Phenanthrene	2019/07/31	16		%	40
			Pyrene	2019/07/31	11		%	40
6262247	AKH	Matrix Spike	13C2-6:2-Fluorotelomersulfonic Acid	2019/08/03		91	%	50 - 150
			13C2-8:2-Fluorotelomersulfonic Acid	2019/08/03		85	%	50 - 150
			13C2-Perfluorodecanoic acid	2019/08/03		86	%	50 - 150
			13C2-Perfluorododecanoic acid	2019/08/03		81	%	50 - 150
			13C2-Perfluorohexanoic acid	2019/08/03		91	%	50 - 150
			13C2-perfluorotetradecanoic acid	2019/08/03		71	%	50 - 150
			13C2-Perfluoroundecanoic acid	2019/08/03		82	%	50 - 150
			13C3-Perfluorobutanesulfonic acid	2019/08/03		91	%	50 - 150
			13C4-Perfluorobutanoic acid	2019/08/03		90	%	50 - 150
			13C4-Perfluoroheptanoic acid	2019/08/03		90	%	50 - 150
			13C4-Perfluorooctanesulfonic acid	2019/08/03		87	%	50 - 150
			13C4-Perfluorooctanoic acid	2019/08/03		90	%	50 - 150
			13C5-Perfluorononanoic acid	2019/08/03		88	%	50 - 150
			13C5-Perfluoropentanoic acid	2019/08/03		89	%	50 - 150
			13C8-Perfluorooctane Sulfonamide	2019/08/03		75	%	50 - 150
			18O2-Perfluorohexanesulfonic acid	2019/08/03		92	%	50 - 150
			D3-MeFOSA	2019/08/03		54	%	50 - 150
			D3-MeFOSAA	2019/08/03		78	%	50 - 150
			D5-EtFOSA	2019/08/03		57	%	50 - 150
			D5-EtFOSAA	2019/08/03		76	%	50 - 150
			D7-MeFOSE	2019/08/03		67	%	50 - 150
			D9-EtFOSE	2019/08/03		63	%	50 - 150
			Perfluorobutanoic acid	2019/08/03		93	%	70 - 130
			Perfluoropentanoic Acid (PFPeA)	2019/08/03		91	%	70 - 130
			Perfluorohexanoic Acid (PFHxA)	2019/08/03		94	%	70 - 130
			Perfluoroheptanoic Acid (PFHpA)	2019/08/03		88	%	70 - 130
			Perfluorooctanoic Acid (PFOA)	2019/08/03		89	%	70 - 130
			Perfluorononanoic Acid (PFNA)	2019/08/03		95	%	70 - 130
			Perfluorodecanoic Acid (PFDA)	2019/08/03		94	%	70 - 130
			Perfluoroundecanoic Acid (PFUnA)	2019/08/03		93	%	70 - 130
			Perfluorododecanoic Acid (PFDoA)	2019/08/03		89	%	70 - 130
			Perfluorotridecanoic Acid	2019/08/03		101	%	70 - 130
			Perfluorotetradecanoic Acid	2019/08/03		89	%	70 - 130
			Perfluorobutanesulfonic acid	2019/08/03		88	%	70 - 130
			Perfluoropentanesulfonic acid	2019/08/03		93	%	70 - 130
			Perfluorohexanesulfonic acid	2019/08/03		90	%	70 - 130
			Perfluoroheptanesulfonic acid	2019/08/03		88	%	70 - 130
			Perfluorooctanesulfonic acid	2019/08/03		95	%	70 - 130
			Perfluorononanesulfonic acid	2019/08/03		89	%	70 - 130
			Perfluorodecanesulfonic acid (PFDS)	2019/08/03		86	%	70 - 130
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/03		84	%	70 - 130
			EtFOSA	2019/08/03		90	%	70 - 130
			MeFOSA	2019/08/03		94	%	70 - 130
			EtFOSE	2019/08/03		95	%	70 - 130
			MeFOSE	2019/08/03		87	%	70 - 130
			EtFOSAA	2019/08/03		93	%	70 - 130

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			MeFOSAA	2019/08/03		96	%	70 - 130
			6:2 Fluorotelomer sulfonic acid	2019/08/03		87	%	70 - 130
			8:2 Fluorotelomer sulfonic acid	2019/08/03		91	%	70 - 130
6262247	AKH	Spiked Blank	13C2-6:2-Fluorotelomersulfonic Acid	2019/08/04		89	%	50 - 150
			13C2-8:2-Fluorotelomersulfonic Acid	2019/08/04		82	%	50 - 150
			13C2-Perfluorodecanoic acid	2019/08/04		81	%	50 - 150
			13C2-Perfluorododecanoic acid	2019/08/04		77	%	50 - 150
			13C2-Perfluorohexanoic acid	2019/08/04		88	%	50 - 150
			13C2-perfluorotetradecanoic acid	2019/08/04		71	%	50 - 150
			13C2-Perfluoroundecanoic acid	2019/08/04		82	%	50 - 150
			13C3-Perfluorobutanesulfonic acid	2019/08/04		87	%	50 - 150
			13C4-Perfluorobutanoic acid	2019/08/04		87	%	50 - 150
			13C4-Perfluoroheptanoic acid	2019/08/04		86	%	50 - 150
			13C4-Perfluorooctanesulfonic acid	2019/08/04		84	%	50 - 150
			13C4-Perfluorooctanoic acid	2019/08/04		85	%	50 - 150
			13C5-Perfluorononanoic acid	2019/08/04		85	%	50 - 150
			13C5-Perfluoropentanoic acid	2019/08/04		87	%	50 - 150
			13C8-Perfluorooctane Sulfonamide	2019/08/04		74	%	50 - 150
			18O2-Perfluorohexanesulfonic acid	2019/08/04		87	%	50 - 150
			D3-MeFOSA	2019/08/04		50	%	50 - 150
			D3-MeFOSAA	2019/08/04		86	%	50 - 150
			D5-EtFOSA	2019/08/04		48 (2)	%	50 - 150
			D5-EtFOSAA	2019/08/04		75	%	50 - 150
			D7-MeFOSE	2019/08/04		69	%	50 - 150
			D9-EtFOSE	2019/08/04		68	%	50 - 150
			Perfluorobutanoic acid	2019/08/04		93	%	70 - 130
			Perfluoropentanoic Acid (PFPeA)	2019/08/04		89	%	70 - 130
			Perfluorohexanoic Acid (PFHxA)	2019/08/04		91	%	70 - 130
			Perfluoroheptanoic Acid (PFHpA)	2019/08/04		88	%	70 - 130
			Perfluorooctanoic Acid (PFOA)	2019/08/04		89	%	70 - 130
			Perfluorononanoic Acid (PFNA)	2019/08/04		93	%	70 - 130
			Perfluorodecanoic Acid (PFDA)	2019/08/04		94	%	70 - 130
			Perfluoroundecanoic Acid (PFUnA)	2019/08/04		91	%	70 - 130
			Perfluorododecanoic Acid (PFDoA)	2019/08/04		92	%	70 - 130
			Perfluorotridecanoic Acid	2019/08/04		100	%	70 - 130
			Perfluorotetradecanoic Acid	2019/08/04		90	%	70 - 130
			Perfluorobutanesulfonic acid	2019/08/04		86	%	70 - 130
			Perfluoropentanesulfonic acid	2019/08/04		88	%	70 - 130
			Perfluorohexanesulfonic acid	2019/08/04		90	%	70 - 130
			Perfluoroheptanesulfonic acid	2019/08/04		86	%	70 - 130
			Perfluorooctanesulfonic acid	2019/08/04		92	%	70 - 130
			Perfluorononanesulfonic acid	2019/08/04		88	%	70 - 130
			Perfluorodecanesulfonic acid (PFDS)	2019/08/04		89	%	70 - 130
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/04		86	%	70 - 130
			EtFOSA	2019/08/04		90	%	70 - 130
			MeFOSA	2019/08/04		86	%	70 - 130
			EtFOSE	2019/08/04		95	%	70 - 130
			MeFOSE	2019/08/04		89	%	70 - 130
			EtFOSAA	2019/08/04		90	%	70 - 130
			MeFOSAA	2019/08/04		92	%	70 - 130
			6:2 Fluorotelomer sulfonic acid	2019/08/04		86	%	70 - 130
			8:2 Fluorotelomer sulfonic acid	2019/08/04		95	%	70 - 130
6262247	AKH	Method Blank	13C2-6:2-Fluorotelomersulfonic Acid	2019/08/04		103	%	50 - 150
			13C2-8:2-Fluorotelomersulfonic Acid	2019/08/04		95	%	50 - 150

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			13C2-Perfluorodecanoic acid	2019/08/04		96	%	50 - 150
			13C2-Perfluorododecanoic acid	2019/08/04		91	%	50 - 150
			13C2-Perfluorohexanoic acid	2019/08/04		109	%	50 - 150
			13C2-perfluorotetradecanoic acid	2019/08/04		86	%	50 - 150
			13C2-Perfluoroundecanoic acid	2019/08/04		92	%	50 - 150
			13C3-Perfluorobutanesulfonic acid	2019/08/04		104	%	50 - 150
			13C4-Perfluorobutanoic acid	2019/08/04		103	%	50 - 150
			13C4-Perfluoroheptanoic acid	2019/08/04		102	%	50 - 150
			13C4-Perfluorooctanesulfonic acid	2019/08/04		97	%	50 - 150
			13C4-Perfluorooctanoic acid	2019/08/04		99	%	50 - 150
			13C5-Perfluorononanoic acid	2019/08/04		98	%	50 - 150
			13C5-Perfluoropentanoic acid	2019/08/04		104	%	50 - 150
			13C8-Perfluorooctane Sulfonamide	2019/08/04		82	%	50 - 150
			18O2-Perfluorohexanesulfonic acid	2019/08/04		99	%	50 - 150
			D3-MeFOSA	2019/08/04		52	%	50 - 150
			D3-MeFOSAA	2019/08/04		92	%	50 - 150
			D5-EtFOSA	2019/08/04		54	%	50 - 150
			D5-EtFOSAA	2019/08/04		91	%	50 - 150
			D7-MeFOSE	2019/08/04		81	%	50 - 150
			D9-EtFOSE	2019/08/04		78	%	50 - 150
			Perfluorobutanoic acid	2019/08/04	<1.0		ug/kg	
			Perfluoropentanoic Acid (PFPeA)	2019/08/04	<1.0		ug/kg	
			Perfluorohexanoic Acid (PFHxA)	2019/08/04	<1.0		ug/kg	
			Perfluoroheptanoic Acid (PFHpA)	2019/08/04	<1.0		ug/kg	
			Perfluorooctanoic Acid (PFOA)	2019/08/04	<1.0		ug/kg	
			Perfluorononanoic Acid (PFNA)	2019/08/04	<1.0		ug/kg	
			Perfluorodecanoic Acid (PFDA)	2019/08/04	<1.0		ug/kg	
			Perfluoroundecanoic Acid (PFUnA)	2019/08/04	<1.0		ug/kg	
			Perfluorododecanoic Acid (PFDoA)	2019/08/04	<1.0		ug/kg	
			Perfluorotridecanoic Acid	2019/08/04	<1.0		ug/kg	
			Perfluorotetradecanoic Acid	2019/08/04	<1.0		ug/kg	
			Perfluorobutanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluoropentanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluorohexanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluoroheptanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluorooctanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluorononanesulfonic acid	2019/08/04	<1.0		ug/kg	
			Perfluorodecanesulfonic acid (PFDS)	2019/08/04	<1.0		ug/kg	
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/04	<1.0		ug/kg	
			EtFOSA	2019/08/04	<1.0		ug/kg	
			MeFOSA	2019/08/04	<1.0		ug/kg	
			EtFOSE	2019/08/04	<1.0		ug/kg	
			MeFOSE	2019/08/04	<1.0		ug/kg	
			EtFOSAA	2019/08/04	<1.0		ug/kg	
			MeFOSAA	2019/08/04	<1.0		ug/kg	
			6:2 Fluorotelomer sulfonic acid	2019/08/04	<1.0		ug/kg	
			8:2 Fluorotelomer sulfonic acid	2019/08/04	<1.0		ug/kg	
6262247	AKH	RPD	Perfluorobutanoic acid	2019/08/04	NC		%	30
			Perfluoropentanoic Acid (PFPeA)	2019/08/04	NC		%	30
			Perfluorohexanoic Acid (PFHxA)	2019/08/04	NC		%	30
			Perfluoroheptanoic Acid (PFHpA)	2019/08/04	NC		%	30
			Perfluorooctanoic Acid (PFOA)	2019/08/04	NC		%	30
			Perfluorononanoic Acid (PFNA)	2019/08/04	NC		%	30
			Perfluorodecanoic Acid (PFDA)	2019/08/04	NC		%	30

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BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Perfluoroundecanoic Acid (PFUnA)	2019/08/04	NC		%	30
			Perfluorododecanoic Acid (PFDoA)	2019/08/04	NC		%	30
			Perfluorotridecanoic Acid	2019/08/04	NC		%	30
			Perfluorotetradecanoic Acid	2019/08/04	NC		%	30
			Perfluorobutanesulfonic acid	2019/08/04	NC		%	30
			Perfluorohexanesulfonic acid	2019/08/04	NC		%	30
			Perfluoroheptanesulfonic acid	2019/08/04	NC		%	30
			Perfluorooctanesulfonic acid	2019/08/04	NC		%	30
			Perfluorodecanesulfonic acid (PFDS)	2019/08/04	NC		%	30
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/04	NC		%	25
			EtFOSAA	2019/08/04	NC		%	30
			MeFOSAA	2019/08/04	NC		%	30
			6:2 Fluorotelomer sulfonic acid	2019/08/04	NC		%	30
			8:2 Fluorotelomer sulfonic acid	2019/08/04	NC		%	30

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

(1) The recovery was above the upper control limit. This may represent a high bias in some results for this specific analyte. For results that were not detected (ND), this potential bias has no impact.

(2) Extracted internal standard analyte recovery was below the defined lower control limit (LCL) which may result in increased variability of the associated native analyte result (N-Ethylperfluorooctane sulfonamide).

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

BV Labs Job #: B9K5175
Report Date: 2019/08/09

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Colm McNamara, Senior Analyst, Liquid Chromatography

CHARTERED
Eva Pranjic
CHEMIST

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

24-Jul-19 11:45
Cristina (Maria) Bacchus
B9K5175
J L ENV-989

Page 1 of 2

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#19397 Dillon Consulting Limited	Company Name:		Quotation #:	
Attention:	Andrew Hounsell	Attention:	Andrew Hounsell	P.O. #:	
Address:	334 - 11th Ave SE Suite 200, Calgary AB T2G 0Y2	Address:		Project:	19-9543
				Project Name:	
Tel:	(403) 215-8880 Fax: (403) 215-8889	Tel:	(403) 604-7164 Fax:	Site #:	
Email:	AHounsell@dillon.ca KBarnes@dillon.ca	Email:	AHounsell@dillon.ca	Sampled By:	A. Hounsell

Bottle Order #: 727706
COC #: C#727706-01-01
Project Manager: Cristina (Maria) Bacchus

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011): Table 1, Table 2, Table 3, Table ___; Res/Park, Ind/Comm, Agri/Other; Medium/Fine, Coarse, For RSC

Other Regulations: CCME, Reg 558, MISA, PWQO, Other; Sanitary Sewer Bylaw, Storm Sewer Bylaw, Municipality ______

Special Instructions

Include Criteria on Certificate of Analysis (Y/N)? ______

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: [X]
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: ______ Time Required: ______
Rush Confirmation Number: ______ (call lab for #)

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

#	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Petroleum Hydrocarbons	PAHs	Glycols in Soil by GC-FID	VOCs by HS	PFAS in soil by SPE/LCMS	# of Bottles	Comments
1		SS01	July 17, 2019	10:05	Soil		X	X		X		5	
2		SS02	↓	10:30	↓		X	X				3	On ice
3		SS03		10:50			X	X				3	
4		SS04		11:20			X	X		X		5	
5		SS05		12:00			X	X				3	
6		SS06		12:10			X	X				3	
7		SS07		12:35			X	X	X			4	
8		SS08		13:50			X	X			X	4	
9		SS09		14:10							X	1	
10		SS10	↓	14:20	↓						X	1	

RECEIVED IN OTTAWA

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Andrew Hounsell	19/07/19	11:30	Ian Campbell	2019/07/24	11:45	
				2019/07/25	0810	

Laboratory Use Only: Time Sensitive; Temperature (°C) on Recei 4, 5, 6; Custody Seal Present: Yes ✓; Intact: Yes ✓

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS. 5/7/4 4/1/0 1/40

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

White: BV Labs Yellow: Client

Bureau Veritas Laboratories
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Page 2 of 2

CHAIN OF CUSTODY RECORD

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#19397 Dillon Consulting Limited	Company Name:		Quotation #:	
Attention:	Andrew Hounsell	Attention:	Andrew Hounsell	P.O. #:	
Address:	334 - 11th Ave SE Suite 200	Address:		Project:	19-9543
	Calgary AB T2G 0Y2			Project Name:	
Tel:	(403) 215-8880 Fax: (403) 215-8889	Tel:	(403) 604-7164 Fax:	Site #:	
Email:	AHounsell@dillon.ca Kbarnes@dillon.ca	Email:	AHounsell@dillon.ca	Sampled By:	A.Hounsell

Laboratory Use Only:

BV Labs Job #:	Bottle Order #:
	727706
COC #:	Project Manager:
C#727706-02-01	Cristina (Maria) Bacchus

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558. ☐ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality ____	
☐ Table ___	☐ PWQO	
	☐ Other ____	

Include Criteria on Certificate of Analysis (Y/N)? ____

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects

Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.

Job Specific Rush TAT (if applies to entire submission)
Date Required: ____ Time Required: ____ ☐
Rush Confirmation Number: ____ *(call lab for #)*

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Petroleum Hydrocarbons	PAHs	Glycols in Soil by GC-FID	VOCs by HS	PFAS in soil by SPE/LCMS	# of Bottles	Comments
1		SS11	July 17, 2019	14:35	Soil						X	1	H- HOLD
2		SS12		14:45							X	1	
3		SS13		14:55			X	X			X	4	
4		SS14		16:30			X	X	X			4	
5		SS15		17:30			X	X	X	X		6	
6		SS16		17:45			X	X	X			4	On ice
7		TP1	July 18, 2019	14:25			X	X				3	RECEIVED IN OTTAWA
8		QAQC01		14:25			X	X				3	
9		QAQC02		16:00	Soil		H					2	
10		TP4		15:45	Soil		X	X				3	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Andrew Hounsell / Andrew Hounsell	19/07/19	11:30	Ian Campbell	2019/07/24	11:45	
				2019/07/25	0:80	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	4, 5, 6	Present	✓	
		Intact	✓	

White: BV Labs Yellow: Client

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS. 5714 2110 1/20

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Bureau Veritas Canada (2019) Inc.

Your Project #: 19-9543
Your C.O.C. #: 727706-03-01

Attention: Andrew Hounsell

Dillon Consulting Limited
334 - 11th Ave SE
Suite 200
Calgary, AB
CANADA T2G 0Y2

Report Date: 2019/07/31
Report #: R5821187
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9K5213
Received: 2019/07/24, 11:45

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Sieve, 75um (1)	1	N/A	2019/07/29	CAM SOP-00467	Carter 2nd ed m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) This test was performed by Bureau Veritas Laboratories Mississauga

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Your Project #: 19-9543
Your C.O.C. #: 727706-03-01

Attention: Andrew Hounsell

Dillon Consulting Limited
334 - 11th Ave SE
Suite 200
Calgary, AB
CANADA T2G 0Y2

Report Date: 2019/07/31
Report #: R5821187
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9K5213
Received: 2019/07/24, 11:45

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas Laboratories
31 Jul 2019 17:01:05

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==
This report has been generated and distributed using a secure automated process.
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BV Labs Job #: B9K5213
Report Date: 2019/07/31

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF SOIL

BV Labs ID		KIY675		
Sampling Date		2019/07/17 12:30		
COC Number		727706-03-01		
	UNITS	**SS04**	**RDL**	**QC Batch**
Miscellaneous Parameters				
Grain Size	%	COARSE	N/A	6252165
Sieve - #200 (<0.075mm)	%	10	1	6252165
Sieve - #200 (>0.075mm)	%	90	1	6252165

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
N/A = Not Applicable

BV Labs Job #: B9K5213
Report Date: 2019/07/31

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	5.0°C

Results relate only to the items tested.

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BV Labs Job #: B9K5213
Report Date: 2019/07/31

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6252165	GYA	QC Standard	Sieve - #200 (<0.075mm)	2019/07/30		56	%	53 - 58
			Sieve - #200 (>0.075mm)	2019/07/30		44	%	42 - 47
6252165	GYA	RPD	Sieve - #200 (<0.075mm)	2019/07/29	0.24		%	20
			Sieve - #200 (>0.075mm)	2019/07/29	0.40		%	20

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

BV Labs Job #: B9K5213
Report Date: 2019/07/31

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Ewa Pranjic, M.Sc., C.Chem, Scientific Specialist

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Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

24-Jul-19 11:45
Cristina (Maria) Bacchus
B9K5213
J L ENV-989

Page 1 of 1

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#19397 Dillon Consulting Limited	Company Name:		Quotation #:	
Attention:	Andrew Hounsell	Attention:	Andrew Hounsell	P.O. #:	
Address:	334 - 11th Ave SE Suite 200	Address:		Project:	19-9543
	Calgary AB T2G 0Y2			Project Name:	
Tel:	(403) 215-8880 Fax: (403) 215-8889	Tel:	(403) 604-7164 Fax:	Site #:	
Email:	AHounsell@dillon.ca Kbarnes@dillon.ca	Email:	AHounsell@dillon.ca	Sampled By:	

Bottle Order #: 727706
COC #: C#727706-03-01
Project Manager: Cristina (Maria) Bacchus

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558 ☐ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality	
☐ Table	☐ PWQO	
	☐ Other	

Include Criteria on Certificate of Analysis (Y/N)?

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: ☒
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission) ☐
Date Required: Time Required:
Rush Confirmation Number: (call lab for #)

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Petroleum Hydrocarbons	PAHs	Glycols in Soil by GC-FID	VOCs by HS	PFAS in soil by SPE/LCMS	Grain Size				# of Bottles	Comments
1		SS04	July 17, 2019	12:30	Soil							X				1	
2																	on ice
3																	RECEIVED IN OTTAWA
4																	
5																	
6																	
7																	
8																	
9																	
10																	

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	# jars used and not submitted
Andrew Hounsell	19/07/19	11:30	Lay Campbell	2019/07/24	11:45	
				2019/07/25	0850	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei 4, 5, 6	Custody Seal	Yes	No
		Present		
		Intact	✓	

White: BV Labs Yellow: Client

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS. 5/7/4 2/1/0 1/2/0

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

Your Project #: 19-9543
Your C.O.C. #: 727707-01-01

Attention: Andrew Hounsell

Dillon Consulting Limited
334 - 11th Ave SE
Suite 200
Calgary, AB
CANADA T2G 0Y2

Report Date: 2019/08/06
Report #: R5828219
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B9K5262
Received: 2019/07/24, 11:45

Sample Matrix: Water
Samples Received: 7

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Methylnaphthalene Sum (1)	7	N/A	2019/07/31	CAM SOP-00301	EPA 8270D m
1,3-Dichloropropene Sum (1)	2	N/A	2019/07/30		EPA 8260C m
Chromium (VI) in Water (1)	7	N/A	2019/07/29	CAM SOP-00436	EPA 7199 m
Petroleum Hydro. CCME F1 & BTEX in Water (1)	5	N/A	2019/07/29	CAM SOP-00315	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (1, 2)	2	2019/07/30	2019/07/30	CAM SOP-00316	CCME PHC-CWS m
Petroleum Hydrocarbons F2-F4 in Water (1, 2)	5	2019/07/30	2019/07/31	CAM SOP-00316	CCME PHC-CWS m
Glycols in Water by GC/FID (1)	2	N/A	2019/07/30	CAM SOP-00322	based on EPA 8015
Mercury (1)	7	2019/07/29	2019/07/29	CAM SOP-00453	EPA 7470A m
Dissolved Metals by ICPMS (1)	7	N/A	2019/07/30	CAM SOP-00447	EPA 6020B m
PAH Compounds in Water by GC/MS (SIM) (1)	2	2019/07/30	2019/07/30	CAM SOP-00318	EPA 8270D m
PAH Compounds in Water by GC/MS (SIM) (1)	5	2019/07/30	2019/07/31	CAM SOP-00318	EPA 8270D m
PFAS in water by SPE/LCMS (1, 3)	2	2019/07/31	2019/08/01	CAM SOP-00894	EPA 537 m
Volatile Organic Compounds and F1 PHCs (1)	2	N/A	2019/07/29	CAM SOP-00230	EPA 8260C m

Remarks:

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.

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Your Project #: 19-9543
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Received: 2019/07/24, 11:45

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Bureau Veritas Laboratories Mississauga

(2) All CCME PHC results met required criteria unless otherwise stated in the report. The CWS PHC methods employed by Bureau Veritas Laboratories conform to all prescribed elements of the reference method and performance based elements have been validated. All modifications have been validated and proven equivalent following “Alberta Environment’s Interpretation of the Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil Validation of Performance-Based Alternative Methods September 2003”. Documentation is available upon request. Modifications from Reference Method for the Canada-wide Standard for Petroleum Hydrocarbons in Soil-Tier 1 Method: F2/F3/F4 data reported using validated cold solvent extraction instead of Soxhlet extraction.

(3) Per- and polyfluoroalkyl substances (PFAS) identified as surrogates on the certificate of analysis represent the extracted internal standard.

Encryption Key

AUTHORIZED REPORT
RAPPORT AUTORISÉ

Bureau Veritas Laboratories
06 Aug 2019 16:37:37

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Christine Gripton, Senior Project Manager
Email: Christine.Gripton@bvlabs.com
Phone# (519)652-9444
==
This report has been generated and distributed using a secure automated process.
BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

BUREAU VERITAS

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF WATER

BV Labs ID		KIY873		KIY875		
Sampling Date		2019/07/18 20:55		2019/07/18 21:55		
COC Number		727707-01-01		727707-01-01		
	UNITS	**19MW-02**	**RDL**	**19MW-03**	**RDL**	**QC Batch**
Perfluorinated Compounds						
Perfluorobutanoic acid	ug/L	0.12	0.020	0.030	0.020	6257053
Perfluoropentanoic Acid (PFPeA)	ug/L	0.99	0.020	0.086	0.020	6257053
Perfluorohexanoic Acid (PFHxA)	ug/L	0.55	0.020	0.055	0.020	6257053
Perfluoroheptanoic Acid (PFHpA)	ug/L	0.37	0.020	0.042	0.020	6257053
Perfluorooctanoic Acid (PFOA)	ug/L	0.32	0.020	0.059	0.020	6257053
Perfluorononanoic Acid (PFNA)	ug/L	0.12	0.020	<0.020	0.020	6257053
Perfluorodecanoic Acid (PFDA)	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluoroundecanoic Acid (PFUnA)	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorododecanoic Acid (PFDoA)	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorotridecanoic Acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorotetradecanoic Acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorobutanesulfonic acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluoropentanesulfonic acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorohexanesulfonic acid	ug/L	<0.020	0.020	0.036	0.020	6257053
Perfluoroheptanesulfonic acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorooctanesulfonic acid	ug/L	0.040	0.020	0.26	0.020	6257053
Perfluorononanesulfonic acid	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorodecanesulfonic acid (PFDS)	ug/L	<0.020	0.020	<0.020	0.020	6257053
Perfluorooctane Sulfonamide (PFOSA)	ug/L	<0.020	0.020	<0.020	0.020	6257053
EtFOSA	ug/L	<0.020	0.020	<0.020	0.020	6257053
MeFOSA	ug/L	<0.020	0.020	<0.020	0.020	6257053
EtFOSE	ug/L	<0.020	0.020	<0.020	0.020	6257053
MeFOSE	ug/L	<0.020	0.020	<0.020	0.020	6257053
EtFOSAA	ug/L	<0.020	0.020	<0.020	0.020	6257053
MeFOSAA	ug/L	<0.020	0.020	<0.020	0.020	6257053
6:2 Fluorotelomer sulfonic acid	ug/L	1.6	0.20	0.046	0.020	6257053
8:2 Fluorotelomer sulfonic acid	ug/L	0.16	0.020	<0.020	0.020	6257053
Surrogate Recovery (%)						
13C2-6:2-Fluorotelomersulfonic Acid	%	97		101		6257053
13C2-8:2-Fluorotelomersulfonic Acid	%	87		89		6257053
13C2-Perfluorodecanoic acid	%	92		92		6257053
13C2-Perfluorododecanoic acid	%	68		79		6257053
13C2-Perfluorohexanoic acid	%	97		104		6257053
13C2-perfluorotetradecanoic acid	%	27 (1)		64		6257053

RDL = Reportable Detection Limit

QC Batch = Quality Control Batch

(1) Extracted internal standard analyte recovery was below the defined lower control limit (LCL). Laboratory spiked water resulted in satisfactory recovery of the extracted internal standard analyte. When considered together, these QC data suggest that matrix interferences may be increasing the variability of the associated native analyte result (Perfluorotetradecanoic acid - PFTeDA).

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BUREAU VERITAS

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

RESULTS OF ANALYSES OF WATER

BV Labs ID		KIY873		KIY875		
Sampling Date		2019/07/18 20:55		2019/07/18 21:55		
COC Number		727707-01-01		727707-01-01		
	UNITS	19MW-02	RDL	19MW-03	RDL	QC Batch
13C2-Perfluoroundecanoic acid	%	87		84		6257053
13C3-Perfluorobutanesulfonic acid	%	92		95		6257053
13C4-Perfluorobutanoic acid	%	79		88		6257053
13C4-Perfluoroheptanoic acid	%	94		95		6257053
13C4-Perfluorooctanesulfonic acid	%	92		90		6257053
13C4-Perfluorooctanoic acid	%	94		96		6257053
13C5-Perfluorononanoic acid	%	95		98		6257053
13C5-Perfluoropentanoic acid	%	88		97		6257053
13C8-Perfluorooctane Sulfonamide	%	81		79		6257053
18O2-Perfluorohexanesulfonic acid	%	93		95		6257053
D3-MeFOSA	%	63		70		6257053
D3-MeFOSAA	%	89		87		6257053
D5-EtFOSA	%	60		71		6257053
D5-EtFOSAA	%	83		84		6257053
D7-MeFOSE	%	71		76		6257053
D9-EtFOSE	%	63		74		6257053

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

GLYCOLS BY GC-FID (WATER)

BV Labs ID		KIY873	KIY875		
Sampling Date		2019/07/18 20:55	2019/07/18 21:55		
COC Number		727707-01-01	727707-01-01		
	UNITS	**19MW-02**	**19MW-03**	**RDL**	**QC Batch**
Glycols					
Propylene Glycol	mg/L	<5	<5	5	6253488
Ethylene Glycol	mg/L	<5	<5	5	6253488
Diethylene Glycol	mg/L	<5	<5	5	6253488
Total Glycol	mg/L	<5	<5	5	6253488

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 METALS PACKAGE (WATER)

BV Labs ID		KIY869			KIY869			KIY870	KIY871		
Sampling Date		2019/07/16 19:20			2019/07/16 19:20			2019/07/16 19:40	2019/07/16 20:00		
COC Number		727707-01-01			727707-01-01			727707-01-01	727707-01-01		
	UNITS	**SW1**	**RDL**	**QC Batch**	**SW1 Lab-Dup**	**RDL**	**QC Batch**	**SW2**	**SW3**	**RDL**	**QC Batch**
Metals											
Chromium (VI)	ug/L	<0.50	0.50	6252715	<0.50	0.50	6252715	<0.50	<0.50	0.50	6252715
Mercury (Hg)	ug/L	<0.1	0.1	6252129				<0.1	<0.1	0.1	6252129
Dissolved Antimony (Sb)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Arsenic (As)	ug/L	<1.0	1.0	6251097				<1.0	<1.0	1.0	6251097
Dissolved Barium (Ba)	ug/L	2.8	2.0	6251097				2.8	2.9	2.0	6251097
Dissolved Beryllium (Be)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Boron (B)	ug/L	<10	10	6251097				<10	<10	10	6251097
Dissolved Cadmium (Cd)	ug/L	<0.10	0.10	6251097				<0.10	<0.10	0.10	6251097
Dissolved Chromium (Cr)	ug/L	<5.0	5.0	6251097				<5.0	<5.0	5.0	6251097
Dissolved Cobalt (Co)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Copper (Cu)	ug/L	<1.0	1.0	6251097				<1.0	<1.0	1.0	6251097
Dissolved Lead (Pb)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Molybdenum (Mo)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Nickel (Ni)	ug/L	<1.0	1.0	6251097				<1.0	<1.0	1.0	6251097
Dissolved Selenium (Se)	ug/L	<2.0	2.0	6251097				<2.0	<2.0	2.0	6251097
Dissolved Silver (Ag)	ug/L	<0.10	0.10	6251097				<0.10	<0.10	0.10	6251097
Dissolved Sodium (Na)	ug/L	1000	100	6251097				1000	1100	100	6251097
Dissolved Thallium (Tl)	ug/L	<0.050	0.050	6251097				<0.050	<0.050	0.050	6251097
Dissolved Uranium (U)	ug/L	<0.10	0.10	6251097				<0.10	<0.10	0.10	6251097
Dissolved Vanadium (V)	ug/L	<0.50	0.50	6251097				<0.50	<0.50	0.50	6251097
Dissolved Zinc (Zn)	ug/L	<5.0	5.0	6251097				<5.0	<5.0	5.0	6251097

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 METALS PACKAGE (WATER)

BV Labs ID		KIY872	KIY873	KIY874	KIY875		
Sampling Date		2019/07/18 19:55	2019/07/18 20:55	2019/07/18 20:55	2019/07/18 21:55		
COC Number		727707-01-01	727707-01-01	727707-01-01	727707-01-01		
	UNITS	19MW-04	19MW-02	QAQC03	19MW-03	RDL	QC Batch
Metals							
Chromium (VI)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6252715
Mercury (Hg)	ug/L	<0.1	<0.1	<0.1	<0.1	0.1	6252129
Dissolved Antimony (Sb)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6251097
Dissolved Arsenic (As)	ug/L	<1.0	1.4	1.2	<1.0	1.0	6251097
Dissolved Barium (Ba)	ug/L	4.3	13	12	5.7	2.0	6251097
Dissolved Beryllium (Be)	ug/L	<0.50	<0.50	<0.50	<0.50	0.50	6251097
Dissolved Boron (B)	ug/L	63	47	46	76	10	6251097
Dissolved Cadmium (Cd)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6251097
Dissolved Chromium (Cr)	ug/L	<5.0	<5.0	<5.0	<5.0	5.0	6251097
Dissolved Cobalt (Co)	ug/L	<0.50	0.52	0.53	<0.50	0.50	6251097
Dissolved Copper (Cu)	ug/L	3.2	10	10	6.2	1.0	6251097
Dissolved Lead (Pb)	ug/L	0.75	0.84	<0.50	<0.50	0.50	6251097
Dissolved Molybdenum (Mo)	ug/L	1.0	1.2	1.2	1.6	0.50	6251097
Dissolved Nickel (Ni)	ug/L	<1.0	2.6	2.8	<1.0	1.0	6251097
Dissolved Selenium (Se)	ug/L	<2.0	<2.0	<2.0	<2.0	2.0	6251097
Dissolved Silver (Ag)	ug/L	<0.10	<0.10	<0.10	<0.10	0.10	6251097
Dissolved Sodium (Na)	ug/L	5100	5600	5800	6500	100	6251097
Dissolved Thallium (Tl)	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6251097
Dissolved Uranium (U)	ug/L	0.79	0.78	0.78	1.3	0.10	6251097
Dissolved Vanadium (V)	ug/L	<0.50	1.6	1.6	<0.50	0.50	6251097
Dissolved Zinc (Zn)	ug/L	<5.0	9.7	9.5	<5.0	5.0	6251097

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (WATER)

BV Labs ID		KIY869	KIY870			KIY870			KIY871		
Sampling Date		2019/07/16 19:20	2019/07/16 19:40			2019/07/16 19:40			2019/07/16 20:00		
COC Number		727707-01-01	727707-01-01			727707-01-01			727707-01-01		
	UNITS	**SW1**	**SW2**	**RDL**	**QC Batch**	**SW2 Lab-Dup**	**RDL**	**QC Batch**	**SW3**	**RDL**	**QC Batch**
Calculated Parameters											
Methylnaphthalene, 2-(1-)	ug/L	<0.071	<0.071	0.071	6249412				<0.071	0.071	6249412
Polyaromatic Hydrocarbons											
Acenaphthene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Acenaphthylene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Anthracene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Benzo(a)anthracene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Benzo(a)pyrene	ug/L	<0.010	<0.010	0.010	6255011	<0.010	0.010	6255011	<0.010	0.010	6255011
Benzo(b/j)fluoranthene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Chrysene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Dibenz(a,h)anthracene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Fluoranthene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Fluorene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
1-Methylnaphthalene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
2-Methylnaphthalene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Naphthalene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Phenanthrene	ug/L	<0.030	<0.030	0.030	6255011	<0.030	0.030	6255011	<0.030	0.030	6255011
Pyrene	ug/L	<0.050	<0.050	0.050	6255011	<0.050	0.050	6255011	<0.050	0.050	6255011
Surrogate Recovery (%)											
D10-Anthracene	%	95	105		6255011	94		6255011	99		6255011
D14-Terphenyl (FS)	%	96	107		6255011	94		6255011	103		6255011
D8-Acenaphthylene	%	94	104		6255011	92		6255011	96		6255011

RDL = Reportable Detection Limit
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Lab-Dup = Laboratory Initiated Duplicate

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BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PAHS (WATER)

BV Labs ID		KIY872	KIY873	KIY874	KIY875		
Sampling Date		2019/07/18 19:55	2019/07/18 20:55	2019/07/18 20:55	2019/07/18 21:55		
COC Number		727707-01-01	727707-01-01	727707-01-01	727707-01-01		
	UNITS	19MW-04	19MW-02	QAQC03	19MW-03	RDL	QC Batch
Calculated Parameters							
Methylnaphthalene, 2-(1-)	ug/L	<0.071	<0.071	<0.071	<0.071	0.071	6249412
Polyaromatic Hydrocarbons							
Acenaphthene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Acenaphthylene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Anthracene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Benzo(a)anthracene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Benzo(a)pyrene	ug/L	0.026	<0.010	<0.010	<0.010	0.010	6255011
Benzo(b/j)fluoranthene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Benzo(g,h,i)perylene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Benzo(k)fluoranthene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Chrysene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Dibenz(a,h)anthracene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Fluoranthene	ug/L	0.066	<0.050	<0.050	<0.050	0.050	6255011
Fluorene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Indeno(1,2,3-cd)pyrene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
1-Methylnaphthalene	ug/L	<0.050	0.057	<0.050	<0.050	0.050	6255011
2-Methylnaphthalene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Naphthalene	ug/L	<0.050	<0.050	<0.050	<0.050	0.050	6255011
Phenanthrene	ug/L	0.065	<0.030	<0.030	<0.030	0.030	6255011
Pyrene	ug/L	0.051	<0.050	<0.050	<0.050	0.050	6255011
Surrogate Recovery (%)							
D10-Anthracene	%	95	97	89	111		6255011
D14-Terphenyl (FS)	%	98	95	88	112		6255011
D8-Acenaphthylene	%	95	98	90	109		6255011

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BUREAU VERITAS

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		KIY869	KIY870			KIY870			KIY871		
Sampling Date		2019/07/16 19:20	2019/07/16 19:40			2019/07/16 19:40			2019/07/16 20:00		
COC Number		727707-01-01	727707-01-01			727707-01-01			727707-01-01		
	UNITS	SW1	SW2	RDL	QC Batch	SW2 Lab-Dup	RDL	QC Batch	SW3	RDL	QC Batch
BTEX & F1 Hydrocarbons											
Benzene	ug/L	<0.20	<0.20	0.20	6252333				<0.20	0.20	6252333
Toluene	ug/L	<0.20	<0.20	0.20	6252333				<0.20	0.20	6252333
Ethylbenzene	ug/L	<0.20	<0.20	0.20	6252333				<0.20	0.20	6252333
o-Xylene	ug/L	<0.20	<0.20	0.20	6252333				<0.20	0.20	6252333
p+m-Xylene	ug/L	<0.40	<0.40	0.40	6252333				<0.40	0.40	6252333
Total Xylenes	ug/L	<0.40	<0.40	0.40	6252333				<0.40	0.40	6252333
F1 (C6-C10)	ug/L	<25	<25	25	6252333				<25	25	6252333
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	6252333				<25	25	6252333
F2-F4 Hydrocarbons											
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	6255020	<100	100	6255020	<100	100	6255020
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	6255020	<200	200	6255020	<200	200	6255020
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	6255020	<200	200	6255020	<200	200	6255020
Reached Baseline at C50	ug/L	Yes	Yes		6255020	Yes		6255020	Yes		6255020
Surrogate Recovery (%)											
1,4-Difluorobenzene	%	100	100		6252333				101		6252333
4-Bromofluorobenzene	%	99	101		6252333				98		6252333
D10-Ethylbenzene	%	103	105		6252333				104		6252333
D4-1,2-Dichloroethane	%	93	93		6252333				93		6252333
o-Terphenyl	%	102	101		6255020	101		6255020	103		6255020

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch
Lab-Dup = Laboratory Initiated Duplicate

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 PHCS, BTEX/F1-F4 (WATER)

BV Labs ID		KIY873	KIY874		
Sampling Date		2019/07/18 20:55	2019/07/18 20:55		
COC Number		727707-01-01	727707-01-01		
	UNITS	19MW-02	QAQC03	RDL	QC Batch
BTEX & F1 Hydrocarbons					
Benzene	ug/L	<0.20	<0.20	0.20	6252333
Toluene	ug/L	<0.20	<0.20	0.20	6252333
Ethylbenzene	ug/L	<0.20	<0.20	0.20	6252333
o-Xylene	ug/L	<0.20	<0.20	0.20	6252333
p+m-Xylene	ug/L	<0.40	<0.40	0.40	6252333
Total Xylenes	ug/L	<0.40	<0.40	0.40	6252333
F1 (C6-C10)	ug/L	<25	<25	25	6252333
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	6252333
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	170	160	100	6255020
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	6255020
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	6255020
Reached Baseline at C50	ug/L	Yes	Yes		6255020
Surrogate Recovery (%)					
1,4-Difluorobenzene	%	99	99		6252333
4-Bromofluorobenzene	%	100	99		6252333
D10-Ethylbenzene	%	105	101		6252333
D4-1,2-Dichloroethane	%	93	92		6252333
o-Terphenyl	%	101	99		6255020

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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BUREAU VERITAS

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (WATER)

BV Labs ID		KIY872	KIY875		
Sampling Date		2019/07/18 19:55	2019/07/18 21:55		
COC Number		727707-01-01	727707-01-01		
	UNITS	19MW-04	19MW-03	RDL	QC Batch
Calculated Parameters					
1,3-Dichloropropene (cis+trans)	ug/L	<0.50	<0.50	0.50	6248989
Volatile Organics					
Acetone (2-Propanone)	ug/L	<10	<10	10	6251138
Benzene	ug/L	<0.20	<0.20	0.20	6251138
Bromodichloromethane	ug/L	<0.50	<0.50	0.50	6251138
Bromoform	ug/L	<1.0	<1.0	1.0	6251138
Bromomethane	ug/L	<0.50	<0.50	0.50	6251138
Carbon Tetrachloride	ug/L	<0.20	<0.20	0.20	6251138
Chlorobenzene	ug/L	<0.20	<0.20	0.20	6251138
Chloroform	ug/L	<0.20	<0.20	0.20	6251138
Dibromochloromethane	ug/L	<0.50	<0.50	0.50	6251138
1,2-Dichlorobenzene	ug/L	<0.50	<0.50	0.50	6251138
1,3-Dichlorobenzene	ug/L	<0.50	<0.50	0.50	6251138
1,4-Dichlorobenzene	ug/L	<0.50	<0.50	0.50	6251138
Dichlorodifluoromethane (FREON 12)	ug/L	<1.0	<1.0	1.0	6251138
1,1-Dichloroethane	ug/L	<0.20	<0.20	0.20	6251138
1,2-Dichloroethane	ug/L	<0.50	<0.50	0.50	6251138
1,1-Dichloroethylene	ug/L	<0.20	<0.20	0.20	6251138
cis-1,2-Dichloroethylene	ug/L	<0.50	<0.50	0.50	6251138
trans-1,2-Dichloroethylene	ug/L	<0.50	<0.50	0.50	6251138
1,2-Dichloropropane	ug/L	<0.20	<0.20	0.20	6251138
cis-1,3-Dichloropropene	ug/L	<0.30	<0.30	0.30	6251138
trans-1,3-Dichloropropene	ug/L	<0.40	<0.40	0.40	6251138
Ethylbenzene	ug/L	<0.20	<0.20	0.20	6251138
Ethylene Dibromide	ug/L	<0.20	<0.20	0.20	6251138
Hexane	ug/L	<1.0	<1.0	1.0	6251138
Methylene Chloride(Dichloromethane)	ug/L	<2.0	<2.0	2.0	6251138
Methyl Ethyl Ketone (2-Butanone)	ug/L	<10	<10	10	6251138
Methyl Isobutyl Ketone	ug/L	<5.0	<5.0	5.0	6251138
Methyl t-butyl ether (MTBE)	ug/L	<0.50	<0.50	0.50	6251138
Styrene	ug/L	<0.50	<0.50	0.50	6251138
1,1,1,2-Tetrachloroethane	ug/L	<0.50	<0.50	0.50	6251138
1,1,2,2-Tetrachloroethane	ug/L	<0.50	<0.50	0.50	6251138
Tetrachloroethylene	ug/L	<0.20	<0.20	0.20	6251138
Toluene	ug/L	<0.20	<0.20	0.20	6251138

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BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

O.REG 153 VOCS BY HS & F1-F4 (WATER)

BV Labs ID		KIY872	KIY875		
Sampling Date		2019/07/18 19:55	2019/07/18 21:55		
COC Number		727707-01-01	727707-01-01		
	UNITS	19MW-04	19MW-03	RDL	QC Batch
1,1,1-Trichloroethane	ug/L	<0.20	<0.20	0.20	6251138
1,1,2-Trichloroethane	ug/L	<0.50	<0.50	0.50	6251138
Trichloroethylene	ug/L	<0.20	<0.20	0.20	6251138
Trichlorofluoromethane (FREON 11)	ug/L	<0.50	<0.50	0.50	6251138
Vinyl Chloride	ug/L	<0.20	<0.20	0.20	6251138
p+m-Xylene	ug/L	<0.20	<0.20	0.20	6251138
o-Xylene	ug/L	<0.20	<0.20	0.20	6251138
Total Xylenes	ug/L	<0.20	<0.20	0.20	6251138
F1 (C6-C10)	ug/L	<25	<25	25	6251138
F1 (C6-C10) - BTEX	ug/L	<25	<25	25	6251138
F2-F4 Hydrocarbons					
F2 (C10-C16 Hydrocarbons)	ug/L	<100	<100	100	6255020
F3 (C16-C34 Hydrocarbons)	ug/L	<200	<200	200	6255020
F4 (C34-C50 Hydrocarbons)	ug/L	<200	<200	200	6255020
Reached Baseline at C50	ug/L	Yes	Yes		6255020
Surrogate Recovery (%)					
o-Terphenyl	%	104	105		6255020
4-Bromofluorobenzene	%	99	99		6251138
D4-1,2-Dichloroethane	%	102	102		6251138
D8-Toluene	%	102	100		6251138

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	1.3°C
Package 2	3.3°C

Sample KIY873 [19MW-02] : Per- and polyfluoroalkyl substances (PFAS): Due to high concentrations of the target analytes, a reduced sample volume was extracted and analyzed. Detection limits were adjusted accordingly.

Results relate only to the items tested.

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
6251097	ADA	Matrix Spike	Dissolved Antimony (Sb)	2019/07/30		99	%	80 - 120
			Dissolved Arsenic (As)	2019/07/30		94	%	80 - 120
			Dissolved Barium (Ba)	2019/07/30		92	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/30		98	%	80 - 120
			Dissolved Boron (B)	2019/07/30		94	%	80 - 120
			Dissolved Cadmium (Cd)	2019/07/30		98	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/30		92	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/30		95	%	80 - 120
			Dissolved Copper (Cu)	2019/07/30		98	%	80 - 120
			Dissolved Lead (Pb)	2019/07/30		95	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/30		99	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/30		90	%	80 - 120
			Dissolved Selenium (Se)	2019/07/30		97	%	80 - 120
			Dissolved Silver (Ag)	2019/07/30		93	%	80 - 120
			Dissolved Sodium (Na)	2019/07/30		95	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/30		98	%	80 - 120
			Dissolved Uranium (U)	2019/07/30		93	%	80 - 120
			Dissolved Vanadium (V)	2019/07/30		93	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/30		94	%	80 - 120
6251097	ADA	Spiked Blank	Dissolved Antimony (Sb)	2019/07/30		98	%	80 - 120
			Dissolved Arsenic (As)	2019/07/30		98	%	80 - 120
			Dissolved Barium (Ba)	2019/07/30		94	%	80 - 120
			Dissolved Beryllium (Be)	2019/07/30		100	%	80 - 120
			Dissolved Boron (B)	2019/07/30		97	%	80 - 120
			Dissolved Cadmium (Cd)	2019/07/30		99	%	80 - 120
			Dissolved Chromium (Cr)	2019/07/30		96	%	80 - 120
			Dissolved Cobalt (Co)	2019/07/30		101	%	80 - 120
			Dissolved Copper (Cu)	2019/07/30		100	%	80 - 120
			Dissolved Lead (Pb)	2019/07/30		95	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/07/30		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/07/30		96	%	80 - 120
			Dissolved Selenium (Se)	2019/07/30		99	%	80 - 120
			Dissolved Silver (Ag)	2019/07/30		95	%	80 - 120
			Dissolved Sodium (Na)	2019/07/30		100	%	80 - 120
			Dissolved Thallium (Tl)	2019/07/30		96	%	80 - 120
			Dissolved Uranium (U)	2019/07/30		94	%	80 - 120
			Dissolved Vanadium (V)	2019/07/30		95	%	80 - 120
			Dissolved Zinc (Zn)	2019/07/30		99	%	80 - 120
6251097	ADA	Method Blank	Dissolved Antimony (Sb)	2019/07/30	<0.50		ug/L	
			Dissolved Arsenic (As)	2019/07/30	<1.0		ug/L	
			Dissolved Barium (Ba)	2019/07/30	<2.0		ug/L	
			Dissolved Beryllium (Be)	2019/07/30	<0.50		ug/L	
			Dissolved Boron (B)	2019/07/30	<10		ug/L	
			Dissolved Cadmium (Cd)	2019/07/30	<0.10		ug/L	
			Dissolved Chromium (Cr)	2019/07/30	<5.0		ug/L	
			Dissolved Cobalt (Co)	2019/07/30	<0.50		ug/L	
			Dissolved Copper (Cu)	2019/07/30	<1.0		ug/L	
			Dissolved Lead (Pb)	2019/07/30	<0.50		ug/L	
			Dissolved Molybdenum (Mo)	2019/07/30	<0.50		ug/L	
			Dissolved Nickel (Ni)	2019/07/30	<1.0		ug/L	
			Dissolved Selenium (Se)	2019/07/30	<2.0		ug/L	
			Dissolved Silver (Ag)	2019/07/30	<0.10		ug/L	
			Dissolved Sodium (Na)	2019/07/30	<100		ug/L	
			Dissolved Thallium (Tl)	2019/07/30	<0.050		ug/L	

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BUREAU VERITAS

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Uranium (U)	2019/07/30	<0.10		ug/L	
			Dissolved Vanadium (V)	2019/07/30	<0.50		ug/L	
			Dissolved Zinc (Zn)	2019/07/30	<5.0		ug/L	
6251097	ADA	RPD	Dissolved Arsenic (As)	2019/07/30	0.60		%	20
			Dissolved Boron (B)	2019/07/30	0.39		%	20
			Dissolved Cadmium (Cd)	2019/07/30	NC		%	20
			Dissolved Chromium (Cr)	2019/07/30	NC		%	20
			Dissolved Copper (Cu)	2019/07/30	3.8		%	20
			Dissolved Lead (Pb)	2019/07/30	1.5		%	20
			Dissolved Nickel (Ni)	2019/07/30	NC		%	20
			Dissolved Sodium (Na)	2019/07/30	0.54		%	20
			Dissolved Zinc (Zn)	2019/07/30	NC		%	20
6251138	DR1	Matrix Spike	4-Bromofluorobenzene	2019/07/29		100	%	70 - 130
			D4-1,2-Dichloroethane	2019/07/29		104	%	70 - 130
			D8-Toluene	2019/07/29		101	%	70 - 130
			Acetone (2-Propanone)	2019/07/29		113	%	60 - 140
			Benzene	2019/07/29		91	%	70 - 130
			Bromodichloromethane	2019/07/29		89	%	70 - 130
			Bromoform	2019/07/29		93	%	70 - 130
			Bromomethane	2019/07/29		138	%	60 - 140
			Carbon Tetrachloride	2019/07/29		90	%	70 - 130
			Chlorobenzene	2019/07/29		89	%	70 - 130
			Chloroform	2019/07/29		88	%	70 - 130
			Dibromochloromethane	2019/07/29		93	%	70 - 130
			1,2-Dichlorobenzene	2019/07/29		86	%	70 - 130
			1,3-Dichlorobenzene	2019/07/29		87	%	70 - 130
			1,4-Dichlorobenzene	2019/07/29		92	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2019/07/29		93	%	60 - 140
			1,1-Dichloroethane	2019/07/29		91	%	70 - 130
			1,2-Dichloroethane	2019/07/29		94	%	70 - 130
			1,1-Dichloroethylene	2019/07/29		99	%	70 - 130
			cis-1,2-Dichloroethylene	2019/07/29		85	%	70 - 130
			trans-1,2-Dichloroethylene	2019/07/29		90	%	70 - 130
			1,2-Dichloropropane	2019/07/29		87	%	70 - 130
			cis-1,3-Dichloropropene	2019/07/29		97	%	70 - 130
			trans-1,3-Dichloropropene	2019/07/29		103	%	70 - 130
			Ethylbenzene	2019/07/29		87	%	70 - 130
			Ethylene Dibromide	2019/07/29		94	%	70 - 130
			Hexane	2019/07/29		94	%	70 - 130
			Methylene Chloride(Dichloromethane)	2019/07/29		87	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2019/07/29		98	%	60 - 140
			Methyl Isobutyl Ketone	2019/07/29		94	%	70 - 130
			Methyl t-butyl ether (MTBE)	2019/07/29		84	%	70 - 130
			Styrene	2019/07/29		86	%	70 - 130
			1,1,1,2-Tetrachloroethane	2019/07/29		93	%	70 - 130
			1,1,2,2-Tetrachloroethane	2019/07/29		96	%	70 - 130
			Tetrachloroethylene	2019/07/29		83	%	70 - 130
			Toluene	2019/07/29		89	%	70 - 130
			1,1,1-Trichloroethane	2019/07/29		90	%	70 - 130
			1,1,2-Trichloroethane	2019/07/29		101	%	70 - 130
			Trichloroethylene	2019/07/29		91	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2019/07/29		104	%	70 - 130
			Vinyl Chloride	2019/07/29		108	%	70 - 130
			p+m-Xylene	2019/07/29		89	%	70 - 130

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			o-Xylene	2019/07/29		89	%	70 - 130
			F1 (C6-C10)	2019/07/29		92	%	60 - 140
6251138	DR1	Spiked Blank	4-Bromofluorobenzene	2019/07/29		102	%	70 - 130
			D4-1,2-Dichloroethane	2019/07/29		106	%	70 - 130
			D8-Toluene	2019/07/29		100	%	70 - 130
			Acetone (2-Propanone)	2019/07/29		114	%	60 - 140
			Benzene	2019/07/29		91	%	70 - 130
			Bromodichloromethane	2019/07/29		91	%	70 - 130
			Bromoform	2019/07/29		100	%	70 - 130
			Bromomethane	2019/07/29		139	%	60 - 140
			Carbon Tetrachloride	2019/07/29		88	%	70 - 130
			Chlorobenzene	2019/07/29		89	%	70 - 130
			Chloroform	2019/07/29		88	%	70 - 130
			Dibromochloromethane	2019/07/29		96	%	70 - 130
			1,2-Dichlorobenzene	2019/07/29		86	%	70 - 130
			1,3-Dichlorobenzene	2019/07/29		87	%	70 - 130
			1,4-Dichlorobenzene	2019/07/29		92	%	70 - 130
			Dichlorodifluoromethane (FREON 12)	2019/07/29		96	%	60 - 140
			1,1-Dichloroethane	2019/07/29		92	%	70 - 130
			1,2-Dichloroethane	2019/07/29		98	%	70 - 130
			1,1-Dichloroethylene	2019/07/29		99	%	70 - 130
			cis-1,2-Dichloroethylene	2019/07/29		87	%	70 - 130
			trans-1,2-Dichloroethylene	2019/07/29		90	%	70 - 130
			1,2-Dichloropropane	2019/07/29		88	%	70 - 130
			cis-1,3-Dichloropropene	2019/07/29		90	%	70 - 130
			trans-1,3-Dichloropropene	2019/07/29		94	%	70 - 130
			Ethylbenzene	2019/07/29		85	%	70 - 130
			Ethylene Dibromide	2019/07/29		98	%	70 - 130
			Hexane	2019/07/29		92	%	70 - 130
			Methylene Chloride(Dichloromethane)	2019/07/29		89	%	70 - 130
			Methyl Ethyl Ketone (2-Butanone)	2019/07/29		102	%	60 - 140
			Methyl Isobutyl Ketone	2019/07/29		101	%	70 - 130
			Methyl t-butyl ether (MTBE)	2019/07/29		86	%	70 - 130
			Styrene	2019/07/29		87	%	70 - 130
			1,1,1,2-Tetrachloroethane	2019/07/29		93	%	70 - 130
			1,1,2,2-Tetrachloroethane	2019/07/29		101	%	70 - 130
			Tetrachloroethylene	2019/07/29		82	%	70 - 130
			Toluene	2019/07/29		86	%	70 - 130
			1,1,1-Trichloroethane	2019/07/29		88	%	70 - 130
			1,1,2-Trichloroethane	2019/07/29		102	%	70 - 130
			Trichloroethylene	2019/07/29		91	%	70 - 130
			Trichlorofluoromethane (FREON 11)	2019/07/29		102	%	70 - 130
			Vinyl Chloride	2019/07/29		113	%	70 - 130
			p+m-Xylene	2019/07/29		87	%	70 - 130
			o-Xylene	2019/07/29		87	%	70 - 130
			F1 (C6-C10)	2019/07/29		95	%	60 - 140
6251138	DR1	Method Blank	4-Bromofluorobenzene	2019/07/29		100	%	70 - 130
			D4-1,2-Dichloroethane	2019/07/29		107	%	70 - 130
			D8-Toluene	2019/07/29		98	%	70 - 130
			Acetone (2-Propanone)	2019/07/29	<10		ug/L	
			Benzene	2019/07/29	<0.20		ug/L	
			Bromodichloromethane	2019/07/29	<0.50		ug/L	
			Bromoform	2019/07/29	<1.0		ug/L	
			Bromomethane	2019/07/29	<0.50		ug/L	

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			Carbon Tetrachloride	2019/07/29	<0.20		ug/L	
			Chlorobenzene	2019/07/29	<0.20		ug/L	
			Chloroform	2019/07/29	<0.20		ug/L	
			Dibromochloromethane	2019/07/29	<0.50		ug/L	
			1,2-Dichlorobenzene	2019/07/29	<0.50		ug/L	
			1,3-Dichlorobenzene	2019/07/29	<0.50		ug/L	
			1,4-Dichlorobenzene	2019/07/29	<0.50		ug/L	
			Dichlorodifluoromethane (FREON 12)	2019/07/29	<1.0		ug/L	
			1,1-Dichloroethane	2019/07/29	<0.20		ug/L	
			1,2-Dichloroethane	2019/07/29	<0.50		ug/L	
			1,1-Dichloroethylene	2019/07/29	<0.20		ug/L	
			cis-1,2-Dichloroethylene	2019/07/29	<0.50		ug/L	
			trans-1,2-Dichloroethylene	2019/07/29	<0.50		ug/L	
			1,2-Dichloropropane	2019/07/29	<0.20		ug/L	
			cis-1,3-Dichloropropene	2019/07/29	<0.30		ug/L	
			trans-1,3-Dichloropropene	2019/07/29	<0.40		ug/L	
			Ethylbenzene	2019/07/29	<0.20		ug/L	
			Ethylene Dibromide	2019/07/29	<0.20		ug/L	
			Hexane	2019/07/29	<1.0		ug/L	
			Methylene Chloride(Dichloromethane)	2019/07/29	<2.0		ug/L	
			Methyl Ethyl Ketone (2-Butanone)	2019/07/29	<10		ug/L	
			Methyl Isobutyl Ketone	2019/07/29	<5.0		ug/L	
			Methyl t-butyl ether (MTBE)	2019/07/29	<0.50		ug/L	
			Styrene	2019/07/29	<0.50		ug/L	
			1,1,1,2-Tetrachloroethane	2019/07/29	<0.50		ug/L	
			1,1,2,2-Tetrachloroethane	2019/07/29	<0.50		ug/L	
			Tetrachloroethylene	2019/07/29	<0.20		ug/L	
			Toluene	2019/07/29	<0.20		ug/L	
			1,1,1-Trichloroethane	2019/07/29	<0.20		ug/L	
			1,1,2-Trichloroethane	2019/07/29	<0.50		ug/L	
			Trichloroethylene	2019/07/29	<0.20		ug/L	
			Trichlorofluoromethane (FREON 11)	2019/07/29	<0.50		ug/L	
			Vinyl Chloride	2019/07/29	<0.20		ug/L	
			p+m-Xylene	2019/07/29	<0.20		ug/L	
			o-Xylene	2019/07/29	<0.20		ug/L	
			Total Xylenes	2019/07/29	<0.20		ug/L	
			F1 (C6-C10)	2019/07/29	<25		ug/L	
			F1 (C6-C10) - BTEX	2019/07/29	<25		ug/L	
6251138	DR1	RPD	Acetone (2-Propanone)	2019/07/29	3.5		%	30
			Benzene	2019/07/29	NC		%	30
			Bromodichloromethane	2019/07/29	NC		%	30
			Bromoform	2019/07/29	NC		%	30
			Bromomethane	2019/07/29	NC		%	30
			Carbon Tetrachloride	2019/07/29	NC		%	30
			Chlorobenzene	2019/07/29	NC		%	30
			Chloroform	2019/07/29	NC		%	30
			Dibromochloromethane	2019/07/29	NC		%	30
			1,2-Dichlorobenzene	2019/07/29	NC		%	30
			1,3-Dichlorobenzene	2019/07/29	NC		%	30
			1,4-Dichlorobenzene	2019/07/29	NC		%	30
			Dichlorodifluoromethane (FREON 12)	2019/07/29	NC		%	30
			1,1-Dichloroethane	2019/07/29	NC		%	30
			1,2-Dichloroethane	2019/07/29	NC		%	30
			1,1-Dichloroethylene	2019/07/29	NC		%	30

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			cis-1,2-Dichloroethylene	2019/07/29	NC		%	30
			trans-1,2-Dichloroethylene	2019/07/29	NC		%	30
			1,2-Dichloropropane	2019/07/29	NC		%	30
			cis-1,3-Dichloropropene	2019/07/29	NC		%	30
			trans-1,3-Dichloropropene	2019/07/29	NC		%	30
			Ethylbenzene	2019/07/29	NC		%	30
			Ethylene Dibromide	2019/07/29	NC		%	30
			Hexane	2019/07/29	NC		%	30
			Methylene Chloride(Dichloromethane)	2019/07/29	NC		%	30
			Methyl Ethyl Ketone (2-Butanone)	2019/07/29	NC		%	30
			Methyl Isobutyl Ketone	2019/07/29	NC		%	30
			Methyl t-butyl ether (MTBE)	2019/07/29	NC		%	30
			Styrene	2019/07/29	NC		%	30
			1,1,1,2-Tetrachloroethane	2019/07/29	NC		%	30
			1,1,2,2-Tetrachloroethane	2019/07/29	NC		%	30
			Tetrachloroethylene	2019/07/29	NC		%	30
			Toluene	2019/07/29	1.2		%	30
			1,1,1-Trichloroethane	2019/07/29	NC		%	30
			1,1,2-Trichloroethane	2019/07/29	NC		%	30
			Trichloroethylene	2019/07/29	NC		%	30
			Trichlorofluoromethane (FREON 11)	2019/07/29	NC		%	30
			Vinyl Chloride	2019/07/29	NC		%	30
			p+m-Xylene	2019/07/29	NC		%	30
			o-Xylene	2019/07/29	NC		%	30
			Total Xylenes	2019/07/29	NC		%	30
			F1 (C6-C10)	2019/07/29	NC		%	30
			F1 (C6-C10) - BTEX	2019/07/29	NC		%	30
6252129	MEN	Matrix Spike	Mercury (Hg)	2019/07/29		99	%	75 - 125
6252129	MEN	Spiked Blank	Mercury (Hg)	2019/07/29		97	%	80 - 120
6252129	MEN	Method Blank	Mercury (Hg)	2019/07/29	<0.1		ug/L	
6252129	MEN	RPD	Mercury (Hg)	2019/07/29	NC		%	20
6252333	LRA	Matrix Spike	1,4-Difluorobenzene	2019/07/29		102	%	70 - 130
			4-Bromofluorobenzene	2019/07/29		99	%	70 - 130
			D10-Ethylbenzene	2019/07/29		103	%	70 - 130
			D4-1,2-Dichloroethane	2019/07/29		94	%	70 - 130
			Benzene	2019/07/29		97	%	70 - 130
			Toluene	2019/07/29		101	%	70 - 130
			Ethylbenzene	2019/07/29		97	%	70 - 130
			o-Xylene	2019/07/29		97	%	70 - 130
			p+m-Xylene	2019/07/29		98	%	70 - 130
			F1 (C6-C10)	2019/07/29		84	%	70 - 130
6252333	LRA	Spiked Blank	1,4-Difluorobenzene	2019/07/29		101	%	70 - 130
			4-Bromofluorobenzene	2019/07/29		98	%	70 - 130
			D10-Ethylbenzene	2019/07/29		93	%	70 - 130
			D4-1,2-Dichloroethane	2019/07/29		96	%	70 - 130
			Benzene	2019/07/29		94	%	70 - 130
			Toluene	2019/07/29		95	%	70 - 130
			Ethylbenzene	2019/07/29		90	%	70 - 130
			o-Xylene	2019/07/29		88	%	70 - 130
			p+m-Xylene	2019/07/29		90	%	70 - 130
			F1 (C6-C10)	2019/07/29		98	%	70 - 130
6252333	LRA	Method Blank	1,4-Difluorobenzene	2019/07/29		99	%	70 - 130
			4-Bromofluorobenzene	2019/07/29		96	%	70 - 130
			D10-Ethylbenzene	2019/07/29		96	%	70 - 130

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			D4-1,2-Dichloroethane	2019/07/29		96	%	70 - 130
			Benzene	2019/07/29	<0.20		ug/L	
			Toluene	2019/07/29	<0.20		ug/L	
			Ethylbenzene	2019/07/29	<0.20		ug/L	
			o-Xylene	2019/07/29	<0.20		ug/L	
			p+m-Xylene	2019/07/29	<0.40		ug/L	
			Total Xylenes	2019/07/29	<0.40		ug/L	
			F1 (C6-C10)	2019/07/29	<25		ug/L	
			F1 (C6-C10) - BTEX	2019/07/29	<25		ug/L	
6252333	LRA	RPD	F1 (C6-C10)	2019/07/29	NC		%	30
			F1 (C6-C10) - BTEX	2019/07/29	NC		%	30
6252715	LLE	Matrix Spike [KIY869-03]	Chromium (VI)	2019/07/29		104	%	80 - 120
6252715	LLE	Spiked Blank	Chromium (VI)	2019/07/29		104	%	80 - 120
6252715	LLE	Method Blank	Chromium (VI)	2019/07/29	<0.50		ug/L	
6252715	LLE	RPD [KIY869-03]	Chromium (VI)	2019/07/29	NC		%	20
6253488	GUL	Matrix Spike	Propylene Glycol	2019/07/30		111	%	60 - 140
			Ethylene Glycol	2019/07/30		103	%	60 - 140
			Diethylene Glycol	2019/07/30		88	%	60 - 140
6253488	GUL	Spiked Blank	Propylene Glycol	2019/07/30		102	%	60 - 140
			Ethylene Glycol	2019/07/30		88	%	60 - 140
			Diethylene Glycol	2019/07/30		81	%	60 - 140
6253488	GUL	Method Blank	Propylene Glycol	2019/07/30	<5		mg/L	
			Ethylene Glycol	2019/07/30	<5		mg/L	
			Diethylene Glycol	2019/07/30	<5		mg/L	
			Total Glycol	2019/07/30	<5		mg/L	
6253488	GUL	RPD	Propylene Glycol	2019/07/30	NC		%	40
			Ethylene Glycol	2019/07/30	NC		%	40
			Diethylene Glycol	2019/07/30	NC		%	40
			Total Glycol	2019/07/30	NC		%	40
6255011	RAJ	Matrix Spike [KIY869-01]	D10-Anthracene	2019/07/30		97	%	50 - 130
			D14-Terphenyl (FS)	2019/07/30		100	%	50 - 130
			D8-Acenaphthylene	2019/07/30		95	%	50 - 130
			Acenaphthene	2019/07/30		104	%	50 - 130
			Acenaphthylene	2019/07/30		104	%	50 - 130
			Anthracene	2019/07/30		104	%	50 - 130
			Benzo(a)anthracene	2019/07/30		112	%	50 - 130
			Benzo(a)pyrene	2019/07/30		111	%	50 - 130
			Benzo(b/j)fluoranthene	2019/07/30		114	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/30		111	%	50 - 130
			Benzo(k)fluoranthene	2019/07/30		117	%	50 - 130
			Chrysene	2019/07/30		108	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/30		116	%	50 - 130
			Fluoranthene	2019/07/30		115	%	50 - 130
			Fluorene	2019/07/30		107	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/30		117	%	50 - 130
			1-Methylnaphthalene	2019/07/30		115	%	50 - 130
			2-Methylnaphthalene	2019/07/30		105	%	50 - 130
			Naphthalene	2019/07/30		97	%	50 - 130
			Phenanthrene	2019/07/30		106	%	50 - 130
			Pyrene	2019/07/30		113	%	50 - 130
6255011	RAJ	Spiked Blank	D10-Anthracene	2019/07/31		94	%	50 - 130
			D14-Terphenyl (FS)	2019/07/31		96	%	50 - 130
			D8-Acenaphthylene	2019/07/31		91	%	50 - 130
			Acenaphthene	2019/07/31		99	%	50 - 130

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			Acenaphthylene	2019/07/31		98	%	50 - 130
			Anthracene	2019/07/31		98	%	50 - 130
			Benzo(a)anthracene	2019/07/31		107	%	50 - 130
			Benzo(a)pyrene	2019/07/31		107	%	50 - 130
			Benzo(b/j)fluoranthene	2019/07/31		110	%	50 - 130
			Benzo(g,h,i)perylene	2019/07/31		109	%	50 - 130
			Benzo(k)fluoranthene	2019/07/31		109	%	50 - 130
			Chrysene	2019/07/31		105	%	50 - 130
			Dibenz(a,h)anthracene	2019/07/31		113	%	50 - 130
			Fluoranthene	2019/07/31		109	%	50 - 130
			Fluorene	2019/07/31		102	%	50 - 130
			Indeno(1,2,3-cd)pyrene	2019/07/31		113	%	50 - 130
			1-Methylnaphthalene	2019/07/31		110	%	50 - 130
			2-Methylnaphthalene	2019/07/31		100	%	50 - 130
			Naphthalene	2019/07/31		93	%	50 - 130
			Phenanthrene	2019/07/31		101	%	50 - 130
			Pyrene	2019/07/31		105	%	50 - 130
6255011	RAJ	Method Blank	D10-Anthracene	2019/07/30		106	%	50 - 130
			D14-Terphenyl (FS)	2019/07/30		108	%	50 - 130
			D8-Acenaphthylene	2019/07/30		105	%	50 - 130
			Acenaphthene	2019/07/30	<0.050		ug/L	
			Acenaphthylene	2019/07/30	<0.050		ug/L	
			Anthracene	2019/07/30	<0.050		ug/L	
			Benzo(a)anthracene	2019/07/30	<0.050		ug/L	
			Benzo(a)pyrene	2019/07/30	<0.010		ug/L	
			Benzo(b/j)fluoranthene	2019/07/30	<0.050		ug/L	
			Benzo(g,h,i)perylene	2019/07/30	<0.050		ug/L	
			Benzo(k)fluoranthene	2019/07/30	<0.050		ug/L	
			Chrysene	2019/07/30	<0.050		ug/L	
			Dibenz(a,h)anthracene	2019/07/30	<0.050		ug/L	
			Fluoranthene	2019/07/30	<0.050		ug/L	
			Fluorene	2019/07/30	<0.050		ug/L	
			Indeno(1,2,3-cd)pyrene	2019/07/30	<0.050		ug/L	
			1-Methylnaphthalene	2019/07/30	<0.050		ug/L	
			2-Methylnaphthalene	2019/07/30	<0.050		ug/L	
			Naphthalene	2019/07/30	<0.050		ug/L	
			Phenanthrene	2019/07/30	<0.030		ug/L	
			Pyrene	2019/07/30	<0.050		ug/L	
6255011	RAJ	RPD [KIY870-01]	Acenaphthene	2019/07/30	NC		%	30
			Acenaphthylene	2019/07/30	NC		%	30
			Anthracene	2019/07/30	NC		%	30
			Benzo(a)anthracene	2019/07/30	NC		%	30
			Benzo(a)pyrene	2019/07/30	NC		%	30
			Benzo(b/j)fluoranthene	2019/07/30	NC		%	30
			Benzo(g,h,i)perylene	2019/07/30	NC		%	30
			Benzo(k)fluoranthene	2019/07/30	NC		%	30
			Chrysene	2019/07/30	NC		%	30
			Dibenz(a,h)anthracene	2019/07/30	NC		%	30
			Fluoranthene	2019/07/30	NC		%	30
			Fluorene	2019/07/30	NC		%	30
			Indeno(1,2,3-cd)pyrene	2019/07/30	NC		%	30
			1-Methylnaphthalene	2019/07/30	NC		%	30
			2-Methylnaphthalene	2019/07/30	NC		%	30
			Naphthalene	2019/07/30	NC		%	30

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			Phenanthrene	2019/07/30	NC		%	30
			Pyrene	2019/07/30	NC		%	30
6255020	GUL	Matrix Spike [KIY871-01]	o-Terphenyl	2019/07/30		103	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/30		109	%	50 - 130
			F3 (C16-C34 Hydrocarbons)	2019/07/30		NC	%	50 - 130
			F4 (C34-C50 Hydrocarbons)	2019/07/30		121	%	50 - 130
6255020	GUL	Spiked Blank	o-Terphenyl	2019/07/30		107	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/30		108	%	60 - 130
			F3 (C16-C34 Hydrocarbons)	2019/07/30		120	%	60 - 130
			F4 (C34-C50 Hydrocarbons)	2019/07/30		127	%	60 - 130
6255020	GUL	Method Blank	o-Terphenyl	2019/07/31		98	%	60 - 130
			F2 (C10-C16 Hydrocarbons)	2019/07/31	<100		ug/L	
			F3 (C16-C34 Hydrocarbons)	2019/07/31	<200		ug/L	
			F4 (C34-C50 Hydrocarbons)	2019/07/31	<200		ug/L	
6255020	GUL	RPD [KIY870-01]	F2 (C10-C16 Hydrocarbons)	2019/07/31	NC		%	30
			F3 (C16-C34 Hydrocarbons)	2019/07/31	NC		%	30
			F4 (C34-C50 Hydrocarbons)	2019/07/31	NC		%	30
6257053	AKH	Spiked Blank	13C2-6:2-Fluorotelomersulfonic Acid	2019/08/01		100	%	50 - 150
			13C2-8:2-Fluorotelomersulfonic Acid	2019/08/01		92	%	50 - 150
			13C2-Perfluorodecanoic acid	2019/08/01		95	%	50 - 150
			13C2-Perfluorododecanoic acid	2019/08/01		84	%	50 - 150
			13C2-Perfluorohexanoic acid	2019/08/01		95	%	50 - 150
			13C2-perfluorotetradecanoic acid	2019/08/01		83	%	50 - 150
			13C2-Perfluoroundecanoic acid	2019/08/01		89	%	50 - 150
			13C3-Perfluorobutanesulfonic acid	2019/08/01		98	%	50 - 150
			13C4-Perfluorobutanoic acid	2019/08/01		94	%	50 - 150
			13C4-Perfluoroheptanoic acid	2019/08/01		94	%	50 - 150
			13C4-Perfluorooctanesulfonic acid	2019/08/01		94	%	50 - 150
			13C4-Perfluorooctanoic acid	2019/08/01		95	%	50 - 150
			13C5-Perfluorononanoic acid	2019/08/01		94	%	50 - 150
			13C5-Perfluoropentanoic acid	2019/08/01		94	%	50 - 150
			13C8-Perfluorooctane Sulfonamide	2019/08/01		86	%	50 - 150
			18O2-Perfluorohexanesulfonic acid	2019/08/01		91	%	50 - 150
			D3-MeFOSA	2019/08/01		78	%	50 - 150
			D3-MeFOSAA	2019/08/01		86	%	50 - 150
			D5-EtFOSA	2019/08/01		77	%	50 - 150
			D5-EtFOSAA	2019/08/01		82	%	50 - 150
			D7-MeFOSE	2019/08/01		84	%	50 - 150
			D9-EtFOSE	2019/08/01		85	%	50 - 150
			Perfluorobutanoic acid	2019/08/01		113	%	70 - 130
			Perfluoropentanoic Acid (PFPeA)	2019/08/01		108	%	70 - 130
			Perfluorohexanoic Acid (PFHxA)	2019/08/01		111	%	70 - 130
			Perfluoroheptanoic Acid (PFHpA)	2019/08/01		108	%	70 - 130
			Perfluorooctanoic Acid (PFOA)	2019/08/01		112	%	70 - 130
			Perfluorononanoic Acid (PFNA)	2019/08/01		112	%	70 - 130
			Perfluorodecanoic Acid (PFDA)	2019/08/01		112	%	70 - 130
			Perfluoroundecanoic Acid (PFUnA)	2019/08/01		112	%	70 - 130
			Perfluorododecanoic Acid (PFDoA)	2019/08/01		112	%	70 - 130
			Perfluorotridecanoic Acid	2019/08/01		112	%	70 - 130
			Perfluorotetradecanoic Acid	2019/08/01		110	%	70 - 130
			Perfluorobutanesulfonic acid	2019/08/01		104	%	70 - 130
			Perfluoropentanesulfonic acid	2019/08/01		109	%	70 - 130
			Perfluorohexanesulfonic acid	2019/08/01		114	%	70 - 130
			Perfluoroheptanesulfonic acid	2019/08/01		108	%	70 - 130

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Perfluorooctanesulfonic acid	2019/08/01		112	%	70 - 130
			Perfluorononanesulfonic acid	2019/08/01		110	%	70 - 130
			Perfluorodecanesulfonic acid (PFDS)	2019/08/01		102	%	70 - 130
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/01		105	%	70 - 130
			EtFOSA	2019/08/01		108	%	70 - 130
			MeFOSA	2019/08/01		100	%	70 - 130
			EtFOSE	2019/08/01		109	%	70 - 130
			MeFOSE	2019/08/01		104	%	70 - 130
			EtFOSAA	2019/08/01		109	%	70 - 130
			MeFOSAA	2019/08/01		112	%	70 - 130
			6:2 Fluorotelomer sulfonic acid	2019/08/01		100	%	70 - 130
			8:2 Fluorotelomer sulfonic acid	2019/08/01		107	%	70 - 130
6257053	AKH	RPD	Perfluorobutanoic acid	2019/08/01	1.4		%	30
			Perfluoropentanoic Acid (PFPeA)	2019/08/01	1.8		%	30
			Perfluorohexanoic Acid (PFHxA)	2019/08/01	0.80		%	30
			Perfluoroheptanoic Acid (PFHpA)	2019/08/01	2.0		%	30
			Perfluorooctanoic Acid (PFOA)	2019/08/01	2.3		%	30
			Perfluorononanoic Acid (PFNA)	2019/08/01	2.7		%	30
			Perfluorodecanoic Acid (PFDA)	2019/08/01	2.0		%	30
			Perfluoroundecanoic Acid (PFUnA)	2019/08/01	0.93		%	30
			Perfluorododecanoic Acid (PFDoA)	2019/08/01	0.68		%	30
			Perfluorotridecanoic Acid	2019/08/01	2.1		%	30
			Perfluorotetradecanoic Acid	2019/08/01	0.40		%	30
			Perfluorobutanesulfonic acid	2019/08/01	2.9		%	30
			Perfluoropentanesulfonic acid	2019/08/01	1.1		%	30
			Perfluorohexanesulfonic acid	2019/08/01	4.3		%	30
			Perfluoroheptanesulfonic acid	2019/08/01	0.95		%	30
			Perfluorooctanesulfonic acid	2019/08/01	0.68		%	30
			Perfluorononanesulfonic acid	2019/08/01	3.9		%	30
			Perfluorodecanesulfonic acid (PFDS)	2019/08/01	1.1		%	30
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/01	2.6		%	30
			EtFOSA	2019/08/01	0.96		%	30
			MeFOSA	2019/08/01	4.8		%	30
			EtFOSE	2019/08/01	0.66		%	30
			MeFOSE	2019/08/01	0.76		%	30
			EtFOSAA	2019/08/01	2.1		%	30
			MeFOSAA	2019/08/01	5.6		%	30
			6:2 Fluorotelomer sulfonic acid	2019/08/01	3.8		%	30
			8:2 Fluorotelomer sulfonic acid	2019/08/01	8.3		%	30
6257053	AKH	Method Blank	13C2-6:2-Fluorotelomersulfonic Acid	2019/08/01		105	%	50 - 150
			13C2-8:2-Fluorotelomersulfonic Acid	2019/08/01		97	%	50 - 150
			13C2-Perfluorodecanoic acid	2019/08/01		98	%	50 - 150
			13C2-Perfluorododecanoic acid	2019/08/01		87	%	50 - 150
			13C2-Perfluorohexanoic acid	2019/08/01		108	%	50 - 150
			13C2-perfluorotetradecanoic acid	2019/08/01		84	%	50 - 150
			13C2-Perfluoroundecanoic acid	2019/08/01		91	%	50 - 150
			13C3-Perfluorobutanesulfonic acid	2019/08/01		102	%	50 - 150
			13C4-Perfluorobutanoic acid	2019/08/01		102	%	50 - 150
			13C4-Perfluoroheptanoic acid	2019/08/01		106	%	50 - 150
			13C4-Perfluorooctanesulfonic acid	2019/08/01		99	%	50 - 150
			13C4-Perfluorooctanoic acid	2019/08/01		103	%	50 - 150
			13C5-Perfluorononanoic acid	2019/08/01		101	%	50 - 150
			13C5-Perfluoropentanoic acid	2019/08/01		102	%	50 - 150
			13C8-Perfluorooctane Sulfonamide	2019/08/01		90	%	50 - 150

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			18O2-Perfluorohexanesulfonic acid	2019/08/01		104	%	50 - 150
			D3-MeFOSA	2019/08/01		74	%	50 - 150
			D3-MeFOSAA	2019/08/01		88	%	50 - 150
			D5-EtFOSA	2019/08/01		72	%	50 - 150
			D5-EtFOSAA	2019/08/01		80	%	50 - 150
			D7-MeFOSE	2019/08/01		83	%	50 - 150
			D9-EtFOSE	2019/08/01		81	%	50 - 150
			Perfluorobutanoic acid	2019/08/01	<0.020		ug/L	
			Perfluoropentanoic Acid (PFPeA)	2019/08/01	<0.020		ug/L	
			Perfluorohexanoic Acid (PFHxA)	2019/08/01	<0.020		ug/L	
			Perfluoroheptanoic Acid (PFHpA)	2019/08/01	<0.020		ug/L	
			Perfluorooctanoic Acid (PFOA)	2019/08/01	<0.020		ug/L	
			Perfluorononanoic Acid (PFNA)	2019/08/01	<0.020		ug/L	
			Perfluorodecanoic Acid (PFDA)	2019/08/01	<0.020		ug/L	
			Perfluoroundecanoic Acid (PFUnA)	2019/08/01	<0.020		ug/L	
			Perfluorododecanoic Acid (PFDoA)	2019/08/01	<0.020		ug/L	
			Perfluorotridecanoic Acid	2019/08/01	<0.020		ug/L	
			Perfluorotetradecanoic Acid	2019/08/01	<0.020		ug/L	
			Perfluorobutanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluoropentanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluorohexanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluoroheptanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluorooctanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluorononanesulfonic acid	2019/08/01	<0.020		ug/L	
			Perfluorodecanesulfonic acid (PFDS)	2019/08/01	<0.020		ug/L	
			Perfluorooctane Sulfonamide (PFOSA)	2019/08/01	<0.020		ug/L	
			EtFOSA	2019/08/01	<0.020		ug/L	
			MeFOSA	2019/08/01	<0.020		ug/L	
			EtFOSE	2019/08/01	<0.020		ug/L	
			MeFOSE	2019/08/01	<0.020		ug/L	
			EtFOSAA	2019/08/01	<0.020		ug/L	
			MeFOSAA	2019/08/01	<0.020		ug/L	
			6:2 Fluorotelomer sulfonic acid	2019/08/01	<0.020		ug/L	
			8:2 Fluorotelomer sulfonic acid	2019/08/01	<0.020		ug/L	

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

Surrogate: A pure or isotopically labeled compound whose behavior mirrors the analytes of interest. Used to evaluate extraction efficiency.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

BV Labs Job #: B9K5262
Report Date: 2019/08/06

Dillon Consulting Limited
Client Project #: 19-9543
Sampler Initials: AH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Colm McNamara, Senior Analyst, Liquid Chromatography

Cristina Carriere, Senior Scientific Specialist

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Bureau Veritas Laboratories 32 Colonnade Rd, Unit #1000, Nepean, ON K2E 7J6 Phone: 613 274-0573 Fax: 613 274-0574 Website: www.bvlabs.com

24-Jul-19 11:45
Cristina (Maria) Bacchus
B9K5262
J_L ENV-1421

Page 1 of 1

Bureau Veritas Laboratories
6740 Campobello Road, Mississauga, Ontario Canada L5N 2L8 Tel:(905) 817-5700 Toll-free:800-563-6266 Fax:(905) 817-5777 www.bvlabs.com

INVOICE TO:		REPORT TO:		PROJECT INFORMATION:	
Company Name:	#19397 Dillon Consulting Limited	Company Name:		Quotation #:	
Attention:	Andrew Hounsell	Attention:	Andrew Hounsell	P.O. #:	
Address:	334 - 11th Ave SE Suite 200	Address:		Project:	19-9543
	Calgary AB T2G 0Y2			Project Name:	
Tel:	(403) 215-8880 Fax: (403) 215-8889	Tel:	(403) 604-7164 Fax:	Site #:	
Email:	AHounsell@dillon.ca, kbarnes@dillon.ca	Email:	AHounsell@dillon.ca	Sampled By:	

Bottle Order #: 727707
COC #: C#727707-01-01
Project Manager: Cristina (Maria) Bacchus

MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BV LABS DRINKING WATER CHAIN OF CUSTODY

Regulation 153 (2011)	Other Regulations	Special Instructions
☐ Table 1 ☐ Res/Park ☐ Medium/Fine	☐ CCME ☐ Sanitary Sewer Bylaw	
☐ Table 2 ☐ Ind/Comm ☐ Coarse	☐ Reg 558. ☐ Storm Sewer Bylaw	
☐ Table 3 ☐ Agri/Other ☐ For RSC	☐ MISA Municipality ____	
☐ Table ___	☐ PWQO	
	☐ Other ____	

Include Criteria on Certificate of Analysis (Y/N)? ______

ANALYSIS REQUESTED (PLEASE BE SPECIFIC)

Turnaround Time (TAT) Required:
Please provide advance notice for rush projects
Regular (Standard) TAT: ☐
(will be applied if Rush TAT is not specified):
Standard TAT = 5-7 Working days for most tests.
Please note: Standard TAT for certain tests such as BOD and Dioxins/Furans are > 5 days - contact your Project Manager for details.
Job Specific Rush TAT (if applies to entire submission)
Date Required: ______ Time Required: ______ ☐
Rush Confirmation Number: ______ *(call lab for #)*

	Sample Barcode Label	Sample (Location) Identification	Date Sampled	Time Sampled	Matrix	Field Filtered (please circle): Metals / Hg / Cr VI	Petroleum Hydrocarbons F2 in Water	Petroleum Hydro. CCME F1 & BTEX in Water	PAHs	Metals Package	Glycols in Water by GC/FID	VOCs by HS	PFAS in water by SPE/LCMS				# of Bottles	Comments
1		SW1	July 16, 2019	19:20	SW		X	X	X	X								SW - Surface Water
2		SW2	↓	19:40	↓		X	X	X	X								GW - Groundwater.
3		SW3	↓	20:00	↓		X	X	X	X								H - HOLD
4		19MW-04	July 18, 2019	19:55	GW		X	X	X	X		X						
5		19MW-02		20:55	↓		X	X	X	X	X		X					On ice
6		QAQC03		20:55			X	X	X	X			H					RECEIVED IN OTTAWA
7		19MW-03		21:55			X	X	X	X	X	X	X					
8		QAQC04		22:20			H	H	H	H			H					
9		QAQC05		22:30	↓		H	H	H	H			H					
10																		Cooler #2 Temp: 4, 3, 3

* RELINQUISHED BY: (Signature/Print)	Date: (YY/MM/DD)	Time	RECEIVED BY: (Signature/Print)	Date: (YYYY/MM/DD)	Time	# jars used and not submitted
[signature] / Andrew Hounsell	19/07/19	11:30	[signature] Jay Campbell	2019/07/24	11:45	
			[signature]	2019/07/25	[illegible]	

Laboratory Use Only				
Time Sensitive	Temperature (°C) on Recei	Custody Seal	Yes	No
	1, 1, 2	Present	X	
		Intact	X	

White: BV Labs Yellow: Client

* UNLESS OTHERWISE AGREED TO IN WRITING, WORK SUBMITTED ON THIS CHAIN OF CUSTODY IS SUBJECT TO BV LABS' STANDARD TERMS AND CONDITIONS. SIGNING OF THIS CHAIN OF CUSTODY DOCUMENT IS ACKNOWLEDGMENT AND ACCEPTANCE OF OUR TERMS WHICH ARE AVAILABLE FOR VIEWING AT WWW.BVLABS.COM/TERMS-AND-CONDITIONS.

* IT IS THE RESPONSIBILITY OF THE RELINQUISHER TO ENSURE THE ACCURACY OF THE CHAIN OF CUSTODY RECORD. AN INCOMPLETE CHAIN OF CUSTODY MAY RESULT IN ANALYTICAL TAT DELAYS.

** SAMPLE CONTAINER, PRESERVATION, HOLD TIME AND PACKAGE INFORMATION CAN BE VIEWED AT WWW.BVLABS.COM/RESOURCES/CHAIN-OF-CUSTODY-FORMS. 5/7/4 2/1/0 1/2/0

SAMPLES MUST BE KEPT COOL (< 10° C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BV LABS

BUREAU VERITAS

Your Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Your C.O.C. #: M086514, M046197

Attention: KEITH BARNES

DILLON CONSULTING LTD.
Suite 200
334 - 11th Avenue SE
CALGARY, AB
CANADA T2G 0Y2

Report Date: 2019/09/14
Report #: R2781311
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B975084
Received: 2019/09/07, 07:45

Sample Matrix: Water
Samples Received: 13

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity @25C (pp, total), CO3,HCO3,OH	5	N/A	2019/09/09	AB SOP-00005	SM 23 2320 B m
Alkalinity @25C (pp, total), CO3,HCO3,OH	8	N/A	2019/09/10	AB SOP-00005	SM 23 2320 B m
Cadmium - low level CCME - Dissolved	8	N/A	2019/09/10		Auto Calc
Cadmium - low level CCME (Total)	13	N/A	2019/09/11		Auto Calc
Chloride/Sulphate by Auto Colourimetry	10	N/A	2019/09/10	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Chloride/Sulphate by Auto Colourimetry	3	N/A	2019/09/11	AB SOP-00020 / AB SOP-00018	SM23-4500-Cl/SO4-E m
Conductivity @25C	5	N/A	2019/09/09	AB SOP-00005	SM 23 2510 B m
Conductivity @25C	7	N/A	2019/09/10	AB SOP-00005	SM 23 2510 B m
Conductivity @25C	1	N/A	2019/09/11	AB SOP-00005	SM 23 2510 B m
Hardness	13	N/A	2019/09/10		Auto Calc
Elements by ICP - Dissolved (1)	13	N/A	2019/09/09	AB SOP-00042	EPA 6010d R5 m
Elements by ICP - Total	13	2019/09/10	2019/09/11	AB SOP-00014 / AB SOP-00042	EPA 6010d R4 m
Elements by ICPMS - Dissolved (1)	7	N/A	2019/09/10	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Dissolved (1)	1	N/A	2019/09/13	AB SOP-00043	EPA 6020b R2 m
Elements by ICPMS - Total	13	2019/09/10	2019/09/10	AB SOP-00014 / AB SOP-00043	EPA 6020b R2 m
Ion Balance	13	N/A	2019/09/10		Auto Calc
Sum of cations, anions	13	N/A	2019/09/10		Auto Calc
Ammonia-N (Total)	13	N/A	2019/09/10	AB SOP-00007	SM 23 4500 NH3 A G m
Nitrate and Nitrite	13	N/A	2019/09/10		Auto Calc
Nitrate + Nitrite-N (calculated)	13	N/A	2019/09/10		Auto Calc
Nitrogen (Nitrite - Nitrate) by IC	13	N/A	2019/09/09	AB SOP-00023	SM 23 4110 B m
pH @25°C (2)	5	N/A	2019/09/09	AB SOP-00005	SM 23 4500 H+ B m
pH @25°C (2)	8	N/A	2019/09/10	AB SOP-00005	SM 23 4500 H+ B m
Total Dissolved Solids (Calculated)	4	N/A	2019/09/10		Auto Calc
Total Dissolved Solids (Calculated)	9	N/A	2019/09/11		Auto Calc
Total Kjeldahl Nitrogen	13	2019/09/12	2019/09/13	AB SOP-00008	EPA 351.1 R 1978 m

Remarks:

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BUREAU VERITAS

Your Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Your C.O.C. #: M086514, M046197

Attention: KEITH BARNES

DILLON CONSULTING LTD.
Suite 200
334 - 11th Avenue SE
CALGARY, AB
CANADA T2G 0Y2

Report Date: 2019/09/14
Report #: R2781311
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BV LABS JOB #: B975084
Received: 2019/09/07, 07:45

Bureau Veritas Laboratories are accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by BV Labs are based upon recognized Provincial, Federal or US method compendia such as CCME, MELCC, EPA, APHA.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in BV Labs profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and BV Labs in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

BV Labs liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. BV Labs has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by BV Labs, unless otherwise agreed in writing. BV Labs is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by BV Labs, results relate to the supplied samples tested.
This Certificate shall not be reproduced except in full, without the written approval of the laboratory.
Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.
(1) Dissolved > Total Imbalance: When applicable, Dissolved and Total results were reviewed and data quality meets acceptable levels unless otherwise noted.
(2) The CCME method requires pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the CCME holding time. Bureau Veritas Laboratories endeavours to analyze samples as soon as possible after receipt.

Encryption Key

AUTHORIZED REPORT
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Bureau Veritas Laboratories
14 Sep 2019 16:34:03

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Ioana Stoica, Key Account Specialist
Email: Ioana.Stoica@bvlabs.com
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==
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BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER (WATER)

BV Labs ID		WL2972		WL2973	WL2974	WL2974		WL2978		
Sampling Date		2019/09/06 10:00		2019/09/06 11:00	2019/09/06 12:00	2019/09/06 12:00				
COC Number		M086514		M086514	M086514	M086514		M046197		
	UNITS	W100	QC Batch	W101	W102	W102 Lab-Dup	QC Batch	QA/QC 3	RDL	QC Batch
Calculated Parameters										
Anion Sum	meq/L	0.65	9580945	1.6	0.96	N/A	9580945	0.0000	N/A	9580945
Cation Sum	meq/L	0.57	9580945	1.6	0.94	N/A	9580945	0.0030	N/A	9580945
Hardness (CaCO3)	mg/L	27	9580942	75	46	N/A	9580942	<0.50	0.50	9580942
Ion Balance (% Difference)	%	6.6	9580944	2.0	0.83	N/A	9580944	NC	N/A	9580944
Dissolved Nitrate (NO3)	mg/L	<0.044	9580946	<0.044	<0.044	N/A	9580946	<0.044	0.044	9580946
Nitrate plus Nitrite (N)	mg/L	<0.014	9580947	<0.014	<0.014	N/A	9580947	<0.014	0.014	9580947
Dissolved Nitrite (NO2)	mg/L	<0.033	9580946	<0.033	<0.033	N/A	9580946	<0.033	0.033	9580946
Calculated Total Dissolved Solids	mg/L	32	9580949	83	48	N/A	9580949	<10	10	9580949
Misc. Inorganics										
Conductivity	uS/cm	61	9581330	160	96	97	9582644	<2.0	2.0	9583396
pH	pH	7.72	9581326	8.03	7.77	7.85	9582640	5.74	N/A	9582633
Anions										
Alkalinity (PP as CaCO3)	mg/L	<1.0	9581329	<1.0	<1.0	<1.0	9582642	<1.0	1.0	9582636
Alkalinity (Total as CaCO3)	mg/L	27	9581329	69	44	44	9582642	<1.0	1.0	9582636
Bicarbonate (HCO3)	mg/L	33	9581329	84	53	54	9582642	<1.0	1.0	9582636
Carbonate (CO3)	mg/L	<1.0	9581329	<1.0	<1.0	<1.0	9582642	<1.0	1.0	9582636
Hydroxide (OH)	mg/L	<1.0	9581329	<1.0	<1.0	<1.0	9582642	<1.0	1.0	9582636
Dissolved Chloride (Cl)	mg/L	1.9	9582093	2.3	<1.0	N/A	9582093	<1.0	1.0	9584401
Dissolved Sulphate (SO4)	mg/L	2.8	9582093	8.5	4.0	N/A	9582093	<1.0	1.0	9584401
Nutrients										
Dissolved Nitrite (N)	mg/L	<0.010	9580545	<0.010	<0.010	N/A	9580545	<0.010	0.010	9580545
Dissolved Nitrate (N)	mg/L	<0.010	9580545	<0.010	<0.010	N/A	9580545	<0.010	0.010	9580545
Elements										
Dissolved Calcium (Ca)	mg/L	9.4	9580219	27	16	N/A	9580219	<0.30	0.30	9580219
Dissolved Iron (Fe)	mg/L	<0.060	9580219	0.067	<0.060	N/A	9580219	<0.060	0.060	9580219
Dissolved Magnesium (Mg)	mg/L	0.87	9580219	1.9	1.4	N/A	9580219	<0.20	0.20	9580219
Dissolved Manganese (Mn)	mg/L	<0.0040	9580219	<0.0040	<0.0040	N/A	9580219	<0.0040	0.0040	9580219
Dissolved Potassium (K)	mg/L	<0.30	9580219	<0.30	<0.30	N/A	9580219	<0.30	0.30	9580219
Dissolved Sodium (Na)	mg/L	0.66	9580219	1.2	0.80	N/A	9580219	<0.50	0.50	9580219

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER (WATER)

BV Labs ID		WL2979		
Sampling Date				
COC Number		M046197		
	UNITS	QA/QC 4	RDL	QC Batch
Calculated Parameters				
Anion Sum	meq/L	1.0	N/A	9580945
Cation Sum	meq/L	0.95	N/A	9580945
Hardness (CaCO3)	mg/L	46	0.50	9580942
Ion Balance (% Difference)	%	3.5	N/A	9580944
Dissolved Nitrate (NO3)	mg/L	<0.044	0.044	9580946
Nitrate plus Nitrite (N)	mg/L	<0.014	0.014	9580947
Dissolved Nitrite (NO2)	mg/L	<0.033	0.033	9580946
Calculated Total Dissolved Solids	mg/L	50	10	9580949
Misc. Inorganics				
Conductivity	uS/cm	100	2.0	9581330
pH	pH	7.87	N/A	9581326
Anions				
Alkalinity (PP as CaCO3)	mg/L	<1.0	1.0	9581329
Alkalinity (Total as CaCO3)	mg/L	45	1.0	9581329
Bicarbonate (HCO3)	mg/L	55	1.0	9581329
Carbonate (CO3)	mg/L	<1.0	1.0	9581329
Hydroxide (OH)	mg/L	<1.0	1.0	9581329
Dissolved Chloride (Cl)	mg/L	1.3	1.0	9582093
Dissolved Sulphate (SO4)	mg/L	4.0	1.0	9582093
Nutrients				
Dissolved Nitrite (N)	mg/L	<0.010	0.010	9580545
Dissolved Nitrate (N)	mg/L	<0.010	0.010	9580545
Elements				
Dissolved Calcium (Ca)	mg/L	16	0.30	9580219
Dissolved Iron (Fe)	mg/L	<0.060	0.060	9580219
Dissolved Magnesium (Mg)	mg/L	1.5	0.20	9580219
Dissolved Manganese (Mn)	mg/L	<0.0040	0.0040	9580219
Dissolved Potassium (K)	mg/L	<0.30	0.30	9580219
Dissolved Sodium (Na)	mg/L	0.80	0.50	9580219

RDL = Reportable Detection Limit
N/A = Not Applicable

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2967	WL2967			WL2968	WL2969		
Sampling Date		2019/09/06 09:00	2019/09/06 09:00			2019/09/06 08:00	2019/09/05 11:00		
COC Number		M086514	M086514			M086514	M086514		
	UNITS	W107	W107 Lab-Dup	RDL	QC Batch	W108	W109	RDL	QC Batch
Calculated Parameters									
Anion Sum	meq/L	41	N/A	N/A	9580945	1.4	2.6	N/A	9580945
Cation Sum	meq/L	40	N/A	N/A	9580945	1.4	2.3	N/A	9580945
Hardness (CaCO3)	mg/L	1900	N/A	0.50	9580942	64	110	0.50	9580942
Ion Balance (% Difference)	%	1.6	N/A	N/A	9580944	2.3	7.2	N/A	9580944
Dissolved Nitrate (NO3)	mg/L	0.080	N/A	0.044	9580946	0.29	<0.044	0.044	9580946
Nitrate plus Nitrite (N)	mg/L	0.17	N/A	0.014	9580947	0.064	<0.014	0.014	9580947
Dissolved Nitrite (NO2)	mg/L	0.50	N/A	0.033	9580946	<0.033	<0.033	0.033	9580946
Calculated Total Dissolved Solids	mg/L	2400	N/A	10	9580949	70	120	10	9580949
Misc. Inorganics									
Conductivity	uS/cm	3000	N/A	2.0	9581330	140	250	2.0	9582644
pH	pH	7.55	N/A	N/A	9581326	7.67	7.88	N/A	9582640
Low Level Elements									
Dissolved Cadmium (Cd)	ug/L	0.14	N/A	0.020	9580941	0.025	0.70	0.020	9580941
Anions									
Alkalinity (PP as CaCO3)	mg/L	<1.0	N/A	1.0	9581329	<1.0	<1.0	1.0	9582642
Alkalinity (Total as CaCO3)	mg/L	460	N/A	1.0	9581329	63	130	1.0	9582642
Bicarbonate (HCO3)	mg/L	570	N/A	1.0	9581329	77	160	1.0	9582642
Carbonate (CO3)	mg/L	<1.0	N/A	1.0	9581329	<1.0	<1.0	1.0	9582642
Hydroxide (OH)	mg/L	<1.0	N/A	1.0	9581329	<1.0	<1.0	1.0	9582642
Dissolved Chloride (Cl)	mg/L	80	N/A	1.0	9582093	2.0	2.3	1.0	9582093
Dissolved Sulphate (SO4)	mg/L	1400 (1)	N/A	10	9582093	4.5	<1.0	1.0	9582093
Nutrients									
Dissolved Nitrite (N)	mg/L	0.15	N/A	0.010	9580545	<0.010	<0.010	0.010	9580545
Dissolved Nitrate (N)	mg/L	0.018	N/A	0.010	9580545	0.064	<0.010	0.010	9580545
Elements									
Dissolved Aluminum (Al)	mg/L	0.0044	0.0047	0.0030	9581085	0.0083	0.015	0.0030	9581085
Dissolved Antimony (Sb)	mg/L	0.0023	0.0021	0.00060	9581085	<0.00060	0.00087	0.00060	9581085
Dissolved Arsenic (As)	mg/L	0.00036	0.00029	0.00020	9581085	<0.00020	<0.00020	0.00020	9581085
Dissolved Barium (Ba)	mg/L	0.059	N/A	0.010	9580219	<0.010	0.017	0.010	9580219

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2967	WL2967			WL2968	WL2969		
Sampling Date		2019/09/06 09:00	2019/09/06 09:00			2019/09/06 08:00	2019/09/05 11:00		
COC Number		M086514	M086514			M086514	M086514		
	UNITS	W107	W107 Lab-Dup	RDL	QC Batch	W108	W109	RDL	QC Batch
Dissolved Beryllium (Be)	mg/L	<0.0010	<0.0010	0.0010	9581085	<0.0010	<0.0010	0.0010	9581085
Dissolved Boron (B)	mg/L	<0.020	N/A	0.020	9580219	<0.020	<0.020	0.020	9580219
Dissolved Calcium (Ca)	mg/L	260	N/A	0.30	9580219	21	40	0.30	9580219
Dissolved Chromium (Cr)	mg/L	<0.0010	<0.0010	0.0010	9581085	<0.0010	<0.0010	0.0010	9581085
Dissolved Cobalt (Co)	mg/L	0.011	0.011	0.00030	9581085	<0.00030	<0.00030	0.00030	9581085
Dissolved Copper (Cu)	mg/L	0.0047	0.0043	0.00020	9581085	0.0039	0.0074	0.00020	9581085
Dissolved Iron (Fe)	mg/L	0.63	N/A	0.060	9580219	<0.060	<0.060	0.060	9580219
Dissolved Lead (Pb)	mg/L	0.00023	<0.00020	0.00020	9581085	<0.00020	<0.00020	0.00020	9581085
Dissolved Lithium (Li)	mg/L	<0.020	N/A	0.020	9580219	<0.020	<0.020	0.020	9580219
Dissolved Magnesium (Mg)	mg/L	310	N/A	0.20	9580219	2.7	2.8	0.20	9580219
Dissolved Manganese (Mn)	mg/L	8.1	N/A	0.0040	9580219	0.0090	0.014	0.0040	9580219
Dissolved Molybdenum (Mo)	mg/L	0.0030	0.0030	0.00020	9581085	0.00050	0.00081	0.00020	9581085
Dissolved Nickel (Ni)	mg/L	0.0094	0.0097	0.00050	9581085	0.0048	0.0011	0.00050	9581085
Dissolved Phosphorus (P)	mg/L	<0.10	N/A	0.10	9580219	<0.10	<0.10	0.10	9580219
Dissolved Potassium (K)	mg/L	4.3	N/A	0.30	9580219	0.44	0.60	0.30	9580219
Dissolved Selenium (Se)	mg/L	<0.00020	<0.00020	0.00020	9581085	<0.00020	<0.00020	0.00020	9581085
Dissolved Silicon (Si)	mg/L	7.7	N/A	0.10	9580219	2.8	2.3	0.10	9580219
Dissolved Silver (Ag)	mg/L	<0.00010	<0.00010	0.00010	9581085	<0.00010	<0.00010	0.00010	9581085
Dissolved Sodium (Na)	mg/L	22	N/A	0.50	9580219	1.3	1.1	0.50	9580219
Dissolved Strontium (Sr)	mg/L	0.54	N/A	0.020	9580219	0.043	0.055	0.020	9580219
Dissolved Sulphur (S)	mg/L	470	N/A	0.20	9580219	1.5	0.53	0.20	9580219
Dissolved Thallium (Tl)	mg/L	<0.00020	<0.00020	0.00020	9581085	<0.00020	<0.00020	0.00020	9581085
Dissolved Tin (Sn)	mg/L	<0.0010	<0.0010	0.0010	9581085	<0.0010	<0.0010	0.0010	9581085
Dissolved Titanium (Ti)	mg/L	<0.0010	<0.0010	0.0010	9581085	<0.0010	<0.0010	0.0010	9581085
Dissolved Uranium (U)	mg/L	0.012	0.012	0.00010	9581085	<0.00010	0.00024	0.00010	9581085
Dissolved Vanadium (V)	mg/L	<0.0010	<0.0010	0.0010	9581085	<0.0010	<0.0010	0.0010	9581085
Dissolved Zinc (Zn)	mg/L	0.0072	0.0067	0.0030	9581085	0.0039	0.0043	0.0030	9581085

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2970		WL2971		WL2975		
Sampling Date		2019/09/05 14:00		2019/09/05 16:00				
COC Number		M086514		M086514		M086514		
	UNITS	W110	QC Batch	W111	QC Batch	QA/QC 1	RDL	QC Batch
Calculated Parameters								
Anion Sum	meq/L	0.91	9580945	1.3	9580945	0.0000	N/A	9580945
Cation Sum	meq/L	0.83	9580945	1.2	9580945	0.0030	N/A	9580945
Hardness ($CaCO_3$)	mg/L	40	9580942	56	9580942	<0.50	0.50	9580942
Ion Balance (% Difference)	%	4.8	9580944	5.1	9580944	NC	N/A	9580944
Dissolved Nitrate (NO_3)	mg/L	0.37	9580946	0.20	9580946	<0.044	0.044	9580946
Nitrate plus Nitrite (N)	mg/L	0.083	9580947	0.044	9580947	<0.014	0.014	9580947
Dissolved Nitrite (NO_2)	mg/L	<0.033	9580946	<0.033	9580946	<0.033	0.033	9580946
Calculated Total Dissolved Solids	mg/L	45	9580949	63	9580949	<10	10	9580949
Misc. Inorganics								
Conductivity	uS/cm	89	9582644	130	9582644	<2.0	2.0	9581330
pH	pH	7.71	9582640	8.11	9582640	5.59	N/A	9581326
Low Level Elements								
Dissolved Cadmium (Cd)	ug/L	<0.020	9580941	0.030	9580941	<0.020	0.020	9580941
Anions								
Alkalinity (PP as $CaCO_3$)	mg/L	<1.0	9582642	<1.0	9582642	<1.0	1.0	9581329
Alkalinity (Total as $CaCO_3$)	mg/L	39	9582642	60	9582642	<1.0	1.0	9581329
Bicarbonate (HCO_3)	mg/L	47	9582642	73	9582642	<1.0	1.0	9581329
Carbonate (CO_3)	mg/L	<1.0	9582642	<1.0	9582642	<1.0	1.0	9581329
Hydroxide (OH)	mg/L	<1.0	9582642	<1.0	9582642	<1.0	1.0	9581329
Dissolved Chloride (Cl)	mg/L	1.9	9582093	1.3	9584401	<1.0	1.0	9584401
Dissolved Sulphate (SO_4)	mg/L	3.8	9582093	3.3	9584401	<1.0	1.0	9584401
Nutrients								
Dissolved Nitrite (N)	mg/L	<0.010	9580545	<0.010	9580545	<0.010	0.010	9580545
Dissolved Nitrate (N)	mg/L	0.083	9580545	0.044	9580545	<0.010	0.010	9580545
Elements								
Dissolved Aluminum (Al)	mg/L	0.014	9581085	0.014	9581085	<0.0030	0.0030	9584531
Dissolved Antimony (Sb)	mg/L	<0.00060	9581085	<0.00060	9581085	<0.00060	0.00060	9584531
Dissolved Arsenic (As)	mg/L	<0.00020	9581085	<0.00020	9581085	<0.00020	0.00020	9584531
Dissolved Barium (Ba)	mg/L	<0.010	9580219	<0.010	9580219	<0.010	0.010	9580219
Dissolved Beryllium (Be)	mg/L	<0.0010	9581085	<0.0010	9581085	<0.0010	0.0010	9584531
Dissolved Boron (B)	mg/L	<0.020	9580219	<0.020	9580219	<0.020	0.020	9580219

RDL = Reportable Detection Limit
N/A = Not Applicable

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2970		WL2971		WL2975		
Sampling Date		2019/09/05 14:00		2019/09/05 16:00				
COC Number		M086514		M086514		M086514		
	UNITS	W110	QC Batch	W111	QC Batch	QA/QC 1	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	12	9580219	20	9580219	<0.30	0.30	9580219
Dissolved Chromium (Cr)	mg/L	<0.0010	9581085	<0.0010	9581085	<0.0010	0.0010	9584531
Dissolved Cobalt (Co)	mg/L	<0.00030	9581085	<0.00030	9581085	<0.00030	0.00030	9584531
Dissolved Copper (Cu)	mg/L	0.0039	9581085	0.0040	9581085	0.0016	0.00020	9584531
Dissolved Iron (Fe)	mg/L	<0.060	9580219	<0.060	9580219	<0.060	0.060	9580219
Dissolved Lead (Pb)	mg/L	<0.00020	9581085	<0.00020	9581085	<0.00020	0.00020	9584531
Dissolved Lithium (Li)	mg/L	<0.020	9580219	<0.020	9580219	<0.020	0.020	9580219
Dissolved Magnesium (Mg)	mg/L	2.3	9580219	1.4	9580219	<0.20	0.20	9580219
Dissolved Manganese (Mn)	mg/L	0.012	9580219	0.011	9580219	<0.0040	0.0040	9580219
Dissolved Molybdenum (Mo)	mg/L	0.00038	9581085	0.0013	9581085	<0.00020	0.00020	9584531
Dissolved Nickel (Ni)	mg/L	<0.00050	9581085	<0.00050	9581085	<0.00050	0.00050	9584531
Dissolved Phosphorus (P)	mg/L	<0.10	9580219	<0.10	9580219	<0.10	0.10	9580219
Dissolved Potassium (K)	mg/L	<0.30	9580219	0.37	9580219	<0.30	0.30	9580219
Dissolved Selenium (Se)	mg/L	<0.00020	9581085	<0.00020	9581085	<0.00020	0.00020	9584531
Dissolved Silicon (Si)	mg/L	2.1	9580219	3.4	9580219	<0.10	0.10	9580219
Dissolved Silver (Ag)	mg/L	<0.00010	9581085	<0.00010	9581085	<0.00010	0.00010	9584531
Dissolved Sodium (Na)	mg/L	0.83	9580219	1.1	9580219	<0.50	0.50	9580219
Dissolved Strontium (Sr)	mg/L	0.020	9580219	0.029	9580219	<0.020	0.020	9580219
Dissolved Sulphur (S)	mg/L	1.1	9580219	1.2	9580219	<0.20	0.20	9580219
Dissolved Thallium (Tl)	mg/L	<0.00020	9581085	<0.00020	9581085	<0.00020	0.00020	9584531
Dissolved Tin (Sn)	mg/L	<0.0010	9581085	<0.0010	9581085	<0.0010	0.0010	9584531
Dissolved Titanium (Ti)	mg/L	<0.0010	9581085	<0.0010	9581085	<0.0010	0.0010	9584531
Dissolved Uranium (U)	mg/L	<0.00010	9581085	0.00019	9581085	<0.00010	0.00010	9584531
Dissolved Vanadium (V)	mg/L	<0.0010	9581085	<0.0010	9581085	<0.0010	0.0010	9584531
Dissolved Zinc (Zn)	mg/L	0.0036	9581085	0.0032	9581085	<0.0030	0.0030	9584531
RDL = Reportable Detection Limit								

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BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2976		WL2980		
Sampling Date						
COC Number		M086514		M046197		
	UNITS	QA/QC 2	QC Batch	TRIP BLANK	RDL	QC Batch
Calculated Parameters						
Anion Sum	meq/L	0.91	9580945	0.0000	N/A	9580945
Cation Sum	meq/L	0.84	9580945	0.0050	N/A	9580945
Hardness (CaCO3)	mg/L	40	9580942	<0.50	0.50	9580942
Ion Balance (% Difference)	%	4.1	9580944	NC	N/A	9580944
Dissolved Nitrate (NO3)	mg/L	0.36	9580946	<0.044	0.044	9580946
Nitrate plus Nitrite (N)	mg/L	0.082	9580947	<0.014	0.014	9580947
Dissolved Nitrite (NO2)	mg/L	<0.033	9580946	<0.033	0.033	9580946
Calculated Total Dissolved Solids	mg/L	44	9580949	<10	10	9580949
Misc. Inorganics						
Conductivity	uS/cm	87	9582644	<2.0	2.0	9581330
pH	pH	7.70	9582640	5.42	N/A	9581326
Low Level Elements						
Dissolved Cadmium (Cd)	ug/L	<0.020	9580941	<0.020	0.020	9580941
Anions						
Alkalinity (PP as CaCO3)	mg/L	<1.0	9582642	<1.0	1.0	9581329
Alkalinity (Total as CaCO3)	mg/L	39	9582642	<1.0	1.0	9581329
Bicarbonate (HCO3)	mg/L	48	9582642	<1.0	1.0	9581329
Carbonate (CO3)	mg/L	<1.0	9582642	<1.0	1.0	9581329
Hydroxide (OH)	mg/L	<1.0	9582642	<1.0	1.0	9581329
Dissolved Chloride (Cl)	mg/L	1.4	9582093	<1.0	1.0	9582093
Dissolved Sulphate (SO4)	mg/L	3.8	9582093	<1.0	1.0	9582093
Nutrients						
Dissolved Nitrite (N)	mg/L	<0.010	9580545	<0.010	0.010	9580545
Dissolved Nitrate (N)	mg/L	0.082	9580545	<0.010	0.010	9580545
Elements						
Dissolved Aluminum (Al)	mg/L	0.014	9581085	<0.0030	0.0030	9581085
Dissolved Antimony (Sb)	mg/L	<0.00060	9581085	<0.00060	0.00060	9581085
Dissolved Arsenic (As)	mg/L	<0.00020	9581085	<0.00020	0.00020	9581085
Dissolved Barium (Ba)	mg/L	<0.010	9580219	<0.010	0.010	9580219
Dissolved Beryllium (Be)	mg/L	<0.0010	9581085	<0.0010	0.0010	9581085
Dissolved Boron (B)	mg/L	<0.020	9580219	<0.020	0.020	9580219

RDL = Reportable Detection Limit
N/A = Not Applicable

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BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

ROUTINE WATER & DISS. REGULATED METALS (WATER)

BV Labs ID		WL2976		WL2980		
Sampling Date						
COC Number		M086514		M046197		
	UNITS	QA/QC 2	QC Batch	TRIP BLANK	RDL	QC Batch
Dissolved Calcium (Ca)	mg/L	12	9580219	<0.30	0.30	9580219
Dissolved Chromium (Cr)	mg/L	<0.0010	9581085	<0.0010	0.0010	9581085
Dissolved Cobalt (Co)	mg/L	<0.00030	9581085	<0.00030	0.00030	9581085
Dissolved Copper (Cu)	mg/L	0.0011	9581085	<0.00020	0.00020	9581085
Dissolved Iron (Fe)	mg/L	<0.060	9580219	<0.060	0.060	9580219
Dissolved Lead (Pb)	mg/L	<0.00020	9581085	<0.00020	0.00020	9581085
Dissolved Lithium (Li)	mg/L	<0.020	9580219	<0.020	0.020	9580219
Dissolved Magnesium (Mg)	mg/L	2.3	9580219	<0.20	0.20	9580219
Dissolved Manganese (Mn)	mg/L	0.012	9580219	<0.0040	0.0040	9580219
Dissolved Molybdenum (Mo)	mg/L	0.00032	9581085	<0.00020	0.00020	9581085
Dissolved Nickel (Ni)	mg/L	<0.00050	9581085	<0.00050	0.00050	9581085
Dissolved Phosphorus (P)	mg/L	<0.10	9580219	<0.10	0.10	9580219
Dissolved Potassium (K)	mg/L	<0.30	9580219	<0.30	0.30	9580219
Dissolved Selenium (Se)	mg/L	<0.00020	9581085	<0.00020	0.00020	9581085
Dissolved Silicon (Si)	mg/L	2.1	9580219	<0.10	0.10	9580219
Dissolved Silver (Ag)	mg/L	<0.00010	9581085	<0.00010	0.00010	9581085
Dissolved Sodium (Na)	mg/L	0.84	9580219	<0.50	0.50	9580219
Dissolved Strontium (Sr)	mg/L	<0.020	9580219	<0.020	0.020	9580219
Dissolved Sulphur (S)	mg/L	1.1	9580219	<0.20	0.20	9580219
Dissolved Thallium (Tl)	mg/L	<0.00020	9581085	<0.00020	0.00020	9581085
Dissolved Tin (Sn)	mg/L	<0.0010	9581085	<0.0010	0.0010	9581085
Dissolved Titanium (Ti)	mg/L	0.0012	9581085	<0.0010	0.0010	9581085
Dissolved Uranium (U)	mg/L	<0.00010	9581085	<0.00010	0.00010	9581085
Dissolved Vanadium (V)	mg/L	<0.0010	9581085	<0.0010	0.0010	9581085
Dissolved Zinc (Zn)	mg/L	<0.0030	9581085	<0.0030	0.0030	9581085
RDL = Reportable Detection Limit						

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BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2967	WL2968	WL2969	WL2970		WL2971		
Sampling Date		2019/09/06 09:00	2019/09/06 08:00	2019/09/05 11:00	2019/09/05 14:00		2019/09/05 16:00		
COC Number		M086514	M086514	M086514	M086514		M086514		
	UNITS	W107	W108	W109	W110	RDL	W111	RDL	QC Batch
Low Level Elements									
Total Cadmium (Cd)	ug/L	0.46	0.045	3.3	0.054	0.020	1.8	0.40	9580827
Elements									
Total Aluminum (Al)	mg/L	21	5.8	16	3.9	0.0030	70	0.060	9582021
Total Antimony (Sb)	mg/L	0.0032	<0.00060	0.0020	<0.00060	0.00060	<0.012	0.012	9582021
Total Arsenic (As)	mg/L	0.0062	0.00071	0.0041	0.00073	0.00020	0.016	0.0040	9582021
Total Barium (Ba)	mg/L	0.28	0.045	0.20	0.035	0.010	0.84	0.010	9582032
Total Beryllium (Be)	mg/L	0.0011	<0.0010	<0.0010	<0.0010	0.0010	<0.020	0.020	9582021
Total Boron (B)	mg/L	0.021	<0.020	<0.020	<0.020	0.020	0.022	0.020	9582032
Total Calcium (Ca)	mg/L	310	21	47	13	0.30	96	0.30	9582032
Total Chromium (Cr)	mg/L	0.045	0.0066	0.028	0.0058	0.0010	0.11	0.020	9582021
Total Cobalt (Co)	mg/L	0.029	0.0027	0.017	0.0031	0.00030	0.092	0.0060	9582021
Total Copper (Cu)	mg/L	0.097	0.015	0.056	0.014	0.00020	0.36	0.0040	9582021
Total Iron (Fe)	mg/L	65	9.1	33	7.8	0.060	190	0.060	9582032
Total Lead (Pb)	mg/L	0.017	0.0025	0.014	0.0029	0.00020	0.069	0.0040	9582021
Total Lithium (Li)	mg/L	0.038	<0.020	0.020	<0.020	0.020	0.087	0.020	9582032
Total Magnesium (Mg)	mg/L	340	5.0	14	4.2	0.20	51	0.20	9582032
Total Manganese (Mn)	mg/L	7.4	0.12	0.91	0.18	0.0040	4.1	0.0040	9582032
Total Molybdenum (Mo)	mg/L	0.0051	0.00050	0.0013	0.00047	0.00020	<0.0040	0.0040	9582021
Total Nickel (Ni)	mg/L	0.047	0.014	0.031	0.0064	0.00050	0.13	0.010	9582021
Total Phosphorus (P)	mg/L	2.3	0.15	0.67	<0.10	0.10	5.1	0.10	9582032
Total Potassium (K)	mg/L	8.3	1.2	3.0	0.88	0.30	13	0.30	9582032
Total Selenium (Se)	mg/L	0.00089	<0.00020	0.00032	<0.00020	0.00020	<0.0040	0.0040	9582021
Total Silicon (Si)	mg/L	41	10	26	8.4	0.10	71	0.10	9582032
Total Silver (Ag)	mg/L	0.00058	<0.00010	0.00013	<0.00010	0.00010	<0.0020	0.0020	9582021
Total Sodium (Na)	mg/L	21	1.4	2.1	1.0	0.50	4.7	0.50	9582032
Total Strontium (Sr)	mg/L	0.62	0.049	0.085	0.026	0.020	0.20	0.020	9582032
Total Sulphur (S)	mg/L	460	1.5	1.0	1.2	0.20	1.9	0.20	9582032
Total Thallium (Tl)	mg/L	0.00027	<0.00020	0.00022	<0.00020	0.00020	<0.0040	0.0040	9582021
Total Tin (Sn)	mg/L	0.0013	<0.0010	<0.0010	<0.0010	0.0010	<0.020	0.020	9582021
Total Titanium (Ti)	mg/L	1.5	0.24	0.87	0.20	0.0010	3.9	0.020	9582021
Total Uranium (U)	mg/L	0.013	0.00023	0.00091	0.00014	0.00010	0.0044	0.0020	9582021

RDL = Reportable Detection Limit

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BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2967	WL2968	WL2969	WL2970		WL2971		
Sampling Date		2019/09/06 09:00	2019/09/06 08:00	2019/09/05 11:00	2019/09/05 14:00		2019/09/05 16:00		
COC Number		M086514	M086514	M086514	M086514		M086514		
	UNITS	**W107**	**W108**	**W109**	**W110**	**RDL**	**W111**	**RDL**	**QC Batch**
Total Vanadium (V)	mg/L	0.058	0.0090	0.032	0.0070	0.0010	0.15	0.020	9582021
Total Zinc (Zn)	mg/L	0.27	0.044	0.12	0.031	0.0030	0.89	0.060	9582021
RDL = Reportable Detection Limit									

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BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2972	WL2973	WL2974	WL2974	WL2975	WL2976		
Sampling Date		2019/09/06 10:00	2019/09/06 11:00	2019/09/06 12:00	2019/09/06 12:00				
COC Number		M086514	M086514	M086514	M086514	M086514	M086514		
	UNITS	**W100**	**W101**	**W102**	**W102 Lab-Dup**	**QA/QC 1**	**QA/QC 2**	**RDL**	**QC Batch**
Low Level Elements									
Total Cadmium (Cd)	ug/L	<0.020	<0.020	<0.020	N/A	<0.020	0.056	0.020	9580827
Elements									
Total Aluminum (Al)	mg/L	0.029	0.0097	0.0063	0.011	0.0038	4.0	0.0030	9582021
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	<0.00060	0.00060	9582021
Total Arsenic (As)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00064	0.00020	9582021
Total Barium (Ba)	mg/L	<0.010	<0.010	<0.010	<0.010	<0.010	0.036	0.010	9582032
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Boron (B)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	9582032
Total Calcium (Ca)	mg/L	8.4	25	15	15	<0.30	13	0.30	9582032
Total Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0062	0.0010	9582021
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	<0.00030	<0.00030	0.0030	0.00030	9582021
Total Copper (Cu)	mg/L	0.00044	0.00064	0.00069	0.00074	0.00033	0.014	0.00020	9582021
Total Iron (Fe)	mg/L	<0.060	0.097	<0.060	<0.060	<0.060	7.8	0.060	9582032
Total Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.0030	0.00020	9582021
Total Lithium (Li)	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0.020	9582032
Total Magnesium (Mg)	mg/L	0.78	1.8	1.4	1.4	<0.20	4.2	0.20	9582032
Total Manganese (Mn)	mg/L	<0.0040	<0.0040	<0.0040	0.0044	<0.0040	0.18	0.0040	9582032
Total Molybdenum (Mo)	mg/L	<0.00020	0.00023	0.00023	0.00022	<0.00020	0.00048	0.00020	9582021
Total Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	0.0064	0.00050	9582021
Total Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	0.10	0.10	9582032
Total Potassium (K)	mg/L	<0.30	0.30	<0.30	<0.30	<0.30	0.87	0.30	9582032
Total Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Silicon (Si)	mg/L	1.1	2.1	1.3	1.2	<0.10	8.3	0.10	9582032
Total Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00010	9582021
Total Sodium (Na)	mg/L	0.59	1.2	0.75	0.73	<0.50	1.0	0.50	9582032
Total Strontium (Sr)	mg/L	<0.020	0.035	0.021	0.021	<0.020	0.026	0.020	9582032
Total Sulphur (S)	mg/L	0.85	2.7	1.3	1.3	<0.20	1.1	0.20	9582032
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Titanium (Ti)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.19	0.0010	9582021

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2972	WL2973	WL2974	WL2974	WL2975	WL2976		
Sampling Date		2019/09/06 10:00	2019/09/06 11:00	2019/09/06 12:00	2019/09/06 12:00				
COC Number		M086514	M086514	M086514	M086514	M086514	M086514		
	UNITS	**W100**	**W101**	**W102**	**W102 Lab-Dup**	**QA/QC 1**	**QA/QC 2**	**RDL**	**QC Batch**
Total Uranium (U)	mg/L	<0.00010	<0.00010	<0.00010	<0.00010	<0.00010	0.00026	0.00010	9582021
Total Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0067	0.0010	9582021
Total Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0033	<0.0030	0.032	0.0030	9582021

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate

Bureau Veritas Laboratories Edmonton: 9331 - 48th Street T6B 2R4 Telephone (780)577-7100 Fax (780)450-4187

BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2978	WL2979	WL2980		
Sampling Date						
COC Number		M046197	M046197	M046197		
	UNITS	QA/QC 3	QA/QC 4	TRIP BLANK	RDL	QC Batch
Low Level Elements						
Total Cadmium (Cd)	ug/L	<0.020	<0.020	<0.020	0.020	9580827
Elements						
Total Aluminum (Al)	mg/L	0.0041	0.0081	0.0031	0.0030	9582021
Total Antimony (Sb)	mg/L	<0.00060	<0.00060	<0.00060	0.00060	9582021
Total Arsenic (As)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Barium (Ba)	mg/L	<0.010	<0.010	<0.010	0.010	9582032
Total Beryllium (Be)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Boron (B)	mg/L	<0.020	<0.020	<0.020	0.020	9582032
Total Calcium (Ca)	mg/L	<0.30	15	<0.30	0.30	9582032
Total Chromium (Cr)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Cobalt (Co)	mg/L	<0.00030	<0.00030	<0.00030	0.00030	9582021
Total Copper (Cu)	mg/L	0.00023	0.00074	<0.00020	0.00020	9582021
Total Iron (Fe)	mg/L	<0.060	<0.060	<0.060	0.060	9582032
Total Lead (Pb)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Lithium (Li)	mg/L	<0.020	<0.020	<0.020	0.020	9582032
Total Magnesium (Mg)	mg/L	<0.20	1.4	<0.20	0.20	9582032
Total Manganese (Mn)	mg/L	<0.0040	<0.0040	<0.0040	0.0040	9582032
Total Molybdenum (Mo)	mg/L	<0.00020	0.00025	<0.00020	0.00020	9582021
Total Nickel (Ni)	mg/L	<0.00050	<0.00050	<0.00050	0.00050	9582021
Total Phosphorus (P)	mg/L	<0.10	<0.10	<0.10	0.10	9582032
Total Potassium (K)	mg/L	<0.30	<0.30	<0.30	0.30	9582032
Total Selenium (Se)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Silicon (Si)	mg/L	<0.10	1.3	<0.10	0.10	9582032
Total Silver (Ag)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9582021
Total Sodium (Na)	mg/L	<0.50	0.74	<0.50	0.50	9582032
Total Strontium (Sr)	mg/L	<0.020	0.021	<0.020	0.020	9582032
Total Sulphur (S)	mg/L	<0.20	1.3	<0.20	0.20	9582032
Total Thallium (Tl)	mg/L	<0.00020	<0.00020	<0.00020	0.00020	9582021
Total Tin (Sn)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Titanium (Ti)	mg/L	0.0012	<0.0010	<0.0010	0.0010	9582021
Total Uranium (U)	mg/L	<0.00010	<0.00010	<0.00010	0.00010	9582021

RDL = Reportable Detection Limit

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REGULATED METALS (CCME/AT1) - TOTAL

BV Labs ID		WL2978	WL2979	WL2980		
Sampling Date						
COC Number		M046197	M046197	M046197		
	UNITS	QA/QC 3	QA/QC 4	TRIP BLANK	RDL	QC Batch
Total Vanadium (V)	mg/L	<0.0010	<0.0010	<0.0010	0.0010	9582021
Total Zinc (Zn)	mg/L	<0.0030	<0.0030	<0.0030	0.0030	9582021
RDL = Reportable Detection Limit						

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RESULTS OF CHEMICAL ANALYSES OF WATER

BV Labs ID		WL2967		WL2968		WL2969		WL2970		WL2971		
Sampling Date		2019/09/06 09:00		2019/09/06 08:00		2019/09/05 11:00		2019/09/05 14:00		2019/09/05 16:00		
COC Number		M086514		M086514		M086514		M086514		M086514		
	UNITS	**W107**	**RDL**	**W108**	**RDL**	**W109**	**RDL**	**W110**	**RDL**	**W111**	**RDL**	**QC Batch**
Nutrients												
Total Ammonia (N)	mg/L	0.26	0.015	0.023	0.015	0.016	0.015	0.019	0.015	0.030	0.015	9582091
Total Total Kjeldahl Nitrogen	mg/L	2.3 (1)	0.25	0.17	0.050	3.4 (1)	0.25	0.24	0.050	14 (1)	0.50	9585993

RDL = Reportable Detection Limit
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

BV Labs ID		WL2971		WL2972	WL2972	WL2973	WL2974	WL2975		
Sampling Date		2019/09/05 16:00		2019/09/06 10:00	2019/09/06 10:00	2019/09/06 11:00	2019/09/06 12:00			
COC Number		M086514		M086514	M086514	M086514	M086514	M086514		
	UNITS	**W111 Lab-Dup**	**RDL**	**W100**	**W100 Lab-Dup**	**W101**	**W102**	**QA/QC 1**	**RDL**	**QC Batch**
Nutrients										
Total Ammonia (N)	mg/L	0.020	0.015	0.023	N/A	0.022	<0.015	<0.015	0.015	9582091
Total Total Kjeldahl Nitrogen	mg/L	N/A	0.50	0.13	0.11	0.30	0.10	<0.050	0.050	9585993

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

BV Labs ID		WL2976	WL2978	WL2978	WL2979	WL2980		
Sampling Date								
COC Number		M086514	M046197	M046197	M046197	M046197		
	UNITS	**QA/QC 2**	**QA/QC 3**	**QA/QC 3 Lab-Dup**	**QA/QC 4**	**TRIP BLANK**	**RDL**	**QC Batch**
Nutrients								
Total Ammonia (N)	mg/L	0.016	0.022	N/A	0.046	0.016	0.015	9582091
Total Total Kjeldahl Nitrogen	mg/L	0.19	<0.050	<0.050	0.10	<0.050	0.050	9585999

RDL = Reportable Detection Limit
Lab-Dup = Laboratory Initiated Duplicate
N/A = Not Applicable

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GENERAL COMMENTS

Each temperature is the average of up to three cooler temperatures taken at receipt

Package 1	7.4°C

Sample WL2969 [W109] : Sample was analyzed past method specified hold time for Nitrogen (Nitrite - Nitrate) by IC. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.

Sample WL2970 [W110] : Sample was analyzed past method specified hold time for Nitrogen (Nitrite - Nitrate) by IC. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.

Sample WL2971 [W111] : Sample was analyzed past method specified hold time for Nitrogen (Nitrite - Nitrate) by IC. Exceedance of hold time increases the uncertainty of test results but does not necessarily imply that results are compromised.

Detection limits raised due to sample matrix. Parameters affected are total Al, Cr, Co, Cu, Pb, Sb, Mo, Ni, Se, Ag, As, Tl, Sn, Ti, U, V, Zn, Be, Cd.

Results relate only to the items tested.

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QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9580219	REL	Matrix Spike	Dissolved Barium (Ba)	2019/09/09		87	%	80 - 120
			Dissolved Boron (B)	2019/09/09		99	%	80 - 120
			Dissolved Calcium (Ca)	2019/09/09		NC	%	80 - 120
			Dissolved Iron (Fe)	2019/09/09		84	%	80 - 120
			Dissolved Lithium (Li)	2019/09/09		96	%	80 - 120
			Dissolved Magnesium (Mg)	2019/09/09		NC	%	80 - 120
			Dissolved Manganese (Mn)	2019/09/09		98	%	80 - 120
			Dissolved Phosphorus (P)	2019/09/09		104	%	80 - 120
			Dissolved Potassium (K)	2019/09/09		104	%	80 - 120
			Dissolved Silicon (Si)	2019/09/09		92	%	80 - 120
			Dissolved Sodium (Na)	2019/09/09		NC	%	80 - 120
			Dissolved Strontium (Sr)	2019/09/09		NC	%	80 - 120
			Dissolved Sulphur (S)	2019/09/09		NC	%	80 - 120
9580219	REL	Spiked Blank	Dissolved Barium (Ba)	2019/09/09		100	%	80 - 120
			Dissolved Boron (B)	2019/09/09		103	%	80 - 120
			Dissolved Calcium (Ca)	2019/09/09		99	%	80 - 120
			Dissolved Iron (Fe)	2019/09/09		105	%	80 - 120
			Dissolved Lithium (Li)	2019/09/09		100	%	80 - 120
			Dissolved Magnesium (Mg)	2019/09/09		98	%	80 - 120
			Dissolved Manganese (Mn)	2019/09/09		99	%	80 - 120
			Dissolved Phosphorus (P)	2019/09/09		101	%	80 - 120
			Dissolved Potassium (K)	2019/09/09		106	%	80 - 120
			Dissolved Silicon (Si)	2019/09/09		100	%	80 - 120
			Dissolved Sodium (Na)	2019/09/09		106	%	80 - 120
			Dissolved Strontium (Sr)	2019/09/09		96	%	80 - 120
			Dissolved Sulphur (S)	2019/09/09		103	%	80 - 120
9580219	REL	Method Blank	Dissolved Barium (Ba)	2019/09/09	<0.010		mg/L	
			Dissolved Boron (B)	2019/09/09	<0.020		mg/L	
			Dissolved Calcium (Ca)	2019/09/09	<0.30		mg/L	
			Dissolved Iron (Fe)	2019/09/09	<0.060		mg/L	
			Dissolved Lithium (Li)	2019/09/09	<0.020		mg/L	
			Dissolved Magnesium (Mg)	2019/09/09	<0.20		mg/L	
			Dissolved Manganese (Mn)	2019/09/09	<0.0040		mg/L	
			Dissolved Phosphorus (P)	2019/09/09	<0.10		mg/L	
			Dissolved Potassium (K)	2019/09/09	<0.30		mg/L	
			Dissolved Silicon (Si)	2019/09/09	<0.10		mg/L	
			Dissolved Sodium (Na)	2019/09/09	<0.50		mg/L	
			Dissolved Strontium (Sr)	2019/09/09	<0.020		mg/L	
			Dissolved Sulphur (S)	2019/09/09	<0.20		mg/L	
9580219	REL	RPD	Dissolved Calcium (Ca)	2019/09/09	0.51		%	20
			Dissolved Magnesium (Mg)	2019/09/09	0.027		%	20
			Dissolved Potassium (K)	2019/09/09	2.7		%	20
			Dissolved Sodium (Na)	2019/09/09	3.2		%	20
9580545	KD5	Matrix Spike	Dissolved Nitrite (N)	2019/09/09		102	%	80 - 120
			Dissolved Nitrate (N)	2019/09/09		103	%	80 - 120
9580545	KD5	Spiked Blank	Dissolved Nitrite (N)	2019/09/09		100	%	80 - 120
			Dissolved Nitrate (N)	2019/09/09		101	%	80 - 120
9580545	KD5	Method Blank	Dissolved Nitrite (N)	2019/09/09	<0.010		mg/L	
			Dissolved Nitrate (N)	2019/09/09	<0.010		mg/L	
9580545	KD5	RPD	Dissolved Nitrite (N)	2019/09/09	0.076		%	20
			Dissolved Nitrate (N)	2019/09/09	0.16		%	20
9581085	APY	Matrix Spike [WL2967-03]	Dissolved Aluminum (Al)	2019/09/10		105	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Antimony (Sb)	2019/09/10		100	%	80 - 120
			Dissolved Arsenic (As)	2019/09/10		100	%	80 - 120
			Dissolved Beryllium (Be)	2019/09/10		99	%	80 - 120
			Dissolved Chromium (Cr)	2019/09/10		100	%	80 - 120
			Dissolved Cobalt (Co)	2019/09/10		96	%	80 - 120
			Dissolved Copper (Cu)	2019/09/10		94	%	80 - 120
			Dissolved Lead (Pb)	2019/09/10		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/09/10		107	%	80 - 120
			Dissolved Nickel (Ni)	2019/09/10		94	%	80 - 120
			Dissolved Selenium (Se)	2019/09/10		102	%	80 - 120
			Dissolved Silver (Ag)	2019/09/10		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/09/10		98	%	80 - 120
			Dissolved Tin (Sn)	2019/09/10		105	%	80 - 120
			Dissolved Titanium (Ti)	2019/09/10		100	%	80 - 120
			Dissolved Uranium (U)	2019/09/10		98	%	80 - 120
			Dissolved Vanadium (V)	2019/09/10		104	%	80 - 120
			Dissolved Zinc (Zn)	2019/09/10		95	%	80 - 120
9581085	APY	Spiked Blank	Dissolved Aluminum (Al)	2019/09/10		100	%	80 - 120
			Dissolved Antimony (Sb)	2019/09/10		94	%	80 - 120
			Dissolved Arsenic (As)	2019/09/10		99	%	80 - 120
			Dissolved Beryllium (Be)	2019/09/10		92	%	80 - 120
			Dissolved Chromium (Cr)	2019/09/10		100	%	80 - 120
			Dissolved Cobalt (Co)	2019/09/10		99	%	80 - 120
			Dissolved Copper (Cu)	2019/09/10		101	%	80 - 120
			Dissolved Lead (Pb)	2019/09/10		99	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/09/10		98	%	80 - 120
			Dissolved Nickel (Ni)	2019/09/10		100	%	80 - 120
			Dissolved Selenium (Se)	2019/09/10		97	%	80 - 120
			Dissolved Silver (Ag)	2019/09/10		96	%	80 - 120
			Dissolved Thallium (Tl)	2019/09/10		99	%	80 - 120
			Dissolved Tin (Sn)	2019/09/10		100	%	80 - 120
			Dissolved Titanium (Ti)	2019/09/10		101	%	80 - 120
			Dissolved Uranium (U)	2019/09/10		95	%	80 - 120
			Dissolved Vanadium (V)	2019/09/10		101	%	80 - 120
			Dissolved Zinc (Zn)	2019/09/10		102	%	80 - 120
9581085	APY	Method Blank	Dissolved Aluminum (Al)	2019/09/10	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/09/10	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/09/10	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/09/10	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/09/10	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/09/10	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/09/10	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/09/10	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/09/10	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/09/10	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/09/10	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/09/10	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/09/10	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/09/10	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/09/10	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/09/10	<0.00010		mg/L	
			Dissolved Vanadium (V)	2019/09/10	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/09/10	<0.0030		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9581085	APY	RPD [WL2967-03]	Dissolved Aluminum (Al)	2019/09/10	6.7		%	20
			Dissolved Antimony (Sb)	2019/09/10	5.7		%	20
			Dissolved Arsenic (As)	2019/09/10	NC		%	20
			Dissolved Beryllium (Be)	2019/09/10	NC		%	20
			Dissolved Chromium (Cr)	2019/09/10	NC		%	20
			Dissolved Cobalt (Co)	2019/09/10	2.7		%	20
			Dissolved Copper (Cu)	2019/09/10	8.2		%	20
			Dissolved Lead (Pb)	2019/09/10	14		%	20
			Dissolved Molybdenum (Mo)	2019/09/10	0.47		%	20
			Dissolved Nickel (Ni)	2019/09/10	2.9		%	20
			Dissolved Selenium (Se)	2019/09/10	NC		%	20
			Dissolved Silver (Ag)	2019/09/10	NC		%	20
			Dissolved Thallium (Tl)	2019/09/10	NC		%	20
			Dissolved Tin (Sn)	2019/09/10	NC		%	20
			Dissolved Titanium (Ti)	2019/09/10	NC		%	20
			Dissolved Uranium (U)	2019/09/10	0.78		%	20
			Dissolved Vanadium (V)	2019/09/10	NC		%	20
			Dissolved Zinc (Zn)	2019/09/10	7.3		%	20
9581326	MA4	Spiked Blank	pH	2019/09/09		100	%	97 - 103
9581326	MA4	RPD	pH	2019/09/09	0.27		%	N/A
9581329	MA4	Spiked Blank	Alkalinity (Total as CaCO3)	2019/09/09		101	%	80 - 120
9581329	MA4	Method Blank	Alkalinity (PP as CaCO3)	2019/09/09	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/09/09	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/09/09	<1.0		mg/L	
			Carbonate (CO3)	2019/09/09	<1.0		mg/L	
			Hydroxide (OH)	2019/09/09	<1.0		mg/L	
9581329	MA4	RPD	Alkalinity (PP as CaCO3)	2019/09/09	NC		%	20
			Alkalinity (Total as CaCO3)	2019/09/09	2.9		%	20
			Bicarbonate (HCO3)	2019/09/09	2.9		%	20
			Carbonate (CO3)	2019/09/09	NC		%	20
			Hydroxide (OH)	2019/09/09	NC		%	20
9581330	MA4	Spiked Blank	Conductivity	2019/09/09		100	%	90 - 110
9581330	MA4	Method Blank	Conductivity	2019/09/09	<2.0		uS/cm	
9581330	MA4	RPD	Conductivity	2019/09/09	0.30		%	10
9582021	ACY	Matrix Spike [WL2972-02]	Total Aluminum (Al)	2019/09/10		85	%	80 - 120
			Total Antimony (Sb)	2019/09/10		92	%	80 - 120
			Total Arsenic (As)	2019/09/10		93	%	80 - 120
			Total Beryllium (Be)	2019/09/10		97	%	80 - 120
			Total Chromium (Cr)	2019/09/10		96	%	80 - 120
			Total Cobalt (Co)	2019/09/10		96	%	80 - 120
			Total Copper (Cu)	2019/09/10		94	%	80 - 120
			Total Lead (Pb)	2019/09/10		95	%	80 - 120
			Total Molybdenum (Mo)	2019/09/10		97	%	80 - 120
			Total Nickel (Ni)	2019/09/10		96	%	80 - 120
			Total Selenium (Se)	2019/09/10		97	%	80 - 120
			Total Silver (Ag)	2019/09/10		94	%	80 - 120
			Total Thallium (Tl)	2019/09/10		102	%	80 - 120
			Total Tin (Sn)	2019/09/10		97	%	80 - 120
			Total Titanium (Ti)	2019/09/10		94	%	80 - 120
			Total Uranium (U)	2019/09/10		97	%	80 - 120
			Total Vanadium (V)	2019/09/10		96	%	80 - 120
			Total Zinc (Zn)	2019/09/10		93	%	80 - 120

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
9582021	ACY	Spiked Blank	Total Aluminum (Al)	2019/09/10		93	%	80 - 120
			Total Antimony (Sb)	2019/09/10		89	%	80 - 120
			Total Arsenic (As)	2019/09/10		92	%	80 - 120
			Total Beryllium (Be)	2019/09/10		94	%	80 - 120
			Total Chromium (Cr)	2019/09/10		94	%	80 - 120
			Total Cobalt (Co)	2019/09/10		94	%	80 - 120
			Total Copper (Cu)	2019/09/10		94	%	80 - 120
			Total Lead (Pb)	2019/09/10		95	%	80 - 120
			Total Molybdenum (Mo)	2019/09/10		94	%	80 - 120
			Total Nickel (Ni)	2019/09/10		94	%	80 - 120
			Total Selenium (Se)	2019/09/10		94	%	80 - 120
			Total Silver (Ag)	2019/09/10		92	%	80 - 120
			Total Thallium (Tl)	2019/09/10		102	%	80 - 120
			Total Tin (Sn)	2019/09/10		95	%	80 - 120
			Total Titanium (Ti)	2019/09/10		91	%	80 - 120
			Total Uranium (U)	2019/09/10		96	%	80 - 120
			Total Vanadium (V)	2019/09/10		94	%	80 - 120
			Total Zinc (Zn)	2019/09/10		92	%	80 - 120
9582021	ACY	Method Blank	Total Aluminum (Al)	2019/09/10	<0.0030		mg/L	
			Total Antimony (Sb)	2019/09/10	<0.00060		mg/L	
			Total Arsenic (As)	2019/09/10	<0.00020		mg/L	
			Total Beryllium (Be)	2019/09/10	<0.0010		mg/L	
			Total Chromium (Cr)	2019/09/10	<0.0010		mg/L	
			Total Cobalt (Co)	2019/09/10	<0.00030		mg/L	
			Total Copper (Cu)	2019/09/10	<0.00020		mg/L	
			Total Lead (Pb)	2019/09/10	<0.00020		mg/L	
			Total Molybdenum (Mo)	2019/09/10	<0.00020		mg/L	
			Total Nickel (Ni)	2019/09/10	<0.00050		mg/L	
			Total Selenium (Se)	2019/09/10	<0.00020		mg/L	
			Total Silver (Ag)	2019/09/10	<0.00010		mg/L	
			Total Thallium (Tl)	2019/09/10	<0.00020		mg/L	
			Total Tin (Sn)	2019/09/10	<0.0010		mg/L	
			Total Titanium (Ti)	2019/09/10	<0.0010		mg/L	
			Total Uranium (U)	2019/09/10	<0.00010		mg/L	
			Total Vanadium (V)	2019/09/10	<0.0010		mg/L	
			Total Zinc (Zn)	2019/09/10	<0.0030		mg/L	
9582021	ACY	RPD [WL2974-02]	Total Aluminum (Al)	2019/09/10	NC		%	20
			Total Antimony (Sb)	2019/09/10	NC		%	20
			Total Arsenic (As)	2019/09/10	NC		%	20
			Total Beryllium (Be)	2019/09/10	NC		%	20
			Total Chromium (Cr)	2019/09/10	NC		%	20
			Total Cobalt (Co)	2019/09/10	NC		%	20
			Total Copper (Cu)	2019/09/10	6.9		%	20
			Total Lead (Pb)	2019/09/10	NC		%	20
			Total Molybdenum (Mo)	2019/09/10	0.89		%	20
			Total Nickel (Ni)	2019/09/10	NC		%	20
			Total Selenium (Se)	2019/09/10	NC		%	20
			Total Silver (Ag)	2019/09/10	NC		%	20
			Total Thallium (Tl)	2019/09/10	NC		%	20
			Total Tin (Sn)	2019/09/10	NC		%	20
			Total Titanium (Ti)	2019/09/10	NC		%	20
			Total Uranium (U)	2019/09/10	NC		%	20
			Total Vanadium (V)	2019/09/10	NC		%	20

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BUREAU VERITAS

BV Labs Job #: B975084
Report Date: 2019/09/14

DILLON CONSULTING LTD.
Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Zinc (Zn)	2019/09/10	9.4		%	20
9582032	MSD	Matrix Spike [WL2973-02]	Total Barium (Ba)	2019/09/11		91	%	80 - 120
			Total Boron (B)	2019/09/11		93	%	80 - 120
			Total Calcium (Ca)	2019/09/11		86	%	80 - 120
			Total Iron (Fe)	2019/09/11		94	%	80 - 120
			Total Lithium (Li)	2019/09/11		94	%	80 - 120
			Total Magnesium (Mg)	2019/09/11		93	%	80 - 120
			Total Manganese (Mn)	2019/09/11		92	%	80 - 120
			Total Phosphorus (P)	2019/09/11		93	%	80 - 120
			Total Potassium (K)	2019/09/11		93	%	80 - 120
			Total Silicon (Si)	2019/09/11		97	%	80 - 120
			Total Sodium (Na)	2019/09/11		96	%	80 - 120
			Total Strontium (Sr)	2019/09/11		92	%	80 - 120
			Total Sulphur (S)	2019/09/11		96	%	80 - 120
9582032	MSD	Spiked Blank	Total Barium (Ba)	2019/09/11		89	%	80 - 120
			Total Boron (B)	2019/09/11		91	%	80 - 120
			Total Calcium (Ca)	2019/09/11		88	%	80 - 120
			Total Iron (Fe)	2019/09/11		97	%	80 - 120
			Total Lithium (Li)	2019/09/11		91	%	80 - 120
			Total Magnesium (Mg)	2019/09/11		92	%	80 - 120
			Total Manganese (Mn)	2019/09/11		91	%	80 - 120
			Total Phosphorus (P)	2019/09/11		91	%	80 - 120
			Total Potassium (K)	2019/09/11		91	%	80 - 120
			Total Silicon (Si)	2019/09/11		96	%	80 - 120
			Total Sodium (Na)	2019/09/11		94	%	80 - 120
			Total Strontium (Sr)	2019/09/11		90	%	80 - 120
			Total Sulphur (S)	2019/09/11		93	%	80 - 120
9582032	MSD	Method Blank	Total Barium (Ba)	2019/09/11	<0.010		mg/L	
			Total Boron (B)	2019/09/11	<0.020		mg/L	
			Total Calcium (Ca)	2019/09/11	<0.30		mg/L	
			Total Iron (Fe)	2019/09/11	<0.060		mg/L	
			Total Lithium (Li)	2019/09/11	<0.020		mg/L	
			Total Magnesium (Mg)	2019/09/11	<0.20		mg/L	
			Total Manganese (Mn)	2019/09/11	<0.0040		mg/L	
			Total Phosphorus (P)	2019/09/11	<0.10		mg/L	
			Total Potassium (K)	2019/09/11	<0.30		mg/L	
			Total Silicon (Si)	2019/09/11	<0.10		mg/L	
			Total Sodium (Na)	2019/09/11	<0.50		mg/L	
			Total Strontium (Sr)	2019/09/11	<0.020		mg/L	
			Total Sulphur (S)	2019/09/11	<0.20		mg/L	
9582032	MSD	RPD [WL2974-02]	Total Barium (Ba)	2019/09/11	NC		%	20
			Total Boron (B)	2019/09/11	NC		%	20
			Total Calcium (Ca)	2019/09/11	2.0		%	20
			Total Iron (Fe)	2019/09/11	NC		%	20
			Total Lithium (Li)	2019/09/11	NC		%	20
			Total Magnesium (Mg)	2019/09/11	2.5		%	20
			Total Manganese (Mn)	2019/09/11	10		%	20
			Total Phosphorus (P)	2019/09/11	NC		%	20
			Total Potassium (K)	2019/09/11	NC		%	20
			Total Silicon (Si)	2019/09/11	1.4		%	20
			Total Sodium (Na)	2019/09/11	2.8		%	20
			Total Strontium (Sr)	2019/09/11	2.3		%	20

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Client Project #: 19-9543
Site Location: IQALUIT PROPOSED LANDFILL
Sampler Initials: JH

QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Total Sulphur (S)	2019/09/11	0.23		%	20
9582091	CH7	Matrix Spike [WL2971-04]	Total Ammonia (N)	2019/09/10		93	%	80 - 120
9582091	CH7	Spiked Blank	Total Ammonia (N)	2019/09/10		103	%	80 - 120
9582091	CH7	Method Blank	Total Ammonia (N)	2019/09/10	<0.015		mg/L	
9582091	CH7	RPD [WL2971-04]	Total Ammonia (N)	2019/09/10	NC		%	20
9582093	MRD	Matrix Spike	Dissolved Chloride (Cl)	2019/09/10		109	%	80 - 120
			Dissolved Sulphate (SO4)	2019/09/10		NC	%	80 - 120
9582093	MRD	Spiked Blank	Dissolved Chloride (Cl)	2019/09/10		111	%	80 - 120
			Dissolved Sulphate (SO4)	2019/09/10		99	%	80 - 120
9582093	MRD	Method Blank	Dissolved Chloride (Cl)	2019/09/10	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/09/10	<1.0		mg/L	
9582093	MRD	RPD	Dissolved Chloride (Cl)	2019/09/10	0.020		%	20
			Dissolved Sulphate (SO4)	2019/09/10	1.5		%	20
9582633	MA4	Spiked Blank	pH	2019/09/10		100	%	97 - 103
9582633	MA4	RPD	pH	2019/09/10	0.048		%	N/A
9582636	MA4	Spiked Blank	Alkalinity (Total as CaCO3)	2019/09/10		101	%	80 - 120
9582636	MA4	Method Blank	Alkalinity (PP as CaCO3)	2019/09/10	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/09/10	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/09/10	<1.0		mg/L	
			Carbonate (CO3)	2019/09/10	<1.0		mg/L	
			Hydroxide (OH)	2019/09/10	<1.0		mg/L	
9582636	MA4	RPD	Alkalinity (PP as CaCO3)	2019/09/10	NC		%	20
			Alkalinity (Total as CaCO3)	2019/09/10	0.99		%	20
			Bicarbonate (HCO3)	2019/09/10	0.99		%	20
			Carbonate (CO3)	2019/09/10	NC		%	20
			Hydroxide (OH)	2019/09/10	NC		%	20
9582640	MA4	Spiked Blank	pH	2019/09/10		100	%	97 - 103
9582640	MA4	RPD [WL2974-01]	pH	2019/09/10	0.99		%	N/A
9582642	MA4	Spiked Blank	Alkalinity (Total as CaCO3)	2019/09/10		100	%	80 - 120
9582642	MA4	Method Blank	Alkalinity (PP as CaCO3)	2019/09/10	<1.0		mg/L	
			Alkalinity (Total as CaCO3)	2019/09/10	<1.0		mg/L	
			Bicarbonate (HCO3)	2019/09/10	<1.0		mg/L	
			Carbonate (CO3)	2019/09/10	<1.0		mg/L	
			Hydroxide (OH)	2019/09/10	<1.0		mg/L	
9582642	MA4	RPD [WL2974-01]	Alkalinity (PP as CaCO3)	2019/09/10	NC		%	20
			Alkalinity (Total as CaCO3)	2019/09/10	1.0		%	20
			Bicarbonate (HCO3)	2019/09/10	1.0		%	20
			Carbonate (CO3)	2019/09/10	NC		%	20
			Hydroxide (OH)	2019/09/10	NC		%	20
9582644	MA4	Spiked Blank	Conductivity	2019/09/10		100	%	90 - 110
9582644	MA4	Method Blank	Conductivity	2019/09/10	<2.0		uS/cm	
9582644	MA4	RPD [WL2974-01]	Conductivity	2019/09/10	1.1		%	10
9583396	MA4	Spiked Blank	Conductivity	2019/09/11		100	%	90 - 110
9583396	MA4	Method Blank	Conductivity	2019/09/11	<2.0		uS/cm	
9583396	MA4	RPD	Conductivity	2019/09/11	1.3		%	10
9584401	CH7	Matrix Spike	Dissolved Chloride (Cl)	2019/09/11		104	%	80 - 120
			Dissolved Sulphate (SO4)	2019/09/11		NC	%	80 - 120
9584401	CH7	Spiked Blank	Dissolved Chloride (Cl)	2019/09/11		108	%	80 - 120
			Dissolved Sulphate (SO4)	2019/09/11		103	%	80 - 120
9584401	CH7	Method Blank	Dissolved Chloride (Cl)	2019/09/11	<1.0		mg/L	
			Dissolved Sulphate (SO4)	2019/09/11	<1.0		mg/L	
9584401	CH7	RPD	Dissolved Chloride (Cl)	2019/09/11	0.87		%	20

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Sulphate (SO4)	2019/09/11	0.92		%	20
9584531	JHS	Matrix Spike	Dissolved Aluminum (Al)	2019/09/13		98	%	80 - 120
			Dissolved Antimony (Sb)	2019/09/13		102	%	80 - 120
			Dissolved Arsenic (As)	2019/09/13		97	%	80 - 120
			Dissolved Beryllium (Be)	2019/09/13		99	%	80 - 120
			Dissolved Chromium (Cr)	2019/09/13		96	%	80 - 120
			Dissolved Cobalt (Co)	2019/09/13		94	%	80 - 120
			Dissolved Copper (Cu)	2019/09/13		94	%	80 - 120
			Dissolved Lead (Pb)	2019/09/13		94	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/09/13		102	%	80 - 120
			Dissolved Nickel (Ni)	2019/09/13		94	%	80 - 120
			Dissolved Selenium (Se)	2019/09/13		93	%	80 - 120
			Dissolved Silver (Ag)	2019/09/13		95	%	80 - 120
			Dissolved Thallium (Tl)	2019/09/13		94	%	80 - 120
			Dissolved Tin (Sn)	2019/09/13		104	%	80 - 120
			Dissolved Titanium (Ti)	2019/09/13		108	%	80 - 120
			Dissolved Uranium (U)	2019/09/13		92	%	80 - 120
			Dissolved Vanadium (V)	2019/09/13		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/09/13		99	%	80 - 120
9584531	JHS	Spiked Blank	Dissolved Aluminum (Al)	2019/09/13		103	%	80 - 120
			Dissolved Antimony (Sb)	2019/09/13		101	%	80 - 120
			Dissolved Arsenic (As)	2019/09/13		98	%	80 - 120
			Dissolved Beryllium (Be)	2019/09/13		99	%	80 - 120
			Dissolved Chromium (Cr)	2019/09/13		97	%	80 - 120
			Dissolved Cobalt (Co)	2019/09/13		96	%	80 - 120
			Dissolved Copper (Cu)	2019/09/13		99	%	80 - 120
			Dissolved Lead (Pb)	2019/09/13		97	%	80 - 120
			Dissolved Molybdenum (Mo)	2019/09/13		101	%	80 - 120
			Dissolved Nickel (Ni)	2019/09/13		96	%	80 - 120
			Dissolved Selenium (Se)	2019/09/13		92	%	80 - 120
			Dissolved Silver (Ag)	2019/09/13		97	%	80 - 120
			Dissolved Thallium (Tl)	2019/09/13		95	%	80 - 120
			Dissolved Tin (Sn)	2019/09/13		105	%	80 - 120
			Dissolved Titanium (Ti)	2019/09/13		113	%	80 - 120
			Dissolved Uranium (U)	2019/09/13		92	%	80 - 120
			Dissolved Vanadium (V)	2019/09/13		99	%	80 - 120
			Dissolved Zinc (Zn)	2019/09/13		100	%	80 - 120
9584531	JHS	Method Blank	Dissolved Aluminum (Al)	2019/09/13	<0.0030		mg/L	
			Dissolved Antimony (Sb)	2019/09/13	<0.00060		mg/L	
			Dissolved Arsenic (As)	2019/09/13	<0.00020		mg/L	
			Dissolved Beryllium (Be)	2019/09/13	<0.0010		mg/L	
			Dissolved Chromium (Cr)	2019/09/13	<0.0010		mg/L	
			Dissolved Cobalt (Co)	2019/09/13	<0.00030		mg/L	
			Dissolved Copper (Cu)	2019/09/13	<0.00020		mg/L	
			Dissolved Lead (Pb)	2019/09/13	<0.00020		mg/L	
			Dissolved Molybdenum (Mo)	2019/09/13	<0.00020		mg/L	
			Dissolved Nickel (Ni)	2019/09/13	<0.00050		mg/L	
			Dissolved Selenium (Se)	2019/09/13	<0.00020		mg/L	
			Dissolved Silver (Ag)	2019/09/13	<0.00010		mg/L	
			Dissolved Thallium (Tl)	2019/09/13	<0.00020		mg/L	
			Dissolved Tin (Sn)	2019/09/13	<0.0010		mg/L	
			Dissolved Titanium (Ti)	2019/09/13	<0.0010		mg/L	
			Dissolved Uranium (U)	2019/09/13	<0.00010		mg/L	

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QUALITY ASSURANCE REPORT(CONT'D)

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	UNITS	QC Limits
			Dissolved Vanadium (V)	2019/09/13	<0.0010		mg/L	
			Dissolved Zinc (Zn)	2019/09/13	<0.0030		mg/L	
9584531	JHS	RPD	Dissolved Aluminum (Al)	2019/09/13	NC		%	20
			Dissolved Antimony (Sb)	2019/09/13	NC		%	20
			Dissolved Arsenic (As)	2019/09/13	NC		%	20
			Dissolved Beryllium (Be)	2019/09/13	NC		%	20
			Dissolved Chromium (Cr)	2019/09/13	1.2		%	20
			Dissolved Cobalt (Co)	2019/09/13	NC		%	20
			Dissolved Copper (Cu)	2019/09/13	NC		%	20
			Dissolved Lead (Pb)	2019/09/13	NC		%	20
			Dissolved Molybdenum (Mo)	2019/09/13	0.75		%	20
			Dissolved Nickel (Ni)	2019/09/13	NC		%	20
			Dissolved Selenium (Se)	2019/09/13	NC		%	20
			Dissolved Silver (Ag)	2019/09/13	NC		%	20
			Dissolved Thallium (Tl)	2019/09/13	NC		%	20
			Dissolved Tin (Sn)	2019/09/13	NC		%	20
			Dissolved Titanium (Ti)	2019/09/13	NC		%	20
			Dissolved Uranium (U)	2019/09/13	NC		%	20
			Dissolved Vanadium (V)	2019/09/13	NC		%	20
			Dissolved Zinc (Zn)	2019/09/13	NC		%	20
9585993	AL2	Matrix Spike [WL2972-04]	Total Total Kjeldahl Nitrogen	2019/09/13		99	%	80 - 120
9585993	AL2	QC Standard	Total Total Kjeldahl Nitrogen	2019/09/13		93	%	80 - 120
9585993	AL2	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/09/13		98	%	80 - 120
9585993	AL2	Method Blank	Total Total Kjeldahl Nitrogen	2019/09/13	<0.050		mg/L	
9585993	AL2	RPD [WL2972-04]	Total Total Kjeldahl Nitrogen	2019/09/13	16		%	20
9585999	AL2	Matrix Spike [WL2978-04]	Total Total Kjeldahl Nitrogen	2019/09/13		98	%	80 - 120
9585999	AL2	QC Standard	Total Total Kjeldahl Nitrogen	2019/09/13		89	%	80 - 120
9585999	AL2	Spiked Blank	Total Total Kjeldahl Nitrogen	2019/09/13		101	%	80 - 120
9585999	AL2	Method Blank	Total Total Kjeldahl Nitrogen	2019/09/13	<0.050		mg/L	
9585999	AL2	RPD [WL2978-04]	Total Total Kjeldahl Nitrogen	2019/09/13	NC		%	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (absolute difference <= 2x RDL).

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VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

Suwan Fock, B.Sc., QP, Inorganics Senior Analyst

Sandy Yuan, M.Sc., QP, Inorganics Supervisor

BV Labs has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam
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Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247
Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247
maxxam.ca

307 (2)

CHAIN OF CUSTODY RECORD

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Invoice Information	Report Information (if differs from invoice)	Project Information	Turnaround Time (TAT) Required
Company: Dillon Consulting Ltd	Company:	Quotation #:	[X] 5 - 7 Days Regular (Most analyses)
Contact Name: Jacob Hoekstra / Keith Barnes	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 334 - 11th Avenue SE Suite 200, Calgary, Alberta, T2G 0Y2	Address:	Project #: 19-9543	Rush TAT (Surcharges will be applied): [ ] Same Day [ ] 2 Days [ ] 1 Day [ ] 3-4 Days
Phone: 867-445-6860 / 405.215.8885	Phone:	Site Location: Iqaluit Proposed landfill	Date Required:
Email: jacob Hoekstra@dillon.ca / Kbarnes@dillon.ca	Email:	Site #:	
Copies:	Copies:	Sampled By: Jacob Hoekstra	Rush Confirmation #:

Laboratory Use Only

	YES	NO	Cooler ID	Temp		
Seal Present	✓			0	0	2
Seal Intact	✓					
Cooling Media	✓					
Seal Present	✓			1	1	0
Seal Intact	✓					
Cooling Media	✓					
Seal Present						
Seal Intact						
Cooling Media						

Depot Reception

Analysis Requested

#	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 [ ] VOC	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals [ ] Tot [ ] Diss	Mercury [ ] Total [ ] Dissolved	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Ammonia -N (Total)	Total Kjeldahl Nitrogen	Elements by ICP - dissolved (F)	Elements by ICPMS - dissolved	Cadmium - low level CCME (total)	Elements by ICP - (Total)	Elements by ICPMS (Total)			HOLD - DO NOT ANALYZE
1	W107	N/A	Sept 6/19	9:00 a.m	water	5				X							X	X	X	X	X	X	X			
2	W108		sept 6/19	8:00 a.m						X									X	X						
3	W109		Sept 5/19	11:00 a.m						X									X	X						
4	W110		Sept 5/19	2:00 p.m						X									X	X						
5	W111		Sept 5/19	4:00 p.m						X									X	X						
6	WS100		Sept 6/19	10:00 a.m						X																
7	WS101		Sept 6/19	11:00 a.m						X																
8	WS102		Sept 6/19	12:00 p.m						X																
9	QA/QC 1									X									X	X						
10	QA/QC 2									X									X	X						
	Please indicate Filtered, Preserved or Both (F, P, F/P)																P	P	F/P	F/P	P	P	P			

Regulatory Criteria

[ ] AT1
[X] CCME
[ ] Drinking Water
[ ] D50 (Drilling Waste)
[ ] Saskatchewan
[ ] Other:

Special Instructions

Received in Yellowknife
By: J. Mercado
7:45 Am
SEP 07 2019
Temp: 8.4 / 6.5 / 8.8
ice - yes
CS - NO

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Maxxam Job #
Jacob Hoekstra	Sept 6/19	21:00	Test.Ali	2019/09/08	1418	B975084

AB FCD-00331/7

Maxxam
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Calgary: 4000 19th St. NE, T2E 6P8. Toll Free (800) 386-7247
Edmonton: 9331-48 St. T6B 2R4. Toll Free (800) 386-7247
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CHAIN OF CUSTODY RECORD

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Report Information

Company: Dillon Consulting Ltd.
Contact: Jacob Hoekstra / Keith Barnes
Phone: 867-445-6860 / 405-215-8885
Email: jacobhoekstra@dillon.ca / Kbarnes@dillon.ca
Sampled by: Jacob Hoekstra

Comments

Same as CoC

Project/LSD
19-9543 / Iqaluit

#	Sample Identification	Depth (Unit)	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	# of containers	BTEX F1 ☐ VOC ☐	BTEX F1-F2	BTEX F1-F4	Routine Water	Regulated Metals Tot ☐ Diss ☐	Mercury Total ☐ Dissolved ☐	Salinity 4	Sieve (75 micron)	Texture (% Sand, Silt, Clay)	Basic Class II Landfill	Ammonia-N (Total)	Total Kjeldahl Nitrogen	Elements by ICP-dissolved	Elements by ICPMS-dissolved	Cadmium-low level CCME (total)	Elements by ICP (total)	Elements by ICPMS (total)		HOLD - DO NOT ANALYZE
11	QA/QC 3	N/A			Water	5				X							X	X			✓	✓	X		
12	QA/QC 4	↓			↓	↓				X							X	X			✓	X	X		
13	Trip Blank	↓			↓	↓				X							X	X	X	X	X	X	X		
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	Please indicate Filtered, Preserved or Both (F, P, F/P)																P	P	F/P	F/P	P	P	P		

Special Instructions

Received in Yellowknife
By: J. Merempo
7:45 AM
SEP 07 2019
Temp: 3.9 / 3.8 / 12.6
Ice - yes
CS - No

Relinquished by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Received by: (Signature/ Print)	DATE (YYYY/MM/DD)	Time (HH:MM)	Maxxam Job #
Jacob Hoekstra	Sept 6, 2019	21:00	Tesfai Ali	2019/09/08	1418	B975084

AB FCD-00331/7

References

CCME, 2016. Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment, Volume 1: Guidance Manual. PN 1551.

Dillon Consulting Limited, 2019. Soil and Groundwater Sampling Results Summary – Baseline Environmental Data Collection. Prepared for: City of Iqaluit.

EXP Services Inc., 2018. Physical and Biological Assessment, Proposed New Landfill Site, Iqaluit, NU. Prepared for: City of Iqaluit.

EXP Services Inc., 2018. Phase II Environmental Site Assessment, New Waste Transfer Station, Iqaluit, NU. Prepared for: City of Iqaluit.

8.2.3 Waste Baling

Following the completion of inspection procedures, material on the tipping floor is pushed using a front end loader to the conveyor infeed. The rate of material transfer from the conveyor to the baler hopper is regulated by the Baler Operator. Similarly, the Baler Operator controls the hydraulic rams, wire tying device and bale wrapper associated with the baler.

Following ejection from the baler, the bales are transferred (utilizing a forklift) to a flatbed truck for transport to the balefill.

8.3 Waste Placement and Covering

8.3.1 Waste Placement

Utilizing the Landfill's access road, bales of municipal solid waste will be delivered by site personnel from the WTS to the active disposal area. With the possible exception of loads of unique or difficult wastes, waste delivery vehicles and/or the general public will not have access to the Landfill area.

The Landfill is constructed from a series of individual lifts. Bales are removed from the flatbed truck via a fork-equipped front end loader. A lift is constructed by stacking bales three to four high; the height limit being set by the reach limit of the front end loader. The total height of a four bale lift is approximately 3 m. During bale stacking, the bales are placed with their widest dimension perpendicular to the direction of balefilling. Processed (shredded) or modest-sized C&D materials can be placed in bale voids on perimeter side slopes with granular fill subsequently being placed to develop a base for the final landfill cap.

To address the potential requirement (due to the temporary unavailability of the WTS baler) to accept unbaled MSW at the Landfill, it is recommended that the material be placed in a constructed void space (e.g., not placing bales in a designated area to establish a shallow "disposal pit") within the active bale placement area. Aggregate cover can then be placed over the material to prevent the potential for blowing litter. A similar containment approach can be used for C&D debris that presents a blowing litter potential. As an alternative, should the baler be inoperable for an extended period, the site could be temporarily operated as a traditional landfill, with waste being placed over a larger horizontal area (e.g., 300 m^2 with individual lifts of 400 to 600 mm) and then compacted with a bulldozer or (if available) the North 40 landfill compactor. To address concerns of blowing litter, a thin (e.g., 75 mm) cover layer of aggregate would need to be placed over the final waste lift at the end of each day.

To allow for a minimum four (horizontal) to one (vertical) side slopes for the fill area, the bales must be staggered during placement, utilizing the arrangements shown in Figure 8-1. The required side slope is *attained, while still providing efficient usage of the available disposal volume. The staggered arrangement should be maintained until the final design elevation is reached.*

9.0 Nuisance Control

9.1 Litter Control

Litter can be a significant problem at municipal solid waste disposal sites. At the facility, three factors will serve to reduce the problem significantly:

1. All incoming waste (except for periodic bulky materials) will be handled within the WTS.
2. Waste arriving at the working face will be in high-density, wire-tied and plastic-wrapped bales, with deposition occurring in an orderly "stacking" manner.
3. Use specialized placement procedures and use of aggregate cover at the Landfill in instances where delivered waste presents a littering potential (see **Section 8.3.1**).

Acknowledging that a notable reduction in litter generation is expected at the City's site (over that associated with a standard landfill), a litter control program will still be maintained at this location. Litter control is best accomplished by a combination of proper disposal operations, litter retaining fences and a litter picking program. A clean, litter-free appearance will be maintained at the site at all times, not only for public relations but also for the efficient operation of the Landfill. Poor litter control would attract unwanted wildlife and contribute to surface drainage problems by blocking ditches and culverts.

In summary, litter control measures to be implemented at the Landfill and WTS include:

- Semi-permanent litter collection fencing shall be positioned around the active area to catch blowing litter (see Engineering Drawings).
- A vigorous litter collection and patrol program shall be directed by the Manager.
- Litter on fencing, on-site roadways, in ditches, in the WTS yard, and adjacent properties shall be monitored and collected on a minimum weekly basis.
- The arriving waste must be covered according to applicable City bylaws. Vehicles arriving uncovered shall be turned away.
- Use of specialized placement procedures at the Landfill for wastes that present a blowing litter potential.

With respect to the plastic bale wrap, it is recommended that its durability be monitored by facility staff on an ongoing basis to identify requirements for operational modificaitons, including applying additional layers of wrap and/or the selection of a different wrap product. This evaluation should be conducted in collaboration with the bale wrapping unit manufacturer.

9.2 Odour Control

Odours will be controlled at the facility by the implementation of the following daily measures:

- *Timely removal of waste from the WTS tipping floor (e.g., baled and delivered to the Landfill).*

A license condition will be requested by the applicant to resolve this commitment

12.0 Leachate Management

As discussed in **Section 4.0**, leachate is created as a result of operations at the Landfill and WTS. Dedicated collection and storage systems serve each location. Management requirements for both locations are discussed in the following sections. Sampling and analysis requirements associated with leachate management are presented in **Section 13.**

12.1 Waste Transfer Station

Leachate within the WTS is generated during the waste baling process, as liquid is squeezed out of the waste mass. This liquid is collected via a shallow trench in the slab around the perimeter of the baling unit, with the effluent subsequently being pumped to the 4500L sewage holding tank. The sewage holding tank is XLPE polyethylene double wall construction. The secondary (outer) tank has 120% of the capacity of the inner tank and serves as containment in the event of a leak or spillage. The tank is equipped with an interstitial leak detector. As required, this liquid is collected and transported to the City's WWTP for treatment.

A record of details related to the transport of leachate to the WWTP (e.g., date, and quantity and/or quality) shall be maintained at the WTS. At the request of the WWTP operator, a characterization of the WTS leachate should be conducted to ensure compatability with the facility's treatment process and infrastructure as defined in Table 2: Summary of Design Flows and Loads (Iqaluit WWTP Upgrade Resdesign Development Report, prepared by Stantec, November 2017).

12.2 Landfill

*The Landfill's leachate collection and management system, as described in **Section 4.2**, will initially incorporate several components, including the leachate collection layer/perforated pipe system within the disposal area liner system, collection sumps/manholes and retention and potential future bioreactor pond. For the first few years of landfill operations, leachate will be stored within the constructed pond system, allowing for the analysis of quality and quantity data towards defining a treatment system (potentially incorporating mechanical components) appropriate to the unique effluent characteristics of* the Iqaluit site.

WARNING! LEACHATE IS POTENTIALLY HAZARDOUS. Take appropriate safety precautions when handling or working near leachate or when entering confined spaces, such as the use of protective clothing, breathing apparatus and ventilation.

For the initial system, primary operational requirements relating to leachate management at the Landfill include the following:

- As leachate is generated and pumped to the new holding lagoons, Dillon recommends that weekly sampling be undertaken for the first three months, switching to monthly sampling afterwards.
    - o If the quality varies significantly, more frequent sampling should be undertaken to properly identy the raw leachate quality.
    - o The parameters that should be examined (at a minimum) are:
        - cBOD
        - BOD
        - COD
        - TSS
        - Particle size distribution
        - TKN
        - TP
        - pH (field)
        - Temperature (field)
        - Total chlorine
        - Total phenols
        - Unionized ammonia
        - Total ammonia
        - Oil & grease,
        - Total dissolved metals
        - Total metals
        - Total coliforms
        - Fecal coliforms
- A summary of the landfill leachate management system activities shall be included in each annual report. This summary shall include, at a minimum:
    - o Landfill leachate generation rates;
    - o Leachate characteristics;
    - o Holding pond capacity; and
    - o Any updates to the leachate management system and/or leachate management activities.
- During the summer months (e.g., mid-June to mid-September), the leachate collection manhole will serve as a location for the extraction of effluent using a portable pump and hosing. During the period of operation, facility staff will be required to monitor effluent depths in the manhole, operating the pump as necessary.
- The pump hosing will direct leachate to piping which will direct flows to the lined ponds. The two ponds have been designed to provide approximately two years of storage, eliminating the need for discharge during the facility's initial operational period based on anticipated rainfall amounts. The pump will be powered by a small portable generator. Staff will bring the portable pump, hosing and

generator to the site each morning and energize the system. Before leaving the site at the end of the day, the equipment will be disconnected and returned to the WTS for storage.

- The manhole pump system will be operated during the period of the year when leachate is being generated and flows into the manhole. Daily assessment of leachate generation status (e.g., observations within the manhole) shall commence in the late spring, confirming when active pumping efforts should be initiated.
- A complete inspection of the leachate collection system elements (manhole, pump, hosing, holding ponds) shall be conducted on an annual basis.
- Should it be determined that storage volumes within the ponds are nearing design capacity as measured by water levels in the ponds and corresponding capacity chart, the City, in consultation with the NWB, will access contingency actions including transporting quantities of leachate effluent via pumper truck from the site to either the West 40 landfill (e.g., controlled discharge through the existing waste mass) or the City's WWTP. As a secondary contingency (to be implemented only with the approval of NWB), a valved discharge manhole at the second storage pond will allow for the controlled release of effluent to a gravel bed diffuser. It is acknowledged that it is anticipated that implementation of the secondary contingency measure will necessitate additional environmental effects (e.g., surface water) monitoring requirements at the Landfill site.
- In the event of significant volumes of poor quality leachate that cannot be stored in the holding ponds, three options are available:
    1. Haul and dispose of at the West 40 site;
    2. Haul and dispose of at the City WWTP (acknowledging the potential impacts to the WWTP process if the strength is significantly above the plant's rated capacity. If this is the case, it may need to be diluted and discharged over an extended period of time;
    3. Discharge to the level spreader under the approval and monitoring of the NWB.
- When treatment equipment is required to be taken offline for short duration maintenance, there is sufficient storage capacity in the holding ponds to accommodate. However, this leachate will need to be re-pumped through the mechanical system once it is back online

Commitment 5
Leachate Retention Ponds
ECCC

Updated drawing to be provided by October 9, 2020

5.0 Monitoring and Inspection

As a defined Contractor responsibility, and consistent with regulatory requirements, monitoring and inspection activities are to be conducted during the construction phase of the project, to assess any impacts to the surrounding environment and habitat. Environmental monitoring and inspections are important during this phase because the potential for negative impacts to the environment and habitats occurring within and outside the site area is high. It is imperative that site activities and incidents that negatively impact the environment and wildlife are reported immediately and appropriate mitigation measures are implemented.

Prior to the initiation of construction activities, a site-specific Construction Monitoring Plan (CMP) will be developed by the contractor responsible for construction. The City of Iqaluit and the Owners Representative will review the CMP and provide comments/improvements as necessary. The CMP must be submitted and approved prior to commencement of construction.The CMP will be available on-site at all time during construction and will be reviewed with relevant project personnel (e.g., engineering, safety and environment employees, observers, and contractor supervisors) in a pre-job meeting prior to construction activities commencing. Field procedures and methodologies should be conducted in accordance with industry standards and/or best practices (e.g., the Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment by the CCME, 2016).

The CMP should include, but is not limited to, the following monitoring and inspection activities identified in the Environmental Protection Measures (**Section 4.0**):

- Routinely inspect erosion and sediment control measures to ensure they are in proper working order. If deficiencies are observed, maintain, amend, or upgrade the measures as required;
- Routinely inspect the project site for drifting soil or topsoil loss within and outside the project area. If evidence of drifting soil or topsoil is observed, apply sediment and erosion control measures as required;
- Regularly inspect machinery, equipment, and vehicles used for the project, including fuel transfer hoses and fuel/oil lines, for leaks and malfunctions. Equipment or vehicles with deficiencies will be taken out of service and repaired.
- Inspect vegetation and the construction footprint for wildlife and bird nest presence prior to vegetation or soil stripping activities. If wildlife or bird nests are observed, consult with the EI;
- Monitor surface water drainage on site following precipitation events for obstructions in natural drainage patterns. If natural drainage patterns are obstructed, implement additional mitigation measures are required;
- Routinely inspect interceptor ditches and sumps for accumulated sediment. If accumulated sediment is observed, clean the interceptor ditches and sumps as required;
- Routinely inspect refuelling points and fuel storage tanks for leaks or malfunctions. If leaks or malfunctions are observed, repair the refuelling point or fuel storage tank immediately; and,

- Prior to discharging any water to the environment, inspect the water for any signs of contaminants. If signs of contaminants are present, the water must be collected and hauled to a disposal facility or sampled and analyzed to determine if the water meets Canadian Council of Ministers of the Environment water quality guidelines for the protection of aquatic life.

5.0 Monitoring and Inspection

As a responsibility of the City of Iqaluit, and consistent with regulatory approval requirements, monitoring and inspection activities are to be conducted during the operations, closure, and post-closure phases of the project to assess any impacts to the surrounding environment and habitat. It is imperative that site activities and incidents that negatively impact the environment and wildlife are reported immediately and appropriate mitigation measures are implemented.
As outlined in the Facility Monitoring Plan (FMP) there are three identified stages during landfill operation: construction, operation and maintenance, and post-closure. Monitoring programs will differ in frequency and focus depending on the stage of the landfill. The monitoring program contained herein is intended for the operation and maintenance stage of the landfill. Long-Term Monitoring (LTM) that will take place during the post-closure stage will include an emphasis on Visual Monitoring and Seepage Monitoring of the landfill isolation cover.

Field procedures and methodologies should be conducted in accordance with industry standards and/or best practices (e.g., the Guidance Manual for Environmental Site Characterization in Support of Environmental and Human Health Risk Assessment by the CCME, 2016).

The following section identifies the key items recommended in the Facility Monitoring Plan (FMP) developed for the operation and maintenance phase of the landfill The complete FMP should be referred to when implementing the FMP activities, and the section below is only intended to act as a summary of the program. There may be a need to revise specific monitoring and inspection activities outlined in the FMP to address unforeseen site-specific conditions or as a result of ongoing operations.

The following operational monitoring activities are recommended during the operation and maintenance phase of the landfill:

- Visual Monitoring will inspect the condition of daily cover, associated berms, culverts, site activities (changes from year to year) and site drainage using recorded observations and documented with photographs;
- Soil Temperature Monitoring will document changes in climatic conditions that may impact the integrity of the facility regarding permafrost depth and active layer variable thickness;
- Seepage Monitoring will identify potential seepage locations along berms, whether containment measures are sufficient, and if corrective action is required through visual inspection;
- Soil Sampling will occur on an as-needed basis in the event that a suspected seepage is observed at the landfill;
- Surface Water Monitoring will document water quality parameters at pre-determined surface water sampling locations in proximity to the landfill to identify potential down-gradient impacts to surface water bodies;
- Sediment Sampling may occur upon site closure or if surface water monitoring results warrant further investigation;

- **Active Layer Groundwater Monitoring** will document water quality parameters at pre-determined groundwater sampling locations in proximity to the landfill; and,
- Natural Environmental Monitoring will document observations of animal usage at the site (e.g., direct observations, tracks, and feces) and discussions with locals knowledgeable with the site regarding site usage by animals.

4.0 Environmental Protection Measures

The purpose of this section is to provide specific mitigation measures for the project team to implement or confirm implementations, to avoid or reduce potential environmental impacts. Mitigation measures for the Contractor to implement are outlined for various components of the project in Tables 4-1 to 4-3 below. Within each table, the mitigation measures are sorted by issue/activity. Revision of specific mitigation measures outlined in the EPP may be required to address unforeseen site-specific conditions or as a result of ongoing consultation.

Applicable Orders, Permits and Licenses for the project are provided in Appendix B.

Table 4-1: Mitigation Measures for Planning and Regulatory Requirements

Issue/Activity	Mitigation Measures
Work Progress Schedule	1. Works must be conducted according to regulatory approvals, permits, and licenses obtained for the work. These documents shall be displayed at each work site. 2. Adhere to planned project scheduling as outlined in the applicable regulatory permits and approvals. 3. Schedule and conduct activities to adhere to applicable timing windows and avoid restricted activity periods, where feasible, as follows: • Where possible, pre-clear shrubs and tall grasses before the onset of migratory bird nesting period (May 6 – September 1) to discourage nesting on the construction footprint. 4. A copy of this EPP and its included plans, regulatory approvals, permits and/or licenses will be available on-site at all times. 5. As part of pre-construction survey marking, conduct the following: • Flag or stake the boundaries of the project area before construction, including the corners of the work areas. Maintain the corner markings until the work areas are reclaimed. • Flag or stake the boundaries of temporary access roads. • Maintain survey markings until construction and clean-up activities are complete.
Discipline	6. Workers who show careless or wanton neglect of the environment, or disregard requirements put forward in the EPP will be identified, the incident recorded, and the Contractor will take appropriate action.
Environmental Training	7. Before the beginning of construction, a pre-job meeting will be held with relevant project personnel (e.g., engineering, safety and environment employees, observers, contractor supervisors) where this EPP, environmental concerns, mitigation measures, and regulations specific to the work, corporate policies and procedures, specific stakeholder conditions, specific conditions on associated permits, and contingency measures will be reviewed with the Contractor. 8. Environmental training will be provided to field level project personnel, as part of the site orientation, before starting work. This training, reviewed by the Owner and their representative, will be provided by the Contractor.

Table 4-2: Mitigations Measures for Construction

Issue/Activity	Mitigation Measures
Work Areas	1. Project activities must occur within the approved workspace. 2. Where necessary, the applicable work area boundaries must be prominently staked or marked with flagging tape.
Erosion and Sediment Control* *: see Appendix C	3. Erosion and sediment control activities shall be conducted in accordance with the Erosion and Sediment Control Plan (Appendix C). 4. Erosion and sediment controls shall be installed before commencing excavations or work in areas susceptible to erosion. 5. If activities involve ground disturbance within 100 m of any watercourse or wetland, erosion control structures must be installed between the natural areas and the work areas to create separation of the work area, as required. 6. Erosion and sediment control measures are to be left in place, where feasible until all work is complete. 7. Erosion and sediment control measures are to be routinely inspected and maintained in proper working order. 8. Erosion and sediment control measures are not static and may need to be upgraded and/or amended as directed by the Regulators, Owner, or their representative, as site conditions change. 9. The Contractor shall repair failed erosion and sediment control measures as soon as possible. 10. If drifting soil or topsoil loss is evident in areas prone to wind erosion, conduct the following: • Suspend topsoil stripping operations during high winds; • Apply a tackifier to the stripped topsoil pile; and/or • Install wind barriers. 11. Topsoil handling will be suspended during high winds when soil erosion is evident and during heavy rains, if soil becomes saturated. Topsoil will not be handled until winds have decreased and/or topsoil has drained and dried. 12. After final grading, stabilize disturbed steep slopes with permanent erosion control structures, especially if heavy runoff or heavy storms are likely, and there is a risk of substantial erosion. 13. Remove silt fence and erosion control measures only after the site has been stabilized.
Equipment Cleaning and **Condition**	14. Construction equipment, including tracked equipment and rubber-tired vehicles, shall arrive on the job site clean (i.e., free of soil and vegetative debris) and in good working order with no oil, hydraulic, or other fluid leaks. 15. Machinery and equipment shall be inspected for leaks throughout construction.
Clearing, Grubbing, and Grading	16. Construction work will be confined to the defined workspace. 17. Soil disturbance will only occur within the designated areas of the project required for surface or subsurface work. 18. Limit the extent of clearing, grubbing and grading to the minimum extent feasible. 19. Store material in discrete piles or windrows. 20. Ensure that stripped or graded soil does not spread outside of the project area. 21. Segregate topsoil from subsoil fill. 22. Consult with the Owner's representative before clearing or removing vegetation near watercourses. 23. Before any vegetation clearing or soil stripping, the appropriate wildlife and birds nest surveys must be completed before the start of clearing operations.

Issue/Activity	Mitigation Measures
Drainage Control	24. Ensure construction activities do not obstruct natural drainage, where possible, and facilitate drainage around the work area when avoidance is not possible. 25. Following construction, grade to re-establish surface drainage patterns and maintain existing site grades. 26. Leave gaps in windrows, at obvious drainages, on side-hill terrain and wherever seepage occurs, to reduce interference with natural drainage patterns. 27. Interceptor ditches and sumps are to be maintained free of accumulated sediment. Inspections are to be carried out regularly; cleaning to occur as required.
Dust and Noise Control	28. Vehicle use on public roads and project access routes will be in accordance with applicable laws and road use agreements (e.g., load restrictions). 29. Vehicles will not exceed speed limits established for the area and will lower speeds in specific conditions, such as areas of high erosion hazard. 30. Personnel will avoid unnecessary wheel spin when travelling or operating on soil. 31. Personnel will not unnecessarily idle vehicles or equipment. 32. Ensure equipment and machinery is in good working order with proper noise abatement equipment (i.e., mufflers or enclosures). 33. Locate stationary equipment, such as compressors and generators, away from noise receptors to limit the transmission of noise off-site. 34. Notify the Owner or their representative of any noise complaints that may be received by project personnel, public agencies, or individuals.
Fuel and Hazardous Material Storage	35. Hazardous materials must be labelled, stored and handled according to Workplace Hazardous Materials Information System regulations. 36. Fuel storage containers and tanks will be appropriately labelled. 37. Adequate spill response materials are available and accessible at the site. 38. Fuel containers and filters must be stored in secondary containment. 39. Jerry cans and other mobile fuel containers must always be stored in secondary containment while being used and returned to the storage area, as soon as feasible following use. 40. Refuelling points and fuel storage tanks, including secondary containment and gas cans, will be inspected regularly. All leaks must be repaired immediately.
Equipment Refueling and Servicing	41. Regularly inspect and maintain all heavy equipment and vehicles used for the project, including fuel transfer hoses and fuel/oil lines, to ensure that the systems are in good condition and free of leaks. Equipment or vehicles with deficiencies will be taken out of service and repaired. 42. Refuelling equipment will be attended at all times while refuelling. 43. Refuelling of equipment will not take place within 30 m of any wetland or watercourse. 44. Drip trays are to be in place while refuelling occurs to contain overfilling, drips and spills. 45. All vehicle servicing with the potential for accidental spills shall take place above an impervious tarp, and servicing will not take place within 30 m of wetlands or watercourses. 46. Spill kits should be accessible while refuelling. 47. Spill mats and/or drip pans/trays will be placed under all mobile fueling containers, equipment, and vehicles, when not in use or parked for longer than two hours.

Issue/Activity	Mitigation Measures
Spill Response, **Reporting and Notification**	48. The Contractor will notify the Owner or their representative, as soon possible, following the discovery of a spill of any volume. 49. The Contractor will notify Regulatory agencies and community liaisons, where required, to notify them of the spill. 50. A written spill report must be submitted to the Owner and their representative by the Contractor within 24 hours of any spill.
Air Emissions	51. Do not unnecessarily idle vehicles or equipment. 52. Ensure equipment is well maintained. 53. Notify the Owner or their representative of any odour complaints that may be received by project personnel, public agencies, or individuals.
Light Emissions	54. Lighting will be restricted to the minimum required to complete the works safely. 55. Lighting will be directed to the work area to reduce light pollution during dark hours to the extent feasible.
Wildlife Encounters and **Sightings**	56. Feeding or harassing wildlife is prohibited. 57. Travel within posted speed limits and yield to wildlife. 58. Report incidents of collisions or close calls with wildlife to the Owner or their representative. 59. The Contractor will notify the Owner and/or their representative of the following wildlife sightings: • Any suspected SAR or suspected species of special status, which are listed in Table 3-1; • Any dead or sick/diseased wildlife; and • Any food caches, dens, or nests found within or close to the site. 60. The Government of Nunavut will be notified of wildlife encounters by the Owner when required. 61. If previously unidentified listed or sensitive wildlife species or their site-specific habitat (e.g., dens, nests) are identified during construction, the Contractor will report the sighting to the Owner or their representative and implement the Wildlife Species of Concern Discovery Contingency Plan (**Section 6.2**).
Water Management	62. Water taking/withdrawal can only be carried out while personnel are on-site or nearby, allowing for regular inspection and maintenance of the pumping and discharge system. 63. Prior to discharging any water to the environment, the water must be inspected for any signs of contaminants. If signs of contaminants are present, the water must be collected and hauled to a disposal facility or sampled and analyzed to determine if the water meets Canadian Council of Ministers of the Environment water quality guidelines for the protection of aquatic life. 64. Water is to be discharged using pumps that will be directed to sediment removal materials (i.e., filter bag) or water settlement areas, in low-lying, vegetated areas at least 30 m away from a watercourse or wetland. At no time shall water be discharged directly into a watercourse or wetland. Dewatering volumes are to be monitored and recorded daily. 65. Where possible, discharge locations should be chosen that are near the dewatered area to maintain the local water table elevation. 66. Suitable discharge locations will be reviewed and confirmed by the Construction Manager and the EI.
Discovery of Heritage	67. Avoid impacts on lands outside of the work areas, including vegetation clearing. 68. If any artifacts or signs of archaeological artifacts are encountered, all work in the area

Issue/Activity	Mitigation Measures
Resources, Sites, **or Artifacts**	will be stopped immediately and the Owner and their representative will be immediately notified. Work will not resume until the Regulator has approved mitigation measures are implemented. Do not operate vehicles or equipment within 30 m of a known or suspected archaeological site, or burial ground. 69. The Owner will notify the following, as soon as possible, upon the discovery of an archaeological or historical site: • Government of Nunavut Territorial Archaeologist 867 934 2040 and include the following information: o Name and contact information of the person who made the discovery; o The date of discovery; o The nature of the object or fossil; o A description of the site and any artifacts/fossils noted; o A few photographs of the artifact/fossil and/or site; o A GPS reading of the location, if possible; o Any other relevant information; and o Regulations: subsection 51 (1) of the Nunavut Act and the Nunavut Archaeological and Palaeontological Sites Regulations. 70. No one shall knowingly remove, disturb, or displace any archaeological specimen or site.
Watercourse **Protection**	71. Install effective erosion control and sediment control measures before starting work to prevent sediment from entering any water body or spreading outside of the work site. 72. Wash, refuel, and service machinery, and store fuel and other materials for the machinery in such a way that prevent any deleterious substances from entering the water. 73. Schedule work to avoid wet, windy, and rainy periods that may cause erosion and sedimentation. 74. Apply the following mitigation measures to ensure fish habitat is maintained when crossing waterbodies: • Install a temporary bridge structure over the waterbody. The temporary bridge will be placed above the ordinary high water mark so that instream works are not required. Use matting to cross non-fish bearing watercourses and wetlands. • Use temporary crossing structures or other practices to cross watercourses with steep and/or highly erodible (e.g., dominated by organic materials and silts) banks and beds. • Design and construct approaches to the watercourse or waterbody, such that they are perpendicular to the watercourse or waterbody to minimize loss or disturbance to riparian vegetation. • The banks of the watercourses are not to be cut unless otherwise authorized by the Regulators. • Do not remove naturally occurring material from the bed and banks of any watercourse below the ordinary high water mark. • Do not store material on the ice surface of a watercourse, unless required for immediate use. • Minimize the disturbance of riparian vegetation within the immediate boundary of watercourse crossings to the extent practical. • Install suitable erosion and sediment controls measures around work areas near watercourses and wetlands to prevent resuspension of sediment into water bodies. • If works around watercourse or wetland crossings cause exposed soils and/or bank stability issues, remediate the exposed banks upon completion of the work. • Do not ford wet streams.

Issue/Activity	Mitigation Measures
	• Remove all construction materials from site upon crossing completion. 75. Notify the Owner's representative if any suspected contamination is discovered in or near a waterbody, who will initiate the applicable investigation and sampling to be completed to confirm suspect soil or water: • Soil or slurry material should be considered contaminated if any of the following are found: o Oil residue; o Gaseous odour; o Discoloured soil; and/or o Sheen on water. • Upon discovery of potential impacted soil or water, the site observer and their Project Manager will consult with the Owner to determine proper sampling requirements. • If required, the Owner will notify the applicable regulators of the newly discovered impacts. • Contaminated materials will be disposed of in accordance with the Waste Management Plan. • Consult with the Owner before disposing of any contaminated waste. Requirements are met and an approved facility has been arranged to receive the waste.

Table 4-3: Waste Management Procedures

Issue/Activity	Mitigation Measures
Waste Handling and Disposal	1. Appropriate waste disposal facilities for each waste type to be produced by the project must be identified by the Contractor, before starting work. 2. All waste leaving the site must be accompanied with an appropriate waybill, bill of lading or waste manifest. Consult with the Owner or their representative to determine what type of paperwork is required. 3. Notify waste disposal facilities of waste shipments before leaving the site and determine if any there are facility sampling requirements. 4. No wastes may be disposed of on-site. 5. If wastes, including wastewater, are to be disposed of at a local municipal waste facility, agreements should be in place between the receiving local municipal waste facility and the Contractor, before any wastes being hauled. 6. All sewage and solid waste will be contained and sealed in watertight containers. 7. Tanks used for transporting greywater will be watertight and will be regularly and properly inspected and maintained by the operator.

4.0 Environmental Protection Measures

The purpose of this section is to provide specific mitigation measures for the City to implement or confirm implementations, to avoid or reduce potential environmental impacts. The mitigation measures outlined in Table 4-1 are to be implemented in the operations, closure and post-closure phases of the project. The operations phase describes the time from when normal operations begin, following construction, until the closure and decommissioning begins. Mitigation measures for the City to implement during the operations phase of the project are outlined in Table 4-2 below. The mitigation measures to implement during the closure phase of the project, which describes the point in time when normal operations cease until when the closure and decommissioning activities end, are outlined in Table 4-3. The mitigation measures to implement during the post-closure phase are outlined in Table 4-4. Within each table, the mitigation measures are sorted by issue/activity. Revisions of specific mitigation measures outlined in the EPP may be required to address unforeseen site-specific conditions or as a result of ongoing operations.

Applicable Orders, Permits and Licenses for the project are provided in Appendix B.

Table 4-1: Mitigation Measures for Post-Construction Phases

Issue/**Activity**	**Mitigation Measures**
Work Progress Schedule	1. Works must be conducted according to regulatory approvals, permits and licenses obtained for the work. These documents shall be displayed at each work site. 2. Adhere to planned project scheduling as outlined in the applicable regulatory permits and approvals. 3. Schedule and conduct activities to adhere to applicable timing windows and avoid restricted activity periods, where feasible. 4. A copy of this EPP and its included plans, regulatory approvals, permits, and/or licenses will be available on-site at all times.
Documentation	5. Maintain an up-to-date documentation record of all site activities related to monitoring, site inspections, maintenance, repairs and remedial actions. 6. Document all incidences of nuisance activity, including illegal dumping, nuisance animals and fires. 7. Document complaints received from individuals, public agencies and project staff.
Nuisance Control	8. Report incidences of illegal dumping to the Manager of Solid Waste and the appropriate legal personnel. 9. Report incidences of nuisance animals to the Manager of Solid Waste and take the appropriate avoidance/deterrence measures. 10. Report incidences of fires on-site to the Manager of Solid Waste and contact the appropriate emergency services
Discipline	11. Workers who show careless or wanton neglect of the environment or disregards requirements put forward in the EPP will be identified, the incident recorded and the Manager of Solid Waste will take appropriate action.
Environmental Training	12. Environmental training will be provided to facility staff, as part of the site orientation, before starting work.

Table 4-2: Mitigations Measures for Site Operations

Issue/Activity	Mitigation Measures
Work Areas	1. Project activities must occur within the approved workspace.
Drainage Control	2. Ensure operation activities do not obstruct natural drainage, where possible. If avoidance is not possible, facilitate drainage around the work area. 3. Interceptor ditches and sumps are to be maintained free of accumulated sediment. Inspections are to be carried out regularly; cleaning to occur as required.
Erosion and Sediment Control* *: see Appendix C	4. Erosion and sediment control activities shall be conducted in accordance with the Erosion and Sediment Control Plan (Appendix C) 5. Erosion and sediment controls shall be installed before activities in areas susceptible to erosion. 6. If activities involve ground disturbance within 100 m of any watercourse or wetland, erosion control structures must be installed between the natural areas and the work areas to create separation of the work area, as required. 7. Erosion and sediment control measures are to be left in place, where feasible until all work is complete and the site has been stabilized. 8. Erosion and sediment control measures are to be routinely inspected and maintained in proper working order. 9. Erosion and sediment control measures are not static and may need to be upgraded and/or amended as directed by the Regulators, as site conditions change. 10. The City shall repair failed erosion and sediment control measures as soon as possible. 11. If drifting soils or topsoil loss is evident in areas prone to wind erosion, conduct the following, as appropriate: • Suspend topsoil stripping operations during high winds; • Apply a tackifier to the stripped topsoil pile; and/or • Install wind barriers. 12. Topsoil handling will be suspended during high winds when soil erosion is evident and during heavy rains, if soil becomes saturated. Topsoil will not be handled until winds have decreased and/or topsoil has drained and dried.
Fuel and Hazardous Material Storage	13. Hazardous materials must be labelled, stored, and handled according to Workplace Hazardous Materials Information System (WHMIS) regulations. 14. Fuel storage containers and tanks will be appropriately labelled. 15. Adequate spill response materials are available and accessible at the site. 16. Fuel containers and filters must be stored in secondary containment. 17. Jerry cans and other mobile fuel containers must always be stored in secondary containment while being used and returned to the storage area, as soon as feasible following use. 18. Refuelling points and fuel storage tanks, including secondary containment and gas cans, will be inspected regularly. All leaks must be repaired immediately.
Equipment Refueling and Servicing	19. Regularly inspect and maintain all heavy equipment and vehicles used during site operation, including fuel transfer hoses and fuel/oil lines, to ensure that the systems are in good condition and free of leaks. Equipment or vehicles with deficiencies will be taken out of service and repaired. 20. Refuelling equipment will be attended at all times while refuelling. 21. Refuelling of equipment will not take place within 30 m of any wetland or watercourse. 22. Drip trays are to be in place while refuelling occurs to contain overfilling, drips and spills. 23. All vehicle servicing with the potential for accidental spills shall take place above an

Issue/Activity	Mitigation Measures
	impervious tarp, and servicing will not take place within 30 m of wetlands or watercourses. 24. Spill kits should be accessible while refuelling. 25. Spill mats and/or drip pans/trays will be placed under all mobile fueling containers.
Spill Response, **Reporting and Notification**	26. Staff will notify the Facility Supervisor, as soon possible, following the discovery of a spill of any volume. The Facility Supervisor will subsequently contact the Manager of Solid Waste with the information. 27. The Manager of Solid Waste will notify regulatory agencies and community liaisons, where required, to notify them of the spill. 28. A written spill report must be submitted to the Manager of Solid Waste within 24 hours of any spill. Inspect hydraulic, fuel and lubrication systems of equipment regularly to ensure that the systems are in good condition and free of leaks. 29. All fuel containers or filters must be stored in secondary containment. 30. Refuelling equipment will be attended at all times while refuelling. 31. Refuelling of equipment will not take place within 30 m of any wetland or watercourse. 32. Drip trays are to be in place while refuelling occurs to contain overfilling, drips and spills. 33. All vehicle servicing with the potential for accidental spills shall take place above an impervious tarp, and servicing will not take place within 30 m of wetlands or watercourses. 34. Spill kits should be accessible while refuelling. 35. Regular inspection and maintenance will be conducted for all heavy equipment and vehicles used for the project, including fuel transfer hoses and fuel/oil lines. Equipment or vehicles with deficiencies will be taken out of service and repaired. 36. Hazardous materials must be labelled, stored and handled according to WHMIS regulations. 37. Spill mats and/or drip pans/trays will be placed under all mobile fueling containers, equipment, and vehicles, when not in use or parked for longer than two hours.
Air Emissions	38. Ensure equipment and vehicles are well maintained. 39. Notify the Manager of Solid Waste of any odour complaints that may be received by project personnel, public agencies or individuals.
Noise	40. Ensure equipment and vehicles are in good working order with proper noise abatement equipment (i.e., mufflers or enclosures).
Light Emissions	41. Lighting will be restricted to the minimum required to complete the works safely. 42. Lighting will be directed to the work area to reduce light pollution during dark hours to the extent feasible.
Wildlife Encounters and **Sightings**	43. Feeding or harassing wildlife is prohibited. 44. Travel within posted speed limits and yield to wildlife. 45. Report incidents of collisions or close calls with wildlife to the Manager of Solid Waste. 46. Notify the Manager of Solid Waste of the following wildlife sightings: • Any suspected species at risk or suspected species of special status, which are listed in Table 3-1; • Any dead or sick/diseased wildlife; and • Any food caches, dens, or nests found within or close to the site. 47. The Government of Nunavut will be notified of wildlife encounters by the Manager of Solid Waste when required.

Issue/Activity	Mitigation Measures
	48. If previously unidentified listed or sensitive wildlife species or their site-specific habitat (e.g., dens, nests) are identified during operation, report the sighting to the Manager of Solid Waste and implement the Wildlife Species of Concern Discovery Contingency Plan (**Section 6.2**).
Water Management	49. Water taking/withdrawal can only be carried out while personnel are on-site or nearby, allowing for regular inspection and maintenance of the pumping and discharge system. 50. Before discharging any water to the environment, the water must be inspected for any signs of contaminants. If signs of contaminants are present the water must be collected and hauled to a disposal facility or sampled and analyzed to determine if the water meets Canadian Council of Ministers of the Environment water quality guidelines for the protection of aquatic life. 51. Water is to be discharged using pumps that will be directed to sediment removal materials (i.e., filter bag) or water settlement areas, in low-lying, vegetated areas at least 30 m away from a watercourse or wetland. At no time shall water be discharged directly into a watercourse or wetland. Dewatering volumes are to be monitored and recorded daily. 52. Where possible, discharge locations should be chosen that are near the dewatered area to maintain the local water table elevation. 53. Suitable discharge locations will be reviewed and confirmed by the Manager of Solid Waste.
Watercourse Protection	54. Install effective erosion control and sediment control measures before starting work near a waterbody. 55. Wash, refuel, and service machinery, and store fuel and other materials for the machinery in such a way that prevent any deleterious substances from entering the water. 56. Schedule work to avoid wet, windy, and rainy periods that may cause erosion and sedimentation. 57. Notify the Manager of Solid Waste if any suspected contamination is discovered in or near a waterbody, who will initiate the applicable investigation and sampling to be completed to confirm suspect soil or water: • Soil or slurry material should be considered contaminated if any of the following are found: o Oil residue; o Gaseous odour; o Discoloured soil; and/or o Sheen on water. • Upon discovery of potential impacted soil or water, staff will consult with the Manager of Solid Waste to determine proper sampling requirements. • If required, the Manager of Solid Waste will notify the applicable regulators of the newly discovered impacts. • Contaminated materials will be disposed of in accordance with the Waste Management Plan.
Leachate Management	58. Complete leachate management activities per the Operations and Maintenance Manual (under separate cover).
Landfill Gas Management	59. Complete landfill gas management activities per the Operations and Maintenance Manual (under separate cover).
Waste Handling and	60. Appropriate waste disposal facilities for each waste type to be produced by the

Issue/Activity	Mitigation Measures
Disposal	project must be identified by the Manager of Solid Waste. 61. All waste leaving the site must be accompanied with an appropriate waybill, bill of lading or waste manifest. Consult with the Manager of Solid Waste to determine what type of paperwork is required. 62. Notify waste disposal facilities of waste shipments before leaving the site and determine if any there are facility sampling requirements. 63. All sewage and solid waste will be contained and sealed in watertight containers. 64. Tanks used for transporting greywater will be watertight and will be regularly and properly inspected and maintained by the operator.
Transportation	65. Vehicle use on public roads and project access routes will be in accordance with applicable laws and road use agreements (e.g., load restrictions). 66. Regularly inspect and maintain vehicles to keep them in proper working order. 67. Drivers must maintain an up-to-date transportation documentation system and carry the appropriate transportation documents (e.g., drivers licence, bill of lading, waybill, log book, etc.). 68. Vehicles will not exceed speed limits established for the area and will lower speeds in specific conditions such as areas of high erosion hazard. 69. Vehicles must yield to wildlife. 70. Personnel will avoid unnecessary wheel spin when travelling or operating on soil. 71. Do not necessarily idle vehicles or equipment. 72. Secure all loads with the appropriate tie-down equipment or load covers, and inspect the load immediately before commencing driving and once arriving at the destination. 73. If the load becomes unstable, immediately cease driving and re-secure the load 74. If a loss-of-load occurs, report the incident to the Manager of Solid Waste and seek guidance about the appropriate procedures moving forward. 75. If a vehicle or equipment breaks down during transportation, report the incident to the Manager of Solid Waste and seek assistance to fix the broken machinery. Do not operate the broken vehicle or equipment until it is in proper working order again. 76. If a vehicle or equipment get into an accident or encounters an accident during transportation, immediately contact the appropriate emergency services and report the incident to the Manager of Solid Waste. 77. Notify the Manager of Solid Waste of any noise complaints that may be received by project personnel, public agencies, or individuals.

Table 4-3: Mitigation Measures for Closure

Issue/Activity	Mitigation Measures
Work Areas	1. Project activities must occur within the approved workspace.
Work Schedule	2. Schedule closure and decommissioning activities to reduce interference with migratory bird restrictions and fish habitat timing restriction, as much as practical.
Reclamation	3. Complete reclamation of the work areas per the Closure and Decommissioning Plan (under separate cover). 4. Restore any trails used by traditional land users that were impacted by the project.
Debris Removal	5. Remove all debris and bins from the work area.
Drainage Control	6. Ensure activities do not obstruct natural drainage, where possible. If avoidance is not possible, facilitate drainage around the work area. 7. Grade to establish a minimum slope of 3% across the top of the waste fill area to

Issue/Activity	Mitigation Measures
	allow surface water drainage off-site and to discourage infiltration, leachate production, and erosion.
Erosion and Sediment Control* *: noted as a low ***potential activity of*** concern given local soil ***conditions.***	8. Erosion and sediment control activities shall be conducted in accordance with the Erosion and Sediment Control Plan (Appendix C). 9. Soil disturbance will only occur within the designated areas of the project. 10. Erosion and sediment control measures shall be installed before commencing excavations or work in areas susceptible to erosion. 11. If activities involve ground disturbance within 100 m of any watercourse or wetland, erosion control structures must be installed between the natural areas and the work areas to create separation of the work area, as required. 12. Erosion and sediment control measures are to be left in place, where feasible until all work is complete and the site has been stabilized. 13. Erosion and sediment control measures are to be routinely inspected and maintained in proper working order. 14. The City shall repair failed erosion and sediment control measures, as soon as possible. 15. Erosion and sediment control measures are not static and may need to be upgraded and/or amended, as directed by the Regulators, as site conditions change. 16. Topsoil handling will be suspended during high winds when soil and erosion is evident, and during heavy rains, if soil becomes saturated. Topsoil will not be handled until winds have decreased and/or topsoil has drained and dried. 17. If drifting soils or topsoil loss is evident in areas prone to wind erosion, conducting the following, as appropriate: • Suspend topsoil disturbing activities during high winds; • Apply a tackifier to the disturbed topsoil; and/or • Install wind barriers.
Fuel and Hazardous Material Storage	18. Hazardous materials must be labelled, stored, and handled according to WHMIS regulations. 19. Fuel storage containers and tanks will be appropriately labelled. 20. Adequate spill response materials are available and accessible at the site. 21. Fuel containers and filters must be stored in secondary containment. 22. Jerry cans and other mobile fuel containers must always be stored in secondary containment while being used and returned to the storage area, as soon as feasible following use. 23. Refuelling points and fuel storage tanks, including secondary containment and gas cans, will be inspected regularly. All leaks must be repaired immediately.
Equipment Refueling and Servicing	24. Regularly inspect and maintain all heavy equipment and vehicles used during site operations, including fuel transfer hoses and fuel/oil lines, to ensure that the systems are in good condition and free of leaks. Equipment or vehicles with deficiencies will be taken out of service and repaired. 25. Refuelling equipment will be attended at all times while refuelling. 26. Refuelling of equipment will not take place within 30 m of any wetland or watercourse. 27. Drip trays are to be in place while refuelling occurs to contain overfilling, drips and spills. 28. All vehicle servicing with the potential for accidental spills shall take place above an impervious tarp, and servicing will not take place within 30 m of wetlands or watercourses. 29. Spill kits should be accessible while refuelling.

Issue/Activity	Mitigation Measures
	30. Spill mats and/or drip pans/trays will be placed under all mobile fueling containers.
Spill Response, **Reporting and Notification**	31. Staff will notify the Facility Supervisor, as soon possible, following the discovery of a spill of any volume. 32. The Manager of Solid Waste will notify regulatory agencies and community liaisons where required to notify them of the spill. 33. A written spill report must be submitted to the Manager of Solid Waste within 24 hours of any spill. Inspect hydraulic, fuel and lubrication systems of equipment regularly to ensure that the systems are in good condition and free of leaks. 34. All fuel containers or filters must be stored in secondary containment. 35. Refuelling equipment will be attended at all times while refuelling. 36. Refuelling of equipment will not take place within 30 m of any wetland or watercourse. 37. Drip trays are to be in place while refuelling occurs to contain overfilling, drips and spills. 38. All vehicle servicing with the potential for accidental spills shall take place above an impervious tarp, and servicing will not take place within 30 m of wetlands or watercourses. 39. Spill kits should be accessible while refuelling. 40. Regular inspection and maintenance will be conducted for all heavy equipment and vehicles used for the project, including fuel transfer hoses and fuel/oil lines. Equipment or vehicles with deficiencies will be taken out of service and repaired. 41. Hazardous materials must be labelled, stored, and handled according to WHMIS regulations. 42. Spill mats and/or drip pans/trays will be placed under all mobile fueling containers and equipment and vehicles when not in use or parked for longer than two hours.
Air Emissions	43. Do not unnecessarily idle vehicles or equipment. 44. Ensure equipment is well maintained. 45. Notify the Manager of Solid Waste of any odour complaints that may be received by project personnel, public agencies, or individuals.
Noise	46. Ensure equipment and machinery is in good working order with proper noise abatement equipment (i.e. mufflers or enclosures).
Light Emissions	47. Lighting will be restricted to the minimum required to complete the works safely. 48. Lighting will be directed to the work area to reduce light pollution during dark hours to the extent feasible.
Wildlife Encounters and **Sightings**	49. Feeding or harassing wildlife is prohibited. 50. Travel within posted speed limits and yield to wildlife. 51. Report incidents of collisions or close calls with wildlife to the Manager of Solid Waste. 52. Notify the Manager of Solid Waste of the following wildlife sightings: • Any suspected species at risk or suspected species of special status, which are listed in Table 3-1; • Any dead or sick/diseased wildlife; and • Any food caches, dens, or nests found within or close to site. 53. The Government of Nunavut will be notified of wildlife encounters by the Manager of Solid Waste when required. 54. If previously unidentified listed or sensitive wildlife species or their site-specific habitat (e.g., dens, nests) are identified during operation, report the sighting to the Manager of Solid Waste and implement the Wildlife Species of Concern Discovery

Issue/Activity	Mitigation Measures
	Contingency Plan (**Section 6**.2).
Transportation	55. Vehicle use on public roads and project access routes will be in accordance with applicable laws and road use agreements (e.g., load restrictions). 56. Drivers must maintain an up-to-date transportation documentation system and carry the appropriate transportation documents (e.g., drivers licence, bill of lading, waybill, log book, etc.). 57. Vehicles will not exceed speed limits established for the area and will lower speeds in specific conditions such as areas of high erosion hazard. 58. Personnel will avoid unnecessary wheel spin when travelling or operating on soil. 59. Do not necessarily idle vehicles or equipment. 60. Ensure equipment and machinery is in good working order. 61. Secure all loads with the appropriate tie-down equipment or load covers, and inspect the load immediately before commencing driving and once arriving at the destination. 62. If the load becomes unstable, immediately cease driving and re-secure the load 63. If a loss-of-load occurs, report the incident to the Manager of Solid Waste and seek guidance about the appropriate procedures moving forward. 64. If a vehicle or equipment breaks down during transportation, report the incident to the Manager of Solid Waste and seek assistance to fix the broken machinery. Do not operate the broken vehicle or equipment until it is in proper working order again. 65. If a vehicle or equipment get into an accident or encounters an accident during transportation, immediately contact the appropriate emergency services and report the incident to the Manager of Solid Waste. 66. Notify the Manager of Solid Waste of any noise complaints that may be received by project personnel, public agencies, or individuals.
Leachate Management	67. Monitor and maintain the leachate collection and treatment systems regularly. 68. Implement appropriate system updates/upgrades, as necessary.
Gas Management	69. Monitor and maintain landfill gas collection and controls regularly. 70. Implement appropriate system updates/upgrades, as necessary.
Waste Handling and Disposal	71. Appropriate waste disposal facilities for each waste type to be produced by the project must be identified by the Manager of Solid Waste. 72. All waste leaving the site must be accompanied with an appropriate waybill, bill of lading or waste manifest. Consult with the Manager of Solid Waste to determine what type of paperwork is required. 73. Notify waste disposal facilities of waste shipments before leaving the site and determine if any there are facility sampling requirements. 74. All sewage and solid waste will be contained and sealed in watertight containers. 75. Tanks used for transporting greywater will be watertight and will be regularly and properly inspected and maintained by the operator.
Vegetation	76. Prepare the site in such a manner as to facilitate natural vegetation establishment.
Hazardous Material Monitoring	77. Before final grading and the installation of the site cover occurs, conduct a hazardous material assessment to determine if there is contamination on-site. The assessment should include air, soil, surface water and groundwater sampling. 78. Report any contamination to the Manager of Solid Waste and in the report describe the type, extent, degree, and approximate volume of the contamination. 79. Wear the appropriate personal protective equipment (PPE) while conducting hazardous material assessment.

Table 4-4: Mitigation Measures for Post-Closure

Issue/Activity	Mitigation Measures
Drainage Control	1. Monitor the final cover integrity and make repairs/additions, as appropriate. 2. Monitor the site for low areas resulting from soil settlement or subsidence of the site. Fill these areas with soil to restore the desired site topography, where appropriate.
Erosion and Sediment Control	3. Erosion and sediment control activities shall be conducted in accordance with the Erosion and Sediment Control Plan (Appendix C). 4. Monitor for erosion of topsoils and implement erosion control measures, where appropriate. 5. Monitor long-term erosion and sediment control structures and make repairs, as necessary.
Leachate Management	6. Monitor and maintain the leachate collection and treatment systems regularly. 7. Implement appropriate system updates/upgrades, as necessary.
Gas Management	8. Monitor and maintain landfill gas collection and controls regularly. 9. Implement appropriate system updates/upgrades, as necessary.
Vegetation	10. Maintain site vegetation and implement vegetation additions, removals, and cutting activities, where appropriate.
Hazardous Material Monitoring	11. Monitor surface water annually and report all incidences of contamination to the Manager of Solid Waste. 12. Monitor groundwater (active layer) for leachate and site contamination. Report all incidences of contamination to the Manager of Solid Waste. 13. Wear the appropriate PPE while conducting the site monitoring activities.

4.0 Site Specific Mitigation Measures

4.1 Erosion and Sediment Control Best Management Practices

As detailed in their respective EPPs, a range of best management practices (BMPs) can be implemented to minimize erosion and the mobilization of sediments during both Construction and Operations, Closure and Post-Closure Phases. The use of adequate erosion and sediment control measures will prevent or *reduce the potential of sediment transport both on-* and *off-site. The key to controlling potential erosion and sedimentation caused by site activities is to stabilize surfaces and control site runoff of surface waters. A wide variety of sediment control devices can be used on site with a selection of options being described in this section.*

An additional reference for potential use to mitigate erosion impacts associated with the Iqaluit solid waste management project is Government of the Northwest Territories Department of Transportation – Erosion and Sediment Control Manual (January 2013). This manual provides guidelines for analysis, *design, construction, and maintenance of erosion and sediment control systems for transportation construction projects in the Northwest Territories (NWT), but can be selectively applied (acknowledging the "Arctic Lowland" soils context of the project site) to construction and related activities in Nunavut. Notably, the manual includes Best Management Practice (BMP) summary sheets, incorporating concise descriptions of construction and maintenance requirements as well as installation details.*

4.2 Erosion and Sediment Control Feature Installation Locations – Construction Phase

Recommended locations for specific erosion and sediment control features to be established during the initial Construction Phase to establish the Landfill and WTS are presented on two sheets included on the original project tendering package; LF-C03 and WTS-*C03. Potentially, at the discretion of the City and depending on observed site conditions, a selection of these management feature locations could be maintained going forward into the Operations Phase. Further, depending on future site conditions and the details of requited decommissioning activities, erosion and sediment control practices presented in* this document could be incorporated into Closure and Post-*Closure activities.*

4.3 Surface Water Mitigation Measures and Best Management Practices

To prevent impacts to surface water resources at both the Landfill and WTS sites during the Project activities, the following BMPs should be implemented:

- Should there be overlap between site waterbodies and proposed work or access areas, retain existing riparian habitat along the waterbody where possible;
- Implement proven surface water management procedures at areas deemed susceptible to erosion, including:
    - Conduct sediment monitoring in relation to any project disturbances in or near water (e.g. in-stream construction).

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- Conduct TSS/turbidity monitoring routinely during in-stream works, per thresholds outlined in Canadian Water Quality Guidelines for the Protection of Aquatic Life and the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life.
- Controlled collection/direction of surface runoff.
- Minimization of exposed areas.
- Project activity timing (e.g., avoidance of storm events).
- Application of surficial stabilization measures.
- Surface roughening.
- Granular material stockpile control (e.g., limiting extend/number and maintain setback distance from sensitive receptors).

- Implement dust control measures to reduce the potential for dust accumulation in and around surface waters. The Project Authority (consistent with the applicable EPP as well as the Facility Operations and Maintenance Manual) should recommend the implementation of dust control measures, should it be observed that dry conditions are resulting in the airborne mobilization of fine soil particles.

The recommended BMPs that are to be employed as part of this ESC Plan include those that will be used to control surface flows from rain events and/or snowmelt which have the potential to result in erosion and ultimately sediment transport. A combination of BMPs, structural or procedural, will be implemented at each of the sites to provide the necessary level of erosion and sediment control.

Design considerations, guidelines, and procedures for the installation or implementation of BMPs are summarized below. For ease of reference, the recommended BMPs are separated into erosion control and sediment control measures.

4.4 Erosion Control Practices

Erosion prevention (source control) is essential and is the most effective method in protecting downstream/receiving aquatic habitat during the construction and operational activities. Erosion control typically includes two categories of action:

- *Source Control practices.*
  - *Protection of exposed surfaces using cover materials*
- *Runoff Control practices.*
  - *Modification of slope surfaces*
  - *Reduction of slope gradients*
  - Control of *flow* velocity
  - Flow diversion
  - Upstream runo*ff* storage

4.4.1 *Source Control Practices*

Riprap Armouring

- *Typical for channel lining with a geotextile underlay.*

3.1.1 Visual Monitoring Plan

The visual inspections will look for evidence of erosion, frost action, vegetation (changes including growth or stress), staining, seepage points, exposed debris, breeches, condition of monitoring instruments and conditions of any warning signage.

At the Landfill, regular visual inspections (i.e., weekly) will be conducted to check the physical integrity of the berms, leachate pond conditions, etc. while the landfill is in operation. Specifically, visual monitoring will be conducted during and following spring freshet and major rainfall events (i.e., greater than 10 mm rainfall within a 24-hour period).

A complete inspection of the leachate collection system elements (manhole, pump, hosing and holding ponds) shall be conducted on an annual basis.

Photographs will be taken to document the condition and substantiate the recorded observations. Pre-determined photograph locations will be established in the first year of monitoring, and these will be used to monitor future changes. At a minimum, photographs should be taken from each of these locations during each monitoring event.

Observations will be recorded, including dimensions and location of each feature and its extent using a differential global positional system (DGPS) unit, noting significant changes.

3.2 Soil Temperature Monitoring

Soil temperature monitoring documents the changing climatic conditions that may impact the integrity of the facility. Seasonal effects and annual trends will be collected and compared over the years to the initial design assumptions regarding permafrost depth and active layer variable thickness.

3.2.1 Soil Temperature Monitoring Plan

Data will be retrieved from each of the data logger stations installed at the Landfill (or retrieved by manual methods, monthly). Once the data is retrieved and confirmed to be retrieved by a second party, the memory of the logger may be deleted to make space for the following years' measurements. Additional manual readings will be taken from each of the four thermistor strings that were installed at the landfill facility, as shown in Error! Reference source not found. (attached).

The readings will be placed into a spreadsheet that converts the voltage readings to ^{0}C. The data will be compared with the anticipated design maximum and minimum assumptions for the facility location. Specifically, anticipated permafrost depth and active layer thickness will be recorded and compared to design assumptions. The data will be presented in a graph in the annual report.

Soil temperature monitoring locations are shown in Table 3-1.

3.4 Soil Sampling

Soil sampling would be conducted on an as-needed basis in the event of observed seepage at the landfill, and or based on site activities and observations at the waste transfer station.

When soil samples are retrieved, the results will be compared to baseline sample concentrations and CCME guidelines (Section 1.1.2). Results will be reported summarized and tabulated in the annual report to the City.

3.4.1 Surface Water Monitoring Plan

Surface water sampling will be conducted at pre-determined surface water sampling stations that have been identified below in Table 3-2 and are shown in Figure 1 and Figure 2. These sampling stations correspond with the sampling stations established during the baseline monitoring.

During the landfill operation stage, each station will be monitored monthly for field parameters including pH, temperature, conductivity, Dissolved Oxygen (DO) and turbidity using a field-calibrated multi-meter (e.g., YSI ProDSS Multi-parameter Water Quality Meter). Equipment calibration and operation should be conducted following the manufacturer's recommendations and/or specifications.

In addition to monthly monitoring for field parameters, surface water sampling during the twice-annual FMP will be analysed for:

- Field parameters as described above;
- PHCs Fractions F1 to F4, including BTEX;
- Total Metals;
- PAHs;
- Phenols; and,
- Major ions, hardness, total dissolved solids, total suspended solids.

Analytical results will be compared to baseline sample concentrations, applicable license requirements, and, the Canadian Council of Ministers of the Environment (CCME) Canadian Water Quality Guidelines (CWQGs), for the protection of freshwater aquatic life.

Surface water monitoring locations are shown below in Table 3-2.

Table 3-2: Surface Water Monitoring Locations

Facility	Monitoring Station ID	Easting (UTM83)	Northing (UTM83)	Monitoring Type	Monitoring Frequency
WTS	SW1	522504.900	7070955.410	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	SW2	522582.950	7070828.940	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	SW3	522652.770	7070728.700	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
Landfill	WS-100	521440.475	7076184.088	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	WS-101	520238.151	7076753.751	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	WS-102	520353.135	7076116.866	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	WS-103 (leachate discharge point)	TBD	TBD	Field measurements	None
				Field measurements + surface water samples	Twice per year (to characterize) and, upon discharge.

Notes:
TBD denotes To Be Determined, i.e., location to be established upon final design/construction. Approximate location shown in Figure 2.

The results will be compared to baseline sample concentrations, as well as the applicable License requirements (Section 3.10) and CCME guidelines (Section 1.1.2). Results will be reported summarized and tabulated in the annual report to the City.

3.5 Sediment Samplings

The natural drainage at both sites is influenced by the bedrock structure. Sediment samples are not a part of the facility monitoring program but may be introduced upon site closure or to whether surface water sample concentrations warrant further investigation. Sampling locations will correspond with surface water monitoring locations. Analysed samples will be compared to baseline/background samples, as well as the applicable CCME guidelines (Section 1.1.2). Results will be reported, summarized and tabulated in the annual report to the City.

3.6 Active Layer Groundwater Monitoring

Active Layer Groundwater sampling will be conducted at pre-determined groundwater sampling stations that have been identified, and are presented below in Table 3-3 and are shown on Figure 1 and Figure 2. These sample stations correspond with the sampling stations established during the baseline monitoring.

As detailed in Section 1.1.2, active layer groundwater results will be compared to the surface water quality guidelines, as the applicable exposure and migration pathways for this intermittent migration pathway are surface water receptors. Overland flow is the primary mode of water transport in the area. Active layer groundwater is not used as a drinking water source in Iqaluit, NU. The site lies within the continuous permafrost zone.

During the landfill operation stage, each station will be monitored monthly for field parameters, including pH, temperature, conductivity, Dissolved Oxygen (DO) and turbidity using a field-calibrated multi-meter. It is anticipated that these monthly sampling events will be limited to months when the active layer is thawed and groundwater is available (i.e., June to September).

In addition to monthly monitoring for field parameters, groundwater sampling during the twice-annual FMP will be analysed for:

- Field parameters as described above;
- PHCs Fractions F1 to F4, including BTEX;
- Metals;
- PFAS (WTS only)
- PAHs; and,
- Dissolved major ions (including alkalinity), hardness, total dissolved solids and total suspended solids.

Analysed samples will be compared to baseline/background samples, applicable License requirements, as well as the applicable CCME guidelines (Section 1.1.2). Results will be reported, summarized and tabulated in the annual report to the City. Groundwater monitoring locations are shown in Table 3-3.

Table 3-3: Groundwater Monitoring Locations

Facility	Monitoring Station ID	Easting (UTM83)	Northing (UTM83)	Monitoring Type	Monitoring Frequency
WTS	19MW-01	522597.930	7070755.780	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	19MW-02	522541.680	7070812.280	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	19MW-03	522945.780	7070726.690	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	19MW-04	522477.550	7070799.770	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	19MW-05	522493.750	7070873.090	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
Landfill	W-107	521118.485	7076109.874	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	W-108	520951.525	7075809.502	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	W-109	520669.000	7076331.199	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	W-110	520760.676	7076678.900	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year
	W-111	521441.000	7076739.000	Field measurements	Monthly
				Field measurements + surface water samples	Twice per year

3.7 Natural Environment Monitoring

Natural environment data will be collected as part of the facility monitoring program for both the WTS and the Landfill. This will include the following:

- *Observations of animal usage at the site (i.e., direct observations, tracks, feces, etc.); and,*
- Discussions with locals knowledgeable with the site regarding site usage.

A more detailed natural environment monitoring plan will be developed for the LTM upon site closure.

3.8 Effluent Discharge Limits

No direct discharge of effluent is anticipated to occur with currently planned site activities. Should seepage be identified or discharge events occur, the sample results will be compared against water quality criteria as defined under the Licence. As of March 2020, the City has elected to move forward with collection, containment, and characterization of the leachate during initial operation of the landfill. Preferable treatment methodologies will then be based upon the volume of leachate generated and chemical characteristics of the leachate under regular operating conditions.

As leachate is generated and pumped to the new holding lagoons, it is recommended that weekly sampling be undertaken for the first month, switching to monthly sampling afterwards. If the quality varies significantly, more frequent sampling should be undertaken to properly identify the raw leachate quality. The parameters that should be examined (at a minimum) are:

- cBOD;
- BOD;
- COD;
- TSS;
- TKN;
- TP;
- pH;
- Temperature;
- Total chlorine;
- Unionized ammonia;
- Total ammonia;
- Oil and grease;
- Total dissolved metals;
- Total metals;
- Total coliforms; and
- Fecal coliforms.

Should it be determined that storage volumes within the ponds are nearing design capacity, the City, in consultation with the Nunavut Water Board, will access contingency actions which may include transporting quantities of effluent via pumper truck from the site to either the West 40 landfill (e.g., controlled discharge through the existing waste mass) or the City's WWTP. The City WWTP (designed in 2016 and commissioned in 2019) was intended for processing organic loading, namely BOD and TSS. Based on typical leachate quality, this has a risk of upsetting the plant.

As secondary contingency (to be implemented only with the approval of NWB), a valved discharge manhole at the second storage pond will allow for the controlled release of effluent to a gravel bed diffuser. The implementation of the secondary contingency measure will necessitate additional surface water monitoring requirements at the Landfill site.

Table 3-4: Effluent Discharge limits as per the Water Licence (to be updated per Water License **Conditions)**

Parameter	Maximum Concentration of any Grab Sample (mg/L)
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD
TBD	TBD

Notes:
TBD denotes To Be Determined

3.9 Quality Assurance and Control Plan

The data quality objectives for this site are to produce a data set that is representative, and consistent in methodologies between sampling periods. A quality assurance and quality control (QA/QC) plan has been developed to meet these objectives.

3.9.1 Soil/Sediment Samples

Samples will be collected from test pits or sediments manually excavated with hand tools (shovel and/or hand shovel) which will be decontaminated between locations using Alconox and distilled water. Field personnel will use a new pair of Nitrile gloves for each sample station. Each solid sample will be collected in laboratory supplied containers that are specific for their analyses (i.e., metals/inorganics plastic bag, methanol vials and jars for organics). Jars will be filled with soil such that no headspace remains in the jars. Samples collected for analysis of volatiles (i.e., VOCs and/or BTEX) will be collected in two 40 mL clear glass vials with methanol for preservation.

Commitment 14
Leachate Management - Landfill
ECCC

12.0 Leachate Management

As discussed in ***Section 4.0***, *leachate is created as a result of operations at the Landfill and WTS. Dedicated collection and storage systems serve each location. Management requirements for both locations are discussed in the following sections. Sampling and analysis requirements associated with* leachate management are presented in ***Section 13.***

12.1 Waste Transfer Station

Leachate within the WTS is generated during the waste baling process, as liquid is squeezed out of the waste mass. This liquid is collected via a shallow trench in the slab around the perimeter of the baling unit, with the effluent subsequently being pumped to the 4500L sewage holding tank. The sewage *holding tank is XLPE polyethylene double wall construction. The secondary (outer) tank has 120% of the* capacity of the inner tank and serves as containment in the event of a leak or spillage. The tank is *equipped with an interstitial leak detector. As required, this liquid is collected and transported to the* City's WWTP for treatment.

A record of details related to the transport of leachate to the WWTP (e.g., date, and quantity and/or quality) shall be maintained at the WTS. At the request of the WWTP operator, a characterization of the WTS leachate will be conducted to ensure compatability with the facility's treatment process and infrastructure.

12.2 Landfill

The Landfill's leachate collection and management system, as described in **Section 4.2**, will initially incorporate several components, including the leachate collection layer/perforated pipe system within the disposal area liner system, collection sumps/manholes and retention and potential future bioreactor pond. For the first few years of landfill operations, leachate will be stored within the constructed pond system, allowing for the analysis of quality and quantity data towards defining a treatment system (potentially incorporating mechanical components) appropriate to the unique effluent characteristics of the Iqaluit site.

WARNING! LEACHATE IS POTENTIALLY HAZARDOUS. Take appropriate safety precautions when handling or working near leachate or when entering confined spaces, such as the use of protective clothing, breathing apparatus and ventilation.

For the initial system, primary operational requirements relating to leachate management at the Landfill include the following:

- As leachate is generated and pumped to the new holding lagoons, Dillon recommends that weekly sampling be undertaken for the first three months, switching to monthly sampling afterwards.
  - If the quality varies significantly, more frequent sampling should be undertaken to properly identy the raw leachate quality.
  - The parameters that should be examined (at a minimum) are:
    - cBOD
    - BOD
    - COD
    - TSS
    - Particle size distribution
    - TKN
    - TP
    - pH (field)
    - Temperature (field)
    - Total chlorine
    - Total phenols
    - Unionized ammonia
    - Total ammonia
    - Oil & grease,
    - Total dissolved metals
    - Total metals
    - Total coliforms
    - Fecal coliforms
- A summary of the landfill leachate management system activities shall be included in each annual report. This summary shall include, at a minimum:
  - Landfill leachate generation rates;
  - Leachate characteristics;
  - Holding pond capacity; and
  - Any updates to the leachate management system and/or leachate management activities.
- During the summer months (e.g., mid-June to mid-September), the leachate collection manhole will serve as a location for the extraction of effluent using a portable pump and hosing. During the period of operation, facility staff will be required to monitor effluent depths in the manhole, operating the pump as necessary.
- The pump hosing will direct leachate to piping which will direct flows to the lined ponds. The two ponds have been designed to provide approximately two years of storage, eliminating the need for discharge during the facility's initial operational period based on anticipated rainfall amounts. The pump will be powered by a small portable generator. Staff will bring the portable pump, hosing and

generator to the site each morning and energize the system. Before leaving the site at the end of the day, the equipment will be disconnected and returned to the WTS for storage.

- The manhole pump system will be operated during the period of the year when leachate is being generated and flows into the manhole. Daily assessment of leachate generation status (e.g., observations within the manhole) shall commence in the late spring, confirming when active pumping efforts should be initiated.
- A complete inspection of the leachate collection system elements (manhole, pump, hosing, holding ponds) shall be conducted on an annual basis.
- Should it be determined that storage volumes within the ponds are nearing design capacity as measured by water levels in the ponds and corresponding capacity chart, the City, in consultation with the NWB, will access contingency actions including transporting quantities of leachate effluent via pumper truck from the site to either the West 40 landfill (e.g., controlled discharge through the existing waste mass) or the City's WWTP. As a secondary contingency (to be implemented only with the approval of NWB), a valved discharge manhole at the second storage pond will allow for the controlled release of effluent to a gravel bed diffuser. It is acknowledged that it is anticipated that implementation of the secondary contingency measure will necessitate additional environmental effects (e.g., surface water) monitoring requirements at the Landfill site.

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WARNING! LEACHATE IS POTENTIALLY HAZARDOUS. Take appropriate safety precautions when handling or working near leachate or when entering confined spaces, such as the use of protective clothing, breathing apparatus and ventilation.

For the initial system, primary operational requirements relating to leachate management at the Landfill include the following:

14.0 Facility Records

Maintaining facility records is important for operational decisions related to both daily activities and long-term facility management. Copies of all records shall be kept at the WTS Office and up-to-date for inspection subsequent reporting purposes. The following records should be maintained as a minimum. It is noted that the daily and weekly checklists discussed in this section (and presented in Appendix A) provide an efficient and concise means to maintain an operational record:

1. **Incoming Material Quantities** – All materials entering the WTS are weighed before subsequent handling. A computerized database serves to consolidate all collected information by source and material type allowing for subsequent reporting. Weigh scale information can be used for determining waste compaction values, soil to waste ratios, trends in waste generation and general quantification of the waste stream.
2. Site Visitor Log – All visitors accessing the Landfill or WTS are to be registered in the site visitor log (see Appendix A). The logbook will be held at the Scale House.
3. Correspondence – A filing system shall be maintained to keep any correspondence associated with site operation.
4. Financial – Complete records of budget forecasts and actual expenditures must be maintained for the operation. This information is to be summarized in an annual report, as well as forecasts for the upcoming year.
5. **Site Operations Log** – The site log will consist of the daily and weekly checklists (see Appendix A), as well as periodic print-offs (i.e., monthly) of Scale House records. Other operations forms, including weather logs, waste inspection forms, complaint forms, can also be incorporated into the site log. It is recommended that the log itself take the form of a binder, allowing for the easy addition of documentation. The landfilling log will be held and maintained by the Manager.
6. Weather – Records relating to temperature, wind conditions and precipitation shall be recorded daily, using a standardized form (see Appendix A).
7. Liner – When landfill cell liner installation is required, a topographic survey of the base area shall be performed before liner construction. The area to receive the liner shall be graded according to the dimensions and elevations shown on the Engineering Drawings. Installation of the liner system shall be undertaken by personnel/firms experienced in the application of the specified materials. Installed sections of liner shall be tested for quality control, as indicated in the specification. Record engineering drawings of the area shall be prepared each time the liner is installed. Inspection records documenting quality control during liner installation shall be maintained by the City. A section of liner capable of accommodating one year of landfilling shall be installed at a minimum. The determination of timing requirements associated with the installation of the liner system is discussed in **Section 7.2**. A sketch of the location of landfilling, with respect to the liner, shall be developed on an annual basis.
8. **Compaction Control** – To monitor site operations on a yearly basis, overall compaction of the balefill shall be examined. A topographic survey of the active soil borrow area and the active Landfill area shall be conducted annually to determine the volume occupied. Survey drawings generated, as part

of this undertaking, shall provide an annual record of site development. Using the weigh scale records, as well as the overall degree of compaction of the balefill, shall be determined.

9. Landfill Cap – When an area reaches final design elevation, a topographic survey shall be conducted to establish final grade. Similar to the disposal area liner, the landfill cap installation shall be undertaken by experienced, qualified personnel with quality control testing being completed, as noted in the specification. All landfill cap installations shall include the completion of record engineering drawings. Other features that shall be noted on the record drawings including leachate collection system elements and surface water runoff ditches. The requirement to install or cap an area shall be forecasted at least 12 months in advance of design and construction for the cap.
10. Leachate Control – Documentation shall include leachate quality test results, sketches showing the progress of installation of the Landfill leachate collection network, leachate pumping and volumes. A record of dates, volumes and any testing data for baler leachate transported from the WTS to the City's WWTF (or other approved facility) shall also be maintained.
11. LFG Control – Documentation associated with the development of the gas vents (if deemed necessary) within the Landfill area, including locations of the gas vents/gas recovery infrastructure and data on periodic gas sampling, shall be maintained.
12. **Surface and Active Layer Water Monitoring** – A database of all surface and active layer (groundwater) monitoring results, including water quality and monitoring point integrity information, shall be maintained.
13. Bird/Pest Control – If control measures are undertaken, all activities are to be recorded on the daily and weekly checklists.
14. Reports – As directed by the Director of Engineering and Public Works, written facility reports shall be prepared by the Manager. Annual material disposal/diversion reports, based on site weigh scale records and in accordance with the requirements of NWB, shall also be prepared.

Commitment 16
Liner Installation Timing and Planning
ECCC

A license condition will be requested by the applicant to resolve this commitment

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

CITY OF IQALUIT

Operations and Maintenance Manual (Revised – Version 4.0)

Landfill and Waste Transfer Station

October 2020 | 19-9543 – Version 4.0

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1.0 Introduction

1.1 Background

The City of Iqaluit (City) is in the process of implementing its Solid Waste Management Strategy to service their near and long-term (75 years) municipal solid waste disposal requirements. Founded on a previously completed conceptual design and facility siting exercise, key elements of the project include a solid waste transfer station (WTS) within the immediate urban area of the City, where residential and commercial waste will be hauled to, processed, and compacted in bales, or in the case of waste wood and cardboard, shredded for use as a fuel source for an on-site biomass boiler. Tires, metal, and some construction and demolition (C&D) wastes will also be shredded and/or baled for landfilling or transported south for recycling. The resulting solid waste bales and possibly a smaller amount of unbaled C&D waste will be trucked to an engineered balefill landfill site (Landfill) located approximately six kilometres from the WTS.

The overall site locations are presented in Figure 1-1, with the layouts for the WTS and the Landfill being provided on Figures 1-2 and 1-3, respectively.

Other planned features of the WTS include a public drop off area for household hazardous wastes (HHW) and a vehicle logger/compactor unit; in both instances allowing for the preparation of waste materials before shipping to approved management facilities in the south.

The access road that will be used to reach the new Landfill has been designed by EXP Services Inc., who will also be providing Construction Contract Administration services for the establishment of the road. It is anticipated that the construction of the road will be included in the new Landfill and WTS Contractor’s scope of work.

To address their objectives, and following a competitive proposal process, the City engaged Dillon Consulting Limited (Dillon) to provide design and construction contract administration services to support the establishment of the WTS/baling facility and the engineered Landfill. The engineered Landfill will be designed for 75 years of operation but the construction/build portion of the project only the first stage of the Landfill (Stage 1 Operational Landfill) will be constructed (e.g., Cell 1 and ancillary components to meet requirements for an initial five years of operation).

Development of the proposed facilities is scheduled to commence in 2021, with facility commissioning occurring in 2023.

Commitment 17	Commitment 29	Commitment 38
New Technology/Lessons Learned	Fencing, Design Drawings (90%)	OMM
ECCC	CIRNAC	CIRNAC

Commitment 17	Commitment 29	Commitment 38
New Technology/Lessons Learned	Fencing, Design Drawings (90%)	OMM
ECCC	CIRNAC	CIRNAC

Figure 1-2: Waste Transfer Station Layout Plan

Figure 1-3: Landfill Layout Plan

1.2 Content

The Operations and Maintenance Manual addresses the following topics:

- Days and hours of operation
- Security and access control
- Staff and equipment
- Waste quantities and types
- Waste control
- Daily bale/waste placement
- Adverse weather conditions
- Initial life construction
- Nuisance control protocols, including litter, dust, noise, odour, birds, vector, vermin and wildlife
- Complaint response protocol
- Traffic control
- Fire prevention and response
- Surface water management
- Leachate management
- Landfill gas (LFG) management
- Inspection and maintenance program
- Record keeping
- Reporting
- Operations monitoring program
- Sample site logs and forms

The development of the site will be consistent with applicable regulations and policies for environmental protection. The facility has been designed with a composite liner system, leachate management system, surface drainage control and an environmental monitoring network.

It is noted that equipment-specific manufacturer's documentation, providing details on operational and maintenance requirements, is to be referred to along with the attached Operations and Maintenance Manual.

2.0 Facility Operations

2.1 Access Control

2.1.1 Hours of Operation

The City of Iqaluit Landfill and WTS is open Monday through Saturday, excluding holidays. The site is open to receive waste from 8:00 am to 4:00 pm Monday through Friday, and 8:00 am to 12:00 pm Saturday. Only the WTS will be accessible by the general public.

The site will be closed on the following holidays:

- New Year's Day
- Good Friday
- Easter Monday
- Victoria Day
- Canada Day
- Nunavut Day
- Civic Day (first Monday in August)
- Labour Day
- Thanksgiving
- Remembrance Day
- Christmas Day
- Boxing Day

Site equipment may operate beyond posted hours. The additional time may be necessary for processing of materials at the WTS preparation of the working area receiving waste and for other work defined by management personnel.

The operating hours are prominently posted on the entrance signs for both the Landfill and WTS, which also identifies the site name and the site telephone number.

2.1.2 Site Security

Due to the nature of the work undertaken at the Landfill and WTS, site security and safety is an important feature of the overall operation. Lockable gates are situated at various locations throughout both properties. As detailed on the Engineering Drawings, permanent 2.4 m chain link fencing is provided around the perimeter of the WTS property. At the Landfill, similar fencing will be established around the leachate holding ponds as well as Cell 1. As additional cells are constructed in the future, the fencing will be extended to contain active and previously developed portions of the Landfill. No trespassing signage will be affixed to the fencing at regular intervals. Fencing of both the leachate ponds and the Landfill will serve as an access deterant to wildlife and the public.

Keys/electronic access cards will be provided to persons employed by the City and directly involved with the operation of the WTS and/or Landfill, at the discretion of the Director of Engineering and Public Works or Manager of Solid Waste (Manager). A record shall be kept at the Scale House relating to who has keys, including contact name and phone number. A general visitor log (Appendix A) shall also be maintained at the Scale House.

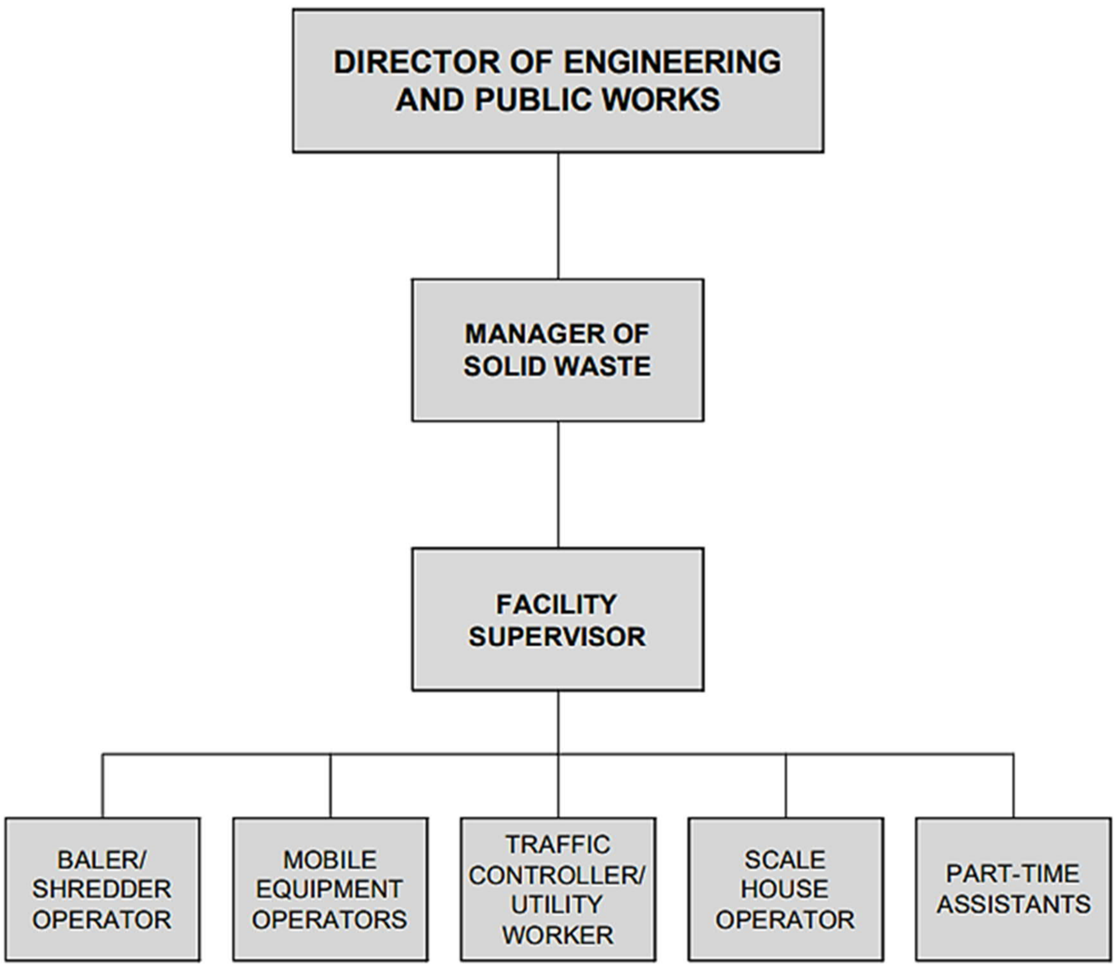
When either site is unattended, the gates will be closed and locked.

3.0 Personnel

3.1 Staffing

The Landfill and WTS will require full and part-time staff. In general, the facility requires a Manager, Facility Supervisor, Baler Operator, Mobile Equipment Operators, Scale House Operator, Traffic Controller/Utility Worker and Part-Time Assistants. An organization chart defining staffing and reporting responsibilities at the Landfill and WTS is presented in Figure 3-1. All employees will be properly trained in accordance with the tasks that they will be expected to complete.

Figure 3-1: Facility Organization Chart



A general outline of the minimum duties and responsibilities of each position follows. It is not intended to be comprehensive or to limit the employee's opportunity to expand their capabilities beyond this scope. It is also not intended to limit the employer's right to assign other duties. Further, it is anticipated that the City of Iqaluit will refine/revise staff member roles and responsibilities consistent with existing employment agreements and identified operational needs.

Generally, consistent with their duties, facility staff will be situated at the WTS during the working day. The exception to this will be when baled or C&D wastes require delivery/placement at the Landfill or when scheduled maintenance or operational activities are necessary at the site.

3.1.1 Director of Engineering and Public Works

The Director of Engineering and Public Works assists the City's Chief Administrative Officer (CAO) and the Manager of Solid Waste in planning and coordinating operation at the Landfill and WTS, as they relate to:

- Developing operational budgets.
- Preparation of annual reports.
- Technical operation.
- Environmental monitoring.

3.1.2 Manager of Solid Waste

The Manager of Solid Waste is responsible to the Director of Engineering and Public Works for the operation of the facility. The Manager oversees and coordinates day-to-day operations at the site.

Reporting Relationships

Reports to: Director of Engineering and Public Works
Supervises: Landfill and WTS Personnel

Maintains Liaison with: CAO
Municipal Engineer
Citizen's Monitoring Committee (as applicable)
Purchasing Manager
Accounting Personnel
Payroll Clerk
Suppliers
Contractors

Duties and Responsibilities

The Manager shall:

1. Perform operations at the facility per the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by Nunavut Water Board (NWB), and in consultation with the CAO.

2. Ensure that only acceptable wastes, as indicated on the approved list for disposal, are permitted at the site, in consultation with the CAO and regulatory agencies.
3. Prepare regularly scheduled reports on progress and planning at the facility.
4. With the assistance of the CAO, prepare facility operating budgets and undertake staffing selections.
5. Communicate (as required) with NWB, including the forwarding of monitoring results.
6. Deal directly with the public, responding to disposal requests.
7. Coordinate site visits/tours.
8. Provide overall direction for daily site activities, including equipment and staff utilization.
9. Maintain the environmental monitoring program.
10. Coordinate the environmental sampling programs.
11. Ensure that site staff receives the required training.
12. Make recommendations to the CAO for major and minor repair work required for site equipment, as well as replacement of same.
13. Ensure that the site is maintained and operated cleanly and safely at all times, including regular collection of litter.
14. Ensure that solid waste bales and C&D debris materials are placed at the Landfill per the Operations and Maintenance Manual (latest approved version), and in consultation with the Municipal Engineer.
15. Coordinate the preparation of balefill areas for operation, including stockpiling cover material, and identifying the requirement for composite liner installation and the establishment of surface water control measures.
16. Ensure that there is no open burning of solid waste at the facility.
17. Perform other related duties, as may be assigned periodically by the CAO.

3.1.3 Facility Supervisor

Under the direction of the Manager, the Facility Supervisor is responsible for equipment and general site maintenance requirements at the facility.

Reporting Relationships

The Facility Supervisor reports directly to the Manager.

Duties and Responsibilities

The Facility Supervisor shall:

1. Perform operations at the facility per the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Manager.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Manager and regulatory agencies.
3. Be responsible for the maintenance of the facility machinery, including mobile equipment, the solid waste baler unit, material shredder, vehicle logger and related systems.

4. Make recommendations to the Manager for major and minor repair work required for facility equipment, as well as replacement of the same.
5. Ensure that the facility is maintained and operated in a clean and safe manner at all times, including regular collection of litter.
6. In coordination with the Manager, ensure that solid waste bales and C&D debris materials are placed at the Landfill, in accordance with the Operations and Maintenance Manual (latest approved version).
7. Be responsible for snow removal on the access roads within the site and other areas, as necessary.
8. Maintain the access roads to ensure there is reasonable access within the site and to the active Landfill at all times.
9. Be responsible for operating and maintaining the leachate handling equipment, and surface water control structures and facilities at the Landfill and WTS.
10. Undertake site security checks and report any problems to the Manager.
11. Inspect the public roads/areas surround the WTS, the Landfill access road, and the Landfill to recover any accumulation of garbage or other debris.
12. Recommend to the Manager the need for bird control, rodent, animal and odour control.
13. Ensure that there is no open burning of solid waste at the site.
14. Maintain records of site equipment usage and maintenance.
15. In coordination with the Manager, maintain the integrity of completed landfill cells and borrow areas.
16. Perform such other related duties, as may be assigned from time to time by the Manager.

3.1.4 Baler/Shredder Operator

Under the direction of the Facility Supervisor, the Baler/Shredder Operator is responsible for operating and maintaining the solid waste baler unit, material shredder, vehicle logger and related systems.

Reporting Relationships

The Baler/Shredder Operator reports directly to the Facility Supervisor.

Duties and Responsibilities

The Baler/Shredder Operator shall:

1. Perform operations at the facility in accordance with the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Facility Supervisor.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Facility Supervisor.
3. Make recommendations to the Facility Supervisor for major and minor repair work required for the solid waste baler, material shredder, vehicle logger, and related systems.
4. Maintain an operational record for the solid waste baler, material shredder, vehicle logger and related systems.

5. Ensure that the tipping floor and baling floor is maintained and operated in a clean and safe manner at all times.
6. Periodically operate mobile equipment associated with site operations.
7. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.5 Mobile Equipment Operators

Under the direction of the Facility Supervisor, the Mobile Equipment Operators are responsible for operating and maintaining mobile equipment utilized for waste handling and disposal operations. At least two Mobile Equipment Operators will be on-site every day the facility is open to the public.

Reporting Relationships
Mobile Equipment Operators report directly to the Facility Supervisor.

Duties and Responsibilities
The Mobile Equipment Operators shall:
1. Perform operations at the facility in accordance with the Operations and Maintenance Manual (latest approved version), applicable Engineering Drawings and the Water License issued by NWB, and in consultation with the Facility Supervisor.
2. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Facility Supervisor.
3. Be responsible for the operation and routine maintenance of the site machinery.
4. Make recommendations to the Facility Supervisor for major and minor repair work required for site equipment.
5. Ensure that the site is maintained and operated in a clean and safe manner at all times.
6. Ensure that solid waste bales and C&D debris materials are placed at the Landfill, in accordance with the instructions of the Facility Supervisor.
7. Carry out activities for the maintenance and repair of access roads, snow removal, preparation of balefill areas, excavation and stockpiling of cover material, and the installation and/or repair of leachate collection and surface water control structures, as directed by the Facility Supervisor.
8. Advise the Facility Supervisor of the need for pest control.
9. Remove freon from refrigerators (and similar equipment) and specified liquids from vehicles, following applicable regulations.
10. Operate the HHW drop off facility.
11. Ensure that there is no open burning of solid waste at the site.
12. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.6 Traffic Controller/Utility Worker

Under the direction of the Facility Supervisor, the Traffic Controller/Utility Worker is responsible for directing the movement of vehicles delivering waste materials to the tipping floor within the WTS.

Reporting Relationships

The Traffic Controller/Utility Worker reports directly to the Facility Supervisor.

Duties and Responsibilities

The Traffic Controller/Utility Worker shall:

1. Direct incoming vehicles to the location on the tipping floor where solid waste is to be deposited.
2. Ensure that adequate signage and traffic control devices are in place in coordination with the Manager.
3. Direct the movements of waste delivery vehicles and their personnel within the transfer station compound to prevent conflicts with facility equipment operations.
4. Ensure that only acceptable wastes as indicated on the approved list for disposal are permitted at the site, in consultation with the Manager.
5. Segregate banned and salvageable materials noted on the tipping floor to designated storage areas.
6. Periodically operate mobile equipment associated with site operations.
7. Ensure that the area around the building and the tipping floor is operated in a clean and safe manner at all times, including regular collection of litter.
8. Perform such other related duties, as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.7 Scale House Operator

Under the direction of the Facility Supervisor, the Scale House Operator performs all duties related to the operation of the facility's scale component.

Reporting Relationships

The Scale House Operator reports directly to the Facility Supervisor or a designated member of staff.

Duties and Responsibilities

The Scale House Operator shall:

1. Identify and register vehicles within the computerized site database.
2. Manage the customer billing system.
3. Collect tipping fees from customers on-site.
4. Inspect incoming waste per the Operations and Maintenance Manual (latest approved version).
5. Answer incoming telephone calls and requests for information, directing such requests as required.
6. Monitor use of the public drop-off door at the WTS.
7. Clean and maintain the scale.
8. Perform such other related duties as may be assigned from time to time by the Facility Supervisor and/or the Manager.

3.1.8 Part-Time Assistants

Under the direction of the Facility Supervisor, the Part-Time Assistants are responsible for tasks assigned to them by a designated member of staff. These positions would typically serve to address periodic site maintenance requirements.

Reporting Relationships

The Part-Time Assistant reports directly to the Facility Supervisor or a designated member of staff.

Duties and Responsibilities

The Part-Time Assistant shall:

1. Perform duties as assigned by the Manager, Balefill Supervisor or a designated member of staff.

3.2 Training

Every Landfill and WTS employee will be trained to perform his or her job in a safe and environmentally responsible manner, following applicable regulations and City policy. Employees will be kept current with changes in regulations and technology through ongoing, comprehensive training courses, in such areas as regulations and the technical aspects of landfill operation. Specific training topics may include surface water control, leachate and LFG management, spill prevention, special wastes control, environmental monitoring and safety. A municipal employee's health and safety committee serves as a forum to identify potential concerns and define appropriate actions.

Continuing on-the-job training will be provided for all employees. The training will emphasize the safe and environmentally sound operation of the Landfill. A review of this Operations and Maintenance Manual will be a prerequisite for any employee before being declared eligible for work at the Landfill and WTS. All employees will be given safety training covering all equipment and systems, with which they will be expected to operate daily. The dangers associated with the use of protective equipment, methane (CH_4) gas and leachate handling, and the handling and precautions associated with special wastes, will also be included in the safety training. Documentation of the employee's participation in the safety and environmental training will be maintained in the employee's personnel file.

A training program for more specific tasks, such as those of the baler, shredder and mobile equipment operators, will be documented with written records of meetings and types of instruction. This instruction will include identification of special wastes and unacceptable wastes; emergency procedures in case of fire, spill or injury; confined space entry; respirator use and fit testing; and other issues that will periodically arise. All individuals must be trained in confined space entry and practice proper safety procedures, following applicable legislation and the requirements of the Nunavut Labour Standards Office. Documentation will also be kept on file at the Manager's office and reviewed annually for any necessary updates.

A general outline of some of the training that employees will require is found in Table 3-1. It is not intended to be a comprehensive list or to limit additional staff training, should legislation change, or limit the employer's or employee's right to require additional training.

Table 3-1: Staff Training Recommendations

Program	Manager of Solid Waste	Facility Supervisor	Equipment Operators	**Control/Utility** Worker	Scale House Operator	Part-Time Assistants

4.0 Site Structures

Primary structures associated with operations at the Landfill and WTS are illustrated in Figures 1-2 and 1-3. Infrastructure descriptions are subdivided as follows: 1) structures at/in proximity to the WTS are discussed in **Section 4.1**, and 2) structures associated with the Landfill are described in **Section 4.2**.

4.1 Waste Transfer Station

4.1.1 Facility Roads

The road network serving the WTS includes 1) Kakivak Court, acting as the main access route and connecting the site to Federal Road, 2) parking and maneuvering areas around the perimeter of the WTS, and 3) dedicated access to from the WTS compound to Qaqqamiut Road (as associated with the transport of baled waste to the Landfill). The perimeter of the WTS property is fenced with lockable access gates, situated at the Kakivak Court and Qaqqamiut Road entrances.

The facility roads/yard areas are private and their maintenance will be the responsibility of the City. Maintenance of the facility roads includes, but is not limited to, dust and mud tracking control, and snow removal/ice control.

4.1.2 Scale and Scale House

The Scale and Scale House are located southeast of the WTS Building. As described in **Section 8.2.1**, all vehicles entering the site are required to report to the Scale House. The Scale House, a premanufactured wood frame structure with electric heating, includes an elevated load inspection video camera and PC-based scale control/invoicing equipment. The Scale House entrance and exit ramps will have an asphalt surface.

4.1.3 WTS Building

The WTS Building is a pre-engineered, steel, slab on grade structure with a total floor area of approximately 2,400 m^2. With reference to Figure 4-1, the interior of the building is divided into five primary areas: 1) the **tipping floor** is used to allow haulage vehicles to discharge their loads within an enclosed area – it also includes a wall opening to allow for public drop off of refuse materials; 2) the baling/bale loading area is where the waste is compressed into wire-tied and plastic-wrapped bales and transferred to the flatbed transport truck; 3) select materials are processed and stored in the shredder area; 4) end of life vehicles are prepared for compaction at the **car and truck lift area**; and 5) a variety of control systems and equipment, including a biomass boiler, are located in the mechanical/electrical area.

Due to the nature of operations, the concrete walls extend upward from the slab in the tipping floor portion (southwest corner) of the building. The tipping floor's concrete walls are 2.4 m high, permitting storage of solid waste against the inside of the building and allowing for a smooth durable surface to work against. The concrete walls around the remainder of the interior perimeter are 1.2 m in height to provide impact protection to the building structure from mobile equipment.

Due to issues associated with clogging and an objective to minimize the number of slab penetrations, there are no floor drains within the interior of the WTS; interior slab slopes are typically towards exterior overhead doors. Liquid on the floor (primarily from incoming waste and hauling vehicles) is continuously monitored by facility staff, using the absorbent capacity of the waste, as required. Cleaning of the floor via sweepers and other means is conducted, as required.

A source of liquid generation at the WTS is the waste baler where liquids are squeezed out of the waste as the baler compacts the waste. The volume generated is variable and dependent on the moisture content of the waste and snow/ice that may be attached to the delivered waste Liquid from the baler would collect in the shallow trench around the baler and flow to a sump where it is pumped to a 4500 l tank for subsequent, testing if required, collection and transfer to the City's wastewater treatment plant (WWTP).

Mechanical and electrical features of the WTS building include the following:

- Interior heating requirements (using a hydronic system) are met using a biomass boiler that uses shredded as fuel. Back up requirements for select interior areas of the WTS will be provided by a No.2 fuel-fired hydronic heating unit. A 4,880 L double-wall aboveground tank situated outside the building provides fuel for the back-up unit.
- Exhaust fans serving the interior of the WTS to provide general ventilation and achieve interior air quality requirements.
- Select use of radiant heaters in defined locations to address equipment requirements and to prevent the freezing of waste.
- Provision of interior fire protection, using a sprinkler system with a dedicated on-site water tank inside a fire-protected room within the WTS.
- Water for interior building maintenance and equipment requirements addressed with an on-site storage tank. Staff washroom and shower facilities are located at the Site Office.

4.1.4 Site Office

A wood-framed, premanufactured building, situated adjacent to the Scale House, serves as the Site Office. The building incorporates staff facilities, including the Facility Supervisor's office, a lunchroom, a locker room and washroom/shower facilities. The building will be heated using an oil-fired, forced air furnace, and will be serviced with a water and wastewater tank.

4.1.5 Household Hazardous Wastes Depot and Storage

Steel intermodal ("seacan") containers, modified to address storage requirements for receiving HHW materials, as well as one pre-fabricated container specifically constructed as an HHW storage container with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent)are situated in the southwestern area of the WTS yard. One 12 m (40 ft) container serves as a public drop off location, where a trained staff member records incoming quantities and directs the materials to an appropriate initial storage location. As required, materials from the Drop Off Container are directed to one of the 12 m storage containers or the purpose-built HHW building with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent). Arrangements are made by the City for subsequent shipping to approved-management facilities in the south, as quantities warrant.

4.1.5.1 Household Hazardous Wastes Acceptable Materials

It is recommended that following wastes not be accepted for landfilling or recycling and instead be considered Household Hazardous Waste (HHW). Please note that this list is not exhaustive and is subject to change per City of Iqaluit and/or Government of Nunavut guidelines, :

- Alkaline batteries
- Button cell batteries
- Rechargeable batteries
- Lead-acid batteries
- Fluid paints, stains, varnishes, and oil paint products
- Empty paint, stain, varnish, and oil paint product cans
- Varnish remover
- Cleaning chemicals and disinfectants (i.e. toilet cleaner, oven cleaner, drain cleaner)
- Antifreeze/radiator fluids
- Bleach
- Brake fluid
- Pesticides/insecticides/rodenticides
- Herbicides/weed killer
- Chemical lawn fertilizers
- Insect repellants
- Gasoline
- Fuel oil
- Used oil products
- Solvents and thinners
- Pharmaceuticals and drugs (or return to pharmacy)
- Aerosols and empty aerosol cans
- BBQ propane tanks
- Camping fuel cylinders
- Oil tanks

- CFL and fluorescent light bulbs
- Fluorescent lighting ballasts manufactured before 1980
- Thermostats
- Household thermometers (mercury-containing)
- Residential fire extinguishers
- Any products labelled as corrosive, toxic, reactive, explosive, oxidizing, poisonous, infectious, or flammable
- Any product or container labelled as follows:

Reactive | Poisonous and **Infectious** | Oxidizing | Flammable and **Combustible** | Corrosive | Compressed Gas

4.1.5.2 Household Hazardous Waste Non-Acceptable Materials

The following materials are not accepted as HHW:

- Electronics
- Sharps and other household medical waste

4.1.6 Exterior Material Process and Storage Areas

The exterior yard area (gravel surface) includes equipment and locations for the processing and temporary segregated storage of select materials, including:

- Vehicle Baler/Logger unit (trailer-based).
- End of life vehicles awaiting decommissioning/crushing, crushed vehicles and salvageable metals.
- End of life vehicle and equipment tires.
- HHW intermodal containers.
- HHW 40’Lx12’D, 4-compartment, built in accordance to FM 6049 Standards (Loraday Model LEP/L73-4013 Storage Container or equivalent)
- Baled waste (to address short-term instances when direct transport to the Landfill is not possible).
- A dedicated area for the potential future installation/operation of an in-vessel organics composting unit (including a curing area allowance).
- A dedicated area for the potential future development of a greenhouse.
- Snow storage areas to support yard clearing efforts.

4.2 Landfill

4.2.1 Landfill Access Road

A two-lane, gravel-surfaced road connecting the existing Qaqqamiut Road to the Landfill site is being established by the City as a component of the Landfill and WTS project. The road will also provide access to the Northwest Aggregate Deposit, situated to the west of the landfill property.

With reference to Figure 1-3, two roads will extend off of the Northwest Aggregate Deposit road to access features of the Landfill;

- Main Landfill access and perimeter road.
- Leachate management system access road.

Lockable security gates are situated at the entrance of each access road, complete with identification signage. As new landfill cells are established, the perimeter road will be extended, as necessary. All site roads are two-lane and gravel-surfaced.

4.2.2 Landfill

A 22 ha area on property approximately 5.5 km north of the WTS has been designated to serve as the disposal location for the City's baled municipal solid waste (MSW), select processed materials (e.g., tires, bulky items) and non-divertible C&D waste materials for 75 years. A primary design feature of the Landfill is the use of a membrane liner system with a dedicated leachate collection layer within the defined landfill footprint. The liner is scheduled to be installed in 12 (number to be refined during the operational life of the facility) sequential sections or "cells" throughout the operational life of the site. As part of the initial construction effort for the Landfill (scheduled for the 2021, 2022 and 2023 construction seasons), the first landfill cell, with a total area of approximately 2.3 ha, is to be installed. Cell 1 has been designed to address the City's disposal requirements for approximately the first five years of operation.

Detailed discussion on the Landfill liner system is provided in **Section 7.0**. A description of waste placement procedures at the Landfill is presented within **Section 8.3**.

4.2.3 Cover Borrow Area

Cover material required to support Landfill operations, including bale/waste covering and final grading, is scheduled to be acquired from the Northwest Aggregate Deposit.

4.2.4 **Attendant's Trailer**

A premanufactured, wood frame trailer will serve as a shelter for site personnel while they are at the Landfill. The trailer will include a wood stove and a composting toilet. No equipment will be stored within the trailer due to the remoteness of the location, and the potential for theft and/or vandalism.

4.2.5 Leachate Management System

The Landfill's leachate management system includes a leachate collection layer/piping within the cell liner, a collection sump with extraction manhole, a portable pump complete with mechanical float control discharge hosing/discharge piping, two retention ponds (with the ability to convert into bioreactors). Acknowledging significant uncertainties regarding the quality and quantity of leachate that will be generated by the landfill (e.g., the unique situation of having plastic wrapped waste bales in an arctic setting), the initial leachate management system will consist of collection and storage infrastructure only. The landfill operator will install the pump and generator each day during the warm season, and the pump will operate on/off based on the float. At the end of the day the operator will remove and store the generator and pump.

The portable pump, located in the manhole, will be conrolled by portable floats in the manhole, which is in the cell sump. The allowable head would be equal to the depth of the sump of 1.0 m or approximately 300 mm over the floor of the cell.The leachate head in the landfill sumps will be measured by a staff gauge bolted (SS316 bolts) to the interior of the manhole. If required, the gauge can be removed at the end of the pumping season to prevent damage. Incase the staff gauge is missing a tapemeasue can be used to appeoximate the depthof leachate. Hoses would not be used for leachaete pumping, Flanged and bolted solid wall HDPE piping would be installed at the start of the season and removed and stored at the end of the pumping season.

The volume of the ponds has been established based (conservatively) with the objective of providing two years of leachate effluent and precipitation storage capacity. By assessing generation rates and effluent characteristics during the initial operational period of the landfill, it is believed that an economic treatment system appropriate to the unique conditions of the City of Iqaluit site can be designed and subsequently installed as part of a future initiative. As the ponds are lined with HDPE a HDPE staff gauge as presented in the design drawings would be welded to HDPE liner on the inside slope of the ponds.

Four sumps, located in Cell 1, Cell 4, Cell 7 and Cell 10, are proposed in the landfill. The Cell 1 sump would receive leachate from from Cells 1, 2 and 3. When Cell 4 is constructed the temporary berm between Cell 1 and Cell 4, as illustrated on Drawing LF-C15, would be removed and leachate in Cells 1 to 3 would flow toward the Cell 4 sump. The removal of the berm is necessary as the Cell 1 sump is located in the north of the cell and will be covered with waste as waste is placed in Cell 4. Cell 4 would receive flow from Cells 4, 5 , 6 and from Cells 1 , 2 nd 3. Cell 7 would accept flow from Cells 7, 8 and 9. And Cell 10 handles Cells 10, 11 and 12. For the sump in Cell 10 false grading is required to eliminate the low pount north of the sump so that leachate can be directed into the sump as illustrated on Drawing LF-C15.

Additional information on the leachate management system, including contingency measures, is presented in **Section 12**.

4.2.6 Monitoring Network

The development of the Landfill and WTS included the establishment of defined monitoring locations for surface water and active layer/groundwater. With regards to potential impacts of landfill infrastructure to permafrost, a thermistor array is situated in the base of the liner systems for both the landfill and the leachate treatment system ponds.

Details on the monitoring network and the overall monitoring program are presented in the latest version (under separate cover) of the Landfill and WTS Facility Monitoring Program (FMP).

5.0 Mobile Equipment

Mobile equipment selection has been based on the evaluation of the operational functions to be performed, including activities within the WTS, within the WTS yard and at the Landfill. Beyond waste handling related activities, other mobile equipment use requirements include access road maintenance, snow removal and dust control. Equipment used as part of site operations is owned by the City. The listing of recommended site equipment is as follows:

1. Wheel Loader
   - 150 - 160 HP, diesel.
   - Provided with quick-detach forks, grapple bucket, plow blade, general-purpose bucket and landfill package.
   - For waste handling in the WTS yard, bale/waste placement at the Landfill, snow removal and road/yard maintenance.
2. Compact Wheel Loader
   - 110 – 120 HP, diesel.
   - Provided with quick-detach forks, grapple bucket, waste handling bucket (complete with rubber leading edge), plow blade, solid tires, transfer station package.
   - Waste/bale handling within the WTS, snow removal and yard maintenance.
3. **Forklift**
   - Electric.
   - 2500 kg lifting capacity.
   - Bale handling within the WTS including loading of the Bale Truck.
4. Bale Truck
   - 350 HP, diesel.
   - Tandem straight truck, flatbed.
5. Vehicle Baler/Logger
   - 175-215 HP, diesel.
   - Trailer-based unit.
   - Provided with hydraulic landing gears, knuckle boom material handler, bale density 400 to 1300 kg/m^3.
   - Crushing and baling end-of-life vehicles, white goods and miscellaneous metals.
6. Portable Tire Shear
   - 25-35 HP, gasoline.
   - Trailer-based unit.
   - Minimum 3000 psi hydraulic rating.
7. Staff Truck
   - 4 x 4 Crew Cab, Super Heavy Duty.
   - Provided with snowplow attachment.

In addition, back up equipment will be available from local rentals and contractors, should anomalous situations dictate the need for additional equipment. Routine maintenance and cleaning will be performed (as necessary) to keep equipment in good operating order.

A maintenance program exists for all on-site equipment and is to be performed following the equipment manufacturer's guidelines. The City holds contracts with heavy equipment suppliers to provide all scheduled maintenance. Daily routine maintenance activities will be the responsibility of the mobile equipment operators. Routine activities will include (but not be limited to) the following:

Tires

- Check for debris embedded in the tire, repairing or replacing, as necessary.
- Check tire wear condition.

Air Filters

- Check for dust clogging and replace, as necessary.

Radiators

- Check for dust and debris clogging and clean, as required.
- Check for punctures and repair or replace, as necessary.

Undercarriage

- Check for damage and repair, as required.

Hydraulic Lines

- Check for wear points, cracks and fitting leaks, replacing, as necessary.

6.0 Stationary Equipment

The following list identifies stationary equipment associated with waste processing activities within the WTS:

1. Waste Baler
   - Two ram configuration.
   - Peak throughput = 20 tonnes/hour.
   - Dual hydraulic pumps, 600 VAC 60 Hz electric TEFC motors.
   - Dedicated above floor conveyor.
   - Automatic wire tier.
   - Complete with bale wrap system.
2. Waste Shredder
   - Stationary, low speed, high torque unit.
   - 30 HP electric drive motor, 460 VAC 60 Hz.
   - Suitable for MSW including wood pallets, furniture, select C&D materials and old corrugated cardboard (OCC).
   - Direction of processed material to either the Biomass Boiler (wood and OCC) or the Waste Baler for disposal at the Landfill.

Further information, including operational and maintenance requirements for the baler, shredder and other equipment/systems supporting WTS operation (e.g., biomass boiler/heating system, ventilation system, fire suppression system, electrical/control systems) is provided in manufacturer documents.

Manufacturer's information should be reviewed in detail by facility personnel before use, maintenance or repair.

7.0 Liner Development and Sequencing

7.1 Landfill Liner System

The four primary components of the landfill liner system, from the top down, consist of a leachate **collection layer**, a geomembrane liner, cushion layer and a base layer. These components are described below. Refer to Figure 7-1 for a typical schematic of the composite liner system.

Leachate Collection Layer

The leachate collection layer consists of a granular layer (38 mm clear stone) with a total thickness of 600 mm and perforated HDPE collection piping. The perforated collection piping is placed at the bottom of the collection layer to collect and direct leachate to the collection sump.

Geomembrane Liner

A flexible geomembrane liner (80 mil textured HDPE) is situated under the leachate collection layer, as the primary barrier to leachate migration. The top and bottom of the flexible membrane liner are protected with non-woven geotextile.

Cushion Layer

The cushion layer, 200 mm of designated fill material, provides the top working surface of the landfill cell and offers protection (e.g., vehicle/equipment movements, waste puncture hazards) to the underlying Leachate Collection Layer.

Base Layer

The entire liner system is constructed on an engineered base. The native material at the site will be graded, and a 200 mm thick granular grading pad will be placed over the native material. Additional compacted soils will be placed at the site, where required for grading. Where possible, a 1.5 m separation distance from the underside of the geomembrane and the seasonal high groundwater table.

To monitor potential impacts of the liner system to permafrost, a thermistor array is situated within the base layer.

Where required for soil separation, a geotextile will be placed below the base.

7.2 Liner Installation Sequence

The overall defined landfill footprint to accommodate 75 years of operation is approximately 22 ha in size. Within that footprint, a total of 12 disposal areas or cells (to be confirmed during site development) have been identified. The first designated cell in the overall sequence, Cells 1, is scheduled for installation during the 2021 and 2022 constructions seasons.

Timing the installation requirement for the next lined area in the sequence is critical. Installation can only be practically completed during the non-winter months and adequate time must be allotted for the development of design documents, tendering and delivery of construction materials. The calculation to determine this timing is linked to defined bale placement requirements. Specific aspects of bale placement are discussed in detail in **Section 8.3**.

Tracking of disposal area utilization is the responsibility of the Manager. The primary elements of the installation timing calculation are as follows:

1. Referring to the Engineering Drawings, determine the remaining space (volume) available for the placement of bales. This estimate must incorporate bale placement requirements including perimeter side slopes and the pre-defined lift installation sequence. For example:
   - Remaining Volume (Vr) = 6,240 m^3
2. Confirm the number of bales of waste per week currently requiring disposal. If significant changes to the current volume of incoming waste are anticipated (i.e., accepting material from a new service area), then this value should be adjusted accordingly. Based on an average bale volume of 1.5 m^3, calculate the weekly bale disposal volume requirement. For example:
   - Bale Volume Requirement (Vbr) = 120 m^3/week
3. Divide the estimate of remaining balefill volume (1) by the weekly bale disposal volume requirement (2) to determine the number of remaining weeks of disposal space. For example:
   - Vr/Vbr = 6,240 m^3/(120 m^3/week)
   - = 52 weeks

If it is determined that inadequate space is available to serve operations until late the following summer (i.e., August), then actions will need to be initiated towards the design and installation of the next lined disposal area in the sequence. For example, if the above sample calculation was completed in January 2024, the expectation would be that available balefilling space would be exhausted 52 weeks later in January 2025. Therefore, construction of the next disposal area would be necessary during the summer of 2024.

8.0 Waste Receiving, Placement and Sequencing

8.1 Types of Waste

8.1.1 Acceptable Wastes

Any waste disposal option has limitations with respect to the waste streams which may be handled in an environmentally safe manner. Limits must be placed on the types of waste accepted at a municipal disposal site, to protect the environment, the employees, the users and neighbours, as well as the equipment from damage, while simultaneously providing adequate levels of service.

The Manager shall allow only those materials to be accepted (for processing and/or disposal) at the Landfill and WTS, except for unique circumstances reviewed in consultation with NWB, for which the facility has been designed to accommodate, namely, MSW. Referencing the Environment and Climate Change Canada (ECCC) document Solid Waste Management for Northern and Remote Communities, Planning and Technical Guidance Document, MSW is defined to include "reusables, recyclables, compostables, and residual waste (i.e., garbage) from homes, businesses, schools, and other *institutions."* Concerning the IWMF, this definition includes end-of-life vehicles, large appliances, salvageable metals, furniture, passenger vehicle tires, and C&D materials

The following materials may be received at the site; although, none of the items listed is considered **suitable for routine baling/disposal**. As a result, the Manager will specify in each case an appropriate disposal method and location. The Manager reserves the right to limit the amount of these materials received at any one time, or to define the material as non-acceptable waste and to specify management requirements.

1. Contaminated soils meeting the acceptance requirements of NWB Analytical test results for all candidate materials will be evaluated by the City and NWB. No material will be accepted for disposal until this evaluation has been completed. Subsequent management requirements for accepted soils will be defined on a case-by-case basis, in consultation with NWB.
2. Non-hazardous incinerator ash, fly ash and wood ash when properly quenched and cooled. Large **quantities of ash may require special pre**-treatment before being accepted at the site and may require special disposal methods.
3. Electrical transformer casings on the condition that all oils have been removed consistent with applicable regulations and that the units have been rendered free of potentially hazardous materials. Salvageable casings will subsequently be held at the site's dedicated metals storage area.
4. Biomedical waste originating from human and animal health care facilities, providing it has been autoclaved or incinerated and is packaged according to the Government of Nunavut Environmental Guideline for Biomedical and Pharmaceutical Waste (dated March 2014 or as amended).
5. Carcasses of animals weighing less than 25 kg.

All wastes not specifically fitting into the above categories, and not specified as unacceptable, will be referred to the Manager and NWB for recommendations as to their acceptability and appropriate disposal methods.

8.1.2 Non-Acceptable Wastes

Wastes, which present a danger to the public, staff, infrastructure or the environment at the WTS or Landfill, which require special disposal techniques, and which may interfere with the level of service to the public or are in contravention with regulatory stipulations, are not acceptable for disposal. In some cases, wastes which are acceptable in small quantities may not be acceptable in large quantities from a single generator because they may cause the level of service to other users to deteriorate and cause handling problems at the site, and increased environmental liability. To some extent, the acceptability of large quantity wastes must be at the Manager's discretion, depending on the ability to accommodate disposal without deterioration in the level of service. In cases where unacceptable wastes are identified, site staff will attempt to identify allowable management alternatives to material haulers.

All wastes which pose potential safety or environmental problems cannot be listed in their entirety. The Manager and site personnel, in general, must be wary of accepting wastes which could cause future operational problems and must watch for the inclusion of unacceptable wastes in regular loads of refuse.

A list of materials which MAY NOT be accepted at the Landfill or the WTS are as follows:

1. Explosives or highly combustible materials of any nature.
2. Gas cylinders, unless the valve has been removed and the cylinder properly drained by a professional trained in handling gas cylinders.
3. Radioactive materials.
4. Chemicals and chemical wastes, including sludges from water and wastewater treatment plants and other generators.
5. Any hazardous materials, which may be classed as corrosive, reactive, toxic or flammable.
6. Carcasses of animals weighing more than 25 kg.
7. Liquid wastes, including herbicides, insecticides or other sprays, paints, oils, and solvents.
8. Septic tank waste and sewage treatment plant sludges, unless a facility is specifically designed for their disposal or they have been pre-treated following the requirements of the Nunavut Water Board and/or other relevant regulatory authority.
9. Fish/meat processing wastes.
10. Hot ashes.
11. Any liquids, or liquid waste, of a quantity greater than 5 L in any one load.
12. Dangerous goods as defined by the *Nunavut Consolidation of Transportation of Dangerous Goods* Act (e.g., poisonous substances, infectious substances, oxidizing substances).

13. Biomedical wastes that are not treated before disposal according to the Government of Nunavut Environmental Guideline for Biomedical and Pharmaceutical Waste (dated March 2014 or as amended).
14. Any other materials not listed as acceptable or conditionally acceptable with the approval of the Manager.

8.2 Waste Receiving and Processing

8.2.1 Waste Inspection and Control

All waste arriving at the WTS is subject to inspection for unacceptable materials (see **Section 8.1.2**). Inspections shall be conducted at the Scale House and on the tipping floor of the WTS. It is the responsibility of employees at the Landfill and WTS to be aware of acceptable wastes, and those that are unacceptable or hazardous to the staff and the general public.

The first opportunity for waste inspection and control at the WTS occurs at the Scale House, where the following procedures shall be employed:

- All incoming vehicles are required to report to the Scale House. Small, private residential haulers (i.e., cars or ½ ton pickup trucks) are directed to the small vehicle drop-off area located on the south wall of the tipping floor. Larger residential-source loads (i.e., ¾ ton pickup trucks, trailers) and all commercial waste haulers are weighed, charged based on the standard per tonne tip fee, and directed to the tipping floor for disposal.
- At the Scale House, all incoming loads are recorded using a computer-based tracking and billing system. Information collected includes waste type, origin and weight. Scale information is collected for materials destined for the WTS tipping floor, WTS material segregation areas and the Landfill.
- Incoming waste is subject to visual checking at the Scale House at the direction of the Facility Supervisor. A high-mounted video camera is provided at the Scale House for spot checks.
- The Scale House Operator shall advise the Facility Supervisor of any observed unacceptable waste.

The second opportunity for waste inspection control exists on the WTS tipping floor:

- Equipment operators and other staff will remain vigilant for unacceptable or potentially hazardous wastes during unloading, conveyor loading, and baling.
- All site operations personnel shall receive training to assist in recognizing unusual, unacceptable and hazardous wastes.
- When a staff member encounters suspect waste on the tipping floor, baling shall cease until the material is segregated and appropriate action (as identified in the **Section 8.2.2**) is taken. The procedures outlined in the facility's Emergency Response Plan (ERP) (see Appendix B) may apply if the waste is suspected to be hazardous.

In addition to these methods, thorough random checks may be performed on the tipping floor at the discretion of the Facility Supervisor:

- The Scale House Operator will inform the hauler that a random check is to be performed. If the hauler refuses, the vehicle will not be permitted entry to the site and will be selected for a check on its next visit. The Scale House Operator will record, as much information as possible, about haulers who refuse a random check.
- The selected hauler will be directed to an area on the tipping floor that is separate from all other incoming waste. Before dumping, the driver of the inspected vehicle will confirm the absence of unacceptable materials. An inspector (the Facility Supervisor or a designate) will examine the load for hazardous or unacceptable wastes.

8.2.2 Handling Unacceptable Waste

Unacceptable wastes may be classified as non-hazardous, potentially hazardous or unacceptable, and, depending on the time of discovery, may or may not be associated with a known hauler. The following outlines appropriate procedures for handling unacceptable waste:

- Non-hazardous, unacceptable waste delivered by a known hauler will be reloaded by the hauler, if necessary, and removed from the site.
- Non-hazardous, unacceptable waste delivered by an unknown hauler may be removed from the site, processed to render it acceptable, or accepted as a special circumstance at the discretion of the Manager.
- Suspected hazardous (and therefore unacceptable) waste delivered by a known hauler will be reloaded by the hauler, if necessary, and removed from the site. The responsible site staff will complete a Waste Inspection/Attempted Delivery of Hazardous Waste Form, included in Appendix A, and inform NWB of the attempted delivery.
- If reloading or further transporting of the suspected hazardous waste is considered unsafe, NWB will be contacted for direction. Costs associated with the attempted delivery will be borne by the hauler and they shall be notified that they will be financially responsible for removal of the waste.
- Suspected hazardous waste delivered by an unknown hauler (i.e., discovered at the site) will be transferred, as directed by the Manager to a portion of the tipping floor designed for storage of suspected hazardous waste. The waste will be tested by a qualified firm at the discretion of NWB and the final disposal options determined based on the results.

Depending on the nature and condition of the suspected waste, safe transfer to the holding area, may not be possible. NWB is to be contacted for direction. The costs will be borne by the City.

Further procedures for handling unacceptable and/or suspected hazardous wastes are provided in the ERP for the Landfill and WTS (see Appendix B).

Once a waste is suspected to be hazardous, the onus is on the hauler to demonstrate otherwise or remove the waste, at their expense. Repeat deliverers of unacceptable or hazardous wastes may be banned from the site at the discretion of, and for a period determined by the Manager and/or the City.

8.2.3 Waste Baling

Following the completion of inspection procedures, material on the tipping floor is pushed using a front end loader to the conveyor infeed. The rate of material transfer from the conveyor to the baler hopper is regulated by the Baler Operator. Similarly, the Baler Operator controls the hydraulic rams, wire tying device and bale wrapper associated with the baler.

Following ejection from the baler, the bales are transferred (utilizing a forklift) to a flatbed truck for transport to the balefill.

8.3 Waste Placement and Covering

8.3.1 Waste Placement

Utilizing the Landfill's access road, bales of municipal solid waste will be delivered by site personnel from the WTS to the active disposal area. With the possible exception of loads of unique or difficult wastes, waste delivery vehicles and/or the general public will not have access to the Landfill area.

The Landfill is constructed from a series of individual lifts. Bales are removed from the flatbed truck via a fork-equipped front end loader. A lift is constructed by stacking bales three to four high; the height limit being set by the reach limit of the front end loader. The total height of a four bale lift is approximately 3 m. During bale stacking, the bales are placed with their widest dimension perpendicular to the direction of balefilling. Processed (shredded) or modest-sized C&D materials can be placed in bale voids on perimeter side slopes with granular fill subsequently being placed to develop a base for the final landfill cap.

To address the potential requirement (due to the temporary unavailability of the WTS baler) to accept unbaled MSW at the Landfill, it is recommended that the material be placed in a constructed void space (e.g., not placing bales in a designated area to establish a shallow "disposal pit") within the active bale placement area. Aggregate cover can then be placed over the material to prevent the potential for blowing litter. A similar containment approach can be used for C&D debris that presents a blowing litter potential. As an alternative, should the baler be inoperable for an extended period, the site could be temporarily operated as a traditional landfill, with waste being placed over a larger horizontal area (e.g., 300 m^2 with individual lifts of 400 to 600 mm) and then compacted with a bulldozer or (if available) the North 40 landfill compactor. To address concerns of blowing litter, a thin (e.g., 75 mm) cover layer of aggregate would need to be placed over the final waste lift at the end of each day.

To allow for a minimum four (horizontal) to one (vertical) side slopes for the fill area, the bales must be staggered during placement, utilizing the arrangements shown in Figure 8-1. The required side slope is attained, while still providing efficient usage of the available disposal volume. The staggered arrangement should be maintained until the final design elevation is reached.

The horizontal top cover should be placed to provide between 2% and 4% grade. A minimum side slope of 1% should also be established on the horizontal surface towards the passive vertical faces to direct runoff away from the working face.

Elements relating to the progression of solid waste balefilling at the facility are illustrated on the Engineering Drawings. The Landfill area development follows a sequence of composite liner installation within a specified disposal area, the orderly placement (or stacking) of cells of baled solid waste within the disposal area, installation of composite liner in the next required disposal area, and the repeat of the process until final grades are reached and the area is capped.

Figure 8-1: Staggered Bale Placement

The staged, sequential development of the individual cells within the balefill area serves as the primary organizing factor in the facility's operation. The sequence established as part of the facility design is based on four main operational requirements:

1. To install the liner sequentially as defined cells.
2. To allow mobile site equipment access to all levels of the fill area.
3. To limit the height of vertical bale faces.
4. To achieve final design height (to allow for the installation of the landfill cap), as soon as possible.

Additional information relating to site development is included on the Engineering Drawings.

As the balefill reaches the final grades proposed on the Engineering Drawings, settlement can be expected. The completed areas should be inspected regularly, and any cracks in daily/intermediate cover or areas of ponding water should be regraded to maximize surface runoff. If necessary, additional cover material should be added to ensure positive surface drainage.

CH_4 gas is a by-product of solid waste anaerobic degradation. **Section 11.0** describes LFG vent installation and the Engineering Drawings present the proposed location of the vents.

8.3.2 Waste Covering

Acknowledging the baled and wrapped condition of the waste materials, the relatively limited amount of annual precipitation and a lack of available low permeability soil cover, the placement of locally-sourced aggregate cover over the waste bales is required only as a precursor to final capping. In select instances, at the discretion of the Manager, the placement of aggregate cover over a non-typical waste material (e.g., presenting a blowing litter, animal/vector attraction and/or litter generation risk) may be deemed appropriate.

8.3.3 Cover Borrow Areas

As noted in **Section 4.2.3**, cover material required to support the Landfill's operations, including bale/waste covering and final grading, is scheduled to be acquired from the Northwest Aggregate Deposit.

8.3.4 Inclement Weather

Wet weather operation may require the use of stockpiled crushed rock and (potentially) demolition rubble to maintain road access to the Landfill working face. This function should be undertaken to ensure reasonable access at all times, as required.

During the winter season, snow clearing of the Qaqqamiut Road, Northwest Aggregate Deposit access road and the two landfill components (Landfill and Leachate Management System) will be required. Similarly, ongoing snow removal the WTS access routes, as well as the general yard area, will be necessary. It is acknowledged that extreme snowfall/blizzard events could result in temporary discontinuation of operations at the WTS and/or Landfill.

8.4 Surveying and Horizontal/Vertical Control

The landfill cell and footprint limits will be clearly defined in the field. To aid in the construction of the Landfill, permanent benchmarks have been established for horizontal and vertical control. The locations of these benchmarks are defined as a component of the Engineering Drawings.

As construction of the Landfill progresses, the Manager will utilize grades stakes to ensure that the construction is in accordance with the approved plans. The frequency of the staking is controlled by the size of the site and the volume of waste received. Due to settlement, stakes set on previously filled areas should not be used as temporary benchmarks for future staking. If the stakes are required for a long period, they will be checked and reset frequently.

During the application of the final cover, elevation control will be established daily. The required thickness of the final cover will be monitored using settlement plates placed at the top of the waste with painted gradations indicating the required layer thicknesses.

It is the Manager's responsibility to see that all necessary construction staking is accomplished and to apprise the equipment operators of their presence. The Manager will employ or engage the services of a qualified individual(s) to perform the day-to-day operational surveying needs of the site.

8.5 Landfill Cap

Upon achieving final design grades, future infiltration of precipitation into the waste mass (and thus the leachate collection system) will be mitigated through the installation of a landfill cap. The cap, as illustrated in Figure 8-2, consists of a surface drainage layer (450 mm of 75 mm clear stone) geomembrane barrier (60 mil textured LLDPE). Nonwoven geotextile is positioned above and below the geomembrane to provide protection during construction and closure activities.

As described in **Section 11**, vents will be installed at select locations in the final cap to allow for the release of LFG.

Figure 8-2: Landfill Cap Schematic

9.0 Nuisance Control

9.1 Litter Control

Litter can be a significant problem at municipal solid waste disposal sites. At the facility, three factors will serve to reduce the problem significantly:

1. All incoming waste (except for periodic bulky materials) will be handled within the WTS.
2. Waste arriving at the working face will be in high-density, wire-tied and plastic-wrapped bales, with deposition occurring in an orderly "stacking" manner.
3. Use specialized placement procedures and use of aggregate cover at the Landfill in instances where delivered waste presents a littering potential (see **Section 8.3.1**).

Acknowledging that a notable reduction in litter generation is expected at the City's site (over that associated with a standard landfill), a litter control program will still be maintained at this location. Litter control is best accomplished by a combination of proper disposal operations, litter retaining fences and a litter picking program. A clean, litter-free appearance will be maintained at the site at all times, not only for public relations but also for the efficient operation of the Landfill. Poor litter control would attract unwanted wildlife and contribute to surface drainage problems by blocking ditches and culverts.

In summary, litter control measures to be implemented at the Landfill and WTS include:

- Semi-permanent litter collection fencing shall be positioned around the active area to catch blowing litter (see Engineering Drawings).
- A vigorous litter collection and patrol program shall be directed by the Manager.
- Litter on fencing, on-site roadways, in ditches, in the WTS yard, and adjacent properties shall be monitored and collected on a minimum weekly basis.
- The arriving waste must be covered according to applicable City bylaws. Vehicles arriving uncovered shall be turned away.
- Use of specialized placement procedures at the Landfill for wastes that present a blowing litter potential.

With respect to the plastic bale wrap, it is recommended that its durability be monitored by facility staff on an ongoing basis to identify requirements for operational modificaitons, including applying additional layers of wrap and/or the selection of a different wrap product. This evaluation should be conducted in collaboration with the bale wrapping unit manufacturer.

9.2 Odour Control

Odours will be controlled at the facility by the implementation of the following daily measures:

- Timely removal of waste from the WTS tipping floor (e.g., baled and delivered to the Landfill).

- Short-term storage of waste bales at the designated location within the WTS yard only in exceptional circumstances (e.g., extreme weather events or landfill access issues).
- Gas venting and collection systems (if necessary) shall be established and maintained in good working order (see **Section 11.2**).
- Leachate springs at the Landfill shall be promptly repaired.
- Complaints regarding odour shall be recorded (see Appendix A) and acted upon. Complaints shall also be correlated to relevant weather information.

Odour control will also be achieved by routine site inspections to identify and eliminate localized surface water ponding and/or surface water drainage problems. Should odours become a problem, an on-site evaluation will be performed and appropriate remedial actions taken based on the results of the evaluation.

9.3 Dust Control

Due to transport and placement activities at the site, as well as the number of gravel surface roadways, dust control will be an important operational consideration. Dust control measures to be implemented at the Landfill and WTS include the following:

- The site shall be monitored daily during dry weather.
- Vehicle speeds shall be limited on-site to 10 kph within the WTS compound and at the Landfill, particularly during dry periods. Adequate signage shall be posted and limits enforced.
- On-site roads shall be maintained to minimize dust emissions.
- Asphalt surfaces (e.g., scale ramps) shall be routinely swept.
- Calcium chloride shall be applied to roads, as necessary. The rate of application shall be recorded, using the daily checklists (see Appendix A).

9.4 Vector and Bird Control

Solid waste disposal facilities can attract rodents and birds due to the availability of food and the potential for breeding habitats in the waste. Limiting the availability of food and void space, resulting from the compacted nature of the baled waste, will discourage their habitation.

9.4.1 Vector and Animal Control

Control measures include the following:

- Litter collection shall be conducted daily to mitigate the attraction of vectors and animals.
- If a baiting program is required for rodents, it shall comply with regulatory requirements regarding the use of pesticides.
- If burrowing animals utilize the leachate holding ponds as habitat, contact Nunavut Department of Natural Resources to determine the safest manner of removing the animals.

Acknowledging the potential risks, all staff assigned to duties at the Landfill shall be properly trained in bear safety.

9.4.2 Bird Control

Control measures include the following:

- Minimize potential roosting areas within the WTS (e.g., using netting and/or landing surface spikes).
- Litter collection shall be conducted daily.
- If the problem is persistent, a more intensive program shall be initiated, which may involve the use of noise-generating devices.

9.5 Noise Control

All equipment powered by internal combustion engines have mufflers installed and will be maintained following manufacturer's recommendations.

Regular hours of operation at the WTS shall be restricted to a posted schedule acknowledging the use of back up alarms/indicators on mobile equipment.

9.6 Open Burning

Open burning of any material will not be permitted at the Landfill or WTS.

9.7 Indiscriminate Dumping

Waste is to be disposed of at designated areas at the facility (i.e., WTS tipping floor, material storage areas or Landfill) only. When indiscriminately dumped materials are discovered, they are to be immediately relocated to the appropriate designated area.

10.0 Surface Water Management

10.1 General Description

Surface water at the Landfill is conveyed primarily via overland and sheet flow, ultimately concentrating into channel flow to the east of Sylvia Grinnell Territorial Park, at which point it flows southerly toward the Iqaluit Airport, ultimately discharging to the Koojesse Inlet at Frobisher Bay. Runoff from the WTS site follows the City's drainage network in a southerly direction and into Koojesse Inlet.

Surface water for the Landfill and WTS is classified into two categories:

Stormwater from Developed (Disturbed) Areas

- Includes any surface water from the WTS compound, active and non-active portions of the constructed Landfill, outside slopes of berms, access roads and capped areas. This water is collected in ditches and directed prescribed discharge points, as indicated on the Engineering Drawings.

Stormwater from Non-Developed (Undisturbed) Areas

- Surface water from undeveloped areas or right-of-way areas. This water is discharged directly off-site.

It is noted that precipitation coming in contact with waste materials (e.g., baled waste and C&D materials) will be captured within the Landfill's leachate collection system and will enter the site's surface water ditching.

10.2 Control Ditching

Surface water control is provided through permanent WTS compound/Landfill perimeter ditching, as well as interim/temporary ditching. All permanent ditching is designed to accommodate the peak 100 year return period stormwater flow condition. Permanent culverts are designed to accommodate peak 10 year return period stormwater flows. The interim ditching and culverts are capable of handling the peak five year return period stormwater flows generated on the site.

Noting the anticipated lack of fine grained, erodible soils at the Landfill or WTS, sedimentation control has not been identified as an issue of concern for the design of surface water management features. General operational procedures to limit the potential for negative impacts associated with erosion and sedimentation are incorporated in the Construction and Operations, Closure and Post-Closure Environmental Protection Plans for the Landfill and WTS project.

Primary operational requirements relating to the surface water control ditching include the following:

- Stable aggregate cover shall be maintained in the ditches and on other site surfaces.
- Positive flow shall be maintained away from all buildings.
- Ditches shall be maintained to prevent side slopes from sloughing.
- Ditches shall be kept free of debris, as required.
- Culvert headwalls shall be maintained.

11.0 Landfill Gas Management

11.1 General Description

CH_4 and carbon dioxide (CO_2) are the primary constituents of LFG and are produced by microorganisms within the balefill, under anaerobic conditions. Carbohydrates from paper, cardboard and similar materials are decomposed initially to sugars, mainly to acetic acid, and finally to CH_4 and CO_2. Other components of LFG include non-methane organic compounds (NMOC) and inorganic compounds. NMOC originate from the disposal of aerosols, paints, oils, solvents and similar products in the Landfill. Inorganic compounds, such as hydrogen sulphide, originate from the decomposition of reactive waste products.

LFG generation, including rate and composition, proceeds through four characteristic phases throughout the lifetime of a landfill. The first phase is aerobic (e.g., with oxygen available) and the primary gas produced is CO_2. The second phase is characterized by O_2 depletion, resulting in an anaerobic environment where large amounts of CO_2 and some hydrogen are produced. In the third anaerobic phase, CH_4 production begins, with an accompanying reduction in the amount of CO_2 produced. Nitrogen (N_2) content is initially high in the balefill gas in the aerobic first phase and declines sharply as the Landfill proceeds through the anaerobic second and third phases. In the fourth phase, gas production of CH_4, CO_2 and N_2 becomes fairly steady. LFG is typically described as comprised of 50% CH_4 and 50% CO_2; although, the percentage of each may vary considerably.

The phase duration and time of gas generation varies with site conditions (e.g., waste composition, cover materials, design, anaerobic state), and may also vary with climatic conditions such as precipitation rates and temperatures. Because CH_4 is combustible, it poses a greater risk to safety than CO_2. If vented in an uncontrolled manner, CH_4 can accumulate in enclosed spaces on, or close to, the disposal site. CH_4 gas is odourless, and because its density, is less dense than air. It rises until its movement is restricted by some impermeable medium. For example, in winter, the frozen surface of the ground may block the vertical escape of CH_4, forcing it to move laterally. Also, CH_4 is insoluble in water; therefore, it will not move below the groundwater table. This presents the risk of fire or explosion. Concentrations of CH_4 between 5 and 15% in air are explosive. With proper venting; however, CH_4 gas should not pose an unacceptable hazard. Research has shown that the rate of decomposition in landfills, as measured by CH_4 gas production, reaches a peak within the first two years and then slowly tapers off; although, continuing in many cases, for periods up to 25 years or more. Therefore, CH_4 venting must be accommodated during and after balefill completion.

It is expected that the low average annual temperature, relatively limited amount of annual precipitation and the baled and wrapped configuration of the waste will tend to reduce the intensity of LFG generation at the City's site. Further, migration of permafrost into the waste mass overtime at the Landfill may serve to deter waste degradation altogether. However, it is acknowledged that ongoing effects associated with climate change (e.g., warmer and wetter weather in the north) could result in increased LFG generation rates in the future.

11.2 Landfill Gas Vents

LFG vents will be installed, as specified throughout the fill area, to allow for the controlled discharge of this gas. Suggested locations for these vents are shown on the Engineering Drawings. The vents should be extended in height as the site is developed. Recommended construction details for a typical gas vent are provided in Figure 11-1.

If explosive concentrations of CH_4 are detected during the monitoring program, the ventilation capability of the vent itself, as well as the overall spacing of vents, should be investigated. It may become necessary to consider a positive type ventilation system (such as gas extraction) if the problem is not easily remedied.

CO_2 gas is not considered to present a high risk to safety with regards to above ground operations. However, since it is heavier than air, CO_2 will collect in the bottom of manholes, poorly vented trenches, and other below-ground areas. Therefore, site personnel should take appropriate precautions, such as the use of a respirator or forced ventilation, before entering these areas.

Primary operational requirements relating to LFG control include the following:

- LFG vents shall be installed in the Landfill area, according to spacing identified on the Engineering Drawings.
- CH_4 gas detection levels shall be monitored at each vent semi-annually and recorded within a database.
- The area immediately surrounding vents shall be checked periodically for surface water ponding. Regrading shall be conducted, as necessary.
- The structural integrity of the exposed portion of vents shall be monitored periodically to ensure they are maintained.
- The gas vents shall be inspected to ensure that the vent caps are properly fitted and maintained.
- The height of the vents shall be checked to ensure that vents extend a minimum of 1200 mm above grade at all times.
- If measured gas concentrations are within the explosive range, venting capacity shall be evaluated for those vents with explosive readings; alternatively, additional passive vents should be installed.
- If the measured gas concentrations are within the explosive range and the condition is not remedied by modifying the passive vent system, the use of a positive venting system shall be evaluated.

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

Figure 11-1: Typical Landfill Gas Vent

12.0 Leachate Management

As discussed in **Section 4.0**, leachate is created as a result of operations at the Landfill and WTS. Dedicated collection and storage systems serve each location. Management requirements for both locations are discussed in the following sections. Sampling and analysis requirements associated with leachate management are presented in **Section 13.**

12.1 Waste Transfer Station

Leachate within the WTS is generated during the waste baling process, as liquid is squeezed out of the waste mass. This liquid is collected via a shallow trench in the slab around the perimeter of the baling unit, with the effluent subsequently being pumped to the 4500L sewage holding tank. The sewage holding tank is XLPE polyethylene double wall construction. The secondary (outer) tank has 120% of the capacity of the inner tank and serves as containment in the event of a leak or spillage. The tank is equipped with an interstitial leak detector. As required, this liquid is collected and transported to the City's WWTP for treatment.

A record of details related to the transport of leachate to the WWTP (e.g., date, and quantity and/or quality) shall be maintained at the WTS. At the request of the WWTP operator, a characterization of the WTS leachate will be conducted to ensure compatability with the facility's treatment process and infrastructure.

12.2 Landfill

The Landfill's leachate collection and management system, as described in ***Section 4.2****, will initially incorporate several components, including the leachate collection layer/perforated pipe system within the disposal area liner system, collection sumps/manholes and retention and potential future bioreactor pond. For the first few years of landfill operations, leachate will be stored within the constructed pond system, allowing for the analysis of quality and quantity data towards defining a treatment system (potentially incorporating mechanical components) appropriate to the unique effluent characteristics of* the Iqaluit site.

WARNING! LEACHATE IS POTENTIALLY HAZARDOUS. Take appropriate safety precautions when handling or working near leachate or when entering confined spaces, such as the use of protective clothing, breathing apparatus and ventilation.

For the initial system, primary operational requirements relating to leachate management at the Landfill include the following:

- As leachate is generated and pumped to the new holding lagoons, Dillon recommends that weekly sampling be undertaken for the first three months, switching to monthly sampling afterwards.
    - If the quality varies significantly, more frequent sampling should be undertaken to properly identy the raw leachate quality.
    - The parameters that should be examined (at a minimum) are:
        - cBOD
        - BOD
        - COD
        - TSS
        - Particle size distribution
        - TKN
        - TP
        - pH (field)
        - Temperature (field)
        - Total chlorine
        - Total phenols
        - Unionized ammonia
        - Total ammonia
        - Oil & grease,
        - Total dissolved metals
        - Total metals
        - Total coliforms
        - Fecal coliforms
- A summary of the landfill leachate management system activities shall be included in each annual report. This summary shall include, at a minimum:
    - Landfill leachate generation rates;
    - Leachate characteristics;
    - Holding pond capacity; and
    - Any updates to the leachate management system and/or leachate management activities.
- During the summer months (e.g., mid-June to mid-September), the leachate collection manhole will serve as a location for the extraction of effluent using a portable pump and hosing. During the period of operation, facility staff will be required to monitor effluent depths in the manhole, operating the pump as necessary.
- The pump hosing will direct leachate to piping which will direct flows to the lined ponds. The two ponds have been designed to provide approximately two years of storage, eliminating the need for discharge during the facility's initial operational period based on anticipated rainfall amounts. The pump will be powered by a small portable generator. Staff will bring the portable pump, hosing and

generator to the site each morning and energize the system. Before leaving the site at the end of the day, the equipment will be disconnected and returned to the WTS for storage.

- The manhole pump system will be operated during the period of the year when leachate is being generated and flows into the manhole. Daily assessment of leachate generation status (e.g., observations within the manhole) shall commence in the late spring, confirming when active pumping efforts should be initiated.
- A complete inspection of the leachate collection system elements (manhole, pump, hosing, holding ponds) shall be conducted on an annual basis.
- Should it be determined that storage volumes within the ponds are nearing design capacity as measured by water levels in the ponds and corresponding capacity chart, the City, in consultation with the NWB, will access contingency actions including transporting quantities of leachate effluent via pumper truck from the site to either the West 40 landfill (e.g., controlled discharge through the existing waste mass) or the City's WWTP. As a secondary contingency (to be implemented only with the approval of NWB), a valved discharge manhole at the second storage pond will allow for the controlled release of effluent to a gravel bed diffuser. It is acknowledged that it is anticipated that implementation of the secondary contingency measure will necessitate additional environmental effects (e.g., surface water) monitoring requirements at the Landfill site.

13.0 Site Monitoring

As described in **Section 4.2.6**, environmental effects monitoring requirements at the Landfill and WTS are defined in the latest version (under separate cover) of the Landfill and WTS Facility Monitoring Program (FMP).

14.0 Facility Records

Maintaining facility records is important for operational decisions related to both daily activities and long-term facility management. Copies of all records shall be kept at the WTS Office and up-to-date for inspection subsequent reporting purposes. The following records should be maintained as a minimum. It is noted that the daily and weekly checklists discussed in this section (and presented in Appendix A) provide an efficient and concise means to maintain an operational record:

1. **Incoming Material Quantities** – All materials entering the WTS are weighed before subsequent handling. A computerized database serves to consolidate all collected information by source and material type allowing for subsequent reporting. Weigh scale information can be used for determining waste compaction values, soil to waste ratios, trends in waste generation and general quantification of the waste stream.
2. Site Visitor Log – All visitors accessing the Landfill or WTS are to be registered in the site visitor log (see Appendix A). The logbook will be held at the Scale House.
3. Correspondence – A filing system shall be maintained to keep any correspondence associated with site operation.
4. Financial – Complete records of budget forecasts and actual expenditures must be maintained for the operation. This information is to be summarized in an annual report, as well as forecasts for the upcoming year.
5. **Site Operations Log** – The site log will consist of the daily and weekly checklists (see Appendix A), as well as periodic print-offs (i.e., monthly) of Scale House records. Other operations forms, including weather logs, waste inspection forms, complaint forms, can also be incorporated into the site log. It is recommended that the log itself take the form of a binder, allowing for the easy addition of documentation. The landfilling log will be held and maintained by the Manager.
6. Weather – Records relating to temperature, wind conditions and precipitation shall be recorded daily, using a standardized form (see Appendix A).
7. Liner – When landfill cell liner installation is required, a topographic survey of the base area shall be performed before liner construction. The area to receive the liner shall be graded according to the dimensions and elevations shown on the Engineering Drawings. Installation of the liner system shall be undertaken by personnel/firms experienced in the application of the specified materials. Installed sections of liner shall be tested for quality control, as indicated in the specification. Record engineering drawings of the area shall be prepared each time the liner is installed. Inspection records documenting quality control during liner installation shall be maintained by the City. A section of liner capable of accommodating one year of landfilling shall be installed at a minimum. The determination of timing requirements associated with the installation of the liner system is discussed in **Section 7.2**. A sketch of the location of landfilling, with respect to the liner, shall be developed on an annual basis.
8. **Compaction Control** – To monitor site operations on a yearly basis, overall compaction of the balefill shall be examined. A topographic survey of the active soil borrow area and the active Landfill area shall be conducted annually to determine the volume occupied. Survey drawings generated, as part

of this undertaking, shall provide an annual record of site development. Using the weigh scale records, as well as the overall degree of compaction of the balefill, shall be determined.

9. Landfill Cap – When an area reaches final design elevation, a topographic survey shall be conducted to establish final grade. Similar to the disposal area liner, the landfill cap installation shall be undertaken by experienced, qualified personnel with quality control testing being completed, as noted in the specification. All landfill cap installations shall include the completion of record engineering drawings. Other features that shall be noted on the record drawings including leachate collection system elements and surface water runoff ditches. The requirement to install or cap an area shall be forecasted at least 12 months in advance of design and construction for the cap.
10. Leachate Control – Documentation shall include leachate quality test results, sketches showing the progress of installation of the Landfill leachate collection network, leachate pumping and volumes. A record of dates, volumes and any testing data for baler leachate transported from the WTS to the City's WWTF (or other approved facility) shall also be maintained.
11. LFG Control – Documentation associated with the development of the gas vents (if deemed necessary) within the Landfill area, including locations of the gas vents/gas recovery infrastructure and data on periodic gas sampling, shall be maintained.
12. **Surface and Active Layer Water Monitoring** – A database of all surface and active layer (groundwater) monitoring results, including water quality and monitoring point integrity information, shall be maintained.
13. Bird/Pest Control – If control measures are undertaken, all activities are to be recorded on the daily and weekly checklists.
14. Reports – As directed by the Director of Engineering and Public Works, written facility reports shall be prepared by the Manager. Annual material disposal/diversion reports, based on site weigh scale records and in accordance with the requirements of NWB, shall also be prepared.

15.0 Summary Schedule of Facility Activities

Section 15 summarizes facility operational (Table 15-1), maintenance (Table 15-2), monitoring (Table 15-3) and reporting (Table 15-4) activities in point form. This section offers a summary of the requirements on a daily, weekly, monthly, quarterly, annual and "as needed" basis for the WTS and Landfill. It is intended for use as a quick reference only and does not encompass detailed information. Supporting sections of this Operations Manual as well as manufacturer's manuals for specific pieces of mobile and stationary equipment should be referred to for further details.

Table 15-1: Schedule of Operations

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Provide initial ERP training to new facility employees.	(LF/WTS) Manager of Solid Waste to conduct a review of the ERP, identifying revisions as necessary.	(WTS) Conduct a building control systems function assessment.	(WTS) Conduct an assessment of the building fire suppression system and facility portable fire extinguishers.	(WTS) Inspect stationary waste processing equipment, including shredder, baler and conveyors, conducting repairs/ maintenance as required.	(WTS) Maintain traffic access to and around the building compound at all times.
(LF/WTS) Train all site staff in safety precautions for handling and identifying hazardous materials.	(LF/WTS) Review status of staff training requirements, including OH&S, defining subsequent action as necessary.	(LF) Prepare a three-month landfill development work plan noting deviations from the previous quarter's predicted requirements.	(LF/WTS) Assess status of first aid kits situated within buildings and mobile equipment, replenishing as necessary.	(WTS) Inspect HHW storage unit containment sumps. Empty and clean as required.	(WTS) Ensure all incoming waste loads are properly covered and secured.
(LF/WTS) Assess requirement for litter collection.	(LF/WTS) Conduct an ERP simulation exercise.			(LF/WTS) Inspect sediment control features. Repair or replace as required.	(LF/WTS) Ensure acceptability of incoming waste per O&M Manual definitions.
(LF/WTS) Undertake pest and wildlife control measures as required.	(LF/WTS) Assess status of portable fire extinguishers situated within buildings and mobile equipment, recharging as necessary.			(LF/WTS) Inspect drainage features and structures. Conduct repairs/maintenance as required.	(WTS) Divert salvageable/ recyclable materials away from tipping floor to designated storage areas when possible.
(WTS) Based on daily noted volume, co-ordinate pumping of leachate holding tanks (baler area) as required.	(LF) Assess requirement for leachate management system modifications.				(LF) Maintain road access to the landfill working face at all times.
(LF) Install temporary stormwater ditching, culverts and access roads.	(WTS) Assess requirements to ship salvaged/segregated materials by sealift to identified management locations.				(LF/WTS) Ensure the site buildings and gates are locked when unattended.
(LF) Maintain a stockpile of 100 m³ of granular material for wet weather operation.	(LF) Assess requirement to develop the next cell in the landfill sequence, acknowledging time required for design, tendering and construction.		.		(LF) Follow the sequential cell development plan as depicted in the design drawings.
(LF/WTS) Apply dust suppressants on access roads and yard areas.	(LF/WTS) Review Facility Operations and Maintenance Manual, updating as				(WTS) Access size of snow storage piles within WTS yard, allowing adequate

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
	necessary.				space for additional snowfall events.
(LF) Install liner system following disposal area development plan.					(LF) Minimize areal extent of disturbance within undeveloped portions of the landfill footprint.
(LF) Remove inter-liner stormwater control piping barriers as required.					
(LF) Install final landfill cap as required.					

Table 15-2: Schedule of Maintenance

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Maintain all stationary and mobile equipment following manufacturer's requirements.	(LF) Commission the leachate lift station in the summer to allow for pumping of effluent to the holding ponds.	(WTS) Inspect Site Office water and wastewater system, repairing as necessary.	(LF/WTS) Take inventory of first aid kits for completeness. Replenish as needed	(LF/WTS) Confirm quantity of bale wire and wrap in storage, replenishing as necessary.	(LF/WTS) Inspect site mobile equipment, assessing the need for maintenance or repair.
(LF/WTS) Maintain snow removal, placement of gravel, pothole repair, culvert cleaning, litter control and ditch upgrade of entrance and internal roads.	(LF) Decommission the leachate lift station in the fall before the onset of winter conditions.	(LF/WTS) Check for surface water ponding around buildings, regrading as necessary.	(LF/WTS) Take inventory of safety equipment and PPE. Replenish as needed.	(WTS) Inspect WTS compound ditching assessing need for maintenance or repair.	(WTS) Monitor weather forecasts for significant rain or snowfall events, making appropriate preparations, including fuel for the backup heating and emergency generator and adequate snow storage capacity.
(WTS) Have Site Office wastewater tank pumped with effluent being transported to an approved management location.	(LF) Check for surface water ponding around monitoring wells, regrading as required.		(WTS) Take inventory of operational supplies including lubricants, filters and other consumables, replenishing as necessary.	(LF) Inspect leachate holding ponds, repairing as necessary.	(LF) Ensure positive surface water drainage (no ponding) within the active landfill area.
(WTS) Have the baler leachate collection tank pumped with the effluent being transported to an	(LF/WTS) Engage qualified persons to inspect building structures and equipment.		(LF) Inspect Attendant's Trailer, repairing as necessary.		(WTS) Clean (sweep/water wash) interior and exterior areas within the WTS compound.

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
approved management location.					
	(LF/WTS) Ensure site building roof structures are weather tight.		(LF) Inspect areas that have achieved final grade for settlement, repairing as necessary.		(WTS) Record fuel level in heating system storage tanks, replenishing as required.
	(LF/WTS) Lubricate and inspect doors of buildings ensuring that they are weather tight.				(LF/WTS) Check for litter within/adjacent to the WTS compound and the Landfill access road and clean up as required.
	(LF) Examine all monitoring wells for structural integrity.				(LF/WTS) Evaluate the requirement for the establishment or removal of sediment control procedures/ structures.
	(LF) Inspect leachate management system, repairing as necessary.				(WTS) Record volume of water and wastewater in Site Office holding tanks, taking follow up action as required.

Table 15-3: Schedule of Monitoring

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF) Visual monitoring as specified in the Facility Monitoring Program.	(LF) Record static water level depth of all monitoring wells.		(LF) Take samples and analyze at groundwater stations as specified in the Facility Monitoring Program.		(LF) Record liquid levels in leachate holding ponds, confirming ability to accommodate forecasted rainfall events.
(LF/WTS) Wildlife monitoring as specified in the Facility Monitoring Program.	(LF) Undertake a topographic survey of the landfill area, assessing fill compaction		(LF) Take samples and analyze at surface water stations as specified in the Facility Monitoring Program.		
	(LF) Compare actual to final design grades.				

Commitment 17
New Technology/Lessons Learned
ECCC

Commitment 29
Fencing, Design Drawings (90%)
CIRNAC

Commitment 38
OMM
CIRNAC

Currently working on scheduling a discussion with all involved parties.

Table 15-4: Schedule of Reporting

As Necessary	Annually	Quarterly	Monthly	Weekly	Daily
(LF/WTS) Complaint forms.	(LF/WTS) Facility Operating Report.		(LF/WTS) Summary of Daily Reports.	(LF/WTS) Facility weekly operations checklist.	(LF/WTS) Facility daily operations checklist.
(LF/WTS) Emergency Response Report.	(LF/WTS) Facility Monitoring Plan Report.		(LF/WTS) Summary of Waste Quantities.		(LF/WTS) Record of waste quantities.
(LF/WTS) Form for attempted delivery of hazardous waste.	(LF/WTS) Contingency Plan for Emergency Response.		(LF/WTS) Summary of Hazardous Waste.		
(LF/WTS) Damage waiver for immobilized vehicles.	(LF/WTS) NWB Waste Diversion Report.				
	(LF/WTS) Wildlife Monitoring Reports.				

Commitment 18 - Reclamation of the West 40 Landfill
Resolved

Commitment 19 - OMM - CIRNAC
Updated drawings will be provided October 9

Commitment 20 - OMM - CIRNAC
Updated drawings will be provided October 9

Response to item 21:

The practice of baling and wrapping MSW in northern climates is, to our knowledge, relatively novel (Yellowknife balefills, but does not wrap). Dillon prepared a risk assessment and options report for the City, which identified several options previously mentioned. The current planned approach as selected by the City/Colliers in November 2019 is to collect and monitor leachate quality in two new lined holding ponds for a period up to two years, or sooner if the leachate quality can be consistently characterized.

During these two years, if effluent at the outlet of the second pond (sampled via the new manhole) meets NWB surface water discharge requirements, it will be released to the level spreader downstream of the lagoons. If the quality does not meet land discharge limits (as defined in Table 1, Non-Point Source Discharge, Environmental Guideline for Industrial Waste Discharges into Municipal Solid Waste and Sewage Treatment Facilities, Government of Nunavut 2011), but is lower than the allowable influent strength at the City's municipal WWTP (as defined in the Iqaluit WWTP Upgrade Redesign Development Report, Stantec, 2017), it may be hauled there instead. Hauling to the City's municipal WWTP or existing West 40 treatment system will also be an emergency backup in the event the ponds begin to fill faster than anticipated due to increased rainfall. This will be monitored through a staff gauge indicating depth and associated volume in each pond. It is important that throughout the life of the landfill, leachate is monitored each year to identify if the quality and quantity is changing.

If the leachate quality is not suitable for disposal on land or at the municipal WWTP, two options are available: potential reuse of the West 40 leachate treatment system, which is largely portable and could be relocated; or, construct a new treatment system at the landfill based on the sampled leachate parameters. It is estimated that it would take three months to design a system, and one construction season to build (after the lagoons are constructed).

The proposed leachate sampling program should consist of weekly sampling of the raw leachate, the outlet of pond 1 and the outlet of pond 2. If the quality appears to stablize after one treatment season, the monitoring may be reviewed and reduced.

Commitment 22 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 23 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Part 1 General

1.1 Description

.1 These specifications describe the manufacture, supply and installation of high density polyethylene (HDPE) geomembrane. All procedures, operations and methods shall be in strict accordance with specifications, plans and engineering drawings.

1.2 Related Requirements

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 01 74 00 – Cleaning.

.4 Section 01 74 19 - Construction Waste Management and Disposal.

.5 Section 31 32 19 - Geotextiles.

.6 Section 31 37 00 - Rip-Rap.

1.3 Measurement and Payment

.1 Furnish and install 2.0mm (80mil) textured HDPE liner:

- .1 Geomembranes will be measured in square metres of surface covered by material. No allowance will be made for seams and overlaps.
- .2 Quality Control all liner and extrusion materials supplied to the job site.
- .3 Quality Control all aspects of liner installation required in this Section.
- .4 Furnish all drawings and reports required in this Section.

1.4 Reference Standards

.1 ASTM International:

- .1 ASTM D638-14, Standard Test Method for Tensile Properties of Plastics.
- .2 ASTM D746-14, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- .3 ASTM D751-19, Standard Test Methods for Coated Fabrics
- .4 ASTM D792-13, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- .5 ASTM D1004-13, Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
- .6 ASTM D1204-14, Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature.
- .7 ASTM D1238-13, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer.
- .8 ASTM D1505-18, Standard Test Method for Density of Plastics by the Density-Gradient Technique.
- .9 ASTM D1603-14, Standard Test Method for Carbon Black in Olefin Plastics.
- .10 ASTM D1693-15, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.

.11 ASTM D4218-15, Standard Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique.

.12 ASTM D4833/D4833M - 07(2013)e1, Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products.

.13 ASTM D5199 - 12(2019), Standard Test Method for Measuring the Nominal Thickness of Geosynthetics.

.14 ASTM D5397 - 19a, Standard Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test.

.15 ASTM D5596 - 03(2016), Standard Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics.

.16 ASTM D5820 - 95(2018), Standard Practice for Pressurized Air Channel Evaluation of Dual-Seamed Geomembranes.

.17 ASTM D5885/D5885M-17, Standard Test Method for Oxidative Induction Time of Polyolefin Geosynthetics by High-Pressure Differential Scanning Calorimetry.

.18 ASTM D5994/D5994-10(2015)e1, Standard Test Method for Measuring Core Thickness of Textured Geomembranes.

.19 ASTM D6392-12(2018), Standard Test Method for Determining the Integrity of Nonreinforced Geomembrane Seams Produced Using Thermo-Fusion Methods.

.20 ASTM D6693/D6693M-04(2015)e1, Standard Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes.

.21 ASTM D7238-06(2017), Standard Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus.

.2 Federal Testing Method Standard:

.1 Puncture Test Federal Test Method Standard (FTMS) 101C - Method 2065.

.3 National Sanitation Foundation:

.1 NSF International Standard 54-1993, Flexible Membrane Liners.

1.5 Action and Informational Submittals

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Manufacturer:

.1 The manufacturer of the geomembrane shall be approved by the Engineer and have satisfactory experience in extruding polyethylene materials and a reputation for producing a high quality product.

.2 The manufacturer shall submit product data as follows:

.1 Manufacturer's instructions, printed product literature and data sheets for geomembrane(s) and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Installer

.1 The Installer shall have at least five (5) years continuous experience in the installation of HDPE geomembrane and/or experience totalling 500,000 m^2 of installed HDPE geomembrane for at least 10 completed projects.

.2 Installation shall be performed under the direction of a single installation supervisor who shall remain on-site and be responsible throughout the liner installation for subgrade acceptance, liner layout, seaming, testing and repairs, and all other activities contracted by the Installer. The installation supervisor shall have supervised the installation of at least 200 000 m^2 of polyethylene geomembrane. No installation will be allowed to proceed without this person present on the site

.3 Actual seaming shall be performed under direction of a master seamer. The master seamer should be present during all seaming operations and shall have a minimum of 100,000 m^2 of polyethylene liner seaming experience using the same type of seaming apparatus specified in this project. The installation supervisor and master seamer shall be on-site whenever seaming is being performed.

.4 The Installer shall be approved by the Manufacturer.

.5 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Nunavut, Canada.

.2 Submit shop drawings and indicate installation layout, dimensions and details, including fabricated and field seams, pipe boots, anchor trenches and protrusion details.

.6 Samples:

.1 Submit four weeks minimum before beginning Work samples as follows:

.1 Minimum 2 m length of standard width membrane.

.2 Minimum of 1 m seam with at least 300 mm of membrane on both sides of seam.

.7 Certificates:

.1 Submit certificates, including test results at least two weeks before delivery of materials to job site.

.2 Prior to inspection and delivery of the geomembrane to the job site, the Contractor shall submit the following to the Engineer for approval. Work shall not commence until the Engineer has all of the following in their possession:

.3 Resin Manufacturer’s Certificates:

.1 Written certification that the product delivered was extruded from the specified resin including the following information:

.1 The origin of the resin: Resin Supplier's name, resin production plant, brand name, number and production date of the resin.

.2 A copy of the quality control certificate issued by the Resin Supplier.

.3 A statement that no reclaimed polymer is added to the resin.

.4 Geomembrane Manufacturer's Certificates:

.1 Submit four copies of manufacturer's mill test data four weeks minimum before beginning Work.

.2 Geomembrane manufacturer's certificates for each shift's production of geomembrane. Quality control certificates shall be signed by responsible parties employed by the Manufacturer. No geomembrane will be permitted to be delivered until the Engineer has in their possession the following information:

.1 Roll numbers and identification.

.2 Sampling procedures and results of quality control tests.

.3 Extrusion rod shall be certified by the Manufacturer that it is made of the same resin as the parent geomembrane supplied.

.3 Manufacturer's Standard Warranty.

.8 Installation and erection data and schedule.

.9 Installer's Quality Control plan.

.10 Installer's guarantee.

.11 Maintenance and repair requirements.

.12 Resumes and certifications of all technical personnel who will perform work on the geomembrane liner installation.

.13 Certificate that the HDPE membrane and its installation complies with the requirements and standards specified herein.

.14 Shop Drawings showing the following:

.1 Proposed Panel Layout:

.1 Drawings showing proposed placement of panels and seams prior to installation, and their proposed numbered sequence, as well as areas for adding material for proposed thermal compensation.

.2 Drawings and detailed descriptions of all methods of welding and patching the membrane, anchoring details, sealing at all penetrations and structures shown on the approved plans.

.2 Record Shop Drawings:

.1 The Installer shall provide final "as recorded" layout drawings <u>to scale</u> to reflect any changes from the proposed panel layout and details.

.2 As-built drawings shall include the numbered identification and location of all seams, panels, patches and areas of added material for proposed thermal compensation.

.3 Included shall be drawings and descriptions of all methods of welding the membrane, anchoring details, sealing at all penetrations and structures.

.15 Construction Waste Management Plan:

.1 Provide project Waste Management Plan highlighting recycling and salvage requirements.

1.6 Quality Control

.1 For the purpose of this specification, quality control is defined as a planned system of inspections and activities carried out by an independent third party company that provides assurance that the geomembrane liner was manufactured and installed as specified and directly monitors and controls the quality of the work.

.2 The quality control program carried out by the Contractor shall meet the requirements of Section 3.9 - Quality Control of this specification.

.3 The Contractor shall assist and cooperate with the Engineer in the execution of the quality assurance program.

1.7 Quality Assurance

.1 Test quality of resin and membrane to ensure consistency of raw material and geomembrane quality in accordance with manufacturer's recommendations.

.2 Test seams in strength and peel at beginning of each seaming period and at least once every four hours if welding operation is interrupted, for each seaming apparatus and seamer used that day.

  .1 Also test at least two samples from each panel, with samples taken from extra material, such that panel is not damaged and blanket geometry is not altered.

.3 If seam test specimen fails in seam, repeat on new specimen.

  .1 If new specimen fails in seam, material will not be used for seaming until deficiencies are corrected and two consecutive successful test seams are achieved.

.4 Test seams by non-destructive methods over their full length, using vacuum test unit or air pressure test as detailed in Section 3.9 - Quality Control of this specification.

.5 Provide test results to the Engineer, for each shift's production, including documentation of non-destructive testing and repairs at end of each shift.

1.8 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 During delivery and storage, protect geo-membranes from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris, deformation, vandalism and animals.

.4 Storage and Handling Requirements:

  .1 Store materials in accordance with manufacturer's recommendations.

  .2 Replace defective or damaged materials with new.

1.9 Schedule of Work

.1 Submit schedule of expected work for approval by the Engineer including means and methods of installation.

  .1 Installer shall submit the expected schedule of work to the Contractor. The schedule shall include:

    .1 Amount of seaming equipment, extrusion and fusion, to be mobilized and maintained on the job site.

    .2 Type and certification of tensiometer to be maintained on the site.

    .3 Resumés of personnel on the job site.

    .4 Requirements for additional labourers.

    .5 Sample forms proposed to be used on the site for equipment start-up, seam vacuum test, seam air pressure test, seam destructive test.

  .2 Adhere to approved schedule. Deviate only after approval from the Engineer.

1.10 Approved Manufacturers

.1 Flexible membrane liner to be supplied by approved manufacturers. Pre-approved flexible membrane liner manufacturers are as follows:

.1 Manufacturer/Supplier
Layfield Group of Companies
117 Basaltic Road, Unit 2
Vaughan, Ontario
L4K 1G4
Phone: (587) 400-8690
Toll-Free: (855) 203-0079
Email: containment@layfieldgroup.com

.2 Manufacturer/Supplier
Solmax
2801 Marie-Victorin Blvd.
Varennes, Quebec
J3X 0J4
Phone: (450) 929-1234
Toll Free: 1-800-571-3904

.3 Manufacturer/Supplier
Titan Environmental Containment
777 Quest Blvd
Ile des Chenes, Manitoba
R0A 0T1
Phone: (204) 478-3955
Toll-Free: (204) 878-3980

Part 2 Products

2.1 HDPE Geomembrane Properties

.1 The geomembrane shall be manufactured from new first quality polyethylene resin of the type specified in this document. Polyethylene geomembrane shall meet all requirements for the specified end use.

.2 Reclaimed polymer shall not be added to the resin except the polymer recycled during the manufacturing process. Recycled polymer shall not exceed 2% by weight.

.3 Manufacturer to provide certificate stating name of resin supplier, complete with product description and stated properties and to certify resin product has not been produced from a blend of resins.

.4 Geomembrane: extruded synthetic sheet:

.1 Supplied in panels of size as indicated.

.2 Composed of high density polyethylene resin with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.

.5 The sheet geomembrane shall demonstrate the typical physical properties from the following table:

	Minimum Average Roll Values (metric)		
Description:	**2.00 mm (80mil) Textured HDPE**		
Material Property	**Standard**	**Units**	**Value**
Thickness (nominal)	ASTM D5199 ASTM D5994	mm	2.00
Thickness (min. avg.)	ASTM D5994	mm	1.90
Indent lowest individual reading	ASTM D5994	mm	1.70
Asperity Height	ASTM D7466	Mm	0.4
Density	ASTM D792 ASTM D1505	g/cm^3	≥0.940
Carbon Black Content	ASTM D4218	%	2.0 – 3.0
Carbon Black Dispersion	ASTM D5596	Category	Cat. 1/Cat. 2
Minimum Tensile Properties	ASTM D6693	-	-
Stress/Strength at Yield		N/cm	29
Strain/Elongation at Yield		%	12
Stress/Strength at Break		N/cm	21
Strain/Elongation at Break		%	100
Tear Resistance	ASTM D1004	N	249
Puncture Resistance	ASTM D4833	N	534
Stress Crack Resistance (SCR)	ASTM D5397	hours	500
UV Resistance (retained after 1600 hours)	ASTM D7238 ASTM D5885	%	50
Low temperature brittleness	ASTM D746	°C	-77
Field Seam Properties	ASTM D6392	N/cm	
Shear Strength			21.0
Peel Strength (fusion)			FTB†/ 17.5
Peel Strength (extrusion)			15.4
†Film Tear Bond (FTB) is defined as failure of one of the sheets by tearing, instead of separating from the welded seam-the test specimen shall not fail by more than 10% into the seam. For double hot wedge fusion welded seam, both inside and outside tracks shall be tested.			

.6 Seams: welded in accordance with manufacturer's recommendations.

.1 Physical properties for resin used for welding are same as those for resin used in manufacture of membrane.

2.2 Manufactured Geomembrane

.1 Material specifications to meet or exceed those listed in Section 2.1.

.2 Geomembrane to have a maximum permeability of 1×10^{-11} cm/sec.

.3 HDPE geomembrane to consist of sheets containing no plasticizers, chemical additives, fillers or extenders, excluding the carbon black content as specified in Section 2.1.

.4 Geomembrane to be free of pinholes, blisters, undispersed raw materials, striations, roughness or any sign of contamination by foreign matter.

.5 Rolls to be minimum 8.0 metres in width consisting of a continuous width seamless panel. Minimum length to be Manufacturer's standard length for the specified thickness and such that seaming requirements are minimized.

.6 Each roll to be clearly marked in two separate locations on the roll with the following information:

.1 Manufacturer
.2 Product Type
.3 Thickness
.4 Resin Lot Number
.5 Roll Number
.6 Length and Width

.7 Failure to label each roll as specified in Section 2.2.5 shall be cause for rejection.

.8 Material Warranty:

.1 The HDPE membrane manufacturer shall provide a written warranty for the membrane against manufacturing defects for a period of twenty (20) years from the date of installation.

2.3 Extrudate Rod and/or Bead

.1 Extrudate rod and/or bead to be produced from the same resin used in the manufacture of the geomembrane rolls. Contractor to provide documentation supporting this requirement.

2.4 Documentation

.1 Prior to delivery of the geomembrane to the job site, the Installer shall be required to provide the Engineer with a written certification that the product delivered was extruded from a resin which meets or exceeds the properties listed in Section 2.1. The manufacturer of the geomembrane shall provide quality control certificates for each batch of resin and each shift's production of geomembrane, and shall follow the quality control testing program as described in Section 1.6. Failure to meet specifications shall be cause for rejection.

.2 Prior to delivery of the geomembrane on site the Installer shall provide the Engineer with their Thermal Compensation Plan. The plan shall address, but not be limited to, stiffness and placement, flexing, seaming/welding, solar heat, moisture, frozen backfill, drop height, portable heat

.3 These quality control certificates shall be signed by responsible parties employed by the Manufacturer, and shall be supplied to the Engineer or his Representative. No geomembrane will be permitted to be delivered until the Engineer has in his possession such certification.

.4 Testing of lining materials prior to delivery.

.1 Lining materials proposed to be used on the project shall be set aside by the manufacturer, complete with certificates. Each roll of geomembrane and extrusion rod shall be marked as specified in Section 2.2 and 2.3 and the following information shall accompany the roll certificates:

.1 Thickness: ASTM D5199/ASTM D5994.
.2 Density: ASTM D1505/ASTMD792.
.3 Melt Flow Index - 190/2.16(max): ASTM D1238.
.4 Tensile Properties: ASTM D6693.
.5 Tear Resistance: ASTM D1004.
.6 Puncture Resistance: ASTM D4833.

.5 Transportation shall be the responsibility of the Installer. Any damaged or unacceptable material shall be replaced by the Installer.

.6 Once on site, storage of the geomembrane shall be the responsibility of the Contractor. The geomembrane shall be stored to avoid deformation of rolled goods from one place to another.

Part 3 Installation

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geomembranes installation in accordance with manufacturer's written instructions.

  .1 Visually inspect substrate in presence of the Engineer.

  .2 Inform the Engineer of unacceptable conditions immediately upon discovery.

  .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Engineer.

.2 Prior to installation, Contractor to survey subgrade and certify it has been graded and compacted to conform to earthworks requirements.

.3 Prior to installation, Contractor to inspect the subgrade and provide written certification to the Engineer stating the prepared surface is suitable for membrane installation.

.4 Contractor to maintain geomembrane subgrade surface to suitable conditions throughout installation period.

.5 Placement of geomembrane shall be done in accordance with sequence on approved shop drawings and may be revised on-site with the approval of the Engineer to suit field conditions.

.6 On slopes steeper than 10%, all seams shall be oriented down slope and not across the slope. No horizontal seams shall occur less than 1.5 m (and preferably 3 metres) from the crest or toe of such slopes.

.7 Panels shall be installed so overlaps are primarily downstream and downwind. Install panels to eliminate the alignment of butt seams of successively joined panels; butt seams should be offset a minimum of 500 mm after production welding, as directed by the Engineer. Install panels so that seams in collection areas or depressions are minimized and preferably eliminated.

.8 Equipment used to handle and weld the geomembrane shall not cause any damage to the geomembrane or on the subgrade due to handling, trafficking, leakage of hydrocarbons or any other means. All damage of soils to be corrected to the Engineer’s satisfaction prior to geomembrane deployment.

.9 Personnel shall not engage in activities or wear footwear which could damage the geomembrane.

.10 **Apart from approved welding equipment, no mechanical equipment shall be allowed on the geomembrane (including rubber tire ATV's).**

.11 Panels shall be placed in such a way as to minimize scratches, crimps and other damage to material. Minimize wrinkles and "fishmouths" along seams.

.12 Do not deploy geomembrane panels if moisture prevents proper placement or seaming.

.13 Do not allow geomembrane to "bridge over" voids or low areas in the subgrade. Repair subgrade if required and place geomembrane such that it rests on the subgrade surface.

.14 At the end of each day or installation segment all unseamed edges shall be anchored by rope, sand bags, or other approved device. Sand bags securing the geomembrane on the side slopes should be connected by rope fastened at the top of the slope section by a temporary anchor. Staples, U-shaped rods or other penetrating anchors shall not be used to secure the geomembrane. Any damage to the liner due to inclement weather shall be the sole responsibility of the Contractor.

.15 Any panel or part thereof which becomes seriously damaged shall be replaced at the Contractor's expense. Such damaged panels shall be removed from the site immediately. Minor damage such as crimps, wrinkles, etc., shall be repaired as described in this section.

.16 Contractor to provide site protection to prevent bird and/or animal attack on the geomembrane.

3.2 Seaming Methods – Equipment

.1 Approved methods for seaming are double wedge fusion welding for general seaming and extrusion welding for patching. Proposed alternatives must be submitted for approval to the Engineer or his Representative. Details of the specific apparatus to be used for seaming, including seaming using approved methods, shall be submitted for approval by the Engineer or his Representative prior to commencement of any seaming.

.2 Double Wedge Fusion Welding. The seam shall be produced by self-propelled wedge welding apparatus. The apparatus shall be equipped with gauges to monitor weld temperature. Weld temperature and machine speed shall be varied according to ambient conditions in order to maintain and demonstrate a consistent acceptable weld. All welding surfaces shall be kept clean and dry.

.3 Extrusion Welding. The seam shall be produced by extruding molten resin at the edge of two overlapped sheets of geomembrane to effect a homogeneous bond. The extrusion apparatus shall be equipped with gauges to monitor extrudate temperature. Temperature and flow rate shall be varied according to ambient conditions to maintain and demonstrate a consistent acceptable weld. The extruder shall be purged of all heat degraded or cooled extrudate prior to the commencement of each seaming sequence.

.4 The Installer shall maintain at least one spare operable seaming unit of each type on-site at all times.

3.3 Seaming Procedures

.1 Where conditions warrant, the Installer shall be allowed to use a temporary support surface between the geomembrane and the subgrade to achieve proper support during the seaming operation. The Engineer or his Representative shall decide whether the support material may be left in place or must be removed on completion of seaming.

.2 Seaming shall be a continuous process with a minimum of interruptions along any given seam.

.3 Prior to seaming, the geomembrane shall be overlapped a minimum of 75 mm for extrusion welding and 100 to 150 mm for fusion welding. Sufficient overlap must be provided on both sides of the double fusion weld to allow for destructive testing in accordance with the specified ASTM procedures.

.4 Seams shall be aligned so as to create a smooth and wrinkle free surface in the overlap area.

.5 Seam area to be free of dirt, dust, moisture, debris or any other foreign matter.

.6 Extrusion Welding.

.1 The weld area shall be prepared by sanding or grinding to a depth of less than 0.02 mm in the sheet surface to be in contact with the extrudate.

.2 Grinding required along a seam shall be done concurrent with or within ten minutes of the seaming operation and shall not damage the geomembrane.

.3 Membrane shall be overlapped a minimum of 75 mm prior to seaming. The weld area shall be kept clean and dry during this process.

.4 Installer shall determine when preheating of the area to be seamed is required.

.5 Artificially induced cooling of extrusion welds, by water or any other means, shall not be allowed.

.6 Care shall be taken during vacuum testing that extrusion welds being vacuum tested are at ambient temperatures.

.7 Cross-seams.

.1 The top and bottom excess overlap shall be removed and the top and bottom edge of the cross-seam shall be ground to a smooth transition prior to seaming.

.2 If the cross seam is welded by means of fusion apparatus, the cross seams shall still be cut back to the edge of the fusion weld and have a bead of extrusion applied 100 mm in all directions from the confluence of the two seams to form a "T".

.8 Seams shall run parallel to the slope.

.9 Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall, at the discretion of the Engineer, be replaced or repaired with an additional piece of HDPE membrane at the Contractors expense.

.10 All geomembrane seams to be welded.

.11 Methods used to temporarily bond adjacent rolls shall not result in any damage to geomembrane. Solvents and/or adhesives shall not be used without written approval of the Engineer.

.12 If hot air leisters are used to provide temporary bonding, no damage to geomembrane will be permitted. If, upon visual inspection or destructive testing techniques damage is noted, it will be repaired to the satisfaction of the Engineer.

.13 If grinding is required along seam, do so according to Manufacturer's recommendations

3.4 Panel Development – Thermal Compensation

.1 Compensation for thermal contraction of the Thermal Compensation geomembrane shall be provided as necessary during the liner installation.

3.5 Climatic Conditions

.1 The following procedure shall be followed when the ambient temperature falls to or below 2°C as measured 600 mm above the surface of the liner by the Engineer.

.1 The temperature shall be measured and logged every hour during cold weather seaming conditions by the Engineer.

.2 Test Seams:

.1 Test seams shall be run as soon as the temperature falls to 2°C and every four hours thereafter, or if the temperature falls an additional 5°C from the time of the last test seam, or if the seaming equipment has not been used for a 2 hour period in the case of fusion welding, one hour in the case of extrusion welding.

.2 Test seams shall be made in the same area and under the same conditions and procedures as the liner about to be installed with experience, including production of each test seam on the subgrade over which the liner will be placed. Test seams shall be sized according to the specifications.

.3 Six samples shall be taken from each test seam, spaced equally along the length of the seam. Four samples shall be tested in peel and two in shear on the Installer's tensionmeter. Seams shall pass all criteria for film tear bond (FTB) and seam strength as listed in that section.

.3 Sampling Frequency of Seams Produced Under Cold Weather Conditions:

.1 End of Seams:

.1 One 125 mm wide sample shall be taken out of the beginning and end of each seam produced:

.1 One 25 mm sample each from each sample shall be tested in peel and shear, and shall meet the requirements for FTB and seam strength as listed in Section 2.1.

.2 The remainder of each sample shall be labelled and saved.

.2 Destructive tests shall be taken at the same frequency as described in Section 3.9.1.4 and tested according to the specifications.

.3 Do not perform seaming when ambient temperatures are greater than 40°C.

.4 Do not place geomembrane under conditions of rain or snow or in the presence of excessive fog or dew.

.5 Keep seam areas clean, dry and sheltered from wind if required, during seaming operation.

3.6 Preparation

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties to sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent containment structure has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.7 Construction Sequence

.1 Coordinate the installation to ensure smooth transfer of responsibilities between earthworks and geosynthetics contracts and operations.

.2 Be responsible for the condition of the prepared sub-grade and surface of the recompacted clay liner once these surfaces have been accepted.

.3 Be responsible for the condition of the geosynthetic materials geotextile, HDPE liner until these installations have been accepted.

3.8 Installation

.1 Geomembrane to be delivered to site with each roll clearly identified on two (2) separate locations on the roll as specified for verification prior to installations. Extensively damaged rolls shall be rejected and replaced at the Installer's expense.

.2 Maintain area of installation free of water, ice, and snow accumulations.

.3 Prepare excessively soft supporting material as directed by the Engineer.

.4 Do not proceed with panel placement and seaming when ambient temperatures are below minus 5 °C or above 40 °C, during precipitation, in presence of excessive moisture (i.e. fog, dew), nor in presence of high winds.

.5 Place and seam panels in accordance with manufacturer's recommendations on graded surface in orientation and locations indicated.

.6 Minimize wrinkles, avoid scratches and crimps to geomembranes and avoid damage to supporting material.

.7 Protect installed membrane from displacement, damage or deterioration before, during and after placement of material layers.

.8 Replace damaged, torn or permanently twisted panels to approval of the Engineer and remove rejected damaged panels from site.

.9 Keep field seaming to a minimum. Locate field seams up and down slopes, with no horizontal field seam less than 1.5 m beyond toe of slope.

.10 Keep seam area clean and free of moisture, dust, dirt, debris and foreign material.

.11 Make field seam samples in accordance with requirements described in PART 2 on fragment pieces of geo-membrane and test to verify that seaming conditions are adequate.

.12 Test field seams as seaming work progresses by non-destructive methods over their full length. Repair seams which do not pass non-destructive test. Reconstruct seam between failed location and any passed test location, until non-destructive testing is successful.

.13 Repair minor tears and pinholes by patching until non-destructive testing is successful. Patches to be round or oval in shape, made of same geomembrane material, and extend minimum of 75 mm beyond edge of defect.

3.9 Quality Control During Installation

.1 Site Test Equipment:

  .1 The Installer shall maintain on-site, in good working order, the following items:

    .1 Field Tensiometer

      .1 The tensiometer shall be a load certified motor driven unit and have jaws capable of travelling at a measured rate of 50 mm/min.

      .2 The tensiometer shall be equipped with a gauge which measures units of force exerted between the jaws.

      .3 Certification of the unit shall have been performed within six months of the installation date.

    .2 Vacuum Box:

      .1 The vacuum box shall consist of a rigid housing with a transparent viewing window on top and a soft, closed-cell neoprene gasket attached to the bottom of the housing.

.2 The housing shall be equipped with a bleed valve and a vacuum gauge capable of reading in tenths of a bar.

.3 A separate vacuum source shall be connected to the vacuum box such that a negative pressure can be created and maintained inside the box.

.4 A sudsy solution consisting of soap and water shall be dispensed on the seam immediately ahead of the vacuum box.

.3 Air Pressure Test Equipment

.1 This method shall apply only when the split hot wedge seaming method is used.

.2 Equipment shall consist of an air pump capable of generating and maintaining a positive pressure of between 1.5 to 2.0 bars.

.3 A manometer capable of reading up to 2.0 bar attached to a needle or nipple shall be used to pressurize the air channel in the seam.

.2 Geomembrane Testing

.1 Contractor to perform a minimum of one complete set of quality control tests on geomembrane rolls from each different resin lot to verify that all other specified parameters are in compliance with the material specifications.

.2 Test samples which fail to meet strength and environmental specifications shall result in rejection of applicable rolls. Conduct further testing on geomembrane manufactured from same resin batch to determine acceptability.

.3 Contractor to provide written certification to the Engineer, for review and acceptance, confirming required quality control has been done and certifying quality of the geomembrane, prior to delivering to job site.

.4 Quality control certificate required for each batch of resin and each production shift. Certificate to include:

.1 Product Identification.

.2 Roll Numbers.

.3 Sampling Procedures.

.4 Test Methods.

.5 Test Results (including Environmental Stress Cracking or single-point Notched and Constant Tensile Load Time to Failure test data).

.6 Signature of Responsible Party.

.7 The Engineer may also request that all production line records be submitted for review.

.5 The Engineer shall have authority to visit the manufacturing facility at any time to witness production and quality control testing, examine production records and to independent samples. The Contractor and/or manufacturer shall extend full cooperation in this regard.

.3 Non-Destructive Testing:

.1 Test Seams (Start-up):

.1 Test seams shall be made to verify that adequate conditions exist for field seaming to proceed.

.2 Each seaming apparatus shall produce a test seam at the beginning of each shift.

.3 In addition, if a seaming operation has been suspended for more than four hours, or after every five hours or if a breakdown of the seaming equipment occurs, a test seam shall be produced prior to resumption of seaming operations.

.4 Test seams shall be made in the field on pieces of the approved geomembrane.

.1 Each test seam shall be at least 1.5 m long by 300 mm wide for extrusion and 3 m long by 300 mm wide for fusion, with sufficient overlap for peel testing in the field tensiometer.

.5 Two samples 25 mm wide shall be taken from each end of the test seam using an approved template.

.1 The samples shall be tested in the field tensiometer, one from each end in peel and shear respectively.

.2 Samples tested in peel shall not fail in the seam.

.3 All test samples shall exhibit film tear bond and strength as defined under seam properties, section 2.1.5.

.6 If the seam fails to pass, the seaming apparatus shall not be used for field seaming until any deficiencies have been corrected. This shall be verified by the production and successful testing of two consecutive test seams.

.2 Vacuum Testing:

.1 All extrusion welded seams and "T" seams shall be evaluated using vacuum box testing.

.2 A sudsy soap solution shall be applied to the test section and the vacuum box placed over the section. The bleed valve is then closed and the vacuum valve opened.

.3 The vacuum box shall maintain at least 20 kPa (0.2 bar) vacuum during the test.

.4 Once a tight seal has been established, the test section shall be visually examined for a period of not less than 10 seconds to determine whether bubbling of the soapy solution at the seam is occurring.

.5 The vacuum box is then moved and the process is repeated on the next adjacent section. A minimum of 100 mm overlap shall be provided between all test sections.

.6 All locations where bubbling of the sudsy solution is observed shall be clearly marked for repairs with a high visibility marker and recorded by number on field test reports.

.1 Any failed portion of seam shall be repaired and retested.

.3 Air Pressure Testing:

.1 Double wedge welded seams shall be sealed off at both ends.

.2 If the end of a seam will be an integral part of the geomembrane, the sealing shall be done in such a way that it does not harm the function of the geomembrane.

.3 The pressure feed device shall be inserted into the air channel at one end of the seam and pressurized to 1.5-2.0 bars. The feed valve shall be closed and the pressure sustained for a period of not less than three minutes.

.1 The pressure shall then be released by slitting the air channel at the opposite end of the seam.

.2 The Engineer shall observe the drop in pressure on the manometer to verify the continuity of the air channel.

.4 If a pressure loss of greater than 0.2 bar is observed or if the required pressure cannot be reached, then the seam shall be rejected, and shall be either reconstructed in its entirety or the leak located and patched. The entire seam shall then be retested according to the procedure outlined above.

.4 All seams shall be non-destructively tested by the Installer over their full length to verify the integrity of the seam.

.1 Non-destructive testing shall be performed concurrently with field seaming.

.2 All non-destructive testing shall be observed and documented by the Engineer.

.5 Repair and test again any seam failing a test.

.6 Cap seams are to be tested by the vacuum box method as described in Section 3.9.1.3.2.

.1 Where cap seams cannot be tested by the vacuum box method, the Engineer may approve a different non-destructive test method.

.2 If no non-destructive test method can be used, the method of remediation of the seam shall be directed by the Engineer, and may include removal and replacement of the seam and adjacent geomembrane panel.

.7 At least one spare operable testing unit shall remain on-site at all times.

.8 Approved non-destructive testing procedure is as above. Alternate procedures shall be submitted for approval to the Owner or the Owner's Representative prior to the commencement of non-destructive testing.

.4 Destructive Testing

.1 Destructive testing of field seams shall be performed at selected locations in order to verify seaming properties.

.2 All sampling and testing shall be done concurrently with field seaming so that verification of field seam properties is made as the work progresses and corrective action implemented, if necessary.

.3 Test samples shall be taken at an average frequency of one test location per 150 meters of seam.

.4 Sample locations shall be determined by the Engineer taking into consideration the difficulty of subsequent repair and testing.

.1 The Installer shall not be informed in advance of the locations where the seam samples will be taken.

.5 Samples shall be cut by the Installer under the direction of the Engineer.

.1 Each sample shall be indelibly numbered and identified.

.2 Each sample shall be identified with the sample number, seam number, panel number, date, name of welding technician, and welding equipment number.

.6 The Engineer may increase the amount of destructive testing based on the results of previous testing.

.1 Additional samples may also be required when the Engineer has reason to suspect the presence of excess crystallinity, contamination, faulty seaming equipment or any other reason affecting seam quality.

.7 The test sample shall measure approximately 300 mm wide by 1.0 metre long with seam centered lengthwise along the sample.

.8 The Owner, at their option, may send the remaining sample to a lab of their choosing for further destructive testing and approval.

.9 In any event, the samples shall not be considered to pass the test until the Engineer is satisfied that they meet the seam pass/fail criteria of film tear bond and minimum seam properties.

.10 2.5 cm wide sample strips shall be cut from the sample using an approved die, and tested in the Installers tensiometer in the presence of the Engineer according to the following procedure:

.1 Two 25 mm wide samples shall be taken from each end for shear and peel testing by the Installer.

.2 Seam shall not fail either test as specified in Section 2.1.

.11 The Owner shall test the remaining sample in an independent tensiometer to qualify seam strength properties and FTB according to the procedures outlined in 4.1.4.

.12 The Engineer shall cut ten (10) 25 mm wide replicate specimens from their sample and shall test five specimens for seam shear strength and 5 for peel strength:

.1 To be acceptable, five out of the five replicate specimens must pass for each mode of testing.

.2 All specimens must fail in Film Tear Bond (FTB).

.3 Any specimen that fails through the weld, or by adhesion at the weld-sheet interface, is a non-film Tear Bond break and shall be considered a failure.

.13 The test method and procedures to be used by the Engineer shall employ a grip separation rate of 50 mm/min for peel and shear.

.14 The area from which the destructive test sample was taken shall be repaired without delay and shall be non-destructively tested by vacuum box as described in Section 3.9.1.3.2.

.5 Inspection and Acceptance:

.1 As the work progresses, the Engineer shall document all locations requiring repair work and shall verify and document that all repairs have been successfully made by the Installer.

.2 No work on the liner shall be allowed if the Engineer is not present.

.1 This is to include start-up tests, general seaming and patching, and any work at penetrations or structures.

.3 Seams are only considered to be accepted after they have passed the specified non-destructive and destructive tests, and the equipment used to produce the seams have passed the required start-up tests.

.1 If a seam fails the above criteria, the Installer must reconstruct the seam.

.4 A double hot wedge fusion seam shall be considered acceptable only when both outside and inside track welds are destructively tested and meet the specification criteria.

.5 If a seam fails the destructive test, the Installer may reconstruct the seam between the point of failure and any previously accepted test.

.1 In lieu of .5 above, Installer may trace the extent of unacceptable seam.

.1 Take 25 mm samples at minimum 3 metre distance on each side of failed section and test in both shear and peel.

.2 If one or both tests fail, continue along seam at minimum 3 metre increments.

.3 Continue until tests indicate pass results. Then take large samples for field laboratory tensiometer testing. If field laboratory tests pass, make repairs - if fail, continue.

.6 Reconstruction or repair of failed seam lengths shall be either by capping of the failed seam (extrusion or fusion weld) or, in the case of a double fusion weld, by extrusion fillet welding the overlap to the bottom sheet:

.1 Cutting off the overlap and topping the failed fusion weld with extrudate will not be permitted.

.7 If the overlap of the outside (i.e. visible) weld is less than 30 mm extrusion welding of the overlap to the bottom sheet in the failed section will not be permitted.

.8 Continuity of all reconstructed seams to be subject to non-destructive testing:

.1 If reconstructed length exceeds 50 metres, sample shall be taken for laboratory destructive testing.

.9 The cost of all failed laboratory destructive tests shall be deducted from monies owning to the Contractor:

.1 Actual cost to be based upon testing company invoices.

.10 The entire geomembrane surface shall be examined by the Engineer to confirm that it is free of any defects, holes, blisters, undispersed raw materials, or contamination by foreign matter:

.1 The geomembrane surface shall be cleaned by the Installer, if required, so that it is free of dust, mud, debris or any other material which may inhibit a thorough examination of the surface.

.2 Any suspect areas shall be clearly marked by the Engineer and non-destructively tested according to the appropriate specified testing procedure.

.11 Overburden shall not be applied to any portion of the liner system until that portion system is inspected by the Contractor and the Engineer and all documents affecting that portion have been approved in writing by the Engineer.

.12 Gouges or scratches associated with grinding or from other sources whose depth is in excess of 10% of the geomembrane thickness shall be classified as defects and will require appropriate repairs in accordance with these specifications.

.13 Small tears, wrinkles or pinholes to be repaired by seaming or patching to the satisfaction of the Engineer.

.14 Patches shall be round or oval, of the same material and thickness as the base geomembrane, and shall extend a minimum of 150 mm beyond the damaged or faulty area in all directions.

.15 Geomembrane surfaces to be patched shall be abraded in accordance with Manufacturer's requirements and these specifications.

.16 Use approved extrusion welding equipment only.

.17 All repairs shall be non-destructively tested.

.18 Cut and repair any large wrinkles or "fishmouths" identified by the Engineer to the satisfaction of the Engineer.

3.10 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials for 01 74 19 - Construction Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 Disposal of Scrap Material

.1 On a daily basis remove scrap material and trash from the site and dispose in a location approved by the Owner:

.1 No scrap material shall be left on the geomembrane surface.

.2 Subsequent installation of other geosynthetics, geotextiles, overburden, or soil over the geomembrane shall not proceed until the geomembrane is accepted by the Engineer.

3.12 Protection

.1 Do not permit vehicular traffic directly on membrane.

3.13 Guarantee

.1 The Contractor shall guarantee the HDPE membrane against defects in installation and workmanship for the period of five (5) years commencing with the date of final acceptance. The guarantee shall include the services of qualified service technicians and all materials required for the repairs. The installer shall further provide a written guarantee that all products have been installed in accordance with the specifications.

Part 4 Completion of Work

4.1 Geomembrane Acceptance

.1 The installation of the geomembrane shall be considered complete when all required deployment, seaming, repairs, testing and site clean-up, including sand bags have been completed by the Installer; the Installer has submitted all the required certifications to the Engineer; and the Engineer is satisfied that the geomembrane has been installed in accordance with the above Specifications.

.2 The geomembrane liner will be accepted by the Engineer when:

.1 The geomembrane is clean.

.2 The entire installation, or an agreed section of the installation, is finished.

.3 All documentation pertaining to the installation has been submitted to the Engineer.

.4 Verification of the adequacy of all field seams, repairs, and associated testing is complete.

.5 As-recorded drawing of the field panels and seams including defects and test locations is submitted.

END OF SECTION

Part 1 General

1.1 Related Requirements

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 61 00 - Common Product Requirements.

.3 Section 01 74 00 - Cleaning.

.4 Section 01 74 19 - Waste Management and Disposal.

.5 Section 31 37 00 - Rip-rap.

.6 Section 33 47 14 - Geomembranes.

1.2 Reference Standards

.1 American Society for Testing and Materials International (ASTM):

- .1 ASTM D4533/D4533M-15, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
- .2 ASTM D4632/D4632M-15a, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
- .3 ASTM D4759-11(2018), Standard Practice for Determining the Specification Conformance of Geosynthetics.
- .4 ASTM D5261-10(2018), Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
- .5 ASTM D6241-14, Standard Test Method for Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.3 Work Included

.1 Materials and installation of polymeric geotextiles used in revetments, breakwaters, retaining wall structures, filtration, drainage structures, and roadbeds, the purpose of which is to:

- .1 Separate and prevent mixing of granular materials of different grading.
- .2 Act as hydraulic filters permitting passage of water while retaining soil strength of granular structure.

1.4 Action and Informational Submittals

.1 Provide in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit to the Engineer following sample at least four (4) weeks prior to beginning Work:

- .1 Provide manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Samples:
  - .1 Minimum length of two (2) m of roll width of geotextile.
  - .2 Methods of joining.
- .3 Test and Evaluation Reports:
  - .1 Submit two (2) copies of mill test data and certificate at.
- .4 Construction Waste Management:

.1 Provide project Construction Waste Management Plan highlighting recycling and salvage requirements in accordance with Section 01 74 19 - Construction Waste Management

1.5 Delivery, Storage and Handling

.1 Deliver, store and handling, protect geotextiles from direct sunlight and ultraviolet rays, excessive heat, mud, dirt, dust, debris, vandalism, and animals.

.2 Replace defective or damaged materials with new.

Part 2 Products

2.1 Materials

.1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.

.1 Width: 3.8 m minimum.

.2 Length: 110 m minimum.

.3 Composed of: minimum 85% by mass of polypropylene with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure for sixty (60) days.

.2 Minimum physical requirements for the geotextiles shall be as follows:

Property	Test Method	Qualifier	Type “A”	Type “B”	Type “C”	Unit
Mass/unit area	ASTM D5261	MARV	-	-	949	g/m^2
Grab tensile strength	ASTM D4632	MARV	712	1330	2447	N
Tear strength	ASTM D4533	MARV	267	510	1112	N
Puncture resistance	ASTM D6241	MARV	1820	3780	8914	N

.1 Type “A” to be Terrafix 360R or approved equal.

.2 Type “B” to be Terrafix 800R or approved equal.

.3 Type “C” to be Geotex 2801 or approved equal.

.4 Approved geotextile manufacturers are:

.1 Texel.

.2 Synthetic Industries.

.3 Nicolon/Mirafi.

.3 Acceptance of geotextile materials shall be based on ASTM D4759.

Part 3 Execution

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geotextile material installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of the Engineer.
- .2 Inform the Engineer of unacceptable conditions immediately upon discovery.
- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Engineer.

3.2 Installation

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with sand bags.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from a minimum of three (3) metres on the flat from the toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.6 After installation, cover with overlying layer within four (4) hours of placement.

.7 Replace damaged or deteriorated geotextile to approval of the Engineer

3.3 Cleaning

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

.3 Waste Management: separate waste materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Remove construction debris from Project site and dispose of debris in an environmentally responsible and legal manner.

3.4 Protection

.1 Vehicular traffic not permitted directly on geotextile.

.2 Do not overload soil or aggregate covering on geotextile.

END OF SECTION

Commitment 25 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 26 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 27 - Resolved

Commitment 28 - Landfill leachate collection, Design Drawings (90%) - CIRNAC
Updated drawings will be provided October 9

Commitment 29
OMM
CIRNAC

2.0 Facility Operations

2.1 Access Control

2.1.1 Hours of Operation

The City of Iqaluit Landfill and WTS is open Monday through Saturday, excluding holidays. The site is open to receive waste from 8:00 am to 4:00 pm Monday through Friday, and 8:00 am to 12:00 pm Saturday. Only the WTS will be accessible by the general public.

The site will be closed on the following holidays:

- New Year's Day
- Good Friday
- Easter Monday
- Victoria Day
- Canada Day
- Nunavut Day
- Civic Day (first Monday in August)
- Labour Day
- Thanksgiving
- Remembrance Day
- Christmas Day
- Boxing Day

Site equipment may operate beyond posted hours. The additional time may be necessary for processing of materials at the WTS preparation of the working area receiving waste and for other work defined by management personnel.

The operating hours are prominently posted on the entrance signs for both the Landfill and WTS, which also identifies the site name and the site telephone number.

2.1.2 Site Security

Due to the nature of the work undertaken at the Landfill and WTS, site security and safety is an important feature of the overall operation. Lockable gates are situated at various locations throughout both properties. As detailed on the Engineering Drawings, permanent 2.4 m chain link fencing is provided around the perimeter of the WTS property. At the Landfill, similar fencing will be established around the leachate holding ponds as well as Cell 1. As additional cells are constructed in the future, the fencing will be extended to contain active and previously developed portions of the Landfill. No trespassing signage will be affixed to the fencing at regular intervals. Fencing of both the leachate ponds and the Landfill will serve as an access deterant to wildlife and the public.

Keys/electronic access cards will be provided to persons employed by the City and directly involved with the operation of the WTS and/or Landfill, at the discretion of the Director of Engineering and Public Works or Manager of Solid Waste (Manager). A record shall be kept at the Scale House relating to who has keys, including contact name and phone number. A general visitor log (Appendix A) shall also be maintained at the Scale House.

When either site is unattended, the gates will be closed and locked.

Commitment 30
Commitment 35
Permafrost, MSC, FMP, OMM
CIRNAC

During construction generally accepted best practices will be followed in accordane with CSA PLUS 4011:19 Technical Guide: Infrastructure in permafrost: A guideline for climate change adapatation. Cuts will be minimized and insulation utilized where possible to prevent heat transfer to permafrost. Future design may be adjusted based on knowledge gained during temperature monitoring from thermistors placed within the active cell.

Commitment 31
Permafrost, MSC, FMP, OMM
CIRNAC

The construction of leachate ponds have been designed to avoid cuts into the active layer and placed over a thick gravel pad on a bedrock base, minimizing potential for impact to permafrost.

Commitment 32
Permafrost, MSC, FMP, OMM
CIRNAC

The original thermistor locations were designed to provide a baseline assessment of the site without drilling conduit holes in locations where bales and drainage paths may be influenced. Once the final alignment of cells is located, thermistors will be placed to best assess the permafrost conditions, that could include vertical and horizontal thermistors. Thermistor installation will be included in the phased cell construction contract, and for the lagoons and WTS. Temperatures below the access road will not be monitored.

Updated drawings will be provided by October 9.

Commitment 33
Permafrost, MSC, FMP, OMM
CIRNAC

Heat generation from decomposing municipal bale waste (high density) in a northern climate has not been well documented. In addition, heat generation is typically delayed, if it occurs at all, until bale placement and thermal-chemical conditions within the bales satisfy conditions to allow for waste decomposition. Such thermal-chemical conditions for heat generation require the presence of oxygen, which will be limited due to the wrapping of the waste bales with LLDPE.

Commitment 34
Permafrost, MSC, FMP, OMM
CIRNAC
Waste Transfer Station geotechnical report - to be provided by City of Iqaluit

8.2.3 Waste Baling

Following the completion of inspection procedures, material on the tipping floor is pushed using a front end loader to the conveyor infeed. The rate of material transfer from the conveyor to the baler hopper is regulated by the Baler Operator. Similarly, the Baler Operator controls the hydraulic rams, wire tying device and bale wrapper associated with the baler.

Following ejection from the baler, the bales are transferred (utilizing a forklift) to a flatbed truck for transport to the balefill.

8.3 Waste Placement and Covering

8.3.1 Waste Placement

Utilizing the Landfill's access road, bales of municipal solid waste will be delivered by site personnel from the WTS to the active disposal area. With the possible exception of loads of unique or difficult wastes, waste delivery vehicles and/or the general public will not have access to the Landfill area.

The Landfill is constructed from a series of individual lifts. Bales are removed from the flatbed truck via a fork-equipped front end loader. A lift is constructed by stacking bales three to four high; the height limit being set by the reach limit of the front end loader. The total height of a four bale lift is approximately 3 m. During bale stacking, the bales are placed with their widest dimension perpendicular to the direction of balefilling. Processed (shredded) or modest-sized C&D materials can be placed in bale voids on perimeter side slopes with granular fill subsequently being placed to develop a base for the final landfill cap.

To address the potential requirement (due to the temporary unavailability of the WTS baler) to accept unbaled MSW at the Landfill, it is recommended that the material be placed in a constructed void space (e.g., not placing bales in a designated area to establish a shallow "disposal pit") within the active bale placement area. Aggregate cover can then be placed over the material to prevent the potential for blowing litter. A similar containment approach can be used for C&D debris that presents a blowing litter potential. As an alternative, should the baler be inoperable for an extended period, the site could be temporarily operated as a traditional landfill, with waste being placed over a larger horizontal area (e.g., 300 m^2 with individual lifts of 400 to 600 mm) and then compacted with a bulldozer or (if available) the North 40 landfill compactor. To address concerns of blowing litter, a thin (e.g., 75 mm) cover layer of aggregate would need to be placed over the final waste lift at the end of each day.

To allow for a minimum four (horizontal) to one (vertical) side slopes for the fill area, the bales must be staggered during placement, utilizing the arrangements shown in Figure 8-1. The required side slope is attained, while still providing efficient usage of the available disposal volume. The staggered arrangement should be maintained until the final design elevation is reached.

The horizontal top cover should be placed to provide between 2% and 4% grade. A minimum side slope of 1% should also be established on the horizontal surface towards the passive vertical faces to direct runoff away from the working face.

Elements relating to the progression of solid waste balefilling at the facility are illustrated on the Engineering Drawings. The Landfill area development follows a sequence of composite liner installation within a specified disposal area, the orderly placement (or stacking) of cells of baled solid waste within the disposal area, installation of composite liner in the next required disposal area, and the repeat of the process until final grades are reached and the area is capped.

4.1.5 Household Hazardous Wastes Depot and Storage

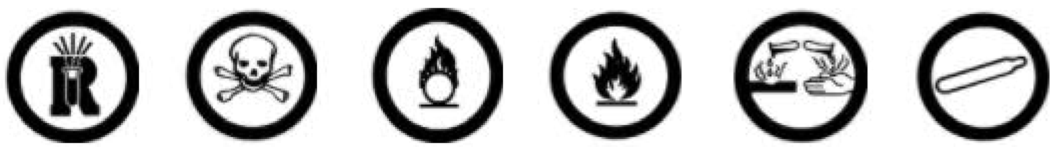
Steel intermodal ("seacan") containers, modified to address storage requirements for receiving HHW materials, as well as one pre-fabricated container specifically constructed as an HHW storage container with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent)are situated in the southwestern area of the WTS yard. One 12 m (40 ft) container serves as a public drop off location, where a trained staff member records incoming quantities and directs the materials to an appropriate initial storage location. As required, materials from the Drop Off Container are directed to one of the 12 m storage containers or the purpose-built HHW building with secondary containment (Loraday Model LEP/L73-4013 Storage Container or equivalent). Arrangements are made by the City for subsequent shipping to approved-management facilities in the south, as quantities warrant.

4.1.5.1 Household Hazardous Wastes Acceptable Materials

It is recommended that following wastes not be accepted for landfilling or recycling and instead be considered Household Hazardous Waste (HHW). Please note that this list is not exhaustive and is subject to change per City of Iqaluit and/or Government of Nunavut guidelines, :

- Alkaline batteries
- Button cell batteries
- Rechargeable batteries
- Lead-acid batteries
- Fluid paints, stains, varnishes, and oil paint products
- Empty paint, stain, varnish, and oil paint product cans
- Varnish remover
- Cleaning chemicals and disinfectants (i.e. toilet cleaner, oven cleaner, drain cleaner)
- Antifreeze/radiator fluids
- Bleach
- Brake fluid
- Pesticides/insecticides/rodenticides
- Herbicides/weed killer
- Chemical lawn fertilizers
- Insect repellants
- Gasoline
- Fuel oil
- Used oil products
- Solvents and thinners
- Pharmaceuticals and drugs (or return to pharmacy)
- Aerosols and empty aerosol cans
- BBQ propane tanks
- Camping fuel cylinders
- Oil tanks

- CFL and fluorescent light bulbs
- Fluorescent lighting ballasts manufactured before 1980
- Thermostats
- Household thermometers (mercury-containing)
- Residential fire extinguishers
- Any products labelled as corrosive, toxic, reactive, explosive, oxidizing, poisonous, infectious, or flammable
- Any product or container labelled as follows:



Reactive | Poisonous and Infectious | Oxidizing | Flammable and Combustible | Corrosive | Compressed Gas

4.1.5.2 Household Hazardous Waste Non-Acceptable Materials

The following materials are not accepted as HHW:

- Electronics
- Sharps and other household medical waste

4.1.6 Exterior Material Process and Storage Areas

The exterior yard area (gravel surface) includes equipment and locations for the processing and temporary segregated storage of select materials, including:

- Vehicle Baler/Logger unit (trailer-based).
- End of life vehicles awaiting decommissioning/crushing, crushed vehicles and salvageable metals.
- End of life vehicle and equipment tires.
- HHW intermodal containers.
- HHW 40'Lx12'D, 4-compartment, built in accordance to FM 6049 Standards (Loraday Model LEP/L73-4013 Storage Container or equivalent)
- Baled waste (to address short-term instances when direct transport to the Landfill is not possible).
- A dedicated area for the potential future installation/operation of an in-vessel organics composting unit (including a curing area allowance).
- A dedicated area for the potential future development of a greenhouse.
- Snow storage areas to support yard clearing efforts.

Commitment 39
OMM
CIRNAC

Resolved

Commitment 40
Regulatory Advice
NWB
See Commitment 12 (Page 178-179)

Commitment 41
Operational Costs
NWB

Request extension to October 23 to respond to this commitment.