

Hamlet of Kugaaruk, NU Sewage Treatment Facility Operation and Maintenance Manual

Hamlet of Kugaaruk

October 6, 2009

Sewage Treatment Facility – Operation and
Maintenance Manual

Community & Government Services, Government
of Nunavut

05-4755

Gary Strong – Project Manager

Submitted by
Dillon Consulting Limited

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Lagoon O&M Manual\Submission to NWB\Kugaaruk
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(In reply, please refer to)
Our File: 05-4755

October 6, 2009



Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU
X0B 1J0

Attention: Phyllis Beaulieu, Manager of Licensing

Re: Operation and Maintenance Manual for Hamlet of Kugaaruk Sewage Lagoon

Dear Ms. Beaulieu:

Please find enclosed a copy of the Operation and Maintenance Manual for the Kugaaruk Sewage Lagoon for your review. This manual is part of the Hamlet's commitment to comply with the current water licence (Licence Number: 3BM-PEL0712) as issued by the Nunavut Water Board. Please note that the Sewage Sludge Management Plan as well as the Quality Assurance/Quality Control (QA/QC) Plan for the newly constructed sewage lagoon has been included in this manual. Please do not hesitate to contact me at (867) 920-4555 should you require further information.

Yours truly,

Dillon Consulting Limited

Gary Strong, P.Eng.

GS/jms

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1 INTRODUCTION

1.1 Purpose

The purpose of this manual is to assist the Hamlet of Kugaaruk personnel with the operation and maintenance of their newly constructed sewage treatment facility. The manual has been developed according to the requirements of the Nunavut Water Board and is based on the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories* (Duong and Kent, 1996).

1.2 Site Setting

The Hamlet of Kugaaruk is located 68.52° north latitude and 89.9° west longitude in central Nunavut. This places Kugaaruk along the east coast of Pelly Bay, which is roughly nine hundred and sixty kilometers (960 km) west of the capital of Iqaluit.

The annual snowfall in Kugaaruk is approximately 125 cm and the annual rainfall is approximately 11 cm. In January the daily mean temperature is approximately -33⁰C while in July the daily mean temperature is approximately 6⁰C. Freeze up usually occurs during the month of November but may happen as early as September or October while spring thaw usually happens around late May.

Prior to construction of the new sewage lagoon, the Hamlet was using a two cell sewage lagoon system and wetland area to treat sewage. The lagoon was placed by the community over an old MSW site at some point in the past 20 years. Berms were uncompacted, porous material laid over fractured granite bedrock. The lagoon has experienced a number of breaches and over-toppings throughout the years. In addition, the lagoon was severely under-capacity for the current population. As the effluent had not been fully treated, it did not meet the required environmental standards. Even though extra local material was periodically added to the upper berm to prevent seepage, exfiltration from the berm remained at unacceptable environmental levels.

The new system is similar to the old system, however, it has been upgraded to meet the Hamlet needs for the next 20 years. The new facility consists of an upper and a lower berm and will also incorporate the use of the adjacent wetland area as a means of secondary treatment of the effluent. The new lagoon has been built exactly where the old lagoon used to be. Please refer to Figure 1-1 for the site location.



**Image taken from Google Earth Pro, July 2008*

Figure 1-1. Site Map of Sewage Lagoon and Solid Waste Facilities

2 BACKGROUND

2.1 Design Data

The following sections describe the data used in the design of the sewage lagoon.

2.1.1 Population Projections

The new sewage treatment facility was designed for a 20 year operational period (2008 – 2028). To size the lagoon, sewage generation rates were determined using population projections obtained from the Nunavut Bureau of Statistics and Statistics Canada. Predicted population values until the year 2020 were provided by the Nunavut Bureau of Statistics. Population values beyond 2020 were predicted using the same growth rate as previous years (20 persons per year), and using a percentage growth rate (2.6%) as illustrated in Figure 2-1. The population for 2028 was predicted to be 1127 persons.

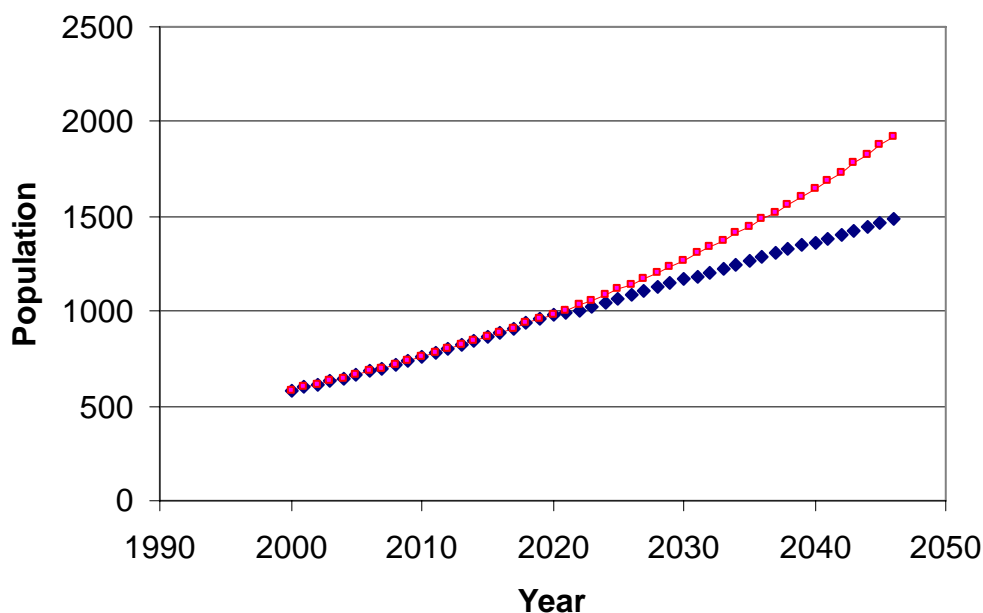


Figure 2-1. Population Projections for the Hamlet of Kugaaruk, NU

*Note: Data prior 2021 was provided by Nunavut Bureau of Statistics and data proceeding 2021 was predicted. Dark blue data points indicate data calculated using a growth rate of 20 persons per year. Red data points indicate data calculated using a percentage growth rate of 2.6%.

2.1.2 Sewage Generation Rates

Sewage generation rates for Northern communities can be calculated by using the following formula (Department of Municipal and Community Affairs, Government of the Northwest Territories):

$$\text{Water Usage (l/c/d)} = 90 \text{ l/c/d} \times (1.0 + 0.00023 \times \text{population})$$

Based on this information, the lagoon was designed to treat 46,600 m³ of sewage per year. Table 4.1 shows the calculated sewage generation for years 2008 – 2028.

Table 2.1. Predicted Sewage Generation 2008 - 2028

Year	Population	MACA Predicted Sewage Production (L)	MACA Predicted Sewage Production (m3)
2008	719	27,525,000	27,525
2009	737	28,314,000	28,314
2010	756	29,153,000	29,153
2011	779	30,175,000	30,175
2012	802	31,205,000	31,205
2013	823	32,153,000	32,153
2014	844	33,107,000	33,107
2015	867	34,160,000	34,160
2016	889	35,175,000	35,175
2017	911	36,197,000	36,197
2018	934	37,273,000	37,273
2019	957	38,357,000	38,357
2020	979	39,402,000	39,402
2021	987	39,780,000	39,780
2022	1007	40,736,000	40,736
2023	1027	41,698,000	41,698
2024	1047	42,665,000	42,665
2025	1067	43,639,000	43,639
2026	1087	44,619,000	44,619
2027	1107	45,605,000	45,605
2028	1127	46,597,000	46,597

2.2 Sewage Collection, Treatment and Disposal

In the past, the sewage lagoon had operated as an exfiltration lagoon with sewage being trucked to the lagoon 5 days per week. Sewage discharged to the lagoon received treatment within the lagoon (physical and biological), and effluent would filter through the north wall.

3 OPERATIONAL AND MAINTENANCE PROCEDURES

3.1 Sewage Lagoon and Wetland System

Sewage collection will be carried out in the same manner as in previous years. Collected sewage will be discharged into the lagoon via the effluent discharge flume. Any effluent spilling onto the truck turn around pad must be cleaned up to prevent accumulation of ice during the winter. Effluent from the lagoon will be discharged once per year from July to October, weather dependent.

Discharge of effluent will take place as soon as the stored effluent has thawed. The valve in the discharge pipe will be opened and effluent will flow from the main lagoon to the smaller holding cell. Once the holding cell has filled, the valve will be throttled back to maintain a discharge flow such that effluent steadily but slowly runs over the top of the secondary cell's rip-rap berm and enters the wetland for secondary treatment. This flow will be regulated so that the wetland is not overwhelmed by any large volume of effluent, and the flow can continue this slow rate throughout the growing season. Treated

effluent from the wetland will discharge into the ocean. As the ocean is the final destination, it is imperative that the effluent sampling monitoring program be completed every year to ensure that the lagoon and wetland are providing adequate treatment.

3.2 Yearly Operation and Maintenance

Operation of the lagoon has been broken down into two sections; operation during the winter months and operation during the summer months. The following dates are estimates as operational changeovers are weather dependent and may occur earlier or later than the anticipated dates.

3.2.1 Operation from Freeze-up to Break-up

Operation of the lagoon during this time is for winter operations. Changeover to winter operations should occur when effluent in the lagoon begins to freeze. Sewage will be collected using the Hamlet's vacuum truck and will be discharged into the lagoon via the sewage discharge flume. Any sewage spilled onto the truck turn around pad must be cleaned up immediately to prevent the accumulation of ice. Also, any accumulation of ice on the discharge flume should be cleared away to keep the flume clean and free of blockages.

3.2.2 Operation from Break-up to Freeze-up

Operation of the lagoon during this time is for summer operations. Changeover to summer operations should occur when stored effluent in the lagoon has thawed. Sewage will be collected and discharged into the lagoon as described for winter operations. The lagoon will also be decanted during this time. As soon as the stored effluent has thawed, the valve in the discharge pipe is to be opened. This will allow effluent to decant from the main lagoon into the smaller holding cell and then into the wetland for secondary treatment. If problems are encountered with the valve, a trash pump will be used to decant the lagoon into the secondary cell at the same rate as described in Section 3.1. Prior to decanting any effluent into the wetland treatment area, the Hamlet must provide notice to an INAC Inspector at least 10 days before decanting occurs. Once the decantation period is over (approximately late September/early October), the valve will be closed and sewage will be stored in the lagoon during the winter months.

During summer operations, implementation of the Lagoon and Wetland Monitoring Program will begin. It is the Hamlet's responsibility to ensure that this program is carried out each summer to remain in compliance with the Hamlet's water licence. Please refer to Section 3.3 for further details.

As well, according to the Hamlet's water licence, the Hamlet must have the lagoon inspected by a Geotechnical Engineer in either July or August of each year. The Hamlet must first consult with the Government of Nunavut for a listing and how to properly retain the services of a Geotechnical Engineer. The Geotechnical Engineer's report must be submitted to the Nunavut Water Board within 60 days of the inspection and include a copy of the Hamlet's plan to implement any recommendations suggested in the report.

3.2.3 Sewage Sludge Management Plan

3.2.3.1 Characterization of Sludge

Collected sewage will mostly come from residential buildings in the Hamlet as there are no industrial or commercial sources. The sludge will generally be a mixture of fecal matter, organic and inorganic material. However, contaminants such as heavy metals, solvents and petroleum products may enter the lagoon due to municipal activities.

3.2.3.2 Storage, Treatment and Disposal of Sludge

During the treatment process, heavier solids in the lagoon liquid will sink to the bottom of the lagoon and collect over time as a sludge blanket. The sludge blanket should be sampled every 5 years to determine the depth of the sludge blanket as well as concentrations for organic and inorganic materials. If the depth of the sludge blanket becomes thick enough to decrease the volume of the lagoon cell significantly or contaminant concentrations become too high, the sludge must be collected from the lagoon and treated according to CCME standards. As a guide, if the height of the sludge is thicker than 0.5m from the bottom of the lagoon floor and has reached the bottom of the decant screen structure, the sludge should be removed from the lagoon. At this point, in consultation with the Government of Nunavut, the Hamlet should retain the services of an Engineer for the design of an appropriate sludge removal, treatment and disposal options. The design will need to be submitted and approved by the Nunavut Water Board prior to implementing the sludge removal process. Prior to any lagoon draining or sludge removal, an INAC inspector must be informed at least ten days in advance.

The Hamlet should also retain the services of an Engineer (in consultation with the Government of Nunavut) to ensure that a proper sampling program for the sludge is completed. As sampling is only recommended every 5 years, requirements for sludge sampling may change; therefore it is important to obtain the most up-to-date requirements before beginning the sludge sampling program. Results are to be reported once analysis has been completed and are to be included in the annual report.

3.3 Lagoon and Wetland Monitoring Program

As per the conditions set out in the Hamlet's water licence, the effluent discharged from the lagoon and wetlands must be monitored during the treatment period. The following sections describe in detail how the program must be completed.

3.3.1 Program Description

The sampling program is divided into two main parts: the lagoon and the wetland treatment area. The lagoon is the main storage and primary treatment facility for the sewage. Solids will settle to the bottom and the remaining effluent is stored until decantation occurs. The wetland area provides secondary treatment of the effluent by removing organic and inorganic materials. The water licence has set the following effluent quality standards for effluent discharged from the lagoon and wetland.

Table 3.1. Quality Standards for Effluent Discharged from Sewage Lagoon (Station PEL-3-1)

Parameter	Maximum Average Concentration
BOD ₅	120 mg/L
Total Suspended Solids	180 mg/L
Fecal Coliforms	1x10 ⁴ CFU/100mL
Oil and Grease	No visible sheen
pH	Between 6 and 9

Table 3.2. Quality Standards for Effluent Discharged from the Wetland Treatment Area (Station PEL-4)

Parameter	Maximum Average Concentration
BOD ₅	45 mg/L
Total Suspended Solids	45 mg/L
Fecal Coliforms	1x10 ⁴ CFU/100mL
Oil and Grease	No visible sheen
pH	Between 6 and 9

Discharged effluent must meet these parameters. As well, the water licence has listed a number of other parameters to be tested. These parameters must meet the CCME marine standards for the Canadian Water Quality Guidelines for the Protection of Aquatic Life. A list of these parameters can be found in Section 3.3.2.

Effluent discharged from the wetland to the ocean must also demonstrate that it is not acutely toxic under the following tests:

1. Acute lethality to Rainbow Trout, *Oncorhynchus mykiss* (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13);
2. Acute lethality to the crustacean, *Daphnia magna* (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14).

Methodology for collecting these samples is covered in Section 3.4.1.

3.3.2 Program Schedule

Figure 3-1 below shows the locations for each sampling point for both the sewage lagoon and the wetland treatment area. A larger image can be found in Appendix A.



*Image taken from Google Earth Pro, July 2008; Pictures from Dillon Consulting Limited, July 2008.

Figure 3-1. Sampling Locations for Sewage Lagoon and Wetland Treatment Facility

Table 3.3. GPS Coordinates for Sampling Stations

Station	Latitude	Longitude
PEL-2	68° 31' 13.66" N	89° 49' 49.25" W
PEL-3-1	68° 31' 16.74" N	89° 50' 05.68" W
PEL-3-2	68° 31' 17.91" N	89° 50' 03.19" W
PEL-4	68° 31' 21.38" N	89° 50' 16.06" W
PEL-5	5m offset from shore into ocean where PEL-4 is located	

The following table is a sampling schedule for the lagoon and wetland treatment area during the decantation period.

Table 3.4. Sampling Program Schedule

Sampling Point	Description	Parameters to be Tested		Sampling Dates
PEL-2	Discharged raw sewage from pump-out truck.	Volume of sewage discharged		Every discharge into the lagoon.
PEL-3-1	Discharge from lagoon to settlement pond.	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Beginning of July
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	
		Oil and Grease (visual)	Total Phenols	
		Magnesium	Calcium	
		Sodium	Potassium	Mid-August
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	
		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	
		Total Cobalt	Total Manganese	End of September
		Total Chromium	Total Nickel	
		Total Copper	Total Lead	
		Total Aluminum	Total Arsenic	
		Total Mercury	Total Organic Carbon (TOC)	
PEL-3-2	Discharge from settlement pond to wetland.	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Beginning of July
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	
		Oil and Grease (visual)	Total Phenols	
		Magnesium	Calcium	
		Sodium	Potassium	Mid-August
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	
		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	
		Total Cobalt	Total Manganese	End of September
		Total Chromium	Total Nickel	
		Total Copper	Total Lead	
		Total Aluminum	Total Arsenic	
		Total Mercury	Total Organic Carbon (TOC)	
PEL-4	Discharge from wetland to ocean.	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Beginning of July
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	

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		Oil and Grease (visual)	Total Phenols	Mid-August
		Magnesium	Calcium	
		Sodium	Potassium	
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	
		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	End of September
		Total Cobalt	Total Manganese	
		Total Chromium	Total Nickel	
		Total Copper	Total Lead	
		Total Aluminum	Total Arsenic	
		Total Mercury	Total Organic Carbon (TOC)	
		Acute lethality to Rainbow Trout, <i>Oncorhynchus mykiss</i> (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13)		Mid-August
		Acute lethality to the crustacean, <i>Daphnia magna</i> (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14)		

PEL-5	Ocean water 5 metres from point where effluent enters ocean.	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Beginning of July
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	
		Oil and Grease (visual)	Total Phenols	
		Magnesium	Calcium	Mid-August
		Sodium	Potassium	
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	
		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	
		Total Cobalt	Total Manganese	End of September
		Total Chromium	Total Nickel	
		Total Copper	Total Lead	
		Total Aluminum	Total Arsenic	
Total Mercury	Total Organic Carbon (TOC)			

All sampling, sample preservation and analysis is to be performed in accordance with methods approved by the Nunavut Water Board. All analysis must be completed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory. Note that an example of one laboratory's sampling instructions is provided in Appendix B.

3.3.3 Record of Sampling Events

It is the responsibility of the Hamlet to file an Annual Report to the Nunavut Water Board no later than March 31st following the reported year. Appendix A contains samples of forms to be filled out and

included in each Annual Report. The amount of water pumped from the water treatment plant to the community and the amount of sewage discharged to the lagoon must be documented monthly and annually. As well, the amount of solids removed from the sewage lagoon each year (if this has proven to be necessary due to excessive sludge accumulation) must be recorded.

3.4 Quality Assurance/Quality Control Plan for Lagoon and Wetland Monitoring Program

Section 3.4.1 to Section 3.4.3 describes the Quality Assurance/Quality Control (QA/QC) Plan for sampling of the Sewage Lagoon and Wetland Treatment Facility. This plan outlines general QA/QC procedures, however, once the Hamlet has chosen a specific laboratory to complete the sample analysis they should obtain more specific instructions on sample collection and handling from the chosen laboratory. They must also obtain a certificate from the lab stating that the lab is certified as a CAEAL Laboratory. Information in developing this plan was taken from *Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class “B” Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan* (Department of Indian and Northern Affairs Canada, Water Resource Division and the Northwest Territories Water Board, July 1996) and *Wastewater Sampling Instructions, Kitikmeot Region* (IEG Environmental, July 2005).

3.4.1 Sample Collection

3.4.1.1 Preparing for Sample Collection

Samples are to be collected from the marked Surveillance Network Program (SNP) locations. Each location has been marked with a sign and location number as well as located with GPS coordinates. Please refer to Figure 3-1 for a map of the SNP locations and Table 3.3 for GPS coordinates. It is the responsibility of the Hamlet to maintain these markers in good condition.

Before collecting samples, follow the list of instructions below:

1. Contact the lab and ask where their lab is located. Tell them you need 5 sets (or 4 sets if the temporary sewage treatment plant is no longer in use) of sampling bottles and equipment to test the following list of parameters in Table 3.5. As well you will need travel blanks and field blanks. Travel blanks are jars of deionized water that are filled in the laboratory and travel in the coolers with the field samples to determine if there is any possible contamination from traveling and handling methods. Field blanks are also filled with deionized water, but must be filled in the field by the sampler during the sample collection process. Also ask the laboratory for an instruction sheet for collecting the samples. An example of an instruction sheet can be found in Appendix B.

Table 3.5. Parameters to be Tested During Water Sampling Program

Biochemical Oxygen Demand (BOD)
Total Suspended Solids
Conductivity
Oil and Grease (visual)
Magnesium
Sodium
Chloride
Total Hardness
Ammonia Nitrogen
Total Cadmium
Total Cobalt
Total Chromium
Total Copper
Total Aluminum
Total Mercury
Fecal Coliforms
pH
Nitrate-Nitrite
Total Phenols
Calcium
Potassium
Sulphate
Total Alkalinity
Total Zinc
Total Iron
Total Manganese
Total Nickel
Total Lead
Total Arsenic
Total Organic Carbon (TOC)

If you are sampling in Mid-August, tell them that you also need a set of sample bottles to perform a **definitive** test (this means you will need to collect approximately 40L of sample water) for the following:

Acute lethality to Rainbow Trout, <i>Oncorhynchus mykiss</i> (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13)
Acute lethality to the crustacean, <i>Daphnia magna</i> (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14)

2. Contact the airport and find out what time the samples must be dropped off in order to make the flight to the city where you are sending them. The samples should be collected shortly before they

are shipped. For example, if the samples must be at the airport by 2:00pm, the samples should be collected that morning. Make sure that you have enough time to collect and package all samples for transport. This is important because the samples must be at the lab within 24 hours from the time they are collected, otherwise they are no longer good for analysis.

3. Go to the sampling locations shown in Figure 3-1 and familiarize yourself with the area. Walk to each location so you know where each sample must be taken.

Once you have received the sampling bottles and equipment from the lab, make sure you have the following things with you before you begin collecting samples:

1. Sample bottles;
2. Preservatives;
3. Coolers that the bottles and preservatives were sent in;
4. Field blanks;
5. Chain of custody forms (also called COCs);
6. Permanent marker to mark on bottles;
7. Pen to fill out chain of custody forms;
8. Nitrile gloves;
9. Packing tape;
10. Ice packs;
11. Shipping label to send samples back to the lab.

Once you have gathered everything, determine which day you will collect the samples. Be sure to check the flight schedule for that day and call the lab to ask if they are able to pick up the samples at the airport when they arrive.

3.4.1.2 Instructions for Sample Collection

Follow these instructions to collect samples from the sewage lagoon and wetland treatment facility:

1. Place ice packs in freezer the night before sampling.
2. In the morning, place ice packs and other equipment into coolers and load into vehicle. Make sure that the travel blanks and field blanks are in the cooler as well.
3. Drive to site and park in a safe spot away from traffic. DO NOT park on the truck turn around pad for the sewage lagoon.
4. Take coolers and equipment to sample location PEL-5. As this location is 5m from the shore into the ocean, make sure to leave cooler and bottles on the shore.
5. Put on a pair of nitrile gloves.
6. Fill the field blanks with deionized water.
7. Take out bottles needed to sample at this location and place beside the cooler. DO NOT OPEN THE BOTTLES.
8. Select the bottles NOT requiring or containing preservatives and put aside.

9. Take the bottles requiring or containing preservatives and sample these first.
10. Please note that some bottles **MUST** be rinsed and some bottles **MUST NOT** be rinsed. Please refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine if the bottle requires rinsing. If rinsing is required, discard rinse water downstream and away from the sampling location. Rinse the bottle three times. If the bottle must not be rinsed, carefully unscrew the cover and place bottle slowly into the water open end up and slightly tilted to allow water to slowly fill the bottle. If the bottle contains preservatives already, be sure not to tip or overfill the bottle as the preservatives will be washed out. Fill as directed by the water sampling instructions provided by the laboratory that sent the sample bottles. To add preservatives (if not already in the bottle) refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine which preservative to add to the sample. Carefully pour contents into the sample bottle. Screw the cover on tightly and mix by gently tipping the bottle back and forth.
11. Label the bottle with the sampling location number (PEL-5), your name, date, time of collection and preservative added. Make sure to use a waterproof/permanent marker to label the bottles. Place filled sample jar in cooler.
12. Continue until all preserved samples have been taken.
13. Now fill the bottles not requiring preservatives. Refer to the water sampling instructions provided by the laboratory that sent the sample bottles to determine which bottles need to be rinsed.
14. Fill bottle as directed in the water sampling instructions provided by the laboratory that sent the sample bottles and screw cover on tightly. Label and place in cooler.
15. Continue until the rest of the bottles have been filled.
16. Take off nitrile gloves and dispose in garbage bag.
17. Collect cooler and move to sampling location PEL-4. Repeat steps 5 to 16.
18. If you are sampling during mid-August, collect samples for the acute lethality tests for Rainbow Trout and *Daphnia magna* using the supplied jugs. Unscrew the cap of the first jug and dip into the water, slowly filling the jug. Rinse the bottle three times and then fill. Screw the cap back on, label and place in the cooler. Repeat for the second jug. Be sure to properly label with the date, time and sampler's name. Keep cool, but make sure that the samples do not freeze.
19. Collect cooler and move to sampling location PEL-3-2. Repeat steps 5 to 16.
20. If necessary collect cooler and move to sampling location PEL-3-1. Repeat steps 5 to 16.
21. Once all samples have been collected and labeled, pack into coolers tightly with ice packs to limit movement during shipping.
22. Fill out the chain of custody form. An example of a filled out form can be found in Appendix C.
23. Place form in a sealable freezer bag, seal and put in the cooler with samples. Tape up the cooler with packing tape. Tape shipping label to top of cooler and bring to the airport.
24. Fill out the shipping forms for sending the cooler to the lab and check that the plane will be on time.
25. Call the lab and tell them that the samples are on the way and give them the flight information.

As part of QA/QC testing, a second set of samples should be taken from one of the sampling points. This means filling two sets of sampling bottles from the same location. This second set of samples is to verify that sample results are accurate and that sampling methods are consistent. The second set of samples

should be taken from a different sampling point during each sampling period. For example, for the early July sampling period two sets of samples may be taken from PEL-5. For the mid-August sampling, two sets of samples may be taken from PEL-4. During the late September sampling, two sets of samples may be taken from PEL-3-2.

3.4.2 Lab Analysis

Once the lab has received the samples, they will begin processing them. A report stating all results as well as the detection limits will be produced and sent to the Hamlet Office. The report will also state any problems that may have occurred during analysis of the samples.

3.5 Site Records

Copies of records pertaining to operation and maintenance of the sewage lagoon should be kept at both the Hamlet Office and the Hamlet's Maintenance Garage. Information that must be included in these records are (*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Facilities in the Northwest Territories*, Duong and Kent, 1996):

- Volumes of any effluent discharged to the environment through an accidental spill;
- Sewage volume collected (both monthly and annually);
- Details of any maintenance undertaken at site;
- Record sheets;
- Copies of annual reports submitted to the NWB;
- Copy of the Hamlet's water licence;
- Copies of all manuals pertaining to the operation and maintenance of the Sewage Lagoon and Wetland Treatment Facility (i.e. Operation and Maintenance Manual, QA/QC Plan, Spill Contingency Plan, Abandonment and Restoration Plan, Sludge Management Plan); and
- Copies of spill reports and related regulations.

3.6 Safety Procedures

The following safety procedures should be obeyed in order to minimize health risks to personnel working in and around the wastewater and solid waste facilities:

- Equipment is to be kept clean;
- Wear protective clothing such as gloves and boots at all times;
- Work clothes must be kept in a designated change room and employees are to change into them when they arrive for work. Work clothes must NOT be worn home. The Hamlet's PW&S Maintenance Garage should be equipped with laundry facilities to wash work coveralls onsite;
- Hands to be washed frequently; as a minimum before eating and after work; and
- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date. Please contact the Department of Health for a list of the appropriate vaccinations.

3.7 Site Access Control

Access to the lagoon and wetland area is uncontrolled. However, there are a number of large boulders placed at the entrance to the top of the berm walls to prevent residents from driving ATVs and snowmobiles along the top of the berm. There are also bollards placed along the edge of the truck turn around pad to prevent the sewage trucks from backing up too far over the edge of the lagoon. Access to the wetland and surrounding area is not restricted.

3.8 Contact Numbers

Contacts of those responsible for overseeing the operation and maintenance of the lagoon are as follows:

Senior Administrative Officer: (867) 769-6281
Public Works Foreman: (867) 769-6131

4 EMERGENCY RESPONSE

The Hamlet must be able to respond efficiently and effectively to all possible emergencies that may be encountered in the operation of the Hamlet's facilities. These include, but are not limited to fuel, chemical and wastewater spills as well as fires. Due to the nature of the Hamlet's facilities, burning or spillage of unknown or hazardous materials may occur. Only personnel who are properly trained to deal with these situations should respond to such emergencies.

Personnel must familiarize themselves with the emergency preparedness plans before an accident or emergency occurs. Copies of these plans must be kept in all sewage and solid waste disposal vehicles as well as in all common work areas. The following sections list contact numbers and outline procedures to follow in the event of an emergency.

4.1 Emergency Contact Numbers

The following is a list of contact numbers in the case of an emergency:

Fire Department: (867) 769-7222
RCMP Detachment: (867) 769-1111
24 Hour Spill Response Line: (867) 920-8130

4.2 Spill Contingency Plan

A spill contingency plan has been created for activities associated with Hamlet operations including the water treatment plant, sewage lagoon, solid waste facility and storage and handling of hazardous materials. A copy of the plan may be found in the Hamlet office and the PW&S Maintenance Garage. Hamlet personnel must familiarize themselves with the plan in order to respond quickly and effectively in the event of a spill.

4.3 Fire Response Plan

The Hamlet Fire Department is responsible for creating a contingency plan to deal with fires in the Hamlet. As burning of waste may produce harmful gases, special precautions should be taken when responding to fires in and around the solid waste facility. In the event of an uncontrolled fire in the Hamlet, the following steps should be taken:

- Immediately evacuate the area and go to the Hamlet's meeting place;
- Keep everyone including Hamlet personnel up-wind from the source; and
- Contact the Hamlet Fire Department at (867) 769-7222.

5 REFERENCES


1. Department of Indian and Northern Affairs Canada, Water Resources Division & The Northwest Territories Water Board. "Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class "B" Licensees in Collecting Representative Water Samples in the Field and for Submission of a QA/QC Plan", July 1996.
2. Dillon Consulting Limited. "Sewage and Solid Waste Sites, Kugaaruk, NU, Phase II Pre-Design Report", Prepared for Public Works & Services, Government of Nunavut, February 2006.
3. Duong, D. and R. Kent. "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solids Waste Disposal Facilities in the Northwest Territories", Produced for MACA, October 1996.
4. Ferguson Simek Clark Engineers and Architects. "Sewage Treatment Best Available Technology", Produced for Indian and Northern Affairs Canada, Water Resources Division, Renewable Resources and Environment, March 2001.
5. IEG Environmental. "Wastewater Sampling Instructions, Kitikmeot Region", Produced for Department of Community and Government Services, Government of Nunavut, July 2005.
6. Nunavut Bureau of Statistics. "Nunavut: Community Population Projections", March 2000.
7. Nunavut Water Board. "Hamlet of Kugaaruk Water Licence, Licence Number: 3BM-PEL0712", September 2007.

APPENDIX A

Sewage Lagoon Treatment Facility Annual Report Forms




ACAD FILE: 41pw gxcad\0547556000\enp locations.dwg
EDIT DATE: 31.07.2008 PLOT DATE: 31.07.2008



PROJECT
KUGARUUK SEWAGE AND
SOLID WASTE DESIGN
SNP MONITORING

TITLE
SNP LOCATIONS AT LAGOON



SCALE	AS SHOWN
DILLON PROJECT NUMBER	05-4755-6000
CLIENT PROJECT NUMBER	NA
DRAWING NUMBER	200

Record of Sampling Data for Kugaaruk Sewage Lagoon and Wetland Treatment Facility

Year:

Amount of Solids Removed from Sewage Lagoon:

Parameters	Early July				Mid-August				Late September			
	PEL-3-1	PEL-3-2	PEL-4	PEL-5	PEL-3-1	PEL-3-2	PEL-4	PEL-5	PEL-3-1	PEL-3-2	PEL-4	PEL-5
Biochemical Oxygen Demand (BOD)												
Total Suspended Solids												
Conductivity												
Oil and Grease (visual)												
Magnesium												
Sodium												
Chloride												
Total Hardness												
Ammonia Nitrogen												
Total Cadmium												
Total Colbalt												
Total Chromium												
Total Copper												
Total Aluminum												
Total Mercury												
Fecal Coliforms												
pH												
Nitrate-Nitrite												
Total Phenols												
Calcium												
Potassium												
Sulphate												
Total Alkalinity												
Total Zinc												
Total Iron												
Total Manganese												
Total Nickel												
Total Lead												
Total Arsenic												
Total Organic Carbon (TOC)												
Acute lethality to Rainbow Trout, <i>Oncorhynchus mykiss</i>	NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR
Acute lethality to the crustacean, <i>Daphnia magna</i>	NR	NR	NR	NR	NR	NR		NR	NR	NR	NR	NR

NR = Not Required

Be sure to indicated units of measurement

**ANNUAL REPORT
FOR THE HAMLET OF KUGAARUK**

YEAR BEING REPORTED: _____

The following information is compiled pursuant to the requirements of Part B, Item 1 of Water Licence 3BM-PEL0712 issued to the Hamlet of Kugaaruk.

- i)- iii) tabular summaries of all data generated under the "Monitoring Program"; monthly and annual quantities in cubic metres of freshwater obtained from all sources; monthly and annual quantities in cubic metres of each and all wastes discharged;

Attached are results for Monitoring station PEL-1 and PEL-2, as well as detailed chemical, physical and biological analysis required at PEL-3-1, PEL-3-2, PEL-4 and PEL-5 (for the months of July to October, inclusive)

Month Reported	Quantity of Water Obtained from all sources	Quantity of Sewage Waste Discharged
January		
February		
March		
April		
May		
June		
July		
August		
September		
October		
November		
December		
ANNUAL TOTAL		

ANNUAL REPORT FOR THE HAMLET OF KUGAARUK

Please indicate volumes in cubic metres - 1 cubic meter equals 1000 litres

- iv. a summary of modifications and/or major maintenance work carried out on the Water Supply and Waste Disposal Facilities, including all associated structures and facilities;

- v. a list of unauthorized discharges and summary of follow-up action taken;

- vi. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;

- vii. a summary of any studies requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned;

- viii. any other details on water use or waste disposal requested by the Board by November 1st of the year being reported; and

**ANNUAL REPORT
FOR THE HAMLET OF KUGAARUK**

- ix. updates or revisions to the approved Operation and Maintenance Plans (ie. O&M Manual, Abandonment and Restoration Plan, QA/QC, etc.).

ADDITIONAL INFORMATION THAT THE LICENSEE DEEMS USEFUL:

FOLLOW-UP REGARDING INSPECTION/COMPLIANCE CONCERNS:

APPENDIX B

Example of Sampling Instructions from Taiga Laboratory



Taiga Environmental Laboratory

4601 52nd Avenue – Yellowknife, NT X1A 2R3

Phone: (867) 669-2788 Fax: (867) 669-2718 Email: taiga@inac-ainc.gc.ca

Water Sampling Instructions

Collecting the Sample



Step One:

Prior to sampling, ensure you have obtained all the sampling equipment you require, such as the proper bottles, filtration devices, *etc.* Refer to the Taiga's Water Sampling Instructions – Ordering Bottles. If there are any questions or concerns, do not hesitate to contact the laboratory. Please have your water license (if applicable) available before contacting the laboratory to ensure proper bottles are ordered. **Note: you may need more than one bottle per sampling site.**



Step Two:

Check your local departure flight schedule to Yellowknife for the day you plan to take your samples. Samples should be shipped to the Laboratory **as soon as possible** after collection. Time your sampling so that the samples can be shipped out by plane as soon as possible.



Step Three:

Follow the sampling instructions on the back of this sheet for each bottle type. Package bottles in a cooler and send to the laboratory. If you require microbiological tests, such as Total Coliforms, E. coli., Fecal Coliforms, BOD, *etc.*, please contact the laboratory with the collection date and time, the Airline name, the waybill number and the expected time of arrival.



Safety Issues:

Wear appropriate gloves when collecting any sample to avoid contamination and possible exposure to unhealthy substances. The sample preservatives provided by the Laboratory are corrosive and will cause a burning sensation on the skin. If you should spill any on your skin or clothes, rinse the area **immediately** with lots of cool water. Call a doctor should the burning sensation continue.



Taiga Environmental Laboratory

4601 52nd Avenue – Yellowknife, NT X1A 2R3

Phone: (867) 669-2788 Fax: (867) 669-2718 Email: taiga@inac-ainc.gc.ca

Water Sampling Instructions

Collecting the Sample

Parameter Group		Marking	Preservative	Instructions
	Routine	GREEN	Keep cool at 4°C	<ol style="list-style-type: none"> 1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle.
	Nutrients	BLACK	Keep cool at 4°C	
	Biochemical Oxygen Demand (BOD)	PURPLE	Keep cool at 4°C	<ol style="list-style-type: none"> 1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours
	Microbiological	STERILE	Sodium thiosulphate and Keep cool at 4°C	<ol style="list-style-type: none"> 1. DO NOT RINSE BOTTLE 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours
	Total Metals	RED	5mL of 1:3 nitric acid in RED-dot vials	<ol style="list-style-type: none"> 1. Rinse bottle three (3) times with sample 2. Fill to near the top. 3. Add contents of preservative vial 4. Cap bottle and mix.
	Dissolved Metals	RED	5mL of 1:3 nitric acid in RED-dot vials	<ol style="list-style-type: none"> 1. Filter Sample with 0.45 µm Cellulose Acetate filter 2. Rinse bottle three (3) times with filtrate 3. Fill to near the top. 4. Add contents of preservative vial 5. Cap bottle and mix.
	Hexane Extractable Material (HEM) (also known as Oil and Grease)	YELLOW	4mL 1:1 sulphuric acid in YELLOW-dot vial	<ol style="list-style-type: none"> 1. DO NOT RINSE BOTTLE 2. Fill to shoulder of bottle. 3. Add contents of preservative vial 4. Cap bottle and mix
	BTEX, THM & Purgeable Hydrocarbons	40 mL CLEAR GLASS W/ WHITE LID	Keep cool at 4°C	<ol style="list-style-type: none"> 1. DO NOT RINSE BOTTLE 2. Fill bottle completely leaving NO air bubbles
	Extractable Hydrocarbons	1 L AMBER GLASS W/ WHITE LID	Keep cool at 4°C	<ol style="list-style-type: none"> 1. DO NOT RINSE BOTTLE 2. Fill to top and cap bottle.
	Cyanide	BLUE	1mL of 6N sodium hydroxide	<ol style="list-style-type: none"> 1. Rinse bottle three (3) times with sample 2. Fill to near the top. 3. Add contents of preservative vial 4. Cap bottle and mix.
	Thiocyanate	ORANGE	2mL of 25% sulphuric acid	
	Phenol	YELLOW with P	2mL of 20% sulphuric acid	
	Sulphide	ORANGE with S	2mL of 25% zinc acetate	
	Radionuclide	RED with R	25mL of 17.5% nitric acid	
	Chlorophyll A	1L BROWN PLASTIC BOTTLE	Keep cool at 4°C	<ol style="list-style-type: none"> 1. Rinse bottle three (3) times with sample 2. Fill to top and cap bottle. 3. Sample must be sent to laboratory within 24 hours

APPENDIX C

**Example of filled out Chain of Custody Forms for Taiga Laboratory
and HydroQual Laboratories Ltd.**



TAIGA ENVIRONMENTAL LABORATORY
LABORATOIRE ENVIRONNEMENTAL TAIGA
4601 – 52 Avenue, P.O. Box 1500, Yellowknife, NT, X1A 2R3
Tel: (867) 669-2788 • Fax: (867) 669-2718
www.taiga.gc.ca

Batch No. :

Send Results & Invoice to:

(Please notify if results or invoice are to be sent to different locations)

Company/Agency: Hamlet of Kuguaruk

Address: Hamlet Office

City/Town: Kuguaruk Province/Territory: NU

Postal Code: X0B 1K0

Phone: (867) 769-6281 Fax: (867) 769-6069

E-mail: _____

Signature : _____

Client Project No: SNP - Sewage Lagoon

Date collected: _____

Time collected: _____

Sampler: _____

Location: Kuguaruk Sewage Lagoon

Rush Required: ☐ Yes ☒ No (Surcharge applies, please check with Laboratory for price and availability)

Note: Analysis may be subcontracted without prior notice.

Date Received: _____ Received By: _____

Comments: _____

(Laboratory use only)

-WATER SAMPLES -

Sample Type (freshwater, sewage, wastewater, potable, groundwater, salt water, etc)	<u>Sewage</u>	<u>Sewage</u>	<u>Sewage</u>
Client Sample ID (As it should appear on final report)	<u>PEL-5</u>	<u>PEL-4</u>	<u>PEL-3-2</u>
Taiga Sample ID (Laboratory use only)			

Bottle Type and Parameter

[✓] PLEASE CHECK PARAMETERS REQUESTED BELOW:

Routine	pH, Conductivity, Alkalinity	pH	Cond	Alk	Cl	SO ₄	F	NO ₂ -N	NO ₃ -N	NO ₂ + NO ₃ -N	Ca	Mg	Na	K	Hardness	SiO ₂	Color	Laboratory use only
Nutrients	Individual Anions Suite <input type="checkbox"/>																	
	Total Nitrite (NO ₂) + Nitrate (NO ₃)																	
	Individual Cations Suite <input type="checkbox"/>																	
	Hardness (Calculated)																	
	Reactive Silica																	
	Chemical Oxygen Demand																	
	Nitrogen: Total, Dissolved																	
	Turbidity																	
	Total Suspended Solids, Dissolved Solids																	
	Ammonia																	
Sterile	Phosphorus: Total, Dissolved, Ortho																	
	Carbon: Total, Dissolved																	
	Chlorine: Total, Residual																	
	Visible Oil and Grease																	
	Fecal Coliforms (FC)																	
	Total Coliforms (TC), E. Coli (EC)																	
	Fecal Streptococcus (FS)																	
	Biological Oxygen Demand																	
	Hexane Extractable Material (O&G)																	
	BTEx, Purgeable HC (40mL x 2 vials)																	
Metals	ICP-MS(1): Cd, Cr, Cu, Co, Mn, Ni, Pb, Zn, Fe																	
	ICP-MS(2): 25 element scan includes As (not included: B, Bi, Hg, Sn)																	
	Individual Metals by ICP-MS (please circle each metal): Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cs, Cu, Fe, Hg, Li, Mn, Mo, Ni, Pb, Rb, Sb, Se, Sn, Sr, Ti, Tl, U, V, Zn																	
	Hexane Extractable Material (O&G)																	
	BTEx, Purgeable HC (40mL x 2 vials)																	
	Extractable HC (1L amber glass bottle)																	
	Trihalomethanes (40 mL x 2 vials)																	
	Other: see special request form																	
	For safety purposes, please disclose any contaminants (e.g. heavy metals, cyanide, etc.) that may be present at high levels and pose a risk to human health:																	
	Wastewater from sewage lagoon, possible pathogens																	



#5, 6125 12th Street SE Calgary, Alberta Canada T2H 2K1
Tel (403) 253-7121 Fax (403) 252-9363 www.hydroqual.ca

Test Request / Chain of Custody

Reporting and Billing Information

Client: Sample:

Client / Operation: <i>Hamlet of Kugaaruk</i>	
Contact: <i>Name of Contact</i>	
Report Address: <i>Hamlet Office</i>	
Billing Address:	
Tel <i>(867) 769-6281</i>	Fax <i>(867) 769-6069</i>
Quote/PO/Job	

Rush: 50% surcharge; 100% surcharge (evenings and weekends); Microtox® required in less than 12 hours 100% surcharge; 24 hours 50%

Sample ID	Sampled By / Date / Time	Location	Method	Type
<i>PEL-4</i>	<i>Name / Date / Time</i>	<i>Kugaaruk Sewage Lagoon</i>	<i>Grab Sample</i>	<i>Sewage</i>
<i>PEL-4</i>	<i>Name / Date / Time</i>	<i>Kugaaruk Sewage Lagoon</i>	<i>Grab Sample</i>	<i>Sewage</i>

Tests Requested (codes on back)
(example: trout with 5 treatments, TR-D)

<i>DA-D</i>						Sample Received Intact (y / n)
<i>TR-D</i>						

Notes: S = single treatment, D = multiple treatments

Check appropriate box below

Relinquished By	Date / Time

Received By (HQ)	Date / Time

Our liability is limited to the cost of the test requested on the sample as received. No liability in whole or in part is assumed for the collection, handling or transport of the sample, application or interpretation of the test data or results in part or in whole.

Test Codes, Volumes, and Sampling Guide

Test (call lab for complete list)	Code	Sample Volume (L)		Holding Time (days)
		undiluted (S)	multiple (D)	
Freshwater <i>Daphnia magna</i> (48 hours, static acute)	DA	1	1	5
rainbow trout (96 hours, static acute)	TR	20	40	5
algal growth inhibition (72 hours, static)	AG	1	1	3
<i>Ceriodaphnia</i> survival and reproduction (7 day) *	CD	3	6	3
fathead minnow survival and growth (7 day) *	FM	10	20	3
<i>Lemna minor</i> survival and growth (7 day)*	LM	1	1	3
Salmonid early life stage	ELS	80	160	3
Sediments <i>Hyalella azteca</i> (14 day, static)	HA	2	5	42
chironomids (10 day, static)	CT	2	5	42
<i>Lumbriculus</i> (10 day, static)	LV	2	5	42
marine amphipod or polychaete	AM/PO	2	5	42
Microbial heterotrophic/hydrocarbon degrading bacteria	THB/HDB	0.25	0.25	na
fungal enumeration	FE	0.25	0.25	na
microbial enumeration by substrate preference	ME	0.25	0.25	na
total coliforms and E.coli or fecal coliforms	TC/EC,FC	0.25	0.25	1
BOD (5 d biological oxygen demand)	BOD	1	1	1
<i>Cryptosporidium</i> and <i>Giardia</i> (raw/potable)	CGE	call lab		96
Microcystin (protein phosphatase inhibition)	PPI	0.1		na
algal identification	AGID	0.1		na
G50 Microtox / bacterial luminescence	G50/BL	0.1	0.1	3
Other seedling emergence	SE	1	1	na
root elongation	RE	1	1	na
earthworm survival (14 days)	EW	1	1	na
treatability	TREAT	call lab		na
ecological health indices	EHI	call lab		na
total suspended solids	TSS	call lab		1
earthworm chronic (60 days)	EW	call lab		na
plant growth studies	PGT	call lab		na

Notes: S, single treatment; D, definitive; na, not applicable; * sample must be divided equally into 3 separate containers upon collection or at lab
 For marine testing call Kate de Windt or Ingrid Carleton-Dodds

Sampling and Shipping Instructions (Supporting Work Instruction 4.3.1.4.1)

Containers

- liquids glass, polyethylene, or polypropylene container
 amber glass bottle with teflon lined cap is preferred for small samples (<2L)
 collapsible 6 and 20L carboys or plastic pails and gasket lined lids
- Solids glass, polyethylene, or polypropylene container (wide mouth)
 polyethylene bags (6mL)
- air new Ziploc® bags for viable samples (RCS), spore traps, swab and tape samples on slides
 new ziploc® bags or jars for bulk samples

Sampling

- liquids rinse three times with sample before filling (>5% of container volume for each rinse)
 fill container to exclude air (minimal headspace) and seal with cap; cover cap with tape and initial
 keep composited sample cool during collection (4 ± 1 °C)
- solids fill and seal container
- air follow manufacturers instructions for air sampling devices
 take bulk samples with sterile cutting tool
 take tape samples with 5 cm piece of clear tape, place on surface to be sampled, remove and
 affix to clean slide (avoid creases)

Labelling

- all label sample container with type of sample (effluent, groundater, surface water, etc.), source,
 date, time of collection, and name of sampler (s)
 tape lids of containers and initial tape - fill out chain of custody and ship with sample

Transport

- samples should be transported in the dark, at 1-8°C. During the winter season, ship samples in
 a heated truck, in order to keep them from freezing.