Hamlet of Hall Beach, NU Sewage Treatment Facility Operation and Maintenance Manual

Hamlet of Hall Beach

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Sewage Treatment Facility – Operation and Maintenance Manual

Community & Government Services, Government of Nunavut

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Submitted by

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1 INTRODUCTION

1.1 Purpose

The purpose of this manual is to assist the Hamlet of Hall Beach personnel with the operation and maintenance of their sewage treatment system. 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 Hall Beach is located on the shore of the Melville Peninsula, at latitude 68°46'N and longitude 81°12'W (Environment Canada, 2011). Hall Beach is situated in the Foxe Basin, 840 km by air northwest of Iqaluit. It has an estimated population of 704 (Government of Nunavut, 2011). Hall Beach is located in continuous permafrost zone. The flat to gently rolling terrain is made up of raised beaches of sand and gravel which is studded by numerous lakes and ponds.

It is estimated that Hall Beach receives an average of 102.3 mm of rainfall and 124 cm of snowfall per year (Environment Canada, 2011). In the month of July, mean high temperatures are 9.4° C and mean low temperatures are 2.8° C (Environment Canada, 2011). In the month of January, mean high temperatures are -25.8° C and mean low temperatures -35.7 C (Environment Canada, 2011). Ice freeze-up typically occurs during the month of November, but may happen as early as September or October. Spring thaw typically usually occurs at the end of May.

2 BACKGROUND

2.1 Design Data

The Hall Beach sewage treatment facility is located approximately 1 km from the community centre. It is comprised of two lagoon cells. Effluent from the lagoons is normally discharged seasonally into the wetland type area using a pump and hose to provide a polishing step prior to effluent flowing into the Foxe Basin. The lagoon berms are composed of gravel and a small quantity of sand. The Hall Beach sewage lagoons were expanded in 2002 after a study by Dillon Consulting Limited and FSC Engineers and Architects found that sewage lagoon expansion and utilization of wetland treatment was necessary to meet the Hamlet's needs for the next 20 years.

During a site visit conducted on August 31st, 2010, it was discovered that only one of the cells is currently in use. It is unclear as to why one of the lagoons is not being used. Additionally, a leak was found in the corner of the lagoon in use, causing sewage to be discharged on a continuous basis.

**Image taken from Google Earth Pro, December 2010*

Figure 2-1. Site Map of Sewage Lagoon and Solid Waste Facilities

2.2 Previous Studies

Wetlands Treatment Study, Hall Beach, Nunavut (2003)

In 2003, Dillon Consulting Limited was retained by Indian and Northern Affairs Canada (INAC) to complete a wetlands study in Hall Beach, Nunavut to assess the effects seasonal changes have on the ability of wetlands to remove contaminants from municipal wastewater. Sampling results indicated that contaminant removal occurred in the sewage lagoon and at the early stages of the wetland, therefore it was determined that the wetland provided a polishing step to wastewater effluent, prior to its discharge into Foxe Basin.

Hall Beach Sewage Lagoon, Hall Beach, Nunavut (2002)

In 2002, FSC Engineers & Architects was retained by the Department of Community and Government & Transportation, Government of Nunavut, to complete a study to assess the capacity of the community's sewage treatment system to provide adequate sewage treatment.

Hydraulic and organic loading rates where utilized to estimate the capacity of the Hall Beach sewage lagoons to provide adequate sewage treatment. The study determined that hydraulic loading rates fell within the recommended rates. Contaminant loading rates were found to be elevated, resulting in recommendations to expand sewage lagoons and modify existing wetlands to maximize wastewater treatment.

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 and authorization from the INAC Inspector has been provided. Effluent will be discharged using a pump and hose to pump effluent from the lagoon into the adjacent wetland area. Effluent will flow through the wetland area until it discharges into Foxe Basin. As Foxe Basin is the final discharge location, 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 using a pump and hose to decant effluent into the adjacent wetland. Prior to decanting any effluent into the wetland, 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 pump and hose system will be disconnected 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.

3.3 Sewage Sludge Management Plan

3.3.1 Characterization of Sludge

Collected sewage will mostly come from residential buildings in the Hamlet as there are few 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.

3.3.2 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. 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.

3.3.3 Methods for Performing Sludge Depth Measurements

According to the National Guide to Sustainable Municipal Infrastructure (2004), sludge depth measurements should be performed each year to determine the depth of sludge and rate of sludge accumulation within the lagoon. This will help Hamlet staff to plan and prepare for lagoon desludging operations. There are a number of methods available for measuring the depth of the sludge blanket; however one of the more economical tools is called a Sludge Judge®. The Sludge Judge® is a clear plastic tube with a check valve on the bottom and measured increment markings on the tube. It comes in 5-foot sections that can be screwed together as necessary. The number of sections required for sampling will be dependent on the depth of the water level in the lagoon.

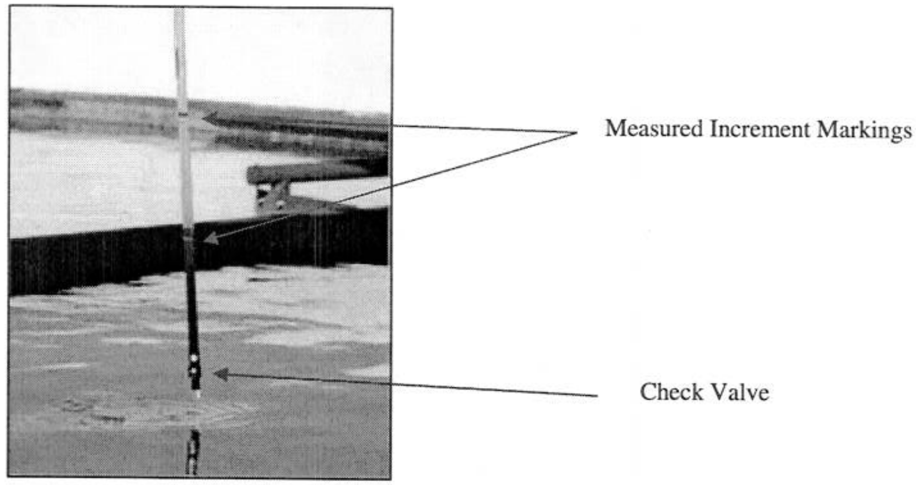

Figure 3-1. Photo of Sludge Judge®

Source: http://www.geneq.com/catalog/en/sludge_judge.htm
Retrieved March 29, 2010

Sludge depth measurements should be taken based on a grid format, and should be taken in the same locations each year. Based on the document *Sludge Survey Methods for Anaerobic Lagoons* (Westerman, Shaffer & Rice, 2008), 6 depths measurements per acre should be collected.

The estimated bottom surface area of the lagoon in Hall Beach is 1.47 acres. Therefore 8 to 9 sludge depth sampling locations are required. Samples should be collected from the bottom of the lagoon using a grid formation. According to Westerman *et al.*(2008), sampling locations on-site should be marked by survey flags or landmarks (sewage truck discharge chute, boulders, outlet pipe, etc.). Hamlet staff can place markers on the side of the lagoon to indicate sampling point locations at intersecting junctures.

To prepare for sludge depth measuring, the follow items must first be obtained:

- A boat (a flat bottom boat should be used as they are more stable than a canoe or V-bottom boat, Westerman *et al.*, 2008)
- Appropriate floatation devices for each sampling team member
- Sludge Judge® or a similar measuring device (ensure that the check valve is operating properly)
- Measuring rod to measure total depth from top of water level to bottom of the lagoon
- Appropriate Personal Protective Equipment (PPE) such as latex or nitrile gloves, CSA certified rubber boots, coveralls, safety goggles, etc.
- Notebook and pen to record measurements

Choose to take depth measurements during the summer, after the lagoon has completely thawed. Take measurements on a calm day when weather conditions (wind, rain, etc.) will not interfere with the process. According to Westerman *et al.* (2008), always have a team of three people to take measurements. One person will stay on shore to monitor and act as a rescuer should the need arise. The other two team members will be in the boat, one person will help to anchor the boat and record depth measurements while the second person uses the Sludge Judge® and measuring rod to obtain the measurements. All team members, including those on the shore, are to wear appropriate floatation devices (Westerman *et al.*, 2008).

To take the depth measurements, follow these steps provided by Westerman *et al.* (2008):

1. Paddle to the first sampling location. Be sure to mark down which location it is (ie. depth sampling point #1).
2. Slowly lower the Sludge Judge® into the lagoon being careful not to move the tube up and down. To determine when the tube has reached the top of the sludge layer, watch the liquid level inside the tube as it is lowered into the lagoon. When the tube has reached the sludge layer, the water level inside the tube will drop slightly.
3. As soon as the tube has reached the sludge layer, tug on the rope to secure the check valve and pull the tube up slowly.
4. Using the increment markings on the tube, measure the depth of the liquid layer (this is the layer of water that sits above the sludge layer). There should be 1 to 2 inches of sludge at the bottom of the tube, indicating that the tube did reach the sludge layer. The depth of the liquid layer in the tube is measured from the top of the sludge to the top of the liquid (Refer to Figure 3-2 below). Record the measurement.

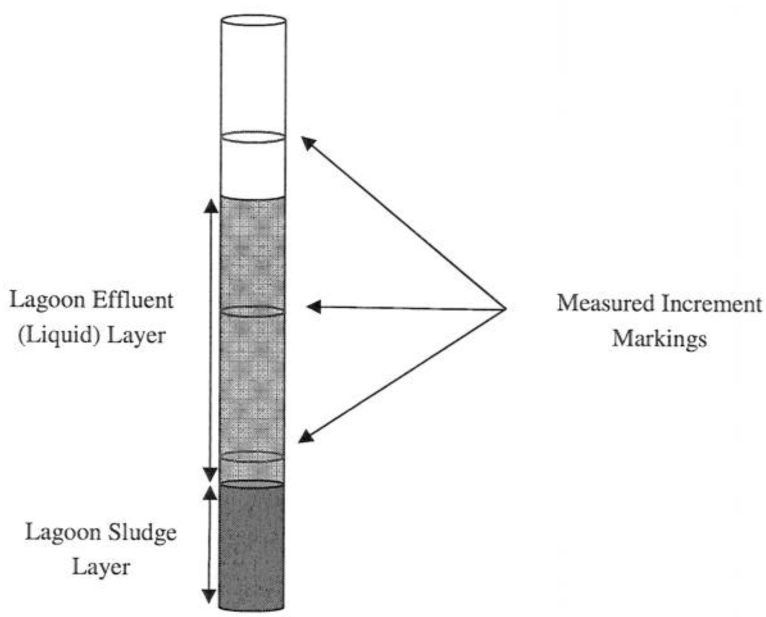

Figure 3-2. Sketch of Tube After Retrieving Lagoon Effluent Depth Measurement (Not to Scale)

5. Empty the contents of the Sludge Judge® back into the lagoon.
6. Take the measuring rod, place it in the lagoon with the zero end pointing downwards. Lower the rod all the way down until the bottom of the rod touches the lagoon floor. Read the water level measurement. This is the total depth of the effluent plus the sludge layer (Refer to Figure 3-3 below). Record the measurement.

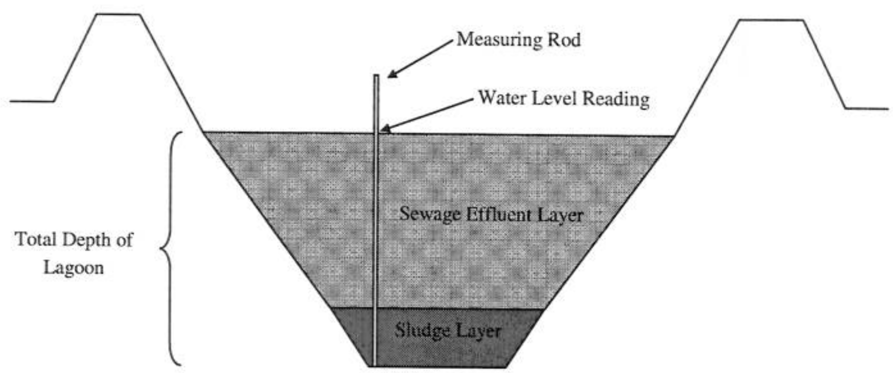

Figure 3-3. Sketch of Lagoon Cross-Section and Total Depth Measurement (Not to Scale)

7. To find the thickness of the sludge layer, subtract the depth of the liquid layer from the total depth.
8. Repeat steps 2 through 7 for the rest of the sampling locations. Be sure to record all measurements and the corresponding sample locations.

An alternative method to measure the depth of the sludge blanket is to lower the Sludge Judge® all the way to the bottom of the lagoon. Sludge and effluent will enter the tube through the check valve. When the tube is lifted out of the water, a distinct layer of sludge will be visible at the bottom of the tube. The distance from the bottom of the tube to the top of the sludge layer in the tube is the estimated thickness of the sludge blanket. Unfortunately this method can provide inaccurate results as the sludge does not enter the tube as easily as the effluent. This may cause the sludge depth measurement to be less than the actual depth of the sludge blanket (Westerman *et al.*, 2008).

When the sludge layer has become thick enough to affect the operation of the lagoon, the sludge should be removed, treated and disposed. 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 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.

3.3.3.1 *Methods for Sampling Sludge*

Although there are no specific guidelines with regards to the frequency of sludge sampling, sampling of sludge once per year should be sufficient to monitor the contaminant concentrations. Therefore sludge samples can be collected during the sludge depth measurements.

As well, parameters to be analyzed in the sludge have not been stated in the Hamlet's water licence. Therefore, prior to initiating the sludge sampling program, the Hamlet must contact the Nunavut Water Board to determine which parameters (ie. microbiological, nutrients, physical, metals, etc.) to test for during the program.

Sludge samples should be collected as a composite sample. This means that sludge samples are taken from various points in the lagoon and mixed together before bottling and sending to a laboratory for analysis (Westerman *et al.*, 2008). To collect sludge samples, gather all items listed in Section 3.3.3 for sludge depth measurements as well as the following:

- Sample bottles
- Preservatives (if required)
- Clean 5 gallon bucket
- Cooler
- Ice packs to keep samples cool
- Chain of custody forms (also called COCs)
- Permanent marker to mark on bottles
- Pen to fill out chain of custody forms
- Packing tape
- Shipping label to send samples back to the lab
- Clean stir-stick to mix sludge samples in 5 gallon bucket (must be clean as an unclean mixer may contaminate the sample, leading to inaccurate results).
- Sealable freezer bag

Samples must be collected shortly before they are sent to the lab for analysis. For example, if the samples must be at the airport by 2:00pm, the samples should be collected that morning. Make sure that there is 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 some of the samples will no longer good for analysis. Be sure to contact the airport and ask what time the samples must be there to make the flight. Contact the lab to let them know that samples will be arriving and ask if they are able to pick them up at the airport.

To collect a composite sludge sample, follow the procedure below (adapted from Westerman *et al.*, 2008):

1. Prior to beginning sampling, label the sample bottles with the date, time of collection, your name and description of sample (ie. sludge from Hall Beach sewage lagoon).
2. After taking the sludge depth measurement using the Sludge Judge®, dip the Sludge Judge® into the lagoon to collect a sample of sludge in the tube. Pull the tube out and release the valve at the bottom to discharge sludge into the 5 gallon bucket. Be careful not to empty any of the effluent (liquid) into the bucket.
3. Continue this step until a sample of sludge has been collected from each sampling location.
4. Mix the sludge samples together in the 5 gallon bucket. Collect samples by dipping sample bottles carefully into the bucket. Do not allow any of the preservatives in the bottles to spill out of the bottle while filling it. Cap bottles and place in cooler.
5. Once all bottles have been filled, pack bottles in cooler with ice packs for shipping. Fill out chain of custody forms, place in a sealable freezer bag and place in the cooler with the samples. Close cooler and secure with packing tape and place shipping label on top of the cooler.
6. Take cooler to the airport and ship to the laboratory immediately. Some sample parameters must be analyzed within 24 hours of collection, otherwise they will be no longer good for analysis. Call the lab and give them the shipping number of the cooler.

Samples should be only of sludge and include as little effluent as possible. This is because of the desludging procedure for the lagoon. When it is time to desludge the lagoon, the lagoon effluent will first be discharged to the wetland treatment area leaving mostly sludge (Westerman *et al.*, 2008). Once the sludge is removed, it will most likely require further treatment prior to disposal. Sampling only the sludge will give a more accurate analysis of the amount of contaminants within the sludge to be treated. Results are to be reported once analysis has been completed and are to be included in the Annual Report.

3.4 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.

3.4.1 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 a polishing step to remove all residual organic and inorganic contaminants. The water licence has set the following effluent quality standards for effluent discharged from the sewage lagoon as illustrated in Table 3.1.

Table 3.1. Quality Standards for Effluent Discharged from Sewage Lagoon (Station HAL-4)

Parameter	Maximum Average Concentration
BOD_5	120 mg/L
Total Suspended Solids	180 mg/L
Fecal Coliforms	$1x10^6$ 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 3.5.1.

3.4.2 Program Schedule

Figure 3-4 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 D.

**Image taken from Google Earth Pro, October 2010.*

Figure 3-4. Sampling Locations for Sewage Lagoon and Wetland Treatment Facility

Table 3.2. GPS Coordinates for Sampling Stations

Station	Latitude	Longitude
HAL-2	68° 48' 28.53" N	82° 43' 47.33" W
HAL-4	64° 9' 56.70" N	84° 49' 25.38" W
HAL-5	68° 31' 17.91" N	81° 44' 15.19" W

The following table is a sampling schedule for the lagoon and wetland treatment area during the decantation period. Note that parameters may change, check the current water licence for updates.

Table 3.3. Sampling Program Schedule

Sampling Point	Description	Parameters to be Tested		Sampling Dates
HAL-2	Runoff from Solid Waste Disposal Facility	Total Petroleum Hydrocarbons (TPH)		Once annually, during periods of runoff or seepage
		Polycyclic Aromatic Hydrocarbons (PAH)		
		BTEX (Benzene, Toluene, Ethylbenzene, Xylene)		
		BOD	Fecal Coliforms	
		pH	Conductivity	
		Total Suspended Solids	Oil and Grease	
		Nitrate-Nitrite	Ammonia Nitrogen	
		Total Phenols	Total Alkalinity	
		Total Hardness	Calcium	
		Magnesium	Potassium	
		Sodium	Sulphate	
		Total Arsenic	Total Cadmium	
		Total Copper	Total Chromium	
		Total Iron	Total Lead	
		Total Mercury	Total Nickel	
HAL-4	Effluent discharged from Sewage Disposal Facility	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Upon providing notice to the inspector and every four weeks thereafter when flow is observed
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	
		Oil and Grease (visual)	Total Phenols	
		Magnesium	Calcium	
		Sodium	Potassium	
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	
		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	
		Total Cobalt	Total Manganese	
		Total Chromium	Total Nickel	
		Total Copper	Total Lead	
		Total Aluminum	Total Arsenic	
		Total Mercury	Total Organic Carbon (TOC)	
HAL-5	Final Effluent Discharge Point prior to entering Foxe Basin	Biochemical Oxygen Demand (BOD)	Fecal Coliforms	Upon providing notice to the inspector and every four weeks thereafter when flow is observed
		Total Suspended Solids	pH	
		Conductivity	Nitrate-Nitrite	
		Oil and Grease (visual)	Total Phenols	
		Magnesium	Calcium	
		Sodium	Potassium	
		Chloride	Sulphate	
		Total Hardness	Total Alkalinity	

		Ammonia Nitrogen	Total Zinc	
		Total Cadmium	Total Iron	
		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, *Oncorhynchus mykiss* (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13) Acute lethality to the crustacean, *Daphnia magna* (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/14)		Once annually, approximately mid-way through discharge

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.

3.4.3 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.

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

Section 3.5.1 to Section 3.5.2 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).

3.5.1 Sample Collection

3.5.1.1 Preparing for Sample Collection

Samples are to be collected from the marked Surveillance Network Program (SNP) locations. Each location should be marked with a sign and location number as well as located with GPS coordinates. Please refer to Figure 3-4 for a map of the SNP locations and

Table 3.2 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 enough sampling bottles and equipment to test the for the list of parameters in Table 3.4. 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.

   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, *Oncorhynchus mykiss* (as per Environment Canada's Environmental Protection Series Biological Test Method EPS/1/RM/13)
Acute lethality to the crustacean, *Daphnia magna* (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 3-4 and familiarize yourself with the area. Walk to each location so you know where each sample must be taken.