(In reply, please refer to)
Our File: 05-4319-3000

DILLON CONSULTING

November 9, 2007

Government of Nunavut
Department of Community and Government Services
P.O. Box 379
Pond Inlet, NU
X0A OSO

Attention: Bhabesh Roy, P.Eng.
Municipal Planning Engineer

Re: Operation and Maintenance Manual

Dear Mr. Roy:

Find enclosed the Operation and Maintenance Manual for the sewage treatment system for the Hamlet of Cape Dorset.

We hope that this manual meets with your requirements at this time.

Sincerely,

Dillon Consulting Limited

Gary Strong, P.Eng.
Project Manager

GS

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Operation and Maintenance Manual, Sewage Treatment System

Hamlet of Cape Dorset

November 9, 2007

Operation and Maintenance Manual, Sewage Treatment System - Hamlet of Cape Dorset

Government of Nunavut, Department of Community and Government Services

05-4319-3000

Gary Strong - Project Manager

Submitted by

Dillon Consulting Limited

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1 INTRODUCTION

1.1 Purpose

The purpose of this manual is to establish standard operation and maintenance protocol for the management of the sewage treatment system for Hamlet of Cape Dorset. Information presented in this manual has been developed based on the document "Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities." This document fulfils Item C of Part II of the Water License that will be issued once it has been obtained from the Nunavut Water Board. The Water License will be included as part of the appendices (**Appendix A**) of the O&M Manual.

To assist personnel that operate the sewage lagoon with proper operation and maintenance procedures, the following requirements are further addressed in this O&M manual:

1. Proper operation and maintenance procedures for the sewage treatment system to provide effective treatment and operation of the facility;
2. Monitoring program description;
3. Appropriate methods and procedures for wastewater sampling, and;
4. A spill contingency plan.

1.2 Site Setting

The Hamlet of Cape Dorset is located on Dorset Island, near the southwest tip of Baffin Island at 64° 14' north latitude and 76°32' west longitude. Situated in the Qikiqtaaluk Region of Nunavut, the community is approximately 402 air km southwest of the city of Iqaluit (see **Figure 1**).

Located in the continuous permafrost zone, Cape Dorset has a climate which consists of short cool summers and long cold winters. Annual snowfall and rainfall are approximately 118 cm and 15 cm, respectively. The typical temperature range for January is between a low of about -29°C and a high of about -23°C whereas in July, the temperatures range between a low of 3°C to a high of about 7°C. Usually, freeze up occurs during the month of November but it may happen as early as October or even September. In some years, early freeze up may thaw again before final freeze up occurs. Spring thaw typically takes place during the month of July, but the time frame can vary as much as freeze up. During spring runoff, the community experiences mild flooding.

The community is situated between two valleys of the Kingnait range of hills. Topography consists of areas of moss surrounded by rock outcrops, bedrock and steep cliffs.

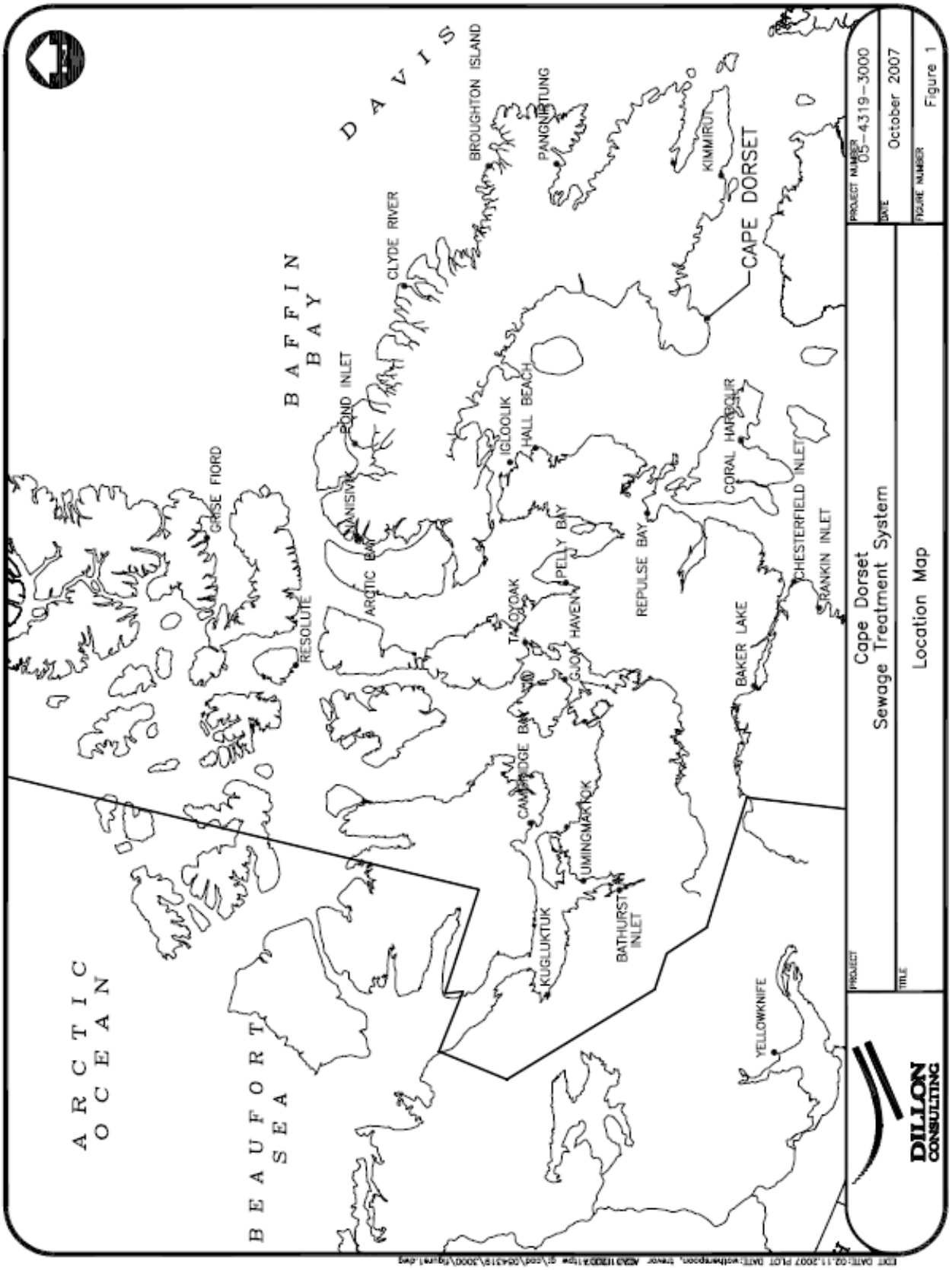

Figure 1: Map of Nunavut

The community uses trucked services for both water delivery and sewage collection. Wastewater is treated using a constructed retention cell treatment system that is located approximately 800 m southwest from the center of the community. **Figure 2** (on page 5) shows the location of the sewage treatment facility in relation to the community and existing plant.

1.3 Population Projection

Presently, the population of Cape Dorset is approximately 1,236 people (Statistics Canada, 2006). **Table 1** shows the population growth for the Hamlet over the lifetime of the plant projected by Nunavut Bureau of Statistics.

Table 1: Population Projections for Cape Dorset

Year	2000	2006	2011	2016	2021	2026
Population	1,213	1,382	1,536	1,692	1,848	2,002

Source: Nunavut Bureau of Statistics.

A population of 2,002 people was used for the design horizon of the facility.

1.4 Contact List

The Hamlet of Cape Dorset has a Maintenance Management Operation System (MMOS) already in place. Regular maintenance will be conducted as outlined in this manual whereas specific work orders for sewage treatment facility and system will be passed through to the MMOS. A list of the individuals that are responsible for the operation and maintenance of the sewage treatment and waste disposal system are as follows:

Senior Administrative Officer	(867) 897-8943
Municipal Works Foreman	(867) 897-8943

2 BACKGROUND

2.1 General

2.1.1 Sewage Treatment Facility

The facility incorporates a constructed lagoon as the treatment system. Lagoon cell was designed with a 365 day hydraulic retention for storage and treatment. As shown in **Figure 3** on page 6, it has a rectangular shape with approximate dimensions of 170 m and 192 m, distances calculated from inner berms. With an operating liquid level of 3.5 m and 1.0 m freeboard, the lagoon cell has an overall, as constructed, volume capacity of 96,100 m^3.

Wastewater is stored in the lagoon cell during the entire year. During the spring and summer, natural biological and physical processes will occur, treating the sewage. In early to mid autumn, the sewage

effluent is discharged into P Lake (with a capacity of 11,650 m^3), prior to freeze up. Further filtration and treatment will occur as the wastewater flows from P Lake into a small wetland area and down over a cliff and then through a mossy area, approximately 370 m in length, before draining into Telik Inlet.

The sewage lagoon can be considered a water retaining structure. The classification of the berms (dams) that comprise the lagoon is considered to have a very low consequence category. In the event of a dam failure there is no expected loss of life, and there are no economic/financial consequences other than to the owner's facilities. This classification is used to determine the operation and maintenance procedures for the berms and structures.

2.1.2 Sewage Collection and Transport

All municipal wastewater of the community is collected and transported to the sewage lagoon by vacuum trucks. The sewage collection service operates 7 days a week. With three trucks operating, about 15 to 20 trips are made to the sewage lagoon per day.

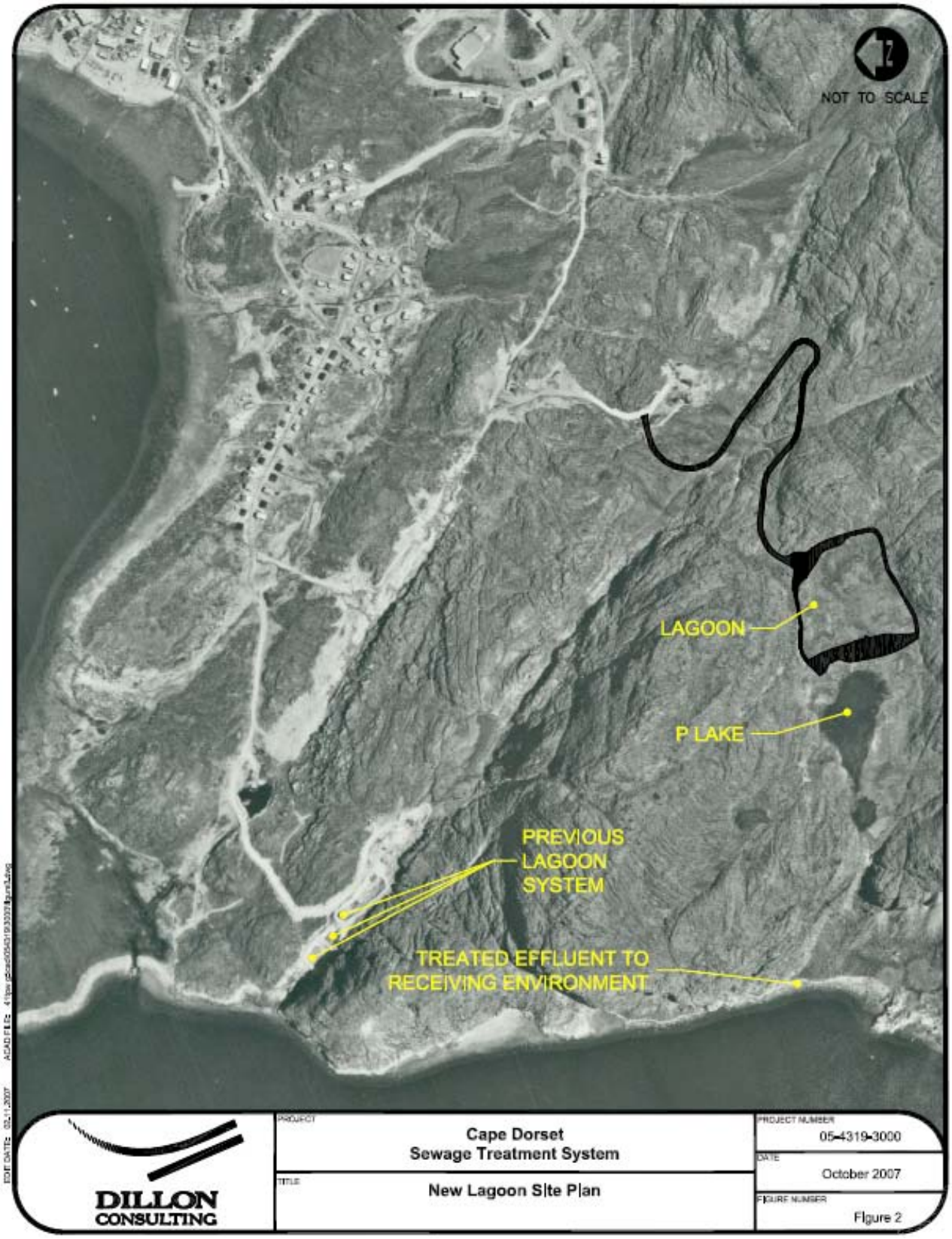

Figure 2: Location of Sewage Treatment Facility

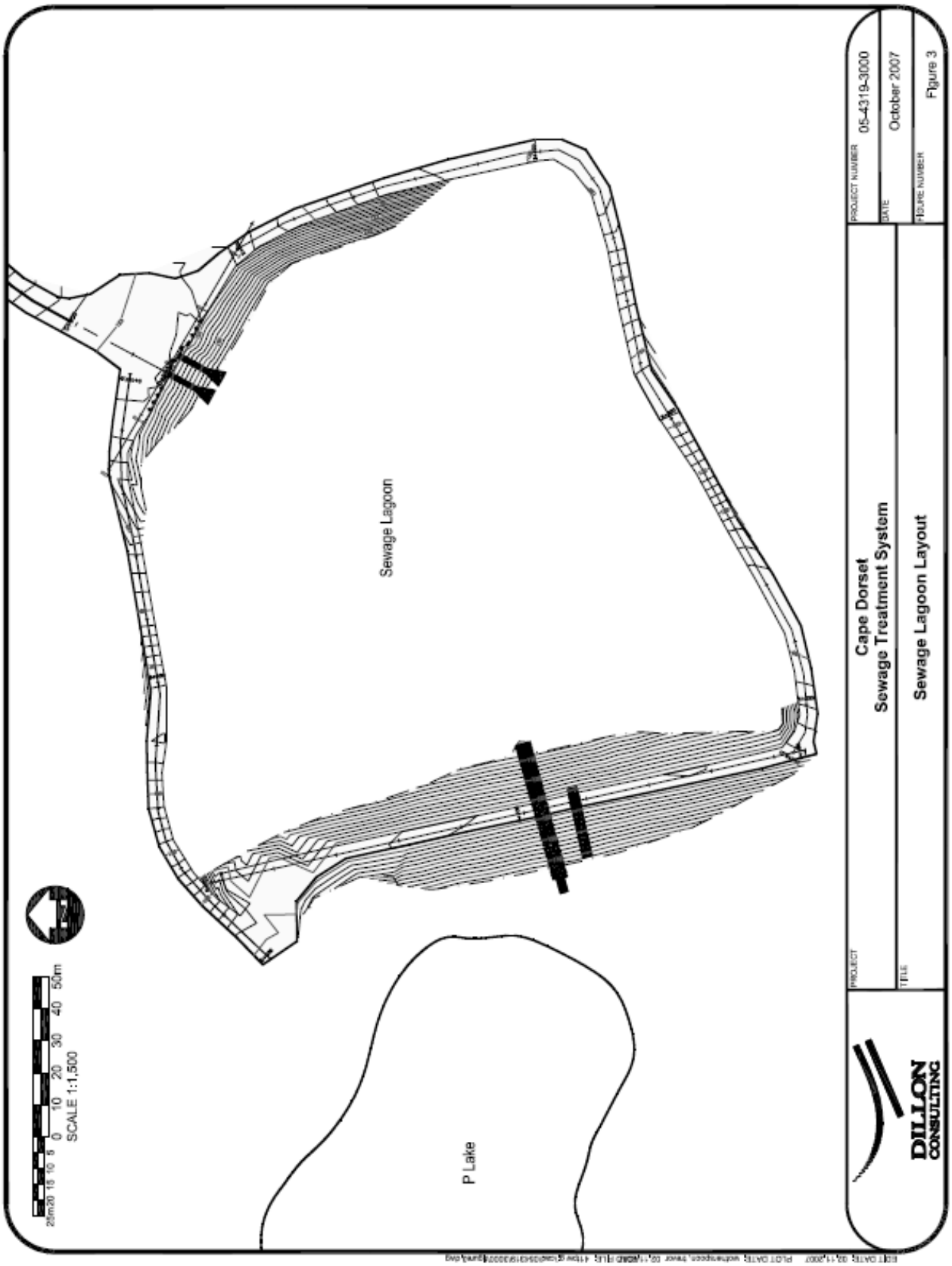

Figure 3: Sewage Lagoon Cell

2.2 Sewage Production

It is approximated, for smaller communities such as Cape Dorset where water distribution is provided by trucks, that the sewage generation is equal to the water consumption. Therefore, the daily and annual sewage generation rates are approximately equivalent to the water consumption rates. The following equation, proposed by MACA, gives the water consumption rate for small communities on trucked services that have a population less than 2,000 people.

$$\textit{Water Use (L/capita/day)} = 90\ \textit{L/capita/day} \times (1.0 + 0.00023 \times \textit{Population})$$

Using the estimated population projections shown in **Table 1**, the projected sewage generation rates over the facility lifetime are shown in **Table 2** below. The lagoon was constructed to hold the annual generation rate of 96,100 m^3 of wastewater.

Table 2: Projected Sewage Generation

Year	Population	Sewage Generation Rate (L/capita/day)	Annual Generation (m^3/yr)
2000	1,213	115.11	50,964
2006	1,382	118.61	59,829
2011	1,536	121.80	68,283
2016	1,692	125.02	77,213
2021	1,848	128.26	86,530
2026	2,002	131.44	96,047

Physical, chemical and biological characteristics of sewage are referred to as its composition. It is assumed that raw wastewater has a typical average concentration of 625 mg/L for BOD_5 and 900 mg/L for SS. For domestic waste, average raw FC concentration is about 2 x 10^9 FCU per 100 mL.

3 SEWAGE DISPOSAL SYSTEM

3.1 Manual Organization

This section of the manual presents the operation and maintenance procedures that are associated with the wastewater treatment facility that designated operators assigned to the plant and system should be aware of concerning the facility and system.

3.2 Equipment

The equipment required to operate the Cape Dorset sewage treatment system consists of three sewage collection trucks with the following capacities:

- 9,092 L (2,000 imp. gal)
- 13,025 L (2,865 imp. gal)
- 13,093 L (2,880 imp. gal)

3.3 Site Personnel

The overall responsibility of the waste disposal site as well as the overseeing of the operation and maintenance personnel is that of the Senior Administrative Officer. Day-to-day operation and maintenance of the facility is the responsibility of the Municipal Works Foreman. In addition, several other employees operate and maintain the sewage trucks on a day-to-day basis.

3.4 Operational Procedures

These procedures must be carried out frequently to ensure efficient operation of the treatment system. Daily operation procedures must/should be carried out frequently to ensure smooth operation of the treatment system.

3.4.1 Basic Operations

1. Municipal wastewater is collected from holding tanks at each residence and commercial building by sewage (vacuum) trucks.
2. Sewage (vacuum) trucks pump the wastewater out of the holding tanks and transport it to the sewage treatment area.
3. Throughout the year, the wastewater is discharged into the lagoon through the offload chute located at the truck pad. The sewage truck backs up to the lagoon (bollards are placed for safety purposes) and the valve is opened. Wastewater is discharged into the lagoon, over the splash pad.
4. The wastewater remains in the lagoon for approximately 12 months. It is naturally treated during the months of June, July, August and September.
5. Decanting occurs once a year, in late September, over a 2 week period. Refer to Section 3.4.2 for the steps to be taken during the decanting stage. The discharged effluent from the lagoon flows into P Lake and further through a small nearby wetland before entering Telik Inlet.

Nunavut Water Board (NWB) requires at least a ten (10) day notification before initiating any decanting of the lagoon. All effluent discharged from the sewage disposal facility at the monitoring program station must meet the following quality standards:

Table 3: Effluent Quality Limits

Parameter	Units	Maximum Average Concentration
Fecal Coliforms, FC	CFU/100 mL	1×10^6
5 Day Biological Oxygen Demand, BOD_5	mg/L	120
Total Suspended Solids, TSS	mg/L	180
Oil and Grease	-	No visible sheen
pH		6 - 9

3.4.2 Decanting Procedure

Once the NWB has been notified and all parameters have been met at the discharge, the decanting procedure can begin.

The steps involved with decanting the lagoon cell are as follows:

- Open the valve at the discharge pipe.
- Monitor flow rate leaving discharge pipe during the two week decant period.
- Monitor for erosion at the end of the discharge pipe and repair as required.
- Check daily for erosion, blockages and other problems that may occur on the upstream slope of the berm. Apply necessary procedures to fix problem to minimize downtime during decanting.
- If the discharge pipe happens to be blocked or frozen at the time of decanting, then the following options should be used:
    - Try to unblock or thaw pipe using a steamer hose. Once unfrozen, proceed with decanting. If necessary, keep applying heat to the discharge pipe to assist with the flow of material.
    - Decant lagoon using a diesel fired pump or siphon system. If a pump system is used for the decanting, then obtain a pump that will give the required flow rate to discharge the lagoon volume over the two week decant timeframe. In year 20, the required pump flow rate is 5,000 L/min.

3.4.3 Service Disruption Contingency

In the event of a disruption in service, for instance, the road to the lagoon is inaccessible, then Cell 1 of the old lagoon system is to be used as a temporary sewage disposal site until the disruption is resolved.

3.4.4 Sampling Procedures and Requirements

A key component to the operations and maintenance of the proposed sewage treatment system is a sampling program. Based on the lagoon's design, the following discharge limits are expected after the treatment stage:

- BOD_5 – 45 mg/L
- TSS – 45 mg/L
- FC – 1.5 x 10^4 FCU/100 mL

The proposed sampling program will help to monitor the treatment while verifying compliance with regulations. As well, it will model the treatment process which with help to understand the behavior of the lagoon for future development and expansions of the system.

It is important such a sampling program be implemented by the Hamlet as a part of the annual operations for the facility. Local members of the community that operate the system are to be trained on the proper operation and procedure methods used in the sampling program. In addition, quality and safety training will also be included which will ensure that the high quality data will be obtained.

All sampling, sample preservation and analyses will be in accordance with methods described in the current edition of *Standard Methods for the Examination of Water and Wastewater*. In addition, a document has been attached in **Appendix B** of this manual that provides guidelines and procedures to follow when sampling wastewater.

To obtain meaningful results from the analysis, the following five factors are of particular importance:

- Sample collection at designated time and location;
- Correct usage of container/sample bottle for parameter being tested;
- Correct labeling of sample bottles and filling out record/field sheet;
- Correct procedure for field sampling;
- Proper and timely shipment of samples to the laboratory.

It is critical, from a quality perspective, that sample collection be performed from an area of lower concentration to an area of higher concentration of contaminants. Therefore, a sample will be collected in the following locations as shown in **Figure 4** and **Figure 5**.

Figure 4: Sampling Locations

Figure 5: Locations of Sampling Points

The locations of the sampling stations for the monitoring program as well as the possible GPS coordinates for each location are listed in **Table 4**, shown on the following page.

Table 4: Sampling Station Locations

Station Tag	Description	Possible GPS Coordinates	
		Latitude	Longitude
Control	Small Lake Area between Lagoon and T Lake	64°12'57.48"	76°33'21.59"
PLk-01	Influent of Wastewater into Lagoon	64°13'15.91"	76°33'53.40"
PLk-02	Effluent Discharge from Lagoon	64°13'14.28"	76°34'01.39"
PLk-02a	Point between Influent Point and Center of P Lake	64°13'14.25"	76°34'03.76"
PLk-02b	Center of P Lake	64°13'14.58"	76°34'06.68"
PLk-02c	Point between Center and Effluent Point of P Lake	64°13'14.33"	76°34'09.91"
PLk-03	Effluent Discharge from P Lake	64°13'13.97"	76°34'14.43"
PLk-04	Effluent Discharge from Wetland area	64°13'13.49"	76°34'20.65"
PLk-05	Wetland pathway, Top of Waterfall	64°13'13.55"	76°34'26.59"
PLk-06	Wetland pathway, Midway down Waterfall	64°13'13.33"	76°34'31.83"
PLk-07	Wetland pathway, Bottom of Cliff	64°13'13.36"	76°34'39.22"

By obtaining samples at each location proposed above, effluent renewal rates can be monitored. Wastewater samples will be taken one (1) week prior and during the course of lagoon discharge. All samples will undergo the same analysis which will contain the following set of tests:

- 5-Day Biological Oxygen Demand, BOD_5
- Total Suspended Solids, TSS
- Fecal Coli forms, FC
- Ammonia-Nitrogen, NH_3-N
- Total Phosphorus, TP

The point of compliance for the water license is the discharge from the lagoon cell into P Lake whereas the compliance point for the Fisheries Act is the discharge into Telik Inlet. **Table 5,** below, lists the test parameters to be analyzed (for the sampling program) based on the receiving water supply

Table 5: Sampling Analysis for Annual Discharge Monitoring

Test Parameter	Water Source	
	Fresh (P Lake)	Marine (Telik Inlet)
Biological Oxygen Demand, BOD_5	X	X
Total Suspended Solids, TSS	X	X
Fecal Coli forms, FC	X	X
Ammonia-Nitrogen, NH_3 - N	X	X
Total Phosphorus, TP (PO_4 - P)	X	
Heavy Metals	X	X

A grab sample will be taken from each of the three sewage trucks during discharge to the lagoon. Surface samples will also be collected from P Lake at three points between the lagoon discharge into the lake and its outlet to the wetland area. Samples from the trucks will provide quality of the raw sewage before it enters the lagoon whereas samples along P Lake will obtain quality of the lake prior to decanting. This data will assist with monitoring the water quality of these areas by comparing the results of both raw and treated wastewater samples. These samples will be taken once during the decanting period.

Any other additional sampling during the year will be at the request of the regulatory agencies. Once collected, the samples will be shipped to the laboratory and analyzed using the same test method/procedure. This sampling program will be conducted over several years to collect sufficient data for trend analysis. It is recommended that following the first year of operation the amount of sampling for the monitoring program be adjusted by eliminating those locations that are not considered essential to monitoring the treatment system. Locations such as the lagoon inflow and outlet pathway though the wetland area may be removed if they are deemed stable over time, i.e. there have been no substantial changes in the parameters, specifically along the wetland pathway.

All lab results for the monitoring program will be submitted to the inspector upon completion. The flow rate of effluent discharge during the decanting period is required as well.

3.4.5 Sludge Monitoring Plan

The sludge blanket will be monitored as part of the annual discharge procedure. Approximately 15 years after commissioning, a study will be undertaken to determine the need and frequency for sludge removal and disposal over the lifetime of the lagoon. The design of the lagoon included storage of the sludge blanket for the first 20 years of operation within the lagoon. If the results from the lagoon discharge point, specifically BOD and TSS analyses, become non-compliance, then sludge removal study can be conducted earlier.

Sludge in sewage lagoons should be sampled more often if required. The purpose of the sampling is to ensure that the sludge remains of a quality suitable for land disposal. Sampling shall consist of a sample collected from the center point of a grid no less than 10 m by 10 m. Sufficient samples shall be taken to describe the entire sewage lagoon. Results from the sludge analysis are to be reported upon completion of the test and in the annual report.

3.4.6 Geothermal Monitoring

During the design stage, a geothermal analysis of the site location was performed. To confirm data that was applied in the model, thermistors will be installed through the berms into the foundation strata to record ground temperatures and monitor its thermal regime over time. This will also help to monitor freeze-back of berm foundation and confirm agreement of lagoon water temperatures used in the geothermal analysis with those of an operational lagoon.

Thermistors will be placed in drilled boreholes, below the depth of zero annual temperature. Geotechnical logs will be collected for each hole drilled. With the placement of the thermistors, early detection of unknown disturbances in the permafrost ground can be observed. Therefore, it is important to verify that the thermistor is working properly so that it can provide accurate measurements and/or readings. The following procedures will be performed for the operation and maintenance of the thermistors:

- Quarterly monitoring and recording of thermistor measurements from each location which includes as a minimum recording of depth and temperature readings.
- Calibration of the thermistors as specified by the supplier/manufacturer.

During the geothermal monitoring, records of the events the geothermal monitoring that will be kept will include:

- Location of borehole(s) and thermistor(s);
- Depths and temperature readings at bead location(s);
- Date and time of readings;
- Method of monitoring – i.e. data logger or manual reading;
- Personnel performing thermistor readings, and;
- Calibration of the geothermal analysis to the thermistor temperature measurements and site data.

3.4.7 Geotechnical Reviews

A Dam Safety review is to be completed by a qualified geotechnical engineer and will be executed at the following times:

- 3 years after commissioning;
- A frequency of 10 years after the first review.

The review is to include a site inspection and report based on the following items:

- Dam classification review to verify the original classification is still valid.
- Site inspection of all berms and structures of the lagoon cell.
- Review of the design and construction to verify the systems meets current applicable safety requirements.
- Complete a geothermal assessment of the system based on the recorded thermister values.
- Safety review to include the operation of all discharge and back up equipment and procedures,
- Maintenance review to verify that all facilities required for safety of the dam and monitoring systems are maintained in satisfactory condition.
- Review of the surveillance and monitoring program and methods to verify that the monitoring program will detect any unsafe conditions in a timely manner.
- Review the level of emergency preparedness to verify that it is appropriate for the facility.
- Review previous report to verify that recommendations have been complied with.

The report generated from the geotechnical review will be submitted as a part of the annual report to the Nunavut Water Board.

3.4.8 Record Keeping and Reporting

Records of all activities and operation should be kept to assist in the planning of annual operations and maintenance as well as the evaluation of the effectiveness of the sewage treatment facility. These records should be kept in the Hamlet Office and be maintained by the facility's supervisor. Sample O&M log sheets are available in **Appendix C** of this document. As a minimum, the following information and data should be recorded:

- Number of trips sewage trucks make to the site per day;
- Approximate volume of sewage discharged to lagoon cell;
- Dates when any monitoring has been conducted;
- Results of the analysis of the sampling and monitoring program;
- Results of thermistors data collection;
- Dates and volume of any spill occurrences, and;
- Dates and description of any maintenance activities carried out on the system.

3.4.9 Health and Safety

Due to the potential health hazards associated with municipal wastewater, it is imperative, for those personnel working in this area, to be familiar with and execute all safety precautions involved with the various work tasks associated with the system.

- Equipment is to be kept clean.
- Wear protective clothing such as gloves and boots at all times.
- Work cloths should not be worn home.
- Hands to be washed frequently; as a minimum before eating and after work.
- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date.

3.5 Maintenance Procedures

In the proceeding sections, maintenance procedures for the different areas of the wastewater treatment infrastructure are discussed and should be carried out to ensure the system runs efficiently.

3.5.1 Sewage Trucks and Holding Tanks

The most important part of the sewage treatment system and process is the collection and transport of the wastewater from the residences and buildings to the lagoon cell. Therefore, it is crucial that the sewage trucks be kept in good repair. Procedures for truck and tank maintenance are as follows:

- Repairs should be completed immediate and take high priority;
- Full tank sewage trucks should not rest for long periods of time, especially during the winter;
- Holding tanks should be kept in good working order and prevented from freezing in the winter.

3.5.2 Access Road and Truck Pad

Basic road maintenance such as those listed below must be performed on a regular basis to ensure that the site is accessible at all times.

- Road and truck pad be graded smooth and reshaped at least twice (2) per year;
- Snow, when necessary during the winter, to be removed to provide unrestricted access to discharge point;
- During snow removal, care is to be taken not to damage berms and surrounding areas;
- Any spilled and/or frozen wastewater should be removed with the snow to appropriate disposal site;
- Discharged point should be monitored for potential erosion problems.

3.5.3 Drainage

The truck pad at the sewage discharge point should be graded such that any wastewater spilled during the offloading procedure will flow into the lagoon cell and sewage treatment system. During the winter

months, it is important to monitor the discharge pipe and weirs as there may be problems with flow during periods of extreme low temperatures. Wastewater remaining in the pipe and weir may freeze, causing blockage and/or buildup which can potentially damage or break the structures.

3.6 Operation and Maintenance Summary

Daily, weekly, monthly and yearly activities and procedures that are required by the operator and maintenance personnel are summarized in **Table 5** shown below.

Table 6: Summary of Operation and Maintenance Tasks

Frequency	Description of Task
Daily	▪ Collection, transportation and disposal of wastewater and/or sewage from residential and commercial holding tanks to the truck discharge point at the sewage treatment lagoon. ▪ Immediate cleaning of any spills. ▪ Clearing of snow from access road and truck turn-around pad as required. ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix C**).
Weekly	▪ Inspection of berms, dykes and drainage courses. ▪ Monitoring of area surrounding thermistor. ▪ Conduct weekly monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix C**).
Monthly	▪ Maintenance of access road and truck pad if required. ▪ Monitoring and recording of thermistor readings for monitoring program. ▪ Confirm location and readability of signs. ▪ Conduct monthly monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix C**).
Yearly	▪ Perform annual decanting of lagoon cell in fall. ▪ Conduct geotechnical review of geothermal monitoring program. ▪ Grading and reshaping of access road and truck pad. ▪ Conduct annual monitoring program (if required). ▪ Maintaining O&M information records (Refer to sample log sheets located in **Appendix C**).

4 SPILL CONTINGENCY PLAN

In the case of an emergency such as a fire and/or spill, a response plan should be established to instruct those personnel involved with direction to take action to such a case in the most appropriate manner. Due to the nature of the facility, uncontrolled fires and spills of unknown or hazardous materials should be treated with extreme caution.

Hamlet personnel that are responsible for the sewage treatment and disposal facility should be trained in Workplace Hazardous Materials Information System (WHMIS), Transportation of Dangerous Goods Act and Regulation (TDGA and TDGR) as well as First Aid. In addition, personnel should ensure that proper vaccinations of employees are kept current and that they are familiar with the response plan. It is good practice to obtain copies of a list of procedures and equipment that are to be used for such emergencies in all sewage trucks and the common work area.

In all response cases, personnel should place their own safety as the highest priority. The procedures that should be taken in the likelihood of a potential fire or spill are described in the following sections.

4.1 Fire

A contingency plan should be developed by the Hamlet Fire Department to describe the response and action protocols to be implemented in the case of a fire. Special precautions should be used in the case of waste burning as it can produce harmful, poisonous gases. If an uncontrolled fire occurs, the following procedure should be implemented:

- Immediately evacuate area and go to community's designated meeting place.
- Keep all personnel up-wind from the source.
- Notify the Hamlet Fire Department at (867) 897-8888.

4.2 Spills

A spill contingency plan has been developed by the Hamlet that identifies the procedures to follow when a spill of any hazardous material has occurred. Similar procedures can be used for the case of sewage spills.

Below, in the subsequent sections, the measures that are to be implemented if a spill or uncontrolled release of a substance occurs during the collection and transportation of wastewater are described for the following areas:

- Initial Response
- Containment Procedures
- Spot Spills
- Spills in Proximity to a Waterbody

4.2.1 Initial Response

If a spill occurs, the first person at the scene will:

1. Perform an initial assessment to identity immediate danger.
2. Identify the material spilled and verify the nature of the hazard by corresponding to the Material Safety Data Sheets (MSDS) so to apply appropriate safety procedures.
3. If possible and safe to do so, cut off and/or stop the source of the spill.
4. Control danger to the human life without further assistance, if possible. If, for instance, the spill creates a fire, explosion or other hazard, remove all potential ignition sources.
5. Obtain immediately assistance from others and start to contain and/or clean up the spill.
6. Contact the Municipal Works Foreman to notify them of the spill as they will contact relevant regulators and community residents of the occurrence.

7. Mark off the spill site as to warn the public of the incident and to prevent access.

Once the Municipal Works Foreman has been contacted and have arrived on site, he/she will immediately ensure that:

1. Necessary arrangements for first aid and removal of injured personnel have been made. Where possible, necessary action will be taken to secure the site to protect human safety.
2. If not already done and is safe to do so, take the appropriate action to stop the flow or release of material/substance as well as to contain or prevent the spread of the spilled material if at all possible.
3. Contact the 24 Hour Spill Line at (867) 920-8130 to report spill and obtain additional assistance.
4. Contact the Hamlet's Senior Administrative Officer.
5. If required, notify the Fire Department at (867) 897-8888 and RCMP Detachment at (867) 897-1111.

4.2.2 Containment Procedures

Response personnel will immediately start to contain the spill to ensure that the spill does not spread and contaminant other areas and/or environment. The following actions might also be taken if relevant to the spill situation:

1. If the source of the spill is coming from a leaking fuel truck, then pump fuel into a suitable container or another tank until the tank is dry.
2. Culverts that have been potentially affected by the spill should be blocked off to minimize travel of the substance.
3. Dig a basin or construct a berm to stop and contain the pathway and flow of the spill.
4. Apply absorbent materials to contain and recover small volumes of spilled substance.
5. Spilled substance and/or material are to be collected and transported to an approved waste disposal facility in the appropriate matter.

4.2.3 Spot Spills

Spot spills are those that involve a small volume of substance in a controlled material over a small, contained surface area. For spot spills involving hazardous materials, the following steps may be taken by personnel:

- Immediately take action to clean up spill by implementing proper or suitable handling and containment procedures for the material spilled.
- Report spill to the Municipal Works Foreman and Hamlet's Senior Administrative Officer.
- Determine suitable methods for removal of contaminated soils and restoring site of the spill. Consult environmental and government agencies for assistance.
- Flag and record locations and information of spot spills for future reference and monitoring.

- In the case of a spot sewage spill, place lime over the sewage, collect and transport the material to the solid waste facility for proper disposal.

4.2.4 Spills in Proximity to a Waterbody

If a spill occurs in close proximity to a waterbody, take necessary actions to prevent the spill entering the nearby waterbody. Similar containment procedures discussed above in Section 4.2.2 can be used to assist with the likelihood of spills located near water bodies.

5 REFERENCES

[1] Dillon Consulting Limited. "Cape Dorset Sewage Facility Study", produced for Department of Community Government and Transportation, Government of Nunavut, March 2001.

[2] Dillon Consulting Limited. "P Lake Area Sewage Lagoon System", produced for Department of Community and Government Services, Government of Nunavut, January 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] Heinke, G.W. et al. "Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems in the Northwest Territories, Volume I: Planning and Design", Produced for MACA, November 1988.

[5] Heinke, G.W. et al. "Guidelines for the Planning, Design, Operation and Maintenance of Wastewater Lagoon Systems in the Northwest Territories, Volume II: Operations and Maintenance", Produced for MACA, November 1988.

APPENDIX A

WATER LICENSE

APPENDIX B

GUIDELINES FOR WASTEWATER SAMPLING

Guidelines for Wastewater Sampling

Reference Document

October 27, 2007

Submitted by
Dillon Consulting Limited

TABLE OF CONTENTS

1 INTRODUCTION

The purpose of this document is to provide guidelines when performing sampling of municipal wastewater. Main objectives are to:

1. provide appropriate methods for conducting wastewater sampling
2. describe the appropriate equipment and containers that should be used in sampling
3. describe the sampling procedure to obtain a representative sample

2 BACKGROUND INFORMATION

2.1 Sampling Equipment

2.1.1 Containers and Bottles

There are two types of sample collection. Intermediate collection uses a bucket, ladle or wide mouthed bottle to collect the sample from the effluent pipe whereas final collection involves transferring the sample to an appropriate sample bottle. Where it is impractical or unsafe to sample by hand, a sampling rod, polycarbonate or stainless steel pole with a clamp or cage on one end, can be used to assist with the sampling. The clamp or cage at the end of the rod is designed to securely hold the sample container during the sampling. This provides extra reach and prevents hands from contaminating the sample and contacting wastes.

The type and size of bottle for the final sample are related to the nature of the analyses needed. Typically, the sample bottle is made of plastic or glass. The sample bottle should not be rinsed before use and care should be taken to not contaminant it; do not touch the inside of the bottle or its cover.

Each laboratory has a preference for the type of bottle that is best for the collection of the sample. Contact the specific laboratory prior to sampling to check what type of bottles is acceptable for final sample collection for a specific parameter.

2.1.2 Apparatus

There are two types of apparatus that are used in obtaining waste water samples: manual and automatic.

For manual sampling, it is not necessary for the same person to always collect the samples. However, it is important to ensure that the person collecting the sample is using proper sampling techniques each time. If a team of 2 or more does the sampling, designate one person to collect the sample while the other person assists. This helps to minimize human error associated with the sampling procedure. When using an automatic sampler, ensure that the sampler is working properly, i.e. the samples that are extracted illustrate a representation sample of the actual waste stream.

2.2 Sampling Procedure

2.2.1 Location

The sampling location should provide a good representative sample of the actual discharge from the facility. Once the best location has been chosen for the sampling location, each sample should be collected at this same point during each time of sampling.

Raw wastewater influent samples may be collected at the wet well of the influent pump station or at the inlet control structure (avoid the bottom where solids may settle). Effluent samples should be collected from the outlet control structure after discharge or from a well-mixed point in the outfall channel.

2.2.2 Frequency and Timing

Each time a sample is taken from a site location, it should always be collected at the same time of day in the case of continuous sampling for monitoring purposes.

2.2.3 Method

There are two distinct types of samples: spot (grab) and composite. In the case of spot sampling, the entire sample is taken at one time whereas with composite sampling, the sample is a mixture of grab samples or a collection of fractions of the waste stream samples taken continuously over a certain time frame.

Samples can be directly collected into the sample bottle when it is practical to do so. However, if it is not practical such as is the case when a sample cannot be collected without the loss of the preservative, an intermediate container may be used. For both types of sampling, the intermediate collection container should be rinsed several times, usual three (3) unless it indicates not to do so, with the liquid being sampled before the actual sample is collected. The sample should be constantly stirred to avoid the settling of any suspended solids to the bottom during the time it takes to extract a final sample. When using a sampling rod, the rod and container should be gently but quickly lowered into the sample to minimize the contribution of surface films to the sample.

Prior to taking the final sample, the sample bottle should be rinsed three (3) times with the sample as well. To take the final sample, insert the container into the sample vertically with the neck facing down, then invert the container to allow sample to flow in, always keeping the month of the container faced into the current. This will minimize surface films from forming on the sample. Once the sample bottle is filled to the appropriate level specified, ensure that the cap is tightly sealed and the outside of the bottle is clean of any contaminants by rinsing it with clean water before shipment. When using a sampling rod, the container should be gently but quickly lowered into the sample to minimize the contribution of surface films to the sample.

2.2.4 Identification and Reporting

Each sample bottle should be clearly labelled, either by writing on the bottle or on a label with waterproof ink or permenant marker. The label should contain the following information:

- Location and/or point of sampling, including site identifier
- Description of sample and/or site
- Test parameter(s) for analysis (if required)
- Date and time of sampling
- Preservative (if required)

The information presented on the collection sample bottle should match that recorded on the sample submission form. A typical example of a properly identified label is shown below.

SAMPLE I.D.:	**WWT-01**		
DESCRIPTION:	**Lagoon Effluent Discharge**		
ANALYSIS:	**BOD_5**	**DATE:**	**08/30/07**
PRESERATIVE:	**None**	**TIME:**	**13:00**

Sometimes labels do not correspond to items that are required for the sample such as company name or project number. In those cases, these areas could be used to provide additonal information and description of the

Along with the sample, a sampling or field report should accompany each sample set, which can contain all the below information:

- Type of sample taken;
- Sample identification which includes location/point of sampling and site identifier;
- Date and time (start and stop) of sampling;
- Preserative added, if required;
- Duration of sampling period;
- Purpose of sampling;
- Details of sampling method and field testing.

2.2.5 Preservation, Storage and Transportation

After samples are collected and labled, they should be kept cool, between between 0°C to 4°C either by refrigeration or the use of a ice packed cooler. During the winter months, ensure that the sample does not freeze. If the sample is not cooled, this could have an effect on the final results of the analysis. Cooling the samples ensures that the sample will not be changed due to biological activity while it is transported to the lab. The samples should be transported immediately (no more than 24 hours after the time of sampling) to the specified laboratory for analysis as some test parameters are time sensitive (i.e. FC and BOD_5).

2.3 Protection and Safety Measures

2.3.1 Safety Protection

Generally, it is common practice to wear protective gear such as gloves, goggles and waders when taking samples to protect from the contaminants in the sample. The most important piece of protective clothing is gloves, which should be worn at all times. Typical medical and/or surgical gloves (neoprene) seem to work best for this application. Powdered gloves should not be used as they could contaminate the sample. Before and after the sampling, wash hands with soap and water and disinfect with hand sanitizer.

3 REFERENCES

[1] Water Quality - Sampling - Part 10: Guidance on Sampling of Waste Waters. International Standard ISO 5567-10: 1992(E).

[2] The *Handbook for Sampling and Sample Preservation of Water and Wastewater* (Environmental Protection Agency 1982).

[3] EPA Guidelines: Regulatory Monitoring and Testing - Water and Wastewater Sampling. June 2007.

APPENDIX C

SAMPLE O&M LOG SHEETS

Daily Maintenance Log Sheet

ITEM	TASK	DATE CHECKED						
		SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1	Volume of sewage collected from holding tanks been recorded?							
2	Have spills been cleaned up and if appicable, been reported to 24 Hour Spill Line?							
3	Snow clearing of road, truck pad and disposal area (if required)							
4	Any other comments, observations and/or concerns noted?							
5								
6								
7								
8								
9								
10								
INITIALS/SIGNATURE								

Weekly Maintenance Log Sheet

ITEM	TASK	DATE CHECKED								
		WK 1	WK 2	WK 3	WK 4	WK 5	WK 6	WK 7	WK 8	WK 9
1	Completed weekly wastewater sampling for monitoring program?									
2	Berms, dykes and drainage courses been inspected?									
3	Non-sewage floating materials been removed from lagoon cell?									
4	Truck and cell discharge locations inspected for significant erosion?									
5	Have thermistors strings been visually checked for maintenance problems?									
6	Any other comments, observations and/or concerns noted?									
7										
8										
9										
10										
INITIALS/SIGNATURE										

Monthly Maintenance Log Sheet

ITEM	TASK	DATE CHECKED											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1	Has access road been graded and maintained (if required)?												
2	Signs present and in readable condition?												
3	Monthly monitoring program (if required) been performed?												
4	Have thermistors readings been taken (quarterly) for geothermal monitoring program?												
5	Any other comments, observations and/or concerns noted?												
6													
7													
8													
9													
10													
INITIALS/SIGNATURE													

Annual Maintenance Log Sheet

ITEM	TASK	DATE CHECKED											
		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
1	Has annual decanting of the lagoon cell been peformed?												
2	Has geotechnical review of geothermal monitoring program been performed?												
3	Hass access road and truck pad been graded and reshaped?												
4	Annual monitoring program been conducted (if required)?												
5	Has there been a review of O&M records?												
6	Any other comments, observations and/or concerns noted?												
7													
8													
9													
10													
INITIALS/SIGNATURE													

Sewage & Spill Inventory Sheet

DATE			NO. OF TRIPS TO SITE	VOLUME OF SEWAGE COLLECTED		NO. OF SPILLS	VOLUME OF SPILL	
D	M	Y		AMOUNT	UNITS ($L/gal/m^3$)		AMOUNT	UNITS ($L/gal/m^3$)

Thermistor Measurements

DATE			BOREHOLE 1		BOREHOLE 2		BOREHOLE 3	
D	M	Y	DEPTH (m)	TEMP (°C)	DEPTH (m)	TEMP (°C)	DEPTH (m)	TEMP (°C)