Government of Nunavut

Operation and Maintenance Manual

Volume I

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1 Introduction

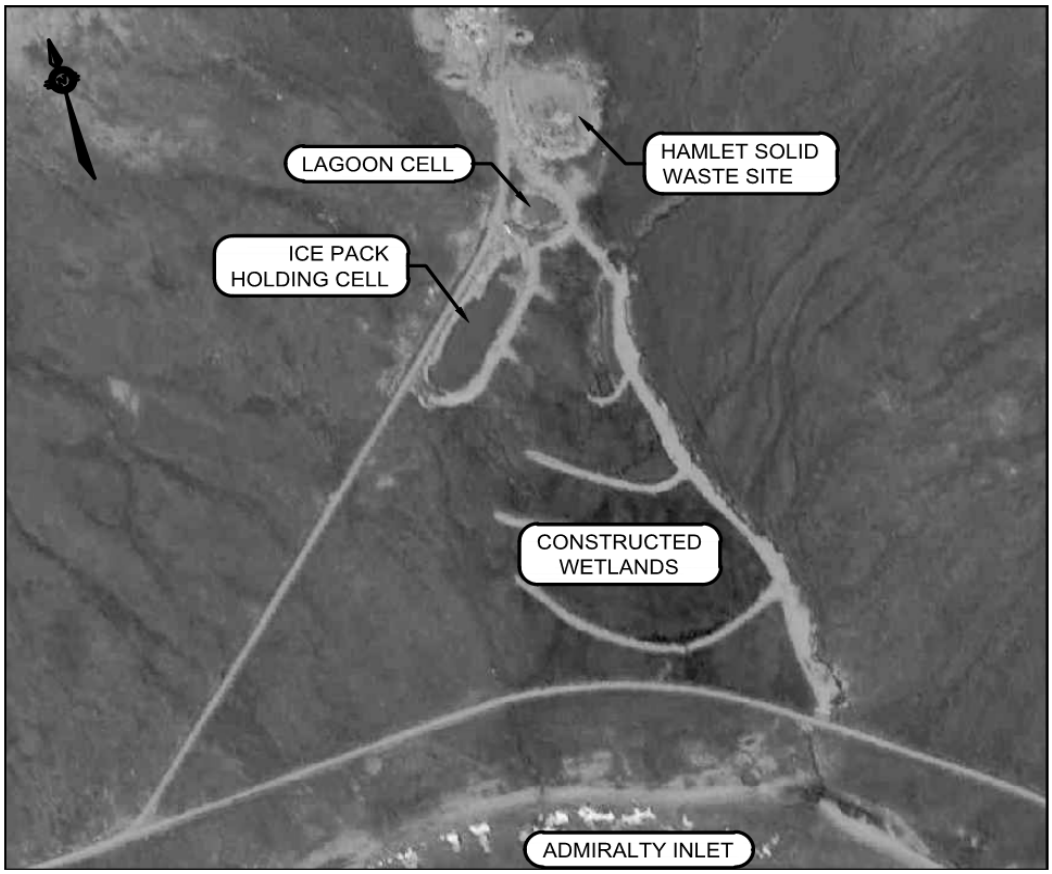
This Manual has been produced to establish standard operation and maintenance protocols for the management and treatment of sewage within the Hamlet of Arctic Bay. Information presented in this manual has been developed based on the document "*Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories, 1996"*.

This operation and maintenance (O&M) manual is intended to instruct designated operators of the sewage lagoon facility on the O&M procedures required to comply with conditions set forth by the Nunavut Water Board in water license 3BM-ARC0810 found in Appendix A.

1.1 Preceding Lagoon

The Hamlet's existing wastewater treatment facility is located approximately 2 km to the east of the community. It is comprised of a single cell lagoon, ice pack storage area and wetlands, as shown in Figure 1-1. The sewage treatment system is bordered to the north by the Hamlet's solid waste disposal site and to the south by the Road to the Nanisivik airport. The existing lagoon was constructed in 1976. It is an unlined earth lagoon with a reported capacity of approximately 21,000 m^3 and was designed to hold sewage for 365 days with manual discharge. In 2003 the sewage system was expanded to include an ice pack area and modifications to improve the efficiency of the wetlands. Works were based on a project plan prepared by Dillon Consulting Ltd. and presented in the reported entitled *Arctic Bay – Wetlands Treatment Facility: Proposed Project Plan* dated 2002.

Figure 1-1: Existing Lagoon and Wetlands



In 2002 and 2003 effluent tests carried out by Indian and Northern Affairs cited problems with the effluent quality from the facility. In addition, effluent samples taken in September 2004 did not comply with the requirements under the Hamlet's water license.

1.2 Existing Water Supply

The Hamlet currently obtains its drinking water from a natural lake located approximately 8 km to the east of the community. The water supply facility is located on the north side of the lake with inclined pipes leading out into the lake where water is withdrawn. Chlorination is required for disinfection of the raw water, and treated drinking water is delivered by water truck to homes and facilities.

The existing water supply and its corresponding watershed are not influenced by the location of the sewage lagoon system. The two sites are separated by approximately 6 km with the new lagoon draining directly into Victor Bay on the north side of the peninsula.

1.3 Site Selection

The proposed sewage lagoon was constructed in a small valley overlooking the existing lagoons and Admiralty Inlet to the south and Victor Bay to the north. The vegetated area between the new lagoon and Victor Bay will be incorporated into the sewage treatment process. A new access road was constructed from the existing sewage lagoons to the new lagoon.

The Hamlet of Arctic Bay is required to operate a new sewage lagoon that is structurally sound and has the necessary capacity to accommodate the projected growth of the community over the next 20 years. In addition, it is necessary to decommission the existing sewage lagoons the berms of which are failing.

The project will not have long term negative effects on the environment or wildlife. Most effects are related to construction activities and are short term and all effects can be mitigated by applying suitable mitigation measures.

The existing site complies with the separation requirements of the Public Health Act (450m buffer), Transport Canada (3000m airport buffer), and the community water supply (400m buffer). The road servicing the old lagoon site is cleared and maintained year round to access the community solid waste site and metal dump. Additional maintenance will be required for the access road beyond the old facility. Figure 1-2 shows the location of the lagoon site with respect to the Hamlet centre, water supply lake, and the airport

Figure 1-2: Location Plan and Setbacks

1.4 Sewage Treatment

The proposed sewage treatment facility must meet the long term needs of the Hamlet, as well as the regulatory requirements of the Hamlet's water license. The Water and Sewage Facility Capital Program Standards and Criteria indicate the design horizon for sewage lagoons is to be between 15 – 20 years. As per the direction of the Community and Government Service, Government of Nunavut, the design horizon for this facility shall be the year 2028.

The wastewater treatment system utilizes the single cell sewage lagoon as the main method of treatment, with the filter strip wetlands providing additional treatment prior to the release to the environment.

As monitoring the performance of natural wetlands is difficult, the Hamlet of Arctic Bay's water license has set the compliance point for the wastewater treatment system at the discharge of the lagoon. This point represents the last point of measurement and control for the system. The water license further recognizes the treatment potential of the natural wetland and has set the compliance criteria recognizing the treatment the effluent will receive through the wetland.

1.5 Population Projections

The population projections for this project will be based on "Nunavut: Community Population Projections" as published by the Nunavut Bureau of Statistics. The Nunavut Bureau of Statistics population projections provide projected populations of the Nunavut communities to the year 2020. As a planning horizon for this project is past the current population projections available from the Nunavut Bureau of Statistics, the population projection from 2020 to 2029 are estimated using the average annual growth rate for the Hamlet between the year 2000 and 2020 of 2.04%. The table below summarizes the population projections to the year 2029.

Table 1-3: Population Projections

Planning Year	Year	Population	Planning Year	Year	Population
	2000	730	6	2015	1019
	2001	747	7	2016	1033
	2002	763	8	2017	1049
	2003	782	9	2018	1065
	2004	801	**10**	**2019**	**1078**
	2005	819	11	2020	1094
	2006	837	12	2021	1116
	2007	855	13	2022	1139
	2008	876	14	2023	1162
0	**2009**	**894**	**15**	**2024**	**1186**
1	2010	916	16	2025	1210
2	2011	939	17	2026	1235
3	2012	960	18	2027	1260
4	2013	980	19	2028	1286
5	**2014**	**1003**	**20**	**2029**	**1312**

The design population for the end of the design horizon, 2029, is projected to be 1312 persons.

1.6 Sewage Generation

Sewage generation rates are generally assumed to be equal to the water consumption rates for a community, with the water consumption rate being the total of the residential and non-residential water consumption. The Water and Sewage Facility Capital Program Standards and Criteria provide the following design values and formulae for estimating the water consumption and therefore the sewage generation rates for communities.

The residential water usage (RWU) for a community is based on the method of water delivery and sewage collection in the community. The litres per capita per day (lpcd) water usage rates for the different methods of water delivery and sewage collection are summarized in the Table 1-4.

Table 1-4: Residential Water Usage

Service Method	Residential Water Usage (RWU)
Trucked water and sewage	90 lpcd
Piped water and sewage	225 lpcd
Piped water supply and truck sewage pump out	110 lpcd
Trucked water delivery and individual septic fields	100 lpcd

The Hamlet of Arctic Bay has a trucked water and sewage system, therefore the RWU for the community is equal to 90 lpcd.

Non-residential water usage by a community tends to increase with increases in the population. To determine the Total Community Water Usage (TCWU), the Residential Water Usage is adjusted based on population to provide a Total Water Usage Per Capita. The daily water consumption by the community is equal to the population multiplied by the Total Water Usage Per Capita. The Total Water Usage Per Capita, including residential and non residential activities are estimated based on the equations in Table 1-5 Total Community Water Usage.

Table 1-5: Total Community Water Usage

Community Population	Total Water Use Per Capita
0 – 2000	RWU x (1.0 + 0.00023 x Population)
2000 – 10,000	RWU x [-1.0 + {0.323 x Ln(Population)}]
Over 10,000	RWU x 2.0

The daily water consumption, and therefore the sewage generated by the community, is equal to the population multiplied by the Total Water Usage Per Capita. Based on the design population of 1312 for the year 2029, and a total water usage per capita rate of 117 lpcd, the daily sewage generation rate is equal to 154,000 lpd. This is equal to a yearly sewage generation rate of 56,029 $m^{3.}$

1.7 Influent Characteristics

The characteristics of sewage generated in a community are heavily dependent upon the type of installation and sanitary facilities. The Hamlet of Arctic Bay water and sewage systems utilize holding tanks and truck delivery and collection systems. The waste generated from this arrangement is considered to be “Moderately Diluted Wastewater”, as per the Cold Climate Utility Manual. Table 1-6 - Characteristics of Basic Wastewater Categories is an excerpt from the Cold Climate Utilities Manual, summarizing the characteristics of moderately diluted wastewater.

Table 1-6: Wastewater Characteristics

Parameter	Units	Moderately Diluted
BOD_5	mg/L	460
COD	mg/L	1000
Suspended Solids	mg/L	490
Total Nitrogen	mg/l as N	--
Phosphorus	mg/L as P	--

‘Canadian Society for Civil Engineering, 1986, *Cold Climate Utilities Manual’*

1.8 Seasonal Climatic Conditions

The average annual rainfall in Arctic Bay, as recorded at the Nanisivik Airport, is 6.1 cm and the average annual snowfall is 173 cm (Environment Canada). Temperatures in the summer range between 0 and 7^{o}C and in winter between -25.0^{o}C and -33^{o}C. Permafrost is present in the soil; it recedes to approximately 1m below the surface in the summer time. Table 3.6 summarizes the Seasonal Climatic Conditions. The data presented is extracted from the climatic normal's from the National Climate Data and Information Archive posted by Environment Canada.

Table 1-7: Monthly Precipitation

Month	Precipitation Rate	Average Daily Maximum Temperature	Average Daily Minimum Temperature
January	7.6 mm	-26.1 °C	-32.1°C
February	3.9 mm	-27.5 °C	-33.1°C
March	6.6 mm	-24.8 °C	-30.8°C
April	9.8 mm	-16.6°C	-23.4°C
May	17.2 mm	-7.8°C	-13.5°C
June	23.5 mm	1.9°C	-2.8°C
July	35.3 mm	7.4°C	2.5°C
August	40.9 mm	3.7°C	-0.8°C
September	43.5 mm	-3.7°C	-7.4°C
October	30.9 mm	-12.5°C	-17.2°C
November	16.0 mm	-19.9 °C	-25.4°C
December	7.3 mm	-23.7 °C	-29.4°C

1.9 Contact List

Title	Phone Number
Senior Administrative Officer (SAO)	867-439-9917
Baffin Regional Director (Timoon Toonoo)	867-897-3601
Municipal Planning Engineer (Bhabesh Roy)	867-899-7314
Spill Contact: Territorial 24-hour Spill Line	867-920-8130
Aboriginal Affairs and Northern Development Canada	1-800-567-9604
GN-Emergency Measures Officer	888-624-4043
Arctic Bay Health Centre	867-439-8816
RCMP (Arctic Bay)	867-439-0123
Environment Canada (Emergency) Iqaluit	867-975-4644
GN Environment Health Office	867-975-4817
First Air Cargo	1-800-267-1247

2 Sewage Disposal System

2.1 Operational Plan

The sewage lagoon system for Arctic Bay is a storage lagoon providing the capacity to store the municipal sewage generated over a one year period.

2.2 Site Personal

The responsibility of the Hamlets lagoon operations are overseen by the Senior Administrative Officer (SAO). The SAO is responsible for the foreman who conducts the day to day operation and maintenance of the sewage system together with one or two Hamlet employed labors to operate the sewage collection vehicles and help maintain the system.

2.3 Operational Procedures

The following details the proposed operations of the sewage treatment system for the Hamlet.

2.3.1 Operation and Maintenance Duties

Daily

- Collection of municipal wastewater from holding tanks and delivery to the sewage lagoon system.
- Minimize spills, and immediately clean up when they occur.
- Repairs to equipment when breakdowns occur.
- Maintain road, discharge point, and truck turning pads free of snow.
- Record Operation and Maintenance information as required.

Weekly

- Remove non-sewage materials from the lagoon. Floating materials such as plastic bags should be removed and solid waste items disposed at the solid waste site adjacent to the lagoon.
- Assess truck discharge location and containment berms for erosion.
- Record Operation and Maintenance information as required.

Monthly

- Preventative measures and maintenance on sewage trucks.
- Assess inventory of parts for truck maintenance.
- Grade and maintain the access road as required.
- Conduct monitoring program as required.
- Record Operation and Maintenance information as required.

Yearly

- Carry out decanting process during the designated timeframe.
- Conduct annual monitoring program.
- Decanting pump maintenance.
- Review the operation and maintenance records to evaluate the effectiveness of the sewage treatment system and plan for the upcoming year.

2.3.2 Collecting Operations

Wastewater is collected from the holding tanks of each residential and municipal serviced structure within the Hamlet. Suction trucks pump the wastewater out of the holding tanks through an outside service pipe accessible to the truck. The quick-connect fitting, on the service pipe and truck intake hosepipe, gives the operator a fast and reliable connection reducing spills and speeding up the operation.

The service truck will follow a predetermined set circuit throughout the Hamlet collecting the wastewater until the holding tank is full. Once full, the truck will travel out to the lagoon site, discharge the contents and then return to the collection circuit. Some structures will have to be serviced more than once per circuit, e.g. the Hamlet office, hotel, and other high wastewater producing structures may require a higher frequency. These high producers will have to be scheduled on a more regular basis.

Each time the wastewater is trucked and discharged into the lagoon; the sewage truck backs up to a chute on the gravel pad at the lagoon, and the valve is opened. Wastewater is discharged through the chute into the lagoon.

2.3.3 Detention Operations

September 15 – August 15

Over the period of eleven months, sewage trucks continually discharge to the lagoon. Discharging operations take place at the designated site on the south berm where the steel chutes are located. The sewage trucks will back up to the chute so that when releasing the contents, the chute directs the effluent to the lagoon. Two chutes are available to the operator. The choice of chute is dependent upon the preference of the operator during the discharge stage. Wind direction, snow buildup, or other factors might lead the operator to choose one chute over the other.

During this period the lagoon acts as a long term detention system containing the liquid and frozen untreated effluent until treatment can have effect.

2.3.4 Decanting Operations

August 15 – September 15

Mid-August the filter strip wetlands are now ice-free and considered active. The lagoon is decanted during this stage to provide a continuous release of effluent over the filter strip during the optimal period for treatment. Sewage trucks will continue discharging to the lagoon throughout the decanting process.

Decanting will be completed using a pump. The pump will be removed from the Hamlet storage garage and delivered to the north berm decanting area prior to the operation as seen in drawing TD1.

The pump suction shall be connected to the lagoon side (intake) infrastructure. The hose gaskets and joints completing the connection from the pump to the intake piping shall be checked for leaks and should be airtight. Be sure that proper suction hoses for this connection are used and can withstand the vacuum of the pump.

The pump discharge shall be connected to the distributing infrastructure (outlet) found on the north side of the berm exiting the lagoon site. The outlet infrastructure is complete with a distribution trough along the toe of the berm and used to disperse the pumped effluent across the head of the filterstrip wetland.

Upon completion of the decanting program, the pump will be disconnected from the fixed structures and returned to the Hamlet garage for over winter storage, along with the connection hoses. Prior to use, and after completing the decanting process, the pump should be inspected and regular start up and storage procedures should be followed. The operation and maintenance manual for the pump can be found in Appendix B.

The natural filterstrip wetlands will provide the post-lagoon final treatment prior to the release into Victor Bay. For public safety, the lagoon operator should publicly inform the Hamlet about the start time, date and estimated duration of the discharge before discharge is started.

2.4 Record Keeping and Recording

Records should be kept to assist in planning for yearly operations and to assist in the evaluation of the effectiveness of the sewage treatment facility. Copies of records pertaining to operation and maintenance of the sewage lagoon should be kept at both the Hamlet Office and the Maintenance Garage and be maintained by the Hamlet Foreman. Information that must be included in these records is listed below:

- Approximate volume of any effluent discharged to the environment.
- Approximate cell level before and after discharge (measured from the top of berm).
- Time required discharging each lagoon cell.
- Details of any maintenance undertaken at site.
- Volume records of delivered potable water from pump/filtration plant.
- Dates of collecting and submitting samples to laboratory.
- Record sheets.
- Copy of the Hamlet's water license.
- Copies of all manuals pertaining to the operation and maintenance of the Sewage Lagoon Facility.

Wastewater volumes will be approximated by the monthly municipal water volumes. Sewage trucks are not equipped with flow meters and therefore the last form of reliable consumption measurement is made at the water treatment plant. This flow measurement will reflect the approximate wastewater volume generated by the Hamlet and must be included in the records.

2.5 Health and Safety

Due to the potential health hazards associated with sewage handling and treatment, the following safety procedures should be obeyed in order to minimize health risks to personnel working in and around the wastewater facilities:

- Equipment is to be kept clean.
- Protective clothing such as gloves and boots are to be worn at all times.
- Work clothes should not be worn home.
- Hands are to be washed frequently, at a minimum before eating and after work.
- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date.
- Change rooms for changing in and out of work clothes, as well as storage lockers to store work clothes, should be provided on site.
- Clothes washing facilities should be available on site to wash soiled work clothes.
- Visit the Health Clinic for all injuries. When working with wastewater the smallest cut or scratch is potentially dangerous.

Lagoon cells are facilities for treating human and industrial wastes, and as such people should be advised to keep away from them.

2.6 Spill Contingency Plan

A spill contingency plan has been developed for the Hamlet that identifies the procedures to follow when a spill of any hazardous material has occurred and can be found in Appendix C. Information presented in the spill contingency plan has been developed based on the document "*Guidelines for Spill Contingency Planning; Indian and Northern Affairs Canada, April 2007"* (INAC, 2007).

3 Maintenance

3.1 Berm Composition

Wastewater treatment lagoons are designed and constructed for the purpose of providing the right environmental conditions for bacteriological processes to proceed. They should be easily and safely operated without causing any adverse effects to the environment. The requirements of good wastewater treatment can be met if lagoon cells are constructed and maintained in such a way as to:

- Control berm seepage.
- Contain the quantity of effluent without interfering with the desired freeboard.
- Maintain an access road around the cell for inspection purposes.

To accomplish this, the berms were designed, constructed with a minimum 3H:1V internal slope and 3H:1V external slope with a 4m crest. The berm core is comprised of compacted Granular 'C'.

As per the recommendations of the geotechnical report and geothermal analysis, a liner on the upstream slope to provide an impermeable boundary will be installed, with an internal ice core dam providing secondary containment. This impermeable liner is installed into the underlying soils, ensuring the liner is keyed into an impermeable surface, i.e. the permafrost.

3.2 Berm Monitoring

Berm monitoring will be vital during the early operational years to ensure the proper freeze-back of permafrost into the base soils and berm core. Temperature records from the berms will also timeline the permafrost levels on a yearly basis summarizing the characteristics of the active layer at the lagoon.

3.2.1 Thermistors

Berm temperatures will be recorded by a data logger at each of the installed thermistor casings along the crest of the berm to model the permafrost. The thermistors are installed with a series of sensors going down to a final depth of approximately 8.0 – 10.0 metres into the berm foundation strata. Monitoring will trace the lower limit of the active permafrost revealing an early warning if the permafrost does not recover.

A sample monitoring sheet is found in Appendix D which requests the observed temperature for the thermistors at the various monitoring sites along the berm. Temperatures are recorded in degrees Celsius for the array of sensors corresponding to the thermistor. This data sheet will contain the information collected from all monitoring site thermistors for the observed date, and stored together with the QA/QC sampling data.

It is recommended that temperature readings be taken at noon on a daily or weekly basis, depending upon the time of the year. The following procedures will be performed for the operation and maintenance of the thermistors:

Calibration of the thermistors as specified by the supplier/manufacturer on an as required basis

Monitoring in the fall, corresponding to the decanting operations when the permafrost will be at its maximum retraction, will be vital to understanding the lower limits of active layer.

Retrieving temperature values from the thermistors is explained in the manufacturer's "Instruction Manual" found in Appendix E.

3.2.2 Sampling Wells

In addition to thermistors, a series of standpipes will be installed to monitor seepage. The standpipes should be monitored yearly, early to mid fall, for the presence of seepage. Sampling procedures will follow the QA/QC requirements.

3.2.3 Settlement Monitoring

Considering that the berms would be constructed on ice rich soils, it is recommended that settlements of the berms should be monitored for 2 to 3 years subsequent to completion of construction. The settlement readings should be undertaken at the beginning of spring and prior to the onset of winter. The settlements should be referenced to the bench mark noted in the site plans.

3.3 Sludge Management

It is anticipated that the sewage lagoon will not require desludging during its 20 year design life, the available storage for sludge is greater than the quantity estimated to be generated.

The effluent quality will guide the Hamlet if or when a sludge management program is implemented. Monitoring of the effluent from the lagoon will indicate when the performance of the lagoon starts to degrade. Degradation of the performance of a lagoon is normally caused by sludge accumulation and will be the indicator to desludge the lagoon.

Prior to disposal, the sludge must be tested to ensure the disposal method chosen is safe and environmentally responsible.

3.3.1 Assessment Criteria

Evaluating the analytical results obtained by sludge sampling, the Government of Nunavut defaults to criteria established by the Canadian Council of Ministers of the Environment (CCME). For soil, the CCME Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (updated September 2007) is used to compare the metals and VOC analytical results. The CCME has also established the Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (April 2001), which is the federal remedial standard for petroleum impacted soils. The CCME and CWS criteria are based on four land use categories: i) agricultural; ii) residential/parkland; iii) commercial; and iv) industrial. As the sludge is to be disposed of at the landfill site, the industrial land use category is utilized for assessing the sludge management.

3.4 Filter Strip Wetland

Treatment of raw sewage in new sewage lagoon in Arctic Bay will be combined with the utilization of a wetlands treatment as a final polishing. The area to be used as wetlands for the Arctic Bay treatment facility is a vegetated filterstrip wetland as described below.

The vegetated area between the lagoon and Victor Bay is incorporated into the sewage treatment process. The filterstrip wetland area is 11.2 hectare (approximately 700 m long and between 86 and 202 m wide) with a slope that varies between 6 to 13 %. Treatment of the pre-treated sewage in the filterstrip wetland area will include removal of TSS, BOD, nutrients and pathogens.

The soil in the filterstrip wetland area is comprised of a topsoil layer with peaty and organic content between 15 and 50 cm thick, silty sand and sand and gravel with permafrost at a depth of approximately 1 m in the summer months. This type of soil is suitable for infiltration processes and will facilitate the two main processes of contaminant removal from pre-treated sewage: uptake of contaminants and nutrients by plant roots and degradation by microorganisms in the rhizosphere.

The well established, native vegetation community will be used and alterations or modifications to the plant community composition are not necessary to increase removal of contaminants. The plant species present, which include willows, grasses, sedges and mosses, are suitable for the phytofiltration processes that will reduce BOD and TSS.

3.5 Filter Strip Protection

Arctic tundra and wetland vegetation communities are very sensitive to physical damage and take a long time to recover from disturbances. Arctic plant species have very slow growth rates and areas damaged by construction activities will not re-vegetate for many years. It is therefore important that construction equipment and trucks does not enter the wetland area. Damage to the wetland area would result in a decrease in treatment efficiency.

4 QA / QC

4.1 Quality Assurance and Quality Control Monitoring

A key component to the operations and maintenance of the sewage lagoon system is a sampling/monitoring program. The following quality assurance (QA) and quality control (QC) program should be implemented to ensure that the analytical results received are accurate and dependable. A QA/QC program is a system of documented checks that validates the reliability of the data collected regarding any given site. Quality Assurance is a system that ensures that quality control procedures are correctly performed and documented. Quality Control refers to the established procedures observed both in the field and in the laboratory, designed to ensure that the resulting end data meets intended quality objectives.

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

It is important such a 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/monitoring program. In addition, quality control and safety training will also be included which will ensure that the data will be properly obtained.

4.2 Sampling Points

Monitoring the operation and efficiency of the system will be accomplished through the establishment of eight sampling points. Sampling will provide information regarding the performance of the system and help identify any degradation to the treatment provided. Table 4-1 provides coordinates of the sampling points.

Table 4-1: Monitoring Points

Monitoring Program Station Number	Description	Northing UTM	Easting UTM
ARC-3	Raw Wastewater Discharge (South Berm)	8105968m	562068m
ARC-4	Lagoon Pump Discharge (North Berm)	8106150m	561824m
ARC-6a	Sampling Well at end of Wetlands	8106769m	561091m
ARC-6b	Surface water near sampling well at end of Wetlands	8106769m	561091m
ARC-7	Water five (5) metres from effluent entering Victor Bay		
ARC-8	Sewage Sludge		

4.3 Sampling Frequency

The following outlines the Sampling Testing and Compliance requirements of the Wastewater Facility. 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. The flow rate of effluent discharge during the decanting period is required as well.

Table 4-2: Sampling Frequency

Monitoring Program Station Number	Description	Frequency
ARC-3	Raw Wastewater Discharge (South Berm)	Water Quality: Monthly and Annually
ARC-4	Lagoon Pump Discharge (North Berm)	Water Quality: Three Times Annually – Start, middle and end of decanting
ARC-6a	Sampling Well at end of Wetlands	Water Quality: Three Times Annually – Start, middle and end of decanting
ARC-6b	Surface water at the end of the Wetland Area	Water Quality: Three Times Annually – Start, middle and end of decanting
ARC-7	Water five (5) metres from effluent enters Victor Bay	Water Quality: Three Times Annually – Start, middle and end of decanting
ARC-8	Sewage Sludge	To be determined

Figure 4-3: Sampling Points

4.4 Sampling Parameters

Samples should be analyzed for the following parameters:

Biochemical Oxygen Demand – BOD_5	Faecal Coliforms
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)q

4.5 Compliance Points

The water license has set the lagoon discharge as the compliance point for the new wastewater facility as it is the last point of measurement and control. The effluent released from the lagoon must meet the criteria list in Table 4-4. This criteria recognizes the treatment ability of the filter strip.

Table 4-4: Effluent Criteria at the Compliance Point

Parameter	Maximum Average Concentration
BOD_5	120 mg/L
Total Suspended Solids (TSS)	180 mg/L
Faecal Coliforms	1×10^6 CFU/100mL
Oil and Grease	No visible sheen
pH	Between 6 and 9

4.6 Laboratory Requirements

All analyses shall be performed by a laboratory certified by the Canadian Association for Laboratory Accreditation (CALA), or as otherwise approved by an Analyst.

4.7 Sampling Procedures

The sampling procedures should be as per “Quality Assurance (QA) and Quality Control (QC) Guidelines for use by Class “B” Licenses in Collecting Representatives water samples in the field”.

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 (American Public Health Association, American Water Works Association, and Water Environment Federation, most current edition).

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

- Sample collection at a designated time and location.
- Correct usage of container/sample bottle for the 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.

4.8 Lagoon Water and Sludge Sampling

Prior to sampling, the appropriate sample bottles/vials, along with coolers and ice packs should be requested from the analytical laboratory.

Latex or nitrile gloves should be worn during sampling and should be replaced with fresh gloves after all sample containers are filled at each sampling location. Sampling equipment such as sampling poles should be cleaned with soap and water after each sample is collected to prevent cross-contamination.

For lagoon water samples

Using a sampling pole, plunge the container into the lagoon water neck first. Immerse to a depth of 10 to 20 cm, depending on the depth of the lagoon. Fill the sampling container with the mouth facing slightly upwards.

For lagoon sludge samples

Using a sampling pole, plunge the container into the lagoon water neck first to maintain an air pocket within the container. Once contact with the sludge is felt, immerse container into sludge neck first to a depth of 5 to 10 cm. Fill the sampling container with sludge and raise sample bottle neck first to prevent sample spillage.

All sample containers should be tightly sealed and properly labeled with the sample ID, date and time of sample collection, location of sample collection and parameters to be analyzed. The outside of the bottles should be cleaned with soap and water prior to placing the samples in the cooler. The samples should be stored on ice in a cooler until delivery to the laboratory. A Chain of Custody Form should be filled out completely and be used to track the samples. Keep the last page and give it to the project manager along with the field notes.

4.9 Groundwater Sampling

In permafrost regions, water may be present for at least part of the year in the active layer. For the purposes of this document, this water is considered groundwater.

Dedicated Waterra™ pumps and tubing or bailers should be installed in each well. Dedicated sampling equipment minimizes the risk of cross-contamination.

Since, water standing in a well is generally not thought to be representative of the conditions within the water bearing formation, well purging is typically done to ensure formation water is sampled. However, in the case of permafrost regions, well purging is not recommended due to the limited amount of water likely to be present in the active layer. Instead, the available groundwater should be collected into the laboratory supplied sample containers and all sample containers should be tightly sealed and properly labeled with the sample ID, date and time of sample collection, location of sample collection and parameters to be analyzed. The samples should be stored on ice in a cooler until delivery to the laboratory. A Chain of Custody Form should be filled out completely and be used to track the samples. Keep the last page and give it to the project manager along with the field notes.

4.10 Quality Assurance and Quality Control Program

Prevention of Cross Contamination

Proper field protocols reduce the chances of cross contamination in the field. As outlined above, latex or nitrile gloves should be worn during sampling and should be replaced with fresh gloves after all sample containers are filled at each sampling location. Sampling equipment such as sampling poles should be cleaned after each sample is collected to prevent cross-contamination.

Proper Field Note Taking Procedures

Proper documentation of all aspects of the sampling program (i.e., field notes and Chain of Custody forms) is essential. Be sure to note any deviations that could potentially cause sampling bias (i.e., broken bottles). It is also important that field notes include the date and time of the sampling event, the

meteorological conditions at the time of sampling (ambient temperature, whether it is raining or snowing, etc.).

Quality Control Samples

Cross contamination is a common source of error in sampling procedures. QC samples help you identify when and how contamination might occur. There are various types of QC samples including: blind duplicates, field blanks, and trip blanks. A blind duplicate is a duplicate sample that is not labeled as such. The purpose of the blind duplicate sample is to ensure analytical precision. A field blank is a sample of analyte free (i.e., clean) water poured into the container in the field, preserved and shipped to the laboratory with field samples and is analyzed along with field samples to check contamination from field conditions during sampling. A trip blank is a clean water sample that stays unopened and that remains with collected samples during transportation and is analyzed along with field samples to check residual contamination (i.e. to determine if cross contamination occurs during shipping).

exp recommends the following number of quality control samples based on the number of samples collected:

- 10% field blanks
- 10% blind duplicates
- 1 trip blank per shipping container (cooler)

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

Sampling Containers, Preservation and Hold Times

Containers, preservatives, holding times, and sample volumes with respect to the target analyses should be selected in accordance with the appropriate protocols (Canadian Council for Ministers of the Environment or CCME). All water samples should be collected in laboratory approved containers with the proper preservative, where applicable.

Sample Identification Requirements

All sample containers must be labeled to prevent misidentification of samples. As mentioned above, the sample containers should be identified with the sample ID, the client ID, date and time of sample collection, location of sample collection and parameters to be analyzed.

Chain of Custody

A chain of custody must accompany the shipment of samples to the laboratory. A legal Chain of Custody is a special type of sample custody that requires the physical possession, transportation and storage of a sample be documented in writing. On the Chain of Custody, you indicate what analyses are to be done by the laboratory and who should receive the results. Keep the last page and give it to the project manager along with the field notes.

Sample Transmittal Documentation

All samples should be logged into the laboratory to verify that all records were complete, correct and entered into the sample custody records.

Initial Check of Samples and Documentation

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

- Verification of the integrity and condition of all sample coolers.
- Verification of the integrity and condition of all sample containers.
- Checks for leakage, cracked or broken closures or containers, evidence of grossly contaminated container exteriors or shipping cooler interiors, and obvious odors, etc.
- Verification of receipt of complete documentation for each container.

- Verification that sample identification numbers on sample transmittal forms correspond to sample identification numbers on the sample containers.
- Verifications that holding times were met and samples were kept cool during transit.

Appendix A – Water License

P.O. Box 119
Gjoa Haven, NU X0B 1J0
Tel: (867) 360-6338
Fax: (867) 360-6369

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File No.: 3BM-ARC0810 Amendment No. 1

April 16, 2009

Mr. Joeli Qamanirq
Senior Administrative Officer
Hamlet of Arctic Bay
P.O. Box 144
Arctic Bay NU X0A 0A0

RE: NWB Licence No. NWB3ARC0810 Amendment No. 1

Dear Mr. Qamanirq:

Please find attached Amendment No. 1 to Licence No. 3BM-ARC0810 Type "B" issued to the Hamlet of Arctic Bay by the Nunavut Water Board (NWB), (Motion 2008-24-L02) pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*. The terms and conditions of the original Licence related to water use and waste disposal remain an integral part of this approval.

The NWB strongly recommends that the Licensee consult the comments received from interested persons on issues identified. This information is attached for your consideration.

Sincerely,

Thomas Kabloona
Nunavut Water Board, Chair

TK/tla/kt

Enclosure: Licence No. 3BM-ARC0810 Amendment No.1
Comments: GN-DoE, GN-CLEY, Env.Can, INAC, BGC[1]

cc: Qikiqtani Distribution List

[1] Indian and Northern Affairs Canada (INAC) dated September 12, 2008; Government of Nunavut Department of Environment (GN-DoE) dated August 21, 2008; Government of Nunavut Department of Culture, Language, Elders and Youth (GN-CLEY) dated August 25, 2008; Environment Canada (EC) dated August 29, 2008; BGC Engineering Inc. (BGC) dated September 5, 2008 and December 10, 2008.

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REASONS FOR DECISION

I. BACKGROUND

The Hamlet of Arctic Bay (Hamlet or Applicant) has a population of approximately 855 and is located at the coordinates of 73° 02' north latitude and 83° 05' west longitude, on the north tip of Baffin Island within the Qikiqtani Region of Nunavut.

Currently, the community generates an estimated 33,600 cubic metres of sewage annually, which is treated in a sewage lagoon, ice pack area and associated wetland located 2.5 km east of the community. The existing lagoon is at the end of its useful life as it does not meet the storage needs of the community or the treatment requirements of the Hamlet's current water licence. Therefore, construction of a new sewage lagoon in a small valley northwest of the existing facility is proposed, with additional treatment through natural wetlands.

The new wastewater treatment facility has been designed for a twenty (20) year life with a projected annual sewage generation rate of 56,029 cubic metres.

II. PROCEDURAL HISTORY

The Nunavut Water Board (NWB) issued a municipal water licence to the Hamlet of Arctic Bay on November 1, 2002, to allow for the use of water and disposal of waste. Following application by the Hamlet, the NWB issued an amendment to the Licence on March 2, 2005 to allow for emergency remedial work required to prevent failure of the lagoon's containment berms, which could result in the release of waste into water and the environment surrounding the Hamlet's Sewage Disposal Facility.

Following the expiration of the water licence on October 31, 2007, a submission of a renewal application and a detailed assessment was received and the Board approved a water licence renewal on March 17, 2008, as Water Licence 3BM-ARC0810.

On August 22, 2008 the Nunavut Planning Commission indicated in an email to the NWB that no conformity determination was required for the Arctic Bay municipal project sewage lagoon. On February 27, 2008, the Nunavut Impact Review Board (NIRB) exempted from screening the construction of the new sewage lagoon.

The Hamlet of Arctic Bay, in conjunction with the Government of Nunavut, Department of Community and Government Services (GN-CGS), submitted an Application for Water Licence Amendment to the NWB on April 30, 2008. Following a preliminary review of the application, the NWB concluded that it met the requirements of section 48(1) of the *Nunavut Waters and Surface Rights Tribunal Act* (the Act) and advised the Applicant and distribution list accordingly on July 30, 2008.

Information contained in the April 30, 2008 submission and distributed for review included:

- Letter from GN-CGS to NWB, regarding *Application for the amendment of the existing Water licence for the Hamlet of Arctic Bay, Baffin Region, Nunavut: 3BM-ARC0810,* dated April 30, 2008;
- Drawings prepared by Trow Associates Inc. for the Government of Nunavut entitled *Government of Nunavut, Arctic Bay, Decommissioning Existing Lagoon*, Project No. OTCD00019054B, signed and stamped by a professional engineer registered in Nunavut;
- Report prepared by Trow Associates Inc. for the Government of Nunavut Community and Government Services Project Management Division – Baffin Region, entitled *Arctic Bay Sewage Lagoon Decommissioning*, dated April 2008, Project No. OTEN00019054C;
- Report prepared by Trow Associates Inc. for the Government of Nunavut Community and Government Services Project Management Division – Baffin Region, entitled *Design Brief New Sewage Lagoon for the Hamlet of Arctic Bay*, dated April 2008, Project No. OTCD00019054A;
- Report prepared by Trow Associates Inc. for the Government of Nunavut Community and Government Services Project Management Division – Baffin Region, entitled *Environmental Assessment Screening New Sewage Lagoon for the Hamlet of Arctic Bay Conducted in Compliance with the Canadian Environmental Assessment Act*, dated April 2008, Project No. HAEN00286312A;
- Report prepared by Trow Associates Inc. for the Government of Nunavut Community and Government Services Project Management Division – Baffin Region, entitled *Geotechnical Investigation Sewage Lagoon, Hamlet of Arctic Bay, NU*, dated April 24, 2008, Project No. OTGE00019054B;
- Report prepared by Naviq Consulting Inc. for Trow Associates Inc., entitled *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay, NU.*, dated April 2008, Project No. J008 Revision 1;
- Drawings prepared by Trow Associates Inc. for the Government of Nunavut entitled *Government of Nunavut, Arctic Bay Wastewater Lagoon*, Project No. OTCD00019054A, signed and stamped by a professional engineer registered in Nunavut;
- Drawings prepared by Trow Associates Inc. for the Government of Nunavut entitled *Government of Nunavut, Arctic Bay Wastewater Lagoon Road*, Project No. OTCD00019054A, signed and stamped by a professional engineer registered in Nunavut;
- Letter from Hamlet of Arctic Bay to Community and Government Services regarding *Sewage Lagoon Project for Arctic Bay*, dated December 19, 2007;
- Report prepared by Rowan, Williams, Davies & Irwin Inc. (RWDI) for Trow Associates Inc., entitled *Snowdrift Assessment Proposed Wastewater Lagoon Arctic Bay, NU*, dated April 14, 2008, Project No. 08-1032A;

- Report prepared by Trow Associates Inc. for the Government of Nunavut Community and Government Services Project Management Division – Baffin Region, entitled *Vegetated Filter Strip Wetland Assessment, Hamlet of Arctic Bay, Nunavut*, dated April 2008, Project No. HAEN00286312A;
- Topographic Map prepared by Trow Associates Inc. for the Government of Nunavut entitled *Arctic Bay Wastewater Lagoon Topographic Map*, dated 11/02/2008, Project No. OTCD00019054A;
- English Summary entitled *Technical Report of the Wastewater Treatment Facility in Arctic Bay*;
- Inuktitut Summary; and
- Completed Water Licence Application form signed February 26, 2008.

The scope of the Application for Water Licence Amendment includes:

- Construction and operation of a new Wastewater Treatment Facility comprised of a single cell sewage lagoon and wetland treatment area;
- Construction of a new gravel access road from the existing lagoon to the new lagoon including stream crossings;
- Effluent release from the new lagoon to a 11.2 hectare Vegetated Filter Strip Wetland area that is approximately 700 metres long, between 86 and 202 metres wide and flows northwest into Victor Bay;
- Decommissioning of the existing Sewage Disposal Facility once the new Wastewater Treatment Facility is commissioned; and
- Quarrying from the Arctic Bay quarry.

The NWB publicly posted notice of this application, in accordance with Section 55.1 of the Act and Article 13 of the *Nunavut Land Claims Agreement* (NLCA), on July 30, 2008. This assessment process included the referral of the application to a variety of Federal, Territorial and local organizations for their review and comment.

As no public concern was expressed, the NWB waived the requirement to hold a public hearing and proceeded with the application process.

The NWB received comments on the application from interested parties including Environment Canada (EC), Indian and Northern Affairs Canada (INAC), the Government of Nunavut Department of Environment (GN-DoE) and the Government of Nunavut Department of Culture, Language, Elders, and Youth (GN-CLEY) on or before September 12, 2008. In addition, on September 5, 2008, BGC Engineering Inc. (BGC), at the request of the NWB, carried out a technical review on the geotechnical and geothermal aspects of the project and provided the NWB with a summary of findings.

Between October 27th, 2008 and November 10th, 2008, the NWB received a response from the Applicant. The response addressed comments from the interested parties and included the following documents:

- Letter from Trow Associates Inc. to GN-CGS regarding response to comments Arctic Bay Sewage Lagoon, Nunavut, dated November 10, 2008;
- Letter from Trow Associates Inc. to GN-CGS regarding response to BGC Letter of September 5, 2008 Geotechnical Investigation, Arctic Bay Sewage Lagoon, Arctic Bay, Nunavut, dated October 27, 2008;
- Letter from Trow Associates Inc. to GN-CGS regarding Sludge Accumulation, Arctic Bay Sewage Lagoon, Nunavut, dated November 10, 2008;
- Table 1: Summary of Review of Geotechnical and Geothermal issues;
- Report prepared by Naviq Consulting Inc., for Trow Associates Inc., entitled *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay, NU* dated October 2008 as revision 2, project number J008; and
- Document prepared by Trow Associates Inc., entitled Arctic Bay Sewage Lagoon O&M Manual Outline, Project number OTCD00019054A.

This additional information was forwarded to BGC on November 13, 2008, for review, to provide the NWB with a final summary of issues, which was provided to the NWB on December 10, 2008.

Based upon the results of the detailed assessment, including consideration of any potential accidents, malfunctions, or impacts to water, that the overall project might have in the area, the Board approved the application and has amended Licence 3BM-ARC0810.

ISSUES

Compliance

The decision for the renewal of Licence 3BM-ARC0810, on March 17, 2008 indicated that there were several issues of non-compliance with conditions of the previous licence 3BM-ARC0207. These included:

- Unauthorized release of Effluent and failure to file a spill report;
- Unacceptable Effluent discharge quality, decant structure, erosion, dike failure, and available freeboard of lagoon;
- Failure to submit annual reports for 2002 to 2005 (2006 annual report received on April 7, 2007);
- The Licensee did not submit an Operations and Maintenance Plan during the Licence term; and
- Incomplete monitoring data.

In response to the above compliance issues, the Board then decided on a shorter two (2) year term for the licence renewal and as noted in its decision fully expected the Licensee to take immediate steps to come into full compliance with the licence requirements. In addition, the Board required, as a condition in Part B Item 10 of 3BM-ARC0810, the Licensee to submit a Plan for Compliance within the lesser of ninety (90) days or upon the filing of any application in relation to the Licence, that clearly demonstrates how the Licensee will achieve full compliance with the Licence conditions.

As part of the review of this Application for Water Licence Amendment, the NWB conducted a compliance assessment of the current licence 3BM-ARC0810. The results of this assessment indicate a number of additional, and continued compliance issues including:

- Failure to submit to the Board, a Plan for Compliance within ninety (90) days or upon the filing of the amendment application in accordance with Part B Item 10;
- Failure to submit to the Board for review, within six (6) months of the issuance of the Licence, a report identifying each Final Discharge Point in accordance with Part D Item 10; and
- Failure to submit to the Board for approval, within ninety (90) days of issuance of the Licence, an Operations and Maintenance Manual in accordance with Part F Item 1.

Plan for Compliance

As noted above, the Licensee to this date, has not complied with Part B, Item 10 of the current licence 3BM-ARC0810, requiring the Licensee to submit a Plan for Compliance that clearly

demonstrates the ways and means the Licensee will undertake to achieve full compliance with the conditions of the Licence, during the licence term.

The NWB is therefore maintaining this requirement, but has amended the condition in Part B Item 10 to require submission of the Plan within a time frame of **thirty (30) days** following issuance of this Licence Amendment, for approval by the Board in writing. In addition, this condition has been amended to require that the Plan clearly demonstrate the measures the Licensee will undertake, including an implementation schedule, to achieve full compliance with the conditions of this Licence, including the issues raised in the Inspector's reports.

Annual Report

As noted above, the Licensee's failure to submit annual reports has been an ongoing compliance issue.

The NWB will maintain the condition in the License to produce annual reports. These reports are important in ensuring that the NWB has an accurate annual update of municipal activities during a calendar year with respect to water use and waste disposal. This information is maintained on the public registry and is available to interested parties upon request. A *Standardized Form for Annual Reporting* is to be used by the Licensee and is available for use by the Licensee at the NWB's ftp site at ftp://nunavutwaterboard.org/ADMINISTRATION/Standardized%20Forms/. This standardized form should not limit the amount and quality of information provided by the Licensee, but is made available to assist in the preparation of the annual report.

Although an Annual Report has been received by the NWB for 2006, not all data that should have been generated under Part H, Monitoring Program was included. The Board is requiring the Licensee to submit all available data generated under the previous Licence NWB3ARC0207 and the Renewal, 3BM-ARC0810 Monitoring Program to the Board within thirty (30) days of issuance of this Licence Amendment.

Design Issues

A number of documents were submitted as part of the Application for Water Licence Amendment in support of the design of the new Wastewater Treatment Facility as indicated in the procedural history of this decision. These documents were reviewed by BGC, an expert reviewer retained by the Board. The results of BGC's review, submitted on September 5, 2008, identified a number of concerns related to the site description and the geothermal and stability analyses for the lagoon including:

- Inconsistency between the results of the geothermal analyses and the design;
- Description and justification for the derivation of parameters used in the slope stability analysis including effective cohesion for ice;

- Uncertainty with respect to the derivation of the design stratigraphic sections used in the stability analyses;
- Uncertainty with respect to the installation of the impermeable liner to be installed along side valleys of the lagoon impoundment to minimize lateral migration of effluent;
- Uncertainty with respect to the effects of predicted long term permafrost thaw and warming;
- Uncertainty with respect to the source, quality and specifications of borrow materials for construction; and
- Thermal, settlement and displacement monitoring.

INAC, in its September 12, 2008 comments also provided a number of recommendations related to the design of the Wastewater Treatment Facility including:

- Details of the installation of the liners to be placed along the upstream slopes of the northwest and southwest berms as well as each side of the valley forming the lagoon should be provided. Details should include (1) the type of liner; (2) how the liner will be incorporated into the cell to prevent seepage; and (3) a discussion on the quality assurance and quality control measures applied during installation;
- The use and location of thermistor cables and vertical slotted standpipes within the lagoon berms for monitoring temperature and effluent seepage should be described as part of the Operations and Maintenance Manual; and
- An explanation regarding the need for any proposed spillways should be provided.

On November 12, 2008, the Applicant submitted additional information in response to the issues raise by BGC, including:

- Letter from Trow Associates Inc. to GN-CGS regarding response to BGC Letter of September 5, 2008 Geotechnical Investigation, Arctic Bay Sewage Lagoon, Arctic Bay, Nunavut, dated October 27, 2008;
- Table 1: Summary of Review of Geotechnical and Geothermal issues; and
- Report prepared by Naviq Consulting Inc., for Trow Associates Inc., entitled *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay, NU* dated October 2008 as revision 2, project number J008

In its final summary, BGC noted that a number of the issues were not addressed in the Applicant's response of November 12, 2008. The main issue of concern being the location of the key trench liner and potential impact of berm displacements on liner integrity. BGC therefore recommended that the location of the liner key trench, horizontally from the upstream toe of the berm, be as recommended in Naviq Consulting Inc.'s geothermal design report. Furthermore, BGC recommended that the proposed 2 metres penetration depth of the lined key trench be considered a minimum and that the construction specifications indicate that it be keyed into sound rock or ice-saturated permafrost mineral soils or rock. Based on these concerns, the Board

has decided to impose the recommendations provided by BGC as conditions of the amendment in Part E Items 8 and 9.

In addition, BGC recommended that a detailed Instrumentation Monitoring and Surveillance Plan be submitted to the NWB for review and approval as a condition of the amendment. BGC recommended that this Plan include details of the proposed instrumentation plan, describe frequency of measurements and identify trigger values or observations for remedial action. INAC similarly recommended that the Operations and Maintenance Manual should provide a description of the thermal and seepage monitoring requirements of the lagoon berms. As such, the Board is requiring the Licensee to submit to the Board as part of the Operations and Maintenance Manual required in Part F Item 1(h), a detailed Instrumentation Monitoring and Surveillance Plan.

The Board has also included a condition in the Licence, Part E, Item 11, requiring the Licensee to submit within sixty (60) days of construction of the Wastewater Treatment Facility, a Construction Summary Report. This Report is to include as-built drawings identifying the areas where field changes were made from the original design drawings, preferably in the form of a revision bubble and a brief note in the revisions section of the title block. Given BGC's concerns regarding the finalization of specifications for fill materials to be used for construction of the berms of the Wastewater Treatment Facility, the Report shall also include details of the fill materials specification for dike and key trench construction. Due to conflicting information regarding the location of the lined key trench in the Application for Water Licence Amendment (the recommended location as indicated in the report prepared by Naviq Consulting Inc., for Trow Associates Inc., entitled *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay, NU* dated October 2008 was at a distance of approximately five (5) metres back from the upstream toe of the dike, whereas drawing DE-2 indicates three (3) metres), the Report shall also include the final location for the lined key trench and reasons for selecting the final location. To address INAC's comments regarding the spillway, the Board is also requiring this Report to include confirmation regarding the requirement for a spillway including a rationale. Lastly, to address INAC comments regarding liner installation, this Report shall include details regarding the installation of impermeable liners including the type of liner, how the liners were incorporated into the cell to prevent seepage, and a discussion of the quality assurance/ quality control measures applied during installation.

Operational Plans

Under the current water licence 3BM-ARC0810, Part F Item 1, the Licensee was required to submit an Operation and Maintenance (O&M) Manual covering the Water Supply Facility, the Sewage Disposal Facility and Solid Waste Disposal Facility including plans for sewage sludge management, spill contingency and Quality Assurance/Quality Control (QA/QC) within ninety (90) days of issuance of the licence. To date, this Manual has not been received.

The GN-DoE, INAC, and EC all commented on the need for an O&M Manual. The GN-DoE commented in its August 21, 2008 submission that an O&M Manual should be provided for the two sewage lagoons (the existing and the proposed).

All parties also commented on the need for a Sewage Sludge Management Plan providing detailed recommendations regarding the contents of the plan including the rate of sludge accumulation, the frequency of desludging, sludge characterization procedures, sludge disposal standards, and sludge disposal procedures.

Moreover, EC commented on the need for a Spill Contingency Plan and INAC commented on the need for a diagram that references Monitoring Program station numbers that could be appended to the Licence.

On November 12, 2008, in response to comments received, the Applicant provided additional information including:

- Document prepared by Trow Associates Inc., entitled *Arctic Bay Sewage Lagoon O&M Manual Outline*, Project number OTCD00019054A;
- Letter from Trow Associates Inc. to GN-CGS regarding *Response to Comments Arctic Bay Sewage Lagoon*, Nunavut, dated November 10, 2008; and
- Letter from Trow Associates Inc. to GN-CGS regarding *Sludge Accumulation, Arctic Bay Sewage Lagoon*, Nunavut, dated November 10, 2008.

With respect to sewage sludge, the additional information indicated that the sewage lagoon would not likely require desludging within the twenty year design life of the lagoon. However, it conceded that sampling should be used as an indicator of the build up of sludge and that guidelines for desludging would be provided as part of the O&M Manual.

The Board acknowledges the Applicant's submission of an O&M Manual outline, but agrees with reviewers that this Plan should be fully developed. The Board is therefore maintaining the requirement for the submission of an O&M Manual. As such, the Board has amended the condition in Part F Item 1 of licence 3BM-ARC0810, to require submission of the O&M Manual for Board approval in writing, within **sixty (60) days** following issuance of this Licence Amendment. The timing for submission of this Manual takes into consideration the Applicant's proposal to begin construction during the summer of 2009. This Manual is to be developed to the satisfaction of the Board and include the following plans:

a. Water Supply Facilities Operation and Maintenance Plan;
b. Solid Waste Operation and Maintenance Plan;
c. Sewage Operation and Maintenance Plan for the existing Sewage Disposal Facility and the new Wastewater Treatment Facility;
d. Sewage Sludge Management Plan;
e. Hazardous Waste Management Plan;

f. Spill Contingency Plan including a Spill Response Plan for Aggregate deposits;
g. Monitoring Program Quality Assurance/Quality Control Plan including a diagram that references Monitoring Program Station Numbers; and
h. Instrumentation Monitoring and Surveillance Plan (See Monitoring section below, as this Plan is due within thirty (30) days of issuance of this Licence Amendment).

Item (c) above is intended to address operation and maintenance for both the existing Sewage Disposal Facility as well as the new Wastewater Treatment Facility.

Given that procurement of material from the Hamlet quarry is required to complete the project, the Board is also requiring as part of the O&M Manual required in Part F Item 1 of the Licence Amendment, that the Licensee's Spill Contingency Plan address operations at the aggregate deposit(s). This condition is also a requirement of NIRB's 06UN036 screening determination which states that the Proponent shall have an NWB approved Spill Contingency Plan in place prior to commencement of construction activities and that this Plan shall address any additional fuel stored at the quarry site.

The purpose of the O&M Manual noted above is to assist Hamlet staff in carrying out the procedures relating to the waste disposal facilities. The O&M Manual should demonstrate to the NWB that the Hamlet is capable of operating and maintaining the infrastructure related to water use and waste disposal and to meet the requirements of the Licence. The O&M Manual should be based, at a minimum on the various NWB-approved guidelines available (i.e. *Guidelines for the Preparation of an Operations and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories*, Duong and Kent, 1996) and other regulatory guidelines.

Sewage

The new Wastewater Treatment Facility comprising a single cell sewage lagoon as the primary treatment system and a wetland as the secondary treatment system is proposed to be constructed in a small valley. This will replace the existing facility built in 1976 and expanded in 2003. Treated sewage effluent from the new lagoon will be pumped to the new 11 hectare Vegetated Filter Strip Wetland Area where it will be further treated and polished prior to runoff into Victor Bay. Victor Bay is a marine environment located approximately 700 metres away from the new lagoon.

The Application for Water Licence Amendment consists of a report, drawings, and recommendations prepared by Trow Associates Inc (Trow), retained by the GN-CGS on behalf of the Hamlet. However, the Applicant does not specify which of Trow's recommendations would be implemented. Thus, for greater certainty the NWB has included a new condition in Part E Item 6 of the Licence Amendment that requires the Licensee to implement the recommended options identified in the Application for Water Licence Amendment document entitled *Design Brief New Sewage Lagoon for the Hamlet of Arctic Bay*, dated April 2008, as

prepared by Trow, Project No. OTCD00019054A. In the event of a conflict between the conditions of this Licence Amendment and the above referenced document, the conditions of this License shall prevail.

The Board acknowledges that the Applicant predicts that effluent from the proposed Vegetated Filter Strip Wetland Area will meet the current licence effluent quality limits. However, due to uncertainty regarding the treatment efficiency of wetlands in the north, the Board has decided that the Final Discharge Point and point of compliance for the Wastewater Treatment Facility be located at the point of discharge from the lagoon to the Vegetated Filter Strip Wetland Area. In order to determine the performance of the Vegetated Filter Strip Wetland Area as a secondary treatment system, the Board further requires that the quality of effluent leaving the Vegetated Filter Strip Wetland Area be monitored and reported.

Furthermore, the Board has set effluent quality standards at the Final Discharge Point of the new Wastewater Treatment Facility at 120 mg/L for BOD_5 and 180 mg/L for TSS. In setting the effluent quality standards, the Board took into consideration EC's August 29th, 2008 comments as well as the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories, 1992*, (Guidelines). According to Table 4.1 of the Guidelines, for a wastewater flow greater than 600 lcd during summer months into a marine receiving environment, the discharge criteria for BOD_5 should be set at 80 mg/L and the discharge criteria for TSS should be 70 mg/L. Taking into consideration note (k) to Table 4.1 of the Guidelines which states that where wetlands are to be used as part of the treatment systems, limits may be chosen to suit the point of measurement and control, the Board has decided to set limits from the lagoon that are less strict than the 80/70 (BOD/TSS) standards to take into account the potential for treatment in the wetland area and to be consistent with other recently issued water licences with comparable systems such as Clyde River. The discharge criteria for the existing Sewage Disposal Facility includes Fecael Coliforms as a licensed parameter and the NWB is maintaining this requirement for the new Wastewater Treatment Facility.

The Board has also amended the effluent quality standards to meet criteria based on the maximum concentration of any grab sample, as opposed to maximum average concentrations which cannot be calculated annually if only three (3) samples are collected per year in accordance with the Monitoring Program.

In addition, due to logistical constraints brought to the Board's attention with respect to providing evidence under the Licence, the Board has removed the requirement for the Licensee to demonstrate that Effluent is non-acutely toxic. However, the Board advises the Licensee, that compliance with this Licence does not absolve the Licensee from the responsibility to comply with other applicable legislation and to ensure that any effluent discharged from the system's Final Discharge Point is in compliance with Section 36(3) of the Fisheries Act. According to Section 36(3) of the Fisheries Act, where the deposition of deleterious substances of any type, under any conditions where the deleterious substance, or any other deleterious substance that results from the deposit of the deleterious substance, may enter such water, is prohibited.

As noted earlier in this Decision, the Licensee has failed to submit to the Board a report identifying each Final Discharge Point for the existing Sewage Disposal Facility in accordance with Part D Item 10 of the current licence 3BM-ARC0810. Given that the existing Sewage Disposal Facility will remain in operation until commissioning of the new Wastewater Treatment Facility, the Board is maintaining this requirement and has amended the condition to require submission of the report within thirty (30) days of issuance of this Licence Amendment.

Stream Crossings

To access the new Wastewater Treatment Facility, a new access road approximately 1.25 km long is required to be constructed, extending from the road to the existing Sewage Disposal Facility to the new Wastewater Treatment Facility. The proposed road alignment is required to cross drainage paths. To accommodate the stream crossings, culverts will be installed at each crossing.

The Board has included a condition in Part E Item 7 prohibiting disturbance of any stream/lake bed or the banks of any definable watercourse unless authorized by the Department of Fisheries and Oceans (DFO).

In addition, the Licensee is reminded that a number of conditions of the original Licence 3BM-ARC0810 apply to stream crossings, including those conditions related to the requirement for as-built plans and drawings of any modifications in Part E Item 3 and the requirement for geotechnical inspections in Part F Item 3, as well as the conditions related to surface drainage, sediment and erosion control.

Quarry

On May 5, 2006, the NIRB issued a screening determination allowing the Arctic Bay Airport Redevelopment Project (NIRB File 06UN036) to proceed subject to terms and conditions. On November 21, 2007, the NIRB exempted the Hamlet's quarry permit application (QB07-001) from screening as it was understood that the application was previously screened under NIRB File 06UN036. On February 27, 2008 the NIRB exempted a revised Quarry Permit Application (QB07-0001) from the GN-CGS involving an additional amount of material to be removed from the Arctic Bay quarry. The additional material was to be used in part for the new sewage lagoon construction.

A new quarry permit (08-703-001) from GN-CGS was issued to the Hamlet on April 18th, 2008 authorizing the taking of 340,000 cubic metres of material from four (4) sites located approximately five (5) miles from the Hamlet. This quarry licence authorizes the taking of a sufficient amount of material for the completion of this project.

The Applicant is advised that the expansion of an existing quarry site or the creation of any new quarry site location requires screening by the NIRB in accordance with Article 12 of the NLCA.

The NWB cannot authorize water use or waste disposal associated with development of a new quarry deposit until NIRB has completed its review of the proposed activity. Finally, any new quarry development(s) that receive an approval to proceed from the NIRB will require an amendment to this Licence.

Those conditions of NIRB's screening decision 06UN036 related to the mandate of the NWB regarding the use of water and disposal of waste, have been incorporated into this Licence Amendment.

Abandonment and Restoration Plan

Under the current water licence 3BM-ARC0810 Part G Item 1, the Licensee was required to submit to the Board for approval at least six (6) months prior to abandoning any facilities or upon submission of the final design drawings for the construction of new facilities to replace existing ones, an Abandonment and Restoration Plan.

On April 30, 2008, the Applicant submitted a report prepared by Trow for the GN-CGS Project Management Division – Baffin Region, entitled *Arctic Bay Sewage Lagoon Decommissioning*, dated April 2008, Project No. OTEN00019054C. This report partially addresses the requirement of Part G Item 1 of the current water licence regarding the existing sewage lagoon. However, the NWB has identified that the report does not provide an implementation schedule, it does not address future area use, nor does it provide a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment as required by sub-items (vi), (x), and (xii) respectively.

In its submission dated September 5, 2008, BGC noted that the *Arctic Bay Sewage Lagoon Decommissioning* report involves adding a cover of fill material over the sludge to encapsulate the sludge in permafrost. However, it was not clear whether maintaining the sludge in a permafrost condition was a design requirement. BGC recommended that if it is a requirement, that geothermal analyses be carried out to confirm that the proposed cover thickness of 1.5 metres is sufficient to encapsulate the sludge in permafrost and if so, for how long a design period considering the effects of climate change. BGC noted again in its December 10th comments, that this issue had not been addressed in the Applicant's November submission of additional information.

Therefore, the Board is requiring as a condition in Part G Item 2 of the Licence Amendment, that the Licensee submit to the Board for approval within ninety (90) days of Licence issuance a detailed Final Abandonment and Restoration Plan for the existing Sewage Disposal Facility. This Plan should incorporate, where applicable, the appropriate sections described in Part G Item 1 and address the concerns raised by BGC.

In its submission dated September 12, 2008, INAC recommended that as-built plans and drawings following the decommissioned existing Sewage Disposal Facility be provided. The

NWB agrees with INAC and is requiring the Licensee, as a condition in Part G Item 5, to submit to the Board within sixty (60) days of completion of decommissioning of the existing Sewage Disposal Facility, a Decommissioning Summary Report including stamped as-built plans and record drawings.

Monitoring Program

According to the report submitted by the Applicant, entitled *Design Brief New Sewage Lagoon for the Hamlet of Arctic Bay*, (Trow, April 2008), the new Wastewater Treatment Facility's earth berms are classified as dams under the Canadian Dam Safety Guidelines. Therefore, the Applicant has proposed ongoing monitoring for stability including temperature and seepage monitoring within the lagoon berms. Furthermore, BGC noted in its December 8, 2008 comments, that the designers have indicated that settlement of the upstream and downstream toes of the berms should be monitored, and that some maintenance of the berms may be required. As such, the Board has amended the Monitoring Program to include additional monitoring stations for the monitoring of temperature, seepage, and settlement of lagoon berms.

A number of geotechnical and geothermal concerns raised by BGC in its September 5, 2008 comments were not addressed by the Applicant in its submission of additional information including:

1. The description of the surficial geology of the proposed wastewater lagoon site;
2. Divergent ground temperature measurements from two borehole locations noted by NCI, 2008 and short thermistor string installation depths;
3. The potential warming influence of thick snow pack developing at the toe of the berms;
4. The depth of thermistor strings into the subgrade soils;
5. The location of the key trench liner from the toe of the berm;
6. The impact of displacements due to thaw settlement and creep strain on liner integrity; and
7. The design intent of a granular cover over sludge for the existing wastewater lagoon for decommissioning.

While items 5 and 7 have been dealt with as part of the construction and abandonment issues, items 1 - 4 and 6 must be dealt with through monitoring. Therefore, the Board is requiring as a condition in Part H Item 16 of the Licence amendment, that the Licensee submit to the Board for approval in writing, within thirty (30) days of issuance of this Licence Amendment, a detailed Instrumentation Monitoring and Surveillance Plan. This Plan is for inclusion in the O&M Manual and takes into consideration the Applicant's proposal to begin construction during the summer of 2009.

To assess the performance of the Wastewater Treatment Facility's lagoon structure, the Board is also requiring as a condition in Part H Item 15 of the Licence Amendment, that the Licensee

submit the monitoring results of thermistor, standpipe, and settlement monitoring semi-annually, due no later than July 31 and January 31 of each year for the first two (2) years of monitoring. In addition, the Licensee shall submit to the Board as an addendum to its Annual Report an annual assessment of the geotechnical and geothermal performance of the Wastewater Treatment Facility.

The Board has also amended the Monitoring Program to include Monitoring Program stations for the monitoring of Effluent from the Wastewater Treatment Facility, quarry runoff and sewage sludge.

Based upon comments received from INAC, GN-DOE and EC and the response from the Applicant on November 10, 2008, the Board has revised the monitoring frequency for effluent discharged from the Wastewater Treatment Facility from monthly between May and August, to three (3) times annually during decant (once and the onset, once during, and once at the end). The Board also notes EC's recommendation that monitoring should be sufficient to inform how the system can best be managed to optimize treatment.

The Board has included a new condition in Part H as Item 13, requiring the Licensee to submit to the Board as part of its O&M Manual, a QA/QC Plan. This Plan is to be developed immediately in consultation with a Canadian Association of Environmental Analytical Laboratories (CAEAL) approved laboratory, chosen to perform the analyses required under the Monitoring Program, to address both the field and laboratory requirements of monitoring this Licence. In addition, this Plan will need to be updated for inclusion in the O&M Manual for the new Wastewater Treatment Facility as required in Part F Item 1.

In addition, regarding effluent monitoring as discussed above under Sewage, the Board has removed the requirement to report all results of acute toxicity testing.

The Board has also removed the requirement that the Licensee measure and record the monthly and annual quantities of raw sewage offloaded from trucks. Raw water intake volumes are sufficient for the Board's purposes for estimating raw sewage generation volumes. However, the Board has included a condition in Part H Item 18 requiring the Licensee to measure and record the monthly and annual quantities of Effluent pumped from the Sewage Disposal Facility and the Wastewater Treatment Facility to account for any input from annual precipitation, runoff and potential losses through control structures and groundwater movement.

LICENCE AMENDMENT No. 1

Licencee:	**Hamlet of Arctic Bay**
Licence No:	**3BM-ARC0810 Type "B"**
Licence Issued:	**March 17, 2008**
Effective Date of Amendment No.1:	**April 16, 2009**

Pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters* and the *Nunavut Surface Rights Tribunal Act*, the Nunavut Water Board hereby grants the following Licence amendment.

The Licence issued March 17, 2008 with an expiry date of March 31, 2010 shall be amended to include the following terms and conditions, with respect to the use of water and deposit of waste for a municipal undertaking in the Hamlet of Arctic Bay, located at the coordinates of 73° 02' north latitude and 83° 05' west longitude on north Baffin Island within the Qikiqtani Region of Nunavut.

New activities to be carried out include:

- Construction and operation of a new Wastewater Treatment Facility comprised of a single cell sewage lagoon and wetland treatment area;
- Construction of a new gravel access road from the existing lagoon to the new lagoon.
- Effluent release from the new lagoon to a 11.2 hectare Vegetated Filter Strip Wetland area that is approximately 700 metres long, 86-202 metres wide and flows northwest into Victor Bay
- Decommissioning of the existing Sewage Disposal Facility once the new Wastewater Treatment Facility is commissioned; and
- Quarrying from the Arctic Bay quarry.

The Licence shall be amended to reflect the following:

PART A: SCOPE AND DEFINITIONS

Insert
Item 2 **Definitions**

"Application for Water Licence Amendment" means the application filed by the Hamlet of Arctic Bay and GN-CGS with the NWB on April 30, 2008 including supporting documents;

"Construction" means any activities undertaken to construct or build any component of, or associated with, the new Wastewater Treatment Facility for the Hamlet of Arctic Bay, as described in the Application for Water Licence Amendment;

"**Dam Safety Guidelines**" means the *Canadian Dam Association (CDA) Dam Safety Guidelines (DSG), January 1999* or subsequent approved editions;

"Waste Disposal Facilities" means all facilities designated for the disposal of waste, and includes the Sewage Disposal Facility, the Wastewater Treatment Facility, and the Solid Waste Disposal Facility, as described in the Application for water licence renewal filed by the Applicant on October 9, 2007 including supporting documents, and as described in the Application for Water Licence Amendment filed by the Applicant on April 30th, 2008;

"Wastewater Treatment Facility" comprises the engineered sewage lagoon and decant structures designed to contain and treat sewage as described in the Application for Water Licence Amendment filed by the Applicant on April 30, 2008 and illustrated in construction drawings prepared by Trow Associates Inc. Project OTCD00019054A;

"Vegetated Filter Strip Wetland Area" comprises approximately 11.2 hectares of land immediately downstream of the sewage lagoon, for approximately 700 metres at a slope of 6 to 13% and includes the lagoon dewatering pump and infrastructure as described in the Application for Water Licence Amendment filed by the Applicant on April 30, 2008 and illustrated in construction drawings prepared by Trow Associates Inc. Project OTCD00019054A;

PART B: GENERAL CONDITIONS

Amend Item 1

The Licensee shall file an Annual Report with the Board no later than March 31st of the year following the calendar year reported which shall contain the following information:

i. tabular summaries of all data generated under the "Monitoring Program", including an interpretation and discussion of wastewater treatment levels of the Sewage Disposal Facilities and/or Wastewater Treatment Facilities, as well as the treatment efficiency of the Vegetated Filter Strip Wetland Area;

ii. any modifications to the Monitoring Program in accordance with Part H Item 12;

iii. the annual quantity in cubic metres or tonnes of sludge removed from the Sewage Disposal Facility along with the treatment/storage/disposal provided as required in Part H Item 10;

iv. the results of sampling and analyses of sewage sludge in accordance with the Operations and Maintenance Manuals referred to in Part F Item 1 and as required in Part H Item 14;

v. An assessment of the geotechnical and geothermal performance of the Wastewater Treatment Facility including an analyses of the results from the thermistor, standpipe and settlement monitoring stations, as required in Part H Item 15;

vi. the monthly and annual quantities in cubic metres of fresh water obtained from all sources;

vii. the monthly and annual quantities in cubic metres of each and all waste discharged;

viii. 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;

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

x. any updates or revisions for manuals and plans (i.e., Operations and Maintenance Manual) as required by changes in operation and/or technology;

xi. detailed minutes of any public consultation and participation with local organizations and the residents of the community regarding licence amendments;

xii. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the following year;

xiii. a summary of any studies, reports, and plans (e.g., Operations and Maintenance, Abandonment and Restoration, Quality Assurance/ Quality Control) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any future studies planned; and

xiv. any other details on water use or waste disposal requested by the Board by

November 1st of the year being reported.

Amend
Item 10 The Licensee shall submit to the Board for approval in writing, within thirty (30) days of Licence issuance or upon the filing of any application in relation to the Licence within that time, a Plan for Compliance that clearly demonstrates the measures the Licensee will undertake, including an implementation schedule, to achieve full compliance with the conditions of this Licence, including the issues raised in the Inspector's Reports.

Amend
Item 11 The Licensee shall, for all Plans, Manuals and Reports submitted under this Licence, include a proposed timetable for implementation. Plans, Manuals and Reports submitted, cannot be undertaken without subsequent written Board approval and direction. The Board may alter or modify a Plan or Manual if necessary to achieve the legislative objectives and will notify the Licensee in writing of acceptance, rejection or alteration of the Plan.

Insert
Item 14 The Licensee shall, for all Plans, Manuals and Reports submitted under this Licence, implement the Plan as approved by the Board in writing.

Insert
Item 15 The Licensee shall submit to the Board for review, within thirty (30) days of Licence 3BM-ARC0810 Amendment No. 1 issuance, all available data generated under licence NWB3ARC0207 and subsequent renewal 3BM-ARC0810.

PART C: CONDITIONS APPLYING TO WATER USE

No changes

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

Amend
Item 1 Prior to commissioning the Wastewater Treatment Facility, the Licensee shall direct all Sewage to the Sewage Disposal Facility. Upon commissioning of the Wastewater Treatment Facility, the Licensee shall direct all Sewage to the Wastewater Treatment Facility, or as otherwise approved by the Board in writing.

Amend
Item 2 The Licensee shall provide notice to an Inspector at least ten (10) days prior to initiating any decant of the Sewage Disposal Facility or the Wastewater Treatment Facility.

Amend
Item 3 All Effluent discharged from the Sewage Disposal Facilities at Monitoring Program Station ARC-3 shall meet the following Effluent quality standards:

Parameter	Maximum Concentration of any Grab Sample
BOD_5	100 mg/L
Total Suspended Solids	120 mg/L
Faecal Coliforms	1×10^6 CFU/100mL
Oil and grease	No visible sheen
pH	between 6 and 9

Amend
Item 5 The Sewage Disposal Facility and Wastewater Treatment Facility shall be maintained and operated, to the satisfaction of an Inspector in such a manner as to prevent structural failure.

Remove
Item 6 All Effluent discharged from the Wetland Treatment Area Final Discharge Point (ARC-4) shall be demonstrated to be Not Acutely Toxic under the following tests to be conducted once annually approximately mid-way through discharge:

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

Amend
Item 10 The Licensee shall submit to the Board for review within thirty (30) days of the issuance of this Licence amendment, a report identifying each Final Discharge Point of the existing Sewage Disposal Facility. The report shall at least include:

a. Plans, specifications, geographic coordinates and a general description of each Final Discharge Point; and
b. A description of how each Final Discharge Point is designed and maintained.

Amend
Item 11 If, during the term of this Licence, additional Final Discharge Points are

identified, the Licensee shall submit the information required by Part D Item 10 for each new Final Discharge Point, at least sixty (60) days prior to depositing Effluent from the new Final Discharge Point.

Insert
Item 12 All Effluent discharged from the Wastewater Treatment Facility at Monitoring Program Station ARC-8 shall not exceed the following Effluent quality standards:

Parameter	Maximum Concentration of any Grab Sample
BOD_5	120 mg/L
Total Suspended Solids	180 mg/L
Faecal Coliforms	1×10^6 CFU/100mL
Oil and grease	No visible sheen
pH	between 6 and 9

Insert
Item 13 The Licensee shall use clean material for construction, operation, and maintenance activities that is free of contaminants, obtained from an approved source and which has been demonstrated not to produce Acid Rock Drainage and to be non-Metal Leaching.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

Insert
Item 6 The Licensee shall implement the recommended options identified in the Water Licence Application document entitled *Design Brief New Sewage Lagoon for the Hamlet of Arctic Bay*, prepared by Trow Associates Inc., dated April 2008, Project No. OTCD00019054A. In the event of a conflict between the conditions of this Licence and the above referenced document, the conditions of this License shall prevail.

Insert
Item 7 The construction or disturbance of any stream/lake bed or the banks of any definable watercourse are not permitted unless authorization is obtained from the Department of Fisheries and Oceans Canada (DFO).

Insert
Item 8 The Licensee shall locate the Wastewater Treatment Facility's lined key trench horizontally from the upstream toe of the berm in accordance with the recommendations provided by Naviq Consulting in the application document

entitled *Geothermal Analysis of Proposed Sewage Lagoon, Arctic Bay, NU* prepared for Trow Associates Inc., Project J008, October 2008, Revision 2.

Insert
Item 9 The depth of the Wastewater Treatment Facility's lined key trench shall penetrate a minimum of 2 metres into sound rock or ice-saturated permafrost mineral soils or rock.

Insert
Item 10 The Licensee shall submit to the Board for approval in writing, prior to commencing construction or procurement of construction materials from the quarry, a Spill Contingency Plan that specifically addresses the quarry site operations and existing facilities. This Plan is to be incorporated into the Operations and Maintenance Manual referred to in Part F Item 1.

Insert
Item 11 Licensee shall, within sixty (60) days of completion of Construction of the Wastewater Treatment Facility, submit to the Board a Construction Summary Report along with stamped as-built plans and record drawings, providing explanation to reflect the deviations from construction drawings taking into account construction and field decisions and how they may affect the performance of the engineered facility. This Report is to include information on the following:

i. The as-built drawings must identify the areas where field changes were made from the original design drawings, preferably in the form of a revision bubble and a brief note in the revisions section of the title block;
ii. Details of the fill materials specifications for dike and key trench construction;
iii. The final location for the lined key trench and reasons for selecting the final location;
iv. Confirmation regarding the requirement for a spillway including a rationale;
v. Details regarding the installation of impermeable liners including the type of liner, how the liners were incorporated into the cell to prevent seepage, and a discussion of the quality assurance/ quality control measures applied during installation.

Insert
Item 12 The Licensee shall implement sediment and erosion control measures prior to and during Construction and blasting activities to prevent the release of sediment into any surrounding water bodies.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

Amend
Item 1 The Licensee shall submit to the Board for approval in writing, within sixty (60) days of issuance of this Licence Amendment, an Operations and Maintenance Manual prepared where appropriate, in accordance with the *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories; 1996.* This Manual shall take into considerations comments received during the application review process as well as any Inspector reports, and shall contain the following plans:

a. Water Supply Facilities Operation and Maintenance Plan;
b. Solid Waste Operation and Maintenance Plan;
c. Sewage Operation and Maintenance Plan for the existing Sewage Disposal Facility and the new Wastewater Treatment Facility;
d. Sewage Sludge Management Plan;
e. Hazardous Waste Management Plan;
f. Spill Contingency Plan including a Spill Response Plan for Aggregate deposits;
g. Monitoring Program Quality Assurance/Quality Control Plan including a diagram that references Monitoring Program Station Numbers; and
h. Instrumentation Monitoring and Surveillance Plan (This Plan is due within 30 days of issuance of this Licence Amendment. See Part H Item 16)

Amend
Item 3 An inspection of all engineered facilities related to the management of water and waste shall be carried out annually in July or August by a Geotechnical Engineer. The inspection shall be conducted in accordance with the *Canadian Dam Safety Guidelines* where applicable and shall include the decommissioned Sewage Disposal Facility. The engineer's report shall be submitted to the Board within sixty (60) days of the inspection, including a covering letter from the Licensee outlining an implementation plan addressing each of the Engineer's recommendations.

Amend
Item 5 If, during the period of this Licence, an unauthorized discharge of waste occurs, or if such a discharge is foreseeable, the Licensee shall:

a. employ the appropriate contingency measures as approved under the Operation and Maintenance Manual for the Hamlet of Arctic Bay;
b. report the incident immediately via the 24-Hour Spill Reporting Line at (867) 920-8130, to the Inspector at (867) 975-4295, and to the Government of Nunavut Department of Environment at (867) 975-7700; and

c. submit to the Inspector, a detailed report on each occurrence, not later than thirty (30) days after initially reporting the event, that provides the necessary information on the location (including the GPS coordinates), initial response action, remediation/clean-up, status of response (ongoing, complete), proposed disposal options for dealing with contaminated materials and any preventative measures to be implemented.

Insert
Item 6 The Licensee shall maintain an undisturbed buffer zone of at least one hundred (100) metres between any proposed quarry operation and the normal high water mark of any water body.

Insert
Item 7 The Licensee shall implement sediment and erosion control measures prior to and during activities carried out under this Part to prevent the release of sediment and minimize erosion.

Insert
Item 8 If water is encountered during permafrost excavation which requires pumping, the Licensee shall locate the discharge for the pumped water above the high water mark of any water body and implement erosion control measures at the point of discharge.

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

Amend
Item 1 The Licensee shall submit to the Board for approval in writing, an Abandonment and Restoration Plan at least six (6) months prior to abandoning any facilities or upon submission of the final design drawings for the construction of new facilities to replace existing ones. Where applicable, the Plan shall include information on the following:

i. Water intake facilities;
ii. The water treatment and waste disposal sites and facilities;
iii. Petroleum and chemical storage areas;
iv. Any site affected by waste spills;
v. Leachate prevention;
vi. An implementation schedule;
vii. Maps delineating all disturbed areas, and site facilities;
viii. Stream crossings;
ix. Consideration of altered drainage patterns;
x. Type and source of cover materials;
xi. Future area use;

xii. Hazardous wastes; and
xiii. A proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

Insert
Item 2 The Licensee shall submit to the Board for approval in writing, within ninety (90) days of Licence issuance, a detailed Final Abandonment and Restoration Plan for the existing Sewage Disposal Facility. The Plan shall incorporate, where applicable, the appropriate sections as described in Part G Item 1 and address intervener comments raised during the review process, including specifications and purpose of cover materials over sludge remaining following decommissioning of the Sewage Disposal Facility.

Insert
Item 3 The Licensee shall practice progressive reclamation of the quarry development in accordance with the restoration guidelines outlined in Indian and Northern Affairs Canada's document entitled *Environmental Guidelines for Pits and Quarries, 1982.*

Insert
Item 4 For site reclamation purposes, the Licensee shall salvage topsoil for future restoration of the site to promote revegetation.

Insert
Item 5 The Licensee shall, within sixty (60) days of completion of decommissioning of the existing Sewage Disposal Facility, submit to the Board a Decommissioning Summary Report. This Report shall include stamped as-built plans and record drawings, providing explanation to reflect any deviations from original plans.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

Amend
Item 1 The Licensee shall maintain Monitoring Program Stations at the following locations and implement the following Program:

Monitoring Program Station Number	Description	Frequency	Status
ARC-1	Raw water intake at Marcil Lake	Volume Monthly and Annually	Active (Volume)
ARC-2	Raw sewage from pump out truck	NA	Inactive

ARC-3	Effluent discharged from the Final Discharge Point of the existing Sewage Disposal Facilities	Volume Monthly and Annually Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	Active*
ARC-4	Discharge Point of the existing Sewage Disposal Facility's Wetland Treatment Area	Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	Active*
ARC-5	Ocean water five (5) metres from point where Effluent enters the ocean from existing Sewage Disposal Facility	Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	Active*
ARC-6	Run-off from the Solid Waste Disposal Facility	Water Quality Annually during periods of runoff or seepage	Active
ARC-7	Runoff from Quarry Site	Water Quality Annually during periods of runoff or seepage	New (Water quality)
ARC-8	Effluent discharged from the Final Discharge Point of the Wastewater Treatment Facility (at the sewage lagoon pump)	Volume Monthly and Annually Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	New (Volume and Water quality)

ARC-9	Discharge Point of the Wastewater Treatment Facility's Vegetated Filter Strip Wetland Area	Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	New (Water quality)
ARC-10	Ocean water five (5) metres from point where Effluent enters the ocean from Wastewater Treatment Facility	Water Quality Three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant)	New (Water Quality)
ARC-11	Thermistors in accordance with approved Instrumentation Monitoring and Surveillance Plan as required in Part H Item 16	TBD	New (Temperature)
ARC-12	Standpipes in accordance with approved Instrumentation Monitoring and Surveillance Plan as required in Part H Item 16	TBD	New (Seepage)
ARC-13	Settlement stations in accordance with approved Instrumentation Monitoring and Surveillance Plan as required in Part H Item 16	TBD	New (Location, Elevation)

* Active until the Sewage Disposal Facility is decommissioned.

Amend
Item 2 The Licensee shall sample water quality at Monitoring Program Stations ARC-3, ARC-4, ARC-5, ARC-8, ARC-9 and ARC-10 three (3) times annually (once at the onset of decant; once during decant; and once at the end of decant). Samples shall be analyzed for the following parameters:

Biochemical Oxygen Demand – BOD_5	Faecal Coliforms
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)

Amend
Item 3 The Licencee shall sample at Monitoring Program Stations ARC-6 and ARC-7 annually during periods of runoff or seepage. Samples shall be analyzed for the following parameters:

TPH (Total Petroleum Hydrocarbons)
PAH (Polycyclic Aromatic Hydrocarbons)
BTEX (Benzene, Toluene, Ethylbenzene, Xylene)

BOD	Faecal 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

Remove
Item 4 The Licensee shall report all results of acute toxicity testing as required under Part D, Item 6 within the Annual Report as per Part B, Item 1.

Remove
Item 6 The Licensee shall measure and record, in cubic metres, the monthly and annual quantities of raw sewage offloaded from trucks at Monitoring Program Station ARC-2, for all purposes.

Amend
Item 10 The Licensee shall measure and record the annual quantities of sludge removed

from the Sewage Disposal Facility and the Wastewater Treatment Facility along with the treatment/storage/disposal provided.

Amend Item 11

The Licensee shall include all of the data and information required by the Monitoring Program as well as an indication of wastewater treatment levels upstream and downstream of the Vegetated Filter Strip Wetland Area in the Licensee's annual report, as required *per* Part B Item 1, or as requested by an Inspector.

Amend Item 12

Modifications to the Monitoring Program may be made only upon written approval from the Board. Requests for changes to the Monitoring Program should be forwarded to the NWB in writing, and should include the justification and appropriate evidence to support the change.

Insert Item 13

The Licensee shall submit to the Board upon approval by an Analyst, for inclusion in the Operations and Maintenance Manual, required under Part F Item 1(g), a Quality Assurance/ Quality Control Plan. The Plan shall include up to date sampling methods to all applicable standards, acceptable to an accredited laboratory as required by Part H Item 8 and Part H Item 9. The Plan shall include a covering letter from the accredited laboratory and Analyst, confirming acceptance of the Plan for analyses to be performed under this Licence.

Insert Item 14

The Licensee shall sample and analyze sludge in accordance with the approved Operations and Maintenance Plan referred to in Part F Item 1. The results shall be reported within the Annual Report as per Part B Item 1.

Insert Item 15

The Licensee shall submit to the Board the monitoring results for thermistor, standpipe, and settlement stations at monitoring stations ARC-11, ARC-12, and ARC-13 semi-annually, due no later than July 31, and January 31 of each year, for the first two (2) years of monitoring. An annual assessment of the geotechnical and geothermal performance of the Wastewater Treatment Facility shall be provided as an addendum to the Annual Report required as per Part B Item 1. This assessment shall include:

i. an interpretation of unexpected monitoring results;
ii. an analyses of settlement station results on liner integrity; and
iii. an analyses of thermistor and seepage results on berm stability.

Insert
Item 16 The Licensee shall submit to the Board for approval in writing, within thirty (30) of issuance of this Licence Amendment, a detailed Instrumentation Monitoring and Surveillance Plan for inclusion in the O&M Manual, required under Part F Item 1(h). This Plan shall include:

i. Details of the proposed instrumentation plan, the frequency of measurements and trigger values or observations for remedial action;
ii. A review of geothermal monitoring plans including the number of thermistors to be installed, the location of thermistor installations, the installation of thermistors within the key trench, the depth of thermistor strings in subgrade soils, justification for the final chosen depth of thermistor strings, and the final detailed design of thermistor strings, taking into consideration reviewer comments; and
iii. Details of settlement monitoring at the upstream and downstream toes of the berms.

Insert
Item 17 The Licensee shall confirm the locations and GPS coordinates for all monitoring stations referred to in Part H Item 1 with an Inspector.

Insert
Item 18 The Licensee shall measure and record in cubic metres, the monthly and annual quantities of effluent pumped from Monitoring Program Stations ARC-3 and ARC-8.

All terms and conditions of Licence 3BM-ARC0810 Type "B" dated March 17th, 2008 still apply.

This Licence Amendment is issued and recorded at Gjoa Haven, NU on April 16, 2009

Approved by,

Thomas Kabloona
Nunavut Water Board, Chair

Appendix B – Spill Contingency Plan

Government of Nunavut

Spill Response Plan - Wastewater Treatment Site
Arctic Bay, Nunavut

Project Name:
Arctic Bay Waste Water Facility

Project Number:
OTCD00019054A

Prepared By:
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Date Submitted:
01/09/11

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List of Appendices

1.0 Introduction

Exp Services Inc. (**exp**) formerly Trow Associates Inc. was retained by the Government of Nunavut – Department of Community and Government Services to prepare a Spill Response Plan (SRP) as part of the operation and maintenance of the Hamlet of Arctic Bay's (Hamlet) wastewater treatment site (sewage lagoons). This SRP also demonstrates the Hamlet's stewardship in environmental management.

The purpose of the SRP is to address potential environmental spill incidents that may occur during the routine operation and maintenance activities of the wastewater treatment site. The SRP is designed to be protective of the local natural environment.

The SRP includes a review of appropriate Government acts and regulations, the identification of foreseeable spill scenarios, spill response procedures and general health, safety and emergency response requirements necessary when conducting activities that may require contact with the subsurface materials. The SRP does not replace any Health & Safety protocols, procedures, etc. already established by the Hamlet but rather is intended to be complimentary to existing protocols.

Situations may arise during the site work that are beyond the scope of the safety procedures stated in this document. In such a situation, it may be necessary to stop on-site work until a revised procedure or SRP is prepared to reflect the changing conditions.

It is recommended that all persons involved with on-site operations read the SRP. If there are any questions regarding any aspect to this document, individuals are encouraged to contact **exp** for additional information or clarification.

2.0 Site Description

The wastewater treatment site (sewage lagoon) in the vicinity of the Hamlet, for which this SRP was developed, is shown on Figure 1 (below) depicted by the lagoon cell. The sewage lagoon was constructed in a small valley overlooking the existing lagoons and Admiralty Inlet to the south and Victor Bay to the north. The vegetated area between the new lagoon and Victor Bay will be incorporated into the sewage treatment process as the filterstrip wetlands.

Figure 1: Location of the Wastewater Treatment Site, Arctic Bay, NU

3.0 Regulations

With respect to spills, the Guidelines for Spill Contingency Planning[1] and Environmental Protection Act (R-068-93) require that all spill response plans include:

- The name, address and job title of the owner or person in charge, management or control of the facility;
- The name, job title and 24-hour telephone number for the person(s) responsible for activating the spill response plan;
- A description of the facility, a description of the type and amount of contaminants normally stored at the facility and a site map of the facility;
- The steps to be taken to report, contain, clean up and dispose of contaminants in the case of a spill;
- The means by which the spill response plan is activated;
- A description of the training provided to employees to respond to a spill;
- An inventory of and the location of response and clean-up equipment available to implement the spill response plan; and,
- The date the spill response plan was prepared.

[1] Prepared by Water Resources Division Indian and Northern Affairs Canada Yellowknife, NT April 2007

4.0 Contacts & Regulatory Authorities

The following table includes the contact information for the persons responsible for the facility. The persons listed below should be contacted in the event of a spill.

Table 1: Contacts

Name	Job Title	24-Hour Telephone #

In each instance that a spill is identified, the Emergency Spill Hotline and the INAC Water Resources Inspector shall be contacted as soon as possible. A NT-NU Spill Report Form (included) should also be completed and faxed to the Emergency Spill Hotline. The necessity to contact the other agencies will be contingent upon direction from the Emergency Spill Hotline.

Emergency Spill Hotline: Phone: (867) 920-8130, Fax (867) 873-6924

INAC Water Resources Inspector: Phone: (867) 975-4295

In addition to the local contacts described above, the following table summarizes the additional regulatory authorities that have a vested interest in the event of a spill.

Table 2: Additional Agencies

Agency	Legislation	Contact Phone #
Nunavut Water Board	Nunavut Waters and Surface Right Tribunal Act	(867) 360-6338
Nunavut Impact Review Board	Nunavut Land Claims Agreement Act	(867) 983-2593
Environment Canada	Canadian Environmental Protection Act, 1999	(867) 975-4464
Transport Canada (Coast Guard)	Transportation of Dangerous Goods Act	(867) 979-5269
Department of Fisheries and Oceans	Fisheries Act	(867) 645-2871

5.0 Potential Contaminants and Spill Scenarios

Potential spill scenarios are dependent on the types and volumes of materials that are being used on the sites and the activities being carried out. For the purpose of this SRP, spill sizes are described as small (<10 litres), medium (>10 litres and <100 litres) or large (>100 litres).

The primary potential contaminants at the wastewater treatment site include raw sewage and sewage sludge. Other materials (potential contaminants) that are anticipated to be present on the site include gasoline, diesel fuel, hydraulic oil, motor oil and other lubricants, antifreeze and coolants from sewage delivery trucks and any heavy equipment in use for maintenance purposes. Spills may be the result of any of the following occurrences:

- Leaks or breaches of the sewage lagoon berms;
- Spill during transfer of liquids (sewage);
- Leaks or ruptures of vehicular fuel or hydraulic oil storage tanks;
- Valve or line failure in systems on vehicles or operating equipment;
- Heat expansion due to overfilling;
- Vehicular accidents; and/or,
- Vandalism.

6.0 Reportable Spill Quantities

In the event of a spill, the following table is to be used as a guide to determine if the spill should be reported to the proper authorities. Any spilled quantities that exceed the specified amounts must be reported to the **Emergency Spills Hotline**. Spills of any quantity that occur near or into fish-bearing waters or sensitive environment, wildlife or habitat must be reported. In addition, spills of any quantity that pose an imminent threat to human health or life or listed species at risk or critical habitat must also be reported. It is recommended that any spill of significant size be reported and the advice received should be followed.

Table 3: Reportable Quantities[1]

Item	TDGA[2] Class	Contaminant	Amount Spilled
1	2	Explosives	Any amount
2	2.1	Compressed Gas (flammable)	Any amount of gas from containers with capacity greater than 100 kg
3	2.2	Compressed Gas (non-corrosive, non-flammable)	Any amount of gas from containers with capacity greater than 100 kg
4	2.3	Compressed Gas (toxic)	Any amount
5	2.4	Compressed Gas (corrosive)	Any amount
6	3.1, 3.2, 3.3	Flammable Liquid	100 L
7	4.1	Flammable Solid	25 kg
8	4.2	Spontaneously Combustible Solids	25 kg
9	4.3	Water Reactant Solids	25 kg
10	5.1	Oxidizing Substances	50 L or 50 kg
11	5.2	Organic Peroxides	1 L or 1 kg
12	6.1	Poisonous Substances	5 L or 5 kg
13	6.2	Infectious Substances	Any amount
14	7	Radioactive	Any amount
15	8	Corrosive Substances	5 L or 5 kg
16	9.1(in part)	Misc. products or Substances Excluding PCB Mixtures	50 L or 50 kg
17	9.2	Environmentally Hazardous	1 L or 1 kg
18	9.3	Dangerous Wastes	5 L or 5 kg
19	9.1 (in part)	PCB Mixtures of 5 or More Parts Per Million	0.5 L or 0.5 kg
20	None	Other Contaminants	100 L or 100 kg

Notes:

[1)] *Environmental Protection Act*, Consolidation of Spill Contingency Planning and Reporting Regulations
[2)] TDGA Class – Transportation of Dangerous Goods Class under the *Transportation of Dangerous Goods Act*.

7.0 Spill Response Procedures

The following section describes the appropriate spill response procedures that should be followed in the event of a spill to various media (bedrock, gravel, soil, water, ice or snow).

7.1. Spills on Land

For spills on land (soil, gravel, sand, rock, and vegetation), the following procedure should be followed:

1. Extinguish all sources of ignition (i.e., shut off engines, no smoking).
2. If possible, identify the spilled material.
3. Make sure the area is safe for entry and the spill does not represent a threat to the health or safety of the responder or others at the spill site.
4. Assess whether the spill can be readily stopped or brought under control and if safe and possible, stop the source of the spill (i.e., plug hole, close valve, install upright container) or place tarp under spill source and build up tarp edges to contain spill.
5. If the spill is sufficiently large that it cannot be controlled with the materials at hand, the spill should be reported immediately.
6. Stop spilled liquids from spreading or entering waterways using absorbent materials or a soil dyke down slope from the spill.
7. Contact facility supervisor and report the spill.
8. If possible with materials at hand, clean up remaining spilled material and store in a secure container for disposal. Do not flush area with water.
9. If possible, pump any contained liquid into drums.
10. Complete a Spill Reporting Sheet.
11. Contact: Emergency Spill Hotline: Phone: (867) 920-8130, Fax (867) 873-6924 for additional advice.
12. Contact: INAC Water Resources Inspector: Phone: (867) 975-4295 to report the spill.
13. Submit to the INAC Water Resources Inspector, a detailed report including the GPS location of the spill, no later than thirty (30) days after initially reporting the event.

7.2. Spills on Water

For spills on water, the following procedure should be followed:

1. Extinguish all sources of ignition (i.e., shut off engines, no smoking).
2. If possible, identify the spilled material.
3. Make sure the area is safe for entry and the spill does not represent a threat to the health or safety of the responder or others at the spill site.
4. Assess whether the spill can be readily stopped or brought under control and if safe and possible, stop the source of the spill (i.e., plug hole, close valve, upright container).
5. If the spill is sufficiently large that it cannot be controlled with the materials at hand, spill report the spill immediately.
6. Use sorbant booms to contain spill for recovery, place sorbant sheets on water within boomed perimeter. For narrow waterways, place one or more booms across the waterway, down stream of the spill location and anchor boom ends on each bank. Store saturated sorbant sheets and booms in drums for disposal.

7. Contact facility supervisor and report the spill.
8. If possible with materials at hand, clean up remaining spilled material and store in a secure container.
9. Complete a Spill Reporting Sheet.
10. Contact: Emergency Spill Hotline: Phone: (867) 920-8130, Fax (867) 873-6924 for additional advice.
11. Contact: INAC Water Resources Inspector: Phone: (867) 975-4295 to report the spill.
12. Submit to the INAC Water Resources Inspector, a detailed report including the GPS location of the spill, no later than thirty (30) days after initially reporting the event.

7.3. Spills on Snow and Ice

Spills on ice present the potential for immediate access of the contaminants to water therefore, immediate response to the spill is essential. For spills on snow and ice, the following procedure should be followed:

1. Extinguish all sources of ignition (i.e., shut off engines, no smoking).
2. If possible, identify the spilled material.
3. Make sure the area is safe for entry (i.e., ice thickness) and the spill does not represent a threat to the health or safety of the responder or others at the spill site.
4. If the spill is sufficiently large that it cannot be controlled with the materials at hand, the spill should be reported immediately.
5. Assess whether the spill can be readily stopped or brought under control and if safe and possible, stop the source of the spill (i.e. plug hole, close valve, install upright container) or place tarp under spill source and build up tarp edges to contain spill.
6. Stop spilled liquids from spreading or entering waterways using absorbent materials or a snow/soil dyke.
7. Contact facility supervisor and report the spill.
8. If possible with materials at hand, clean up remaining spilled material and store in a secure container (i.e., drum, polyethylene bags). Store impacted snow in drums for disposal.
9. Contact: Emergency Spill Hotline: Phone: (867) 920-8130, Fax (867) 873-6924 for additional advice.
10. Contact: INAC Water Resources Inspector: Phone: (867) 975-4295 to report the spill.
11. Submit to the INAC Water Resources Inspector, a detailed report including the GPS location of the spill, no later than thirty (30) days after initially reporting the event.

7.4. Additional Spill Delineation/Monitoring

As a result of a large spill in which not all of the spilled material can be readily recovered as described above, additional delineation in the form of a subsurface investigation (i.e., test pits, boreholes, and monitoring wells) may be required to determine the lateral and vertical extents of the impacts to the subsurface soil and/or groundwater. The additional delineation/monitoring information will be used to develop an appropriate remediation plan. In such cases, a qualified environmental consultant should be retained to provide advice with respect to how to proceed with the additional assessment.

8.0 Spill Kit and Training Requirements

The following section presents the recommended minimum requirements for the content and number of spill kits that should be present.

8.1. Spill Kit

Each spill kit should be inspected regularly to ensure that it contains, as a minimum, the following:

- 1 – 205 litre, open top steel drum with a lid, bolting ring and gasket;
- 1 Spark proof shovel;
- 1 package of 10 disposable 5 mil polyethylene bags (approx. 65 cm x 100 cm);
- 4 – 12.5 cm (approx. 5") x 3 m (approx. 10') sorbant (oil-absorbing) booms;
- 10 kg bag of sorbant particulate;
- 1 bail of 50 cm x 50 cm (approx.) sorbant sheet (100 Sheets/bail);
- 1 x 5m x 5m approx. plastic tarp;
- 2 pairs of oil resistant gloves; and,
- 2 pairs of splash protective goggles.

8.2. Additional Spill Response Supplies

In addition to the materials contained in the spill kits, an inventory of the following supplies should be available for use if required.

- 10 – 205 litre, open top steel drum with a lid, bolting ring and gasket;
- 2 Spark proof shovels;
- 5 packages of 10 disposable 5 mil polyethylene bags (approx. 65 cm x 100 cm);
- 10 – 12.5 cm x 3 m sorbant (oil-absorbing) booms;
- 5 x 10 kg bags of sorbant particulate;
- 5 bails of 50 cm x 50 cm (approx.) sorbant sheet (100 Sheets/bail);
- 2 pairs of oil resistant gloves; and,
- 2 pairs of splash protective goggles.

8.3. Spill Kit Locations

The spill kit, with the exception of the shovel, can be contained within the 205 L drum which should be sealed securely to protect the contents. The drum should also be accessible without the use of tools (i.e., bolt ring only finger tight). The bolt ring should be inspected regularly to ensure that it turns freely and lubricated if it does not.

8.4. Training

To ensure the effectiveness of the SRP, the following actions should be followed:

1. The SRP should be reviewed, as a minimum, on an annual basis and updated as required by changes in operation and/or technology.
2. The SRP should be distributed to the personnel on the site.
3. The personnel should be informed of the locations of all potentially hazardous materials and their associated Material Safety Data Sheets (MSDS).
4. The personnel should be trained in the use of the MSDS and the techniques and materials used to contain and remediate spilled materials.
5. The personnel should be informed as to the importance of first response with respect to the protection of human health and safety, the environment, property, wildlife and the ecosystem by reducing the impact of spills.

9.0 General Safety Practices and Site Rules

The following is a list of site rules that should be followed to maintain safe working conditions during a spill response:

1. Eating, drinking, chewing gum and smoking are prohibited in contaminated or potentially contaminated areas, or where the possibility for the transfer of contamination exists. This would include areas of active excavation and metal removal.
2. Personnel who have worked on-site shall wash their hands and face thoroughly with soap and water and remove themselves from the spill area prior to eating, drinking or smoking.
3. All field crew workers should be aware of potentially dangerous situations that they should avoid (i.e. the presence of strong, irritating or nauseating odours). Field crew workers should also be familiar with the physical characteristics of the site including:
    - wind direction in relation to areas of known contamination;
    - accessibility to equipment and vehicles;
    - communications; and,
    - site access.

Table 4: Outside Emergency Contacts

Agency	Function	Phone Number
Hamlet of Arctic Bay	On-site Supervisor	(867) 439-9917
Arctic Bay Health Centre	Medical Emergency	(867) 439-8816
Fire	Fire, Accident or Rescue	(867) 439-9999
RCMP (Arctic Bay)	Security, Vandalism	(867) 439-1111

10. Closure

This Spill Response Plan has been prepared for the Hamlet of Arctic Bay's wastewater treatment site. It does not replace, nor is intended to replace, the general provision of the applicable Federal and Territorial statutes regarding workplace safety or any protocols previously established by the Hamlet. Instead, it may be used to augment any existing plans.

Appendix 1 – NT-NU Spill Report Form

NT-NU SPILL REPORT

OIL, GASOLINE, CHEMICALS AND OTHER HAZARDOUS MATERIALS

NT-NU 24-HOUR SPILL REPORT LINE
TEL: (867) 920-8130
FAX: (867) 873-6924
EMAIL: spills@gov.nt.ca

REPORT LINE USE ONLY

A	REPORT DATE: MONTH – DAY – YEAR	REPORT TIME	☐ ORIGINAL SPILL REPORT, OR ☐ UPDATE # _____ TO THE ORIGINAL SPILL REPORT	REPORT NUMBER ____-_____
B	OCCURRENCE DATE: MONTH – DAY – YEAR	OCCURRENCE TIME		

C	LAND USE PERMIT NUMBER (IF APPLICABLE)	WATER LICENCE NUMBER (IF APPLICABLE)
D	GEOGRAPHIC PLACE NAME OR DISTANCE AND DIRECTION FROM NAMED LOCATION	REGION ☐ NWT ☐ NUNAVUT ☐ ADJACENT JURISDICTION OR OCEAN
E	LATITUDE DEGREES MINUTES SECONDS	LONGITUDE DEGREES MINUTES SECONDS

F	RESPONSIBLE PARTY OR VESSEL NAME	RESPONSIBLE PARTY ADDRESS OR OFFICE LOCATION	
G	ANY CONTRACTOR INVOLVED	CONTRACTOR ADDRESS OR OFFICE LOCATION	
H	PRODUCT SPILLED	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
	SECOND PRODUCT SPILLED (IF APPLICABLE)	QUANTITY IN LITRES, KILOGRAMS OR CUBIC METRES	U.N. NUMBER
I	SPILL SOURCE	SPILL CAUSE	AREA OF CONTAMINATION IN SQUARE METRES
J	FACTORS AFFECTING SPILL OR RECOVERY	DESCRIBE ANY ASSISTANCE REQUIRED	HAZARDS TO PERSONS, PROPERTY OR ENVIRONMENT
K	ADDITIONAL INFORMATION, COMMENTS, ACTIONS PROPOSED OR TAKEN TO CONTAIN, RECOVER OR DISPOSE OF SPILLED PRODUCT AND CONTAMINATED MATERIALS		

L	REPORTED TO SPILL LINE BY	POSITION	EMPLOYER	LOCATION CALLING FROM	TELEPHONE
M	ANY ALTERNATE CONTACT	POSITION	EMPLOYER	ALTERNATE CONTACT LOCATION	ALTERNATE TELEPHONE

REPORT LINE USE ONLY

N	RECEIVED AT SPILL LINE BY	POSITION STATION OPERATOR	EMPLOYER	LOCATION CALLED YELLOWKNIFE, NT	REPORT LINE NUMBER (867) 920-8130

LEAD AGENCY ☐ EC ☐ CCG ☐ GNWT ☐ GN ☐ ILA ☐ INAC ☐ NEB ☐ TC

SIGNIFICANCE ☐ MINOR ☐ MAJOR ☐ UNKNOWN

FILE STATUS ☐ OPEN ☐ CLOSED

AGENCY	CONTACT NAME	CONTACT TIME	REMARKS
LEAD AGENCY			
FIRST SUPPORT AGENCY			
SECOND SUPPORT AGENCY			
THIRD SUPPORT AGENCY			

Appendix C – Sampling Sheets

Thermistor Record Sheet

MONITORING SITE
(TEMPERATURE RECORDED IN DEGREES CELSIUS)

SENSOR	DEPTH (m)	1	2	3	4	5
1	0					
2	0.5					
3	1					
4	2					
5	4					
6	6					
7	8					
8	10					

INITIALS/SIGNATURE:

DATE:

Appendix D – Thermistor Data Collection

Quickstart for Installation Validation of the Thermistor String

1.0 Installation Validation Steps

- Installation of the loggernet software on the computer
- Connect the thermistor string to the test box (using the rectangular-shaped connector)
- Turn the power on with the terminal block blade
- Start the computer and the LoggerNet Software (setup the connection)
- Monitor data
- Collect data

2.0 LoggerNet Software

2.1 Description

The LoggerNet is a fullly featured Windows-based software package that allows direct communication with the test box using a RS-232 connection. A “Connect” screen provides real-time tools to set the datalogger clock in order to send the program to the datalogger and manually collect data using a computer. In addition, data can also be retrieved automatically, based on a predefined schedule. Measurements can be viewed in real-time on both numeric and graphical displays. In addition to these basic tools, the software package includes a datalogger program editor, a report generation tool and a data viewer with basic plotting capabilities.

This application note is intended to give the user a quickstart in getting the datalogger powered up and running. However, we strongly recommend that the user read the LoggerNet manual in order to get familiar with its features.

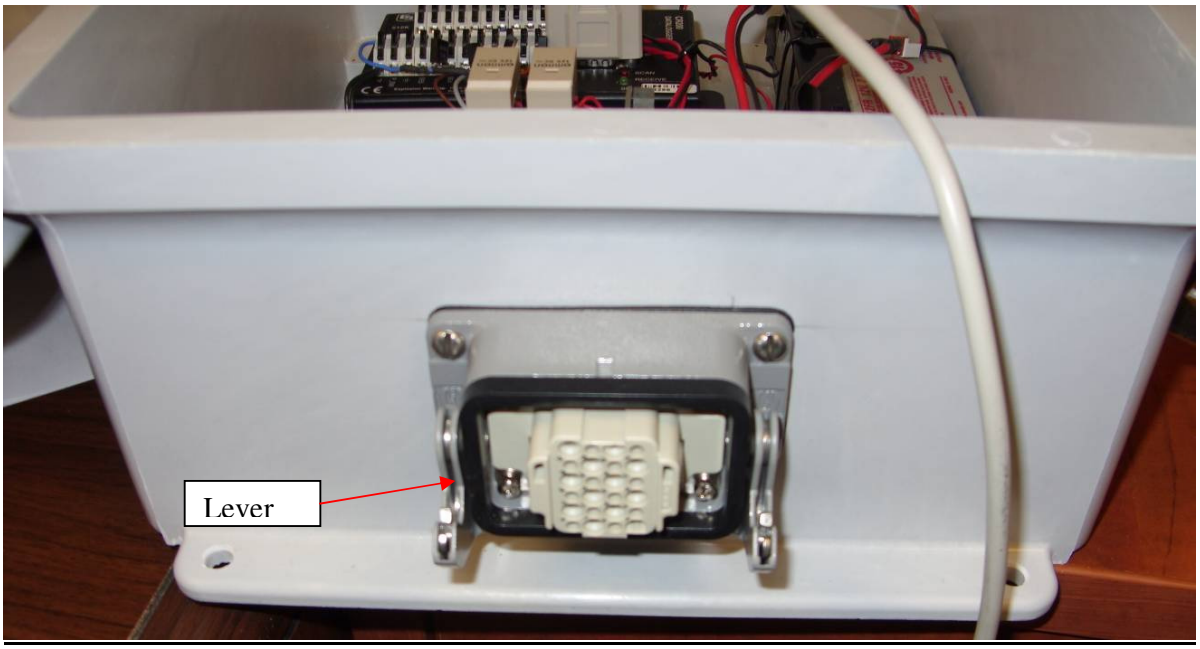
2.2 Software Installation

The LoggerNet is a collection of 32-bit programs designed for Intel-based computers running Microsoft Windows 2000, Windows XP or Vista.

As with all softwares, we strongly recommend that a back-up of critical files be performed before software installation. Place the installation disk in your computer’s CD/DVD drive. If autorun is enabled, LoggerNet installation will start. If it does not start, select START > RUN fom the Windows’s START menu. Locate the SETUP.EXE file on the CD/DVD drive and click OK. Follow the instructions on the screen. Refer to the LoggerNet manual for further details.

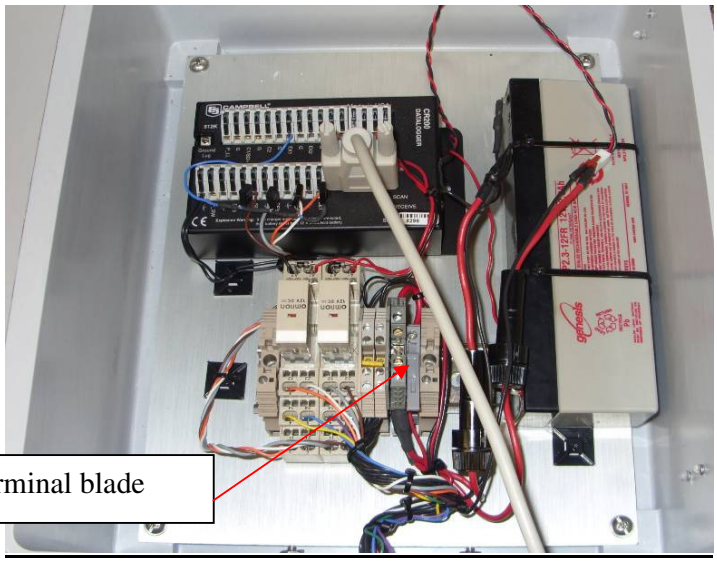
When the installation is done, a LoggerNet icon will be placed on your desktop.

3.0 Connection of the Thermistor String to the Test Box



Connect the connector to the mating on the test box and lift up the lever to secure the connector in place. *NOTE: make sure to seal back the connector of the thermistor string to avoid any water infiltration in the connector before the final installation.*

4.0 Turn the Power On on the Test Box



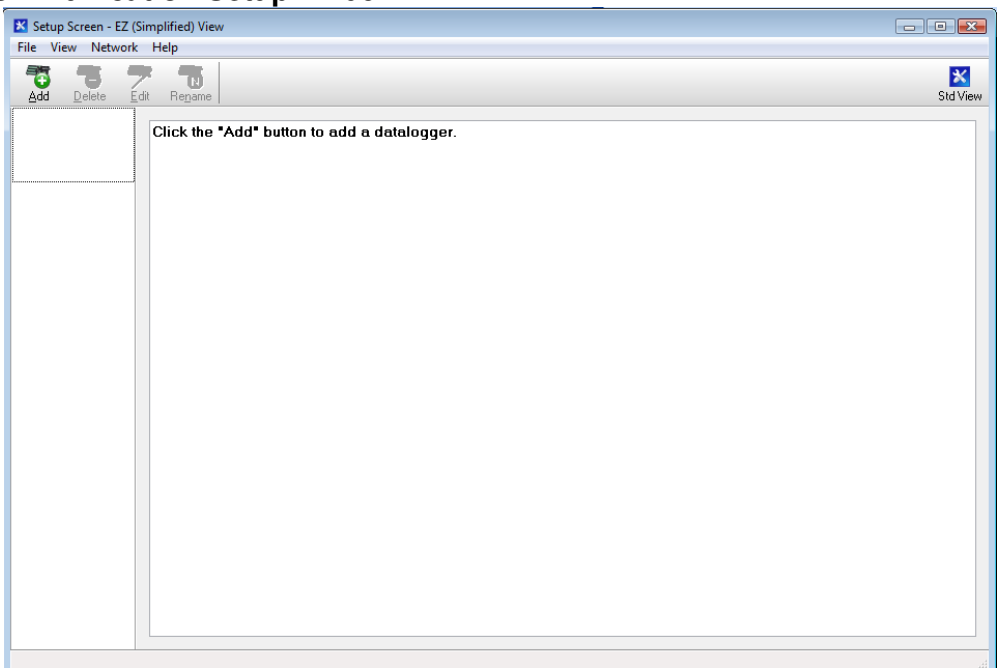
The terminal blade is used to turn the power OFF. Lower the blade to turn the unit ON. Make sure to raise the blade at the end of the test to avoid any battery drainage.

5.0 Setup the Connection

The hardware and software setups are done. The following steps describe the instructions to connect the datalogger, to collect or monitor data

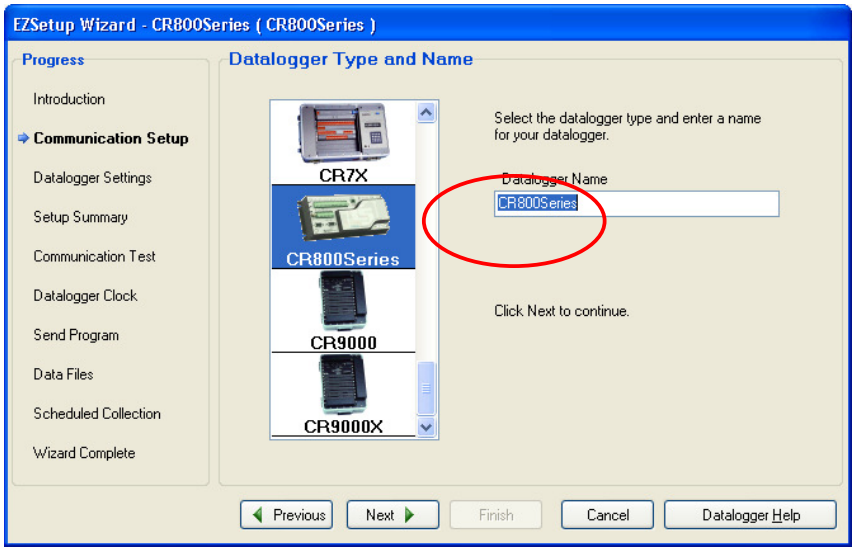
To start the LoggerNet, double click on the LoggerNet desktop icon.

- From the **MAIN** / **SETUP**, click **Add** and then click **Next**, which will get you to the **Communication Setup** window.

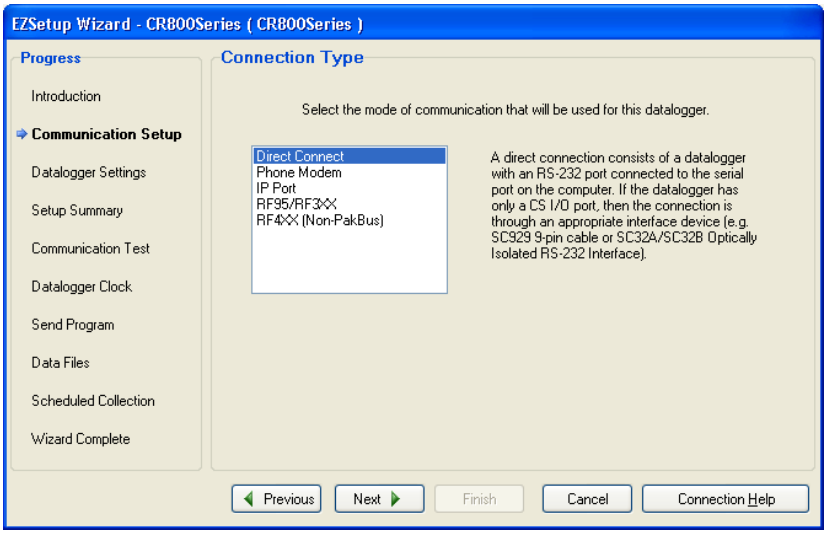


- Wait at least 15 seconds after powering up the unit before attempting to communicate with it.

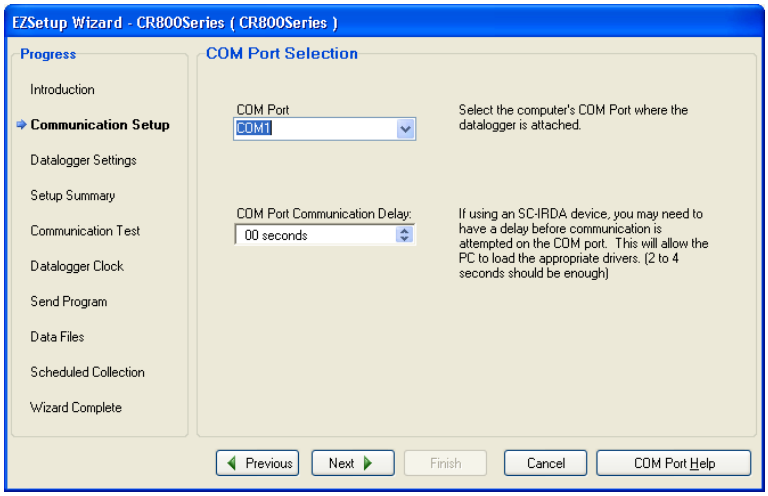
- Under **Datalogger Type and Name**, select **CR200 Series,** and next under **Datalogger Name**, choose a name that best represents your application. For example, type ***Thermistor*** and click **Next**. This datalogger name will be used later to connect to the Thermistor datalogger.



- Select **Direct Connect** and click **Next**.

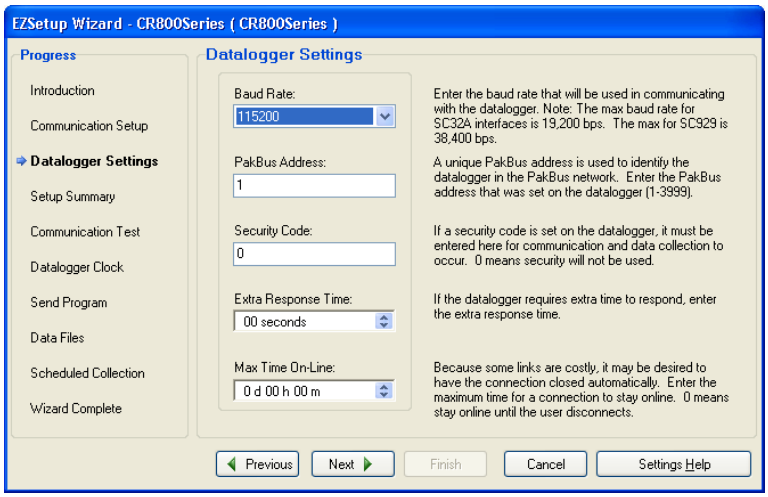


- Select the appropriate **COM port** on your computer. Usually, if you have a serial port on your computer, **COM 1** will be available. However, if you use a USB Serial adaptor, a virtual port will be created and a new COM port number will be assigned. Click **Next** when done.

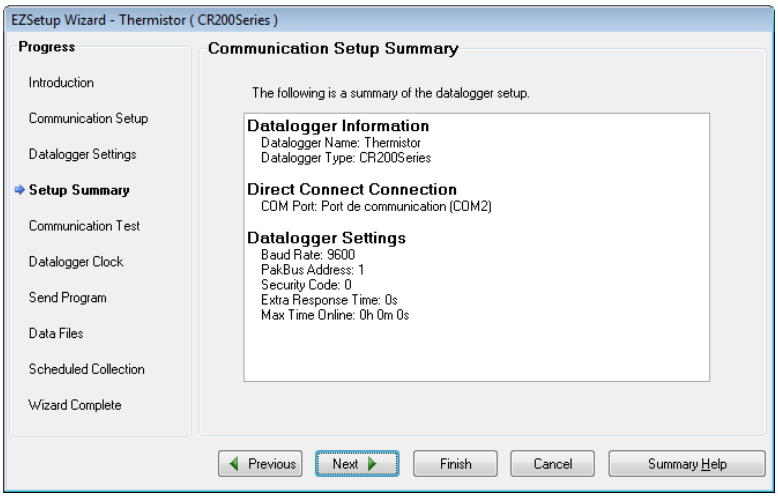


- Use the default parameters and click **Next**.

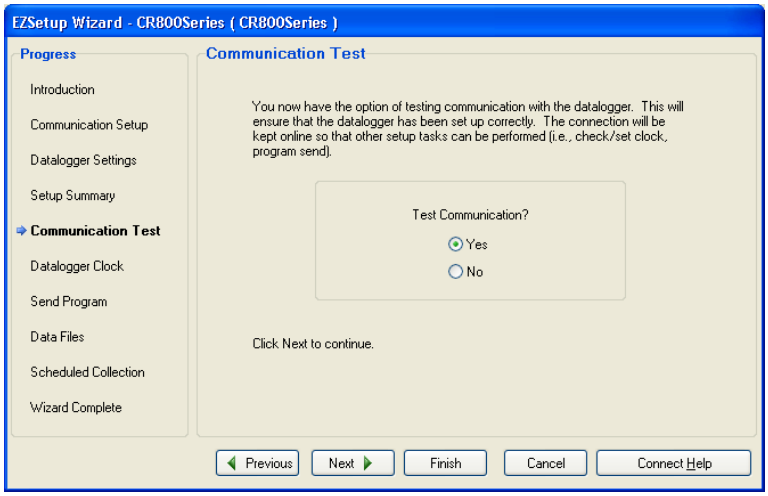
Note: If you use a USB Serial adapter you may need to lower the Baud Rate, in general **9600** works fine with the adapter.



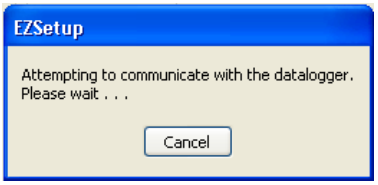
- The following window displays the Communication Setup Summary. Click **Next**.



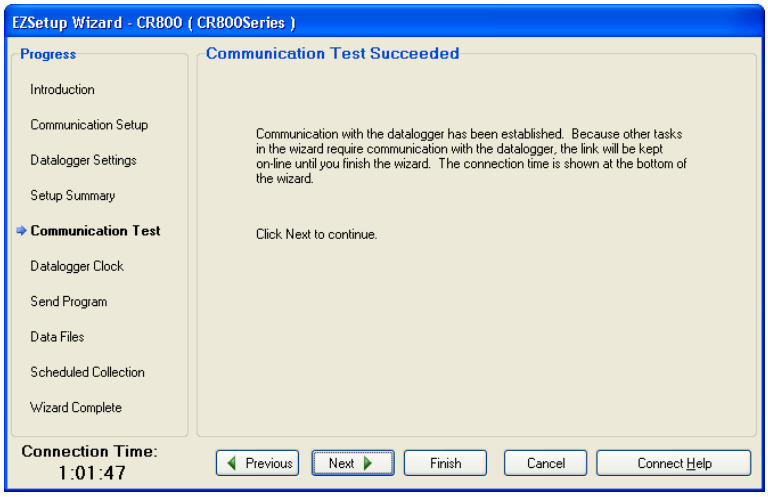
- To test the communication, select **Yes** and click **Next**.



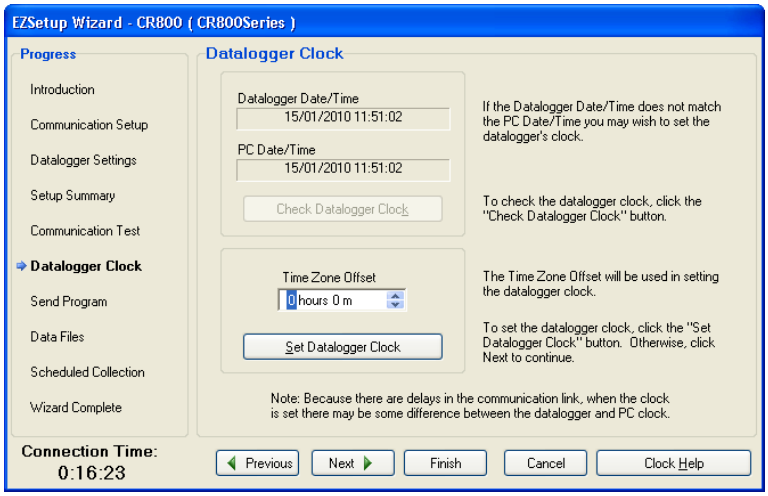
The following message will appear on the screen while your computer is attempting to communicate with the Thermistor datalogger.



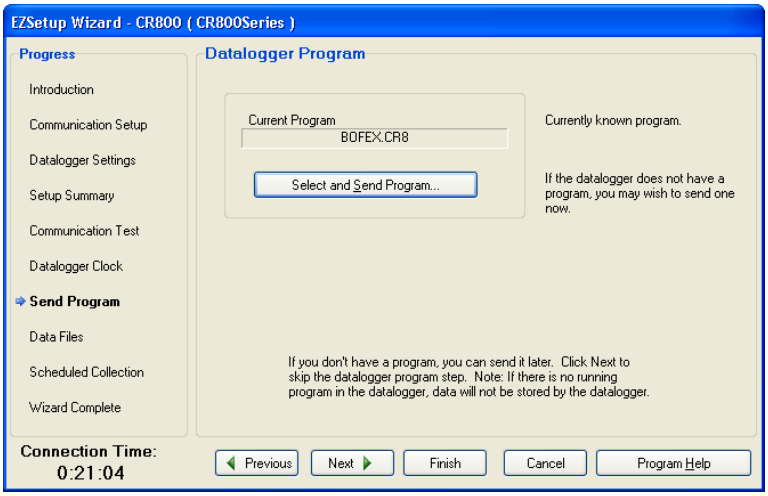
- The next windows will indicate if communication is successful. Click **Next**.



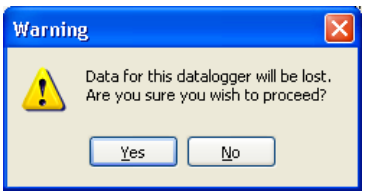
- Adjust the clock to set it at your local time zone. Make sure your computer is adjusted to your local time, then click **Set Datalogger Clock**. When done, click **Next**.



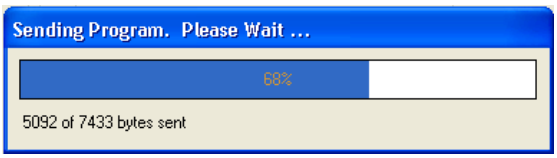
- The datalogger is usually shipped with the Application Program pre-loaded in the datalogger. The program will be displayed under **Current Program**. If it shows **no program** or if the program name shown is not for your application, you will need to upload your Application Program in the datalogger. Click **Finish** to save your settings. At this point, the datalogger setup is completed. To quit the **EZSetup** wizard, select **File** from the menu and click **Exit**. Proceed to section 4.2.



- To download your application program, click **Select and Send Program**. Locate the program on your computer's HD drive or on the one supplied by email, and click **Open**. The following warning message will be displayed on your screen. Click **Yes**.

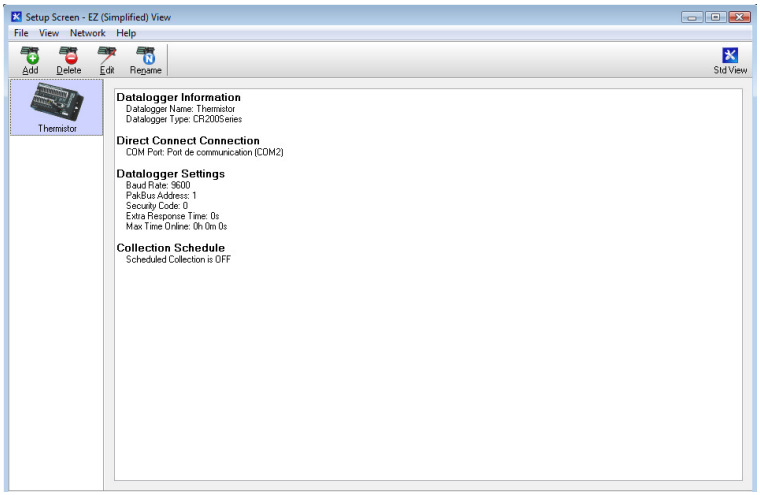


- A progress bar will display the download progress. If successful, a message will indicate it.



- Click **Finish** to save your settings. This completes the datalogger setup using the **EZSetup** wizard.

- To quit the **EZSetup**, select **File** from the **Menu**, and click **Exit.**

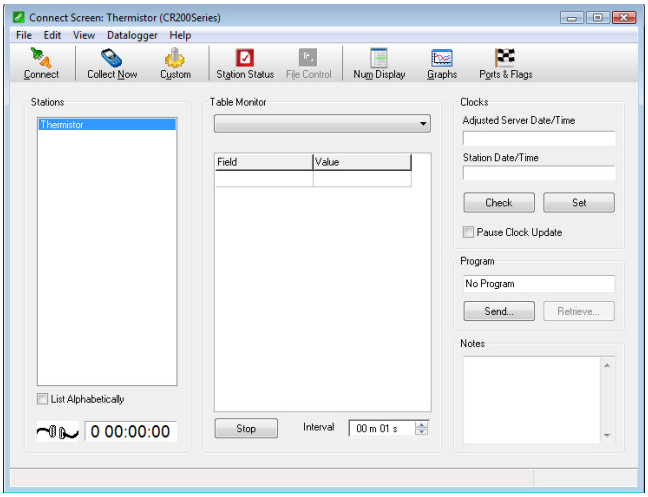


6.0 Monitoring Data With a Computer

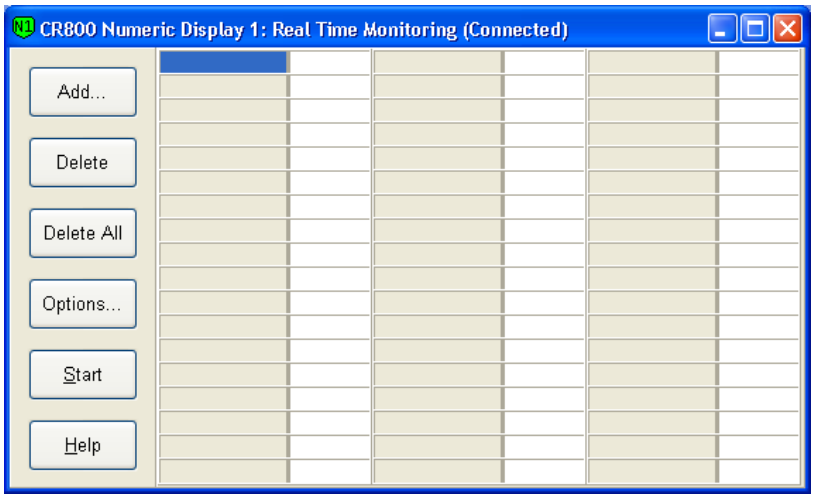
- Connect the supplied Serial Cable between the RS232 Input on the CR200 datalogger and your computer's serial port or USB Serial Adapter.

- Start the LoggerNet by double clicking on the LoggerNet desktop icon.

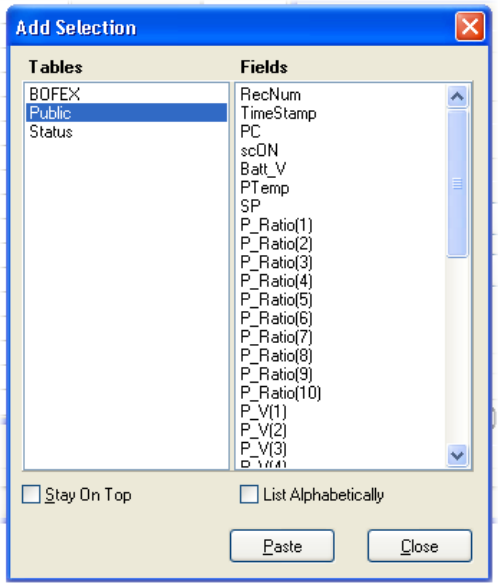
- From the **MAIN/CONNECT**, click on the station **Thermistor**, then **Connect**



- The cable at the bottom of the screen will be connected when the link will be established. Click **Num.Display/Display 1**. The following window should appear.



- Click the **Add** button and under **Tables**, highlight **Public**. The following window should appear.

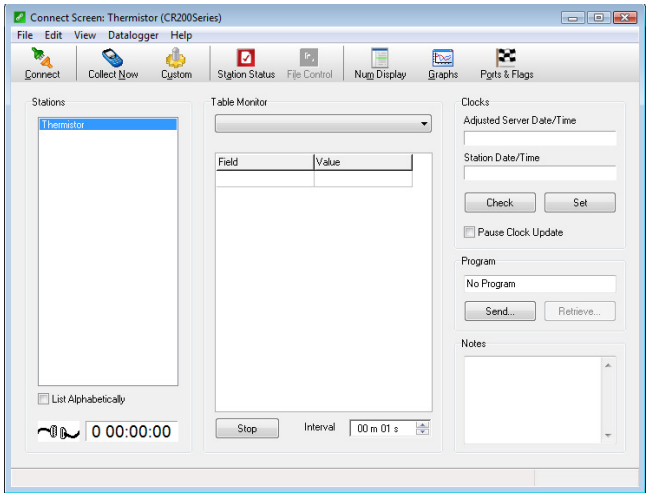


- Under **Fields**, select (highlight) the sensors (labels) you wish to view during the Test. You can use a combination of Shift & Ctrl keys on the computer's keyboard to select multiple labels. Next, on the **Display 1** window, highlight the location where you want to place the labels and finally, from the **Add Selection** window, click **Paste**. We recommend you to monitor the entire content in **Public**. The variable **Thermistor** represents the temperature and the value **Resistor** represents the resistor value of the thermistor.

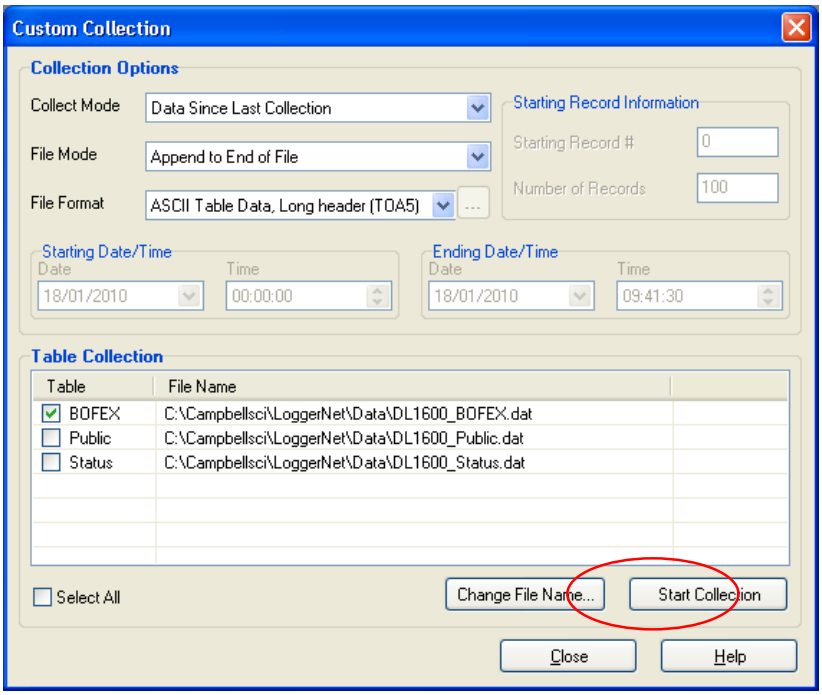
7.0 Collect Data

When a Test is completed, readings should be collected immediately. The following steps assume that the computer is already connected and that the LoggerNet is already running.

- From the **Connect Screen**, click the **Collect Now** button.



- Click on the Data_X.dat file to see the content. The records are displayed in a table.
- To modify the data output, click **Custom** in the connect screen. The following screen will appear.

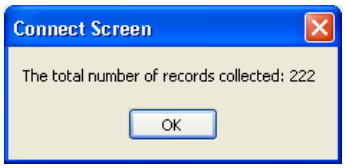


- Under **Collection Options**, make sure the following options are selected:
    - **Data Since Last Collection**
    - **Append to End of File**
    - **ASCII Table Data, Long header (TOA5)**
- Under **Table Collection**, make sure that **Data_X** is checked and that the file path where to save the file is defined. You do not need to check the **Public** and **Status** boxes.

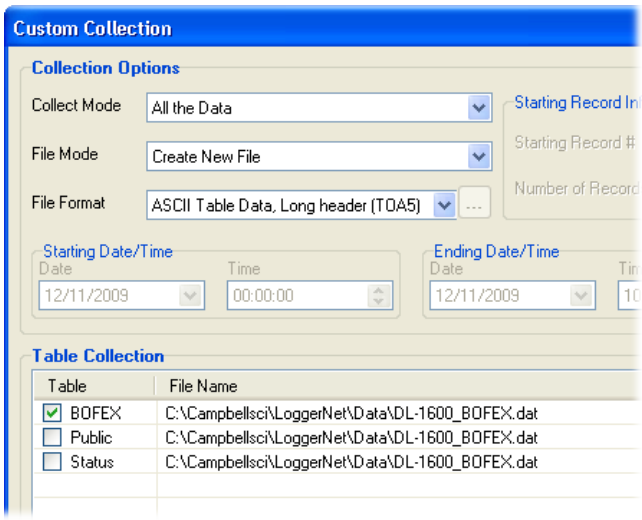
When collecting readings for the first time, you may need to collect all the data from the test box. This will set all memory pointers so that the next time you collect readings, the datalogger will know what readings were previously collected, and only new readings will be collected. All new readings will be appended to the previously collected file, or a new file will be created.

- Click **Start Collection**. The following message will appear, showing the collection progress and total records collected.

Note: A single record includes the timestamp, the record number, all sensors readings in Celcius degrees, and finally, the datalogger's battery voltage.



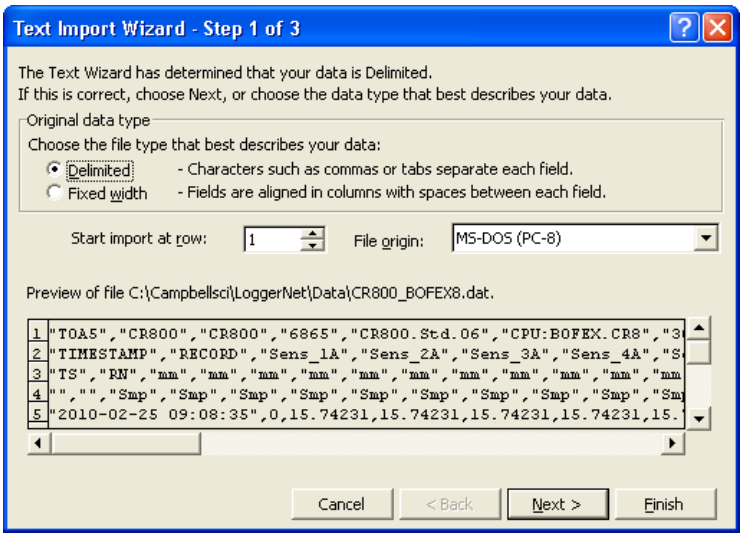
If the message window shows zero records collected, set the **Collection Options** as follow and do the **Start Collection** again.



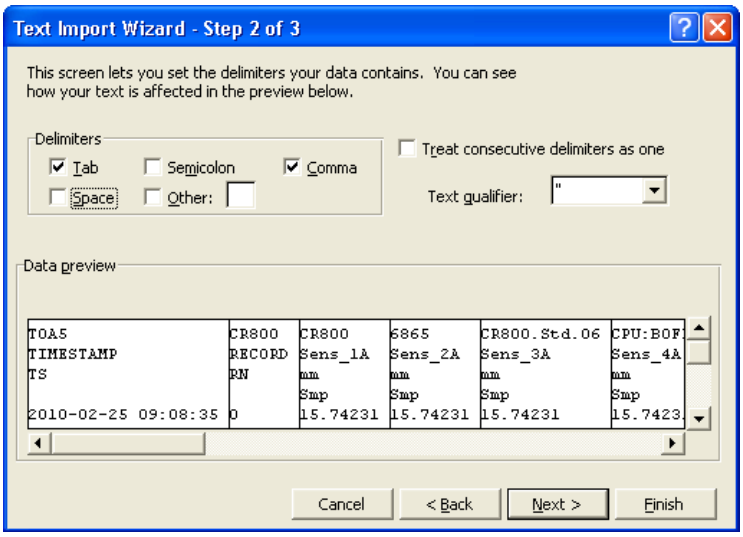
All collected readings are saved in the file specified under Table Collection. The readings saved with the file format **ASCII Table Data, Long header (TOA5)** are separated by commas (CSV) and can be imported into Microsoft Excel for data reduction.

7.1 Import Readings Into Excel

- Start Excel, go to **File** > **Open**, in the **Files of type** field, then select **All Files (*)**.
- Locate and select the file to import and click **Open**. The Text Import Wizard will open.



- Select **Delimited** and click **Next**.



- Select **Tab**, **Comma** and click **Finish**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	TOA5	CR800	CR800	6865	CR800.Stc	CPU:BOFI	3022	BOFEX						
2	TIMESTAMP	RECORD	Sens_1A	Sens_2A	Sens_3A	Sens_4A	Sens_5A	Sens_1B	Sens_2B	Sens_3B	Sens_4B	Sens_5B	S_Range	Load
3	TS	RN	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	
4			Smp	Smp	Smp	Smp	Smp	Smp	Smp	Smp	Smp	Smp	Smp	Smp
5	25/09/2009 09:08	0	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	50	0
6	25/09/2009 09:08	1	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	50	0
7	25/09/2009 09:08	2	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	50	0
8	25/09/2009 09:08	3	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	50	0
9	25/09/2009 09:08	4	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	15.74231	50	0
10														

Appendix E – Record Drawings