CLYDE RIVER WASTE WATER FACILITY
CLYDE RIVER, NUNAVUT

OPERATIONS AND MAINTENANCE MANUAL
VOLUMES 1 AND 2

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Volume 1 – Final Document

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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 Clyde River. 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 licence 3BM-CLY0909 found in Appendix A.

1.1 Preceding Lagoon

The location of the previous sewage lagoon is approximately 1,200 metres west of the Hamlet of Clyde River and 800 metres north of Patricia Bay. In the vicinity of the lagoon is a scrap metal dump located to the north and the community landfill to the east, all serviced by the same access road. There is a small watercourse to the west of the lagoon which runs south to Patricia Bay.

The previous sewage lagoon did not have sufficient holding capacity for the present population size of Clyde River of 870 people. The berms of the lagoon were failing and raw sewage was leaking out of the toes of the berms in several places. The previous lagoon was constructed in 1976. It was an unlined earth lagoon with a reported capacity of approximately 11,600 m3 and was designed to hold sewage for 365 days with annual discharge.

The previous sewage lagoon no longer meet the current storage requirements of the Hamlet, and effluent samples taken in August 2006 did not meet the regulatory requirements of the Hamlet's water licence.

1.2 Existing Water Supply

The Hamlet currently obtains its drinking water from a natural lake located 1,200m north of the community. This lake is fed by a series of larger lakes and a drainage basin all north of the water supply lake. The water supply facility is located on the south side of the lake with inclined pipes leading out into the lake where water is withdrawn. Chlorination is required for the primary 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 current location of the sewage lagoon system. The two sites are separated by approximately 1,500 metres with the water supply lake and corresponding watershed both elevated above the lagoon which drains directly to Patricia Bay.

1.3 Site Selection

The site location was based on the scope of works as presented in the "Clyde River Sewage Management – Planning Study (2003)" – completed by Dillon Consulting Limited. The report indicated that the existing site is suited for sewage treatment and the feedback from community officials and regulators approved the location.

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 existing road servicing the lagoon is cleared and maintained year round to access the community solid waste site, metal dump as well as the current lagoon system. Figure 3.1 shows the location of the lagoon site with respect to the hamlet centre, water supply lake, and the airport.

Figure 1 - 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 licence. 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 sewage lagoons as the main method of treatment, with the filter strip wetlands providing additional treatment prior to the release to the environment.

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

As monitoring the performance of natural wetlands is difficult, the Hamlet of Clyde River's water licence 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 licence 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, 2010 to 2036" as published by the Nunavut Bureau of Statistics 'June 2010'. The Nunavut Bureau of Statistics population projections provide projected populations of the Nunavut communities to the year 2036. As a planning horizon for this project, the values published up to 2028 will be used to evaluate the effluent production rates produced by the community.

The table below summarizes the population projections to the year 2028.

Table 1.1 - Population Projections

Planning Year	Year	Population	Planning Year	Year	Population
	2006	856	10	2018	1017
	2007	868	11	2019	1031
0	2008	883	12	2020	1044
1	2009	895	13	2021	1056
2	2010	908	14	2022	1068
3	2011	922	15	2023	1080
4	2012	935	16	2024	1093
5	2013	949	17	2025	1107
6	2014	963	18	2026	1120
7	2015	977	19	2027	1135
8	2016	991	**20**	**2028**	**1149**
9	2017	1004			

The design population for the end of the design horizon, 2028, is projected to be 1149 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 3.2.

Table 1.2 - 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 Clyde River has a trucked water and sewage system, therefore the RWU for the community from table 3.2 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 is estimated based on the equations in Table 3.3 – Total Community Water Usage.

Table 1.3 - 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 1149 for the year 2028, and a total water usage per capita rate of 114 lpcd, the daily sewage generation rate is equal to 131,000 lpd. This is equal to a yearly sewage generation rate of 47,800 m^3.

1.7 Influent Characteristics

The characteristics of sewage generated in a community are heavily dependent on the type of installation and sanitary facilities adopted. The Hamlet of Clyde River water and sewage systems utilize holding tanks and truck delivery/collection systems. The waste generated from this arrangement is considered to be "Moderately Diluted Wastewater", as per the Cold Climate Utility Manual. Table 3.4 - Characteristics of Basic Wastewater is an excerpt from the Cold Climate Utilities Manual summarizing the characteristics of moderately diluted wastewater.

Table 1.4 - Waste Water 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 Regulatory Requirements

The sewage treatment facility will be required to meet the effluent quality standards as set out in the Hamlet's water licence. The effluent quality standards set out in the water licence are summarized in the Table 3.5 - Effluent Quality Standards.

Table 1.5 - Effluent Quality Standards

Parameters	Maximum Average Concentration
BOD_5	120mg/L
Total suspended solids (TSS)	180mg/L
Faecal coliforms	1 x 10^6 CFU/dl
Oil and grease	No visible sheen
pH	6 and 9

1.9 Seasonal Climatic Conditions

The average annual rainfall in Clyde River is 4.6 cm and the average annual snowfall is 203 cm (RWDI, 2008). Temperatures in the summer range between 0 and 8^{o}C and in winter between -22.5^{o}C and -30^{o}C. It is generally quite windy with an average wind speed of 14.4 km/h (Dillon, 2003). 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 normals from the National Climate Data and Information Archive posted by Environment Canada.

Table 1.6 - Monthly Precipitation

Month	Precipitation Rate	Average Daily Maximum Temperature	Average Daily Minimum Temperature
January	8 mm	-24.2 °C	-31.9°C
February	4 mm	-25.6 °C	-33.4°C
March	7 mm	-22.7 °C	-31.5°C
April	10 mm	-14.1°C	-23.9°C
May	17 mm	-4.3°C	-12.7°C
June	23 mm	3.6°C	-2.3°C
July	35 mm	8.2°C	0.6°C
August	41 mm	7.1°C	-0.6°C
September	43 mm	2.4°C	-2.4°C
October	31 mm	-4.5°C	-10.6°C
November	16 mm	-13.8 °C	-21.0°C
December	7 mm	-21.0 °C	-28.5°C

1.10 Contact List

Title	Phone Number
Senior Administrative Officer (SAO)	867-924-6220
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 – Manager of Field Operations	867-975-4295
GN-Emergency Measures Officer	888-624-4043
Clyde River Health Centre	867-924-6377
RCMP (Clyde River)	867-924-1111
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 Clyde River is a two-cell storage lagoon providing the capacity to store the municipal sewage generated over the period of one year.

2.2 Site Personnel

The responsibility of the Hamlets lagoon operations are overseen by the Senior Administrative Officer (SAO). The SAO is responsible for the Forman who conducts the day to day operation and maintenance of the sewage system together with one or two Hamlet employed labours 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 as required 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 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.
- Decanting pump maintenance.
- Conduct annual monitoring program.
- 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 continence and then return to the collection circuit where it left off. Some structures will have to be serviced more than once per circuit, the Hamlet office, hotel, and other high wastewater producing structures may require a higher frequency. These high producers will have to be schedule 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, from mid September to mid August, sewage trucks continually discharge to the lagoon cells. Discharging operations take place at the designated sites along the berm where the steel chutes are located. The sewage truck will back up to the chute so that when releasing the contents, the chute directs the effluent to the lagoon. During this period the lagoon cells act as a long term detention system containing the liquid and frozen untreated effluent until treatment can have effect.

Three chutes are available to the operators, and the choice of chute is dependent on 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. Operators will be encouraged to discharge to the larger main cell prior to filling the smaller rehabilitated call when weather and sit conditions permit.

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 decanting area prior to the operation as seen in drawing TD1.

The pump will be set-up to decant the cell with the least freeboard. Decanting the cells will be completed one after the other, emptying one cell completely prior to beginning the next.

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 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 relocated back 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 startup 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 Patricia 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 Forman. Information that must be included in these records is listed below:

- Approximate volume of any effluent discharged to the environment.
- Cell level before and after discharge.
- Time required discharging each lagoon cell.
- Details of any maintenance undertaken at site.
- Volume of municipal potable water
- Dates of collecting and submitting samples to laboratory.
- Record sheets.
- Copy of the Hamlet's water licence.
- 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.
- Wear protective clothing such as gloves and boots at all times.
- Work cloths should not be worn home.
- Hands to be washed frequently, as a minimum before eating and after work.

- Personnel should receive appropriate vaccinations and ensure they are kept up-to-date.
- 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.

Lagoons 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 cells for inspection purposes.
- Maintain the overflow at the designed operating level installed between the primary and secondary cell.

To accomplish this, the berms were designed, constructed and rehabilitated with a minimum 3.5H:1V internal slope and 2.75H:1V external slope with a 4m crest. The berm core is comprised of compacted Granular 'C', and where the original cell berms were used, Granular 'C' was keyed into the side slopes.

As per the recommendations of the geotechnical report and geothermal analysis, a liner on the upstream slope to provide an impermeable boundary has been installed, with an internal ice core dam providing secondary containment. This impermeable liner was installed into the underlying soils, ensuring the liner is keyed into an impermeable surface, i.e. the permafrost. Improvements to the existing cells will follow the same specifications on the existing berms, slopes will be improved to 3.5H:1V and will be keyed into the steep side slopes of the existing cell.

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 periodically together with the QA/QC sampling data.

The coordinates and the bead depths of each thermistor string are listed in Table 5.2 below.

Table 3.1 - Thermistor String Bead Locations and Depths

Thermistor		1	2	3V	3H	4	5
Coordinates UTM	N	7818241.8	7818217.9	7818155.2	7818155.2	7818142.1	7818235.5
	E	513695.3	513806.7	513715.1	513715.1	513623.9	513560.8
Beads		**Depth of Bead in meters (m) of Thermistor**					
1st		0	0	0	4.25	0	0
2nd		0.5	0.5	0.5	4.5	0.5	0.5
3rd		1	1	1	4.5	1	1
4th		2	2	2	4.5	2	2
5th		4	4	4	5.5	4	4
6th		6	6	6	6.5	6	6
7th		8	8	8	7.5	8	8
8th		10	10	10	-	10	10

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

- The thermistors are recoding temperatures at one minute intervals continuously. It is therefore important to download and clear the memory frequently.
- 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 manufactures “Instruction Manual” found in Appendix E.

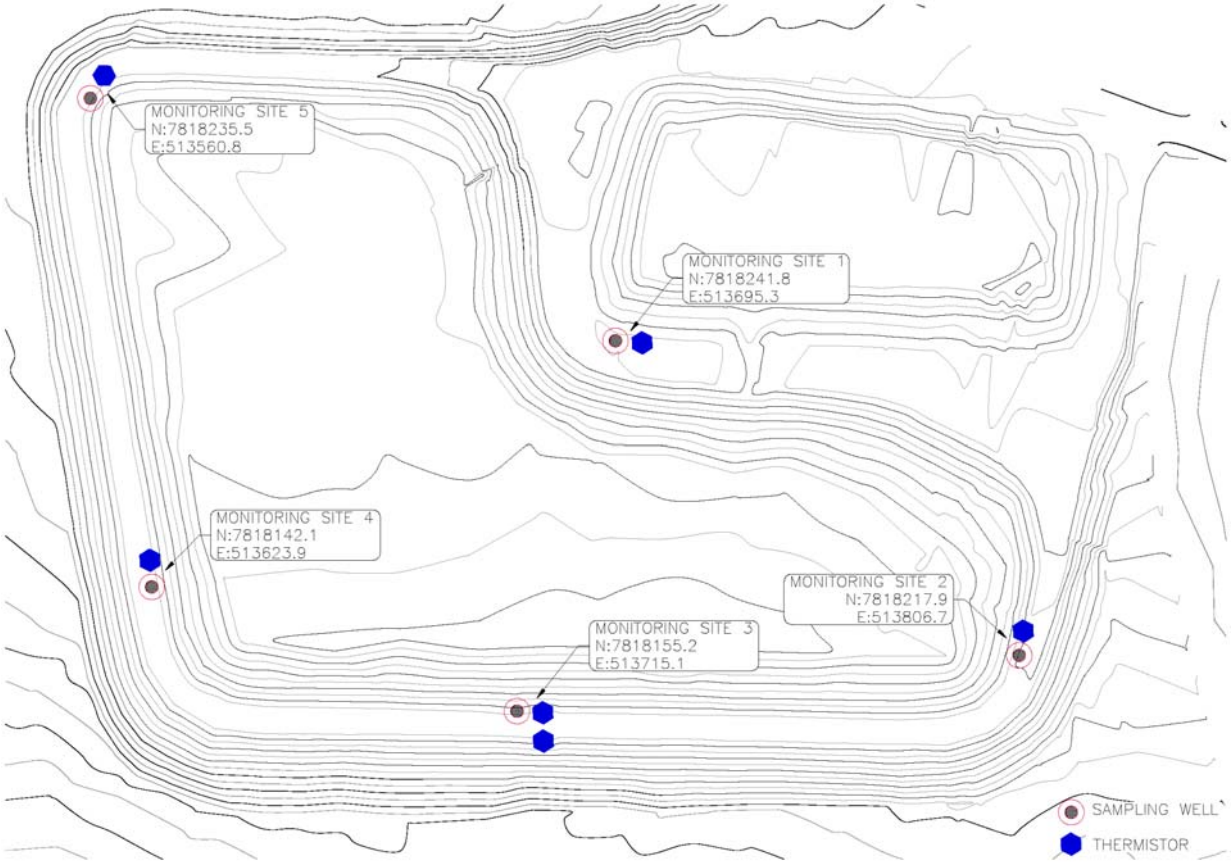
3.2.2 Sampling Wells

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 in Chapter 6.

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 onset of winter. The settlements should be referenced to the bench mark noted in the site plans.

Figure 2 - Monitoring Site Locations



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.

Effluent quality will guide 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 sledge management.

3.4 Snowdrift Management

The wastewater lagoon is located in a relatively wind exposed area west of the Hamlet where drifting snow is not expected to be a major problem. The sloped terrain in this area is not sufficient to create significant drifting problems.

Large boulders are used as safety barriers. Driver safety measures are essential, but it must be understood that the boulders will cause snowdrifts to form around them, and they will also impede snow removal operations. The Hamlet will use a front-end loader to remove snow from the lagoon area as necessary. Snow should be dumped to the east side of the lagoon to reduce the potential of the piled snow causing secondary drifting on top of the travelled berm.

3.5 Filter Strip Wetland

Vegetated filter strips are described as areas of vegetation designed to remove sediment and other pollutants from surface water runoff. A vegetated filter strip is an area that maintains soil aeration as opposed to a wetland that, at times, exhibits anaerobic soil conditions.

The filter strip wetland area is 23.5 hectares (58 acres) in size approximately 720 m long and 325 m wide with a slope of 6 to 7 %. Treatment of the pre-treated sewage in the filter strip wetland area will include removal of TSS, BOD, nutrients and pathogens.

Geotechnical investigations carried out in August 2007 found that the soil in the filter strip wetland area is comprised of silty sand with permafrost at 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.

3.6 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 do 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 validate 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 meet 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 and safety training will also be included which will ensure that the high quality data will be 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 6.1 provides coordinates of the sampling points.

Table 4.1 - Monitoring Points

Monitoring Program Station Number	Description	Northing UTM	Easting UTM
CLY-3a	Raw Wastewater Discharge (existing cell)	7818328.8m	513784.1m
CLY-3b	Raw Wastewater Discharge (new cell)	7818263.4m	513822.5m
CLY-4	Lagoon Pump Discharge (existing cell)	7818255.9m	513834.3m
CLY-5	Lagoon Pump Discharge (new cell) (same as CLY-4)	7818255.9m	513834.3m
CLY-6a	Sampling Well at end of Wetlands	7817523.6m	514035.6m
CLY-6b	Surface water near sampling well at end of Wetlands	7817523.6m	514035.6m
CLY-7	Water five (5) metres from effluent entering Patricia Bay		
CLY-8	Sewage Sludge		

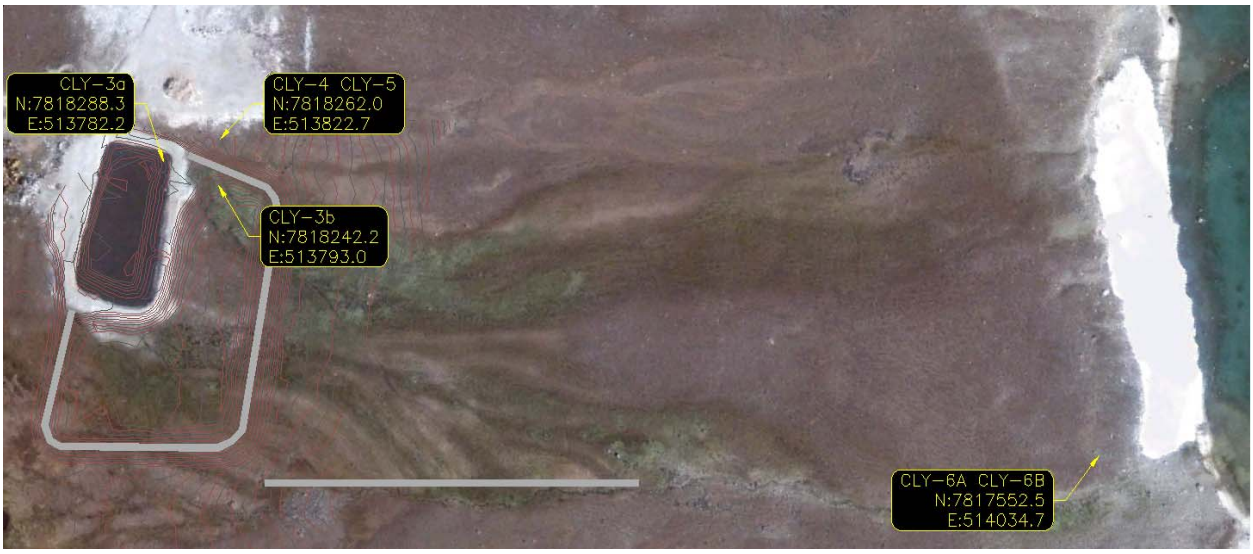
4.3 Sampling Frequency

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
CLY-3a	Raw Wastewater Discharge (existing cell)	Water Quality: Monthly and Annually
CLY-3b	Raw Wastewater Discharge (new cell)	Water Quality: Monthly and Annually
CLY-4	Lagoon Pump Discharge (existing cell)	Water Quality: Three Times Annually – Start, middle and end of decanting
CLY-5	Lagoon Pump Discharge (new cell) (same as CLY-4)	Water Quality: Three Times Annually – Start, middle and end of decanting
CLY-6a	Sampling Well at end of Wetlands	Water Quality: Three Times Annually – Start, middle and end of decanting
CLY-6b	Surface water at the end of the Wetland Area	Water Quality: Three Times Annually – Start, middle and end of decanting
CLY-7	Water five (5) metres from effluent enters Patricia Bay	Water Quality: Three Times Annually – Start, middle and end of decanting
CLY-8	Sewage Sludge	To be determined

Figure 4 - 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 licence 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 6.3. This criteria recognizes the treatment ability of the filter strip.

Table 4.3 - 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” Licences 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 designated time and location.
- Correct usage of container/sample bottle for parameter being tested.
- Correct labeling of sample bottles and filling out record/field sheet.
- Correct procedure for field sampling.
- Proper and timely shipment of samples to the laboratory.

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 labelled 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 labelled 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 import 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 labelled 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 labelled 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, transport 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 odours, etc.
- Verification of receipt of complete documentation for each container.
- Verification that sample identification numbers on sample transmittal forms corresponds to sample identification numbers on the sample containers.
- Verifications that holding times were met and samples were kept cool during transit.

CADUCEON™
ENVIRONMENTAL LABORATORIES
Client committed. Quality assured

T. Troy Jenkins
Municipality of Clyde River
P.O. Box 89
Clyde River, Nunavut
X0A 0E0

Dear T. Troy Jenkins:

Caduceon Environmental Laboratories looks forward to aiding Clyde River in their environmental analysis. The Caduceon staff has reviewed the PDF document entitled "*QA/QC for the Wastewater Treatment Facility Hamlet of Clyde River*" that was provided to our Ottawa Laboratory.

Our staff has read and understands the requirements found within this document and see no issues with providing you quality service and analysis. In addition, it has been noted that it is necessary that all testing be completed under CALA accreditation. Caduceon Environmental Laboratories are accredited for all of the parameters listed within the document.

I believe you have already been provided with our CALA Scopes of Accreditation for your records. Should you require any further information please call either Mr. Gord Murphy (Lab Supervisor) or Greg Clarkin (Lab Manager) at the Ottawa office and they will be more than happy to help you out.

Again, thanks for the opportunity to work with the Municipality of Clyde River.

Regards.

Damien Gilbert
Director of Business Development
cc: Gord Murphy
Greg Clarkin

Appendix A – Water Licence

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-CLY0909

March 19, 2009

Mr. Sandy Kautuq
Assistant Senior Administrative Officer
Municipality of Clyde River
Box 89
Clyde River, NU
X0A 0E0

RE: NWB Licence No. 3BM-CLY0909

Dear Mr. Kautuq:

Please find attached Licence No. 3BM-CLY0909 issued to the Hamlet of Clyde River by the Nunavut Water Board (NWB) 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 attached Licence related to water use and waste disposal are an integral part of this approval.

If the Licensee contemplates the renewal of this Licence, it is the responsibility of the Licensee to apply to the NWB for its renewal. The past performance of the Licensee, new documentation and information, and issues raised during a public hearing, if the NWB is required to hold one, will be used to determine the terms and conditions of the Licence renewal. Note that if the Licence expires before the NWB issues a new one, then water use and waste disposal must cease, or the Licensee will be in contravention of the *Nunavut Land Claims Agreement* (NLCA) and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA). However, the expiry or cancellation of a licence does not relieve the holder from any obligations imposed by the licence. The NWB recommends that an application for the renewal of this Licence be filed at least three (3) months prior to the Licence expiry date.

If the Licensee contemplates or requires an amendment to this Licence, the NWB may decide, in the public interest, to hold a public hearing. An application for amendment may be required for upgrades to the solid waste disposal facility. The Licensee should submit applications for amendment as soon as possible to give the NWB sufficient time to go through the amendment process. The process and timing may vary depending on the scope of the amendment, however a minimum of sixty (60) days is required from time of acceptance by the

NWB. It is the responsibility of the Licensee to ensure that all application materials have been received and acknowledged by the Manager of Licensing.

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-CLY0909
Comments from EC, GN-DoE, INAC, and GN-CLEY

cc: Qikiqtani Distribution List

P.O. Box 119
Gjoa Haven, NU X0B 1J0
Tel: (867) 360-6338
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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

DECISION

LICENCE NUMBER: 3BM-CLY0909

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence renewal received August 19, 2008 made by:

HAMLET OF CLYDE RIVER

to allow for the use of water and disposal of waste for the Hamlet of Clyde River, located within the Qikiqtani region of Nunavut. With respect to this application, the NWB gave notice to the public that the Hamlet had filed an application for a water licence renewal.

DECISION

After having been satisfied that the application was exempt from the requirement for screening by the Nunavut Impact Review Board in accordance with S. 12.3.2 of the *Nunavut Land Claims Agreement* (NLCA), the NWB decided that the application could proceed through the regulatory process. After reviewing the full submission of the Applicant and written comments expressed by interested parties, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *NLCA* and of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), decided to waive the requirement to hold a public hearing and determined that:

Licence Number 3BM-CLY0909 be issued subject to the terms and conditions contained therein. (Motion #: 2008-20-L03)

SIGNED this 18th day of March, 2009 at Gjoa Haven, NU.

Thomas Kabloona
Nunavut Water Board, Chair

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I. BACKGROUND

The Hamlet of Clyde River has a population of approximately 940 and is located on Patricia Bay on the east coast of Baffin Island at the coordinates of 70°27'N latitude and 68°33'W longitude within the Qikiqtani Region of Nunavut.

Currently, the annual average wastewater discharge volume of the community is approximately 36,000 cubic metres. The existing wastewater treatment facility is undersized to satisfy the present demand of the community and has not fully complied with the current water licence NWB3CLY0308. A condition assessment study in 2003 recommended expansion of the existing facility, and, a new lagoon was designed to operate jointly with the existing facility so that both lagoons could function as storage cell lagoons and work in conjunction with an area of wetlands.

The project has been designed for a 20 year lifetime with a storage capacity of 58,500 cubic metres. Construction was to begin during the summer of 2008, however construction is currently planned for the 2009 and 2010 seasons.

II. PROCEDURAL HISTORY

The NWB issued municipal water licence NWB3CLY0308 to the Hamlet of Clyde River on September 15, 2003, to allow for the use of water and disposal of waste.

On October 8, 2008, following a detailed assessment of an amendment application filed by the Licensee in conjunction with the Government of Nunavut Community Government Services (GN-CGS), the Board issued an amendment to water licence NWB3CLY0308 to allow for new activities to be carried out including:

- Rehabilitation of the existing Sewage Disposal Facility comprised of a sewage lagoon;
- Construction of a new sewage treatment cell to the south and west of the existing lagoon;
- Controlled effluent release to a Vegetated Filterstrip Wetland Area that is approximately 720 meters long, 325 meters wide, and flows into the marine environment at Patricia Bay; and
- Quarry development.

The original licence NWB3CLY0308 expired on September 15, 2008, during the licensing process for the requested amendment. Given that a renewal application for NWB3CLY0308 had been filed during the amendment process, the NWB extended the expiry date of the licence by six (6) months, from September 15, 2008 to March 15, 2009, to allow for processing of the renewal application and work to proceed under the amendment.

The application for renewal was submitted to the NWB by the Hamlet of Clyde River, in

conjunction with the GN-CGS on August 19, 2008. Information contained in the August 19, 2008 submission included:

- Application renewal cover letter signed by Sandy Kautuq, Assistant Senior Adminstrative Officer (SAO) for the Hamlet of Clyde River, dated August 19, 2008;
- Application summary in English;
- Application summary in Inuktitut;
- Water licence application form; and
- Municipal Questionnaire;

Following a preliminary review of the application documents, on October 30, 2008, the NWB requested a response and clarification on a few issues prior to distributing the application including:

- Anticipated changes to the solid waste disposal facility;
- Further changes to the sewage disposal facility;
- Hazardous waste disposal; and
- Compliance.

Subsequently, the Licensee submitted a document entitled *draft Spill Response Plan Aggregate Deposits, Clyde River, Nunavut*, prepared by Trow Associates Inc. (Trow), dated November 2008, Project no. OTCD00019055A.

On December 3, 2008 the GN-CGS submitted a response to the NWB's request and on December 8, 2008, the NWB publicly posted notice of the application in accordance with Section 55.1 of the Act and Article 13 of the *Nunavut Land Claims Agreement* (NLCA). This assessment process included the referral of the application to a variety of federal, territorial, and local organizations for review and comment.

No public concern was expressed during this review. Therefore, 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 Indian and Northern Affairs Canada (INAC), the Government of Nunavut Department of Environment (GN-DOE), the GN Department of Culture, Language, Elders, and Youth (CLEY), and Environment Canada (EC).

In addition, on January 8th, 2009, Trow submitted comments to the NWB on behalf of the GN-CGS regarding the water licence amendment to NWB3CLY0308, expressing concerns regarding the final discharge point for the Enhanced Sewage Disposal Facility, the discharge criteria, and the requirement within the Licence for sewage effluent to be proven non-acutely toxic.

On February 13th, 2009, the NWB facilitated a technical meeting via teleconference including representatives of GN-CGS, Trow, INAC, EC, and GN-DOE to discuss among other things the concerns outlined in Trow's January 8th, 2009 letter as well as the NWB's concerns regarding compliance with the amended licence NWB3CLY0308. This teleconference was followed up with a distribution of the meeting notes via email on March 3, 2009.

Based on the results of the detailed assessment of the renewal application file, including consideration of any potential accidents, malfunctions, or impacts to water that the overall project might have in the area, the Board has approved the application and has issued licence 3BM-CLY0909.

III. ISSUES

Compliance and Term of Licence

In accordance with Section 45 of the Act, the NWB may issue a licence for a term not exceeding twenty-five years. In determining an appropriate term of a water licence, the Board considers a number of factors, including the results of INAC site inspections and the overall compliance record of the Applicant. In review of the previous water licence NWB3CLY0308 inspection reports, the NWB has noted that there were compliance issues and other related problems identified by the Inspector. A Municipal Water Use Inspection Report dated August 8, 2006 included the following issues:

- Unacceptable decant structure; and
- Insufficient freeboard

Another inspection conducted on July 13th, 2007 and reported on December 4, 2007 identified additional compliance issues and related problems including:

- Failure to submit annual reports including the results of the monitoring program;
- Failure to maintain the appropriate signage and warnings at Surveillance Network Program stations;
- Structural issues with the sewage lagoon;
- Failure to submit a Sewage and Solid Waste Disposal Operations and Maintenance Manual; and
- Failure to collect and submit for analysis the samples required as part of the Monitoring Program.

In addition, the NWB notes INAC's comments on the application submitted January 2, 2008 with respect to Part B Item #10 of amended licence NWB3CLY0308, requiring the Licensee to submit a Plan for Compliance within ninety (90) days of licence issuance or upon the filing of any application in relation to the licence within that time. To date, the NWB has not received a Plan for Compliance.

Through its own compliance assessment the NWB notes that the Quality Assurance/ Quality Control (QA/QC) Plan required as a condition of Part H Item 6 of amended licence NWB3CLY0308 to be submitted to the Analyst within sixty (60) days of Licence issuance, has not, to this date, been received by the NWB. Also, the Board is not in receipt of as-built drawings of any modifications to the existing Sewage Disposal Facility required in accordance with Part E Item 4 of licence NWB3CLY0308.

In its August 19th water licence application form, the Hamlet indicated a request for a term of five (5) years for the Licence renewal (September 15, 2008 to September 15, 2013). No comments were received from interested parties with respect to the length of term, however, based on issues with non-compliance that are related to the 2003 Licence renewal and again with the issuance of the Amendment No.1 in October, 2008, including non-compliance with administrative and reporting requirements, the NWB has decided on an eight month term for the Licence.

The eight month Licence term is intended to provide the Licensee time to take immediate action towards achieving full compliance with all Licence requirements for its existing facilities and to begin and complete the first year's construction of its Enhanced Sewage Disposal Facility, as part of this process. Upon submission of an application to renew the Licence in approximately five (5) months from the date of this Licence, the Board fully expects the Hamlet to be in compliance with the Licence. As per Part B, Item 12 of the Licence, the Licensee must submit a Plan for Compliance that clearly demonstrates how the Hamlet will achieve full compliance with the Licence conditions during this time period and subsequent licence term(s).

The NWB reminds the Licensee of its responsibility to be in compliance with the conditions of the Licence. If monitoring results demonstrate that effluent does not meet discharge limits, the Licensee is required to take the necessary measures to correct the situation and maintain compliance.

Plan for Compliance

INAC noted in its comments dated January 2, 2008 regarding the condition of Part B Item 10 of amended licence NWB2CLY0308 requiring the Licensee to submit to the Board for approval, within ninety (90) 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 the licence. This Plan was to include the issues raised in the inspector's reports. The Plan has not been received by the NWB. Although information was provided following a Teleconference meeting on February 13, 2009, the submission was not considered acceptable as the specific content requested was not provided and the document was poorly organized which included numerous scanned, secondary documents that were unreferenced. The NWB therefore requires that the Licensee, as a condition of this Licence renewal, submit a "Plan

For Compliance" to the Board, within a reduced time frame of **thirty (30) days** following the issuance of this renewal, for approval in writing.

Quality Assurance/ Quality Control Plan (QA/QC Plan)

The Licensee to this date, has not submitted a QA/QC Plan as required in Part H Item 6 of amended licence NWB3CLY0308. As with the Plan for Compliance above, the NWB did receive, following the Teleconference of February 13, 2009, a submission that included several, unreferenced documents that somewhat inferred to be Quality Control and Quality Assurance procedures for monitoring, sampling and analyses. However this information was considered incomplete and therefore, the NWB requires that the Licensee, as a condition of this Licence renewal, submit a QA/QC Plan within **sixty (60) days** of issuance of this Licence renewal that has met the conditions of Part H, Item 13. 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 Part H and Schedule 1, to address both the field and laboratory requirements of monitoring for this Licence under Part H. In addition, this Plan will need to be updated for inclusion in the Operation and Maintenance Plan for the Enhanced Sewage Disposal Facility as required in Part F Item 2.

Annual Report

The previous licence NWB3CLY0308 included a condition requiring the submission of annual reports. As identified by the inspector, annual reporting including the results of the monitoring program have not been submitted. The GN-CGS advised the Board in its December 3, 2008 response to the NWB's preliminary technical review that a monitoring program has been set up and the Hamlet staff are being trained. The Hamlet has been advised by the GN-CGS to follow-up on the annual report and to attach all laboratory test results with the annual report.

The NWB will maintain the condition in the License to produce annual reports. These reports are for the purpose of 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/.

Although an Annual Report has been received by the NWB for 2008, not all data generated under Part H, Monitoring Program was included. The Board is requiring the Licensee to submit all data generated under the previous Licence NWB3CLY0308 and the Amendment No.1 "Monitoring Program" to the Board within thirty (30) days of issuance of this Licence, 3BM-CLY0909.

Operational Plans

The previous licence NWB3CLY0308, included a condition in Part F Item 1 requiring the submission of a Plan for the Operation and Maintenance (O&M) of the Sewage and Solid Waste Facilities before March 31, 2004. This plan has not been received. During the amendment process for NWB3CLY0308, the Licensee submitted a draft O&M Manual outline and indicated during a teleconference that a complete O&M Manual would be available prior to commissioning the Enhanced Sewage Disposal Facility. The amended licence NWB3CLY0308 continued to require submission of an O&M Manual for facilities currently in use, adding a condition that this Manual be revised and submitted ninety (90) days prior to commissioning of the Enhanced Sewage Disposal Facility, for approval of the Board in writing.

The O&M Manual required under Part F, Item 1, to be submitted within **sixty (60) days** following issuance of the Licence, and revision under Part F, Item 2 is to be developed to the satisfaction of the NWB and shall include plans for;

a) the operation and maintenance of Water Supply Facilities;
b) the operation and maintenance of **ALL** sewage and solid waste disposal facilities;
c) hazardous waste management procedures;
d) the management of sludge from the Sewage Disposal Facility and Enhanced Sewage Disposal Facility;
e) the protection of the environment with regard to potential spills through day-to-day operations through a Spill Contingency Plan; and
f) include a monitoring program Quality Assurance/Quality Control Plan.

The Board acknowledges receipt of the document entitled *draft Spill Response Plan Aggregate Deposits, Clyde River, Nunavut*, prepared by Trow Associates Inc., dated November 2008, Project no. OTCD00019055A, submitted in accordance with Part F Item 6 of the amended licence NWB3CLY0308. As recommended by INAC, GN-DOE and EC in their written comments, the Board is requiring that this plan be revised and updated to address the parties' comments and be incorporated into the O&M Manual discussed above, for submission ninety (90) days prior to commissioning of the Enhanced Sewage Disposal Facility.

The purpose of the O&M Manual is to assist Hamlet staff in carrying out the procedures relating to the water use and 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 as deemed appropriate.

Quarry

The design of the Enhanced Sewage Disposal Facility as described in the application for amendment to water licence NWB3CLY0308, requires in excess of 40,000 cubic metres of granular material. Since the Hamlet's current quarry sites are being used for municipal needs and do not have sufficient material to complete the project, a new quarry site was approved for development under the amendment.

This quarry development underwent an environmental screening by NIRB and on June 18, 2008, NIRB issued its screening determination for file #08QN055 recommending that the project proposal proceed subject to specific terms and conditions. Conditions related to the mandate of the NWB regarding the use of water and disposal of waste, were incorporated into the amendment of NWB3CLY0308 and have been forwarded into this renewal.

In addition, the NWB is continuing to require as a new condition of the Licence amendment, that an undisturbed buffer zone of at least 100 metres be maintained between any proposed quarry operation and the normal high water mark of any water body.

Water Use

The Hamlet of Clyde River currently uses Water Source Lake as its source of potable water with the quantity not to exceed 38,000 cubic meters annually. No concerns were raised by the parties in their written submissions as to the amount of water required by the Hamlet, the manner in which it is obtained, or the manner in which it will be used. The NWB has renewed the terms and conditions associated with water use accordingly.

Sewage

The Hamlet of Clyde River currently utilizes a Sewage Disposal Facility approximately 1.2 km west of the municipality. Currently, the Sewage Disposal Facility is a single-cell exfiltration lagoon with a capacity of 19,500 m^3. The effluent that exfiltrates from the lagoon berm proceeds downstream through an undefined natural wetland where it receives additional treatment prior to reaching the marine environment. The Board notes that to date no as-built drawings of the existing Sewage Disposal Facility have been received by the NWB in accordance with Part E Item 4 of licence NWB3CLY0308.

With an annual average wastewater discharge volume from the community of an estimated 36,636 cubic metres, the existing Sewage Disposal Facility is undersized and has failed to meet the effluent quality criteria of the Licence. As such, expansion of the existing facility was approved by the NWB in the scope of the amendment to water licence NWB3CLY0308, including the construction of a new lagoon to the south and west of the existing lagoon to supplement the current storage capacity.

The land between the current facility (and approved expansion) and Patricia Bay was also approved in the scope of the amendment to water licence NWB3CLY0308 to remain as a Vegetated Filter Strip Wetland Area. The treated sewage effluent will be pumped from the lagoon to the wetland area beginning in mid-August and continuing until mid to late September. The end of the Vegetated Filter Strip Wetland Area is located approximately 720 metres from the discharge point of the sewage lagoon, at Patricia Bay.

The Board acknowledges comments submitted by Trow Associates Inc. regarding the conditions of Amendment No.1 to water licence NWB2CLY0308, on the following three sewage related issues:

1. the final discharge point for the Enhanced Sewage Disposal Facility;
2. the discharge criteria for effluent discharged from the Enhanced Sewage Disposal Facility; and
3. the requirement for effluent discharged from the Enhanced Sewage Disposal Facility to be proven non-acutely toxic.

With respect to the first issue regarding Trow's concern with the contradictory nature of the inclusion of two separate Final Discharge Points and criteria, one at the discharge point of the sewage lagoon, and the second at the discharge of the wetlands, the Board does not fully agree with the argument provided by Trow. Trow argues that the final discharge point should be considered to be the end of the wetlands as the operator can control the rate of sewage applied to the wetlands and therefore has control of the quality of treatment from the wetlands. As noted by EC in their comments dated January 16, 2009 in response to Trow's concern, "real time" data is not available for effluent quality and in order to consider the wetland area discharge as a compliance point, real time data and evidence of treatment efficiency is required. As such, the Board has decided that in order to minimize the potential for release of poor quality effluent to Patricia Bay, that the Final Discharge Point and point of compliance 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 wetland as a secondary treatment system, the Board further requires that the quality of effluent leaving the wetland be monitored and reported.

With respect to the second issue regarding Trow's concern with the discharge criteria, the Board has agreed with Trow. The Board also notes EC's January 6, 2009 comments recommending that effluent quality standards applied to this licence should be at least equivalent to those outlined in the 1992 document "*Guidelines for discharge of treated municipal wastewater in the Northwest Territories*". 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 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 and also, that are consistent with the previous licence NWB3CLY0308 to

take into account the potential for treatment of the wetland area. The discharge criteria for the existing Sewage Disposal Facility include Fecal Coliforms as a licensed parameter and the NWB is maintaining this requirement for the Enhanced Sewage Disposal Facility.

Furthermore, the Board refers the Licensee to EC's January 16th advice regarding the establishment of future discharge criteria for consideration upon licence renewal. EC recommends that the Hamlet investigate using the sewage treatment system to hold sewage in one cell while a longer decant is done from the second cell to take advantage of the growing (treatment) season without overwhelming the wetland vegetation. However, if shorter discharge periods are implemented, lower effluent discharge limits would be appropriate with some allowance made for polishing by the wetlands. EC's recommendations should be considered in the development of the O&M Manual.

With respect to the third issue of Trow's letter, concerning the requirement for effluent to be proven non-acutely toxic and that it is not a requirement of the Canadian Council Ministers of Environment Canada-wide Strategy for the Management of Municipal Wastewater effluent, the Board agrees with Trow, as long as there are no industrial inputs into the system. The Board notes EC's January 16th recommendations in making the decision to remove this requirement and refers the Licensee to EC's statement regarding acute toxicity testing done as part of the risk assessment and monitoring efforts of the CCME Strategy, if logistical constraints can be handled.

Furthermore, in making this decision, the Board also notes EC's January 6th, 2009 submission, advising the Licensee 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, 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. The Licensee is further advised that compliance with this Licence does not absolve the Licensee from the responsibility to comply with other applicable legislation.

Solid Waste

The Hamlet has one Solid Waste Disposal Facility located east of the lagoon. The site is unfenced, waste is not segregated and wastes are burned regularly. A waste oil storage area is located outside the landfill site. A metal dump is also located to the west of the lagoon. At the time of application, it was indicated that budgeting for optimization of the landfill site had been planned under the GN-CGS's Capital Planning Program for the period of 2009-2011.

Recommendations relevant to solid waste disposal operations in the Hamlet were received by INAC, EC, and the GN-DOE regarding waste segregation, fencing, open burning, hazardous waste, drainage management, and planned facility upgrades.

EC recommended that waste segregation practices should be identified and used to ensure removal of salvageable items and hazardous waste materials from the general waste and that dedicated locations should be identified for hazardous wastes, including batteries, waste oil, honey bags, animal carcasses, and contaminated soils. The Licensee is encouraged to consider those recommendations in the development of its O&M Manual and the NWB has modified the condition in Part D Item 7 of NWB3CLY0308 to require the Licensee segregates and stores all hazardous materials and/or hazardous waste, including waste oil, within the Solid Waste Disposal Facility in a manner as to prevent the deposit of deleterious substances into any water until such a time as proper disposal arrangements are made.

EC and GN-DOE both noted in their submissions that the Solid Waste Disposal Facility requires proper fencing. Fencing is required to control the spread of debris and to prevent waste entering waters. All solid waste is to be contained at the Solid Waste Disposal Facility under Part D Item 6 of the renewal Licence.

The Board acknowledges comments received by INAC, EC and GN-DOE regarding the Licensee's practice of open burning and advises the Licensee of the requirement to comply with the *Canada Wide Standards for Dioxin and Furans* and the *Canada Wide Standard for Mercury Emissions* for the management and incineration of municipal wastes. The Licensee is also advised to adhere to the GN-DOE policy document, entitled *Municipal Solid Wastes Suitable for Open Burning*.

EC provided recommendations regarding hazardous waste including waste oil and fuel barrels, as well as recommendations regarding drainage management to minimize leachate generation from the Solid Waste Disposal Facility. The Licensee is encouraged to consider those recommendations in the development of its operating procedures and the O&M Manual.

Finally, the Board notes the Licensee's plans with respect to upgrading its Solid Waste Disposal facility, including an increase in its area, the construction of separate cells for different types of waste, and recycling/waste reduction plans. The Board would like to take the opportunity to advise the Licensee that an application for amendment is required for the planned upgrades to the Solid Waste Disposal Facility. The Licensee should submit applications for amendment as soon as possible to give the NWB sufficient time to go through the amendment process. The process and timing may vary depending on the scope of the amendment, however a minimum of sixty (60) days is required from time of acceptance by the NWB.

Signage

Recommendations regarding signage were received from EC and GN-DOE noting that signage at the Solid Waste Disposal Facility, the Sewage Disposal Facility and the Vegetated Filter Strip Wetland Area were required. The Board agrees with parties' recommendations and is requiring as a condition in Part B Item 7 of the licence renewal, that the Licensee post signs in the

appropriate areas to inform the public of the location of Water Supply Facilities and Waste Disposal Facilities and that all signs be in English and Inuktitut.

In addition, the Board is continuing to require that signage be posted to identify Monitoring Program station locations.

Monitoring

The Board has revised the Monitoring Program requirements in this Licence renewal to reflect the changes to compliance monitoring for the Sewage Disposal Facility.

Specific changes include the removal of acute toxicity as a parameter to be monitored. In addition, the Monitoring Program no longer requires compliance monitoring at the end of the wetland, but maintains the requirement for water quality monitoring at that station to determine the performance of the wetland as a secondary treatment system.

Due to concerns regarding the effectiveness of wetland treatment, the Board has added a condition in Part H Item 16 of the License renewal, requiring the Licensee provide an indication of wastewater treatment levels upstream and downstream of the Vegetated Filter Strip Wetland Area in the annual report.

Within Amendment No.1, the Board had decided to impose additional thermal monitoring within the lagoon liner key trench and that the vertical thermistors and casings extend at least 5 metres below the base of the berm (ie below existing ground level).

In maintaining consistency with the previous licence and amendment issued, the Board has retained the condition, Part F, Item 5, to ensure that the additional thermistor stations are installed within the Key Trench of the Enhanced Sewage Disposal Facility berms and monitoring takes place. Additionally, the Board has retained the requirement for settlement monitoring of the lagoon berms. This monitoring data will be essential to the assessment of the geotechnical and geothermal performance of the lagoons following construction, as required in Part H Item 12.

LICENCE 3BM-CLY0909

Pursuant to the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* and the *Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada*, the Nunavut Water Board, hereinafter referred to as the Board, hereby grants to

THE HAMLET OF CLYDE RIVER
(Licensee)

of

BOX 89, CLYDE RIVER, NUNAVUT X0A 0E0
(Mailing Address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water or dispose of waste for a period subject to restrictions and conditions contained within this Licence:

Licence Number **3BM-CLY0909**

Water Management Area **NUNAVUT 05**

Location **CLYDE RIVER, QIKIQTANI REGION, NU (Latitude 70°27'N and Longitude 68°33'W)**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to Exceed **30,000 CUBIC METRES ANNUALLY**

Date of Licence **MARCH 18, 2009**

Expiry Date of Licence **NOVEMBER 13, 2009**

Dated this 18th of March, 2009 at Gjoa Haven, NU.

Thomas Kabloona
Nunavut Water Board
Chair

PART A: SCOPE AND DEFINITIONS

1. Scope

a. This Licence allows for the use of water and the disposal of waste for a municipal undertaking at the Hamlet of Clyde River, Qikiqtani Region, Nunavut (70°27' N; 68°33'W);

b. This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposits of such waste may enter any waters. Whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*, or other statutes imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be subject to such requirements; and

c. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of all applicable Federal, Territorial and Municipal legislation.

2. Definitions

In this Licence: **3BM-CLY0909**

"**Act**" means the *Nunavut Waters and Nunavut Surface Rights Tribunal Act;*

"**Amendment**" means a change to original terms and conditions of this Licence requiring correction, addition or deletion of specific terms and conditions of the Licence; modifications inconsistent with the terms of the set terms and conditions of the Licence;

"**Analyst**" means an Analyst designated by the Minister under Section 85 (1) of the Act;

"**Application for Water Licence Amendment**" means the application filed by the Hamlet of Clyde River and GN-CGS with the NWB on March 10th, 2008 including supporting documents.

"**Appurtenant undertaking**" means an undertaking in relation to which a use of waters or a deposit of waste is permitted by a licence issued by the Board;

"Average Concentration for Fecal Coliforms" means the geometric mean of the last four consecutive analytical results for fecal coliforms contained in composite or grab samples collected from the Sewage Disposal Facility's and Enhanced Sewage Disposal Facility's Final Discharge Point.

"Board" means the Nunavut Water Board established under the *Nunavut Land Claims Agreement*;

"Chief Administrative Officer" means the Executive Director of the Nunavut Water Board;

"Effluent" means treated or untreated liquid waste material that is discharged into the environment from a structure such as a settling pond or a treatment plant;

"**Engineer**" means a professional engineer registered to practice in Nunavut in accordance with the *Engineering, Geological and Geophysical Act (Nunavut)* S.N.W.T. 1998, c.38, s.5;

"Enhanced Sewage Disposal Facility" comprises the area and engineered sewage lagoons, decant structures, and Vegetated Filter Strip Wetland Area designed to contain and treat sewage as described in the Application for Water Licence Amendment filed by the Applicant on March 10, 2008 and illustrated in Drawings SP-1, CSM-1, SP-2, SEC-1, TD-1, DE-1, and DE-2 prepared by Trow Associates Inc., project no. 0TCD00019055A, dated August 30, 2007;

"Final Discharge Point" in respect of an effluent means an identifiable discharge point of a facility beyond which the operator of the facility no longer exercises control over the quality of the effluent;

"Freeboard" means the vertical distance between water line and crest on a dam or dyke's upstream slope;

"Geotechnical Engineer" means a professional engineer registered with the Association of Professional Engineers, Geologist and Geophysicists of Nunavut and whose principal field of specialization with the engineering properties of earth materials in dealing with man-made structures and earthworks that will be built on a site. These can include shallow and deep foundations, retaining walls, dams, and embankments;

"Greywater" means all liquid wastes from showers, baths, sinks, kitchens and domestic washing facilities, but does not include toilet wastes;

"**Inspector**" means an Inspector designated by the Minister under Section 85 (1) of the Act;

"Licensee" means the holder of this Licence;

"Modification" means an alteration to a physical work that introduces new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion, and changes to the operating system that are consistent with the terms of this Licence and do not require amendment;

"Monitoring Program" means a monitoring program established to collect data on surface water and groundwater quality to assess impacts to the freshwater aquatic environment of an appurtenant undertaking;

"Nunavut Land Claims Agreement" (NLCA) means the *"Agreement Between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in right of Canada"*, including its preamble and schedules, and any amendments to that agreement made pursuant to it;

"Sewage" means all toilet wastes and greywater;

"Sewage Disposal Facility" comprises the area and engineered lagoon and decant structures designed to contain and treat sewage as described in the Application for Water Licence filed by the Applicant on February 5th, 2003 and illustrated in Drawing No. 2002-1000-050;

"Solid Waste Disposal Facility" comprises the area and associated structures designed to contain solid waste as described in the Application for Water Licence filed by the Applicant on February 5, 2003 and illustrated in Drawing No. 2002-1000-050;

"Toilet Wastes" means all human excreta and associated products, but does not include greywater;

"Waste" means, as defined in S.4 of the Act, any substance that, by itself or in combination with other substances found in water, would have the effect of altering the quality of any water to which the substance is added to an extent that is detrimental to its use by people or by any animal, fish or plant, or any water that would have that effect because of the quantity or concentration of the substances contained in it or because it has been treated or changed, by heat or other means;

"Waste Disposal Facilities" means all facilities designated for the disposal of waste, and includes the Sewage Disposal Facility, the Enhanced Sewage Disposal Facility, the Solid Waste Disposal Facility, and Bagged Toilet Waste Disposal Facility, as described in the Application for Water Licence filed by the Applicant on February 5, 2003 and illustrated

in Drawings No. 2002-1000-050, and as described in the Application for Water Licence Amendment filed by the Applicant on March 10, 2008;

"Water Supply Facilities" comprises the area and associated intake infrastructure at Water Source Lake, as described in the Application for Water Licence filed by the Applicant on February 5, 2003 and illustrated in Drawing No. 2002-1000-050; and

"Vegetated Filter Strip Wetland Area" comprises approximately 23.5 hectares of land immediately downstream of the sewage lagoon, for approximately 720 metres at a slope of 6 to 7% and includes the lagoon dewatering pump and infrastructure as well as diversion berm and fencing as described in the Application for Water Licence filed by the Applicant on March 10, 2008 and illustrated in Construction Drawings prepared by Trow Associates Inc. Project OTCD00019055A dated August 2007.

3. Enforcement

a. Failure to comply with this Licence will be a violation of the Act, subjecting the Licensee to the enforcement measures and the penalties provided for in the Act;

b. All inspection and enforcement services regarding this Licence will be provided by Inspectors appointed under the Act;

c. For the purpose of enforcing this Licence and with respect to the use of water and deposit or discharge of waste by the Licensee, Inspectors appointed under the Act, hold all powers, privileges and protections that are conferred upon them by the Act or by other applicable law; and

d. The Licensee shall, in relation to any application to renew or amend the Licence, have in place a Plan for Compliance approved by the Board in writing, to achieve full compliance with the conditions of this Licence, or a Plan for Compliance must be submitted at the time of Application, in order for the Application to be deemed complete.

PART B: GENERAL CONDITIONS

1. The Licensee shall submit to the Board for review, within thirty (30) days of Licence 3BM-CLY0909 issuance, all available data generated under licence NWB3CLY0308 and subsequent amendment "Monitoring Program".

2. 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:

a. 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 the Enhanced Sewage Disposal Facilities, as well as the treatment efficiency of the Vegetated Filter Strip Wetland Area;

b. modifications to the "Monitoring Program" in accordance with Part H Item 17;

c. the annual quantity of sludge removed from the Sewage Disposal Facility and the Enhanced Sewage Disposal Facility along with the treatment/storage/disposal provided, as required in Part H Item 6;

d. the results of sampling and analyses of sewage sludge in accordance with the Operations and Maintenance Manual referred to in Part F Item 2, as required in Part H Item 8;

e. An assessment of the geotechnical and geothermal performance of the Enhanced Sewage Disposal Facility including an analyses of the results from the thermistor, standpipe and settlement monitoring stations, as required in Part H Item 12;

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

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

h. 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;

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

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

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

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

m. a summary of any studies, reports, and plans (e.g., Operations and Maintenance, Abandonment, Restoration and Closure, QA/QC) requested by the Board that relate to waste disposal, water use or reclamation, and a brief description of any

future studies planned; and

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

3. The Licensee shall comply with the "Monitoring Program" described in this Licence, and any amendments to the "Monitoring Program" as may be made from time to time, pursuant to the conditions of this Licence.

4. The "Monitoring Program" and compliance dates specified in the Licence may be modified at the discretion of the Board.

5. Meters, devices or other such methods used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee.

6. The Licensee shall, within ninety (90) days after the first visit by the Inspector following issuance of this Licence, post the necessary signs to identify the stations of the "Monitoring Program". All signage postings shall be in the Official Languages of Nunavut.

7. The Licensee shall post signs in the appropriate areas to inform the public of the locations of the Water Supply Facility and the Waste Disposal Facilities. All signage postings shall be in the Official Languages of Nunavut.

8. The Licensee shall immediately report to the 24-Hour Spill Report Line (867-920-8130) any spills of Waste, which are reported to, or observed by the Licensee, within the municipal boundaries or in the areas of the Water Supply or Waste Disposal Facilities.

9. The Licensee shall ensure a copy of this Licence is maintained at the Municipal Office at all times. Any communication with respect to this Licence shall be made in writing to the attention of:

(a) Manager of Licensing:
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369
Email: licensing@nunavutwaterboard.org

(b) Inspector Contact:
Water Resources Officer
Nunavut District, Nunavut Region

P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4295
Fax: (867) 979-6445

10. The Licensee shall submit one paper copy and one electronic copy of all reports, studies, and plans to the Board. Reports or studies submitted to the Board by the Licensee shall include a detailed executive summary in Inuktitut.

11. The Licensee shall ensure that all document(s) and correspondence submitted by the Licensee, to the Board, are received and acknowledged by the Manager of Licensing.

12. The Licensee shall submit to the Board for approval, within **thirty (30) days** of issuance of this Licence, 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 during the public review of the application and those of the Inspector's Reports.

13. 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, Manual or Report if necessary to achieve the legislative objectives and will notify the Licensee in writing of acceptance, rejection or alteration of the Plan.

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

15. Every Plan to be carried out pursuant to the terms and conditions of this Licence shall become a part of this Licence, and any additional terms and condition imposed upon approval of a Plan by the Board become part of this Licence. All terms and conditions of the Licence should be contemplated in the development of a Plan where appropriate.

16. This Licence is not assignable except as provided in Section 44 of the Act.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from Water Source Lake using the Water Supply Facilities or as otherwise approved by the Board in writing.

2. The annual quantity of water, used for all purposes, shall not exceed thirty eight thousand (38,000) cubic metres.

3. The Licensee shall maintain the Water Supply Facilities to the satisfaction of the Inspector.

4. The Licensee shall equip all water intake hoses with a screen of appropriate mesh size to ensure that fish are not entrained and shall withdrawl water at a rate such that fish do not become impinged on the screen.

5. The Licensee shall not remove any material from below the ordinary high water mark of any water body unless otherwise approved by the Board in writing.

6. The Licensee shall not cause erosion to the banks of any body of water and shall provide necessary controls to prevent such erosion.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. Prior to commissioning the Enhanced Sewage Disposal Facility, the Licensee shall direct all Sewage to the Sewage Disposal Facility. Following construction of the Enhanced Sewage Disposal Facility, the Licensee shall direct all Sewage to the Enhanced Sewage Disposal Facility, or as otherwise approved by the Board in writing.

2. All Effluent discharged from the Sewage Disposal Facility at Monitoring Program Station CLY-4 and from the Enhanced Sewage Disposal Facility at Monitoring Program Station CLY-5 shall not exceed the following effluent quality standards:

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

3. A Freeboard limit of 1.0 metre, or as recommended by a qualified geotechnical engineer and as approved by the Board in writing, shall be maintained at all dams, dykes or structures intended to contain, withhold, divert, or retain water or wastes.

4. The Licensee shall provide at least ten (10) days notification to an Inspector, prior to initiating the release of effluent from the Waste Disposal Facilities.

5. The Sewage Disposal Facility and the Enhanced Sewage Disposal Facility shall be maintained and operated, in such a manner as to prevent structural failure.

6. The Licensee shall dispose of and permanently contain all Solid Wastes at the Solid Waste Disposal Facility or as otherwise approved by the Board in writing.

7. The Licensee shall segregate and store all hazardous materials and/or hazardous waste, including waste oil, within the Solid Waste Disposal Facility in a manner as to prevent the deposit of deleterious substances into any water, until such a time as proper disposal arrangements are made.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall implement the recommended options identified in the Water Licence Application document entitled "*Design Brief New Sewage Lagoon and Rehabilitation of Exisiting Sewage Lagoon for the Hamlet of Clyde River*" dated February 2008 and prepared by Trow Associates Inc. In the event of a conflict between the conditions of this Licence and the above referenced document, the conditions of this License shall prevail.

2. The Licensee shall submit to the Board for approval, design drawings stamped and signed by a qualified engineer registered in Nunavut, six (6) months prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

3. The Licensee may, without written approval from the Board, carry out modifications to the Water Supply and Waste Disposal Facilities provided that such modifications are consistent with the terms of this Licence and the following requirements are met:

   a. the Licensee has notified the Board in writing of such proposed modifications at least sixty (60) days prior to beginning the modifications;

   b. these modifications do not place the Licensee in contravention of the Licence or the Act;

   c. the Board has not, during the sixty (60) days following notification of the proposed modifications, informed the Licensee that review of the proposal will require more than sixty (60) days; and

   d. the Board has not rejected the proposed modifications.

4. Modifications for which all of the conditions referred to in Part E, Item 3, have not been met, may only be carried out upon written approval from the Board. The Licensee shall provide as-built plans and drawings of the Modifications referred to in this Licence

within ninety (90) days of completion of the Modification. These plans and drawings shall be stamped by an Engineer.

5. All activities shall be conducted in such a way as to minimize impacts on surface drainage and the Licensee shall immediately undertake any corrective measures in the event of any impacts on surface drainage.

6. The Licensee shall ensure that sediment and erosion control measures are implemented prior to and maintained during activities carried out under this Part to prevent the release of sediment and minimize erosion.

7. The construction or disturbance of any stream/lake bed or banks of any definable water course are not permitted, unless authorized by the Board in writing.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall submit to the Board for approval in writing, within sixty (60) days of issuance of this Licence, an Operation and Maintenance Manual (O&M 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 specifically address issues which were identified in the August 21, 2001 DIAND Inspection Report, with respect to the operations and facility capacity at the Sewage Disposal Facility and include the following Plans:

   a. *Water Supply Facility Operation and Maintenance Plan;*
   b. *Sewage and Solid Waste Operation and Maintenance Plan;*
   c. *Hazardous Waste Management Plan;*
   d. *Sludge Management Procedures;*
   e. *Spill Contingency Plan, including updated Spill Response Plan for Aggregate Deposits; and*
   f. *Monitoring Program Quality Assurance/Quality Control Plan (QA/QC Plan)*

2. The Licensee shall submit to the Board for approval, a minimum of ninety (90) days prior to commissioning of the Enhanced Sewage Disposal Facility, a revision to the Operations and Maintenance (O&M) Manual referred to in Part F Item 1. The Manual shall take into consideration the new facility and comments received during the application review.

3. The Licensee shall review the O&M Manual referred to in Part F, Item 1 and Item 2 as required by changes in operation and/or technology and modify accordingly. Revisions are to be submitted in the form of an Addendum to be included with the Annual Report.

4. 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 Clyde River;
   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.

5. The Licensee shall, prior to commissioning of the Enhanced Sewage Disposal Facility, install thermistors, monitoring standpipes and settlement monitoring stations as described in the application documents, dated March 10, 2008. In addition, thermistors are to be installed within the key trench corresponding to each station of vertical thermistor installation, for the determination of permafrost development around the key trench and confirmation of design criteria with respect to the reliability of permafrost as an engineered system for seepage control.

6. The Licensee shall submit to the Board, prior to commencing construction or procurement of construction materials from the quarry, a revised final *Spill Response Plan Aggregate Deposits, Clyde River, Nunavut*, prepared by Trow Associates Inc., dated November 2008, Project no. OTCD00019055A, that specifically addresses the quarry site operations and existing facilities and takes into consideration issues raised by parties during the review process. This Plan is to be incorporated into the O&M Manual, Part F, Item 1, as an addendum upon approval by the Board in writing.

7. The Licensee shall maintain an undisturbed buffer zone of at least 100 metres between any proposed quarry operation and the normal high water mark of any water body.

8. 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 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.

9. The Licensee shall perform more frequent inspections of the engineered facilities at the request of an Inspector.

10. The Licensee shall ensure that sediment and erosion control measures are implemented prior to and maintained during activities carried out under this Part to prevent the release of sediment and minimize erosion.

PART G: CONDITIONS APPLYING TO ABANDONMENT, RESTORATION AND CLOSURE

1. The Licensee shall submit to the Board for approval, an *Abandonment, Restoration and Closure Plan,* at least six (6) months prior to a) abandoning of any facilities and b) the construction of new facilities to replace existing ones. Where applicable, the Plan shall include information on the following:

   a. solid waste disposal facility;
   b. water intake facilities;
   c. the water treatment and waste disposal sites and facilities;
   d. petroleum and chemical storage areas;
   e. any site affected by waste spills;
   f. leachate prevention;
   g. an implementation schedule;
   h. maps delineating all disturbed areas, and site facilities;
   i. consideration of altered drainage patterns;
   j. type and source of cover materials;
   k. future area use;
   l. hazardous wastes; and
   m. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

2. For site reclamation purposes, the Licensee shall salvage top soil for future restoration of the site to promote re-vegetation.

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.

4. The Licensee shall complete the restoration work within the time schedule specified in the Plan, or as subsequently revised and approved by the Board.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain Monitoring Program Stations and implement the Program as described in Schedule I attached to this Licence and conditions under this Part.

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

3. The Licensee shall sample water quality at Monitoring Program Stations CLY-4, CLY-5, CLY-6a, CLY-6b and CLY-7 a minimum of three (3) times annually, to include once upon commencement, once approximately mid-way through discharge, and once prior to discharge ending. Samples shall be analyzed for the following parameters:

Biochemical Oxygen Demand – BOD_5	Fecal Coliforms
Total Suspended Solids	pH
Conductivity	Nitrate-Nitrite
Oil and Grease (visual)	
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)

4. If the discharge at Station CLY-4 or CLY-5 has been suspended and subsequently restarted with more than a 48 hour lapse, the sampling sequence described in Part H, Item 3 of the Monitoring Program shall be repeated.

5. The Licensee shall measure and record in cubic metres, the monthly and annual quantities of water pumped from Monitoring Program Station CLY-1 for all purposes and effluent pumped or discharged from Monitoring Program Stations CLY-4 and CLY-5.

6. The Licensee shall measure and record the annual quantities of sludge removed from the Sewage Disposal Facility and the Enhanced Sewage Disposal Facility, along with the methods of treatment, storage, and disposal provided.

7. The Licensee shall sample water quality at Monitoring Stations CLY-2 and CLY-13 once at the beginning, middle and near the end of the season during observed flow. Samples shall be analyzed for the parameters listed in Part H Item 3 as well as Total Petroleum Hydrocarbons.

8. The Licensee shall sample and analyze sludge in accordance with the approved Operations and Maintenance Plan referred to in Part F Item (d).

9. The Licensee shall monitor annually in early to mid fall, prior to freezing, for the presence of seepage within standpipes at Monitoring Station(s) CLY-11. If seepage is observed, the licensee shall sample and analyze the seepage for the parameters listed in Part H Item 3.

10. The Licensee shall monitor temperature at Monitoring Station(s) CLY-9 and CLY-10, a minimum of once every two months for the first two years following construction of the Enhanced Sewage Disposal Facility, and twice annually thereafter, in early spring and mid to late fall.

11. The Licensee shall monitor settlement and displacement annually at Monitoring Station(s) CLY-12.

12. The Licensee shall provide the monitoring results for thermistor, standpipe, and settlement stations at Monitoring Stations CLY-9, CLY-10, CLY-11, and CLY-12 semi-annually, due no later than July 31 and January 31 of each year, for the first two years of monitoring. An annual assessment of the geotechnical and geothermal performance of the Enhanced Sewage Disposal Facility shall be provided as an addendum to the Annual Report.

13. The Licensee shall submit to the Board upon approval by an analyst, for inclusion with the O&M Manual, required under Part F, Item 1(f), a Quality Assurance/Quality Control (QA/QC) 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 14 and Part H, Item 15. 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.

14. All sampling, sample preservation and analyses shall be conducted in accordance with methods prescribed in the current edition of *Standard Methods for the Examination of Water and Wastewater*, or as approved by the Board in writing.

15. All analyses shall be performed in a laboratory accredited according to ISO/IEC Standard 17025. The accreditation shall be current and in good standing.

16. 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 Vegetate Filter Strip Wetland Area in the Licensee's annual report, as required *per* Part B, Item 2, or as requested by an Inspector.

17. 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

18. Additional sampling and analysis may be requested by an Inspector.

SCHEDULE I
WATER LICENCE NO. 3BM-CLY0909

Monitoring	Description	Frequency	Status
CLY-1	Raw water supply intake at Water Source Lake	Volume: Monthly and Annually	Active (Volume)
CLY-2	Runoff from the Solid Waste Disposal Facilities	Once at the beginning, middle and near the end of the season during observed flow/seepage	Active (Water Quality)
CLY-3a	Raw sewage at truck offload point (existing cell)	Volume: Monthly and Annually	Not Active (Volume)
CLY-3b	Raw sewage at truck offload point (new cell)	Volume: Monthly and Annually	Not Active - New (Volume)
CLY-4	Effluent discharge from existing Sewage Disposal Facility	Volume: Monthly and Annually Water Quality: Three times annually (as per Part H, Item 3);	Active (Volume and Water Quality)
CLY-5	Effluent discharge from Enhanced Sewage Disposal Facility (Lagoon decanting point)	Same as CLY-4	New (Volume, Water Quality)
CLY-6a	Sampling well at the end of Vegetated Filter Strip Wetland at location shown on drawing CSM-1	Water Quality: Three times annually (as per Part H, Item 3);	New (Water Quality)
CLY-6b	Surface water at the end of the Vegetated Filter Strip Wetland in vicinity of CLY-6a	Water Quality: Three times annually (as per Part H, Item 3);	New (Water Quality)
CLY-7	Water five (5) metres from the point where Effluent enters Patricia Bay	Water Quality: Three times annually (as per Part H, Item 3);	New (Water Quality)
CLY-8	Sewage sludge	To be determined in accordance with Part F Item 2(c) and Part H Items 10 and 15	New (Volume and Quality)

Monitoring	Description	Frequency	Status
CLY-9	All thermistors at locations shown in drawing SP-2 of the Application for Water Licence Amendment (casings to extend 5 m below the base of the berm)	Temperature: Minimum once every two months for the first two years following construction, then twice annually (early spring and mid to late fall) thereafter	New (Temperature)
CLY-10	All single-bead thermistors placed below the liner and into key trench at locations adjacent to those defined in CLY-9	Same as CLY-9	New (Temperature)
CLY-11	All standpipes at locations shown in drawing SP-2 of the Application for Water Licence Amendment	Seepage: Annually early to mid fall Water Quality: When seepage is observed	New (Seepage and Water Quality)
CLY-12	All settlement stations at locations adjacent to thermistors shown in drawing SP-2 of the Application for Water Licence Amendment	Settlement: Annually	New (location, elevation)
CLY-13	Runoff from the quarry site	Once at the beginning, middle and near the end of the season during observed flow	New (Water Quality)

Appendix B – Pump Maintenance and Repair

July 27, 2001
Rev. B 10-03-02

GORMAN-RUPP PUMPS

PRIME-AIRE® SERIES
PA6C Pumps

MANUAL PART 3 of 3

MAINTENANCE AND REPAIR WITH TROUBLESHOOTING

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

www.gormanrupp.com

GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA Printed in U.S.A.

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects or other reproductive harm.

INTRODUCTION

Thank You for purchasing a Gorman-Rupp Prime-Aire® Series priming-assisted pump. **Read this manual** carefully to learn how to safely maintain and service your pump. Failure to do so could result in personal injury or damage to the pump.

A set of three manuals accompanies your pump. The Installation/Operation Manual contains essential information on installing and operating the pump, and on making electrical connections. The Parts List Manual provides performance curve(s), a pump model cross-section drawing, and parts list for your pump.

This Maintenance and Repair Manual provides troubleshooting instructions required to properly diagnose operational problems. Maintenance instructions within this manual are limited to the pump hydraulic and drive components only. For maintenance and repair of the engine or air compressor, consult the separate literature provided by the manufacturers.

This pump is a PA Series®, priming-assisted centrifugal model. The unit is designed for handling non-volatile, non-flammable liquids containing specified entrained solids. For specific service, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

As described on the following page, this manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that **only** safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed **only** after establishing that neither personal safety nor pump integrity are compromised by such practices.

If there are any questions regarding the pump which are not covered in this manual or in other literature accompanying the unit, please contact your Gorman-Rupp distributor or the Gorman-Rupp Company:

The Gorman-Rupp Company
P.O. Box 1217
Mansfield, Ohio 44901-1217
Phone: (419) 755-1011
or:
Gorman-Rupp of Canada Limited
70 Burwell Road
St. Thomas, Ontario N5P 3R7
Phone: (519) 631-2870

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RECORDING MODEL AND SERIAL NUMBERS

Please record the pump model and serial number in the spaces provided below. Your Gorman-Rupp distributor needs this information when you require parts or service.

Pump Model: _____

Serial Number: _____

WARRANTY INFORMATION

The warranty provided with your pump is part of Gorman-Rupp's support program for customers who operate and maintain their equipment as described in this and the other accompanying literature. Please note that should the equipment be abused or modified to change its performance beyond the original factory specifications, the warranty will become void and any claim will be denied.

The following are used to alert personnel to procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel:

DANGER!

Immediate hazards which WILL result in severe personal injury or death. These instructions describe the procedure required and the injury which will result from failure to follow the procedure.

WARNING!

Hazards or unsafe practices which COULD result in severe personal injury or death. These instructions describe the procedure required and the injury which could result from failure to follow the procedure.

CAUTION

Hazards or unsafe practices which COULD result in minor personal injury or product or property damage. These instructions describe the requirements and the possible damage which could result from failure to follow the procedure.

NOTE

Instructions to aid in installation, operation, and maintenance or which clarify a procedure.

SAFETY – SECTION A

The following information applies throughout this manual to Gorman-Rupp Prime Aire® Series pumps.

This manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed instructions and precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that only safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed only after establishing that neither personal safety nor pump integrity are compromised by such practices.

WARNING!

Before attempting to install, operate, or service this pump, familiarize yourself with this manual, and with all other literature shipped with the pump. Unfamiliarity with all aspects of pump operation covered in this manual could lead to destruction of equipment, injury, or death to personnel.

WARNING!

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Shut down the engine and disconnect the positive battery cable (engine driven units) or lock out and tag out incoming power to the control box (electric motor driven units) and take precautions to ensure that the pump will remain inoperative.
3. Allow the pump to completely cool if overheated.
4. Check the temperature before opening any covers, plates, or plugs.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the pump.

WARNING!

This pump is may be used to handle materials which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Attach lifting equipment to the lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

WARNING!

After the pump has been installed, make certain that the pump and all piping or hose connections are tight, properly supported and secure before operation.

WARNING!

Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to completely cool before servicing.

WARNING!

Overheated pumps can cause severe burns and injuries, and produce explosive fumes. If overheating of the pump occurs:

1. **Stop the pump immediately.**
2. **Ventilate the area.**
3. **Allow the pump to completely cool.**
4. **Check the temperature and make sure it is cool before opening any covers, plates, gauges, or plugs.**
5. **Vent the pump slowly and cautiously.**
6. **Refer to instructions in the manuals accompanying the pump before restarting the pump.**

WARNING!

Do not operate the pump without the guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.

CAUTION

Use **only** replacement parts provided or approved by Gorman-Rupp. Use of non-authorized parts may result in damage to the equipment and/or injury to personnel and **will** invalidate the warranty.

CAUTION

Make sure the pump is level. Lower jack stands and chock the wheels, if so equipped. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank.

DANGER!

Do not operate an internal combustion engine in an explosive atmosphere. When operating an internal combustion engine in an enclosed area, make sure exhaust fumes are piped to the outside. These fumes contain carbon monoxide, a deadly gas that is colorless, tasteless and odorless.

WARNING!

Fuel used by internal combustion engines presents an extreme explosion and fire hazard. Make certain that all fuel lines are securely connected and free of leaks. Never refuel a hot or running engine. Avoid overfilling the fuel tank. Always use the correct type of fuel.

WARNING!

Never tamper with the governor on engine driven units to gain more power.

The governor establishes safe operating limits that should not be exceeded. Refer to the pump Performance Curve for the maximum continuous operating speed.

TROUBLESHOOTING – SECTION B

Review all SAFETY information in Section A.

WARNING!

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine and disconnect the positive battery cable (engine driven units) or lock out and tag out incoming power to the control box (electric motor driven units) and take precautions to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure pump is cool before opening any covers, plates, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Discharge check valve contaminated, damaged, or unable to seat.	Clean or replace check valve.
	Air compressor head 180° out.	Consult factory.
	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Eductor safety valve leaking.	Check and replace safety valve.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See **INSTALLATION**.
	Pump speed too slow (engine driven units).	Check driver output; consult driver operation manual.
	Eductor clogged.	Check and clean eductor.
	Air compressor damaged or belts broken.	Check and repair/replace.
	Strainer clogged.	Check strainer and clean if necessary.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE	Eductor clogged.	Check and clean eductor.
	Air leak in suction line.	Correct leak.
	Lining of suction hose collapsed.	Replace suction hose.
	Leaking or worn seal or pump gasket.	Check pump vacuum. Replace leaking or worn seal or gasket.
	Strainer clogged.	Check strainer and clean if necessary.
	Discharge check valve clogged.	Check and clean check vavle.
	Suction intake not submerged at proper level or sump too small.	Check installation and correct submergence as needed.
	Impeller or other wearing parts worn or damaged.	Replace worn or damaged parts. Check that impeller is properly centered and rotates freely.
	Impeller clogged.	Free impeller of debris.
	Discharge head too high.	Install bypass line.
	Suction lift too high.	Measure lift w/vacuum gauge. Reduce lift and/or friction losses in suction line.
	Pump speed too slow (engine driven units).	Check driver output; consult driver operation manual.
	Belt or flexible coupling broken.	Check and replace as necessary.
PUMP REQUIRES TOO MUCH POWER	Pump speed too high (engine driven units).	Check driver output.
	Extreme ambient temperature.	Reduce pump output.
	Discharge head too low.	Adjust discharge valve.
	Fuel filter clogged (engine driven units.	Check & replace often in extreme operating conditions.
	Liquid solution too thick.	Dilute if possible.
	Fuel contaminated (engine driven units.	Check and replace as required.
	Pump or jack shaft bearing(s) frozen.	Disassemble, check and replace bearing(s) as required..
PUMP CLOGS FREQUENTLY	Discharge flow too slow.	Open discharge valve fully to increase flow rate, for engine driven units, run engine at maximum governed speed.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Liquid solution too thick.	Dilute if possible.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
EXCESSIVE NOISE	Cavitation in pump.	Reduce suction lift and/or friction losses in suction line. Record vacuum and pressure gauge readings and consult local representative or factory.
	Pumping entrained air.	Locate and eliminate source of air bubble.
	Pump or drive not securely mounted.	Secure mounting hardware.
	Impeller clogged or damaged.	Clean out debris; replace damaged parts.
BEARINGS RUN TOO HOT	Bearing temperature is high, but within limits.	Check bearing temperature regularly to monitor any increase.
	Low or incorrect lubricant.	Check for proper type and level of lubricant.
	Suction and discharge lines not properly supported.	Check piping installation for proper support.
	Drive misaligned.	Align drive properly.
	Excessive tension on drive belt.	Check belt tension. Adjust as required.

PREVENTIVE MAINTENANCE

Since pump applications are seldom identical, and pump wear is directly affected by such things as the abrasive qualities, pressure and temperature of the liquid being pumped, this section is intended only to provide general recommendations and practices for preventive maintenance. Regardless of the application however, following a routine preventive maintenance schedule will help assure trouble-free performance and long life from your Gorman-Rupp pump. For specific questions concerning your application, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

Record keeping is an essential component of a good preventive maintenance program. Changes in suction and discharge gauge readings (if so equipped) between regularly scheduled inspections can indicate problems that can be corrected before system damage or catastrophic failure occurs. The appearance of wearing parts should also be documented at each inspection for comparison as well. Also, if records indicate that a certain part (such as the seal) fails at approximately the same duty cycle, the part can be checked and replaced before failure occurs, reducing unscheduled down time.

For new applications, a first inspection of wearing parts at 250 hours will give insight into the wear rate for your particular application. Subsequent inspections should be performed at the intervals shown on the chart below. Critical applications should be inspected more frequently.

Preventive Maintenance Schedule

Item	Service Interval*				
	Daily	Weekly	Monthly	Semi-Annually	Annually
General Condition (Temperature, Unusual Noises or Vibrations, Cracks, Leaks, Loose Hardware, Etc.)	I				
Pump Performance (Gauges, Speed, Flow)	I				
Bearing Lubrication		I			R
Seal Lubrication (And Packing Adjustment, If So Equipped)		I			R
V-Belts (If So Equipped)			I		
Air Release Valve Plunger Rod (If So Equipped)			I	C	
Front Impeller Clearance (Wear Plate)				I	
Rear Impeller Clearance (Seal Plate)				I	
Check Valve					I
Pressure Relief Valve (If So Equipped)					C
Pump and Driver Alignment					I
Shaft Deflection					I
Bearings					I
Bearing Housing					I
Piping					I
Driver Lubrication -- See Mfgr's Literature					

Legend:
I = Inspect, Clean, Adjust, Repair or Replace as Necessary
C = Clean
R = Replace

* Service interval based on an intermittent duty cycle equal to approximately 4000 hours annually. Adjust schedule as required for lower or higher duty cycles or extreme operating conditions.

PUMP MAINTENANCE AND REPAIR – SECTION C

Review all SAFETY information in Section A.

Follow the instructions on all tags, label and decals attached to the pump.

WARNING!

Before attempting to install, operate, or service this pump, familiarize yourself with this manual, and with all other literature shipped with the pump. Unfamiliarity with all aspects of operation or maintenance could lead to destruction of equipment, injury or death to personnel.

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. If slings or chains are used to move the pump or components, make sure that the load is balanced; otherwise serious personal injury or death could result. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

The maintenance and repair instructions in this manual are keyed to the sectional views and the corresponding parts identification lists on the following pages. Refer to the separate Parts List Manual for replacement parts.

This Maintenance and Repair Manual provides troubleshooting instructions required to properly diagnose operational problems. Maintenance instructions within this manual are limited to the pump hydraulic, priming and drive components only. The pump assembly may be close-coupled to either a factory-supplied or customer-supplied engine. Maintenance of engines and factory-supplied air compressors are detailed in separate literature provided by the manufacturer(s).

Check **TROUBLESHOOTING**, Section B to determine causes and remedies of pump problems. Disassemble the pump only as far as required.

As described in the **SAFETY** Section, this manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that **only** safe, established shop procedures are used, and that any procedures not addressed in this manual are performed **only** after establishing that neither personal safety nor pump integrity are compromised by such practices.

Select a suitable location, preferably indoors, to perform required maintenance. All work must be performed by qualified personnel.

Lifting

Use lifting equipment with a capacity of **at least five times the weight of the component being lifted**. When lifting the complete unit, the lifting equipment must also be capable of lifting the weight of any options or customer-installed accessories. Suction and discharge hoses or piping **must** be removed before attempting to lift the pump.

For the approximate weight of your pump, refer to the pump specification data sheet or contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

SECTION DRAWING

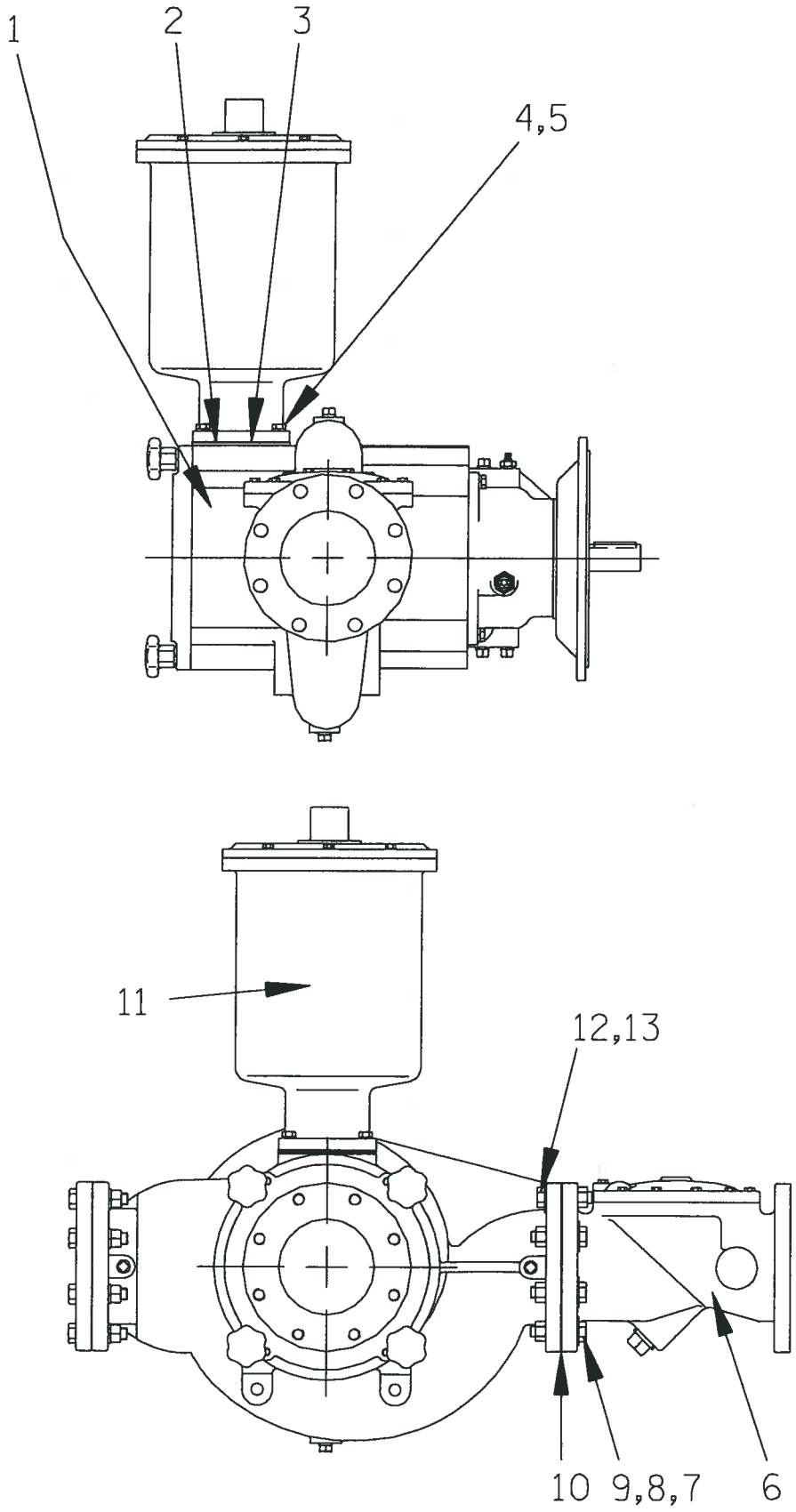

Figure C–1. PA6C60 Pump Model Assembly

PA6C60 Pump Model Assembly
Part Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	PUMP END ASSEMBLY
2	BAFFLE
3	GASKET
4	HEX HEAD CAPSCREW
5	LOCKWASHER
6	CHECK VALVE ASSEMBLY
7	HEX HEAD CAPSCREW
8	LOCKWASHER
9	HEX NUT
10	GASKET
11	PRIMING CHAMBER ASSEMBLY
12	HEX HEAD CAPSCREW
13	HEX NUT

NOTE: Maintenance instructions in this manual are limited to the pump hydraulic, priming and drive components only. Maintenance of engines and factory-supplied air compressors are detailed in separate literature provided by the manufacturer(s).

SECTION DRAWING

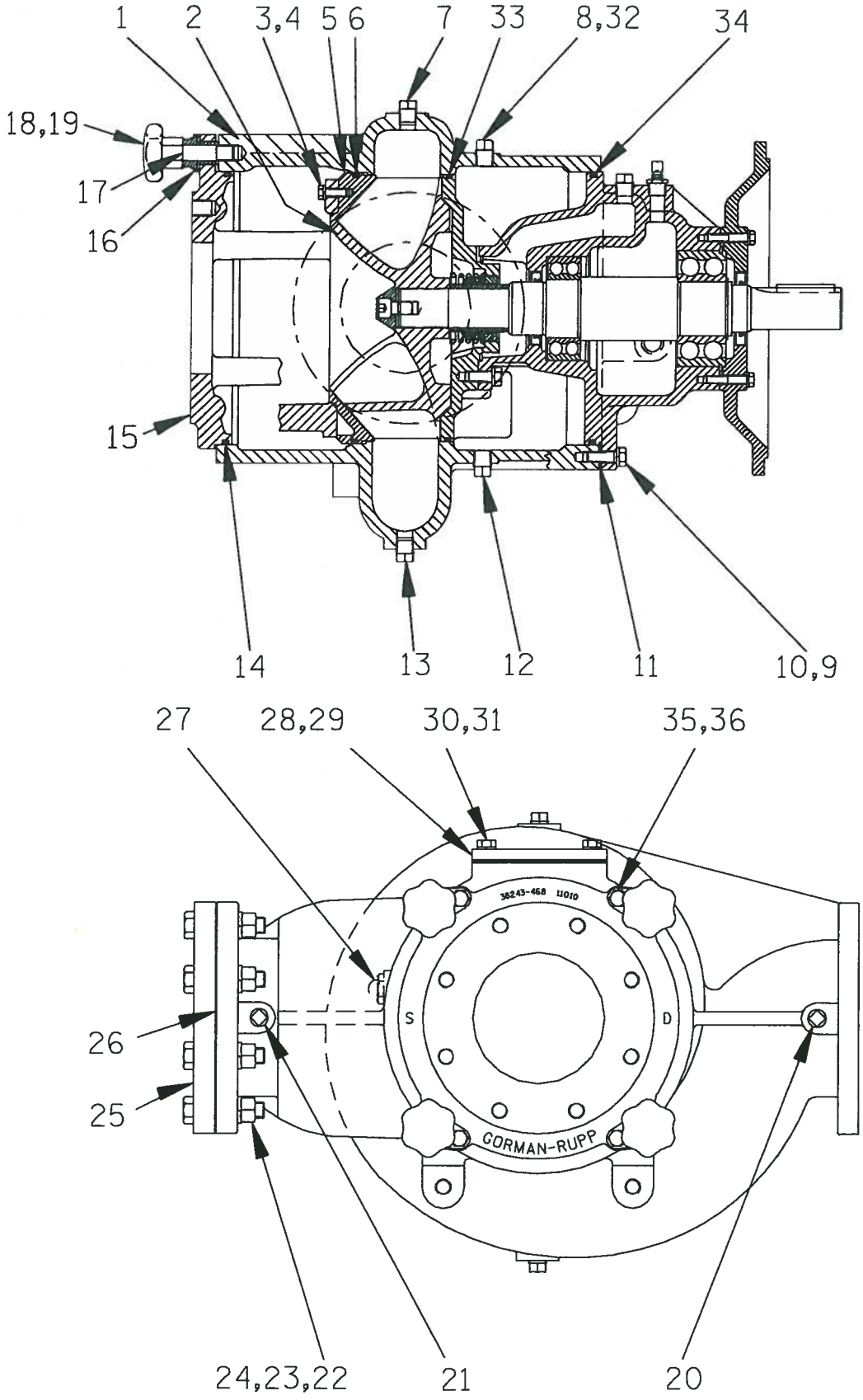

Figure C–2. 66F60 Pump End Assembly

66F60 Pump End Assembly
Part Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	PUMP CASING
2	REPAIR ROTATING ASSEMBLY
3	HEX HEAD CAPSCREW
4	LOCKWASHER
5	WEAR RING
6	WEAR RING O-RING
7	PIPE PLUG
8	VENTED PLUG
9	HEX HEAD CAPSCREW
10	LOCKWASHER
11	ADJUSTING SHIM SET
12	PIPE PLUG
13	CASING DRAIN PLUG
14	BACK COVER PLATE O-RING
15	BACK COVER PLATE
16	ADJUSTING SCREW
17	LOCKING COLLAR
18	STUD
19	HAND KNOB
20	PIPE PLUG
21	PIPE PLUG
22	HEX HEAD CAPSCREW
23	LOCKWASHER
24	HEX NUT
25	BLIND FLANGE ASSEMBLY
26	FLANGE GASKET
27	SIGHT GAUGE
28	COVER PLATE
29	COVER PLATE GASKET
30	HEX HEAD CAPSCREW
31	LOCKWASHER
32	SHIPPING PLUG
33	SEAL PLATE O-RING
34	BEARING HOUSING O-RING
35	HEX HEAD CAPSCREW
36	LOCKWASHER

SECTION DRAWING

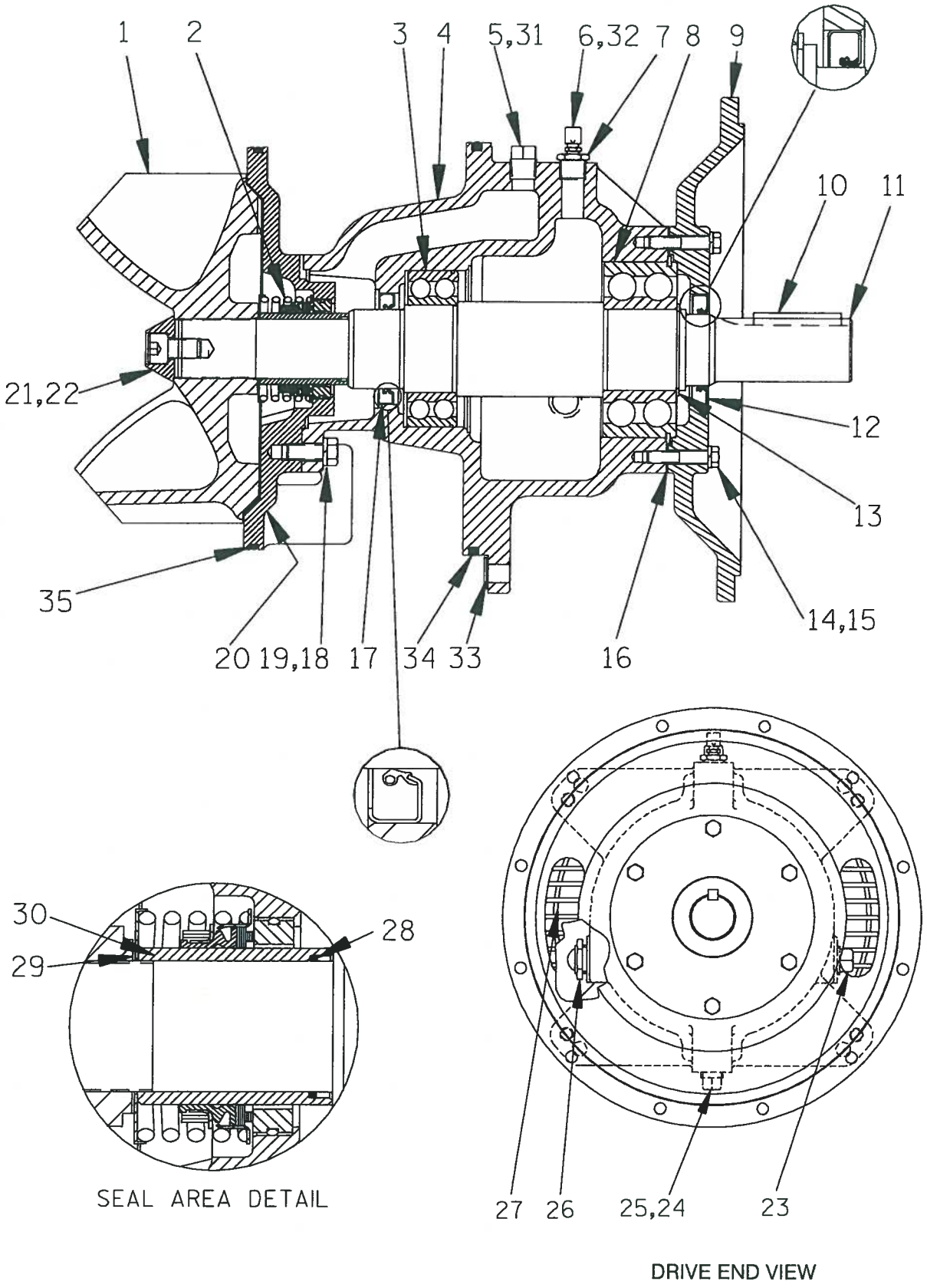

Figure C–3. Repair Rotating Assembly

Repair Rotating Assembly
Part Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	IMPELLER
2	SEAL ASSEMBLY
3	INBOARD BALL BEARING
4	BEARING HOUSING
5	VENTED PLUG
6	AIR VENT
7	RED PIPE BUSHING
8	OUTBOARD BALL BEARING
9	DRIVE FLANGE
10	IMPELLER SHAFT KEY
11	IMPELLER SHAFT
12	OIL SEAL
13	SNAP RING
14	HEX HEAD CAPSCREW
15	LOCKWASHER
16	BEARING HOUSING GASKET
17	OIL SEAL
18	HEX HEAD CAPSCREW
19	LOCKWASHER
20	SEAL PLATE
21	SOCKET HEAD CAPSCREW
22	IMPELLER WASHER
23	PIPE PLUG
24	PIPE PLUG
25	BEARING CAVITY DRAIN PLUG
26	SIGHT GAUGE
27	INTERMEDIATE GUARDS
28	SHAFT SLEEVE O-RING
29	IMPELLER ADJ SHIM SET
30	SHAFT SLEEVE
31	SHIP PLUG
32	SHIP PLUG
33	ADJ SHIM SET
34	BRG HOUSING O-RING
35	SEAL PLATE O-RING

SECTION DRAWING

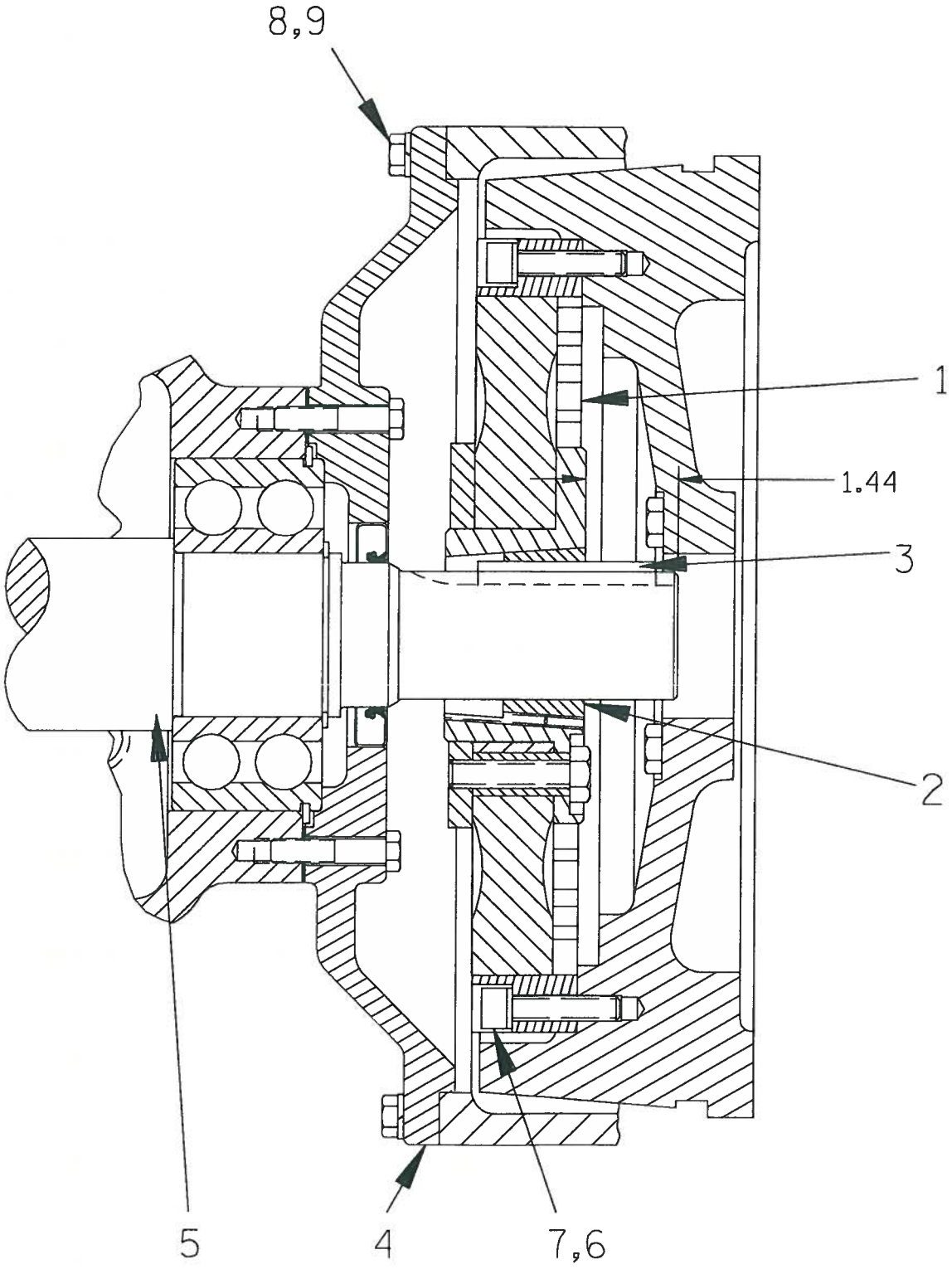

Figure C–4. Drive Assembly (Engine Driven Units)

Drive Assembly (Engine Driven Units)
Part Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	COUPLING ASSEMBLY
2	BUSHING
3	–KEY
4	DRIVE FLANGE (REF)
5	IMPELLER SHAFT (REF)
6	LOCKWASHER
7	SOC HD CAPSCREW
8	HEX HD CAPSCREW
9	LOCKWASHER

SECTION DRAWING

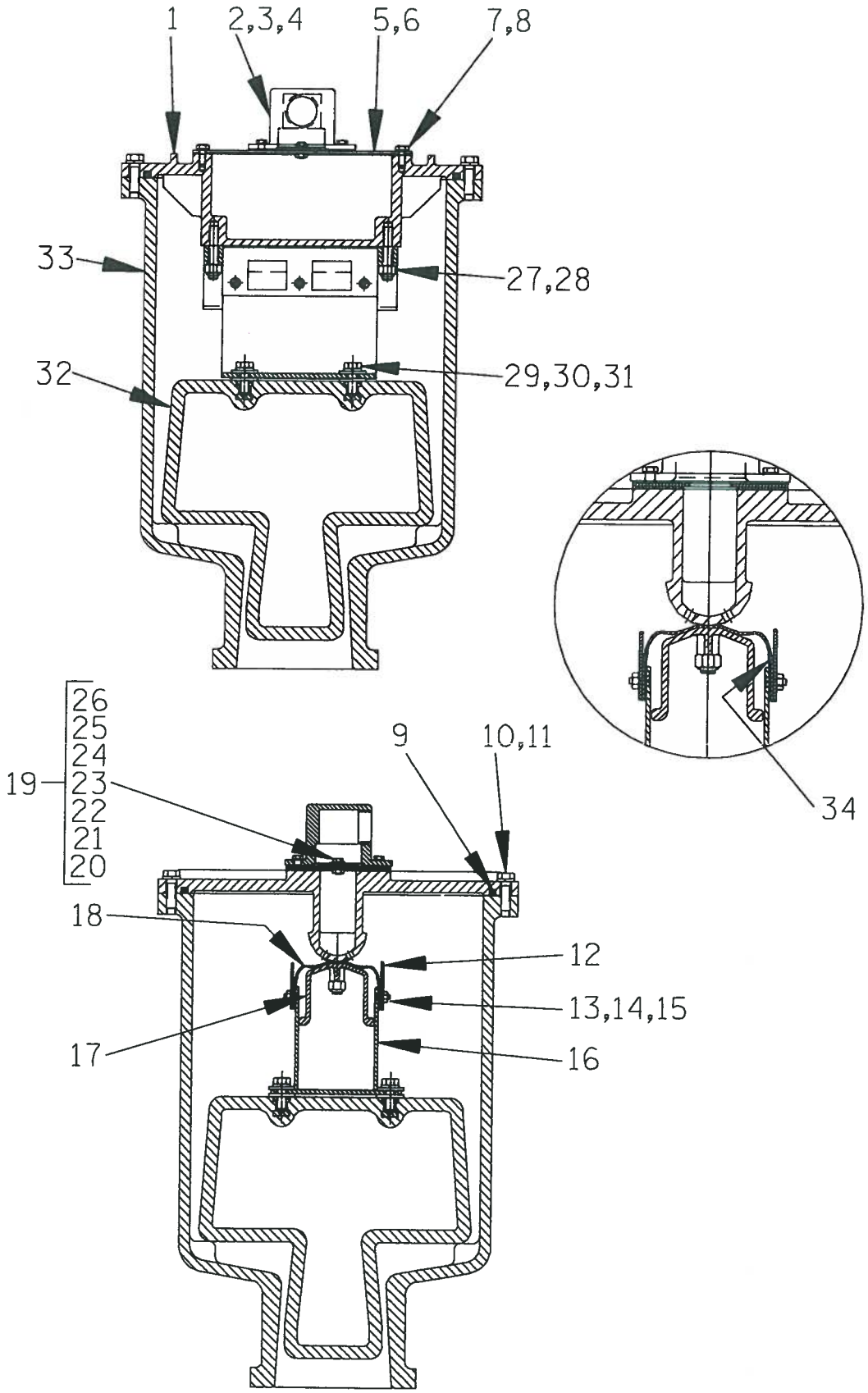

Figure C–5. Peeler Type Priming Valve

Peeler Type Priming Valve
Part Identification List

Refer to the separate Parts List Manual for serviceable parts, part numbers and quantities.

ITEM NO.	PART NAME
1	PRIMING CHAMBER LID
2	PEELER VALVE NECK
3	HEX HEAD CAPSCREW
4	LOCKWASHER
5	VALVE PLATE GASKET
6	VALVE PLATE
7	HEX HEAD CAPSCREW
8	LOCKWASHER
9	LINEAR O-RING
10	HEXHEAD CAPSCREW
11	LOCKWASHER
12	GUIDE PLATE
13	FLAT HEAD CAPSCREW
14	LOCKWASHER
15	HEX NUT
16	VALVE STRAP BRACKET ASSEMBLY
17	CLAMP PLATE
18	VALVE STRAP
19	CHECK VALVE ASSEMBLY
20	–CHECK VALVE
21	–LOCKWASHER
22	–HEX NUT
23	–FLAT WASHER
24	–HEX HEAD CAPSCREW
25	–FLAT WASHER
26	–SEALING WASHER
27	STUD
28	HEX LOCK NUT
29	HEX HEAD CAPSCREW
30	LOCKWASHER
31	FLAT WASHER
32	PRIMING VALVE FLOAT
33	PRIMING CHAMBER
34	VALVE STRAP PROTECTOR

PUMP AND SEAL DISASSEMBLY AND REASSEMBLY

Review all SAFETY information in Section A.

Follow the instructions on all tags, label and decals attached to the pump.

This pump requires little service due to its rugged, minimum-maintenance design. However, if it becomes necessary to inspect or replace the wearing parts, follow these instructions which are keyed to the Sectional Views (see Figures C–1, C–2, C–3, C–4 and C–5) and the corresponding Parts Identification Lists. Maintenance and repair instructions for the engine and air compressor are covered separately in the specific literature supplied by the manufacturers.

For part numbers and quantities for your specific pump, refer to the separate Parts List manual accompanying the pump.

Many pump service functions may be performed without separating the pump end assembly from the power source. However, the following instructions assume complete disassembly of the pump is required.

Before attempting to service the pump, shut down the engine and disconnect the positive battery cable (engine driven units) or lock out and tag out incoming power to the control box (electric motor driven units) take precautions to ensure that the pump will remain inoperative. Close all valves in the suction and discharge lines, allow the pump to completely cool, and drain the pump casing.

WARNING!

This manual will alert personnel to known procedures which require special attention, to those which could damage equipment, and to those which could be dangerous to personnel. However, this manual cannot possibly anticipate and provide detailed instructions and precautions for every situation that might occur during maintenance of the unit. Therefore, it is the responsibility of the owner/maintenance personnel to ensure that only safe, established maintenance procedures are used, and that any procedures not addressed in this manual are performed only after establishing that neither personal safety nor pump integrity are compromised by such practices.

WARNING!

Before attempting to open or service the pump:

1. **Familiarize yourself with this manual.**
2. **Shut down the engine and disconnect the positive battery cable (engine driven units) or lock out and tag out incoming power to the control box (electric motor driven units) and take precautions to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure it is cool before opening any covers, plates, gauges, or plugs.**
5. **Close the suction and discharge valves.**
6. **Vent the pump slowly and cautiously.**
7. **Drain the pump.**

WARNING!

This pump is designed to handle material which could cause illness through direct exposure or emitted fumes. Wear adequate protective clothing when working on the pump or piping.

WARNING!

Use lifting and moving equipment in good repair and with adequate capacity

to prevent injuries to personnel or damage to equipment. The bail is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting. If chains or cables are used to lift pump components, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced.

CAUTION

Use **only** replacement parts provided or approved by Gorman-Rupp. Use of non-authorized parts may result in damage to the equipment and/or injury to personnel and **will** invalidate the warranty.

Priming Chamber Removal And Disassembly

(Figure C-1)

Disconnect both the suction piping and the air discharge tubing from the priming chamber assembly (11). Support the priming chamber assembly using a sling and a suitable lifting device. Remove the hardware (4 and 5) and separate the priming chamber assembly, baffle (2) and gasket (3) from the pump assembly (1).

(Figure C-5)

Remove the hardware (10 and 11) securing the priming chamber lid (1) to the priming chamber (33). Carefully lift the lid and valve components from the priming chamber. If the priming valve float (32) is stuck or the check valve assembly (19) is clogged, they can usually be cleaned without further disassembly.

Inspect the O-ring strip (9) and, if replacement is required, remove the gasket and **all** of the old adhesive.

To remove the float (32), disconnect the hardware (29, 30 and 31).

To replace the valve strap (18), disengage the hardware (13, 14 and 15) and separate the guide plates (12), clamp plate (17) and valve protector (34) from the valve strap. Disengage the hardware (27 and 28) and remove the valve strap.

To remove the check valve assembly (19), disengage the hardware (3 and 4). Remove the peeler valve neck (2) and check valve assembly.

Inspect the check valve components. If the check valve (20) requires replacement, remove the hardware (22, 24 and 25) securing the valve weights (23 and 26) to the check valve.

It is not necessary to remove the valve plate (6) unless the gasket (5) requires replacement. To remove the valve plate, disengage the hardware (7 and 8).

Discharge Check Valve Removal and Disassembly

(Figure C-1)

Support the discharge check valve assembly (6) using a sling and a suitable lifting device. Remove the hardware (7, 8 and 9) securing the discharge check valve assembly and gasket to the pump assembly.

The flapper and gasket are the only serviceable parts of the check valve. If the flapper requires replacement, remove the hardware securing the cover and gasket. Separate the cover and remove the flapper.

Back Cover Plate and Wear Plate Removal

(Figure C-2)

The wear plate (5) is easily accessible and may be serviced by removing the back cover (15). Before attempting to service the pump, remove the pump casing drain plug (13) and drain the pump. Clean and reinstall the drain plug.

Remove the hand knobs (19) and pry the back cover and assembled wear plate from the pump casing (1).

NOTE

An alternate method of removing the back cover from the pump casing is to remove the hand knobs (19) and two diagonally opposing locking collars (17). Use the adjusting screws (16) to press the back cover out of the pump casing.

Remove and discard the O-rings (6 and14).

Inspect the wear plate (5) and, if replacement is required, remove the hardware (3 and 4) securing it to the back cover plate.

Separating Pump End From Power Source

Further disassembly of the pump requires separating the pump end from the power source. Disconnect the discharge piping from the pump casing.

Remove the hardware securing the drive flange (9, Figure 3) to the guard (not shown, motor driven units only) or bellhousing (engine driven units). On electric motor driven units, remove the coupling guard and separate the coupling halves.

Pull the pump end straight away from the power source. Remove the coupling half from the impeller shaft (motor driven units).

(Engine Driven Units, Figure C–4)

As the assemblies separate, the flexible portion of the coupling assembly (1) will remain on the shaft. To remove the coupling from the shaft, unscrew the two allen head setscrews from the bushing (2). Screw one of the setscrews into the puller hole on the circumference of the bushing. As the coupling and bushing separate, remove the bushing, and slide the coupling off the shaft. Remove the shaft key (3).

It is not necessary to remove the outer ring of the coupling from the engine flywheel unless the coupling must be replaced. To remove the ring, disengage the hardware (6 and 7) securing it to the flywheel.

Move the pump end to a clean, well equipped shop area for further disassembly.

Draining Oil From Seal Cavity

(Figure C–2)

If any further disassembly is to be performed on the pump, the seal cavity oil must be drained to prevent the oil in the seal cavity from escaping as the pump casing is removed.

Position a large (3 gallon [11,4 liter] minimum), **clean** container under the seal cavity drain plug (12). Remove the drain plug and drain the oil from the seal cavity into the container. Clean and reinstall the drain plug. Inspect the oil for water, dirt or a cloudy condition which could indicate seal failure.

Loosening Impeller

(Figures C–3 and C–6)

With the pump end separated from the engine, insert a block of wood through the pump discharge and wedge it between the vanes of the impeller and the pump casing to prevent rotation. Remove the impeller capscrew and washer (21 and 22).

Install the shaft key (10) in the shaft keyway. Install a lathe dog on the drive end of the shaft (11) with the "V" notch positioned over the shaft key.

With the impeller rotation still blocked, see Figure C–6 and use a long piece of heavy bar stock to pry against the arm of the lathe dog in a counterclockwise direction (when facing the drive end of the shaft). **Use caution** not to damage the shaft or keyway. When the impeller breaks loose, remove the lathe dog, key and wood block.

NOTE

Do not remove the impeller until the rotating assembly has been removed from the pump casing.

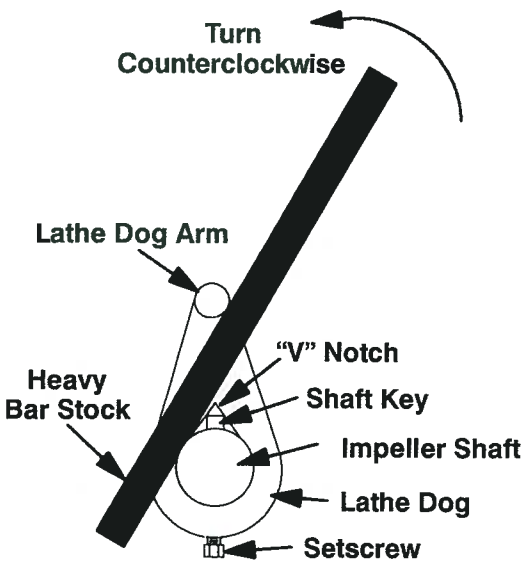

Figure C–6. Loosening Impeller

Pump Casing Removal

(Figure C–2)

Support the pump casing using a suitable hoist and sling, and remove the hardware (9 and 10).

Install four 1/2–13 UNC x 2-inch long jacking screws in the tapped holes in the bearing housing (4, Figure C–3). Tighten the jacking screws in an alternating pattern until the pump casing is pushed off of the bearing housing. Remove the jacking screws.

Impeller Removal

(Figure C–3)

To remove the impeller (1), unscrew it in a counterclockwise direction (when facing the impeller). Use caution when removing the impeller; tension on the shaft seal spring will be released as the impeller is unscrewed. Inspect the impeller and replace it if cracked or badly worn.

Seal Removal

(Figures C–3 and C–7)

Slide the impeller adjusting shims (29) off the impeller shaft (11). Tie and tag the shims or measure and record their thickness for ease of reassembly.

Remove the spring centering washer and seal spring. Slide the shaft sleeve (30) and rotating portion of the seal (consisting of the bellows, retainer, and rotating element) off the shaft as a unit.

Apply oil to the sleeve and work it up under the rubber bellows. Slide the rotating portion of the seal off the sleeve.

Remove the seal sleeve O-ring (28).

Slide a pair of stiff wires with hooked ends along the shaft and hook the stationary seat from the back side. Pull the stationary seat and O-ring from the seal plate.

An alternate method of removing the stationary seal components is to remove the hardware (18 and 19) and separate the seal plate from the bearing housing (4). Position the seal plate on a flat surface with the impeller side down. Use a wooden dowel or other suitable tool to press on the back side of the stationary seat until the seat and O-ring can be removed.

Remove the seal plate O-ring (35).

If no further disassembly is required, refer to **Seal Installation**.

Shaft and Bearing Removal and Disassembly

(Figure C–3)

When the pump is properly operated and maintained, the bearing housing should not require disassembly. Disassemble the shaft and bearings **only** when there is evidence of wear or damage.

CAUTION

Shaft and bearing disassembly in the field is not recommended. These operations should be performed only in a properly-equipped shop by qualified personnel.

Remove the bearing housing drain plug (24) and drain the lubricant. Clean and reinstall the drain plug.

Disengage the hardware (14 and 15) and remove the drive flange (9), gasket (16) and oil seal (12). Use a suitably sized dowel to press the oil seal from the drive flange.

Place a block of wood against the impeller end of the shaft (11) and tap the shaft and assembled bearings from the intermediate. Press the inboard oil seal (17) out of the bearing housing.

Remove the bearing housing O-ring (34).

After removing the shaft and bearings, clean and inspect the bearings **in place** as follows.

CAUTION

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

Clean the bearing housing, shaft and all component parts (except the bearings) with a soft cloth soaked in cleaning solvent. Inspect the parts for wear or damage and replace as necessary.

WARNING!

Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

Clean the bearings thoroughly in **fresh** cleaning solvent. Dry the bearings with filtered compressed air and coat with light oil.

CAUTION

Bearings must be kept free of all dirt and foreign material. Failure to do so will greatly shorten bearing life. **Do not** spin dry bearings. This may scratch the balls or races and cause premature bearing failure.

Rotate the bearings by hand to check for roughness or binding and inspect the bearing balls. If rotation is rough or the bearing balls are discolored, replace the bearings.

The bearing tolerances provide a tight press fit onto the shaft and a snug slip fit into the bearing housing. Replace the bearings, shaft, or bearing housing if the proper bearing fit is not achieved.

If bearing replacement is required, remove the snap ring (13) and use a bearing puller to remove the inboard and outboard bearings (3 and 8) from the shaft.

Shaft and Bearing Reassembly and Installation

(Figure C–3)

Inspect the shaft for distortion, nicks or scratches, or for thread damage on the impeller end. Dress small nicks and burrs with a fine file or emery cloth. Replace the shaft if defective.

Clean and inspect the bearings as indicated in **Shaft And Bearing Removal And Disassembly**.

CAUTION

To prevent damage during removal from the shaft, it is recommended that bearings be cleaned and inspected **in place**. It is **strongly** recommended that the bearings be replaced **any** time the shaft and bearings are removed.

NOTE

*The inboard bearing (3) comes from the manufacturer with a retaining ring installed on the bearing O.D. This retaining ring **must** be removed prior to installation.*

The bearings may be heated to ease installation. An induction heater, hot oil bath, electric oven, or hot plate may be used to heat the bearings. Bearings should **never** be heated with a direct flame or directly on a hot plate.

NOTE

*If a hot oil bath is used to heat the bearings, both the oil and the container must be **absolutely** clean. If the oil has been previously used, it must be **thoroughly** filtered.*

Heat the bearings to a uniform temperature **no higher than** 250°F (120°C), and slide the bearings onto the shaft, one at a time, until they are fully seated. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

After the bearings have been installed and allowed to cool, check to ensure that they have not moved away from the shaft shoulders in shrinking. If movement has occurred, use a suitably sized sleeve and a press to reposition the bearings against the shaft shoulders.

If heating the bearings is not practical, use a suitably sized sleeve, and an arbor (or hydraulic) press to install the bearings on the shaft.

CAUTION

When installing the bearings onto the shaft, **never** press or hit against the outer

race, balls, or ball cage. Press **only** on the inner race.

Secure the outboard bearing (8) to the shaft with the retaining ring (13).

Apply a light coating of oil to the lip of the inboard oil seal (17) and press it into the bearing housing with the lip positioned as shown in Figure C-3. Press the oil seal into the housing until the face is **just flush** with the machined surface on the housing.

Slide the shaft and assembled bearings into the intermediate bore until the inboard bearing is fully seated against the bore shoulder. Use caution not to damage the lip seal on the shaft threads.

CAUTION

When installing the shaft and bearings into the bearing bore, push against the outer race. **Never** hit the balls or ball cage.

Apply a light coating of oil to the lip of the outboard oil seal (12) and press it into the drive flange (9) with the lip positioned as shown in Figure C-3. The face of the oil seal should be just flush with the outer face of the drive flange.

Install the drive flange gasket (16) and secure the drive flange to the bearing housing with the hardware (14 and 15). **Be careful** not to damage the lip of the oil seal (12) on the shaft keyway.

Lubricate a new bearing housing O-ring (34) with grease and install it in the groove in the bearing housing.

Lubricate the bearings as indicated in **LUBRICATION** at the end of this section.

Seal Reassembly and Installation

(Figures C-3 and C-7)

Clean the seal cavity and shaft with a cloth soaked in fresh cleaning solvent.

WARNING!

Most cleaning solvents are toxic and flammable. Use them only in a well ventilated area free from excessive heat, sparks, and flame. Read and follow all precautions printed on solvent containers.

The seal is not normally reused because wear patterns on the finished faces cannot be realigned during reassembly. This could result in premature failure. If necessary to reuse an old seal in an emergency, **carefully** wash all metallic parts in **fresh** cleaning solvent and allow to dry thoroughly.

Handle the seal parts with extreme care to prevent damage. Be careful not to contaminate precision finished faces; even fingerprints on the faces can shorten seal life. If necessary, clean the faces with a non-oil based solvent and a clean, lint-free tissue. Wipe **lightly** in a concentric pattern to avoid scratching the faces.

Inspect the seal components for wear, scoring, grooves, and other damage that might cause leakage. Clean and polish the shaft sleeve, or replace it if there are nicks or cuts on either end. If any components are worn, replace the complete seal; **never mix old and new seal parts.**

If a replacement seal is being used, remove it from the container and inspect the precision finished faces to ensure that they are free of any foreign matter.

To ease installation of the seal, lubricate the O-rings and bellows with water or a very **small** amount of oil, and apply a drop of light lubricating oil on the finished faces. Assemble the seal as follows, (see Figure C-7).

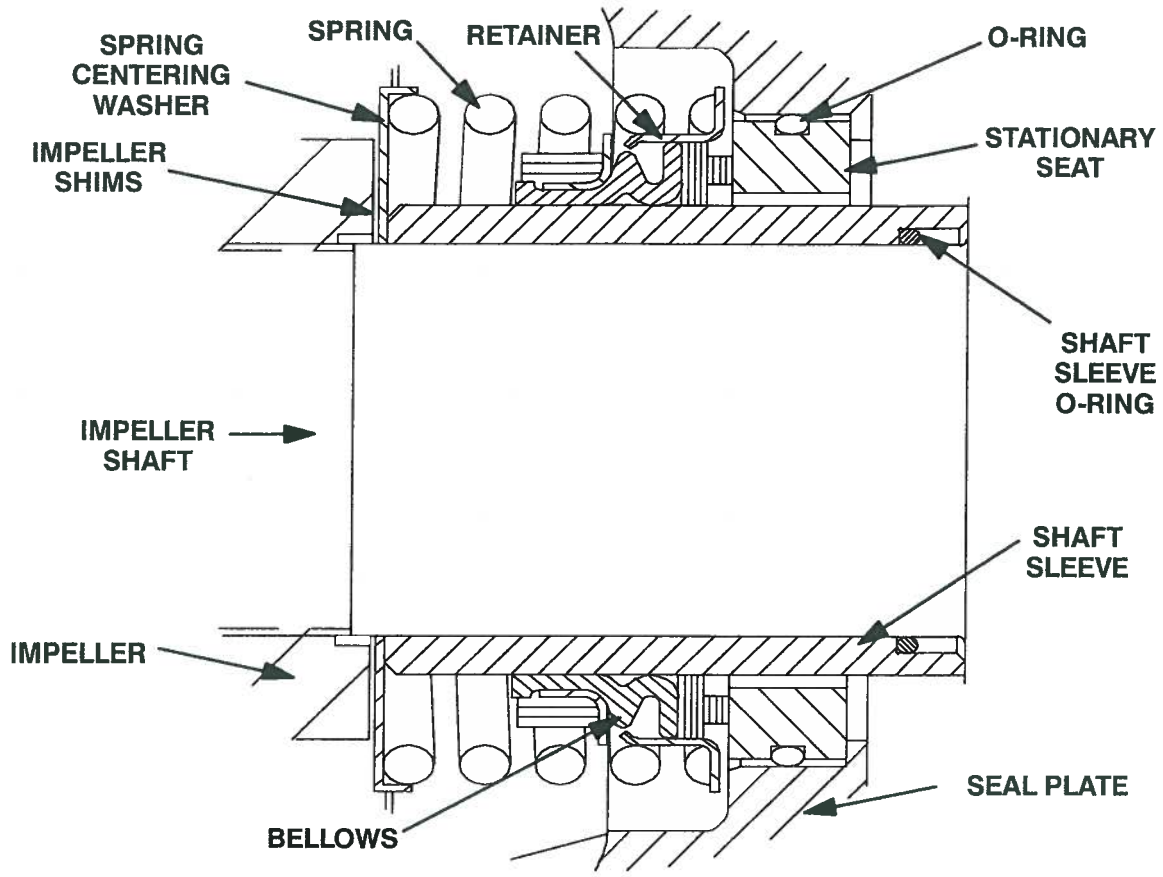

Figure C–7. Seal Assembly

CAUTION

This seal is not designed for operation at temperatures above 160°F (71°C). Do not use at higher operating temperatures.

Lubricate the stationary seat O-ring with water or light oil. Press the stationary seat into the seal plate (20) until fully seated.

Position the seal plate over the shaft and secure it to the bearing housing (4) with the hardware (18 and 19). **Be careful** not to damage the stationary seat on the shaft threads.

Lubricate a new seal plate O-ring (35) with grease and install it in the groove in the seal plate.

Lubricate the shaft sleeve O-ring (28) and position it over the last thread on the impeller shaft. **Use caution** not to cut the O-ring on the threads.

Slide the shaft sleeve (30) onto the shaft until the O-ring is fully seated in the undercut. Continue to press the sleeve onto the shaft until fully seated against the shaft shoulder.

Lubricate the O.D. of the seal sleeve with a **small** amount of light oil. Slide the rotating subassembly (consisting of rotating element, bellows and retainer), onto the sleeve until the seal faces contact.

Install the seal spring and centering washer. Lubricate the seal as indicated in **LUBRICATION** after the impeller is installed.

Impeller Installation And Adjustment

(Figure C–3)

Inspect the impeller (1) and replace it if cracked or badly worn.

CAUTION

The shaft and impeller threads **must** be completely clean before reinstalling the impeller. Even the slightest amount of dirt on the threads can cause the impeller to seize

to the shaft, making future removal difficult or impossible without damage to the impeller or shaft.

Install the same thickness of impeller adjusting shims (29) as previously removed and screw the impeller assembly onto the shaft until tight.

NOTE

*At the slightest sign of binding, **immediately** back the impeller off, and check the threads for dirt. **Do not** try to force the impeller onto the shaft.*

A clearance of .025 to .040 inch (0,64 to 1,02 mm) between the impeller and the seal plate is necessary for maximum pump efficiency. Measure this clearance, and add or remove impeller adjusting shims as required.

Secure the impeller to the shaft with the impeller washer and capscrew (21 and 22).

Pump Casing Installation

(Figure C–2)

Lubricate the rotating assembly O-rings (34 and 35, Figure C–3) with a light coating of grease. Use a suitable hoist and sling to slide the pump casing (1) over the rotating assembly.

Install 0.120 inch (3 mm) of shims (11) at each mounting location and secure the casing to the rotating assembly (2) with the hardware (9 and 10).

Drive Assembly Installation (Engine Driven Units Only)

(Figure C–4)

Install the shaft key in the shaft keyway. Position the flexible portion of the coupling assembly (1) on the shaft as shown in Figure C–4.

NOTE

*The flexible portion of the coupling must be properly positioned on the shaft. The heads of the capscrews in the center of the coupling **must be positioned away from the pump end of the shaft.***

Align the keyway in the bushing (2) with the shaft key, and slide it onto the shaft to the dimension shown in Figure C–4. Rotate the flexible portion of the coupling until the tapped holes for the two setscrews align with those in the bushing, and install the setscrews.

CAUTION

Make certain that the flexible portion of the coupling is mounted as shown in Figure C–4. **This is critical.** If the coupling is not properly positioned on the shaft, the coupling parts may not fully engage, or a pre-load condition can cause premature bearing failure.

The coupling must be positioned 1.44 inches (37 mm) from the end of the shaft. This will allow the two portions of the coupling to fully engage when the drive flange is secured to the engine bellhousing, without pre-loading the bearings.

With the flexible portion of the coupling and the bushing properly positioned on the shaft, tighten the two setscrews in an alternating sequence until the bushing and coupling are fully secured. Torque the setscrews to 14.6 ft. lbs. (175 in. lbs. or 2 m. kg.).

If the complete coupling assembly is being replaced, apply 'Loctite Retaining Compound No. 242' or equivalent to the threads of the hardware (6 and 7), and secure the outer ring of the coupling to the engine flywheel by torquing the hardware to 45 ft. lbs. (540 in. lbs. or 6,2 m. kg.).

Securing Pump End to Power Source

(Engine Driven Units Only, Figure C–4)

Using a suitable lifting device, position the pump end assembly and coupling so the flexible portion of the coupling seats inside the outer ring attached to the engine flywheel.

NOTE

*To ease installation, **lightly** lubricate the rubber portion of the coupling with a **non-petroleum based lubricant** such as vegetable oil or glycerin, or a silicon-based lubricant such as "WD40" or equivalent. **Do not** use petroleum-based lubricants, or any oth-*

er substance which may soften or otherwise damage the rubber.

If removed, install the guards (27, Figure C-3), and secure the drive flange to the engine bellhousing with the previously removed hardware (8 and 9).

(Electric Motor Driven Units Only, Not Shown)

Install the coupling half on the impeller shaft. Using a suitable lifting device, position the pump end assembly on the base. Align the coupling halves and reinstall the attaching hardware. Install the coupling guard and secure the drive flange to the guard with the previously removed hardware.

Wear Plate And Back Cover Plate Installation And Adjustment

(Figures C-2 and C-6)

If the wear plate (5) was removed for replacement, carefully center it on the back cover (15) and secure it with the hardware (3 and 4).

Lubricate the O-rings (6 and 14) with light grease and install them in the grooves in the wear plate and back cover.

Clearance between the impeller and wear plate is adjusted using four hand knobs (19) and locking collars (17). There are 18 detents on the I.D. of each locking collar. Indexing the collars one detent on the adjusting screws represents approximately .005 inch (0,13 mm) of wear plate clearance. The recommended clearance between the wear plate and the impeller is .010 to .020 inch (0,25 to 0,50 mm).

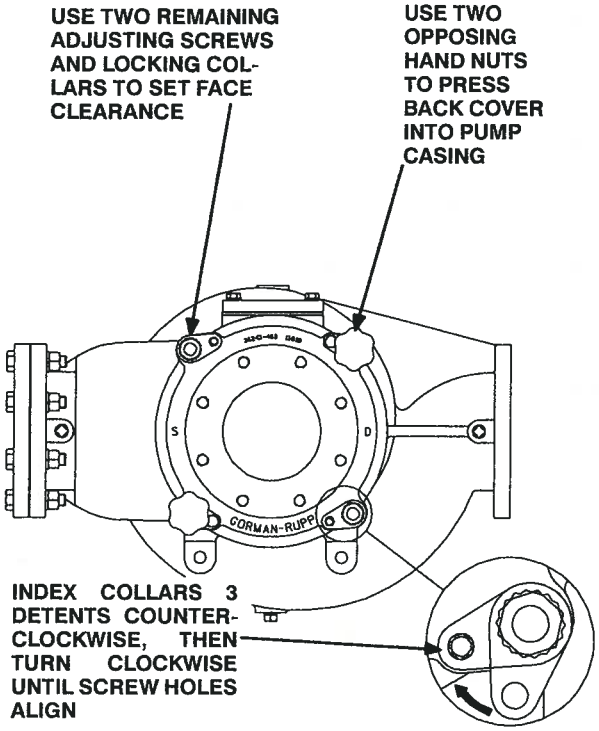

Figure C-6. Installing and Adjusting Back Cover

Screw the four adjusting screws (16) into the tapped holes in the back cover plate until they are **just flush** with the machined surface on the back side of the cover plate.

Align the back cover plate over the studs (18) and slide it into the pump casing. Use two hand knobs (19) on diagonally opposing studs to press the back cover into the pump casing until the wear plate **just touches** the impeller when the shaft is turned by hand. **Tighten the hand knobs evenly to avoid binding.**

With the wear plate just touching the impeller, turn the two free adjusting screws until they engage the pump casing. Position the locking collars over the adjusting screws so the holes in the collars for the locking screws align approximately with the holes in the cover plate.

Loosen the hand knobs used to press the back cover into the pump casing one full turn.

Pull the collars off the adjusting screws, index them three detents counterclockwise, and reinstall the collars on the adjusting screws. Use the collars to turn the adjusting screws clockwise until the holes in the locking collars realign with the tapped screw holes in the back cover plate. Secure the locking

collars to the back cover plate with the hardware (35 and 36). Install the two remaining hand knobs snugly against the adjusting screws.

Remove the first two hand knobs from their studs. Turn the adjusting screws clockwise until they engage the pump casing. Install the locking collars and hardware (35 and 36). Reinstall the hand knobs.

Be sure the wear plate does not scrape against the impeller.

Over time it may be necessary to repeat the adjustment process to compensate for normal wear between the impeller and wear plate. When all of the adjustment has been used on the back cover side of the pump, an additional 0.125 inch (3,2 mm) of adjustment may be obtained by removing the rotating assembly adjusting shims (11).

Allow an installed pump to completely cool before draining liquid from the pump casing. Disengage the hardware (9 and 10), remove the rotating assembly adjusting shims, then reinstall the hardware securing the rotating assembly to the pump casing. Reach through the suction opening and measure the clearance between the wear ring and impeller. Perform the back cover adjustment procedure described above to obtain the proper face clearance.

Priming Chamber Assembly And Installation

(Figure C–5)

Assemble the valve strap (18), guide plates (12), and protectors (33), and **loosely** attach them to the bracket assembly (16) with the hardware (13, 14 and 15). The smooth side of the valve strap **must** be positioned **away from** the bracket assembly.

Position the priming chamber lid (1) upside down on a flat work surface. Install the preassembled valve strap and bracket over the studs (27). Allow the valve strap to fully wrap over the peeler valve to ensure a proper seal without any wrinkles in the strap, and fully tighten the hardware (13, 14, and 15).

Position the clamp plate (17) over the studs (27). Apply "Loctite Threadlocker No. 242" or equivalent compound to the studs, and secure with the lock nuts (28).

Lay the lid and preassembled valve strap components on its side. Apply "Loctite Threadlocker No. 242" or equivalent compound to the capscrews (29) and secure the bracket assembly (16) to the float (32) with the hardware (29, 30 and 31).

Apply 3-M Scotchgrip Adhesive No. 847" or equivalent compound to the linear O-ring (9) and install the O-ring in the groove in the priming chamber lid (1).

NOTE

Cut the lap joint where the two ends of the O-ring (9) meet at a 45° angle.

Carefully lower the assembled lid and float into the valve body (33). Secure the lid to the body with the hardware (10 and 11).

If removed, install the gasket (5) and secure the valve plate (6) to the lid with the hardware (7 and 8).

If the check valve (19) was disassembled for replacement, install the sealing washer (26) against the head of the capscrew (25). Install the large valve weight (25) against the sealing washer. Install the check valve (20) and small valve weight (23), and secure the assembly with the lockwasher and hex nut (21 and 22).

Position the check valve assembly over the holes in the valve plate (5) with the large weight (25) facing up. Position the valve neck (2) over the check valve assembly and secure with the hardware (3 and 4).

(Figure C–1)

Install the gasket (3) and use a sling and suitable lifting device to position the priming chamber assembly against the baffle plate (2) and cover plate (28, Figure C–2). Secure the priming chamber assembly with the hardware (4 and 5).

Reconnect both the suction piping and the air discharge tubing to the priming chamber assembly.

Discharge Check Valve Assembly And Installation

(Figure C-1)

The flapper and gasket are the only serviceable parts of the check valve (6). If the flapper requires replacement, remove the hardware securing the cover and gasket. Separate the valve cap and replace the flapper.

Install the valve cap gasket and secure the cap with the previously removed hardware.

Install the discharge check valve assembly in the discharge piping with the hardware (7, 8 and 9).

Wear Ring Adjustment

(Figure C-2)

Pump performance is adversely affected by increased clearance between the wear ring (5) and the impeller. When it becomes necessary to adjust the clearance, loosen the hand knobs (19) and pry the back cover approximately 1/8 inch (3,2 mm) out of the pump casing.

Disengage the hardware (9 and 10), remove the shims (11) and reinstall the hardware (9 and 10).

Reach through the suction opening and measure the clearance between the wear ring and impeller. Adjust the wear ring-to-impeller clearance as previously described in **Wear Plate And Back Cover Plate Installation And Adjustment**.

LUBRICATION

Seal Assembly

(Figure C-2)

Fill the seal cavity through the hole for the vented plug (8) with SAE No. 30 non-detergent oil. Check the oil level regularly at the sight gauge (27) and refill as required. When lubricating a dry seal cavity, add approximately approximately 8 U.S. quarts (7,6 liters) of oil to the center of the sight gauge.

NOTE

The white reflector in the sight gauge must be positioned horizontally to provide proper drainage.

Bearings

(Figure C-3)

The bearing housing was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (26) and maintain it at the midpoint of the gauge. When lubrication is required, remove the air vent (6) and add SAE No. 30 non-detergent oil through the opening. When lubricating a dry (overhauled) bearing housing, fill the bearing cavity with approximately 40 ounces (1,2 liters) of oil. Clean and reinstall the air vent. **Do not** over-lubricate. Over-lubrication can cause the bearings to over-heat, resulting in premature bearing failure.

NOTE

The white reflector in the sight gauge must be positioned horizontally to provide proper drainage.

Under normal conditions, drain the bearing housing once each year and refill with clean oil. Change the oil more frequently if the pump is operated continuously or installed in an environment with rapid temperature change.

CAUTION

Monitor the condition of the bearing lubricant regularly for evidence of rust or moisture condensation. This is especially important in areas where variable hot and cold temperatures are common.

For cold weather operation, consult the factory or a lubricant supplier for the recommended grade of oil.

Power Unit

Consult the literature supplied with the power unit, or contact your local power unit representative.

For U.S. and International Warranty Information,
Please Visit www.grpumps.com/warranty
or call:
U.S.: 419—755—1280
International: +1—419—755—1352

For Canadian Warranty Information,
Please Visit www.grcanada.com/warranty
or call:
519—631—2870

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

Appendix C – Spill Contingency Plan

Spill Response Plan
Wastewater Treatment Site

Clyde River, Nunavut

Prepared For:

Hamlet of Clyde River
Nunavut
X0A 0E0

Trow Associates Inc.
P.O. Box 6, Iqaluit, NU X0A 0H0
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Project No: OTT-00019055-A0
Report date: December 2010

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NT-NU Spill Report Form

1.0 Introduction

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 Clyde River (Hamlet)'s 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 Trow for additional information or clarification.

2.0 Site Description

The wastewater treatment site (sewage lagoons) in the vicinity of the Hamlet, for which this SRP was developed, is shown on Figure 1 (below). The sewage treatment facility comprises of the existing (upper) sewage lagoon and a newly constructed (lower) sewage lagoon.

Figure 1: Location of the Wastewater Treatment Site, Clyde River, 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 immanent 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

Item	TDGA[2] Class	Contaminant	Amount Spilled
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. At least one spill kit should be clearly identified and readily available during any maintenance work undertaken at the wastewater treatment facility.

8.4. Hamlet Spill Kit Availability

The number of spill kits available throughout the Hamlet and their storage locations should be determined during the preparation of an overall Spill Contingency Plan for the Hamlet. As indicated in Section 8.3 (above), at least one spill kit should be readily available during maintenance activities at the wastewater treatment facility.

8.5. 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.

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 Clyde River	On-site Supervisor	(867) 924-6220
Clyde River Health Centre	Medical Emergency	(867) 924-6377
Fire	Fire, Accident or Rescue	(867) 979-4422
RCMP (Clyde River)	Security, Vandalism	(867) 924 -1111

10.0 Closure

This Spill Response Plan has been prepared for the Hamlet of Clyde River'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.

Yours truly,

Trow Associates Inc.

Robert Renaud, M.Sc.
Environmental Scientist
Earth and Environment

Steven Burden, P.Eng.
Manager
Infrastructure - Municipal

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 D – Geothermal Modeling

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 E – 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.

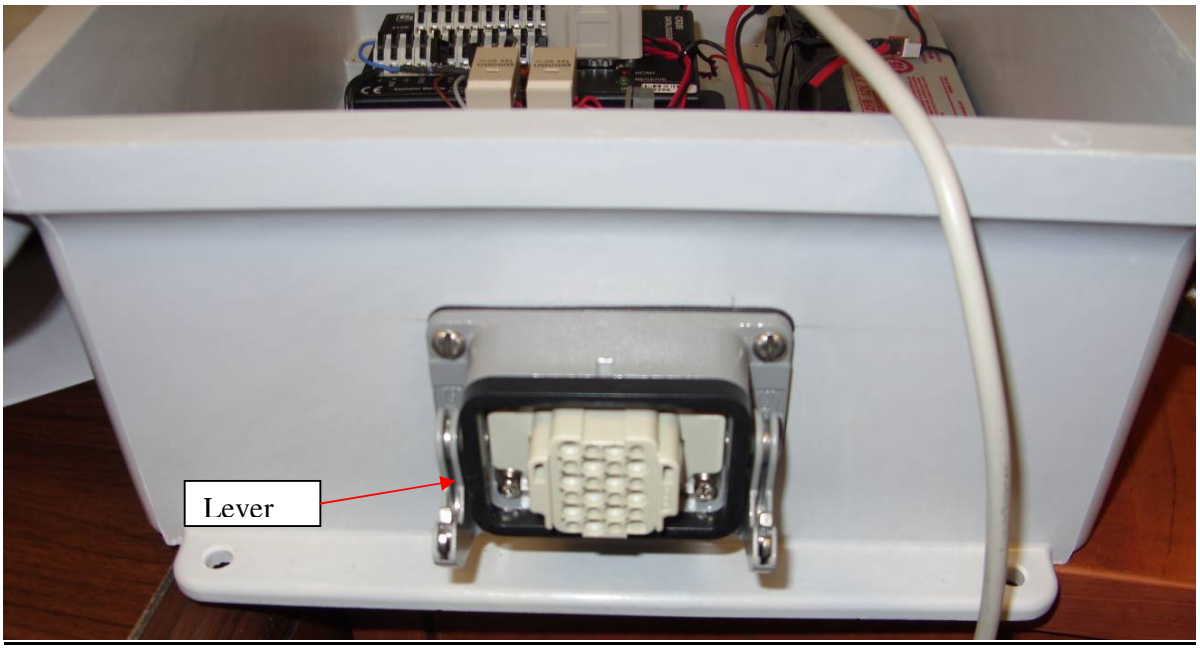
2.2 Software Installation

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.

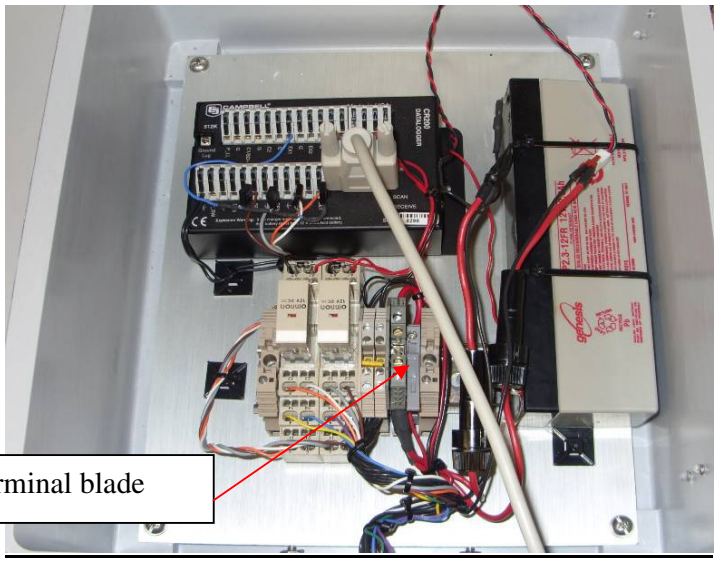
When the installation is done, a LoggerNet icon will be placed on your desktop.

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



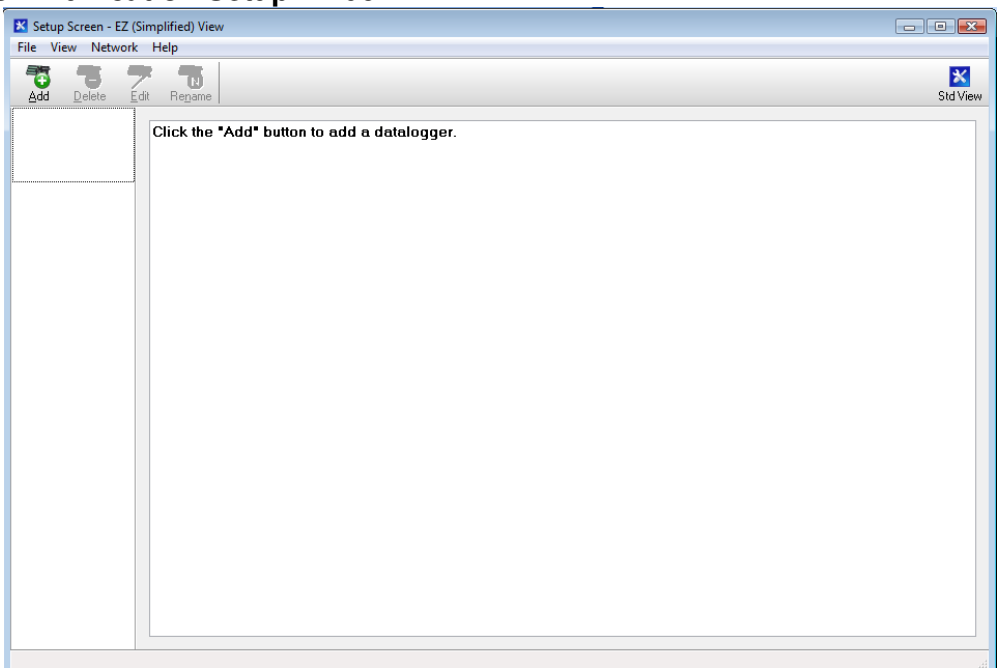
The terminal blade is used to turn the power OFF. Lower the blade to turn the unit ON. Make sure to raise the blade at the end of the test to avoid any battery drainage.

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

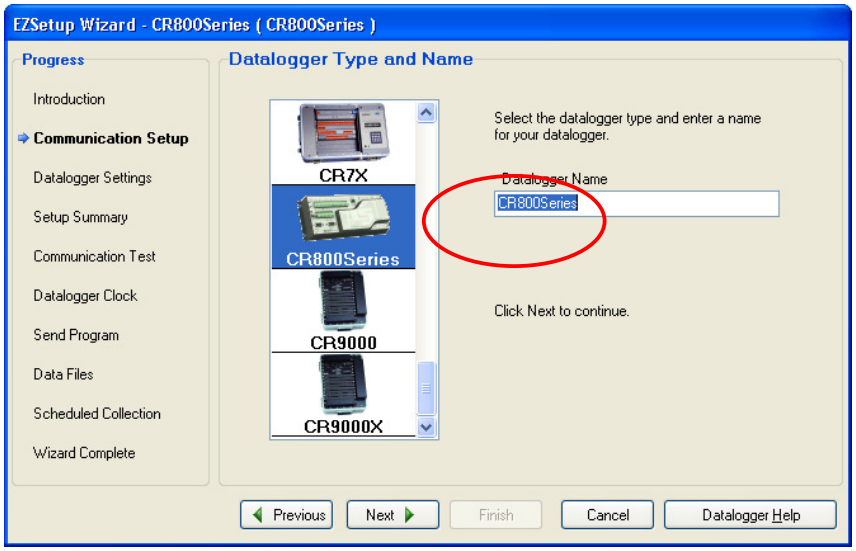
To start the LoggerNet, double click on the LoggerNet desktop icon.

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

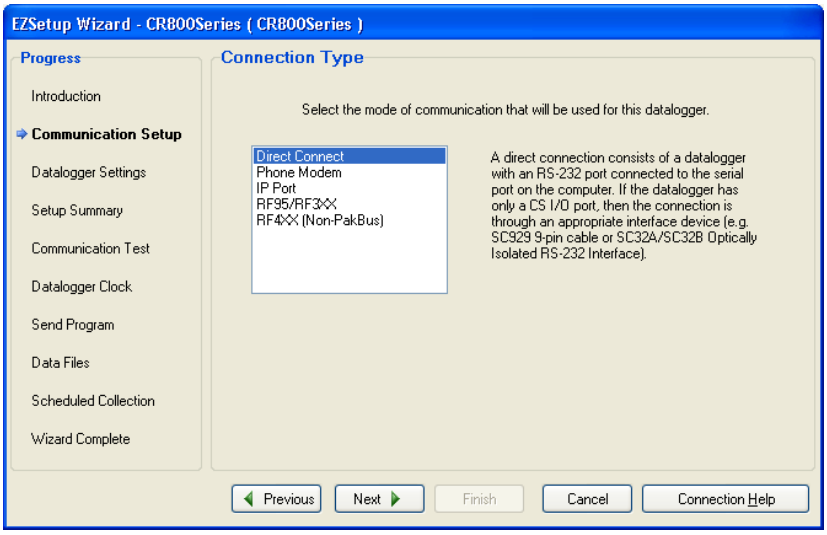


- Wait at least 15 seconds after powering up the unit before attempting to communicate with it.

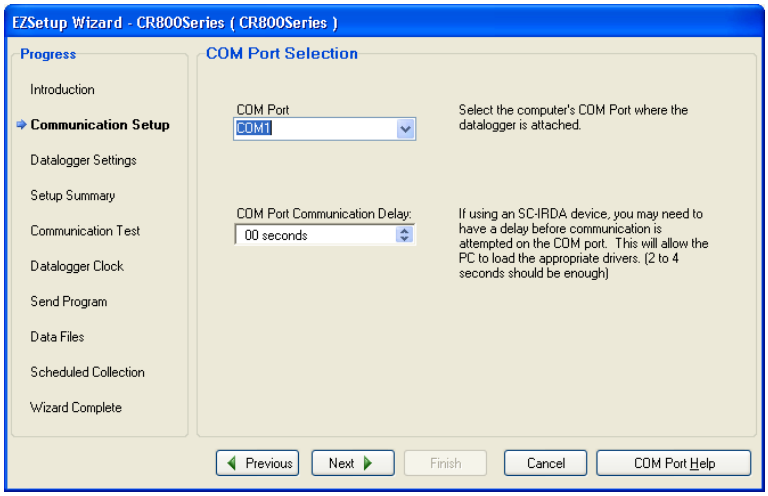
- Under **Datalogger Type and Name**, select **CR200 Series,** and next under **Datalogger Name**, choose a name that best represents your application. For example, type ***Thermistor*** and click **Next**. This datalogger name will be used later to connect to the Thermistor datalogger.



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

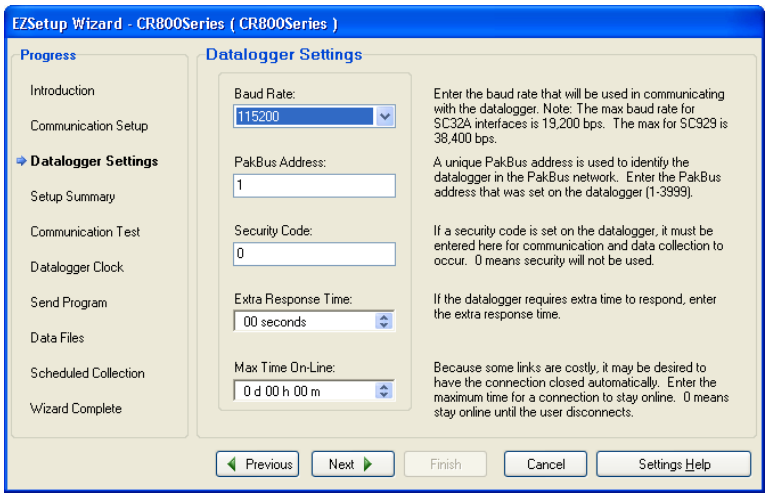


- Select the appropriate **COM port** on your computer. Usually, if you have a serial port on your computer, **COM 1** will be available. However, if you use a USB Serial adaptor, a virtual port will be created and a new COM port number will be assigned. Click **Next** when done.

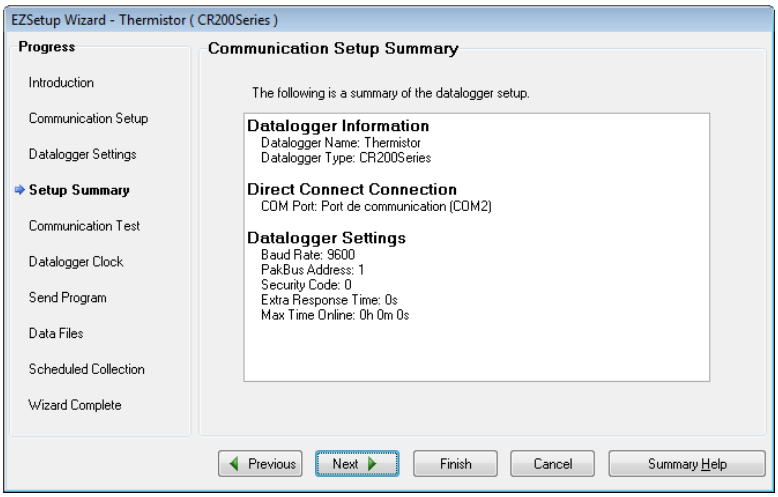


- Use the default parameters and click **Next**.

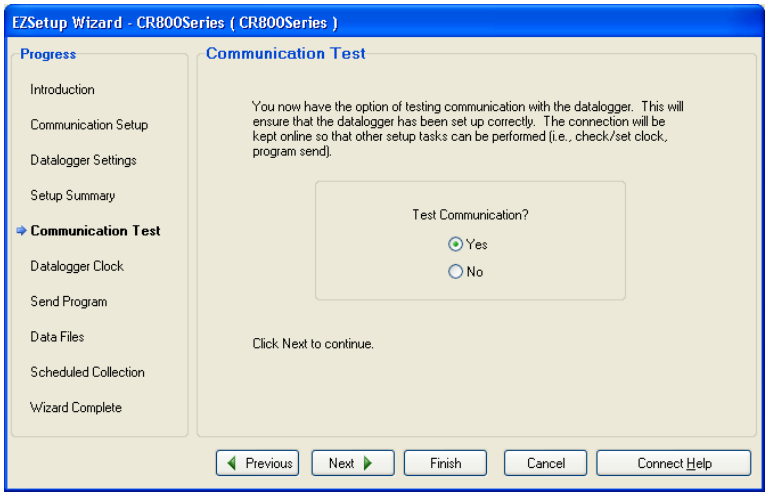
Note: If you use a USB Serial adapter you may need to lower the Baud Rate, in general **9600** works fine with the adapter.



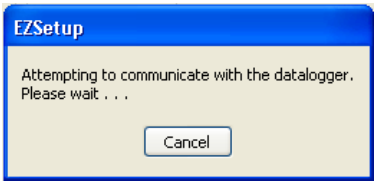
- The following window displays the Communication Setup Summary. Click **Next**.



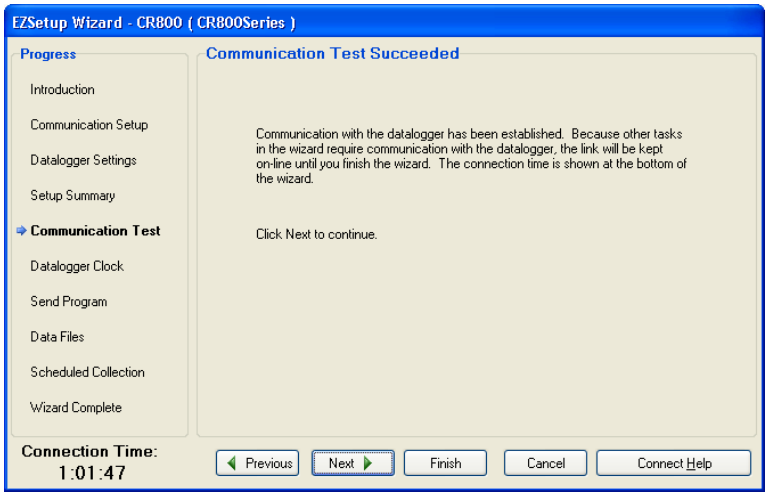
- To test the communication, select **Yes** and click **Next**.



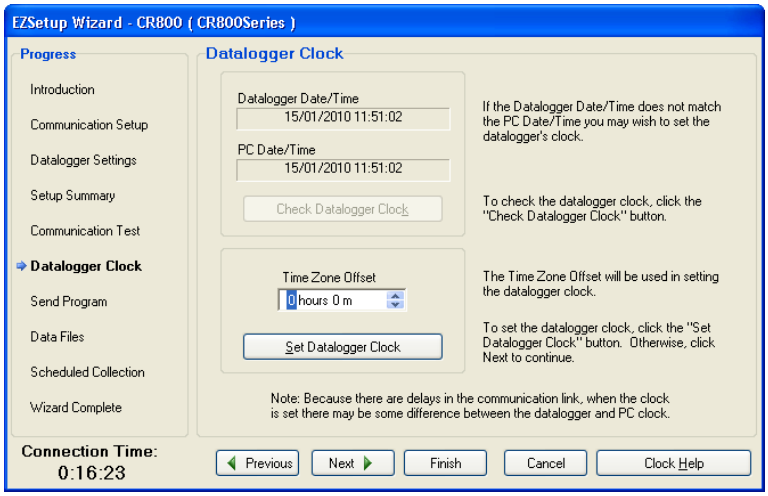
The following message will appear on the screen while your computer is attempting to communicate with the Thermistor datalogger.



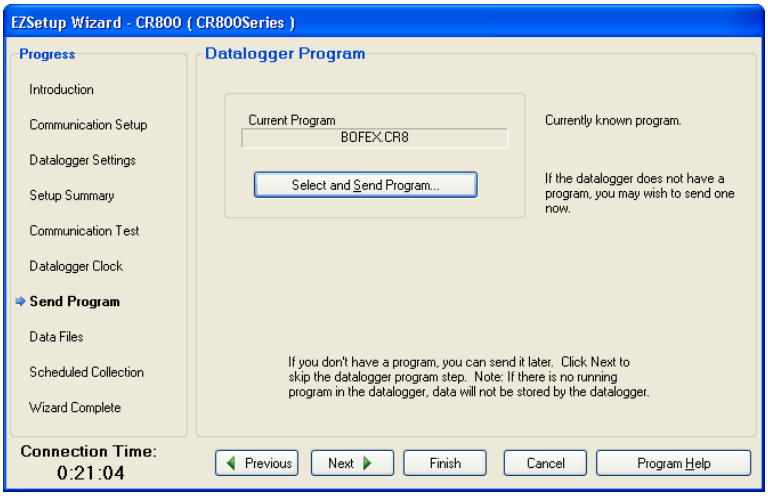
- The next windows will indicate if communication is successful. Click **Next**.



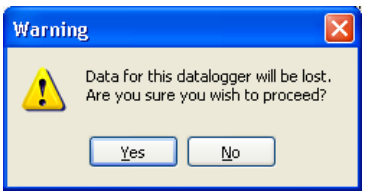
- Adjust the clock to set it at your local time zone. Make sure your computer is adjusted to your local time, then click **Set Datalogger Clock**. When done, click **Next**.



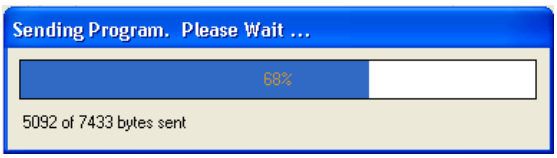
- The datalogger is usually shipped with the Application Program pre-loaded in the datalogger. The program will be displayed under **Current Program**. If it shows **no program** or if the program name shown is not for your application, you will need to upload your Application Program in the datalogger. 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**.

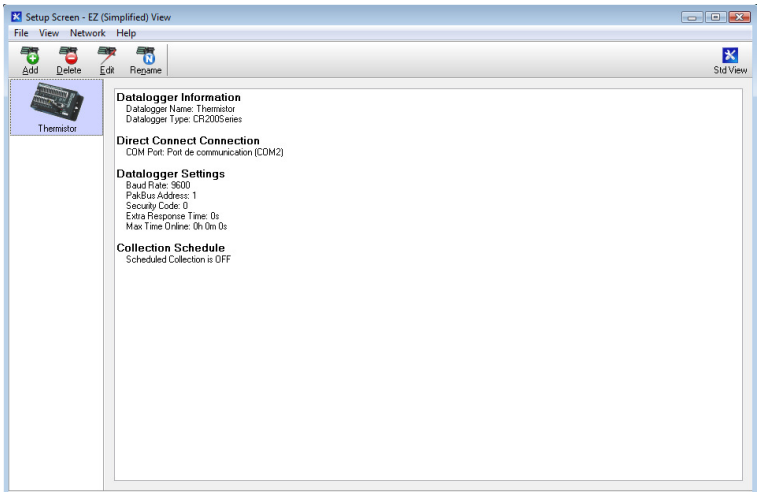


- A progress bar will display the download progress. If successful, a message will indicate it.



- 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.**

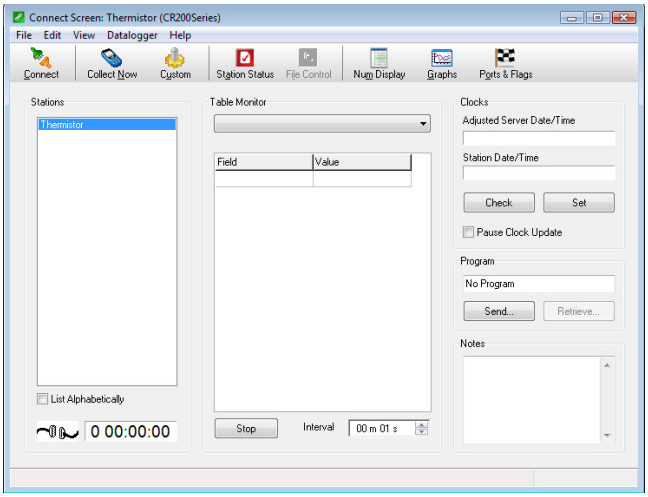


6.0 Monitoring Data With a Computer

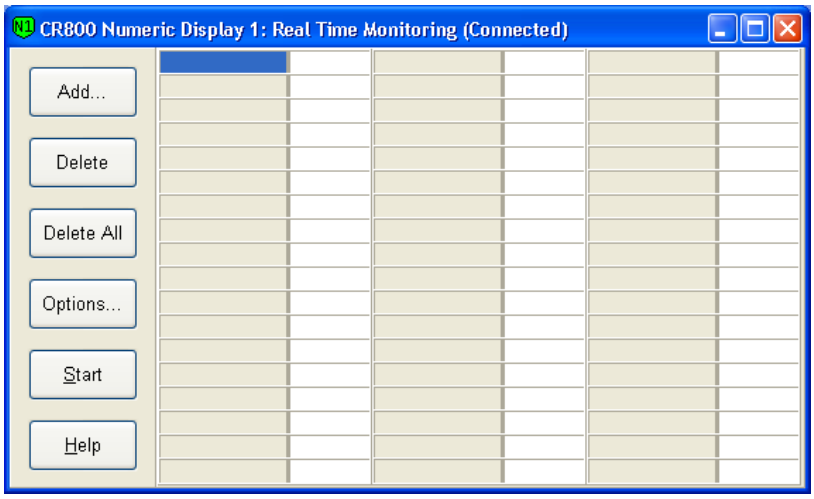
- Connect the supplied Serial Cable between the RS232 Input on the CR200 datalogger and your computer's serial port or USB Serial Adapter.

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

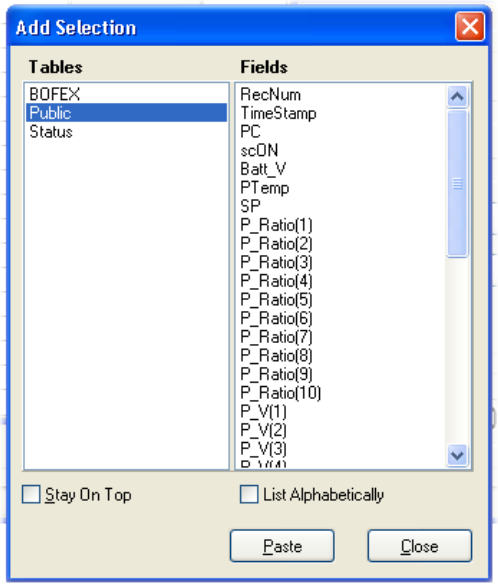
- From the **MAIN/CONNECT**, click on the station **Thermistor**, then **Connect**



- 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.

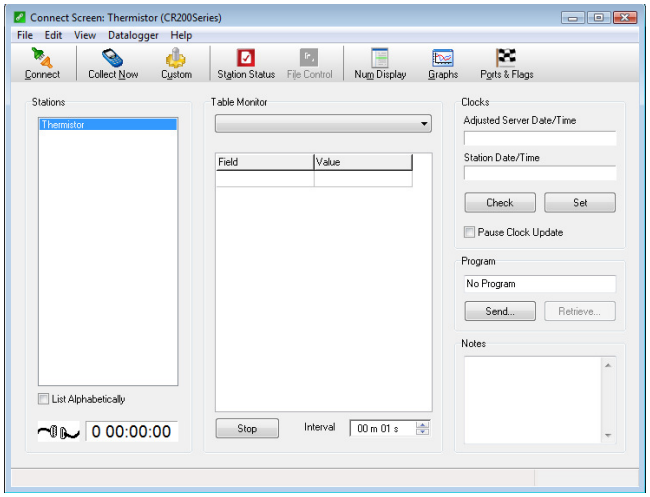


- Under **Fields**, select (highlight) the sensors (labels) you wish to view during the Test. You can use a combination of Shift & Ctrl keys on the computer's keyboard to select multiple labels. Next, on the **Display 1** window, highlight the location where you want to place the labels and finally, 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.

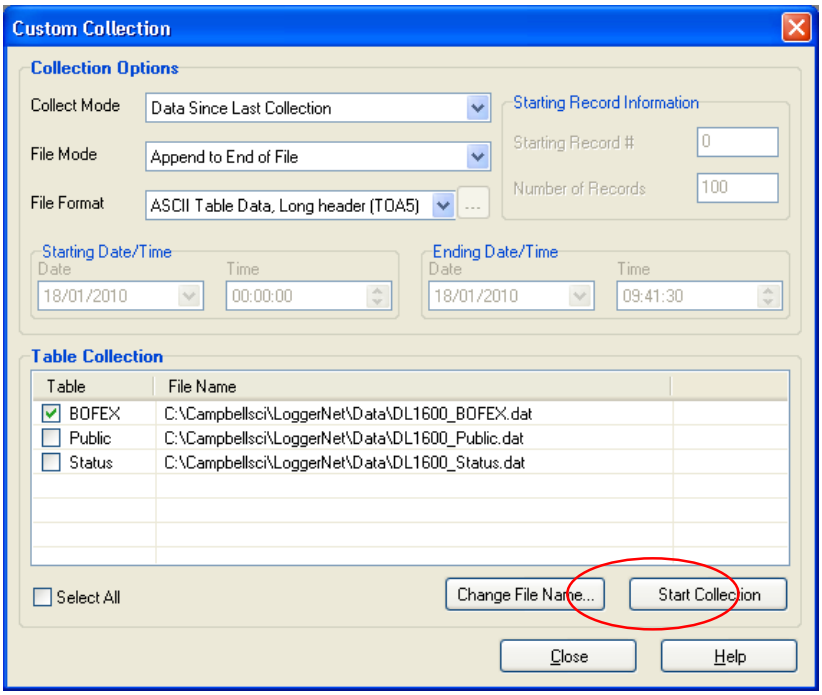
7.0 Collect Data

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.

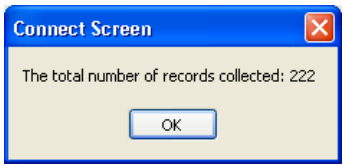


- Under **Collection Options**, make sure the following options are selected:
    - **Data Since Last Collection**
    - **Append to End of File**
    - **ASCII Table Data, Long header (TOA5)**
- Under **Table Collection**, make sure that **Data_X** is checked and that the file path where to save the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

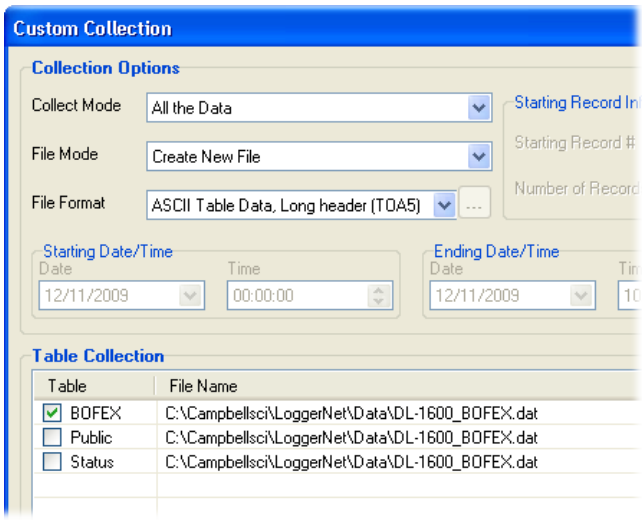
When collecting readings for the first time, you may need to collect all the data from the test box. This will set all memory pointers so that the next time you collect readings, the datalogger will know what readings were previously collected, and only new readings will be collected. All new readings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



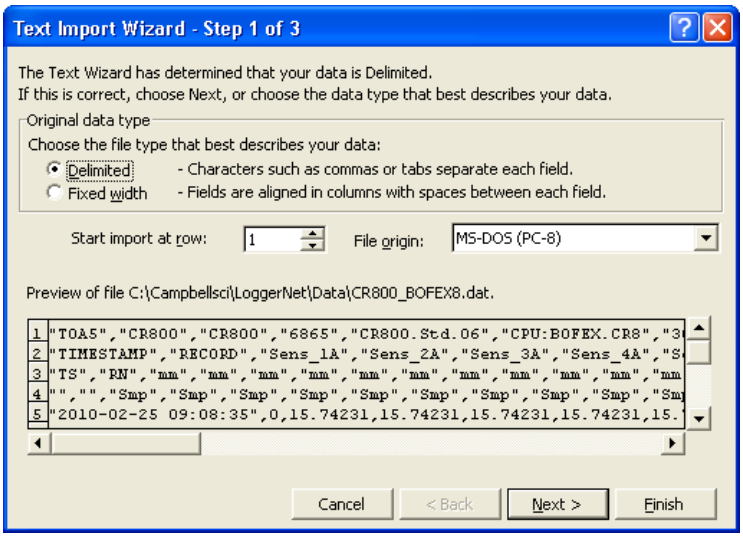
If the message window shows zero records collected, set the **Collection Options** as follow and do the **Start Collection** again.



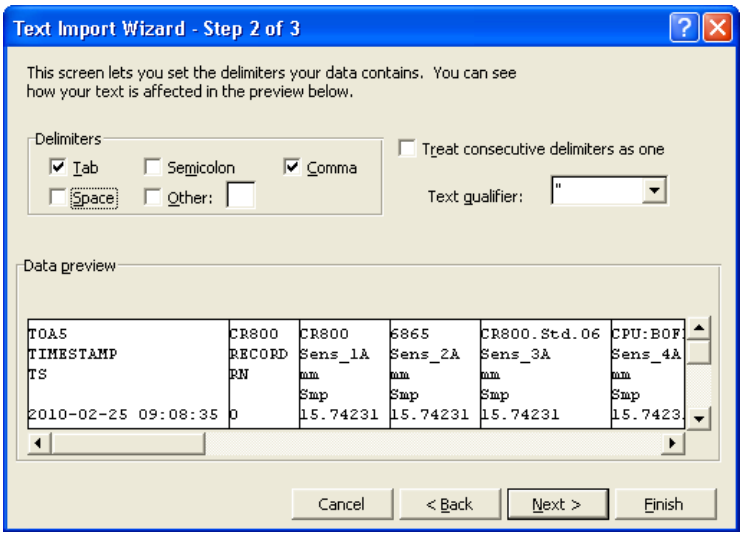
All collected readings are saved in the file specified under Table Collection. The readings saved with the file format **ASCII Table Data, Long header (TOA5)** are separated by commas (CSV) and can be imported into Microsoft Excel for data reduction.

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**.

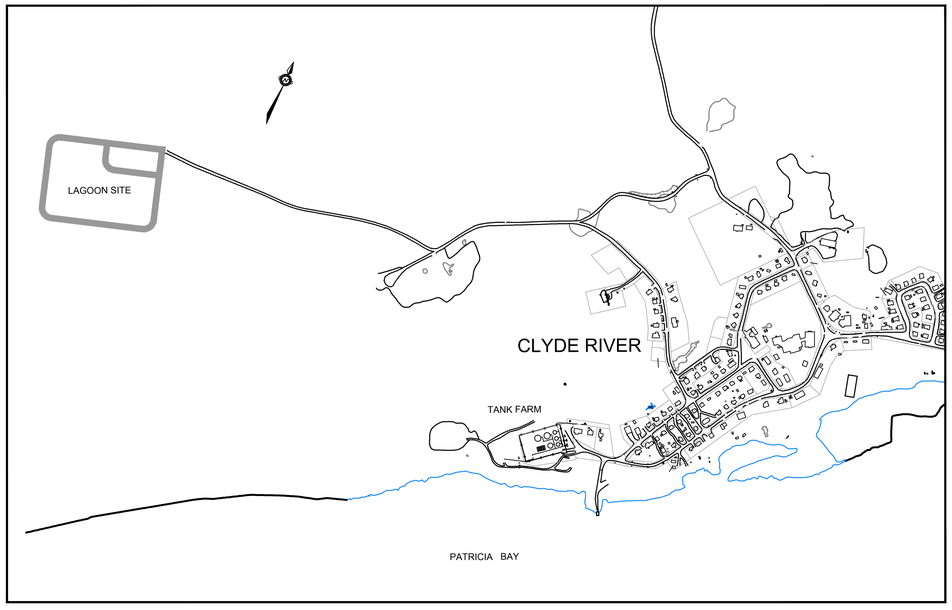


- Select **Tab**, **Comma** and click **Finish**.

	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 F – Record Drawings

GOVERNMENT OF NUNAVUT



INDEX OF INCLUDED DRAWINGS

DRAWING NO.	REVISION	DESCRIPTION
		COVER
OTCD00019055A-SP1	REV 6	OVERALL SITE PLAN
OTCD00019055A-SP2	REV 6	SITE PLAN
OTCD00019055A-TD1	REV 7	TRUCK DISCHARGE SITE PLANS
OTCD00019055A-DE1	REV 6	DETAILS
OTCD00019055A-DE2	REV 6	DETAILS
OTCD00019055A-T1	REV 3	MUNICIPAL LOCATION PLAN

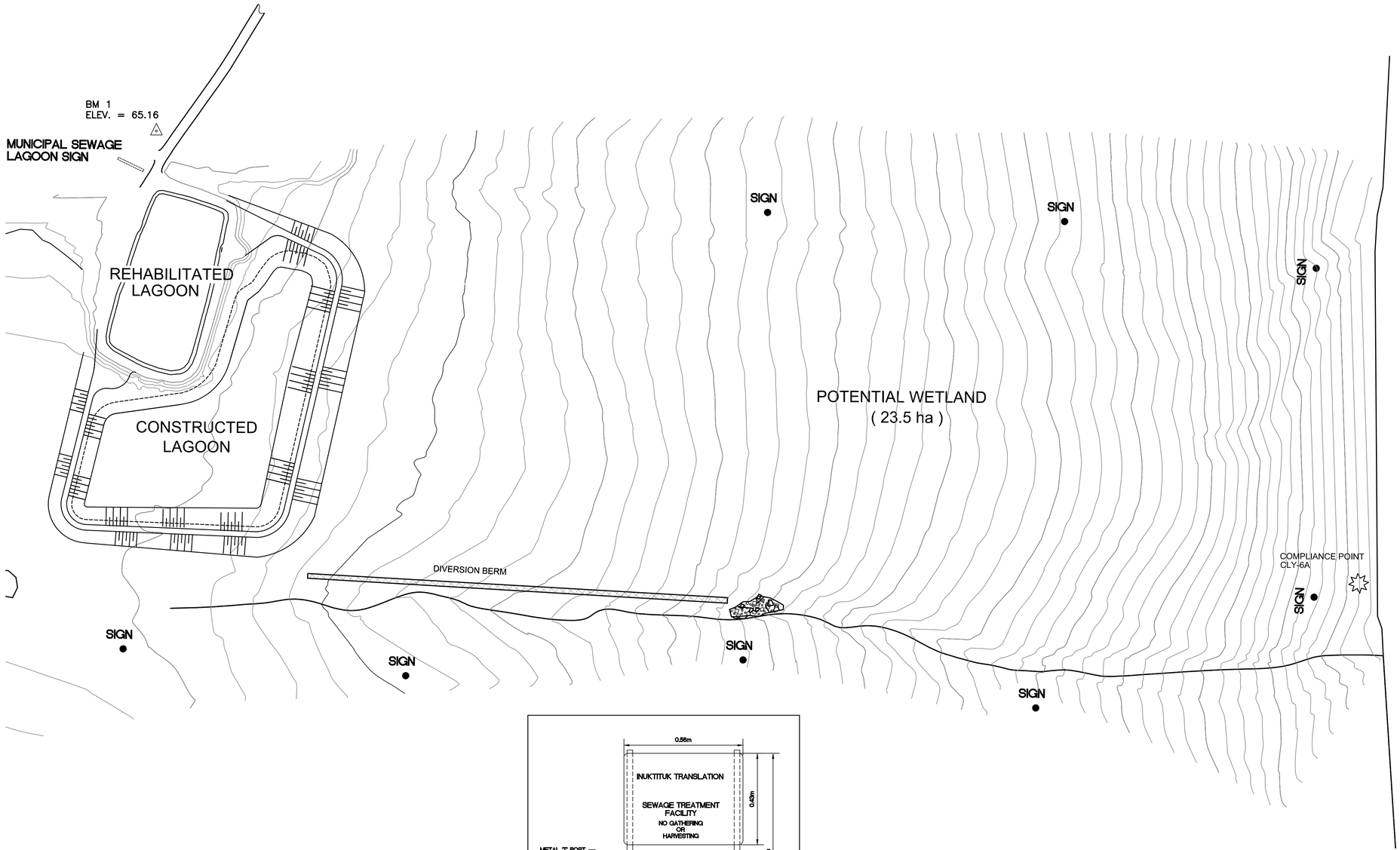
CLYDE RIVER
WASTEWATER LAGOON
(NEW SEWAGE LAGOON AND REHABILITATE EXISTING LAGOON)

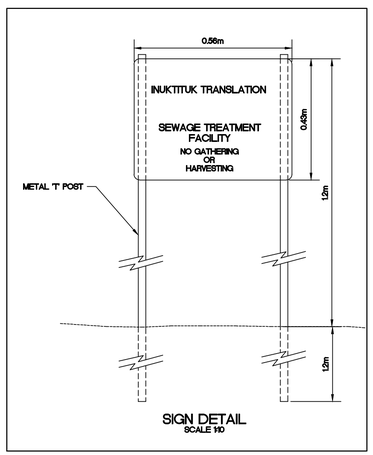
Trow Associates Inc.
100-2650 Queensview Drive
Ottawa, Ont. K2B 8H6
PHONE: (613) 688-1899
FAX: (613) 225-7337

AS-BUILT INFORMATION PROVIDED BY KUDLIK CONSTRUCTION LTD. OCTOBER 25 2011

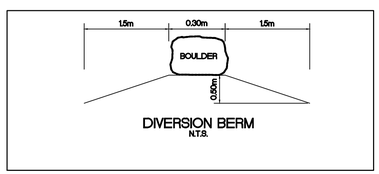
AS-BUILT

DATE: DECEMBER 31st, 2011





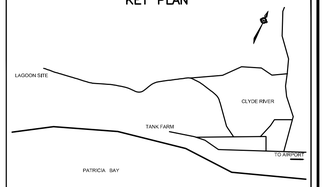
SIGN DETAIL
SCALE 1\10



DIVERSION BERM
N.T.S.

NOTES
CONTOUR INFORMATION WAS DERIVED BY TROW ASSOCIATES INC. SURVEY DATED AUGUST 23, 2007.
CONTOUR INTERVALS ARE SET AT 1.00m

KEY PLAN



AS-BUILT

DATE: DECEMBER 31st, 2011

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D
6	AS-BUILT	31/12/11	MEB	SLB
5	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
4	AS-CONSTRUCTED	02/12/10	MEB	SLB
3	ISSUED FOR CONSTRUCTION	15/06/09	MMR	SLB
2	REVISED FOR TENDER	28/05/08	MMR	SLB
1	ISSUED FOR TENDER	28/04/08	MMR	SLB

REVISIONS

DRAWINGS ORIGINALLY SEALED BY S.L.BURDEN, P.eng. OF exp. SERVICES Inc. MAY 28TH, 2008

Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ont. K2E 7J5
Tel:(613)225-9940
Fax:(613)225-7337

CLIENT
GOVERNMENT OF NUNAVUT

PROJECT
CLYDE RIVER
WASTEWATER LAGOON

TITLE
OVERALL
SITE PLAN

design by	SAD
drawn by	MEB
checked by	SLB
date	30/08/2007
scale	HORIZ 1:1500
project no.	OTCD00019055A
drawing no.	SP-1

RIP-RAP ARMOUR

MONITORING SITE

BOLLARDS

TRUCK DISCHARGE LOCATION

BOLLARDS

TRUCK DISCHARGE LOCATION

BOLLARDS

EXISTING LAGOON CELL
(REHABILITATED)
TOP OF BERM ELEV. 64.80m
TOP OF FREEBOARD ELEV. 63.60m
TOTAL OPERATIONAL VOLUME 5,000cu.m.

A

BM 1

4.55

3.5:1

2.75:1

9.28

BENTOFIX LINER

LAGOON DECANTING INLET

GABION MAT

MONITORING SITE

EMERGENCY SPILLWAY

TRUCK DISCHARGE LOCATION

BOLLARDS

BOLLARDS

10.52

BENTOFIX LINER

CONSTRUCTED LAGOON CELL
TOP OF BERM ELEV. 63.75m
TOP OF FREEBOARD ELEV. 62.75m
TOTAL OPERATIONAL VOLUME 46,300cu.m.

LAGOON DECANTING OUTLET

22.0m-150ø HDPE PIPE

A

B

LAGOON DECANTING INLET

4.72

300mmø HDPE PIPE

MONITORING SITE

MONITORING SITE

BENTOFIX LINER

THERMISTOR BELOW LINER

EMERGENCY SPILLWAY

MONITORING SITE

16.68

4.40

19.05

600mmø NESTED PIPE

DIVERSION BERM

B

LEGEND

- MONITORING WELL (SAMPLING POINT)
- THERMISTOR
- THERMISTOR BELOW LINER
- 10 / ×65.53 / AB — SPOT ELEVATION
- BOULDER
- GABION MAT
- BENTOFIX LINER
- TRUCK ROUTE

AS-BUILT

DATE: DECEMBER 31st, 2011

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D
6	AS-BUILT	31/12/11	MEB	SLB
5	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
4	AS-CONSTRUCTED	02/12/10	MEB	SLB
3	ISSUED FOR CONSTRUCTION	15/06/09	MMR	SLB
2	REVISED FOR TENDER	28/05/08	MMR	SLB
1	ISSUED FOR TENDER	28/04/08	MMR	SLB

REVISIONS

DRAWINGS ORIGINALLY SEALED BY S.L.BURDEN, P.eng. OF exp. SERVICES Inc. MAY 28TH, 2008

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100-2650 Queensview Drive Ottawa, Ont. K2B 8H6
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CLIENT

GOVERNMENT OF NUNAVUT

PROJECT

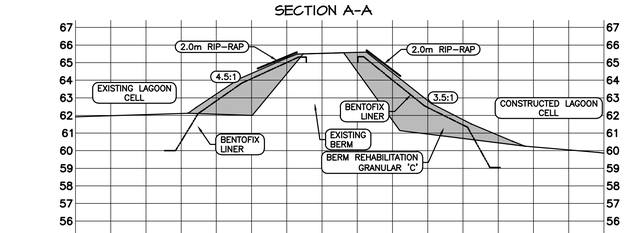
CLYDE RIVER
WASTEWATER LAGOON

TITLE

SITE PLAN

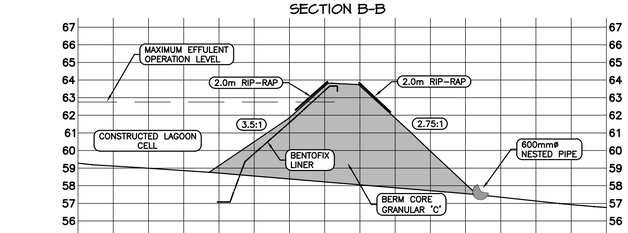
design by	SAD	project no.	OTCD00019055A
drawn by	MEB	drawing no.	SP-2
checked by	SLB		
date	30/08/2007		
scale	HORIZ 1:500		

SECTION A-A

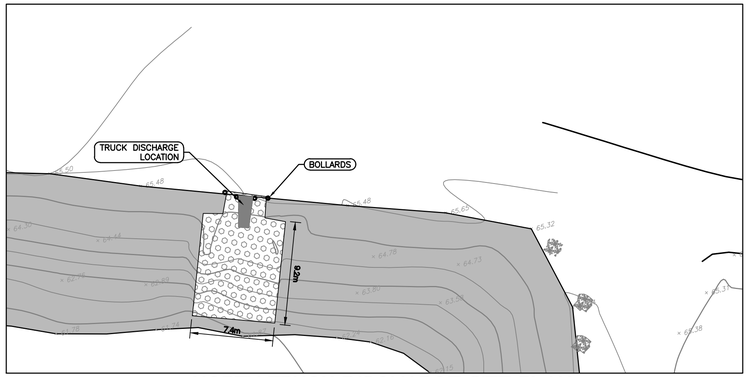


CHAINAGE	0+005	0+010	0+015	0+020	0+025	0+030	0+035	0+040	0+045	0+050	0+055	0+060	0+065	0+070
AS-BUILT ELEVATION	61.99	62.05	62.11	63.22	64.39	65.26	65.53	65.58	64.42	62.84	61.76	60.87	60.21	60.04

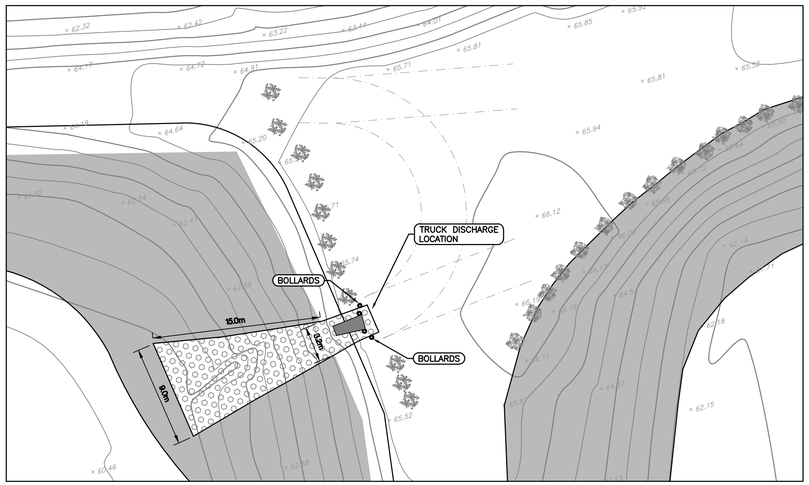
SECTION B-B



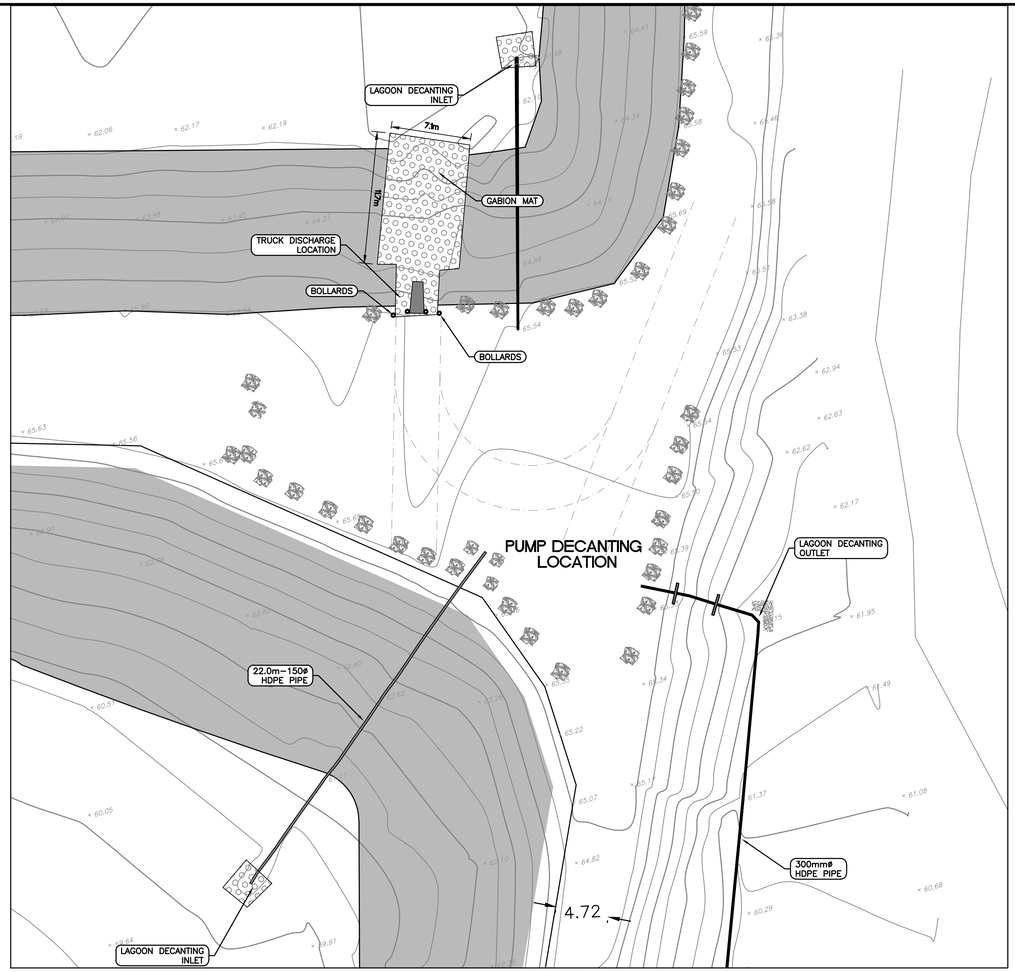
CHAINAGE	0+005	0+010	0+015	0+020	0+025	0+030	0+035	0+040	0+045	0+050	0+055	0+060	0+065	0+070
AS-BUILT ELEVATION	59.12	58.99	58.86	59.15	60.50	61.86	63.65	63.68	61.85	59.97	58.10	57.35	57.14	56.93



NORTH TRUCK DISCHARGE SITE PLAN



WEST TRUCK DISCHARGE SITE PLAN



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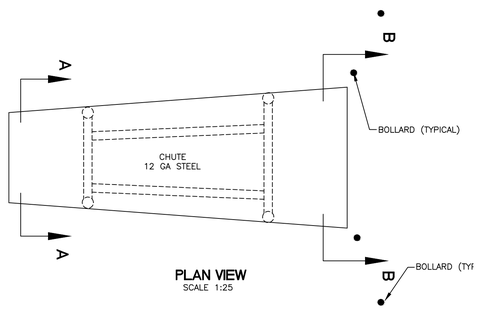
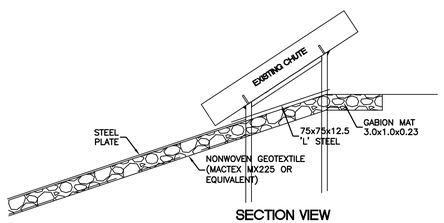
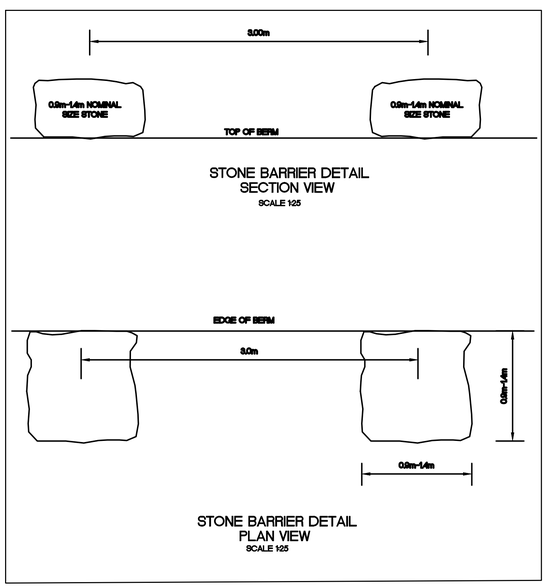


PLAN VIEW
SCALE 1:25



SECTION VIEW
SCALE 1:50

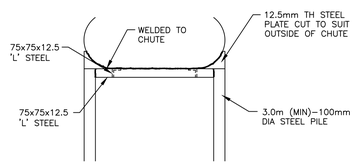
INSET



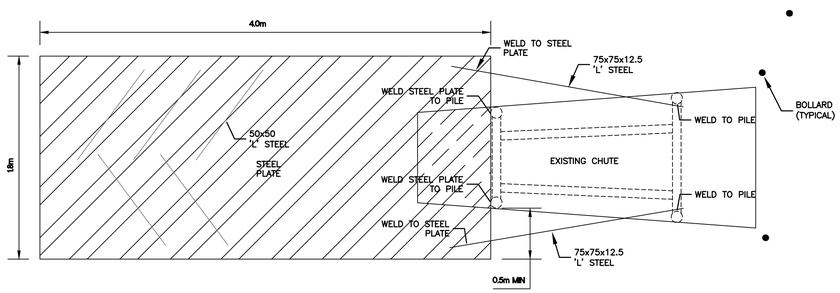
STONE BARRIER DETAIL
SECTION VIEW
SCALE 1:25

STONE BARRIER DETAIL
PLAN VIEW
SCALE 1:25

TRUCK DISCHARGE CHUTE DETAIL

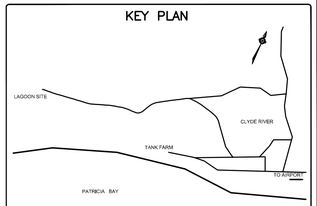


END VIEW
SCALE 1:25



PLAN VIEW
SCALE 1:25

KEY PLAN



AS-BUILT

DATE: DECEMBER 31st, 2011

BENCH MARK

BM 1 ELEV. = 65.16

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD. NORTH-EAST OF THE LAGOON SITE.

No.	DESCRIPTION	DATE	BY	APP'D
7	AS-BUILT	31/12/11	MEB	SLB
6	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
5	AS-CONSTRUCTED	02/12/10	MEB	SLB
4	REV DEWATERING INLET	10/08/09	MMR	SLB
3	ISSUED FOR CONSTRUCTION	15/06/09	MMR	SLB
2	REVISED FOR TENDER	28/05/08	MMR	SLB
1	ISSUED FOR TENDER	28/04/08	MMR	SLB

REVISIONS

DRAWINGS ORIGINALLY SEALED BY S.L.BURDEN, P.eng. OF exp. SERVICES Inc. MAY 28TH, 2008

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FAX: (613) 225–7337

CLIENT

GOVERNMENT OF NUNAVUT

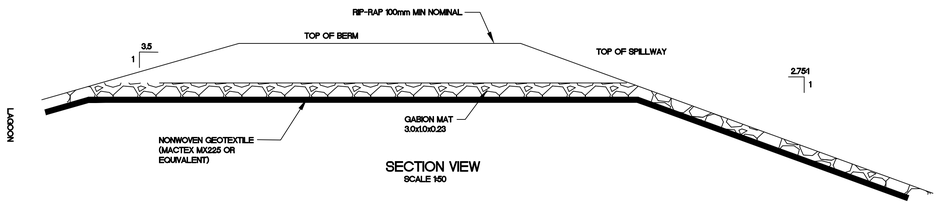
PROJECT

CLYDE RIVER WASTEWATER LAGOON

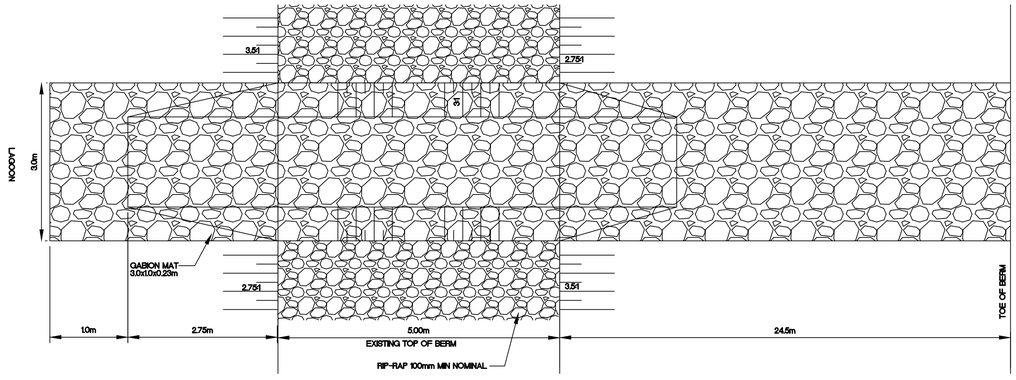
TITLE

TRUCK DISCHARGE SITE PLANS

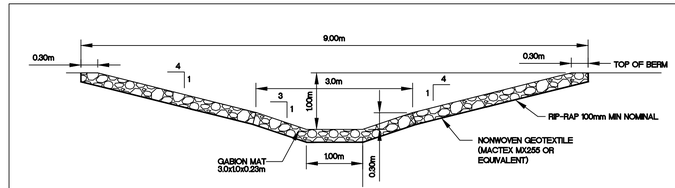
design by	SAD	project no.	OTCD000190554
drawn by	MEB	drawing no.	TD1
checked by	S.L.B.		
date	30/08/2007		
scale	1:250		



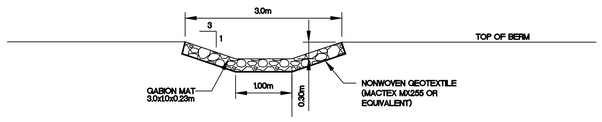
SECTION VIEW
SCALE 150



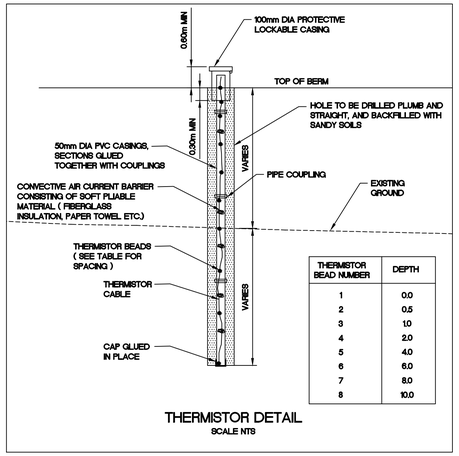
SPILLWAY BERM DETAIL
PLAN VIEW
SCALE 150



SPILLWAY DETAIL
SECTION VIEW
SCALE 150

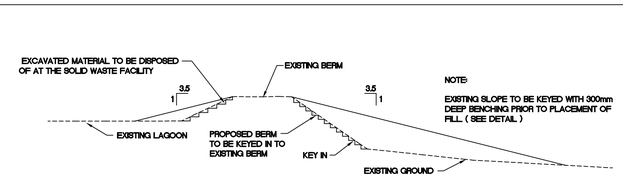


EMERGENCY
SPILLWAY DETAIL
SECTION VIEW
SCALE 150

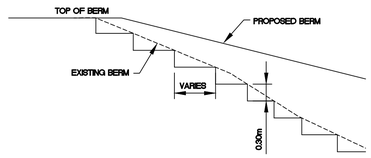


THERMISTOR BEAD NUMBER	DEPTH
1	0.0
2	0.5
3	1.0
4	2.0
5	4.0
6	6.0
7	8.0
8	10.0

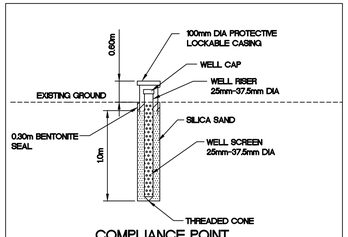
THERMISTOR DETAIL
SCALE NTS



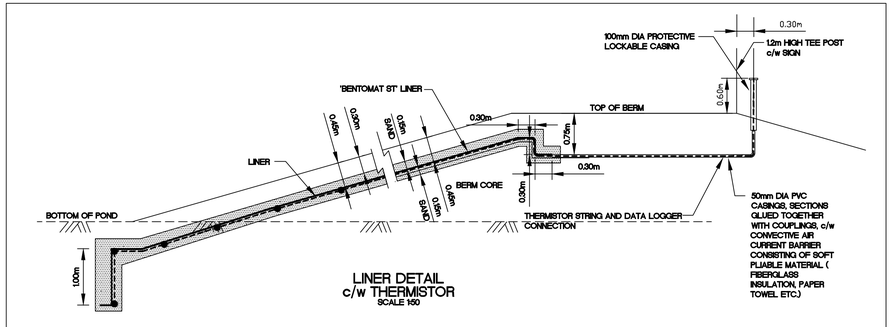
EXISTING BERM
REHABILITATION
SCALE 1200



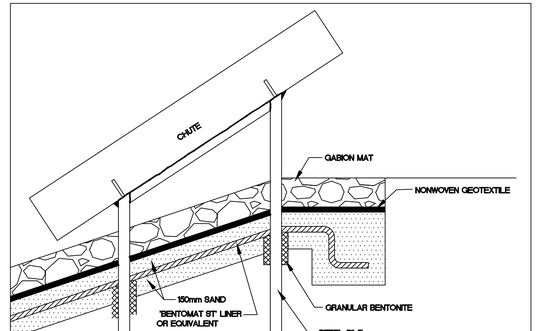
KEY IN DETAIL
SCALE 150



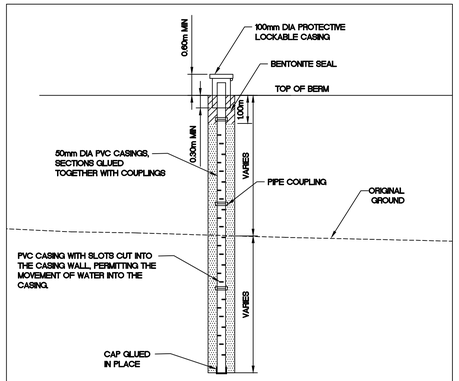
COMPLIANCE POINT
SAMPLING WELL DETAIL
SCALE NTS



LINER DETAIL
c/w THERMISTOR
SCALE 150



PILE PENETRATION
OF LAGOON LINER
SCALE 125



SEEPAGE MONITORING CASING
SCALE NTS

AS-BUILT

DATE: DECEMBER 31st, 2011

No.	DESCRIPTION	DATE	BY	APP'D
6	AS-BUILT	31/12/11	MEB	SLB
5	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
4	AS-CONSTRUCTED	02/12/10	MEB	SLB
3	ISSUED FOR CONSTRUCTION	15/06/09	MMR	SLB
2	REVISED FOR TENDER	28/05/08	MMR	SLB
1	ISSUED FOR TENDER	28/04/08	MMR	SLB

R E V I S I O N S

DRAWINGS ORIGINALLY
SEALED BY
S.L.BURDEN, P.eng. OF
exp. SERVICES Inc.
MAY 28TH, 2008

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Ottawa, Ont. K2B 8H6
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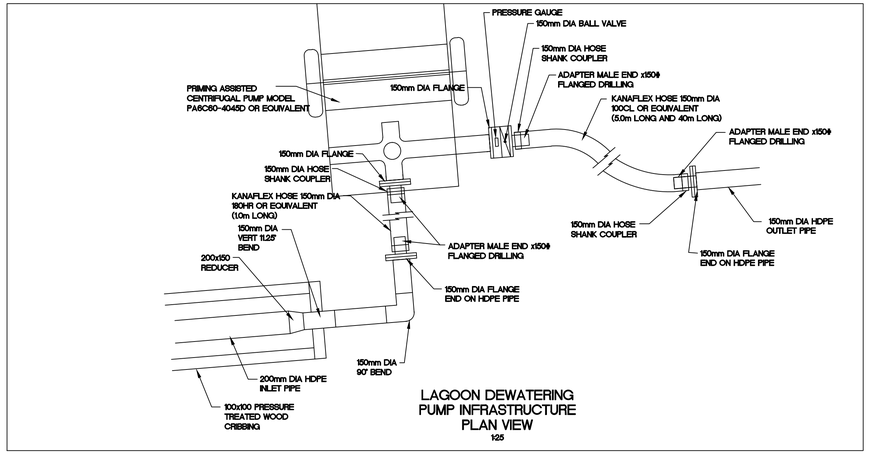
FAX: (613) 225-7337

CLIENT
GOVERNMENT OF NUNAVUT

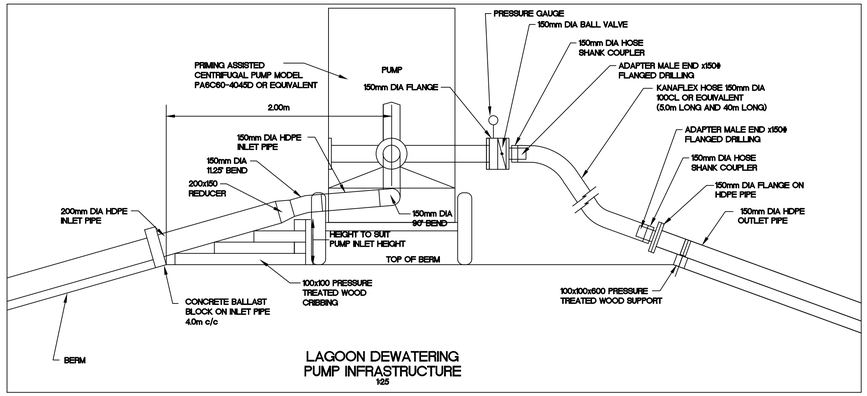
PROJECT
CLYDE RIVER
WASTE WATER
LAGOON

TITLE
DETAILS

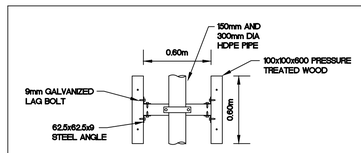
design by	S.A.D.
drawn by	M.M.R.
checked by	S.L.B.
date	14/12/07
scale	AS SHOWN
project no.	OTCD19055A
drawing no.	DE-1



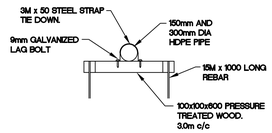
LAGOON DEWATERING
PUMP INFRASTRUCTURE
PLAN VIEW
1:25



LAGOON DEWATERING
PUMP INFRASTRUCTURE
1:25

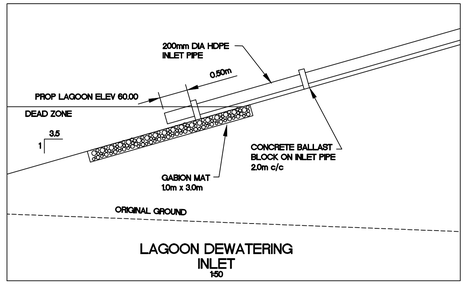


PLAN VIEW
1:25

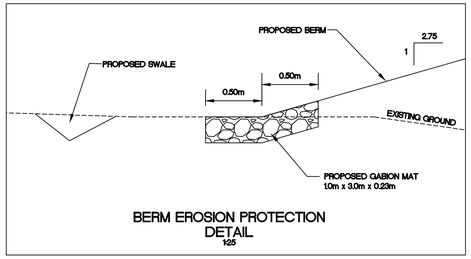


SECTION VIEW
1:25

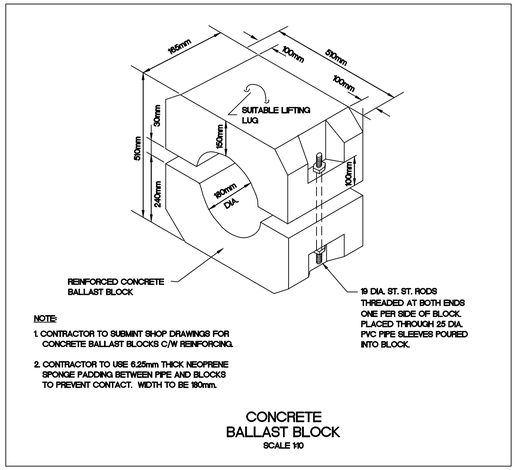
OUTLET PIPE SUPPORT



LAGOON DEWATERING
INLET
1:50



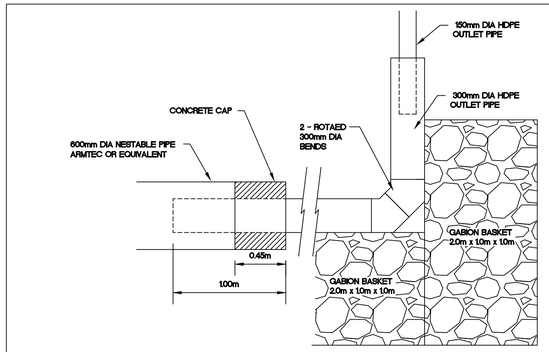
BERM EROSION PROTECTION
DETAIL
1:25



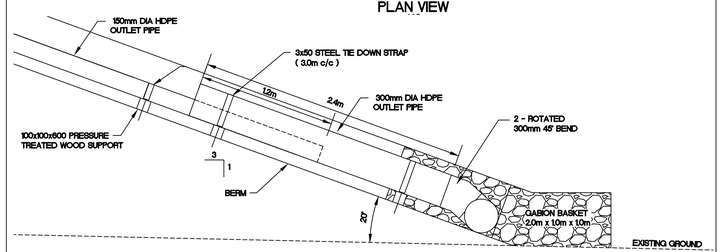
NOTE:

1. CONTRACTOR TO SUBMINT SHOP DRAWINGS FOR CONCRETE BALLAST BLOCKS C/W REINFORCING.
2. CONTRACTOR TO USE 6.25mm THICK NEOPRENE SPONGE PADDING BETWEEN PIPE AND BLOCKS TO PREVENT CONTACT. WIDTH TO BE 180mm.

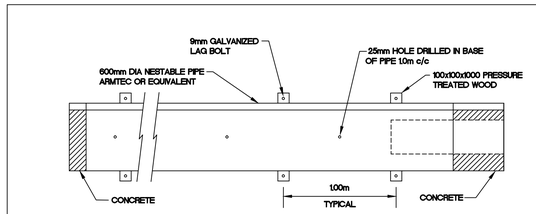
CONCRETE
BALLAST BLOCK
SCALE 1:10



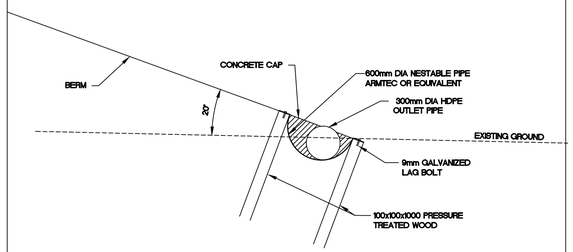
PLAN VIEW



LAGOON DEWATERING
OUTLET INFRASTRUCTURE
SECTION VIEW
1:25



PLAN VIEW
1:25



NESTABLE PIPE DETAIL
END VIEW
1:25

AS-BUILT

DATE: DECEMBER 31st, 2011

No.	DESCRIPTION	DATE	BY	APP'D
6	AS-BUILT	31/12/11	MEB	SLB
5	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
4	AS-CONSTRUCTED	02/12/10	MEB	SLB
3	ISSUED FOR CONSTRUCTION	15/06/09	MMR	SLB
2	REVISED FOR TENDER	28/05/08	MMR	SLB
1	ISSUED FOR TENDER	28/04/08	MMR	SLB

REVISIONS

DRAWINGS ORIGINALLY SEALED BY S.L.BURDEN, P.eng. OF exp. SERVICES Inc. MAY 28TH, 2008

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Ottawa, Ont. K2B 8H6
PHONE: (613) 688-1899
FAX: (613) 225-7337

CLIENT

GOVERNMENT OF NUNAVUT

PROJECT

CLYDE RIVER
WASTE WATER
LAGOON

TITLE

DETAILS

design by	S.A.D.	project no.	OTCD19055A
drawn by	M.M.R.	drawing no.	DE-2
checked by	S.L.B.		
date	14/12/07		
scale	AS SHOWN		

AS-BUILT

DATE: DECEMBER 31st, 2011

No.	DESCRIPTION	DATE	BY	APP'D
3	AS-BUILT	31/12/11	MEB	SLB
2	AS-CONSTRUCTED 2011	18/11/11	MEB	SLB
1	AS-CONSTRUCTED	02/12/10	MEB	SLB

REVISIONS

DRAWINGS ORIGINALLY SEALED BY S.L.BURDEN, P.eng. OF exp. SERVICES Inc. MAY 28TH, 2008

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FAX: (613) 225-7337

CLIENT

GOVERNMENT OF NUNAVUT

PROJECT

CLYDE RIVER
WASTEWATER LAGOON

TITLE

CLYDE RIVER
MUNICIPAL LOCATION PLAN

design by	SAD
drawn by	MEB
checked by	SLB
date	11/02/2008
scale	HORIZ 1:5000
project no.	OTCD000190554
drawing no.	T-1

Appendix G - Spill Response Plan – Aggregate Deposits

Spill Response Plan
Aggregate Deposits

Clyde River, Nunavut

Prepared For:

Hamlet of Clyde River
Nunavut
X0A 0E0

Trow Associates Inc.
P.O. Box 6, Iqaluit, NU X0A 0H0
Telephone: (867) 979-5914
Facsimile: (867) 979-0347
E-mail: nunavut@trow.com
Web Site: www.trow.com

Project No: OTT-00019055-A0
Report date: December 2010

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3.0 Regulations **3**
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Appendices

Appendix A: Figures
Appendix B: NT-NU Spill Report Form

1.0 Introduction

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 permitting process for the ongoing management of the Hamlet of Clyde River (Hamlet)'s aggregate sources. 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 of the borrow pits. The SRP is designed to be protective of the local natural environment and the new aggregate sources.

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 Trow for additional information or clarification.

2.0 Site Description

The aggregate deposits in the vicinity of the Hamlet, for which this SRP was developed, are shown on Figure 1 (in Appendix A). The locations are best described as borrow pits that contain no permanent or semi-permanent structures. As such, no potential contaminants are likely to be stored at the pits.

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 (Appendix B) 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 materials (potential contaminants) that are anticipated to be used on the site include gasoline, diesel fuel, hydraulic oil, motor oil and other lubricants, antifreeze and coolants. Spills may be the result of any of the following occurrences:

- Leaks or ruptures of storage tanks;
- Valve or line failure in systems, vehicles or operating equipment;
- Heat expansion due to overfilling;
- Improper storage;
- Vehicular accidents;
- Spill during transfer of liquid; 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 immanent 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

Item	TDGA[2] Class	Contaminant	Amount Spilled
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. At least one spill kit should be clearly identified and present on the site when a pit is being actively worked.

8.4. Hamlet Spill Kit Availability

The number of spill kits available throughout the Hamlet and their storage locations should be determined during the preparation of an overall Spill Contingency Plan for the Hamlet. As indicated in Section 8.3 (above), at least one spill kit should be readily available when a pit is being actively worked.

8.5. 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 Clyde River	On-site Supervisor	(867) 924-6220
Clyde River Health Centre	Medical Emergency	(867) 924-6377
Fire	Fire, Accident or Rescue	(867) 979-4422
RCMP (Clyde River)	Security, Vandalism	(867) 924 -1111

10.0 Closure

This Spill Response Plan has been prepared for the ongoing management of the Hamlet's aggregate sources. 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.

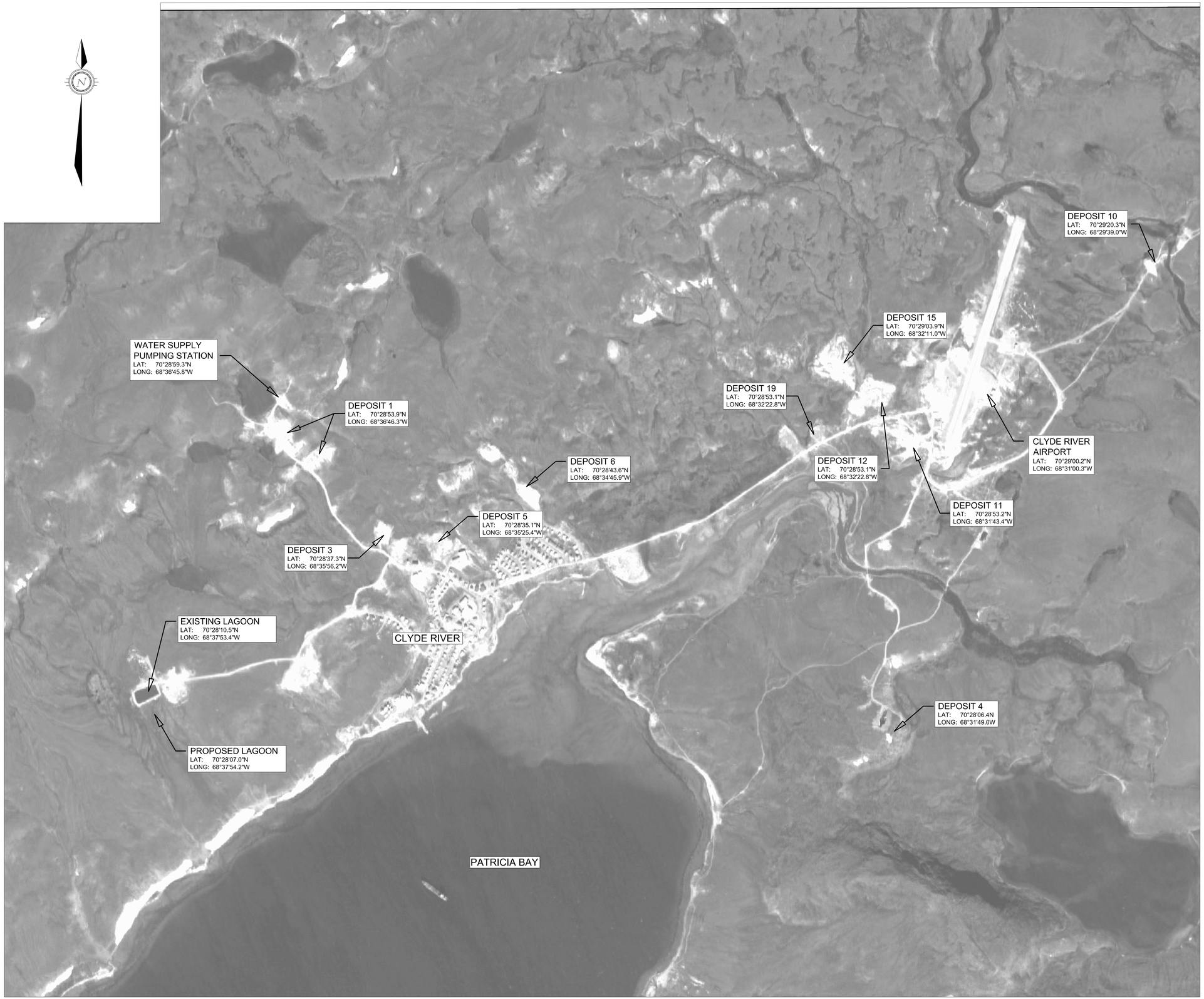
Yours truly,

Trow Associates Inc.

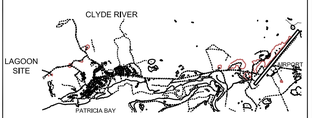
Robert Renaud, M.Sc., P.Geo.
Senior Geoscientist
Earth and Environment

Steven Burden, P.Eng.
Manager
Infrastructure - Municipal

Appendix A:
Figures



KEY PLAN



NOTE

NOTED DEPOSITS COORESPOND TO THE "EVALUATION OF GRANULAR MATERIAL DEPOSITS NEAR CLYDE RIVER, N.W.T." REPORT; PREPARED BY TERRAIN ANALYSIS AND MAPPING SERVICES LTD.

BENCH MARK

BM 1 **ELEV. = 65.16m**

RE-BAR SET NEAR THE INTERSECTION OF THE LAGOON ACCESS ROAD AND METAL DUMP ACCESS ROAD, NORTH-EAST OF THE LAGOON SITE.

NO.	REVISION	DD/MN/YR	A.B.C.	A.B.C.
No.	DESCRIPTION	DATE	BY	APP'D

R E V I S I O N S

Trow Associates Inc.
154 Colonnade Road South
Ottawa, Ont. K2E 7J5
Tel:(613)225-9940
Fax:(613)225-7337

CLIENT

GOVERNMENT OF NUNAVUT

PROJECT

SPILL RESPONSE PLAN

TITLE

AGGREGATE DEPOSIT LOCATION

design by	SAD	project no.	OTCD000190554
drawn by	MEB	drawing no.	ADL-1
checked by	K.K.		
date	06/11/08		
scale	NTS		

Appendix B:
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 EQUIPMENT
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			

Government of Nunavut

Operations & Maintenance Manual
Volume II – Final Document

Project Name
Clyde River Waste Water Facility

Project Number
OTCD00019055A

Prepared By:

exp Services Inc.
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada

Date Submitted
July 2012

Government of Nunavut

Operation and Maintenance Manual Volume II

Type of Document:
Final

Project Name:
Clyde River Waste Water Facility

Project Number:
OTCD00019055A

Prepared By:
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Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

Date Submitted:
July 2012

Manufacturing Data and Service Information

Technical Specifications Pump

Technical Specifications Truck Discharge

Technical Specifications HDPE Pipe

Technical Specifications Gabion

Technical Specifications Bentofix

Technical Specifications Thermistors

Technical Specifications Facility Sign

Technical Specifications Wells

Technical Specifications Nested Pipe

Technical Specifications Geotextile

Technical Specifications Pump

ACDEU

Diesel Engine Driven
Priming Assisted Centrifugal Pump w/Autostart
Model PA6C60–4045D
Size 6" x 6"

Total Head		Capacity of Pump in U.S. Gallons per Minute (GPM) at Continuous Performance				
P.S.I.	Feet					
63.3	146	200	200	200	200	200
60.7	140	400	400	400	400	400
52.0	120	820	1000	1000	1000	1000
43.4	100	960	1380	1420	1420	1420
34.7	80	1040	1500	1770	1770	1770
26.0	60	1100	1510	1815	2050	2050
17.4	40	1140	1505	1820	2120	2250
8.7	20	1200	1550	1820	2150	2360
Suction Lift		25'	20'	15'	10'	5'

PUMP SPECIFICATIONS

Size: 6" x 6" (152 mm x 152 mm) Flanged.
Casing: Ductile Iron No. 65-45-12. Maximum Operating Pressure 100 psi (690 kPa).*
Open Type, Two Vane Impeller: Ductile Iron No. 65-45-12. Handles 3" (76,2 mm) Diameter Spherical Solids.
Impeller Shaft: Stainless Steel No. 17-4 PH.
Replaceable Wear Plate: Ductile Iron No. 80-60-03.
Removeable Cleanout Cover Plate: Gray Iron No. 30.
Intermediate Bracket: Gray Iron No. 30.
Seal Plate: Gray Iron No. 30.
Seal: Mechanical, Oil-Lubricated. Silicon Carbide Rotating and Stationary Faces. Stainless Steel No. 316 Stationary Seat. Fluorocarbon Elastomers (DuPont Viton® or Equivalent). Stainless Steel No. 18-8 Cage and Spring. Maximum Temperature of Liquid Pumped, 160°F (71°C).*
Shaft Sleeve: Stainless Steel No. 17-4 PH.
Priming Chamber: Gray Iron No. 30.
Discharge Check Valve: Gray Iron No. 30 Housing w/Buna-N Flapper.
Radial and Thrust Bearings: Open Double Ball.
Bearing and Seal Cavity Lubrication: SAE No. 30 Non-Detergent Oil.
Flanges: Gray Iron No. 30.
Gaskets: Resistant Synthetic Rubber, Cork, PTFE, Vegetable Fiber, and Compressed Synthetic Fibers.
Hardware: Standard Plated Steel.
Bearing and Seal Cavity Oil Level Sight Gauges.

**Consult Factory for Applications Exceeding Maximum Pressure and/or Temperature Indicated.*

Standard Equipment: Gear-Driven Air Compressor. Hoisting Bail. Combination Skid Base w/Fuel Tank. Strainer. Single Ball Type Float Switch.**

***50 Ft. (15 m) Standard Length; Dual Switches and Alternate Cable Lengths Available From the Factory.*

Optional Equipment: Battery. High Speed (55 MPH/89 KM/H) Wheel Kit with ST225/75R15 Pneumatic Tires. Over-the-Road Trailer (Meets D.O.T. and Transport Canada Requirements) Available w/Either Electric or Hydraulic Surge Brakes, Running Lights, Two Trailer Jack Stands and Safety Chains. EPS w/Submersible Transducer Liquid Level Sensor (50 Ft. [15 M] Cable Standard, Alternate Lengths Available).

SHOWN WITH OPTIONAL NPT SUCTION AND DISCHARGE FLANGES

WARNING!
Do not use in explosive atmosphere or for pumping volatile flammable liquids.

ENGINE SPECIFICATIONS

Model: John Deere 4045D "Power Tech".
Type: Four Cylinder, Four Cycle, Liquid Cooled Diesel Engine.
Displacement: 276 Cu. In. (4,5 liters).
Governor: Mechanical.
Lubrication: Forced Circulation.
Air Cleaner: Dry Type.
Oil Reservoir: 9 U.S. Qts. (8,5 liters) Dry; 8 U.S. Qts. (7,6 liters) Refill.
Fuel Tank: 88 U.S. Gals. (330 liters).
Full Load Operating Time: 26.1 Hrs.
Starter: 12V Electric.

Standard Features: Low Oil Pressure, High Coolant Temperature and Start Failure Safety Shut Down Switches/Indicators. Throttle Control. Autostart Instrument Panel Includes: Tachometer, Voltmeter, Hourmeter, Coolant Temperature and Oil Pressure Indicators, Manual/Stop/Auto Key Switch, 10 Amp Fuse, Audible Startup Warning Delay. Muffler w/Guard and Weather Cap.

JOHN DEERE PUBLISHED PERFORMANCE:
Maximum Continuous BHP 76 (57 kW) @ 2500 RPM
Maximum Dynamic BHP 80 (60 kW) @ 2500 RPM

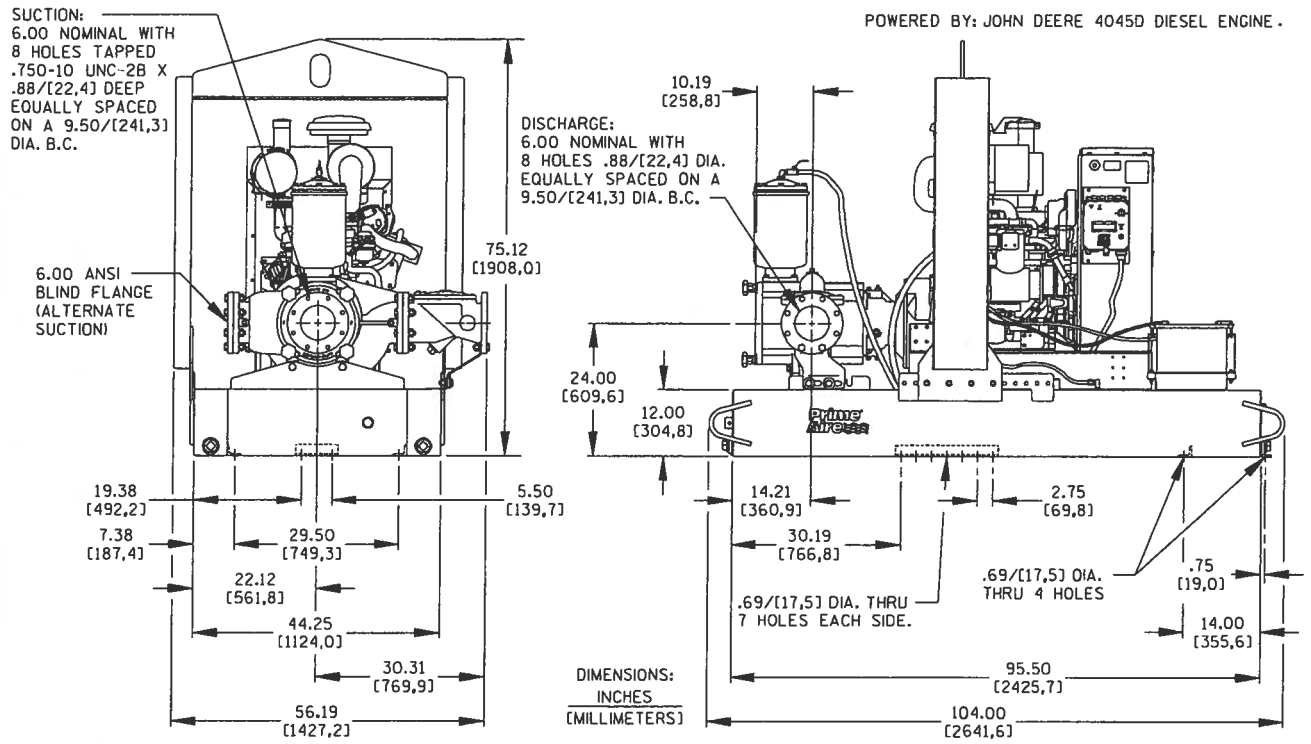
THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA
www.grpumps.com
Specifications Subject to Change Without Notice
Printed in U.S.A.

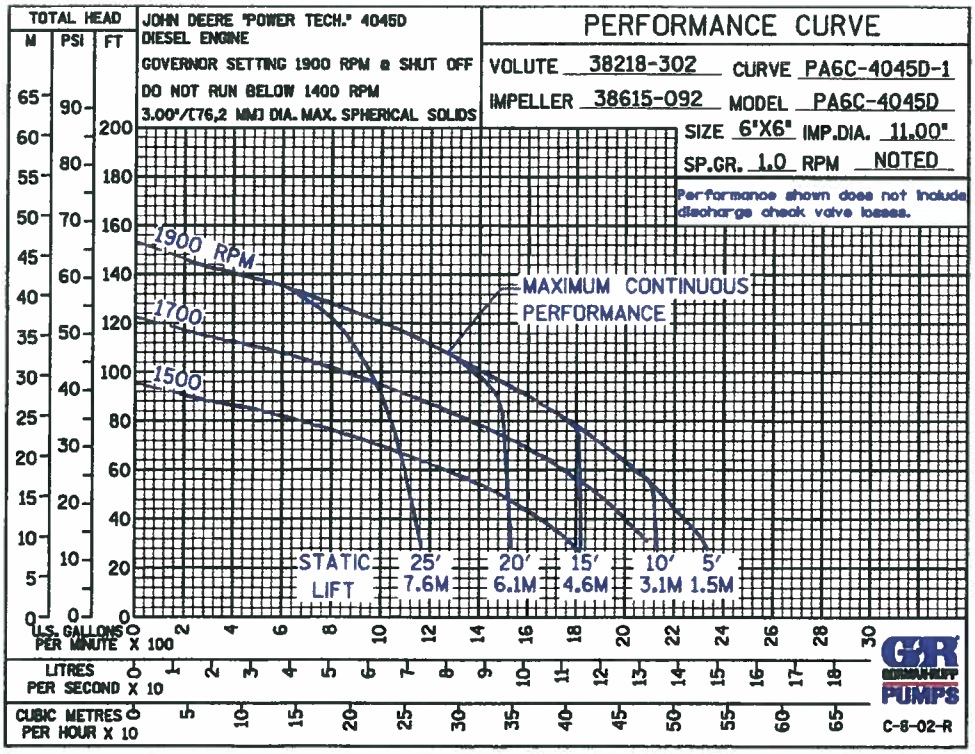
Specification Data

SECTION 42, PAGE 1100

APPROXIMATE DIMENSIONS and WEIGHTS

	SKID BASE	2-WHEEL
NET WEIGHT:	3310 LBS. (1501 KG.)	3600 LBS. (1633 KG.)
SHIPPING WEIGHT:	3460 LBS. (1569 KG.)	3600 LBS. (1633 KG.)
EXPORT CRATE SIZE:	247 CU. FT. (7 CU. M.)	





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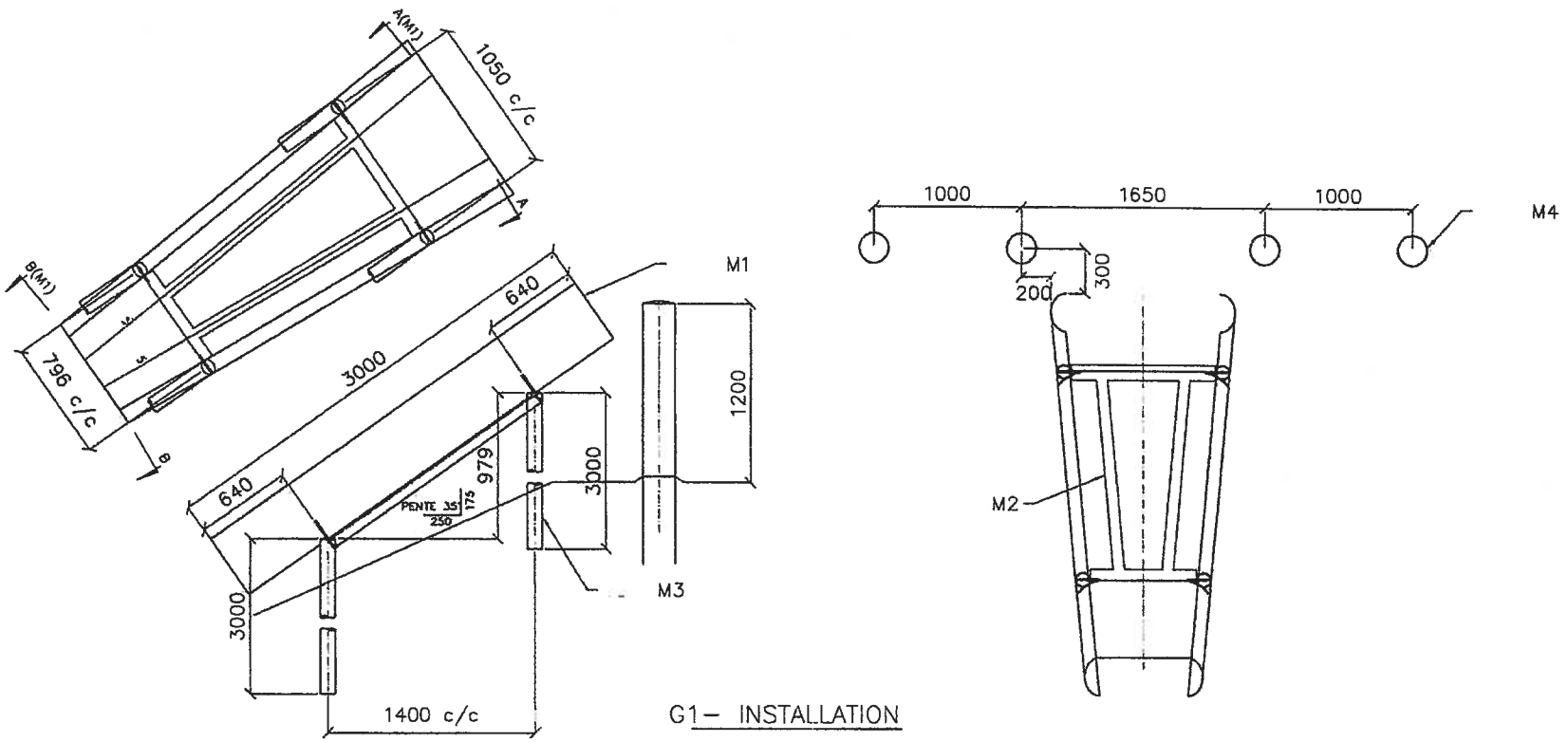
GORMAN-RUPP OF CANADA LIMITED • ST. THOMAS, ONTARIO, CANADA

Specifications Subject to Change Without Notice

Printed in U.S.A.

Technical Specifications Truck Discharge



G1– INSTALLATION

DESSIN #G1 A

REVISIONS			
A	08.08.11	EMIS POUR APPROBATION	

NOTES

LISTE DE MATÉRIEL

QUANTITÉ CONT.	QUANTITÉ ASS.	MQE	DESCRIPTION	LONG.	GRADE	REMARQUE	MASSE
						ASS.	

MASSE UNITAIRE ASSEMBLAGE: 281.2 Kg TOTAL: 561.4 Kg

SERVICES TECHNIQUES DCE
1808 RTE DE L'AÉROPORT
STE-FOY, QUÉ G2G 2P7
TEL: 418-872-5218 FAX: 418-872-6804
dce@dce-qc.com

CLIENT: Kudlik Construction Ltd

PROJET: Clyde River

TITRE: Truck discharge

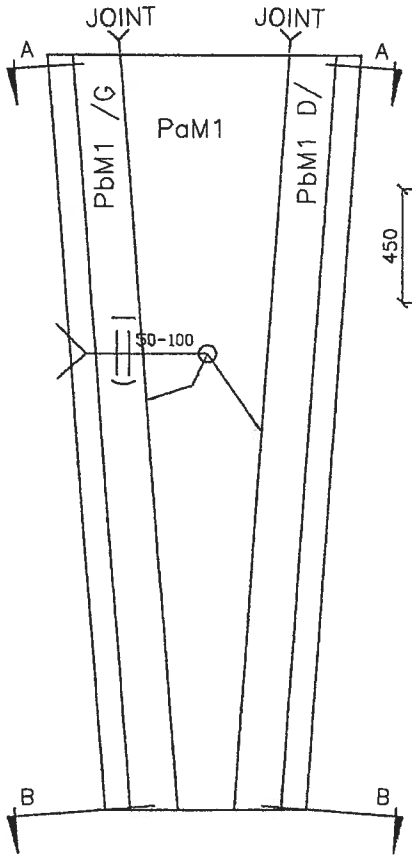
DESSINÉ: Serge Desbiens

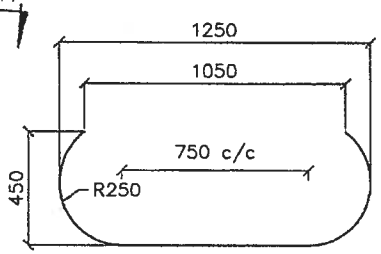
VÉRIFIÉ: .

DATE: AOÛT 2008

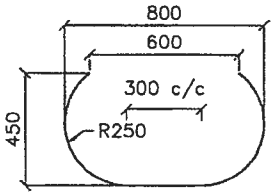
RAPPORT:

PROJET #: 12350





COUPE A–A



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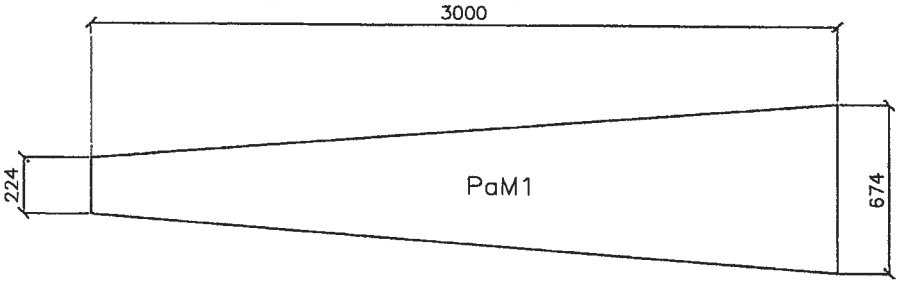

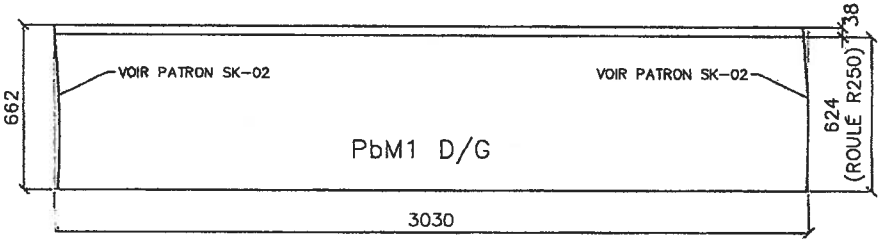

M1 Drawing

DESSIN #M1 A

REVISIONS

A	08.08.11	EMIS POUR APPROBATION	.

NOTES

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LISTE DE MATÉRIEL

QUANTITÉ CONT.	QUANTITÉ ASS.	MQE		DESCRIPTION	LONG.	GRADE	REMARQUE	MASSE
12	UN	PaM1	PL.	674 x 12G	3000	NOIR	ASS. M1	31.6
12	UN/UN	PbM1	PL.	662 x 12G	3030	NOIR		96.8

MASSE UNITAIRE ASSEMBLAGE: 90.0 Kg TOTAL: 1080 Kg

SERVICES TECHNIQUES DCE
1808 RTE DE L'AÉROPORT
STE-FOY, QUÉ G2G 2P7
TEL: 418-872-5218 FAX: 418-872-6804
dce@dce-qc.com

CLIENT: **Kudlik Construction Ltd**

PROJET: **Clyde River**

TITRE: Truck discharge

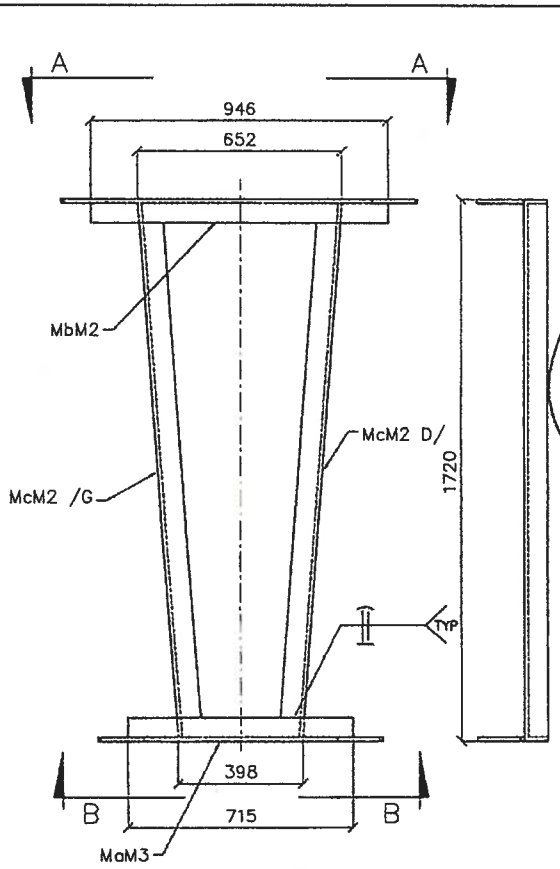
DESSINÉ: Serge Desbiens

VÉRIFIÉ: .

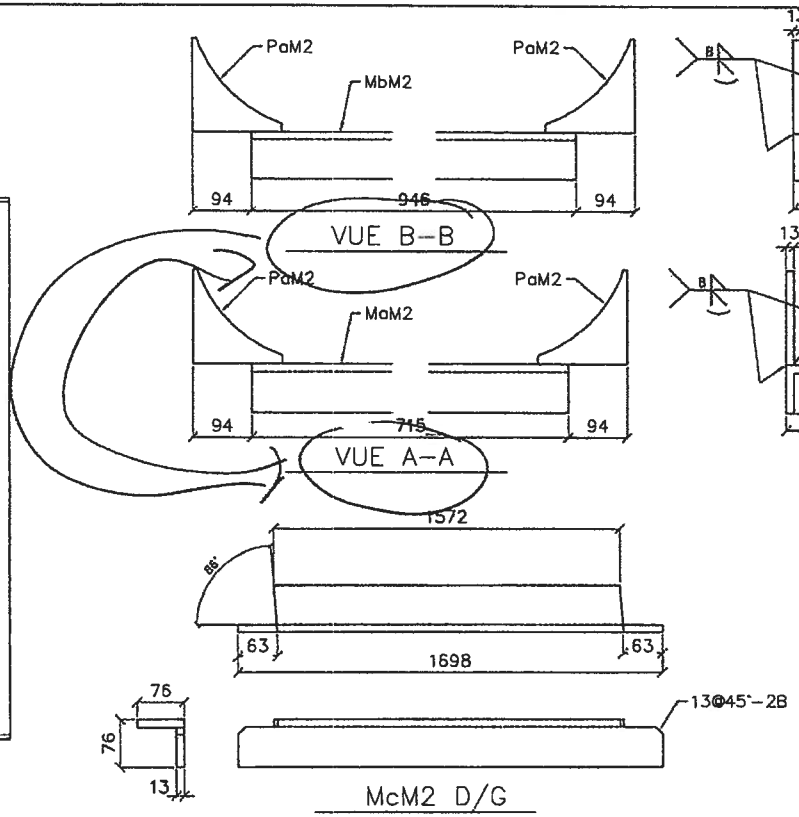
DATE: AOÛT 2008

RAPPORT:

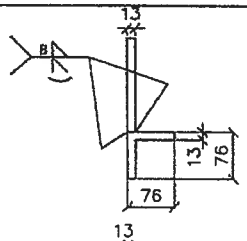
PROJET # **12350**

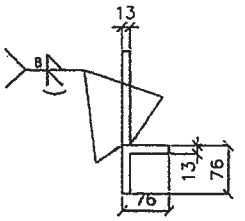


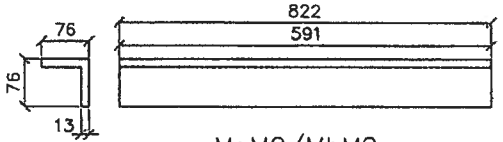
M2– 3 REQUIS



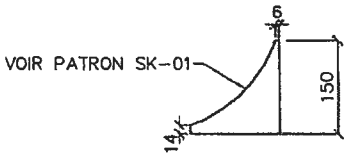
McM2 D/G







MaM2/MbM2



PaM2

DESSIN #M2 A

REVISIONS				
A	08.08.11	EMIS POUR APPROBATION		

NOTES

LISTE DE MATÉRIEL

QUANTITÉ CONT.	QUANTITÉ ASS.	MQE		DESCRIPTION	LONG.	GRADE	REMARQUE	MASSE
12	4	PaM2	PL	143x12,7	250	NOIR	ASS. M2	12.1
3	UN	MaM2	L	76x76x12,7	946	NOIR		11.5
3	UN	MbM2	L	76x76x12,7	715	NOIR		8,3
3 / 3	UN / UN	McM2	L	76x76x12,7	1698	NOIR		47,6

MASSE UNITAIRE ASSEMBLAGE: 79.5 Kg TOTAL: 238.5 Kg

SERVICES TECHNIQUES DCE
1808 RTE DE L'AÉROPORT
STE-FOY, QUÉ G2G 2P7
TEL: 418-872-5218 FAX: 418-872-6804
dce@dce-qc.com

CLIENT: **Kudlik Construction Ltd**

PROJET: **Clyde River**

TITRE: Truck Discharge (rack)

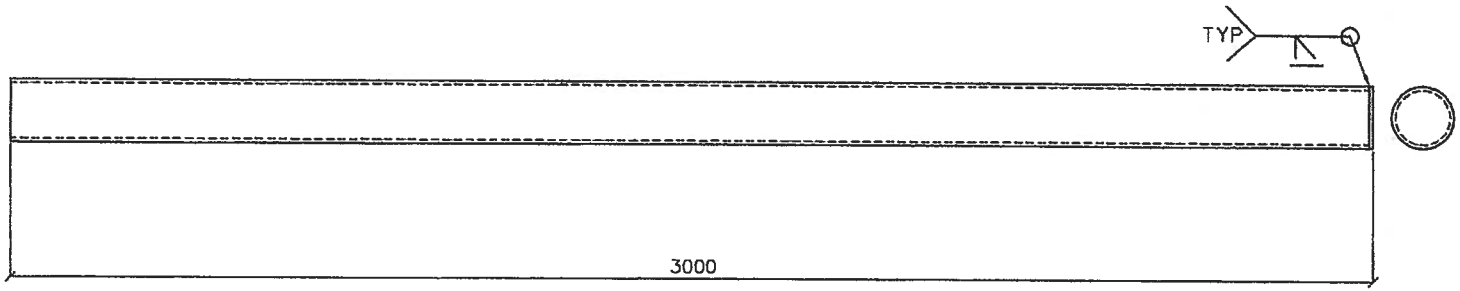
DESSINÉ: Serge Desbiens

VÉRIFIÉ:

DATE: AOÛT 2008

RAPPORT:

PROJET #: **12350**



M3-12

DESSIN #M3 A

REVISIONS

A	08.08.11	EMIS POUR APPROBATION	

NOTES

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LISTE DE MATÉRIEL

QUANTITÉ CONT.	QUANTITÉ ASS.	MQE		DESCRIPTION	LONG.	GRADE	REMARQUE	MASSE
12	UN	M3	HSS	ø100 EXT.-CÉD. 40	2994	NOIR	ASS. M3	53.0
12	UN	paM3	PL.	PL. ø100x6		NOIR		.2

MASSE UNITAIRE ASSEMBLAGE: 53.2 Kg TOTAL: 212.8 Kg

SERVICES TECHNIQUES DCE
1808 RTE DE L'AÉROPORT
STE-FOY, QUÉ G2G 2P7
TEL: 418-872-5218 FAX: 418-872-6804
dce@dce-qc.com

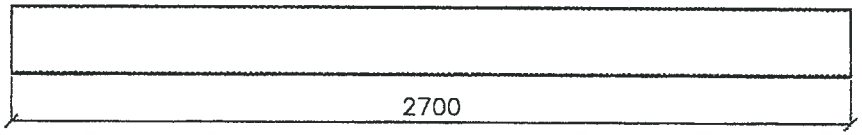
CLIENT: Kudlik Construction Ltd

PROJET: Clyde River

TITRE: Truck Discharge (steel pile)

DESSINÉ: Serge Desbiens | VÉRIFIÉ: .

DATE: AOÛT 2008 | RAPPORT: | PROJET #: 12350



GALVANISÉ
SOUDURES ÉTANCHES
PRÉVOIR TROUS NÉCESSAIRES

M4–12

DESSIN #M4 (A)

REVISIONS				
A	08.08.11	EMIS POUR APPROBATION	.	

NOTES

LISTE DE MATÉRIEL

QUANTITÉ CONT.	QUANTITÉ ASS.	MQE		DESCRIPTION	LONG.	GRADE	REMARQUE	MASSE
12	UN	M4	HSS	ø219 EXT.–CÉD.20	2700	NOIR	ASS. M4	90.0

MASSE UNITAIRE ASSEMBLAGE: 90.0 Kg TOTAL: 1080 Kg

SERVICES TECHNIQUES DCE
1808 RTE DE L'AÉROPORT
STE-FOY, QUÉ G2G 2P7
TEL: 418-872-5218 FAX: 418-872-6804
dce@dce-qc.com

CLIENT: **Kudlik Construction Ltd**

PROJET: **Clyde River**

TITRE: Truck Discharge **(Bollard)**

DESSINÉ: Serge Desbiens | VÉRIFIÉ: .

DATE: AOÛT 2008 | RAPPORT: | PROJET #: **12350**

Technical Specifications HDPE Pipe

For more information and technical assistance contact:

Performance Pipe, a division of
Chevron Phillips Chemical Company LP
P.O. Box 269006
Plano, TX 75026-9006
800.527.0662

DriscoPlex®
PE3608 / (PE3408) Pipe
Pipe and Fittings Data Sheet

Typical Material Physical Properties of DriscoPlex® PE3608 / (PE3408)

High Density Polyethylene Materials

Property	Unit	Test Procedure	Typical Value
Material Designation	---	PPI TR-4	PE3608
Cell Classification	---	ASTM D3350	345464C
Pipe Properties			
Density	gms / cm^3	ASTM D1505	0.955 (black)
Melt Index Condition 190 / 2.16	gms / 10 minutes	ASTM D1238	0.08
Hydrostatic Design Basis 73°F (23°C)	psi	ASTM D2837	1600
Hydrostatic Design Basis 140°F (60°C)	psi	ASTM D2837	800
Color: UV Stabilizer [C] [E]	---	ASTM D3350	Min 2% carbon Black Color UV Stabilizer
Material Properties			
Flexural Modulus 2% Secant - 16:1 span; depth, 0.5 in / min	psi	ASTM D790	>110,000
Tensile Strength at Yield	psi	ASTM D638 Type IV	3200
Elongation at Break 2 in / min., Type IV bar	%	ASTM D638	>700
Elastic Modulus	psi	ASTM D638	>150,000
Hardness	Shore D	ASTM D2240	62
PENT	hrs	ASTM F1473	>100
Thermal Properties			
Vicat Softening Temperature	°F	ASTM D1525	256
Brittleness Temperature	°F	ASTM D746	-103
Thermal Expansion	in / in / °F	ASTM D696	1.0×10^{-4}

For more information and technical assistance contact:

Performance Pipe, a division of
Chevron Phillips Chemical Company LP
P.O. Box 269006
Plano, TX 75026-9006
800.527.0662

SUGGESTED INDUSTRIES AND APPLICATIONS

Potable Water Mains	Horizontal Directional Drilling (HDD)	Marine Service
Sliplining	Water transmission Lines	Pipe Bursting
Industrial Water Mains	Ash, Tailings & Abrasives	Mining
Municipal Water Utilities	Open-cut and Bury	Culverts
Rural Water Distribution	River Crossings	Plow-in
Mun. & Ind. Sewer	Trenchless Technologies	Crude oil
Fire Main Piping	Rural Water Distribution	Plow-in

Butt Fusion Conditions

- 60-90 psig (4.14-6.21 bar) interfacial fusion pressure.
- 400-450° (204-232°C) heater surface temperature range.
- Please refer to Performance Pipe's PE3608 (PE3408) fusion procedure, Bulletin PP 750.

Available Sizes

- ¾" through 54" IPS
- 4" through 36" DIPS

Specification Data

The resin, pipe and fitting listed may comply with one or more of the standards below.

Applicable Standards	DriscoPlex® Pipe Series	PE3608 (PE3408)	PE4710 (d_f)
ASTM F714, NSF 61, ASTM D3035	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
AWWA C906, AWWA C901	4000, 4100, 4200, 4300, 4400, 4500, 4600, 4700	0.5	0.63
FMA, AWWA, F714	1500, 1600	0.5	---
API 15LE, ASTM D2513			0.63

For more information and technical assistance contact:

Performance Pipe, a division of
Chevron Phillips Chemical Company LP
P.O. Box 269006
Plano, TX 75026-9006
800.527.0662

	6400	0.5	

PERFORMANCE PIPE
A Division of Chevron Phillips Chemical Company LP

Revised 03-17-2008

IPS Size and Dimension Data

PE3608 (PE3408)

DriscoPlex® Municipal & Industrial & Energy Series/IPS Pipe Data

Pressure Ratings are calculated using 0.50 design factor for HDS at 73°F as listed in PPI TR-4 for PE 3608 materials.
Temperature, Chemical, and Environmental use considerations may require use of additional design factors.

Pressure Rating		100 psi DR 17.0			80 psi DR 21.0			65 psi DR 26.0			50 psi DR 32.5			
IPS Pipe Size	Nominal OD (in)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	Minimum Wall (in)	Average ID (in)	Weight (lbs/ft)	IPS Pipe Size
1/2	1.660													1/2
3/4	1.900													3/4
1	2.375	0.140	2.078	0.43										1
1 1/4	3.500	0.206	3.063	0.93										1 1/4
1 1/2	4.500	0.265	3.938	1.54	0.206	4.046	1.26							1 1/2
→ 2	6.625	0.391	5.798	3.34	0.304	5.957	2.74	0.255	6.084	2.23	0.204	6.193	1.80	2
3	8.625	0.508	7.550	5.66	0.396	7.754	4.64	0.332	7.924	3.78	0.265	8.063	3.05	3
4	10.750	0.633	9.410	8.79	0.493	9.665	7.20	0.413	9.874	5.88	0.331	10.048	4.74	4
→ 5	12.750	0.750	11.160	12.36	0.585	11.463	10.13	0.490	11.711	8.27	0.392	11.919	6.67	5
6	14.000	0.824	12.253	14.90	0.642	12.586	12.22	0.538	12.859	9.97	0.431	13.086	8.04	6
7	16.000	0.941	14.005	19.47	0.734	14.385	15.96	0.615	14.696	13.02	0.492	14.957	10.51	7
8	18.000	1.059	15.755	24.64	0.826	16.183	20.20	0.692	16.533	16.48	0.554	16.826	13.30	8
9	20.000	1.176	17.507	30.42	0.917	17.982	24.94	0.769	18.370	20.35	0.615	18.696	16.42	9
10	22.000	1.294	19.257	36.81	1.009	19.778	30.17	0.846	20.206	24.62	0.677	20.565	19.86	10
11	24.000	1.412	21.007	43.80	1.101	21.577	35.91	0.923	22.043	29.30	0.738	22.435	23.64	11
12	26.000	1.529	22.759	51.41	1.192	23.375	42.14	1.000	23.880	34.39	0.800	24.304	27.74	12
13	28.000	1.647	24.508	59.62	1.284	25.174	48.87	1.077	25.717	39.88	0.862	26.173	32.17	13
14	30.000	1.765	26.258	68.44	1.376	26.971	56.11	1.154	27.554	45.78	0.923	28.043	36.93	14
15	32.000	1.882	28.010	77.87	1.467	28.769	63.84	1.231	29.390	52.09	0.985	29.912	42.02	15
16	34.000	2.000	29.760	87.91	1.559	30.568	72.06	1.308	31.227	58.80	1.046	31.782	47.44	16
17	36.000	2.118	31.510	98.55	1.651	32.366	80.79	1.385	33.064	65.92	1.108	33.651	53.19	17
18	42.000	2.471	36.761	134.14	1.926	37.760	109.97	1.615	38.576	89.73	1.292	39.261	72.39	18
20	48.000	2.824	42.013	175.21	2.201	43.154	143.63	1.846	44.086	117.19	1.477	44.869	94.55	20
24	54.000				2.476	48.549	181.78	2.077	49.597	148.32	1.662	50.477	119.67	24

Performance Pipe can produce to specialized pipe dimensions. Check with your Performance Pipe contact for availability of dimensions not listed.
Visit www.performancepipe.com for the most current literature.

INDEPENDENT PIPE PRODUCTS, INC.

"BETTER BY DESIGN"®

Elbow Design Information and End Options

The design basis for forge-molded elbows and fabricated segment elbows is well known. A 90 degree elbow is one-fourth of a torus (doughnut). The wedge removed from the straight pipe to make a miter-curve causes a force imbalance within the elbow. The ell tries to straighten out, sort of like a kink in a pressurized fire-hose. The ell must be derated or extra mass added to maintain the same pressure rating as the pipe itself. The heat-fusion welds are a focus point for the bending stress trying to straighten the ell. Continuous bend pipe without mitered fusion joints offer a higher pressure rating because there is no stress intensification factor (SIF) (i.e., no joints). Forge molded ells offer the same tight radius, no fusion joint flow turbulence, no miter joint stress intensification, and full pressure rating. Fabricated miter-ells have about the same radius of curvature, 4 turbulence amplifying fusion joints close together, and must be re-rated for WPR. The END OPTIONS for elbows include butt-end, flanged, and DIMJA.

ASME B31.3-1996 Edition

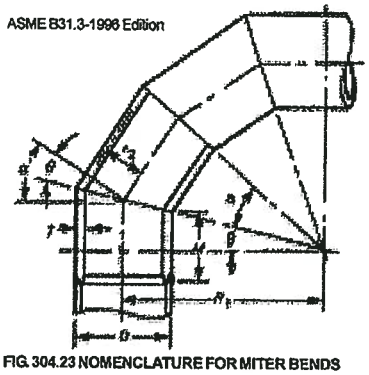


FIG. 304.23 NOMENCLATURE FOR MITER BENDS

The following nomenclature is used in the equations for pressure design of straight pipe.

- t_m = minimum required thickness, including mechanical, corrosion, and erosion allowances
- t = pressure design thickness, as calculated in accordance with para. 304.1.2 for internal pressure or as determined in accordance with para. 304.1.3 for external pressure
- c = the sum of the mechanical allowances (thread or groove depth) plus corrosion and erosion allowance". For threaded components, the nominal thread depth (dimension h of ASME B1.20.1, or equivalent) shall apply. For machined surfaces or grooves where the tolerance is not specified, the tolerance shall be assumed to be 0.5 mm (0.02 in.) in addition to the specified depth of the cut.
- T = pipe wall thickness (measured or minimum per purchase specification)
- d = inside diameter of pipe. For pressure design calculation, the inside diameter of the pipe is the maximum value allowable under the purchase specification.
- P = internal design gage pressure
- D = outside diameter of pipe as listed in tables of standards or specifications or as measured
- E = quality factor from Table A-1A or A-1B
- S = stress value for material from Table A-1
- Y= coefficient from Table 304.1.1, valid for $t < D/6$ and for materials shown. The value of Y may be interpolated for intermediate temperatures. For $t \geq D/6$.

$$y = \frac{d + 2c}{D + d + 2c}$$

Multiple Miter Bends. The maximum allowable internal pressure shall be the lesser value calculated from Eqs. (4a) and (4b). These equations are not applicable when θ exceeds 22.5 deg.

$$P_m = \frac{SE(T-c)}{r_2}\left(\frac{T-c}{(T-c) + 0.643 \tan\theta \sqrt{r_2(T-c)}}\right) \quad (4a)$$

$$P_m = \frac{SE(T-c)}{r_2}\left(\frac{R_1 - r_2}{R_1 - 0.5r_2}\right) \quad (4b)$$

(b) Single Miter Bends

(1) The maximum allowable internal pressure for a single miter bend with angle α not greater than 22.5 deg. shall be calculated by Eq. (4a).

(2) The maximum allowable internal pressure for a single miter bend with angle α greater than 22.5 deg. shall be calculated by Eq. (4c):

$$P_m = \frac{SE(T-c)}{r_2}\left(\frac{T-c}{(T-c) + 1.25 \tan\theta \sqrt{r_2(T-c)}}\right) \quad (4c)$$

c) The miter pipe wall thickness T used in Eqs. (4a), (4b), and (4c) shall extend a distance not less than M from the inside crotch of the end miter welds where

M = the larger of $2.5(r_2 T)^{0.5}$ or $\tan\theta\,(R_1 - r_2)$

The length of taper at the end of the miter pipe may be included in the distance M.

(d) The following nomenclature is used in Eqs. (4a), (4b), and (4c) for the pressure design of miter bends:

- c = same as defined in para. 304.1.1
- E = same as defined in para. 304.1.1
- P_m = maximum allowable internal pressure for miter bends
- r_2 = mean radius of pipe using nominal wall T
- R_1 = effective radius of miter bend, defined as the shortest distance from the pipe centerline to the intersection of the planes of adjacent miter joints
- S = same as defined in para. 304.1.1
- T = miter pipe wall thickness (measured or minimum per purchase specification)
- θ = angle of miter cut
- α = angle of change in direction at miter joint = 2θ

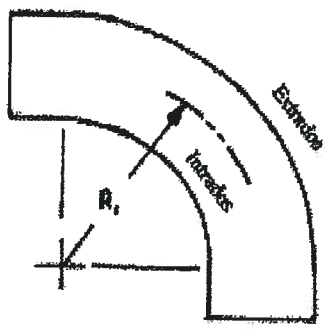
For compliance with this Code, the value of R_1 shall be not less than that given by Eq. (5):

$$R_1 = \frac{A}{\tan\theta} + \frac{D}{2} \quad (5)$$

where A has the following empirical values:

for U.S. customary units:

$\frac{(T-c), \text{in.}}{}$	$\frac{A}{}$
≤ 0.5	1.0
$0.5 < (T-c) < 0.88$	$2(T-c)$
≥ 0.88	$[2(T-c)/3] + 1.17$



$$I = \frac{PD}{((SEI) + PY)}$$

where at the intrados (inside bend radius)

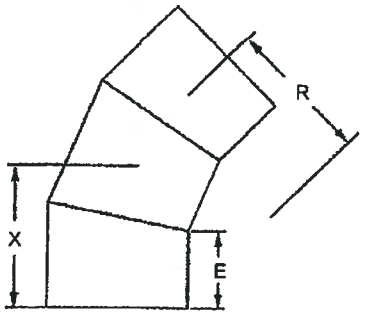
$$I = \frac{4(R/D) - 1}{4(R/D) - 2}$$

where at the extrados (outside bend radius)

$$I = \frac{4(R/D) - 1}{4(R/D) - 2}$$

and at the sidewall on the bend centerline radius, I=1.0.

R_1 = centerline radius of bend or elbow



IPS 45°
3 Segment Elbow
Fabricated (1/8 Bend)
(Dimensions in Inches)

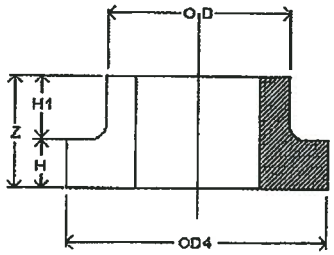
IPS Size	R/D Ratio	R	X	E	SDR	WPR (psi)	Weight (lbs)
2"	5.4	12.7	6.6	4.0	7 9 11&17	200 160 128/80	1.5 1 1
3"	3.8	13.2	6.8	4.0	7 9 11&17	200 160 128/80	3 2 2
4"	3.0	13.7	7.0	4.0	7 9 11&17	200 160 128/80	6 5 4
6"	2.2	14.7	9.4	6.0	7 9 11&17	200 160 128/80	1 11 9
8"	1.8	16.0	10.3	6.5	7 9 11 17	200 160 128 80	24 19 16 12
10"	1.6	17.0	10.7	8.0	7 9 11 17	200 160 128 80	39 32 26 18
12"	1.5	19.1	12.8	8.0	7 9 11 17	200 160 128 80	62 51 43 29
14"	1.5	21.0	13.2	8.0	7 9 11 17	200 160 128 80	79 64 53 36
16"	1.5	24.0	14.0	8.0	7 9 11 17	200 160 128 80	112 91 76 51
18"	1.5	27.0	14.7	8.0	7 9 11 17	200 160 128 80	146 119 101 68

• IPS 3 Segment 45's Continued Next Page •

Other sizes, DR's and custom radius ell's not listed are available - Call For Quick Quote

Sizes 24" and smaller meet AWWA C906 fitting requirements, sizes 26" and larger are quoted per fitting.

Stub Ends - Butt Fusion (Molded)

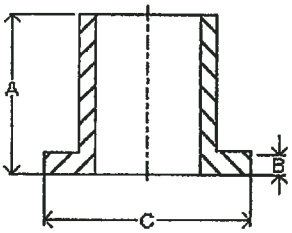


Dimensions

Nominal Pipe Size	OD	OD4	Z	H1	H	Rahn Part #: HDPE3408 Black	DR
1-¼" IPS	1.660	2.750	1.400	1.125	0.250	SE-125	DR9
1-½" IPS	1.900	3.000	1.500	1.250	0.250	SE-150	DR9
2" IPS	2.375	3.894	1.750	1.350	0.400	SE-2	DR7
3" IPS	3.500	4.900	2.250	1.560	0.690	SE-3	DR7
4" IPS	4.500	6.630	1.732	0.748	0.984	SE-4	DR9
5" IPS	5.563	7.543	2.008	1.024	0.984	SE-5	DR9
6" IPS	6.625	8.535	2.008	0.945	1.063	SE-6	DR9
8" IPS	8.625	10.760	2.244	0.984	1.260	SE-8	DR9
10" IPS	10.750	13.133	2.717	1.217	1.500	SE-10	DR7
12" IPS	12.750	15.525	3.150	1.400	1.750	SE-12	DR9
14" IPS	14.000	17.354	3.843	2.093	1.750	SE-14	DR9
16" IPS	16.000	19.317	3.937	1.575	2.362	SE-16	DR9
18" IPS	18.000	21.171	4.528	1.772	2.756	SE-18	DR9
20" IPS	20.000	23.435	4.724	1.968	2.756	SE-20	DR9

- Specify SDR required when ordering.

Flange Adapter - Butt Fusion (Molded)

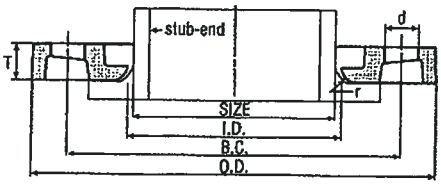


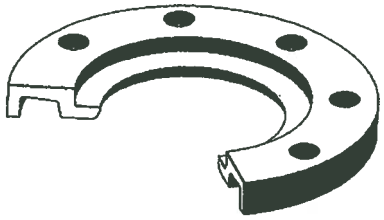
Dimensions

Nominal Pipe Size	A	B	C	Rahn Part #: HDPE3408 Black	DR
1-¼" IPS	6.000	0.250	2.750	3158B-125	DR9
1-½" IPS	6.000	0.275	3.125	3158B-150	DR9
2" IPS	6.000	0.450	3.875	3158B-2	DR7
3" IPS	6.000	0.600	5.000	3158B-3	DR5
4" IPS	6.000	1.000	6.600	3158B-4	DR5
4" DIPS	6.000	1.000	6.600	3158B-4-DIPS	DR9
5" IPS	8.000	1.100	7.515	3158B-5	DR9
6" IPS	8.000	1.100	8.500	3158B-6	DR5
6" DIPS	8.000	1.100	8.500	3158B-6-DIPS	DR9
8" IPS	9.000	1.500	10.600	3158B-8	DR7
10" IPS	12.000	1.500	12.750	3158B-10	DR9
12" IPS	12.000	1.775	15.500	3158B-12	DR9

BUP-SDR

Convoluted Flange/Backup Ring





- **Description** Utilizes the patented IPP Deltaflex® flange cross section.
- **Utilization** HDPE and PP thermoplastic piping systems.
- **Materials** Ductile iron, ASTM A536-84.
- **Dimensions** Mate with all 150 lb flanges, ANSI B16.5, B16.47, B16.1 AWWA C207.
- **Finish** Red oxide primed, hot dip galvanized, epoxy coated.

Pipe Diameter	IPP Product Code	Outside Dia. O.D.	Flange Thickness T	Inside Dia. I.D.	Bolt Count N	Dia. Bolt Hole B.D.	Bolt Circle B.C.	Radius r	Weight lbs/pc	Operating[1] Pressure
1/2"	BUP-SDR7-0050C	3.50	0.50	0.90	4	0.63	2.38	0.13	1.0	267
3/4"	BUP-SDR7-0075C	3.88	0.50	1.11	4	0.63	2.75	0.13	1.0	267
1"	BUP-SDR7-01C	4.25	0.56	1.38	4	0.63	3.13	0.13	1.0	267
1 1/4"	BUP-SDR7-0125C	4.63	0.63	1.72	4	0.63	3.50	0.19	2.0	267
1 1/2"	BUP-SDR7-0150C	5.00	0.69	1.97	4	0.63	3.88	0.25	2.0	267
2"	BUP-SDR7-02C	6.00	0.75	2.46	4	0.75	4.75	0.31	3.0	267
2"	BUP-SDR11-02B	6.00	0.50	2.63	4	0.75	4.75	0.20	1.5	160
2 1/2"	BUP-SDR7-0250C	7.00	0.88	2.97	4	0.75	5.50	0.31	4.0	267
3"	BUP-SDR7-03C	7.50	0.94	3.60	4	0.75	6.00	0.40	4.0	267
3"	BUP-SDR11-03B	7.50	0.53	3.75	4	0.75	6.00	0.28	2.5	160
4"	BUP-SDR7-04C	9.00	0.94	4.60	8	0.75	7.50	0.40	5.5	267
4"	BUP-SDR11-04B	9.00	0.55	4.75	8	0.75	7.50	0.28	3.5	160
5"	BUP-SDR7-05C	10.00	0.94	5.69	8	0.88	8.50	0.44	6.0	267
6"	BUP-SDR7-06C	11.00	1.00	6.75	8	0.88	9.50	0.40	7.0	267
6"	BUP-SDR11-06B	11.00	0.63	6.88	8	0.88	9.50	0.28	4.5	160
8"	BUP-SDR7-08C	13.50	1.12	8.75	8	0.88	11.75	0.40	11.0	267
8"	BUP-SDR11-08B	13.50	0.85	8.88	8	0.88	11.75	0.28	8.0	160
10"	BUP-SDR7-10C	16.00	1.19	10.92	12	1.00	14.25	0.40	16.0	267
10"	BUP-SDR11-10B	16.00	0.98	11.00	12	1.00	14.25	0.31	12.0	160
12"	BUP-SDR7-12C	19.00	1.50	12.92	12	1.00	17.00	0.40	23.0	267
12"	BUP-SDR9.3-12B	19.00	1.25	13.13	12	1.00	17.00	0.31	22.0	192
12"	BUP-SDR11-12B	19.00	1.25	13.13	12	1.00	17.00	0.28	20.0	160
14"	BUP-SDR7-14C	21.00	1.63	14.18	12	1.13	18.75	0.40	37.0	267
14"	BUP-SDR11-14B	21.00	1.38	14.38	12	1.13	18.75	0.31	30.0	160
16"	BUP-SDR7-16C	23.50	1.88	16.19	16	1.13	21.25	0.40	49.0	267

1. Operating pressure on an HDPE stub-end with a safety factor of 2.

Continued for sizes 16" through 63" on pg. 12

Technical Specifications Gabion

GABION
GALVANIZED & PVC COATED

FORWARD

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NOTES:

The following items have been changed or updated from previous versions. The current date of this specification is August 2005.

The following ASTM standards and specifications have been added or updated:

ASTM A975-97	Standard Specification for Double-Twisted Hexagonal Mesh Gabions and Revet Mattresses (Metallic-Coated Steel Wire or Metallic-Coated Steel Wire with Polyvinyl Chloride (PVC) Coating)
ASTM A641/A641M-03	Specification for Zinc Coated (Galvanized) Carbon Steel Wire
ASTM A370-97a	Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A313/A313M-98	Specification for Chromium-Nickel Stainless and Heat-Resisting Steel Spring Wire
ASTM A764-95(2001)	Specification for Steel Wire, Carbon, Drawn Galvanized and Galvanized at Size for Mechanical Springs
ASTM B117-97	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1242-95a	Standard Test Methods for Resistance of Plastic Materials to Abrasion
ASTM D1499-99	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics
ASTM D2240-04	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D412-98a	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
ASTM D746-04	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D792-00	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM G152-00	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-metallic Materials
UL 746B	Polymeric Materials-Long Term Property Evaluation

Gabion – Galvanized & PVC Coated
August 2005

1.0 Description

This work shall consist of furnishing, assembling, and filling woven wire mesh gabions with rock as specified in the contract to the dimensions, lines and grades shown on the plans, or as determined by the engineer. These specifications are in accordance with ASTM A975-97 and include gabions as manufactured for Maccaferri Canada Ltd.

2.0 Materials

2.1 Woven Mesh Gabions

2.1.1 Wire (Zinc Coated):

All tests on the wire must be performed prior to manufacturing the mesh.

- *Tensile strength*: both the wire used for the manufacture of gabions and the lacing wire, shall have a maximum tensile strength of 515 MPa, in accordance with ASTM A641/A641M-03.
- *Elongation*: the test must be carried out on a sample at least 300 mm long. Elongation shall not be less than 12%, in accordance with ASTM A370-97a.
- *Zinc coating*: minimum quantities of zinc according to ASTM A641/A641M-03, Class III soft temper coating.
- *Adhesion of zinc coating*: the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns around a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M-03.

2.1.2 PVC (Polyvinyl Chloride) Coating

- *Specific gravity*: 1.30-1.35 kg/dm^3, in accordance with ASTM D792-00, Table 1;
- *Hardness*: between 50 and 60 Shore D, according to ASTM D 2240-04;
- *Tensile strength*: not less than 20.6 MPa, according to ASTM D412-98a;
- *Modulus of elasticity*: not less than 18.6 MPa, according to ASTM D412-98a;
- *Abrasion resistance*: the percentage of the weight loss shall be less than 12%, according to ASTM D1242-95a.
- *Heat Aging Test*: prior to UV and abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:

- *Salt spray test*: test period 3,000 hours, test method ASTM B117-97;
- *Exposure to UV rays*: test period 3,000 hours at 63°C, test method ASTM D1499-99 and ASTM G152-00;
- *Brittleness temperature*: no higher than - 9°C, or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746-04.

The properties after aging tests shall be as follows:

- *Appearance of coated mesh*: no cracking, stripping or air bubbles, and no appreciable variation in color;
- *Specific gravity*: variations shall not exceed 6%;
- *Hardness*: variations shall not exceed 10%;
- *Tensile strength*: variations shall not exceed 25%;
- *Modulus of elasticity*: variations shall not exceed 25%;
- *Abrasion resistance*: variations shall not exceed 10%;
- *Brittleness temperature*: shall not exceed +18°C.

2.1.3 Galvanized and PVC coated wire mesh gabions (8 x 10 mesh type):

- *PVC coating thickness:* Nominal – 0.5 mm, Minimum – 0.38 mm
- *Mesh Wire*: Diameter – 2.70 mm internal, 3.70 mm external
- *Selvedge Wire*: Diameter – 3.40 mm internal, 4.40 mm external
- *Mesh Opening*: Nominal Dimension D = 83 mm, as per Fig. 1.

2.1.4 Galvanized and PVC coated lacing wire and internal stiffeners:

- *PVC coating thickness:* Nominal – 0.5 mm, Minimum – 0.38 mm
- *Lacing wire*: Diameter – 2.20 mm internal, 3.20 mm external
- *Cross Tie/Stiffener wire*: Diameter - 2.20 mm internal, 3.20 mm external
- *Preformed Stiffener:* Diameter – 3.40 mm internal, 4.40 mm external

2.1.5 Steel Mesh properties

- *Mesh Tensile Strength:* shall have a minimum strength of 42.3 kN/m when tested in accordance with ASTM A975 section 13.1.1.
- *Punch Test Resistance:* shall have a minimum resistance of 23.6 kN/m when tested in accordance with ASTM A975 section 13.1.4.
- *Connection to selvedges:* shall have a minimum resistance of 17.5 kN/m when tested in accordance with ASTM A975.

2.1.6 Spenax Fasteners (Overlapping Fasteners):

Overlapping stainless steel fasteners may be used in lieu of, or to complement, lacing wire for basket assembly and installation. The spacing of the fasteners during all phases of assembly and installation shall be in accordance with spacing based on 17.5 kN/m, pull apart resistance for PVC coated mesh tested in accordance with ASTM A975 section 13.1.2 and with a nominal spacing of 100 mm, and not to exceed 150 mm.

- *Stainless steel fasteners*: diameter: 3.05 mm, according to ASTM A313/A313M-98, Type 302, Class I.
- *Tensile strength:* 1530 to 1744 MPa in accordance with ASTM A313/A313M-98.
- *Proper installation of rings:* A properly formed Spenax fastener shall have a nominal overlap of 25mm after closure (Fig. 2).

2.2 Tolerances

- *Wire*: Zinc coating, in accordance with ASTM A641/A641M-03, Class III soft temper coating.
- *Gabions*: ± 5 % on the length, width, and height.
- *Mesh opening*: Tolerances on the hexagonal, double twisted wire mesh opening shall not exceed ± 10% on the nominal dimension D values (see Fig.1):

Fig. 1

Mesh Type	Nominal Dimension D
8 x 10	83 mm

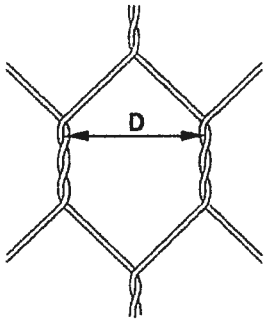
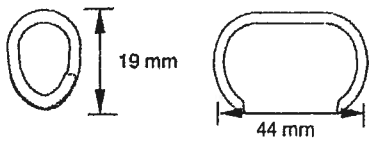


Fig. 2



Normal overlap of 25 mm after closure

2.3 Standard Unit Size

Table of sizes for gabions			
L=Length (m)	W=Width (m)	H=Height (m)	# of cells
2	1	1	2
3	1	1	3
4	1	1	4
2	1	0.5	2
3	1	0.5	3
4	1	0.5	4
2	1	0.3	2
3	1	0.3	3
4	1	0.3	4

All sizes and dimensions are nominal. Tolerances of ± 5% of the width, and length height, of the gabions shall be permitted.

2.4 Fabrication

Gablons shall be manufactured and shipped with all components mechanically connected at the production facility. The front, base, back and lid of the gabions shall be woven into a single unit. The ends and diaphragm(s) shall be factory connected to the base. All perimeter edges of the mesh forming the basket and top, or lid, shall be selvedged with wire having a larger dlameter.

The gabion is divided into cells by means of diaphragms positioned at approximately 1 m centers. The diaphragms shall be secured in position to the base so that no additional lacing is necessary at the jobsite. See Figure 3.

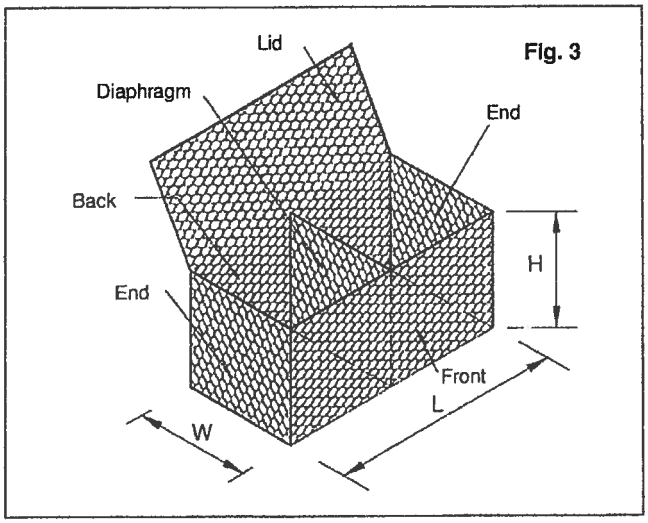


Fig. 3

2.5 Rock

The rock for gabions shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. Gabion rocks shall range between 100 mm and 200 mm. The range in sizes shall allow for a variation of 5% oversize and/or 5% undersize rock, provided it is not placed on the

gabion exposed surface. The size shall be such that a minimum of three layers of rock must be achieved when filling a 1m high gabion.

3.0 Construction Requirements

3.1 Assembly

Gabions are supplied folded flat and packed in bundles. The units are assembled individually by erecting the sides, ends, and diaphragms, ensuring that all panels are in the correct position, and the tops of all sides are aligned. The four corners shall be connected first, followed by the internal diaphragms to the outside walls. All connections should use lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.6.

The procedure for using lacing wire consists of cutting a sufficient length of wire, and first looping and/or twisting to secure the lacing wire to the wire mesh. Proceed to lace with alternating double and single loops through every mesh opening approximately every 150 mm, pulling each loop tight and finally securing the end of the lacing wire to the wire mesh by looping and/or twisting.

The use of fasteners shall be in accordance with the manufacturer's recommendations as specified in Section 2.1.6.

3.2 Installation

After initial assembly, the gabions are carried to their final position and are securely joined together along the vertical and top edges of their contact surfaces using the same connecting procedure(s) described in Section 3.1. Whenever a structure requires more than one layer, the upper empty baskets shall also be connected to the top of the lower layer along the front and back edges of the contact surface using the same connecting procedure(s) described in Section 3.1.

3.3 Filling

Gabions shall be filled with rock as specified in Section 2.4. During the filling operation some manual stone placement is required to minimize voids. The exposed faces of vertical structures shall be carefully hand placed to give a neat, flat, and compact appearance. Care shall be taken when placing fill material to ensure that the sheathing on the PVC coated baskets is not damaged.

The cells shall be filled in stages so that local deformation may be avoided. That is, at no time shall any cell be filled to a depth exceeding 300 mm higher than the adjoining cell. It is also recommended to slightly overfill the baskets by 25 to 50 mm to allow for settlement of the rock. Behind gabion walls, compact the backfill material simultaneously to the same level as the filled gabions.

3.4 Internal Connecting Wires

MacTie preformed stiffeners or lacing wire can be used as internal connecting wires when a structure requires more than one layer of gabions to be stacked on top of each other. Internal Connecting Wires with lacing wire shall connect the exposed face of a cell to the opposite side of the cell. Internal Connecting Preformed stiffeners shall connect the exposed face of a cell to the adjacent side of the cell. Preformed stiffeners are installed at 45° to the face/side of the unit, extending an equal distance along each side to be braced (approximately 300 mm). An exposed face is any side of a gabion cell that will be exposed or unsupported after the structure is completed.

3.4.1 1 m High Gabions

1 m high gabions shall be filled in three layers, 300 mm at a time. Connecting wires/bracings shall be installed after the placement of each layer, that is, at 300 mm high and 600 mm high.

3.4.2 0.5 m High Gabions

0.5 m high gabions do not require connecting wires/bracings unless the baskets are used to build vertical structures. In some cases, these units shall be filled in two layers, 250 mm at a time. Connecting wires shall be installed after the placement of the first layer, which is at 250 mm high.

3.5 Lid Closing

Once the gabion baskets are completely full, the lids will be pulled tight until the lid meets the perimeter edges of the basket. A tool such as a lid closer can be used. The lid must then be tightly laced and/or fastened along all edges, ends and tops of diaphragm(s) in the same manner as described in Section 3.1.

3.6 Mesh cutting and folding

Where shown on the drawings or otherwise directed by the engineer, the gabions shall be cut, folded and fastened together to suit site conditions. The mesh must be cleanly cut and surplus mesh either folded back or overlapped so that it can be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped gabions shall be assembled, installed, filled and closed as specified in the previous sections.

4.0 Method of Measurement

4.1 The payment quantities for excavation shall be determined by the outside limits of the gabion structure. Quantities will be determined from cross sections and the linear distance, and paid for under the appropriate excavation bid items.

4.2 The quantity to be paid for "In place gabions" shall be the number of cubic meters of gabions measured in their final position. Project conditions and material availability will determine the actual size of gabions to be used.

4.3 Excavated material beyond the limits of the gabions shall be backfilled with gravel, crushed rock or other material approved by the engineer.

4.4 This bid price shall include the installed in place cost of all materials, equipment, and labor, including gabions, rock, and backfill material.

5.0 Basis of Payment

Accepted gabions will be paid for at the unit price for each pay item included in the contract.

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MACCAFERRI

Maccaferri Canada Ltd.

TECHNICAL DATA SHEET

MACTEX
MX225S NONWOVEN GEOTEXTILE

MacTex MX225S is a needle-punched nonwoven geotextile made of 100% polypropylene staple fibres, which are formed into a random network for dimensional stability. MacTex MX225S resists ultraviolet deterioration, rotting, biological degradation, naturally encountered basics and acids. Polypropylene is stable within a pH range of 2 to 13. MacTex MX225S conforms to the physical property values listed below:

PROPERTY	TEST METHOD	UNIT	M.A.R.V. (Minimum Average Roll Value)
Weight (Typical)	ASTM D 5261	g/m^2	203
Grab Tensile	ASTM D 4632	kN	0.711
Grab Elongation	ASTM D 4632	%	50
Trapezoid Tear Strength	ASTM D 4533	kN	0.289
Puncture Resistance	ASTM D 4833	kN	0.40
Mullen Burst Strength	ASTM D 3786	kPa	2170
Permittivity*	ASTM D 4491	sec^{-1}	1.6
Water Flow*	ASTM D 4491	$l/min/m^2$	4480
AOS*	ASTM D 4751	US Sieve (mm)	70 (0.212)
UV Resistance	ASTM D 4355	%/hrs	70/500

PACKAGING	
Roll Dimensions (W x L) – m	3.81 x 109.8/ 4.57 x 91.5
Square Metres Per Roll	418
Estimated Roll Weight – kgs	88.6

* At the time of manufacturing. Handling may change these properties.

Seller makes no warranty, express or implied, concerning the product furnished hereunder other than at the time of delivery it shall be of the quality and specifications stated herein. *ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS EXPRESSLY EXCLUDED AND, TO THE EXTENT THAT IT IS CONTRARY TO THE FOREGOING SENTENCE ANY IMPLIED WARRANTY OF MERCHANTABILITY IS EXPRESSLY EXCLUDED.* Any recommendations made by the Seller concerning uses or applications of said product are believed reliable, and Seller makes no warranty of results to be obtained. The technical information supplied for this product type is subject to change at any time without notice.

This Data Sheet supercedes all previous Data Sheets for this style and is subject to change without notice.

MTEX-MX225S 09/04

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Vancouver, BC tel: 604-683-4824

GABION MAT
GALVANIZED & PVC COATED

FORWARD

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ASTM B117-97	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1242-95a	Standard Test Methods for Resistance of Plastic Materials to Abrasion
ASTM D1499-99	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Plastics
ASTM D2240-04	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D412-98a	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
ASTM D746-04	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM D792-00	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM G152-00	Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-metallic materials.
UL 746B	Polymeric Materials- Long Term Property Evaluation

Gabion Mat-Galvanized & PVC Coated
April 2006

1.0 Description

This work shall consist of furnishing, assembling and filling woven wire mesh containers with rock to form gabion mats as specified in the contract in conformity with the dimensions, lines and grades shown on the plans, or as determined by the engineer and manufacturer.

2.0 Materials

2.1 Woven Mesh Gabion Mats

2.1.1 Wire (Zinc Coated)

All tests on wire must be performed prior to manufacturing the mesh.

- *Tensile strength:* both the wire used for the manufacture of gabion mats and the lacing wire, shall have a maximum tensile strength of 38 – 48 kg/mm^2, in accordance with ASTM A641-97.
- *Elongation:* the test must be carried out on a sample at least 30 cm long. Elongation shall not be less than 12%, in accordance with ASTM A370-97a.
- *Zinc coating:* minimum quantities of zinc according to ASTM A641/A641M-03, Class III soft temper coating.
- *Adhesion of zinc coating:* the adhesion of the zinc coating to the wire shall be such that, when the wire is wrapped six turns round on a mandrel having four times the diameter of the wire, it does not flake or crack when rubbing it with the bare fingers, in accordance with ASTM A641/A641M-03 for zinc coating.

2.1.2 PVC (Polyvinyl Chloride) Coating

When specified in the plans:

- *Specific gravity:* 1.30-1.35 kg/dm^3, in accordance with ASTM D792-00, Table 1,
- *Hardness:* between 50 and 60 Shore D, according to ASTM D2240-04,
- *Tensile strength:* not less than 20.6 MPa, according to ASTM D412-98a,
- *Modulus of elasticity:* not less than 18.6 MPa, in accordance with ASTM D412-98a,
- *Abrasion resistance:* the percentage of the weight loss shall be less than 12%, according to ASTM D1242-95a.
- *Heat Aging Test*: prior to UV and Abrasion degradation, the PVC polymer coating shall have a projected durability life of 60 years when tested in accordance with UL 746B.

The accelerated aging tests are:

- *Salt spray test:* test period 3,000 hours, test method ASTM B117-97,
- *Exposure to UV rays:* test period 3,000 hours at 63°C, test method ASTM D1499-99 and ASTM G152-00.
- *Brittleness temperature:* no higher than - 9°C, or lower temperature when specified by the purchaser, when tested in accordance with ASTM D746-04.

The properties after aging tests shall be as follows:

- *Appearance of coated mesh:* no cracking, stripping or air bubbles, and no appreciable variation in color;
- *Specific gravity:* variations shall not exceed 6%;
- *Hardness:* variations shall not exceed 10%;
- *Tensile strength:* variations shall not exceed 25%;
- *Modulus of elasticity:* variations shall not exceed 25%;
- *Abrasion resistance:* variations shall not exceed 10%;
- *Brittleness temperature:* shall not exceed +18°C.

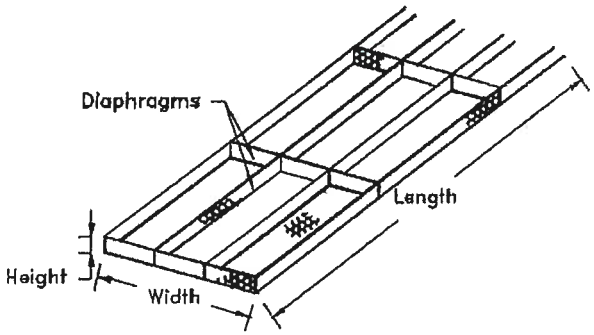
2.3 Standard Unit Size

Table of sizes for gabion mats			
L=Length (m)	W=Width (m)	H=Height (m)	# of cells
30	2	0.23	20
30	3	0.23	30
30	2	0.3	20
30	3	0.3	30

2.4 Fabrication

Gabion mattresses shall be manufactured with all components mechanically connected at the production facility with the exception of the lid, which is produced separately from the base. The base, sides and ends of the gabion mats shall be woven into a single unit. The diaphragms are connected to the base in the factory. All perimeter edges of the mesh forming the base and lid shall be selvedged with selvedge wire.

The gabion mat is divided into cells by means of diaphragms. The diaphragms create cells of 1 m by 3 m. The diaphragms shall be secured in position of the base so that no additional tying is necessary at the jobsite.



2.5 Rock

All rock shall be hard, angular to round, durable and of such quality that they shall not disintegrate on exposure to water or weathering during the life of the structure. Also, the size shall be such that a minimum of two layers of rock can be achieved when filling any gabion mat. Any rock smaller than the minimum size can not be less than 5% by weight; any rock greater than the maximum size can not be greater than 5% by weight, provided it is not on the exposed surface of the gabion mat.

- Gabion Mat rock shall be in the full range size of the lower and upper limits - 100-200 mm.

3.0 Construction Requirements

3.1 Assembly

Gabion mats are supplied in rolls, the base in one roll and the lid in another. The units shall be assembled individually by erecting the sides, ends and diaphragms ensuring that all panels are in the correct position and the tops of all sides are aligned. The four corners of the unit shall be connected first, followed by the internal diaphragms to the sides. All connections should be accomplished using lacing wire or fasteners as previously described in Section 2.1.4 and Section 2.1.5.

The recommended procedure to apply lacing wire consists of first cutting a sufficient length of wire. Secure one end of the wire by looping and twisting, then proceed to lace with alternating single and double loops every mesh opening (approximately every 100 mm) and securely fasten the other end of the lacing wire.
The installation of the fasteners specified in Section 2.1.5 shall be in accordance with the manufacturer's recommendations.

3.2 Installation

Initial assembly should occur with the gabion mats in their final position. The adjacent empty mats must be securely joined together using the same connecting procedure(s) described in Section 3.1 along the vertical and top edges of their contact surfaces.

3.3 Filling

Gabion mats shall be filled with rock as specified in Section 2.5. During the filling operation or placement some manual stone is required to minimize voids. Care shall be taken when placing fill material to ensure that the PVC sheathing is not damaged.

The cells in any row shall be filled in stages so that local deformation may be avoided. It is also recommended to slightly overfill the baskets 25 to 50 mm to allow for settlement of the rock.

3.4 Lid Closing

Once the mats are completely full, the lids shall be pulled tight using a tool such as a lid closer until the lid meets the perimeter edges of the mattress. The lid shall then be tightly laced and/or fastened along all edges, ends and tops of diaphragms in the same manner as described in Section 3.1.

3.4 Mesh cutting and folding

Where shown on the drawings or otherwise directed by the engineer, the gabion mat mesh shall be cut, folded and fastened together to suit existing site conditions. The mesh must be cleanly cut and the surplus mesh folded back and neatly wired to an adjacent gabion mat. The cut edges of the mesh shall be securely fastened together with lacing wire or fasteners in the manner described in Section 3.1. Any reshaped gabion mats shall be assembled, installed, filled and closed as specified in the previous sections.

4.0 Method of Measurement

4.1 The pay limits for excavation of gabion mats shall be a line coincident with the bottom and non-exposed side of the mattresses. Excavation quantities will be determined from the cross sections and paid for under the appropriate classified excavation items.

4.2 The quantity to be paid for "In Place Gabion Mats" shall be the number of square meters of mattresses measured in their final position. Job conditions and availability will determine the actual size of gabion mats to be used.

4.3 Excavated material beyond the limits of the mats shall be backfilled with gravel, crushed rock or other material meeting the approval of the engineer.

4.4 This bid price shall include the cost of furnishing all labor, materials, and equipment including mattresses, rock, and backfill material installed in place.

5.0 Basis of Payment

Accepted gabion mats will be paid for at the unit price for each of the pay items included in the contract.

Headquarters:	**MACCAFERRI INC.**	Halifax, NS	tel: 902-468-8615
400 Collier MacMillan Drive, Unit B		Montréal, QC	tel: 450-420-1845
Cambridge, ON, N1R 7H7	e-mail: hq@maccaferri-canada.com	Edmonton, AB	tel: 780-447-2719
tel: 519-623-9990 / fax: 519-623-1309	Website: www.maccaferri.com	Vancouver, BC	tel: 604-683-4824

Technical Specifications Bentofix

BENTOFIX TECHNOLOGIES, INC.

23 Truman Road
Barrie, ON L4M 6E7 Canada

Tel: 705-726-1938
Fax: 705-726-8860

BENTOFIX® MANUFACTURING CERTIFICATION

CUSTOMER: TERRAFIX GEOSYNTHETICS, INC.

PROJECT: TERRAFIX- QUEBEC CITY **# ROLLS:** 80

ORDER NO.: BH-07-24/08 **PRODUCT TYPE:** BENTOFIX® NWL

Bentofix Technologies, Inc. hereby certifies that the Bentofix® Geosynthetic Clay Liner purchased and shipped for the above referenced project does meet or exceed Bentofix Technologies, Inc.'s specifications for Bentofix®.

The Bentofix® product has been continuously inspected for the presence of needles and is certified to be needle free.

BENTONITE testing was performed as follows:

Swell Index	ASTM D 5890	1/100,000 lbs (50,000 kg)
Moisture Content	ASTM D 4643	1/100,000 lbs (50,000 kg)
Fluid Loss	ASTM D 5891	1/100,000 lbs (50,000 kg)

GEOTEXTILE testing on the raw materials was performed as follows:

Mass Per Unit Area	ASTM D 5261	1/200,000 ft² [20,000 mt²]

GEOSYNTHETIC CLAY LINER testing on the finished product was performed as follows:

Bentonite Mass Per Unit Area	ASTM D 5993	1/40,000 ft² [4,000 mt²]
Grab Tensile/Elongation / Peel Strength	ASTM D 4632	1/40,000 ft² [4,000 mt²]
Hydraulic Conductivity	ASTM D 5084	Weekly
Index Flux	ASTM D 5887	Weekly
**certified to meet the required specification of < 1x 10^{-9} $m^3/m^2/s$*		
Internal Shear	ASTM D 6243	Periodically
** hydrated 24 hours and sheared under 200 psf normal stress is certified to be 500 psf*		

The LOT and ROLL numbers for this shipment are as follows:

LOT# 18072504—

ROLL# — SEE ATTACHED—

BENTOFIX LAB APPROVAL

7-29-08.
DATE

[redacted]

BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD
BARRIE, ON L4M 6E7

TEL: 705-725-1938
FAX: 705-725-8860

BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY
LOT # 18072504
STYLE: NWL
DATE: JULY 28, 2008.

	BENTOFIX ROLL #	LENGTH (m)	WIDTH (m)
1	110301	45.72	4.72
2	110302	45.72	4.72
3	110303	45.72	4.72
4	110304	45.72	4.72
5	110305	45.72	4.72
6	110306	45.72	4.72
7	110307	45.72	4.72
8	110308	45.72	4.72
9	110309	45.72	4.72
10	110310	45.72	4.72
11	110311	45.72	4.72
12	110312	45.72	4.72
13	110313	45.72	4.72
14	110314	45.72	4.72
15	110315	45.72	4.72
16	110316	45.72	4.72
17	110317	45.72	4.72
18	110318	45.72	4.72
19	110319	45.72	4.72
20	110320	45.72	4.72
21	110321	45.72	4.72
22	110322	45.72	4.72
23	110323	45.72	4.72
24	110324	45.72	4.72
25	110325	45.72	4.72
26	110326	45.72	4.72
27	110327	45.72	4.72
28	110328	45.72	4.72
29	110329	45.72	4.72
30	110330	45.72	4.72

[redacted]

BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD
BARRIE, ON L4M 6E7

TEL: 705-725-1938
FAX: 705-725-8860

BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY
LOT # 18072504
STYLE: NWL
DATE: JULY 28, 2008.

	BENTOFIX ROLL #	LENGTH (m)	WIDTH (m)
31	110331	45.72	4.72
32	110332	45.72	4.72
33	110333	45.72	4.72
34	110334	45.72	4.72
35	110335	45.72	4.72
36	110336	45.72	4.72
37	110337	45.72	4.72
38	110338	45.72	4.72
39	110339	45.72	4.72
40	110340	45.72	4.72
41	110341	45.72	4.72
42	110342	45.72	4.72
43	110343	45.72	4.72
44	110344	45.72	4.72
45	110345	45.72	4.72
46	110346	45.72	4.72
47	110347	45.72	4.72
48	110348	45.72	4.72
49	110349	45.72	4.72
50	110350	45.72	4.72
51	110351	45.72	4.72
52	110352	45.72	4.72
53	110353	45.72	4.72
54	110354	45.72	4.72
55	110355	45.72	4.72
56	110356	45.72	4.72

[redacted]

BENTOFIX TECHNOLOGIES, INC.

23 TRUMAN ROAD
BARRIE, ON L4M 6E7

TEL: 705-725-1938
FAX: 705-725-8860

BENTOFIX ROLL LIST

PROJECT: TERRAFIX-QUEBEC CITY
LOT # 18072504
STYLE: NWL
DATE: JULY 28, 2008.

	BENTOFIX ROLL #	LENGTH (m)	WIDTH (m)
57	110357	45.72	4.72
58	110358	45.72	4.72
59	110359	45.72	4.72
60	110360	45.72	4.72
61	110361	45.72	4.72
62	110362	45.72	4.72
63	110363	45.72	4.72
64	110364	45.72	4.72
65	110365	45.72	4.72
66	110366	45.72	4.72
67	110367	45.72	4.72
68	110368	45.72	4.72
69	110369	45.72	4.72
70	110370	45.72	4.72
71	110371	45.72	4.72
72	110372	45.72	4.72
73	110373	45.72	4.72
74	110374	45.72	4.72
75	110375	45.72	4.72
76	110376	45.72	4.72
77	110377	45.72	4.72
78	110378	45.72	4.72
79	110379	45.72	4.72
80	110380	45.72	4.72

[redacted]

BENTOFIX TECHNOLOGIES INC.

Quality Control Certificate

Lot #	Roll #	Date Produced	Product	Length	Width	BOL#
18072504	110301	7/25/2008	BENTOFIX NWL	150.00 ft 45.72 m	15.5 ft 4.72 m	

	Type	NWL		
GCL Mass Per Unit Area ASTM D 5993		5,009	g/m²	1.025 lb/ft²
Grab Tensile Strength ASTM D 4632		106	kg	233.7 lb
Elongation		113	%	
Peel Strength ASTM D 4632 mod		15.2	kg	33.5 lb
Hydraulic Conductivity ASTM D 5887		$<5x10^{-9}$	cm/s	
Index Flux ASTM D 5887		$<1x10^{-8}$	m³/m²/s	

	Type	Non-Woven		
	Lot #	080716205B-2		
Mass Per Unit Area ASTM D 5261		249	g/m²	7.34 oz/yd²

	Type	Non-Woven		
	Lot #	080717215B		
Mass Per Unit Area ASTM D 5261		221	g/m²	6.52 oz/yd²

	Lot #	422193		
Moisture Content ASTM D 4643		7.50	%	
Swell Index ASTM D 5890		30.0	ml	
Fluid Loss ASTM D 5891		15.6	ml	
Bentonite Mass Per Unit Area @ 0% mc ASTM D 5993		4,199	g/m²	0.859 lb/ft²

BENTOFIX TECHNOLOGIES INC.

Quality Control Certificate

Lot #	Roll #	Date Produced	Product	Length	Width	BOL#
18072504	110301	7/25/2008	BENTOFIX NWL	150.00 ft 45.72 m	15.5 ft 4.72 m	

Type	NWL		
GCL Mass Per Unit Area ASTM D 5993	5,009 g/m²	1.025 lb/ft²	
Grab Tensile Strength ASTM D 4632	106 kg	233.7 lb	
Elongation	113 %		
Peel Strength ASTM D 4632 mod	15.2 kg	33.5 lb	
Hydraulic Conductivity ASTM D 5887	$<5x10^{-9}$ cm/s		
Index Flux ASTM D 5887	$<1x10^{-8}$ m³/m²/s		

Type	Non-Woven		
Lot #	080716205B-2		
Mass Per Unit Area ASTM D 5261	249 g/m²	7.34 oz/yd²	

Type	Non-Woven		
Lot #	080717215B		
Mass Per Unit Area ASTM D 5261	221 g/m²	6.52 oz/yd²	

Lot #	422193		
Moisture Content ASTM D 4643	7.50 %		
Swell Index ASTM D 5890	30.0 ml		
Fluid Loss ASTM D 5891	15.6 ml		
Bentonite Mass Per Unit Area @ 0% mc ASTM D 5993	4,199 g/m²	0.859 lb/ft²	

BENTOFIX TECHNOLOGIES INC.

Quality Control Certificate

Lot #	Roll #	Date Produced	Product	Length	Width	BOL#
18072504	110349	7/28/2008	BENTOFIX NWL	150.00 ft 45.72 m	15.5 ft 4.72 m	

	Type	NWL		
GCL Mass Per Unit Area ASTM D 5993		4,937	g/m²	1.011 lb/ft²
Grab Tensile Strength ASTM D 4632		96	kg	211.6 lb
Elongation		101	%	
Peel Strength ASTM D 4632 mod		15.1	kg	33.3 lb
Hydraulic Conductivity ASTM D 5887		$<5x10^{-9}$	cm/s	
Index Flux ASTM D 5887		$<1x10^{-8}$	m³/m²/s	

Type	Non-Woven		
Lot #	080722205B		
Mass Per Unit Area ASTM D 5261	250	g/m²	7.37 oz/yd²

Type	Non-Woven		
Lot #	080717215B		
Mass Per Unit Area ASTM D 5261	221	g/m²	6.52 oz/yd²

Lot #	422193		
Moisture Content ASTM D 4643	7.50	%	
Swell Index ASTM D 5890	30.0	ml	
Fluid Loss ASTM D 5891	15.6	ml	
Bentonite Mass Per Unit Area @ 0% mc ASTM D 5993	4,131	g/m²	0.846 lb/ft²

BENTOFIX TECHNOLOGIES INC.

Quality Control Certificate

Lot #	Roll #	Date Produced	Product	Length	Width	BOL#
18072504	110365	7/28/2008	BENTOFIX NWL	150.00 ft 45.72 m	15.5 ft 4.72 m	

	Type	NWL		
GCL Mass Per Unit Area ASTM D 5993		4,970 g/m²	1.017	lb/ft²
Grab Tensile Strength ASTM D 4632		92 kg	202.8	lb
Elongation		116 %		
Peel Strength ASTM D 4632 mod		9.5 kg	20.9	lb
Hydraulic Conductivity ASTM D 5887		$<5x10^{-9}$ cm/s		
Index Flux ASTM D 5887		$<1x10^{-8}$ m³/m²/s		

Type	Non-Woven		
Lot #	080722205B		
Mass Per Unit Area ASTM D 5261	250 g/m²	7.37	oz/yd²

Type	Non-Woven		
Lot #	080717215B		
Mass Per Unit Area ASTM D 5261	221 g/m²	6.52	oz/yd²

Lot #	422193		
Moisture Content ASTM D 4643	7.50 %		
Swell Index ASTM D 5890	30.0 ml		
Fluid Loss ASTM D 5891	15.6 ml		
Bentonite Mass Per Unit Area @ 0% mc ASTM D 5993	4,162 g/m²	0.852	lb/ft²

BENTOFIX TECHNOLOGIES, INC.

23 Truman Road
Barrie, ON
L4M 6E7 Canada

TEL: 705-726-1938
FAX: 705-726-8860

PROJECT: TERRAFIX-QUEBEC CITY
LOT # : 18072504

BENTONITE LABORATORY ANALYSIS

DATE:	July 25, 2008.	**RAILCAR #:**	BNSF 422193
SUPPLIER:	LOVELL, WY.	**TYPE:**	BARAKADE LD 30

SAMPLE #: 1

1. Moisture content according to ASTM D2216 mod:

   % of moisture = 7.5

2. Swell Test according to ASTM D5890:

   Swell Index = 30 ml/2g

3. Fluid loss according to ASTM D5891:

   Fluid Loss = 15.6 ml

SAMPLE #: 2

1. Moisture content according to ASTM D2216 mod:

   % of moisture = 8.7

2. Swell Test according to ASTM D5890:

   Swell Index = 31 ml / 2g

3. Fluid loss according to ASTM D5891:

   Fluid Loss = 16.0 ml

TESTING COMPLETED BY: DAMON WHEELER

[redacted]

Technical Specifications Thermistors

INSTRUCTION MANUAL

THERMISTOR STRING

Model TH-C

This product should be installed and operated only by qualified personnel. Its misuse is potentially dangerous. The Company makes no warranty as to the information furnished in this manual and assumes no liability for damages resulting from the installation or use of this product. The information herein is subject to change without notification.

Tel.: 1.450.465.1113 • 1.877.ROCTEST (Canada, USA) • 33 (1) 64.06.40.80 (Europe) • www.roctest.com • www.telemac.fr

E1133E-17062010

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1 PRODUCT

1.1 GENERAL DESCRIPTION

Roctest manufactures a thermistor string to measure the temperature at different deepness's. The thermistor string is a multi-conductor cable with individual temperature sensors distributed along the cable. The chains can be submerged underwater as well as underground. The cable is flexible even at low temperature. The thermistor arrays are customizable to the customer needs.

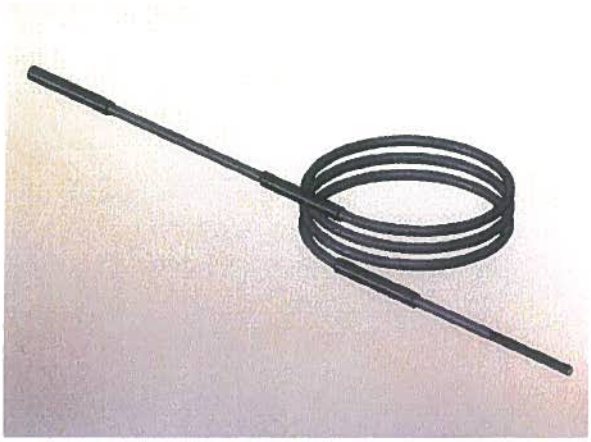

Figure 1: TH-C Thermistor String

The string is made of a thermistor embedded in a PVC cable. The sensor location is reinforced to mechanically protect the assembly. The encapsulation is flexible in order to compensate for the pressure and the deformation of the cable insulation. This compensation is required in order to be submersible, according to IP68. The thermistor used in the string has a good stability over time. The temperature value can be obtained from a portable handheld readout instrument or a complete datalogger system.

1.2 SPECIFICATIONS

- Operating temperature range: -40°C to +85°C
- Submersible up to 200m deep (IP68)
- Can be buried underground
- Accuracy up to ± 0.05°C (depends on the choice of the thermistor)
- Up to 22 sensors per cable
- Temperature drift at 25°C: less than 0.01°C after 100 months
- Rugged assembly
- Maximum diameter of the string cable: 20mm

1.3 OPERATION PRINCIPLE

The heart of the TH-C is a miniature thermistor. Temperature changes affect the resistance of the device, following a law described later in the manual.

Note: The standard thermistor used in the TH-C sensor is a 3 kΩ thermistor.

2 READING PROCEDURE

Different readout procedures can be used to get the temperature from the sensor resistance.

2.1 MB-6T READOUT UNIT

The MB-6T(L) readout unit reads the thermistor integrated in the gage, then converts the resistance value into temperature and displays the temperature in °C and °F.

Connect the jumper cable into the sockets on the front panel of the MB-6T(L). Connect the alligator clips on the jumper cable to the TH-C cable according to the pinout in the drawing provided with the equipment. The pinout and the layout is subject to change depending on the number of thermistor

Connect the shield socket on the MB-6T(L) front to the cable shield using the single lead jumper cable.

The jumper cable should never be short-circuited when it is connected to the readout unit front panel.

Depending of the type of thermistor used in the gage, switch the thermistor selector on the MB-6T(L) to the correct position, using the following table. Otherwise, position the selector on D and record the resistance value. The latter is to be converted subsequently, using conversion tables or polynomial equation appropriate to the thermistor type.

Selector position	Function
A	2 kΩ thermistor
B	3 kΩ thermistor
C	10 kΩ thermistor
D	Ohmmeter mode

Table 2: Thermistor type or function vs. Selector position

For complete details about the MB-6T(L) readout, please refer to its instruction manual.

2.2 OHMMETER

An ohmmeter may also be used to monitor the TH-C gage. Zero the ohmmeter by connecting together its two connecting wires.

Measure the resistance between the thermistor wires (refer to the drawing provided with the equipment). Convert the reading in ohms to temperature using conversion tables or polynomial equation appropriate to the thermistor type.

2.3 SENSLOG DATA ACQUISITION SYSTEM

The TH-C can also be read using a SENSLOG data acquisition system. The latter reads a V_{out} output, then converts it in ohms according to the following relation:

$$R_T = R_{25} \cdot \left(\frac{A}{V_{out}} - B \right)$$

where R_T = resistance in ohms

R_{25} = resistance in ohms at 25°C depending of the type of thermistor used (2 000, 3 000 or 10 000 Ω)

A, B = conversion factors depending on the type of thermistor

V_{out} = voltage output in volts

	Thermistor type		
	2 kΩ	3 kΩ	10 kΩ
A	6.25	4.17	1.25
B	3.0	2.0	0.6

Table 3: Conversion factors vs. Thermistor types

Example:

With V_{out} = 1.00 V

R_{25} = 3 000 Ω (3 kΩ thermistor)

We get $R_T = 3000 \cdot \left(\frac{4.17}{1.00} - 2.0 \right) = 6\ 510\ \Omega$

2.4 QUICK VERIFICATION OF MEASUREMENTS

On site, even before converting raw readings into engineering values, several checks can be done to prevent a bad measurement.

- Compare readings to previous ones. Are they in the same range? Are they changing slowly or abruptly? Consider external factors that can affect the measurements like construction activities, excavations or fills...

- In any case, it is advised to take several readings to confirm the measurement. Then, repeatability can be appreciated and dummy readings erased.

3 CONVERSION OF RESISTANCE READINGS

A temperature reading is obtained from a resistance reading using one of the following relations.

3.1 POLYNOMIAL APPROXIMATION

The following polynomial approximation can be use:

$$T = C_0 + C_1 X + C_2 X^2 + C_3 X^3 + C_4 X^4 \text{ with } X = \ln \frac{R_T}{R_{25}}$$

where T = temperature in degrees Celsius

R_T = resistance in ohms

R_{25} = resistance in ohms at 25°C depending of the type of thermistor used (2 000, 3 000 or 10 000 Ω)

C_0 = 25.032

C_1 = -22.756

C_2 = 1.4997

C_3 = -0.1196

C_4 = 0.0114

Example:

With R_T = 5 500 Ω

R_{25} = 3 000 Ω (3 kΩ thermistor)

We get X = 0.6061 and T = 11.8°C

3.2 ANOTHER RELATION

Please note that many formulae can be used to transform ohm readings in temperature readings. One of the most accurate one is:

$$T = \frac{1}{A + B \cdot \ln R_T + C \cdot \ln^3 R_T} - 273.15$$

where T = temperature in degrees Celsius

$\ln R_T$ = natural logarithm of the resistance in ohms

A, B, C = constant factors

A, B, C have been determined following empirical measurements. These factors will vary according to the type of thermistor (refer to table below).

The accuracy of this formula is ± 0.15 °C with a range of -50°C to +150°C.

	Thermistor type (from Dale Electronics)		
	2 kΩ	**3 kΩ**	**10 kΩ**
A	$1{,}49896.10^{-3}$	$1{,}4051.10^{-3}$	$1{,}1303.10^{-3}$
B	$2{,}3781.10^{-4}$	$2{,}369.10^{-4}$	$2{,}339.10^{-4}$
C	$1{,}0668.10^{-7}$	$1{,}019.10^{-7}$	$8{,}863.10^{-8}$

Table 4: Conversion factors

4 TROUBLESHOOTING

Periodically check cable connections and terminals. The transducers themselves are sealed and cannot be opened for inspection.

4.1 UNSTABLE READING

- Check if the same troubles occur with other gages. If so, compare cable routes or check the readout unit.

- Is the shield drain wire correctly connected to the readout unit?

- Check the battery of the readout unit.

- The sensor body may be shorted to the shield. Check the resistance between the shield drain and the sensor housing.

- Check the integrity of the cable.

4.2 NO READING

- Check the battery of the readout unit.

- Check if the same troubles occur with other instruments. If so, the readout unit may be suspected and the factory should be consulted.

- The sensor body may be shorted to the shield. Check the resistance between the shield drain and the sensor housing.

- Check the cable resistance. An estimation of its resistance can be calculated: the resistance of a 22 gage copper cable is approximately 0.07Ω/m. Having an idea of the temperature, convert it into ohms (using chart below for example) and add the cable resistance twice.
  - If the resistance is high or infinite, a cut cable must be suspected.
  - If the resistance is close to zero, a short must be suspected.

- Cuts or shorts are located, the cable may be spliced in accordance with recommended procedures.

5 MISCELLANEOUS

	To Convert From	To	Multiply By
LENGTH	Microns	Inches	3.94E-05
	Millimetres	Inches	0.0394
	Meters	Feet	3.2808
AREA	Square millimetres	Square inches	0.0016
	Square meters	Square feet	10.7643
VOLUME	Cubic centimetres	Cubic inches	0.06101
	Cubic meters	Cubic feet	35.3357
	Litres	U.S. gallon	0.26420
	Litres	Can–Br gallon	0.21997
MASS	Kilograms	Pounds	2.20459
	Kilograms	Short tons	0.00110
	Kilograms	Long tons	0.00098
FORCE	Newtons	Pounds-force	0.22482
	Newtons	Kilograms-force	0.10197
	Newtons	Kips	0.00023
PRESSURE AND STRESS	Kilopascals	Psi	0.14503
	Bars	Psi	14.4928
	Inches head of water*	Psi	0.03606
	Inches head of Hg	Psi	0.49116
	Pascal	Newton / square meter	1
	Kilopascals	Atmospheres	0.00987
	Kilopascals	Bars	0.01
	Kilopascals	Meters head of water*	0.10197
TEMPERATURE	Temp. in °F = (1.8 x Temp. in °C) + 32		
	Temp. in °C = (Temp. in °F – 32) / 1.8		

*at 4 °C

Table 5: Conversion factors E6TabConv-990505

APPENDIX 1

CONVERSION TABLE: THERMISTOR RESISTANCE vs. TEMPERATURE

Temp. °C	Reading in Ohms			Temp. °C	Reading in Ohms		
	With a 2K Thermistor	With a 3K Thermistor	With a 10K Thermistor		With a 2K Thermistor	With a 3K Thermistor	With a 10K Thermistor
-50		201100	670500	1	6208	9310	31030
-49		187300	670500	2	5900	8851	29500
-48		174500	624300	3	5612	8417	28060
-47		162700	581700	4	5336	8006	26690
-46		151700	542200	5	5080	7618	25400
-45		141600	440800	6	4836	7252	24170
-44		132200	472000	7	4604	6905	23020
-43		123500	411700	8	4384	6576	21920
-42		115400	384800	9	4176	6265	20880
-41		107900	359800	10	3980	5971	19900
-40	67320	101000	336500	11	3794	5692	18970
-39	63000	94480	315000	12	3618	5427	18090
-38	59000	88460	294900	13	3452	5177	17260
-37	55280	82870	276200	14	3292	4939	16470
-36	51800	77660	258900	15	3142	4714	15710
-35	48560	72810	242700	16	3000	4500	15000
-34	45560	68300	227700	17	2864	4297	14330
-33	42760	64090	213600	18	2736	4105	13680
-32	40120	60170	200600	19	2614	3922	13070
-31	37680	56510	188400	20	2498	3748	12500
-30	35400	53100	177000	21	2388	3583	11940
-29	33280	49910	166400	22	2284	3426	11420
-28	31300	46940	156500	23	2184	3277	10920
-27	29440	44160	147200	24	2090	3135	10450
-26	27700	41560	138500	25	2000	3000	10000
-25	26080	39130	130500	26	1915	2872	9574
-24	24580	36860	122900	27	1833	2750	9165
-23	23160	34730	115800	28	1756	2633	8779
-22	21820	32740	109100	29	1682	2523	8410
-21	20580	30870	102900	30	1612	2417	8060
-20	19424	29130	97110	31	1544	2317	7722
-19	18332	27490	91650	32	1481	2221	7402
-18	17308	25950	86500	33	1420	2130	7100
-17	16344	24510	81710	34	1362	2042	6807
-16	15444	23160	77220	35	1306	1959	6532
-15	14596	21890	72960	36	1254	1880	6270
-14	13800	20700	69010	37	1203	1805	6017
-13	13052	19580	65280	38	1155	1733	5777
-12	12352	18520	61770	39	1109	1664	5546
-11	11692	17530	58440	40	1065	1598	5329
-10	11068	16600	55330	41	1024	1535	5116
-9	10484	15720	52440	42	984	1475	4916
-8	9932	14900	49690	43	945	1418	4725
-7	9416	14120	47070	44	909	1363	4543
-6	8928	13390	44630	45	874	1310	4369
-5	8468	12700	42340	46	840	1260	4202
-4	8032	12050	40170	47	808	1212	4042
-3	7624	11440	38130	48	778	1167	3889
-2	7240	10860	36190	49	748	1123	3743
-1	6876	10310	34370	50	720	1081	3603
0	6532	9796	32660	51	694	1040	3469

Table 6: Conversion table (continued)

Temp. °C	Reading in Ohms			Temp. °C	Reading in Ohms		
	With a 2K Thermistor	With a 3K Thermistor	With a 10K Thermistor		With a 2K Thermistor	With a 3K Thermistor	With a 10K Thermistor
52	668	1002	3340	102	128	192.2	640.3
53	643	965.0	3217	103	125	186.8	622.1
54	620	929.6	3099	104	121	181.5	604.4
55	597	895.8	2986	105	118	176.4	587.5
56	576	863.3	2878	106	114	171.4	571.0
57	555	832.2	2774	107	111	166.7	555.1
58	535	802.3	2675	108	108	162.0	540.0
59	516	773.7	2580	109	105	157.6	524.9
60	498	746.3	2488	110	102	153.2	510.7
61	480	719.9	2400	111	99	149.0	496.4
62	463	694.7	2316	112	97	145.0	483.1
63	447	670.4	2235	113	94	141.1	469.8
64	432	647.1	2157	114	91	137.2	457.4
65	416	624.7	2083	115	89	133.6	444.9
66	402	603.3	2011	116	87	130.0	433.4
67	388	582.6	1942	117	84	126.5	421.8
68	375	562.8	1876	118	82	123.2	410.7
69	363	543.7	1813	119	80	119.9	399.6
70	350	525.4	1752	120	78	116.8	389.4
71	339	507.8	1693	121	76	113.8	379.2
72	327	490.9	1636	122	74	110.8	369.4
73	316	474.7	1582	123	72	107.9	360.1
74	306	459.0	1530	124	70	105.2	350.8
75	296	444.0	1479	125	68	102.5	341.9
76	286	429.5	1431	126	67	99.9	333.0
77	277	415.6	1385	127	65	97.3	324.6
78	268	402.2	1340	128	63	94.9	316.6
79	260	389.3	1297	129	62	92.5	308.6
80	251	376.9	1255	130	60	90.2	301.1
81	243	364.9	1215	131	59	87.9	293.5
82	236	353.4	1177	132	57	85.7	286.0
83	228	342.2	1140	133	56	83.6	279.3
84	221	331.5	1104	134	54	81.6	272.2
85	214	321.2	1070	135	53	79.6	265.5
86	208	311.3	1036	136	52	77.6	259.3
87	201	301.7	1004	137	51	75.8	253.1
88	195	292.4	973.8	138	49	73.9	246.9
89	189	283.5	944.1	139	48	72.2	241.1
90	183	274.9	915.2	140	47	70.4	235.3
91	178	266.6	887.7	141	46	68.8	229.6
92	172	258.6	861.0	142	45	67.1	224.2
93	167	250.9	835.3	143	44	65.5	218.9
94	162	243.4	810.4	144	43	64.0	214.0
95	157	236.2	786.4	145	42	62.5	208.7
96	153	229.3	763.3	146	41	61.1	203.8
97	148	222.6	741.1	147	40	59.6	199.4
98	144	216.1	719.4	148	39	58.3	194.5
99	140	209.8	698.5	149	38	56.8	190.1
100	136	203.8	678.5	150	37	55.6	185.9
101	132	197.9	659.0				

Table 6: Conversion table

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10001** **Total length: 12m**

Thermistor located at (m)	Color code	Pin code
10 (bottom)	Black & White-Black	15-16
8	Black & Blue/Black	13-14
6	Black & Orange-Black	11-12
4	Red & Gray-Red	9-10
2	Red & White-Red	7-8
1	Green & Red-Green	5-6
0,5	Red & Orange-Red	3-4
0 (ground level)	Blue & White-Blue	1-2

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10002** **Total length: 12m**

Thermistor located at (m)	Color code	Pin code
10 (bottom)	Black & White-Black	15-16
8	Black & Blue/Black	13-14
6	Black & Orange-Black	11-12
4	Red & Gray-Red	9-10
2	Red & White-Red	7-8
1	Green & Red-Green	5-6
0,5	Red & Orange-Red	3-4
0 (ground level)	Blue & White-Blue	1-2

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Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10003** **Total length: 12m**

Thermistor located at (m)	Color code	Pin code
10 (bottom)	Black & White-Black	15-16
8	Black & Blue/Black	13-14
6	Black & Orange-Black	11-12
4	Red & Gray-Red	9-10
2	Red & White-Red	7-8
1	Green & Red-Green	5-6
0,5	Red & Orange-Red	3-4
0 (ground level)	Blue & White-Blue	1-2

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Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10004** **Total length: 12m**

Thermistor located at (m)	Color code	Pin code
10 (bottom)	Black & White-Black	15-16
8	Black & Blue/Black	13-14
6	Black & Orange-Black	11-12
4	Red & Gray-Red	9-10
2	Red & White-Red	7-8
1	Green & Red-Green	5-6
0,5	Red & Orange-Red	3-4
0 (ground level)	Blue & White-Blue	1-2

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10005** **Total length: 12m**

Thermistor located at (m)	Color code	Pin code
10 (bottom)	Black & White-Black	15-16
8	Black & Blue/Black	13-14
6	Black & Orange-Black	11-12
4	Red & Gray-Red	9-10
2	Red & White-Red	7-8
1	Green & Red-Green	5-6
0,5	Red & Orange-Red	3-4
0 (ground level)	Blue & White-Blue	1-2

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

ROCTEST TELEMAC

CERTIFICATE OF QUALITY & CONFORMITY
THERMISTOR STRING

Model: **Thermistor string**

Serial number: **133E10006** **Total length: 29m**

Thermistor located at (m)	Color code	Pin code
27 (bottom)	Black & White-Black	1 - 2
26	Blue & White/Blue	3 - 4
25	Red & Orange-Red	5 - 6
24	Green & Red-Green	7 - 8
23	Black & Blue-Black	9 - 10
22	Orange & Orange-Black	11 - 12
21	Red & Gray-Red	13 - 14

We certify that the following product(s) complies with specifications published in our technical documents and, when applicable, in the documents related to the customer order.

In order to ensure a high level of quality, our products are manufactured and tested according to our business process, which satisfy the requirements of ISO 9001 standards.

Certificate no: E7133E-100617-24271

Certified by: Melina Morales Date: 6/17/2010

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.

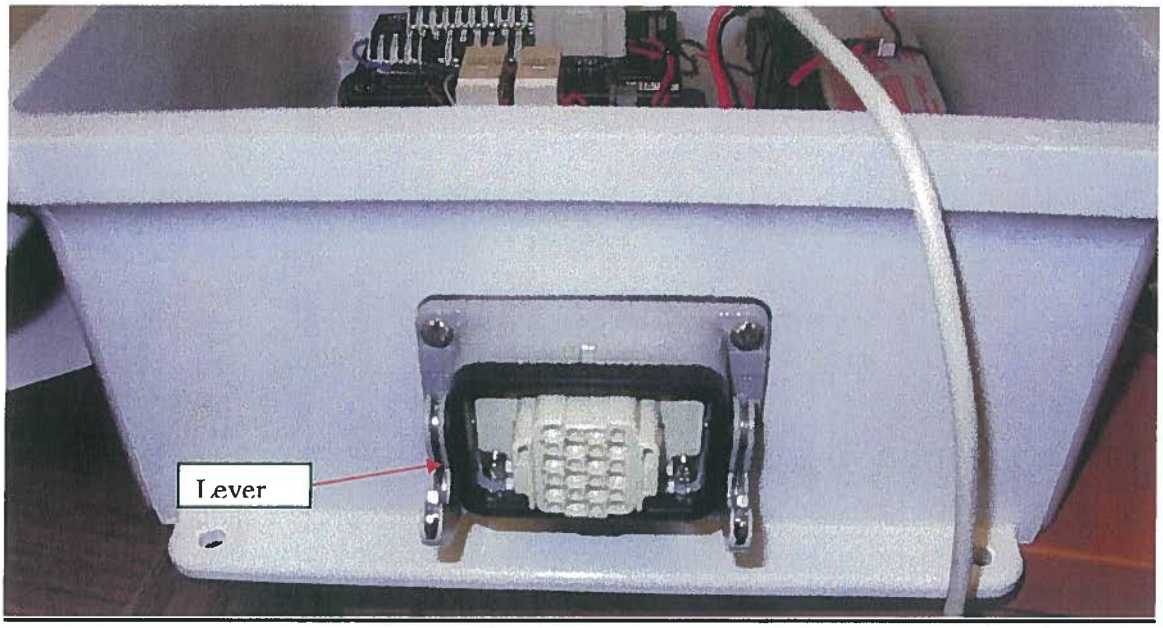
2.2 Software Installation

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.

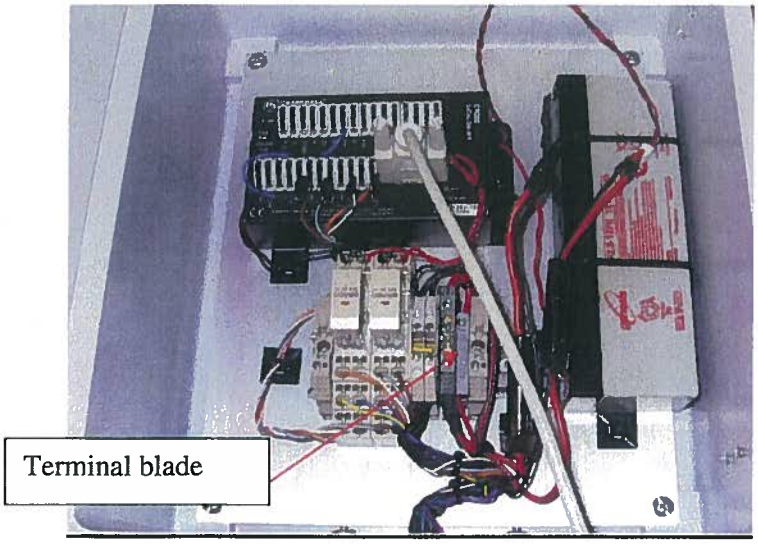
When the installation is done, a LoggerNet icon will be placed on your desktop.

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



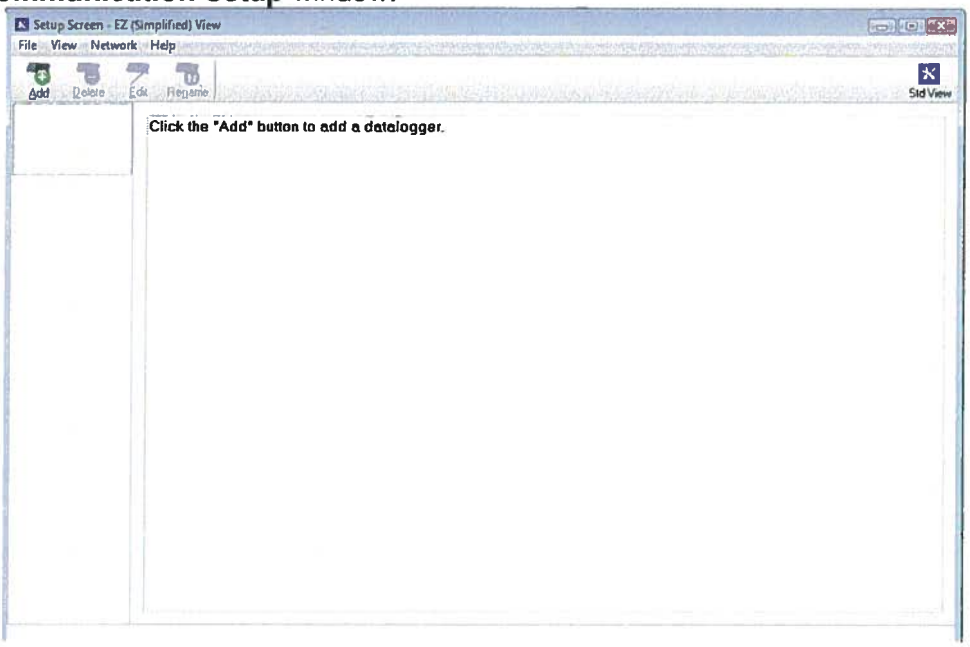
The terminal blade is used to turn the power OFF. Lower the blade to turn the unit ON. Make sure to raise the blade at the end of the test to avoid any battery drainage.

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

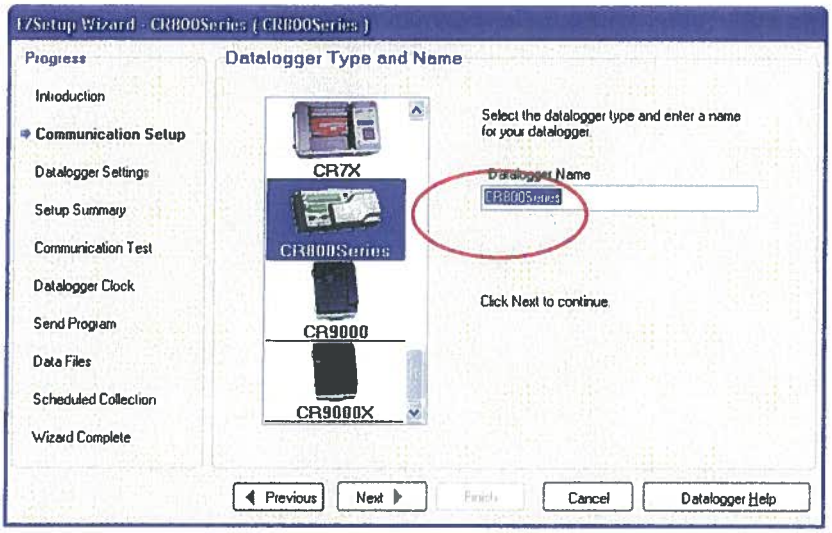
To start the LoggerNet, double click on the LoggerNet desktop icon.

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

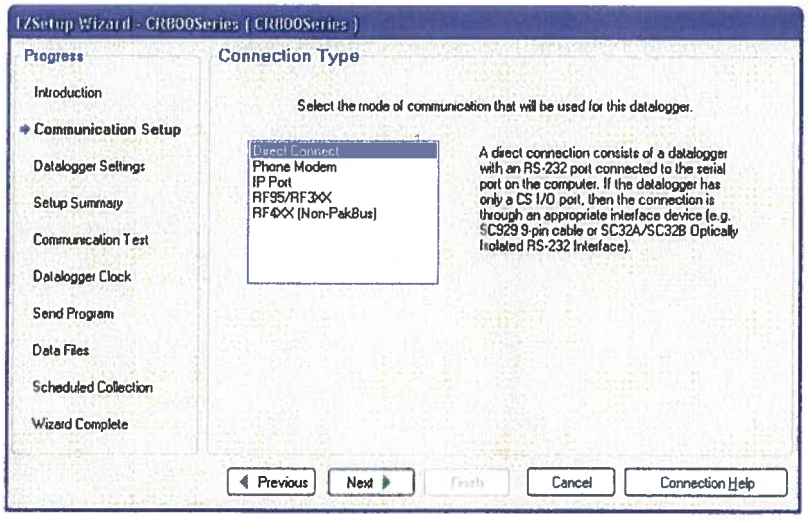


- Wait at least 15 seconds after powering up the unit before attempting to communicate with it.

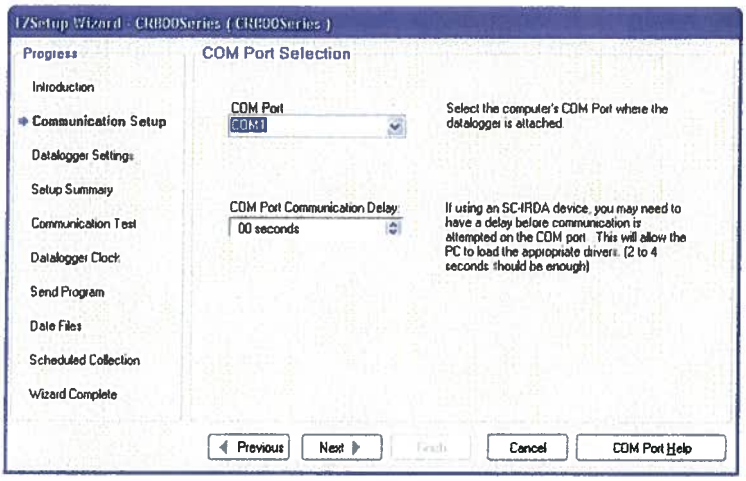
- Under **Datalogger Type and Name**, select **CR200 Series,** and next under **Datalogger Name**, choose a name that best represents your application. For example, type ***Thermistor*** and click **Next**. This datalogger name will be used later to connect to the Thermistor datalogger.



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

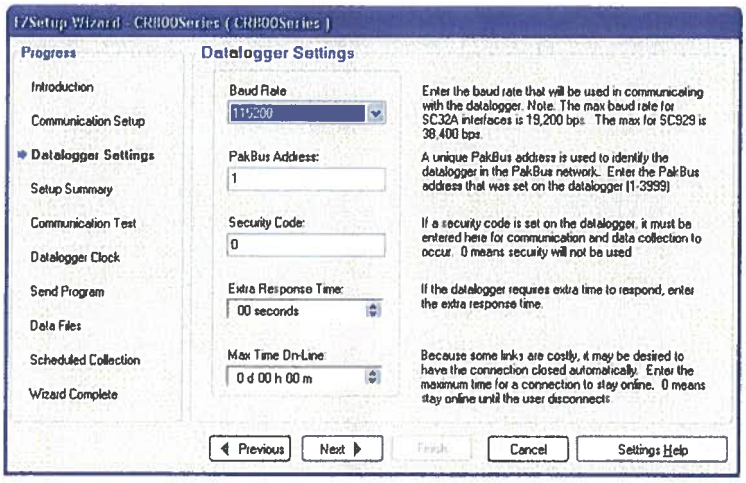


- Select the appropriate **COM port** on your computer. Usually, if you have a serial port on your computer, **COM 1** will be available. However, if you use a USB Serial adaptor, a virtual port will be created and a new COM port number will be assigned. Click **Next** when done.

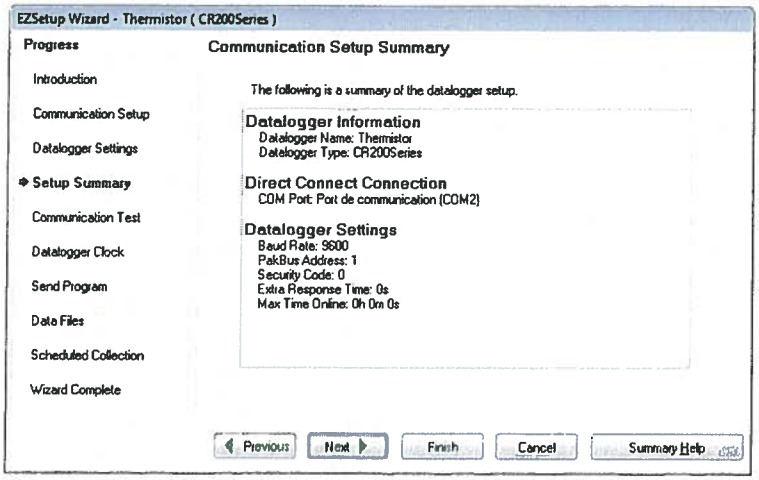


- Use the default parameters and click **Next**.

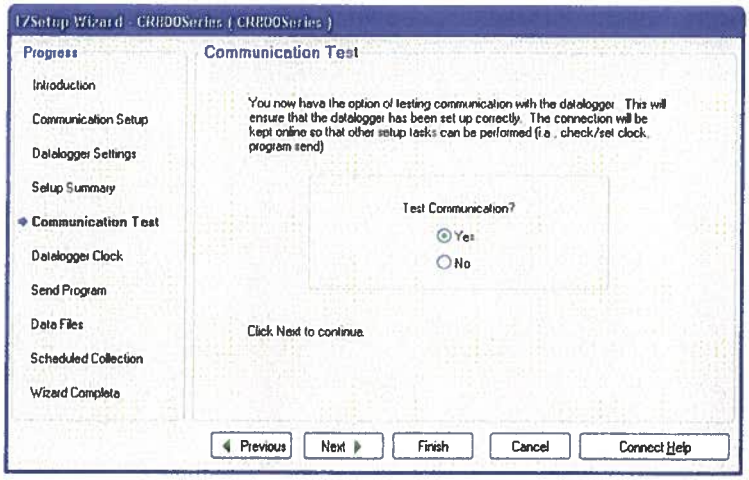
Note: If you use a USB Serial adapter you may need to lower the Baud Rate, in general **9600** works fine with the adapter.



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

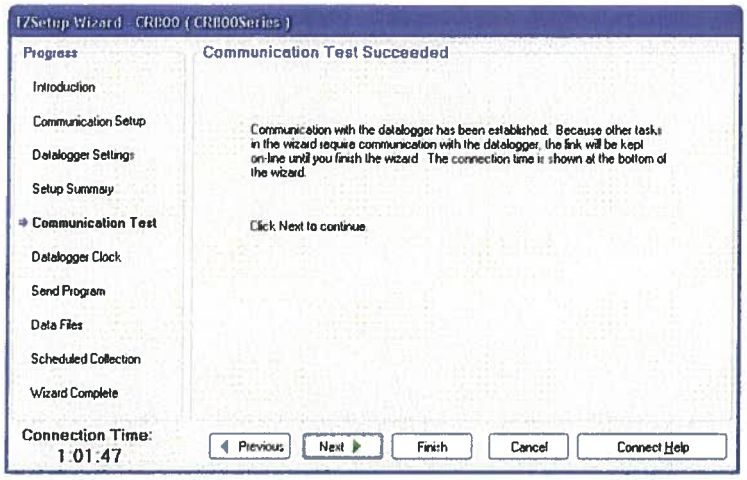


- To test the communication, select **Yes** and click **Next**.

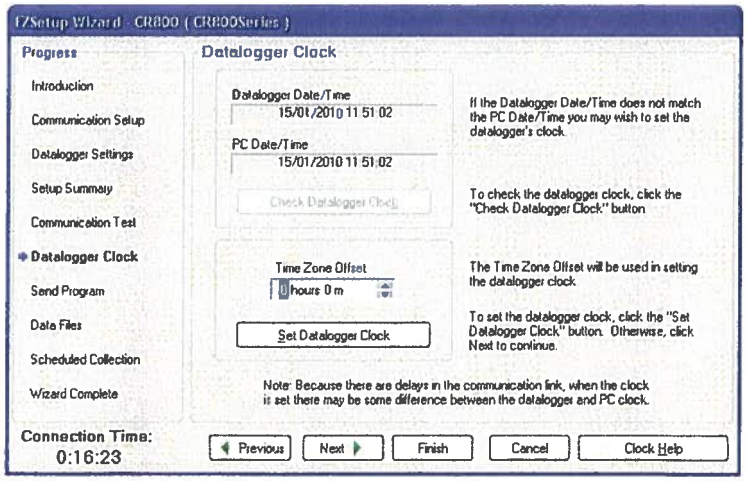


The following message will appear on the screen while your computer is attempting to communicate with the Thermistor datalogger.

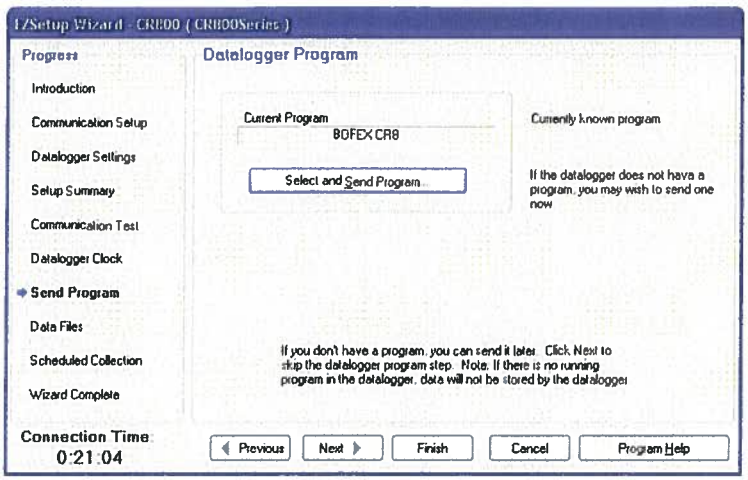
- The next windows will indicate if communication is successful. Click **Next**.



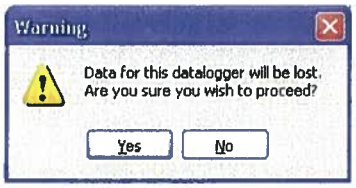
- Adjust the clock to set it at your local time zone. Make sure your computer is adjusted to your local time, then click **Set Datalogger Clock**. When done, click **Next**.



- 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**.



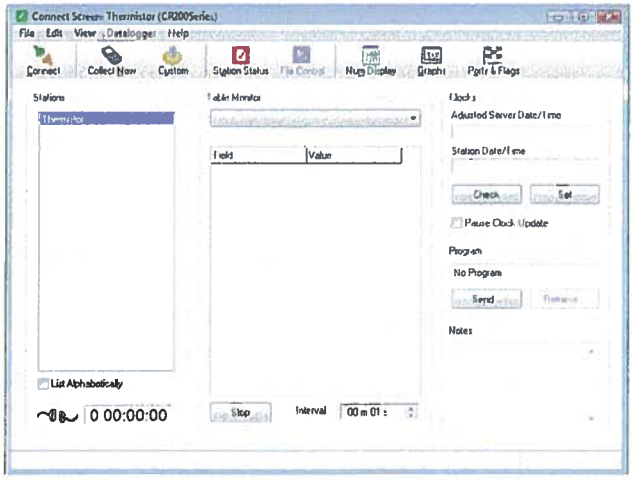
- A progress bar will display the download progress. If successful, a message will indicate it.

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

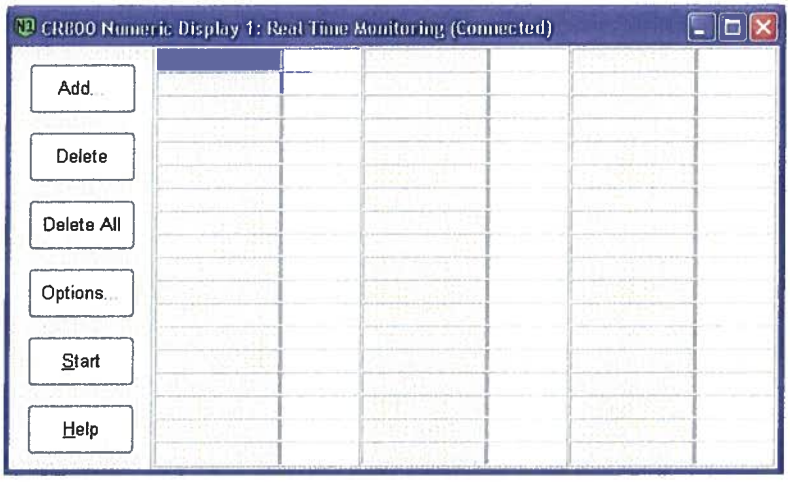
- To quit the **EZSetup**, select **File** from the **Menu**, and click **Exit.**

6.0 Monitoring Data With a Computer

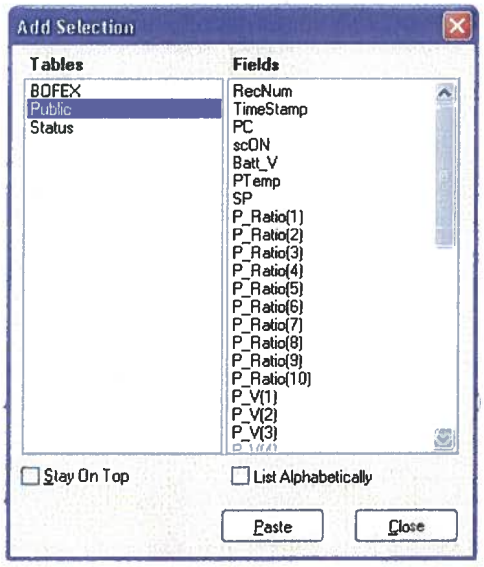
- Connect the supplied Serial Cable between the RS232 Input on the CR200 datalogger and your computer's serial port or USB Serial Adapter.
- Start the LoggerNet by double clicking on the LoggerNet desktop icon.
- From the **MAIN/CONNECT**, click on the station **Thermistor**, then **Connect**



- 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.

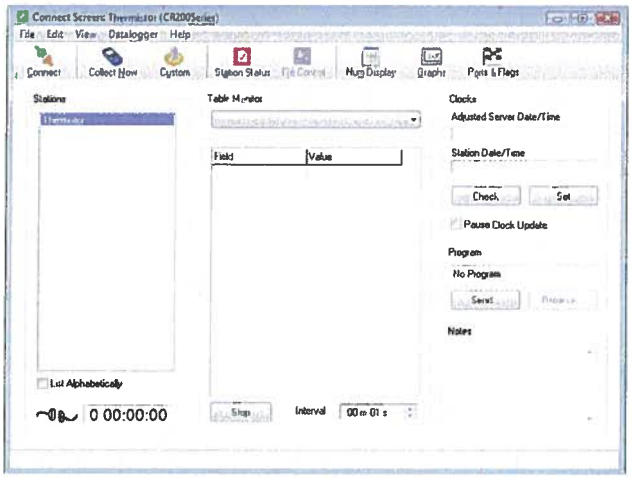


- Under **Fields**, select (highlight) the sensors (labels) you wish to view during the Test. You can use a combination of Shift & Ctrl keys on the computer's keyboard to select multiple labels. Next, on the **Display 1** window, highlight the location where you want to place the labels and finally, 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.

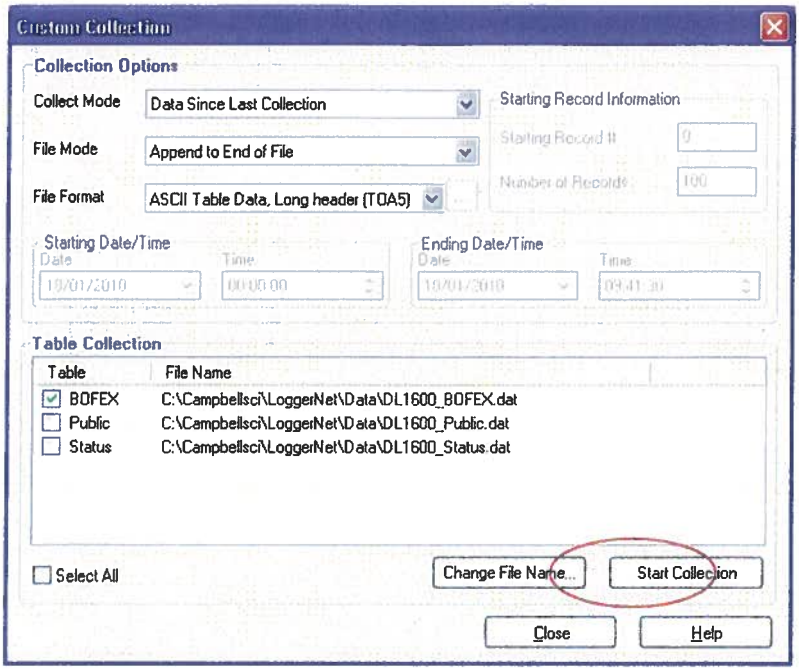
7.0 Collect Data

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.

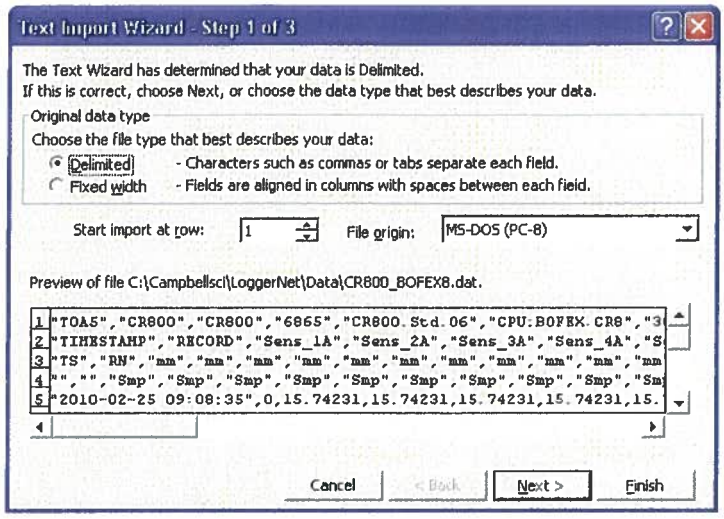
Note: A single record includes the timestamp, the record number, all sensors readings in Celcius degrees, and finally, the datalogger's battery voltage.

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

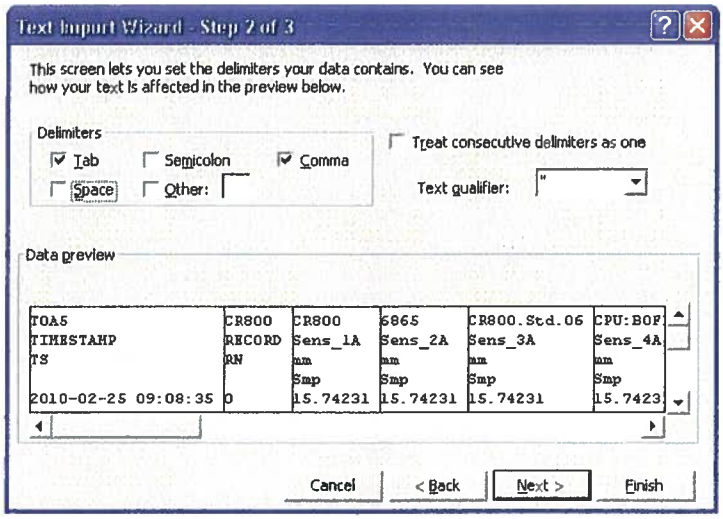
All collected readings are saved in the file specified under Table Collection. The readings saved with the file format **ASCII Table Data, Long header (TOA5)** are separated by commas (CSV) and can be imported into Microsoft Excel for data reduction.

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.

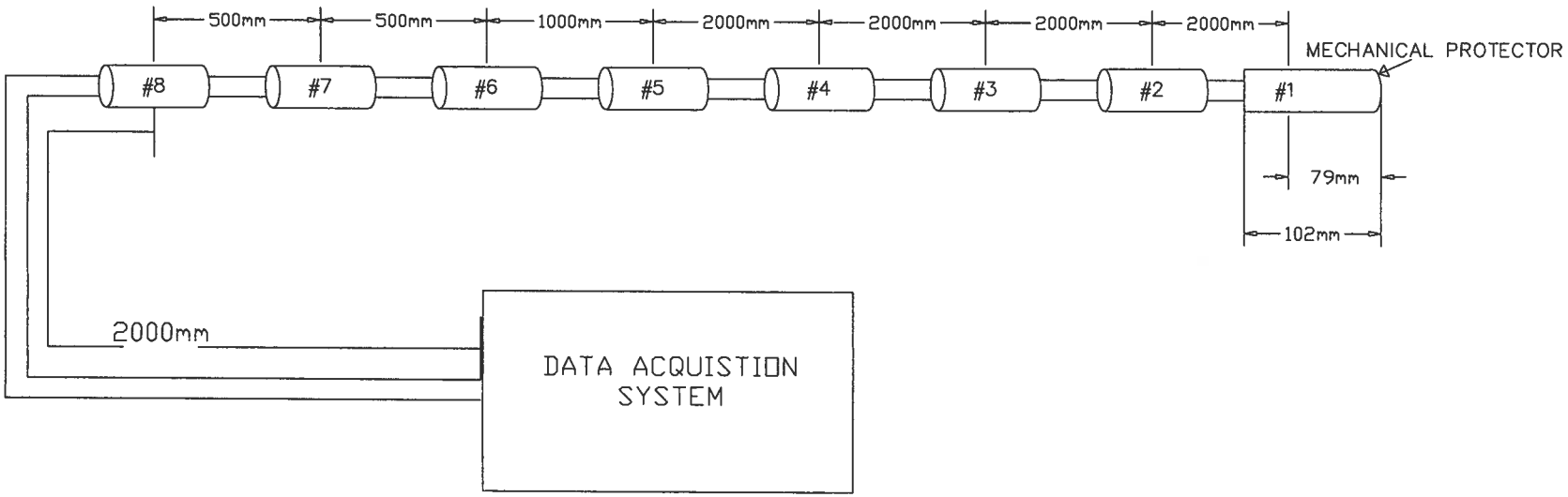


- Select **Delimited** and click **Next**.



- 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:BOFE	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														



Position / wire color	Connector pin
10 m color: black - white/black	15-16
8 m color: black - blue/black	13-14
6 m color: black - orange/black	11-12
4 m color: red - gray/red	9-10
2 m color: red - white/red	7-8
1 m color: green - red/green	5-6
0.5m color: red - orange/red	3-4
0 m color: blue - white/blue	1-2

ROCTEST

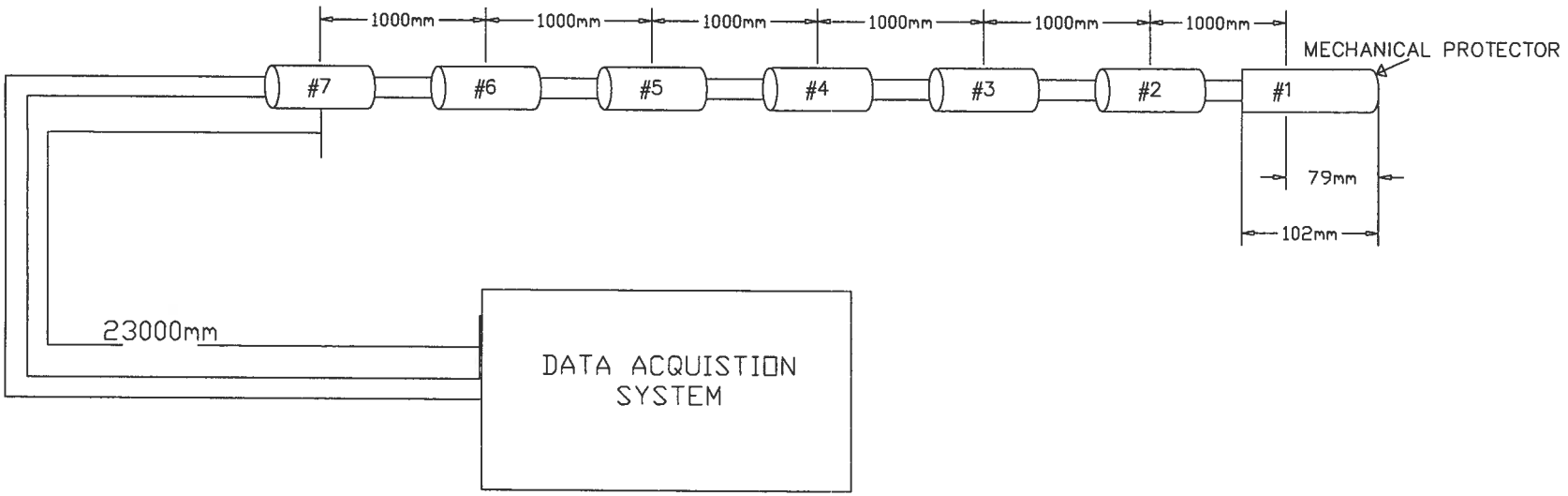
APPLICATION: THERMISTOR STRING 12 meters

TITLE: WIRING SCHEMATIC TO DAS

REVISION NO.	DESCRIPTION	DATE	APPR.

DRAW	D.LABRE	10-06-18
CHECK	D.LABRE	10-06-18
DESIGNED	D.LABRE	10-06-18
APPROVED	D.LABRE	10-06-18

PAGE 1 OF 1 | SCALE N/A | CODE NO. 137 | DRAWING NO. 60499_1 | REV. NO. 0



Position / wire color	Connector pin
27 m color: black - white/black	1-2
26 m color: blue - white/blue	3-4
25 m color: red - orange/red	5-6
24 m color: green - red/green	7-8
23 m color: black - blue/black	9-10
22 m color: black - orange/black	11-12
21 m color: red - gray/red	13-14

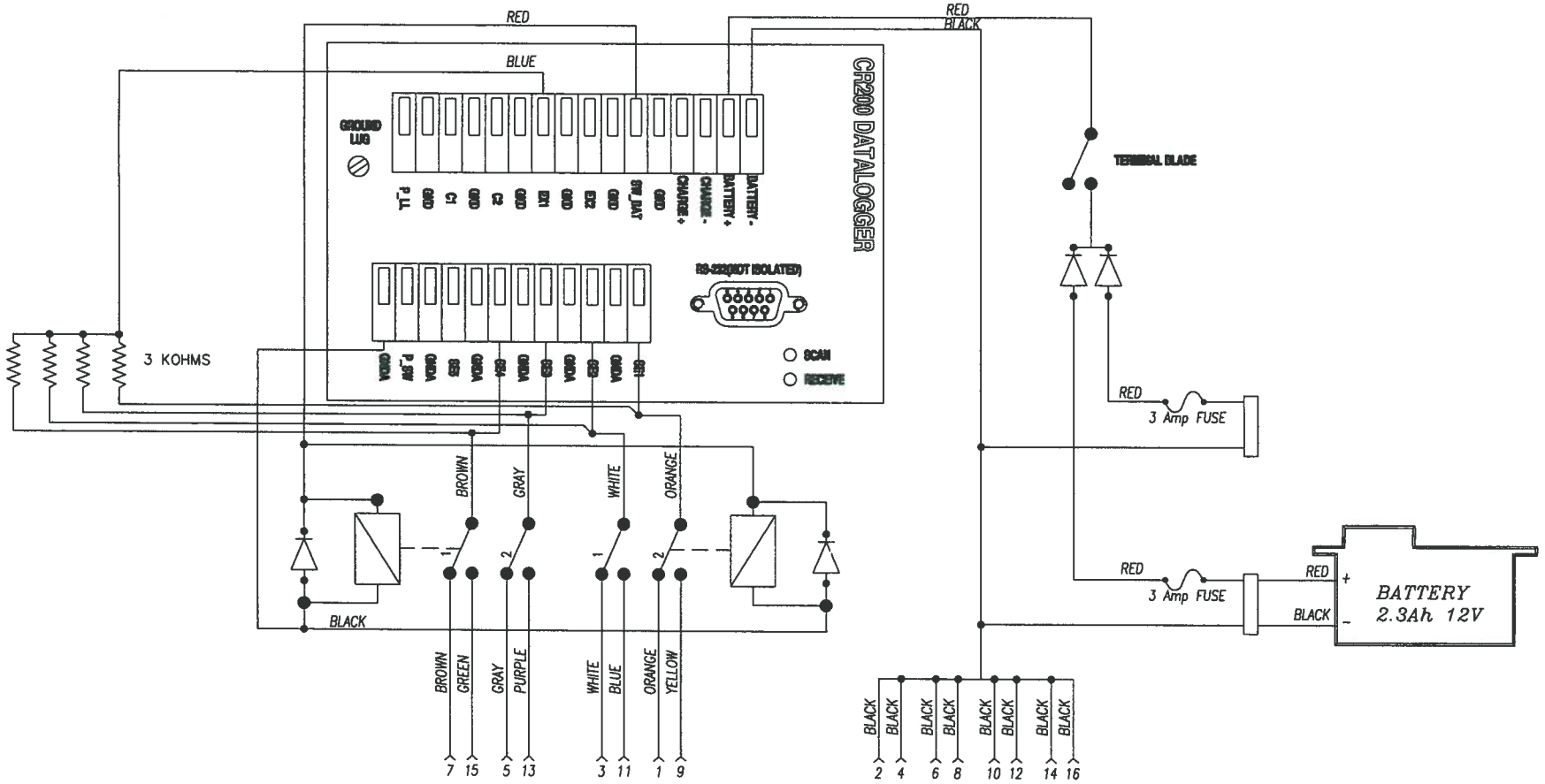
ROCTEST

APPLICATION: THERMISTOR STRING 29 meters

TITLE: WIRING SCHEMATIC TO DAS

REVISION						
NO.	DESCRIPTION	DATE	APPR.			
				DRAW	D.LABRE	10-06-18
				CHECK	D.LABRE	10-06-18
				DESIGNED	D.LABRE	10-06-18
				APPROVED	D.LABRE	10-06-18

PAGE 1 OF 1	CODE NO.	DRAWING NO.	REV. NO.
SCALE N/A	137	60499_2	0



REVISION					
NO.	DESCRIPTION	DATE	APPR.		
				DRAW D.LABRE	10-06-18
				CHECK D.LABRE	10-06-18
				DESIGNED D.LABRE	10-06-18
				APPROVED D.LABRE	10-06-18

ROCTEST

APPLICATION: DATA ACQUISITION SYSTEM

TITLE: WIRING SCHEMATIC

PAGE 1 OF 1	CODE NO.	DRAWING NO.	REV. NO.
SCALE N/A	137	60499_3	0

Technical Specifications Facility Sign

14 X

4 TROUS

PANNEAU 60 X 45 CM X 3,2 MM

TEXTE ET BORDURE NOIRS

SUR FOND BLANC G.I.

Technical Specifications Wells

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Well Caps

Locking well

	ITEM	Ø	WEIGHT
→	412LKWC	4-1/2"	1.7 lb (0.8 kg)
→	658LKWC	6-5/8"	2.1 lb (1 kg)
	834LKWC	8-3/4"	2.7 lb (1.2 kg)
	1034LKWC	10-3/4"	5.4 lb (2.5 kg)
	1234LKWC	12-3/4"	6.5 lb (2.9 kg)

ACCESSORIES

→	HDPE-4	DR-21 HDPE pipe, size 4-1/2"
→	HDPE-6	DR-21 HDPE pipe, size 6-5/8"
	834-102	40mm padlock #834

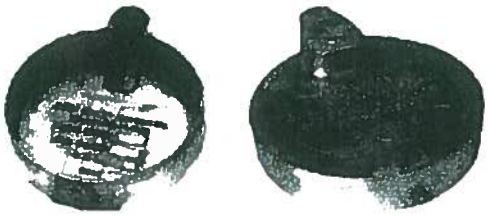
caps

Locking conduit well caps

ITEM	DIAM.	CONDUIT
6LKCC1	6"	1"
834LKCC1	8¾"	1"
10LKCC1	10"	1"

Locking watertight conduit well

ITEM	DIAM.	CONDUIT
558CC1	5-5/8"	1"
658CC1	6-5/8"	1"
834CC1	8-3/4"	1"



caps

Watertight well caps

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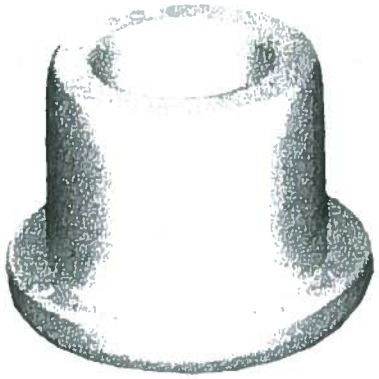
Tread flush joint

MALE CAPS

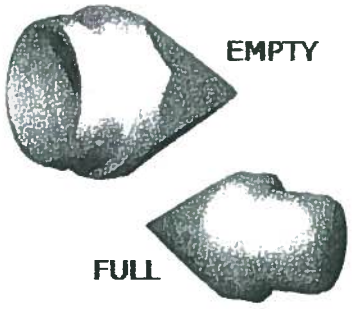


ITEM	DIAMETER	TYPE
CMS-007	¾"	Insert
CMS-010	1"	Insert
CMS-015	1½"	Insert
CMS-020	2"	Insert
CMS-030	3"	Insert
CMS-040	4"	Insert
CMS-050	5"	Insert
CMS-060	6"	Insert
CMS-080	8"	Insert

FEM CAPS

ITEM	DIAMETER	TYPE
CF447005	½"	Insert
CF447007	¾"	Insert
CF447010	1"	Insert
CF447015	1½"	Insert
→ CF447020	2"	Insert
CF447030	3"	Insert
CF447040	4"	Insert
CF447060	6"	Insert
CF447080	8"	Insert

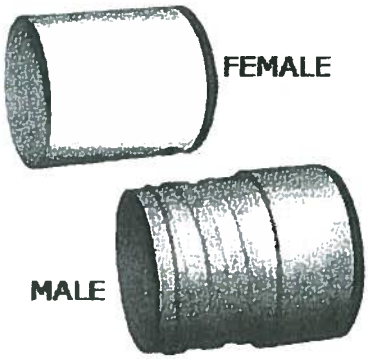
INSERTION POINT



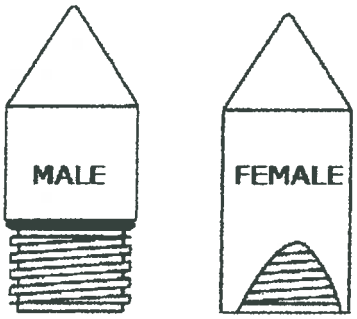
ITEM	DIAMETER	TYPE
PIP-007	¾"	Full
PI-010	1"	Empty
PIP-010	1"	Full
PI-015	1½"	Empty
PIP-015	1½"	Full
PI-020	2"	Empty
PIP-020	2"	Full

TFJ CAPS

ITEM	DIAMETER	TYPE
CTFJ-007M	¾"	TFJ male
CTFJ-007F	¾"	TFJ female
CTFJ-010M	1"	TFJ male
CTFJ-010F	1"	TFJ female
CTFJ-015M	1½"	TFJ male
CTFJ-015F	1½"	TFJ female
CTFJ-020M	2"	TFJ male
CTFJ-020F	2"	TFJ female



TFJ POINT

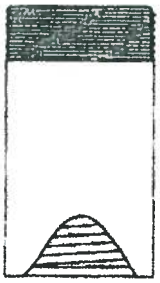


ITEM	DIAMETER	TYPE
PTFJ-007M	¾"	TFJ male
PTFJ-007F	¾"	TFJ female
PTFJ-010M	1"	TFJ male
PTFJ-010F	1"	TFJ female
PTFJ-015M	1½"	TFJ male
PTFJ-015F	1½"	TFJ female
PTFJ-020M	2"	TFJ male
PTFJ-020F	2"	TFJ female

TFJ ACCESS.

ITEM	DIAMETER	TYPE
MLTFJ-020	2"	TFJ male
MLTFJ-040	4"	TFJ male
MLTFJ-060	6"	TFJ male
NPTTFJ-007	¾"	NPT / TFJ
NPTTFJ-010	1"	NPT / TFJ
NPTTFJ-015	1½"	NPT / TFJ
NPTTFJ-020	2"	NPT / TFJ
NPTTFJ-040	4"	NPT / TFJ


NPTFJ


MLTFJ

ITEM	DESCRIPTION
CMS-007	Insertion male caps 3/4".
CMS-010	Insertion male caps 1".
CMS-015	Insertion male caps 1-1/2".
CMS-020	Insertion male caps 2".

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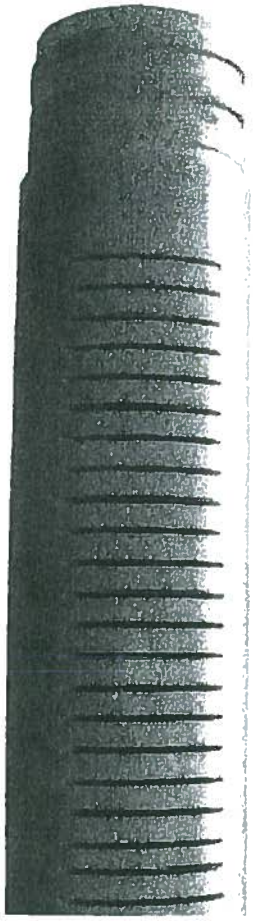
Intake Screens



Aquamerik Threaded Flush Joint is manufactured on "CNC" computer controlled machines.

Close machining tolerances are maintained to ensure an exact fit every time. A taper and relief area is designed into every end to allow the joints to be positioned and started easily without cross threading.

Flush Joints eliminate the need for couplings allowing the pipe to be assembled without the use of solvents. Flush Joints also help to prevent bridging of the backfill materials and can be installed in small diameter openings.

Hybrid wells can be constructed using PVC, Stainless Steel and other materials.

Construction: PVC (standard), CPVC, HDPE, PP
Pipe length: more than 20 feet (10 feet standard)
Pipe diameter: 1/2" to 24".
Construction: Sch40 (standard) -Sch80 - SDR
Slot Sizes: 0.006" & + (0.010" standard)
Slot Spacing: 0.100" & + (0.250" standard)

*Consult factory for pipe sizes available.

Please consult us for your specific requirements. Some materials may not be available in all sizes.

DISCOUNT AVAILABLE ON QUANTITY, DON'T HESITATE TO CALL

TOOL FREE: (888) 278-4776

ITEM	DESCRIPTION
WS075-5-10	3/4" x 5' x 0.01" screen TFJ PVC sch 40
WS075-10-10	3/4" x 10' x 0.01" screen TFJ PVC sch 40
WS100-5-10	1" x 5' x 0.01" screen TFJ PVC sch 40
WS100-10-10	1" x 10' x 0.01" screen TFJ PVC sch 40
WS100-10-20	1" x 10' x 0.02" screen TFJ PVC sch 40
WS100-10-40	1" x 10' x 0.04" screen TFJ PVC sch 40
WS150-5-10	1½" x 5' x 0.01" screen TFJ PVC sch 40
WS150-10-10	1½" x 10' x 0.01" screen TFJ PVC sch 40
WS150-10-20	1½" x 10' x 0.02" screen TFJ PVC sch 40

WS150-10-40	1½" x 10' x 0.04" screen TFJ PVC sch 40
WS200-5-10	2" x 5' x 0.01" screen TFJ PVC sch 40
WS200-10-10	2" x 10' x 0.01" screen TFJ PVC sch 40
WS200-10-20	2" x 10' x 0.02" screen TFJ PVC sch 40
WS200-10-40	2" x 10' x 0.04" screen TFJ PVC sch 40
WS200-10-80	2" x 10' x 0.08" screen TFJ PVC sch 40
WS300-5-10	3" x 5' x 0.01" screen TFJ PVC sch 40
WS300-10-10	3" x 10' x 0.01" screen TFJ PVC sch 40
WS300-10-20	3" x 10' x 0.01" screen TFJ PVC sch 40
WS300-10-40	3" x 10' x 0.01" screen TFJ PVC sch 40
WS400-5-10	4" x 5' x 0.01" screen TFJ PVC sch 40
WS400-10-10	4" x 10' x 0.01" screen TFJ PVC sch 40
WS400-10-20	4" x 10' x 0.02" screen TFJ PVC sch 40
WS400-10-40	4" x 10' x 0.04" screen TFJ PVC sch 40
WS600-5-10	6" x 5' x 0.01" screen TFJ PVC sch 40
WS600-10-10	6" x 10' x 0.01" screen TFJ PVC sch 40
WS600-10-20	6" x 10' x 0.02" screen TFJ PVC sch 40
WS600-10-40	6" x 10' x 0.04" screen TFJ PVC sch 40
WS800-10-10	8" x 10' x 0.01" screen TFJ PVC sch 40
WS800-10-20	8" x 10' x 0.02" screen TFJ PVC sch 40
WS800-10-40	8" x 10' x 0.04" screen TFJ PVC sch 40
WS075-5	Screen PVC 3/4" diam. x 5'
WS075-10	Screen PVC 3/4" diam. x 10'
WS100-5	Screen PVC 1" diam. x 5'
WS100-10	Screen PVC 1" diam. x 10'
WS150-5	Screen PVC 1 1/2" diam. x 5'
WS150-10	Screen PVC 1 1/2" diam. x 10'
WS200-5	Screen PVC 2" diam. x 5'
WS200-10	Screen PVC 2" diam. x 10'
WS300-5	Screen PVC 3" diam. x 5'
WS300-10	Screen PVC 3" diam. x 10'
WS400-5	Screen PVC 4" diam. x 5'
WS400-10	Screen PVC 4" diam. x 10'
WS600-5	Screen PVC 6" diam. x 5'
WS600-10	Screen PVC 6" diam. x 10'
WS800-5	Screen PVC 8" diam. x 5'
WS800-10	Screen PVC 8" diam. x 10'

Last Update: January 20, 2010

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Bentonite

ITEM	DESCRIPTION
MEDIUM	Holeplug 3/8", bag of 50 lb.
COARSE	Holeplug 3/4", bag of 50 lbs.
B313	Quik-gel 200 mesh, bag of 50 lbs.
B304	Benseal #8, bag of 50 lbs.
GRA-38	Granular bentonite, 3/8", bucket of 50 lbs.

Last Update: January 29, 2010

TABLEAU DE RÉFÉRENCE

PRODUIT	DESCRIPTION	SURFACTANT	RÉDUCTEUR DE FILTRANT	VISCOSITÉ / ÉPAISSISSANT	FORAGE AIR / MOUSSE	CIMENTATION ET COLMATAGE	COLMATAGE DE BASSIN	STABILISATION DES SOLS	HOMOLOGUE NSF	PUITS D'EAU	TROUS DE TIRS SISMIQUES	EXPLORATION MINÉRALE	FORAGE HORIZONTAL	PUITS FORÉS ET FOND	PUITS DE CONTRÔLE	PUITS DE REMÉDIATION	EAU DOUCE	EAU SAUMÂTRE	EAU SALÉE
Agent de scellement et de colmatage																			
Pellets 1/4" ®	Granule de bentonite sodique					■				■		■	■		■	■	■	■	
Pellets 3/8" ®	Granule de bentonite sodique					■				■		■	■		■	■	■	■	
Pellets 1/2" ®	Granule de bentonite sodique					■				■		■	■		■	■	■	■	
Coarse	Ben. sodique calibrée -3/4" + 3/8"					■				■		■	■		■	■	■	■	
Holeplug ®	Ben. sodique calibrée -3/8" + 1/4"					■				■		■	■		■	■	■	■	
Casing Seal ®	Mélange ben. sodique (cal. 8 à 14)					■	■	■		■		■	■		■	■	■	■	
Agent de cimentation souterraine																			
Aquaguard ®	Ciment de bentonite sodique (cal.30)					■				■		■	■		■	■	■		
Produit gélifiant; améliorant la viscosité (ht rend.)																			
Quick Gel ®	Bentonite sodique traitée, haut rend.		■	■						■		■	■	■	■	■	■		
Produit gélifiant; améliorant la viscosité																			
Aqua Gel ®	Montmorillonite sod. traitée (cal. 200)		■	■			■			■		■	■	■	■	■	■		
Agent moussant																			
Drill Foam ®	Agent moussant biodégradable				■					■		■	■			■	■		
Agent stabilisateur; améliorant la viscosité																			
E-Z Mud ®	Émulsion de polymères liquide PHPA		■	■	■					■		■	■		■	■	■		
Agent de mouillage																			
Con Det ®	Surfactant soluble dans l'eau	■			■					■		■	■		■	■	■		
Fluide de forage horizontal																			
Boregel ®	Fluide de forage		■	■						■		■	■			■	■		

■ Fonction principale ■ Fonction secondaire

AUSSI DISPONIBLE:

- ENVIROPLUG GRANULE
- ENVIROPLUG GROUT
- DÉTERGENT
- THERM-EX GROUT
- PERCOL 728
- PRO-YIELD
- ZETAG 7692
- TRUBORE
- WYOMING GEL
- PRO-FARM
- PRO-PAC
- POLY-PRO
- HYDROGEL
- SODA-ASH

TABLEAU DU TAUX D'APPLICATION DES PRODUITS ENVIROPLUG

	Aquaguard		Holeplug		Coarse	
Diamètre du trou	Gal. / pied de trou	Pied de trou / sac	LB / pied de trou	Pied de trou / sac	LB / pied de trou	Pied de trou / sac
2.50"	0.25	68.00	2.50	20.00	NR	NR
3.50"	0.50	34.00	5.50	10.00	4.25	11.75
4.00"	0.65	26.00	6.50	7.50	5.50	9.00
4.50"	0.83	20.50	8.50	5.75	7.00	7.00
5.00"	1.00	17.00	10.75	5.00	8.75	5.75
5.50"	1.23	13.80	12.50	4.00	10.50	5.50
6.00"	1.50	11.30	15.50	3.25	12.50	4.00
6.50"	1.70	10.00	20.50	2.50	14.75	3.50
8.00"	2.60	6.50	28.00	1.75	22.50	2.25
8.50"	2.90	5.90	32.00	1.50	25.25	2.00
10.00"	4.10	4.10	41.00	1.25	34.75	1.50
12.00"	5.90	2.90	80.00	0.75	50.00	1.00
16.00"	10.40	1.60	94.00	0.50	89.00	0.50

www.aquamerik.com

Filtration sands and gravels

The Aquamerik filtration Sand is composed of silica whole grains crystalline of a great hardness.

They are durable and dense, which enables them to be resistant to degradation.

Each grade is washed, dried and classified according to the most strict quality control. This sand is adequate for the use in the filters with pressure and density. it is also used in the filters of swimming pool like in various industrial processes and auxiliary applications.

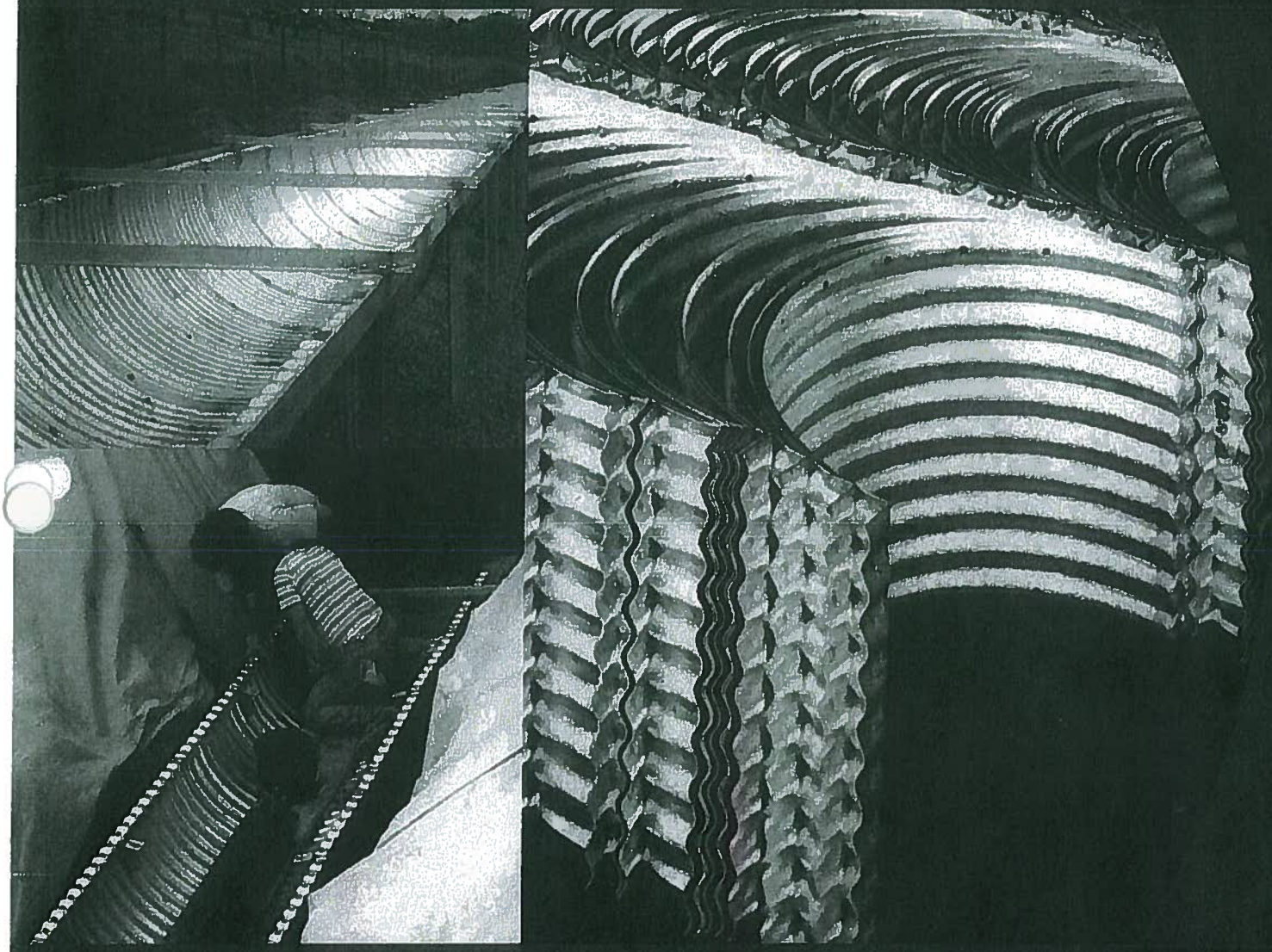
Moreover, our sands meet AWWA B-100, ANSI and NSF-61 standards. Shipped in 50 and 100 lbs bags, 3000 lbs available upon request.

These sands can also be used in the systems of industrial and municipal drinking water filtration. They are available in granulometry going from: 0.40mm, 1.5mm to 1/16"

ITEM	DESCRIPTION
507-22	Filtration sand, 0.45 - 0.55 mm (0.017 - 0.021"), 50 lbs.
507-45	Filtration sand, 0.45 - 0.55 mm (0.017 - 0.021"), 100 lbs.
520-22	Filtration sand, 0.65 mm (0.025"), 50 lbs.
→ SA-1	Filtration sand, 0.65 - 0.75 mm (0.025 - 0.029"), 50 lbs.
521-22	Filtration sand, 0.75 mm (0.029"), 50 lbs.
521-45	Filtration sand, 0.75 mm (0.029"), 100 lbs.
516-22	Filtration sand, 0.80 - 1.2 mm (0.031 - 0.047"), 50 lbs.
516-45	Filtration sand, 0.80 - 1.2 mm (0.031 - 0.047"), 100 lbs.
509-22	Filtration sand, 0.90 - 1.6 mm (0.035 - 0.063"), 50 lbs.
509-45	Filtration sand, 0.90 - 1.6 mm (0.035 - 0.063"), 100 lbs.
530-22	Filtration sand, 1.4 mm (0.055"), 50 lbs.
529-22	Filtration sand, 1.4 - 1.66 mm (0.035 - 0.065"), 50 lbs.
529-45	Filtration sand, 1.4 - 1.66 mm (0.035 - 0.065"), 100 lbs.
510-22	Filtration sand / gravel, 1.6 - 3.2 mm (1/16 - 1/8"), 50 lbs.
510-45	Filtration sand / gravel, 1.6 - 3.2 mm (1/16 - 1/8"), 100 lbs.
525-22	Filtration sand/gravel, 1.7 - 3.35 mm (0.067 - 0.131"), 50 lbs.
524-22	Filtration sand / gravel, 2.00 - 4.75 mm (0.078-0.187"), 50 lbs.
512-22	Filtration gravel, 3.2 - 6.4 mm (1/8 - 1/4"), 50 lbs.
512-45	Filtration gravel, 3.2 - 6.4 mm (1/8 - 1/4"), 100 lbs.

Technical Specifications Nested Pipe

FLANGED NESTABLE CORRUGATED STEEL PIPE



arm

FLANGED NESTABLE CORRUGATED STEEL PIPE

Flanged Nestable Corrugated Steel Pipe consists of half-round sections with side flanges that can be easily bolted together to form a circular corrugated steel pipe.

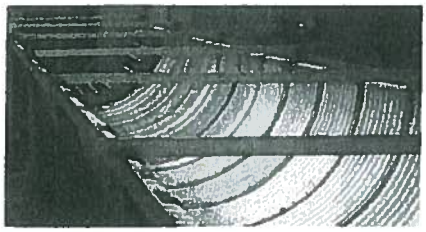
Flanged Nestable Pipe has many uses – as culverts, storm sewers, drains, casing and utilidors. The product is especially useful where a casing is to be installed around an existing utility without disturbing its operation.

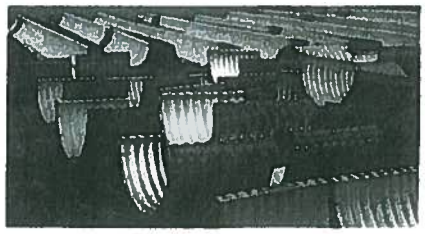
The 610 mm long sections, all galvanized to Z 610, provide a product that is highly durable under normal conditions and which has proven itself since it was first produced in the early 1930's. Flanged Nestable is also available in Aluminized Steel Type II for added durability.

The sections are shipped nested and bundled together to save space during shipping. This results in cost savings, especially where the product is being shipped long distances to remote northern areas or overseas.

FASTENING METHOD: Flanged Nestable Pipe is easily assembled and no special instructions are necessary. Simple tools such as spud or socket wrenches are all that is required.

FLANGED NESTABLE PIPE SPECIFICATIONS: Half round sections are manufactured from 68 mm x 13 mm corrugated galvanized or Aluminized Type II in accordance with CSA G401 corrugated steel pipe products. Five corrugation long pieces are used on the top at both ends to introduce a circumferential seam stagger. The 50 mm wide flanges have slotted holes spaced at 68 mm centre to centre on both sides and are bolted together using galvanized 10 mm diameter bolts and nuts. All circumferential laps should be in the direction of flow.





H20 Live Load Steel Thickness of Flanged Nestable Pipe (mm)

DIAMETER	AREA	HEIGHT OF COVER ABOVE TOP OF PIPE IN METRES				
mm	m^2	3	4.5	6.0	7.5	9.0
300	.07	1.6	1.6	1.6	1.6	1.6
400	.13	1.6	1.6	1.6	1.6	1.6
450	.16	1.6	1.6	1.6	2.0	2.0
500	.20	1.6	1.6	1.6	2.0	2.0
→ 600	.28	1.6	1.6	2.0	2.0	2.0
700	.38	2.0	2.0	2.0	2.0	2.8
800	.50	2.0	2.0	2.0	2.8	2.8
900	.64	2.0	2.0	2.0	2.8	2.8
1000	.79	2.0	2.0	2.8	2.8	2.8
1200	1.13	2.8	2.8	2.8	2.8	3.5
1400	1.51	2.8	2.8	2.8	3.5	3.5
1600	2.01	2.8	2.8	3.5	3.5	3.5

Note: 1. Minimum Cover is 300 mm up to 1200 mm diameter and 500 for 1400 mm and1600 mm diameter.
2. Structures should be backfilled with well compacted granular backfill to a minimum of 95% Standard Proctor Density.

Approximate Weights kg/m

DIAMETER	WALL THICKNESS mm			
mm	1.6	2.0	2.8	3.5
300	18	22	31	39
400	22	28	39	49
450	24	31	43	54
500	27	34	48	60
→ 600	31	39	54	68
700	36	45	62	79
800	41	51	70	89
900	45	56	77	97
1000	48	61	83	101
1200	59	74	102	126
1400	68	85	118	146
1600	78	97	134	166

arm

Head Office: 370 Speedvale Ave. W., P.O. Box 3000, Guelph, Ontario N1H 6P2
www.armtec.com

Sales Offices:
Nanaimo, Prince George, Langley, Edmonton, Calgary, Lethbridge, Saskatoon, Winnipeg, Thunder Bay, Sudbury, Guelph, Toronto, Peterborough, Chesterville, Forest, Orangeville, Comber, Montreal, Quebec City, St. Clet, Sackville, Truro, Summerside, Bishop's Falls and St. John's.

FNP/BP/30C/0607

Technical Specifications Geotextile

FICHE TECHNIQUE TEXEL

7612

Texel® A DIVISION OF UNE DIVISION DE ADS INC.

IDENTIFICATION DU PRODUIT		EMBALLAGE ET EXPÉDITION	
Nom et code du produit:	7612 / 21902	Format:	Rouleaux
Description:	7612 3.50M PP GR H 100M BNQ 701	Dimensions²:	3.50 m X 100 m (ASTM D461.8 et .9)
Type de produit: modèl	Non-tissé aiguilleté, Monofilament court	Emballage:	Sac de plastique
Type de fibre:	Polypropylène	Étiquetage:	Des étiquettes identifiant le produit sont placées sur la queue du sac, sur le coté du rouleau et dans le tube.
Armature:	Aucune		

FONCTION PREMIÈRE ☒ Séparation ☐ Filtration ☐ Imperméabilisation ☐ Drainage ☐ Protection ☐ Renforcement

SPECIFICATIONS DU PRODUIT

PROPRIÉTÉS	MÉTHODE DE TEST	FRÉQUENCE	RÉSULTATS	MIN¹-MOY-MAX
Physiques				
Épaisseur²	ASTM D5199	Standard	1.4 mm	MIN
Mécaniques				
Tension (SP)	ONGC 148.1-7.3	Standard	800 N	MIN
Tension (ST)	ONGC 148.1-7.3	Standard	800 N	MIN
Allongement à la rupture (SP)	ONGC 148.1-7.3	Standard	56% - 84%	MIN-MAX
Allongement à la rupture (ST)	ONGC 148.1-7.3	Standard	56% - 84%	MIN-MAX
Déchirure (SP)	ONGC 4.2-12.2	Standard	360 N	MIN
Déchirure (ST)	ONGC 4.2-12.2	Standard	360 N	MIN
Résistance à l'éclatement (Mullen)	ONGC 4.2-11.1	Standard	2275 kPa	MIN
Hydrauliques				
Diamètre d'ouverture de filtration (FOS)	ONGC 148.1-10	1 / an	70 µm - 130 µm	MIN-MAX
Permittivité	ONGC 148.1-4	1 / an	0.96 s-1	MIN
Perméabilité²	ONGC 148.1-4	1 / an	0.20 cm/s	MIN

MIN¹ : valeurs minimales de la tolérance 95 de la spécification GCTTG 3001-06 en fonction de la valeur nominale de certification.

²: Cette caractéristique ne fait pas partie de la certification à la spécification GCTTG 2001-06.

- Cette information technique provient du manufacturier et a été transcrite par Texel Géosol. L'utilisateur est par conséquent invité à s'assurer d'obtenir la dernière mise à jour.
- Le manufacturier n'offre aucune garantie et n'assume aucune responsabilité relative à l'usage, à l'installation et/ou à la convenance d'utilisation.
- Le manufacturier doit être informé de tout défaut ou non-conformité du produit avant son installation. Sa responsabilité se limite au remplacement du produit non-conforme ou défectueux.
- La conformité aux spécifications est basée sur un intervalle de confiance de 95% sur un lot.

- Les produits Texel sont fabriqués au Québec depuis 1967 et sont contrôlés par un service de qualité certifiée.

Veuillez consulter notre représentant technique pour plus d'informations sur les produits Texel Géosol et sur les projets réalisés depuis près de 45 ans avec les géosynthétiques Texel Géosol.

Pour le service de coupe et couture en usine ou au chantier, veuillez consulter nos représentants.

distribué par:

Texel Géosol
Certifié ISO 9001 : 2008

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MISE À JOUR CHEZ TEXEL GÉOSOL
EN DATE DU: 2008-08-19 / 2010-09-07
VÉRIFIÉ PAR: RT

TEXEL TECHNICAL DATA SHEET

7612

Texel® A DIVISION OF UNE DIVISION DE ADS INC.

PRODUCT IDENTIFICATION		PACKING AND SHIPPING	
Product name and code:	7612 / 21902	Format:	Rouleaux
Description:	7612 3.50M PP GR H 100M BNQ 701	Dimensions[2]:	3.50 m X 100 m (ASTM D461.8 et .9)
Product type:	Needleounched nonwoven, short staple fiber	Packing:	Plastic bag
Fiber composition:	Polypropylene	Labeling:	Tags identifying the product are placed: on the tail of the bag, on one side of the roll and in the core
Reinforcement:	None		

FIRST FUNCTION [x] Separation [ ] Filtration [ ] Proofing [ ] Drainage [ ] Protection [ ] Reinforcement

PRODUCT SPECIFICATIONS				
PROPERTIES	TEST METHOD	FREQUENCY	RESULTS	MIN[1]-MOY-MAX
Physical				
Thickness[2]	ASTM D5199	Standard	1.4 mm	MIN
Mechanical				
Elongation at break (CD)	CGSB 148.1-7.3	Standard	800 N	MIN
Elongation at break (MD)	CGSB 148.1-7.3	Standard	800 N	MIN
Tensile strength (CD)	CGSB 148.1-7.3	Standard	56% - 84%	MIN-MAX
Tensile strength (MD)	CGSB 148.1-7.3	Standard	56% - 84%	MIN-MAX
Tear strength (CD)	CGSB 4.2-12.2	Standard	360 N	MIN
Tear strength (MD)	CGSB 4.2-12.2	Standard	360 N	MIN
Bursting strength (Mullen)	CGSB 4.2-12.2	Standard	2275 kPa	MIN
Hydraulic				
Diamètre d'ouverture de filtration (FOS)	CGSB 148.1-10	1 / yr	70 µm - 130 µm	MIN-MAX
Permittivité	CGSB 148.1-4	1 / yr	0.96 s-1	MIN
Perméabilité[2]	CGSB 148.1-4	1 / yr	0.20 cm/s	MIN

MIN[1] : minimum values of tolerance 95 specification GCTTG 3001-06 based on the nominal value of certification.

2*: This feature is not part of the certification specification GCTTG 2001-06.

- This technical information comes from the manufacturer and was transcribed by Texel Geosol. The user is consequently invited to ensure himself to obtain the last update.
- The manufacturer does not offer any guarantee and does not assume any comparative responsability with use, the installation and/or the suitability of use.
- The manufacturer must be informed of any default or nonconformity of the product before its installation. Its responsibility is limited to the replacement of the product not-in conformity or defective.
- The conformity to the specifications is based on a confidence level of 95% within a lot.

- Texel products are manufactured in Quebec since 1967 and are controlled by a certified quality service.

Please consult our technical representative for more information on Texel Geosol products and the projects carried out for more than 45 years with Texel Geosol's geosynthetics.

For our cutting and sewing services at our warehouse or on your jobsite, please consult our representatives.

distributed by:

Texel GEOSOL

Certified ISO 9001 : 2008

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CHECKED BY: RT