• Government of Nunavut

Operations & Maintenance Manual
Volume 1 –Document

Project Name
Igloolik Waste Water Facility

Project Number
OTCD000119838AO

Prepared By:

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

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Prepared By:
exp
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

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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 Igloolik. 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-IGL1520 found in Appendix A.

1.1 Preceding Lagoon

The existing sewage lagoon is located approximately 1.3 km north of the community and adjacent to the Hamlet's solid waste site as shown on *Figure 1.1*. Effluent from the existing facility flows approximately 450 metres to the northeast towards Turton Bay. The land between the existing sewage lagoon and Turton Bay is undeveloped tundra.

The Geotechnical Report prepared as part of this project concluded that the slopes of the berms of the existing lagoon do not meet the factor of safety for static conditions nor under seismic loading. The report therefore considered the slopes inherently unstable and recommended that they should be rehabilitated.

It is estimated that the existing lagoons have a capacity of approximately 42,000 m^3. The required sewage storage requirement for 2014 is estimated to have been approximately 75,000 m^3. Therefore the existing sewage lagoon does not meet the current or future storage requirements for the Hamlet

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

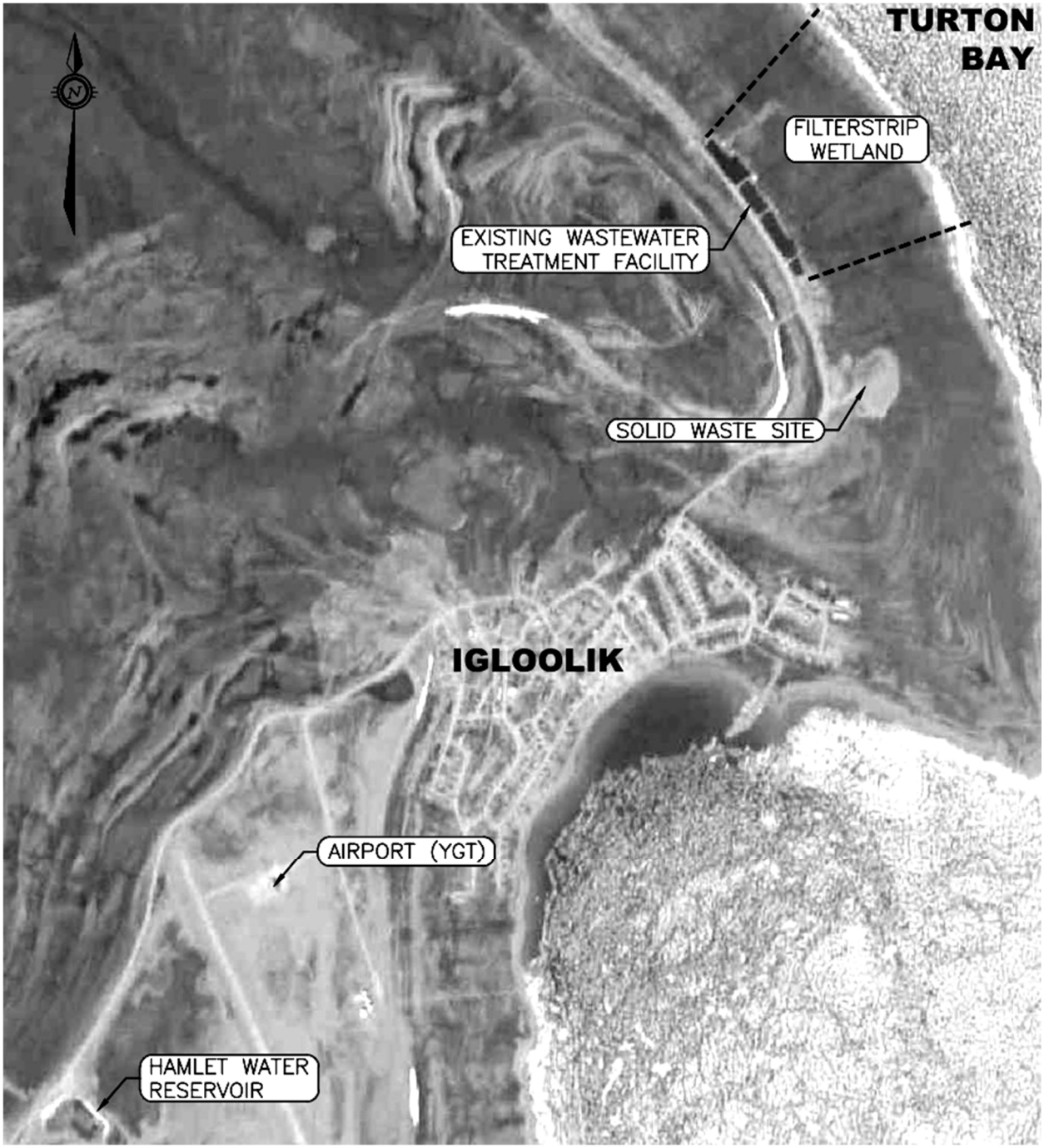
The Hamlet currently obtains its drinking water from Airstrip Lake and South Lake to annually supply a reservoir lake located 2,000m north of the community. This lake is fed by a drainage basin all north of the water supply lake. The water supply facility is located on the south side of the reservoir with inclined pipes leading out into the reservoir 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 5,300 metres with the water supply lake and corresponding watershed are both at a higher elevation than the lagoon

1.3 Existing Site

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 1 shows the location of the lagoon site with respect to the hamlet centre, water supply lake, and the airport.

Figure 1 - Location Plan



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 2036.

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 Igloolik 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 2036 will be used to evaluate the effluent production rates produced by the community.

The table below summarizes the population projections to the year 2036.

Table 0.1: Population Projections

Planning Year	Year	Population	Planning Year	Year	Population
	2014	1760	10	2026	2098
	2015	1784	11	2027	2129
0	2016	1811	12	2028	2161
1	**2017**	**1839**	13	2029	2193
2	2018	1867	14	2030	2226
3	2019	1894	15	2031	2260
4	2020	1922	16	2032	2294
5	2021	1949	17	2033	2329
6	2022	1976	18	2034	2364
7	2023	2005	19	2035	2397
8	2024	2035	**20**	**2036**	**2431**
9	2025	2067			

The design population for the end of the design horizon, 2036, is projected to be 2431 persons.

1.6 Sewage Generation

To determine the volume of sewage the facility must treat the sewage generation rate must be determined. 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 2.2.

Table 2.2 - 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

The Hamlet of Igloolik has a trucked water and sewage system, therefore the RWU for the community from table 2.2 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 2.3 – Total Community Water Usage.

Table 2.3 - 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 2431 for the year 2036, and a total water usage per capita rate of 137 lpcd, the daily sewage generation rate is equal to 337,185 lpd. This is equal to a yearly sewage generation rate of 123,073 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 Igloolik 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 2.4 - Characteristics of Basic Wastewater is an excerpt from the Cold Climate Utilities Manual summarizing the characteristics of moderately diluted wastewater.

Table 2.4 - 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 2.5 - Effluent Quality Standards.

Table 2.5 - Effluent Quality Standards

Parameters	Maximum Average Concentration
BOD_5	100mg/L
Total suspended solids (TSS)	120mg/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 Iqloolik is 102.5 mm and the average annual snowfall is 183.1 cm (RWDI, 2008). Temperatures in the summer range between 1.6 and 7°C and in winter between -19.5°C and -30°C. It is generally quite windy with an average wind speed of 14.4 km/h Permafrost is present in the soil; it recedes to approximately 1m below the surface in the summer time. Table 2.6 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 2.6 - Monthly Precipitation

Month	Precipitation Rate	Average Daily Maximum Temperature	Average Daily Minimum Temperature
January	12.8 mm	-27.4 °C	-34.3°C
February	9.7 mm	-27.9 °C	-34.7°C
March	14.7 mm	-24.1 °C	-31.6°C
April	16.3 mm	-15.0°C	-23.2°C
May	20.5 mm	-4.6°C	-11.7°C
June	19.2 mm	4.7°C	-0.7°C
July	27.9 mm	11.3°C	3.8°C
August	43 mm	8.0°C	2.2°C
September	31 mm	1.8°C	-1.9°C
October	32.1 mm	-5.8°C	-10.7°C
November	31.1 mm	-15.6 °C	-22.3°C
December	16.7 mm	-22.3 °C	-29.2°C

1.10 Contact List

Title	Phone Number
Senior Administrative Officer (SAO)	867-934-8940
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
Igloolik Health Centre	867-934-2100
RCMP (Igloolik)	867-934-0123
Environment Canada (Emergency) Iqaluit	867-975-4644
GN Environment Health Office	867-975-4817
First Air Cargo	1-800-267-1247

2 Sewage Disposal System

2.1 Operational Plan

The sewage lagoon system for Iqloolik is a 3-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 filter strip wetlands will provide the post-lagoon final treatment prior to the release into Turton 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.H:1V internal slope and 3.25H: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 3H: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 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.

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 28.9 hectares in size approximately 470 m long and 615 m wide with a slope of 2.5 to 9 %. 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 two sampling points. Sampling will provide information regarding the performance of the system and help identify any degradation to the treatment provided. Table 4.1 provides coordinates of the sampling points.

Table 4.1 - Monitoring Points

Monitoring Program Station Number	Description	Cell	Northing UTM	Easting UTM
IGL-4	Final Control point from modified sewage disposal facility	A	7698455.0	468711.0
		B	7698233.0	468939.0
		C	7698192.6	468998.1
IGL-5	Final Effluent discharge point prior to entering Foxe Basin	A	7698806.9	468836.6
		B	7698568.0	469132.0
		C	7698356.1	469352.1

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
IGL-4	Final Control point from modified sewage disposal facility	Effluent Quality: monthly during periods of observed flow
IGL-5	Final Effluent discharge point prior to entering Foxe Basin	Effluent Quality: monthly during periods of observed flow

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)
Carbonaceous Biochemical Oxygen Demand (cBOD5)	

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 4.3. 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	100 mg/L
Total Suspended Solids (TSS)	120 mg/L
Faecal Coliforms	1 x 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.

Appendix A – Water Licence

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File No.: 3BM-IGL1520/Renewal

March 31, 2015

Brian Flemming
Senior Administrative Officer
Hamlet of Igloolik
P.O.Box 30
Igloolik, NU XOA 0A0

E-mail: igloolik@magma.ca

Bhabesh Roy, P. Eng.
Municipal Planning Engineer, Baffin Region
Government of Nunavut
Dept. Community and Government Services
P.O Box 379, Pond Inlet, NU X0A 0S0

E-mail: broy@gov.nu.ca

RE: NWB Renewal Licence No. 3BM-IGL1520

Dear Mr. Flemming and Mr. Roy;

Please find attached Licence No. **3BM-IGL1520** issued to Hamlet of Igloolik 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* (*Nunavut Land Claims Agreement or NLCA*). 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 may be in contravention of the *Nunavut Land Claims Agreement* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. 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's interest, to hold a public hearing. 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 are

acknowledged by the Manager of Licensing.

The NWB strongly recommends that the Licensee consult the comments received by interested persons on issues identified. This information is attached for your consideration.[1]

Sincerely,

Thomas Kabloona
Nunavut Water Board
Chair

TK/ce/ri

Enclosure: Licence No. **3BM-IGL1520**
Comments – AANDC

Cc: Qikiqtani Distribution List

[1] Aboriginal Affairs and Northern Development Canada (AANDC), September 11, 2014;

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DECISION

LICENCE NUMBER: 3BM-IGL1520

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence renewal received on March 13, 2014, made by:

HAMLET OF IGLOOLIK

to allow for the use of water and deposit of waste during municipal activities by the Hamlet of Igloolik, located within the Qikiqtani Region of Nunavut at geographical coordinates as follows:

Latitude: 69°23'N and Longitude: 81°46'W

DECISION

After having been satisfied that the application was for a location that falls outside of an area with an approved Land Use Plan[2] as determined by the Nunavut Planning Commission (NPC) and exempt from the requirement for screening as described within Schedule 12-1 by the Nunavut Impact Review Board[3] in accordance with Article 12 of the *Nunavut Land Claims Agreement* (*NLCA*), the NWB decided that the application could proceed through the regulatory process. In accordance with S.55.1 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (*Act*) and Article 13 of the *NLCA*, public notice of the application was given and interested persons were invited to make representations to the NWB.

After reviewing the submission of the Applicant and considering the representations made by interested persons, 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 *Act*, waived the requirement to hold a public hearing, and determined that:

Licence No. 3BM-IGL0911 be renewed as Licence No. 3BM-IGL1520 subject to the terms and conditions contained therein. (Motion #: 2014-B1-045)

Signed this 31st day of March, 2015 at Gjoa Haven, NU.

Thomas Kabloona
Nunavut Water Board, Chair

TK/ce/ri

[2] Nunavut Planning Commission (NPC) Conformity Determination, August 13, 2014.
[3] Nunavut Impact Review Board (NIRB) Screen Exemption from Screening Decision, August 20, 2014

I. BACKGROUND

The Hamlet of Igloolik (Hamlet or Igloolik) is located on Igloolik Island in the northwest region of the Foxe Basin within the Qikiqtani Region of Nunavut, at the following coordinates: Latitude: 69°23'N and Longitude: 81°46'W. Igloolik is located within a zone of continuous permafrost and the island is composed of dolomitic conglomerates, with sandstone, dolostone and siltstone. The island is at a very low elevation with numerous ponds and an extensive tidal foreshore.

In 2014, the Hamlet of Igloolik has an estimated population of approximately 1,780. Existing Water Use and Waste Disposal Facilities include a freshwater intake pump, reservoir, truck fill station, a three cell sewage exfiltration lagoon system with a wetland, an older fourth sewage cell constructed prior to the three cell lagoon system, domestic landfill, and metallic waste landfill.

The Water Supply, Waste Water treatment by lagoon process and Waste Management systems within this Water Licence are at different stages with system upgrades and design/construction activities. The following is an update provided by the Licensee for each system:

Water Supply: This system consists of a Water Truck Fill Station, Water Storage Reservoir and an intake pipe from South Lake to the Water Storage Reservoir. The Licensee has indicated that the design and construction plans to expand the Water Storage Reservoir are currently on hold, pending capital fund approvals. The Board advises that an amendment application with construction drawings shall be submitted prior to the commencement of construction for the Water Supply system.

Wastewater Treatment by Lagoon: A three cell exfiltration lagoon is used to treat the entire wastewater produced annually in the Community. The older cell constructed prior to these three cells is still there and sometimes is used in case of emergency. The design for rehabilitation and improvement of the sewage lagoons is complete. The Licensee has expressed that the project is on hold. The Board advises that an amendment application with construction drawings shall be submitted prior to the commencement of construction for the Wastewater Treatment Facility.

Solid Waste Management: The solid waste management for the Hamlet is comprised of a domestic waste site and a metal waste site. The Licensee has expressed that the rehabilitation plans for the Waste Management Facilities is currently on hold due to funding. The Board advises that an amendment application with construction drawings shall be submitted prior to the commencement of construction or upgrades for the new Waste Management System.

II. FILE HISTORY

Information contained on the NWB's FTP site indicates that the Nunavut Water Board (NWB) has issued two licences to the Hamlet of Igloolik in past years.

Licences issued by the NWB to the Hamlet of Igloolik are the followings:

- ***Licence NWB3IGL0308***
  This licence was issued on February 5, 2003 with an expiry date of August 31, 2008. The licence allowed for the use of 70,000 cubic metres of water annually and deposit of waste in support of a Municipal undertaking.

- ***Licence 3BM-IGL0911***
  This licence was issued on July 10, 2009 with an expiry date of July 31, 2011. The licence allowed for the use of 70,000 cubic metres of water annually and deposit of waste in support of a Municipal undertaking.

III. PROCEDUAL HISTORY

The NWB received from the Government of Nunavut – Community Government Services (GN-CGS), on behalf of the Hamlet of Igloolik, the following application documents (Application) for the ten (10) year renewal of Licence 3BM-IGL0911, from March 13, 2014 to May 16, 2014:

- Hamlet Annual Reports 2009, 2010, 2011, 2012 and 2013
- Renewal Application Cover Letter, May 16 2014
- Hazardous Materials Spill Database, Baffin Spills in 2013
- Igloolik Bathymetic Survey, Arktis Solutions Incorporated, August 2011
- Igloolik Cover Letter to NWB Application March 2014
- Igloolik Water Licence Application March 2014
- Location of South Lake 2014
- Hamlet of Igloolik, Plan for Compliance Igloolik
- Technical Summary of Environmental Facilities under the Water License # 3BM-IGL 0911 (Part B:1.a) of the Hamlet of Igloolik, Baffin Region, Nunavut (in English & Inuktitut) March 2014
- Igloolik Water Supply Design Development ARKTIS March 2014
- CGS Letter to NWB for Igloolik May 2014
- Department of Community and Government Services Letter to NWB, May 16, 2014
- Igloolik Chemical Analysis of raw water 2008
- Igloolik Lab Final Report, Taiga Environmental Laboratory, September 04 2008
- Igloolik Operations and Maintenance Manual Water Truck Fill Station, 1980 (Chapter 1- 10)
- Design Development Report – Improvement of Water Supply System, Igloolik, Nunavut, 15 October2011

Following receipt and an internal review, NWB distributed the Application for a thirty (30)-day comment period on August 12, 2014. On September 11, 2014, submission was received from Aboriginal Affairs and Northern Development Canada (AANDC).

The NWB has placed in its Public Registry copies of the Application and all comments received from interveners. This information can be accessed on the NWB's File Transfer Protocol (FTP) site using the following link (Username: **public**; Password: **registr***y*):

ftp://ftp.nwb-oen.ca/1%20PRUC%20PUBLIC%20REGISTRY/3%20MUNICIPAL/3B/3BM%20-%20Municipality/3BM-IGL0911/

Based upon the results of the detailed assessment, including consideration of any potential accidents, malfunctions, or impacts to water that the overall project might have in the area, the Board approved the application and has renewed the Licence 3BM-IGL0911 as Licence 3BM-IGL1520.

IV. ISSUES

The following sections provide background information relevant to the terms and conditions included in this Licence, in the context of submissions received and/or the Board's rationale. Where appropriate, the Board has removed or modified terms and conditions associated with the previous licence, which are no longer applicable under this renewal Licence.

Term of the Licence

In accordance with s. 45 of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA or the Act), the NWB may issue a licence for a term not exceeding twenty-five (25) years. In determining an appropriate term for a renewal licence, the Board generally takes into consideration several factors including intervener's comments, the Licensee's compliance history, as well as the rationale contained in the Application.

The Licensee requested in its Application a ten (10) year term for the licence. The intervening party, AANDC, in their submissions recommended a renewal term of not more than five (5) years. The Board in examining the compliance history of the Licensee and the comments received from AANDC has granted a term of five (5) years to the Licence. In so doing, the Board believes and expects that the five-year terms will provide the Licensee with significant opportunities to prove that it can consistently abide by the terms and conditions in the licence overtime.

Moreover, it is noted that the Hamlet's actual daily water use may be higher than 300 cubic metres per day when filling the Water Storage Reservoir which could trigger a change of the Licence Type "B" to Type 'A". The five (5) year term shall allow the Licensee to measure the daily water use during two (2) full years and help the Board to accurately determine the Type of Licence for the future renewal

Annual Report

Under the reporting section of the Licence, Part B, Item 1, the Licensee is required to submit, on an annual basis, a report pertaining to water use and waste deposit activities. Although the 2011-2013 reports submitted include useful information, the AANDC noted that the reporting requirements specified in Part B, Item 1 of the Licence were not being fully satisfied. The NWB concurs with AANDC's recommendations and requests that the Licensee supplement the standard NWB reporting forms with additional documentation in order to ensure that all monitoring requirements are satisfied. The Licensee is encouraged to develop its own annual reporting template. This template should include tabular summaries of monitoring data pursuant of Part B, Item 1 (a) of the Licence. The Licensee is encouraged to contact AANDC, the NWB, or the GN-CGS to discuss its licensed monitoring program. This reporting information will be kept in the NWB's public registry

and made available to interested persons upon request. Further, the NWB maintains annual reporting information on its FTP site, which can be accessed using the following link (username: **public** and password: **registry**): ftp://ftp.nwb-oen.ca/1%20PRUC%20PUBLIC%20REGISTRY/.

Water Supply Facilities

The Hamlet of Igloolik currently obtains its potable water from South Lake to annually supply an existing reservoir with a capacity of 65,000 cubic metres. The Licensee has indicated that the Hamlet's plans to expand the existing reservoir are currently on hold, pending capital fund approvals. Water is currently withdrawn during the months of August and September with a maximum authorized water use quantity of 70,000 cubic metres 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 in the manner in which this water will be used.

In review of the application, the NWB relied on the new Nunavut Waters Regulations (Regulations) issued on April 18, 2013 and the definition of "Use" provided by the Act. All water taken from the South Lake, main water source to fill the reservoir would qualify under the definition as "use of water". Therefore, having given due consideration to the information presented during the review, the NWB has determined that water extracted from the source water supply, for any purposes, is considered as a Use of water and that the Licensee is requested to daily measure directly, on the source at the Freshwater Intake Pump, all freshwater used for all purposes. The Licensee shall also measure and on a daily, monthly and annual basis all freshwater used for all purposes at the Truck-fill Station.

The Licensee is also advised that according to the Schedule 2 of Regulations any use of 300 cubic metres or more per day and any use of waters related to the storage of 60,000 cubic metres or more water would require a Type "A" Water Licence. The Board has, therefore, set the maximum water usage for all purposes specified in this Licence at 81,208 cubic metres per year or up to 299 cubic metres per day for filling of the reservoir. Lastly, please note that the NWB has renewed the terms and conditions associated with water use by the Hamlet accordingly.

Sewage Disposal Facilities

The Hamlet of Igloolik currently provides trucked sewage services for the Community residents, businesses and institutions. No concerns were raised by the parties in their written submissions as to the manner in which the sewage is treated and disposed of. The NWB has renewed the terms and conditions associated with Sewage Disposal Facility accordingly. The NWB requests that the Licensee install flow-meters on the waste discharge pipelines by May 31, 2015 in order to accurately measure the sewage disposal volumes (of the year following the calendar year being reported) and comply with Part B, Item 1 and 4 of the current Licence. The NWB has also added a requirement that all inspection of engineered facilities related to the management of water and waste shall be carried by an Engineer (Civil, Municipal or Geotechnical) annually, in order to comply with Part F, item 3, the Licensee must ensure that it will provide annual Engineer reports within 60 days of inspections, including a cover letter outlining an implementation plan

addressing each of the Engineer's recommendations. The Board acknowledges that though no reports or cover letters have been provided to date, the Licensee has set forth, in the Igloolik Compliance Plan, a plan to comply with this condition in the future.

Finally, as part of the Sewage Disposal Facility Operation and Maintenance (O&M) Plan, the NWB requires that the Licensee include procedures and frequencies of inspections to be carried out to verify whether or not/when there is flow from the Sewage Disposal Facility. Visual inspections to verify flow from the Sewage Disposal Facility are required to ensure that the monitoring program under Part D, Item 2 of the Licence is initiated at the appropriate time and that the Inspector is notified upon its commencement.

Solid Waste Disposal Facilities

In the recently submitted *Technical Summary of the Environmental Facilities* document, the Hamlet expressed plans in 2014 to segregate hazardous wastes like batteries etc. The Board requests that the Hamlet submit an Operation and Maintenance (O&M) Plan for the Solid Waste Disposal Facilities that include procedures for the segregation, storage and eventual removal/disposal of hazardous wastes, including waste oil, and runoff management. The Licensee should note that a condition has been included in the licence for the submission of O &M Plan for the Solid Waste Disposal Facilities within ninety (90) days of issuance of this Licence under Part F, Item 1.

Operation & Maintenance Plans

In accordance with Part F, Item 1, of the expired licence, the Licensee was required to submit a Sewage Disposal Facility Operation and Maintenance (O&M) Plan (including the Sewage Sludge Management Plan, a Solid Waste Disposal Facility Operation and Maintenance (O&M) Plan, and a Spill Contingency Plan. These Plans need to be developed to the satisfaction of the NWB for the operation and maintenance of the facilities, the protection of the environment with regard to potential spills through day-to-day operations, and abandonment and restoration of various sites.

The Licensee has submitted a document entitled: Igloolik Operations and Maintenance Plan Water Truck Fill Station that needs to be updated to include an Abandonment & Restoration Planning, and Spill Contingency Planning. The renewed Licence has therefore continued to include the requirement to provide separate updated O&M Manuals for Water Supply and Waste Disposal Facilities, to the NWB within a set timeframe of issuance of the Licence. The NWB reviewed and deemed the short-term goals of the submitted Compliance Plan dated March 13 2014, as satisfactory. The NWB also reviewed the Department of Community and Government Services' Letter to NWB, dated May 16 2014, clarifying and answering the questions put forward by the Board on the submitted Compliance Plan by the Licensee.

The only comments received from interested parties were from the AANDC. AANDC indicated that the NWB should either require the Licensee to submit any outstanding Operational Plans before renewing the licence, or require the submissions within 90 days of renewing the licence. This includes plans for Operation and Maintenance of the Solid Waste Management and Sewage Disposal Areas, Abandonment and Restoration and Spill Contingency.

Taking into account the review of the application and comments received, the O&M

Manuals to be submitted are as follows, in accordance with Part F, Item 1 of the Licence:

a. *Updates to the Water Storage and Distribution Facility Operation and Maintenance (O&M) Plan*; *Amendments required include:*
    i. *An improved description of the technology and process;*
    ii. *A detailed breakdown of maintenance work and schedule of work required for the system equipment (including the submersible pumps, intake screens, and valves);*
    iii. *Revisions to the faded Intake Screen and Reservoir Fill Line Drawings (Drawing No. 78-IB7-101 to 106); and*
    iv. *Submitted O &M details 1979 Service Contracts for the operating pumps, if these Service Contracts are still required please renew and update the submitted information.*
b. *Sewage Disposal Facility Operation and Maintenance (O&M) Plan* (including the *Sewage Sludge Management Plan)*;
c. *Solid Waste Disposal Facility Operation and Maintenance (O&M) Plan*; and
d. *Spill Contingency Plan;*

The purpose of the O&M Manuals noted above is to assist Hamlet staff in carrying out the procedures relating to their water distribution and waste disposal facilities. The O&M Manuals should demonstrate to the NWB that the Hamlet is capable of operating and maintaining the infrastructure related to water use and waste disposal to meet the requirements of the Licence. The O&M Manuals should be based, at a minimum on the various 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) acceptable by NWB, and other regulatory guidelines as deemed appropriate.

Abandonment and Restoration Plan

General terms and conditions under Part G, Item 1 in the licence require the Licensee to submit an Abandonment and Restoration (A&R) Plan at least six (6) months prior to abandoning any facility under the scope of this renewal Licence. It should be noted that the Board is aware that the Licensee is contemplating abandoning the old water intake structure and pump house associated with the potable water treatment facilities. The Board expects that an appropriate A&R plan will be submitted in accordance with the terms and conditions in this licence.

Monitoring Plan

Although the 2011-2013 reports submitted include some of the required information, however, the reporting requirements specified in Part B, Item 1 of the Licence are not being fully satisfied. The Licensee needs to submit a relevant Monitoring and Quality Assurance / Quality Control (QA/QC) Plan for its operations, more detailed requirements for the QA/QC Plan are included in Part H, Item 9 and 10 of this Licence.

Engineered Drawings and Designs

The Licensee has stated that it will construct a new sewage lagoon, waste disposal facility, and expand its water reservoir once it secures the necessary capital funding. The Licensee shall refer to Part E of this Licence for the conditions applying to modifications and construction of the facilities included in this Licence. Part E Item 1 states that the Licensee

shall submit to the Board for approval in writing, for construction design drawings stamped by a qualified Engineer, sixty (60) days prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes. Part E, Item 4 of this Licence requires the Licensee to provide to the Board, for review, as-built plans and drawings, for facilities included under the scope of that licence, within ninety (90) days of completion of construction or, if already constructed, within ninety (90) days of issuance of the Licence.

Licence No. 3BM-IGL1520

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

HAMLET OF IGLOOLIK
(Licensee)

P.O. BOX 30 IGLOOLIK NUNAVUT X0A 0L0
(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 renewal:

Licence Number/Type:	3BM-IGL1520 TYPE "B"
Water Management Area:	KINGORA WATERSHED - 20
Location:	HAMLET OF IGLOOLIK QIKIQTANI REGION, NUNAVUT
Classification:	MUNICIPAL UNDERTAKING
Purpose:	DIRECT WATER USE AND DEPOSIT OF WASTE
Quantity of Water use not to Exceed:	81,208 CUBIC METRES *PER* ANNUM OR MAXIMUM OF 299 CUBIC METRES *PER* DAY
Date of Licence Issuance:	MARCH 31, 2015
Expiry of Licence:	MARCH 30, 2020

This Licence renewal, issued and recorded at Gjoa Haven, Nunavut, includes and is subject to the annexed conditions.

Thomas Kabloona,
Nunavut Water Board, Chair

PART A: SCOPE, DEFINITIONS AND ENFORCEMENT

1. Scope

This Licence allows for the use of water and the deposit of waste for a Municipal undertakings at the Hamlet of Igloolik, located within the Qikiqtani Region, Nunavut(Latitude: 69°23'N and Longitude: 81°46'W).

a. 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

b. 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

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

"**Addendum**" means the supplemental text that is added to a full plan or report usually included at the end of the document and is not intended to require a full resubmission of the revised report;

"**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;

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

"**Board**" means the Nunavut Water Board established under the *Nunavut Land Claims Agreement* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act;*

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

"**Engineer**" means a professional engineer registered to practice in Nunavut in accordance with the *Consolidation of Engineers and Geoscientists Act S. Nu 2008, c.2*

and the *Engineering and Geoscience Professions Act S.N.W.T. 2006, c.16 Amended by S.N.W.T. 2009, c.12*;

"**Existing Sewage Disposal Facilities**" refers to the pre-upgraded Sewage Disposal Facilities under Licence 3BM-IGL1520 that comprised numerous ponds as identified in the Technical Summary Environmental Facilities Report March 2014;

"**Existing Solid Waste Disposal Facilities**" refers to the pre-upgraded Solid Waste Disposal Facilities under Licence 3BM-IGL1520 designated for the disposal of solid waste, as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**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 the designed maximum operating height on the crest of 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;

"**Grab Sample**" means an undiluted single water or wastewater sample, collected at a particular time and place that may be representative of the total substance being sampled, at the time and place it was collected.

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

"**High Water Mark**" means the usual or average level to which a body of water rises at its highest point and remains for sufficient time so as to change the characteristics of the land (ref. Department of Fisheries and Oceans Canada, Operational Statement: Mineral Exploration Activities);

"**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 a new structure or eliminates an existing structure and does not alter the purpose or function of the work, but does not include an expansion;

"**Modified Sewage Disposal Facility**" refers to the upgrade Sewage Disposal Facilities that comprises the Primary Sewage Lagoon and Retention Sewage Lagoon as identified on Drawing No. C-O1, C-02 and C-04, Government of Nunavut Igloolik Waste Facilities, October 3, 2008, also as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**Modified Solid Waste Disposal Facilities**" referred to the up-graded Solid Waste Disposal Facilities designated for the disposal of solid waste, as identified on Drawing No. C-O1, C-02 and C-04, Government of Nunavut Igloolik Waste Facilities, October 3, 2008 and modified as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

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

"**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;

"**Regulations**" means the *Nunavut Waters Regulations* SOR/2013-69 18th April, 2013;

"**Retention Sewage Lagoon**" is the secondary cell of the Modified Sewage Disposal Facilities and is identified within the drawings submission dated October 3, 2008, "Igloolik Sewage and Solid Waste Facilities", specifically on Drawing No. C-01, Process Summary and drawing C-04, Sewage Lagoon Improvement Plan as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**Sewage**" means all toilet wastes and greywater;

"**Sewage Wetland**" compromises of the 'Sewage Wetland' Area Drawing No. C-O1, 'Wetland' Drawing No. C-02 and 'Proposed Wetland' Drawing No.C-04, Government of Nunavut Igloolik Waste Facilities, October 3, 2008 as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**Spill Contingency Plan**" means a Plan developed to deal with unforeseen petroleum and hazardous materials events that may occur during the operations conducted under the Licence;

"**Sump or Sumps**" A structure or depression that collects, controls, and filters liquid waste before it is released to the environment. This structure should be designed to prevent erosion while allowing percolation of liquid waste;

"**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**" consist of the Modified Sewage Disposal Facilities and the Modified Solid Waste Disposal Facilities as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**Water Supply Facilities**" comprises the area and associated intake infrastructure at Water Lake, the Intake Pump House and back-up truck fill station, the Water Treatment Plant, the Storage Tanks adjacent to the Water Treatment Plant and the Water Supply Pipe as described in the renewal application dated March 13, 2014 and supplementary documents submitted with the application;

"**Water" or "Waters**" means waters as defined in section 4 of the Act.

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*; and

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.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report on the Appurtenant Undertaking with the Board no later than March 31 of the year following the calendar year being reported, containing the following information:

   a. an executive summary as required by Part B, Item 8;
   b. tabular summaries of all data generated under the "Monitoring Program";
   c. the daily, monthly and annual quantities in cubic metres of fresh water obtained at the Water Supply Facilities;
   d. the daily, monthly and annual quantities in cubic metres of all waste discharged;
   e. 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;

f. a list of unauthorized discharges and summary of follow-up action taken;
g. a summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year;
h. any Addendum with updates or revisions for manuals and plans (i.e., *Operations and Maintenance Manuals/Plans*) as required by changes in operation and/or technology;
i. a summary of any studies or reports requested by the Board that relate to water use and waste disposal or restoration, and a brief description of any future studies planned; and
j. any other details on water use or waste disposal requested by the Board by November 1 of the year being reported;

2. 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.

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

4. Meters, devices or other such methods as approved by the Board in writing, used for measuring the volumes of water used and waste discharged shall be installed, operated and maintained by the Licensee.

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

6. 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.

7. 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 and any notice provided to an Inspector, 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@nwb-oen.ca

(b) Inspector Contact:
Manager of Field Operations, AANDC
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0

Telephone: (867) 975-4295
Fax: (867) 979-6445

8. 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.

9. 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.

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

11. The Licensee shall, for all Plans submitted under this Licence, implement the Plan as approved by the Board in writing.

12. 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.

13. 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 South Lake using the Water Supply Facilities, to be stored in the Hamlet Reservoir, or as otherwise approved by the Board in writing.

2. The annual quantity of water used for all purposes shall not exceed 81,208 cubic metres annually or a daily quantity of water for all purposes shall not exceed 299 cubic metres.

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

4. 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.

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

6. Sediment and erosion control measures shall be implemented prior to and maintained during the operation to prevent entry of sediment into water.

7. The Licensee shall submit to the Board for approval in writing, at least thirty (30) days prior to the use of water in sufficient volume that the source water body may be drawn down, the following information: volume required, hydrological overview of the water body, details of impacts, and proposed mitigation measures.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage to the Modified Sewage Disposal Facilities included under the scope of this licence.

2. The Licensee shall provide a minimum of ten (10) days' notice annually to an Inspector of the intent to discharge effluent from either the Modified Sewage Disposal Facilities.

3. All Effluent discharged from the Sewage Disposal Facility at Monitoring Program Station IGL-4, and IGL-5 shall meet the following Effluent quality standards:

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

4. The Licensee shall maintain at all times, a freeboard of at least 1.0 metre, or as recommended by a qualified engineer and as approved by the Board in writing, for all dams, dykes or other structures intended to contain, withhold, divert or retain water or wastes.

5. The Modified Sewage Disposal Facilities 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 Modified Solid Waste Disposal Facilities, or as otherwise approved by the Board in writing.

7. The Licensee shall segregate and store all hazardous materials and/or hazardous waste within the Modified Solid Waste Disposal Facilities in such a manner as to prevent the

deposit of deleterious substances into any water, until such a time that the materials have been removed for proper disposal at an approved facility.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval in writing, for construction design drawings stamped by a qualified Engineer, sixty (60) days prior to the construction of any dams, dykes or structures intended to contain, withhold, divert or retain water or wastes.

2. 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.

3. Modifications for which all of the conditions referred to in Part E, Item 2, have not been met may be carried out only with 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.

4. The Licensee shall provide to the NWB for review, as-built plans and drawings, stamped and signed by an Engineer, within ninety (90) days of completion of construction.

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 implement and maintain sediment and erosion control measures prior to and during activities carried out under this Part, to prevent the release of sediment and minimize erosion.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall submit to the Board for approval, within ninety (90) days of issuance of the Licence, Operations and Maintenance Manuals 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". The following Manuals and Plans shall take into consideration the comments received during the application review process:

a. Sewage Disposal Facility Operation and Maintenance (O&M) Plan (including the Sewage Sludge Management Plan;
b. Solid Waste Disposal Facility Operation and Maintenance (O&M) Plan; and
c. Spill Contingency Plan;

2. The Licensee shall review the Water Distribution Facility Operation and Maintenance (O&M) Plan. Changes in operation and technology should be modified accordingly. Revisions are to be submitted in the form of an Addendum to be included with the Annual Report. Additionally, the following specific amendments are required for the O&M:
    a. An improved description of the technology and process;
    b. A detailed breakdown of maintenance work and schedule of work required for the system equipment (including the submersible pumps, intake screens, and valves);
    c. Revisions to the faded Intake Screen and Reservoir Fill Line Drawings (Drawing No. 78-IB7-101 to 106); and
    d. Submitted O &M details 1979 Service Contracts for the operating pumps, if these Service Contracts are still required please renew and update the submitted information.

3. An inspection of all engineered facilities related to the management of water and waste shall be conducted by an Engineer (Civil, Municipal or Geotechnical) annually and before commissioning any facility. The Engineer's report shall be submitted to the Board within sixty (60) days of the inspection, including a Cover Letter from the Licensee outlining an implementation plan addressing each of the Engineer's recommendations.

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

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

    a. employ the appropriate contingency measures as approved under the Operation and Maintenance Manuals for the Hamlet of Igloolik;
    b. report the incident immediately via the 24-Hour Spill Reporting Line at (867) 920-8130 and to the Inspector at (867) 975-4295; 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 preventative measures to be implemented.

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 abandoning any facilities or upon submission of the final design drawings for the construction of new facilities to replace existing ones. Where applicable, the Plan shall include information on the following:

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

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

3. All disturbed areas shall be stabilized and re-vegetated as required, upon completion of work, and restored as practically as possible to a pre-disturbed state.

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

1. The Licensee shall maintain Monitoring Program Stations at the following locations:

Monitoring Program Station Number	Description	Status
IGL-1	Raw water supply intake at South Lake	Active (Volume)
IGL-2	Runoff from Solid Waste Disposal Facility	Active (Water Quality)
IGL-3	Raw Sewage at Discharge point into the Sewage Disposal Facility	**Not** Active
IGL-4	Final control point from Sewage Disposal Facility	Active (Water Quality)
IGL-5	Final Effluent Discharge Point prior entering Foxe Basin	New (Water Quality)

2. The Licensee shall measure and record, in cubic metres, the monthly and annual quantities of water pumped at Monitoring Program Station IGL-1, for all purposes.

3. The Licensee shall sample at Monitoring Program Stations IGL-4 and IGL-5, monthly during periods of observed flow. 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)	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)
Carbonaceous Biochemical Oxygen Demand (cBOD5)	

4. The Licensee shall sample at Monitoring Program Station IGL-2 once at the beginning, middle and near the end of discharge/run-off observed. . Samples shall be analyzed for the parameters under Part H, Item 3.

   The Licensee shall measure and record the annual quantities of sewage solids removed from the Waste Water Treatment Plant along with the treatment/storage/disposal provided.

5. If additional Final Discharge Points are identified during the term of this Licence, the Licensee shall submit, along with the Annual Report, the following information:

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

6. 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 by such other methods approved by the Board in writing.

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

8. The Licensee shall submit to the Board for review, within ninety (90) days of issuance of the Licence, a Quality Assurance/Quality Control Plan that conforms to the guidance document *Quality Assurance (QA) and Quality Control (QC) Guidelines For Use by Class "B" Licensees in Collecting Representative Water Samples in the Field*

and for Submission of a QAQC Plan INAC (1996). The Plan shall be acceptable to an accredited laboratory and include a covering letter from the accredited laboratory confirming acceptance of the Plan for analyses to be performed under the Licence.

9. The Licensee shall annually review the Quality Assurance/Quality Control Plan as required in Part H, Item 8 and modify the Plan as necessary. Proposed modifications shall be submitted to the accredited laboratory for approval.

10. Additional monitoring stations, sampling and analyses may be requested by an Inspector.

11. The Licensee shall include all of the data and information required by the "Monitoring Program" in the Licensee's Annual Report, as required per Part B, Item 1, or as requested by an Inspector.

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

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File No.: 3BM-IGL1520/Amendment No. 1

February 16, 2016

Brian Flemming
Senior Administrative Officer
Hamlet of Igloolik
P.O.Box 30
Igloolik, NU XOA 0A0

E-mail: igloolik@magma.ca

Bhabesh Roy, P. Eng.
Municipal Planning Engineer, Baffin Region
Government of Nunavut
Dept. Community and Government Services
P.O Box 379, Pond Inlet, NU X0A 0S0

E-mail: broy@gov.nu.ca

RE: Licence No. 3BM-IGL1520, Type "B" – Amendment No. 1 – Expansion and Rehabilitation of the Sewage Lagoon Facility

Dear Mr. Flemming and Mr. Roy:

Please find attached, Amendment No. 1 to Licence No. **3BM-IGL1520** issued to Hamlet of Igloolik by the Nunavut Water Board (NWB) under Motion 2015-27-56, 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* (*Nunavut Land Claims Agreement or NLCA*). The terms and conditions of the original Licence related to the use of Water and the deposit of Waste remain an integral part of this approval.

The Licensee is advised that this Amendment is for an undertaking that falls outside of an area with an approved Land Use Plan[1] as determined by the Nunavut Planning Commission (NPC) and subject to a 12.4.4(a) Screening Decision as described within Schedule 12-1 by the Nunavut Impact Review Board[2] in accordance with Article 12 of the *Nunavut Land Claims Agreement* (NLCA).

The NWB strongly recommends that the Licensee consult the comments received by interested persons on issues identified. This information is attached for your consideration.[3, 4]

[1] Nunavut Planning Commission (NPC) Conformity Determination, June 9, 2015.
[2] Nunavut Impact Review Board (NIRB), Screening Decision, dated December 8, 2015.
[3] Aboriginal Affairs and Northern Development Canada (AANDC), June 26, 2015;
[4] Fisheries and Oceans Canada (DFO), May 28, 2015;

Sincerely,

Thomas Kabloona
Nunavut Water Board
Chair

TK/ce/kk

Enclosure: **Licence No. 3BM-IGL1520 – Amendment No. 1**
Comments – AANDC, DFO

Cc: Qikiqtani Distribution List

LICENCE AMENDMENT No. 1

Licensee:	**Hamlet of Igloolik**
Licence No:	**3BM-IGL1520 – Type "B"**
Licence Issued:	**March 31, 2015**
Expiry Date:	**March 30, 2020**
Effective Date:	**February 16, 2016**

DECISION

Licence No. 3BM-IGL1520, issued on March 31, 2015 and set to expire on March 30, 2020, shall be amended to allow for the construction of a new lagoon cell and the rehabilitation of the Modified Sewage Lagoon Facility, as described in the Application received by the Board on April 20, 2015, for use as required in the deposit and management of Sewage Waste, operated by the Hamlet of Igloolik (the Hamlet or the Licensee), which is located within the Qikiqtani Region of Nunavut.

The NWB received from the Government of Nunavut – Community Government Services (GN-CGS), on behalf of the Hamlet of Igloolik, from March 16, 2015 to December 14, 2015, the following application documents (Application) for the amendment of Licence 3BM-IGL1520:

Water Licence Amendment Application, April 20, 2015

- Completed Amendment Application form and Cover Letter, April 20, 2015
- Hamlet Authorization letter by SAO, April 20, 2015
- Technical Summary of the Wastewater Treatment Facility, in English and Inuktitut, April 20, 2015
- Wastewater Treatment Facility, Hamlet of Igloolik (IGL-1 to IGL-8), dated March 27, 2015, April 20, 2015
- Operation and Maintenance Plan, Wastewater Treatment Plant, originally developed in 1979, April 20, 2015
- Operation and Maintenance Plan, additional amendments for the Wastewater Treatment Plant, August 17, 2015
- Preliminary Spill Contingency Plan, August 17, 2015
- Hamlet Annual Report 2014, March 16, 2015
- Design Brief, Optimization of the Wastewater Facility, Igloolik, Nunavut developed by exp Services Inc., dated November 2014, submitted April 20, 2015
- Vegetated Filterstrip Wetland Assessment for the Treatment of Pre-treated Sewage, Hamlet of Igloolik (Final), MTE, October 8, 2014. Prepared for the Government of Nunavut, CGS,
- Specifications Document, Government of Nunavut, Igloolik Sewage Lagoon (OTCD-00019838A); Stamped and Signed by exp Services Inc., November 13, 2015
- Stamped and Signed Tender Drawings, Rev.5, issued for NWB review, drawings IGL1 through IGL8
- Additional Geotechnical Investigation, developed by exp Services Inc., dated September 29, 2014, April 20, 2015

- Additional Geotechnical Investigation Results, developed by exp Services Inc., dated October and November, 2009, April 20, 2015
- Geothermal Analysis of Proposed Sewage Lagoon, developed by Naviq Consulting Inc, dated June 2010, April 20, 2015
- Geotechnical Investigation-attached results, developed by exp Services Inc., dated March 16, 2010, April 20, 2015
- Sewage Lagoon Upgrade Project Schedule, dated November, 2014, April 20, 2015
- Environmental Assessment Screening (Draft), Construction of New Sewage Lagoon and Rehabilitation of Existing Lagoons, developed by Global Tox, dated November, 2009, April 20, 2015
- Geotechnical Investigation, developed by Trow Associates Inc., dated March 16, 2010, July 30, 2015
- Geotechnical Report Letter, by exp Services Inc., dated November 5, 2014, December 14, 2015
- Email Correspondence for Amendment Application, July 20, 2015, August 5, 2015, and December 14, 2015

Following receipt and an internal preliminary review, NWB distributed the Application for a thirty (30)-day comment period on May 26, 2014. On May 28, 2015 a submission was received from Fisheries and Oceans Canada (DFO). On June 26, 2015, a submission was received from Aboriginal Affairs and Northern Development Canada (AANDC).

In their submission, the DFO requested clarification on whether any planned dewatering activities that are required for the new pipe installation, would have any impact on fish or fish habitat. Clarification was provided that areas of dewatering involved surface runoff areas that had no record of fish habitation.

AANDC, in their submission, requested additional information on the handling and storage of sewage sludge and confirmation that the storage of sludge has been considered in the design of the new and rehabilitated sewage lagoons. In addition, a description on how the Licensee planned to store excavated sludge during the rehabilitation of the existing sewage lagoon cells was requested.

Following the receipt of the comments, the applicant confirmed in its email correspondence of December 15, 2015 the use of the older cell for sludge storage and emergency use. It was also confirmed that the new construction would include design for 0.5m depth for sludge accumulation and that there are no plans to dispose of any sludge in a landfill.

Other concerns noted in AANDC's submission were the references to documents not submitted with the Application and the absence during the review. These supporting documents were either located in the NWB files or provided by the Applicant and subsequently placed in the Public Registry for future reference.

With respect to operational plans, AANDC submitted that all outstanding plans should be provided, including those for the Operation and Maintenance of the Solid Waste Management and Sewage Disposal Areas, Abandonment and Restoration and the Spill Contingency Plan.

Although the Licensee, with this amendment application, submitted two additional O&M documents[5,6] with respect to plans, further updates are required and have been addressed through the amendment of Part F, Item 1 of this amendment.

In addition to the intervener's comments received, the NWB received pre-licensing requirements in the form of the Nunavut Planning Commission's (NPC) Land Use Conformity Determination for the file, on June 9, 2015 and the Nunavut Impact Review Board's (NIRB) Screening Report on December 8, 2015.

The NWB has placed in its Public Registry copies of the Application documents, including all comments received from interveners. This information is maintained in the NWB's public registry and is available to interested persons upon request. In addition, the NWB maintains reporting information on its FTP site, which can be accessed using the following link: ftp.nwb-oen.ca

The NWB, having considered the information provided in support of the Application and the comments received from parties during the review process, and pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters* and the *Nunavut Surface Rights Tribunal Act*, hereby grants Amendment No.1 to Licence No. 3BM-IGL1520. The amendment is subject to the following terms and conditions that are based on the comments received, and standard conditions imposed by the NWB for similar undertakings:

PART A: SCOPE, DEFINITIONS AND ENFORCEMENT

1. Definitions

Insert

> **"Upgraded Sewage Disposal Facilty"** consists of the new and rehabilitated Modified Sewage Disposal Facility, used for treating the waste water collected by the Hamlet of Igloolik, as described in the amendment application dated April 20, 2015 and supplementary documents submitted with the Application;
>
> **"Vegetative Filter Strip Wetland"** means the combination of treatment wetlands and vegetated filter strip areas and process as described in the document '*Vegetated Filter Strip Assessment for the Treatment of Pre-treated Sewage, Hamlet of Igloolik'*, prepared for the Government of Nunavut, CGS by MTE, dated October 8, 2014 (through exp Services Inc.);
>
> "**Waste Disposal Facilities**" consists of the Modified Solid Waste Disposal Facilities and the Modified Sewage Disposal Facilities (or upon completion, the Upgraded

[5]Operation and Maintenance Plan, additional amendments for the Wastewater Treatment Plant, August 17, 2015;
[6]Supplemental Spill Contingency information, August 17, 2015

Sewage Disposal Facility) as described in the renewal application dated March 13, 2014 and the amendment application dated April 20, 2015, as well as the supplementary documents associated with each application.

PART B: GENERAL CONDITIONS

Insert Item 1(k)

Provide an updated/revised Plan for Compliance, taking into account works achieved during the year, noting areas of (new) compliance and the anticipated goals and timelines for the next and future years.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

Amend Item 1

The Licensee shall direct all Sewage to the Modified Sewage Disposal Facility, or upon commissioning, to the Upgraded Sewage Disposal Facility, or as otherwise approved by the Board in writing.

Amend Item 2

The Licensee shall provide a minimum of ten (10) days' notice to an Inspector, of the intent to discharge Effluent from the Modified Sewage Disposal Facility, or upon commissioning, the Upgraded Sewage Disposal Facility.

Amend Item 3

All Effluent discharged from the Modified Sewage Disposal Facility, or upon commissioning, the Upgraded Sewage Disposal Facility, at Monitoring Program Stations IGL-4, and IGL-5 shall not exceed the following Effluent quality limits: (See Licence table).

Amend Item 5

The Modified Sewage Disposal Facilities, or upon commissioning, the Upgraded Sewage Disposal Facility, shall be maintained and operated in such a manner as to prevent structural failure.

Insert Item 8

The Licensee shall locate areas designated for waste disposal at a minimum distance of thirty-one (31) metres from the ordinary High Water Mark of any water body such that the quality, quantity or flow of Water is not impaired, unless otherwise approved by the Board in writing.

Insert Item 9

The Licensee shall dispose of and permanently contain all solid wastes at the Waste Disposal Facilities, or as otherwise approved by the Board in writing.

Insert Item 10

The Licensee shall not open burn plastics, wood treated with preservatives, electric wire, Styrofoam, asbestos or painted wood to prevent the deposition of Waste materials of incomplete combustion and/or leachate from contaminated ash residual,

from impacting any surrounding waters, unless otherwise approved by the Board in writing.

Insert Item 11

The Licensee shall segregate and store all hazardous materials and hazardous Waste including waste oil, within the Waste Disposal Facilities in a manner to prevent the deposit of deleterious substances into any Water, until such a time that the materials are to be removed for proper disposal at licensed facility.

Insert Item 12

The Licensee shall implement measures to ensure leachate from the Waste Disposal Facilities do not enter Water.

Insert Item 13

The Licensee shall remove and treat hydrocarbon contaminated soils on site or transport them to an approved disposal site for treatment.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

Amend Item 1(a)(i), (ii) and (iii)

a. Sewage Disposal Facility Operation and Maintenance (O&M) Plan (including the Sewage Sludge Management Plan), to include the following information:
   i. a summary of how the sludge management lagoon will be rehabilitated (e.g., re-enforced berms, lining, etc.);
   ii. how Effluent that accumulates within the sludge management lagoon will be managed;
   iii. design drawings of the sludge management lagoon including drawings that reference the sludge management cell relative to the planned new sewage lagoon and rehabilitated sewage lagoons;
   iv. the testing requirements that will be applied to sewage sludge and the criteria required prior to any plans for landfill disposal;
   v. a description of how sludge will be disposed in the landfill.

Insert Item 6

The Licensee shall conduct any equipment maintenance and servicing in designated areas and shall implement special procedures (such as the use of drip pans and liners) to manage motor fluids and other waste and contain potential spills.

Insert Item 7

The Licensee shall maintain appropriate spill response equipment and clean-up materials (e.g., shovels, pumps, barrels, drip pans, and absorbents) and be readily available during any transfer of fuel or hazardous substances.

PART H: CONDITIONS APPLYING TO MONITORING

Amend Item 1

The Licensee shall maintain Monitoring Program Stations at the following locations:

Monitoring Program Station Number	Description	Status
IGL-1	Raw Water supply intake at South Lake	Active (Volume)
IGL-2	Runoff from Modified Solid Waste Disposal Facilities	Active (Water Quality)
IGL-3	Raw Sewage at Discharge point into the Modified Sewage Disposal Facility	**Not** Active
IGL-4	Final control point from the Modified Sewage Disposal Facility or upon commissioning, the Upgraded Sewage Disposal Facility	Active (Water Quality)
IGL-5	Final Effluent discharge point prior entering Foxe Basin	New (Water Quality)

Amend Item 4

Delete second paragraph "The Licensee shall measure and record…"

All remaining terms and conditions of Licence No. 3BM-IGL1520, Type 'B", issued March 31, 2015, are still applicable.

This Licence Amendment issued and recorded at Gjoa Haven, NU on February 16, 2016.

Approved by,

Thomas Kabloona
Nunavut Water Board, Chair

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI
OFFICE DES EAUX DU NUNAVUT

File: 3BM-IGL1520 / Amendment No. 2

September 1, 2016

Shawn Stuckey
Senior Administrative Officer
Hamlet of Igloolik
P.O. Box 30
Igloolik, NU XOA 0L0

Email: igloolik@magma.ca

Bhabesh Roy, P. Eng.
Municipal Planning Engineer, Baffin Region
GN -Community and Government Services
P. O. Box 379
Pond Inlet, NU X0A 0S0

Email: broy@gov.nu.ca

RE: Licence No. 3BM-IGL1520, Type "B" – Amendment No. 2

Dear Mr. Stuckey and Mr. Roy:

Please find attached **Amendment No. 2** to Type "B" Water **Licence No. 3BM-IGL1520**, issued to the Hamlet of Igloolik by the Nunavut Water Board (NWB) under **Motion 2016-B1-011** pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters and Nunavut Surface Rights Tribunal Act*. The terms and conditions of the original Licence as they related to Waste deposit and Water use, remain an integral part of this approval.

The Licensee is advised that this Amendment is for an undertaking that falls outside of an area with an approved Land Use Plan as determined by the Nunavut Planning Commission (NPC)[1] and does not require a review pursuant to section 92(1)(a) of the Nunavut Planning and Project Assessment Act (NuPPAA) as indicated in the Nunavut Impact Review Board's (NIRB) Screening Decision Report.[2]

The NWB strongly recommends that the Licensee consult the comments and/or recommendations provided by intervener(s). This information is attached for your consideration.[3]

[1] Nunavut Planning Commission (NPC) Determination, March 1, 2016.
[2] Nunavut Impact Review Board (NIRB) Screening Decision Report, May 13, 20.16.
[3] Indigenous and Northern Affairs Canada (INAC) Comment Submission, August 22, 2016.

Sincerely,

Thomas Kabloona
Nunavut Water Board, Chair

TK/sj/vk

Enclosure: **Licence No. 3BM-IGL1520 – <u>Amendment No. 2</u>**
Comments – INAC

Cc: Qikiqtani Distribution List

Background

On June 2, 2016, the Government of Nunavut – Community and Government Services (the "GN-CGS"), on behalf of the Hamlet of Igloolik, submitted to the Nunavut Water Board ("NWB" or "Board") for consideration, an application and supporting information (the "Application") to amend Type "B" Water Licence No. 3BM – IGL1520 (the "Existing Licence") to allow for the expansion of an existing potable water supply reservoir, replacement of an intake line that transmits water from the South Lake source to the Hamlet's water supply reservoir, the construction of a new truck-fill station, and the inclusion of Fish Lake as an alternative water source to the scope of the Existing Licence.

Details included in the Application to amend the Existing Licence indicate that in 2015 the Hamlet experienced a shortage in the reservoir's over-winter water storage due to anoxic conditions at the South Lake water source. To protect the public's safety, the Government of Nunavut – Department of Health (GN-DOH) advised that use of the South Lake water source should be temporarily discontinued. The Hamlet accepted the GN-DOH advise, and it decided to use Fish Lake as its water supply source until the integrity of the South Lake source was restored.

The Hamlet indicated in its Application that to minimize the possibility of similar shortages in the future, it is proposing, as stated above, to expand the reservoir's annual over-winter storage capacity from 79,000 m^3 to 102,800 m^3 as well as upgrade some of the other structures/equipment associated with the Water Supply Facilities.

The Application submitted to amend Licence No. 3BM-IGL1520 included the following documents:

- Igloolik Approval Letter
- Reservoir Expansion Letter
- Amendment 2 Letter
- 012500 Special Provisions rev April 11, 2016
- Certificate of Analysis B1515523 R
- February 2, 2016 Final Design Brief
- Iglolik Amendment 2 Letter
- Igloolik Bathymetric Survey ARKTIS
- Igloolik Fish Lake Hydrology study August 12, 2015
- Igloolik Reservoir Expansion Sketch
- Igloolik Water Supply Design Development ARKTIS
- Inspectors Direction
- May 27, 2016 INAC Letter to Igloolik Reservoir Expansion Request
- NIRB Project Proposal of Igloolik Water Reservoir Expansion Project, February 18, 2016
- NIRB Project Proposal of Igloolik Water Reservoir Expansion Project, March 3, 2016
- October 27, 2015 Risk Assessment Report Final
- Signature Water Licence Amendment 2 Application
- Water Licence Amendment 2 Application

Following an internal preliminary review and receipt of additional information as well as confirmation from the respective regulators regarding pre-licensing issues related to the Application, the NWB distributed the Application on July 22, 2016 for a thirty (30) day comment and review period with the deadline for submissions set for August 22, 2016. Before

the deadline for comments elapsed, a submission was received from Indigenous and Northern Affairs Canada (INAC) in which INAC provided several comments and recommendations, which are summarized below:

- The Operation and Maintenance Plan associated with the undertaking should be updated to included the water supply system's two pump houses. The updated plan should be submitted to the NWB for review and approval;
- A spill contingency plan should be submitted to the NWB for review and approval;
- Spill involving fuel or hazardous material that occur adjacent to or into a water body regardless of quantity or size should be reported immediately to the NWT, 24-hour spill report line and to INAC's Manager of Field Operations; and
- In accordance with the *Consolidation of Spill Contingency Planning and Reporting Regulations* (R-068-93), any person storing contaminants in an above-ground storage facility, with capacity equal to or greater than 20,000 litres/kilograms, is required to file a spill contingency plan.

With respect to pre-licensing matters, the Nunavut Planning Commission (NPC) issued its determination[4] for the Application on March 1, 2016, stating that the project falls outside of the area in which an approved Land Use Plan is in place and that the proposal was forwarded to the Nunavut Impact Review Board (NIRB) for screening as it did not belong to the class of exempt works or activities. On May 13, 2016, the NIRB issue its Screening Determination[5] for the project.

Issues Considered by the Board

The following sections provide an overview of some of the main issues that the Board considered in its decision on whether or not to grant Amendment No. 2 to Licence No. 3BM-IGL1520:

Inspector's Direction

On June 2, 2016, Indigenous and Northern Affairs Canada (INAC) issued an Inspector's Direction[6] regarding the shortage of over-winter water storage for the Hamlet of Igloolik. The Inspector directed that the issue(s) that created the shortage be addressed immediately to prevent any potential threat to public health and safety. Further, the Inspector requested that a plan be provided prior to any work occurring, including the timelines and details of work required to address public health and safety concerns pertaining to the water shortage and that a final summary of work completed be provided on or prior to October 31, 2016.

In keeping with the Inspector's Direction and as part of the Licensee's strategy to prevent future shortages, the Licensee, as mentioned above, is proposing to expand the water storage facility and associated infrastructure. Written letters of support[7] for the proposed expansion were provided by the Nunavut's Deputy Chief Medical Officer of Health and the Mayor of the Hamlet of Igloolik.

Water Use/Type of Licence

[4] Nunavut Planning Commission (NPC), Land Use Determination, March 1, 2016.
[5] Nunavut Impact Review Board (NIRB) Screening Decision, May 13, 2016.
[6] J. Hack, Water Resource Officer, INAC, to D. Flynn, Assistant Deputy Minister, Local Government – GN-CGS; CC'd: E. Allain, INAC, Licensing, NWB; T. Toonoo, CGS; Dr. K. Barker and M. LeBlanc Havard, Department of Health; SAO, Hamlet of Igloolik; Re: Nunavut Waters and Nunavut Surface Rights Tribunal Act Inspector's Direction, June 2, 2116.
[7] Letter from P. Ivalu, Mayor, Municipality of Igloolik, to B. Roy, Municipal Planning Engineer, Re: Igloolik Water Reservoir Expansion, February 26, 2016; and letter from, M. Kaikie, Deputy Chief Medical Officer of Health, to M. Heath, Director of Community Infrastructure Division, GN- CGS, Re: Igloolik Water Reservoir Expansion, February 25. 20165.

Details included in the Application to amend the Licence indicate that while the Licensee is proposing to increase the storage capacity of the reservoir from 79,000 m^3 to 102,800 m^3, the actual water consumption rate for the Hamlet in the short-term will remain at the current volume allowed in Existing Licence. The Existing Licence authorizes the use of up to 81,208 cubic metres of water annually not exceeding 299 cubic metres per day directly from the water source authorized under the Existing Licence; however, the Licensee's 2013, 2014, and 2015 Annual Reports suggest that the Hamlet's annual water usage was on average 54,000 cubic metres during the aforementioned periods and that the rate of usage is unlikely to change in the short-term.

It should be noted that in the decision section of the Existing Licence, which was issued on March 31, 2015, it was mentioned that Schedule 2 of the *Nunavut Waters Regulations* (the "Regulations"), which came into effect on April 18, 2013, states that a Type "A" water licence is required for activities involving the storage of more than 60,000 cubic metres of water and/or the used of at least 300 cubic metres of water per day. It should be noted that the Board did not apply this requirement at the time the Existing Licence was issued due to a number of factors including the nature of the storage facility involved (the Regulations are based on storage utilizing dams or dikes – Column 2, Item 3 of Schedule 2) and the fact that the Hamlet's direct water usage from the source or its reservoir did not exceed the threshold outlined in Schedule 2 of the Regulations. The Licensee is advised, however, that if there is any proposed increase in direct source water use related to the Existing Licence in future, the associated renewal or amendment application for this potential increase in use may potentially be treated as a Type "A" application and processed in accordance with the relevant thresholds established in the Regulations.

Water Sources

Conditions included in the Existing Licence allow for the use of South Lake as the Hamlet's primary and only source of water supply. However, due to the over-winter shortage experienced in 2015 as a result of poor water quality that temporarily effected the South Lake source, the Hamlet was obliged to use Fish Lake as an alternative water source during that period. As part of its Application (Amendment No. 2 Application), the Licensee requested the inclusion of Fish Lake as a secondary water supply source. The memorandum entitled *Fish Lake Hydrology Study: Igloolik*, included as part of the Application, the yield to Fish Lake is estimated at 302,000 cubic metres, excluding evaporation and some other factors, while the annual community demand is expected reach approximately 165,000 cubic metres by the year 2045. Although the assessment did not examine the suitability of Fish Lake as an over-winter source, based on the information presented, Fish Lake may be considered capable of meeting the Hamlet's water supply needs as a secondary source, to some extent.

A bathymetric survey conducted by Arktis Solutions Incorporated for the South Lake water supply source estimates its volume at 491,956 cubic metres, suggesting, with the consideration of other factors, that the Hamlet's current and future water demand (20-year projection) could continue to be met by this source assuming that its integrity and yield are maintained over time.

The Board has considered the Licensee's request in the context of previous and potential risk(s) that may be inherent in using the South Lake water source as well as the potential implications for the Hamlet should such risk come to fruition, in deciding to grant the Licensee's request under Part C, Item 1 of this Amendment. The Licensee should note that in granting the use of Fish Lake as an alternative water source, the Board included requirements to inform the NWB

and the Inspector at least ten (10) days prior to withdrawing water from Fish Lake for any purpose under the Licence.

Management Plans
In accordance with the terms and conditions included in the Existing Licence, the Licensee is required to submit to the Board for review and/or approval, the following management plans:

a. An Operation and Maintenance Manual for the Sewage and Solid Waste Disposal Facilities, within ninety (90) days of issuance of the Existing Licence (Part F, Item 1). The Licensee submitted on August 17, 2015, a one-page document entitled *Operation and Maintenance Procedure of Wastewater Treatment by Lagoons of the Hamlet of Igloolik*, which the Board determined as being insufficient for meeting the requirements in the Licence. Therefore, the Licensee should note that the conditions in the Existing Licence as well as any added requirements imposed by Amendment No. 1 to the Existing Licence remain applicable and in effect.

   The Licensee should also be advised that the requirements under Part F, Item 1, which include the submission of a Spill Contingency Plan (SCP), remain outstanding. INAC in its submission related to this Application, requested that a SCP be submitted to the Board for approval, which the Board is in agreement with. As there is no SCP currently approved under the Existing Licence or submitted for approval at the time of the Application, the Board has included the condition under Part E, Item 8 of this Amendment for the submission of a separate spill contingency plan for the proposed construction activities.

b. Changes to the Operation and Maintenance Manual for the Water Distribution Facility, as an addendum within the annual report submitted for the Existing Licence (Part F, Item 2). The Licensee submitted on August 8, 2015 a document to satisfy this requirement; however, the Board determined shortly following submission that the document needed to be revised as it was inadequate. Consequently, this requirement remains outstanding and must be addressed as stipulated in the Exiting Licence and/or Amendment No. 1 to the Existing Licence.

   Apart from the aforementioned item, the Board has included terms and condition under Part F, Item 8 of this Amendment for the submission, within sixty (60) days of completion of the Water Supply Facilities expansion, an O&M manual that captures the upgraded facilities authorized under this amendment (Amendment No. 2). The Licensee should note that the requirement in the Existing Licence for submission of an O&M Manual for the current Water Supply Facilities remains in effect and outstanding. However, condition has been added to this Amendment for the submission of an O&M manual for the expanded facility once completed and commissioned that should take into consideration INAC's relevant comments and recommendations.

c. Submission of a Quality Assurance/Quality Control (QA/QC) Plan, within ninety (90) days of issuance of the Existing Licence (Part H, Item 8). The Licensee has indicated that it intends to submit a QA/QC Plan within ninety (90) days of issuance of Amendment No. 2. No changes have been made to this requirement in this Amendment or in Amendment No. 1; therefore, the requirement as included in the Existing Licence remains in effect and outstanding.

Closure and Reclamation

As the pertinent requirements in the Existing Licence are quite general and adequate enough to address closure and reclamation procedures for the current Water Supply Facilities once construction of the expanded facilities is completed and the facility is commissioned, the Board has not included any additional conditions regarding closure and reclamation activities. Licensee should note that the Water Supply Facilities and infrastructure that are no longer in use will require closure and reclamation in accordance with Part G, Item 1 of the Existing Licence.

Compliance

As mentioned above, the Board notes that some of the management plans associated with the Existing Licence remain outstanding and that an Inspector's direction, dated June 2, 2016, has been issued and remains in effect. Further, the Board notes that the Plan for Compliance required under Part B, Item 1(k) of Amendment No. 1 to the Existing Licence remains outstanding. The Board advises that it is the obligation of the Licensee to ensure that all requirements associated with its Existing Licence and related Amendment(s) are accordingly addressed.

Design Drawings

As part of the Application to amend the Existing Licence, the Licensee submitted a report prepared by exp Services Inc. that contained design parameters and drawings pertaining to the reservoir expansion, Figures 1 and 2. Further, a design development report for the water supply system improvement, prepared by Arktis Piusitippaa Inc., contained in addition to relevant design parameters, design drawings for the truck-fill station and pump house, Figures 5-12. The Licensee should note that as the drawings provided in both documents were not signed and stamped by an engineer, and it is inconclusive as to whether they are for-construction or for tendering purposes. Conditions have been included under Part E, Item 9 in this Amendment, requiring the submission of for-construction drawings for the Board's review at least two (2) weeks prior to the commencement of construction activities.

Project Execution

Based on details included in the Application, the proposed expansion of the reservoir will be undertaken in two phases:

- Phase 1 – Mobilization, dewatering of existing reservoir, drill and blasting, excavation, temporary water truck filling facility, and recharging of reservoir. Phase 1 is schedule to commence September 30, 2016 or prior to the freeze-up period.
- Phase 2 – Mobilization, dewatering of existing reservoir, drill and blasting excavation, temporary water truck filling facility, and recharging of reservoir. Phase 2 is schedule to commence September 30, 2017 or prior to the freeze-up period.

Decision

Considering that above-mentioned issues and the Licensee proposed investment in infrastructure improvements to enhance its ability to adequately address the community's potable water supply needs, the Board has decided to approve the issuance of Amendment No. 2 to Licence No. 3BM-IGL1520.

LICENCE AMENDMENT No. 2

Licensee:	**Hamlet of Igloolik**
Licence No:	**3BM-IGL1520, Type "B"**
Licence Issued:	**March 31, 2015**
Amendment No.1	**February 16, 2016**
Amendment Effective Date:	**September 1, 2016**
Expiry Date:	**March 30, 2020**

Pursuant to its authority under Article 13 of the *Agreement between the Inuit of the Nunavut Settlement Area and Her Majesty the Queen in Right of Canada* and the *Nunavut Waters and the Nunavut Surface Rights Tribunal Act*, with respect to the Application for Amendment No. 2 to Licence No. 3BM-IGL1520, dated April 29, 2016, made by the Government of Nunavut – Community and Government Services (GN-CGS) on behalf of the Hamlet of Igloolik, the Nunavut Water Board hereby grants the following Licence Amendment.

The Licence issued on March 31, 2015 with an expiry date of March 30, 2020, shall be further amended to include the following terms and conditions, with respect to the use of Water and the deposit of Waste for a Municipal undertaking within the boundaries of the Hamlet of Igloolik, in the Qikiqtani Region, Nunavut, at the following geographical coordinates: Latitude: 69º 23' N and Longitude 81º 46' W.

The Licence shall be amended as follows:

PART A: SCOPE, DEFINITIONS AND ENFORCEMENT

Item 1 – Scope

Amended to read:

> This Licence allows for the deposit of Waste use and use of Water, including the expansion of the Hamlet's water supply reservoir, construction of a new truck-fill station, replacement of the transmission main that supplies water from the South Lake water source, and the use of Fish Lake as an alternative water source; for a Municipal undertaking at the Hamlet of Igloolik, located within the Qikiqtani Region, Nunavut (Latitude: 69°23'N and Longitude: 81°46'W).

Item 2 –Definitions

Amended to read

> "**Water Supply Facilities**" – Consists of pre-expanded and/or expanded facilities and associated infrastructure including the South Lake water source, intake infrastructure, and transmission line to the Hamlet's water supply reservoir and the reservoir, as well as the

Fish Lake Water source, a secondary and alternative source, as described in the Application dated March 13, 2015 and/or Amendment No. 2 Application dated June 2, 2016.

PART C: CONDITIONS APPLYING TO WATER USE

Item 1 Amended to read:

The Licensee is authorized to withdraw freshwater using the Water Supply Facilities for the purposes allowed under the Licence and associated amendments, from either South Lake, as a primary source, or Fish Lake, as a secondary source.

Insert Item 8

The Licensee shall provide to the Board and an Inspector, at least (10) days written notice, prior to withdrawing and using fresh water from Fish Lake, the secondary water source authorized under this Amendment.

PART E: CONDITIONS APPLYING TO MODIFICTAION AND CONSTRUCTION

Insert Item 7

The Licensee shall, within ninety (90) days of completion of construction of the reservoir expansion and related infrastructure, submit to the Board for review a Construction Summary Report that includes stamped, as-built plans and drawings, explanations for deviations from the construction specifications and drawings, and consideration of construction and field decisions and their effects on the performance of engineered facilities.

Insert Item 8

The Licensee shall submit to the Board for Approval, within thirty (30) days prior to commencing construction activities, a Spill Contingency Plan to assist the Licensee in preventing and/or minimizing spills during construction works and activities.

Insert Item 9

The Licensee shall submit to the Board for review, at least two (2) weeks prior to commencing construction activities, for-construction drawings and plans, signed and stamped by Engineer.

Insert Item 10

The Licensee shall ensure that surface runoff or discharges impacted by construction activities associated with the undertaking, not exceed the following Effluent Quality Limits, where flow may directly or indirectly enter Water:

Parameter	**Maximum Average Concentration**	**Maximum Concentration of Any Grab Sample (mg/L)**
Total Suspended Solids	50	100
Oil and Grease	No Visible Sheen	No Visible Sheen
pH	Between 6.0 and 9.5	Between 6.0 and 9.5

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

Insert Item 8

The Licensee shall submit, to the Board for approval, an Operation and Maintenance Manual for the updated or expanded Water Supply Facilities authorized under the scope of Amendment No. 2, at least sixty (60) days prior to commissioning the facility.

PART H: CONDITIONS APPLYING TO MONITORING PROGRAM

Item 1 Amended to read:

The Licensee shall maintain Monitoring Program Stations at the following locations:

Monitoring Station ID	**Description**	**Status**
IGL-1	Raw Water Supply Intake at South Lake	Active (Volume)
IGL-1a (New)	Raw Water Supply Intake at Fish Lake	Active (Volume)
IGL-2	Runoff from the Modified Solid Waste Disposal Facility	Active (Water Quality)
IGL-3	Raw Sewage at Discharge point into the Modified Sewage Disposal Facility	Not Active
IGL-4	Final control point from the Modified Sewage Disposal Facility or upon commissioning, the Upgraded Sewage Disposal Facility	Active (Water Quality)
IGL-5	Final Effluent Discharge Point prior entering Foxe Basin	Active (Water Quality)

Item 2 Amended to read:

> The Licensee shall measure and record, in cubic metres, the monthly and annual quantities of water pumped at Monitoring Program Stations IGL-1, and IGL-1a for all purposes under the Existing Licence associated Amendments.

All remaining terms and conditions of Licence No. 3BM-IGL1520, Type 'B", dated March 31, 2015, and Amendment No.1 dated February 16, 2016 still apply.

This Amendment, Amendment No. 2 to Licence No. 3BM-IGL1520, is issued and recorded at Gjoa Haven, NU on September 1, 2016.

Approved by,

Thomas Kabloona
Nunavut Water Board, Chair

Appendix B – Pump Maintenance and Repair

COM—06487—01
October 5, 2011
REV B October 8, 2014

INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

WITH PARTS LIST

GORMAN-RUPP PUMPS™

PA SERIES PUMP

MODEL

PA6A60—4045T

THE GORMAN-RUPP COMPANY • MANSFIELD, OHIO

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

www.grpumps.com.

Register your new
Gorman-Rupp pump online at
www.grpumps.com

Valid serial number and e-mail address required.

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

RECORD YOUR PUMP MODEL AND SERIAL NUMBER

Please record your 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: _____

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(continued)

INTRODUCTION

Thank You for purchasing a Gorman-Rupp pump. **Read this manual** carefully to learn how to safely install and operate your pump. Failure to do so could result in personal injury or damage to the pump.

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. The basic material of construction is ductile iron, with alloy steel shaft and ductile iron wear ring.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for every aspect of each specific application. Therefore, it is the responsibility of the owner/installer of the pump to ensure that applications not addressed in this manual are performed **only** after establishing that neither operator safety nor pump integrity are compromised by the installation. Pumps and related equipment **must** be installed and operated according to all national, local and industry standards.

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

For information or technical assistance on the engine, contact the engine manufacturer's local dealer or representative.

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:

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.

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.

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

This information applies to Prime Aire® Series pumps. Refer to the manual accompanying the engine or power source before attempting to begin operation.

Because pump installations are seldom identical, this manual cannot possibly provide detailed instructions and precautions for each specific application. Therefore, it is the owner/installer's responsibility to ensure that applications not addressed in this manual are performed only after establishing that neither operator safety nor pump integrity are compromised by the installation.

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 to ensure that the pump will remain inoperative.**
3. **Allow the pump to completely cool if overheated.**
4. **Check the temperature and make sure the 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.**

This pump is equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

Do not attempt to disengage any part of an overheated pump unit. Vapor pressure within the pump casing can eject these parts with great force when they are disengaged. Allow the pump to completely cool before servicing it.

This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.

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.

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 operate the pump against a closed discharge valve. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode. Momentary closure of a discharge valve is acceptable only when required for startup or shutdown procedures.

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 cool completely before servicing.

WARNING!

This pump 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!

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

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 to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the performance curve on page E—1 for the maximum continuous operating speed for this pump.

INSTALLATION – SECTION B

Review all SAFETY information in Section A.

Since pump installations are seldom identical, this section offers only general recommendations and practices required to inspect, position, and arrange the pump and piping.

Most of the information pertains to a standard **static lift** application where the pump is positioned above the free level of liquid to be pumped.

If installed in a **flooded suction application** where the liquid is supplied to the pump under pressure, some of the information such as mounting, line configuration, and priming must be tailored to the specific application. Since the pressure supplied to the pump is critical to performance and safety, **be sure** to limit the incoming pressure to 50% of the maximum permissible operating pressure as shown on the pump performance curve.

For further assistance, contact your Gorman-Rupp distributor or the Gorman-Rupp Company.

PREINSTALLATION INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, inspect the pump for damage which may have occurred during shipment. Check as follows:

a. Inspect the pump for cracks, dents, damaged threads, and other obvious damage.

b. Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

c. Carefully read all tags, decals, and markings on the pump assembly, and perform all duties indicated. Note that the pump shaft rotates in the required direction.

CAUTION

Only operate this pump in the direction indicated by the arrow on the pump body and on the accompanying decal. Otherwise, the impeller could become loosened from the shaft and seriously damage the pump.

d. Check levels and lubricate as necessary. Refer to **LUBRICATION** in the **Maintenance and Repair Manual** and perform duties as instructed.

e. If the pump has been stored for more than 12 months, some of the components or lubricants may have exceeded their maximum shelf life. These **must be inspected or replaced** to ensure maximum pump service.

If the maximum shelf life has been exceeded, or if anything appears to be abnormal, contact your Gorman-Rupp distributor or the factory to determine the repair or updating policy. **Do not** put the pump into service until appropriate action has been taken.

Battery Installation

Unless otherwise specified on the pump order, the engine battery is **not** included with engine driven units.

Refer to the information accompanying the battery and/or electrolyte solution for activation and charging instructions.

Before installing the battery, clean the positive and negative cable connectors, and the battery terminals. Secure the battery by tightening the holddown brackets. The terminals and clamps may be coated with petroleum jelly to retard corrosion. Connect and tighten the positive cable first, then the negative cable.

POSITIONING PUMP

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.

Lifting

Pump unit weights will vary depending on the mounting and drive provided. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Drain the pump and remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.

CAUTION

The pump assembly can be seriously damaged if the chains or cables used to lift and move the unit are improperly wrapped around the pump.

Mounting

Locate the pump in an accessible place as close as practical to the liquid being pumped. Level mounting is essential for proper operation. The pump may have to be supported or shimmed to provide for level operation and eliminate vibration.

For engine driven units, the pump **must** be positioned as level as possible to ensure sufficient lubrication and fuel supply to the engine.

If the pump has been mounted on a moveable base, make certain the base is stationary by setting the brake and blocking the wheels before attempting to operate the pump.

WARNING!

If the pump has been mounted on a movable base, do not attempt to operate the pump unless the unit is level. Be sure the leveling stands are positioned on a solid surface, and the wheels are chocked.

SUCTION AND DISCHARGE PIPING

Pump performance is adversely effected by increased suction lift, discharge elevation, and friction losses. See the performance curve and operating range shown on Page E-1 to be sure your overall application allows pump to operate within the safe operation range.

Materials

Either pipe or hose maybe used for suction and discharge lines; however, the materials must be compatible with the liquid being pumped. If hose is used in suction lines, it must be the rigid-wall, reinforced type to prevent collapse under suction. Using piping couplings in suction lines is not recommended.

Line Configuration

Keep suction and discharge lines as straight as possible to minimize friction losses. Make minimum use of elbows and fittings, which substantially increase friction loss. If elbows are necessary, use the long-radius type to minimize friction loss.

Connections to Pump

Before tightening a connecting flange, align it exactly with the pump port. Never pull a pipe line into place by tightening the flange bolts and/or couplings.

Lines near the pump must be independently supported to avoid strain on the pump which could

cause excessive vibration, decreased bearing life, and increased shaft and seal wear. If hose-type lines are used, they should have adequate support to secure them when filled with liquid and under pressure.

Gauges

The pump is drilled and tapped for installing discharge pressure and vacuum suction gauges. It is recommended that gauges be installed to monitor pump performance. Seal the gauge threads with pipe dope to ensure an airtight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

SUCTION LINES

To avoid air pockets which could affect pump priming, the suction line must be as short and direct as possible. When operation involves a suction lift, the line must always slope upward to the pump from the source of the liquid being pumped; if the line slopes down to the pump at any point along the suction run, air pockets will be created.

Fittings

Suction lines should be the same size as the pump inlet. If reducers are used in suction lines, they should be the eccentric type, and should be installed with the flat part of the reducers uppermost to avoid creating air pockets. Valves are not normally used in suction lines, but if a valve is used, install it with the stem horizontal to avoid air pockets.

Strainers

Be certain to use the strainer furnished with the pump; any spherical solids which pass through the strainer will also pass through the pump itself.

If a strainer not furnished with the pump is installed by the pump user, make certain that the total area of the openings in the strainer is at least three or four times the cross section of the suction line, and that the openings will not permit passage of solids larger than the solids handling capability of the pump.

This pump is designed to handle up to 3 inch (76,2 mm) diameter spherical solids.

Sealing

Since even a slight leak will affect priming, head, and capacity, especially when operating with a high suction lift, all connections in the suction line should be sealed with pipe dope to ensure an airtight seal. Follow the sealant manufacturer's recommendations when selecting and applying the pipe dope. The pipe dope should be compatible with the liquid being pumped.

Suction Lines In Sumps

If a single suction line is installed in a sump, it should be positioned away from the wall of the sump at a distance equal to 1 1/2 times the diameter of the suction line.

If there is a liquid flow from an open pipe into the sump, the flow should be kept away from the suction inlet because the inflow will carry air down into the sump, and air entering the suction line will reduce pump efficiency.

If it is necessary to position inflow close to the suction inlet, install a baffle between the inflow and the suction inlet at a distance 1-1/2 times the diameter of the suction pipe. The baffle will allow entrained air to escape from the liquid before it is drawn into the suction inlet.

If two suction lines are installed in a single sump, the flow paths may interact, reducing the efficiency of one or both pumps. To avoid this, position the suction inlets so that they are separated by a distance equal to at least 3 times the diameter of the suction pipe.

Suction Line Positioning

The depth of submergence of the suction line is critical to **efficient** pump operation. Figure 2 shows recommended minimum submergence vs. velocity.

Although not recommended, the vacuum assisted priming feature allows the pump to be operated

temporarily in a “slurping” application with varying water levels.

NOTE

The pipe submergence required may be reduced by installing a standard pipe increaser fitting at the end of the suction line. The larger opening size will reduce the inlet velocity. Calculate the required submergence using the following formula based on the increased opening size (area or diameter).

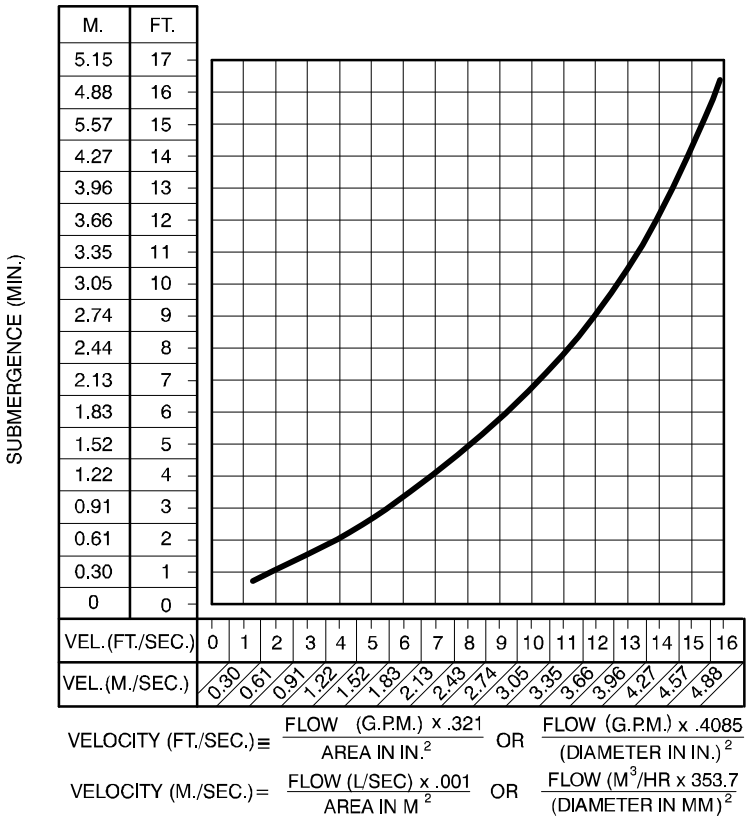


Figure 2. Recommended Minimum Suction Line Submergence vs. Velocity

DISCHARGE LINES

Siphoning

Do not terminate the discharge line at a level lower than that of the liquid being pumped unless a siphon breaker is used in the line. Otherwise, a siphoning action causing damage to the pump could result.

Valves

This pump is designed with a check valve in the discharge line.

If a throttling valve is desired in the discharge line, use a valve as large as the largest pipe to minimize friction losses. Never install a throttling valve in a suction line.

With high discharge heads, it is recommended that a throttling valve be installed in the discharge line to protect the pump from excessive shock pressure and reverse rotation when it is stopped.

CAUTION

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

ALIGNMENT

The alignment of the pump, air compressor and engine is critical for trouble-free mechanical operation. See Section E, **Securing Intermediate And Drive Assembly To Engine** in **MAINTENANCE AND REPAIR**, for details.

AUTO-START

The standard pump is equipped with an auto-start control system which allows the pump to start and stop as the liquid level in the wet well or sump rises and falls.

Refer to the information which follows for installation details for the liquid level sensing system provided with your pump.

Float Switch Installation

The Float Switch autostart system employs either a single or double float switch, where a bulb raises or lowers (floats) with the liquid level, thus activating an enclosed miniature switch. The floats are equipped with a socket type connector that plugs into a matching receptacle on the auto-start control box.

Standard floats are equipped with 50 feet (15,2 m) of cable.

When installing the floats, note the following:

a. **Be sure** to provide sufficient room in the wet well or sump so that floats do not get obstructed or drawn into the suction line. If a flexible suction hose is used, it may be extended to lay along the bottom of the wet well or sump and the float can be attached to the hose above the point where it bends along the bottom. Direct the suction line toward the flow, and the float(s) away from the flow. If a standpipe is available, attach the float switch cable to the standpipe in the sump at the approximate desired liquid level.

b. In a single float system, the cable can be tethered to the suction line or standpipe approximately 6 inches (152 mm) above the float. This setting allows approximately 9 inches (229 mm) of liquid rise between pump start/stop. The start/stop interval may be increased by extending the float end of the cable. The liquid level in the sump will increase approximately 8 inches (203 mm) between start/stop intervals for every 6 inches (152 mm) of cable increase.

c. If a double float switch system is used, position the “Start” float at the desired high water level in the sump, and the “Stop” float at the desired low water level in the pump.

d. Refer to Figure 3 for additional float switch data.

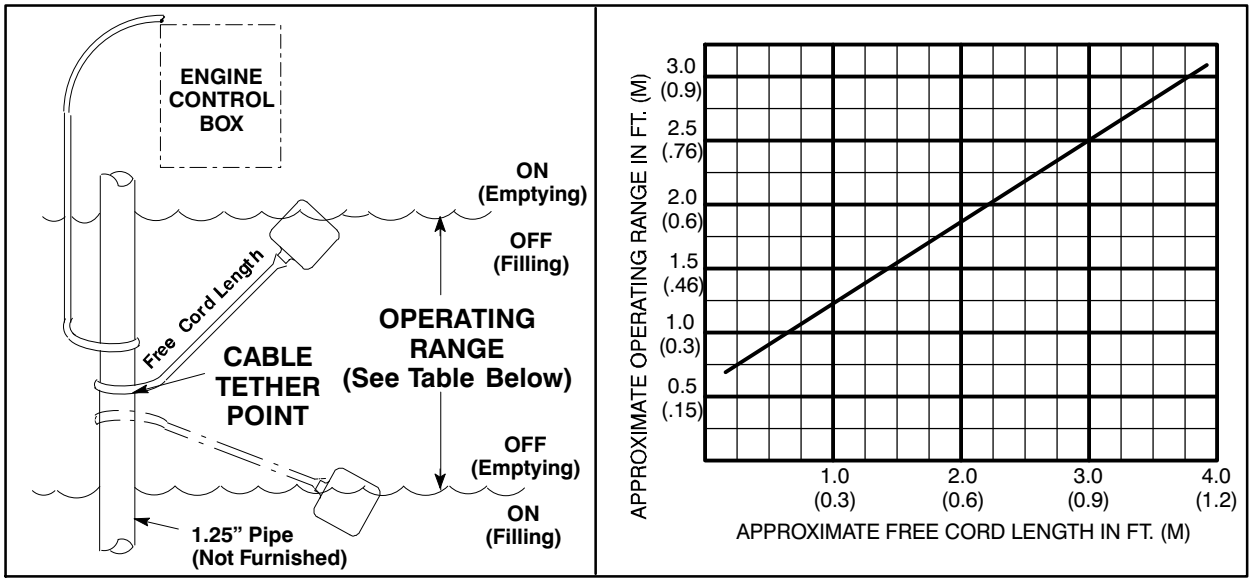


Figure 3. Float Switch Data

OPERATION – SECTION C

Review all SAFETY information in Section A.

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

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.

OPERATION

WARNING!

This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids and corrosives. Do not attempt to pump volatile, corrosive, or flammable liquids which may damage the pump or endanger personnel as a result of pump failure.

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the performance curve in Section E on page E–1.

PRIMING

Install the pump and piping as described in **INSTALLATION**. Make sure that the piping connections are tight, and that the pump is securely mounted. Check that the pump is properly lubricated (see **LUBRICATION** in **MAINTENANCE AND REPAIR**).

The pump will begin to prime upon startup. The air in the suction line will be discharged from the eductor discharge line. Complete priming is indicated by a positive discharge pressure reading.

If full priming is not achieved, the discharge check valve may be malfunctioning. If this occurs, shut down the pump and consult **Maintenance and Repair,** Section E for further details.

STARTING

Check the fuel level and oil levels in the engine, air compressor, pump bearings and seal housing.

Make sure the pump is level. Lower the jack stands and chock the wheels, if so equipped.

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.

WARNING!

This pump is equipped with automatic liquid level controls, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

Consult the engine operations manual before attempting to start the unit.

Manual Starting

On initial start-up, set the engine speed at the half-throttle position. Turn the key switch on the control

box to the “MANUAL” position, then press and hold the “ENTER” button until the engine starts.

CAUTION

Pump speed and operating condition points must be within the continuous performance range shown on the curve on Page E-1.

Automatic Starting

With the float system installed, follow the procedures outlined for manual starting and adjust the throttle to the desired flow rate. Turn the key switch to “OFF”, then move it to the “AUTO” position.

The pump will start automatically when the liquid level in the sump or wet well increases and the float(s) rise to the “on” position. An alarm will sound and the control box will begin a countdown display before the unit starts. When the liquid is sufficiently pumped down, the unit will automatically shut down.

The unit can be stopped while in the “AUTO” mode by moving the key switch to the “OFF” position.

NOTE

If the key switch is moved to the “OFF” position while in the “AUTO” mode, the engine will stop. However, the auto-start process will continue as soon as the key switch is moved back to the “AUTO” position.

The control panel is equipped with high oil temperature, low oil pressure, engine overspeed and engine overcrank safety shutdowns. If any of these problems occur, the engine will not start. When the problem is corrected, turn the key switch to the “OFF” position to reset the control.

Priming

The pump will begin to prime upon startup. The air in the suction line will be discharged from the eductor discharge line. Complete priming is indicated by a positive discharge pressure reading.

If full priming is not achieved, the discharge check valve may be malfunctioning. If this occurs, shut down the pump and consult the separate **Maintenance and Repair** manual for further details.

Routine Operation

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.

Adjust the engine speed to achieve the desired output. Do not exceed the factory set engine speed and system operating pressure. Do not operate below the recommended operating speed (if applicable).

WARNING!

Never tamper with the governor to gain more power. The governor establishes safe operating limits that should not be exceeded. Refer to the performance curve on page E—1 for the maximum continuous operating speed for this pump.

Operation In Extreme Heat

The safety shutdown system will automatically stop the unit if engine operating temperature exceeds design limits. If engine over-temperature shutdown occurs, allow the unit to cool before restarting.

If engine overheating continues, check the engine lubricant level and viscosity. Consult the engine operation manual for the recommended lubricant for operation in extreme heat.

If the unit is being operated in the **automatic** mode, adjust the float(s) to allow shorter run and longer cooling periods, if possible.

WARNING!

This pump is equipped with automatic liquid level controls, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the battery before performing any maintenance. Failure to do so may result in serious personal injury.

OPERATIONAL CHECKS

Leakage

Once the pump is fully primed, no leakage should be visible at pump mating surfaces, or at pump connections or fittings. Keep all line connections and fittings tight to maintain maximum pump efficiency.

Pump Vacuum Check

Read the vacuum gauge with the pump primed and at operation speed. Shut off the pump. The vacuum gauge reading will immediately drop proportionate to static suction lift, and should then stabilize. If the vacuum reading falls off rapidly after stabilization, an air leak exists. Before checking for the source of the leak, check the point of installation of the vacuum gauge.

Liquid Temperature And Overheating

The **maximum** liquid temperature for this pump is 160° F (71°C). Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump immediately and allow it to completely cool before servicing it. **Approach any over-heated pump cautiously**.

WARNING!

Allow an over-heated pump to completely cool before servicing. Do not remove plates, covers, gauges, or fittings from an overheated pump. Liquid within the pump can reach boiling temperatures, and vapor pressure within the pump can cause parts being disengaged to be ejected with great force. After the pump cools, drain the liquid from the pump by removing the casing drain plug. Use caution when removing the plug to prevent injury to personnel from hot liquid.

Strainer Check

Check the strainer regularly, and clean it as necessary. The strainer should also be checked if pump flow rate begins to drop. Monitor and record the vacuum suction gauge readings regularly to detect strainer blockage.

Never introduce air or steam pressure into the pump casing or piping to remove a blockage. This could result in personal injury or damage to the equipment. If backflushing is absolutely necessary, **liquid pressure** must be limited to 50% of the maximum permissible operating pressure shown on the pump performance curve.

STOPPING

Manual Stopping

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly.

In the manual mode, reduce the throttle speed slowly, and allow the engine to idle briefly before switching the engine key switch to ‘OFF’.

CAUTION

If the application involves a high discharge head, gradually close the discharge throttling valve before stopping the pump.

After stopping the pump, switch off the engine ignition and remove the key to ensure that the pump will remain inoperative.

Automatic Stopping

In the automatic mode, the pump will stop when the liquid in the wet well or sump lowers and activates the “Off” float switch(s). The pump will restart automatically when the liquid rises and activates the “On” float switch(s).

Safety Shutdown System

The unit is equipped with a safety system to automatically shut down the engine under certain conditions. The engine will automatically shut down:

1. If the engine exceeds its safe operating temperature.
2. If the engine oil pressure drops below design limits.
3. If the engine fails to start within a pre-set period of time.
4. If the engine speed exceeds the safe operating range.
5. If the engine fan belt breaks.

Lights on the control panel will indicate which of the safety features has caused the engine to shut down.

Should any of the safety features cause the engine to shut down, **the cause must be determined and corrected** before putting the unit back into service. The engine **will not restart** until the key switch has been returned to the ‘OFF’ position for at least 10 seconds.

All safety shutdown features are pre-set at the factory for optimum performance and safety; **do not** attempt to adjust these settings.

WARNING!

Never disconnect any of the safety shutdown features; this will void the warranty and could result in serious damage to the unit and/or injury to personnel. Safety shutdown features are pre-set at the factory; do not attempt to adjust any of the settings. Determine the cause of shutdown before putting the unit back into service. Consult the factory for additional information.

PERIODIC CHECKS

Seal Cavity And Bearing Lubrication

Both the seal and bearing cavities were fully lubricated at the factory. Check the lubrication levels before startup, and regularly thereafter as indicated in Section E, **Maintenance and Repair**. When lubrication is required, use **only** SAE No. 30 non-detergent oil.

Bearing Temperature Check

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160°F (71°C) are considered normal for bearings, and they can operate safely to at least 180°F (82°C).

Checking bearing temperatures by hand is inaccurate. Bearing temperatures can be measured accurately by placing a contact-type thermometer against the housing. Record this temperature for future reference.

A sudden increase in bearing temperatures is a warning that the bearings are at the point of failing to operate properly. Make certain that the bearing lubricant is of the proper viscosity and at the correct level (see **LUBRICATION** in Section E, **Maintenance and Repair**). Bearing overheating can also be caused by shaft misalignment and/or excessive vibration.

When pumps are first started, the bearings may seem to run at temperatures above normal. Continued operation should bring the temperatures down to normal levels.

Engine Fuel Filter

Consult the manual accompanying the engine, and change the fuel filter periodically as indicated. If operated under extremely dusty and/or humid

conditions, change the filter more frequently. Irregular performance and loss of power usually indicate a dirty fuel filter.

Engine Oil

The engine was lubricated for test at the factory. However, **always** check the lubrication level before startup.

Consult the manual accompanying the engine, and change the oil filter periodically as indicated. If operated under extremely dusty conditions, change the filter more frequently.

Consult the manual accompanying the air compressor and preform all duties and checks as indicated.

COLD WEATHER PRESERVATION

In below freezing conditions, drain the pump to prevent damage from freezing. Also, clean out any solids by flushing with a hose. Operate the pump for approximately one minute; this will remove any remaining liquid that could freeze the pump rotating parts. If the pump will be idle for more than a few hours, or if it has been pumping liquids containing a large amount of solids, drain the pump, and flush it thoroughly with clean water. To prevent large solids from clogging the drain port and preventing the pump from completely draining, insert a rod or stiff wire in the drain port, and agitate the liquid during the draining process. Clean out any remaining solids by flushing with a hose.

TROUBLESHOOTING — SECTION D

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 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 equipped with an automatic starting system, and is subject to automatic restart. Keep hands and clothing away from the unit to prevent injury during automatic operation. Disconnect the positive battery cable before performing any maintenance. Failure to do so may result in serious personal injury.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP FAILS TO PRIME	Discharge check valve contaminated, damaged, or unable to seat.	Clean or replace check valve.
	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.
	Suction lift or discharge head too high.	Check piping installation and install bypass line if needed. See **INSTALLATION**.
	Air compressor damaged or belts broken.	Check and repair/replace.
	Strainer clogged.	Check strainer and clean if necessary.
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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
PUMP STOPS OR FAILS TO DELIVER RATED FLOW OR PRESSURE (cont.)	Strainer clogged.	Check strainer and clean if necessary.
	Discharge check valve clogged.	Check and clean check valve.
	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.	Check engine output; consult engine operation manual.
	Belt or flexible coupling broken.	Check and replace as necessary.
PUMP REQUIRES TOO MUCH POWER	Pump speed too high.	Check engine output.
	Extreme ambient temperature.	Reduce pump output.
	Discharge head too low.	Adjust discharge valve.
	Fuel filter clogged.	Check & replace often in extreme operating conditions.
	Liquid solution too thick.	Dilute if possible.
	Fuel contaminated.	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, and run engine at maximum governed speed.
	Suction check valve or foot valve clogged or binding.	Clean valve.
	Liquid solution too thick.	Dilute if possible.
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.

TROUBLE	POSSIBLE CAUSE	PROBABLE REMEDY
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 E

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 lists on the following pages.

This 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. Maintenance of engines and factory-supplied air compressors are detailed in separate literature provided by the manufacturer(s).

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

As described in **SAFETY**, Section A, 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

Pump unit weights will vary depending on the mounting and drive provided. Check the shipping tag on the unit packaging for the actual weight, and use lifting equipment with appropriate capacity. Drain the pump and remove all customer-installed equipment such as suction and discharge hoses or piping before attempting to lift existing, installed units.

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.

ILLUSTRATION

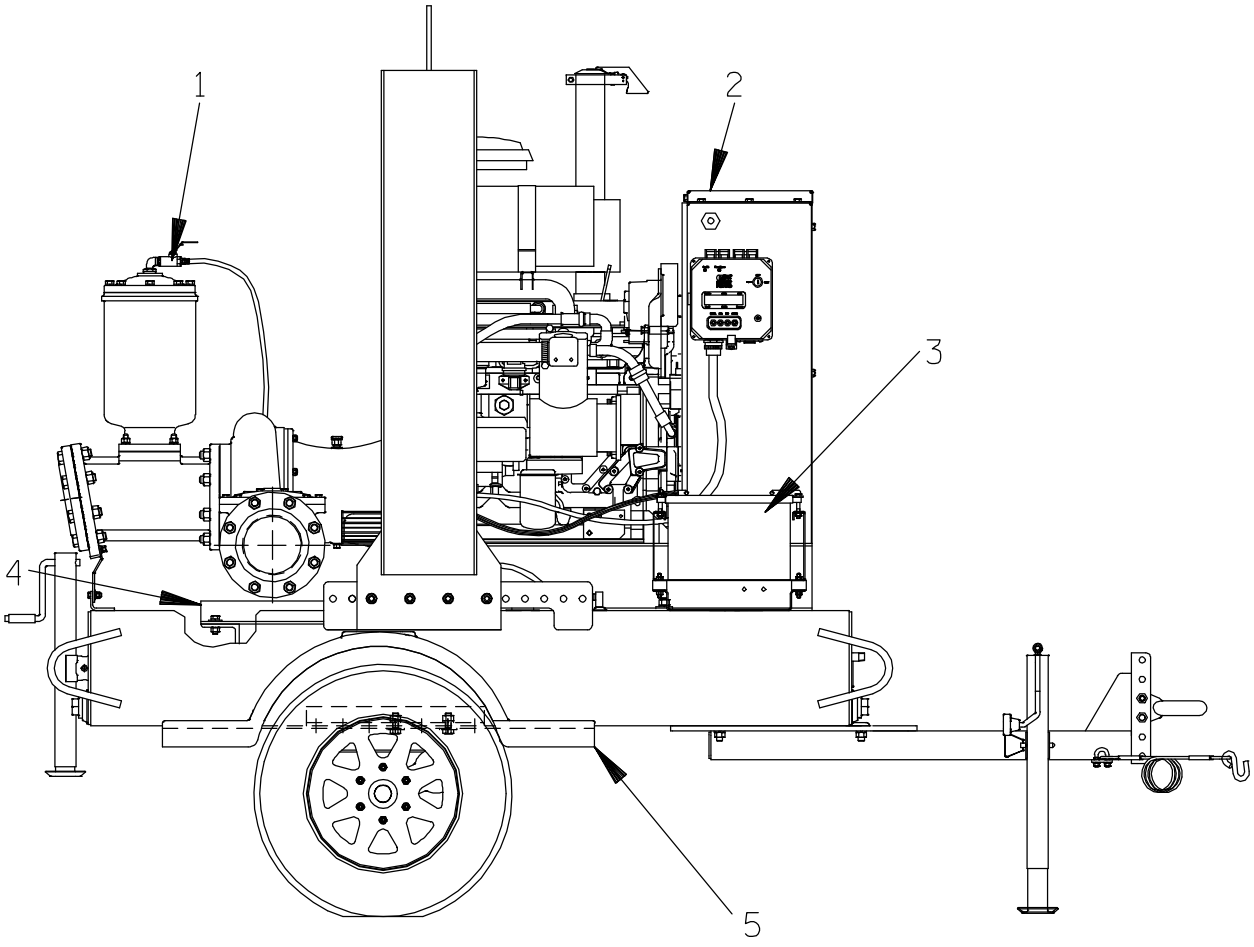


Figure 1. Pump Model PA6A60–4045T

Pump Model PA6A60–4045T

PARTS LIST

(CANADA S/N 1498445 Up)

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY	
1	PUMP END ASSEMBLY	PA6A60–(SAE 4/10)	–––	1	
2	POWER UNIT	46143–114	–––	1	
3	BATTERY	29331–527	–––	1	(REF)
4	PUMP MOUNTING KIT	48157–033	–––	1	
5	WHEEL KIT (OPTIONAL)	GRP30–262	–––	1	
NOT SHOWN:					
	G-R DECAL	GRC06	–––	3	
	PRIME AIRE DECAL	38812–078	–––	2	
	INSTRUCTION TAG	38817–085	–––	1	
	CAUTION DECAL	2613FJ	–––	1	

ILLUSTRATION

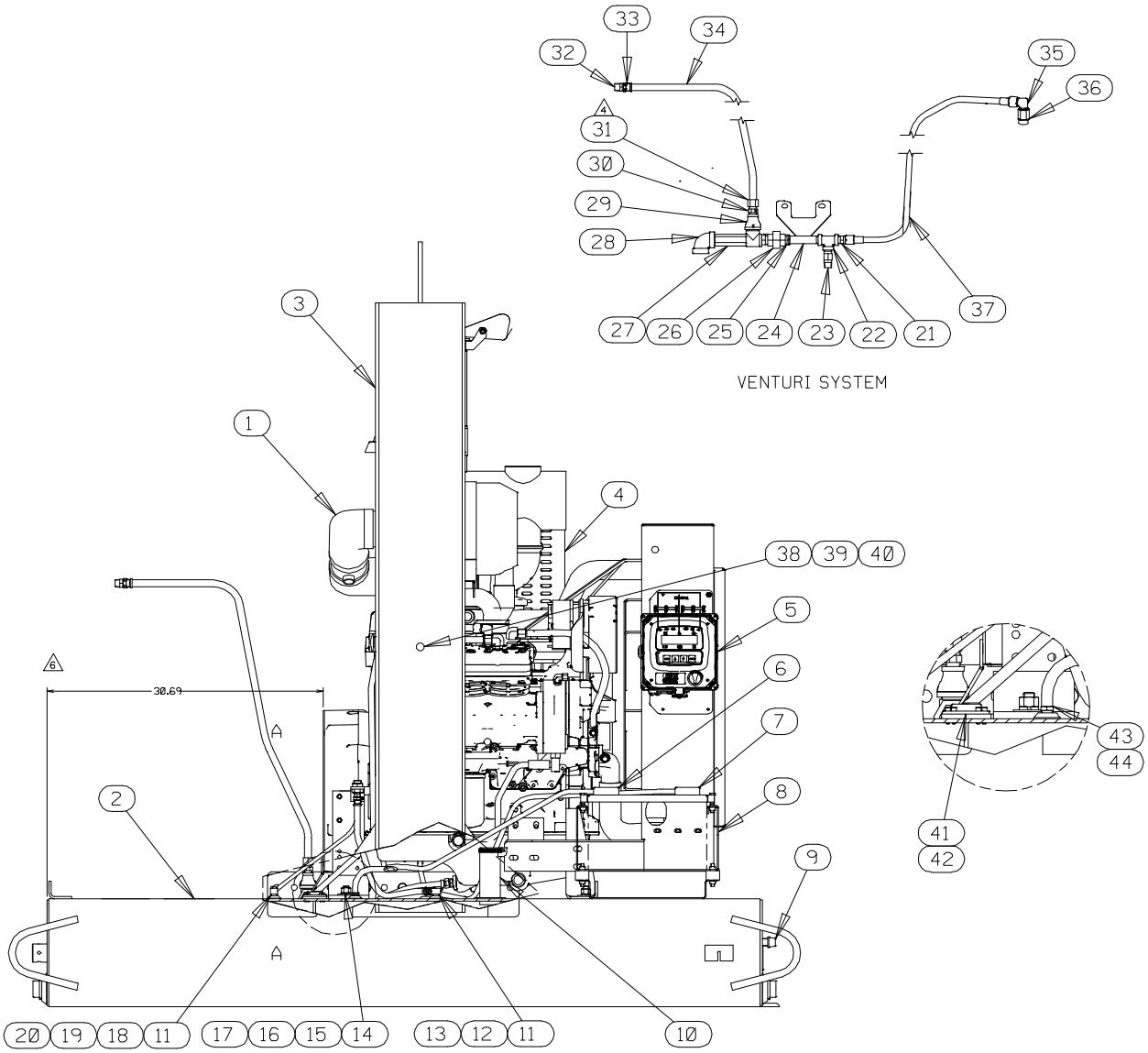


Figure 2. 46143–114 Power Unit Kit

PARTS LIST
46143–114 Power Unit Kit

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	J.D. ENGINE	29224–373	–––	1
2	BASE/FUEL TANK	41553–029	24150	1
3	LIFTING BAIL KIT	48274–804	–––	1
4	MUFFLER GRD ASSY	42331–061	–––	1
5	CONTROL PANEL	48122–543	–––	1
6	NEG BATT CABLE	47311–173	–––	1
7	POS BATT CABLE	47311–118	–––	1
8	BATTERY BOX KIT	42432–005	–––	1
9	OIL DRAIN ASSY	46342–013	–––	1
10	FUEL GAUGE	29332–111	–––	1
11	FUEL PICKUP/RETURN	29332–145	–––	2
12	CONNECTOR	S1447	–––	2
13	HOSE ASSY	46341–787	–––	1
14	FLAT WASHER	K10	15991	8
15	HEX HD CAPSCREW	B1008	15991	4
16	LOCK WASHER	J10	15991	4
17	HEX NUT	D10	15991	4
18	HOSE BARB FITTING	26523–386	–––	2
19	HOSE CLAMP	26518–641	–––	2
20	HOSE	11308G	–––	1
21	CONNECTOR	26351–065	–––	1
22	PIPE TEE	U08	11999	1
23	PRESS RELIEV VALVE	26662–028	–––	1
24	VENTURI MTG BRACKET	41888–199	24150	1
25	RED PIPE BUSHING	AP1208	15079	1
26	PIPE UNION	AH12	11999	1
27	VENTURI	26817–001	–––	1
28	PIPE ELBOW	R16	11999	1
29	REDUCING COUPLING	AE1608	15079	1
30	CHECK VALVE	26641–092	–––	1
31	HOSE BARB FITTING	26523–446	–––	1
32	CONNECTOR	S1598	–––	1
33	HOSE BARB FITTING	26523–047	–––	1
34	.50 ID X 60 IN LG HOSE	18513–113	–––	1
35	MALE ELBOW	26341–310	–––	1
36	HEX ADAPTOR	26523–188	–––	1
37	HOSE ASSY	46341–427	–––	1
38	AIR VENT	S1703	–––	1
39	HOSE BARB FITTING	26523–447	–––	1
40	CABLE TIE	27111–218	–––	1
41	MECH FUEL GUAGE ASSY	29332–173	–––	1
42	SOC HEAD CAPSCREW	BD#10–03S	15991	5
43	HOSE BARB FITTING	26523–389	–––	1
44	HOSE	18513–302	–––	3
NOT SHOWN:				
	ENGINE STARTUP TAG	38816–269	–––	1
	WARNING DECAL	38816–203	–––	4
	INSTRUCTION DECAL	38818–144	–––	1
	FLOAT SWITCH KIT	48312–980	–––	1

ILLUSTRATION

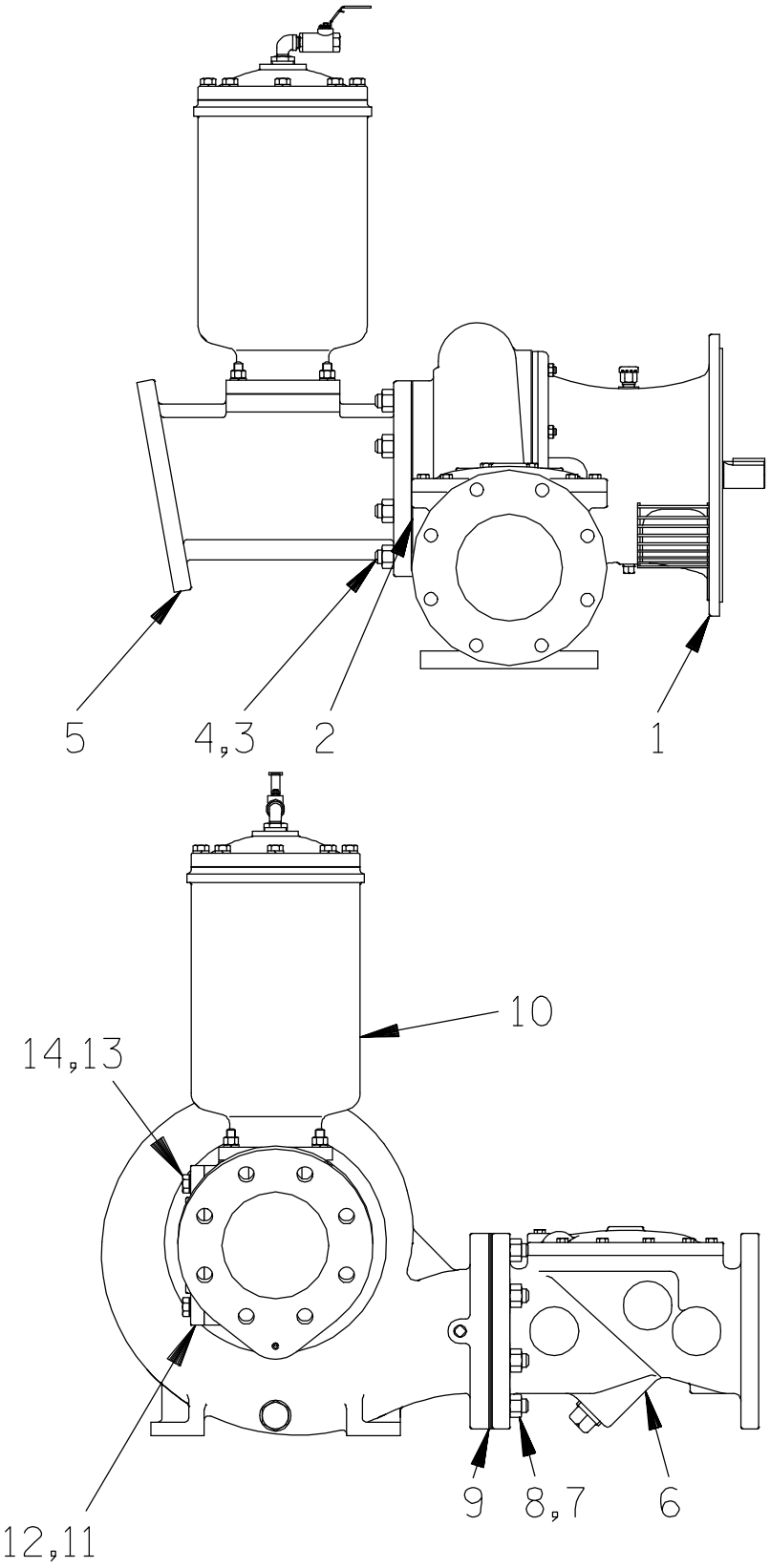


Figure 3. PA6A60–(SAE 4/10) Pump End Assembly

PA6A60–(SAE 4/10) Pump End Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PUMP MODEL ASSY	66E60–(SAE 4/10)	–––	1
2	✳	FLANGE GASKET	1679G	18000	1
3		STUD	C1211	15991	8
4		HEX NUT	D12	15991	8
5		HOPPER SPOOL	38642–507	–––	1
6		DISCH CHECK VALVE ASSY	26642–126	–––	1
	✳	–FLAPPER	26688–001	–––	1
	✳	–COVER O-RING	25152–377	–––	1
7		STUD	C1211	15991	8
8		HEX NUT	D12	15991	8
9	✳	CHECK VALVE GASKET	25113–036	–––	1
10		PRIMING CHAMBER ASSEMBLY	48275–005	–––	1
11		4" BLIND FLANGE	25353–908	–––	1
12	✳	4" GASKET	25113–034	–––	1
13		HEX HEAD CAP SCREW	B1008	15991	8
14		LOCKWASHER	J10	15991	8
NOT SHOWN:					
		G-R DECAL	GR–06	–––	1
		LUBE DECAL	38816–079	–––	1
		SUCTION STICKER	6588AG	–––	1
		DISCHARGE STICKER	6588BJ	–––	1
		WARNING DECAL	2613FE	–––	1
		STRAINER	7823A	24000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

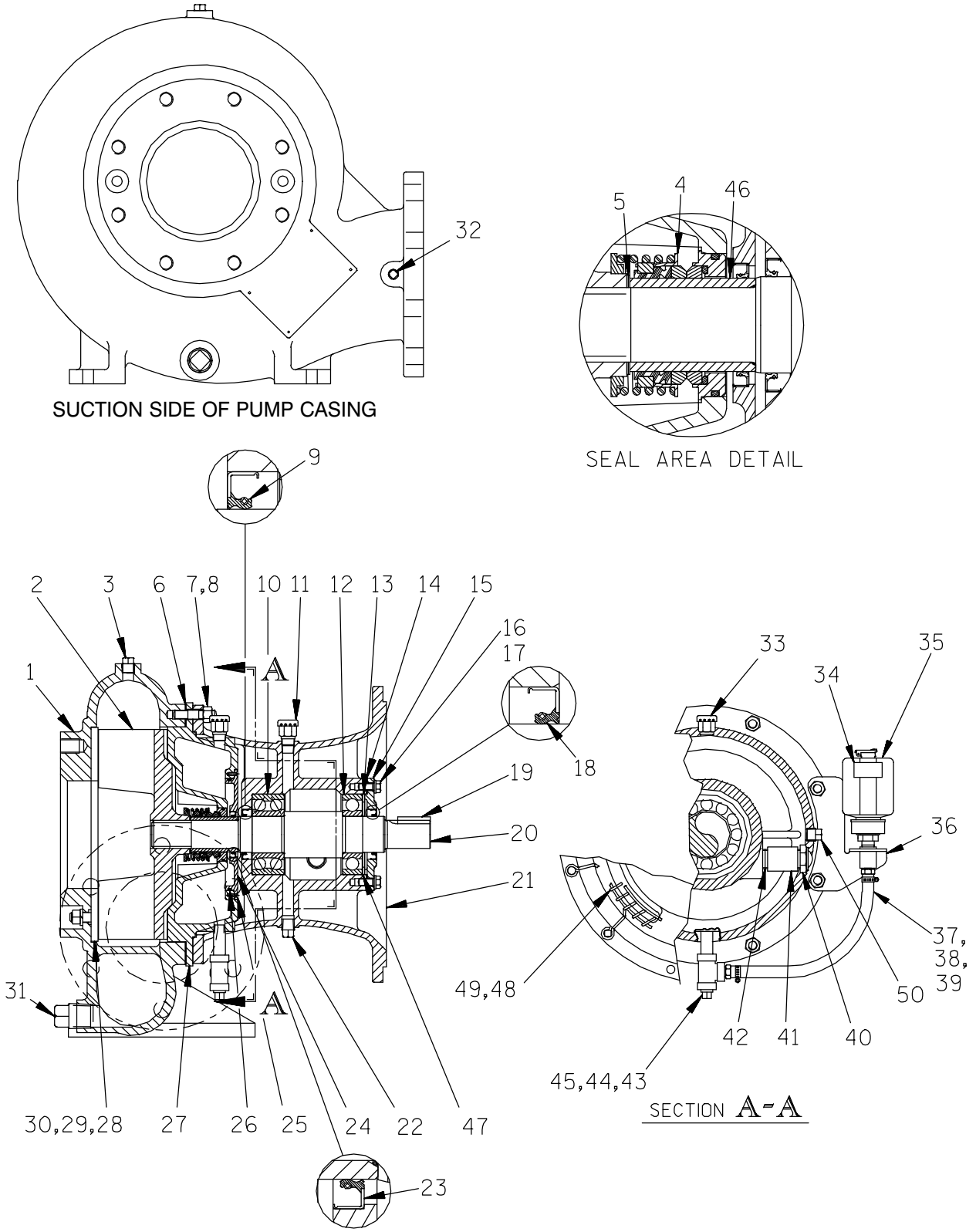


Figure 4. 66E60—(SAE 4/10) Pump End Assembly

PARTS LIST
66E60–(SAE 4/10) Pump End Assembly

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PUMP CASING	38218–014	10000	1
2	✳	IMPELLER ASSY	46151–409	–––	1
3		PIPE PLUG	P06	15079	1
4	✳	SEAL ASSY	46512–048	–––	1
5	✳	ADJ SHIM SET	5091	17090	1
6	✳	CASING GASKET SET	34G	18000	1
7		STUD	C0809	15991	8
8		HEX NUT	D08	15991	8
9	✳	OIL SEAL	25258–622	–––	1
10	✳	INBOARD BALL BEARING	23421–461	–––	1
11		AIR VENT	S1703	–––	1
12	✳	OUTBOARD BALL BRG	S1077	–––	1
13		THRUST WASHER	31133–197	15210	1
14	✳	BRG COVER GSKT	5413G	18000	1
15		BEARING CAP	4185A	10010	1
16		HEX HD CAPSCREW	B0604	15991	4
17		LOCKWASHER	J06	15991	4
18	✳	OIL SEAL	25258–622	–––	1
19	✳	IMP SHAFT KEY	N0607	15990	1
20	✳	IMPELLER SHAFT	38514–807	1706H	1
21		INTERMEDIATE	38263–614	10010	1
22		BRG CAV DRAIN PLUG	P06	15079	1
23	✳	OIL SEAL	25258–620	–––	1
24		SEAL PLATE COVER	38242–707	10000	1
25		FH MACHINE SCREW	Y#10–02	15991	4
26	✳	SEAL PLATE O-RING	25152–256	–––	1
27		SEAL PLATE	38272–527	10000	1
28	✳	WEAR PLATE ASSY	46451–746	24150	1
29		HEX NUT	D08	15991	2
30		LOCKWASHER	J08	15991	2
31		PIPE PLUG	P16	10009	1
32		PIPE PLUG	P04	15079	1
33		AIR VENT	S1703	–––	1
34		OIL LEVEL DECAL	38816–123	–––	1
35		BOTTLE OILER	26713–004	–––	1
36		BOTTLE OILER BRKT	41881–619	24150	1
37		MALE CONNECTOR	26523–409	–––	2
38		HOSE	18513–054	–––	1
39		HOSE CLAMP	26518–642	–––	2
40		OIL LVL SIGHT GAUGE	S1471	–––	1
41		PIPE COUPLING	AE12	15079	1
42		PIPE NIPPLE	T12	15079	1
43		PIPE NIPPLE	T0608	15079	1
44		PIPE TEE	U06	11999	1
45		SEAL CVTY DRAIN PLUG	P06	15079	1
46	✳	SHAFT SLEEVE	31163–016	1706H	1
47	✳	BRG SHIM SET	8546	15990	1
48		INTERMEDIATE GUARD	42381–031	24152	1
49		INTERMEDIATE GUARD	42381–032	24152	1
NOT SHOWN:					
		DRIVE ASSY	44162–119	–––	1
		NAME PLATE	38818–127	13000	1
		DRIVE SCREW	BM#04–03	17000	4

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

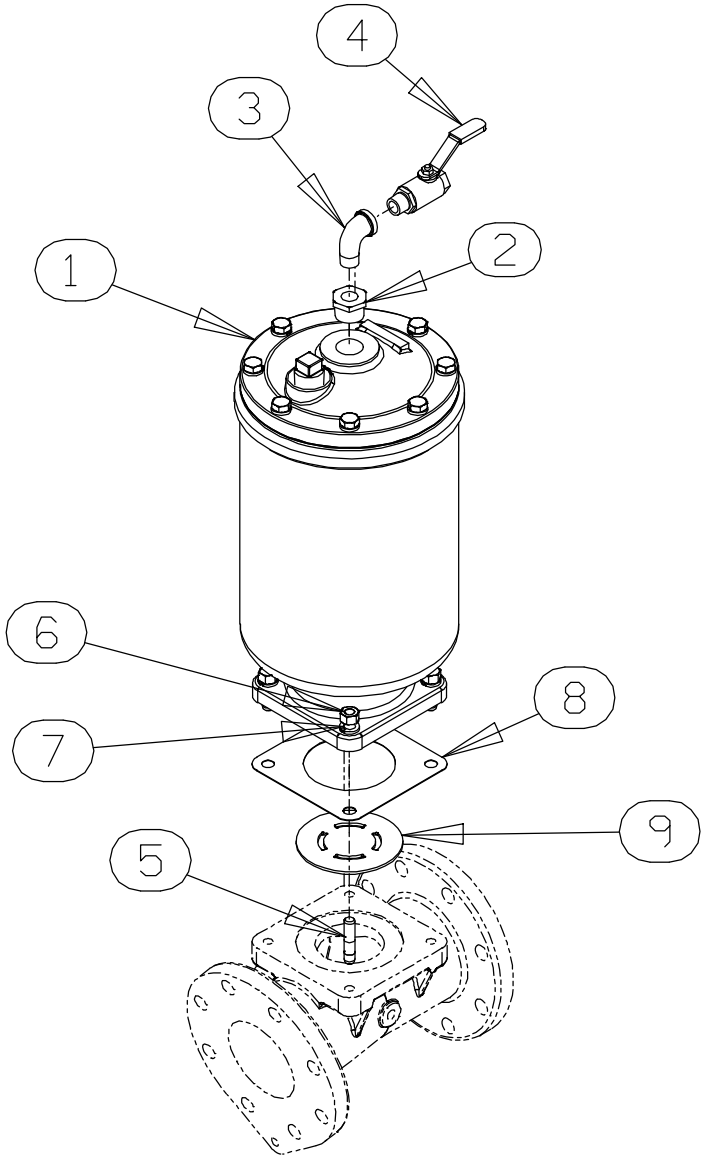


Figure 5. 48275−005 Priming Chamber Kit

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PRIMING CHAMBER ASSY	46112−709	−−−	1
2		PIPE BUSHING	AP1608	11999	1
3		STREET ELBOW	RS08	11999	1
4		BALL VALVE	26631−052	−−−	1
5		STUD	C0809	15991	4
6		HEX NUT	D08	15991	4
7		LOCK WASHER	J08	15991	4
8	✳	GASKET	38687−053	19060	1
9		BAFFLE	31113−011	17000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

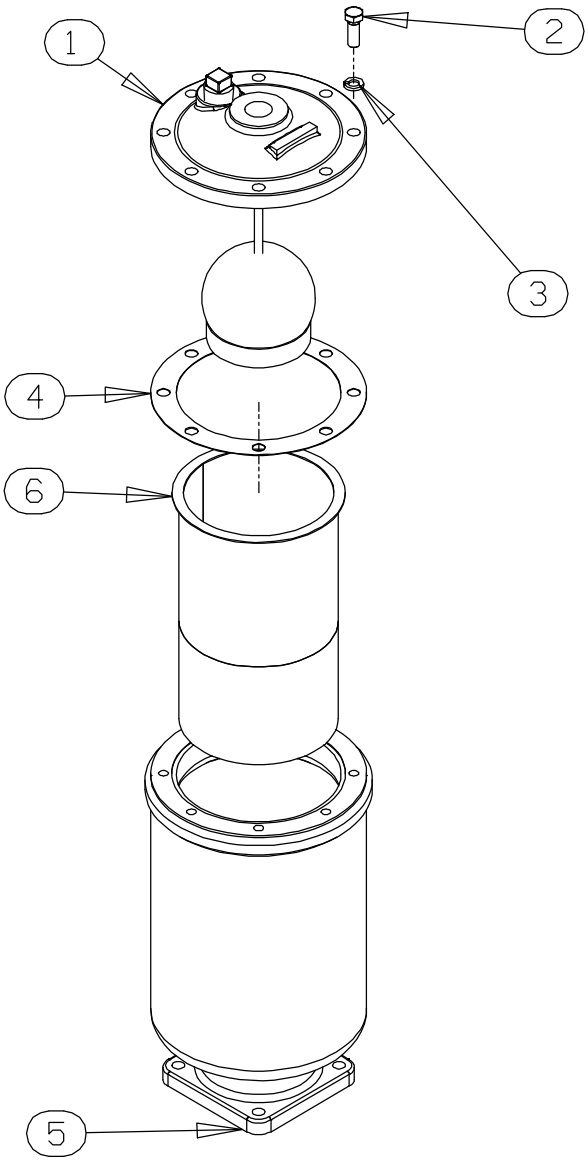


Figure 6. 46112–709 Priming Chamber Assembly

PARTS LIST

ITEM NO.		PART NAME	PART NUMBER	MAT'L CODE	QTY
1		PRIMING VALVE	26664–007	–––	1
		–ORIFICE BUTTON	26688–021	–––	1
2		HEX HD CAPSCREW	B0806	15991	8
3		LOCKWASHER	J08	15991	8
4	✳	PRIMING VALVE GASKET	38683–657	19060	1
5		PRIMING CHAMBER	38343–020	10000	1
6		STRAINER ASSY	46641–222	17000	1

✳ INDICATES PARTS RECOMMENDED FOR STOCK

ILLUSTRATION

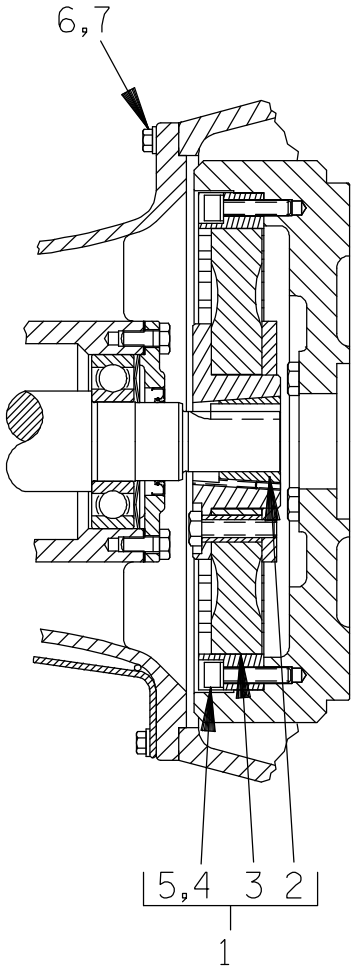


Figure 7. 44162–119 Drive Assembly

ITEM NO.	PART NAME	PART NUMBER	MAT'L CODE	QTY
1	COUPLING KIT	48112–001	–––	1
2	–BUSHING	24131–345	–––	1
3	–COUPLING ASSEMBLY	44165–011	–––	1
4	–LOCKWASHER	21171–536	–––	8
5	–SOCKET HD CAPSCREW	22644–220	–––	8
6	HEX HD CAPSCREW	B0605	15991	12
7	LOCKWASHER	J06	15991	12

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 illustrations (see Figures 1 through 7) and the corresponding Parts Lists. Instructions for the engine are covered separately in specific literature supplied by the manufacturer.

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.

Some pump service functions may be performed without separating the pump end assembly from the engine. However, the priming chamber (2, Figure 4) and discharge check valve assembly (12, Figure 4) must be removed to service most pump components. The following instructions assume complete disassembly of the pump is required.

Before attempting to service the pump, shut down the engine and take precautions to ensure that it will remain inoperative. Close all valves in the suction and discharge lines and drain the pump casing by removing the lowermost pipe plug (5, Figure 5). Clean and reinstall the plug.

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 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!

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. Suction and discharge hoses and piping must be removed from the pump before lifting.

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 5)

Disconnect both the suction piping and the air discharge tubing from the priming chamber assembly (10, Figure 3). Support the priming chamber assembly using a sling and a suitable lifting device. Remove the hardware (6 and 7) and separate the priming chamber assembly, gasket (8) and baffle (9) from the spool (5, Figure 3).

(Figure 6)

Remove the hardware (2 and 3) securing the priming valve (1) to the priming chamber (5). Carefully lift the valve components from the priming chamber. Remove the gasket (4) and clean the mating surfaces.

If the priming valve float is stuck or the strainer (6) is clogged, it can usually be cleaned without further disassembly.

The only serviceable part of the priming valve is the orifice button (not shown). If liquid continues to bypass through the priming chamber after adjusting the orifice button (see **Priming Chamber Reassembly and Installation** for adjustment), the button may require replacement. To replace the orifice button, remove one of the “e-clips” from the pivot pin closest to the orifice button and remove the pivot pin. This will allow the linkage to be raised high enough to access the orifice button.

Remove the hex nut and lockwasher securing the orifice button to the linkage bar and unscrew the orifice button from the linkage bar.

Discharge Check Valve Removal and Disassembly

(Figure 3)

Remove the hardware (not shown) securing the discharge check valve bracket to the base.

Support the discharge check valve assembly (6) using a sling and a suitable lifting device. Remove the nuts (8) and separate the discharge check valve assembly and gasket (9) from the pump assembly (1).

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

Pump Casing And Wear Plate Removal

(Figure 4)

Support the pump casing using a suitable hoist and sling.

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. Suction and discharge hoses and piping must be removed from the pump before lifting.

Remove the hardware (not shown) securing the pump casing to the base.

NOTE

Unless impeller or seal replacement is required, it is not necessary to drain the oil from the bottle oiler (35) or seal cavity when removing the pump casing.

Remove the nuts (8) securing the pump casing and bracket assembly (36) to the intermediate. Loop a piece of wire through one of the holes in the support and around the seal cavity air vent (33) to support the sight gauge assembly while removing the pump casing.

Pull the pump casing straight away from the intermediate to prevent binding on the impeller. Remove the casing gasket (6) and clean the contacting surfaces.

Inspect the wear plate assembly (28) for excessive wear or scoring. If replacement is required, remove the hardware (29 and 30) and pull the wear plate out of the volute casing.

Draining Oil From Seal Cavity

(Figure 4)

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

Lower the bottle oiler (35) below the seal cavity drain plug (45) to prevent the oil in the bottle oiler from being released as the seal cavity is drained.

Position a **clean** container under the seal cavity drain plug. Remove the 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.

With the bottle oiler below the level of the drain plug, loosen the lower hose clamp (39) and pull the hose (38) off the connector (37) at the tee (44). Plug the end of the hose and rest the bottle oiler in a vertical position to prevent the oil from spilling.

Impeller Removal

(Figure 4)

To remove the impeller (2), tap the vanes in counterclockwise direction (when facing the impeller) with a block of wood or soft-faced mallet. **Be careful** not to damage the impeller. When the impeller breaks loose, unscrew it from the shaft. 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 4 and 9)

This pump is designed with two seals; a primary mechanical seal (4) located directly behind the impeller and a secondary oil seal (23) located at the back of the seal plate (27). If the liquid being pumped leaks past the oil seal, both seals should be replaced immediately.

Slide the impeller adjusting shims (5) off the impeller shaft (20). Tie and tag the shims or measure and record their thickness for ease of reassembly.

Remove the seal spring. Slide the shaft sleeve (46) and rotating portion of the seal (consisting of the bellows, retainer, and rotating element) off the shaft as a unit.

Remove the rotating element. Apply oil to the sleeve and work it up under the rubber bellows. Slide the bellows and retainer off the sleeve.

Carefully slide the seal plate and stationary portion of the seal off the shaft as a unit. Remove the machine screws (25) and pull the seal plate cover (24) and oil seal (23) out of the seal plate as a unit. Use a suitable sized dowel to press the stationary portion of the seal out of the seal plate from the back side.

Inspect the oil seal and, if replacement is required, press it from the seal plate cover. Remove the O-ring (26) from the seal plate cover.

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

Separating Intermediate And Drive Assembly From Engine

(Figure 5)

If it is necessary to separate the intermediate and drive assemblies from the engine, support the intermediate using a hoist and sling, and remove the hardware (6 and 7) securing the intermediate to the engine bellhousing. Remove the intermediate guards (48 and 49, Figure 4), and separate the assemblies by pulling the intermediate straight away from the engine.

As the assemblies separate, the flexible portion of the coupling assembly (3) 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 (19, Figure 4).

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 (4 and 5) securing it to the flywheel.

Shaft and Bearing Removal and Disassembly

(Figure 4)

When the pump is properly operated and maintained, the intermediate 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 intermediate drain plug (22) and drain the lubricant. Clean and reinstall the drain plug.

Disengage the hardware (16 and 17) and remove the bearing cap (15), gasket (14), bearing cap oil seal (18), and thrust washer (13). Press the oil seal from the bearing cap.

Place a block of wood against the impeller end of the shaft (20) and tap the shaft and assembled bearings from the intermediate. Press the inboard oil seal (9) from the intermediate.

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 intermediate, 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 intermediate if the proper bearing fit is not achieved.

If bearing replacement is required, use a bearing puller to remove the inboard and outboard bearings (10 and 12) from the shaft.

Shaft and Bearing Reassembly and Installation

(Figure 4)

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.

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.

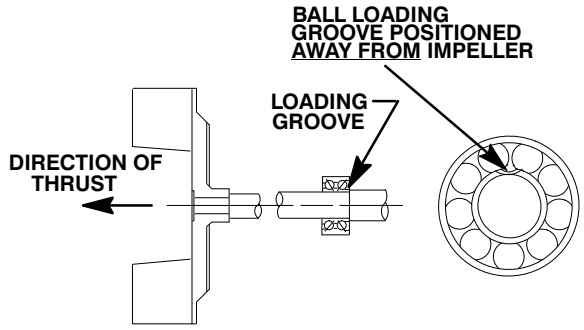
NOTE

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.*

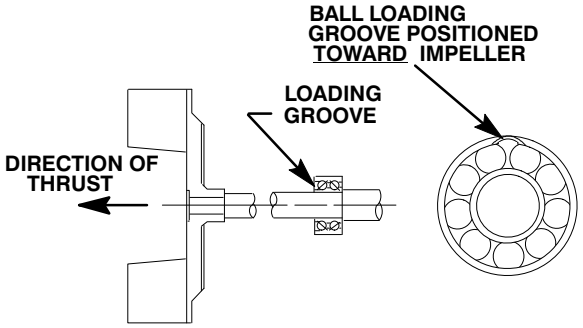
Heat the bearings to a uniform temperature **no higher than** 250°F (120°C) and slide the bearings onto the shaft, one at a time, until they are fully seated. This should be done quickly, in one continuous motion, to prevent the bearings from cooling and sticking on the shaft.

NOTE

Position the inboard bearing (10) on the shaft as indicated in Figure 8.



INSTALLATION OF NEW DEPARTURE OR BCA/FEDERAL MOGAL 5300W SERIES BEARINGS (OPEN OR ENCLOSED IMPELLERS)



INSTALLATION OF MRC/SKF 5300M OR FAFNIR 5300W SERIES BEARINGS (OPEN OR ENCLOSED IMPELLERS)

Figure 8. Inboard Bearing Positioning

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 suitable sized sleeve and a press to reposition the bearings against the shaft shoulders.

If heating the bearings is not practical, use a suitable 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.

Slide the shaft (20) and assembled bearings (10 and 12) into the intermediate bore until the inboard bearing is fully seated against the bore shoulder.

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 inboard oil seal (9) and press it into the intermediate bore with the lip positioned as shown in Figure 4. Press the oil seal into the housing until the face is **just flush** with the machined surface on the housing.

Apply a light coating of oil to the lip of the outboard oil seal (18) and press it into the bearing cap (15) with the lip positioned as shown in Figure 4. The face of the oil seal should be just flush with the outer face of the bearing cap.

Install the thrust washer (13) and bearing cap gasket (14), and secure the bearing cap to the intermediate with the hardware (16 and 17). **Be careful** not to damage the lip of the oil seal (18) on the shaft keyway.

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

Securing Intermediate And Drive Assembly To Engine

(Figure 5)

Install the shaft key (19, Figure 4) in the shaft keyway. Position the flexible portion of the coupling assembly (3) on the shaft as shown in Figure 5.

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 toward the pump end of the shaft****.*

Align the keyway in the bushing (2) with the shaft key, and slide it onto the shaft until it is **just flush** with the end of the shaft. 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 5. **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 end of the shaft must be **just flush** with the face of the bushing. This will allow the two portions of the coupling to fully engage when the intermediate 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 (4 and 5), 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.).

Using a suitable lifting device, position the assembled coupling, intermediate, shaft and bearings 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 other substance which may soften or otherwise damage the rubber.*

Install the intermediate guards (48 and 49, Figure 4), and secure the intermediate to the engine bell-

housing with the previously removed hardware (6 and 7).

Seal Reassembly and Installation

(Figures 4 and 9)

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 9).

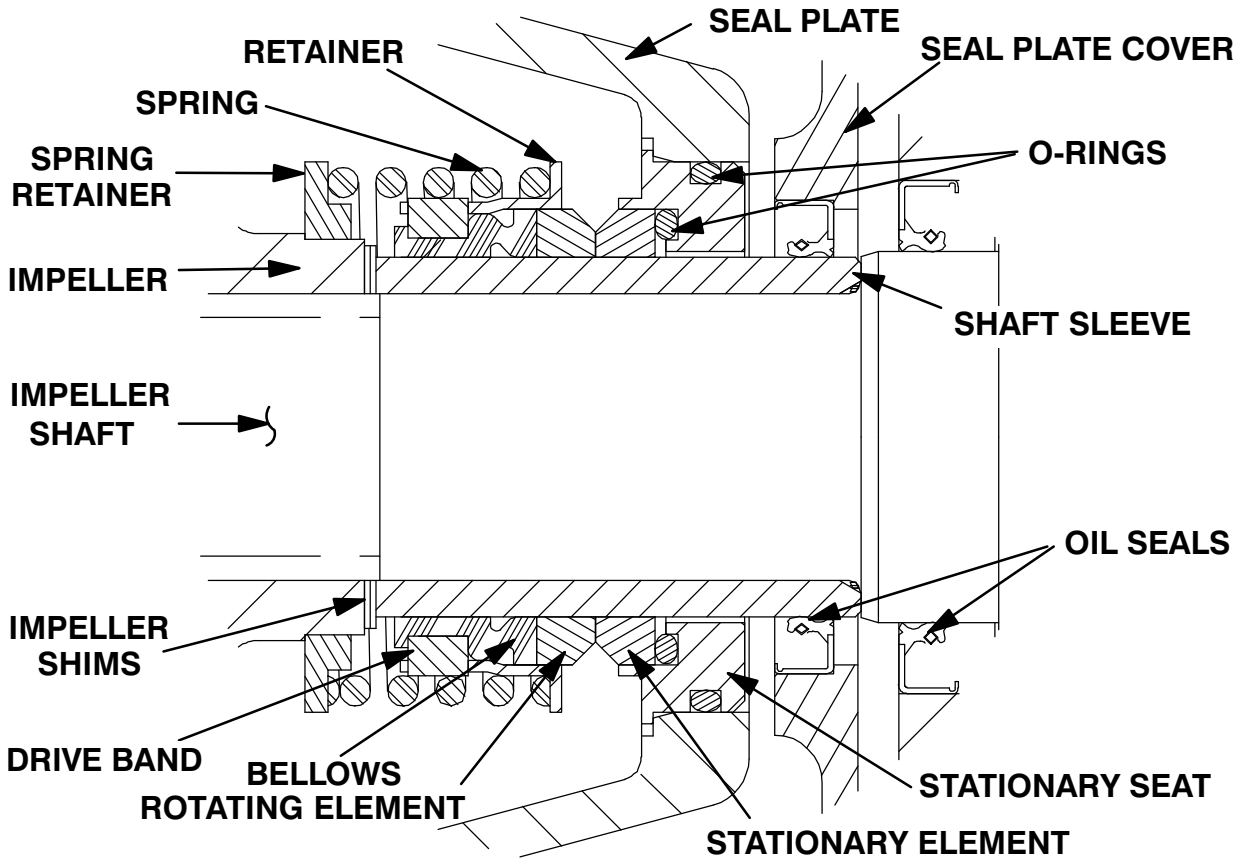


Figure 9. Seal Assembly

CAUTION

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

Press the oil seal (23) into the seal plate cover (24) with the lip positioned as shown in Figure 4. Make sure the oil seal is fully seated. Lubricate the O-ring (26) and install it in the groove in the seal plate cover. Press the seal plate cover into the seal plate and secure it with the machine screws (25).

To ease installation it is recommended that the shaft sleeve (46) be installed in the seal plate cover before installing the seal plate (27). Lubricate the sleeve and slide it through the oil seal from the intermediate side of the seal plate cover. **Be sure** to position the sleeve with the chamfered end toward the intermediate side of the cover.

Slide the assembled shaft sleeve and seal plate onto the shaft until the sleeve seats against the shaft shoulder. Position the seal plate against the intermediate with the air vent (33) toward the top and temporarily secure the seal plate to the intermediate with two capscrews and nuts (1/2 UNC by 1—1/2 inch long, not supplied).

Assemble the O-rings into the stationary seat. Press the stationary element into the stationary seat with the chamfered side facing away from the seat. Press this subassembly into the seal plate bore until fully seated. A push tube cut from a length of plastic pipe would aid this installation. The I.D. of the tube should be approximately the same as the I.D. of the seal spring.

It is recommended that a tapered sleeve be installed over the shaft threads to ease installation of the seal. With the tapered sleeve in place, subassemble the rotating element into the rotating portion of the seal assembly with the chamfered side facing out. Lubricate the I.D. of the bellows and slide the rotating portion of the seal assembly onto the shaft sleeve until the sealing faces contact.

Remove the tapered sleeve and install the seal spring.

Lubricate the seal as indicated in **LUBRICATION**, after the impeller has been installed.

Impeller Installation And Adjustment

(Figure 4)

Inspect the impeller assembly (2) and replace it if cracked or badly worn. The impeller assembly consists of the impeller with a spring retainer (2A) pressed onto the back side. If the retainer requires replacement, use a puller to remove the old one. Press the new retainer onto the impeller with the step toward the seal side of the impeller.

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 (5) as previously removed and screw the impeller assembly onto the shaft until tight. **Make sure** the seal spring seats squarely over the step on the spring retainer.

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.

Pump Casing And Wear Plate Installation

(Figure 4)

If the wear plate (28) was removed, position the replacement wear plate in the pump casing and secure it with the hardware (29 and 30).

Remove the two capscrews temporarily holding the seal plate and install the same thickness of casing gaskets (6) as previously removed. Secure the seal plate and pump casing to the intermediate with the nuts (8). **Do not** fully tighten the nuts until the impeller face clearance has been set.

A clearance of .010 to .020 inch (0,25 to 0,51 mm) between the impeller and the wear plate is also recommended for maximum pump efficiency. This clearance may be determined by reaching through the suction inlet and measuring the clearance with a feeler gauge. Add or remove gaskets in the pump casing gasket set until the proper clearance is achieved.

Reinstall any leveling shims used under the casing mounting feet and secure the casing to the base with the previously removed hardware.

Connect the hose (38) to the connector (37) and secure it with the hose clamp (39). Secure the bottle oiler (35) and bracket (36) to the back of the intermediate with the previously removed hardware.

(Figure 3)

Apply a small amount of light grease to the gasket (9) to hold it in place and position it against the pump casing flange. Position the discharge check valve assembly (5) and secure it with the nuts (8).

Discharge Check Valve Reassembly And Installation

(Figure 3)

If the discharge check valve (6) was disassembled to replace the flapper or cover O-ring, position the flapper in the valve body and check to ensure free movement.

Install the valve cover O-ring and secure the cover to the body with the previously removed hardware.

Apply a small amount of light grease to the discharge flange gasket (9) to hold it in place and position it against the pump casing flange. Support the discharge check valve assembly using a sling and a suitable lifting device. Using the previously removed nuts (8), secure the discharge check valve assembly and flange gasket to the pump assembly (1). Secure the discharge check valve to its support bracket using the previously removed hardware.

Priming Chamber Assembly And Installation

(Figure 6)

Clean and inspect the components of the priming valve (1). Inspect the linkage and ensure the orifice button (not shown) squarely engages the valve seat. Replace the orifice button if required (see **Priming Chamber Removal and Disassembly** for orifice button removal).

If the orifice button was removed, screw the new orifice button into the linkage bar until fully seated. Align the hole in the linkage bar with the holes in the bracket and reinstall the pivot pin. Secure the pivot pin with the previously removed “e-clip”.

Adjust the orifice button seating as necessary by screwing the orifice button into or out of the linkage bar. Proper adjustment is achieved when the orifice button fully seats against the orifice before the linkage bar on the float bottoms against the threads on the orifice button. When adjustment is complete, install and tighten the lock washer and hex nut securing the orifice button.

Install the strainer (6) and priming valve gasket (4).

Lower the float into the priming chamber (5) and secure the priming valve with the previously removed hardware (2 and 3).

(Figure 5)

Install the baffle and gasket (8 and 9) and use a sling and suitable lifting device to position the priming chamber assembly on the pump suction spool (7, Figure 4). Secure the priming chamber assembly with the hardware (6 and 7).

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

LUBRICATION

Seal Assembly

Fill the bottle oiler (35) to the line on the glass with SAE No. 30 non-detergent oil. When lubricating a dry seal cavity, add approximately 3 quarts (2,8 L) of oil through the air vent (33) to level indicated. Check the oil level regularly and refill as required.

Bearings

The intermediate was fully lubricated when shipped from the factory. Check the oil level regularly through the sight gauge (40) and maintain it at the midpoint of the gauge. When lubrication is required, remove the air vent (11) and add SAE No. 30 non-detergent oil through the opening. When lubricating a dry (overhauled) intermediate, fill the bearing cavity with approximately 7.5 ounces (222 ml.). 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.

Engine

Consult the literature supplied with the engine, or contact your local engine 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 Contingency Plan
Wastewater Treatment Facility
Igloolik, Nunavut

Type of Document
Final

Client:
Hamlet of Igloolik
Nunavut X0A 0L0

Project Number
OTCD00019838A0

Prepared By: Robert Renaud

Reviewed By: Steve Burden

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

Date Submitted
October 27, 2014

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Prepared By:
exp
100-2650 Queensview Drive
Ottawa, ON K2B 8H6
Canada
T: 613 688-1899
F: 613 225-7337
www.exp.com

Robert Renaud, M.Sc., P.Geo.
Practice Lead – Northern Environmental Services
Earth & Environment

Steve Burden, P.Eng.
Senior Manager
Infrastructure Services

Date Submitted:
October 27, 2014

Legal Notification

This report was prepared by **exp** Services Inc. for the account of **Hamlet of Igloolik**.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. **Exp** Services Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this project

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1 Introduction

Exp Services Inc. (**exp**) was retained by the Department of Community & Government Services (CGS), Government of Nunavut (GN) to prepare a Spill Contingency Plan (SCP) as part of the operation and maintenance of the Hamlet of Igloolik (Hamlet)'s wastewater treatment facility (sewage lagoons). This SCP also demonstrates the Hamlet's stewardship in environmental management.

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

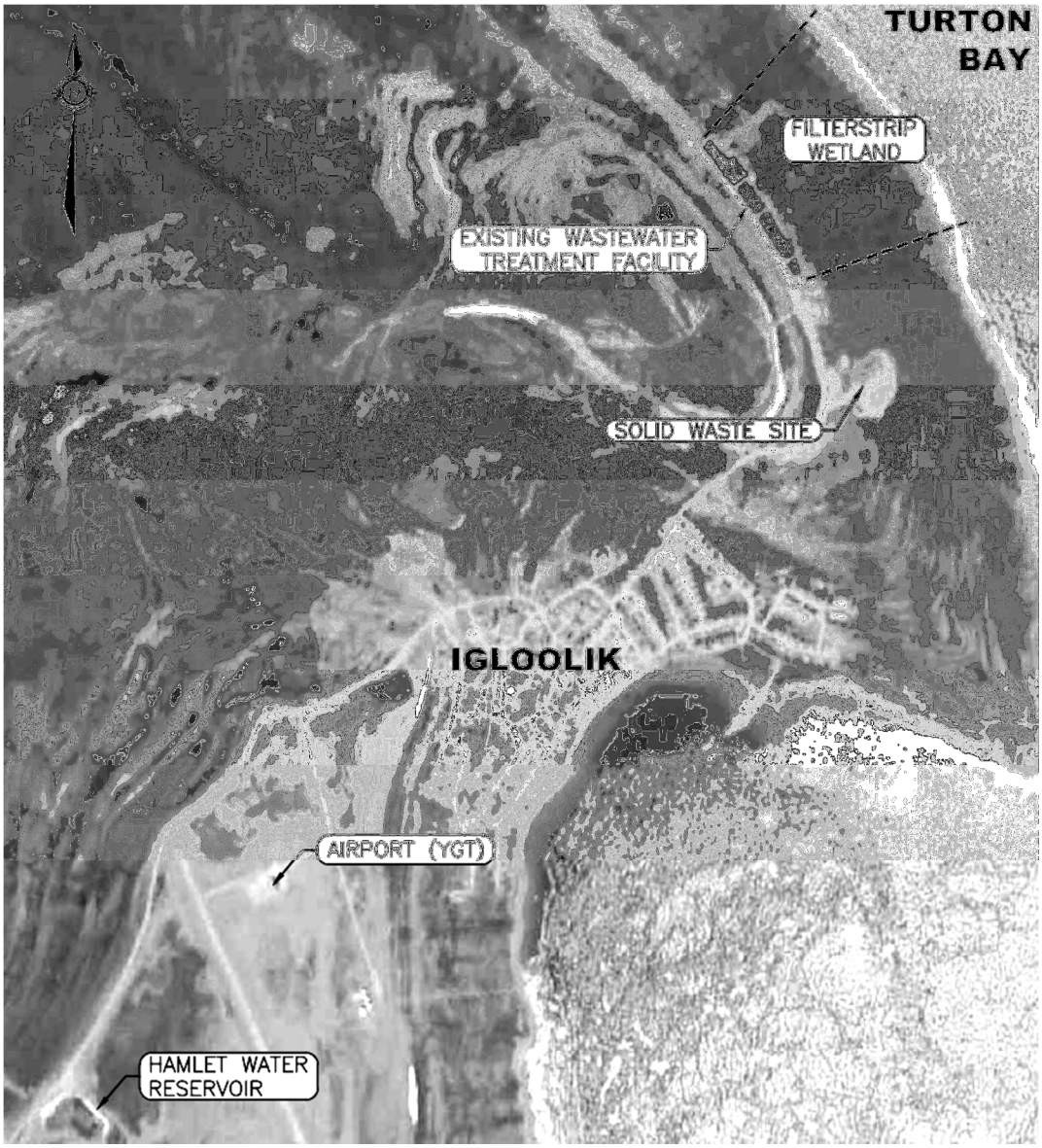
Situations may arise during the site operations that are beyond the scope of the safety procedures stated in this document. In such a situation, it may be necessary to stop on-site work until a revised procedure or SCP is prepared to reflect the changing conditions.

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

2 Site Description

The existing sewage lagoon is located approximately 1.3 km north of the community and adjacent to the Hamlet's solid waste site as shown on Figure 1 (below). Effluent from the existing facility flows approximately 450 m to the northeast towards Turton Bay. The land between the existing sewage lagoon and Turton Bay is undeveloped tundra.

Figure 1: Location of the Wastewater Treatment Facility, Igloolik, NU



3 Regulations

With respect to spills, the Environmental Protection Act (R-068-93) requires that all Spill Contingency 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 Contingency Plan;
- A description of the facility, including the location, size, and storage capacity;
- A description of the type and amount of contaminants normally stored at the facility;
- A site map of the location;
- 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 Contingency 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 Contingency Plan; and,
- The date the Spill Contingency Plan was prepared.

4 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 #
Joasai Kublu	Acting Public Works Director	(867) 934-8789
Johnny Angirliq	Water and Sewage Manager	(867) 934-8230
Brian Fleming	SAO	(867) 934-4172

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 (see Appendix A) 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 Name	Regulation	24-Hour Telephone #
Nunavut Water Board	Nunavut Waters and Surface Right Tribunal Act	(867) 360-6338
Nunavut Impact Review Board	Nunavut Land Claims Agreement Act	(866) 233-3033
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 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 SCP, 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;
- Spills 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 Reportable Spill Quantities

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

Table 1: Reportable Quantities[1]

Item	TDGA[2] Class	Contaminant	Amount Spilled
1	1	Explosives	Any amount
2	2.1	Compressed Gas (flammable)	Any amount of gas from containers with capacity greater than 100 L
3	2.2	Compressed Gas (non-corrosive, non-flammable)	Any amount of gas from containers with capacity greater than 100 L
4	2.3	Compressed Gas (toxic)	Any amount
5	2.4	Compressed Gas (corrosive)	Any amount
6	3.1, 3.2, 3.3	Flammable Liquid	100 L
7	4.1	Flammable Solid	25 kg
8	4.2	Spontaneously Combustible Solids	25 kg
9	4.3	Water Reactant Solids	25 kg
10	5.1	Oxidizing Substances	50 L or 50 kg
11	5.2	Organic Peroxides	1 L or 1 kg
12	6.1	Poisonous Substances	5 L or 5 kg
13	6.2	Infectious Substances	Any amount
14	7	Radioactive	Any amount
15	8	Corrosive Substances	5 L or 5 kg
16	9.1(in part)	Misc. Products or Substances, excluding PCB mixtures	50 L or 50 kg
17	9.2	Environmentally Hazardous	1 L or 1 kg
18	9.3	Dangerous Wastes	5 L or 5 kg
19	9.1 (in part)	PCB mixtures of 5 or more parts per million (ppm)	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 Spill Contingency Procedures

The following section describes the appropriate spill Contingency 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 location of the spill (coordinates collected by GPS), 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 sorbent booms to contain spill for recovery, place sorbent 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 sorbent 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 location of the spill (coordinates collected by GPS), 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 Contingency 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 location of the spill (coordinates collected by GPS), 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 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 L, 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);
- 2 – 12.5 cm (approx. 5") x 3 m (approx. 10') sorbent (oil-absorbing) booms;
- 10 kg bag of sorbent particulate;
- 1 bail of 50 cm x 50 cm (approx.) sorbent sheet (100 Sheets/bail);
- 1 – 5 m x 5 m approx. plastic tarp;
- 2 pairs of oil resistant gloves; and,
- 2 pairs of splash protective goggles.

8.2 Additional Spill Contingency Supplies

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

- 2 – 205 litre, open top steel drum with a lid, bolting ring and gasket;
- 1 spark proof shovels;
- 2 packages of 10 disposable 5 mil polyethylene bags (approx. 65 cm x 100 cm);
- 2 – 12.5 cm x 3 m sorbent (oil-absorbing) booms;
- 5 – 10 kg bags of sorbent particulate;
- 5 bails of 50 cm x 50 cm (approx.) sorbent 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 SCP, the following actions should be followed:

1. The SCP should be reviewed, as a minimum, on an annual basis and updated as required by changes in operation and/or technology.
2. The SCP 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 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 2: Outside Emergency Contacts

Agency	Function	Phone Number
Health Centre	Medical Emergency	(867) 934-2100
Fire	Fire, Accident or Rescue	(867) 934-8888
RCMP (Emergencies)	Security, Vandalism	(867) 934-1111
Hamlet of Igloolik	Hamlet Office	(867) 934-8730

10 Closure

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

Appendix A –
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

Naviq Consulting Inc.
Specialist Geotechnical and Permafrost Engineering

GEOTHERMAL ANALYSIS OF PROPOSED SEWAGE LAGOON

IGLOOLIK, NU

Prepared for:

Trow Associates Inc.
Ottawa, ON

Prepared by:

Naviq Consulting Inc.
Calgary AB

Naviq Project No. J011G
May 2010
Revision A2
DRAFT

Important Notice

This Report represents the professional engineering work of Naviq Consulting Inc. (Naviq) performed to normal engineering principles and practices and to a reasonable standard of care for the engineering work and the terms of reference provided by Naviq's contractual customer, Trow Associates Inc. (the "Customer"). The standard of care for the professional engineering and related services performed or furnished by Naviq to the Customer is the care and skill ordinarily used by members of Naviq's profession practicing under similar conditions at the same time and in the same locality.

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Important Terms and Conditions that apply to this Report are contained in Appendix A. These Terms and Conditions limit the liability of Naviq Consulting Inc.

EXECUTIVE SUMMARY

This report provides details of geothermal analyses conducted in support of the design of a sewage lagoon structure near Igloolik, NU. The analyses considered a variety of conditions including climate warming, pore water salinity effects, initial soil temperatures in the containment structures and others.

Soil conditions were taken from a geotechnical report prepared for the project by Trow Associates Inc. Climatic data were taken from Environment Canada climate normals.

The geothermal modeling indicates seasonal thawing of the lagoon structure (berm) to a depth of about 3 m below the crest on a season basis after 20 years, with climate warming applied at 0.16 °C/year.

For the site specific conditions assumed, it is recommended that a controlling design isotherm of -2 °C be used. This value includes an amount to account for freezing point depression of high saline soils, and for uncertainties in some input parameters.

The reliance on a frozen core dam concept as the primary containment method is not considered to be prudent based on the analyses conducted. Therefore, a liner or other barrier should be incorporated into the design. Details on the installation of the liner at the upstream toe of the berm are discussed. Installation of the liner in cut-off trench to unweather bedrock is recommended.

No secondary cooling of the containment berm structure is presently recommended. However, monitoring of ground temperatures and seepage through the containment structure should be undertaken during operations. Secondary cooling, by way of thermosyphons, may be required if operational monitoring indicate warmer than anticipated temperatures or seepage within the berm structure.

It is recommended that drainage piping or access manholes in or through the containment structure be avoided because of a number of geothermal and geotechnical issues related to performance of the earthen berm structure.

REVISION LOG

The following table lists the changes made in this version of the report compared to previous revisions.

Section/Figure	Description of Revision
	This table is blank in the current version.

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1.0 INTRODUCTION

Naviq Consulting Inc. (Naviq) was retained by Trow Associates Inc. (Trow) of Ottawa, ON to provide permafrost engineering and geothermal analysis with respect to the design of a municipal waste-water (sewage) lagoon in Igloolik, NU.

The scope of work included conducting a geothermal assessment of the proposed lagoon containment dykes to assess the geothermal behavior of the structure over its projected lifespan.

This report addresses the geothermal modeling of the proposed containment structures.

2.0 GEOTECHNICAL INVESTIGATIONS AND RELATED INFORMATION

Trow undertook a geotechnical investigation at the site of the proposed lagoon adjacent land fill from September 29 and October 5, 2009 and on November 3 and 4, 2009. Eleven boreholes were drilling within the proposed footprint of the proposed lagoon containment berms, and also through segments of the existing lagoon berms. This section provides a summary of the geotechnical character of the subsurface conditions. For a full description of the site conditions, and other important details of the investigation and testing, the reader is referred to the geotechnical investigation report (Trow, 2010).

2.1 Subsurface Conditions

The boreholes at the proposed lagoon site were advanced to depths of 1.65 m to 5.5 m. At the time of the geotechnical investigation, the active layer was assessed to range in thickness from 0.6 m to 1.7 m.

The general stratigraphy at the borehole locations consisted of a surface layer of organics or top soil-like material between 0.05 m and 0.4 m thick, being predominately sand and gravel sized particles. This layer was underlain by coarse grained soils consisting of variable proportions of sand and gravel, with some fines (particles smaller than 0.08 mm) content. The natural moisture content of these soils was typically measured to be about 10 percent, by dry weight.

Table 2.1 presents the subsurface stratigraphy that was used for the purposes of the geothermal analysis.

Table 2.1. Subsurface stratigraphy used for the geothermal assessment

Soil unit	Top of stratum (m)	Bottom of stratum (m)	Water content (%)	Dry density (kN/m^3)
Silty sand	0	2	5	19
Sandy silt Till	2	3.25	15	20
Siltstone bedrock (weathered)	3.25	5.5	10	22
Siltstone bedrock (unweathered)	5.5	100	5	22

2.2 Ground Temperatures

Thermistor cables were installed in two boreholes at the lagoon site. The ground temperatures were measured for several days in early November 2009. In addition, ground temperatures were also measured at the site of the proposed Community Centre in late October, 2009 (Trow 2009). It is considered that these recorded temperatures are not sufficient to provide a full ground temperature profile.

The Geological Survey of Canada (GSC) maintains a multi-bead thermistor cables at a site within the Igloolik municipal limits. Figure 2.1 presents the minimum and maximum ground temperature profiles for the GSC data. Also included are the Trow temperature data from the Community Centre and lagoon sites Trow (2009, 2010).

The mean annual ground temperature in Igloolik is approximately -8 ˚C. The Trow ground temperature data from the lagoon site is seen to fit within the limits of the GSC data.

The active layer was considered to be 1.5 m deep.

2.3 Lagoon Structure Dimensions and Construction

The lagoon containment berms are understood to have the following dimensions:

Crest width	3 m
Typical dyke height	4 .6 m
Downstream face slope	3.5H:1V
Upstream face slope	3H:1V

The containment structure is assumed to be constructed from locally available soils, to be placed in controlled lifts and compacted in non-freezing conditions to achieve an engineered level of compaction. This construction method will necessitate construction in the summer months. Furthermore, this construction method is intended to avoid damage to the organic layer outside of the footprint of the lagoon structure.

Subject to the geothermal analyses reported herein, the containment structure will be designed, constructed and operated as an impermeable berm using an internal impermeable liner to provide the primary containment. Permafrost that is present under the containment structure or may develop within the containment berm will provide secondary containment. It is understood that removal of treated effluent will be by pumping over the berms. No discharge conduits will be constructed through the structure.

Within the lagoon containment area, a layer of water saturated sludge, 0.5 m thick was assumed to be present overlying the native soils.

3.0 GEOTHERMAL ANALYSIS OF CONTAINMENT STUCTURE

The geothermal performance of the lagoon dykes is a function of the thermal energy balance between the atmosphere and the ground surface on and around the dykes. As such, ground surface temperatures vary continuously throughout the year. When climate warming is

considered, the seasonal ground surface temperatures increases upward at a specified constant rate.

This subsection outlines the various boundary conditions that have been applied to the physical problem, lists the various analyses considered, and presents the results of the analyses. Numerical modeling results are presented in Section 4 of this report. The presence of an impermeable liner within the containment structure has been ignored in these analyses.

3.1 Numerical Model Input Parameters and Boundary Conditions

3.1.1 Climatic Data

The Hamlet of Igloolik is located at 69° 22.8' N and 81° 48.0' on Igloolik Island within the Foxe Basin, immediately east of Melville Peninsula. It is located in the zone of continuous permafrost. Environment Canada provides historical climatic data records from the early 1980s.

The long-term mean annual air temperature at the Igloolik airport is -13.1 °C. The freezing index is approximately 5100 °C-days and the thawing index is approximately 400 °C-days. Mean monthly temperatures in December and January are in the order of -30 °C and mean monthly temperatures in June and July are in the order of +5 °C.

Total annual snowfall is about 1.8 m. Snow and sub-freezing temperature are possible all year-round.

3.1.2 Ground Temperatures and Permafrost Depth

Ground temperatures were measured at the proposed lagoon site by Trow during their geotechnical investigations. A full ground temperature profile was also measured by the GSC. Figure 2.1 present these data.

Mean annual ground temperatures, based on the GSC data are expected to be in the order of -8 °C.

Permafrost is likely to extend over 500 m below ground surface.

3.1.3 Climate Warming

The design life of the containment structure is expected to be in the order of 20 years. For this period, climate warming is assumed to be active and should be accounted for in the design of the structure. One method of addressing the potential for regional atmospheric warming in a particular location is to extrapolate the historical warming rate forward for the design life of the project. Figure 3.1 presents the mean annual air temperature for the Igloolik airport for the period of 1983 through 2007. A linear regression best-fit line has been fitted to the data, and the slope of the regression line represents the annual historical warming trend. For the available data, the historical warming rate is 0.16 °C/year. This value is considered to be very high compared to historical climate warming trends for other communities in the Melville Peninsula/Baffin Island. A more typical regional climate warming rate is about 0.08 °C/year.

Using the Igloolik specific climate warming data, if this is projected forward for a design life of 20 years, the mean annual air temperature may rise by approximately 3.2 °C.

Climate warming is incorporated into the geothermal modeling by adjusting the mean annual air temperatures for each year of the simulation. In the case of the lagoon contents (sewage), a temperature warming rate of one-half the air temperature rate was applied (0.08 °C/year). This is considered to be a conservative assumption.

3.1.4 Soil Pore Water Salinity

The soils in the Baffin Island region are known to contain salts within the soil. The effect of salinity is to depress the freezing and thawing temperature below 0 °C. This means that saline soils will freeze and thaw at temperatures colder than 0 °C and this depressed temperature must be used to assess the freeze-thaw behaviour of the soils.

Trow (2009) reported salinities in the range of 0.26 PPT to 1.32 PPT, which are considered to represent soils of low salinity. Hivon and Sego (1993) reported on the pore water salinity of soils across northern Canada. Although they did not report salinities for soils in Igloolik, they did report salinities for regional communities as follows:

Repulse Bay:	0.5 to 10.4 PPT
Cape Dorset:	0.4 to 25.2 PPT
Pelly Bay:	12.0 to 33.7 PPT
Arctic Bay:	1.0 – 32.0 PPT

From the above information it is considered prudent to assume a conservative soil pore water salinity of about 20 PPT.

Freezing point depression is a linear function of pore water salinity. For soil pore water with a salinity of 35 PPT, the freezing point will be depressed to about –2°C. For this analysis a soil salinity of 20 PPT was assumed, with a corresponding freezing/thawing temperature of about -1.1 °C. Thus in the analysis of subgrade temperatures the threshold thaw temperature is taken as -1 °C.

3.1.5 Lagoon Content Elevation and Temperatures

The elevation and temperature of the lagoon contents will be seasonally variable and transient over the life of the structure. It is understood that the lagoon berm height and lagoon volume is based on projected community population growth over the next 20 years. Hence, full lagoon sewage elevations are not expected to be reached for many years.

The operation of the lagoon assumes that the effluent will be removed seasonally, typically between early August and mid-September each year. Refilling of the lagoon would take place from September through July of the following year.

For the geothermal analyses a constant lagoon elevation at one-half the height of the containment berm was assumed. The assumption of the fixed lagoon elevation is considered to very conservative in the initial life of the structure as the mean annual height of the sewage in the early period of the facility will be much less than that assumed. In later years of the structure, the fixed elevation of the lagoon will be essentially neutral from a modeling perspective because the sewage height will fluctuate throughout the year.

For the lagoon contents, a single temperature regime was considered. The lagoon temperature was assumed to be +1 °C all year around. In a separate study for a sewage lagoon at Clyde

River, NU Naviq compared two scenarios for lagoon temperatures where in the first case the lagoon temperature was held constant at +1 °C all year around, and in the second case the temperature of the surface of the lagoon varied according to seasonal conditions, with higher surface temperatures when the lagoon was empty in late summer, and cooler, but still "warmer than ambient" temperatures during the winter months. Comparison of the results of this modeling showed that the constant positive temperature approach was more conservative and was therefore adopted for this study (Naviq, 2008).

When long-term climate warming was considered in the analyses, a warming rate of 0.08 °C/year was applied to the lagoon temperature of +1 °C. Thus after 20 years, the lagoon content temperature was assumed to be +2.6 °C.

3.2 Geothermal Input Parameters

Table 3.1 lists the geothermal properties of the various soil layers assumed in the analysis. Table 3.2 list the climatic input data for the analysis. Table 3.3 presents the surface energy balance input parameters corresponding to the ground surface.

3.3 Analysis Scenarios

The first modeling step was to perform a one-dimensional model calibration whereby climate data representative of Igloolik was input to the model, and calibration was performed such that the model calculated long-term ground temperatures at depth that were also generally representative of Igloolik. The purpose of this analysis was to establish the surface boundary conditions (surface energy balance) that would result in ground temperatures typical of the local environment. The metrological inputs included: monthly air temperature, snow cover, surface albedo, and evapotranspiration rates. Snow thermal conductivity and factors for summer albedo and evapotranspiration were adjusted to achieve model-computed ground temperatures that were consistent with representative ground temperatures for Arctic Bay.

Two-dimensional geothermal analyses were then conducted using the commercial program TEMP/W, developed by Geo-Slope International. This program is capable of analyzing a variety of complex temperature problems, both steady state and transient in nature.

The analyses conducted for this study included the following:

- Initial model calibration of site conditions without the presence or influence of the lagoon structures
- Placement of the lagoon structure and modeling geothermal response for 20 years without applying climate warming.
- Placement of the lagoon structure and modeling geothermal response for 20 years including applying climate warming, as described in Section 3.1.3.
- Placement of the lagoon structure and modeling geothermal response for 20 years including applying climate warming and snow drifting on the downstream toe of the lagoon berm. To simulate snow drifting, the climate warming scenario was modified such that the normal snow thickness function (values listed in Table 3.2) were increased by a factor of two along the downstream slope of the lagoon berm.

The initial modeling scenario was set-up with an initial simulated period of five years with an undisturbed ground surface and non-climate warming boundary conditions. This initial period was intended to allow the model to reach a seasonal steady state geothermal condition. After the initial five year simulation, the containment structure was placed on the ground surface (instantaneously on about August first of Year 5). The berm was assumed to have constant temperature of +8 °C. The simulations were then run for an additional 20 years for various modeling scenarios.

Table 3.1. Thermal data of soils for input to geothermal model.

Material	Thermal Conductivity Thawed (W/m-°C)	Thermal Conductivity Frozen (W/m-°C)	Water Content (g/g)	Unfrozen Water Content Parameter A	Unfrozen Water Content Parameter B	Dry Density (kg/m^3)	Heat Capacity Thawed (kJ/d-m-°C)	Heat Capacity Frozen (kJ/d-m-°C)
Silty Sand	2.1	2.30	0.05	0.01	-0.80	1940	1796	1588
Sandy Silt	1.60	2.00	0.15	0.05	-0.50	2040	2759	2105
Siltstone bedrock (weathered)	2.50	2.80	0.10	0.01	-0.80	2240	2528	2061
Siltstone bedrock (unweathered)	3.00	3.10	0.05	0.005	-0.90	2240	2073	1834
Lagoon Sludge	1.30	1.80	0.56	0.300	-0.80	1000	3064	1888

Table 3.2. Climatic data for input to geothermal model.

Parameter	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Air temperature (°C)	-30.6	-31.2	-28	-19.3	-8.3	1.6	7	4.9	-0.4	-8.9	-19.5	-26.1
Wind velocity (km/hr)	15.4	14.9	15.5	15.9	16	14.2	12.7	15.7	17.5	19.8	18	15.9
Monthly solar radiation (W/m^2)	4.8	17.9	82.3	184	266.3	273.6	215.5	135.6	72.6	29.1	7.3	0
Snow depth (cm)	31	33	37	41	42	20	0	0	1	10	22	28

Note: Air temperature and wind velocity are taken from Igloolik airport data.
Snow depths were taken from Hall Beach airport data because no equivalent data was available for Igloolik.
Monthly solar radiation data was taken from published historical data for the Canadian arctic (Thompson, 1967).
Last and first snow cover days of year are ordinal days 172 (June 22) and 259 (September 17), respectively.

Table 3.3. Surface energy balance input parameters.

Property	Undisturbed Terrain	Containment Berm	Containment Berm with Snow Drift
Summer Albedo [1]	0.20	0.20	0.20
Winter Albedo [1]	0.85	0.85	0.85
Evapotranspiration Factor [1]	0.20	0.20	0.20
Snow Depth Factor [2]	1.0	1.0	2.0
Snow Thermal Conductivity (W/m-°C)	0.19		
[1] Values can range from 0 to 1. [2] Values can range from 0 and up.			

4.0 GEOTHERMAL MODELING RESULTS

This section addresses the results of the geothermal modeling described in Section 3. In interpreting geothermal modeling the results are a reflection of the assumptions made as input parameters and boundary conditions. If these values are representative of the actual conditions, then the results should be comparably representative of the future conditions.

As noted in Section 3, the pore water salinity that may be present in the soils in and around Igloolik can be high. For this study, a pore water salinity of 20 PPT has been assumed. This will result in a freezing and thawing temperature depression of about 1 °C.

For design purposes, it is prudent to incorporate conservatism to account for uncertainty in the input design parameters. Conservatism can be incorporated by using a colder design temperature than would be normally needed. In this case the controlling parameter is the thawing temperature of the soils, which is -1 °C when pore water salinity is accounted for. For design purposes therefore, it is proposed that the "adjusted" design temperature be assigned as -2 °C, one degree below the control temperature.

4.1 Initial Pre-construction Conditions

A base case was implemented wherein the first five years of the geothermal analysis considered only the undisturbed soil prior to containment berm construction. Figure 4.1 shows the model domain for this analysis and the temperature distribution after 4.59 years, which corresponds to ground temperatures representative of early August. As shown in the Figure 4.1 the active layer depth in mid-summer is approximately 1.5 m, based on the depth of the -1 °C isotherm below the undisturbed terrain.

4.2 Long-Term Thermal Performance – No Climate Warming

Building on the base case, above, at 4.59 years, the containment berm was instantaneously placed at a temperature of +8 C to simulate placement of relatively warm soil during summer construction. At the same time the sludge layer, with a thickness of 2 m was also applied with the liquid effluent boundary condition set to a constant +1 C for the entire simulation time period. The model was run for an additional 20 years.

Figure 4.2 shows results from 20 years after containment berm construction and is representative of the maximum thaw each year. As shown in the figure, the maximum active layer depth in the undisturbed terrain remains just over 1 m. The relatively warm effluent temperature in the lagoon however increases the maximum thaw depth (based on the -1°C isotherm) to approximately 8.0 m below the lagoon.

This figure shows that the -2 °C isotherm progresses to about 3 m below the crest of the berm during thawing each year. This means that, under the conditions analyzed, approximately 66% of the berm cross section (by area) warms to -2 °C or warmer annually.

An unfrozen zone (talik) develops under the lagoon, based on a melting temperature of -1 °C. If ice-rich soils are present these soils may melt, resulting in settlement of lagoon base and potentially the upstream toe of the containment structure.

The downstream terrain is thermally unaffected by the presence of the lagoon structure. A small amount of warming of the soil at the downstream toe of the dyke may result in some localized thaw settlement.

4.3 Long-Term Thermal Performance – Climate Warming

Figure 4.3 presents a cross-section of the lagoon structure showing the temperature contours in late summer after 20 years of operation for the case where the lagoon content surface is held at a constant temperature of +1 °C.

In Figure 4.3 it is seen that the ground temperature at depth remote from the lagoon (lower left corner) is in the order of -5 °C. This is compared to the -8°C temperature seen in Figure 4-1, and reflects the significant warming as a result of the 20 years of atmospheric warming applied at the ground surface.

The progression of the -2 °C isotherm within the berm structure has deepened compared to the non-climate warming case. Approximately 80% of the dyke cross-section (by area) thaws out by late summer. The -2 °C isotherm is approximately 4 m below the crest of the containment berm. On the upstream side of the berm structure, the -2 °C isotherm has shifted towards the center of the berm, compared to the non-climate warming case. This transition arises because of the annual increase in the lagoon content temperatures according to the applied climate warming rate. The volume of the unfrozen zone under the lagoon area is greater than for the case of no climate warming. This could result in more thaw settlement of the subgrade compared to the no climate warming case.

4.4 Long-Term Thermal Performance – Climate Warming and Snow Drifting Effects

Figure 4.4 presents the predicted ground temperature contours for the case where climate warming and snow drifting on the downstream of the containment berm is applied. To simulate snow drifting, climate warming analysis was modified such that the normal snow thickness function was increased by a factor of two along the slope of the dyke opposite the lagoon. Therefore this case includes the combined effects of snow drifting and climate warming.

Snow drifting on the downstream slope of the berm provides an insulating effect during winter and thus increases ground temperatures. Thaw in this case is increased somewhat but the effect of snow drifting on overall ground temperatures is not as significant as ground temperature increases caused by climate warming.

For this case essentially 100% of the berm structure thaws during the summer, 20 years after construction. The active layer on the downstream side of the structure progressed from an initial depth of about 1.5 m to about 2.5 m.

5.0 DISCUSSION OF MODELING RESULTS AND IMPLICATION TO LAGOON DESIGN

Section 3 described the various geothermal model inputs and the analyses that were to be undertaken for this study. Section 4 presents the results of the geothermal modeling. This section provides a discussion of the implications of the modeling results to the lagoon design.

The geothermal modeling showed that long-term thawing into the bedrock at depth will develop. It is considered likely that the unweathered bedrock may provide a suitably impermeable barrier

to the lagoon contents. Hence, in terms of assessing potential seepage paths, the -2 °C isotherm was truncated to the weathered-unweathered bedrock interface in Figure 4.2 through Figure 4.4.

The geothermal modeling has confirmed that the installation of an impermeable liner within the lagoon containment structure (berm) is a prudent design approach, and that integrity of an ice-core containment structure may not be sufficient in all years, and during extreme warming seasons.

A liner is not considered warranted under the main lagoon containment area. The geothermal modeling shows that while there may be significant thawing under the containment area (particularly in the climate warming case), the overall lateral containment of the frozen mass surrounding the containment area should be adequate to confine or restrict any seepage. Seepage will also be likely impeded by the presence of unweathered bedrock at depth.

The design and construction installation details for an impermeable liner should be undertaken considering the environment in which the liner will operate and the construction equipment and skills available for installation. Issues to be considered include, but may not be limited to protection from ice and vehicle damage, slope stability, keying the liner into the subgrade and others.

The operation of impermeable liners and perforations or apertures within the berm structure is generally incompatible. That is, where drainage pipes or access manholes are installed in the lagoon containment structure and these features penetrate the liner, an opportunity of leakage and seepage will be present. Therefore, the design of the structure should avoid the installation of drainage pipes, access manholes and other potential seepage points.

Monitoring during construction and operations represents part of good design practice. Therefore, to assess the performance of the lagoon structure, it is recommended that thermistors and seepage monitoring facilities be incorporated into the design and construction plans. Monitoring of ground temperatures and review of data on a regular basis, including assessment and investigation of unexpected data or trends should be part of the operating procedures.

6.0 RECOMMENDATONS

This section provides recommendations for the design, construction and operation of the sewage lagoon structure, based on the geothermal modeling and discussion presented in this report.

1. The use of moderately high saline soils for the berm construction has been assumed in this analysis. If low saline soils can be located and used for the berm construction, then a controlling design isotherm of -1 °C instead of -2 °C may be used. This would be generally advantageous in terms of geothermal performance.

2. The seasonal thawing of the berm structure, even in the absence of climate warming effects, means that a frozen-core impermeable design approach may not be feasible, based on the geothermal modeling conducted for this study. For this reason, it is recommended that primary containment be provided by a liner or other impermeable barrier or system. (This analysis ignores the fact that the maximum thaw in the lagoon containment berms occurs after the annual draw-down of the lagoon, so that seepage through the unfrozen zone of the berm may not occur.)

3. A liner or barrier in the containment berm to provide primary containment should be located along the upstream face of the earth structure. At the upstream toe of the berm, the liner should be keyed into the native soil. On the cross-sections shown in Figure 4.2 through Figure 4.4 the key-trench should be located in the order of Station 45. The liner should be placed to the interface between weathered and unweathered bedrock, which is assumed to be at a depth of 5.5 m below the native ground surface.

4. Selection of the liner material requires careful consideration. Current industry practice is moving away from the use of high density polyurethane (HDPE) liners and geosynthetic clay liners (GCL). Both these systems have reportedly experienced performance issues in cold temperature applications. An alternative liner material that is gaining favor in locations such as the North Slope of Alaska (Prudhoe Bay area) is polymeric geomembranes, which may include thermoplastic polyurethane. Polyether polyurethane materials are reported to provide good low temperature properties. These materials are reportedly satisfactory for liner materials, landfill covers, potable water and fuel containment liners and similar applications.

5. The geothermal analyses have assumed that the lagoon berms will be constructed without any perforations or apertures. Drainage culverts and access man holes are two examples of openings that may be installed in or through the dyke structure. These apertures represent sources of geothermal discontinuities that could negatively impact the temperature regime in the vicinity of the apertures. In addition, it is possible that a drainage pipe through the berm could experience freeze-up and ice blockage for much of the year. Therefore, from a geothermal perspective, it is recommended that no drainage pipes or vertical access man holes be installed through or in the berm structure.

6. Where drainage pipes are installed through the lagoon berm, it will be necessary to pass the drainage pipe through the impermeable liner. Such a perforation represents a potentially serious source for leakage as it is often difficult to ensure an impermeable seal around the liner-drain pipe connection. Therefore, from a geotechnical perspective, it is recommended that no drainage pipes be installed through the containment structure.

7. Given the limitations in installing a vertical cut-off barrier to impede seepage towards the center of the berm structure, as discussed in Recommendation 3, it is further recommended that the thermal and seepage performance of the containment structure be incorporated into its design and operation. Sealed PVC casings should be installed through the structure and into the subgrade soils into which thermistor cables may be installed to monitor ground temperatures. These casings should be installed at approximately 15 m to 20 m centers along the crest of the dyke. Selected casings could be "battered" to the upstream side so to provide the opportunity to monitor dyke and subgrade temperatures on the upstream side.

   To monitor seepage, vertical slotted standpipes should be installed at approximately 15 m to 20 m centers along the crest of the dyke. These standpipes should be of a diameter to permit the recovery of liquid within the standpipe for environmental/biological testing.

   Care should be taken to ensure that the monitoring casings do not penetrate the impermeable liner. Additional specifications on monitoring installations and instrumentation may be provided on request.

8. It is considered that the need for a secondary cooling system, such as thermosyphons is not supported by the current analysis, subject to the implementation of the above recommendations. If, during operations, monitoring of the berm and subgrade temperatures indicates a warming of the structure higher than predicted by this study, then thermosyphons may be considered. Based on a preliminary assessment, vertical thermosyphons, installed along the crest at approximately 2 m centers to a depth of about 2 m below the base of the berm would provide additional cooling of the core of the berm to maintain a frozen core. Shallow rigid insulation could also be installed in conjunction with the thermosyphons to reduce the seasonal active layer thickness. Additional modeling and design work is needed to advance any proposal to install thermosyphons.

7.0 CLOSURE

This report has been prepared for the exclusive use of Trow Associates Inc. for the specific application and project described herein. The use of this report by third parties or for an application not described in this report is at the sole risk and responsibility of those parties.

If at any time, the soil or climatic conditions be found to be different from what has been assumed in this report, Naviq should be notified and given the opportunity to examine the different conditions and the impact they may have on the analyses and recommendations reported herein.

Prepared by:
Naviq Consulting Inc.

DRAFT

J.M. Oswell, Ph.D., P.Eng.
Senior Permafrost Engineer

Reviewed by: R. Coutts, M.Sc., P.Eng. (AB)
Senior Geothermal Engineer
Ardent Innovation Inc.

NAPEGG Permit to Practice: P611

8.0 REFERENCES

Hivon, E.G. and Sego, D.C. 1993. Distribution of saline permafrost in the Northwest Territories, Canada. Canadian Geotechnical Journal, 30(3): 506 – 514.

Naviq Consulting Inc. 2008. Geothermal analysis of proposed sewage lagoon, Clyde River, NU. Revision 0. Prepared for Trow Associates Inc. Naviq Project No. J008, February 2008.

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APPENDIX A

TERMS AND CONDITIONS

TERMS AND CONDITIONS

The following Terms and Conditions form part of this Report. Acceptance of the report by the Client shall be interpreted as acknowledgement and agreement by the Client with the Terms and Conditions provided herein. Acceptance of the Report means that the Client has not objected to the Report in writing within seven days of receipt.

1. STANDARD OF CARE: Naviq will strive to perform Services in a manner consistent with that level of care and skill ordinarily exercised by other members of Naviq's profession currently practicing in the same locality under similar conditions.

   NO OTHER REPRESENTATION, GUARANTEE, OR WARRANTY, EXPRESS OR IMPLIED, IS INCLUDED OR INTENDED IN THESE TERMS AND CONDITIONS, OR IN ANY COMMUNICATION (ORAL OR WRITTEN), REPORT, OPINION, DOCUMENT, OR INSTRUMENT OF SERVICE.

2. CHANGES: Client may order changes within the general scope of the Services by altering, adding to, or deleting from the Services to be performed. Further, if Naviq believes any subsurface or physical condition at or contiguous to the site is of an unusual nature and differs materially from conditions generally encountered or generally recognized as inherent in the character of Services provided in these Terms and Conditions, a change exists. If any such change causes an increase or decrease in Naviq's cost of, or the time required for, the performance of any part of the Services, a mutually acceptable equitable adjustment shall be made to the price and performance schedule.

3. FORCE MAJEURE: Should performance of Services by Naviq be affected by causes beyond its reasonable control, Force Majeure results. Force Majeure includes, but is not restricted to: acts of God; acts of a legislative, administrative or judicial entity; acts of contractors other than contractors engaged directly by Naviq; fires; floods; labor disturbances; and unusually severe weather. Naviq will be granted a time extension and the parties will negotiate an equitable adjustment to the price for the Services, where appropriate, based upon the effect of the Force Majeure on performance by Naviq.

4. INSTRUMENTS OF SERVICE: All reports, drawings, plans, or other documents (or copies) furnished to Naviq by the Client, shall at Client's written request, be returned on completion of the Services hereunder; provided, however, that Naviq may retain one copy of all such documents. All reports, drawings, plans, documents, software, source code, object code, field notes and work product (or copies thereof) in any form prepared or furnished by Naviq under these Terms and Conditions are instruments of service. Exclusive ownership, copyright and title to all instruments of service remain with Naviq. Client's right of use of instruments of service, if any, is limited to that use reasonably considered necessary for performance of the Client's duties and obligations. The instruments of service are not intended or represented to be suitable for reuse by Client or others on extensions of the work or on any other project.

5. CLIENT'S RESPONSIBILITIES: Client agrees to: (i) provide Naviq all available material, data, and information pertaining to the Services, including, without limitation as appropriate, the composition, quantity, toxicity, or potentially hazardous properties of any material known or believed to be present at any site, any hazards that may be present, the nature and location of underground or otherwise not readily apparent utilities, summaries and assessments of the site's past and present compliance status, and the status of any filed or pending judicial or administrative action concerning the site; (ii) convey and discuss such materials, data, and information with Naviq; and (iii) ensure cooperation of Client's employees.

   Client shall indemnify, defend, and save Naviq harmless from and against any liability, claim, judgment, demand, or cause of action arising out of or relating to: (i) Client's breach of these Terms and Conditions; (ii) the negligent acts or omissions of Client or its employees, contractors, or agents; (iii) any allegation that Naviq is the owner or operator of a site, or arranged for the treatment, transportation or

disposal of hazardous materials, including all adverse health effects thereof and (iv) site access or damages to any subterranean structures or any damage required for site access.

In addition, where the Services include preparation of plans and specifications and/or construction oversight activities for Client, Client agrees to have its construction contractors agree in writing to indemnify and save harmless Naviq from and against loss, damage, injury, or liability attributable to personal injury or property damage arising out of or resulting from such contractors' performance or nonperformance of their work.

6. LIMITATION OF LIABILITY: As part of the consideration Naviq requires for provision of the Services, Client agrees that any claim for damages filed against Naviq by Client or any contractor or subcontractor hired directly or indirectly by Client will be filed solely against Naviq or its successors or assigns and that no individual person shall be made personally liable for damages, in whole or in part.

   Client's sole and exclusive remedy for any alleged breach of Naviq's standard of care hereunder shall be to require Naviq to re-perform any defective Services. Notwithstanding any other provision of these Terms and Conditions, the total liability of Naviq, its officers, directors and employees for liabilities, claims, judgments, demands and causes of action arising under or related to the Services or these Terms and Conditions, whether based in contract or tort, shall be limited to the total compensation actually paid to Naviq for the Services or $10,000, whichever is less. All claims by Client shall be deemed relinquished unless filed within one (1) year after substantial completion of the Services.

   Naviq and Client shall not be responsible to each other for any special, iNaviqdental, indirect, or consequential damages (including lost profits) incurred by either Naviq or Client or for which either party may be liable to any third party, which damages have been or are occasioned by Services performed or reports prepared or other work performed hereunder.

7. DISPUTE RESOLUTION: If a claim, dispute, or controversy arises out of or relates to the interpretation, application, enforcement, or performance of Services under these Terms and Conditions, Naviq and Client agree first to try in good faith to settle the dispute by negotiations between senior management. If such negotiations are unsuccessful, the parties agree to attempt to settle the dispute by good faith mediation. If the dispute can not be resolved through mediation and unless otherwise mutually agreed, the dispute shall be settled by litigation in an appropriate court in the Province of Alberta. Client hereby waives the right to trial by jury for any disputes arising out of these Terms and Conditions.

   The non-prevailing party in any litigation shall reimburse the prevailing party for the prevailing party's documented legal costs (including reasonable attorneys' fees), in addition to whatever other judgments or settlement sums may be due.

8. WAIVER OF TERMS AND CONDITIONS: The failure of either Naviq or Client in any one or more instances to enforce one or more of these Terms and Conditions or to exercise any right or privilege in these Terms and Conditions or the waiver by Naviq or Client of any breach of the these Terms and Conditions shall not be construed as thereafter waiving any such terms, conditions, rights, or privileges, and the same shall continue and remain in force and effect as if no such failure to enforce had occurred.

9. SEVERABILITY: Notwithstanding any possible future finding by a duly constituted authority that a particular term or provision is invalid, void, or unenforceable, these Terms and Conditions have been made with the clear intention that the validity and enforceability of the remaining parts, terms, and provisions shall not be affected thereby.

10. GOVERNING LAWS: This Agreement shall be governed and construed in accordance with the laws of the Province of Alberta.

FIGURES

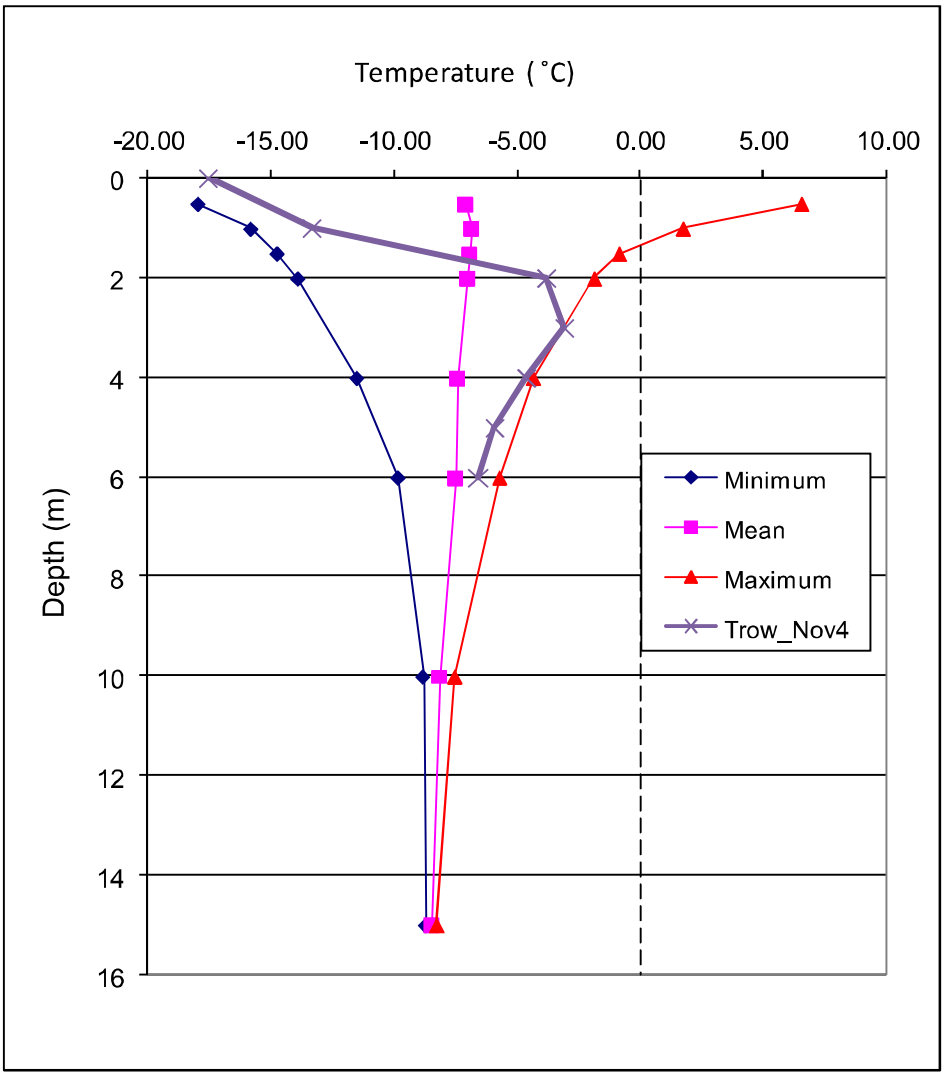


Figure 2.1. Ground temperature data for Igloolik, NU. (Data source: Geological Survey of Canada and Trow, 2009, 2010).

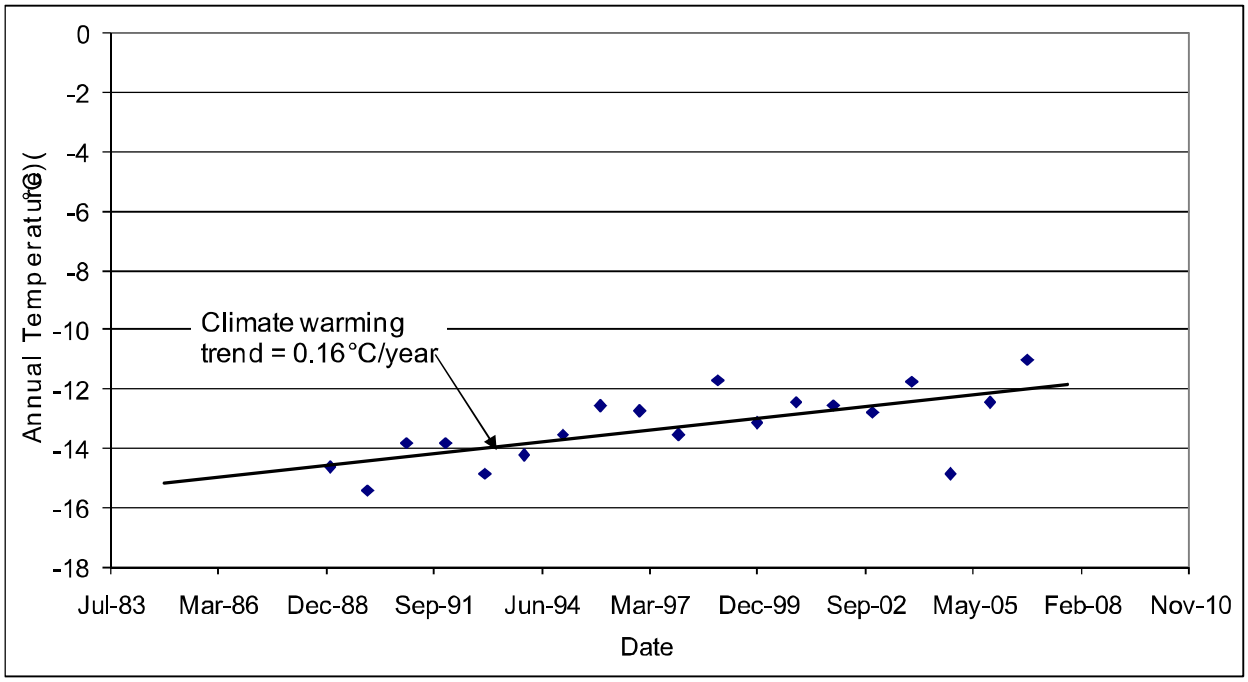


Figure 3-1. Historical variation in mean annual air temperature (1983 through 2007). Data source: Environment Canada website.

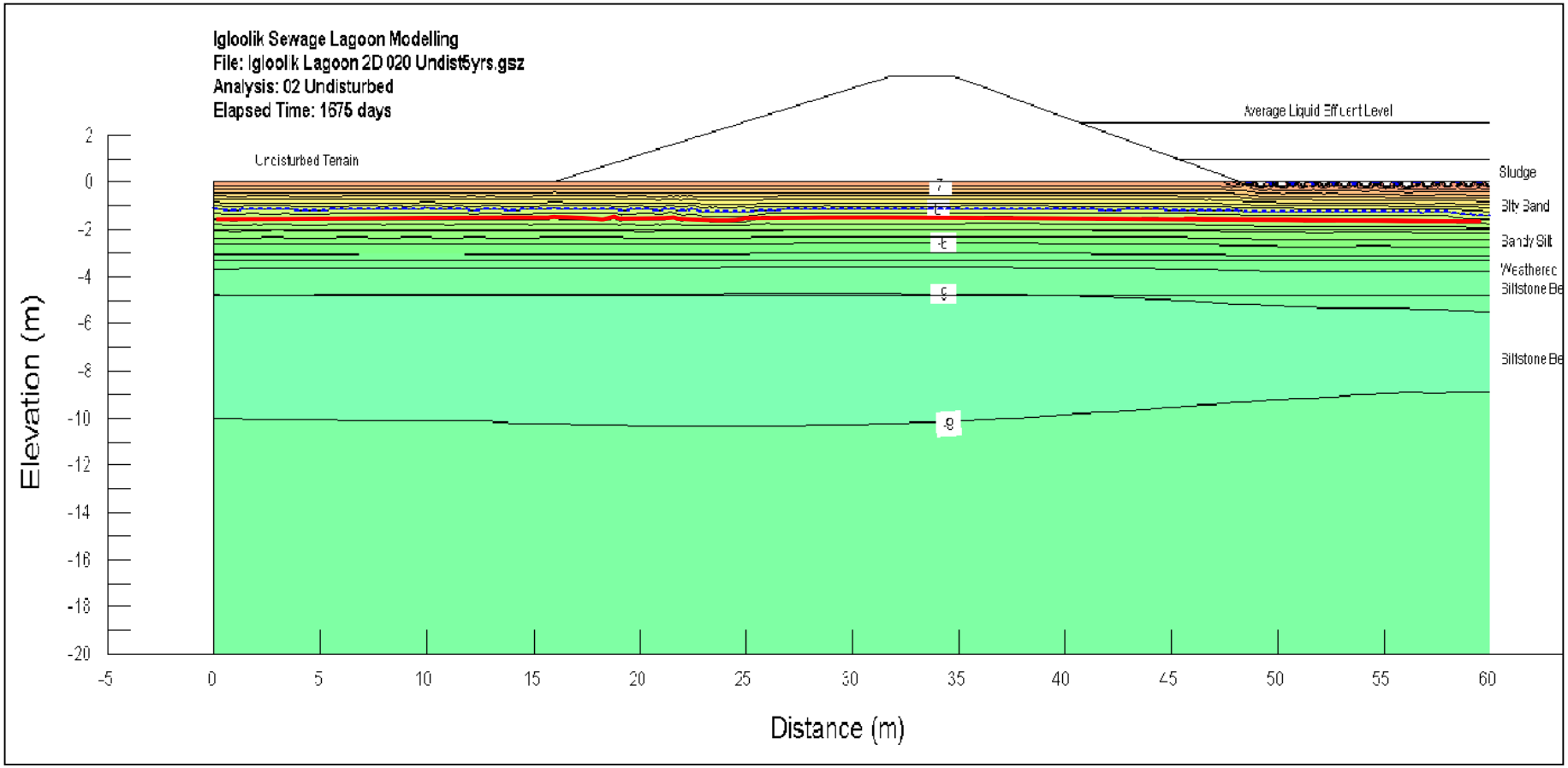


Figure 4-1. Cross-section of berm sub-grade showing ground temperature contours at maximum thaw at 4.59 years, prior to construction of the containment structure. The red contour line represents the -2 °C isotherm.

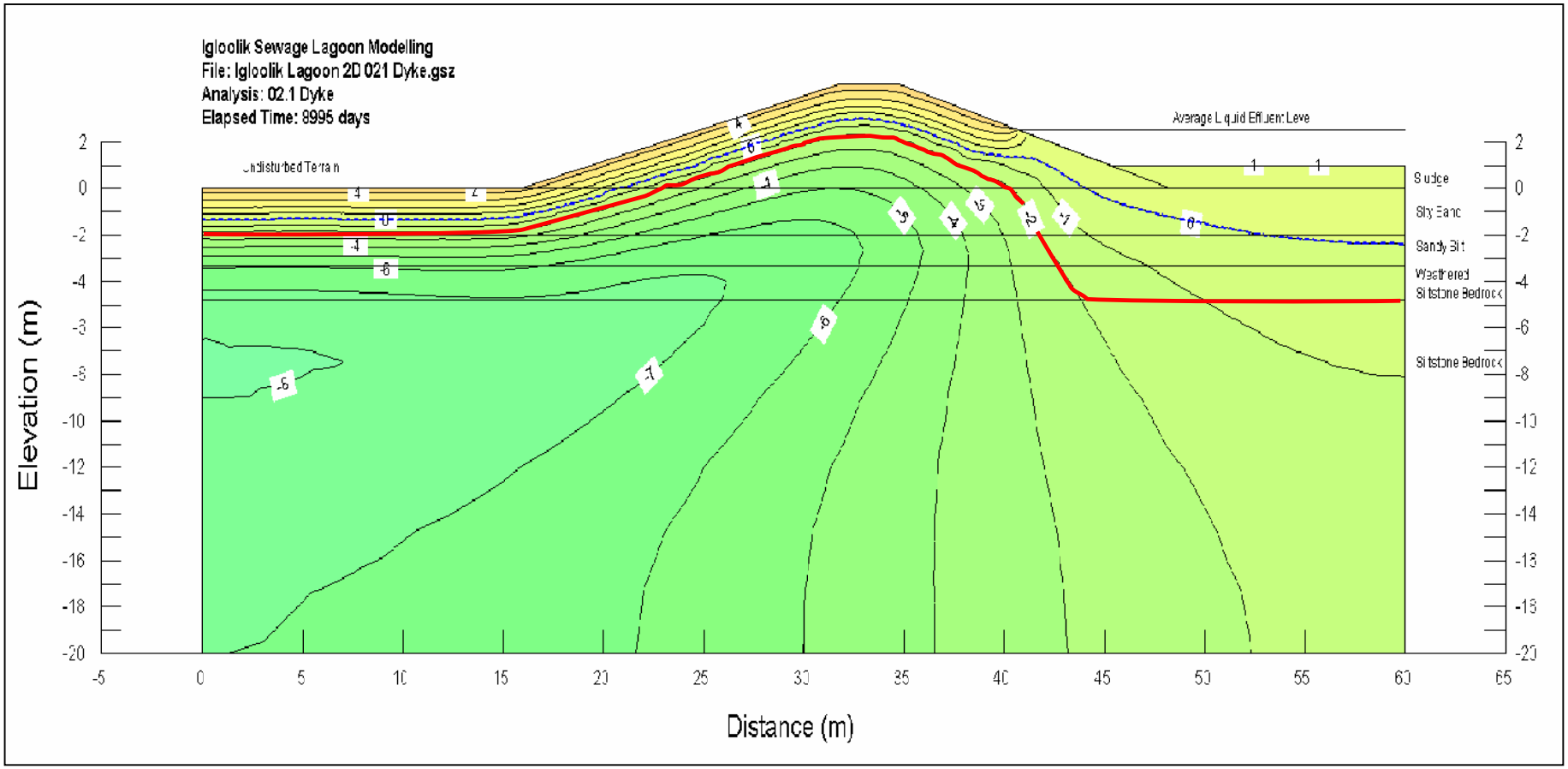


Figure 4-2. Cross-section of containment structure showing ground temperature contours after 20 years. No climate warming effects are included. The red contour line represents the -2 °C isotherm above the bedrock elevation and the weathered/unweathered bedrock interface.

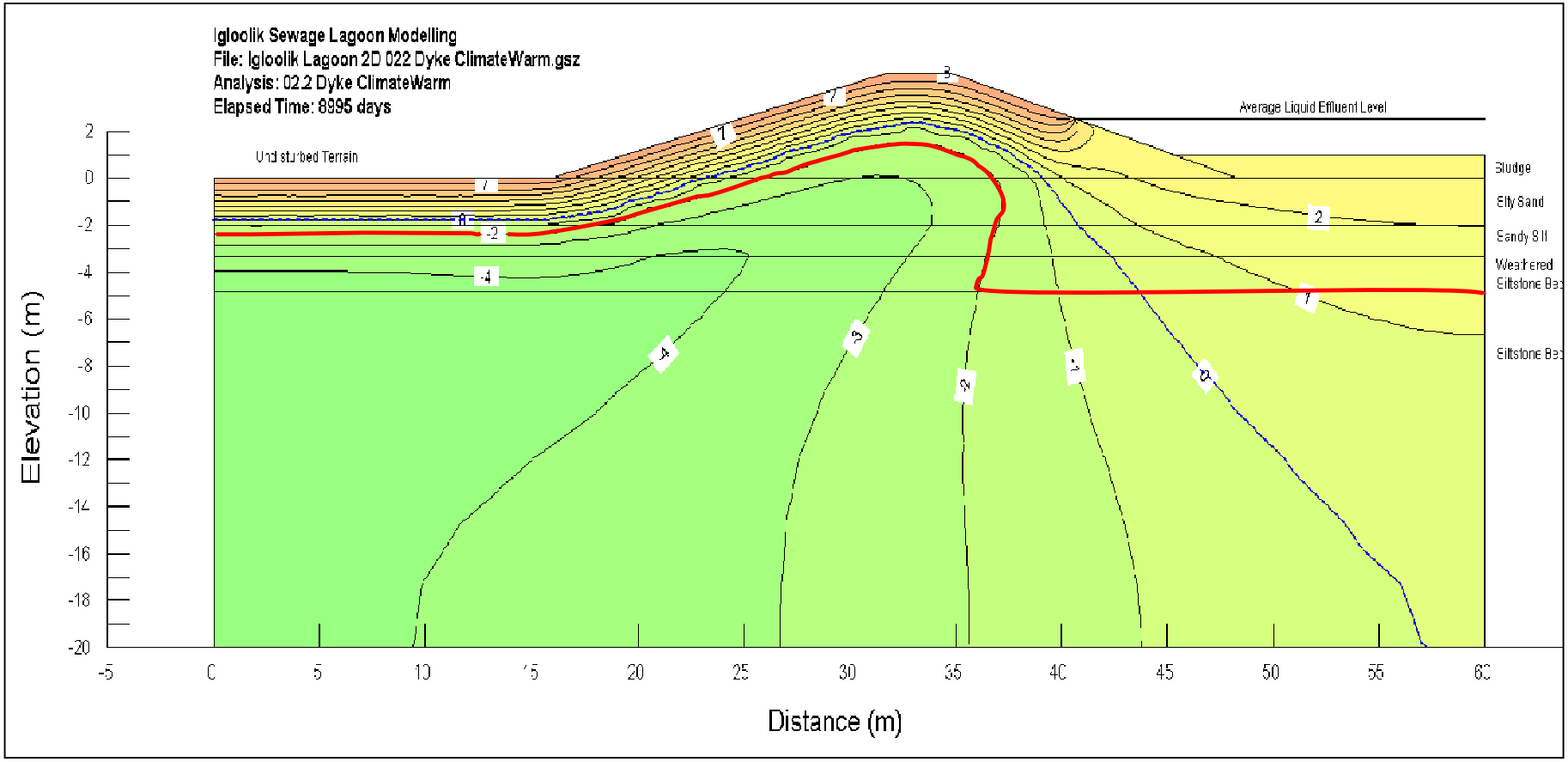


Figure 4-3. Cross-section of containment structure showing ground temperature contours after 20 years. Climate warming effects are included. The red contour line represents the -2 °C isotherm above the bedrock elevation and the weathered/unweathered bedrock interface.

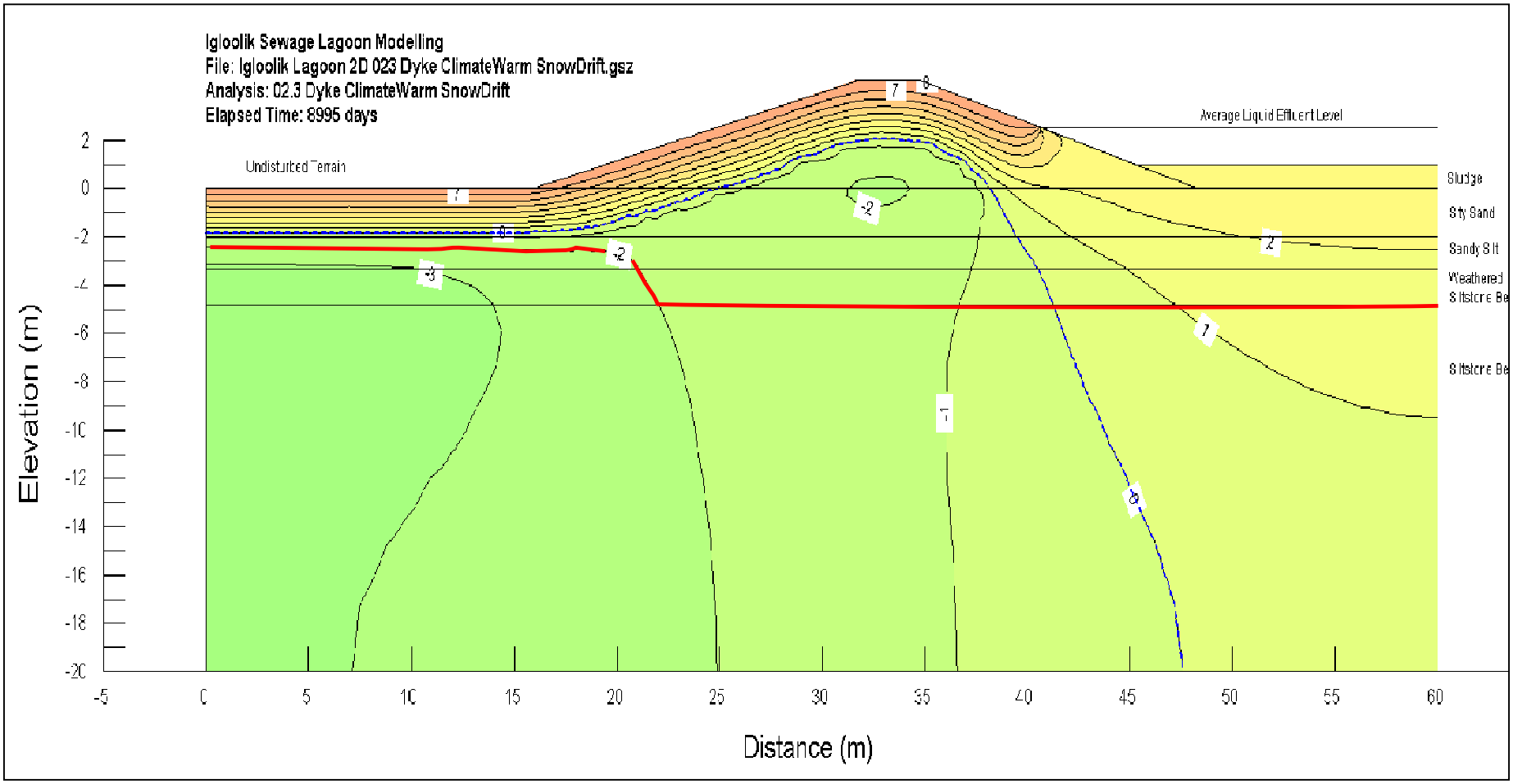
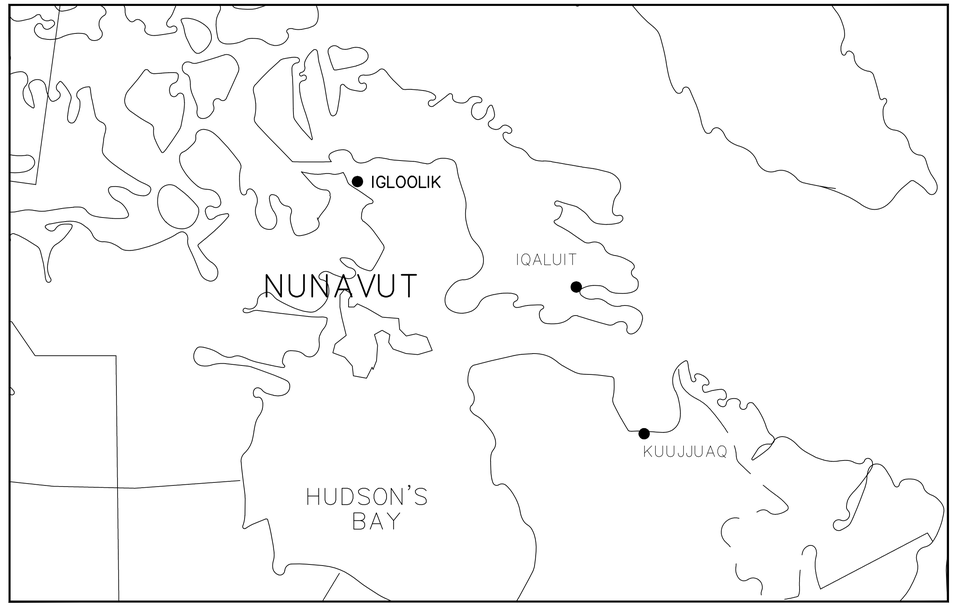


Figure 4-4. Cross-section of containment structure showing ground temperature contours after 20 years. Climate warming and snow drifting effects are included. The red contour line represents the -2 °C isotherm above the bedrock elevation and the weathered/unweathered bedrock interface.

Appendix E – Record Drawings

HAMLET OF IGLOOLIK



INDEX OF INCLUDED DRAWINGS

DRAWING NO.	REVISION	DESCRIPTION
		COVER SHEET
OTCD00019838-IGL-1	REV 7	SITE LOCATION PLAN
OTCD00019838-IGL-3	REV 7	PROPOSED FACILITY AND PHASING PLAN
OTCD00019838-IGL-4	REV 9	NEW LAGOON CELL 'A'
OTCD00019838-IGL-5	REV 9	NEW LAGOON CELL 'B' & 'C'
OTCD00019838-IGL-6	REV 7	PUMPING AND DEWATERING DETAILS
OTCD00019838-IGL-7	REV 7	LINER AND SPILLWAY DETAILS
OTCD00019838-IGL-8	REV 7	TRUCK DISCHARGE AND MISC. DETAILS

RECORD
DRAWINGS
DATE: SEPTEMBER 25, 2018

GOVERNMENT OF NUNAVUT
WASTEWATER MANAGEMENT FACILITY

PROJECT OTT-00019838-A0

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7330
2650 Queensview Drive, Unit 100
Ottawa, ON K2B 8H6
Canada
www.exp.com

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NOTES

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RECORD DRAWINGS

DATE: SEPTEMBER 25, 2018

NO.	REVISION DESCRIPTION	DATE	BY	APPD
7	RECORD DRAWINGS	25/09/18	AO	IPC

NO.	REVISION DESCRIPTION	DATE	BY	APPD
7	ISSUED FOR CONSTRUCTION	19/09/16	IPC	SLB
6	ISSUED FOR TENDER	27/04/15	IPC	SLB
5	ISSUED FOR NWB REVIEW	27/03/15	IPC	SLB
4	ISSUED FOR 100% REVIEW	05/03/15	IPC	SLB
3	ISSUED FOR 99% REVIEW	19/01/15	IPC	SLB
2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
1	ISSUED FOR REVIEW	13/03/12	MEB	SLB

SCALE

HORZ 1:5000

0 50m 100m 200m HORIZONTAL 1:5,000

DESIGNED BY

REVIEWED BY

CLIENT

GOVERNMENT OF NUNAVUT
DEPARTMENT OF COMMUNITY
AND GOVERNMENT SERVICES

exp.

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
Canada
www.exp.com
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BASEPLAN	exp.
DESIGN	IPC
CHECKED	SLB
CAD	IPC
PROJ. MAN	SLB
APPROVED	SLB

PROJECT

WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

TITLE

SITE LOCATION PLAN

PROJ NO.	OTCD00019838A
SURVEY	exp.
DATE	NOV. 2014
DRAWING NO.	IGL–1

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NOTES

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RECORD DRAWINGS

DATE: SEPTEMBER 25, 2018

NO.	REVISION DESCRIPTION	DATE	BY	APPD	NO.	REVISION DESCRIPTION	DATE	BY	APPD
					7	ISSUED FOR CONSTRUCTION	19/09/16	IPC	SLB
					6	ISSUED FOR TENDER	27/10/15	IPC	SLB
					5	ISSUED FOR NEW REVIEW	27/03/15	IPC	SLB
					4	ISSUED FOR 100% REVIEW	05/03/15	IPC	SLB
					3	ISSUED FOR 99% REVIEW	19/01/15	IPC	SLB
					2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
7	RECORD DRAWINGS	25/09/18	AO	IPC	1	ISSUED FOR REVIEW	13/03/12	MEB	SLB

SCALE
HORZ 1:1500
0 15m 30m 60m
HORIZONTAL 1:1500

DESIGNED BY

REVIEWED BY

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DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES

exp Services Inc.
t: +1.613.688.1899 | f: +1.613.225.7337
2650 Queensview Drive, Suite 100
Ottawa, ON K2B 8H6
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BASEPLAN: exp.
DESIGN: IPC
CHECKED: SLB
CAD: SLB
PROJ. MAN: SLB
APPROVED: SLB

PROJECT
WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

TITLE
PROPOSED FACILITY AND PHASING PLAN

PROJ NO. OTCD00019838A
SURVEY: exp.
DATE: NOV. 2014
DRAWING NO. IGL–2

NOTES

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RECORD DRAWINGS

DATE: SEPTEMBER 25, 2018

NO.	REVISION DESCRIPTION	DATE	BY	APPD	NO.	REVISION DESCRIPTION	DATE	BY	APPD
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					5	ISSUED FOR NWB REVIEW	27/03/15	IPC	SLB
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					3	ISSUED FOR 99% REVIEW	19/01/15	IPC	SLB
9	RECORD DRAWINGS	25/09/18	AO	IPC	2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
8	AS–BUILTS	17/09/18	SAB	IPC	1	ISSUED FOR REVIEW	13/03/12	MEB	SLB

SCALE: HORZ 1:750

0 5m 10m 30m HORIZONTAL 1:750

DESIGNED BY

REVIEWED BY

CLIENT: GOVERNMENT OF NUNAVUT
DEPARTMENT OF COMMUNITY AND GOVERNMENT SERVICES

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t: +1.613.688.1899 | f: +1.613.225.7337
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Canada
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• INDUSTRIAL • INFRASTRUCTURE • SUSTAINABILITY •

BASEPLAN	exp.
DESIGN	IPC
CHECKED	SLB
CAD	IPC
PROJ. MAN	SLB
APPROVED	SLB

PROJECT: WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

TITLE: NEW LAGOON CELL 'A'
PHASE I

PROJ NO. OTCD00019838A

SURVEY exp.

DATE NOV. 2014

DRAWING NO. IGL–3

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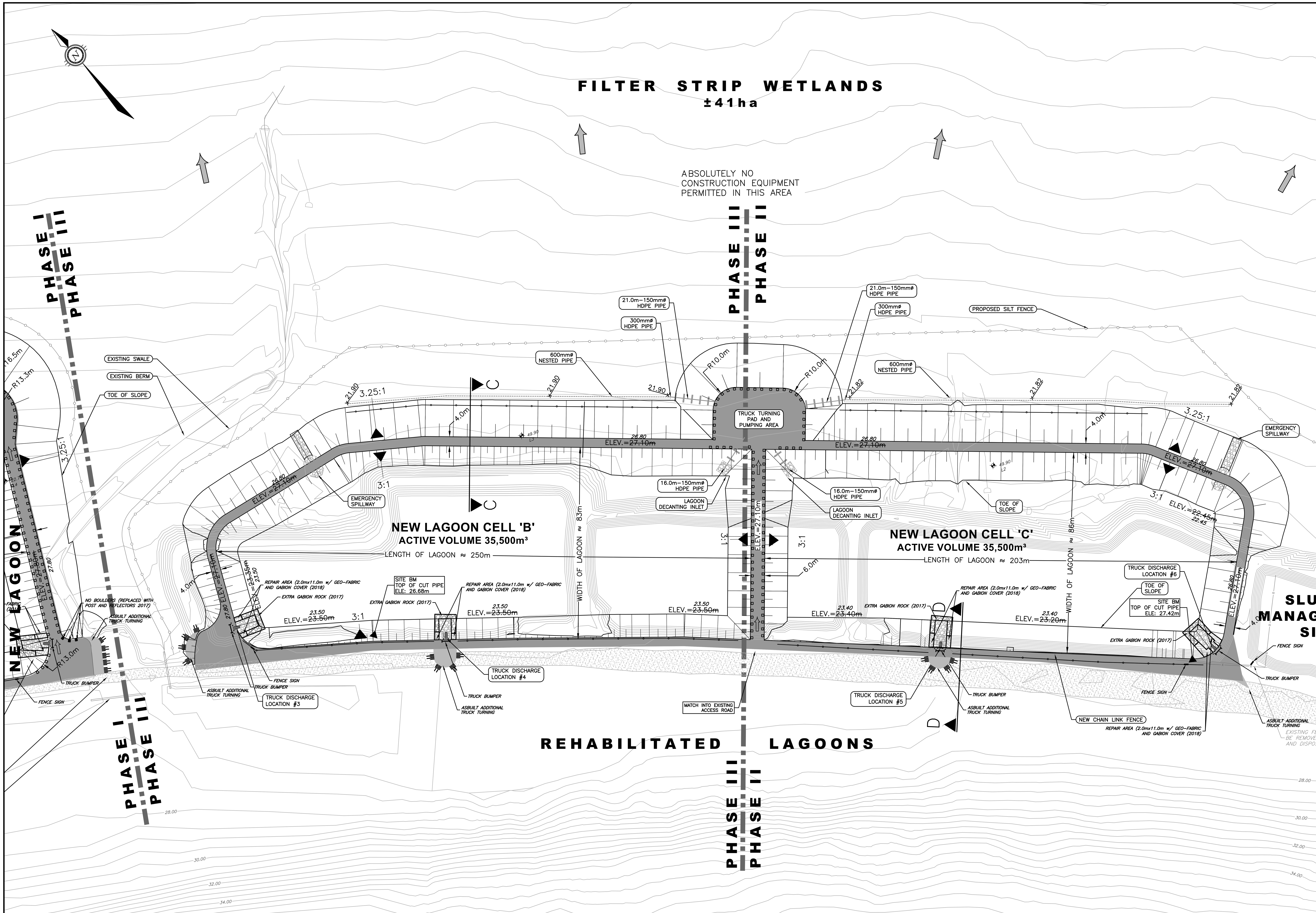

FILTER STRIP WETLANDS
±41ha
ABSOLUTELY NO CONSTRUCTION EQUIPMENT PERMITTED IN THIS AREA
PHASE I
PHASE III
PHASE II
NEW LAGOON
NEW LAGOON CELL 'B'
ACTIVE VOLUME 35,500m³
LENGTH OF LAGOON ≈ 250m
WIDTH OF LAGOON ≈ 83m
NEW LAGOON CELL 'C'
ACTIVE VOLUME 35,500m³
LENGTH OF LAGOON ≈ 203m
WIDTH OF LAGOON ≈ 86m
SLUDGE MANAGEMENT SITE
REHABILITATED LAGOONS
EXISTING SWALE
EXISTING BERM
TOE OF SLOPE
600mmø NESTED PIPE
21.0m–150mmø HDPE PIPE
300mmø HDPE PIPE
PROPOSED SILT FENCE
TRUCK TURNING PAD AND PUMPING AREA
16.0m–150mmø HDPE PIPE
LAGOON DECANTING INLET
EMERGENCY SPILLWAY
SITE BM TOP OF CUT PIPE ELE: 26.68m
SITE BM TOP OF CUT PIPE ELE: 27.42m
TRUCK DISCHARGE LOCATION #3
TRUCK DISCHARGE LOCATION #4
TRUCK DISCHARGE LOCATION #5
TRUCK DISCHARGE LOCATION #6
MATCH INTO EXISTING ACCESS ROAD
NEW CHAIN LINK FENCE
REPAIR AREA (2.0mx11.0m w/ GEO-FABRIC AND GABION COVER (2018)
EXTRA GABION ROCK (2017)
ASBUILT ADDITIONAL TRUCK TURNING
TRUCK BUMPER
FENCE SIGN
NO BOULDERS (REPLACED WITH POST AND REFLECTORS 2017)
EXISTING FENCE TO BE REMOVED AND DISPOSED OF
ELEV.=27.10m
ELEV.=23.50m
ELEV.=23.40m
ELEV.=23.20m
3.25:1
3:1

LEGEND

- EXISTING SWALE
- GABION MAT
- TOP OF BERM
- TRUCK ROUTE
- DIRECTION OF OVERLAND FLOW (WETLANDS)
- 600mm PERFORATED NESTED PIPE
- EROSION CONTROL – SILT FENCE
- NEW FENCE LOCATION
- 76.58 PROPOSED GRADES
- STONE BOULDERS–SEE DETAIL SHEET FOR SPACING
- 4.0% SLOPE
- EXISTING DITCH LINE

NOTES

DISTANCES AND ELEVATIONS ARE EXPRESSED IN METERS AND ARE HORIZONTAL AT GROUND LEVEL.

ALL GRID REFERENCES REFER TO THE CENTRAL MERIDIAN OF UTM ZONE 17.

ELEVATION DATUM: COORDINATE CONTROL MONUMENT – IGLOOLIK CBM M009001, ELEVATION – 46.74 METERS ABOVE MEAN SEA LEVEL–SEE SITE PLAN FOR LOCATION.

CONTOUR INTERVAL = 0.5m.

THE RE–USE OF BERM MATERIALS FROM THE EXISTING SEWAGE LAGOON SHALL BE ON CONDITION THAT THEY DO NOT POSE UNACCEPTABLE ACUTE HEALTH RISKS TO SITE WORKERS. PRIOR TO RE–USE SAMPLES OF THE BERM MATERIALS SHALL BE SUBMITTED FOR LABORATORY TESTING FOR BACTERIOLOGICAL PATHOGENS (INCLUDING AT A MINIMUM–E.COLI, TOTAL COLIFORMS, AND FECAL COLIFORMS). SITE WORKERS SHOULD USE APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT WHEN HANDLING BERM MATERIALS FROM EXISTING SEWAGE LAGOONS.

NOTES

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RECORD DRAWINGS

DATE: SEPTEMBER 25, 2018

NO.	REVISION DESCRIPTION	DATE	BY	APPD
9	RECORD DRAWINGS	25/09/18	AO	IPC
8	AS–BUILTS	17/09/18	SABG	IPC
7	ISSUED FOR CONSTRUCTION	19/09/16	IPC	SLB
6	ISSUED FOR TENDER	12/11/15	IPC	SLB
5	ISSUED FOR NWB REVIEW	27/03/15	IPC	SLB
4	ISSUED FOR 100% REVIEW	05/03/15	IPC	SLB
3	ISSUED FOR 99% REVIEW	19/01/15	IPC	SLB
2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
1	ISSUED FOR REVIEW	13/03/12	MEB	SLB

SCALE: HORZ 1:750

0 5m 10m 30m HORIZONTAL 1:750

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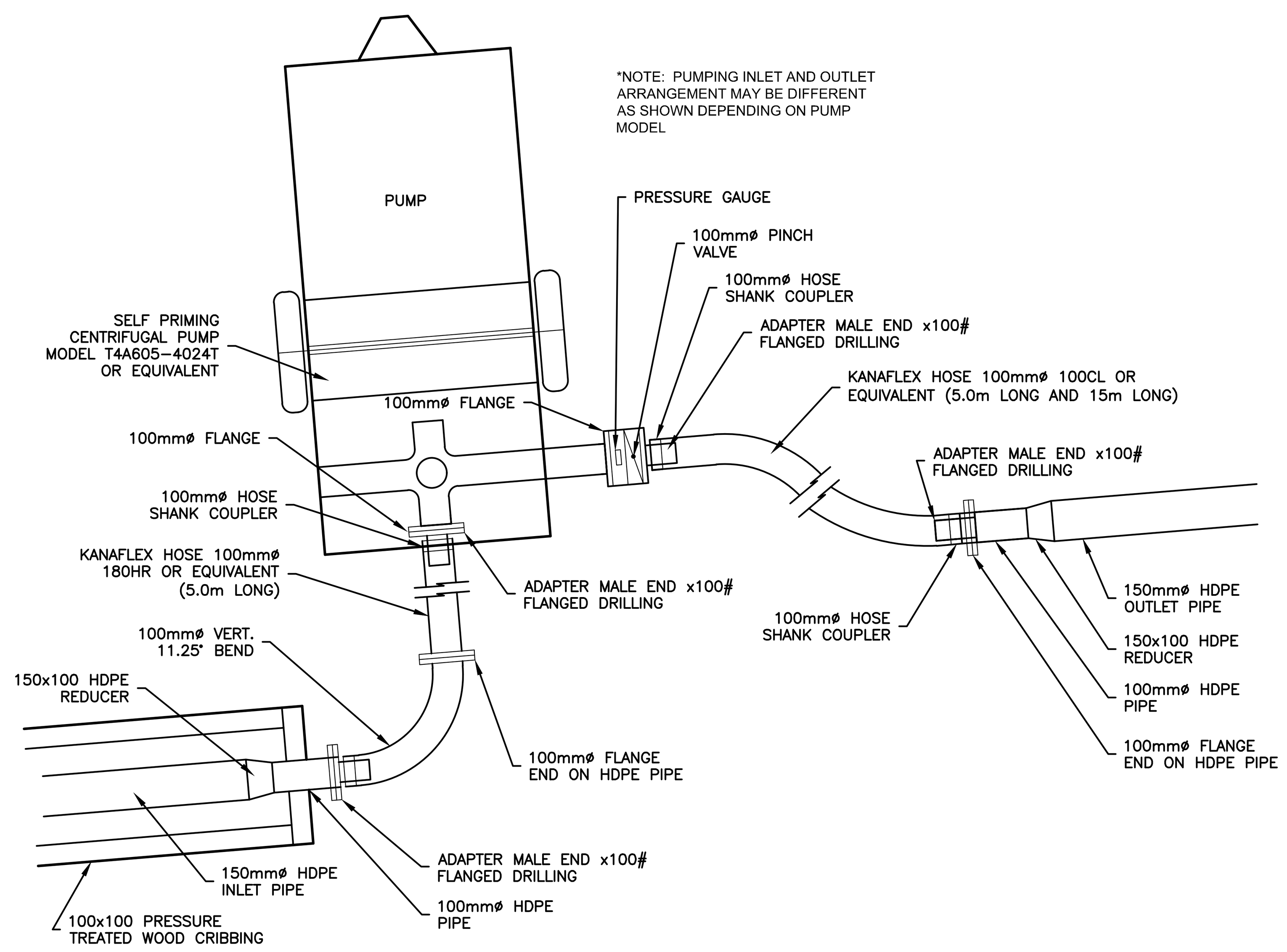
BASEPLAN	exp.
DESIGN	IPC
CHECKED	SLB
CAD	IPC
PROJ. MAN	SLB
APPROVED	SLB

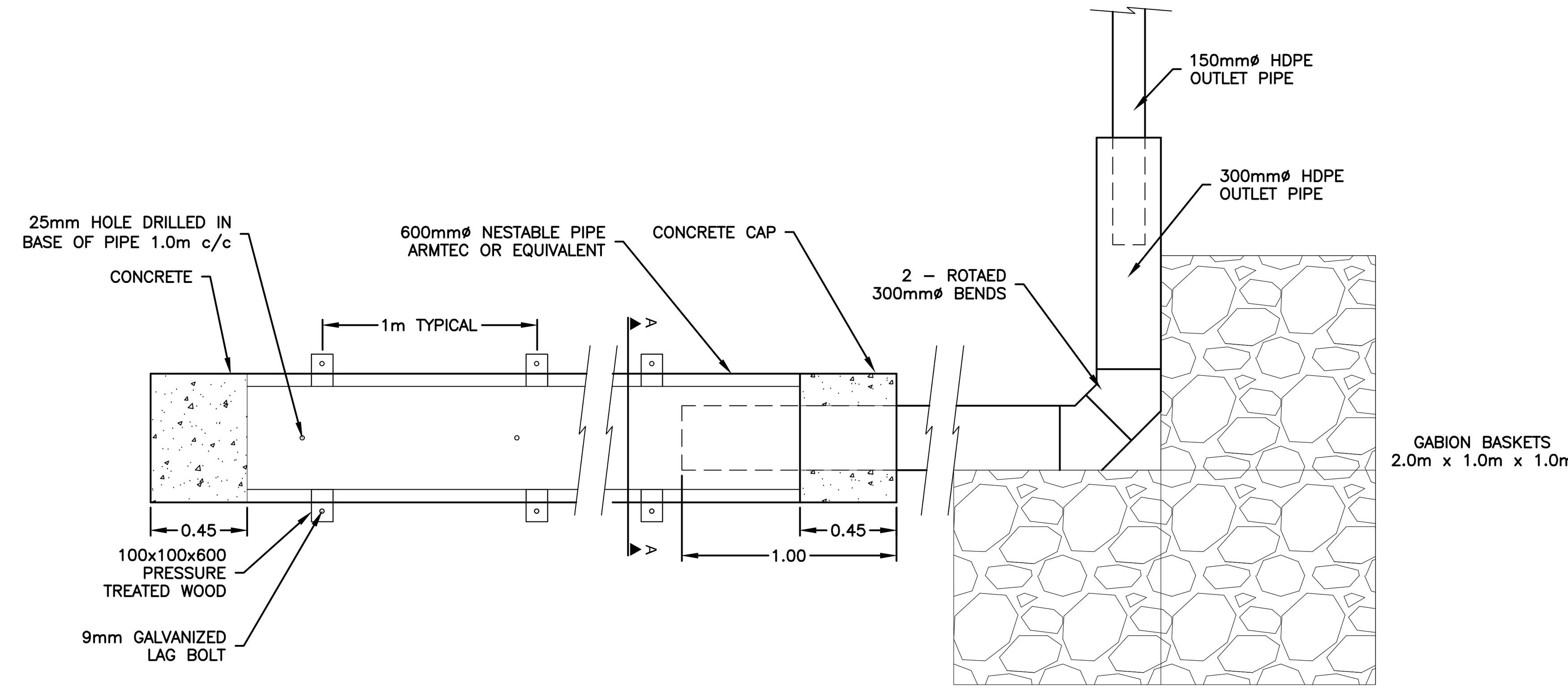
PROJECT: WASTEWATER TREATMENT FACILITY IGLOOLIK, NUNAVUT

TITLE: NEW LAGOON CELLS 'B' & 'C' PHASE II & PHASE III

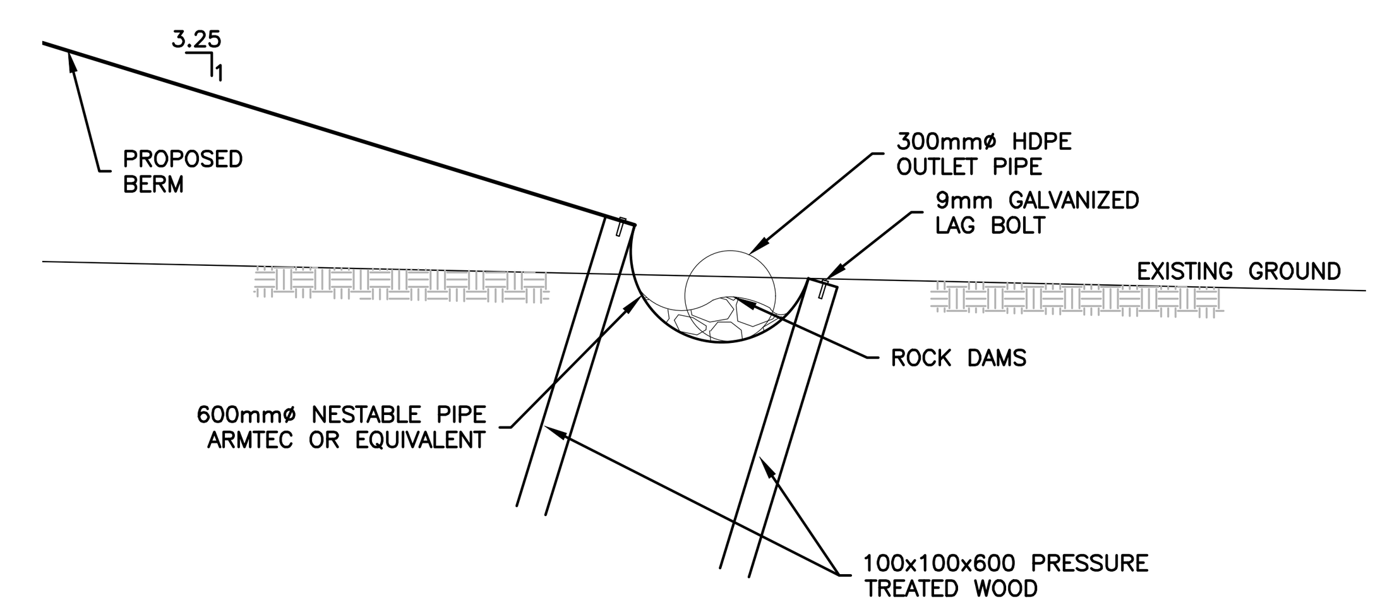
PROJ NO.	OTCD00019838A
SURVEY	exp.
DATE	NOV. 2014
DRAWING NO.	IGL–4



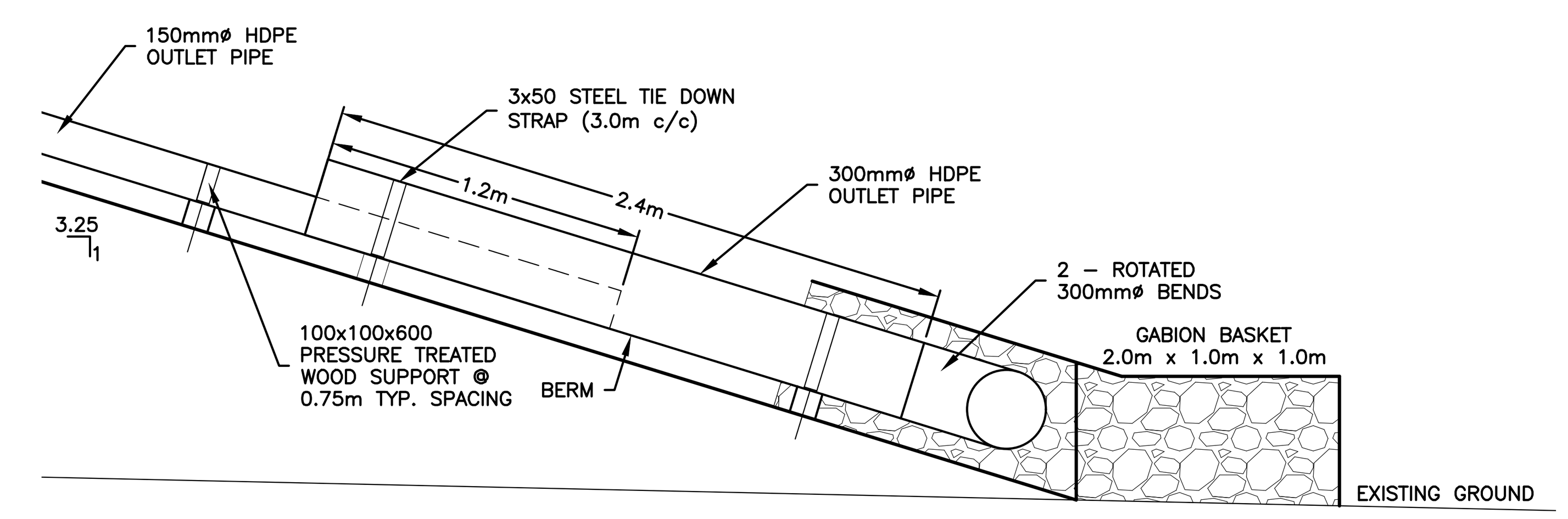
LAGOON DEWATERING PUMP INFRASTRUCTURE PLAN VIEW
1:25



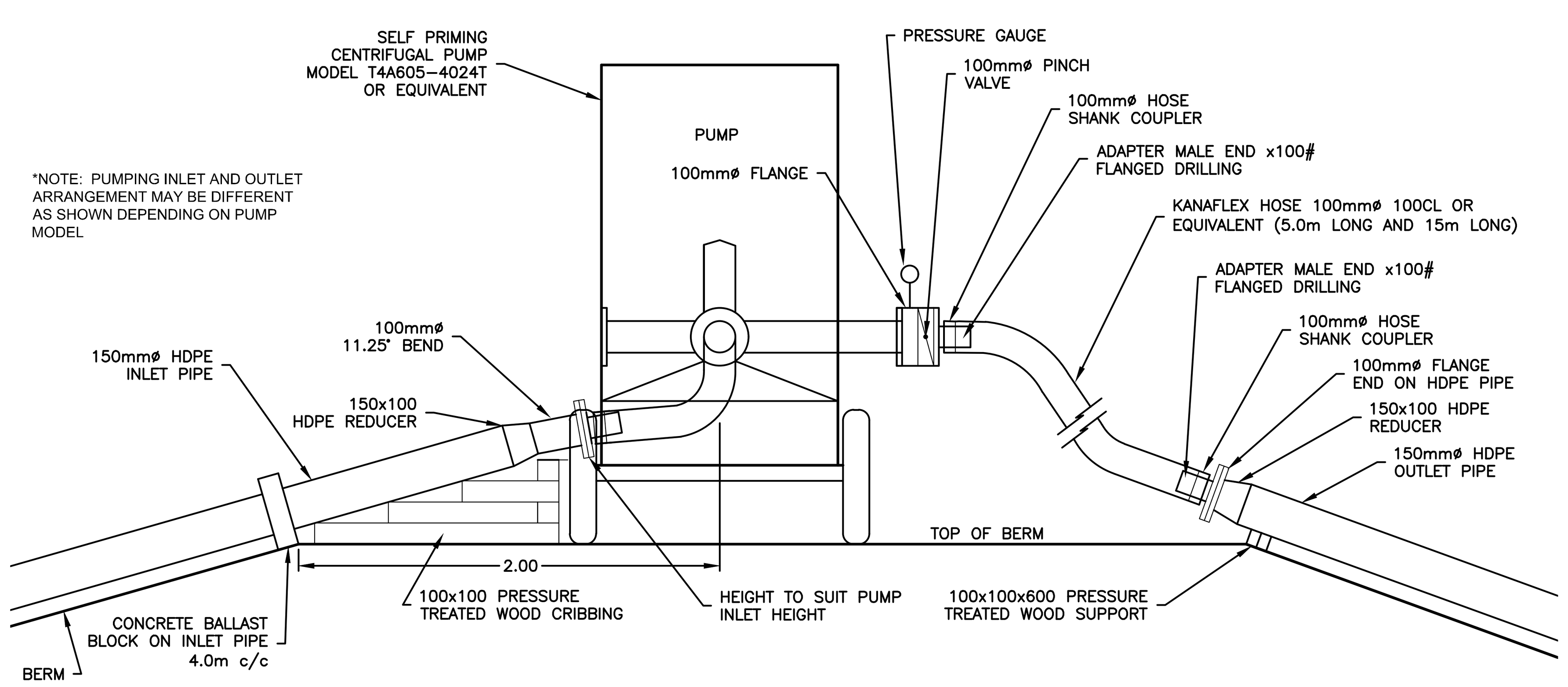
LAGOON DEWATERING OUTLET PLAN VIEW
1:25



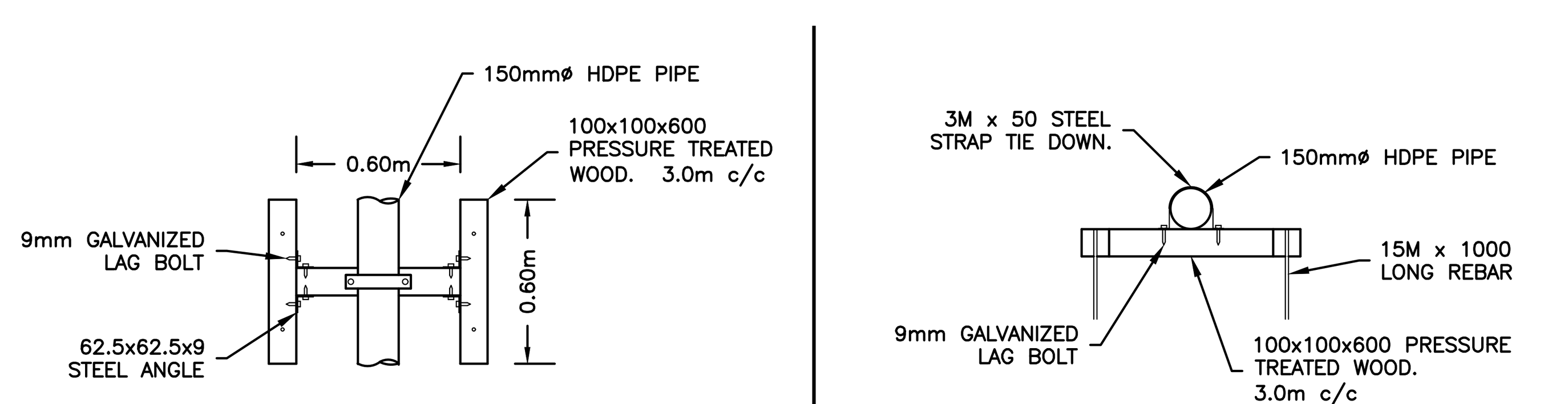
NESTABLE PIPE DETAIL SECTION A–A
1:25



LAGOON DEWATERING OUTLET INFRASTRUCTURE SECTION VIEW
1:25

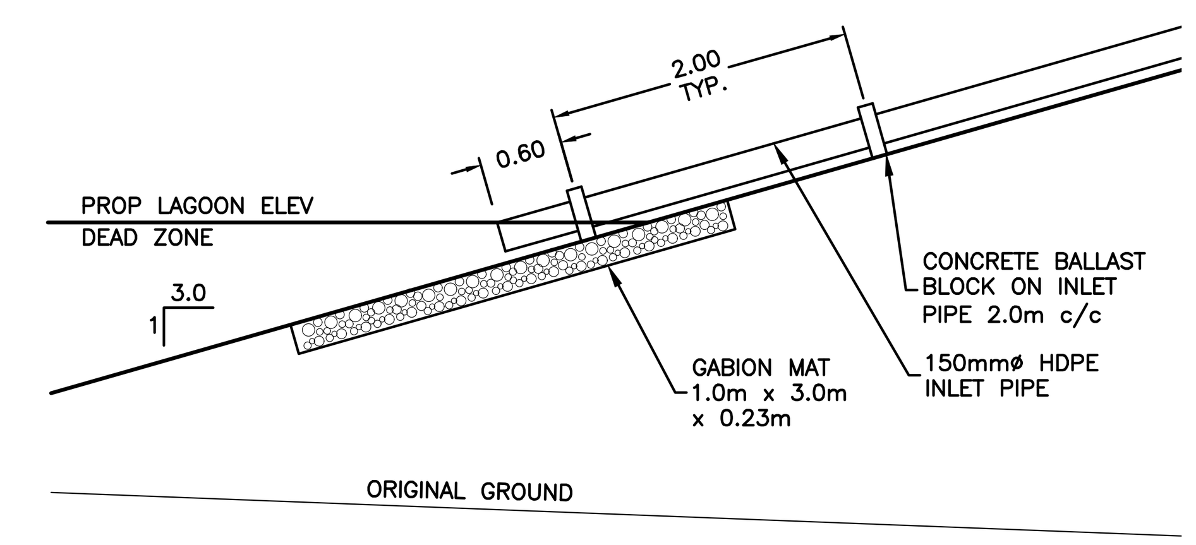


LAGOON DEWATERING PUMP INFRASTRUCTURE
1:25

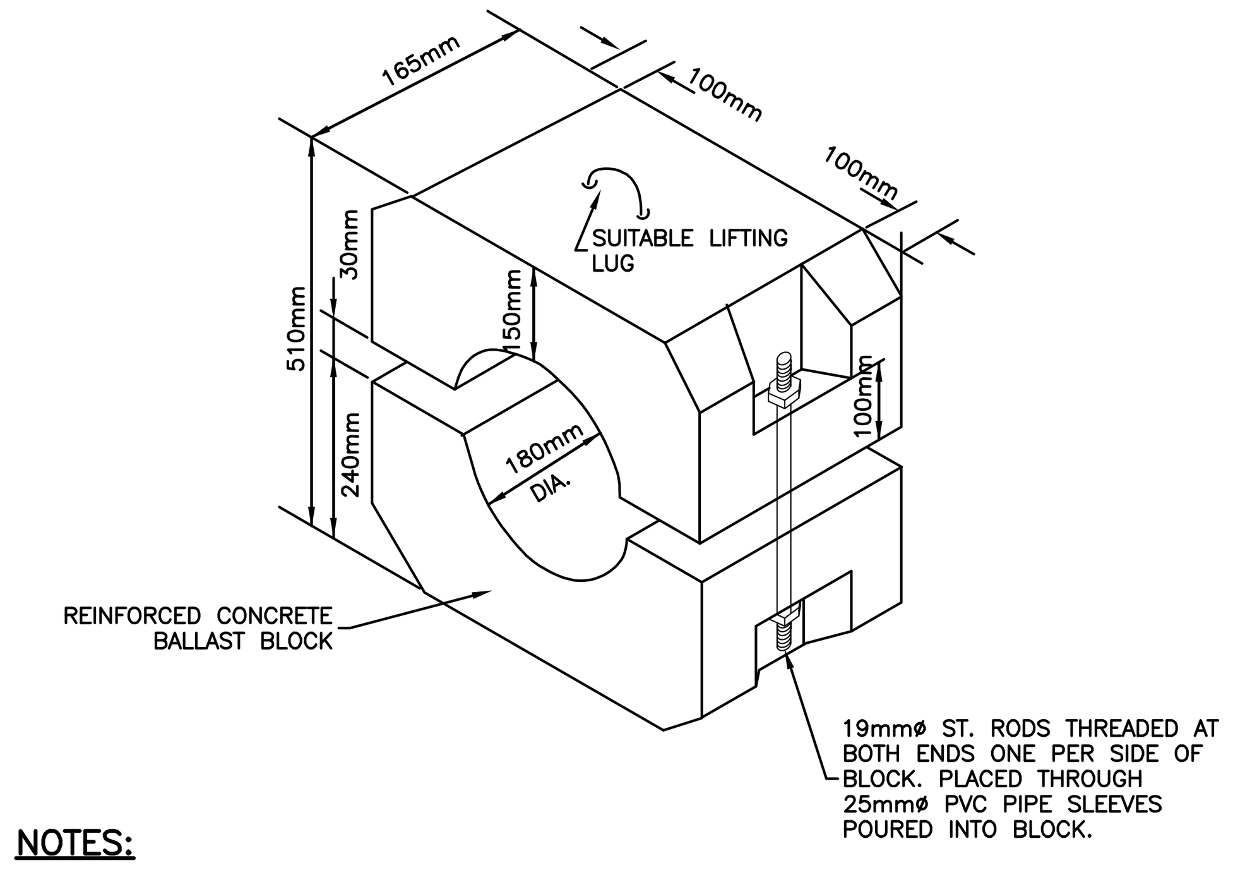


OUTLET PIPE SUPPORT
1:25

	CELL A	CELL B AND C
TOP OF BERM	27.80	27.10
FREEBOARD	1m FROM TOP OF BERM	1m FROM TOP OF BERM
ACTIVE ZONE	VARIES	VARIES
DEAD ZONE	1m FROM BOTTOM OF LAGOON	1m FROM BOTTOM OF LAGOON
BOTTOM OF LAGOON	VARIES	VARIES



LAGOON DEWATERING INLET
1:50



NOTES:

1. CONTRACTOR TO SUBMIT 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
N.T.S

NOTES

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DATE: SEPTEMBER 25, 2018

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2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
1	ISSUED FOR REVIEW	13/03/12	SAB	SLB

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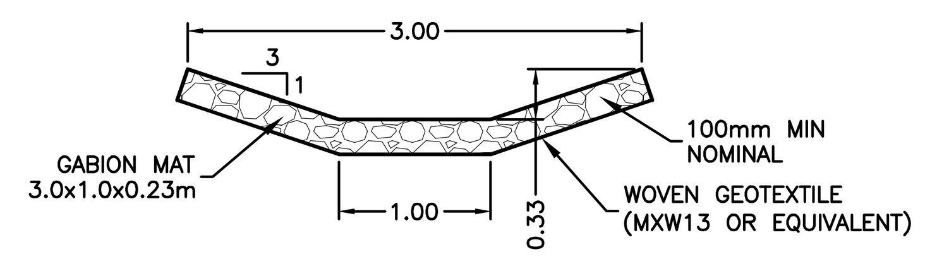
BASEPLAN: exp.
DESIGN: IPC
CHECKED: SLB
CAD: IPC
PROJ. MAN: SLB
APPROVED: SLB

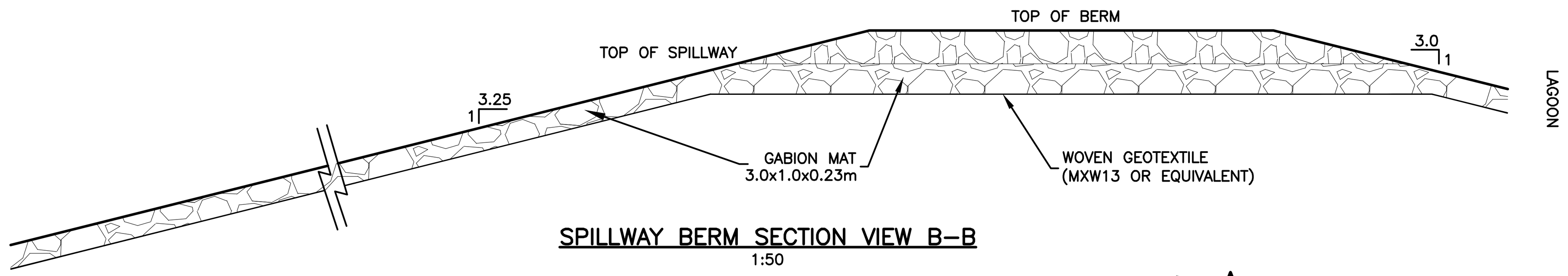
PROJECT
WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

TITLE
DETAIL PLAN
PUMPING AND DEWATERING DETAILS

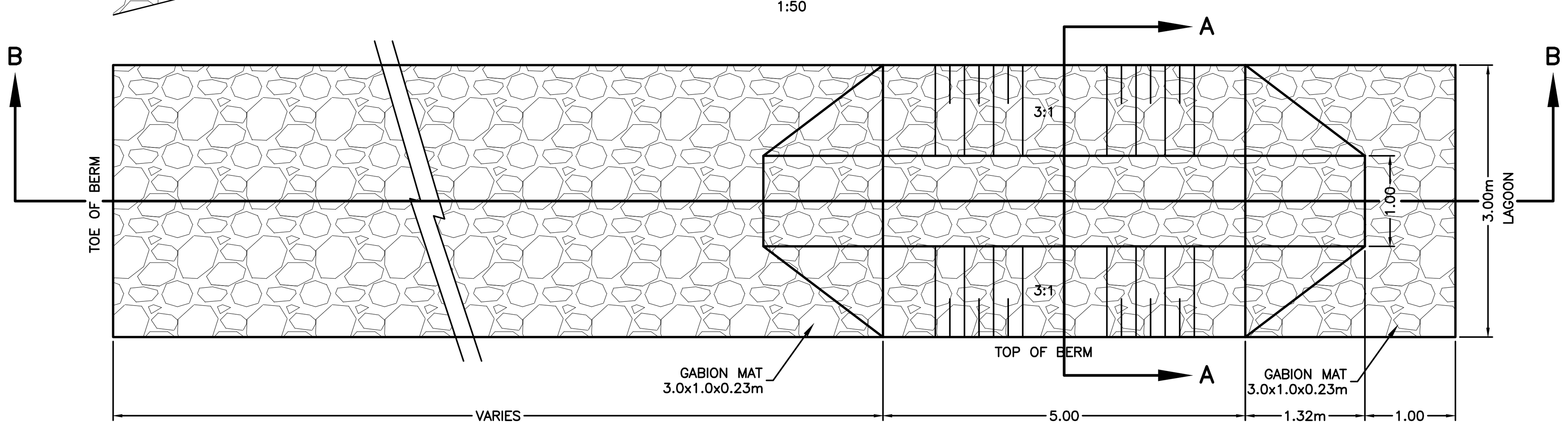
PROJ. NO.: OTCD00019838A
SURVEY: exp.
DATE: NOV. 2014
DRAWING NO.: IGL–5



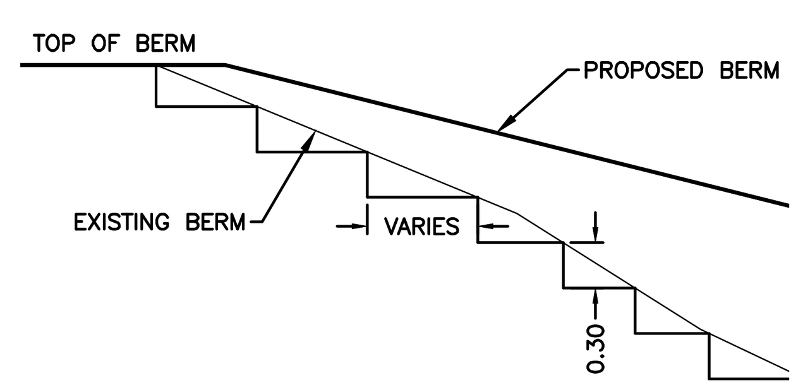
SPILLWAY DETAIL SECTION VIEW A-A
1:50



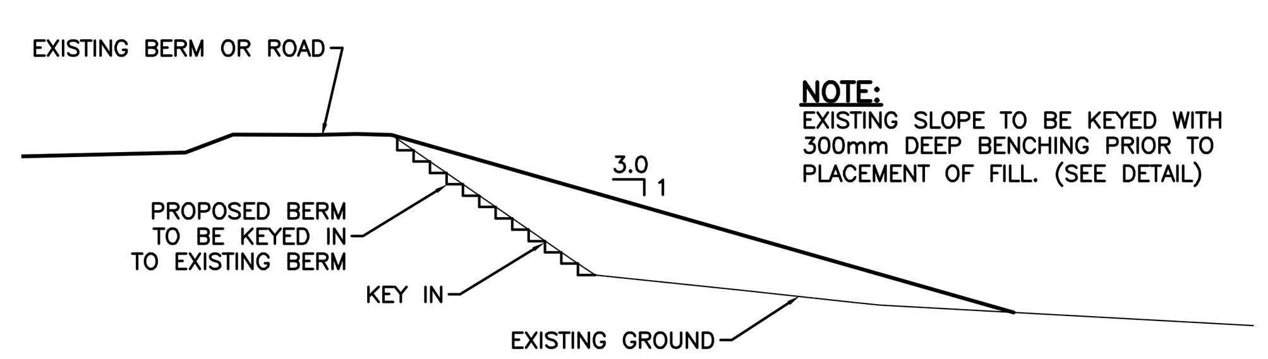
SPILLWAY BERM SECTION VIEW B-B
1:50



SPILLWAY BERM PLAN VIEW
1:50

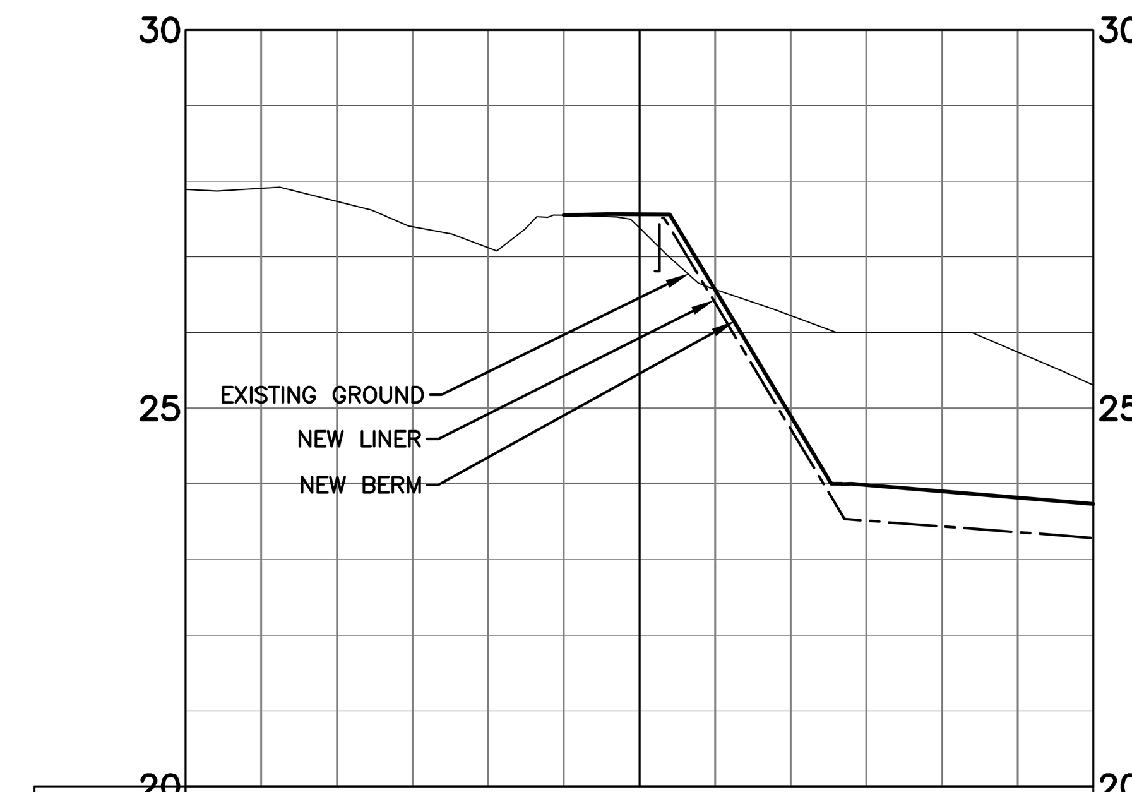


KEY IN DETAIL
1:50



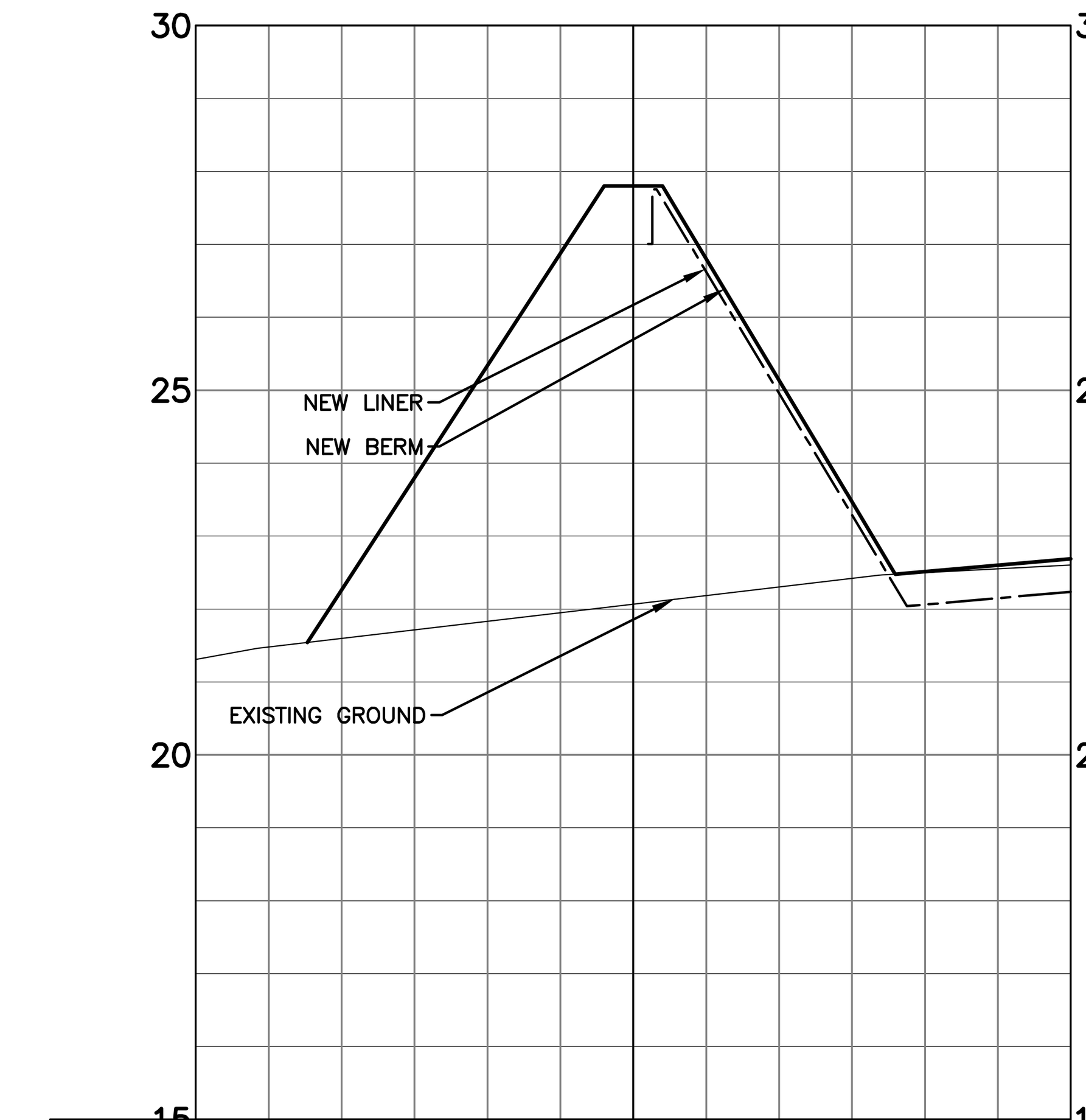
NOTE:
EXISTING SLOPE TO BE KEYED WITH 300mm DEEP BENCHING PRIOR TO PLACEMENT OF FILL. (SEE DETAIL)

EXISTING BERM REHABILITATION DETAIL
1:200



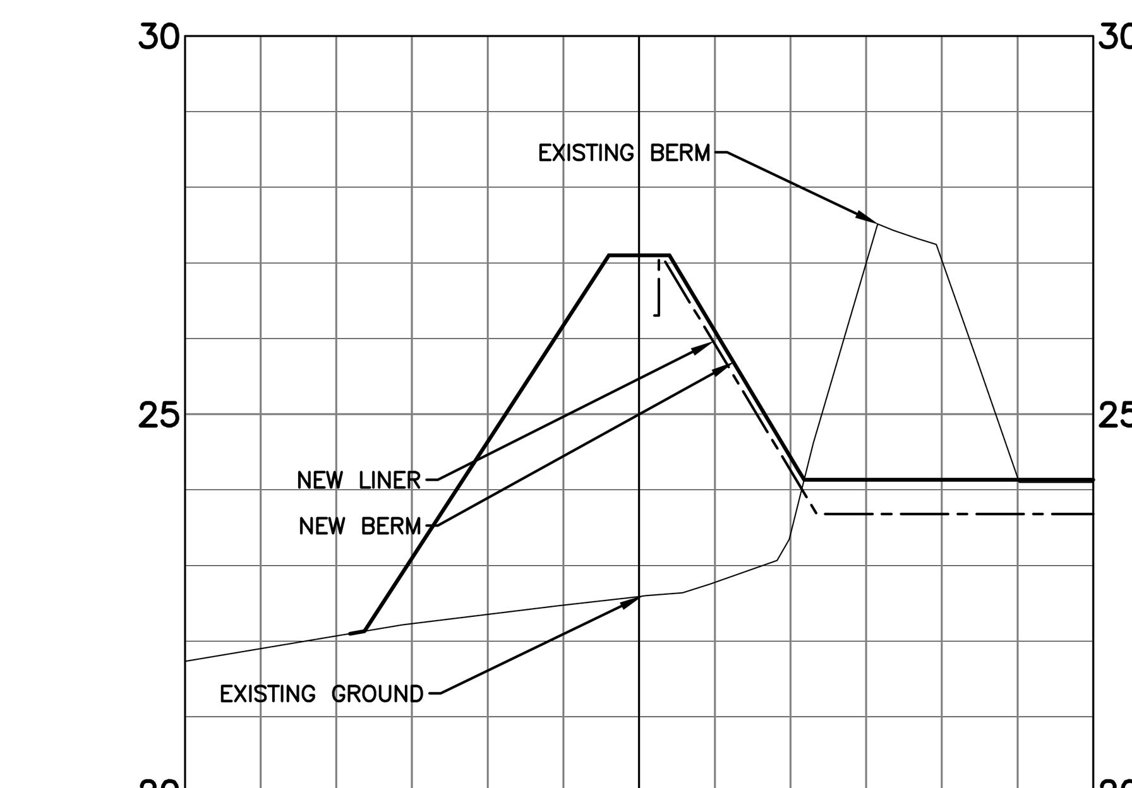
OFFSET	-25	-20	-15	-10	-5	0.00	5	10	15	20	25
PROPOSED ELEVATION					27.56	27.56	26.56	24.90	23.98	23.90	23.82
EXISTING ELEVATION	27.91	27.73	27.40	27.12	27.55	27.38	26.57	26.22	26.00	26.00	25.74

SECTION A (DWG NO. IGL-4 AND IGL-5)
1:500 HORIZ
1:100 VERT



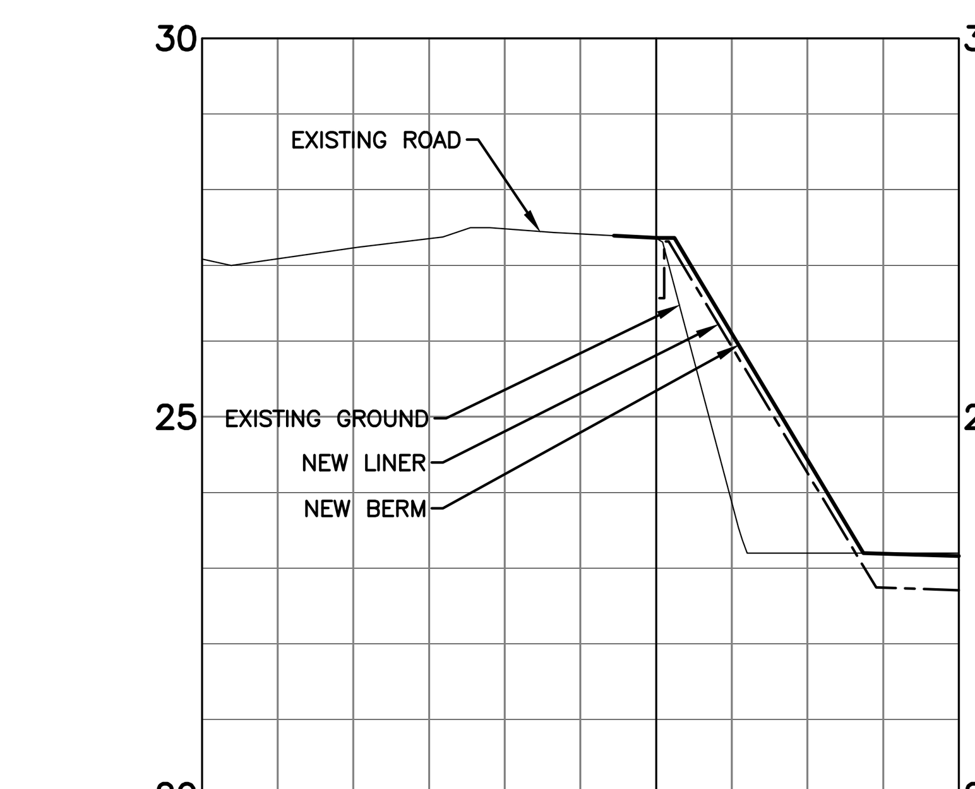
OFFSET	-25	-20	-15	-10	-5	0.00	5	10	15	20	25
PROPOSED ELEVATION		22.26	23.80	25.34	26.88	27.80	26.80	25.13	23.47	22.51	22.60
EXISTING ELEVATION	21.48	21.60	21.71	21.83	21.95	22.07	22.19	22.30	22.42	22.50	22.55

SECTION B (DWG NO. IGL-4 AND IGL-5)
1:500 HORIZ
1:100 VERT



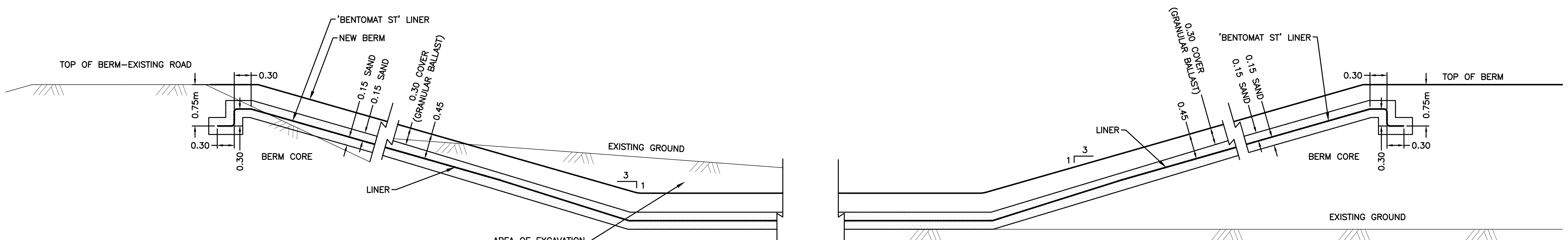
OFFSET	-25	-20	-15	-10	-5	0.00	5	10	15	20	25
PROPOSED ELEVATION		22.07	23.01	24.16	26.06	27.10	26.10	24.43			
EXISTING ELEVATION	21.90	22.07	22.23	22.35	22.47	22.59	22.78	23.41	27.00	27.03	24.17

SECTION C (DWG NO. IGL-4 AND IGL-5)
1:500 HORIZ
1:100 VERT



OFFSET	-25	-20	-15	-10	-5	0.00	5	10	15
PROPOSED ELEVATION					27.10	27.10	26.10	24.43	23.19
EXISTING ELEVATION	27.09	27.23	27.35	27.48	27.42	27.36	23.87	23.20	23.20

SECTION D (DWG NO. IGL-5)
1:500 HORIZ
1:100 VERT



LINER DETAIL
1:50

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DATE: SEPTEMBER 25, 2018

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3	ISSUED FOR 90% REVIEW	19/01/15	IPC	SLB
2	ISSUED FOR 75% REVIEW	21/11/14	IPC	SLB
1	ISSUED FOR REVIEW	13/03/12	SAB	SLB

SCALE

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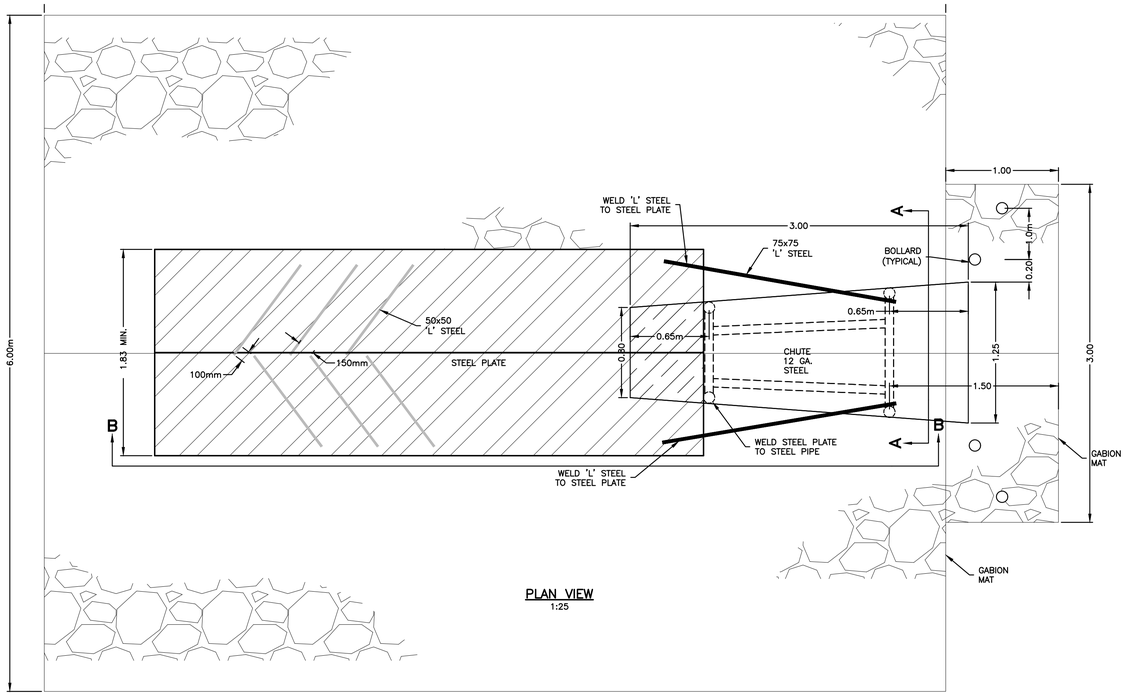
BASEPLAN	exp.
DESIGN	IPC
CHECKED	SLB
CAD	IPC
PROJ. MAN	SLB
APPROVED	SLB

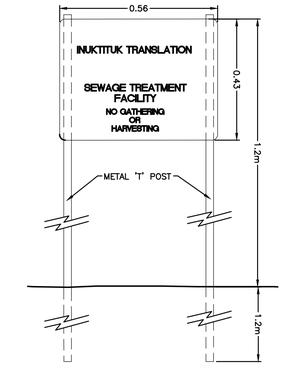
PROJECT
WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

TITLE
DETAIL PLAN
LINER AND SPILLWAY DETAILS AND CROSS SECTIONS

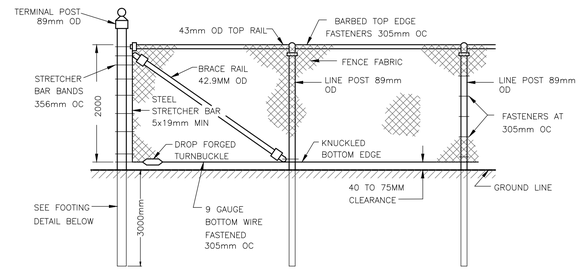
PROJ. NO. OTCD00019838A
SURVEY exp.
DATE NOV. 2014
DRAWING NO. IGL-6



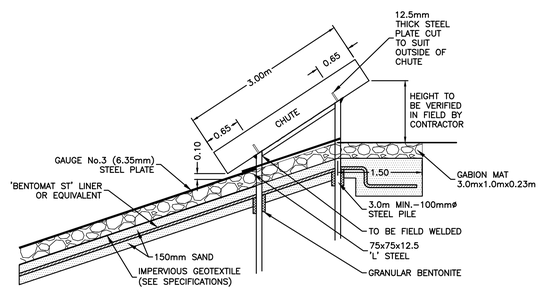
PLAN VIEW
1:25



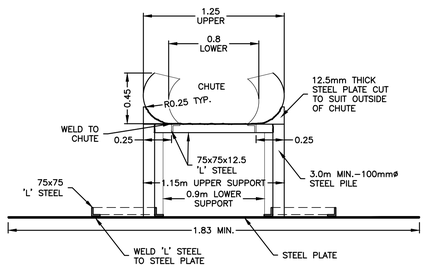
SIGN DETAIL
SCALE 1:10



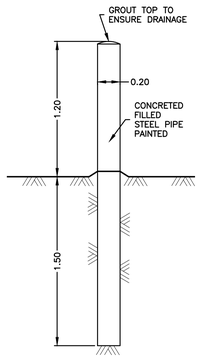
CHAIN LINK FENCE WITH TOP RAIL
N.T.S.



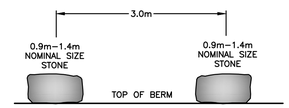
TRUCK DISCHARGE CHUTE SECTION B–B VIEW
1:50



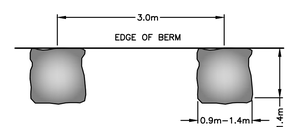
TRUCK DISCHARGE CHUTE SECTION A–A VIEW
1:25



BOLLARD DETAIL
1:25



STONE BARRIER DETAIL SECTION VIEW
N.T.S.



STONE BARRIER DETAIL PLAN VIEW
N.T.S.

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1	ISSUED FOR REVIEW	13/03/12	SAB	SLB

SCALE

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BASEPLAN: exp.
DESIGN: IPC
CHECKED: SLB
CAD: IPC
PROJ. MAN: SLB
APPROVED: SLB

PROJECT
WASTEWATER TREATMENT FACILITY
IGLOOLIK, NUNAVUT

PROJ. NO.: OTCD00019838A
SURVEY: exp.
DATE: NOV. 2014

TITLE
DETAIL PLAN
TRUCK DISCHARGE AND MISC. DETAILS

DRAWING NO.: IGL–7

Plot Table: ---
References: Details.dwg, 04-05 - NEW LAGOON.xab,dwg