Water Supply Facility
Operation and Maintenance (O&M) Plan
Hamlet of Arviat

Prepared by

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May 2009
Revised May 2010

File No: N-O 15746

Water Supply Facility
Operation and Maintenance (O&M) Plan
Hamlet of Arviat

May 2009
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Executive Summary

The Hamlet of Arviat obtains its water supply from Wolf River, which is stored in reservoirs close to the Hamlet. Delivery is via water trucks using a truck-fill station at the reservoirs.

The facility operates under NWB License NWB3ARV03018, which expired in December 2008. Application for a new Type "A" license is in progress.

A Water Supply Facility O&M Plan dated May 2009 was prepared by Nuna Burnside, as required by the original license and submitted in support of the application for a new license.

As noted in the May 2009 O&M Plan, as per the NWB license, the Plan is to be reviewed and updated annually. This May 2010 update of the Plan also addresses comments provided by review agencies during the Type A license application process, in particular the Compilation of Issues from the Technical Meeting/Pre-Hearing Conference conducted in March 2010.

The Compilation of Issues included:

- Drawdown of Wolf River
- Water Intake – DFO fish screen
- Data collection and reporting.

As-built drawings for the water intake have not been located to date and may have to be recreated to comply with license requirements.

Some of these items will require conducting seasonal studies and perhaps engineering to fully address. This O&M Plan outlines the studies and efforts required to meet the requirements of review agencies.

Table of Contents

Figures

Appendices

Water Supply Facility
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May 2009
Revised May 2010

1.0 Introduction

1.1 Purpose

The purpose of the Operation and Maintenance (O&M) Plan is to provide guidance for Water Supply Facility Operations, with regard to meeting the requirements of the Water License. This O&M Plan does not include the requirements or detailed guidance of the handling and treatment of water for domestic consumption. The NWB Water License is for water withdrawal and impacts to the environment. This O&M Plan focuses on withdrawal of water from the environment without causing a significant impact, and how the potential for environmental impact is monitored annually.

1.2 Hamlet Description

The Hamlet of Arviat is located within the Kivalliq Region, Nunavut, at general latitude 61°6'N and general longitude 94°3'W. The Community is located approximately 225 km south of Rankin Inlet and 265 km north of Churchill, Manitoba (Figure 1).

The community is situated on the northern shore of a peninsula that extends easterly into Hudson Bay. The topography surrounding the Hamlet of Arviat is relatively flat with a sight rise when moving inland away from Hudson Bay. Local bedrock is generally overlain by glacial fluvial sediments. Arviat is located in the physiographic region of the Hudson Bay lowlands, characterized by low topographic relief, occasional bedrock outcrops and glacial and glacio-fluvial overburden sediments. Boulder fields and eskers are common. Approximately 20 to 30 percent of the land is shallow ponds with depths of 1 m or less. Land between the ponds is marshy, vegetated by grasses and sedges.

The community has a population of approximately 2060 (2006), with an approximate 1.4 percent projected growth rate over the 20-year design period. Community infrastructure includes:

- A Water Supply Facility consisting of a water intake pumphouse on Wolf River, two water reservoirs, treatment system and truckfill water station
- A Sewage Treatment Facility consisting of a sewage lagoon which receives trucked sewage collected from holding tanks in each building and sewage treatment via an exfiltration lagoon to a wetland discharging to the ocean
- A Solid Waste Management Facility and Bulky Metals Disposal area
- Diesel powered generators.

A layout of the entire community and infrastructure is displayed on Figure 2.

1.3 Nunavut Water Board License

The Hamlet of Arviat operates their municipal water, sewage, and solid waste facilities under the Nunavut Water Board (NWB) License NWB3ARV0308 (Appendix A). The licence dated January 9, 2004, expired on December 31, 2008. Part G, Section 1 requires that an Operation and Maintenance (O&M) Plan be submitted for the facilities in accordance with applicable regulations and guidelines. The Hamlet is currently in the process of renewing the licence. This O&M Plan may need to be updated when the NWB license is renewed.

The O&M Plan of the Water Supply Facility will be used in conjunction with the normal operating procedures. This document provides a list of tasks and procedures that will assist the Hamlet's operations staff in the O&M of the facility.

1.4 Climate

The closest climate station to Arviat is the Rankin Inlet Airport Weather Station. The Rankin Inlet area receives an average of 18.1 cm of rainfall and 107 cm of snowfall per annum. Mean annual precipitation totals 29.7 cm per annum. July mean high and low temperatures are 14.9^{o}C and 5.9^{o}C, respectively. January mean high and low temperatures are -28.3^{o}C and -35.5^{o}C, respectively. Winds are generally north-west, and average 23 km/h (Rankin Inlet Weather Station, Climate Normals 1991-2000, Environment Canada, 2008). Climate data is included in Appendix B.

1.5 Wolf River Water Supply

The Hamlet of Arviat obtains its water from Wolf River located 8.0 km southwest of the Hamlet. The drainage basin of Wolf River is estimated to be 650,000,000 m^2 (IEG Environmental and Komex, 2005). A copy of the report is included in Appendix H.

Using an annual precipitation rate of 297 mm and an annual evapotranspiration rate of 200 mm, the net recharge to the catchment area is approximately 63,180,000 m^3 per year (calculation details are included in Appendix C).

1.6 Water Use Volumes

Using population numbers from Census Reports between the years 1981 and 2006 and average provincial growth rate projections from Statistics Canada (Statistics Canada, 2000), a growth rate of 1.4 percent was determined. Table 1 shows the projected population of the Hamlet for the next 20 years.

Table 1: Arviat Population Projections

Year	Projected Population
2006	2060
2007	2089
2008	2119
2009	2149
2010	2180
2011	2211
2012	2242
2013	2274
2014	2306
2015	2339
2016	2372
2017	2406
2018	2440
2019	2475
2020	2510
2021	2546
2022	2582
2023	2619
2024	2656
2025	2694
2026	2732
2027	2771
2028	2810
2029	2850

The Municipal and Community Affairs (MACA) planning guidelines suggest that the increase in the projected per capita water use in a community of less than 2000 people should calculated using the following formulae. Although Arviat has a population greater than 2000, they are still on a truck distribution system and therefore this formula has been used.

RWU x (1.0 + (0.00023 x Population)

The RWU is the residential water use rate per capita. In the MACA guidelines it is assumed to be 90 L per capita. To fit the recorded water usage rates for the Hamlet, the RWU residential water use was modified to be 65 L per capita (Lpcd). This is a lower RWU than most communities however it has been confirmed that Arviat has a lower water use rate per capita than other communities. The same RWU was used in the Potable Water Supply Study completed by IEG in 2005. The factor 0.00023 x population represents the commercial and industrial water use.

This equation was used to produce projected water use requirements for the next 10 years (Table 2 and Figure B). Calculations are included in Appendix B.

Table 2: Projected Water Use Requirements

Year	Projected Population	Projected Daily Consumption m^3	Projected Annual Consumption m^3
2006	2060	197	72,030
2007	2089	201	73,374
2008	2119	205	74,775
2009	2149	209	76,185
2010	2180	213	77,653
2011	2211	217	79,131
2012	2242	221	80,620
2013	2274	225	82,168
2014	2306	229	83,727
2015	2339	234	85,346
2016	2372	238	86,977
2017	2406	243	88,671
2018	2440	248	90,376

1.7 Health and Safety

Health and safety of workers and the public is the first priority while operating the Water Supply Facility. The requirements of the Nunavut Safety Act must be followed at all times. All actions and operations must be undertaken with safety as the first priority.

Template forms to assist staff in operating the facility, planning and costing the short term and long term use of the facility are included in Appendix D.

1.8 Training

Staff training is an important aspect of the operation of a Water Supply Facility. Staff must be adequately trained to follow this O&M Plan and operate the facility. This O&M Plan is dependent on sufficient site specific training to allow staff to operate the facility.

1.9 Land Use Planning

The Wolf River drainage basin should be recognized in community land use plans and zoning. The drainage basin should be classified as a sensitive area where land uses must

be restricted to prevent impacts to the lake water supply. A 400 metre setback around the water reservoirs is identified in the Arviat Community Plan, Schedule 2 – Land Use Map. The area is designated as protective development.

1.10 Impact on Wolf River

The estimated withdrawal rate of approximately 92,145 m^3/year by year 2019 is less than 1 percent of the estimated river catchment recharge rate of approximately 63,180,000 m^3 year. Therefore the withdrawal of water from the river for Hamlet usage is unlikely to cause a significant impact on the river flows, however detailed studies have not been completed to date. A detailed study including an assessment, during the period of pumping in the late summer, is required to determine the potential for long term impacts (to the environment and fish habitat), as well as determining the sustainability of supply.

2.0 Operation and Maintenance for Environmental Protection

2.1 Overview

The Hamlet of Arviat provides trucked water services for the Community's residents, businesses, and institutions. The community obtains its potable water from Wolf River, located approximately 8.0 km southwest of the community (Figure 2). The water supply system consists of a pumphouse, a water intake line, two lined water reservoirs and a truck fill station (Figure 3). Photographs of the facility taken in October 2008 are included in Appendix E.

2.2 Water Supply Facility Design

The raw water source is Wolf River. The NWB Water Licence contained in Appendix A, identifies the maximum water withdrawal rate from Wolf River.

A pump house is located beside Wolf River 7 to 8 km south of the Hamlet. An intake line pumps from pooled area along creek at a depth of approximately 4 metres. Portable diesel power pumps housed in the pump house are used to pump the water from the river to an 8" HDPE pipe which transports the water 8 km over the tundra to Arviat's water reservoirs. As-built drawings have not been found to date and may have to be recreated to comply with licensing requirements.

Tender documents from the 1991 design by the Government of the NWT are included in Appendix J.

Two water reservoirs are used to store water for the Hamlet. Water is pumped to the reservoirs in the summer and provides water for the Hamlet for the entire year. The water reservoirs have a combined storage capacity of 143,000,000 Litres. Cell 1 has a capacity of 87,000 m^3 and cell two is 56,000 m^3 (IEG, 2005). The reservoirs are lined with impermeable HDPE membranes. A fence protects the reservoirs from outsiders.

A truck fill station is located beside the water reservoirs. An overhead truckfill arm is used to supply the water to the water trucks. The truckfill arm has a flexible downspout, with thaw capability controlled by a manually activated heat trace. Water for the hypochlorite-mixing tank is supplied from the discharge line. The hypochlorite feed pump is controlled by the flow rate of water supplied to the water trucks. Chlorine is injected into water as water is filled into the water trucks. The chlorine is supplied to the main line by a tube and chlorine injector. The estimated chlorine residual at the point of domestic supply is 0.2 mg/L for the typical truck delivery system.

Water supply filtration upgrades were designed by Dillon Consulting in 2008. A copy is included in Appendix I. The upgrades do no significantly change the NWB License related aspects of the facility. General operations remain the same.

2.3 Water Supply Facility Operational Procedures

The following water distribution operational procedures shall be carried out by the Hamlet of Arviat on a daily basis (weather dependent):

- Residential, institutional, and commercial water storage tanks shall be filled from Hamlet-operated water delivery vehicles, with water obtained from the Hamlet Water Reservoirs

- Daily water usage volumes obtained from the Hamlet Water Supply Facility, as well as trip counts shall be recorded on the recording form attached in Appendix D

- In the event of an accident, a spill of petroleum products or a fire during water distribution operations, *the Hamlet of Arviat Environmental Emergency Response Plan* (separate document) shall be implemented.

2.4 Water Supply Facility Truckfill Station General Operational Procedures

The following general operational procedures are to be carried out by the Hamlet of Arviat during water treatment and truckfill operations at the Hamlet Water Supply Facility:

- Untreated water from the reservoirs shall be transferred by submersible pump to the water distribution vehicles through the truckfill station, at a rate of approximately 1,000 L/min (minimum recommended for fire protection)

- The monitoring level of treatment shall be primary and secondary disinfection, through the addition of sodium hypochlorite

- The chlorine feed system shall be inspected daily

- Water being transferred to the distribution vehicles shall be dosed with sodium hypochlorite at a rate sufficient that a free chlorine residual of 0.2 mg/L, after thorough mixing and 20 minutes of contact time is maintained, in accordance with the Public Health Act (1992) and associated Regulations

- Chlorine residuals shall be monitored daily, or as directed by a Public Health Inspector (as defined by the Public Health Act (1992))

- Facility generators and associated fuel storage shall be monitored daily.

These general operational procedures are for guidance and are not to be considered as the legal requirements to operate the facility, to treat, and supply drinking water for human consumption. The training, procedures, and guidelines for operating the system and complying with the regulations for provision of drinking water are provided elsewhere.

2.5 Periodic and Seasonal Maintenance Procedures

The following general procedures shall be undertaken by the staff of the Hamlet of Arviat during periodic and seasonal maintenance operations at the Water Supply Facility:

- The roadway and truck pad shall be maintained by snow clearing in the winter and grading in the summer, and repaired as necessary

- Ditches and drainage channels at the Water Supply Facility shall be inspected during the summer for erosion and repaired as necessary

- Site warning signage, which identifies the boundaries of the Water Supply Facility shall be inspected weekly, and repaired or replaced as necessary

- The truck fill station at the Water Supply Facility shall be inspected for damage or displacement weekly, and repaired as necessary

- Any airborne litter shall be removed from the Water Supply Facility to the Hamlet landfill weekly, or as required

- The berms at the Water Supply Facility reservoirs shall be inspected during the summer for erosion and settlement weekly, and repaired as necessary

- No motorized vehicles should be operated in the river or on the ice of the lake due to risk of fuel spills

- If the river is used for fishing, no motorized augers shall be used and there should be no materials that could contaminate the water brought onto the ice of the river.

Forms to assist site staff in conducting the inspections and data recording are included in Appendix D.

The activities described above shall be completed by the staff of the Hamlet and details of any repairs shall be reported in the Annual Report submitted to the Nunavut Water Board, in compliance with the Hamlet's Water License.

2.6 Water Intake System Monitoring Procedures

All water sampling completed by the Hamlet of Arviat shall be in accordance with the *Hamlet of Arviat Environmental Monitoring Program and Quality Assurance/Quality Control (QA/QC) Plan* (separate document).

Daily monitoring of residual chlorine levels shall be undertaken, to facilitate and confirm the maintenance of a free chlorine residual in treated water in accordance with the *Public Health Act* (1992) and associated Regulations.

2.6.1 Water License Requirements

As outlined in the NWB water license, regular monitoring of the quantities of water obtained from the Water Supply Facility is required.

As part of the general conditions, the licence requires that monthly and annual quantities in cubic metres of fresh water obtained be recorded and reported in the Annual Reports. It also requires that meters, devices or other such methods to record the volume of water used be installed, operated and maintained by the Licensee. The Licensee must maintain the Facilities to the satisfaction of the Inspector.

A Surveillance Station will be established at the raw water supply before treatment (ARV-1), as shown on Figure 4. Monthly and annual quantities of raw water pumped will be measured and recorded in the official operations logbook on a form similar to that presented in Appendix D.

3.0 Emergency Response and Contingencies

In the event of an emergency, guidance regarding containment and site emergency response can be obtained from the following sources (Table 1):

Table 1: Emergency Contacts

Contact	Location	Telephone Number	Fax Number
INAC – Water/Wastewater Resources Manager	Iqaluit	(867) 975-4550	(867) 979-6445
Hamlet of Arviat – SAO	Arviat	(867) 857-2841	(867) 857-2591
Government of Nunavut (Regional Engineer)	Rankin Inlet	(867) 645-8156	(867) 645-8196
Environment Canada – Inspector	Iqaluit	(867) 975-4644	(867) 975-4594
Fire Department	Arviat	(867) 867-2525	-
RCMP Detachment	Arviat	(867) 867-1111	-
Community Health Center	Arviat	(867) 867-3100	-

Contingency plans are designed to provide site staff with direction and options when there is an unexpected event or accident.

The Environmental Emergency Contingency Plan, Hamlet of Arviat (prepared as a separate document) provides procedures and direction in the case of a spill or environmental emergency.

In the event of a contaminant being released into the river or reservoirs, the operator would be required to contact the Nunavut Spill Hot-line and the regional Environmental Health Officer of Health Canada. The operator would based on consultation with these offices determine the required course of action to be taken.

As outlined in the Environmental Emergency Contingency Plan, the health and safety of workers and the public are the first priority.

4.0 Reporting

The Nunavut Water Board License in Part B: General Conditions include the requirement to file an Annual Report with the NWB no later than March 31st of each calendar year. The report shall include:

- Tabular summaries of all data generated under the "Monitoring Program"
- The monthly and annual quantities in cubic metres of freshwater obtained from all sources
- The monthly and annual quantities in cubic metres of each and all waste discharged
- A summary of modifications and/or major maintenance work carried out on the Water Supply Facilities, including all associated structures
- A list of unauthorized discharges and summary of follow-up action taken
- A summary of any abandonment and restoration work completed during the year and an outline of any work anticipated for the next year
- A summary of any studies, reports and plans (i.e. Operation and Maintenance, Abandonment and Restoration, QA/QC) requested by the Board that relate to water use or reclamation, and a brief description of any future studies planned
- Any other details on water use requested by the Board by November 1st of the reporting year.

The format of the NWB Annual Report is included in Appendix F.

The creation of the report can be greatly simplified by staff regularly filling in and filing the Site Forms included in Appendix D. The forms include:

- Form 1 – Monthly Water Delivery Log – describing the day to day delivery of water and site activities
- Form 2 – Water Supply Facility Monthly Inspection Form – to document the inspection and observation of the site operations and infrastructure

- Form 3 – Water Supply Facility Planning Form – which provides a list of items to be discussed by the site foreman and Hamlet Council related to short term and long term water supply and treatment decision making.

In addition to these forms, there would be sampling information and analytical data collected. The Monitoring Plan and QA/QC Plan (prepared as a separate document) outlines sample collection and analytical data handling protocols. Using the forms and following the procedures provided herein should make submitting the Annual Monitoring Report relatively straight forward.

5.0 Summary

5.1 Overview

This Operation and Maintenance Plan (O&M) has been prepared for the Hamlet of Arviat Water Supply Facility.

Appropriate training for site staff is necessary as part of the implementation of this O&M Plan. This document should be reviewed and updated annually, and whenever the NWB Water License is amended or new relevant legislation is issued.

The Wolf River drainage basin should be recognized in community land use plans and zoning. The drainage basin should be classified as a sensitive area where land uses must be restricted to prevent impacts to the lake water supply.

This O&M Plan pertains to those aspects of operating the water supply facility within the NWB mandate for environmental protection. This O&M Plan does not address issues of water quality for human consumption, which is the mandate of other agencies.

5.2 Outstanding Issues

The Technical Meeting/Pre-Hearing Conference for the new NWB License conducted in Arviat in March 2010 resulted in the creation of a Compilation of Issues related to the Water Supply Facility. A copy of a letter from DFO outlining their concerns is included in Appendix G. The letter includes the following comments:

> *Based on the above information and in conjunction with the review currently being undertaken by the NWB, DFO is in the opinion that the proposal could result in impacts to fish and fish habitat and requires additional information for further review. Of particular concern is draw down of the Wolf River and the intake fish screen.*
>
> *In order to provide our advice with respect to the impact to fish and fish habitat or determine our potential role related to this Type "A" Water Licence, we require, at a minimum, the following additional information on impacts to fish and fish habitat:*
>
> - *A detailed assessment of the proposed volume of water to be withdrawn from Wolf River against total annual recharge and the potential ramifications of draw down*

- *A detailed description of the proposed water intake. Refer to the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995), which is available at www~ mpo.gc.ca/library/223669.pdj.*

There is limited information available regarding Wolf River and the fish habitat, however local people indicate there is fish in Wolf River and there are concerns of impacts due to drawdown.

There are several issues that require the acquisition of field data during the late summer when reservoir filling occurs. For the purpose of addressing the above noted issues, we suggest that DFO's requirements be added as "Conditions" to the licence to be fulfilled by December 31, 2010. Should engineering and construction be required to achieve compliance with DFO requirements, we suggest that they be required to be completed by December 31, 2011.

INAC also requested “operating capacity of pump used and intake screen size used”.

As discussed above, no data was found detailing this information. Provision of this data including as-built drawings (or newly created as-builts if the originals cannot be found) should be a condition of the license.

This O&M Plan should be revised annually or whenever new information becomes available regarding the facility.

6.0 References

Department of Municipal and Community Affairs, Government of Northwest Territories, October 1996. *Guidelines for the Preparation of an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities in the Northwest Territories*. Queen's Printer: Yellowknife, Northwest Territories.

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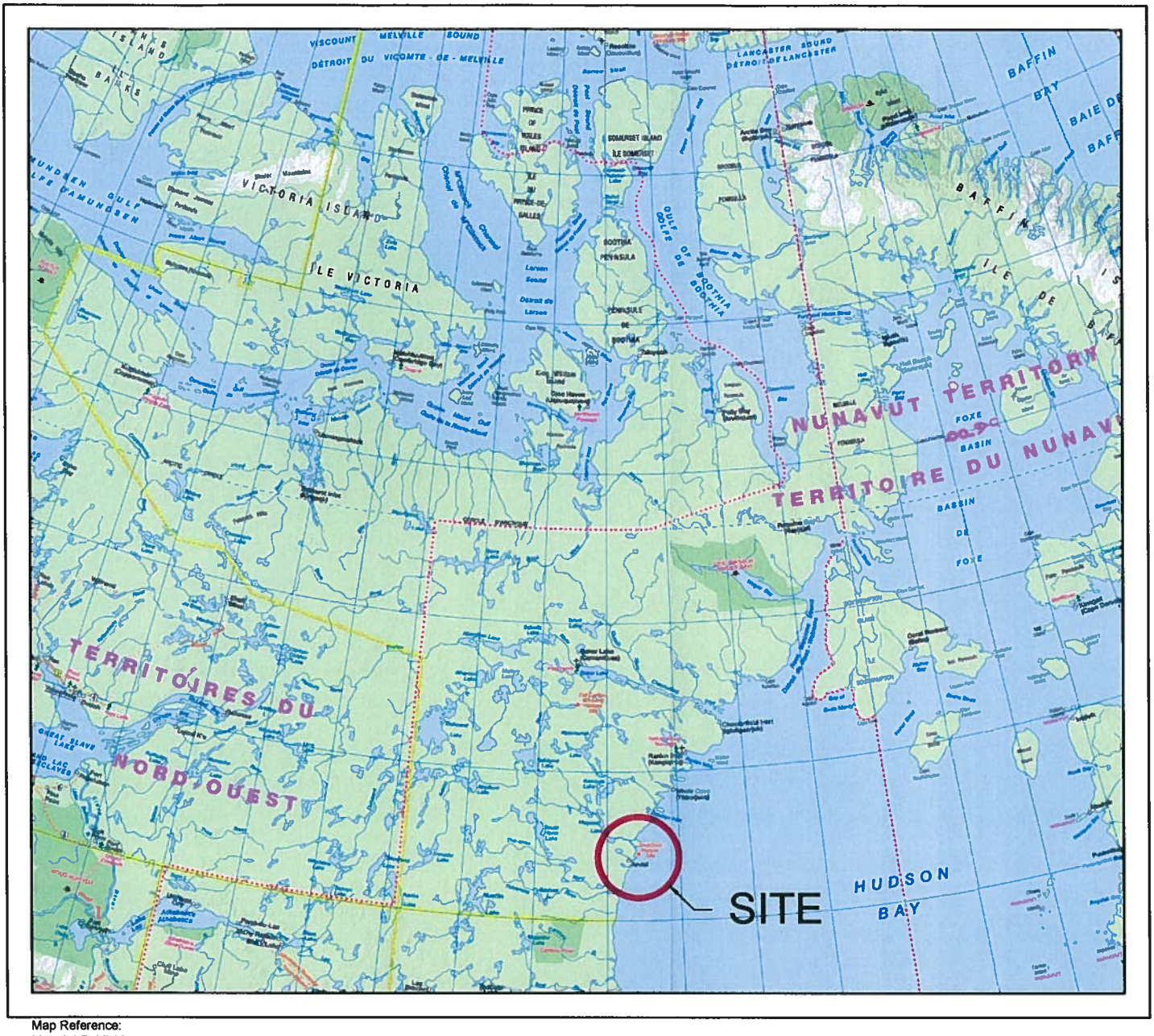
Nuna Burnside Engineering & Environmental Ltd., (2009, revised May 2010). *Environmental Emergency Contingency Plan, Hamlet of Arviat.*

Nuna Burnside Engineering & Environmental Ltd., (2009, revised May 2010). *Environmental Monitoring Program and Quality Assurance/Quality Control Plan, Hamlet of Arviat*.

Figures



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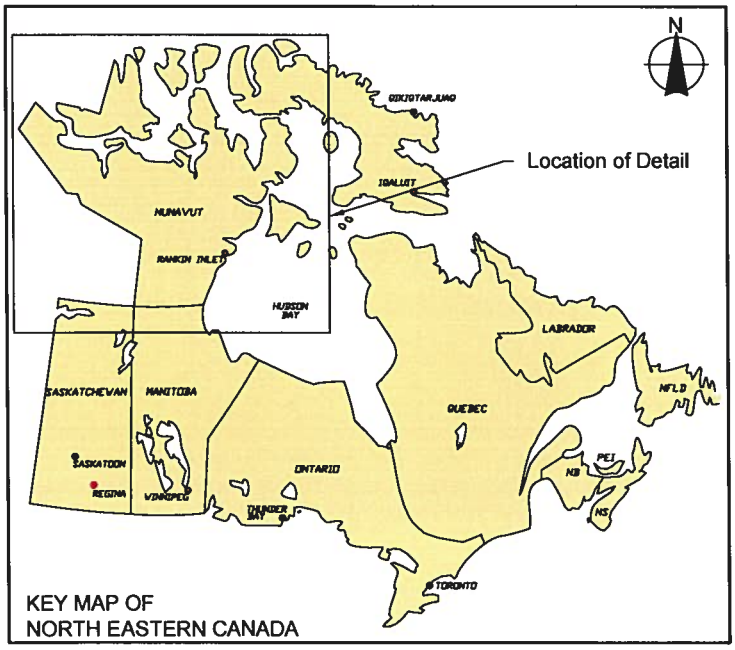

KEY MAP OF
NORTH EASTERN CANADA

FIGURE 1 - SITE LOCATION MAP

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT

WATER SUPPLY FACILITY OPERATIONS & MAINTENANCE PLAN

January 2009
Project Number: N-O15746

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O15746 WATER SUPPLY O&M PLAN SL.dwg

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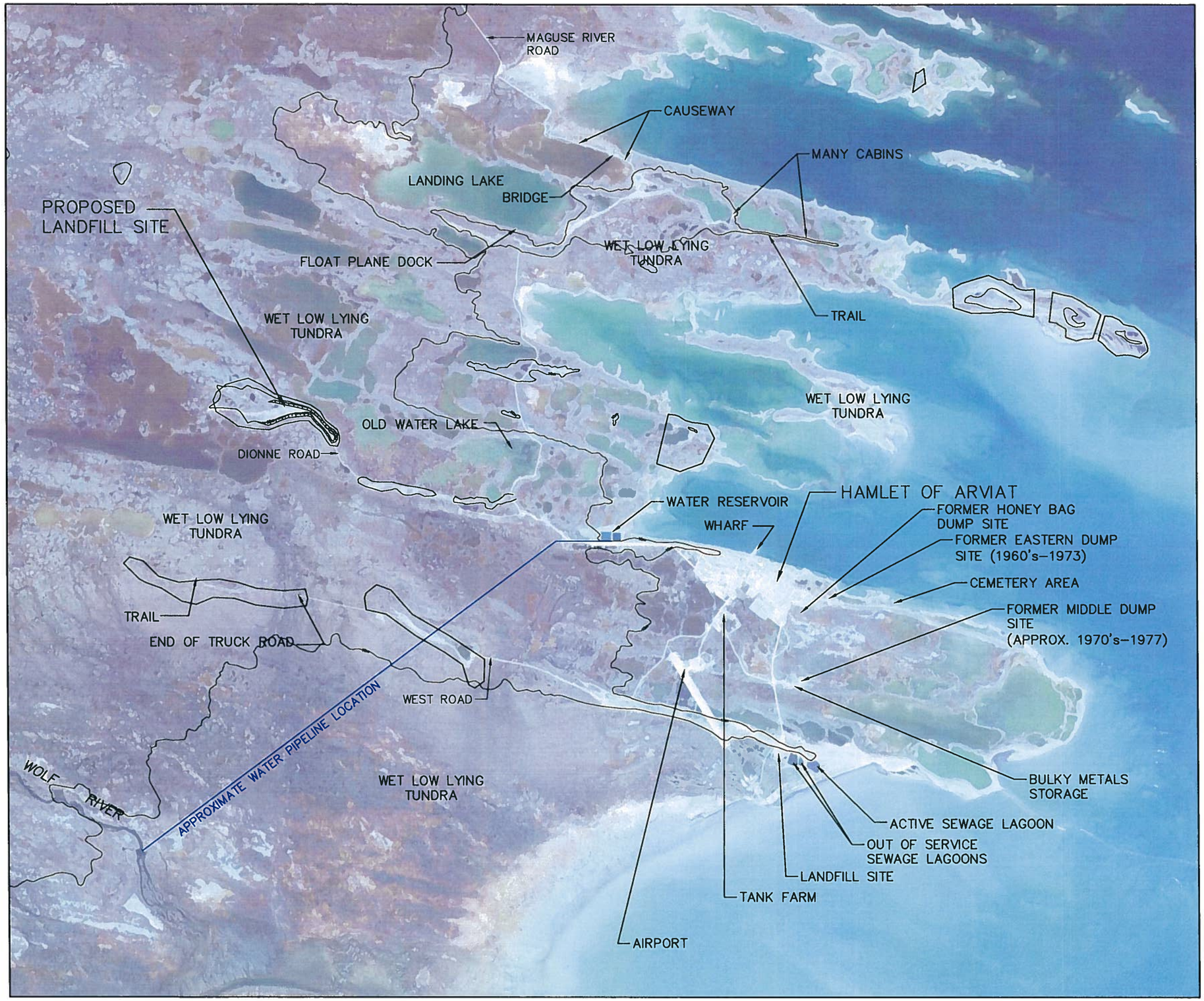

FIGURE 2

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

COMMUNITY PLAN

Satellite Image Source:
Background colour satellite image obtained from Google Earth Pro.

Map Source:
Background physical features obtained from the National Topographic Database Website.

N

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Kilometres

1:50,000
December 2008
Project Number: N-015746

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

NUNA BURNSIDE

N-015746 WATER SUPPLY O&M PLAN CP.dwg

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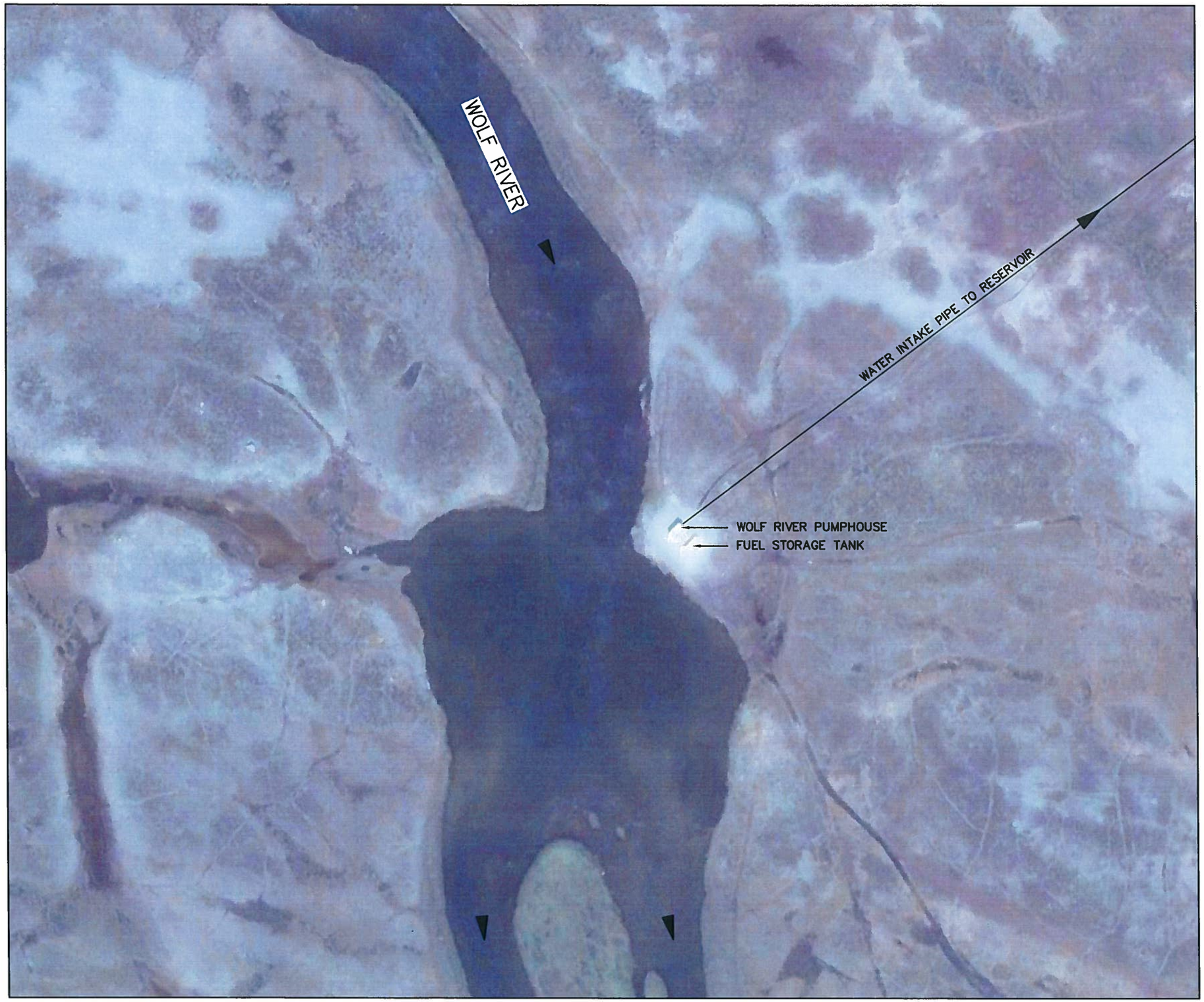

FIGURE 3

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

WOLF RIVER WATER INTAKE

LEGEND

WATER FLOW DIRECTION

Satellite Image Source:
Background colour satellite image obtained from Google Earth Pro.

N

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Metres

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December 2008
Project Number: N-O15746

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O15746 WATER SUPPLY O&M PLAN WI.dwg

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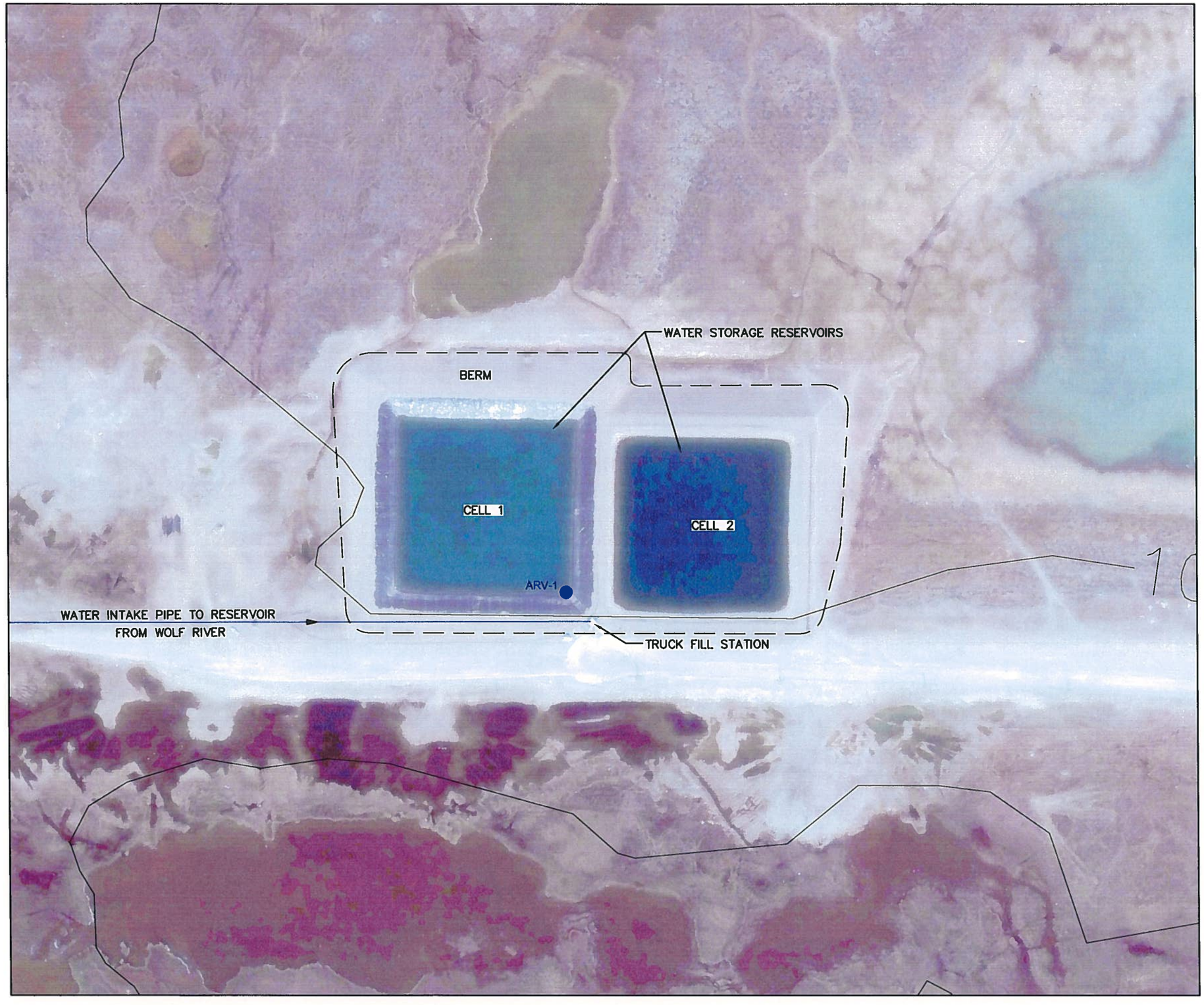

FIGURE 4

HAMLET OF ARVIAT
HAMLET OF ARVIAT, NUNAVUT
WATER SUPPLY FACILITY O&M PLAN

WATER RESERVOIRS & TRUCK FILL STATION

LEGEND

ARV-1 ● MONITORING LOCATION

Satellite Image Source:
Background colour satellite image obtained from Google Earth Pro.

Map Source:
Background physical features obtained from the National Topographic Database Website.

N

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1:2,500
December 2008
Project Number: N-O15746

Projection: UTM Zone 15
Datum: NAD83

Prepared by: C. Sheppard

Verified by: J. Walls

BURNSIDE

N-O15746 WATER SUPPLY O&M PLAN WR.dwg

Plot Time: Jun 08, 2009 - 11:21am

BURNSIDE

Appendix A
Nunavut Water Licence

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

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NUNAVUT WATER BOARD
NUNAVUT IMALIRIYIN KATIMAYINGI

DECISION

LICENCE NUMBER: NWB3ARV0308

This is the decision of the Nunavut Water Board (NWB) with respect to an application for a Licence dated September 2, 2003, made by:

Hamlet of Arviat

to allow for the use of water and disposal of waste by the Hamlet of Arviat, Nunavut. With respect to this application, the NWB gave notice to the public that the Hamlet had filed an application for a water licence.

DECISION

After having been satisfied that the application was exempt from the requirement for screening by the Nunavut Impact Review Board in accordance with S. 12.3.2 of the *Nunavut Land Claim Agreement* (NLCA), the NWB decided that the application could proceed through the regulatory process. After reviewing the submission of the Applicant and written comments expressed by interested parties, the NWB, having given due regard to the facts and circumstances, the merits of the submissions made to it and to the purpose, scope and intent of the *Nunavut Land Claims Agreement* and of the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* (NWNSRTA), decided to waive the requirement to hold a public hearing and furthermore to delegate its authority to approve the application to the Chief Administrative Officer pursuant to S. 49(a) of the NWNSRTA and determined that:

Licence Number NWB3ARV0308 be issued subject to the terms and conditions contained therein. (Motion #: 2003-39)

SIGNED this 9th day of January 2004 at Gjoa Haven, NU.

P diPizzo

Philippe di Pizzo
Chief Administrative Officer

TABLE OF CONTENTS

I. BACKGROUND

The Hamlet of Arviat is located on the northern shore of a peninsula on the west coast of Hudson Bay. Arviat is located at 61°05' N and 94° 00'W, and is 241 km southwest of Rankin Inlet and 265 air km north of Churchill, Manitoba. The topography of Arviat, which is located on a low and narrow coastal strip, is characterized by low topographic variations, occasional bedrock outcrops and a thick mantle of glacio- fluvial debris. Features include till, fine- grained marine deposits, and extensive beaches. The permafrost is continuous, extending to depths from 30 m to over 100 m. The active layer varies between 0.5 m and 0.3 m. Numerous ponds and lakes are present in the vicinity of the Hamlet, making drainage difficult. The average annual precipitation in Arviat consists of 16 cm of rainfall and 118 cm of snowfall. The mean high in July is 13.1 degrees with a mean low of 4.5 degrees. In January, the mean high is -27.9 degrees and a mean low of -35.0 degrees. The predominant local vegetation consists of mosses and lichens on rocky outcrops, with hardy grasses and sages in swampy and/or more sheltered areas.

II. PROCEDURAL HISTORY

On September 2, 2003, an application for a water licence was filed by the Hamlet of Arviat, which was previously un-licensed by the NWB. The Nunavut Water Board publicly posted notice of this application, in accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S.55.1 and Article 13 of the *Nunavut Land Claims Agreement,* on October 7, 2003. An assessment of the Hamlet's request for a municipal water licence for water use and waste disposal activities within the Hamlet was then undertaken, so that the Board could make a fully informed decision on the merits of application. This assessment process included the referral of the application to a variety of Federal, Territorial and local organizations for their review and comment. As no public concern was expressed, the NWB waived the requirement to hold a public hearing for the application.

Based upon the results of the detailed assessment, which was completed, including consideration of any potential accidents, malfunctions, or cumulative environmental effects that the overall project might have in the area, the Board delegated to the Chief Administrative Officer authority to approve the application pursuant to S. 13.7.5 of the *Agreement.*

III. ISSUES

Term of the Licence

In accordance with the *Nunavut Waters and Nunavut Surface Rights Tribunal Act* S. 45, the NWB may issue a licence for a term not exceeding twenty-five years. In determining an appropriate term of a water licence, the Board considers a number of factors, including the results of the annual Department of Indian Affairs and Northern Development (DIAND) site inspection and the

compliance record of the Applicant. Specifically, the August 12, 2002 DIAND Inspection Report indicated:

1. The lagoon currently in operation does not have sufficient freeboard, and capacity should be increased;
2. Concentrations of ammonia exceeded the levels recommended in the *Canadian Guidelines for the Protection of Freshwater Aquatic Life*; and
3. Levels of Total Suspended Solids and BOD exceeded the *Municipal Wastewater Effluent Quality Guidelines*.

The NWB has imposed the requirement to produce an Annual Report. These Reports are for the purpose of ensuring that the NWB has an accurate annual update of municipal activities during a calendar year. This information is maintained on the public registry and is available to any interested parties upon request. The Licensee's attention is drawn to the attached standard form for completing the Annual Report (see Attachment I).

The NWB has also imposed on the Licensee the requirement to produce an Operations and Maintenance Manual for their sewage and solid waste operations. The purpose of an Operation and Maintenance Manual is to assist Hamlet staff in the proper operation and maintenance of their waste disposal facilities. The manual should demonstrate to the Nunavut Water Board that the Hamlet is capable of operating and maintaining all waste disposal sites adequately. The Plan should be completed using the *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; see Attachment II). Additionally, the Plan shall address the operational issues identified at the Sewage Disposal Facility in the July 11, 2002 DIAND Inspection Report

The NWB believes that a term of five (5) years is appropriate, and will allow enough time for the Hamlet to establish a consistent compliance record with the terms and conditions of its licence. It will also ensure that sufficient time is given to permit the Licensee to develop, submit, and implement the plans required under its licence to the satisfaction of the NWB.

Water Use

The Municipality currently receives water from the Wolf Creek water supply located 8.0 km southwest of the Hamlet. Water is stored in a 57,000 m^3, 2-cell reservoir located 1.5 km west of the Hamlet, adjacent to the truck fill station. The water receives a chlorine treatment and is then distributed to the community by truck. Water requirements for 2003 were reported as 64,871 m^3. Demand for 2008 was not reported in application. Utilizing the water demand formula developed by the Department of Municipal and Community Affairs (Government of the Northwest Territories), projected demand requirements for 2008 was calculated at 78,273 m^3.

No concerns were expressed by the parties in their written submissions as to the amount of water required by the Applicant or the manner in which this water will be used. Based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage. Accordingly, and based upon the projected requirements of the Hamlet, the Board has set the terms and conditions in the water licence, which govern water usage and which are contained herein. The maximum permitted usage of water by the Hamlet of Arviat, over the term of the water license and for all purposes, has been set at 81,000 m^3 *per annum*.

Deposit of Waste

Sewage

The Hamlet of Arviat utilizes a Sewage Disposal Facility approximately 2.8 km southeast of the Municipality. This Sewage Disposal Facility is located in an area adjacent to the Solid Waste Disposal Facility, and consists of a 55,000 m^3 single-cell exfiltration lagoon. The effluent from this lagoon proceeds downstream to the marine environment through an undefined, natural wetland along a 200 m flow path prior to entering Hudson Bay.

Specific comments relevant to sewage disposal operations in the Hamlet were provided by DIAND, and Environment Canada. DIAND and Environment Canada recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans. DIAND and Environment Canada further recommended that the Hamlet take steps to remedy capacity and effluent quality issues currently evidenced at the Sewage Disposal Facility.

Additionally, DIAND provided recommendations concerning effluent discharge criteria, which are consistent with the *Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories* (Northwest Territories Water Board; 1992), as well as specific recommendations concerning the Monitoring Program. This Program is established to collect data on water quality to assess the effectiveness of treatment for protection of public health and to assess potential impacts to the environment associated with the municipal facilities. The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence. The Board also draws the attention of the Licensee to their requirements to implement the Quality Assurance/Quality Control (QA/QC) Plan to be provided by the NWB. The purpose of the QA/QC Plan is to ensure that samples taken in the field as part of the Monitoring Program will maintain a high quality, so as to accurately represent the physical and chemical nature of the samples being taken. It should also be noted that while minimum sampling requirements have been imposed, additional sampling may be requested by an Inspector.

Solid Waste

The Hamlet's solid waste management site is located adjacent to the Sewage Disposal system, approximately 2.8 km southeast of the community. Waste is segregated, with a generic landfill area,

a bulky wastes area, and an area segregated for hazardous wastes. Combustible wastes are burned regularly, and the landfill is compacted and covered annually.

Recommendations relevant to solid waste disposal operations in the Hamlet were provided by DIAND, DFO and Environment Canada. DIAND and Environment Canada recommended that the Hamlet develop appropriate Operations and Maintenance and Spill Contingency Plans. DIAND further recommended that the Hamlet segregate hazardous materials such as waste oils and batteries from municipal solid waste, and that these materials be disposed of off-site in an approved facility. DIAND, Environment Canada and DFO recommended the appropriate management of waste oil at the solid waste site, so as to prevent the deposition of hydrocarbons into water in contravention of the *Fisheries Act*. The Board concurs with these recommendations, which are reflected in the terms and conditions of the Water Licence.

LICENCE NWB3ARV0308

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 ARVIAT

(Licensee)

of **ARVIAT, NUNAVUT, X0A 0J0**

(Mailing Address)

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

Licence Number **NWB3ARV0308**

Water Management Area **NUNAVUT 06**

Location **ARVIAT, NUNAVUT**

Purpose **WATER USE AND WASTE DISPOSAL**

Description **MUNICIPAL UNDERTAKINGS**

Quantity of Water Not to be Exceeded **81,000 CUBIC METRES ANNUALLY**

Date of Licence **JANUARY 9, 2004**

Expiry Date of Licence **DECEMBER 31, 2008**

Dated ~~this~~ 9th day of January 2004 at Gjoa Haven, NU.

Philippe di Pizzo
Chief Administrative Officer

Philippe di Pizzo
Chief Administrative Officer

PART A: SCOPE AND DEFINITIONS

1. Scope

a. This Licence allows for the use of water and the disposal of waste for municipal undertakings at the Hamlet of Arviat, Nunavut (63°21' N; 90° 42'W);

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

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

2. Definitions

In this Licence: **NWB3ARV0308**

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

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

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

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

"Average Concentration" means the arithmetic mean of the last four consecutive analytical results for contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

"**Average Concentration For Faecal Coliforms**" means the geometric mean of the last four consecutive analytical results for faecal coliforms contained in composite or grab samples collected from the Waste Disposal Facility's final discharge point;

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

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

"**Commercial Waste Water**" means water and associated waste generated by the operation of a commercial enterprise, but does not include toilet wastes or greywater;

"**Composite Sample**" means a water or wastewater sample made up of four (4) samples taken at regular periods over a 24 hour period;

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

"**Final Discharge Point**" means an identifiable discharge point of a Waste Disposal Facility beyond which the Licensee no longer exercises care and control over the quality of the Effluent;

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

"**Grab Sample**" means a single water or wastewater sample taken at a time and place representative of the total discharge;

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

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

"**Licensee**" means the holder of this Licence;

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

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

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

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

"**Sewage Disposal Facilities**" comprises the area and engineered lagoon and decant structures designed to contain and treat sewage as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-0440-04/1-3;

"**Solid Waste Disposal Facilities**" comprises the area and associated structures designed to contain solid waste as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-08-26;

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

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

"**Waste Disposal Facilities**" means all facilities designated for the disposal of waste, and includes the Sewage Disposal Facilities and Solid Waste Disposal Facilities, as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 2003-0440-04/1-3; and

"**Water Supply Facilities**" comprises the area and associated intake infrastructure at the Wolf Creek Water Supply, as described in the Application for Water Licence filed by the Applicant on September 2, 2003 and illustrated in Drawing # 1998-08-24/2.

PART B: GENERAL CONDITIONS

1. The Licensee shall file an Annual Report with the Board not later than March 31st of the year following the calendar year reported which shall contain the following information:

i. tabular summaries of all data generated under the "Monitoring Program";

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

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

iv. 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;

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

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

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

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

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.

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

5. The Licensee shall, within ninety (90) days after the first visit of the Inspector, post the necessary signs, where possible, to identify the stations of the "Monitoring Program." All signage postings shall be in the Official Languages of Nunavut, and shall be located and maintained to the satisfaction of an Inspector.

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.

8. Any communication with respect to this Licence shall be made in writing to the attention of:

(i) **Chief Administrative Officer:**
Executive Director
Nunavut Water Board
P.O. Box 119
Gjoa Haven, NU X0B 1J0
Telephone: (867) 360-6338
Fax: (867) 360-6369

(ii) **Inspector Contact:**
Water Resources Officer
Nunavut District, Nunavut Region
P.O. Box 100
Iqaluit, NU X0A 0H0
Telephone: (867) 975-4298
Fax: (867) 979-6445

(iii) **Analyst Contact:**
Taiga Laboratories
Department of Indian and Northern Affairs
4601 - 52 Avenue, P.O. Box 1500
Yellowknife, NT X1A 2R3
Telephone: (867) 669-2781
Fax: (867) 669-2718

9. 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.

PART C: CONDITIONS APPLYING TO WATER USE

1. The Licensee shall obtain all fresh water from the Wolf Creek Water Supply using the Water Supply Facilities or as otherwise approved by the Board.

2. The annual quantity of water used for all purposes shall not exceed 81,000 cubic metres.

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

4. The water intake hose used on the water pumps shall be equipped with a screen with a mesh size sufficient to ensure no entrainment of fish.

PART D: CONDITIONS APPLYING TO WASTE DISPOSAL

1. The Licensee shall direct all Sewage to the Sewage Disposal Facilities or as otherwise approved by the Board.

2. All Effluent discharged from the Sewage Disposal Facilities at Monitoring Program Station ARV-4 shall meet the following effluent quality standards:

Parameter	Maximum Average Concentration
Faecal Coliforms	1×10^4 CFU/dl
BOD_5	80 mg/L
Total Suspended Solids	100 mg/L
Oil and grease	No visible sheen
pH	between 6 and 9

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

4. The Licensee shall advise an Inspector at least ten (10) days prior to initiating any decant of the sewage lagoon.

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

6. The Licensee shall dispose of and contain all solid wastes at the Solid Waste Disposal Facilities or as otherwise approved by the Board.

7. The Licensee shall implement measures to ensure hazardous materials and/or leachate from the Solid Waste Disposal Facility does not enter water.

8. The Licensee shall submit to the Board for review within six (6) months of the issuance of this license a report identifying each Final Discharge Point. The report shall at least include:

    a. Plans, specifications and a general description of each Final Discharge Point together with its specific geo-referenced location;

    b. A description of how each Final Discharge Point is designed and maintained.

9. If, during the term of this Licence, additional Final Discharge Points are identified, the Licensee shall submit the information as required by Part D, Item 8 for each new Final Discharge Point within 30 days after the discharge point is identified and at least 60 days prior to depositing Effluent from the new Final Discharge Point and/or proposed changes are made to a Final Discharge Point.

PART E: CONDITIONS APPLYING TO MODIFICATION AND CONSTRUCTION

1. The Licensee shall submit to the Board for approval design drawings stamped by a qualified engineer registered in Nunavut 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:

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

    ii. said modifications do not place the Licensee in contravention of the Licence or the *Act*;

iii. 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

iv. the Board has not rejected the proposed modifications.

3. Modifications for which all of the conditions referred to in Part E, Item 1, have not been met may be carried out only with written approval from the Board.

4. The Licensee shall provide as built plans/drawings of the modifications referred to in this Licence within ninety (90) days of completion of the modifications.

PART F: CONDITIONS APPLYING TO OPERATION AND MAINTENANCE

1. The Licensee shall, within 6 months of the issuance of this license, submit to the Board for approval, a Plan for the Operation and Maintenance of the Sewage and Solid Waste Disposal Facilities in accordance with *"Guidelines for Preparing an Operation and Maintenance Manual for Sewage and Solid Waste Disposal Facilities"* (October 1996). This Plan shall specifically address hazardous waste disposal and operational issues at the Solid Disposal Facility.

2. The Licensee shall implement the Plan specified in Part F, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part F, Item 1, if not acceptable to the Board. The revised Plan shall be submitted to the Board for approval within thirty (30) days of notification of the Board decision

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

   i. employ the appropriate contingency plan as provided for in the Operation and Maintenance Plan;
   ii. report the incident immediately via the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
   iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

5. In the absence of a contingency plan contained within an approved Operation and Maintenance Plan, and should during the period of this Licence an unauthorized discharge of

waste occur, or if such a discharge is foreseeable, the Licensee shall:

i. take whatever steps are immediately practicable to protect human life, health and the environment;
ii. without delay seek guidance from the Departments of Community Government and Transportation and Sustainable Development with regards to mitigation and remedial actions required to address the discharge;
ii. report the incident immediately *via* the 24-Hour Spill Reporting Line at (867) 920-8130 and to an Inspector; and
iii. submit to an Inspector a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

PART G: CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

1. The Licensee shall submit to the Board for approval an Abandonment and Restoration Plan at least six (6) months prior to abandoning any facilities and the construction of new facilities to replace existing ones. The Plan shall include, but not be limited to where applicable:

   i. water intake facilities;
   ii. the water treatment and waste disposal sites and facilities;
   iii. petroleum and chemical storage areas;
   iv. any site affected by waste spills;
   v. leachate prevention;
   vi. an implementation schedule;
   vii. maps delineating all disturbed areas, and site facilities;
   viii. consideration of altered drainage patterns;
   ix. type and source of cover materials;
   x. future area use;
   xi. hazardous wastes; and
   xii. a proposal identifying measures by which restoration costs will be financed by the Licensee upon abandonment.

2. The Licensee shall implement the plan specified in Part G, Item 1 as and when approved by the Board.

3. The Licensee shall revise the Plan referred to in Part G, Item 1 if not approved. The revised Plan shall be submitted to the Board for approval within thirty (30) days of receiving notification of the Board's decision.

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

PART H: CONDITIONS APPLYING TO THE MONITORING PROGRAM

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

Monitoring Station	Description
ARV-1	Raw water supply at the Wolf Creek Water Supply prior to treatment
ARV-2	Effluent discharge from the Final Discharge Point of the Solid Waste Disposal Facilities
ARV-3	Raw Sewage at truck offload point
ARV-4	Effluent discharge from the Final Discharge Point of the Sewage Disposal Facilities

2. The Licensee shall sample monthly at Monitoring Station ARV-2 and ARV-4 during the months of May to August, inclusive. Samples shall be analyzed for the following parameters:

BOD	Faecal Coliforms
pH	Conductivity
Total Suspended Solids	Ammonia Nitrogen
Nitrate-Nitrite	Oil and Grease (visual)
Total Phenols	Sulphate
Sodium	Potassium
Magnesium	Calcium
Total Arsenic	Total Cadmium
Total Copper	Total Chromium
Total Iron	Total Lead
Total Mercury	Total Nickel
Total Zinc	

3. The Licensee shall measure and record in cubic metres the monthly and annual quantities of water pumped from Monitoring Station ARV-1 for all purposes.

4. The Licensee shall measure and record in cubic metres the monthly and annual quantities of raw sewage offloaded from trucks at Monitoring Station ARV-3 for all purposes.

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

6. The Licensee shall conform to the Quality Assurance/Quality Control (QA/QC) Plan which shall be provided to the Licensee by the NWB within 120 days of the issuance of this license.

7. 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.

8. All analyses shall be performed in a Canadian Association of Environmental Analytical Laboratories (CAEAL) Certified Laboratory, or as otherwise approved by an Analyst.

9. The Licensee shall measure and record the annual quantities of sewage solids removed from the Sewage Disposal Facility.

10. The Licensee shall, unless otherwise requested by an Inspector, 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.

11. Modifications to the Monitoring Program may be made only upon written approval of the Chief Administrative Officer.

BURNSIDE

Appendix B
Climate Data

Climate Data

Table 1: Rankin Inlet Climate Normals Data Summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Total
Total Precipitation (mm)	6.6	8.9	12.6	14.3	18.4	29.8	39.5	57.6	43.8	34.6	19.8	11.3	297.2
Rain (mm)	0.0	0.1	0.0	1.0	7.4	25.0	39.5	57.3	39.2	11.9	0.1	0.0	181.5
Snow (cm)	6.7	9.3	12.9	13.6	11.5	4.9	0.0	0.3	4.6	23.1	20.9	11.9	107.8
Wind Speeds (km/hour)	23.9	23.9	23.4	22.4	22.1	19.8	19.2	21.1	24.2	26.5	25.3	24.0	
Average Temperatures (°C)	-31.9	-30.1	-25.2	-16.3	-5.9	4.2	10.4	9.5	3.4	-5.3	-17.8	-26.7	

*Canadian Climate Normals 1971-2000, Environment Canada, Rankin Inlet Airport Weather Station

Specific climate data for Arviat was not available. The closest weather station is located in Rankin Inlet, 225 km north of Arviat.

BURNSIDE

Appendix C
Water Use Calculations

Water Use Projections for the Hamlet of Arviat, Nunavut

Key Assumptions

Starting Year:	2006	Starting Population:	2060
Population Growth Rate:	1.4%	Residential Water Usage Rate [L/cd]::	65.0

Planning Year	Calendar Year	Projected Population[1]	Projected Water Consumption[2]	Projected Total Consumption Volume			
			[Lpcd]	[Litres/day]	[Litres/year]	[m3/day]	[m3/year]
	2006	2060	95.8	197342	72,029,764	197	72,030
	2007	2089	96.2	201026	73,374,351	201	73,374
	2008	2119	96.7	204863	74,774,961	205	74,775
0	2009	2149	97.1	208727	76,185,393	209	76,185
	2010	2180	97.6	212748	77,653,159	213	77,653
	2011	2211	98.1	216798	79,131,412	217	79,131
	2012	2242	98.5	220877	80,620,153	221	80,620
	2013	2274	99.0	225118	82,167,919	225	82,168
5	2014	2306	99.5	229389	83,726,860	229	83,727
	2015	2339	100.0	233825	85,346,223	234	85,346
	2016	2372	100.5	238294	86,977,471	238	86,977
	2017	2406	101.0	242933	88,670,581	243	88,671
	2018	2440	101.5	247606	90,376,307	248	90,376
10	2019	2475	102.0	252453	92,145,379	252	92,145
	2020	2510	102.5	257336	93,927,821	257	93,928
	2021	2546	103.1	262398	95,775,136	262	95,775
	2022	2582	103.6	267498	97,636,596	267	97,637
	2023	2619	104.2	272779	99,564,502	273	99,565
	2024	2656	104.7	278102	101,507,348	278	101,507
	2025	2694	105.3	283612	103,518,255	284	103,518
	2026	2732	105.8	289164	105,544,922	289	105,545
	2027	2771	106.4	294908	107,641,308	295	107,641
	2028	2810	107.0	300697	109,754,294	301	109,754
20	2029	2850	107.6	306681	111,938,702	307	111,939
	2030	2890	108.2	312714	114,140,572	313	114,141
	2031	2931	108.8	318947	116,415,610	319	116,416
	2032	2973	109.4	325384	118,765,159	325	118,765
	2033	3015	110.1	331874	121,133,960	332	121,134
	2034	3058	110.7	338573	123,579,106	339	123,579
	2035	3101	111.4	345327	126,044,430	345	126,044
	2036	3145	112.0	352296	128,587,976	352	128,588
	2037	3190	112.7	359483	131,211,184	359	131,211
	2038	3235	113.4	366730	133,856,492	367	133,856
30	2039	3281	114.1	374201	136,583,426	374	136,583

Note:

1) Population in 2006 taken from Statistics Canada 2006 Census of Population. A population growth of 1.4% was applied to the subsequent years.

2) The projected water consumption is based on the Nunavut water usage formula [RWU L/c/d x (1 + (0.00023 x [population]).

3) The Residential Water Usesage Rate is estimated to be 90 L/c/d for municipalities where water is not distributed by a piping system. To fit the recorded water use data the RWU rate was lowerd to 65 L/c/d.

Hydrology Calculations, Hamlet of Arviat

Annual Rainfall (m/year)	0.2972	*Canadian Climate Normals 1971-2000, Environment Canada, Rankin Inlet Airport Weather Station
Evapotranspiration (m/year)	0.200	* Specific values for Arviat were not available, estimated using several references, see below.

Wolf River Drainage Basin

River Catchment Area (m^2)*	650,000,000
Rain and Runoff (m^3/year)	193,180,000
Evapotranspiration (m^3/year)	130,000,000
Net Recharge of Catchment Area (m^3/year)	63,180,000

* IEG Environmental, 2005

Evapotranspiration Rates

Location	Value (mm)	Reference
Arviat, Nunavut	203	FSC Architects & Engineers, 2003
Mackenzie Basin, Yukon	241	Serrereze et al, 2003
Lena Basin, Russai	182	Serrereze et al, 2003
Knob Lake, Quebec	280	Church, 1974
Boot Creek, Inuvik, NWT	75	Church, 1974
Mackenzie River Basin, Yukon	216	Yi Yip, 2008
Average	**200**	

References:

FSC Architects & Engineers, 2003. Design Concept for Arviat Sewage Lagoon prepared for Department of Community Government and Transportation, Government of Nunavut.

Church, M. 1974. Hydrology and Permafrost with Reference to Northern North America. In Proceedings: Workshop Seminar on Permafrost Hydrology, 7-20. Ottawa: Canadian National Committee, International Hydrological Decade (IHD).

Yi Yip, Q.M. 2008. Climate Impacts on Hydrometric Variables in Mackenzie River Basin. University of Waterloo, Waterloo, 2008.

Serreze, M.C., D.H. Bromwich, M.P. Clark, A.J. Etringer, T. Zhang and R. Lammers, 2003. Large-scale hydro-climatology of the terrestrial Arctic drainage system. Journal Geophysical Research, 108(D2). Doi:10. 1029/2002JD000919

BURNSIDE

Appendix D

Site Forms

Form 1
Daily Water Delivery Log
Hamlet of Arviat

Month: _____ **Truck #:** _____

Date	Number of Trips	Volume per Trip	Total Daily Volume (liters)	Comments and Concerns
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				

Date	Number of Trips	Volume per Trip	Total Daily Volume (liters)	Comments and Concerns
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
Monthly Totals				

15746_Water Delivery Log Form2008-12-09 1:24 PM

Form 2
Monthly Water Supply Facility Inspection Form
Hamlet of Arviat

Inspected By:_____ Date:_____

Wind Direction:_____ Temperature:_____

Precipitation:_____ Ground Cover:_____

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Health and Safety (dangers and concerns)		
Signs		
Access Road and Truck Pad (condition, drainage, snow, surface, etc.)		
Truck Fill Station		
Chlorine Feed System		
Berm		
Water Intake Pipe		

Issues and Conditions	Description/Condition/Problems	Action/Maintenance Required
Pumphouse and Fuel Storage Tank		
Equipment (water truck, pump, etc.)		
Ice		
Litter		
Other Issues and Concerns		

Form 3
Water Supply Facility Planning Form
Hamlet of Arviat

Prepared By: _____

Date: _____

Water Supply Facility Planning Issue	Current Operations	To Do Items and Schedule
Health and Safety		
Site Inspection Results/Concerns		
Current Volumes		
Water Treatment Process		
Annual Reporting		
Nunavut Water Board License Requirements		

Water Supply Facility Planning Issue	Current Operations	To Do Items and Schedule
Flow Monitoring		
Staffing		
Equipment		
Costs		
Other Issues/Concerns		

BURNSIDE

Appendix E
Site Photographs

Photo 1: Truck Fill Station

Photo 2: Water Reservoir

Photo 3: Water Pipeline

Appendix F

Annual Monitoring Report Format

NWB Annual Report **Year being reported:** Select

License No: **Issued Date:**
Expiry Date:

Project Name:

Licensee:

Mailing Address:

Name of Company filing Annual Report (**if different from Name of Licensee please clarify relationship between the two entities, if applicable**):

General Background Information on the Project (***optional**):

Licence Requirements: the licensee must provide the following information in accodance with

Select Select

A summary report of water use and waste disposal activities, including, but not limited to: methods of obtaining water; sewage and greywater management; drill waste management; solid and hazardous waste management.

Water Source(s):
Water Quantity:
- Quantity Allowable Domestic (cu.m)
- Actual Quantity Used Domestic (cu.m)
- Quantity Allowable Drilling (cu.m)
- Total Quantity Used Drilling (cu.m)

Waste Management and/or Disposal
- ☐ Solid Waste Disposal
- ☐ Sewage
- ☐ Drill Waste
- ☐ Greywater
- ☐ Hazardous
- ☐ Other:

Additional Details:

A list of unauthorized discharges and a summary of follow-up actions taken.

Spill No.: (as reported to the Spill Hot-line)
Date of Spill:
Date of Notification to an Inspector:
Additional Details: (impacts to water, mitigation measures, short/long term monitoring, etc)

Revisions to the Spill Contingency Plan

Select

Additional Details:

Revisions to the Abandonment and Restoration Plan

Select

Additional Details:

Progressive Reclamation Work Undertaken

Additional Details (i.e., work completed and future works proposed)

Results of the Monitoring Program including:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where sources of water are utilized;

Select

Additional Details:

The GPS Co-ordinates (in degrees, minutes and seconds of latitude and longitude) of each location where wastes associated with the licence are deposited;

Select

Additional Details:

Results of any additional sampling and/or analysis that was requested by an Inspector

Select

Additional Details: (date of request, analysis of results, data attached, etc)

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

Select

Additional Details: (Attached or provided below)

Any responses or follow-up actions on inspection/compliance reports

Select

Additional Details: (Dates of Report, Follow-up by the Licensee)

Any additional comments or information for the Board to consider

Date Submitted:
Submitted/Prepared by:
Contact Information:
Tel:
Fax:
email:

Appendix G

Fisheries and Oceans Canada Letter

Dated February 24, 2010

Fisheries and Oceans Canada
Pêches et Océans Canada

Eastern Arctic Area
P.O. Box 358
Iqaluit, Nunavut X0A 0H0
Tel: (867) 979-8000
Fax: (867) 979-8039

Secteur de l'Arctique de l'est
Boite postale 358
Iqaluit, Nunavut X0A 0H0
Tél: (867) 979-800
Téléc: (867) 979-8039

Your file *Votre référence*
3AM-ARV----

Our file *Notre référence*
NU-09-0043

February 24, 2010

Richard Dwyer
Manager of Licensing
Nunavut Water Board
P.O. Box 119
Gjoa Haven, Nunavut
X0B 1J0

via e-mail: licensing@nunavutboard.org

Dear R. Dwyer:

Subject: New Type "A" Water Licence and Technical Review in Renewal of the Type "B" 3BM-ARV0308

Fisheries and Oceans Canada (DFO) received a Completeness Check from the Nunavut Water Board (NWB) on December 21, 2009 requesting to provide input concerning the project proposal submitted by the Hamlet of Arviat. The proposal has been reviewed to determine whether it is likely to result in impacts to fish and fish habitat which are prohibited by the habitat protection provisions of the *Fisheries Act* or those prohibitions of the *Species at Risk Act* that apply to aquatic species. Our review was limited to fish and fish habitat.

Our January 12, 2010 letter to the NWB provided the proponent with specific recommendations and requests for additional information, as applicable to their project, in relation to our regulatory mandate under the federal *Fisheries Act* and in context to our national Policy for the Management of Fish and Fish Habitat. In response to the NWB's January 25, 2010 letter, DFO is grateful for the opportunity to provide further input and submit specific additional information requests to further the review for the above noted project.

Our review consisted of:

- *Water Licence Complete Submission, Main Body," prepared by Nuna Burnside Engineering and Environmental Ltd., dated December 23, 2008, received by DFO December 21, 2009.*
- *"Figure 3, Hamlet of Arviat, Nunavut, Water Licence Submission, Major Drainage Basins" prepared by Nuna Burnside Engineering and Environmental Ltd., received by DFO December 21, 2009..*

Based on the above information and in conjunction with the review currently being undertaken by the NWB, DFO is in the opinion that the proposal could result in impacts to fish and fish habitat and requires additional information for further review. Of particular concern is draw down of the Wolf River and the intake fish screen.

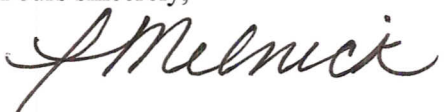
In order to provide our advice with respect to the impact to fish and fish habitat or determine our potential role related to this Type "A" Water Licence, we require, at a minimum, the following additional information on impacts to fish and fish habitat:

- A detailed assessment of the proposed volume of water to be withdrawn from Wolf River against total annual recharge and the potential ramifications of draw down.
- A detailed description of the proposed water intake. Refer to the Freshwater Intake End-of-Pipe Fish Screen Guideline (DFO 1995), which is available at www.dfo-mpo.gc.ca/library/223669.pdf.

For more information on those sections most relevant to the review of development proposals, including 20, 22, 32 and 35 of the *Fisheries Act* and sections 32, 33 and 58 of the *Species at Risk Act*, please visit www.dfo-mpo.gc.ca. Please be advised that any impacts to fish and fish habitat which result from proceeding with this proposal could lead to corrective action such as enforcement.

I trust that the additional information requested will be of assistance in the Nunavut Water Board's review for the new Type "A" Water Licence for the Hamlet of Arviat. If you or the proponent have any questions concerning the above, please contact me directly by telephone at (204) 983-2632, by fax (204) 983-7983, or by e-mail at Loriena.Melnick@dfo-mpo.gc.ca.

Yours sincerely,



Loriena Melnick
Habitat Management Biologist
Fisheries and Oceans Canada – Eastern Arctic Area

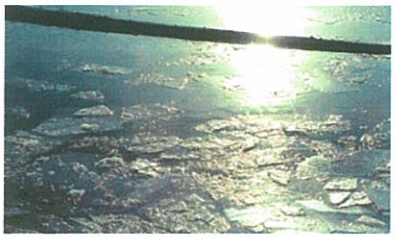
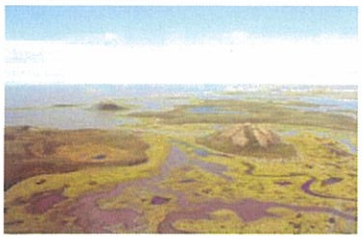
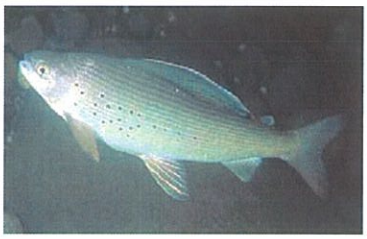
Copy: Eric Kan – Fisheries and Oceans Canada

Appendix H

Potable Water Supply Study, Arviat, Nunavut, IEG and Komex, December 2005

FINAL REPORT

POTABLE WATER SUPPLY STUDY
ARVIAT, NU

Prepared for:

Government of Nunavut
Department of Community Government Services

Prepared by:

IEG Environmental

In association with

KOMEX

December 2005
IEG Project 5706-04

FINAL REPORT

POTABLE WATER SUPPLY STUDY
ARVIAT, NU

Submitted to:

Wayne Thistle
Government of Nunavut
Department of Community Government Services
PO Bag 002, Rankin Inlet, NU
X0C 0G0

DISTRIBUTION:

4 Hard Copies, Wayne Thistle, Department of Community &Government Services, GN

4 CDs of electronic files, Wayne Thistle, Department of Community &Government Services, GN

1 Hard Copy, IEG Environmental Yellowknife

1 Hard Copy, Komex International, Calgary

TABLE OF CONTENTS

1.0 INTRODUCTION

IEG Environmental in association with Komex International were contracted by the Department of Community & Government Services (CGS) to undertake a potable water supply study for the Hamlet of Arviat. The overall objectives of the project were:

- Assemble and review existing information regarding potable water supply in Arviat, Nunavut;
- Complete a 20-year projected potable water volume study based on expected population growth;
- Determine community potable water goals using western science and engineering and Inuit Qaujimaituqangit;
- Inspect the current potable water source and water reservoirs;

Inspect and sample the four alternative water sources as described in the RFP, i.e. Dionne Lake, Goose Lake, Mikilaaq Lake and the Maguse River;

- Compare identified potential water supply sources based on:
    - Adherence to design objectives;
    - Compliance with Fisheries and Oceans Canada (DFO) regulations;
    - Water truck accessibility;
    - Source water quality and quantity;
    - Capital costs for design procurement and construction (Class D);
    - Operations and Maintenance (O&M) costs (Class D);
    - 20-year life cycle cost (Class D); and
    - Potential treatment requirements
- Identification of possible locations for a second truck fill station at the drinking water reservoir.

1.1 Current Water Infrastructure

Currently the Hamlet of Arviat's raw water source is Wolf Creek. Raw water is pumped seasonally from Wolf Creek to two reservoirs. There is a truckfill station at the reservoirs and while the water delivery trucks are filling chlorine is added for disinfection. Residual chlorine persists throughout the distribution system.

The Department of Community and Government Services (CGS) owns the pumphouse, reservoirs and truckfill station. CGS operates the truckfill station, is responsible for daily water testing and for maintenance of the reservoir, pipeline and pumphouse. CGS contracts the pumping to a third party in Arviat. The pumphouse on Wolf Creek is approximately 7 to 8 km south of the hamlet. The pumphouse inlet line into Wolf Creek is in a pool that is approximately 4 m deep.

The reservoirs, approximately 1.5km from the Hamlet, are both lined with impermeable membranes. Capacity of cell one is 87,000 m^3 and cell two is 56,000 m^3. Total reservoir capacity

equals 143,000 m^3. Pumping to the reservoir occurs once a year, usually in August. Pumping takes between 27-30 days. Fluoride is added to the reservoirs just before they are full.During the winter time pumping from the reservoirs alternates monthly.

The Hamlet operates four water delivery trucks and is going to add another truck to the fleet in the near future. While the water delivery trucks are filling, chlorine is added for disinfection. Residual chlorine persists throughout the distribution system. All four trucks run 8 hours a day, three of them do the residential houses from 8am to 5pm and one does the commercial buildings and callouts from 12pm to 8pm. There are currently problems with lineups at the truckfill station.

2.0 SITE VISIT SUMMARY

The purpose of the site visit was to:

- Meet with the SAO and other hamlet and GN staff to discuss the project, if possible;
- Travel to the current water source, Wolf Creek, and to each potential water source, collect samples and observe the surrounding terrain; and
- Investigate the pumphouse, water supply line, water reservoirs, and truckfill station.

All of the above were completed during the site visit August 31- September 3, 2004.

IEG met with the SAO, Richard Van Horne and the Mayor, Peter Kritaqliluk. During the meeting, the mayor expressed concern that the water volumes in Wolf Creek appear to be declining. To illustrate, he suggested a site visit to an important feature on the creek, upstream of the Arviat raw water intake. The location was a narrow spot in the creek that used to wide enough that a bridge was required to cross. Recently the creek had width had changed in that spot so that a bridge was no longer required to cross. The mayor was concerned that the same phenomenon could occur where the intake is located at Wolf Creek, hindering municipal use of the creek for drinking water. Mr. Kritaqliluk had no other observations or concerns with the other sites.

It was determined by the SAO that consulting with the mayor was sufficient to collect Inuit Qaujimaituqangit for this study. No other residents were contacted during the site visit.

Photos of the site visit can be found in Appendix A and a site diagram of the different potential water supply sources and sampling locations can be found in Appendix B.

2.1 Additional Sampling

The main concern of residents is reduced water level in Wolf Creek in the fall. To assess whether water quality is affected by lower flows, water quality was sampled in early September, and again in late September. IEG conducted the water quality sampling in September. A cooler with sampling supplies and sample instructions were left with the SAO during the site visit. Stephen Hartman with CGS was in Arviat on other business and collected the second sample at Wolf Creek on September 28, 2004. All samples were shipped by air to Enviro-Test Laboratories in Winnipeg, MB for analysis.

3.0 WATER STUDY

The results of the water analysis are listed in Table 1 and compared to the *Summary of Guidelines for Canadian Drinking Water Quality (GCDWQ)*. The current source water from Wolf Creek as well as the four future prospective sites all meet or are lower than the guidelines, except for turbidity at Wolf Creek when it was sampled the second time by Steve Hartman later in September.

The bacteriological samples, Fecal Coliforms, Total Coliforms, Heterotrophic Plate Count are included at the bottom of Table 1. They are however not compared to the GCDWQ because the GCDWQ are guidelines for drinking water, the drinking water in Arviat is disinfected prior to being delivered. This is to meet the bacteriological requirements of the GCDWQ and the *Public Health Act*, therefore it is not accurate to compare the source bacteriological data to the GCDWQ. The Environmental Health Officer (EHO) for the Kivalliq region was contacted to determine if there were any water quality issues in Arviat. The EHO responded that the drinking water in Arviat has always met the Public Health Act requirements except for one time at the school but that was a localized occurrence within the water tank at the school it was not a water supply or distribution issue.

The bacteriological samples for Dionne Lake did not reach the lab in the required 24 hour hold time and for Goose Lake E.Coli was analyzed instead of Fecal Coliforms.

The laboratory sample results are appended in Appendix C and the GCDWQ can be found in Appendix D.

3.1 Turbidity

Turbidity from the second water quality sample collected from Wolf Creek (WOLF -2) was 1.2 NTU. The current guideline is 1.0 NTU, with an aesthetic objective of ≤ 5 NTU. Turbidity could likely be higher in the creek when the second sample was collected, due to the greater potential for substrate disruption and because of reduced dilution potential. This may not be of concern because settling in the reservoir before the raw water is disinfected and pumped into the distribution system should settle out enough particles to reduce the turbidity below the guidelines.

The guideline of 1 NTU is currently being reviewed by Health Canada, publishers of the GCDWQ, and it is anticipated that the guideline may be reduced to 0.35 or 0.1 NTU. This reduction would require filtration for all surface drinking water sources across Canada.

The Government of Nunavut in the past has adopted the GCDWQ and used them as design criteria for water treatment projects. Should the GN adopt the new proposed guideline for turbidity across the territory all communities in Nunavut would be affected not just Arviat.

As the proposed guideline is still proposed and has not been adopted, for the purpose of this planning report the current turbidity guideline will be used.

Table 1 Water Quality Analysis Compared to the Guidelines on Canadian Drinking Water Guidelines

ANALYTE	UNITS	GUIDELINE[1]	MIKILAAQ LAKE	WOLF CREEK (SEPT 1)	DIONNE LAKE	WOLF CREEK (SEPT 28)	MAGUSE LAKE	GOOSE LAKE
			MIK-1	WOLF-1	DIONNE-1	WOLF-2	MAG-1	GOOSE-1
pH	pH units	6.5-8.5[2]	7.26	6.85	6.66	6.89	6.92	6.92
Turbidity	NTU	1	0.7	0.25	0.5	1.2	0.4	0.75
Sulphate (SO4)- Soluble	mg/L	<500[2]	15	<9	<9	9	<9	<9
Calcium (Ca)- Extractable	mg/L	N.G	11.6	3.3	3.29	5.37	3.07	5.74
Potassium (K) - Extractable	mg/L	N.G	4.69	0.92	0.87	1.07	0.77	1.52
Magnesium (Mg) - Extractable	mg/L	N.G	16.2	1.65	1.47	2.84	1.04	4.02
Sodium (Na) - Extractable	mg/L	N.G	110	8	7.17	13.6	2.64	22.6
Ion Balance	%	N.G	93.2	Low EC	Low EC	82.7	Low EC	115
TDS (Calculated)	mg/L	<500[2]	403	34	33	72	14	83
Hardness (as CaC03)	mg/L	N.G	96	15	14	25	12	31
Fluoride (F) - Soluble	mg/L	1.5	0.2	<0.1	<0.1	<0.1	<0.1	<0.1
Conductivity	umhos/cm	N.G	843	79	75	134	42.0	205
Chloride (Cl) - Soluble	mg/L	<250[2]	232	15	14	35	<9	41
Alkalinity, Total (As CaC03)	mg/L	N.G	23	9	9	9	10	13
Bicarbonate (HC03)	mg/L	N.G	28	11	11	11	12	16
Carbonate (C03)	mg/L	N.G	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6
Hydroxide (OH)	mg/L	N.G	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4
Nitrate + Nitrite- N	mg/L	45	0.03	<0.01	0.13	0.03	<0.01	0.02
Iron (Fe) - Extractable	mg/L	N.G	0.05	0.11	0.08	0.17	0.05	0.09
Manganese (Mn)- Extractable	mg/L	N.G	0.0041	0.0078	0.0067	0.0146	0.0059	0.0045
Silver(Ag) - Total	mg/L	N.G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Aluminum (Al) - Total	mg/L	N.G	0.13	0.13	0.05	0.07	0.14	0.14
Arsenic (As) - Total	mg/L	0.025	0.0013	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Boron (B) - Total	mg/L	5	0.11	<0.03	<0.03	<0.03	<0.03	0.04
Barium (Ba) - Total	mg/L	1	0.0133	0.0056	0.0064	0.0104	0.0094	0.0074
Beryllium (Be) - Total	mg/L	N.G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bismuth (Bi) - Total	mg/L	N.G	0.001	<0.0001	<0.0001	0.0007	<0.0001	<0.0001
Calcium (Ca) - Total	mg/L	N.G	16.3	4.3	3.8	9.4	3.7	7.1

ANALYTE	UNITS	GUIDELINE[1]	MIKILAAQ LAKE	WOLF CREEK (SEPT 1)	DIONNE LAKE	WOLF CREEK (SEPT 28)	MAGUSE LAKE	GOOSE LAKE
			MIK-1	WOLF-1	DIONNE-1	WOLF-2	MAG-1	GOOSE-1
Cadmium (Cd) - Total	mg/L	0.005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Cobalt (Co) - Total	mg/L	N.G	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chromium (Cr) - Total	mg/L	0.05	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Cesium (Cs) - Total	mg/L	N.G	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Copper (Cu) - Total	mg/L	N.G	0.006	0.003	0.008	<0.001	0.004	0.004
Iron (Fe) - Total	mg/L	<0.3[2]	0.07	0.12	0.13	0.12	<0.05	0.18
Potassium (K) - Total	mg/L	N.G	6.4	1	0.8	1	0.8	1.6
Lithium (Li) - Total	mg/L	N.G	<0.01	<0.01	<0.01	0.02	<0.01	<0.01
Magnesium (Mg) - Total	mg/L	N.G	23.1	2.1	1.63	2.71	1.32	5
Manganese (Mn) - Total	mg/L	<0.05[2]	0.0055	0.0107	0.0082	0.0156	0.007	0.0075
Molybdenum (Mo) - Total	mg/L	N.G	0.0175	0.0106	0.0003	0.0005	<0.0002	0.0003
Mercury (HG) - Total	mg/L	0.001	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003	<0.0003
Sodium (Na) - Total	mg/L	<200[2]	155	10	7.67	13.3	3.35	27.8
Nickel (Ni) - Total	mg/L	N.G	<0.002	<0.002	<0.002	<0.002	0.002	<0.002
Phosphorus (P) - Total	mg/L	N.G	0.1	0.08	<0.05	<0.05	0.06	0.06
Lead (Pb) - Total	mg/L	0.01	0.0033	<0.0005	0.0008	0.0007	<0.0005	<0.0005
Rubidium (Rb) - Total	mg/L	N.G	0.005	0.0025	0.0022	0.0021	0.0021	0.0035
Antimony (Sb) - Total	mg/L	0.006	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium (Se) - Total	mg/L	0.01	0.005	0.002	<0.001	<0.001	0.002	0.002
Tin (Sn) - Total	mg/L	N.G	0.001	0.0027	<0.0005	0.0009	0.0007	0.0006
Strontium (Sr) - Total	mg/L	N.G	0.202	0.029	0.0261	0.0385	0.0209	0.0647
Tellurium (Te) - Total	mg/L	N.G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Titanium (Ti) - Total	mg/L	N.G	<0.0009	<0.0009	0.001	0.0015	0.0173	0.0035
Thallium (Tl) - Total	mg/L	N.G	0.0006	0.0002	0.0005	0.0003	<0.0001	0.0002
Uranium (U) - Total	mg/L	0.02	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Vanadium (V) - Total	mg/L	N.G	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tungsten (W) - Total	mg/L	N.G	0.0015	0.0003	<0.0002	0.0006	<0.0002	<0.0002
Zinc (Zn) - Total	mg/L	N.G	0.02	<0.01	<0.01	0.14	<0.01	<0.01
Zirconium (Zr) - Total	mg/L	N.G	0.0014	0.0005	0.0004	0.001	<0.0004	<0.0004

ANALYTE	UNITS	GUIDELINE[1]	MIKILAAQ LAKE	WOLF CREEK (SEPT 1)	DIONNE LAKE	WOLF CREEK (SEPT 28)	MAGUSE LAKE	GOOSE LAKE
			MIK-1	WOLF-1	DIONNE-1	WOLF-2	MAG-1	GOOSE-1
BACTERIOLOGICAL								
Fecal Coli	CFU/100mL		<10	<10	-	<10	<10	
Total Coliforms	CFU/100mL		<10	<10	-	<10	1580	309
Heterotrophic Plate Count	CFU/mL		775	485	-	90	155	1500
E.Coli	CFU/100mL		-	-	-	-	-	1

1: Guideline for Canadian Drinking Water Quality

2: Aesthetic Objectives

N.G: No Guideline Established

N.L: No limit established

Field analyses were conducted at all sites using a YSI handheld meter and are presented below.

Table 2 Field Water Quality Analysis

PARAMETER	UNITS	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Temperature	°C	11.26	11.2	11.2	9.87	11.45
Conductivity	µS/cm	60	30	53	617	155
Total Dissolved Solids	mg/L	52	26	47	564	136
Dissolved Oxygen	mg/L	9.74	8.71	8.58	10.42	9.78

3.2 Water Demand Projection

3.2.1 Population Projection

To estimate future water use, the population of Arviat was projected for the next 20-years. The 20-year population projection calculated from population statistics from the GN website, www.stats.gov.nu.ca, is shown in Table 1.

Table 3 Census Population Statistics, Arviat, NU

Census year	Population
1981	1,002
1986	1,189
1991	1,323
1996	1,559
2001	1,899

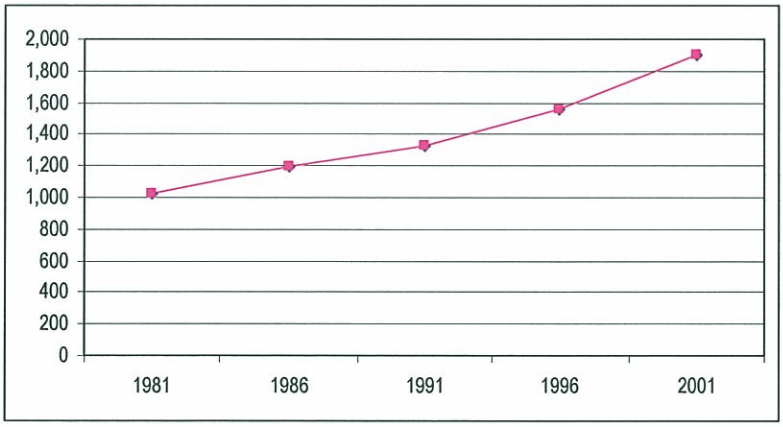


Figure 1 Population Increase, 1981 - 2001

A population growth rate of 2.9% was calculated from the census information.

Past experience has shown that census numbers can under-represent the actual population in communities throughout Nunavut. During the site visit, the SAO mentioned that the Hamlet

conducted their own population study in 2000 and determined there were 1,934 residents. The SAO estimates there are approximately 80 births per year. For the best available estimate, IEG will use water data provided by CGS in conjunction with the population growth rate determined by the population increase in the census data to calculate the projected water use rates.

3.2.2 Past Water Use Rates

Water use data was provided by CGS for the 2001-2002 and 2003-2004 fiscal years. From April 1, 2001 to March 31, 2002 the Hamlet of Arviat consumed approximately 57,405,564 L and from April 1, 2003 to March 31, 2004 65,482,349 L.

3.2.3 Projected Water Use Rates

To project future water use for the Hamlet of Arviat, the CGS model was modified. The CGS water use model is as follows:

Projected per capita water use = RWU*(1+(0.00023*Population))

Where:

- The projected per capita water use is the volume of liters used per person per year and includes all commercial and institutional water use
- RWU = Residential water use rate, assumed to be 90 litres per capita per day (lpcd)
- Population is the projected population of the Hamlet for the year

The formula was modified to correspond with the water use rates provided by CGS, the modification was to 65 lpcd for the RWU. This is a relatively low RWU and it was confirmed by the Maintenance Coordinator for the Kivalliq Region, Joe Strickland, that he has observed that Arviat has a lower water use rate per capita than other communities. The following table outlines the per capita and annual projected water use rates for the Hamlet.

Table 4 20-Year Water Use Projection

PLANNING YEAR	CALENDAR YEAR	TOTAL POPULATION[1]	PROJECTED WATER USE (lpcd)	PROJECTED VOLUME (litres/day)	PROJECTED VOLUME (litres/year)	PROJECTED VOLUME (m^3/year)
	2001	1,899	93.4	177,348	64,731,912	64,732
	2002	1,954	94.2	184,100	67,196,353	67,196
	2003	2,011	95.1	191,142	69,766,815	69,767
	2004	2,069	95.9	198,489	72,448,406	72,448
0	2005	2,129	96.8	206,155	75,246,501	75,247
	2006	2,191	97.8	214,156	78,166,758	78,167
	2007	2,254	98.7	222,507	81,215,134	81,215
	2008	2,320	99.7	231,227	84,397,899	84,398
	2009	2,387	100.7	240,333	87,721,657	87,722
5	2010	2,456	101.7	249,845	91,193,361	91,193
	2011	2,527	102.8	259,782	94,820,337	94,820
	2012	2,601	103.9	270,165	98,610,298	98,610
	2013	2,676	105.0	281,017	102,571,372	102,571
	2014	2,754	106.2	292,362	106,712,124	106,712
10	2015	2,834	107.4	304,223	111,041,577	111,042
	2016	2,916	108.6	316,628	115,569,241	115,569
	2017	3,000	109.9	329,603	120,305,140	120,305
	2018	3,087	111.2	343,178	125,259,838	125,260
	2019	3,177	112.5	357,382	130,444,475	130,444
15	2020	3,269	113.9	372,249	135,870,793	135,871
	2021	3,364	115.3	387,811	141,551,176	141,551
	2022	3,461	116.7	404,106	147,498,681	147,499
	2023	3,562	118.2	421,170	153,727,079	153,727
	2024	3,665	119.8	439,044	160,250,895	160,251
20	2025	3,771	121.4	457,768	167,085,452	167,085

[1] Population Increase = 2.9%

[2] Residential Water Use Rate (RWU) = 65 lpcd

The projected water use rates estimated for the Hamlet's water licence submission closely match the IEG water use projection, given that the projection is an estimate. The water licence submission estimates water use rates of 64,871m^3 in 2003 and 78,273m^3 in 2008 compared with the estimates in the above table of 69,767m^3 for 2003 and 84,398m^3 in 2008. For the planning purposes of this study the higher estimates calculated in the table will be used.

3.3 Water Reservoir Capacity

Based on the information provided by CGS and the projected water use prepared by IEG, the 145,000 m^3 of reservoir storage should last the Hamlet until 2021.

3.4 Upgrades

Based on observations during the site visit and on conversations with the Maintenance Coordinator for the Kivalliq region, the SAO and the Mayor, there do not appear to be any requirements for upgrades to the current infrastructure outside those routinely undertaken as part of the Operation and Maintenance program.

3.5 Secondary Truckfill Arm

It was requested by CGS that the potential of a second truckfill be investigated as part of this study because the trucks get backed up at the truckfill station waiting to fill their trucks. The location of the current truckfill arm is not conducive to adding a second arm. The approach to the truckfill station is a half-circle with the arm at the center of the half-circle, so there is not room for two trucks to be lined up even if there was a second arm, please see photos in Appendix A.

Currently a problem does not exist with callouts after hours either due to insufficient time to complete the routes or fill all the tanks on the route. Therefore, modifications to the current schedule may solve the problem of trucks lining up at the truckfill station. If the trucks were to start the day staggered or if routes were changed so not all the trucks fill at the same time, then the waiting time at the truckfill might be alleviated. These options should be explored and implemented to determine effectiveness before planning and design is carried out to expand the current truckfill station and construct another truckfill arm.

4.0 SUSTAINABILITY ASSESSMENT

4.1 General

It is necessary to evaluate each of the sources in order to determine their sustainability. The general features of the area and the individual water sources are evaluated in terms of geology, terrain, and other special features. The quantity that is withdrawn should represent a small portion of the source volume or flow rate. This will ensure that there is no short or long term depletion of the source. Source depletion may have negative environmental impacts. It may also affect the viability of the intake structures and the quality of the extracted water.

4.2 Geological Setting

Arviat and the lakes and creek that have been selected as possible water sources for Arviat are located on the western side of Hudson Bay. Bedrock underlying all of the lakes and Wolf Creek is Precambrian in origin. Wolf Creek, Mikilaaq Lake, Goose Lake and Dionne Lake are all underlain by Precambrian gneiss and schist (Geological Map of Canada, 1250A). Maguse Lake is underlain by Precambrian volcanic rock.

The study area was glaciated by an ice sheet that was standing in the Tyrell Sea; an expanded version of Hudson Bay. This sea covered areas up to 168 m above modern sea level inland and 213 m above sea level near the present coast. Glacial till was deposited in moraines along with sand and gravel deposited by glacio-fluvial melt. The glacial deposits and features were strongly influenced by the ice fronting in and retreating through the deep sea water (Shilts, Kettles, and Arsenault, 1976).

The land rose due to isostatic rebound after the glacier retreated. It rose rapidly at first but the rate of uplift decreased with time. As the land rose out of the sea, shorelines migrated towards the present coast of Hudson Bay. A series of beaches (near shore sediments) formed across the region. These beaches mostly formed where sand and gravel deposited by the glacier was available for "washing" or where uplift was slowest (i.e., where beach locations were left for the longest time). The rate of uplift decreased toward the coast. Therefore, the youngest near shore deposits are best developed.

As the sea retreated, permafrost grew to depths of greater than 3050 m. Peri-glacial patterns developed controlled by the physical properties of the surficial sediments. For example, mud boils are confined to the muddy sediments of glacial or marine origin. Polygonal or orthogonal cracking patterns are found in more stable sandy, gravely, or peaty sediments such as eskers, beaches, or alluvial flats.

4.2.1 Potential Water Sources

Characteristics of the five potential water sources are described in Table 5. The information included in this table was compiled from the Geological Survey of Canada surficial geology map of the Eskimo Point map sheet (GSC Map 8-1980) and from airphotos (not stereoscopic) supplied by the project. A topographic map at 1:250 000 scale (55e) and the figure in Appendix B were also used for the analysis.

Lake size, distance from Arviat, and bedrock and surficial sediments along the lakes and Wolf Creek were described in Table 1. Also a description of material that would be crossed by a water line from each of the sources to Arviat was determined.

Any special features that might affect the water source were also listed, e.g. the turbid lake processes at the west end of Goose Lake, due to surficial geology. An attempt was made to outline both shallow and deeper sections of the lakes (where airphotos were available).

Table 5 Geomorphology Summary

WATER SOURCE	GEOLOGIC SETTING	SPECIAL FEATURES	TERRAIN ALONG ROUTE TO ARVIAT (STRAIGHT LINE	COMMENTS
Wolf Creek (Existing Source)	Bedrock underlying the Quaternary sediments in this area consists of Precambrian igneous and metamorphic rocks (gneiss and schist). The creek is located in a flat area consisting of alluvium with some marine silt and sand that was either washed from slopes by wave action during marine submergence or deposited by melt water streams. The lakes feeding the stream are located in off lap sediments that consist of a thin sheet of sand over clayey marine silt and sand. The creek passes through an area that was once a small glacial lake basin of silt with organic carbon.	The alluvium is covered by .4 to 1 m of peat. Active layer is 15 to 50 cm deep. Ice wedges, thaw ponds, and frost polygons may be present in the alluvial deposits. The sediments in the vicinity of the lakes that feed Wolf Creek have been affected by periglacial processes and gullying.	The most common terrain found between Wolf Creek and Arviat is an area of coastal plain tidal flat sediments. The sediments are poorly sorted stony silt and sand and marine silt. The area was originally a till plain that was affected by marine processes. An esker and marine beach ridges are located immediately south of Arviat. Material from these ridges could be used for construction purposes.	Lakes feeding Wolf Creek may be shallow and will freeze to the bottom. Wolf Creek passes through an area of glacial lake deposits with organic carbon that may affect water quality
Mikilaaq Lake	Bedrock underlying the Quaternary sediments in this area consists of Precambrian igneous and metamorphic rocks (gneiss and schist). Mikilaaq Lake is located in an area of near shore sediments that consists of sand, gravel, cobbles or boulders deposited as beaches, bars, spits, and ice pushed ridges. These deposits appear in the beach ridges north and south of the lake (see airphoto 28-07-92. South of this beach area on the south side of the lake and at the west end of the lake there are coastal plain tidal sediments (silt, sand, clayey silt).	The lake has been infilled to some extent by sediments. These were eroded from the adjacent land areas. Airphoto 28-07-92 shows the areas where sediment deposition has made the lake shallower. Areas underlain by near shore sediments have sparse vegetation and orthogonal frost cracks. Areas underlain by coastal tidal plain sediments have organic cover, shallow thaw lakes and periglacial features.	The most common terrain found between Mikilaaq and Arviat is an area of coastal plain tidal flat sediments. The sediments are poorly sorted stony silt and sand and marine silt. The area was originally a till plain that was affected by marine processes. An esker and marine beach ridges are located immediately south of Arviat. Material from these ridges could be used for construction purposes. Construction material could also be taken from the beach ridge at the south side of Mikilaaq Lake. The existing road to Arviat appears to be made from common borrow material along the road alignment.	Mikilaaq Lake has easy road access to Arviat. The lake has some sections, particularly on the south side that look a bit deeper. It would be prudent to get into the deeper area of the lake for water intake. It is unknown if this lake will freeze to the bottom in winter. This lake appears to be underlain by near shore sediments. Water quality may be better in lake underlain by these sediments.
Goose Lake	Bedrock underlying the Quaternary sediments in this area consists of Precambrian igneous and metamorphic rocks (gneiss and schist).	Areas underlain by coastal tidal plain sediments have organic cover, shallow thaw lakes and periglacial features.	The most common terrain found between Goose Lake and Arviat is an area of coastal plain tidal flat sediments. The sediments are poorly sorted stony silt and sand and marine silt. The area was originally a till plain that was affected by	This lake appears to be underlain by coastal plain tidal flat sediments that are mostly fine grained.

WATER SOURCE	GEOLOGIC SETTING	SPECIAL FEATURES	TERRAIN ALONG ROUTE TO ARVIAT (STRAIGHT LINE	COMMENTS
	The lake is located in an area of coastal plain tidal flat sediments. The sediments are poorly sorted stony silt and sand and marine silt, clayey silt, and pockets of near shore sand and gravel deposits. The area was originally a till plain that was affected by marine processes. A beach ridge of near shore sediments is located south of Goose Lake.	The surficial geology map by GSC Map 8-1980 shows that Goose Lake, particularly the NW end, is a turbid lake that receives a continual load of suspended sediments during ice free periods. Terrain near this lake may exhibit instability or alteration of the active layer because of wave washing or solifluction. Airphotos 25582, # 75 and 37 show the locations in Goose Lake where sediment deposition has made the lake shallower. It is difficult to tell how deep the easternmost part of the lake is from the airphotos. However, the west end is quite infilled.	marine processes. There is an area of near shore beach sediments both south and east of Goose Lake. An esker and marine beach ridges are located immediately south of Arviat. Material from these deposits and from beach ridges to the south and east of Goose Lake could be used for construction materials.	Airphotos and the GSC map 8-1980 indicate that Goose Lake is a turbid lake that is infilling with sediments during ice free periods. It might be difficult to find a deep area in this lake that is close to the shoreline for the water intake (see airphotos 25582 #37 and 75. This lake might freeze to the bottom.
Dionne Lake	Bedrock underlying the Quaternary sediments in this area consists of Precambrian igneous and metamorphic rocks (gneiss and schist). The lake lies within landforms (moraine plain and ridge deposits) that are made of till sediments. These sediments are usually grey sandy, silty, and noncalcareous with <25% clay-sized particles. There are patches of clay- rich red till in the till sediments. At the east end of the lake there are near shore deposits of sand and gravel that form beach ridges. In this area there are also offlap sediments of sand deposited by a migrating shoreline. An esker deposited by melt water crosses the lake.	Till sediments have liquid limits of 8 to 18% and a plasticity index of 0 to 8%. These sediments are susceptible to liquefaction under loading or during periods of increased moisture (heavy rain or spring thaw). Lakes have cobble and boulder paved shorelines. Mudboils and periglacial features occur on till deposits. One shallow part of Dionne Lake was located on its east end (see airphoto A18911 #33).	The terrain between Dionne Lake and Arviat consists of both an area of coastal plain tidal flat sediments near Arviat and an area of near shore and off lap deposits immediately east of Dionne Lake. The coastal plain tidal flat sediments are poorly sorted stony silt and sand and marine silt. The area was originally a till plain that was affected by marine processes. There is an area of near shore beach sediments east of Dionne Lake. An esker and marine beach ridges are located immediately south of Arviat. Material from these deposits and from beach ridges and an esker in Dionne Lake could be used for construction materials.	If is difficult to determine the depth of the lake from the 1:80 000 scale airphotos. One shallow section was determined on the east end. This lake is located in till deposits. The lake is bigger than Goose or Mikilaaq lakes.
Maguse Lake	Bedrock underlying the Quaternary sediments in this area consists of Precambrian volcanic rocks.	Till sediments have liquid limits of 8 to 18% and a plasticity index of 0 to	The terrain between MaguseLake and Arviat consists of coastal plain tidal flat sediments near	If is difficult to determine the depth of the lake because no

WATER SOURCE	GEOLOGIC SETTING	SPECIAL FEATURES	TERRAIN ALONG ROUTE TO ARVIAT (STRAIGHT LINE	COMMENTS
	The lake lies within landforms (moraine plain, ridge, and hummocky deposits) that are made of thicker till sediments. There is also shallow rock around the shoreline of the lake in some locations. Near the proposed water intake location there are some morainal deposits, glaciofluvial outwash, and alluvial deposits. Morainal deposits are made of till sediments that are usually grey sandy, silty, and noncalcareous with <25% clay-sized particles. There are patches of clay- rich red till in the till sediments.	8%. These sediments are susceptible to liquefaction under loading or during periods of increased moisture (heavy rain or spring thaw). Lakes have cobble and boulder paved shorelines. Mudboils and periglacial features occur on till deposits. There were no airphotos available to determine shallow areas within Maguse Lake.	Arviat and areas of morainal, glaciofluvial, alluvial and scattered near shore and off lap deposits immediately east of Maguse Lake. An esker and marine beach ridges are located immediately south of Arviat. Material from these glaciofluvial deposits and from an esker in Maguse Lake could be used for construction materials. It might be possible to follow the esker and/or lakes as a route back to the Maguse River near Hudson Bay. From there a route for the water line could head due south to Arviat.	airphotos were available. This lake is located mostly in shallow bedrock and till deposits. The lake is bigger than Goose, Mikilaaq, or Dionne lakes. This lake may not freeze to the bottom because of its size and possible depth. However, no airphotos were available to assess the lake.

4.3 Flow Modeling

There is no runoff data available for any of the sources being assessed. In order to estimate the runoff volumes and trends we need to model each possible source. The model yields a useful estimate of each sources flow volumes and trends.

Each possible source is associated with a catchment area, which is determined using topographical maps (Energy Mines and Resources Canada, 1994). The annual runoff volumes associated with each catchment is modeled using local precipitation data (Environment Canada, 2004) and the rational method. A run-off coefficients for similar northern terrain was used (Global Runoff Data Center, 2004). The flow profiles for the catchments are simulated using flow trend data from similar catchments in the region (Water Survey of Canada, 2004).

The run-off in these catchments is seasonal. The flow volume that occur after break-up (i.e., June 1) and before freeze-up (i.e., December 1) represent the majority of the annual run-off. There is very little run-off flow during the winter months except for a relatively large lake with a large catchment such as Maguse Lake.

The surface area of the lake sources is estimated using scaled maps (Energy Mines and Resources Canada, 1994). The annual drawdown can be determined using the surface area and the extraction rate. The drawdown is compared to the annual inflow volumes coming from runoff entering the lake. When the water is extracted from a creek, the flow rate of the creek is compared to the extraction rate.

Where the extraction rate has an insignificant drawdown and the inflow or stream flow rate is much greater than the extraction rate, the source is sustainable. The sources are assessed at a maximum extraction rate of 0.05 m^3/s and a maximum annual withdrawal volume of 150,000 m^3. Using this baseline, all of the sources are sustainable.

If we compare the withdrawal rate to the smallest source (i.e., Mikilaaq Lake), it can be seen that the inflow rate is more than ten times greater than the maximum extraction rate. The summary of this analysis is shown below. All of these values are estimates derived from indirect data by the method detailed above.

Table 6 Sustainability Summary Analysis

SOURCE	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Catchment Area (km^2)	650	12,000	490	38	240
Lake Surface Area (km^2)	n/a	250	40	1	4
Average Flow (m^3/s) -Dec 1 to May 31	0.01	23.6	0.01	0.001	0.003
Average Flow (m^3/s) -Jun 1 to Nov 30	11.6	142.3	8.8	0.7	4.3
Surface Drawdown (mm/yr) - 150,000 m^3 extracted	n/a	0.6	3.8	150	38
Surface Rise due to Inflow (mm/yr)	n/a	9,600	2,400	7,600	12,000

4.4 Regulatory Compliance

If the water sources are fish bearing, as it is suspected they are, special intake screens will be required depending on the types of fish in lake. Should the site selection process move into design the required fish intake screen will have to comply with the DFO *Freshwater Intake End of Pipe Guidelines* prior to preparing the tender documents.

4.5 Cost estimate

4.5.1 General

A screening level cost estimate is a useful tool for evaluating and comparing the economic feasibility of the different sources. At this point, only the basic information of level of service, intake structures, elevations, and route are known. Subsequent investigation and design may result in different characteristics. To establish a common criterion for analysis the following assumptions were made:

- Maximum pumping flow rate of 2,500 m^3/day (460 USgpm),
- Total annual volume of 150,000 m^3,
- Same inlet structure for each source, and;
- Route distance equal to direct map distance plus 10%

Using these assumptions and information compiled from topographic maps, a preliminary hydraulic analysis was done for each source. The hydraulic analysis was performed using EPANET 2.0. The system consists of an intake structure, a pump house located near to the intake, and a pipeline terminating at the Arviat reservoirs. The pipeline slope is assumed to be uniform with no intermediate pumping.

4.5.2 Construction

No major obstructions were identified for the pipeline routes from the various sources.

The pipeline material used is butt-fusion welded high density polyethylene (HDPE). The nominal diameter of the pipeline is 200 mm (8") with a 110 kPa (160psi) working pressure rating. The construction materials and methods are also likely to change in response to further information and design.

The accuracy of the screening level cost estimates presented can be considered accurate within a confidence of minus 50% to plus 100%. The fixed costs assumed may be variable for each route due to varying field conditions. These costs do not include costs such as transporting materials and technical personnel to Arviat or other items not specifically mentioned. The costs were estimated using a fixed cost for the intake and pump house and an incremental cost (by length) for pipeline materials and installation as shown below.

Table 7 Construction Cost Estimate

ITEM	COST BASIS	COST PER UNIT
Pipeline Materials **-Pipe, fittings, supports, valves, etc.**	Cost per meter	$40.00
Pipeline Installation **-Technician, Labor, Operator, Inspection, and Equipment**	Cost per meter	$20.00
Intake and Pump House **-Supply and Install**	Lump Sum	$300,000

The following table lists the estimated screening level costs for material and installation for each source:

Table 8 Installation Cost Estimate

SOURCE	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Direct Distance (km)	8	48	25	7	17
Cost ($)	830,000	3,470,000	1,950,000	770,000	1,430,000

4.5.3 Operation & Maintenance

The source chosen will impact the associated operation and maintenance costs. Some maintenance costs are fixed however most of the costs are incremental according increased distance to the source. Some of the incremental operation and maintenance costs associated with longer pipeline lengths are:

- greater pumping energy and associated energy costs,
- longer operator travel time,
- increased monitoring,
- more difficulty draining the pipeline before freeze-up, and;
- higher operating pressure leading to increased equipment maintenance.

The approximate pumping energy requirements for each source were determined by the hydraulic analysis. Energy costs are considerable in the region regardless of the source (electricity, diesel fuel, etc.) The energy costs will represent a significant portion of the operation and maintenance costs. Using sources with higher elevations can decrease the pumping energy required and facilitate pipeline drainage. The estimated energy costs due to pumping are given below. The energy costs have been estimated at $0.50 per kilowatt-hour.

Table 9 Pumping Costs Estimate

SOURCE	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Pumping Energy (kw)	17	88	42	15	31
Annual Cost ($)	16,000	84,000	41,000	14,000	30,000

4.5.4 20-year Life Cycle Costs

The 20 year life cycle cost allows us to compare the different alternatives. All of the alternatives have similar qualities and assumptions attached to them. The life cycle costs have been calculated based on the capital costs, replacement costs, energy costs, and maintenance costs. The 20 year life cycle costs were calculated using two different discount rates. The calculations assume that community growth will not affect the costs which have been evenly dispersed.

The life expectancy of the pipeline has been estimated to be 25 years while the life expectancy of the intake and pumphouse were estimated to be 15 years. The salvage value of both of these items was assumed to be zero.

The energy costs were assumed to be consistent through the 20 year period. The lifetime maintenance costs were assumed to be twice the capital cost divided evenly over the life expectancy of the equipment.

Table 10 20-year life cycle cost (8% discount rate)

ITEM	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Pipeline - Capital Cost	480,000	2,880,000	1,500,000	420,000	1,020,000
Intake and Pump House - Capital Cost	350,000	590,000	450,000	350,000	410,000
Pipeline Replacement - Present Worth of Replacement	71,000	421,000	220,000	62,000	149,000
Intake and Pump House – Present Worth of Replacement	111,000	186,000	142,000	111,000	130,000
Energy Costs – Present Worth	174,000	909,000	444,000	152,000	325,000
Maintenance Costs – Present Worth	920,000	3,343,000	1,948,000	866,000	1,472,000
Total	**2,106,000**	**8,329,000**	**4,704,000**	**1,961,000**	**3,506,000**

Table 11 20-year life cycle cost (6% discount rate)

ITEM	WOLF CREEK	MAGUSE LAKE	DIONNE LAKE	MIKILAAQ LAKE	GOOSE LAKE
Pipeline - Capital Cost	480,000	2,880,000	1,500,000	420,000	1,020,000
Intake and Pump House - Capital Cost	350,000	590,000	450,000	350,000	410,000
Pipeline Replacement - Present Worth of Replacement	112,000	672,000	350,000	98,000	238,000
Intake and Pump House – Present Worth of Replacement	147,000	247,000	188,000	147,000	172,000
Energy Costs – Present Worth	200,000	1,048,000	512,000	175,000	375,000
Maintenance Costs – Present Worth	1,060,000	3,854,000	2,245,000	998,000	1,696,000
Total	**2,349,000**	**9,291,000**	**5,245,000**	**2,188,000**	**3,911,000**

4.5.5 Potential Treatment Requirements

Wolf Creek and all of the potential drinking water sources, Maguse Lake, Dionne Lake, Mikilaaq Lake and Goose Lake meet the current drinking water guidelines at the reservoir outlet. As discussed in an earlier section there may be legislated changes in the future regarding turbidity, which would require filtration of surface water sources. This would be consistent with changes in legislation in other provinces in Canada where filtration and disinfection is required or will soon be required. These requirements would be for new or upgraded systems, with a set deadline for existing systems.

While not confirmed during this study, it is likely that the two reservoirs provide some improvement in turbidity over the raw water from Wolf Creek. However, should a filtration system be required in the future, the most effective location in the process would be between the storage reservoir and the delivery trucks. A 1-micron absolute filtration system would be sufficient for turbidity and certain micro-organisms. An ultrafiltration system or a system using multimedia filters with 1-micron cartridge filters would cost in the order of $150,000, housed and skid mounted for installation at the reservoir near the truck fill station.

4.5.6 Discussion

The estimates show the costs for each source increase with distance from the reservoirs in Arviat in terms of construction and operation and maintenance. Other incremental costs that have not been accounted for would only serve to reinforce this conclusion.

The choice of a source that is a greater distance from Arviat would have to be justified in other terms. All of the sources discussed have adequate flow volumes for seasonal withdrawal. The quality varies seasonally and according to the source. To provide an improved and consistent level of service, it may be more cost effective to invest in improved intake facilities and/or water treatment systems.

5.0 CONCLUSIONS & RECOMMENDATIONS

5.1 Conclusions

- The total reservoir capacity is 143,000 m^3.
- All of the potential new drinking water sources and Wolf Creek meet the Guidelines *for Canadian Drinking Water Quality*, except for the fall sample at Wolf Creek which was higher slightly higher for turbidity than the guidelines.
- The bacteriological results, Fecal Coliforms, Total Coliforms and the Heterophic Plate Count are expected for surface water.
- There is sufficient capacity at all the sources for at least the next 20 years.
- The cost of a seasonal pipeline from the different potential new sources to the current reservoir where proportional to the distance from the source to the reservoir. Therefore Maguse Lake had the highest NPV cost and Mikilaaq Lake the lowest.
- Community concerns were with the capacity of Wolf Creek because it appears to be drying up. Based on the geomorphological study and the flow measurements the water source is sustainable.
- The mayor had concerns that a creek between Dionne Lake and Wolf Creek was changing, part of it was drying up and a bridge was moved further downstream. Mr. Kritaqliluk concern was that a similar phenomen may occur in Wolf Creek.
- The geomorphological study and catchment area calculations determined the current water supply source, Wolf Creek has sufficient capacity to meet the Hamlet's needs for the next 20 years.
- A second truckfill arm may not be required. Changes to scheduling so the trucks are not filling up at the same time should be investigated before design in new infrastructure is undertaken.
- A filtration system could be installed at the reservoir to achieve 1-micron absolute filtration at a capital cost in the order of $150,000.

5.2 Recommendations

- The census population for the Hamlet of Arviat may not be accurate and the population growth rate is higher than most other communities in Nunavut. The population should be monitored and any changes affecting water supply, water treatment & distribution, wastewater collection & treatment and solid waste management should be investigated.
- The water quality at the reservoir meets the *Guidelines for Canadian Drinking Water Quality.* Source water treatment, disinfection, for municipal use is always required. Water quality and palatability at the tap may be of concern to community residents. This falls

outside the jurisdiction of the GN but could be discussed with the Hamlet to determine a resolution, if required.

- The water delivery schedule should be reviewed to have the trucks filling up at different times so they are not at the truckfill station at the same time. There is currently not a problem with call outs so the schedule is efficient in delivering water to the consumers.
- This study is for feasibility purposes. Confirmation of the suitability of the source water supply is required prior to infrastructure construction.

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Water Survey of Canada, 2004, Archived Hydrometric Data 1989-1995, Diana River Near Rankin Inlet (06NC001). http://www.wsc.ec.gc.ca/hydat/H2O/

Appendix A-Photos

Appendix B-Figures

Appendix C – Laboratory Results

PHOTO LOG

Date: 09/01/04	Location: Goose Lake
Description: Field sampling equipment looking onto lake	

Date: 09/01/04	Location: Goose Lake
Description: Small creek flowing into Goose Lake	

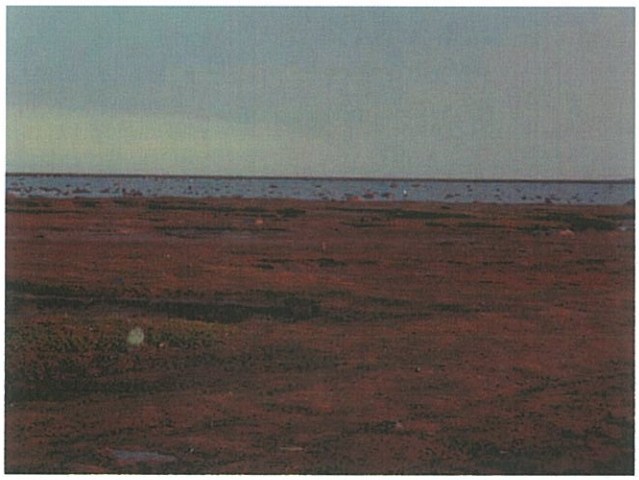
Date: 09/01/04	Location: Water line pipeline
Description: Pipeline between water supply and reservoir	

Date: 09/01/04	Location: Wolf Creek
Description: Downstream of the natural pond where the intake line is	

Date: 09/01/04	Location: Wolf Creek
Description: Natural pond where the intake line is located	

Date: 09/01/04	Location: Wolf Creek
Description: Pumphouse and natural pond where the intake line is located	

Date: 09/01/04	Location: Wolf Creek
Description: Upstream of the natural pond where the intake line is located	



Date: 09/01/04	Location: Shore of Hudson Bay
Description: Access trail between the pumphouse and Arviat	

Date: 09/01/04	Location: Mikilaaq Lake
Description: Mikilaaq Lake	

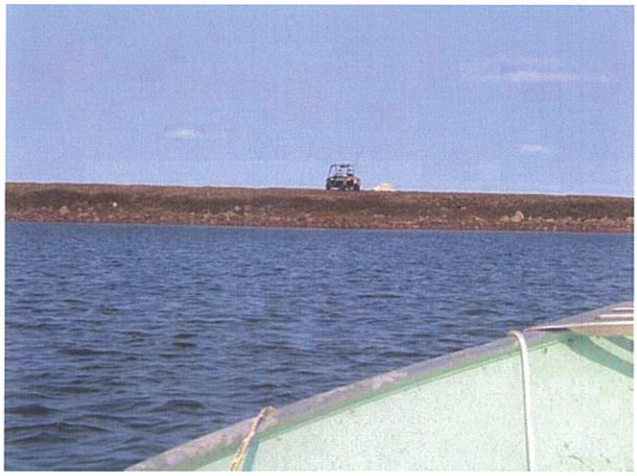
Date: 09/02/04	Location: Creek between Dionne Lake & Wolf Creek
Description: Where the bridge used to be looking upstream towards Dionne Lake	

Date: 09/02/04	Location: Creek between Dionne Lake & Wolf Creek
Description: Where the bridge used to be, water depth approximately 6"	

Date: 09/02/04	Location: Creek between Dionne Lake & Wolf Creek
Description: Where the bridge used to be, looking up to the bank	

Date: 09/02/04	Location: Creek between Dionne Lake & Wolf Creek
Description: Where the bridge is now, looking downstream	

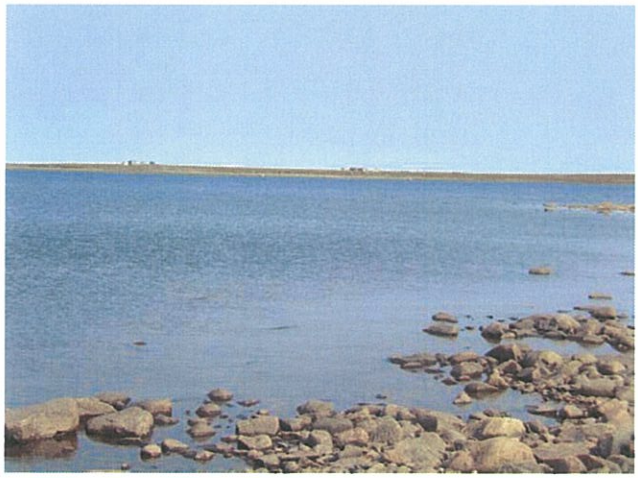
Date: 09/02/04	Location: Creek between Dionne Lake & Wolf Creek
Description: Where the bridge is now, looking downstream	



Date: 09/02/04	Location: Dionne Lake
Description: Photo taken from boat, facing the bank ATV in background	

Date: 09/02/04	Location: Dionne Lake
Description: Photo taken from shore looking out onto the lake	

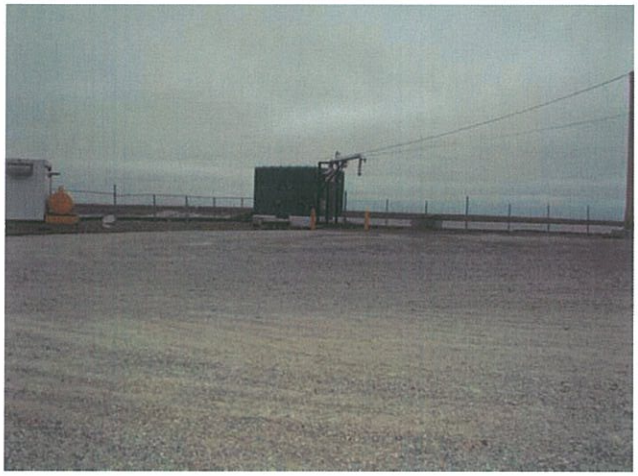
Date: 09/02/04	Location: Trail from Dionne Lake to Arviat
Description: Trail from Dionne Lake to Arviat	



Date: 09/03/04	Location: Maguse Lake
Description: Sample location, cabins in the background	

Date: 09/03/04	Location: Maguse Lake
Description: From the shore of lake looking up to where cabins are located	

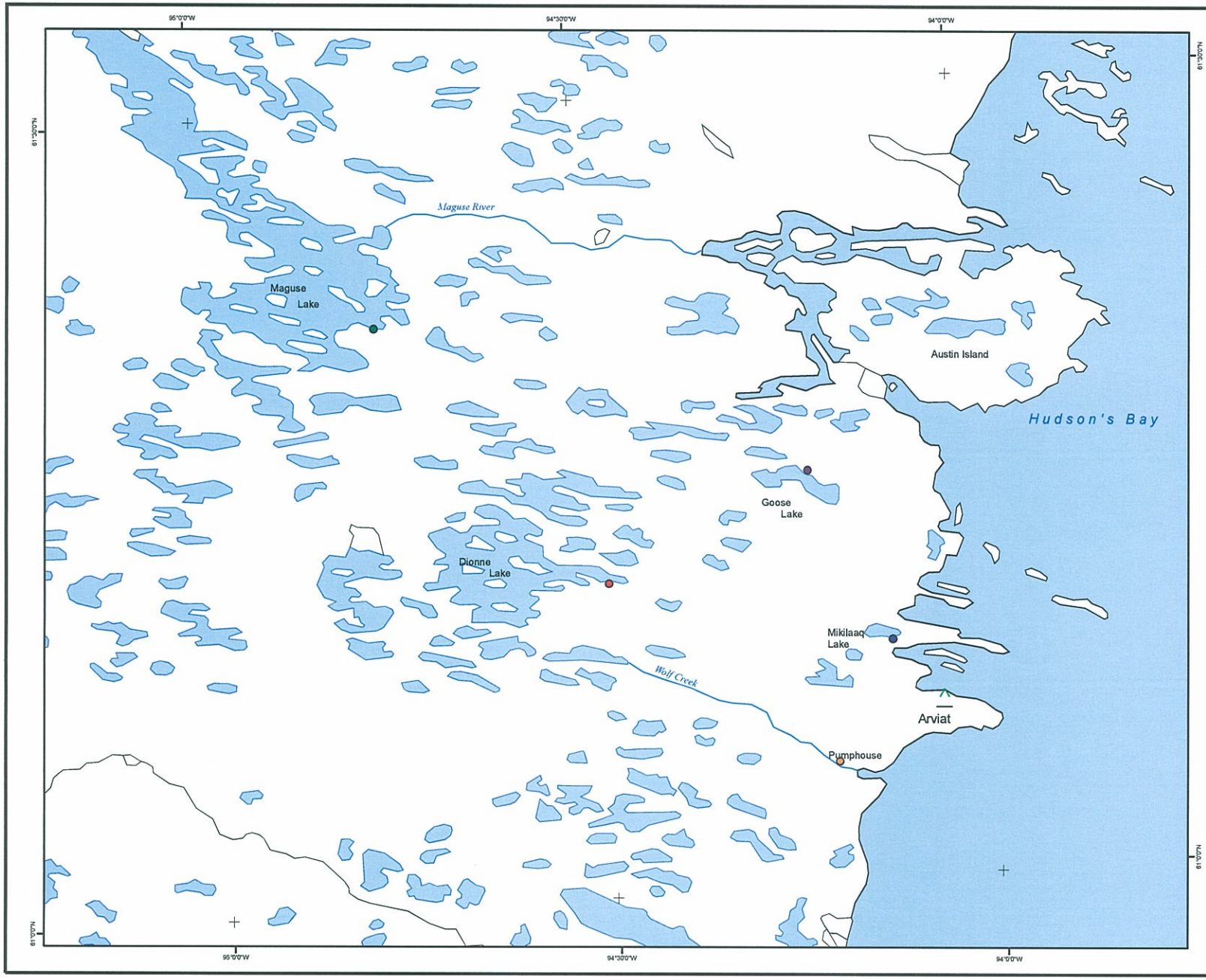
Date: 09/03/04	Location: Reservoir & truckfill station
Description: Easter berm of reservoir	



Date: 09/03/04	Location: Reservoir & truckfill station
Description: Truckfill station & truck turnaround area	

Date: 09/03/04	Location: Reservoir & truckfill station
Description: Common berm between two reservoir cells	

Arviat Water Supply
Arviat, Nunavut



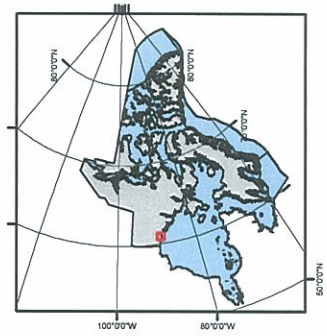
Legend

Field Survey Locations

- Dionne Lake - Sample Location
- Goose Lake - Sample Location
- Maguse Lake - Sample Location
- Mikilaaq Lake - Sample Location
- Pumphouse - Sample Location

2.5 1.25 0 2.5 5 7.5 10 Kilometers

1:250,000



Datum: NAD 83 Zone 15N

Internal Project: 5706-04

Drawn by: RR-B

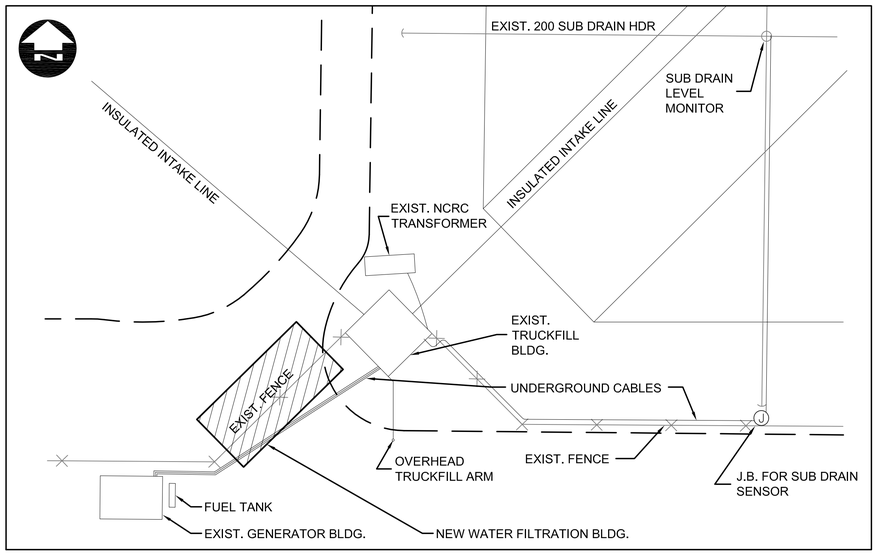
Date: January, 2005

IEG Environmental

Appendix I

Water Supply Filtration Upgrades

4920 47TH STREET, YELLOWKNIFE NT, X1A 2P1, PHONE 867.920.4555



THE GOVERNMENT OF NUNAVUT
PUBLIC WORKS AND SERVICES

ARVIAT WATER SUPPLY FILTRATION UPGRADE

ISSUED FOR TENDER

APRIL, 2008

PROJECT No. 078254

Drawing List	
Sheet Number	Sheet Title
000	Cover
101	Siteworks
102	Building Layout
103	Filtration Building Elevations
104	Metal Skid Plan & Details and Pump Skid Detail
201	P & ID Process Legend
202	Process Water Flow Schematic
203	Building Mechanical
204	Filtration System
205	Domestic Plumbing
301	Existing Plans Details and Schematics
302	Diagrams Schematics and Panel Schedule
303	New Filtration Building Electrical
304	Wiring Controls and Schematics
305	Schedules

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HES	GS
DRAWN	CHECKED BY
JMS	GS

DATE: APRIL 2008

SCALE: 1:150

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

SITEWORKS

PROJECT NO. 07-8254-1000

SHEET NO. **101**

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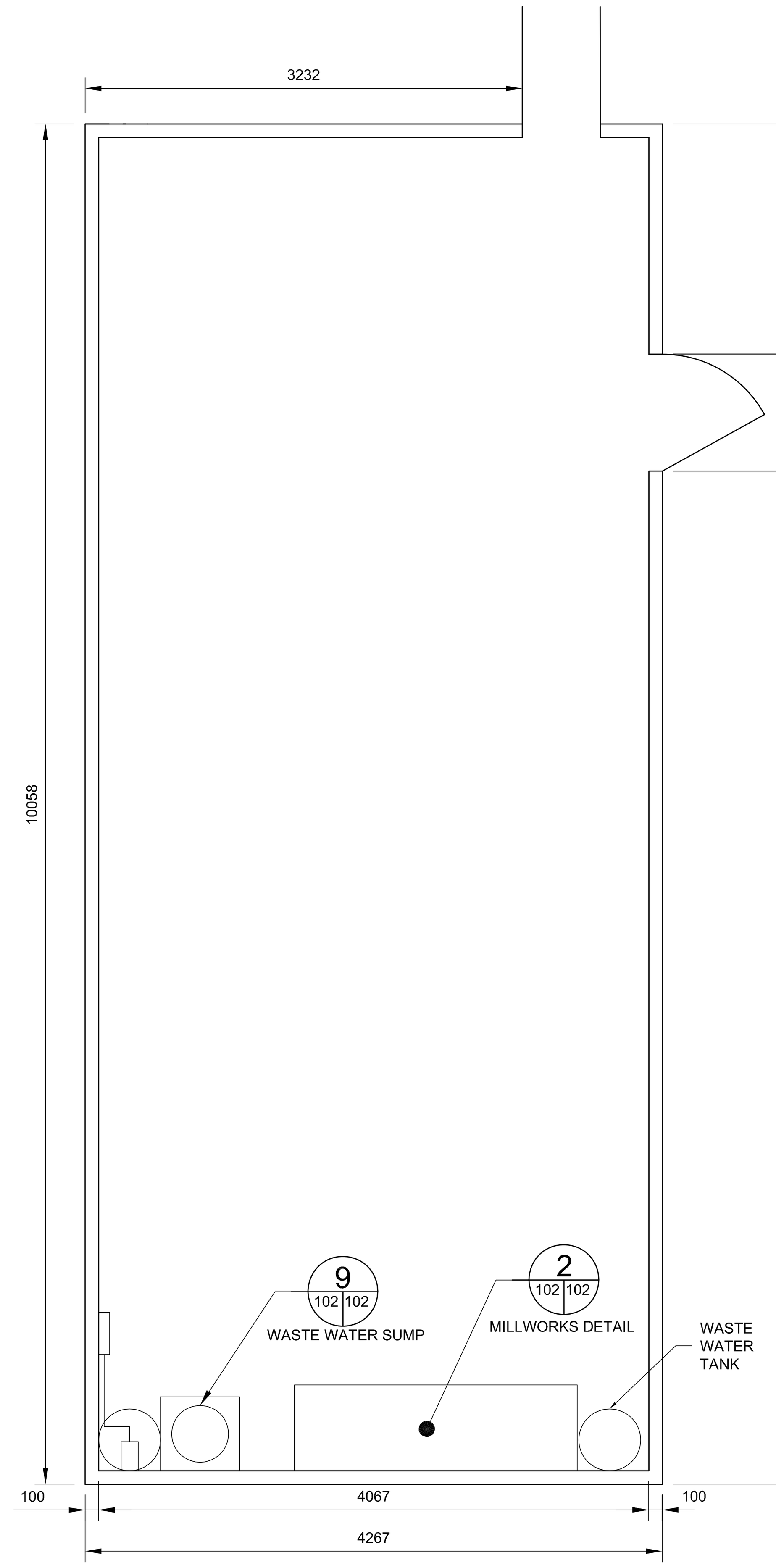

1 INTAKE PUMP HOUSE FLOOR PLAN
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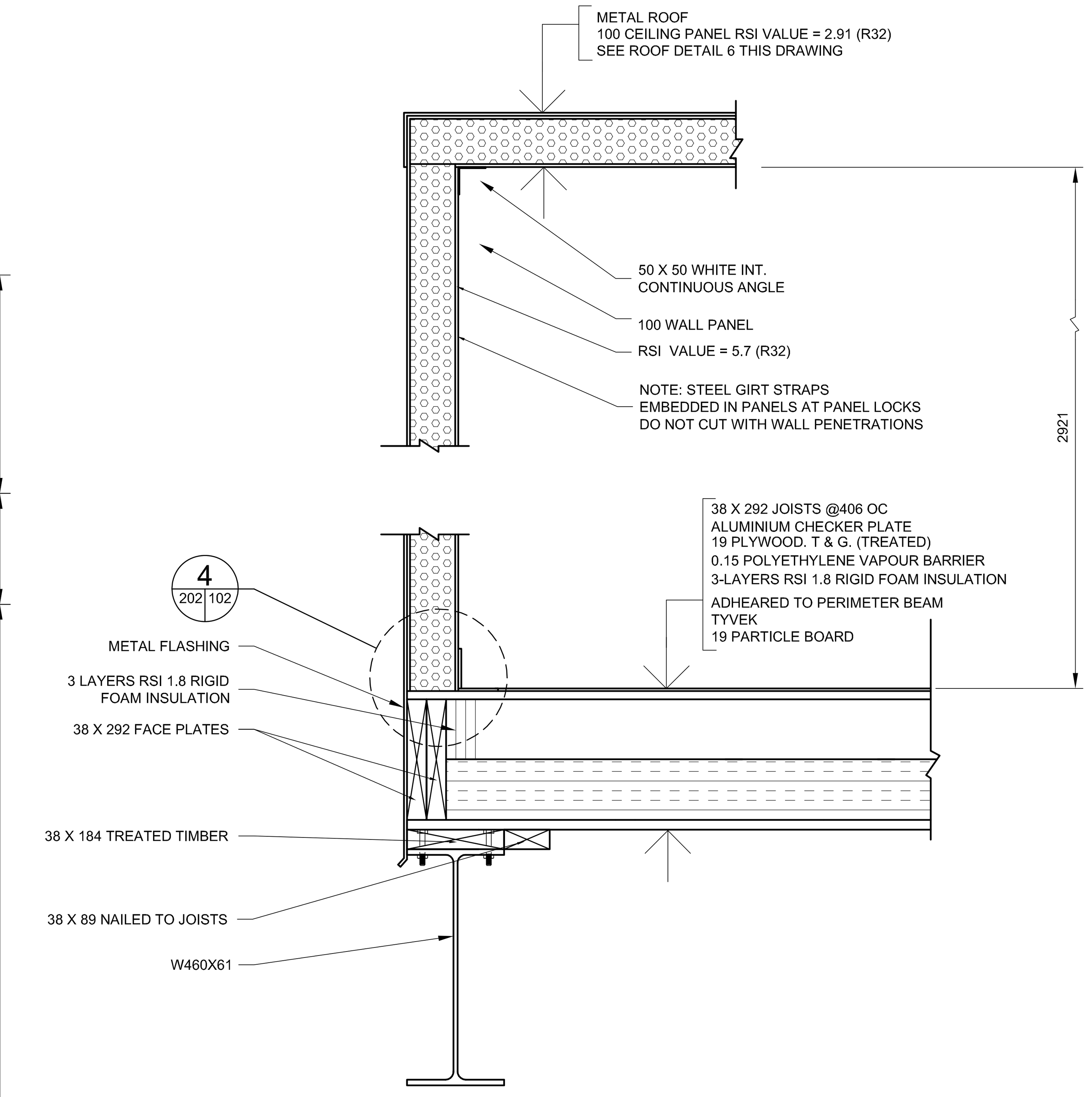
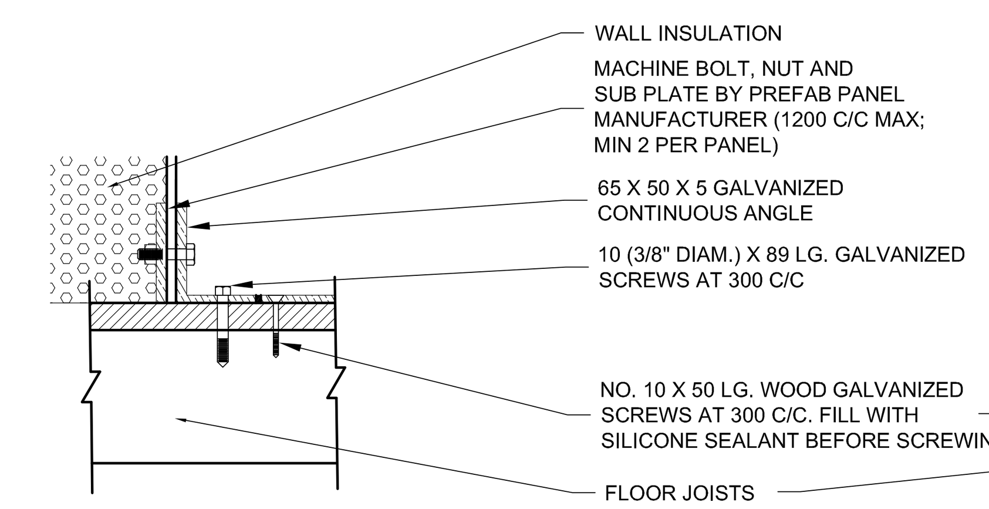
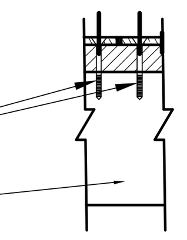


8 WALL SECTION
102 102 SCALE 1:10



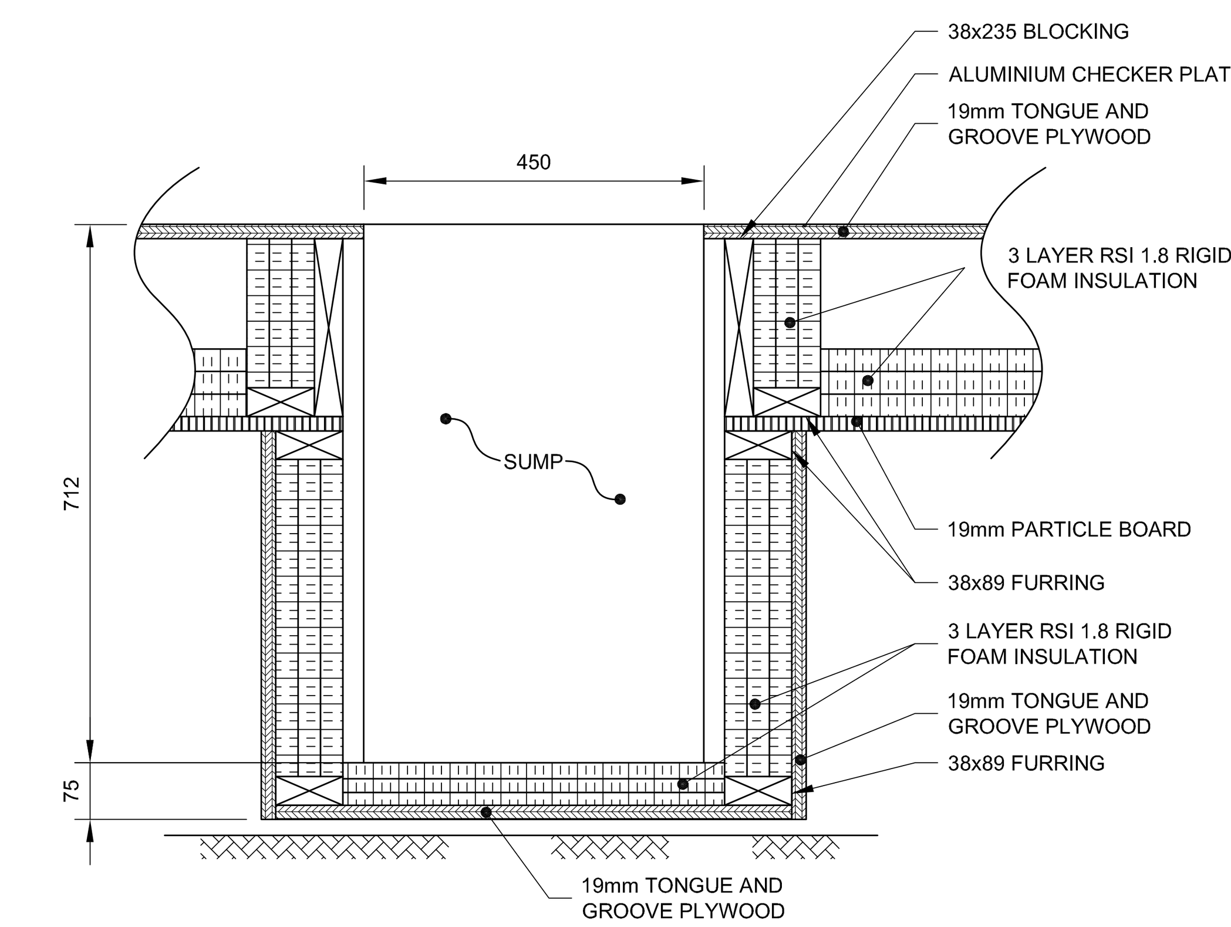
6 TYPICAL WALL ANCHOR DETAIL
102 102 SCALE 1:5



5 TYPICAL PLATE JOINT DETAIL
202 102 SCALE 1:5

NOTES:

HOUSE KEEPING PAD SIZES TO BE COORDINATED WITH EQUIPMENT INSTALLER.



9 WASTE WATER SUMP DETAIL
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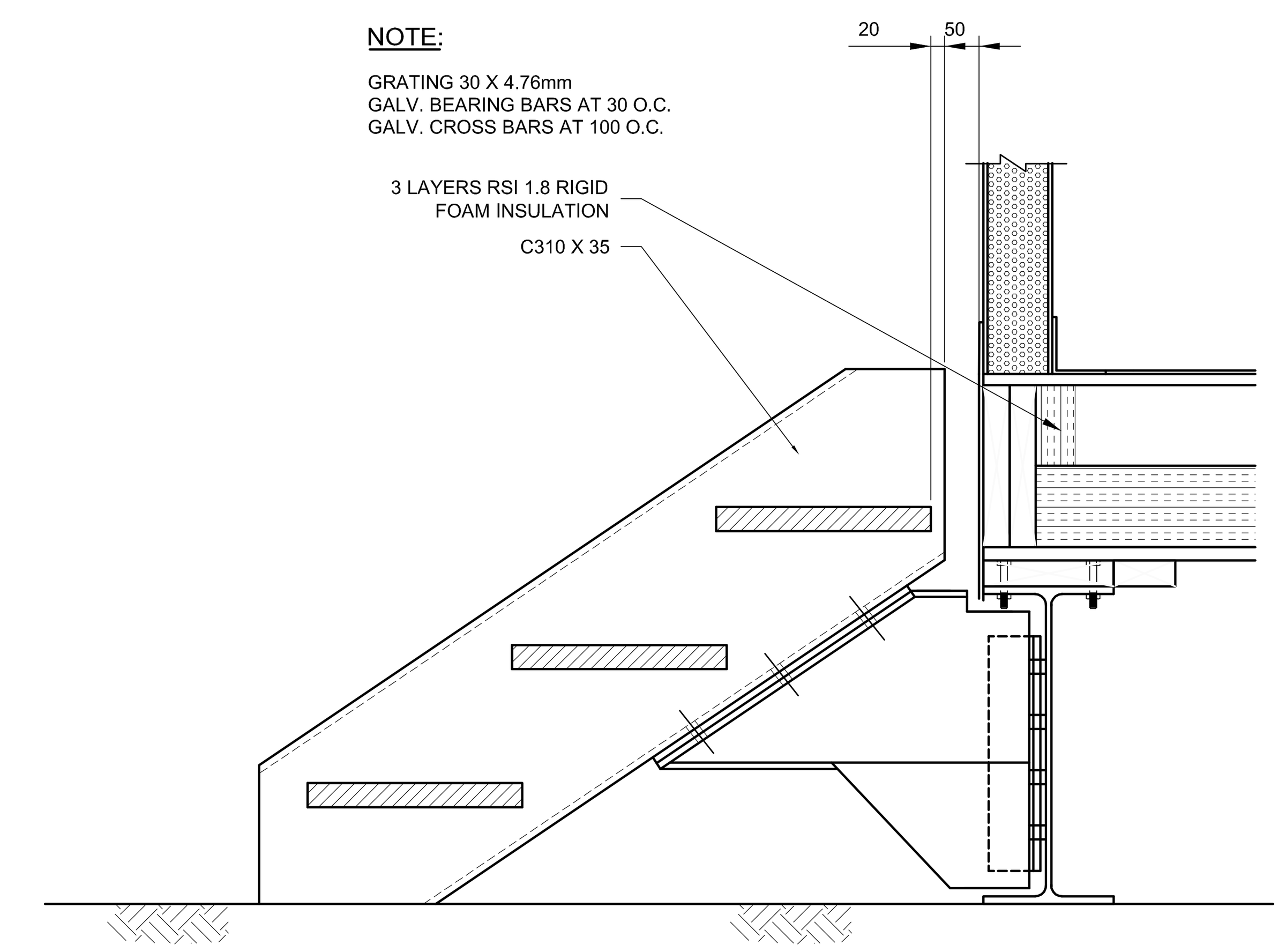

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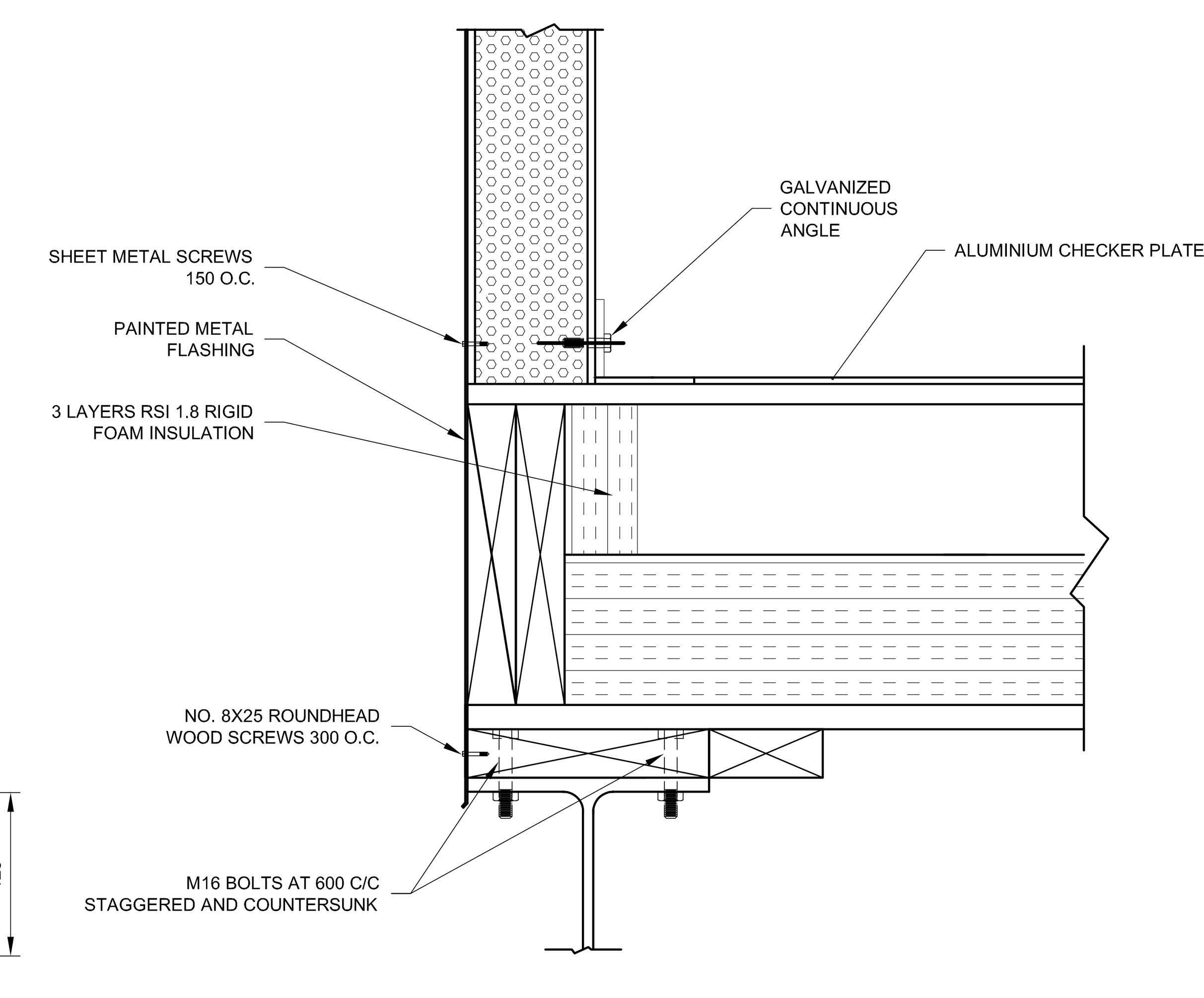
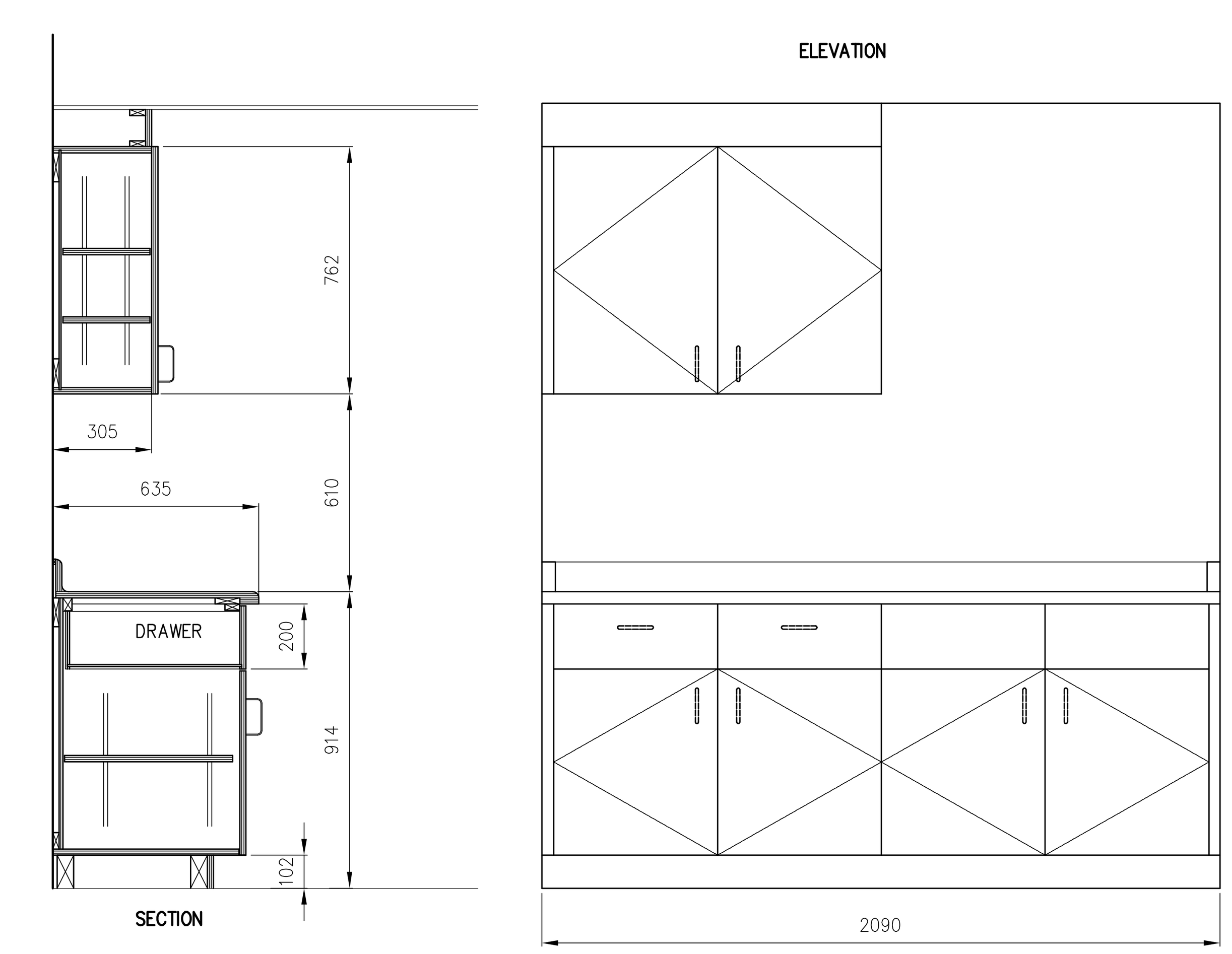


7 WALL DETAIL
102 102 SCALE 1:5



MILLWORK NOTES:

CABINET BOXES, DOOR, AND DRAWER FRONTS OF 19MM PLYWOOD COVERED WITH PLASTIC LAMINATE ON ALL EXPOSED SURFACES AND EDGES

CABINET BACKS OF 12MM PLYWOOD COVERED WITH PLASTIC LAMINATE ON EXPOSED SURFACES

DRAWERS TO SLIDE ON METAL TRACKS WITH NYLON WHEELS

DOORS TO HAVE CONCEALED HINGES WITH 110 DEGREE OPENING

PULLS OF BRUSHED STAINLESS STEEL 10MM DIAM BY 100 LONG D HANDLES

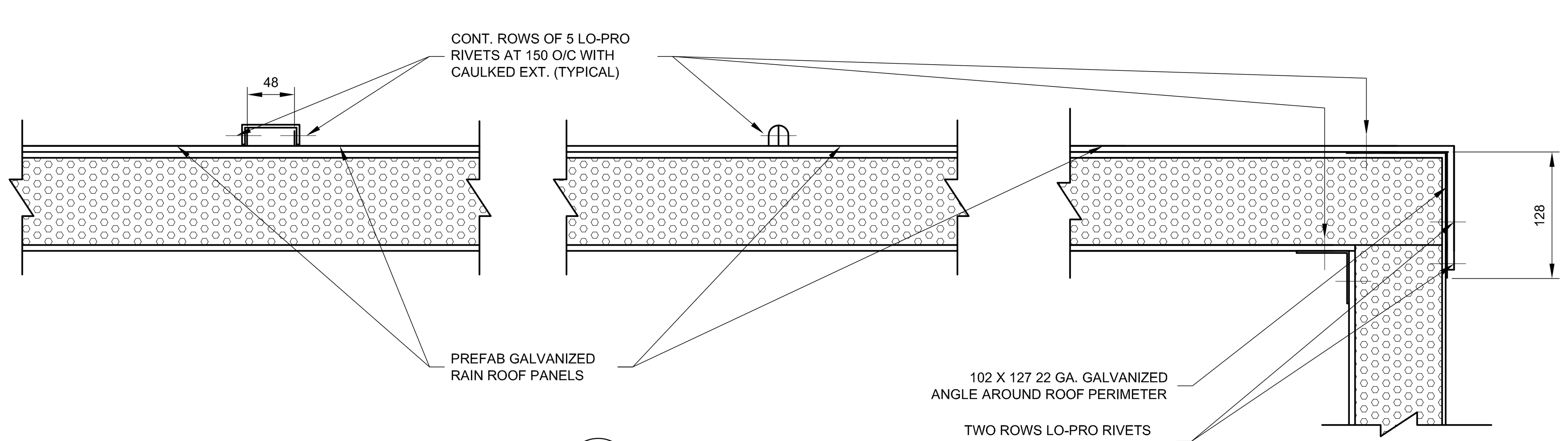
SHELVES SUPPORTED BY RECESSED ADJUSTABLE BRACKETS

COUNTER TOP OF POST FORMED PLASTIC LAMINATE WITH INTEGRAL MOULDED BACKSPLASH

COVER BASE TO MATCH BASE OF ROOM

PROVIDE VALENCE AT TOP AND INFILL PIECES AT EDGES SCRIBED TO ADJACENT SURFACES

2 MILLWORKS DETAIL
102 102 SCALE 1:20



3 ROOF DETAIL
102 102 SCALE 1:5

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WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

BUILDING LAYOUT

PROJECT NO. 07-8254-1000

SHEET NO. 102

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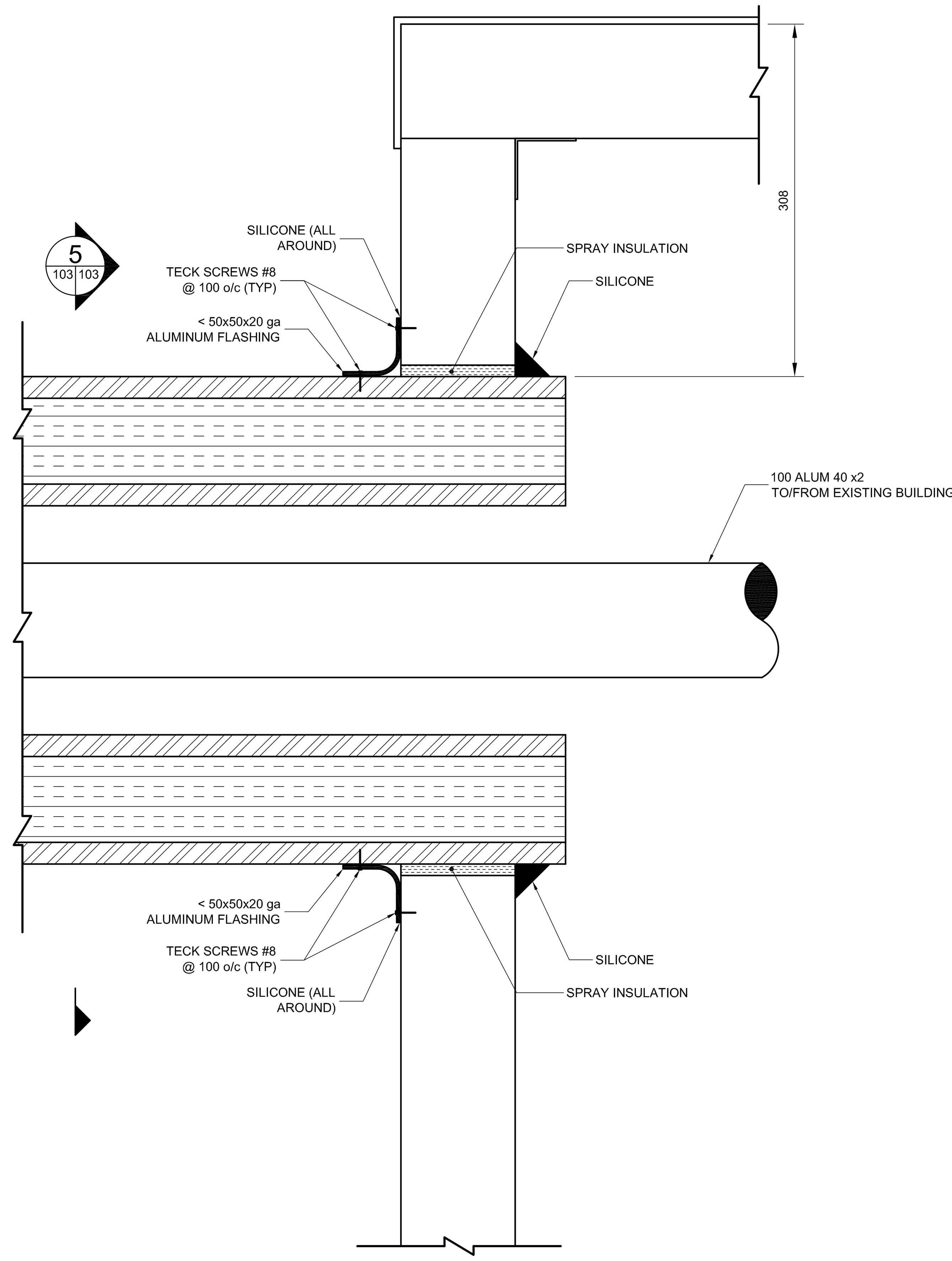

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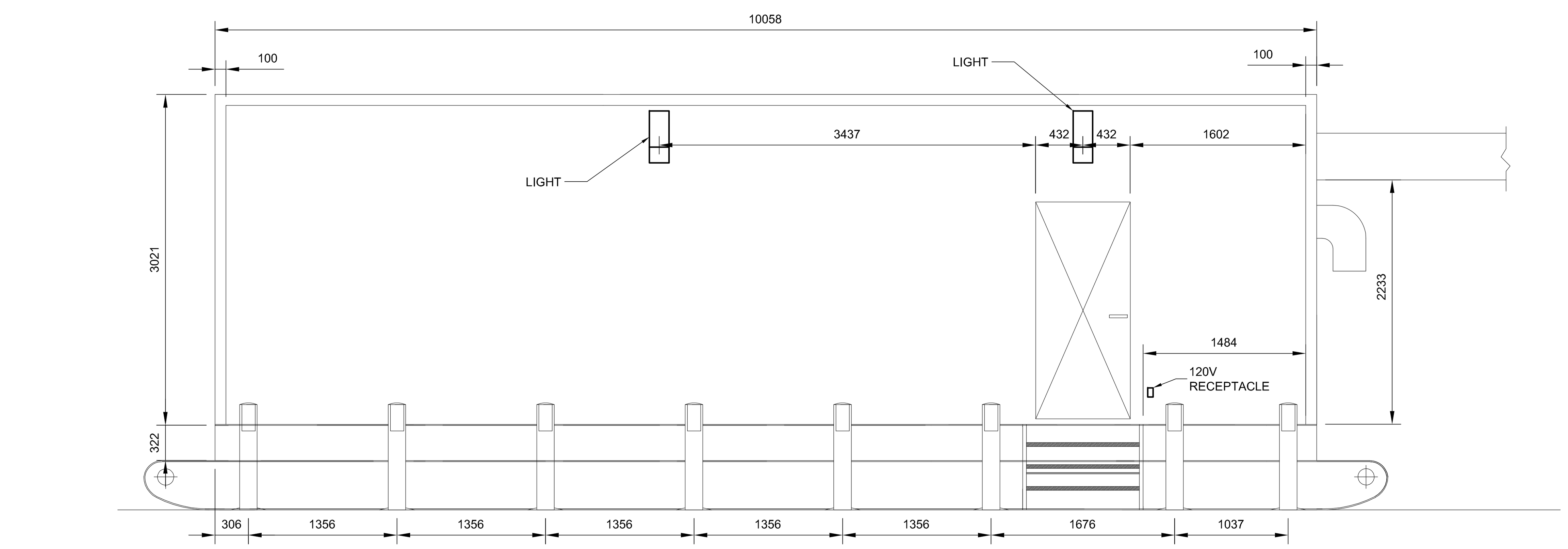

1 (103 | 103) FILTRATION BUILDING FRONT ELEVATION
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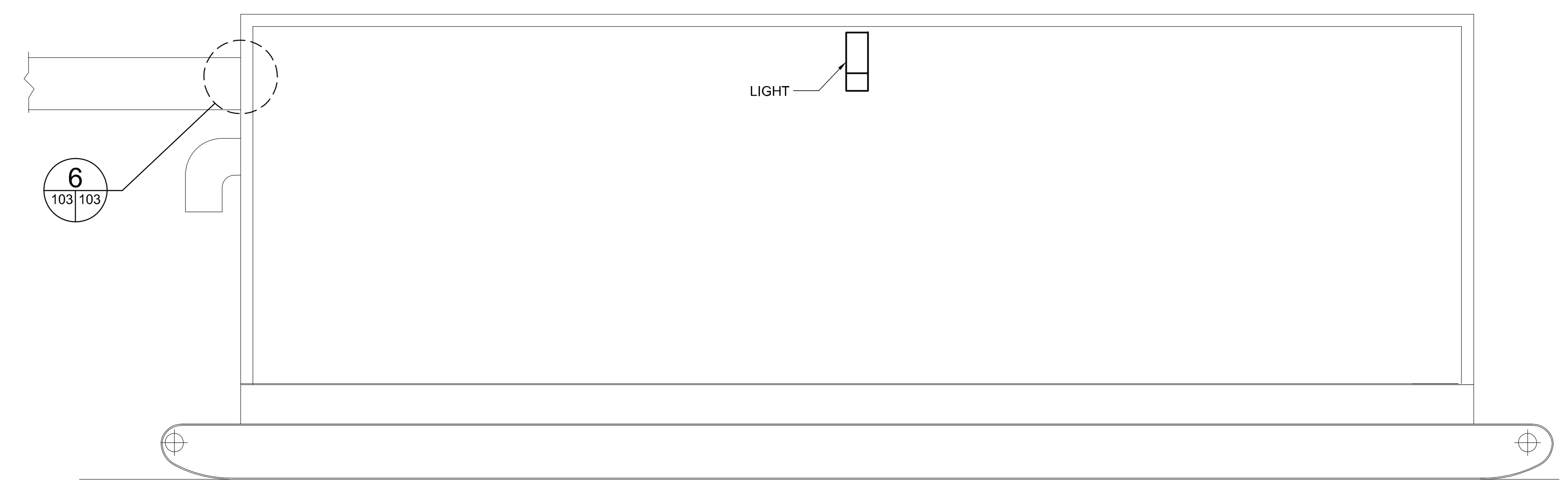

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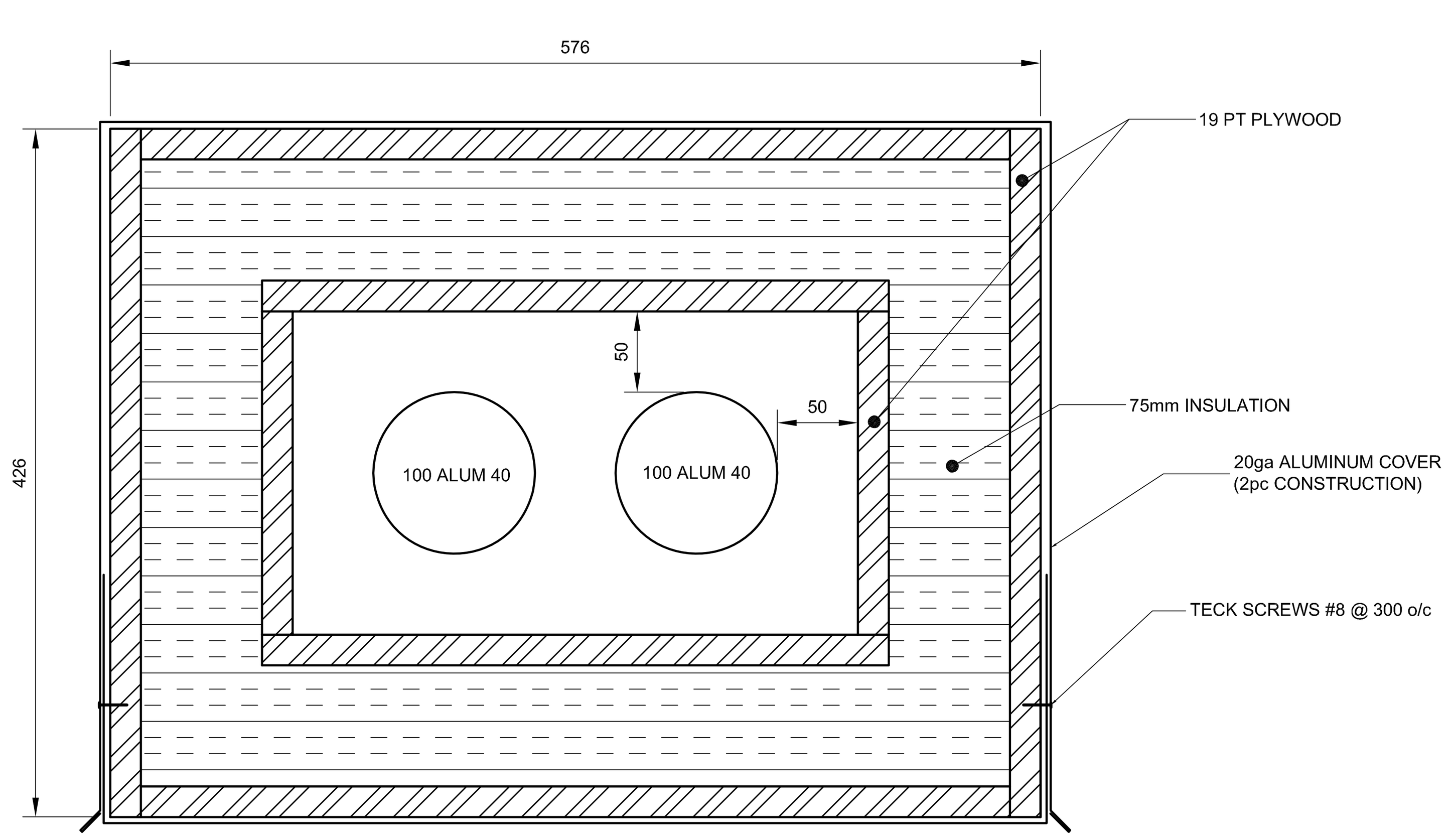

5 (103 | 103) UTILIDOR DETAIL
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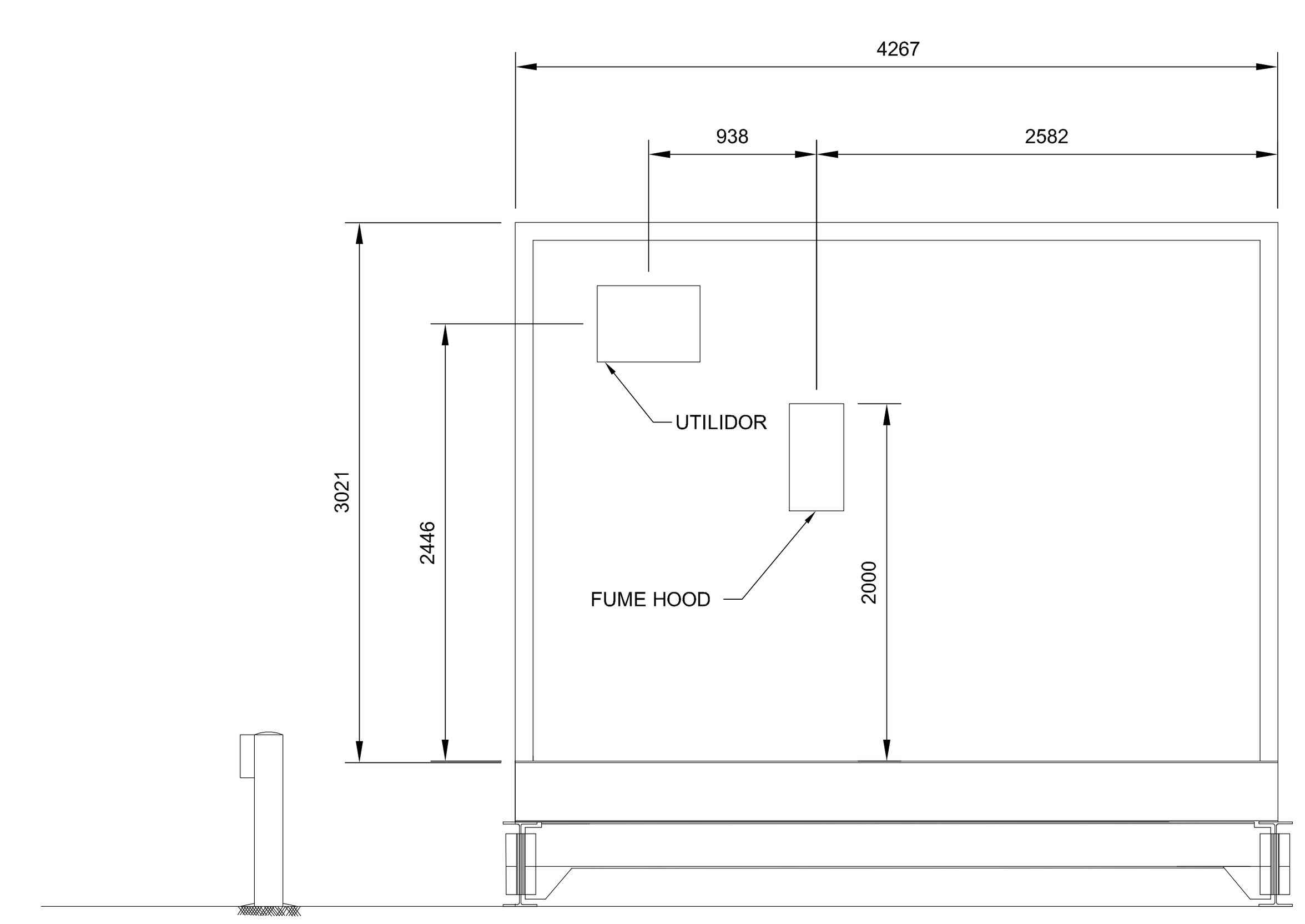

4 (103 | 103) FILTRATION BUILDING RIGHT ELEVATION
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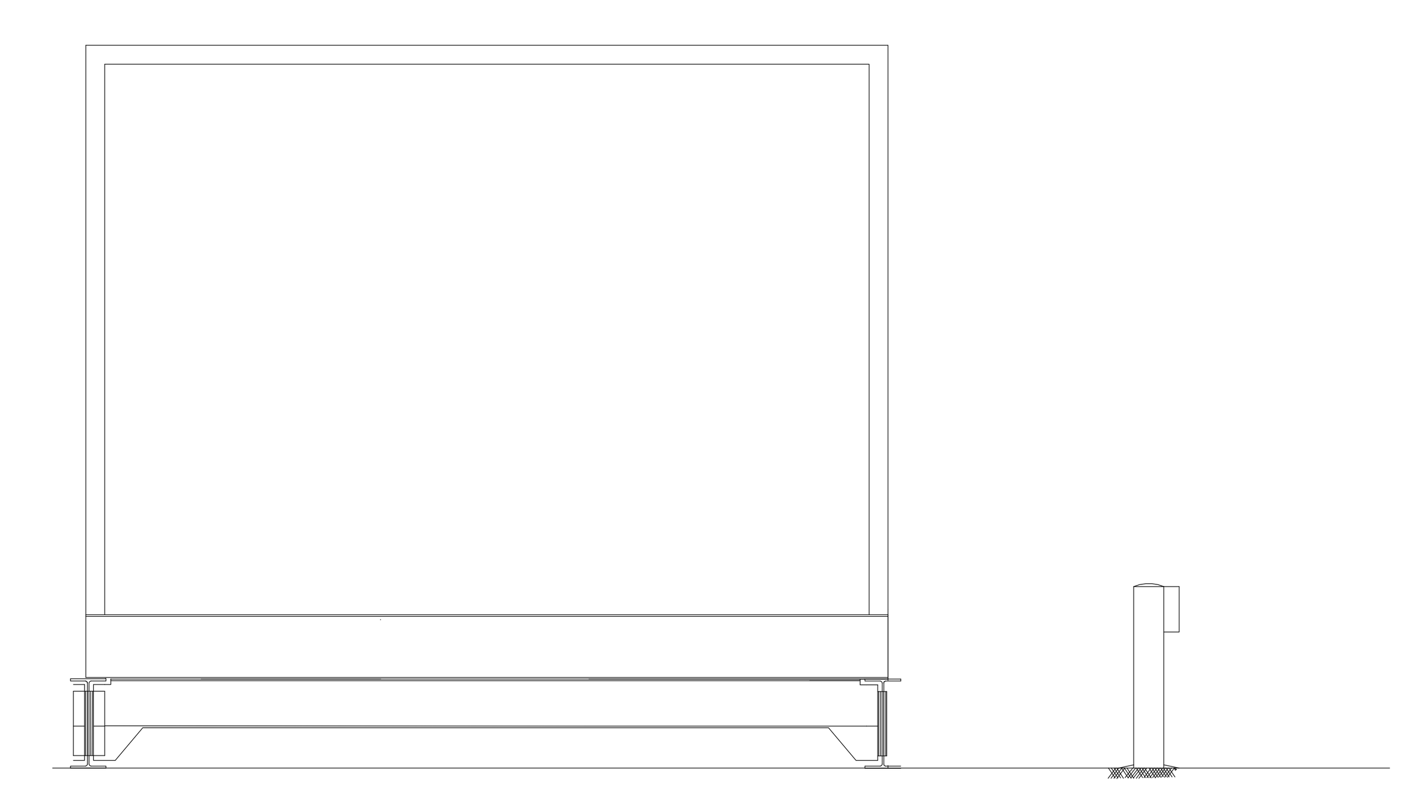

3 (103 | 103) FILTRATION BUILDING LEFT ELEVATION
SCALE 1:40

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WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

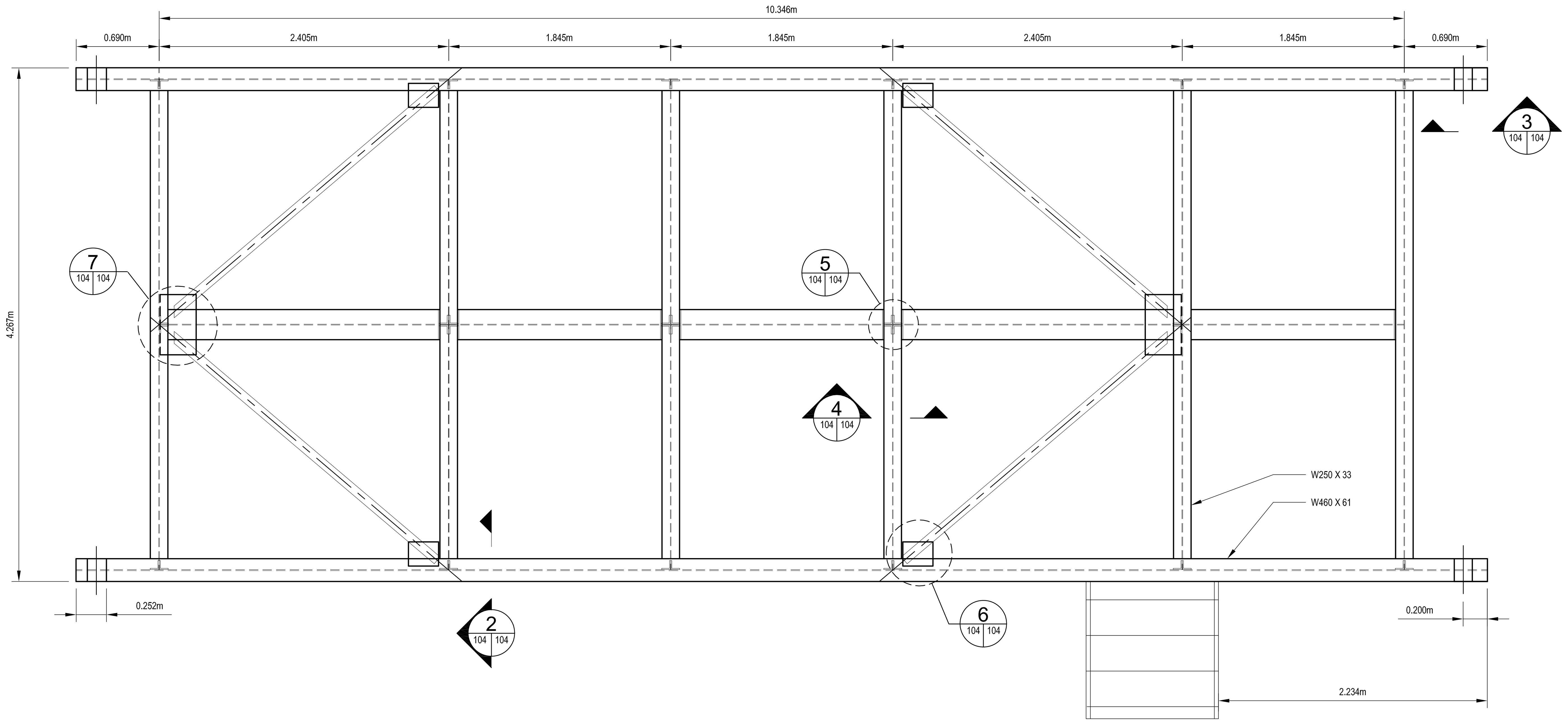
FILTRATION BUILDING ELEVATIONS

PROJECT NO. 07-8254-1000

SHEET NO. **103**

NOTES

1. ALL STEEL TO BE 300 W.T.
2. ELECTRODES TO BE 480 XX.
3. SKID COMPONENT TO BE GALVANIZED.



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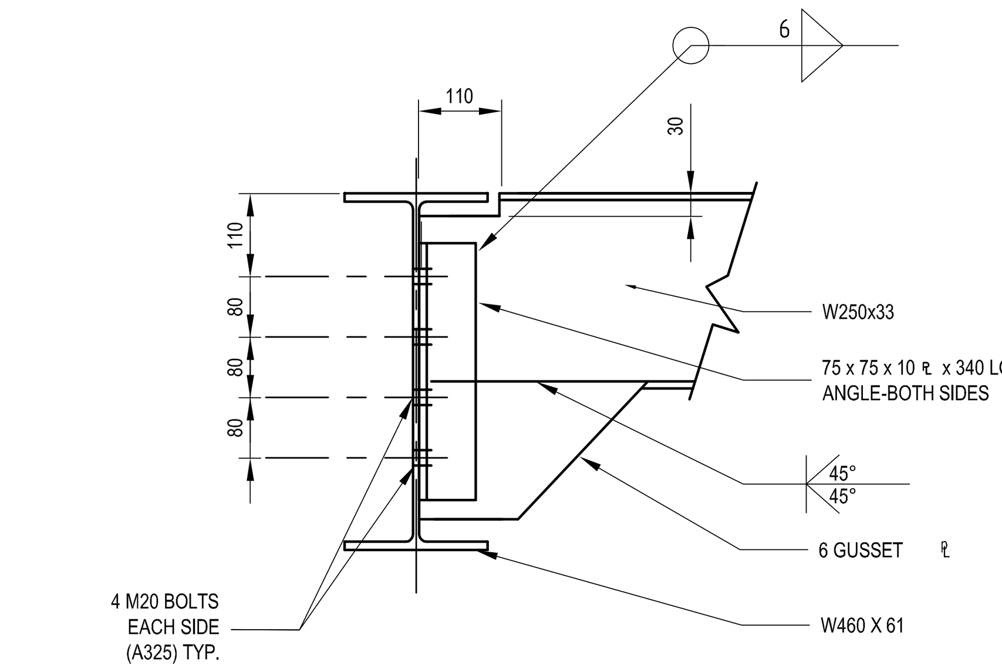

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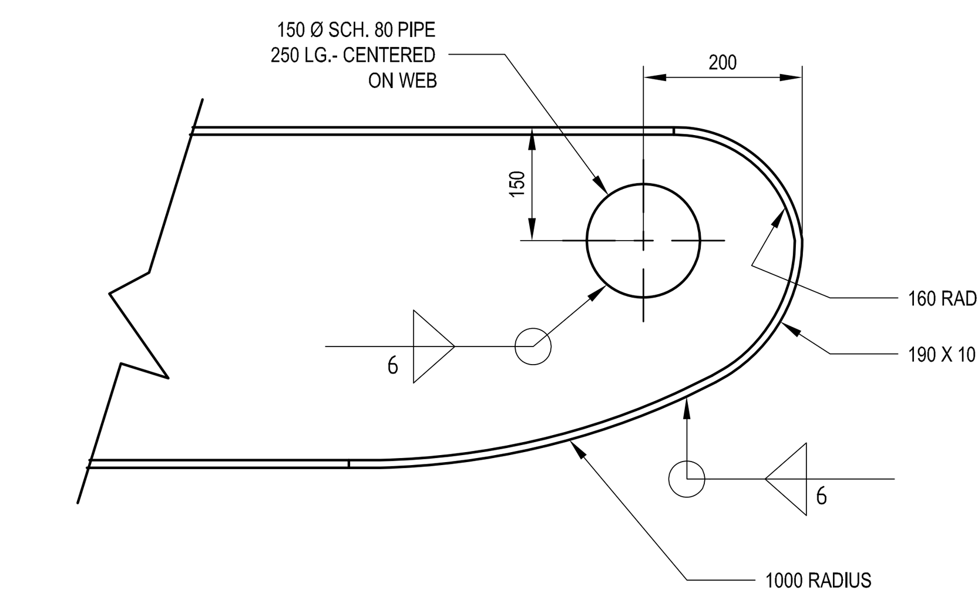

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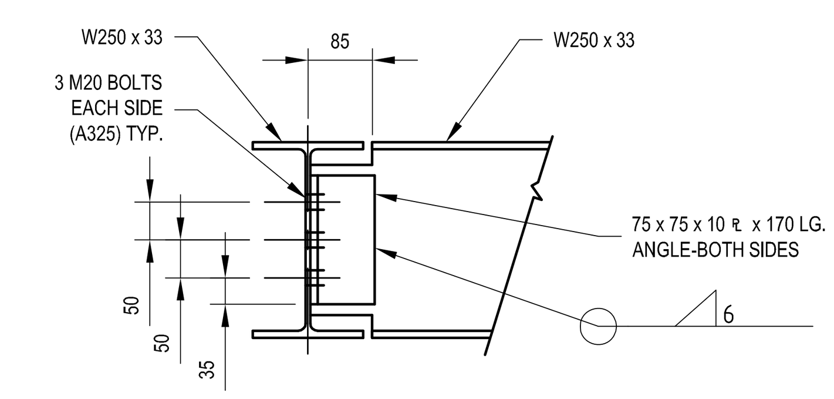

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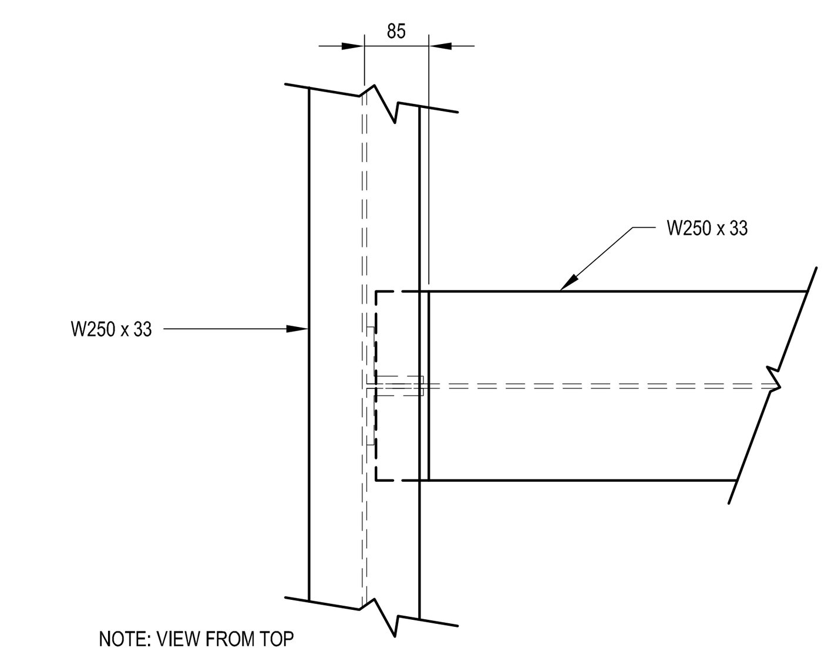
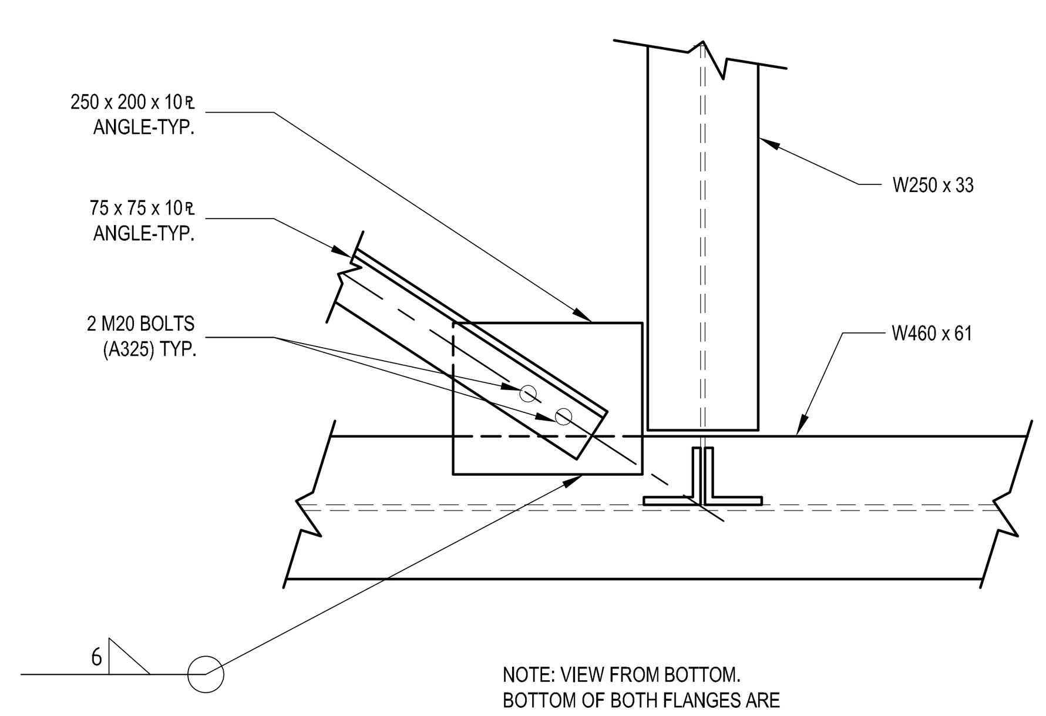
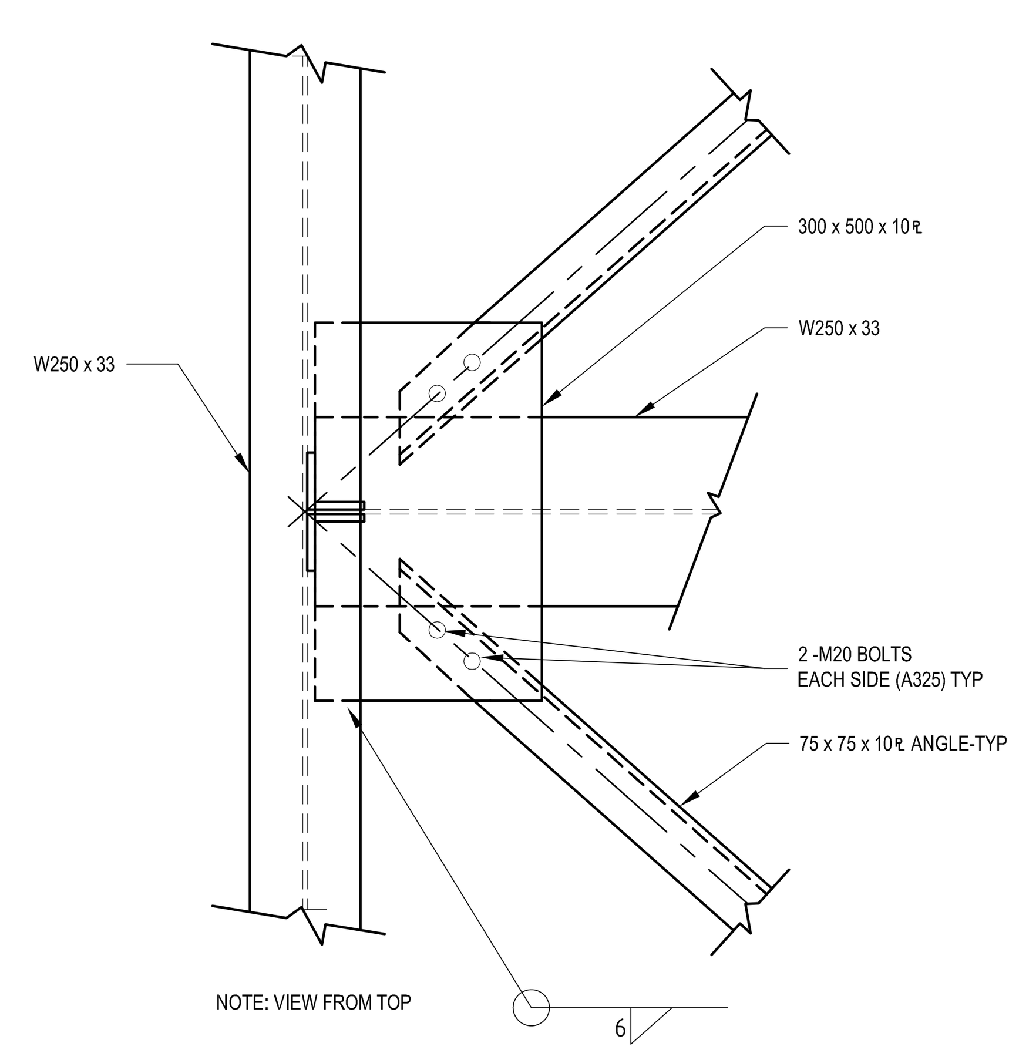


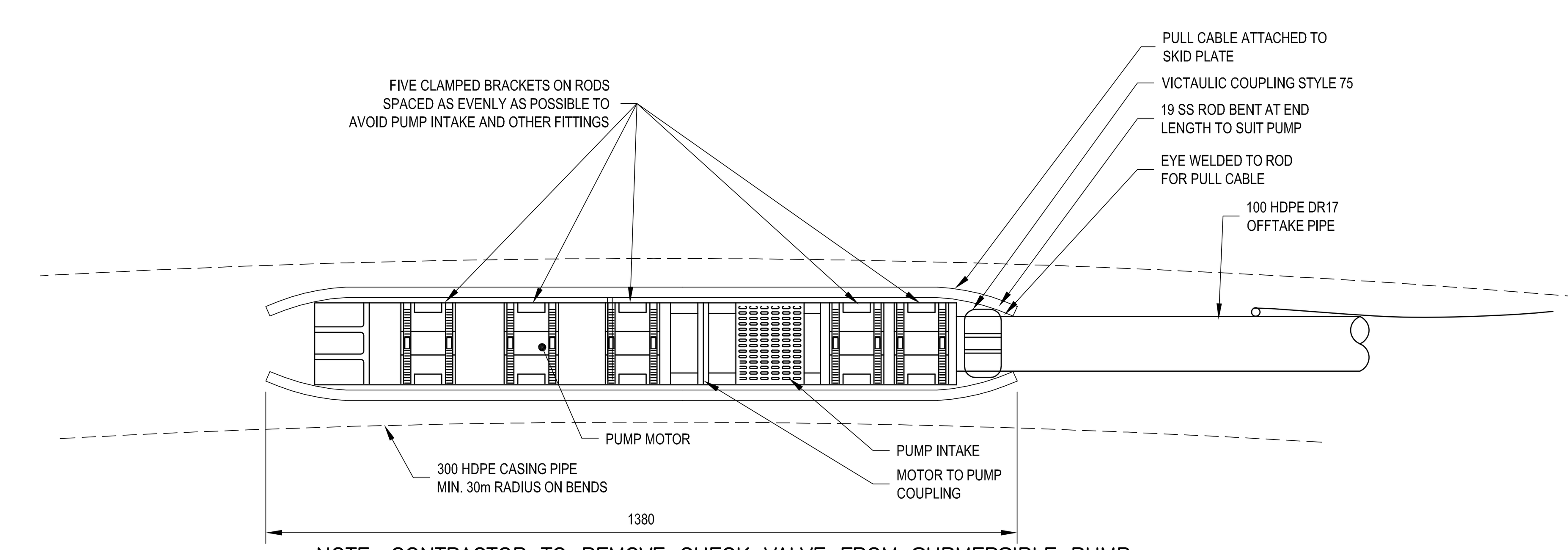
5 SKID SUPPORT DETAIL
SCALE 1:10



6 SKID SUPPORT DETAIL
SCALE 1:10



7 SKID SUPPORT DETAIL
SCALE 1:10



NOTE: CONTRACTOR TO REMOVE CHECK VALVE FROM SUBMERSIBLE PUMP DURING INSTALLATION

8 PUMP SKID DETAIL
SCALE 1:10

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WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

METAL SKID PLAN & DETAILS AND PUMP SKID DETAIL

PROJECT NO. 07-8254-1000

SHEET NO. 104

PROCESS LEGEND — MISCELLANEOUS

EQUIPMENT FRAGMENT No. DESIGNATION

LLLL–S–PPP–EEE##

- LOCATION ELEMENT
- SECTION ELEMENT
- PROCESS
- EQUIPMENT

NOTE :
– EQUIPMENT No.'s RESTART AT 1 FOR EACH SECTION.

NON PROCESS RELATED EQUIPMENT

(ie. PANEL, SUMP PUMP, ETC.)

LLL–B##–EEE##

- LOCATION ELEMENT
- BUILDING
- EQUIPMENT
- BUILDING LEVEL
  1 – LOWEST
  R – ROOF
- EQUIPMENT # (120/240)
- LETTER 600V

PIPING LINE DESIGNATION

50–PAC–CS#C+E+I

- DIAMETER (mm)
- SERVICE
- PIPE SPECIFICATION
- MULTIPLE PIPE SPECIFICATION No.
- DOUBLE CONTAINMENT
- ELECTRIC TRACED AND INSULATED

PIPE SIZE CONVERSION

IMPERIAL(in)	METRIC(mm)	IMPERIAL(in)	METRIC(mm)
1/8	3	14	350
1/4	6	15	380
3/8	10	16	400
1/2	12	18	450
3/4	20	20	500
1	25	24	600
1–1/4	32	30	750
1–1/2	40	36	900
2	50	42	1050
2–1/2	65	48	1200
3	75	54	1350
4	100	60	1500
5	125	66	1650
6	150	72	1800
8	200	78	2000
10	250	84	2100
12	300		

NOTE :
–PIPE SIZES ARE NOMINAL
–PIPE SIZES FROM 2" TO 60" CONVERSION BASED ON CSA STANDARD Z245.1
–PIPE SIZES FROM 2" AND SMALLER CONVERSION BASED ON EUROPEAN ISO STANDARD
–OTHER PIPE SIZES ARE CONVERSIONS ROUNDED TO THE NEAREST ARBITRARILY ASSIGNED WHOLE NUMBER

PIPE MATERIAL ABBREVIATIONS

SYMBOL	MATERIAL
ABS	ACRYLONITRILE BUTADIENE STYRENE
AL	ALUMINUM
AC	ASBESTOS CEMENT
CONC	CONCRETE GRAVITY
CPP	CONCRETE PRESSURE
CS#	CARBON STEEL
CU#	COPPER
DI	DUCTILE IRON
FRP	FIBERLASS REINFORCED PLASTIC
GALV	GALVANIZED STEEL
RR	REINFORCED RUBBER
PE	POLYETHYLENE
PPL	POLYPROPYLENE LINED CARBON STL.
PVC#	POLYVINYL CHLORIDE
SS#	STAINLESS STEEL
TUB#	TUBING

FOLLOWING SYMBOL INDICATES PIPING WITH MULTIPLE MATERIAL SPECIFICATIONS
EXAMPLE : SS1 (SCH. 40 316SS)
SS2 (SCH. 80 316SS)

PROCESS LEGEND — SERVICE ABBREVIATIONS

SYMBOL	COMMODITY	SYMBOL	COMMODITY
AA	AQUEOUS AMMONIA	NaOCl	SODIUM HYPOCHLORITE
AAS	AERATION AIR SUPPLY	NaOH	SODIUM HYDROXIDE
ACTSI	ACTIVATED SILICA	NaSI	SODIUM SILICATE
AMG	AMMONIA GAS (ANHYDROUS)	NG	NATURAL GAS
AML	AMMONIA LIQUID (ANHYDROUS)	OF	OVERFLOW
AMS	AMMONIA SOLUTION	OZNE	OZONE TANK EFFLUENT
ALUM	ALUMINUM SULPHATE	OZNI	OZONE TANK INFLUENT
AS	AERATED SEWAGE	OZ	OZONE
CBD	CLARIFIER BLOWDOWN	PA	PROCESS AIR
CHW	CHEMICAL WASTE	PACL	POLYALUMINUM CHLORIDE
CLD	CHLORINE DIOXIDE	PLY	POLYELECTROLYTE
CLG	CHLORINE GAS	PLYPH	POLYPHOSPHATE
CLS	CHLORINE SOLUTION	PS	PRIMARY SLUDGE
CO2	CARBON DIOXIDE	PSW	PLANT SERVICE WATER
CUS	COPPER SULPHATE	PW	POTABLE WATER
CW	COLD WATER	RAS	RETURN ACTIVATED SLUDGE
CWR	COOLING WATER RETURN	RSD	RECIRCULATED SLUDGE DISCHARGE
CWS	COOLING WATER SUPPLY	RSS	RECIRCULATED SLUDGE SUCTION
CWW	COOLING WATER WASTE	RSW	RAW SEWAGE
DHW	DOMESTIC HOT WATER	RW	RAW WATER
DIS	DIGESTED SLUDGE	RWAS	RAW WASTE ACTIVATED SLUDGE
DR	DRAIN	RWL	RAINWATER LEADER
EE	ENGINE EXHAUST	SA	SCOURING AIR
EW	EFFLUENT WATER	SAM	SAMPLE
F	FLUORIDE	SAN	SANITARY
FA	FLUOSILICIC ACID	SCE	SECONDARY CLARIFIER EFFLUENT
FBW	FILTER BACKWASH SUPPLY	SCS	SCRUBBING SOLUTION
FEC	FERRIC CHLORIDE	SCUM	SCUM
FEFF	FILTER EFFLUENT	SDG	SULPHUR DIOXIDE GAS
FESU	FERRIC SULPHATE	SDS	SULPHUR DIOXIDE SOLUTION
FHS	HYDROFLUOSILICIC ACID	SETW	SETTLED WATER
FILW	FILTER TO WASTE	SG	SLUDGE GAS (DIGESTER)
FINF	FILTER INFLUENT	SGC	SLUDGE GAS CIRCULATED (DIGESTER)
FLW	FLOCCULATED WATER	SGF	SLUDGE GAS FUEL (DIGESTER)
FLS	FLUORIDE SOLUTION	SGH	SLUDGE GAS (HIGH PRESSURE)
FO	FUEL OIL	SLD	SETTLED SLUDGE
FOF	FUEL OIL FILL	SLG	MIXED SLUDGE
FOR	FUEL OIL RETURN	SLU	SLUDGE UNLOADING
FOS	FUEL OIL SUPPLY	SQW	SQUEEZE WATER (FILTER PRESS)
FOV	FUEL OIL VENT	STM	STORM
FSW	FILTER SURFACE WASH	SUP	SUPERNATANT
FW	FILTERED WATER	TRW	TREATED WATER
HCL	HYDROCHLORIC ACID	TS	THICKENED SLUDGE
HSO	SULPHURIC ACID	TWAS	TREATED WASTE ACTIVATED SLUDGE
HWR	HOT WATER RETURN (HEATING)	V	VENT
HWS	HOT WATER SUPPLY (HEATING)	VA	VENT (AIR)
IA	INSTRUMENT AIR	VP	VENT (PUMPING)
LPG	LIQUID PROPANE GAS	VT	VENT (TANK)
KMnO	POTASSIUM PERMANGANATE	WAS	WASTE ACTIVATED SLUDGE
NaCO	SODIUM CARBONATE	WD	WASTE DRAIN
NaHCO	SODIUM BICARBONATE	WBW	WASTE BACKWASH WATER

PROCESS LEGEND — VALVE SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
VGA*	GATE	VGL*	GLOBE
VTW*	THREE–WAY	VAN*	ANGLE
VBA*	BALL	VPL*	PLUG
VBU*	BUTTERFLY	VSQ*	STOP COCK
VKG*	KNIFE GATE	VNE*	NEEDLE
VDM*	DIAPHRAGM	VPN*	PINCH
VMU*	MUD	VSQ*	SQUARE HEAD COCK
VSC*	SWING CHECK	VSC*	SPRING CHECK
VSC*	WEIGHTED CHECK	E VEC*	ELECTRIC CHECK
VDC*	DOUBLE DOOR CHECK	VBC*	BALL CHECK
VFP*	FLAP	VFS*	FOOT VALVE/ STRAINER
VAC*	AIR VACUUM	VAV*	AIR & VACUUM
VAR*	AIR RELEASE	VSR*	SAFETY RELIEF
PRV*	PRESSURE REDUCING (SELF CONTAINED)	PRV*	PRESSURE REDUCING
BPV*	BACK PRESSURE (SELF CONTAINED)	BPV*	BACK PRESSURE
SG*	STOP GATE	AWG*	ADJUSTABLE WEIR GATE
SLG*	SLIDE GATE	STL*	STOP LOGS
VRO*	ROTARY	VHYD*	YARD HYDRANT
	DAMPER		

1. DIRECTION OF FLOW FOR THE ABOVE SYMBOLS IS FROM LEFT TO RIGHT.
2. STATUS MAY BE SHOWN– N.O.=NORMALLY OPEN, N.C.=NORMALLY CLOSED.
3. (VKG*) VKG INDICATES VALVE TYPE AND * INDICATES SPECIFICATION No..
4. ADD ACTUATORS TO VALVES FROM VALVE ACTUATOR TABLE.

PROCESS LEGEND — VALVE ACTUATORS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	FLOAT		DIAPHRAGM
G	GEAR	S	SOLENOID
	LEVER	CW	CHAIN WHEEL
M	MOTORIZED		VALVE BOX (C/W EXTENSION STEM)
	NON RISING STEM (HANDWHEEL)		QUICK OPENING
	RISING STEM (HANDWHEEL)		
	SINGLE ACTION PISTON (FAIL OPEN)		DOUBLE ACTION PISTON (FAIL CLOSE)

NOTE : GATE VALVES ARE USED FOR ILLUSTRATION PURPOSES ONLY

PROCESS LEGEND — EQUIPMENT

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
M	CENTRIFUGAL PUMP	M	ROTARY PUMP
M	METERING PUMP	M	DUPLEX METERING PUMP
M	VERTICAL TURBINE PUMP	M	CIRCULATING PUMP
M	SUBMERSIBLE PUMP	M	PROGRESSIVE CAVITY PUMP
M	SUMP PUMP	M	RECIPROCATING PUMP
M	RECIPROCATING COMPRESSOR	M	BLOWER (LOBE TYPE)
ENG.	COMBUSTION ENGINE	GEN. EI	GENERATOR
M	CENTRIFUGAL COMPRESSOR	M	BLOWER (CENTRIFUGAL)
VAC M	VACUUM PUMP	M M	CENTRIFUGE
M	INLINE MIXER	M	TRAVELLING WATER SCREEN
M	MIXER		HEAT EXCHANGER
	TANK (OPEN)		PRESSURE TANK OR ACCUMULATOR
OR	TANK (CLOSED)		GAS CYLINDER (INDICATE CONTENTS)
	SWAB LAUNCHER		SWAB CATCHER

M – DENOTES CONSTANT SPEED DRIVE

VSD * – DENOTES VARIABLE SPEED DRIVE (* M FOR MECHANICAL, E FOR ELECTRICAL)
CONSTANT SPEED DRIVES ARE USED FOR ILLUSTRATION PURPOSES ONLY.

PROCESS LEGEND — P & ID SYMBOL DESIGNATIONS

SYMBOL	DESCRIPTION
	PRIMARY FLOW LINE
	SECONDARY FLOW LINE
	TERTIARY LINE
	EXISTING PRIMARY FLOW LINE
	EXISTING SECONDARY FLOW LINE
	EXISTING TERTIARY LINE
	FUTURE LINE
	DIRECTION OF FLOW
2% SLOPE	DIRECTION OF SLOPE
	CONNECTION LINE
	LINES CROSSING OVER (BREAK VERTICAL LINE)
	CHANNEL
TEXT TEXT	LINE CONTINUATION– TO ANOTHER DRAWING
TEXT TEXT	LINE CONTINUATION– FROM ANOTHER DRAWING
SS PVC	LINE SPECIFICATION CHANGE
	PNEUMATIC LINE
	ELECTRICAL SIGNAL
	HYDRAULIC LINE
	INSULATED LINE
E	INSULATED LINE WITH ELECTRIC TRACING
	FLEXIBLE LINE

PROCESS LEGEND — INSTRUMENTATION

INSTRUMENTATION DESIGNATION — TYPICAL LETTER COMBINATION

FIRST–LETTERS	INITIATING OR MEASURED VARIABLE	CONTROLLERS		READOUT DEVICES	SWITCHES AND ALARM DEVICES*			TRANSMITTERS		PRIMARY ELEMENT	VIEWING DEVICE, GLASS	SAFETY DEVICE	VALVE
		INDICATING	BLIND	INDICATING	HIGH**	LOW**	COMB	INDICATING	BLIND				
A ***	ANALYSIS	AIC	AC	AI	ASH	ASL	ASHL	AIT	AT	AE			
D	DENSITY	DIC	DC	DI	DSH	DSL	DSHL	DIT	DT	DE			
F	FLOW RATE	FIC	FC	FI	FSH	FSL	FSHL	FIT	FT	FE	FG		FCV
H	HAND ON/OFF	HIC	HC										HV
I	CURRENT	IIC		II	ISH	ISL	ISHL	IIT	IT	IE			
L	LEVEL	LIC	LC	LI	LSH	LSL	LSHL	LIT	LT	LE	LG		LCV
M	MOTORIZED												MV
P	PRESSURE/ VACUUM	PIC	PC	PI	PSH	PSL	PSHL	PIT	PT	PE		PSV,PSE	PCV
PD	PRESSURE, DIFFERENTIAL	PDIC	PDC	PDI	PDSH	PDSL		PDIT	PDT	PE			PDCV
S	SPEED/ FREQUENCY	SIC	SC	SI	SSH	SSL	SSHL	SIT	ST	SE			SCV
T	TEMPERATURE	TIC	TC	TI	TSH	TSL	TSHL	TIT	TT	TE		TSE	TCV
V	VIBRATION			VI	VSH	VSL	VSHL	VIT	VT	VE			
W	WEIGHT/FORCE	WIC	WC	WI	WSH	WSL	WSHL	WIT	WT	WE			WCV
Y	STATUS	YIC	YC	YI	YSH	YSL			YT	YE			
Z	POSITION/ DIMENSION	ZIC	ZC	ZI	ZSH	ZSL	ZSHL	ZIT	ZT	ZE			ZCV

WATER TREATMENT

***	DESCRIPTION
pH	pH
CLR	CHLORINE RESIDUAL
CLC	CHLORINE LEAK
Tu	TURBIDITY
OZR	OZONE RESIDUAL
OZL	OZONE LEAK
SCD	STREAMING CURRENT DETECTOR
ALU	ALUMINUM
COL	COLOUR
F	FLUORIDE
CON	CONDUCTIVITY
SBI	SLUDGE BLANKET INTERFACE

WASTEWATER

***	DESCRIPTION
pH	pH
CLR	CHLORINE RESIDUAL
CLC	CHLORINE LEAK
CB	COMBUSTION GAS
H2S	HYDROGEN SULPHIDE
CO	CARBON MONOXIDE
CH4	METHANE
DO	DISSOLVED OXYGEN
ALU	ALUMINUM
Tu	TURBIDITY
SS	SUSPENDED SOLIDS

NOTE :

THIS TABLE IS NOT ALL–INCLUSIVE.

*A, ALARM, THE ANNUNCIATING DEVICE, MAY BE USED IN THE SAME FASHION AS S, SWITCH, THE ACTUATING DEVICE.

**THE LETTERS H AND L MAY BE OMITTED IN THE UNDEFINED CASE.

GENERAL INSTRUMENTATION

SYMBOL	DESCRIPTION	GROUP	SYMBOL	DESCRIPTION	GROUP
	MOUNTED LOCALLY	INSTRUMENT SYMBOLS	AND	LOGIC GATE – AND (INTERLOCK IS EFFECTIVE ONLY IF ALL INPUTS ARE ACTIVE)	INTERLOCK SYMBOLS
	MOUNTED ON FACE OF PANEL	INSTRUMENT SYMBOLS	OR	LOGIC GATE – OR (INTERLOCK IS EFFECTIVE IF ONE OR MORE INPUTS ARE ACTIVE)	INTERLOCK SYMBOLS
	MOUNTED BEHIND PANEL DOOR	INSTRUMENT SYMBOLS	XOR	LOGIC GATE – OR (INTERLOCK IS EFFECTIVE IF ONE OR MORE INPUTS ARE ACTIVE)	INTERLOCK SYMBOLS
	SCADA INPUT/OUTPUT	SCADA SYMBOL	I	COMPLEX OR UNDEFINED INTERLOCK	INTERLOCK SYMBOLS
	NOT ACCESSIBLE TO OPERATOR	DISTRIBUTED CONTROL SYMBOLS OR SHARED INSTRUMENTS	n	PANEL NUMBER n	AUTOMATION SYMBOLS
	ACCESSIBLE TO OPERATOR	DISTRIBUTED CONTROL SYMBOLS OR SHARED INSTRUMENTS	n	MOTOR CONTROL CENTRE NUMBER n	AUTOMATION SYMBOLS
	AUXILIARY LOCATION	DISTRIBUTED CONTROL SYMBOLS OR SHARED INSTRUMENTS	n	PROGRAMMABLE CONTROLLER I/O RACK NUMBER n	AUTOMATION SYMBOLS
	NOT ACCESSIBLE TO OPERATOR	PROGRAMMABLE CONTROLLER SYMBOLS		SUPPLIED AND INSTALLED BY OTHER DIVISIONS. CONNECTED BY THIS DIVISION.	AUTOMATION SYMBOLS
	ACCESSIBLE TO OPERATOR	PROGRAMMABLE CONTROLLER SYMBOLS	R	RESET FOR LATCH TYPE ACTUATOR	MISCELLANEOUS SYMBOLS
	PILOT LIGHT		P	PURGE OR FLUSHING DEVICE	MISCELLANEOUS SYMBOLS

PROCESS LEGEND — PRIMARY FLOW ELEMENTS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	WEIR	F	SNAP–ON FLOW METER
	INSERT VENTURI		SONIC FLOW METER
	PITOT TUBE (SINGLE)	M	MAGNETIC FLOW METER
	PITOT TUBE (AVERAGING)		ORIFICE PLATE
	FLUME	FG	FLOW SIGHT GLASS
	TURBINE / PROPELLER	FG	ROTAMETER
	POSITIVE DISPLACEMENT		STATIC INLINE MIXER
	GUAGE INDICATOR		

PROCESS LEGEND — MISCELLANEOUS SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
S.P.	SAMPLE POINT (12mm)		UNION
D.P.	DRAIN POINT (MIN. 12mm)		HOSE CONNECTION
	IN LINE STRAINER		EYEWASH
	DRAIN / OVERFLOW		

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DESIGN | REVIEWED BY | DRAWN | CHECKED BY

DATE: APRIL 2008

SCALE: N.T.S.

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

P & ID PROCESS LEGEND

PROJECT NO. 07-8254-1000

SHEET NO. 201

Notes:

1) Coordinate instrument installation with electrical and mechanical

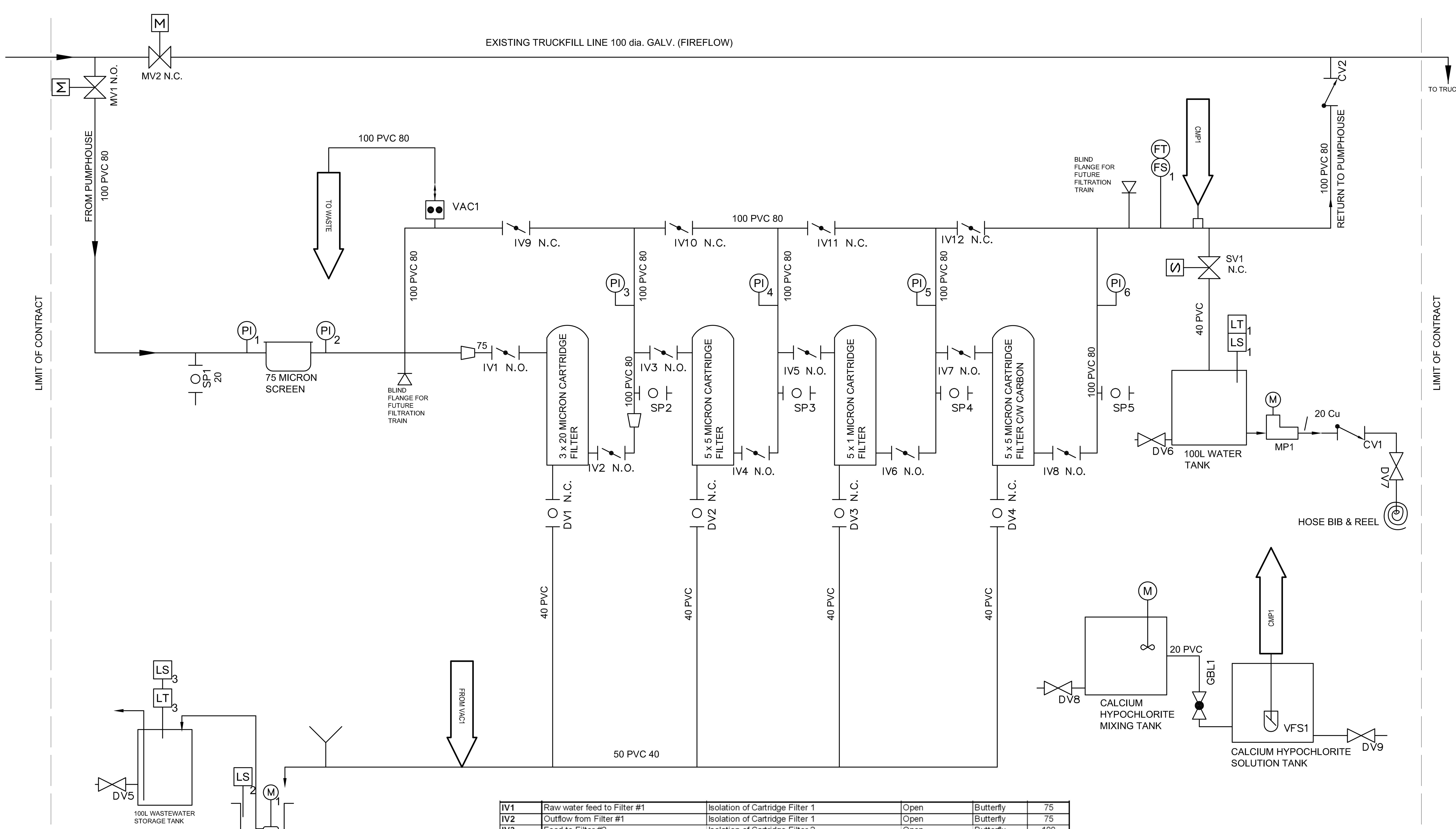
2) Install instruments to manufacturer recommendations

3) Piping materials - see specifications

4) Install flanges and unions as required to facilitate equipment removal and maintenance

5) Install valve tags per specifications

6) Label all equipment per specifications



IV1	Raw water feed to Filter #1	Isolation of Cartridge Filter 1	Open	Butterfly	75
IV2	Outflow from Filter #1	Isolation of Cartridge Filter 1	Open	Butterfly	75
IV3	Feed to Filter #2	Isolation of Cartridge Filter 2	Open	Butterfly	100
IV4	Outflow from Filter #2	Isolation of Cartridge Filter 2	Open	Butterfly	100
IV5	Feed to Filter #3	Isolation of Cartridge Filter 3	Open	Butterfly	100
IV6	Outflow from Filter #3	Isolation of Cartridge Filter 3	Open	Butterfly	100
IV7	Feed to Filter #4	Isolation of Cartridge Filter 4	Open	Butterfly	100
IV8	Outflow from Filter #4	Isolation of Cartridge Filter 4	Open	Butterfly	100
IV9	Outflow By-Pass Filter #1	By-pass of Filter 1	Closed	Butterfly	100
IV10	Outflow from filter by-pass line	By-pass of Filter 2	Closed	Butterfly	100
IV11	Outflow from filter by-pass line	By-pass of Filter 3	Closed	Butterfly	100
IV12	Outflow from filter by-pass line	By-pass of Filter 4	Closed	Butterfly	100
DV1	Filter #1	Drain	Closed	Ball	40
DV2	Filter #2	Drain	Closed	Ball	40
DV3	Filter #3	Drain	Closed	Ball	40
DV4	Filter #4	Drain	Closed	Ball	40
DV5	Wastewater Storage Tank	Drain	Closed	Gate	50
DV6	Water Storage Tank	Drain	Closed	Gate	20
DV7	Feed to Hose Bib & Reel	Drain	Closed	Gate	20
DV8	Calcium Hypochlorite Mixing Tank	Drain	Closed	Gate	20
DV9	Calcium Hypochlorite Solution Tank	Drain	Closed	Gate	20
CV1	Feed to Hose Bib & Reel	Prevents backflow into pump	Closed	Swing Check	20
SV1	Feed Line to Hose Bib & Reel	Controls flow to hose	Closed	Solonoid	40
VAC1	Raw Water Line	Bypass to Waste	Closed	Vacuum	100
SP1	Raw Water Line	Sampling Port - Filter Screen	Closed	Ball	20
SP2	Outlet of Filter #1	Sampling Port - Filter 1	Closed	Ball	20
SP3	Outlet of Filter #2	Sampling Port - Filter 2	Closed	Ball	20
SP4	Outlet of Filter #3	Sampling Port - Filter 3	Closed	Ball	20
SP5	Outlet of Filter #4	Sampling Port - Filter 4	Closed	Ball	20

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FileName:g:\cad\078254\tender\process water flow schematic.dwg

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DESIGN: HES	REVIEWED BY: GS
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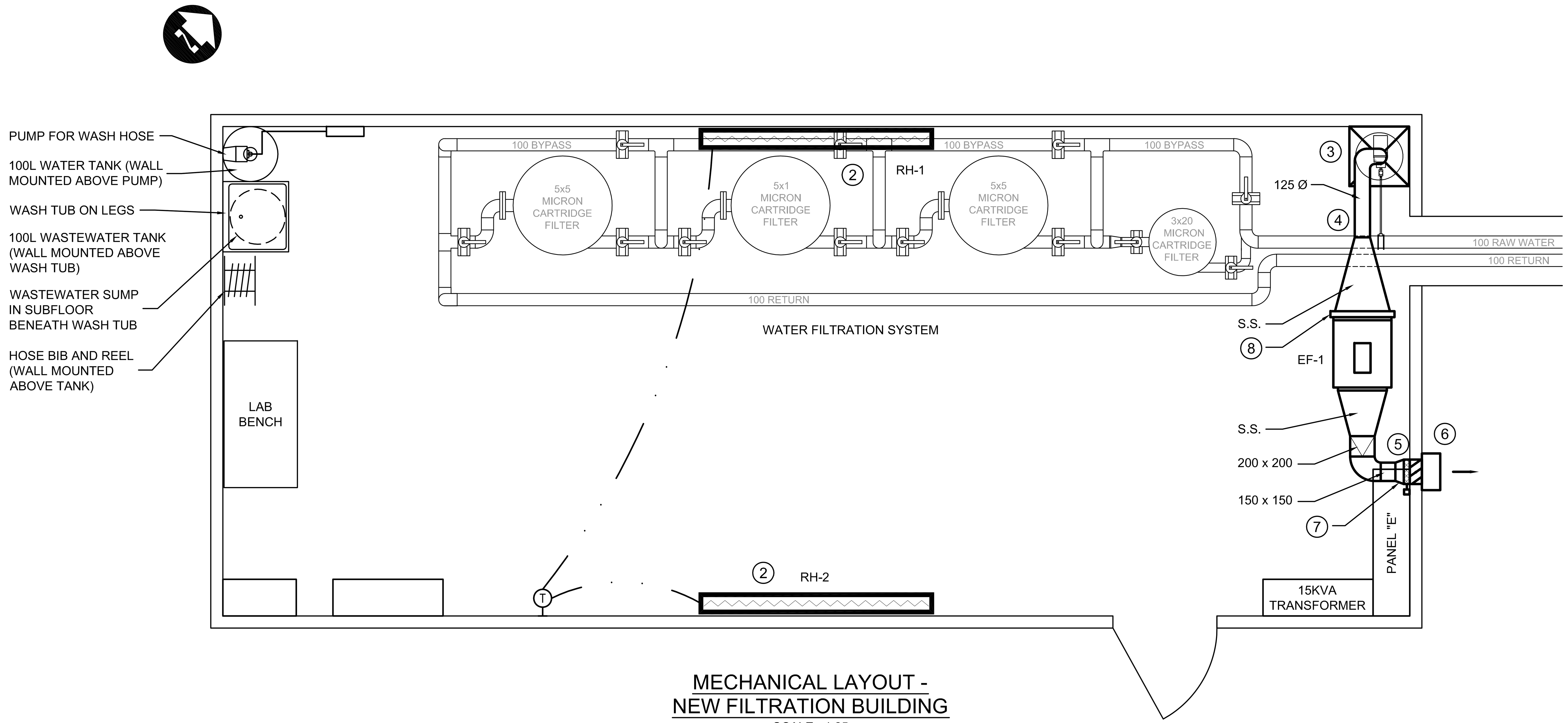
DATE: APRIL 2008	
SCALE: N.T.S.	

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

PROCESS WATER FLOW SCHEMATIC

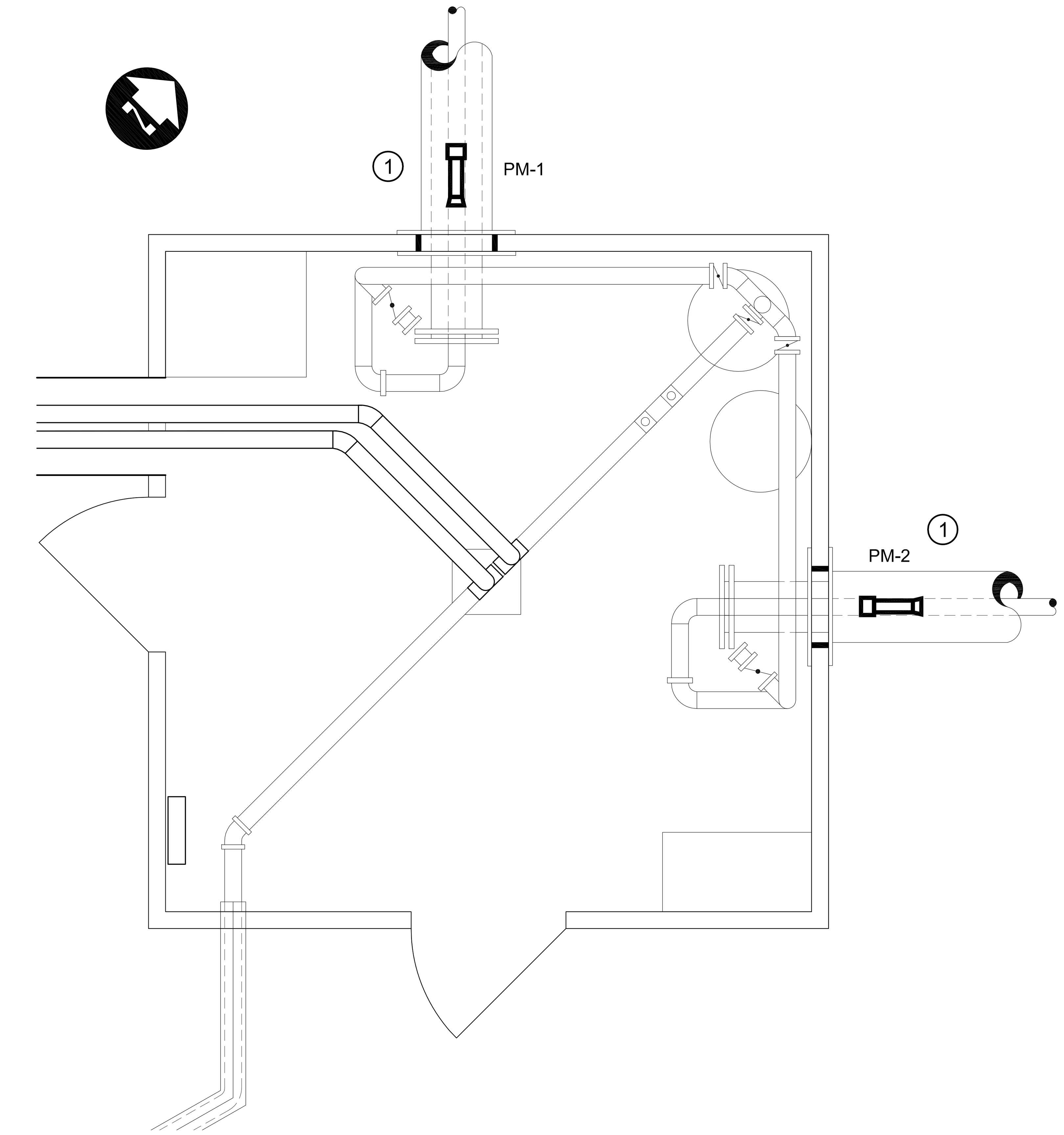
PROJECT NO. 07-8254-1000

SHEET NO. **202**



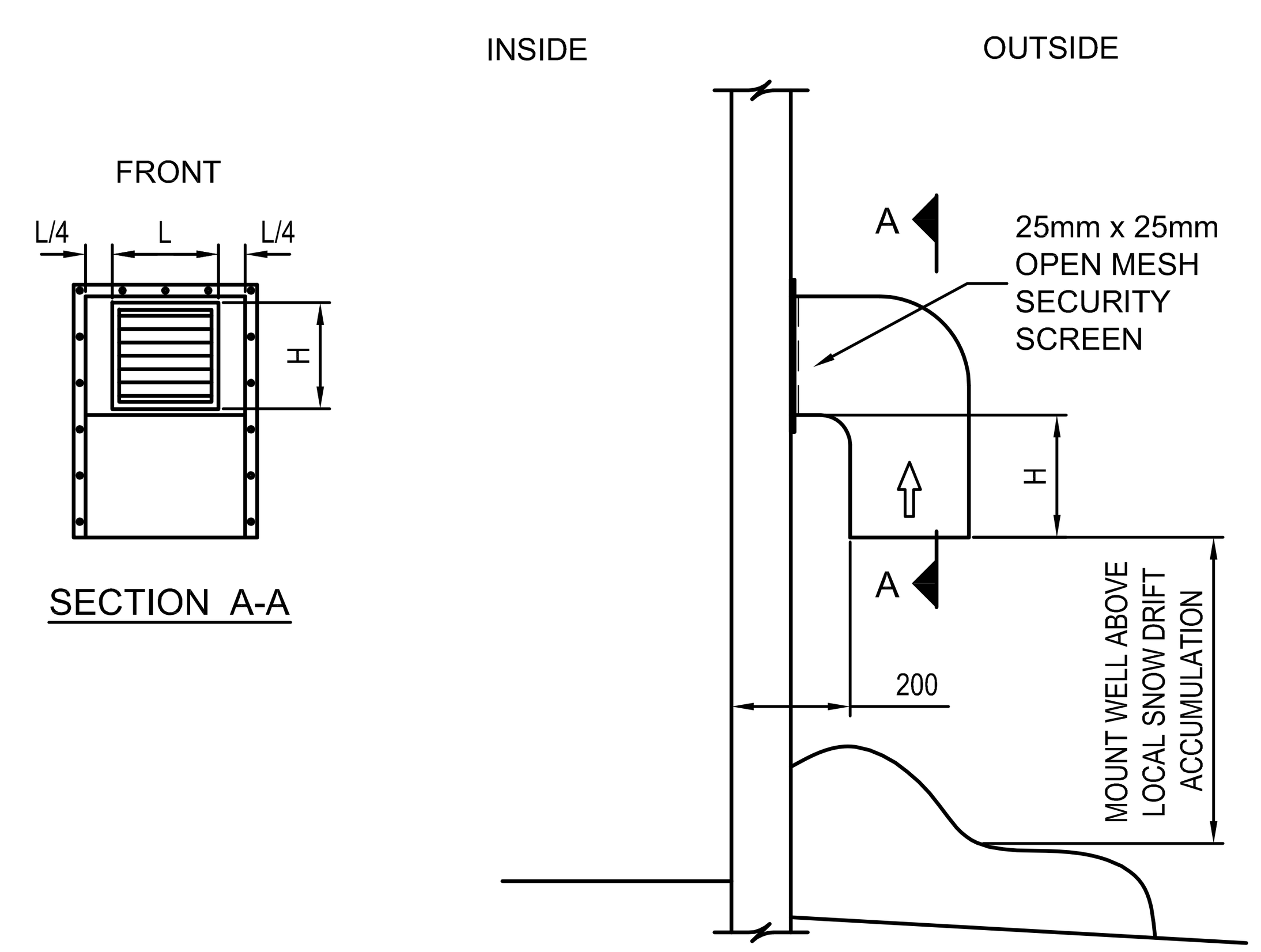
MECHANICAL LAYOUT - NEW FILTRATION BUILDING

SCALE: 1:25



MECHANICAL LAYOUT - EXISTING TRUCKFILL BUILDING

SCALE: 1:25



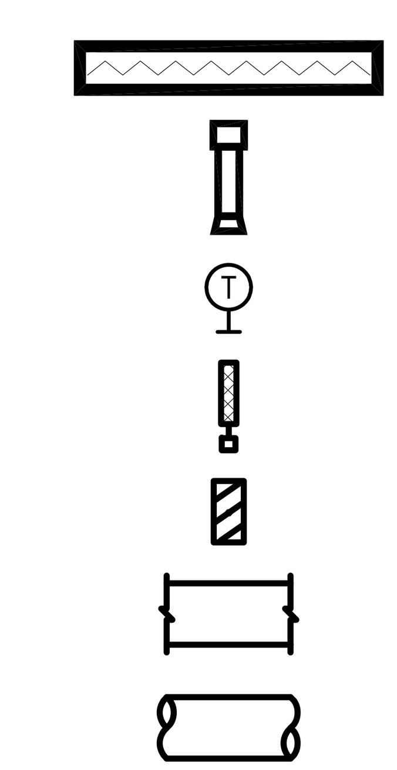
DISCHARGE HOOD DETAIL

N.T.S.

NOTES:

1. REMOVE EXISTING SUBMERSIBLE INTAKE PUMPS AND PROVIDE NEW 15 HP PUMPS; TO BE INSTALLED IN THE EXISTING INTAKE LINE. SEE EQUIPMENT SCHEDULE FOR DETAILED DESCRIPTION.
2. 5.0KW RADIANT ELECTRIC HEATER MOUNTED ON WALL BELOW CEILING.
3. STAINLESS STEEL CHLORINE TANK HOOD TO BE INSTALLED 1200mm A.F.F..
4. RUN EXHAUST DUCT OVER PROCESS PIPING AND CO-ORDINATE WITH LIGHTING.
5. EXHAUST DAMPER ACCEPTABLE PRODUCT: RUSKIN MODEL CD36 LOW LEAKAGE CONTROL DAMPER C/W BELIMO 120V AC MOTOR
6. EXHAUST LOUVRE ACCEPTABLE PRODUCT: E.H. PRICE MODEL K6774X (S.S.) SEE DISCHARGE HOOD DETAIL.
7. PROVIDE 25mm THERMAL INSULATION ON THE EXHAUST DUCT FROM EF-1 DISCHARGE TO THE INTERIOR WALL.
8. PROVIDE 25mm FILTER AND FILTER RACK, ACCESS FROM THE SIDE, ON SUCTION OF EF-1.

LEGEND



- RADIANT HEATER
- INTAKE PUMP
- WALL MOUNTED THERMOSTAT
- MOTORIZED DAMPER
- LOUVRE
- RECTANGULAR DUCTWORK (SIZE AS SHOWN)
- SPIRAL DUCTWORK (SIZE AS SHOWN)

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REGISTERED PROFESSIONAL ENGINEER W. C. D. DeGAGNE LICENSEE N.W.T.

Nunavut

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DESIGN: MCL	REVIEWED BY: WCDD
DRAWN: ACP	CHECKED BY: WCDD
DATE: APRIL 2008	
SCALE: AS SHOWN	

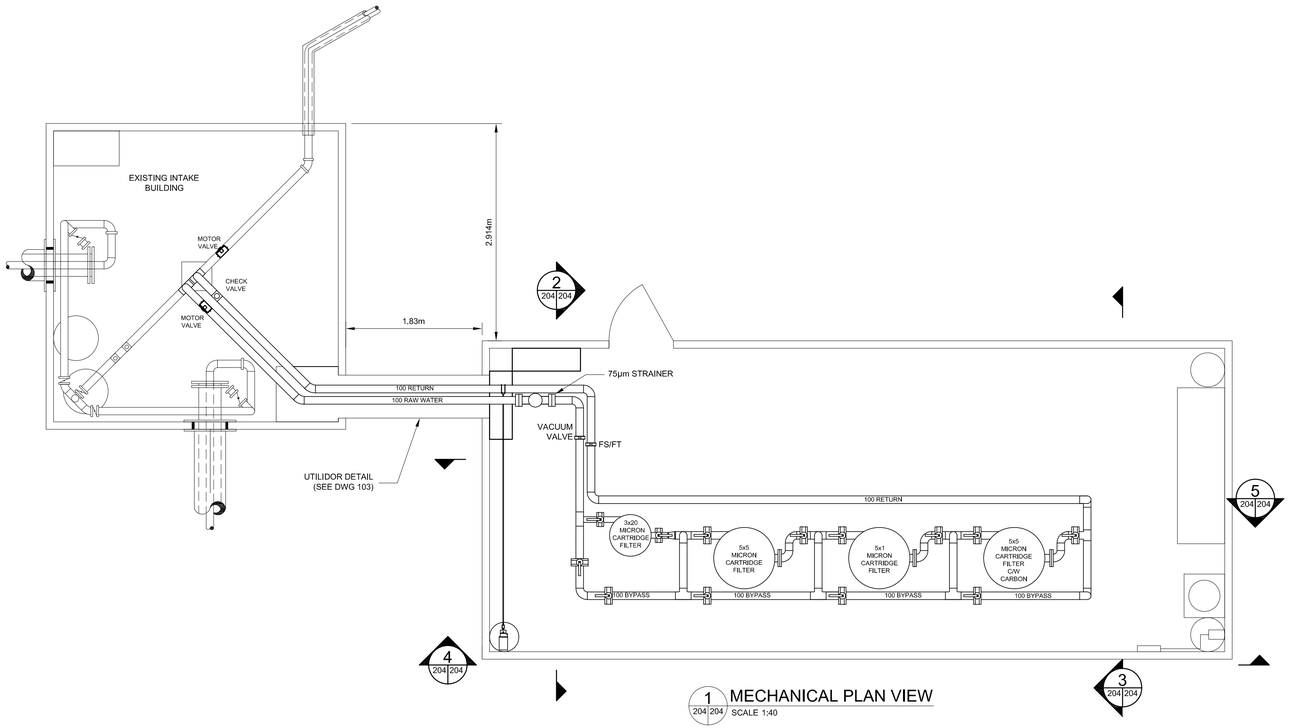
WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

BUILDING MECHANICAL

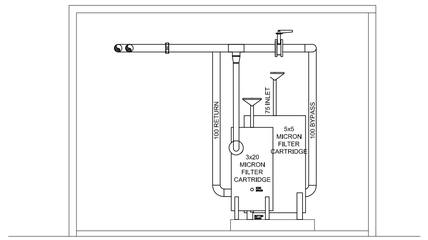
PROJECT NO. 07-8254-1000

SHEET NO. 203

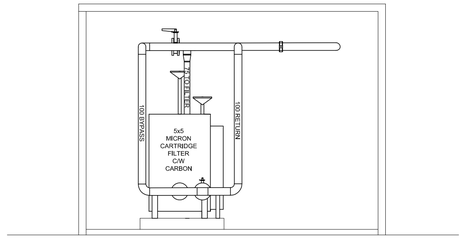
FileName:g:\cad\078254\tender\078254m.dwg



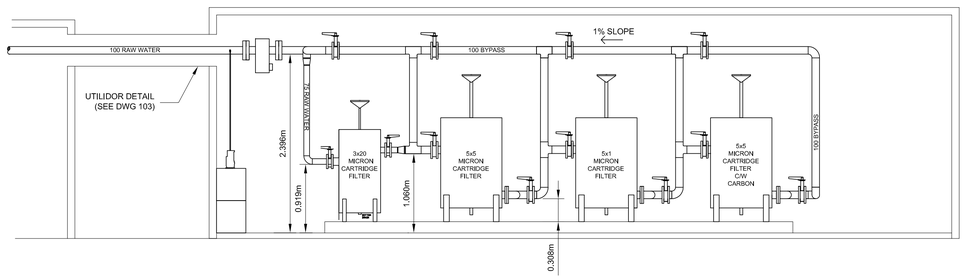
1 204 204 MECHANICAL PLAN VIEW
SCALE 1:40



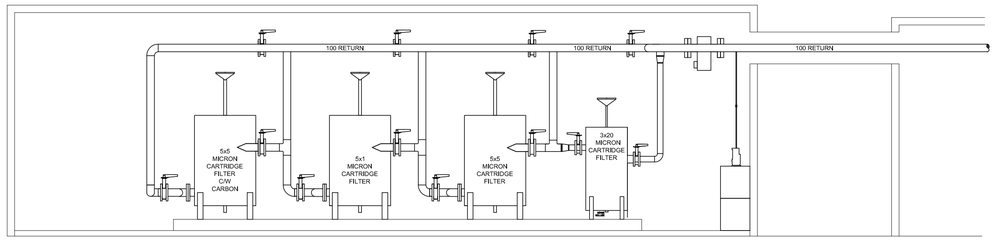
2 204 204 LEFT ELEVATION
SCALE 1:40



3 204 204 RIGHT ELEVATION
SCALE 1:40



4 204 204 FRONT ELEVATION
SCALE 1:40



5 204 204 BACK ELEVATION
SCALE 1:40

Conditions of Use

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GS	GS
DRAWN	CHECKED BY
NTB	GS
DATE	APRIL 2008
SCALE	AS SHOWN

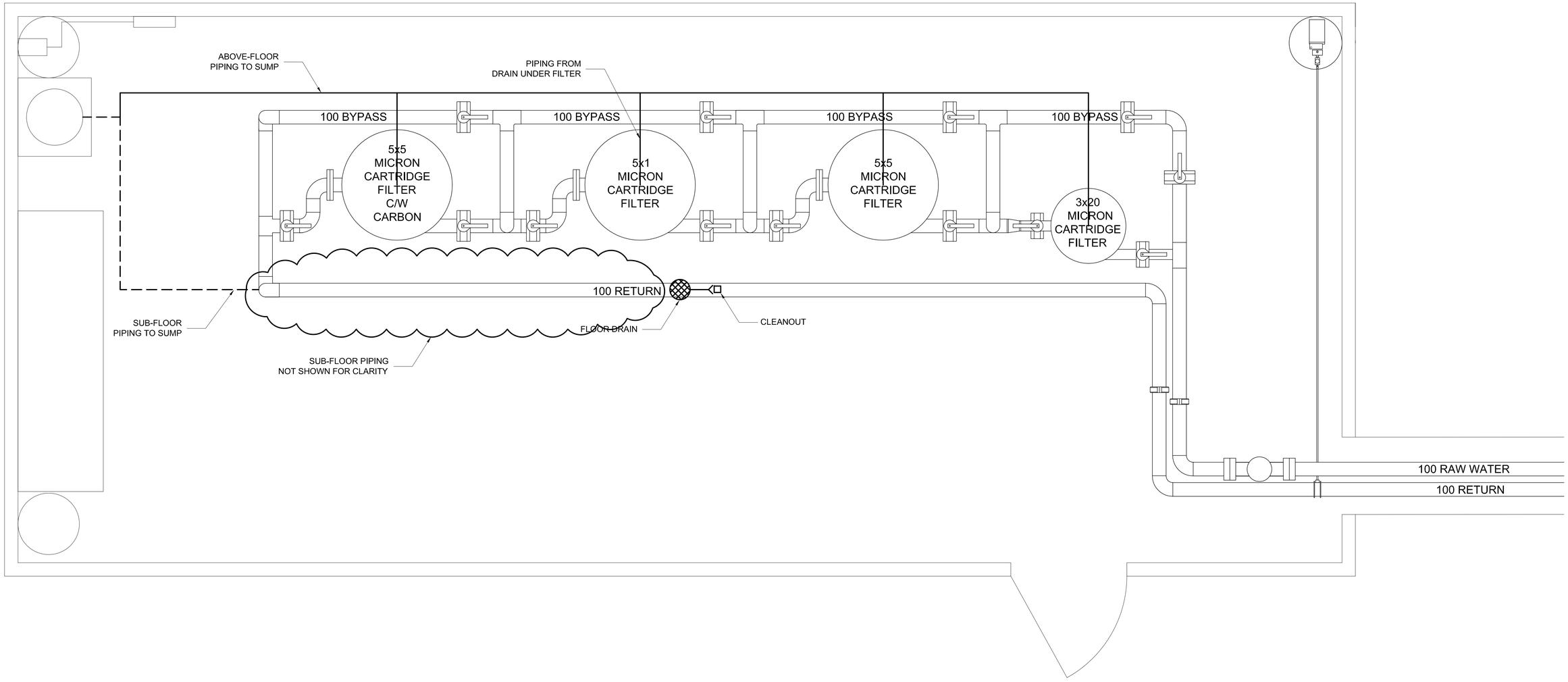
WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

PROJECT NO. 07-8254-1000

FILTRATION SYSTEM

SHEET NO. 204

4920 47TH STREET, YELLOWKNIFE NT, X1A 2P1, PHONE 867.920.4555



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File Name: g:\cad\87254\standard\process water.dwg

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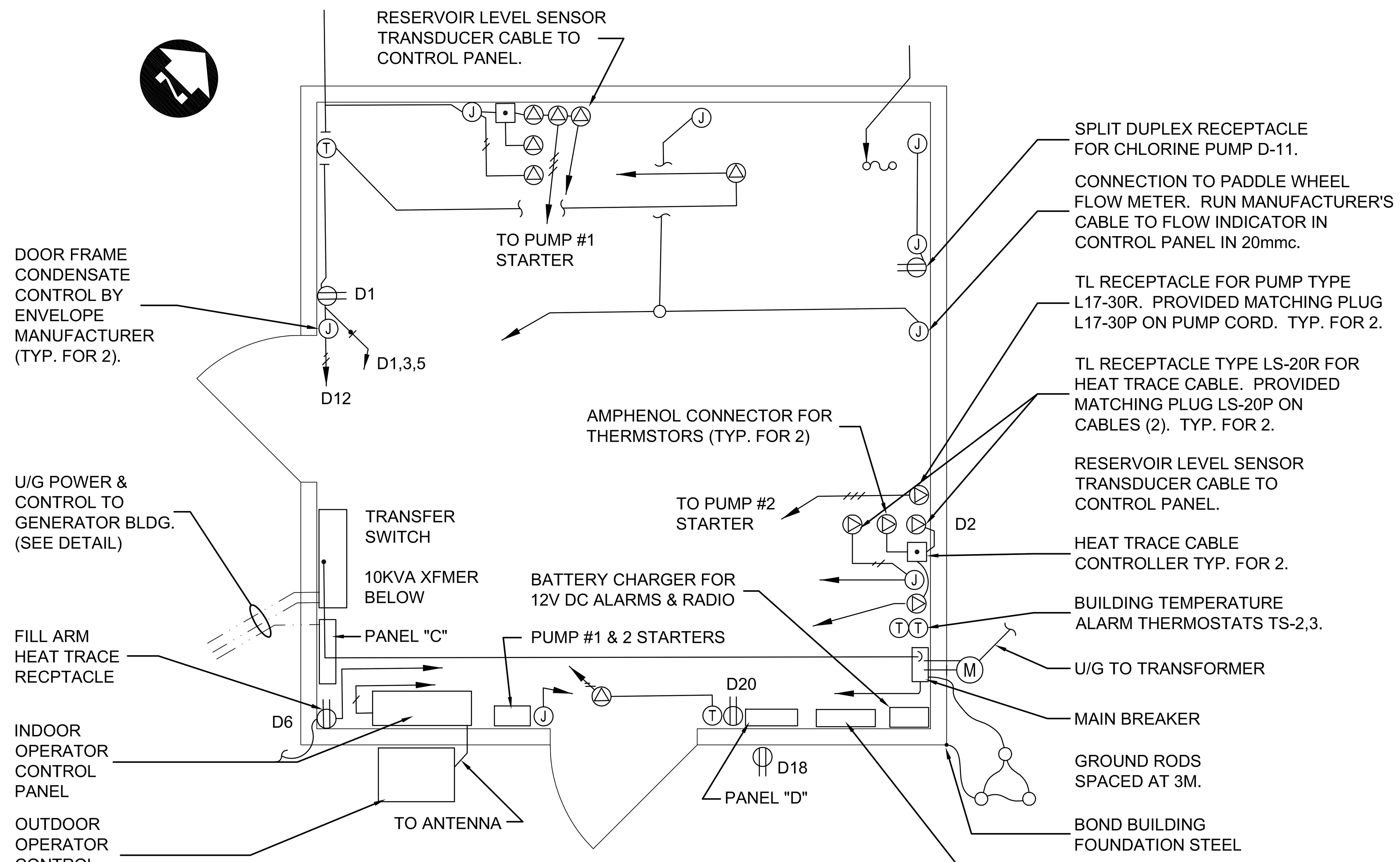
NTB	GS
DATE	APRIL 2008
SCALE	1:150

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

PROJECT NO. 07-8254-1000

DOMESTIC PLUMBING

SHEET NO. 205

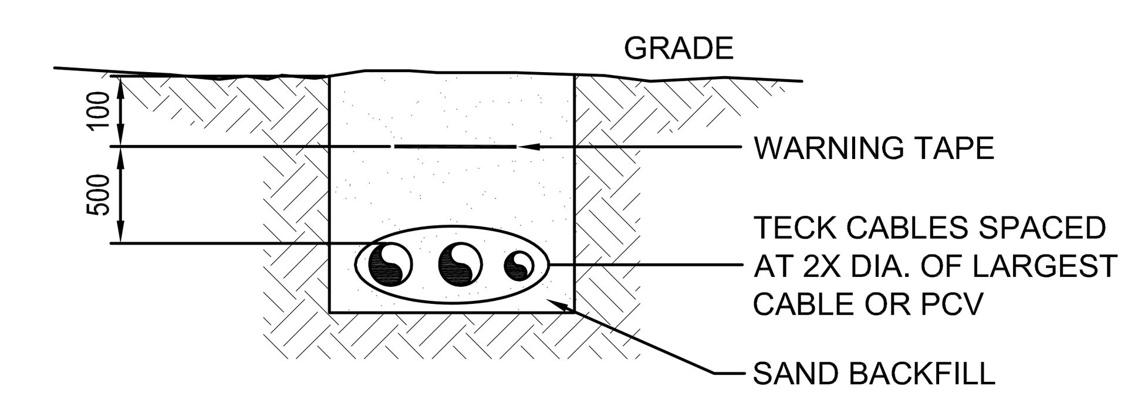


EXISTING POWER LAYOUT

SCALE: 1:25

NOTES:

1. EXISTING ACROSS THE LINE STARTERS FOR SUBMERSIBLE INTAKE PUMPS TO BE REMOVED.
2. REMOVE EXISTING EMERGENCY BATTERY PACK.
3. EXISTING 7 1/2 HP INTAKE PUMPS TO BE REMOVED BY THE MECHANICAL CONTRACTOR.



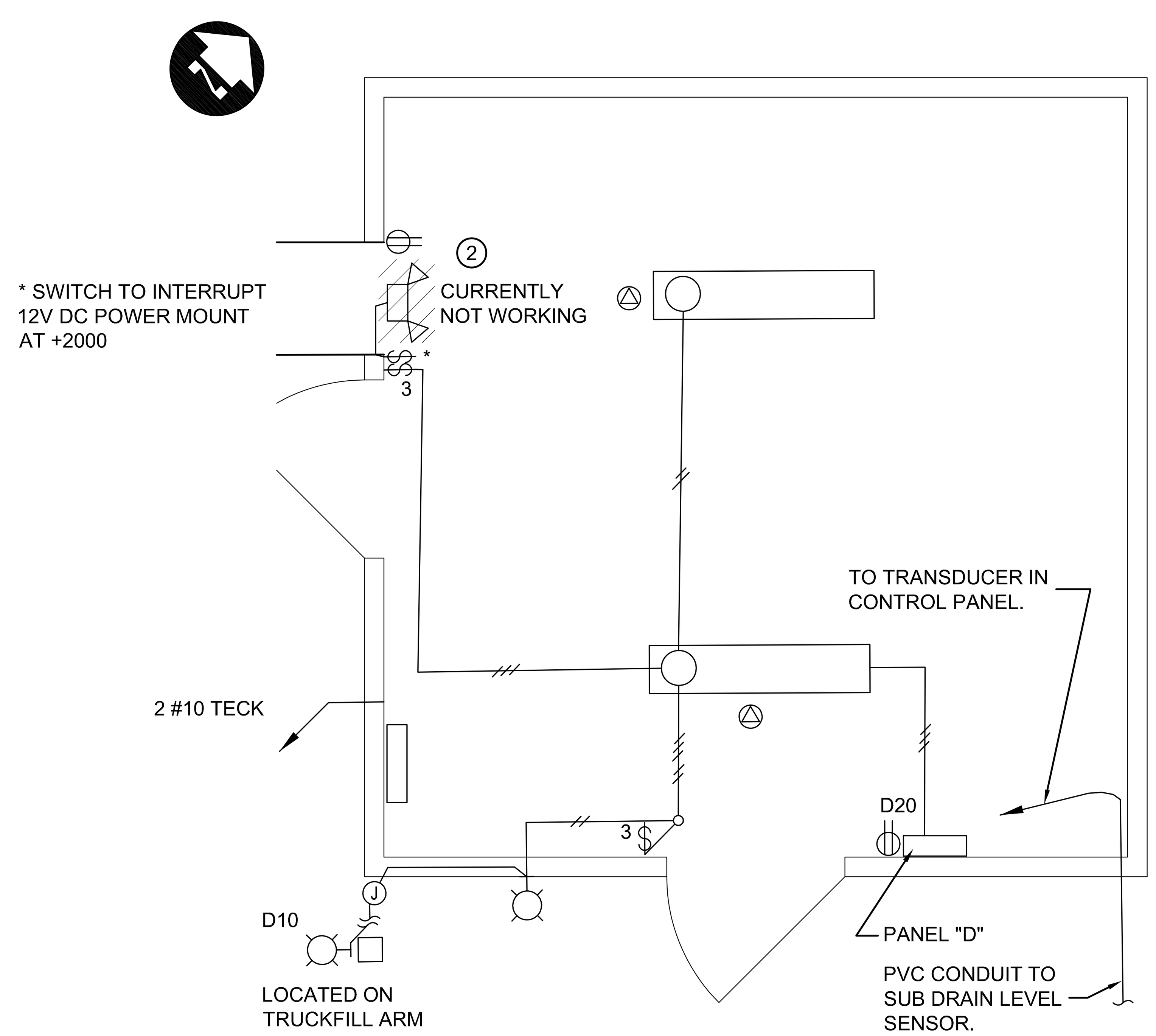
EXISTING UNDERGROUND CABLE DETAIL

N.T.S.

VOLTS: 600/347	PANEL: 'C'	TYPE: SQUARE D COL
PHASE: 3	LOCATION: SOUTH WALL	MAINS: 225
WIRE: 4	FEED: 15 kVA	ENTRY: SURFACE

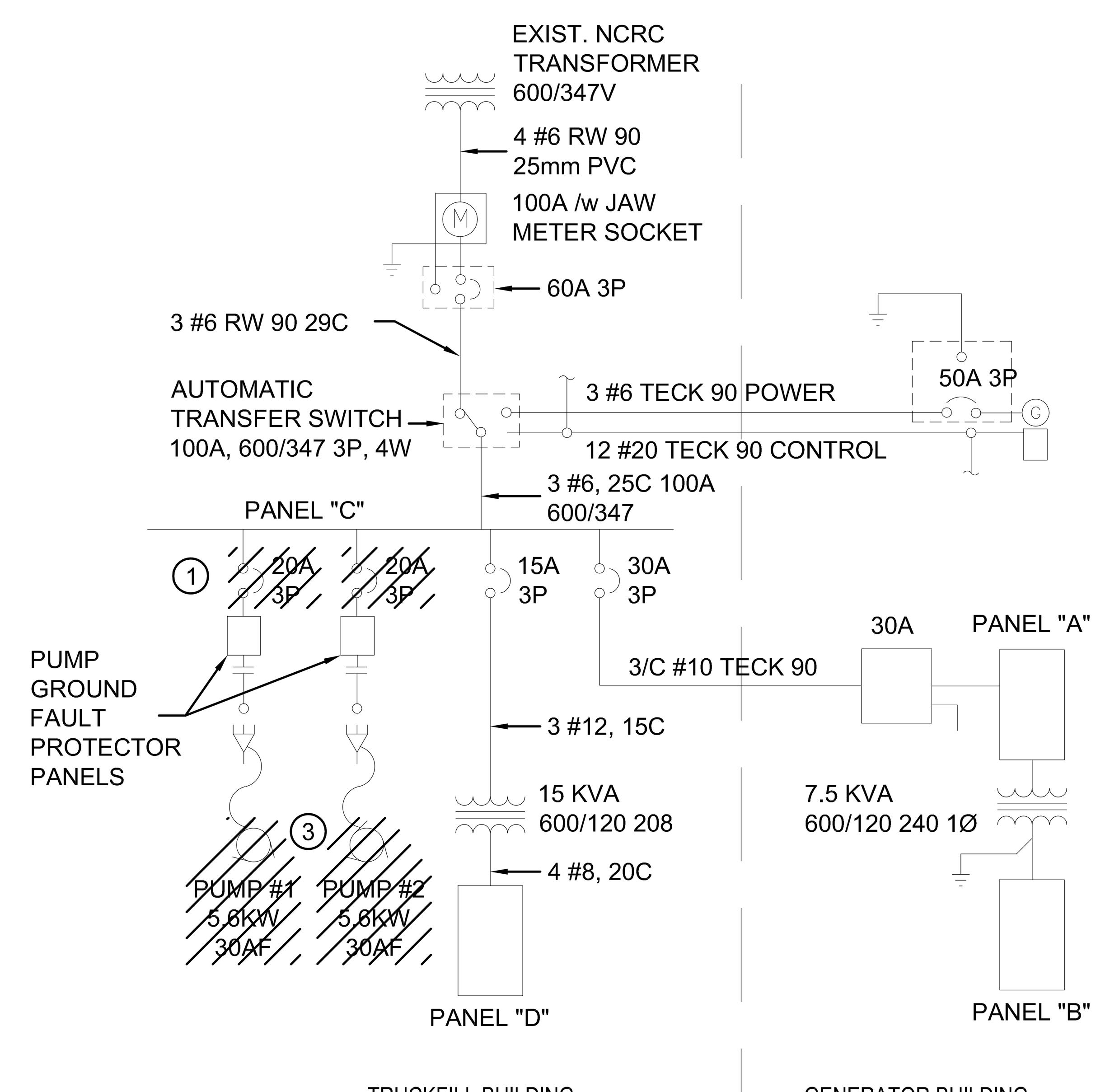
DESCRIPTION	POLE	AMP	CCT. No.	CCT. No.	AMP	POLE	DESCRIPTION
PUMP #1	3	20	1	2	30	3	PANEL A/B GENERATOR BUILDING
PUMP #1	3	20	3	4	30	3	PANEL A/B GENERATOR BUILDING
PUMP #1	3	20	5	6	30	3	PANEL A/B GENERATOR BUILDING
PUMP #2	3	20	7	8	15	3	15kVA TRANSFORMER
PUMP #2	3	20	9	10	15	3	15kVA TRANSFORMER
PUMP #2	3	20	11	12	15	3	15kVA TRANSFORMER
SPARE			13	14	15	3	FLUORIDE SHED
SPARE			15	16	15	3	FLUORIDE SHED
SPARE			17	18	15	3	FLUORIDE SHED
SPARE			19	20			SPARE
SPARE			21	22			SPARE
SPARE			23	24			SPARE
SPARE			25	26			SPARE
SPARE			27	28			SPARE
SPARE			29	30			SPARE
SPARE			31	32			SPARE
SPARE			33	34			SPARE
SPARE			35	36			SPARE
SPARE			37	38			SPARE
SPARE			39	40			SPARE
SPARE			41	42			SPARE

EXISTING PANEL SCHEDULE



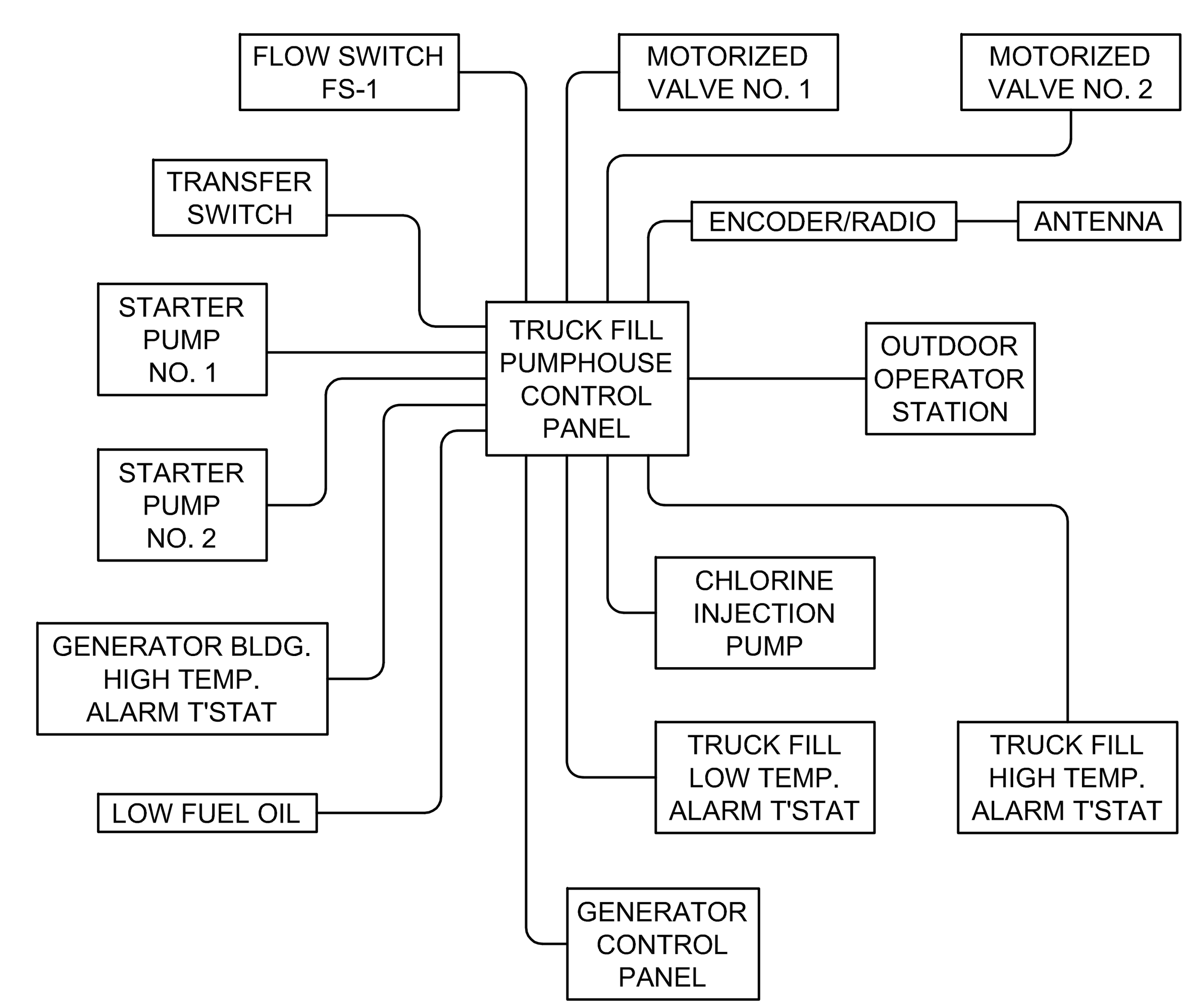
EXISTING LIGHTING LAYOUT

SCALE: 1:25



EXISTING SINGLE LINE DIAGRAM

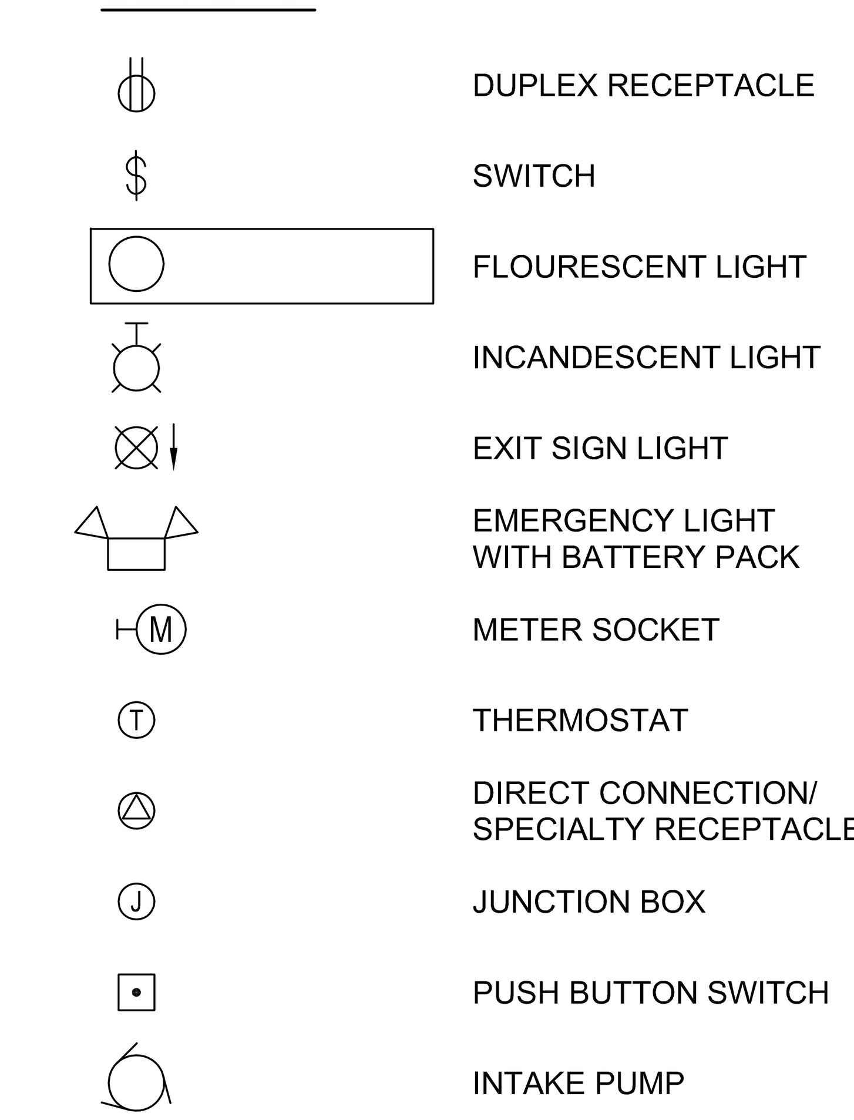
N.T.S.



EXISTING CONTROL SCHEMATIC

N.T.S.

LEGEND



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MCL	WCDD
DRAWN: ACP	CHECKED BY: WCDD
DATE: APRIL 2008	
SCALE: AS SHOWN	

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

EXISTING PLANS DETAILS AND SCHEMATICS

PROJECT NO. 07-8254-1000

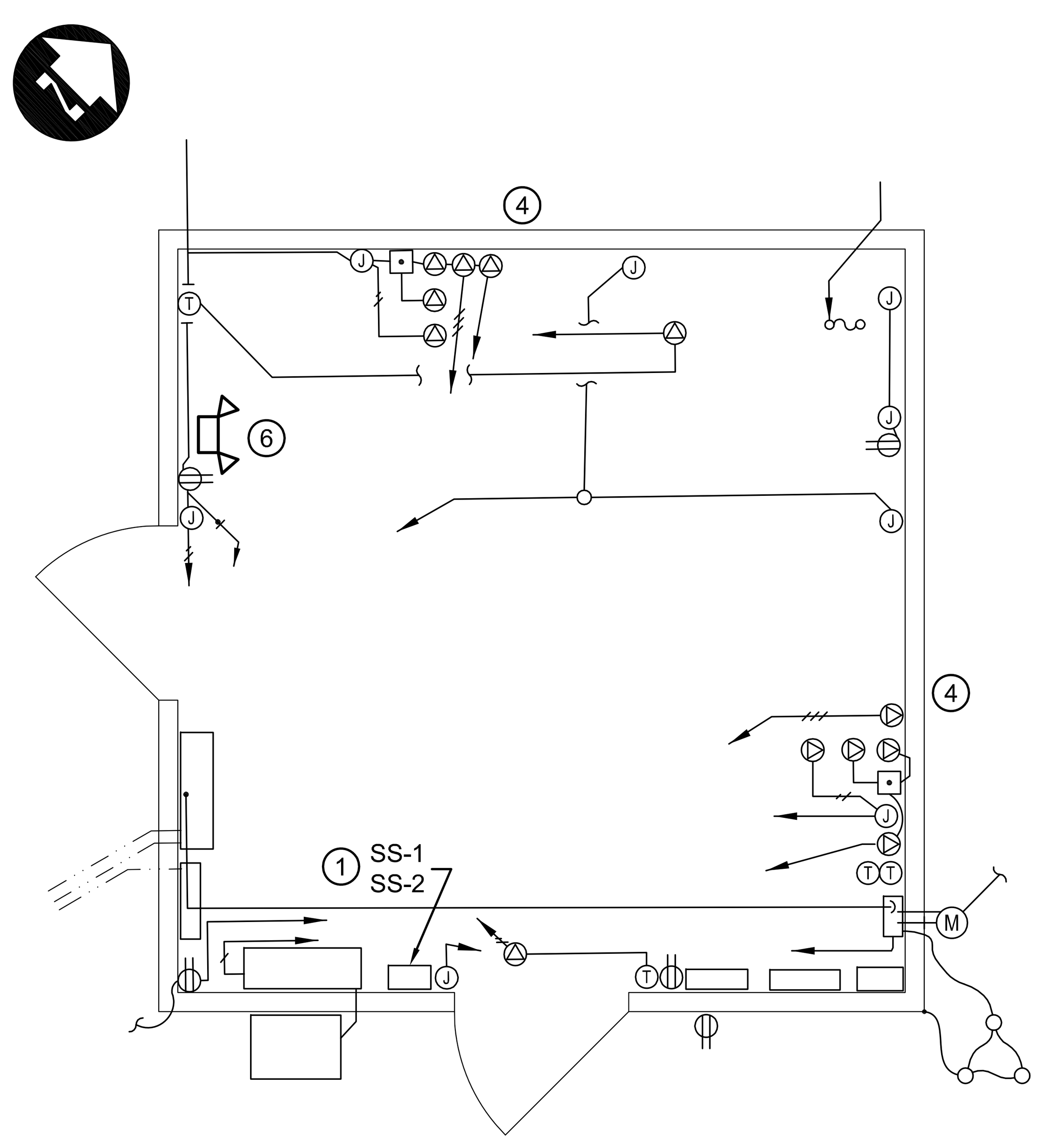
SHEET NO. 301

VOLTS: 120/208	PANEL: 'D'	TYPE: SQUARE D COL
PHASE: 3	LOCATION: TRUCK FILL BDG	MAINS: 100
WIRE: 4	FEED: 10kVA TRANSFORMER	ENTRY: BOTTOM

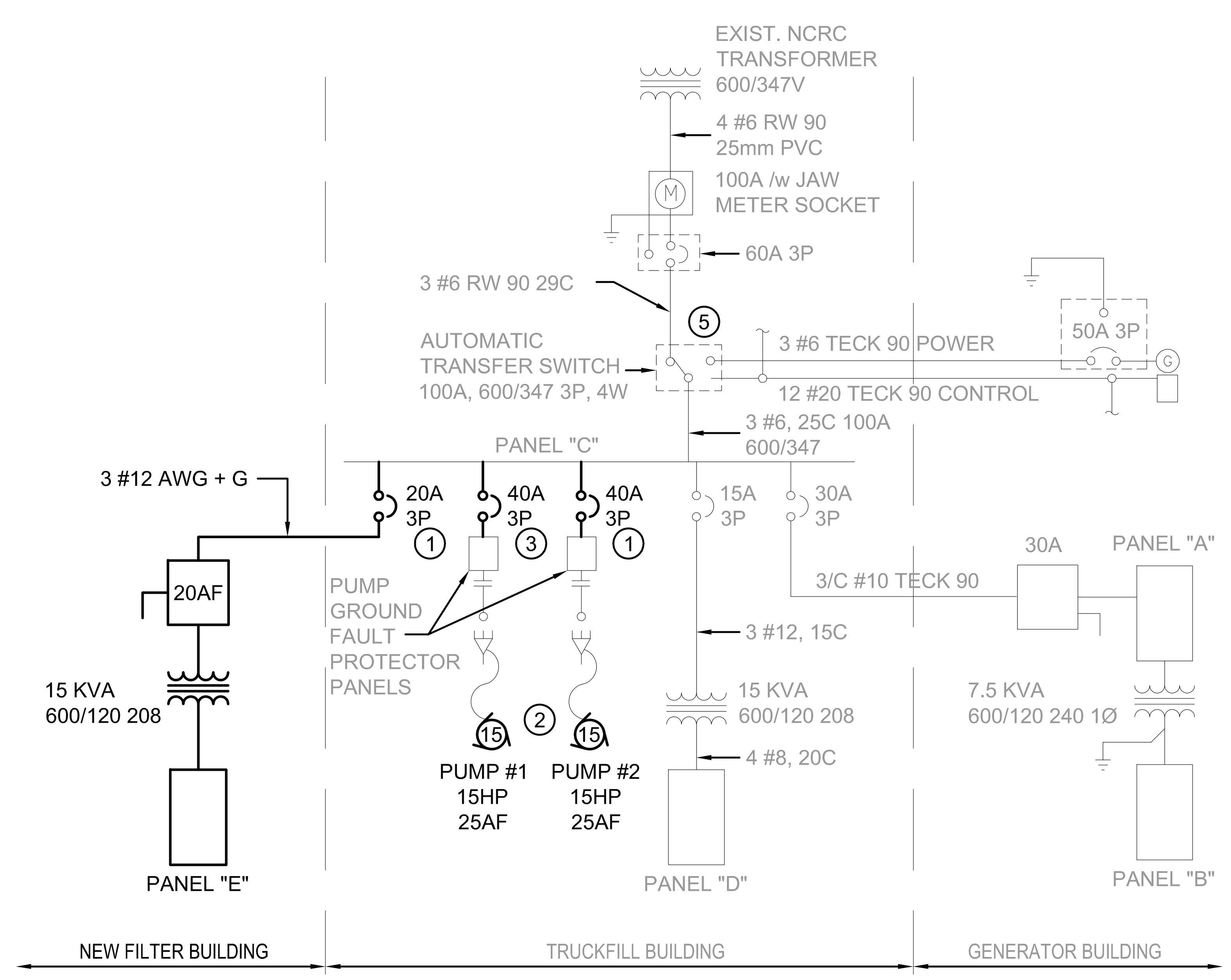
DESCRIPTION	POLE	AMP	CCT. No.	CCT. No.	AMP	POLE	DESCRIPTION
RECEPTACLE	1	15	1	2	30	1	HEAT TRACE-DUTY (CELL2)
HEAT TRACE-DUTY (CELL1)	1	30	3	4	30	1	HEAT TRACE-STANDBY (CELL2)
HEAT TRACE-STANDBY (CELL1)	1	30	5	6	15	1	HEAT TRACE-ARM
CONTROL PNL	1	15	7	8	15	1	BATTERY CHARGER
LIGHTING	1	15	9	10	15	1	EXT. LIGHTING
CHLORINE PUMP	1	15	11	12	15	1	DOOR HTRS
HEATER 1	2	15	13	14	15	1	MV1
HEATER 1	2	15	15	16	15	1	MV2
HEATER 2	2	15	17	18	15	1	EXT. RECEPTACLE
HEATER 2	2	15	19	20	15	1	RECEPTACLE
BATTERY PACK	1	15	21	22	15	1	**MV3**
SPARE			23	24	15	1	**MV4**
SPARE			25	26			SPARE
SPARE			27	28			SPARE

VOLTS: 600/347	PANEL: 'C'	TYPE: SQUARE D COL
PHASE: 3	LOCATION: SOUTH WALL	MAINS: 225
WIRE: 4	FEED: 15 kVA	ENTRY: SURFACE

DESCRIPTION	POLE	AMP	CCT. No.	CCT. No.	AMP	POLE	DESCRIPTION
PUMP #1	3	**25**	1	2	30	3	PANEL A/B GENERATOR BUILDING
PUMP #1	3	**25**	3	4	30	3	PANEL A/B GENERATOR BUILDING
PUMP #1	3	**25**	5	6	30	3	PANEL A/B GENERATOR BUILDING
PUMP #2	3	**25**	7	8	15	3	15kVA TRANSFORMER
PUMP #2	3	**25**	9	10	15	3	15kVA TRANSFORMER
PUMP #2	3	**25**	11	12	15	3	15kVA TRANSFORMER
15kVA TRANSFORMER – FILTER BLDG.	3	20	13	14	15	3	FLUORIDE SHED
15kVA TRANSFORMER – FILTER BLDG.	3	20	15	16	15	3	FLUORIDE SHED
15kVA TRANSFORMER – FILTER BLDG.	3	20	17	18	15	3	FLUORIDE SHED
SPARE			19	20			SPARE
SPARE			21	22			SPARE
SPARE			23	24			SPARE
SPARE			25	26			SPARE
SPARE			27	28			SPARE
SPARE			29	30			SPARE
SPARE			31	32			SPARE
SPARE			33	34			SPARE
SPARE			35	36			SPARE
SPARE			37	38			SPARE
SPARE			39	40			SPARE
SPARE			41	42			SPARE



EXISTING TRUCKFILL BUILDING
N.T.S.



SINGLE LINE DIAGRAM
N.T.S.

NOTES:

1. PROVIDE NEW SOLID STATE SOFT STARTERS FOR NEW 15HP INTAKE PUMPS. INSTALL IN EXISTING STARTER CABINET. SEE EQUIP. SCHEDULE.
2. NEW 15 HP INTAKE PUMPS TO BE INSTALLED BY THE MECHANICAL CONTRACTOR. THE ELECTRICAL CONTRACTOR TO PROVIDE 3-#10 AWG WIRING FOR THE NEW PUMPS.
3. THE ELECTRICAL CONTRACTOR TO CONFIRM THAT THE EXISTING GROUND FAULT PROTECTION CAN ACCOMODATE THE NEW 15 HP PUMPS.
4. AFTER NEW INTAKE PUMPS ARE INSTALLED, THE ELECTRICAL CONTRACTOR TO CONFIRM THAT THE HEAT TRACE SYSTEMS ARE OPERATING EFFECTIVELY.
5. PROVIDE AUXILLARY CONTACT IN TRANSFER SWITCH TO LOCK OUT OPERATION OF RADIANT HEATER 1 (RH-1) WHEN EMERGENCY GENERATOR IS IN OPERATION.
6. PROVIDE NEW EMERGENCY BATTERY PACK.
7. ALL ELECTRICAL EQUIPMENT TO BE NEMA 4X RATED IN ACCORDANCE WITH ELECTRICAL AND ELECTRONIC MANUFACTURERS' ASSOCIATION OF CANADA (EEMAC).

LEGEND

- DUPLEX RECEPTACLE
- SWITCH
- FLOURESCENT LIGHT
- INCANDESCENT LIGHT
- EXIT SIGN LIGHT
- EMERGENCY LIGHT WITH BATTERY PACK
- METER SOCKET
- THERMOSTAT
- DIRECT CONNECTION/ SPECIALTY RECEPTACLE
- JUNCTION BOX
- PUSH BUTTON SWITCH
- INTAKE PUMP (HP NOTED)

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DESIGN: MCL — REVIEWED BY: WCDD
DRAWN: ACP — CHECKED BY: WCDD
DATE: APRIL 2008
SCALE: N.T.S.

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

DIAGRAMS SCHEMATICS AND PANEL SCHEDULE

PROJECT NO. 07-8254-1000

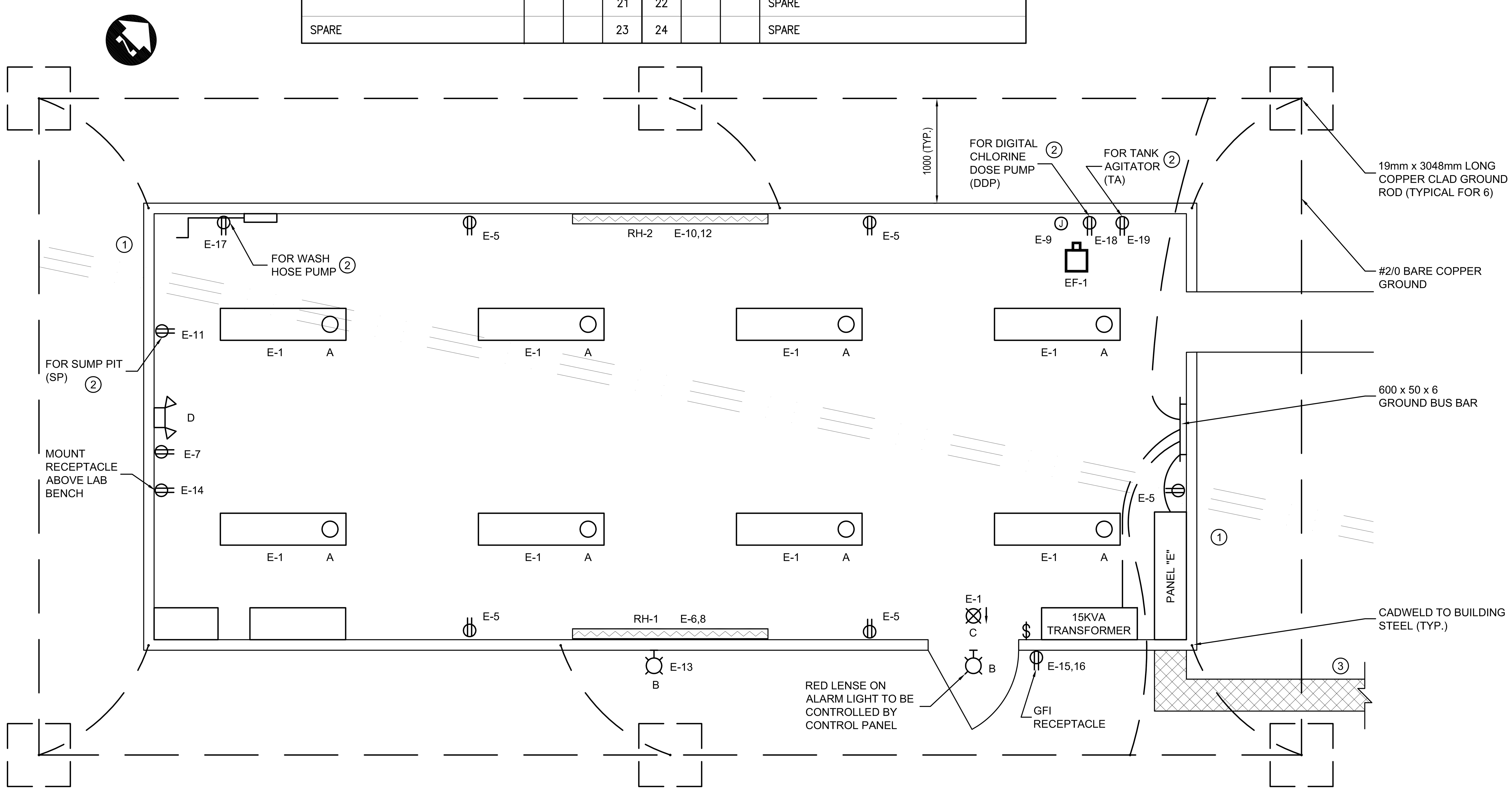
SHEET NO. 302

VOLTS: 600/120/208	PANEL: 'E'	TYPE: SQUARE D COL
PHASE: 3	LOCATION: SOUTH WALL	MAINS: 225
WIRE: 4	FEED: 15 kVA	ENTRY: SURFACE

DESCRIPTION	POLE	AMP	CCT. No.	CCT. No.	AMP	POLE	DESCRIPTION
LIGHTING	1	15	1	2	15	1	SPARE
CHLORINATION SYSTEM	1	15	3	4	15	1	SPARE
RECEPTACLES	1	15	5	6	15	2	RADIANT HEATER – RH–1
BATTERY PACK RECEPTACLES	1	15	7	8	15	2	RADIANT HEATER – RH–1
CHLORINE EXHAUST FAN EF–1	1	15	9	10	15	2	RADIANT HEATER – RH–2
SUMP PIT RECEPTACLE SP	1	15	11	12	15	2	RADIANT HEATER – RH–2
EXTERIOR LIGHTING	1	15	13	14	15	1	LAB BENCH RECEPTACLE
EXTERIOR RECEPTACLES			15	16	15	1	EXTERIOR RECEPTACLES
DOMESTIC WATER PUMP RECEPTACLE			17	18	15	1	DIGITAL CHLORINE DOSE PUMP RECEPTACLE DDP
TANK AGITATOR RECEPTACLE TA			19	20			
			21	22			SPARE
SPARE			23	24			SPARE

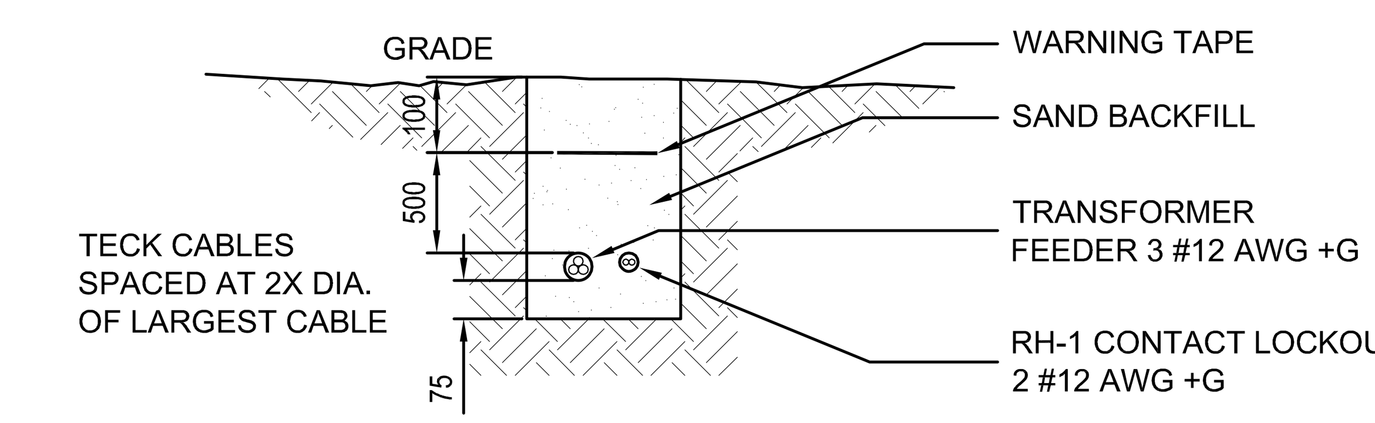
NOTE:

1. PROVIDE A WARNING SIGN ON SIDE OF NEW BUILDING THAT STATES EXISTING UNDERGROUND CONDUIT/ CONDUCTORS RUN UNDERNEATH THE NEW BUILDING.
2. CO-ORDINATE RECEPTACLE PLACEMENT WITH ON SITE LOCATION OF MECHANICAL EQUIPMENT BEING SERVED.
3. UNDERGROUND CABLE FROM PANEL 'C' IN TRENCH (SEE DETAIL THIS DRAWING). CO-ORDINATE INSTALLATION WITH EXISTING UNDERGROUND CABLES.



LIGHTING AND POWER LAYOUT

SCALE: 1:25



UNDERGROUND CABLE DETAIL

N.T.S.

LEGEND

- DUPLEX RECEPTACLE
- SWITCH
- FLOURESCENT LIGHT
- INCANDESCENT LIGHT
- EXIT SIGN LIGHT
- EMERGENCY LIGHT WITH BATTERY PACK
- METER SOCKET
- THERMOSTAT
- DIRECT CONNECTION/ SPECIALTY RECEPTACLE
- JUNCTION BOX
- PUSH BUTTON SWITCH
- INTAKE PUMP

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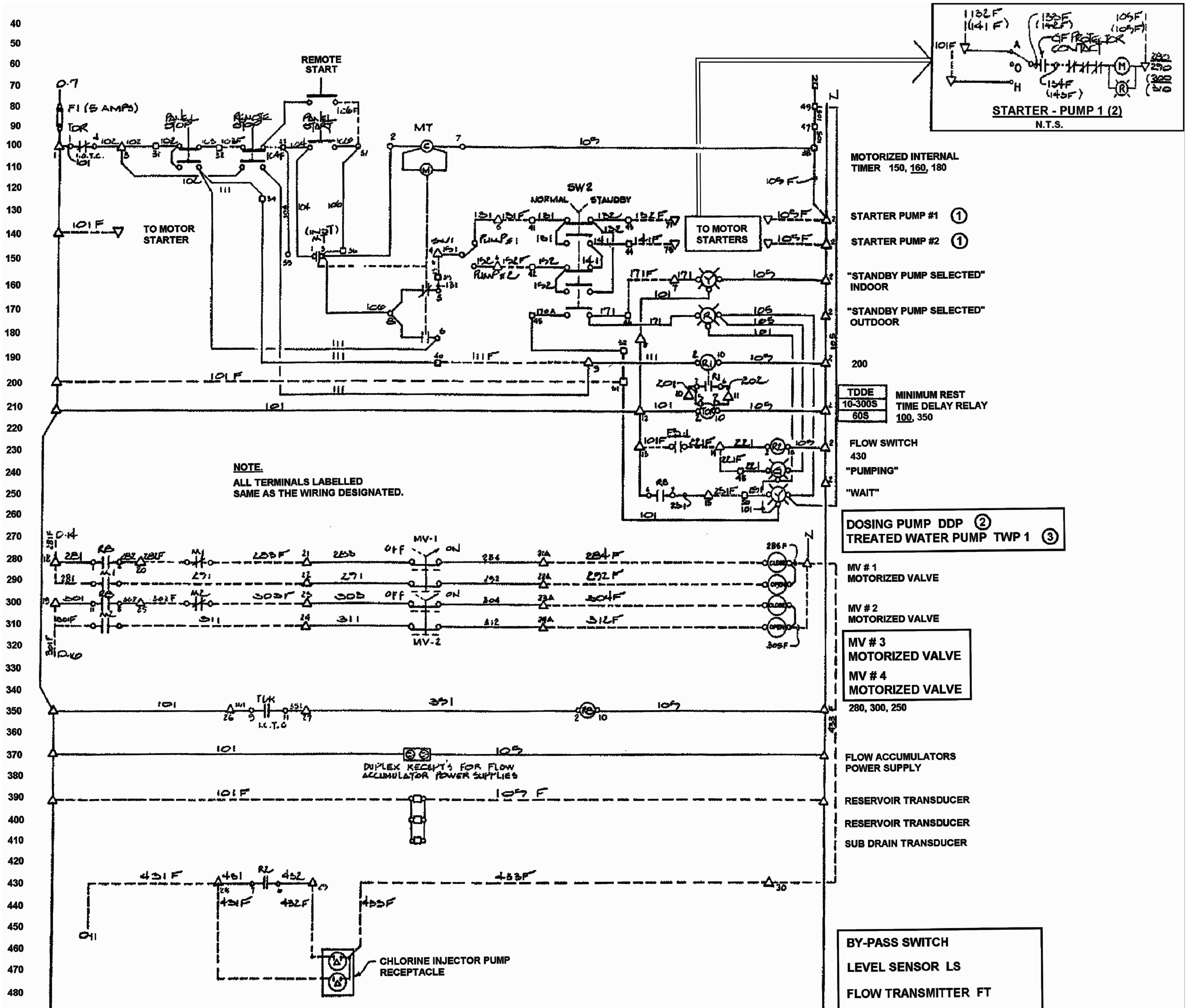
WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

NEW FILTRATION BUILDING ELECTRICAL

PROJECT NO. 07-8254-1000

SHEET NO. 303

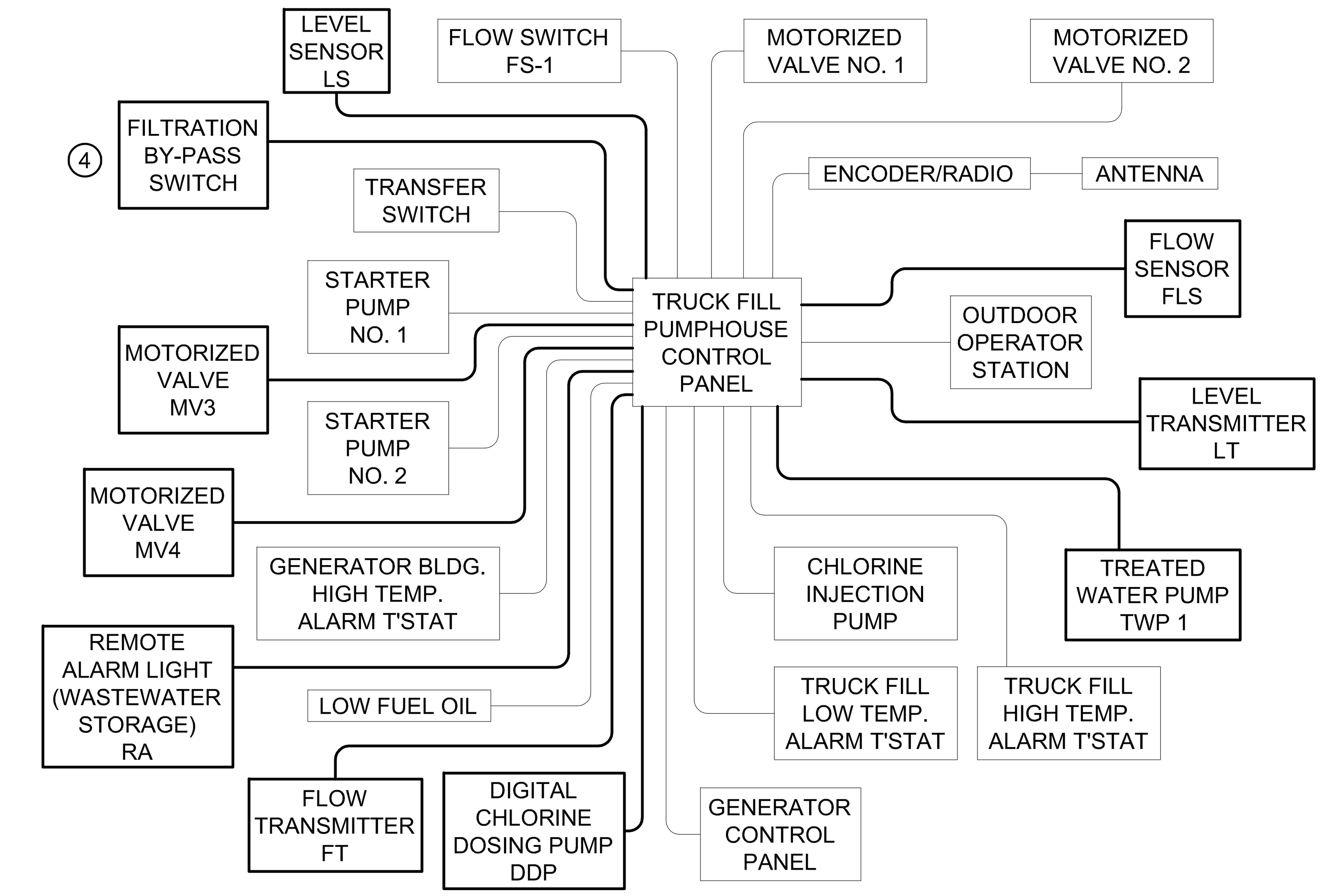
FileName:g:\cad\078254\tender\078254rv.dwg



NOTES:

1. STARTER FOR NEW 15 HP PUMP SEE DRAWING E-2.
2. DOSING PUMP TRIGGERED BY FLOW TRANSMITTER FT.
3. REMOTE ALARM AND TWP 1 ARE TRIGGERED BY THE LEVEL TRANSMITTER LT.
4. BY-PASS SWITCH TO DIVERT FLOW TO THE TRUCK FILL FOR FIRE FLOW OPERATION.

AC SCHEMATIC DIAGRAM - PUMPHOUSE CONTROLS



NEW CONTROL SCHEMATIC

N.T.S.

GENERAL NOTES:

THE EXISTING CONTROL PANEL WILL BE MODIFIED TO INCLUDE THE NEW PROCESS EQUIPMENT. THE NEW COMPONENTS ARE SHOWN IN THE "NEW CONTROL SCHEMATIC". THE CONTRACTOR WILL INCORPORATE THESE NEW FEATURES INTO THE WIRING DIAGRAM AND SUBMIT THE NEW WIRING DIAGRAM FOR APPROVAL AT THE SHOP DRAWING REVIEW STAGE.

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REGISTERED PROFESSIONAL ENGINEER — W. G. D'ENTREMONT(?) — LICENSEE — N.W.T.

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DESIGN: MCL	REVIEWED BY: WCDD
DRAWN: ACP	CHECKED BY: WCDD
DATE: APRIL 2008	
SCALE: N.T.S.	

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

WIRING CONTROLS AND SCHEMATICS

PROJECT NO. 07-8254-1000

SHEET NO. 304

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TYPE	SIZE (mm)	WATTAGE	LAMPS	VOLTAGE	LENS	MOUNTING	MANUFACTURER	COMMENTS
	LUMINARIE SCHEDULE							
A	300 X 1200	32W/CW T8 OCTRON	2	120	-	SURFACE (CEILING)	LITHONIA 2LB-2-32-120-GEB10IS CSA	-18C ELECTRONIC BALLAST
B	260 X 360	70W HPS CLEAR	1	120	POLYCARB WIRE CAGE	SURFACE (WALL):	HOLOPHANE WP2B-070HP-12-B2-PA	-30C BALLAST C/W CAT.NO.13004 PHOTO-CELL
C	241 X 273	12W HALOGEN	2	120	-	SURFACE (WALL):	LITHONIA TITAN M1272-120-CS-M1212-CSA	-
D	311X197	1W LED	MULTIPLE	120		SURFACE (CEILING)	LITHONIA LK-S-W-1-R-120-ELN-CSA	DC SOCKET C/W 12V LAMP

LUMINAIRE SCHEDULE

Tag	Name	Equipment Characteristics	Manufacturer	Model No.	Operating Equipment Weight	Electrical	Motor (KW)	Motor (HP)	Remarks
FT	Filter System Flow Transmitter	Convert the signal from all Signet flow sensors, into a 4 to 20 mA signal for long distance.	Signet	8550	-	12-24 VDC +/- 10%, regulated			New Flow Transmitter to be controlled through the Pump House Control System and to be mounted in the existing panel
FLS	Stainless Steel High Performance Paddlewheel Flow Sensor	Enabling flow measurement of 0.1 to 6 m/s.	Signet	2540	-	5 to 24 VDC 1.5mA max			New Flow Sensor to be mounted in the common existing water line, and controlled through the Pump House Control System.
LS LT	Water Tank Level Sensor/ Level Transmitter		Flygt	LSU 100	-	12-40VDC, two wire system			To be mounted in the water tank, and controlled through the Pump House Control System.
PM1	Submersible Intake Pump #1	357 US gpm at 111' Head, 3450 RPM	Grundfos	192430C2 SP 95-2-B	-	575/3Ø/60		15	To be Controlled through the Pump House Control System
PM2	Submersible Intake Pump #2	357 US gpm at 111' Head, 3450 RPM	Grundfos	192430C2 SP 95-2-B	-	575/3P/60		15	To be Controlled through the Pump House Control System
SP	Sump Pit	20 US gpm at 15' Head	Grundfos	SU332AV	-	115V, 1phase		1/3	Complete with level control switch
BN	Basin	18" x 30", 30 gallons,	Grundfos	96001004	-	-	-	-	
P1	Domestic Water Pump	Intermittent duty 2.5 GPM at 20 psi Head	SHURflo	2088-492-144	-	120/1Ø/60		-	Compete with Adjustable Pressure Switch and Check Valve
CCF	Activated Carbon Cartridges		Harmsco Hurricane		-	-	-	-	To be selected
SNK	Laundry tub (Sink)	514mm x 438mm x 330mm Overall height is 883mm	Fiat Products	FL-1 Floor mounted serv-a-sink	-	-	-	-	
TA	Tank Agitator	1725 RPM, Pumps 436 gallons per minute	Dynamix	MMX-21O3D-99S7DD	-	120/1Ø/60		1/3 HP	Complete with switch
CT	Cylindrical Tanks		Polyrama Plastics		-	-	-	-	To be selected
BSK	Basket Strainers		Hayward		-	-	-	-	To be selected
PPC	Polypleat-Cartridges		Danamark Watercare		-	-	-	-	To be selected
DDP	Digital Chlorine Dosing Pump	16 Lph at 43.5 psi	Grundfos	M 209-20D E41 D00 R00 P03		120/1Ø/60			To be Controlled through the Pump House Control System via the Flow Transmitter
SBH	Swing Bolt Housings		Danamark Watercare		-	-	-	-	To be selected
SS1	Motor Soft Starter 1		Allen Bradley	150-C19NCD	-	120/1Ø/60			To be Installed in existing Starter Cabinet
SS2	Motor Soft Starter 2		Allen Bradley	150-C19NCD	-	120/1Ø/60			To be Installed in existing Starter Cabinet
EF-1	Chlorine Exhaust Fan	115 CFM at 0.02 E.S.P.	Loren-Cook	60TCNB	-	120/1Ø/60		0.25	To be controlled by light switch. Complete with: back draft damper; explosion proof motor; belt guard; AMCA A construction, and; Phenolic epoxy coating
RH-1	Radiant Electric Heater	5.0 kW	Chromalox	KRR6504C131	22 lbs	240/1Ø/60	5.0		Wall Mounted, Complete with Field Installed Thermostat. Unit to be locked out when the emergency generator is operating
RH-2	Radiant Electric Heater	5.0 kW	Chromalox	KRR6504C131	22 lbs	240/1Ø/60	5.0		Wall Mounted, Complete with Field Installed Thermostat

EQUIPMENT SCHEDULE

Conditions of Use

Verify elevations and/or dimensions on drawing prior to use. Report any discrepancies to Dillon Consulting Limited.

Do not scale dimensions from drawing.

Do not modify drawing, re-use it, or use it for purposes other than those intended at the time of its preparation without prior written permission from Dillon Consulting Limited.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS, GEOLOGISTS and GEOPHYSICISTS OF THE NORTHWEST TERRITORIES
PERMIT NUMBER P 010
DILLON CONSULTING LIMITED

REGISTERED PROFESSIONAL ENGINEER W. C. D. DeGAGNE LICENSEE N.W.T.

Nunavut

DILLON CONSULTING

No.	ISSUED FOR	DATE	BY
3	ISSUED FOR TENDER	04/23/08	GS
2	ISSUED FOR 100% CLIENT REVIEW	04/08/08	GS
1	ISSUED FOR 75% CLIENT REVIEW	03/14/08	GS

DESIGN: MCL | REVIEWED BY: WCDD
DRAWN: ACP | CHECKED BY: WCDD
DATE: APRIL 2008
SCALE: N.T.S.

WATER SUPPLY FILTRATION SYSTEM
ARVIAT, NUNAVUT

SCHEDULES

PROJECT NO. 07-8254-1000

SHEET NO. 305

FileName:g:\cad\078254\tender\078254m.dwg

Appendix J

Tender Document Details from 1991

Pumphouse and Supply Line Contract

Government of the N.W.T.
Wolf Creek Water Supply
Arviat, N.W.T.
Project No. 91–5501

APPENDIX D

SCHEDULE OF CONTRACT UNIT PRICES

ITEM NO.	DESCRIPTION	PAYMENT CLAUSE	EST. QUANTITY	UNIT	UNIT PRICE	EXTENSION
1	Overland Fill Line Installation	02713 1.2.1	7500	lin.m.		
2	Culvert	02713 1.2.2	15	lin.m.		
3	Flanged HDPE Tee	02713 1.2.3	1	each		
4	Flanged HDPE 45 Bend	02713 1.2.4	2	each		
5	Sclairloc Couplers	02713 1.2.5	17	each		
6	Gate Valves	02713 1.2.6	2	each		
7	Check Valves	02713 1.2.7	1	each		
8	Air & Vacum Valve Assembiies	02713 1.2.9	2	each		
9	HDPE to Hose Connection	02713 1.2.10	1	each		
10	Suction Hoses	15404 2.1.1	10	each		
11	"Dolphin Suction Strainer"	15404 2.1.2	1	each		
12	Reservoir Fill Pump	15422 1.2.1	1	each		
13	Pump Building		1	each		

TOTAL TENDER

1.0 GENERAL

1.1 The description which follows is approximate and abbreviated. The Work of the Contract includes, but is not necessarily limited to, the supply of all labour, materials and equipment necessary to:

a) Supply and install pump storage building.

b) Supply and install pump and related materials.

c) Supply miscellaneous fittings.

d) Install approximately 7.5 km of 200 mm overland HDPE reservoir fill line and associated fittings.

2.0 PRE-PURCHASED MATERIAL

2.1 The Government of the Northwest Territories has pre-purchased the following materials F.O.B. Arviat, N.W.T.:

200 mm IPS HDPE DR17 (Series 100) pipe in 12.2 m lengths	8,000 m
200 mm IPS stub ends DR17 (Series 100)	140
200 mm IPS Backup rings	140
19 mm x 165 mm galvanized flange bolts, nuts and washers, HDPE - HDPE	70 sets
3 mm thick neoprene full face gaskets for above	70

2.2 The Contractor shall supply all other material required to complete the work.

3.0 DEFINITION OF TRADES/JURISDICTION

3.1 For convenience of reference only, the specifications are separated into titled sections (see Table of Contents). Sections are identified by title and a five digit numbering system.

3.2 In the case of a dispute, the General Contractor shall decide which Subcontractor supplies and installs required materials or equipment. Extras will not be considered on the grounds of differences in interpretation of the specifications as to which Subcontractor does what work.

END OF SECTION

1. GENERAL

1.1 Description

.1 Work Included:

.1 Supply and fabrication of steel skid for pumping equipment building.

.2 Supply all labour, materials and equipment to complete the pre-fabricated building required for this work as indicated on the drawings or specified herein including, but not necessarily limited to the pumping equipment building.

.3 Supply and application of all paints and coatings

.2 Related Work Described Elsewhere

.1 Metal Fabrication — Section 05500

1.2 Quality Assurance

.1 Qualifications of Suppliers and Personnel

.1 Provide at least one person who shall be present at all times during execution of the work and who shall have two years experience in erection of pre-fabricated buildings.

.2 All welding shall be performed by certified welders.

.2 Codes and Standards

.1 In additional to complying with all pertinent codes and regulations, comply to:

.1 CSA CAN3-S16.1-M84 and CSA S136.

.2 CSA W59.1 and CSA W47.1 for welding, fabrication and erection.

.3 Canadian Institute of Steel Construction (CISC) - Code of Standard Practice for Buildings.

.4 National Building Code 1990.

1.3 Shop Drawings

.1 Submit shop drawings in accordance with Section 01340.

.2 Drawings showing design details, connections and sectional member details are to bear the stamp of a Professional Engineer registered in the Northwest Territories.

.3 Clearly indicate shop and erection details including holes, cuts, connections and panel layout configuration, and safe wind and snow loads.

1.4 Design

.1 Design pre-engineered metal building to withstand their own weight, dead and live loads as shown on drawings and in accordance with NBC Code Requirements. Certify that the building components and assemblages meet the appropriate fire code requirements.

2. GENERAL DESIGN REQUIREMENT

2.1 General

.1 The building shall be self-framing gable type with dimensions shown on the drawings.

.2 Roof shall be clear span gable type with slope of 4:12.

.3 Makloc Self-Framing Gable Type or approved equal.

2.2 Structural Steel

.1 All structural steel shapes and plates shall meet the requirements of CSA CAN3-G40.21-M81 Type 300W with yield strength of 300 MPa.

.2 All hollow structural sections shall meet the requirements of CSA CAN3-G40.21-M81 Type 350W with yield strength of 350 MPa.

.3 All machine bolts and anchor bolts shall meet the requirements of ASTM A307.

.4 All high tensile bolts for connections shall meet the requirements of ASTM A325.

.5 Nuts and washers to CSA S16.

.6 Primer Paint: shop coat primer to CISC/CPMA Standard 1-73.

.7 Galvanizing shall be CSA G164 hot dipping galvanizing.

2.3 Roof Systems

.1 System to be Maklok Self-Framing Roof Panel complete with tie rod and upright as supplied by Maklok Metal Building Ltd.

.2 Roof Panels

.1 The exposed metal roof covering shall be 0.85 (22 GA minimum) roll formed, zinc aluminum coated steel panels, of such configuration to provide the specified load carrying capabilities and deflection requirements of this specification. Roof panels shall be of interlocking design with a concealed structural fastening system.

.2 Colour coated metal panels shall carry a fire hazard rating equal to a Class 1 material as classified by Factory Mutual System. Colour to be selected by Engineer.

.3 Deflection of the roof panel shall not exceed L/180 of its span under design loads.

.4 Roof panel shall be: Maklok R75-500

.5 Guarantee: Durability of coated roof panels due to rupture, structural failure or perforation shall be guaranteed for a period of 20 years by the building manufacturer. A specimen copy of the document must accompany the bid, clearly stating the conditions under which the guarantee is valid.

2.4 Wall System

.1 Wall Panels

.1 Metal wall panels shall be of the exterior self-framing type (Maklok W75-500 or approved equal). The metal faces of either side shall be of zinc coated steel and shall be supplied with a factory applied colour coating. The colour finish applied to the exterior (exposed) surface of the panel shall be of such composition as to provide 20 years of film and colour life. Exterior wall panels shall be 0.85 mm (22 GA minimum) thickness. Colour to be selected by Engineer.

.2 Colour coated metal panels shall carry a fire hazard rating equal to a Class 1 material as classified by Factory Mutual System.

.3 The covering width and configuration of the panel shall be the building manufacturer's standard provided all design criteria including deflection is met or exceeded. Side seams shall be interlocking, concealed or tongue-and-groove.

.4 The top, bottom and intermediate panel closures, flashing fascias, and trim shall be the building manufacturer's standard, compatible with the material furnished as wall panels.

.3 Performance

.1 The exterior colour (baked-on) finish for the wall system shall be a performance-proven durable coating providing a minimum 20 year coating system against blistering, peeling, cracking, flaking, checking and chipping.

2.5 Fasteners

.1 Screws: Cadmium plated steel to CSA B35.3-1962, head colour to match exterior sheet, dished steel/neoprene.

2.6 Appurtenances

.1 Contractor to provide sufficient materials to provide all building openings during site erection.

.2 Unless otherwise specified, all appurtenances included with the steel building system shall be to the manufacturer's standards.

.3 Framed openings for doors and other appurtenances shall be designed to structurally replace the cladding or framing members they displace.

2.7

.1 Sealant for Pre-engineered Metal Buildings shall be provided by building manufacturer necessary to provide a weatherproof and finished appearance.

2.8 Skid Frame

.1 The skid frame shall be of welded and bolted steel construction complete with floor grating, as detailed on the Drawings.

.2 The building shall be attached to the skid frame by means of bolts, washers and nuts as shown on the Drawings.

3. EXECUTION

3.1 Preparation

.1 All components shall be clearly marked and referenced to erection drawings, prior to export crating. Erection drawings shall be supplied for identification and assembly of components.

.2 Provide such temporary bracing as may be required to withstand all loads to which the structure may be subjected to during erection and subsequent construction including wind loads, equipment loads and loads due to operating of equipment. Temporary bracing shall remain in place as long as required, and shall be removed upon completion, unless each bracing forms part of the final bracing system.

.3 Erection of metal building, accessories, and interior finish, shall be performed by erectors authorized by the manufacturer as trained and qualified to erect that manufacturer's product.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1	Submittals	Section 01300
.2	Plumbing Specialties	Section 15404
.3	Gauges	Section 15405
.4	Operation and Maintenance Manuals	Section 01730

1.2 Measurement for Payment

.1 Reservoir Fill Pump: shall be paid at the Contract Lump Sum Price which shall be full compensation for supplying to site the complete pump, as specified complete with specified and detailed modifications to standard pump assembly, and installation in the building.

2.0 PRODUCTS

2.1 Description of System

.1 A portable pump shall be provided, mounted on two (2) axles and four (4) pneumatic tires and complete with trailer hitch suitable for towing the pump. This pump is to be used to fill the reservoir from the creek.

2.2 Portable Pump

.1 The pump capacity shall be 525 USGPM at 165 feet heat at 1800 RPM. It shall be a 4" Gorman Rupp self-priming centrifugal, mounted on pneumatic tires and driven by a diesel engine. Catalogue No. 04B3-F4L or approved equal. Unit shall be complete with a minimum 300 litre fuel tank. The engine shall be a Deutz 4 cylinder, 4 cycle, air cooled diesel, Model F4L complete with tachometer, hour meter, oil pressure gauge, oil temperature gauge and means to visually check oil level without shutting off the engine. The pump shall be complete with pressure gauge mounted on the pump discharge and a suitable vacuum gauge mounted on the suction side. Gauges shall be complete with shut-off valves and as specified in Section 15405.

The wheeled frame and fuel tank for the pump and motor shall be fabricated by the supplier to accommodate the specified fuel tank and the additional piping and fittings as detailed on the drawings. The pump assembly shall be supplied to site as a complete unit, including all piping and fittings.

Piping shall be galvanized steel standard wall, complete with flanged or N.P.T. ends where indicated. Ball valve shall be Worcester 100 mm ϕ, Series 45, 4444TT-150 flanged or approved equal. All piping shall be firmly fixed to the pump unit frame to eliminate stress on the pump casing.

The pump shall be mounted on four (4) stands in the building (stands by others). The pump supplier shall provide four (4) plates permanently fastened to the base frame to support these stands. The plates shall be 8" square with four (4) 3/4" holes on a 6" square.

.2 **Operation**

It is intended for this pump to run once a year continuous for a two to four week period. It is anticipated to be running at approximately 1800 RPM. Service manuals shall be prepared based on these operating conditions, and one year's supply of all maintenance materials, oil, grease, filters, etc., shall be supplied with the pump. The materials are in addition to those outlined in Section 02411, 2.2

.3 Turnover Operation and Maintenance data in accordance with Section 01730 before requesting Interim Inspection.

.4 Estimated N.P.S.H. available is 16.8 feet with a total suction lift of 16.9 feet.

END OF SECTION

1.0 GENERAL

1.1 Related Work

.1 Reservoir Fill Pump — Section 15422

.2 Operation and Maintenance Manuals — Section 01730

1.2 Measurement and Payment

.1 Suction Hoses: will be measured as number of units supplied as detailed and paid at the Contract Unit Price per assembled hose, which shall be full compensation for assembling and supplying hoses to site.

.2 Dolphin Suction Strainer: will be paid at the Contract Lump Sum Price for a complete unit supplied as detailed.

2.0 PRODUCTS

2.1 Reservoir Fill Pump

.1 Provide portable pump suction hose assemblies consisting of ten (10) 4 m lengths of 150 ϕ reinforced suction hose , Goodyear Tan Flexwing or approved equal. Each hose shall have one male adaptor and one female adaptor of the Kamlock quick coupling type as follows:

.1 Male O.P.W. Kamlock Model 633E aluminum hose shank adaptor, 150 ϕ or approved equal.

.2 Female O.P.W. Kamlock Model 633C aluminium hose shank adaptor, 150 ϕ or approved equal.

.3 Gaskets: Buna "N" O.P.W. Kamlock No. H-5324-M or approved equal.

.4 Minimum of two stainless steel banding hose clamps, suitable for 150 ϕ hose and 150 psi, shall be supplied for each adaptor.

.2 A "Dolphin" floating suction strainer complete with 18/8 Stainless steel strainer and tube with adaptors to 150 ϕ hose. Strainer shall be as manufactured by Megator Corporation or approved equal. The following accessories shall be furnished:

.1 One 400 mm length of 150 ϕ suction hose; Goodyear Tan Flexwing or approved equal.

.2 Minimum of two stainless steel banding hose clamps, suitable for 150 ϕ hose and 150 psi, shall be supplied for each adaptor.

.3 One 150 ϕ aluminum hose shank adaptor, female O.P.W. Kamlock #633C, all as per detail on drawing.