3. DESIGN DATA

3.1 General

The settlement of Lake Harbour is a thriving community of approximately 365 located 62 51' North Latitude 69 53' West Longitude. It is situated on the southern shore of Baffin Island, 120 km south of Iqaluit and 2245 air km from Yellowknife. The community is serviced by scheduled air service and seasonal sea lifts.

Lake Harbour region has been inhabited for centuries by the Inuit. The harbour was a frequent and favored shipping and whaling port for the south Baffin area. The community also centered around a thriving mica mine employing local Inuit. The Hudson's Bay Company arrived in the community in 1911 and the RCMP set up a post in 1927. The economy is based on Marine mammal harvesting, hunting/fishing and carving.

The communities water source was obtained from trucked services, pumped and untreated from the same lake the truckfill is built on. The water is delivered by a 4540 L capacity water truck. Sewage disposal is pumped by a vacuum truck and hauled to the dump for disposal in a lagoon system. Solid waste is collected three times a week and disposed of at the landfill site.

The terrain of Lake Harbour exists on rocky outcrops, uneven glacial deposits and high rolling hills. The permafrost in the area extends to a depth of 60m. The climate is typical of an arctic coastal community. The precipitation averages 210.1 cm snowfall and 20.2 cm rainfall. The July mean temperatures are a high of 12.2°C and a low of 3.9°C. In January the mean high is -20°C and the mean low is -27.2°C. Depending on the season the winds prevail from the North and the South and an average of 18 knots.

3.2 Background Data

The water distribution system in Lake Harbour is based on individual building storage tanks serviced by water truck. A need was identified for the construction of a permanent water truck fill station to ensure a safe dependable water supply for domestic needs.

In the past, the water supply has been obtained from Fundo Lake by driving the water truck to the lakeshore or onto the ice. Truck filling was accomplished by drawing water from the source with the truck pump. Disinfection, when practised, was achieved by adding calcium or sodium hypochlorite directly to the truck water.

The design water demand for the Settlement is based on the GNWT recommended value of 90 lpcd. Population projections generated by the GNWT Bureau of Statistices from the 1991 census to 2006 and extrapolated to 2015 farecast the population of Lake Harbour to be 640 in twenty years or a yearly demand of 24,120m^3.

3.2.1 System Description

The location of the water supply facility was selected by the Department of Public Works. DPW supplied Ferguson Simek Clark with digitized mapping of the ground and the design for the access road, turn around and the building pad. FSC inspected this site in its original state and carried out a bathymetric survey on which the design was based along with the DPW information.

An inclined shaft casing with a submersible pump draws water from the lake. The intake screen is at a depth of approximately 5m. The intake casing is embedded in a berm constructed on the lake bed for the majority of its length. The upper portion of the intake casing is covered with granular material and protected with rip-rap to minimize ice scour and heat loss.

Power is provided by a engine generator set contained within the building. A spare engine generator set has been supplied and is stored in the community for use if the primary set fails.

All controls necessary for truck filling are located in a control panel accessible to the truck driver from the outside of the building. The truck driver does not need to have access to the building interior.

The building operator has access to all building facilities.

3.3 Design Data

3.3.1 Design Constraints

- *harsh climate*
- *remote location*
- *access by air and sealift only*

3.3.2 Design Criteria

- *system must be capable of recovery from freezing without damage.*
- *system must be capable of start-up under adverse conditions.*
- *the minimum truckfill rate is 1000 L/min.*
- *the operator must be immediately alerted to major alarm conditions.*

3.3.3 Design Assumptions

Design assumptions listed below are from the National Building Code of Canada (NBCC),

Atmospheric Environment Service (AES), and Energy Mines and Resources (EMR).

3.3.3.1 Demand

Population:	365 (1991) 640 (2015)
Truckfill Rate:	1000 L/min

3.3.3.2 Climate

Exterior Temperature:	January:	-45°C (minimum assumed)
Interior Temperature:		10°C (assumed)
Wind Speed:		18 knots (mean)
Prevailing Wind:		North and South
Ground Snow Load:		3.9 kPa (NBCC)
Annual Rainfall:		20.2cm (mean)
Annual Snowfall:		210.1cm (mean water equiv.)
Annual Precipitation:		41.2cm (mean)

3.3.3.3 Physical

Design Foundation Elevation:	38.30m ASL (based on water elev.)
Lake Water Level:	33.60 ASL (assumed)
Truck Size:	6.2 L x 2.4 W x 2.2 H
Turning Radius:	14.7m
Maximum Permissible Grade:	10%
Maximum Desirable Grade:	6%
Maximum Ice Thickness:	2.5m (assumed)
Minimum Water Depth at Intake:	5.0m (assumed)
Desirable Water Depth:	6.0m (assumed)

3.3.3.4 Electrical

Prime power from engine generator set. Output: 15kW minimum, 20 kVA, Power Factor. 0.8, 120/208 V, 3 phase, 60Hz.

3.3.3.5 Fuel

Arctic Grade diesel (P50).

3.3.3.6 Building Heat

Pump room; 1 kW infrared heater normal, identical standby unit.

Engine room; 1 kW infrared heater normal, identical standby unit. Waste heat from engine-generator unit during standby operation. Cooling air can be exhausted or by-passed to room as required.

3.3.3.7 Design Features

The facility is designed to be easy to operate and maintain. Off-line or shelf standby is provided for components difficult to obtain.

It is designed to recover from a freeze-up with no major damage. The truckfill rate is a policy matter and no provision has been made to increase it. Should an increase in truckfill rate be required, it could likely be accommodated by using larger pumps, however, this would have to be investigated at the time.

While the facility is designed for a minimum truckfill rate of 1000 L/min, the actual capacity is dependent on valve setting, equipment condition and lake level at that time.

There is no provision in the design for water storage on site. No expansion of the facility is foreseen since the truck hauling capacity and not the truckfill station controls the water supply capability. The only treatment provided by this facility is disinfection by chlorine treatment. A spare fitting has been provided for future flouridation equipment. If the truckfill station is out of service, water would be drawn from the lake by the water truck pump.

3.4 Standby

3.4.1 On-line

On-line standby systems discussed below are of the automatic type. No operator intervention is required to activate them.

3.4.1.1 Infrared Heaters

Two electric infrared heaters, controlled by individual thermostats, provide duty and standby heat to each the pump and engine rooms. The duty heater thermostat is set to a higher temperature than the standby heater thermostat. Thus, in the event of failure of the duty heater, the standby heater system will energize as the room temperature falls to its setpoint.

If, for some reason, the duty heater cannot keep up with the heat loss (e.g.., if the door was left open), the standby heater system would energize as its setpoint is reached, even though the duty heater is still functioning.

3.4.2 Installed

Installed (manual) standby systems require some action on the part of the operator to activate them.

3.4.2.1 Heat Trace

Each intake has a spare heat trace cable installed. If the duty heat trace fails, it can be unplugged from the controller and the standby heat trace plugged into the controller.

As well, a spare, uncontrolled outlet is provided so that both heat trace cables can be plugged in if the intake freezes.

3.4.3 Shelf Standby

Shelf standby consists of equipment provided for installation by the Owner if required by failure of the originally installed equipment.

3.4.3.1 Engine-generator Set

A second engine generator set has been provided. In the event of a major engine-generator set failure the primary engine-generator set can be removed and replaced with the standby unit.

3.4.3.2 Chemical Feed Pump

A spare chemical feed pump is provided, along with accessories. Installation requires unplugging the pump from the receptacle, removal of the bolts holding the installed pump and disconnecting the suction tubing and solution feed tubing. The tubing can then be attached to the replacement pump, the pump bolted down and plugged in.

3.4.3.3 Pump

A spare water pump has been provided. In the event of a pump failure, the shelf standby pump would be used to replace the faulty pump. To replace the pump, follow the procedure outlined for pump withdrawal and replacement.

3.4.3.4 Spares

Spares have been provided for components such as fuses, switches, lamps, small valves, gauges and meters which may be expected to require replacement and may not be available locally. Keep the spares cabinets fully stocked, replacing spares as they are used. Spares, as well as consumable items, are listed below.

A list of spares is also contained in Section 8, Operations and Maintenance Records. That list can be used as a check-list to keep track of the quantities on hand and for ordering.

Spare relays are contained in the Alarm panel and control panel.

3.5 Overload and Expansion Capability

No overload or expansion capability has been explicitly designed into the facility.

However, the system should accommodate a truckfill rate of 1500 L/min if the present pumps are replaced with higher capacity pumps. If larger pumps are to be installed, the replacement pumps would have to be similar in diameter to the original pumps. Power requirements of the replacement pumps must be within the capacity of the engine-generator sets, considering other electrical loads.

Two plugged weldolets have been provided for future chemical injection.

3.6 Emergency and Trouble Responses

3.6.1 Alarm System

The alarm system transmits an alarm to an autodialer when a major trouble condition requires the attendance of the operator. The precise trouble condition is indicated by a pilot light on the alarm panel, with the exception of a complete loss of power. This condition would be apparent upon arrival at the facility.

Any alarm received should be treated as an emergency condition and the facility operator should go to the truck fill station immediately to determine the cause of the alarm.

Minor trouble conditions, not requiring immediate action, do not transmit an alarm. They are indicated by a pilot light on the alarm panel which will be detected during routine maintenance.

3.6.2 Trouble Conditions

3.6.2.1 Loss-of-Power - Transmitted Alarm

This alarm transmits if the building is without power caused by failure of the prime power.

A loss-of-power condition will transmit an alarm approximately 5 minutes after the loss of power.

The cause of failure of generator unit will be indicated on the engine control panel in the engine room. Conditions indicated on the engine control panel are: no speed signal, high engine temperature, low oil pressure and over crank.

3.6.2.2 Pump Room High Temperature - Transmitted Alarm

Transmits and illuminates alarm panel light if pump room temperature rises above the setpoint. Alarm triggered by thermostat located in pump room which closes at 35°C.

3.6.2.3 Pump Room Low Temperature - Transmitted Alarm

Transmits and illuminates alarm panel light if pump room temperature falls below the setpoint. Alarm triggered by thermostat located in pump room which opens at 4.5°C.

3.6.2.4 Engine Room High Temperature - Transmitted Alarm

Transmits and illuminates alarm panel light if engine room temperature falls below the setpoint. Alarm triggered by thermostat located in engine room which closes at 35°C.

3.6.2.5 Fuel Tank 1/4 Full - Transmitted Alarm

Transmits and illuminates alarm panel light if fuel tank fuel level falls below 1/4 full.

4. SCHEMATICS & FUNCTIONAL DATA

4.1 General

Section 4 contains tables and sketches that list components and a short description of their function.

Table 4.1 contains descriptions of components and functions. Refer to the schematic diagrams following the table for the location of the components.

Lake Harbour Truckfill Station
Water Delivery Component Description
Table 4.1

DIA.	ITEM NO.	SECT.10 TAB	COMPONENT	FUNCTION	REMARKS
4.1	1	10.1	Intake Screen	Screen debris from water	Stainless steel, 3 mm openings
4.1	2	10.1	Intake Casing	Protects pump	350mm Schd 40 HDPE with 50mm urethane insulation
4.1	3	10.2	Water Pump	Pumps water from lake to truck	
4.1	4	10.1	Discharge line	Carries water from pump to water truck	100mm Schd 80 HDPE pipe
4.1	5	10.1	Backwash fitting	Allows for connection of backwash hose for helping with thawing of intake. Can also attach water truck hose for backwashing intake casing or assisting with thawing	
4.1	6	10.1	Intake Casing Plug	Seals intake casing	See section 6.5.2 for instructions on removal
4.1	7	10.1	Domestic Water Tap	Provides water for mixing hypochlorite and cleaning	Hose is hung on wall
4.1	8	10.3	Thermometer	Measures water temperature	0 to 50°C range
4.1	9	10.1	Backwash Water Supply Valve	Allows for connection of backwash hose for helping with thawing of intake	50mm Kamlok male fitting with cover
4.1	10	10.3	Pressure Gauge	Measures water pressure	0 to 400 kPa range
4.1	11	10.1	Main Control Valve	Controls water flow and allows for supply of domestic water and backflushing	100mm V-Port Ball Valve with handwheel
4.1	12	10.3	Flow Switch	Starts chlorine pump when water is flowing	
4.1	13	10.4	Chlorine injector	Adds chlorine to water supply	
4.1	14	10.1	Spare fitting	Spare fitting for future fluoridation of water supply	
4.1	15	10.3	Paddlewheel flow meter	Measures water flow rate and provides signal to meters	Paddlewheel type flow meter
4.1	16	10.1	Discharge line	Conveys water from pump to water truck	100mm Schd 80 galvanized steel inside building
4.1	17	10.1	Truckfill hose	For filling water truck with water. Different lengths provided to allow for ice buildup in winter	100mm arctic type flexible hose
4.1	18	10.4	Mixer	Mixes hypochlorite powder with water	Mounted on upper tank
4.1	19	10.4	Mixing tank	Tank for mixing hypochlorite powder and water. Drain into lower storage tank when mixed.	115L tank marked in 10L increments
4.1	20	10.4	Chlorine Pump	Pumps chlorine solution from storage tank into water line	Solenoid pump. Set to provide 0.2 mg/L residual.
4.1	21	10.4	Mixing Tank Valve	Allows transfer of solution from upper to lower tank	
4.1	22	10.4	Solution Tank	Stores chlorine solution	115L tank marked in 10L increments

Lake Harbour Truckfill Station
Water Delivery Component Description
Table 4.1

DIA.	ITEM NO.	SECT.10 TAB	COMPONENT	FUNCTION	REMARKS
4.2	1	10.5	Fuel tank vent	Vents fuel tank	
4.2	2	10.5	Remote Level Gauge	Provides signal when tank is $^1/_2$ and $^1/_4$ full	Connected to alarm lights on control panel
4.2	3	10.5	Level Gauge	Provides visual indication of fuel level in tank	
4.2	4	10.5	Fuel Oil Fill Point	Fitting to allow filling of tank with fuel oil	With lockable spill box.
4.2	5	10.5	Water drain pump	To remove water from tank or containment	Stored in engine room
4.2	6	10.5	Fuel oil valve	Controls fuel oil supply to generator	Ball valves outside and inside
4.2	7	10.5	Flexible Connections	Permits movement of fuel oil lines	Braided stainless steel
4.2	8	10.5	Fuel Oil Supply Line	Supplies fuel oil from tank to generator	50mm steel outside, 19mm steel inside
4.2	9	10.5	Fuel Oil Tank	Fuel storage for standby generator	1135 litre capacity
4.2	10	10.5	Fusible Link Valve	Shuts off fuel supply in the event of a fire	
4.2	11	10.5	Fuel Filter	Filters impurities from generator fuel supply	replaceable cartridge type with water drain
4.2	12	10.6	Supply Air Hood	Provide cooling and combustion air for generator	400x400mm with 300mm extention to keep snow out
4.2	13	10.6	Supply Air Damper	Open to allow supply of cooling & combustion air, closed when generator not working to retain heat in building	Automatically controlled to maintain temp at 21°C while generator running
4.2	14	10.6	Recirculation Air Damper	Opens and closes to keep room temp at 21°C while standby generator running	Automatically controlled
4.2	15	10.9	Generator Exhaust	Carries generator exhaust fumes from generator to outside	
4.2	16	10.6	Supply Air Fan	Forces cooling combustion air into room	Pressurizes room
4.2	17	10.6	Damper Thermostat	Controls opening and closing air into room	
4.2	18	10.9	Generator	Provides power to facility	Air cooled 2 cylinder diesel, 15kW genset
4.2	19	10.9	Muffler	Reduces noise of generator exhaust	
4.2	20	10.6	Exhaust Air Damper	Opens to exhaust engine cooling air outside when building temp exceeds 21°C	Automatically controlled by thermostat
4.2	21	10.6	Exhaust Air Hood	Exhausts air outside building	Extended to prevent snow entry

Lake Harbour Truckfill Station
Water Delivery Component Description
Table 4.1

DIA.	ITEM NO.	SECT.10 TAB	COMPONENT	FUNCTION	REMARKS
1. OPERATOR CONTROL PANEL					
1/4.3	1	10.10	Pump Start Push Switch	Starts water pump to fill water truck	Green, oversize mushroom cap for winter use
1/4.3	2	10.10	Pump Wait Pilot Light	Alerts operator that pump will not operate	Anti-turbine protection for pump prevents pump from starting until water has drained out (approx. 15 sec.)
1/4.3	3	10.10	Pump Stop Push Switch	Stops water pump	Red, oversize mushroom cap for winter use
1/4.3	4	10.10	Emergency Override Pump Run	Bypasses timer and control circuits to provide immediate water supply in emergency	Push and hold to pump water
1/4.3	5	10.10	Pump Timer	Times how long pump will operate when start button pushed	0-10 minute Eagle twist timer
1/4.3	6	10.10	Resettable Totalizer	Records amount of water pump	Push to reset
2. ALARM/CONTROL PANEL					
2/4.3	7	10.10	Low Fuel Alarm Pilot Light	Red light indicating that fuel tank is less than 1/4 full	Alarm transmitted to pager. Push light to test
2/4.3	8	10.10	Pump Room Low Temp Light	Red light indicating temp in pump room is below 5°C	Alarm transmitted to pager. Push light to test
2/4.3	9	10.10	Pump Room Height Temp Light	Red light indicating temp in pump room is below 35°C	Alarm transmitted to pager. Push light to test
2/4.3	10	10.10	Engine Room Low Temp Light	Red light indicating temp in engine room is below 0°C	Alarm transmitted to pager. Push light to test
2/4.3	11	10.10	Power Outage Light	Red light indicating that both NWTPC power and standby generator have failed	Alarm transmitted to pager. Push light to test. Five minute delay to allow generator to warm up
2/4.3	12	10.10	Alarm Light Reset Button	Push button to turn off alarm lights and stop pager alarm	
2/4.3	13	10.10	Engine Room High Temp Light	Red light indicating temp in engine room is above 35°C	Alarm transmitted to pager. Push light to test
2/4.3	14	10.10	Low Fuel Warning Light	Yellow light warning that fuel tank is less than half full	No pager alarm. Push light to test
2/4.3	15	10.10	Low Intake Temp Light	Red light indicating intake casing temp is below 0°C	Alarm transmitted to pager. Push light to test
2/4.3	16	10.10	Flow Meter & Accumulator	Indicates flow rate and total water volume pumped to date	Flow rate in liters per minute. Volume in cubic meters
3. TRANSFER SWITCH					
3/4.3	17	10.9	Emergency Power Indicator	Red light indicating that power is being supplied by genset.	No alarm transmitted. Push light to test