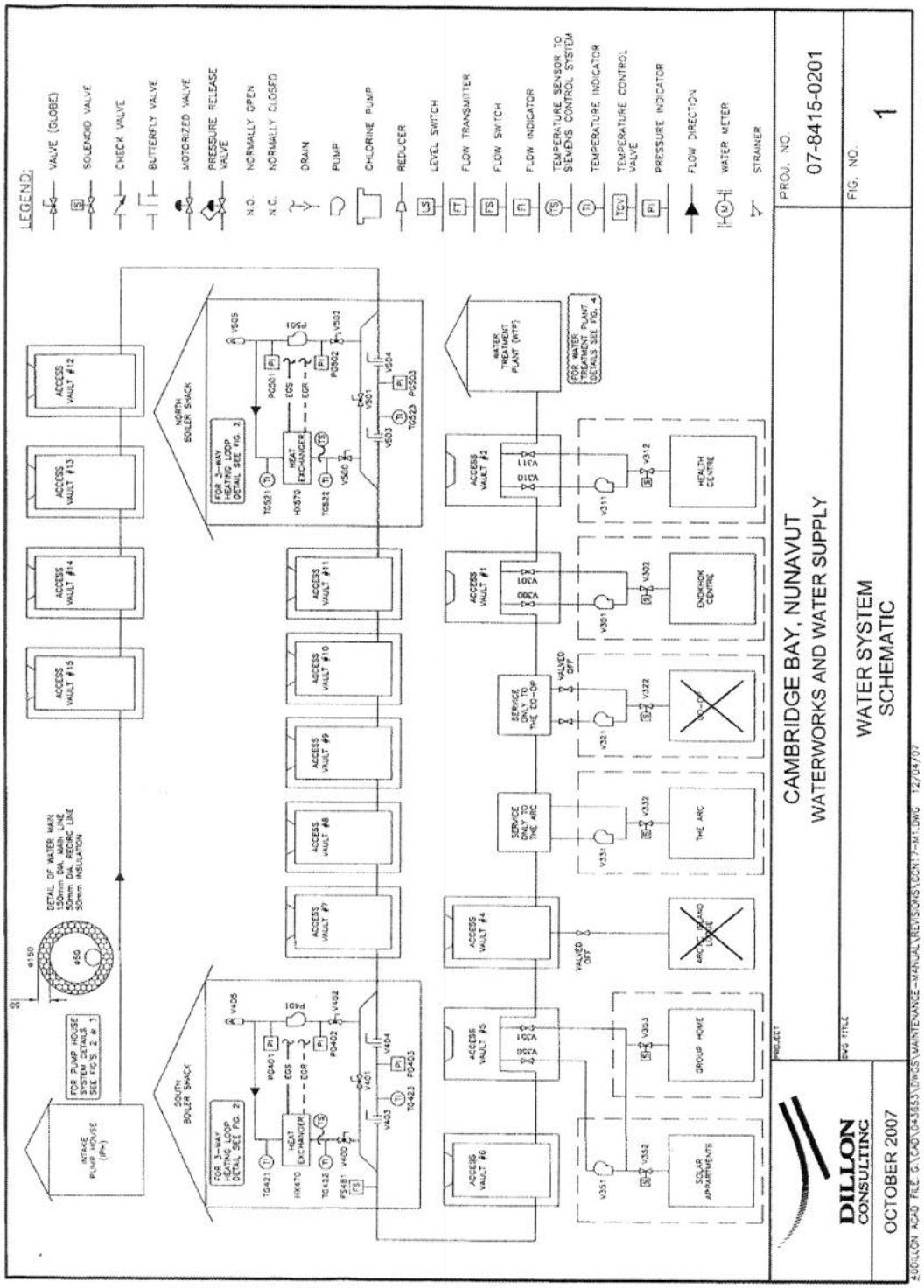
3 SYSTEM DESCRIPTION

There are four major systems in the water supply and treatment process for the community. Each system has several sub-systems. The four (4) major systems are (Refer to Drawing 301 of Appendix A):

- The Intake Pump House (IPH) and back-up truck fill station.
- The water supply pipeline between IPH and WTP including NBS, SBS and access vaults.
- The WTP.
- The Storage tanks located adjacent to the WTP.

Cambridge Bay, NU potable water and the fire fighting water is supplied from Water Lake, which is located approximately 2.6 km north of the community. The water is supplied through an underground 6"Ø pipe from the lake, through north and south boiler heating shacks, which ensure that the line stays above freezing temperatures, then finally to the water treatment plant and storage tank. The system also provides water for community fire fighting purposes.

Figure 1: Water System Schematic



3.1 Intake Pump House

The Intake Pump House (IPH) is located on the shores of Water Lake. It was originally one building installed with the water supply system in 1980. Since that time there have been at least two sets of modifications completed to the IPH. These include:

- The installation of one (1) boiler and heat exchanger to provide heating to the raw water supply at the IPH. These boilers are located in a separate building to the side of the IPH. Two 1,100 L fuel oil tanks are located in the same structure as the boilers. These boilers replace the use of the electric heat trace system installed in 1980, which subsequently failed.
- The installation of a drain that will allow the transmission pipeline to be drained from the intake pump house. The length of line that would be drained through this pipe is approximately 40 m.

The schematic drawing of the IPH is shown in Drawing 301, along with the schematic for the system as a whole. The major components of the IPH are:

- The intake casing pipe, pump and off take pipe. The intake casing is a 250 mm HDPE pipe, insulated with 50 mm of urethane foam insulated and shielded with a galvanized steel shielding. Once the pipeline is within the thermal effect of the lake, the casing does not have insulation. The pump and off take piping fit inside the casing pipe and can be removed to service or change the pump. There is a stainless steel screen installed on the end of the casing pipe. In September 2002, under the contract to Dillon Consulting Limited, Arctic Divers completed an underwater inspection of stainless steel screen. The intake casing was in good condition with no defects noted during the inspection. Arctic Divers emphasized that the intake was not supported at the end, and may be subjected to damage in the event of a large storm. They further suggested that the installation of a support pile would be all that is required to ease the situation. A VHS recording of the divers' inspection was made, and a copy forwarded to the Department of Public Works for record purposes.
- The IPH building is a Cold Stream pre-engineered building constructed over an insulated concrete slab on grade. No major defects in the building construction were noted while on site.
- The boiler building was a stick built building. One deficiency was noted that needs to be addressed in the near future, is the lack of secondary containment for the two fuel storage tanks. Even though there is no code requirement to provide secondary containment for storage tanks of that size, due to the fact that they are located up-gradient and immediate proximity to the community water supply intake would make the installation of secondary containment essential.
- The boilers, heat exchangers, and recirculation pumps act as one part of the total pipeline freeze protection system. The recirculation pumps were installed with the original system, and the boilers and heat exchangers were added later. These components were found to be in good working order, and operating at the time of the inspection. Periodic maintenance is completed, and will need to be completed to maintain this system.

- The chlorination system consists of a chemical tank, injection pump, a flow switch, and an injection point on the truck-fill arm. There is a second injection point on the raw water supply line.
- The truck-fill system operates off the intake pump. The truck-fill controller is located outside the building. Two manual valves are operated to enable the truck-fill system. This system is only used in the event that the primary truck-fill system located at the WTP is not functioning.

For summer and winter operation, on a call for water from the ultrasonic level sensor located at the top of the water storage tank, the intake pump starts to fill tank through the 6"Ø water line. The pump will start when water level in the tank drops below 4.9 m and shuts off when the level reached 5.9 m. A liquid chlorination system operates when the intake pump is running and proven by the flow switch. A minimum of 0.2 parts per million concentration are maintained by a injection pump. The flow switch verifies the water flow before the chlorine injection pump is started. This concentration level can be adjusted at the pump. Concentrations are checked on a daily basis and adjusted accordingly to maintain the minimum set point. Chlorinated water samples are sent to Stanton General Hospital, Yellowknife, NWT to test for Fecal Coli forms ***(see Maintenance Schedule in Section 6)***. Main line water flow, temperature, and pressure are monitored at the pump house through the Siemens automated control system, (a display monitor is located in the Treatment Plant control room) and by visual gauges at the site. The flow meter readings are located on the west wall

The intake pump house truck-fill station is operated manually. Inside the pump house, the truck operator closes the normally open main line valve V-601, and opens normally closed truck-fill valve V-600. The truck operator then places the intake pump starter H-O-A to "Hand". The chlorination system operates automatically with the truck-fill. When the intake pump house truck-fill station is no longer needed, the valves are placed back to their normal positions.

For winter operation, a 2"Ø re-circulation pipe inside the 6"Ø main protects the main line from freezing. At the pump house, the recirculation line temperature is manually set by partially closing the isolation valves on the re-circulating side of the heat exchanger. The re-recirculation line flows, in the opposite direction to that of the water line, from the water treatment plant, which located at Kamotik Road, down to the pump house. The re-circulating line enters the intake pump line and flows through booster pumps P601 and P602 (one duty and one stand by, alternated every two weeks). Pressure, temperature, and flow are monitored by the Siemens automated control system with temperature and flow alarmed through the control system. Visual readings are shown on gauges inside the pump house and the flow meter on the east wall.

To ensure chlorinated water is not discharged back into the lake and the main water supply is pre-heated, a by pass line has been installed. The duty re-circulating pump runs continuously. On a pump shut an alarm signal will be activated by the Siemens automated control system. When the intake pump is energized from the ultrasonic sensor, the normally open solenoid valve, V-1 on the re-circulating line, will close and the normally closed by pass line valve V-2 will open, allowing the heated re-circulated water to flow inside the inner pipe casing back to the suction side of the pump. An alarm will be activated if the intake pump is energized and a no flow condition is sensed by the flow switch. When the

level in the tank is satisfied and the intake pump stops, V-1 will open allowing re-circulated water to heat the discharge of the intake pump. V-2 will close.

For summer operation (typically July, August, and September) the re-circulating heating system is shut down and could be operated if necessary.

See the IPH Piping Schematic Figure 2 on the following page.

5. Take a sample in a measuring cup or some clean container from the fill hole in the top of the truck.

6. Test the sample as per above Section 5.2.6.3 "Using the HACH {Pocket Colorimeter Chlorine Tester".

7. If the test result is below 1.0 mg/l, increase the stroke of the pump and/or the rate. However, the stroke and rate should always be between 30% and 100%.

8. If the test result is below 1.0 mg/l, the truck water is inadequately chlorinated, and should not be delivered to residents. You may do one of two things:

   a) Manually add bleach to the truck to increase the dosage in the truck. If you do add additional bleach, refer to step 9 in section 6.3.2.3 "Using the HACH Pocket Colorimeter Chlorine Tester". Repeat the test until 1.0 mg/l residual chlorine is reached.

   b) Empty the truck and repeat steps 3 to 7. Repeat the test until 1.0 mg/l free chlorine is reached.

9. If the test is above 1.0 mg/l, decrease the stroke and/or the rate. Follow the limits stroke and rate limits in step 7.

10. Empty the truck and repeat steps 3 to 7. Repeat the steps until 1.0 mg/l free chlorine is reached.

5.2.7 Heating System

Heat is supplied to the truck-fill station by a boiler and unit heater system. One (1) boiler supplies heated glycol/water solution to the individual unit heaters located throughout the plant.

A thermostat controls each pair of overhead unit heaters. The thermostats control the individual room temperatures.

The thermostats in the process room should be set at 15 ºC

These temperatures are above the low temperature alarm setting of 10 °C and below the high temperature alarm setting of 40 °C. The setting should always be between the high and low alarm temperatures. There should NOT normally be a need to change the thermostat settings.

5.2.8 Intake Screen Backwashing

The intake screen has been size such that cleaning should not ever be required. However, the only practical method to completely clean the screen is to have divers unclog and clean the screen by hand, or by applying high pressure air from the inside of the screen.

5.3 Special Procedures

5.3.1 Intake Pump Removal

If the IPH pump, or other equipment within the intake casing, fails, the intake pipe and all attached equipment can be removed from inside the IPH. DO NOT attempt to remove the pump unless an electrician is present to disconnect the power cables.

Water from the IPH will not be available during the pump removal and replacement.

1. Location: At the main breaker panel.
2. Turn off the breakers for the IPH pump and the heat trace controllers.
3. Location: Raw water casing inlet to building.
4. Disassemble flanges connecting intake casing pipe and pipe reduction flange. This will allow access to the intake line and pull cable wire.
5. Location: Cable Winch.
6. Use WINCH to pull cable wire that is attached to intake pump SKID PLATE. TURN winch crank CLOCKWISE and pull pump up through casing pipe.
7. Location: Skid Plate.
8. Remove bolts from skid plates. Remove intake pump from within skid plate to provide maintenance access.

5.4 Trouble Shooting Procedures

5.4.1 Alarm System

5.4.1.1 Alarms

The WTP building houses a new Siemens monitoring and controls system for the replaced pipeline, which still has to be fully commissioned. Due to the age, and problems with the existing control panel, a new panel was installed to control the pipeline operation. The system will have two (2) levels of alarms: major and minor. The alarms for this system are set as follows: