Shell Canada Energy

Farewell Camp and Stockpile Site

Updated Operations and Maintenance Plan

DRAFT

September 2012
A04012A04

ISO 9001:2008
Certificate No. FS 62747

TABLE OF CONTENTS

List of Tables

List of Figures

TABLE OF CONTENTS

(continued)

List of Appendices

1 OPERATIONAL PLAN SUMMARY

Shell Canada Energy (Shell) retained IEG Consultants Ltd. (IEG) to update the 2006 Operations and Maintenance Plan for the Farewell Camp and Stockpile Site (site). The following subsections outline the Operational Plan Summary for Shell's water treatment system at the site. The site is not currently in use; however, if the treatment system is required in the future, this Operations and Maintenance Plan will be followed.

1.1 Start Up

- The Northwest Territories Water Board (NWTWB) water licence (N7L1-1834) defines the regulatory requirement for the use of water and discharge of effluents.
- Maintain a copy of the water licence at the site at all times.
- The Shell or consultant's Project Manager or Site Supervisor will review the water licence and ensure requirements are executed.
- Start up the treatment plant as per the manufacturer's procedures.
- Effluent generated by the treatment plant will be stored in on-site storage tanks, pumped off into trucks and transported to the Town of Inuvik's sewage lagoon.

1.2 Modifications

- The NWTWB must be notified within 45 days prior to beginning modifications to the treatment plant.
- The latest modification involved replacing the previous treatment system with the current treatment plan in July 2002.
- The current treatment plant includes an equalization tank, aeration tanks, aerated sludge digester, final clarifier, and ultraviolet light disinfection.
- The on-site sewage lagoon will be closed in 2013 and will no longer be used to contain effluent.

1.3 Operation

- An Aboriginal Affairs and Northern Development Canada (AANDC) inspector must be notified five days before the start of any planned discharge.
- A sample must be collected from surface water prior to discharge; analytical results from the sample must meet the requirements in the current water licence.
- If discharging continuously from the treatment plant directly to the Mackenzie River, samples and analyses are required every two weeks.

- Maintain the treatment plant as per the manufacturer's operations and maintenance manual.
- Monitor levels in the holding tanks and remove with vacuum truck for transport to the Town of Inuvik sewage lagoon.
- In the event of a spill, handle as per the Spill Contingency Plan included in the Emergency Response Plan.
- Spills must be reported to the Government of the Northwest Territories (GNWT) 24-hour spill reporting line.
- Submit the "Water Licence Field Requirement Checklist" to the Shell Project Manager on a monthly basis when the site is in use (Appendix I).
- Maintain a record of water withdrawn from the Mackenzie River and use the "Water Withdrawal Volumes" form for tracking (Appendix I).
- Maintain a record of water discharged to the Mackenzie River and use the "Waste Water Disposal Volumes" form for tracking (Appendix I).
- Complete an annual report to the NWTWB on volumes of water withdrawn and volumes of effluent discharged to the Mackenzie River.

1.4 Shut Down

- Shut down the treatment plant as per the manufacturer's procedures.
- Transport residual effluent and sludge to the Town of Inuvik sewage lagoon.

2 EXTENDED AERATION ACTIVATED SLUDGE UNIT – WASTE WATER TREATMENT SYSTEM PROCESS

Aerobic digestion of organic based contaminants is employed as the main treatment process within the treatment plant. Sludge settling, recycling of sludge, and final effluent disinfection complete the treatment process.

In aerobic digestion, micro-organisms use the dissolved and suspended organic matter in sewage as food. They also ingest dead microorganisms. In addition to food the micro-organisms need oxygen. The oxygen is added in aeration tanks where air is bubbled through the water, organic matter and microorganisms to provide oxygen to the microorganisms and to ensure that the microorganisms contact the organic material. In the extended aeration activated sludge process, the microorganisms ingest each other as well as sewage. This cannibalism results in a biologically inert sludge with limited microorganisms in it. This is achieved by a retention time in the aeration tanks of 24 hours and having more microorganisms than necessary to ingest the sewage. The products of the aeration tanks are water, carbon dioxide, micro-organisms, and a biologically inert residue.

The mixture of treated water and micro-organisms is settled out in settling tanks (clarifiers). The settled out alive and active microorganisms (called activated sludge) are returned to the aeration tanks. As there are more microorganisms in the activated sludge than needed to eat the incoming sewage, some of the microorganisms along with the inert sludge are wasted.

With the microorganisms settled out, clean and clear water flows out over the top of the settling tanks. Passing it through banks of ultraviolet lights disinfects this water. After disinfection, the water is discharged to the Mackenzie River

The treatment plant is contained within two containers that measure approximately 12 m long by 2 m wide by 2 m tall. The two containers are parallel to one another and are connected by pipes and electrical cables. One container contains a flow equalization chamber, four settling tanks, a sludge holding tank, a chlorine contact chamber, two banks of ultraviolet disinfection lights, pumps, air blowers, electrical panels and instrumentation controls. The second container has aeration tanks. Power to operate the plant's pumps, heating and control system is supplied by Camp Farewell's generating facility.

The flow of sewage through the treatment facility is as follows:

- Camp Farewell's wastewater outfall line discharges to a lift station placed below grade to accept this flow under gravity. The lift station is equipped with a level activated submersible lifting and grinding pump, which pumps the sewage to the sewage treatment plant.
- The pumped sewage flows into a flow equalization chamber. This chamber smoothes out the peaks and valleys of sewage flow to the aeration tanks. It has a minimal amount of air bubbling through it to prevent it from becoming septic and resulting in odours. Overflow from the sludge holding tank and some wasted activated sludge are also pumped into this chamber. Grinder pumps pump sewage from the bottom of this tank to the aeration tanks.

- In the aeration tanks the sewage from the flow equalization chamber has activated sludge added. Air is blown through this to add oxygen and mix the sewage and microorganisms into a uniform mixture. Retention time in this unit is approximately 24 hours. As sewage is pumped in at one end of an aeration tank, a mixture of water, inert sludge and microorganisms flows out the other end to the settling tanks.
- After four hours of settling the clear, treated discharge water runs over a weir to a holding tank. The settled sludge containing microorganisms is then pumped using airlifts to the aeration tanks. This is the 2 " PVC Returning Activated Sludge line shown on the Saniterm P&ID drawing (Appendix II). Two valves allow some of this sludge to be wasted to either the sludge holding tank or the flow equalization chamber. These are the WAS (Waste Activated Sludge) lines shown on the Sanitherm P&ID drawing. Inert material will be recycled through the system until it eventually ends up in the sludge holding tank where it stays.
- While the holding tank could be used as a chlorine contact chamber, it is not planned that chlorine be added to the water for disinfection. After flowing through the holding tank, the water enters into two banks of Ultraviolet lights for disinfection. Then the water leaves the building through a 5 cm male cam lock connection. If the discharged water does not meet quality specifications in the current water licence, it can be diverted to holding tanks for disposal at the Town of Inuvik sewage lagoon.
- The discharge line is heated to prevent freezing. Sufficient discharge hose, dependent on yearly water levels will transport the treated water to a discharge point in the Mackenzie River adjacent to Camp Farewell. The discharged water flows from the pipe directly into the moving water.

Float switches control the pumps that pump from the flow equalization tank to the aeration tanks. A timer in the control panel controls the aeration blowers. There are two flow equalization pumps and two aeration pumps so that there is 100% stand-by. These blowers provide air for the aeration, flow equalization and holding tanks and for the airlift pumps installed in the settling tanks. The airlift pumps have no other controls on them. They are on when the blowers are on and off when the blowers are off. A copy of the treatment plan as-built is included in Appendix II.

Samples of discharged water are taken after the disinfection point. This sample point is easily accessible for collection in a safe and hygienic manner. A small PVC bucket is used to collect approximately 2 L of sample. The sample is then decanted into three separate sample bottles provided by a third party laboratory. Samples are shipped directly to the laboratory for analysis of pH, biological oxygen demand (BOD), total suspended solids (TSS), fecal coliform counts, oil and grease and free chlorine concentration. An insulated cooler with ice packs is used to transport the samples to the laboratory, preventing them from warming and maintaining a constant sample temperature. Some of the analyses must be conducted within 24 hours of sampling; therefore sampling and expediting planning is of utmost importance. For full details on sampling and analysis, refer to water license N7L1-1834 and the Quality Assurance/Quality Control (QA/QC) Program (Section 4).

3 EXTENDED AERATION ACTIVATED SLUDGE UNIT – WASTE WATER TREATMENT SYSTEM OPERATIONS AND MAINTENANCE GUIDE

3.1 Quick Start Procedure

This procedure is used when the plant is being restarted after being shut down

1. Check that electrical is still connected. Energize all breakers within the plant panel. Turn on heaters to warm building up.
2. Check that all drains have been closed. Check that pipes are not cracked or broken. Check that all pipes are connected.
3. Ensure weight loaded relief valve on air blower is operational.
4. Check out the air blower as outlined in Section 3.2 (System Start-up Procedure)
5. Energize breakers within electrical panel after equipment has been checked for operability and required maintenance has been done.
6. If UV bulbs and quartz sleeves were removed reinstall them per Section 3.6. Clean quartz sleeves as outlined in Section 3.6.
7. Check that heat tracing on pipe to river is working.
8. Check oil level in Barnes submersible pumps. Check oil levels in air blowers. Grease air blowers.
9. Start up lift station and fill flow equalization chamber. Start up blower and start filling up aeration tanks and then settling tanks.
10. Check submersible pumps for operability. Do not run until they are submerged.
11. It is not recommended that the UV bulbs be energized unless they are at room temperature. Pre warming of the bulbs may be required. Check that UV works electrically. Do not run full time until there is water covering the UV lights in the UV troughs.
12. Divert discharge from plant to lagoon until such time as four samples have an average within the license discharge criteria.
13. Inform Inspector that samples are within criteria and obtain his approval to discharge to the Mackenzie River.

NOTE: Sanitherm is no longer an active company; however, Ecofluid can be contacted to provide assistance with the treatment system. Ecofluid has technicians that can come to the camp to provide start-up assistance. If unsure of any part of the start-up procedure, contact Ecofluid at 1-604-662-4544.

3.2 System Start-Up Procedure

1. Ensure the packaged treatment plant is set on level secure ground.
2. Connect the piping and electrical from the aeration container to the container containing the settling, flow equalization and holding tanks.
3. Follow the quick start up procedure outlines above plus the following points.
4. Energize the control panel.
5. Check rotation of all three phase powered equipment within the plant. Energize all circuits within the breaker panel.
6. As the building is warming, all control circuitry within the plant should be tested. Turn the selector switch to the blower and pumps quickly on then off to ensure their operation.
7. Check out the air blowers. Steps in checking them out are as follows:

    a. Check the unit and all piping for foreign material and clean if required.

    b. Check the flatness of the feet and the alignment of the drive. Feet that are bolted down in a bind can cause case distortion and internal rubbing. Misaligned V-drives can cause the impellers to rub against the headplates and cause a reduction in the volumetric efficiency of the unit. Misaligned couplings can ruin bearings.

    c. If blower is V-belt driven, check the belt tension and alignment. Over-tensioned belts create heavy-bearing loads, which leads to premature failure.

    d. Be sure adequate drive guards are in place to protect the operator from severe personal injury due to incidental contact.

    e. Check the unit for proper lubrication. Proper oil level cannot be overemphasized. Too little oil will ruin bearings and gears. Too much oil will cause overheating and can ruin gears and cause other damage. Ensure drive end bearings are greased.

    f. With motor locked out, turn the drive shaft by hand to be certain the impellers do not bind.

    g. “Jog” the unit with the motor a few times to check rotation and to be certain it turns freely and smoothly.

    h. The internal surfaces of all Sutorbilt units are mist sprayed with rust preventive to protect the machine during the shipping and installation period. This film should be removed upon initial start up.

    i. Start the unit and operate 15 minutes at no load. During this time, check for hot spots and other indications of interference.

j. Apply the load and observe the operation of the unit for one hour. Check frequently during the first day of operation.

8. Insert the UV bulb(s). Procedure for UV installation is as follows:

a. Slide lamp into the domed quartz sleeve by inserting the non-connector end of the lamp into the open end of the quartz sleeve. If quartz dome is touched or if it is dirty, clean it with alcohol.

b. Slide a compression nut over the end of the quartz sleeve.

c. Place O-ring over the end of the quartz sleeve.

d. Insert the domed end of quartz sleeve into the receiver of the lamp rack. An O-ring should be in the receiver end of the lap rack assembly.

e. Bring the connector end of the lamp up to the connector in the nipple of the lamp rack and connect them together.

f. Move the open end of the quartz sleeve forward from the receiver and insert into the nipple on the lamp rack.

g. Move the O-ring and compression nut up to the nipple. Engage the threads of eh compression nut and nipple.

h. Tighten the compression nut by hand until it cannot be turned any further. Then tighten nut by a ¼ turn with a wrench. Do not overtighten. This will create a waterproof seal.

i. After all laps have been connected, install the lamp racks on the UV bank supports in the channel.

j. Connect multi-pin connectors with their receptacles mounted on sides of the wireway.

k. Install UV sensor on lamp number 1 of the lamp rack assembly and position between lamp numbers 1 and 2. Direct sensor eye towards lamp number 2.

l. The three-pin connector for the sensor is connected to the outside of the wireway.

m. It is not recommended that the UV bulbs be energized unless they are at room temperature. Pre-warming of the bulbs may be required. Spare bulbs should be stored in a warm environment.

n. The ICH UV horizontal disinfection system is designed to operate with the effluent flowing parallel and between the horizontal lamp racks. A dry channel condition may cause the system's lamps to overheat, resulting in a decrease in lamp life and damage to other system components.

o. Always maintain proper effluent levels when operating this system. All lamps should be submersed in the effluent at all times. Water level should be 3 cm maximum above the top of the protective quartz sleeve of lamp number 1.

9. Start up the UV system. The procedure is as follows:

   a. Turn ON the GFIs located in the Ballast Power Enclosure.

   b. Turn ON the Main Power Feed.

   c. Turn the OFF switch to the ON position on the side of the Ballast Power Enclosure.

   d. Verify that the UV lamps are ON in the first lamp rack assembly by viewing the LED array located behind the display window of the Ballast Power Enclosure.

10. Calibrate UV meter. The UV meter for each bank of lamps can only be calibrated with the power is ON and the UV lamps are operational. Allow the lamps to warm up for 2 minutes prior to calibrating. This should only be done with new lamps that have been in operation for approximately 100 hours. The UV sensor is located between lamp number 1 and lamp number 2; then sensor eye should be pointed directing at lamp number 2.

    a. To set the low UV intensity alarms, find the test switches located near the intensity meter on the front inside display panel of the Ballast Power Enclosure. Flip the RUN/SET switch to the SET position. The meter will go to approximately 60%.

    b. Adjust the set point by turning the potentiometer marked SET, located near the test switches.

    c. Turn clockwise for upscale. Turn counter-clockwise for down scale.

    d. Return RUN/Set switch to RUN position.

    e. To test for low UV intensity, turn scale potentiometer, adjusting 0-100% meter scale, down below 60% level. The low UV intensity light will come on. When turning the meter back up, the light/alarm will stay on for 30 seconds.

    f. Set meter at 100%.

3.3 System Shut Down Procedure

1. Flush all discharge lines within Camp Farewell with water. The lift station will fill sending the flush water into the sewage treatment plant.

2. Once the discharge lines have been flushed, disconnect the discharge line from the lift station. Loosen the lift station lid bolts and slide to one side so the pump and level switch are visible.

3. Disconnect the discharge line at the lift station and plant inlet. Roll line up and store within the plant building.

4. Pump out the sludge holding tank and haul the sludge to the Town of Inuvik sewage lagoon or alternate site approved by the Inspector.
5. Drain the remaining tanks and ship the contents to the Town of Inuvik sewage lagoon for further treatment. Wash tanks and piping to remove all solids. A vacuum truck is required to remove all remaining fluid from the tank system.
6. Put tray under valving at grinder pump discharges. Disconnect piping before check valve and drain pipe into tray.
7. Put tray valving at grinder pump inlets. Disconnect inlet line to grinder pumps and drain piping. Disconnect the submersible sewage pumps and drain their bowls.
8. Leave all drain valves open to prevent them from cracking due to freezing.
9. The fluid within the UV system must be removed. Open the small drains on the UV transition boxes. Drain fluid into bucket.
10. Disconnect piping from blower. Spray rust inhibiting aerosol into pump. Place few packets of silica gel desiccant. Cap off motor. If possible, rotate shaft by hand every month.
11. Turn all breakers off.

3.4 Trouble-shooting

The following table describes trouble-shooting options in the event of equipment malfunction according to the manufacturer.

Table 1 Trouble-shooting

Problem	Cause	Possible Remedy
Lift station filling, pump not running	Level switch caught in down position	Shake lift station tank to free switch. Remove tank cover and re-position switch.
	Impeller requires service	Replace impeller and seal.
	No power to pump	Check breaker and electric connection.
Blower not turning	No power to blower	Check breaker and selector.
	Motor starter tripped off	Reset motor contactor and ensure heater pack set points are properly set to full load amperage of the motor.
Blower knocking	Unit out of time	Retime impellers.
	Distortion due to improper	Check mounting alignment and relieve pipe strains.
	Excessive pressure	Reduce to manufacturer's recommended pressure. Examine relief valve, re-set if necessary.
	Worn gears	Replace timing gears.
	Worn bearings	Replace bearings.
Excessive blower Temperature	Too much oil in gear case	Reduce oil level.

Problem	Cause	Possible Remedy
	Too low operating speed	Increase blower speed.
	Clogged filter or muffler	Remove cause of obstruction.
	Excessive pressure differential	Reduce pressure differential across the blower.
	Worn impeller clearances	Replace impeller.
	Internal contact	Correct clearances.
Impeller end or tip drag	Insufficient assembled clearances	Correct clearances.
	Case or frame distortion	Check mounting and pipe strain.
	Excessive operating pressure	Remove cause.
	Excessive operating temperature	Remove cause.
Lack of volume	Slipping belts	Tighten belts.
	Worn clearances	Re-establish proper clearances.
Excessive bearing Or gear wear	Improper lubrication	Correct lubrication level. Replace dirty oil.
Loss of oil	Headplate, gear case or drive cover vents plugged	Clean vents.
Low discharge pressure from blower	Blockage at intake line	Remove and clean breather.
High discharge pressure from blower	Blockage at discharge line	Ensure valve(s) open.
Blower turning in wrong direction	Incorrect three phase wiring	Interchange two of the wiring phases. To be done only by licensed electrician.
Blower has intermittent operation	Motor starter overload	Reset heater packs to proper full load settings. Faulty contactor or heater pack. Replace items.
Supernatant Pump not activating	Control timer in “OFF” mode	Wait for timer to time out.
	Level switch stuck in down position	Reposition level switch for free movement.
	No power to pump	Check breaker and selector.
Sludge light brown instead of dark brown	Insufficient sludge return	Reduce amount of sludge being wasted.
	Plant being started up	Reduce amount of sludge being wasted.
Sludge not settling in settling tanks	Too low level of solids in system	Decrease amount of sludge being wasted (sludge too young).
	Too much grease	Cut down kitchen wasting of oils and grease.
	Alkaline waste from laundry	Stagger laundry usage.
		Use low phosphate detergent.
Sludge building up in settling tank	Insufficient activated sludge being wasted	Increase amount of sludge being wasted.
High Coliform reading on discharge sample	Limited UV radiation	Ensure UV bulbs are on Bulbs may need replacing. UV quartz sleeves require cleaning
	Cross contamination when obtaining sample	Follow proper sampling protocols for collection and handling sample.
High BOD reading on discharge sample	Limited aeration	Increase aeration time.
	Contamination of influent	Ensure cleaning products used are biodegradeable. Reduce volume of chlorine and ammonia based cleaning agents.
	Plant is “hydraulically overloaded	Ensure that water inlet rate is less than 70 gpd per person being serviced by plant.

Problem	Cause	Possible Remedy
	Cross contamination when obtaining sample	Follow proper sampling protocols for collection and handling sample.
High TSS reading on discharge sample	Contamination of influent	Ensure cleaning products used are biodegradable. Reduce volume of chlorine and ammonia based cleaning agents.
	Cross contamination when obtaining sample	Follow proper sampling protocols for collection and handling sample.
	Plant is “hydraulically overloaded	Ensure that water inlet rate is less than 70 gpd per person being serviced by plant.
Offensive odour from plant	Septic conditions in plant	Increase aeration or ensure there are not blockages in aeration line. Ensure cleaning products used are biodegradable. Reduce volume of chlorine and ammonia based cleaning agents.
Gray or black biomass	Septic conditions in plant	Increase aeration or ensure there are not blockages in aeration line. Ensure cleaning products used are biodegradable. Reduce volume of chlorine and ammonia based cleaning agents.
Clumps of black smelly solids on top of settling tanks	Solids too long in settling tanks	Increase sludge return rate.
	Sludge lines plugged	Check and unplug lines.
Reddish biomass	Over aeration	Reduce air to tanks.
UV system not working	Quartz sleeve is cracked	Remove and replace quartz sleeve (see installation instructions).
	Compression nut seal is leaking	Reseat O-ring and tighten compression nut.
	0-ring is damaged	Replace O-ring and tighten compression nut.
	Liquid tight cable connection is loose or damaged	Contact Ideal Horizons Waste Water Sales Dept. and return the lamp rack assembly to the factory for repair. Attempts to repair the unit by unauthorized person(s) may void the warranty.
	Lamp out indicator is on	Check and verify the location of the lamp out condition. Turn OFF the lamp rack assembly that has the lamp out. Replace the defective lamp and turn the module ON.
	Defective ballast	Verify that the ballast is defective. NOTE: Each ballast controls two (2) lamps in sequence. Verify that two (2) lamps in sequence are out. Lamp numbers are on female 6-pin connector.
	Lamp wiring failure	Use multimeter to test system. Set the meter to the Ohm scale. Turn OFF power to the module. Check point to point from the lamp to its corresponding ballast, looking for an OPEN circuit. If the circuit is open, reseat the connection and retest the circuit. Turn ON module power.
	Lamp Status Board Failure	Locate the suspect lamp status board Turn

Problem	Cause	Possible Remedy
		OFF the corresponding module. Disconnect the LED array connector from the board and remove the board. Replace the suspect lamp status board with a known operational board and turn ON the module. It the problem persists (LED's will not light), follow the procedure outlined in LAMP WIRING.
	Defective Wiring	Obtain a mutimeter and set to the Ohm scale. Turn the GFI to OFF. Check point to point from the GFI to the power ON relay socket pin in the Ballast Power Enclosure. If a circuit is OPEN, reconnect the wire. If the problem persists, check the ON/OFF/AUTO switch.
	On/off/auto switch	Turn OFF the power to the suspect module at the GFI's in the control box. Module switch needs to be in the ON position. Obtain a multimeter and set to the Ohm scale. Read the resistance between the two contacts on the switch that corresponds to the module in question. If the meter reads OPEN, replace the switch.
	Ultraviolet meter circuit board failure	Turn OFF the power to the bank. Remove the suspect board, and replace it with a known operational board. Turn ON the power and read the ultraviolet intensity on the meter. If the meter reads above 60%, replace the defective board. If the meter continues to read low UV, contact the factory representative.
	Lamp bank failure	If there is a lamp bank failure, or partial bank fail check the following five (4) areas: GFI breaker- SIB ON. Multi- pin connectors should be plugged in Wiring (see previous defective wiring) ON OFF/AUTO switch-select proper setting
		NOTE: If the GFI breaker has tripped reset the breaker and check the bank. If the breaker continues to trip, inspect the quartz sleeve for cracks or water intrusion. Check ballast assemblies or ground faults.

3.5 Equipment and Flow Description

All the equipment is contained within two containers, which have connecting piping, and electrical cabling installed to tie them together. The electrical supply to these containers is three-phase 210 volt at 60 amps.

Camp sewage flows into a lift station. The lift station periodically pumps the sewage to a flow equalization tank in the first container. A float switch controls the pump. The purpose of the flow equalization tank is to smooth out flow to the aeration tanks. The flow equalization tank is aerated to prevent the sewage from going septic. Microorganisms from the settling tanks are also pumped into this tank. Because there is only a small amount of air being bubbled through the tank, there is not a lot of sewage treatment done in this tank.

Pumps remove sewage from the bottom of the flow equalization tank and grind and pump it to the aeration tanks. These tanks are located in the second container.

Here the sewage is mixed with active (living) microorganisms being returned from the bottom of the settling tanks. This mixture has air bubbled through it. The air mixes the contents and provides air for the microorganisms. A mixture of water and microorganisms overflow the aeration tanks and flows to settling tanks located in the first container.

In the settling tanks the microorganisms settle to the bottom of the holding tank. The water overflows the settling tanks to a holding tank. It then flows from the holding tank through Ultraviolet lights where the light kills any microorganisms left in the water.

Airlift pumps pump the settled sludge out of the bottom of the settling tanks. Some of the sludge is returned to the aeration tanks. The remainder is wasted to either the Solids Holding Tank or Flow Equalization Tank.

The Sludge Holding Tank is also aerated to prevent it from going septic. The air bubbling through the tank ensures that all organic material is consumed. Thus the sludge that settles out is biologically inert. This sludge is pumped out and hauled to the local municipal sewage treatment plant. A pump is located in the middle of this tank to pump the watery liquid left after settlement into the Flow Equalization tank for further treatment.

3.6 Routine and Periodic Maintenance

1. The protective quartz sleeve that encompasses each UV lamp needs to be removed from the channel for cleaning on a routine basis. Any build-up of dirt or scaling on the sleeve must be removed. The cleanliness of the lamp and its protective quartz sleeve is instrumental in the UV systems performance. Cleaning of the lamp rack assemblies should occur every time the intensity drops below 65. Detailed cleaning procedure is as follows:

a. Mix one (1) part citric acid to nine (9) parts water in a two-gallon bucket. Rubber gloves face mask and apron must be worn while cleaning the ultraviolet (UV) lamp rack.

b. Disconnect the UV light multi-pin connectors from the wireway to avoid high voltage electrical shock. Remove each rack from the channel for cleaning, one at a time. Make sure the multi-pin connector does not fall into the channel. If you have spare UV lamp racks, replace each rack to be cleaned with a spare to ensure that the bank of lamps are in operation during the cleaning process.

c. Wipe down each lamp rack with the citric acid solution

d. Rinse down the UV lamp rack and wipe each quartz sleeve with a soft, clean cloth to remove the cleaning solution residue.

e. Return the UV lamp rack to its position in the channel and attach the multi-pin connectors to their appropriate connection points. After cleaning of the lamp rack assemblies be certain that the multi -pin connectors have been thoroughly dried before making the connection.

f. Repeat the above process for each UV lamp rack.

g. If the proper ultraviolet intensity levels cannot be obtained through repeated cleaning of the quartz sleeves of the lamp and the sensor, one of the following may be causing it.

i. UV sensor location. - reposition or change the sensor unit located on the lamp rack assembly

ii. Plant effluent transmissivity – check effluent for clearness. If not clear fix process problem.

iii. Lamps produce less light as they age. The lamp may need to be replaced.

iv. The protective quartz sleeve can also degrade due to long exposure to the UV. This exposure causes quartz tube to turn light brown and effect UV output. The quartz sleeve should be replaced.

2. Lift/Sludge/Discharge Pumps –the pumps should be checked daily to ensure they are functioning and that the level switches are able to freely float within their respective tanks. Amperage draw should be checked every month. Increasing amperage indicates water in motor housing and impeller seal should be replaced. Check impeller every 6 months for wear or breakage. Replace as required.

3. Air Blowers – clean inlet filters monthly. Replace as required.
    i. Check oil level daily. Add fresh oil as required
    ii. Drain oil from gearbox and replace every 1500 hours (about 2 months)
    iii. Grease bearings in drive end every 500 hours (about 3 weeks)
    iv. Ensure vents on drive end are always open to prevent overpressure damaging seals

Precautionary Note:

The extended activated sludge wastewater treatment system is designed to employ aerobic digestion of organic based contaminants within the wastewater stream. Inorganic matter that may impact the plant's ability to digest and produce consistent quality of treated effluents, such as plastics, cigarette butts and sanitary napkins, must be prevented from entering the camp wastewater outfall system.

Large volumes of disinfecting agents, oils, grease, high sudsing detergents, or discharge volume from water softening equipment should also be restricted from entering the camp wastewater outfall system.

4 QUALITY ASSURANCE/QUALITY CONTROL PLAN

This QA/QC Plan identifies the types of sampling required, the location of sample collection, the frequency of sampling, proper sample handling methods and documentation and the analytical parameters for laboratory analysis to fulfill the requirements of the current water licence N7L1-1834.

4.1 Sample Collection

4.1.1 Location

Water sample collection for laboratory analysis will occur at the discharge point (SNP #1) from the sewage treatment plant prior to entering the receiving environment.

The sewage lagoon is planned to be decommissioned in 2013. If the sewage lagoon is used prior to 2013, a water sample will be collected from the southeast corner of the lagoon (SNP #2), and from the discharge point (SNP #3) prior to entering the receiving environment.

The sampling locations are shown on Figure 1.

4.1.2 Sampling Equipment

The water sample collection will require personal protective equipment (PPE) that should include: disposable nitrile gloves, rubber boots, Tyvek or other protective clothing and eye protection. For the protection and preservation of the collected water samples, equipment includes: labels for sample identification, laboratory provided sterile sample containers, coolers, ice packs, bubble wrap for packing, chain of custody forms and collection of field notes. Additional equipment that may be required includes a pH meter, electrical conductivity (EC) meter and temperature probe.

4.1.3 Sampling Methodology

The general procedure for sampling is as follows:

- Acquire necessary equipment, including: PPE, sample labels, laboratory supplied sample containers, writing tools, documentation forms, chain of custody forms, weigh bill for shipping, coolers and ice packs, bubble wrap, clear packing tape, camera and any additional equipment.
- Don PPE.
- At sampling location, if required, perform field screening for pH, EC and temperature and record values in field notes.
- Label sample containers. Place clear packing tape over label to avoid it from washing off in the cooler.
- Rinse sample containers three times with sample water prior to filling. Omit this step for fecal coliform and oil & grease sample containers.

- Collect sample in sample container. Qualitative observations of the sample should be noted in the field notes (ie. sample colour, odour, opaqueness, presence of particulates). Complete the chain of custody form with required analysis listed for each collected sample.
- Carefully bubble wrap the sample containers and place in ice chilled cooler maintained at approximately 4 °C for transport to the laboratory. The sampling and transportation of the samples must be completed within the laboratory specified handling times for the parameters.
- Complete field notes and log samples. Retain paperwork for submission to the NWTWB, if necessary.

4.1.4 Sample Handling

Sampling handling procedures are imperative to the integrity of the sample. Documentation is an important part of QA/QC and includes information on the sample labels and in the field notes. The minimum documentation requirements include:

- sampling date;
- sampling time;
- identification code or number;
- sampler's name;
- site;
- sampling conditions;
- field observations;
- sample type;
- sampling equipment;
- storage and preservation methods;
- time of storage and preservation;
- deviation from sampling protocols; and
- chain of custody information.

Preservation of the samples is done to ensure sample integrity until analysis at the laboratory. Preservation methods include refrigeration or cooling, filtration, and/or the addition of chemicals. Preservation methods are parameter specific and will be conducted according to laboratory instruction.

The samples should be properly packed with bubble wrap and ice, and a copy of the chain of custody form should travel with the samples. The cooler(s) will be shipped directly to the laboratory for analysis as soon as practicable.

4.2 Laboratory Analysis

ALS Laboratories in Yellowknife, NT has been selected as the primary laboratory for analyses of water samples collected at Camp Farewell. Taiga Environmental Laboratory in Yellowknife, NT is the secondary laboratory and will be used to fecal coliforms analysis only. Copies of the laboratory accreditation certificates are included in Appendix III. Table 2 contains the parameters for analysis.

Table 2 Analytical Parameters

Parameter	Detection Limit	Quality Requirements	Sample Container	Sample Size	Preservation Method	Holding Time
Biological Oxygen Demand	2 mg/L	70 mg/L	Polyethylene	1000 mL	Chill to 4 °C	48 hours
Total Suspended Solids	3 mg/L	70 mg/L	Polyethylene	1000 mL	Chill to 4 °C	7 days
Fecal Coliforms	1 x 10^4 CFU/dL	1 x 10^4 CFU/dL	Polyethylene	250 mL	Sodium thiosulfate	30 hours
Oil & Grease	1 mg/L	5 mg/L	Brown glass	1000 mL	2 mL hydrochloric acid or sulfuric acid	28 days
Total Residual Chlorine	0.1 mg/L	0.1 mg/L	Polyethylene	125 mL	Chill to 4 °C	<0.25 hours
pH	0.1	6 to 9	Polyethylene	1000 mL	Chill to 4 °C	<0.25 hours
Ammonia	0.05 mg/L	N/A	Polyethylene	250 mL	1 mL sulfuric acid	28 days
Phosphorus	0.005 mg/L	N/A	Polyethylene	250 mL	1 mL sulfuric acid	28 days

The methods of analysis for each parameter are included in Table 3.

Table 3 Analysis Methods

Parameter	Code	Method*
Biological Oxygen Demand	BOD-ED	APHA 5210-B, 5 day incubation – O_2 electrode
Total Suspended Solids	SOLIDS-TOTSUS-ED	APHA 2540-D gravimetric
Fecal Coliforms	N/A	APHA 9221-E fecal coliforms, membrane filter procedure
Oil & Grease	OGG-LLE-ED	APHA 5520-B hexane MTBE extraction gravimetric
Total Residual Chlorine	CL2-TOT-ED	APHA 4500-Cl G colorimetry
pH	PH-ED	APHA 4500-H electrode
Ammonia	NH4-CL	APHA 4500-NH3/H colorimetric
Phosphorus	P-T-COL-CL	APHA 4500-P PHOSPHORUS

*Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998.

4.3 Reporting Requirements

In accordance with the current water licence, an annual report must be submitted to the NWTWB no later than March 31 of each calendar year, containing:

- the monthly and annual quantities in cubic meters of fresh water obtained from all sources;
- the monthly and annual quantities in cubic meters of waste discharged;
- the location and direction of flow of waste discharged to the water or the land;
- a summary of the monthly and annual quantities of waste stored on site and transported off site;
- the results of sampling carried out under the Surveillance Network Program;
- a summary of modifications carried out on the water supply facilities and sewage treatment facilities, including associated structures;
- a list of spills and unauthorized discharges;
- details on the restoration of sumps;
- a summary of abandonment and restoration work completed during the year with an outline of any work anticipated for the next year;
- a summary of studies requested by the NWTWB that relate to waste disposal, water use, or reclamation, and a brief description of future studies planned;
- notation of updates and/or revisions to the approved Spill Contingency Plan, Waste Disposal Facilities, Operations and Maintenance Plan, and Sewage Treatment Plan;
- an outline of spill training and communications exercises carried out; and
- any other details of water use or waste disposal requested by the NWTWB within 45 days before the annual report is due.

5 SOLID WASTE DISPOSAL PLAN

Solids designated for disposal and the disposal options vary depending on the material. Six major solid waste streams have been identified and the disposal plans are addressed as follows:

1. Combustible camp waste (including paper and cardboard products) will continue to be burned in the incinerator located within the camp.
2. The larger construction debris (pallets etc) that was previously burned in an earthen pit on-site will now be burned in a metal sloop. This will contain the fire and eliminate the introduction of waste materials to the soil. The residual ashes from the incinerator and burn sloop will be transported to the Inuvik landfill for final disposal after obtaining appropriate approval.
3. Recyclable materials will be collected and recycled. Materials including, but not limited to used oil, used anti-freeze, oily rags, etc. will be shipped to suitable facilities located in Alberta. Metal including aluminum and scrap steel are separated into bins that will be shipped from the location to appropriate recycling facilities.
4. Un-usable drilling products including, but not limited to cement, potash, caustic soda, etc. are either recycled or shipped to appropriate disposal facilities in Alberta.
5. Upon approval of the District Inspector, the digested sludge and sediment that has accumulated in the sewage lagoon is to be air dried to reduce hydrocarbons and pathogens. The sediment can then be used on-site as fill or as a topsoil amendment as a component of site reclamation. See Camp Farewell Reclamation Plan, submitted under separate cover, for additional details.

Waste materials will be managed and disposed of in accordance with Northwest Territories Regulations and Guidelines.

FIGURES

Legend

⊕ Surveillance Network Plan Sampling Location

CLIENT

IEG CONSULTANTS LTD.

PROJECT
Farewell Camp and Stockpile Site Operations and Maintenance Plan

TITLE
Site Plan

PROJECT No. A04012A04

FIG. No. FIGURE 1

APPENDIX I

Water Use and Discharge Reporting Forms

Camp Farewell **Year: _____**

Water Water Disposal Volumes

Water License Field Requirements

For Reporting Requirements, only Monthly Volume Required.
Daily Tracking is only for Operational Monitoring

Date	January	February	March	April	May	June	July	August	September	October	November	December
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Total M3												

Fax to: Shell Canada Limited, DAR/Construction Manager on the first of every month @ (403) 269-7948

Camp Farewell

Water License Field Requirements

Check List

	Circle appropriate answer	**Date**	**Initials**
1. Copy on site: License	Yes / No		
Contingency Plan	Yes / No		
QA/QC Plan	Yes / No		
2. Five Day Notice to Inspector Prior to Discharge	Yes / No		
3. Screened Water Intake	Yes / No		
4. Discharge Sample Point Sign in place w/ "1762-1 Treated Effluent Discharge Sample Point"	Yes / No		
5. Volumes of Water withdrawn for the camp are recorded	Yes / No		
6. Treatment Facilities were modified. If yes: Describe: 45 Day Notice given. As-builts submitted within 90 days of completion	Yes / No Yes / No Yes / No		

Biweekly Discharge Samples

	Date Sampled	***Sampler***		***Date Sampled***	***Sampler***
1			14		
2			15		
3			16		
4			17		
5			18		
6			19		
7			20		
8			21		
9			22		
10			23		
11			24		
12			25		
13			26		

Fax to Shell Canada Limited, DAR/Construction Manager on the first of every month. Fax: (403) 269-7948

Camp Farewell **Year:** _____

Water Withdrawal Volumes

Water License Field Requirements

Fill in the Number of Loads for Camp Use Only Truck Volume: m3 per load.

Date	January	February	March	April	May	June	July	August	September	October	November	December
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Total Loads												
Total M3												

Fax to: Shell Canada Limited, DAR/Construction Manager on the first of every month @ (403) 269-7948

APPENDIX II

Treatment Plant Information

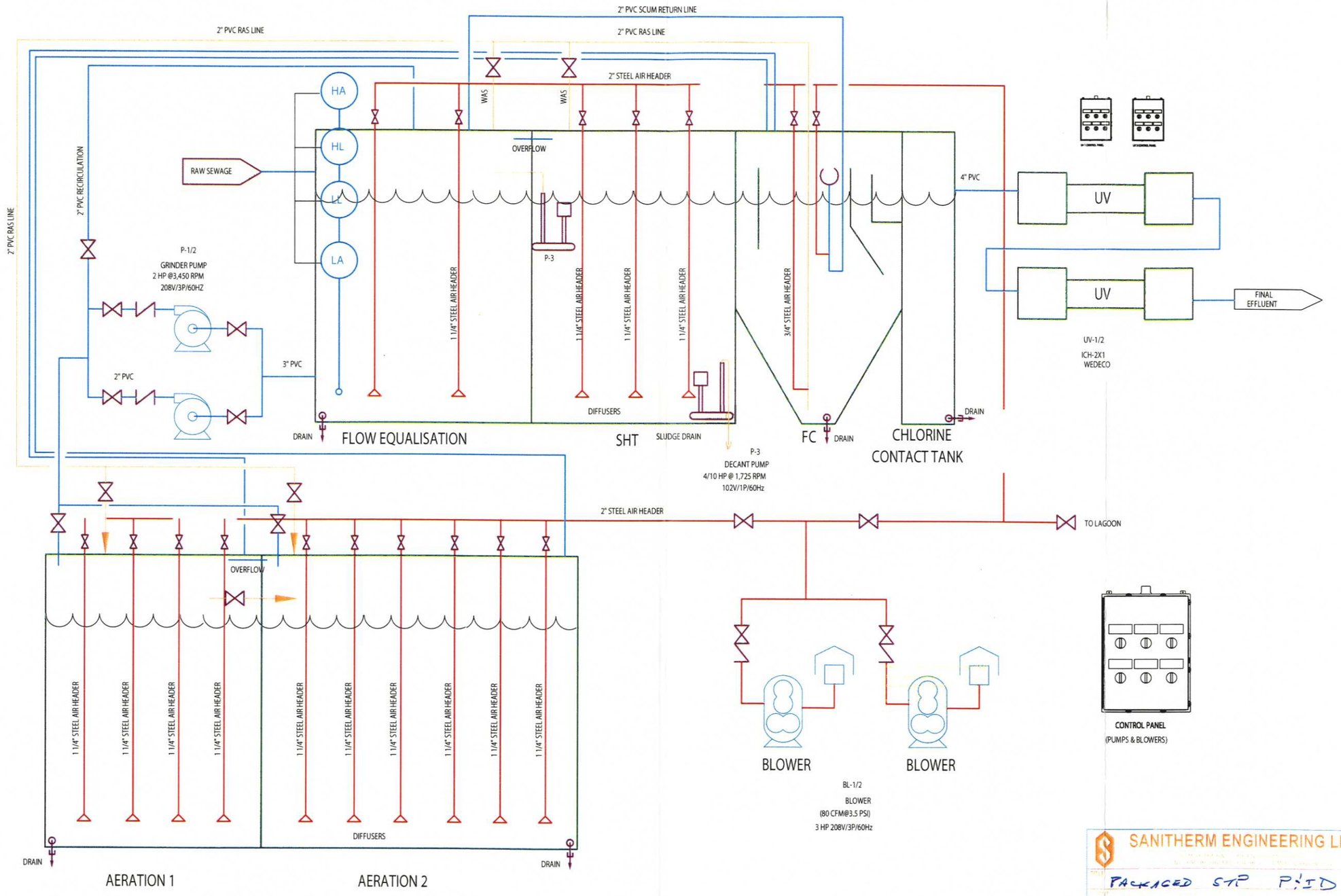
Sewage Treatment Plant – GOLDEN RULES

This module contains Safe Work Procedure to assist you in safely performing various tasks based on recognized hazards. Although a lot of thought has gone into the development of the SWP, they only serve as a guideline to put you in the right frame of mind prior to conducting a task. It is also realized that some tasks are more critical than others and as such require more stringent procedures.

The following list contains SWP from this module which Shell considers non-negotiable. **Failure to comply to these procedures may result in immediate dismissal.**

Golden Rules

- Any persons that enter the sewage treatment area must first use an air monitor to ensure the proper air quality is available. Anything below an acceptable level must not be entered unless proper steps are taken to ensure acceptable entry.
- Persons who are designated to work in the area must have immunization shots (i.e., Tetanus, Diphtheria and Hepatitis A & B.
- Workers must properly wash was once leaving the contaminated area (hands, face, etc.)
- Any persons with exposed wounds are not permitted in the sewage area.
- Only designated tools are to be used in the sewage area. Those tools are not to be removed and are only used in this area.
- Proper PPE must be worn. Eye glasses, rubber gloves, face masks, disposable or area designated clothing.
- At no time is anyone who has entered the sewage treatment center allowed into the eating area unless properly washed and wearing clean clothing.
- Contaminated clothing is to be immediately removed and washed in the designated washing area.
- UV light is to be managed following the manufacture recommendations.



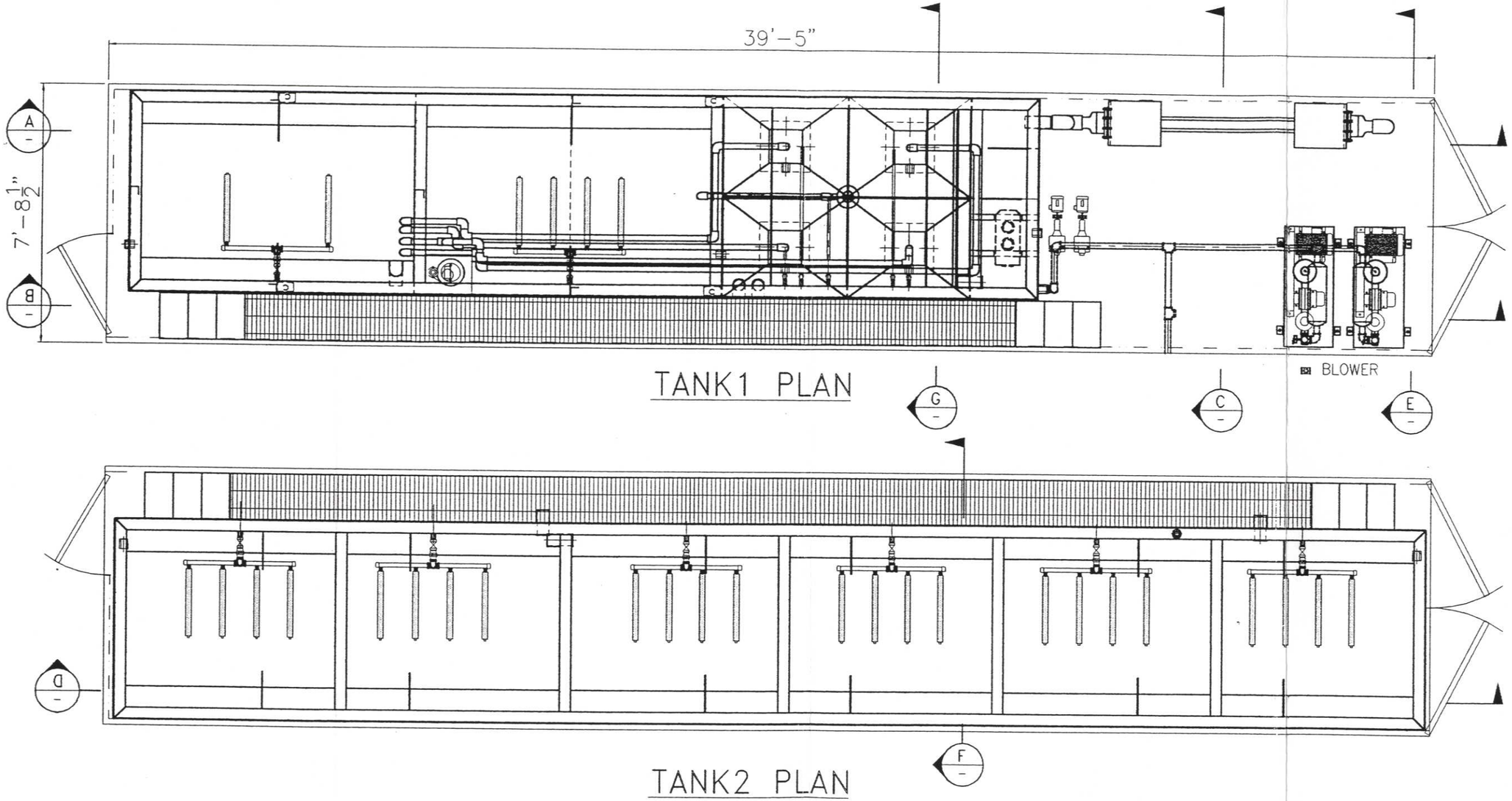
SANITHERM ENGINEERING LIMITED

PACKAGED STP P.I.D

SHELL CANADA LIMITED

CAMP FAREWELL 120 MAN STP

07/02 AS BUILT



TANK1 PLAN

TANK2 PLAN

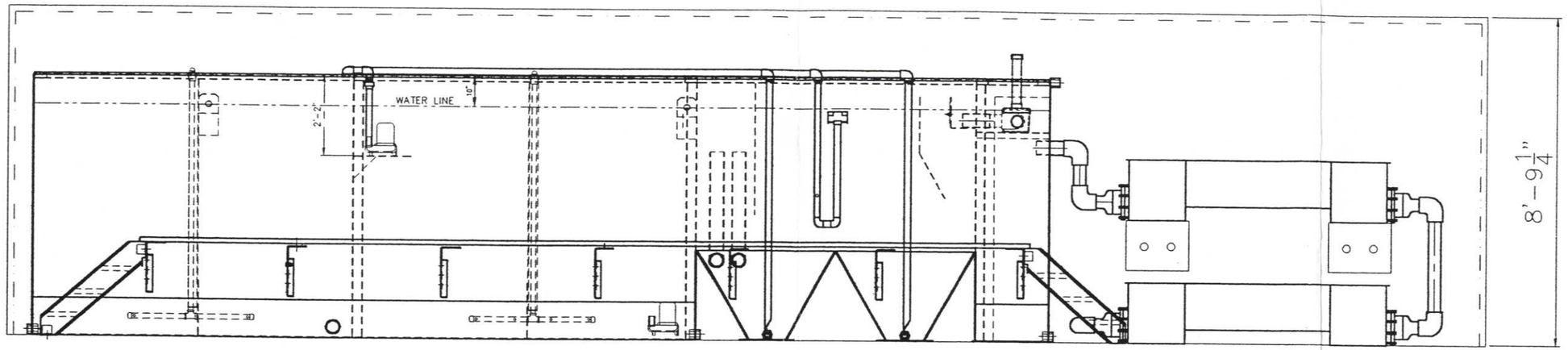
SANITHERM ENGINEERING LIMITED

431 MOUNTAIN HWY., SUITE 4, NORTH VANCOUVER, B.C., V7J 2L1
TEL : (604) 986-6166 FAX : (604) 986-5377 E-MAIL : sanmar@direct.ca

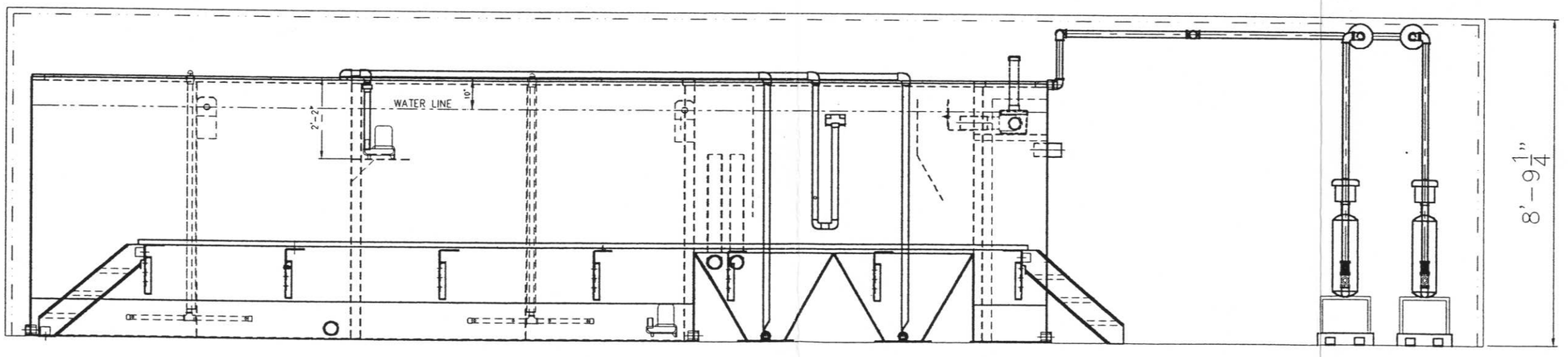
TITLE	PACKAGE SEWAGE TREATMENT PLANT GA
CLIENT	SHELL CANADA LTD.
PROJECT	CAMP FAREWELL 120 MAN STP

REVISION ISSUE	DATE	DESCRIPTION

DRAWN BY SC	JOB REF NO. A2565	SCALE N.T.S.	PAPER SIZE 17" X 11"	REVISION
CHECKED BY DMB	DATE 10-JUN-2002	SHEET 1 OF 3	DWG NO. SA-36-002	



SECTION A
NTS



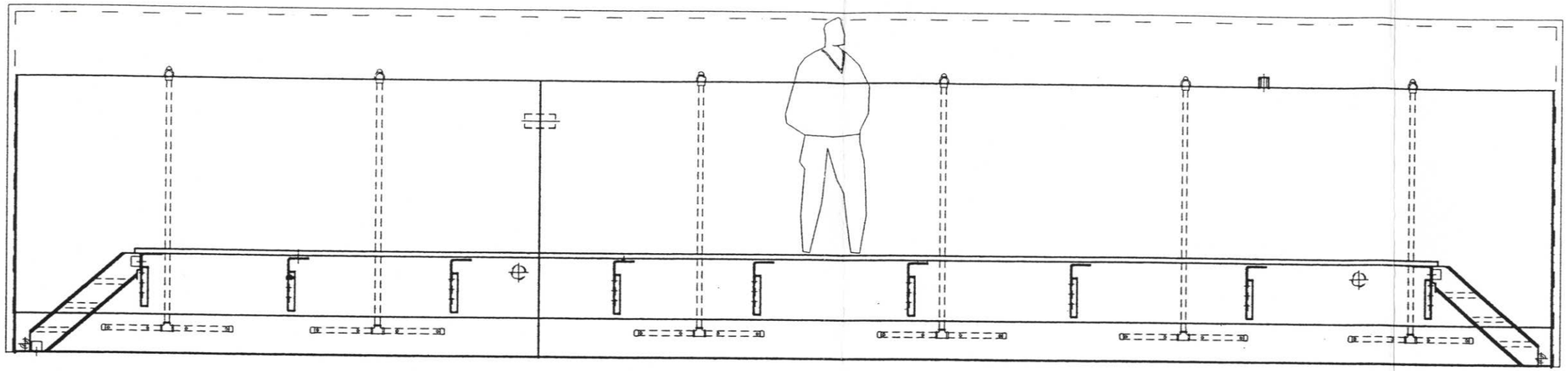
SECTION B
NTS

SANITHERM ENGINEERING LIMITED
431 MOUNTAIN HWY., SUITE 4, NORTH VANCOUVER, B.C., V7J 2L1
TEL : (604) 986-8168 FAX : (604) 986-5377 E-MAIL : sanengr@direct.ca

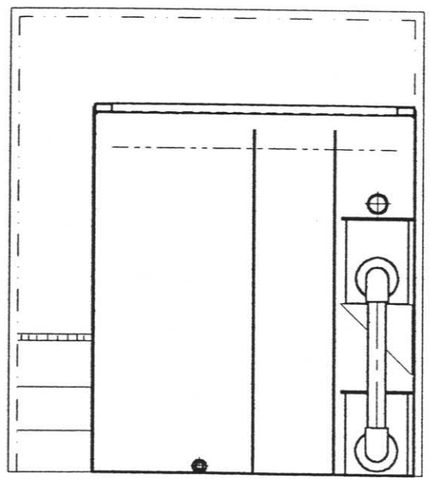
TITLE	PACKAGE SEWAGE TREATMENT PLANT GA
CLIENT	SHELL CANADA LTD
PROJECT	CAMP FAREWELL 120 MAN STP

DRAWN BY: SC	JOB REF NO. A2565	SCALE N.T.S.	PAPER SIZE 17" X 11"	REVISION	
CHECKED BY DMB	DATE 10-JUN-2002	SHEET 2 OF 3	DWG NO. SA-38-002		

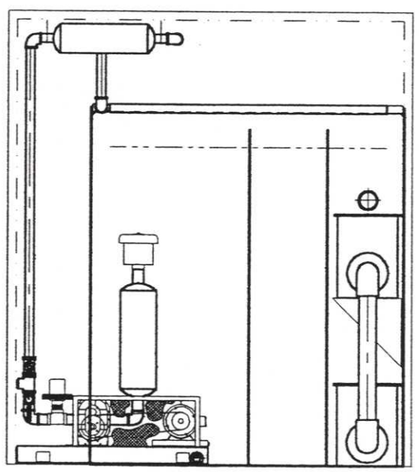
REVISION CODE	DATE	DESCRIPTION



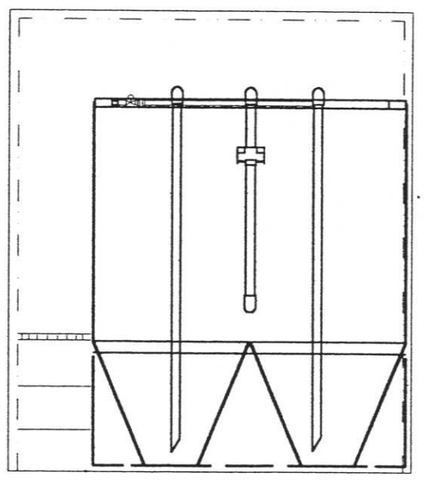
SECTION D
NTS -



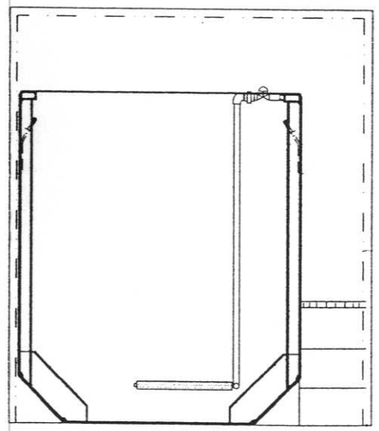
SECTION C
NTS -



SECTION E
NTS -



SECTION G
NTS -



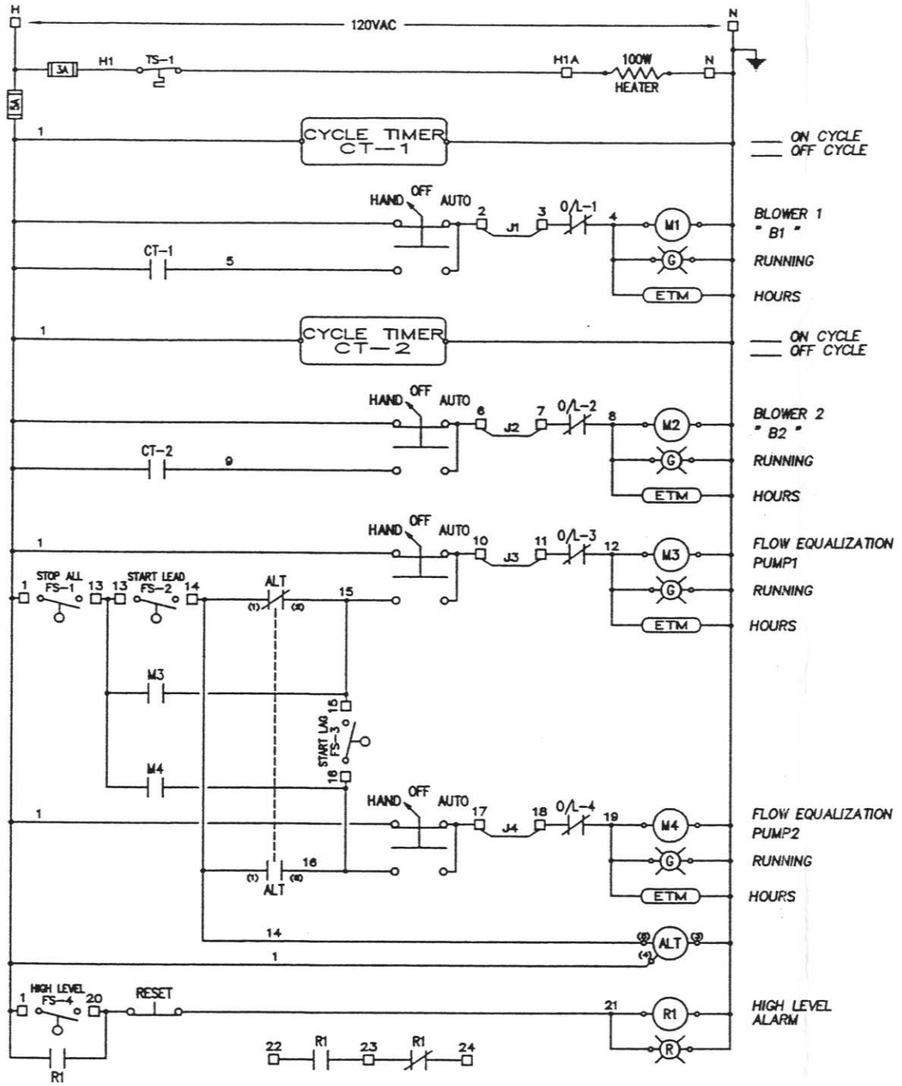
SECTION F
NTS -

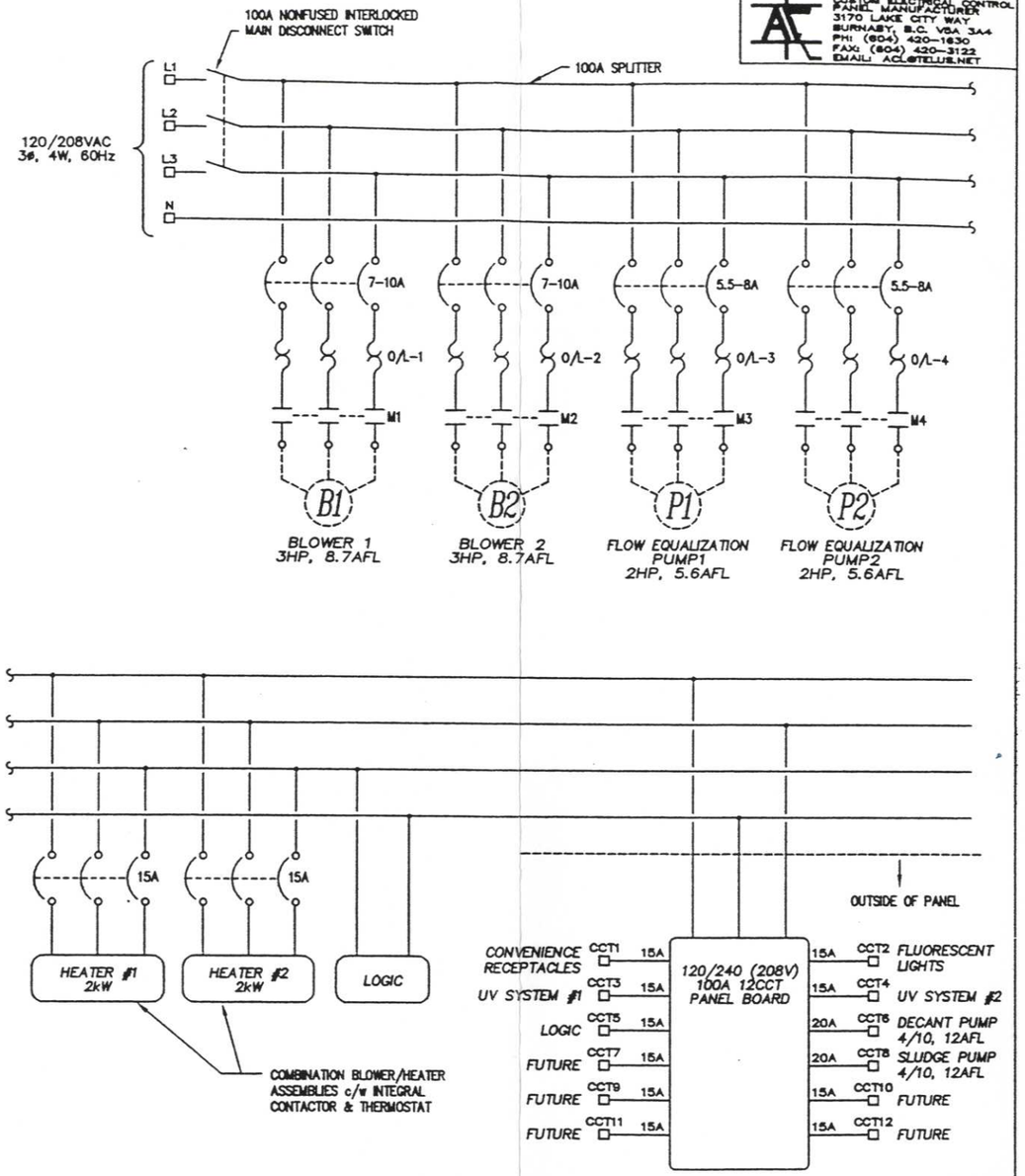
SANITHERM ENGINEERING LIMITED
430 MOUNTAIN HWY., SUITE 4, NORTH VANCOUVER, B.C., V7J 2L1
TEL : (604) 985-6168 FAX : (604) 986-5377 E-MAIL : sanengltd@telus.net

TITLE	PACKAGE SEWAGE TREATMENT PLANT GA
CLIENT	SHELL CANADA LTD
PROJECT	CAMP FAREWELL 120 MAN STP

DRAWN BY SC	JOB REF NO. A2565	SCALE N.T.S.	PAPER SIZE 17" X 11"	REVISION
CHECKED BY DMB	DATE 10-JUN-2002	SHEET 3 OF 3	DWG. NO. SA-38-002	

REVISION ISSUE	DATE	DESCRIPTION



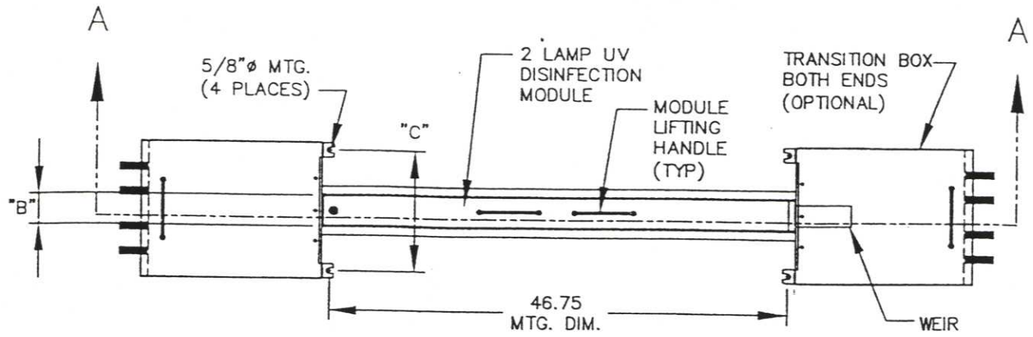


ALLIED CONTROLS LIMITED
CUSTOM ELECTRICAL CONTROL PANEL MANUFACTURER
3170 LAKE CITY WAY
BURNABY, B.C. V5A 3A4
PH: (604) 420-1630
FAX: (604) 420-3122
EMAIL: ACL@TELUS.NET

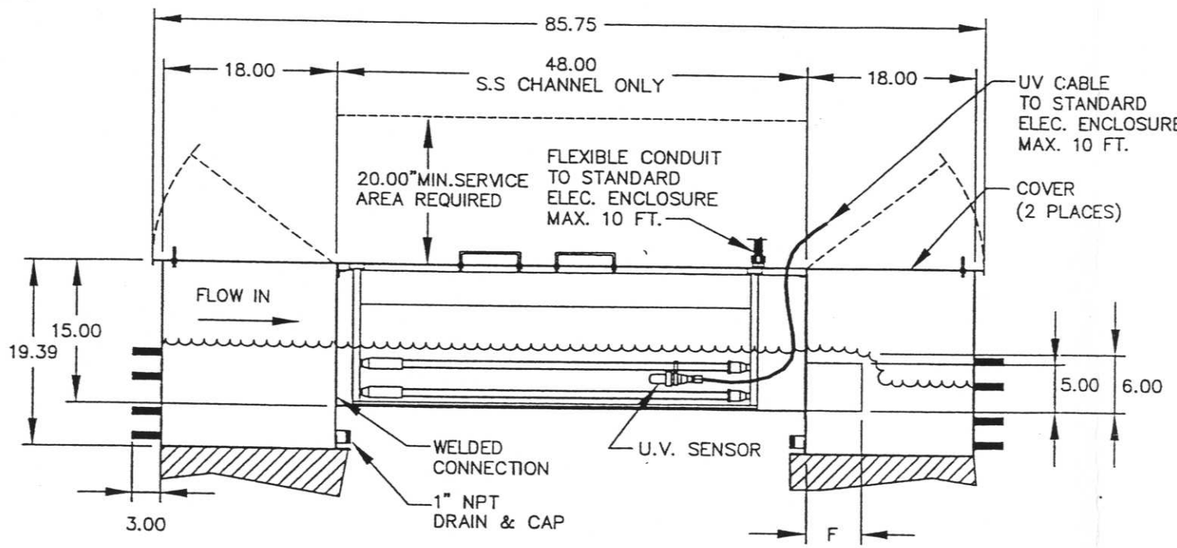
NOTES:

1) THE PANEL IS TO BE EEMAC 12.
2) THE MAIN DISCONNECT IS INTERLOCKED WITH THE DOOR.
3) FS-1 TO FS-4 CLOSE ON RISING LEVEL.
4) JUMPERS J1 TO J4 ARE FOR FUTURE SHUTDOWN CIRCUITS.
5) CT1 AND CT2 ARE LOCATED ON THE BACK PAN
6) THE PANELBOARD IS TO BE SUPPLIED LOOSE.

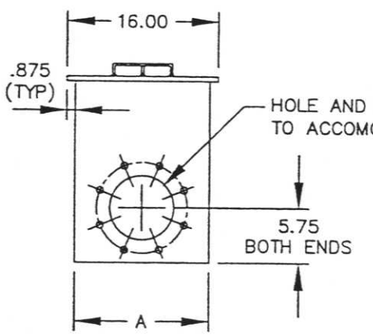
ALLIED CONTROLS LIMITED			
DATE DRAWN: 06/2002	APPROVED BY: G.A.V.	DRAWN BY: T.N.	
DRAWING SCALE: N.T.S.	WORK ORDER NUMBER: 3413	REV. NUM.: 0	REV. DATE: —
SHELL RESOURCES/CAMP FAREWELL TUKTOYAKTUK, N.W.T. WASTE WATER TREATMENT PLANT POWER & SCHEMATIC DIAGRAM			
CUSTOMER: SANITHERM ENGINEERING		DRAWING NUMBER: 02413-C1140	

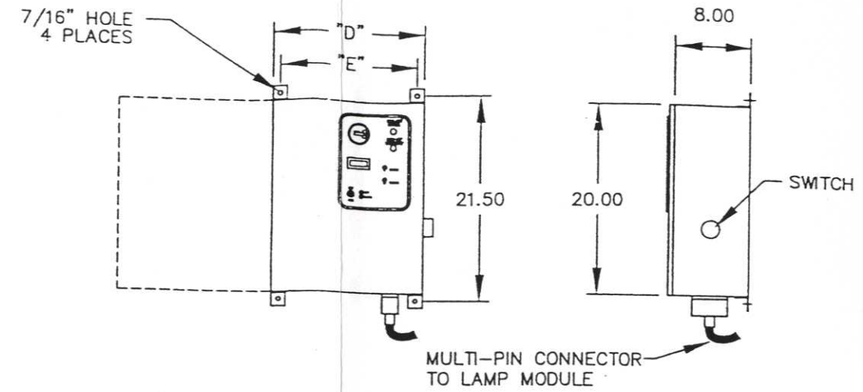


PLAN



SECTION A-A





SYSTEM CONTROL ENCLOSURE

MODEL	# OF LAMPS	# OF RACKS	"A"	"B"	"C"	"D"	"E"	"F"
ICH-2X1-S	2	1	14.00	3.125	12.50	16.00	14.50	2
ICH-2X2-S	4	2	14.00	6.125	12.50	20.00	18.50	4
ICH-2X3-S	6	3	14.00	9.125	12.50	20.00	18.50	6

NOTES:

1. ALL DIMENSIONS ARE IN INCHES & TOLERANCES AS PER WEDECO IDEAL HORIZONS' ENGINEERING STANDARDS
2. MODEL ICH-2X1-S SHOWN

SPECIFICATIONS :

1. WETTED PARTS, DISINFECTION CHANNEL MAT'L-304 SS 11 GAGE MATERIAL
2. ELECTRICAL : 120V AC/60 HZ SINGLE PHASE
   OPTIONAL : 220V AC/50 HZ SINGLE PHASE
3. ELECTRICAL ENCLOSURE : 304 SS NEMA 4X MODIFIED

LTR	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

FOR DISCUSSION PURPOSES ONLY
NOT FOR CONSTRUCTION

PROJECT
LOCATION
ENGINEER

Drawn by	VOV	11/08/01
Checked by		
Approved by		
Proj. Engr.		

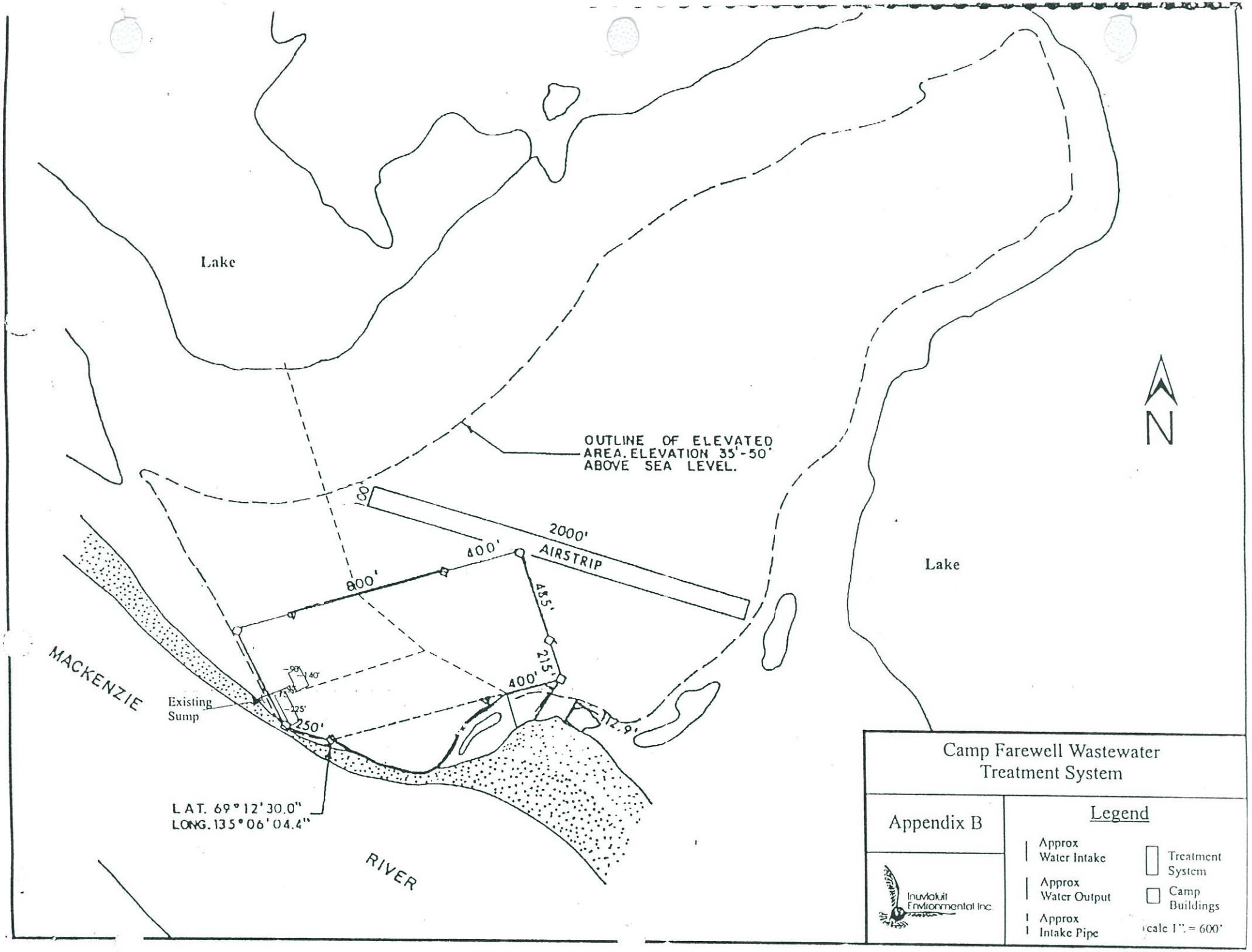
WEDECO
Ideal Horizons
WEDECO-Ideal Horizons, Inc.
212 Ideal Way
Poultney, VT 05764 USA
(802) 287-4488
Fax (802) 287-4486
www.wedecouv.com

MODEL: ICH-S

UV DISINFECTION SYSTEM ICH-S SERIES

Size	Drawing #	Rev.
B	ICH-S SERIES	

Scale	WT.	Sheet
NTS		


Lake
OUTLINE OF ELEVATED AREA. ELEVATION 35'-50' ABOVE SEA LEVEL.
N
2000'
AIRSTRIP
400'
800'
485'
215'
400'
Lake
MACKENZIE
Existing Sump
250'
LAT. 69°12'30.0"
LONG. 135°06'04.4"
RIVER
Camp Farewell Wastewater Treatment System
Appendix B
Inuvialuit Environmental Inc.
Legend
Approx Water Intake
Approx Water Output
Approx Intake Pipe
Treatment System
Camp Buildings
Scale 1" = 600'

APPENDIX III

Laboratory Accreditation Information

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

Taiga Environmental Laboratory
Aboriginal Affairs and Northern Development Canada (AANDC)
4601 - 52nd Avenue
P.O. Box 1500
Yellowknife, Northwest Territories

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

CANADIAN ASSOCIATION FOR LABORATORY ACCREDITATION INC. CALA

Accreditation No.:	A2635
Issued On:	August 5, 2011
Accreditation Date:	January 3, 2005
Expiry Date:	February 5, 2014

President & CEO

ilac-MRA CALA

Canadian Association for Laboratory Accreditation Inc.

CALA

Certificate of Accreditation

ALS Environmental (Yellowknife)
ALS Canada Ltd.
75 Con Road
Yellowknife, Northwest Territories

This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation No.:	A 3590
Issued on:	September 28, 2010
Accreditation Date:	February 4, 2008
Expiry Date:	September 28, 2013

Chief Executive Officer

ilac-MRA CALA