Shandon SRRA

Wastewater Treatment System

Start-up, Operations, and Maintenance Manual

Shandon, CA

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I. INTRODUCTION

The wastewater treatment system described in this manual was designed to produce an effluent low in total nitrogen to meet regulatory requirements while minimizing energy use and simplifying operation and maintenance needs. While the treatment system makes use of processes that are mostly passive, the operation and maintenance activities described in this manual are critical for long-term operation and performance.

Assistance

For additional assistance on the information and instructions found in this manual, contact Water and Wastewater Branch staff in the Division of Engineering Services. (916) 227 8526.

Maintenance Staff Inspection

Upon construction completion, Maintenance staff shall tour and become familiar with the components and operation of the wastewater treatment system. The Resident Engineer shall provide all equipment operation maintenance manuals, material samples and specifications, warranties, replacement parts, etc required in the contract.

About the Shandon SRRA System

The Regional Water Quality Control Board has required Caltrans to install a wastewater treatment system at the Shandon SRRA to minimize the impact by sewage effluent on local groundwater resources. Of primary concern is the impact of excessive nitrogen loading in the basin. The treatment system installed at Shandon SRRA has been designed to reduce nitrogen discharge concentration to levels that comply with the Basin Plan. To ensure this compliance, the following start-up, operation, and maintenance manual has been prepared. In this section, the system components are described. A schematic flow diagram of the treatment system is shown on Fig. 1.

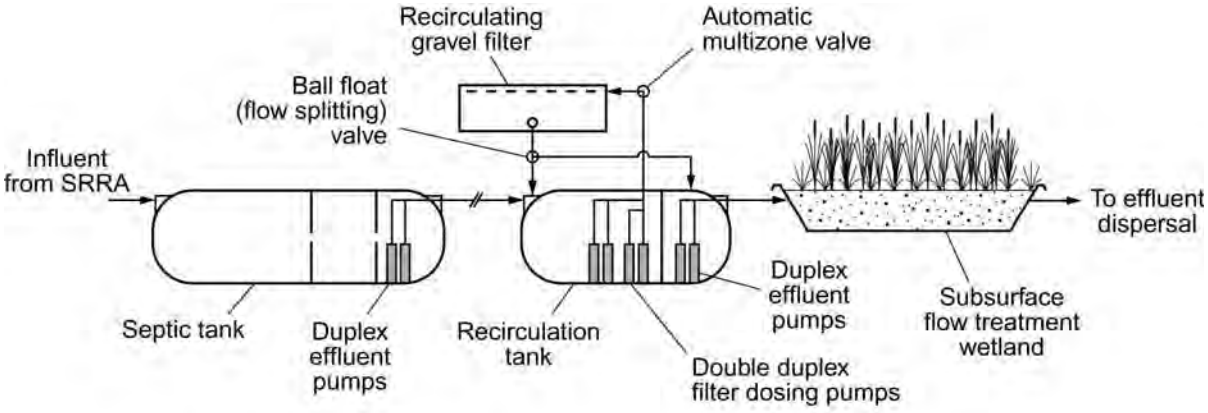

Figure 1

Schematic flow diagram for Shandon SRRA wastewater treatment system

Septic tank

A primary septic tank, with a capacity of 25,000 gallons, will collect sewage from the comfort stations, crew building, and vending kiosk. In the septic tank, heavy solids (known as sludge) settle to the bottom while the lighter material (known as scum) floats to the top of the liquid contents. Facultative and anaerobic digestion converts the organic matter to gases. Facultative microbes convert the complex organic material to volatile organic acids while strict anaerobes ferment the volatile organic acids to gases (methane, carbon dioxide, etc.). For the system to operate properly, it is essential that all tanks be watertight and have solids removed periodically.

Recirculation Tank

Relatively clear effluent from the mid-level of the watertight primary septic tank enters a filter vault from which it is pumped to a 12,000 gallon recirculation tank. The recirculation tank is sized to equal the estimated peak daily flow, in this case approximately 10,000 gallons, allowing for a one-day hydraulic retention under high flow conditions. The tank inlets are placed so that incoming effluent from the septic tank and return effluent from the recirculating gravel filter (RGF) enter at or near the first riser and away from the pump discharge to the RGF. This allows for the new and return effluent to mix before being pumped onto the filter. Two-effluent turbine

duplex filtered pump systems (duplex pump system) operate intermittently and sequentially 24 hours per day, seven days per week. Each pump is 1/2 HP, 230 Volt, 1 phase, designed for sewage effluent.

Recirculating Gravel Filter (RGF)

The recirculating gravel filter is designed to treat up to approximately 9800 gal/d, with a design average flow rate of 4300 gpd. It has a filter area of 3000 square feet. The RGF consists of one cell and is subdivided into six zones. The two sets of duplex filtered pump systems, in the recirculation tank, alternate and sequentially dose each zone of the RGF with effluent by an automatic multizone valve. The laterals are spaced 2 feet on center (30 total, or 5 per zone). Each lateral contains 1/8" diameter orifices spaced 2 feet on center (25 orifices per lateral). The design residual head (squirt from the orifice) is 5 feet at the most remote orifice, with no more than 10% differential in flow between any two orifices. The flow rate in each zone is approximately 80 gal/min. The recirculation ratio of the effluent is 5:1. The initial setting for the programmable timer, located in the control panel, is to run the set of duplex filtered pumps (pumps) for 1.5 minutes "on" per zone and 1.0 minute "off." Pump(s) 3 & 4 will operate together through the first cycle and pump(s) 5 & 6 will operate through the next, etc. The control panel is designed with remote monitoring, and contains a heater and current sensors to monitor pump operation. See specifications for dual pump, three pump or all pump failure conditions.

Each time the RGF is dosed by the pumps in the recirculation tank, the effluent trickles through the filter media where it is treated by naturally occurring microorganisms that are continuously populating the filter. After passing through the filter media, the treated effluent is collected in a underdrain pipe at the bottom of the filter through which it is conveyed back to a ball float valve, i.e., recirculating splitter valve (RSV), assembly installed and located in the recirculation tank's first riser nearest the inlet to the tank. The RSV is designed and located at a depth to return approximately 80% of the effluent to the tank and 20% of the effluent to the subsurface wetlands during average daily flow period. The RSV will also return

100% of the flow to the recirculation tank in the event the liquid level in the recirculation tank has not reached capacity. If the tank reaches capacity (high effluent level) the RSV shall divert all effluent draining from the RGF to the subsurface wetlands until the effluent level is reduced to open the RSV.

Subsurface Wetlands

A pressure manifold is used to distribute nitrified effluent from the RGF system to the subsurface wetlands treatment system (wetlands). Effluent discharged to the wetlands will be treated under anoxic conditions. To maximize nitrogen removal in the system, all influent ammonium should be converted to nitrite or nitrate prior to treatment in the wetlands. Woodchips and plant biomass (known as vegetated filter bed) are used to simultaneously drive the anoxic conditions and provide the carbon source for the denitrification reaction. While the plants may provide some anecdotal treatment, they form a critical role in cycling carbon through the treatment system. *Thus, living and dead plant matter should never be removed from the system.*

Treatment occurs as the water flows horizontally through the vegetated filter bed. A submerged pipe collects the treated water at the outlet end of the wetlands. A swing pipe is used to control the water level in the wetlands. The water level should be maintained about 4 to 6 inches below the surface of the wood chips at all times to prevent odors and for vector control. The water level should never be dropped such that the plant roots are not at least partially submerged to prevent plant die-off. Effluent from the wetlands flows by gravity for soil dispersal through absorption chamber system as described below.

Soil-Based Effluent Absorption Chamber Field System

The effluent absorption chamber field system is designed to distribute the treated water to infiltration laterals for final polishing treatment in the soil. Distribution boxes have been located, inside risers, at the junction of each lateral in the distribution system with adjustable weirs for flow control to each line. Under ideal conditions

and normal flow conditions, an equal flow of water will be discharged to each infiltration lateral to an absorption chamber.

II. START UP

An engineer from Division of Engineering Services, Water and Wastewater Section (916) 227-8526 and the equipment manufacturer should be at the site during start up to answer questions. **Note that all tanks should be started up full of fresh water for the start up testing and again before the system is put online and never allowed to fill up only with raw sewage.** Only after successfully completing this start up procedure should any wastewater be directed into the system. This procedure should be conducted in advance of opening the facility in case repairs or adjustments need to be made. It is important to take appropriate safety precautions regarding the safe handling of wastewater and equipment used for wastewater treatment.

SEPTIC TANK

The septic tank consists of a 25,000 gal three-compartment fiberglass tank with an effluent duplex filtered pump system in the final compartment. The effluent turbine duplex filtered pump system includes two pumps, filter cartridge, pump vault, discharge pipe assembly, float tree assembly and associated wiring system. The following items should be observed to ensure proper operation of the septic tank system.

A. Leak check

During construction, the septic tank should have been water tested in the ground (per specifications), prior to any backfilling that would have covered any tank penetrations. Prior to start-up, an additional in-place leak test shall be preformed. The pumps shall be manually turned off. The water level shall be brought up above any joint a minimum of two inches into the access riser, so that the inlet, outlet, and riser connections are all proven to be watertight prior to start-up. Confirm that the water level does not change after 24 hours. Should the water level decrease, report the incident to the resident engineer and then perform an investigation to determine the cause. Once the cause of the change in water level is determined report the

findings to the resident engineer. The resident engineer shall give approval to continue with the start up procedures.

After the leak test is completed turn on pumps P1 and P2 and run until the water level is at 3'-6'' below the inner diameter of the top of the tank and the lag pump deenergizes.

B. Septic Tank Pumping System

The septic tank pumps are operated utilizing a programmable logic controller (PLC) in combination with a float tree assembly. The septic tank pumping system has five float switches (floats) with the following functions:

Float Switch (Float) ID	Float Location	Float Function
S1	Top Float (Up position)	"High Effluent" close water shut-off valve sends alarm to maintenance personnel pagers
S4	Second Float (Up position)	Lag pump "On", turns on alarm light, sends alarm to maintenance personnel pagers
S5	Third Float (Down position)	Lag pump "Off"
S2	Fourth Float (Up position)	Energizes the pumps to start cycling (activates timer control)
S3	Bottom Float (Down position)	"Low Effluent", Lead and lag pumps "Off"

1. Simulate normal operation. During normal operation, the bottom float S3 (low effluent) will be in the up position (i.e. "On"). Ensure the float is in the up position prior to checking the system normal operation. Normal cycles start on the half hour.

2. Check the programmable timer settings. The programmable timer should be set to the following design settings. The design cycle starts on the half hour.

Design ON 3.4 minutes

Design OFF 26.6 minutes

Should any situation occur that may require the adjustment or change of any settings, the Division of Engineering Services, Water and Wastewater Branch (916) 227-8526 should be notified of the changes. The setting change shall be recorded in the system diary with the following: the date and time the changes to settings were completed, reason for the change of the settings, the existing settings and the new settings.

3. Check Discharge Pipe Assembly. Fully open the ball valve on the discharge pipe assembly. Ensure the pumps are submerged in effluent before continuing.

4. Check the automatic operation of the alarms. *Prior to testing alarms inform the district you are testing the alarm system.* Check the operation of the first warning of a high effluent level and alarm by raising the S4 (second) float. The alarm light and audible alarm should become activated. If the light does not illuminate, check the lamp for possible damage. Lower the float to deactivate the alarm light and audible alarm. Check for the automatic reset of the alarm by again lifting the float(s) and checking for activation of the alarm light and audible alarms.

Locate the water shutoff valve and ensure the valve is all the way opened. Check the operation of the high level alarm and the potable water shut-off valve by raising the S1 (top) float. The water supply to the comfort station building should be automatically shut-off. Verify the water shutoff valve is in the closed position. After confirming proper operation of the water shut-off valve, return the float to the down position and reset the shut-off valve and pump timer controls by pushing reset buttons in control panel. Caution: When performing this check the water system for the rest area shall be shut off by the valve. This may impact the facility and visitors of the facility, therefore, this test procedure should be performed prior to opening the facility, when the facility is closed for maintenance, or at a time and day when there is a low volume of visitors expected to be present at the rest area. The procedure shall never be performed during a peak use day or prior to a holiday weekend.

If the water shutoff valve does not open and reset, it shall be opened manually. If the water shut off valve can not be opened manually, the manual by-pass shall be opened.

5. Check the manual operation of the pumps. Turn Pump 1 (P1) to manual operation in the control panel. Ensure that the pump is running. Using a loop ammeter, place the loop around the pump cable. The amperage should be in the range as specified by the manufacturer. If the amperage is significantly different than specified, check the connections and cable sizing. Measure the voltage while the pump is running. Record these values in the control panel on the label provided. Repeat for the P2 pump.

Septic Tank Pumping System: Date of Start Up:_____

Voltage Pump #P1:_____ Voltage Pump #P2:_____

Amperage Pump #P1:_____ Amperage Pump #P2:_____

Should any situation occur that may require the adjustment or change of any settings, the Division of Engineering Services, Water and Wastewater Branch (916) 227-8526 should be notified of the changes. The setting change shall be recorded in the system diary with the following: the date and time the changes to settings were completed, reason for the change of the settings, the existing settings and the new settings.

6. Check the automatic operation of the pumps. *Note; This check assumes the effluent level is less than 9" above the top of the filter cartridge.*

- ***a. Check the automatic operation of the lead pumps.*** Switch both pumps to the automatic operation in the control panel and raising the S2 float (fourth) to

energize the lead pump timer. Raising the S2 float activates the timer to start the cycle. The lead pump (P1 or P2 could be the lead pump depending on the cycle) shall energize (turn on) on the half hour and run for 3.4 minutes. When the timer enters the pump "off" cycle, the lead pump will deenergize and the PLC control panel will switch the lag pump to the lead pump. The pumps alternate every 26.6 minutes and run for 3.4 minutes. Observe the complete cycling of the timer (one hour) through a minimum of three cycles and observe that the pumps alternate in the lead pump position and turn on and off with the timer.

b. Check the operation of the High Level Alarm/Lag Pump Enable. Ensure the High Level Alarm and Lag Pump Enable feature of the PLC is set to operate under automatic control mode. Lift up the float S4 and verify that pumps P1 and P2 turn on while under timer control conditions and that the warning of a high effluent level alarm has been activated. Now lower S4 the second float and confirm that normal operations continue.

c. Check the operation of the Lag Pump Disable. Lower the S4 (second) float and S5 (third) float with the PLC in automatic control mode. The S2 and S3 (bottom) floats should be in the up position. The lead pump should continue to run under timer control conditions while the lag pump is turned off.

d. Check the Redundant Off**.** Ensure the Redundant Off feature operates in both manual and automatic operation. Hold the S3 float (bottom) in the upright position and manually turn on both pumps, P1 and P2 using the PLC. Lower the S3 float and verify that both pumps have shut off. Switch the pump controls to automatic and lift the four bottom floats S2, S3, S4 and S5. Wait for the timer to enter its "on" cycle, so that both pumps will be running. Lower the S3 float and verify that both pumps have shut off. Raise S3 and verify system resumes normal operations.

e. Check the Water Shut-Off Valve. *Prior to testing alarms inform the district you are testing the alarm system.* Ensure the S1 (top) float closes the automatic shut off valve that controls the water supply for the facility. In the event of a system failure that progresses until wastewater is going to overflow from the septic tank, the S1 float will shut-off the water supply and, therefore, the influent wastewater. To test the Water Shut-Off Valve operation, raise the S1 float and confirm that the water supply to the comfort station has been turned off. To turn the water supply back on, lower the float and press the reset button on the control panel. See Item 4 for more information on the water supply shut off valve functions and caution.

7. Check for easy removal of components for maintenance. *Prior to testing alarms or performing maintenance that may activate an alarm, inform the district you are testing the alarm system.* The ability to easily remove the pump vault for maintenance is essential and depends upon proper installation. To be certain that correct installation has been achieved and to avoid future maintenance problems, exercise the removal process described as follows (steps a-j).

WARNING! IMPORTANT! Before doing any work on either the wiring to the level control floats and pump or in the PLC, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions and red tag/lock out.

a. Remove access riser cover from the septic tank that encloses the effluent turbine duplex filtered pump system (pumps) for P1 and P2

b. Completely close the ball valve on the pump discharge assembly and disconnect the PVC union located next to the ball valve.

c. Remove each pump and set it aside on the access riser cover or on a piece of plastic film to protect it from mud or sand. The pump's electrical cord need not be disconnected.

d. Remove the float tree assembly from the pump vault and lay it aside.

e. Pull the pump vault out of the tank. There should be ample clearance between the ball valve and the splice box to allow unhindered removal of the vault.

f. Once vault removal is demonstrated, replace the float tree assembly into the vault and lower the vault into the tank. Caution: When replacing the float tree assembly be careful to ensure the floats do not change elevations. To prevent the vault from floating, run clear water (from a hose protected against cross contamination of the water supply) into the vault to sink it. Replace pumps and reconnect plumbing.

g. Open the ball valve completely.

h. Replace access riser lid.

i. Reset circuit breakers to “ON” and switch on the power to the system at the service entrance panel.

j. Observe the discharge assembly for leaks once the pumps go on.

C. Appurtenances

Items associated with the septic tank that require checking prior to start-up, include the internal sanitary tees, air vents with carbon filters, and security of riser lids.

1. Sanitary Tees. The cross-overs and inlet piping should be secure and free from movement. Check that water is able to move freely between the compartments.

2. Air Vents With Carbon Filters. Check that the carbon filters are installed, contain activated carbon packing, and are able to filter gases from the septic tank. Check for odors. Odor may indicate a defective/faulty or exhausted filter.

3. Riser Lids. Check that all lids are securely bolted down. CAUTION! The tank access lid must be properly secured to the riser at all times. If bolts are lost or damaged, contact manufacturer immediately for replacements. AN UNLOCKED LID OR OPEN TANK ACCESS IS A SAFETY HAZARD!

RECIRCULATION TANK

The recirculation tank consists of a 12,000 gal, two-compartment fiberglass tank with effluent turbine duplex filtered pump systems. The first compartment has two sets of effluent turbine duplex filtered pump systems for dosing the gravel filter and operates on a continuous, 30 minute cycle, timed dose, control system. The second compartment has one effluent turbine duplex filtered pump system for discharging effluent to the wetland system and operates on a flow level, float switch driven control system. The following items should be observed to ensure proper operation of the recirculation tank system.

A. Leak check

The recirculation tank should have been water tested during installation. An additional leak test should be performed prior to start-up. In this test, the water level is brought up two inches into the access riser, so that the inlet, outlet, and riser connections are all proven to be watertight prior to start-up. If risers have joints between sections, they also must be tested for watertight integrity. Confirm that the water level does not change after 24 hours. If there is a change in the water level, the cause must be determined and repaired prior to start up.

B. Recirculation Tank Dosing Pump System

The recirculation tank dosing pumps, located in the first compartment, consist of two sets of effluent duplex filtered pumps and are operated with a programmable control panel and float tree assemblies. The pumps are designated in the first set, P3 & P4, and the second set, P5 & P6, for duplex pump sets 1 and 2, respectively. The recirculation tank dosing pump system has six floats with the following functions:

Float Switch (Float) ID	Float Location	Float Function
R1	Top Float (Up position)	"High Effluent" close water shut-off valve, shuts off P1 and P2 in septic tank and sends alarm to maintenance personnel pagers
R3	Second Float (Up position)	Lag pump "On", turns on alarm light, sends alarm to maintenance personnel pagers
R2	Third Float (Down position)	Lag pump "Off"
R4	Fourth Float (Up position)	Energizes the pumps to start cycling (activates timer control)
R5	Bottom Float (Down position)	"Low Effluent", Lead and lag pumps "Off"

1. Simulate normal operation. During normal operation, the bottom (R5) float will be in the up position. Ensure the float is in the up position prior to checking the normal operation of the system.

2. Check the programmable timer settings. The programmable timer is set to the following design settings. The design settings are listed below.
The first set of duplex pumps shall start 5.4 minutes after the half hour.
The dosing timing for the pumps are

Design ON 1.5 minutes
Design OFF 1.0 minutes

The total pump run time per cycle is 9 minutes. The total time to dose all six zones is 14 minutes. A complete cycle, starting on the half hour, from the septic tank, to the recirculation tank, dose all six zones and the automatic multizone valve returns to zone 1 takes 19.4 minutes. After the automatic multizone valve returns to zone 1, the alternate set of duplex pumps will start 16 minutes later or 5.4 minutes after the half hour.

Should any situation occur that may require the adjustment or change of any settings, the Division of Engineering Services, Water and Wastewater Branch (916) 227-8526 should be notified of the changes. The setting change shall be recorded in the system diary with the following: the date and time the changes to settings were completed, reason for the change of the settings, the existing settings and the new settings.

3. Check Discharge Pipe Assembly Fully open the ball valve on the discharge pipe assembly. Ensure the pumps are submerged in effluent before continuing.

4. Check the automatic operation of the alarms. *Prior to testing alarms inform the district you are testing the alarm system.* Check the operation of the High Level Alarm by raising the R3 (second) float. The alarm light and audible alarm should become activated. If the alarm light does not illuminate, check the lamp for possible damage. Lower the float and reset the alarm light and audible alarm. Check for the automatic reset of the alarm by again lifting the float and checking for activation of the alarm light and audible alarms.

Check the operation of the potable water shut-off valve by raising the R1 (top) float. The water supply to the facility should automatically shut-off. In addition, pumps P1 and P2 in the septic tank should be disabled. With the R1 float raised, switch pumps P1 and P2 to manual control and confirm that they have been disabled. After confirming proper operation of the water shut-off valve and pump disable, return the R1 float to the down position and reset the shut-off valve and pump timer controls

located in the control panel(s). *See II. B. Septic tank, Item 4, for water shut-off valve for more information.*

5. Check the manual operation of the pumps. Turn Pump P3 to manual operation in the control panel. Ensure that the pump is now running. Using a loop ammeter, place the loop around the pump cable. The amperage should be in the range as specified by the manufacturer. If the amperage is significantly different than specified, check the connections and cable sizing. Measure the voltage while the pump is running. Record these values in the control panel on the label provided. Repeat for pumps P4, P5, and P6.

Recirculation Tank Dosing Pump System: Date of Start Up:_____

Voltage Pump #P3:_____ Amperage Pump #P3:_____

Voltage Pump #P4:_____ Amperage Pump #P4:_____

Voltage Pump #P5:_____ Amperage Pump #P5:_____

Voltage Pump #P6:_____ Amperage Pump #P6:_____

6. Check the automatic operation of the pumps.

a. Check the automatic operation of the lead pumps. Switch both sets of duplex pumps to the automatic operation in the control panel and raising the R4 float (fourth) to energize the lead pump. Raising the R4 float activates the timer start cycle. The lead set of duplex pumps (note that either P3 & P4 or P5 & P6 could be the lead set of duplex pumps). As the timer completes a full cycle after dosing all six zones, the pumps will enter an “off” cycle and the lead pumps will stop. Observe the complete cycling of the timer through a

minimum of three complete cycles (1.5 hours) and observe that the pumps alternate in the lead pump position and turn on and off with the timer.

b. Check the operation of the High Level Alarm/Timer Override. *Prior to testing alarms inform the district you are testing the alarm system.* Ensure the High Level Alarm and Timer Override feature of the PLC is set to operate under automatic control mode. Lift up R3 float and verify the pump run time is as follows:

Design ON 1.5 minutes

Design OFF 1.0 minutes

After the timer override is triggered, the lead pumps will complete the dosing cycle and shut off (deenergize). Thirty seconds after the lead pumps shut off the lag pumps will start pumping and complete a dosing cycle until all six zones are dosed. Both sets of pumps shall complete one cycle in a 30 minute period. The next half hour, or 5.4 minutes, the lead pumps shall energize and complete a cycle. If the effluent level has lowered the float switch R3, and shut off the programmed override function, the system shall return to normal operation on the half hour cycle.

Lift up R2, R3, and R4 floats and verify that both the duplex pump systems turn on while controlled by the timer, run for the specified time and cycle before turning off. Complete 2-30 minute cycles with both pumps completing a cycle within a half hour. Verify that the light and audio warning for high level Alarm has been activated. Ensure the alternating switch is operating correctly and that the sets of duplex pumps are in an alternating configuration under high flow conditions.

Should any situation occur that may require the adjustment or change of any settings, the Division of Engineering Services, Water and Wastewater Branch (916) 227-8526 should be notified of the changes. The setting change shall

be recorded in the system diary with the following: the date and time the changes to settings were completed, reason for the change of the settings, the existing settings and the new settings.

c. Check the Redundant Off/Low Level Alarm. There are two floats located at the position R5, one for each set of duplex pumps. Prior to performing this check ensure the system is in normal operation and the effluent level is not below the setting of the R5 (bottom) float switch. Ensure Redundant Off/Low Effluent Level Alarm feature operates in both manual and automatic operation. Hold the R5 float (bottom) associated with the first set of duplex pumps to the upright position and manually turn on P3 and P4 (the first set of duplex pumps) using the PLC. Lower the R5 float and verify that both pumps have shut off and that the Low Level Alarm has been activated. Raise R5 to resume normal operations. After normal operations start, repeat for the P5 and P6 (the second set of duplex pumps) and their corresponding R5 float.

d. Check the Water Shut-Off Valve. Prior to performing this check, see Section II. B. Item 4. Ensure the float R1 closes the Water Shut-Off Valve that controls the water supply for the facility. In the event of a system failure that progresses until wastewater is going to overflow from the recirculation tank, the R1 float (top) will shut-off the water supply and, therefore, the influent wastewater. To test the Water Shut-Off Valve, raise the R1 float and confirm that the water supply to the facility has been turned off. Verify pump operations (P3, P4, P5 and P6) continue normal operations. Verify Pumps P1 and P2 are shut off and the water shut-off valve has closed. Lower floats R2 and R3 and raise float R4 (fourth) to confirm that normal operations do not start. Reset Pumps P1 and P2 and the water shutoff valve. Raise float R4 (fourth) and confirm the system returns to normal operations by observing two half hour cycles. Confirm the water shut-off valve opens and all alarms are off.

7. Check for easy removal of components for maintenance. The ability to easily remove the pump vault for maintenance is essential and depends on proper installation. To be certain that correct installation has been achieved and to avoid future maintenance problems, exercise the removal process described as follows (steps a-j) for both sets of duplex pumps.

IMPORTANT! Before doing any work on either the wiring to the level control floats, pump or in the PLC, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions and red tag/lock out.

a. Removing the access riser covers over the filter dosing pump systems.

b. Completely close the ball valves on the pump discharge assemblies and disconnect the PVC unions located next to the ball valves.

c. Remove each pump from its sleeve, setting it aside on the access riser cover or on a piece of plastic film to protect it from mud or sand. The pump's electrical cord need not be disconnected.

d. Remove the float tree assembly from the vault and lay it aside.

e. Pull the pump vaults out of the tank. There should be ample clearance between the ball valve and the splice box to allow unhindered removal of the vault.

f. Once the vault removal is demonstrated, replace the float assembly into the vault, and lower the vault into the tank. To prevent the vault from floating, run clear water (from a hose protected against cross contamination of the water supply, hose bib) into the vault to sink it. Replace pumps and reconnect plumbing.

g. Open the ball valves completely.

h. Replace access riser lids.

i. Reset circuit breakers to “ON” and switch on the power to the system at the service entrance panel.

j. Observe the discharge assembly for leaks once the pumps go on.

C. Recirculation Tank Effluent Pumping System (To Subsurface Wetlands)

The recirculation tank effluent pumps are operated with a programmable control panel and float assembly. The recirculation tank pumping system has six floats with the following functions:

Float Switch (Float) ID	Float Location	Float Function
W1	Top Float (Up position)	"High Effluent" close water shut-off valve, shuts off P1 and P2 in septic tank and sends alarm to state personnel pagers
W4	Second Float (Up position)	Lag pump "On", Alarm light and sends alarm to state personnel
W5	Third Float (Down position)	Lag pump "Off"
W2	Fourth Float (Up position)	Lead pump "On"
W3	Fifth Float (Down position)	Lead pump "Off"
W6	Bottom Float (Down position)	"Low Effluent", Lead and lag pump "Off", Alarm light and sends alarm to state personnel

1. Simulate normal operation. During normal operation, the W6 float (bottom) will be in the up position. Verify W6 float is in the up position to simulate normal operation.

2. Check the automatic operation of the alarms. Check the operation of the warning High Effluent Level Alarm by raising the W4 (second) float. The alarm light and audible alarm should become activated. If the alarm light does not illuminate, check the lamp for possible damage. Lower the float to reset the alarm light and audible alarm. Check for the reset of the alarm by again lifting the float and checking for activation of the alarm light and audible alarms.

Check the operation of the potable water shut-off valve by raising the W1 (top) float. The water supply to the facility should automatically shut-off. In addition, pumps P1 and P2 in the septic tank should be disabled. With the W1 float raised, switch pumps P1 and P2 to manual control and confirm that they have been disabled. After confirming proper operation of the water shut-off valve and pump disable, return the W1 float to the down position and reset the shut-off valve and pump timer controls located in the control panel(s). *See II. B. Septic tank, Item 4, for water shut-off valve for more information.*

3. Check the manual operation of the pumps. Turn P7 Pump to manual operation in the PLC. Ensure that the pump is now running. Using a loop ammeter, place the loop around the pump cable. The amperage should be in the range as specified by the manufacturer. If the amperage is significantly different than specified, check the connections and cable sizing. Measure the voltage while the pump is running. Record these values in the control panel on the label provided. Repeat for the P8 pump.

Recirculation Tank Effluent Pumping System: Date of Start Up_____

Voltage Pump #P7:_____ Voltage Pump #P8:_____

Amperage Pump #P7:_____ Amperage Pump #P8:_____

4. Check the automatic operation of the pumps. Caution: Prior to testing these pumps ensure there is a minimum of 14 inches of effluent above the filter cartridge.

a. Check the automatic operation of the lead pumps by switching both pumps to the automatic operation in the PLC and raising the W2 float (fourth) to energize the lead pump. Lower W2 float and observe the pump is shut off. Wait 2 minutes and raise W2, the other pump should energize. Observe that the pumps alternate in the lead pump position and turn on and off.

b. Check the operation of the High Level Alarm/Lag Pump Enable. *Prior to testing alarms inform the district you are testing the alarm system.* Ensure the High Level Alarm and Lag Pump Enable feature of the PLC is set to operate under automatic control mode. Lift up the W4 (second) float and verify that both pumps are on and the high water warning alarm has been activated.

c. Check the operation of the Lag Pump Disable. Lower the W4 (second) and W5 (third) floats with the system in automatic control mode and the W2, W3, and W6 floats in the up position.. The lead pump should continue to run while the lag pump is turned off.

d. Check the Redundant Off/Low Level Alarm. Ensure the Redundant Off/Low Level Alarm feature operates in both manual and automatic operation. Raise the W6 (bottom) float in the up position and manually turn on both pump, P7 and P8 using the PLC. Lower the W6 float and verify that both pumps have shut off and that the Low Level Alarm has activated (both audio and visual alarms). Switch the pump controls to automatic control and lift the four bottom floats W5, W4, W2, W3 and W6. Verify both pumps are running.

e. Check the Water Shut-Off Valve. Ensure the W1 float closes the automatic water shut off valve that controls the water supply for the facility. In the event of a system failure that progresses until wastewater is going to overflow from the recirculation tank, the W1 float will shut-off the water supply and, therefore, the influent wastewater. To test the Water Shut-Off Valve, raise the W1 (upper) float and confirm that the water supply to the facility has been turned off. To turn the water supply back on, lower the float and press the reset button on the control panel.

5. Check for easy removal of components for maintenance. The ability to easily remove the pump vault for maintenance is essential and depends upon careful installation in accordance with the preceding instructions. To be certain that correct installation has been achieved and to avoid future maintenance problems, exercise the removal process described as follows (steps a-j).

*IMPORTANT! Before doing any work on either the wiring to the level control floats and pump or in the pump PLC, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions and red tag/lock out.***.**

a. Remove access riser cover from the recirculation tank that enclose the duplex pumps P7 and P8.

b. Completely close the ball valve on the pump discharge assembly and disconnect the PVC union located next to the ball valve.

c. Remove each pump from its sleeve, setting it aside on the access riser cover or on a piece of plastic film to protect it from mud or sand. The pump's electrical cord need not be disconnected.

d. Remove the float tree assembly from the vault and lay it aside.

e. Pull the pump vault out of the tank. There should be ample clearance between the ball valve and the splice box to allow unhindered removal of the vault.

f. Once the vault removal is demonstrated, replace the float tree assembly into the vault and lower the vault into the tank. To prevent the vault from floating, run clear water (from a hose protected against cross contamination of the water supply) into the vault to sink it. Replace pumps and reconnect plumbing.

g. Open the ball valve completely.

h. Replace access riser lid.

i. Reset circuit breakers to "ON" and switch on the power to the system at the service entrance panel.

j. Observe the discharge assembly for leaks once the pumps go on.

D. Appurtenances

A number of items associated with the septic tank checked prior to start-up, including the internal sanitary tees, air vent with carbon filters, and security of riser lids.

1. Ball Float Valve. The ball float valve is located in the access riser closest to the recirculation tank influent inlet. It should work automatically and be open (unseated) during average daily flow and closed when the wastewater level (or peak flow) is 6 feet above the bottom of the recirculation tank. Check that the float seats properly and the ball is free from defects and moves freely in the cage. Remove the valve and rinse off with a brush and water and reinstall.

2. Air Vent With Carbon filters. Check that the carbon filters are installed and contain activated carbon packing. If odor is present replace the filter.

3. Check that all lids are securely bolted down. CAUTION! The tank access lid must be properly secured to the riser at all times. If bolts are lost or damaged, contact manufacturer immediately for replacements. AN UNLOCKED LID OR OPEN TANK ACCESS IS A SAFETY HAZARD!

4. Flow meter. Check the operation of the effluent flow meter located in the valve box near the outlet of the recirculation tank by observing the dials moving when effluent is pumped through the device. Record the volume reading of the flow meter at the time of start up. Check the water meter and record the volume.

Date:_____ Effluent Flow Meter reading:_____

Water Supply Flow Meter reading:_____

RECIRCULATING GRAVEL FILTER

The recirculating gravel filter (RGF) consists of a bed of uniform sand media, lining, distribution, system automatic multizone valve, observation wells, and drainage system. It provides biological pre-treatment to the septic tank effluent prior to treatment in the constructed wetland.

A. RGF Distribution System

Pumps P3, P4, P5 and P6 supply effluent to the RGF distributing system. The RGF distribution system consist of 2 inch PVC force main, automatic multizone valve, 1-1/2 inch PVC zone distribution lines, 1 inch perforated PVC effluent application pipe, cleanouts, and slotted orifice shields. There are 6 zones for effluent application in the RGF.

Ensure all components of the RGF distribution system are free of all foreign materials and debris prior to performing startup tests. (Caution: sand, gravel or foreign objects may damage the distribution valve.)

Open all cleanouts on all zones and toggle pumps through each zone to flush pipes.. After flushing all pipes, close cleanouts to prepare for distribution system pressure testing.

To test system pressure, a pressure gauge can be threaded into the cleanout port for direct reading of system pressure. Alternately, system pressure can be determined indirectly by observation of squirt height. To determine squirt height, uncover and remove the slotted orifice shield form the last two orifices of each lateral on each zone of the distribution system. In the PLC, set the first set of duplex pumps P3 and P4 to manual control. Toggle the pumping system until Zone 1 of the recirculating sand filter has been pressurized. Pump 1 should engage and pressurize the first zone. Measure the height of squirt on the sand filter manifold at Zone 1 and record below. Repeat the procedure above to test and record squirt height values for all remaining zone by toggling the first set of duplex pumps to advance to each zone. Repeat the procedure again for the second set of duplex pumps P5 and P6. Record all vales below. Following measurement of system pressure, replace gravel and covers over orifices, if needed, and replace covers on clean-out boxes.

Note: These values will be used in the future to determine clogged orifices, so measure and record carefully.

Date of Start up:_____

P3&P4 Pressure Zone #1:_____ P3&P4 Pressure Zone #2:_____

P5&P6 Pressure Zone #1:_____ P5&P6 Pressure Zone #2:_____

P3&P4 Pressure Zone #3:_____ P3&P4 Pressure Zone #4:_____

P5&P6 Pressure Zone #3:_____ P5&P6 Pressure Zone #4:_____

P3&P4 Pressure Zone #5:_____ P3&P4 Pressure Zone #6:_____

P5&P6 Pressure Zone #5:_____ P5&P6 Pressure Zone #6:_____

B. Automatic Multizone Valve

Run pumps P3 thru P6 and ensure the Automatic Multizone valve cycles through each port. In the event of valve malfunction refer to the manufacturers trouble shooting manual. Replace covers on valve box containing distribution valve.

IMPORTANT! After testing and recording, be sure to return the pump controls to AUTOMATIC operation of the system.

SUBSURFACE WETLANDS

The subsurface wetlands consists of a PVC force main, a liner, wood chip media, plants, drain line, cleanouts, and water level control box. The systems is designed for the removal of residual nitrogen following the RGF. It is designed to work for a period of time while the plants are being established, but long-term performance requires sequential plant growth and cessation.

A. Plant establishment.

Confirm that plants have been planted according to specifications and they show new growth after 2 weeks. Living and dead plant material should never be removed from the wetland system as this material is required for nitrogen removal. Plants can be transplanted to dense growth areas to sparse areas to obtain uniform plant cover.

B. Adjust water level.

Ensure water level in the subsurface wetlands is approximately 3 to 6 in. below surface of woodchip (after plants are established). Adjust water level in the subsurface wetlands by rotating pipes, in the water level control box that correspond to each subsurface wetlands, until the desired water level is achieved. Confirm that the woodchip surface is even and that there are no areas of exposed water surface. Replace and secure grating/cover on water level control structure

C. Check clean outs on inlet and outlet piping.

Ensure inlet and outlet pipes are free of debris. Replace the cleanout covers.

SOIL BASED EFFLUENT ABSORPTION CHAMBER FIELD SYSTEM

The Soil-Based Effluent Absorption Chamber Field System consists of drain pipe, risers, distribution boxes, absorption chambers, and monitoring wells.

A. Adjust distribution boxes.

Remove lids from risers over distribution boxes and adjust weirs such that the following conditions are achieved when water is flowing into the first (of five total) distribution box. A garden hose with a flowrate of 5 gal/min into the first box will simulate the influent flow.

Box 1 bypass 80% of influent flow

Box 2 bypass 75% of influent flow

Box 3 bypass 66% of influent flow

Box 4 bypass 50% of influent flow

The flow that is not bypassed (sent to the next box in series) should be divided evenly to flow equally to each of the four attached adsorption chambers. Adjustable

weirs should be placed over the ends of each pipe in the distribution box and adjusted to obtain the desired flow splitting. Replace covers on distribution boxes.

B. Check monitoring well covers.

Ensure monitoring well covers are removable. Replace and secure covers after verification. Record Effluent levels in the monitoring wells in system diary.

III. OPERATION AND MAINTENANCE

Operation and maintenance activities are essential to the successful long-term performance of this Onsite Wastewater Treatment System. The following list is provided as a guide to O&M activities, however, if any problems are observed at any time, Division of Engineering Services, Water and Wastewater Section (916) 227-8526, should be notified immediately.

RECORD KEEPING

Maintain a written diary describing all activities relating to the Onsite Wastewater Treatment System. Once a month, send copies of the diary, by mail, fax or electronic transmission, to Department of Transportation, Division of Engineering Services, Water and Wastewater Section, 1801 30th St. MS 9-3/11H, . To submit copies of the reports by fax or electronic transmission, contact the Division at (916) 227-8526. This information is very valuable for analysis and trouble shooting if problems should occur.

ROUTINE MAINTENANCE

The routine maintenance procedures are outlined below. Specific maintenance activities are described in the following section.

A. Every Day.

Once a day, during the first year of operation,

- Record values from all flow meters, including water supply well, RO system, and wastewater treatment system.

B. Every Week.

Once a week, during the first year of operation,

- Perform water quality testing as listed in Section IV for weekly samples.

C. Every Month.

Once a month, during the first year of operation,

- Perform water quality testing listed in Section IV for monthly samples. Use a testing laboratory that is certified by the California Department of Public Health. In general, samples shall be collected and delivered to the lab in accordance with their directions. A copy of all lab results obtained shall be sent to, the Department of Transportation, Division of Engineering Services, Water and Wastewater Section, 1801 30th Street, MS 9-3/11H, Sacramento, CA 95814. To submit copies of the reports by fax or electronic transmission, contact the Division at (916) 227-8526.

  Measure scum and sludge and water level in septic tank's first and second compartments.
- Check the pump run times and event counters for all pumps once a month. The pumps in each treatment component should run approximately the same number of hours and turn on the same number of times. If the run and/or cycle times differ significantly between pumps, note the incident in the diary and perform and investigation as to the possible cause of the discrepancy. Once the possible causes are determined notify the Water and Wastewater Section at (916) 227-8526 prior to taking corrective measures.
- Check that the automatic multizone valve is working correctly and providing proportional flow distribution. Observe pressure in distribution system using pressure gauge or uncover one orifice in each zone. Manually operate the pumps through 3 cycles and ensure that the automatic multizone valve is operating properly by observing that the pressure or effluent squirt height corresponds to the recorded startup testing from each successive zone orifice.
- Remove weeds from the Recirculating Gravel Filter.
- Recirculating Pumps Visual inspection of pump controls, pump and pressures.
- Automatic Distribution Valve(s) Inspect monthly for even distribution of flow to each zone.
- Check the Recirculating Ball Float Valve monthly for proper seating. Clean if necessary.

- Visually inspect the Subsurface Wetlands water level, plant condition, and general system health. Raise and Lower levels in cells monthly during months of May, June, July, August, and September. Water may surface in the wetlands if they are hydraulically overloaded, the packing has decayed, or the water level control stand pipe is out of adjustment. If water is surfacing, add additional woodchip packing or lower the water level by rotating stand pipe.

D. Every Three Months (Quarterly).

- Conduct monthly maintenance activities.
- Check the effluent filters in the septic tank and recirculating tank and clean when necessary. To determine whether the effluent filter needs cleaning, test the change in the tank's liquid level when the pump is on. To do this, while watching the liquid level inside the screened vault, Manually turn the pump on at the PLC for approximately 30 seconds. If there is any noticeable liquid level difference between the inside of the screened vault and the tank liquid level (about 2-inches), the filter cartridge shall be cleaned. Never leave the access lid to the tank open, as someone may fall into the tank. Cleaning instructions are provided in section **SPECIFIC MAINTENANCE ACTIVITIES**.
- Measure the pressure in each zone of the gravel filter distribution system using squirt height or using a pressure gauge.
- Subsurface Wetlands Check slopes and berms for erosion, inspect liner for wear or tears and repair as needed, remove heavy weed or grass growth. Check for water surfacing, fill low spots with woodchips. Areas that are bare of plant growth should be filled in by transplanting rhizome material from dense plant areas.
- Check the Dosing Pumps for the Recirculating Gravel Filter. Record pressure from pressure gauge on pumps. If inconsistent, check squirt height of last orifice in line or pressure gauge.
- Check the solids accumulation in the three compartment of the septic tank using a plastic pipe or other approved solids measuring device. The septic tank has three layers of liquid: a grease/scum layer at the top, a clear water layer, and a

layer of sludge at the bottom. The top and bottom layers should not occupy more than 1/3 of the total depth as determined using the plastic pipe. If either of these two layers are greater than 1/3 of the total depth, the tank(s) should be pumped. Notify the District contact that the tank(s) require to pumping out and note it in the system diary.

- Clear any obstructions around float switches and check the operation of the pumps. NOTE: This tank is considered a confined space and all OSHA guidelines for entering a confined space must be followed.

E. Every Six Months.

- Conduct the monthly and quarterly maintenance activities.
- Check the pressure in the distribution system directly with a pressure gauge of inspect the squirt height of the laterals in the Recirculating Gravel Filter. To inspect squirt height, uncover and remove a few orifice shields in each zone. Observe and measure the squirt height in each zone. Refer back to section **II. Start Up** for initial measurements of squirt height. If the observed pressure (or squirt height) exceeds the initial pressure (or squirt height) by more than 15-20%, it can be assumed that a significant number of orifices are plugged and the laterals require flushing and/or cleaning. If the orifices are substantially plugged after six months, then it may be prudent to inspect the system pressure every three months and adjust scheduled testing and flushing of the laterals accordingly.

F. Every Year.

- Conduct the monthly, quarterly, and semi-annual maintenance.
- Flush the laterals. Laterals should be inspected every six months and cleaned at that time if necessary. However, the laterals should be flushed at least once per year regardless of the inspected squirt heights.
- Replace carbon filter cartridges if odors are present
- Send copies of the complete activity diary to Water and Wastewater staff in the Division of Engineering Services, 1801 30th Street, Sacramento, CA 95814,

(916) 227-8526. This information is very valuable for analysis and trouble shooting if problems should occur.

SPECIFIC MAINTENANCE ACTIVITIES

Contained in this section are specific maintenance procedures that may need to be conducted on a regular basis, however, some of the procedures listed below will only need to be applied infrequently or in the event of equipment failure.

1. Cleaning the effluent filter in the pump vault.

Prior to testing alarms or performing maintenance that may activate an alarm, inform the district you are testing the alarm system. It is essential that the effluent filter is cleaned regularly in order for the onsite wastewater treatment system to operate properly and to prevent alarm conditions.

a. Disable power to the pump by switching controls to the “Off” position, and opening the pump control circuit breaker(s) and the control circuit breaker and red tag/lock-out. All of these switches are located inside the pump control panel.

b. Ensure the ball valve on the discharge assembly is completely closed. If necessary, disconnect the union to allow removal of the filter. The float assembly may need to be removed.

c. Slide the filter cartridge out of the vault and hold it over the open access riser on the first chamber of the septic tank, or in the case of the recirculation tank its first chamber. Carefully spray the buildup that has formed on the cartridge tubes back into the tank. Important: After cleaning the filter cartridge, inspect the pump vault, pump, and float tree assembly. If any further maintenance is required, complete other maintenance before replacing the filter cartridge.

d. Slide the cartridge back into the vault. Make sure to open the ball valve. The vault does not normally need to be removed for basic cartridge cleaning. However, when pumping the tank, also inspect and clean the vault (See Step 3).

e. Slide the cleaned cartridge into the vault. Attach the float tree assembly onto the cartridge. Return the vault into the tank and gently lower the pump into the vault. Important: To prevent the vault from floating and the cartridge from being fouled by solids floating in the tank, it is essential to run clear water (as from a hose that is protected from cross contamination) into the vault to sink it. If the pump chamber has been pumped, refill the tank with clean water to the system's normal operating level.

f. Connect the union and make sure the ball valve is open.

g. Record that you have cleaned the cartridge in the system diary. Also record any observations that you made regarding the tank or system in general.

h. Return power to the system.

2. Pumping the Tank

Prior to tank pumping the following must be completed:

a. Remove the effluent filter and pump vault (see Step 3). Otherwise the scum mat on top is drawn past the inlet ports and can cause future clogging problems.

b. Pump tank contents.

c. Replace pump vault and effluent filter (Step 3).

d. Refill tank with water to a level above the inlet ports after pumping and before introducing new sewage into the tank.

3. Vault Removal and Cleaning

The pump vault may need to be removed for operation and maintenance activities on the septic and recirculation tanks.

a. Remove and clean effluent filter as described in Step 2.

b. Disconnect and pull the pumps out.

c. Slowly lift the pump vault out of the tank, allowing the effluent in the vault to empty out the drain flap. Any solids should be dumped back onto the first compartment of the septic tank.

d. To replace pump vault, slide the cleaned cartridge into the vault. Attach the float tree assembly onto the cartridge. Return the vault into the tank and gently lower the pump into the vault. Important: To prevent the vault from floating and the cartridge from being fouled by solids floating in the tank, it is essential to run clear water (as from a hose that is protected from cross contamination) into the vault to sink it. If the pump chamber has been pumped, refill the tank with clean water to the system's normal operating level.

e. Connect the union and make sure the ball valve is open.

f. Record all maintenance activities in the system diary. Also record any observations that you made regarding the tank or system in general.

g. Return power to the system.

4. Alarms

Alarms are displayed by a red light and an audio sound. The alarms are used to monitor pumps and the tank conditions in both the septic tank and the recirculating

tank. Alarm conditions occur under the following situations: (a) High water shut off, (b) High water level, (c) Low water level, and (d) Pump Failure. Note: Audio alarms are silenced by pushing the red light at the PLC.

When responding to an alarm, first discern whether a high- or low-level condition has caused the alarm. If it is due to pump failure (as indicated by a light on the recirculation panel), test each pump manually and locate the failed pump. To replace the pump, see **8. Removing & Replacing Inoperative Pumps**. Remove the access riser lid and visually inspect the liquid level. If the high water shut off has caused the alarm, follow the procedure described below to diagnose/repair the problem and then refer to **7. High Water Shut-off Valve.** If the high liquid level has caused the alarm, follow the ensuing procedures. If a low liquid level caused the condition, see **6. Low Liquid Level Alarm**.

When a high liquid level condition exists, the source of the problem is likely one of the following:

a. When a high liquid level is present, first check the circuit breakers, switches, and fuses in the system control panel. If separate breakers in the main panel were used for the pumps and controls, also check these breakers. If a breaker is found to be tripped reset the breaker and observe the operation for continuous tripping. If tripping does not recur, then the problem has likely been found or corrected itself. Test the automatic function of the system as shown in the **Start Up & Operation** section of this manual to verify proper operation.

b. If, after checking the circuit breakers, fuses, and switches, the pump still does not operate, move the switch to manual operation. If the pump engages, the problem is likely in the float system. If the motor contactor engages, but the pump doesn't run, go to Step f. Pump the tank down to a level below the “Override Timer On/Off” float. Cycle the pump to simulate the timer on and off periods so that the effluent is dosed to different zones of the RGF. Return the

switch to automatic operation. Do not leave a pump in the manual operation position unattended. If you do, the "Redundant Off/Low Level Alarm" float should turn off the pump and sound a low-level alarm. However, in the event of a "Redundant Off" float failure, the pump can continue to operate without liquid, possibly drawing solids to the filter and causing potential failure problems.

c. Isolate the float switches and check to ensure all floats are operating properly. If a float is found to be faulty, refer to the section entitled **7. Removing & Replacing Inoperative Floats**.

d. Check pumps for discharge flow. Close the ball valve, disconnect the union in the discharge plumbing assembly and turn the union so that it is facing down. Engage the pump and visually inspect the approximate flow rate being discharged. If you are unsure of the discharge rate, measure the time it takes to fill a five-gallon bucket with the discharge. Check this value against the appropriate pump curve. If the flow rate is insufficient, the pump may need to be cleaned.

e. If the pump operates in the proper flow range, check all downstream valves to ensure that they are in the open position. If the valves are all open, test the discharge pressure of the pump.

f. Check the panel to verify that the motor contactor engages. If it engages, but the pump doesn't operate, then it is either a pump failure or a bad electrical connection.

IMPORTANT! Before doing any work on either the wiring to the level control floats and pump or in the pump control panel, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions.

g. Remove the access riser lid and the stainless steel screws from the splice box lid, being careful not to drop the screws into the tank. If the splice box was submerged, or if there is a crack in the conduit, there may be water in the splice box. If this is the case, remove the water with a syringe or other appropriate method. Carefully check the splices to ensure that they are intact and remain watertight. If all splices are found to be watertight, replace the splice box lid. In the control panel, carefully tug on each wire going to the splice box. Correct any wires that are loose. Reactivate and retest the system.

h. If the system operates but can't keep up with the flow, check the system for watertight integrity. A leaking tank can infiltrate enough water to overcome the pump. Also check for leaking fixtures in the home, though it is unlikely that a leaky fixture could provide enough liquid to overcome the pump.

5. Low Liquid Level Alarm

When a low liquid level condition exists, the source of the problem is likely one of three things:

a. The "Pumps Off" float has failed in the closed position. If the liquid level is at the "Redundant Off/Low Level Alarm", it is possible that the "Pumps Off" float has failed with the circuit closed or there is a loose electrical connection. To check this, lift the "Redundant Off/Low Level Alarm" float. If the pump immediately engages, check the electrical connections for the "Pumps Off" float. If the connections are found to be adequate, check for proper operation of the float switch. Replace if faulty (See **7. Removing & Replacing Inoperative Floats**). If the pump doesn't engage when raising the "Redundant Off/Low Level Alarm" float, go to Step 2.

b. The tank may be siphoning. Inspect the liquid level in the tank. If the liquid level is below the "Redundant Off/Low Level Alarm" float, then likely the problem is either a leaky tank or siphoning. Siphoning typically occurs when the system is

pumping downhill. A system will not necessarily siphon every time it operates. It is dependent on the system design. A siphoning system can be retrofitted with an anti-siphon valve. Most siphoning problems will manifest in the first months of operation.

c. If the hydraulics of the system do not allow for siphoning, then it is likely that the tank is leaking. Fill the tank to a normal operating level and return to inspect the tank at a later time. If the liquid level is below the normal operating level, the tank is leaking and needs to be repaired or replaced.

6. High Water Shut-off Valve

Should the effluent level reach the float switch R1, the float switch shall close the water shut-off valve and deenergize pumps P1 and P2. The reset button in the control panel will start the pump cycle on the next half hour and it will open the water shut-off valve. If the water shut-off valve does not open, the manual by pass water valve will have to be manually opened and the water shut-off valve will have to be repaired. Once the valve is repaired the manual valve must be closed.

7. Removing & Replacing Inoperative Floats

IMPORTANT! Before doing any work on either the wiring to the level control floats and pump or in the pump control panel, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions and red tag/lockout.

a. Remove the float tree assembly from the vault. There is no reason to move the settings of the floats to remove and replace a float. After noting the tether length, snap the inoperative float out of the holding collar.

b. Remove the inoperative float and replace it with a new one. Refer to electrical plans and specification for installation of new float.

c. Splice the float wires to the wires from the control panel following the instructions provided by the equipment manufacturer.

d. Replace the float in the collar, using the same tether length, and return the tree assembly to the pump vault.

e. Reconnect power and test the unit per the instructions provided in section **II. Start Up** of this manual.

8. Removing & Replacing Inoperative Pumps

The pump unit is a water well turbine type pump that has a useful life of approximately 7 - 10 years. No maintenance is required during the normal operating life. Pumps may fail or become clogged. If pump failure is not due to obvious conditions such as a fouled or jammed turbine, then the pump should be replaced with a spare pump that matches the failed pump.

IMPORTANT! Before doing any work on either the wiring to the level control floats and pump or in the pump control panel, switch off the power to the system at the service entrance panel, set the circuit breakers in the panel to their "OFF" positions redtag/lockout.

a. Close the ball valve on the discharge plumbing assembly, disconnect the union, and carefully remove the pump and attached plumbing from the tank Vault. Disconnect the pump from the discharge plumbing assembly.

b. Not splice box in the riser.

Need to refer to electrical plans and spec in order to address this.

c. Remove the inoperative pump and replace it with a new one of the same type as listed in the pump specifications. Push the pump cable through the watertight cord grip into the electrical splice box. Leave an adequate length of electrical

cord coiled inside the riser to allow for easy removal of the pump. Tighten the cord grip *by hand, not by tool*, then test the tightness of the cord grip by tugging on the cord. A cable is secure when the cord grip is tight enough to prevent slippage. An adequate length of cord should be left to allow for easy removal for future disconnecting and re-splicing.

d. Splice the pump wires to the appropriate wires from the control panel following the manufacturer instructions. Always use watertight heat shrink splice kits for all connections!

e. Reattach the discharge plumbing assembly and carefully lower the pump into the PVC sleeve alongside the pump vault. Be careful not to lower the pump by the cable or to pinch the cable when lowering it into the sleeve. Reconnect the union and open the ball valve.

f. Reconnect power and test the unit per the instructions provided in section **II. Start Up** of this manual.

g. The failed pump should be sent to the manufacturer's representative for repair.

9. Air Vents With Carbon Filters

Replace the carbon filters in the tank air vents when they stop absorbing odors. Replacement packages can be ordered from the manufacturer.

10. Cleaning and Flushing Laterals

If the observed squirt height or pressure exceeds the initial squirt height pressure by more than 15-20%, it can be assumed that a significant number of orifices are plugged and the laterals require flushing. Flush the laterals by:

a. Open the end of each lateral in a zone.

b. Turn the pump on manually and let it run for about one minute to flush any material from the lateral. Repeat for each zone.

c. Recheck the squirt height to ensure that the laterals have been sufficiently cleared.

d. If there is still a significant difference in initial and current squirt height, try either a bottle brush attached to the end of a plumber's snake or a high-pressure washer to clean the laterals.

e. Orifices may also be cleaned individually. When an orifice is clear, you can hear the sound of the spray hitting the orifice shield that covers it. In the absence of that sound, lift off the shield and clear the orifice with a wire.

f. If the orifices are substantially plugged after six months, then it may be prudent to inspect the squirt height every three months and adjust scheduled testing and flushing of the laterals accordingly.

IV. SAMPLING AND DATA COLLECTION

Sampling and monitoring of the treatment system is to demonstrate compliance with regulatory standards and evaluate system performance is given below.

Sampling Locations

Samples should be obtained from 4 points in the water system: (1) potable supply [PS] from the sample tap located at the well head (2) from the hose faucet [HF1] located before the recirculation tank, (3) on the hose faucet [HF2] located after the recirculation tank, and (4) from the level control box for the subsurface wetland [SW]. Additionally, samples will be taken from the reverse osmosis water system from the product water [ROP] and from the waste brine line [ROB].

To sample from HF1, an assistant will need to manually activate the effluent pumps in the septic tank. To sample from HF2, an assistant will need to manually activate the effluent pumps in the recirculation tank. When sampling from HF1 or HF2, flush the line for 20 seconds before taking the sample to ensure a representative sample is obtained.

To sample from SW, simply hold a sample collection container under the overflow pipe to capture the sample without moving or disturbing the pipe. If the pipe has been disturbed, wait for 10 minutes for the effluent to stabilize before sampling.

Sample Care & Handling

The samples shall be collected in laboratory provided containers and delivered for analysis to the laboratory pursuant to their direction. Check with the laboratory in advance for direction on sample volumes required, preservation techniques, and handling prior to analysis.

Sample Schedule

The samples should be analyzed according to the following schedule:

		Sample location					
Parameter	Unit	PS	HF1	HF2	SW	ROP	ROB
Biochemical oxygen demand, BOD	mg/L	NA	Weekly	Weekly	Weekly	NA	NA
Chemical oxygen demand, COD	mg/L	NA	Weekly	Weekly	Weekly	NA	NA
Total suspended solids, TSS	mg/L	NA	Weekly	Monthly	Monthly	NA	NA
Total dissolved solids, TDS	mg/L	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Total coliform	No./100 mL	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly
Total nitrogen, TN	mg/L as N	NA	Weekly	Weekly	Weekly	NA	NA
Ammonium, NH_4	mg/L as N	NA	Weekly	Weekly	Weekly	NA	NA
Nitrite, NO_2	mg/L as N	NA	NA	Monthly	Monthly	NA	NA
Nitrate, NO_3	mg/L as N	Monthly	NA	Weekly	Weekly	NA	NA
pH	-	Monthly	Weekly	Weekly	Weekly	Monthly	Monthly
Alkalinity	mg/L as $CaCO_3$	Monthly	Weekly	Weekly	Weekly	Monthly	Monthly
Temperature	°C	Weekly	Weekly	Weekly	Weekly	NA	NA
Dissolved oxygen	mg/L	NA	NA	Monthly	NA	NA	NA
General Mineral (comprehensive)		Quarterly				Quarterly	