

EcoCheck, Inc

4444 Centerville Road, Suite 140 • White Bear Lake, MN •

Phone: 651-255-5075 • Fax: 651-255-5060



April 26, 2005

Client Name

PO Box 123

Your Town, Minnesota 54321

RE: Wastewater System Assessment for Your Development
Your Town, Minnesota

Dear Client:

EcoCheck met with your operation staff on April 20 and 21 to assess the wastewater treatment system designed for the townhomes in your development (Units A, B D and F). The system was designed for a flow of 6,840 gallons in 1996 by Engineering Firm A. Your current operations staff informed EcoCheck of past issues with the frozen or cracked supply and return lines, biological build-up inside the drip irrigation emitters and other operational issues.

EcoCheck performed diagnostics of these operational issues after consulting with the current staff. Based upon these interviews, three main issues were identified. These include: 1) an assessment of biological slime growth inside the drip irrigation tubing, 2) an evaluation of the drainback of the system, and 3) an assessment of the amount of flow being delivered to the drip irrigation site.

System Description

The system consists of approximately 14,000 gallons of septic tank capacity for the A, B D and F units. The septic tanks are located in areas adjacent to the respective buildings. Septic tank effluent flows from the septic tank into a series of surge tanks (with a capacity of approximately 15,000 gallons) to account for peak flows. The surge tanks are interconnected in the bottom to allow for peak flows to equalize and provide temporary storage until the water can be pumped up to the top of the hill for disposal of the water. The lift station pumps the water to a tank near the control building whenever capacity exists in the drip irrigation tank.

At the top of the hill, water from the lift station is discharged into the settling tank and two drywell pumps that pump the water to one of 10 drip irrigation zones. Water is delivered to one of the zones once per hour as determined by programming of the PLC. The PLC controls which solenoid valves open and close as well as when the drainback valves open and close for the supply and return lines. In order to properly dose the zones within design guidelines, a maximum of 285 gallons of effluent may be discharged per zone per hour. This results in one operational zone per hour.

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Figure 1: Settling tank on top of hill for the drip irrigation system.

The initial installation consisted of ½-inch netafim tubing with 0.6 gallon per hour emitters. However an assessment of the operation of the facility noted that the emitters were becoming plugged by biological growth on the inside of the pipe. To counter this, the system was retrofitted with ¾- inch heavy wall netafim tubing with 1.0 gallon per hour emitters. Since the tubing was replaced with higher output rates, two to four of the lines were disconnected from each zone to prevent over application to the drip irrigation field.

The operators of the facility have attempted to continually provide insulation to the drip irrigation field by installing hog fuel (finely ground wood chips) on top of the drip irrigation lines. This has provided additional insulation, however movement of the hogfuel occurs due to steep slopes and precipitation and snow fall events.

Issues Identified and Recommendations

EcoCheck identified the following issues during the site visit:

1. **Flows and Hydraulics** – The system is supplied with three 7,500 gallon surge tanks, however during peak flow events, this capacity is not adequate. The system is designed to discharge only 6840 gallons per day. Engineering controls were designed into the system to prevent the over application of water to the drip irrigation system. For example, if the high water level float is activated at the drip irrigation tanks, the lift station pumps will be disabled and extraneous water needs to be pumped out of the surge tanks.

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During peak use periods, Eagle Ridge needs to pump the surge tanks. During these times, greater than 6840 gallons per day are discharged to the tanks. Even with the existing surge tanks, it appears that the tanks do not provide enough capacity to prevent pumping of the tanks.

Recommendation – Below are a few recommendations for you to consider:

a. *Implement a Water Conservation Program* – This purpose of this program is to minimize flows to the wastewater system at the source (i.e. condo units). This can be accomplished by a variety of means, including:

- Installing 1.6 gallon per flush toilets (which may have already been completed in all units);
- Install low water use showerheads (2.5 gal/min instead of 4.5 gal/min)
- Install faucet aerators which use 2 gal/min instead of 3-5 gal/min.
- Reduce pressures of the water distribution system towards 50-60 psi.

Another procedure is to encourage guests to re-use bathroom towels during their stay instead of washing towels after being used once. Using these methods can significantly reduce water discharge rates.

b. *Determine Actual Soil Capacity* – The drip irrigation system appears to be handling the application of 285 gallons per hour. It is possible that the soils could handle additional flows. To determine this, a study of the soil loading rates, past operational experience during peak flows and other operational issues could be evaluated. In interviewing the operations staff, high water level alarms have not been an operational problem. If soils were hydraulically overloaded, evidence would be observed in the field. During EcoCheck's site visit, water from the drip system or other evidence was not observed to be flowing on top of the ground. Therefore additional capacity (beyond the 285 gallons per hour) may exist in the drip irrigation zones. Before proceeding with this recommendation, your County should be consulted to see if this is a viable option.

c. *Install Additional Surge Tank(s)* – Another surge tank could be installed to assist in providing more temporary storage. Past pumping records would indicate the size of an additional surge tank.

d. *System Expansion* – If the first three options do not show system improvement, system expansion may be necessary. Options would include installing more drip irrigation zones, installing a back-up trench system for the drip irrigation system or provide pre-treatment. These options would need to be further evaluated based upon historical flow meter readings.

2. **Bacterial Build-up on Drip Irrigation Emitters** – When evaluating the drip irrigation system performance, EcoCheck exposed several of the lines at the supply and return sides. Each zone was activated and performance of the emitters was evaluated. All of the emitters at the supply side discharged water. At the return side, some of the emitters were discharging water slower, and others were not discharging any water at all.

Some of the suspect emitters were cut out to observe the internal condition of the tubing. We found that some of the emitters that were not discharging water had significant biological growth on the emitter, while operating emitters had significantly less biological growth. Based upon observation, the problem emitters may be plugged due to a pressure drop towards the end of the tubing runs causing a decrease in scour velocity (the ability of the water pressure to clean the inside of the pipe). Another possible explanation is that the tubing cannot drain back to the supply or header lines and the effluent remains trapped in the tubing, causing bacteria to grow.

Noting that approximately 10-15% of the emitters were experiencing a plugging condition, EcoCheck prepared an approximate 50 parts per million (ppm) solution of 6% sodium hypochlorite (Chlorox) in the pumping chamber of the settling tank. This was completed to attempt to “shock” the bacterial growth that had been occurring on the outside of the emitters and causing reduced or plugged orifices (see Figures 1 and 2).



Figure 2 – Drip irrigation emitter without bacterial growth.



Figure 3 – Drip irrigation emitter with extensive bacterial growth, plugging the emitter.

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The sodium hypochlorite was applied to each zone for a period of 10-20 minutes. After this time period, improvements were noted in some of the emitters. Some emitters that were not dripping at all experienced a drip every 2-7 seconds. Based upon this observation, we believe the application of the sodium hypochlorite did provide an improvement to the operation of the zones.

EcoCheck left several of the lines uncovered for operations staff to observe how the emitters are responding after a week. We recommend burying the lines again prior to winter.

Recommendation – Periodic application of sodium hypochlorite should be completed during times of low flow activity. We recommend operations staff to perform this 1-2 times a year. If orifices are plugged, they should be removed and inspected to determine the cause of the plugging (i.e. biological growth, dirt, sand or other obstruction). Please consult EcoCheck on sodium hypochlorite dilution rates.

3. **Return Line Pipe Diameter** – The supply and return lines have a pipe diameter of 1 ½ inches. Different modes of operation should be implemented in the warm and cold seasons. For cold season operation the drainback valves close during pump operation and open when the pump shuts off. In the warm season operating mode, the drainback valves are manually closed during pump on and off modes. This causes a few operational issues that need to be addressed. These include:
 - a. In summer, there is a significant amount of pipe that will be filled with water which will be unable to drain out. In this scenario, bacterial build-up can occur in all of the lines that do not drain back (i.e. return lines). This can cause a plugging concern in the return line pipes and cause complications with drainback in the winter.
 - b. The supply and return lines in the drip zones have a larger pipe diameter than at the drainback line (where all water in the system drains back to the settling tank). Both supply and return lines are 1-1/2 inches in diameter, yet when the lines connect near the control building, the supply line drainback is ½-inch diameter and the return line pipe diameter is reduced to 1-inch.

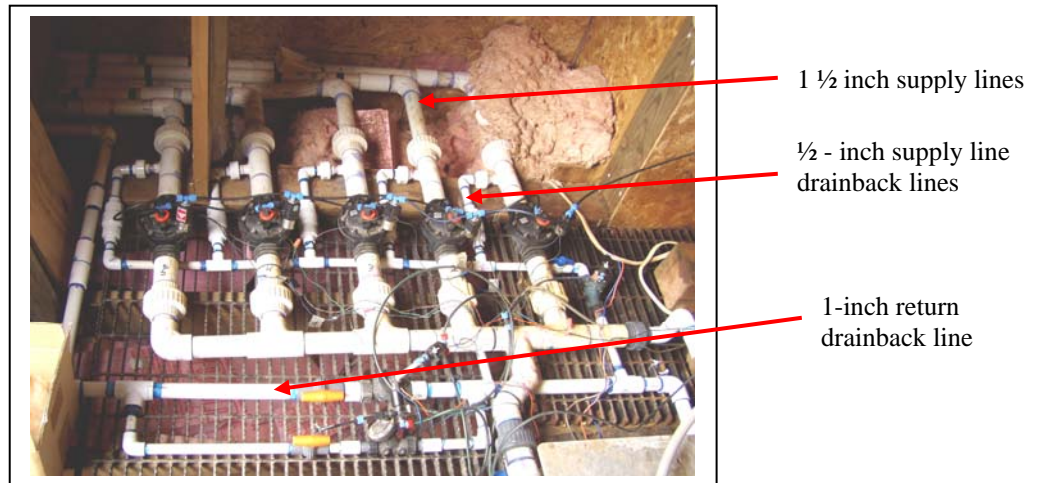


Figure 4: Supply and return line pipe diameters.

- c. In drip irrigation systems, it is important to drain the supply and return lines quickly to prevent the potential for line freezing. The current situation slows the drainback process and increases the freezing potential. This may be part of the reason why supply and header lines have become broken in the past.

Recommendation – To minimize freezing, EcoCheck believes the piping inside the control building should be modified to a larger diameter pipe (i.e. 3-4 inch in diameter). This should improve drainback time. Further, we believe an operational change should occur by not manually shutting off the valves outside of winter if plugging is occurring in the return lines (which can be confirmed by operational staff).

4. **Solenoid Operation** – It is difficult to tell whether the solenoid valves are opening or closing based upon the PLC logic. We attempted to do this, however in manual pumping mode, the solenoids do not operate unless the valves are opened in automatic mode by the PLC logic. Based upon observation during automatic operation, it appears the drainback valves are not opening or closing as they should be. When the pumps turn on, the supply and return valves should close (when not in flushing mode) and should open when the pumps turn off to allow for drainback. An output light is located on the PLC which does not light up when the valves open or close. Because of this, we believe the PLC is not communicating with the drainback solenoid valves.

Recommendation – An electrician should look at the PLC outputs and confirm solenoid operation for the supply and return lines.

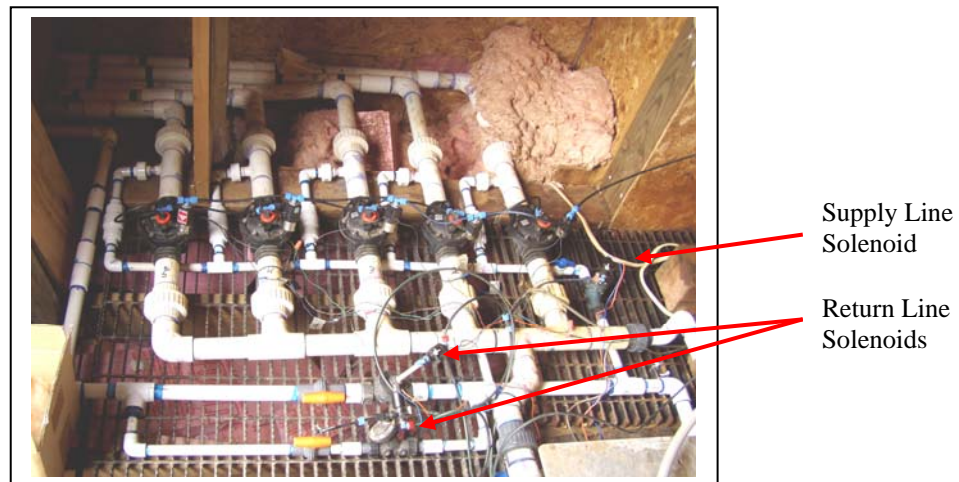


Figure 5: Head works of Zones 1-5 and supply and return lines.

- 5. Tubing and Air Release Valves** - The drip irrigation lines were initially thought to be pressure compensating tubing. Pressure compensating tubing evenly distributes water across the entire zone until reaching a certain pressure at which time all of the emitters open at the same time. Non-pressure compensating tubing allows the emitters to discharge water as soon as the water is introduced to the emitter. Based upon field tests, EcoCheck confirmed the tubing is acting as non-pressure compensating tubing.

Air release valves are located at the highest location of the drip irrigation supply headers.

Recommendation – An air release valve may be needed at the highest point of the return lines also in order to provide more efficient distribution. This should allow the tubing to act like pressure compensating tubing since pressures would not build-up until the return line air release valve is seated. This should also improve drainback of the return lines. Another benefit of installing the air release valves is to prevent soil particles from being sucked back into the emitters, causing potential plugging issues. EcoCheck did not observe this happening in the field, but it can potentially occur.

- 6. Drip Irrigation Pressure Valves** – It is difficult to tell what pressures the drip irrigation zones are operating at. No pressure valves are placed at the supply or return headers. To accurately determine how much water the drip irrigation system is ridding of, the pressure of the zones need to be determined. The amount of water that is delivered to the soil is dependent

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upon the pressures. Water delivered to the soil can vary by 40% in between a pressure of 15 to 40 psi. If air release valves incorporating a schraeder fitting were placed at the supply and return headers, the operator can more accurately calculate the amount of water discharged to the field by measuring the water pressure with a portable gauge.

Recommendation – To measure drip zone pressures, schraeder valves should be placed on the supply and return headers at the supply and return lines of each zone. This would help the operator understand how much water is being released from the emitters in the zone and would help optimize the timer settings for each zone. The operator should maintain a log of operating pressure for each zone during warm and cold season operation. Based upon operating pressures in each zone, additional modifications may be needed to increase or decrease pressures in the zones.

Once pressures are known, a spreadsheet should be created showing the actual amount of time the PLC should be programmed for to dispose of 285 gallons per hour.

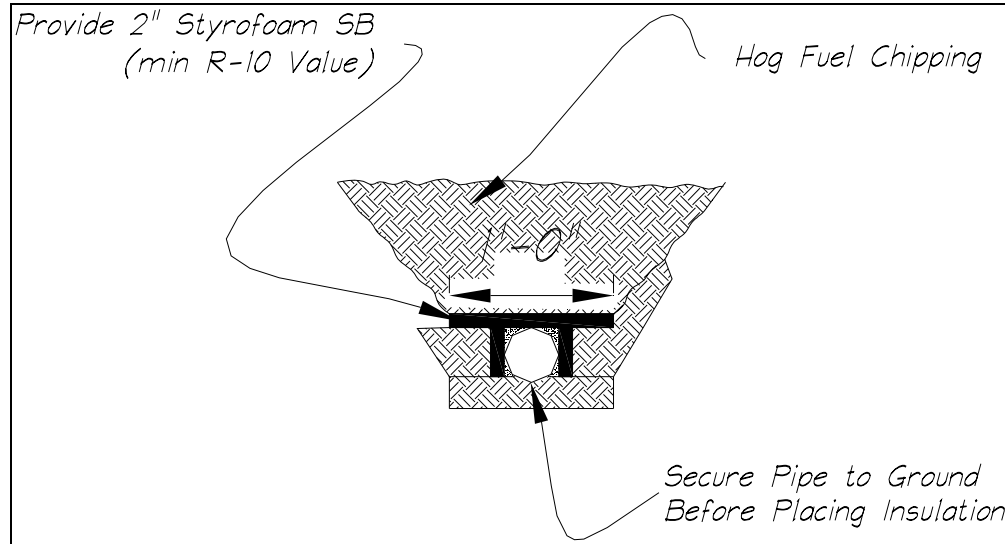
7. **Insulating Supply and Return Lines** – Several of the supply and return lines are exposed to the open environment and have not been buried. The operators have described issues with repairing pipe breaks in the supply and return lines. The broken lines may be occurring from recurring fill and drain cycles, causing ice sheeting on the inside of the pipes. This is the likely scenario since pipe breaks have occurred in areas that appeared to have adequate slope for drainback.

Recommendation – The supply and return lines should be secured to the ground by a U-Clamp, if it is lying on top of the ground. To minimize freezing potential, the operator should provide box insulation (as shown in the figure below) of all of the exposed pipe and cover the insulation with hogfuel.

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Thank you for the opportunity to work with you. We are able to assist you further in the implementation of these recommendations if you wish. Please let us know if we can further assist you in these areas. If you have any questions, you may contact me at 651-255-5049.

Sincerely,

EcoCheck, Inc.

Ryan C. Brandt
Vice President