Florida Department of Health
Onsite Nitrogen Reduction Strategies Study

Contract CORCL

TASK B.6

Installation Report for Passive Nitrogen Reduction System B-HS4

June 2013

Task B of the Florida Onsite Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified and pilot tested in FOSNRS Task A. To meet this objective, full scale treatment systems will be installed at various residential sites in Florida, operated on septic tank effluent under actual onsite conditions, and monitored over an extended timeframe. The Task B Quality Assurance Project Plan (Task B.5) documents the objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at the home sites. This report documents the installation of a passive nitrogen reduction system at a home site in Seminole County, Florida (B-HS4).

System Overview

The B-HS4 passive nitrogen reduction system (PNRS) was installed in Seminole County, Florida in June 2013. The property had two existing onsite sewage treatment and disposal systems. The existing 1,200 gallon concrete septic tank, located on the west side of the property, will continue to provide primary treatment for the PNRS system. The existing 900 gallon septic tank, located on the northeast side of the property, was converted to a lift station, and pumps the raw sewage from that system to the new gravity flow PNRS. The passive nitrogen reduction system consists of an addition of two tanks and a new drainfield to the existing permitted systems. A 2,800 gallon concrete Stage 1 unsaturated media biofilter and 1,500 gallon two chamber concrete Stage 2 saturated media biofilter were installed. Figure 1 is a site schematic showing the system components and layout of the installation. The complete as-built system drawings are included in the attached Appendix A.

The septic tank contents are discharged by gravity to a distribution box, located inside the Stage 1 biofilter, which splits the flow between two perforated distribution pipes along the top of the unsaturated Stage 1 biofilter media. The Stage 1 biofilter contains 10 inches of coarse expanded clay media (Riverlite^{TM} 1/4; 1.1 to 4.8 mm) above 20 inches of finer expanded clay media (Riverlite^{TM} 3/16; 0.6 to 2.4 mm). Wastewater percolates downward through the expanded clay media where nitrification occurs. Stage 1 biofilter effluent then flows by gravity into the Stage 2 biofilter tank. Effluent from the unsaturated (Stage 1) media tank enters the denitrification (Stage 2) biofilter into a standing water column lying above the media in the first chamber (lignocellulosic media), flows downward through the media, moves laterally through the baffle wall to the bottom of the second chamber, and upward through the media in the second chamber (elemental sulfur and oyster shell). The Stage 2 biofilter contains 42-inches of lignocellulosic media in the first chamber. A collection pipe along the bottom transfers the effluent to the second chamber which contains 18-inches of elemental sulfur mixed with oyster shell media. The Stage 2 biofilter effluent discharges near the top of the tank; therefore denitrification occurs in the saturated environment. The denitrified treated effluent is discharged into the soil via a new drainfield. The effluent is split between four low-profile Infiltrator chamber trenches by a concrete distribution box. Three of the trenches have 11 chambers and one trench has 12 chambers as depicted in Figure 1. A flow schematic of the system is shown on Figure 2.

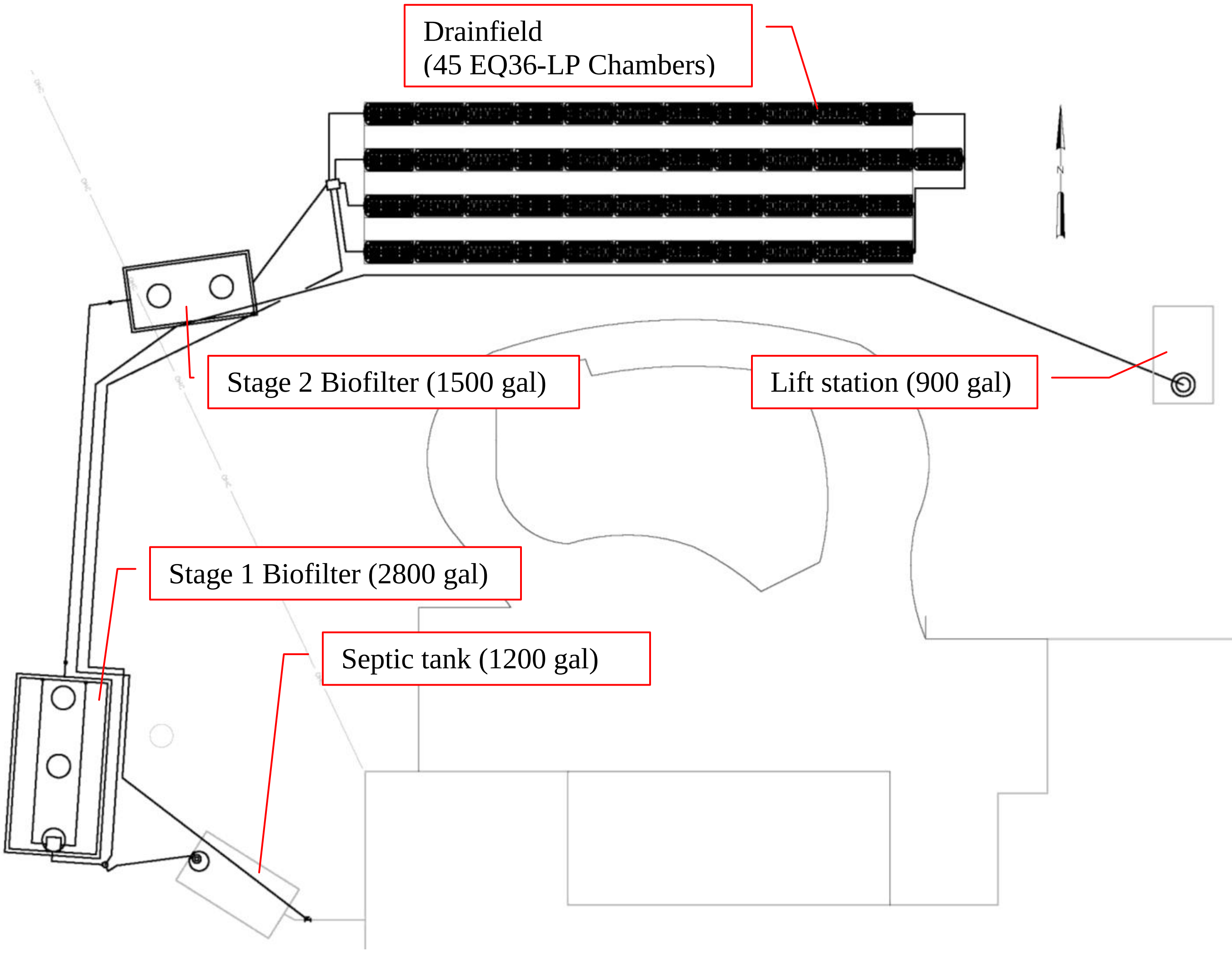

Figure 1
Schematic of B-HS4 PNRS installed in Seminole county

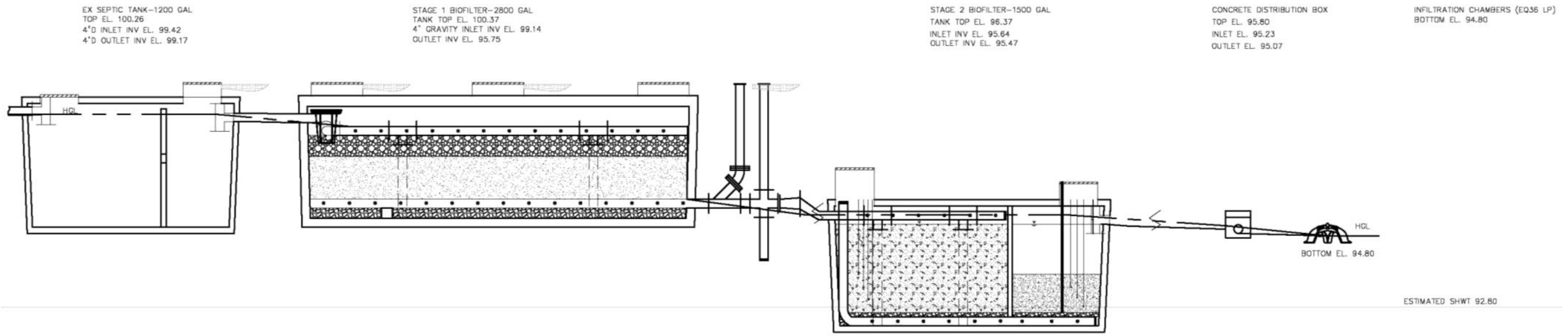

Figure 2
Flow Schematic of B-HS4 PNRS installed in Seminole county

Installation

Installation of the system commenced June 19, 2013 and was completed on June 28, 2013. As previously discussed, the existing 1,200 gallon septic tank will continue to provide primary treatment. Prior to the existing 1,200 gallon septic tank a 2-inch pipe connection was made into the sewer line from the house (Figure 3). The 2-inch diameter pipe conveys the wastewater from the converted 800 gallon lift station via a Liberty grinder pump model number PRG101A-2 (Figure 4) placed within the first chamber. Within the 1,200 gallon septic tank a new effluent filter (Polylok™, PL-68) was installed in the outlet tee (Figure 5). A new lid with manhole (Figure 5) was installed to allow access to the filter for maintenance. Following the 1,200 gallon septic tank, a two-way valve (Bull Run™) (Figure 6) was installed to allow for a means to bypass the PNRS system and discharge septic tank effluent directly into the new drainfield (via the concrete distribution box). A riser pipe was installed to grade over the valve, so that the valve can be turned after installation is complete. The valve is turned with a wrench on a rod which is long enough to reach with the riser installed.

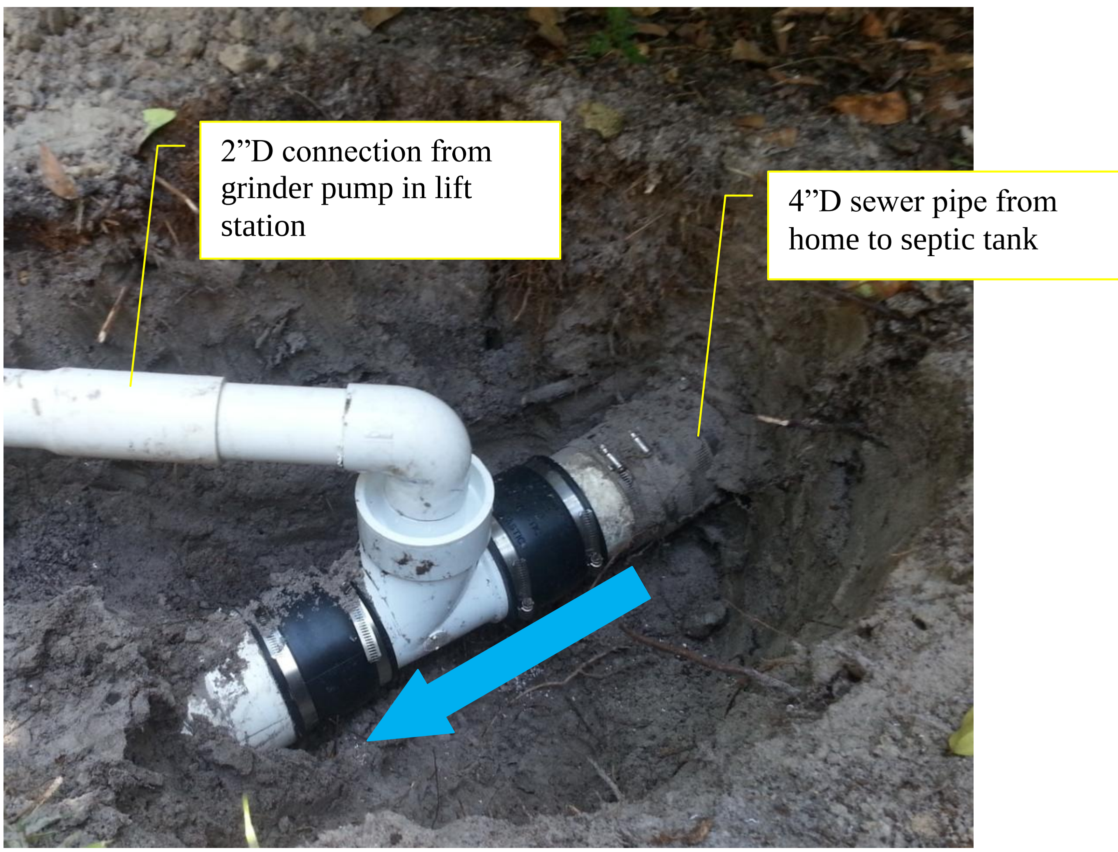

Figure 3
Pipe from Lift Station

Figure 4
Liberty pump within lift station

Figure 5
Septic tank outlet screen and manhole

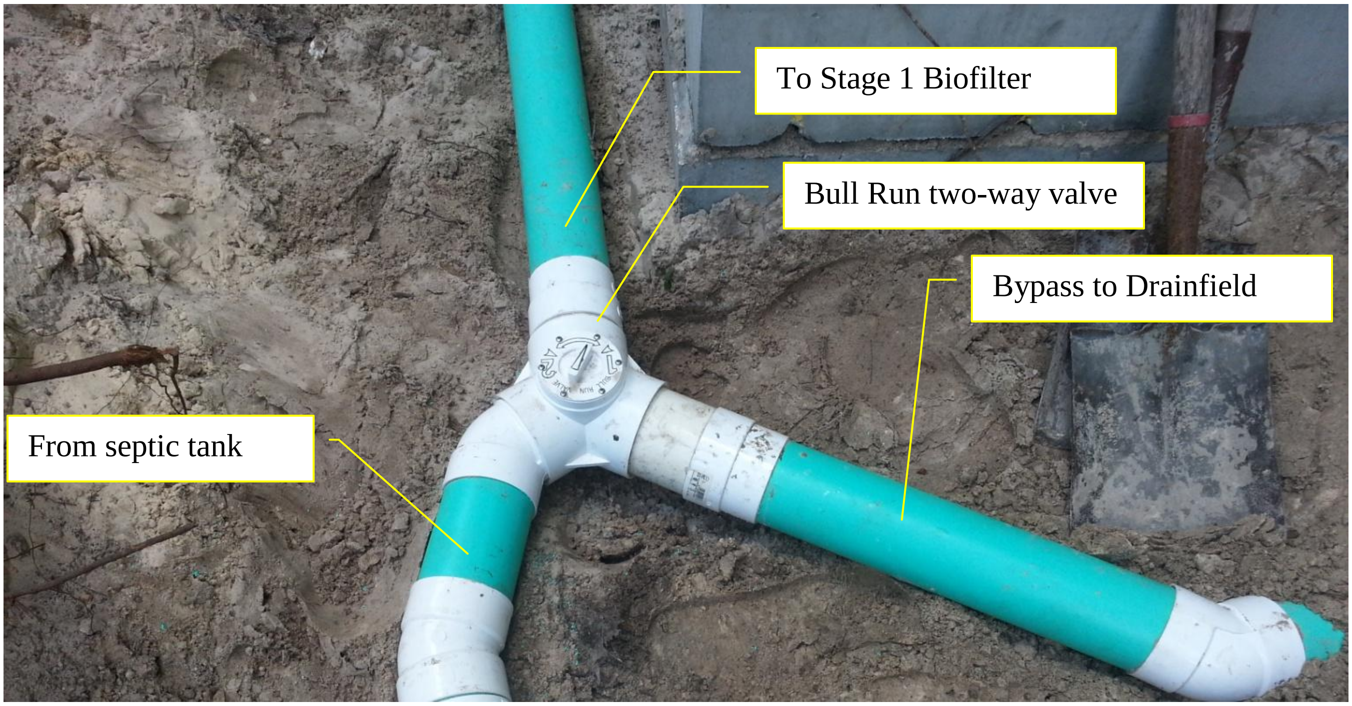

Figure 6
Bull run valve for PNRS bypass

The remaining passive nitrogen reduction system components were installed (Table 1). A single chamber (2,800 gallon) concrete tank was installed beside the primary tank (Figure 7). The purpose of this tank is to hold the Stage 1 expanded clay media. The 4"D inlet of the tank is connected (gravity flow) to the septic tank discharge. The 4"D outlet (Figure 7) of the pipe is located near the bottom of the tank to allow for unsaturated operation. The 4"D underdrain pipe (perforated) with gravel surrounding was installed along the centerline of the bottom of the tank for effluent collection (Figure 8). Following gravel installation and leveling, 20-inches of fine (3/16 Riverlite™) expanded clay media was installed (Figure 9). Above the fine media, 10-inches of coarse (1/4 Riverlite™) expanded clay media was installed (Figure 10). Following media installation and leveling, the influent distribution network was installed. The 4"D influent pipe, connected to the septic tank discharge, discharges into a distribution box which flows to two 4"D perforated pipes across the top of the media (Figure 10). The distribution box includes two Polylok equalizer™ weirs to allow for the adjustment of the flow split (Figure 11). The Stage 1 biofilter outlet pipe includes a clean-out (Figure 12).

Table 1
Passive Nitrogen Reduction System Components

	Tank Volume (gal)	Surface Area (ft^2)	Media
Primary Tank	1,200	47.5	none
Stage 1 Biofilter	2,800	113.3	• 10” Riverlite 1/4 • 20” Riverlite 3/16
Stage 2a Biofilter, downflow	1,000 (1,500 total)	36 (54 total)	42” lignocellulosic (Southern yellow pine)
Stage 2b Biofilter, upflow	500 (1,500 total)	18 (54 total)	18” Elemental sulfur (90%) & oyster shell mixture (10%)

Figure 7
2,800 gallon, single chamber, stage 1 biofilter tank

Figure 8
Stage 1 biofilter gravel underdrain

Figure 9
Stage 1 biofilter 20-inches of fine media (3/16 Riverlite™)

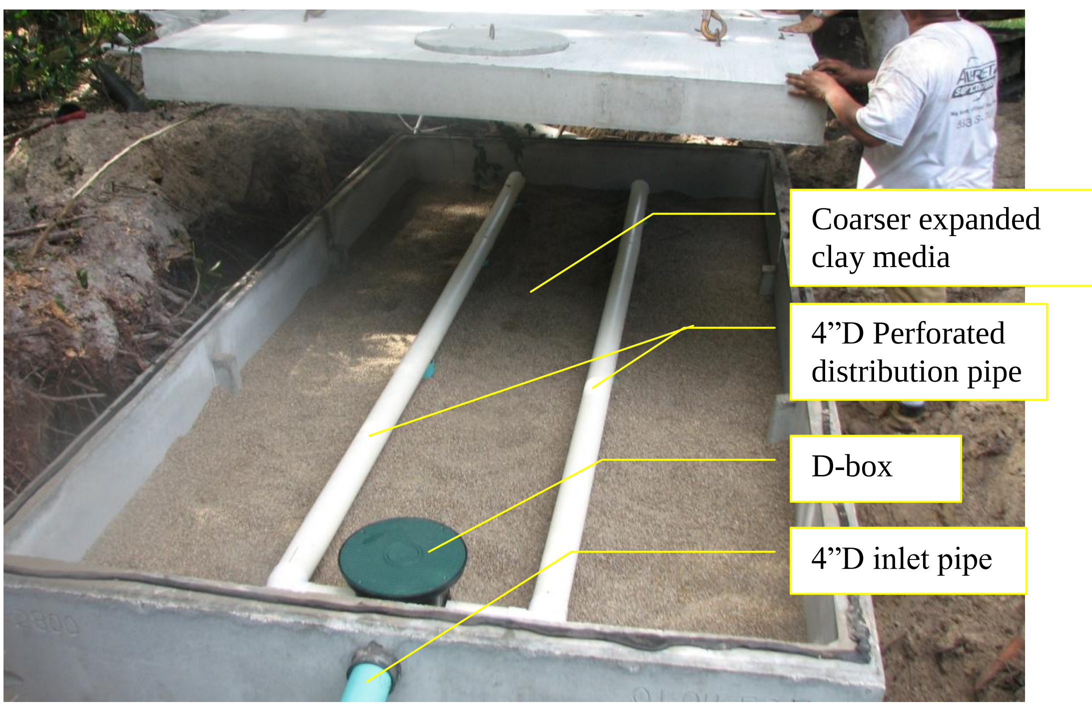

Figure 10
Stage 1 biofilter 10-inches of coarse media (1/4 Riverlite™)

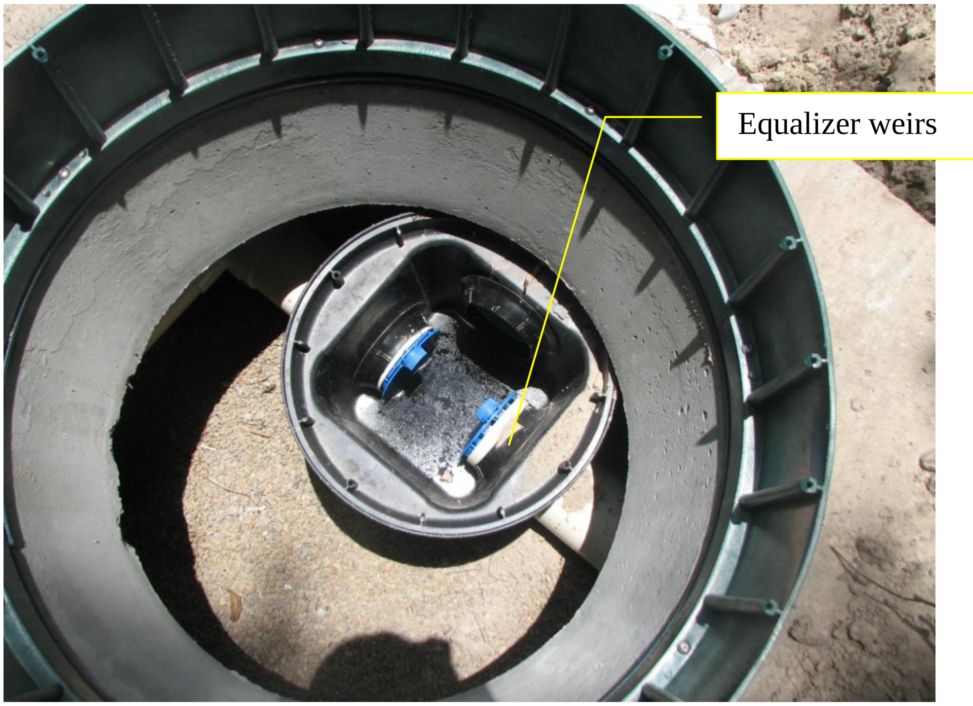

Figure 11
Stage 1 biofilter d-box

Figure 12
Stage 1 biofilter 4”D outlet pipe, with cleanout

The second tank installed was a two chamber (1,500 gallon) concrete tank (Figure 13). The purpose of this tank is to hold the Stage 2 lignocellulosic and sulfur media. The 4"D pipe from the Stage 1 biofilter connects to a perforated pipe which distributes nitrified effluent over the lignocellulosic media within the first chamber of the Stage 2 biofilter. The nitrified effluent flows downward through the lignocellulosic media (within first chamber) and upward through the sulfur media mixture (within second chamber).

A 4"D perforated underdrain pipe (Figure 13) with gravel surrounding (Figure 14) was installed along the centerline of the bottom of the tank for transfer from the first chamber to the second chamber. The tank arrived with a coupling cast into the baffle wall near the bottom to connect both chambers of the tank. Following the underdrain gravel installation (Figure 14) and leveling, 18-inches of elemental sulfur and oyster shell media was installed and mixed (Figure 15) within the second chamber. A stainless steel drivepoint sampler tree (Figure 15) was installed for sampling at 6 and 12-inches above the bottom of the sulfur media mixture.

Above the gravel underdrain within the first chamber of the tank, 42-inches of lignocellulosic media was installed (Figure 16). A stainless steel drivepoint sampler tree was installed for sampling at 0, 12, 24 and 36-inches above the bottom of the lignocellulosic media. A 4"D perforated pipe was connected to the inlet of the tank for effluent dispersal above the lignocellulosic media (Figure 16). A 4"D tee was installed at the outlet of the tank which allows for saturated operating conditions across the biofilter (Figure 17). The 4"D outlet is connected to the distribution box to the drainfield.

Figure 13
Stage 2 biofilter perforated pipe through wall

Figure 14
Stage 2 biofilter gravel underdrain

Figure 15
Stage 2 biofilter 18-inches of sulfur and oyster shell media

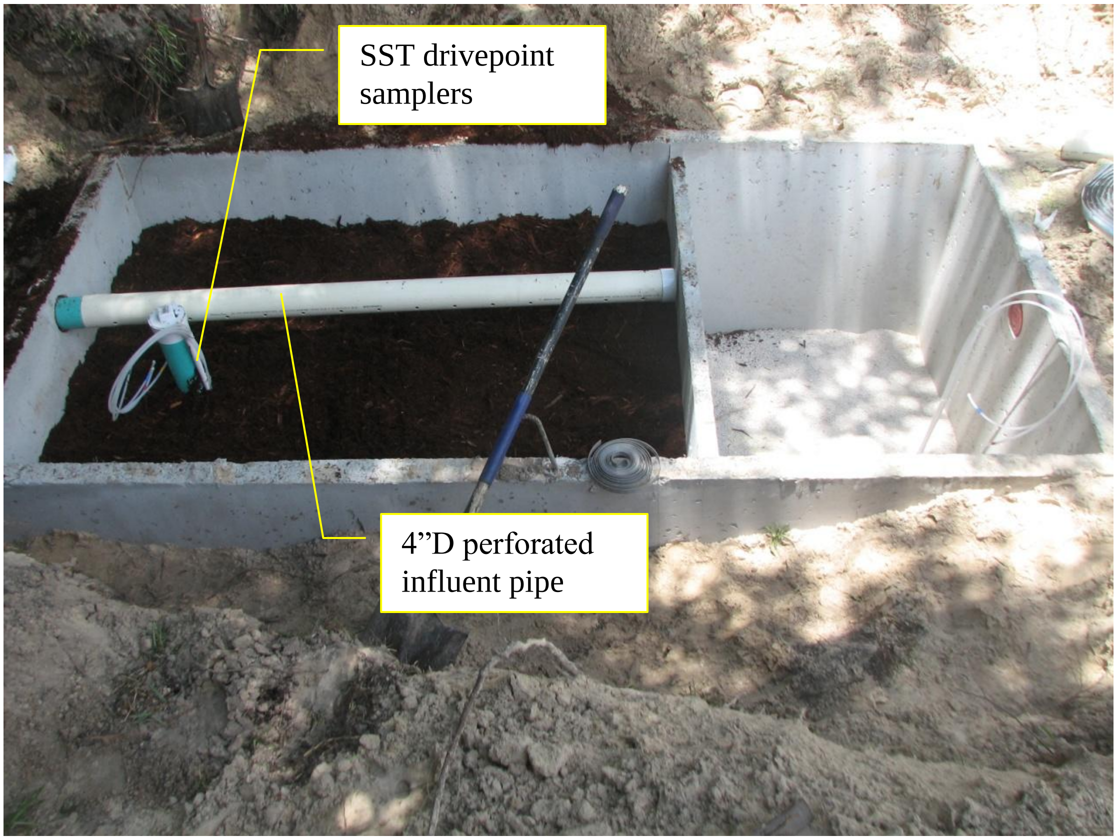

Figure 16
Stage 2 biofilter 42-inches of lignocellulosic media

Figure 17
Stage 2 biofilter outlet tee

The Stage 2 biofilter effluent is discharged into the soil via a new drainfield. The effluent is split between four low-profile Infiltrator chamber trenches by a concrete distribution box (Figure 18). Three of the trenches have 11 chambers and one trench has 12 chambers (Figure 19).

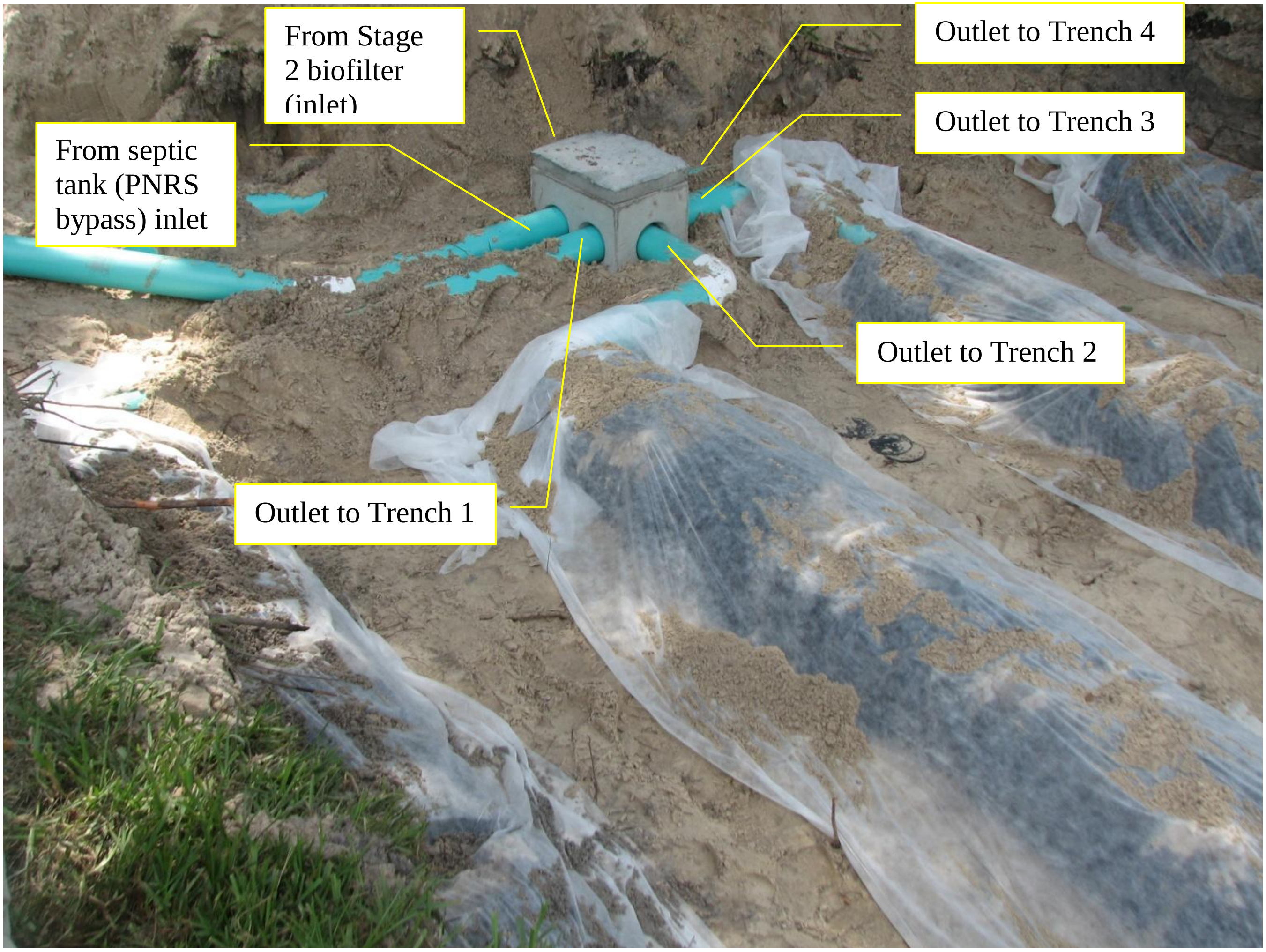

Figure 18
Drainfield distribution box

Figure 19
Drainfield trenches

A power meter was installed between the main power box of the house and the grinder pump to record cumulative power usage of the pump in kilowatts. Figure 20 shows the power meter installed inside an outdoor enclosure. Figure 21 shows the electrical outlet that was installed for the pump to plug into.

Figure 20
Power meter inside outdoor enclosure

Figure 21
Power outlet for grinder pump in lift station

During final testing of the system, the system operated with no visible signs of leaks, etc. The system area was filled and all disturbed areas on the property were graded (Figure 22).

Figure 22
Overall PNRS system installed

Estimated Cost

The final construction cost for the installed system was $19,842.84 as detailed in Appendix B.

System Start-up

The system was started up July 8, 2013, when all flow was diverted to the new passive system. Routine checks of the system were made for the first two weeks to ensure the system was functioning as intended. Preliminary sampling will begin in July to monitor nitrification.

APPENDIX A

RECORD DRAWINGS

APPENDIX B

CONSTRUCTION COSTS