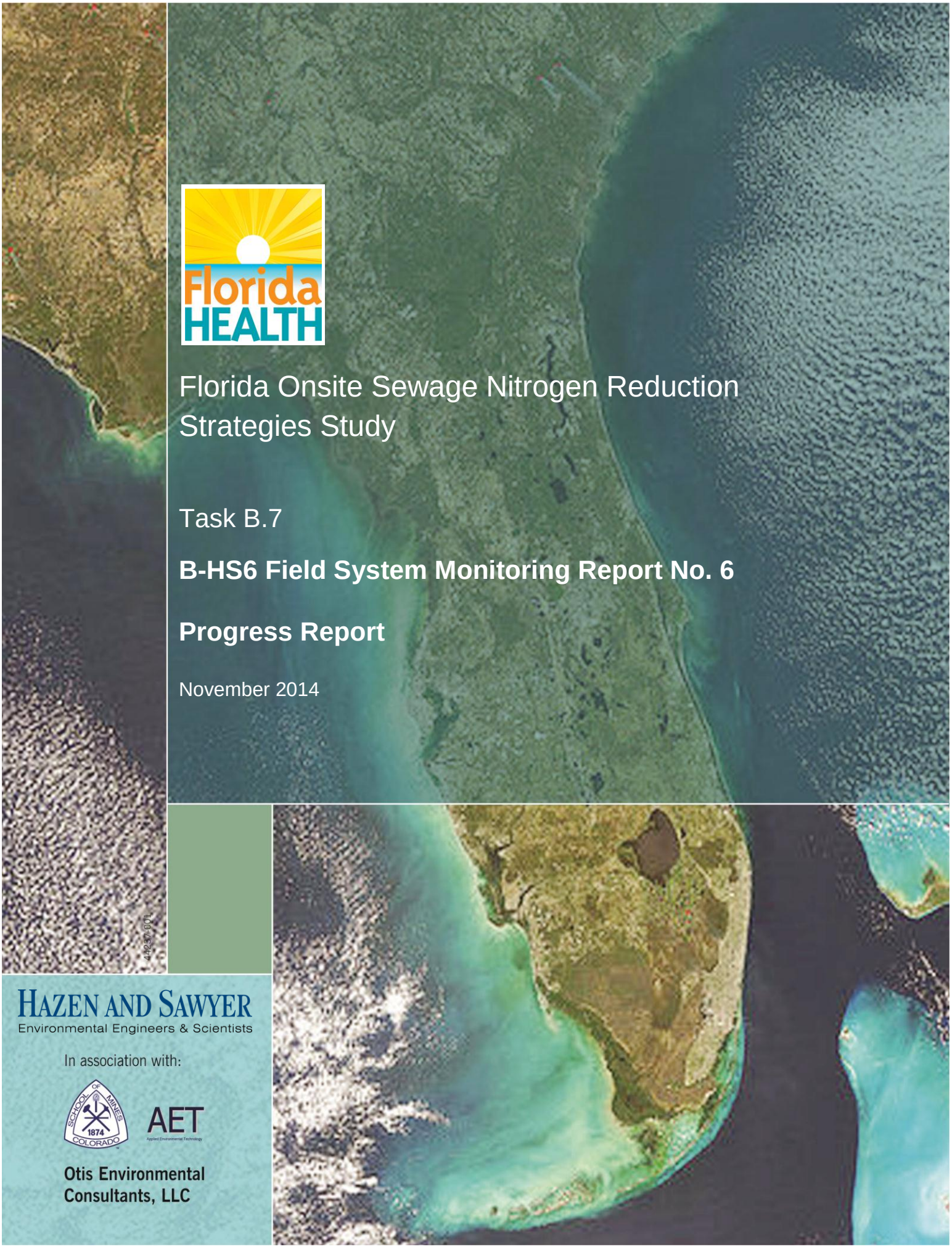

Florida HEALTH

Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task B.7

B-HS6 Field System Monitoring Report No. 6

Progress Report

November 2014

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Environmental Engineers & Scientists

In association with:

SCHOOL OF MINES 1874 COLORADO

AET Applied Environmental Technology

Otis Environmental Consultants, LLC

4423-001

Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK B.7
PROGRESS REPORT

B-HS6 Field System
Monitoring Report No. 6

Prepared for:

Florida Department of Health
Division of Disease Control and Health Protection
Bureau of Environmental Health
Onsite Sewage Programs
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November 2014

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B-HS6 Field System
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1.0 Background

Task B of the Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified in FOSNRS Task A.9 and pilot tested in PNRS II. To meet this objective, full scale treatment systems are being installed at various residential sites in Florida and monitored over an extended timeframe under actual onsite conditions. 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 sixth sample event of the passive nitrogen reduction system at home site B-HS6 in Wakulla County, Florida.

2.0 Purpose

This monitoring report documents data collected from the sixth B-HS6 monitoring and sampling event conducted on October 30, 2014 (Experimental Day 350). This monitoring event consisted of collecting flow measurements from the household water use meter, treatment system flow meters, recording electricity use, monitoring of field parameters, collection of water samples from seven points in the treatment system, and chemical analyses of water samples by a NELAC certified laboratory.

3.0 Materials and Methods

3.1 Project Site

The B-HS6 field site is located in Wakulla County, FL. The nitrogen reducing onsite treatment system for the single family residence was installed in November 2013. Operation commenced on November 14, 2013. Design and construction details were presented previously in the Task B.6 document. Figure 1 is a system schematic showing the system components and layout of the installation. A flow schematic of the system is shown in Figure 2. The new system replaced the previously installed PNRS system installed at field site B-HS1. The previously installed components that were removed were the Aerocell™ unsaturated media filter chamber, Nitrex™ media and split

recirculation device. The existing 1,500 gallon dual chamber septic tank will continue to provide primary treatment for the new PNRS system. However, the effluent screen was moved to the outlet and a vented tee was installed between the chambers per 64E-6.013(2)(h). The existing pump and floats were moved from the second chamber of the primary tank into a new 275 gallon pump tank. A 1,650 gallon concrete tank housing a combined Stage 1 and Stage 2a media biofilter was installed. The existing 1,500 gallon concrete single chamber tank which had contained the Nitrex™ media was converted to a Stage 2b saturated sulfur media biofilter. The denitrified treated effluent is discharged into the soil via the existing drainfield (standard Infiltrator EQ36 Quick 4 trenches).

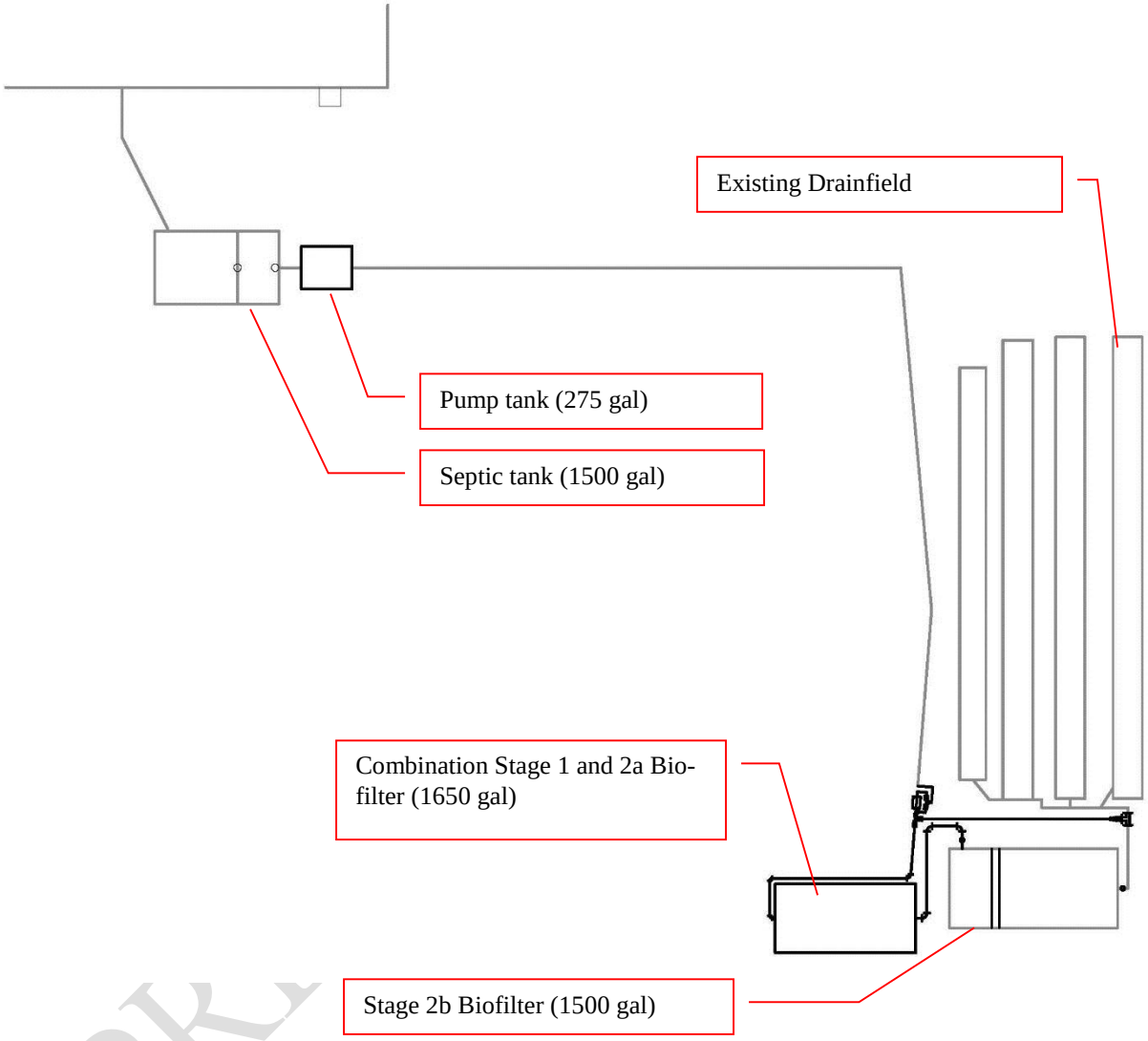

Figure 1
Plan view of B-HS6 system layout installed in Wakulla County

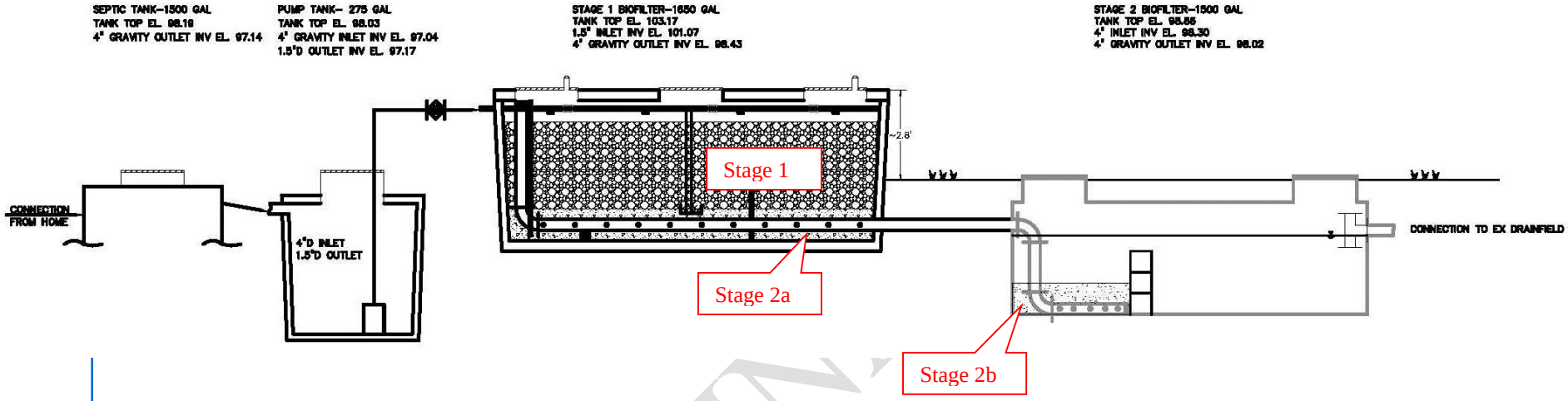

Figure 2
Flow Schematic of B-HS6 PNRS installed in Wakulla County

3.2 Monitoring and Sample Locations and Identification

Seven of the eight monitoring points shown in Figure 3 were sampled for this sample event. Monitoring point B-HS6-ST2b-T was not sampled as the water quality was very similar to the adjacent monitoring point B-HS6-STb-P. Household wastewater enters the 1st chamber of the primary tank and exits the second chamber as septic tank effluent through an effluent screen into the pump tank (which contains the pump and float switches). The first monitoring point, B-HS6-STE, is the effluent sampled from a sample port on the pump discharge line (Figure 4), which is referred to as primary effluent or septic tank effluent (STE). Samples from monitoring point B-HS6-STE are representative of the whole household wastewater and represent the influent to the remainder of the onsite nitrogen reduction system.

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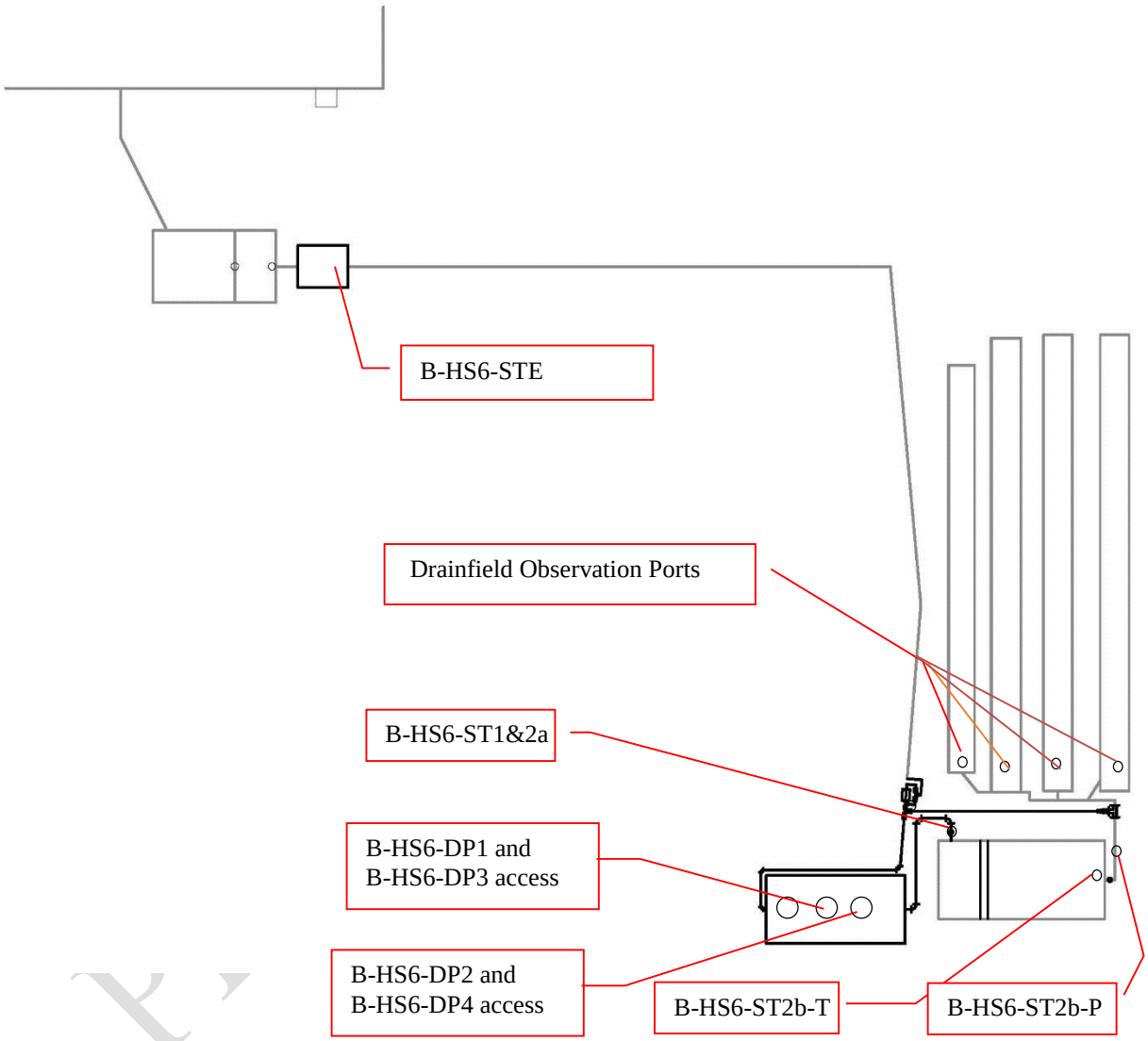

Figure 3
B-HS6 Treatment System Sampling and Monitoring Locations

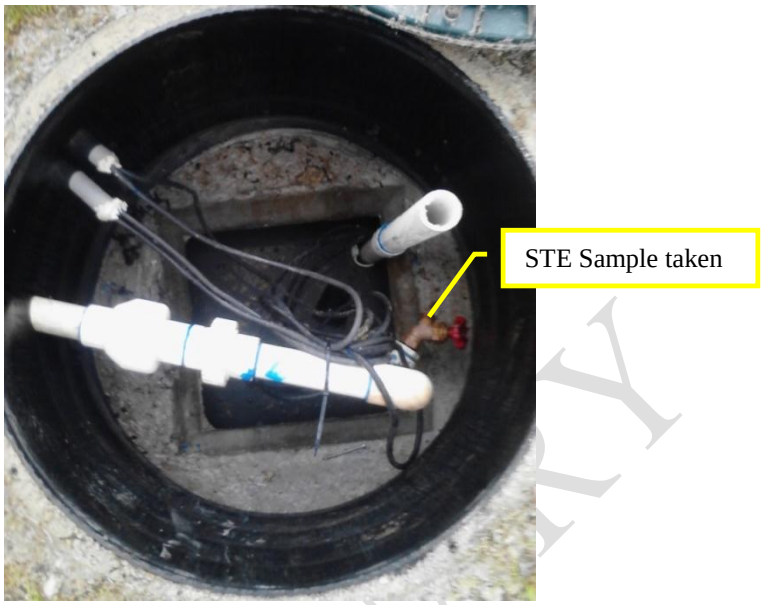

Figure 4
Primary Effluent (B-HS6-STE sample)

The pump tank contents are discharged to the top of the Stage 1 biofilter through three Orenco™ spin nozzles. The spin nozzles appear to adequately cover the surface area of the biofilter and provide relatively uniform flow distribution. The four spray nozzles that were originally installed were replaced with the three spin nozzles sprayers on March 20, 2014. In the Stage 1 biofilter, wastewater percolates downward through the unsaturated expanded clay media where nitrification occurs. The Stage 1 biofilter contains 30 inches of coarse expanded clay media (Riverlite™ 1/4; 1.1 to 4.8 mm). Two shallow pans, each containing a drive point sampler, were installed underneath the expanded clay layer and on top of the Stage 2a lignocellulosic media (see Figure 5). The second and third sampling points (B-HS6-DP1 and B-HS6-DP2) are sampled by connecting a peristaltic pump to the drivepoint tubing, representing the Stage 1 biofilter effluent.

Figure 5
Stage 1 Unsaturated Biofilter Effluent (B-HS6-DP1 and B-HS6-DP2 sample)

Twelve inches of lignocellulosic media, a blended waste wood from AAA Tree Experts, Tallahassee, FL, was installed underneath the expanded clay media as a supplemental carbon source for denitrification. A single 4-inch diameter outlet pipe connected the Stage 1&2a tank to the Stage 2b tank. The pipe was installed along the centerline of the Stage 1&2a tank with invert at 4-inches above the interior bottom of the tank. Therefore, approximately 4-inches of the lignocellulosic media is saturated, promoting oxygen depletion and denitrification of the nitrified effluent. Two additional stainless steel drive points were installed at the bottom of the Stage 2a saturated lignocellulosic media (see Figure 6). These drive points sampled water from near the very bottom of the tank. The fourth and fifth sampling points (B-HS6-DP3 and B-HS6-DP4) are sampled by connecting a peristaltic pump to the drive point tubing, representing the Stage 2a saturated biofilter effluent.

Figure 6
Stage 2a Saturated Biofilter Effluent (B-HS6-DP3 and B-HS6-DP4) sample tubing

The tubing for sample points B-HS6-DP1 and B-HS6-DP3 are accessed via the middle tank cover (Figure 7), and B-HS6-DP2 and B-HS6-DP4 are accessed through the tank cover on the outlet side of the tank.

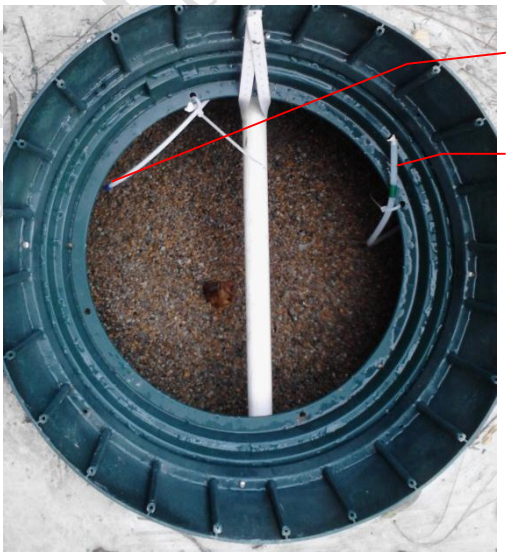

Figure 7
Drivepoint tubing access (B-HS6-DP1 and B-HS6-DP3 sample)

The effluent from the Stage 1&2a biofilter flows into the Stage 2b biofilter by gravity. The sixth sampling point (B-HS6-ST1&2a) is taken from a sample port in the gravity pipe connecting the Stage 1&2a biofilter outlet to the Stage 2b biofilter inlet representing the Stage 1&2a biofilter effluent (see Figure 8).

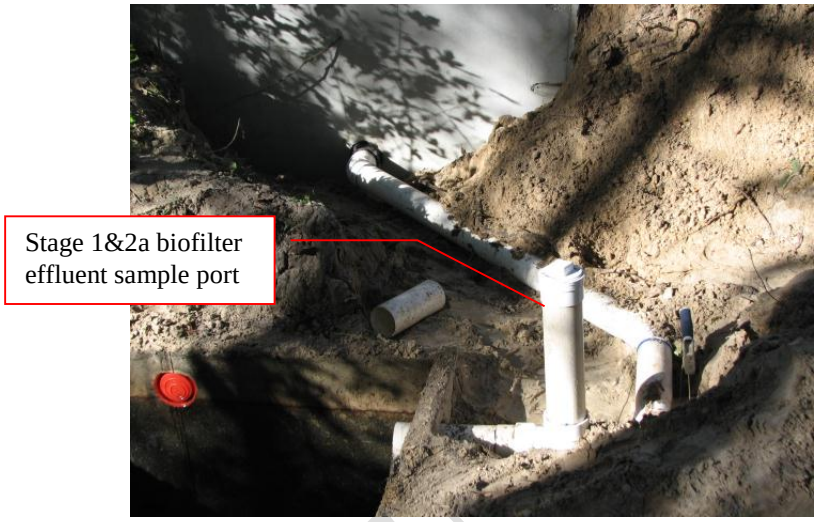

Figure 8
Stage 1&2a Biofilter Effluent Sample Port (B-HS6-ST1&2a sample)

Effluent from the Stage 1&2a biofilter enters the saturated denitrification (Stage 2b) biofilter at the bottom of the tank through a 4-inch diameter perforated pipe, flows upward through the 12-inches of elemental sulfur and oyster shell media mixture, and moves laterally over a concrete block wall to the second chamber. The Stage 2b biofilter effluent discharges near the top of the tank; therefore denitrification occurs in the saturated environment. The seventh primary sampling point, (B-HS6-ST2b-T) is the second chamber of the Stage 2 biofilter effluent which is sampled approximately 1 foot below the surface of the effluent baffle tee. This sample location is after passage through the sulfur media; it is the final effluent from the treatment system prior to being discharged to the soil infiltration system, or drainfield (Figure 9).

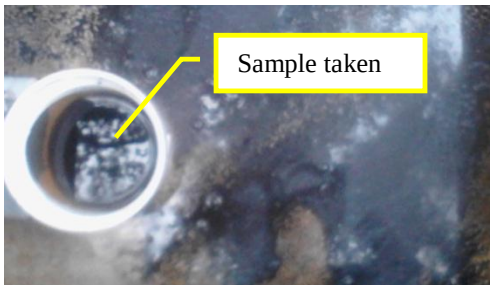

Figure 9
Stage 2b Biofilter Effluent (B-HS6-ST2b-T sample)

The eighth sampling point (B-HS6-ST2b-P) is from a sample port in the gravity pipe connecting the Stage 2b biofilter outlet to the drainfield inlet also representing the treated effluent (Figure 10).

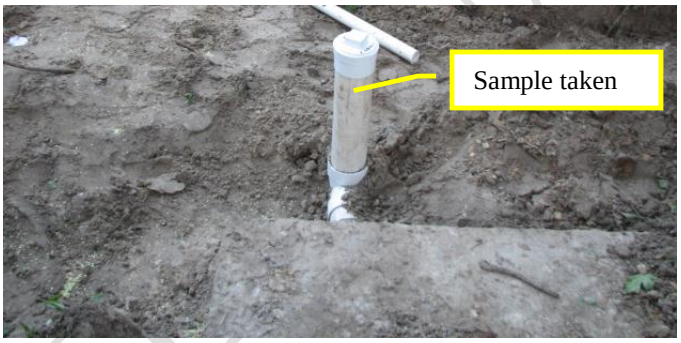

Figure 10
Stage 2b Biofilter Effluent (B-HS6-ST2b-P sample)

Treated effluent is discharged to a soil dispersal system (drainfield) consisting of four Infiltrator trenches. Three of the four Infiltrator trenches are 40 feet in length, and the fourth is 36 feet. The layout of the system and a flow schematic are shown in Figures 1 and 2, respectively.

3.3 Operational Monitoring

Start-up of the system occurred on November 14, 2013 (Experimental Day 0). The PNRS system has operated continually since that date. For this sixth formal sampling event, the water meter for the house and treatment system flow meters were read and recorded on October 30, 2014 (Experimental Day 350).

The household water meter is located on the potable water line from the onsite well prior to entering the household plumbing. The water meter does not include the irrigation water use. Therefore, the water meter reading should be indicative of the wastewater flow to the PNRS system.

The PNRS treatment system flow meter (Figure 11) is located on the pump tank discharge line and records the cumulative flow in gallons pumped from the pump chamber to the combined Stage 1&2a biofilter. The control panel includes telemetry where reports are generated regarding alarms, pump cycles, and other information using a Vericomm control panel system.

Figure 11
Treatment system flow meter

3.4 Energy Consumption

Energy consumption was monitored using an electrical meter installed between the main power box for the house and the control panel. The electrical meter records the cumulative power usage of the system in kilowatt-hours. The power usage of the system is primarily due to the single lift station pump installed within the pump tank, although a small amount of power is used by the control panel itself. There are no chemicals added to

the system. However, the Stage 2 biofilter media (lignocellulosic and sulfur) are "reactive" media which will be consumed during operation. The Stage 1&2a biofilter was initially filled with 12 inches of lignocellulosic media. The Stage 2b biofilter was filled with 12 inches of sulfur and oyster shell mixture media, which ostensibly will last for many years without replenishment or replacement.

3.5 Water Quality Sample Collection and Analyses

The sixth formal sample event (Sample Event No. 6), which is the subject of this report, was conducted on October 30, 2014 (Experimental Day 350). A full suite of influent, intermediate and effluent water quality samples were collected from the system for water quality analysis. Samples were collected at seven monitoring points described in Section 3.2: B-HS6-STE, B-HS6-DP1, B-HS6-DP2, B-HS6-DP3, B-HS6-DP4, B-HS6-ST1&2a, B-HS6-ST2b-P. A duplicate sample was also taken at B-HS6-ST1&2a. A peristaltic pump was used to collect samples and route them directly into analysis-specific containers after sufficient flushing of the tubing had occurred. Field parameters were then recorded. For sample B-HS6-STE, the system pump was briefly turned on to collect sample from the spigot.

The analysis-specific containers were supplied by the analytical laboratories and contained appropriate preservatives. The analysis-specific containers were labeled, placed in coolers and transported on ice to the analytical laboratories. Each sample container was secured in packing material as appropriate to prevent damage and spills, and was recorded on chain-of-custody forms supplied by the laboratory. Chain of custody forms, provided in Appendix A, were used to document the transfer of samples from field personnel to the analytical laboratory.

Field parameters were measured using portable electronic probes and included temperature (Temp), dissolved oxygen (DO), oxidation-reduction potential (ORP), pH, and specific conductance. Field parameters were measured directly in the tank/port for the B-HS6-STE, B-HS6-ST1, and B-HS6-ST2-P samples. Due to the design of the probe, ORP was measured in a container overflowing with sample water. All field parameters were measured in an overflowing container for samples B-HS6-DP3 and B-HS6-DP4. Due to low sample volume, no field parameters were taken during sampling of B-HS6-DP1 and B-HS6-DP2.

The influent, intermediate, and effluent samples were analyzed by the laboratory for: total alkalinity, chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN-N), ammonia nitrogen (NH_3-N), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), total phosphorus (TP), orthophosphate (Ortho P), total suspended solids (TSS), volatile suspended solids (VSS), total organic carbon (TOC), fecal coliform (fecal), and E. coli. The influ-

ent and sulfur media samples included sulfate, sulfide, and hydrogen sulfide (unionized). Due to sample volume limits, B-HS6-DP1 and B-HS6-DP2 were only analyzed for the nitrogen species and $CBOD_5$. All analyses were performed by independent and fully NELAC certified analytical laboratories (Southern Analytical Laboratory and Ackuritlabs, Inc.). Table 1 lists the analytical parameters, analytical methods, and detection limits for laboratory analyses.

Table 1
Analytical Parameters, Method of Analysis, and Detection Limits

Analytical Parameter	Method of Analysis	Method Detection Limit (mg/L)
Total Alkalinity as $CaCO_3$	SM 2320B	2 mg/L
Chemical Oxygen Demand (COD)	EPA 410.4	10 mg/L
Total Kjeldahl Nitrogen (TKN-N)	EPA 351.2	0.05 mg/L
Ammonia Nitrogen (NH_3-N)	EPA 350.1	0.005 mg/L
Nitrate Nitrogen (NO_3-N)	EPA 300.0	0.01 mg/L
Nitrite Nitrogen (NO_2-N)	EPA 300.0	0.01 mg/L
Nitrate+Nitrite Nitrogen (NOX-N)	EPA 300.0	0.02 mg/L
Total Phosphorus (TP)	SM 4500P-E	0.01 mg/L
Orthophosphate as P (Ortho P)	EPA 300.0	0.01 mg/L
Carbonaceous Biological Oxygen Demand ($CBOD_5$)	SM5210B	2 mg/L
Total Solids (TS)	EPA 160.3	.01 % by wt
Total Suspended Solids (TSS)	SM 2540D	1 mg/L
Volatile Suspended Solids (VSS)	EPA 160.4	1 mg/L
Total Organic Carbon (TOC)	SM5310B	0.06 mg/L
Sulfate	EPA 300.0	2.0 mg/L
Sulfide	SM 4500SF	0.10 mg/L
Hydrogen Sulfide (unionized)	SM 4550SF	0.01 mg/L
Fecal Coliform (fecal)	SM9222D	1 ct/100mL
E.coli	EPA1603	2 ct/100mL

4.0 Results and Discussion

4.1 Operational Monitoring

Table 2 provides a summary of the household water use since the new treatment system installation on November 6, 2013. The treatment system flow meter readings for the B-HS6 field site are summarized in Table 2. The operation and maintenance log which includes actions taken since start-up is provided in Appendix B. Summary tables of the Vericomm PLC recorded data are provided in Appendix C. These include daily and cumulative pump runtime and system alarms that are used to check general pump operation and performance.

Table 2
Summary of Flowmeters

Date and Time Read	Household Water Meter Reading	Average Daily Household Flow between readings	PNRS Flow Meter Reading	Average PNRS Flow between readings	Ratio PNRS flow to Household flow
	Cumulative Volume (gallons)	gallons/ day	Cumulative Volume (gallons)	gallons/ day	PNRS:HH
11/6/2013 12:15	99,030.4	Installed	1,027,435.3	Installed	Installed
11/14/2013 12:30	100,113.9	Start-up	1,027,435.3	Start-up	Start-up
11/20/2013 8:04	100,925.7	139.6	1,028,375.4	161.7	1.16
12/4/2013 7:52	102,616.8	120.9	1,030,645.4	162.3	1.34
12/20/2013 12:46	104,570.6	120.6	1,033,374.2	168.4	1.40
1/9/2014 11:49	107,163.1	129.9	1,036,306.1	146.9	1.13
1/22/2014 8:55	109,061.5	147.4	1,038,248.5	150.8	1.02
3/7/2014 10:30	115,093.0	136.9	1,045,302.0	160.1	1.17
3/20/2014 11:45	116,543.0	111.1	1,047,111.1	138.6	1.25
3/24/2014 10:50	116,979.0	110.1	1,047,597.8	122.9	1.12
4/10/2014 9:29	118,873.3	111.8	1,050,015.7	142.7	1.28
4/14/2014 19:15	119,370.5	112.8	1,050,622.9	137.8	1.22
4/16/2014 14:29	119,594.6	124.4	1,050,904.4	156.3	1.26
4/28/2014 12:47	120,956.3	114.1	1,052,696.0	150.2	1.32
5/7/2014 9:33	122,109.1	130.0	1,054,174.5	166.8	1.28
5/27/2014 12:26	124,623.2	125.0	1,057,401.8	160.4	1.28
5/30/2014 9:45	124,853.9	79.9	1,057,698.3	102.6	1.28
6/23/2014 9:00	127,482.8	109.7	1,060,658.0	123.5	1.13
7/21/2014 11:34	130,874.8	120.7	1,064,238.6	127.4	1.06
8/26/2014 8:54	135,223.9	121.2	1,068,857.5	128.7	1.06
8/27/2014 10:05	135,334.0	104.9	1,069,055.3	188.4	1.80
9/26/2014 11:27	139,560.0	140.6	1,074,161.6	169.9	1.21
10/3/2014 9:59	140,410.5	122.6	1,075,072.1	131.2	1.07
10/16/2014 11:36	142,525.8	161.9	1,077,527.8	187.9	1.16
10/30/2014 9:30	144,872.7	168.7	1,080,135.5	187.4	1.11
Average since start-up to October 30, 2014		127.9		150.6	1.18

On November 14, 2013, an alarm indicated a pump failure and upon inspection loose wiring was discovered and repaired. PNRS flow readings indicated that the pump had not run since installation until the time the wiring was repaired, therefore the official start-up of the PNRS system was November 14, 2013 (Experimental Day 0). From system start-up through October 30, 2014, the household water use average was 127.9 gallons per day with periods of higher and lower flows (Table 2). The average pumped flow to

the PNRS was 150.6 gallons per day from start-up through October 30, 2014. The metered PNRS flow is continuously reading higher (by approximately 20 percent) than the household water meter. The reason for the difference in the two meter readings is not known. There is a possibility that there is some drainage back to the pump tank following each dose cycle, because a check valve was not installed on the pump discharge line.

Based on the hydraulic design of the system, a normally expected water level in the Stage 1&2a tank would be approximately 98.52 ft. elevation, or a depth above tank bottom of 4.8 inches. The normal operation level in the Stage 1&2a tanks therefore could be expected to vary between 4 and 6 inches above the tank bottom. Water levels above these values could adversely affect treatment performance and would suggest hydraulic blockages in the system. While purging the Stage 1 effluent drive points DP1 and DP2 during Sample Event No. 2, it was observed that the water level in the Stage 1&2a tank was elevated above the pans holding the drive points. The water level in the Stage 1&2a tank was found to be elevated approximately 10-inches above the invert of the collection pipe during that sample event. This water level would saturate all 12-inches of the lignocellulosic media and approximately 2-inches of the expanded clay media. The elevated water level could quite possibly have affected the performance of the system as monitored in Sample Event 2. A piezometer was installed within the Stage 1&2a tank on April 10, 2014 to provide water level observations (Figure 12).

Figure 12
Piezometer installed on April 19, 2014 in the Stage 1&2a Tank

Table 3 summarizes the water level readings recorded. On April 14, 2014, it was determined the clog in the system was in the inlet pipe on the Stage 2b sulfur tank. An unsuccessful attempt was made with a plumbing snake to clear the clog. On April 16, 2014, the clog was cleared using compressed air and a 4-inch rubber bladder; the water level in the Stage 1&2a tank was restored to normal operational levels. During the following monitoring event, Sample Event No. 3, the water level in the Stage 1&2a tank was at normal operational levels. A system check on May 27, 2014 indicated that the water level was elevated approximately 8 inches above the tank bottom. A repair on the inlet pipe to the Stage 2b sulfur tank was completed on May 31, 2014. The repair included drilling additional holes in the inlet pipe and replacing the mesh material surrounding the pipe with a different type with larger mesh size to prevent future clogging. During a system check on September 26, 2014, the water level in the Stage 1&2a tank piezometer was elevated by approximately 8 inches. This could have results in greater saturation of lignocellulosic media in Stage 2a, but submergence of the pans holding drive points DP1 and DP2 would not be expected. It was determined that the out flow pipe of the Stage 1&2a tank was partially clogged. A clean out was installed on the outflow pipe, just downgradient of the Stage 1&2a tank on October 9, 2014 which allowed access to clean the perforations in the effluent collection pipe. In addition, additional holes were drilled in the effluent collection pipe inside the tank. The water level in the Stage 1&2a tank was at normal operational levels during Sample Event No. 6, the subject of this report.

Table 3
Summary of Stage 1&2a Water Level

Date and Time Read	Water level In Stage1&2a PZ from TOC	Water Elev	Water level above bottom of tank[1]	Water level above outlet invert
	(ft)	(ft)	(in)	(in)
4/14/2014 19:20	3.74	99.57	17.63	13.63
4/14/2014 19:35	3.75	99.56	17.51	13.51
4/16/2014 14:35	3.77	99.54	17.27	13.27
4/16/2014 16:16	4.76	98.55	5.39	1.39
4/16/2014 16:25	4.79	98.52	5.03	1.03
4/16/2014 16:49	4.81	98.50	4.79	0.79
5/6/2014 9:35	4.71	98.60	5.99	1.99
5/6/2014 9:58	4.66	98.65	6.59	2.59
5/7/2014 9:39	4.68	98.63	6.35	2.35
5/7/2014 10:51	4.70	98.61	6.11	2.11
5/27/2014 12:00	4.02	99.29	14.27	10.27
5/30/2014 9:51	4.09	99.22	13.43	9.43
5/30/2014 15:10	4.79	98.52	5.03	1.03
5/31/2014 19:03	4.79	98.52	5.03	1.03
6/23/2014 9:06	4.61	98.70	7.19	3.19
6/23/2014 12:25	4.52	98.79	8.27	4.27
7/21/2014 11:43	4.49	98.82	8.63	4.63
8/26/2014 9:05	4.36	98.95	10.19	6.19
8/27/2014 10:13	4.33	98.98	10.55	6.55
9/26/2014 12:32	4.04	99.27	14.03	10.03
10/3/2014 10:03	4.11	99.20	13.19	9.19
10/20/2014 15:58	4.70	98.61	6.11	2.11
10/29/2014 13:19	4.71	98.60	5.99	1.99
10/30/2014 9:33	4.71	98.60	5.99	1.99

[1]Stage 1&2a tank interior bottom elev = 98.10

4.2 Energy Consumption

Energy consumption is monitored using an electrical meter installed between the main power box for the house and the control panel to record cumulative power usage of the pump in kilowatt-hours. The recorded electrical use for the system is summarized in Table 4 and has been fairly consistent through system operation.

Table 4
Summary of System Electrical Use

Date and Time Read	Electrical Meter Reading	Average Daily Electrical Use	Average Electrical Use per Gallon Treated	Average Electrical Use per 1,000 Gallons Treated
	Cumulative (kWh)	(kWh/day)	(kWh/gal)	(kWh/ 1,000 gal)
11/6/2013 12:22	2,749	0.00		
11/14/2013 12:32	2,749	0.00		
11/20/2013 8:08	2,751	0.34	0.0021	2.127
12/4/2013 7:54	2,757	0.43	0.0026	2.643
12/20/2013 12:48	2,764	0.43	0.0026	2.565
1/9/2014 11:53	2,772	0.40	0.0027	2.729
1/22/2014 8:57	2,777	0.39	0.0026	2.574
3/7/2014 10:32	2,797	0.45	0.0028	2.836
3/20/14 11:47	2,802	0.38	0.0028	2.764
3/24/2014 10:51	2,803	0.25	0.0021	2.054
4/10/2014 9:32	2,811	0.47	0.0033	3.309
4/14/2014 19:17	2,813	0.45	0.0033	3.293
4/16/2014 14:31	2,814	0.56	0.0036	3.552
4/28/2014 12:48	2,820	0.50	0.0033	3.349
5/7/2014 9:34	2,825	0.99	0.0034	3.382
5/27/2014 12:27	2,835	0.50	0.0031	3.099
5/30/2014 9:47	2,836	0.35	0.0034	3.373
6/23/2014 9:01	2,846	0.42	0.0034	3.379
7/21/2014 11:36	2,857	0.39	0.0031	3.072
8/27/2014 10:03	2,876	0.51	0.0024	2.417
9/26/2014 11:25	2,897	0.70	0.0041	4.113
10/3/2014 9:57	2,901	0.58	0.0044	4.393
10/16/2014 11:35	2,910	0.69	0.0037	3.665
10/30/2014 9:28	2,918	0.58	0.0031	3.068
Total average start-up to 10/30/2014		0.48	0.0032	3.207

The total average electrical use through October 30, 2014 was 0.48 kWh per day. The average electrical use per 1,000 gallons treated was 3.21 kWh per 1,000 gallons treated, and this parameter has been fairly stable since start-up.

4.3 Water Quality

As discussed in the Sample Event No. 1 (SE1) report, the preliminary sampling results indicated that ammonia reduction through the Stage 1 biofilter was limited. During preliminary sampling, it was observed that the sprayers were not spraying uniformly over the Stage 1 media surface. Therefore on December 21, 2013, the sprayers were rotated to spray up on the tank lid rather than straight down for better distribution over the media surface. The results from the SE1 DP1 and DP2 samples indicated significant nitrification was occurring with this sprayer set-up; however, the long-term operation and maintenance of the sprayers in this set-up was a concern. Therefore, on March 20, 2014, the four originally installed spray nozzles were replaced by three Orenco^{TM} spin nozzles positioned under the tank lids allowing for easy maintenance and maximum spray coverage. During a system check on October 3, 2014, two of the Orenco^{TM} spin nozzles were observed to be spinning slowly and not providing full coverage. New nozzles were installed on October 20, 2014 prior to the current Sample Event 6.

Water quality results for the sixth full sampling event (Sample Event No. 6) are listed in Table 5. Nitrogen results are graphically displayed in Figure 13. The laboratory report containing the raw analytical data is included in Appendix A. The following discussion summarizes the water quality analytical results for Sample Event No. 6. The performance of the various system components was compared by considering the changes through treatment of nitrogen species (TKN, NH_3-N, and NO_X-N), as well as supporting water quality parameters.

$CBOD_5$ mg/L	62	200	3	12	13	13	7
TKN mg N/L	59	0.5	0.5	0.5	0.5	3.1	4.2
NH_3 mg N/L	44	0.1	0.1	0.4	0.2	2.7	3.0
NO_x mg N/L	0.2	56	52	13	6.5	35.2	0.1
TN mg N/L	59.2	56.6	53	13.6	7.0	38.3	4.3
Sulfate mg/L	3	NA	NA	NA	17	16	150
Fecal Coliform (Ct/100mL)	200,000	NA	NA	11,000	1,400	15,000	6,000

NA = not analyzed

Figure 13
Graphical Representation of Nitrogen Results
Sample Event 6 October 30, 2014 (Experimental Day 350)

Septic Tank Effluent (STE) Quality: The water quality characteristics of STE collected in Sample Event 6 were within the typical range generally expected for domestic STE. The measured TN concentration for this sample event was approximately 59 mg-N/L, which is in the range typically seen for this household.

Stage 1 Unsaturated Effluent (DP1 and DP2): Stage 1 effluent (DP1 and DP2) NO_x-N concentration were 56 and 52 mg/L for samples DP1 and DP2, respectively. The TKN and NH_3-N concentrations in both samples were below 0.5 mg/L and 0.1 mg/L, respectively. These results indicate complete nitrification of the effluent by the Stage 1 biofilter. With the replacement of two sprayers, it appears that the water quality characteristics are more similar in the two monitoring locations; therefore there is less variability in performance across the biofilter surface area.

Stage 2a Saturated Effluent (DP3 and DP4): Stage 2a saturated effluent is collected from two drive points (DP3 and DP4) located on the bottom of the Stage 1&2a tank. DP3 and DP4 effluent TKN concentrations were below the method detection level of 0.5 mg/L, and the NH_3-N concentrations were 0.44 mg/L and 0.18 mg/L, respectively. NO_x-N concentrations in DP3 and DP4 samples were 13.1 mg/L and 6.5 mg/L, respectively, and were accompanied by a measured DO of 0.30 and 0.33 mg/L and ORP of -144 and -184 mV, respectively. The $CBOD_5$ concentrations were 12 mg/L and 13 mg/L in DP3 and DP4 samples, respectively. The Stage 2a samples also indicate less variability in performance across the biofilter.

Stage 1&2a Tank Effluent (ST1&2a): The sample port between the Stage 1&2a combination tank and the Stage 2b sulfur tank represents the effluent from the Stage 1&2a tank and the influent to the Stage 2b biofilter. The Stage 1&2a sample port effluent TKN was 3.1 mg/L of which 2.7 mg/L was NH_3-N. The NO_x-N concentration was 35.2 mg/L and was accompanied by a measured DO of 0.64 mg/L DO and ORP of -25 mV. The Stage 1&2a effluent TSS concentration was 6 mg/L and $CBOD_5$ was 13 mg/L. The ST1 sample indicates incomplete nitrification and some denitrification in the Stage 1&2a biofilter.

Stage 2b Tank Effluent (ST2b): In Sample Events 1 and 2 the monitoring points, B-HS6-ST2b-T and B-HS6-ST2b-P had nearly identical nitrogen concentrations. For this sample event, B-HS6-ST2b-T was not sampled. B-HS6-ST2b-P was chosen as the preferred sample point as it is located in the pipe leading from the PNRS system to the drainfield.

Effluent NO_x-N from the Stage 2b biofilter was approximately 0.13 mg/L. The low NO_x-N was accompanied by a measured DO of 0.56 mg/L and ORP of -139 mV. The Stage 2b biofilter achieved complete NO_x-N reduction. However, the only partially successful NH_3-N reduction through the Stage 1&2a biofilter, was evidenced in the Stage 2b effluent NH_3-N concentration of 3.0 mg/L and TKN of 4.2 mg/L. Final total nitrogen (TN) in the treatment system effluent was 4.3 mg/L. The Stage 2b effluent sulfate concentration was 150 mg/L.

As discussed above, the samples from inside the Stage 1&2a tank (DP3 and DP4) had different water quality characteristics as compared to the ST1&2a tank effluent. The 35 mg/L NO_x-N concentration in the ST1&2a sample was higher than the DP03 and DP04 NO_x-N concentrations of 13 mg/L and 6.4 mg/L, respectively.

A stoichiometric equation for autotrophic denitrification using sulfur as an electron donor is (Batchelor and Lawrence, 1978):

$$1.0\ NO_3^- + 1.10\ S^0 + 0.40\ CO_2 + 0.76\ H_2O + 0.08\ NH_4^+ \rightarrow 0.08\ C_5H_7O_2N + 0.50\ N_2 + 1.10\ SO_4^{2-} + 1.28\ H^+$$

Based on this equation, for each gram of NO_3^-N removed approximately 7.54 g SO_4^{2-} are generated. The ST2b sulfate concentration of 150 mg/L is much less than expected with an influent (ST1&2a) NO_x-N concentration of 35.2 mg-N/L and complete NO_x-N removal as indicated with effluent (ST2b) NO_x-N concentration of 0.13 mg-N/L.

In addition, total alkalinity was shown to increase when comparing the DP1 and DP2 concentrations of 130 and 170 mg/L with the DP3 and DP4 concentrations of 310 and 370 mg/L as expected with heterotrophic denitrification which produces alkalinity. However, the lower than expected Stage 1&2a total alkalinity concentration of 200 mg/L does not show similar increases in alkalinity. The ST1&2a duplicate sample does confirm sample accuracy with similar NO_x-N concentration of 36.17 mg-N/L and total alkalinity of 190 mg/L.

Lastly, the Stage 1 samples (DP1 and DP2) showed nearly complete nitrification with TKN and NH_3-N concentrations in both samples below 0.5 mg/L and 0.1 mg/L, respectively. The DP3 and DP4 were similar with TKN and NH_3-N concentrations below 0.5 mg/L. However, the ST1&2a differed again with higher TKN and NH_3-N concentrations of 3.1 and 2.7, respectively. Interestingly, the higher TKN and NH_3-N concentrations in the ST1&2a effluent is more similar to the ST2b concentrations of 4.2 and 3 mg/L, respectively. The unexpected differences in water quality at the various sample locations as discussed above cannot be explained at this time; however, could be attributed to hydraulic residence time, sampling methodology, an artifact from hydraulic issues previously discussed, etc.

Table 5
Water Quality Analytical Results

Sample ID	Sample Date/Time	Temp (°C)	pH	Total Alkalinity (mg/L)	DO (mg/L)	ORP (mV)	Specific Conductance (µS)	TSS (mg/L)	VSS (mg/L)	$CBOD_5$ (mg/L)	COD (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH_3-N (mg/L N)	NO_3-N (mg/L N)	NO_2-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	TP (mg/L)	Ortho P (mg/L P)	Sulfate (mg/L)	H_2S (mg/L)	Sulfide (mg/L)	Fecal (Ct/100 mL)	E-coli (Ct/100 mL)
BHS6-STE	10/30/14 10:02	21.9	7.35	460	0.23	-220	1018	21	21	62	150	59.2	59	15.0	44	0.11	0.08	0.19	44.19	6.6	5.6	2.6	0.01	0.79	200,000	190,000
BHS6-DP01	10/30/14 10:44			130				74	52	200	54	56.6	0.5	0.4	0.095	56	0.13	56.13	56.225							
BHS6-DP02	10/30/14 10:48			170				104	44	3	20	52.7	0.5	0.4	0.096	52	0.18	52.18	52.276							
BHS6-DP03	10/30/14 10:24	20.4	6.29	310	0.3	-144	795	2	2	12	45	13.6	0.5	0.1	0.44	13	0.14	13.14	13.58	0.19					11,000	9,000
BHS6-DP04	10/30/14 10:30	20.3	6.43	370	0.33	-184	904	1	1	13	68	7.0	0.5	0.3	0.18	6.4	0.05	6.45	6.63			17			1,400	760
BHS6-ST1&2a	10/30/14 10:08	20.5	6.47	200	0.64	-25	790	6	6	13	37	38.3	3.1	0.4	2.7	35	0.18	35.18	37.88	3.7	3.2	16	0.3	0.38	15,000	13,000
BHS6-ST1&2a-DUP	10/30/14 10:12	20.5	6.47	190	0.57	-28	795	6	6	16	39	38.9	2.7	0.8	1.9	36	0.17	36.17	38.07	3.5	3.3	16	0.3	0.38	13,000	12,000
BHS6-ST2b-Port	10/30/14 9:50	20.1	6.64	290	0.56	-139	981	4	4	7	37	4.3	4.2	1.2	3	0.11	0.02	0.13	3.13	3.1	2.7	150	0.14	0.18	6,000	6,000
BHS6-EB	10/30/14 10:38	19.1	6.76	2.2	0.3	22	2.8	1	1	2	10	0.08	0.05	0.0	0.018	0.02	0.01	0.03	0.048	0.01	0.016	0.2	0.01	0.1	2.0	2.0

Table 6
Water Quality Analytical Results

Sample ID	Statistical Parameter	Temp (°C)	pH[4]	Total Alkalinity (mg/L)	DO (mg/L)	ORP (mV)	Specific Conductance (µS)	TSS (mg/L)	VSS (mg/L)	$CBOD_5$ (mg/L)	COD (mg/L)	TN (mg/L N)[1]	TKN (mg/L N)	Organic N (mg/L N)[2]	NH_3-N (mg/L N)	NO_3-N (mg/L N)	NO_2-N (mg/L N)	NOx (mg/L N)	TIN (mg/L N)[3]	TP (mg/L)	Ortho P (mg/L P)	Sulfate (mg/L)	H2S (mg/L)	Sulfide (mg/L)	Fecal[4] (Ct/100 mL)	E-coli[4] (Ct/100 mL)
BHS6-STE	n	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	7
	MEAN	20.9	7.2	516.3	0.1	-187.1	1,145.4	26.3	24.1	73.9	163.8	65.8	54.8	-1.8	56.6	0.0	0.0	0.1	56.7	10.0	5.2	3.0	1.5	3.1	320,693	220,716
	STD. DEV.	3.1		46.3	0.1	55.5	93.8	7.8	7.1	27.2	24.5	19.3	24.5	35.1	21.0	0.0	0.0	0.1	21.0	3.8	0.7	2.1	1.0	1.6		
	MIN	16.1	7.1	460.0	0.0	-245.0	1,018.0	16.0	15.0	60.0	140.0	33.0	7.4	-87.6	23.0	0.0	0.0	0.0	23.0	6.3	4.4	0.5	0.0	0.8	120,000	64,000
	MAX	25.9	7.4	600.0	0.2	-98.0	1,278.0	42.0	38.0	140.0	200.0	95.0	81.0	20.0	95.0	0.1	0.1	0.2	95.0	17.0	6.3	6.9	2.6	4.9	1,900,000	1,800,000
BHS6-ST1&2a	n	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	7	7
	MEAN	20.0	6.4	304.3	0.7	-91.0	906.0	6.7	6.3	36.4	81.7	31.5	14.3	3.4	10.9	16.4	0.8	17.2	28.1	5.7	2.7	15.8	0.8	1.1	12,354	10,332
	STD. DEV.	3.8		98.8	0.5	47.2	95.3	3.7	3.5	27.9	68.6	12.2	15.6	2.9	13.0	13.8	0.6	13.3	10.9	4.2	0.8	3.8	1.4	1.9		
	MIN	13.8	6.2	200.0	0.2	-146.0	790.0	1.0	1.0	10.0	37.0	10.8	3.1	0.4	1.8	0.0	0.1	0.9	9.6	2.8	1.4	9.0	0.0	0.1	3,700	3,600
	MAX	26.5	6.7	500.0	1.7	-25.0	1091.0	11.0	10.0	72.0	230.0	49.7	48.0	9.0	39.0	35.0	1.5	35.2	40.7	15.0	3.7	20.0	3.5	5.0	63,000	51,000
BHS6-ST2b-Port	n	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
	MEAN	19.7	6.6	362.9	0.3	-180.4	1059.1	8.4	6.7	19.6	94.3	11.7	11.7	2.5	9.2	0.0	0.0	0.0	9.2	5.5	2.8	125.3	5.4	6.9	3,105	2,919
	STD. DEV.	4.1		68.7	0.1	57.5	103.8	13.1	8.5	27.5	126.2	8.9	8.9	1.7	7.3	0.0	0.0	0.0	7.3	4.3	0.9	34.3	9.2	10.5		
	MIN	13.6	6.2	290.0	0.2	-239.0	895.0	2.0	2.0	3.0	35.0	4.3	4.2	1.0	3.0	0.0	0.0	0.0	3.1	3.0	2.0	64.0	0.1	0.2	1,000	1,000
	MAX	25.7	6.9	480.0	0.6	-71.0	1216.0	38.0	26.0	78.0	380.0	31.0	31.0	6.0	25.0	0.1	0.0	0.1	25.0	15.0	4.7	160.0	26.0	30.0	6,000	6,000
BHS6-ST2b-Tee	n	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	MEAN	16.3	6.6	400.0	0.1	-181.0	1082.7	21.0	18.7	32.0	146.3	20.4	20.3	6.3	14.1	0.0	0.0	0.0	14.1	6.9	3.2	95.0	7.9	10.3	4,320	3,729
	STD. DEV.	2.3		88.9	0.0	95.3	166.1	18.1	16.6	21.4	167.7	15.3	15.3	6.8	8.6	0.0	0.0	0.0	8.6	6.2	1.3	33.6	8.2	9.3		
	MIN	13.7	6.2	300.0	0.1	-237.0	897.0	2.0	1.0	15.0	49.0	11.0	11.0	1.5	8.7	0.0	0.0	0.0	8.8	3.0	2.0	63.0	1.0	1.4	1,800	1,800
	MAX	17.9	6.9	470.0	0.1	-71.0	1217.0	38.0	34.0	56.0	340.0	38.0	38.0	14.0	24.0	0.1	0.0	0.1	24.0	14.0	4.5	130.0	17.0	20.0	8,000	6,000
BHS6-DP01	n	1	1	3	1	1	1	2	2	4	3	5	5	5	7	6	7	7	7	0	0	0	0	0	0	0
	MEAN	19.7	6.9	119.0	2.5	40.0	929.0	41.0	28.0	55.8	32.3	49.7	6.0	2.6	11.0	42.7	0.4	36.9	47.9							
	STD. DEV.			28.2				46.7	33.9	96.2	18.8	28.4	5.9	2.2	21.1	25.0	0.6	27.9	22.8							
	MIN	19.7	6.9	87.0	2.5	40.0	929.0	8.0	4.0	5.0	20.0	3.3	0.5	0.1	0.1	0.1	0.0	0.1	3.2							
	MAX	19.7	6.9	140.0	2.5	40.0	929.0	74.0	52.0	200.0	54.0	81.0	16.0	5.1	58.0	76.0	1.6	76.0	77.5							
BHS6-DP02	n	1	1	2	1	1	1	2	2	3	2	4	4	4	6	5	6	6	6	0	0	0	0	0	0	0
	MEAN	19.8	7.0	127.1	3.4	12.0	917.0	141.3	61.5	3.1	21.0	35.3	4.5	1.4	4.0	17.6	0.2	8.1	36.9							
	STD. DEV.							62.2	29.7	1.5	1.4	29.2	5.0	0.9	18.7	25.1	0.8	27.3	22.7							
	MIN	19.8	7.0	95.0	3.4	12.0	917.0	104.0	44.0	2.0	20.0	7.4	0.5	0.4	0.1	0.3	0.0	0.0	5.6							
	MAX	19.8	7.0	170.0	3.4	12.0	917.0	192.0	86.0	5.0	22.0	77.6	12.0	2.3	50.0	68.0	2.1	68.0	75.3							
BHS6-DP03	n	6	6	3	6	6	6	3	3	6	2	6	6	6	6	6	6	6	6	1	0	0	0	0	2	2
	MEAN	20.7	6.3	374.3	0.4	-132.5	933.8	3.8	3.5	75.5	49.5	20.1	10.1	4.0	6.1	9.7	0.6	10.1	16.1	0.2					13,266	4,837
	STD. DEV.	4.6		81.9	0.2	32.2	107.5	2.5	2.6	130.2	6.4	10.8	6.5	4.2	4.9	9.6	0.8	9.3	11.1							
	MIN	14.4	5.5	310.0	0.2	-184.0	795.0	2.0	2.0	2.0	45.0	5.6	0.5	0.1	0.4	0.0	0.0	0.0	3.8	0.2					11,000	2,600
	MAX	26.8	6.8	470.0	0.8	-93.0	1101.0	7.0	7.0	340.0	54.0	34.0	16.0	11.9	14.0	22.0	2.1	22.0	29.4	0.2					16,000	9,000
BHS6-DP04	n	6	6	3	6	6	6	3	3	6	3	6	6	6	6	6	6	6	6	0	0	3	0	0	2	2
	MEAN	20.6	6.2	353.3	0.4	-142.7	979.0	4.0	4.0	109.7	99.3	11.8	8.5	4.2	4.3	2.9	0.4	3.3	7.5			8.0			11,225	775
	STD. DEV.	4.7		56.9	0.2	45.0	102.6	4.4	4.4	169.6	27.6	7.6	7.0	5.3	5.6	3.5	0.4	3.6	7.5			7.8				
	MIN	14.2	5.3	290.0	0.2	-184.0	888.0	1.0	1.0	13.0	68.0	3.8	0.5	0.3	0.2	0.0	0.0	0.0	1.2			3.4			1,400	760
	MAX	26.7	6.5	400.0	0.9	-80.0	1166.0	9.0	9.0	450.0	120.0	21.0	16.0	14.8	14.0	8.3	1.1	9.0	17.3			17.0			90,000	790

Notes:

[1]Total Nitrogen (TN) is a calculated value equal to the sum of TKN and NO_X.

[2]Organic Nitrogen (ON) is a calculated value equal to the difference of TKN and NH_3.

[3]Total Inorganic Nitrogen (TIN) is a calculated value equal to the sum of NH_3 and NO_X.

[4]Geometric mean provided rather than arithmetic mean.

5.0 B-HS6 Sample Event No. 6: Summary

5.1 Summary

The Sample Event No. 6 results indicate that:

- Septic tank effluent (STE) quality is characteristic of typical household STE quality, although in the lower range seen at this household. The total nitrogen of 59 mg/L is in the range of values typically reported for Florida single family residence STE.

- The Stage 1 biofilter samples DP1 and DP2 showed 99.8% reduction in ammonium concentration; effluent in the DP1 and the DP2 samples were below the method detection level of 0.5 mg/L ammonia-N.

- The Stage 1&2a effluent sample port (ST1&2a) between the Stage 1&2a combination tank outlet and the Stage 2b sulfur tank inlet, showed 94% reduction in ammonium concentration from STE.

- The Stage 2b sulfur biofilter (ST2b) effluent NO_x-N was 0.13 mg/L.

- The total nitrogen concentration in the final effluent from the total treatment system was 4.3 mg/L, of which 3.0 mg/L was NH_3-N, an approximately 93% reduction from STE.

Appendix A: Laboratory Report

SOUTHERN ANALYTICAL LABORATORIES, INC.
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Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

November 13, 2014
Work Order: 1410871

Laboratory Report

Project Name **BHS6 SE#7**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS6-STE**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-01**						
Date/Time Collected		**10/30/14 10:02**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	11/10/14 10:13	11/10/14 10:22	1
Ammonia as N	mg/L	44 J5	EPA 350.1	3.6	0.85		11/03/14 15:49	90
Carbonaceous BOD	mg/L	62	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	150	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	0.10 U	EPA 353.2	0.40	0.10		11/03/14 11:24	10
Nitrite (as N)	mg/L	0.08	SM 4500NO2-B	0.04	0.01		10/31/14 14:11	1
Orthophosphate as P	mg/L	5.6	SM 4500P-E	0.040	0.012		10/31/14 14:23	1
Phosphorous - Total as P	mg/L	6.6	SM 4500P-E	0.80	0.20	11/03/14 08:41	11/04/14 08:01	20
Sulfate	mg/L	2.6 I	EPA 300.0	6.0	2.0		11/12/14 17:05	10
Sulfide	mg/L	0.79	SM 4500SF	0.40	0.10		11/06/14 18:37	1
Total Alkalinity	mg/L	460	SM 2320B	8.0	2.0		11/03/14 14:54	1
Total Kjeldahl Nitrogen	mg/L	59	EPA 351.2	4.0	1.0	11/03/14 08:41	11/04/14 08:01	20
Total Suspended Solids	mg/L	21	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	21	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	0.11 U	EPA 353.2	0.44	0.11		11/03/14 11:24	10
Sample Description		**BHS6-DP01**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-02**						
Date/Time Collected		**10/30/14 10:44**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Ammonia as N	mg/L	0.095 U	EPA 350.1	0.40	0.095		11/03/14 15:16	10
Carbonaceous BOD	mg/L	200	SM 5210B	2	2	11/01/14 10:37	11/08/14 10:53	1
Chemical Oxygen Demand	mg/L	54	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	56	EPA 353.2	4.0	1.0		11/03/14 12:22	100
Nitrite (as N)	mg/L	0.13	SM 4500NO2-B	0.04	0.01		10/31/14 14:11	1
Total Alkalinity	mg/L	130	SM 2320B	8.0	2.0		11/03/14 14:58	1
Total Kjeldahl Nitrogen	mg/L	0.50 U	EPA 351.2	2.0	0.50	11/03/14 08:41	11/04/14 08:01	10
Total Suspended Solids	mg/L	74	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	52	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	56	EPA 353.2	4.0	1.0		11/03/14 12:22	100

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November 13, 2014
Work Order: 1410871

Laboratory Report

Project Name **BHS6 SE#7**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS6-DP02**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-03**						
Date/Time Collected		**10/30/14 10:48**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Ammonia as N	mg/L	0.096	EPA 350.1	0.040	0.009		11/03/14 14:24	1
Carbonaceous BOD	mg/L	3	SM 5210B	2	2	11/01/14 10:37	11/08/14 10:53	1
Chemical Oxygen Demand	mg/L	20 I	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	53	EPA 353.2	4.0	1.0		11/03/14 12:23	100
Nitrite (as N)	mg/L	0.18 I	SM 4500NO2-B	0.40	0.10		10/31/14 14:30	10
Total Alkalinity	mg/L	170	SM 2320B	8.0	2.0		11/03/14 15:05	1
Total Kjeldahl Nitrogen	mg/L	0.50 U	EPA 351.2	2.0	0.50	11/03/14 08:41	11/04/14 08:01	10
Total Suspended Solids	mg/L	104	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	44	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	52	EPA 353.2	4.4	1.1		11/03/14 12:23	100
Sample Description		**BHS6-DP03**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-04**						
Date/Time Collected		**10/30/14 10:24**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Ammonia as N	mg/L	0.44	EPA 350.1	0.040	0.009		11/03/14 14:25	1
Carbonaceous BOD	mg/L	12	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	45	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	13	EPA 353.2	0.40	0.10		11/03/14 11:35	10
Nitrite (as N)	mg/L	0.14	SM 4500NO2-B	0.04	0.01		10/31/14 14:13	1
Phosphorous - Total as P	mg/L	0.19 I	SM 4500P-E	0.40	0.10	11/03/14 08:41	11/04/14 08:01	10
Total Alkalinity	mg/L	310	SM 2320B	8.0	2.0		11/03/14 15:22	1
Total Kjeldahl Nitrogen	mg/L	0.50 U	EPA 351.2	2.0	0.50	11/03/14 08:41	11/04/14 08:01	10
Total Suspended Solids	mg/L	2	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	2	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	13	EPA 353.2	0.44	0.11		11/03/14 11:35	10

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November 13, 2014
Work Order: 1410871

Laboratory Report

Project Name		BHS6 SE#7						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS6-DP04**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-05**						
Date/Time Collected		**10/30/14 10:30**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Ammonia as N	mg/L	0.18	EPA 350.1	0.040	0.009		11/03/14 14:27	1
Carbonaceous BOD	mg/L	13	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	68	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	6.4	EPA 353.2	0.40	0.10		11/03/14 11:37	10
Nitrite (as N)	mg/L	0.05	SM 4500NO2-B	0.04	0.01		10/31/14 14:14	1
Sulfate	mg/L	17	EPA 300.0	6.0	2.0		11/12/14 17:16	10
Total Alkalinity	mg/L	370	SM 2320B	8.0	2.0		11/03/14 15:35	1
Total Kjeldahl Nitrogen	mg/L	0.50 U	EPA 351.2	2.0	0.50	11/03/14 08:41	11/04/14 08:01	10
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	6.4	EPA 353.2	0.44	0.11		11/03/14 11:37	10
Sample Description		**BHS6-ST1&2a**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-06**						
Date/Time Collected		**10/30/14 10:08**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.30	SM 4550SF	0.04	0.01	11/10/14 10:13	11/10/14 10:22	1
Ammonia as N	mg/L	2.7	EPA 350.1	0.40	0.095		11/03/14 15:18	10
Carbonaceous BOD	mg/L	13	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	37	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	35	EPA 353.2	0.96	0.24		11/03/14 12:24	24
Nitrite (as N)	mg/L	0.18	SM 4500NO2-B	0.04	0.01		10/31/14 14:14	1
Orthophosphate as P	mg/L	3.2	SM 4500P-E	0.040	0.012		10/31/14 14:23	1
Phosphorous - Total as P	mg/L	3.7	SM 4500P-E	0.080	0.020	11/03/14 08:41	11/04/14 08:01	2
Sulfate	mg/L	16	EPA 300.0	3.0	1.0		11/12/14 18:01	5
Sulfide	mg/L	0.38 I	SM 4500SF	0.40	0.10		11/06/14 18:37	1
Total Alkalinity	mg/L	200	SM 2320B	8.0	2.0		11/03/14 15:44	1
Total Kjeldahl Nitrogen	mg/L	3.1	EPA 351.2	0.40	0.10	11/03/14 08:41	11/04/14 08:01	2
Total Suspended Solids	mg/L	6	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	6	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	35	EPA 353.2	1.0	0.25		11/03/14 12:24	24

Florida Certification Number: E84129
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November 13, 2014
Work Order: 1410871

Laboratory Report

Project Name		**BHS6 SE#7**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS6-ST1&2a-DUP**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-07**						
Date/Time Collected		**10/30/14 10:12**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.30	SM 4550SF	0.04	0.01	11/10/14 10:13	11/10/14 10:22	1
Ammonia as N	mg/L	1.9	EPA 350.1	0.040	0.009		11/03/14 14:30	1
Carbonaceous BOD	mg/L	16	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	39	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	36	EPA 353.2	0.96	0.24		11/03/14 12:25	24
Nitrite (as N)	mg/L	0.17	SM 4500NO2-B	0.04	0.01		10/31/14 14:15	1
Orthophosphate as P	mg/L	3.3	SM 4500P-E	0.040	0.012		10/31/14 14:23	1
Phosphorous - Total as P	mg/L	3.5	SM 4500P-E	0.080	0.020	11/03/14 08:41	11/04/14 08:01	2
Sulfate	mg/L	16	EPA 300.0	3.0	1.0		11/12/14 18:12	5
Sulfide	mg/L	0.38 I	SM 4500SF	0.40	0.10		11/06/14 18:37	1
Total Alkalinity	mg/L	190	SM 2320B	8.0	2.0		11/03/14 15:53	1
Total Kjeldahl Nitrogen	mg/L	2.7	EPA 351.2	0.40	0.10	11/03/14 08:41	11/04/14 08:01	2
Total Suspended Solids	mg/L	6	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	6	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	36	EPA 353.2	1.0	0.25		11/03/14 12:25	24
Sample Description		**BHS6-ST2b-P**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-08**						
Date/Time Collected		**10/30/14 09:50**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.14	SM 4550SF	0.04	0.01	11/10/14 10:13	11/10/14 10:22	1
Ammonia as N	mg/L	3.0	EPA 350.1	0.40	0.095		11/03/14 15:19	10
Carbonaceous BOD	mg/L	7	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	37	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	0.10 U	EPA 353.2	0.40	0.10		11/03/14 11:43	10
Nitrite (as N)	mg/L	0.02 I	SM 4500NO2-B	0.04	0.01		10/31/14 14:15	1
Orthophosphate as P	mg/L	2.7	SM 4500P-E	0.040	0.012		10/31/14 14:23	1
Phosphorous - Total as P	mg/L	3.1	SM 4500P-E	0.20	0.050	11/03/14 08:41	11/04/14 08:01	5
Sulfate	mg/L	150	EPA 300.0	6.0	2.0		11/12/14 18:23	10
Sulfide	mg/L	0.18 I	SM 4500SF	0.40	0.10		11/06/14 18:37	1
Total Alkalinity	mg/L	290	SM 2320B	8.0	2.0		11/03/14 16:03	1
Total Kjeldahl Nitrogen	mg/L	4.2	EPA 351.2	1.0	0.25	11/03/14 08:41	11/04/14 08:01	5

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Laboratory Report

Project Name		**BHS6 SE#7**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS6-ST2b-P**						
Matrix		**Wastewater**						
SAL Sample Number		**1410871-08**						
Date/Time Collected		**10/30/14 09:50**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Total Suspended Solids	mg/L	4	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	4	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	0.11 U	EPA 353.2	0.44	0.11		11/03/14 11:43	10
Sample Description		**BHS6-EB**						
Matrix		**Reagent Water**						
SAL Sample Number		**1410871-09**						
Date/Time Collected		**10/30/14 10:36**						
Collected by		**Harmon Harden**						
Date/Time Received		**10/31/14 10:25**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	11/10/14 10:13	11/10/14 10:22	1
Ammonia as N	mg/L	0.018 I	EPA 350.1	0.040	0.009		11/03/14 14:34	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	10/31/14 10:05	11/05/14 15:16	1
Chemical Oxygen Demand	mg/L	10 U	EPA 410.4	25	10	11/10/14 11:37	11/10/14 15:55	1
Nitrate+Nitrite (N)	mg/L	0.01 U	EPA 353.2	0.04	0.01		11/03/14 11:45	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		10/31/14 14:16	1
Orthophosphate as P	mg/L	0.016 I	SM 4500P-E	0.040	0.012		10/31/14 14:23	1
Phosphorous - Total as P	mg/L	0.010 U	SM 4500P-E	0.040	0.010	11/03/14 08:41	11/04/14 08:01	1
Sulfate	mg/L	0.20 U	EPA 300.0	0.60	0.20		11/12/14 18:35	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		11/06/14 18:37	1
Total Alkalinity	mg/L	2.2 I	SM 2320B	8.0	2.0		11/03/14 16:06	1
Total Kjeldahl Nitrogen	mg/L	0.05 U	EPA 351.2	0.20	0.05	11/03/14 08:41	11/04/14 08:01	1
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	11/04/14 08:10	11/05/14 16:46	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	11/04/14 08:10	11/05/14 16:46	1
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		11/03/14 11:45	1

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ43104 - Ortho phosphorus SM4500P-E by seal										
Blank (BJ43104-BLK1)					Prepared & Analyzed: 10/31/14 10:17					
Orthophosphate as P	0.012 U	0.040	0.012	mg/L						
LCS (BJ43104-BS1)					Prepared & Analyzed: 10/31/14 10:17					
Orthophosphate as P	0.807	0.040	0.012	mg/L	0.80		101	90-110		
Matrix Spike (BJ43104-MS1)		**Source: 1411695-01**			Prepared & Analyzed: 10/31/14 10:18					
Orthophosphate as P	1.16	0.040	0.012	mg/L	1.0	0.166	100	90-110		
Matrix Spike Dup (BJ43104-MSD1)		**Source: 1411695-01**			Prepared & Analyzed: 10/31/14 10:19					
Orthophosphate as P	1.14	0.040	0.012	mg/L	1.0	0.166	97	90-110	2	20
Batch BJ43111 - BOD										
Blank (BJ43111-BLK1)					Prepared: 10/31/14 Analyzed: 11/05/14 15:16					
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BJ43111-BS1)					Prepared: 10/31/14 Analyzed: 11/05/14 15:16					
Carbonaceous BOD	196	2	2	mg/L	200		98	85-115		
LCS Dup (BJ43111-BSD1)					Prepared: 10/31/14 Analyzed: 11/05/14 15:16					
Carbonaceous BOD	199	2	2	mg/L	200		99	85-115	1	200
Duplicate (BJ43111-DUP1)		**Source: 1411703-01**			Prepared: 10/31/14 Analyzed: 11/05/14 15:16					
Carbonaceous BOD	440	2	2	mg/L		440			2	25
Batch BJ43118 - Nitrate 353.2 by seal										
Blank (BJ43118-BLK1)					Prepared & Analyzed: 11/03/14 11:11					
Nitrate+Nitrite (N)	0.01 U	0.04	0.01	mg/L						

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BJ43118 - Nitrate 353.2 by seal										
LCS (BJ43118-BS1)					Prepared & Analyzed: 11/03/14 11:13					
Nitrate+Nitrite (N)	0.818	0.04	0.01	mg/L	0.80		102	90-110		
Matrix Spike (BJ43118-MS1)		**Source: 1410871-01**			Prepared & Analyzed: 11/03/14 11:15					
Nitrate+Nitrite (N)	1.21	0.40	0.10	mg/L	1.0	ND	121	90-110		
Matrix Spike (BJ43118-MS2)		**Source: 1411696-01**			Prepared & Analyzed: 11/03/14 11:20					
Nitrate+Nitrite (N)	1.40	0.04	0.01	mg/L	1.0	0.335	106	90-110		
Matrix Spike Dup (BJ43118-MSD1)		**Source: 1410871-01**			Prepared & Analyzed: 11/03/14 11:17					
Nitrate+Nitrite (N)	1.05	0.40	0.10	mg/L	1.0	ND	105	90-110	14	20
Matrix Spike Dup (BJ43118-MSD2)		**Source: 1411696-01**			Prepared & Analyzed: 11/03/14 11:22					
Nitrate+Nitrite (N)	1.43	0.04	0.01	mg/L	1.0	0.335	109	90-110	2	20
Batch BJ43121 - Nitrite SM 4500NO2-B by seal										
Blank (BJ43121-BLK1)					Prepared & Analyzed: 10/31/14 14:09					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
LCS (BJ43121-BS1)					Prepared & Analyzed: 10/31/14 14:09					
Nitrite (as N)	0.0774	0.04	0.01	mg/L	0.080		97	90-110		
Matrix Spike (BJ43121-MS1)		**Source: 1410871-09**			Prepared & Analyzed: 10/31/14 14:10					
Nitrite (as N)	0.0990	0.04	0.01	mg/L	0.10	ND	99	77-119		
Matrix Spike Dup (BJ43121-MSD1)		**Source: 1410871-09**			Prepared & Analyzed: 10/31/14 14:10					
Nitrite (as N)	0.0972	0.04	0.01	mg/L	0.10	ND	97	77-119	2	20

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BK40303 - Digestion for TP and TKN										
Blank (BK40303-BLK1)					Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Phosphorous - Total as P	0.010 U	0.040	0.010	mg/L						
Total Kjeldahl Nitrogen	0.05 U	0.20	0.05	mg/L						
LCS (BK40303-BS1)					Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Phosphorous - Total as P	1.00	0.040	0.010	mg/L	1.0		100	90-110		
Total Kjeldahl Nitrogen	0.904	0.20	0.05	mg/L	1.0		90	90-110		
Matrix Spike (BK40303-MS1)		**Source: 1411755-07**			Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Phosphorous - Total as P	1.22	0.040	0.010	mg/L	1.0	0.187	103	90-110		
Total Kjeldahl Nitrogen	1.50 J2	0.20	0.05	mg/L	1.0	0.720	78	90-110		
Matrix Spike (BK40303-MS2)		**Source: 1410871-09**			Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Total Kjeldahl Nitrogen	0.953 J2	0.20	0.05	mg/L	1.0	ND	95	90-110		
Phosphorous - Total as P	1.13	0.040	0.010	mg/L	1.0	ND	113	90-110		
Matrix Spike Dup (BK40303-MSD1)		**Source: 1411755-07**			Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Total Kjeldahl Nitrogen	2.42 J3	0.20	0.05	mg/L	1.0	0.720	170	90-110	47	20
Phosphorous - Total as P	2.24 J3	0.040	0.010	mg/L	1.0	0.187	205	90-110	59	25
Matrix Spike Dup (BK40303-MSD2)		**Source: 1410871-09**			Prepared: 11/03/14 Analyzed: 11/04/14 08:01					
Phosphorous - Total as P	1.10	0.040	0.010	mg/L	1.0	ND	110	90-110	3	25
Total Kjeldahl Nitrogen	0.959 J2	0.20	0.05	mg/L	1.0	ND	96	90-110	0.6	20
Batch BK40306 - alkalinity										
Blank (BK40306-BLK1)					Prepared & Analyzed: 11/03/14 14:32					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						

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November 13, 2014
Work Order: 1410871

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BK40306 - alkalinity										
LCS (BK40306-BS1)					Prepared & Analyzed: 11/03/14 14:42					
Total Alkalinity	130	8.0	2.0	mg/L	120		106	90-110		
Matrix Spike (BK40306-MS1)		**Source: 1410871-09**			Prepared & Analyzed: 11/03/14 16:11					
Total Alkalinity	130	8.0	2.0	mg/L	120	2.2	106	80-120		
Matrix Spike Dup (BK40306-MSD1)		**Source: 1410871-09**			Prepared & Analyzed: 11/03/14 16:17					
Total Alkalinity	130	8.0	2.0	mg/L	120	2.2	105	80-120	0.6	26
Batch BK40320 - Ammonia by SEAL										
Blank (BK40320-BLK1)					Prepared & Analyzed: 11/03/14 14:06					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
LCS (BK40320-BS1)					Prepared & Analyzed: 11/03/14 14:08					
Ammonia as N	0.50	0.040	0.009	mg/L	0.50		99	90-110		
Matrix Spike (BK40320-MS1)		**Source: 1410871-01**			Prepared & Analyzed: 11/03/14 15:46					
Ammonia as N	41 L	3.6	0.85	mg/L	0.50	44	NR	90-110		
Matrix Spike (BK40320-MS2)		**Source: 1411442-01**			Prepared & Analyzed: 11/03/14 14:13					
Ammonia as N	1.7 J2	0.040	0.009	mg/L	0.50	1.3	80	90-110		
Matrix Spike Dup (BK40320-MSD1)		**Source: 1410871-01**			Prepared & Analyzed: 11/03/14 15:48					
Ammonia as N	42 L	3.6	0.85	mg/L	0.50	44	NR	90-110	2	10
Matrix Spike Dup (BK40320-MSD2)		**Source: 1411442-01**			Prepared & Analyzed: 11/03/14 14:15					
Ammonia as N	1.8 J2	0.040	0.009	mg/L	0.50	1.3	84	90-110	1	10

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November 13, 2014
Work Order: 1410871

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BK40324 - BOD										
Blank (BK40324-BLK1)					Prepared: 11/03/14 Analyzed: 11/08/14 10:53					
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BK40324-BS1)					Prepared: 11/03/14 Analyzed: 11/08/14 10:53					
Carbonaceous BOD	185	2	2	mg/L	200		93	85-115		
LCS Dup (BK40324-BSD1)					Prepared: 11/03/14 Analyzed: 11/08/14 10:53					
Carbonaceous BOD	199	2	2	mg/L	200		99	85-115	7	200
Duplicate (BK40324-DUP1)		**Source: 1411771-01**			Prepared: 11/03/14 Analyzed: 11/08/14 10:53					
Carbonaceous BOD	260	2	2	mg/L		240			8	25
Batch BK40402 - VSS Prep										
Blank (BK40402-BLK1)					Prepared: 11/04/14 Analyzed: 11/05/14 16:46					
Volatile Suspended Solids	1 U	1		mg/L						
Total Suspended Solids	1 U	1	1	mg/L						
LCS (BK40402-BS1)					Prepared: 11/04/14 Analyzed: 11/05/14 16:46					
Total Suspended Solids	52.0	1	1	mg/L	50		104	85-115		
Duplicate (BK40402-DUP1)		**Source: 1410871-01**			Prepared: 11/04/14 Analyzed: 11/05/14 16:46					
Volatile Suspended Solids	21.0	1		mg/L		21.0			0	20
Total Suspended Solids	21.0	1	1	mg/L		21.0			0	30
Batch BK40526 - Sulfide prep										
Blank (BK40526-BLK1)					Prepared & Analyzed: 11/07/14 11:37					
Sulfide	0.10 U	0.40	0.10	mg/L						

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November 13, 2014
Work Order: 1410871

Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BK40526 - Sulfide prep										
LCS (BK40526-BS1)					Prepared & Analyzed: 11/07/14 11:37					
Sulfide	5.20	0.40	0.10	mg/L	5.0		104	85-115		
Matrix Spike (BK40526-MS1)		**Source: 1410871-09**			Prepared & Analyzed: 11/07/14 11:37					
Sulfide	5.00	0.40	0.10	mg/L	5.0	ND	100	85-115		
Matrix Spike Dup (BK40526-MSD1)		**Source: 1410871-09**			Prepared & Analyzed: 11/07/14 11:37					
Sulfide	5.20	0.40	0.10	mg/L	5.0	ND	104	85-115	4	14
Batch BK41022 - COD prep										
Blank (BK41022-BLK1)					Prepared & Analyzed: 11/10/14 15:55					
Chemical Oxygen Demand	10 U	25	10	mg/L						
LCS (BK41022-BS1)					Prepared & Analyzed: 11/10/14 15:55					
Chemical Oxygen Demand	52	25	10	mg/L	50		104	90-110		
Matrix Spike (BK41022-MS1)		**Source: 1410871-09**			Prepared & Analyzed: 11/10/14 15:55					
Chemical Oxygen Demand	52	25	10	mg/L	50	ND	104	85-115		
Matrix Spike Dup (BK41022-MSD1)		**Source: 1410871-09**			Prepared & Analyzed: 11/10/14 15:55					
Chemical Oxygen Demand	47	25	10	mg/L	50	ND	94	85-115	10	32
Batch BK41207 - Ion Chromatography 300.0 Prep										
Blank (BK41207-BLK1)					Prepared & Analyzed: 11/12/14 15:01					
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	*0.865*			*mg/L*	*1.0*		*86*	*78-120*		

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November 13, 2014
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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BK41207 - Ion Chromatography 300.0 Prep										
LCS (BK41207-BS1)					Prepared & Analyzed: 11/12/14 15:12					
Sulfate	9.20	0.60	0.20	mg/L	9.0		102	85-115		
Surrogate: Dichloroacetate	*0.977*			*mg/L*	*1.0*		*98*	*78-120*		
LCS Dup (BK41207-BSD1)					Prepared & Analyzed: 11/12/14 15:23					
Sulfate	9.30	0.60	0.20	mg/L	9.0		103	85-115	1	200
Surrogate: Dichloroacetate	*1.04*			*mg/L*	*1.0*		*104*	*78-120*		
Matrix Spike (BK41207-MS1)		**Source: 1410871-05**			Prepared & Analyzed: 11/12/14 17:27					
Sulfate	95.0	6.0	2.0	mg/L	90	16.8	87	85-115		
Surrogate: Dichloroacetate	*0.972*			*mg/L*	*1.0*		*97*	*78-120*		
Matrix Spike (BK41207-MS2)		**Source: 1412098-02**			Prepared & Analyzed: 11/12/14 19:53					
Sulfate	1,490	60	20	mg/L	900	536	106	85-115		
Surrogate: Dichloroacetate	*1.02*			*mg/L*	*1.0*		*102*	*78-120*		

SOUTHERN ANALYTICAL LABORATORIES, INC.
110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218

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Tampa, FL 33619

November 13, 2014
Work Order: 1410871

* Qualifiers, Notes and Definitions

Results followed by a "U" indicate that the sample was analyzed but the compound was not detected. Results followed by "I" indicate that the reported value is between the laboratory method detection limts and the laboratory practical quantitation limit.

A statement of estimated uncertainty of test results is available upon request.

For methods marked with **, all QC criteria have been met for this method which is equivalent to a SAL certified method.

Test results in this report meet all the requirements of the NELAC standards. Any applicable qualifiers are shown below.

L	Off-scale high. Result exceeded highest calibration standard.
J5	Matrix spike of this sample was outside typical range. All other QC criteria were acceptable.
J3	Quality control value for precision was outside control limits.
J2	Quality control value for accuracy was outside control limits.

Questions regarding this report should be directed to :

Kathryn Nordmark
Telephone (813) 855-1844 FAX (813) 855-2218
Kathryn@southernanalyticallabs.com

SOUTHERN ANALYTICAL LABORATORIES, INC.
110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 fax 813-855-2218

SAL Project No. 141087

Client Name	Contact / Phone:
Hazen and Sawyer	
Project Name / Location: BHS6 SE#7	
Samplers: (Signature)	

Matrix Codes: DW-Drinking Water WW-Wastewater SW-SurfaceWater SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water

PARAMETER / CONTAINER DESCRIPTION

SAL Use Only Sample No.	Sample Description	Date	Time	Matrix	Composite	Grab	500mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx, OP, SO_4	125mLP, H_2SO_4 COD, TKN, NH_3, TP	500mLP, NaOH & Zn Acetate H_2S	250mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx	125mLP, H_2SO_4 COD, TKN, NH_3	500mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx	500mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx, SO_4			Field pH	Field Temperature	Field Conductivity	Field DO			No. of Containers (Total per each location)
01	BHS6-STE	10/30	10:02	WW		X	2	1	1							7.35	21.9	1018	.23			
02	BHS6-DP01	10/30	10:44	WW		X				1	1											
03	BHS6-DP02	10/30	10:48	WW		X				1	1											
04	BHS6-DP03	10/30	10:24	WW		X					1	2				6.29	20.4	795	.30			
05	BHS6-DP04	10/30	10:30	WW		X					1		2			6.43	20.3	904	.33			
06	BHS6-ST1&2a	10/30	10:08	WW		X	2	1	1							6.48	20.5	783	.75			
07	BHS6-ST1&2a-DUP	10/30	10:12	WW		X	2	1	1							6.47	20.5	798	.55			
08	BHS6-ST2b-P	10/30	9:50	WW		X	2	1	1							6.64	20.1	981	.56			
09	BHS6-EB	10/30	10:36	R		X	2	1	1							6.76	19.1	2.8	.30			

Containers Prepared/ Relinquished:	Date/Time:	Received:	Date/Time:
MJM	100814		
Relinquished:	Date/Time:	Received:	Date/Time:
	1400 10/30/14	Fed Ex	
Relinquished:	Date/Time:	Received:	Date/Time:
Fed Ex		K Nudsment	1025 10/31/14
Relinquished:	Date/Time:	Received:	Date/Time:
Relinquished:	Date/Time:	Received:	Date/Time:

Seal intact?	Y N N/A
Samples intact upon arrival?	Y N N/A
Received on ice? Temp 2.1	Y N N/A
Proper preservatives indicated?	Y N N/A
Rec'd within holding time?	Y N N/A
Volatiles rec'd w /out headspace?	Y N N/A
Proper containers used?	Y N N/A

Instructions / Remarks:
Ship to:
Harmon Harden
1825 Cottage Grove Rd.
Talahassee, FL 32303 850-212-4378

Chain of Custody.xls
Rev.Date 11/19/01

Chain of Custody

141087

Ackuritlabs, Inc.

3345 North Monroe Street, Tallahassee, FL 32303 • Telephone (850) 562-7751

Environmental Services Section

REPORT OF MICROBIOLOGICAL ANALYSIS

Hazen and Sawyer, P.C.
Attn: Josefin Edeback-Hirst, PE
10002 Princess Palm Avenue
Suite 200
Tampa, FL 33619

Report #: 25368
Report Date: November 10, 2014
NELAC#: E81350
FDEPQA#: 920087G
Project#: 211296
Sampled By: Mark Busby
Sample Site: [redacted] Drive Septic System
Sample Date: 10-30-14

Table 1. Samples received 10-30-14.

	Fecal Coliform	Dilution	*E. coli*	Dilution
Units:	# colonies/100 mL	Factor	# colonies/100 mL	Factor
Methodology:	SM 9222D		EPA 1603	
Detection Limit:	2.0		2.0	
Analysis Date:	10-30-14		10-30-14	
Analysis Time:	15:30		15:30	
Analyst:	AL		AL	
Sample Location/Time:				
Lab Number:				
ST2-P, 09:50				
#126158	**6,000**	100	**6,000**	100
STE, 10:02				
#126159	**200,000**	10,000	**190,000**	10,000
ST1, 10:08				
#126160	**15,000**	1,000	**13,000**	1,000
ST1 Dup, 10:12				
#126161	**13,000**	1,000	**12,000**	1,000
DP03, 10:24				
#126162	**11,000**	1,000	**9,000**	1,000
DP04, 10:30				
#126163	**1,400**	100	**760**	10
EB, 10:36				
#126164	**2.0 U**	2	**2.0 U**	2

Data Qualifiers that may apply:
U = Analyte was not detected and the indicated value is the detection limit.
B = Colony count exceeded the ideal of 20-60 (fecal coliform) or 20-80 (*E. coli*) colonies per plate.

Data Release Authorization:
Sample integrity and reliability certified by lab personnel prior to analysis. All quality assurance samples met quality control limits unless otherwise specified. The reported analytical results relate only to the sample submitted. This report shall not be reproduced, except in full, without the written approval of Ackuritlabs. Please contact the undersigned at the above phone number with any questions regarding this report.

Amanda Lawhon 11-10-14

Amanda Lawhon, QA Officer

Ackuritlabs, Inc.

3345 N. Monroe Street, Tallahassee, FL 32303 · Telephone (850) 562-7751

№ 125368

CHAIN OF CUSTODY RECORD

Page 1 of 1

CLIENT NAME & ADDRESS: Hazen & Sawyer

LAB PROJECT #: 21296

PROJECT NAME: [redacted] Septic System

CONTACT PERSON:

SAMPLE CONTAINERS / QUANTITY	PRESERVATIVE: A NH_4Cl	N HNO_3	S H_2SO_4	H HCl	B NaOH	Z $Zn(C_2H_3O_2)_2$	T $Na_2S_2O_3$			PLASTIC CONTAINERS: 125 mL	250 mL	500 mL	1 Liter	WHIRLPAK - DW	WHIRLPAK - WW	WHIRLPAK - ICE		GLASS CONTAINERS: 40 mL	125 mL	250 mL	500 mL	1 Liter			TRIP BLANK	REMARKS

PRECLEANED CONTAINERS RELINQUISHED BY: Mark Busby — DATE: 10-29-14 — TIME: 0900 — RECEIVED BY: Mark Busby — DATE: 10-29-14 — TIME: 0900

RELINQUISHED BY: — DATE: — TIME: — RECEIVED BY: — DATE: — TIME:

SAMPLE COLLECTION 2014

SAMPLERS: (PRINT NAME) MARK Busby

SAMPLERS: (SIGNATURE) Mark Busby

FIELD ID NUMBER	DATE MM/DD/YY	TIME	STATION LOCATION/NUMBER	MATRIX	GRAB OR COMPOSITE	NO. OF CONTAINERS	ANALYSES REQUESTED: Fecal	E. coli							LAB ID#
#1	10-30-14	0950	ST2-P	ww	G	1	X	X							126158
#2		1002	STE												126159
#3		1008	ST1												126160
#4		1012	ST1 Dup												126161
#5		1024	DP03												126162
#6		1030	DP04												126163
#7		1036	EB												126164

COMMENTS:

SAMPLES RECEIVED: ICED Y / N

TEMP: _____ ° C HOLD TIME Y / N PROPER PRESERVATION Y / N

RELINQUISHED BY(SIGNATURE) / AFFILIATION / DATE & TIME: Mark Busby / ACK / 10-30-14 1435

RECEIVED BY(SIGNATURE) / AFFILIATION / DATE & TIME: Amanda Lawson 10-30-14 @ 1435

RELINQUISHED BY(SIGNATURE) / AFFILIATION / DATE & TIME:

RECEIVED BY(SIGNATURE) / AFFILIATION / DATE & TIME:

RELINQUISHED BY(SIGNATURE) / AFFILIATION / DATE & TIME:

RECEIVED BY(SIGNATURE) / AFFILIATION / DATE & TIME:

MATRIX TYPES:

SW SURFACE WATER
WW WASTE WATER
GW GROUND WATER
DW DRINKING WATER
FT FISH TISSUE
SO SOIL
SL SLUDGE
MI MICROBENTHIC INVERTEBRATES
SH SHELLFISH
HZ HAZARDOUS WASTE
SE SEDIMENT
OT OTHER

Appendix B: Operation & Maintenance Log

Table B.1
Operation and Maintenance Log

Date	Description
9/12/2013	Checked system. Met with contractor regarding second system construction.
11/5/2013	Started installation of second passive treatment system.
11/6/2013	Finished installation
11/14/2013	High water alarm in pump tank. Pump was not working.
	Contractor repaired loose wiring. Pump had not run from time of installation.
	Cleaned two Stage 1 sprayers clogged with construction debris.
11/20/2013	Preliminary Sample Event No. 1 (STE and ST1).
	No ponding in drainfield observation ports.
	Cleaned all four Stage 1 sprayers - not clogged but were not spraying properly.
12/4/2013	Preliminary Sample Event No. 2
	Ponding of 1.5 inches in drainfield obs. port #2, other three ports were dry.
12/20/2013	Preliminary sampling indicated nitrification was insufficient
	Checked and cleaned Stage 1 sprayers.
	Even after cleaning, majority of spray going straight down.
12/21/2013	Rotated Stage 1 sprayers so they are spraying straight up on the tank lid.
	Observed better coverage of Stage 1 media
1/9/2014	Site visit. System ok.
	Observed that vents on Stage 1 tank were pushed down (kids had pushed down).
	Vents were pulled back up and resealed with existing mastic.
	The owner has not mentioned any odor concerns.
1/22/2014	Sample Event No. 1
3/7/2014	Site visit. System ok. Observed one of the sprayers had a broken tip.
	Ponding of ¼ inch in observation port #2, all others dry.
3/20/2014	Removed existing sprayers. Installed 3 Orenco sprayers.
3/24/2014	Site visit. System ok. Ponding of 1/4 inch in observation port #2, all others dry.
	Sprayers working well.
4/10/2014	Sample Event No. 2
	Water level within Stage 1&2a tank elevated approximately 14-inches.
4/10/2014	Installed piezometer in the Stage 1&2a tank.
4/14/2014	Attempt to clear clog in the inlet pipe to Stage 2b tank with plumbing snake.
4/16/2014	Cleared clog in inlet pipe to Stage 2b tank with compressed air and rubber bladder.
	Water level in piezometer in Stage 1&2a tank dropped by approximately 12 inches.
4/28/2014	System Check. Ponding of 1/4 inch in observation port #2, all others dry.
	Sprayers working well. Water level in ST1 sample port elevated by less than 2 inches.

Table B.1 (con't)
Operation and Maintenance Log

5/7/2014	Sample Event No. 3.
	Water level in ST1 sample port elevated by approximately 4 inches.
5/27/2014	System Check
	Water level in ST1 sample port elevated by approximately 8 inches
5/30/2014	Started repair of sulfur tank inlet pipe. Drained tank, removed a portion of sulfur.
5/31/2014	Finished removing sulfur from the tank to access inlet pipe at the bottom of media.
	Repaired inlet pipe to sulfur tank and placed sulfur back into the tank.
6/23/2014	Sample Event No. 4
	Water level in Stage 1 tank at normal operational level.
7/21/2014	System Check
	Water level in Stage 1 tank elevated by approximately 1 inch.
8/27/2014	Sample Event No. 5
	Water level in Stage 1 tank elevated by approximately 2 inches.
9/26/2014	System Check
	Water level in Stage 1 tank elevated by approximately 8 inches.
10/3/2014	System Check
	Water level in Stage 1 tank elevated by approximately 7 inches.
	Two end sprayers are spinning slow, not full coverage.
10/7/2014	System repair
	Began installation of cleanout on outflow pipe of Stage 1&2a tank.
10/9/2014	System repair
	Finished installation of cleanout on outflow pipe of Stage 1&2a tank.
10/16/2014	System repair
	Drilled holes in Stage1&2a effluent collection pipe, inside of Stage 1&2a tank.
	Cleaned PNRS flowmeter. This increased dose volume back to normal level.
10/19/2014	System repair
	Drilled additional holes Stage1&2a effluent collection pipe, inside tank.
10/20/2014	System repair
	Replaced all three sprayers with new ones.
10/30/2014	Sample Event No. 6
	Water level in Stage 1 tank at normal operational level.

Appendix C: Vericomm PLC Data

System Status			10/30/14 9:29	10/19/14 21:45	10/3/14 9:58	9/26/14 12:35
Point	Description	Status	Value	Value	Value	Value
1	Alarm Status	Automatic	OK	OK	OK	OK
2	Alert Status	Automatic	OK	OK	OK	OK
3	System Mode	Automatic	Normal	Normal	Normal	Normal
5	Timer Mode	Automatic	Normal	Normal	Normal	Normal
6	Active Off Time	Automatic	180.0 Minutes	180.0 Minutes	180.0 Minutes	180.0 Minutes
7	Active On Time	Automatic	2.0 Minutes	2.0 Minutes	2.0 Minutes	2.0 Minutes
9	Pump Mode	Automatic	OffCycl	OffCycl	OffCycl	OffCycl
10	Pump Status	Automatic	Off	Off	Off	Off
Settings						
Point	Description	Status	Value	Value	Value	Value
17	Off Cycle Time	Constant/Setpoint	180.0 Minutes	180.0 Minutes	180.0 Minutes	180.0 Minutes
18	On Cycle Time	Constant/Setpoint	2.0 Minutes	2.0 Minutes	2.0 Minutes	2.0 Minutes
19	Override Off Cycle Time	Constant/Setpoint	30.0 Minutes	30.0 Minutes	30.0 Minutes	30.0 Minutes
20	Override On Cycle Time	Constant/Setpoint	2.0 Minutes	2.0 Minutes	2.0 Minutes	2.0 Minutes
21	Minimum Override Cycles	Automatic	3.0 Cycles	3.0 Cycles	3.0 Cycles	3.0 Cycles
23	Override Cycle Limit per Day	Constant/Setpoint	21.0 Cycles	21.0 Cycles	21.0 Cycles	21.0 Cycles
24	Time Limit per Day	Constant/Setpoint	200.0 Minutes	200.0 Minutes	200.0 Minutes	200.0 Minutes
25	High Level Pump Test	Automatic	5.0 Minutes	5.0 Minutes	5.0 Minutes	5.0 Minutes
28	Alarm Update Interval	Timing Override	120.0 Minutes	480.0 Minutes	120.0 Minutes	240.0 Minutes
29	Page Delay	Automatic	960.0 Minutes	960.0 Minutes	960.0 Minutes	960.0 Minutes
30	Page Interval	Automatic	30.0 Minutes	30.0 Minutes	30.0 Minutes	30.0 Minutes
31	Local Alarm Delay	Constant/Setpoint	1140.0 Minutes	1140.0 Minutes	1140.0 Minutes	1140.0 Minutes
32	Local Reactivate Delay	Automatic	120.0 Minutes	120.0 Minutes	120.0 Minutes	120.0 Minutes
Troubleshooting						
Point	Description	Status	Value	Value	Value	Value
33	Top Float Status	Automatic	OK	OK	OK	OK
34	Middle Float Status	Automatic	OK	OK	OK	OK
35	Bottom Float Status	Automatic	OK	OK	OK	OK
37	Contactor Status	Automatic	OK	OK	OK	OK
38	Pump Status	Automatic	OK	OK	OK	OK
40	Filter Status	Automatic	OK	OK	OK	OK
41	Tank Status	Automatic	OK	OK	OK	OK
43	Power Status	Automatic	OK	OK	OK	OK
Flow Data (at the time of Vericomm call-in)						
Point	Description	Status	Value	Value	Value	Value
49	Pump Run Time Today	Automatic	6.1 Minutes	31.0 Minutes	6.0 Minutes	17.2 Minutes
50	Override Cycles Today	Automatic	0.0	8.0	0.0	4.0
51	Pump Cycles Today	Automatic	3.0 Cycles	14.0 Cycles	3.0 Cycles	7.0 Cycles
52	Average Run Time per Cycle Today	Automatic	2.0 Minutes	2.2 Minutes	2.0 Minutes	2.5 Minutes
54	Brownouts Today	Automatic	0.0	0.0	0.0	0.0

30-Day History Data			10/30/14 9:29	10/19/14 21:45	10/3/14 9:58	9/26/14 12:35
Point	Description	Status	Value	Value	Value	Value
65	30 Day Average Run Time per Day	Automatic	21.7 Minutes	23.5 Minutes	21.2 Minutes	22.8 Minutes
66	30 Day Average Override Cycles per Day	Automatic	2.7 Cycles	3.7 Cycles	2.8 Cycles	3.9 Cycles
67	30 Day Average Cycles per Day	Automatic	10.4 Cycles	11.4 Cycles	10.1 Cycles	10.9 Cycles
68	30 Day Average Run Time per Cycle	Automatic	2.1 Minutes	2.1 Minutes	2.1 Minutes	2.1 Minutes
71	30 Day Total Pump Run Time	Automatic	650.7 Minutes	706.0 Minutes	637.2 Minutes	683.5 Minutes
72	30 Day Total Override Cycles	Automatic	82.0 Cycles	112.0 Cycles	84.0 Cycles	117.0 Cycles
73	30 Day Total Cycles	Automatic	312.0 Cycles	341.0 Cycles	302.0 Cycles	327.0 Cycles
76	30 Day Total Brownouts	Automatic	0.0	0.0	0.0	0.0
Totalized Pump Data						
Point	Description	Status	Value	Value	Value	Value
82	Pump Total Run Time	Automatic	1674.3 Hours	1671.6 Hours	1664.3 Hours	1662.3 Hours
83	Pump Total Cycles	Automatic	50424.0 Cycles	50345.0 Cycles	50136.0 Cycles	50079.0 Cycles
Miscellaneous						
Point	Description	Status	Value	Value	Value	Value
145	Pump On Auto	Automatic	Off	Off	Off	Off
147	Pump Test Today	Automatic	Off	On	Off	On
148	Pump Check Enable	Automatic	Off	Off	Off	Off
149	Total Override Cycles	Automatic	0.0	0.0	0.0	0.0
150	High Level Condition	Automatic	Off	Off	Off	Off
151	Leak Check Enable	Automatic	On	On	On	On
152	Brownout State	Automatic	Off	Off	Off	Off
153	Test Mode	Automatic	Off	Off	Off	Off
Alarm Points						
Point	Description	Status	Value	Value	Value	Value
161	General Alarm	Automatic	Off	Off	Off	Off
162	New Alarm	Automatic	Off	Off	Off	Off
163	Update Central Enable	Automatic	On	On	On	Off
167	Page Alarm Start	Automatic	Off	Off	Off	Off
168	Pager Signal	Override Off	Off	Off	Off	Off
169	Local Alarm Start	Automatic	Off	Off	Off	Off
170	Local Alarm Silence	Automatic	Off	Off	Off	Off
Inputs & Outputs						
Point	Description	Status	Value	Value	Value	Value
177	High Level/Override Timer Float Input	Automatic	Off	Off	Off	Off
178	Timer Float Input	Automatic	On	On	On	On
179	Redundant Off Float & Low Level Alarm Input	Automatic	On	On	On	On
181	Push To Silence Input	Automatic	Off	Off	Off	Off
182	Auxiliary Contact Input	Automatic	Off	Off	Off	Off
186	Pump Output	Automatic	Off	Off	Off	Off
188	Alarm Light Output	Automatic	Off	Off	Off	Off
189	Audible Alarm Output	Automatic	Off	Off	Off	Off