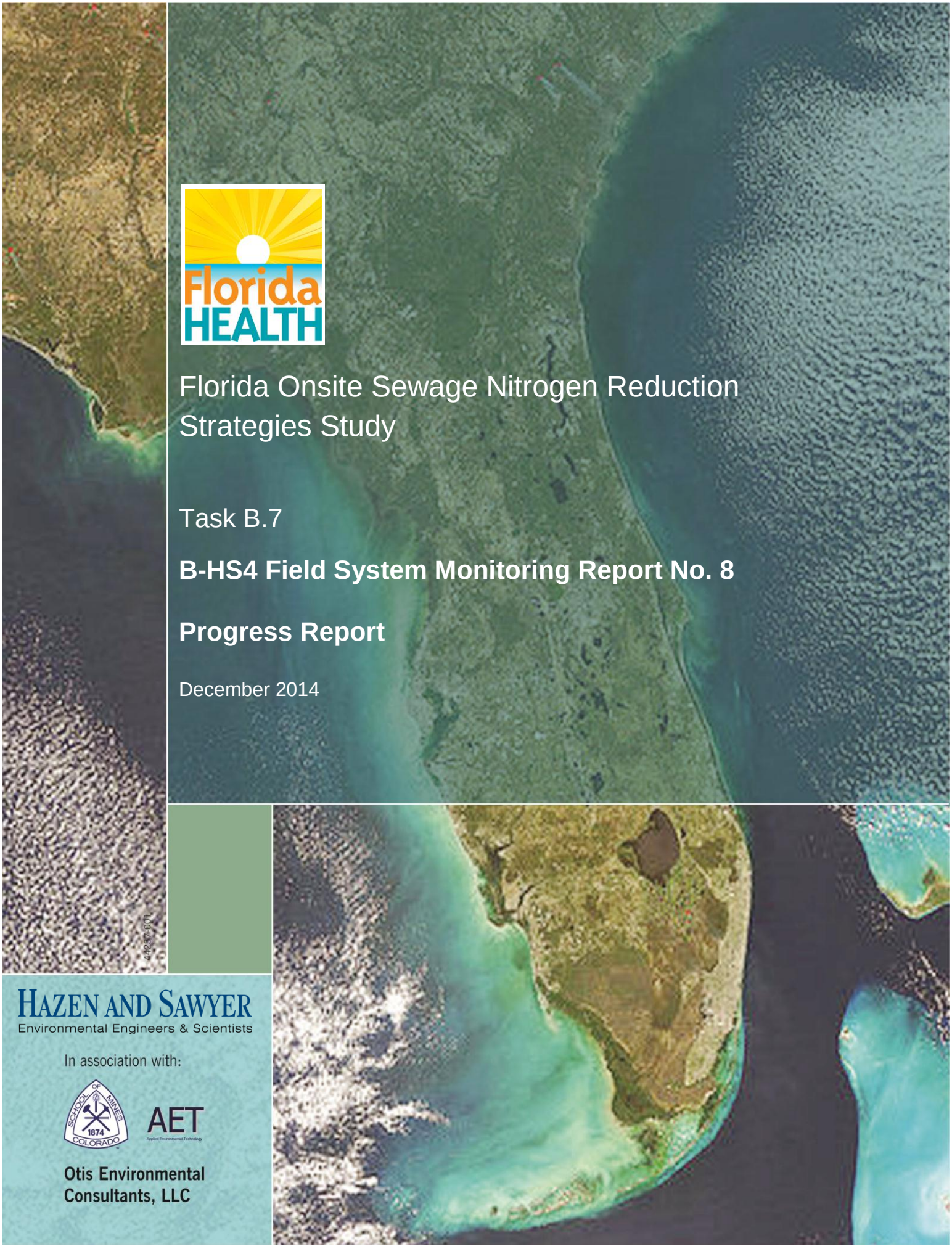

Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task B.7

B-HS4 Field System Monitoring Report No. 8

Progress Report

December 2014

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Environmental Engineers & Scientists

In association with:

AET

Otis Environmental Consultants, LLC

Florida Onsite Sewage Nitrogen Reduction Strategies Study

TASK B.7
PROGRESS REPORT

B-HS4 Field System
Monitoring Report No. 8

Prepared for:

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

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B-HS4 Field System Monitoring Report No. 8

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 Task A.26. 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 eighth and final sample event of the passive nitrogen reduction system at home site B-HS4 in Seminole County, Florida.

2.0 Purpose

Operation of the B-HS4 system was initiated on July 9, 2013. This monitoring report documents data collected from the eighth B-HS4 monitoring and sampling event conducted on December 16, 2014 (Experimental Day 525). This monitoring event consisted of conducting flow measurements from the household water use meter, recording electricity use, monitoring of field parameters, collection of water samples from nine 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-HS4 field site is located in Seminole County, FL. The nitrogen reducing onsite treatment system for the single family residence was installed in June 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. Prior to the installation of the nitrogen removal system, the property had two existing onsite sewage treatment and

disposal systems. The pre-existing 1,200 gallon concrete septic tank, located on the west side of the property, continues to provide primary treatment, now as part of the PNRS system. The pre-existing 900 gallon septic tank, located on the northeast side of the property, was converted to a lift station. In the new configuration, raw sewage is pumped from the 900 gallon lift station to the head end of the new gravity flow PNRS. All subsequent flow through the PNRS is by gravity. The passive nitrogen reduction system consists of the septic tank, two treatment tanks and a new drainfield that replaced the two existing permitted systems. The B-HS4 PNRS tankage includes a 2,800 gallon concrete tank that houses a Stage 1 unsaturated media biofilter and 1,500 gallon two chamber concrete tank that houses a Stage 2 saturated media biofilter. Based on measured average wastewater flow and tank volumes, there is over a ten day transit time through the treatment system prior to dispersal. The treated effluent from the Stage 2 biofilter is discharged into the soil via the new drainfield (EQ36-LP™ chambers).

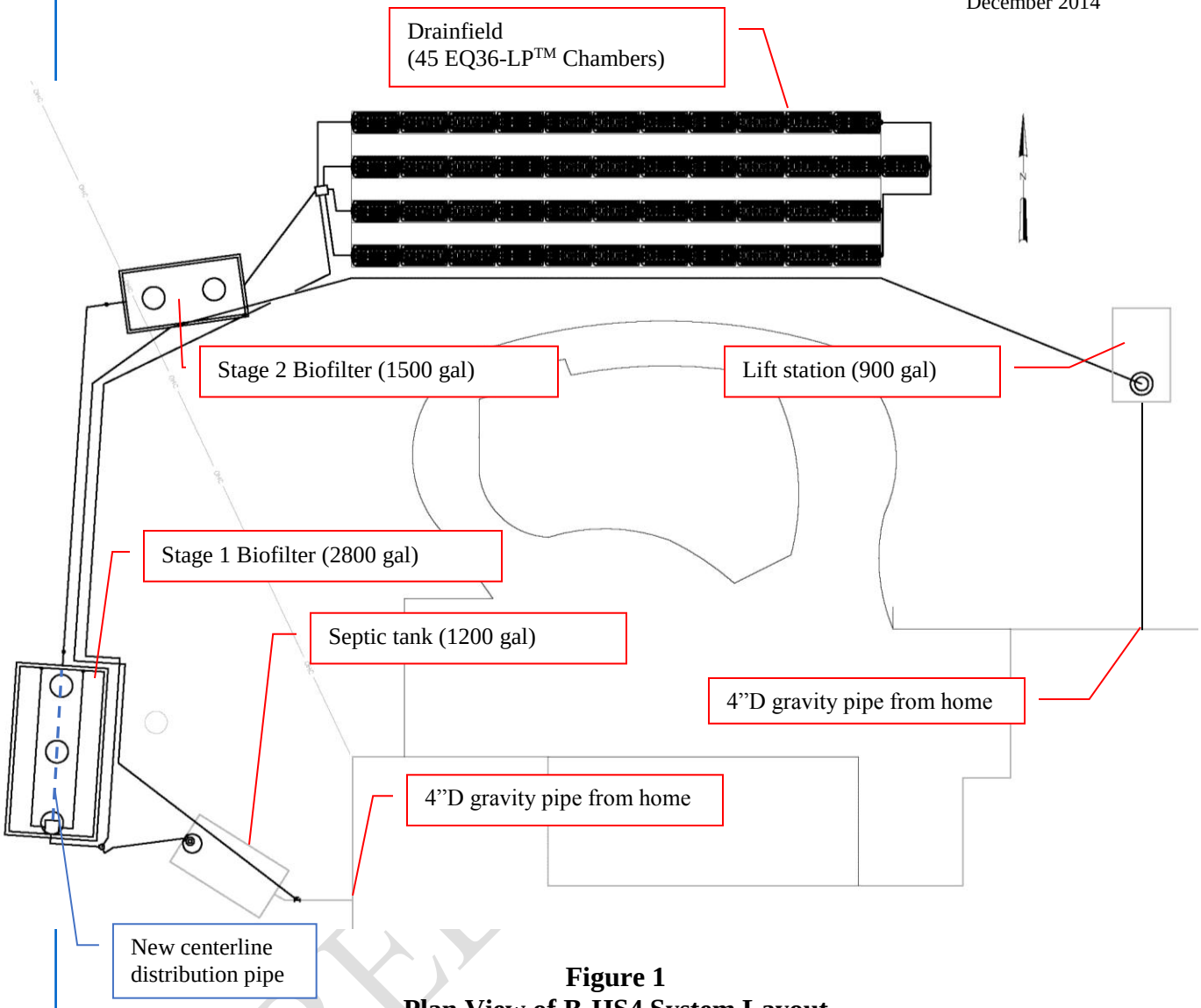


Figure 1
Plan View of B-HS4 System Layout

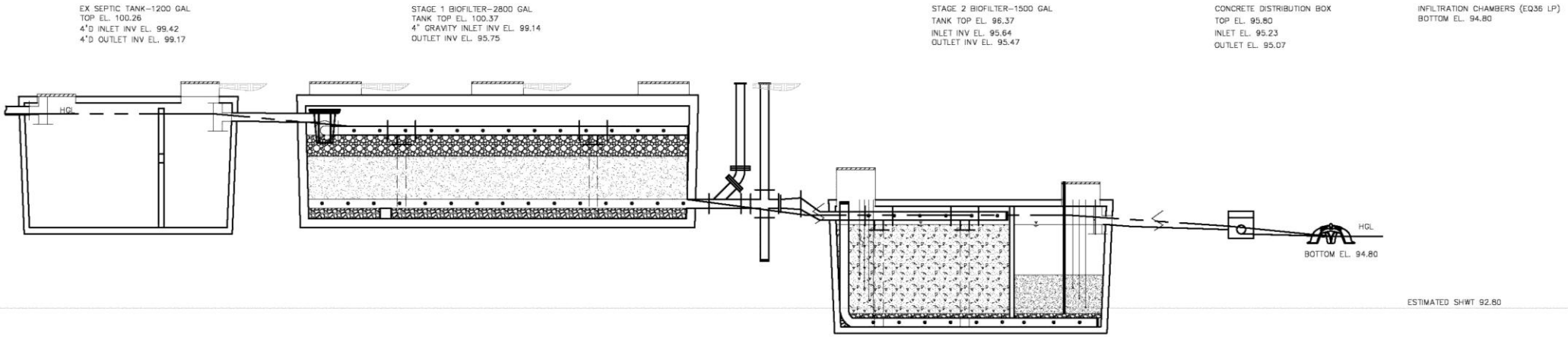


Figure 2
Flow Schematic of B-HS4 PNRS

3.2 Monitoring and Sample Locations and Identification

The nine monitoring points are shown in Figure 3. Household wastewater enters the primary tank and exits as septic tank effluent through an effluent filter screen into the Stage 1 biofilter. The first monitoring point, B-HS4-STE, is the effluent sampled approximately 1.5 feet below the surface of the primary tank before the effluent filter screen (Figure 4), which is referred to as primary effluent or septic tank effluent (STE). The lift station wastewater is pumped into the inlet side of the primary tank; therefore, samples from monitoring point B-HS4-STE are representative of the whole household wastewater and are the influent to the remainder of the onsite nitrogen reduction system.

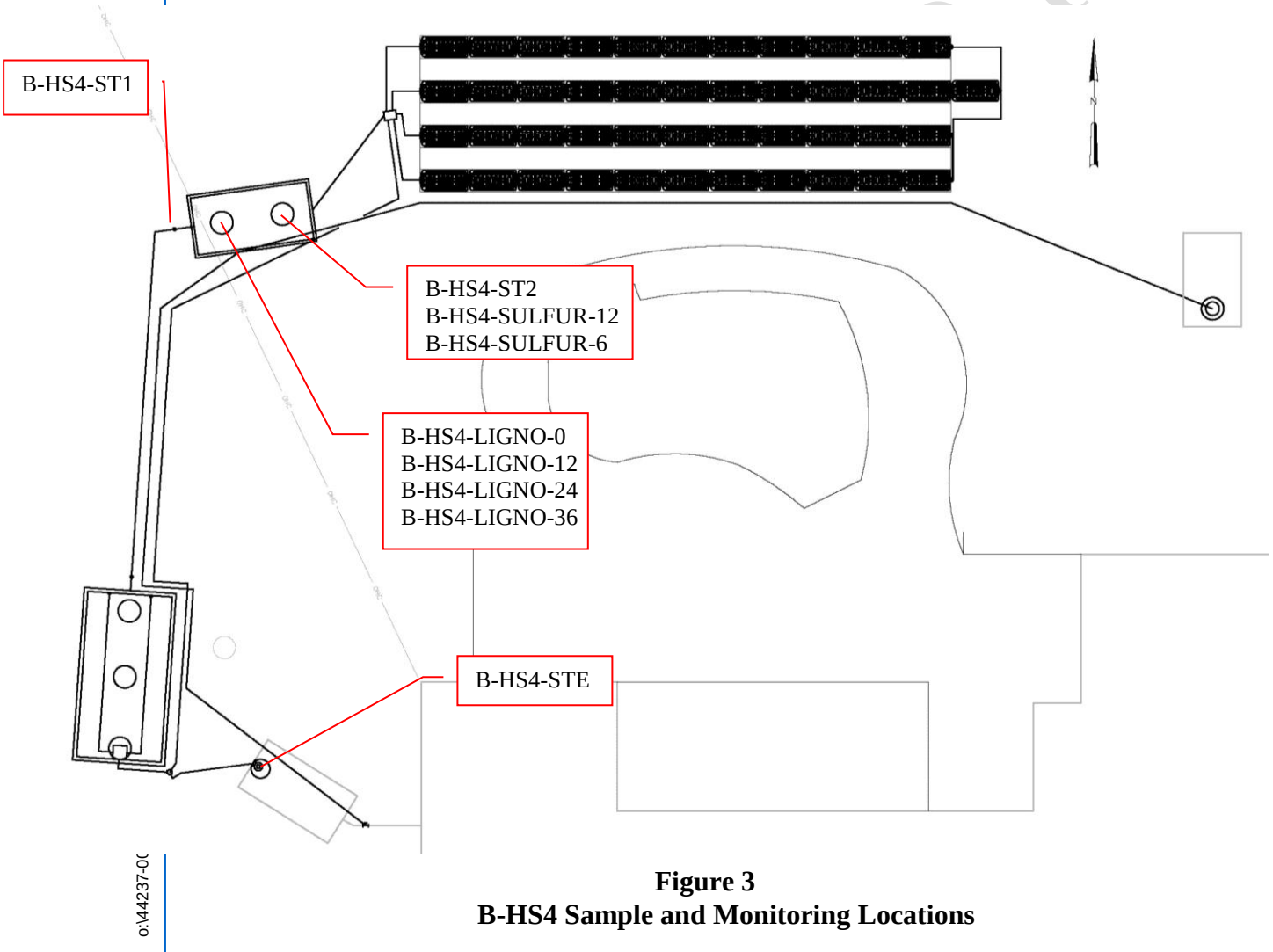


Figure 3
B-HS4 Sample and Monitoring Locations

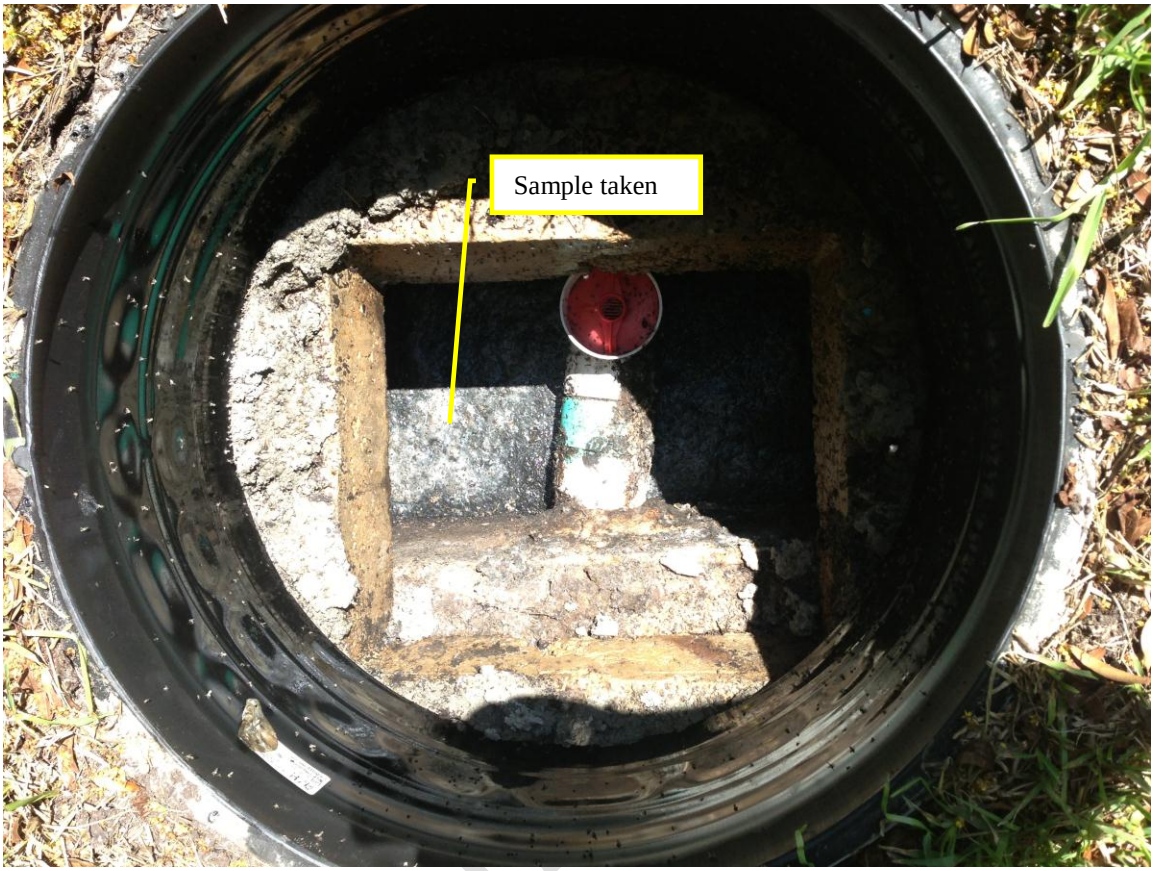


Figure 4
Primary Tank (B-HS4-STE Sample)

The primary tank contents are discharged by gravity to a distribution box, located inside the Stage 1 biofilter, which splits the flow between three perforated distribution pipes which run along the top of the unsaturated Stage 1 biofilter media. In the Stage 1 biofilter, wastewater percolates downward through 30-inches of unsaturated expanded clay media where nitrification occurs. Stage 1 biofilter effluent flows into the Stage 2 biofilter by gravity. The second sampling point (B-HS4-ST1) represents the Stage 1 biofilter effluent, and is taken from a sample port in the gravity pipe connecting the Stage 1 biofilter outlet to the Stage 2 biofilter inlet (Figure 3).

Effluent from the unsaturated (Stage 1) media tank enters the saturated denitrification (Stage 2) biofilter above the media in the first chamber (lignocellulosic media), flows downward through the media, moves laterally in a perforated 4-inch pipe 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 first chamber of the Stage 2 biofilter contains 42-inches of lignocellulosic media (Southern Yellow Pine (SYP)). Stainless steel samplers are positioned at 12-inch increments for vertical profiling throughout the lignocellulosic media. The third primary sampling point is a stainless steel sampler positioned at the bottom of the lignocellulosic media (B-HS4-LIGNO-0) with tubing to the surface. Twelve inches above B-HS4-LIGNO-0 is another stainless steel drivepoint sampler B-HS4-LIGNO-12, and so forth (B-HS4-LIGNO-24 and B-HS4-LIGNO-36). The B-HS4-LIGNO-0 sample represents the lignocellulosic media effluent (Figure 5).

Figure 5
First Chamber of Stage 2 Biofilter (B-HS4-LIGNO-0 Sample)

A collection pipe along the bottom transfers the first chamber (lignocellulosic media) effluent to the second chamber, which contains 18-inches of elemental sulfur mixed with oyster shell media. Similar to the lignocellulosic media chamber, stainless steel drive-point samplers are positioned to create a vertical profile. B-HS4-SULFUR-6 and B-HS4-SULFUR-12 are positioned 6-inches and 12-inches, respectively, above the bottom of the sulfur media. The fourth primary sampling point, B-HS4-ST2, 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 6).

Figure 6
Second Chamber of Stage 2 Biofilter (B-HS4-ST2 Sample)

3.3 Operational Monitoring

Start-up of the system occurred on July 9, 2013 (Experimental Day 0). Preliminary sampling for several key parameters was conducted July 29, 2013 (Experimental Day 20) to evaluate start-up performance. It was noted during sampling that the incoming lift station wastewater flow into the primary tank was causing mixing in the primary tank and the carryover of solids into the Stage 1 biofilter d-box. Therefore, the PNRS system was bypassed on August 15, 2013. On September 5, 2013 a smaller pump (lower horsepower) was installed in the lift station with a mechanical float switch. This modification results in more frequent and lower volume doses from the lift station to the primary tank and reduced mixing within the primary tank. The PNRS system has operated continually since September 5, 2013 (Experimental Day 58). For the eighth formal sampling event, Sample Event No. 8, the water meter for the house was read and recorded on December 16, 2014. 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 system.

3.4 Energy Consumption

The new PNRS system at this site is a gravity flow system and uses no energy for wastewater treatment. As indicated previously however, a small lift station pump was required to transfer a fraction of the total wastewater flow from the second existing OSTDS to the new gravity PNRS. Energy consumption by this lift station pump 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. 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 2 biofilter was initially filled with 42 inches of lignocellulosic media and 18 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 eighth formal sample event was conducted on December 16, 2014. A full suite of samples were collected for water quality analysis, including influent, intermediate and effluent points. Samples were collected at each of the nine monitoring points described in Section 3.3: B-HS4-STE, B-HS4-ST1, B-HS4-LIGNO-36, B-HS4-LIGNO-24, B-HS4-LIGNO-12, B-HS4-LIGNO-0, B-HS4-SULFULR-6, B-HS4-SULFULR-12, and B-HS4-ST2. 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.

Lastly, field blank (FB) and field duplicate samples were taken. The field blank was collected by filling sample containers with deionized water that had been transported into the field along with other sample containers. The field sample duplicate (B-HS4-ST2) was collected immediately subsequent to the regular samples. These samples were then analyzed for the same parameters as the monitoring samples.

The analysis-specific containers were supplied by the analytical laboratory 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. The field parameters were measured by placing the analytical probes in a container overflowing with sample water. The influent, intermediate, and effluent primary monitoring samples were analyzed by the laboratory for: carbonaceous biological oxygen demand ($CBOD_5$), 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), total suspended solids (TSS), sulfate, sulfide, hydrogen sulfide (unionized), total organic carbon (TOC), fecal coliform (fecal), and E.coli. The Stage 2 intermediate drivepoint samples were analyzed for: Carbonaceous Biological Oxygen Demand ($CBOD_5$), total Kjeldahl nitrogen (TKN), ammonia nitrogen (NH_3-N), nitrate nitrogen (NO_3-N), nitrite nitrogen (NO_2-N), and sulfate. All analyses were performed by an independent and fully NELAC certified analytical laboratory (Southern Analytical Laboratory). 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)
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)	SM 4500NO2-B	0.01 mg/L
Nitrate+Nitrite Nitrogen (NOX-N)	EPA 353.2	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 Suspended Solids (TSS)	SM 2540D	1 mg/L
Total Organic Carbon (TOC)	SM 5310B	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)	SM 9222D	1 ct/100mL
E.coli	SM 9223B	2 ct/100mL

4.0 Results and Discussion

4.1 Operational Monitoring

Table 2 provides a summary of the household water use since the water meter installation on February 8, 2013. The average daily household water use since start-up is 310 gallons per day. The operation and maintenance log which includes actions taken since start-up is provided in Appendix B.

Table 2
Summary of Household Water Use

Date and Time Read	Cumulative Volume (gallons)	Avg. Daily Household Flow between readings, Q (gpd)	Avg. Household Flow since PNRS start-up, Q (gpd)
2/8/2013 13:45	0.0	INSTALLED	
2/21/2013 11:25	4,391.0	340.3	
2/28/2013 12:00	6,292.5	270.7	
6/7/2013 8:00	34,417.4	284.6	
6/14/2013 8:00	36,179.5	251.7	
6/20/2013 12:40	37,981.2	290.9	
7/9/2013 15:35	42334.44	227.7	PNRS start-up
7/17/2013 14:30	45,422.8	388.2	388.2
7/23/2013 13:32	47,051.9	273.4	339.0
7/29/2013 11:25	48,658.8	271.8	319.0
8/6/2013 12:15	50,922.9	281.8	308.3
8/12/2013 10:24	52,614.2	285.6	304.3
8/15/2013 8:20	53,328.4	245.1	299.6
8/27/2013 10:20	56,550.0	266.6	291.4
9/5/2013 9:59	58,748.1	244.6	284.1
9/30/2013 13:15	65,633.7	273.9	281.0
11/8/2013 11:00	76,559.6	280.8	281.0
11/27/2013 11:15	82,039.9	288.3	282.0
12/2/2013 13:30	83,048.8	198.1	279.0
12/23/2013 13:00	88,271.2	248.9	275.2
1/23/2014 10:30	98,116.0	318.6	282.0
1/31/2014 10:48	100,521.0	300.2	282.7
2/3/2014 11:20	101,475.3	315.8	283.2
2/4/2014 10:05	101,844.6	389.6	283.7
2/5/2014 8:05	102,095.7	273.9	283.6
2/6/2014 9:25	102,275.2	170.1	283.1
2/7/2014 9:11	102,557.9	285.5	283.1
2/12/2014 11:30	103,986.0	280.2	283.0
3/14/2014 9:00	112,449.7	283.1	283.0
4/3/2014 12:00	118,146.5	283.1	283.0
4/25/2014 8:50	124,728.7	301.0	284.4
4/29/2014 11:15	125,962.6	300.9	284.6
5/29/2014 11:20	136,114.3	338.4	289.6
6/9/2014 11:15	138,848.1	248.6	288.3
7/11/2014 10:30	147,011.9	255.4	285.4
7/29/2014 14:15	152,624.1	309.1	286.5
8/22/2014 9:30	166,932.8	601.2	304.8
9/19/14 11:20	175,287.4	297.6	304.4
10/23/2014 8:00	187,775.5	368.8	309.0
11/21/2014 10:00	197,976.1	350.7	311.4
12/16/2014 9:22	204,946.0	279.1	309.9

4.2 Energy Consumption

As mentioned previously, the PNRS at this site is a gravity system and uses no electrical energy for treatment. However, energy is required to transfer a fraction of the total wastewater from the second existing OSTDS to the head end of the PNRS system. The energy consumption by the lift station pump that transfers flow from the second existing OSTDS is monitored using an electrical meter installed between the main power box for the house and the lift station pump outlet to record cumulative power usage of the pump in kilowatt-hours. The recorded electrical use for the system is summarized in Table 3. The total average electrical use through December 16, 2014 was 0.150 kWh per day. The cause for the increase in electrical use between the March 14th and April 3rd, 2014 readings is attributed to a clog in the lift station throttling valve (ball valve). The clog was causing the pump to run longer with a very slow flow rate.

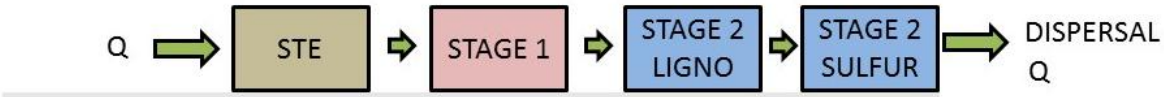
Table 3
Summary of System Electrical Use

Date and Time Read	Cumulative Electrical Meter Reading (kWh)	Average Daily Electrical Use btwn readings (kWh/day)
6/20/2013 14:00		Installed
7/9/2013 15:45	0.3	PNRS start-up
7/17/2013 10:41	0.5	0.026
7/23/2013 13:34	0.6	0.016
7/29/2013 11:30	0.8	0.034
8/6/2013 11:42	0.9	0.012
8/12/2013 10:24	1.2	0.050
8/15/2013 8:20	1.3	0.034
8/27/2013 10:20	1.8	0.041
9/5/2013 9:59	2.2	0.045
9/30/2013 13:15	5.8	0.143
11/8/2013 11:00	12.3	0.167
11/27/2013 11:15	14.1	0.095
12/2/2013 12:55	14.5	0.079
12/23/2013 13:00	17.3	0.133
1/23/2014 10:30	21.1	0.123
1/31/2014 10:48	22.2	0.137
2/3/2014 11:20	22.7	0.165
2/4/2014 10:05	22.9	0.211
2/5/2014 8:05	23.0	0.109
2/6/2014 9:25	23.1	0.095
2/7/2014 9:11	23.1	0.000
2/12/2014 11:30	23.9	0.157
3/14/2014 9:00	29.7	0.194
4/3/2014 12:00	62.2	1.615
4/25/2014 8:50	66.8	0.210
4/29/2014 11:15	68.4	0.390
5/29/2014 11:20	73.7	0.177
6/9/2014 11:15	73.9	0.018
7/11/2014 10:30	74.7	0.025
8/22/2014 9:30	75.9	0.029
9/19/2014 11:20	76.6	0.025
10/23/2014 8:00	77.5	0.027
11/21/2014 10:00	78.3	0.028
12/16/2014 9:22	79.1	0.032
Total average through 12/16/14		0.150

4.3 Water Quality

Water quality analytical results, for Sample Event No. 8 are listed in Table 4 and key results are graphically displayed in Figure 7. The laboratory report containing the raw

analytical data is included in Appendix A. The following discussion summarizes the water quality analytical results. 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	170	10	8	11
TKN mg N/L	78	8.2	3.3	4.8
NH_3 mg N/L	74	2.9	0.3	2.7
NO_x mg N/L	0.12	49.0	6.3	9.4
TN mg N/L	78.1	57.2	9.6	14.2
Sulfate mg/L	1.6	26	28	68
Fecal Coliform (Ct/100mL)	200,000	200	570	2900

Figure 7
Graphical Representation of Nitrogen Results
Sample Event No. 8 December 16, 2014 (Experimental Day 525)

Septic Tank Effluent (STE) Quality: The water quality characteristics of STE collected in Sample Event 8 were within the typical range generally expected for domestic STE for all parameters. The measured STE total nitrogen (TN) concentration was 78.1 mg/L, which is within the high end of the range that has been typically reported for Florida single family residence STE. The measured $CBOD_5$ concentration was 170 mg/L.

Stage 1 Effluent (ST1): The Stage 1 effluent NH_3-N level was 2.9 mg/L with a DO level at 1.11 mg/L (Table 4). The Stage 1 effluent TSS and $CBOD_5$ concentrations were 7 and 10 mg/L, respectively. The Stage 1 biofilter effluent NH_3-N concentration was 2.9 mg/L and effluent TKN was 8.2 mg/L. The Stage 1 effluent NO_x-N was 49.0 mg/L. The Stage 1 effluent TN of 57.2 mg/L was 27% lower than that in the STE, suggesting denitrification in the Stage 1 biofilter.

Stage 2 Biofilter Effluent (LIGNO-0" and ST2): The Stage 2 system produced a reducing environment and NO_x-N removal occurred. Effluent NO_x-N from the Stage 2 biofilter monitoring point was 9.4 mg/L and was accompanied by a measured DO of 0.07 mg/L. The effluent NO_x-N of the lignocellulosic media biofilter was 6.3 mg/L. The cause for the higher concentration of NO_x-N in the final effluent (9.4 mg/L) as compared to the ligno-

cellulosic effluent NO_x-N concentration (6.3 mg/L) is unknown. It does not appear to be a laboratory issue, since a duplicate sample of BHS4-ST2 was taken and showed a similar NO_x-N concentration (9.1 mg/L). This is the first sample event that the final effluent had a NO_x-N concentration greater than 0.07 mg/L. This result may indicate a sampling problem with the BHS4-ST2 sample. As a result, final total nitrogen (TN) in the treatment system effluent was 14.2 mg/L. The Stage 2 biofilter lignocellulosic media effluent and sulfur media effluent $CBOD_5$ were 8 and 11 mg/L, respectively. The Stage 2 effluent sulfate concentration was 68 mg/L.

As previously discussed in Section 3.3, Sample Event 8 also included Stage 2 biofilter profile samples. As depicted in Figure 8, the unsaturated Stage 1 biofilter effluent is pumped to the top of the first chamber of the Stage 2 biofilter which contains lignocellulosic media. The effluent flows downward through the lignocellulosic media, moves laterally in a perforated 4-inch pipe through the baffle wall to the bottom of the second chamber, and upward through the sulfur media mixture in the second chamber. The nitrogen results at the various depths of the Stage 2 biofilter are graphically displayed in Figure 8. Each stainless steel drivepoint sampler was assigned a unique identification indicating the depth (in inches) the sampler was placed above the bottom of the media. For example LIGNO-36 is a stainless steel drivepoint sampler located at 36 inches above the bottom of the lignocellulosic media. The profile results from this event indicate that the NO_x-N was effectively reduced below the method detection limit at profile sampler SULFUR-6; however, as previously discussed, it is unclear why the final sulfur media effluent NO_x-N concentration was 9.4 mg/L. The NO_x-N concentration progressively decreased with passage through the lignocellulosic media in the downflow biofilter, which accounted for approximately 87 percent of the NO_x-N reduction. Residual NO_x-N in the effluent of the downflow lignocellulosic biofilter was reduced to 0.05 mg/L at the 6-inch depth through the sulfur media.

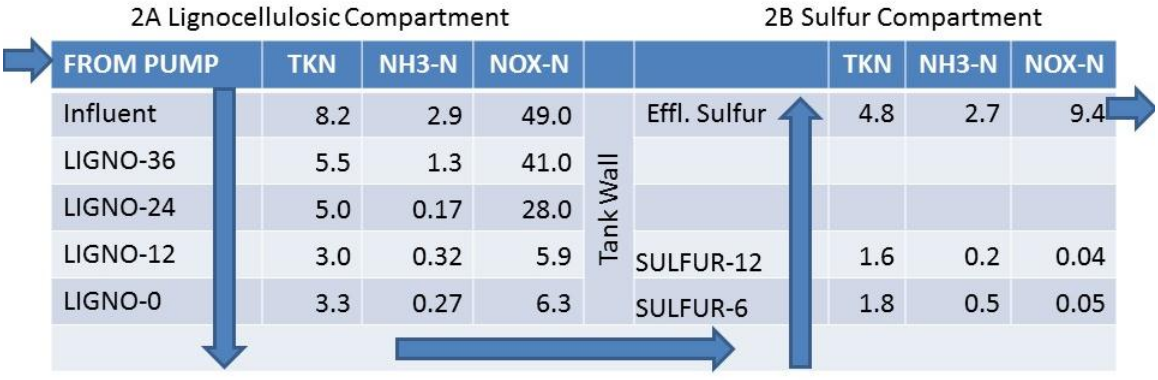


Figure 8
Graphical Representation of Stage 2 Biofilter Profile Nitrogen Results

Field Blank (EB): Described in Section 3.5, the field blank (FB) results for most of the parameters measured were at or below the method detection limit. The slightly elevated parameters were TKN 0.2 mg/L and total phosphorus 0.033 mg/L.

Table 4
Water Quality Analytical Results

Sample ID	Sample Date/Time	Temp (°C)	pH	Specific Conductance (uS/cm)	DO (mg/L)	ORP (mV)	Total Alkalinity (mg/L)	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)	Hydrogen Sulfide (mg/L)	Sulfide (mg/L)	Fecal (Ct/100 mL)	E-coli (Ct/100 mL)	TOC (mg/L)
BHS4-STE	12/16/2014 11:20	21.8	7.25	1291	0.08	-262.4		58		170	270	78.12	78	4.00	74	0.02	0.1	0.12	74.12	8.3		1.6	0.5	1.4	200000	200000	57
BHS4-ST1	12/16/2014 10:55	19.8	6.68	1412	1.11	-23.8		7		10	23	57.23	8.2	5.30	2.9	49	0.03	49.03	51.93	0.35		26	0.01	0.1	200	160	10
BHS4-LIGNO-36	12/16/2014 10:50	19.7	6.66	1284	0.4	-86.1				2		46.51	5.5	4.20	1.3	41	0.01	41.01	42.31			25					
BHS4-LIGNO-24	12/16/2014 10:45	20.6	6.64	1259	0.14	-105.5				6		33.03	5	4.83	0.17	28	0.03	28.03	28.20			26					
BHS4-LIGNO-12	12/16/2014 10:40	21.1	6.68	1211	0.2	-123.4				8		8.94	3	2.68	0.32	5.3	0.64	5.94	6.26			28					
BHS4-LIGNO-0	12/16/2014 10:30	21.1	6.68	1214	0.2	-218.4		6		8	20	9.57	3.3	3.03	0.27	5.7	0.57	6.27	6.54	1.4		28	0.01	0.1	570	480	9.6
BHS4-SULFUR-6	12/16/2014 10:20	21.8	6.57	1232	0.16	-280				22		1.85	1.8	1.31	0.49	0.02	0.03	0.05	0.54			77					
BHS4-SULFUR-12	12/16/2014 10:15	22.0	6.73	1227	0.24	-241.5				23		1.64	1.6	1.36	0.24	0.03	0.01	0.04	0.28			73					
BHS4-ST2	12/16/2014 9:40	21.0	6.66	1229	0.07			5		11	25	14.20	4.8	2.10	2.7	6.9	2.5	9.4	12.10	1.6		68	0.01	0.1	2900	2400	11
BHS4-ST2-DUP	12/16/2014 9:55	21.0	6.66	1229	0.07			8		10	29	14.10	5	2.20	2.8	6.3	2.8	9.1	11.90	1.6		64	0.01	0.1	3000	2400	11
BHS4-FB	12/16/2014 11:30	18.4	5.37	1.54	8.79	75.3		1		2	10	0.23	0.2	0.19	0.009	0.02	0.01	0.03	0.04	0.033		0.2	0.01	0.1	1	2	0.06

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.

Gray-shaded data points indicate values below method detection level (mdl), mdl value used for statistical analyses.

Yellow-shaded data points indicate the reported value is between the laboratory method detection limit and the laboratory practical quantitation limit, value used for statistical analysis.

4.4 Water Quality Monitoring Summary

A summary of the water quality data collected for the test system is presented in Table 5. Figure 9 provides a time series of influent and effluent TN over the study period. Figures 10 through 16 show box and whisker plots of the various monitoring points for the key parameters measured during the study period.

Figure 9
Total Nitrogen Time Series Graph
September 30, 2013 through December 16, 2014

Table 5
Summary of Water Quality Analytical Results

Sample ID	Statistical Parameter	Temp (°C)	pH	Specific Conductance (uS/cm)	DO (mg/L)	ORP (mV)	Total Alkalinity (mg/L)	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)	Hydrogen Sulfide (mg/L)	Sulfide (mg/L)	Fecal (Ct/100 mL)	E-coli (Ct/100 mL)	TOC (mg/L)
STE	n	12	12	12	12	12	11	12	11	12	12	12	12	12	12	12	12	12	12	12	11	12	12	12	12	11	12
	MEAN	22.80	6.83	1185.00	0.15	-221.22	442.73	61.08	58.18	136.92	218.17	70.11	70.00	7.67	62.33	0.09	0.03	0.11	62.44	9.44	6.42	1.66	2.92	4.82	48,499	17,916	64.50
	STD. DEV.	3.15		117.36	0.21	54.88	30.69	20.97	20.71	53.04	108.56	9.94	9.84	7.54	7.32	0.18	0.04	0.21	7.36	2.06	2.29	1.50	1.23	1.79			15.51
	MIN	19.50	6.52	1027.00	0.01	-321.80	400.00	38.00	38.00	23.00	10.00	56.06	56.00	-5.00	49.00	0.01	0.01	0.02	49.07	7.60	0.01	0.20	0.50	1.40	21,000	690	34.00
	MAX	28.32	7.25	1329.00	0.79	-131.40	490.00	118.00	111.00	220.00	330.00	87.14	87.00	23.00	75.00	0.66	0.10	0.76	75.02	14.00	9.20	5.40	4.50	6.80	200,000	200,000	85.00
Stage 1	n	12	12	12	12	12	11	12	11	12	12	12	12	12	12	11	11	12	12	12	11	10	9	9	12	11	12
	MEAN	22.34	6.82	1190.42	2.55	85.86	321.82	9.42	8.55	8.75	40.58	45.58	11.98	3.92	8.06	33.36	0.16	33.60	41.66	3.33	2.86	19.70	0.27	0.54	2,764	1,452	14.95
	STD. DEV.	3.22		154.62	1.54	150.18	37.10	6.10	5.34	6.20	32.20	10.58	7.50	3.86	8.18	16.45	0.30	15.55	10.51	1.46	0.96	3.13	0.32	0.60			5.83
	MIN	19.00	6.42	978.00	0.87	-69.70	270.00	3.00	3.00	2.00	10.00	27.00	3.20	0.00	0.38	12.00	0.01	12.00	27.00	0.35	1.50	16.00	0.01	0.10	100	41	6.50
	MAX	27.60	7.39	1412.00	5.16	508.20	390.00	22.00	18.00	18.00	120.00	63.30	25.00	14.44	23.00	57.00	0.85	57.00	58.80	5.50	4.10	26.00	1.00	1.80	32,000	24,000	24.00
Stage 2a Ligno	n	12	12	12	12	12	11	12	11	12	12	12	12	12	12	12	12	12	12	12	11	11	9	9	12	11	12
	MEAN	22.83	6.64	1113.00	0.59	-155.59	426.36	5.33	5.00	12.67	44.33	11.83	8.67	3.07	5.60	3.10	0.08	3.17	8.76	2.71	2.24	14.67	1.13	1.68	1,150	607	14.39
	STD. DEV.	3.49		85.66	0.64	94.52	22.03	3.65	3.46	6.64	17.32	4.42	6.15	3.36	6.24	4.01	0.17	4.11	4.83	1.36	1.19	7.50	0.65	0.94			4.29
	MIN	18.20	6.46	956.00	0.13	-238.00	400.00	1.00	1.00	2.00	20.00	3.30	2.00	0.70	0.13	0.03	0.01	0.03	1.21	0.42	0.18	5.70	0.01	0.10	30	10	6.20
	MAX	28.51	6.80	1247.00	2.16	58.20	460.00	12.00	12.00	23.00	79.00	17.04	17.00	13.49	15.00	13.00	0.57	13.27	15.04	4.10	3.30	28.00	2.10	3.00	17,200	6,100	19.00
Stage 2b Sulfur	n	12	12	12	12	11	11	12	11	12	12	12	12	12	12	12	12	12	12	12	11	12	12	12	12	11	12
	MEAN	22.34	6.73	1167.92	0.17	-222.68	462.73	4.08	3.45	12.25	43.08	7.42	6.61	2.25	4.36	0.60	0.22	0.82	5.17	2.64	2.23	37.17	4.18	5.93	409	264	13.74
	STD. DEV.	2.99		88.79	0.11	59.91	24.53	2.31	2.58	8.15	13.39	4.83	4.36	3.09	4.02	1.98	0.72	2.70	4.55	1.11	1.02	17.61	2.68	3.44			3.89
	MIN	19.60	5.79	1054.00	0.04	-348.90	440.00	2.00	1.00	3.00	25.00	1.03	0.99	0.29	0.51	0.01	0.01	0.02	0.53	0.70	0.32	21.00	0.01	0.10	1	2	6.50
	MAX	27.60	7.66	1306.00	0.44	-132.60	510.00	9.00	8.00	30.00	64.00	14.20	13.00	11.70	10.00	6.90	2.50	9.40	12.10	4.10	3.50	71.00	9.90	11.00	5,400	2,400	18.00
Well	n	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	MEAN	27.90	7.32	529.00	5.10	101.30	150.00	1.00	1.00	2.00	10.00	1.58	0.18	0.16	0.02	1.40	0.01	1.40	1.42	0.49	0.20	8.70	0.13	0.41	1	2	2.10
	STD. DEV.																										
	MIN	27.90	7.32	529.00	5.10	101.30	150.00	1.00	1.00	2.00	10.00	1.58	0.18	0.16	0.02	1.40	0.01	1.40	1.42	0.49	0.20	8.70	0.13	0.41	1	2	2.10
	MAX	27.90	7.32	529.00	5.10	101.30	150.00	1.00	1.00	2.00	10.00	1.58	0.18	0.16	0.02	1.40	0.01	1.40	1.42	0.49	0.20	8.70	0.13	0.41	1	2	2.10

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]Fecal coliform and pH values are reported as geometric mean.

Gray-shaded data points indicate values below method detection level (mdl), mdl value used for statistical analyses.

Yellow-shaded data points indicate the reported value is between the laboratory method detection limit and the laboratory practical quantitation limit, value used for statistical analysis.

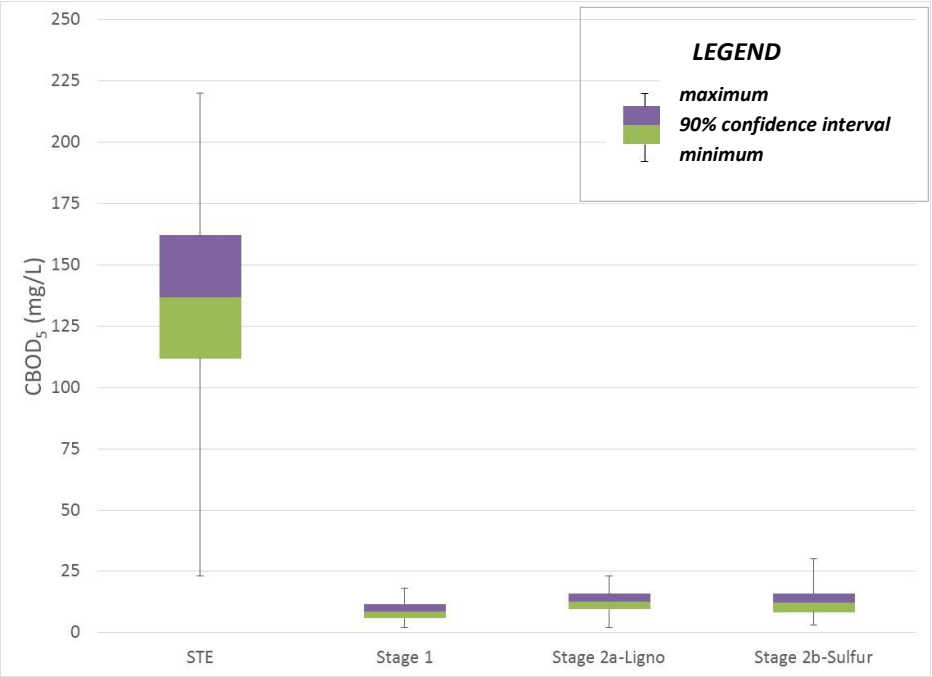


Figure 10
$CBOD_5$ Box and Whisker Plot

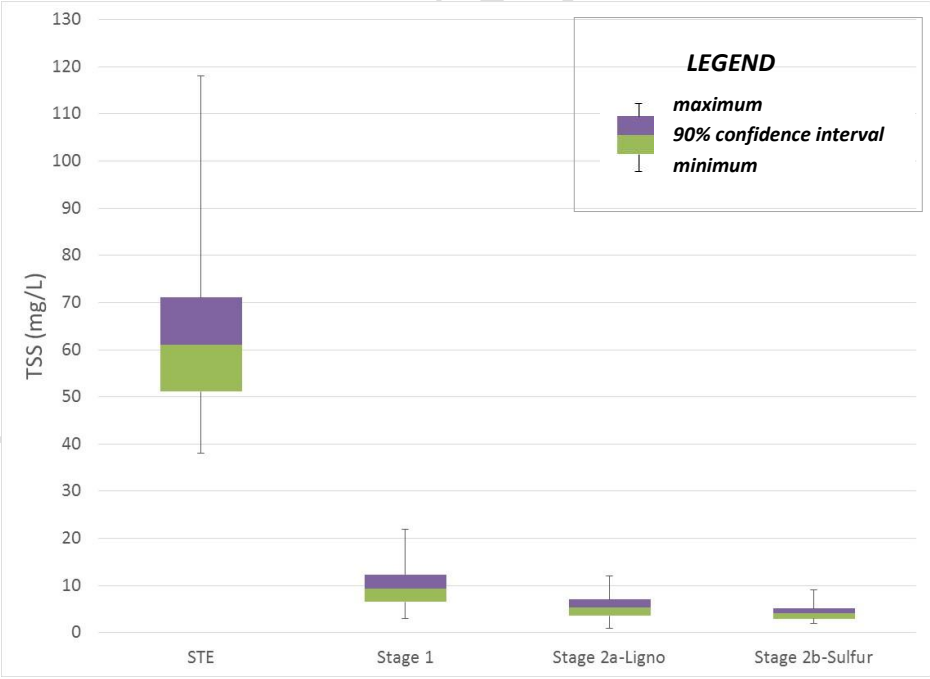


Figure 11
TSS Box and Whisker Plot

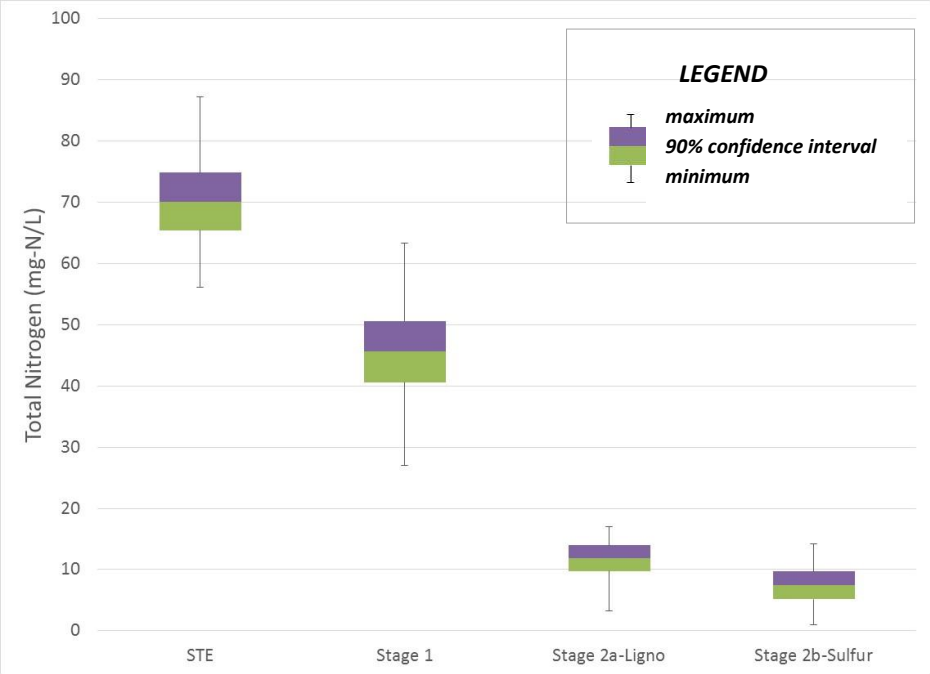


Figure 12
Total Nitrogen (TN) Box and Whisker Plot

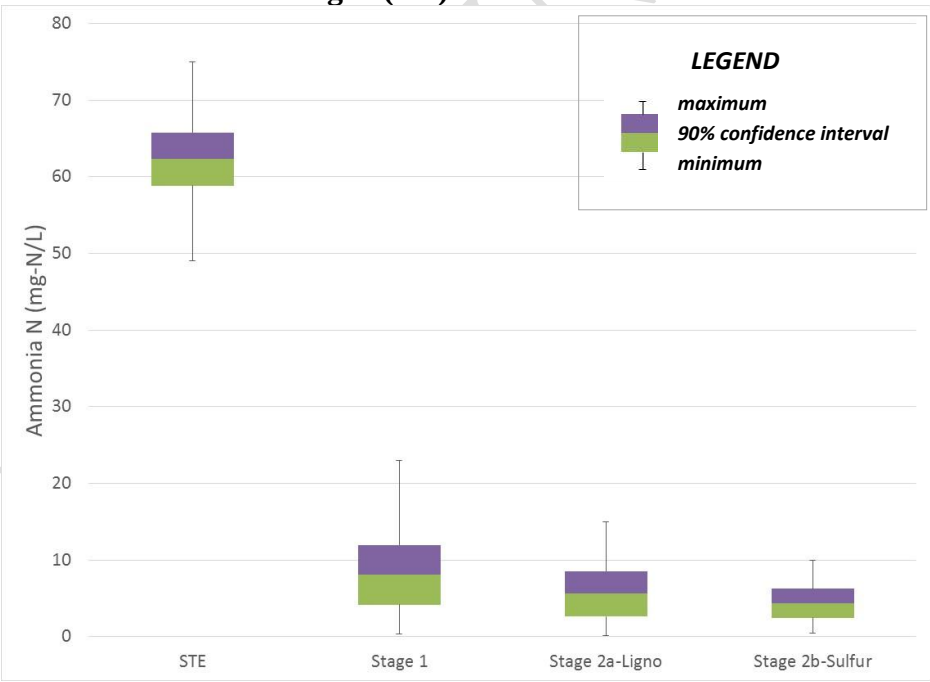


Figure 13
Ammonia N (NH3-N) Box and Whisker Plot

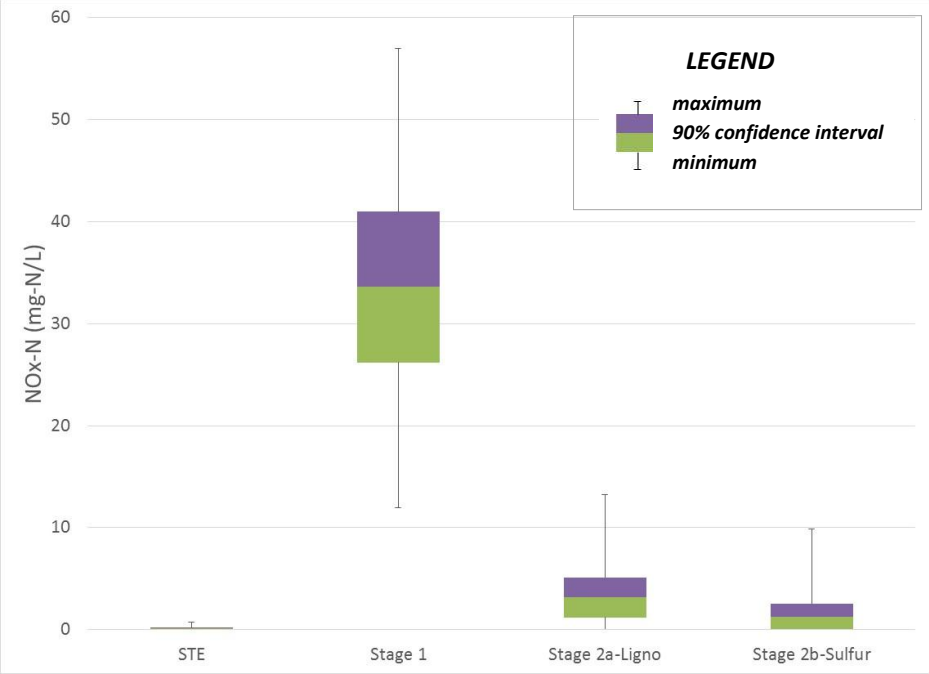


Figure 14
Nitrate+Nitrite Nitrogen (NO_X-N) Box and Whisker Plot

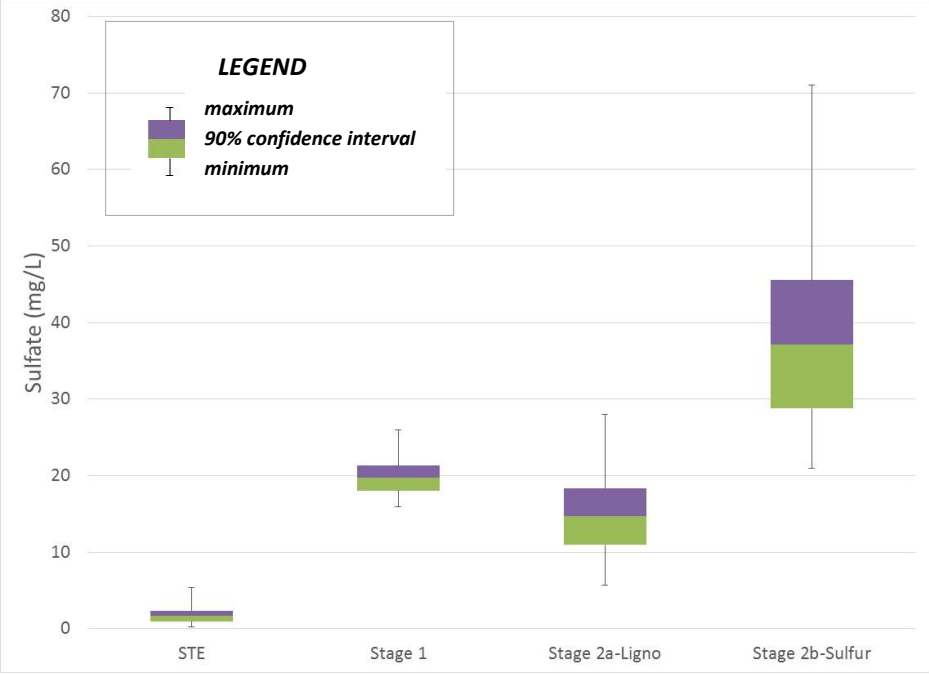


Figure 15
Sulfate (SO_4) Box and Whisker Plot

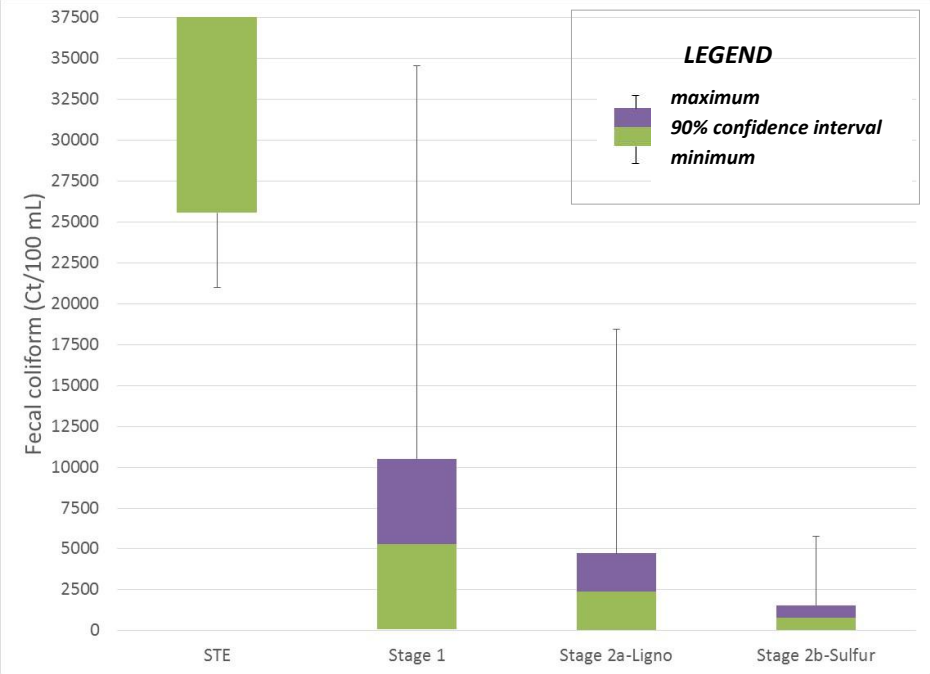


Figure 16
Fecal Coliform Box and Whisker Plot

5.0 B-HS4 Sample Event No. 8: Summary and Recommendations

5.1 Summary

The eighth and final sampling results indicate that:

- Septic tank effluent (STE) quality is characteristic of typical household STE quality. The total nitrogen concentration of 78.1 mg/L is within the high end of the range of values typically reported for Florida single family residence STE.
- The Stage 1 biofilter reduced TN and TKN by 27 and 89%, respectively.
- The Stage 1 biofilter reduced TKN and ammonium; effluent TKN and ammonia N were 8.2 and 2.9 mg/L, respectively.
- The Stage 2 biofilter effluent NO_x-N was 9.4 mg N/L, which was unusually high and may indicate a sampling problem.
- The total nitrogen concentration in the final effluent from the total treatment system was 14.2 mg/L, an approximately 82% reduction in STE TN.

5.2 Conclusions

Sample Event 8 was the last funded sample event for the B-HS4 treatment system. Sections 4.4 summarized the water quality data collected over the 1.4 year monitoring period for this system. These results indicate that:

- The septic tank effluent average total nitrogen concentration of 70.1 mg/L is in the upper range of values typically reported for Florida single family residence STE.
- The Stage 1 biofilter provided significant ammonia removal with an average NH_3-N concentration of 8.1 mg/L and average TKN of 12.0 mg/L. The Stage 1 biofilter effluent average NO_x-N was 33.6 mg/L. These results indicate denitrification (approximately 35% total nitrogen reduction) was likely occurring in the Stage 1 biofilter.
- The Stage 2 biofilter was effective in producing a reducing environment and achieving significant NO_x-N removal (average NO_x-N concentration of 0.82 mg/L). The average final total nitrogen (TN) in the treatment system effluent was 7.4 mg/L, primarily TKN (average TKN concentration of 6.6 mg/L), which represents an 89 percent average total nitrogen reduction from this PNRS.

Further analysis of the results obtained at this site will occur as Task B results are compiled and summarized. The results of the data collected to date have provided insights into the performance of a full-scale passive single pass nitrogen reduction system monitored over an extended timeframe (525 experimental days) under actual onsite conditions.

Appendix A: Laboratory Report

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

ACCREDITED IN ACCORDANCE WITH nelac

Hazen and Sawyer
10002 Princess Palm Ave, Suite 200
Tampa, FL 33619

December 30, 2014
Work Order: 1412943

Laboratory Report

Project Name **B-HS4 SE#12**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS4-STE**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-01**						
Date/Time Collected		**12/16/14 11:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.50	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	74	EPA 350.1	4.0	0.95		12/17/14 18:25	100
Carbonaceous BOD	mg/L	170	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	270	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1
Nitrate+Nitrite (N)	mg/L	0.06	EPA 353.2	0.04	0.01		12/18/14 12:05	1
Nitrite (as N)	mg/L	0.10 J5	SM 4500NO2-B	0.04	0.01		12/17/14 11:27	1
Phosphorous - Total as P	mg/L	8.3	SM 4500P-E	0.80	0.20	12/17/14 11:17	12/18/14 11:14	20
Sulfate	mg/L	1.6	EPA 300.0	0.60	0.20		12/23/14 18:35	1
Sulfide	mg/L	1.4	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	78	EPA 351.2	4.0	1.0	12/17/14 11:17	12/18/14 11:14	20
Total Organic Carbon	mg/L	57	SM 5310B	10	0.60		12/18/14 11:26	10
Total Suspended Solids	mg/L	58	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		12/18/14 12:05	1
Microbiology								
E. Coli	MPN/100 mL	200,000	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	200,000	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1
Sample Description		**BHS4-ST1**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-02**						
Date/Time Collected		**12/16/14 10:55**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	2.9	EPA 350.1	0.40	0.095		12/17/14 17:57	10
Carbonaceous BOD	mg/L	10	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	23 I	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1
Nitrate+Nitrite (N)	mg/L	49	EPA 353.2	2.0	0.50		12/18/14 12:07	50
Nitrite (as N)	mg/L	0.03 I	SM 4500NO2-B	0.04	0.01		12/17/14 11:27	1
Phosphorous - Total as P	mg/L	0.35	SM 4500P-E	0.20	0.050	12/17/14 11:17	12/18/14 11:14	5
Sulfate	mg/L	26	EPA 300.0	0.60	0.20		12/23/14 18:47	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	8.2	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Total Organic Carbon	mg/L	10	SM 5310B	1.0	0.060		12/18/14 11:26	1

Florida Certification Number: E84129
NELAP Accredited

Francis I. Daniels, Laboratory Director
Leslie C. Boardman, Q.A. Manager

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

December 30, 2014
Work Order: 1412943

Laboratory Report

Project Name		**B-HS4 SE#12**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS4-ST1**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-02**						
Date/Time Collected		**12/16/14 10:55**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Total Suspended Solids	mg/L	7	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	49	EPA 353.2	2.0	0.51		12/18/14 12:07	50
Microbiology								
E. Coli	MPN/100 mL	160	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	200	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1
Sample Description		**BHS4-LIGNO-36**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-03**						
Date/Time Collected		**12/16/14 10:50**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Ammonia as N	mg/L	1.3	EPA 350.1	0.040	0.009		12/17/14 16:53	1
Carbonaceous BOD	mg/L	2	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Nitrate+Nitrite (N)	mg/L	41	EPA 353.2	2.0	0.50		12/18/14 12:09	50
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		12/17/14 11:28	1
Sulfate	mg/L	25	EPA 300.0	0.60	0.20		12/24/14 04:30	1
Total Kjeldahl Nitrogen	mg/L	5.5	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Nitrate (as N)	mg/L	41	EPA 353.2	2.0	0.51		12/18/14 12:09	50
Sample Description		**BHS4-LIGNO-24**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-04**						
Date/Time Collected		**12/16/14 10:45**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Ammonia as N	mg/L	0.17	EPA 350.1	0.040	0.009		12/17/14 16:55	1
Carbonaceous BOD	mg/L	6	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Nitrate+Nitrite (N)	mg/L	28	EPA 353.2	2.0	0.50		12/18/14 12:11	50
Nitrite (as N)	mg/L	0.03 I	SM 4500NO2-B	0.04	0.01		12/17/14 11:28	1
Sulfate	mg/L	26	EPA 300.0	0.60	0.20		12/24/14 04:41	1
Total Kjeldahl Nitrogen	mg/L	5.0	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Nitrate (as N)	mg/L	28	EPA 353.2	2.0	0.51		12/18/14 12:11	50

Florida Certification Number: E84129
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December 30, 2014
Work Order: 1412943

Laboratory Report

Project Name		**B-HS4 SE#12**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS4-LIGNO-12**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-05**						
Date/Time Collected		**12/16/14 10:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Ammonia as N	mg/L	0.32	EPA 350.1	0.040	0.009		12/17/14 16:56	1
Carbonaceous BOD	mg/L	8	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Nitrate+Nitrite (N)	mg/L	5.9	EPA 353.2	0.20	0.05		12/18/14 12:14	5
Nitrite (as N)	mg/L	0.64	SM 4500NO2-B	0.40	0.10		12/17/14 11:52	10
Sulfate	mg/L	28	EPA 300.0	0.60	0.20		12/24/14 04:52	1
Total Kjeldahl Nitrogen	mg/L	3.0	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Nitrate (as N)	mg/L	5.3	EPA 353.2	0.60	0.15		12/18/14 12:14	10
Sample Description		**BHS4-LIGNO-0**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-06**						
Date/Time Collected		**12/16/14 10:30**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	0.27	EPA 350.1	0.040	0.009		12/17/14 16:58	1
Carbonaceous BOD	mg/L	8	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	20 I	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1
Nitrate+Nitrite (N)	mg/L	6.3	EPA 353.2	0.20	0.05		12/18/14 12:16	5
Nitrite (as N)	mg/L	0.57	SM 4500NO2-B	0.40	0.10		12/17/14 11:52	10
Phosphorous - Total as P	mg/L	1.4	SM 4500P-E	0.20	0.050	12/17/14 11:17	12/18/14 11:14	5
Sulfate	mg/L	28	EPA 300.0	0.60	0.20		12/24/14 05:03	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	3.3	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Total Organic Carbon	mg/L	9.6	SM 5310B	1.0	0.060		12/18/14 11:26	1
Total Suspended Solids	mg/L	6	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	5.7	EPA 353.2	0.60	0.15		12/18/14 12:16	10
Microbiology								
E. Coli	MPN/100 mL	480	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	570	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1

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Laboratory Report

Project Name **B-HS4 SE#12**

Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		**BHS4-SULFUR-6**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-07**						
Date/Time Collected		**12/16/14 10:20**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Ammonia as N	mg/L	0.49	EPA 350.1	0.040	0.009		12/17/14 17:00	1
Carbonaceous BOD	mg/L	22	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Nitrate+Nitrite (N)	mg/L	0.01 I	EPA 353.2	0.04	0.01		12/18/14 12:18	1
Nitrite (as N)	mg/L	0.03 I	SM 4500NO2-B	0.04	0.01		12/17/14 11:30	1
Sulfate	mg/L	77	EPA 300.0	0.60	0.20		12/24/14 05:15	1
Total Kjeldahl Nitrogen	mg/L	1.8	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		12/18/14 12:18	1
Sample Description		**BHS4-SULFUR-12**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-08**						
Date/Time Collected		**12/16/14 10:15**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Ammonia as N	mg/L	0.24	EPA 350.1	0.040	0.009		12/17/14 17:01	1
Carbonaceous BOD	mg/L	23	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Nitrate+Nitrite (N)	mg/L	0.03 I	EPA 353.2	0.04	0.01		12/18/14 12:20	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		12/17/14 11:30	1
Sulfate	mg/L	73	EPA 300.0	0.60	0.20		12/24/14 05:26	1
Total Kjeldahl Nitrogen	mg/L	1.6	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Nitrate (as N)	mg/L	0.03 I	EPA 353.2	0.08	0.02		12/18/14 12:20	1
Sample Description		**BHS4-ST2**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-09**						
Date/Time Collected		**12/16/14 09:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	2.7	EPA 350.1	0.40	0.095		12/18/14 09:18	10
Carbonaceous BOD	mg/L	11	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	25	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1

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Project Name		**B-HS4 SE#12**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS4-ST2**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-09**						
Date/Time Collected		**12/16/14 09:40**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Nitrate+Nitrite (N)	mg/L	9.5	EPA 353.2	2.0	0.50		12/18/14 13:22	50
Nitrite (as N)	mg/L	2.5 I	SM 4500NO2-B	3.6	0.90		12/17/14 12:31	90
Phosphorous - Total as P	mg/L	1.6	SM 4500P-E	0.20	0.050	12/17/14 11:17	12/18/14 11:14	5
Sulfate	mg/L	68	EPA 300.0	6.0	2.0		12/24/14 18:21	10
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	4.8	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Total Organic Carbon	mg/L	11	SM 5310B	1.0	0.060		12/18/14 11:26	1
Total Suspended Solids	mg/L	5	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	6.9	EPA 353.2	5.6	1.4		12/18/14 13:22	90
Microbiology								
E. Coli	MPN/100 mL	2,400	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	2,900	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1
Sample Description		**BHS4-ST2-DUP**						
Matrix		**Wastewater**						
SAL Sample Number		**1412943-10**						
Date/Time Collected		**12/16/14 09:55**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	2.8	EPA 350.1	0.40	0.095		12/18/14 09:19	10
Carbonaceous BOD	mg/L	10	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	29	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1
Nitrate+Nitrite (N)	mg/L	9.2	EPA 353.2	2.0	0.50		12/18/14 13:23	50
Nitrite (as N)	mg/L	2.8 I	SM 4500NO2-B	3.6	0.90		12/17/14 12:10	90
Phosphorous - Total as P	mg/L	1.6	SM 4500P-E	0.20	0.050	12/17/14 11:17	12/18/14 11:14	5
Sulfate	mg/L	64	EPA 300.0	6.0	2.0		12/24/14 18:30	10
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	5.0	EPA 351.2	1.0	0.25	12/17/14 11:17	12/18/14 11:14	5
Total Organic Carbon	mg/L	11	SM 5310B	1.0	0.060		12/18/14 11:26	1
Total Suspended Solids	mg/L	8	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	6.3	EPA 353.2	5.6	1.4		12/18/14 13:23	90
Microbiology								
E. Coli	MPN/100 mL	2,400	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	3,000	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1

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Laboratory Report

Project Name		**B-HS4 SE#12**						
Parameters	**Units**	**Results ***	**Method**	**PQL**	**MDL**	**Prepared**	**Analyzed**	**Dilution**
Sample Description		**BHS4-FB**						
Matrix		**Reagent Water**						
SAL Sample Number		**1412943-12**						
Date/Time Collected		**12/16/14 11:30**						
Collected by		**Josefin Hirst**						
Date/Time Received		**12/16/14 14:05**						
Inorganics								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	12/24/14 10:01	12/24/14 10:06	1
Ammonia as N	mg/L	0.009 U	EPA 350.1	0.040	0.009		12/18/14 09:21	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	12/17/14 09:06	12/22/14 13:12	1
Chemical Oxygen Demand	mg/L	10 U	EPA 410.4	25	10	12/22/14 10:37	12/22/14 12:39	1
Nitrate+Nitrite (N)	mg/L	0.01 U	EPA 353.2	0.04	0.01		12/18/14 13:24	1
Nitrite (as N)	mg/L	0.01 U	SM 4500NO2-B	0.04	0.01		12/18/14 10:10	1
Phosphorous - Total as P	mg/L	0.033 I	SM 4500P-E	0.040	0.010	12/17/14 11:17	12/18/14 11:14	1
Sulfate	mg/L	0.20 U	EPA 300.0	0.60	0.20		12/24/14 18:41	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		12/23/14 13:56	1
Total Kjeldahl Nitrogen	mg/L	0.20	EPA 351.2	0.20	0.05	12/17/14 11:17	12/18/14 11:14	1
Total Organic Carbon	mg/L	0.060 U	SM 5310B	1.0	0.060		12/18/14 11:26	1
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	12/17/14 08:19	12/18/14 15:43	1
Nitrate (as N)	mg/L	0.02 U	EPA 353.2	0.08	0.02		12/18/14 13:24	1
Microbiology								
E. Coli	MPN/100 mL	2.0 U	SM 9223B	2.0	2.0	12/16/14 15:22	12/17/14 10:05	1
Fecal Coliforms	CFU/100 ml	1 U	SM 9222D	1	1	12/16/14 15:07	12/17/14 13:41	1

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41625 - TOC prep										
Blank (BL41625-BLK1)					Prepared & Analyzed: 12/18/14 11:26					
Total Organic Carbon	0.060 U	1.0	0.060	mg/L						
LCS (BL41625-BS1)					Prepared & Analyzed: 12/18/14 11:26					
Total Organic Carbon	9.80	1.0	0.060	mg/L	10		98	90-110		
Matrix Spike (BL41625-MS1)		**Source: 1412944-02**			Prepared & Analyzed: 12/18/14 11:26					
Total Organic Carbon	12.6	1.0	0.060	mg/L	10	3.38	92	85-115		
Matrix Spike Dup (BL41625-MSD1)		**Source: 1412944-02**			Prepared & Analyzed: 12/18/14 11:26					
Total Organic Carbon	12.9	1.0	0.060	mg/L	10	3.38	95	85-115	2	10
Batch BL41703 - TSS prep										
Blank (BL41703-BLK1)					Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	1 U	1	1	mg/L						
Blank (BL41703-BLK2)					Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	1 U	1	1	mg/L						
LCS (BL41703-BS1)					Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	53.5	1	1	mg/L	50		107	85-115		
LCS (BL41703-BS2)					Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	47.0	1	1	mg/L	50		94	85-115		
Duplicate (BL41703-DUP1)		**Source: 1413204-01**			Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	115	1	1	mg/L		115			0	30

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41703 - TSS prep										
Duplicate (BL41703-DUP2)		**Source: 1413217-01**			Prepared: 12/17/14 Analyzed: 12/18/14 15:43					
Total Suspended Solids	181	1	1	mg/L		179			1	30
Batch BL41706 - BOD										
Blank (BL41706-BLK1)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	2 U	2	2	mg/L						
Blank (BL41706-BLK2)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BL41706-BS1)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	172	2	2	mg/L	200		86	85-115		
LCS (BL41706-BS2)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	177	2	2	mg/L	200		88	85-115		
LCS Dup (BL41706-BSD1)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	188	2	2	mg/L	200		94	85-115	9	200
LCS Dup (BL41706-BSD2)					Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	189	2	2	mg/L	200		94	85-115	7	200
Duplicate (BL41706-DUP1)		**Source: 1412943-01**			Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	170	2	2	mg/L		170			3	25
Duplicate (BL41706-DUP2)		**Source: 1413217-01**			Prepared: 12/17/14 Analyzed: 12/22/14 13:12					
Carbonaceous BOD	310	2	2	mg/L		300			4	25

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41708 - Nitrite SM 4500NO2-B by seal										
Blank (BL41708-BLK1)					Prepared & Analyzed: 12/17/14 11:25					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
LCS (BL41708-BS1)					Prepared & Analyzed: 12/17/14 11:25					
Nitrite (as N)	0.0816	0.04	0.01	mg/L	0.080		102	90-110		
Matrix Spike (BL41708-MS1)		**Source: 1412943-01**			Prepared & Analyzed: 12/17/14 11:26					
Nitrite (as N)	0.163 J2	0.04	0.01	mg/L	0.10	0.103	60	77-119		
Matrix Spike (BL41708-MS2)		**Source: 1412943-10**			Prepared & Analyzed: 12/17/14 12:09					
Nitrite (as N)	2.55 I,L2	3.6	0.90	mg/L	0.10	2.84	NR	77-119		
Matrix Spike Dup (BL41708-MSD1)		**Source: 1412943-01**			Prepared & Analyzed: 12/17/14 11:26					
Nitrite (as N)	0.169 J2	0.04	0.01	mg/L	0.10	0.103	66	77-119	3	20
Matrix Spike Dup (BL41708-MSD2)		**Source: 1412943-10**			Prepared & Analyzed: 12/17/14 12:09					
Nitrite (as N)	2.49 I,L2	3.6	0.90	mg/L	0.10	2.84	NR	77-119	2	20
Batch BL41710 - Nitrate 353.2 by seal										
Blank (BL41710-BLK1)					Prepared & Analyzed: 12/18/14 11:57					
Nitrate+Nitrite (N)	0.01 U	0.04	0.01	mg/L						
LCS (BL41710-BS1)					Prepared & Analyzed: 12/18/14 11:59					
Nitrate+Nitrite (N)	0.813	0.04	0.01	mg/L	0.80		102	90-110		
Matrix Spike (BL41710-MS1)		**Source: 1412943-01**			Prepared & Analyzed: 12/18/14 12:01					
Nitrate+Nitrite (N)	1.06	0.04	0.01	mg/L	1.0	0.0590	100	90-110		

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41710 - Nitrate 353.2 by seal										
Matrix Spike (BL41710-MS2)		**Source: 1413191-01**			Prepared & Analyzed: 12/18/14 13:19					
Nitrate+Nitrite (N)	7.75 L2	0.20	0.05	mg/L	1.0	7.17	58	90-110		
Matrix Spike Dup (BL41710-MSD1)		**Source: 1412943-01**			Prepared & Analyzed: 12/18/14 12:03					
Nitrate+Nitrite (N)	1.14	0.04	0.01	mg/L	1.0	0.0590	108	90-110	7	20
Matrix Spike Dup (BL41710-MSD2)		**Source: 1413191-01**			Prepared & Analyzed: 12/18/14 13:21					
Nitrate+Nitrite (N)	8.00 L2	0.20	0.05	mg/L	1.0	7.17	83	90-110	3	20
Batch BL41712 - Digestion for TP and TKN										
Blank (BL41712-BLK1)					Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	0.0500 I	0.20	0.05	mg/L						
Phosphorous - Total as P	0.010 U	0.040	0.010	mg/L						
Blank (BL41712-BLK2)					Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	0.05 U	0.20	0.05	mg/L						
Phosphorous - Total as P	0.010 U	0.040	0.010	mg/L						
LCS (BL41712-BS1)					Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	0.944	0.20	0.05	mg/L	1.0		94	90-110		
Phosphorous - Total as P	1.07	0.040	0.010	mg/L	1.0		107	90-110		
LCS (BL41712-BS2)					Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	1.09	0.20	0.05	mg/L	1.0		109	90-110		
Phosphorous - Total as P	1.01	0.040	0.010	mg/L	1.0		101	90-110		
Matrix Spike (BL41712-MS1)		**Source: 1412943-10**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	6.10	0.20	0.05	mg/L	1.0	5.02	108	90-110		
Phosphorous - Total as P	2.53	0.040	0.010	mg/L	1.0	1.63	90	90-110		

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41712 - Digestion for TP and TKN										
Matrix Spike (BL41712-MS2)		**Source: 1412943-12**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	1.17	0.20	0.05	mg/L	1.0	0.198	97	90-110		
Phosphorous - Total as P	1.06	0.040	0.010	mg/L	1.0	0.0334	102	90-110		
Matrix Spike (BL41712-MS3)		**Source: 1413212-07**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Phosphorous - Total as P	1.50	0.040	0.010	mg/L	1.0	0.583	92	90-110		
Total Kjeldahl Nitrogen	1.10	0.20	0.05	mg/L	1.0	ND	110	90-110		
Matrix Spike (BL41712-MS4)		**Source: 1413217-07**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Phosphorous - Total as P	1.19	0.040	0.010	mg/L	1.0	0.166	102	90-110		
Total Kjeldahl Nitrogen	2.10	0.20	0.05	mg/L	1.0	1.09	101	90-110		
Matrix Spike Dup (BL41712-MSD1)		**Source: 1412943-10**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Phosphorous - Total as P	2.69	0.040	0.010	mg/L	1.0	1.63	107	90-110	6	25
Total Kjeldahl Nitrogen	6.00	0.20	0.05	mg/L	1.0	5.02	99	90-110	2	20
Matrix Spike Dup (BL41712-MSD2)		**Source: 1412943-12**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Total Kjeldahl Nitrogen	1.10	0.20	0.05	mg/L	1.0	0.198	90	90-110	6	20
Phosphorous - Total as P	1.00	0.040	0.010	mg/L	1.0	0.0334	97	90-110	5	25
Matrix Spike Dup (BL41712-MSD3)		**Source: 1413212-07**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Phosphorous - Total as P	1.50	0.040	0.010	mg/L	1.0	0.583	92	90-110	0.3	25
Total Kjeldahl Nitrogen	1.03	0.20	0.05	mg/L	1.0	ND	103	90-110	7	20
Matrix Spike Dup (BL41712-MSD4)		**Source: 1413217-07**			Prepared: 12/17/14 Analyzed: 12/18/14 11:14					
Phosphorous - Total as P	1.09	0.040	0.010	mg/L	1.0	0.166	92	90-110	9	25
Total Kjeldahl Nitrogen	2.15	0.20	0.05	mg/L	1.0	1.09	106	90-110	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 BL41714 - Ammonia by SEAL										
Blank (BL41714-BLK1)					Prepared & Analyzed: 12/17/14 16:43					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
LCS (BL41714-BS1)					Prepared & Analyzed: 12/17/14 16:44					
Ammonia as N	0.48	0.040	0.009	mg/L	0.50		96	90-110		
Matrix Spike (BL41714-MS1)		**Source: 1412943-01**			Prepared & Analyzed: 12/17/14 18:22					
Ammonia as N	61 L2	1.0	0.24	mg/L	0.50	74	NR	90-110		
Matrix Spike (BL41714-MS2)		**Source: 1413196-01**			Prepared & Analyzed: 12/18/14 09:14					
Ammonia as N	0.56	0.040	0.009	mg/L	0.50	0.032	106	90-110		
Matrix Spike Dup (BL41714-MSD1)		**Source: 1412943-01**			Prepared & Analyzed: 12/17/14 18:24					
Ammonia as N	61 L2	1.0	0.24	mg/L	0.50	74	NR	90-110	0.6	10
Matrix Spike Dup (BL41714-MSD2)		**Source: 1413196-01**			Prepared & Analyzed: 12/18/14 09:16					
Ammonia as N	0.61	0.040	0.009	mg/L	0.50	0.032	115	90-110	7	10
Batch BL41728 - Sulfide prep										
Blank (BL41728-BLK1)					Prepared & Analyzed: 12/23/14 13:56					
Sulfide	0.10 U	0.40	0.10	mg/L						
Blank (BL41728-BLK2)					Prepared & Analyzed: 12/23/14 13:56					
Sulfide	0.10 U	0.40	0.10	mg/L						
LCS (BL41728-BS1)					Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.92	0.40	0.10	mg/L	5.0		98	85-115		

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Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41728 - Sulfide prep										
LCS (BL41728-BS2)					Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.92	0.40	0.10	mg/L	5.0		98	85-115		
Matrix Spike (BL41728-MS1)		**Source: 1412942-20**			Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.72	0.40	0.10	mg/L	5.0	ND	94	85-115		
Matrix Spike (BL41728-MS2)		**Source: 1412943-12**			Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.82	0.40	0.10	mg/L	5.0	ND	96	85-115		
Matrix Spike Dup (BL41728-MSD1)		**Source: 1412942-20**			Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.72	0.40	0.10	mg/L	5.0	ND	94	85-115	0	14
Matrix Spike Dup (BL41728-MSD2)		**Source: 1412943-12**			Prepared & Analyzed: 12/23/14 13:56					
Sulfide	4.82	0.40	0.10	mg/L	5.0	ND	96	85-115	0	14
Batch BL41803 - Nitrite SM 4500NO2-B by seal										
Blank (BL41803-BLK1)					Prepared & Analyzed: 12/18/14 10:07					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
LCS (BL41803-BS1)					Prepared & Analyzed: 12/18/14 10:08					
Nitrite (as N)	0.0803	0.04	0.01	mg/L	0.080		100	90-110		
Matrix Spike (BL41803-MS1)		**Source: 1413284-01**			Prepared & Analyzed: 12/18/14 10:08					
Nitrite (as N)	0.170	0.04	0.01	mg/L	0.080	0.105	81	77-119		
Matrix Spike Dup (BL41803-MSD1)		**Source: 1413284-01**			Prepared & Analyzed: 12/18/14 16:29					
Nitrite (as N)	0.167	0.04	0.01	mg/L	0.080	0.105	78	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 BL42212 - COD prep										
Blank (BL42212-BLK1)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	10 U	25	10	mg/L						
Blank (BL42212-BLK2)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	10 U	25	10	mg/L						
Blank (BL42212-BLK3)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	10 U	25	10	mg/L						
LCS (BL42212-BS1)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	49	25	10	mg/L	50		98	90-110		
LCS (BL42212-BS2)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	47	25	10	mg/L	50		94	90-110		
LCS (BL42212-BS3)					Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	45	25	10	mg/L	50		90	90-110		
Matrix Spike (BL42212-MS1)		**Source: 1412942-19**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	45	25	10	mg/L	50	ND	90	85-115		
Matrix Spike (BL42212-MS2)		**Source: 1412944-11**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	47	25	10	mg/L	50	ND	94	85-115		
Matrix Spike (BL42212-MS3)		**Source: 1412946-21**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	45	25	10	mg/L	50	ND	90	85-115		
Matrix Spike Dup (BL42212-MSD1)		**Source: 1412942-19**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	45	25	10	mg/L	50	ND	90	85-115	0	32

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL42212 - COD prep										
Matrix Spike Dup (BL42212-MSD2)		**Source: 1412944-11**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	45	25	10	mg/L	50	ND	90	85-115	4	32
Matrix Spike Dup (BL42212-MSD3)		**Source: 1412946-21**			Prepared & Analyzed: 12/22/14 12:39					
Chemical Oxygen Demand	43	25	10	mg/L	50	ND	86	85-115	5	32
Batch BL42306 - Ion Chromatography 300.0 Prep										
Blank (BL42306-BLK1)					Prepared & Analyzed: 12/23/14 18:02					
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	*0.847*			*mg/L*	*1.0*		*85*	*78-120*		
LCS (BL42306-BS1)					Prepared & Analyzed: 12/23/14 18:13					
Sulfate	9.27	0.60	0.20	mg/L	9.0		103	85-115		
Surrogate: Dichloroacetate	*0.979*			*mg/L*	*1.0*		*98*	*78-120*		
LCS Dup (BL42306-BSD1)					Prepared & Analyzed: 12/23/14 18:24					
Sulfate	9.56	0.60	0.20	mg/L	9.0		106	85-115	3	200
Surrogate: Dichloroacetate	*1.09*			*mg/L*	*1.0*		*109*	*78-120*		
Matrix Spike (BL42306-MS1)		**Source: 1412942-06**			Prepared & Analyzed: 12/23/14 20:28					
Sulfate	269 L	0.60	0.20	mg/L	9.0	253	180	85-115		
Surrogate: Dichloroacetate	*0.845*			*mg/L*	*1.0*		*84*	*78-120*		
Matrix Spike (BL42306-MS2)		**Source: 1412942-16**			Prepared & Analyzed: 12/23/14 22:31					
Sulfate	59.0	0.60	0.20	mg/L	9.0	51.2	87	85-115		
Surrogate: Dichloroacetate	*1.12*			*mg/L*	*1.0*		*112*	*78-120*		

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL42316 - Ion Chromatography 300.0 Prep										
Blank (BL42316-BLK1)					Prepared & Analyzed: 12/24/14 00:46					
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	*0.840*			*mg/L*	*1.0*		*84*	*78-120*		
LCS (BL42316-BS1)					Prepared & Analyzed: 12/24/14 00:57					
Sulfate	9.54	0.60	0.20	mg/L	9.0		106	85-115		
Surrogate: Dichloroacetate	*1.04*			*mg/L*	*1.0*		*104*	*78-120*		
LCS Dup (BL42316-BSD1)					Prepared & Analyzed: 12/24/14 01:08					
Sulfate	9.24	0.60	0.20	mg/L	9.0		103	85-115	3	200
Surrogate: Dichloroacetate	*0.987*			*mg/L*	*1.0*		*99*	*78-120*		
Matrix Spike (BL42316-MS1)		**Source: 1412944-08**			Prepared & Analyzed: 12/24/14 03:11					
Sulfate	298 L	0.60	0.20	mg/L	9.0	262	405	85-115		
Surrogate: Dichloroacetate	*0.826*			*mg/L*	*1.0*		*83*	*78-120*		
Matrix Spike (BL42316-MS2)		**Source: 1412943-08**			Prepared & Analyzed: 12/24/14 05:37					
Sulfate	82.7	0.60	0.20	mg/L	9.0	72.7	111	85-115		
Surrogate: Dichloroacetate	*0.868*			*mg/L*	*1.0*		*87*	*78-120*		
Batch BL42414 - Ion Chromatography 300.0 Prep										
Blank (BL42414-BLK1)					Prepared & Analyzed: 12/24/14 17:26					
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	*0.966*			*mg/L*	*1.0*		*97*	*78-120*		
LCS (BL42414-BS1)					Prepared & Analyzed: 12/24/14 17:35					
Sulfate	8.76	0.60	0.20	mg/L	9.0		97	85-115		
Surrogate: Dichloroacetate	*1.05*			*mg/L*	*1.0*		*105*	*78-120*		

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Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL42414 - Ion Chromatography 300.0 Prep										
LCS Dup (BL42414-BSD1)					Prepared & Analyzed: 12/24/14 17:53					
Sulfate	9.16	0.60	0.20	mg/L	9.0		102	85-115	4	200
Surrogate: Dichloroacetate	*1.04*			*mg/L*	*1.0*		*104*	*78-120*		
Matrix Spike (BL42414-MS1)		**Source: 1413401-01**			Prepared & Analyzed: 12/24/14 19:37					
Sulfate	453	6.0	2.0	mg/L	90	372	90	85-115		
Surrogate: Dichloroacetate	*1.10*			*mg/L*	*1.0*		*110*	*78-120*		
Matrix Spike (BL42414-MS2)		**Source: 1412944-10**			Prepared & Analyzed: 12/26/14 11:40					
Sulfate	395	6.0	2.0	mg/L	90	314	90	85-115		
Surrogate: Dichloroacetate	*1.07*			*mg/L*	*1.0*		*107*	*78-120*		

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Microbiology - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BL41631 - FC-MF										
Blank (BL41631-BLK1)					Prepared: 12/16/14 Analyzed: 12/17/14 13:41					
Fecal Coliforms	1 U	1	1	CFU/100 ml						
Duplicate (BL41631-DUP1)		**Source: 1412943-12**			Prepared: 12/16/14 Analyzed: 12/17/14 13:41					
Fecal Coliforms	1 U	1	1	CFU/100 ml		ND				200

SOUTHERN ANALYTICAL LABORATORIES, INC.
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* 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.

L2	Analyte level in sample invalidated Matrix Spike.
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.
J2	Quality control value for accuracy was outside control limits.

Questions regarding this report should be directed to :

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Kathryn@southernanalyticallabs.com

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

SAL Project No. 1412943

Client Name	Contact / Phone:
Hazen and Sawyer	
Project Name / Location: B-HS4 SE#12	
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	125mLP, Sterile, $Na_2S_2O_3$ FC-MF, FC-QT	500mLP, Cool TSS, CBOD, NOx, SO_4	125mLP, H_2SO_4 COD, TKN, NH_3, TP	500mLP, NaOH, Zn Acetate H_2S	40mLaV, HCl TOC	500mLP, Cool CBOD, NOx, SO_4	125mLP, H_2SO_4 TKN, NH_3					pH	Temperature	Conductivity	DO
01	BHS4-STE	12/16/14	11:20	WW		X	4	2	1	1	2							7.25	21.8	1291	
02	BHS4-ST1		10:55	WW		X	4	2	1	1	2					1412		6.68	19.8	1412*	1.11
03	BHS4-LIGNO-36		10:50	WW		X						1	1					6.66	19.7	1284	0.40
04	BHS4-LIGNO-24		10:45	WW		X						1	1					6.64	20.6	1259	0.14
05	BHS4-LIGNO-12		10:40	WW		X						1	1					6.68	21.1	1211	0.20
06	BHS4-LIGNO-0		10:30	WW		X	4	2	1	1	2							6.68	21.1	1214	0.20
07	BHS4-SULFUR-6		10:20	WW		X						1	1					6.57	21.8	1232	0.16
08	BHS4-SULFUR-12		10:15	WW		X						1	1					6.73	22.0	1227	0.24
09	BHS4-ST2		9:40	WW		X	4	2	1	1	2							6.66	21.0	1229	0.07
10	BHS4-ST2-DUP		9:55	WW		X	4	2	1	1	2							6.66	21.0	1229	0.07
~~11~~	~~BHS4-EB~~			WW		X	4	2	1	1	2										
12	BHS4-FB		11:30	WW		X	4	2	1	1	2										

Containers Prepared/ Relinquished	Date/Time	Received	Date/Time
MJM	12/09/14 2:15		121014 13:00
	12/16/14 11:45		121614 11:45
X	12-16-14 1405		12-16-14 1405

Seal intact?	Y N N/A	
Samples intact upon arrival?	Y N N/A	
Received on ice? Temp_____	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:

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

Chain of Custody

Appendix B: Operation & Maintenance Log

Table B.1
Operation and Maintenance Log

Date	Description
6/19/2013	Construction - Stage 1 and Stage 2 tank installed
6/20/2013	Construction - drainfield installed
6/21/2013	Construction - electrical work
7/9/2013	System Start-up
	Bull run valve switched from drainfield to Stage 1 biofilter
7/17/2013	Site visit. System ok.
7/23/2013	Construction - sod installation
7/29/2013	Preliminary sampling event
8/6/2013	Site visit.
	Back-up in STE tank, water level above outlet effluent screen
8/12/2013	Back-up in STE tank again, removed filter screen
	Lift station pump causing lots of mixing in STE tank
	Shortened float swing on lift station pump to reduce pump runtime
	Lots of solids in Stage 1 Biofilter
	During lift station pump dose, ponding in Stage 1 biofilter
8/15/2013	Bull run valve switched to drainfield
9/5/2013	Lift station pump replaced with smaller pump
	Smaller pump installed in second chamber of old septic tank
	Switched bull run valve to PNRS system
9/10/2013	Site visit. System ok.
9/30/2013	Sample Event No. 1
11/8/2013	Site visit. System ok.
11/27/2013	Site visit. System ok.
12/2/2013	Sample Event No. 2
	Cleaned STE effluent filter screen
	A little bit of ponding in Stage 1 biofilter influent side
	No ponding in all 4 drainfield observation ports
	*homeowners were out of town for Thanksgiving holiday
12/23/2013	Site visit. System ok. No ponding in all 4 drainfield observation ports
1/23/2014	Site visit.

Date	Description
1/23/2014	Ponding near Stage 1 d-box, adjusted pipe and raked media
	No ponding in all 4 drainfield observation ports
1/31/2014	Site visit.
	Fixed Stage 1 biofilter distribution pipe (east side) which was off support
	No ponding in all 4 drainfield observation ports
2/3/2014	Sample Event No. 3 (formal No. 3)
	No ponding in all 4 drainfield observation ports
2/4/2014	Sample Event No. 4
	No ponding in all 4 drainfield observation ports
2/5/2014	Sample Event No. 5
	No ponding in all 4 drainfield observation ports
2/6/2014	Sample Event No. 6
	No ponding in all 4 drainfield observation ports
2/7/2014	Sample Event No. 7
	No ponding in all 4 drainfield observation ports
2/12/2014	Site visit. System ok. No visible ponding in Stage 1 biofilter.
3/14/2014	Site visit. System ok. No visible ponding in Stage 1 biofilter.
4/3/2014	Sample Event No. 8 (formal No. 4)
	No ponding in all 4 drainfield observation ports
	No visible ponding in Stage 1 biofilter.
	High power meter reading. Checked lift station pump which was ok.
4/25/2014	Site visit. System ok.
	Installed piezometer in Stage 1 biofilter to monitor water level.
	Leveled Stage 1 biofilter distribution pipes
	Adjusted weirs inside Stage 1 d-box
4/29/2014	Site visit. System ok.
	Installed third Stage 1 distribution pipe along centerline of biofilter
5/19/2014	Septic tank effluent screen severely clogged.
	Cleaned STE effluent screen
	Also cleared clog within ball valve from lift station
5/29/2014	Sample Event No. 9 (formal No. 5)
	No ponding in all 4 drainfield observation ports
	No visible ponding in Stage 1 biofilter.
6/9/2014	Re-sampled B-HS4-ST2 for toxicity testing.
	Measured lift station dose runtime
7/11/2014	Site visit.

Date	Description
7/11/2014	STE effluent screen severely clogged again.
	Cleaned STE effluent screen
7/29/2014	Site visit. System ok.
	Cleaned STE effluent screen, it was not severely clogged.
	Black biomat present in Stage 1
8/22/2014	Sample Event No. 10 (formal No. 6)
	Cleaned STE effluent screen, it was not severely clogged.
	Repositioned Stage 1 center distribution pipe.
	Stage 1 center distribution pipe seal in d-box needs to be replaced.
	No ponding in all 4 drainfield observation ports
9/19/2014	Site visit. System ok.
	Cleaned STE effluent screen.
	Black biomat present in Stage 1
10/23/2014	Sample Event No. 11 (formal No. 7)
	Cleaned STE effluent screen, it was not severely clogged.
	No ponding in all 4 drainfield observation ports
11/21/2014	Site visit. System ok.
	Cleaned STE effluent screen.
12/16/2014	Sample Event No. 12 (formal No. 8)
	Cleaned STE effluent screen, it was severely clogged.
	No ponding in all 4 drainfield observation ports