



# Florida Onsite Sewage Nitrogen Reduction Strategies Study

Task B.7

## **B-HS4 Field System Monitoring Report No. 6**

### **Progress Report**

September 2014

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**HAZEN AND SAWYER**  
Environmental Engineers & Scientists

In association with:



**AET**  
Applied Environmental Technology

**Otis Environmental  
Consultants, LLC**

# **Florida Onsite Sewage Nitrogen Reduction Strategies Study**

## **TASK B.7 PROGRESS REPORT**

### **B-HS4 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  
4042 Bald Cypress Way Bin #A-08  
Tallahassee, FL 32399-1713

FDOH Contract CORCL

**September 2014**

#### **Prepared by:**

**HAZEN AND SAWYER**  
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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 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 sixth 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 sixth B-HS4 monitoring and sampling event conducted on August 22, 2014 (Experimental Day 409). 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 four points in the treatment system, and chemical analyses of water samples by a NELAC certified laboratory.

### **3.0 Materials and Methods**

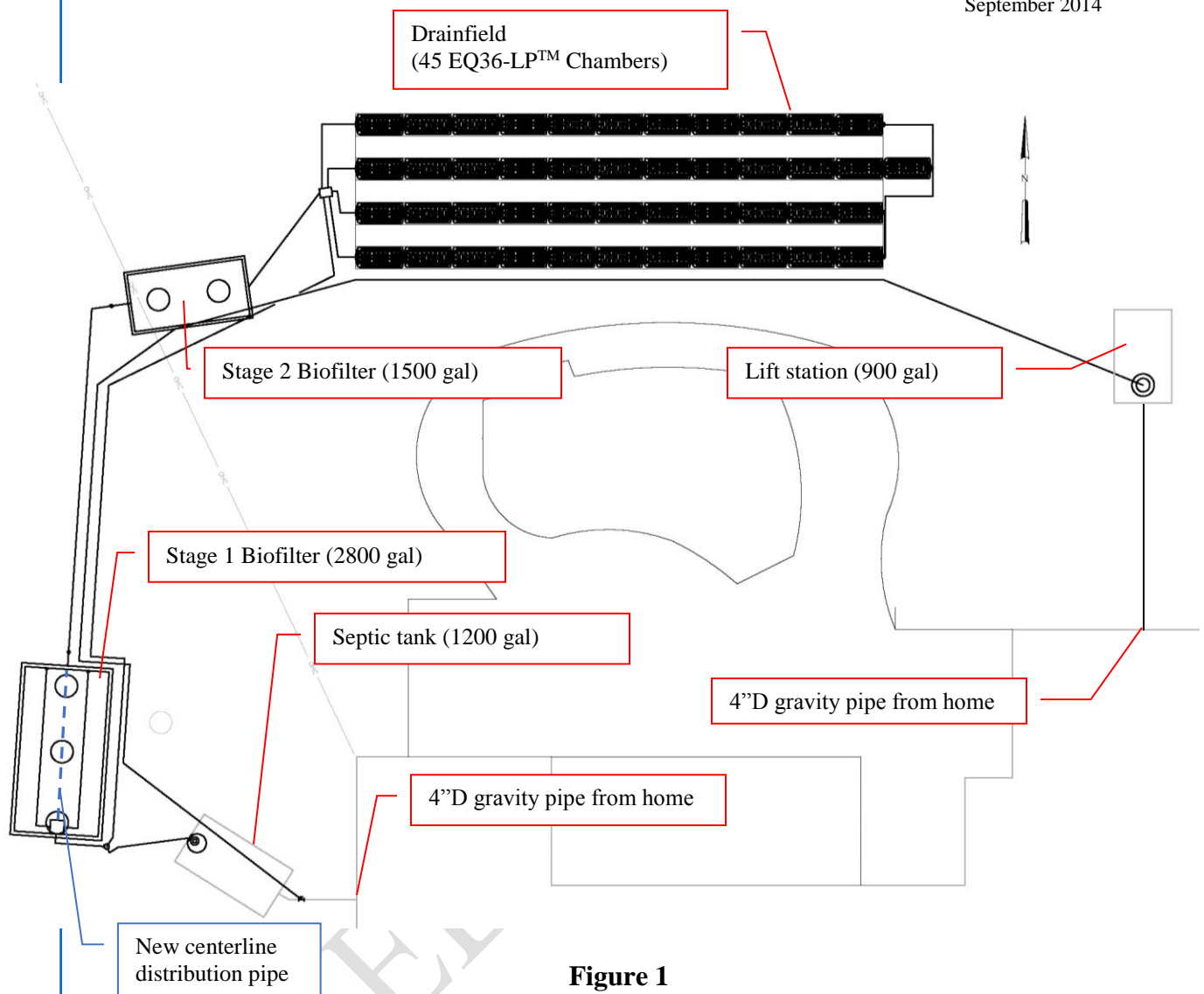
#### **3.1 Project Site**

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

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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, it pumps the raw sewage from that system to the head end of the new gravity flow PNRS. All subsequent flow is by gravity. The passive nitrogen reduction system consists of an addition of two tanks and a new drainfield to the existing permitted systems. The B-HS4 tankage includes a 2,800 gallon concrete Stage 1 unsaturated media biofilter and 1,500 gallon two chamber concrete 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).

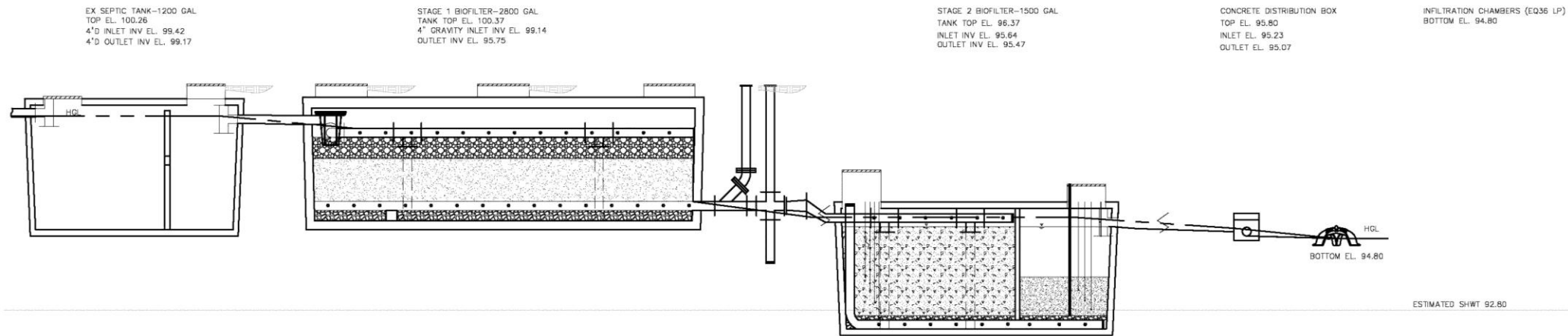
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**Figure 1**  
**Plan View of B-HS4 System Layout**

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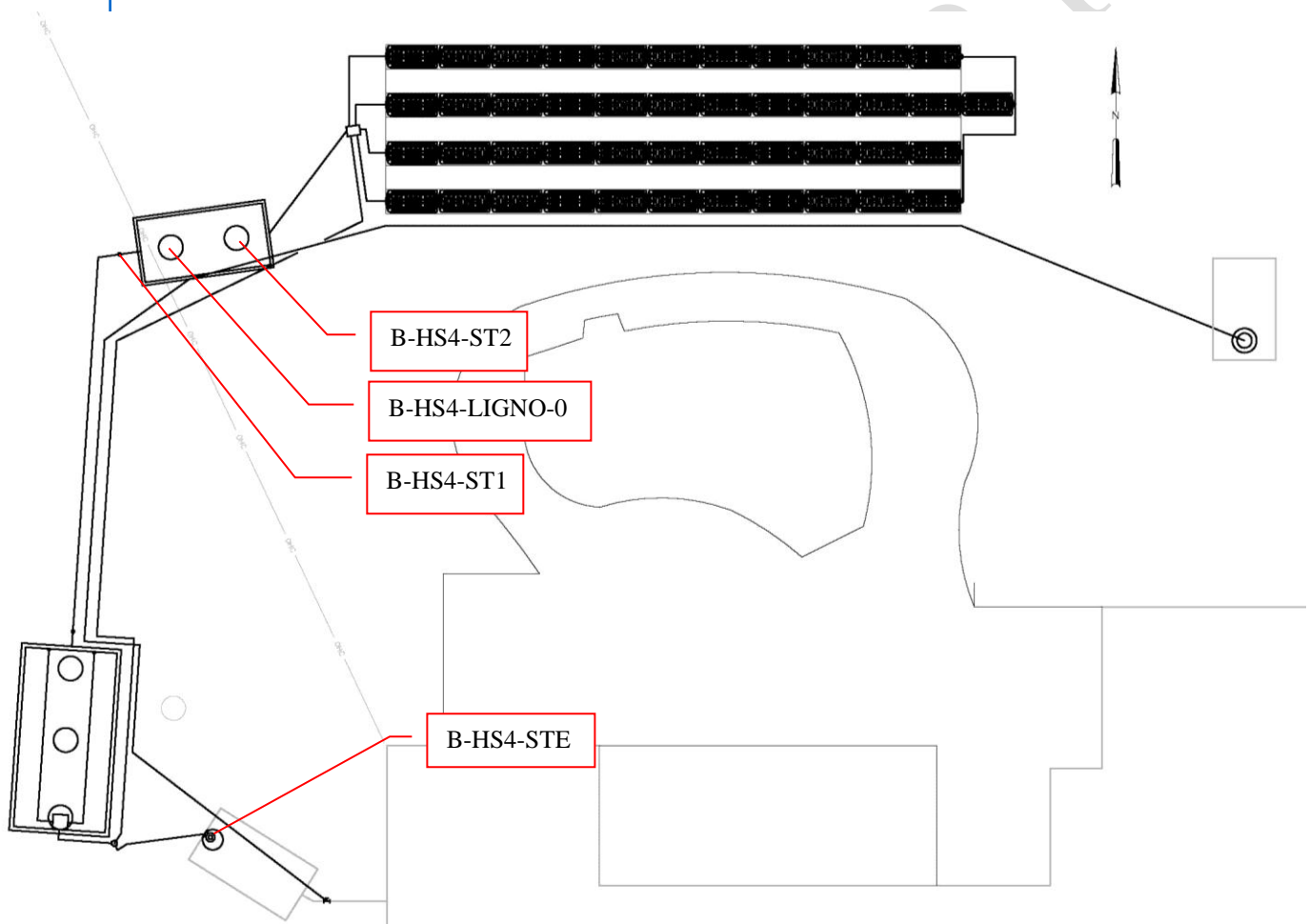
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**Figure 2**  
**Flow Schematic of B-HS4 PNRS**

### 3.2 Monitoring and Sample Locations and Identification

The four primary 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**

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**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 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) is taken from a sample port in the gravity pipe connecting the Stage 1 biofilter outlet to the Stage 2 biofilter inlet representing the Stage 1 biofilter effluent.

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. 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. 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. 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 (less horsepower) pump was installed in the lift station with a mechanical float switch to cause the lift station to dose less volume but more frequent doses to the primary tank which resulted in less mixing within the primary tank. The PNRS system has operated continually since that date. For the sixth formal sampling event, Sample Event No. 6, the water meter for the house was read and recorded on August 22, 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 wastewater 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 sixth formal sample event was conducted on August 22, 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-0, 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.

Immediately subsequent to the regular samples for each primary monitoring point, additional sample was collected to be filtered at the laboratory (0.45 micron filter) for analysis of CBOD<sub>5</sub> and the nitrogen species to allow for comparison to the unfiltered sample water quality results.

Lastly, equipment blank (EB) and field duplicate samples were taken. The equipment blank was collected by pumping deionized water through the cleaned pump tubing. The field sample duplicate (B-HS4-ST1) 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 samples were analyzed by the laboratory for: total alkalinity, chemical oxygen demand (COD), total Kjeldahl nitrogen (TKN-N), ammonia nitrogen (NH<sub>3</sub>-N), nitrate nitrogen (NO<sub>3</sub>-N), nitrite nitrogen (NO<sub>2</sub>-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 influent and sulfur media samples included sulfate, sulfide, and hydrogen sulfide (unionized). 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**

<b>Analytical Parameter</b>	<b>Method of Analysis</b>	<b>Method Detection Limit (mg/L)</b>
Total Alkalinity as CaCO <sub>3</sub>	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 <sub>3</sub> -N)	EPA 350.1	0.005 mg/L
Nitrate Nitrogen (NO <sub>3</sub> -N)	EPA 300.0	0.01 mg/L
Nitrite Nitrogen (NO <sub>2</sub> -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 <sub>5</sub> )	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	SM9223B	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 operation and maintenance log which includes actions taken since start-up is provided in Appendix B.

**Table 2**  
**Summary of Household Water Use**

<b>Date and Time Read</b>	<b>Cumulative Volume (gallons)</b>	<b>Average Daily Household Flow between readings, Q (gpd)</b>	<b>Average Household Flow since PNRS start-up, Q (gpd)</b>
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	42,334.44	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

From PNRS system start-up through August 22, 2014, the household water use average was 304.8 gallons per day with periods of higher and lower flows (Table 2). In the three

weeks prior to this sample event, the household water use was high with an average flow of 601.2 gallons per day.

## 4.2 Energy Consumption

As mentioned previously, the PNRS at this site is a gravity system and uses no electrical energy for treatment. 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.

**Table 3  
Summary of System Electrical Use**

<b>Date and Time Read</b>	<b>Cumulative Electrical Meter Reading (kWh)</b>	<b>Average Daily Electrical Use btwn readings (kWh/day)</b>
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	0.239
5/29/2014 11:20	73.7	0.202
6/9/2014 11:15	73.9	0.134
7/11/2014 10:30	74.7	0.023
8/22/2014 9:30	75.9	0.027
Total average through 8/22/14		0.185

The total average electrical use through August 22, 2014 was 0.185 kWh per day. The cause for the increase in electrical use between the March 14<sup>th</sup> and April 3<sup>rd</sup>, 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.

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### 4.3 Water Quality

Water quality analytical results, for Sample Event No. 6 are listed in Table 4 and key results are graphically displayed in Figure 7. A summary of the water quality data collected to date for the test system is presented in Table 5. 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,  $\text{NH}_3\text{-N}$ , and  $\text{NO}_x\text{-N}$ ), as well as supporting water quality parameters.



**Figure 7**  
**Graphical Representation of Nitrogen Results**  
**Sample Event No. 6 August 22, 2014 (Experimental Day 409)**

**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 for all parameters except CBOD<sub>5</sub>. The measured STE total nitrogen (TN) concentration was 70 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<sub>5</sub> concentration was 23 mg/L, which is below the range that has been typically reported.

**Stage 1 Effluent (ST1):** The Stage 1 effluent  $\text{NH}_3\text{-N}$  level was 5.1 mg/L with a DO level at 1.45 mg/L (Table 4). The Stage 1 effluent TSS concentration was 6 mg/L and CBOD<sub>5</sub> was 4 mg/L. The Stage 1 biofilter showed substantial but incomplete nitrification with an effluent  $\text{NH}_3\text{-N}$  concentration of 5.1 mg/L and TKN of 5.8 mg/L. The Stage 1 effluent  $\text{NO}_x\text{-N}$  was 34 mg/L. The Stage 1 effluent TN of 39.8 mg/L was 43% 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 highly reducing environment and achieved complete NO<sub>x</sub>-N reduction. Effluent NO<sub>x</sub>-N from the Stage 2 biofilter monitoring point was below the method detection limit of 0.02 mg/L. The low NO<sub>x</sub>-N was accompanied by a measured 0.08 mg/L DO and -133 mV ORP. The lignocellulosic media effluent NO<sub>x</sub>-N was 5.7 mg/L. Final total nitrogen (TN) in the treatment system effluent was approximately 3.2 mg/L. The Stage 2 biofilter lignocellulosic media effluent and sulfur media effluent CBOD<sub>5</sub> were 19 and 5 mg/L, respectively. The Stage 2 effluent sulfate concentration was 22 mg/L.

**Equipment Blank (EB):** Described in Section 3.5, the equipment blank (EB) results for most of the parameters measured were at or below the method detection limit. The slightly elevated parameters were total alkalinity 2.4 mg/L, TKN 0.09 mg/L, total phosphorus 0.043 mg/L and sulfate 0.23 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	CBOD <sub>5</sub> (mg/L)	COD (mg/L)	TN (mg/L N) <sup>1</sup>	TKN (mg/L N)	Organic N (mg/L N) <sup>2</sup>	NH <sub>3</sub> -N (mg/L N)	NO <sub>3</sub> -N (mg/L N)	NO <sub>2</sub> -N (mg/L N)	NOx (mg/L N)	TIN (mg/L N) <sup>3</sup>	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	8/22/2014 10:45	28.32	6.83	1313	0.03	-131.4	470	45	43	23	140	70.02	70	6	64	0.01	0.01	0.02	64.02	9.8	7.1	0.26	2.1	3.6	80000	690	34
BHS4-STE-FILTERED	8/22/2014 10:45	28.32	6.83	1313	0.03	-131.4				60		64.02	64	7	57	0.01	0.01	0.02	57.02								
BHS4-ST1	8/22/2014 10:15	27.6	6.59	1192	1.45	167.1	310	6	6	4	22	39.8	5.8	0.7	5.1	34	0.01	34	39.1	3	2.5	20	0.01	0.1	3900	5200	6.5
BHS4-ST1-DUP	8/22/2014 10:20	27.6	6.59	1192	1.45	167.1	310	6	6	9	23	38.6	5.6	0.8	4.8	33	0.01	33	37.8	3.1	2.5	20			4300	5500	6.6
BHS4-ST1-FILTERED	8/22/2014 10:15	27.6	6.59	1192	1.45	167.1				6		32.2	5.2	0.2	5	27	0.01	27	32								
BHS4-LIGNO-0	8/22/2014 10:08	28.51	6.68	1099	0.22	18.7	410	4	4	19	25	8.9	3.2	1.2	2	5.7	0.01	5.7	7.7	3	2.1	19	1.4	2.4	3500	490	6.2
BHS4-LIGNO-0-FILTERED	8/22/2014 10:08	28.51	6.68	1099	0.22	18.7				9		9.7	3.5	1.9	1.6	6.2	0.01	6.2	7.8								
BHS4-ST2	8/22/2014 9:52	27.60	6.92	1219	0.08	-132.6	500	2	1	5	29	3.22	3.2	1.5	1.7	0.01	0.01	0.02	1.72	2.7	2	22	3.1	5.6	200	140	6.5
BHS4-ST2-FILTERED	8/22/2014 9:52	27.60	6.92	1219	0.08	-132.6				10		3.62	3.6	2.1	1.5	0.01	0.01	0.02	1.52			27					
BHS4-EB	8/22/2014 10:50	25.70	5.17	2.5	8.15		2.4	1	1	2	10	0.11	0.09	0.081	0.009	0.01	0.01	0.02	0.029	0.043	0.01	0.23	0.01	0.1	1	2	0.06

Notes:

<sup>1</sup>Total Nitrogen (TN) is a calculated value equal to the sum of TKN and NO<sub>x</sub>.

<sup>2</sup>Organic Nitrogen (ON) is a calculated value equal to the difference of TKN and NH<sub>3</sub>.

<sup>3</sup>Total Inorganic Nitrogen (TIN) is a calculated value equal to the sum of NH<sub>3</sub> and NO<sub>x</sub>.

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.

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**Table 5**  
**Summary of Water Quality Data**

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 <sub>5</sub> (mg/L)	COD (mg/L)	TN (mg/L N) <sup>1</sup>	TKN (mg/L N)	Organic N (mg/L N) <sup>2</sup>	NH <sub>3</sub> -N (mg/L N)	NO <sub>3</sub> -N (mg/L N)	NO <sub>2</sub> -N (mg/L N)	NOx (mg/L N)	TIN (mg/L N) <sup>3</sup>	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	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10
	MEAN	22.72	6.79	1165.10	0.17	-219.09	438.00	63.00	59.60	136.30	203.80	68.05	68.00	7.20	60.80	0.04	0.01	0.05	60.85	9.50	6.14	1.81	3.14	5.00	40,754	10,481	65.80
	STD. DEV.	3.42	0.00	119.10	0.23	58.68	27.81	22.44	21.26	56.88	113.75	9.55	9.53	7.74	6.80	0.04	0.00	0.04	6.79	2.24	2.22	1.57	1.07	1.52			16.81
	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	0.26	1.50	2.60	21,000	690	34.00
	MAX	28.32	6.94	1329.00	0.79	-131.40	470.00	118.00	111.00	220.00	330.00	87.14	87.00	23.00	75.00	0.14	0.01	0.14	75.02	14.00	7.50	5.40	4.50	6.80	80,000	24,000	85.00
Stage 1	n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	9	10	10	10	10	8	7	7	10	9	10
	MEAN	22.29	6.79	1155.60	2.54	54.59	324.00	10.30	9.10	9.00	44.60	43.14	13.24	4.11	9.13	29.22	0.18	29.90	39.03	3.64	2.87	18.38	0.28	0.51	4,240	2,313	16.15
	STD. DEV.	3.31	0.00	143.66	1.55	72.97	38.36	6.27	5.28	6.72	34.03	9.85	7.54	4.10	8.61	15.16	0.33	14.23	9.34	1.22	1.01	1.51	0.34	0.61			5.63
	MIN	19.00	6.42	978.00	0.87	-69.70	270.00	3.00	3.00	2.00	10.00	27.00	5.40	0.00	0.38	12.00	0.01	12.00	27.00	1.80	1.50	16.00	0.01	0.10	100	41	6.50
	MAX	27.60	7.39	1385.00	5.16	167.10	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	20.00	1.00	1.80	32,000	24,000	24.00
Stage 2 Ligno	n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	8	8	10	9	10
	MEAN	22.71	6.65	1099.30	0.53	-170.69	429.00	5.70	5.40	13.80	43.30	11.55	9.70	3.08	6.62	1.85	0.01	1.85	8.47	2.85	2.22	12.60	1.24	1.83	1,275	603	15.42
	STD. DEV.	3.69	0.00	86.51	0.62	71.76	21.32	3.74	3.37	6.71	12.89	4.51	6.26	3.71	6.37	2.51	0.00	2.51	4.99	1.43	1.25	6.30	0.61	0.90			3.93
	MIN	18.20	6.46	956.00	0.13	-238.00	400.00	2.00	2.00	2.00	25.00	3.30	2.00	0.70	0.13	0.03	0.01	0.03	1.21	0.42	0.18	5.70	0.00	0.00	30	10	6.20
	MAX	28.51	6.80	1247.00	2.16	18.70	460.00	12.00	12.00	23.00	64.00	17.04	17.00	13.49	15.00	5.90	0.01	5.90	15.04	4.10	3.30	23.00	2.10	3.00	17,200	6,100	19.00
Stage 2 Sulfur	n	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	9	10
	MEAN	22.22	6.75	1158.60	0.17	-227.09	464.00	4.20	3.70	12.90	46.10	7.39	7.35	2.46	4.89	0.03	0.01	0.04	4.92	2.79	2.24	30.70	4.67	6.63	337	199	14.55
	STD. DEV.	3.16	0.47	94.93	0.11	61.24	25.47	2.44	2.58	8.80	12.51	4.35	4.33	3.35	4.20	0.02	0.00	0.02	4.20	1.16	1.08	9.98	2.55	3.17			3.72
	MIN	19.60	5.79	1054.00	0.04	-348.90	440.00	2.00	1.00	3.00	29.00	1.32	1.30	0.30	0.51	0.01	0.01	0.02	0.53	0.70	0.32	21.00	1.30	1.30	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	13.07	13.00	11.70	10.00	0.07	0.01	0.07	10.04	4.10	3.50	50.00	9.90	11.00	5,400	1,400	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:

<sup>1</sup>Total Nitrogen (TN) is a calculated value equal to the sum of TKN and NO<sub>x</sub>.

<sup>2</sup>Organic Nitrogen (ON) is a calculated value equal to the difference of TKN and NH<sub>3</sub>.

<sup>3</sup>Total Inorganic Nitrogen (TIN) is a calculated value equal to the sum of NH<sub>3</sub> and NO<sub>x</sub>.

<sup>4</sup>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.



## **5.0 B-HS4 Sample Event No. 6: Summary and Recommendations**

### **5.1 Summary**

The results of the sixth sampling event indicate that:

- Septic tank effluent (STE) quality is characteristic of typical household STE quality in most parameters except CBOD<sub>5</sub>. The total nitrogen concentration of 70 mg/L is within the high end of the range of values typically reported for Florida single family residence STE. The measured CBOD<sub>5</sub> concentration was 23 mg/L, which is below the range that has been typically reported.
- The Stage 1 biofilter reduced TN and TKN by 43 and 92%, respectively.
- The Stage 1 biofilter substantially reduced TKN and ammonium; effluent TKN and ammonia N were 5.8 and 5.1 mg/L, respectively.
- The Stage 2 biofilter effluent NO<sub>x</sub>-N was below the method detection limit of 0.02 mg N/L.
- The total nitrogen concentration in the final effluent from the total treatment system was 3.2 mg/L, an approximately 95% reduction in STE TN.



## **Appendix A: Laboratory Report**

PRELIMINARY

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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-STE						
Matrix		Wastewater						
SAL Sample Number		1407975-01						
Date/Time Collected		08/22/14 10:45						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganics</u></b>								
Hydrogen Sulfide (Unionized)	mg/L	2.1	SM 4550SF	0.04	0.01	08/26/14 09:43	09/05/14 10:46	1
Ammonia as N	mg/L	64	EPA 350.1	3.6	0.85		08/27/14 19:29	90
Carbonaceous BOD	mg/L	23	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	140	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/22/14 23:33	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/22/14 23:33	1
Orthophosphate as P	mg/L	7.1	EPA 300.0	0.040	0.010		08/22/14 23:33	1
Phosphorous - Total as P	mg/L	9.8	SM 4500P-E	0.040	0.010	08/26/14 10:56	08/26/14 14:39	1
Sulfate	mg/L	0.26 I	EPA 300.0	0.60	0.20		08/22/14 23:33	1
Sulfide	mg/L	3.6	SM 4500SF	0.40	0.10		08/26/14 15:15	1
Total Alkalinity	mg/L	470	SM 2320B	8.0	2.0	09/05/14 08:45	09/05/14 15:17	1
Total Kjeldahl Nitrogen	mg/L	70	EPA 351.2	0.20	0.05	08/26/14 10:56	08/26/14 14:39	1
Total Organic Carbon	mg/L	34	SM 5310B	10	0.60		09/08/14 11:38	10
Total Suspended Solids	mg/L	45	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	43	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	0.02 U	EPA 300.0	0.08	0.02		08/22/14 23:33	1
<b><u>Microbiology</u></b>								
E. Coli	MPN/100 mL	690	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	80,000 Z	SM 9222D	1000	1000	08/22/14 16:06	08/23/14 12:20	1000
Sample Description		BHS4-STE-FILTERED						
Matrix		Wastewater						
SAL Sample Number		1407975-02						
Date/Time Collected		08/22/14 10:45						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganic, Dissolved</u></b>								
Ammonia as N	mg/L	57	EPA 350.1	3.6	0.85		09/08/14 18:04	90
Carbonaceous BOD	mg/L	60	SM 5210B	2	2	08/22/14 15:20	08/28/14 11:49	1
Nitrate (as N)	mg/L	0.01 U,J	EPA 300.0	0.04	0.01		08/22/14 23:42	1
Nitrite (as N)	mg/L	0.01 U,J	EPA 300.0	0.04	0.01		08/22/14 23:42	1
Total Kjeldahl Nitrogen	mg/L	64	EPA 351.2	0.20	0.050	09/02/14 12:46	09/04/14 15:10	1
Nitrate+Nitrite (N)	mg/L	0.02 U	EPA 300.0	0.08	0.02		08/22/14 23:42	1
Lab filtration for diss. analytes							08/22/14 15:00	

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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-ST1						
Matrix		Wastewater						
SAL Sample Number		1407975-03						
Date/Time Collected		08/22/14 10:15						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganics</u></b>								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	08/26/14 09:43	09/05/14 10:46	1
Ammonia as N	mg/L	5.1	EPA 350.1	0.040	0.009		08/27/14 11:46	1
Carbonaceous BOD	mg/L	4	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	22 I	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	34	EPA 300.0	0.04	0.01		08/22/14 23:52	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/22/14 23:52	1
Orthophosphate as P	mg/L	2.5	EPA 300.0	0.040	0.010		08/22/14 23:52	1
Phosphorous - Total as P	mg/L	3.0	SM 4500P-E	0.040	0.010	08/26/14 10:56	08/26/14 14:39	1
Sulfate	mg/L	20	EPA 300.0	0.60	0.20		08/22/14 23:52	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		08/26/14 15:15	1
Total Alkalinity	mg/L	310	SM 2320B	8.0	2.0	09/05/14 08:45	09/05/14 15:24	1
Total Kjeldahl Nitrogen	mg/L	5.8	EPA 351.2	0.20	0.05	08/26/14 10:56	08/26/14 14:39	1
Total Organic Carbon	mg/L	6.5	SM 5310B	1.0	0.060		09/08/14 11:38	1
Total Suspended Solids	mg/L	6	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	6	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	34	EPA 300.0	0.08	0.02		08/22/14 23:52	1
<b><u>Microbiology</u></b>								
E. Coli	MPN/100 mL	5,200	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	3,900	SM 9222D	10	10	08/22/14 16:06	08/23/14 12:20	10

Sample Description **BHS4-ST1-DUP**  
 Matrix **Wastewater**  
 SAL Sample Number **1407975-04**  
 Date/Time Collected **08/22/14 10:20**  
 Collected by **Josefin Hirst**  
 Date/Time Received **08/22/14 15:00**

<b><u>Inorganics</u></b>								
Ammonia as N	mg/L	4.8	EPA 350.1	0.040	0.009		08/27/14 11:43	1
Carbonaceous BOD	mg/L	9	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	23 I	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	33	EPA 300.0	0.04	0.01		08/23/14 00:01	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:01	1
Orthophosphate as P	mg/L	2.5	EPA 300.0	0.040	0.010		08/23/14 00:01	1
Phosphorous - Total as P	mg/L	3.1	SM 4500P-E	0.040	0.010	08/26/14 10:56	08/26/14 14:39	1
Sulfate	mg/L	20	EPA 300.0	0.60	0.20		08/23/14 00:01	1
Total Alkalinity	mg/L	310	SM 2320B	8.0	2.0	09/05/14 08:45	09/05/14 15:32	1



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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-ST1-DUP						
Matrix		Wastewater						
SAL Sample Number		1407975-04						
Date/Time Collected		08/22/14 10:20						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
Total Kjeldahl Nitrogen	mg/L	5.6	EPA 351.2	0.20	0.05	08/26/14 10:56	08/26/14 14:39	1
Total Organic Carbon	mg/L	6.6	SM 5310B	1.0	0.060		09/08/14 11:38	1
Total Suspended Solids	mg/L	6	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	6	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	33	EPA 300.0	0.08	0.02		08/23/14 00:01	1
<u>Microbiology</u>								
E. Coli	MPN/100 mL	5,500	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	4,300	SM 9222D	10	10	08/22/14 16:06	08/23/14 12:20	10
Sample Description		BHS4-ST1-FILTERED						
Matrix		Wastewater						
SAL Sample Number		1407975-05						
Date/Time Collected		08/22/14 10:15						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<u>Inorganic, Dissolved</u>								
Ammonia as N	mg/L	5.0	EPA 350.1	0.040	0.009	09/10/14 15:21	09/10/14 17:00	1
Carbonaceous BOD	mg/L	6	SM 5210B	2	2	08/22/14 15:20	08/28/14 11:49	1
Nitrate (as N)	mg/L	27	EPA 300.0	0.04	0.01		08/23/14 00:11	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:11	1
Total Kjeldahl Nitrogen	mg/L	5.2	EPA 351.2	0.20	0.050	09/02/14 12:46	09/04/14 15:10	1
Nitrate+Nitrite (N)	mg/L	27	EPA 300.0	0.08	0.02		08/23/14 00:11	1
Lab filtration for diss. analytes							08/22/14 15:00	
Sample Description		BHS4-LIGNO-0						
Matrix		Wastewater						
SAL Sample Number		1407975-06						
Date/Time Collected		08/22/14 10:08						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<u>Inorganics</u>								
Hydrogen Sulfide (Unionized)	mg/L	1.4	SM 4550SF	0.04	0.01	08/26/14 09:43	09/05/14 10:46	1
Ammonia as N	mg/L	2.0	EPA 350.1	0.040	0.009		08/27/14 11:44	1
Carbonaceous BOD	mg/L	19	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	25	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	5.7	EPA 300.0	0.04	0.01		08/23/14 00:20	1

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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-LIGNO-0						
Matrix		Wastewater						
SAL Sample Number		1407975-06						
Date/Time Collected		08/22/14 10:08						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:20	1
Orthophosphate as P	mg/L	2.1	EPA 300.0	0.040	0.010		08/23/14 00:20	1
Phosphorous - Total as P	mg/L	3.0	SM 4500P-E	0.040	0.010	08/26/14 10:58	08/26/14 15:03	1
Sulfate	mg/L	19	EPA 300.0	0.60	0.20		08/23/14 00:20	1
Sulfide	mg/L	2.4	SM 4500SF	0.40	0.10		08/26/14 15:15	1
Total Alkalinity	mg/L	410	SM 2320B	8.0	2.0	09/05/14 08:45	09/05/14 15:42	1
Total Kjeldahl Nitrogen	mg/L	3.2	EPA 351.2	0.20	0.05	08/26/14 10:58	08/26/14 15:03	1
Total Organic Carbon	mg/L	6.2	SM 5310B	1.0	0.060		09/08/14 16:17	1
Total Suspended Solids	mg/L	4	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	4	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	5.7	EPA 300.0	0.08	0.02		08/23/14 00:20	1
<b>Microbiology</b>								
E. Coli	MPN/100 mL	490	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	3,500	SM 9222D	10	10	08/22/14 16:06	08/23/14 12:20	10

Sample Description **BHS4-LIGNO-0-FILTERED**  
 Matrix **Wastewater**  
 SAL Sample Number **1407975-07**  
 Date/Time Collected **08/22/14 10:08**  
 Collected by **Josefin Hirst**  
 Date/Time Received **08/22/14 15:00**

### Inorganic, Dissolved

Ammonia as N	mg/L	1.6	EPA 350.1	0.040	0.009	09/10/14 15:21	09/10/14 17:00	1
Carbonaceous BOD	mg/L	9	SM 5210B	2	2	08/22/14 15:20	08/28/14 11:49	1
Nitrate (as N)	mg/L	6.2	EPA 300.0	0.04	0.01		08/23/14 00:29	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:29	1
Total Kjeldahl Nitrogen	mg/L	3.5	EPA 351.2	0.20	0.050	09/02/14 12:46	09/04/14 15:10	1
Nitrate+Nitrite (N)	mg/L	6.2	EPA 300.0	0.08	0.02		08/23/14 00:29	1
Lab filtration for diss. analytes							08/22/14 15:00	

Sample Description **BHS4-ST2**  
 Matrix **Wastewater**  
 SAL Sample Number **1407975-08**  
 Date/Time Collected **08/22/14 09:52**  
 Collected by **Josefin Hirst**  
 Date/Time Received **08/22/14 15:00**

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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-ST2						
Matrix		Wastewater						
SAL Sample Number		1407975-08						
Date/Time Collected		08/22/14 09:52						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganics</u></b>								
Hydrogen Sulfide (Unionized)	mg/L	3.1	SM 4550SF	0.04	0.01	08/26/14 09:43	09/05/14 10:46	1
Ammonia as N	mg/L	1.7	EPA 350.1	0.040	0.009		08/27/14 18:48	1
Carbonaceous BOD	mg/L	5	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	29	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:39	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:39	1
Orthophosphate as P	mg/L	2.0	EPA 300.0	0.040	0.010		08/23/14 00:39	1
Phosphorous - Total as P	mg/L	2.7	SM 4500P-E	0.040	0.010	08/26/14 10:58	08/26/14 15:03	1
Sulfate	mg/L	22	EPA 300.0	0.60	0.20		08/23/14 00:39	1
Sulfide	mg/L	5.6	SM 4500SF	0.40	0.10		08/26/14 15:15	1
Total Alkalinity	mg/L	500	SM 2320B	8.0	2.0	09/05/14 08:45	09/05/14 15:52	1
Total Kjeldahl Nitrogen	mg/L	3.2	EPA 351.2	0.20	0.05	08/26/14 10:58	08/26/14 15:03	1
Total Organic Carbon	mg/L	6.5	SM 5310B	1.0	0.060		09/08/14 16:17	1
Total Suspended Solids	mg/L	2	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	0.02 U	EPA 300.0	0.08	0.02		08/23/14 00:39	1
<b><u>Microbiology</u></b>								
E. Coli	MPN/100 mL	140	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	200	SM 9222D	10	10	08/22/14 16:06	08/23/14 12:20	10
Sample Description		BHS4-ST2-FILTERED						
Matrix		Wastewater						
SAL Sample Number		1407975-09						
Date/Time Collected		08/22/14 09:52						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganics</u></b>								
Sulfate	mg/L	27	EPA 300.0	0.60	0.20		08/23/14 00:48	1
<b><u>Inorganic, Dissolved</u></b>								
Ammonia as N	mg/L	1.5	EPA 350.1	0.040	0.009	09/10/14 15:21	09/10/14 17:00	1
Carbonaceous BOD	mg/L	10	SM 5210B	2	2	08/22/14 15:20	08/28/14 11:49	1
Nitrate (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:48	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 00:48	1
Total Kjeldahl Nitrogen	mg/L	3.6	EPA 351.2	0.20	0.050	09/02/14 12:46	09/04/14 15:10	1
Nitrate+Nitrite (N)	mg/L	0.02 U	EPA 300.0	0.08	0.02		08/23/14 00:48	1
Lab filtration for diss. analytes							08/22/14 15:00	

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

**September 22, 2014**  
**Work Order: 1407975**

## Laboratory Report

Project Name		B-HS4 SE#10						
Parameters	Units	Results *	Method	PQL	MDL	Prepared	Analyzed	Dilution
Sample Description		BHS4-EB						
Matrix		Reagent Water						
SAL Sample Number		1407975-10						
Date/Time Collected		08/22/14 10:50						
Collected by		Josefin Hirst						
Date/Time Received		08/22/14 15:00						
<b><u>Inorganics</u></b>								
Hydrogen Sulfide (Unionized)	mg/L	0.01 U	SM 4550SF	0.04	0.01	08/26/14 09:43	09/05/14 10:46	1
Ammonia as N	mg/L	0.009 U	EPA 350.1	0.040	0.009		08/27/14 11:41	1
Carbonaceous BOD	mg/L	2 U	SM 5210B	2	2	08/22/14 15:23	08/27/14 11:43	1
Chemical Oxygen Demand	mg/L	10 U	EPA 410.4	25	10	09/05/14 08:42	09/05/14 17:06	1
Nitrate (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 01:07	1
Nitrite (as N)	mg/L	0.01 U	EPA 300.0	0.04	0.01		08/23/14 01:07	1
Orthophosphate as P	mg/L	0.010 U	EPA 300.0	0.040	0.010		08/23/14 01:07	1
Phosphorous - Total as P	mg/L	0.043	SM 4500P-E	0.040	0.010	08/26/14 10:58	08/26/14 15:03	1
Sulfate	mg/L	0.23 I	EPA 300.0	0.60	0.20		08/23/14 01:07	1
Sulfide	mg/L	0.10 U	SM 4500SF	0.40	0.10		08/26/14 15:15	1
Total Alkalinity	mg/L	2.4 I	SM 2320B	8.0	2.0	08/26/14 11:22	08/26/14 15:15	1
Total Kjeldahl Nitrogen	mg/L	0.09 I	EPA 351.2	0.20	0.05	08/26/14 10:58	08/26/14 15:03	1
Total Organic Carbon	mg/L	0.060 U	SM 5310B	1.0	0.060		09/08/14 16:17	1
Total Suspended Solids	mg/L	1 U	SM 2540D	1	1	08/28/14 08:55	09/29/14 09:58	1
Volatile Suspended Solids	mg/L	1 U	EPA 160.4	1	1	08/28/14 08:55	08/29/14 17:10	1
Nitrate+Nitrite (N)	mg/L	0.02 U	EPA 300.0	0.08	0.02		08/23/14 01:07	1
<b><u>Microbiology</u></b>								
E. Coli	MPN/100 mL	2.0 U	SM 9223B	2.0	2.0	08/22/14 16:20	08/23/14 11:15	1
Fecal Coliforms	CFU/100 ml	1 U	SM 9222D	1	1	08/22/14 16:06	08/23/14 12:20	1

**SOUTHERN ANALYTICAL LABORATORIES, INC.**

110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



Hazen and Sawyer

10002 Princess Palm Ave, Suite 200

Tampa, FL 33619

September 22, 2014

Work Order: 1407975

**Inorganics - Quality Control**

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42238 - Ion Chromatography 300.0 Prep</b>										
<b>Blank (BH42238-BLK1)</b>					Prepared & Analyzed: 08/22/14 23:05					
Orthophosphate as P	0.010 U	0.040	0.010	mg/L						
Nitrate (as N)	0.01 U	0.04	0.01	mg/L						
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
Sulfate	0.20 U	0.60	0.20	mg/L						
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
<b>LCS (BH42238-BS1)</b>					Prepared & Analyzed: 08/22/14 23:14					
Sulfate	8.84	0.60	0.20	mg/L	9.0		98	85-115		
Orthophosphate as P	0.922	0.040	0.010	mg/L	0.90		102	85-115		
Nitrite (as N)	1.32	0.04	0.01	mg/L	1.4		94	85-115		
Nitrate (as N)	1.60	0.04	0.01	mg/L	1.7		94	85-115		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
<b>LCS Dup (BH42238-BSD1)</b>					Prepared & Analyzed: 08/22/14 23:24					
Orthophosphate as P	0.925	0.040	0.010	mg/L	0.90		103	85-115	0.3	200
Sulfate	8.77	0.60	0.20	mg/L	9.0		97	85-115	0.8	200
Nitrate (as N)	1.58	0.04	0.01	mg/L	1.7		93	85-115	2	200
Nitrite (as N)	1.28	0.04	0.01	mg/L	1.4		92	85-115	3	200
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		



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110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



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

September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
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### Batch BH42238 - Ion Chromatography 300.0 Prep

Matrix Spike (BH42238-MS1)		Source: 1407975-09			Prepared & Analyzed: 08/23/14 00:57					
Nitrite (as N)	2.84 J2,J6	0.04	0.01	mg/L	1.4	ND	203	85-115		
Nitrate (as N)	1.72	0.04	0.01	mg/L	1.7	ND	101	85-115		
Orthophosphate as P	2.74 L2	0.040	0.010	mg/L	0.90	2.22	58	85-115		
Sulfate	32.7 L2	0.60	0.20	mg/L	9.0	26.7	67	85-115		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		

Matrix Spike (BH42238-MS2)		Source: 1408223-02			Prepared & Analyzed: 08/23/14 03:09					
Orthophosphate as P	8.20	0.40	0.10	mg/L	9.0	ND	91	85-115		
Sulfate	129	6.0	2.0	mg/L	90	44.8	93	85-115		
Nitrate (as N)	15.9	0.40	0.10	mg/L	17	0.670	89	85-115		
Nitrite (as N)	12.8	0.40	0.10	mg/L	14	0.650	87	85-115		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		

### Batch BH42239 - BOD

Blank (BH42239-BLK1)		Prepared: 08/22/14 Analyzed: 08/27/14 11:43								
Carbonaceous BOD	2 U	2	2	mg/L						
LCS (BH42239-BS1)		Prepared: 08/22/14 Analyzed: 08/27/14 11:43								
Carbonaceous BOD	190	2	2	mg/L	200		95	85-115		

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

September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42239 - BOD</b>										
<b>LCS Dup (BH42239-BSD1)</b>					Prepared: 08/22/14 Analyzed: 08/27/14 11:43					
Carbonaceous BOD	174	2	2	mg/L	200		87	85-115	9	200
<b>Duplicate (BH42239-DUP1)</b>					Source: 1407939-01 Prepared: 08/22/14 Analyzed: 08/27/14 11:43					
Carbonaceous BOD	65	2	2	mg/L		72			10	25
<b>Batch BH42505 - TOC prep</b>										
<b>Blank (BH42505-BLK1)</b>					Prepared & Analyzed: 09/08/14 11:38					
Total Organic Carbon	0.060 U	1.0	0.060	mg/L						
<b>LCS (BH42505-BS1)</b>					Prepared & Analyzed: 09/08/14 11:38					
Total Organic Carbon	11.0	1.0	0.060	mg/L	10		110	90-110		
<b>Matrix Spike (BH42505-MS1)</b>					Source: 1409007-03 Prepared & Analyzed: 09/08/14 11:38					
Total Organic Carbon	11.2	1.0	0.060	mg/L	10	1.74	94	85-115		
<b>Matrix Spike Dup (BH42505-MSD1)</b>					Source: 1409007-03 Prepared & Analyzed: 09/08/14 11:38					
Total Organic Carbon	11.1	1.0	0.060	mg/L	10	1.74	93	85-115	0.5	10
<b>Batch BH42523 - TOC prep</b>										
<b>Blank (BH42523-BLK1)</b>					Prepared & Analyzed: 09/08/14 16:17					
Total Organic Carbon	0.060 U	1.0	0.060	mg/L						
<b>LCS (BH42523-BS1)</b>					Prepared & Analyzed: 09/08/14 16:17					
Total Organic Carbon	10.8	1.0	0.060	mg/L	10		108	90-110		

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Hazen and Sawyer  
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Tampa, FL 33619

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## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BH42523 - TOC prep										
Matrix Spike (BH42523-MS1)		Source: 1407975-08			Prepared & Analyzed: 09/08/14 16:17					
Total Organic Carbon	6.65 J5	1.0	0.060	mg/L	10	6.53	1	85-115		
Matrix Spike Dup (BH42523-MSD1)		Source: 1407975-08			Prepared & Analyzed: 09/08/14 16:17					
Total Organic Carbon	6.92 J5	1.0	0.060	mg/L	10	6.53	4	85-115	4	10
Batch BH42604 - Sulfide prep										
Blank (BH42604-BLK1)					Prepared & Analyzed: 08/26/14 15:15					
Sulfide	0.10 U	0.40	0.10	mg/L						
Blank (BH42604-BLK2)					Prepared & Analyzed: 08/26/14 15:15					
Sulfide	0.10 U	0.40	0.10	mg/L						
LCS (BH42604-BS1)					Prepared & Analyzed: 08/26/14 15:15					
Sulfide	5.03	0.40	0.10	mg/L	5.0		101	85-115		
LCS (BH42604-BS2)					Prepared & Analyzed: 08/26/14 15:15					
Sulfide	5.03	0.40	0.10	mg/L	5.0		101	85-115		
Matrix Spike (BH42604-MS1)		Source: 1408911-01			Prepared & Analyzed: 08/26/14 15:15					
Sulfide	4.83	0.40	0.10	mg/L	5.0	ND	97	85-115		
Matrix Spike (BH42604-MS2)		Source: 1408911-01			Prepared & Analyzed: 08/26/14 15:15					
Sulfide	4.83	0.40	0.10	mg/L	5.0	ND	97	85-115		
Matrix Spike Dup (BH42604-MSD1)		Source: 1408911-01			Prepared & Analyzed: 08/26/14 15:15					
Sulfide	4.83	0.40	0.10	ma/L	5.0	ND	97	85-115	0	14

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

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**Inorganics - Quality Control**

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BH42604 - Sulfide prep										
Matrix Spike Dup (BH42604-MSD2)		Source: 1408911-01			Prepared & Analyzed: 08/26/14 15:15					
Sulfide	4.83	0.40	0.10	mg/L	5.0	ND	97	85-115	0	14
Batch BH42610 - alkalinity										
Blank (BH42610-BLK1)					Prepared & Analyzed: 09/04/14 11:22					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
Blank (BH42610-BLK2)					Prepared & Analyzed: 08/26/14 12:42					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
LCS (BH42610-BS1)					Prepared & Analyzed: 08/26/14 12:57					
Total Alkalinity	120	8.0	2.0	mg/L	120		98	90-110		
LCS (BH42610-BS2)					Prepared & Analyzed: 08/26/14 13:03					
Total Alkalinity	120	8.0	2.0	mg/L	120		97	90-110		
Matrix Spike (BH42610-MS1)		Source: 1407939-01			Prepared & Analyzed: 08/26/14 13:24					
Total Alkalinity	520	8.0	2.0	mg/L	120	410	83	80-120		
Matrix Spike (BH42610-MS2)		Source: 1407976-01			Prepared: 08/26/14 Analyzed: 09/04/14 11:22					
Total Alkalinity	560	8.0	2.0	mg/L	120	440	97	80-120		
Matrix Spike Dup (BH42610-MSD1)		Source: 1407939-01			Prepared & Analyzed: 08/26/14 13:34					
Total Alkalinity	510	8.0	2.0	mg/L	120	410	82	80-120	0.2	26
Matrix Spike Dup (BH42610-MSD2)		Source: 1407976-01			Prepared: 08/26/14 Analyzed: 09/04/14 11:22					
Total Alkalinity	560	8.0	2.0	mg/L	120	440	95	80-120	0.4	26

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10002 Princess Palm Ave, Suite 200  
Tampa, FL 33619

September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42619 - Digestion for TP and TKN</b>										
<b>Blank (BH42619-BLK1)</b>					Prepared & Analyzed: 08/26/14 14:39					
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						
<b>LCS (BH42619-BS1)</b>					Prepared & Analyzed: 08/26/14 14:39					
Total Kjeldahl Nitrogen	0.978	0.20	0.05	mg/L	1.0		98	90-110		
Phosphorous - Total as P	1.07	0.040	0.010	mg/L	1.0		107	90-110		
<b>Matrix Spike (BH42619-MS1)</b>					<b>Source: 1407939-13</b>		Prepared & Analyzed: 08/26/14 14:39			
Phosphorous - Total as P	1.35	0.040	0.010	mg/L	1.0	0.335	102	90-110		
Total Kjeldahl Nitrogen	1.77	0.20	0.05	mg/L	1.0	0.844	93	90-110		
<b>Matrix Spike (BH42619-MS2)</b>					<b>Source: 1407975-04</b>		Prepared & Analyzed: 08/26/14 14:39			
Total Kjeldahl Nitrogen	7.28 J5	0.20	0.05	mg/L	1.0	5.56	172	90-110		
Phosphorous - Total as P	4.20	0.040	0.010	mg/L	1.0	3.14	106	90-110		
<b>Matrix Spike Dup (BH42619-MSD1)</b>					<b>Source: 1407939-13</b>		Prepared & Analyzed: 08/26/14 14:39			
Phosphorous - Total as P	1.34	0.040	0.010	mg/L	1.0	0.335	101	90-110	0.7	25
Total Kjeldahl Nitrogen	1.83	0.20	0.05	mg/L	1.0	0.844	98	90-110	3	20
<b>Matrix Spike Dup (BH42619-MSD2)</b>					<b>Source: 1407975-04</b>		Prepared & Analyzed: 08/26/14 14:39			
Total Kjeldahl Nitrogen	5.12 J5	0.20	0.05	mg/L	1.0	5.56	NR	90-110	35	20
Phosphorous - Total as P	4.16	0.040	0.010	mg/L	1.0	3.14	101	90-110	1	25
<b>Batch BH42620 - Digestion for TP and TKN</b>										
<b>Blank (BH42620-BLK1)</b>					Prepared & Analyzed: 08/26/14 15:03					
Total Kjeldahl Nitrogen	0.05 U	0.20	0.05	mg/L						
Phosphorous - Total as P	0.0150 I	0.040	0.010	mg/L						



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110 BAYVIEW BOULEVARD, OLDSMAR, FL 34677 813-855-1844 FAX 813-855-2218



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

September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42620 - Digestion for TP and TKN</b>										
<b>LCS (BH42620-BS1)</b>					Prepared & Analyzed: 08/26/14 15:03					
Total Kjeldahl Nitrogen	0.952	0.20	0.05	mg/L	1.0		95	90-110		
Phosphorous - Total as P	1.04	0.040	0.010	mg/L	1.0		104	90-110		
<b>Matrix Spike (BH42620-MS1)</b>					<b>Source: 1408512-01</b>		Prepared & Analyzed: 08/26/14 15:03			
Total Kjeldahl Nitrogen	47.7	0.20	0.05	mg/L	1.0	46.6	109	90-110		
Phosphorous - Total as P	6.75	0.040	0.010	mg/L	1.0	5.66	108	90-110		
<b>Matrix Spike (BH42620-MS2)</b>					<b>Source: 1408512-13</b>		Prepared & Analyzed: 08/26/14 15:03			
Phosphorous - Total as P	2.40	0.040	0.010	mg/L	1.0	1.34	106	90-110		
Total Kjeldahl Nitrogen	2.76 J5	0.20	0.05	mg/L	1.0	1.45	131	90-110		
<b>Matrix Spike Dup (BH42620-MSD1)</b>					<b>Source: 1408512-01</b>		Prepared & Analyzed: 08/26/14 15:03			
Phosphorous - Total as P	6.76	0.040	0.010	mg/L	1.0	5.66	110	90-110	0.2	25
Total Kjeldahl Nitrogen	47.7	0.20	0.05	mg/L	1.0	46.6	109	90-110	0.002	20
<b>Matrix Spike Dup (BH42620-MSD2)</b>					<b>Source: 1408512-13</b>		Prepared & Analyzed: 08/26/14 15:03			
Phosphorous - Total as P	2.43	0.040	0.010	mg/L	1.0	1.34	109	90-110	1	25
Total Kjeldahl Nitrogen	2.53	0.20	0.05	mg/L	1.0	1.45	108	90-110	9	20
<b>Batch BH42639 - Ammonia by SEAL</b>										
<b>Blank (BH42639-BLK1)</b>					Prepared & Analyzed: 08/27/14 10:56					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
<b>LCS (BH42639-BS1)</b>					Prepared & Analyzed: 08/27/14 10:58					
Ammonia as N	0.52	0.040	0.009	mg/L	0.50		105	90-110		

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

September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42639 - Ammonia by SEAL</b>										
<b>Matrix Spike (BH42639-MS1)</b>		<b>Source: 1408931-07</b>			Prepared & Analyzed: 08/27/14 11:00					
Ammonia as N	0.25 J5	0.040	0.009	mg/L	0.50	ND	50	90-110		
<b>Matrix Spike (BH42639-MS2)</b>		<b>Source: 1407939-16</b>			Prepared & Analyzed: 08/27/14 11:24					
Ammonia as N	0.39 J5	0.040	0.009	mg/L	0.50	0.047	68	90-110		
<b>Matrix Spike Dup (BH42639-MSD1)</b>		<b>Source: 1408931-07</b>			Prepared & Analyzed: 08/27/14 11:01					
Ammonia as N	0.40 J5	0.040	0.009	mg/L	0.50	ND	81	90-110	47	10
<b>Matrix Spike Dup (BH42639-MSD2)</b>		<b>Source: 1407939-16</b>			Prepared & Analyzed: 08/27/14 11:25					
Ammonia as N	0.34 J5	0.040	0.009	mg/L	0.50	0.047	58	90-110	14	10
<b>Batch BH42719 - Ammonia by SEAL</b>										
<b>Blank (BH42719-BLK1)</b>		Prepared & Analyzed: 08/27/14 16:14								
Ammonia as N	0.009 U	0.040	0.009	mg/L						
<b>LCS (BH42719-BS1)</b>		Prepared & Analyzed: 08/27/14 16:16								
Ammonia as N	0.52	0.040	0.009	mg/L	0.50		105	90-110		
<b>Matrix Spike (BH42719-MS1)</b>		<b>Source: 1407939-01</b>			Prepared & Analyzed: 08/27/14 19:24					
Ammonia as N	39 J5	3.6	0.85	mg/L	0.50	44	NR	90-110		
<b>Matrix Spike (BH42719-MS2)</b>		<b>Source: 1407975-08</b>			Prepared & Analyzed: 08/27/14 18:45					
Ammonia as N	1.8 J5	0.040	0.009	mg/L	0.50	1.7	24	90-110		
<b>Matrix Spike Dup (BH42719-MSD1)</b>		<b>Source: 1407939-01</b>			Prepared & Analyzed: 08/27/14 19:26					
Ammonia as N	39 J5	3.6	0.85	mg/L	0.50	44	NR	90-110	1	10

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September 22, 2014  
Work Order: 1407975

## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BH42719 - Ammonia by SEAL										
Matrix Spike Dup (BH42719-MSD2)		Source: 1407975-08			Prepared & Analyzed: 08/27/14 18:47					
Ammonia as N	1.8 J5	0.040	0.009	mg/L	0.50	1.7	16	90-110	2	10
Batch BH42807 - VSS Prep										
Blank (BH42807-BLK1)					Prepared: 08/28/14 Analyzed: 08/29/14 17:10					
Total Suspended Solids	1 U	1	1	mg/L						
Volatile Suspended Solids	1 U	1		mg/L						
LCS (BH42807-BS1)					Prepared: 08/28/14 Analyzed: 08/29/14 17:10					
Total Suspended Solids	51.0	1	1	mg/L	50		102	85-115		
Duplicate (BH42807-DUP1)		Source: 1407939-20			Prepared: 08/28/14 Analyzed: 08/29/14 17:10					
Total Suspended Solids	1 U	1	1	mg/L		ND				30
Volatile Suspended Solids	1 U	1		mg/L		ND				20
Batch BI40505 - COD prep										
Blank (BI40505-BLK1)					Prepared & Analyzed: 09/05/14 17:06					
Chemical Oxygen Demand	10 U	25	10	mg/L						
LCS (BI40505-BS1)					Prepared & Analyzed: 09/05/14 17:06					
Chemical Oxygen Demand	50	25	10	mg/L	50		100	90-110		
Matrix Spike (BI40505-MS1)		Source: 1407975-10			Prepared & Analyzed: 09/05/14 17:06					
Chemical Oxygen Demand	52	25	10	mg/L	50	ND	104	85-115		

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## Inorganics - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch BI40505 - COD prep										
Matrix Spike Dup (BI40505-MSD1)		Source: 1407975-10			Prepared & Analyzed: 09/05/14 17:06					
Chemical Oxygen Demand	49	25	10	mg/L	50	ND	98	85-115	6	32
Batch BI40506 - alkalinity										
Blank (BI40506-BLK1)					Prepared & Analyzed: 09/05/14 12:35					
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
Blank (BI40506-BLK2)										
Total Alkalinity	2.0 U	8.0	2.0	mg/L						
LCS (BI40506-BS1)										
Total Alkalinity	130	8.0	2.0	mg/L	120		101	90-110		
LCS (BI40506-BS2)					Prepared & Analyzed: 09/05/14 12:59					
Total Alkalinity	120	8.0	2.0	mg/L	120		99	90-110		
Matrix Spike (BI40506-MS1)		Source: 1407939-20			Prepared & Analyzed: 09/05/14 14:59					
Total Alkalinity	130	8.0	2.0	mg/L	120	2.1	103	80-120		
Matrix Spike (BI40506-MS2)		Source: 1408501-09			Prepared: 09/05/14 Analyzed: 09/08/14 12:10					
Total Alkalinity	120	8.0	2.0	mg/L	120	2.8	97	80-120		
Matrix Spike Dup (BI40506-MSD1)		Source: 1407939-20			Prepared & Analyzed: 09/05/14 15:10					
Total Alkalinity	130	8.0	2.0	mg/L	120	2.1	103	80-120	0.08	26
Matrix Spike Dup (BI40506-MSD2)		Source: 1408501-09			Prepared: 09/05/14 Analyzed: 09/08/14 12:15					
Total Alkalinity	120	8.0	2.0	mg/L	120	2.8	97	80-120	0.3	26

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## Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42235 - BOD Dissolved</b>										
<b>Blank (BH42235-BLK1)</b>					Prepared: 08/22/14 Analyzed: 08/28/14 11:49					
Carbonaceous BOD	2 U	2	2	mg/L						
<b>LCS (BH42235-BS1)</b>					Prepared: 08/22/14 Analyzed: 08/28/14 11:49					
Carbonaceous BOD	183	2	2	mg/L	200		92	85-115		
<b>LCS Dup (BH42235-BSD1)</b>					Prepared: 08/22/14 Analyzed: 08/28/14 11:49					
Carbonaceous BOD	175	2	2	mg/L	200		87	85-115	5	200
<b>Duplicate (BH42235-DUP1)</b>					Prepared: 08/22/14 Analyzed: 08/28/14 11:49					
Carbonaceous BOD	21	2	2	mg/L		22			6	25
<b>Batch BH42238 - Ion Chromatography 300.0 Prep</b>										
<b>Blank (BH42238-BLK1)</b>					Prepared & Analyzed: 08/22/14 23:05					
Nitrite (as N)	0.01 U	0.04	0.01	mg/L						
Nitrate (as N)	0.01 U	0.04	0.01	mg/L						
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
Surrogate: Dichloroacetate	1.02			mg/L	1.0		102	78-120		
<b>LCS (BH42238-BS1)</b>					Prepared & Analyzed: 08/22/14 23:14					
Nitrite (as N)	1.32	0.04	0.01	mg/L	1.4		94	85-115		
Nitrate (as N)	1.60	0.04	0.01	mg/L	1.7		94	85-115		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
Surrogate: Dichloroacetate	1.08			mg/L	1.0		108	78-120		
<b>LCS Dup (BH42238-BSD1)</b>					Prepared & Analyzed: 08/22/14 23:24					
Nitrate (as N)	1.58	0.04	0.01	mg/L	1.7		93	85-115	2	200
Nitrite (as N)	1.28	0.04	0.01	mg/L	1.4		92	85-115	3	200
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		
Surrogate: Dichloroacetate	1.07			mg/L	1.0		107	78-120		



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September 22, 2014  
Work Order: 1407975

## Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42238 - Ion Chromatography 300.0 Prep</b>										
<b>Matrix Spike (BH42238-MS1)</b>		<b>Source: 1407975-09</b>			Prepared & Analyzed: 08/23/14 00:57					
Nitrite (as N)	2.84 J2,J6	0.04	0.01	mg/L	1.4	ND	203	85-115		
Nitrate (as N)	1.72	0.04	0.01	mg/L	1.7	ND	101	85-115		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		
Surrogate: Dichloroacetate	0.991			mg/L	1.0		99	78-120		
<b>Matrix Spike (BH42238-MS2)</b>		<b>Source: 1408223-02</b>			Prepared & Analyzed: 08/23/14 03:09					
Nitrite (as N)	12.8	0.40	0.10	mg/L	14	0.650	87	85-115		
Nitrate (as N)	15.9	0.40	0.10	mg/L	17	0.670	89	85-115		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		
Surrogate: Dichloroacetate	1.03			mg/L	1.0		103	78-120		
<b>Batch BI40224 - Digestion for TP and TKN</b>										
<b>Blank (BI40224-BLK1)</b>		Prepared: 09/02/14 Analyzed: 09/04/14 15:10								
Total Kjeldahl Nitrogen	0.0740 I	0.20	0.050	mg/L						
<b>LCS (BI40224-BS1)</b>		Prepared: 09/02/14 Analyzed: 09/04/14 15:10								
Total Kjeldahl Nitrogen	1.02	0.20	0.050	mg/L	1.0		102	90-110		
<b>Matrix Spike (BI40224-MS1)</b>		<b>Source: 1407975-09</b>			Prepared: 09/02/14 Analyzed: 09/04/14 15:10					
Total Kjeldahl Nitrogen	4.68	0.20	0.050	mg/L	1.0	3.60	108	90-110		
<b>Matrix Spike Dup (BI40224-MSD1)</b>		<b>Source: 1407975-09</b>			Prepared: 09/02/14 Analyzed: 09/04/14 15:10					
Total Kjeldahl Nitrogen	4.70	0.20	0.050	mg/L	1.0	3.60	110	90-110	0.4	20
<b>Batch BI40331 - Ammonia by SEAL</b>										
<b>Blank (BI40331-BLK1)</b>		Prepared & Analyzed: 09/08/14 14:27								
Ammonia as N	0.009 U	0.040	0.009	mg/L						

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## Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BI40331 - Ammonia by SEAL</b>										
<b>LCS (BI40331-BS1)</b>					Prepared & Analyzed: 09/08/14 14:36					
Ammonia as N	0.53	0.040	0.009	mg/L	0.50		106	90-110		
<b>Matrix Spike (BI40331-MS1)</b>					<b>Source: 1409399-06</b> Prepared & Analyzed: 09/08/14 17:07					
Ammonia as N	1.2 L	0.40	0.095	mg/L	0.50	19	NR	90-110		
<b>Matrix Spike (BI40331-MS2)</b>					<b>Source: 1409390-07</b> Prepared & Analyzed: 09/08/14 15:02					
Ammonia as N	0.60 J2	0.040	0.009	mg/L	0.50	ND	120	90-110		
<b>Matrix Spike Dup (BI40331-MSD1)</b>					<b>Source: 1409399-06</b> Prepared & Analyzed: 09/08/14 17:57					
Ammonia as N	22 L	3.6	0.85	mg/L	0.50	19	567	90-110	179	10
<b>Matrix Spike Dup (BI40331-MSD2)</b>					<b>Source: 1409390-07</b> Prepared & Analyzed: 09/08/14 15:03					
Ammonia as N	0.56 J2	0.040	0.009	mg/L	0.50	ND	113	90-110	6	10
<b>Batch BI41029 - Ammonia by SEAL</b>										
<b>Blank (BI41029-BLK1)</b>					Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.009 U	0.040	0.009	mg/L						
<b>LCS (BI41029-BS1)</b>					Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.50	0.040	0.009	mg/L	0.50		101	90-110		
<b>Matrix Spike (BI41029-MS1)</b>					<b>Source: 1409456-02</b> Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.67 J2	0.040	0.009	mg/L	0.60	0.13	89	90-110		
<b>Matrix Spike (BI41029-MS2)</b>					<b>Source: 1409492-02</b> Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.91	0.040	0.009	mg/L	0.60	0.25	111	90-110		

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## Inorganic, Dissolved - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BI41029 - Ammonia by SEAL</b>										
<b>Matrix Spike Dup (BI41029-MSD1)</b>		<b>Source: 1409456-02</b>			Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.73	0.040	0.009	mg/L	0.60	0.13	100	90-110	10	10
<b>Matrix Spike Dup (BI41029-MSD2)</b>		<b>Source: 1409492-02</b>			Prepared & Analyzed: 09/10/14 17:00					
Ammonia as N	0.83	0.040	0.009	mg/L	0.60	0.25	97	90-110	10	10

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## Microbiology - Quality Control

Analyte	Result	PQL	MDL	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
<b>Batch BH42236 - FC-MF</b>										
<b>Blank (BH42236-BLK1)</b>					Prepared: 08/22/14 Analyzed: 08/23/14 12:20					
Fecal Coliforms	1 U	1	1	CFU/100 ml						
<b>Duplicate (BH42236-DUP1)</b>					<b>Source: 1407939-20</b> Prepared: 08/22/14 Analyzed: 08/23/14 12:20					
Fecal Coliforms	5.00	1	1	CFU/100 ml		1.00			133	200
<b>Duplicate (BH42236-DUP2)</b>					<b>Source: 1407975-10</b> Prepared: 08/22/14 Analyzed: 08/23/14 12:20					
Fecal Coliforms	1 U	1	1	CFU/100 ml		ND				200

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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 limits 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.

- Z Too many colonies were present for accurate counting.
- L2 Analyte level in sample invalidated Matrix Spike.
- L Off-scale high. Result exceeded highest calibration standard.
- J6 The sample matrix interfered with the ability to make any accurate determination.
- 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.
- J Estimated value. Indicated concentration may not be accurate. See additional explanation below:

Questions regarding this report should be directed to :

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





Client Name <b>Hazen and Sawyer</b>	Contact / Phone:
Project Name / Location <b>B-HS4 SE#10</b>	

Samplers: (Signature)		PARAMETER / CONTAINER DESCRIPTION																				
Matrix Codes: DW-Drinking Water WW-Wastewater SW-Surface Water SL-Sludge SO-Soil GW-Groundwater SA-Saline Water O-Other R-Reagent Water		Date	Time	Matrix	Composite	Grab	125mLP, Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> FC-MF, FC-QT	500mLP, Cool Total Alkalinity, TSS, VSS, CBOD, NOx, OP, SO <sub>4</sub>	125mLP, H <sub>2</sub> SO <sub>4</sub> COD, TKN, NH <sub>3</sub> , TP	500mLP, NaOH & Zn Acetate H <sub>2</sub> S	40mLaV, HCL TOC	500mLP, Cool Lab Filtered (CBOD, TKN, NH <sub>3</sub> , NOx)	500mLP, Cool Lab Filtered (CBOD, TKN, NH <sub>3</sub> , NOx, SO <sub>4</sub> )						pH	Temperature	Conductivity	DO
SAL Use Only Sample No.	Sample Description																					
01	BHS4-STE	8/24/14	10:45	WW		X	4	2	1	1	2								6.83	28.32	1313	0.03
02	BHS4-STE-FILTERED		10:45	WW		X						1							6.83	28.32	1313	0.03
03	BHS4-ST1		10:15	WW		X	4	2	1	1	2								6.59	27.6	1192	1.45
04	BHS4-ST1-DUP		10:20	WW		X	4	2	1		2								6.59	27.6	1192	1.75
05	BHS4-ST1-FILTERED		10:15	WW		X						1							6.59	27.6	1192	1.45
06	BHS4-LIGNO-0		10:08	WW		X	4	2	1	1	2								6.82	28.4	1094	0.16
07	BHS4-LIGNO-0-FILTERED		10:08	WW		X						1							6.82	28.4	1094	0.16
08	BHS4-ST2		9:52	WW		X	4	2	1	1	2								6.92	27.6	1219	0.08
09	BHS4-ST2-FILTERED		9:52	WW		X							1						6.92	27.6	1219	0.08
10	BHS4-EB		10:50	R		X	4	2	1	1	2								5.17	25.7	2.5	8.15

Containers Prepared/ Relinquished: <i>[Signature]</i>	Date/Time: <b>11/30/07</b>	Received: <i>[Signature]</i>	Date/Time: <b>13:00</b>	Seal intact? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	Instructions / Remarks:
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>13:20</b>	Samples intact upon arrival? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>15:00</b>	Received on ice? Temp _____ <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>15:00</b>	Proper preservatives indicated? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>15:00</b>	Rec'd w/in holding time? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>15:00</b>	Volatiles rec'd w/out headspace? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	
Relinquished: <i>[Signature]</i>	Date/Time: <b>08/22/14</b>	Received: <i>[Signature]</i>	Date/Time: <b>15:00</b>	Proper containers used? <input checked="" type="checkbox"/> N <input type="checkbox"/> N/A	



## 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.

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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
	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
	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
	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.

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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
8/22/2014	Sample Event No. 10
	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.