Florida Department of Health
Onsite Nitrogen Reduction Strategies Study

Contract CORCL

TASK B.6

Installation Report for Passive Nitrogen Reduction System B-HS2

September 2012

Task B of the Florida Onsite Nitrogen Reduction Strategies Study (FOSNRS) includes performing field experiments to critically evaluate the performance of nitrogen removal technologies that were identified and pilot tested in FOSNRS Task A. To meet this objective, full scale treatment systems will be installed at various residential sites in Florida, operated on septic tank effluent under actual onsite conditions, and monitored over an extended timeframe. The Task B Quality Assurance Project Plan (Task B.5) documents the objectives, monitoring framework, sample frequency and duration, and analytical methods to be used at the home sites. This report documents the installation of a passive nitrogen reduction system at a home site in Hillsborough County, Florida (B-HS2).

System Overview

The B-HS2 system was installed in Hillsborough County, Florida in September 2012. It consists of a replacement 1,050 gallon two chamber concrete primary tank; 300 gallon concrete recirculation tank; 900 gallon concrete Stage 1 unsaturated media filter; 300 gallon concrete pump tank; and 1,500 gallon two chamber concrete Stage 2 saturated media biofilter. Figure 1 is a site schematic showing the system components and layout of the installation. The complete as-built system drawings are included in the attached Appendix A.

Household wastewater enters the 1st chamber of the primary tank and exits the second chamber as septic tank effluent through an effluent screen into the recirculation tank. The recirculation tank contents are discharged by gravity to a distribution box, located inside the Stage 1 biofilter, which splits the flow between two perforated distribution pipes along the top of the unsaturated Stage 1 biofilter media. The Stage 1 biofilter contains 10 inches of coarse expanded clay media (Riverlite^{TM} 1/4; 1.1 to 4.8 mm) above 20 inches of finer expanded clay media (Riverlite^{TM} 3/16; 0.6 to 2.4 mm). Wastewater proceeds downward through the expanded clay media where nitrification occurs. Stage 1 biofilter effluent then flows into the pump tank (which contains the pump and float switches). The pump tank discharge is split via two throttling globe valves which allow for a portion of the Stage 1 biofilter effluent to be sent back for recirculation with the rest proceeding to the Stage 2 biofilter. The system was designed with two recirculation modes of operation. The first option (which will initially be tested) is to have the recirculated effluent return to the recirculation tank for mixing with incoming septic tank effluent. The second option is to have the recirculated effluent return to the top of the Stage 1 biofilter, dispersed by three spray nozzles. Recirculation back to either the recirculation tank or Stage 1 biofilter increases the hydraulic loading on the Stage 1 biofilter. Effluent form the unsaturated (Stage 1) media tank enters the denitrification (Stage 2) biofilter into a standing water column lying above the media in the first chamber (lignocellulosic media), flows downward through the media, moves laterally through the baffle wall to the bottom of the second chamber, and upward through the media in the second chamber (elemental sulfur and oyster shell). The Stage 2 biofilter contains 42-inches of lignocellulosic media in the first chamber. A collection pipe along the bottom transfers the effluent to the second chamber which contains 24-inches of elemental sulfur mixed with oyster shell media. The Stage 2 biofilter effluent discharges near the top of the tank; therefore denitrification occurs in the saturated environment. The denitrified treated effluent is discharged into the soil via the existing mounded drainfield (P.T.I.™ bundles). A flow schematic of the system is shown on Figure 2.

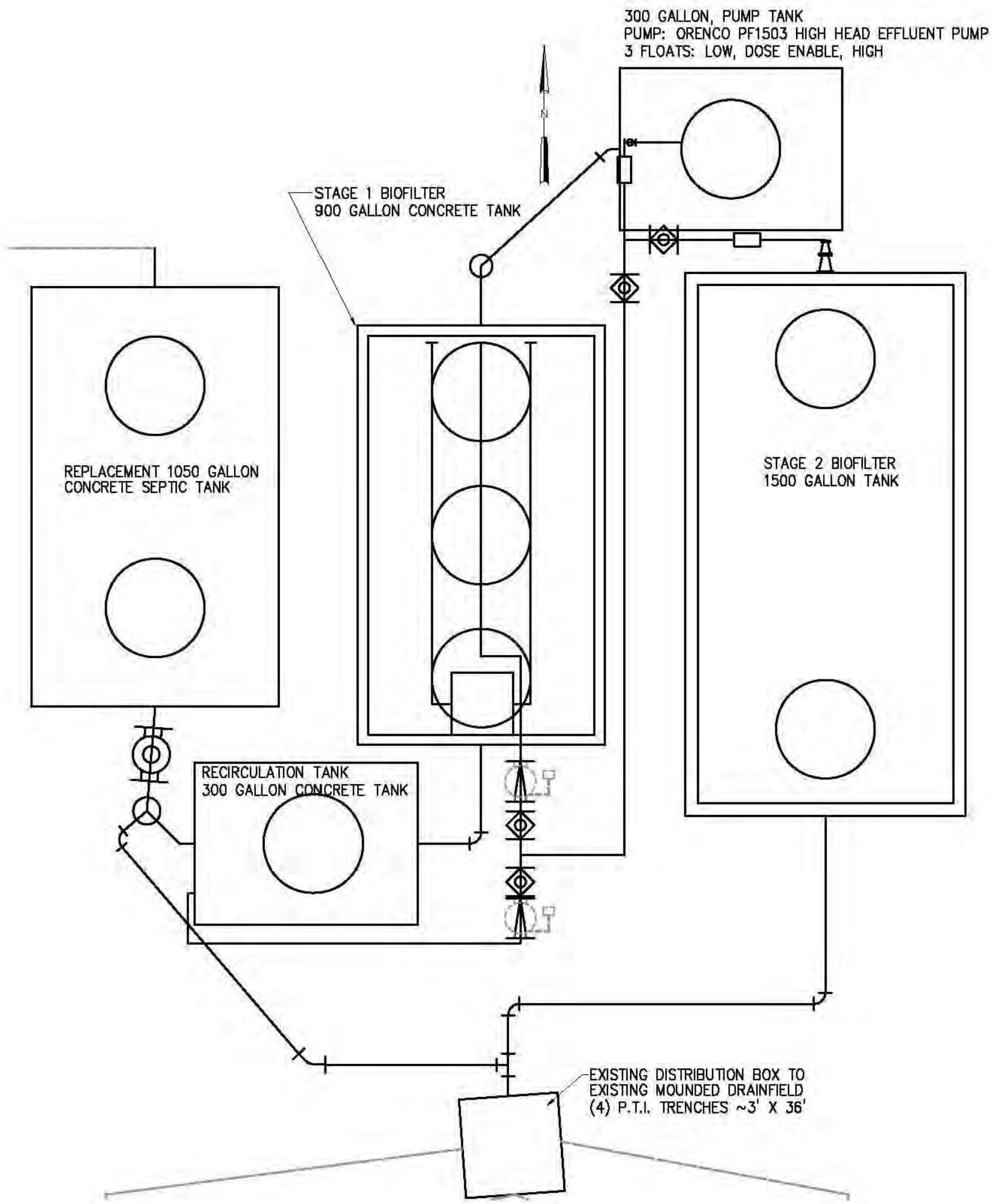
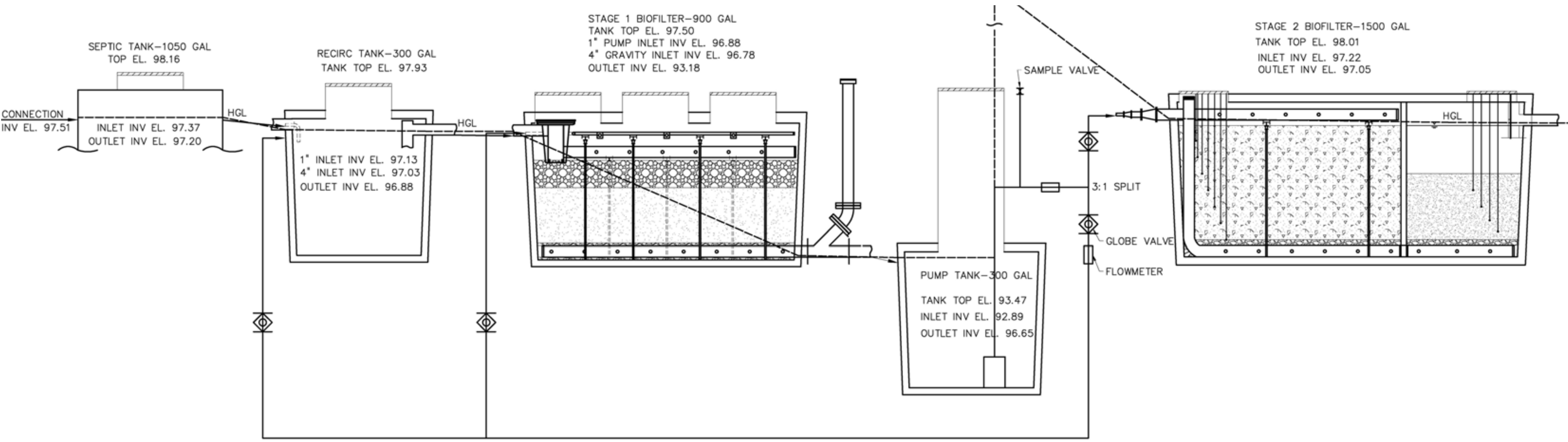


Figure 1
Schematic of B-HS2 PNRS installed in Hillsborough county



NOTE: HGL SHOWN IS FOR RECIRCULATION TANK MODE OF OPERATION

Figure 2
Flow Schematic of B-HS2 PNRS installed in Hillsborough county

Installation

Installation of the system commenced September 10, 2012 and was completed on September 12, 2012. The installation began with a pump out and removal of the existing 1,050 gallon septic tank, which was found to be cracked during the system evaluation. After the pump out was completed, the old septic tank was removed (Figure 3).

Figure 3
Old septic tank removed

A 1,050 gallon, two compartment replacement concrete primary tank was installed. The first larger chamber serves as a primary receiving tank, receiving the raw sewage from the household. The sewer pipe from the house was plumbed into the 4"D (diameter) inlet hole shown in Figure 4. An effluent screen (Polylok™, PL-68) was installed in the outlet tee of the second chamber (Figure 5).

Figure 4
1,050 gallon, two chamber, primary Tank

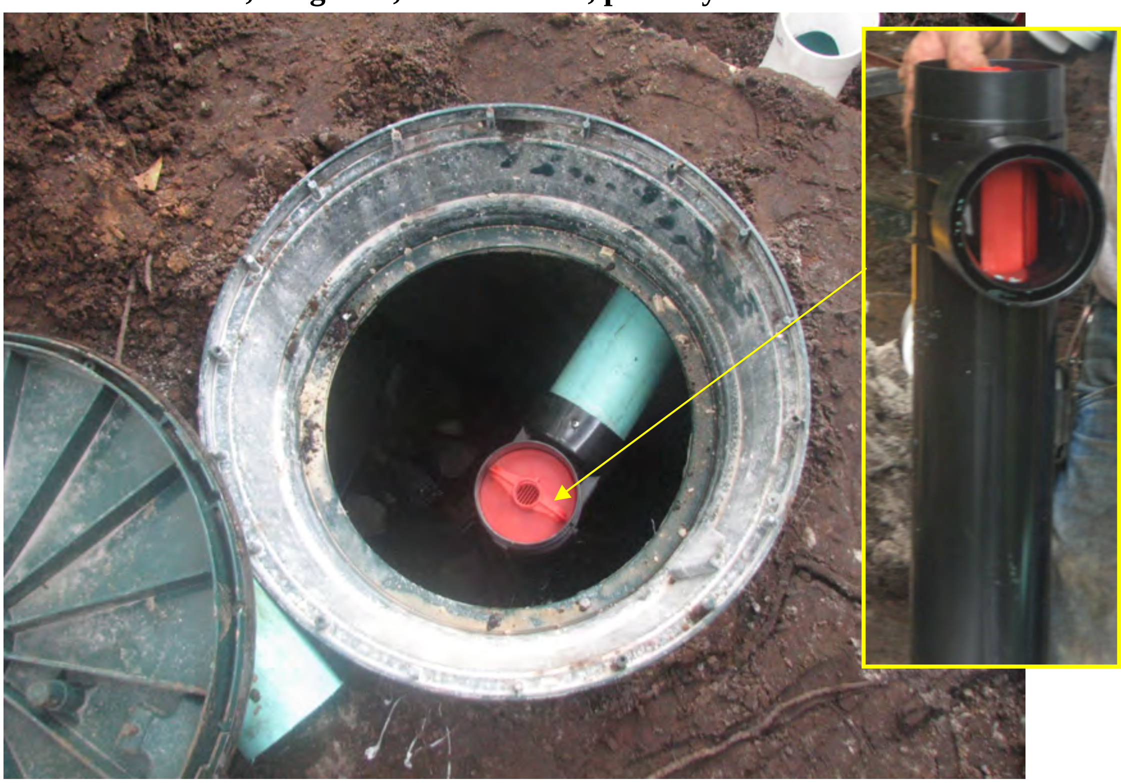


Figure 5
Primary tank effluent screen

Following the primary tank installation, the remaining passive nitrogen reduction system components were installed (Table 1). A single chamber (900 gallon) concrete tank was installed beside the primary tank (Figure 6). The purpose of this tank is to hold the Stage 1 expanded clay media. The 4”D inlet of the tank is connected (gravity flow) to the recirculation tank discharge. The 2”D inlet is connected (pressurized flow) to the recirculation pipe from the pump tank. The 4”D outlet (Figure 7) of the pipe is located near the bottom of the tank to allow for unsaturated operation. The 4”D underdrain pipe (perforated) with gravel surrounding was installed along the centerline of the bottom of the tank for effluent collection (Figure 8). Following gravel installation and leveling, 20-inches of fine (3/16 Riverlite™) expanded clay media was installed (Figure 9). Above the fine media, 10-inches of coarse (1/4 Riverlite™) expanded clay media was installed (Figure 10). Following media installation and leveling, the influent distribution network was installed. The 4”D influent pipe, connected to the recirculation tank discharge, discharges into a distribution box which flows to two 4”D perforated pipes across the top of the media (Figure 11). The distribution box includes two Polylok equalizer™ weirs to allow for the adjustment of the flow split (Figure 12). The 2”D influent pipe is reduced to a 1”D pipe along the centerline with three spray nozzles attached to distribute the recirculated effluent. The spray nozzles are removable for cleaning in the event clogging occurs (Figure 13).

Table 1
Passive Nitrogen Reduction System Components

	Tank Volume (gal)	Surface Area (ft^2)	Media
Primary Tank	1,050	37	none
Recirculation Tank	300	12	none
Stage 1 Biofilter	900	37	• 10” Riverlite 1/4 • 20” Riverlite 3/16
Pump Tank	300	12	none
Stage 2a Biofilter, downflow	1,000 (1,500 total)	36 (54 total)	42” lignocellulosic (Southern yellow pine)
Stage 2b Biofilter, upflow	500 (1,500 total)	18 (54 total)	24” Elemental sulfur (90%) & oyster shell mixture (10%)

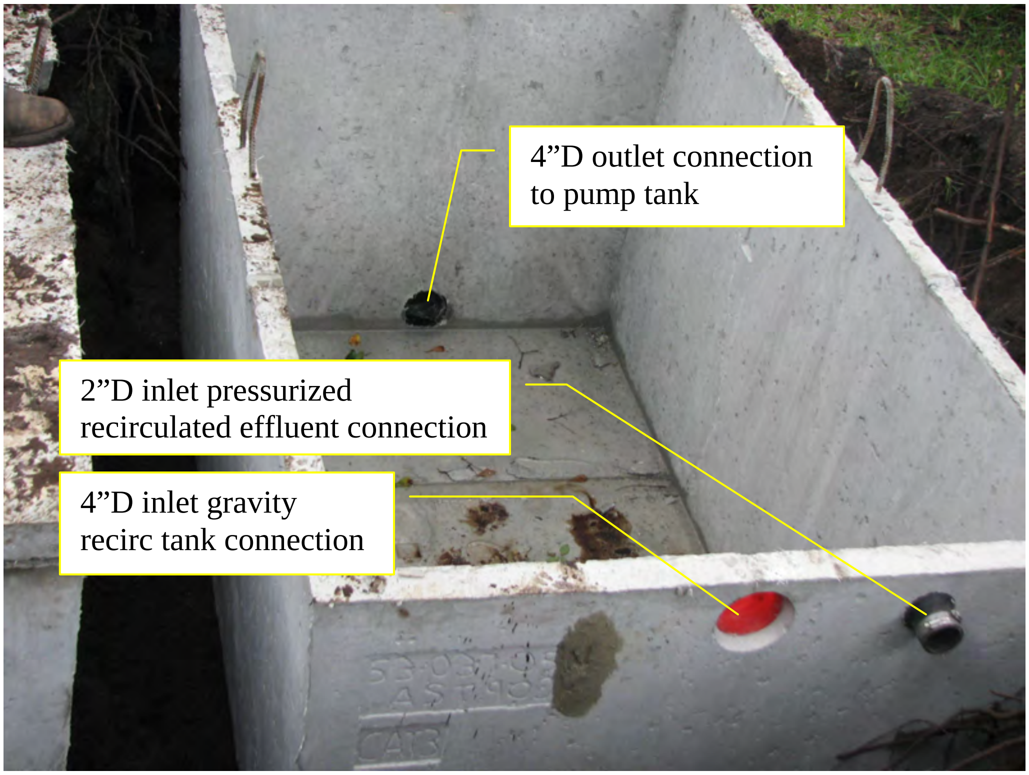


Figure 6
900 gallon, single chamber, stage 1 biofilter tank

Figure 7
Stage 1 biofilter 4”D outlet pipe, with cleanout

Figure 8
Stage 1 biofilter gravel underdrain

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

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

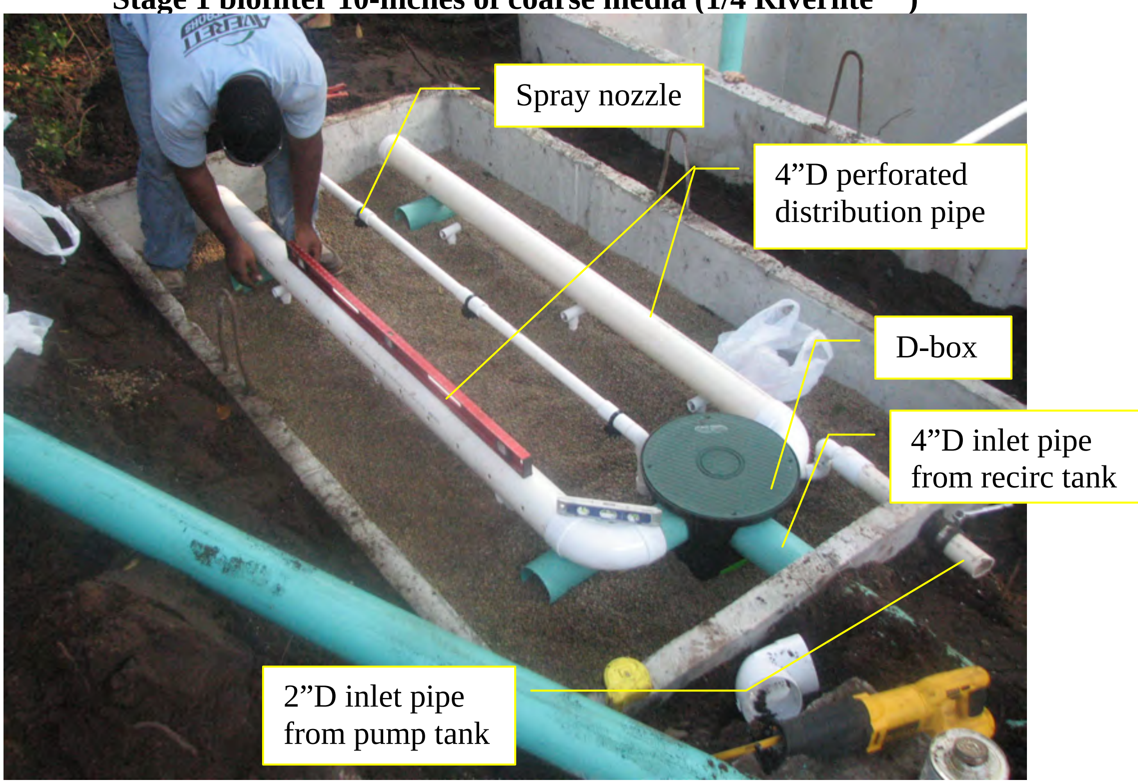


Figure 11
Stage 1 biofilter influent distribution system

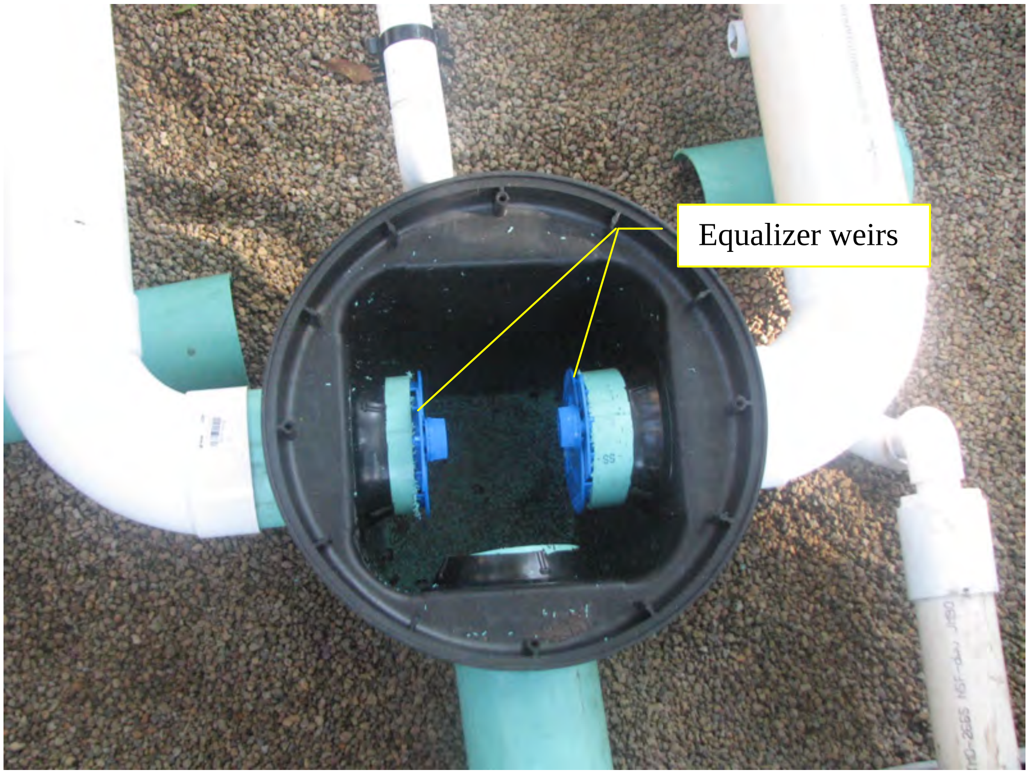


Figure 12
Stage 1 biofilter d-box

Figure 13
Removable spray nozzle

The 300 gallon concrete recirculation tank was then installed (Figure 14). The 4”D inlet is connected to the septic tank effluent discharge, and the 2” D inlet is connected to the recirculation pipe from the pump tank. A bull run valve™ (Figure 15) was installed following the septic tank outlet to allow the flow to either be completely directed to the new passive system (to the recirculation tank) or to the existing distribution box (to the existing drainfield). A riser pipe was installed to grade over the valve, so that the valve can be turned after installation is complete. The valve is turned with a wrench on a rod which is long enough to reach with the riser installed (Figure 15).

Figure 14
300 gallon recirculation tank

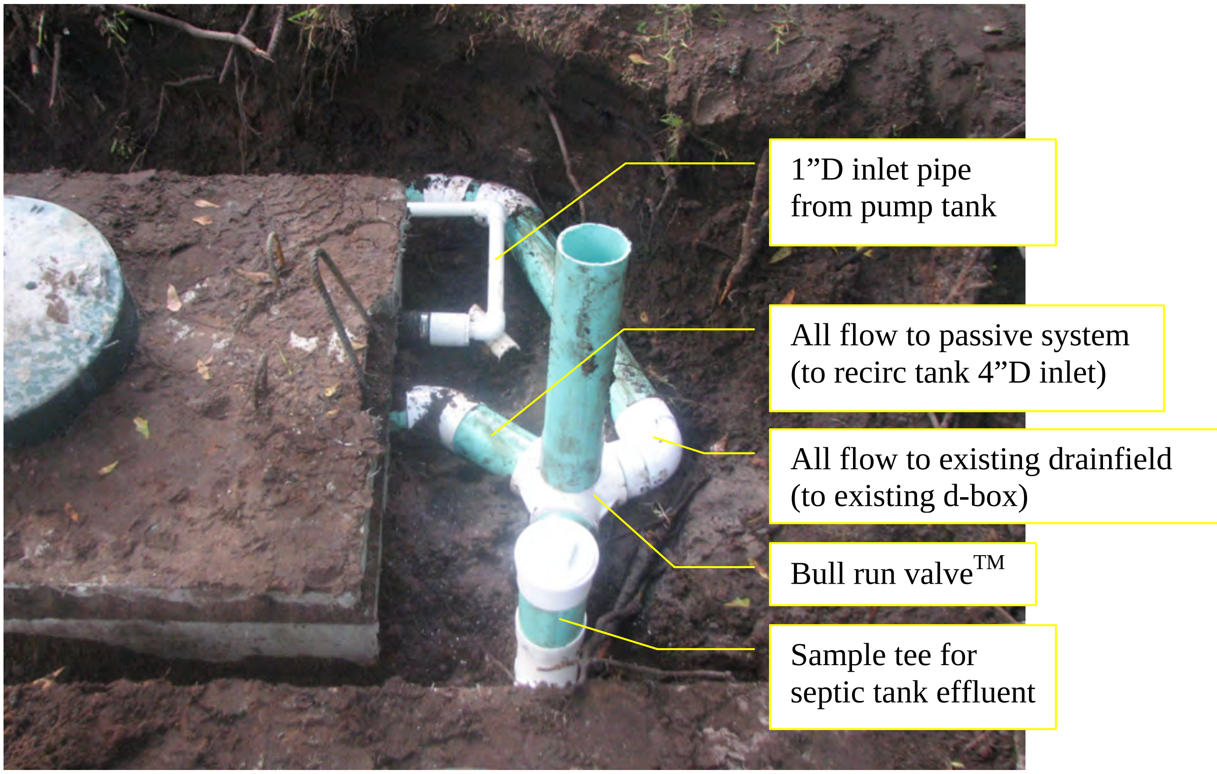


Figure 15
Bull run valve™

Next, the 300 gallon concrete pump tank was installed downgradient of the Stage 1 biofilter (Figure 16). The outlet pipe connection was plugged since the pump discharge pipe is installed through the riser. The pump was installed within a holding bracket which also supports the float tree (Figure 17). Three float switches were installed to maintain the effluent level in the pump tank and are attached to a float tree installed in the pump tank and connected to the control panel. The height of the floats is adjustable and once the proper heights were established, screws were used to secure the floats to the float tree.

Two inline flow meters were installed following the pump discharge. The first inline flow meter was installed prior to the recirculation flow split, to record the cumulative flow in gallons pumped from the pump tank (Figure 18). At this location, the flowmeter measurement includes the forward wastewater flow (F) and the recirculation flow (R). Two throttling globe valves were installed to allow for the adjustment of F and R flow to achieve the target recirculation ratio (initially set at approximately 3:1). The second flowmeter installed downstream of the F globe valve measures the forward wastewater flow to the Stage 2 biofilter (Figure 18). As previously discussed, the design includes two modes of operation for the recirculation of Stage 1 effluent: 1) to the recirculation tank or 2) to the Stage 1 biofilter spray nozzles. Two ball valves were installed (Figure 19) which either shut on or off the recirculation mode desired (initially set so that all the recirculation flow returns to the recirculation tank).

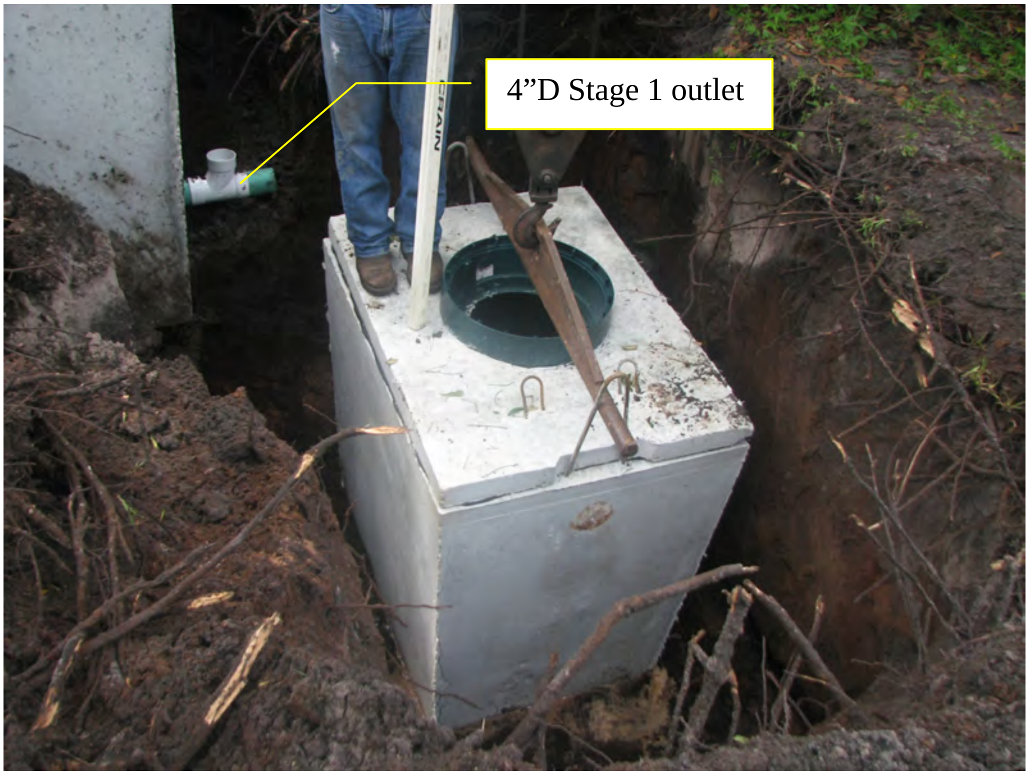


Figure 16
300 gallon pump tank

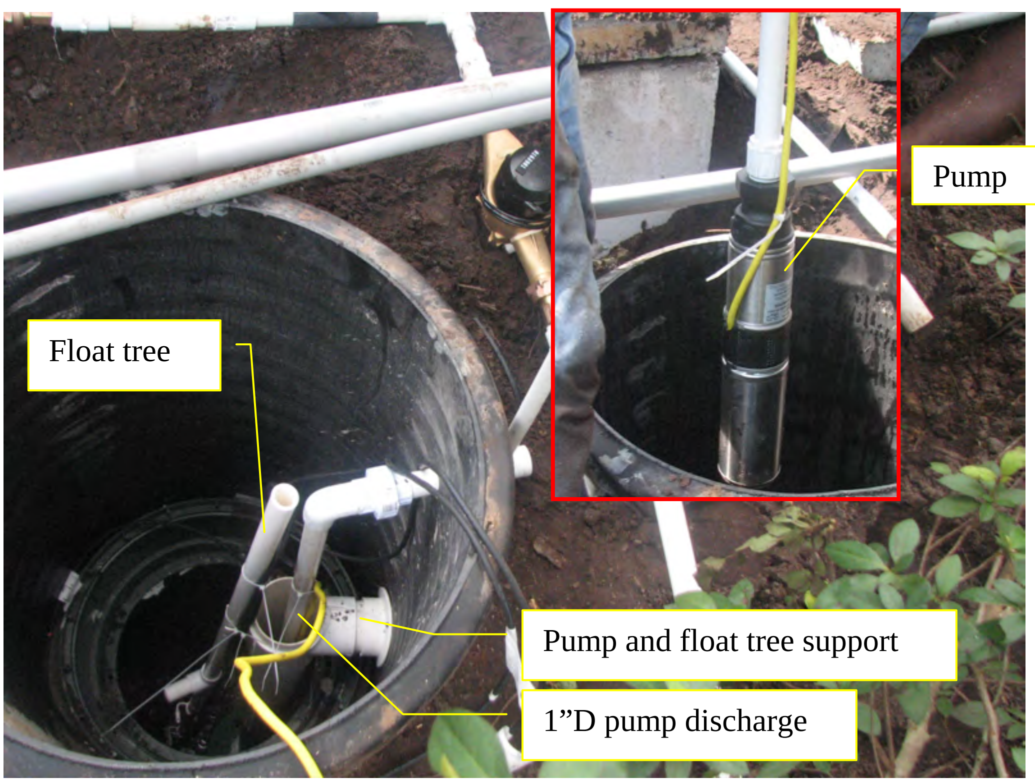


Figure 17
300 gallon pump tank (pump and float tree)

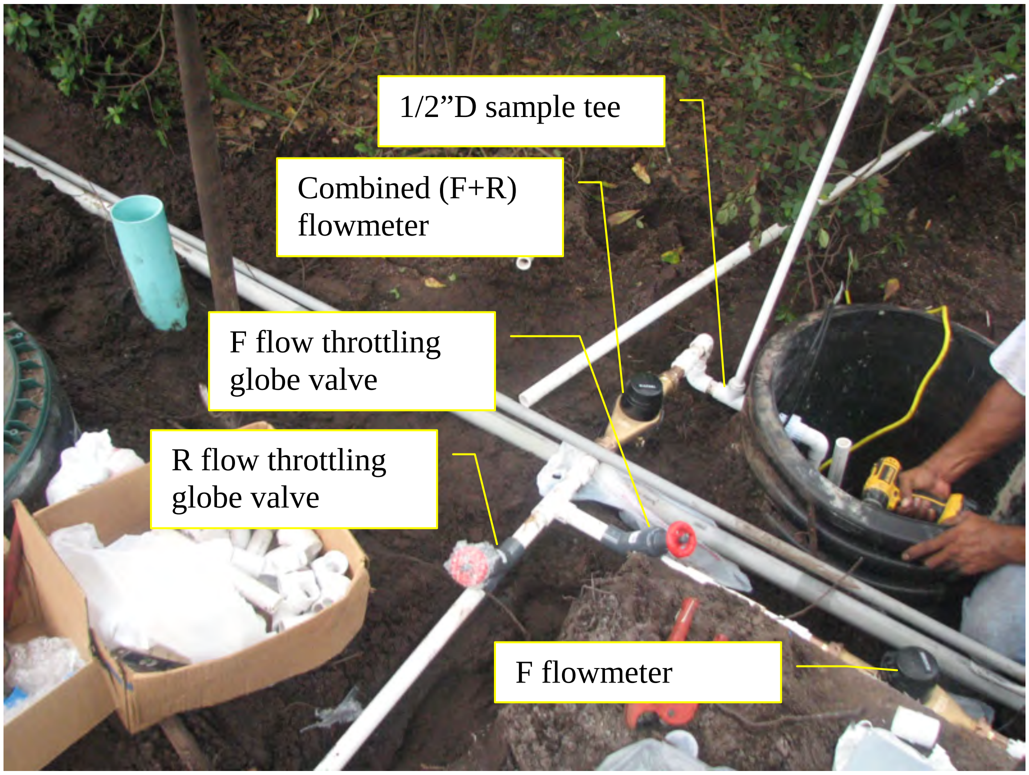


Figure 18
Recirculation flow split and monitoring

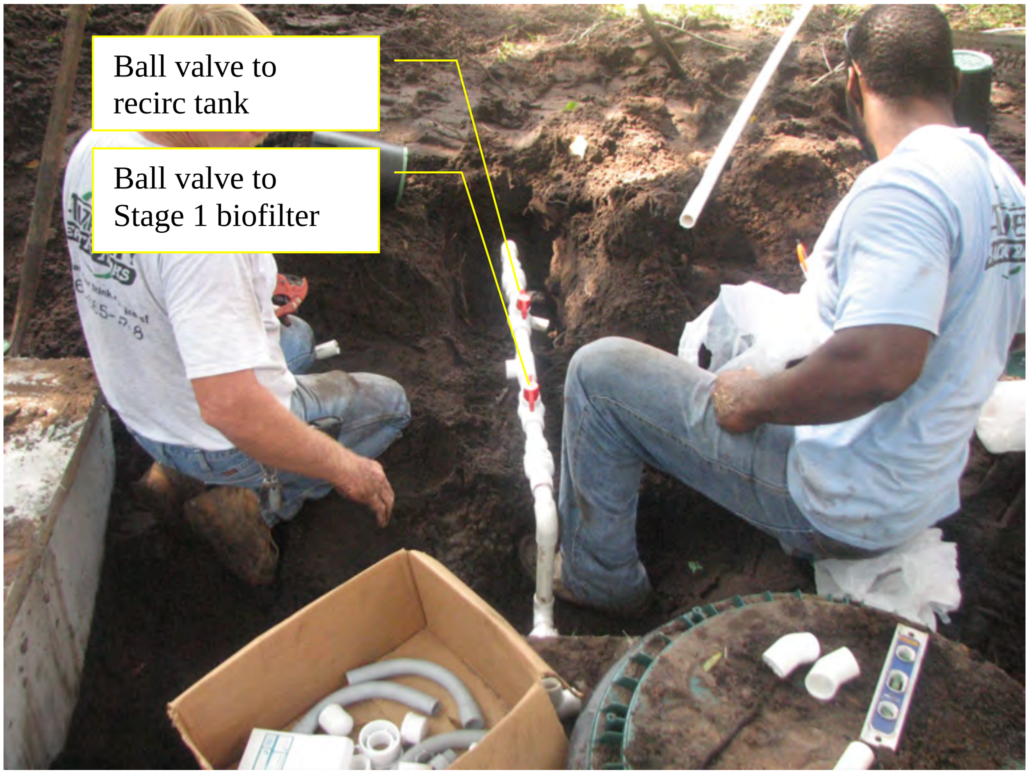


Figure 19
Recirculation mode of operation flow split

The last tank installed was a two chamber (1,500 gallon) concrete tank (Figure 20). The purpose of this tank is to hold the Stage 2 lignocellulosic and sulfur media. The 1"D pipe downstream of the F flowmeter is expanded to 4"D and connects to a perforated pipe which distributes nitrified effluent over the lignocellulosic media within the first chamber of the Stage 2 biofilter. The nitrified effluent flows downward through the lignocellulosic media (within first chamber) and upward through the sulfur media mixture (within second chamber).

A 4"D underdrain pipe (perforated) with gravel surrounding was installed along the centerline of the bottom of the tank for transfer from the first chamber to the second chamber (Figure 21). The tank arrived with a coupling cast into the baffle wall near the bottom to connect both chambers of the tank. Following the underdrain gravel installation (Figure 22) and leveling, 24-inches of elemental sulfur and oyster shell media was installed and mixed (Figure 23) within the second chamber. A stainless steel drivepoint sampler tree (Figure 24) was installed for sampling at 3, 7, 12, and 18-inches above the bottom of the sulfur media mixture (Figure 23).

Above the gravel underdrain within the first chamber of the tank, 42-inches of lignocellulosic media was installed (Figure 25). A stainless steel drivepoint sampler tree was installed for sampling at 0, 6, 12, 18, 24, 30, and 36-inches above the bottom of the lignocellulosic media. A 4"D perforated pipe was connected to the inlet of the tank for effluent dispersal above the lignocellulosic media. A 4"D tee was installed at the outlet of the tank which allows for saturated operating conditions across the biofilter (Figure 26). The 4"D outlet is connected to the distribution box to the existing drainfield.

Figure 20
1,500 gallon stage 2 biofilter tank

Figure 21
Stage 2 biofilter tank perforated pipe along bottom (lignocellulosic chamber)

Figure 22
Stage 2 biofilter tank gravel underdrain (sulfur chamber)

Figure 23
Stage 2 biofilter tank (sulfur mixed with oyster shell)

Figure 24
Stage 2 biofilter tank SST drivepoint sampler tree (sulfur chamber)

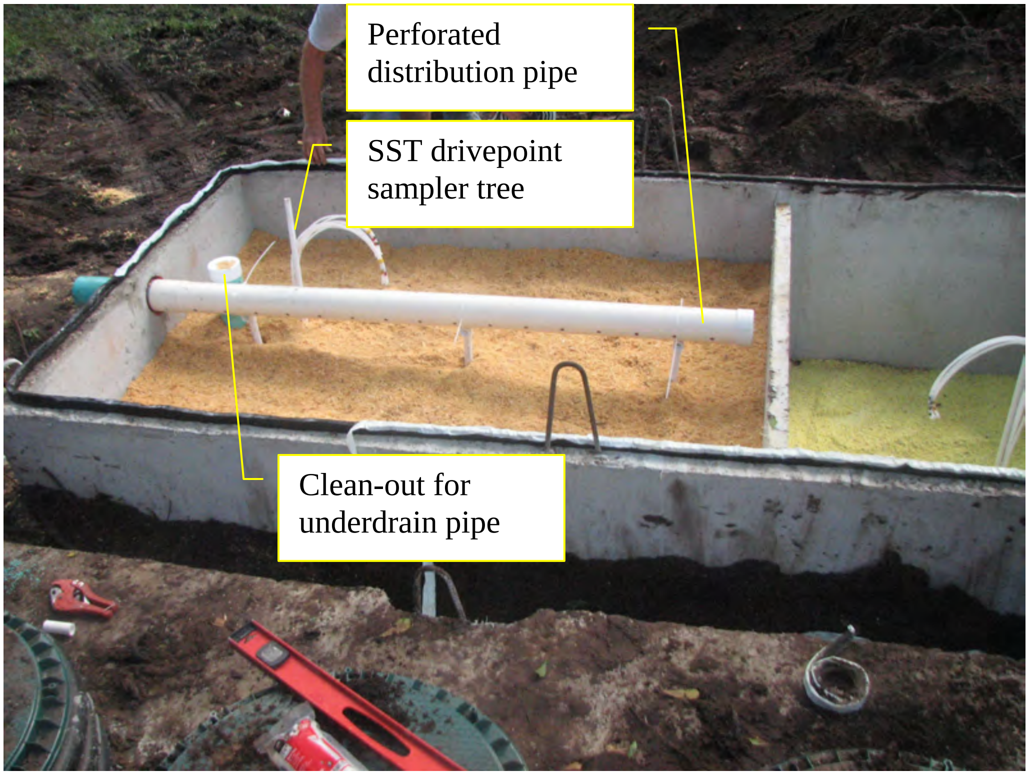


Figure 25
Stage 2 biofilter tank (lignocellulosic media)

Figure 26
Stage 2 biofilter tank outlet tee

A power meter was installed between the main power box of the house and the control panel to record cumulative power usage of the system in kilowatts. The equipment connected to the power meter are the recirculation pump and the control panel. Figure 27 shows the power meter installed inside the control panel.

The system control panel (Figure 27) allows for a timed pump cycle which can be overridden if the effluent levels are too low or too high in the pump tank. If the floats indicate a low effluent level in the tank, the timed cycle is turned off to protect the pump. If the floats indicate a high effluent tank level, then the pump cycles faster (off cycle reduced) until the water level reaches the optimal range. An alarm will indicate if the water level goes above a critical level. The control panel is connected to a phone line which transmits data to Vericomm for monitoring.

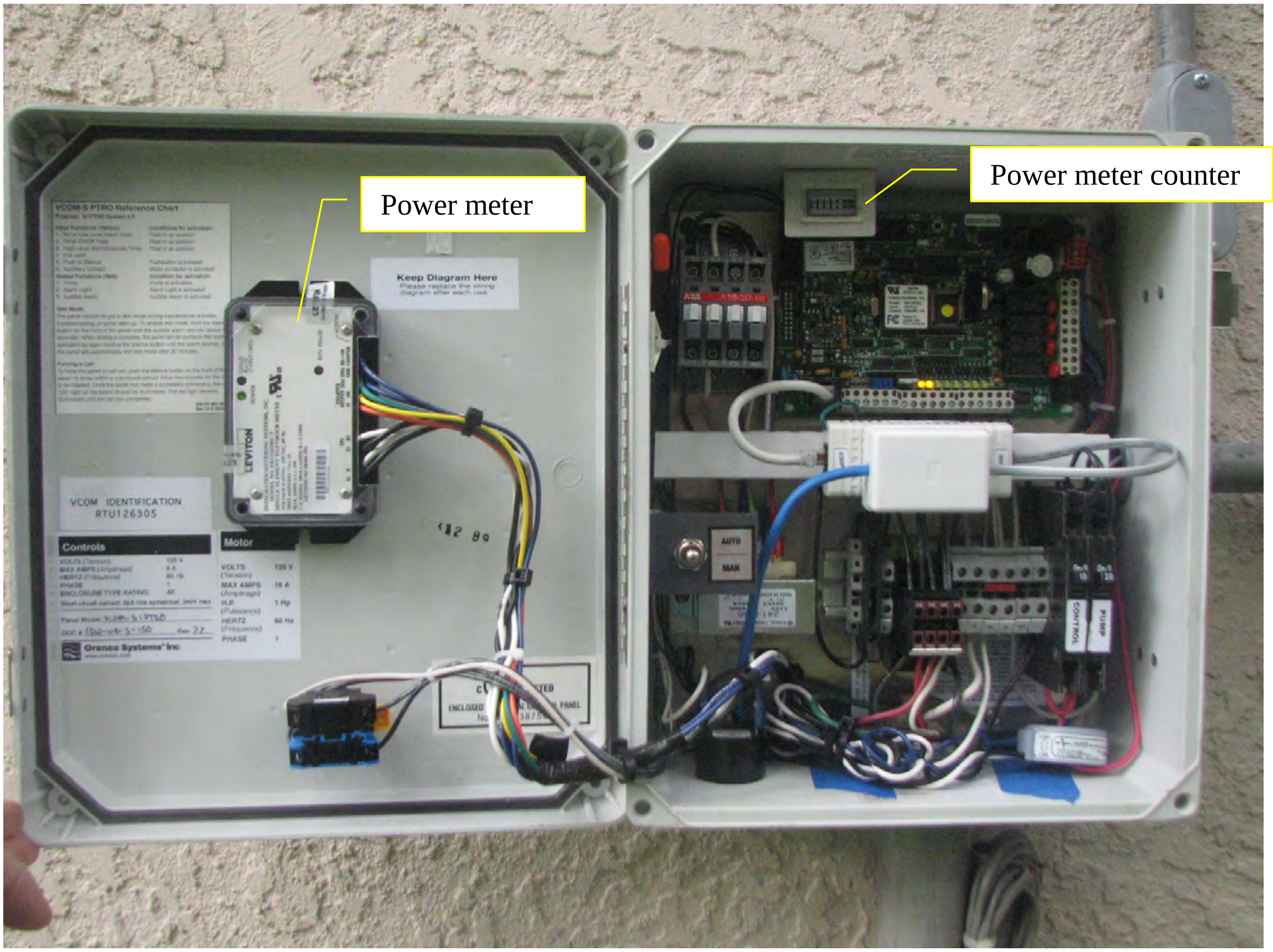


Figure 27
Control Panel

During final testing of the system, the system operated with no visible signs of leaks, etc. The system area was filled and all disturbed areas on the property were graded (Figure 28) and covered with sod (Figure 29).

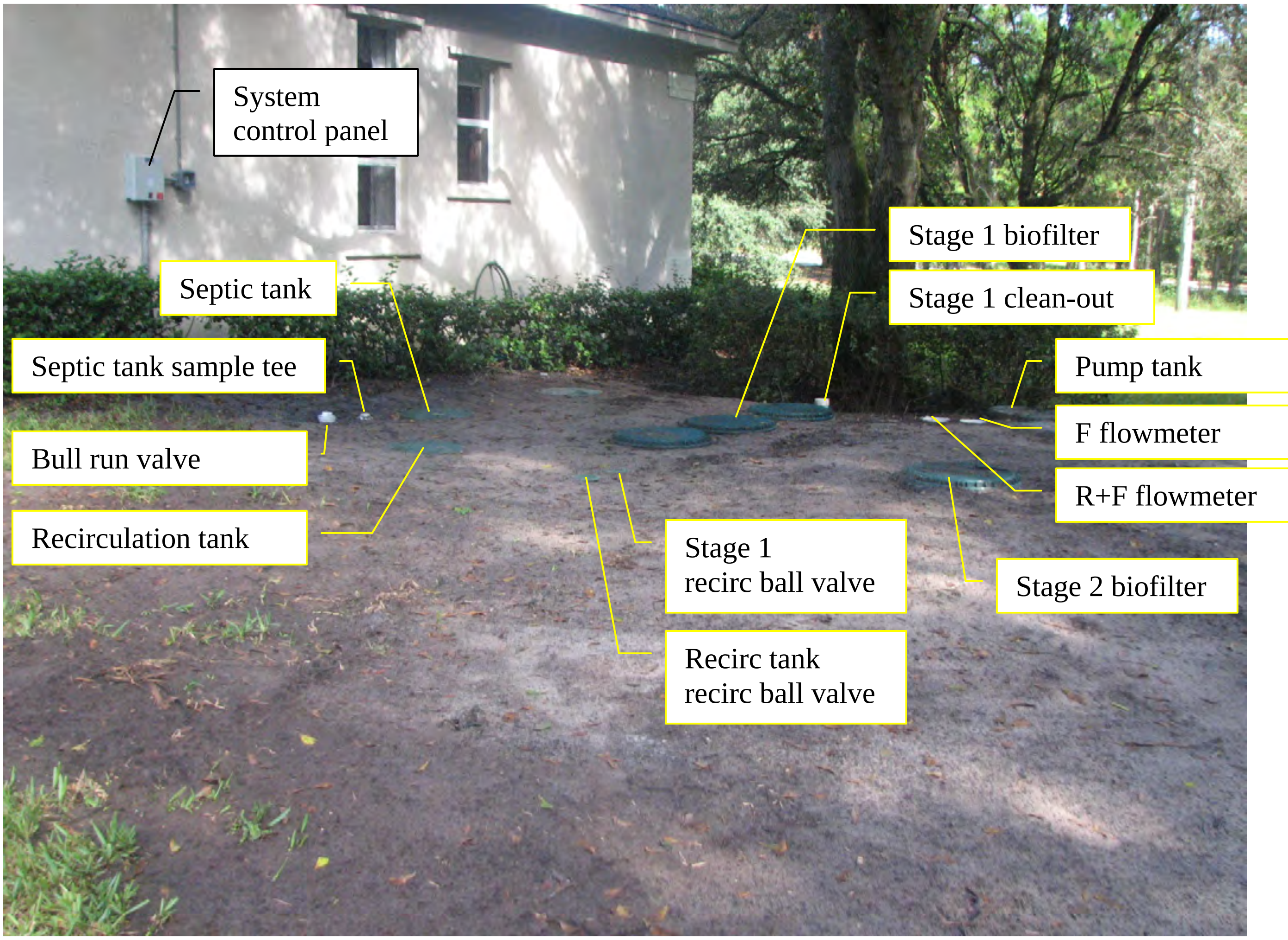


Figure 28
Overall PNRS system installed

Figure 29
Sod cover over PNRS system

Operation and Verification

On September 25, 2012, the pump tank was filled with potable water for system operational testing. The pump was tested, and the globe valves were set to an approximate 3 to 1 recirculation split, with 3 parts going back to the recirculation tank and 1 part going to the Stage 2 biofilter tank. Through the Vericomm system, the on and off pump cycles were set. A call to Vericomm was initiated from the control panel to transmit the data following the testing. In addition, the two flowmeters and electric meter were read and recorded (Table 1).

Table 1
Initial Settings and Readings Recorded

	September 25, 2012 11:45am
Recirculation Ratio	3:1
Control Panel Settings	
Pump Run Time (hr:min)	0:07
Pump Cycles Today	5
Override Cycles Today	1
On time cycle (min:sec)	01:12
Off time cycle (min:sec)	60:00
Electric Meter Reading	
Electric Meter (kWh)	2
Flowmeter Readings	
Household use flowmeter (gal)	32660
Combined flowmeter (R+F) (gal)	00000351.9
Stage 2 flowmeter (F) (gal)	00000102.2

Estimated Cost

The final construction cost for the installed system was $19,142.18 as detailed in Appendix B.

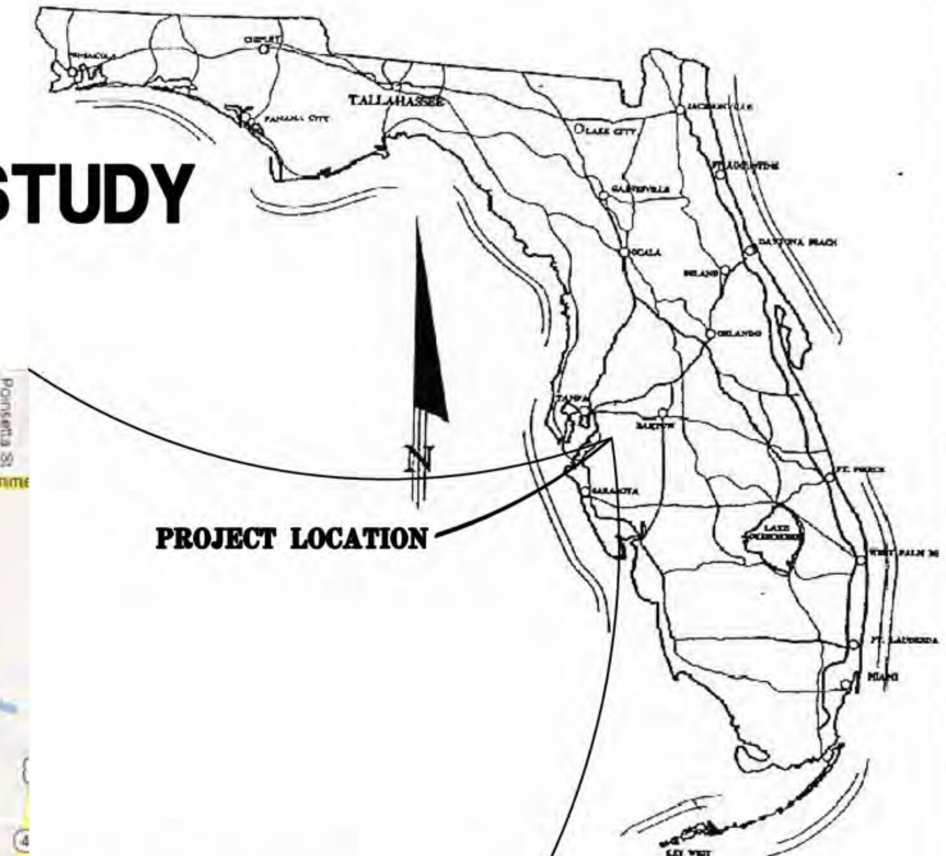
System Start-up

The system was started up September 25, 2012, when all flow was diverted to the new passive system. Routine checks of the system were made for the first two weeks to ensure the system was functioning as intended. Tanks were noted to be full on October 5, 2012. Preliminary sampling will begin in October to monitor nitrification.

APPENDIX A

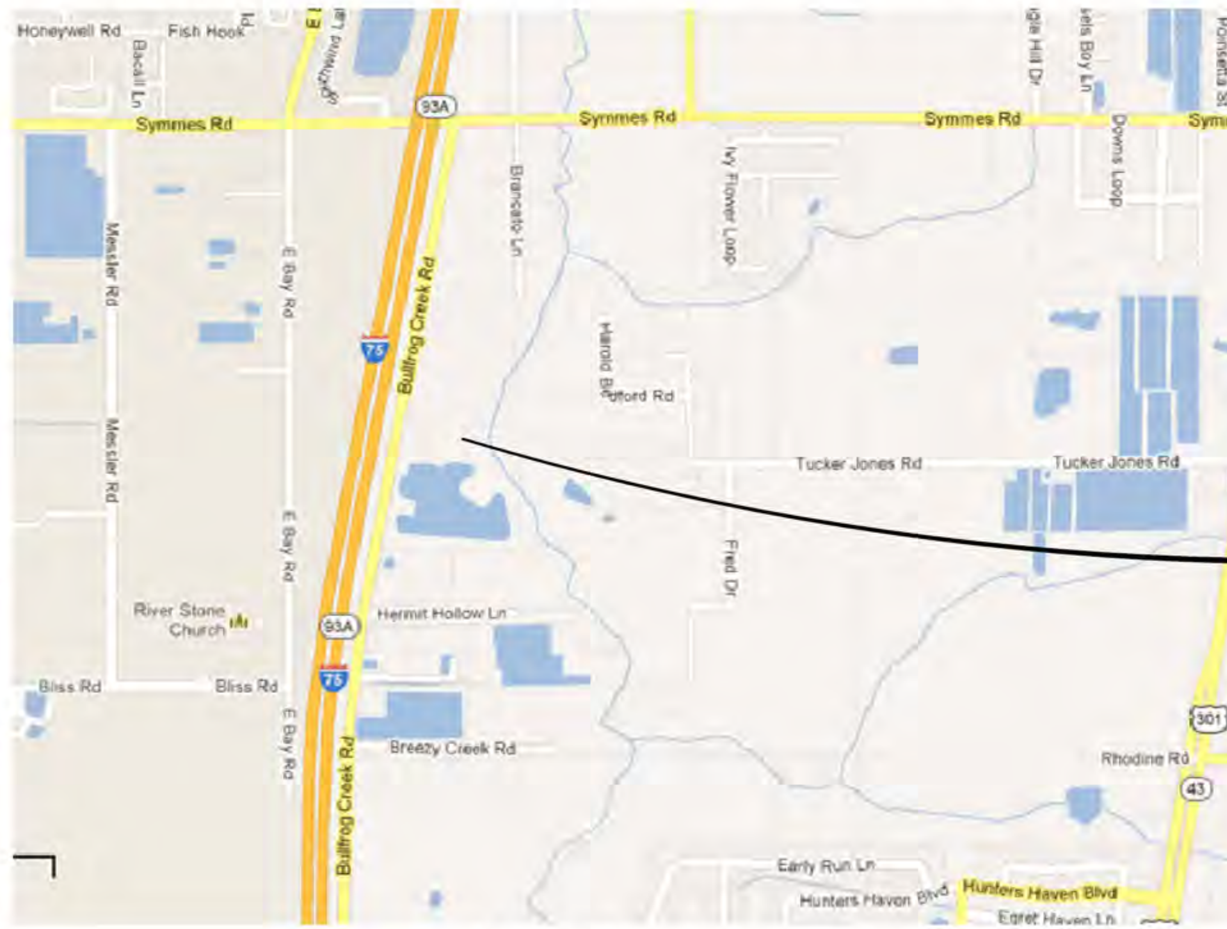
RECORD DRAWINGS

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES STUDY B-HS2 RECORD DRAWINGS



LIST OF DRAWINGS

SHEET COUNT	SHEET NUMBER	SHEET TITLE
		GENERAL
1	G-1	COVER SHEET AND INDEX OF DRAWINGS
		CIVIL
2	C-1	OVERALL PROPOSED SITE PLAN
3	C-2	PROPOSED SYSTEM LAYOUT
4	C-3	STAGE 1 AND 2 BIOFILTER CROSS SECTIONS
5	C-4	RECIRCULATION TANK CROSS SECTIONS
6	C-5	OVERALL SYSTEM CROSS SECTION
7	C-6	SYSTEM FLOW DIAGRAM
		ELECTRICAL
8	E-1	ELECTRICAL SITE PLAN



PROJECT LOCATION
B-HS2
Gibsonton, FL

LOCATION MAP
N.T.S.

HAZEN AND SAWYER
Environmental Engineers & Scientists

10002 Princess Palm Ave., Suite 200
Tampa, Florida 33619
Certificate of Authorization Number: 2771

IN ASSOCIATION WITH

SCHOOL OF MINES 1874 COLORADO

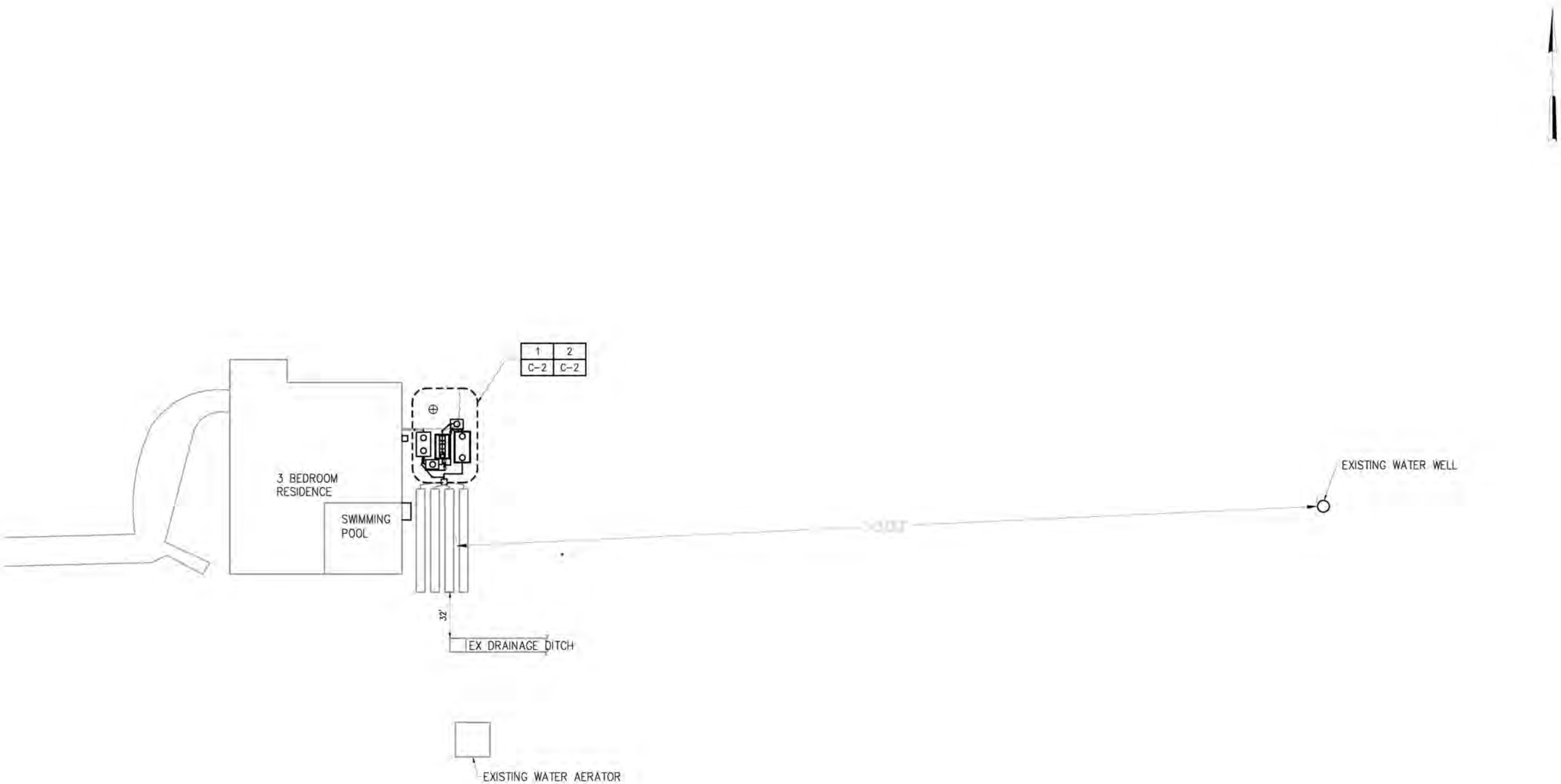
OTIS ENVIRONMENTAL CONSULTANTS, LLC

AET Applied Environmental Technology

FLORIDA DEPARTMENT OF HEALTH

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FLORIDA 32399-1713
(850)-245-4070

NOTICE:
THESE "RECORD DRAWINGS" REPRESENT THE FINAL CONDITIONS OF THE CONSTRUCTION PROJECT BASED UPON THE LOCATIONS, DOCUMENTATION, AND INFORMATION FURNISHED TO HAZEN AND SAWYER BY OTHERS, FIELD OBSERVATION AND SUPPORTING PROJECTS RECORDS.



PROPOSED SITE PLAN

1"=20'

1"=20'-0"

20 10 0 20'

DESIGNED	JME
DRAWN	CMS
CHECKED	DBS
	JME
APPROVED	DLA

JOSEFIN M. EDEBACK

69835

HAZEN AND SAWYER
Environmental Engineers & Scientists

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FL 32399-1713
(850)-245-4070

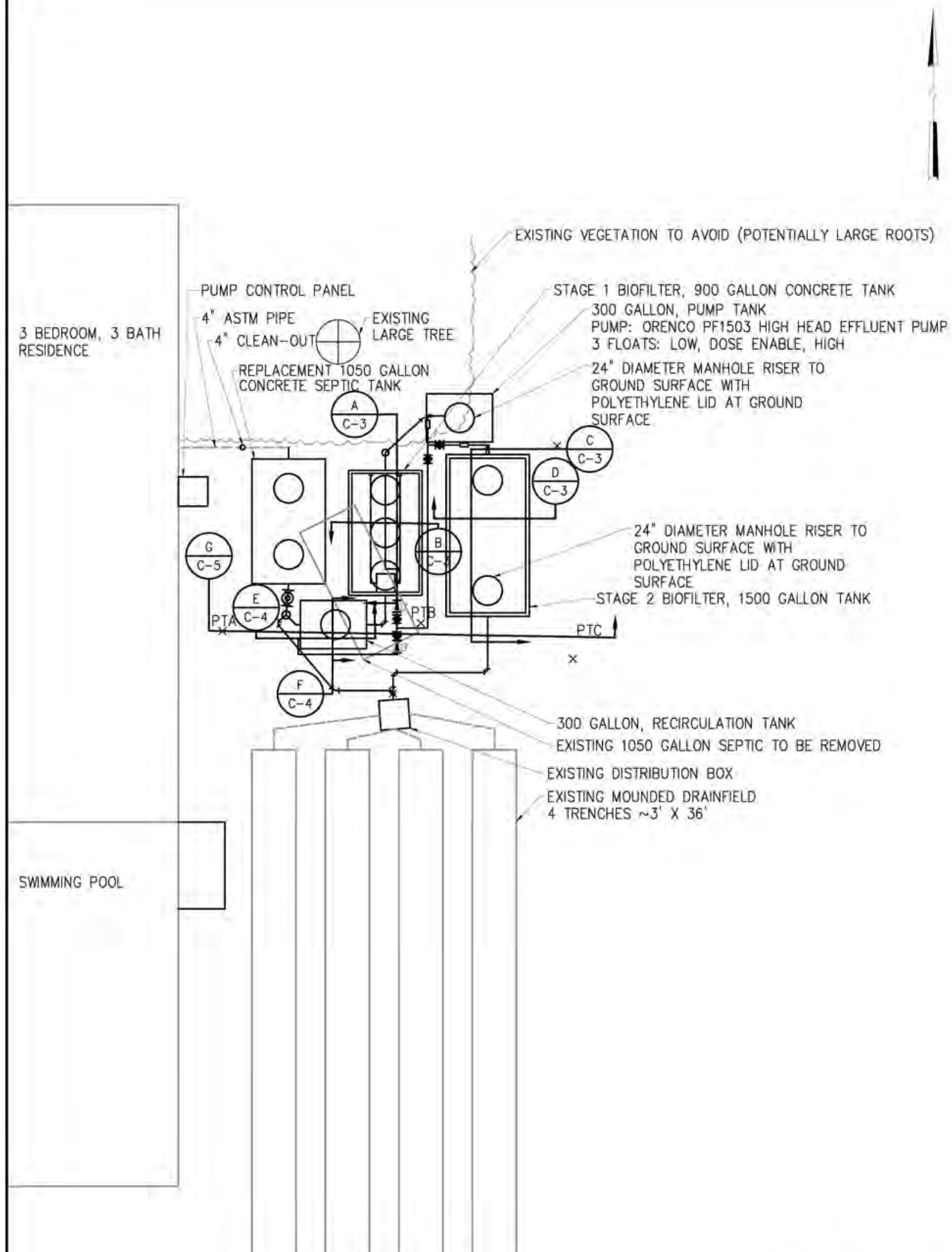
FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

OVERALL PROPOSED SITE PLAN

DATE SEPTEMBER 2012

44237-001

C-1

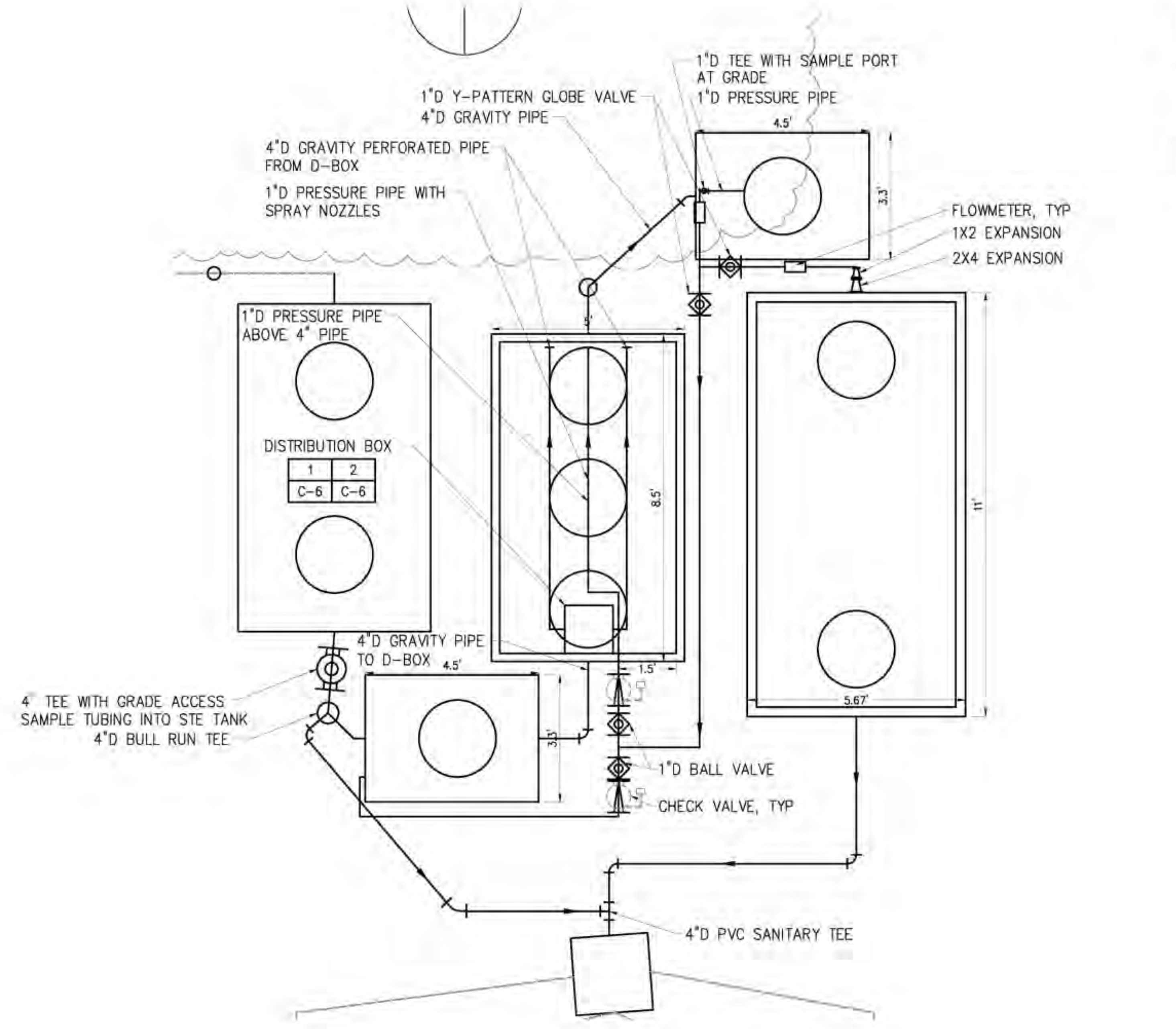


PROPOSED SYSTEM LAYOUT

DETAIL 1 / C-1

1" = 5'-0"

1"=5'-0" 5 2.5 0 5'



YARD PIPING PLAN

DETAIL 2 / C-1

1" = 2'-0"

1"=2'-0" 2 1 0 2'

NOTES:

1. 45 DEGREE ELBOWS SHALL BE USED. 90 DEGREE ELBOWS SHALL NOT BE USED.
2. ALL GATE VALVES AND FLOWMETERS SHALL BE INSTALLED WITH VALVE BOX COVER, WITH RISER AS APPLICABLE, FOR ACCESS AT GROUND SURFACE.
3. GLOBE VALVES SHALL BE SPEARS Y-GLOBE VALVES OR EQUAL. VALVES SHALL BE CONSTRUCTED FROM PVC. ALL VALVES SHALL HAVE A MINIMUM PRESSURE RATING OF 90 PSI.
4. ALL 4"D TANK INLET AND OUTLET CONNECTIONS SHALL INCLUDE POLYLOK IV EPDM SEALS.
5. ALL TANK LIDS SHALL BE SEALED WITH APPROPRIATE SEALANTS TO ENSURE WATER TIGHTNESS.

DESIGNED	JME
DRAWN	CMS
CHECKED	DBS
	JME
APPROVED	DLA

NO. | ISSUED FOR | DATE | BY

JOSEFIN M. EDEBACK 69835

HAZEN AND SAWYER
Environmental Engineers & Scientists

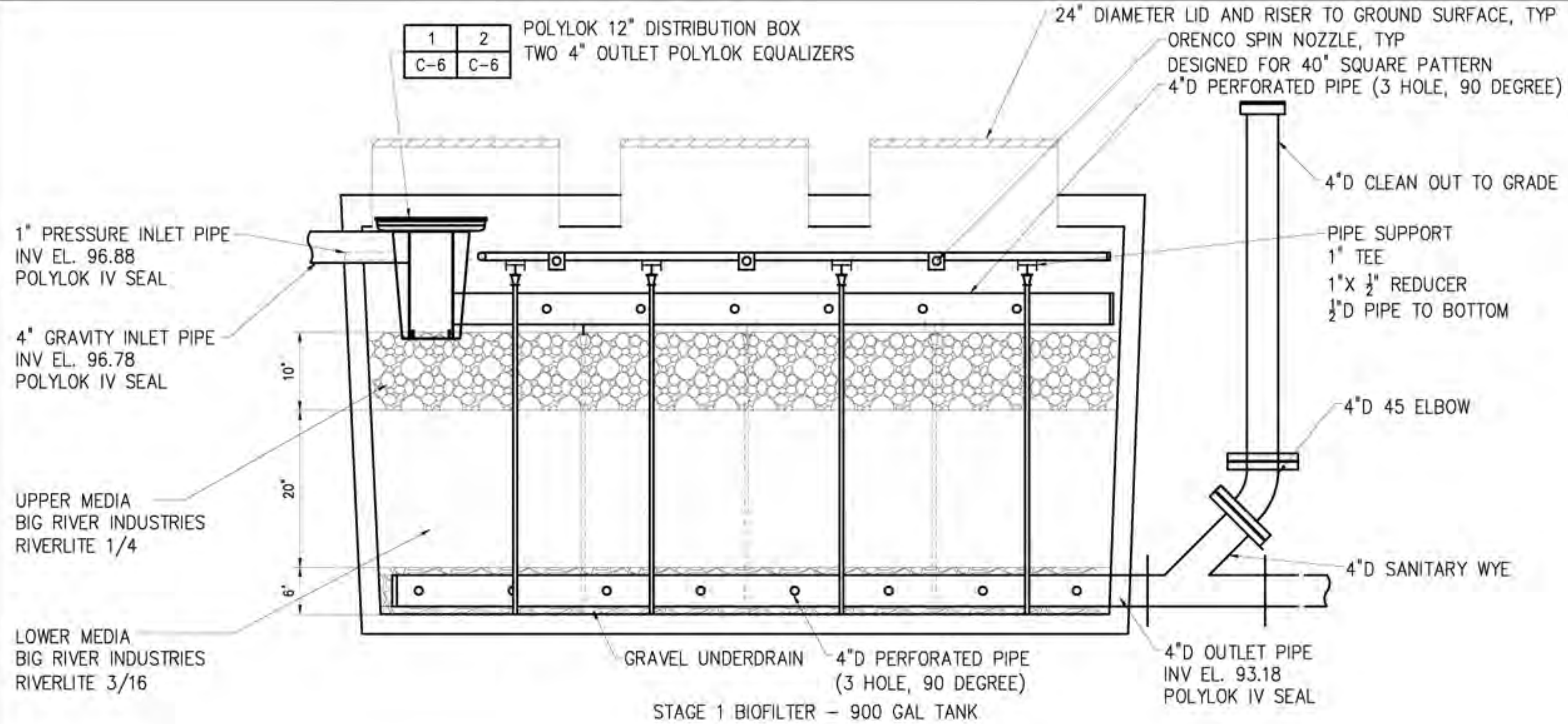
HEALTH

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FL 32399-1713
(850)-245-4070

FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

PROPOSED SYSTEM LAYOUT

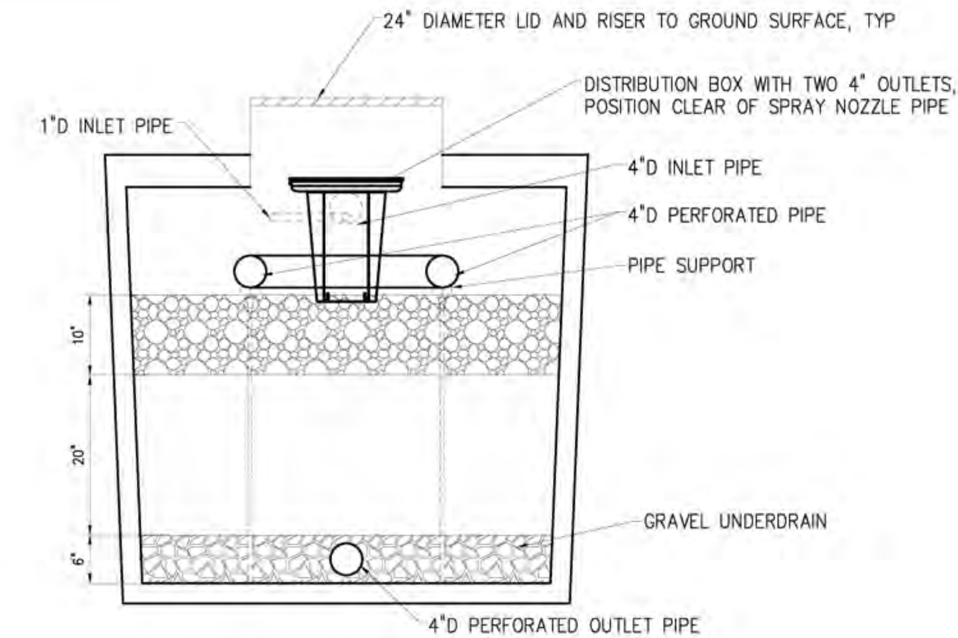
DATE SEPTEMBER 2012
44237-001
DRAWING NUMBER
C-2



STAGE 1 BIOFILTER – 900 GAL TANK

SECTION A C-2

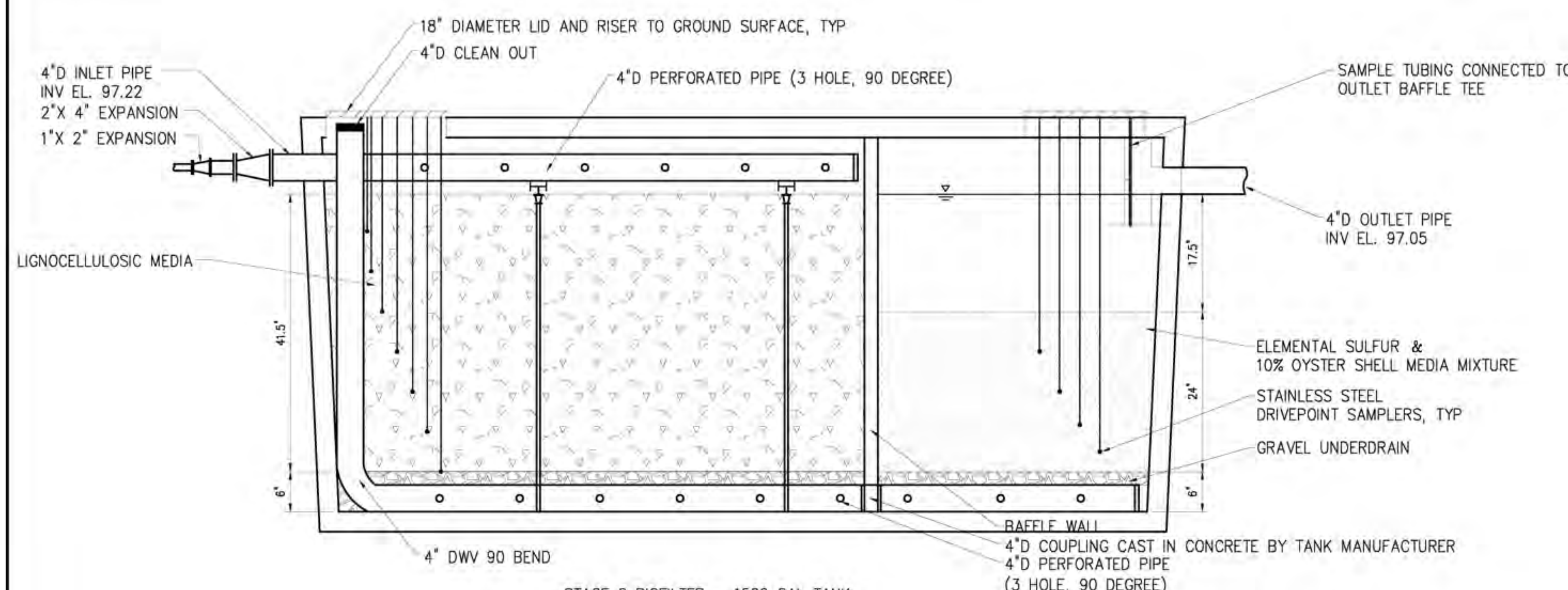
1" = 1'



STAGE 1 BIOFILTER – 900 GAL TANK

SECTION B C-2

1" = 1'



STAGE 2 BIOFILTER – 1500 GAL TANK

SECTION C C-2

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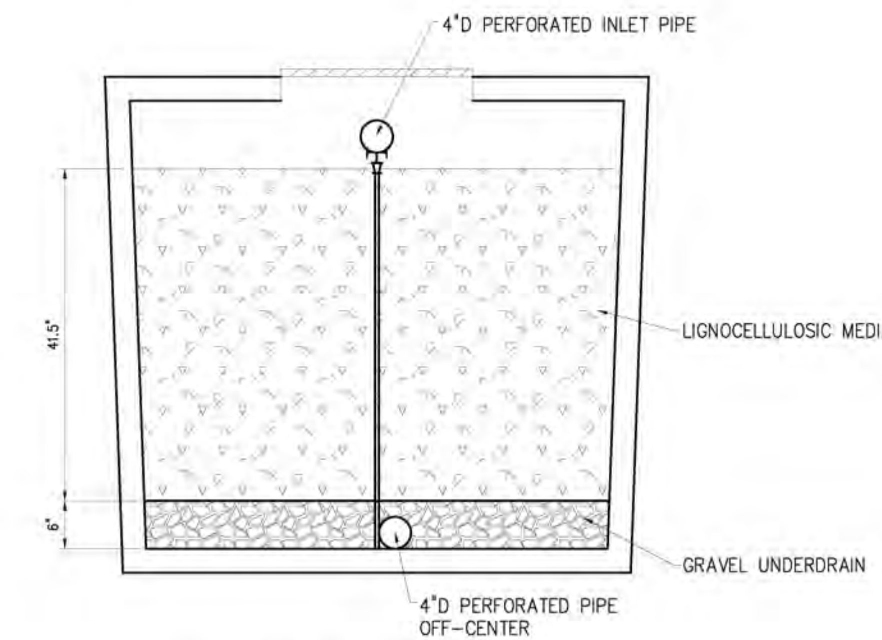


STAGE 2 BIOFILTER – 1500 GAL TANK

SECTION D C-2

1" = 1'

1"=1'-0" 12" 6 0 1'

NO.	ISSUED FOR	DATE	BY	DESIGNED JME DRAWN CMS CHECKED DBS PROJ. ENGR. JME DLA APPROVED	JOSEFIN M. EDEBACK Florida Professional Engineer's Registration Number 69835	HAZEN AND SAWYER Environmental Engineers & Scientists	FLORIDA DEPARTMENT OF HEALTH 4052 BALD CYPRESS WAY, BIN A08 TALLAHASSEE, FL 32399-1713 (850)-245-4070

FLORIDA DEPARTMENT OF HEALTH

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

STAGE 1 AND 2 BIOFILTER CROSS SECTIONS

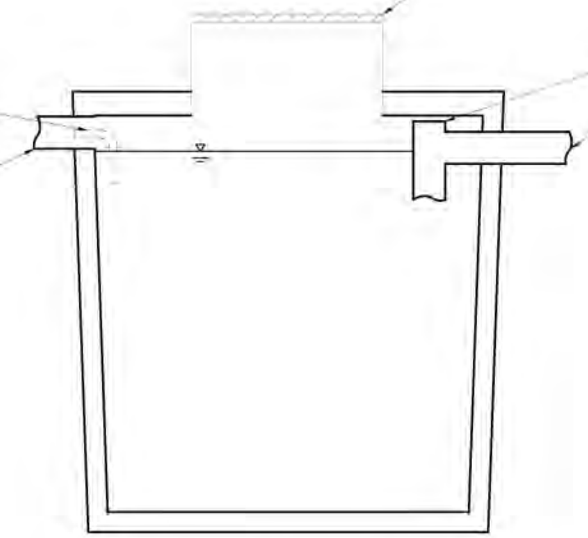
THE SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING

DATE SEPTEMBER 2012

H & S JOB NUMBER 44237-001

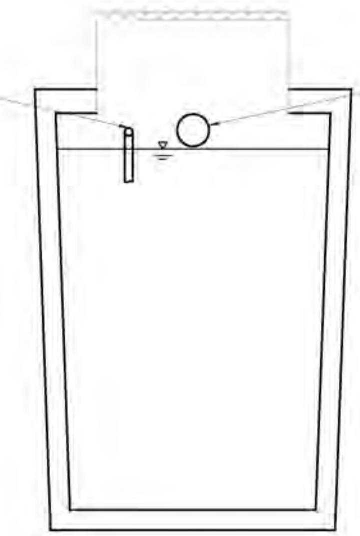
CONTRACT NUMBER

DRAWING NUMBER C-3



RECIRCULATION TANK – 300 GALLON TANK

SECTION E / C-2
1" = 1'



RECIRCULATION TANK – 300 GALLON TANK

SECTION F / C-2
1" = 1'

1"=1'-0" 12" 6 0 1'

DESIGNED	JME	
DRAWN	CMS	
CHECKED	DBS	
FINAL CHECK	JME	
APPROVED	DLA	

JOSEFIN M. EDEBACK
Florida Professional Engineer's Registration Number: 69835

HAZEN AND SAWYER
Environmental Engineers & Scientists

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FL 32399-1713
(850)-245-4070

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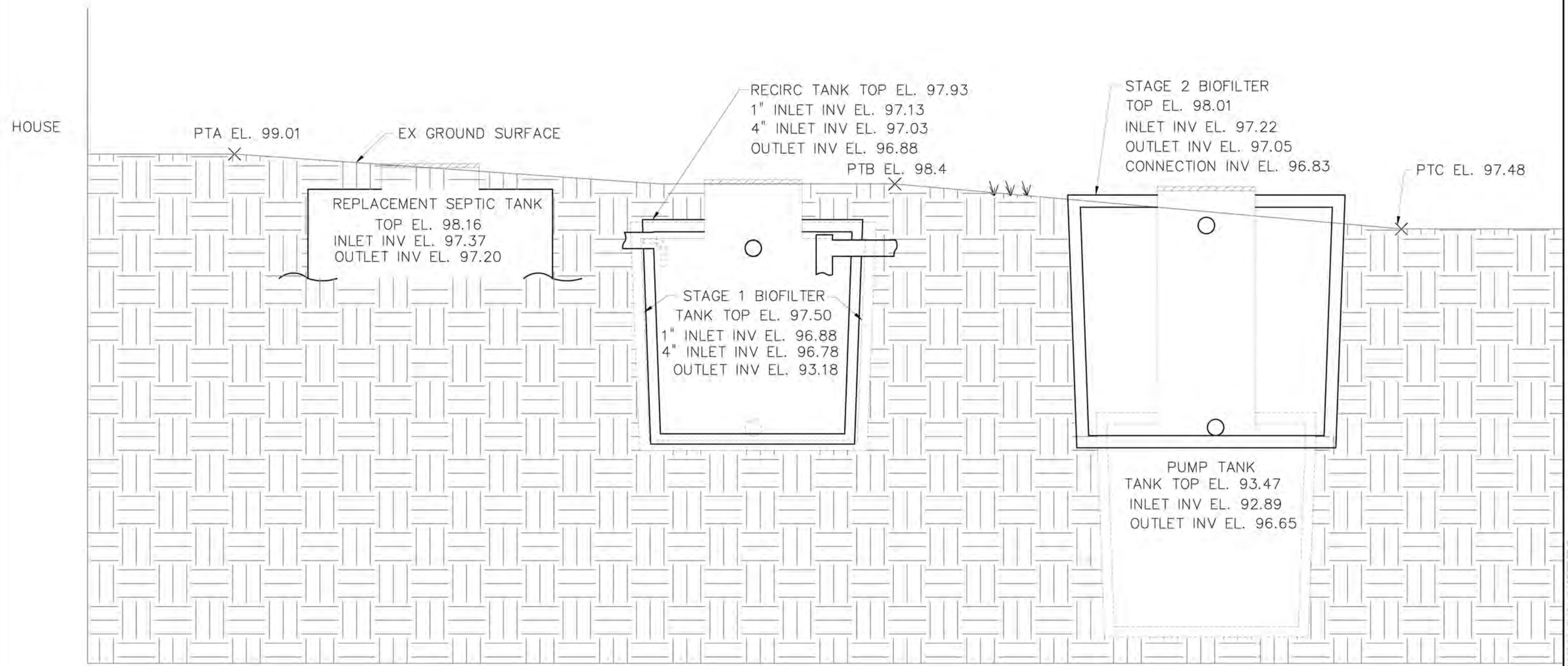
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

RECIRCULATION TANK CROSS SECTIONS

DATE: SEPTEMBER 2012
H & S JOB NUMBER: 44237-001
CONTRACT NUMBER
DRAWING NUMBER: C-4



CROSS SECTION EX SEPTIC TANK AND PROPOSED TANKS

SECTION G / C-2
1" = 1'

1"=1'-0" 12" 6 0 1'

NO.	ISSUED FOR	DATE	BY

DESIGNED JME
DRAWN CMS
CHECKED DBS
PROJ. ENGR. JME
APPROVED DLA

JOSEFIN M. EDEBACK
Name Date
Florida Professional Engineer's Registration Number 69835

HAZEN AND SAWYER
Environmental Engineers & Scientists
10002 Princess Palm Avenue
Regency One Building, Suite 200
Tampa, Florida 33619
Certificate of Authorization Number 2771

FLORIDA DEPARTMENT OF HEALTH
4052 BALD CYPRESS WAY, BIN A08
TALLAHASSEE, FL 32399-1713
(850)-245-4070

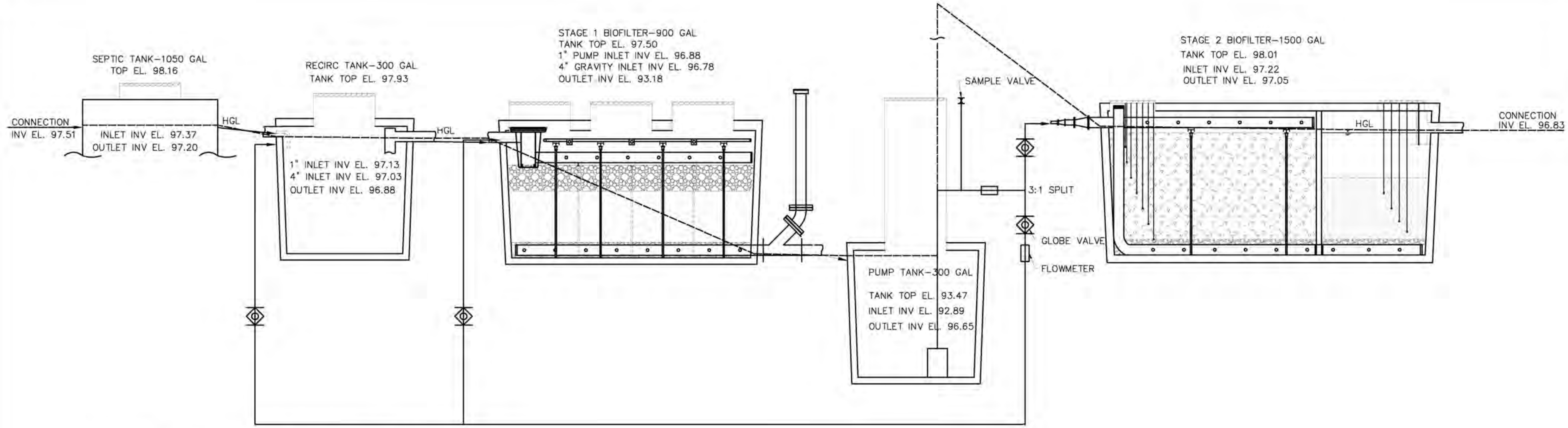
FLORIDA DEPARTMENT OF HEALTH

FLORIDA DEPARTMENT OF HEALTH
FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATIGIES STUDY

OVERALL SYSTEM CROSS SECTION

TOP SCALE BAR SHOWN BELOW MEASURES ONE INCH LONG ON THE ORIGINAL DRAWING

DATE SEPTEMBER 2012
H & S JOB NUMBER 44237-001
CONTRACT NUMBER
DRAWING NUMBER C-5



NOTE: HGL SHOWN IS FOR RECIRCULATION TANK MODE OF OPERATION

DESIGN CALCULATIONS

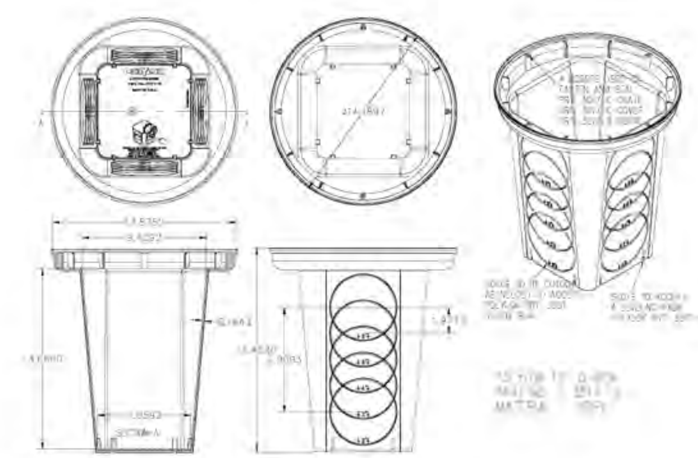
A. FLOW CALCULATIONS
- NUMBER OF BEDROOMS = 3
- BUILDING AREA = 2542 SF
- Q = (3 BR X 100 GPD/BR) + ((2542 SF – 2250 SF) X 100 GPD/750 SF)
- F.A.C. MINIMUM DESIGN FLOW = 400 GPD

B. TREATMENT DESIGN
- STAGE 1 BIOFILTER = 900 GAL = 37.1 SF
- STAGE 2 BIOFILTER = 1500 GAL = 61.3 SF
  - LIGNO ($\frac{2}{3}$) = 40.8 SF
  - SULFUR ($\frac{1}{3}$) = 20.4 SF

C. SYSTEM FLOWS
- RECYCLE RATIO = 3:1
- RECYCLE FLOW = 1200 GPD
- NUMBER OF DOSES = 24
- TOTAL GAL PER DOSE = 66.7
- DESIGN MINIMUM PUMP FLOW RATE = 5.2 GPM
- FORWARD FLOW = 16.7 GAL/DOSE
- RECYCLE FLOW = 50 GAL/DOSE
- MINUTES PER CYCLE = 12.8

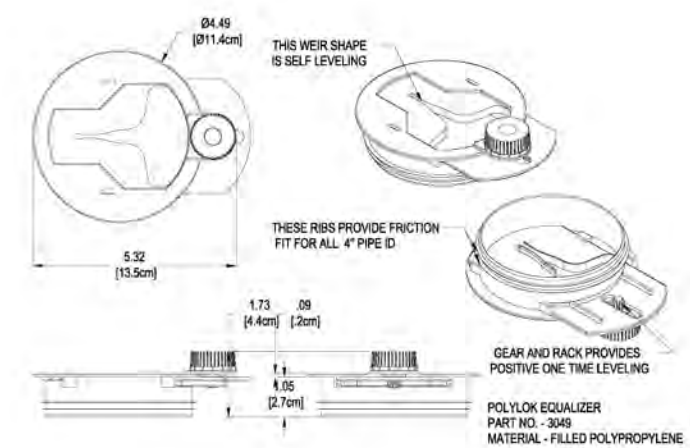
D. HYDRAULIC LOADING RATE
- STAGE 1 FORWARD FLOW = 10.8 GAL/DAY-SF
- STAGE 1 TOTAL FLOW = 43.2 GAL/DAY-SF
- STAGE 2 LIGNO = 9.8 GAL/DAY-SF
- STAGE 2 SULFUR = 19.6 GAL/DAY-SF

E. TWO MODES OF OPERATION
1. RECIRCULATION TANK MODE = ALL RECYCLE FLOW TO RECIRCULATION TANK
2. SPRAYER MODE = ALL RECYCLE FLOW TO STAGE 1 BIOFILTER SPRAY NOZZLES



POLYLOK 12" D-BOX

DETAIL 1 NTS C-3



POLYLOK EQUALIZER

DETAIL 2 NTS C-3

DESIGNED	JME
DRAWN	CMS
CHECKED	DBS
PROJ. ENGR.	JME
APPROVED	DLA

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Hazen Professional Engineer's Registration Number 69835

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SYSTEM FLOW DIAGRAM

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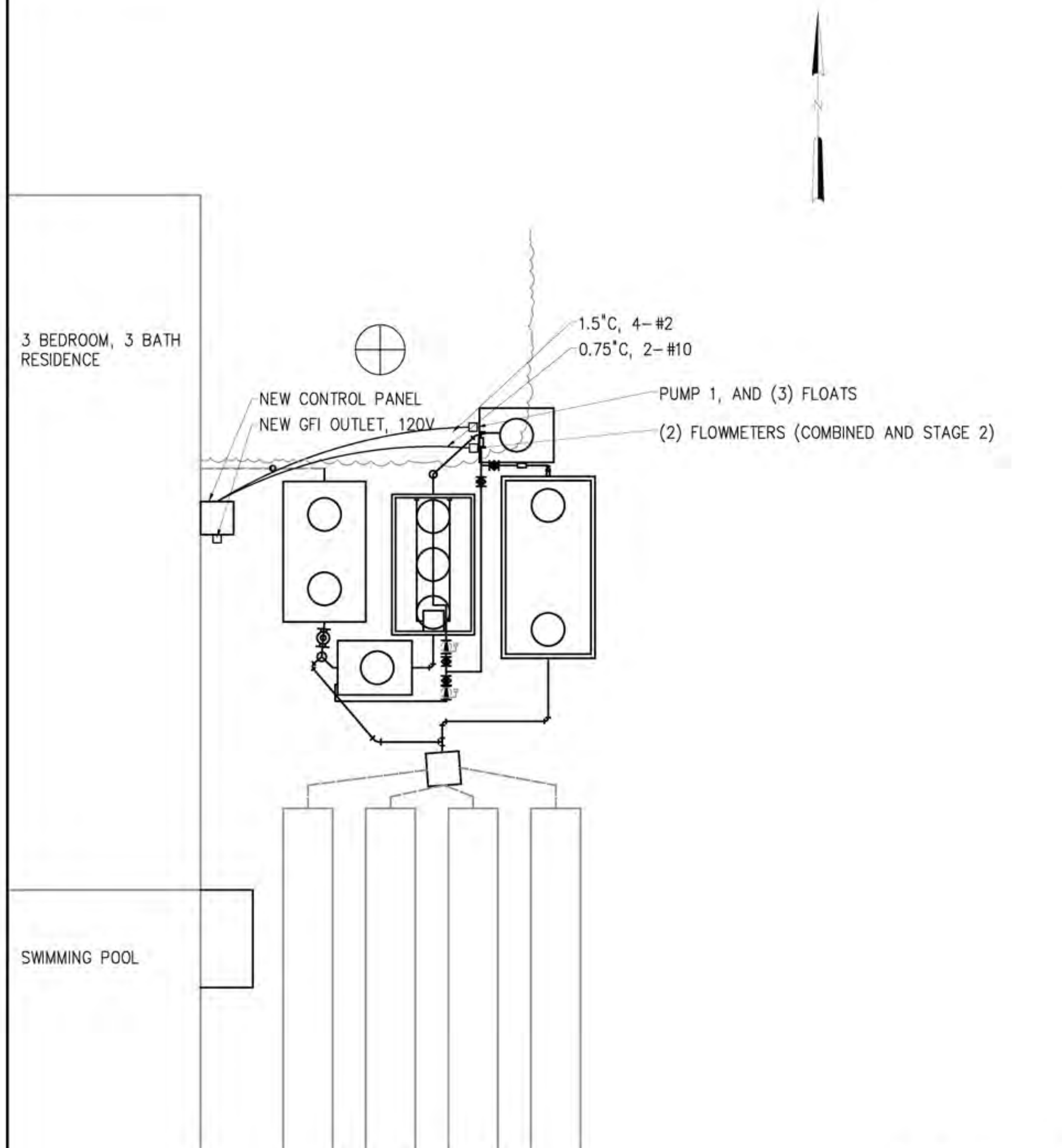

ELECTRICAL SITE PLAN

DETAIL 1 / C-1

1" = 5'-0"

1"=5'-0"   5   2.5   0   5'

ELECTRICAL NOTES

COORDINATE LOCATIONS OF ELECTRICAL EQUIPMENT, DEVICES, OUTLETS, FIXTURES, ETC. WITH CIVIL, STRUCTURAL, MECHANICAL, AND INSTRUMENTATION DRAWINGS PRIOR TO ROUGH-IN WORK. DO NOT SCALE ELECTRICAL.

ALL WIRE SHALL BE COPPER.

PROVIDE INSULATED GROUNDING CONDUCTOR FROM EACH EQUIPMENT CONNECTION AND OUTLET TO GROUNDING BAR IN PANELBOARDS.

PROVIDE AN INSULATED GROUNDING CONDUCTOR IN ALL FEEDER AND BRANCH CIRCUITS.

CONTRACTOR SHALL PROVIDE ADDITIONAL JUNCTION BOXES, CONDUCTORS AND OTHER MATERIALS AND LABOR NECESSARY TO CONNECT PARALLEL FEEDER RUNS WHERE SUCH FEEDERS EXCEED CONNECTION CAPACITY OF CIRCUIT BREAKERS, PANELBOARDS AND OTHER CONNECTION POINTS.

RISER DIAGRAMS SHOW ONLY THE GENERAL CONFIGURATION OF THE SYSTEM. REFER TO THE APPROPRIATE DRAWINGS FOR EXACT DEVICE, QUANTITIES AND LOCATIONS.

ALL ELECTRICAL EQUIPMENT, DEVICES, ETC. LOCATED OUTDOORS SHALL BE WEATHERPROOF.

REFER TO STRUCTURAL DRAWINGS FOR CONCRETE WORK.

EXISTING UTILITIES AND OTHER UNDERGROUND OR CONCEALED ITEMS ARE SHOWN FOR REFERENCE ONLY. ADDITIONAL ITEMS NOT SHOWN MAY BE PRESENT AND LOCATIONS MAY DIFFER FROM THAT SHOWN. CONTRACTOR SHALL EXCAVATE AND CONDUCT DEMOLITION SO AS TO AVOID DAMAGE TO EXISTING ITEMS, SHALL NOTIFY OWNER AND ENGINEER AT ONCE OF ALL DAMAGE AND SHALL REPAIR DAMAGE TO ORIGINAL CONDITION TO THE SATISFACTION OF OWNER AND ENGINEER AT NO CHANGE IN CONTRACT AMOUNT.

ELECTRICAL SPECIFICATIONS

1. THE CONTRACTOR SHALL FURNISH ALL LABOR, MATERIALS AND EQUIPMENT NECESSARY FOR THE INSTALLATION OF A COMPLETE ELECTRICAL SYSTEM AS INDICATED WITHIN THESE DRAWINGS.
2. ALL WORK SHALL BE INSTALLED IN STRICT ACCORDANCE WITH ALL APPLICABLE CODES AND ORDINANCES AND WITH MANUFACTURERS RECOMMENDATIONS. ALL WORK, MATERIALS AND EQUIPMENT SHALL COMPLY WITH THE NATIONAL ELECTRICAL CODE 2002 EDITION.
3. ALL MATERIALS AND EQUIPMENT SHALL BE INSTALLED IN A NEAT, FIRST CLASS, WORKMANLIKE MANNER, TO THE APPROVAL OF THE ENGINEER AND GOVERNING AUTHORITIES.
4. GUARANTEES AND SERVICE: IN ADDITION TO THE MANUFACTURERS STANDARD GUARANTEES, THE CONTRACTOR SHALL GUARANTEE ALL MATERIALS, EQUIPMENT AND WORKMANSHIP AGAINST DEFECTS FOR ONE YEAR FROM THE DATE OF FINAL ACCEPTANCE, AND SHALL CORRECT ANY DEFECTS AT NO ADDITIONAL COST TO THE OWNER. ALL LAMPS SHALL BE GUARANTEED FOR 30 DAYS.
5. CONDUIT AND WIRING: THE CONTRACTOR SHALL PROVIDE COPPER CONDUCTORS IN METALLIC RACEWAY. CONDUITS SHALL CONTAIN AN INSULATED GREEN GROUND CONDUCTOR. FOLLOW RULES AND REGULATIONS OF THE NEC FOR PROPER INSTALLATION REGARDING INSTALLATION AND SUPPORT.

   CONDUIT SHALL BE INSTALLED AS NOTED. IF NOT SPECIFICALLY ADDRESSED THE FOLLOWING SHALL APPLY: (A) PROVIDE RIGID ALUMINUM IN EXPOSED LOCATIONS. (B) PROVIDE PVC (POLY VINYL CHLORIDE) UNDERGROUND. (C) PROVIDE LIQUID-TITE FLEXIBLE METALLIC CONDUIT FOR EQUIPMENT CONNECTIONS WHERE POSSIBILITY OF VIBRATION EXISTS. PROVIDE FITTINGS AS MANUFACTURED FOR CONDUIT USED.

   PROVIDE COPPER CONDUCTORS WITH DUAL RATED THWN-THHN TYPE INSULATION.

FUNCTIONAL CONTROL DESCRIPTIONS

1.01 THE REQUIREMENT

A. Furnish, test, install and place in satisfactory operation all PLC control strategies, operator interface programming, and related programming as noted herein.

B. The PLC programming and operator interface is to be fully tested at the manufacturer's shop prior to shipping. Once delivered, the programming is to be checked out prior to operation of the system and is to be demonstrated to the Engineer that the programs perform all functions as intended.

C. All control functions are to be performed by the PLC. The operator interface is to be used for manual override of equipment, adjustment of setpoints, and to download stored data from the PLC.

1.02 OPERATOR INTERFACE

A. The PLC shall communicate with a laptop computer which shall function as the operator interface. The operator interface software shall be supplied with the PLC control panel and be set up to provide full access to the PLC for operator manual override of all equipment, ability to make adjustments to setpoints, download stored data from the PLC, and make modifications to the PLC program itself as needed.

B. The PLC shall include a data storage module capable of storing up to a month of data as described herein. The operator interface laptop will be used to download the data on a periodic basis. Data shall be transferable in MS Excel spreadsheet format.

C. The following displays shall be created and stored on the laptop for operator interface.

Menu Bar – menu bar across the top of each display to provide quick access to any display.

Control Display – Tabular display of pump. For each device, provide an ON / OFF / AUTO button for point and click control of the equipment. For each device, provide a RED run indicator (open indicator for valves) that is grey when not running (or valve closed). For each pump, provide the totalized runtime value calculated by the PLC (in hours and tenths of hours up to 999,999.9). For the pump with an associated flow meter, provide the totalized flow value calculated by the PLC. For each pump, or valve on timer control, provide indication of time remaining until (or time HH:MM of) next start or, if running, time remaining until the equipment stops (or closes). For each pump whose normal sequence can be interrupted, provide indication of the override (low level shutoff of Pump "X" running (interrupt).

Setpoint Display – Tabular display(s) for all control setpoints as described herein with simple point and click access to each setpoint that allows value changes by typing in a numeric value and pressing the ENTER key.

Timer Setpoint Display – For all timer setpoints, provide a 24-hour, bar graph format display to show the relative on and off times of each pump.

1.03 PUMP 1 – STAGE 1 RECIRCULATION PUMP

A. Control Description: Pump shall start a set number of times a day (up to 24 times) and run for a set amount of time. The number of start times a day and the cycle duration time setpoint (in MM:SS format) shall be adjustable from the operator interface. The PLC shall divide the number of start times a day entered into 1,440 minutes (24 hours) to determine the start times of the pump starting from 30 minutes after midnight. For example, if 16 times a day were selected, the pumps would start every 90 minutes (00:30, 02:00, 03:30 ... 21:30, 23:00). For uneven values, the PLC shall round to the nearest minute. The Pump shall be controlled by three float switches "LOW", "DOSE ENABLE", and "HIGH".

1. LOW – The water level within the PUMP TANK must be high enough to overcome the "LOW" float in order for the pump to be permitted to run.
2. DOSE ENABLE – When the water level rises high enough to overcome the "DOSE ENABLE" (second) float within the PUMP TANK and the time clock has timed out, the pump will activate and run a "NORMAL" dose cycle. The pump will continue to run for the length of time input as the "cycle duration time setpoint" on the operator interface and then shut off.
3. HIGH – If the water level rises enough to overcome the "HIGH" (third) float within the PUMP TANK, the audiovisual alarm will activate. The audio portion of the alarm shall be silenced by pressing the RESET/SILENCE switch (located on the outside of the control panel) to the silence position. The alarm circuit will latch until manually reset after the "HIGH" float returns to its normal (down) position. The alarm circuit shall be manually reset by switching the RESET/SILENCE switch to the RESET position. In addition, the pump will activate and run an "OVERRIDE" dose cycle to decrease the water level within the tank. The pump shall continue to run for the length of time input as the "cycle duration time setpoint" on the operator interface and then shut off.

B. Data Storage: Record totalized: pump runtime, "NORMAL" dose cycles, "OVERRIDE" dose cycles; daily: pump runtime, "NORMAL" dose cycles, "OVERRIDE" dose cycles. Receive pulse input from flow meters and record totalized and daily volume pumped to STAGE 2 flowmeter and RECIRC flowmeter. One pulse equals one gallon. The current totalized values for the pump runtime, dose cycles and flowmeters shall be displayed on the main control display.

NO.	ISSUED FOR	DATE	BY

DESIGNED JME
DRAWN CMS
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ELECTRICAL SITE PLAN

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APPENDIX B

CONSTRUCTION COSTS

Table B.1
Construction Cost Summary

HAZEN AND SAWYER
Environmental Engineers & Scientists

PROJECT: **FOSNRS Study Field Site Installation B-HS2**
CLIENT: **FDOH**

ITEM NO.	DESCRIPTION	ENGINEER OR CONTRACTOR SUPPLIED	QUANTITY	UNIT	UNIT PRICE	TOTAL
				TOTAL		**$ 19,142.18**
STE Tank						$ 903.59
1	Inlet pipe (4"D) and connection to existing 4" SDR	Contractor	1	LS	$ 100.00	$ 100.00
2	1050 gallon concrete septic tank (2 polyethylene lids and risers to grade)	Contractor	1	EA	$ 680.00	$ 680.00
3	4" tee on outlet pipe for sample collection with grade access	Contractor	1	LS	$ 20.00	$ 20.00
4	4" outlet pipe	Contractor	1	LS	$ 30.00	$ 30.00
5	Bull run valve	Engineer	1	EA	$ 73.59	$ 73.59
Recirculation Tank						$ 425.00
6	300 gallon concrete tank (1 polyethylene lid and riser to grade)	Contractor	1	EA	$ 390.00	$ 390.00
7	1"D pressure pipe connection (seal)	Contractor	1	LS	$ 15.00	$ 15.00
8	4"D outlet pipe, baffle tee	Contractor	1	LS	$ 20.00	$ 20.00
Stage 1 Biofilter						$ 2,114.98
9	900 gallon concrete tank (3 polyethylene lids and risers to grade)	Contractor	1	EA	$ 800.00	$ 800.00
10	Polylok distribution box and accessories	Engineer	1	LS	$ 109.38	$ 109.38
11	4"D perforated pipe (inlet and outlet)	Engineer	1	LS	$ 45.19	$ 45.19
12	4"D pipe connections inlet and outlet	Contractor	1	LS	$ 15.00	$ 15.00
13	1"D pipe connection into tank	Contractor	1	LS	$ 15.00	$ 15.00
14	Orenco spin nozzles	Engineer	3	EA	$ 16.45	$ 49.35
15	Pipe support	Engineer	1	LS	$ 23.58	$ 23.58
16	Upper media (super sack 1/4 Riverlite)	Engineer	1	EA	$ 275.83	$ 275.83
17	Lower media (super sack 3/16 Riverlite)	Engineer	2	EA	$ 275.83	$ 551.65
18	Gravel underdrain	Contractor	3	CY	$ 50.00	$ 150.00
19	4" sanitary wye, 45 elbow, and clean out to grade	Contractor	1	LS	$ 35.00	$ 35.00
20	4"D outlet pipe and cleanout	Contractor	1	LS	$ 45.00	$ 45.00
Pump Tank						$ 3,023.47
21	300 gallon concrete tank (1 polyethylene lid and riser to grade)	Contractor	1	LS	$ 390.00	$ 390.00
22	Effluent pump	Engineer	1	LS	$ 531.00	$ 531.00
23	Float assembly	Engineer	1	EA	$ 202.40	$ 202.40
24	Vericomm Control panel	Engineer	1	EA	$ 900.00	$ 900.00
25	Power meter	Engineer	1	EA	$ 287.90	$ 287.90
26	2 flowmeters	Engineer	2	EA	$ 151.40	$ 302.80
27	2 globe valves	Engineer	1	LS	$ 159.37	$ 159.37
28	1"D Ball valves	Contractor	2	Ea	$ 7.50	$ 15.00
29	1"D Check valves	Contractor	2	Ea	$ 10.00	$ 20.00
30	1"D pipe	Contractor	1	LS	$ 100.00	$ 100.00
31	Fittings to expand from 1"D to 4"D	Contractor	1	LS	$ 15.00	$ 15.00
32	Electrical wire to panel, conduit (for flowmeters, floats, pump connection)	Contractor	1	LS	$ 100.00	$ 100.00
Stage 2 Biofilter						$ 2,790.15
33	1500 gallon concrete tank (2 polyethylene lids and risers to grade)	Contractor	1	LS	$ 1,000.00	$ 1,000.00
34	Baffle wall pipe connection (4"D)	Contractor	1	LS	$ 60.00	$ 60.00
35	4"D baffle tee on outlet	Contractor	1	LS	$ 20.00	$ 20.00
36	4"D perforated pipe (inlet and outlet)	Engineer	1	LS	$ 45.19	$ 45.19
37	Stainless steel drivepoint samplers, tubing	Engineer	1	LS	$ 10.00	$ 10.00
38	Media - sawdust	Contractor	1	LS	$ 500.00	$ 500.00
39	Media - elemental sulfur	Engineer	1	LS	$ 969.96	$ 969.96
40	Media - oyster shell	Engineer	10	EA	$ 13.50	$ 135.00
41	4"D outlet pipe	Contractor	1	LS	$ 25.00	$ 25.00
42	4"D Tee for STE pipe and outlet pipe connection to existing d-box	Contractor	1	LS	$ 25.00	$ 25.00
Miscellaneous						$ 9,885.00
43	Onsite system contractor Labor (8 hr day onsite)	Contractor	2	EA	$ 1,500.00	$ 3,000.00
44	Onsite system contractor mobilization and transport	Contractor	1	LS	$ 5,000.00	$ 5,000.00
45	Fill around tanks	Contractor	1	LS	$ 220.00	$ 220.00
46	St. Augustine grass restoration	Contractor	1	LS	$ 1,000.00	$ 1,000.00
47	Pump out old septic tank	Contractor	1	LS	$ 300.00	$ 300.00
48	Existing system evaluation	Contractor	1	LS	$ 365.00	$ 365.00

LS = Lump Sum