# Continued Monitoring on Passive Nitrogen-Reducing Systems

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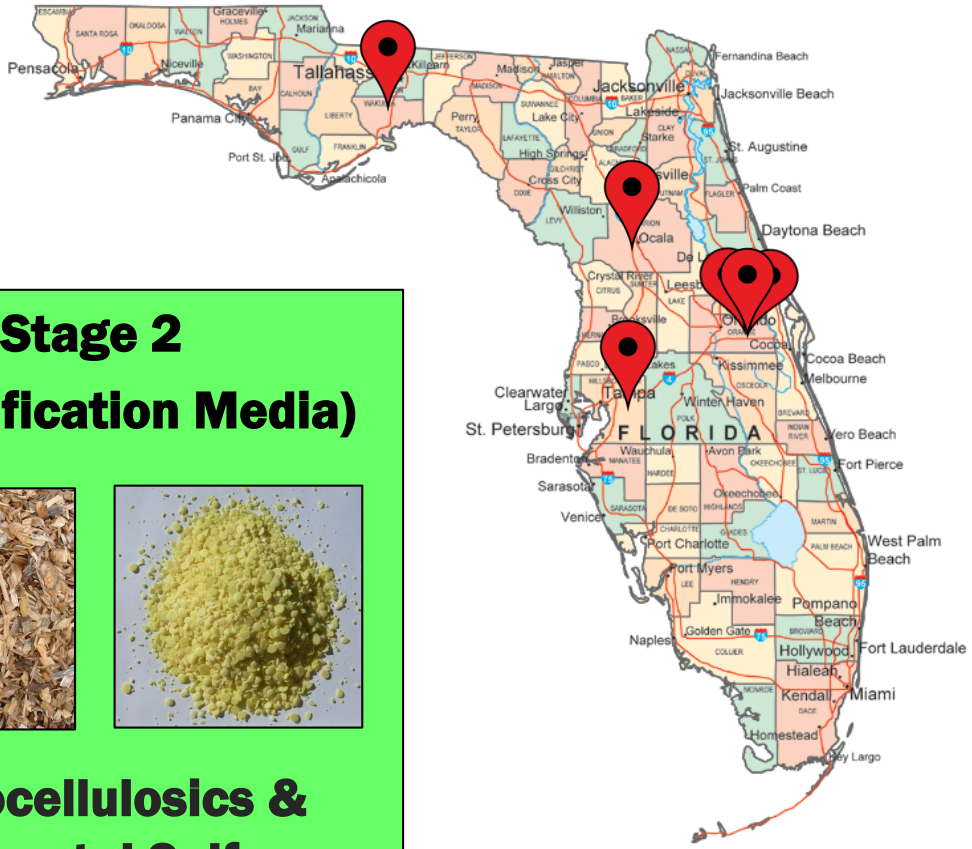
# Continued Monitoring of FOSNRS Systems

- Florida Onsite Sewage Nitrogen Reduction Strategy (FOSNRS) study installed seven full-scale passive nitrogen-reducing systems and monitored for about two years.
- Results showed average total nitrogen (TN) removal efficiency from 65% to 97%.
- The FOSNRS report recommended continuing to monitor systems to:
  - Evaluate continued system performance.
  - Observe longevity of the media.
  - Estimate system maintenance and operating costs.

# FOSNRS Study

## *2009-2015*




**Stage 1**

**(Nitrification Media)**

**Sand & Expanded Clay**

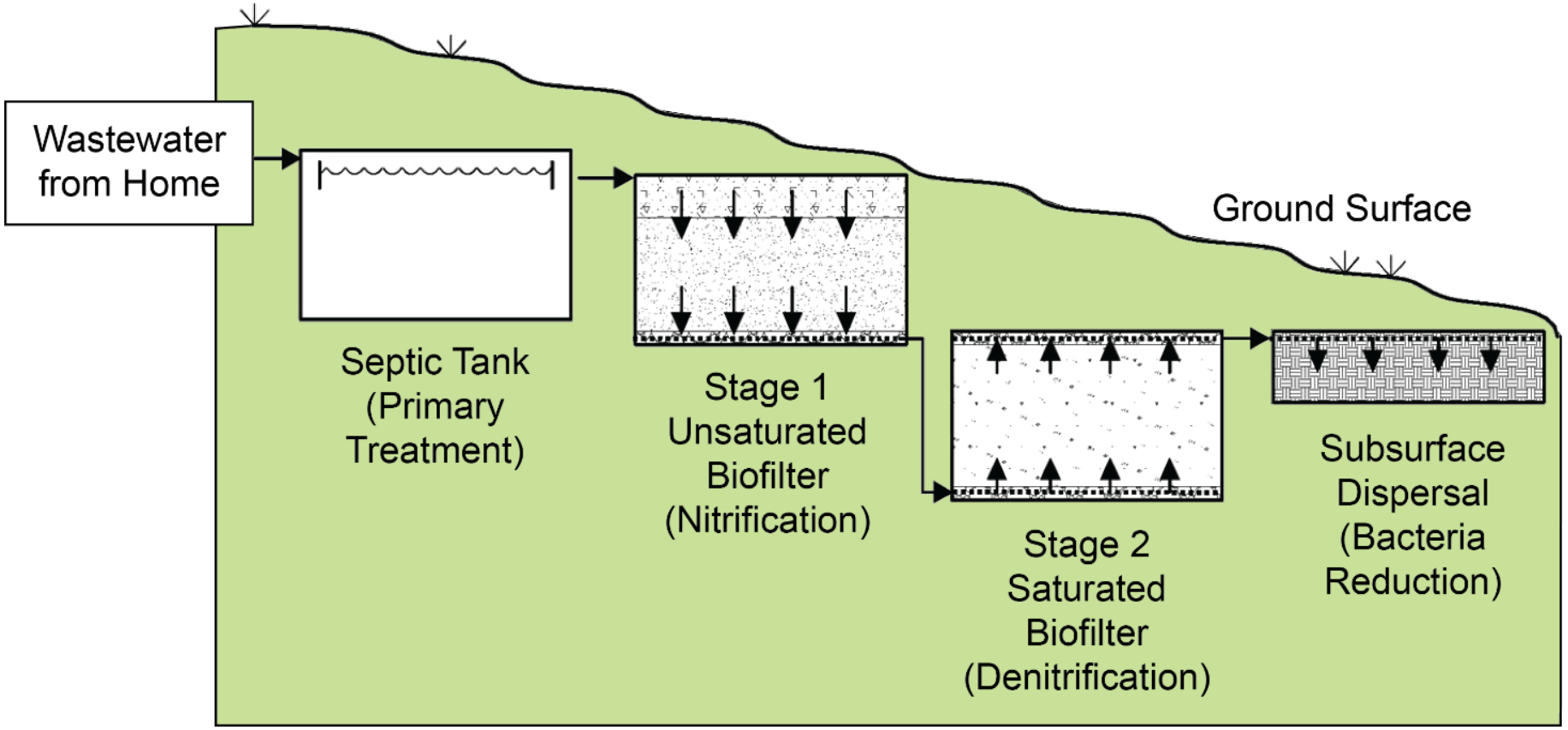
**Stage 2**

**(Denitrification Media)**

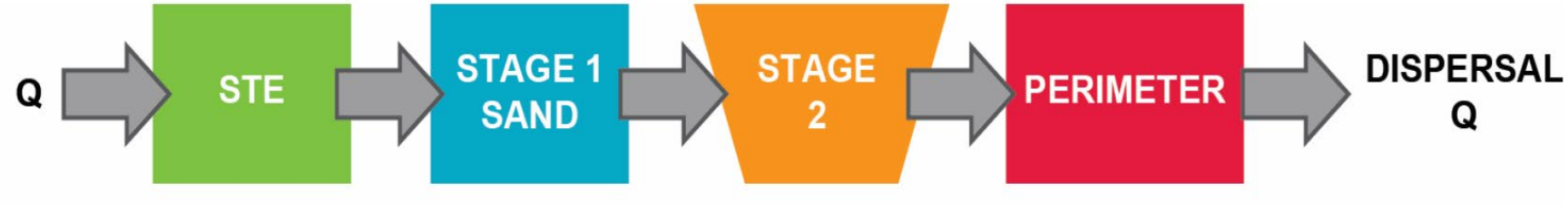


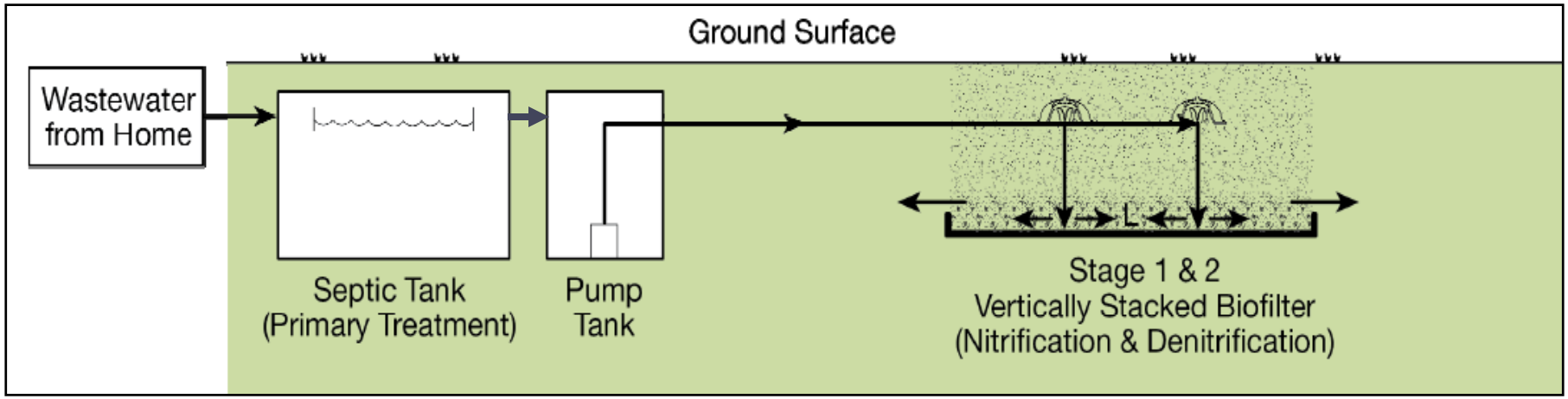
**Lignocellulosics & Elemental Sulfur**

# In-Tank Passive Nitrogen-Reducing Systems



# In-Tank Passive Nitrogen-Reducing Systems (2)

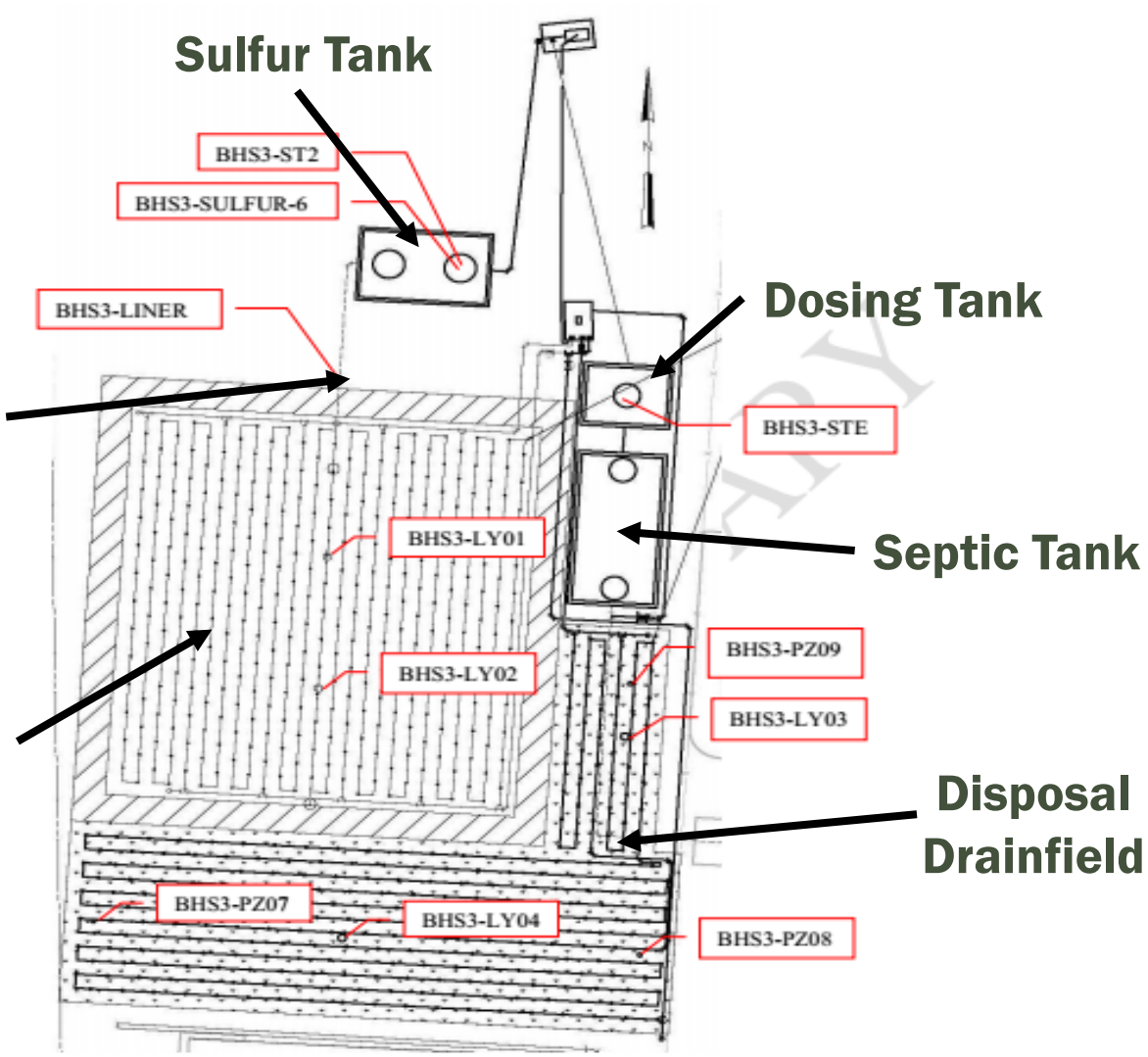


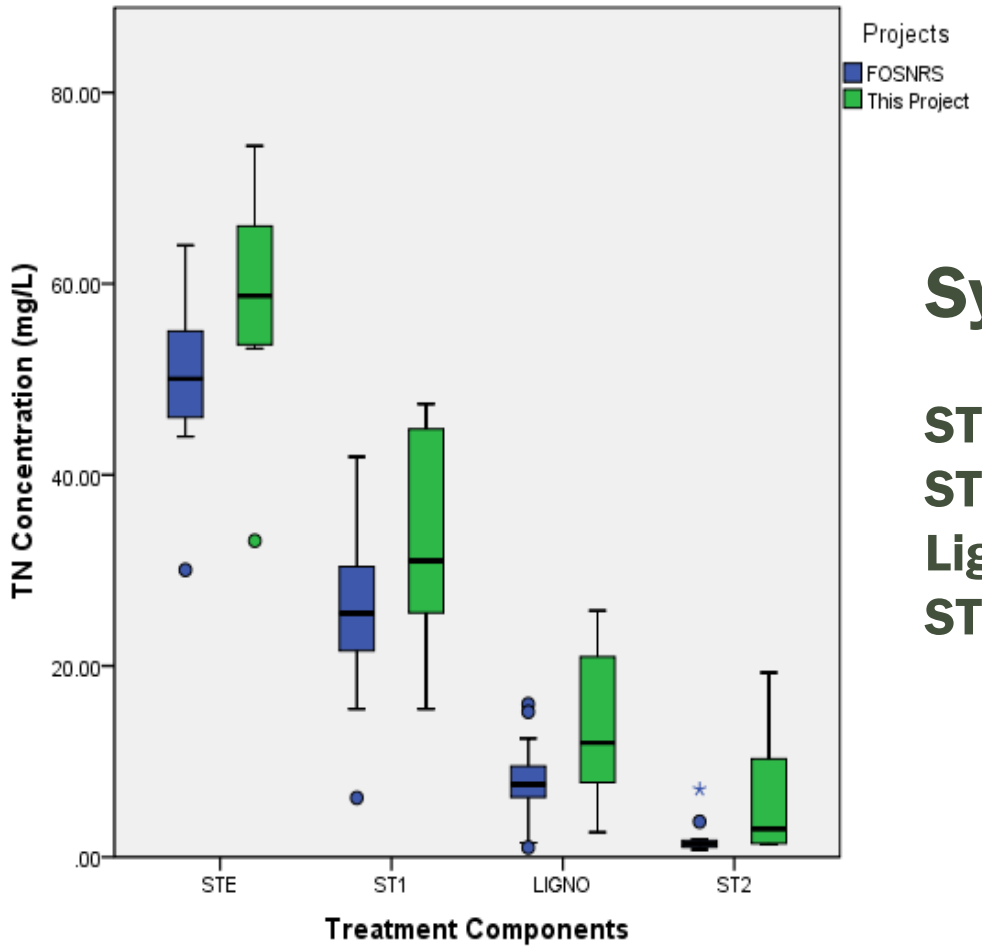
# Continued Monitoring of FOSNRS Systems (2)

- Continued monitoring started in early 2017.
- Four passive nitrogen-reducing systems remained in operation (B-HS3, B-HS4, B-HS5, and B-HS7).
- Two in-tank systems, one in-ground system, one hybrid system.
- Systems were inspected and monitored twice in 2017 (March and November), twice in 2018 (April and November), and four times in 2019 (February, May, September, and December).
- Funded by Environmental Protection Agency 319 grant.

# System B-HS3


Sulfur Tank
BHS3-ST2
BHS3-SULFUR-6
BHS3-LINER
Dosing Tank
Lignocellulose Media Effluent Sampling Port
BHS3-STE
BHS3-LY01
Septic Tank
BHS3-PZ09
BHS3-LY02
BHS3-LY03
Treatment Drainfield
Disposal Drainfield
BHS3-PZ07
BHS3-LY04
BHS3-PZ08

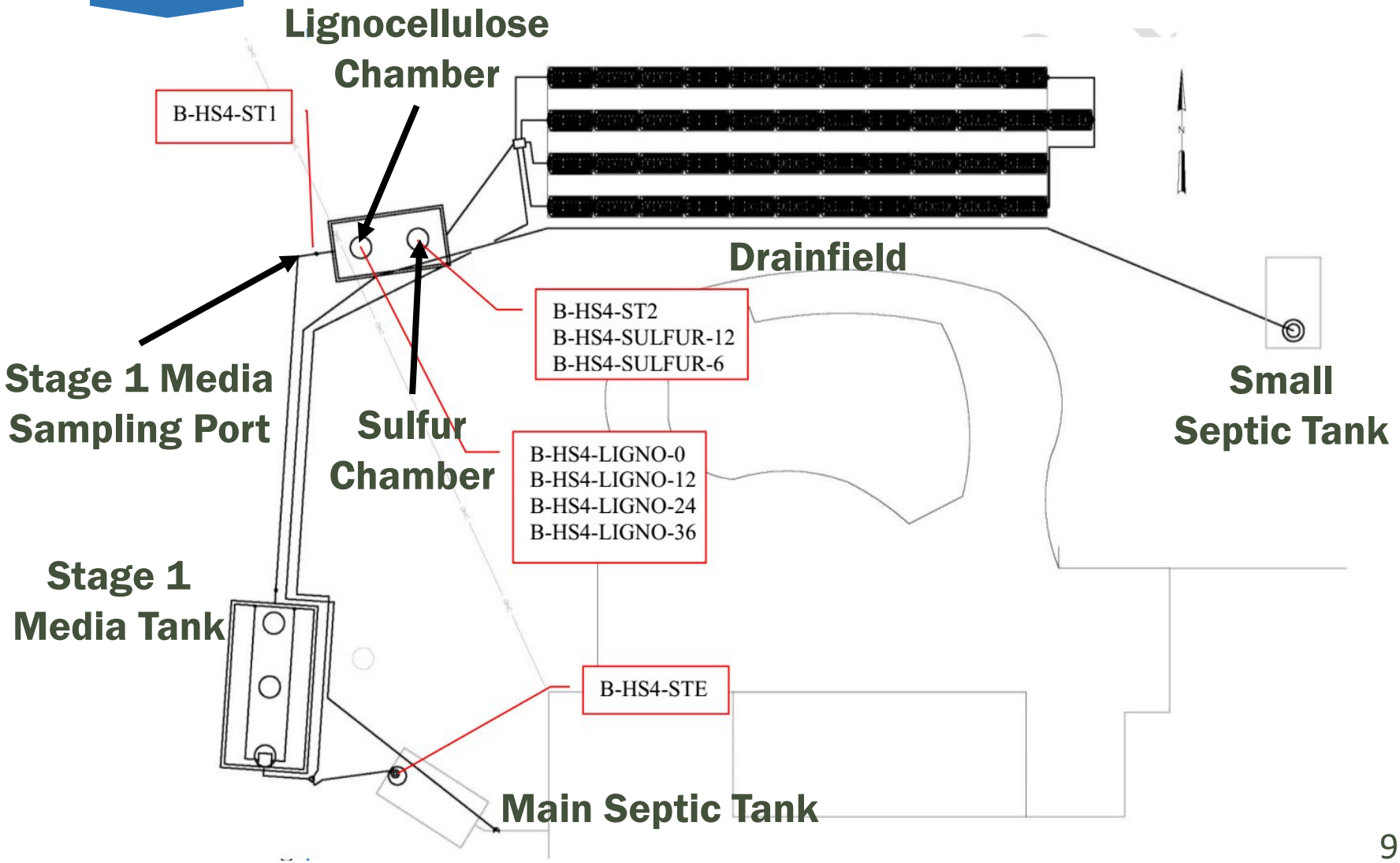
# TN Concentrations Along the Treatment Train



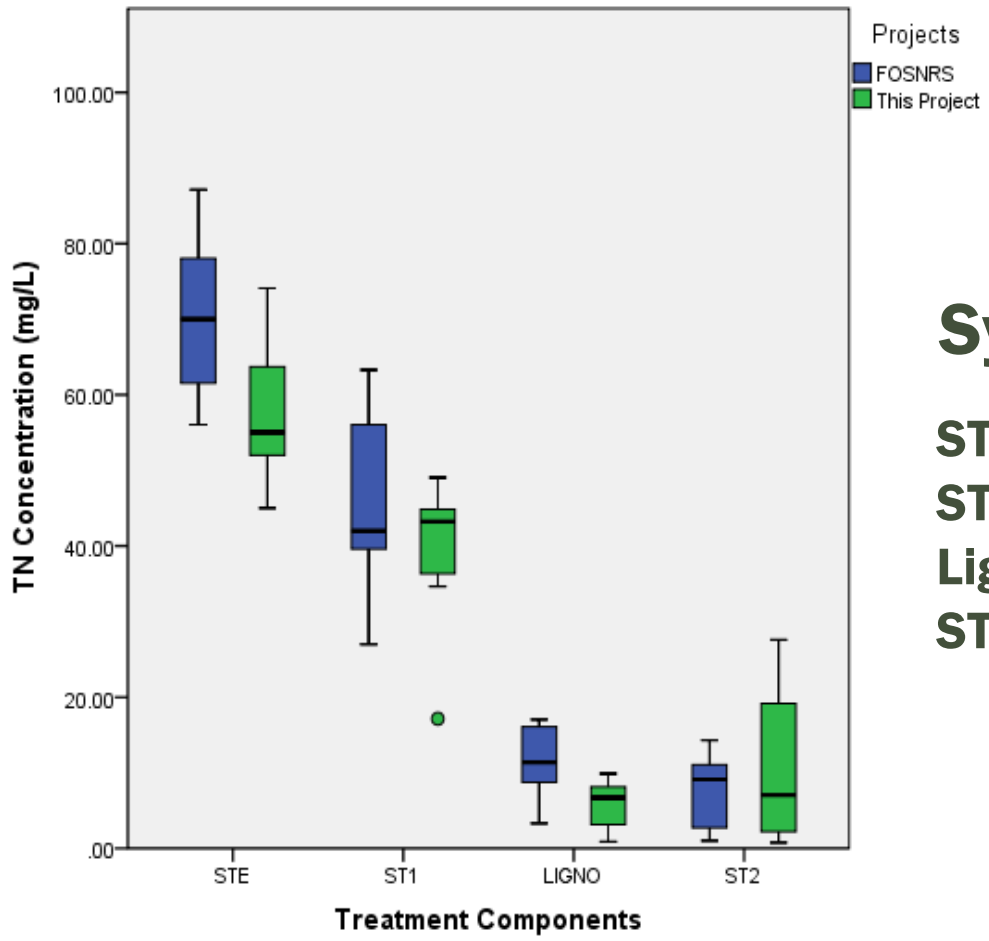

## System B-HS3

**STE: Septic Tank Effluent**
**ST1: Stage 1 Media**
**Ligno: Lignocellulose Media**
**ST2: Sulfur Media**

# System B-HS4


Lignocellulose Chamber
B-HS4-ST1
Drainfield
B-HS4-ST2
B-HS4-SULFUR-12
B-HS4-SULFUR-6
Stage 1 Media Sampling Port
Sulfur Chamber
Small Septic Tank
B-HS4-LIGNO-0
B-HS4-LIGNO-12
B-HS4-LIGNO-24
B-HS4-LIGNO-36
Stage 1 Media Tank
B-HS4-STE
Main Septic Tank

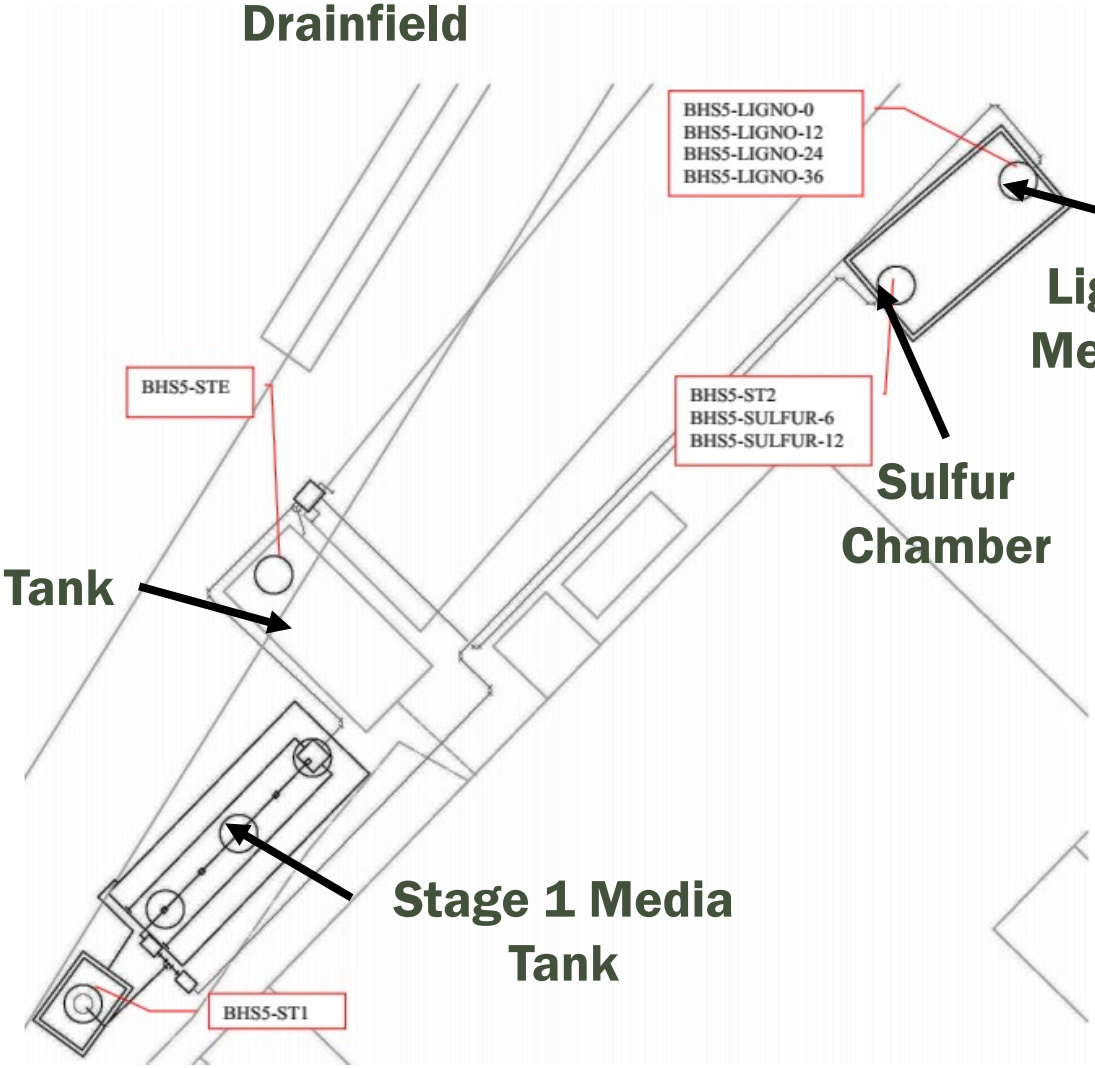
# TN Concentrations Along the Treatment Train (2)



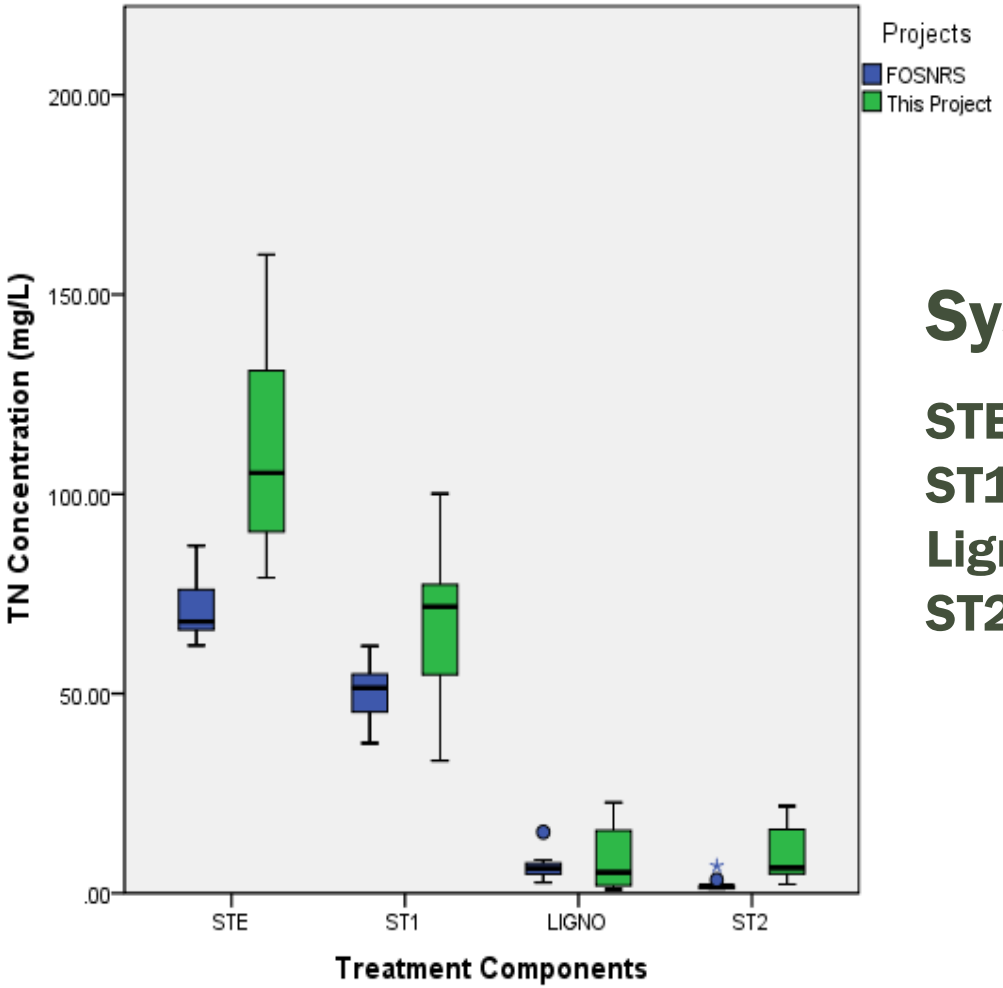

## System B-HS4

**STE: Septic Tank Effluent**
**ST1: Stage 1 Media**
**Ligno: Lignocellulose Media**
**ST2: Sulfur Media**

# System B-HS5


Drainfield
BHS5-LIGNO-0
BHS5-LIGNO-12
BHS5-LIGNO-24
BHS5-LIGNO-36
Lignocellulose Media Chamber
BHS5-STE
BHS5-ST2
BHS5-SULFUR-6
BHS5-SULFUR-12
Sulfur Chamber
Septic Tank
Stage 1 Media Tank
Pump Tank
BHS5-ST1

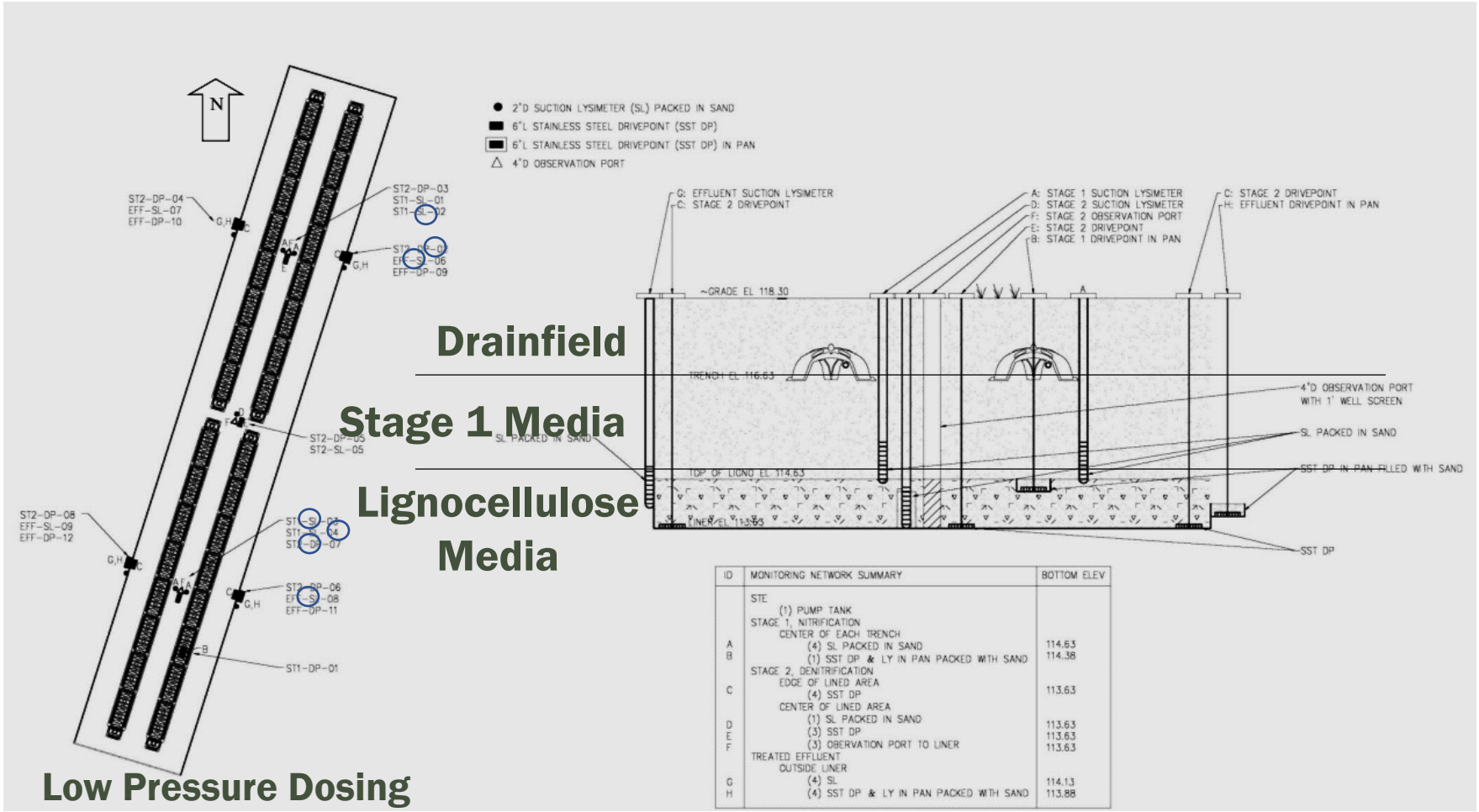
# TN Concentrations Along the Treatment Train (3)




## System B-HS5

**STE: Septic Tank Effluent**
**ST1: Stage 1 Media**
**Ligno: Lignocellulose Media**
**ST2: Sulfur Media**

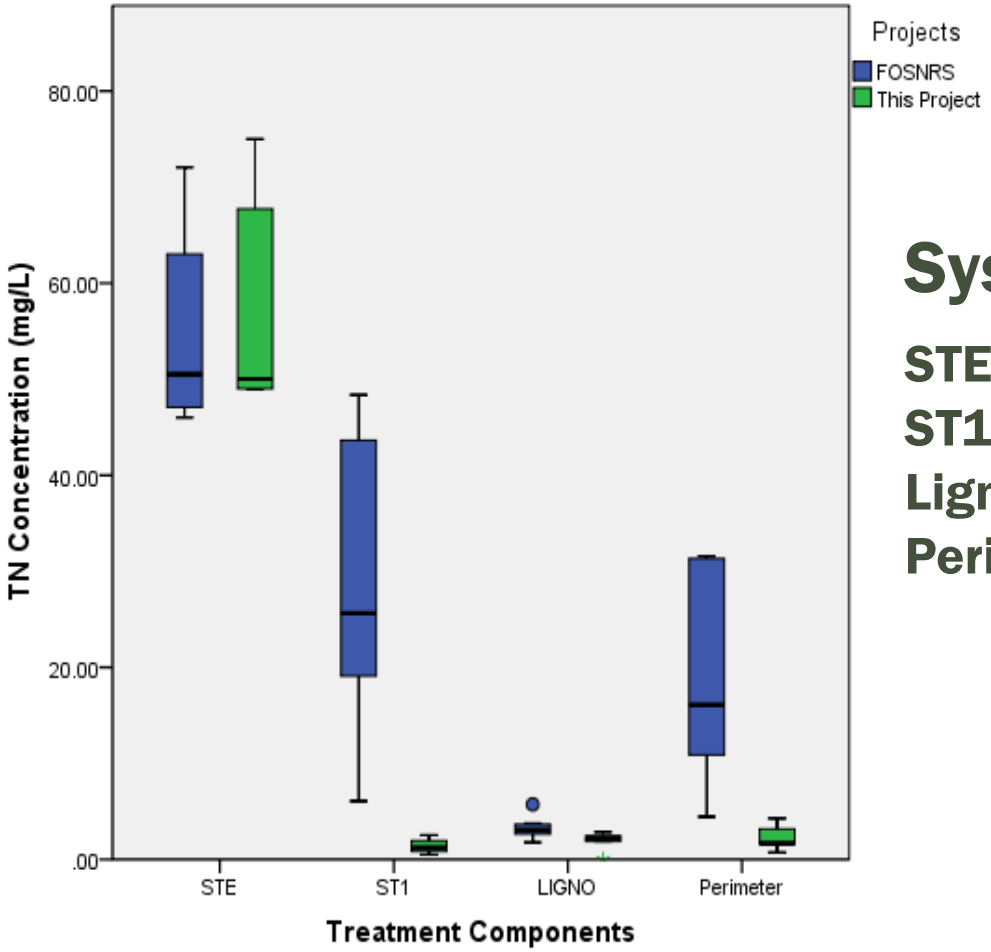
# System B-HS7




| ID | MONITORING NETWORK SUMMARY | BOTTOM ELEV |
|---|---|---|
| | STE | |
| | (1) PUMP TANK | |
| | STAGE 1, NITRIFICATION | |
| | CENTER OF EACH TRENCH | |
| A | (4) SL PACKED IN SAND | 114.63 |
| B | (1) SST DP & LY IN PAN PACKED WITH SAND | 114.38 |
| | STAGE 2, DENITRIFICATION | |
| | EDGE OF LINED AREA | |
| C | (4) SST DP | 113.63 |
| | CENTER OF LINED AREA | |
| D | (1) SL PACKED IN SAND | 113.63 |
| E | (3) SST DP | 113.63 |
| F | (3) OBERVATION PORT TO LINER | 113.63 |
| | TREATED EFFLUENT | |
| | OUTSIDE LINER | |
| G | (4) SL | 114.13 |
| H | (4) SST DP & LY IN PAN PACKED WITH SAND | 113.88 |

**Low Pressure Dosing Drainfield**

# TN Concentrations Along the Treatment Train (4)




## System B-HS7

**STE: Septic Tank Effluent**
**ST1: Stage 1 Media**
**Ligno: Lignocellulose Media**
**Perimeter: Effluent Point**

# Total Phosphorus (TP) Treatment Efficiency

| Site | FOSNRS Study (mg/L) | | | Continued Monitoring (mg/L) | | |
|---|---|---|---|---|---|---|
| | Mean | Standard Deviation | Treatment Efficiency | Mean | Standard Deviation | Treatment Efficiency |
| B-HS3 | 5.59 | 1.74 | 96.2% | 6.18 | 1.02 | 61.8% |
| | 0.21 | 0.24 | | 2.36 | 3.82 | |
| B-HS4 | 9.44 | 2.06 | 72.0% | 8.75 | 2.83 | 58.0% |
| | 2.64 | 1.11 | | 3.68 | 5.15 | |
| B-HS5 | 5.60 | 3.60 | 71.4% | 11.01 | 0.57 | 76.0% |
| | 1.60 | 0.70 | | 2.63 | 1.84 | |
| B-HS7 | 6.93 | 1.24 | 90.1% | 8.7 | 0.91 | 93.2% |
| | 0.69 | 1.00 | | 0.59 | 1.10 | |

**Red font: System Influent. Blue font: System Effluent.**

# Summary of Continued Monitoring of FOSNRS Systems

- Median TN removal efficiencies for B-HS3, B-HS4 and B-HS7 above 90%, and median TN removal for B-HS5 above 86% six years after the initial installation.
- Phosphorus removal decreased for some systems, but the effluent concentrations still better than the advanced secondary treatment standard.
- Vast majority of organic carbon, suspended particles, and fecal coliform were removed by these media systems.

# Summary of Continued Monitoring of FOSNRS Systems (2)

- Lignocellulose media did not add large amount of organic carbon to effluent.
- Systems with elemental sulfur as denitrification media still met secondary drinking water standard for sulfate concentration in the effluent.
- Energy consumption remained low, electricity cost for pumps was usually less than $3 per month.

# Contact Information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