



Florida Department of Health
Bureau of Onsite Sewage Programs
Research Review and Advisory Committee Meeting

DATE AND TIME: September 8, 2011 at 1:00 p.m. ET

PLACE: Florida Department of Health Southwood Complex
4042 Bald Cypress Way, Room #240P
Tallahassee, FL 32399

Or via conference call / web conference:

Toll free call in number: 1-888-808-6959

Conference code: 1454070

Website: <http://connectpro22543231.na5.acrobat.com/rrac/>

This meeting is open to the public

AGENDA: DRAFT 23AUGUST11

1. Introductions and Housekeeping
2. Review Minutes of Meeting April 20, 2011
3. Nitrogen Study
 - a. Review of progress to date
 - b. Discussion on budget and process forward
4. Other Business
5. Public Comment
6. Closing Comments, Next Meeting, and Adjournment

Florida Department of Health
Research Review and Advisory Committee for the Bureau of Onsite Sewage Programs

Draft Minutes of the Meeting held at the Betty Easley Conference Center, Tallahassee, FL
April 20, 2011

In attendance:

- **Committee Members and Alternates:**

- In person:**

- Bill Melton (member, Consumer)
 - Patti Sanzone (member, Environmental Interest Group)
 - Clay Tappan (chairman, member, Professional Engineer)

- Via teleconference:**

- Quentin (Bob) Beitel (alternate, Real Estate Profession)
 - Kim Dove (member, Division of Environmental Health)
 - Bob Himschoot (member, Septic Tank Industry)
 - Kriss Kaye (alternate, Home Building Industry)
 - Carl Ludecke (vice-chairman, member, Home Building Industry)
 - Tom Miller (member, Local Government)
 - Jim Peters (alternate, Professional Engineer)
 - Eanix Poole (alternate, Consumer)
 - John Schert (member, State University System)

- Absent members and alternates:**

- Sam Averett (alternate, Septic Tank Industry)
 - John Dryden (alternate, State University System)
 - Tom Higginbotham (alternate, Division of Environmental Health)
 - Mike McInarnay (alternate, Septic Tank Industry)
 - David Richardson (alternate, Local Government)
 - Restaurant Industry (no appointed member/alternate)

- **Visitors:**

- In person:**

- Robert Arredondo (DCA)
 - Richard Hicks (DEP)
 - Maria Pecoraro (Rep. Nelson)
 - Lee Smith (ECT)
 - Shanin Speas-Frost (DEP)

- Via teleconference:**

- Damann Anderson (Hazen and Sawyer)
 - Andrea Samson
 - Jim Spinnenweber
 - Pam Tucker

- **Department of Health (DOH), Bureau of Onsite Sewage Programs:**

- In person:**

- Eberhard Roeder, Professional Engineer
 - Elke Ursin, Environmental Health Program Consultant

- Via teleconference:**

- Paul Booher, Professional Engineer
 - Kim Duffek, Environmental Health Program Consultant
 - Kara Loewe, Distributed Computer Systems Consultant

1. **Introductions** – Nine out of ten groups were present, representing a quorum. The group that was not represented was the Restaurant Industry. Chairman Tappan called the meeting to order at 1:03 p.m. Introductions were made and some housekeeping issues were discussed.

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- 2. Review of Previous Meeting Minutes** – The minutes of March 24, 2011 were reviewed. Clay Tappan suggested a change to the minutes to clarify what he stated during the meeting regarding the reason why extensive testing on existing untested products is not part of the study. He said that these product manufacturers should be doing their own research and development not at taxpayer's expense. Quentin Beitel asked whether Patti Sanzone is representing DEP while at these meetings, and she said that as a RRAC member she is representing an environmental interest group but that she attends the RRAC meetings regardless of whether she is a member or not as part of her job duties. Shanin Speas-Frost and Rick Hicks are at the meeting representing DEP as part of the legislative language directing DEP to have maximum technical input over the nitrogen study. Quentin Beitel asked whether the 319 project was a project that RRAC is responsible for and Elke Ursin stated that this is a federal grant so technically RRAC is not responsible but that RRAC is generally made aware of these projects and input is requested due to their expertise. Quentin Beitel asked whether the information requested in the minutes was provided on the number of pumped systems in Florida and Elke Ursin stated that they were provided shortly after the last meeting.

Motion by Bob Himschoot, seconded by Carl Ludecke, to approve the minutes as amended. All were in favor with none opposed and the motion passed unanimously.

3. Nitrogen Study

- a) Discussion on status report for Legislature** –The status report for the Legislature, as outlined in the legislative language in this year's budget, is due on May 16, 2011 and will need to be routed internally shortly after this meeting. Elke Ursin presented a revised draft to the RRAC based on comments made at the March 24, 2011 meeting. A total of \$1,886,919 is remaining in budget as of April 15, 2011. RRAC discussed modifications to the draft status report.

Quentin Beitel made a motion, seconded by Bob Himschoot, to approve the status report for the Legislature as amended during the meeting. All were in favor, none opposed, and the motion passed.

- b) Other business** – Elke Ursin stated that Hazen and Sawyer and the Colorado School of Mines are both presenting on the passive nitrogen reduction strategies study at this years National Onsite Wastewater Recycling Association (NOWRA) in Columbus Ohio in June. She stated that it is competitive to get your paper/presentation approved, and it will be great exposure for this project to a national audience. She will send the final paper/presentation to the RRAC when it is available.

A discussion was had on the results of the pump information requested at the last RRAC meeting. Elke Ursin presented the table with the results and clarified that these numbers are a conservative estimate. There is no definitive field on the final inspection form that is filled out for every case where a pump is installed. The form is developed to note issues and deficiencies in what was installed and has a blank to enter the number of pumps installed, but these fields are not always filled out if there were no issues/deficiencies. Often this information is checked as being in compliance, but that does not definitively indicate that there was a pump installed. The numbers shown in the table presented show when a number greater than zero was entered for the field that indicates the number of pumps. She reemphasized that these numbers are likely the low estimate for the number of pumps. Clay

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Tappan indicated that he was surprised that there were so few mounded systems with pumps. Carl Ludecke indicated that often the house is built up in new construction.

Maria Pecoraro presented on the letter from several members of the Legislature regarding the definition of passive. She stated that this letter explains their intention regarding what the definition of passive is. She stated that if there are any questions or comments that anyone is welcome to meet with Representative Nelson. Bob Himschoot stated that this definition seems to match RRAC's definition. Maria Pecoraro asked how the current contracted definition complements a conventional system and Damann Anderson stated that a passive system could complement an existing system depending on the condition of the existing system. Clay Tappan stated that a mound complements a conventional system. He stated that the pump is to move effluent; the only mandatory part would be the reactive media for nitrogen removal. Damann Anderson stated that the treatment system may need to be dosed in some situations. Bill Melton stated that by adding a component between the tank and drainfield you lose fall and will probably need a pump. Clay Tappan mentioned that there is no rulemaking associated with this project so he cannot answer the question Maria is asking about how specifically a homeowner could use his existing system, but he feels that if the tank and drainfield are working fine they may not need to do anything and be grandfathered in. Damann Anderson stated that the legislation that enacted this project does not say that these nitrogen reducing systems will complement existing systems, it says that these systems will complement conventional onsite systems. He said that if the existing system does not have the characteristics by which it can be used, then a pump may be needed. Clay Tappan stated that at the end of this, no one is going to say that a specific system needs to be put in. He said that the homeowner will still have the choice on whether to go with an active system or a passive system. He said that this study is providing a cost-effective option for the homeowner. Rick Hicks stated that the basic concept is that a tank will be put in downstream of the septic tank and if they cannot get gravity flow to the existing drainfield they will most likely need to put in a pump. Damann Anderson stated that this study is looking for a more passive long-term life cycle cost. The initial cost may not be that much cheaper than some of the systems available today. Maria Pecoraro stated that anything that costs over \$500 will make many people angry. Damann Anderson stated that not everyone will need to do this, only those that need to reduce nitrogen. Maria Pecoraro stated that taxpayers are concerned that they will have a mandate put on them that requires a significant upfront cost. Bob Himschoot stated that one of the other options communities may have is to connect to sewer which often costs \$25,000 to connect and then there are monthly bills on top of that. He stated that in order to achieve nitrogen reduction there are two options: sewer, where the effluent is transported to a central facility and monitored on a daily basis; or onsite systems, which can treat the effluent onsite and achieve the water quality and health standards. Shanin Speas-Frost stated that everyone foots the bill for wastewater. She stated that two-thirds of the population is on sewer and pay monthly. She stated that the onsite sewage system owners do not put away money monthly and now it is time for upgrades to happen for nitrogen reduction and this study is coming up with options to make it more amenable for them. Maria Pecoraro stated that the letter is clear that they understand that there is a need to protect Florida's ecosystems but that they are also accountable to voters.

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She stated that if there were options for homeowners to spread payments over longer periods of time that that will help. Shanin Speas-Frost stated that what Maria is saying about spreading costs sounds a lot like EPA's existing models 4 and 5 for management of decentralized systems. Pam Tucker stated that when she sells a house with a septic system the homeowner mortgages the house and the land, including the septic system. Clay Tappan stated that there will most likely not be one rule that will cover every ecosystem, water body, or utility. He stated that this study has evolved to provide an alternative option. He does not see a significant difference between the definition of passive in the letter from the members of the Legislature and the definition in the contract. The pump is to be used to move effluent. Maria Pecoraro stated that if the study can make a gravity system work, that that is a step in the right direction. She stated that she understands that gravity is not always going to work. There was a discussion on some other pending legislation regarding onsite sewage treatment and disposal systems. Andrea Samson asked how many different types of media are being studied, and Clay Tappan and Damann Anderson stated that there are multiple types of media being studied between the tank and the drainfield as well as researching an option to build the media into the drainfield. On the market right now there are many different types of mechanical treatment systems that use a wide variety of process descriptions to reduce nitrogen. Andrea Samson stated that she has done some calculations regarding exfiltration from central sewer lines and if 10% exfiltration into the groundwater is assumed from the house to the sewer plant and then that number is compared to the DOH failure number of 10%, there is a 22:1 ratio between what sewers are contributing as compared to septic systems. She stated that she is sincerely trying to solve the problem but does not see septic system owners as the problem. There is a proof of need, and if this is proved there is a need for solutions that work with conventional systems so that everyone can get back to living. She stated that she is delighted with the study and supports its continuation. She was pleased to hear that there will be some presentations made to a national audience. She stated that this study is doing groundbreaking work that the world needs to know about. Maria Pecoraro asked if the committee could give her a response to the letter and she will forward it on. Quentin Beitel made a motion, seconded by Carl Ludecke, for Chairman Tappan to meet with DOH staff to develop a response to the legislative letter. There was a discussion and the general consensus was that a formal response letter is not necessary, that the letter from the legislature is in line with what is currently being done. Quentin Beitel withdrew the motion. Staff will send the draft meeting minutes to Maria Pecoraro and other interested parties once they have been drafted. Maria Pecoraro read the names of the legislative members who signed the letter: Representative Nelson, Representative Plakon, Representative Ford, Representative Broxson, Representative Gaetz, Representative Dorworth, Representative Porter, Representative Corcoran, Representative Coley, Representative Ingram, Representative Drake, Representative Bemby, and Representative Kreegel.

Elke Ursin presented the latest funding figures for the study, updated as of April 15, 2011. These numbers will be posted on the website after the meeting.

4. **Other Business** – Elke Ursin provided an update on the 319 project on the performance and management of advanced onsite systems. One of the main issues that has occurred since the last meeting is that the contract staff employee who was to perform the bulk of the sampling has

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resigned her position. Currently Eb Roeder and she are working on hiring a Wakulla County Health Department employee to conduct the statewide sampling that is not being covered by other counties. This employee is certified in onsite sewage and currently permits and inspects advanced systems. A formal grant change order will be required to shift funds between categories to allow this change. Elke Ursin asked how the RRAC thought they should proceed regarding vacant and foreclosed homes and whether they should be sampled if they are included in our random sample. Bob Himschoot suggested not to waste time and money sampling these sites if DOH deems the site inactive. Patti Sanzone asked how many back-up systems have been selected, and Elke Ursin stated that currently there are 1000 systems selected and there is a goal to sample 700 systems. After the file review, which is revealing these vacant/foreclosed systems, there are approximately 723 systems that are active advanced systems including those that are vacant/foreclosed. Patti Sanzone suggested that the sampler use their judgment and not sample one system that is several hours away that could be vacant/foreclosed but that if it is close to others to go ahead and check it out. Quentin Beitel asked if a preliminary call is made to the owner before going out and Elke Ursin stated that that may skew the sampling results as this is to be a snapshot of what is going on in the field and if the system is turned off or not working right announcing the visit may give the owner time to correct the issue. She stated that they are coordinating to the best extent possible with the County Health Departments and maintenance entities. Quentin Beitel asked how they can get over the liability issue with going onto someone's property, and Bob Himschoot stated that the statute allows for this as it is a system that is permitted with DOH. Elke Ursin stated that the first step when getting to a site is to knock on the door and ask for permission to do the sampling. If the owner does not grant permission the site will not be sampled. The counties that have signed agreements to conduct the sampling are Monroe, Lee, Charlotte, and Volusia. Eb Roeder has standardized all except Volusia. These counties cover about half of the systems that are to be sampled with this project and the Wakulla employee will sample the rest. Bob Himschoot asked how the information will be logged and Elke Ursin stated that it will be done in the Access database created for this project. Bob Himschoot stated that there are some problems and issues with some of the county health departments not recognizing the transfer of electronic information through Carmody. Elke Ursin stated that there seems to be a disconnect. Her understanding is that the county health departments should be accepting Carmody information. She will get with someone in her office to try and resolve these issues once Bob Himschoot sends her some specific examples.

Elke Ursin stated that the research priorities will be presented at the next Technical Review and Advisory Panel meeting which could occur within the next month.

Maria Pecoraro will email Elke Ursin the details regarding when the Legislature will discuss the budget which will be forwarded to the RRAC.

5. **Public Comment** – The public were allowed to comment throughout the meeting. There was no additional public comment.
6. **Closing Comments, Next Meeting, and Adjournment** – Potential dates for the next RRAC meeting will be emailed to RRAC members and alternates to determine the next meeting date. It is anticipated that this meeting will occur sometime after the 2011-2012 budget has been approved.

Bill Melton made a motion, seconded by Patti Sanzone, to adjourn at 3:49 p.m. All were in favor, none opposed, and the motion passed.

Florida Department of Health
Research Review and Advisory Committee for the Bureau of Onsite Sewage Programs

Approved Minutes of the Meeting held at the Southwood Office Complex, Tallahassee, FL
September 8, 2011

In attendance:

- **Committee Members and Alternates:**

- In person:**

- Mike McInarnay (alternate, Septic Tank Industry)
 - Bill Melton (member, Consumer)
 - Patti Sanzone (member, Environmental Interest Group)
 - Clay Tappan (chairman, member, Professional Engineer)

- Via teleconference:**

- Quentin (Bob) Beitel (alternate, Real Estate Profession)
 - Kim Dove (member, Division of Environmental Health)
 - Tom Higginbotham (alternate, Division of Environmental Health)
 - Bob Himschoot (member, Septic Tank Industry)
 - Kriss Kaye (alternate, Home Building Industry)
 - Tom Miller (member, Local Government)
 - Jim Peters (alternate, Professional Engineer)
 - Eanix Poole (alternate, Consumer)
 - David Richardson (alternate, Local Government)
 - John Schert (member, State University System)

- Absent members and alternates:**

- Sam Averett (alternate, Septic Tank Industry)
 - John Dryden (alternate, State University System)
 - Carl Ludecke (vice-chairman, member, Home Building Industry)
 - Restaurant Industry (no appointed member/alternate)

- **Visitors:**

- In person:**

- Damann Anderson (Hazen and Sawyer)
 - Wendy Hedrick (FOWA)
 - Keith Hetrick (FHBA)
 - Richard Hicks (DEP)
 - Paul Runk (Florida Senate)
 - Lee Smith (ECT)
 - Shanin Speas-Frost (DEP)

- Via teleconference:**

- Josefin Edeback (Hazen and Sawyer)
 - Sara Fowler
 - Gina
 - Kathryn Lowe (CSM)
 - Maria Pecoraro (Rep. Nelson)
 - Andrea Samson
 - Jim Spinnenweber
 - Pam Tucker

- **Department of Health (DOH), Bureau of Onsite Sewage Programs:**

- In person:**

- Eberhard Roeder, Professional Engineer
 - Elke Ursin, Environmental Health Program Consultant

- Via teleconference:**

- Bart Harriss, Environmental Manager

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1. **Introductions** – Nine out of ten groups were present, representing a quorum. The group that was not represented was the Restaurant Industry. Chairman Tappan called the meeting to order at 1:01 p.m. Introductions were made and some housekeeping issues were discussed.
2. **Review of previous meeting minutes** – The minutes of the April 20, 2011 meeting were reviewed.
Motion by Bob Himschoot, seconded by Bill Melton, to approve the minutes as presented. All were in favor with none opposed and the motion passed unanimously.

3. Nitrogen Study

- a) **Review of progress to date** – Elke Ursin presented on the progress to date. The status report on the nitrogen study was sent to the Legislature and the Governor by May 16, 2011. Hazen and Sawyer and the Colorado School of Mines presented on this study at the annual meeting for the National Onsite Wastewater Recycling Association (NOWRA), the National Environmental Health Association (NEHA), and the State Onsite Regulators Alliance (SORA) in Columbus, Ohio in June 2011. This was a great opportunity to get news of this project out to a mix of people who work in government, private industry, and academia.

Damann Anderson presented some preliminary results from the passive biofilters at the test center at the Gulf Coast Research and Education Center (GCREC) in Wimauma, Florida. The focus of the results presented was around the sulphur-based denitrification systems. Results from two-stage passive biofilter are encouraging after 12 months of testing, showing a total nitrogen reduction of over 95% (2.6 mg/L). There were some clarification questions from the RRAC that were discussed.

Damann Anderson went over the next steps for the project. The pilot scale work will be done by the end of the year. They are starting to install full-scale systems at actual home sites. They are also working on vertically stacked biofilters, which are designed similar to a drainfield. Plans are being designed currently to install some of these systems at the GCREC. They will need to be built large enough to last the lifetime of the system so that they do not need to be dug up to replenish the media.

- b) **Discussion on budget and process forward** – The RRAC were sent an email with a proposed contract amendment and a summary of the changes. Damann Anderson presented on what contract changes are proposed with this amendment. He stated that now that the funding has been appropriated, the contract needs to be amended to reflect what is to be done during Phase 3 of the project. Bob Himschoot asked for a clarification that this is not showing an overall cost savings, and Damann Anderson stated that that was correct; this amendment is just shifting money around between tasks. Bob Himschoot stated that it would be prudent to show a cost savings where possible without losing the quality of work. Damann Anderson stated that the deliverables were originally split up prior to having done any design work, so this amendment aligns the costs. Task A is mostly complete, so there are not many changes. The major change is to reduce the number of innovative systems applications due to there likely being less proprietary technologies being tested. Task B changes include a reduction in the number of vendor agreements, reduction of the number of field tested systems by one and the corresponding number of sample events were also reduced, finally the deliverable costs for the final report was reduced. One Task C change was an increase in the cost for the monitoring of the soil and ground water test facility due to needing to use a drill rig for much of the work. There were also increases to the sampling and reporting due to the increased time and equipment required to complete this task. The final changes were to reduce the number of

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sample event reports due to not being able to determine groundwater flow direction for one of the home sites because of the karst topography. Task D revised from 29 tasks to 18 tasks per previous discussions with the RRAC and the project team. Quentin Beitel asked what staff's opinion is on the consolidation of tasks and Eberhard Roeder stated that this way is organized better than it was before while still achieving the same end results. Task E changes include an increase in the number of RRAC or TRAP meeting presentations, and the number of meetings they will attend. Another Task E change included a reduction in the cost for the Project Advisory Committee (PAC) meeting. The PAC is made up of key scientists in the wastewater community, and the intent was to include them for feedback and guidance. As the project went along, funding was sporadic, and the PAC was one of the subtasks that could be postponed until more funding was secured. Now, the project has moved along and the role of the PAC needs to be redefined as it will be difficult for them to provide guidance on where the project goes. It would be good for them to provide peer reviewed input at the end of the project. Paul Runk stated that the Legislature would appreciate having this project peer reviewed. After a discussion it was decided to leave that cost in, as outlined in the amendment, and the details on how that will be worked out will be decided at a later time.

Motion by Quentin Beitel, seconded by Bill Melton, to accept contract Amendment 3 as presented. All were in favor with none opposed and the motion passed unanimously.

Elke Ursin stated that the likely process forward is to do this amendment and then renew the contract for another three years as the contract expires in January. Elke Ursin stated that \$1.8 million has been encumbered for this fiscal year. Out of the original cash that was received, most of that amount is covered. \$350,000 is not covered under the current cash and the DOH budget office has the ability to cover that amount from the DOH Grants and Donations Trust Fund. In the past, cash was transferred from a DEP trust fund which was transferred over to DOH. This round of funding, although the authority to spend was made, there is not cash in the DOH Grants and Donations Trust Fund to cover the remaining cash needs.

Bob Himschoot stated that he would like to see this project come in under budget without damaging the quality of the final work product. He stated that he would like the minutes to reflect that this committee is conscious of the current state of the Florida economy and that they will do everything they can to promote due diligence and frugality.

Quentin Beitel stated that it is important for everyone to get with their respective organizations to make sure to find the money to fund the rest of the nitrogen study.

Elke Ursin stated that a legislative report on the completion of Phase II and progress on Phase III that is due in February 2012.

4. **Other Business** – Bob Himschoot asked for an update on the 319 project on the performance and management of advanced onsite systems in Florida. Elke Ursin stated that this project is not part of the agenda for this meeting, but that there has been quite a bit of work done on this project since the last meeting. She stated that the sampling will complete at the end of September when the grant is over and another RRAC meeting will be held in the future to discuss the results of that project.

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Elke Ursin stated that the research priorities that were ranked at a previous RRAC meeting have not had much progress due to the 319 project taking up the majority of staff's time. There will be a TRAP meeting in October, and Elke Ursin will present the ranked priorities to them for approval per the statute requirements.

5. **Public Comment** – The public were allowed to comment throughout the meeting. There was no additional public comment.
6. **Closing Comments, Next Meeting, and Adjournment** – Potential dates for the next RRAC meeting will be emailed to RRAC members and alternates to determine the next meeting date. An upcoming meeting topic is a discussion on the 319 grant report on the performance of advanced OSTDS in Florida.

Bill Melton made a motion, seconded by Bob Himschoot, to adjourn at 3:55 p.m. All were in favor, none opposed, and the motion passed.

Contract Amendment No. 3

Revisions to Amendment No. 2

1. Tasks A.10 and A.11 reduced from (4) to (1) deliverable each
2. Task B.2 reduced from (8) to (2) deliverables
3. Task B.6 reduced from (8) to (7) home system installations
4. Task B.7 revised to per system, per event rather than per event. Therefore 56 deliverables (7 sites x 8 events) and per deliverable decreased to \$8,402.33
5. Task B.8 reduced from (8) to (7) deliverables
6. Task B.10 reduced from (8) to (7) deliverables
7. Task B.13 reduced from (8) to (7) deliverables
8. Task B.14 decreased deliverable to \$45,120.00
9. Task B.15 decreased deliverable to \$22,500.00
10. Task C.14 increased deliverable to \$43,074.00
11. Task C.16 increased deliverable to \$47,523.28
12. Task C.17 increased deliverable to \$13,240.00
13. Task C.24 and Task C.25 reduced from (16) to (13) deliverables since abandoning C-HS1 after first sample event.
14. Task D revised from 29 Tasks to 18 Tasks per previous discussions (team mtg discussion & RRAC meeting 3/24/11)
15. Task E.3 increased from (7) deliverables to (8)
16. Task E.4 increased from (6) deliverables to (8)
17. Task E.5 reduced from (4) meetings to (1) larger workshop. Therefore, increased deliverable to \$41,900.00, but decreased subtask total.

THIS AMENDMENT, entered into between the State of Florida, Department of Health, hereinafter referred to as the "department" and Hazen and Sawyer, P.C., hereinafter referred to as the "provider", amends contract # CORCL.

1. Attachment I of Contract is hereby amended to read:

Section B. and Section C. shall be amended to read:

B. MANNER OF SERVICE PROVISION

1. Service Tasks

a) Task List

This section describes the tasks, subtasks and deliverables associated with the Florida Onsite Sewage Nitrogen Reduction Strategies project. Following the task and deliverable descriptions is a table (Table I) summarizing the estimated cost components by deliverable and phase.

Task A: Technology Evaluation for Field Testing: Review, Prioritization, and Development

The provider will:

- Perform literature review to evaluate nitrogen reduction technologies
- Develop technology classification scheme
- Formulate criteria for ranking of nitrogen reducing technologies
- Rank and prioritize nitrogen reduction technologies for field testing
- Conduct technology ranking workshop with RRAC
- Prepare innovative systems application
- Conduct Technology Development in Passive Nitrogen Removal Study II

Sub-tasks and Deliverables

1. Literature Review (draft)

The literature review of nitrogen reducing technologies completed as part of the Passive Nitrogen Removal Study commissioned by FDOH in 2007 will be updated with information which has emerged since the original study. The scope of the review will be expanded from the Passive Nitrogen Removal Study to include source separation, active systems, modifications to conventional onsite treatment systems, including modified soil treatment units, in addition to passive systems. The provider shall produce a searchable literature reference database, compatible with Endnote X or other department approved software format. The literature reference database shall not infringe on any copyrights. The provider shall also produce a technology database, in tabular or other department approved format, that will facilitate establishment of categories for summary and comparison, assessment of individual citations within the context of organizational categories, and analysis of trends and differences among systems. The categories shall include items such as treatment classification, media type, wastewater source, treatment configuration, documented effectiveness, documented and theoretical longevity, cost, nutrient recovery, and effect of water chemistry. The provider shall summarize the updated literature review in a report.

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Some tasks are identified to occur in years after the first year. Funding for these tasks is not available at the time of execution of this document and is uncertain. Details of the tasks identified for subsequent years, including deliverables and prices, will be determined in an amendment to this contract before work on these tasks begins.

Deleted: The department will authorize the provider to proceed with the individual tasks in writing.

Deliverables: Draft updated literature reference database; draft updated technology database; draft updated literature review report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

2. Literature Review (final)

The department will gather comments on the draft documents of sub-task A1 from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables for the literature review within one month of receiving comments.

Deliverables: Updated literature reference database; updated technology database; updated literature review report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

3. Classification of Technologies (draft)

The provider will develop a scheme to classify and group identified nitrogen reduction technologies and practices to summarize the literature and facilitate comparisons between similar technologies. Four classifications are envisioned: waste stream alteration (such as blackwater systems, and urine separation); conventional OSTDS alteration (such as dosed vs. gravity systems, operational strategies, installation depth); passive nitrogen removal (OSTDS systems using no more than one pump and excluding aerators); active nitrogen removal (mechanical systems utilizing more than one pump or aerators). The preliminary classification scheme will be presented to the RRAC at a workshop, which will provide a forum for full vetting and discussion.

Deliverable: Draft classification scheme of technologies report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

4. Technology Ranking Criteria (draft)

The provider will develop evaluation criteria to rank technologies and practices to determine which best meet the goals of the project and shall have priority for further development or field evaluation. Criteria will build on and may lead to revisions to the categories developed in the literature review and include characterizations of nitrogen removal effectiveness, maturity of technology including status in Florida, costs (energy, maintenance, monitoring, replacement of parts and media), critical knowledge gaps, likelihood of success, need to field test, and the feasibility of obtaining data from existing installations in Florida. The provider will evaluate the technologies classified in sub-task A3 relative to each criterion. The provider will propose draft sets of weights to characterize the relative importance of each criterion for a) work during the initial funding period; b) work during future funding periods. The provider will prepare a working document, such as a calculation table, that shows the ranking of technologies given the evaluations relative to the criteria and the relative weights of each criterion. The provider will summarize criteria and weights in a report.

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Deliverables: Draft summary of criteria and proposed weights for short-term and long-term testing, working document for obtaining technology ranks from evaluations to

criteria and criteria weights. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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5. **Priority List for Testing (draft)**

The provider will propose additional criteria to consider in establishing priorities for testing from the top ranked technologies and practices. Such criteria may address representation of several technology classifications (sub-task A3), similarity of technologies or several maturity levels in the study. The purpose of prioritization is to select the more promising technologies that may not have sufficient prior testing or that may be differently configured to improve performance, and to avoid duplicating testing where substantial experience already exists. The provider will also list technologies to be considered for sub task A10 and A11 (innovative system application assistance).

Deliverable: Draft summary of additional criteria; Draft priority list for testing. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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6. **Technology Classification, Ranking and Prioritization Workshop**

The provider will present the preliminary technology classification, rankings and priority lists developed in sub-task A3, A4 and A5 to the RRAC at a public workshop, which will provide a forum for full vetting and discussion of evaluation criteria and their assigned weights. This one day roundtable workshop with the Research Review and Advisory Committee (RRAC) will present the results and recommendations contained in the draft reports of technology classification, ranking and prioritization. The provider will facilitate RRAC's development of guidance on modifications to the draft classification, ranking and prioritization. Unless this guidance results in a need for further information collection by the provider, RRAC will provide comments on the priority lists for the initial and future funding periods. The comments and concerns of the RRAC will be documented and incorporated into the three final reports.

Deliverable: Public RRAC-Workshop, Summary of the workshop. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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7. **Classification of Technologies (final)**

The provider will incorporate RRAC comments and concerns and comments provided by the department within two weeks of the workshop into the final classification scheme.

Deliverable: Final report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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8. **Technology Ranking Criteria (final)**

The provider will incorporate RRAC comments and concerns and comments provided by the department within two weeks of the workshop into the final technology ranking scheme.

Deliverable: Final report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

9. **Priority List for Testing (final)**

The provider will incorporate RRAC comments and concerns and comments provided by the department within two weeks of the workshop into the draft priority list.

Deliverable: Final report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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10. **Innovative Systems Application Report (draft)**

Based on the technology evaluation in sub-task A5, the provider will identify emerging and innovative technologies that have not matured or are not currently permitted by FDOH but rank high for consideration for testing. For up to five technologies, the provider will complete or assist the manufacturer if appropriate, in completing an innovative system application for acceptance by FDOH, for which field testing of Task B will be part of the proposed innovative system monitoring protocol.

Deliverable: Innovative system application (per technology).

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11. **Innovative Systems Application Report (final)**

The provider will respond or assist the manufacturer in responding to any requests for additional information by the department in regard to the innovative system applications.

Deliverable: Additional information resulting in an innovative permit by the department (per technology if additional information is requested by the department).

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12. **Identification of Test Facility Sites (per site agreement)**

The provider will identify and evaluate potential sites for their suitability for establishing test centers. Among these potential sites will be the Gulf Coast Research and Education Center and the University of South Florida (USF) Lysimeter Station. Test facility site evaluations will include the feasibility of multiple treatment technology testing as well as the ability to monitor non-comingled subsurface plumes and the assessment of subsurface nitrogen fate and transport. Salient issues include space availability, site access, wastewater source of sufficient quantity and availability, subsurface hydrology, power supply, and security. The provider will obtain a letter of authorization from the respective property owners for establishing and operating test centers on their property and for ownership and continued use after project is completed. If a potential site is deemed unsuitable for use in this project, a brief evaluation memo shall be prepared documenting the evaluation of the site and reasons for not recommending the site as a test facility location.

Deliverables: Site evaluation memo, or letter of authorization **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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13. **Passive Nitrogen Removal Study II Quality Assurance Project Plan (draft)**

The provider will develop a draft QAPP that documents the objectives, experimental design, system operation, analytical methods, and sampling frequencies to be used in PNRS II. The objectives are to 1) directly address denitrification, which the provider proposes as the highest priority onsite nitrogen removal knowledge gap; 2) expand the performance envelope for the innovative unsaturated filter media filters demonstrated in

the PNRS I; 3) delineate TN removal capability of PNRS I media using pre-denitrification; 4) establish test systems that are close to full scale; 5) enable critical testing of a large number of systems to be completed within the first project year; 5) produce key data which can then be used directly for design of denitrification filters for subsequent full scale testing at home sites; 6) develop data for preliminary life cycle cost analysis and resource needs.

The experimental design is expected to consist of a battery of passive nitrogen removal treatment systems fabricated to evaluate salient design features of passive nitrogen removal systems including filter media, media stratification, surface loading rates, filter length, geometry, and aspect ratios, and unsaturated filter recycle for pre-denitrification and alkalinity recovery. The test configuration is anticipated to consist of a common wastewater feed stream, a suite of vertical unsaturated filters supplied by a common septic tank effluent (STE) feed stream, mixing of the unsaturated filter effluents to provide a common influent to the denitrification filters, a suite of horizontal saturated filters using lignocellulosic and sulfur reactive media and liquid carbon dosing as well as other system designs, and a means of final effluent disposal. The draft QAPP will address additives issues per Florida Administrative Code (FAC) Chapter 64E-6. The draft QAPP will propose where the test facility will be located and operated to determine nitrogen removal performance and optimize design variables.

Deliverable: Draft QAPP. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

14. **Recommendation for Process Forward**

Based on the details agreed upon in the draft QAPP, the provider will develop a recommendation whether or not to proceed with the remainder of Task A as outlined below, or recommend an amendment to this contract, and present a revised cost estimate. This will include a recommendation on whether the USF Lysimeter Station should be renovated and utilized as a test facility for this project. Both the provider and FDOH shall reach a written agreement prior to moving forward with the remaining parts of Task A.

Deliverable: Meeting summary and recommended scope and budget revisions. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

15. **PNRS II Quality Assurance Project Plan (final)**

The department will gather comments on the draft QAPP from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments. If the provider subsequently recommends modifying or adding procedures to address conditions encountered in the field, the QAPP may be revised or appended upon mutual agreement between provider and the department.

Deliverable: Final QAPP to be approved by FDOH. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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16. Materials Testing for FDOH Additives Rule

The engineered media for the biofilters proposed in the PNRSII QAPP will be tested as required to meet 64E-6.0151 F.A.C. for additives. Effluent from the tank based pilot systems will be used as the effluent source for this testing. A brief technical memo describing the results of this testing will be prepared and presented to FDOH prior to constructing biofilter systems at the GREC test facility or elsewhere in the field. The department may authorize the provider in writing to perform such testing for additional materials.

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Deliverable: Technical memo describing the results of additives rule testing per 64E-6.0151, per additive tested. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

17. PNRS II Specification Reports

The provider will specify, order and purchase specialty materials for test facility construction and experimental monitoring. The provider will oversee preparation of materials to meet specifications, and prepare procurement and assembly reports that document design and fabrication of the test systems, procurement of treatment system construction materials as well as the media for the filters, site preparation, monitoring instrumentation and equipment, and start-up testing of the PNRS II systems. Actual cost for materials and supplies will be documented as part of this subtask and be included in the construction budget for PNRSII construction.

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Deliverables: Specification reports, materials list and cost and as-built diagrams of the treatment systems to be tested as part of PNRS II. **Two specification reports will be provided, one for the in-tank PNRS II testing and one for the in-situ testing.**

18. PNRS II Test Facility Design (50%)

The provider will design the test facility. Since the GREC was chosen as the only test facility, the design will include both PNRSII pilot testing facilities and Task C groundwater fate and transport monitoring facilities. However these components will be separated into two construction phases on the design drawings to the extent possible. The PNRSII test facility 50% design submittal under this subtask will include preliminary layout sketches and design concepts and criteria. Provisions for supporting the installation and operation of in-tank treatment systems and in-situ biofilters monitoring systems, including supply of power, , a common wastewater source at controllable flowrates, provision for wastewater source routing to pilot facilities and effluent routing to soil treatment units, sampling collection and monitoring appurtenances, and a preliminary flow diagram will be included. The 50% design documents will be submitted to FDOH for review and comment. The department will provide comments within two weeks of receipt.

Deliverable: 50% design documents. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

19. PNRS II Test Facility Design (100%)

The provider and the department will agree on the design concepts based on review of the 50% design submittal. The provider will prepare a test facility 100% design submittal

based on these concepts. The 100% design submittal will include the design details and technical specifications for the ~~work plan~~ described in the PNRS II QAPP, and include the stage 1 unsaturated biofilters, stage 2 denitrification filters, and in-situ engineered media biofilter systems. These documents will provide the level of detail necessary to estimate construction cost. These documents will be submitted to FDOH for review and comment. The department will provide comments within two weeks of receipt.

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Deliverable: 100% design documents. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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20. PNRS II Test Facility Construction Support and Administration

The provider will work with a construction contractor for facility construction using a design-build methodology within the amount budgeted for construction in this attachment or its amendments. Construction will be completed in two phases, with Phase 1 relating mostly to PNRSII pilot test facilities while Phase 2 will primarily involve construction of facilities related to Task C fate and transport studies. This subtask will cover the Phase 1 construction. There will be some overlap between PNRSII and Task C facilities, for example power supply for the test facility will be constructed in this task but will also serve the Task C facilities. The in-situ biofilter systems for PNRSII will be constructed in Phase II along with the mini-mounds for Task C.

Provider will be onsite during construction to review materials and equipment being used to determine if work is conducted in accordance with the construction plans and will assist with installation of monitoring equipment. Construction will be reviewed for completeness by the provider and for conformance with the design intent. As necessary, the provider will propose a contract amendment to increase funds or test facility design changes to decrease costs as feasible.

Deliverable: Compensation for this subtask will be in two phases: 50% upon start of facility construction and the remaining 50% at construction completion. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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21. PNRS II Test Facility Construction (50%)

The provider will monitor facility construction as needed to monitor progress and conformance with design documents. For budgeting purposes, the provider and the department have assumed a construction cost value in this scope and budget. At the time the contractor is onsite and construction is started, invoices for materials and mobilization will be submitted to the Department by the Provider for payment. When the provider determines that approximately 50% of the facility construction is complete, a construction progress report will be provided for documentation and this subtask will be deemed complete, and the remaining amount in the Section C. cost schedule for this subtask will be paid to provider.

Deliverable: Construction Progress Report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

22. PNRS II Test Facility Construction (100 % construction)

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Provider will monitor facility construction as needed to monitor progress and conformance with design documents. This task will include the construction cost of the facility based on the construction estimate and any approved additional costs. For budgeting purpose the provider and the department have assumed a construction cost value in this scope and budget. This subtask will be based on this amount as a cost reimbursable item not to exceed the estimated total construction cost value, and will be documented by contractor invoices, material and equipment bills, and other provider incurred expenses. The amount paid will be the total documented construction cost less the amount paid to provider in subtask A-21 above.

Deliverable: Construction Progress Report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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23. Test Facility Construction (substantial completion)

Provider will conduct a site inspection to determine if the project is substantially complete. The inspection will result in the preparation of a punch list to be delivered to the contractor in writing for final completion.

Deliverable: Construction punch list. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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24. Test Facility Construction (accept construction)

The provider will conduct one final inspection for the project to determine if the work has been completed in accordance with the contract documents and the punch list. Subsequent to this final inspection, the provider will make final payment to the subcontractor. The provider shall give written notice to FDOH that the work is complete. As-built drawings will then be developed by the provider for the facility.

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Deliverable: As-built drawings of the test facility. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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25. Sample Event Reports

After each sampling event, the provider will provide sample event reports verifying operation of the test systems, flowrate monitoring, field parameter results, and chain of custody forms that document sample collection and delivery to the analytical laboratory. The number of events and the parameters to be analyzed shall be as provided in the PNRSII QAPP at a minimum. Sampling events subsequent to the number in the budget for this task are subject to available funding and the department shall authorize the provider in writing to perform each additional sampling event.

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Deliverables: Sampling event report (per sampling event).

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26. Data Summary Reports

The provider will provide data reports that verify completion of analyses by an analytical laboratory and that include compiled data from field and analytical laboratory analyses in electronic and paper form. This task is contingent on the previous task.

Deliverables: Data Summary Reports (per sampling event).

27. PNRS II Report (draft)

The provider will prepare a PNRS II report that includes PNRS II objectives, experimental methods, results, discussion, conclusions and recommendations. For each nitrogen reduction technology tested at the GCREC pilot facility a technical description will be prepared that includes name, supplier, operating principles, salient physical description, flow sequence, pertinent design details, manufacturer or designer claims of treatment goals, and operating recommendations. The draft report will be provided to the department for comments from the department and the RRAC prior to submitting a final report.

Deliverable: Draft report.

28. PNRS II Report (final)

The department will gather comments on the draft report from RRAC and FDOH review and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

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Deliverable: Final report.

29. Task A Final Report (draft)

The provider will submit a draft final report summarizing the results of the technology classification, ranking and prioritization efforts in Task A and the conclusions from PNRSII and provide recommendations for onsite nitrogen reduction technologies for Florida.

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Deliverable: Draft report.

30. Task A Final Report (final)

The department will gather comments on the draft report from RRAC and FDOH review and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

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Deliverable: Final report.

31. Change-order Allowance

From time to time the Department may find it necessary to make minor changes or adjustments to activities under this task based on results that indicate a potential improvement to the project by making a change. Examples of such changes include additional or revised sample locations and parameters, minor modifications to test systems or field activities based on problems encountered, or conditions that develop requiring expedient actions to correct a potentially serious problem. Up to \$ 40,000 will be allocated from the contract budget for such minor changes to research activities under this task. Upon determination by the Department that changes should be made, all or a portion of these funds may be authorized by written notification from the

Department to the Provider directing specific changes to research activities be made, and the amount budgeted for the changes specified.

Deliverable: As specified in the authorization.

Task B Field Testing of Technologies and Cost Documentation

The objectives of Task B are:

- Identify home sites and establish use agreements
- Establish vendor agreements
- Quality Assurance Project Plan
- Design and construct test facilities
- Install field systems at test facilities and home sites
- Operate and monitor field systems
- Compile results in report format
- Provide technical description of nitrogen removal technologies
- Acceptance of systems by homeowners
- Conduct Life Cycle Cost Analyses
- Final Report for Task B

Sub-tasks and Deliverables

1. Identification of Home Sites (per homeowner agreement)

The provider will identify individual homeowner sites for their suitability for establishing technologies for field evaluation. Criteria considered in the suitability will include homeowner willingness, site access, number of residents and continuousness of occupancy, power supply, security, location, adequate space, access for monitoring and maintenance, participation in previous or concurrent studies, and pre-existing treatment technologies. The provider will survey the homeowners and/or system users on use characteristics. Agreements will be established between homeowners and the provider for establishing and monitoring treatment systems. Written homeowner agreements will specify the arrangements in regards to responsibility for application for permits, modifications, operation, maintenance, monitoring, inspections, removal or leaving the system in place at study termination. If a homeowner site will also be used for fate and transport studies (Task C), then access will be needed for monitoring equipment in the downgradient direction and lack of interference with other systems must be ascertained. Up to ten (10) home sites at various locations in Florida (e.g. Wekiva Study Area, Wakulla and south Florida) will be indentified for **potential** testing under this task.

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Deliverable: Written agreements between homeowner and provider, completed homeowner survey.

2. Vendor Agreement Report (per vendor agreement)

The provider will contact technology vendors to explain the testing project, to identify specifics of the technology offering and special considerations, to delineate to the vendor the arrangements by which testing will be conducted, to identify specific models to be tested, and to obtain a price quotation for purchase or ascertain vendor interest in donating a system. Vendors will agree to specifications that vendors will not be allowed

to physically modify or manipulate equipment once installed. Any exceptions to this default policy will be fully documented. Up to 2 vendors will be identified for testing under this task.

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Deliverable: Written agreements between vendor and provider.

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3. Quality Assurance Project Plan for Field Testing (draft)

A QAPP will be developed to document the objectives, specific systems for testing, and technology configurations that will be tested, operation of the systems, sampling and monitoring methodology and frequency, analytical parameters and methods, and data and document management. The monitoring program will develop performance data sets for total treatment systems and also for intermediate points such as aerobic treatment unit effluent or mixed aerobic effluent with STE and pre-denitrification. Monitoring of intermediate locations will provide data sets for separate evaluation of loading and performance for individual treatment components. The anticipated monitoring program will begin six weeks after startup and approximately 8 sample events per system will be conducted. Monitoring points will include septic tank effluent (STE), aerobic effluent (if applicable), and denitrification filter effluent (if applicable). Anticipated parameters for influent STE include TSS, cBOD5, TKN, NH4+, and NOx, as well as temperature, pH, alkalinity, dissolved oxygen and oxidation reduction potential. Stage 1 and Stage 2 effluents will be monitored for the same parameters, with less frequent analyses for TSS and cBOD5. Lower frequency monitoring will be conducted as necessary for a number of parameters: total phosphorus, PO4, and fecal coliform in STE, aerobic and denitrification effluents, SO4 and H2S in sulfur denitrification filter influent and effluent, and cBOD5 in lignocellulosic filter effluents.

The provider will develop a data management and storage template for cataloging and assessing performance data from disparate treatment systems and technology combinations and influent wastewater characteristics.

The selection of systems for testing will follow the recommendations developed in Task A. The provider will consider the use of and the addition of components to existing systems.

The exact sequencing of installations over the multi-year project will be established in the QAPP based on the priority list developed in Task A and refinements through the study.

Deliverable: A draft QAPP will be provided to the Department. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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4. Recommendation for Process Forward (per meeting)

Based on the details agreed upon in the final QAPP, the provider will develop a revised cost estimate and recommendation as to the number of systems included in the initial and future funding phases and whether or not to proceed with the remainder of Task B as outlined below, or recommend an amendment to this contract. Both the provider and FDOH shall reach a written agreement prior to moving forward with Task B.

Deliverable: Meeting summary and recommended scope and budget revisions. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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5. Quality Assurance Project Plan (final)

The department will gather comments on the draft QAPP from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final QAPP accepted by FDOH. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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6. Field Systems Installation Report (per system)

The provider will submit existing system evaluations performed by individuals authorized by the department to perform such work, modifications, or new system permits as appropriate for the respective home sites and shall ensure proper permitting through the department for such permits. The provider will be, or will hire, an engineer of record for innovative or performance-based treatment system applications and identify the maintenance entity for each system. The provider will be responsible for individual field test systems to be purchased or fabricated and installed at individual homeowner sites. Field system installation will include providing all materials and assembly needed to produce a fully functional and working treatment system, including initial test evaluation and installation report. If necessary an existing system evaluation will be conducted per FAC Chapter 64E-6. The provider will ensure that operating permits and maintenance entity contracts for the system exist, as required by FDOH. The provider will address the event if one or several of the homeowners seek to withdraw from the program by assisting with installing a replacement onsite wastewater system or fund system repair or maintenance.

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Deliverable: Copy of final system permit including operating permit if necessary; detailed installation report, construction costs.

7. Field Systems Monitoring Report (per system, per event)

Subject to details specified in the QAPP, the provider, in cooperation with the homeowner and the maintenance entity, will operate field technologies for a base period of up to 24 months and monitored for at least the following parameters: temperature, pH, alkalinity, DO, ORP, TKN, NH₃, NO_x, TSS, C-BOD₅. Additional parameters will be monitored less frequently for other parameters of interest (COD, TP, PO₄, fecal coliform, total ~~Enterococci~~, and SO₄ and H₂S for systems with sulfur-based denitrification). Up to 8 sample events will be conducted on each of the systems monitored.

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The provider will submit deliverables after each monitoring event for the systems installed in Task B6, which will also include results for flowrate or treated volume, electricity and/or media use, field parameter results, chain of custody forms for samples delivered to analytical laboratory, analytical laboratory reports, and compiled results.

Deliverables: Monitoring reports in tabular form.

8. Field Systems Operation, Maintenance, and Repairs Report (per system)

The provider, in cooperation with the homeowner, maintenance entity, and county health department, will maintain copies of records of repairs, maintenance actions, inspection results and system observations. The provider will develop a report form for each entity and a summary report for each treatment system. Records will include date, description of repair and pertinent factors, and repair cost.

Deliverable: Report form for each system, summary report of observations.

9. Technical Description of Nitrogen Reduction Technology Report

The provider will develop a technical description for each nitrogen reduction technology studied, including information such as if the technology is vendor supplied or custom design, trade name, model number, unit specifications, purported operating principals, description of process flows and hydraulics, physical features including tanks, fixed film media, pumps, aerators, and other appurtenances, addition of chemicals or other materials, performance claims, observations, operational experience and measured performance during the study. The report will include a brief description of nitrogen removal processes and factsheets for each nitrogen removal system studied.

Deliverable: Draft and final nitrogen reduction technology report.

10. Acceptance of System by Owner Report (per system)

At the conclusion of system monitoring, a homeowner acceptance document will be provided that transfers complete ownership and operational responsibility of the system to the homeowner. In the event the homeowner does not desire to keep the study systems, funds from Task B6, up to the funding limit available, will be utilized to restore the system to its original condition.

Deliverable: Acceptance of System by Owner Report.

11. Life Cycle Cost Analysis draft (template and user guidelines)

The provider will develop a Life Cycle Cost Analysis (LCCA) template, with the PNRS I LCCA as a starting point and will summarize the features of the template in a user guidelines document. Costs will be expressed in a variety of ways, such as uniform annual cost, cost effectiveness of nitrogen removal, marginal cost effectiveness of additional treatment components etc. The analysis will include equipment, material and installation costs for treatment systems, recurrent costs for energy, maintenance, repair, permitting and monitoring, and replacement of materials such as reactive media or electron donor supply for denitrification. Materials costs include the purchase cost and delivery cost of vendor systems, or costs to purchase and prepare materials and media for custom designed systems. Use of a common LCCA template will enable all nitrogen removal technologies to be evaluated on an equivalent basis, and will be useful for future systems that are not evaluated within this project. In developing the template, the provider will illustrate its use with existing data, such as developed as part of Task A, the Keys Onsite Wastewater Nutrient Reduction Systems study or the information obtained from homeowners surveyed during this task.

Deliverable: Draft LCCA template and user guidelines.

12. Life Cycle Cost Analysis final (template and user guidelines)

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The department will gather comments on the draft LCCA from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final LCCA template and user guidelines.

13. Life Cycle Cost Analysis Report (per system)

Based on the LCCA Template, the provider will conduct an LCCA analysis for each nitrogen reduction technology evaluated during field testing using actual purchase prices, installation cost estimates, and operational costs records.

Deliverable: LCCA Report (per system tested) including cost analysis.

14. Task B Final Report (draft)

The provider will develop a final report that will summarize the results of the Task B evaluations of treatment technologies, including an aggregation of technology reports and LCCA completed over the course of the study. The report will provide summary recommendations for deploying the tested technologies to meet the objectives of the Florida Onsite Nitrogen Removal Strategy. The report will include the data on which it is based, in tabular form.

Deliverable: Draft Task B Final Report.

15. Task B Final Report (final)

The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Task B Final Report.

16. Change-order Allowance

From time to time the Department may find it necessary to make minor changes or adjustments to activities under this task based on results that indicate a potential improvement to the project by making a change. Examples of such changes include additional or revised sample locations and parameters, minor modifications to test systems or field activities based on problems encountered, or conditions that develop requiring expedient actions to correct a potentially serious problem. Up to \$ 50,000 will be allocated from the contract budget for such minor changes to research activities under this task. Upon determination by the Department that changes should be made, all or a portion of these funds may be authorized by written notification from the Department to the Provider directing specific changes to research activities be made, and the amount budgeted for the changes specified.

Deliverable: As specified in the authorization.

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Task C. Evaluation of Nitrogen Reduction Provided by Soils and Shallow Groundwater

The objectives of Task C are:

- Critical characterization of nitrogen reduction in Florida soils and groundwater
- Develop Quality Assurance Project Plan
- Establish a controlled test facility
- Identify home sites and make use agreements
- Instrument field systems at test facility and home sites
- Operate and monitor field systems
- Compile data in report format
- Close-out of home sites and controlled test facility
- Provide Final Report for Task C

Sub-tasks and Deliverables

1. Literature Review (draft)

The provider will review available literature to assess the current status of knowledge related to nitrogen fate and transport in saturated and unsaturated soils. Literature from other fields (e.g. agriculture, agronomy, hydrogeology, soil science, environmental science, ecology, biosystems engineering) will be reviewed for its application to OSTDS in Florida. Particular focus will be placed on studies that have measured and documented denitrification rates in soil and groundwater. This review will expand on the literature review on denitrification in soil performed for the department's Wekiva study and a complementary literature review, recently completed by the Colorado School of Mines. Results of the literature reviewed in this task will be added to the searchable literature reference database established in Task A.

Deliverable: Draft literature review and updated reference database. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

2. Literature Review (final)

The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final report and updated reference database. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

3. Quality Assurance Project Plan for field and test center sites (draft)

The provider will develop a QAPP to document Task C objectives and the monitoring framework for field sites. Information gained during the literature review conducted as part of Task D will be incorporated, as appropriate, into the monitoring framework to ensure data required for model inputs will be collected. The monitoring framework will encompass the "Observational Approach" to allow information obtained in the field and during other tasks (e.g., Task D2, D7, D10, etc.) to be utilized to direct subsequent monitoring. The QAPP will describe the number and type of homeowner systems to be monitored, sample frequency and duration, analytical parameters and methods, data handling and management, and document control.

It is anticipated that each site will be monitored to delineate the OSTDS effluent quality, hydraulic and nitrogen loading rates to the soil, and potential groundwater impacts. Flow meters will be installed as needed to determine actual soil loading rates. Shallow piezometers will be installed within the soil treatment unit and downgradient of the system to evaluate nitrogen fate and transport. Tracer tests using a conservative tracer will be conducted **where necessary** to determine connectivity of the OSTDS-vadose zone-groundwater system as well as evaluate subsurface travel times. Water quality analyses will be conducted on all field samples and will include temperature, total nitrogen, ammonium nitrogen, nitrate-nitrogen, and chloride. Less frequent analyses will be conducted on samples as necessary and will include pH, alkalinity, cBOD5, total phosphorus, anions, cations, fecal coliform, and E. coli. Should a total nitrogen plume be identified from an OSTDS, additional piezometers may be installed to enable further hydrogeologic characterization affecting fate and transport (i.e., groundwater velocity, hydraulic gradient) and assessment of nitrogen concentrations over time. This field monitoring framework will enable evaluation of the current nitrogen reduction in soil and groundwater and provide input to parameter selection for Task D. Results will also enable validation and verification of simple models developed and refined as described in Task D.

It is anticipated that ~~subsurface monitoring sites will be established at each of three dispersed locations in Florida to provide geographical variety. Example candidate locations are the Wakulla area (north Florida), the Wekiva area (central Florida), and a south Florida site to be determined. It is anticipated that four monitoring events will be conducted at each site~~ **unless results indicate no value from additional monitoring events**. Sites will be selected and monitored to encompass a range of conditions affecting nitrogen mass loading to the environment and the resulting groundwater concentrations. Site selection will be leveraged, to the extent possible, with Task B to enable complete evaluation of the onsite system from STE through nitrogen treatment units and including soils. The key conditions of importance will be the hydraulic loading rate of effluent to the soil, and the effluent quality discharged to the soil.

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It is anticipated that a soil treatment and groundwater monitoring test center will also be established in this task to provide performance evaluations of multiple wastewater treatment systems; systems that will provide a broad range of nitrogen removal capabilities. The subsequent application of treated effluent to soil treatment and dispersal units will result in separate, non-comingled plumes which can be used for monitoring of nitrogen fate and transport in the subsurface. Subsurface monitoring will be used to develop data sets for nitrogen fate and transport for parallel systems receiving widely varying nitrogen concentrations. Subsurface sites at the test center will be monitored for a variety of parameters at different frequencies, including pH, alkalinity, DO, ORP, TKN, NH₃, NO_x, C-BOD₅, TP, PO₄, fecal coliform, and total ~~Enterococci~~. Duration and frequency of monitoring at each of the sites will be specified in the QAPP.

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Deliverables: Draft QAPP for field sites and test center. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

4. Recommendation for Process Forward

Based on the details agreed upon in the draft QAPP, the provider will develop a revised cost estimate and a recommendation whether or not to proceed with the remainder of Task C as outlined below, or recommend an amendment to this contract. Both the provider and FDOH shall reach a written agreement prior to moving forward with Task C.

Deliverable: Meeting summary and recommended scope and budget revisions. **THIS SUBTASK WAS 50% COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

5. **Quality Assurance Project Plan (final)**

The department will gather comments on the draft final report from RRAC and FDOH internal review and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments. If the provider subsequently recommends modifying or adding procedures to address conditions encountered in the field, the QAPP may be revised or appended upon mutual agreement between provider and the department.

Deliverable: Final QAPP acceptable to FDOH. **THIS SUBTASK WAS 80% COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

6. **Soil Treatment and Groundwater Monitoring Test Facility Design (50%)**

The Gulf Coast Research & Education Center of the University of Florida has been evaluated by the provider for establishing a controlled test site for side-by-side evaluation of multiple soil treatment unit regimes and the resulting nitrogen groundwater fate and transport. This task will be leveraged with tasks B and D.

Since both the Task A and Task C test facilities will be located at the GCREC, the provider will design the test facility for Task C in concert with the Task A test facility. The Task C test facility 50% design submittal will include preliminary layout sketches and design concepts and criteria. Provisions for supporting installation, operation, and monitoring of treatment systems and groundwater plumes, including controllable dosing flowrates, effluent quality, soil hydraulic loading rates, and staging for field efforts. The monitoring framework will support evaluation of time and spatial variations of soil treatment and groundwater plume configurations (e.g. groundwater flow velocity, concentrations, etc.). Provisions will be made for supporting the installation and operation of in-tank treatment systems or unsaturated groundwater monitoring systems, including supply of power, treatment system sub-components, a common wastewater source at controllable flowrates, provision for effluent routing to soil treatment units, sampling collection and monitoring apparatuses, and staging of field analytical work and sampling will be included.

The 50% design documents will be submitted to FDOH for review and comment. Comments will be provided by the department within two weeks of receipt.

Deliverable: 50% design documents. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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7. Soil Treatment and Groundwater Monitoring Test Facility Design (100%)

The provider and the department will agree on the test facility design and experimental concepts based on review of the 50% design submittal. The provider will prepare the test facility 100% design submittal based on these concepts. The 100% design submittal will include all design details and technical specifications necessary to estimate construction cost. These documents will be submitted to FDOH for review and comment. Comments will be provided by the department within two weeks of receipt.

Deliverable: 100% design documents. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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8. Soil Treatment and Groundwater Monitoring Test Facility Design (Final)

In preparing the test facility final design submittal, the provider will include final revisions based on the review of the 100% design submittal. This will result in a set of signed and sealed construction plans suitable for facility construction.

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Deliverable: Signed and sealed construction plans. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

9. Soil and Groundwater Test Facility Construction Support and Administration

The provider will work with a construction contractor for facility construction using a design-build methodology within the amount budgeted for construction in this attachment or its amendments. Construction will be completed in two phases, with Phase 1 relating mostly to PNRSII pilot test facilities while Phase 2 will primarily involve construction of facilities related to Task C soil treatment and groundwater monitoring studies. This subtask will cover the Phase 2 construction. There will be some overlap between PNRSII and Task C facilities, for example power supply for the test facility will be constructed in Phase 1 (Task A) but will also serve the Task C facilities. The in-situ biofilter systems for PNRSII will be constructed in Phase II along with the mini-mounds for Task C.

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Provider will be onsite during construction to review materials and equipment being used to determine if work is conducted in accordance with the construction plans and will assist with installation of monitoring equipment. Construction will be reviewed for completeness by the provider and for conformance with the design intent. The provider will propose a contract amendment to increase funds or test facility design changes to decrease costs as necessary and feasible to maintain budget. Provider will respond to Contractor requests for information and prepare any necessary addenda. Construction will be reviewed for completeness by the provider and conformance with contract documents.

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Deliverable: Compensation for this subtask will be in two phases: 50% upon start of facility construction and the remaining 50% at construction completion.

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10. Soil and Groundwater Test Facility Construction (50% construction)

The provider will monitor facility construction as needed to monitor progress and conformance with design documents. For budgeting purposes, the provider and the department have assumed a construction cost value in this scope and budget. At the time the contractor is onsite and construction is started, invoices for materials and

mobilization will be submitted to the Department by the Provider for payment. When the provider determines that approximately 50% of the facility construction is complete, a construction progress report will be provided for documentation and this subtask will be deemed complete, and the remaining amount in the Section C. cost schedule for this subtask will be paid to provider.

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Deliverables: Documentation of contractor and equipment onsite and Construction Progress Report (at 50% complete).

11. Soil and Groundwater Test Facility Construction (100% construction)

Provider will monitor facility construction as needed to monitor progress and conformance with design documents. This task will include the construction cost of the facility based on the construction estimate and any approved additional costs. For budgeting purpose the provider and the department have assumed a construction cost value in this scope and budget. This subtask will be based on this amount as a cost reimbursable item not to exceed the estimated total construction cost value, and will be documented by contractor invoices, material and equipment bills, and other provider incurred expenses The amount paid will be the total documented Task C construction cost less the amount paid to provider in subtask C-10 above.

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Deliverable: Construction progress report.

12. Soil and Groundwater Test Facility Construction (substantial completion)

Provider will conduct a site inspection to determine if the project is substantially complete. The inspection will result in the preparation of a punch list to be delivered to the contractor in writing for final completion.

Deliverable: Construction punch list.

13. Soil and Groundwater Test Facility Construction (accept construction)

The provider will conduct one final inspection for the project to determine if the work has been completed in accordance with the contract documents and the punch list. Subsequent to this final inspection, the provider will make final payment to the subcontractor. Written notice shall be provided to FDOH that the work is complete. As-built drawings will then be developed by the provider for the facility.

Deliverable: As-built drawings of the test facility.

14. Soils and Hydrogeologic Characterization and Monitoring Plan for Test Facility Site

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The soil and groundwater characteristics of the test facility site will be determined by the provider as described in the QAPP. Characterization will include soils analyses, aquifer testing, piezometer installation and tracer testing with a conservative tracer to establish groundwater flow parameters. Based on the results of this characterization, a monitoring plan will be established for the six mini-mound systems at the soil and groundwater test facility. The location, number and frequency of sampling will be as generally defined in the QAPP, but refined based on results of this task. Additionally, field assessment for Task D model parameter estimation, model verification and validation will also be included as available from results of this task.

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Deliverable: Soil and groundwater characterization memo and revised QAPP element for test facility.

15. Tracer testing at research sites (per tracer test)

Groundwater tracer tests will be conducted at the research sites based on the protocols outlined in the QAPP. First, an ambient groundwater tracer test will be conducted at or immediately adjacent to the site of the Soil and Groundwater Test Facility to determine existing groundwater flow characteristics using a conservative tracer substance. Second, a groundwater tracer test will be initiated at the GCREC Mound system to delineate groundwater flow characteristics downgradient of the mound. Third, a groundwater tracer test will be conducted at one of the mini-mounds at the Soil and Groundwater Test Facility after start-up to characterize groundwater flow and contaminant transport from these systems. Deliverables for this task will be a tracer test memo describing each test and the results, and payment will be per test memo. The Department may authorize the Provider in writing to perform additional tracer tests as part of this project.

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Deliverables: Tracer Test Memo (per tracer test).

16. Soil and Groundwater Test Facility Sample Event Reports (per system sampling event)

The monitoring and data collection framework for the soil and groundwater test facility will be described in the revised QAPP including number of sampling points for each plume, sampling frequency and duration, and analytical parameters. Monitoring reports, based on the QAPP framework, will be provided that describe site conditions and interim sample results (i.e., compiled data from field and analytical laboratory analyses). A brief description of the monitoring progress will be provided.

Deliverable: Sampling event report (per sampling event).

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17. Soil and Groundwater Test Facility Data Summary Reports

The provider will provide data reports that verify completion of analyses by an analytical laboratory and that include compiled data from field and analytical laboratory analyses in electronic and paper form. This task is contingent on the previous task.

Deliverables: Data Summary Reports (per sampling event).

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18. Test Facility Closeout Report

At the conclusion of controlled test site monitoring, the provider will determine if the test facility infrastructure will be transferred to the property owner or the site restored to prior condition. If the property owner wishes to keep the facility, the provider will submit an acceptance document to the department that documents transfer of ownership and complete responsibility of test site infrastructure to the owner. A report will be provided to document close-out of the site.

Deliverable: Test Facility Closeout Report.

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19. Field Site Selection (per property owner agreement)

Candidate field sites will be identified by the provider for subsurface monitoring activities. FDOH permit information will be gathered by the provider as available on candidate sites, and a system inspection and evaluation conducted on selected sites. Monitoring

at the sites will be used to assess the current level of nitrogen reduction obtained by Florida soils, to assess groundwater impacts due to conventional systems, and to provide data for parameter estimation, and verification and validation of models developed in Task D. Sites will be monitored by the provider to encompass a range of conditions affecting nitrogen mass loading to the environment and the resulting groundwater concentrations. Specifically, key conditions of importance will be the hydraulic loading regime, the rate of effluent discharged to the soil, and the effluent quality (e.g. BOD, nitrogen) discharged to the soil. Factors considered during site selection include property owner amenability, site access, occupancy, system age, type of system and daily wastewater flow. While numerous subtleties exist between individual OSTDS, monitoring a range of these key conditions and factors will enable comparison of sites. Based on the previous subtasks and the process forward meeting, the first site to be monitored will be the existing mound system at the GREC, for which the property owner agreement has already been established in subtask A12. This will allow establishment of materials and methods for subsequent field site monitoring, and provides a large, unobstructed area to study a nitrogen plume in more detail than could be accomplished at a private home site.

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Agreements will be established with property owners by the provider for establishing monitoring systems. It is anticipated that up to seven (7) field sites will be identified for potential inclusion in the study. Availability of funding and site characteristics will be used to establish which of these will be included for monitoring.

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Deliverable: Property Owner agreement.

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20. Instrumentation of GREC Mound System & Plume

The QAPP documents the objectives, monitoring framework, sample frequency and duration and analytical methods to be used at the GREC existing mound system site. Additional soil and groundwater testing will be conducted if necessary, based on the results in Task C 14. Instrumentation of the site, in accordance with the QAPP, will include providing all materials and assembly needed to establish the monitoring framework at the site, and will be performed by the provider. A monitoring installation report will be provided by the provider for the GREC site describing the monitoring system and any additional characterization

Deliverable: GREC Mound Characterization and Monitoring Installation report. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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21. GREC Mound Sample Event Report (per sampling event)

The monitoring framework established at the GREC will be described in the QAPP including number of sampling points, sampling frequency and duration, and analytical parameters. Monitoring reports, based on the QAPP framework, will be provided that describe site conditions and interim sample results (i.e., compiled data from field and analytical laboratory analyses).

Deliverable: GREC Mound sampling event report (per sampling event).

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22. GCREC Mound Data Summary Reports

The provider will provide data reports that verify completion of analyses by an analytical laboratory and that include compiled data from field and analytical laboratory analyses in electronic and paper form. This task is contingent on the previous task.

Deliverables: Data Summary Reports (per sampling event).

23. Instrumentation of Remaining Field Sites Report (per site)

The QAPP will document the objectives, monitoring framework, sample frequency and duration and analytical methods to be used at the remaining field sites, presumably individual private home sites. Instrumentation of the sites, in accordance with the QAPP, will include providing all materials and assembly needed to establish the monitoring framework at each home site, and will be performed by the provider. A monitoring installation report will be provided by the provider for each of up to ~~four~~ (4) individual home sites describing the monitoring system.

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Deliverable: Monitoring Installation report.

24. Field Sites Sample Event Report (per sampling event, per site)

The monitoring framework will be described in the QAPP including number of sampling points at each site, sampling frequency and duration, and analytical parameters. Monitoring reports, based on the QAPP framework, will be provided that describe site conditions and interim sample results (i.e., compiled data from field and analytical laboratory analyses).

Deliverable: Sampling event report, (per sampling event, ~~per site~~)

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25. Field Sites Data Summary Reports

The provider will provide data reports that verify completion of analyses by an analytical laboratory and that include compiled data from field and analytical laboratory analyses in electronic and paper form. This task is contingent on the previous task.

Deliverables: Data Summary Reports (per sampling event, ~~per site~~).

26. Draft Site Summary and Close-out Memo (each site)

The provider will ~~prepare data tables~~ summarizing the observations for each site, including site conditions, onsite system characteristics and soil and ground water concentrations and conditions found.

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At the conclusion of home site monitoring, the provider will submit homeowner acceptance documents to the department that either transfer ownership and responsibility of monitoring points to the homeowner (e.g., piezometers), or all monitoring points will be removed by the provider and the site shall be returned to its original configuration.

A report will be provided to the department to document close-out of each home site. The draft close-out ~~memos~~ will be submitted to FDOH for review and comment.

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Deliverable: Draft Site Close-out ~~memo~~

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27. Final Site Close-Out Memo (per site)

Comments will be provided by the department within two weeks of receipt and the provider will prepare a final close-out memo.

Deliverable: Final site close-out memo acceptable to FDOH.

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28. Task C Final Report (draft)

The final report will summarize results of Task C activities on nitrogen reduction in Florida soil and shallow groundwater. The report will include task objectives, methods, results, discussion, conclusions and recommendations.

Deliverable: A draft report will be provided for comment prior to submittal of the final report.

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29. Task C Final Report (final)

The department will gather comments on the draft final report from RRAC and FDOH review and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final report.

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30. Change-order Allowance

From time to time the Department may find it necessary to make minor changes or adjustments to activities under this task based on results that indicate a potential improvement to the project by making a change. Examples of such changes include additional or revised sample locations and parameters, minor modifications to test systems or field activities based on problems encountered, or conditions that develop requiring expedient actions to correct a potentially serious problem. Up to \$ 40,000 will be allocated from the contract budget for such minor changes to research activities under this task. Upon determination by the Department that changes should be made, all or a portion of these funds may be authorized by written notification from the Department to the Provider directing specific changes to research activities be made, and the amount budgeted for the changes specified.

Deliverable: As specified in the authorization.

Task D Nitrogen Fate and Transport Modeling

The objectives of Task D are:

- Literature Review
- Plan Development
- Model Development
 - Simple soil tool to estimate nitrogen removal in different Florida soils
 - Complex soil treatment module for input into the groundwater modeling tool
 - Analytical modeling tool to predict temporal and spatial concentrations and fluxes of nitrate in groundwater
 - Integration of complex soil treatment module with the groundwater analytical model
 - Incorporation of multiple spatial inputs (i.e., development scale model)

- Performance Evaluation
 - Select existing site data for model-performance evaluation
 - Calibrate/corroborate models using existing site data (including from Task C)
 - Validate models
 - Conduct uncertainty analysis of model input parameters
- Decision Support Framework
 - Guidance for determining model input parameters
 - Risk-based approach for model selection

Subtasks and Deliverables

1. Literature Review of Nitrogen Fate and Transport Models (draft)

A literature review will be conducted to determine the current practice for modeling nitrogen fate and transport in soils and groundwater. Particular attention will be paid to data gathered from the Task C literature reviews that have relevance to model parameterization of nitrogen fate and transport. If feasible, sensitivity analysis will be conducted based on previous work for conditions relevant to Florida soil and hydrology to help direct Task C monitoring and future modeling efforts.

Currently available models for nitrogen fate and transport will be reviewed, and the hydraulic and transport/transformation parameters for the models and estimation tools that the provider deems to be applicable, will be summarized so that a plan for fieldwork can begin to be developed at an early stage in the project. Existing available models specific to OSTDS or similar source types will be included in this review to determine the appropriate starting point for model development for this project.

Results of the literature reviewed in this task will be added to the searchable literature reference database established in Task A.

Deliverable: Draft literature review and updated reference database. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

2. Literature Review of Nitrogen Fate and Transport Models (final)

The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final literature review and updated reference database. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

3. Selection of Existing Data Sets for Calibration Report

The provider will select data from existing sites in Florida or elsewhere to evaluate the performance of a soil and aquifer model, and will provide recommendations for future data collection efforts for subsequent model calibration. The sites shall have information on a nitrogen plume, and data will be obtained via document review and by working with FDOH.

Deliverable: Brief memo describing calibration data sets. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

4. Quality Assurance Project Plan Nitrogen Fate and Transport Models (draft)

A detailed QAPP will be drafted describing the subtasks to be completed in Task D. The overall goal will be to develop a model representing soil and shallow groundwater that is capable of predicting nitrogen concentrations at a specified location downgradient of an OSTDS source and determining nitrogen loadings/mass flux at a specified location. A simplified, user friendly modeling approach (e.g., programmed Microsoft Excel spreadsheet) will be employed that includes parameters that model the dominant soil and hydraulic factors that influence nitrogen reduction. The development of the fate and transport model will be accompanied with a parallel assessment of soil characterization at individual sites that provide data for model parameterization and calibration (Task C). The Florida soils classification system is one potential source of soil characterization data that could be used for a simple estimation of unsaturated zone transport.

The development of a model can include several steps from the concept over implementation of a mathematical model, assurance of numerical accuracy (code verification), adjustment of model parameters to best match a real world experimental data set (calibration), comparison of predictions from a calibrated model to different experimental data (model validation or verification), analysis of the effect of uncertainty in model parameter values on model results or of uncertainty and variability in data sets on calibrated parameter values (sensitivity analysis) and adjustments of the concept, mathematical, or calibrated model to better represent observations (model redesign) can be potentially a never-ending circular process as new data become available for comparison over time. The QAPP will describe how model development will proceed from the literature review, initial model development, calibration to existing data, model verification with other existing data or data gathered during this study, and model redesign to a final model product. It will also describe how the developed models and sensitivity analyses can guide data gathering efforts (in particular for task C), provide insights into nitrogen behavior in the environment, and provide a framework for decision making.

The final product of Task D is anticipated to be a simplified site scale model that predicts nitrogen concentration and mass flux at selected distances downgradient from the source loading location. Comparisons of this modeling approach with the results of non-steady state models and complex soil models will characterize the limitations of this model. The model will be a combination of a simple soil model and averaged aquifer model. The simple soil model will predict nitrogen reduction in unsaturated soil and the loading of nitrogen to the aquifer at the groundwater table surface. The simplified soil model may take the form of a simple algorithm or correlation that predicts nitrogen reduction as a function of such unsaturated soil characteristics as grain size distribution, water content and organic matter. The aquifer model will likely be time averaged and predict nitrogen concentration and attenuation with distance from the source. Input information includes the direction of groundwater flow at the average groundwater flow velocity and organic matter content. Model parameter values will be derived from calibration for Florida locations using data from Task C and suggested model parameters will be provided.

Deliverable: Draft Task D QAPP. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

5. Recommendation for Process Forward (per meeting)

Based on the details agreed upon in the final QAPP, the provider will develop a recommendation whether or not to proceed with the remainder of Task D as outlined below, a revised cost estimate, or recommend an amendment to this contract. Both the provider and FDOH shall reach a written agreement prior to moving forward with Task D.

Deliverable: Meeting summary and recommended scope and budget revisions. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

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6. Quality Assurance Project Plan Nitrogen Fate and Transport Models (final)

The department will gather comments on the draft QAPP from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final QAPP acceptable by FDOH. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 3 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

7. Simple Soil Tools

The simple soil tools will be a series of look-up tables providing estimated nitrogen removal based on common OSTDS operating conditions. The tables will be generated from the complex soil model developed in subsequent tasks (subtask D8 through D13), or from existing numerical models (e.g., HYDRUS-2D). The model will be corroborated and calibrated for a subset of conditions for which data exist. The specific conditions included in the simple soil model tools will be limited (not to exceed 60 conditions) and agreed upon by FDOH.

Deliverable: White paper describing simple soil tool development, tool use, and the look-up tables.

8. Complex Soil Model

This subtask includes development of the conceptual framework for the complex soil model including the coding and code evaluation required to implement the theory. The complex soil model will be based on unsaturated soil transport mechanisms adapted to Florida-specific soil and climate data, but incorporated into a simplified approach (e.g., STUMOD programmed into a Microsoft Excel spreadsheet) that includes parameters representing dominant soil properties. The soil treatment module will enable estimation of site-specific soil treatment in the vadose zone with the model output being the loading at the water table (input to aquifer models). This soil-treatment module will be developed to account for evapotranspiration, and the effect of high/seasonal variable water tables on nitrogen removal in the soil.

Deliverables: Complex Soil Model Specification Memo including theory for coding and code evaluation progress.

9. Complex Soil Model Performance Evaluation

The general user will most likely assess performance by comparing model output to field observations (e.g., simplified comparison of values). Similar implementation checks will be performed using robust field data sets (as available). Performance evaluation will also include corroboration/calibration to better understand the quality and quantity of data required by comparing simulated parameter values to the corresponding measured values (calibration targets). Calibration targets will include nitrogen concentrations (weighted equally in space) and mass loading of contaminant from the OSTDS. In addition, a parameter sensitivity analysis will be performed to identify the most relevant model parameters. An uncertainty analysis will also be performed where probability-based ranges for model input parameters will be used to generate probable model outcomes.

A more rigorous performance evaluation approach is required for technical users. For this case, the model-performance assessment will be conducted by using model-evaluation statistics to determine whether the model can appropriately simulate the observed data. Multiple methods for evaluating the model performance will be used to ensure model quality assurance evaluation that is not hindered by the specific limitations of a single calibration statistic or identify if further evaluation of the model is warranted.

Deliverable: White paper describing performance evaluation methods and results with the draft model in electronic format (e.g., Microsoft Excel spreadsheet).

10. Validate/Refine Complex Soil Model

Based on the results from subtask D9, the complex soil model will be revised/improved. As additional data is available from Task C, the model will be revised to incorporate more complex mechanisms. Validation will be used to compare the corroborated/calibrated model to actual field data. Model validation ensures that the model meets the intended requirements and identifies the range of appropriate conditions (e.g., capabilities and limitations). Data from Task C home sites as well as other available data sources will be used to validate the model.

Deliverable: Complex Soil Model white paper, nomographs for conditions represented in D7, and the final complex soil model in electronic format (e.g., Microsoft Excel spreadsheet).

11. Aquifer Model Combined with Complex Soil Model Development

A steady state or non-steady state aquifer model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from a single OSTDS source, or a surface area that can be estimated as a single OSTDS source. This aquifer model and the complex soil model (D.10) will be integrated together to produce groundwater output predictions for nitrogen concentration or mass flux from a single OSTDS source.

Deliverables:

- a. Aquifer Model Specification Memo describing review and development of the aquifer model (subtask is 50% complete).
- b. Aquifer-Complex Soil Model Specification Memo describing progress status for integrating the two models (subtask is 75% complete).
- c. Draft integrated model in electronic format (subtask is 100% complete).

12. Aquifer-Complex Soil Model Performance Evaluation

Performance evaluation of the aquifer-complex soil model will include implementation checks, corroboration/calibration, parameter sensitivity analysis and an uncertainty analysis. Data sets from Florida identified during subtask D3 and Task C will be used. Metrics will include average concentration in the plume or mass flux crossing a boundary between actual field data (as available) and model output, the range in calibrated parameter set values that result in similar agreement between model results and data, model-parameter correlation and bias, and the potential for different parameter combinations to achieve the same agreement between model results and data.

Similar to the complex soil model, a more rigorous performance evaluation is also required. Model-evaluation statistics will be used to determine whether the model can appropriately simulate the observed data. Multiple methods for evaluating the model performance will be used to ensure model quality assurance evaluation that is not hindered by the specific limitations of a single calibration statistic or identify if further evaluation of the model is warranted.

Deliverables:

- a. Aquifer-Complex Soil Model Specification Memo describing progress status for performance evaluation (subtask is 50% complete).
- b. White paper describing performance evaluation methods and preliminary results (subtask is 100% complete).

13. Validate/Refine Aquifer-Complex Soil Model with Data Collection from Task C

Based on the results from subtask D12, the integrated aquifer and complex soil model will be revised/improved using site-scale field data collected from Task C. Validation will be used to compare the corroborated/calibrated model to actual field data. The validation/refinement procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself (parameterization or improvements). Data from Task C home sites as well as other available data sources will be used to validate the model.

Deliverable: Integrated Aquifer-Complex Soil Model white paper and the final integrated model in electronic format (e.g., Microsoft Excel spreadsheet).

14. Development of Aquifer-Complex Soil Model for Multiple Spatial Inputs

A model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from several OSTDS in a development-scale area. The model will be calibrated using existing data from a development-scale plume, based on metrics such as average concentration in the plume or mass flux crossing a boundary.

Deliverable: Aquifer-Complex Soil Model for Multiple Spatial Inputs white paper and the model in electronic format (e.g., Microsoft Excel spreadsheet).

15. Decision-Making Framework Considering Uncertainty

A methodology will be developed to describe how planners can include the uncertainty associated with both calibrated and non-calibrated models in the decision-making

process. The report will be in the form of a guidance manual to guide users through the assessment of parameters, tool selection, and how to use those tools.

Deliverable: Modeling decision-making framework white paper.

16. Task D Guidance Manual (Draft)

The Task D draft final report will be developed based on a compilation of Task D white papers, progress reports, and technical memos to summarize the results of the Task D modeling. The report will be in the form of a Guidance Manual and User's Guide providing a decision support framework (Task D.15), model development, input parameter selection, and uncertainty assessment. The Guidance Manual will provide an introduction to each tool, assumptions/limitations of the tool, and how to use the tools. The complementary User's Guide will provide detailed technical data including fundamental assumptions that were incorporated into tool development, description of the tool development, and description of parameters that affect nitrogen reduction performance.

Deliverable: Draft Task D Guidance Manual

17. Task D Guidance Manual (Final)

The department will gather comments on the draft guidance manual from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final Task D Guidance Manual with final models in electronic format.

18. Change-order Allowance

From time to time the Department may find it necessary to make minor changes or adjustments to activities under this task based on results that indicate a potential improvement to the project by making a change. Examples of such changes include additional or revised sample locations or parameters, minor modifications to test systems or field activities based on problems encountered, or conditions that develop requiring expedient actions to correct a potentially serious problem. Up to \$10,000 will be allocated from the contract budget for such minor changes to research activities under this task. Upon determination by the Department the changes should be made, all or a portion of these funds may be authorized by written notification from the Department to the Provider directing specific changes to research activities be made, and the amount budgeted for the changes specified.

Deliverable: As specified in the authorization

Task E Project Management, Coordination and Meetings

The objectives of Project management, coordination and meetings are:

- Conduct project kickoff meeting
- Prepare progress reports
- Attend and Make presentations to RRAC and TRAP meetings
- Conduct PAC meetings

Deleted: Task D Nitrogen Fate and Transport Modeling

The objectives of Task D are:

- <#>Literature review on fate and transport models
- <#>Quality Assurance Project Plan
- <#>Space time variable aquifer model with simplified soil treatment
- <#>Development-scale aquifer model creation and calibration
- <#>Space time variable model with complex soil treatment
- <#>Development-scale model with aquifer and soil treatment
- <#>Uncertainty analysis
- <#>Validate and refine models using data from Task C
- <#>Develop decision making framework
- <#>Final Report for Task D

Sub-tasks and Deliverables

Literature Review of Nitrogen Fate and Transport Models (draft)

A literature review will be conducted to determine the current practice for modeling nitrogen fate and transport in soils and ground-water. Particular attention will be paid to data gathered from the Task C literature reviews that have relevance to model parameterization of nitrogen fate and transport. If feasible, sensitivity analysis will be conducted based on previous work for conditions relevant to Florida soil and hydrology to help direct Task C monitoring and future modeling efforts.

Currently available models for nitrogen fate and transport will be reviewed, and the hydraulic and transport/transformation parameters for the models and estimation tools that the provider deems to be applicable, will be summarized so that a plan for fieldwork can begin to be developed at an early stage in the project. Existing available models specific to OSTDS or similar source types will be included in this review to determine the appropriate starting point for model development for this project.

Results of the literature reviewed in this task will be added to the searchable literature reference database established in Task A.

Deliverable: Draft literature review and updated reference database.

THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.

Sub-tasks and Deliverables

1. Project Kick-Off Meeting (conference call)

The provider will hold a project kick-off meeting to establish contact information, routes of communication, points of contact, and administrative procedures. A list of attendees, contact information sheet and meeting minutes will be produced by the provider.

THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE

2. PM - Project Progress Reports (per bimonthly report)

Bimonthly progress reports will be provided that summarize the general status of each task, progress during the reporting period, activities planned in the next reporting period, and any issues, problems or decisions with significant effect on project implementation. This task includes time for the project manager, for project team and Program Coordination, Subcontract maintenance, project financial analysis, and invoicing.

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3. RRAC or TRAP Presentation (per meeting)

The provider shall present project result updates to the RRAC, TRAP or other occasions as requested by the department in writing.

4. RRAC or TRAP Meeting Attendance (per meeting)

The provider shall attend meetings of the RRAC, TRAP or other occasions as requested by the department in writing.

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5. Project Advisory Committee PAC Meetings (per meeting)

Project Advisory Committee (PAC) review panel will be assembled and a project review meeting coordinated with the project team. Prior to the review meeting, PAC members will be provided information concerning the background and motivation for this project, goals, methods, and initial results. At the review meeting project team members will present the technical approach and findings such that the PAC can critique the project work. A summary report that documents PAC input and team response will be provided.

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Task F. Other Services

Other subtasks, including deliverables and prices, may be defined and added to this contract by amendment. These subtasks shall be within the general scope of the original Invitation to Negotiate leading to this contract. Criteria to initiate an amendment will include: either RRAC direction or changes in funding and/or direction by the Legislature, and agreement between the department and the provider. Any amendments shall be prospective, and the provider shall not perform the revised tasks until the amendment has been fully executed. All task amendments shall be within the scope of the original Invitation to Negotiate.

b) Task Limits

Services are limited to the contract specifications and the availability of funds.

The provider shall not perform any tasks related to the project other than those described in Section B, Manner of Service Provision, Paragraph 1(a), Task List without the express written consent of the department.

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2. Staffing Requirements

a) Staffing levels

Provider will have at least one project manager and a qualified person to do field work available on staff. The provider shall maintain an adequate administrative organizational structure and support staff sufficient to discharge its contractual responsibilities. In the event the department determines that the provider's staffing levels do not conform to those promised in the proposal, it shall advise the provider in writing who shall have thirty (30) days to remedy the identified staffing deficiencies.

The provider shall replace any employee whose continued presence would be detrimental to the success of the project as determined by the department with an employee of equal or superior qualifications. The department's contract manager will exercise exclusive judgment in this matter.

b) Professional Qualifications

Qualifications shall include evidence of either work experience or training in sampling of water quality.

c) Staffing Changes

If such staff ceases to be available, provider may substitute staff with equivalent qualifications, provided that the substitute shall be trained on the project by the provider, and the department is given two weeks notice of such a change and the provider's plan for the transition.

d) Subcontractors

Subcontractors may be used by the provider; their role shall be described in the associated QAPP documents.

1. Service Location and Equipment

a) Service Location

Field work shall be performed in the State of Florida. Analytical work and data analysis shall be performed in the field, at the laboratory, or office locations as chosen by the provider, and subject to the associated QAPP documents.

b) Service Delivery Location

Services listed under Section B, Manner of Service Provision, Paragraph 1(a), Task List will be delivered at the following location:

Department of Health, Division of Environmental Health
Bureau of Onsite Sewage Programs
4052 Bald Cypress Way, Bin #A-08
Tallahassee, Florida 32399-1713

c) Change in Location

Upon any change in location, provider shall report to the department within two weeks of such a change and the provider's plan for the transition. All changes in location must be approved by the department.

d) Equipment

The provider and its subcontractors will be responsible for supplying, at its own expense, either directly or indirectly, all equipment necessary to perform, conduct, and complete the contract including, but not limited to, computers, telephones, copiers, fax machines, sampling equipment, supplies and maintenance, as well as needed office supplies. Liability for the use of equipment shall be exclusively the domain of the provider. See the provisions in the standard contract for liability.

4. Deliverables

a) Service Unit

See Section B, Manner of Service Provision, Paragraph 1(a), Task List for list of deliverables and the associated tasks.

b) Reports

The provider shall provide an expenditure report for the project together with the final invoice. The expenditure report shall include date, amount, recipient, and category of expenditures.

c) Records and Documentation

Copies of deliverables shall be kept at the provider's office in electronic and paper format. Field records shall be kept at the provider's office in the format they were obtained. See the provisions of the standard contract for length of record keeping.

5. Performance Specifications

a) Outcomes and Outputs

Outcomes shall be measured in service tasks as specified in Section B, Manner of Service Provision, Paragraph 1(a), Task List. The deliverables will be evaluated for accuracy and percentage completed.

b) Monitoring and Evaluation Methodology

The department shall monitor performance of the provider by review of the deliverables and by attending at least one of the sampling events to observe if sampling procedures outlined in the QAPP are followed. Any observed shortcomings shall be noted to and resolved by the provider.

6. Provider responsibility

All unique activities that the provider is responsible for are outlined in this contract under section B, Manner of Service Provision, Paragraph 1(a), Task List.

7. Department responsibility

The department has final authority over approving quality acceptability of service deliverables. The department reserves the right to renegotiate or terminate this contract if the performance standards are not satisfactorily met.

The department shall facilitate review of QAPP, other deliverables, and reports.

Department staff shall also perform one contract monitoring evaluation to demonstrate that the terms of the contract are met.

C. METHOD OF PAYMENT

1. Payment Clause.

This is a fixed price (unit cost) contract except Task A.22 and Task C.11 which will be cost reimbursable. The department shall pay the provider, upon satisfactory completion of the services outlined in the Attachment I of this contract in accordance with the terms of this contract for a total dollar amount not to exceed \$4,999,999.00, subject to the availability of funds. There shall be no equipment budget. The purchase of any equipment is the responsibility of the provider as are any cost overruns.

Fixed Price Presentation

Deliverables, listed in Section B, Manner of Service Provision, Paragraph 1(a), Task List., developed during completion of the tasks described in Section B, Manner of Service Provision, Paragraph 1(a), Task List shall be paid according to the schedule on the following pages:

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TASK NO.	Task	Per Deliverable Subtotal	No. of Deliverables			Total Cost			
			PH1	PH2	PH3	PH1	PH2	PH3	Total
A	Task A: Technology Selection & Prioritization					\$352,144	\$336,514	\$35,480	\$724,138
A.1	Draft Literature Review Report	\$ 13,796.00	1	0	0	\$13,796	\$0	\$0	\$13,796
A.2	Final Literature Review Report	\$ 6,092.00	1	0	0	\$6,092	\$0	\$0	\$6,092
A.3	Draft Classification of Technologies Report	\$ 12,830.60	1	0	0	\$12,831	\$0	\$0	\$12,831
A.4	Draft Technology Ranking Criteria Report	\$ 10,096.00	1	0	0	\$10,096	\$0	\$0	\$10,096
A.5	Draft Priority List for Testing Report	\$ 14,858.60	1	0	0	\$14,859	\$0	\$0	\$14,859
A.6	Technology Classification, Ranking and Prioritization Workshop	\$ 18,242.60	1	0	0	\$18,243	\$0	\$0	\$18,243
A.7	Final Classification of Technologies Report	\$ 5,044.00	1	0	0	\$5,044	\$0	\$0	\$5,044
A.8	Final Technology Ranking Criteria Report	\$ 7,944.00	1	0	0	\$7,944	\$0	\$0	\$7,944
A.9	Final Priority List for Testing Report	\$ 7,786.60	1	0	0	\$7,787	\$0	\$0	\$7,787
A.10	Draft Innovative Systems Applications Report (per technology)	\$ 11,655.00	0	1	0	\$0	\$11,655	\$0	\$11,655
A.11	Final Innovative Systems Applications Report (per technology)	\$ 9,219.00	0	1	0	\$0	\$9,219	\$0	\$9,219
A.12	Identification of Test Facility Sites (per site agreement)	\$ 2,538.25	2	0	0	\$5,077	\$0	\$0	\$5,077
A.13	Draft PNRS II QAPP	\$ 13,170.50	1	0	0	\$13,171	\$0	\$0	\$13,171
A.14	Recommendation for Process Forward (per meeting)	\$ 6,236.50	1	0	0	\$6,237	\$0	\$0	\$6,237
A.15	Final PNRS II QAPP	\$ 4,496.00	1	0	0	\$4,496	\$0	\$0	\$4,496
A.16	Materials Testing for FDOH Additives Rule	\$ 4,000.00	2	2	0	\$8,000	\$8,000	\$0	\$16,000
A.17	PNRS Specification Reports	\$ 18,715.00	1	1	0	\$18,715	\$18,715	\$0	\$37,430
A.18	PNRS II Test Facility Design 50%	\$ 11,721.48	1	0	0	\$11,721	\$0	\$0	\$11,721
A.19	PNRS II Test Facility Design 100%	\$ 16,200.50	1	0	0	\$16,201	\$0	\$0	\$16,201
A.20	PNRS II Test Facility Construction Support and Administration (2 deliverables, 50% at start, 50% at completion)	\$ 16,601.00	2	0	0	\$33,202	\$0	\$0	\$33,202
A.21	PNRS II Test Facility Construction 50% (2 deliverables, start and 50% complete)	\$ 25,000.00	2	0	0	\$50,000	\$0	\$0	\$50,000
A.22	PNRS II Test Facility Construction 100% (cost reimbursable)	\$ 40,000.00	1	0	0	\$40,000	\$0	\$0	\$40,000
A.23	PNRS II Test Facility Construction Substantial Completion	\$ 10,000.00	1	0	0	\$10,000	\$0	\$0	\$10,000
A.24	PNRS II Test Facility Accept Construction	\$ 9,650.00	1	0	0	\$9,650	\$0	\$0	\$9,650
A.25	Monitoring and Sample Event Reports (per sample event)	\$ 28,985.00	1	6	0	\$28,985	\$173,910	\$0	\$202,895
A.26	Data Summary Report (per sample event)	\$ 3,365.00	0	7	0	\$0	\$23,555	\$0	\$23,555

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A.27	Draft PNRS II Report	\$ 34,220.00	0	1	0	\$0	\$34,220	\$0	\$34,220
A.28	Final PNRS II Report	\$ 17,240.00	0	1	0	\$0	\$17,240	\$0	\$17,240
A.29	Draft Task A Final Report	\$ 26,000.00	0	0	1	\$0	\$0	\$26,000	\$26,000
A.30	Task A Final Report	\$ 9,480.00	0	0	1	\$0	\$0	\$9,480	\$9,480
A.31	Change-order Allowance	\$ 40,000.00	0	1	0	\$0	\$40,000	\$0	\$40,000
B	Task B: Field Testing of Technologies					\$50,202	\$599,610	\$529,243	\$1,179,054
B.1	Identification of Home Sites (per homeowner agreement)	\$ 9,341.67	1	9	0	\$9,342	\$84,075	\$0	\$93,417
B.2	Vendor Agreement Report (per vendor agreement)	\$ 7,580.00	2	0	0	\$15,160	\$0	\$0	\$15,160
B.3	Draft QAPP for Field Testing	\$ 25,700.00	1	0	0	\$25,700	\$0	\$0	\$25,700
B.4	Recommendation for Process Forward (per meeting)	\$ 6,780.00	0	1	0	\$0	\$6,780	\$0	\$6,780
B.5	Final QAPP Field Testing	\$ 11,060.00	0	1	0	\$0	\$11,060	\$0	\$11,060
B.6	Field Systems Installation Report (per system)	\$ 37,900.00	0	4	3	\$0	\$151,600	\$113,700	\$265,300
B.7	Field Systems Monitoring Report (per system, per event)	\$ 8,402.33	0	32	24	\$0	\$268,875	\$201,656	\$470,531
B.8	Field Systems Operation, Maintenance and Repairs Report (per system)	\$ 8,630.00	0	0	7	\$0	\$0	\$60,410	\$60,410
B.9	Technical Description of Nitrogen Reduction Technology Report	\$ 17,271.00	0	0	1	\$0	\$0	\$17,271	\$17,271
B.10	Acceptance of System by Owner Report (per system)	\$ 4,758.00	0	0	7	\$0	\$0	\$33,306	\$33,306
B.11	LCCA Template Report (draft template and user guidelines)	\$ 18,140.00	0	1	0	\$0	\$18,140	\$0	\$18,140
B.12	LCCA Template Report (final template and user guidelines)	\$ 9,080.00	0	1	0	\$0	\$9,080	\$0	\$9,080
B.13	LCCA Report (per system)	\$ 5,040.00	0	0	7	\$0	\$0	\$35,280	\$35,280
B.14	Draft Task B Final Report	\$ 45,120.00	0	0	1	\$0	\$0	\$45,120	\$45,120
B.15	Task B Final Report	\$ 22,500.00	0	0	1	\$0	\$0	\$22,500	\$22,500
B.16	Change-order Allowance	\$ 50,000.00	0	1	0	\$0	\$50,000	\$0	\$50,000
C	Task C: Evaluation of Nitrogen Reduction by Soils & Shallow GW					\$216,164	\$1,095,977	\$598,860	\$1,911,001
C.1	Draft Literature Review on Nitrogen Reduction in Soil Report	\$ 11,300.00	1	0	0	\$11,300	\$0	\$0	\$11,300
C.2	Final Literature Review on Nitrogen Reduction in Soil Report	\$ 6,900.00	1	0	0	\$6,900	\$0	\$0	\$6,900
C.3	Draft QAPP Evaluation of N Reduction by Soils & Shallow GW	\$ 38,939.50	1	0	0	\$38,940	\$0	\$0	\$38,940
C.4	Recommendation for Process Forward (per meeting)	\$ 5,906.50	1	0	0	\$5,907	\$0	\$0	\$5,907
C.5	Final QAPP Evaluation of N Reduction by Soils & Shallow GW	\$ 9,189.73	1	0	0	\$9,190	\$0	\$0	\$9,190
C.6	S&GW Test Facility Design 50%	\$ 26,470.50	1	0	0	\$26,471	\$0	\$0	\$26,471
C.7	S&GW Test Facility Design 100%	\$ 26,570.50	1	0	0	\$26,571	\$0	\$0	\$26,571
C.8	S&GW Test Facility Design Final	\$ 21,207.00	1	0	0	\$21,207	\$0	\$0	\$21,207

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C.9	S&GW Construction Support & Administration (2 deliverables, 50% at start, 50% at completion)	\$ 13,560.00	0	2	0	\$0	\$27,120	\$0	\$27,120*	Formatted Table
C.10	S&GW Test Facility Construction 50% (2 deliverables, start and 50% complete)	\$ 15,000.00	2	0	0	\$30,000	\$0	\$0	\$30,000	
C.11	S&GW Test Facility Construction 100% (cost reimbursable)	\$ 40,000.00	0	1	0	\$0	\$40,000	\$0	\$40,000	
C.12	S&GW Test Facility Construction Substantial Completion	\$ 3,680.00	0	1	0	\$0	\$3,680	\$0	\$3,680	
C.13	S&GW Test Facility Accept Construction	\$ 7,480.00	0	1	0	\$0	\$7,480	\$0	\$7,480	
C.14	Soils & Hydrogeologic and Monitoring Plan for S&GW Test Facility	\$ 43,074.00	0	1	0	\$0	\$43,074	\$0	\$43,074	
C.15	Tracer Testing at GCREC (per tracer test)	\$ 18,910.00	0	3	0	\$0	\$56,730	\$0	\$56,730	
C.16	S&GW Sample Event Reports (per sample event)	\$ 47,523.28	0	3	3	\$0	\$142,570	\$142,570	\$285,140	
C.17	S&GW Data Summary Report (per sample event)	\$ 13,240.00	0	3	3	\$0	\$39,720	\$39,720	\$79,440	
C.18	Test Facility Closeout Report	\$ 13,080.00	0	0	1	\$0	\$0	\$13,080	\$13,080	
C.19	Field Site Selection (per property owner agreement)	\$ 9,932.67	1	6	0	\$9,933	\$59,596	\$0	\$69,529	
C.20	Instrumentation of GCREC Mound System	\$ 59,495.00	0.5	0.5	0	\$29,748	\$29,748	\$0	\$59,495	Formatted Table
C.21	GCREC Mound Sample Event Report (per sampling event)	\$ 38,290.00	0	4	0	\$0	\$153,160	\$0	\$153,160*	
C.22	GCREC Mound Data Summary Report (per sampling event)	\$ 8,160.00	0	4	0	\$0	\$32,640	\$0	\$32,640	
C.23	Instrumentation of Remaining Field Sites Report (per site)	\$ 43,075.00	0	4	0	\$0	\$172,300	\$0	\$172,300	
C.24	Field Sites Sample Event Reports (per sample event, per site)	\$ 36,520.00	0	6	7	\$0	\$219,120	\$255,640	\$474,760	
C.25	Field Sites Data Summary Report (per sample event, per site)	\$ 4,840.00	0	6	7	\$0	\$29,040	\$33,880	\$62,920	
C.26	Draft Site Summary and Close-out Memo (per site)	\$ 8,680.00	0	0	5	\$0	\$0	\$43,400	\$43,400	
C.27	Final Site Close-Out Memo (per site)	\$ 2,670.00	0	0	5	\$0	\$0	\$13,350	\$13,350	
C.28	Draft Task C Final Report	\$ 40,040.00	0	0	1	\$0	\$0	\$40,040	\$40,040	
C.29	Task C Final Report	\$ 17,180.00	0	0	1	\$0	\$0	\$17,180	\$17,180	
C.30	Change-order Allowance	\$ 40,000.00	0	1	0	\$0	\$40,000	\$0	\$40,000	
D	Task D: Nitrogen Fate and Transport Models					\$74,357	\$93,477	\$640,189	\$808,023	Formatted Table
D.1	Draft Literature Review on Nitrogen Fate & Transport Model Report	\$ 15,533.23	1	0	0	\$15,533	\$0	\$0	\$15,533	
D.2	Final Literature Review on Nitrogen Fate & Transport Model Report	\$ 5,211.08	1	0	0	\$5,211	\$0	\$0	\$5,211	
D.3	Selection of Existing Data Set for Calibration Report	\$ 15,092.20	1	0	0	\$15,092	\$0	\$0	\$15,092	
D.4	Draft QAPP N Fate and Transport Models	\$ 32,186.76	1	0	0	\$32,187	\$0	\$0	\$32,187	
D.5	Recommendation for Process Forward (per meeting)	\$ 6,334.00	1	0	0	\$6,334	\$0	\$0	\$6,334	
D.6	Final QAPP N Fate and Transport Models	\$ 15,657.38	0	1	0	\$0	\$15,657	\$0	\$15,657	
D.7	Simple Soil Tools	\$ 52,448.00	0	1	0	\$0	\$52,448	\$0	\$52,448*	
D.8	Complex Soil Model	\$ 86,641.00	0	0	1	\$0	\$0	\$86,641	\$86,641	

D.9	Complex Soil Model Performance Evaluation	\$ 48,577.00	0	0	1	\$0	\$0	\$48,577	\$48,577
D.10	Validate/Refine Complex Soil Model	\$ 72,132.04	0	0	1	\$0	\$0	\$72,132	\$72,132
D.11	Aquifer Model Combined with Complex Soil Model Development	\$ 113,411.22	0	0	1	\$0	\$0	\$113,411	\$113,411
D.12	Aquifer-Complex Soil Model Performance Evaluation	\$ 127,922.99	0	0	1	\$0	\$0	\$127,923	\$127,923
D.13	Validate/Refine Aquifer-Complex Soil Model with Data Collection from Task C	\$ 95,733.70	0	0	1	\$0	\$0	\$95,734	\$95,734
D.14	Development of Aquifer-Complex Soil Model for Multiple Spatial Inputs	\$ 25,371.84	0	1	0	\$0	\$25,372	\$0	\$25,372
D.15	Decision-Making Framework Considering Uncertainty	\$ 52,638.54	0	0	1	\$0	\$0	\$52,639	\$52,639
D.16	Task D Guidance Manual (Draft)	\$ 20,590.63	0	0	1	\$0	\$0	\$20,591	\$20,591
D.17	Task D Guidance Manual (Final)	\$ 12,541.41	0	0	1	\$0	\$0	\$12,541	\$12,541
D.18	Change-order Allowance	\$ 10,000.00	0	0	1	\$0	\$0	\$10,000	\$10,000
E	Task E: Project Management, Coordination, and Meetings					\$90,695	\$52,642	\$234,446	\$377,782
E.1	Project Kick-Off Meeting (conference call)	\$ 7,724.00	1	0	0	\$7,724	\$0	\$0	\$7,724
E.2	PM-Project Progress Reports (per bimonthly report)	\$ 9,298.00	6	4	12	\$55,788	\$37,192	\$111,576	\$204,556
E.3	RRAC or TRAP Presentation (per meeting)	\$ 11,732.25	2	1	5	\$23,465	\$11,732	\$58,661	\$93,858
E.4	RRAC or TRAP Meeting Attendance (per meeting)	\$ 3,718.05	1	1	6	\$3,718	\$3,718	\$22,308	\$29,744
E.5	PAC Meetings (per meeting)	\$ 41,900.00	0	0	1	\$0	\$0	\$41,900	\$41,900
F	Task F: Other								
PROJECT TOTALS						\$783,561	\$2,178,220	\$2,038,217	\$4,999,999

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2. Invoice Requirements.

The provider shall submit an invoice to the contract manager at the address listed in the department's standard contract on a monthly basis using the form of Attachment III within 30 days following the end of the period for which payment is being requested. Payment shall be authorized only for service tasks on the invoice that are in accord with the above list and other terms and conditions of this contract. Documentation of completion of service tasks shall be submitted to the contract manager prior to, or with the invoice. Partially completed tasks may be invoiced and paid based on the percentage of the service task completed.

This amendment shall begin on ~~October 1, 2011~~, or the date on which the amendment has been signed by both parties and the project officer at the Environmental Protection Agency has approved it, whichever is later.

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All provisions in the contract and any attachments thereto in conflict with this amendment shall be and are hereby changed to conform with this amendment.

All provisions not in conflict with this amendment are still in effect and are to be performed at the level specified in the contract.

This amendment and all its attachments are hereby made a part of the contract.

IN WITNESS THEREOF, the parties hereto have caused this 39 page amendment to be executed by their officials thereunto duly authorized.

STATE OF FLORIDA
DEPARTMENT OF
HEALTH

PROVIDER: Hazen and Sawyer, P.C.

SIGNED

BY: _____

NAME: Damann L. Anderson

TITLE: Vice President

DATE: _____

FEDERAL ID NUMBER:

13-2904652

SIGNED

BY: _____

NAME: Jean Kline, R.N., B.S.N., M.P.H.

TITLE: Deputy Secretary of Health

DATE: _____

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Task D Nitrogen Fate and Transport Modeling

The objectives of Task D are:

- Literature review on fate and transport models
- Quality Assurance Project Plan
- Space time variable aquifer model with simplified soil treatment
- Development-scale aquifer model creation and calibration
- Space time variable model with complex soil treatment
- Development-scale model with aquifer and soil treatment
- Uncertainty analysis
- Validate and refine models using data from Task C
- Develop decision making framework
- Final Report for Task D

Sub-tasks and Deliverables

Literature Review of Nitrogen Fate and Transport Models (draft)

A literature review will be conducted to determine the current practice for modeling nitrogen fate and transport in soils and ground-water. Particular attention will be paid to data gathered from the Task C literature reviews that have relevance to model parameterization of nitrogen fate and transport. If feasible, sensitivity analysis will be conducted based on previous work for conditions relevant to Florida soil and hydrology to help direct Task C monitoring and future modeling efforts.

Currently available models for nitrogen fate and transport will be reviewed, and the hydraulic and transport/transformation parameters for the models and estimation tools that the provider deems to be applicable, will be summarized so that a plan for fieldwork can begin to be developed at an early stage in the project. Existing available models specific to OSTDS or similar source types will be included in this review to determine the appropriate starting point for model development for this project.

Results of the literature reviewed in this task will be added to the searchable literature reference database established in Task A.

Deliverable: Draft literature review and updated reference database. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

Literature Review of Nitrogen Fate and Transport Models (final)

The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final literature review and updated reference database. **THIS SUBTASK WAS 80% COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

Selection of Existing Data Sets for Calibration Report

The provider will select data from existing sites in Florida or elsewhere to evaluate the performance of a soil and aquifer model, and will provide recommendations for future data collection efforts for subsequent model calibration. The sites shall have information on a nitrogen plume, and data will be obtained via document review and by working with FDOH.

Deliverable: Brief memo describing calibration data sets. **THIS SUBTASK WAS COMPLETED PRIOR TO AMENDMENT 1 AND IS ONLY INCLUDED HERE TO MAINTAIN COMPLETENESS OF SCOPE.**

Quality Assurance Project Plan Nitrogen Fate and Transport Models (draft)

A detailed QAPP will be drafted describing the sub-tasks to be completed in Task D. The overall goal will be to develop a model representing soil and shallow groundwater that is capable of predicting nitrogen concentrations at a specified location downgradient of an OSTDS source and determining nitrogen loadings/mass flux at a specified location. A simplified, user friendly modeling approach (e.g., programmed Microsoft Excel spreadsheet) will be employed that includes parameters that model the dominant soil and hydraulic factors that influence nitrogen reduction. The development of the fate and transport model will be accompanied with a parallel assessment of soil characterization at individual sites that provide data for model parameterization and calibration (Task C). The Florida soils classification system is one potential source of soil characterization data that could be used for a simple estimation of unsaturated zone transport.

The development of a model can include several steps from the concept over implementation of a mathematical model, assurance of numerical accuracy (code verification), adjustment of model parameters to best match a real world experimental data set (calibration), comparison of predictions from a calibrated model to different experimental data (model validation or verification), analysis of the effect of uncertainty in model parameter values on model results or of uncertainty and variability in data sets on calibrated parameter values (sensitivity analysis) and adjustments of the concept, mathematical, or calibrated model to better represent observations (model redesign) can be potentially a never-ending circular process as new data become available for comparison over time. The QAPP will describe how model development will proceed from the literature review, initial model development, calibration to existing data, model verification with other existing data or data gathered during this study, and model redesign to a final model product. It will also describe how the developed models and sensitivity analyses can guide data gathering efforts (in particular for task C), provide insights into nitrogen behavior in the environment, and provide a framework for decision making.

The final product of Task D is anticipated to be a simplified site scale model that predicts nitrogen concentration and mass flux at selected distances

downgradient from the source loading location. Comparisons of this modeling approach with the results of non-steady state models and complex soil models will characterize the limitations of this model. The model will be a combination of a simple soil model and averaged aquifer model. The simple soil model will predict nitrogen reduction in unsaturated soil and the loading of nitrogen to the aquifer at the groundwater table surface. The simplified soil model may take the form of a simple algorithm or correlation that predicts nitrogen reduction as a function of such unsaturated soil characteristics as grain size distribution, water content and organic matter. The aquifer model will likely be time averaged and predict nitrogen concentration and attenuation with distance from the source. Input information includes the direction of groundwater flow at the average groundwater flow velocity and organic matter content. Model parameter values will be derived from calibration for Florida locations using data from Task C and suggested model parameters will be provided.

Deliverable: Draft Task D QAPP.

Recommendation for Process Forward (per meeting)

Based on the details agreed upon in the final QAPP, the provider will develop a recommendation whether or not to proceed with the remainder of Task D as outlined below, a revised cost estimate, or recommend an amendment to this contract. Both the provider and FDOH shall reach a written agreement prior to moving forward with Task D.

Deliverable: Meeting summary and recommended scope and budget revisions.

Quality Assurance Project Plan Nitrogen Fate and Transport Models (final)

The department will gather comments on the draft QAPP from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final QAPP acceptable by FDOH.

Simple Soil Model Development

This model will use a simple classification approach for soil treatment of nitrogen based on prior research. A soil classification model will be adapted (such as developed by D. Otis for the Wekiva study) or developed. A more detailed model for soil treatment will be developed in a subsequent task (subtask D15), however, a simple soil treatment model will allow aquifer model development to proceed much sooner, and is expected to be easier to use for many sites where detailed information for such a soil treatment model is not available.

Deliverable: Simple Soil Model Specification memo.

Non-steady state aquifer model with simple soil model

A non-steady state aquifer model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from a single OSTDS source, or a surface area that can be estimated as a single OSTDS source. The simple soil model from D7 will be linked to this model, and it is anticipated that aerial nitrogen input and loading will depend on

factors such as pretreatment, recharge, soil conditions, and property size. Model development will be based on information gained in the literature review.

Deliverable: Brief modeling memo and model in electronic format (e.g., Microsoft Excel spreadsheet).

Aquifer model with averaged output with simple soil model

A model will be developed, possibly by revising the model developed in Task D8, to produce averaged output predictions for nitrogen concentration or mass flux.

Deliverable: Brief modeling memo and model in electronic format.

Multiple source aquifer model

A model will be developed, possibly by revising an existing model, to simulate nitrogen concentrations and mass flux in space and time from several OSTDS in a development-scale area.

Deliverable: Brief modeling memo and model in electronic format.

Calibrate non-steady state aquifer model to existing data sets

The models will be initially calibrated using existing data sets from Florida or other sites identified during subtask 3. The aquifer model performance will be evaluated using measures of difference between available actual field data and model results. By comparing predictions from a calibrated model to another data set, this task may result in verification of the model. Experience during calibration or sensitivity analysis of the model will likely be useful to better understand the quality and quantity of data required to enable a rigorous calibration using data from Task C.

Deliverable: Model calibration memo.

Calibrate aquifer model with averaged output to existing data sets

The aquifer model will be calibrated using existing data sets based on metrics such as average concentration in the plume or mass flux crossing a boundary.

Deliverable: Model calibration memo.

Calibrate multi-source aquifer model to existing data sets

The aquifer model will be calibrated using existing data from a development-scale plume, based on metrics such as average concentration in the plume or mass flux crossing a boundary.

Deliverable: Model calibration memo.

Complex Soil Model

The complex soil model will be based on unsaturated soil transport mechanisms, and based on Florida-specific soil and climate data, but still incorporated into a simplified approach (e.g., programmed into a Microsoft Excel spreadsheet) useable by most practitioners with basic training. For example, the complex soil model may incorporate a field-capacity/mass-balance approach for water flow similar to that used by the Yucca Mountain project to estimate infiltration, which

addresses the capacity of soil to store water and tracks water entering and leaving the soil. The soil treatment module would enable estimation of site-specific soil treatment in the vadose zone, and model output will be the loading at the water table to the aquifer models. Development of the complex soil treatment module will be further described in the QAPP.

Deliverable: Complex Soil Model specification memo.

Non-steady state aquifer model with complex soil model

The complex soil-treatment model from D14 will be interfaced with the non-steady state aquifer model. Development of the non-steady state aquifer model based on a complex soil treatment module will be further described in the QAPP.

Deliverable: Brief modeling memo and model in electronic format.

Aquifer model with averaged output, with complex soil model

The complex soil-treatment model will be interfaced with the averaged aquifer model. Development of the averaged aquifer model based on a complex soil treatment module will be further described in the QAPP.

Deliverable: Brief modeling memo and model in electronic format.

Multi-source aquifer model, with complex soil model

The complex soil-treatment model will be interfaced with the averaged aquifer model, taking into account numerous OSTDS in an area.

Deliverable: Brief modeling memo and model in electronic format.

Calibrate non-steady state and averaged aquifer and complex soil model to existing data sets

Aquifer model performance will be evaluated using available actual field data and rigorous calibration techniques for the integrated soil-treatment/aquifer model. By comparing predictions from a calibrated model to another data set, this task may result in verification of the model. Experience during calibration or sensitivity analysis of the model will likely be useful to better understand the quality and quantity of data required to rigorously calibrate the model (Task C).

Deliverable: Model calibration memo.

Calibrate multi-source aquifer model and complex soil model to existing data sets

Aquifer model performance will be evaluated using data from a development-scale plume and rigorous calibration techniques for the integrated soil treatment/aquifer model.

Deliverable: Model calibration memo.

Uncertainty Analysis for Non-Calibrated Models

A methodology will be developed whereby the developed models can be used for decision making even if sufficient site-specific data does not exist to calibrate the model. Probability-based ranges for model input parameters will be used to

generate probable model outcomes, providing planners with the option of using the most probable model outcome in the decision making process, or the model outcome that would lead to a more conservative or liberal decision as the specific case warrants. To the extent possible (without precluding model-performance evaluation of the aquifer model in year 1), model uncertainty and sensitivity analyses will be conducted.

Deliverable: Uncertainty analysis memo.

Validate/Refine non-steady state aquifer model with data collection from Task C

Aquifer model performance will be evaluated using ground-water data collected from Task C and rigorous calibration techniques. The calibration procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself.

Deliverable: Model validation memo.

Validate/Refine complex soil model with data collected from Task C

Soil treatment model performance will be evaluated using field data collected from Task C (soil, vadose zone, shallow water table) and rigorous calibration techniques. The calibration procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself.

Deliverable: Model validation memo.

Uncertainty analysis for calibrated models

The uncertainty in results produced by calibrated models (e.g., nitrogen concentration or mass flux) will be characterized based on factors such as range in calibrated parameter set values that result in similar agreement between model results and data, model-parameter correlation and bias, and the potential for different parameter combinations to achieve the same agreement between model results and data.

Deliverable: Model uncertainty analysis memo.

Validate/Refine non-steady state aquifer, complex soil model with Data Collected from Task C

Soil/aquifer integrated model performance will be evaluated using site-scale field data collected from Task C and rigorous calibration techniques. The calibration procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself.

Deliverable: Model validation memo.

Decision-Making Framework Considering Uncertainty

A methodology will be developed based on the results of subtask 20 to describe how planners can include the uncertainty associated with both calibrated and non-calibrated models in the decision-making process.

Deliverable: Modeling decision-making memo.

Validate/Refine multi-source aquifer model, complex soil model with data collected from Task C

Soil/aquifer integrated model performance will be evaluated using development-scale plume field data collected from Task C and rigorous calibration techniques. The calibration procedure will be an iterative process and may suggest revisions in the data collection plan or in the model itself.

Deliverable: Model validation memo.

Task D Final Report (draft)

The draft final report will be developed to summarize the results of the Task D modeling development.

Deliverable: Draft Task D Report.

Task D Final Report (final)

The department will gather comments on the draft final report from RRAC and any other interested parties and transmit such comments to the provider within one month of receiving the draft. The provider will address these comments in preparing final deliverables within one month of receiving comments.

Deliverable: Final Task D Report.

TASK NO.	Task	Per Deliverable Subtotal	Jun-09	Jul-09	Aug-09	Sep
A	Task A: Technology Selection & Prioritization					
A.1	Draft Literature Review Report	\$ 13,796.00	1	0	0	
A.2	Final Literature Review Report	\$ 6,092.00	1	0	0	
A.3	Draft Classification of Technologies Report	\$ 12,830.60	1	0	0	
A.4	Draft Technology Ranking Criteria Report	\$ 10,096.00	1	0	0	
A.5	Draft Priority List for Testing Report	\$ 14,858.60	1	0	0	
A.6	Technology Classification, Ranking and Prioritization Workshop	\$ 18,242.60	1	0	0	
A.7	Final Classification of Technologies Report	\$ 5,044.00	0	0	1	
A.8	Final Technology Ranking Criteria Report	\$ 7,944.00	0	0	1	
A.9	Final Priority List for Testing Report	\$ 7,786.60	0	0	0	
A.10	Draft Innovative Systems Applications Report (per technology, up to five)	\$ 11,655.00	0	0	0	
A.11	Final Innovative Systems Applications Report (per technology, up to five)	\$ 9,219.00	0	0	0	

A.12	Identification of Test Facility Sites (per site agreement)	\$ 2,538.25	1.8	0	0
A.13	Draft PNRS II QAPP	\$ 13,170.50	1	0	0
A.14	Recommendation for Process Forward (per meeting)	\$ 6,236.50	0	0	0
A.15	Final PNRS II QAPP	\$ 4,496.00	0	0	0
A.16	Materials Testing for FDoH Additives Rule	\$ 4,000.00	0	0	0
A.17	PNRS Specification Reports	\$ 23,635.00	0	0	0
A.18	PNRS II Test Facility Design 50%	\$ 11,721.48	0	0	1
A.19	PNRS II Test Facility Design 100%	\$ 16,200.50	0	0	0
A.20	PNRS II Test Facility Construction Support and Administration (2 deliverables, 50% at start, 50% at completion)	\$ 19,991.00	0	0	0
A.21	PNRS II Test Facility Construction 50% (2 deliverables, start and 50% complete)	\$ 25,000.00	0	0	0
A.22	PNRS II Test Facility Construction 100% (cost reimbursable)	\$ 40,000.00	0	0	0
A.23	PNRS II Test Facility Construction Substantial Completion	\$ 11,000.00	0	0	0
A.24	PNRS II Test Facility Accept Construction	\$ 10,650.00	0	0	0
A.25	Monitoring and Sample Event Reports (per sample event)	\$ 32,489.00	0	0	0
A.26	Data Summary Report (per sample event)	\$ 3,368.25	0	0	0
A.27	Draft PNRS II Report	\$ 34,220.00	0	0	0
A.28	Final PNRS II Report	\$ 17,240.00	0	0	0
A.29	Draft Task A Final Report	\$ 26,000.00	0	0	0
A.30	Task A Final Report	\$ 9,343.00	0	0	0
B	Task B: Field Testing of Technologies				
B.1	Identification of Home Sites (per homeowner agreement)	\$ 9,341.67	0	0	0
B.2	Vendor Agreement Report (per vendor agreement)	\$ 7,580.00	0	0	0
B.3	Draft QAPP for Field Testing	\$ 25,700.00	0	0	0
B.4	Recommendation for Process Forward (per meeting)	\$ 6,780.00	0	0	0
B.5	Final QAPP Field Testing	\$ 11,060.00	0	0	0
B.6	Field Systems Installation Report (per system)	\$ 47,060.00	0	0	0
B.7	Field Systems Monitoring Report (per event)	\$ 35,200.00	0	0	0
B.8	Field Systems Operation, Maintenance and Repairs Report (per system)	\$ 9,130.00	0	0	0
B.9	Technical Description of Nitrogen Reduction Technology Report	\$ 19,660.00	0	0	0

B.10	Acceptance of System by Owner Report (per system)	\$ 4,758.00	0	0	0
B.11	LCCA Template Report (draft template and user guidelines)	\$ 18,140.00	0	0	0
B.12	LCCA Template Report (final template and user guidelines)	\$ 9,080.00	0	0	0
B.13	LCCA Report (per system)	\$ 5,040.00	0	0	0
B.14	Draft Task B Final Report	\$ 57,600.00	0	0	0
B.15	Task B Final Report	\$ 29,760.00	0	0	0
C	Task C: Evaluation of Nitrogen Reduction by Soils & Shallow GW				
C.1	Draft Literature Review on Nitrogen Reduction in Soil Report	\$ 11,300.00	1	0	0
C.2	Final Literature Review on Nitrogen Reduction in Soil Report	\$ 6,900.00	0	0	0
C.3	Draft QAPP Evaluation of N Reduction by Soils & Shallow GW	\$ 38,939.50	0	0	0
C.4	Recommendation for Process Forward (per meeting)	\$ 5,906.50	0	0	0
C.5	Final QAPP Evaluation of N Reduction by Soils & Shallow GW	\$ 9,189.73	0	0	0
C.6	S&GW Test Facility Design 50%	\$ 26,470.50	1	0	0
C.7	S&GW Test Facility Design 100%	\$ 26,570.50	0	0	0
C.8	S&GW Test Facility Design Final	\$ 21,207.00	0	0	0
C.9	S&GW Construction Support & Administration (2 deliverables, 50% at start, 50% at completion)	\$ 17,740.00	0	0	0
C.10	S&GW Test Facility Construction 50% (2 deliverables, start and 50% complete)	\$ 15,000.00	0	0	0
C.11	S&GW Test Facility Construction 100% (cost reimbursable)	\$ 30,000.00	0	0	0
C.12	S&GW Test Facility Construction Substantial Completion	\$ 4,680.00	0	0	0
C.13	S&GW Test Facility Accept Construction	\$ 10,380.00	0	0	0
C.14	Soils & Hydrogeologic and Monitoring Plan for S&GW Test Facility	\$ 31,845.00	0	0	0
C.15	Tracer Testing at GCREC (per tracer test)	\$ 20,410.00	0	0	0
C.16	S&GW Sample Event Reports (per sample event)	\$ 39,413.28	0	0	0
C.17	S&GW Data Summary Report (per sample event)	\$ 3,240.00	0	0	0
C.18	Test Facility Closeout Report	\$ 15,580.00	0	0	0
C.19	Field Site Selection (per property owner agreement)	\$ 9,932.67	0	0	0
C.20	Instrumentation of GCREC Mound System	\$ 56,075.00	0	0	0
C.21	GCREC Mound Sample Event Report (per sampling event)	\$ 45,265.00	0	0	0

C.22	GCREC Mound Data Summary Report (per sampling event)	\$ 3,840.00	0	0	0
C.23	Instrumentation of Remaining Field Sites Report (per site)	\$ 40,075.00	0	0	0
C.24	Field Sites Sample Event Reports (per sample event, per site)	\$ 46,545.00	0	0	0
C.25	Field Sites Data Summary Report (per sample event, per site)	\$ 2,840.00	0	0	0
C.26	Draft Site Summary and Close-out Report (per site)	\$ 8,680.00	0	0	0
C.27	Final Site Close-Out Report (per site)	\$ 2,670.00	0	0	0
C.28	Draft Task C Final Report	\$ 50,040.00	0	0	0
C.29	Task C Final Report	\$ 19,680.00	0	0	0
D	Task D: Nitrogen Fate and Transport Models				
D.1	Draft Literature Review on Nitrogen Fate & Transport Model Report	\$ 15,533.23	1	0	0
D.2	Final Literature Review on Nitrogen Fate & Transport Model Report	\$ 5,211.08	0	0	0
D.3	Selection of Existing Data Set for Calibration Report	\$ 15,092.20	1	0	0
D.4	Draft QAPP N Fate and Transport Models	\$ 32,186.76	0	0	0
D.5	Recommendation for Process Forward (per meeting)	\$ 6,334.00	0	0	0
D.6	Final QAPP N Fate and Transport Models	\$ 15,657.38	0	0	0
D.7	Simple Soil Model Development	\$ 4,263.26	0	0	0
D.8	Non-Steady State Aquifer Model, Simple Soil Model	\$ 17,053.04	0	0	0
D.9	Aquifer Model with Averaged Output, Simple Soil Model	\$ 20,008.30	0	0	0
D.10	Multi-Source Aquifer Model	\$ 22,834.75	0	0	0
D.11	Calibrate Non-Steady State Aquifer Model to Existing Data Sets	\$ 34,033.63	0	0	0
D.12	Calibrate Aquifer Model with Averaged Output to Existing Data Sets	\$ 11,634.88	0	0	0
D.13	Calibrate Multi-Source Aquifer Model to Existing Data Sets	\$ 22,834.75	0	0	0
D.14	Complex Soil Model Development	\$ 63,936.61	0	0	0
D.15	Non-Steady State Aquifer Model, Complex Soil Model	\$ 27,401.40	0	0	0
D.16	Aquifer Model with Averaged Output, Complex Soil Model	\$ 12,942.88	0	0	0
D.17	Multi-Source Aquifer Model, Complex Soil Model	\$ 12,942.88	0	0	0
D.18	Calibrate Non-Steady State Aquifer Model, Complex Soil Model to Existing Data Sets	\$ 16,480.93	0	0	0
D.19	Calibrate Multi-Source Aquifer Model, Complex Soil Model to Existing Data Sets	\$ 16,480.93	0	0	0
D.20	Uncertainty Analysis for Non-Calibrated Models	\$ 43,658.81	0	0	0

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES (FOSNRS) STUDY

RRAC Meeting Presentation
September 8, 2011



Agenda

- Proposed Project Scope and Budget – Phase III

Scope & Budget – Task A

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
A.1 Draft Lit Review	1		\$ 13,796	\$0
A.2 Final Lit Review	1		\$ 6,092	\$0
A.3 Draft Classification of Tech	1		\$ 12,831	\$0
A.4 Draft Tech Ranking Criteria	1		\$ 10,096	\$0
A.5 Draft Priority List for Testing	1		\$ 14,859	\$0
A.6 Tech Class., Ranking & Prioritization Workshop	1		\$ 18,243	\$0
A.7 Final Classification of Tech	1		\$ 5,044	\$0
A.8 Final Tech Ranking Criteria	1		\$ 7,944	\$0
A.9 Final Priority List for Testing	1		\$ 7,787	\$0
A.10 Draft Innovative Systems Application		1	\$ -	\$11,655
A.11 Final Innovative Systems Application		1	\$ -	\$9,219
A.12 Identification of Test Facility Sites	2		\$ 5,077	\$0
A.13 Draft QAPP PNRS II	1		\$ 13,171	\$0
A.14 Recommendation for Process Forward	1		\$ 6,237	\$0
A.15 Final QAPP PNRS II	1		\$ 4,496	\$0
A.16 Materials Testing for FDOH Additives Rule	4		\$ 16,000	\$0
A.17 PNRS II Specification Reports	1	1	\$ 18,715	\$18,715

Scope & Budget– Task A (continued)

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
A.18 PNRS II Test Facility Design 50%	1		\$ 11,721	\$0
A.19 PNRS II Test Facility Design 100%	1		\$ 16,201	\$0
A.20 PNRS II Test Facility Construction Support & Admin	2		\$ 33,202	\$0
A.21 PNRS II Test Facility Construction 50%	2		\$ 50,000	\$0
A.22 PNRS II Test Facility Construction 100%	1		\$ 40,000	\$0
A.23 PNRS II Test Facility Construction Sub. Completion	1		\$ 10,000	\$0
A.24 PNRS II Test Facility Accept Construction	1		\$ 9,650	\$0
A.25 Monitoring and Sample Event Reports	6	1	\$ 173,910	\$28,985
A.26 Data Summary Report	6	1	\$ 20,190	\$3,365
A.27 Draft PNRS II Report		1	\$ -	\$34,220
A.28 Final PNRS II Report		1	\$ -	\$17,240
A.29 Draft Task A Final Report		1	\$ -	\$26,000
A.30 Task A Final Report		1	\$ -	\$9,480
A.31 Change-order Allowance		1	\$ 20,000	\$ 20,000

Scope & Budget – Task B

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
B.1 Identification of Home Sites	9	1	\$ 84,075	\$9,342
B.2 Vendor Agreement Report	1	1	\$ 7,580	\$7,580
B.3 Draft QAPP for Field Testing	1		\$ 25,700	\$0
B.4 Recommendation for Process Forward	1		\$ 6,780	\$0
B.5 Final QAPP for Field Testing	1		\$ 11,060	\$0
B.6 Field System Installation Report	0.75	6.25	\$ 28,425	\$236,875
B.7 Field System Monitoring Report		56	\$ -	\$470,531
B.8 Field System Op., Maintenance & Repairs Report		7	\$ -	\$60,410
B.9 Technical Description of Nitrogen Reduction Tech. Report		1	\$ -	\$17,271
B.10 Acceptance of System by Owner Report		7	\$ -	\$33,306
B.11 Draft LCAA Template Report		1	\$ -	\$18,140
B.12 Final LCCA Template Report		1	\$ -	\$9,080
B.13 LCCA Report (per system)		7	\$ -	\$35,280
B.14 Draft Task B Final Report		1	\$ -	\$45,120
B.15 Task B Final Report		1	\$ -	\$22,500
B.16 Change-order Allowance		1	\$ -	\$50,000

Scope & Budget – Task C

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
C.1 Draft Literature Review on N Reduction in Soil	1		\$ 11,300	\$0
C.2 Final Literature Review on N Reduction in Soil	1		\$ 6,900	\$0
C.3 Draft QAPP Eval. of N Red. by Soils & Shallow GW	1		\$ 38,940	\$0
C.4 Recommendation for Process Forward	1		\$ 5,907	\$0
C.5 Final QAPP Eval. of N Red. by Soils & Shallow GW	1		\$ 9,190	\$0
C.6 S&GW Test Facility Design 50%	1		\$ 26,471	\$0
C.7 S&GW Test Facility Design 100%	1		\$ 26,571	\$0
C.8 S&GW Test Facility Design Final	1		\$ 21,207	\$0
C.9 S&GW Construction Support & Admin.		2	\$ -	\$27,120
C.10 S&GW Test Facility Construction 50%		2	\$ -	\$30,000
C.11 S&GW Test Facility Construction 100%		1	\$ -	\$40,000
C.12 S&GW Test Facility Con. Substantial Completion		1	\$ -	\$3,680
C.13 S&GW Test Facility Accept Construction		1	\$ -	\$7,480
C.14 Soils & Hydrogeologic & Monitoring Plan for S&GW		1	\$ -	\$43,074
C.15 Tracer Testing at GCREC	1	2	\$ 18,910	\$37,820
C.16 S&GW Sample Event Reports		6	\$ -	\$285,140

Scope & Budget – Task C (continued)

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
C.17 S&GW Data Summary Report		6	\$ -	\$79,440
C.18 Test Facility Closeout Report		1	\$ -	\$13,080
C.19 Field Site Selection	6	1	\$ 59,596	\$9,933
C.20 Instrumentation of GCREC Mound System	1		\$ 59,495	\$0
C.21 GCREC Mound Sample Event Report	3	1	\$ 114,870	\$38,290
C.22 GCREC Mound Data Summary Report	2	2	\$ 16,320	\$16,320
C.23 Instrumentation of Remaining Field Sites Report	2	2	\$ 86,150	\$86,150
C.24 Field Sites Sample Event Reports	2	11	\$ 73,040	\$401,720
C.25 Field Sites Data Summary Report	1	12	\$ 4,840	\$58,080
C.26 Draft Site Summary and Close-Out Report		5	\$ -	\$43,400
C.27 Final Site Close-Out Report		5	\$ -	\$13,350
C.28 Draft Task C Final Report		1	\$ -	\$40,040
C.29 Task C Final Report		1	\$ -	\$17,180
C.30 Change-order Allowance		1	\$ -	\$40,000

Scope & Budget – Task D

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
D.1 Draft Lit Review on N Fate & Transport Model	1		\$ 15,533	\$ 0
D.2 Final Lit Review on N Fate & Transport Model	1		\$ 5,211	\$ 0
D.3 Selection of Existing Data Set for Calibration	1		\$ 15,092	\$ 0
D.4 Draft QAPP N Fate & Transport Models	1		\$ 32,187	\$ 0
D.5 Recommendation for Process Forward	1		\$ 6,334	\$ 0
D.6 Final QAPP N Fate & Transport Models	1		\$ 15,657	\$ 0
D.7 Simple Soil Tools		1	\$ -	\$52,448
D.8 Complex Soil Model		1	\$ -	\$86,641
D.9 Complex Soil Model Performance Evaluation		1	\$ -	\$48,577
D.10 Validate/Refine Complex Soil Model		1	\$ -	\$72,132
D.11 Aquifer Model Combined with Complex Soil Model Development		1	\$ -	\$113,411
D.12 Aquifer-Complex Soil Model Performance Ev.		1	\$ -	\$127,923
D.13 Validate/Refine Aquifer-Complex Soil Model w/ Data Collection from Task C		1	\$ -	\$95,734
D.14 Dev. of Aquifer-Complex Soil Model for Multiple Spatial Inputs		1	\$ -	\$25,372
D.15 Decision-Making Framework Considering Uncertainty		1	\$ -	\$52,638
D.16 Task D Guidance Manual (Draft)		1	\$ -	\$20,591
D.17 Task D Guidance Manual (Final)		1	\$ -	\$12,541
D.18 Change-order Allowance		1	\$ -	\$10,000

Scope & Budget – Task E

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
E.1 Project Kick-Off Meeting	1		\$ 7,724	\$0
E.2 PM – Project Progress Reports	10	12	\$ 92,980	\$111,576
E.3 RRAC or TRAP Presentation	3	5	\$ 35,197	\$58,661
E.4 RRAC or TRAP Meeting Attendance	2	6	\$ 7,436	\$22,308
E.5 PAC Meeting		1	\$ -	\$41,900

Budget Summary as of July 31st

Task	Total Estimated Cost	Spent (\$)	Remaining (\$)
Task A: Technology Selection & Prioritization	\$ 724,138	\$ 545,259	\$ 178,879
Task B: Field Testing of Technologies	\$ 1,179,054	\$ 174,171	\$ 1,004,883
Task C: Evaluation of Nitrogen Reduction by Soils & Shallow GW	\$ 1,911,001	\$ 579,705	\$ 1,331,296
Task D: Nitrogen Fate and Transport Models	\$ 808,023	\$ 90,015	\$ 718,008
Task E: Project Management, Coordination and Meetings	\$ 377,783	\$ 143,337	\$ 234,446
Total Project	\$ 4,999,999	\$ 1,532,487	\$ 3,467,512

Questions?



**2011 STATUS REPORT ON PHASE II OF THE FLORIDA
ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES
STUDY**

Bureau of Onsite Sewage Programs

May 16, 2011

H. Frank Farmer, Jr., M.D., Ph.D.
State Surgeon General

Rick Scott
Governor

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STATUS REPORT ON PHASE II OF THE FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES STUDY

EXECUTIVE SUMMARY

The Florida Legislature has appropriated a total of \$2.9 million for Phases I and II of a three phase project with a total estimated cost of \$5.1 million to develop passive strategies for nitrogen reduction for onsite sewage treatment and disposal systems (OSTDS). This report is submitted in compliance with Line Item 486 Section 3, Conference Report on House Bill 5001, General Appropriations Act for Fiscal Year 2010-2011. Currently, this project requires an appropriation of the remaining \$2.2 million to complete the study.

Funds appropriated and expended to date have established necessary viable protocols and have been appropriately used to test, calibrate, and refine technologies and strategies to be tested in the field. Without further funding for the final Phase 3 of the project, necessary and extensive field testing will not occur. If field testing does not occur, the project will not yield results that can be used to develop viable, cost-effective alternative passive technologies for use by homeowners for nitrogen issues associated with onsite systems.

Regardless of the source, excessive nitrogen has negative effects on public health and the environment. The significance of this innovative project is that it evaluates and develops strategies to reduce nitrogen impacts from OSTDS regulated by the Florida Department of Health (DOH). The goal is to develop systems that are affordable and ecologically protective with reduced engineering and installation costs that assist in sustainable development. This project has been endorsed by Florida TaxWatch as a good use of public funds (Wenner 2008).

The contractor, in coordination with DOH and the Department's Research Review and Advisory Committee (RRAC) per 381.0065(4)(o) F.S., has successfully completed portions of each major task including prioritization of treatment technologies, construction of a test facility, and completion of several sample events. Work remaining for the 2010-2011 fiscal year includes: initiating field sampling of passive systems; field sampling of the soil and groundwater under OSTDS at residential homes throughout Florida and at the test facility; and initiating development of a nitrogen fate and transport model.

Further testing is required to verify the results to date and to provide data for development of the specifications for full system designs. The tasks associated with the final phase include: continuation and completion of field monitoring of the performance and cost of technologies at home sites and of nitrogen fate and transport in the shallow groundwater; development of nitrogen fate and transport models that will be calibrated with the field sampling results; and final reporting on all tasks with recommendations on onsite sewage nitrogen reduction strategies.

DOH and its Research Review and Advisory Committee recommend that the Legislature:

1. Provide funding and budget authority to DOH in the amount of \$2.2 million for the fiscal year 2011-2012 for continuation and completion of the tasks associated with this legislatively mandated study.
2. Provide DOH budget authority for any remaining funds from the 2010 appropriation to carry over to fiscal year 2011-2012.

Continued support for this project will ultimately benefit Florida's approximately 2.7 million onsite system owners by finding cost-effective nitrogen reduction strategies that will improve environmental and public health protection. If fully funded, the results of this project will assist with producing nitrogen reducing systems that protect groundwater with both reduced life-cycle costs and lower energy demands.

INTRODUCTION

The 2010 Legislature appropriated \$2.0 million for Phase II of a three phase project with a total estimated cost of \$5.1 million to develop passive strategies for nitrogen reduction for onsite sewage treatment and disposal systems (OSTDS). This followed an initial appropriation of \$900,000 by the 2008 Legislature for the first phase of this study. Currently, this project requires an appropriation of the remaining \$2.2 million to complete the study. This report is submitted in compliance with Line Item 486 Section 3, Conference Report on House Bill 5001, General Appropriations Act for Fiscal Year 2010-2011, which appropriated the funding for the study.

This study was based on budget language in 2008 (Line Item 1682, House Bill 5001, General Appropriations Act for Fiscal Year 2008-2009) that instructed:

...the Department of Health to further develop cost-effective nitrogen reduction strategies. The Department of Health shall contract, by request for proposal, for Phase I of an anticipated 3-year project to develop passive strategies for nitrogen reduction that complement use of conventional onsite wastewater treatment systems. The project shall be controlled by the Department of Health's Research Review and Advisory Committee and shall include the following components: 1) comprehensive review of existing or ongoing studies on passive technologies; 2) field testing of nitrogen reducing technologies at actual home sites for comparison of conventional, passive technologies and performance-based treatment systems to determine nitrogen reduction performance; 3) documentation of all capital, energy and life-cycle costs of various technologies for nitrogen reduction; 4) evaluation of nitrogen reduction provided by soils and the shallow groundwater below and down gradient of various systems; and 5) development of a simple model for predicting nitrogen fate and transport from onsite wastewater systems. A progress report shall be presented to the Executive Office of the Governor, the President of the Senate and the Speaker of the House of Representatives on February 1, 2009, including recommendations for funding additional phases of the study.

The 2010 legislative direction (included in Appendix A) specified that the existing contract for this project will remain in full force; that the Department, the Department's Research Review and Advisory Committee (RRAC), and the Florida Department of Environmental Protection (DEP) shall work together to provide technical oversight and that DEP will have maximum technical input; that the main focus and priority for work in Phase II shall be in developing, testing, and recommending cost-effective passive technologies for nitrogen reduction; that field installations for this project will be subject to significant testing and monitoring; and that no state agency shall implement any rule or policy that requires nitrogen reducing systems or increases their costs until the study is complete.

Regardless of the source, excessive nitrogen has negative effects on public health and the environment. The primary motivations for this study are the environmental impacts that the increased levels of nitrogen in water bodies can cause. Programs within DEP identify water bodies impaired by excessive nitrogen, establish targets for maximum nutrient loads, and develop management action plans to restore the water bodies. The relative contribution of OSTDS to total nitrogen impacts varies from watershed to watershed with estimates ranging from below five to more than 20 percent. There is widespread interest in the management of OSTDS and their nitrogen impacts. This project has been endorsed by Florida TaxWatch as a study that is a good use of public funds and that provides homeowners with cost-effective options for nitrogen reduction (email communication from Kurt Wenner to Jerry McDaniel June

2, 2008). The significance of this innovative project is that it evaluates and develops strategies to reduce nitrogen impacts from OSTDS regulated by the Florida Department of Health (DOH). The goal is to develop systems that complement the use of conventional OSTDS and are also affordable and ecologically protective with reduced engineering and installation costs that assist in sustainable development.

The study contract was awarded in January 2009 to a Project Team led by Hazen and Sawyer, P.C., and was based upon an anticipated budget of \$5 million over a 3 – 5 year project timeframe, with an additional \$100,000 budget to DOH for project management. As a result of the time required for contracting, unspent monies in fiscal year 2008-2009 were budgeted in 2009 to complete the initial tasks of the project. The contract identifies the following tasks:

Task A – Technology Evaluation for Field Testing: Review, Prioritization, and Development: This task includes literature review, technology evaluation, prioritization of technologies to be examined during field testing, and further experimentation with approaches tested in a previous DOH passive nitrogen removal study. Objectives of this task are to prioritize technologies for testing at actual home sites and to perform controlled tests at a test facility to develop design criteria for new passive nitrogen reduction systems.

Task B – Field Testing of Technologies and Cost Documentation: This task includes installation of top ranked nitrogen reduction technologies at actual homes, with documentation of their performance and cost.

Task C – Evaluation of Nitrogen Reduction Provided by Soils and Shallow Groundwater: This task includes several field evaluations of nitrogen reduction in Florida soils and shallow groundwater and also will provide data for the development of a simple planning model in Task D.

Task D – Nitrogen Fate and Transport Modeling: The objective of this task is to develop a simple fate and transport model of nitrogen from OSTDS that can be used for assessment, planning and siting of OSTDS.

FLORIDA DEPARTMENT OF HEALTH

Florida Onsite Sewage Nitrogen Reduction Strategies Project
FDOH Contract CORCL

Objective:
To develop nitrogen reduction strategies for onsite sewage treatment and disposal systems (OSTDS) in Florida

Study Areas:

- A* Development and pilot testing of passive nitrogen reduction systems (PNRS)
- B* Field testing of full-scale nitrogen reduction systems to determine performance and cost
- C* Assessment of the fate and transport of nitrogen from OSTDS in soil and groundwater
- D* Development of decision support tools for OSTDS planning and nitrogen reduction

HAZEN AND SAWYER
Environmental Engineers & Scientists *in association with*

UNIVERSITY OF COLORADO
1874

AET
Applied Environmental Technology

OTIS ENVIRONMENTAL CONSULTANTS

UF UNIVERSITY OF FLORIDA
Gulf Coast Research and Education Center

Figure 1. Sign posted at the University of Florida's Gulf Coast Research & Education Center's test facility.

1 PROJECT STATUS

Funding for the first and second phases of this project has been appropriated. A summary of the major project elements and their timing with funding phases is shown in Table 1. The contractor, in coordination with the RRAC and DOH, has successfully completed parts of Tasks A, B, C, and D, including literature reviews; ranking of nitrogen reduction technologies for field testing; design and construction of a test facility for further development of passive technologies; development of quality assurance documents for the test facility work, groundwater monitoring, field testing, and nitrogen fate and transport modeling; and completion of several sampling events at the test facility.



Figure 2. Test facility constructed at the University of Florida's Gulf Coast Research & Education Center.

Current efforts and work remaining for the 2010-2011 fiscal year includes: initiating field sampling of passive systems; installation of field sites at residential homes throughout Florida for the testing of passive systems and to test the soil and groundwater under OSTDS; design and construction of a soil and groundwater test facility; sampling at the soil and groundwater test facility; continued sampling of passive technologies at the test facility; and initiating development of a nitrogen fate and transport model. In particular, the following work by task will proceed with the current funding level:

1. The technology evaluation (Task A) will include a total of 7 sample events at the passive nitrogen test facility, measuring 14 different analytes at 23 sampling points, as well as a final report on the pilot passive nitrogen removal study at the Gulf Coast Research and Education Center (GCREC).
Current Status as of April 15, 2011: A total of 5 sample events have been completed.
2. For field testing of technologies (Task B), the quality assurance project plan has been finalized. Approximately four onsite systems utilizing various nitrogen removal

technologies will be installed at home locations throughout the State of Florida. It is anticipated that four field system performance monitoring events will be conducted on these systems, measuring 16 different analytes at 2-8 different sampling points. A life cycle cost assessment template will also be completed.

Current Status as of April 15, 2011: Over ten homeowners have agreed to participate in the study to date for Tasks B and C and a final determination of which sites will be used for which task will be accomplished in the near future. At least one of the home sites will have a gravity-fed system installed. Construction will commence for one onsite system once permitting is approved.

3. To evaluate nitrogen reduction provided by soils and shallow groundwater (Task C), it is anticipated that a soil and groundwater test facility will be constructed to show how groundwater fate and transport of nitrogen occurs in multiple soil treatment unit regimes. Three sampling events will be completed, sampling six different locations at each site, measuring multiple parameters in the effluent, soil, groundwater, and soil moisture. Instrumentation of the existing OSTDS mound system at the University of Florida's Gulf Coast Research & Education Center (GCREC) in Wimauma, Florida will be done to study how nitrogen behaves in the soil and groundwater. Four sampling events, examining multiple parameters, will be completed at the existing OSTDS mound system at GCREC. At least one soil and groundwater monitoring event will occur at up to four home sites to evaluate nitrogen movement in the soil and groundwater in the field, measuring multiple parameters in the effluent, soil, and groundwater.

Current Status as of April 15, 2011: Testing of media components has commenced as per 381.0065(4)(m) F.S. and is required to be completed prior to construction of the soil and groundwater test facility. Instrumentation of the existing OSTDS mound system at GCREC has been completed and 2 sample events have been conducted. Over ten homeowners have agreed to participate in the study to date for Tasks B and C and a final determination of which sites will be used for which task will be accomplished in the near future. One home site has been selected and instrumentation has begun.

4. To address nitrogen fate and transport modeling for Task D, a final quality assurance project plan has been completed, and the first steps will include the development of a soil model to show how nitrogen is affected by treatment in Florida-specific soils.

Current Status as of April 15, 2011: Work has focused primarily on soil modeling under the current budget. Development of a soil model is underway and will be utilized to generate a simple tool for prediction of nitrogen removal in the unsaturated zone of Florida soils.

2 ANTICIPATED PROGRESS IN 2011-2012

During the 2011-2012 fiscal year, additional funding will be critical to complete the tasks associated with the final phase. These include: continuation and completion of field monitoring of performance and cost of technologies at home sites and of nitrogen fate and transport in the shallow groundwater; development of various nitrogen fate and transport models that will be calibrated with the field sampling results; and final reporting on all tasks with recommendations on onsite sewage nitrogen reduction strategies. In particular, the following work by task will occur with the final phase of funding, which is being requested with this report:

1. For Task A, the final task report will be written, which will include a summary of the accomplishments of the passive nitrogen removal test facility.
2. For Task B, it is anticipated that an additional four onsite systems utilizing various nitrogen removal technologies will be installed at home locations throughout the State of Florida, four field system performance monitoring events will be conducted

- on these systems, and final reporting on all of the field work associated with this task, including life cycle cost assessments, will be completed.
3. For Task C, monitoring events will occur at four home sites to evaluate nitrogen movement in the soil and groundwater in the field, and at six groundwater test areas at the soil and groundwater test facility to show how groundwater fate and transport of nitrogen occurs. Final reporting for this task will be completed.
 4. For Task D, the soil model will be completed and integrated with groundwater models which will be developed, calibrated, and validated, utilizing the results of the field work collected in previous tasks, and a final task report will be written summarizing the results of this task.

3 FUNDING NEEDS

Activities in fiscal years 2008-2011 have prepared the framework for rapid implementation of all remaining project tasks in fiscal year 2011-2012. Funding for fiscal year 2011-2012 is required to reap the benefits of all previous work and to complete the goals of this project. For the 2011-2012 budget year, \$2.2 million dollars is required to fund the completion of this study.

Funds appropriated and expended to date have established necessary viable protocols and have been appropriately used to test, calibrate, and refine technologies and strategies to be tested in the field. Without further funding for the final Phase 3 of the project, necessary and extensive field testing, the major portion of Task B, will not occur and, if field testing does not occur, the project will essentially not yield results that can be used to develop viable, cost-effective alternative passive technologies for use by homeowners for nitrogen issues associated with onsite systems.

Project Tasks (described previously) are broken down further into funding phases as follows:

Initial Funding in 2008-2010 (Phase I): \$900,000 appropriated (in 2008 and 2009 state budgets) – status: Complete. The initial funding was targeted to prioritize systems for testing, summarize existing knowledge, develop testing protocols, and establish a test facility for detailed soil and groundwater monitoring and for preliminary testing of pilot scale passive nitrogen reduction systems.

Funding in 2010-2011: \$2 million appropriated (in 2010 state budget) – status: Ongoing. This funding is for field monitoring over at least a one-year monitoring period of performance and cost of technologies at home sites, and of nitrogen fate and transport. This funding will also continue the development and monitoring work at the test facility and continue the modeling work.

Funding in 2011-2012: To adequately fund the final phase of the project, \$2.2 million will need to be appropriated during the 2011 legislative session. The preliminary results of the project are encouraging. Further testing is required to verify the results to date and to provide data for development of the engineering specifications for full system designs. The funds will be used to complete monitoring and other field activities, additional testing as deemed appropriate by the Legislature, and final reporting with recommendations on onsite sewage nitrogen reduction strategies for Florida's future.

Further information on this project, including previous legislative reports and detailed project reports, can be found on the Department's website:

<http://www.doh.state.fl.us/environment/ostds/research/Nitrogen.html>

Table 1. Summary of Funding Phase Tasks and Associated Number of Deliverables.

Task	Phase I ^a \$900,000 (July 2008- November 2010, completed)	Phase II ^a \$2,000,000 (Current Funding, in progress)	Phase III ^a \$2,200,000 (Future Funding, yet to be funded)
A Task A: Technology Selection & Prioritization	\$352,144	\$399,136	\$35,480
Literature review	1		
Ranking of nitrogen reduction technologies for field testing	1		
Design and construction of test facility	1		
Quality assurance project plan	1		
Monitoring and sample events		7	
Final test facility report		1	
Final task report			1
B Task B: Field Testing of Technologies	\$50,202	\$471,035	\$559,115
Quality assurance project plan		1	
Installation of ranked nitrogen reduction technologies at 8 field sites		4	4
System performance monitoring events at 8 sites		4	4
Life cycle cost assessment template development		1	
Final life cycle cost assessment report (per system)			8
Final task report			1
C Task C: Evaluation of Nitrogen Reduction by Soils & Shallow Groundwater	\$216,164	\$1,027,848	\$662,940
Quality assurance project plan	1		
Design of test facility	1		
Construction of test facility		1	
Monitoring and sample events (6 test areas)		3	3
Instrumentation of existing OSTDS mound at GCREC facility		1	
GCREC mound sample events		4	
Field sites sample events (4 sites)		1	3
Final task report			1
D Task D: Nitrogen Fate and Transport Models	\$74,357	\$93,857	\$639,808
Quality assurance project plan	0.5 (draft)	0.5 (final)	
Soil model		1	
Shallow groundwater models			1
Calibration of models to existing data sets			1
Uncertainty analysis for models			1
Validation and refinement of models			1
Final task report			1
Project Management (sum of contractor and DOH)	\$119,953	\$95,304	\$302,657
Contractor project management	\$90,695	\$77,932	\$249,247
DOH project management	\$29,258	\$17,372 ^b	\$53,410 ^b
Total Budget^c	\$812,820	\$2,087,180	\$2,200,000
Total Budget Remaining as of April 15, 2011	\$0	\$1,886,919	\$2,200,000

a. Numbers in each subtask represent the numbers of budgeted deliverables.

b. DOH project management costs for Phases II and III are estimated costs.

c. Budgeted totals differ from the legislative funding amounts due to scheduling.

DOH – Department of Health

GCREC – Gulf Coast Research & Education Center

OSTDS – Onsite Sewage Treatment and Disposal Systems

4 RECOMMENDATIONS

DOH and its Research Review and Advisory Committee recommend that the Legislature:

1. Provide funding and budget authority to DOH in the amount of \$2.2 million for the fiscal year 2011-2012 for continuation and completion of the tasks associated with the legislatively mandated Florida Onsite Sewage Nitrogen Reduction Strategies Study.
2. Provide DOH budget authority for any remaining funds from the 2010 appropriation to carry over to fiscal year 2011-2012.

This additional funding will be applied to the final phase of the project, primarily continuation and completion of field monitoring of performance and cost of technologies at home sites and of nitrogen fate and transport in the shallow groundwater, development of various nitrogen fate and transport models that will be calibrated with the field sampling results, and final reporting on all tasks with recommendations on onsite sewage nitrogen reduction strategies.

Continued support for this project will ultimately benefit Florida's approximately 2.7 million onsite system owners by finding cost-effective nitrogen reduction strategies that will improve environmental and public health protection. If fully funded, the results of this project will assist with producing nitrogen reducing systems that protect groundwater with both reduced life-cycle costs and lower energy demands.

APPENDIX A. 2010 Legislative Language

SECTION 3 – HUMAN SERVICES

486 SPECIAL CATEGORIES

CONTRACTED SERVICES

FROM GENERAL REVENUE FUND	153,772
FROM ADMINISTRATIVE TRUST FUND . . .	337,765
FROM FEDERAL GRANTS TRUST FUND . . .	348,235
FROM GRANTS AND DONATIONS TRUST FUND	2,648,438
FROM RADIATION PROTECTION TRUST FUND	150,000

From the funds in Specific Appropriation 486, \$2,000,000 from the Grants and Donations Trust Fund is provided to the department to continue phase II and complete the study authorized in Specific Appropriation 1682 of chapter 2008-152, Laws of Florida. The report shall include recommendations on passive strategies for nitrogen reduction that complement use of conventional onsite wastewater treatment systems. The department shall submit an interim report of phase II on February 1, 2011, a subsequent status report on May 16, 2011, and a final report upon completion of phase II to the Governor, the President of the Senate, and the Speaker of the House of Representatives prior to proceeding with any nitrogen reduction activities.

Section 14. In order to implement Specific Appropriation 486 of the 2010-2011 General Appropriations Act, and for the 2010-2011 fiscal year only, the following requirements shall govern Phase 2 of the Department of Health's Florida Onsite Sewage Nitrogen Reduction Strategies Study:

(1) The underlying contract for which the study was let shall remain in full force and effect with the Department of Health and funding the contract for Phase 2 of the study shall be through the Department of Health.

(2) The Department of Health, the Department of Health's Research Review and Advisory Committee, and the Department of Environmental Protection shall work together to provide the necessary technical oversight of Phase 2 of the project, with the Department of Environmental Protection having maximum technical input.

(3) Management and oversight of Phase 2 shall be consistent with the terms of the existing contract; however, the main focus and priority for work to be completed for Phase 2 shall be in developing, testing, and recommending cost-effective passive technology design criteria for nitrogen reduction.

(4) The systems installed at actual home sites are experimental in nature and shall be installed with significant field testing and monitoring. The Department of Health is specifically authorized to allow installation of these experimental systems. In addition, before Phase 2 of the study is complete and notwithstanding any law to the contrary, a state agency may not adopt or implement a rule or policy that:

(a) Mandates, establishes, or implements any new nitrogen-reduction standards that apply to existing or new onsite sewage treatment systems or modification of such systems;

(b) Increases the cost of treatment for nitrogen reduction from onsite sewage treatment systems; or

(c) Directly requires or has the indirect effect of requiring, for nitrogen reduction, the use of performance-based treatment systems or any similar technology; provided the Department of Environmental Protection administrative orders recognizing onsite system modifications, developed

through a basin management action plan adopted pursuant to section 403.067, Florida Statutes, are not subject to the above restrictions where implementation of onsite system modifications are phased in after completion of Phase 2, except that no onsite system modification developed in a basin management action plan shall directly or indirectly require the installation of performance-based treatment systems.

SECTION 3 - HUMAN SERVICES

ENVIRONMENTAL HEALTH SERVICES

	APPROVED SALARY RATE	9,769,560		
459	SALARIES AND BENEFITS	POSITIONS	215.50	
	FROM GENERAL REVENUE FUND		1,684,847	
	FROM ADMINISTRATIVE TRUST FUND			2,359,097
	FROM FEDERAL GRANTS TRUST FUND			1,612,406
	FROM GRANTS AND DONATIONS TRUST FUND			1,896,302
	FROM RADIATION PROTECTION TRUST FUND			6,143,674
460	OTHER PERSONAL SERVICES			
	FROM ADMINISTRATIVE TRUST FUND			71,060
	FROM FEDERAL GRANTS TRUST FUND			131,791
	FROM GRANTS AND DONATIONS TRUST FUND			130,415
	FROM RADIATION PROTECTION TRUST FUND			33,393
461	EXPENSES			
	FROM GENERAL REVENUE FUND	209,662		
	FROM ADMINISTRATIVE TRUST FUND			978,799
	FROM FEDERAL GRANTS TRUST FUND			348,011
	FROM GRANTS AND DONATIONS TRUST FUND			321,055
	FROM RADIATION PROTECTION TRUST FUND			1,734,991
462	AID TO LOCAL GOVERNMENTS			
	CONTRIBUTION TO COUNTY HEALTH UNITS			
	FROM GENERAL REVENUE FUND	2,200,270		
	FROM ADMINISTRATIVE TRUST FUND			427,426
	FROM GRANTS AND DONATIONS TRUST FUND			2,194,571
463	OPERATING CAPITAL OUTLAY			
	FROM ADMINISTRATIVE TRUST FUND			15,000
	FROM FEDERAL GRANTS TRUST FUND			31,698
	FROM RADIATION PROTECTION TRUST FUND			56,997
464	SPECIAL CATEGORIES			
	ACQUISITION OF MOTOR VEHICLES			
	FROM ADMINISTRATIVE TRUST FUND			80,000
	FROM RADIATION PROTECTION TRUST FUND			130,856
465	SPECIAL CATEGORIES			
	CONTRACTED SERVICES			
	FROM GENERAL REVENUE FUND	97,489		
	FROM ADMINISTRATIVE TRUST FUND			335,165
	FROM FEDERAL GRANTS TRUST FUND			643,776
	FROM GRANTS AND DONATIONS TRUST FUND			3,401,038
	FROM RADIATION PROTECTION TRUST FUND			150,000
* 466	SPECIAL CATEGORIES			
	GRANTS AND AIDS - CONTRACTED SERVICES			
	FROM FEDERAL GRANTS TRUST FUND			750,000

* From the funds in Specific Appropriation 465, \$2,725,000 in nonrecurring funds from the Grants and Donations Trust Fund is provided to the department to complete phase II and phase III and complete the study authorized in Specific Appropriation 1682 of chapter 2008-152, Laws of Florida. The report shall include recommendations on passive strategies for nitrogen reduction that complement use of conventional onsite wastewater treatment systems. The department shall submit an interim report of the completion of phase II and progress on phase III on February 1, 2012, a subsequent status report on May 16, 2012, and a final report upon completion of phase III to the Governor, the President of the Senate, and the Speaker of the House of Representatives prior to proceeding with any nitrogen reduction activities.

**ENROLLED SB 2002, 2nd Engrossed
2011 Legislature**

Section 7. In order to implement Specific Appropriation 465 of the 2011-2012 General Appropriations Act, and for the 2011-2012 fiscal year only, the following requirements govern the completion of Phase 2 and Phase 3 of the Department of Health's Florida Onsite Sewage Nitrogen Reduction Strategies Study:

(1) The Department of Health's underlying contract for the study remains in full force and effect and funding for completion of Phase 2 and Phase 3 is through the Department of Health.

(2) The Department of Health, the Department of Health's Research Review and Advisory Committee, and the Department of Environmental Protection shall work together to provide the necessary technical oversight of the completion of Phase 2 and 338 Phase 3 of the project.

(3) Management and oversight of the completion of Phase 2 and Phase 3 must be consistent with the terms of the existing contract. However, the main focus and priority to be completed during Phase 3 shall be developing, testing, and recommending cost-effective passive technology design criteria for nitrogen reduction.

(4) The systems installed at homesites are experimental in nature and shall be installed with significant field testing and monitoring. The Department of Health is specifically authorized to allow installation of these experimental systems.

Notwithstanding any other law, before Phase 3 of the study is completed, a state agency may not adopt or implement a rule or policy that:

(a) Mandates, establishes, or implements more restrictive nitrogen-reduction standards to existing or new onsite sewage treatment systems or modification of such systems; or

(b) Directly or indirectly requires the use of performance-based treatment systems or similar technology, such as through an administrative order developed by the Department of Environmental Protection as part of a basin management action plan adopted pursuant to s. 403.067, Florida Statutes. However, the implementation of more restrictive nitrogen-reduction standards for onsite systems may be required through a basin management action plan if such plan is phased in after completion of Phase 3.

**FLORIDA DEPARTMENT OF HEALTH
ONSITE NITROGEN REDUCTION STRATEGIES STUDY**

**PROGRESS REPORT NO. 11
(June, 2011)**

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A – Technology Evaluation for Field Testing: Review, Prioritization, and Development				
Task A.1, Draft Literature Review Report	Task Complete	Draft literature review report completed on May 19, 2009.	None	N/A
Task A.2, Final Literature Review Report	Task Complete	Final literature review report completed on June 30, 2009. Revised Final report submitted on September 4, 2009.	None	N/A
Task A.3, Draft Classification of Technologies Report	Task Complete	Draft Classification, Ranking and Prioritization report completed on May 19, 2009.	None	N/A
Task A.4, Draft Technology Ranking Criteria Report	Task Complete	Draft Classification, Ranking and Prioritization report completed on May 19, 2009.	None	N/A
Task A.5, Draft Priority List for Testing Report	Task Complete	Draft Prioritization report completed on June 30, 2009.	None	N/A
Task A.6, Technology Classification, Ranking and Prioritization Workshop	Task Complete	Workshop presentation materials were developed. Workshop was conducted on May 28, 2009.	None	N/A
Task A.7, Final Classification of Technologies Report	Task Complete	Final Classification, Ranking and Prioritization report completed on September 24, 2009	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A.8, Final Technology Ranking Criteria Report	Task Complete	Final Classification, Ranking and Prioritization report completed on September 24, 2009	None	N/A
Task A.9, Final Priority List for Testing Report	Task Complete	Final Classification, Ranking and Prioritization report completed on September 24, 2009	None	N/A
Task A.10, Draft Innovative Systems Applications Reports	Not started	No activity	N/A	N/A
Task A.11, Final Innovative Systems Applications Reports	Not started	No activity	N/A	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A.12, Identification of Test Facility Sites	Task Complete	<p><i>USF Lysimeter Station</i> – A general assessment of lysimeter station rehabilitation needs has been determined and is summarized in a memorandum completed on June 18, 2009.</p> <p><i>UF Gulf Coast Research and Education Center</i> – Preliminary agreement from GCREC to participate on December 22, 2008. A summary of the site conditions and recommendations was sent to Elke and distributed May 19, 2009. On May 28, 2009 the RRAC voted to use the GCREC facility site as the only test facility site. Draft agreement submitted to GCREC on June 8, 2009, and returned to FDOH July 31, 2009 with revisions. Comments from review by FDOH received November 11, 2009. Draft letter of authorization for GCREC sent February 2, 2010 to FDOH. MOU signed June 1, 2010.</p>	Lysimeter station rehabilitation costs alone were likely to be in excess of \$60,000, which exceed the total construction budget for the Task A test facility.	We are recommending consolidating our activities to one test facility. We recommended to conduct all test facility activities at GCREC site
Task A.13, Draft QAPP PNRS II	Task Complete	Draft QAPP for PNRS II report completed on June 18, 2009.	None	N/A
Task A.14, Recommendation for Process Forward Meeting	Task Complete	Recommendation for Process Forward meeting held on October 13, 2009. Task completed upon execution of contract amendment in February 2010.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A.15, Final QAPP PNRS II	Task Complete	Final QAPP for PNRS II report completed on November 24, 2009. Revised and amended for additives rule report completed on February 4, 2010. Amended report for sodium sesquicarbonate media completed on June 4, 2010.	None	N/A
Task A.16 Materials Testing for FDOH Additives Rule	Underway	<p>Florida additive rule for septic system products, evaluation of limestone and oyster shell, report completed on June 30, 2010.</p> <p>Florida additive rule for septic system products, evaluation of effluent of biofilters containing clinoptilolite, elemental sulfur, and lignocellulosic material report completed on April 15, 2011 and revised June 12, 2011.</p> <p>Additional WET testing on the effluent from bioreactor In-situ 1 (UNSAT-IS1) completed on July 29, 2011.</p>	None	N/A
Task A.17, PNRS Specification Reports	Underway	Specification report I completed on May 7, 2010. A revised final report was completed on May 24, 2010.	None	N/A
Task A.18, Test Facility Design 50%	Task Complete	50% revised Design Drawings completed on September 4, 2009.	None	N/A
Task A.19, Test Facility Design 100%	Task Complete	100% Design Drawings completed on December 31, 2009.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A.20 PNRS II Test Facility Construction Support & Administration	Task Complete	Construction was started February 15, 2010. 50% construction completed April 2, 2010. 100% construction completed April 30, 2010.	None	N/A
Task A.21 PNRS II Test Facility Construction 50%	Task Complete	Construction was started February 15, 2010, 50% construction progress report completed on April 2, 2010.	None	N/A
Task A.22 PNRS II Test Facility Construction 100%	Task Complete	100% construction progress report completed on April 30, 2010.	None	N/A
Task A.23 PNRS II Test Facility Construction Substantial Completion	Task Complete	Construction punch list completed on April 27, 2010.	None	N/A
Task A.24 PNRS II Test Facility Accept Construction	Task Complete	As-built documents completed on May 28, 2010.	None	N/A
Task A.25 Monitoring & Sample Event Reports	Underway	Sample Event Report (SER) No. 1 completed on July 16, 2010. SER No. 2 completed on September 28, 2010. SER No. 3 completed on December 16, 2010. SER No. 4 completed on February 2, 2011. SER No. 5 completed on May 12, 2011. SER No. 6 completed on June 9, 2011.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task A.26 Data Summary Reports	Underway	Data Summary Report (DSR) No. 1 completed on September 2, 2010. DSR No. 2 completed on October 5, 2010. DSR No. 3 completed on January 20, 2011. DSR No. 4 completed on March 4, 2011. DSR No. 5 completed on May 12, 2011. DSR No. 6 completed on July 5, 2011.	None	N/A
Task A.27 Draft PNRS II Report	Not started	No activity	N/A	N/A
Task A.28 Final PNRS II Report	Not started	No activity	N/A	N/A
Task A.31 Change-order Allowance	Underway	FDOH authorized \$20,000 for the PNRS II modifications completed December 16, 2010. FDOH authorized \$19,000 to perform a simulation of bioreactor filtration treatment of onsite wastewater April 4, 2011.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task B – Field Testing of Technologies and Cost Documentation				
Task B.1, Identification of Home Sites	Underway	Several home sites in Manasota Key, Wakulla County, Seminole County, Lee County, Hillsborough County and Marion County have been visited to perform preliminary evaluation of sites with homeowners interested in the project. Two Wakulla County homeowner agreements completed on October 5, 2010. One Hillsborough County homeowner agreement completed on March 4, 2011. One Seminole County homeowner agreement completed on April 25, 2011. Two Seminole County, one Marion County, one Wakulla County and one Lee County homeowner agreement completed on July 6, 2011.	None	N/A
Task B.2, Vendor Agreement Reports	Underway	Started work on vendor agreements. One vendor agreement completed on April 13, 2011.	None	N/A
Task B.3, Draft QAPP for Field Testing	Task Complete	Draft QAPP for field testing report completed on July 16, 2010.	None	N/A
Task B.4, Recommendation for Process Forward Meeting	Task Complete	Conference call meeting was held on October 11, 2010. Meeting minutes were submitted on November 1, 2010.	None	N/A
Task B.5, Final QAPP Field Testing	Task Complete	Final QAPP for field testing report completed on November 1, 2010.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task B.6 Field Systems Installation Report (per system)	Underway	B-HS1, located in Wakulla County, Nitrex™ system installation completed on June 10, 2011. Installation report completed on July 6, 2011.	None	N/A
Task B.7 Field Systems Monitoring Report (per event)	Not started	No activity	N/A	N/A
Task B.11, LCCA Template Report (draft)	Not started	No activity	N/A	N/A
Task B.12 LCCA Template Report (final)	Not started	No activity	N/A	N/A
Task B.16 Change-order Allowance	Underway	FDOH authorized \$3,718.05 for RRAC meeting attendance on March 24, 2011. FDOH authorized \$4,702 for the third sample for Task A.16 additives testing completed on April 15, 2011. FDOH authorized \$2,131 for an additional WET test on UNSAT-IS1 effluent for Task A.16 additives testing completed on July 29, 2011.	N/A	N/A
Task C – Evaluation of Nitrogen Reduction Provided by Soils and Shallow Groundwater				
Task C.1, Draft Literature Review on Nitrogen Reduction in Soils & Shallow GW Report	Task Complete	Draft Literature Review on nitrogen reduction in soils and shallow groundwater report completed on June 30, 2009.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task C.2, Final Literature Review on Nitrogen Reduction in Soils & Shallow GW Report	Task Complete	Final Literature Review on nitrogen reduction in soils and shallow groundwater report completed on November 24, 2009.	None	N/A
Task C.3, Draft QAPP Evaluation of Nitrogen Reduction Provided by Soils & Shallow GW	Task Complete	Draft QAPP on nitrogen reduction in soils and shallow groundwater report completed on October 30, 2009.	None	N/A
Task C.4, Recommendation for Process Forward Meeting	Task Complete	Conference call meeting was held on November 23, 2009. Meeting minutes submitted on November 25, 2009 served as half of the deliverable. Task complete upon completion of contract amendment executed February 2010.	None	N/A
Task C.5, Final QAPP Evaluation of Nitrogen Reduction Provided by Soils & Shallow GW	Task Complete	Final QAPP on nitrogen reduction in soils and shallow groundwater report was submitted on December 4, 2009. Determined to be 80% complete on December 23, 2009. Revisions completed February 5, 2010.	None	N/A
Task C.6, S&GW Test Facility Design 50%	Task Complete	Test Facility Design 50% drawings completed on June 30, 2009.	None	N/A
Task C.7, S&GW Test Facility Design 100%	Task Complete	100% Design Drawings completed on December 31, 2009	None	N/A
Task C.8, S&GW Test Facility Design Final	Task Complete	Final S&GW Test Facility Design completed on March 4, 2010.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task C.9, S&GW Test Facility Construction Support & Administration	Not started	No activity	N/A	N/A
Task C.10, S&GW Test Facility Construction 50%	Not started	No activity	N/A	N/A
Task C.11, S&GW Test Facility Construction 100%	Not started	No activity	N/A	N/A
Task C.12, S&GW Test Facility Construction Substantial Completion	Not started	No activity	N/A	N/A
Task C.13, S&GW Test Facility Accept Construction	Not started	No activity	N/A	N/A
Task C.14, Soils & Hydrogeologic & Monitoring Plan for S&GW Test Facility	Underway	Started work on soils, hydrogeologic and monitoring plan for S&GW test facility.	N/A	N/A
Task C.15, Tracer Testing at GCREC	Underway	A tracer test at the GCREC mound site was started April 6, 2011. Tracer Test Memo No. 1 completed on July 6, 2011.	N/A	N/A
Task C.16 S&GW Sample Event Report	Not started	No activity	N/A	N/A
Task C.17 S&GW Data Summary Report	Not started	No activity	N/A	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task C.19 Field Site Selection	Underway	Several home sites in Wakulla County, Lee County, Seminole County and Marion County have been visited to perform preliminary evaluation of sites with homeowners interested in the project. One Wakulla County homeowner agreement completed on October 5, 2010. One Seminole County homeowner agreement completed on April 25, 2011. Two Seminole County, one Marion County, and one Hillsborough County homeowner agreement completed on July 6, 2011.	None	N/A
Task C.20 Instrumentation of GCREC Mound System	Task Complete	Instrumentation of GCREC Mound system 100% progress report completed on December 16, 2010.	None	N/A
Task C.21 GCREC Mound Sample Event Report	Underway	GCREC Mound Sample Event Report (SER) No. 1 completed on March 7, 2011. SER No. 2 completed on May 12, 2011. SER No. 3 completed on July 6, 2011.	N/A	N/A
Task C.22 GCREC Mound Data Summary Report	Underway	GCREC Mound data summary report (DSR) No. 1 completed on May 12, 2011. DSR No. 2 completed on July 6, 2011.	N/A	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task C.23 Instrumentation of Remaining Field Sites	Underway	Instrumentation at C-HS1 located in Wakulla County completed in May 2011. Instrumentation report completed on July 6, 2011. Instrumentation at C-HS2 located in Seminole County completed in July 2011. Instrumentation report completed August 17, 2011. Instrumentation at C-HS3 located Seminole County was started in July 2011.	Karst geology encountered at C-HS1 site has caused difficulty in installing monitoring points and determining groundwater flow direction.	N/A
Task C.24 Field Sites Sample Event Reports	Underway	C-HS1 Sample Event Report (SER) No. 1 completed on July 6, 2011. C-HS2 Sample Event Report (SER) No. 1 completed on August 17, 2011.	N/A	N/A
Task C.25 Field Sites Data Summary Report	Underway	C-HS1 Data Summary Report (DSR) No. 1 completed on July 6, 2011.	N/A	N/A
Task C.30 Change-order Allowance	Not started	No activity	N/A	N/A
Task D – Nitrogen Fate and Transport Modeling				
Task D.1, Draft Literature Review on Nitrogen Fate & Transport Model Report	Task Complete	Draft Literature Review on nitrogen fate and transport model report completed on June 30, 2009.	None	N/A
Task D.2, Final Literature Review on Nitrogen Fate & Transport Model Report	Task Complete	Final Literature Review on nitrogen fate and transport model report completed on December 4, 2009. Determined to be 80% complete on December 23, 2009. Revised report complete on February 5, 2010.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task D.3, Selection of Existing Data Set for Calibration Report	Task Complete	Selection of Existing Data Set for Calibration report completed on June 30, 2009.	None	N/A
Task D.4, Draft QAPP N Fate and Transport Modeling	Task Complete	Draft QAPP report completed on April 2, 2010.	None	N/A
Task D.5, Recommendation for Process Forward	Task Complete	Conference call meeting was held on July 13, 2010. Meeting minutes submitted on August 14, 2010.	None	N/A
Task D.6, Final QAPP N Fate and Transport Modeling	Task Complete	Final QAPP report completed on September 22, 2009.	None	N/A
Task D.7 Simple Soil Model Development	Not started	No activity	N/A	N/A
Task D.14 Complex Soil Model Development	Underway	Started work on complex soil model development.	None	N/A
Task D.29 Change-order Allowance	Not started	No activity	N/A	N/A
Task E – Project Management, Coordination and Meetings				
Task E.1, Project Kick-off Meeting	Task Complete	The project kick-off meeting was held February 27, 2009. Meeting minutes were completed on March 19, 2009.	None	N/A
Task E.2, PM-Project Progress Report	Progress Report 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 - Complete	The July 2011 quarterly progress report (this report) was completed August 1, 2011.	None	N/A

Task	Task Status	Activity this Period	Technical, Schedule, or Budget Problems Encountered	Recommended Methods to Resolve Problems
Task E.3, RRAC or TRAP Presentation	Underway	RRAC meeting was attended and a presentation given on July 1, 2009; March 23, 2010; and June 10, 2010. TRAP meeting was attended and a presentation given August 27, 2009. RRAC meeting presentation and tour of GCREC PNRS II facility was given December 10, 2010.	None	N/A
Task E.4 RRAC or TRAP Meeting Attendance	Underway	RRAC meeting was attended: <ul style="list-style-type: none"> • December 16, 2009 • November 5, 2010 • March 24, 2011 • April 20, 2011 	None	N/A
Task E.4, PAC Meeting	Not started	No activity	N/A	N/A

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FLORIDA DEPARTMENT OF
HEALTH

**EFFECTIVE, USER-FRIENDLY
NITROGEN REDUCING ONSITE
WASTEWATER SYSTEMS**

by
**Josefin E. Hirst, P.E. and
Damann L. Anderson, P.E.**

**NEHA 2011 AEC – OWS Summit
June 18th, 2011**

UF FLORIDA
Center for Research
and Education Center

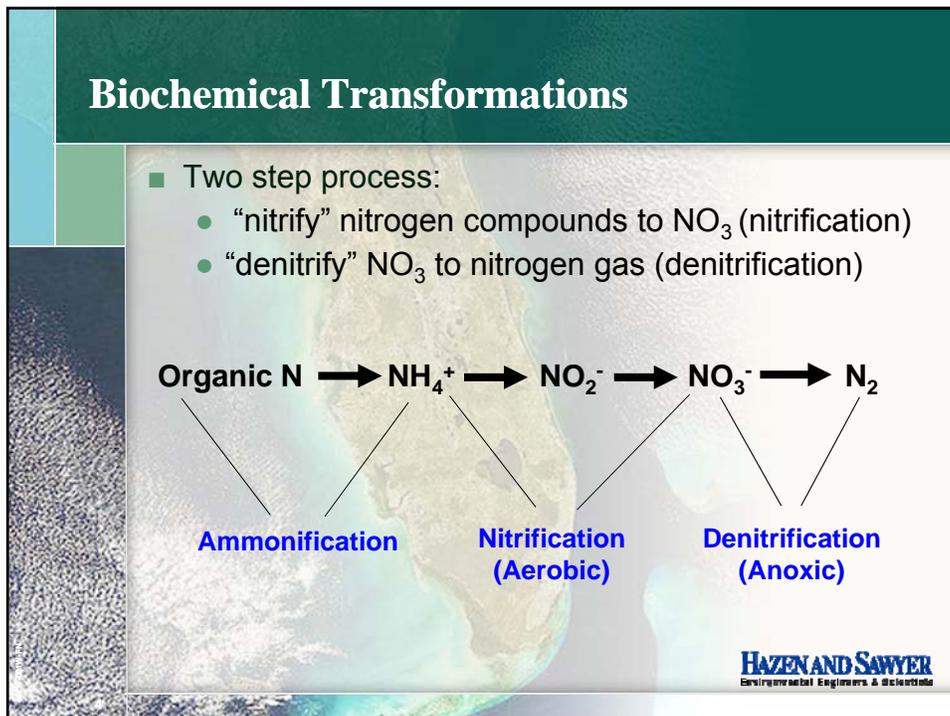
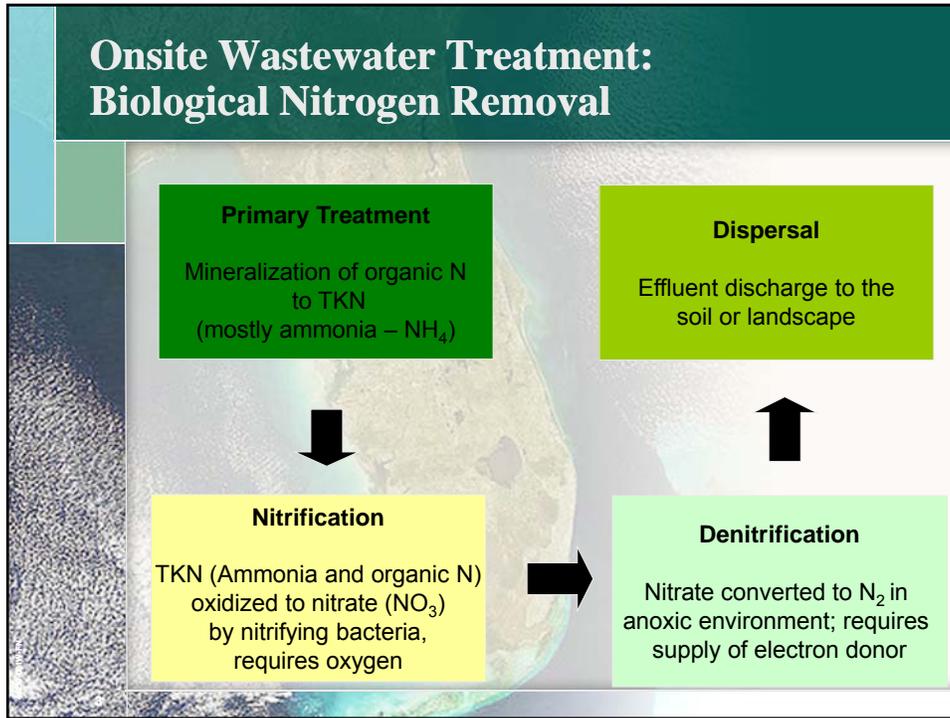
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Presentation Overview

- “Passive” Nitrogen Reduction Systems
- FOSNRS Project Background
- Literature Review
- Review of PNRS I
- PNRS II
- What’s Next?
- Summary
- Questions and Answers

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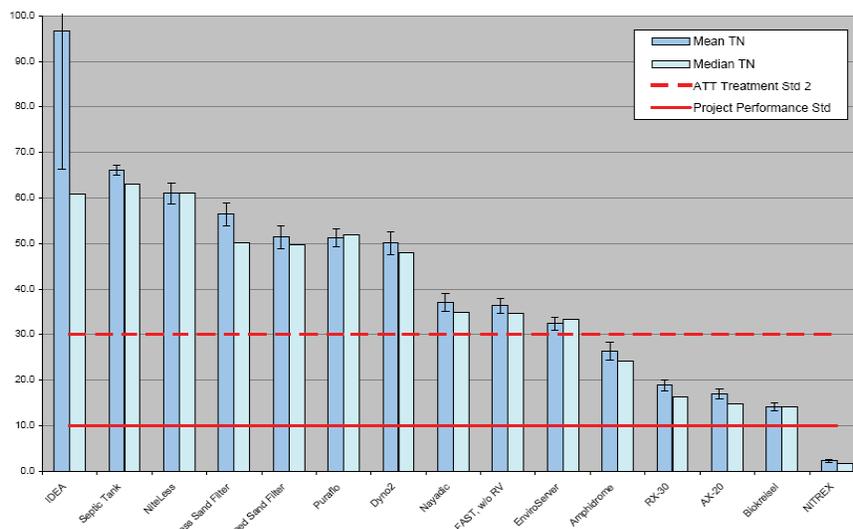


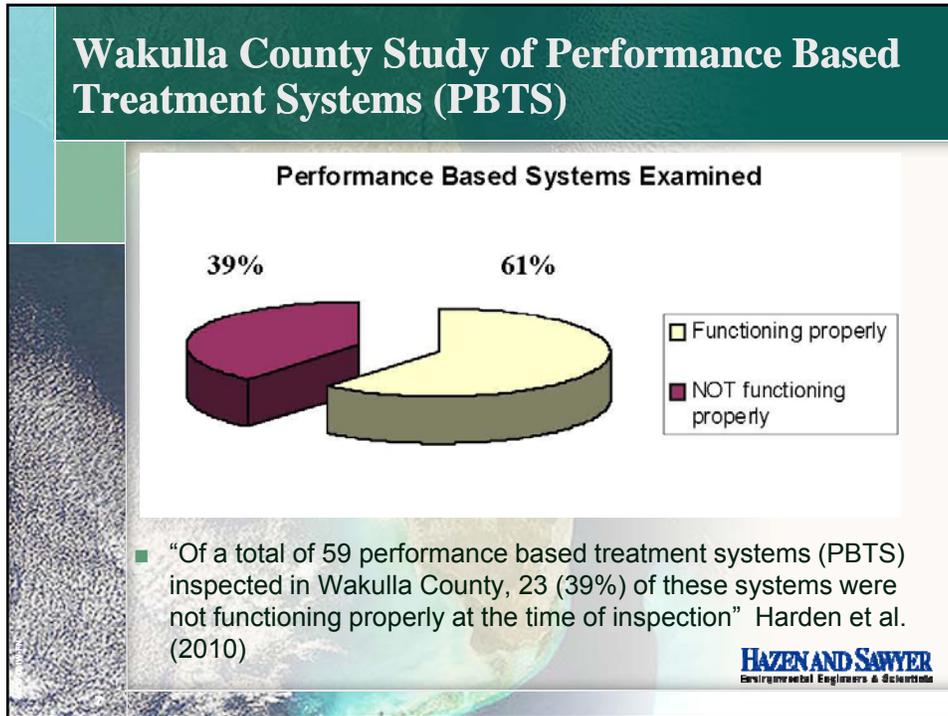
What are “Passive” nitrogen reduction systems?

- Most N-removing onsite systems currently used in FL are mechanical treatment units utilizing an activated sludge biological process, typically utilizing pumps, blowers and other controls.
- “Passive” nitrogen removal is intended to describe nitrogen reducing OSTDS that are more similar to conventional onsite systems in their operation and maintenance.
- Passive nitrogen removal systems are those that achieve TN concentrations of ≤ 10 mg/L using a “reactive media” for denitrification, and no more than 1 pump, if necessary.

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Performance of N-Reduction Systems (La Pine National Demonstration Project)



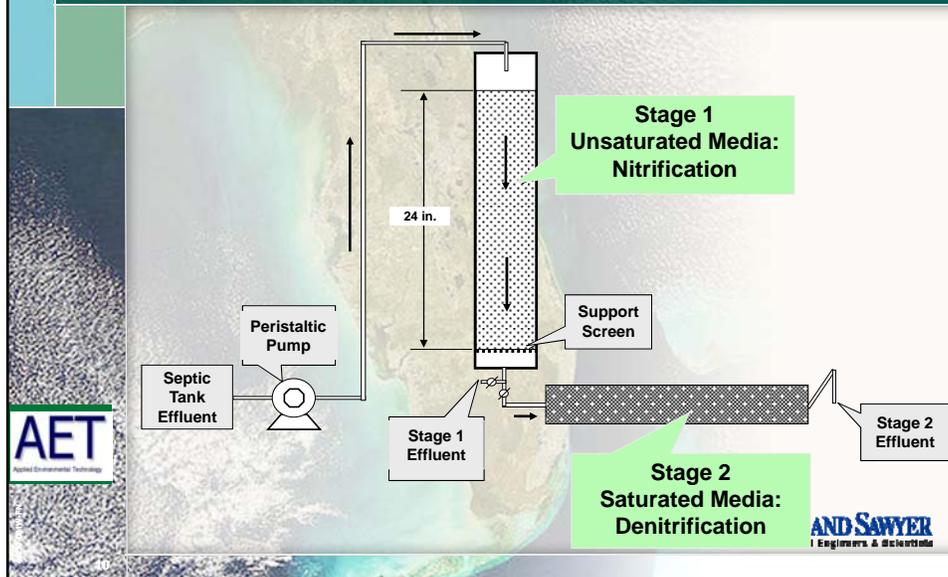


- ### Florida Project Background
- Laws of Florida, 2008-152, directed FDOH to conduct a study to further develop more “*passive*” & cost-effective nitrogen reduction strategies for OSTDS
 - Initiated the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Project in 2009
 - This presentation focuses on preliminary project results from passive biofilters with sulphur-based denitrification processes
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Previous Studies of Sulphur-based Denitrification

Reference	Denitrification Media	Results
Kanter, Tyler and Converse (1998)	Sulphur/Dolomite Sulphur: <2.5 mm	TN Removal: 87.9% Nitrified Influent: 23.5 mg-N/L Effluent: 3.0 mg-N/L
Sengupta and Ergas (2006)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 4.7 mm	NO ₃ -N Removal: 80% Influent: 2-32 mg NO ₃ -N/L Effluent: 4.2 mg NO ₃ -N/L
Brighton (2007)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 81.7% Nitrified Influent: 23 mg-N/L Effluent: 4.2 mg-N/L
Smith et al. (2008)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 93.8% Nitrified Influent: 35.2 mg-N/L Effluent: 2.2 mg-N/L

Bench-Scale Passive Two Stage Biofiltration (Smith et al., 2008)



Bench-Scale Passive Nitrogen Removal Study (Smith et. al., 2008)

- 8 months operation of bench-scale units at Flatwoods Park, Hillsborough County
- Elemental sulphur as electron donor for denitrification
- 97% nitrogen reduction from septic tank effluent



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Bench Scale Passive Nitrogen Removal Study

PNRS I Results (Smith, 2008)

- Showed feasibility of passive two stage biofiltration
- One pump, no aerators, reactive media
- Continuous 24/7 operation for 8 months
- Proof of passive 2-stage biofiltration concept provided

Treatment Media	Effluent TN (mg/L)	TN Reduction (%)
Zeolite & Sulphur Media	2.2	97
Expanded Clay & Sulphur	2.6	96.2

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Pilot-Scale Passive Nitrogen Removal Study

PNRS II Objectives

- Follow up to PNRS I with larger, pilot scale units and various media
- Develop detailed performance data for passive biofiltration designs
- Produce scalable design data from pilot scale biofilters for subsequent full-scale testing

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Passive Nitrogen Removal Study II

PNRS II Approach

- Establish test facility at Gulf Coast Education and Research Center (University of Florida IFAS)
- Test program for in-vessel and in-situ pilot systems
- Operate on septic tank effluent for 12 months
- Various nitrification and denitrification biofilters to be tested

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Unique Pilot Facility Constructed at UF Center



Source: <http://gcrc.ifas.ufl.edu/>

Gulf Coast Research and Education Center

- University of Florida, Institute for Food & Agricultural Sciences (IFAS)
- 475 acres of land in SE Hillsborough County
- Facility conducts agricultural research & trials for vegetables, fruit and ornamental plants
- 16 laboratories housed onsite (1 water quality lab)

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Significant Features

- Two-stage biofilters:
 1. Nitrification
 2. Denitrification
- Stage 1 unsaturated filter: 2 layer stratification design with 2 media depths
- Evaluate lignocellulosic and sulphur based Stage 2 denitrification biofilters
- Couple first stage recycle (mixed biomass) to denitrification (separate stage biomass)
- Test reactive media in in-ground systems

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PNRS II Test Facility Construction



This collage illustrates the construction of the PNRS II Test Facility. It features four main photographs: 'Setting up tanks' shows a row of white cylindrical tanks on a wooden platform; 'Gravel underdrain' shows a circular view of gravel in a tank; 'Mixing media batches' shows a yellow rotating drum; and a fourth photo shows a close-up of a gravel surface. The Hazen and Sawyer logo is in the bottom right.

Setting up tanks

Gravel underdrain

Mixing media batches

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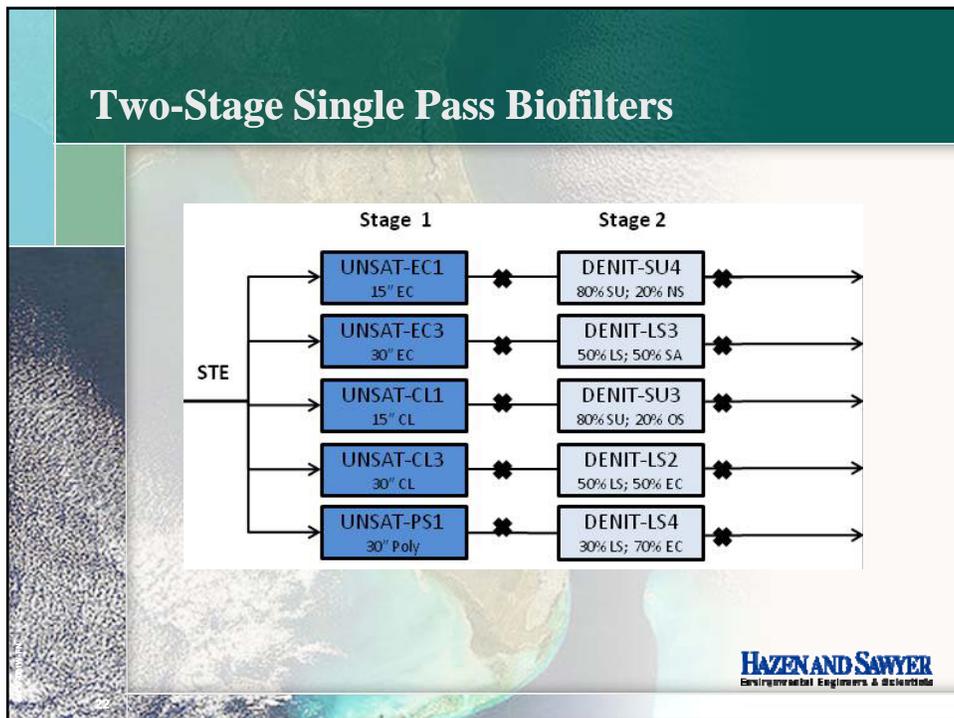
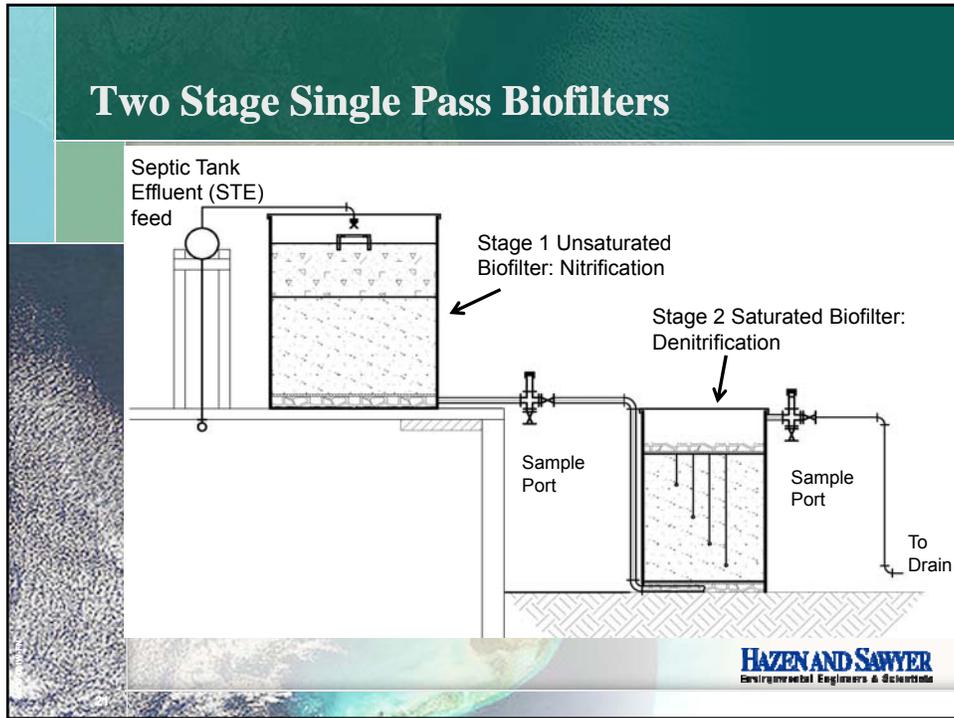
Placing media in tanks

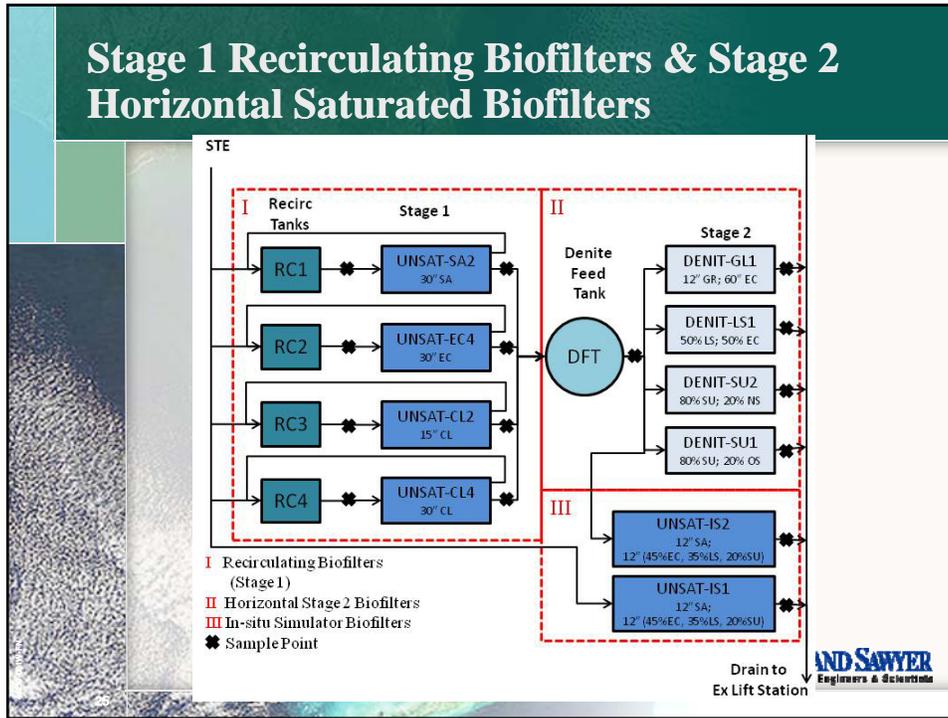


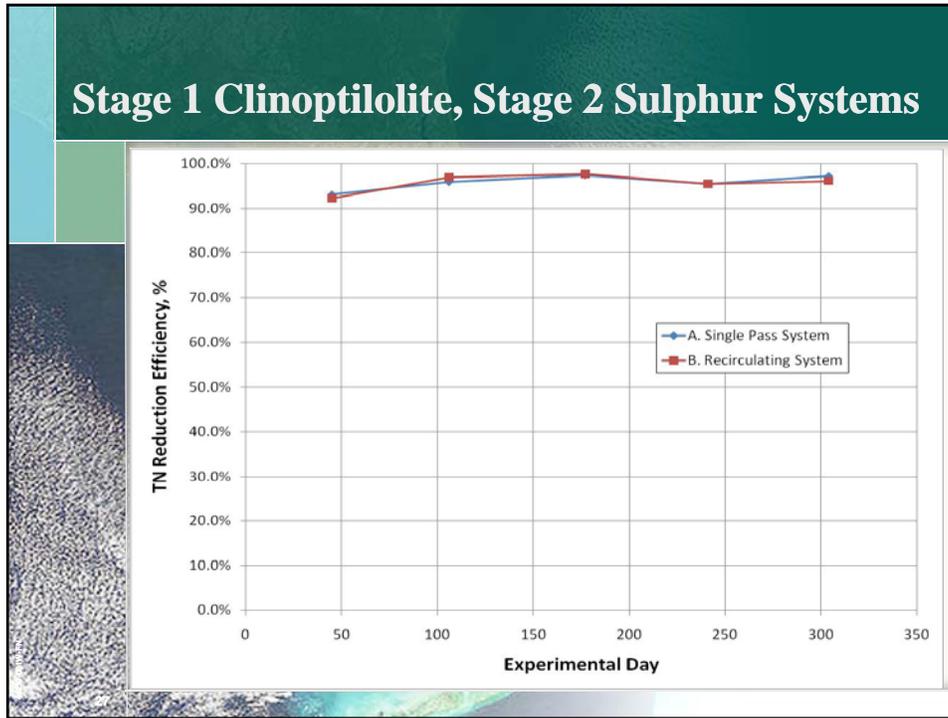
This collage shows the process of placing media into the tanks. It includes three photographs: one showing a hose being used to fill a tank with brown media; another showing a person leveling the media in a tank with a tool; and a third showing a bucket of media being poured into a tank. The Hazen and Sawyer logo is in the bottom right.

Placing media in tanks

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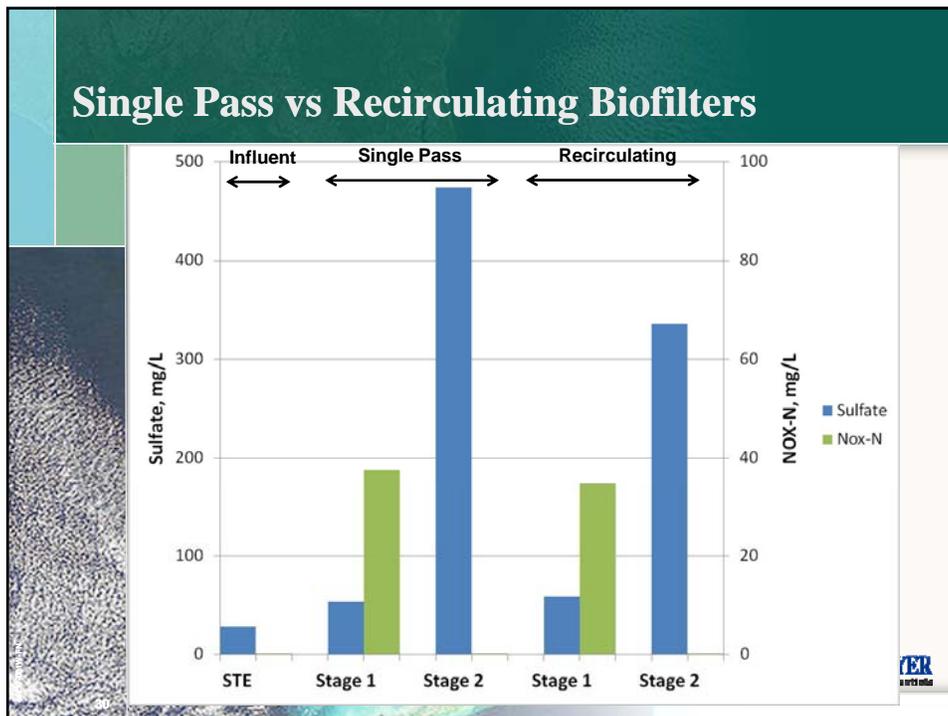
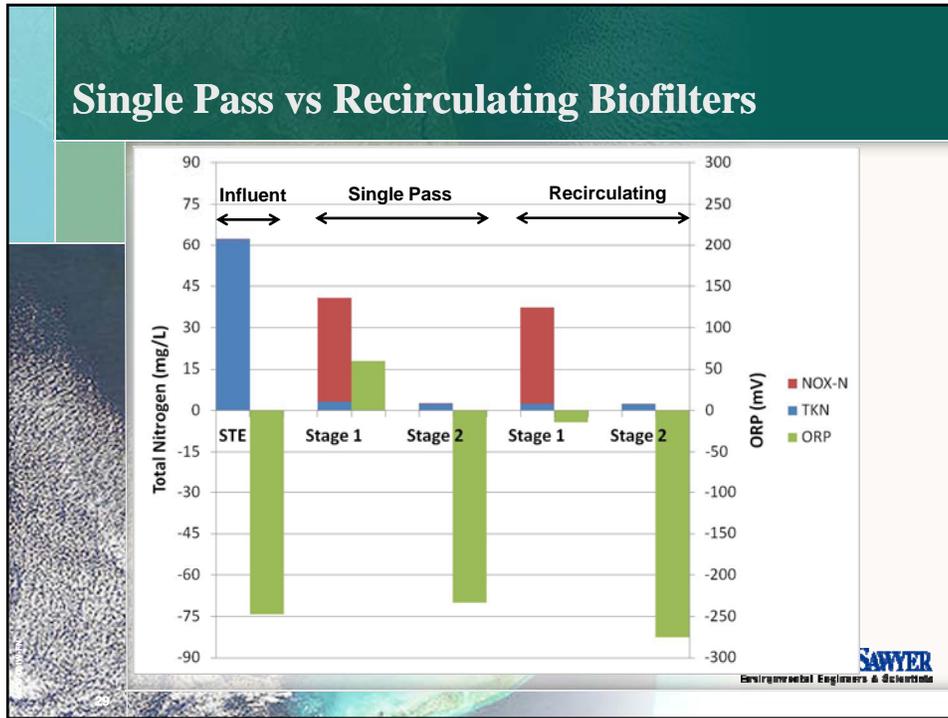


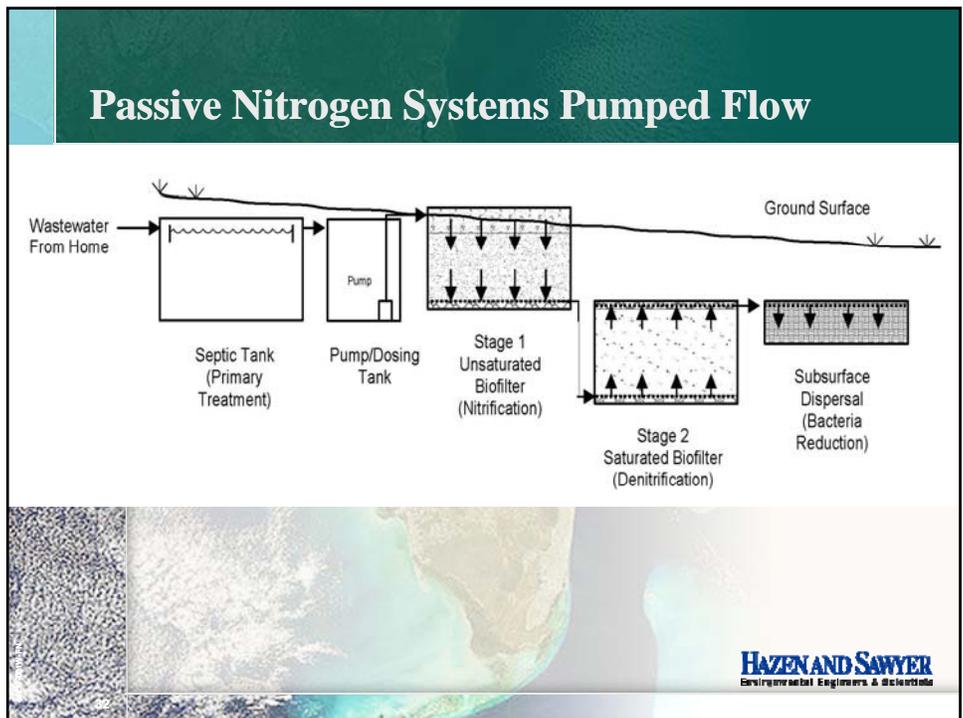
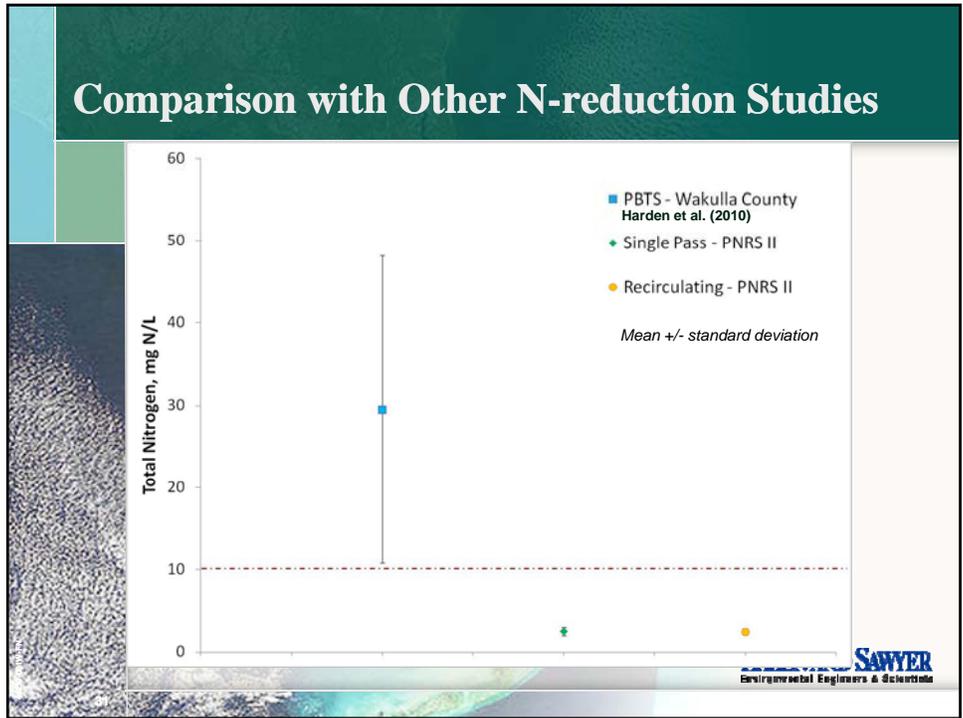
Preliminary Results

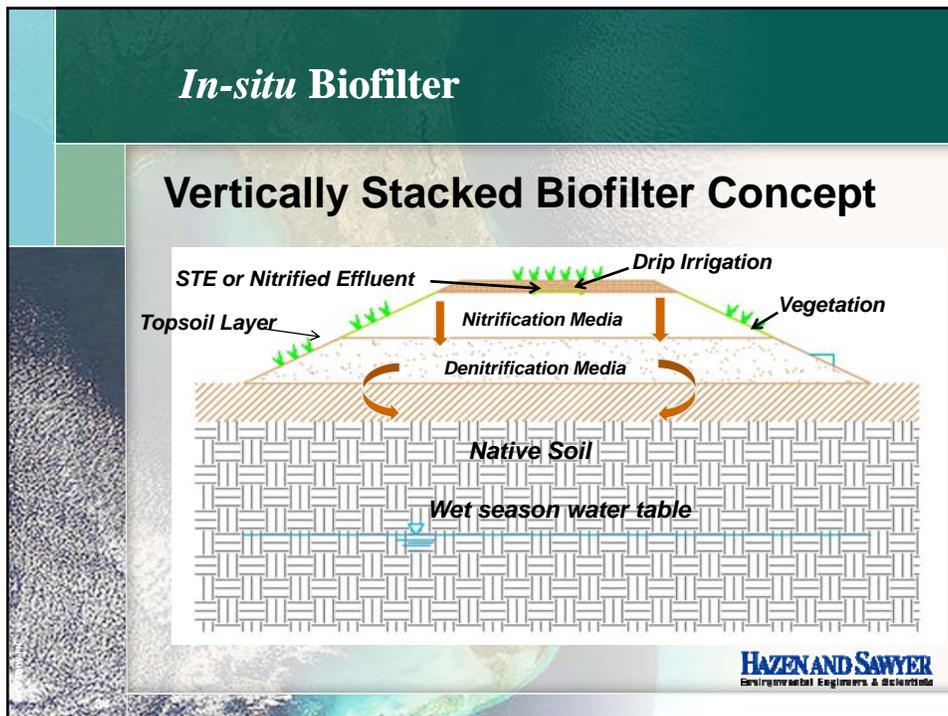
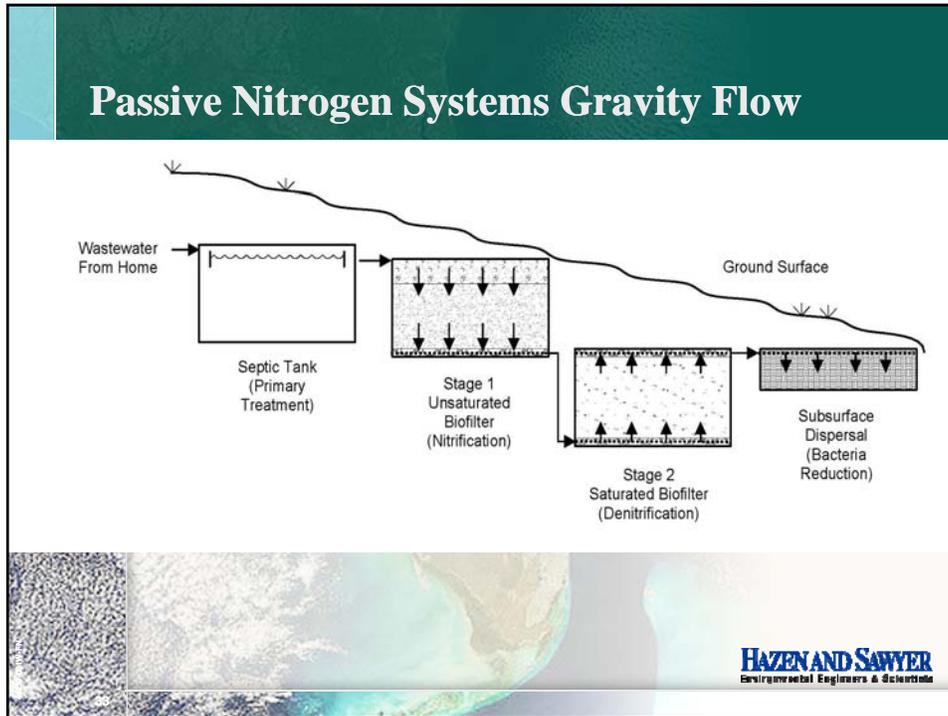
	Stage 1 Treatment Media	Stage 2 Treatment Media	Effluent TN ¹ (mg N/L)		TN Reduction (%)
STE			MEAN	65.24	
			STD DEV	18.02	
			MIN	35.02	
			MAX	80.01	
Single Pass	Clinoptilolite	Sulphur	MEAN	2.51	96.1
			STD DEV	0.54	
			MIN	1.85	
			MAX	3.02	
Recirculation	Clinoptilolite	Sulphur	MEAN	2.46	96.2
			STD DEV	0.38	
			MIN	2.04	
			MAX	2.95	

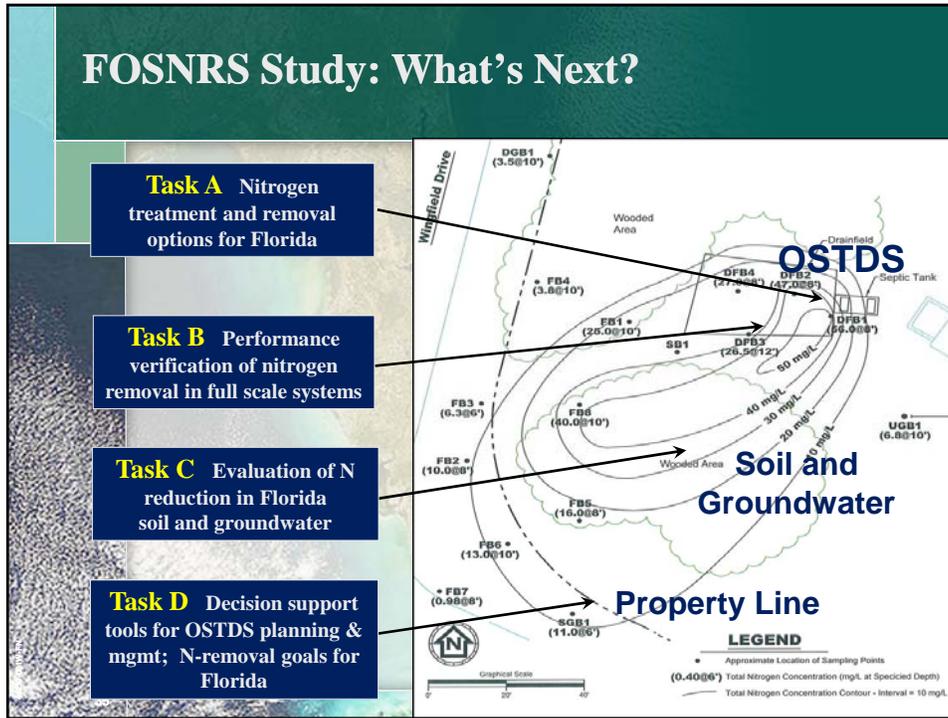
¹Continuous operation for 304 days

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Task A Nitrogen treatment and removal options for Florida

Task B Performance verification of nitrogen removal in full scale systems

Task C Evaluation of N reduction in Florida soil and groundwater

Task D Decision support tools for OSTDS planning & mgmt; N-removal goals for Florida

Summary

- The pilot-scale systems are functioning as intended:
 - STE quality supplied to PNRS II systems is reasonably characteristic of typical household STE quality
 - Stage 1 unsaturated biofilters are nitrifying
 - Stage 2 saturated biofilters are denitrifying
 - Sulphur-based Single Pass and Recirculating systems are achieving TN reduction of 96%
- Successful results would allow OSTDS to achieve nutrient removal similar to wastewater treatment plants in an effective and user-friendly manner playing a role in nitrogen reduction in sensitive watersheds.

<http://www.doh.state.fl.us/Environment/ostds/research/Nitrogen.html>

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FLORIDA DEPARTMENT OF
HEALTH

Questions?

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References

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- Harden, H., et al. (2010). Wakulla County Septic Tank Study Phase II Report on Performance Based Treatment Systems – Report to the Florida Department of Environmental Protection.
- Kanter, R. D., E. J. Tyler, et al. (1998). A denitrification system for domestic wastewater using sulfur oxidizing bacteria. On-Site Wastewater Treatment – Eighth National Symposium of Individual and Small Community Sewage Systems, Orlando, Florida, American Society of Agricultural Engineers.
- Sengupta, S., S. J. Ergas, et al. (2007). “Investigation of Solid-Phase Buffers for Sulfur-Oxidizing Autotrophic Denitrification.” Water Environment Research **79**: 2519-26.
- Smith, D.P., R. J. Otis, et al. (2008). Florida Passive Nitrogen Removal Study – Final Report to the Florida Department of Health, Applied Environmental Technology, Thonotosassa, Florida.

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Evaluation of Nitrogen Reduction from Onsite Wastewater Treatment Systems as Provided by Soils and Shallow Groundwater

by

Maria B Tucholke

Kathryn S Lowe, Damann Anderson, Josefin Edeback

NEHA 2011 AEC – OWS Summit
June 18th, 2011



Project Background



- The Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Project was initiated in 2009
- The project aims to further develop more “passive” & cost-effective nitrogen reduction strategies for OSTDS
- Directed by FDOH
- Collaborative effort between:
 - Hazen and Sawyer, P.C.
 - ▶ Damann Anderson, Josefin Edeback
 - Colorado School of Mines
 - ▶ Dr. Siegrist, Dr. McCray, Dr. Geza, Kathryn Lowe, Maria Tucholke
 - Applied Environmental Technology
 - ▶ Dr. Smith
 - Otis Environmental Consultants, LLC
 - ▶ Dr. Otis

FOSNRS Study Objectives



- Task A:
 - Nitrogen treatment and removal options for Florida
- Task B:
 - Performance verification of nitrogen removal in full scale systems
- Task C:
 - Evaluation of N reduction in Florida soil and groundwater
- Task D:
 - Decision support tools for OSTDS planning & mgmt; N-removal goals for Florida

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Task C – Goal and Objectives



The overall goal of Task C is to critically characterize nitrogen reduction in Florida soils and groundwater

- Objectives:
 - determine the cumulative mass loading of N to the soil and groundwater
 - identify how currently designed and implemented OSTDS perform
 - understand treatment processes involved
 - obtain/refine parameter for model inputs

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Task C - Approach



- Characterization of nitrogen from onsite wastewater treatment systems in sandy soils
- Delineation of a nitrogen plume in shallow groundwater at existing mound
- Conduct tracer tests to obtain relevant site information for future modeling (Task D)
- Evaluation of nitrogen transformations
- Mini-mounds & Home-sites
 - Controlled fieldwork

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Presentation Overview



- 1. Field site
 - Description of GCREC
- 2. Installation of monitoring points
 - Drive-points and piezometers
- 3. Monitoring groundwater elevations
 - Determine direction, gradient & velocity
- 4. Water quality analysis
 - Field & analytical parameters
 - Nitrogen plume delineation
- 5. Tracer test
- 6. Next step

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1. Field Site



Gulf Coast Research and Education Center

Source: <http://gcrec.ifas.ufl.edu/>



- The GCREC mound is located at the University of Florida Gulf Coast Research and Education Center (GCREC) in SE Hillsborough County, Florida
- GCREC conducts agricultural research & trials for vegetables, fruit and ornamental plants
- 16 laboratories housed onsite (1 water quality lab), offices and housing

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1. Field Site



- Wastewater from the GCREC research offices and onsite dormitories flow to an existing OSTDS
- The OSTDS consists of a pressure dosed mound system designed for 2,850 gallons/day
- Two septic tanks (2,500 and 1,250 gallons) provide primary treatment followed by a dosing tank (3,000 gallons)
- The mound soil treatment unit has 4,351 ft² of infiltrative area (design hydraulic loading rate of 0.65 gpd/ft²)

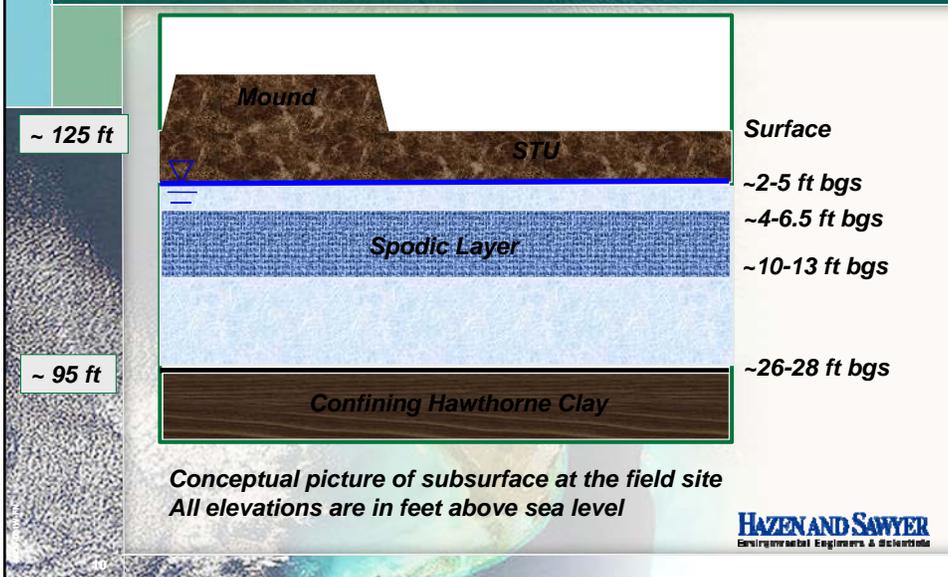
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1. Field Site



View of field site looking north towards the mound and research facility

1. Field Site



2. Installation of Monitoring Points



6620 Geoprobe



Diedrich 120

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2. Installation of Monitoring Points



121 Drive Points were installed
(Stainless steel, with mesh screen, umbrella and tubing to the surface)

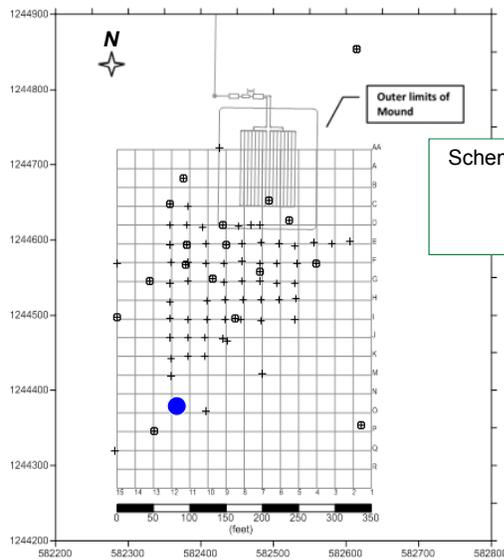
4 DP above spodic layer
54 DP within the spodic layer
63 DP below spodic layer



26 Piezometer were installed
($\frac{3}{4}$ -in., 1 $\frac{1}{4}$ -in., or 2-in. diameter PVC with 1-ft, 4-ft, 5-ft, or 10-ft long screens and risers extending to the ground surface)

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2. Installation of Monitoring Points



Schematic of GCREC Monitoring Network
(UTM coordinates are used)
⊕ denotes piezometers
+ denotes drive points



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3. Groundwater Monitoring



Groundwater elevation measurements

↓
Generate contour map

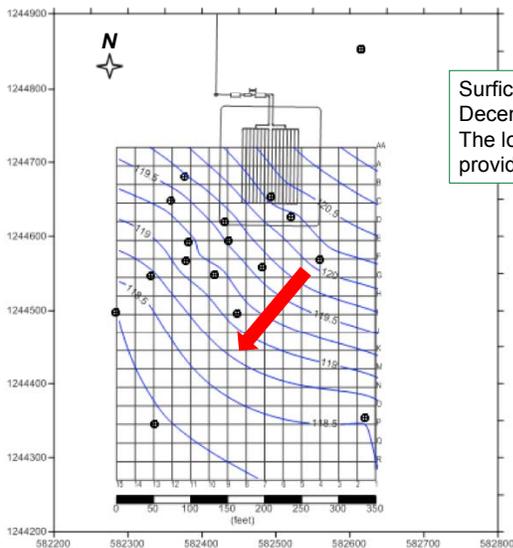
↓
Determine the direction of flow

↓
Calculate gradient

↓
Estimate linear velocity

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3. Groundwater Monitoring



Surficial Groundwater Contours
December 9, 2011
The locations of the piezometers are provided for reference

Direction of flow:
~ 220 degrees

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3. Groundwater Monitoring



Gradient Determination (Dec 9, 2010)

Red line = 160 ft
Elevation drop = 1.25 ft
Gradient = 0.0078

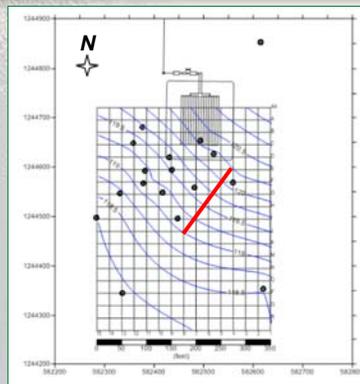
Estimate Linear Velocity (v)

$$v = \frac{K * \text{gradient}}{n_e}$$

K = hydraulic conductivity → K for fine sand ~ 33 ft/day

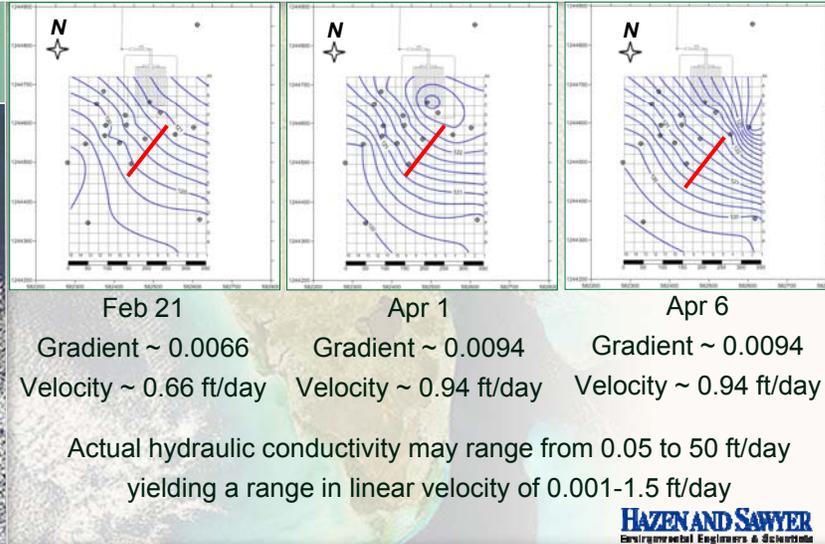
n_e = effective porosity → n_e for fine sand ~ 0.33

Linear Velocity = $33 * 0.0078 / 0.33 = 0.78$ ft/day



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3. Groundwater Monitoring



3. Groundwater Monitoring - Summary

- 26 piezometers
- Frequent monitoring during the year show:
 - No variation in groundwater flow direction
 - Depth to groundwater varies with the season and with rain events, but there is:
 - ▶ Little change in gradient
 - ▶ Little change in velocity
- Linear velocity is estimated to be 0.001-1.5 ft/day depending on the actual hydraulic conductivity at site
 - Estimate was used when designing the tracer test



4. Water Quality Analysis



Completed Sampling Events:
December 2010
March 2011

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4. Water Quality Analysis



Field Parameters

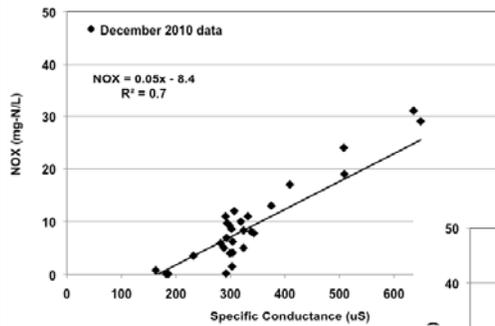
Field Parameters	Range	USE
Temperature (C)	20.7-27.6	21.0-22.7
pH	4.2-9.7	4.5-9.0
(pH (small))	8.2-11	8.5-11
Specific conductance (µS)	183-448	200-300

Analytical Parameters:

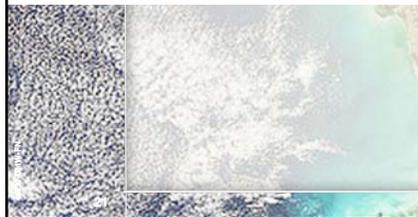
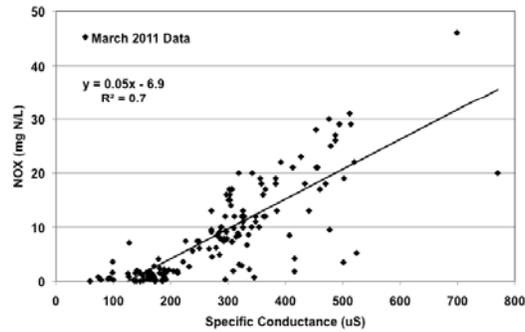
- total alkalinity (as CaCO₃), < 10 mg/L
- total Kjeldahl nitrogen (TKN-N), < 4 mg/L
- ammonia nitrogen (NH₃-N), < 3 mg/L
- nitrate/nitrite nitrogen (NOX-N)
- TOC & DOC

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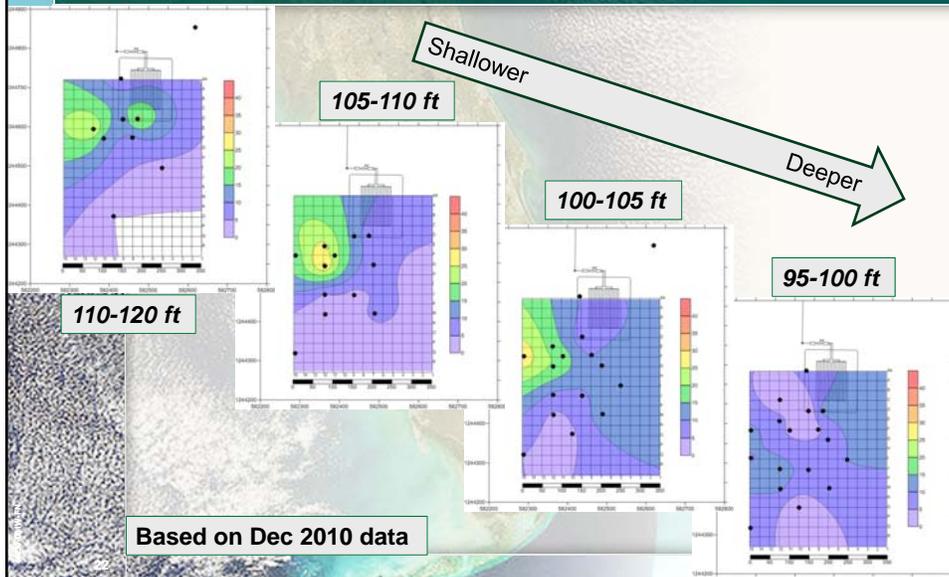
4. Water Quality Analysis



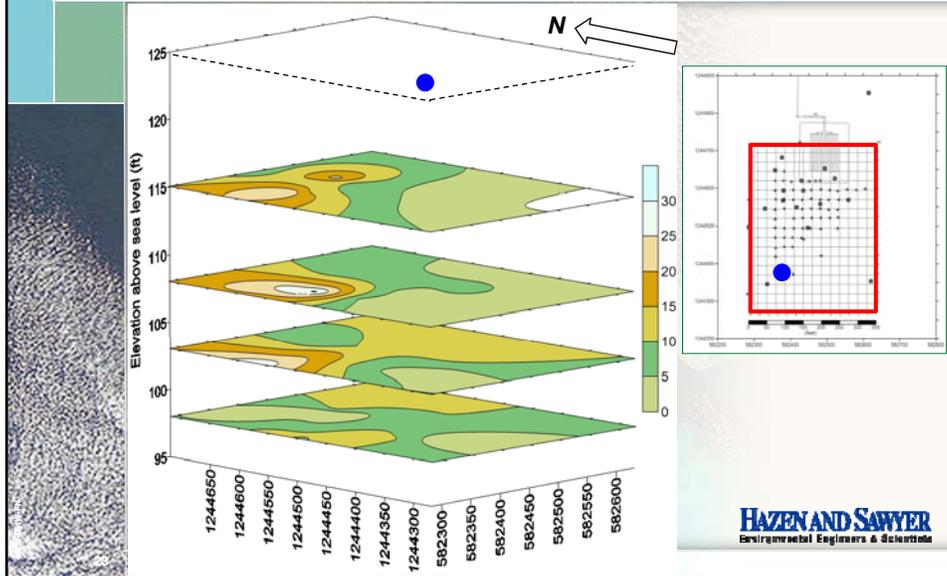
Correlations can be used to estimate design parameters



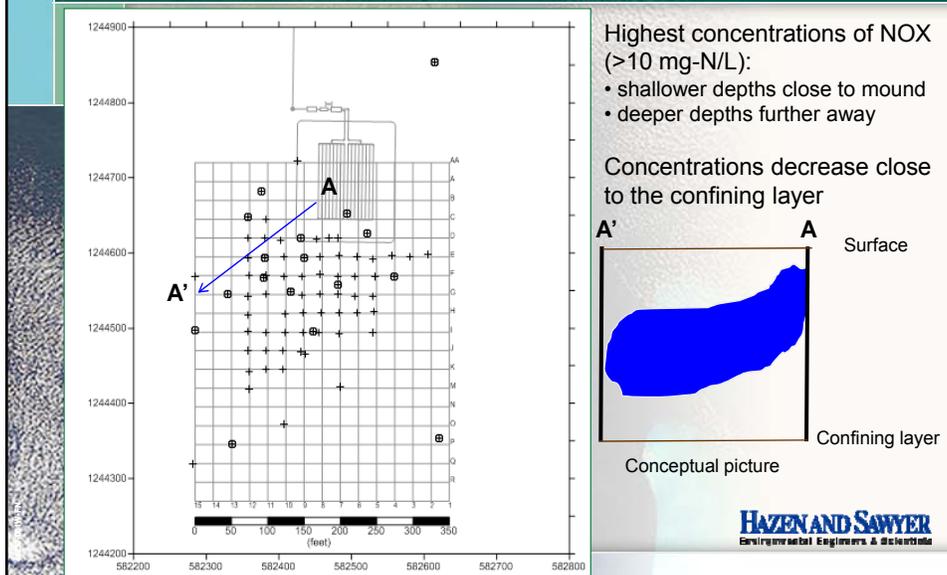
4. Water Quality Analysis – NOX Plume



4. Water Quality Analysis – NOX Plume



4. Water Quality Analysis – NOX Plume



4. Water Quality Analysis – Summary



- Field parameters (temp, pH, DO & SC) vary little
- TKN and NH₃-N are consistently low (<4 mg/L)
- Alkalinity is typically low (<10 mg/L)
- Correlation between NOX and Specific Conductance (R²=0.7)
- Nitrogen plume appears to be confined within 300 feet of mound in a SW direction
 - little vertical gradient keeps the plume relatively depth confined
 - Highest concentrations of NOX are present at 100-110 ft (below spodic layer)

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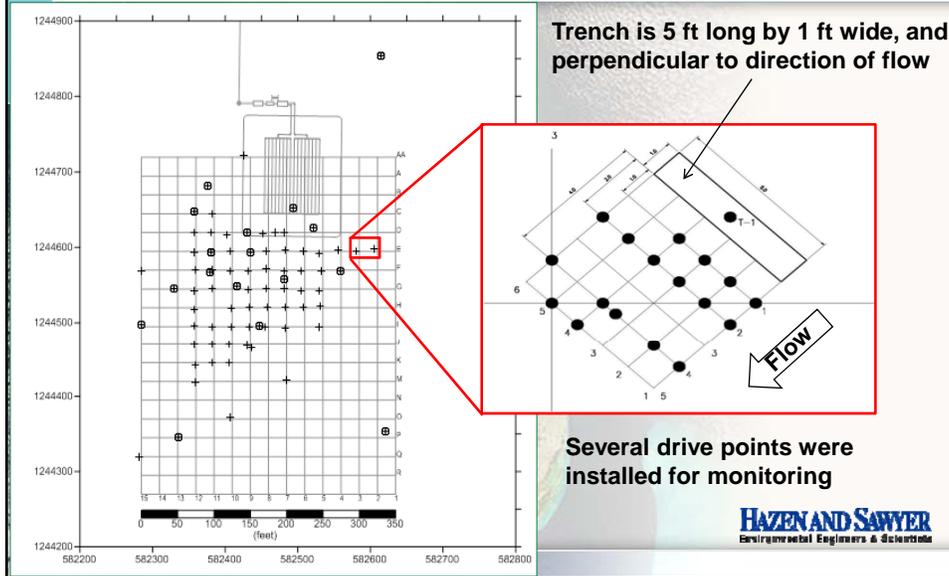
5. Tracer Test



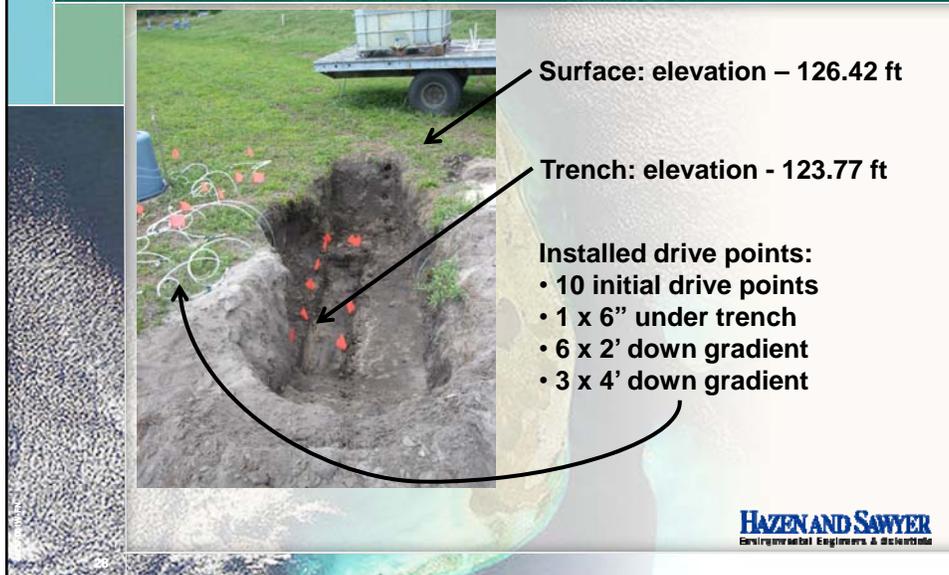
- Characterize aquifer properties
 - Velocity
- Conservative tracer
 - 10,000 ppm Potassium Bromide (KBr)
- Conduct in area that is representative of area of interest without having any negative impacts
- Determine tracer loading rate:
 - Common rate is ~10% of K_{sat}
 - K_{sat} ~ 1000 cm/day → tracer loading ~100 cm/day
 - 100 cm/day = 25 gal/ft²/day
- Ambient tracer test
 - Dosing an open trench over a period of 27 hours

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5. Tracer Test



5. Tracer Test



5. Tracer Test – Bromide Solution



250 gallon tank with bromide solution



Submersible pump with stirring tree

Continuous dosing rate - 125 gal/day using a peristaltic pump
Followed by continuous flushing with clean water at the same rate

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5. Tracer Test – Dosing Setup

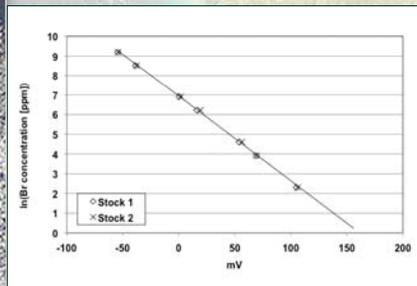


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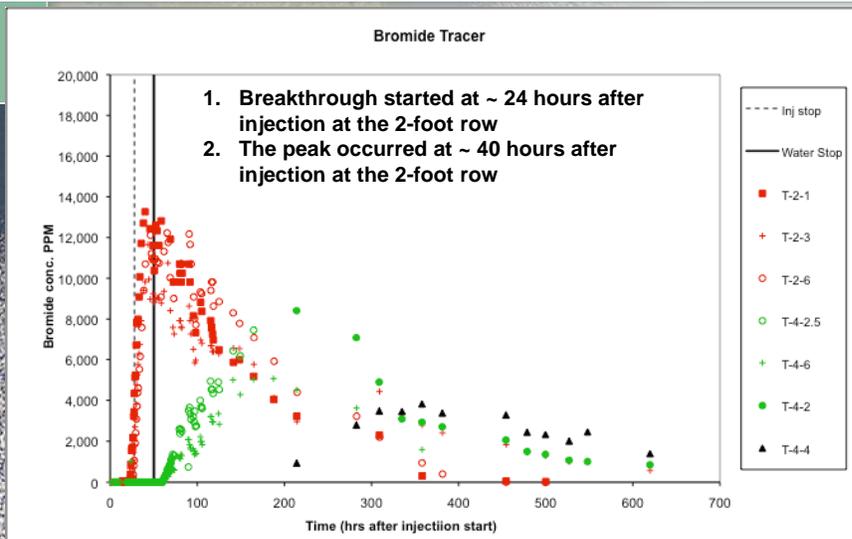
5. Tracer Test - Measurements



- Samples were collected at all DPs using a peristaltic pump
- Measurements were taken using a bromide meter measuring concentrations in mV
- Concentrations were determined from calibration curves



5. Tracer Test – Breakthrough Curves



5. Tracer Test – Velocity Calculations



The linear velocities were calculated from the breakthrough curves at the 2-foot row using the follow equations developed by Huang (1991):

$$C_{max} = \frac{M_{inj}}{V} \left[\frac{C_{inj}}{C_{max}} \right]^{1/n}$$

$$v = \frac{\sqrt{2M_{inj}}}{\sqrt{2M_{inj}}} \frac{1}{t_{max}}$$

Early estimates suggest linear velocities from of 0.4-1.2 ft/day

$$v = \frac{K * gradient}{n_e}$$

Hydraulic conductivity can be calculated using Darcy's Law

Huang, H., 1991. On a One-Dimensional Tracer Model. Ground Water 29 (1):18-20.

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5. Tracer Test - Summary



- Total tracer volume ~ 140 gallons
 - Concentration ~ 10,000 ppm
 - Total mass ~ 5.3 kg
- Breakthrough started at ~ 24 hours after injection at the 2-foot row
- The peak occurred at ~ 40 hours after injection
- Average linear velocity is estimated to be 0.4-1.2 ft/day
- Hydraulic conductivity can be estimated
- Additional analysis of the tracer test data will provide further insight into the aquifer properties at the site

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6. Next step – Additional Field Work



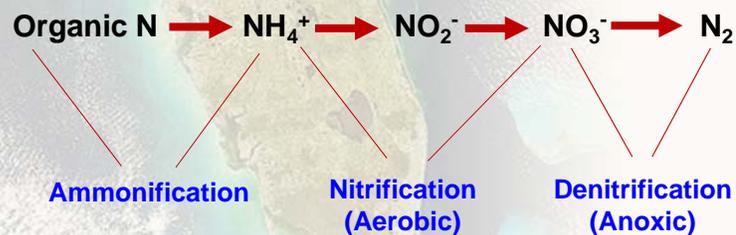
- Additional field monitoring
 - Home-sites (4):
 - ▶ Evaluate nitrogen reduction in different soil conditions throughout Florida
 - ▶ Seasonal variability
 - Controlled field testing at GCREC
 - ▶ 4 mini-mounds 20 ft x 2 ft
 - ▶ STE & nitrified effluent
 - ▶ Groundwater monitoring
- More efficient instrumentation and monitoring
- Results will provide data for parameter estimations, and validations of models developed in Task D

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6. Next Step – N transformations



- Gain a better understanding of nitrogen transformations in the groundwater by collecting appropriate data, i.e.:
 - accurately quantify the transformations
 - refine model parameter inputs



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Summary

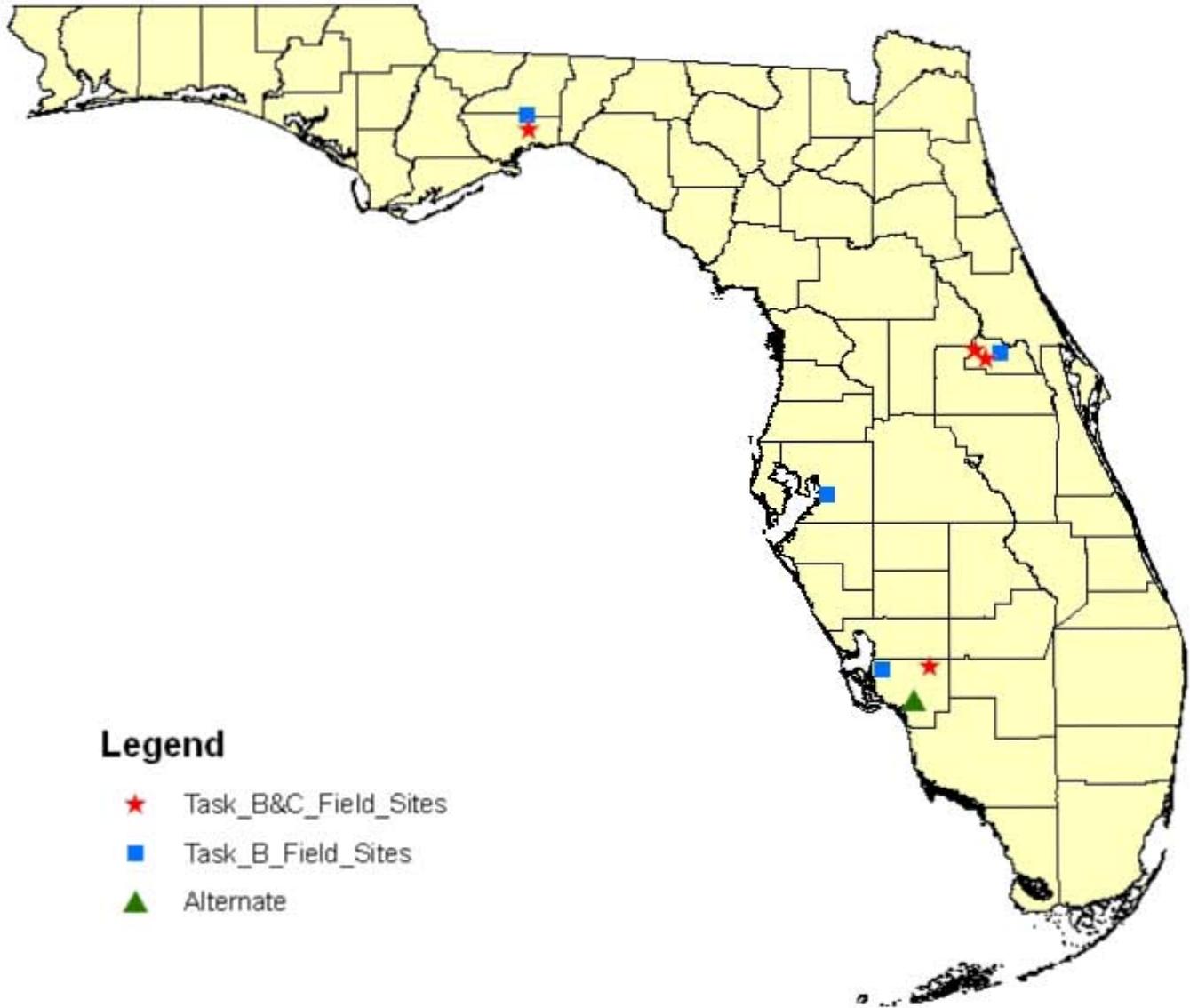


- A monitoring framework has been established at GCREC for the existing mound
- The existing nitrogen plume has been identified
- Direction of groundwater flow has been determined
- Tracer test will provide relevant aquifer properties
- The information gained at the GCREC will be confirmed with additional field work at home sites and more controlled mini-mound work

- Our approach will provide Florida specific information on nitrogen transformations in the soil and groundwater from onsite wastewater treatment systems

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FOSNRS Field Sites



Legend

- ★ Task_B&C_Field_Sites
- Task_B_Field_Sites
- ▲ Alternate

Field sites for the Florida Onsite Nitrogen Reduction Systems Study are located throughout Florida.

Task B & C field sites are located in Wakulla County (1 site), Seminole County (2 sites), and Lee County (1 site).

Task B field sites are located in Wakulla County (1 site), Seminole County (1 site), Hillsborough County (1 site), and Lee County (1 site).

An alternate site is located in Lee County.

FLORIDA ONSITE SEWAGE NITROGEN REDUCTION STRATEGIES (FOSNRS) STUDY

RRAC Meeting Presentation
September 8, 2011



Agenda

- Proposed Project Scope and Budget – Phase III

Scope & Budget – Task A

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
A.1 Draft Lit Review	1		\$ 13,796	\$0
A.2 Final Lit Review	1		\$ 6,092	\$0
A.3 Draft Classification of Tech	1		\$ 12,831	\$0
A.4 Draft Tech Ranking Criteria	1		\$ 10,096	\$0
A.5 Draft Priority List for Testing	1		\$ 14,859	\$0
A.6 Tech Class., Ranking & Prioritization Workshop	1		\$ 18,243	\$0
A.7 Final Classification of Tech	1		\$ 5,044	\$0
A.8 Final Tech Ranking Criteria	1		\$ 7,944	\$0
A.9 Final Priority List for Testing	1		\$ 7,787	\$0
A.10 Draft Innovative Systems Application		1	\$ -	\$11,655
A.11 Final Innovative Systems Application		1	\$ -	\$9,219
A.12 Identification of Test Facility Sites	2		\$ 5,077	\$0
A.13 Draft QAPP PNRS II	1		\$ 13,171	\$0
A.14 Recommendation for Process Forward	1		\$ 6,237	\$0
A.15 Final QAPP PNRS II	1		\$ 4,496	\$0
A.16 Materials Testing for FDOH Additives Rule	4		\$ 16,000	\$0
A.17 PNRS II Specification Reports	1	1	\$ 18,715	\$18,715

Scope & Budget– Task A (continued)

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
A.18 PNRS II Test Facility Design 50%	1		\$ 11,721	\$0
A.19 PNRS II Test Facility Design 100%	1		\$ 16,201	\$0
A.20 PNRS II Test Facility Construction Support & Admin	2		\$ 33,202	\$0
A.21 PNRS II Test Facility Construction 50%	2		\$ 50,000	\$0
A.22 PNRS II Test Facility Construction 100%	1		\$ 40,000	\$0
A.23 PNRS II Test Facility Construction Sub. Completion	1		\$ 10,000	\$0
A.24 PNRS II Test Facility Accept Construction	1		\$ 9,650	\$0
A.25 Monitoring and Sample Event Reports	6	1	\$ 173,910	\$28,985
A.26 Data Summary Report	6	1	\$ 20,190	\$3,365
A.27 Draft PNRS II Report		1	\$ -	\$34,220
A.28 Final PNRS II Report		1	\$ -	\$17,240
A.29 Draft Task A Final Report		1	\$ -	\$26,000
A.30 Task A Final Report		1	\$ -	\$9,480
A.31 Change-order Allowance		1	\$ 20,000	\$ 20,000

Scope & Budget – Task B

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
B.1 Identification of Home Sites	9	1	\$ 84,075	\$9,342
B.2 Vendor Agreement Report	1	1	\$ 7,580	\$7,580
B.3 Draft QAPP for Field Testing	1		\$ 25,700	\$0
B.4 Recommendation for Process Forward	1		\$ 6,780	\$0
B.5 Final QAPP for Field Testing	1		\$ 11,060	\$0
B.6 Field System Installation Report	0.75	6.25	\$ 28,425	\$236,875
B.7 Field System Monitoring Report		56	\$ -	\$470,531
B.8 Field System Op., Maintenance & Repairs Report		7	\$ -	\$60,410
B.9 Technical Description of Nitrogen Reduction Tech. Report		1	\$ -	\$17,271
B.10 Acceptance of System by Owner Report		7	\$ -	\$33,306
B.11 Draft LCAA Template Report		1	\$ -	\$18,140
B.12 Final LCCA Template Report		1	\$ -	\$9,080
B.13 LCCA Report (per system)		7	\$ -	\$35,280
B.14 Draft Task B Final Report		1	\$ -	\$45,120
B.15 Task B Final Report		1	\$ -	\$22,500
B.16 Change-order Allowance		1	\$ -	\$50,000

Scope & Budget – Task C

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
C.1 Draft Literature Review on N Reduction in Soil	1		\$ 11,300	\$0
C.2 Final Literature Review on N Reduction in Soil	1		\$ 6,900	\$0
C.3 Draft QAPP Eval. of N Red. by Soils & Shallow GW	1		\$ 38,940	\$0
C.4 Recommendation for Process Forward	1		\$ 5,907	\$0
C.5 Final QAPP Eval. of N Red. by Soils & Shallow GW	1		\$ 9,190	\$0
C.6 S&GW Test Facility Design 50%	1		\$ 26,471	\$0
C.7 S&GW Test Facility Design 100%	1		\$ 26,571	\$0
C.8 S&GW Test Facility Design Final	1		\$ 21,207	\$0
C.9 S&GW Construction Support & Admin.		2	\$ -	\$27,120
C.10 S&GW Test Facility Construction 50%		2	\$ -	\$30,000
C.11 S&GW Test Facility Construction 100%		1	\$ -	\$40,000
C.12 S&GW Test Facility Con. Substantial Completion		1	\$ -	\$3,680
C.13 S&GW Test Facility Accept Construction		1	\$ -	\$7,480
C.14 Soils & Hydrogeologic & Monitoring Plan for S&GW		1	\$ -	\$43,074
C.15 Tracer Testing at GCREC	1	2	\$ 18,910	\$37,820
C.16 S&GW Sample Event Reports		6	\$ -	\$285,140

Scope & Budget – Task C (continued)

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
C.17 S&GW Data Summary Report		6	\$ -	\$79,440
C.18 Test Facility Closeout Report		1	\$ -	\$13,080
C.19 Field Site Selection	6	1	\$ 59,596	\$9,933
C.20 Instrumentation of GCREC Mound System	1		\$ 59,495	\$0
C.21 GCREC Mound Sample Event Report	3	1	\$ 114,870	\$38,290
C.22 GCREC Mound Data Summary Report	2	2	\$ 16,320	\$16,320
C.23 Instrumentation of Remaining Field Sites Report	2	2	\$ 86,150	\$86,150
C.24 Field Sites Sample Event Reports	2	11	\$ 73,040	\$401,720
C.25 Field Sites Data Summary Report	1	12	\$ 4,840	\$58,080
C.26 Draft Site Summary and Close-Out Report		5	\$ -	\$43,400
C.27 Final Site Close-Out Report		5	\$ -	\$13,350
C.28 Draft Task C Final Report		1	\$ -	\$40,040
C.29 Task C Final Report		1	\$ -	\$17,180
C.30 Change-order Allowance		1	\$ -	\$40,000

Scope & Budget – Task D

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
D.1 Draft Lit Review on N Fate & Transport Model	1		\$ 15,533	\$ 0
D.2 Final Lit Review on N Fate & Transport Model	1		\$ 5,211	\$ 0
D.3 Selection of Existing Data Set for Calibration	1		\$ 15,092	\$ 0
D.4 Draft QAPP N Fate & Transport Models	1		\$ 32,187	\$ 0
D.5 Recommendation for Process Forward	1		\$ 6,334	\$ 0
D.6 Final QAPP N Fate & Transport Models	1		\$ 15,657	\$ 0
D.7 Simple Soil Tools		1	\$ -	\$52,448
D.8 Complex Soil Model		1	\$ -	\$86,641
D.9 Complex Soil Model Performance Evaluation		1	\$ -	\$48,577
D.10 Validate/Refine Complex Soil Model		1	\$ -	\$72,132
D.11 Aquifer Model Combined with Complex Soil Model Development		1	\$ -	\$113,411
D.12 Aquifer-Complex Soil Model Performance Ev.		1	\$ -	\$127,923
D.13 Validate/Refine Aquifer-Complex Soil Model w/ Data Collection from Task C		1	\$ -	\$95,734
D.14 Dev. of Aquifer-Complex Soil Model for Multiple Spatial Inputs		1	\$ -	\$25,372
D.15 Decision-Making Framework Considering Uncertainty		1	\$ -	\$52,638
D.16 Task D Guidance Manual (Draft)		1	\$ -	\$20,591
D.17 Task D Guidance Manual (Final)		1	\$ -	\$12,541
D.18 Change-order Allowance		1	\$ -	\$10,000

Scope & Budget – Task E

Task	Completed	Phase II & III	Spent (\$)	Remaining (\$)
E.1 Project Kick-Off Meeting	1		\$ 7,724	\$0
E.2 PM – Project Progress Reports	10	12	\$ 92,980	\$111,576
E.3 RRAC or TRAP Presentation	3	5	\$ 35,197	\$58,661
E.4 RRAC or TRAP Meeting Attendance	2	6	\$ 7,436	\$22,308
E.5 PAC Meeting		1	\$ -	\$41,900

Budget Summary as of July 31st

Task	Total Estimated Cost	Spent (\$)	Remaining (\$)
Task A: Technology Selection & Prioritization	\$ 724,138	\$ 545,259	\$ 178,879
Task B: Field Testing of Technologies	\$ 1,179,054	\$ 174,171	\$ 1,004,883
Task C: Evaluation of Nitrogen Reduction by Soils & Shallow GW	\$ 1,911,001	\$ 579,705	\$ 1,331,296
Task D: Nitrogen Fate and Transport Models	\$ 808,023	\$ 90,015	\$ 718,008
Task E: Project Management, Coordination and Meetings	\$ 377,783	\$ 143,337	\$ 234,446
Total Project	\$ 4,999,999	\$ 1,532,487	\$ 3,467,512

Questions?

Florida Onsite Sewage Nitrogen Reduction Strategies Study (FOSNRS)

PNRS II – Preliminary Results

by:
Damann L. Anderson, P.E.

Presentation to FDOH RRAC Meeting:
September 8th, 2011



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FOSNRS project initiated by Florida legislature

- Laws of Florida, 2008-152, directed FDOH to conduct a study to further develop more “passive” & cost-effective nitrogen reduction strategies for OSTDS
- Initiated the Florida Onsite Sewage Nitrogen Reduction Strategies (FOSNRS) Project in 2009
- This presentation focuses on preliminary project results from passive biofilters with sulphur-based denitrification processes

Presentation today focuses on sulphur-based denitrification systems

Previous Studies of Sulphur-based Denitrification

Reference	Denitrification Media	Results
Kanter, Tyler and Converse (1998)	Sulphur/Dolomite Sulphur: <2.5 mm	TN Removal: 87.9% Nitrified Influent: 23.5 mg-N/L Effluent: 3.0 mg-N/L
Sengupta and Ergas (2006)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 4.7 mm	NO ₃ -N Removal: 80% Influent: 2-32 mg NO ₃ -N/L Effluent: 4.2 mg NO ₃ -N/L
Brighton (2007)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 81.7% Nitrified Influent: 23 mg-N/L Effluent: 4.2 mg-N/L
Smith et al. (2008)	Sulphur/Oyster Shell (75/25% by volume) Sulphur: 2 - 5 mm	TN Removal: 93.8% Nitrified Influent: 35.2 mg-N/L Effluent: 2.2 mg-N/L

PNRS I results were encouraging

- Showed feasibility of passive two stage biofiltration
- One pump, no aerators, reactive media
- Continuous 24/7 operation for 8 months
- Proof of passive 2-stage biofiltration concept provided

Treatment Media	Effluent TN (mg/L)	TN Reduction (%)
Zeolite & Sulphur Media	2.2	97
Expanded Clay & Sulphur	2.6	96.2

PNRS II



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PNRS II was designed to further the concepts developed in PNRS I

- Follow up to PNRS I with larger, pilot scale units and various media combinations
- Developed detailed performance data for passive biofiltration designs
- Produce scalable design criteria from pilot scale biofilters for subsequent full-scale testing



PNRS II test facility was developed

- Established test facility at Gulf Coast Education and Research Center (University of Florida IFAS)
- Test program for in-vessel and in-situ pilot systems
- Operated on septic tank effluent for 12+ months
- Various nitrification and denitrification biofilters have been tested

Test facility includes numerous treatment trains

- All use two-stage biofilters:
 - Stage 1 Nitrification
 - Stage 2 Denitrification
- Stage 1 unsaturated filters included 2 media layers and evaluated 15" and 30" media depths
- We also evaluated single pass vs recirculating stage 1 biofilters
- For denitrification, we evaluated both lignocellulosic and sulphur denitrification biofilters
- We are also testing reactive media in a more in-situ/in-ground system approach

Various nitrification media are being studied

Examples of Stage 1 Media



Zeo-Pure clinoptilolite



Expanded polystyrene



Torpedo sand



Expanded clay

Various denitrification media are being studied

Examples of Stage 2 Media



Lignocellulosics

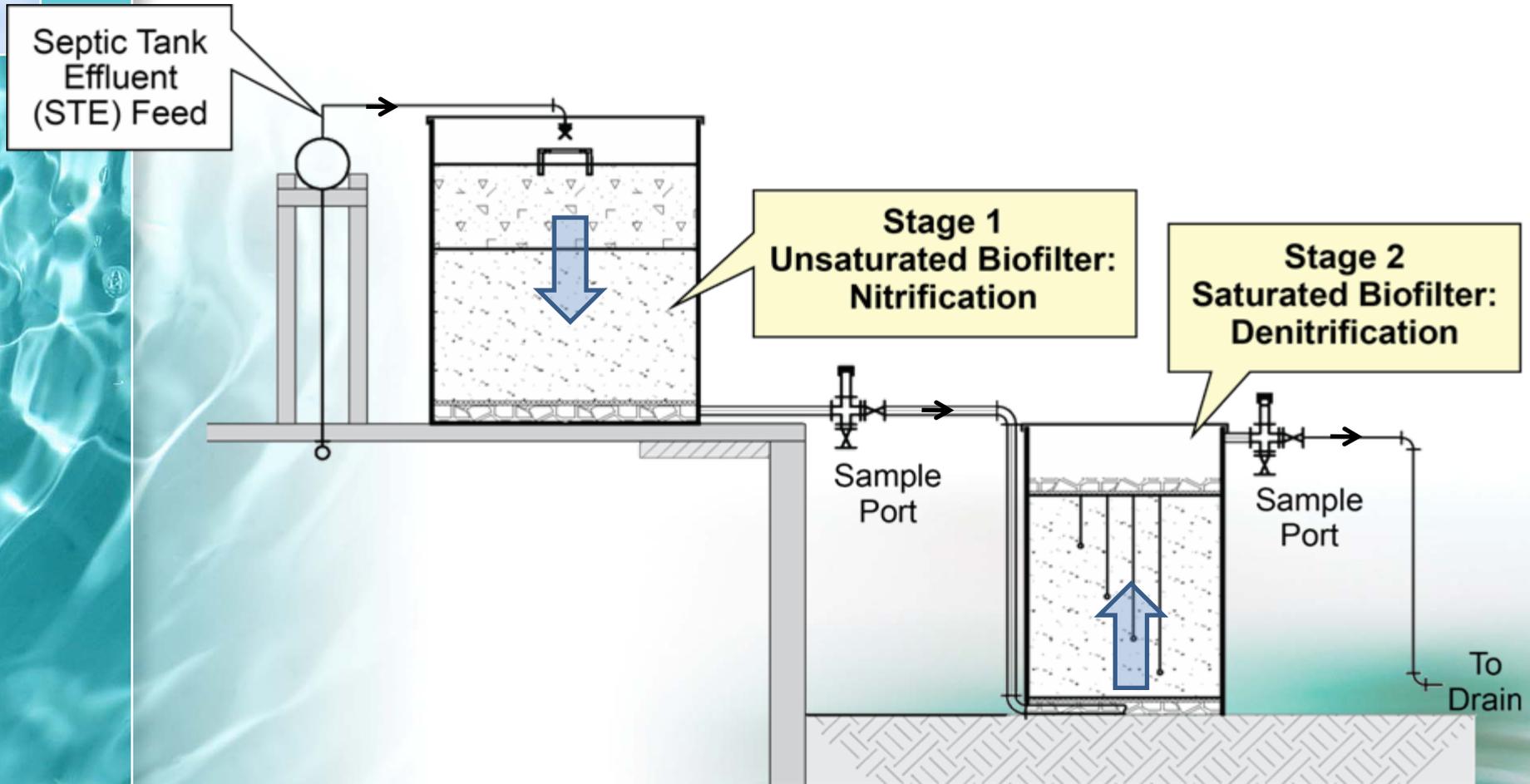


Elemental Sulphur

Expanded Clay



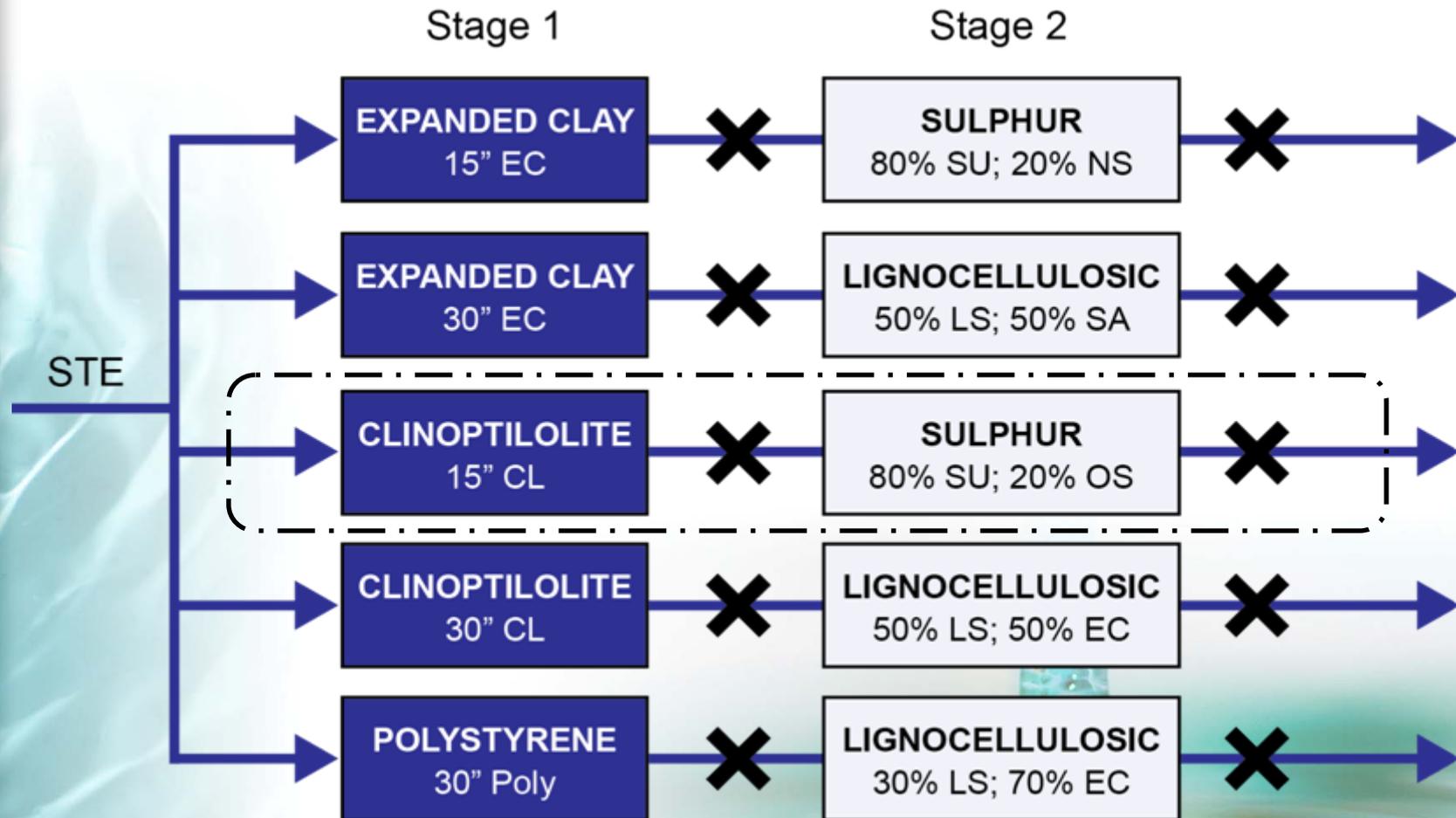
Two stage single pass biofilters



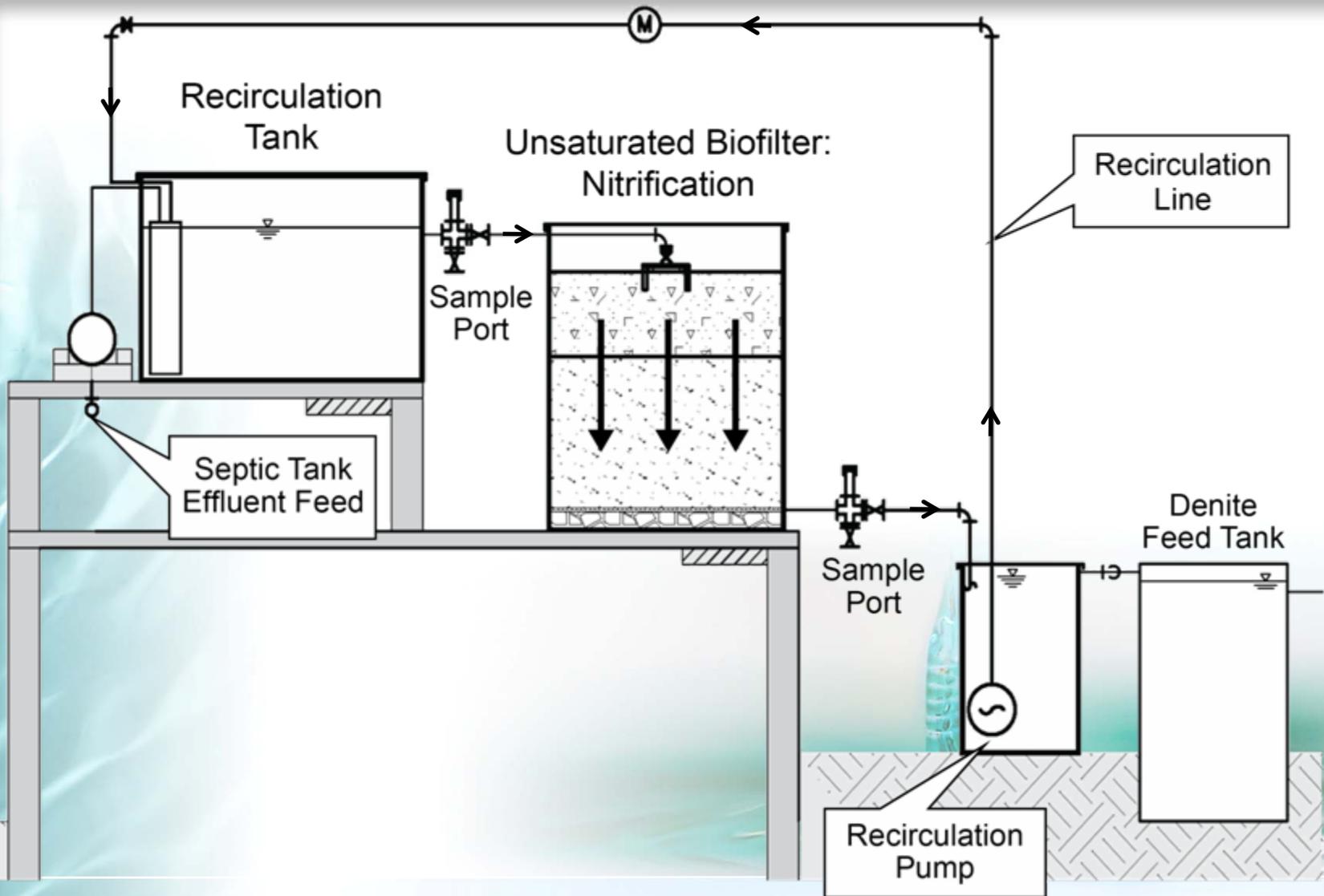
Two-stage single pass biofilters



Two-stage single pass treatment trains under evaluation



Stage 1 recirculating biofilters



Stage 1 recirculating biofilters & Stage 2 horizontal saturated biofilters

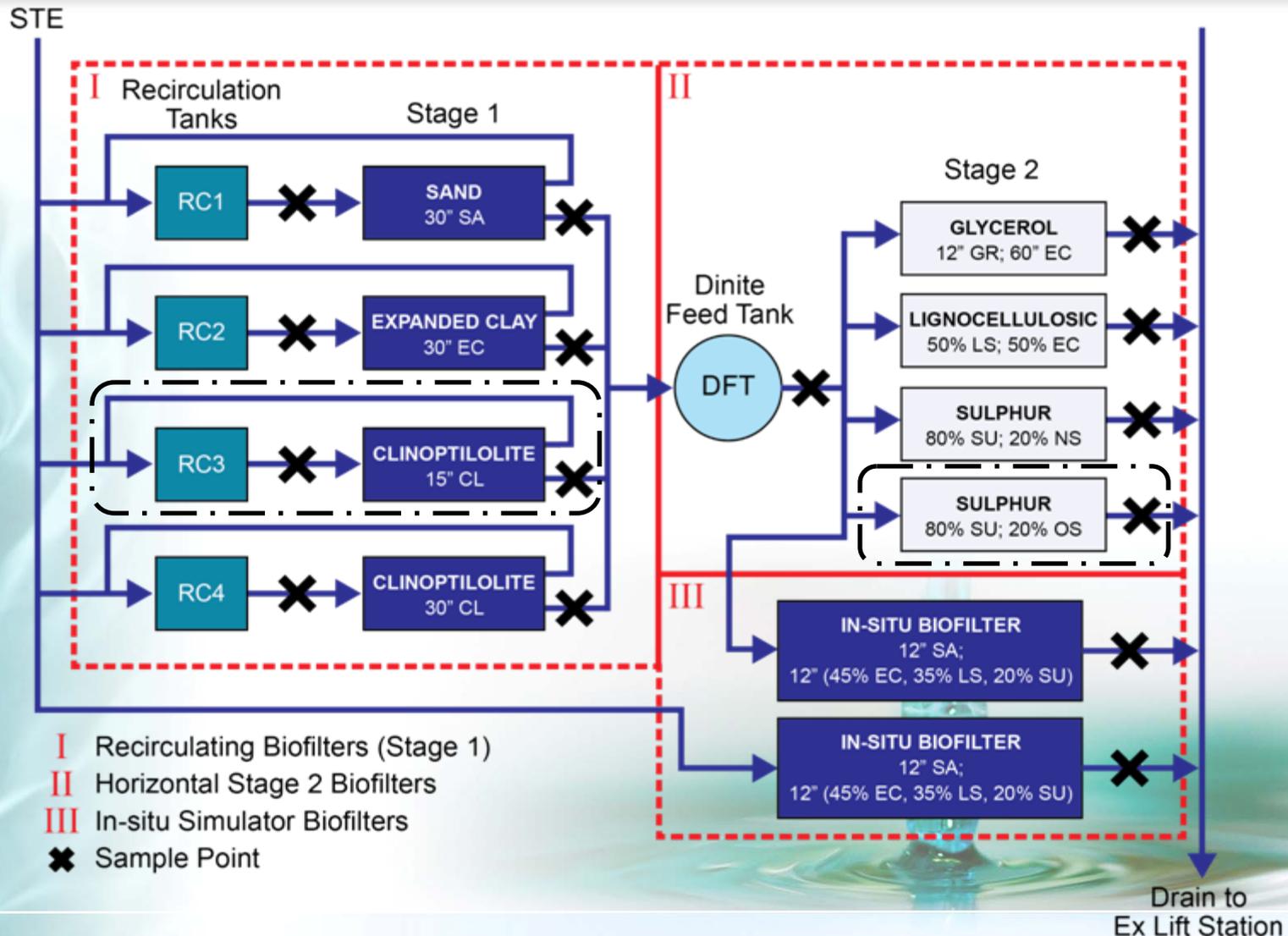


**Stage 1
Recirculating Biofilters**

**Stage 2
Saturated Biofilters**



We are also evaluating recirculating biofilters and horizontal saturated biofilters

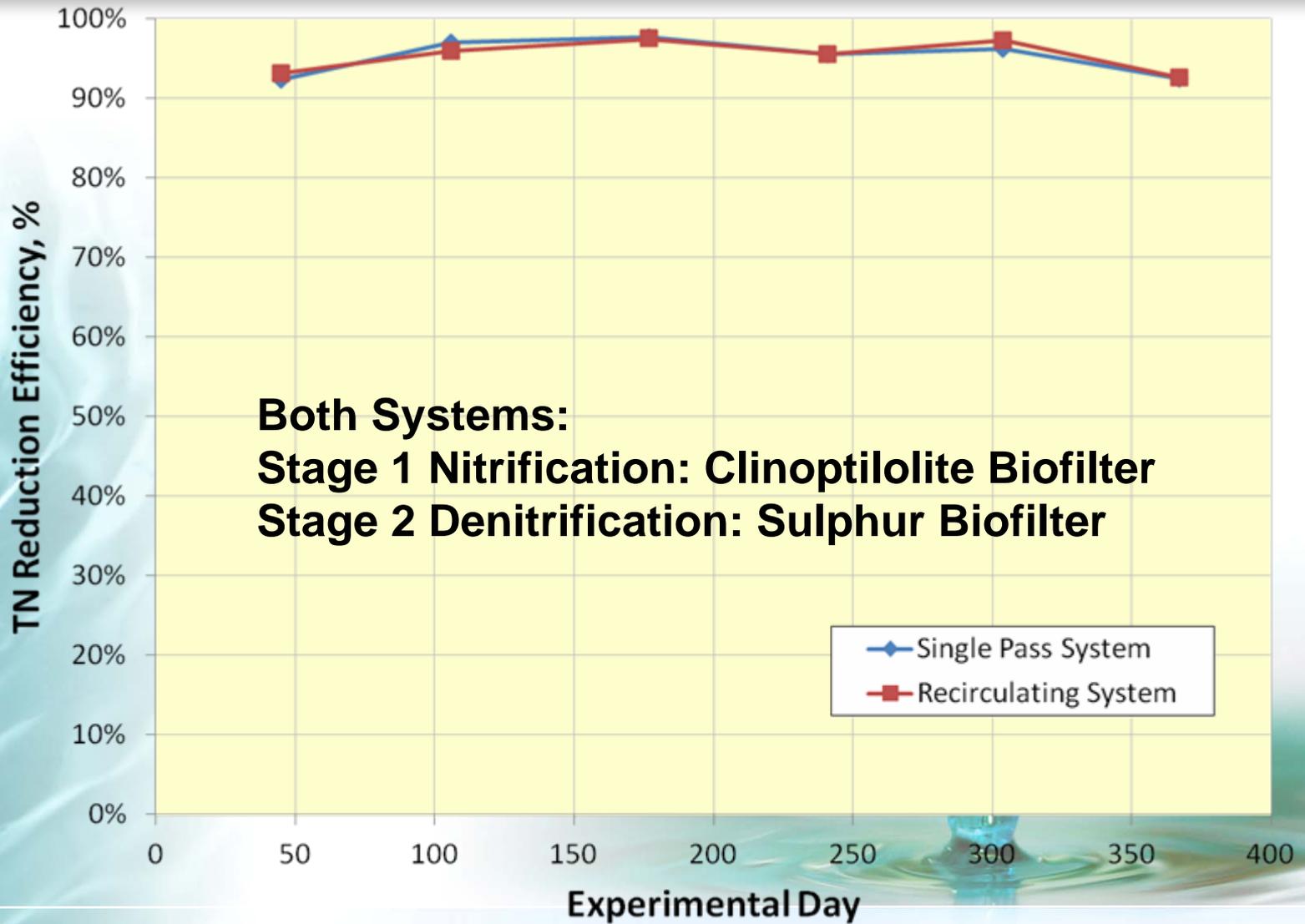


PNRS II Preliminary Results



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Preliminary results are encouraging



Both Systems:
Stage 1 Nitrification: Clinoptilolite Biofilter
Stage 2 Denitrification: Sulphur Biofilter

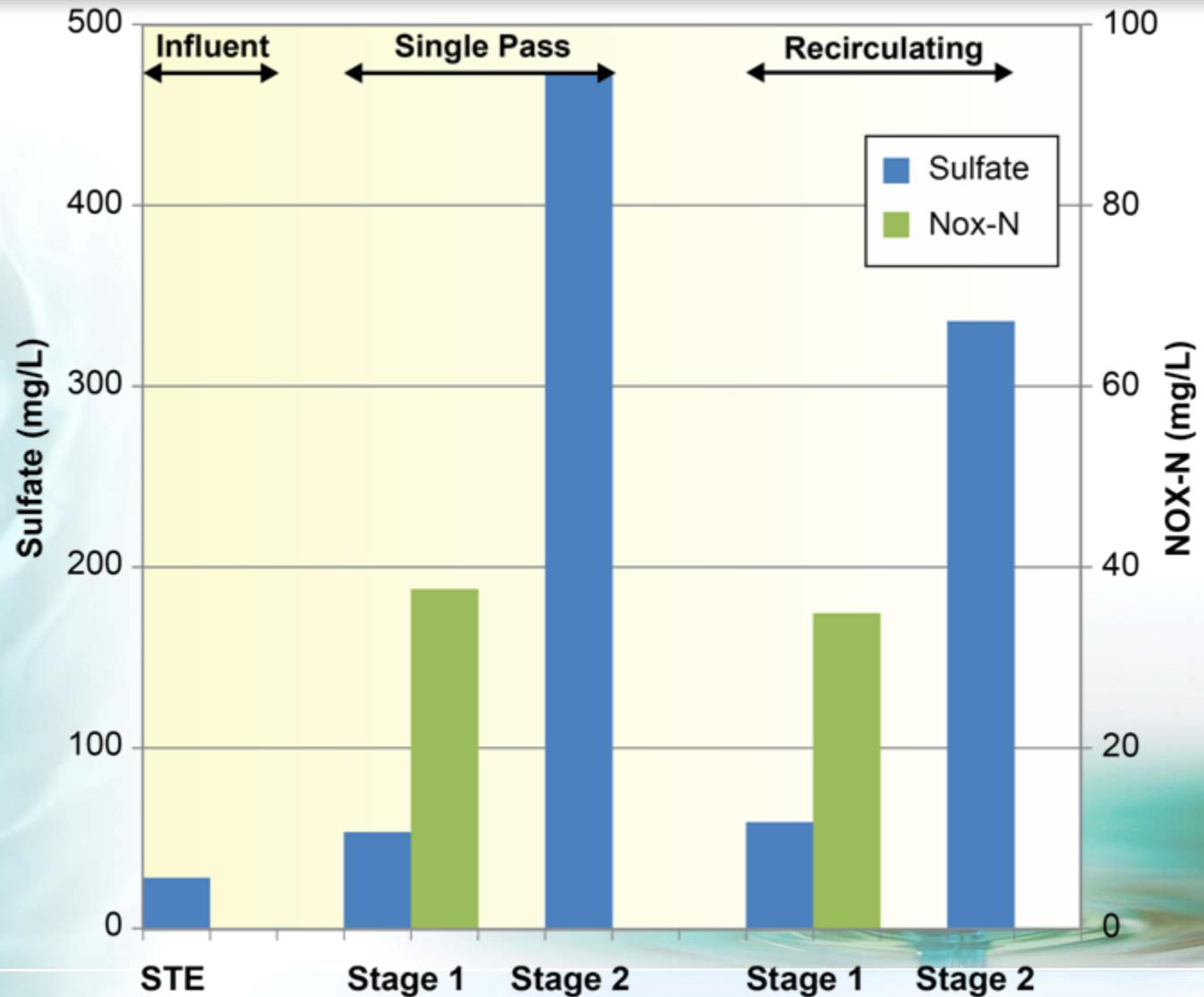
◆ Single Pass System
■ Recirculating System

Detailed results show consistent treatment

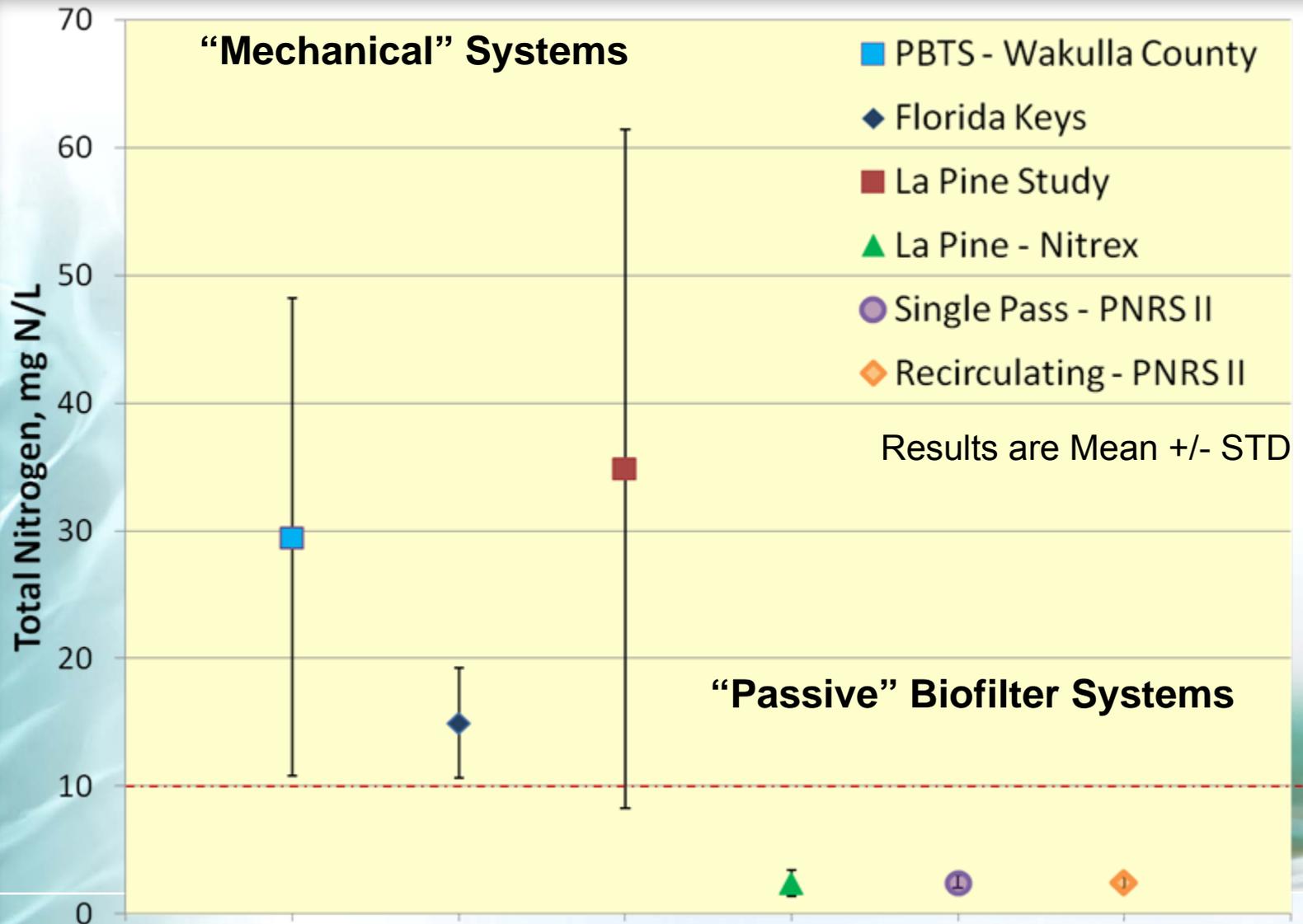
	Stage 1 Treatment Media	Stage 2 Treatment Media	Effluent TN ¹ (mg N/L)		TN Reduction (%)
			MEAN	STD DEV	
STE			MEAN	61.04	
			STD DEV	19.12	
			MIN	35.02	
			MAX	80.01	
Single Pass	Clinoptilolite	Sulphur	MEAN	2.60	95.2
			STD DEV	0.52	
			MIN	1.85	
			MAX	3.02	
Recirculation	Clinoptilolite	Sulphur	MEAN	2.54	95.3
			STD DEV	0.40	
			MIN	2.04	
			MAX	2.96	

¹Continuous operation for 367 days

Single pass vs recirculating biofilters: sulfate



Comparison with other N-reduction studies



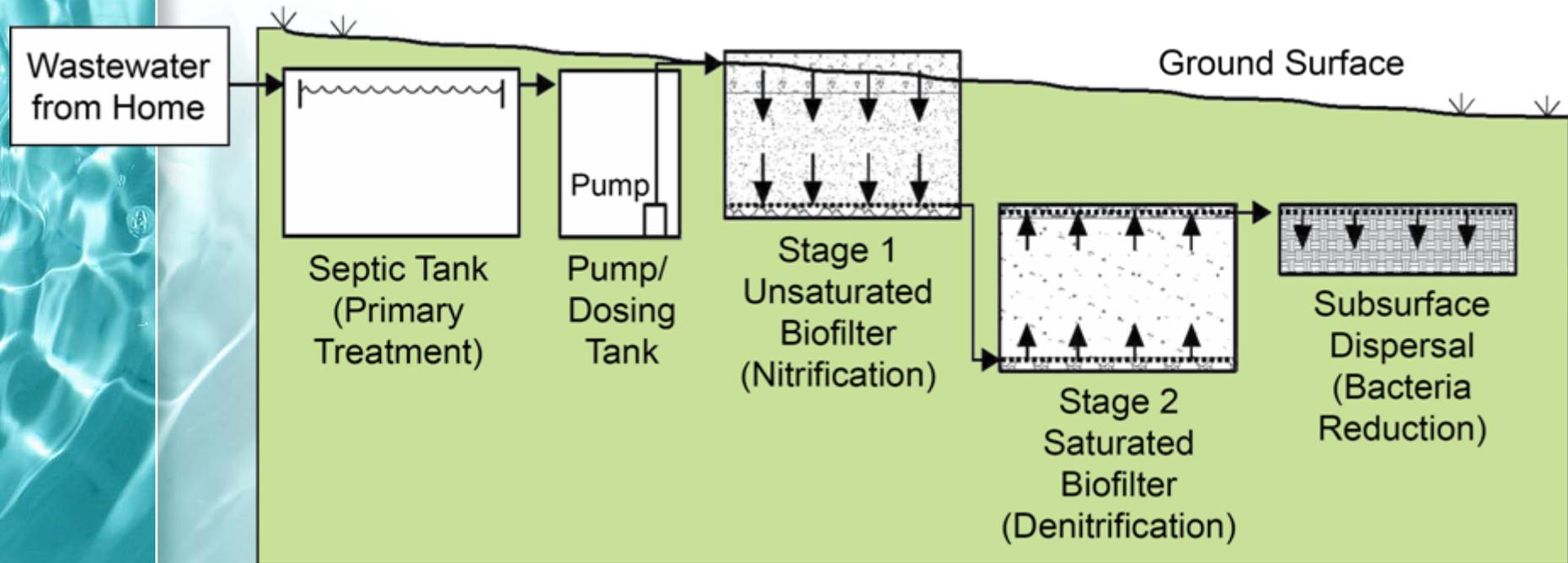
Next Steps



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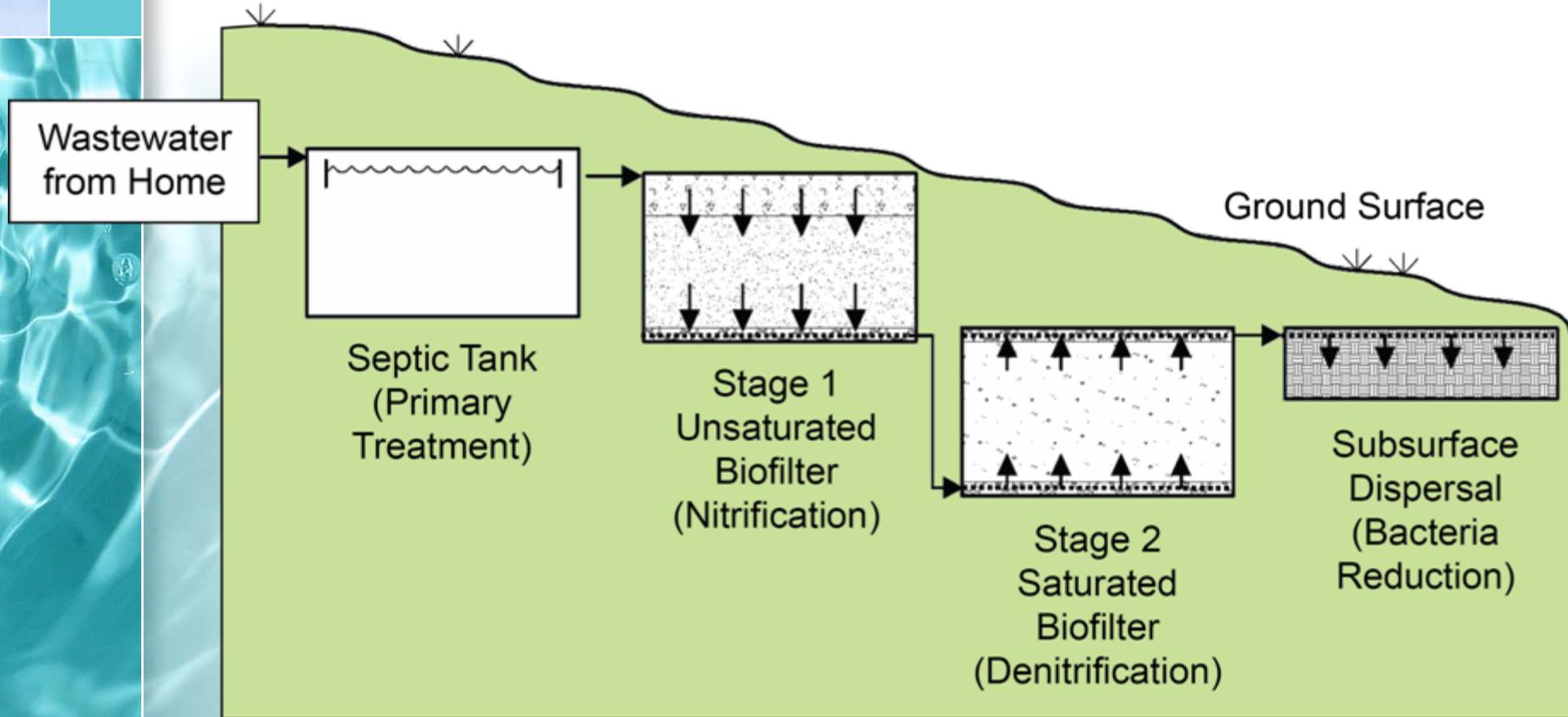
Install full-scale systems at actual home sites

Passive Nitrogen Systems Pumped Flow



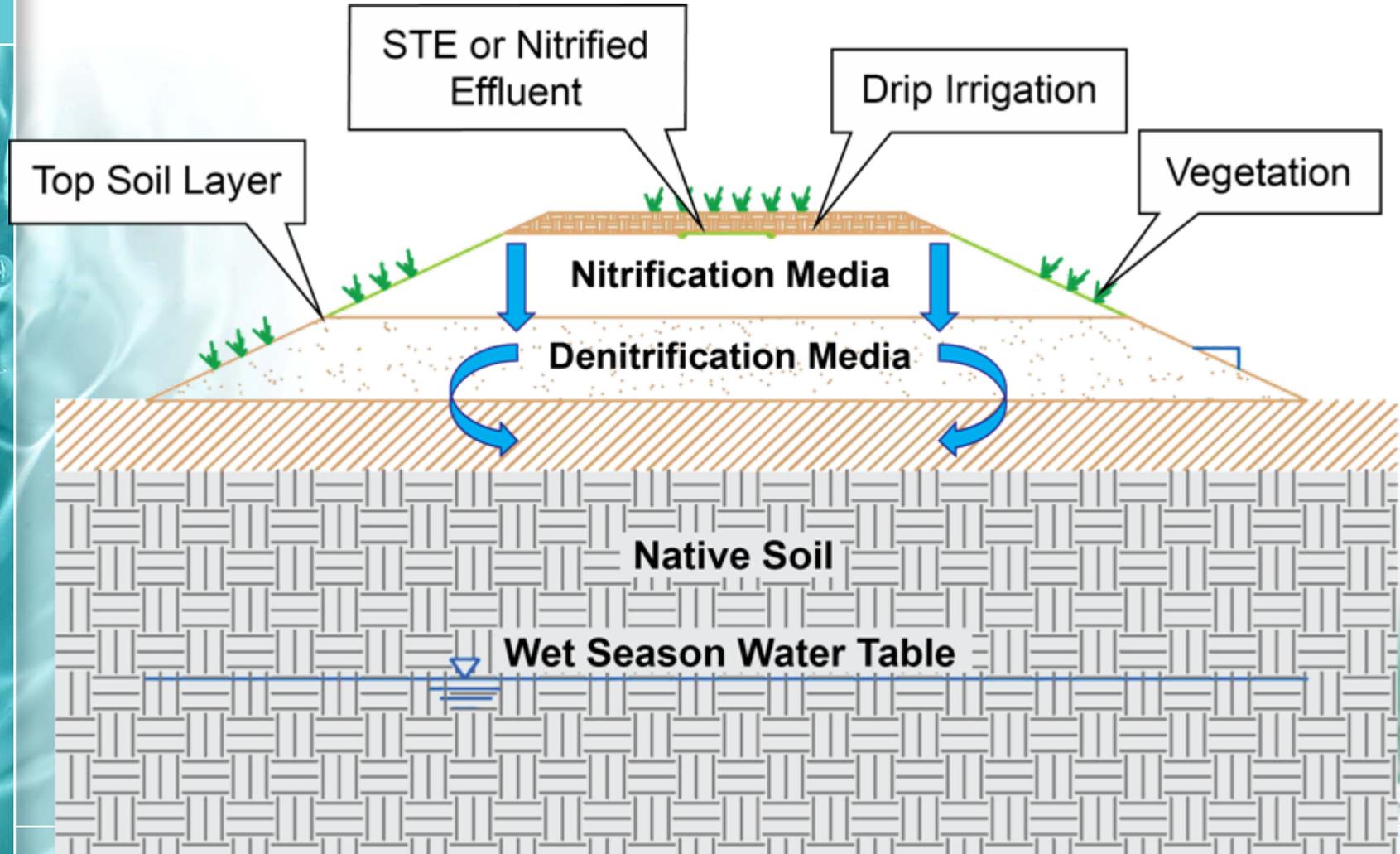
If topography allows, we will try gravity systems

Passive Nitrogen Systems Gravity Flow



Also will be investigating in-situ or mounded biofilters

Vertically Stacked In-situ Biofilter Concept



Questions?



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Department of Health
Bureau of Onsite Sewage Programs
Research Review and Advisory Committee

Thursday September 8, 2011

1:00 pm - 4:00 pm



Agenda:

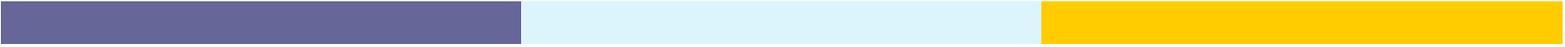
- Introductions and Housekeeping
- Review Minutes of Meeting April 20, 2011
- Nitrogen Study
 - Review of progress to date
 - Discussion on budget and process forward
- Other Business
- Public Comment
- Closing Comments, Next Meeting, and Adjournment



Introductions & Housekeeping

- Roll call
- Identification of audience
- How to view web conference
- DO NOT PUT YOUR PHONE ON HOLD!!!!
- Download reports:

<http://www.myfloridaeh.com/ostds/research/Index.html>



Review Minutes of Meeting April 20, 2011

- See draft minutes



Florida Onsite Sewage Nitrogen Reduction Strategies Study

Purpose: Develop passive strategies for nitrogen reduction that complement use of conventional onsite sewage treatment and disposal systems, and further develop cost-effective nitrogen reduction strategies



Florida Onsite Sewage Nitrogen Reduction Strategies Study

- Status report on nitrogen study sent May 16, 2011
- Hazen and Sawyer and the Colorado School of Mines presented on this study at the National Onsite Wastewater Recycling Association (NOWRA) annual meeting in Columbus Ohio in June 2011



Florida Onsite Sewage Nitrogen Reduction Strategies Study

- Nitrogen Study preliminary results presentation
- Nitrogen Study proposed scope and budget presentation



Other Business



Public Comment



Next Meeting

Upcoming meeting topics:

- Discussion on 319 grant report on the performance of advanced OSTDS in Florida

Proposed dates for next meeting:

- Suggestions?



Closing Comments and Adjournment