



SOURCES & LOADS OF NITRATE TO THE WEKIVA RIVER SYSTEM

PRELIMINARY ASSESSMENT



**FLORIDA DEPARTMENT
OF ENVIRONMENTAL
PROTECTION**



**MACTEC
ENGINEERING AND
CONSULTING**



**ST. JOHNS RIVER
WATER MANAGEMENT
DISTRICT**

WEKIVA BASIN NITRATE SOURCING STUDY

- Special legislative appropriation to Florida Dept. of Environmental Protection in 2006 (\$250,000)
- The Department contracted with St. Johns River Water Management District to implement a “Phase 1” assessment** using existing data and models (max. of \$100,000)
- SJRWMD used the services of their contractor - MACTEC Engineering and Consulting (Gainesville, FL)
- Deficiencies identified in Phase 1 would be addressed as part of a follow-up Phase 2 effort

** Constraints: report ready by start of 2007 Session & available for Florida Dept. of Health to use

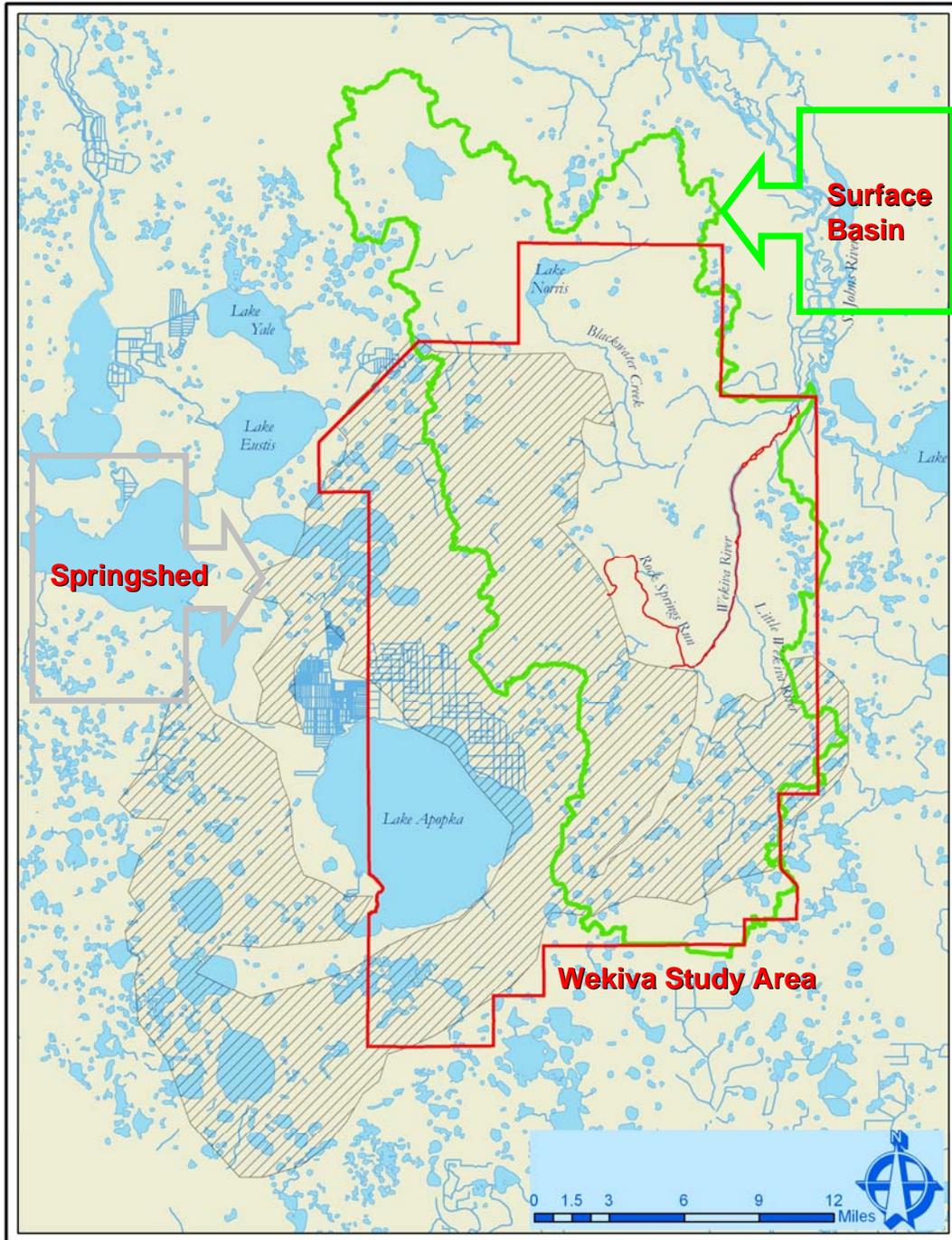


MACTEC TASKS

(DEVELOPED IN SCOPE OF WORK)

- Obtain, review and integrate existing data and models
- Conduct “desk-top” (i.e., “planning level”) inventory of potential sources of nitrate loading to surface and ground waters
- Review & summarize literature on nitrate loading to surface and ground waters from land uses in the Wekiva basin
- Develop preliminary nitrate budget for the basin (“pie chart”)
- Develop preliminary recommendations for nitrate load reduction strategies
- Develop recommendations for follow-up work (Phase 2)
- Produce report summarizing the above efforts





STUDY AREA WAS THE "WEKIVA BASIN"

- Surface water drainage and "springshed"
- Most technically defensible
- Needed for future modeling efforts
- Needed for Total Max. Daily Load development



WEKIVA BASIN NITROGEN SOURCING STUDY

Data sources:

- SJRWMD land use/land cover data (1999 & 2004)
- East Central Florida Groundwater Model (SJRWMD) – recharge estimates
- Wekiva Study Area stormwater model (WMM)
- Approx. 250 technical publications
- Technical review/guidance by:
 - Del Bottcher, Ph.D. (Soil & Water Engineering Technology, Inc.)
 - Wendy Graham, Ph.D. (University of Florida Dept. of Soil & Water Science and Chair, Florida Water Institute)



NITRATE SOURCES CONSIDERED

- Industrial & Domestic wastewater
- Septic tank drainfields
- Fertilizer
 - Agricultural (row crop, citrus, nurseries, pasture)
 - Residential
 - Golf course
 - ‘Other’ (ball fields, roadside, etc.)
- Livestock
- Atmospheric deposition



PROCEDURAL ISSUES

- Nitrate data were used when available
- Total nitrogen (TN) data used when nitrate not available/reported (assumed to be a surrogate for nitrate)
- Use of reclaimed water for irrigation assumed to replace fertilizer use
- Surface water nitrate loads diverted to stormwater systems assumed to load to ground water



Source Type

Transport Mechanism

Delivered to Wekiva Basin

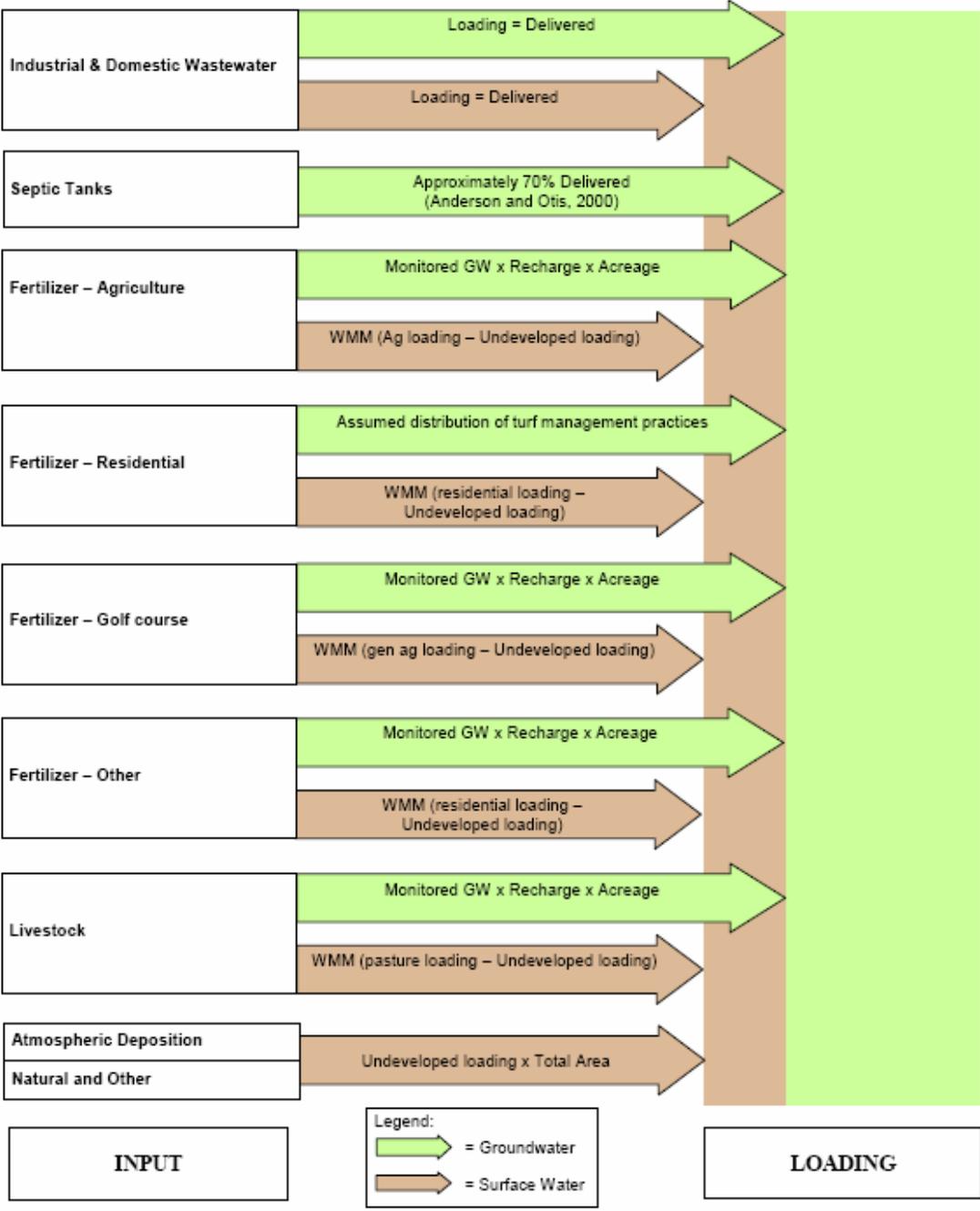
INPUTS

Amount of nitrate applied to the landscape; a.k.a. "what goes on/into the ground"

LOADS

Amount of nitrate delivered to waters of the basin after plant uptake, volatilization, denitrification, etc.

NOTE: stormwater is a transport mechanism, not a "source"



INPUT QUANTIFICATION

- Wastewater – FDEP permit files and discharge monitoring reports
- Septic tank – published literature and FDOH data
- Fertilizer – IFAS recommended application rates (by crop type; turfgrass/lawns; golf course greens). 3 crop rotations/year
- Livestock – estimates of # cattle in basin times cattle waste output
- Atmospheric – CASTNET monitoring data

FDEP – Florida Dept. of Environmental Protection

FDOH – Florida Dept. of Health

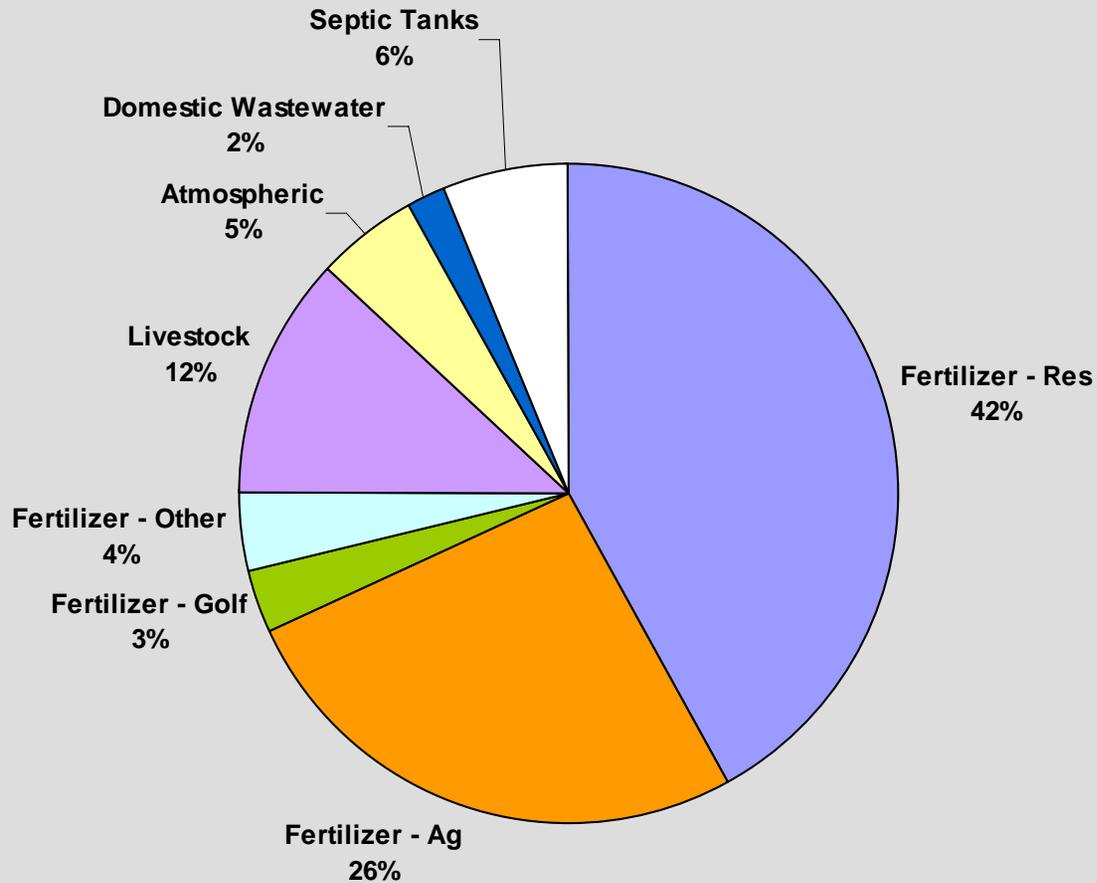
IFAS – Institute of Food and Agricultural Sciences, University of Florida

CASTNET – Clean Air Status and Trends NETwork

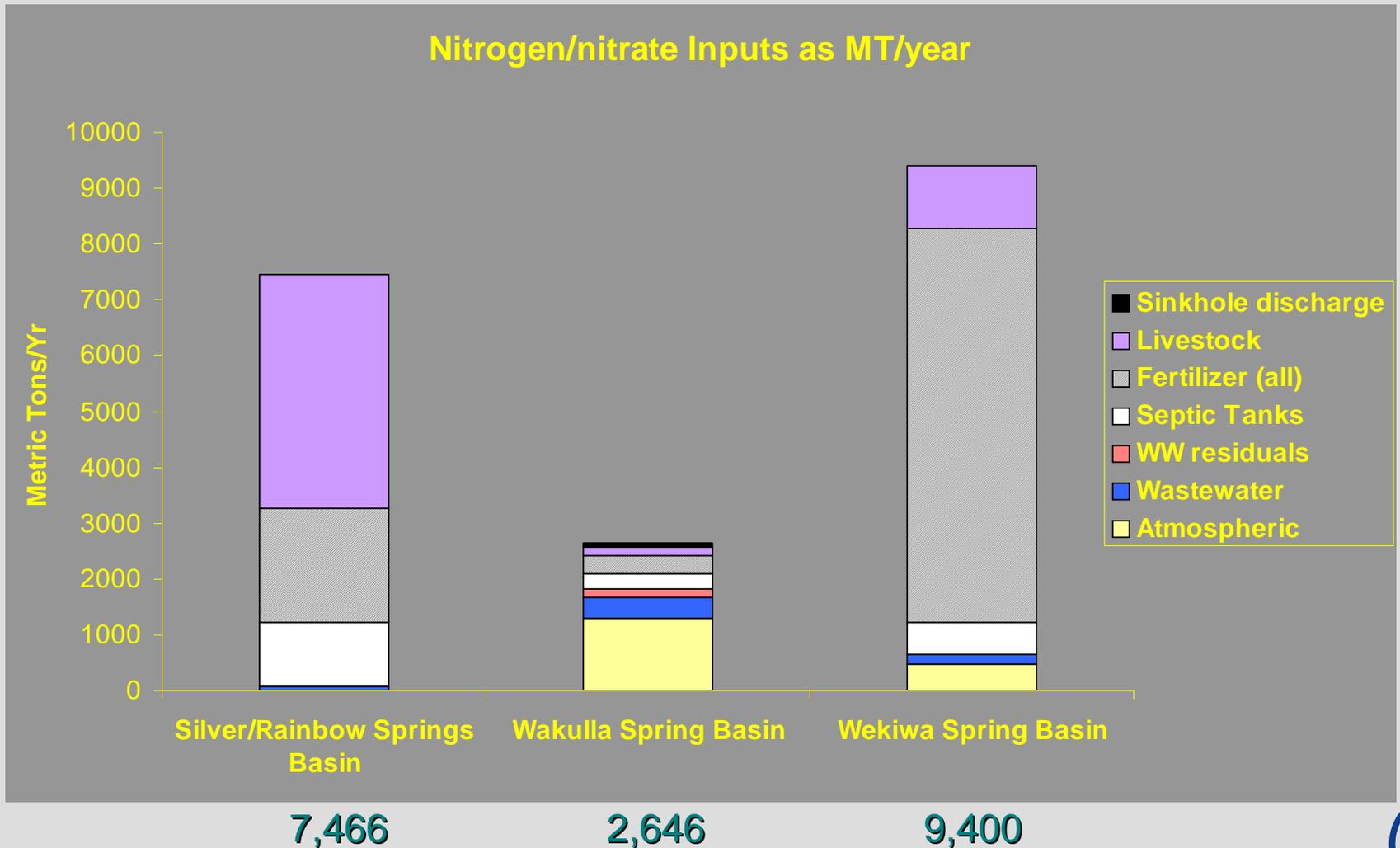


NITROGEN INPUTS (BY SOURCE)

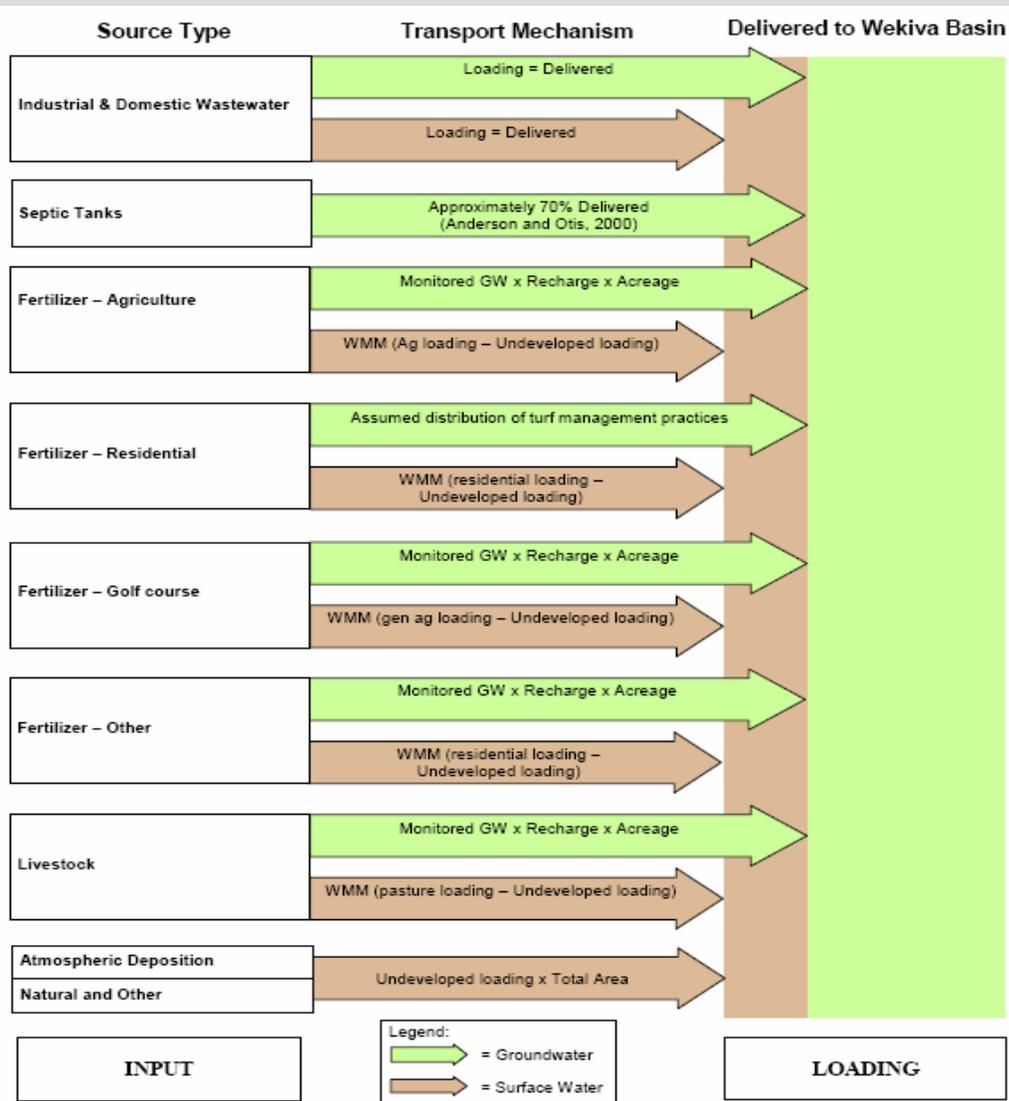
9,400 Metric Tons/Year



NITROGEN INPUTS (BY SOURCE) IN SELECTED SPRING BASINS



LOAD QUANTIFICATION



Wastewater = amount of nitrate delivered to waters of the basin after treatment

Fertilizer = shallow ground water nitrate x recharge rate (=“load”) x landuse

Livestock = shallow ground water nitrate x recharge rate (=“load”) x landuse

Surface water load = WMM model output



LOAD QUANTIFICATION

- Wastewater – published literature and FDEP discharge data
- Septic tank – published literature on drainfield treatment performance; FDOH data & estimated # tanks in the basin (~65,000)
- Fertilizer – published literature on shallow groundwater nitrate concentrations (by land use) combined with recharge estimates (=GW load); stormwater model output (=SW load) & land use
- Livestock – published literature on shallow groundwater nitrate concentrations combined with groundwater recharge estimates (=GW load); stormwater model output (=SW load) & land use
- Atmospheric – CASTNET monitoring data supplemented with estimates from the literature of atmospheric loads in urban areas



LOAD

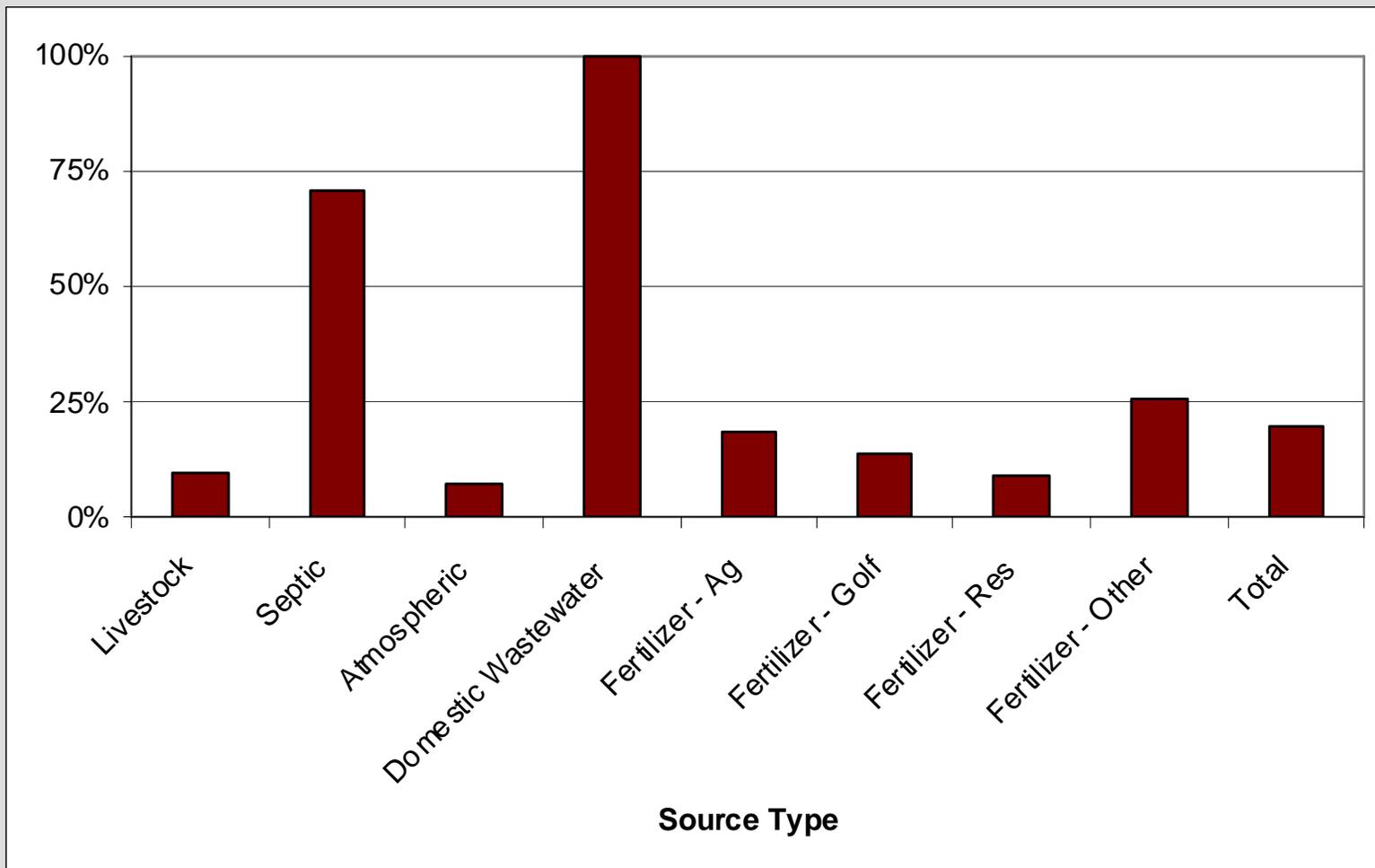
QUANTIFICATION

SHALLOW GROUNDWATER CONCENTRATIONS

- **Agricultural fertilizer**
 - row crops (Florida & SE U.S. studies); 23 mg/L NO₃-N
 - citrus (Florida studies); 6 mg/L NO₃-N
 - ornamental nurseries (several states, including FL); 6 mg/L
- **Agricultural cattle** - 5.5mg/L NO₃-N for pasture (SE U.S. studies). 18 mg/L for CAFO's (Florida studies)
- **Residential fertilizer** – 3 mg/L NO₃-N (25% don't fertilize; 50% use recommended; 25% overfertilize)
- **Golf Course fertilizer** – 8 mg/L NO₃-N

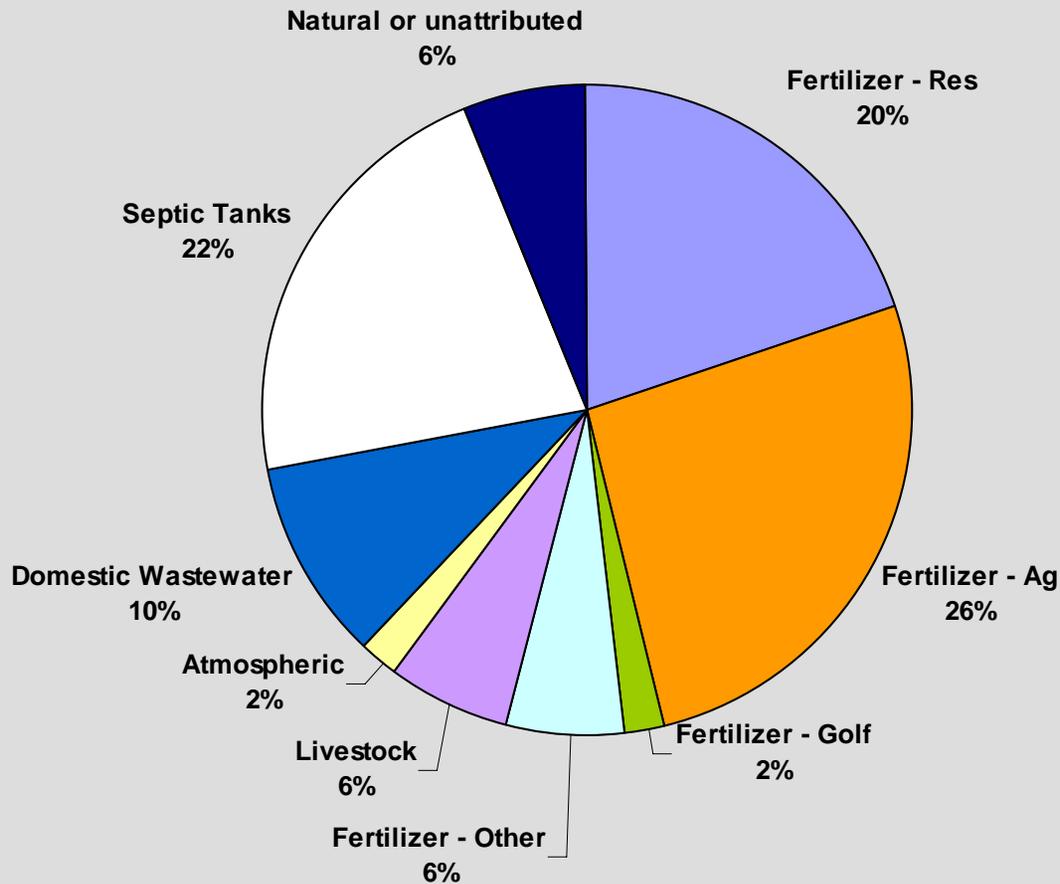


NITRATE - FRACTION THAT REACHES BASIN WATERS



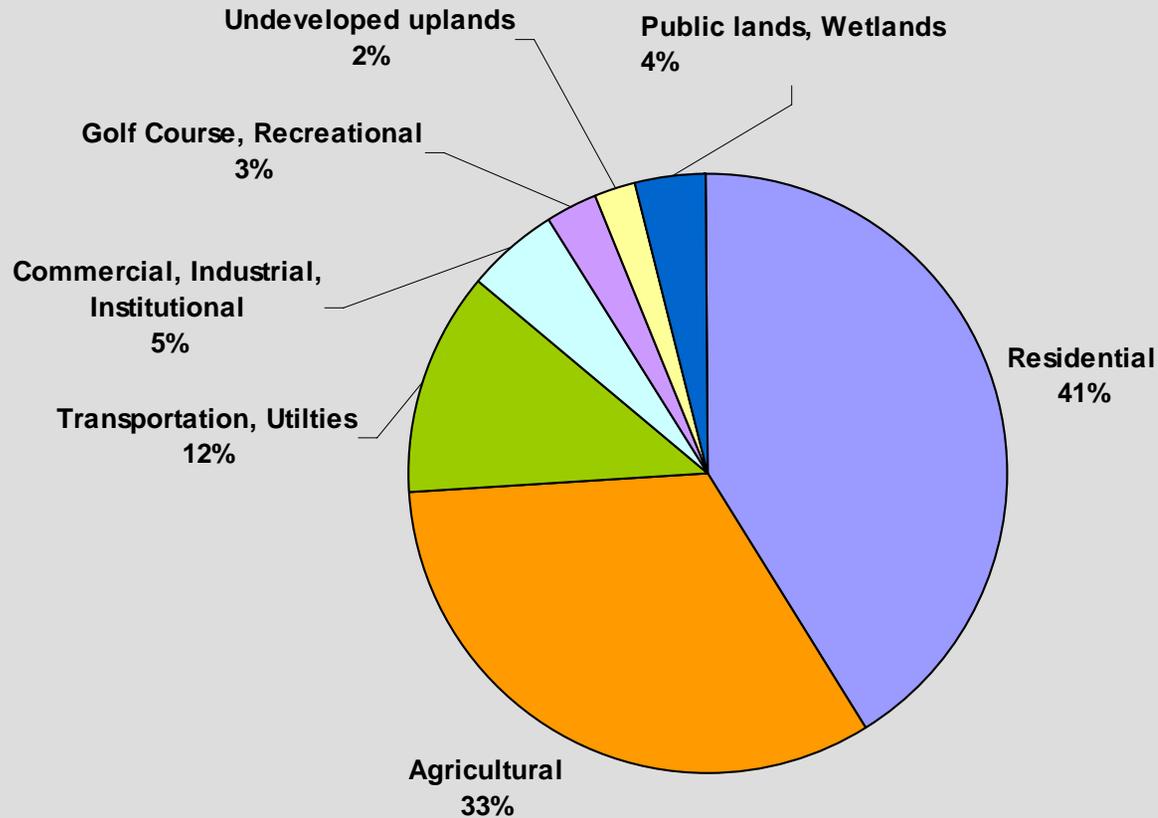
NITRATE LOADS (BY SOURCE)

1,800 Metric Tons/Year



NITRATE LOADS (BY LAND USE)

1,800 Metric Tons/Year



ISSUES TO CONSIDER

- Proximity of loads to springs (Wekiva Study Area focus)
- Loads to shallow groundwater and what gets to the Floridan Aquifer
- Transformation and fate of nitrate in groundwater (esp. when it gets to the Floridan Aquifer)
- “Legacy” nitrogen (loading from past land uses/lag times)
- Assumptions regarding displacement of fertilizer use by wastewater reuse and removal of groundwater nitrate load by stormwater treatment systems



WEKIVA BASIN NITRATE SOURCING STUDY-PHASE 2

- Study of water quality of recharging ground-water, by land use & location likely to have greatest impact on springs
- Development of integrated ground and surface water quality model with potential to simulate $\text{NO}_3\text{-N}$ transformations and transport in runoff, shallow, and deep groundwater compartments; and discharge of groundwater to springs and streams
- Need more data on impacts of residential land uses on shallow and deep ground water



WEKIVA BASIN NITRATE SOURCING STUDY

Funding Summary (\$250,000):

- **Initial Work Order with MACTEC - \$49,707.60**
- **Supplemental work - \$8,782.64**
- **Total spent with MACTEC - \$58,490.24**
- **Phase 1 remaining - \$41,509.76**
- **Phase 2 available - \$191,509.76**



? QUESTIONS ?

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

Approved Minutes of the Meeting held at Sylvan Lake Park, Sanford, FL
May 8, 2007

Approved by RRAC on June 12, 2007

In attendance:

- **Committee Membership and Alternates:** Sam Averett (alternate, Septic Tank Industry); David C. Carter (member, Home Building Industry); Paul E. Davis (member, DOH-Environmental Health); Marc Hawes (alternate, Home Building Industry); Stan Keely (alternate, Professional Engineer); Patti Sanzone (alternate, Environmental Interest Group); Clay Tappan (member, Professional Engineer); Pam Tucker (member, Real Estate Profession); and Ellen Vause (alternate, Septic Tank Industry)
 - **Not represented:** Consumer; Restaurant Industry; State University System
 - **Visitors:** Quentin Beitel (Markham Woods Association); Dominic Buhot (Greens Environmental Services); John Byrd (Aide to Orange County Commissioner Brummer); James Clark (Town of Windermere); Michael Corry (Infiltrator Systems); Sergio Duarte (Orange County Environmental Protection Department); Doug Everson (Plastic Tubing Inc.); Chris Ferraro (Florida Department of Environmental Protection); Chris Finkbeiner (Office of Representative Bryan Nelson); Bonnie Hall (Florida Department of Environmental Protection); Ray Hanson (Orange County Utilities); John Higgins (Markham Woods Association); Ken Jones (Markham Woods Association); Greg Kong (World Wide Water Recycling Inc. & Environmental Air Solutions LLC); Rob Mattson (St. Johns River Water Management District); Mark Mechling (Ellis & Associates); Steve Meints (Averett Septic); Russ Melling (Lake County Environmental Health Department); Erich Morzolf (St. Johns River Water Management District); Don Orr (ADS/Hancor); Harley Pattee (World Wide Water Recycling Inc.); Chris Rowe (Plastic Tubing Inc.); Kevin Sherman (Onsite Management Consultants, Inc.); Nancy Smith (Orange County Environmental Health Department); William Tucker (MACTEC, Inc.); Meghan Whidden (Seminole County Environmental Health Department); Walter Wood (Lake County Environmental Services);
 - **Department of Health (DOH), Bureau of Onsite Sewage Programs:** Paul Booher; Eberhard Roeder; and Elke Ursin
1. **Introductions:** Six out of nine groups were present, representing a quorum. Chairman David Carter calls the meeting to order at 9:40 am.
 2. **Review Minutes of Meeting February 6, 2007:**
 - a. **Motion was made by Sam Averett and seconded by Clay Tappan for the RRAC to approve the April 10, 2007 meeting minutes. No changes were proposed. All are in favor with none opposed, and the motion passed.**
 3. **Updates on other projects**
 - a. Ongoing projects
 - i. **Florida Alternative Disposal Systems Assessment:** An overview of the project was given by Elke Ursin. The basic tasks are to complete a Quality Assurance Project Plan (QAPP), select sites, select alternative drainfield products, install test systems and sampling equipment, assess treatment effectiveness, complete a report, and either remove the test systems or train

DOH staff to continue the project. The QAPP has been reviewed and comments from DOH, RRAC, and interested parties were compiled and sent to Dr. Sherman. The finalized QAPP was submitted to DOH today. A phone teleconference was held with DOH, Dr. Sherman, and various alternative drainfield product manufacturers on April 26, 2007. The issue regarding the drainfield size was not resolved. The conversation focused more on the overall study design. Some of the key discussion items:

- Sample size
- Possibility of doing either test center study or destructive auger sampling instead of field study
- Evaluation only three products

There was a presentation given by Eberhard Roeder comparing this study with a similar study done by the Colorado School of Mines. The study focused largely on infiltrative rates and hydraulic loading issues. The results indicated that the hydraulic loading rate was the most important factor, and the next most important issue was the infiltrative surface architecture (chamber, aggregate, etc.) Dr. Sherman states that one of the comments discussed during the teleconference was that this study should be looked at as a scoping study, due to the sample size and the fact that it is a field study with some uncontrolled variables. This study would give some indications as to what variables are important and what sample size would be appropriate, but would not be enough to make any regulatory changes. There was a discussion on the overall concerns regarding this project in response to the information presented. The overall project objectives from the revised QAPP were read:

“The goals of the Florida alternative disposal systems assessment are to systematically evaluate the performance of alternative drainfield materials and configurations in comparison to conventional gravel systems for removal effectiveness of CBOD5, Total Suspended Solids, Total Nitrogen and Total Phosphorous and pathogen indicators (virus), and for the distribution of effluent in the drainfield. A secondary goal is the characterization of failure loading rates. Results will be used to determine the scope of a larger study that could recommend modifications to designs and regulatory methods. Performance of drainfields is important to the mission of the Bureau of Onsite Sewage Programs, “Protecting the public health and environment through a comprehensive onsite sewage program”.

The research project should provide scientifically defensible information on how a limited number of ADMs perform under carefully monitored, yet still real-world conditions. The project will assess the treatment effectiveness of alternative drainfield materials under standardized conditions in comparison to conventional drainfield materials and will also compare low-pressure dosed and gravity fed conditions.”

There was a motion made by Paul Davis and seconded by Pam Tucker to go ahead with the study as is understanding that the study is limited and may point to other studies. There was a discussion regarding the phrasing within the

QAPP regarding the ability to use the results to make regulatory changes. Eberhard Roeder is asked how he feels about continuing the study, and he states that he is comfortable with moving forward with the project. Either the results will be significant and there will be a clear idea of where to go, or the results will not be significant and then the project will stop, or the results will be in the middle and more thought will need to be given as to what direction to go. After the discussion Pam Tucker withdrew her second and the motion was amended to remove the wording in the QAPP: "Results will be used to determine the scope of a larger study that could recommend modifications to designs and regulatory methods". Sam Averett seconded the amended motion, and the motion passed. All were in favor with none opposed.

- ii. **Taylor County Source Tracking Study:** Daniel Meeroff made a presentation on the final report with his co-investigator Dr. Bloetscher. There is a discussion on whether there is a possibility and need for additional work. Clay Tappan makes a motion and Sam Averett seconds it, for staff to work on getting a follow-up sampling event started as soon as possible to capture the May seasonal low water table event.
- iii. **Monroe County PBTS Performance Assessment:** A presentation was made on some of the preliminary Monroe County sampling results. Eberhard Roeder presents some of the background information on the project. The Florida Keys are a nutrient-sensitive environment, with both nitrogen and phosphorus being key components in the wastewater. An evaluation of nutrient reducing onsite technologies was performed for DOH by Ayres Associates during 1996-2000. This study recommended a county-wide utility be established to share costs and utilize cluster systems. As a result of the study, specific standards for nutrient reduction were adopted for the Florida Keys: 10 mg/L CBOD5, 10 mg/L TSS, 10 mg/L TN, and 1 mg/L TP. There were several sources of variability with some of the factors being what day the sample is taken, the sampling location, the influent concentration, etc. In 2001 the rule was amended to allow for aerobic treatment units without nutrient reduction in areas scheduled to be sewered by 2010. At this time the operating permit fees, which previously had paid for sampling, were reduced and the amount of sampling decreased significantly. The current Monroe County PBTS Performance Assessment is a follow-up study to see how well these systems are working. The approach was to focus on the nutrient reduction systems (15 systems selected) and add some interim ATU systems (5 systems selected) for comparison. Each system will be sampled twice during the peak season and twice during the off season, with the sample being a 24-hour composite sample from the P-trap. Sampling started 2/18/07. There was a discussion on whether the rule requires an absolute number or a percentage reduction. If the influent comes in at very high concentrations it will be very difficult to reach the 10 mg/L goal. The initial data was presented. The data has not gone through quality control, and will be released as soon as it has.
- iv. **Columbia County Well Testing Project:** Not much has happened with the project since the last RRAC meeting. DOH is waiting to get pricing information from the DOH Lab. The nitrogen isotope sampling was approved to be done at the last RRAC meeting, and sourcing for this is still ongoing.

b. Projects coming up

- i. **319 Project on Performance and Management of Advanced Onsite Systems:** Proposal has been submitted to DEP to collect data on Performance Based Treatment Systems, how they are managed, and where they are located. Patti Sanzone indicates that there is no update on this project to report.

4. Wekiva Onsite Nitrogen Contribution Study:

- a. **DEP/SJRWMD report:** Rob Mattson with SJRWMD presented a report on the progress of the DEP portion of the Wekiva Study. Bonnie Hall with DEP and Dr. William Tucker with MACTEC are available for questions too. The Phase I report has been completed by MACTEC, consisting of mainly a “desk-top” review of existing literature and information to detail loading of nitrates to surface and ground-waters in the Wekiva Basin (DOH was tasked to look at Wekiva Study Area). The basin is a combination of the surface water drainage of the Wekiva River and the groundwater contributing area (or springshed). In order to be most technically defensible they needed to look at all areas which could be contributing nitrate to the Wekiva River system. The reason they took the Phase I / Phase II direction was that the original language associated with the funding required a report to the legislature at the beginning of this year’s session. This deadline was missed by a few weeks. This information was made available for DOH to use in their study. Contributions by all sources were reviewed in two regards: inputs (what is released to the environment) and loads (what makes it to the groundwater). Nitrogen inputs released to the environment for onsite systems were 6%, domestic wastewater treatment facilities were 2%, and total fertilizers were 75%. Nitrate loads released to the groundwater for onsite systems were 22%, domestic wastewater facilities were 10%, and total fertilizers were 54%. A Phase II study is being discussed at DEP which may look at testing some of the assumptions made during the Phase I report through field work. There was a discussion on atmospheric deposition and why results are so much lower than those presented in other reports. Dr. Tucker states that it might be due to the fact that they were looking at nitrate, and the other reports may have been looking at total nitrogen. There was a discussion on the loading numbers being in the nitrate form and whether the numbers would be very different if looking at total nitrogen. Dr. Tucker states that they did not do that calculation, but thinks that the number would not change much. He points out that nitrate is very mobile in the environment so that it the more common form that makes it to water. There was a clarification that the inputs pie chart should be total nitrogen instead of nitrate on the handout that was passed out. John Byrd asks whether Phase II will be done and Bonnie Hall indicates that it will be. John Byrd asks whether the DOH number will supersede the assumption made in the MACTEC report if it is found to be different and Bonnie Hall states that that would be a decision for the legislature to make. Eberhard Roeder asks whether the nitrate loads are counted twice with the atmospheric deposition, once as natural/unattributed and then again as atmospheric deposition. Dr. Tucker states that they used background water quality to determine the load from atmospheric deposition. David Carter asks DOH staff whether Dr. Otis’ work uses nitrate or total nitrogen. Elke Ursin answers that he uses total nitrogen but splits it up into TKN and nitrate whenever he can. David Carter asks whether the DOH study is looking at the Wekiva Study Area and Elke Ursin answers yes. David Carter then asks how the DOH and DEP reports are going to come together, and Eberhard Roeder answers that Linda Young’s task is to base her calculations on what MACTEC was doing, use the same assumptions to get from the inputs to the loads, but the numbers will apply to the Wekiva Study Area. There was a question about the source of the 70% of nitrogen input from onsite systems that

becomes a load to the groundwater as opposed to the total nitrogen input. The source was from a report by Anderson and Otis 2000, could range from 50 – 90% and they took the middle. The study was a literature study over several states. Eberhard Roeder states that both authors had a lot of experience in Florida, so the information does include Florida data. Bonnie Hall states that this Phase I report is not the final answer from DEP on the Wekiva issue. There will be a Phase II study that will help to refine the assumptions in the report. John Byrd states that in the original scope of work for the DEP study, it was to include field data collection to verify or refute the assumptions made in Phase I. Bonnie Hall states that Phase I was a preliminary estimate based on existing information, and Phase II will be designed to include more refined information, field data collection, to make the pie chart more accurate. David Carter asks whether DEP has a June 30, 2007 deadline like DOH does. Bonnie Hall states that they do not have this deadline. They do anticipate incorporating the DOH study into their report. There will be a meeting within the week to discuss what to do for Phase II. David Carter states that DEP's numbers are given in pounds per year and DOH's is in kilograms per year, and there is confusion on whether the numbers are given in total nitrogen or nitrate, and he would like the report to be clear on these differences. DEP's legislative mandate specifies that they look at the nitrate contributors, and DOH's is tasked to see if onsite systems are significant contributors of nitrogen. There is an assumption that if a property has reclaimed water that they use less or no fertilizers.

- b. Summary of progress as of the last RRAC meeting and decisions made during the current meeting for the DOH study:
 - i. **Task 1** (Field Work, \$200,000): Mark Mechling with Ellis & Associates, Inc. presented the draft report on the results of all three sites investigated as part of this study. Mark Mechling outlines how all three sites meet the selection criteria developed by RRAC in previous meetings except that the Lake County site was served by an onsite well. The well did have a temporary meter installed to record water usage during the study period. There was a site in the primary Wekiva Aquifer Vulnerability Assessment (WAVA) zone (Orange County), in the secondary WAVA zone (Lake County), and the tertiary WAVA zone (Seminole). The water use in these sites fell within the expected range except for Lake County, which slightly exceeded the estimates. The daily total nitrogen inputs from the septic systems were slightly above the expected range for the Seminole and Lake County sites and within the expected range for the Orange County site. The Seminole County site had very homogeneous soils (Myakka fine sand), whereas the Lake and Orange County sites were more heterogeneous (Tavares fine sand) with the top of the soil being continuous fine sand, then a mix of sandy clay loam / clay / fine sand below. The nitrogen plume direction was as expected on the Seminole County site, but not for the Orange and Lake county sites. This can be due to the intermittent clay in the soils. The nitrogen plume moved opposite from what was expected in the Lake and Orange county sites. The plumes at the Lake and Orange County sites were almost 100% in the nitrate form. At all three sites, the total nitrogen appeared to be reduced by 70% to 80% as compared to effluent concentrations within about 80 feet of the source area. There was a discussion on how much of the reduction in nitrogen was due to dilution. The loading from the onsite systems will be outlined in the final report. A longer term study could more accurately assess the variability and more accurately define what background concentrations are. Wednesday May 16th is the deadline for comments

regarding the report. The final report will be submitted to DOH at the end of May.

- ii. **Task 2** (Categorization and quantification of nitrogen loading, \$25,000): Dr. Otis was not able to attend this meeting. The table outlining the estimated denitrification potential of soils in the Wekiva Study Area has been received and is posted on the DOH website. He will work on a report and have it in by the end of May. The categories are drainage class, water table class, organic matter class, soil series taxonomy, soil series description, the applied nitrogen, and the estimated total nitrogen removal potential. Each system in soils with high water table or for which digouts are common will be assumed to discharge TKN regardless of the pretreatment since if the organic carbon is removed by the dig out, then it doesn't make any difference what the influent form of N is, the removal will be similar to that when only TKN is applied. Dr. Otis will try to attend the next RRAC meeting.
- iii. **Task 3** (Assessment of the contribution of OWTS relative to other sources, \$25,000): Dr. Young was not able to attend this meeting. The draft final report for the assessment of total loading in the Wekiva Study Area has been received and is posted on the DOH website. This report follows the process used in the DEP report but looks at the Wekiva Study Area as opposed to the Wekiva Basin. The report indicates the nitrogen inputs for onsite systems were 6.24%, domestic wastewater facilities were 1.9%, and total fertilizers were 78.77%. The report does not go into the nitrogen loadings to the groundwater at this point. The final report will include this information. It is expected to follow a similar trend as the DEP report with fertilizer loadings decreasing, and onsite sewage system loads increasing. At this point Dr. Young can take the estimates of percentage of nitrogen removal in the soils from Dr. Otis to come up with a load estimates.
- iv. **Task 4** (Cost-effective solutions): Eberhard Roeder presented the progress thus far. He tried to come up with some thoughts that could be a response if the nitrogen contributions are found to be significant. The outline will be similar to the management guidelines developed by EPA. There is a question on who will implement these changes. It can range from the homeowner to a responsible management entity. He is preparing a report that has not gone through internal DOH review as of the meeting and is planned to be completed in early June.

5. Public Comment

- a. None.

6. Closing Comments, Next Meeting, and Adjournment

- a. Next Meeting: A date of June 12, 2007 was set, with the meeting beginning at 9:30 at Sylvan Lake Park in Sanford. The meeting will be limited to discussing the Wekiva project. The meeting adjourned at 5:10 pm.



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

Tuesday May 8, 2007
9:30 am - 3 pm

Sylvan Lake Park
845 Lake Markham Road
Sanford, FL 32771



Agenda:

- Introductions
- Review Minutes of Meeting 04/10/07
- Alternative Drainfield Product Assessment update
- Taylor County Source Tracking Presentation
- Updates on other projects
- Wekiva Onsite Nitrogen Contribution Study updates: DEP/SJRWMD presentation, Tasks 1 - 4
- Public Comment
- Closing Comments, Next Meeting, and Adjournment



Introductions & Housekeeping

-
- Travel reimbursement forms



Review Minutes of Meeting 04/10/07

- See draft minutes



Updates on current projects



Florida Alternative Disposal Systems Assessment

- Contract executed February 16, 2007 with Dr. Kevin Sherman, On Site Management and Consultants, Inc.
- Tasks:
 - QAPP
 - Site selection and alternative drainfield material selection
 - Installation of systems for testing and associated sampling equipment
 - Assessment of treatment effectiveness and functioning of disposal systems
 - Report
 - Drainfield Removal / Training of DOH staff to continue project



Florida Alternative Disposal Systems Assessment

- QAPP reviewed, comments from DOH, RRAC, and interested parties compiled and sent to Dr. Sherman on May 1st
- Final QAPP to be distributed to RRAC today



Florida Alternative Disposal Systems Assessment

- Phone teleconference with alternative drainfield manufacturers on April 26'th
- Didn't resolve the issue regarding drainfield size
- Conversation focused more on overall study design. Some of the key discussion items:
 - Sample size
 - Possibility of doing either test center study or destructive auger sampling instead of field study
 - Evaluation three products
- Comparison with Colorado School of Mines study



Disposal Assessment - Comparison with CSM Study

- Sandy loam in Colorado
(Perc rate 6 min/cm or 15 min/in)
- Test center receives student housing
waste (TN=85 mg/L; TP=25.3 mg/L)
- simulated gravity (16 hours constant
flow)

HYDRAULIC LOADING RATE AND INFILTRATIVE SURFACE ARCHITECTURE
EFFECTS ON SEPTIC TANK EFFLUENT TREATMENT
DURING SOIL INFILTRATION

Kathryn S. Lowe, Robert. L. Siegrist, and Kyle N. Tackett. Presentation PE-06-40 at NOWRA 2006



CSM-Experiment

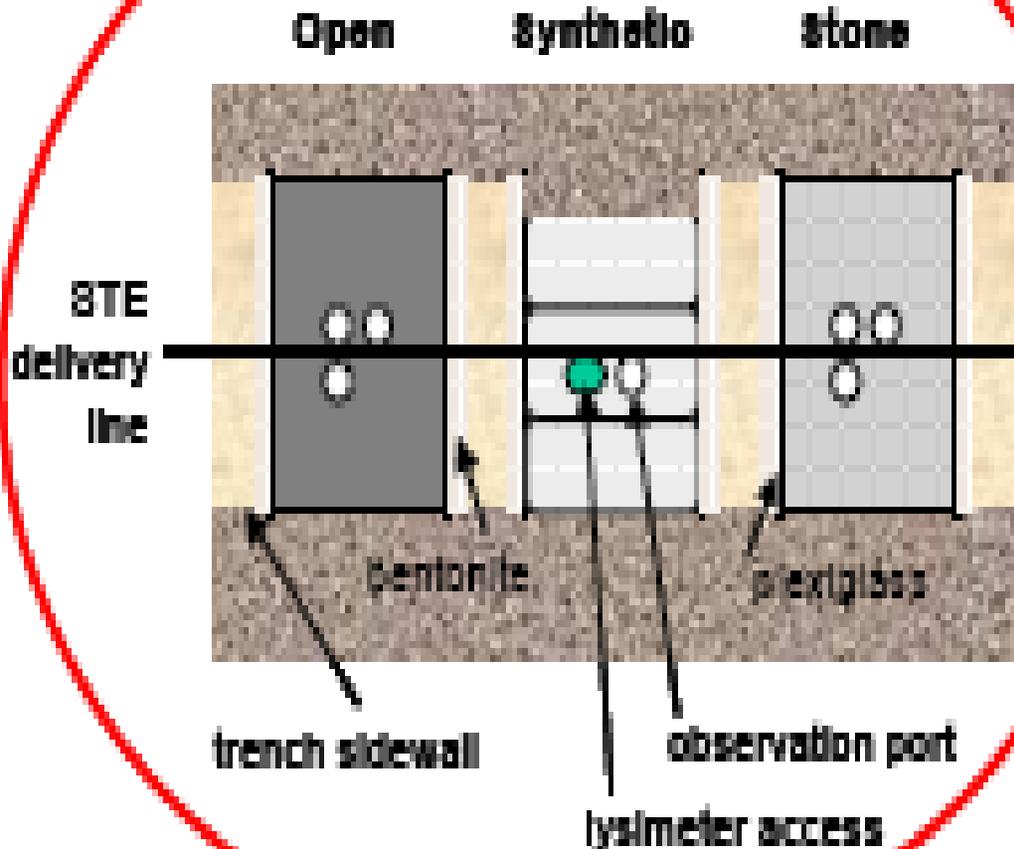
- factorial design (30 + 4 controls)
 - 3 drainfield products (gravel, chamber, artificial gravel)
 - 2 loading rates (2 and 4 times design loading rate),
 - 5 replicates ()
- “ accelerated loading rates are representative of feasible design conditions where STE is delivered unequally to the soil treatment unit (e.g. all effluent directed to one of four trenches, or gravity delivery to the initial portion of each trench)” .



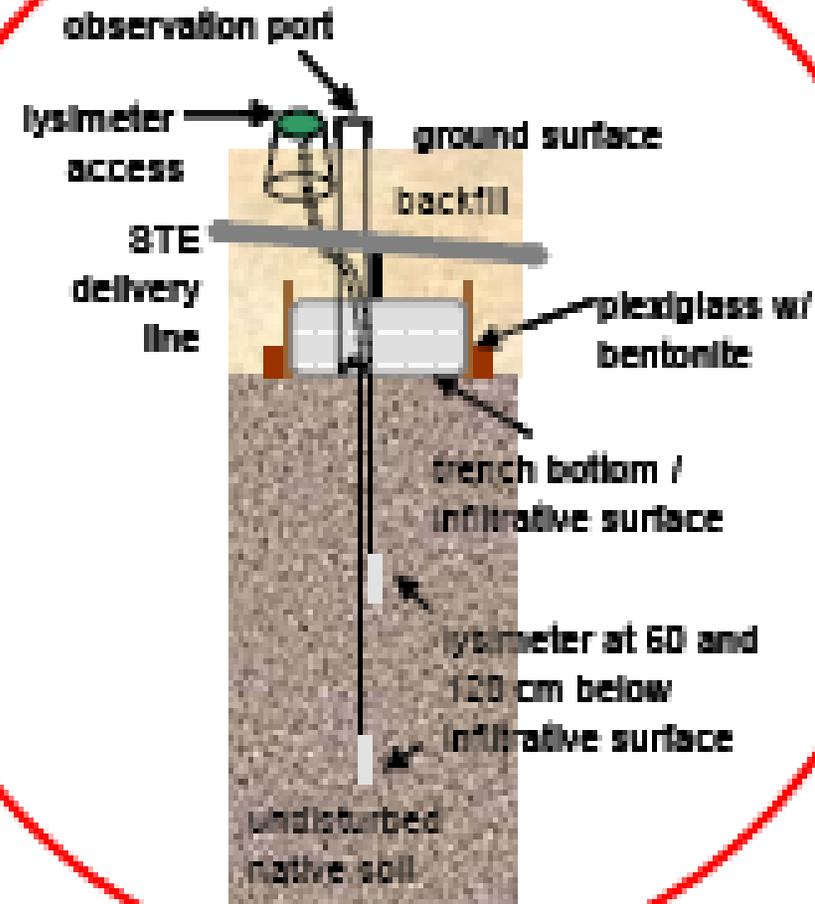
CSM-Experiment

- actual bottom area evaluated;
Cells were 26" \pm 2" long by 31" \pm 4" wide

Plan View



Profile View



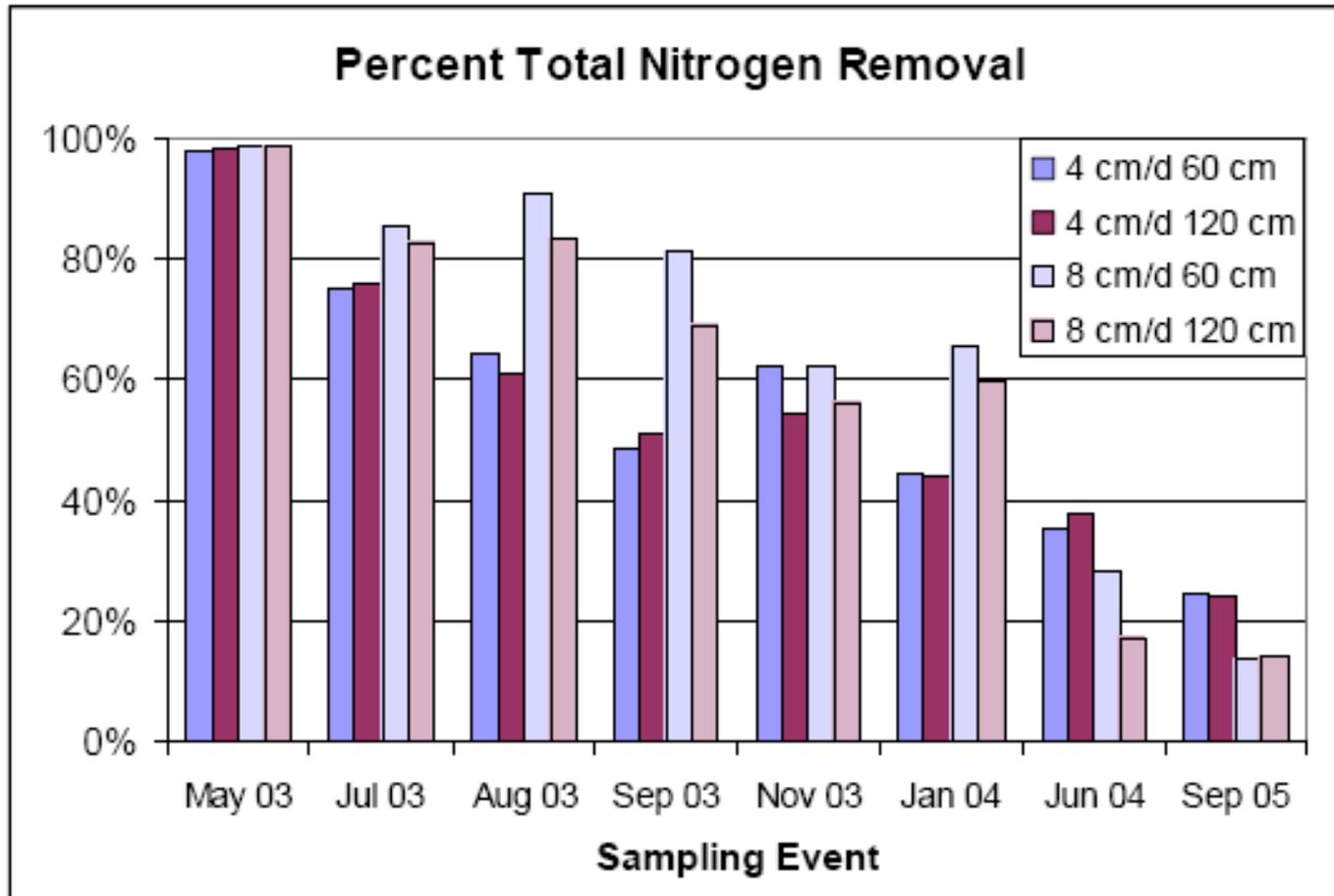


Results: Infiltration rates

- “As expected, the HLR had the most impact on the end state infiltration rate (79% of the variance), but the ISA played an important role as well (16% of the variance) with little impact attributed to the sample variance (5%)”
- End state infiltration rate (after 3 weeks ponding to 20 cm (8"))
 - Loading at four times the design loading rate resulted in an end rate about 2/3 of the design loading rate.
 - Loading at twice the design loading rate resulted in an end infiltration rate about 1/4 of the design loading rate
 - Cells appear to have worked fine under continued dosing with design loading rate



“Soil solution sampling over time revealed changes in purification with the greatest effects associated with HLR and vadose zone depth. The ISA did not have an affect on purification performance with respect to organic carbon, total nitrogen, or total phosphorus.”





Proposed study

- Fine sand, common in Florida
- Drainfield products compared relative to approved hydraulic loading rate in Florida
- Randomized block design (4 treatments; pressure/gravity blocks), keep hydraulic loading rate constant between pressure and gravity
- Reducing the number of products to two would make it statistically harder to find differences (e.g., $F_{0.05}$ 3.59 \rightarrow 4.67)
- Doubling the number of houses does help little with detection of differences between products (e.g., $F_{0.05}$ 3.59 \rightarrow 2.96) or pressure/gravity ($F_{0.05}$ 4.84 \rightarrow 4.21)



Taylor County Source Tracking Study

- Final project report submitted
- Presentation by Dr. Daniel Meeroff with Florida Atlantic University



Monroe County PBTS Performance Assessment

- Contract executed
- Sampling began February 18, 2007

[Keys Monitoring Study Update](#)



Columbia County Well Testing Project

- CHD and Bureau of Water Programs fund testing of drinking water wells in similar situation as Magnolia II along the river. Sampling began 9/18 for pathogen indicators and nitrate.
- OSTDS plans to fund one additional event including analysis for TKN and TP (when available from DOH-labs), and TKN and TP part during high flow conditions. In addition proposing possible N-isotope sampling as well.
- Waiting for DOH lab to confirm pricing



Projects coming up



319 Project on Performance and Management of Advanced Onsite Systems

- Revised scope in response to DEP comments



DEP / SJRWMD Report Update

- Presentation by Rob Mattson with SJRWMD on Phase I Report: Wekiva River Basin Nitrate Sourcing Study (executive summary in packets)



Wekiva Onsite Nitrogen Contribution Study

Overview of Tasks

- Task 1: Field Study to identify and quantify nitrogen loading at a few sample OWTS in the Wekiva Study Area (Ellis and Associates, Inc.)
- Task 2: Categorization and Quantification of Nitrogen Loading from Onsite Wastewater Treatment System Types (Otis Environmental Consultants, LLC)
- Task 3: Assessment if OWTS are a significant source of nitrogen to the underlying groundwater relative to other sources; in particular enumeration and aggregation of OWTS loading (University of Florida)
- Task 4: Recommend a range of possible cost-effective OWTS nitrogen reduction strategies if significant (Staff)



Wekiva Onsite Nitrogen Contribution Study Task 1

- Sampling completed for all sites
- Draft report for all sites completed



Wekiva Onsite Nitrogen Contribution Study Task 1

- Presentation by Mark Mechling with Ellis & Associates



Wekiva Onsite Nitrogen Contribution Study

Task 2

Draft table submitted

- Estimated TN Removal Potential are the % removals from the pretreatment effluent. Since we are working with concentrations, to determine the removals we need to convert to mass.

Conversion to mass loading:

- Based on previous studies, each individual excretes about 11.2 gm N/day.
- Assuming all of that goes into the onsite system, that amounts to about 4.1 kg/person/yr.
- About 10-15% of that is removed by the septic tank, which is pumped out with the septage.
- That leaves about 3.5 kg/person/yr, which is applied to the soil.
- The average household size in the Wekiva Area is 2.6 persons so the annual discharge to the soil is 2.6×3.5 or 9.1 kg/household/year.
- Knowing the number of households in a soil mapping unit, we can estimate the mass on N discharged to the groundwater annually.
- If the Water Table Class is <3.5 ft, then the applied nitrogen is split into TKN (septic tank effluent) and NO_3 (nitrified effluent). It would depend on how the effluent is applied whether to use the TKN or NO_3 or some combination of the two.
- To complicate things further, "dig outs" are common. In the process of digging out the natural soil, much of the nitrogen removal capacity is probably removed. Each system in this category will be assumed to discharge TKN regardless of the pretreatment since if the organic carbon is removed by the dig out, then it doesn't make any difference what the influent form of N is, the removal will be similar to that when only TKN is applied.



Wekiva Onsite Nitrogen Contribution Study

Task 3

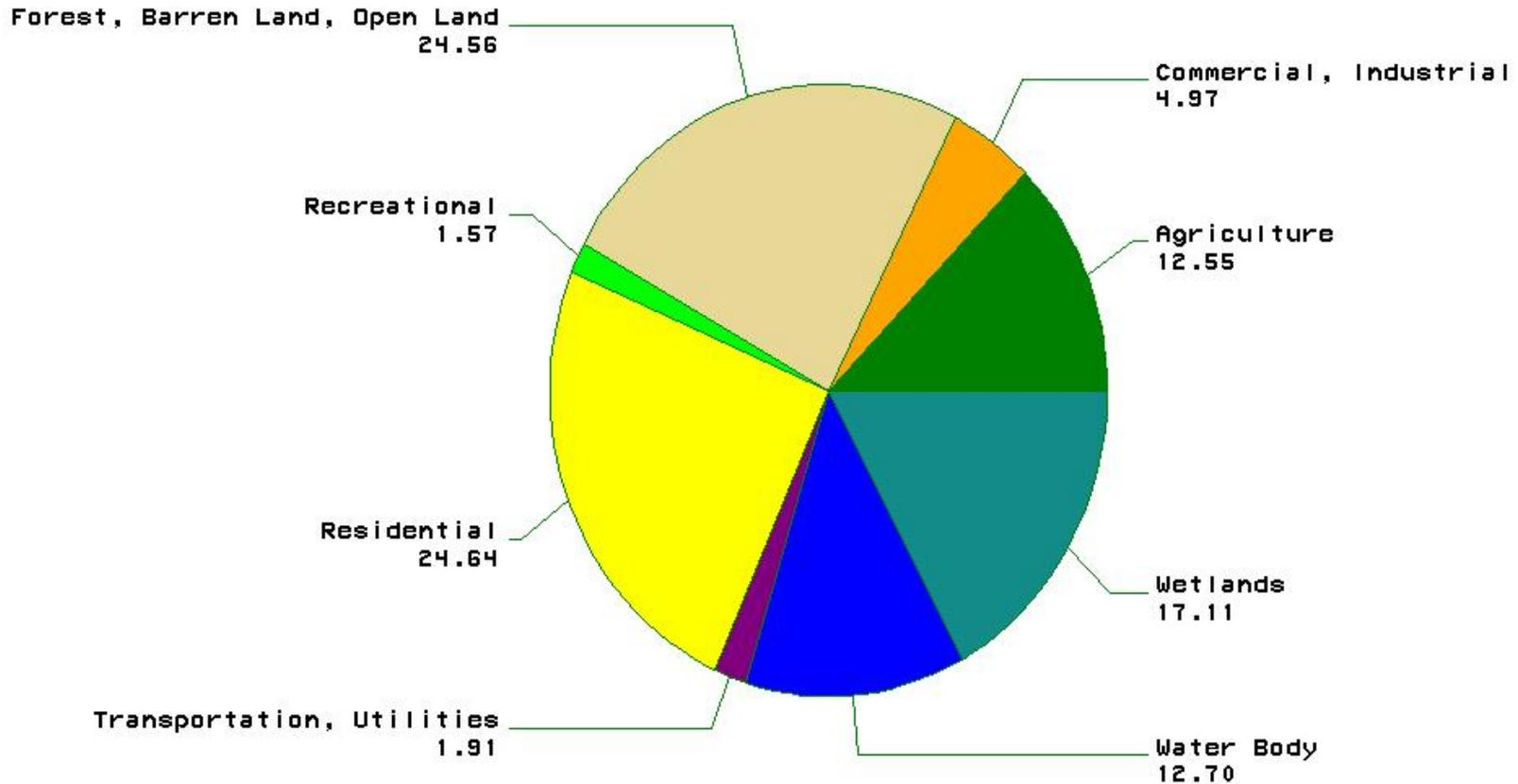
- Draft report submitted



Wekiva Onsite Nitrogen Contribution Study

Task 3

Land uses in Wekiva Study Area





Wekiva Onsite Nitrogen Contribution Study

Task 3

Estimated Nitrogen Inputs to the Wekiva Study Area from Septic Systems

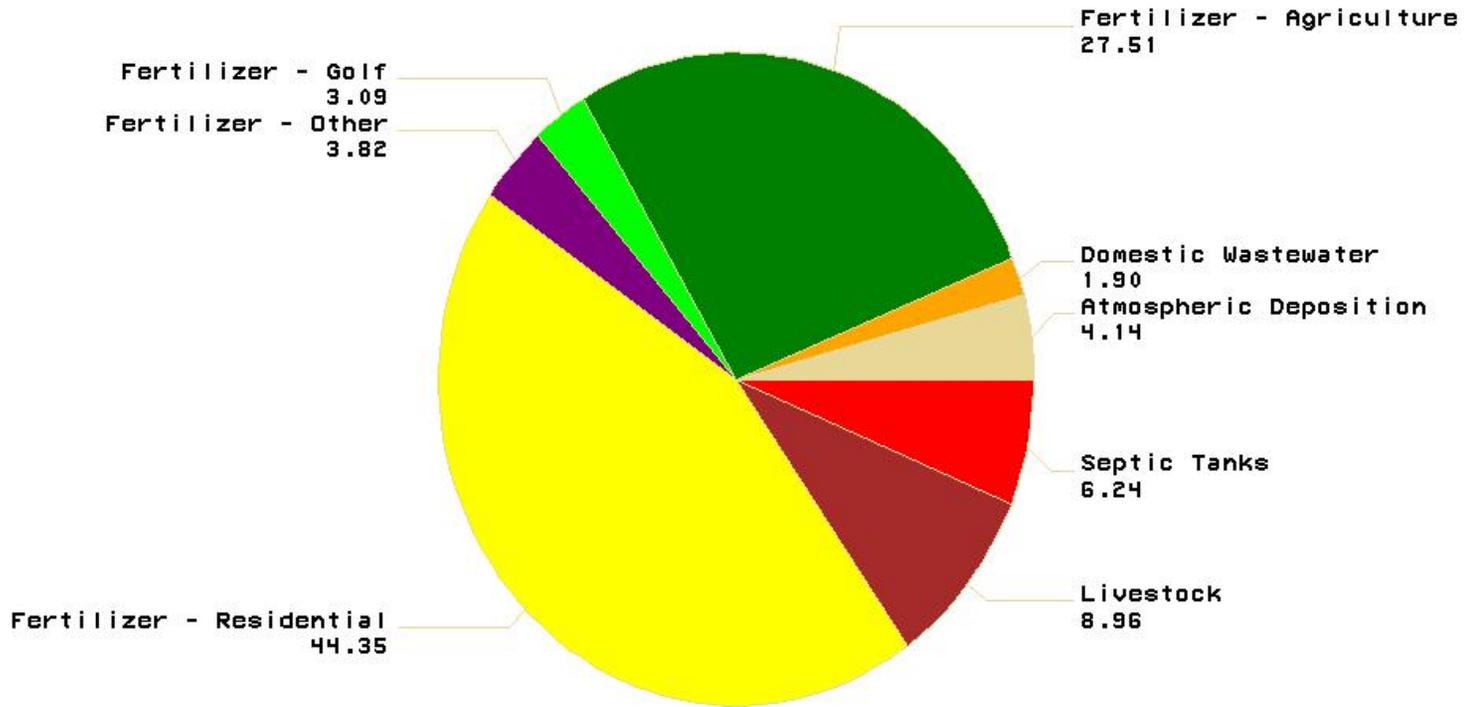
| SOIL | Number of Septic Systems | Nitrates (MT/year) | Percentage of N Contribution |
|-------------|---------------------------------|---------------------------|-------------------------------------|
| OTHER SOILS | 9839 | 80.678 | 17.7540601 |
| ASTATULA | 2585 | 21.197 | 4.66462744 |
| SMYRNA | 2657 | 21.787 | 4.79446327 |
| URBAN LAND | 8070 | 66.174 | 14.5622992 |
| TAVARES | 10120 | 82.984 | 18.2615202 |
| CANDLER | 22146 | 181.597 | 39.9623696 |
| | 55,417 | 454.42 | 100 |



Wekiva Onsite Nitrogen Contribution Study

Task 3

Nitrate Releases to WSA by Source





Wekiva Onsite Nitrogen Contribution Study Task 4

Range of Cost Effective Strategies

Status:

Reviewed information from permitting database

Continued cost gathering for typical systems for various treatment levels

Outline along management elements of EPA's guidelines

[Link to presentation](#)



Public Comment



Closing Comments, Next Meeting, and Adjournment

Important dates:

TRAP meeting: 5/17/07

Task 1 Field work final report due date: 5/30/07

Wekiva Commission meeting: 6/1/07

Final Wekiva report due: 6/30/07

Proposed dates for next meeting:

- Tuesday 6/12/07
- Tuesday 6/19/07
- Thursday 6/14/07
- Thursday 6/21/07

Do we want to meet to discuss Field work report, or the entire project report? If entire project report, suggest meeting closer to June 30, 2007 deadline.

Florida Department of Health

Research Review and Advisory Committee Meeting Summary

Meeting on May 8, 2007 at Sylvan Lake Park, Sanford

- **RRAC Members/Alternates Present:** Sam Averett, David Carter, Paul Davis, Marc Hawes, Stan Keely, Patti Sanzone, Clay Tappan, Pam Tucker, and Ellen Vause. Six out of nine groups were present, representing a quorum.
- **Review of Previous Meeting Minutes:** No comments or corrections on the April 10, 2007 meeting minutes. The minutes were approved as written.
- **Wekiva Onsite Nitrogen Contribution Study:**
 - **DEP/SJRWMD report:** a report was made on the progress of the DEP portion of the Wekiva Study. The Phase I report has been completed by MACTEC, consisting of mainly a “desk-top” review of existing literature and information to detail loading of nitrates to surface and ground-waters in the Wekiva Basin (DOH was tasked to look at Wekiva Study Area). There are two main thresholds: inputs (what is released to the environment) and loads (what makes it to the groundwater). Nitrogen inputs released to the environment for onsite systems were 6%, domestic wastewater treatment facilities were 2%, and total fertilizers were 75%. Nitrate loads released to the groundwater for onsite systems were 22%, domestic wastewater facilities were 10%, and total fertilizers were 54%. A Phase II study is being discussed at DEP which may look at testing some of the assumptions made during the Phase I report through field work.
 - Summary of progress as of the last RRAC meeting and decisions made during the current meeting for the DOH study:
 - **Task 1** (Field Work, \$200,000): Mark Mechling with Ellis & Associates, Inc. presented the draft report on the results of all three sites investigated as part of this study. Mark Mechling outlines how all three sites meet the selection criteria developed by RRAC in previous meetings except that the Lake County site was served by an onsite well. The well did have a temporary meter installed to record water usage during the study period. The water use in these sites fell within the expected range except for Lake County, which exceeded the estimates. The Seminole County site had very homogeneous soils, whereas the Lake and Orange County sites were more heterogeneous with the top of the soil being continuous fine sand, then a mix of sandy clay loam / loamy sand / fine sand below. The nitrogen plume moved opposite from what was expected in the Lake and Orange county sites. There was a discussion on how much of the reduction in nitrogen was due to dilution. The loading from the onsite systems will be outlined in the final report. Wednesday May 16th is the deadline for comments regarding the report.
 - **Task 2** (Categorization and quantification of nitrogen loading, \$25,000): The table outlining the estimated denitrification potential of soils in the Wekiva Study Area has been received and is posted on the DOH website.

- **Task 3** (Assessment of the contribution of OWTS relative to other sources, \$25,000): The draft final report for the assessment of total loading in the Wekiva Study Area has been received and is posted on the DOH website. This report follows the process used in the DEP report but looks at the Wekiva Study Area as opposed to the Wekiva Basin. The report indicates the nitrogen inputs for onsite systems were 6.24%, domestic wastewater facilities were 1.9%, and total fertilizers were 78.77%. The report does not go into the nitrogen loadings to the environment at this point. The final report will include this information. It is expected to follow a similar trend as the DEP report with fertilizer loadings decreasing, and onsite sewage system loads increasing.
 - **Task 4** (Cost-effective solutions): Eberhard Roeder presented the progress thus far. The outline will be similar to the management guidelines developed by EPA. He is preparing a report that has not gone through internal review as of the meeting.
- **Updates on other projects:**

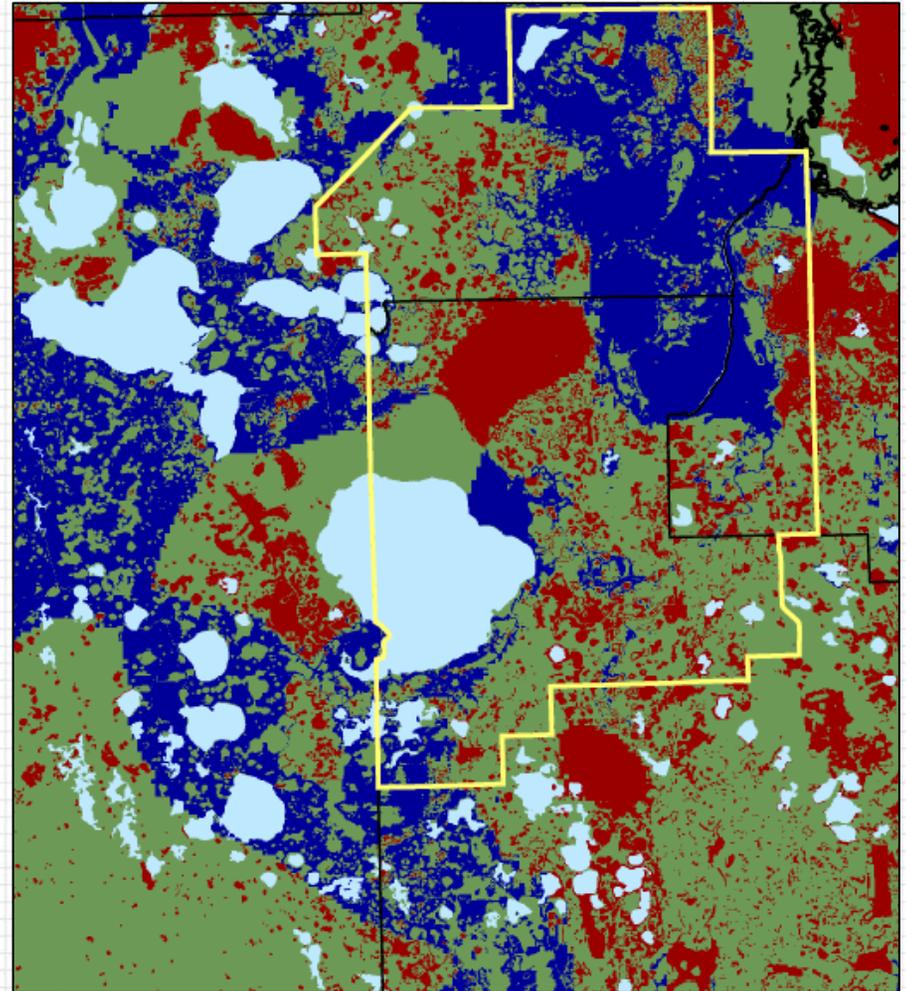
Several other projects that are proposed or ongoing were discussed. Some of the highlights:

 - **Florida Alternative Drainfield Product Assessment:** An overview of the project was given. A summary was given of the phone conference DOH and the provider had with various interested parties. Conversation focused more on overall study design. Some of the key discussion items:
 - Sample size
 - Possibility of doing either test center study or destructive auger sampling instead of field study
 - Evaluation three products

There was a motion made and passed to go ahead with the project with the removal of wording in the QAPP indicating that the results will be used to make regulatory changes. All were in favor with none opposed.

 - **Taylor County Source Tracking Study:** Daniel Meeroff made a presentation on the final report. There is a discussion on whether there is a possibility for additional work, and RRAC advises staff to work on getting a follow-up study started as soon as possible to capture the May seasonal low water table event.
 - **Monroe County PBTS Performance Assessment:** A presentation was made on some of the Monroe County sampling results. The data has not gone through quality control, and will be released as soon as it has.
- **Next Meeting:** A date of June 12, 2007 was set, with the meeting beginning at 9:30 at Sylvan Lake Park in Sanford.

Multiple Nitrogen
Loading Assessments
from Onsite Waste
Treatment and Disposal
Systems Within the
Wekiva River Basin
Wekiva Study Area, Florida
May 2007



**Wekiva study area and Wekiva Aquifer
Vulnerability Zones**

Source: Cichon et al, 2005

INTRODUCTION

In May of 2006, the Florida Department of Health was authorized to “conduct or contract for a study to further identify and quantify the nitrogen loading from onsite wastewater treatment systems (OWTS) within the Wekiva Study Area.”

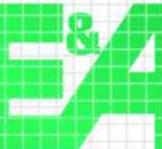


METHODOLOGY

Criteria for selection of properties to be investigated were prepared by DOH with input from the Research Review and Advisory Committee (RRAC).

Site selection criteria included:

- Selection of one site from each of Lake, Orange and Seminole counties;
- Depth to water within reach of direct push drilling method;



METHODOLOGY

Site selection criteria continued:

- Selection of sites with varying depth to groundwater;
- Septic systems installed after 1982 but with no repairs since 1999;
- Properties large enough to capture the nitrogen plume on-site and avoid interference from upgradient drainfields;
- Properties using minimal fertilizer and no reclaimed water;



METHODOLOGY

Site selection criteria continued:

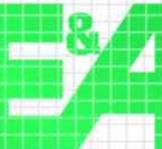
- Properties with homes on public water supply with year-round residents;
- Properties with no excessive number of occupants;
- If compatible with other criteria, one site in each Wekiva Aquifer Vulnerability Assessment (WAVA) vulnerability class.

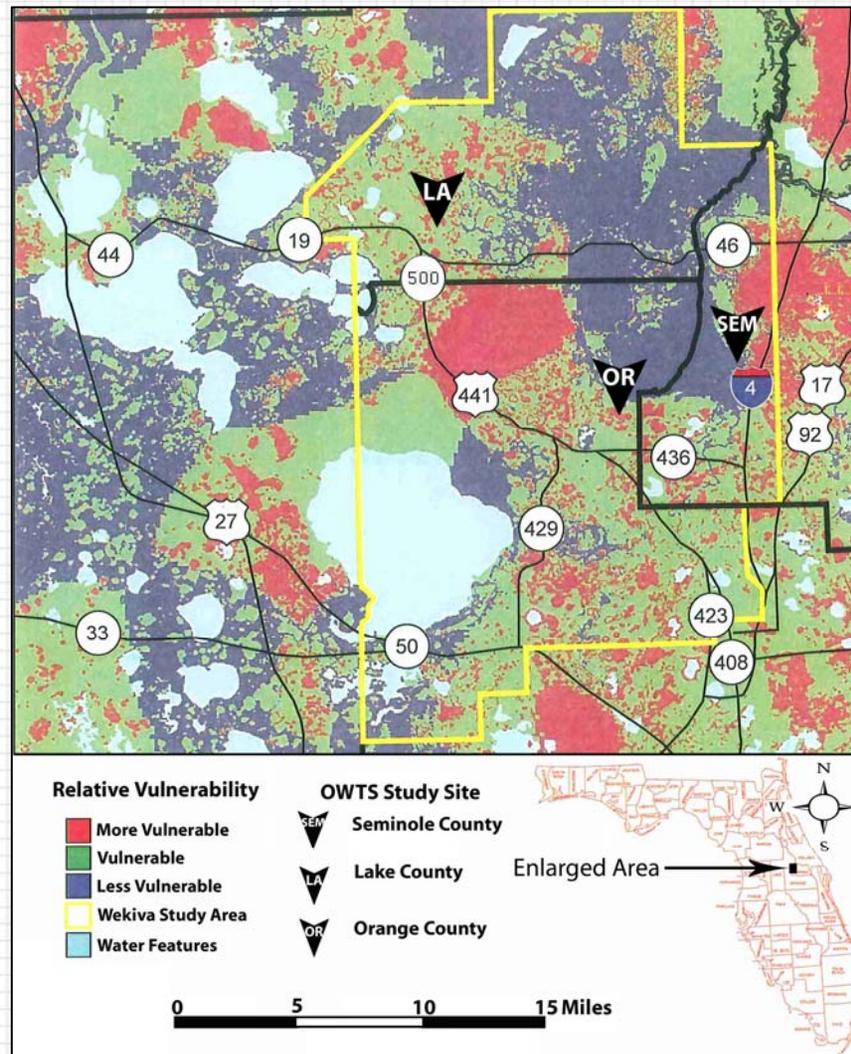


METHODOLOGY

The WAVA utilized soil permeability, the thickness of the surficial and intermediate aquifers, and karst features to establish areas of relative “vulnerability” of the Floridian Aquifer System.

- “Primary” = “more vulnerable”
- “Secondary” = “vulnerable”
- “Tertiary” = “less vulnerable”





Regional view depicting Onsite Waste Treatment System (OWTS) study sites in relation to Wekiva Aquifer Vulnerability Zones and the Wekiva Study Area. (Adapted from Cichon, et al, 2005)

TASKS

- Development of a site-specific Quality Assurance Project Plan;
- Identifying (in conjunction with DOH) properties meeting the established criteria for site selection;
- Securing approval from property owners to access the candidate properties and conduct assessment activities;
- Characterization of the onsite wastewater treatment systems;
- Determination of soil lithology and soil analyses;
- Delineation of nitrate and nitrogen in groundwater;
- Data interpretation and mass balance modeling.



RESULTS

- Water use for the three sites fell within the previously documented expected range (EPA, 2007) with the exception of the Lake County site, which was greater than the expected range.
- Concentrations of nitrogen and phosphorus in the septic tank effluent fell within expected range for all three sites.
- Daily total nitrogen loading into the septic systems was slightly above the expected range for the Seminole and Lake County sites and within the expected range for the Orange County site.



RESULTS

Soil types

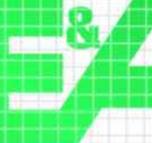
- Seminole County site:
 - Myakka fine sands
- Lake County site:
 - Tavares Series fine sands near the surface, followed by alternating, non-continuous intervals of clay, clayey sands, and fine sands
- Orange County site:
 - Tavares Series fine sands near the surface, followed by interfingering layers of clay loam, loamy sands, and fine sands



RESULTS

Mean organic content of soils

- Seminole County site: 1.29%
- Lake County site: 3.01%
- Orange County site: 1.39%



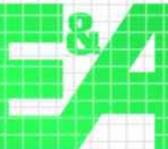
RESULTS

- Short-term groundwater elevation measurement was found to be a reliable indicator of groundwater flow direction and contaminant plume direction only at the Seminole County site.
- The short-term groundwater elevation measurements at the Lake and Orange County sites were not good predictors of contaminant plume direction.
- Likely influenced by lower than normal rainfall during past calendar year.



RESULTS

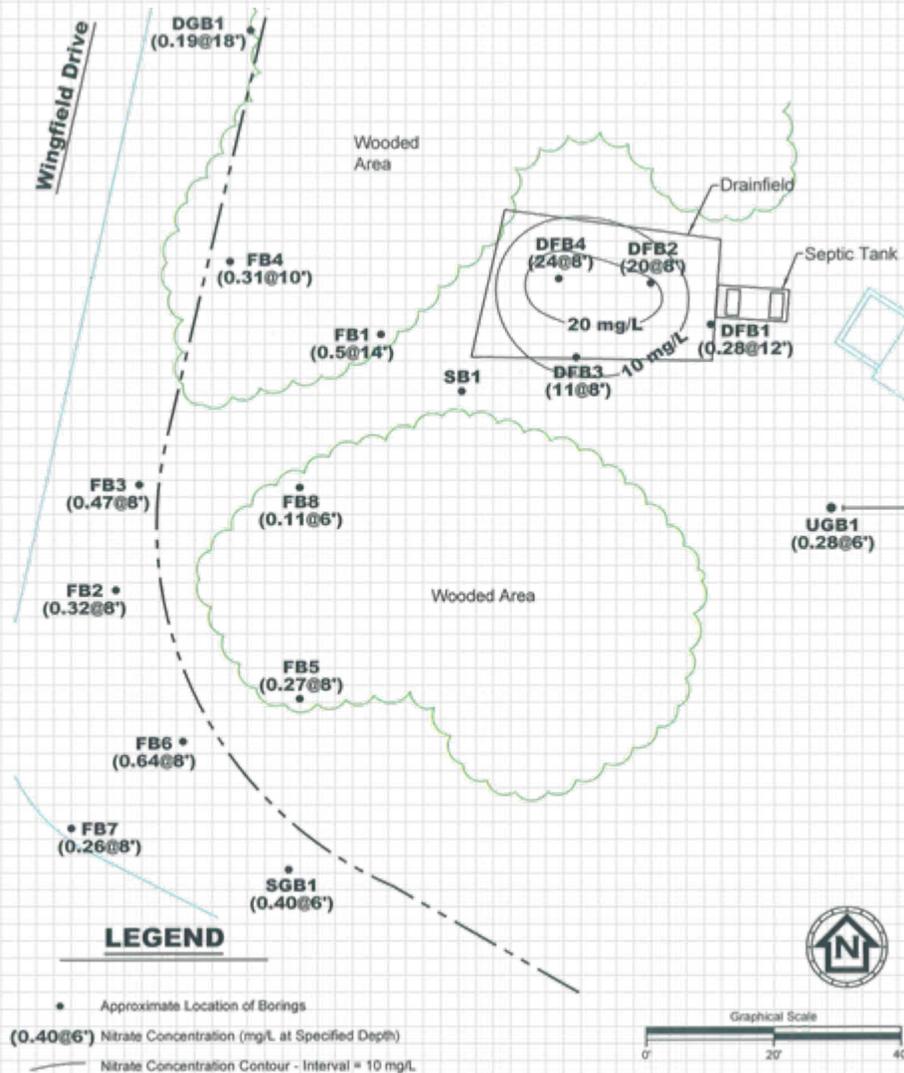
- Rainfall records from Orlando, Florida indicate less than normal rainfall in 11 of the previous 12 calendar months.
- Total Rainfall during this period was 22% below normal (National Weather Service, May 2006 – April 2007).
- A more realistic picture of groundwater flow direction could be drawn with measurements made over a longer period of time (seasonal for a year at a minimum).



RESULTS

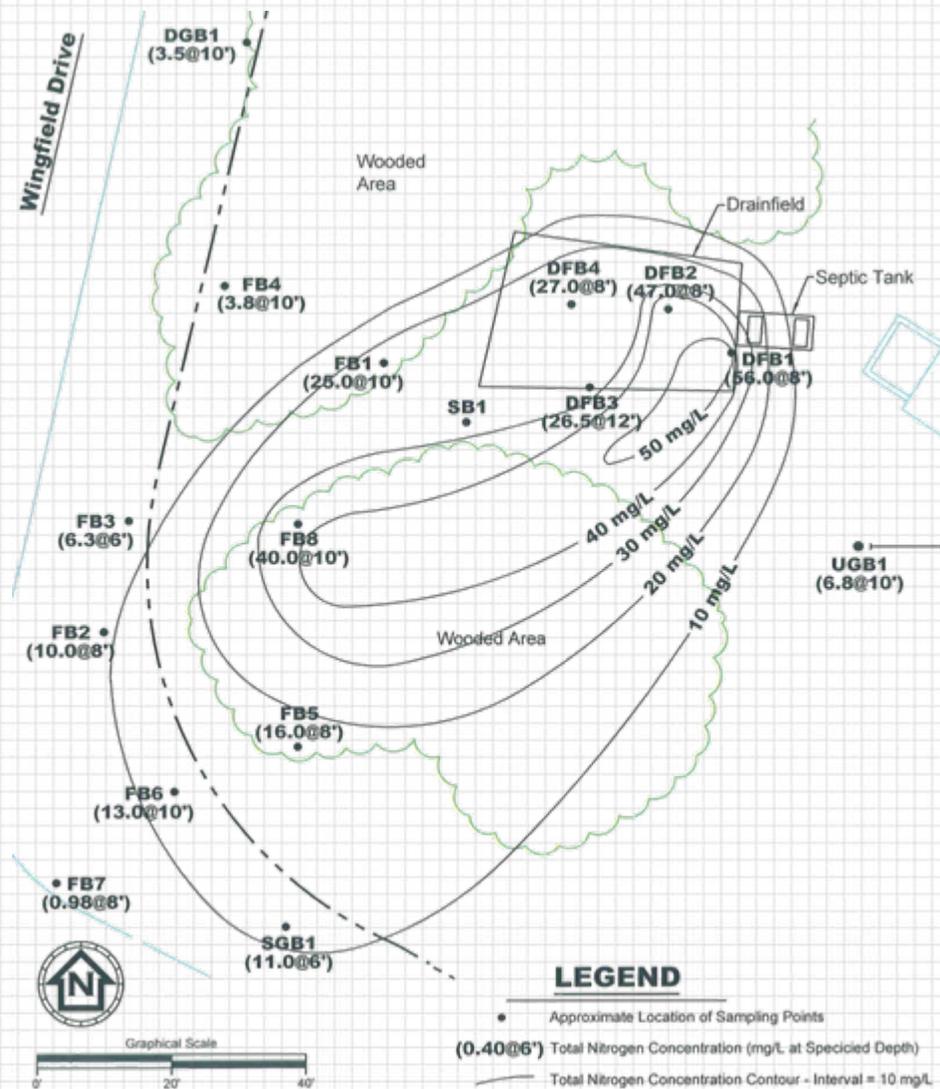
- The Seminole County site showed a shallow groundwater table (both seasonal high groundwater and observed groundwater depth) within several feet of ground surface.
- Nitrification and denitrification appeared to occur mainly in the immediate area of the drainfield.
- Denitrification of nitrates in the area of the drainfield appeared nearly complete within 20 to 30 feet downgradient of the drainfield.
- A Total Kjeldahl Nitrogen (TKN) plume extended well downgradient of the drainfield and appeared to be attenuated primarily by dilution from background water.





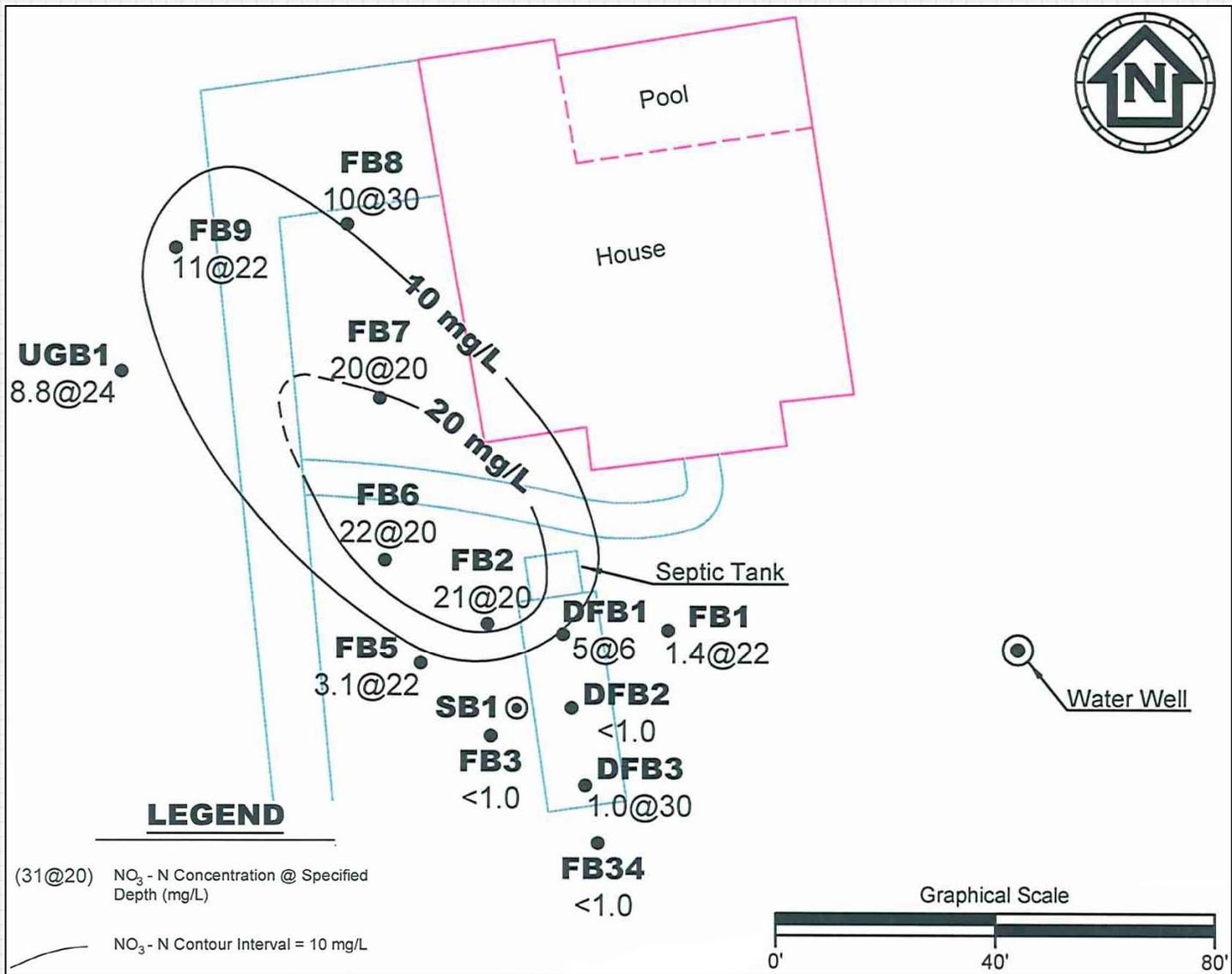
The nitrate plume encountered during the January/February 2007 Seminole County sampling event





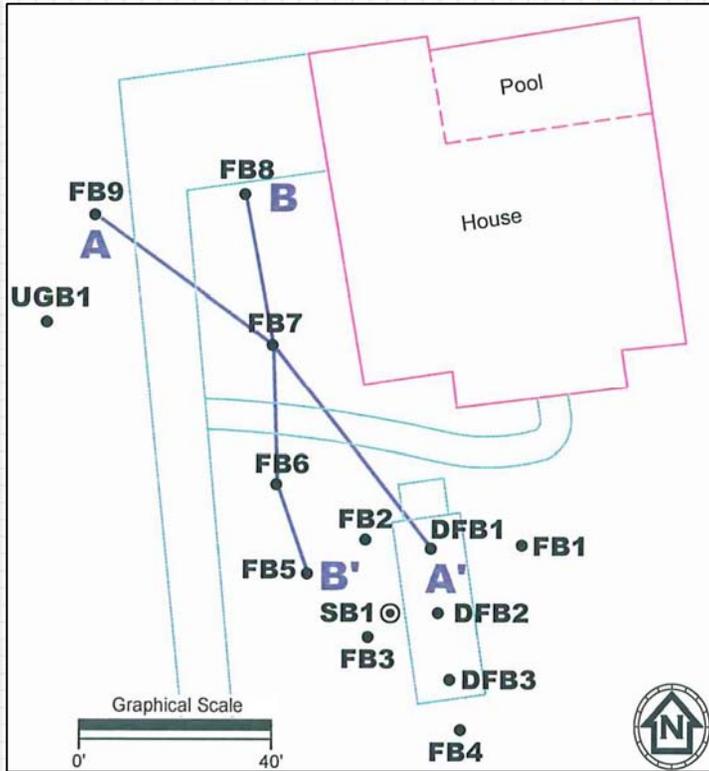
The total nitrogen plume encountered during the January/February 2007 Seminole County sampling event



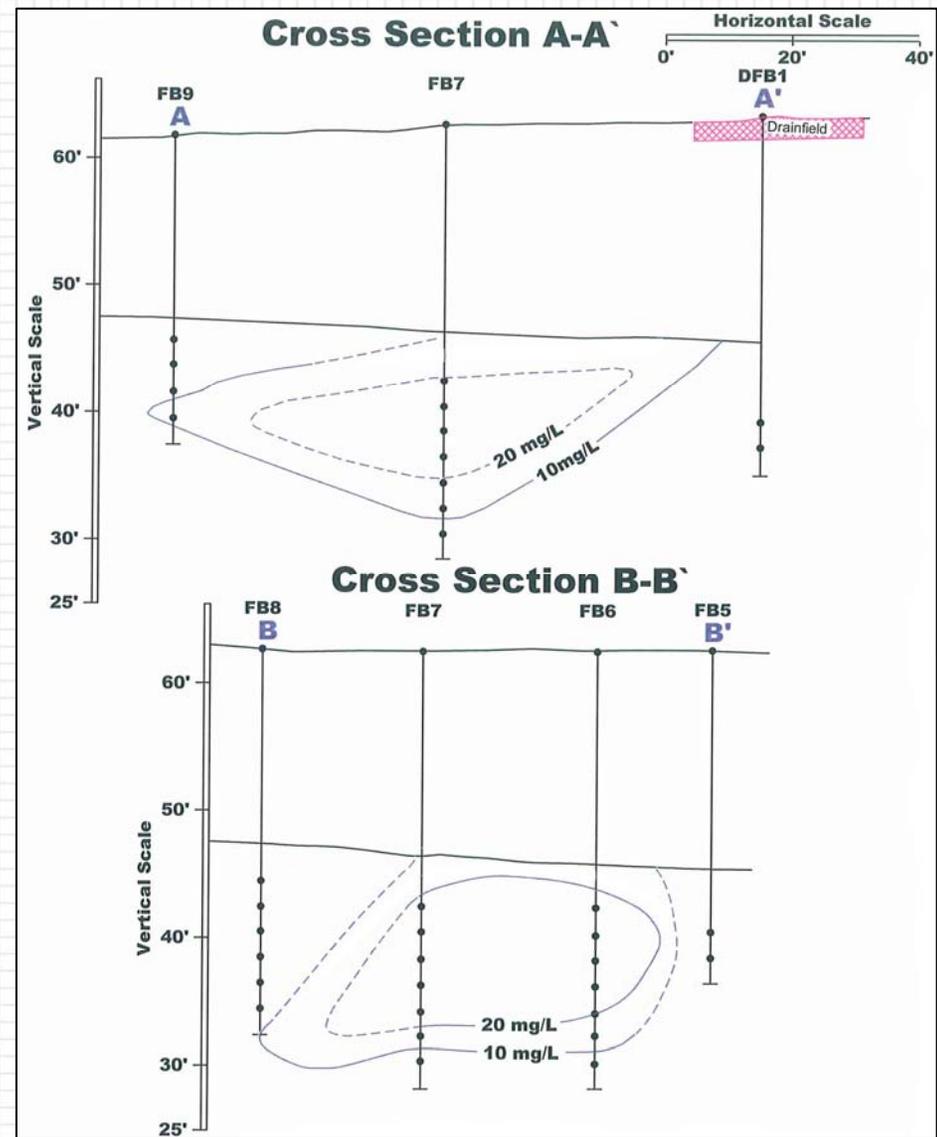


The nitrate (NO₃-N) plume encountered during the April 2007 Lake County sampling event

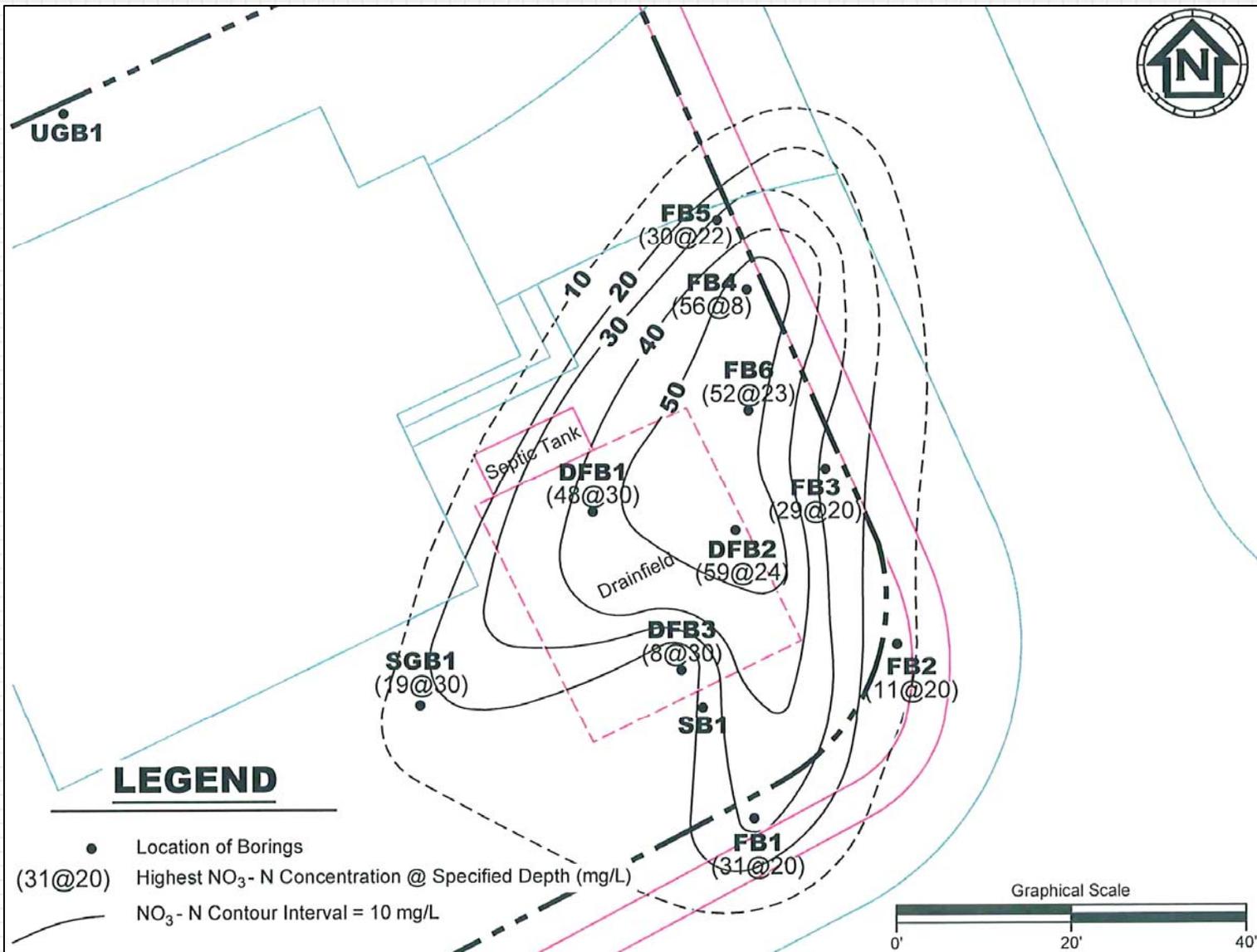




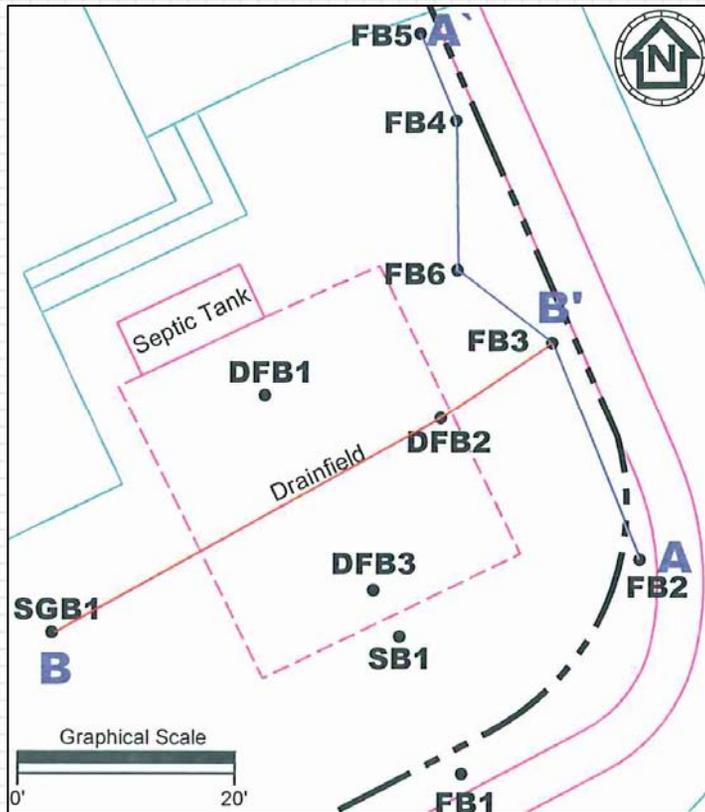
Locations of Lake County cross sections A-A' and B-B'



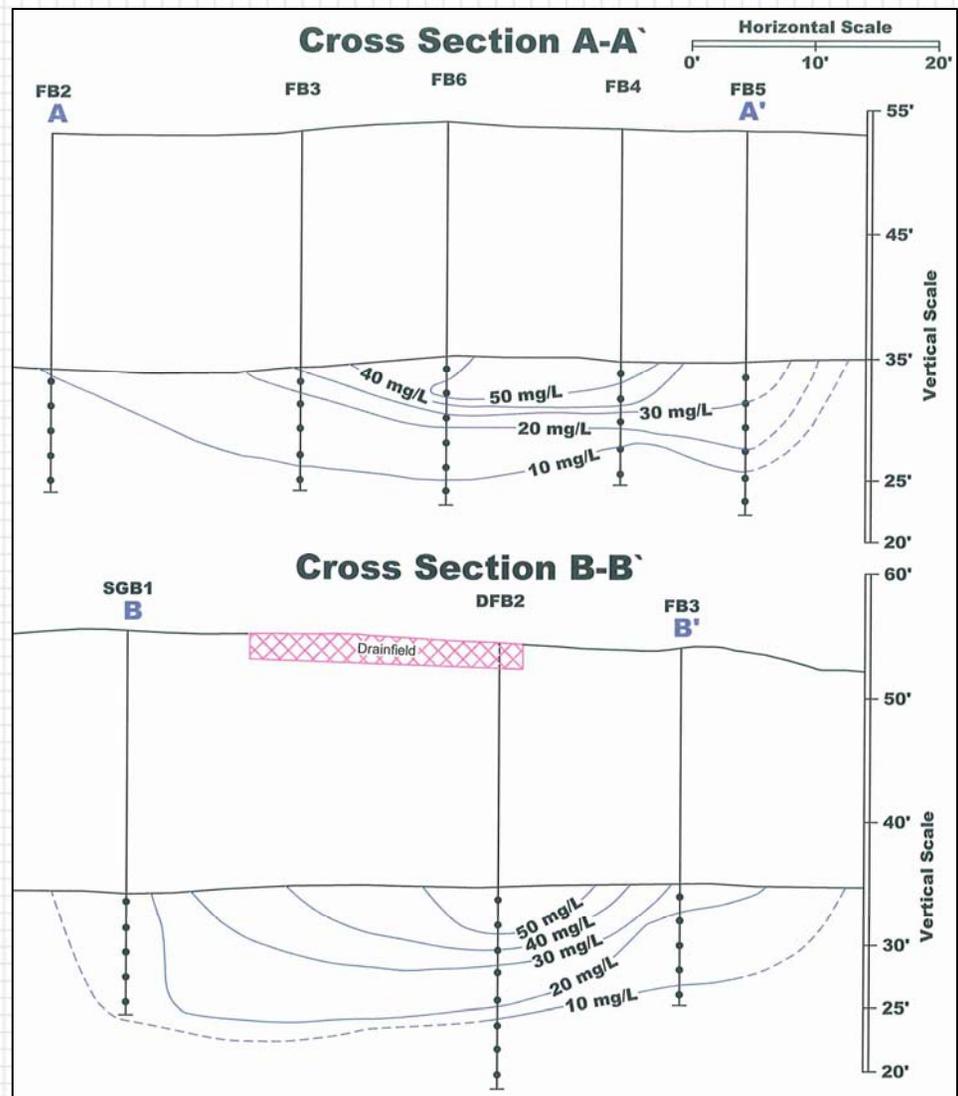
Cross sections A-A' and B-B' through the nitrate plume at the Lake County OWTS study site



The nitrate plume encountered during the February 2007 Orange County OWTS sampling event



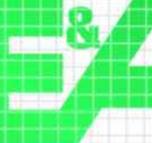
Locations of Orange County cross sections A-A' and B-B'



Cross sections A-A' and B-B' through the nitrate plume at the Orange County OWTS study site

DISCUSSION / CONCLUSIONS

- In all three cases, total nitrogen appeared to be reduced by 70% to 80% compared to effluent concentrations within about 80 feet of the source area.



DISCUSSION / CONCLUSIONS

- Seasonal variability – particularly as related to rainfall amounts – could effect the observed nitrogen concentrations over time.
- Longer term studies could more accurately assess the variability in attenuation associated with normal or above normal rainfall.
- The “background” conditions reported here may be used as a comparison to plume concentrations, but would be more appropriately determined over a longer period of time.



DISCUSSION / CONCLUSIONS

- Mass loading estimates for these sites appear to be appropriate only for the Seminole County site
- The Lake County and Orange County sites, by contrast, revealed heterogeneous soil lithology, poor hydraulic gradient data (based upon plume delineation results) and are therefore poor candidates for mass balance calculations based on available data.
- More extensive study and more time would be required to accurately address the nitrogen mass balance for these sites.



DISCUSSION / CONCLUSIONS

- Nitrogen and nitrate loading to the land surface, groundwater, and surface water comes from a number of sources in addition to onsite wastewater treatment systems
- A number of other studies are recently or soon to be completed which address loading from these other sources. The results of these studies should be used to complement the results of this assessment, in order to establish realistic means of reducing nitrogen loading to the Wekiva Study Area in a manner that addresses all nitrogen loading sources.



A range of cost-effective
strategies

DRAFT

Some concepts for discussion

E. Roeder

Strategy Elements



Draft 05/08/07, has not undergone agency review

Who implements?

- Management levels
 - Homeowner awareness:
Property owner within the framework of state and local construction standards
 - Maintenance contract:
Property owner within the framework of state and local construction permits
 - Operating permit:
Property owner within the framework of state and local construction, operation and maintenance standards
 - Responsible Management Entity (RME) for operation and maintenance:
property owner constructs, RME ensures operation and maintenance
 - Responsible Management Entity (RME) ownership (utility):
RME oversees construction, operation and maintenance
- Department of Health is permitting agency implementing state and local onsite regulations

Strategy Elements

- Recordkeeping, Inventory
- Performance Requirements
- Planning
- Financial Assistance and Funding
- Assuring Performance
 - Training and Certification
 - Site Evaluation
 - Design
 - Construction
 - Operation and Maintenance
 - Inspection and Monitoring, Reporting
- Corrective Action
- Public Education and Participation
- Residuals Management

Strategy Element

Recordkeeping, Inventory

- Status
 - Wekiva Study Area coverage of improved properties without sewer (October 2004)
 - OSTDS Permitting Records central database and county datasets (~1997-2006)
- Could be implemented by County Health Departments, Property Tax appraisers, responsible management entities

1: Create and maintain current inventory of OWTS

Example of Inventory Question: Age of Systems

| COUNTY | 1970(census) | 1982 | 1990 | 1997-98 |
|----------|--------------|------|------|---------|
| Lake | 26% | 50% | 65% | 83% |
| Orange | 43% | 57% | 87% | 95% |
| Seminole | 37% | 59% | 83% | 93% |
| TOTAL | 36% | 55% | 79% | 91% |

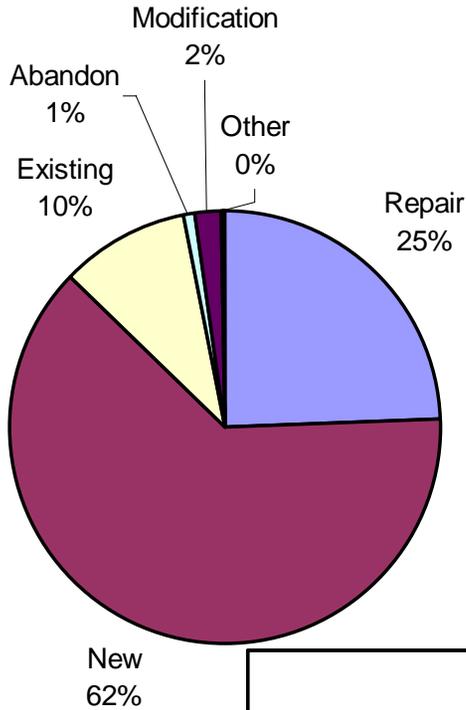
Percent of the total number of OWTS at end of fiscal year 2004/2005 that had been originally installed by 1970, 1982 (water table separation requirement), 1990, and 1997/1998 (prior to permitting database).

Draft 05/08/07, has not undergone agency review

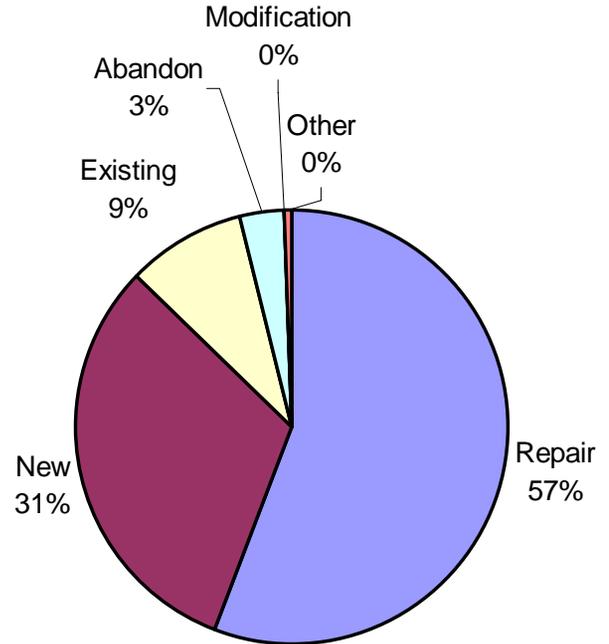
Recordkeeping, Inventory

- 2:
Integrate geospatial information, such as location of OWTS and parcel information, with information about construction
- Illustrate with sample of permitting records located in the Wekiva Study Area
 - Residential OSTDS dominate (95-98%)
 - Type of permits
 - Size of typical system

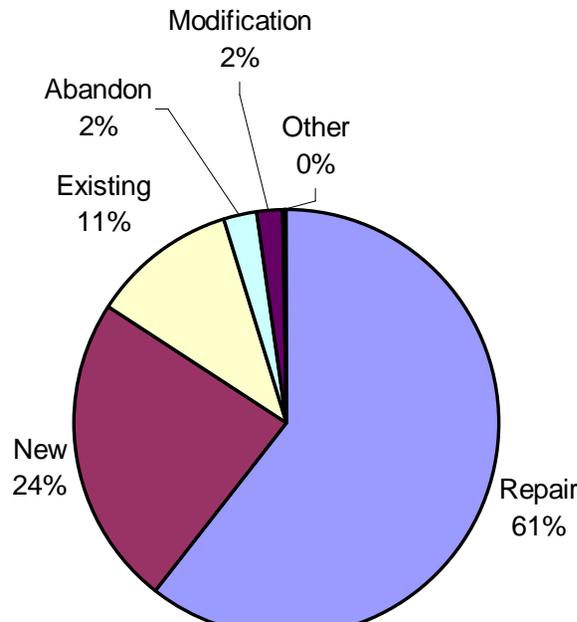
Lake County WSA



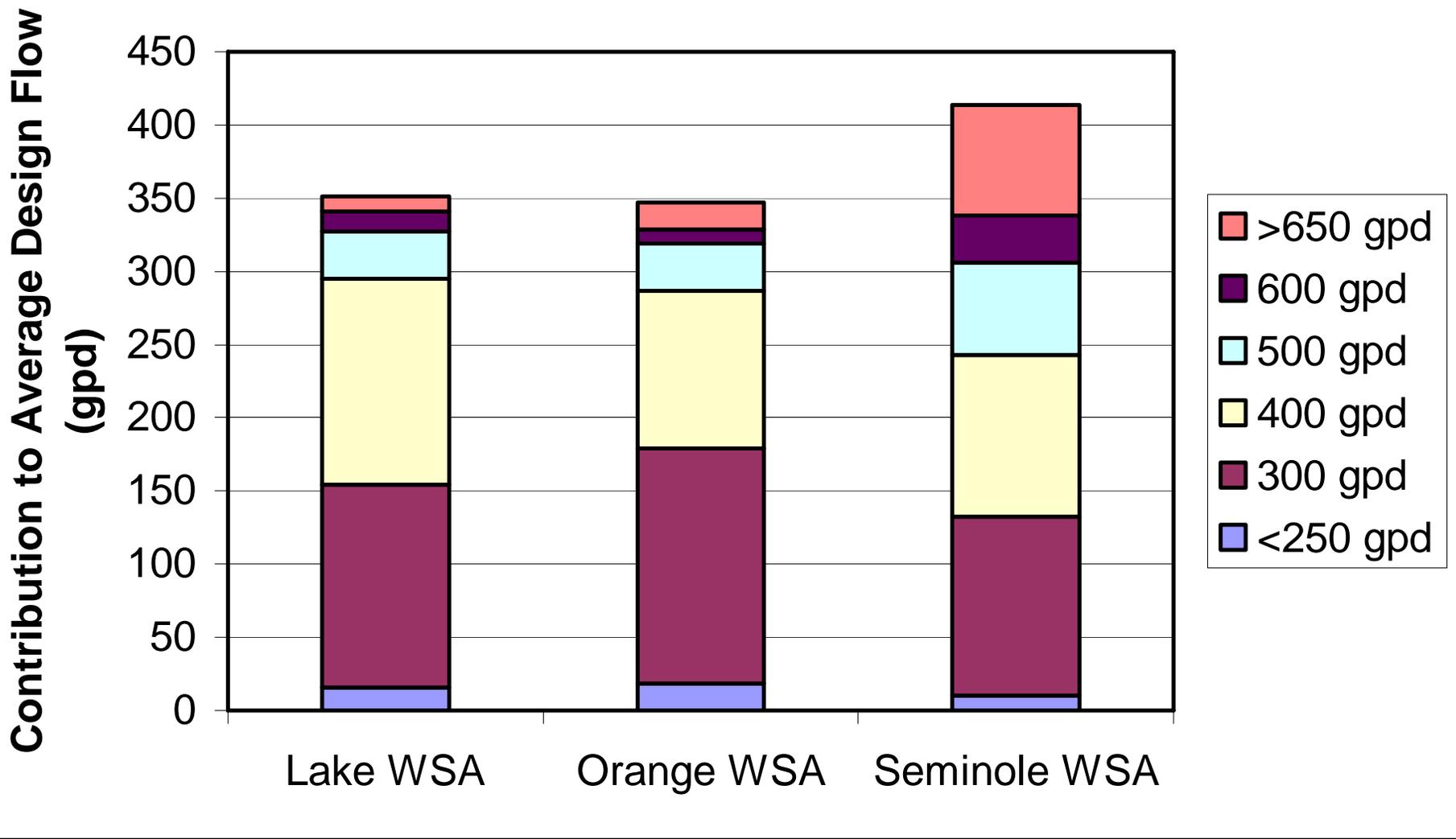
Orange County WSA



Seminole County WSA



Average (2001-2005) distribution of OSTDS permits geocoded to the Wekiva Study Area in the three counties



Contribution of different system sizes to the overall average permit design flow in the Wekiva Study Area.

Draft 05/08/07, has not undergone agency review

Average design flow for permits

| | County | WSA | County | WSA |
|------------------------------|---------|--------|--------|-----|
| average design flow (gpd) | repairs | repair | new | new |
| Lake | 321 | 316 | 361 | 363 |
| Orange | 327 | 313 | 471 | 420 |
| Seminole | 361 | 370 | 455 | 533 |

Typical System

| Percent of issued permits that are "typical systems" | 300 gpd | 300 gpd | 400 gpd | 400 gpd |
|--|----------------|-------------|------------|---------|
| | repairs county | repairs WSA | new county | new WSA |
| Lake | 58% | 55% | 34% | 37% |
| Orange | 53% | 61% | 34% | 36% |
| Seminole | 50% | 50% | 31% | 21% |

Record Keeping/Inventory

- 3: Inventory systems that have no current permitting records
- 4: Manage inventory by tracking additions and subtractions
- 5: Check inventory periodically to answer questions such as:
 - How many systems are failing at a given time?
 - What is the separation of the drainfield bottom from the estimated wet season high water table and the observed water table?
 - How full of sludge are septic tanks?

Strategy Element Performance Requirements

- Could be implemented through permitting requirements by the Department of Health, and/or through Responsible Management Entities

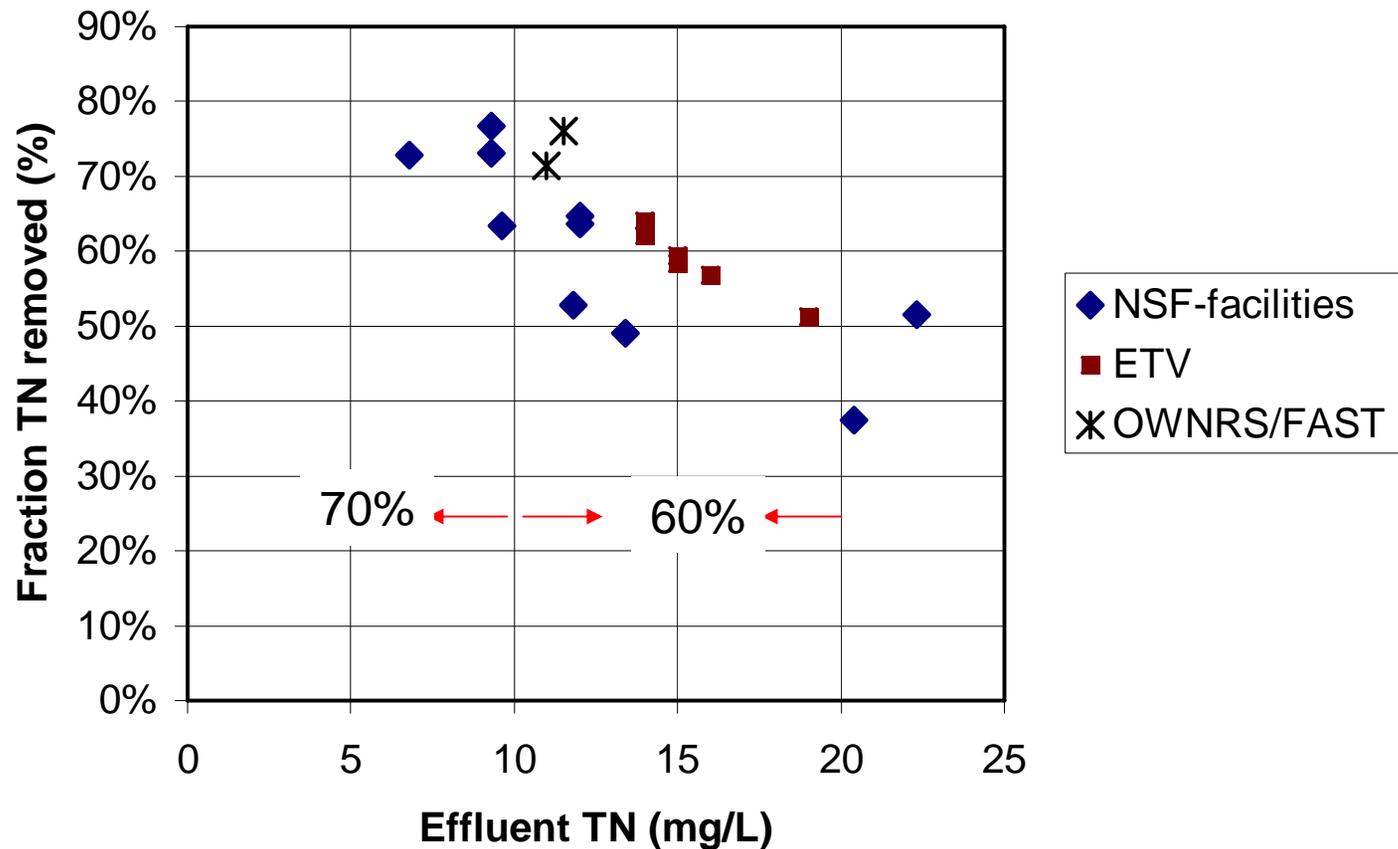
1. Re-evaluate loading per system

| TN concentration mg/L | Flow gal/capita day | household size person/house | household flow gal/day | load/house lb TN/year | load/person lb TN/year person | data sources |
|--------------------------|---------------------------|-----------------------------------|------------------------------|--------------------------|-------------------------------------|--|
| 39 | 68.6 | 2.46 | 169 | 19.7 | 8.0 | Ayres Associates 1993, EPA 2000, Florida 2000 census |
| | | 2.6 | | 20.0 | 7.7 | Otis, 2007 |
| 63 | 44 | | | | 8.4 | EPA, 1980 |
| 50.5 | 68.6 | | | | 10.5 | EPA, 2000 |
| 68 | 60 | | | | 12.4 | McCray et al, 2005 |
| 57 | 80 | 5 | 400 | 69.4 | 13.9 | Anderson, 1998 |
| 74 | 63 | 5 | 315 | 70.9 | 14.2 | Seminole Site |
| 43 | 112.5 | 4 | 450 | 58.9 | 14.7 | Lake Site |
| 69 | 35 | 1 | 35 | 7.3 | 7.3 | Orange Site |
| | | 2.6 | | 28.7 | 11.0 | (mid-range per capita load observed in Wekiva) |

2. Evaluate technology for nitrogen removal

- Source separation
- Treatment of mixed wastewater
 - ATU ~30% TN removal
 - Recirculating treatment systems without carbon addition ~40-75% TN removal
 - Treatment with carbon addition or alternative electron acceptor, possibly higher removal

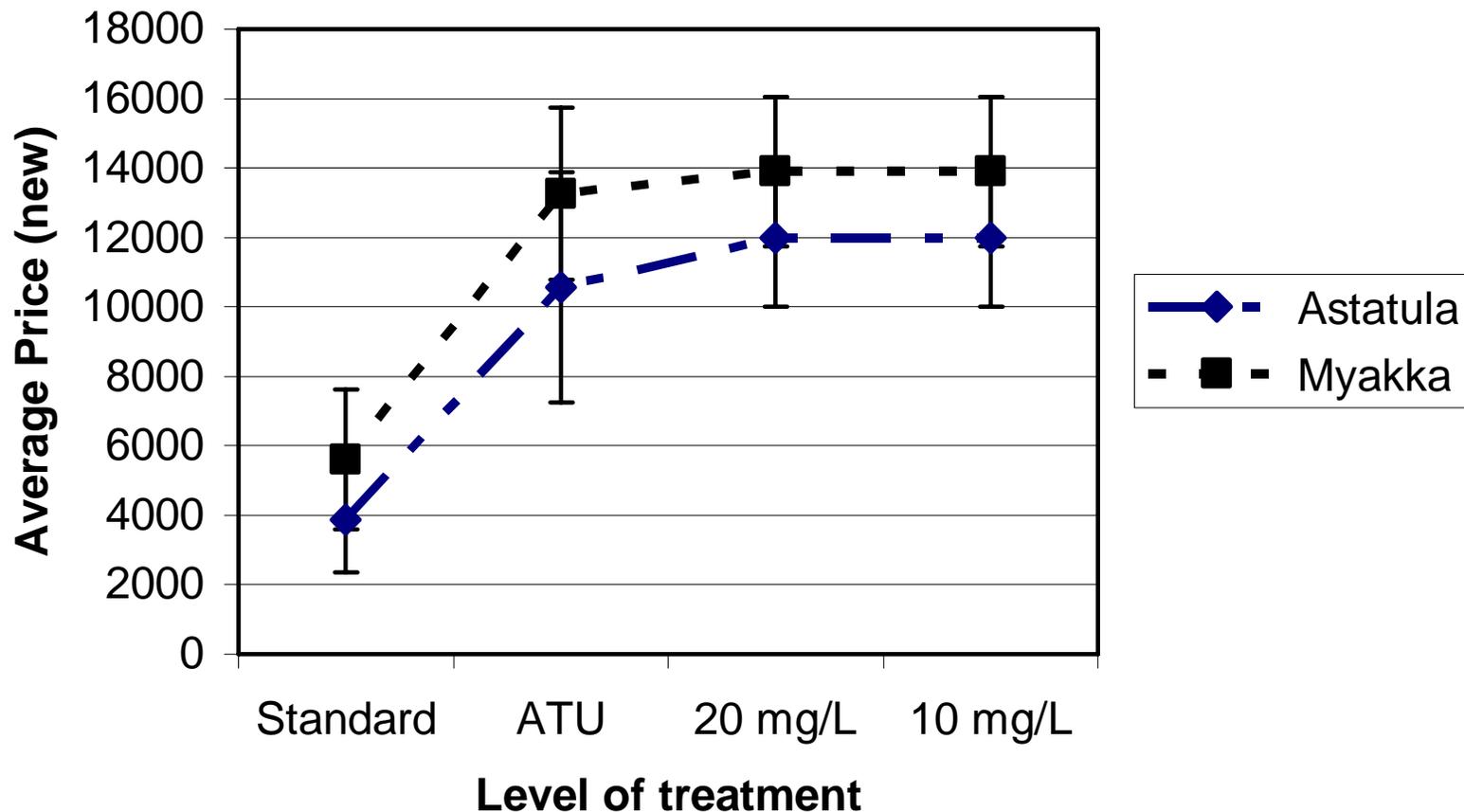
3. Establish performance standards that explicitly incorporate concentration and load reduction



4. Evaluate cost-effectiveness of a range of nitrogen removal performance requirements

- Surveyed installers and distributors on costs of treatment
- Focused on systems that are commonly installed and have test center results <10mg/L
- Compared Astatula and Myakka installations
- Asked for total installation cost, including first two years of maintenance contract, etc

4. Evaluate cost effectiveness of a range of nitrogen removal performance requirements



Example:
Survey of
cost for
new
system

Installation costs and effects for new systems

| Load to drainfield (lb TN/system year) | | Treatment System | | | |
|--|------------------|---|-------|---------|---------|
| | Soil(%removal) | Conventional | ATU | 20 mg/L | 10 mg/L |
| | | pretreatment effectiveness | 30 | 60 | 70 |
| | | Average Cost (\$) | | | |
| | Astatula | 3886 | 10566 | 12000 | 12000 |
| | Myakka | 5602 | 13263 | 13900 | 13900 |
| | | Incremental Cost Difference (\$) | | | |
| | Astatula | | 6680 | 1434 | 0 |
| | Myakka | | 7661 | 637 | 0 |
| | | Load to groundwater (lb TN/system year) | | | |
| 20 | Astatula (5%) | 19.0 | 13.3 | 7.6 | 5.7 |
| 20 | Myakka (50%/95%) | 10.0 | 0.7 | 0.4 | 0.3 |
| 29 | Astatula (5%) | 27.6 | 19.3 | 11.0 | 8.3 |
| 29 | Myakka (50%/95%) | 14.5 | 1.0 | 0.6 | 0.4 |

Cost-effectiveness for new systems (based on initial installation cost)

| Load to drainfield (lb TN/system year) | | Treatment System | | | |
|--|----------------------------|---|---------|---------|--|
| Soil(%removal) | Conventional | ATU | 20 mg/L | 10 mg/L | |
| | pretreatment effectiveness | 30 | 60 | 70 | |
| | | Overall Cost-Effectiveness (\$/lb TN/year removed compared to conventional) | | | |
| 20 | Astatula (5%) | 1172 | 712 | 610 | |
| 20 | Myakka (50%/95%) | 824 | 864 | 855 | |
| 29 | Astatula (5%) | 808 | 491 | 421 | |
| 29 | Myakka (50%/95%) | 568 | 596 | 590 | |

Cost-effectiveness for drainfield repair out of the ground water

| Load to drainfield (lb TN/system year) | Treatment System Option for a Drainfield Repair in Myakka Soil | | | | |
|--|---|-----------|---------|-------------|-------------|
| | currently | New mound | new ATU | new 20 mg/L | new 10 mg/L |
| | Average Cost (\$) | | | | |
| | | 5497 | 13633 | 13633 | 13633 |
| | Incremental Cost Difference (\$) | | | | |
| | | 5497 | 8137 | 0 | 0 |
| | Load to groundwater (lb TN/system year) | | | | |
| 20 | 20 | 10 | 0.7 | 0.4 | 0.3 |
| 29 | 29 | 14.5 | 1.0 | 0.6 | 0.4 |
| | Incremental Cost-Effectiveness (\$/additional lb TN/year removed) | | | | |
| 20 | | 550 | 875 | 0 | 0 |
| 29 | | 379 | 603 | 0 | 0 |
| | Overall Cost-Effectiveness (\$/ lb TN/year removed) | | | | |
| 20 | | 550 | 706 | 696 | 692 |
| 29 | | 379 | 487 | 480 | 477 |

Draft 05/08/07, has not undergone agency review

Cost-effectiveness for pretreatment in existing system w/ gravity drainfield

| Load to drainfield (lb TN/system year) | Treatment System Option for a Retrofit in Astatula Soil keeping drainfield | | | | |
|--|--|--------------|---------|-------------|-------------|
| | currently | 50% retrofit | new ATU | new 20 mg/L | new 10 mg/L |
| | Average Cost (\$) | | | | |
| | | 4500 | 7917 | 7917 | 7917 |
| | Incremental Cost Difference (\$) | | | | |
| | | 4500 | 7917 | 0 | 0 |
| | Load to groundwater (lb TN/system year) | | | | |
| 20 | 19.0 | 9.5 | 13.3 | 7.6 | 5.7 |
| 29 | 27.6 | 13.8 | 19.3 | 11.0 | 8.3 |
| | Incremental Cost-Effectiveness (\$/additional lb TN/year removed) | | | | |
| 20 | | 474 | 1389 | 0 | 0 |
| 29 | | 326 | 952 | 0 | 0 |
| | Overall Cost-Effectiveness (\$/ lb TN/year removed) | | | | |
| 20 | | 474 | 1389 | 694 | 595 |
| 29 | | 326 | 952 | 477 | 409 |

Draft 05/08/07 has not undergone agency review

- **5. Consider density reduction as a means to achieve lower nitrogen loading**
- **6. Establish performance standards that encourage improvements in the effectiveness of treatment systems**
- **7. Review if construction standards, in particular for filled and mound systems, achieve the goal of 2 feet separation from the estimated wet season water table and nitrification**
- **8. Pretreatment performance standards apply before discharge to the disposal system**

Planning

- Different entities will be in charge of planning and implementing under all onsite management levels except utility

1: Build on existing assessments of the vulnerability of receiving waters

- Wekiva Aquifer Vulnerability Assessment of Floridan Aquifer (not intended for lot-scale decisions)
- Transform vulnerability map into a format that could be more useful for onsite permitting decisions
- (Florida Aquifer Vulnerability Assessments of Surficial and Floridan Aquifers
- Surface Water Vulnerability?)
- Pollutant Load Reduction Goals

1: Build on existing assessments of the vulnerability of receiving waters

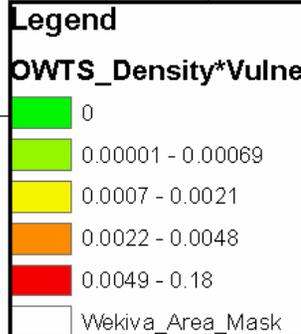
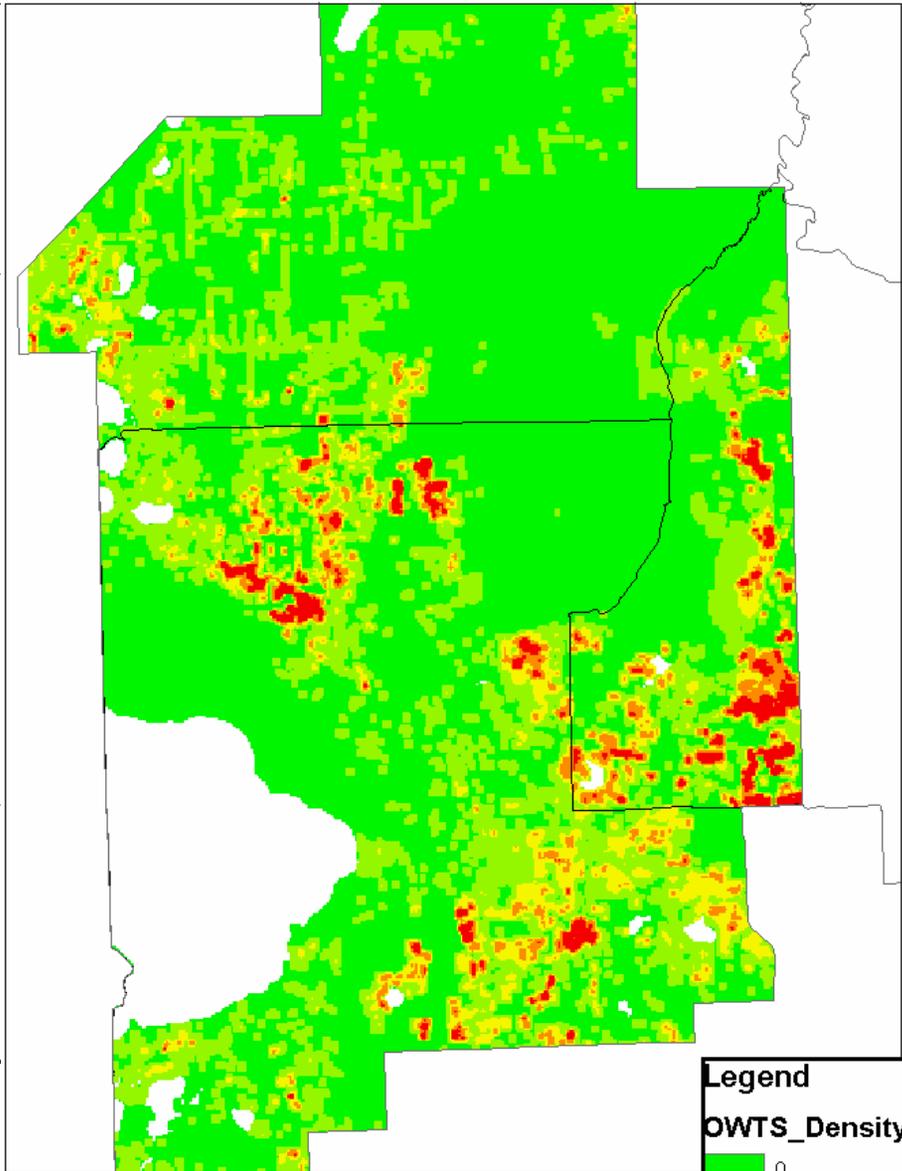
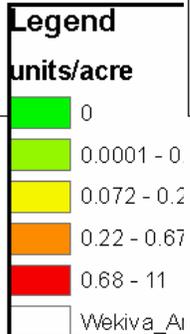
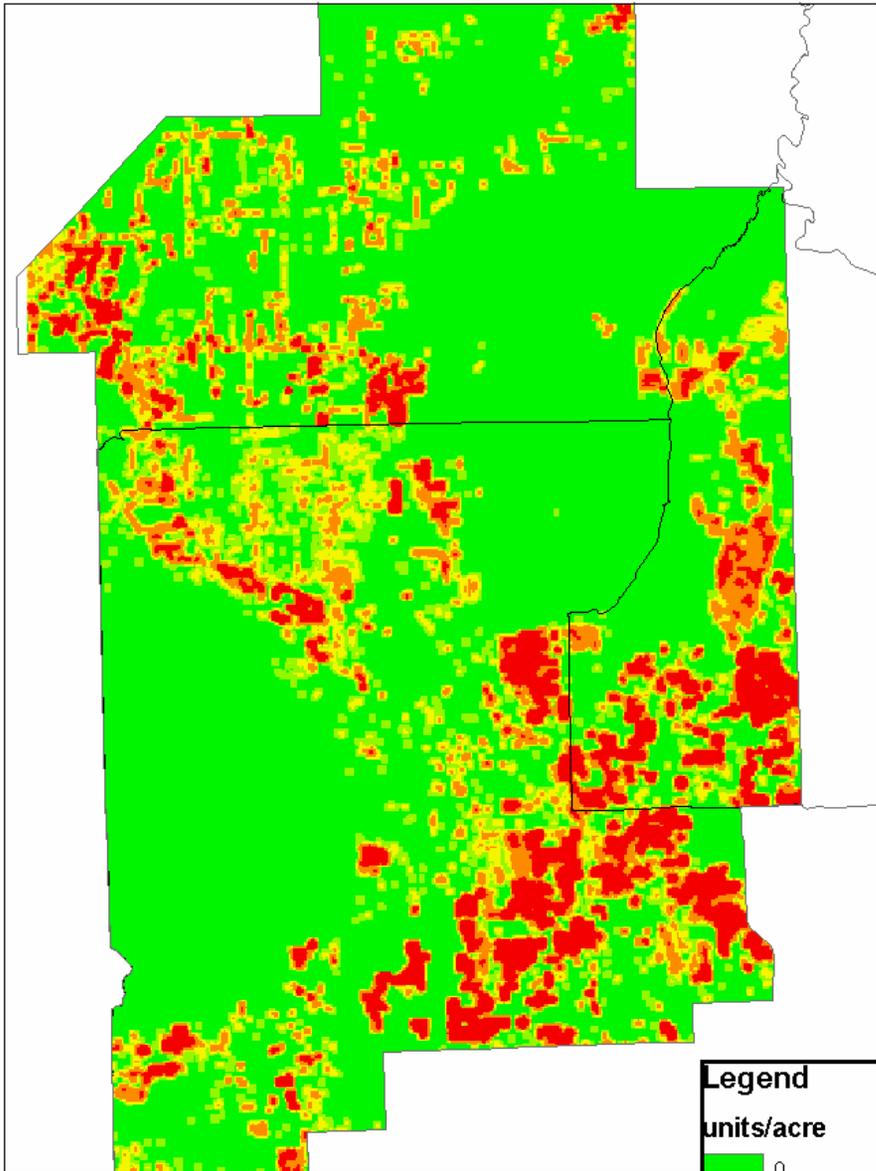
| Pollutant Load Reduction Goal | Nitrate | Total Phosphorus | Total Coliform Bacteria |
|---|---------|------------------|-------------------------|
| Wekiwa Spring | 82% | - - - | - - - |
| Upper Wekiva River (to Little Wekiva River) | 69% | 50% | 49% |
| Lower Wekiva River (to Blackwater Creek) | 36% | 50% | 30% |
| Rock Spring | 85% | - - - | - - - |
| Rock Springs Run | 52% | 29% | 50% |

2006 Pollution Load Reduction Goal published by SJRWMD

Draft 05/08/07, has not undergone agency review

2. Integrate land use, wastewater management, and aquifer vulnerability

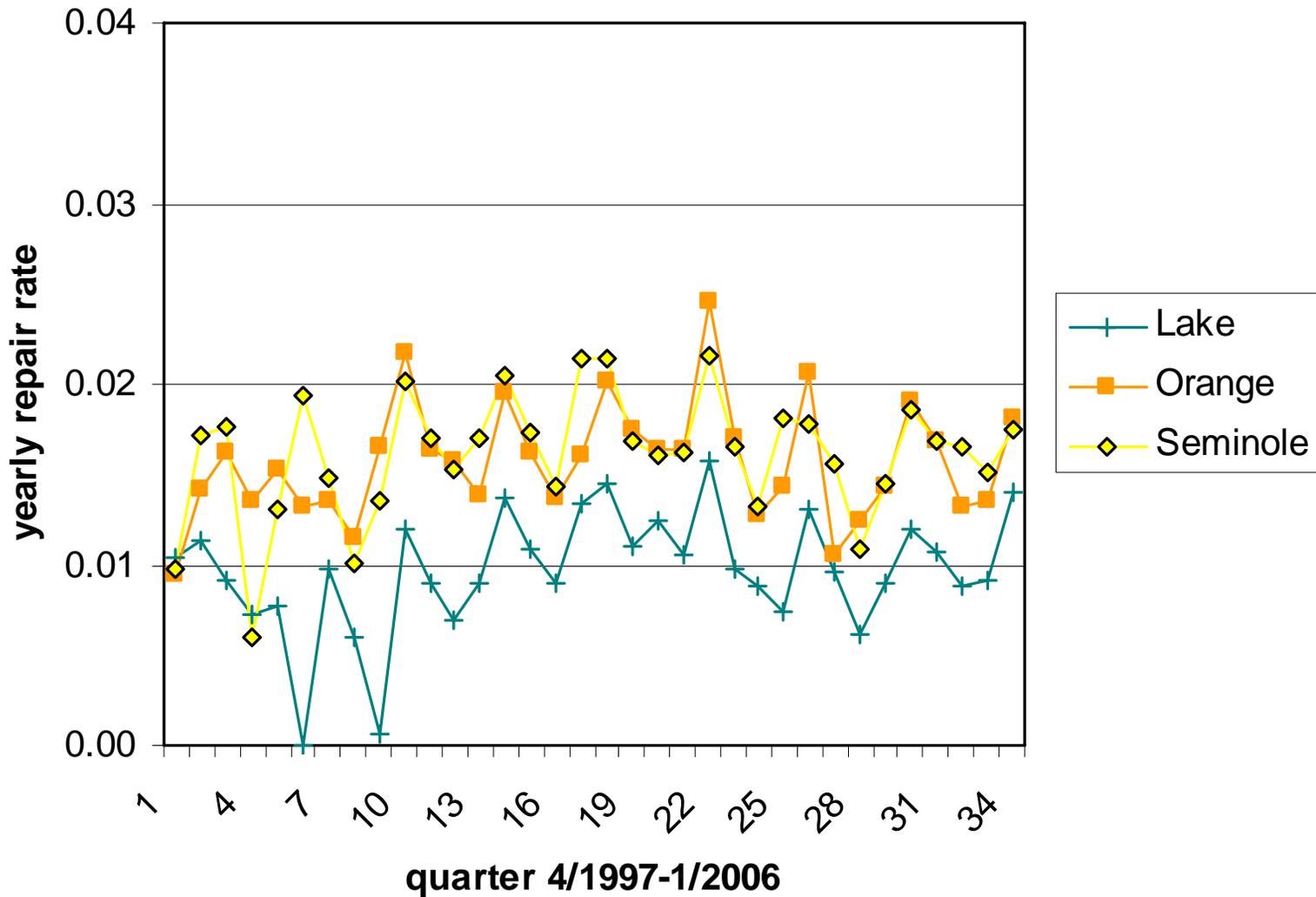
- Vulnerability-based approach: prioritize increased treatment in more vulnerable areas (e.g. centralized wastewater facilities, 2004 DOH recommendations)
- Risk-based approach: Prioritize increased treatment in areas with high density and high vulnerability



3. Assess extent to which changes in DOH-regulations effect OWTS loading without changing management approach

- Performance discussed in a different section
- Assess numbers of permits that would be impacted without any other changes

Yearly Repair Rates



Reach of DOH-regulations

- Over 20 years, about 30% of current systems in Orange and Seminole County need repairs (1.5%/year * 20 years)
- Over 20 years, about 20% of current systems in Lake County need repairs (1%/year * 20 years)
- Rates may change in response to inspections and costs
- Other strategies may increase rate of upgrades or abandonments

- # 4. For DOH-regulated systems, establish performance standards
- Could use reduction standards based on:
 - pollution load reduction goals,
 - best available technology,
 - same as central sewer
 - Bounding estimate:
no load increase from OWTS, due to new systems

No net increase goal: required load/system reduction

| County | County new | County repair | County load reduction | WSA new | WSA repair | WSA load reduction |
|----------|------------|---------------|-----------------------|---------|------------|--------------------|
| Lake | 1670 | 598 | 74% | 278 | 111 | 72% |
| Orange | 848 | 1211 | 41% | 268 | 537 | 33% |
| Seminole | 281 | 447 | 39% | 88 | 253 | 26% |
| TOTAL | 2798 | 2256 | 55% | 636 | 901 | 41% |

Annually issued new and repair permits and percent reduction required from both to achieve no net load increase.

- 5. For new developments, evaluate a range of wastewater management alternatives, such as onsite, clustering, and central facilities for nitrogen reducing treatments**
- 6. Designate priority areas for upgrades to existing OWTS infrastructure. Designate responsible entity for upgrades ranging from the property owner to a utility**

Financial Assistance and Funding

- Costs
 - Planning
 - Design
 - Permitting
 - Construction
 - Operation
 - Maintenance
 - Monitoring
 - Record Keeping
 - Corrective Action
- Largely the responsibility of system owner

Responsibility, Equity, Affordability

- A property owner who installs a cost-effective system pays for the savings of a lot-owner who does not have to install a cost-ineffective system -> need for a cost-sharing mechanism
- The occurrence of the need for a repair, which could lead to an upgrade is random -> need for an insurance mechanism
- Increased maintenance or living with unsanitary conditions could be results of requiring upgrades, neither of which contribute to nitrogen reduction. -> need for an incentive mechanism

Financial arrangements

- Shift responsibility to a utility
 - Possibility to finance cost-effective solutions across scales (e.g. central sewer)
 - Still needs funding
- Cost-sharing mechanism
 - Trading (cost-ineffective lots pay for cost-effective lots)
 - Discharge fees per pound of nitrogen discharged (at marginal costs of N-removal),
 - onsite system fee, by type of pretreatment or flat rate
- Insurance mechanism
 - Regular small payments to fund the number of repairs occurring in the covered area
- Incentives
 - Subsidy/Grant program (fee, or taxpayers of local, regional, state, or federal entity)
 - Lower fees for higher treatment

Ensuring Performance

- Training and Certification
 - Engineers
 - Permit Reviewers
 - Installers
 - Maintenance entities
 - Inspectors
- Design
 - Need balance between prescriptive (easy to permit, presumed to comply) and performance-based (flexible, compliance determined by monitoring) elements
 - trade-off between assurance up-front and later

 - Construction
 - Site Evaluation
- Operation and Maintenance, Inspection and Monitoring, Reporting
 - Require system inspection/maintenance for all systems
 - Treatment effectiveness in the field is more variable than under testing conditions; need measures of average compliance and follow-up with high sources
- Corrective Action/ Accountability

Other Strategy Elements

- Public Education and Participation
- Residuals Management



Florida Atlantic University
College of Engineering & Computer Science

Taylor County Beaches

Pathogen and Nutrient Sources Assessment Study

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Florida Department of Health, Research Review and Advisory Committee (RRAC) Meeting
Lake Sylvan Park, FL - May 8, 2007

Outline of Presentation

- Rationale
- Scope of Project
- Sites/Site Selection
- Methodology
- Water Quality Results
- Major Findings
- Recommendations



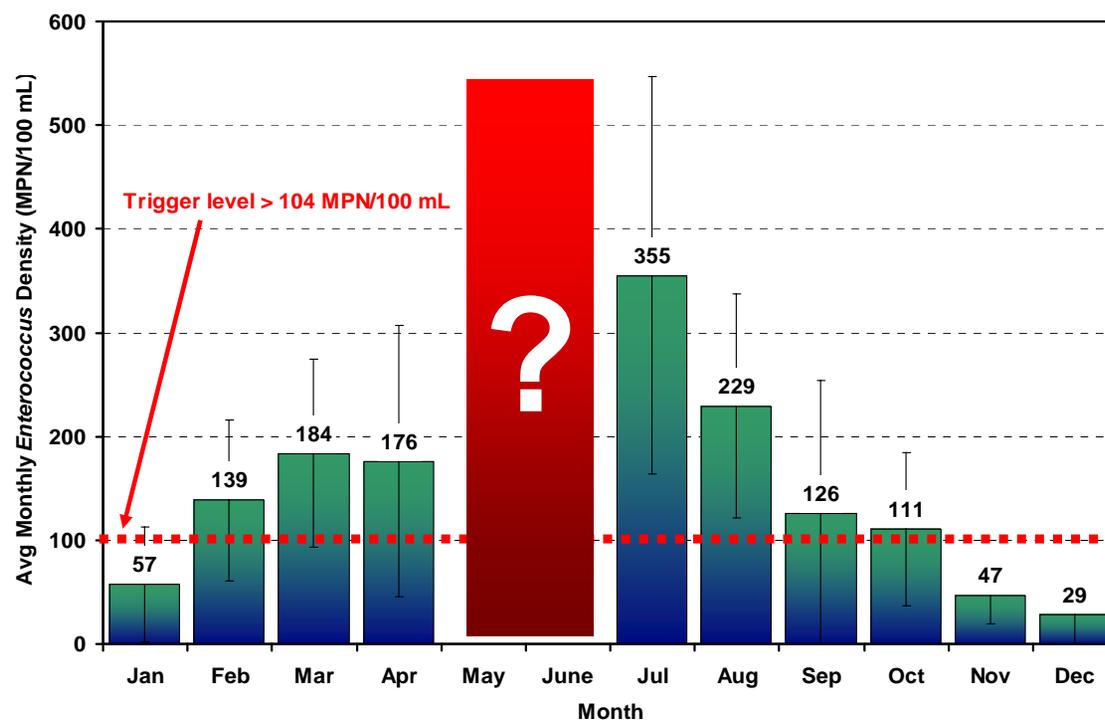
Photograph taken by Dr. Eberhard Roeder, May 3, 2006

Rationale

- Taylor County is classified* as:
 - “*Outstanding Florida Waters*”
 - For Class III recreational use and fish & wildlife health
- But water quality criteria are not being met
- 94 of 181 samples (52%) failed for *Enterococci* (2004-06)**

*FAC 602-302.530

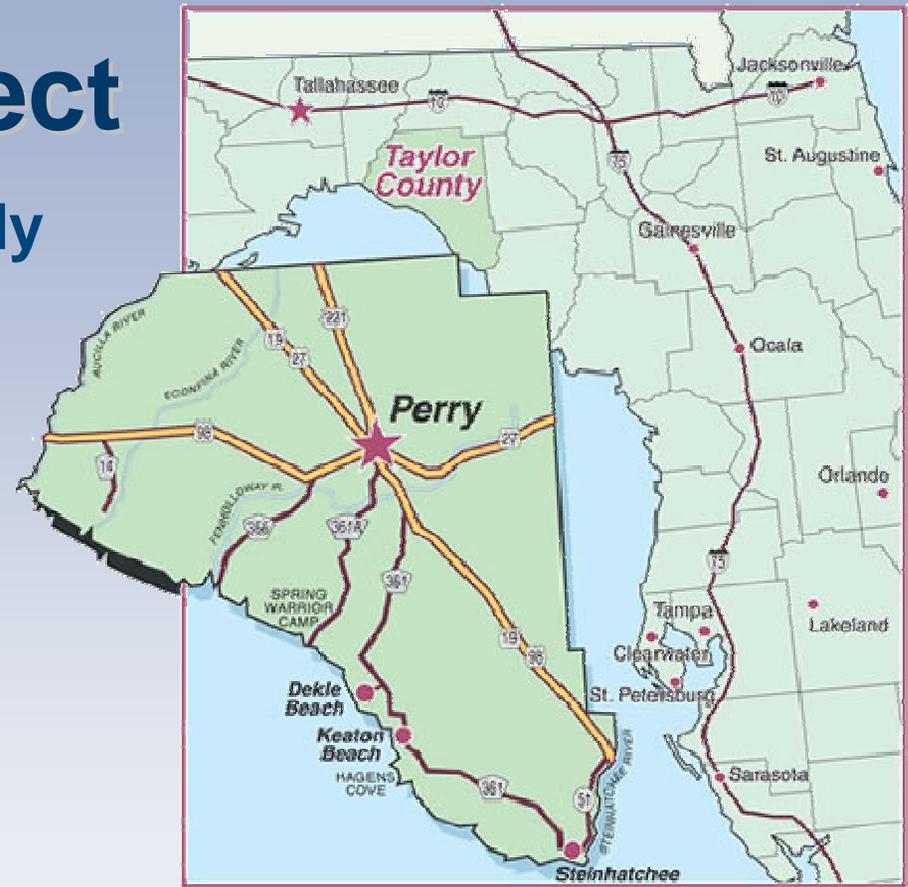
** Data from SRWMD and TCHD



- Beach advisories are posted 46% of this time due to high pathogen indicators
 - **Fecal coliform >400 CFU/100mL**
 - ***Enterococci* >100 CFU/100mL**

Scope of the Project

- To conduct a scientific study in Taylor County, FL to assess:
 - Sources of pathogen indicators
 - Contribution of OSTDS to surface water quality

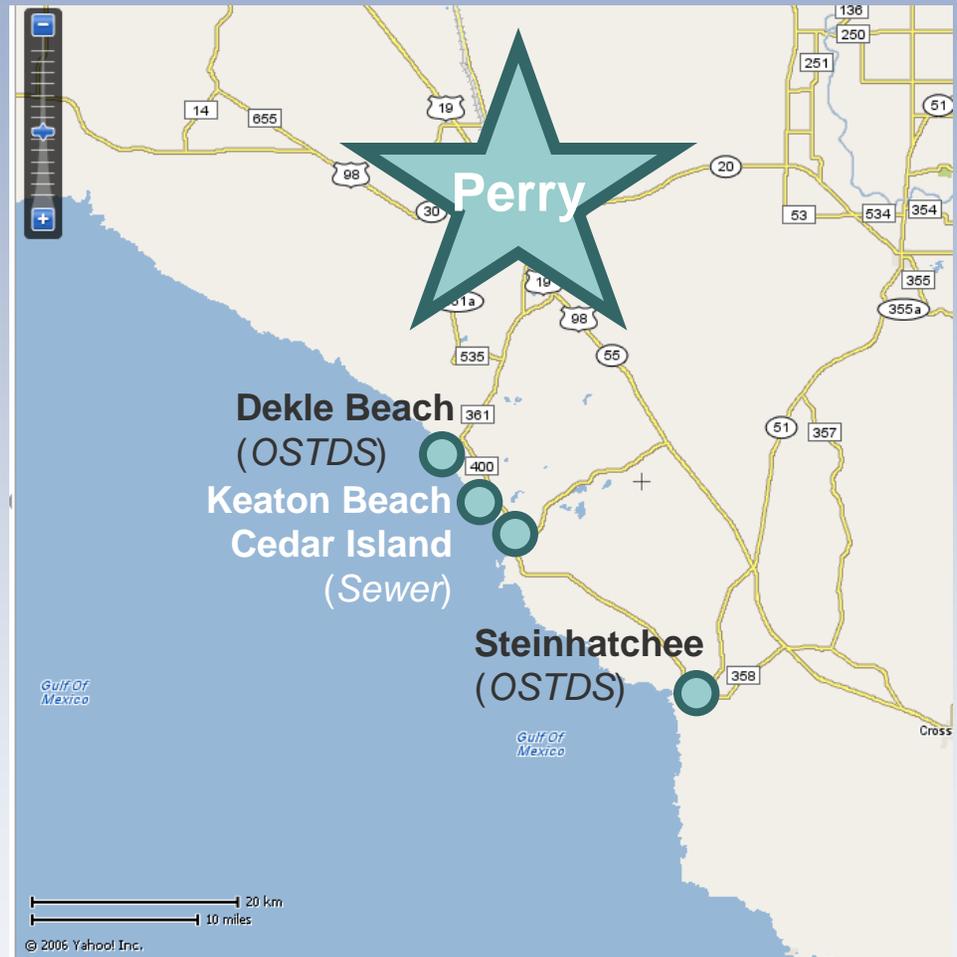


Objectives

- **Hypothesis:**
 - **OSTDS contribute to water quality degradation**
 - **The contribution is enhanced during the seasonal high water table elevation (SHWT)**
- **Source tracking to distinguish between human and natural sources will be evaluated using:**
 - **Pair-wise comparison**
 - **Intervention analysis**
 - **Multiple tracers**

Site Locations

- Sites represent four categories:
 1. **Background**
 - Inland upstream
 2. **Developed area**
 - Sewer
 3. **Developed area**
 - OSTDS
 4. **Beaches**
 - Downstream



Site Selection

Sites were selected and approved with input from the TCHD and the FDOH Bureau of Onsite Sewage Programs

| Location | Beach | Canal/Creek (Upstream) | Background |
|----------------------|-----------------------|---|---------------------------|
| Dekle Beach (OSDTS) | A. Dekle Beach | B. Dekle Beach Canal | C. Creek at Dekle |
| Steinhatchee (OSTDS) | J. Main Street | K. Third Avenue Fork; M. Boggy Creek@Airstrip L. Boggy Creek@51 | N. Steinhatchee Falls |
| Keaton Beach (Sewer) | F. Keaton Beach | D. Cortez Road Upstream E. Cortez Pump Station | G. Blue Creek @Beach Road |
| Cedar Island (Sewer) | I. Cedar Island Beach | H. Heron Road | G. Blue Creek @Beach Road |

Taylor County



Dekle Beach



Remnants of the homes wiped out by the "No Name Storm" in March 1993

Dekle Beach (OSTDS)

Dekle Beach (A) Dekle Canal (B) Crook of Dekle Beach (C)

Image © 2006 The Florida Department of Environmental Protection

Google™

908 ft



A. Dekle Beach



- The beach is narrow and located just at the side of the road
- Along the shore, old septic tank remains are found

B. Dekle Beach Canal @ Mexico Rd



- The canal is directly connected to the ocean
- It is surrounded by homes on both sides
- Some neighbors have boats in the canal

C. Creek @ Dekle Beach



- The creek connects a marsh area to the end of the canal
- A two-lane bridge passes over the creek

Keaton Beach



Keaton Beach (Sewer)



F. Keaton Beach



- The beach has calm waters and is located near a coastal wetlands opening into a small bay
- Across the bay is Cedar Island Beach (0.70 km)
- Samples were collected in shallow water along the north side of the pier

E. Cortez Rd Upstream



- Located in the middle of a shallow canal with ocean access
- In May, two jet skis were stored; in Sept/Dec a small motor boat
- No residents were encountered, suggesting a holiday house

D. Cortez Rd Pump Station



- Located at the inland end of the canal, 100 feet from a new pump station
- According to the collection system layout, no sewer pipes are located within a 100 ft distance from the sampling site
- The water is shallow and looks stagnant



WE SUPPORT
Environmentally Responsible Development

G. Blue Creek



- This is a background site, with freshwater flow
- It allows assessment of further inland sources
- The water has a dark tea color, presumably from humic, fulvic, and tannic substances



Cedar Island

Cedar Island (Sewer)

G Blue Creek @ Beach Road

I Cedar Island Beach

H Heron Road Canal

Image © 2006 The Florida Department of Environmental Protection

© 2006 Google™

2266 ft



I. Cedar Island Beach



- Located on the beach in front of an old concrete foundation at the end of a road
- The beach has very calm shallow water and resembles a bay with trapped stagnant water

H. Heron Road Canal



- Located on a dead-end canal surrounded by residential development
- The channel is shallow even during high tide
- The bottom is visible, and the soil is muck suitable for mangroves

Steinhatchee

**STEINHATCHEE
PLACE RESORT
DAY - WEEK - MONTH
352 - 498 - 7740**



Steinhatchee (OSTDS)



2.51 mi

Image © 2006 The Florida Department of Environmental Protection
© 2006 Europa Technologies

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J. Main Street @ Roy's



- Located on the mouth of the Steinhatchee River, east of Roy's Restaurant
- There is a large commercial septic tank on the property, with an infiltration field and mound located on the opposite side of the road

K. Third Avenue Fork (Japanese Garden)



- Located at a dead-end street along an isolated finger of the Steinhatchee River
- The site is close to private property, but it was a popular lunch time hang out

L. Boggy Creek @ 51



- This site represents the tributary structure upstream of the Steinhatchee River

M. Airstrip Drive



- Small community development, with no sewer network
- Located on the Steinhatchee downstream of Boggy Creek
- Homes were not inhabited year-round

N. Steinhatchee Falls



- Represents the natural background condition for the Steinhatchee River basin
- The water velocity is rapid at this site due to an elevation drop and narrow channel
- Samples were collected just upstream from the falls



Steinhatchee Falls

Welcome to a place where you can still enjoy Florida the way visitors did a century ago. There are no crowded lines or costly admission tickets, no jammed freeways or man-made amusements. Here, you are your own tour guide, free to take a stroll along the riverbank, explore the forests unique to a river flood plain or sit for a spell and enjoy a quiet moment. The Suwannee River Water Management District has acquired these lands through the Save Our Rivers and Preservation 2000 land conservation programs for flood control, water quality protection and natural resource conservation.

Steinhatchee Falls was acquired by the Suwannee River Water Management District in 1996 as part of the 38,000 acre Rivers of the Big Bend acquisition. These lands were acquired to protect the flood plains of the Steinhatchee, Aucilla, Econfina and Wacissa Rivers. Protecting the river floodplains and keeping them in a forested state is vital for flood control, water quality protection and preservation of unique natural ecosystems that provide high quality habitat for numerous rare animal and plant species.

HOURS

- April 1 – October 31 8:00 a.m. - 7:00 p.m.
- November 1 – March 31 8:00 a.m. - Dark

ACTIVITIES ALLOWED

- Hiking, Fishing, Picnicking, Nature study
- Night fishing and reservation of picnic shelter available by Special Use Authorization for the District, 1-800-226-1066.

For additional recreation information on lands acquired by the SRWMD please contact us at 1-800-226-1066 or 386-362-1001 to receive our free Recreational Guide. You can also contact us on the internet at www.srwmd.state.fl.us.

GENERAL RULES FOR PUBLIC USE

Please note that the boundaries of the lands are marked with red paint and yellow signs. The following activities are regulated on these lands under Chapter 40B-9, Florida Administrative Code, and subject to law enforcement actions:

- The possession of alcoholic beverages on these Lands is prohibited.
- All vehicles must have a valid tag, be legal to drive on Florida highways, and operated in a safe manner only on roads not designated as closed to vehicles.
- Off-road use of vehicles, including all terrain vehicles, is prohibited.
- Littering, trash dumping and vandalism of SRWMD property is prohibited.
- Firearms are prohibited unless the Land is designated as a Wildlife Management Area. Possession is then Subject to Management Area rules.
- Dogs should be kept on a leash. Free-running hunting dogs are prohibited.
- The removal or disturbance of trees, plants, soil or mineral matter, and cultural artifacts is prohibited.
- Public uses of the Land other than those listed on the entrance sign are prohibited unless authorized in writing by the SRWMD.

WARNING

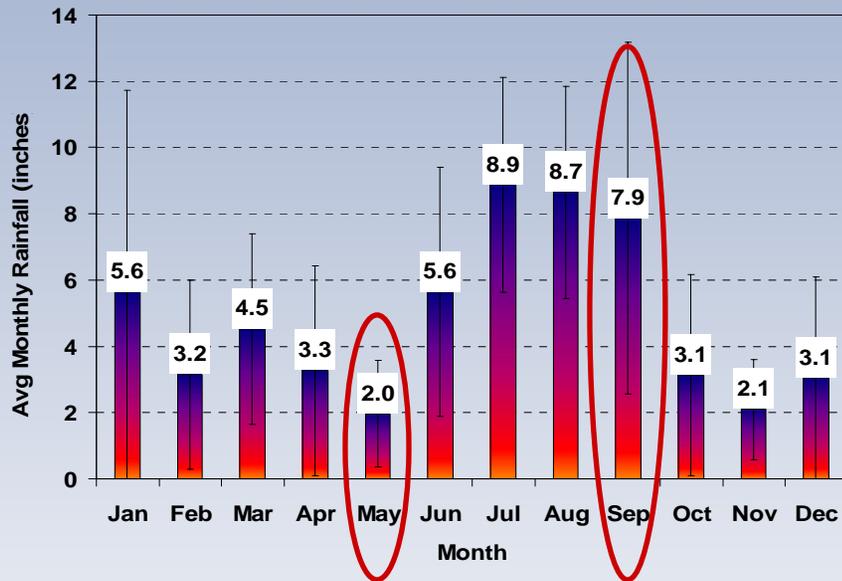
District lands are managed as wilderness areas where natural conditions, plants, or animals could pose danger to an individual, their equipment, or an animal. It is the duty of the individual to exercise reasonable caution and care when on District land.

Methodology

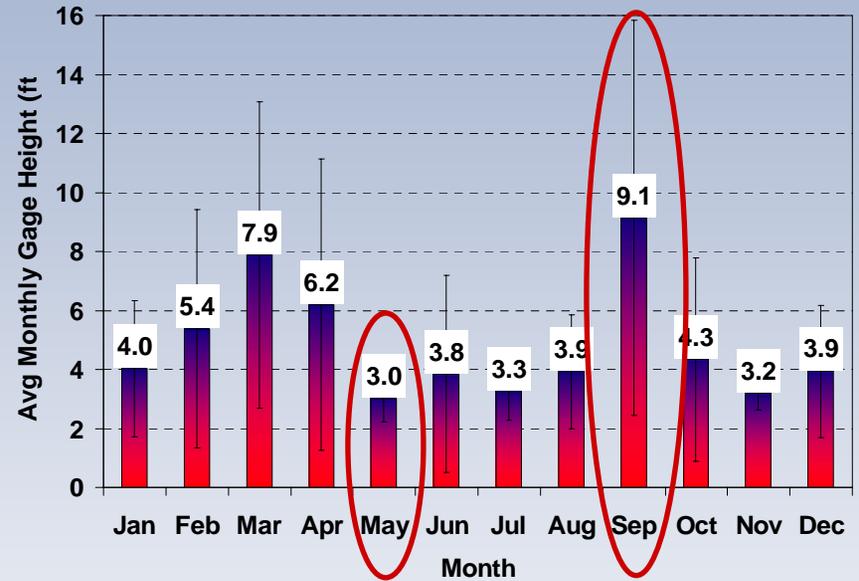
- Analyze seasonal hydrologic patterns (SWHT v. SLWT)
 - **Rainfall**
 - **Tidal Heights**
 - **River Water Levels**
 - **GWT Elevations**
 - **Previous Monitoring Data (2004 – 2005)**
 - **Water Use**
- Sampling is timed to coincide with ebb tide
- Downstream to upstream for 3 consecutive days during SWHT and SLWT

Seasonal Hydrologic Patterns

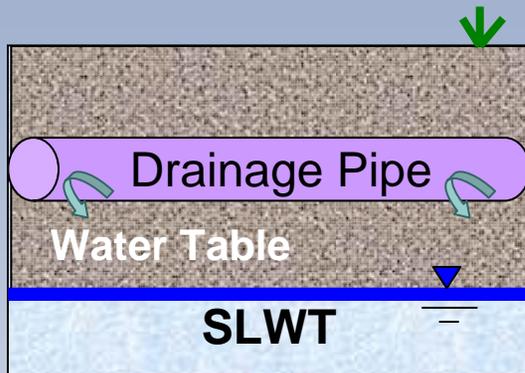
Rainfall



River Water Levels

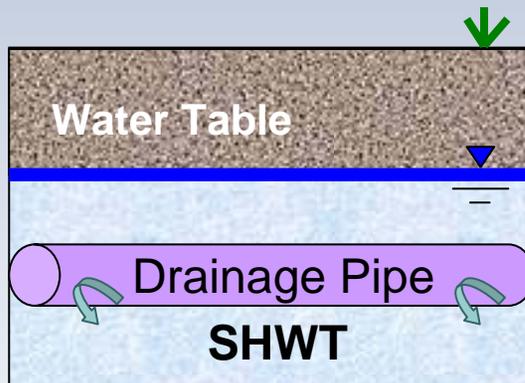


| Condition | Rainfall | Soil Survey | River Level | Tidal | 2004/05 Data | GWT | Water Use |
|-----------|---------------------------|---------------------------|---------------------------|-----------|--------------|---------------------------|-----------|
| High | Jun – Sep or Jan – Mar | Jun – Sep or Jan – Mar | Mar – Apr or Sep | Aug – Oct | Jul | Mar – Apr or Sep – Oct | Apr – Aug |
| Low | Nov – Dec or Apr – May | Oct – Dec or Apr – May | May – Jul or Nov – Dec | Dec – Feb | Nov – Jan | Jun – Jul or Dec – Jan | Sep – Mar |



SLWT: Seasonal low water table
(**May** and also **December**)

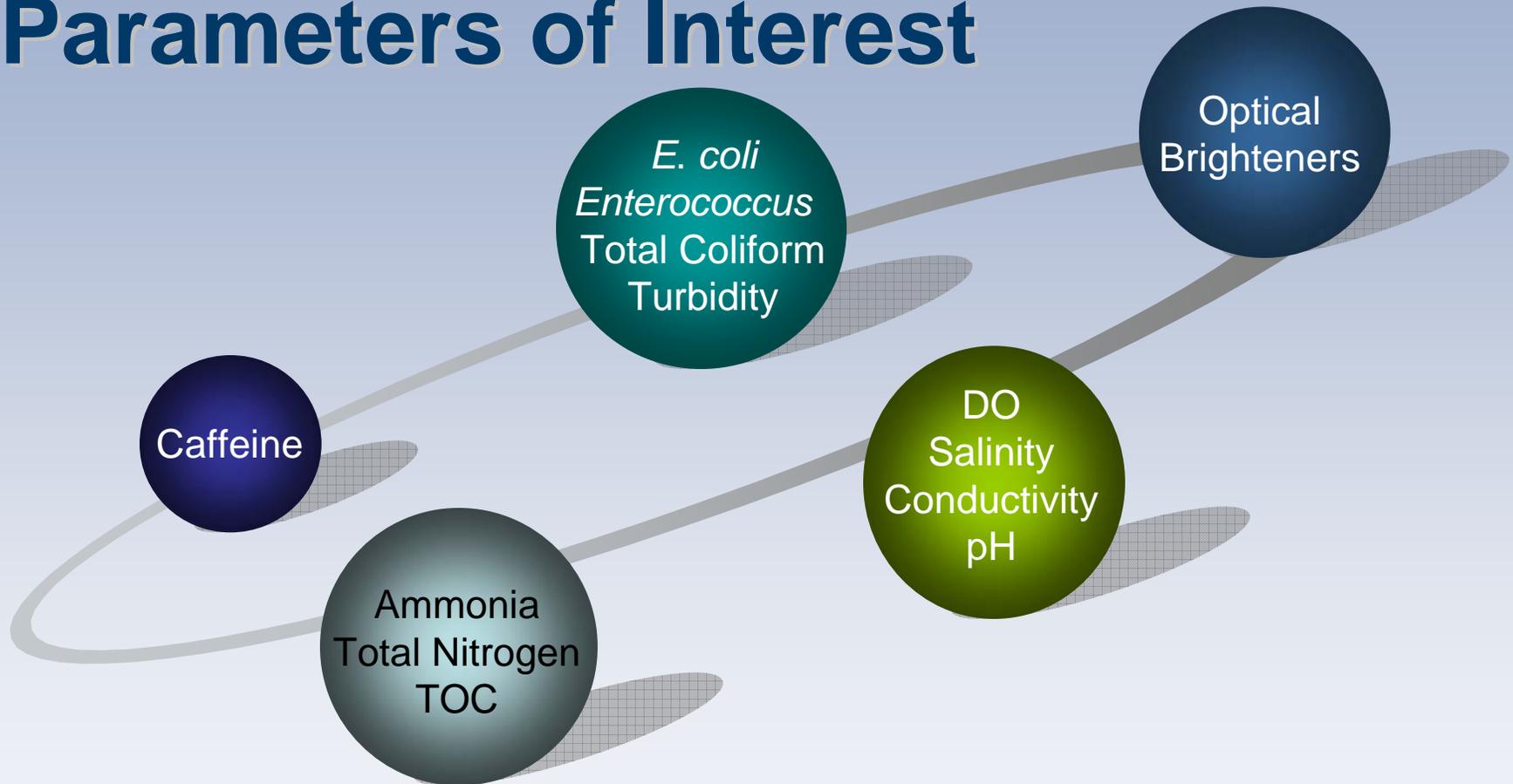
- Soil treatment occurs well above the water table



SHWT: Seasonal high water table
(**September** and also **April**)

- Little or no treatment occurs if below the water table

Parameters of Interest







Laboratories for Engineered Environmental Solutions



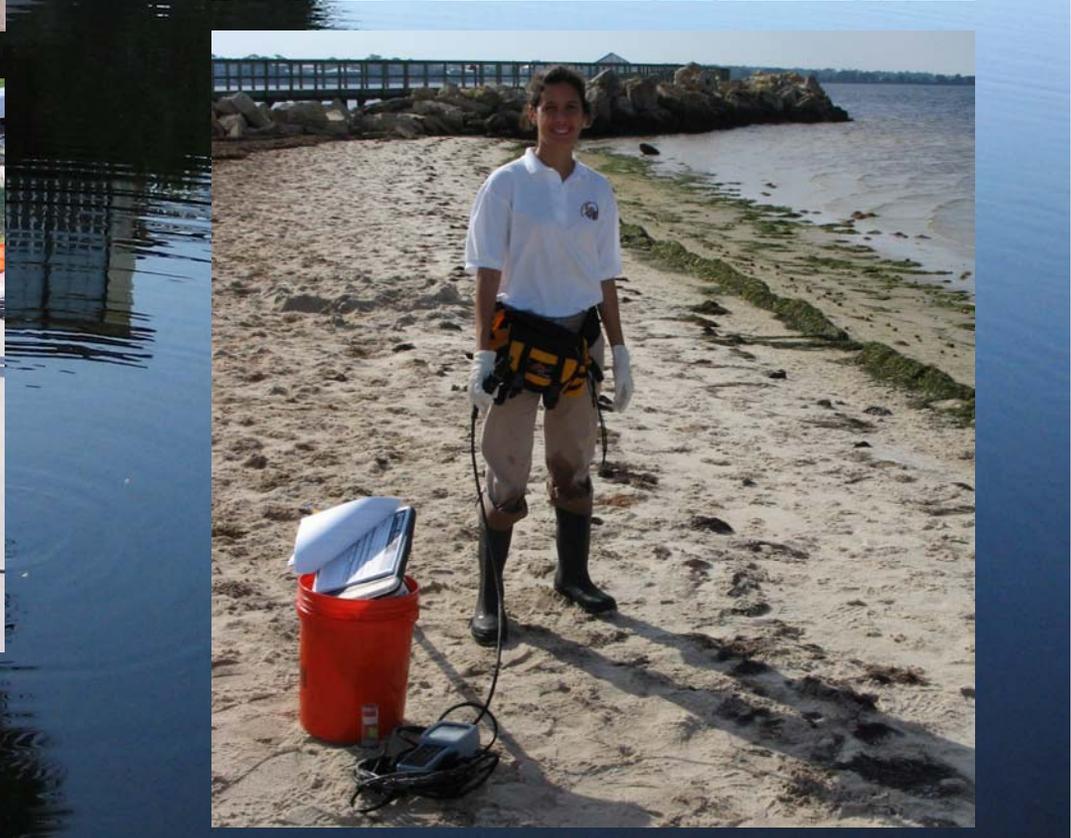
Florida Atlantic University
Department of Civil Engineering

Field Log

| | | | | | | | | | | | | | |
|--|--|---|--------------------------------------|---------------------------------------|---------------------------------|--------------------------------------|----------------------------------|--|------------------------------------|---------------------------------|------------------------------------|--------------------------------------|----------------------------------|
| Project Name: | | | | | | Site ID Code: <i>yyymmddr</i> | | | Sample <input type="checkbox"/> | Dup <input type="checkbox"/> | | | |
| Site Name: | | | | | | Latitude (xx° xx.xxx') | | | Longitude (xx° xx.xxx') | | | | |
| Sampled By (print name/affiliation) | | | | | | Sample Date (mm/dd/yy) | | | Sample Time (hh:mm) | | | | |
| TIDAL CONDITIONS (ebb, flood, slack; high, med, low) | | | | | | RAINFALL RECORDS (in.) | | | CURRENT DIRECTION | | CURRENT STRENGTH | | |
| Ebb <input type="checkbox"/> | Flood <input type="checkbox"/> | Slack <input type="checkbox"/> | High <input type="checkbox"/> | Med <input type="checkbox"/> | Low <input type="checkbox"/> | Prev. 24 hrs | Prev. 3 days | Prev. week | In <input type="checkbox"/> | Out <input type="checkbox"/> | Strong <input type="checkbox"/> | Moderate <input type="checkbox"/> | Weak <input type="checkbox"/> |
| GENERAL CONDITIONS | | | | TEMPERATURES | | | | CLIMATE CONDITIONS | | | | | |
| Weather <small>0000</small> | | | | Air Temp. (°C) <small>0000</small> | | Water Temp. (°C) <small>0000</small> | | Avg Wind | Max Wind | Rel. Hum. ▲% | Heat Stress ▲%#°F | Dewpoint ▲°F | |
| 1. Clear <input type="checkbox"/> | 2. Partly Cloudy <input type="checkbox"/> | 3. Cloudy <input type="checkbox"/> | 4. Rainy <input type="checkbox"/> | | | | | | | | | | |
| SAMPLE INFORMATION | | | | | | | | | | | | | |
| Sample ID <i>yyymmddr-p</i> | | Secchi Depth (m) <small>0000</small> | | Sample Depth (m) <small>0000</small> | | Total Depth (m) <small>0000</small> | | COMMENTS, which document anything that could affect sample (i.e. unusual circumstances; boat traffic, sea birds overhead, pets, evidence of litter, winds, etc.) | | | | | |
| Rep. No. <small>STORET CODE</small> | SC (mS/cm) <small>0000</small> | Conductivity (mS/cm) <small>0000</small> | TDS (mg/L) <small>0000</small> | Salinity (ppt) <small>0000</small> | DO (%) <small>0000</small> | DO (mg/L) <small>0000</small> | pH (x.xx) <small>0000</small> | ORP (mV) <small>0000</small> | | | | | |
| 1 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |

Field Measurements

| Parameter | Trigger Level | Expected Level | Encountered Range |
|---------------------|---------------|---------------------|-----------------------|
| pH | N/A | 6.0 - 8.5 | 7.0 - 8.5 |
| Conductivity | N/A | 5 - 55 mS/cm | 0.1 - 41 mS/cm |
| Salinity | N/A | 9,000 - 40,000 mg/L | 100 - 41,000 mg/L |
| Temperature | N/A | 15 - 25°C | 11 - 28°C |
| Dissolved Oxygen | < 4.0 mg/L | < 9.0 mg/L | 0.5 - 10.5 mg/L |
| Turbidity | >29 NTU | < 10 NTU | 0.1 - 21 NTU |
| Optical Brighteners | N/A | Absent | Absent - Inconclusive |





Lab Measurements

| Parameter | Trigger Level | Expected Level | Encountered Range |
|----------------------------------|--------------------|----------------------|-------------------------|
| <i>E. coli</i> & Total coliforms | > 400 CFU/100 mL | 5 – 800 CFU/100 mL | BDL – 24,000 CFU/100 mL |
| <i>Enterococcus</i> | > 104 CFU/100 mL | 5 – 2,000 CFU/100 mL | BDL – 610 CFU/100 mL |
| Nitrate | NA (> 0.07 mg N/L) | < 5.0 mg/L | BDL – 0.13 mg/L |
| Ammonia | NA (> 0.07 mg N/L) | < 5.0 mg/L | BDL – 0.9 mg/L |
| TN | None | < 10.0 mg/L | BDL – 1.8 mg/L |
| TOC | None | 1 – 200 mg C/L | BDL – 100 mg/L |
| Caffeine | > 0.10 µg/L | BDL | BDL – 0.32 µg/L |









TAYLOR COUNTY HEALTH DEPARTMENT



1215 NORTH PEACOCK AVENUE
PERRY, FLORIDA 32347
584-5087





1215

Environmental Health



HEALTH









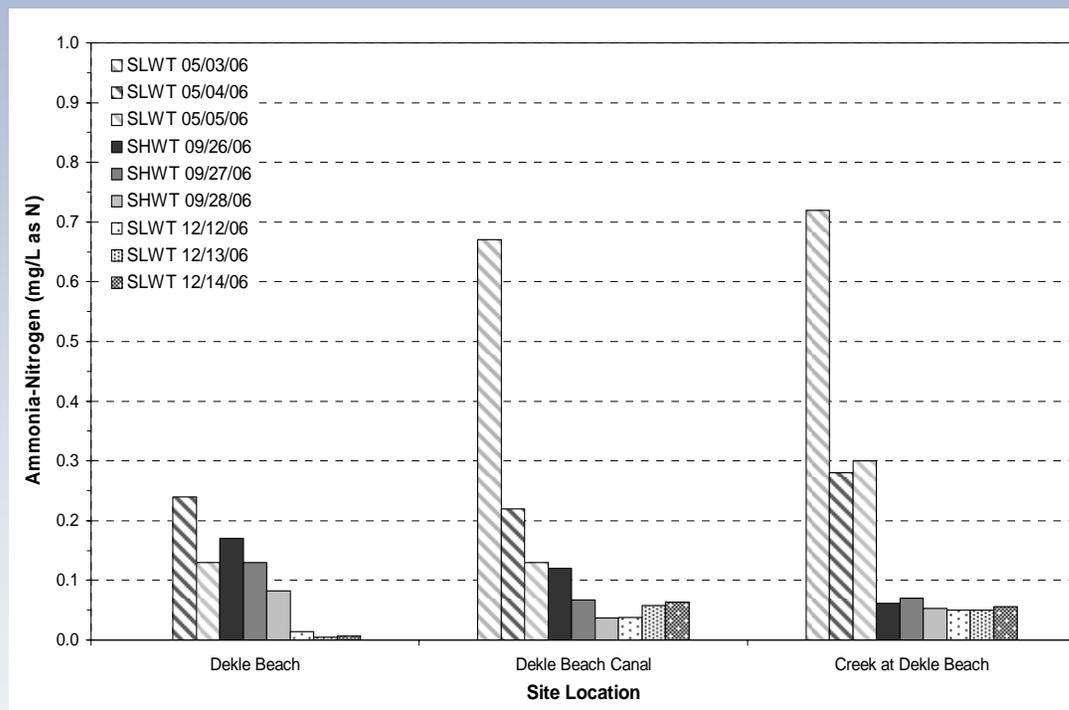




Results By Site

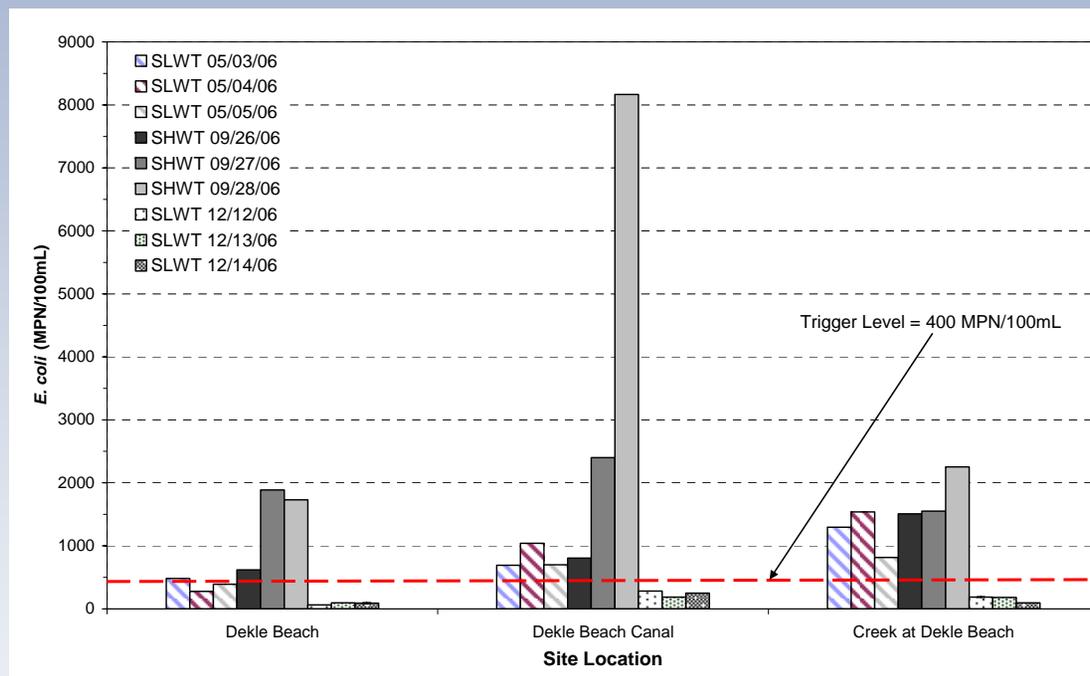
Dekle Beach (OSTDS)

- Ammonia was higher during SLWT (May)
 - During the SLWT, ammonia increased in the upstream direction
 - During the SHWT, the opposite was found
- TOC and TN were higher during SHWT but similar between sites



Dekle Beach (OSTDS)

- Both *Enterococcus* and *E. coli* were slightly higher in SHWT
- Both *Enterococcus* and *E. coli* were higher upstream (Dekle Beach Canal)
- Results were very low in December (SLWT)

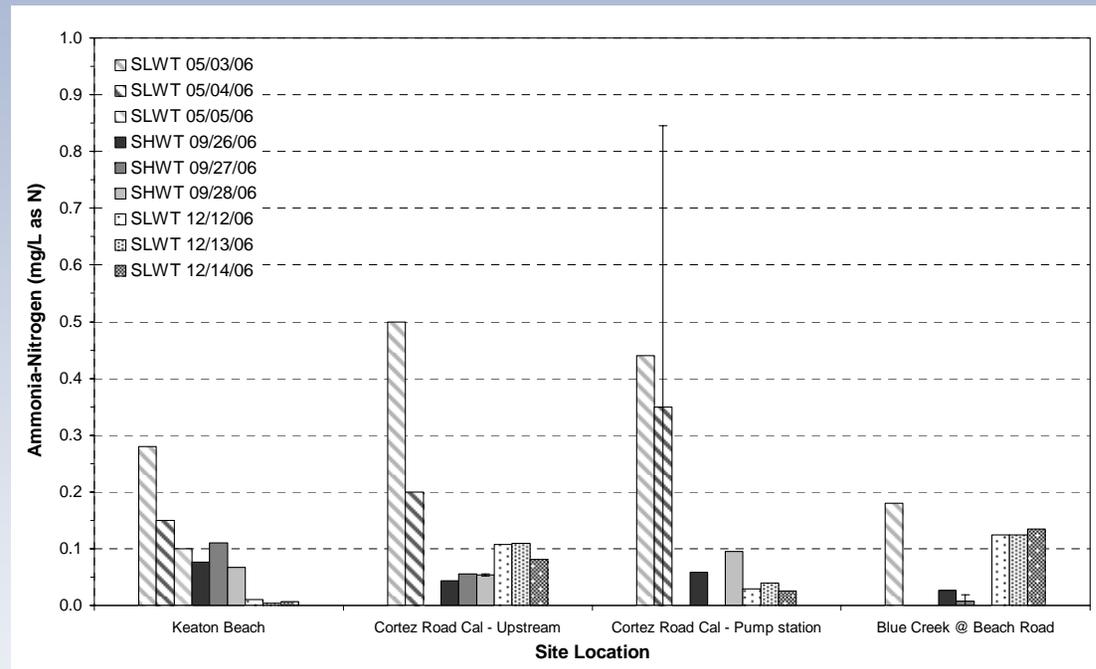


Dekle Beach (*OSTDS*)

- Class III criteria for DO in marine waters (>4.0 mg/L) was met in only 4 of 9 samples at SHWT
- OSTDS are expected to work properly during SLWT, but high ammonia in May could result from fertilizers
 - **First applications are generally done in spring**
 - **May has the highest water average use → irrigation**
 - **This would result in increased runoff of ammonia-based fertilizers**
- **A more representative background site might resolve this issue in follow-up testing**

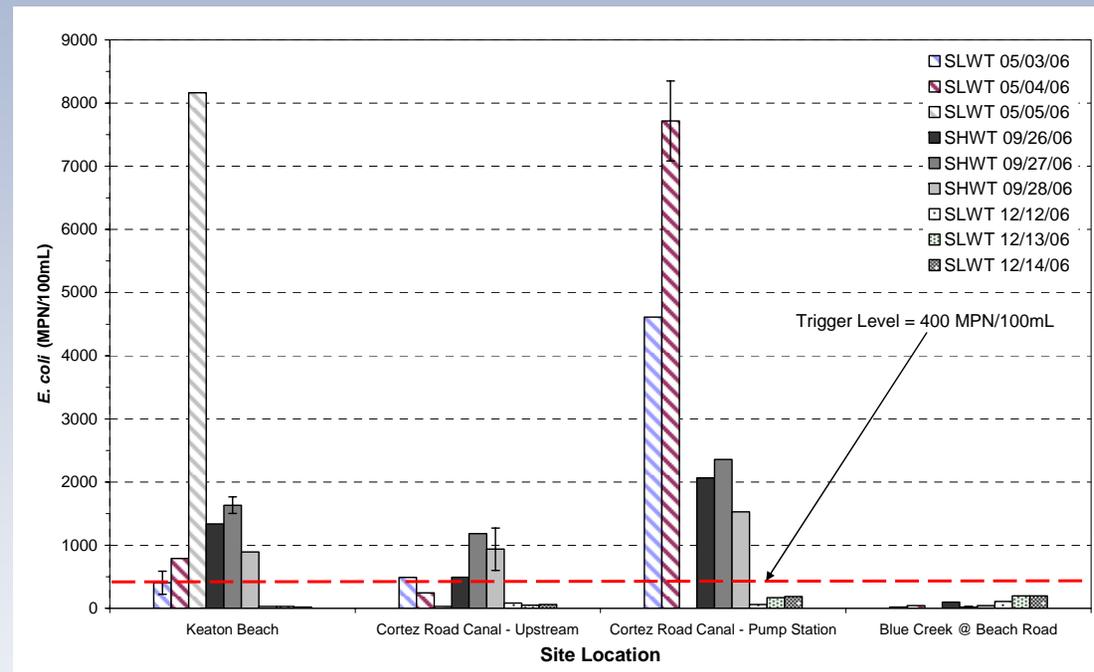
Keaton Beach (*Sewer*)

- TN increased in the upstream direction
 - **SHWT results were slightly higher than SLWT**
 - **Most TN is of organic origin**
- Ammonia was slightly lower than OSTDS sites



Keaton Beach (*Sewer*)

- TOC also increased in the upstream direction
 - **At the beach, the change from SLWT to SHWT was double**
 - **Upstream, the change was much higher (3 to 7 times)**
 - **Recent application of fertilizers is not suggested since ammonia was low**
- **Both *E. coli* and *Enterococcus* were very low in December (SLWT)**

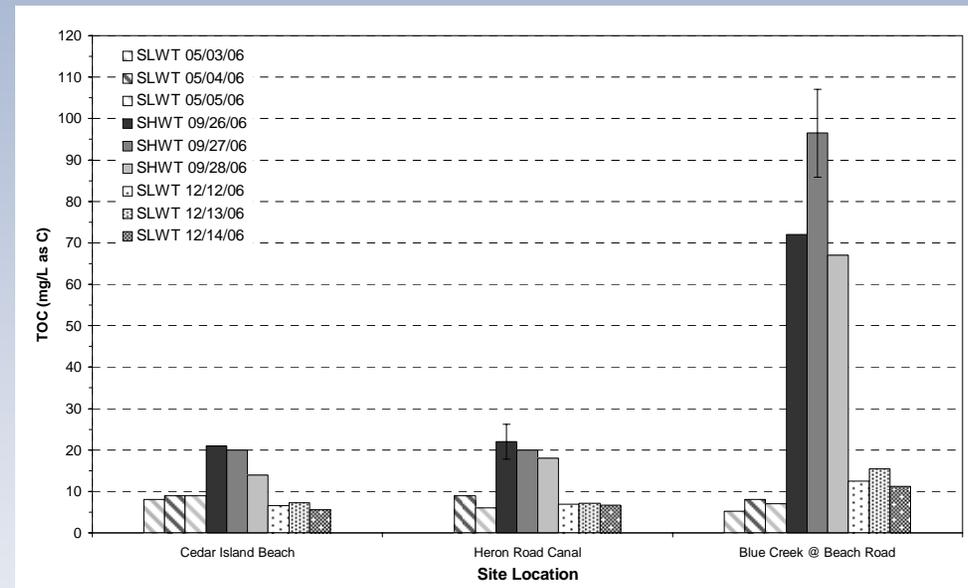


Keaton Beach (*Sewer*)

- Extremely high microbial indicators and ammonia in SLWT seem to implicate a sewer leak
 - Water quality does not show improvement compared to Dekle Beach (OSTDS) sites
 - It is possible that remnant OSTDS inputs have not been completely flushed from the surficial soils
- Follow-up testing with more station density and a survey of sewer leaks will resolve this issue

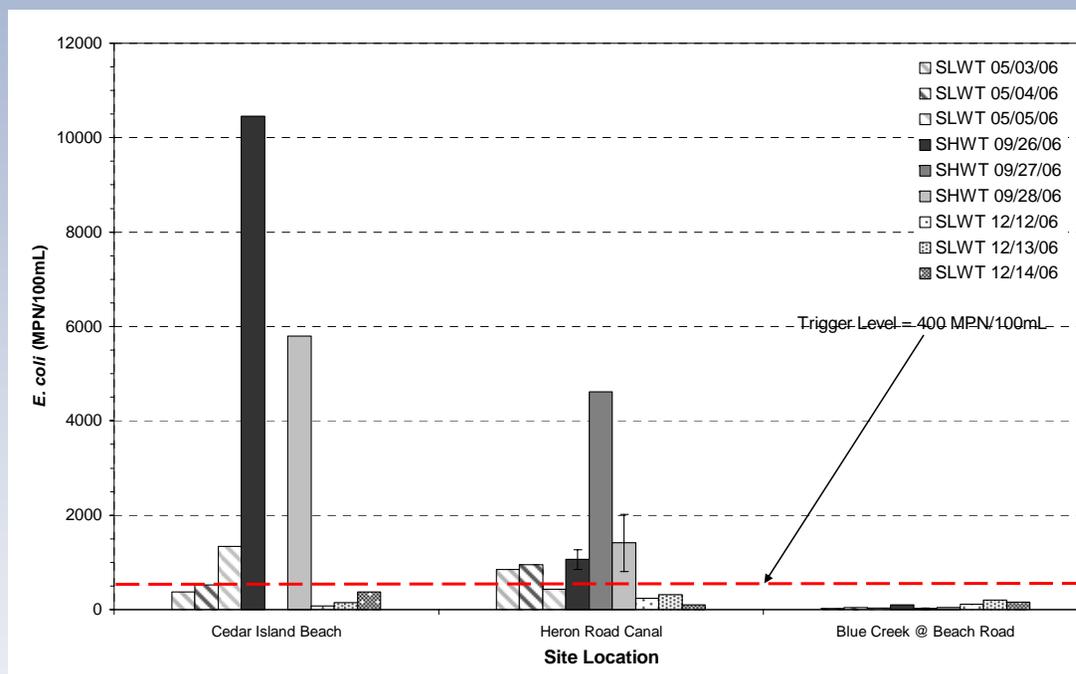
Cedar Island (*Sewer*)

- Ammonia was higher during the SLWT (May)
 - During SLWT, ammonia increased in the upstream direction
 - During the SHWT, the opposite was found
- TN and TOC increased in the upstream direction during the SHWT similar to Keaton Beach (sewer)
 - This was not observed in sites with OSTDS



Cedar Island Beach (*Sewer*)

- *Enterococcus* and *E. coli* were higher during SHWT
- Background site had low levels, with no differences between seasons

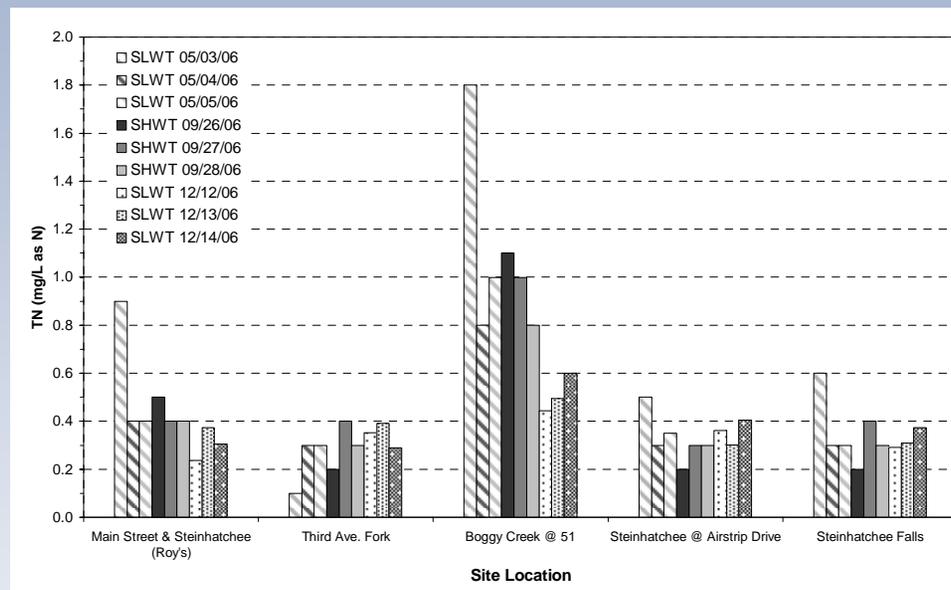


Cedar Island (*Sewer*)

- Extremely high microbial densities (from 1840 up to >24,200) and ammonia were recorded during SHWT
 - Values of 10^5 CFU/100 mL are more characteristic of urban or agricultural wastewater than natural levels
 - It is possible that re-growth in the estuary is an issue here
- Study of shallow sediments for re-growth patterns in the Blue Creek estuary along with more station density will resolve this issue

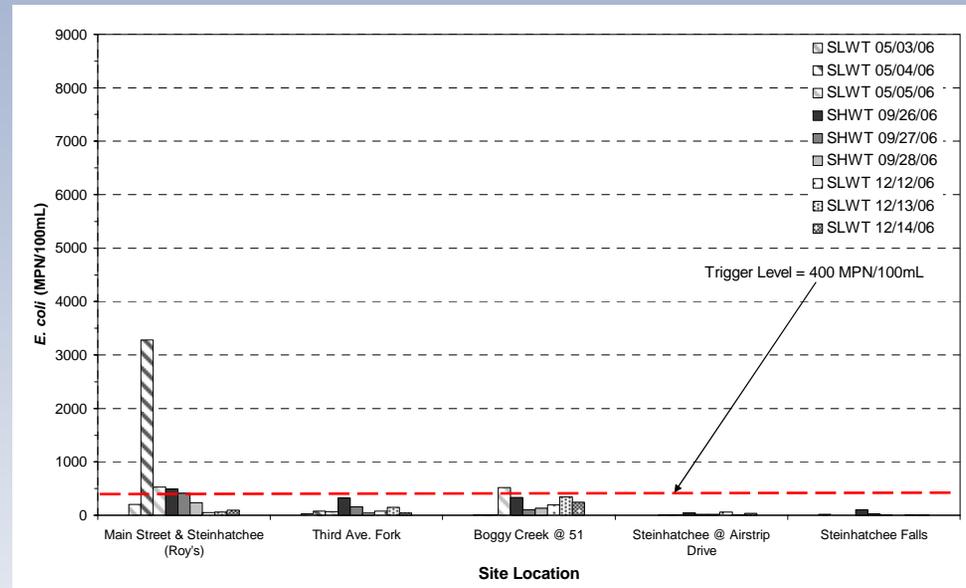
Steinhatchee (OSTDS)

- TOC and TN were similar between sites and seasons
 - With the exception of Boggy Creek (elevated)
- Ammonia concentrations were higher in all sites during the SLWT (May)
 - December (SLWT) values were higher than September (SHWT)
 - But half the values measured in May (SLWT)



Steinhatchee (OSTDS)

- **Enterococcus levels were generally higher at SHWT**
 - **With the exception of Boggy Creek**
- **E. coli counts were generally low**
 - **Peaks were observed in May (SLWT) at the river mouth**



Boggy Creek Tributary Issues

- High nutrients, TOC, bacteria
- Deserves further investigation because:
 - **No known point sources**
 - **No agricultural inputs**
- During all 3 sampling events, we noted evidence of recent activity:
 - **Recently deposited litter**
 - **Fresh tire tracks**
 - **Animal carcasses (wild boars)**
 - **Fresh hydrocarbon sheens**
 - **Gun shots**
 - **Turbidity increased**
- Samples were deep reddish-brown indicative of decaying vegetation



Summary of Violations

| Site | Dissolved Oxygen | | <i>Enterococcus</i> | | <i>E. coli</i> | |
|-------|------------------|------|---------------------|------|----------------|------|
| | SLWT | SHWT | SLWT | SHWT | SLWT | SHWT |
| OSTDS | 21% | 71% | 8% | 42% | 19% | 46% |
| Sewer | 0% | 57% | 2% | 24% | 26% | 71% |

- Very high *E. coli* occurred during both events at:
 - Cedar Island Beach (sewer)
 - Cortez Rd Pump Station (sewer)
 - Dekle Beach Canal (OSTDS)
- As expected both *Enterococcus* and *E. coli* are higher in SHWT
- But unexpectedly, *E. coli* is higher at sewer sites

How Do We Explain This?

- The sewer system was only just recently installed
 - Conditions monitored may still reflect previous contamination from older OSTDS
 - Or microbial regrowth in warm, shallow, stagnant waters
- The only way to tell for sure is to repeat monitoring, particularly in SLWT (May) and SHWT (September)

E.coli/Enterococcus ratio

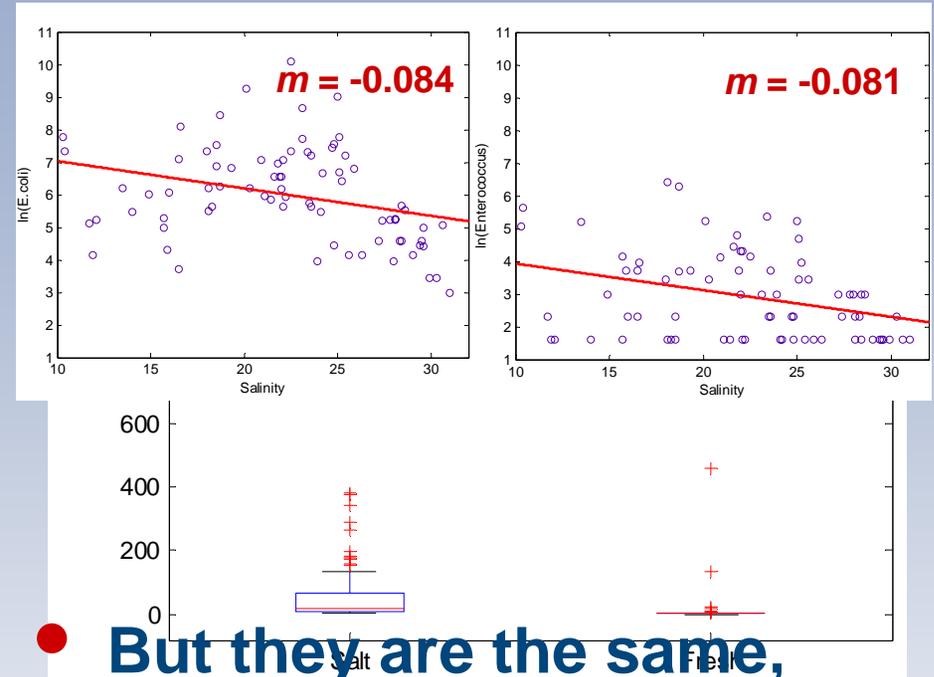
Ratio < 1 → Non-Human
Ratio > 4 → Human

| Site Name | Type | Frequency/Number | Ratio | Origin |
|-------------------------------------|-------|------------------|-----------|-----------|
| Keaton Beach (Pump Station Site) | Sewer | 3/4 | 0.8 – 15 | Human |
| Cedar Island Beach | Sewer | 2/2 | 8.5 – 57 | Human |
| Dekle Beach | OSTDS | 4/4 | 7.4 – 44 | Human |
| Steinhatchee | OSTDS | 0/10 | 0.2 – 2.7 | Non-Human |

- Note: only those with *Enterococcus* > 100 MPN/100 mL are listed
- All background sites < 1.0 (Non-human source)
- Nearly all of the beach sites showed *E. coli/Enterococcus* ratios that were well above 4.0 (Human source)

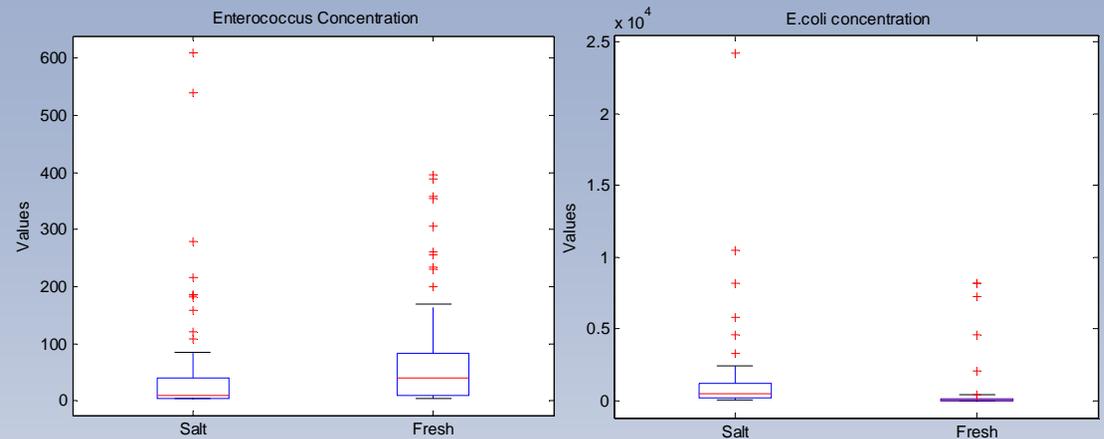
Salinity Effect?

- Brackish/salt water sites tended to be higher
- Freshwater sites tended to be closer to zero (<1)
- Increased die-off of *E. coli* with respect to *Enterococcus* would tend to reduce the ratio with higher salinity
- If the slopes are different



● But they are the same, indicating a similar die-off

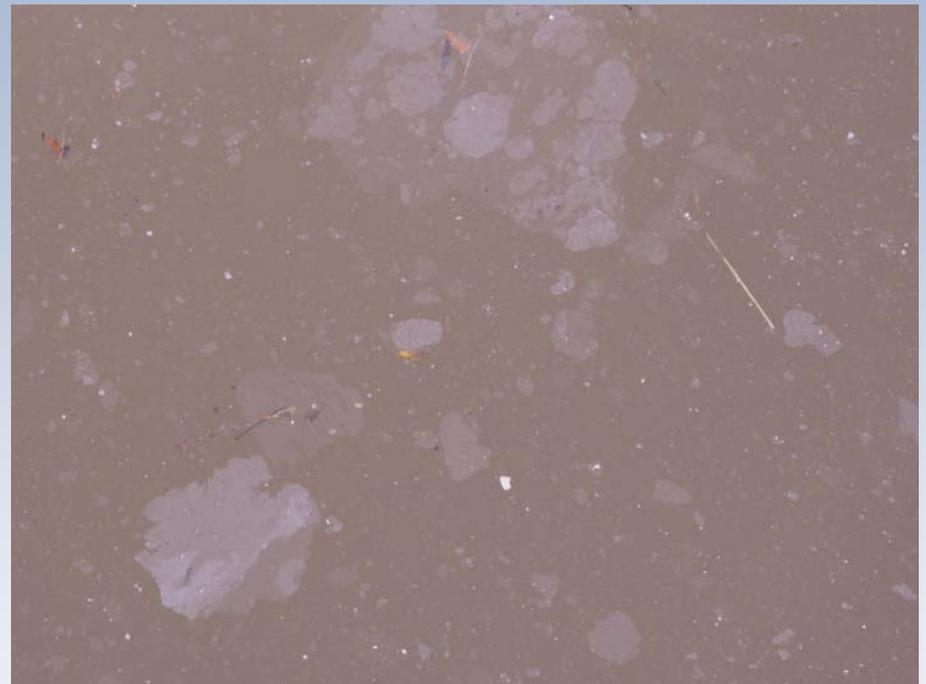
So what is going on?



- ***Enterococcus* is supposed to be a better marine indicator, but we find higher *E. coli* at the beaches**
- **The implication is that:**
 - 1. The *E. coli* is of marine origin or transported from an upstream terrestrial source**
 - 2. The majority of the OSTDS input is directly into the beach**
 - 3. Re-growth is occurring in the near shore environment**

Alternative Tracer – Optical Brighteners

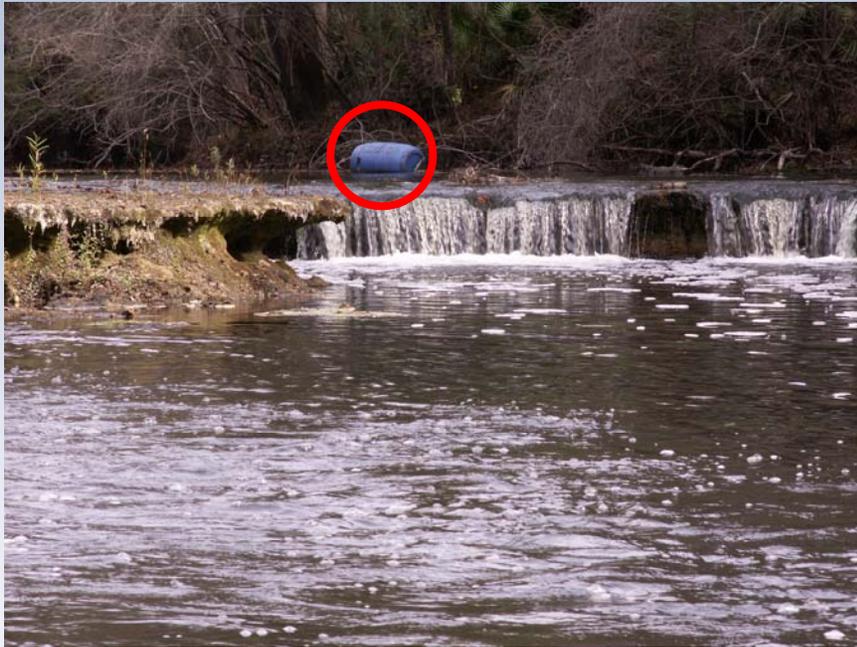
- No significant glow detected in:
 - **May (SLWT), except for once at Site J (Roy's)**
 - **Sept (SHWT)**
- **But in December (SLWT), possible optical brighteners detected under ambient sunlight**



Site M, Air Strip Drive, Steinhatchee
December, 2006 (SLWT)

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- In December (SLWT), we discover one possible explanation at Steinhatchee Falls

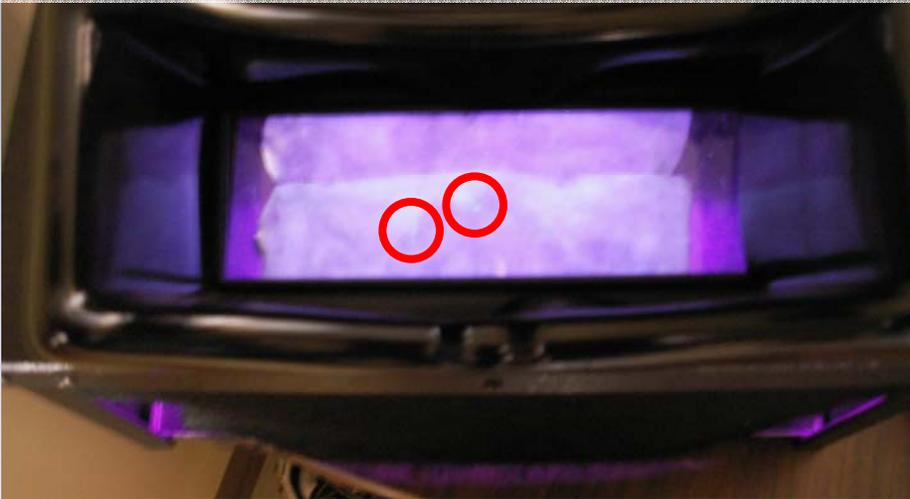


- A similar drum is also found at Roy's



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- **Tiny flakes are evident under UV light**



- **Optical brightener control pad for comparison**



- **The absence of fluorescence does not indicate that the sites are free of human gray water contribution**
- **The qualitative method is not sensitive enough to be considered an effective tracer**

Alternative Tracer – Caffeine

- Detected only 3 times (May SLWT) at very low levels ($< 0.04 \mu\text{g/L}$)
 - **Steinhatchee Falls (Site N)**
 - **Third Avenue Fork (Site K)**
 - **Cedar Island Beach (Site I)**
- Results are inconclusive due to high dilution and low development intensity
- Caffeine was not shown to be an effective tracer for Taylor County

Alternative Tracer – DNA

NOAA-AOML Ocean Chemistry Division (Kelly Goodwin et.al) offered to try experimental molecular techniques to trace human sources

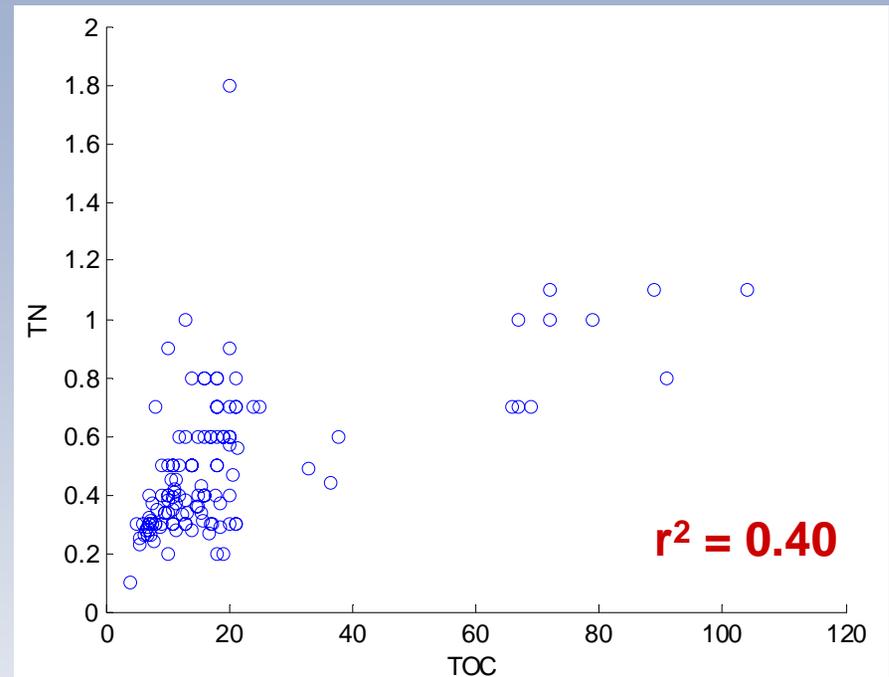
| Site ID | Site Description | IDEXX Fecal Indicators (MPN/100mL) | universal bacterial 16S rRNA gene | Enterococci 23S rRNA gene | Human marker, Enterococci esp gene | Human marker, <i>Bacteroides</i> HF8 cluster | <i>Salmonella</i> spp. <i>lpaB</i> gene | <i>Staphylococcus aureus</i> <i>clfA</i> gene | <i>E. coli</i> O157:H7, <i>rfb</i> gene |
|---------|------------------------|------------------------------------|-----------------------------------|---------------------------|------------------------------------|--|---|---|---|
| 060928L | Boggy Creek | EC = 132 ENT = 262 | + | + | - | - | - | - | - |
| 060928I | Cedar Isl Bch | EC = 5794 ENT = 20 | + | + | - | - | - | - | - |
| 060928C | Creek at Dekle | EC = 2254 ENT = 20 | + | - | - | - | - | - | - |
| 060928F | Keaton Beach | EC = 891 ENT = <10 | + | - | - | - | - | - | - |
| 061213D | Cortez Rd Pump Station | EC = 187 ENT = <10 | + | + | - | - | - | - | - |

- None of the samples (n = 8) showed confluent growth, thus results were inconclusive
- However, this is a promising technique

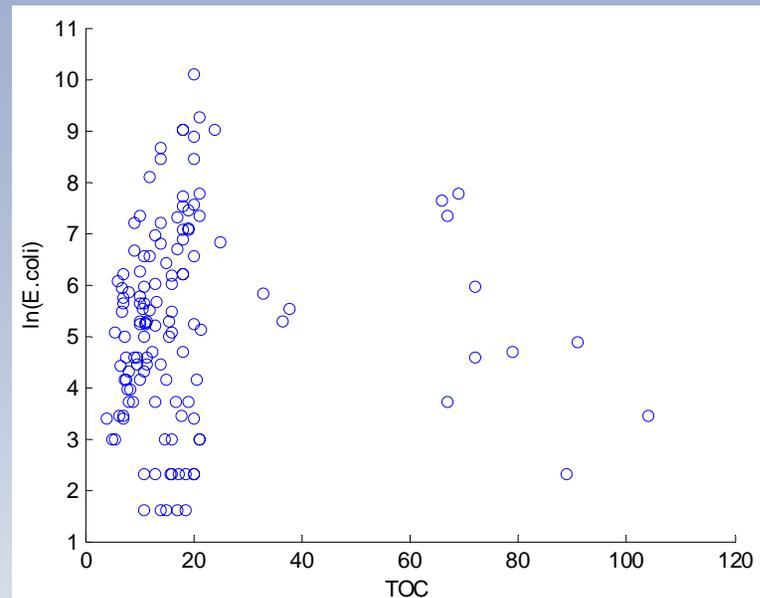
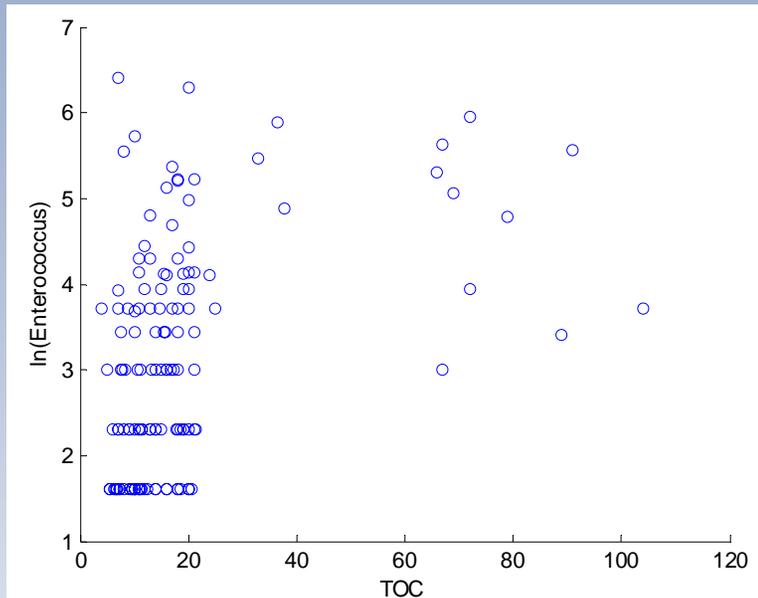
Major Findings

Nutrients

- Ammonia was highest during May (SLWT) and decreased to very low levels in December (SLWT)
 - Nearly 25% were still considered high (>0.07 mg N/L)
 - Sign of improving conditions?
- Nitrate levels were very low
- Nitrogen speciation suggested that most was in the form of organic nitrogen
 - If this nitrogen is mostly biomass, it will correlate with TOC
 - Thus, TOC and TN were plotted



- Now if the TOC/TN is mostly biomass, they should correlate with *E. coli* and *Enterococcus*



- **Neither of the microbial indicators correlated well with TOC**
- **The TOC/TN correlation is more likely the result of natural organic color than microbial biomass**

Summary of Results

- Ammonia (as %TN) was higher during SLWT (May)
 - **No differences were noted between sites with sewer and sites with OSTDS for ammonia**
 - TOC, *Enterococcus*, and *E. coli* were higher during SHWT for both sewer and OSTDS sites
 - **Indicates anthropogenic sources (i.e. lawn fertilizer runoff or industry), but this requires further research**
 - *Enterococcus* levels were higher for OSTDS sites
 - *E. coli* levels were higher for sewer sites
- **Need to determine if this *E. coli* is from human or natural sources and if it can survive in the environment without external input**

Recommendations

- Studies of shallow sediments are recommended to determine re-growth patterns of microbial indicators
- Estuarine sampling may help identify the source of high upstream *Enterococcus* in sewer sites
 - Hydraulic studies of prevailing currents in the estuary will help identify other sources of contamination
 - Nitrogen isotopic ratios could be useful to separate fertilizer inputs from OSTDS inputs
 - Increase the number of molecular tracer samples collected

Recommendations

- **Revise sampling locations to resolve upstream – downstream influence**
 - **Add more representative background sites**
 - **More station density at Cedar Island and Dekle Beach**
 - **Monitor Fenholloway River input with respect to proposed new industrial treatment upgrades and pipeline**
 - **Sewer leaks in the newly installed areas must be cataloged to eliminate confounding**
- **It is critical to monitor sewerred areas long-term to see if water quality improves**
 - **Another year of sampling should resolve this**
 - **May (SLWT) and Sept (SHWT) sampling events with revised locations would be useful**

Acknowledgements

- **Florida Department of Health
Bureau of Onsite Sewage
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 - **Dr. Eberhard Roeder**
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 - **Mark Hooks**
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Department**
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 - **Steve Tullos**
 - **Connie Ernst**
 - **Gerald Murphy**
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 - **Linda Hess**
 - **Dan Kuhn**
 - **Eli Brossell**
 - **Anthony Ruffini**

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Florida Department of Health, Research Review and Advisory Committee (RRAC) Meeting
Lake Sylvan Park, FL - May 8, 2007

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| | SLWT (May) | SHWT (Sept) | SLWT (Dec) | SLWT (May) | SHWT (Sept) | SLWT (Dec) |
|-------|----------------------------|-------------|------------|---------------------------------|-------------|------------|
| | <i>E. coli</i> (MPN/100mL) | | | <i>Enterococcus</i> (MPN/100mL) | | |
| Sewer | 490 | 1121 | 107 | 15 | 44 | 8.8 |
| OSTDS | 111 | 280 | 114 | 28 | 56 | 65 |
| | <i>TOC</i> (mg/L as C) | | | <i>TN</i> (mg/L as C) | | |
| Sewer | 10 | 37 | 11 | 0.46 | 0.70 | 0.33 |
| OSTDS | 12 | 26 | 14 | 0.56 | 0.53 | 0.36 |
| | <i>Ammonia</i> (mg/L as N) | | | <i>Nitrate</i> (mg/L as N) | | |
| Sewer | 0.20 | 0.05 | 0.06 | 0.01 | 0.01 | 0.02 |
| OSTDS | 0.26 | 0.05 | 0.05 | 0.01 | 0.02 | 0.02 |

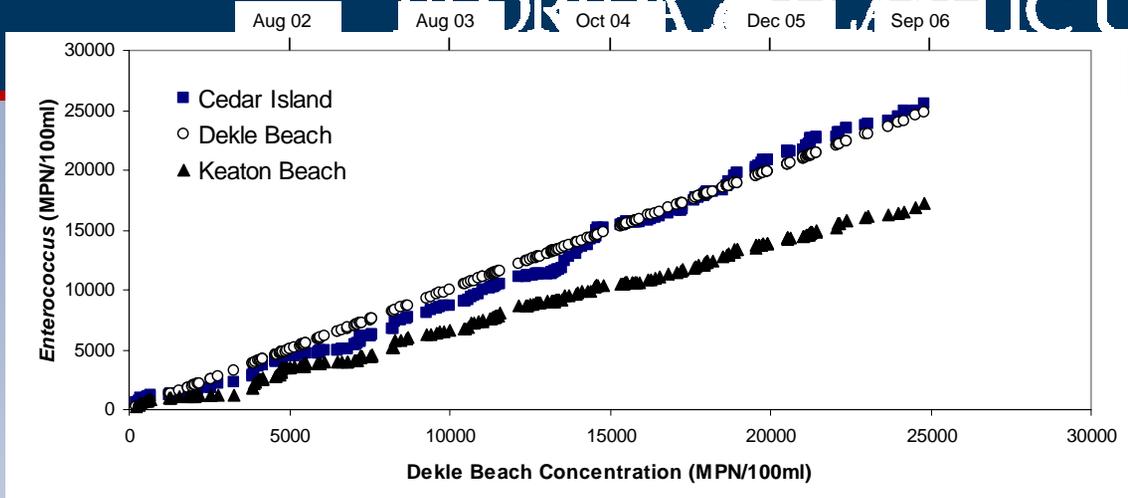


Figure 34 – *Enterococcus* correlation of Keaton Beach and Cedar Island sites with Dekle Beach.

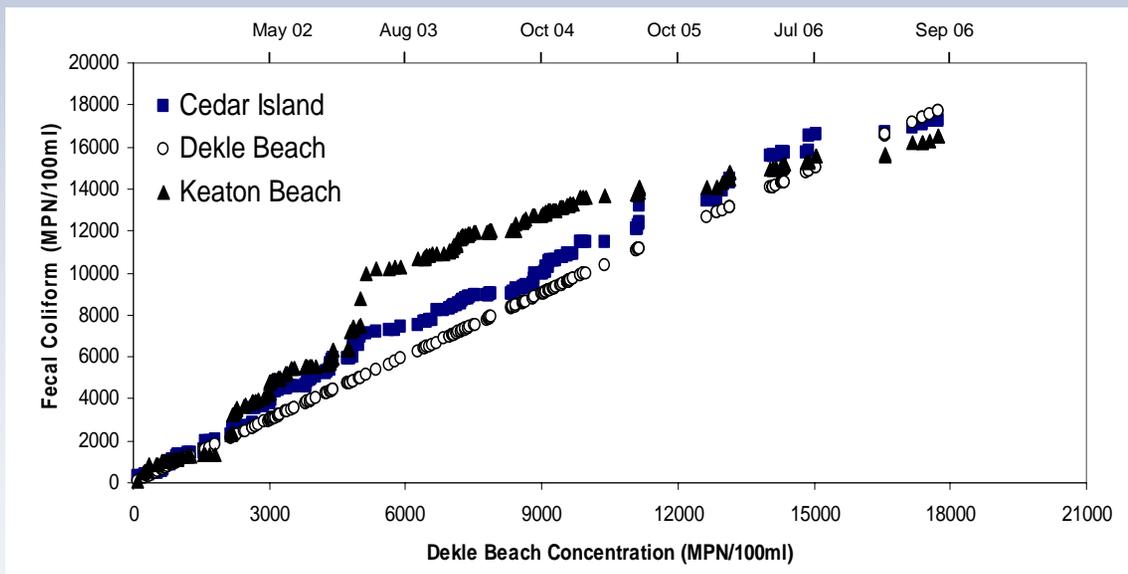


Figure 35 – Fecal coliform correlation of Keaton Beach and Cedar Island sites with Dekle Beach.

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It was hypothesized that the Fernholloway River, upstream of the impacted areas, north of Dekle Beach, may be a potential source of nutrient. A large industrial source, Buckeye Cellulose Mill, discharges into the river and during the SHWT may account to up 80% of its flow.

Some samples collected downstream of the plant showed high values of nitrate (>3.0 mg/L as N) and TOC. The table below shows some water quality data from the Paper Mill.

| Parameter | USEPA 2003 | FDEP FILES FOR 2004 | Proposed TMDL (USEPA 2003) |
|----------------------|------------|---------------------|----------------------------|
| Flow | 43 MGD | 44 MGD | |
| BOD ₅ | 8200 lb/d | 8200 lb/d | 1050 – 1255 lb/d |
| TSS | -- | 5000 lb/d | -- |
| Ammonia | 1200 lb/d | -- | 37 – 360 lb/d |
| Total Nitrogen | 1800 lb/d | 2600 lb/d | 10.5 – 1075 lb/d |
| Total Phosphorus | 750 lb/d | 550 lb/d | 79 – 360 lb/d |
| Specific Conductance | -- | 2700 µmhos/cm | -- |
| Color | -- | 1200 PCU | -- |

Dekle Beach (OSTDS)

Dekle Canal B
Dekle Beach A
Creek at Dekle B

A - The beach is narrow and located just at the side of the road. Along the shore, the remains of old septic tank units can be observed.



B - The canal is directly connected to the ocean and it is surrounded by homes on both sides. Some neighbors have boats in the canal.



C - The creek connects a marsh area to the end of the canal. A two-lane bridge passes over the creek.



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Keaton Beach (Sev)

F - The beach has calm waters and is located in a delta.

E - Located in the middle of a canal that leads out to the ocean directly below a residential pier. There

D - Located at the inland end of the canal in Cortez Road Canal, less than 100 feet from a new pump station. According to the team on site, the water system home,

G - This is a background site, with freshwater flow. It allows assessment of further inland sources. The water has a dark tea color, presumably from humic, fulvic, and tannic substances.

I – The site is on the beach in front of the concrete foundation of a house located at the end of a road. The beach has very calm shallow water and resembles a bay. It is well protected, and the width of the channel leads to seemingly stagnant water.

H - Located on a dead-end canal surrounded by residential development. The sampling location was a small dock in the yard of an unoccupied home. The channel is shallow even during high tide. The bottom is usually visible, and the soil is muck suitable for mangroves.



Cedar island Beach (Sewer)

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M - This site represents the tributary structure upstream of the Steinhatchee River.

N - This site represents the natural background condition for the Steinhatchee River basin. The water velocity is rapid at this site due to a relatively important elevation drop and narrow channel. Samples were collected just upstream from the falls.

the Steinhatchee River, just downstream from a restaurant known as Roy's. There is a large septic tank on the property, with an infiltration field and mound located on the other side of the road.

owners of the nearby homes do not inhabit them year-round

K
stre
finger of the Steinhatchee River. The site is close to private property. It was noted that people go to the site during lunch time to eat.

Steinhatchee (OSTDS)

2.51 mi

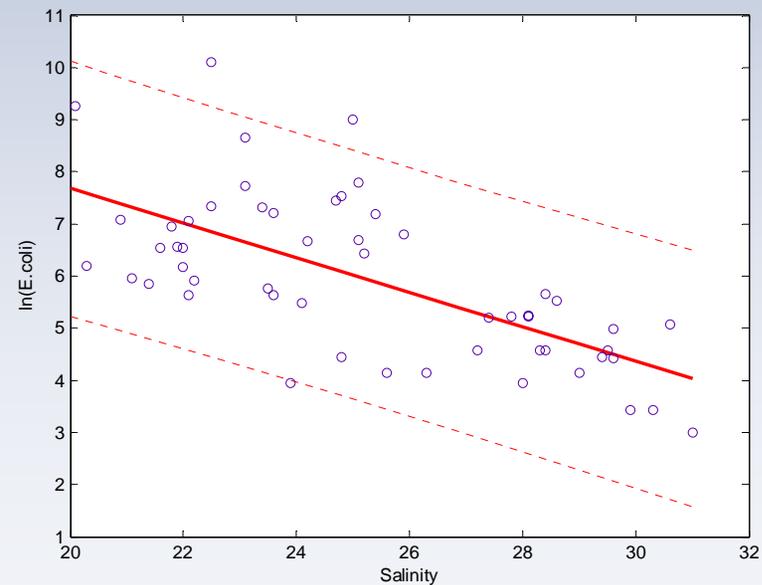
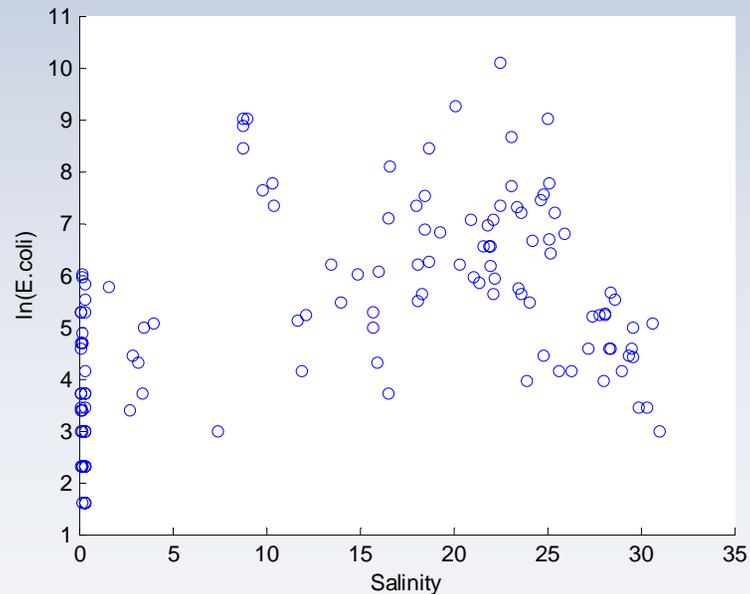
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Major Findings

The natural log plot of *E. coli* density vs. salinity for all sites with salinity > 20 ‰ is showed below ($r^2 = 0.435$) with the 95% confidence interval plotted (bottom right).



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