Water Quality Improvement Workshop

Research Opportunities

April 29, 2019

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and Don Rainey

University of Florida

Institute of Agricultural and Food Science/Extension

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WELCOME

Our goal is to describe who we are, the scope of proposals, applications and resources required to analysis nutrients and utilize specific BMPs to affect water quality.

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UF/IFAS MISSION

The Mission of UF/IFAS is to develop knowledge in agricultural, human and natural resources and to make that knowledge accessible to sustain and enhance the quality of human life.

Research

Extension

Teaching

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UF/IFAS EXTENSION MISSION

Is a **statewide** network of experts that fulfills the UF/IFAS outreach mission by **partnering with communities** to provide high-quality, relevant education and research-based expertise to foster healthy people, healthy environments and healthy communities.

UF/IFAS Extension is funded by federal, state and county sources. UF/IFAS Extension personnel maintain close contact with local leaders, focusing on local concerns via grassroots engagement.

Access to Sea Grant College Agents and Specialist

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UF/IFAS RESEARCH

The UF/IFAS research enterprise represents the work of **568 faculty** members with research appointments from every academic department and discipline within UF/IFAS Departments.

Natural resources topics under study include climate variability, water quality and conservation, energy conservation, land-use issues, wildlife, invasive species, fisheries, forest science, ecotourism, ecology and ecosystem services.

Funding for UF/IFAS research activity comes from a variety of sources including federal grants, state appropriations, support from producers, contracts and grants, donations, and licensing revenues from crop cultivars and technologies developed by UF/IFAS personnel.

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UF/IFAS EXTENSION AND RESEARCH EXCHANGE

Provide the latest technology and knowledge available to the public, government agencies and industry professionals.

Support all stakeholders involved via information deliver, knowledge gain, behavior change and continual assessment to maintain quality life and identify future challenges.

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TEAM MARCO AND STAKEHOLDERS

City of Marco

- Council
- Staff and Specialists
- Beaches and Shoreline Committee
- Beautification Committee
- Marco Sportfishing Club
- Citizens

Collier County UF/IFAS Extension

University of Florida – Institute of Food and Agricultural Sciences Research

Departments:

Soil and Water Sciences

Ag. and Biological Engineering

Florida Department of Agriculture and Consumer Services

Florida Department of Environmental Protection

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COLLIER COUNTY – UF/IFAS EXTENSION

Mrs. Twyla Leigh – County Extension Director

Dr. Doug Caldwell – Commercial/Residential Horticulture Agent

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DR. MARY LUSK

Assistant Professor And Extension Specialist
Soil And Water Science
University Of Florida/IFAS
Gulf Coast Research And Education Center

Research and Extension:

- Urban water quality, stormwater, and low impact development for urban areas
- Urban fertilizer ordinances
- Pathogens in water bodies
- Onsite wastewater treatment (septic systems)
- Urban agriculture

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DR. ALEXANDER J. REISINGER

Soil And Water Sciences Department
Assistant Professor And Extension Specialist
UF Campus – Gainesville

Research and Extension:

- Nutrient, Pesticide and Waste Management
- Soil, Water, and Aquifer Remediation
- Wetlands and Aquatic Ecosystems
- Watershed ecology
- Emerging contaminants

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DR. EBAN BEAN

Assistant Professor And Ext. Specialist
Agricultural And Biological Engineering Dept.
Professional Engineer (P.E.)
UF Campus - Gainesville

Research and Extension

- Watershed Hydrology
- Urban Stormwater Management
- Green infrastructure
- Wet/dry stormwater ponds for hydrologic and water quality performance
- Hydrologic and water quality monitoring of urban drainage systems
- Evaluating land use change on receiving waters

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DR. ASHLEY SMYTH

Assistant Professor And Extension Specialist
Soil And Water Science Department
Biogeochemistry
Tropical Research And Education Center

Research and Extension:

- Biogeochemistry, microbial ecology and marine ecology.
- Focus on increasing public awareness regarding climate predictions for South Florida.
- Use of field observations and laboratory manipulation experiments to understand how environmental change and disturbance influence the fate and transport of nutrients in coastal and marine ecosystems.

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DR. LAURA K. REYNOLDS

Assistant Professor And Extension Specialist
Soil And Water Science Department
Coastal and Marine Ecology
Gainesville Campus

Research and Extension:

- Research integrates approaches from population and community ecology, biogeochemistry, and plant physiology to better understand how environmental and individual variability influences the functions and stability of nearshore marine ecosystems.
- Seagrass

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Current Situation

- Growth and Development
- Increasing impervious surfaces, sediment and nutrient loading
- High Turbidy – loss of seagrass beds and fisheries
- Failing TMDL – sustained elevated nitrogen levels
- Beach Closings – bacteria from septic, pet and wildlife
- Reclaimed Water N and P concentrations
- Inadequate stormwater treatment infrastructure and design
- Insufficient Data – monitoring and locations

66 Miles of Canals

EXPECTATIONS

- Return of seagrass beds and fisheries
- Achieve TMDL goals

PROPOSED PROJECT GOALS

- To quantify the nutrient contributions of various sources to Marco Island waterways
- To make recommendations for how to reduce the contributions of these sources
- To change public and industry behavior
- To train and assist city staff to facilitate appropriate water quality monitoring, improvement and protection practices

PROJECT METHODOLOGY

Objective 1: Provide data analysis support of nutrient concentration data obtained by Marco Island's internal water monitoring efforts.

Objective 2: Develop high spatial resolution monitoring data of Marco Island canals.

Objective 3: Employ stable isotope tools to identify and track sources of nitrate-N to local waterways, including fertilizers, wastewater, atmospheric deposition, soil and organic debris such as grass clippings.

PROJECT METHODOLOGY

Objective 4: Quantify the N and P loading to stormwater from particulate matter on the island's impervious surfaces.

Objective 5: Describe how Marco Island's canals impact and are impacted by excess N and P

PROJECT METHODOLOGY

Deliverables

- Recommend structural and non-structural BMPs that will overall address nutrient loading
- Recommend residential irrigation and fertilizer BMPs to protect water quality.
- Recommend outreach education strategies to reduce negative impacts.
- Recommend impervious stormwater retro-fit initiative to improve water treatment functions.
- Work with UF Specialists to culture, propagate and regenerate seagrasses and shellfish habitat (filter-feeders).

Project Timeline

Task	Summer 2019	Fall 2019	Spring 2020	Summer 2020	Fall 2020	Spring 2021
Obj. 1- data analysis support	X	X	X	X	X	
Obj. 2- high resolution spatial monitoring of canals	X	X	X			
Obj 3- runoff study and source identification			X	X	X	
Obj. 4- street particulate study			X	X	X	
Obj. 5- sediment nutrient flux study	X	X	X	X		
Education and outreach support	X	X	X	X	X	X
Delivery of final report and recommendations						X

RESEARCH PROPOSALS

- Street Sweeping Study
- Canal Monitoring Study
- Source Tracking and Analysis Study
- Gator Byte Database
- Advanced Ecological / Biogeochemical Monitoring

Street Sweeping – Dr. Lusk

Perform a comprehensive – one year study

- Study of N and P load reductions

Assess particulate matter on streets and other impervious surfaces

- Leaf litter
- Grass clippings
- Eroded soil

Street Sweeping Study Design

1. **Set at least 9 Treatment areas**
   - Land use: highway, commercial, or residential
   - Varying tree canopy coverage – determine annual leaf litter loads
2. **Quarterly street sweeping by commercial or city**
   - Determine weight and volume
   - Use Florida Stormwater Association Load Reduction Assessment Tool (FDEP)
   - Analysis of island-specific N and P contents or DEP default values

CANAL MONITORING – Dr. REISINGER

Recommend to continue monitoring historic locations

- Increase monitoring to monthly

Perform at least two intensive monitoring events:

- Wet and dry seasons
- Sample at least 100 surface waters

Outcomes:

- Capture long-term trends
- Identify hot-spots (loading areas)
- Identify and recommend BMPs to reduce N and P loading

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CANAL MONITORING DESIGN

Collect water samples

- Locate at least 100 sample sites
- Analyze for nitrate (NO3), ammonium (NH4), and total kjeldahl nitrogen (TKN), as well as phosphate (PO4) and total phosphorus (TP).
- Measure water quality parameters at each sampling location, including temperature, pH, conductivity, water clarity, and dissolved oxygen concentrations.
    - Record water quality parameters along a depth profile per location
- Collect sediment samples from subset of location (~25) to identify the potential for dredging.

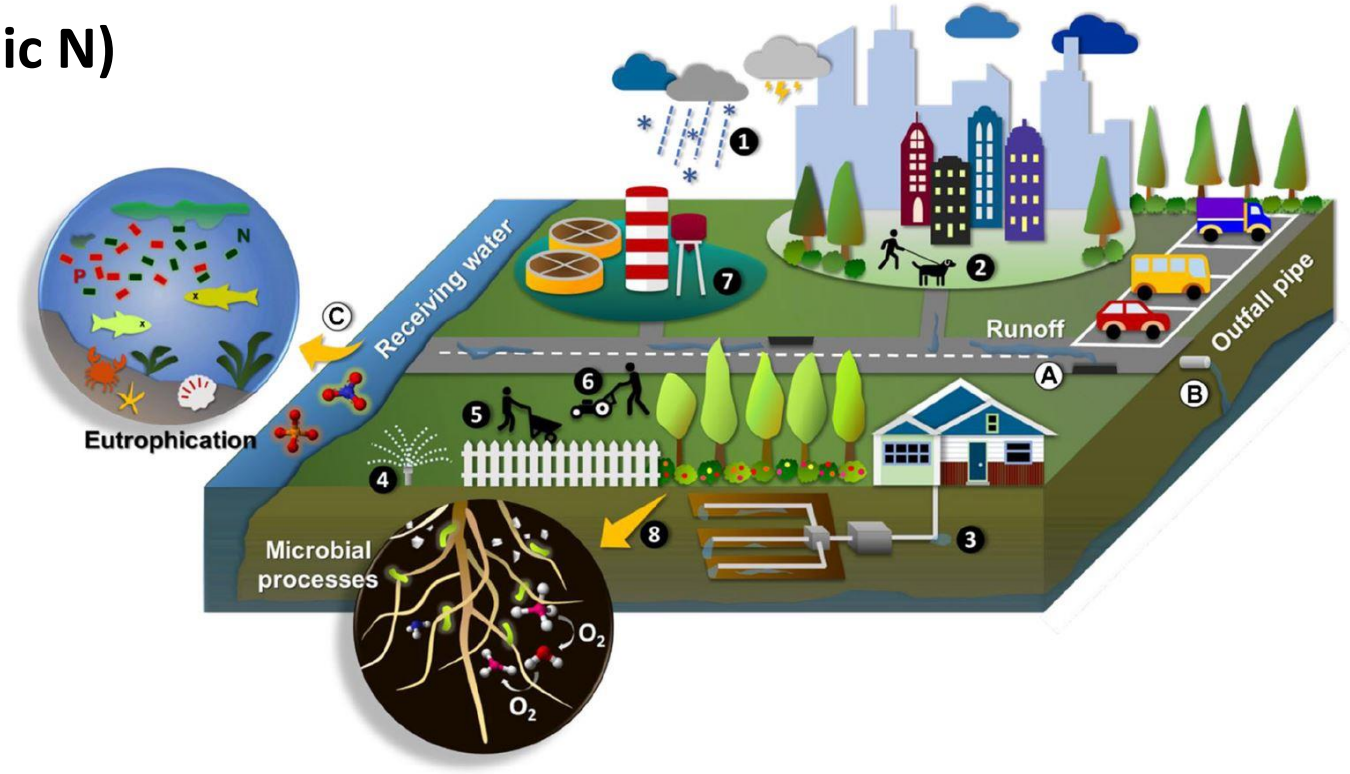
CANAL MONITORING

Measurable parameters

- Quantitative assessment of conditions throughout the entire body of water.
- Identify the potential for dredging to alleviate water quality impairments based on the nitrogen and phosphorus concentrations in the sediments.
- By assessing concentrations at a broader spatial scale, we can identify hotspots of nutrient pollution and areas of concern, which will allow us to develop recommendations for dealing with specific areas

URBAN WATERSHED

1. Atmosphere (NH_4, $No_{x,}$ NO_3, NO_2, organic N)
2. Pet Waste (NH_4 organic N)
3. Onsite Septic Treatment
4. Reclaimed Water (NH_3, NO_3, No_x , organic N)
5. Fertilizer (NH_4, NO_3, organic N)
6. Leaf Litter and plant debris (organic N)
7. Central Treatment Effluent
8. Soils (NH_4, NO_3, organic N)



Yang and Lusk, 2018

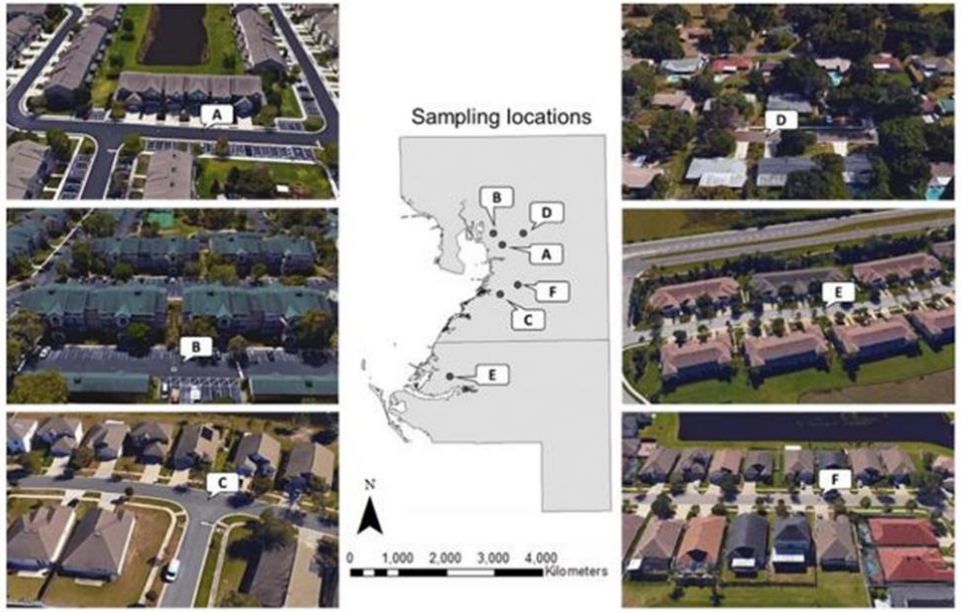
SOURCE TRACKING – Dr. LUSK

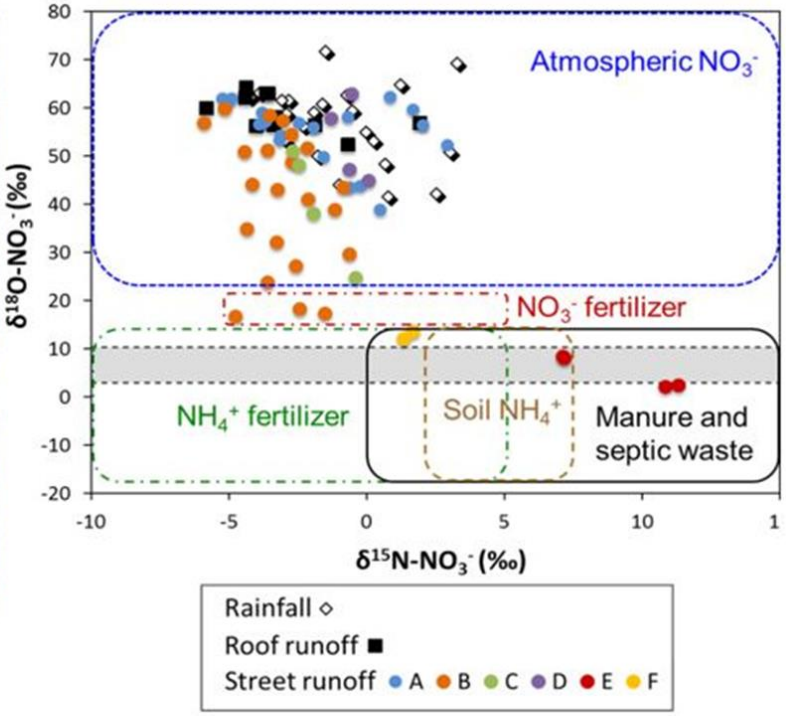
Identify and track sources of nutrients to local waterways include fertilizers, reclaimed water used for irrigation, septic systems, atmospheric deposition, and soil and organic debris such as grass clippings.

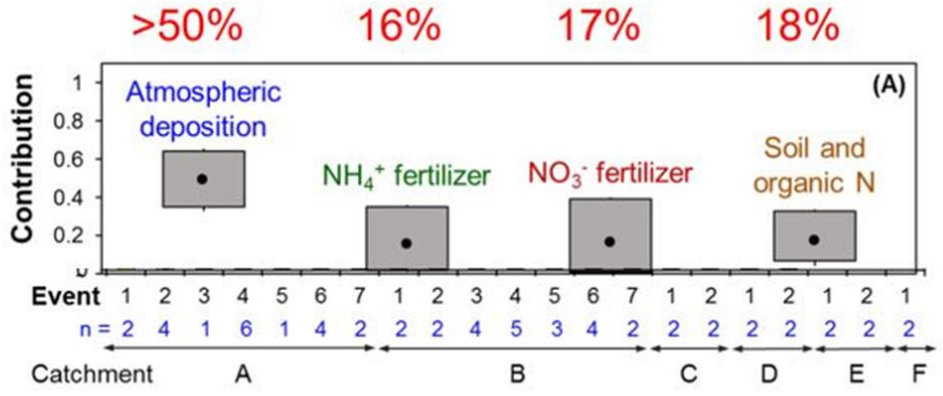
Common tools for tracking sources of nutrients to waterways include:

- isotopic tools, which can be used to infer sources of nitrate-N, and analysis of sucralose, which is used to infer a human wastewater source.

SOURCE TRACKING







- **Nitrate was ~20% of total N**
- **Fertilizers were 37% of nitrate or <10% of total N**

Yang and Toor. 2017. Water Research

SOURCE TRACKING DESIGN

- **Identify at least 6 sites among 3 land uses (highway, commercial, residential and/or golf)**
- **Conducting 9 months (to capture dry and wet seasons) of monitoring stormwater runoff for N and P concentrations, N and O isotopic characterization of NO_3, and sucralose.**
- **At least one of the research sites should include parts of the island still serviced by septic systems.**
  - instrumenting the stormwater conveyance systems at each study site with an autosampler and flow meter, so nutrient concentrations in runoff can be converted to mass of N and P loading .

GATOR BYTE – Dr. BEAN

A. Station Monitoring and Design

- Monitor water quality (pH, conductivity, DO, temperature, and potentially others) continuously at 15 minute intervals at three locations.
- Data will be provided via a web interface.

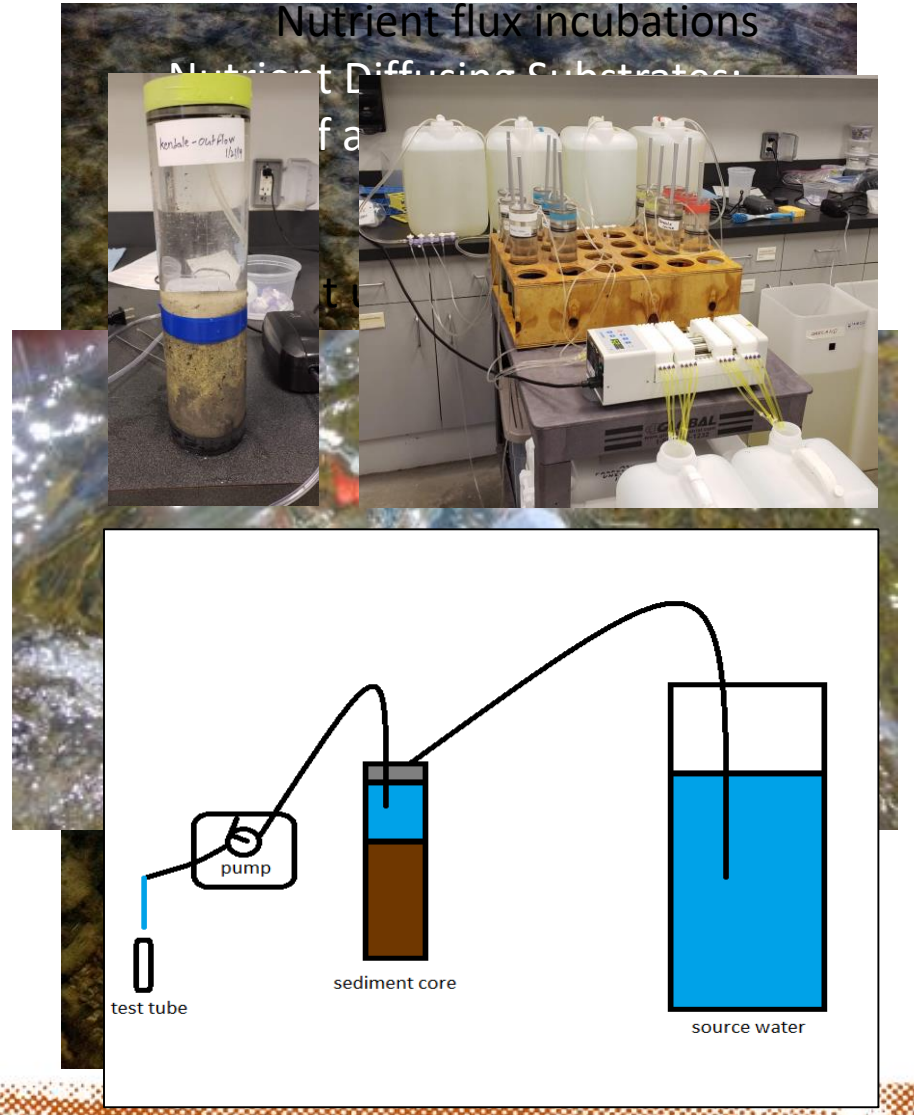
B. Bouy

- Three water quality buoys (pH, conductivity, DO, temperature, and potentially others) that will be used to collect water quality and position to map spatial variability.

ADVANCED ECOLOGICAL / BIOGEOCHEMICAL MONITORING – Drs. REISINGER AND SMYTH

Study of the underlying ecological processes related to how the canals impact and are impacted by elevated nutrients using advanced ecological monitoring program to assess various ecosystem processes within the canals.

- Evaluate nutrient limitation using nutrient diffusing substrates
  - How do algae and other microbes respond to elevated nutrients
- Estimate water column nutrient removal using chamber incubations
  - Algae and other microbes consume N and P, converting it into biomass
  - This doesn't represent a permanent nutrient removal, but can reduce the nutrient 'quality'
- Quantify N and P flux from canal sediments
  - Are sediments removing N and P, or are they a source?
  - How much N removal is permanent?



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ADVANCED ECOLOGICAL / BIOGEOCHEMICAL MONITORING

Outcome: Through these approaches, we can develop a more mechanistic understanding of the ecological processes occurring within the canals and identify strategies to maximize this internal nutrient removal.

EDUCATION TO CHANGE BEHAVIOR

A. Irrigation Audit and Education – utilize workshops, incentives and a Mobile Irrigation Lab (MIL) to identify irrigation over-use and inappropriate system operation.

B. Calculate Reclaimed Nutrient Values: Assist the owner in formulating a fertilizer budget base on nitrogen content. Additionally, work with residence using reclaimed water appropriately.

C. Florida-Friendly Landscape Yard Workshops and Checklist – UF/IFAS Extension Professional provides onsite inspection and recommendations to address stormwater conditions and possible nutrient contribution.

D. HOA Landscape Management Model Contract – editable document template designed to help HOA representatives determine, prescribe and monitor Landscape maintenance BMPs such as fertilizer and pesticide application scheduling.

E. Report Educational Efforts: Address BMPs listed in the MS4 Phase II minimum requirements and investigate measure goals for alignment and impacts. Stormwater education workshops to increase activity and program impact.

QUESTIONS