

Making the Most of Reclaimed Water

We're using water wisely
by irrigating with
reclaimed water



Please don't drink the water



Department of
Natural Resources and Parks
Wastewater Treatment Division



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Water & Nutrients

Erich Marzolf, Ph.D

St. Johns River Water Management District

What is Reclaimed Water?

“Water reuse involves taking domestic wastewater, giving it a high degree of treatment, and using the resulting high-quality reclaimed water for a new, beneficial purpose. Extensive treatment and disinfection ensure that public health and environmental quality are protected.”

Source: FDEP website



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The Case for Reuse of Reclaimed Water

- There is an ongoing search for water sources other than aquifers (rivers, estuaries, oceans, reuse) to meet growing demand
- Reducing effluent disposal into water bodies helps reduce nutrient pollution
- Our wastewater has to go somewhere
- Since ~50% of domestic water goes for landscape irrigation, reclaimed water appears to be a good alternative to irrigating with potable water



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2009 WaterReuse Foundation Study



A Reconnaissance-Level Quantitative
Comparison of Reclaimed Water,
Surface Water, and Groundwater

**Has been
summarized,
“Reclaimed,
surface and
ground water
more similar
than dissimilar”**

**True for many
compounds, but
not nutrients**



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2009

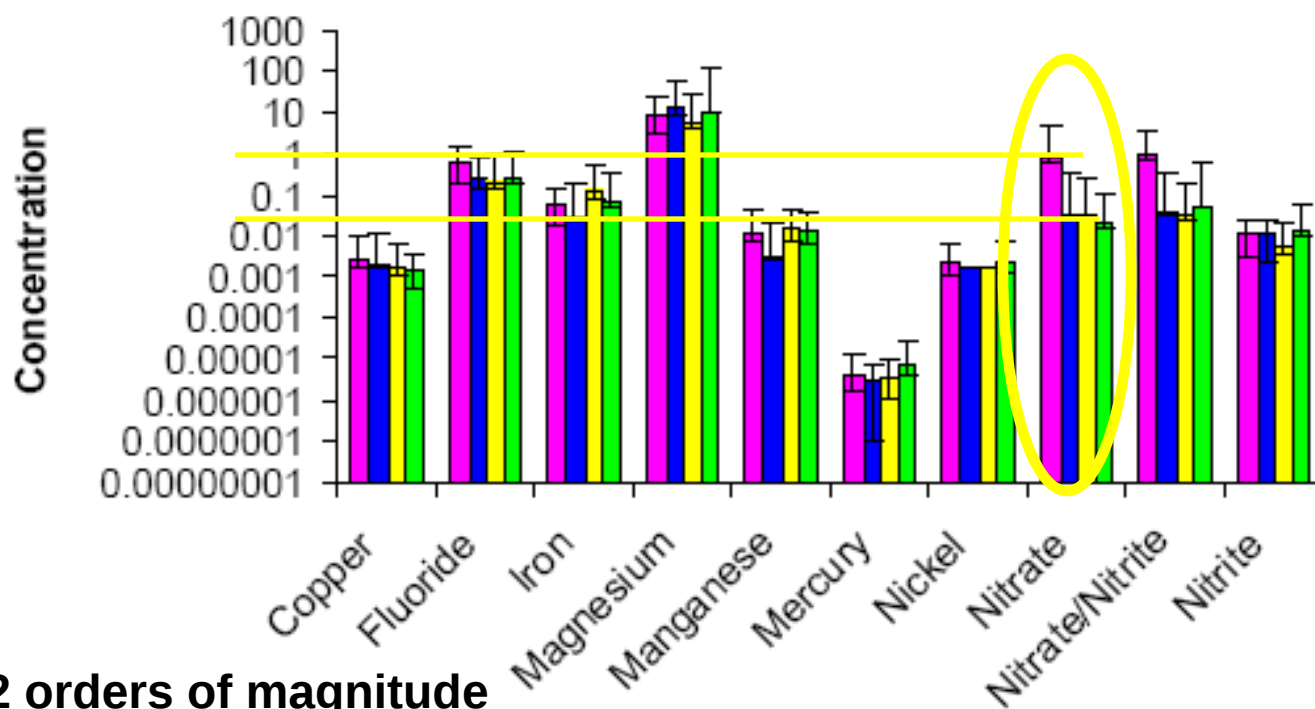
WaterReuse
Foundation

2009 WaterReuse Foundation Study Water Quality Data

FIGURE 4

Concentrations of inorganic constituents (mg/L) (continued)

■ Reclaimed Water ■ Surface Water
■ Ground Water ■ Surface Water Under Influence



Y-axis: 12 orders of magnitude

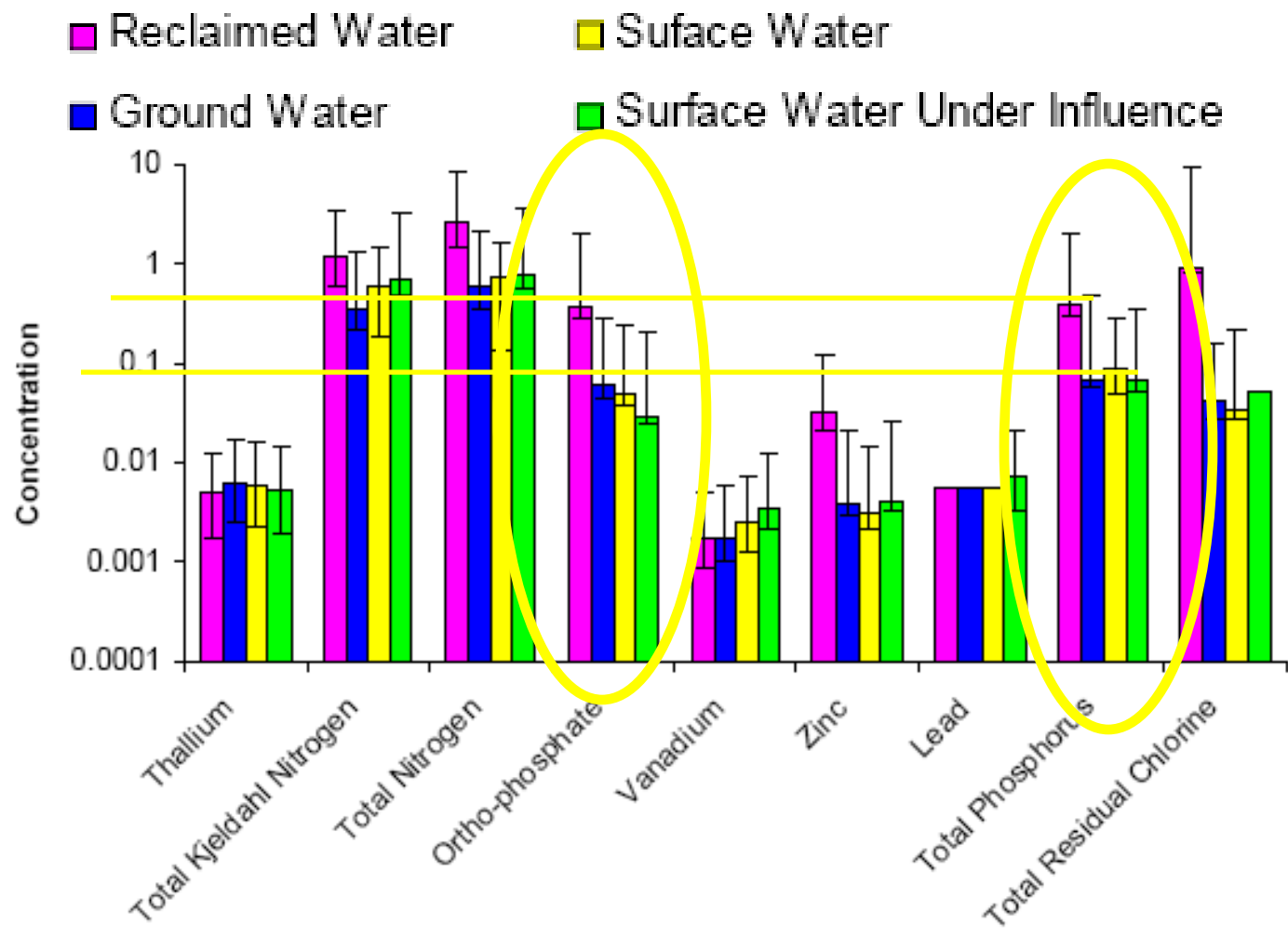


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2009 WaterReuse Foundation Study Water Quality Data

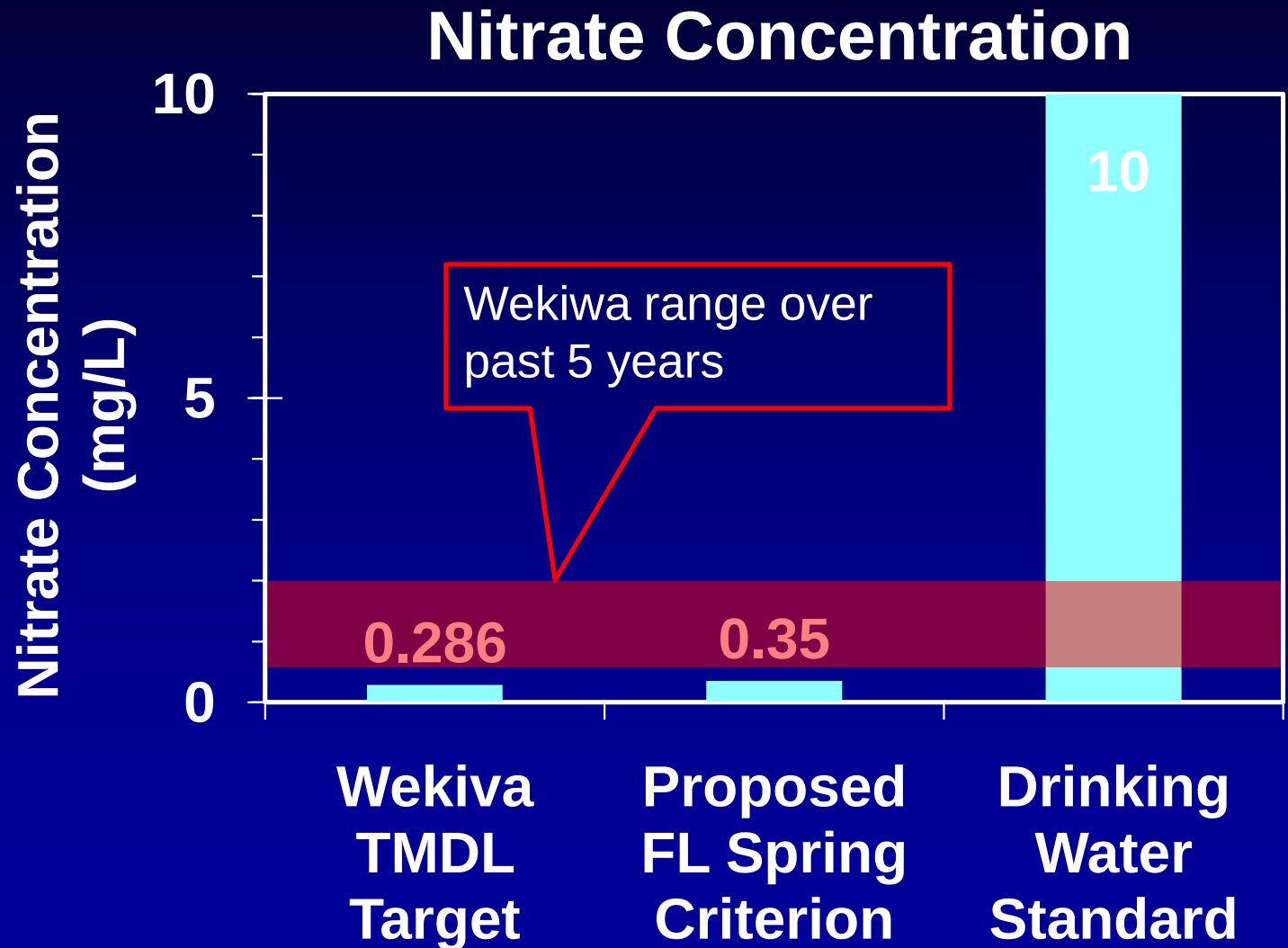
FIGURE 15

Concentrations of inorganic constituents (mg/L) (continued)



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Nitrate Criteria Comparison



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Impacts of Nutrient Pollution on Freshwaters in US

- 90% of rivers in 12 of 14 regions had excessive nitrogen and phosphorus
- 25% of freshwater threatened and endangered species are imperiled by eutrophication
- \$4.3B annual economic cost to US, although authors suggest this is an underestimate



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Source: Dodds et al. 2009. Environ. Sci. Technol., 43 (1), pp 12–19

Impacts of Nutrient Pollution on Freshwaters in US

- Nutrients are the #1 cause of water quality pollution for lakes, reservoirs and ponds
- 3.8 million acres of waters are eutrophic due to nutrient pollution



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Source: US EPA 2002 National Water Quality Inventory

Impacts of Nutrient Pollution in Florida

- 1,000 miles of rivers and streams are nutrient impaired
 - 16% of assessed miles
- 350,000 acres of lakes are nutrient impaired
 - 36% of assessed area
- 575,000 acres of estuaries are nutrient impaired
 - 25% of assessed area



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Source: 2008 Florida Integrated Report
(http://www.dep.state.fl.us/water/docs/2008_Integrated_Report.pdf)

Impacts of Nutrient Pollution on the St. Johns River

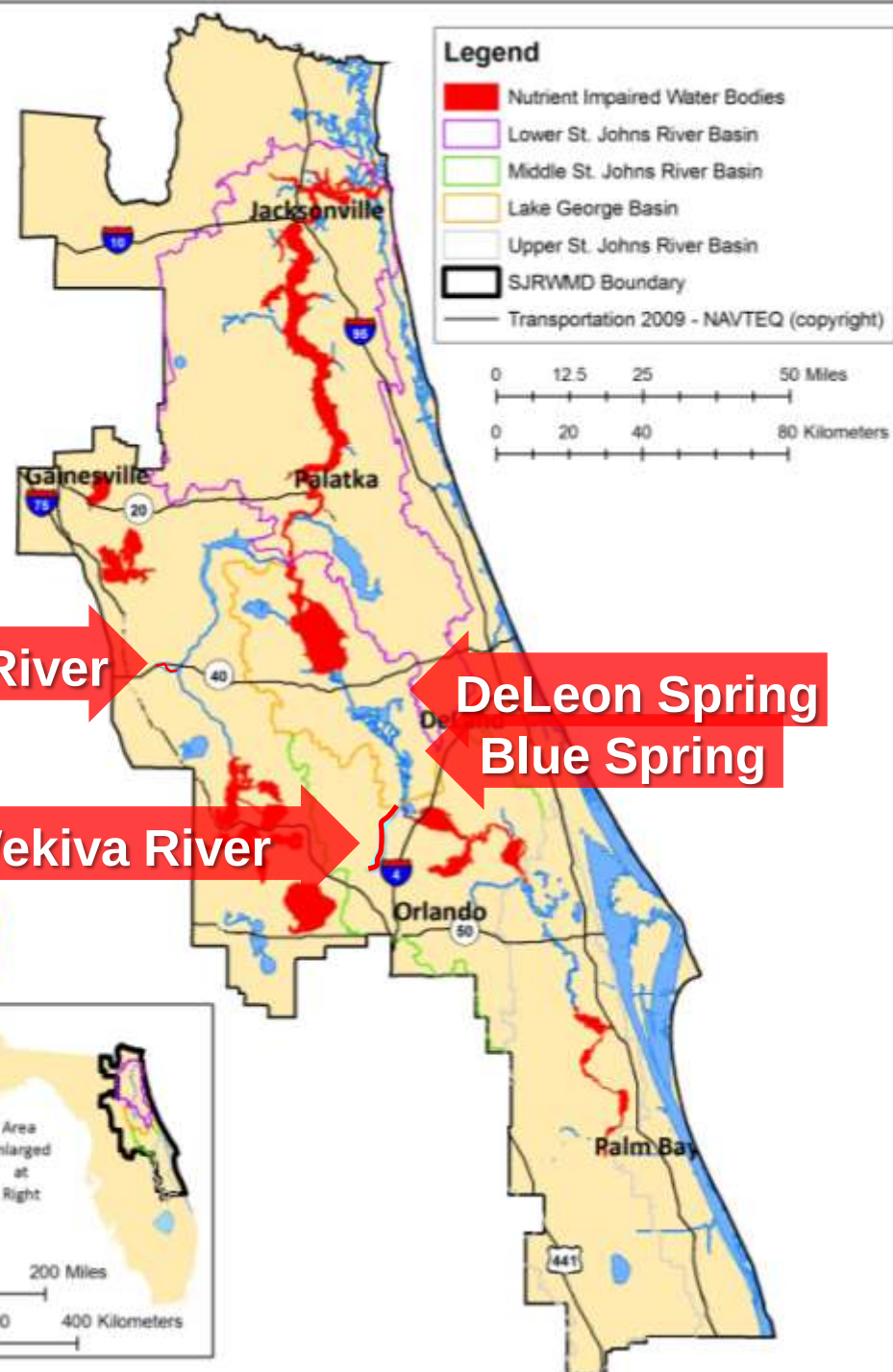


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Silver River

DeLeon Spring
Blue Spring

Wekiva River



Fertilizer Use

- In 2007, agriculture applied 13,194,400 tons of nitrogen and 4,571,700 tons of phosphorus in the US
- From July 2006 through June 2007, 1,579,356 tons of N and/or P containing fertilizer was sold in FL

Sources:

<http://www.ers.usda.gov/Data/FertilizerUse/>

<http://www.flaes.org/pdf/Historical%20Total%20Fertilizer%20Summary%202008.pdf>



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Nutrient Distribution

**Grow More Plants;
Fertilize**



**Reduce Nutrient
Pollution**



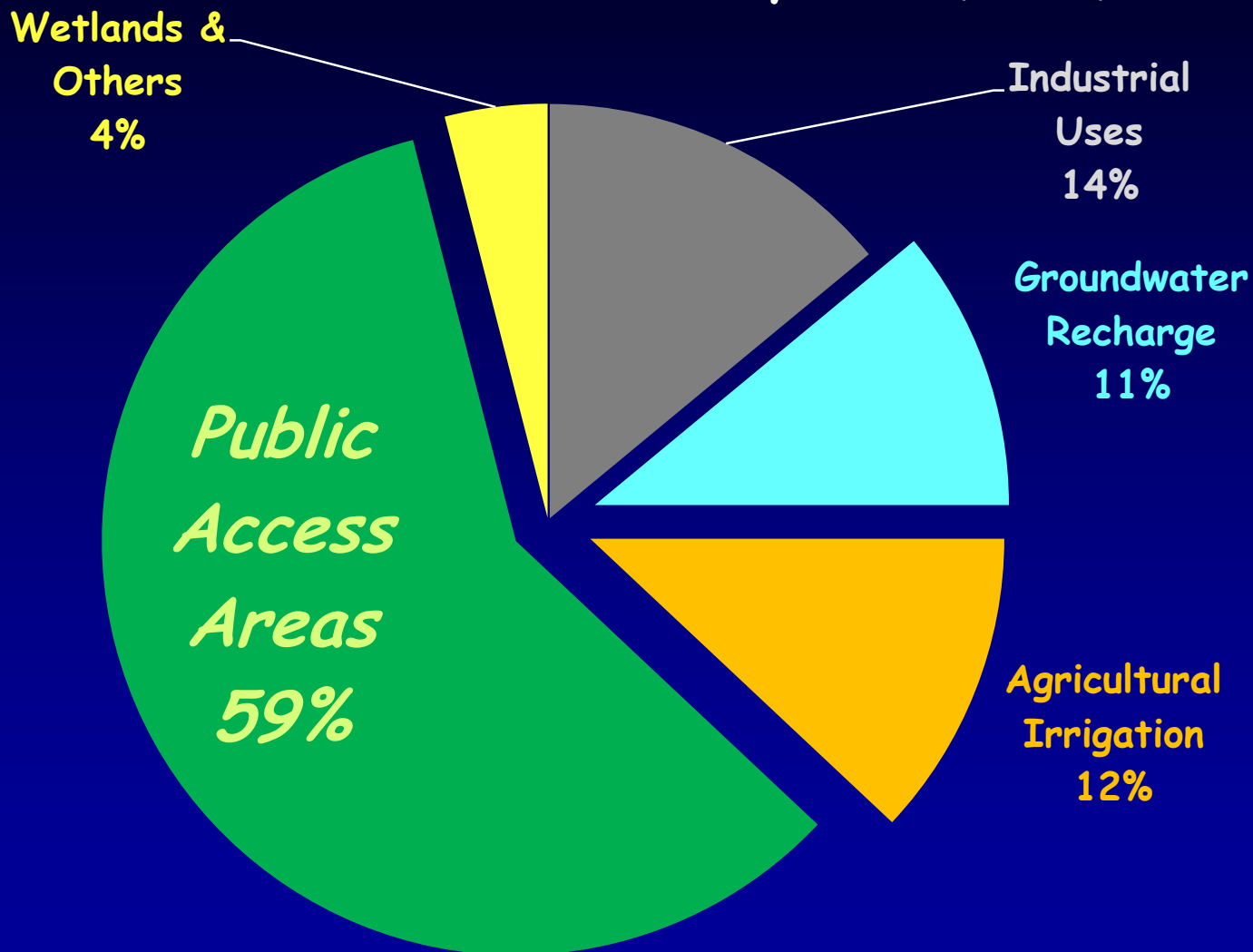
- Our nutrient impairment problems are in part, distribution problems
- Reuse is one way that nutrient distribution can create a better balance between need and supply, thus reducing pollution



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Reclaimed Water Use

Reclaimed Water Use by Flow (2007)



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Shanin Speas-Frost – FDEP Reuse Coordinator

Where Do The Nutrients in Reclaimed Water Go?

- Is there a potential for nutrients in reclaimed water to make it back to water bodies? **Yes!**
- Just like we can't ignore other activities which distribute nutrients on the ground (fertilizer, manure, septic systems, biosolids), reuse can't be ignored. We shouldn't assume that all nutrients distributed by reuse will be bound up by plants and soils.



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Wekiva Basin

Legend

-  Wekiva River GW Recharge Area delineated from 1995-
-  Wastewater Treatment Plants
-  Reuse Lines
-  Agricultural Irrigation
-  Groundwater Recharge and Indirect Potable Reuse
-  Industrial
-  Public Access Areas and Landscape Irrigation
-  UNKNOWN
-  Wetland



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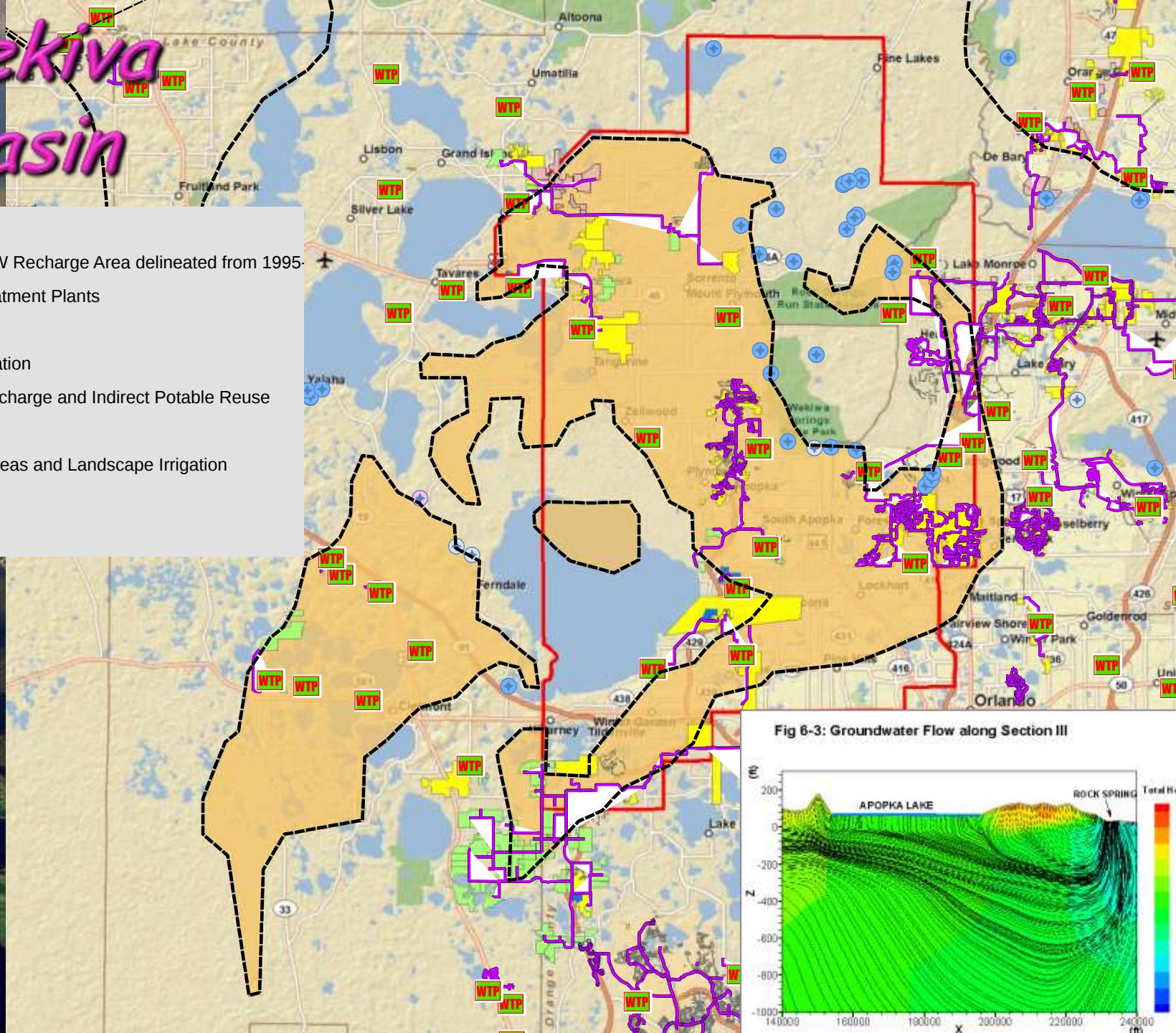
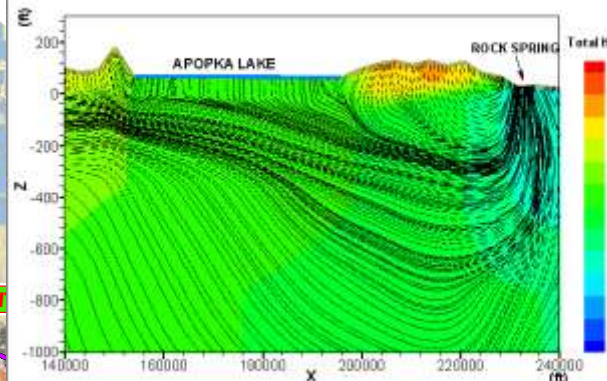


Fig 6-3: Groundwater Flow along Section III



Nutrient Needs of Plants

*What Reclaimed Water Concentration
Meets Turf's Nutrient Demands?*

*Where in Florida?
What kind of plants?*

$$\frac{\text{MASS}}{\text{VOLUME}} = \text{CONCENTRATION}$$

FDACS (2008) rule
lbs/year

Water Use
up to 3"/week

*Where in Florida?
Local irrigation rules*

For St. Augustine grass in central FL, irrigated at the District's revised potable water irrigation rate, the critical P concentration is ~0.65 mg P/L. For nitrogen the concentrations are a range, 6 to 9 mg N/L.



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What If Reclaimed Water Meets Turf's Nutrient Demands?

IF
REUSE **>** **RULE**
CONCENTRATION **CONCENTRATION**



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Fertilizer Needs by Reclaimed Customers

- Most reclaimed water will supply customers' lawns with enough Phosphorus and can use Phosphorus-free fertilizer.
- The need for additional Nitrogen fertilizer is more variable.
- Utilities have information necessary to inform their reuse customers of the mass of nutrients delivered.



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Potential Winners!



Environment (less pollution)



Homeowners (buy less fertilizer)



Taxpayers (buy less fertilizer)



Taxpayers (less pollution cleanup)



Utilities (TMDL credit for offset??)



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Residential Fertilization Practices in the Wekiva Springshed

Table 8: Frequency of fertilizer application (Last 12 Months) with outliers removed

Population Segment	Average Annual Fertilizer Application Rate	(n)
All (Overall average)	3.53	(525)
Internal fertilizers (homeowner applied)	2.88	(341)
External fertilizers (lawn care company applied)	4.76	(183)
Homes using reclaimed water	4.56	(50)



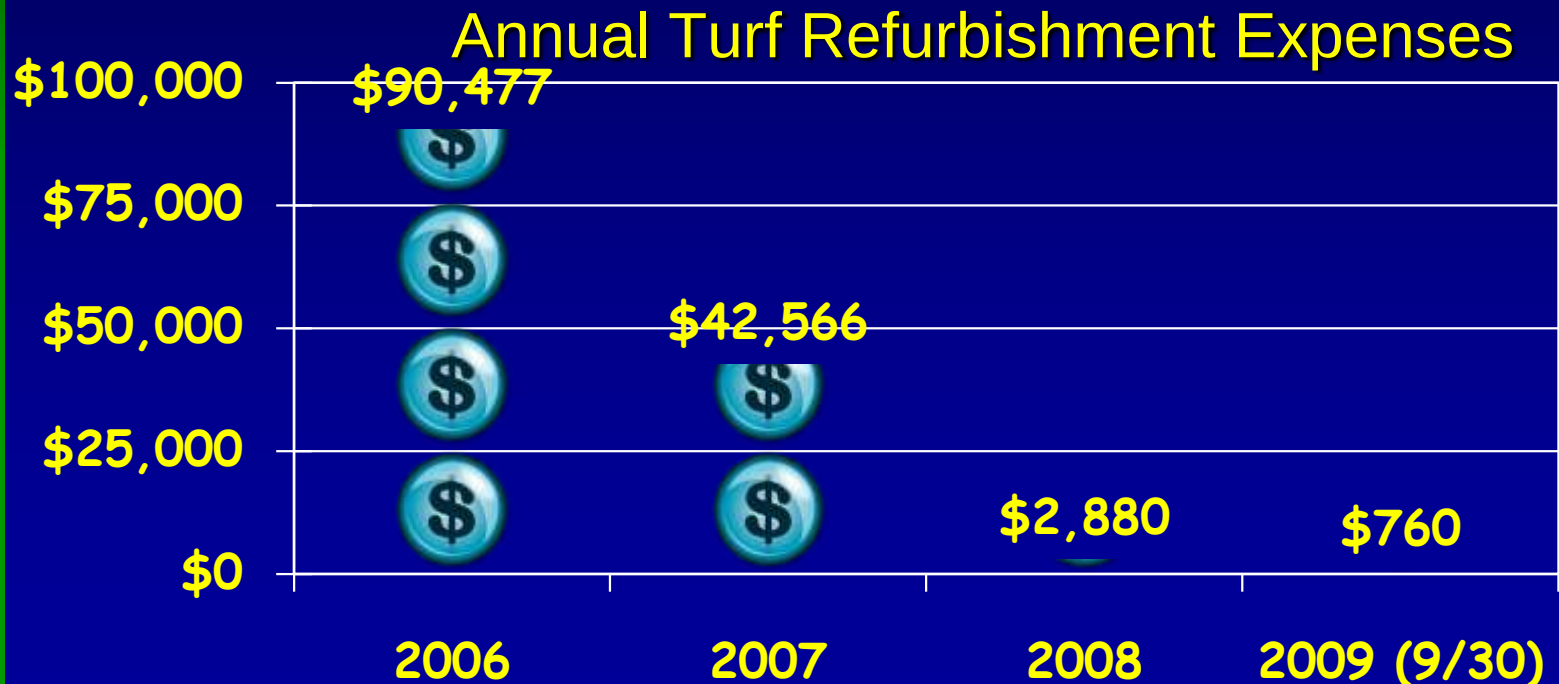
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Wekiva Residential Fertilizer Practices. 2009.
http://www.dep.state.fl.us/water/wekiva/docs/wekiva-survey_fr0310.pdf

Savings Example

Palmer Ranch Master Property Owners Association altered turf management on ~200 acres to account for reuse nutrients (based on soil, water and plant tissue data)

- Less prompt of unnecessary summer growth
- Reduced mowing saves \$16,000/yr
- Increase in turf health & appearance



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Reuse Irrigation Management



1. Expensive Point Source
2. Overspray greatly exacerbates nutrient runoff
3. No “fertilizer” buffer to protect pond is missing

Grand Haven (Flagler Co.)

PO₄ ~ 4.5 mg/L

DIN ~ 8.9 mg/L

Photos by Dr. Mark Clark, UF

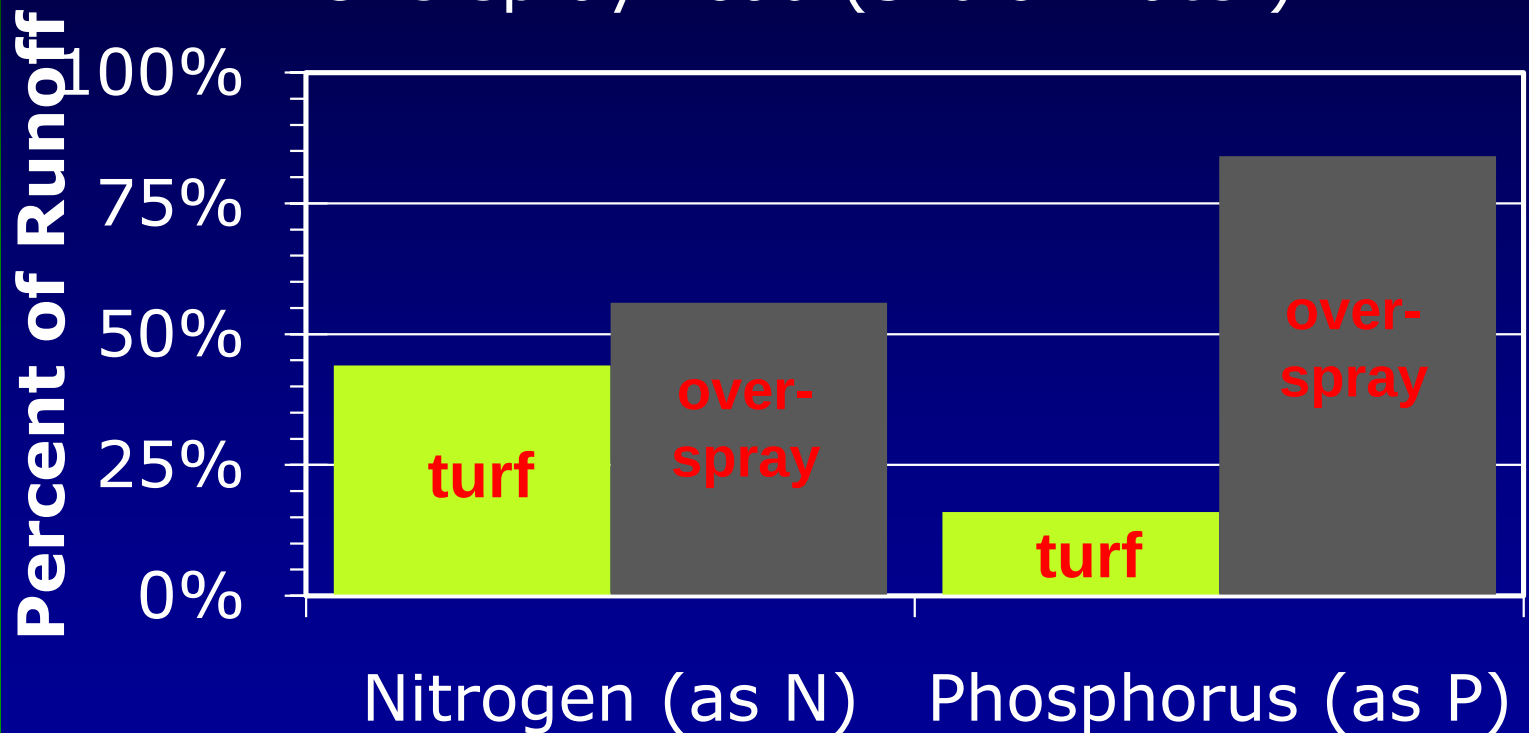


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Estimated Overspray Loadings

Percent of Nutrient Runoff

- Lawn Load (95% of water)
- Overspray Load (5% of water)



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Good aim is important

Lake Tibet Watershed (Butler Chain of Lakes)



Mean Concentrations of NO_x in Groundwater Samples Collected from Lake Tibet Sub-basins 1 and 2 from August 2008-February 2009

- Groundwater NOx standard = 10,000 ppb
- Values below golf course areas exceed this value

Source: Dr. Harvey Harper, PE
Environmental Research & Design



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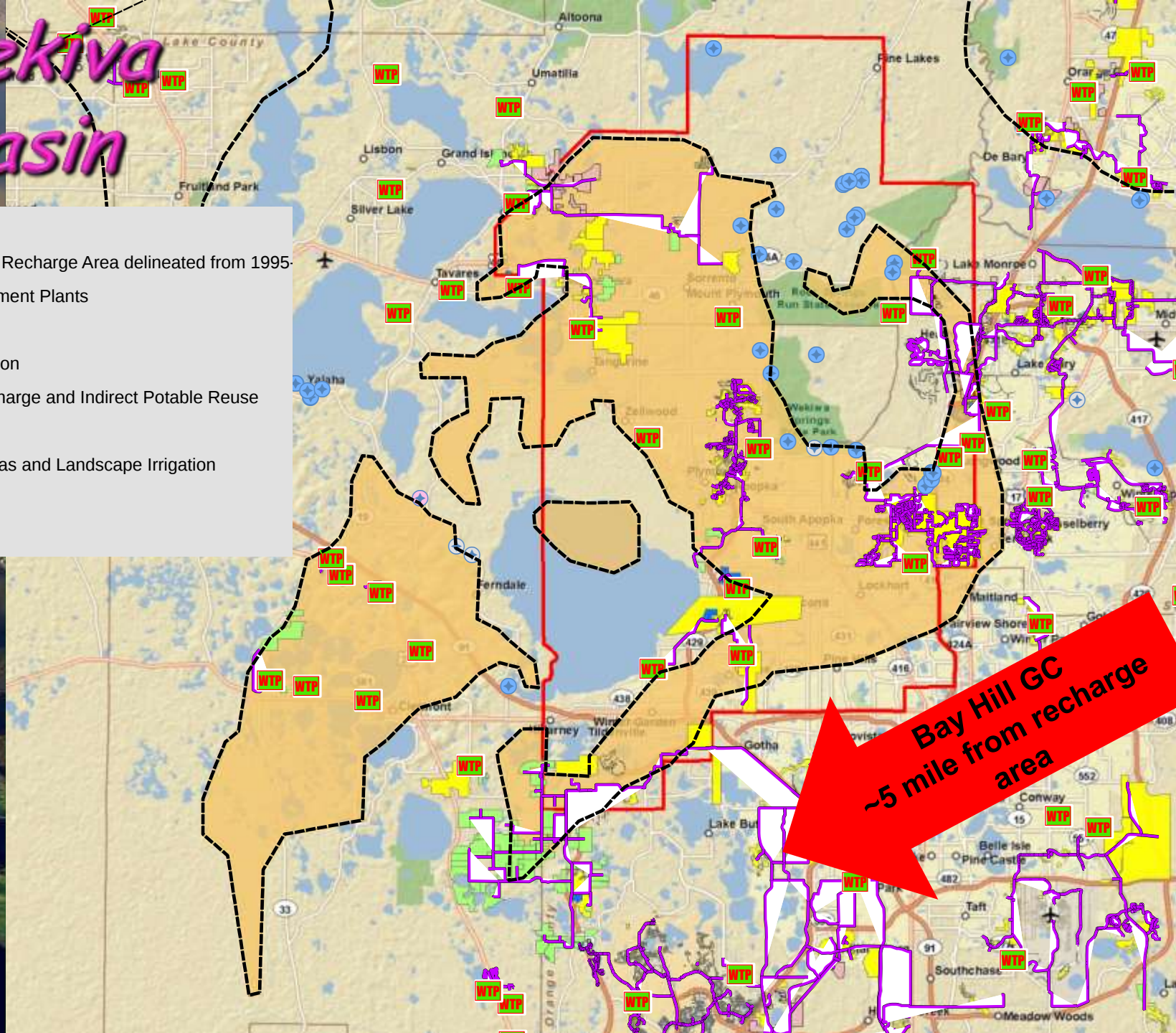
Wekiva Basin

Legend

- Wekiva River GW Recharge Area delineated from 1995
- Wastewater Treatment Plants
- Reuse Lines
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- Public Access Areas and Landscape Irrigation
- UNKNOWN
- Wetland



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Bay Hill GC
~5 mile from recharge
area

Pollution Prevention Vs. Pollution Clean Up

- General Rule:
Prevention is cheaper
than Clean Up
- When evaluating
techniques to meet
nutrient load reductions
(TMDLs) costs should
matter to everyone
- Look for the easy, cheap
low hanging fruit



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Recent Progress

- DACS created rule in 2008 to address nutrients in fertilizer. DACS expects a 20 to 25 percent reduction in nitrogen and a 15 percent reduction in phosphorus in every bag of fertilizer sold to the public. The new rule requires that all fertilizer products labeled for use on urban turf, sports turf and lawns be limited to the amount of nitrogen and phosphorus needed to support healthy turf maintenance

Orange and Seminole Counties have fertilizer ordinances.

FDEP is requiring Wastewater Treatment Plants to monitor and submit nutrient data as part of permit renewals

UF/IFAS is developing a Scope of Work to develop Best Management Practices (BMPs) for reuse, including a fertilizer offset for reclaimed water.

- The recent Report by the Florida Senate Select Committee on Florida's Inlands Waters included the following;
"Require the DEP to study the effects that reclaimed water have on nutrient loading in Florida's water bodies and report its findings to the Legislature. If it is determined that using reclaimed water has negative effects, then the DEP must provide recommendations in its report that eliminate such effects."

Presentation Error:

In my presentation I stated that Seminole county had passed a fertilizer ordinance. This is incorrect, I regret the error.

Erich



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Wastewater Management Requirements for the Wekiva Study Area (2006)

Primary Zone

- No new RIBS or restricted access sprayfields
- New reclaimed water limits:
 - Existing RIBs – 3 mg/L TN
 - Reuse irrigation systems – 10 mg/L TN
- Package Plants – 10 mg/L or connect
- No land disposal of residuals
- Five years to implement

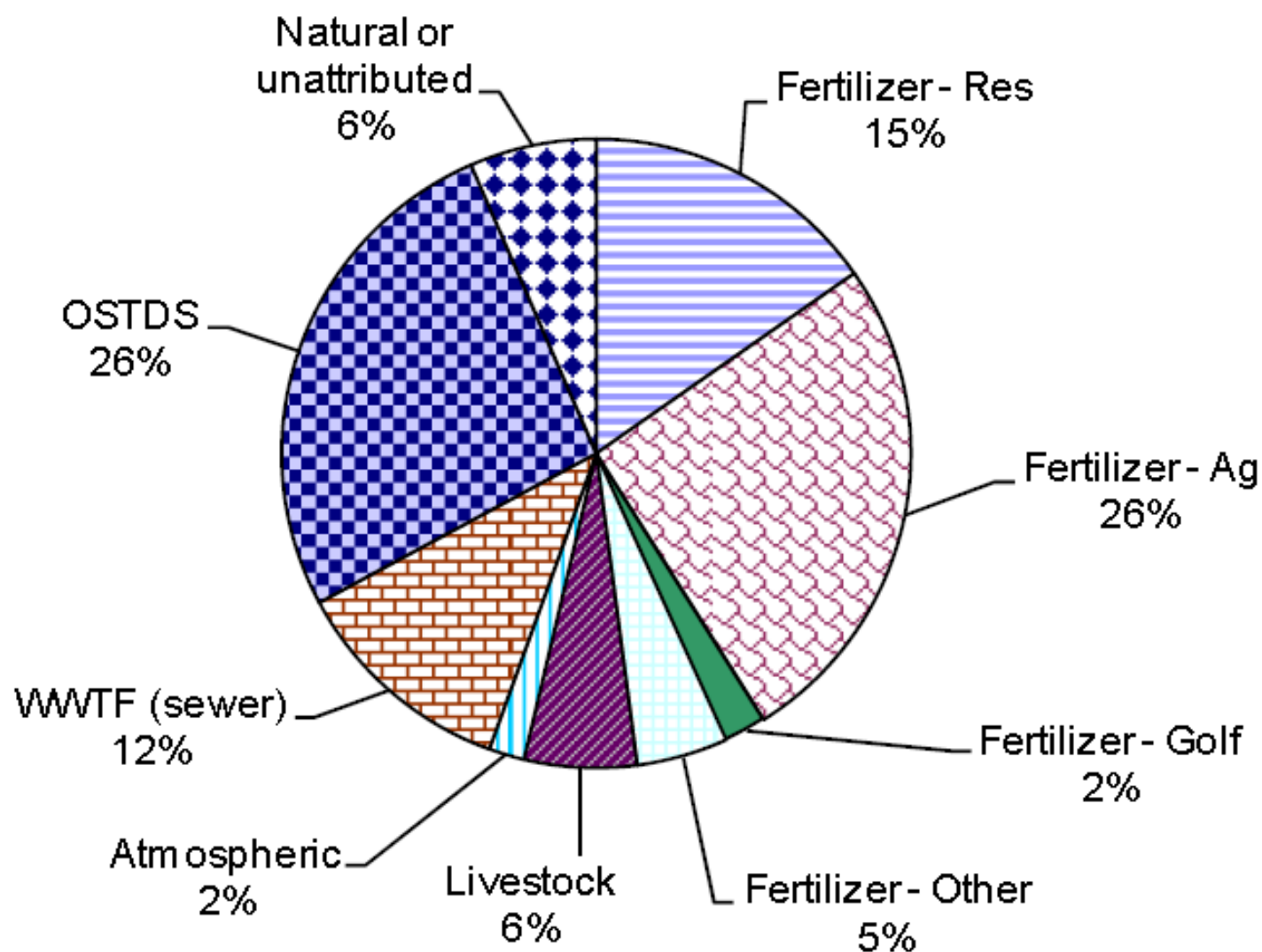
Secondary Zone

- New RIBS or restricted access sprayfields allowed
- New reclaimed water limits:
 - Existing RIBs – 6 mg/L TN
 - Reuse irrigation systems – 10 mg/L TN
- Package Plants – 10 mg/L or connect
- No land disposal of residuals
- Five years to implement (10 years for package plants)



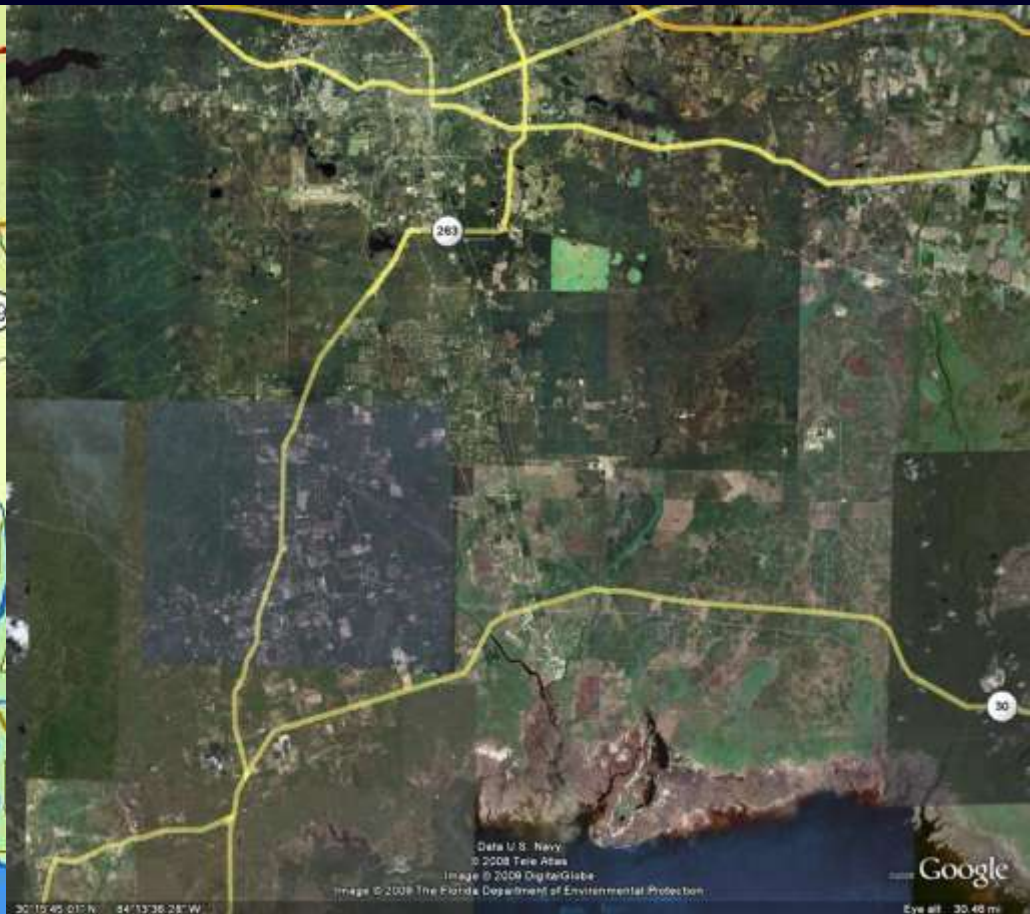
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Nitrate Loads to Wekiva Mactec 2010



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Wakulla Springs



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Sources:

<http://www.floridasprings.org/exploration/featured/wakulla/text/protecting/map/>
& Google Earth

Wakulla Springs

Southeast Farm

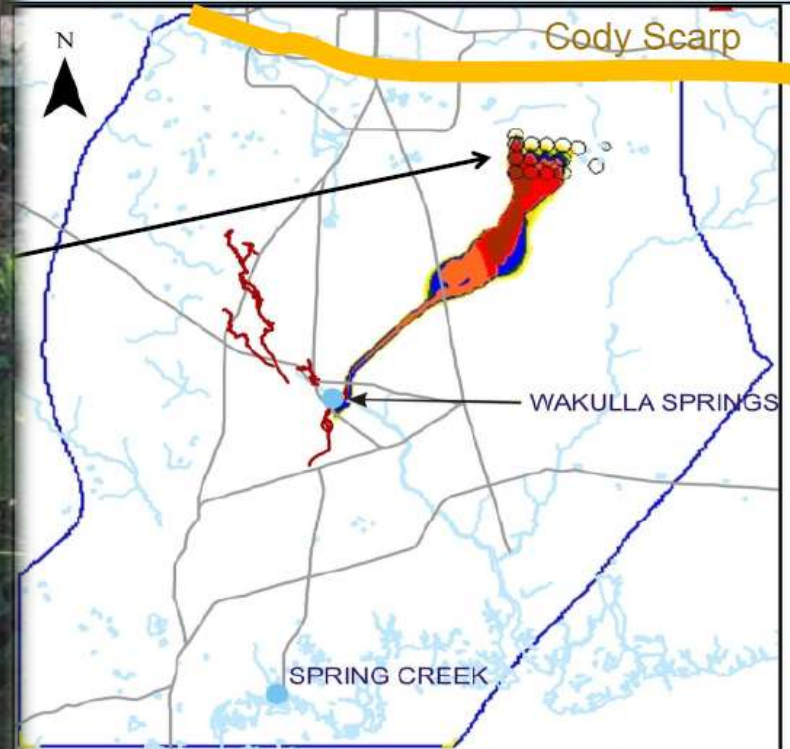
An Award-Winning Water Reuse Facility

City of Tallahassee
Your Own Utilities



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Southeast Farm Sprayfield and Related Nitrate Concentrations.



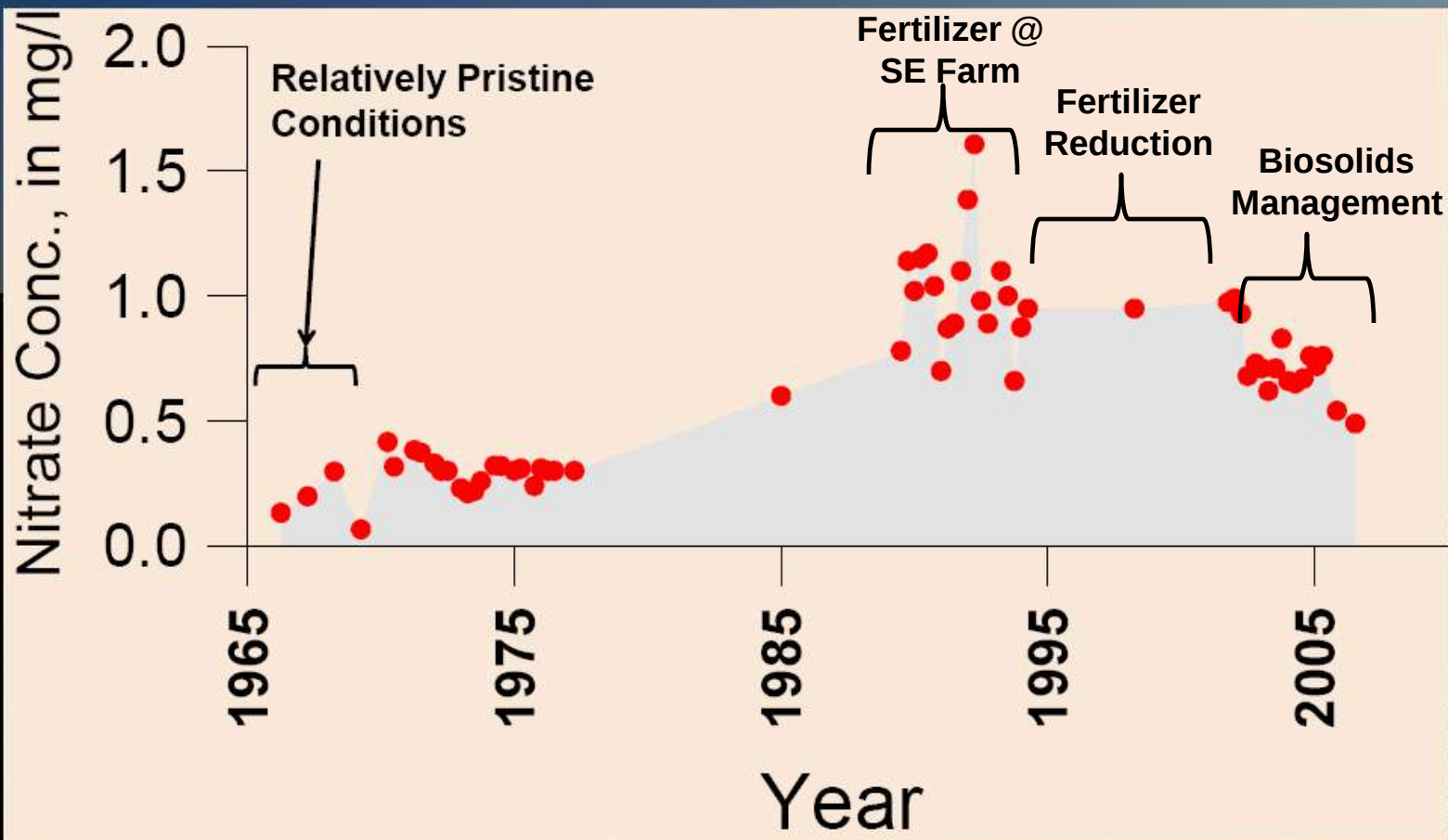
Simulated Nitrate Concentrations:

- Greater Than 0.1 mg/l
- Greater Than 0.2 mg/l
- Greater Than 0.3 mg/l
- Greater Than 0.4 mg/l
- Greater Than 0.5 mg/l
- Greater Than 0.6 mg/l
- Greater Than 0.7 mg/l

0 2 4 8 Miles

Wakulla Springs Nitrate Concentrations

Nitrate Concentrations in Wakulla Springs from 1965 to 2006



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Hal Davis, USGS, Feb 25, 2009.

Wakulla County Septic Tank Ordinance

Advanced treatment of nitrogen for new and repaired OSTDS became a requirement for Wakulla County residents when Ordinance 2006-58 went into effect in October 2006. The Wakulla County ordinance states that *“only performance-based septic systems that can produce a treatment standard of 10 mg/L nitrogen shall be installed in new construction and as replacements when older systems fail or are replaced”*. This ordinance applies to the entire county as a springs protection measure.



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County Code Example

MARION COUNTY LAND DEVELOPMENT CODE SPRINGS PROTECTION OVERLAY ZONE (Silver & Rainbow Springs)

- (4) Any WWTF that provides Public Access Reuse shall institute a program to educate the end user about the value and benefits of Reuse. The program shall be designed to enable the user to easily calculate the amount of nitrogen was applied to the disposal area and, therefore, promote reduced use of purchased sources of nitrogen. The owners of the WWTF shall coordinate such program efforts with the Marion County Conservation Coordinator.



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Reuse BMP Development

Objective: Evaluate the nutrients delivered via reuse from a fertilization perspective and develop BMPs for reuse irrigation of turf and to develop EMCs for areas with reuse to improve nutrient loading models

Contractor: UF/IFAS

Participants: FDEP, SJRWMD, others?? eg. WateReuse Foundation, utilities, local governments

Experimentally evaluate role of irrigation rates, nutrient species, seasonality, soils and latitude

Tentative Assumption

- Irrigation with any reclaimed water source will supply the phosphorus needs of turf without the addition of P-containing fertilizer

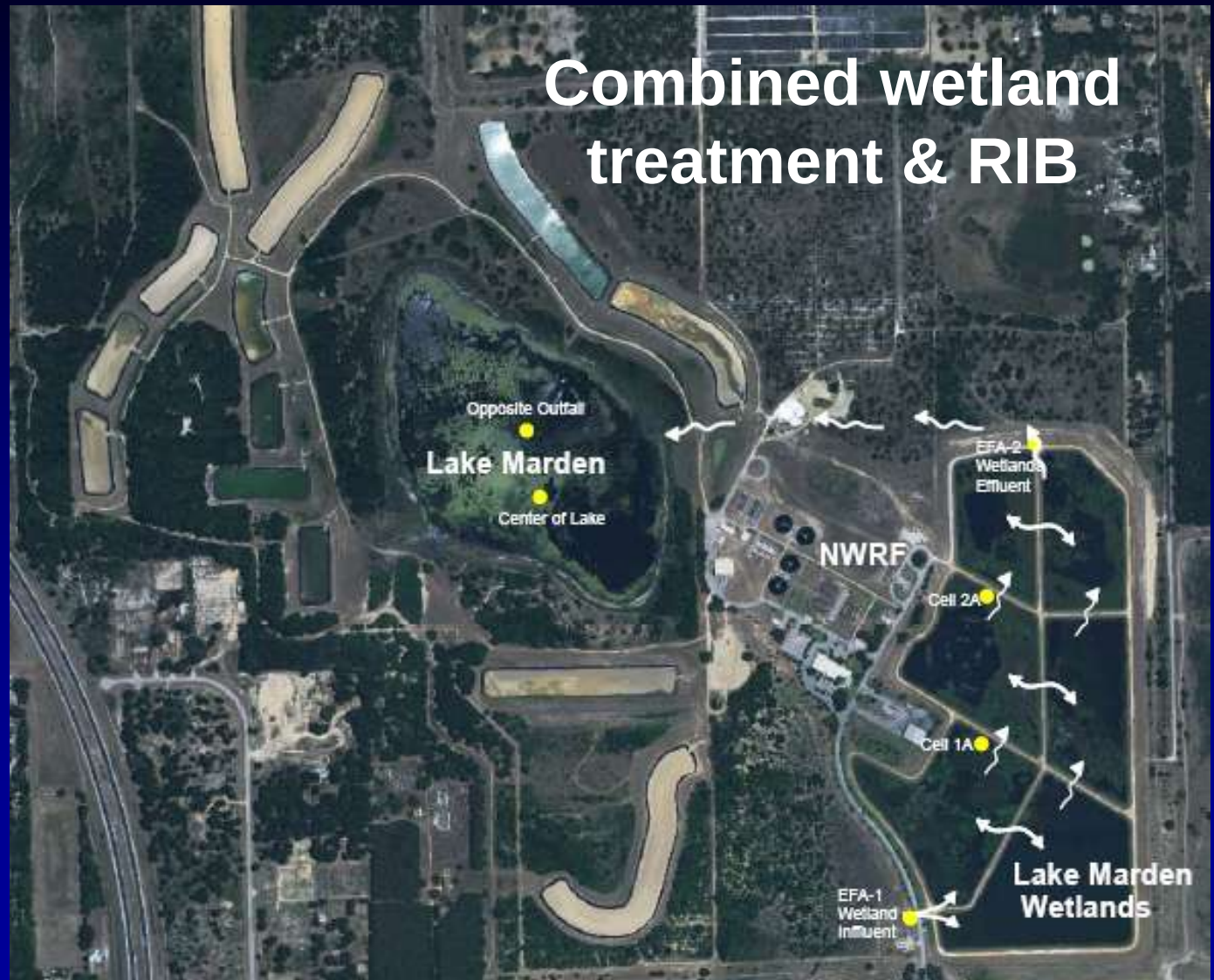
New BMP: All reuse customers should use P-free fertilizer



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RIB Enhancement Lake Marden wetlands - OCUD

Combined wetland treatment & RIB



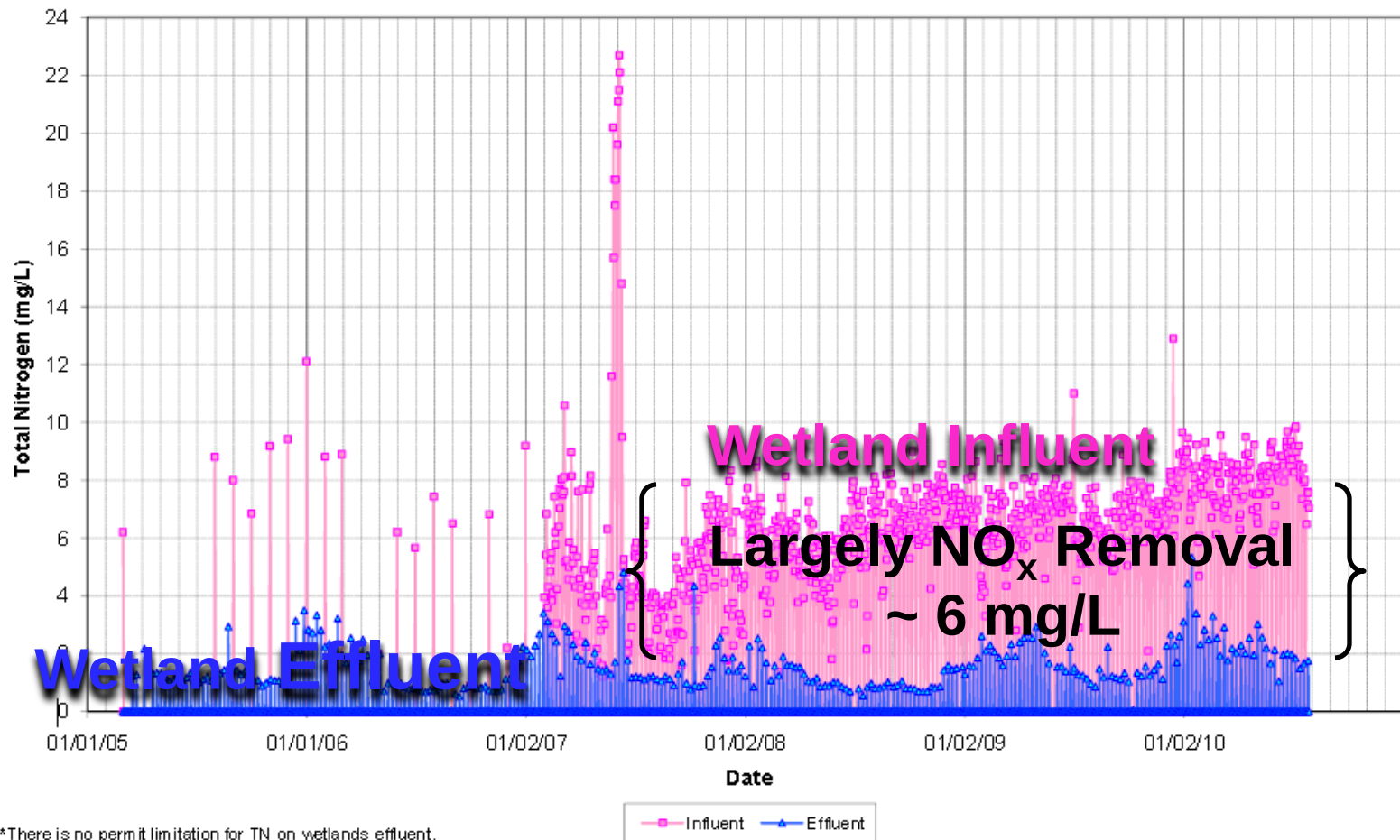
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Lake Marden Wetlands



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Lake Marden Wetlands Influent Vs Effluent - Total Nitrogen (TN)*



*There is no permit limitation for TN on wetlands effluent.

RIB Enhancement Infiltrating Wetland - GRU

- Gainesville Regional Utilities has constructed a modified rapid infiltration basin (RIB) that they call an infiltrating wetland at the Kanapaha WWTP.
- The concept is to keep the RIB wet enough to grow a wetland. The wetland's carbon production fuels denitrification which converts nitrate to nitrogen gas.
- Operation of demo & full scale projects demonstrate that nitrate concentration is reduced from >4 to ~ 0.65 mg/L while maintaining adequate infiltration rates (> 11 cm/day).



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RIB, Septic & Stormwater Enhancement

- UCF Stormwater Academy evaluated use of ground up old tires to enhance nutrient removal
- Potential benefits for
 - Septic tank drain fields
 - Rapid infiltration basins
 - Stormwater ponds



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Final Report

Feasibility Study of Waste Tire Use in Pollution Control for Stormwater Management, Drainfields and Water Conservation in Florida

A Research Program of Seminole County, Florida Department of Environmental Protection and the Stormwater Management Academy



Submitted by

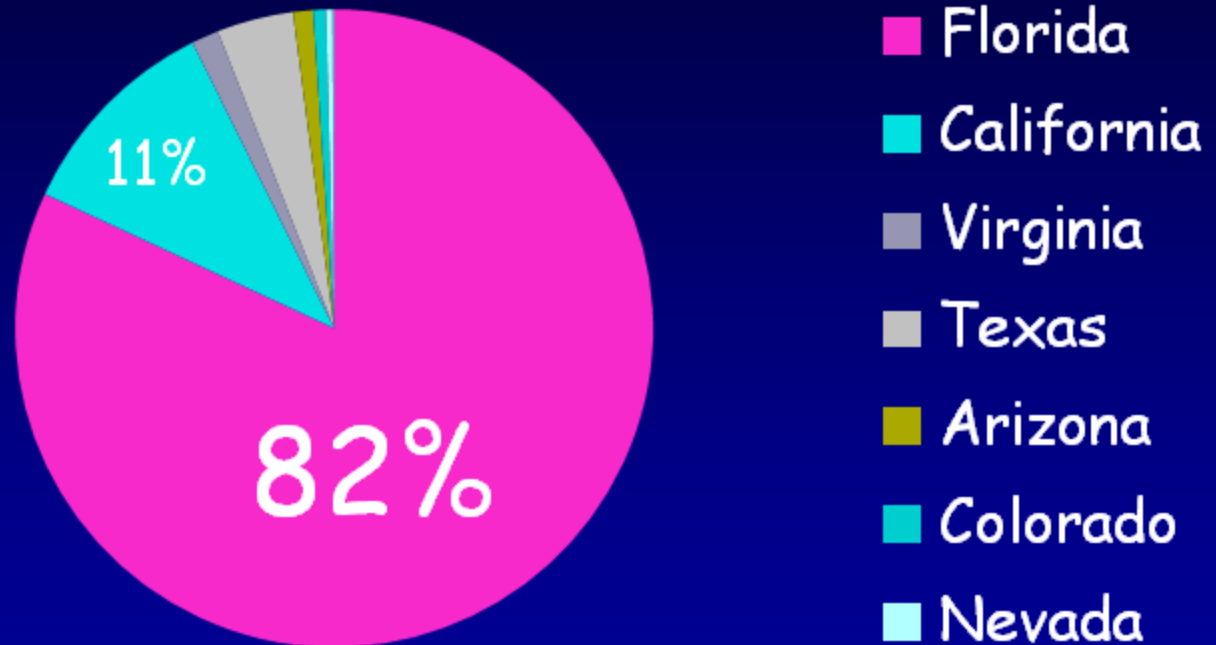
Marty Wanielista, Trillian Baldassari, Patrick Ryan,
Brian Rivera, Timir Shah and Erik Stuart

Stormwater Management Academy
University of Central Florida
Orlando, FL 32816



U.S. Reclaimed Water Use

Reported Reuse (mgd)



*From the Water Reuse Foundation National Database of Water Reuse Facilities Summary Report, 2006

**The state of Washington reported reuse systems and reuse pipe, but no reuse flow as of 2006.

<http://www.dep.state.fl.us/water/reuse/inventory.htm>



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Closing Thoughts

- Reuse was developed as an alternative to dumping effluent in water bodies. Our waste has to go somewhere.
- We can use reclaimed water as a means to better balance areas of nutrient need and nutrient pollution.
- View reuse as a means to offset both potable water and fertilizer demand.
- When using reclaimed water consider applying fertilizer best management practices (BMPs).
- Avoid overspray – it wastes water and greatly increases pollution.
- Reuse is a relatively new approach and improvements are being made. We are learning from our experiences around Florida.
- Remember Bob Kelly's rule:
“Don't Just Move Nutrients, Remove Nutrients”



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Questions? Comments? Discussion?

Reuse &
Restoration



OR

Reuse Restoration



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