



Sources of Nitrate to Springs of the Lower Santa Fe River Basin

Presentation to:

Santa Fe Springs Basin Working Group

March 17, 2010



Lower Santa Fe River at Rum Island Spring



Scope of Project

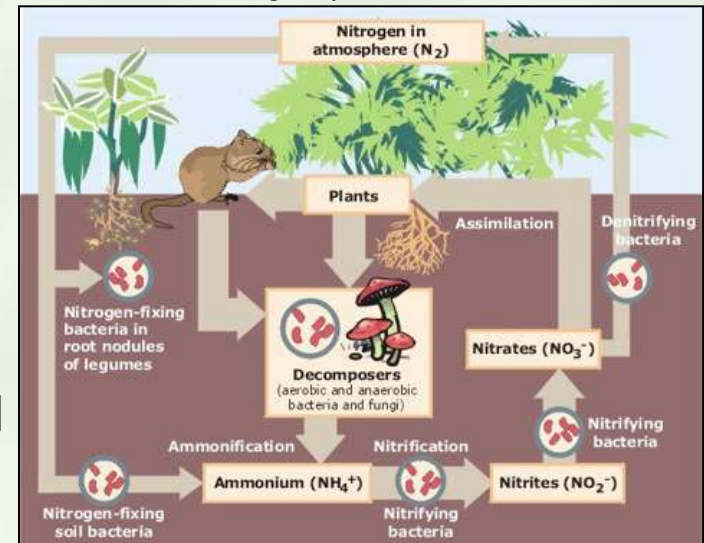
- Use best available information to develop a GIS application that
 - Estimates loadings of nitrate to groundwater in the springsheds of the lower Santa Fe River
 - Excludes springs discharging to Ichetucknee River
 - Produces pie charts illustrating relative contribution of various source types
 - Can be used by Alachua County to evaluate alternative management decisions, e.g.
 - Comp Plan
 - Land development regulations
 - BMPs
 - Specific development proposals



Nitrate (NO₃-N)

- Nitrogen exists in many chemical forms in the environment
 - Bacteria facilitate transformations between the various chemical forms, creating the Nitrogen Cycle
 - To “keep track” quantities are expressed as the amount of nitrogen in the chemical, e.g., nitrate-nitrogen (NO₃-N)

Nitrogen Cycle (USEPA, 2006a)



- Nitrate is a soluble ion readily available to plants, including aquatic plants and algae, which can cause eutrophication
- The Santa Fe River and several of its springs are impaired because of elevated NO₃-N (FDEP)



Study Area

- Springsheds of the lower Santa Fe River
 - Excluding springs discharging to Ichetucknee River
 - Based on springshed delineation by SDII (2009)
 - Some boundaries are uncertain





Approach

- Technical approach closely follows a similar project MACTEC performed for the Wekiva River Basin
 - funded by FDEP and performed by MACTEC under technical direction of the St. Johns River Water Management District
 - Initiated in 2006 with Final Report Mar 4, 2010
 - <http://www.dep.state.fl.us/water/wekiva/index.htm>



Approach

- Area (Non-point) Sources and Point Sources
 - Area sources include fertilizer use and livestock waste
 - Calculations are based on land use and area
 - Point Sources account for sanitary wastewater
 - Septic systems and central sewer
 - Calculations are based on the individual “units”



Approach

- Area (Non-point) Sources
 - Area sources include fertilizer use and livestock waste
 - based on land use
 - Estimate groundwater concentrations associated with various land uses
 - Multiply concentration x recharge rate to get groundwater loading
 - Concentration from field studies in Florida or SE US
 - Recharge rate from groundwater model (USGS “megamodel”)



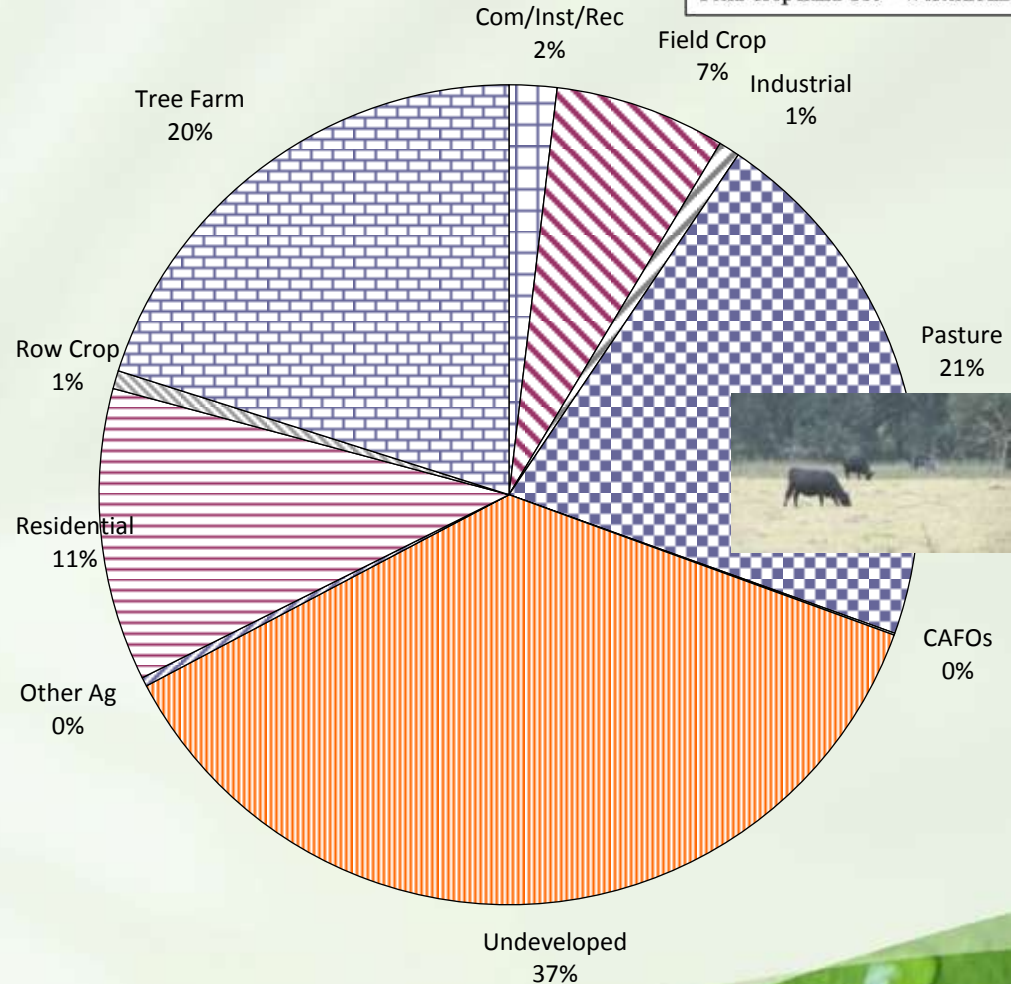
Land Use



Field Crop Land Use – Western Alachua County

- Mostly rural
 - Undeveloped (37%)
 - Pasture (21%)
 - Tree Farms (20%)
 - Crops (8%)
- and residential (11%)

Data source: 2004 land use;
St. Johns and Southwest
Florida Water
Management Districts





Groundwater NO₃-N (mg/L) Depends on Land Use

- MACTEC's 2007 Wekiva study reviewed > 250 technical publications to define groundwater concentrations associated with various land uses
- Monitoring data from Florida were used for
 - citrus,
 - nurseries,
 - row crop,
 - golf courses,
 - Concentrated Animal Feeding Operations (CAFOs) ,
and
 - residential



Groundwater NO₃-N (mg/L) Depends on Land Use

- The following land uses are most important in the lower Santa Fe River springsheds
 - **Pasture** – a USGS study in the Mid-Atlantic Region evaluated groundwater quality at 850 sites, categorized by land use – pasture averaged **5.5 mg/L**
 - **Silviculture** – MACTEC estimated a concentration of **2 mg/L** based on UF/IFAS recommended fertilization rates
 - **Field Crop (corn, hay, sorghum)** – 2 published studies of leaching from wheat and alfalfa \approx **4 mg/L**
 - **Residential Fertilizer Impact** – MACTEC (2009) monitored groundwater quality in central Florida residential areas served by central sewer – (24 wells x 4 samples each) averaged **2 mg/L**



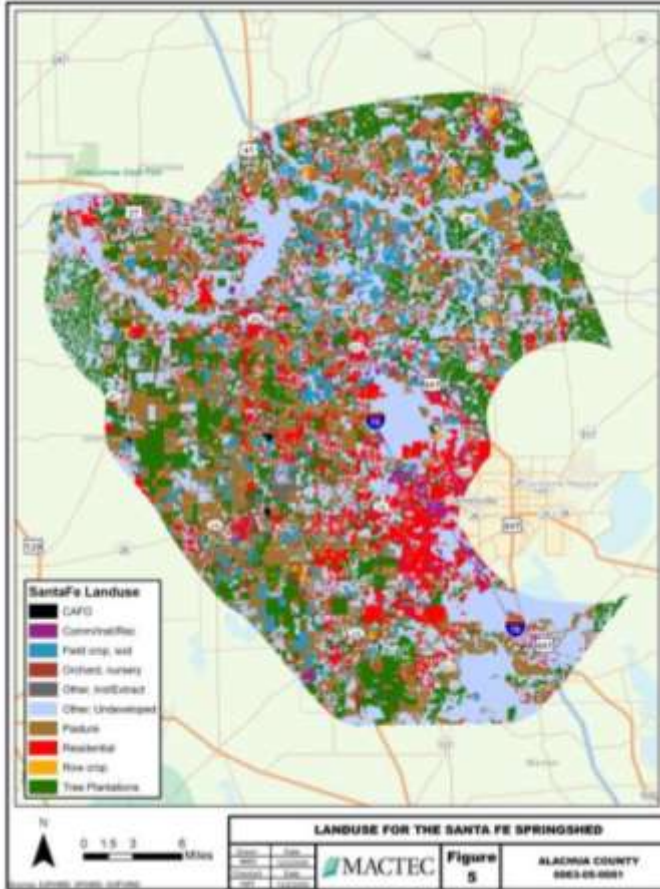
Groundwater NO₃-N (mg/L) Depends on Land Use

Row crops	23
Feeding operations (CAFOs)	18
Citrus	15
Golf courses	8
Nurseries	6
Pasture	5.5
Field crops, sod farms	4
Tree farms	2
Residential + institutional, recreational, commercial	2
Undeveloped/Unfertilized	0.1

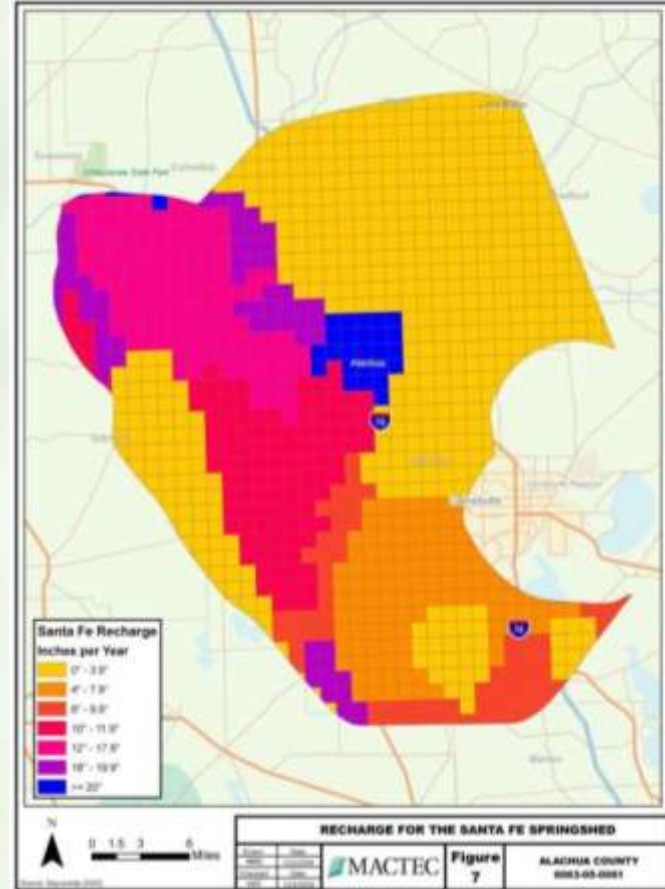


Area Sources

Overlay Land Use and Recharge Maps



+





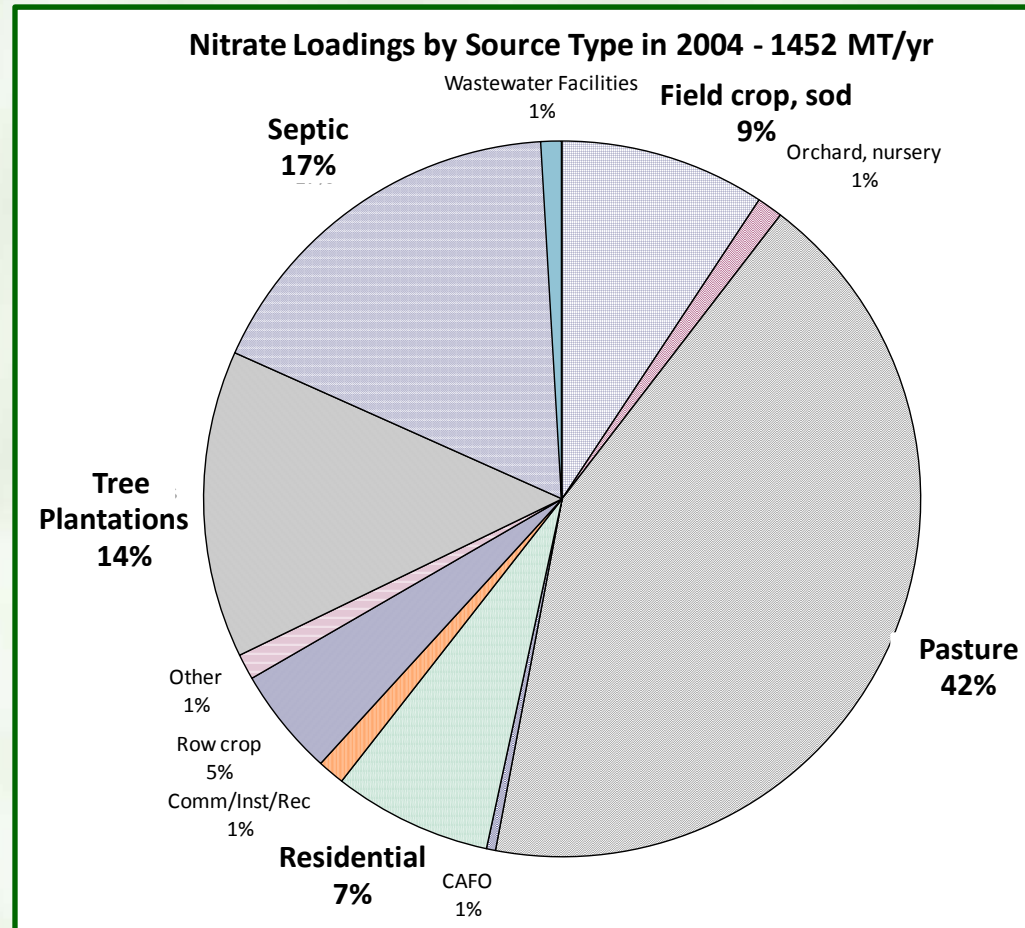
Point Sources

- **Septic Systems**
 - Number of systems estimated from FDOH data
 - ≈ 40,000 in the springsheds
 - ≈ Each system leaches 14 lb NO₃-N to groundwater per year
 - ≈ 250 metric tons NO₃-N/yr (551,000 lb/yr)
- **Central sewer systems**
 - Required to monitor effluents and report to FDEP
 - Used FDEP data to estimate discharges to groundwater



Loadings to Lower Santa Fe River Springsheds

Category	Loading	
	(MT/yr)	(lb/yr)
Pasture	618	1,360,000
Septic	252	556,000
Tree Plantations	202	445,000
Field crop, sod	134	295,000
Residential	104	229,000
Row crop	71	157,000
Comm/Inst/Rec	18	40,000
Orchard, nursery	17	37,000
Other	17	37,000
Wastewater Facilities	13	29,000
CAFO	6	13,000
TOTAL	1452	3,200,000



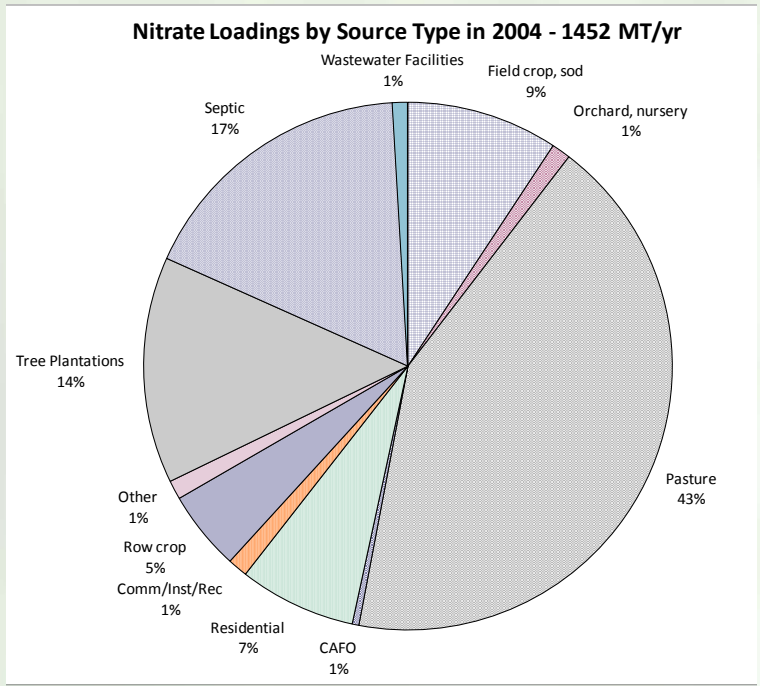


Sources of Nitrate to Springs of the Lower Santa Fe River Basin

Questions?



Lower Santa Fe River at Rum Island Spring



Pasture Land Use – Western Alachua County



Field Crop Land Use – Western Alachua County