Florida Department of Environmental Protection

Wakulla Springs Basin Nitrogen Sourcing Inventory

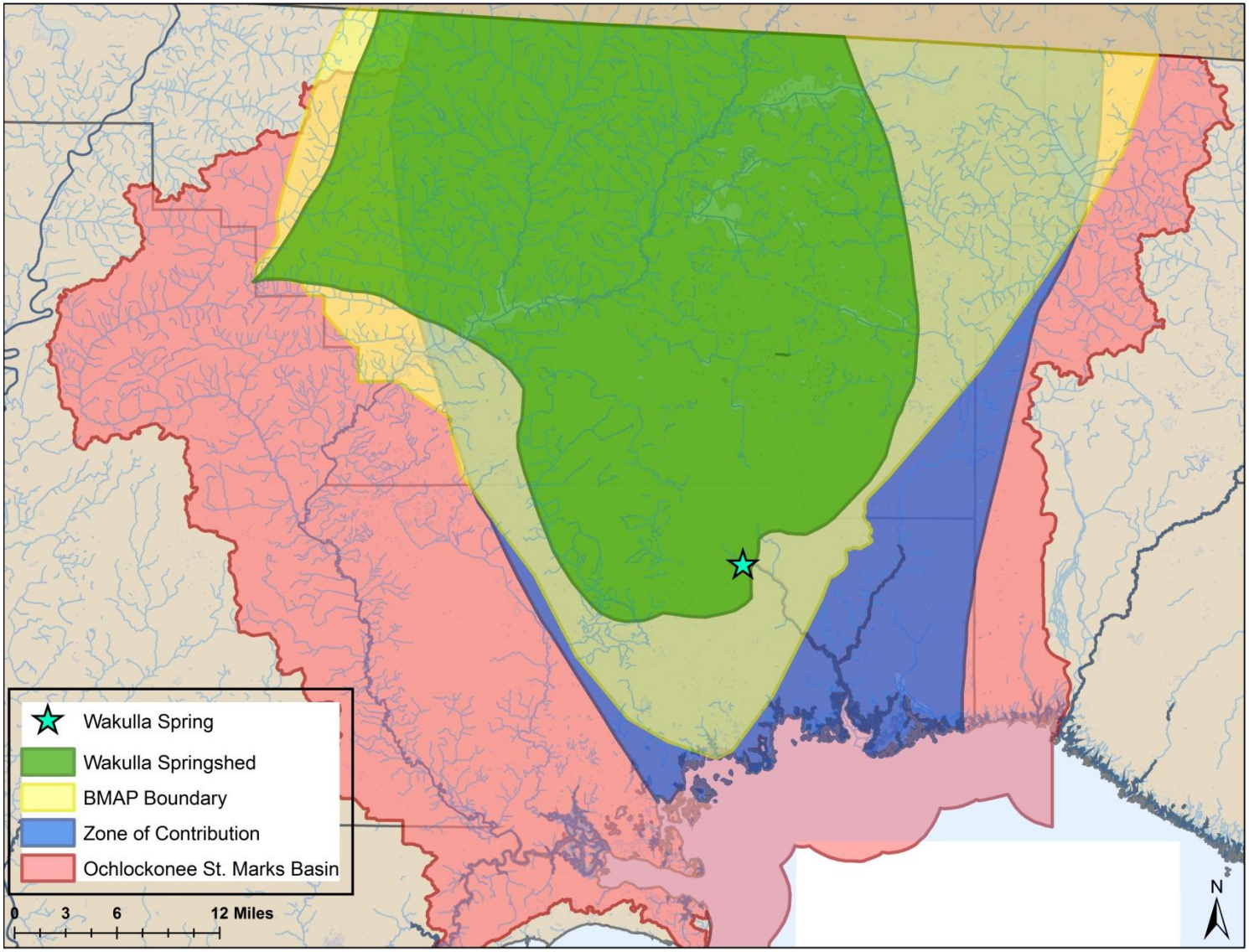
Kirstin Eller, Brian Katz, and Richard Hicks
Ground Water Management Section

(and applicability of the tool for Silver Springs BMAP)

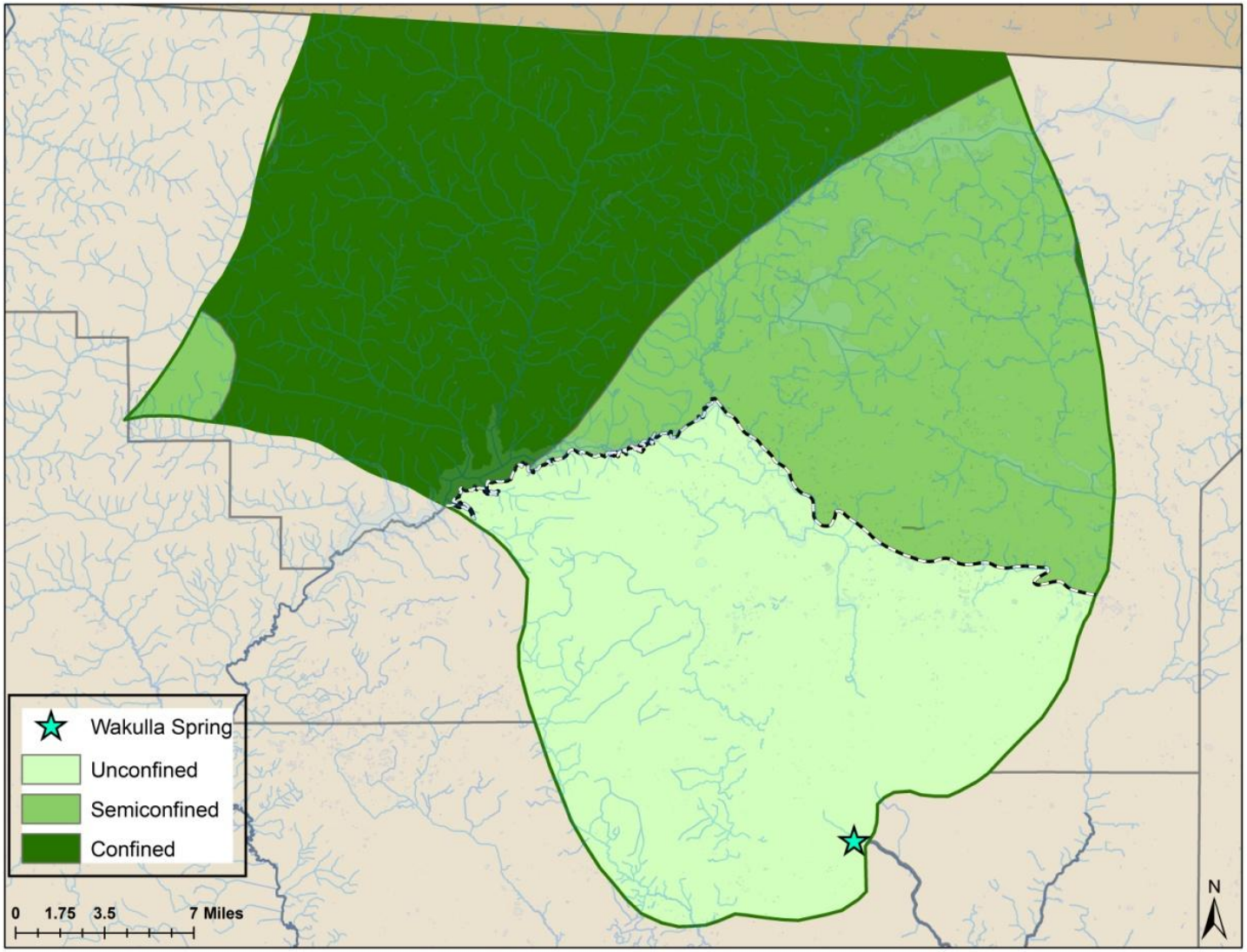




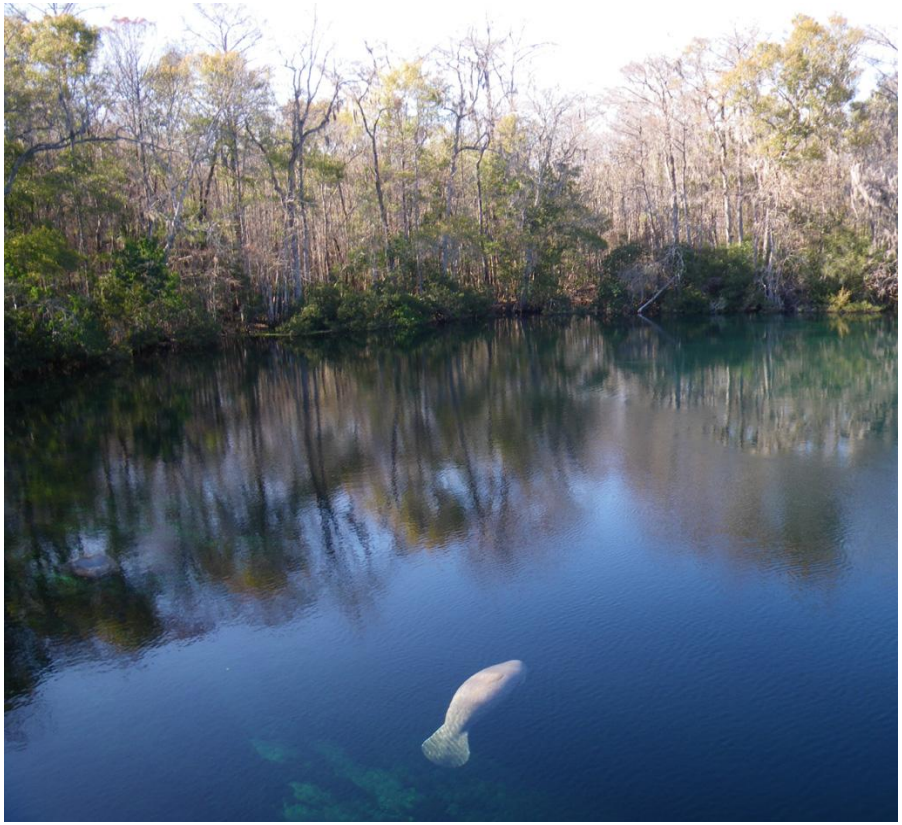
Study Areas


Wakulla Spring
Wakulla Springshed
BMAP Boundary
Zone of Contribution
Ochlockonee St. Marks Basin
0 3 6 12 Miles
N

Study Area
Confinement of Upper Floridan Aquifer



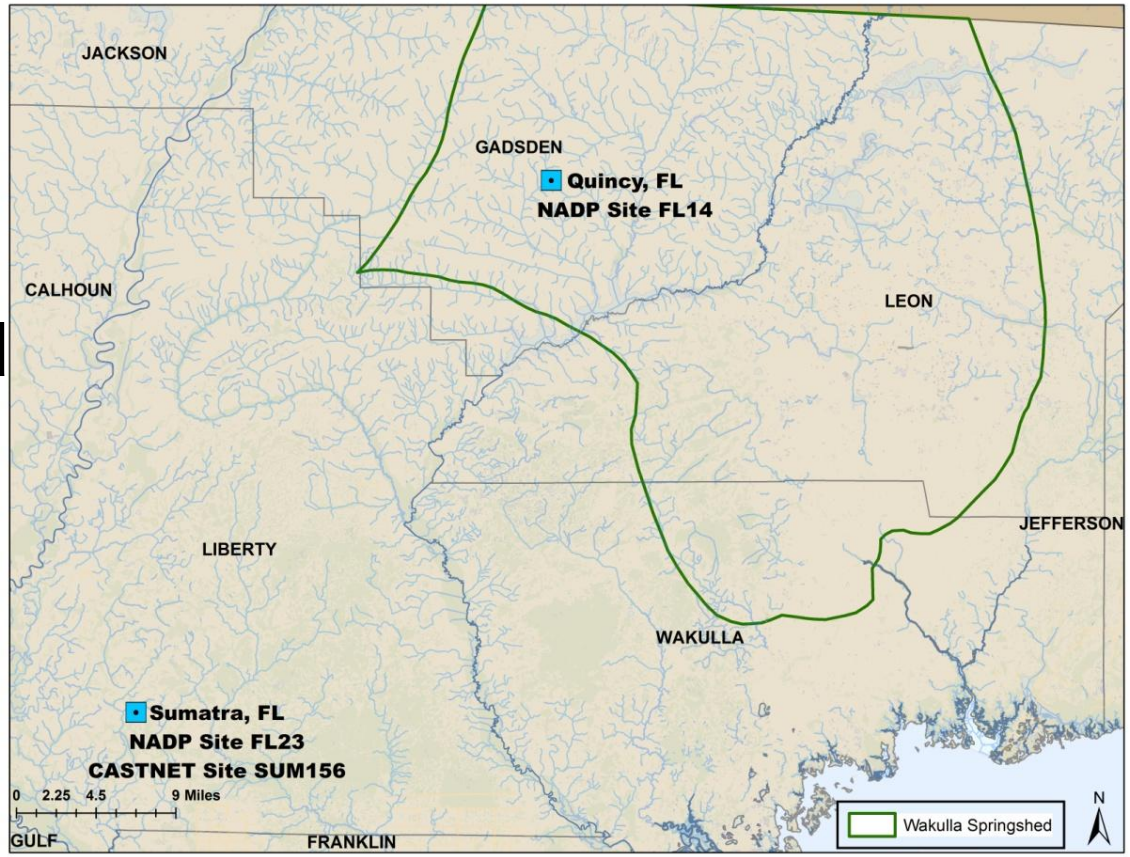
Sources of Nitrogen



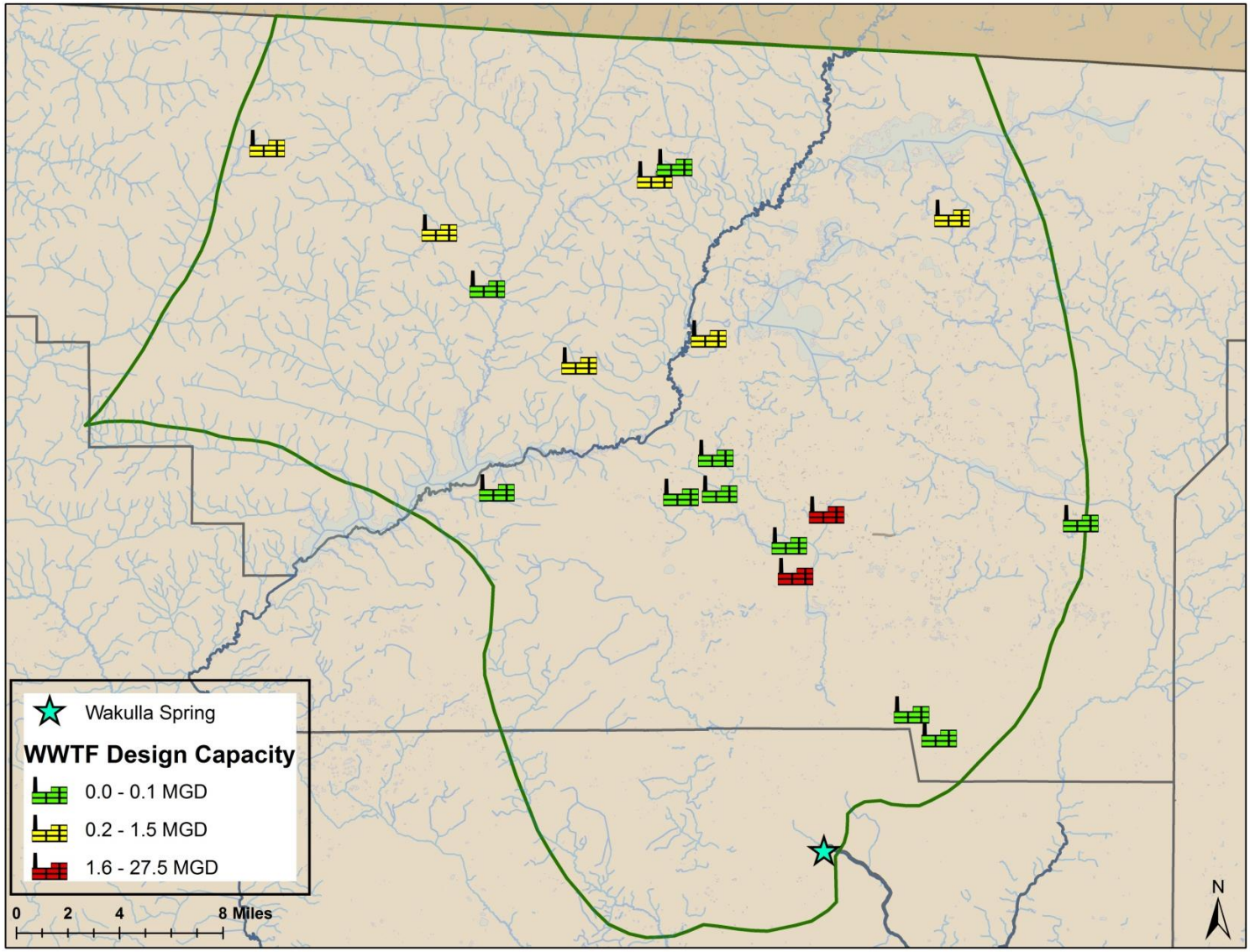
- Atmospheric Deposition
- Wastewater Treatment Facilities
- Septic Tanks
- Fertilizers (Farm and Residential)
- Livestock Waste
- Sinking Streams
- Data analyzed from 2002-2012

Atmospheric Deposition

- National Atmospheric Deposition Program (NADP)
  - Wet deposition
  - Sumatra, FL
  - Qunicy, FL
- Clean Air Status and Trend Network (CASTNET)
  - Dry deposition
  - Sumatra, FL



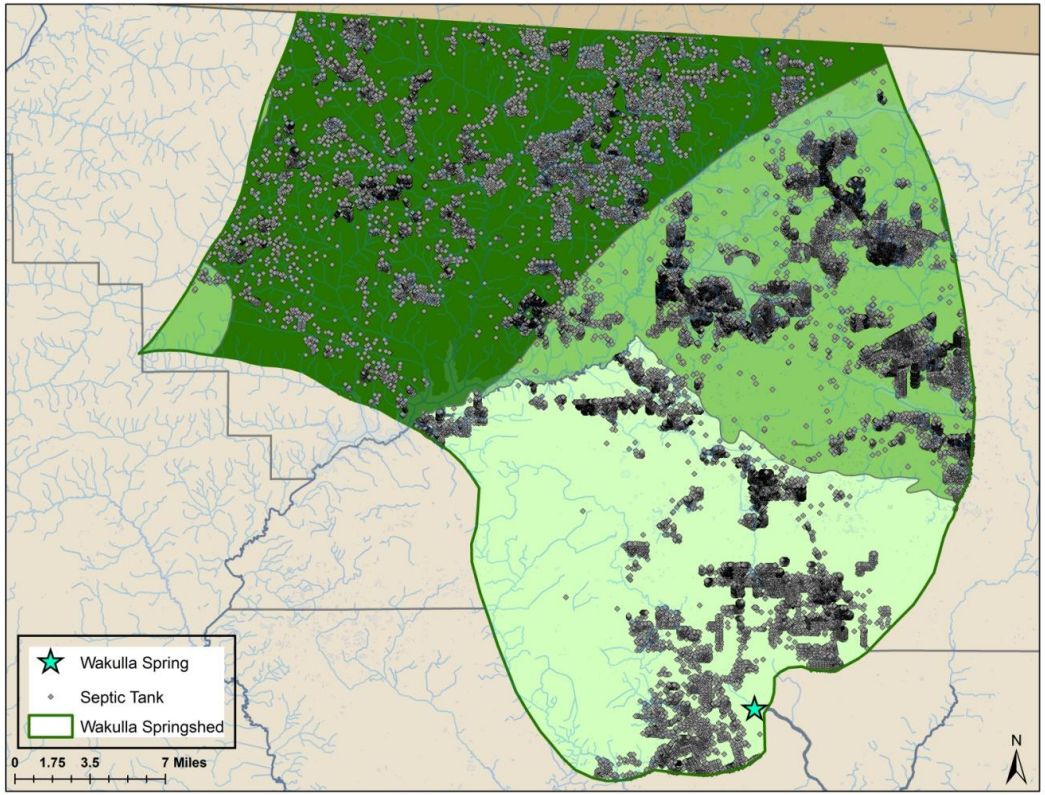
Wastewater Treatment Facilities



Septic Tanks

- DOH model relying on tax parcel data and sewer service areas

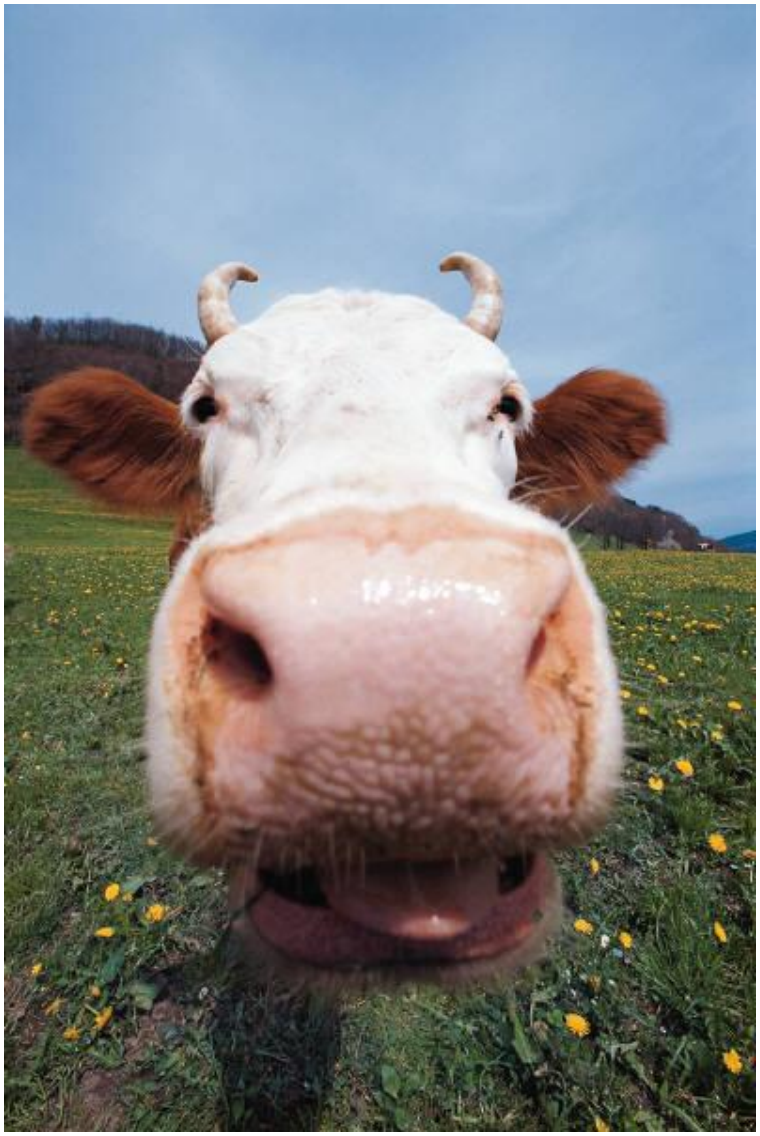
County	People per household (2010 Census)	Recharge Area	# of septic tanks
Leon	2.48	Unconfined	7,682
		Semi-Confined	17,883
		Confined	362
Wakulla	2.93	Unconfined	2,952
Gadsden	2.74	Semi-Confined	369
		Confined	10,932



- Average N input per person – 4.24 kg-N/yr

Livestock

- Census of Agriculture
  - Department of Agriculture
  - Every 5 years
  - # of livestock (categorized by animal)
  - Full county data only
- Aerial imagery analysis was preformed to confirm cow and horse populations
- Loading factors were applied to livestock estimates
  - Cows – 0.219 kg-N/day/animal
  - Horses – 0.124 kg-N/day/animal



Farm and Residential Fertilizer

- FL Department of Agriculture Fertilizer Sales Data
  - Total Fertilizer in tons
  - Total N in Fertilizer in tons
  - Total Fertilizer for Farm practices
  - Total Fertilizer for Non-farm practices

Farm and Residential Fertilizer

- FL Department of Agriculture Fertilizer Sales Data
  - Total Fertilizer in tons
  - Total N in Fertilizer in tons
  - Total Fertilizer for Farm practices
  - Total Fertilizer for Non-farm practices

→ Calculated % N in fertilizer

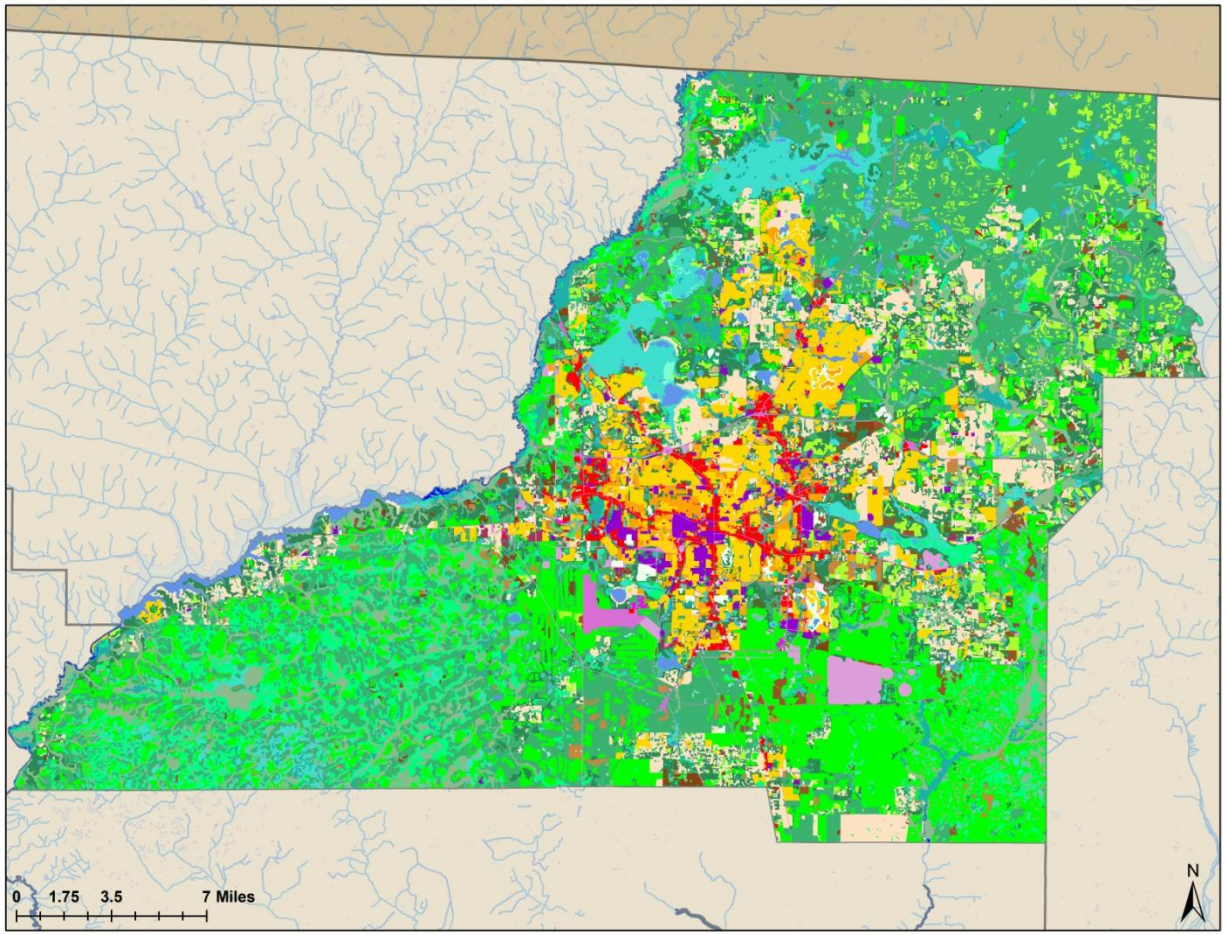
Farm and Residential Fertilizer

- FL Department of Agriculture Fertilizer Sales Data
  - Total Fertilizer in tons
  - Total N in Fertilizer in tons
  - Total Fertilizer for Farm practices
  - Total Fertilizer for Non-farm practices

Calculated % N in fertilizer

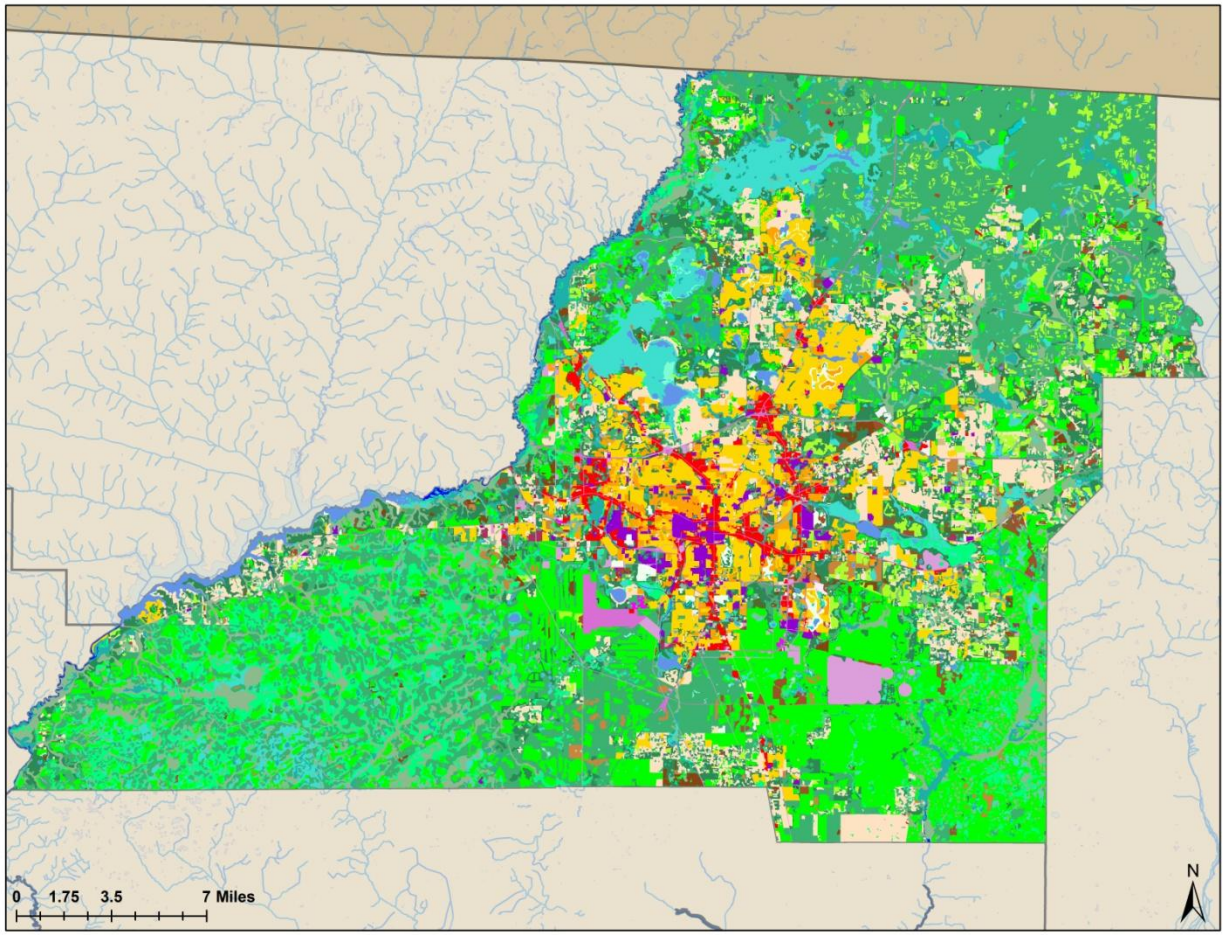
Total N in fertilizer

Landuse for Fertilizer



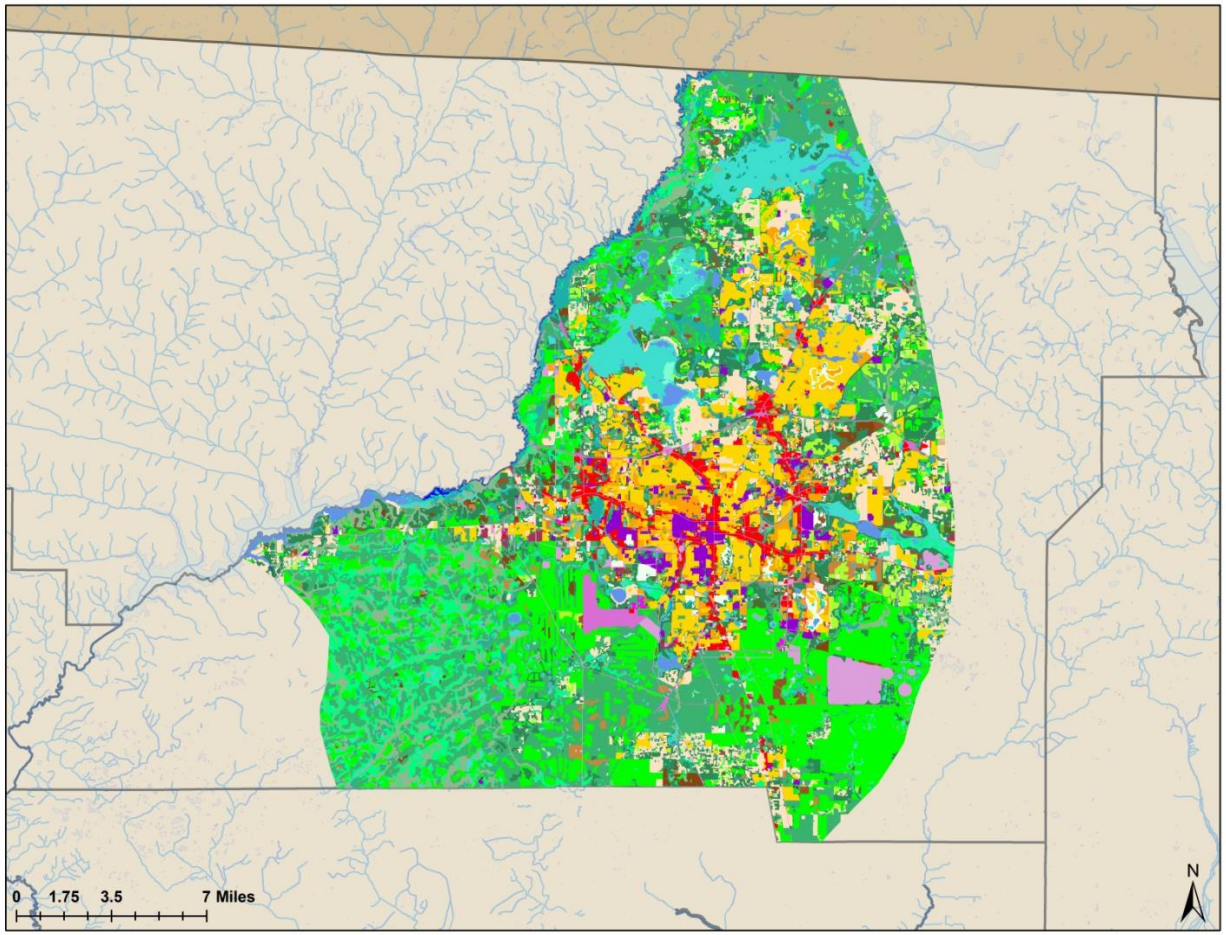
- Row Crops
- Field Crops
- Hay Fields
- Other Groves
- Nurseries and Vineyards
- Tree Nurseries
- Sod Farms
- Ornamentals

Landuse for Fertilizer



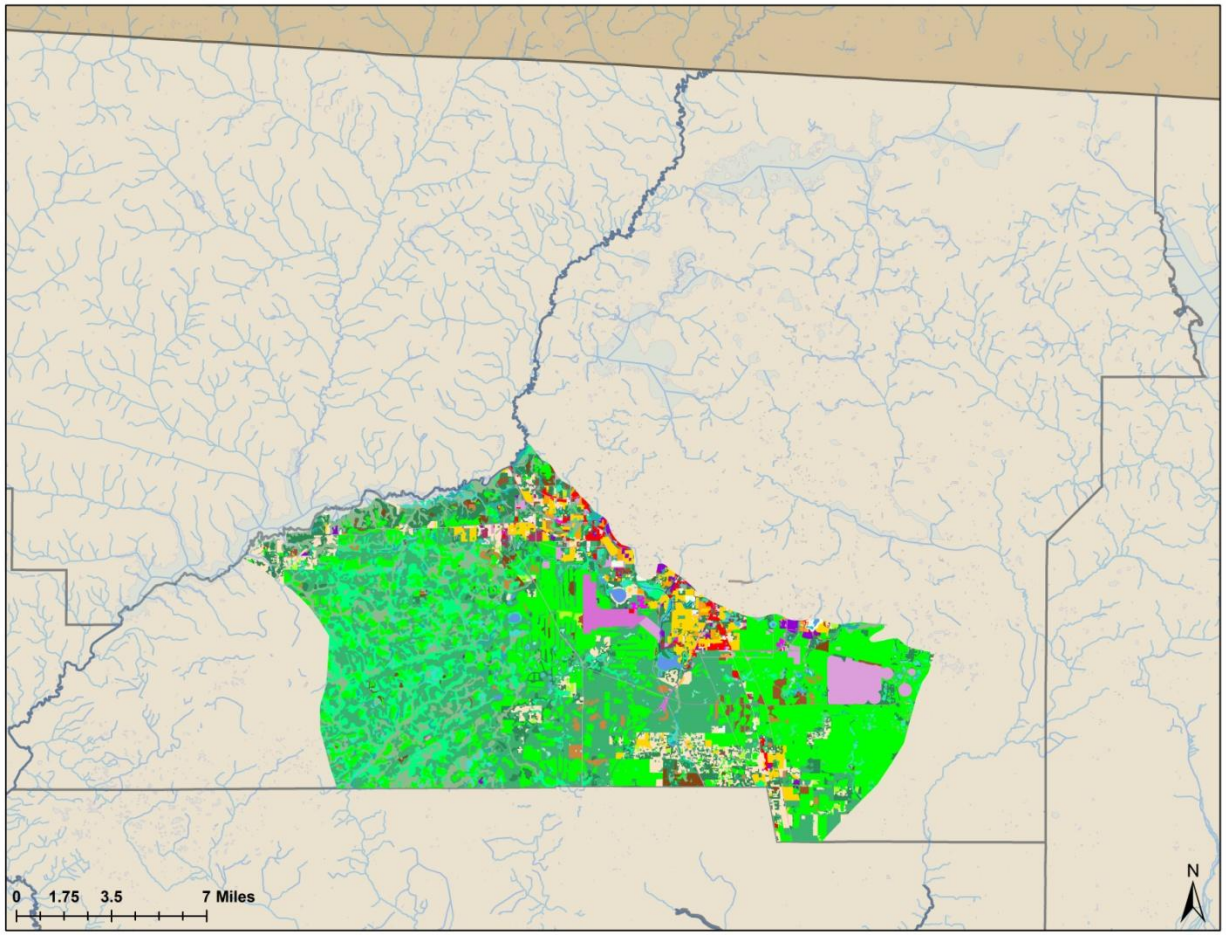
- Fertilizer lands in Leon County
  - Leon County – 3470 ha

Landuse for Fertilizer



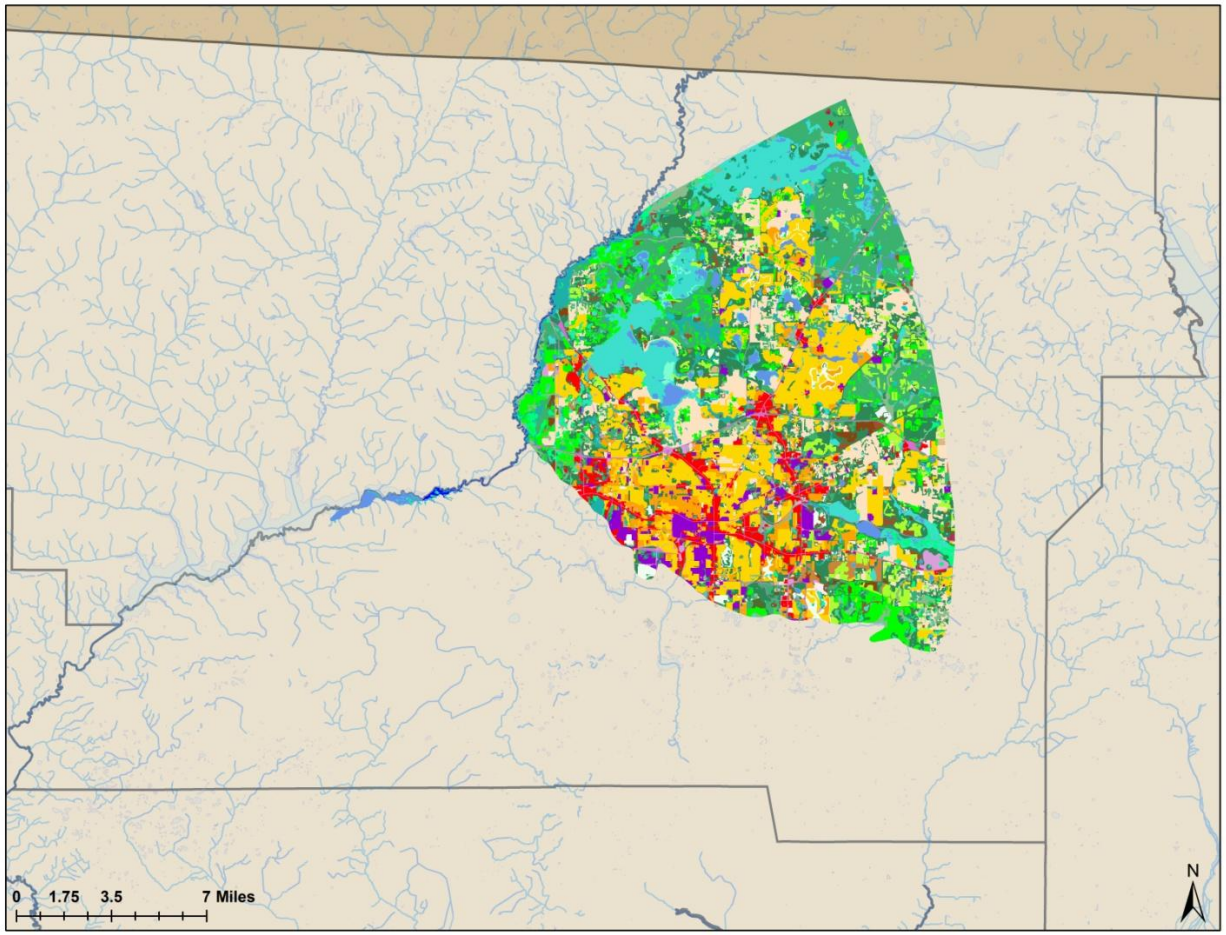
- Fertilizer lands in Leon County
  - Leon County – 3470 ha
  - Springshed – 981 ha, 28%

Landuse for Fertilizer



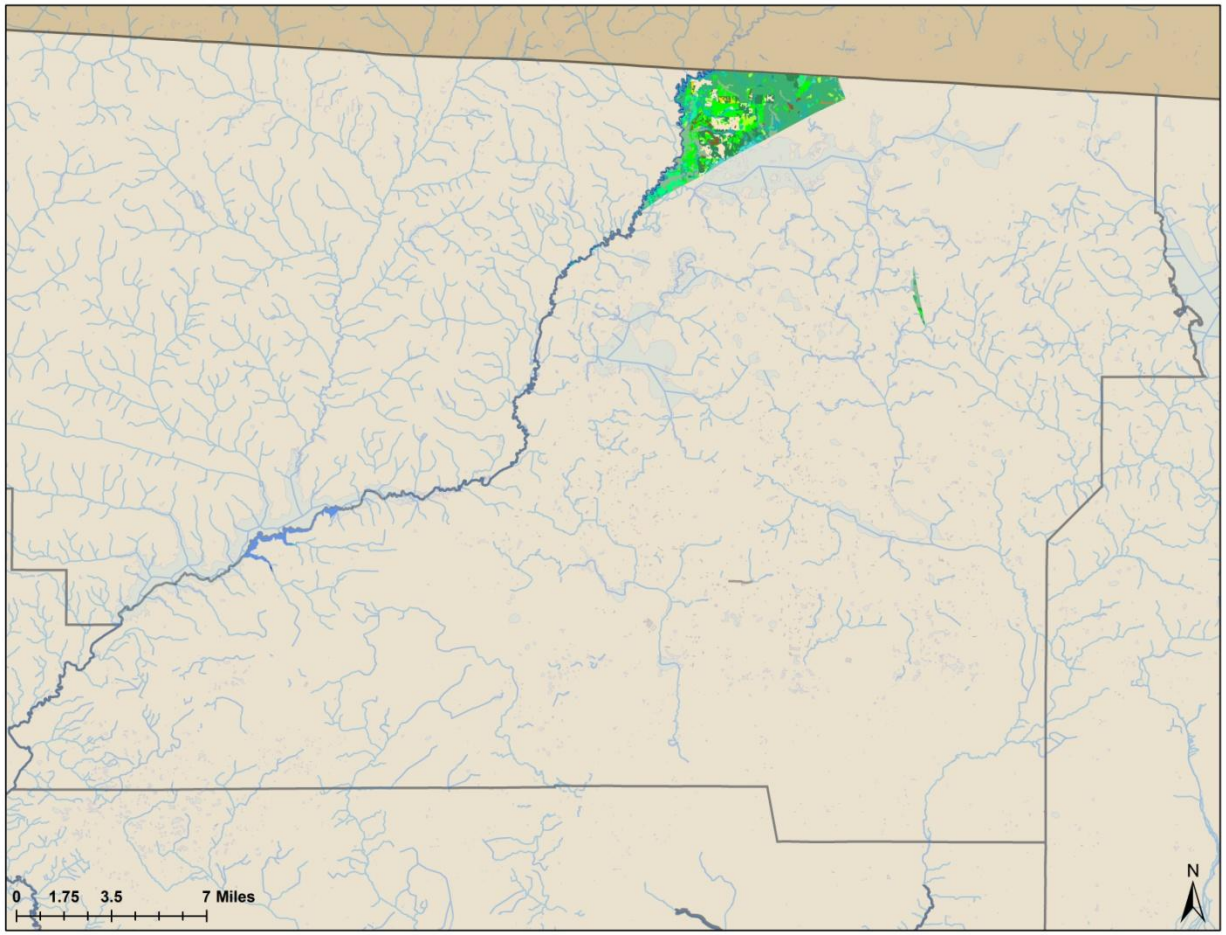
- Fertilizer lands in Leon County
  - Leon County – 3470 ha
  - Springshed – 981 ha, 28%
  - Unconfined – 74 ha, 2%

Landuse for Fertilizer



- Fertilizer lands in Leon County
  - Leon County – 3470 ha
  - Springshed – 981 ha, 28%
  - Unconfined – 74 ha, 2%
  - Semi-confined – 814 ha, 23%

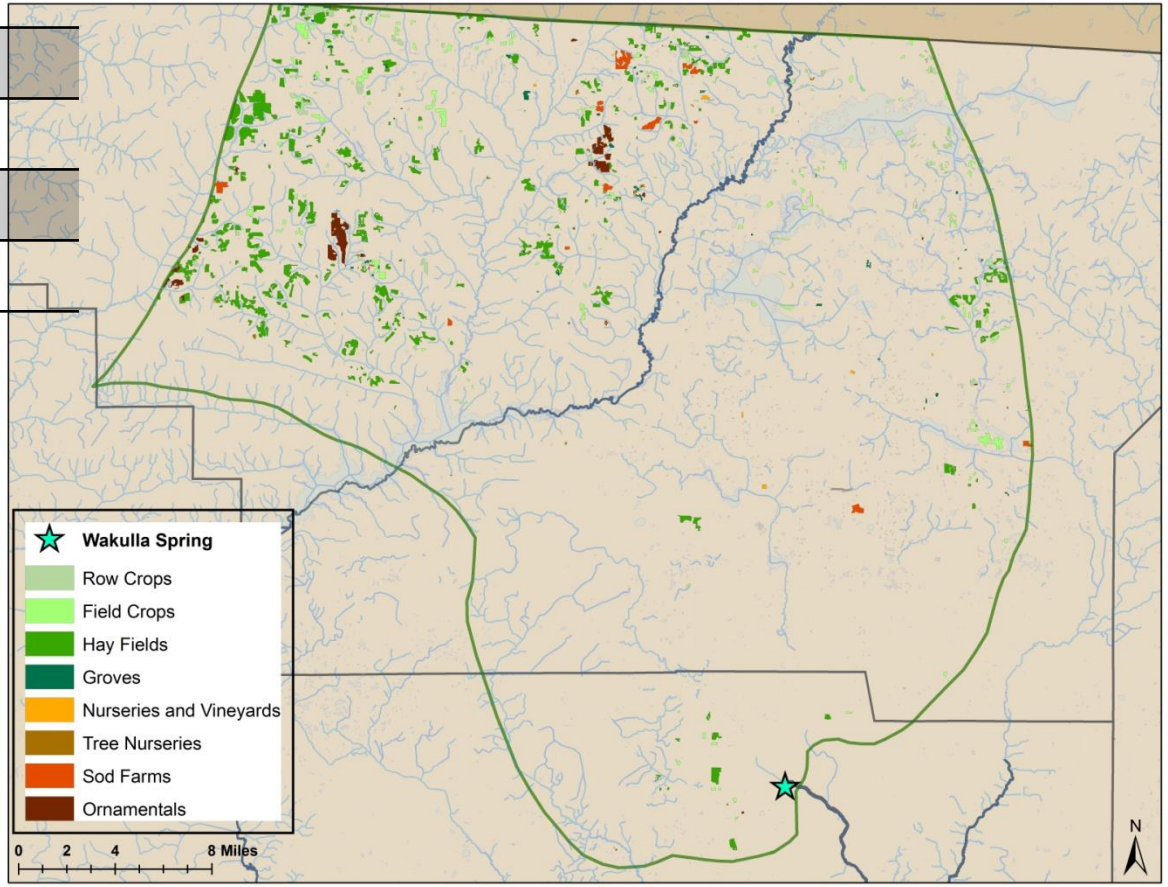
Landuse for Fertilizer



- Fertilizer lands in Leon County
  - Leon County – 3470 ha
  - Springshed – 981 ha, 28%
  - Unconfined – 74 ha, 2%
  - Semi-confined – 814 ha, 23%
  - Confined – 62 ha, 2%

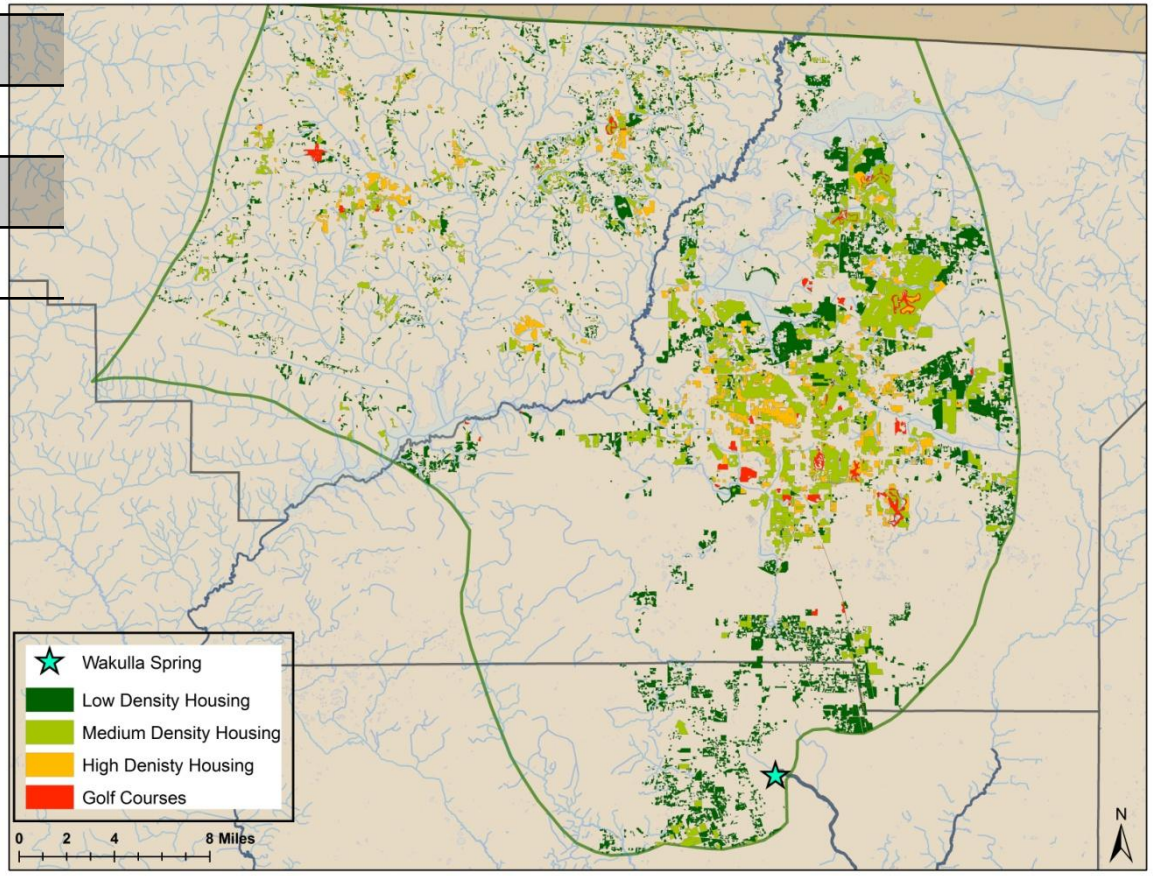
Landuse for Farm Fertilizer

LEON COUNTY DATA		
Land Delineation	Land %	N contribution (kg-N/yr)
County	100%	59,347
Springshed	28%	15,662
Unconfined	2%	1,180
Semi-confined	23%	12,989
Confined	2%	982



Landuse for Residential Fertilizer

LEON COUNTY DATA		
Land Delineation	Land %	N contribution (kg-N/yr)
County	100%	220,904
Springshed	82%	180,258
Unconfined	16%	36,007
Semi-confined	64%	141,820
Confined	1%	2,430



Sinking Streams

Baseflow and Stormwater Runoff to Sinkholes and Swallets

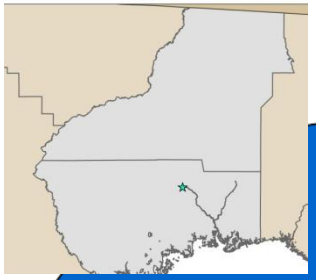

Black Creek, courtesy of Z. Kulakowski

- Fisher Creek
- Black Creek
- Munson Slough
- Discharge was obtained from USGS gauging stations
- Nutrient data was taken from the most southern station data available in IWR

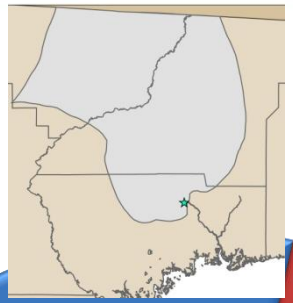
Nitrogen Inputs to Land Surface

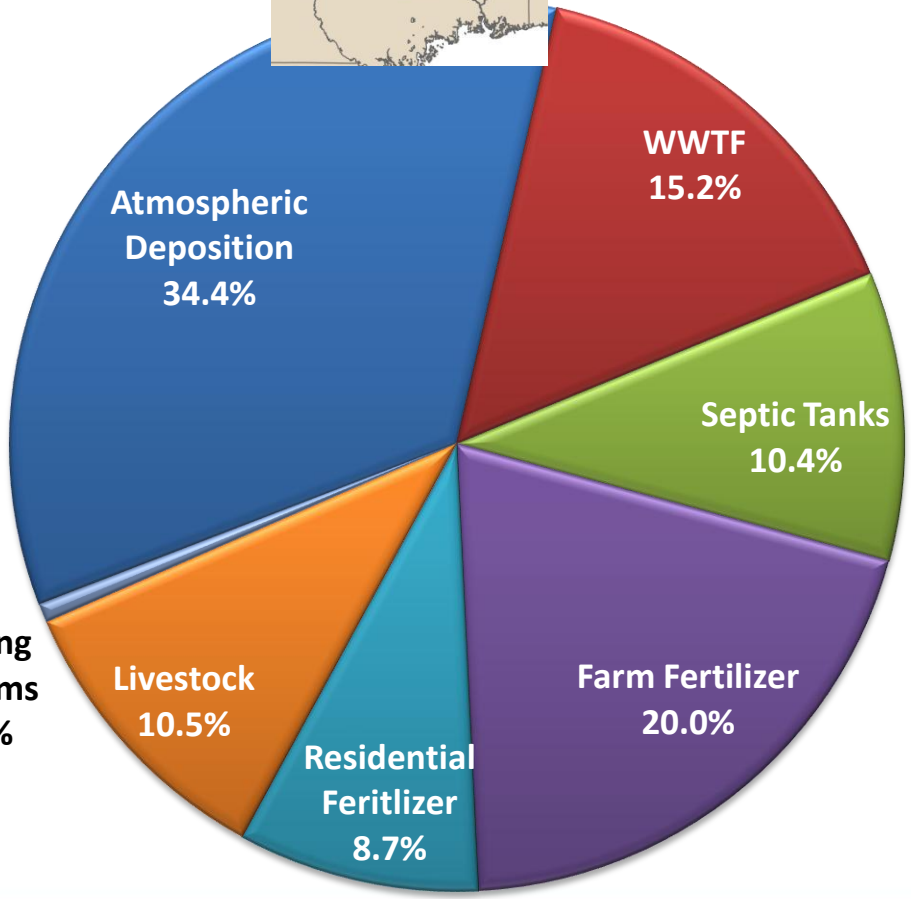
1990-2000

Chelette et al 2002



2002-2012





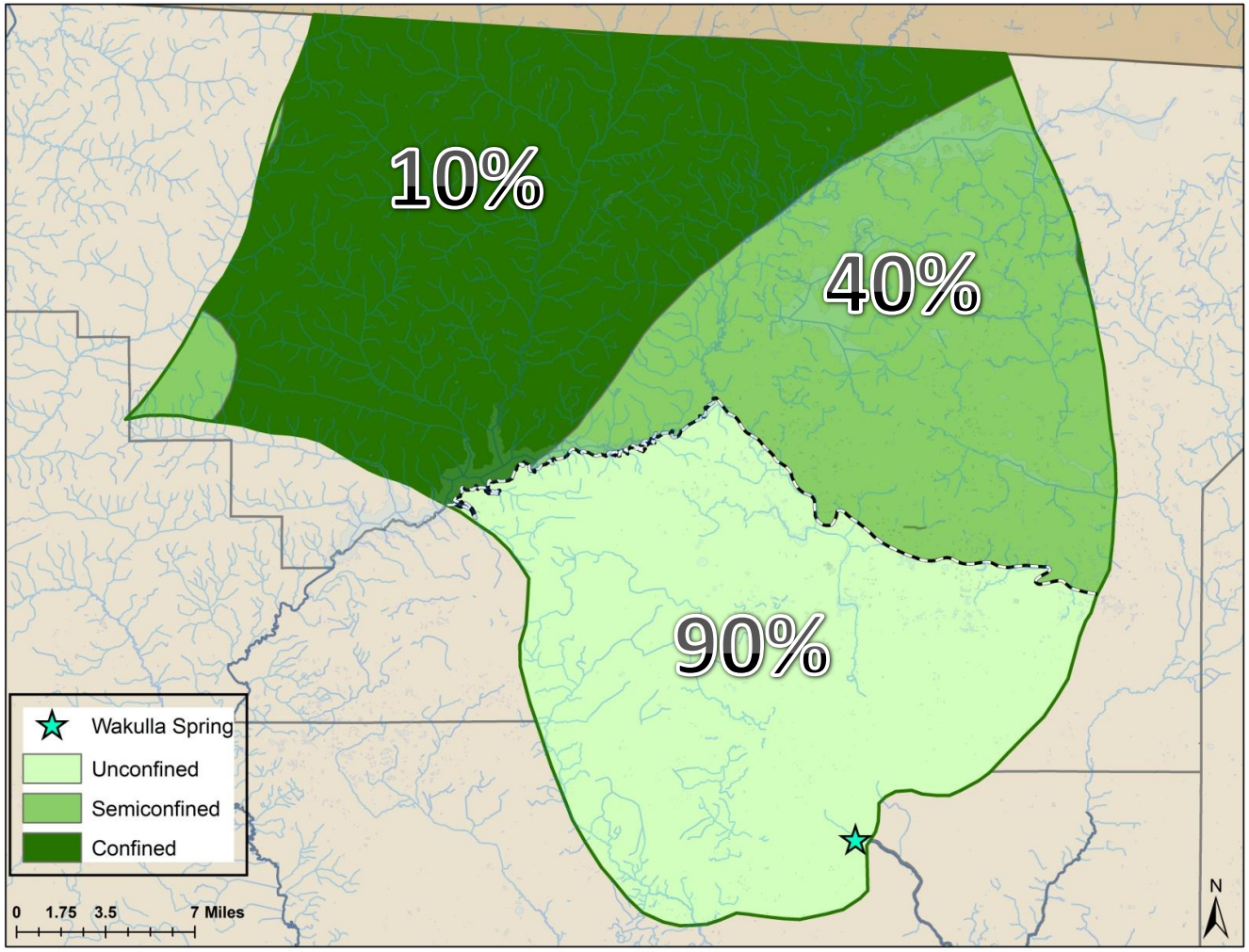
Attenuation of Nitrogen

- Factors represent the percentage of uptake from the environment
- Based on factors used in similar past studies and found in relevant literature

Loading Category	Attenuation Factor
Atmospheric Deposition	90%
Waste Water	60%
Septic Tanks	30%
Farm Fertilizer	70%
Residential Fertilizer	80%
Livestock	75%
Sinking Streams	20%

Recharge Areas

- Factors describe the percentage of recharge expected

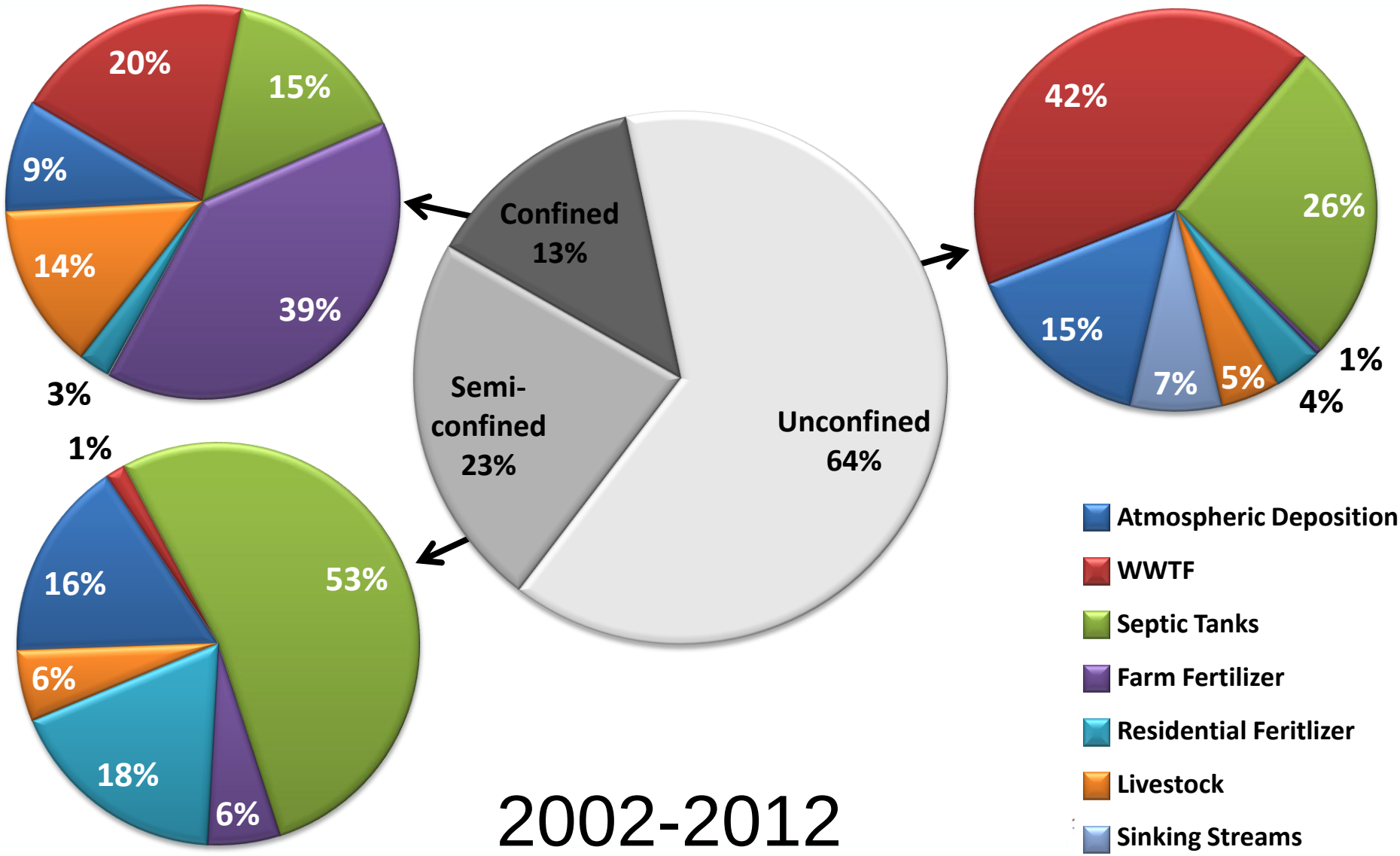


TN reaching to Floridan Aquifer (2002-2012)

	Area (ha)	Atm Dep	WWTF	Septic Tanks	Fertilizer		Livestock	Sinking Streams
					Farm	Res.		
Sorted by County								
Leon	112,500	25,100	69,300	59,200	1,900	16,200	4,400	11,800
Wakulla	25,300	8,200	---	13,200	500	400	6,100	
Gadsden	91,300	4,200	6,800	5,800	15,300	1,000	5,200	---
Sorted by Recharge Area								
Unconfined	76,900	25,000	68,400	42,200	800	6,300	7,700	11,800
Semi-confined	65,000	9,400	1,000	30,700	3,400	10,400	3,300	---
Confined	87,200	3,200	6,800	5,200	13,500	900	4,700	---
TOTAL	**229,100**	**37,600**	**76,100**	**78,200**	**17,700**	**17,600**	**15,700**	**11,800**
PERCENTAGE		**14.8%**	**29.9%**	**30.7%**	**6.9%**	**6.9%**	**6.2%**	**4.6%**

- All values are rounded to the nearest 100
- Units – kg-N/yr

Average Annual Loading to Floridan



2002-2012

Applying this approach to Silver

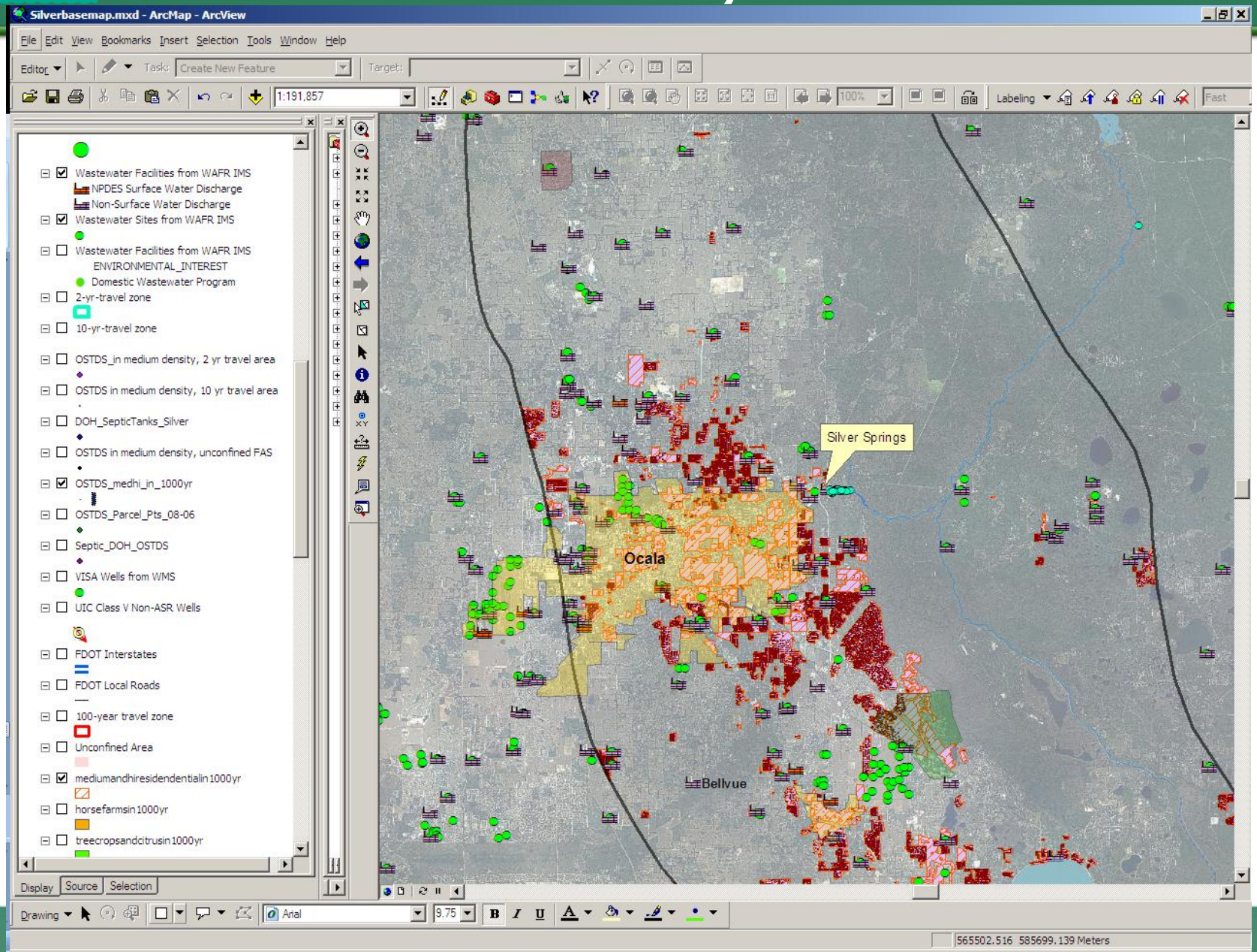
The setup:

- Verify land use coverage in GIS
- Define the area(s) to evaluate
- Estimate nitrogen loads by source category and time frame
- Characterize hydrogeology of Floridan aquifer
- Establish attenuation factors based on recharge & aquifer confinement

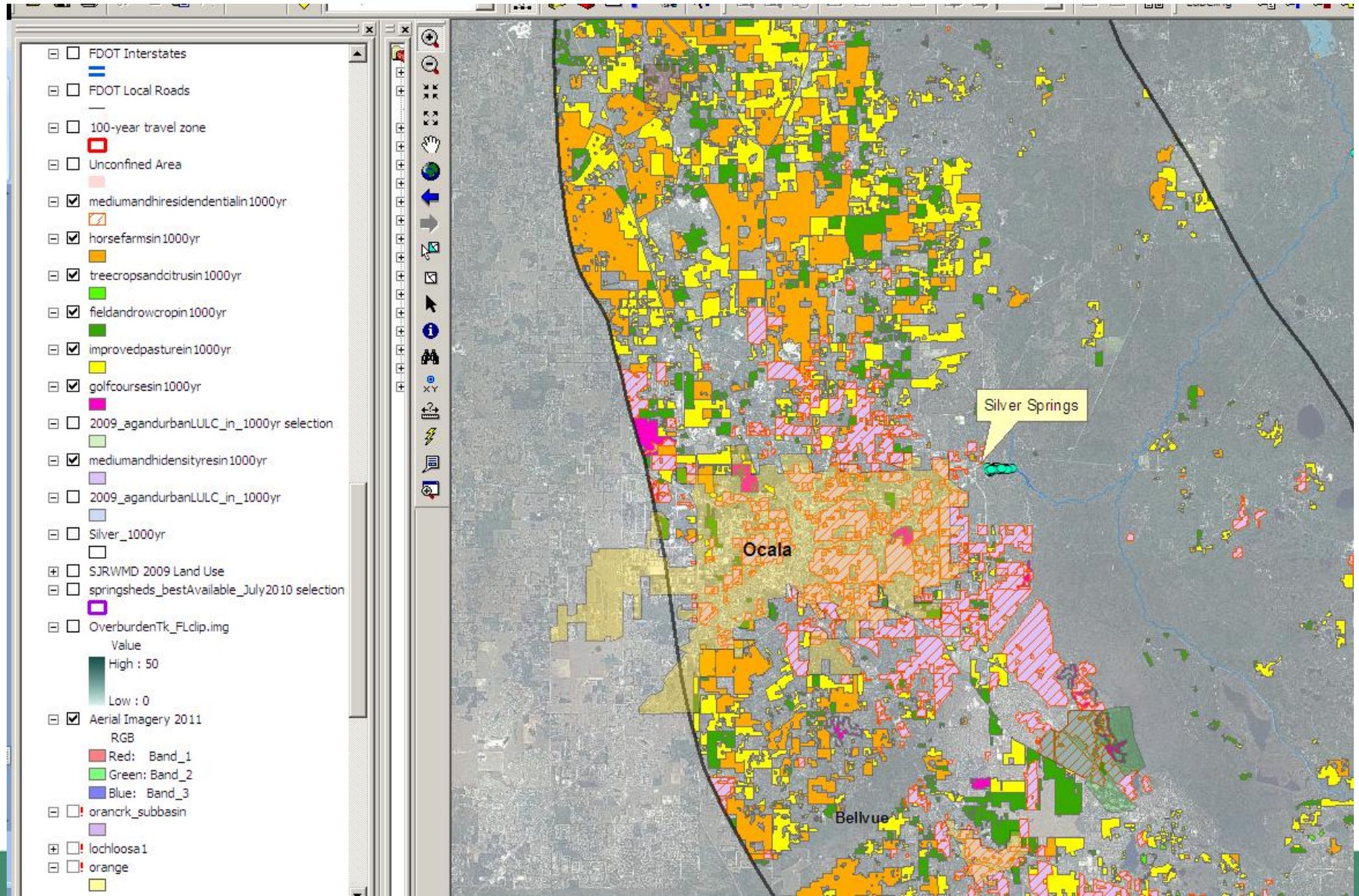
Applying this approach to Silver

- Establish nitrogen loads by source category
  - Wastewater
  - OSTDS
  - Agricultural fertilizer
  - Urban fertilizer
  - Animal waste
  - Direct stormwater
  - Stormwater via drainage wells
  - Lake seepage
  - Atmospheric deposition

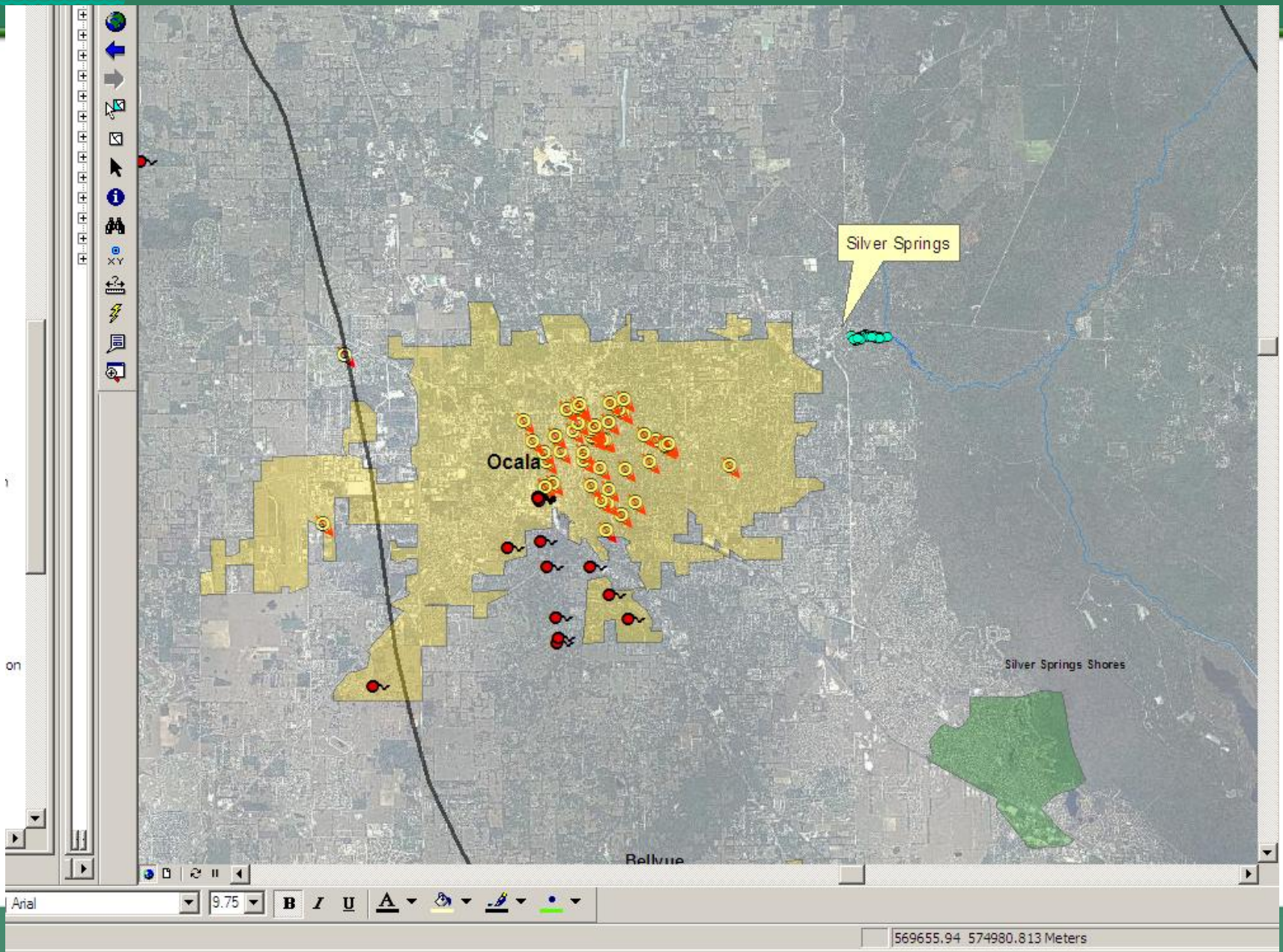
Wastewater, OSTDS



Fertilizer, Animal Waste



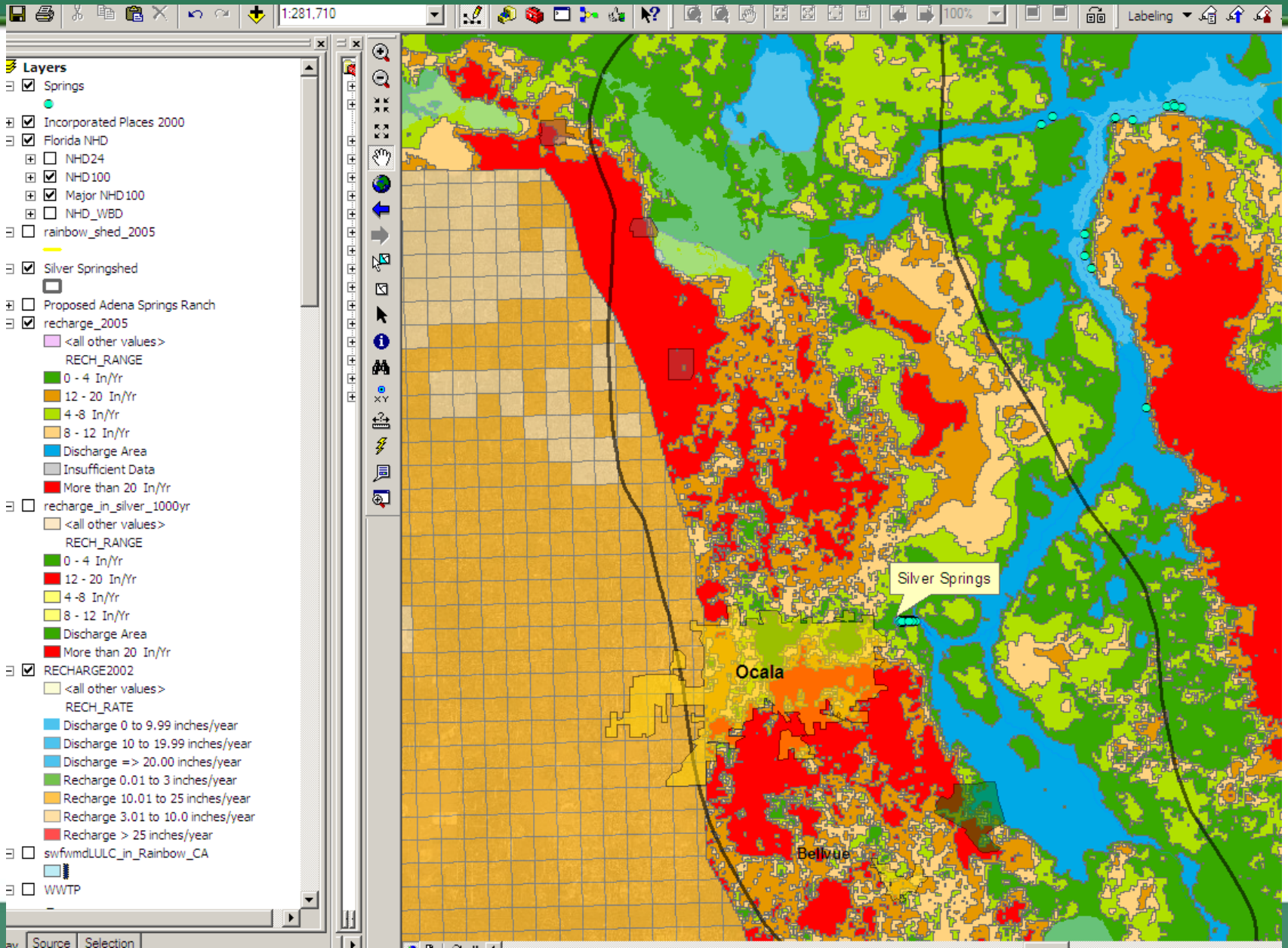
Stormwater inflows



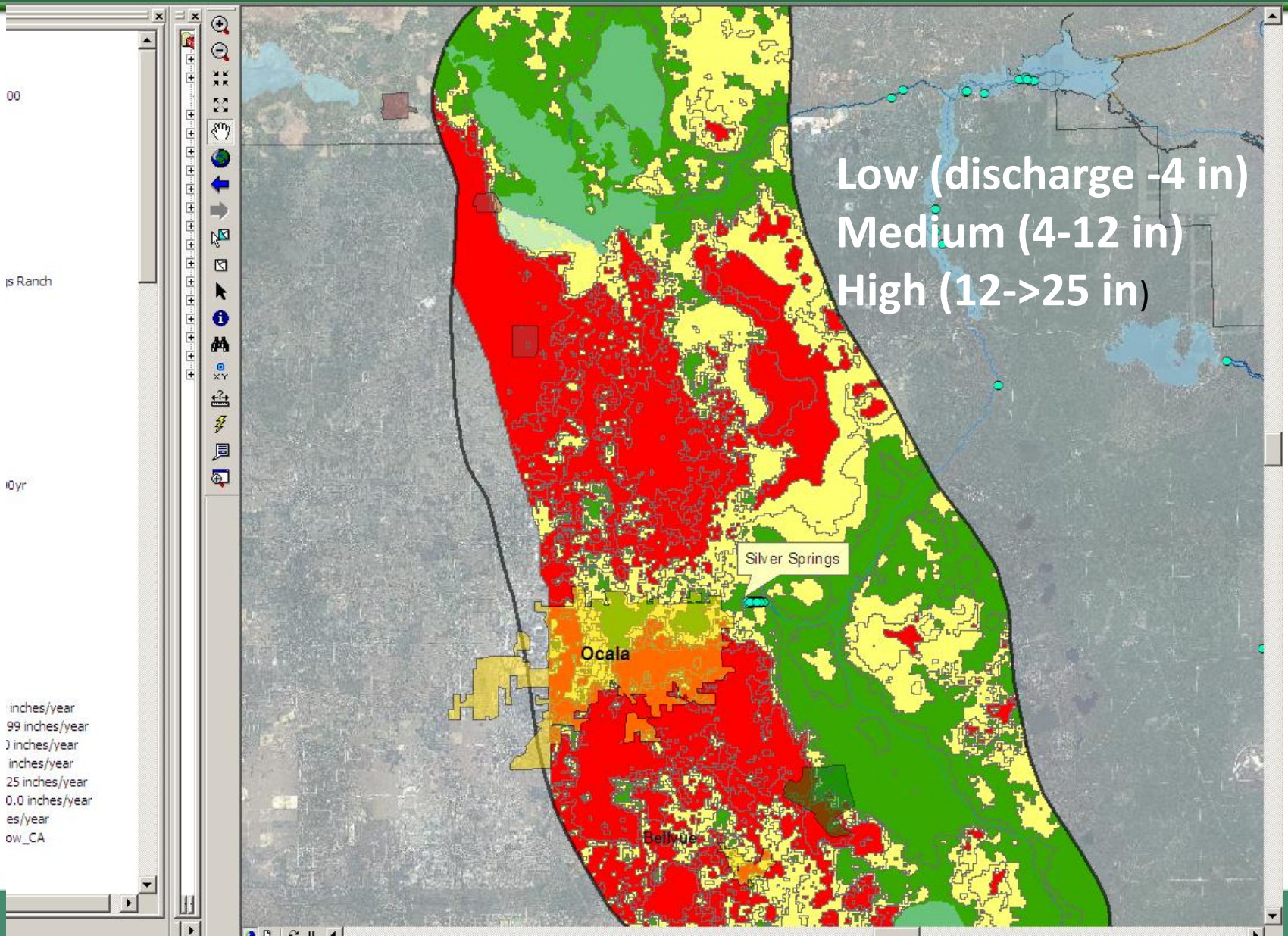
Characterizing hydrogeology

- Recharge potential
- Confinement

Recharge to Floridan Aquifer



Recharge- 3 ranges



Next steps

- Refine land uses, field verification work
- Obtain loading information for wastewater
- Obtain fertilizer use and animal count information
- Obtain the best available counts on OSTDS
- Develop basin-specific attenuation from literature and previous work for the area
- Identify areas for which we need nitrogen loading information