

Florida Department of Environmental Protection
 Division of Environmental Assessment
 and Restoration

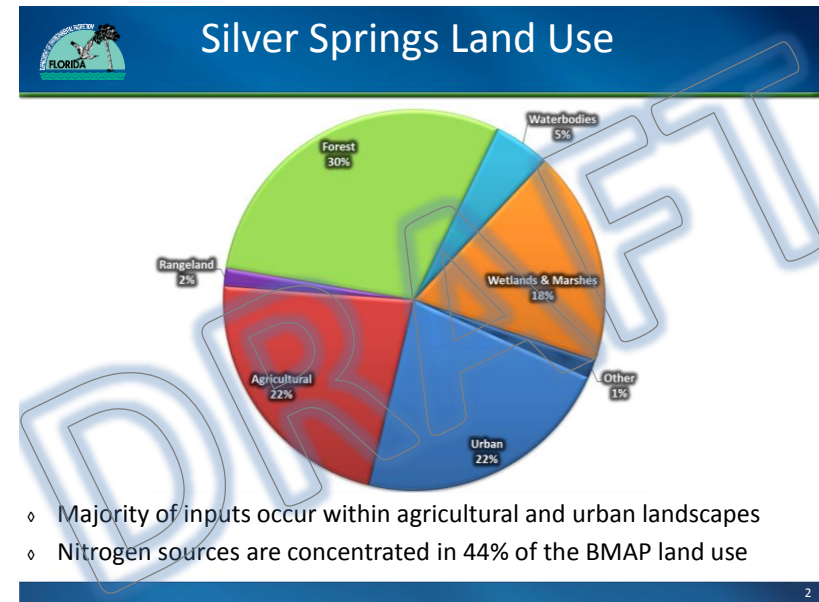
**Silver Springs Nitrogen Source Inventory
 and Loading Updates**

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 Ground Water Management Section

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1

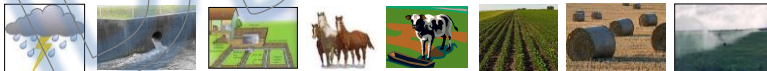




Estimating Nitrogen Loads to Ground Water

Process:

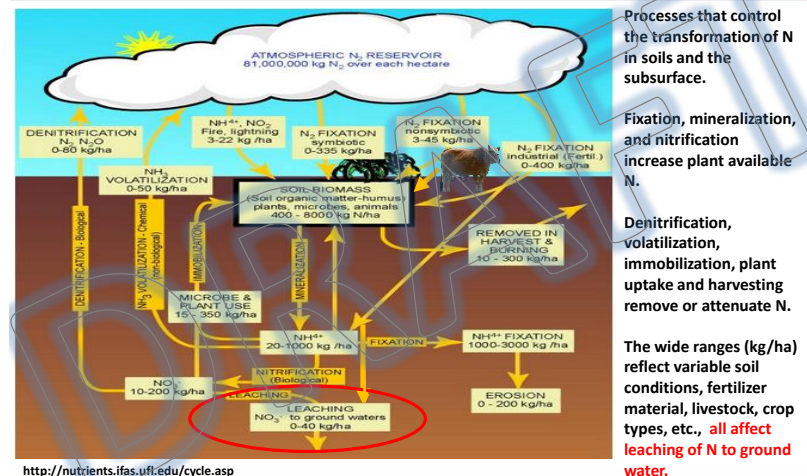
1. Estimate the inputs of nitrogen to the land surface from the source inventory information (**best available**).
2. Apply attenuation factors based on the various environmental processes that could transform the various forms of nitrogen in the subsurface (such as denitrification, nitrification of ammonia, uptake by vegetation, mineralization of organic nitrogen).
3. Apply an areal weighting factor that is based on the rate of recharge to ground water to get nitrogen loads to ground water.
4. Account for proximity of N source to spring. Fine-tune estimates after getting feedback from stakeholders.



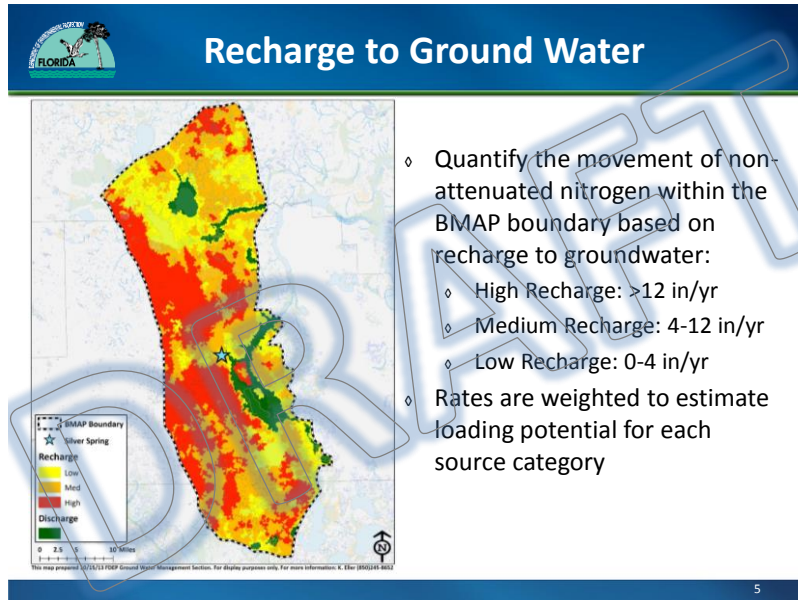
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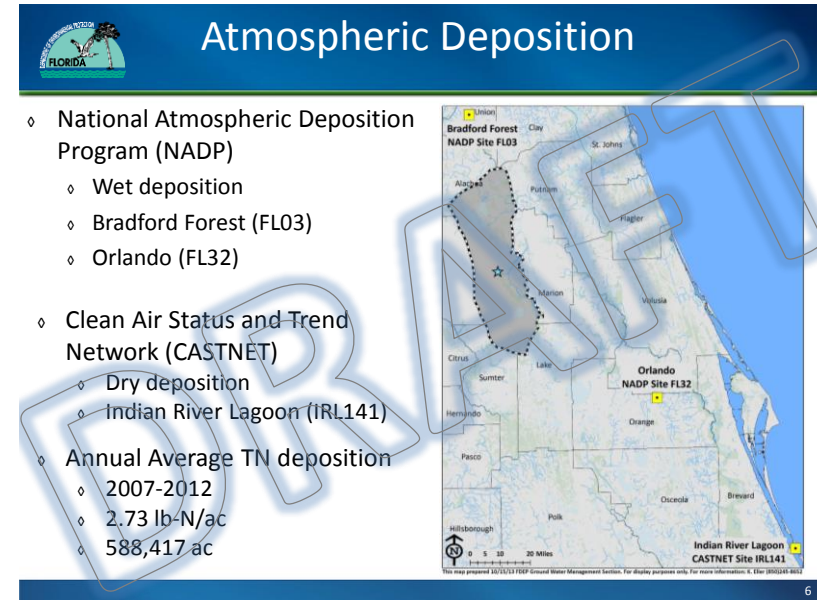
Nitrogen Cycle and Nitrogen Attenuation



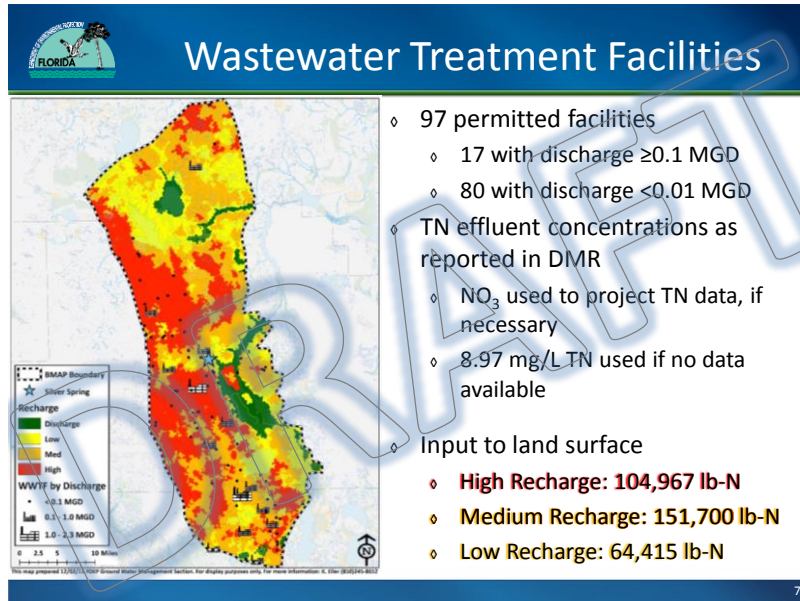
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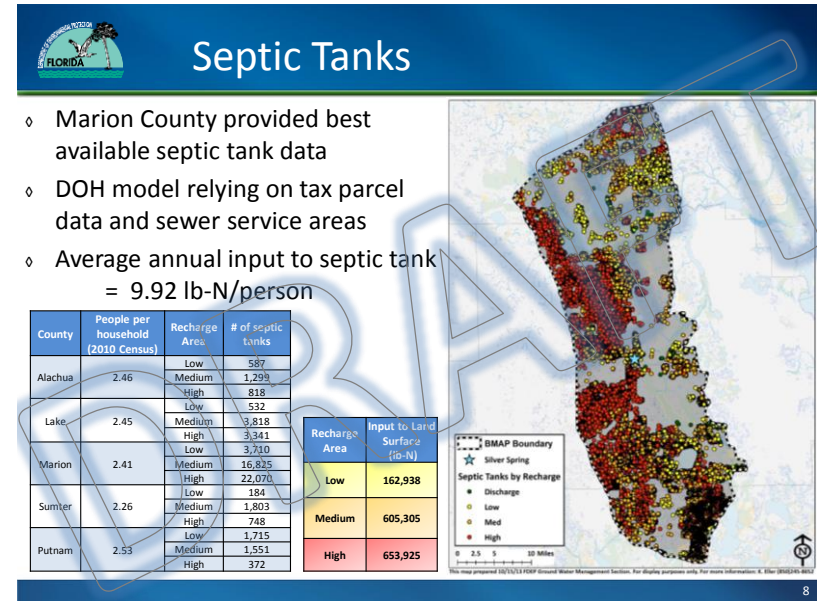
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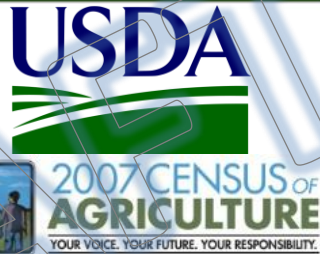
Livestock Populations

- ◊ Census of Agriculture
 - ◊ Dept of Agriculture
 - ◊ Every 5 years
 - ◊ # of livestock (categorized by animal)
 - ◊ Full county data ONLY

- ◊ Livestock waste factors (lb-N/animal/day)

- ◊ Cow: 0.337
- ◊ Calf: 0.068
- ◊ Horse: 0.273
- ◊ Goats: 0.035
- ◊ Hogs: 0.190

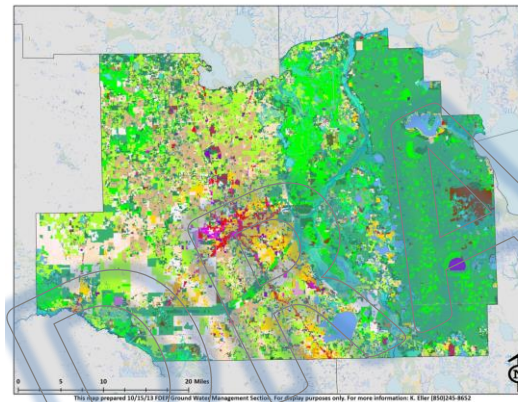
- ◊ Sheep: 0.198
- ◊ Turkey: 0.006
- ◊ Broiler Chickens: 0.159
- ◊ Layer Chickens: 0.003



9



Livestock: Land use Percentages



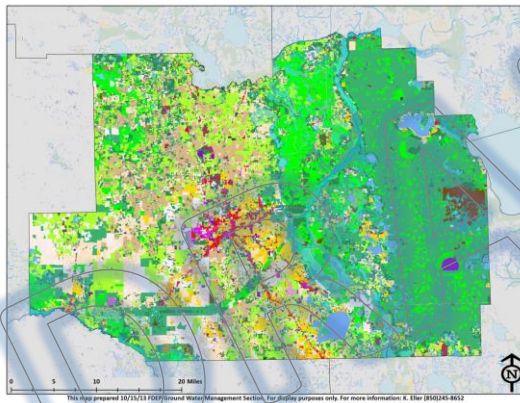
- ◊ Pastures
 - ◊ Improved
 - ◊ Unimproved
 - ◊ Woodland
- ◊ Feeding Operations
 - ◊ Cattle
 - ◊ Poultry
 - ◊ Dairies

- ◊ Separate Category
 - ◊ Horse Farms

10



Land use Percentages: Horse Farms

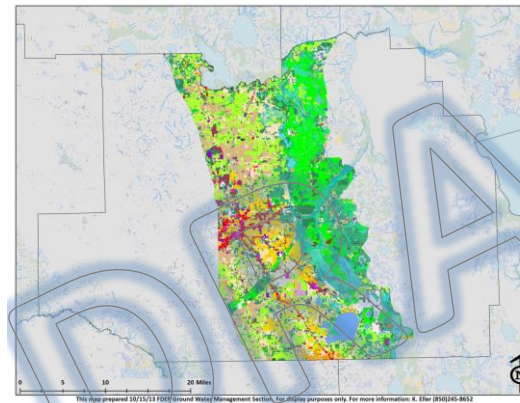


- ◊ EXAMPLE:
- Marion County Horse Farms
- ◊ Marion County- 68,845 ac

11



Land use Percentages: Horse Farms

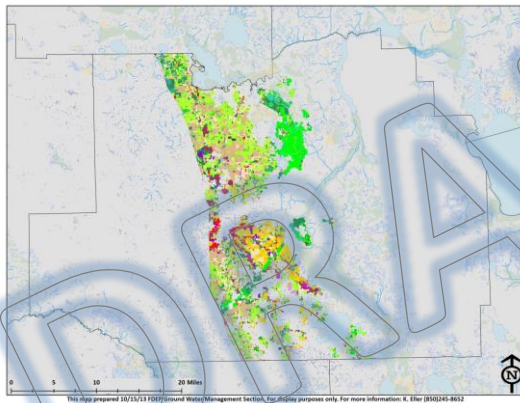


- ◊ EXAMPLE:
- Marion County Horse Farms
- ◊ Marion County- 68,845 ac
- ◊ BMAP Area- 28,541 ac, 41%

12



Land use Percentages: Horse Farms

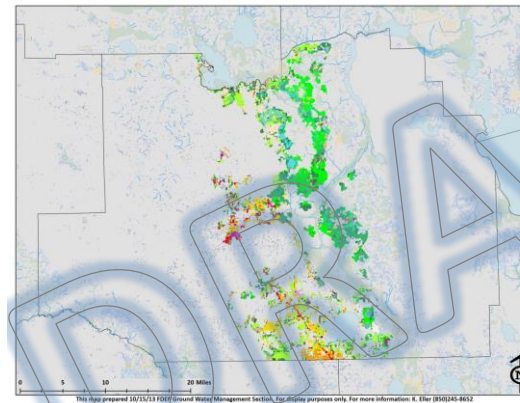


- ◊ EXAMPLE:
- Marion County Horse Farms
- ◊ Marion County- 68,845 ac
- ◊ BMAP Area- 28,541 ac, 41%
- ◊ **High Recharge- 24,173 ac, 35.1%**

13



Land use Percentages: Horse Farms

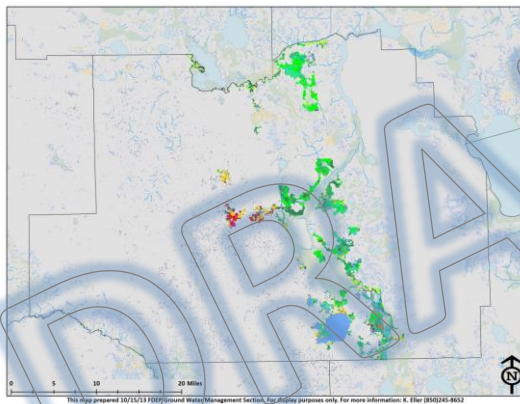


- ◊ EXAMPLE:
- Marion County Horse Farms
- ◊ Marion County- 68,845 ac
- ◊ BMAP Area- 28,541 ac, 41%
- ◊ **High Recharge- 24,173 ac, 35.1%**
- ◊ **Medium Recharge- 3,816 ac, 5.5%**

14



Land use Percentages: Horse Farms



- ◊ EXAMPLE:
- Marion County Horse Farms
- ◊ Marion County- 68,845 ac
- ◊ BMAP Area- 28,541 ac, 41%
- ◊ **High Recharge- 24,173 ac, 35.1%**
- ◊ **Medium Recharge- 3,816 ac, 5.5%**
- ◊ **Low Recharge- 551 ac, 0.8%**

15



Horse Farms: N in Waste



- ◊ Determined only 62% of population contributes N in the BMAP area based on a summary of information from horse farm visits by the Marion Co. Extension Office (J. Cohen)
- ◊ Estimated that 8,818 horses contribute N to the BMAP boundary
- ◊ Daily waste factor = 0.273 lb-N/day
- ◊ Input to land surface
 - ◊ **High Recharge: 692,255 lb-N**
 - ◊ **Medium Recharge: 152,727 lb-N**
 - ◊ **Low Recharge: 34,911 lb-N**

16



Horse Farms: Fertilizer N

- ◊ Land use data used to estimate the percentage of horse farms within each recharge area
 - ◊ Marion County, High Recharge
 - ◊ 56,412 ac all livestock lands
 - ◊ 24,173 ac horse farms
 - ◊ 43% horse farms
- ◊ Property appraiser data provided pasture and hay acreage
 - ◊ Estimate horse vs cattle pasture acreage
 - ◊ Application rates and frequencies (based on horse farm visits)
 - ◊ 26% at 30 lb-N /ac
 - ◊ 21% at 100 lb-N /ac
 - ◊ 53% no fertilization
 - ◊ Input to land surface
 - ◊ **High Recharge: 702,191 lb-N**
 - ◊ **Medium Recharge: 122,406 lb-N**
 - ◊ **Low Recharge: 21,424 lb-N**



17



Cattle Farms: N in Waste

- ◊ Full county data multiplied by the land use percentages
- ◊ Estimated 21,180 cows and 14,752 calves within BMAP boundary
- ◊ Daily waste factor
 - ◊ Cow: 0.337 lb-N
 - ◊ Calf: 0.068 lb-N
- ◊ Calves spend approximately 6 months in Florida
- ◊ Input to land surface
 - ◊ **High Recharge: 1,343,692 lb-N**
 - ◊ **Medium Recharge: 1,086,652 lb-N**
 - ◊ **Low Recharge: 359,432 lb-N**



18



Cattle Farms: Fertilizer N



- ◊ Improved and semi-improved pastures and hay fields are fertilized
 - ◊ 81,561 ac
- ◊ Land areas calculated from property appraiser data
- ◊ 17 lb-N/ac application rate
- ◊ Input to land surface
 - ◊ **High Recharge: 728,752 lb-N**
 - ◊ **Medium Recharge: 490,587 lb-N**
 - ◊ **Low Recharge: 167,205 lb-N**

19



Miscellaneous Livestock Waste

- ◊ BMAP populations estimated with land use percentages
 - ◊ 337 broiler chickens
 - ◊ 2,912 layer chickens
 - ◊ 2,396 goats
 - ◊ 767 hogs
 - ◊ 605 sheep
 - ◊ 99 turkey
- ◊ Daily waste factors applied
- ◊ Input to land surface
 - ◊ **High Recharge: 80,890 lb-N**
 - ◊ **Medium Recharge: 53,616 lb-N**
 - ◊ **Low Recharge: 15,792 lb-N**



20



Crop Fertilizer N

- ◊ Property appraised land use data was compiled
 - ◊ Each county was evaluated individually
 - ◊ Land areas for specific crops were estimated
 - ◊ Application rates based on IFAS recommendations (lb-N/ac)
 - ◊ 0: Peanuts
 - ◊ 80: Ornamentals, sod
 - ◊ 120: Cotton, watermelons, corn
 - ◊ 150: Citrus, Orchards
- ◊ Input to land surface
 - ◊ **High Recharge: 501,255 lb-N**
 - ◊ **Medium Recharge: 161,809 lb-N**
 - ◊ **Low Recharge: 145,022 lb-N**

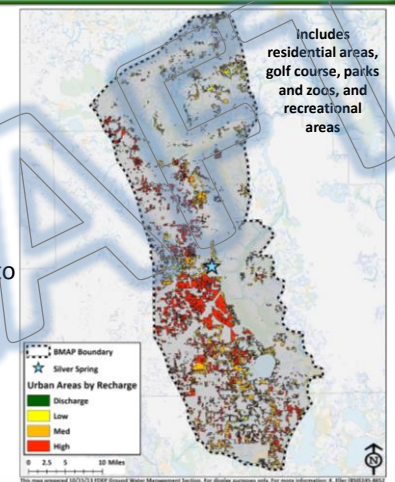


21



N in Fertilizers: Urban uses

- ◊ FL Dept of Ag Fertilizer Sales Data
 - ◊ Annual data
 - ◊ Total Fertilizer Sold
 - ◊ Total N in Fertilizer Sold
 - ◊ Total Fertilizer for Non-Farm Applications
 - ◊ Full County data ONLY
- ◊ Land use percentages were used to appropriate the fertilizers applied with the BMAP boundary
- ◊ Input to land surface
 - ◊ **High Recharge: 437,130 lb-N**
 - ◊ **Medium Recharge: 474,143 lb-N**
 - ◊ **Low Recharge: 116,846 lb-N**

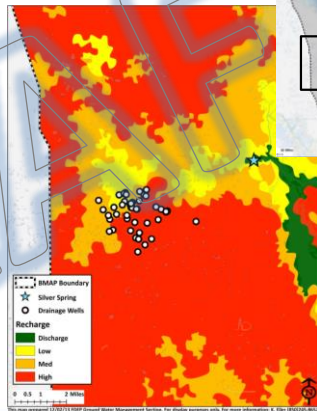


22



Storm water runoff to drainage wells

- ◊ 42 City of Ocala drainage wells
 - ◊ 33% in Low Recharge
 - ◊ 21% in Medium Recharge
 - ◊ 45% in High Recharge
- ◊ Runoff curve numbers and event mean N concentrations (H. Harper, 2011) used to calculate N loads for each sub-basin land use
- ◊ Ave. annual rainfall of 50.8 in/yr
- ◊ **Storm water N input to wells**
 - **High Recharge: 18,230 lb-N**
 - ◊ **Medium Recharge: 8,635 lb-N**
 - ◊ **Low Recharge: 13,433 lb-N**

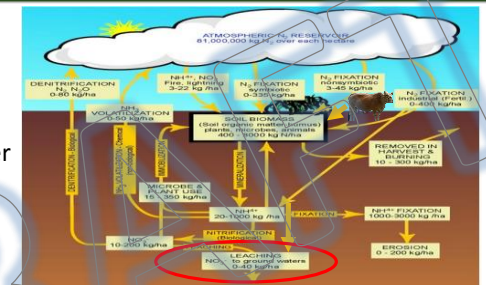


23



Environmental Attenuation Factors (EAFs)

- ◊ EAFs represent the percentage of N removed and therefore not available for leaching to groundwater
- ◊ Examples
 - ◊ Volatilization
 - ◊ Plant uptake
 - ◊ Denitrification
- ◊ Based on factors used in similar past studies and found in relevant literature



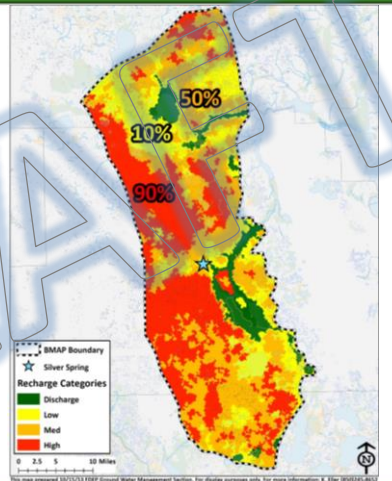
Loading Category	Attenuation Factor
Atmospheric Deposition	90%
Wastewater Treatment Facilities	60%
Septic Tanks	40%
Urban Fertilizers	80%
Crop Fertilizers	70%
All Livestock	90%
Drainage Wells	35%

24



Recharge Factors

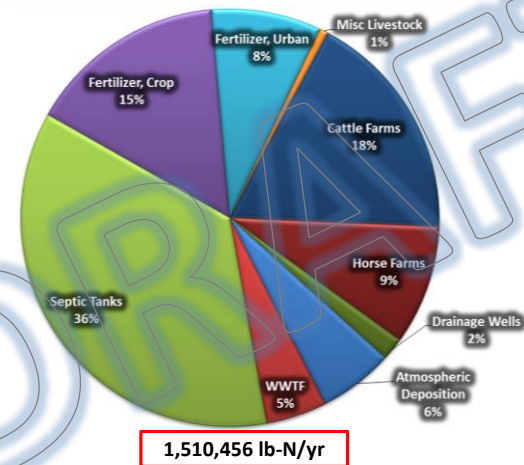
- Recharge factors are used to estimate the percentage of the non-attenuated nitrogen expected to reach the aquifer
- Drainage wells are direct conduits to the aquifer; therefore, recharge factors not applied



25

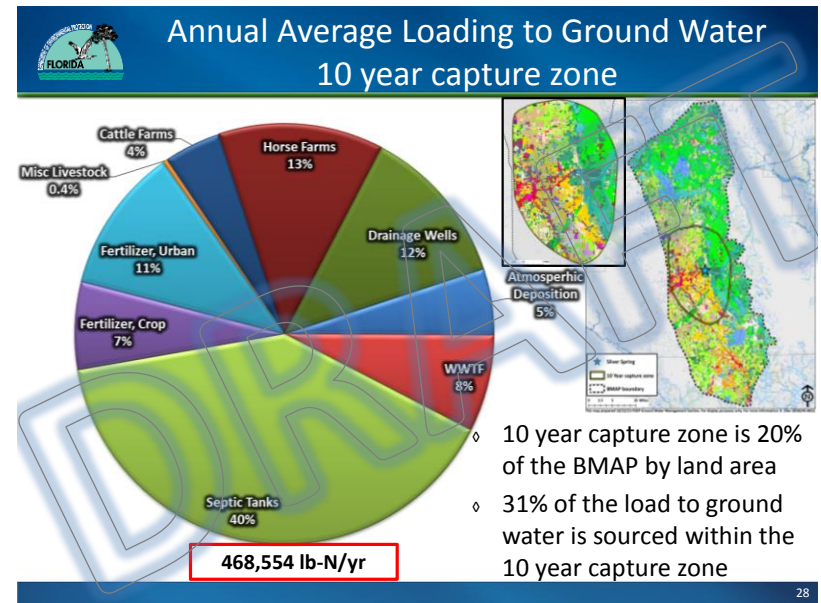
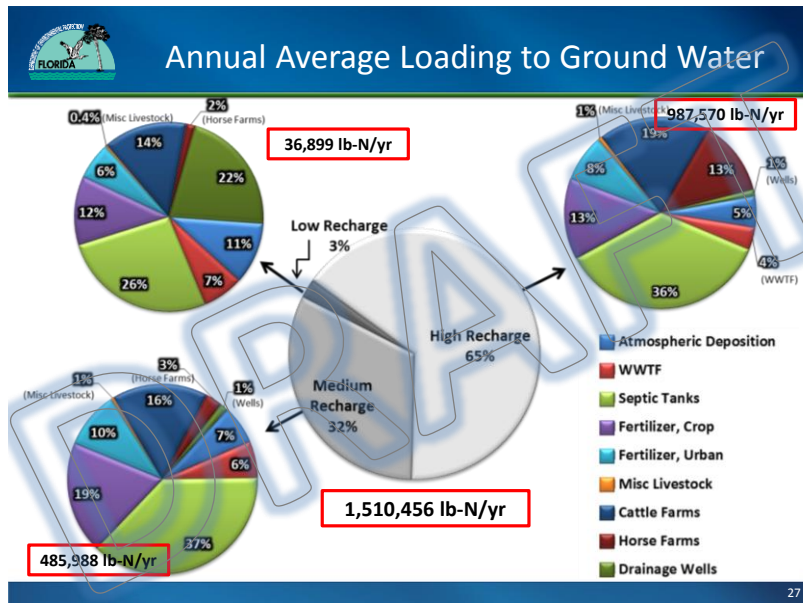


Annual Average Loading to Ground Water



1,510,456 lb-N/yr

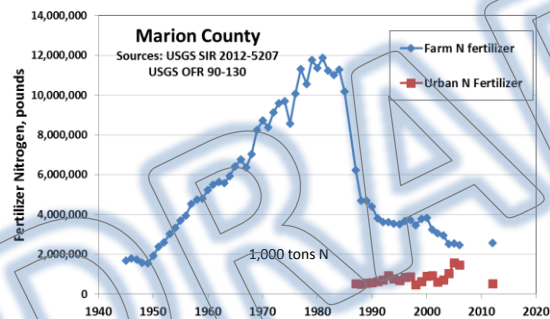
26





Legacy nitrogen in the subsurface

County Fertilizer Sales Data

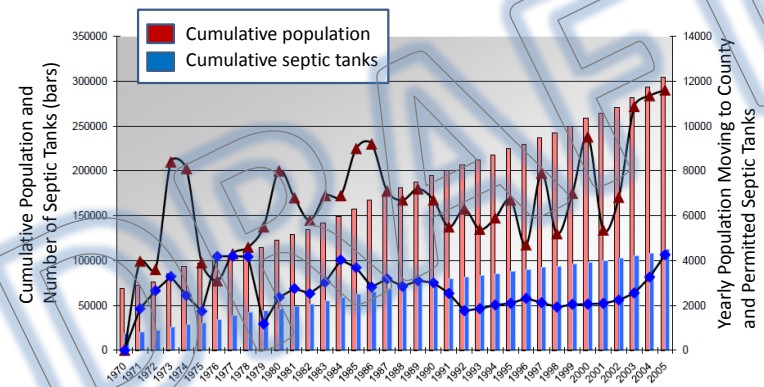


**** Legacy nitrate from commercial fertilizer applications several decades ago could still be in the subsurface and moving toward springs.**

29



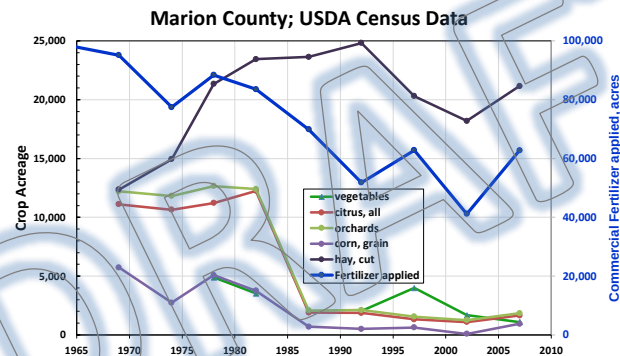
Population and Septic Tanks, 1970-2005



30



Historical Crop Acreage and Commercial Fertilizer Applications

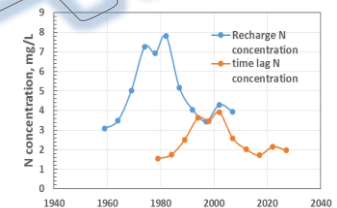
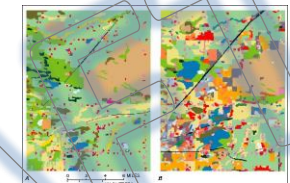


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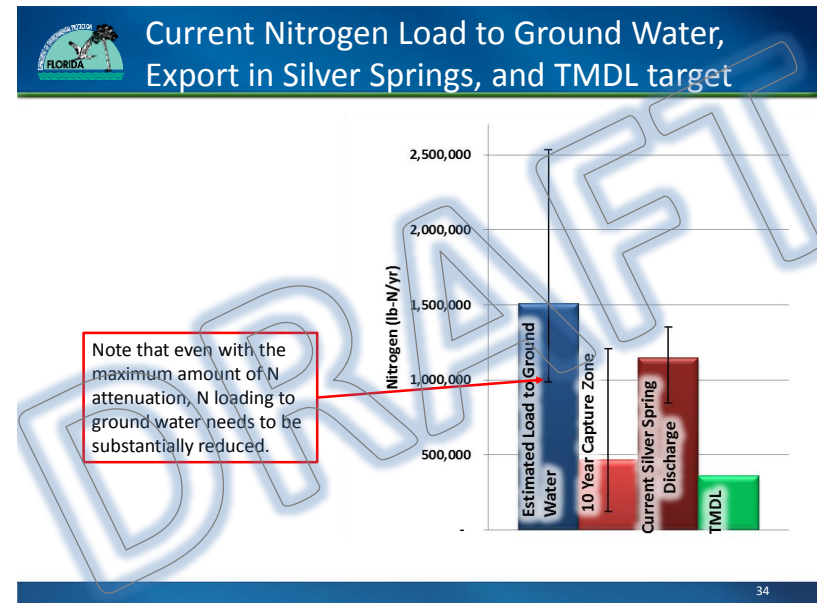
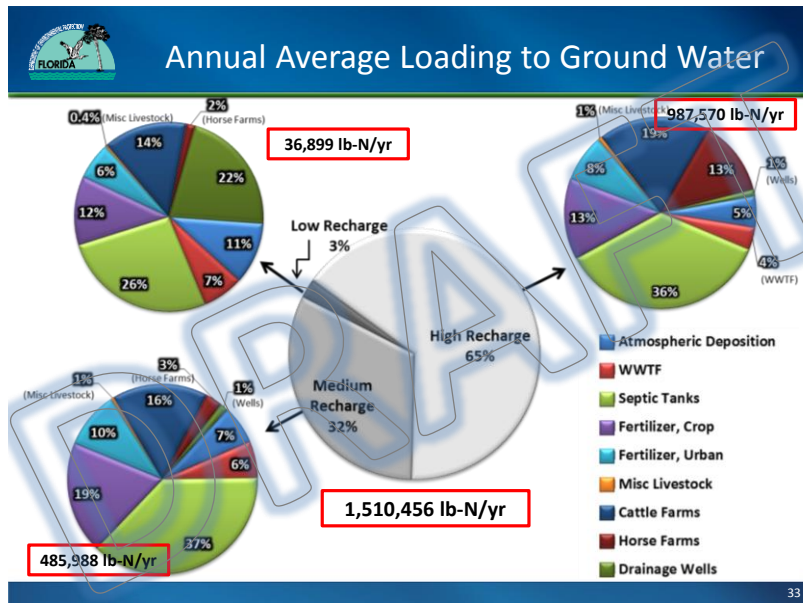


Next Steps

- Compile historical information on wastewater and other N sources
- Compare historical land use information from past GIS datasets
- Analyze nitrate data from multiple agencies to look at changes and trends in nitrate concentrations in ground water over time
- Estimate the time required for legacy nitrate to discharge from ground water system



32





QUESTIONS??



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