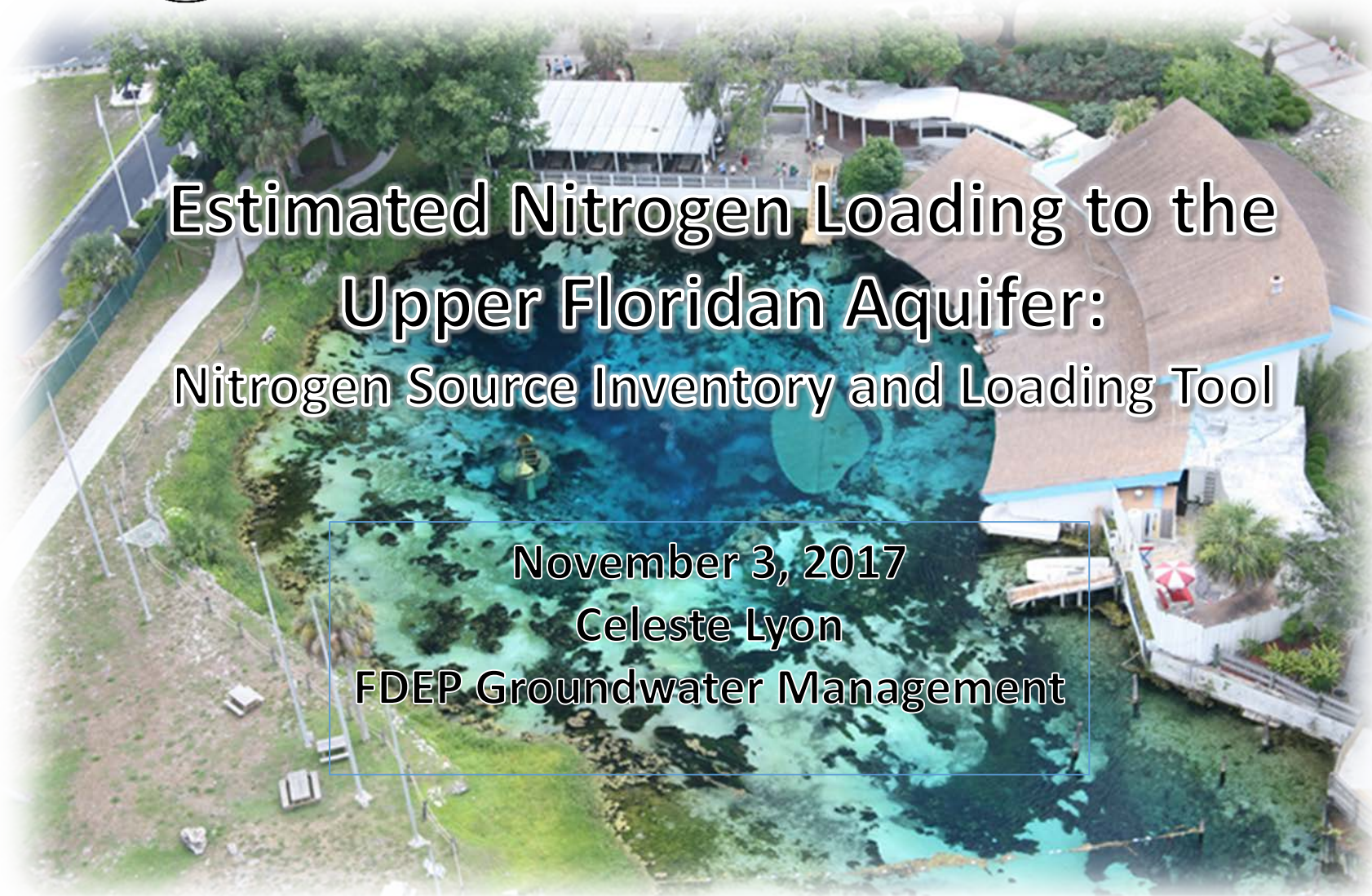
Florida Department of Environmental Protection

Division of Environmental Assessment and Restoration

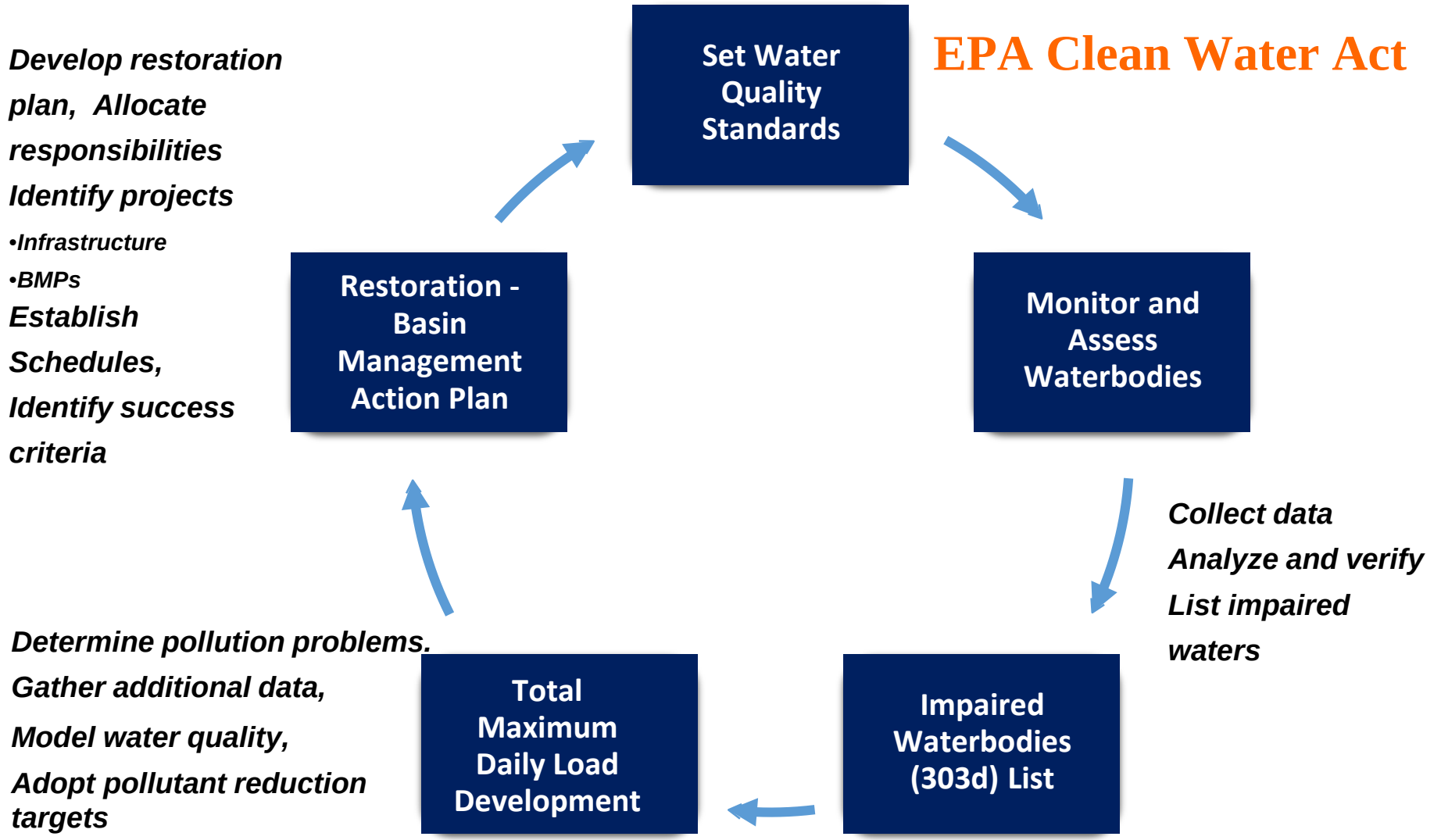


Estimated Nitrogen Loading to the Upper Floridan Aquifer:

Nitrogen Source Inventory and Loading Tool

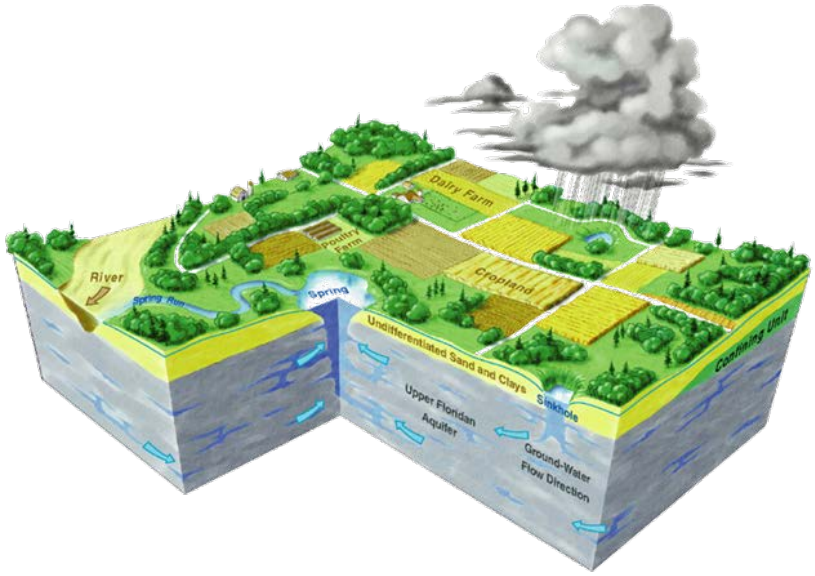
November 3, 2017
Celeste Lyon
FDEP Groundwater Management

FDEP Water Quality Protection Framework



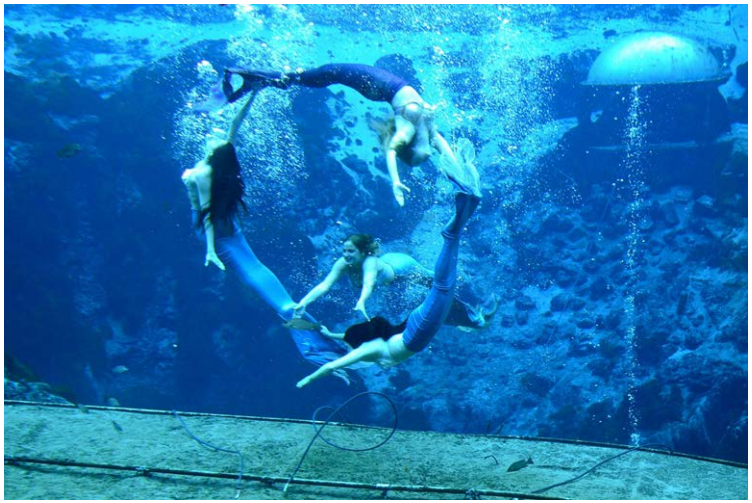
Nitrate-Impaired Spring Waters

- The water quality in several Outstanding Florida Springs is impaired due to elevated nitrate concentrations
- Many sources contribute nitrogen in each springshed:
  - atmospheric deposition
  - urban turfgrass fertilizers
  - sports turfgrass fertilizers
  - septic tanks
  - land application of wastewater
  - livestock manure
  - farm fertilizers



Nitrogen Source Inventory and Loading Tool

- Estimate N loading to ground water within BMAP areas
- Identify sources for which reductions in N loading could achieve restoration of impaired waters
- Customize for individual spring basins
- Inventories have been completed for Wakulla, Silver, Rainbow, Kings Bay, Jackson Blue Springs, Suwannee, Wekiva, Chassahowitzka, Homosassa, and Weeki Wachee BMAP areas

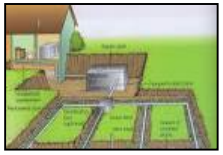


Estimating Nitrogen Loads to Ground Water

Steps:

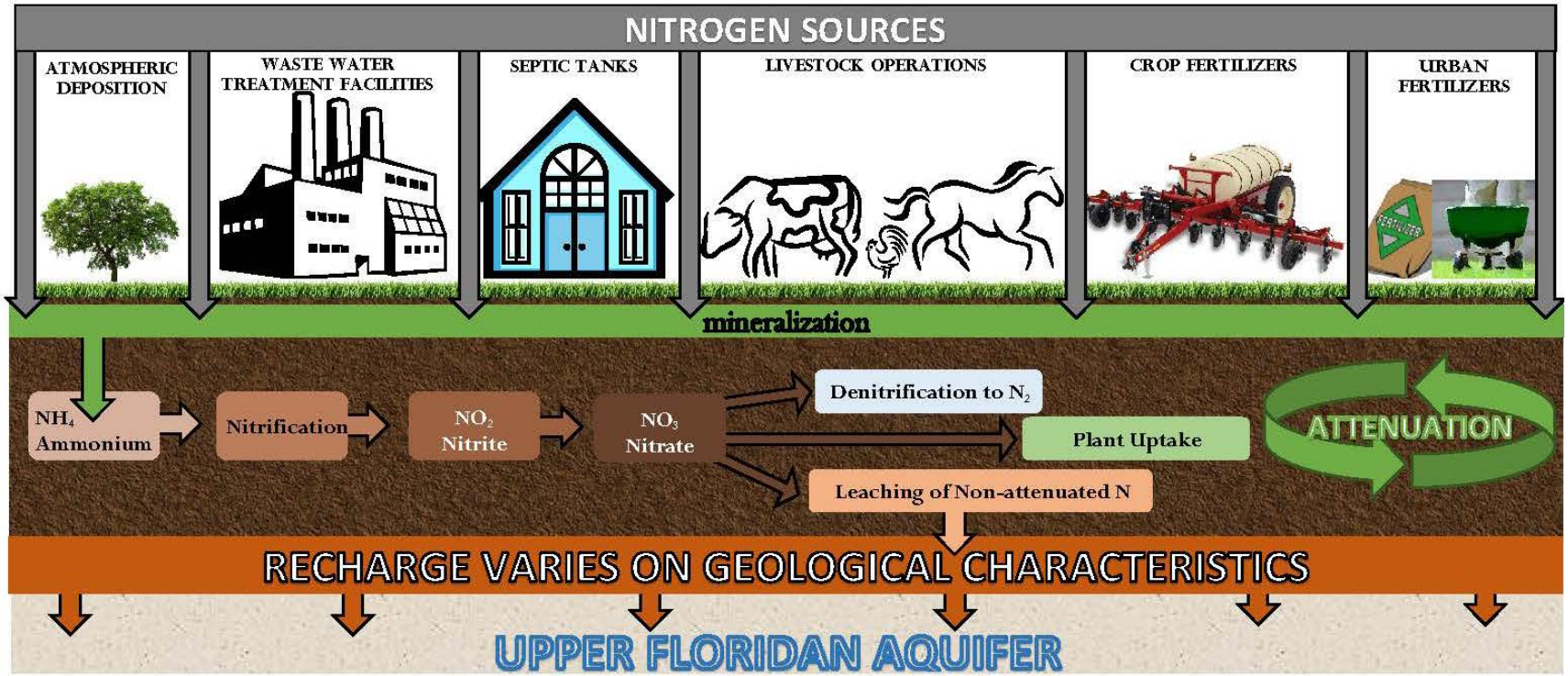
1. Estimate the inputs of nitrogen to the land surface from the source inventory information (best available).
2. Apply attenuation factors based on the various environmental processes that could transform the various forms of nitrogen in the subsurface (such as denitrification, nitrification of ammonia,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








Nitrogen Cycle and Nitrogen Attenuation

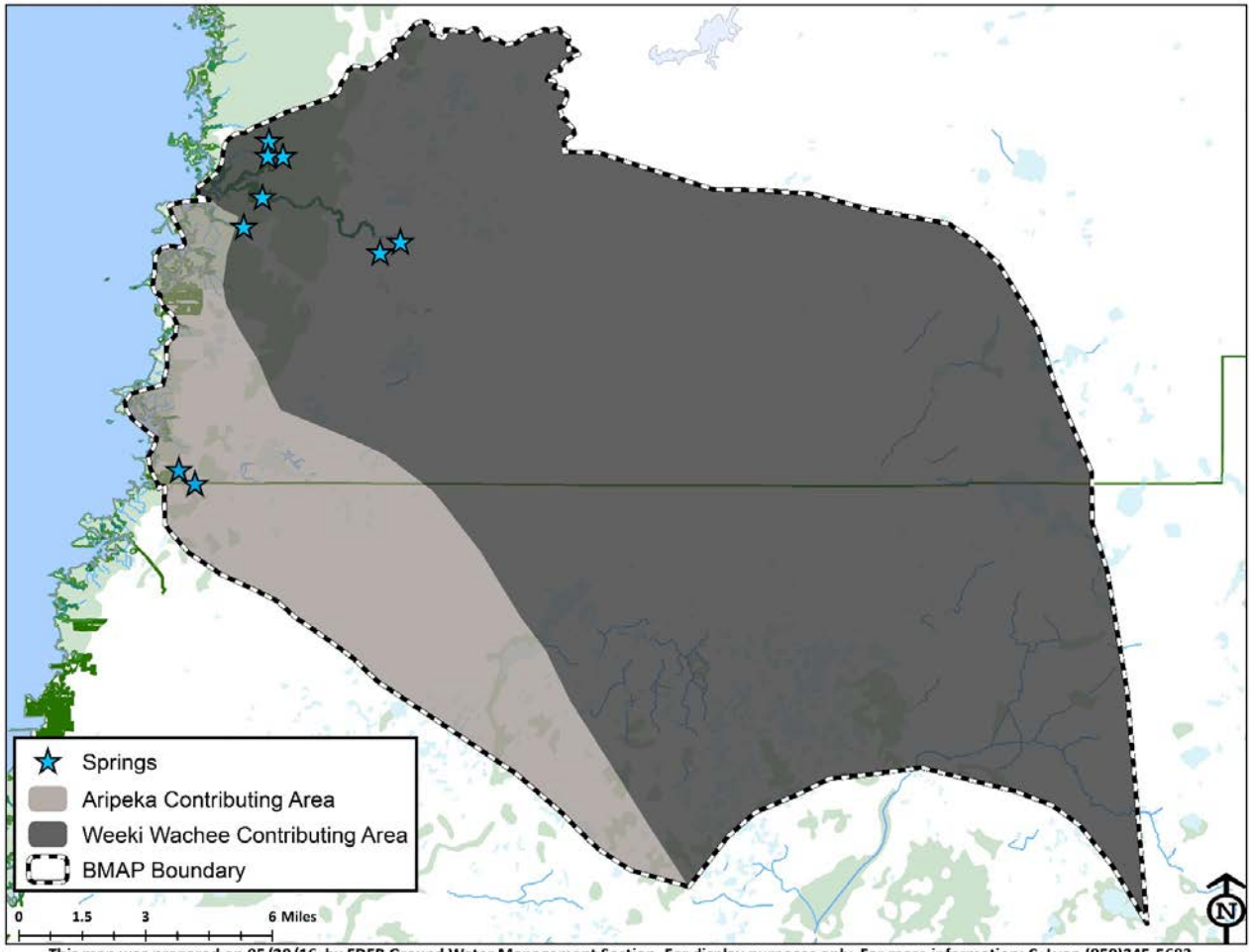


Processes that control the transformation of N in soils and the subsurface.

The wide ranges reflect variable soil conditions, fertilizer material, livestock, crop types, etc.,

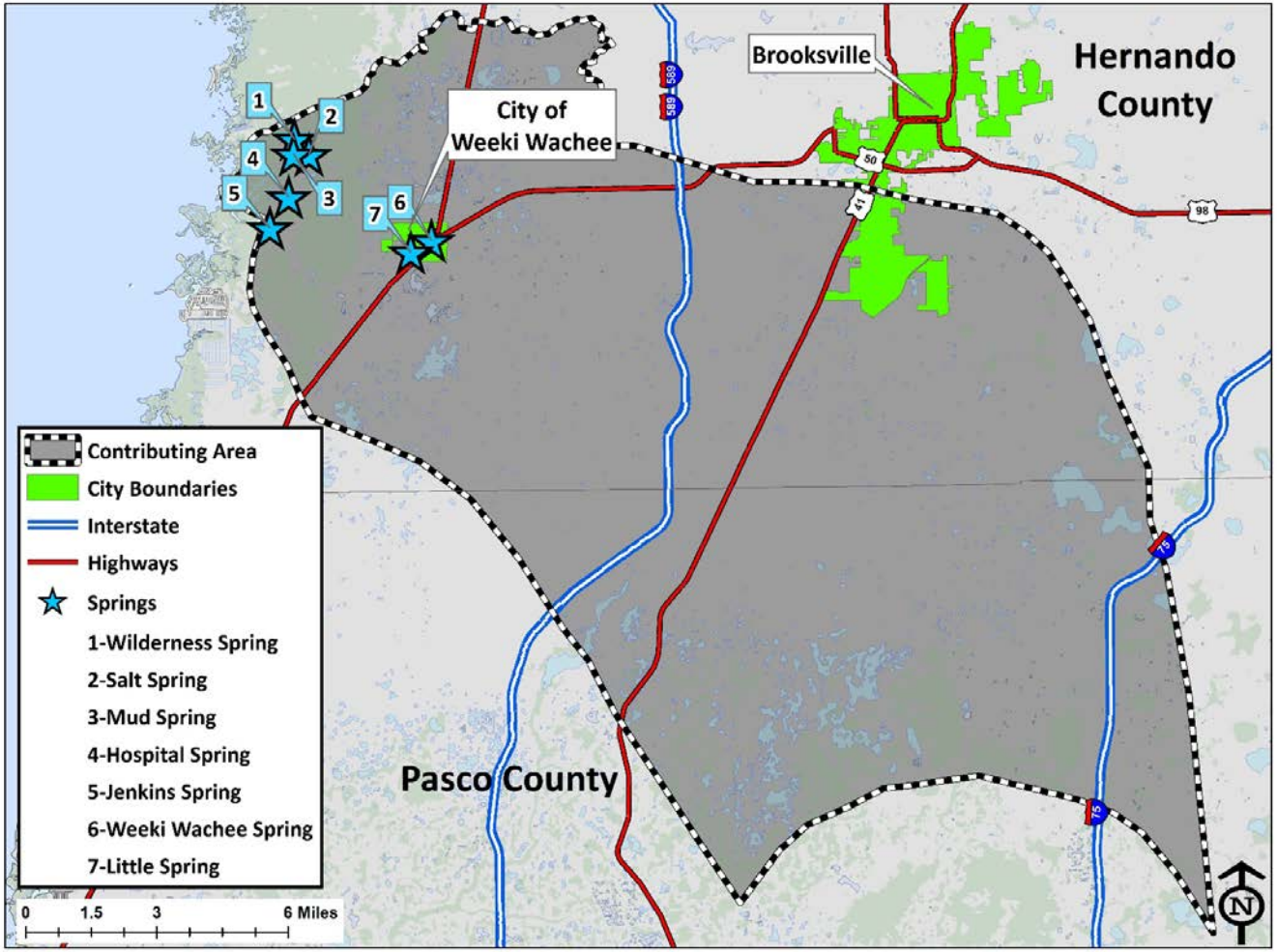
ALL AFFECT LEACHING OF N TO GROUND WATER

BMAP Boundary

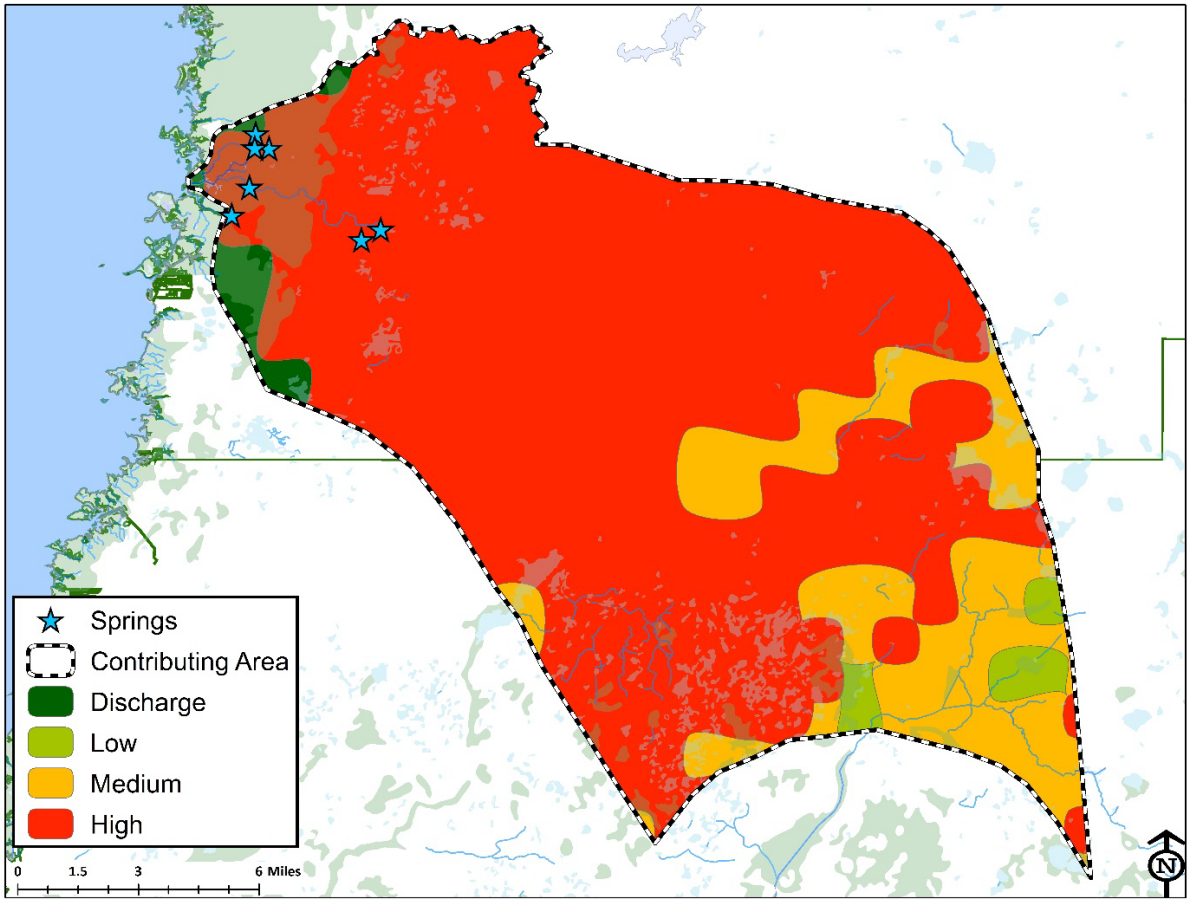


This map was prepared on 05/20/16 by FDEP Ground Water Management Section. For display purposes only. For more information: C. Lyon (850)245-5683.

Weeki Wachee Contributing Area



Ground Water Recharge Areas

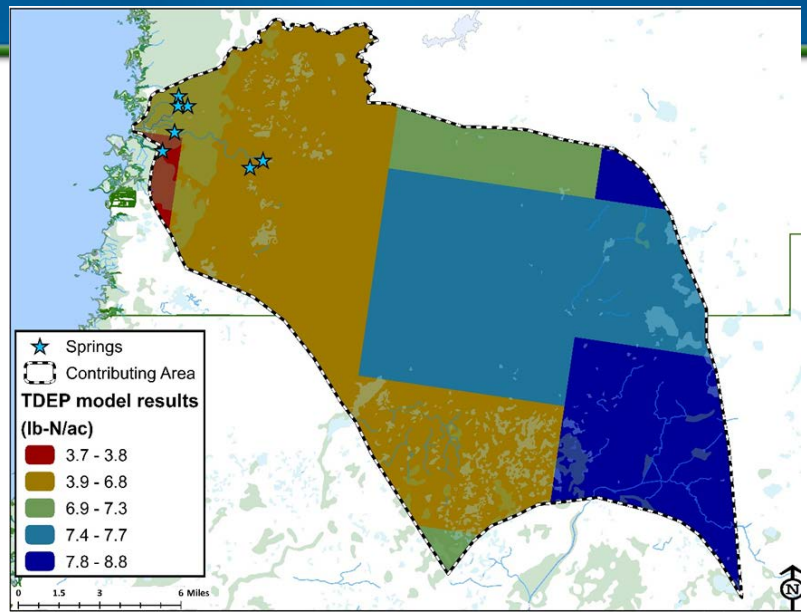


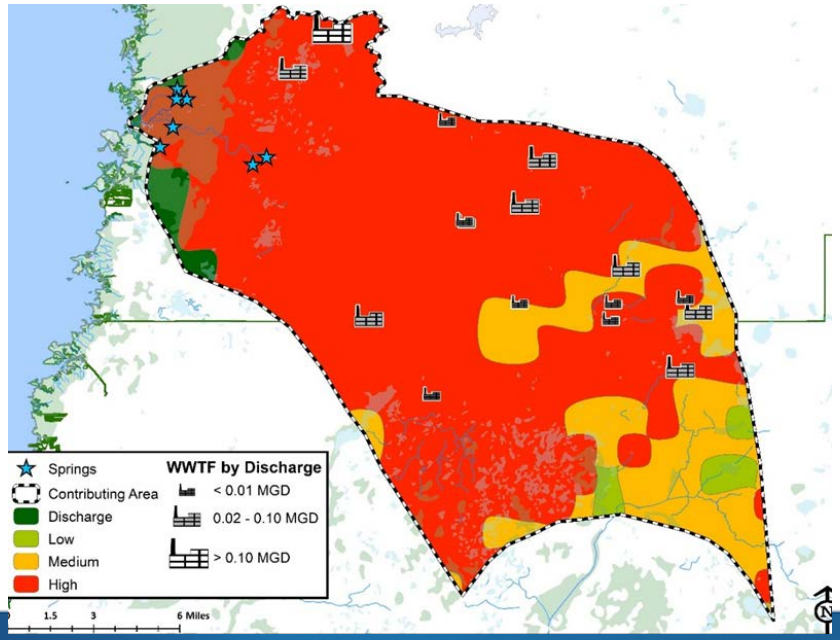
- Inputs to land and loads to groundwater are calculated by recharge region within the springshed
- Quantify the rate of recharge to the UFA within the WW contributing area
  - High Recharge: >10 in/yr
  - Medium Recharge: 3-10 in/yr
  - Low Recharge: 0-3 in/yr
- Rates are weighted to estimate loading potential for each source category

The amount of nitrate that is transported to the UFA in a given year is related to the rate of recharge to the aquifer

Methods Summary

- Atmospheric Deposition
  - Estimated deposition based on monitoring stations and modeled atmospheric concentrations
  - Model year is an average from 2011 to 2013
- Average TN deposition
  - Range 3.7-8.8 lb-N/ac/yr

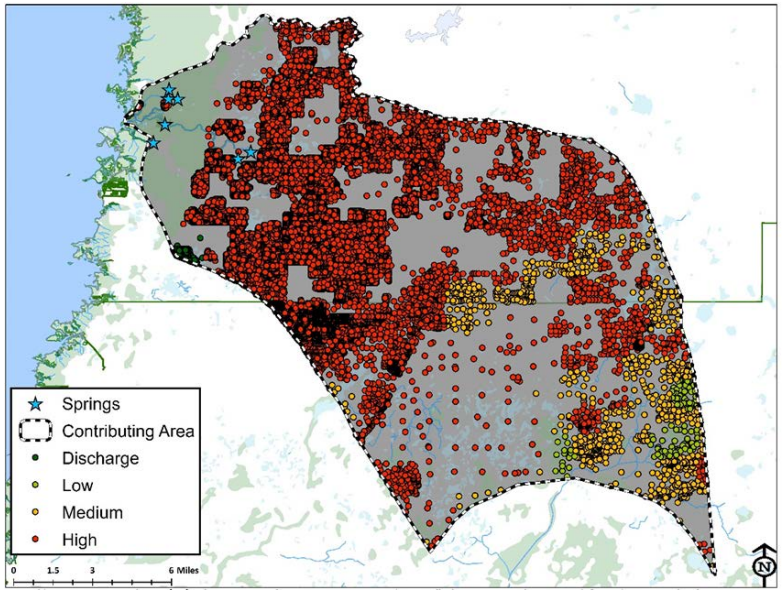




- Wastewater Treatment Facilities
  - Effluent data separated based on treatment type
    - RIBs, Absorption Fields
    - Sprayfields
    - Reuse
  - NO3 used to project TN data, if necessary

Methods Summary

- Septic Systems
  - Estimate number of people on systems
    - Florida Water Management Inventory
    - # of septic tanks verified by FDOH
    - People per household
  - Calculate input by factoring in annual N contribution per person
    - Average annual input to septic tank = 9.012 lb-N/person (US EPA)



Animal	DWF (lb-N/day)
Beef Cattle	0.337
Dairy Cow	0.977
Broiler Chickens	0.159
Goats	0.035
Hogs	0.190
Sheep	0.198
Turkey	0.006
Horses	.273

- Livestock Waste
  - Estimate livestock populations within contributing area based on:
    - 2012 Census of Agriculture data
    - Land use data
  - Daily waste factors are applied based on individual animal nitrogen excretion

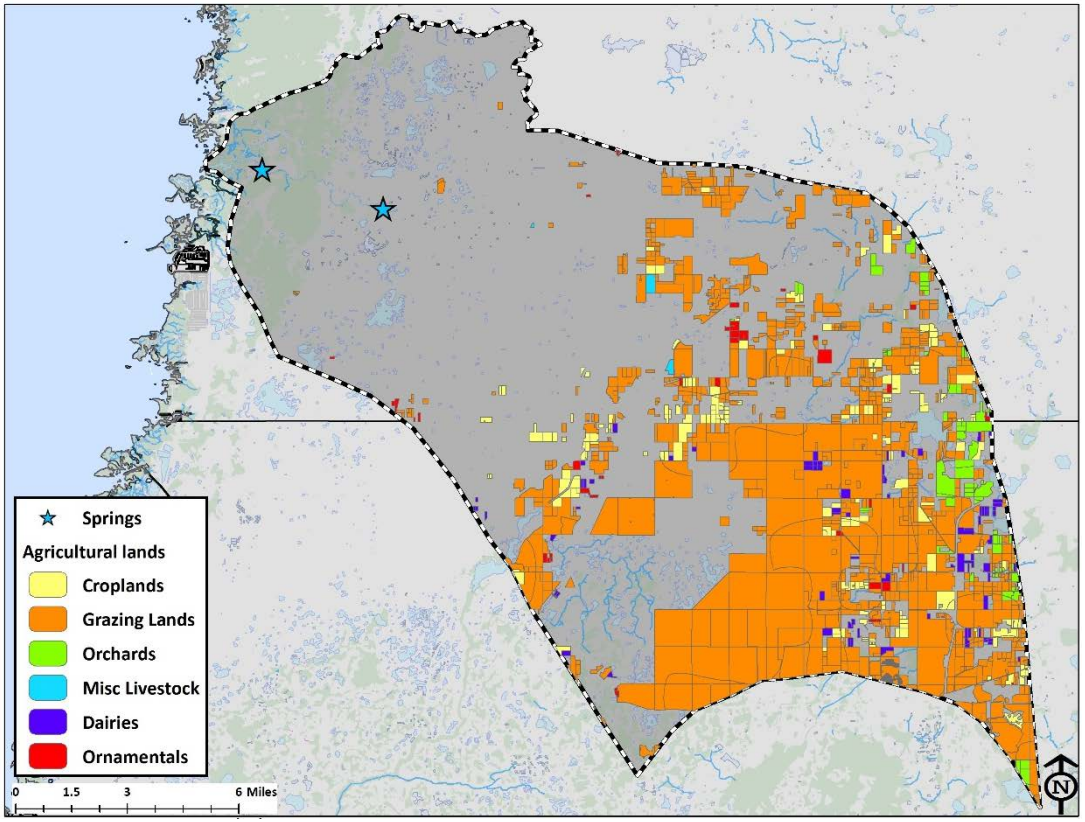
Methods Summary

Animal	Estimated BMAP population
Beef Cattle*	6,270
Dairy Cows	539
Horses	2,367
Broiler Chickens	659
Goats	1,380
Hogs	298
Sheep	334
Turkey	31

*Beef Cattle population estimated based on a stocking rate vetted by local agricultural producers of 8 ac per cow

Use County-level land use information to estimate livestock population within the springshed

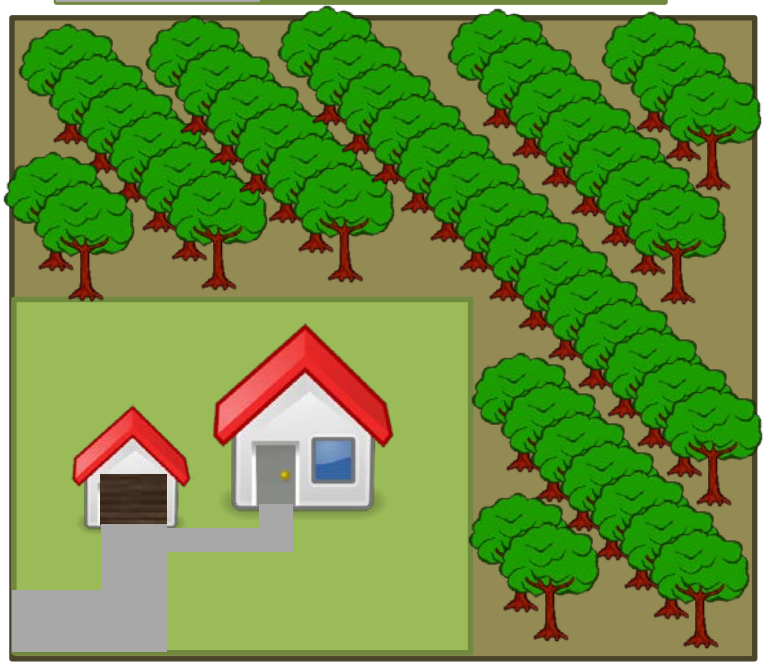
Methods Summary



- Farm Fertilizers
  - Property appraiser land use data was compiled
  - Each county was evaluated individually
  - Land areas for specific crops were estimated
  - Application rates based on IFAS recommendations and farmer feedback
  - Moving forward with FSAID
    - Statewide Agricultural Irrigation Demand Geodatabase

Methods Summary

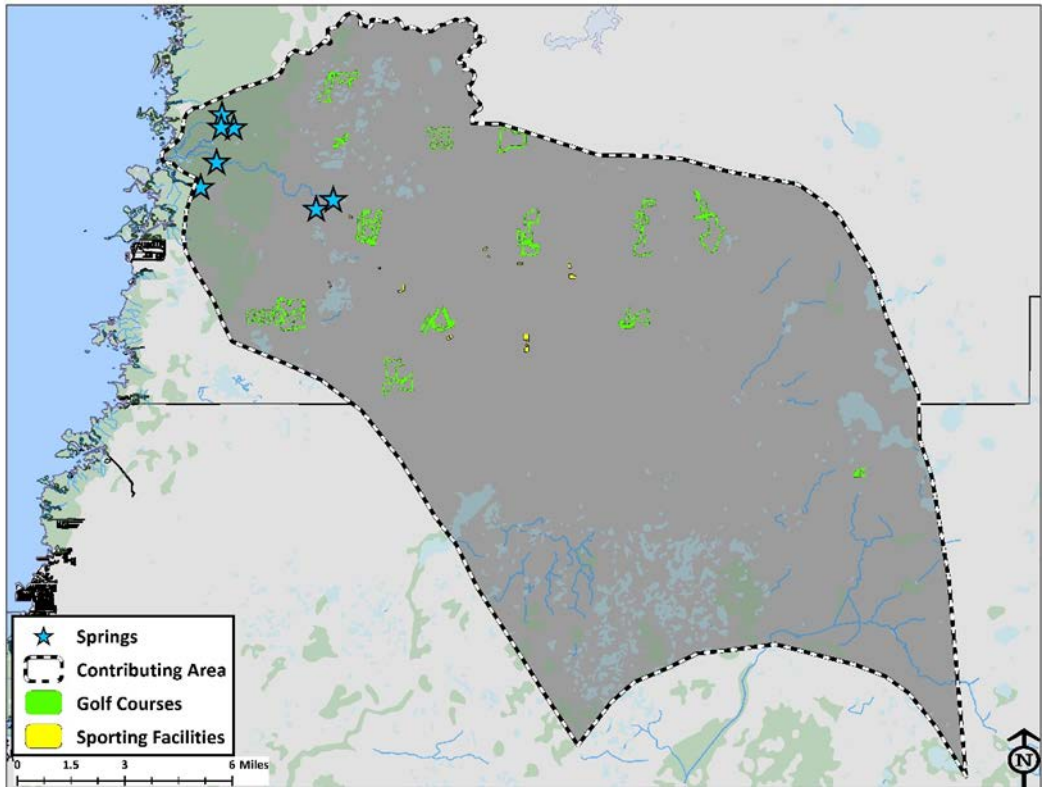
- Urban Turfgrass fertilizer
- Acreage likely to receive fertilizer estimated from PA data and property values
  - Residential
  - Non-residential
- Zoning information to determine impervious, and therefore not fertilized, land area
- Maximum fertilizable acreage was capped at 1 acre
- Property values used to assess probability of fertilization
- Annual Application Rates and Frequencies based on SWFWMD Study
  - 51% fertilized by owners
    - 2.98 times year
  - 33% fertilized by lawn service
    - 2 times a year
  - 16% non-fertilized



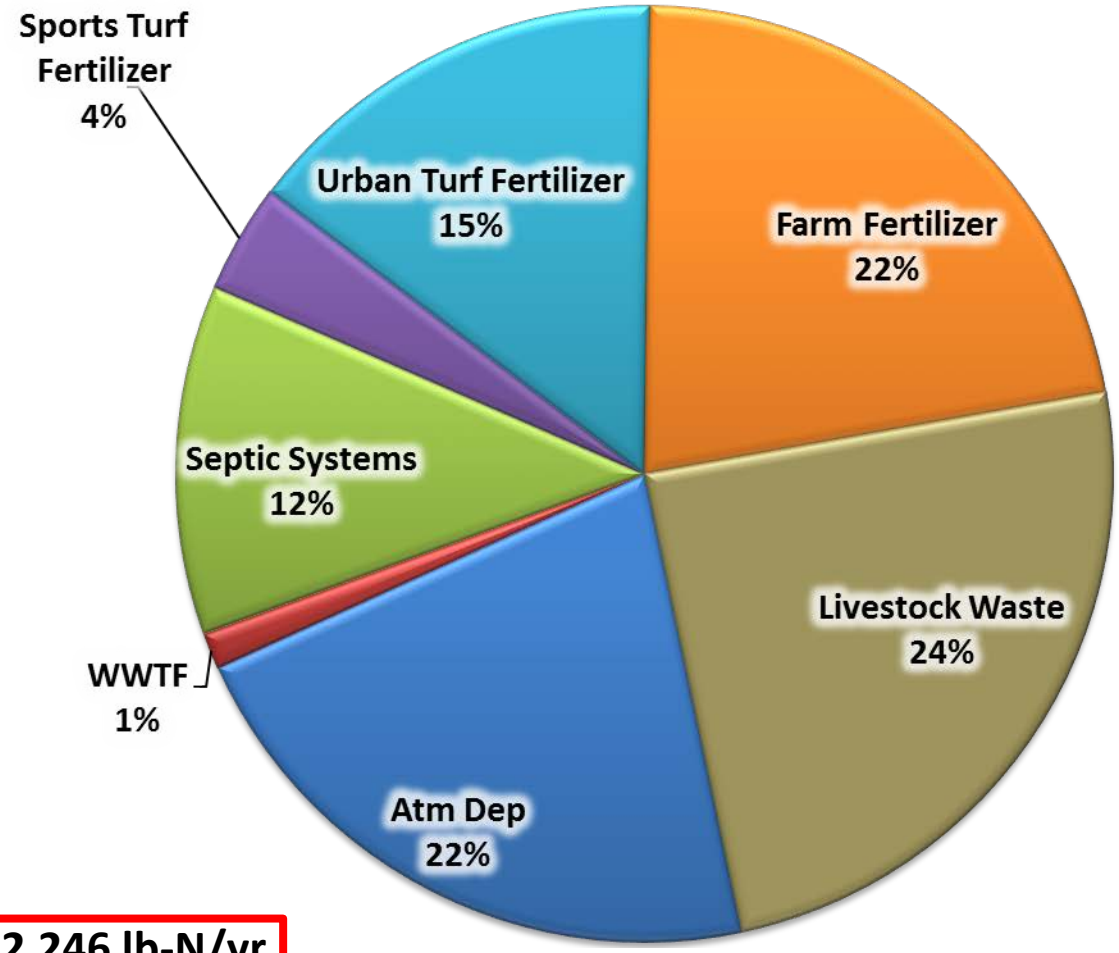
Methods Summary

- Sports Turfgrass Fertilizers
  - Sports fields (ie baseball fields, football fields)
  - Acreage estimates from aerial analysis of PA landuse data
  - Application rates based on lawn service company estimates

- Golf Courses
  - Acreage estimated through PA landuse data
  - Application rates based on data provided by golf courses
  - Annual application rate = 4.5 lb-N/1,000 sq ft

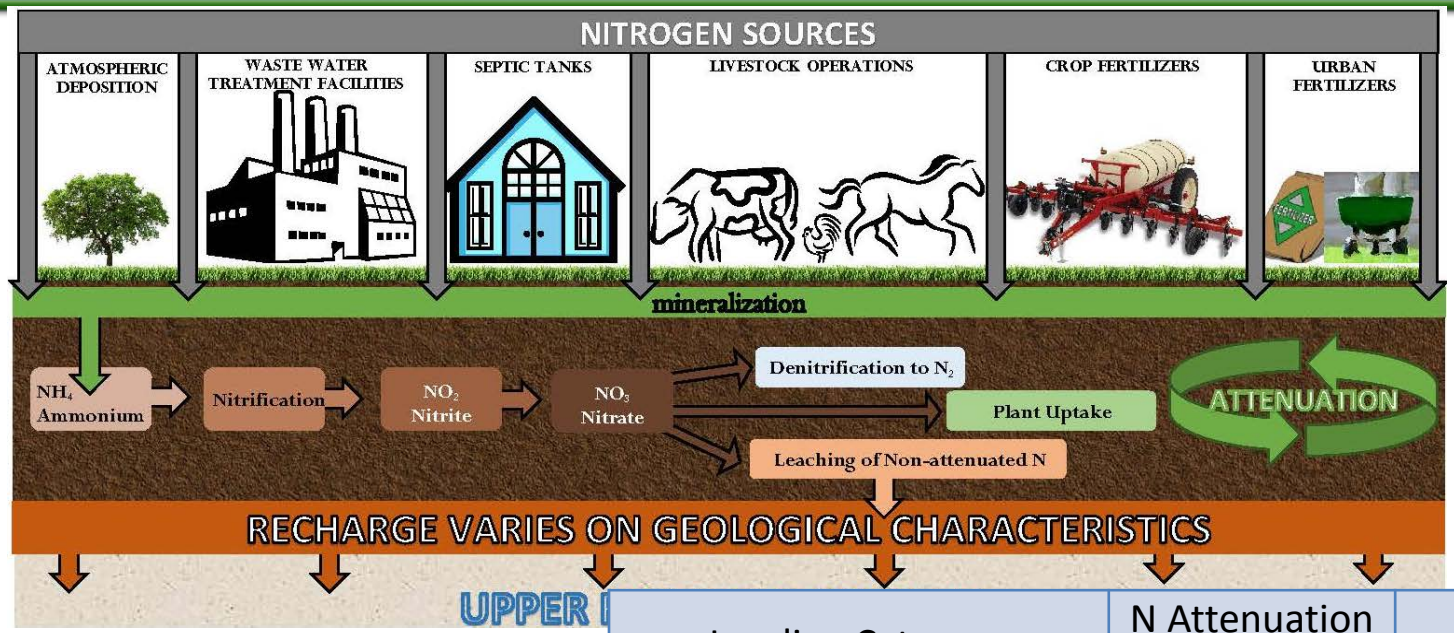


Estimated Annual Input to Land Surface



5,312,246 lb-N/yr

Biochemical Attenuation Factors

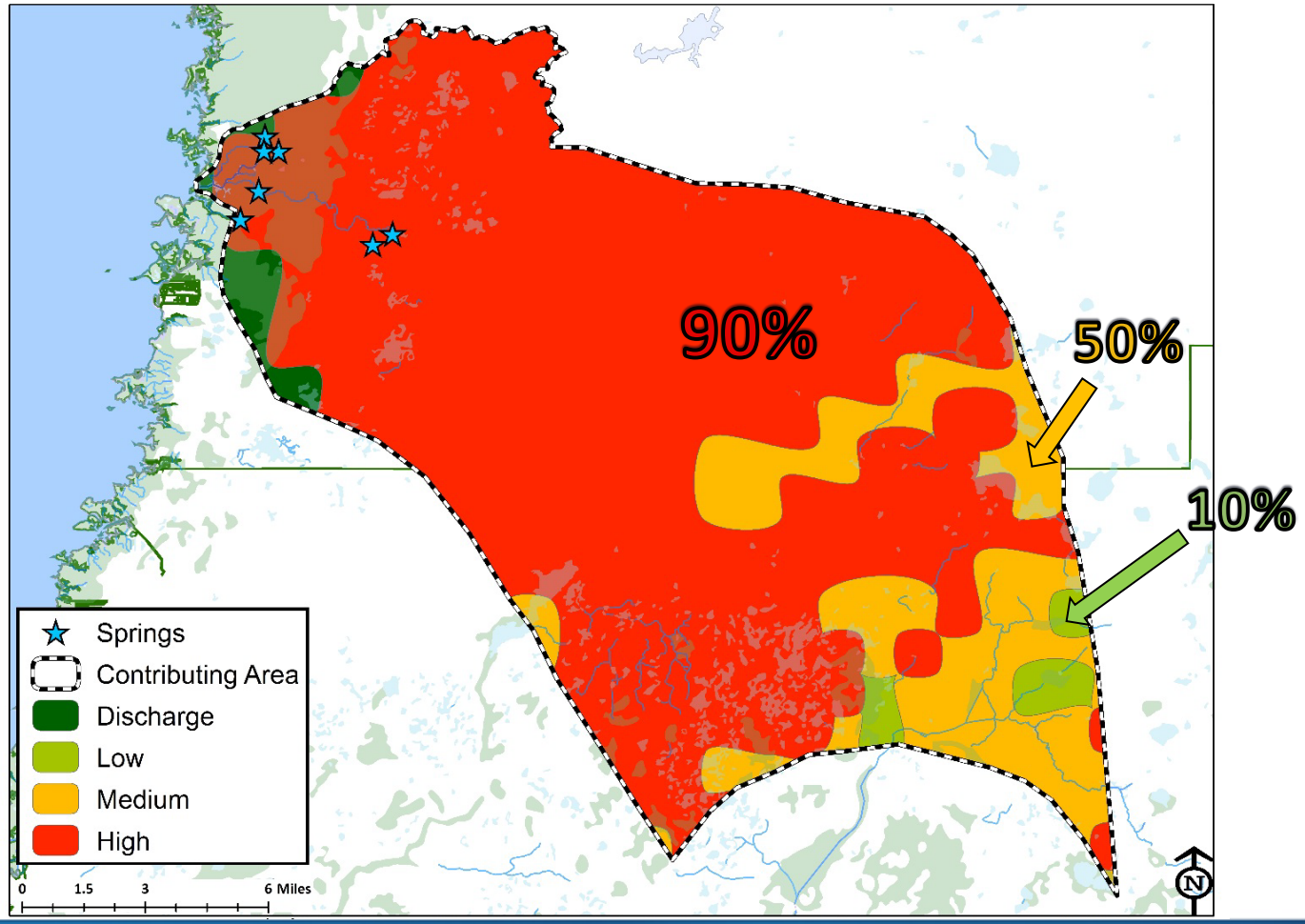


- Represent the percentage of N removed and therefore not available for leaching to groundwater
- Based on factors used in similar past studies and found in relevant literature

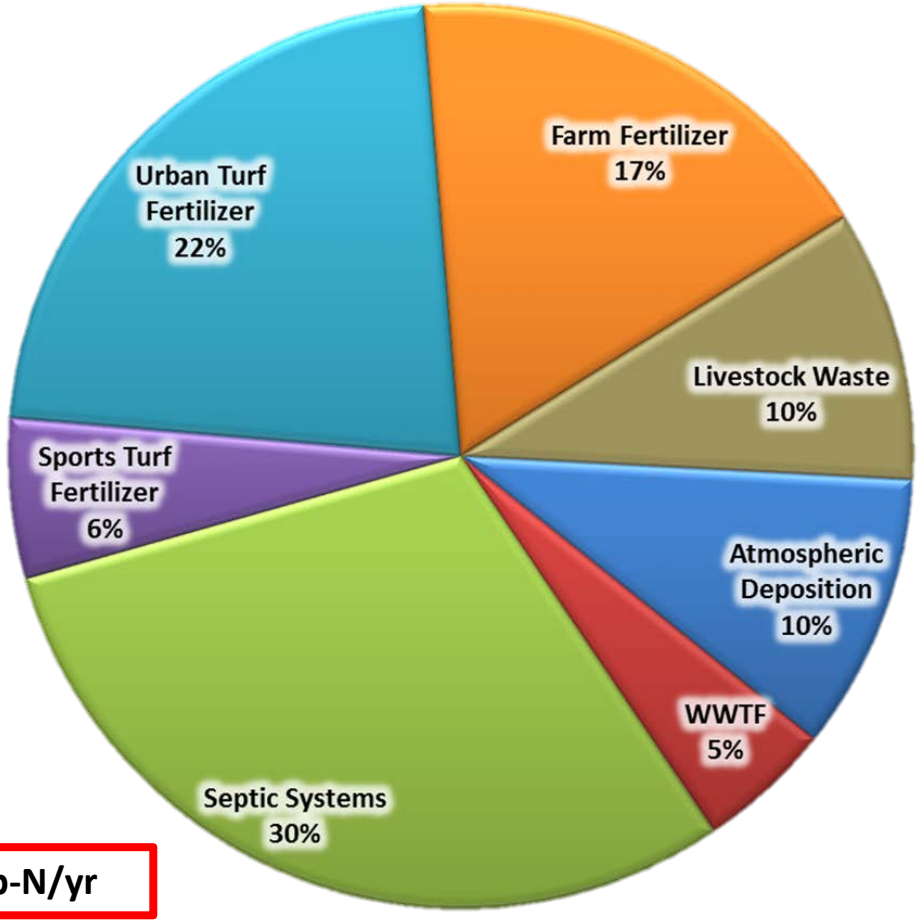
Loading Category	N Attenuation Factor	N Leaching
Atmospheric Deposition	90%	10%
Septic Systems	50%	50%
WWTF-RIB	25%	75%
WWTF-Sprayfield	60%	40%
WWTF-Reuse	75%	25%
Urban Turfgrass Fertilizers	70%	30%
Sports Turfgrass Fertilizers	70%	30%
Farm Fertilizers	80%	20%
Livestock	90%	10%

Hydrogeological Attenuation Factors Based on Recharge to UFA

- Recharge factors are used to estimate the percentage of the non-attenuated nitrogen expected to reach the aquifer in a year

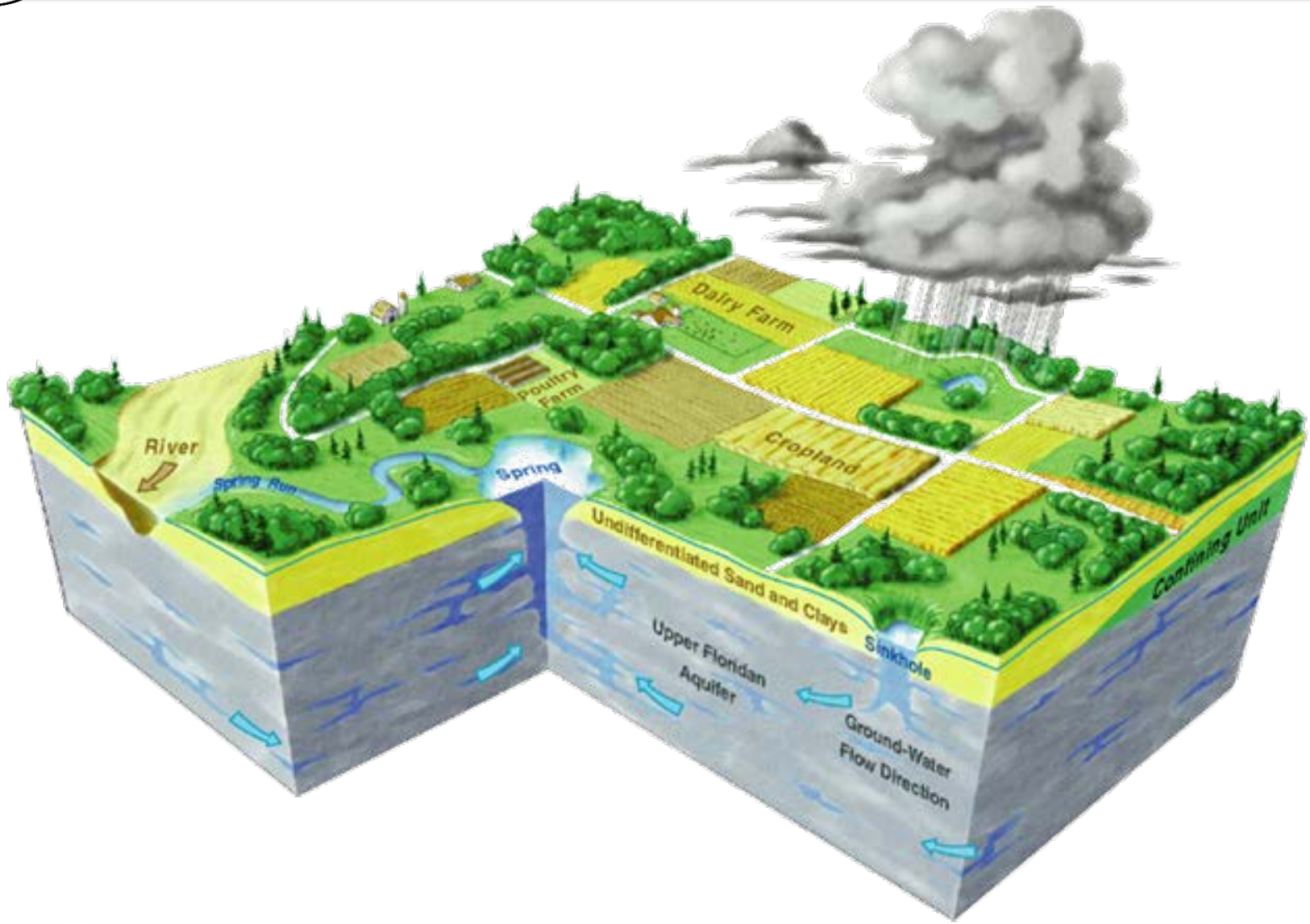


Estimated Annual Average Loading to Ground Water

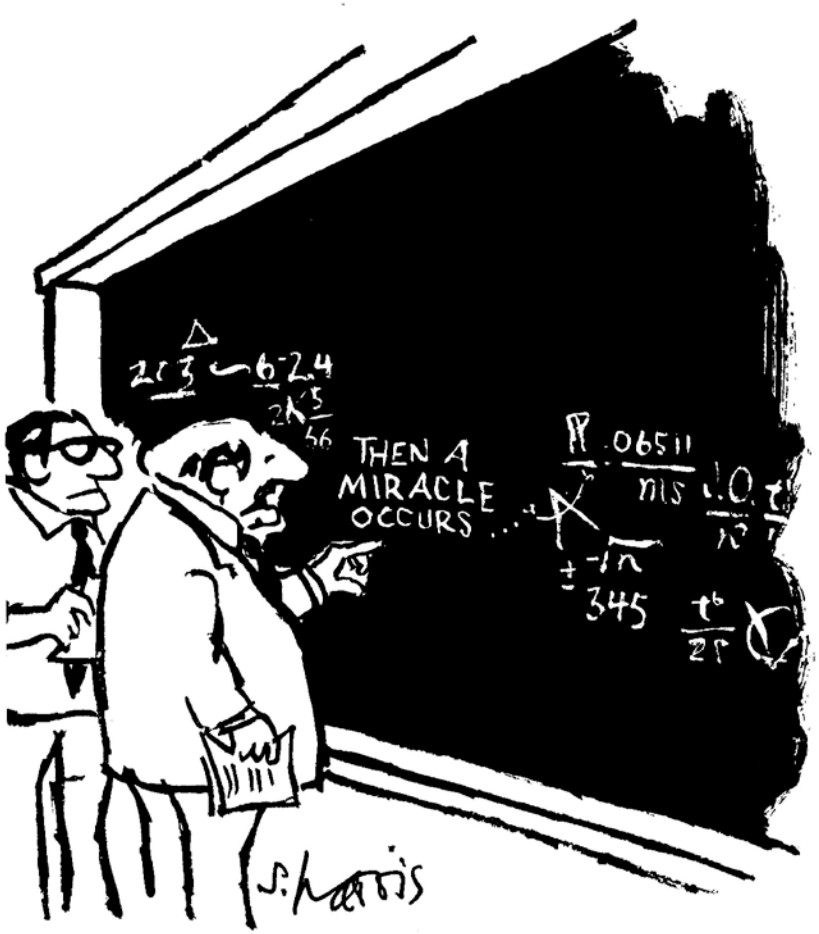


928,021 lb-N/yr

Estimating the Load to the Top of the Aquifer



What happens from there?



"I think you should be more explicit here in step two."

QUESTIONS??