Onsite Systems, Nitrogen and Springs Protection

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Jackson County

Eberhard Roeder, Ph.D., P.E.
Professional Engineer III
Bureau of Onsite Sewage Programs
Division of Environmental Health
Florida Department of Health

Outline

- Onsite Systems, Karst and Nitrogen
- Advanced Onsite Systems
- Onsite Management
- Springs Protection and advanced onsite systems

Onsite Sewage Treatment and Disposal Systems

- Treated and disposed of at the location where it is generated (on property)
- Uses standard septic tank, aerobic treatment unit, or performance based treatment system, and subsurface drainfield.
- Domestic wastewater up to 10,000 gal/day
- Commercial wastewater up to 5,000 gal/day
- No toxic, hazardous, or industrial waste
- Cluster systems and shared components, e.g. drainfields, also included

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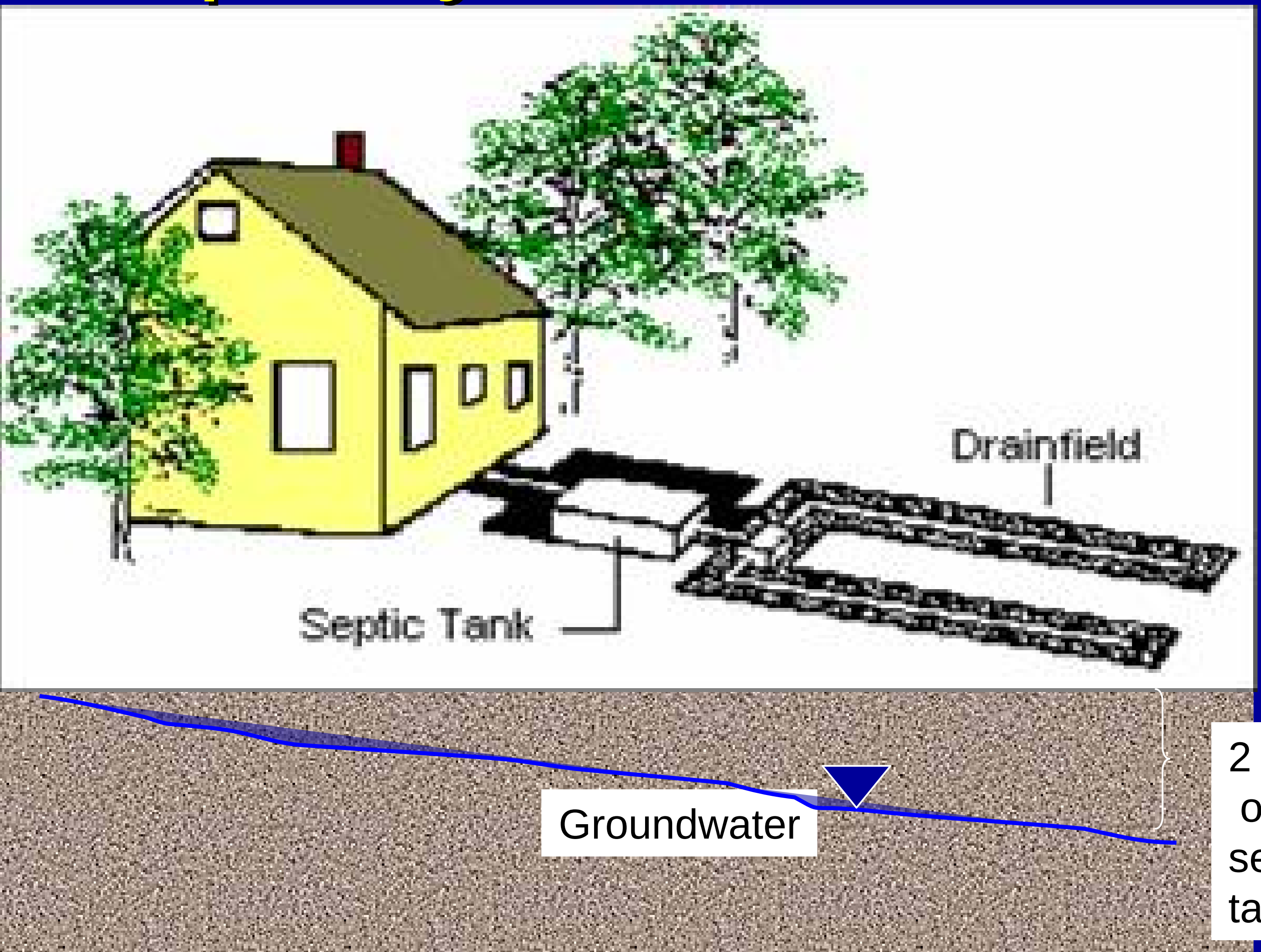
What is a standard/conventional septic system?



2 feet between bottom of drainfield and seasonal high water table (since 1983)

What's happening in the septic tank?

- Septic tank (anaerobic):
  - Collects solids (~60lbs/year TSS) -> must be pumped regularly
  - Nitrogen from protein is converted into ammonia
- Rules: Approval testing for water tightness and structural integrity required since mid-1990s

How Much Does an Onsite System Add?

- Septic tank effluent: About 20 Pounds of Nitrogen per year per household (One large bag of fertilizer).

- Total contribution depends on the number of systems. Relative contribution depends on presence of other sources

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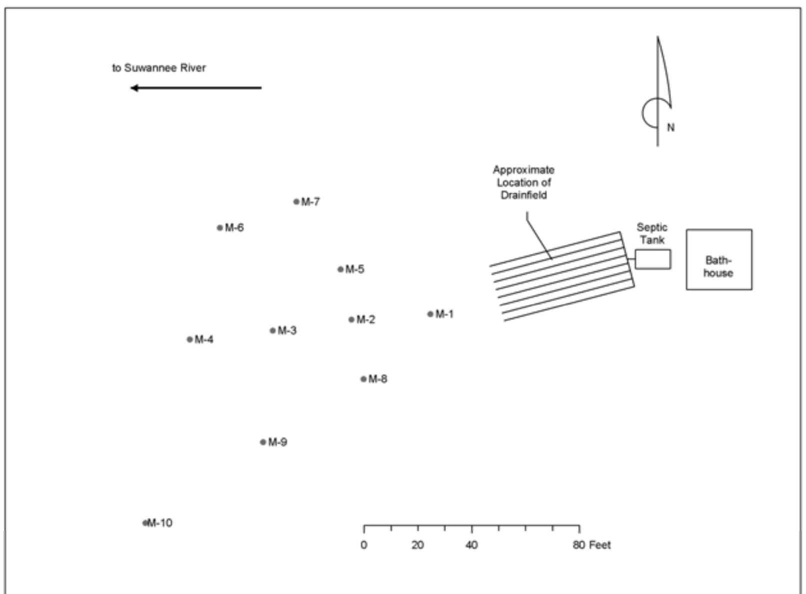
What's happening in the drainfield?

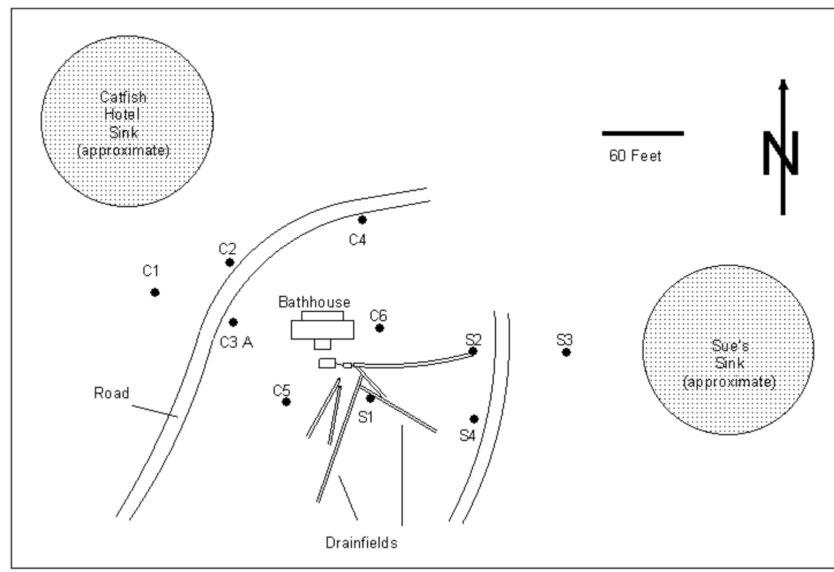
- Drainfield (aerobic):
  - Consumes biodegradable material (cBOD5, TSS) using oxygen
  - Removes/filters pathogens, cBOD, suspended solids in the unsaturated zone above groundwater (2 feet minimum separation to water table is foundation of system design)
  - Converts ammonia to nitrate, some N-removal (20-40%)
  - Disposes of water

Karst Study of Conventional OSTDS

- Research at Manatee Springs State Park:
  - Monitoring of Groundwater downstream of two OSTDS for chemical tracers, nutrients and fecal coliforms

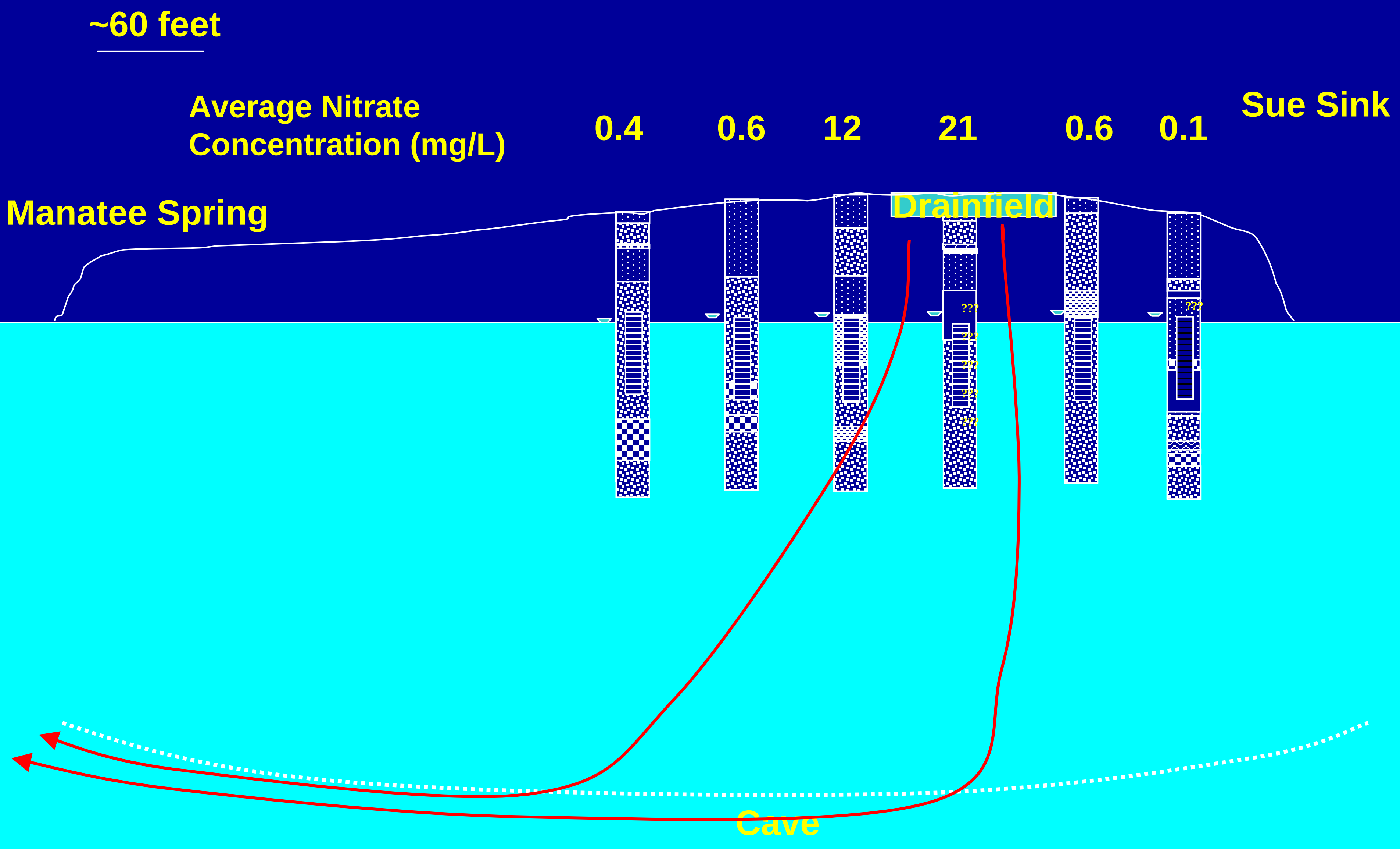


River Front

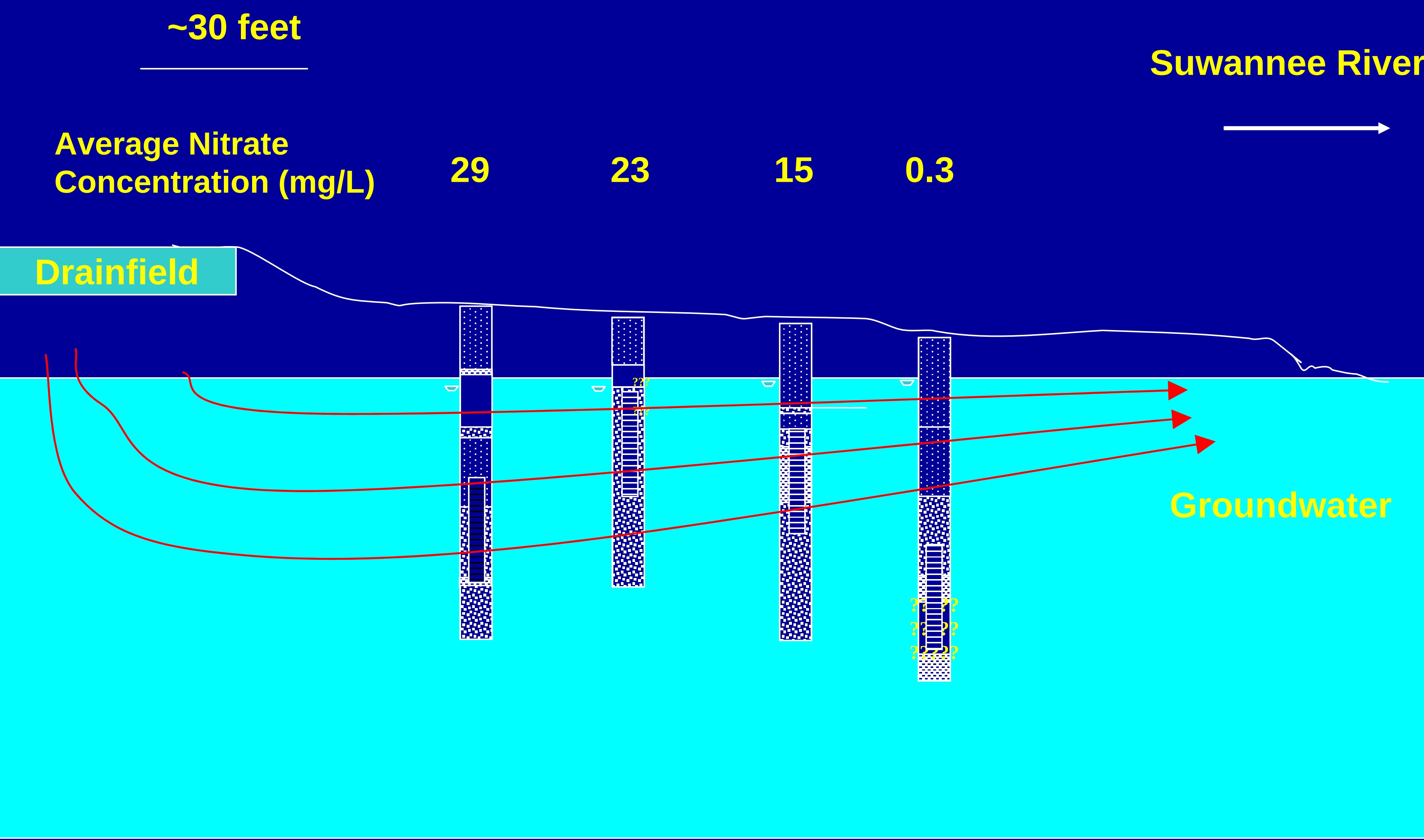


Upland, on Top of Cave System

Inferred Flow Direction: Upland



Inferred Flow Direction: River Front

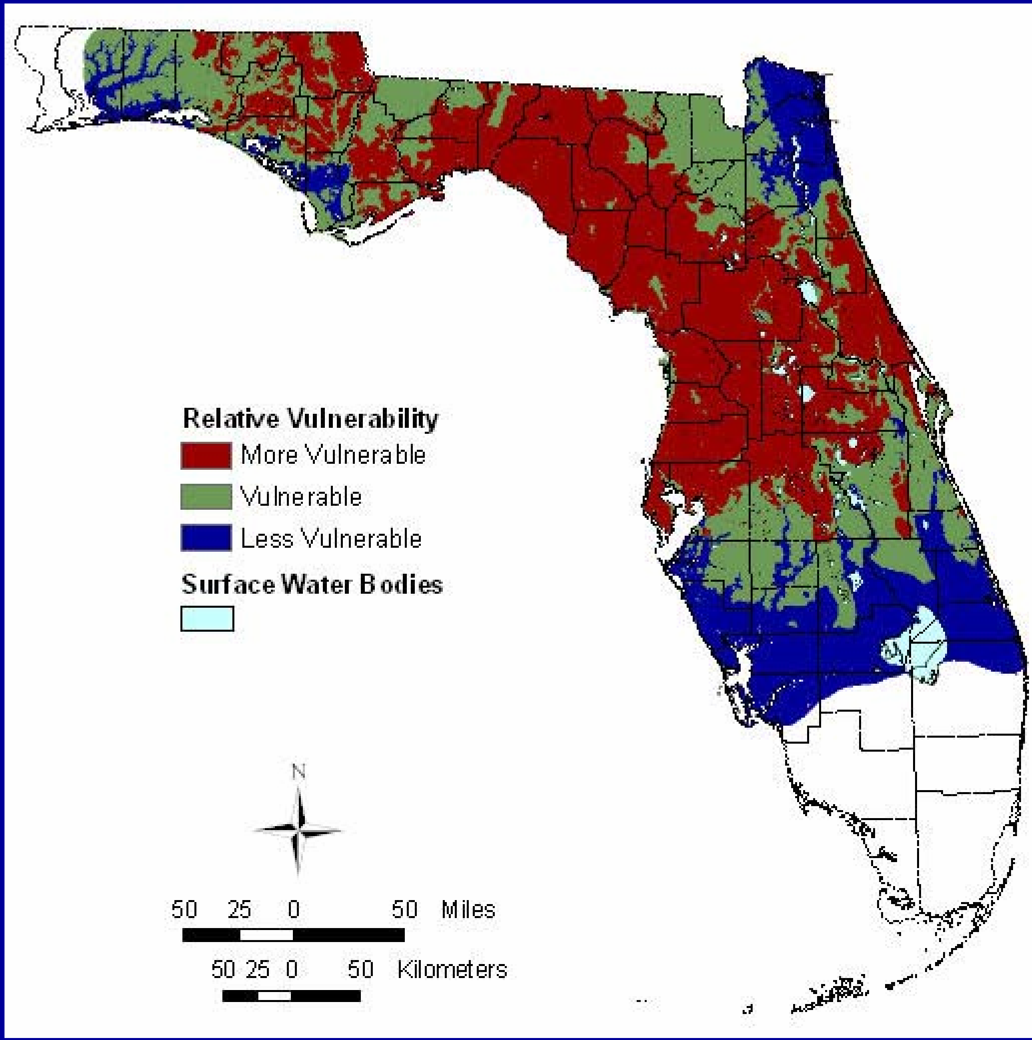


Karst Study Results

- Nitrate concentrations in excess of drinking water standards at many monitoring wells (from 2 to 6 times the 10 mg/L limit)
- Rapid transport of wastewater tracers to wells
- Very good at removing the Germs!

The FAVA Map

- Florida Aquifer Vulnerability Assessment
- Considers measured well concentrations
- Looks at the likelihood of finding an impacted well given:
  - Distance to karst features
  - Thickness of confining units
  - Soil permeability
  - Direction groundwater flow (up/down)



http://www.dep.state.fl.us/geology/programs/hydrogeology/fava.htm

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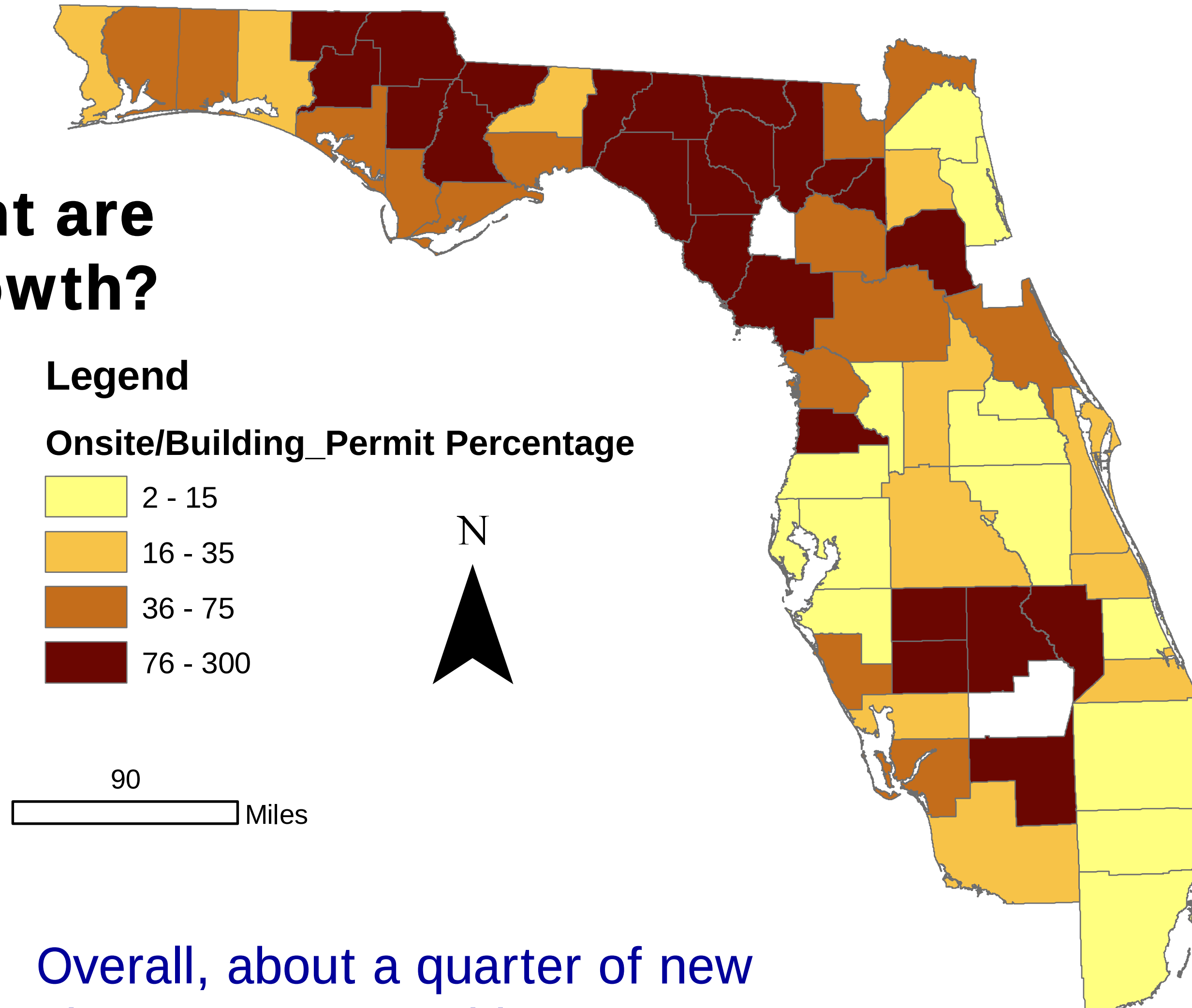
Prevalence of Onsite Systems in New Construction

How important are OSTDS for growth?



Overall, about a quarter of new houses are served by OSTDS

(Divided average new OSDTS permits for FY2002/3-2004/5 by average of 2003+2004 US census building permits

What's happening to nitrogen?

- 1) Ammonification in the septic tank to **ammonia**

  Organic N + microorganisms

  -> NH_3/NH_4^+ + microorganisms

- 2) Nitrification to **nitrate** in the presence of oxygen (drainfield or ATU)

  $NH_4^+ + 2O_2 \rightarrow NO_3^- + 2\ H^+ + 2\ H_2O$

3) The Nitrogen removal step: Denitrification to **nitrogen gas**

NO_3^- + organic matter (no air)-> N_2 + CO_2 + OH^- + H_2O

- Problem: little organic matter left after drainfield (need extra carbon for denitrification)
- Solutions:
  - Recycle nutrients to vegetation via drip-irrigation (generally in conjunction with an ATU, effectiveness unclear)
  - Advanced wastewater treatment in onsite systems. Recirculate nitrate-rich effluent to septic tank or add carbon.

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What are some advanced OSTDS?

- Aerobic Treatment Unit (ATU)
  - – Bring sewage into contact with air, (usually pretreated by septic tank)
  - – Allows smaller drainfield
  - – Approved on NSF-certification

- Drip-Irrigation Systems
  - Water reuse, less fill material needed
  - Requires pretreatment
  - Engineer-designed

What are some advanced OSTDS?

- Performance-based treatment systems (PBTS)
  - Engineer-designed to achieve specified treatment levels (DEP values)
  - Includes nutrient-reducing systems where required (Florida Keys, proposed for Wekiva area)
  - In most cases, build on ATUs

- All Advanced Systems Require: Operating Permits, Maintenance Contracts, Regular Maintenance and Inspections

Performance Levels- a review

- Primary Treatment (settling of solids)
- Conventional Treatment
- Secondary Treatment (removal of biological oxygen demand and TSS)
- Advanced Secondary Treatment
- Advanced Secondary Treatment Plus (Florida Keys)
- Advanced Wastewater Treatment

PERFORMANCE STANDARDS

POLLUTANT	BASELINE SYSTEM STANDARDS Septic tank effluent	BASELINE SYSTEM STANDARDS @ base of 24 inch unsaturated zone	AEROBIC TREATMENT UNIT (effluent)	SECONDARY TREATMENT STANDARDS (effluent)	ADVANCED SECONDARY TREATMENT STANDARDS (effluent)	ADVANCED WASTEWATER TREATMENT STANDARDS (effluent)
$CBOD_5$ (Carbonaceous Biochemical Oxygen Demand)	**120-240 mg/l**	**< 5 mg/l**	**=or< 30 mg/l**	**=or< 20 mg/l**	**=or< 10 mg/l**	**=or< 5 mg/l**
TSS (Total Suspended Solids)	**65-176 mg/l**	**< 5 mg/l**	**=or< 30 mg/l**	**=or< 20 mg/l**	**=or< 10 mg/l**	**=or< 5 mg/l**
TN (Total Nitrogen)	**36-45 mg/l**	**15-25 mg/l**	**not applicable**	**not applicable**	**=or< 20 mg/l**	**=or< 3 mg/l**
TP (Total Phosphorus)	**6-10 mg/l**	**< 5 mg/l**	**not applicable**	**not applicable**	**=or< 10 mg/l**	**=or< 1 mg/l**
Fecal coliform		**undetected**	**not applicable**	**=or< 200 fc col/100 ml**	**=or<200 fc col/100 ml**	**BDL for 100 ml**
DRAINFIELD REDUCTIONS	not applicable	not applicable	25% in slightly limited soil	25%	30%	40%
INCREASE AUTHORIZED FLOWS	no change	no change	no change	25%	50%	100%

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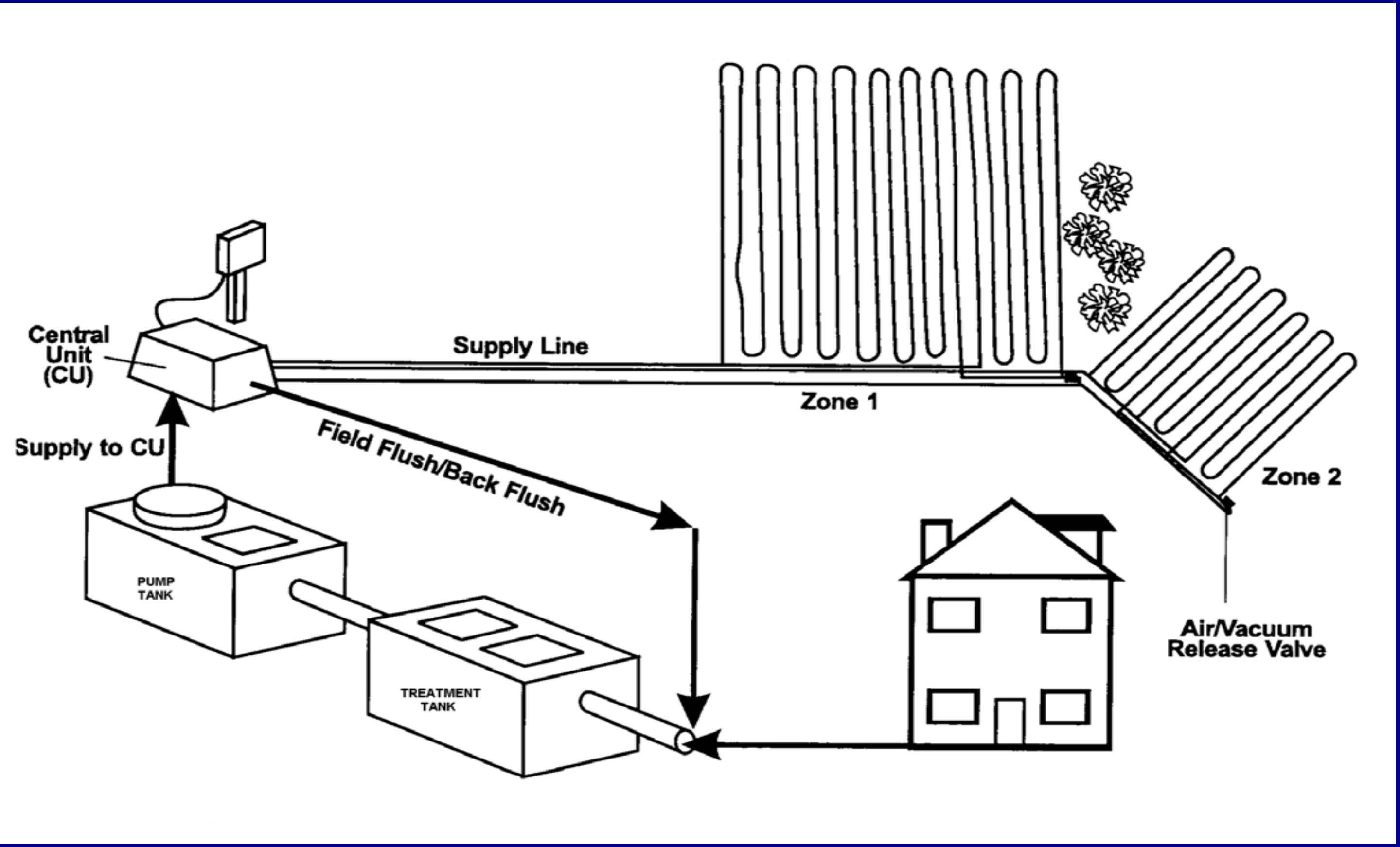
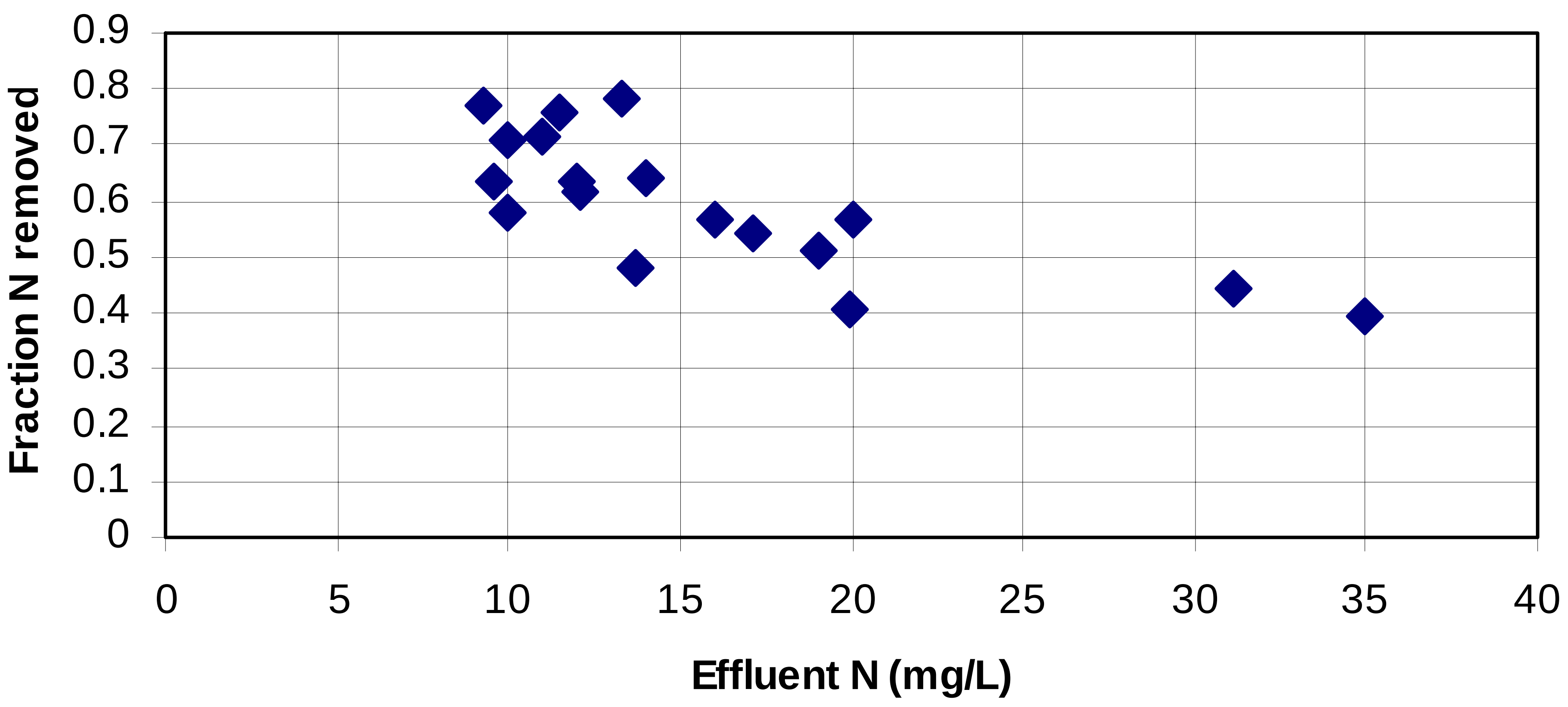
Proposed Onsite Nitrogen Reducing System for more protected zones in the Wekiva area



A Nutrient Reducing System with Drip Irrigation

Preliminary review of third-party nitrogen reduction performance data



What do advanced systems cost?

	drainfield bottom elevation relative to ground surface	conventional drainfield area (sqft)	PBTS-cost (advanced secondary TN=10 mg/L)	conventional system cost
dosed system (low-pressure or drip irrigation)	24" above	300	$11,275(drip) $11,350 (low pressure)	$8,150 (drip) $7,850 (low pressure)
dosed system (low-pressure or drip irrigation)	3" below	462	$10,875 (drip) $8,800 (low pressure)	$6,000 (drip) $5,300 (low pressure)
dosed system (low-pressure or drip irrigation)	18" below	334	$10,575 (drip) $7,060 (low pressure)	$3,800 (drip) $3,560 (low pressure)
gravity system	18" below	334	$7,253 $5,375	$2,100 $1,875

Wakulla Prices for 300 gpd new construction,
does not include maintenance and operating costs

How to Manage Onsite Systems?

- Levels of Management will depend on:
  - severety of expected impacts (protection zones)
  - technical complexity of onsite systems,
  - amount and type of available funding
  - enforcement capabilities

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How to Manage Onsite Systems?

- EPA March 2003 Voluntary Guidelines provide a framework for discussion

http://www.epa.gov/owm/septic/pubs/septic_guidelines.pdf

EPA’s Management Models

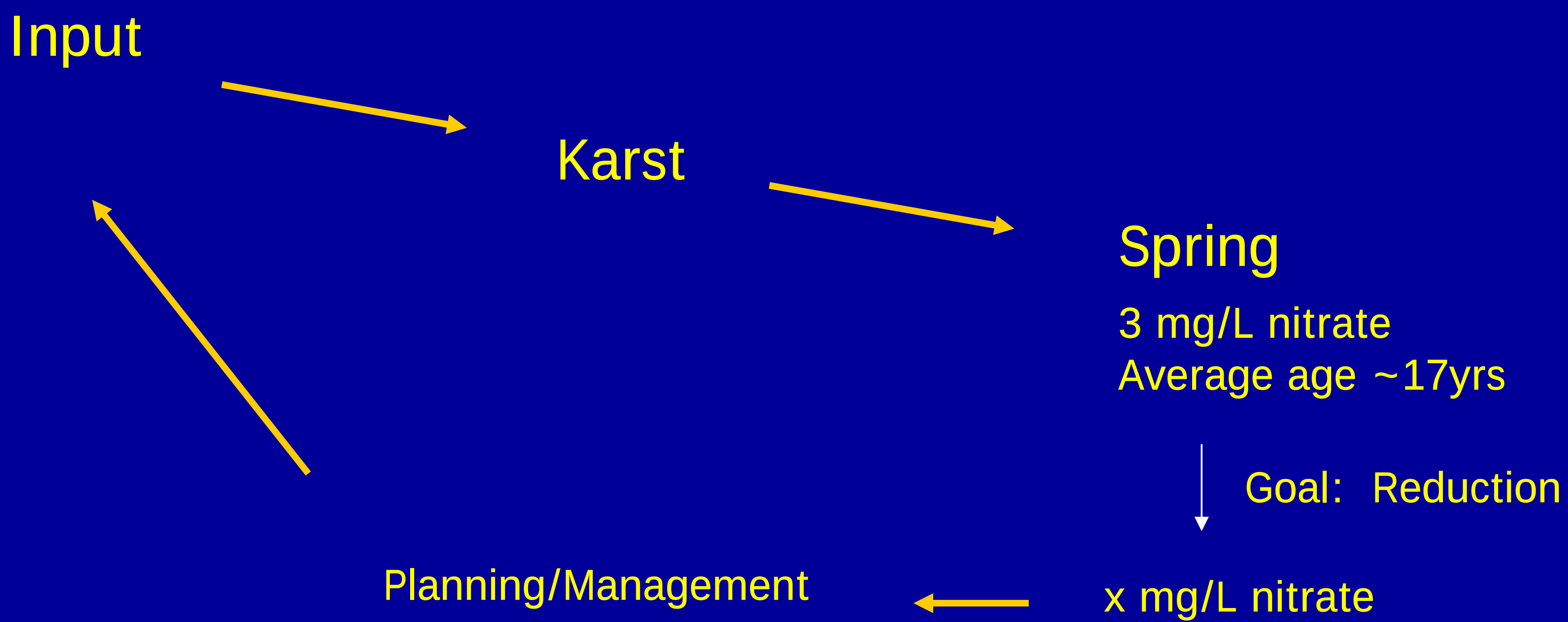
- 1 Homeowner Awareness
- 2 Maintenance Contracts
- 3 Operating Permits
- 4 Responsible Management Entity Operation and Maintenance
- 5 Responsible Management Entity Ownership (Utility)

http://www.epa.gov/owm/septic/pubs/septic_guidelines.pdf

How does Florida manage?

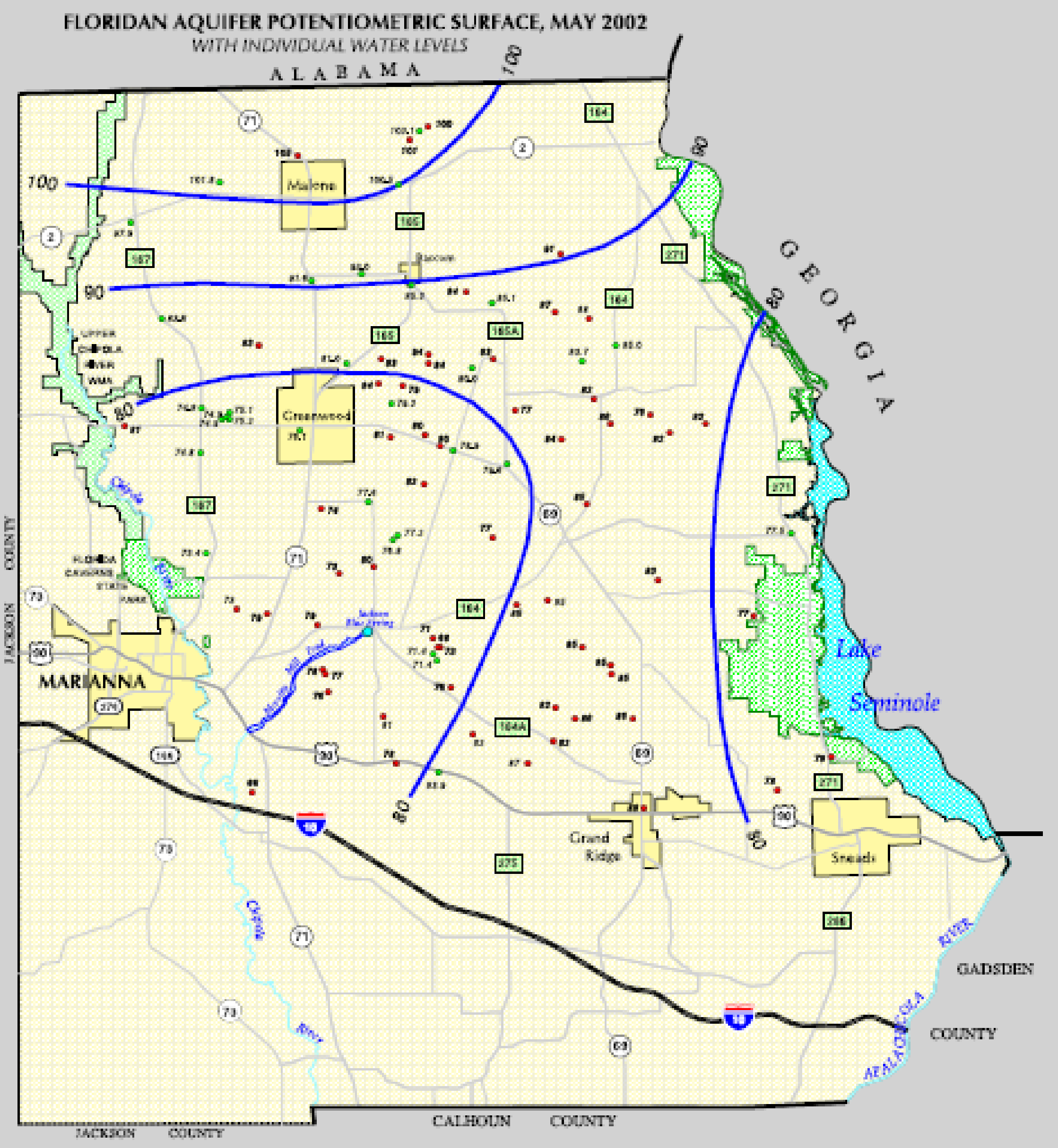
- Standard Septic Systems:
  - Level 1 homeowner awareness;
  - also: design, construction and training certification and standards, (e.g. water tightness)
- Aerobic treatment units:
  - Level 2/3/4 operating permit requires contract of owner with qualified maintenance entity. Regular inspection required
- Performance-based treatment systems:
  - Level 2/3/4 engineer-designed; operating permit requires contract of owner with qualified maintenance entity. More frequent inspection and sampling required.

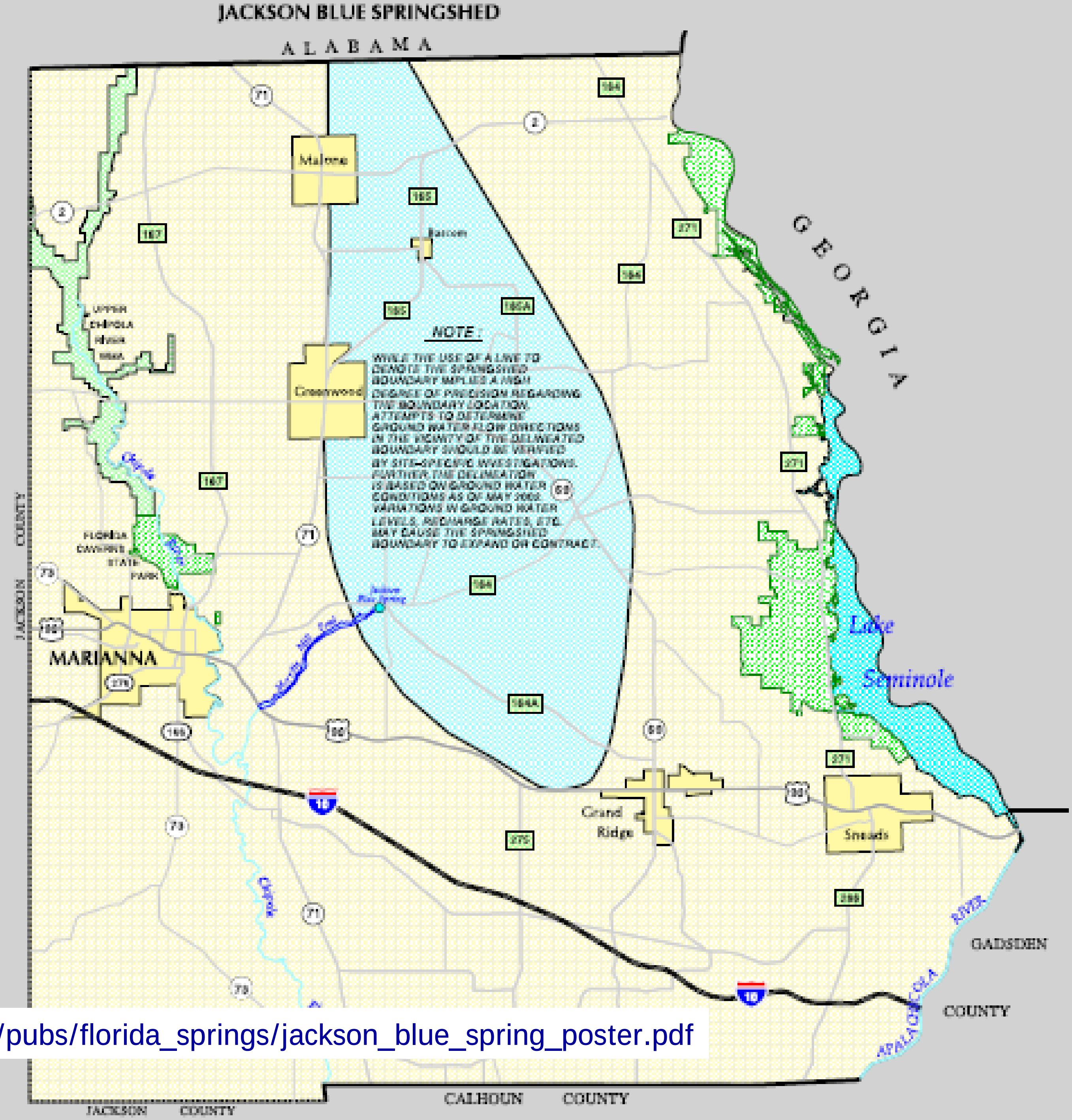
Jackson Blue Springs



Jackson Blue Springs

- What are the goals?
  - springs protection
  - drinking water protection
  - flow protection





http://www.nwfwmd.state.fl.us/pubs/florida_springs/jackson_blue_spring_poster.pdf

- NWFWMD study
  - Delineated springshed
  - Summarized land uses
  - Assessed inputs

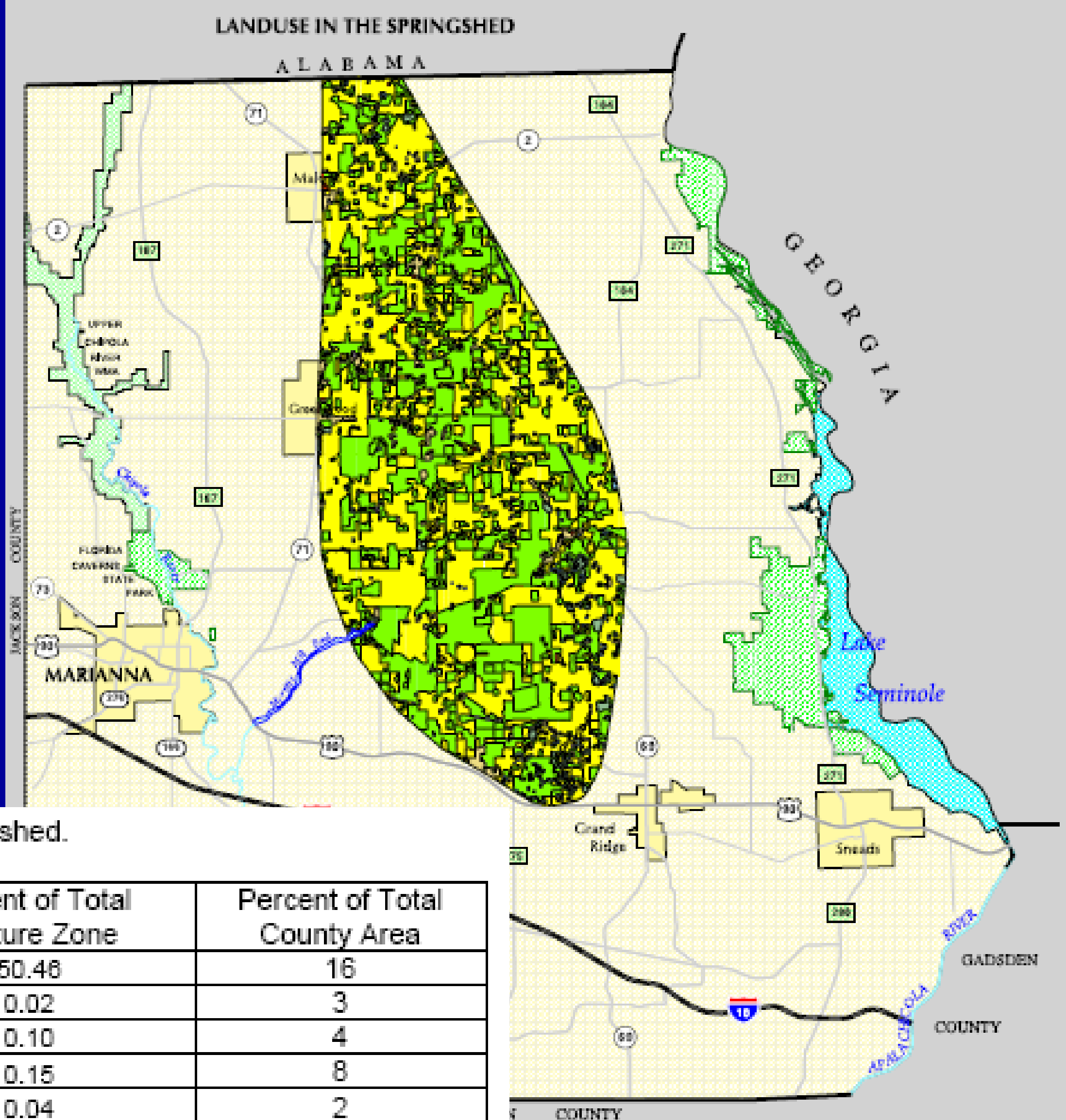


Table 3. Summary of Land Use in the Jackson Blue Springshed.

Category	Acres	Percent of Total Capture Zone	Percent of Total County Area
Agriculture	35,193	50.46	16
Barren Land	17	0.02	3
Commercial & Services	67	0.10	4
Industrial	105	0.15	8
Institutional	31	0.04	2
Open Land	0	0	0
Recreational	0	0	0
Residential	2,131	3.06	11
Transportation, Communication & Utilities	101	0.14	2
Upland Forests	30,913	44.33	11
Water	173	0.25	1
Wetlands	1,010	1.45	2

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Current Inputs

- Agricultural Fertilizer

Table 4. Estimated Nitrogen Loading to Jackson Blue Springshed as a Function of Time.

year	N (tons)	year	N (tons)	year	N (tons)
1974	1208	1984	1340	1993	849
1975	967	1985	1211	1994	ND
1976	1170	1986	1015	1995	611
1977	1525	1987	879	1996	ND
1978	1325	1988	1054	1997	555
1979	1510	1989	1526	1998	ND
1980	1330	1990	2970	1999	279
1981	1636	1991	ND	2000	307
1982	1344	1992	ND	2001	456
1983	1277				

Future Input Expectations

- Decreasing agricultural input
- Increasing residential input
  - fertilizer
  - sewage
  - less forest

- Natural attenuation:
  - In karst areas natural attenuation processes appear to be less important, it is unlikely to change from current levels

Nitrogen Management Approaches:

- No sewage, no fertilizer, no livestock
- Limit flow and/or number of OSTDS per acre. This approach has been in Florida OSTDS rules for at least 30 years.
- Increase Treatment:
  - drip-irrigation (generally in conjunction with an ATU)
  - Nitrogen removal in onsite systems (tested in Keys Demonstration Study, required in Keys, proposed for Wekiva).
- Export

Estimates of Wastewater Inputs of Nitrogen per Household

Conventional OSTDS	~20lbs/ year
Advanced Secondary OSTDS or centralized WWTP	~10lbs/year
Keys Standard OSTDS	~5lbs/year
Advanced Wastewater Treatment Standards centralized WWTP or future OSTDS	~1.5 lbs/year

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Application to Springs Protection

- Desired Intensity of Wastewater Management will depend on:
  - severety of expected impacts (protection zones)
  - technical complexity of onsite systems,
  - amount and type of available funding
  - enforcement capabilities