



Watershed Planning Lessons Learned from Florida's Springs

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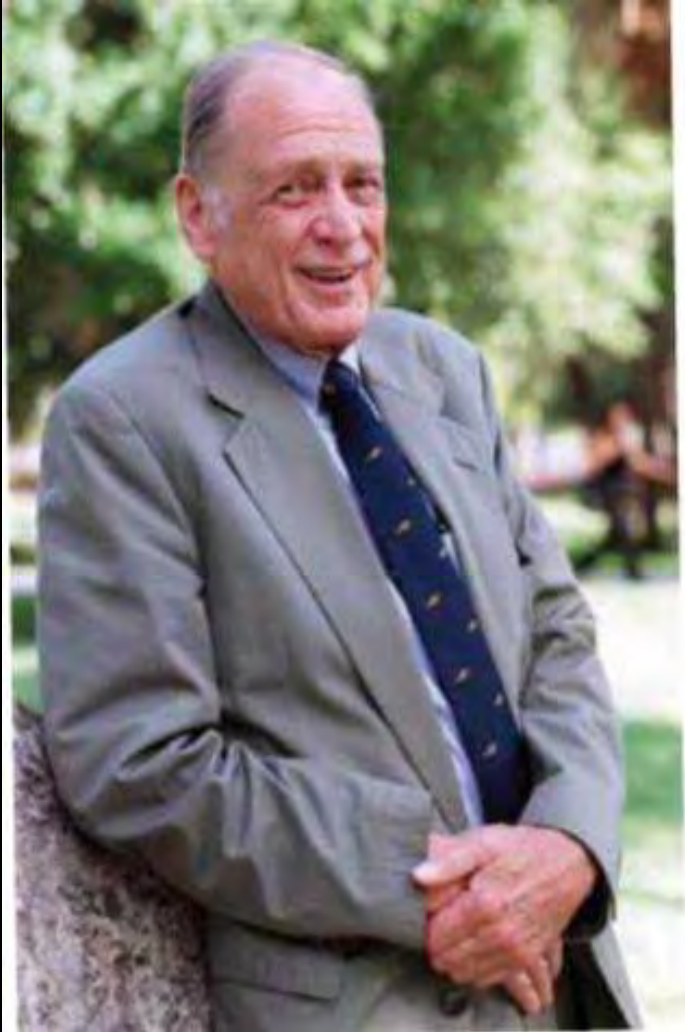
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Dr. John M. DeGrove



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THIS WEBINAR:

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- Applied for CLE with Florida Bar – approval anticipated in October
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Presenters

About Jim Stevenson



- Retired as Senior Biologist after 38-year career at the Department of Environmental Protection
- Chief Biologist for Florida State Parks System for 20 years
- Coordinated spring basin working groups for Wakulla Spring and Ichetucknee Springs for 18 years
- Chaired the Florida Springs Task Force and directed Governor's Florida Springs Initiative
- State of Florida named "Stevenson Spring" on the Suwannee River in his honor
- Governor and Cabinet dedicated the "Jim Stevenson Resource Manager of the Year Award," given annually

About Robert L. Knight, Ph.D.



- Environmental scientist with more than 35 years of professional experience in Florida.
- Founder and president of the Howard T. Odum Florida Springs Institute
- Adjunct professor in the Department of Environmental Engineering Sciences at the University Florida
- Active on restoration efforts at the following springs: Santa Fe River, Kings Bay/Crystal River, Ichetucknee, Rainbow, Wakulla, Glen, and Silver Springs

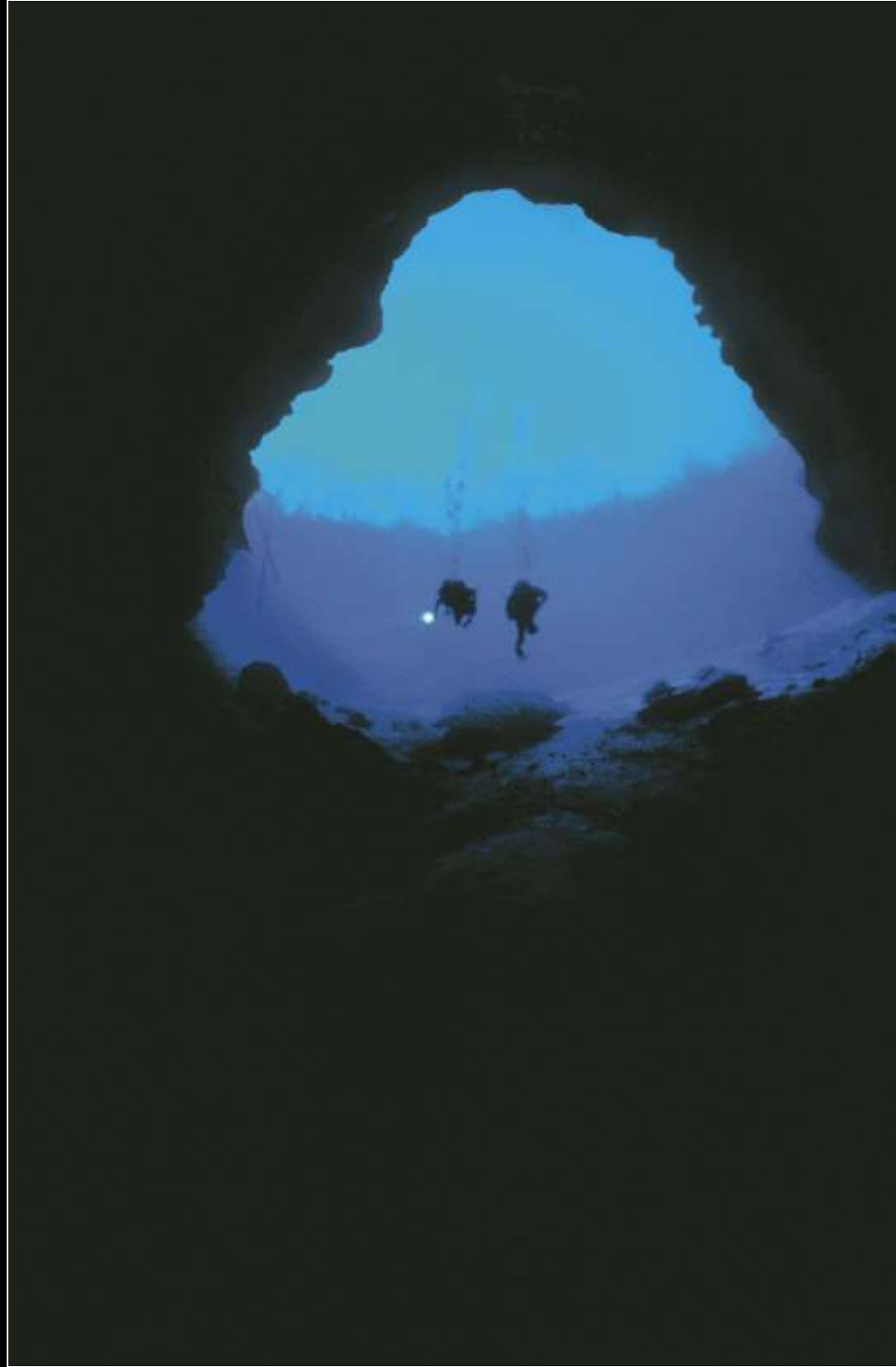
Florida Springs

**Natural Gems -- Troubled
Waters**



JUAN PONCE DE LEON AT THE FOUNTAIN OF YOUTH.













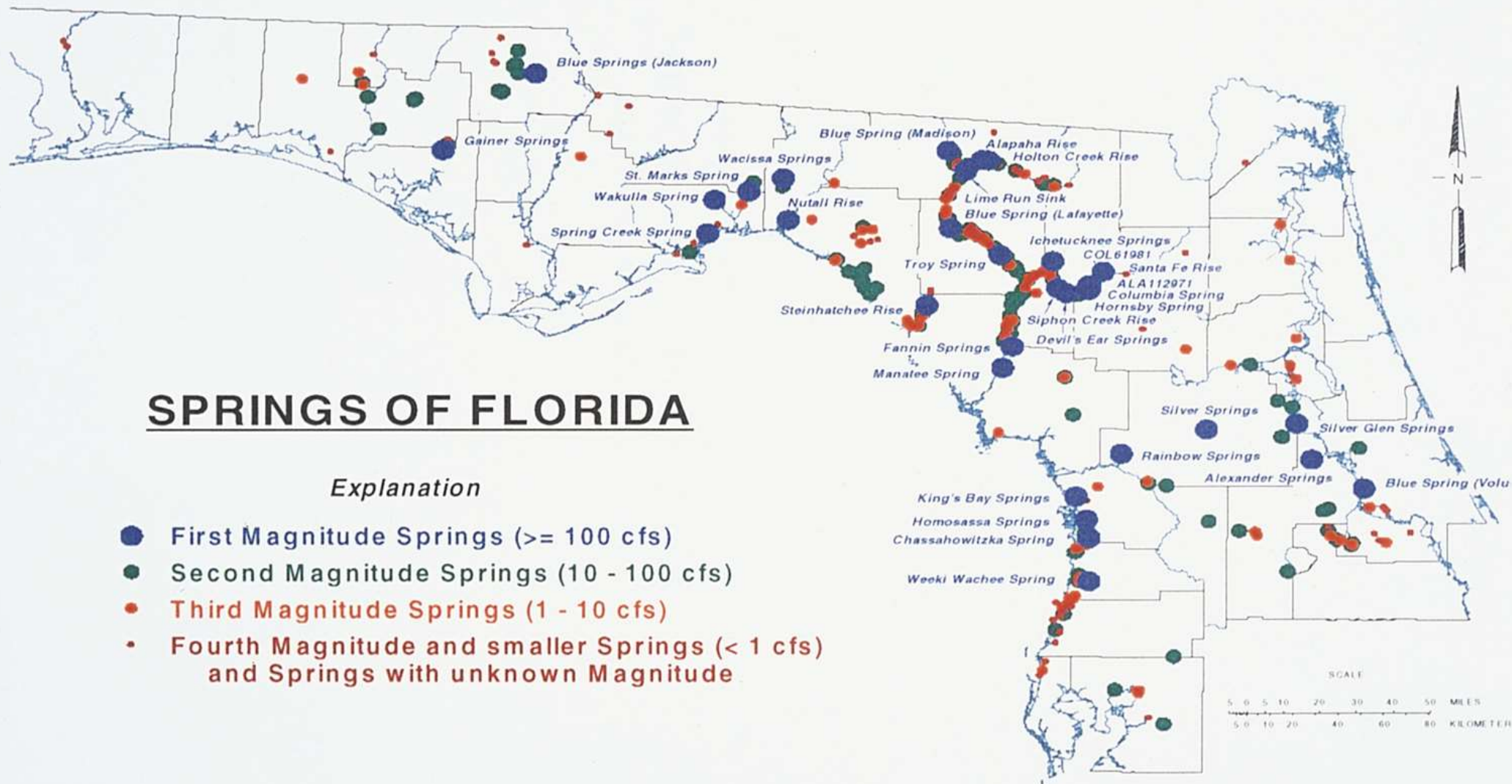




SPRINGS OF FLORIDA

Explanation

- First Magnitude Springs (≥ 100 cfs)
- Second Magnitude Springs (10 - 100 cfs)
- Third Magnitude Springs (1 - 10 cfs)
- Fourth Magnitude and smaller Springs (< 1 cfs)
and Springs with unknown Magnitude







Danone
International
Brands





6221. SILVER SPRINGS ON THE OCKLAWAHA, FLA.

This is one of the prettiest springs
in Florida. It is near Ocala,
the water is clear as crystal.
This is the head water of the
Ocklawaha River, which is a very shallow
narrow stream, and beautiful. The spring is reached



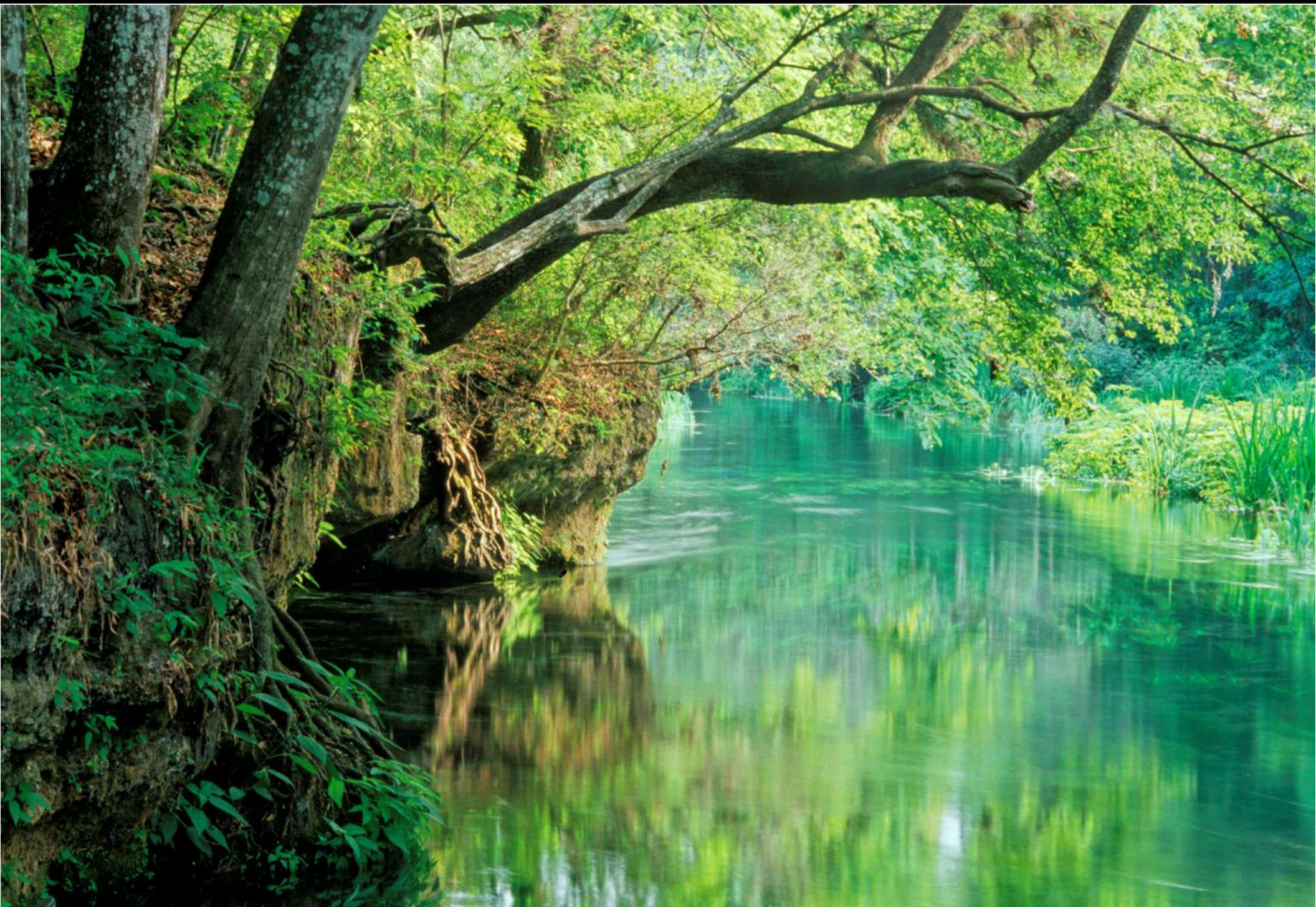






"MEMORIAL DAY WEEKEND '99," SILVER GLEN SPRINGS, FLORIDA

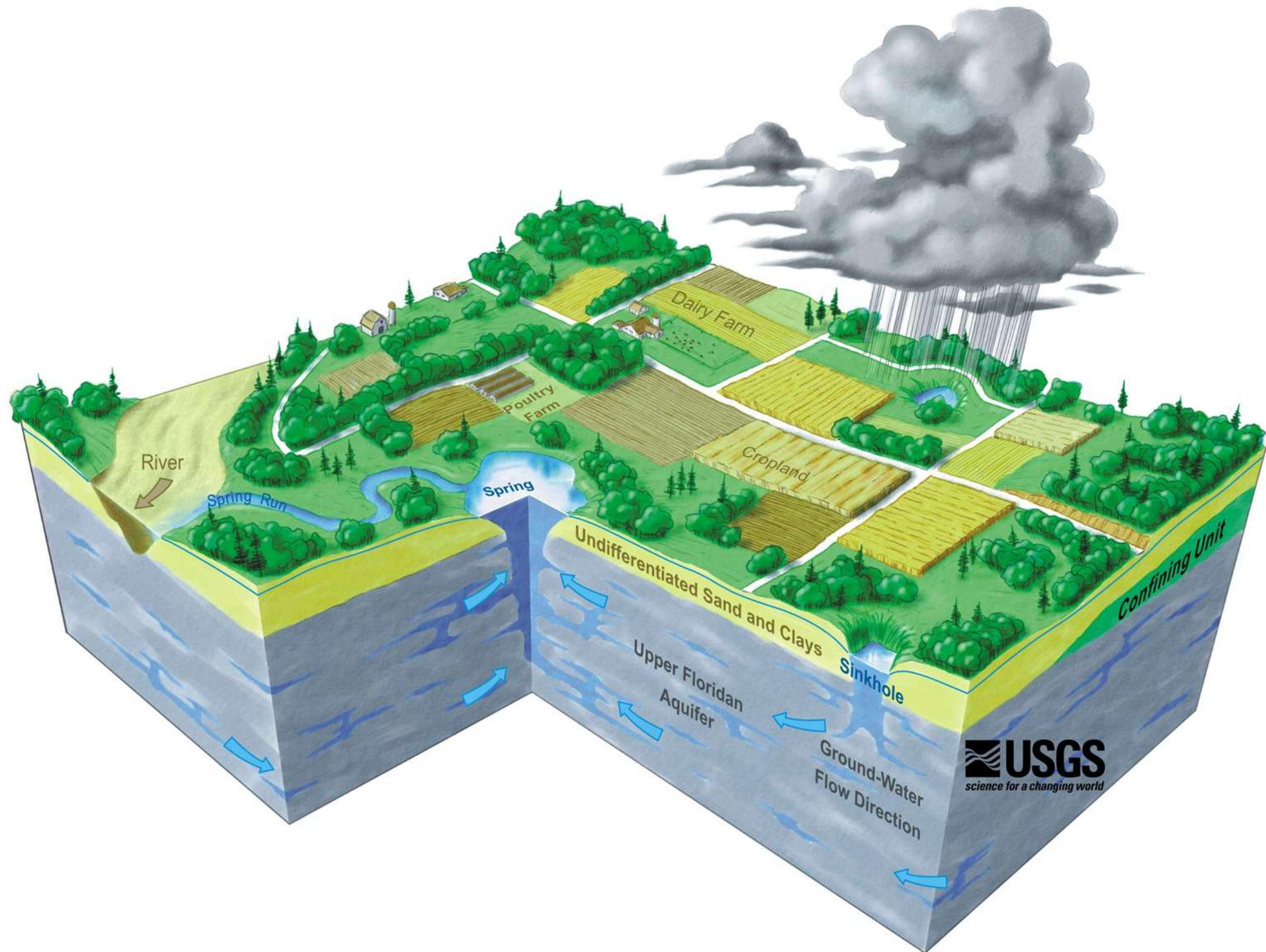
Photo by Overexposed Aerial Photography © Orlando, FL 1-800-EXPOSE-U exposed@bellsouth.net







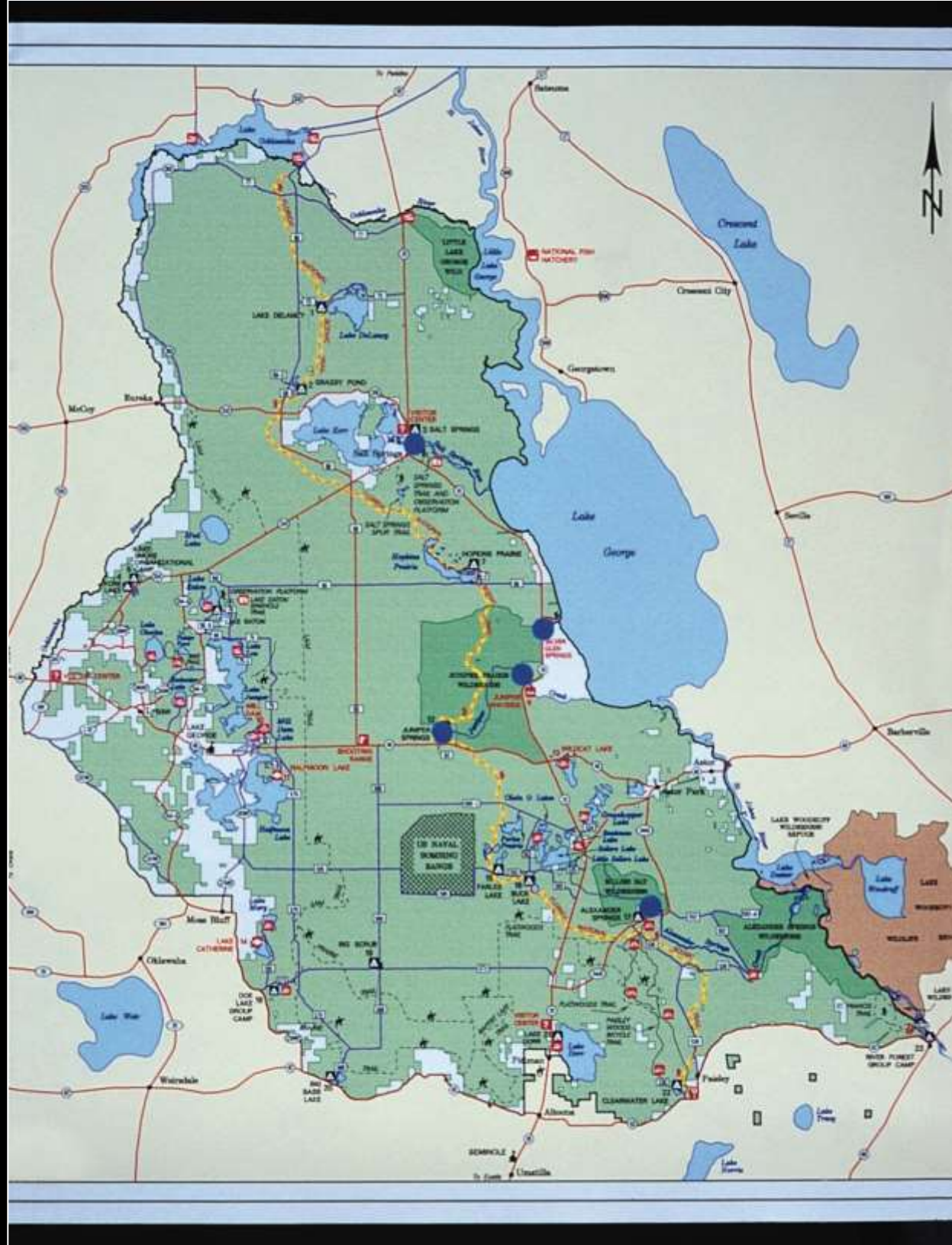






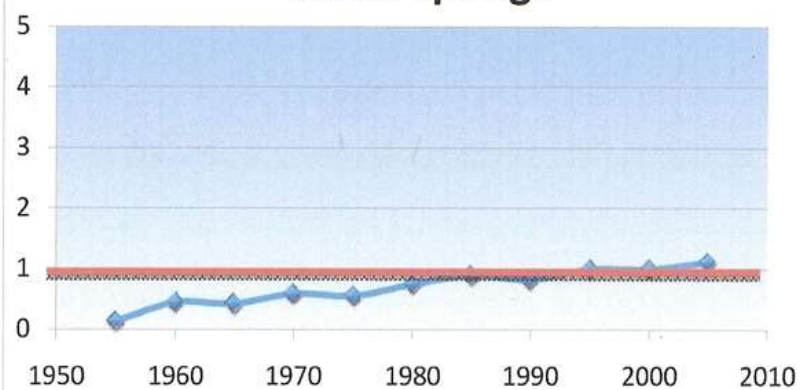




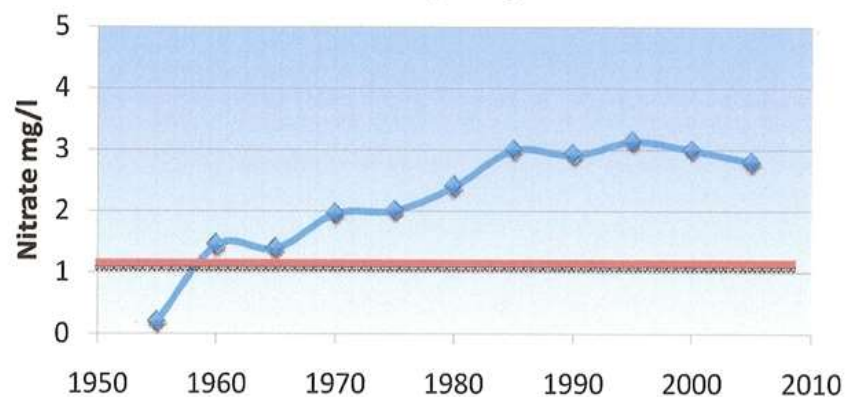


60 Year Nitrate Trend in 4 Florida Springs

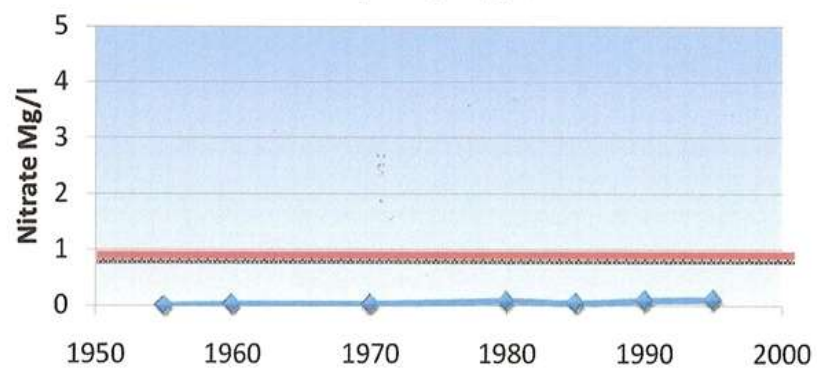
Silver Springs



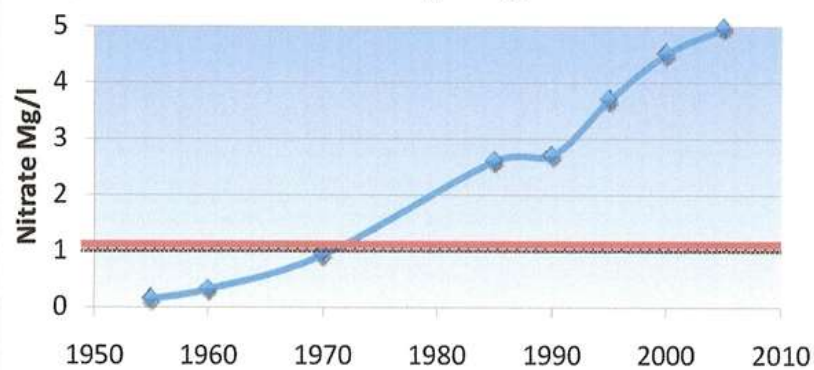
Lithia Springs



Juniper Springs

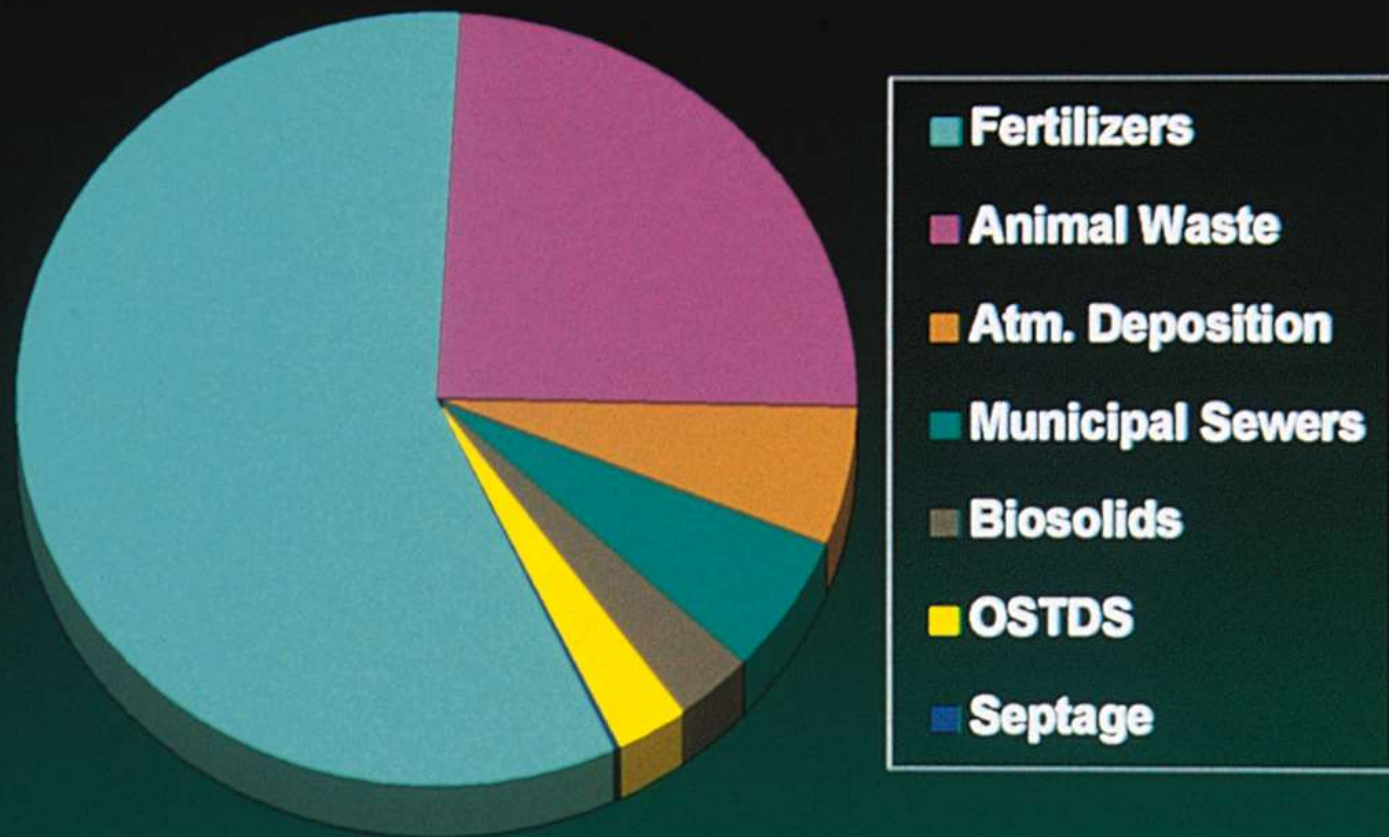


Fannin Springs



Nitrogen Sources in Florida

source: Mayer, 1995







An underwater photograph showing two divers in silhouette, forming a heart shape with their bodies. The water is a deep blue, and numerous bubbles are visible around the divers. A bright light source, likely the sun, is visible in the background, creating a strong backlight effect. The overall mood is romantic and serene.

Florida's
**Weeki
Wachee**

Weeki Wachee Springs



0.0500.08.1 Miles



Population and nitrate Weeki Wachee Springs

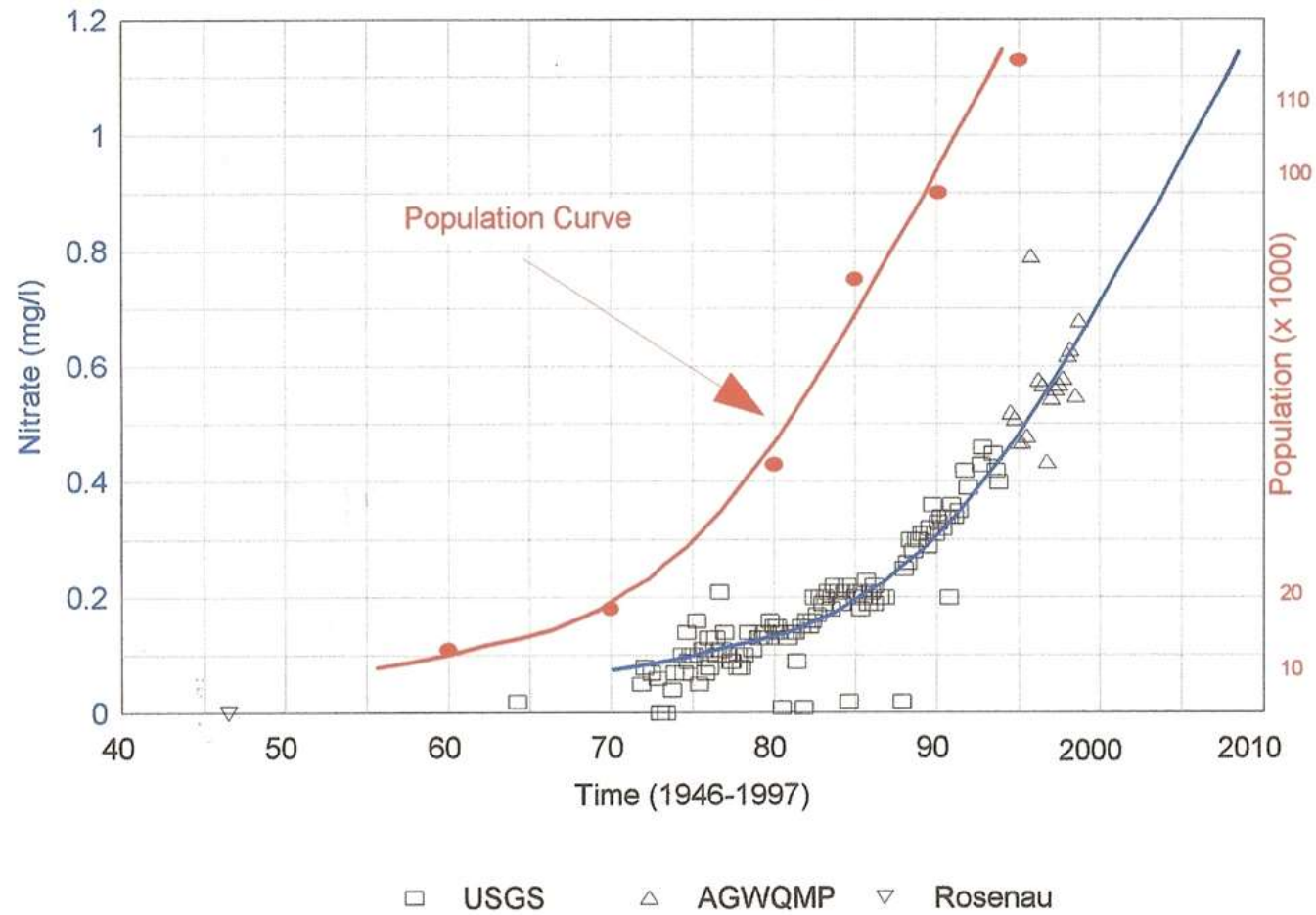




Photo By
Burgess Bros.
Lima

Y-231







Guaranteed for Rheumatism,
Indigestion, Dyspepsia, Stomach,
Kidney, Bladder Troubles,
Gastritis and Skin
Diseases.

HAMPTON SPRING WATER
Hotel Hampton
The National Health Resort

HAMPTON SPRINGS
TAYLOR COUNTY
FLORIDA

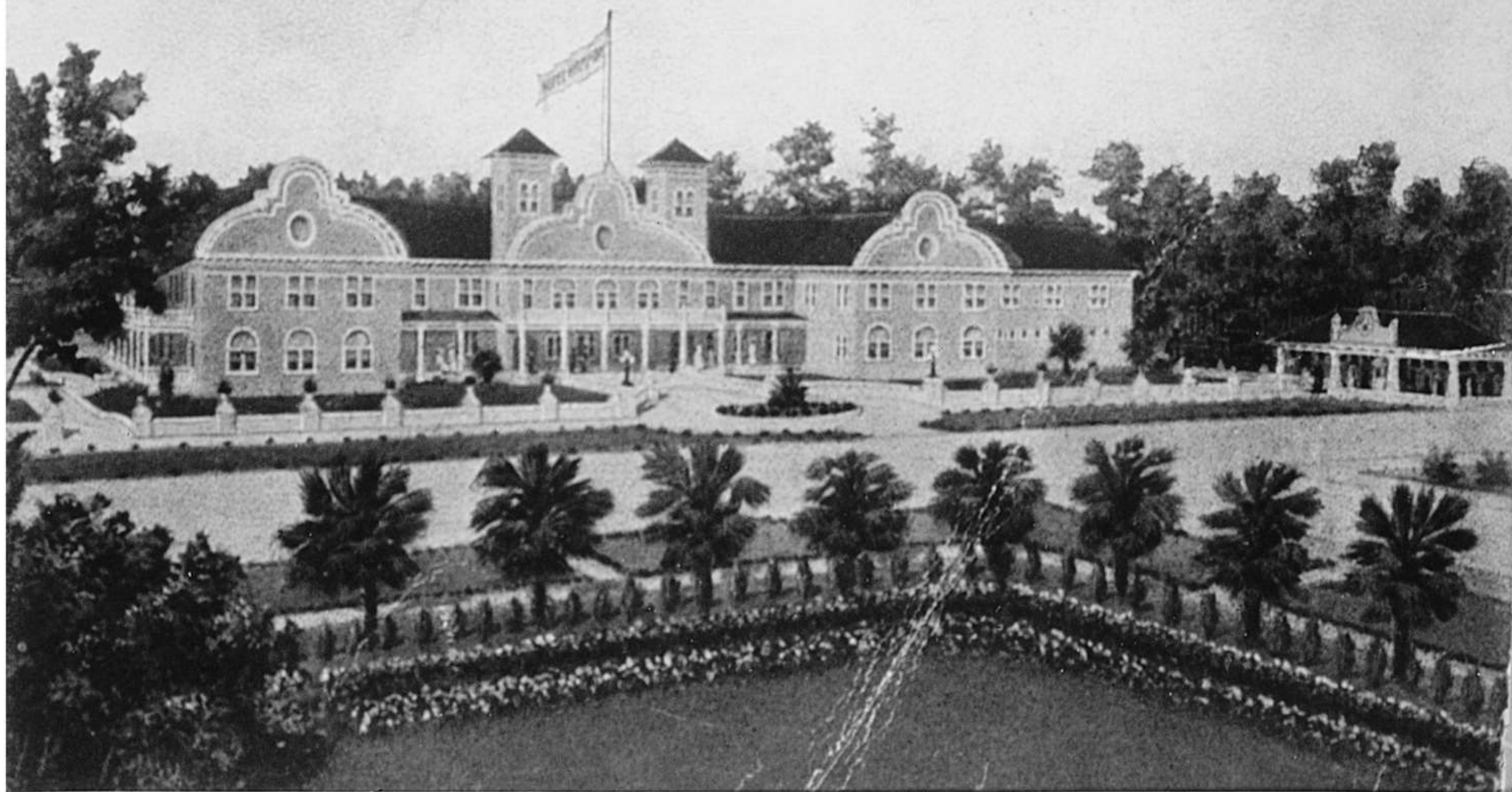








FIGURE 28. General view of recreational developments at *Kissengen Springs*







Florida Springs Task Force Protection Strategies

- Spring Basin Work Groups
- Education
- Land Use Planning
- Land Acquisition
- Spring Flow Protection
- Best Management Practices
- Regulations
- Monitoring
- Research
- Spring Management
- Endangered Species
- Funding

September 18, 2013

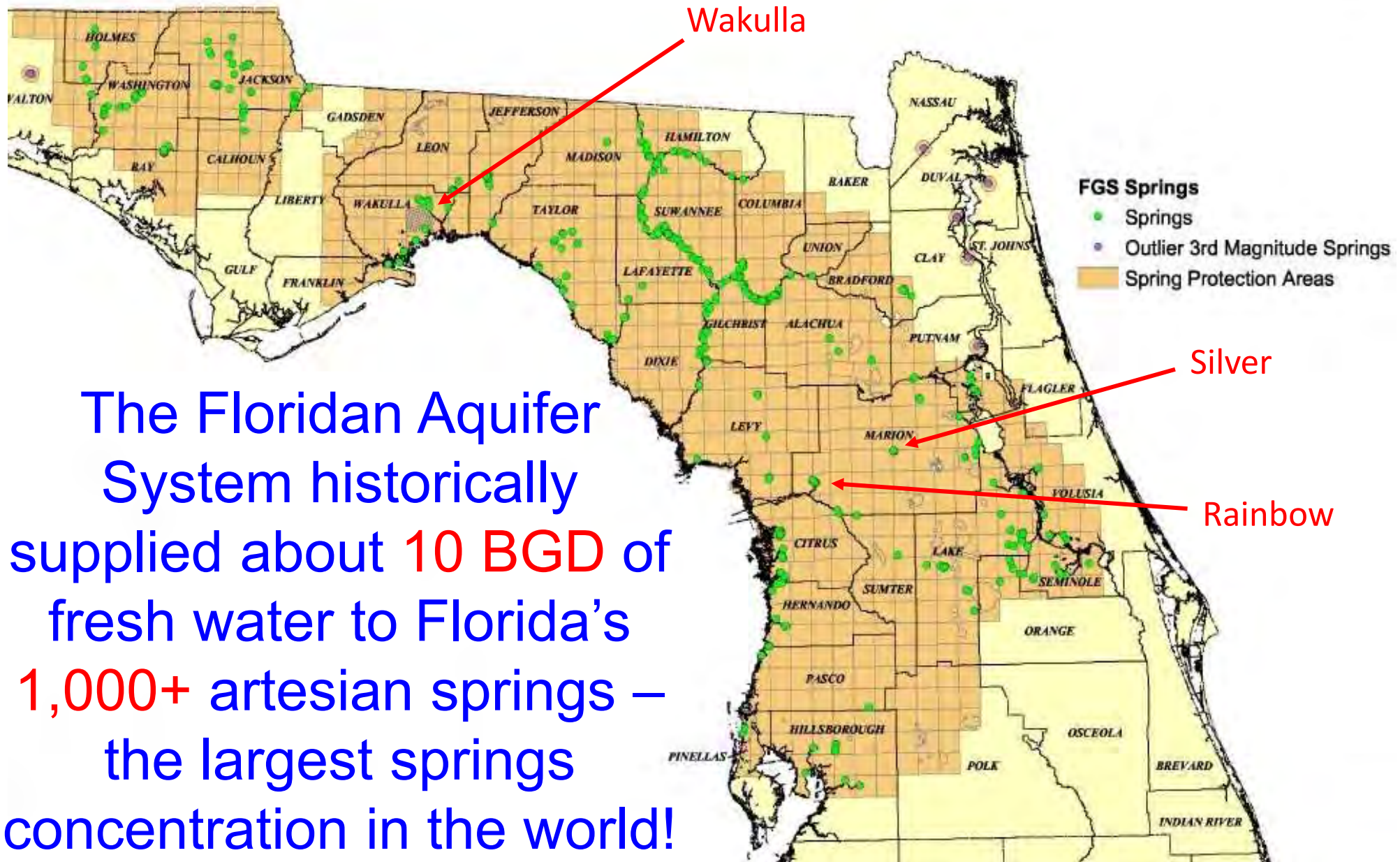
1,000 Friends of Florida Webinar

Florida's Springs Restoration and Protection **Rainbow Springs Case History**

Robert L. Knight, Ph.D.



Florida Springs Location Map



Springs Support a Unique Ecology

*Florida's
springs are
essential
habitat for a
diverse and
unique
assemblage
of plants and
wildlife*



Springs Provide Economic Benefits

*The direct economic value of Florida's largest springs is estimated to be over **\$300,000,000** per year*



Springs Are Protected by Law

- Outstanding Florida Waters
 - The standard is “**no degradation**”
 - Springs with declining flows often have: increasing temperature, specific conductance, and nitrate; and decreasing dissolved oxygen and water clarity- **All violations of OFW requirements!**



Wes Skiles photo

But, most springs are impaired by algal mats ...

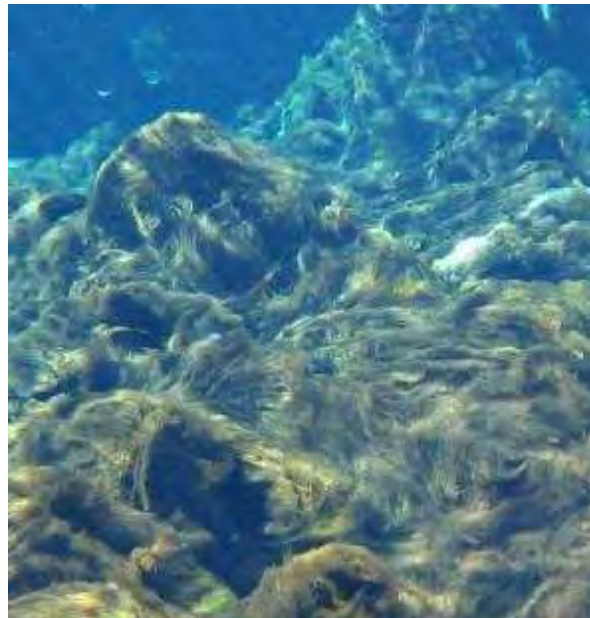
- Kings Bay
- Volusia Blue
- Wekiwa
- Jackson Blue
- Silver Springs
- Rainbow
- Weeki Wachee
- Fanning
- Manatee
- Wakulla
- etc_(FDEP)



Silver



Jackson Blue



Weeki Wachee

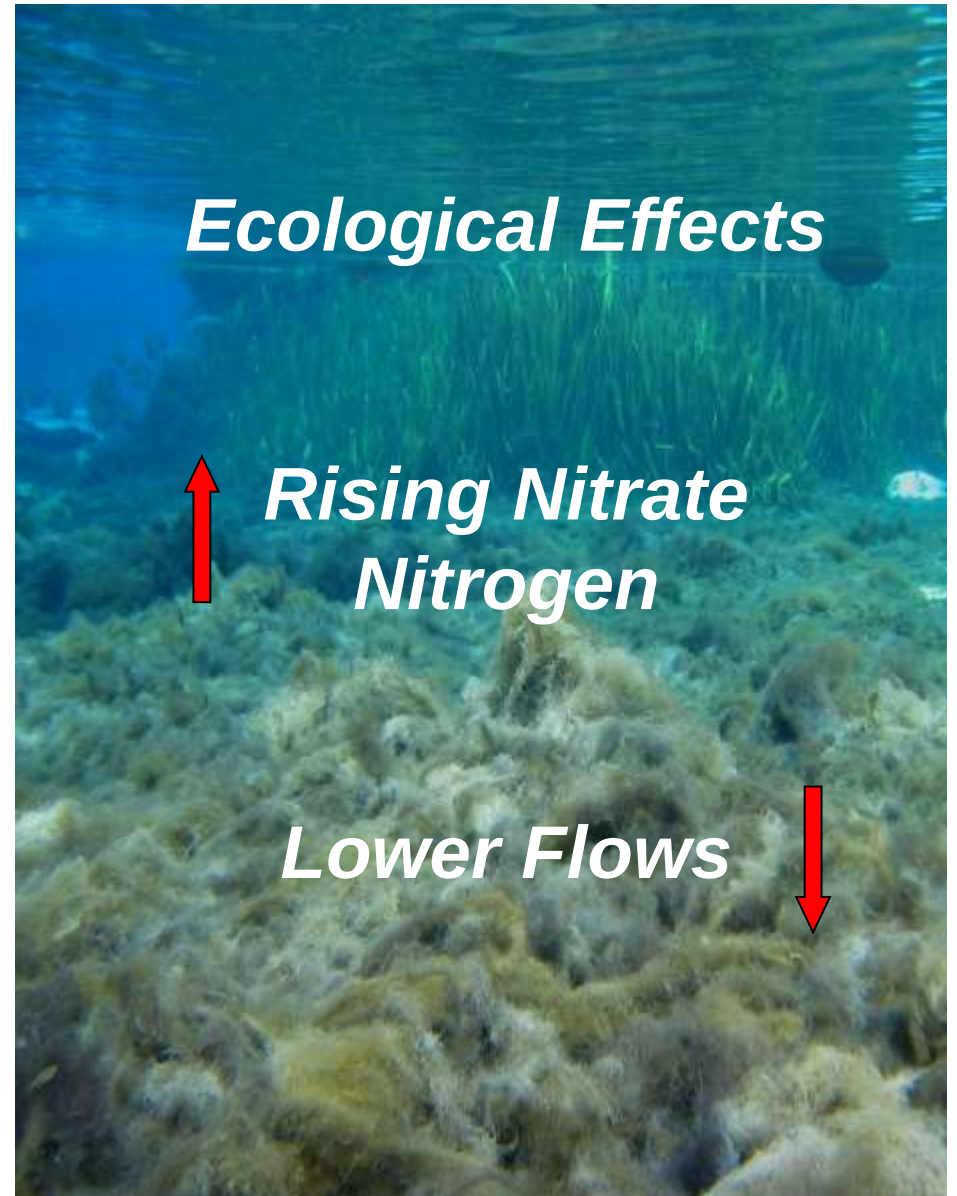


Rainbow

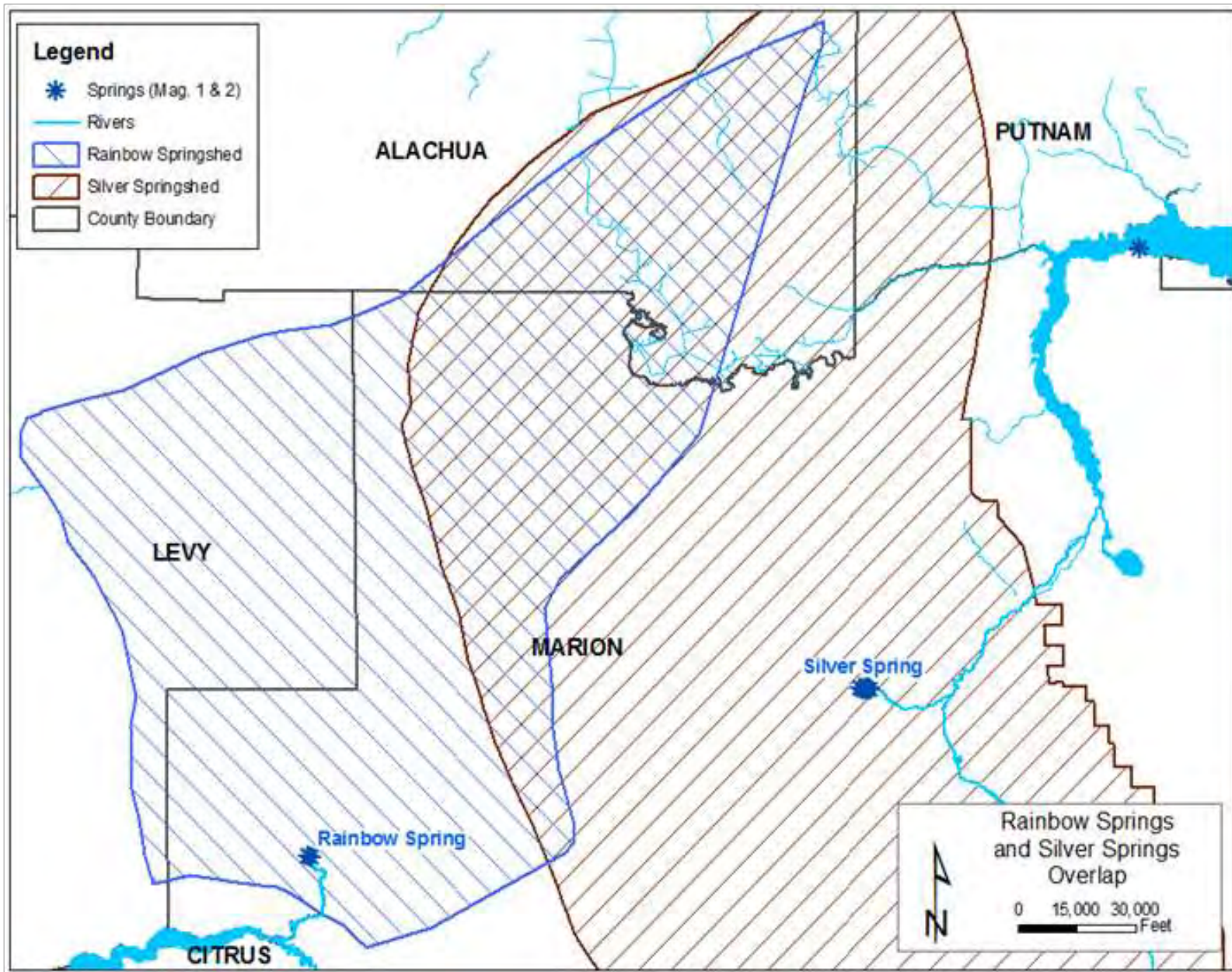
Springs Impairments

Synergistic Effects of
Decreasing Flows and
Increasing Nitrate:

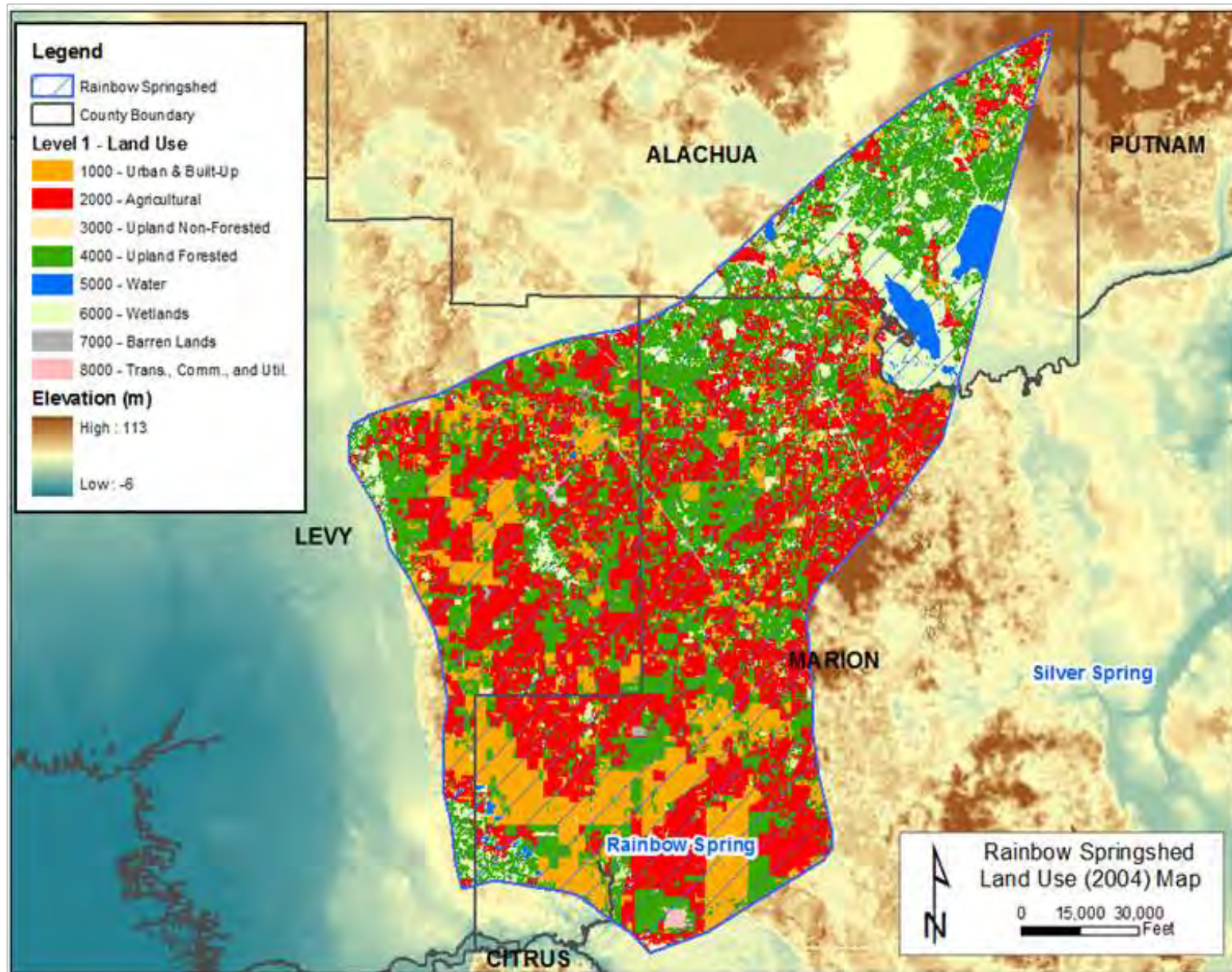
- Increased algal densities
- Declining cover of native plants
- Reduced photosynthetic efficiencies
- Declining native fish and turtle populations
- Invasions by exotic fish and wildlife species, etc.



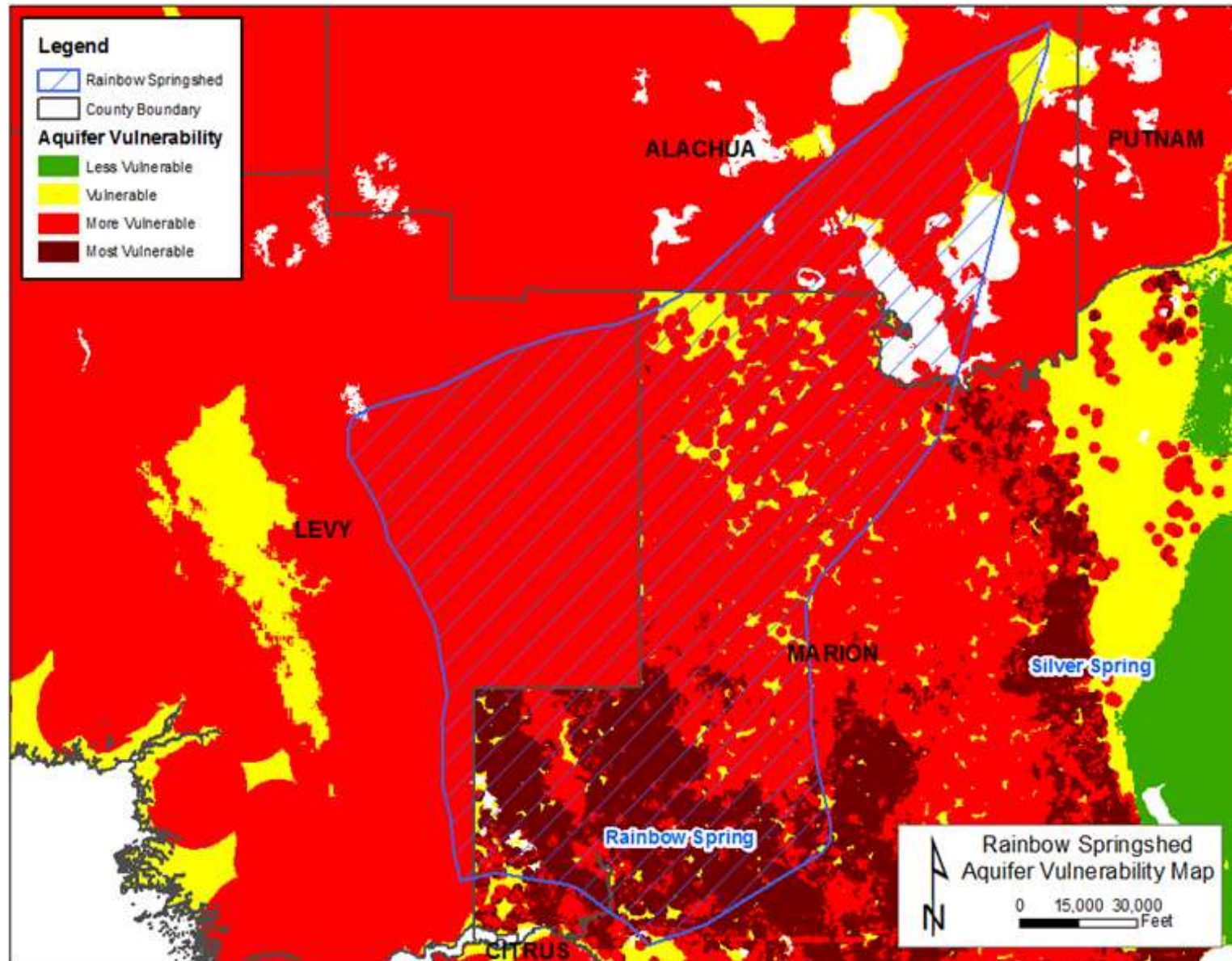
Rainbow Springshed Maximum Extent: 472,000 acres (737 mi²)



Rainbow Springshed 2004 Land Uses: agriculture (37%), forested (33%), urban (17%)



Rainbow Springshed Aquifer Vulnerability: >95% is “more” or “most”



Rainbow Springs Problem – Part I

Groundwater resources are stressed:

- Groundwater consumption is increasing
- Groundwater levels are falling
- Spring flows are declining



Residential

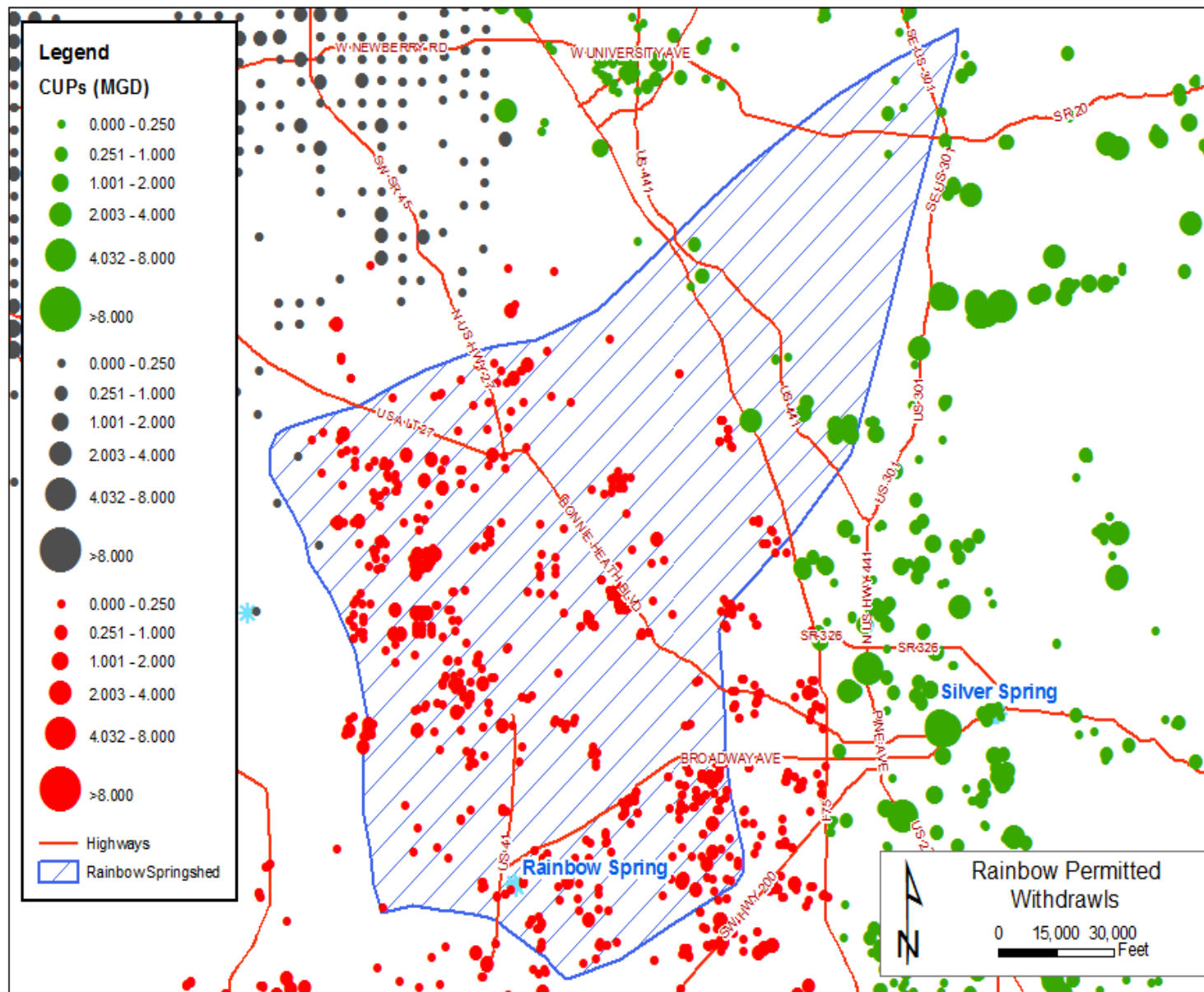


Agriculture



Golf Courses

Rainbow Springshed Permitted Groundwater Withdrawals = 50 MGD

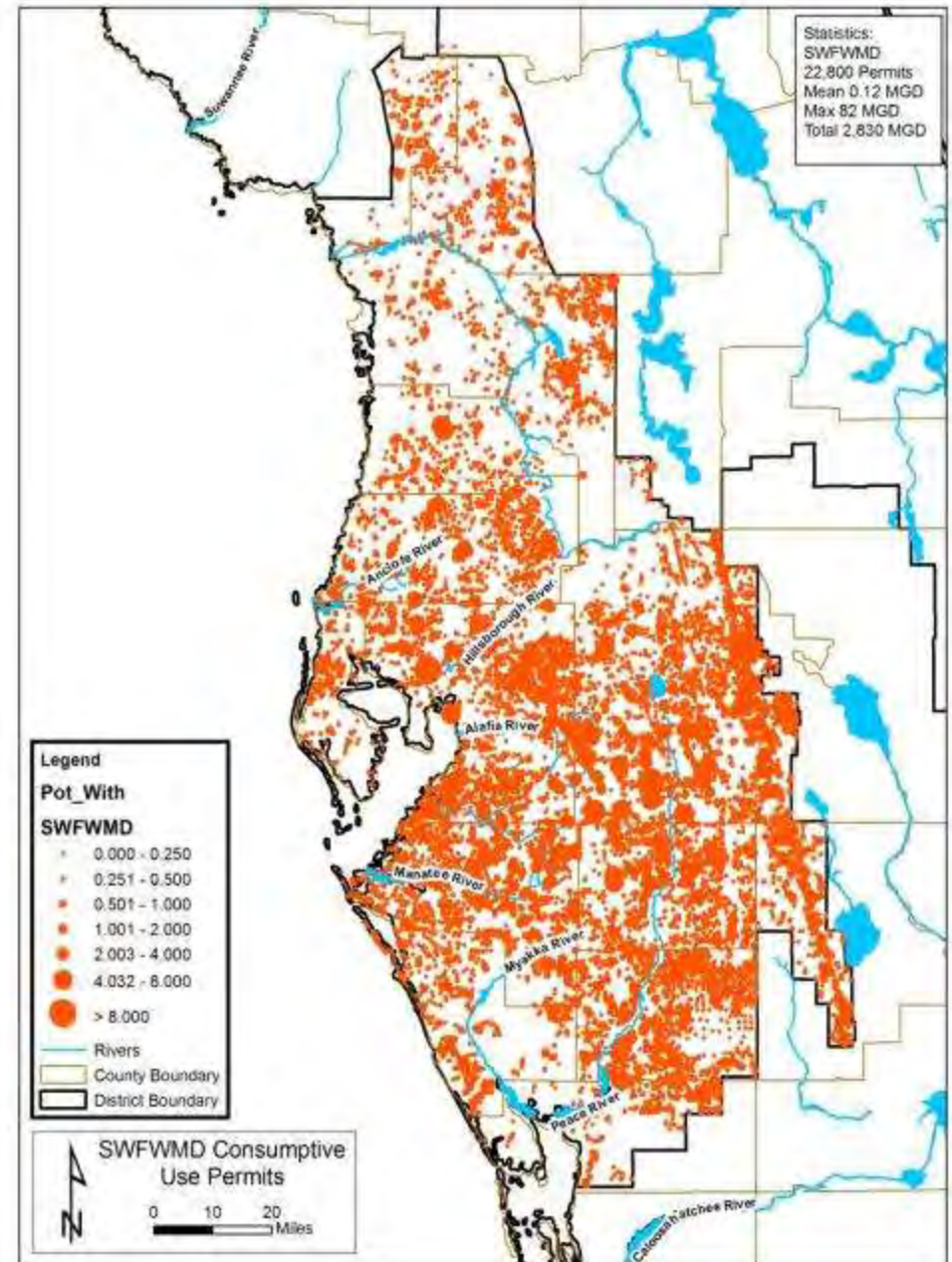


SWFWMD Groundwater Permits

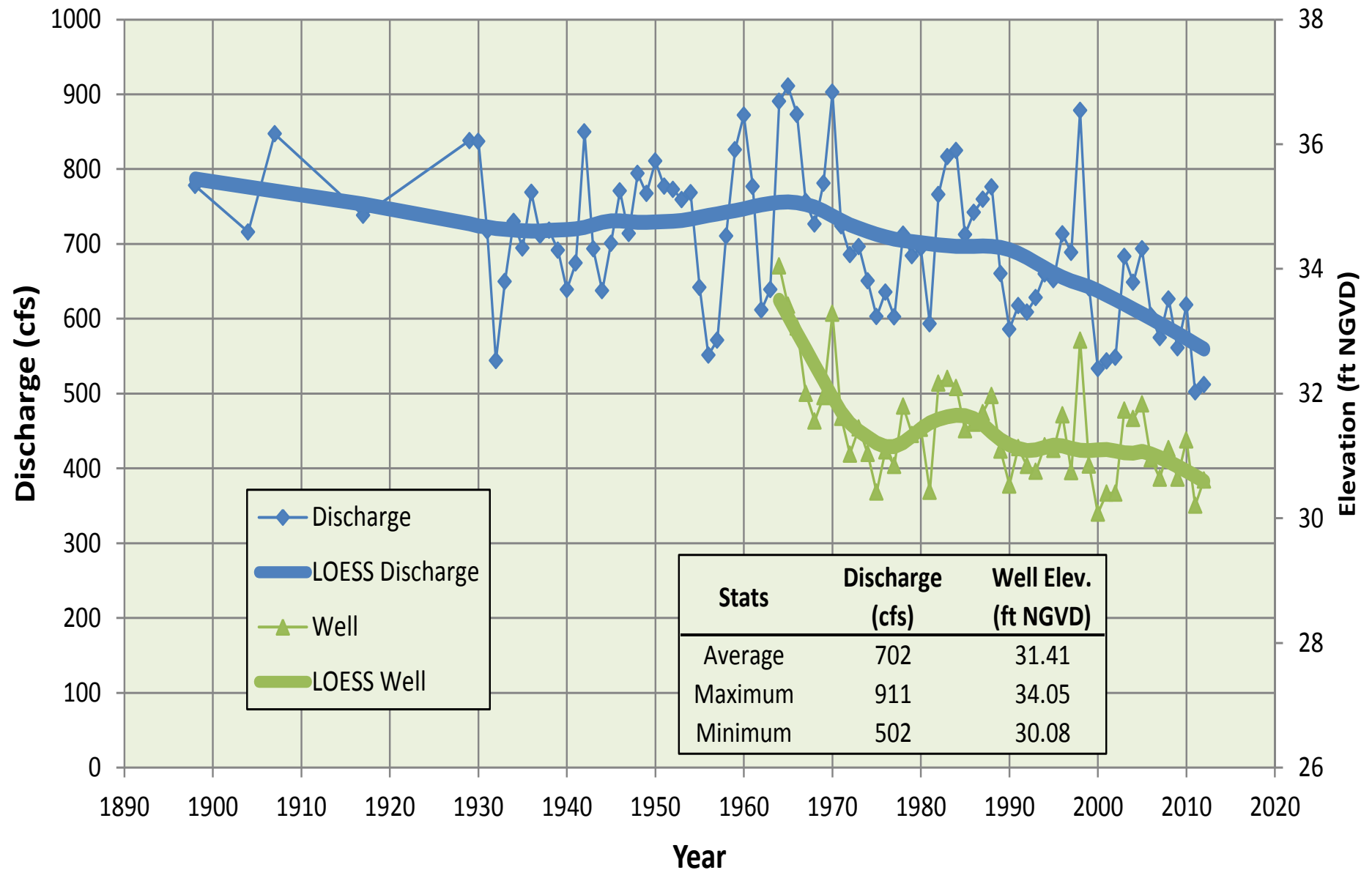
Existing Groundwater Consumptive Use Permits:

- Total permits – **22,800**
- Estimated 2010 pumping – **965 MGD**
= **39%** of average aquifer recharge
- Total allocated groundwater use – **2,830 MGD** = **116%** of local recharge!

Water Management District data



Declining Rainbow Springs Flows (142 MGD) and Groundwater Elevations (3 ft)



Rainbow Spring Flows are Declining

Key Findings:

- Average flow decline at Rainbow Springs is estimated as 25 percent, well beyond the range typically recognized as “significant harm”;*
- A large fraction of this flow declines is resulting from excessive groundwater uses outside the Rainbow Springshed;*
- Regional groundwater pumping will need to be reduced by about 60% to restore protective flows at Rainbow Springs.*



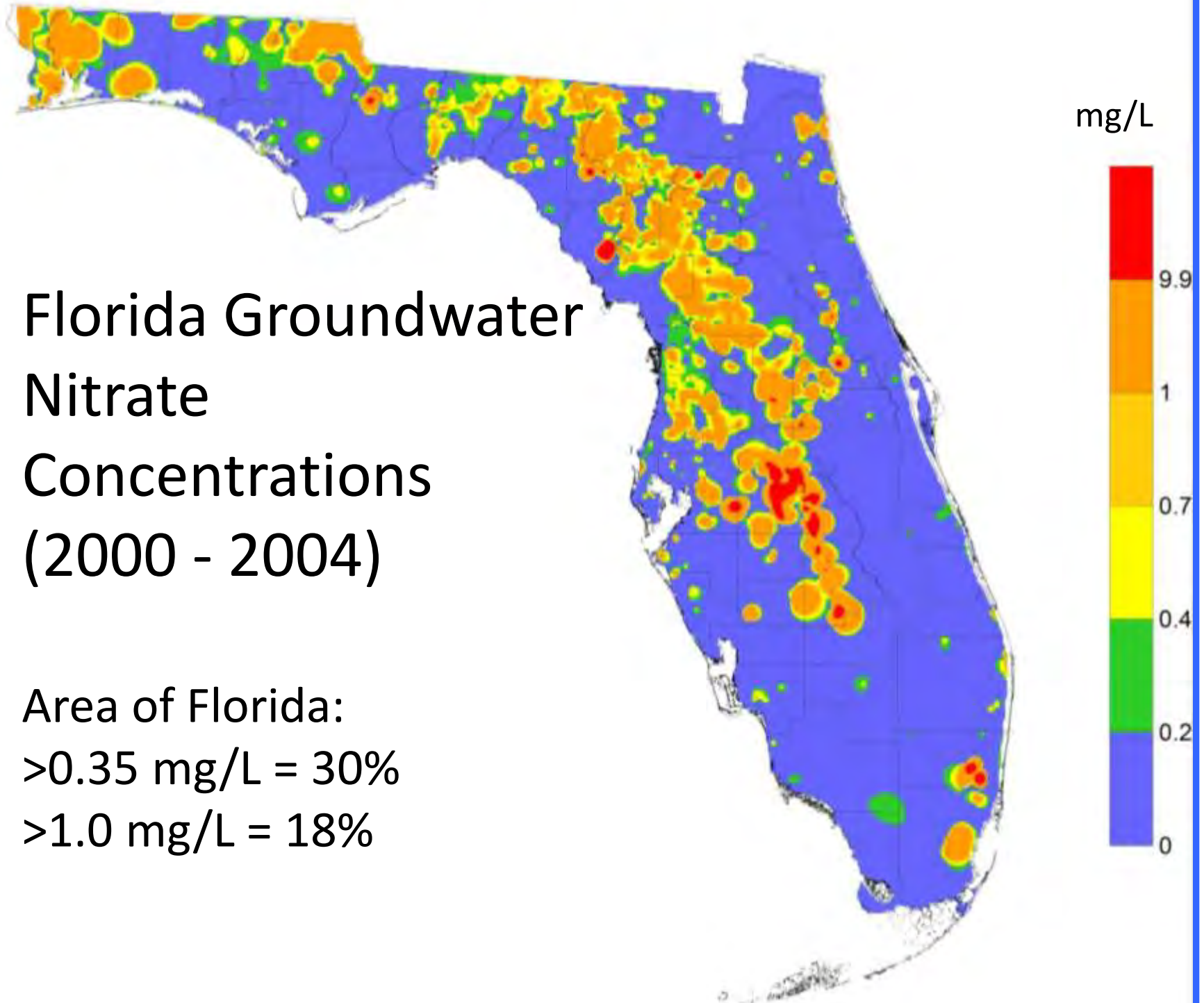
Rainbow Springs Problem – Part 2

- GW nitrate nitrogen levels are increasing:
 - Nitrate contamination is widespread in the Floridan Aquifer
 - Springs are sensitive to elevated nitrate

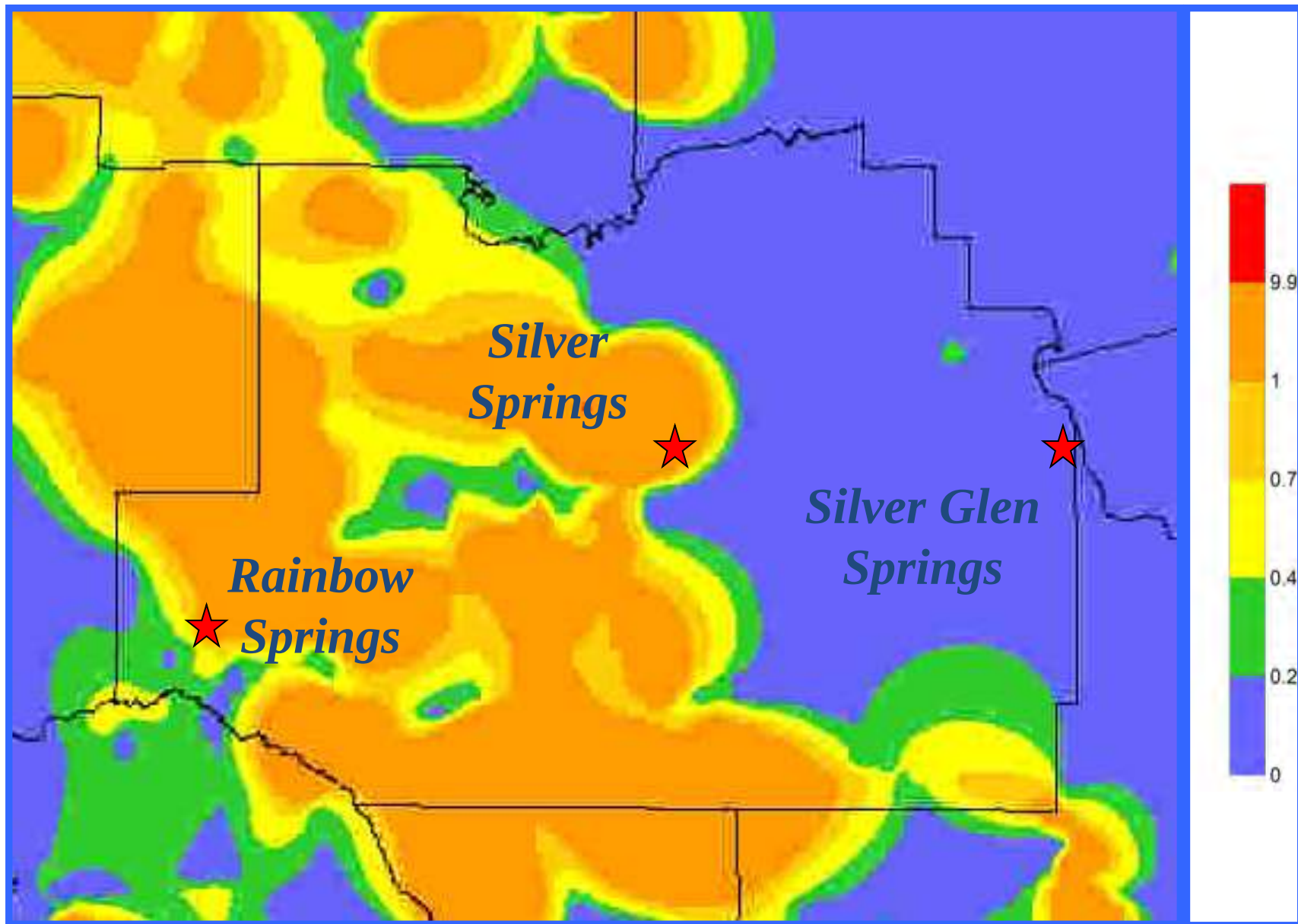


Florida Groundwater Nitrate Concentrations (2000 - 2004)

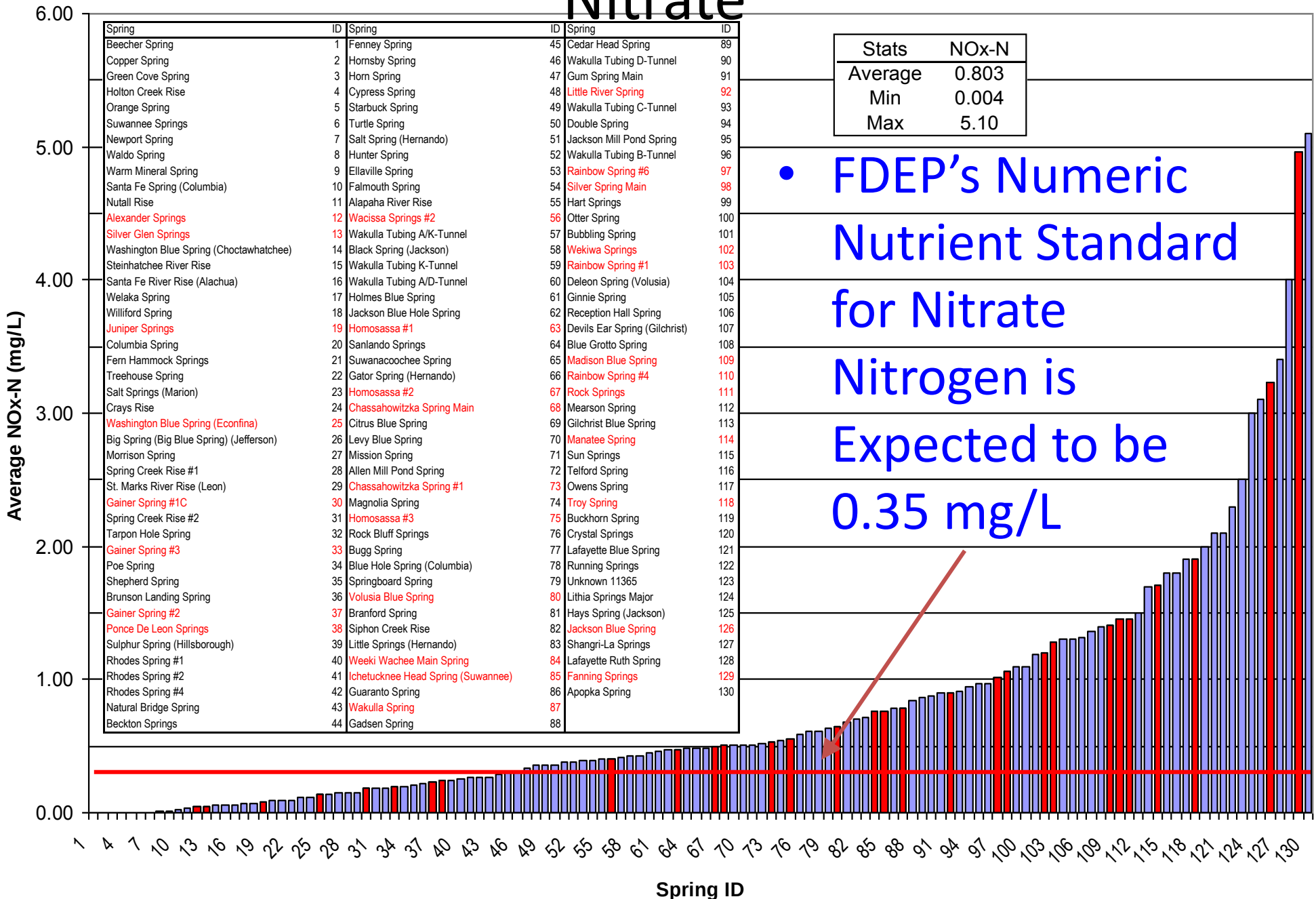
Area of Florida:
>0.35 mg/L = 30%
>1.0 mg/L = 18%



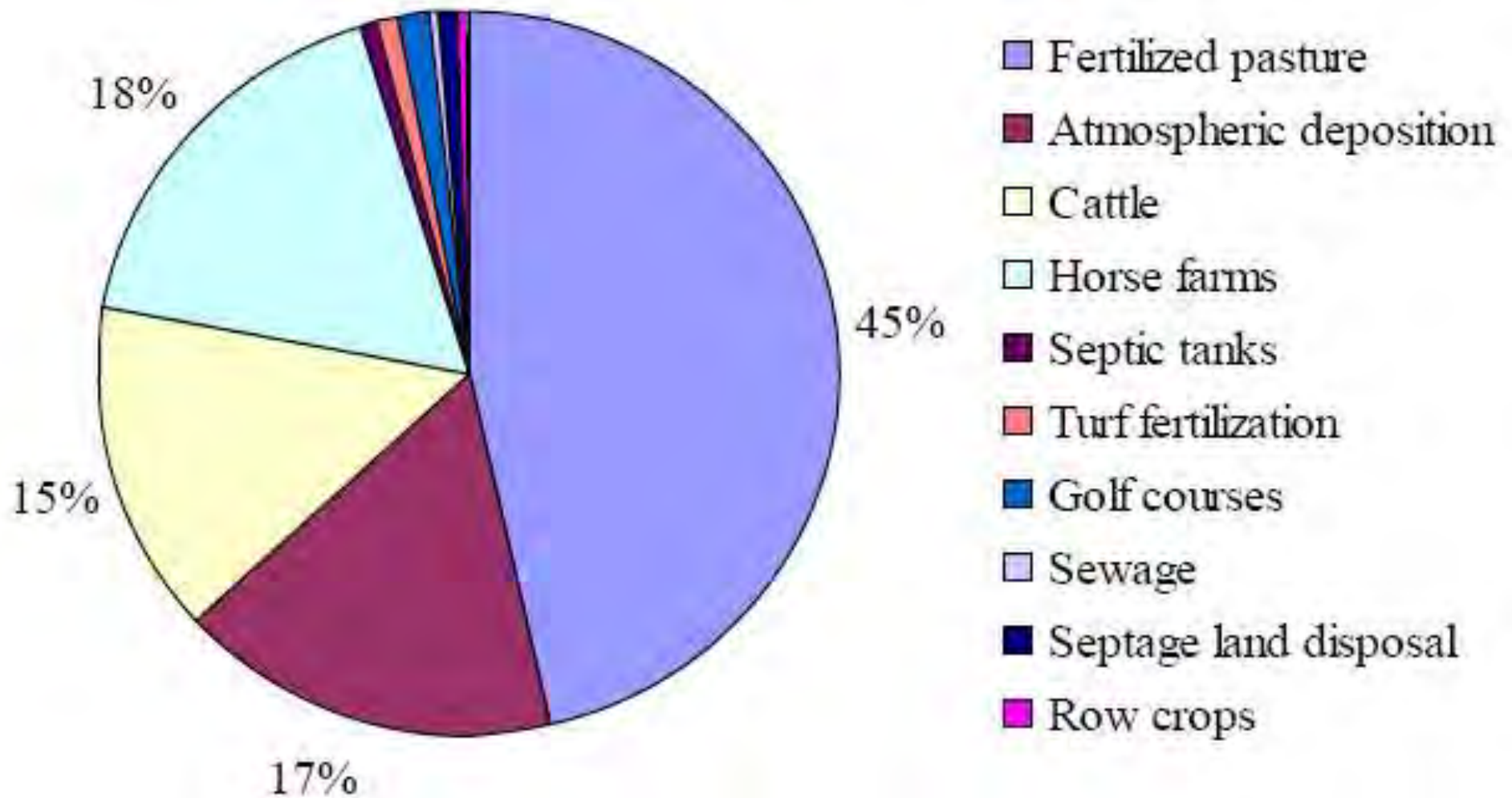
Marion County Groundwater Nitrate Concentrations (mg N/L)



>60% of Florida's Springs are Impaired by Nitrate



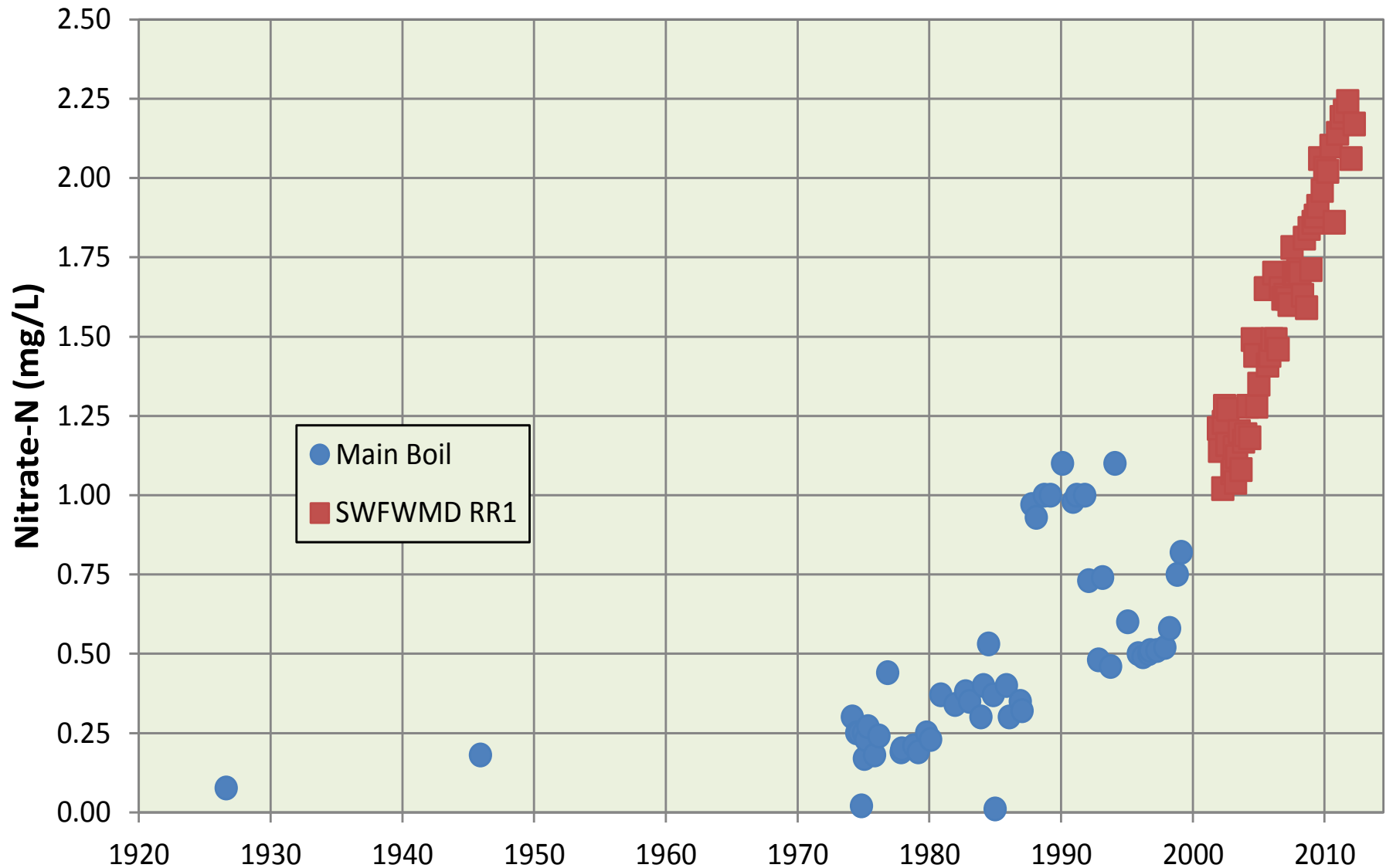
Rainbow Springs Nitrogen Sources



(Jones *et al.* 1996)

Agriculture = 95%

Rainbow Springs Nitrate Concentrations: 2,700% increase since 1920s



Rainbow Springs Annual Nitrate Loads

Period	Avg. Flow (cfs)	Avg. Nitrate-N (mg/L)	Nitrate-N Annual Load (MT)
1925-1934 ¹	719	0.08	49
1935-1944	708	--	--
1945-1954 ²	763	0.18	123
1955-1964	709	--	--
1965-1974 ²	771	0.30	207
1975-1984	693	0.26	161
1985-1994	675	0.69	415
1995-2004	653	0.97	565
2005-2012	587	1.75	917

¹Flow is for 1929-1934 with Nitrate-N from 1927

²Only a single Nitrate-N concentration available



Nitrate is the Principal Pollutant in Rainbow Springs

Key Findings:

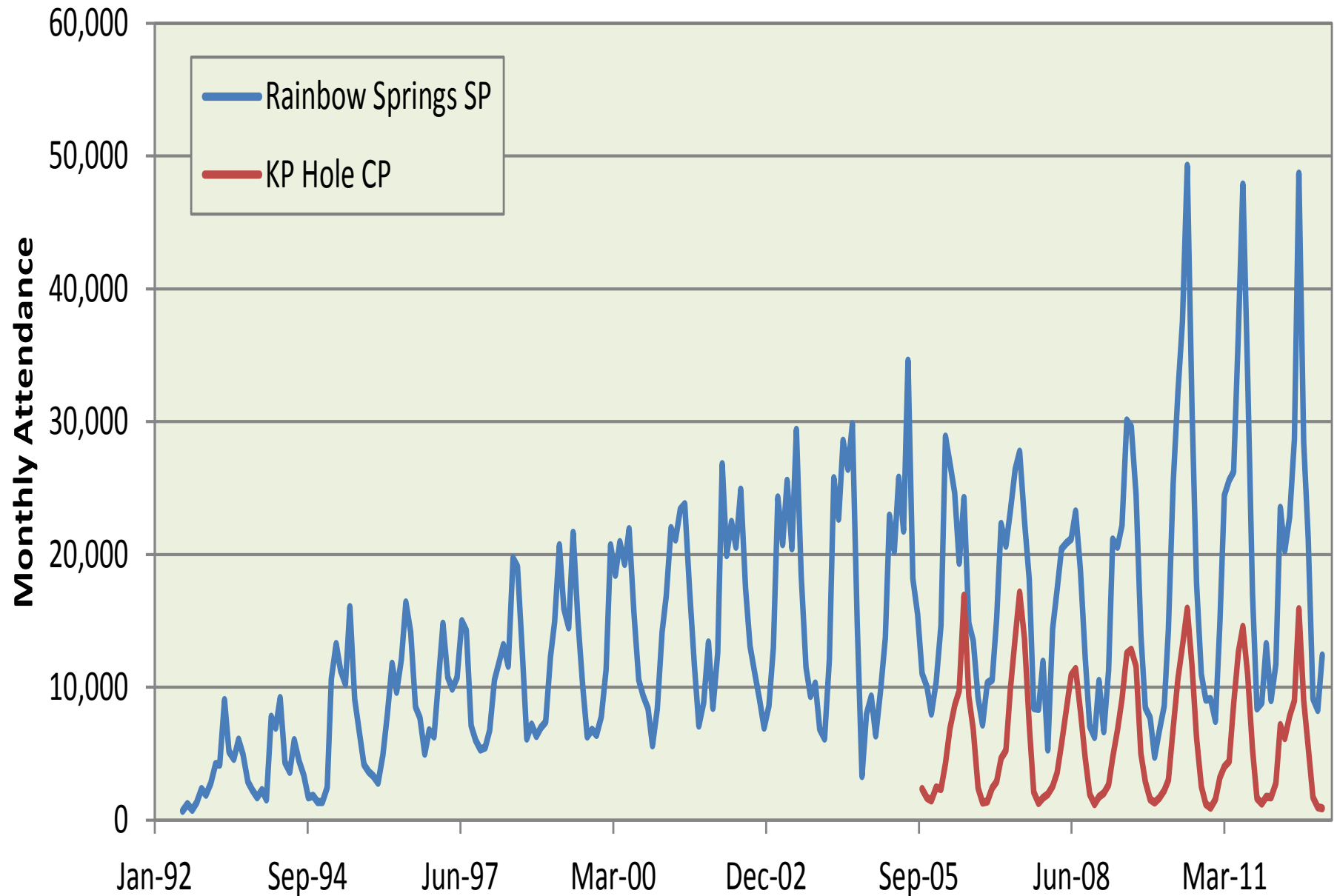
- *Groundwater feeding Rainbow Springs is contaminated by nitrate nitrogen derived principally from fertilizers and human and animal waste disposal practices;*
- *Nitrate concentrations in Rainbow Springs are above levels considered by the State of Florida to cause nutrient impairment;*
- *Increased populations of filamentous algae provide visible evidence of this impairment;*
- *Nitrogen loading in the Rainbow Springshed will need to be reduced by about 82% to meet the water quality standard.*

Rainbow Springs Problem – Part 3

- Recreational uses are increasing:
 - Vegetation trampling and motor scarring
 - 2011-12 human uses:
 - Tubers – 84,000
 - Kayaks/canoes – 16,500
 - Swimmers/divers – 9,000
 - Motorboats – 6,600
 - Scuba boats – 1,000

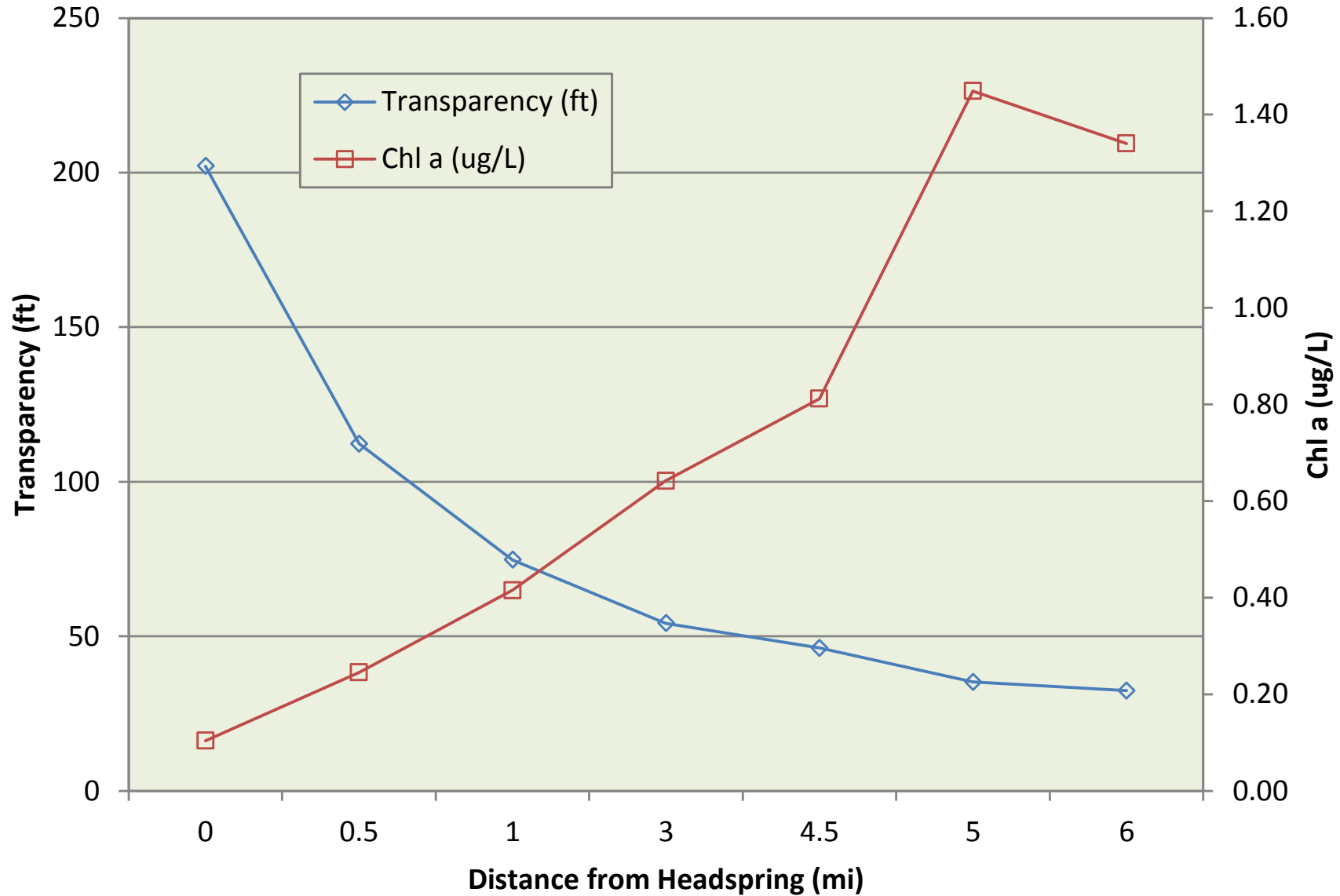


Rainbow River 2011 Recreational Use: more than 334,000 people



Rainbow River Downstream

Decline in Water Clarity





Excessive Recreation Causes Impairment at Rainbow Springs

Key Findings:

- Motor-boating is the most damaging recreational use in the Rainbow River due to prop scarring;*
- Crowding of recreational users results in impacts to submerged aquatic vegetation;*
- Water clarity suffers as a result of high recreational use;*
- Motor size and tubes/kayaks/canoe use-intensity need to be reduced.*

So...What Can Be Done to Protect Rainbow Springs?



A Water Sustainability Checklist

- ✓ As individuals, we can conserve water at home and at work



John Moran photo

A Water Sustainability Checklist

- ✓ As individuals, we can conserve water at home and at work
- ✓ As professionals, we can collect the data and inform the state's water management agencies



John Moran photo

A Water Sustainability Checklist

- ✓ As individuals, we can conserve water at home and at work
- ✓ As professionals, we can collect the data and inform the state's water management agencies
- ✓ As citizens we can contact our legislators and other government officials urging them to pass laws that better protect the Floridan Aquifer and our springs



John Moran photo

A Water Sustainability Checklist

- ✓ As individuals, we can conserve water at home and at work
- ✓ As professionals, we can collect the data and inform the state's water management agencies
- ✓ As citizens we can contact our legislators and other government officials urging them to pass laws that better protect the Floridan Aquifer and our springs
- ✓ We must do everything in our power to insure a sustainable water future - "Springs Eternal – Florida's Fragile Fountain of Youth"



John Moran photo

Rainbow Springs Will Heal When We:

- Reduce permitted groundwater extractions by 60%;
- Reduce nitrogen fertilizer use by 82%;
- Limit recreation to sustainable levels;
- Protect Outstanding Florida Waters!



Be Sure to Visit the Florida Museum of Natural History Springs Eternal Exhibit



John Moran photo

WAKULLA SPRINGS
BY JIM STEVENSON













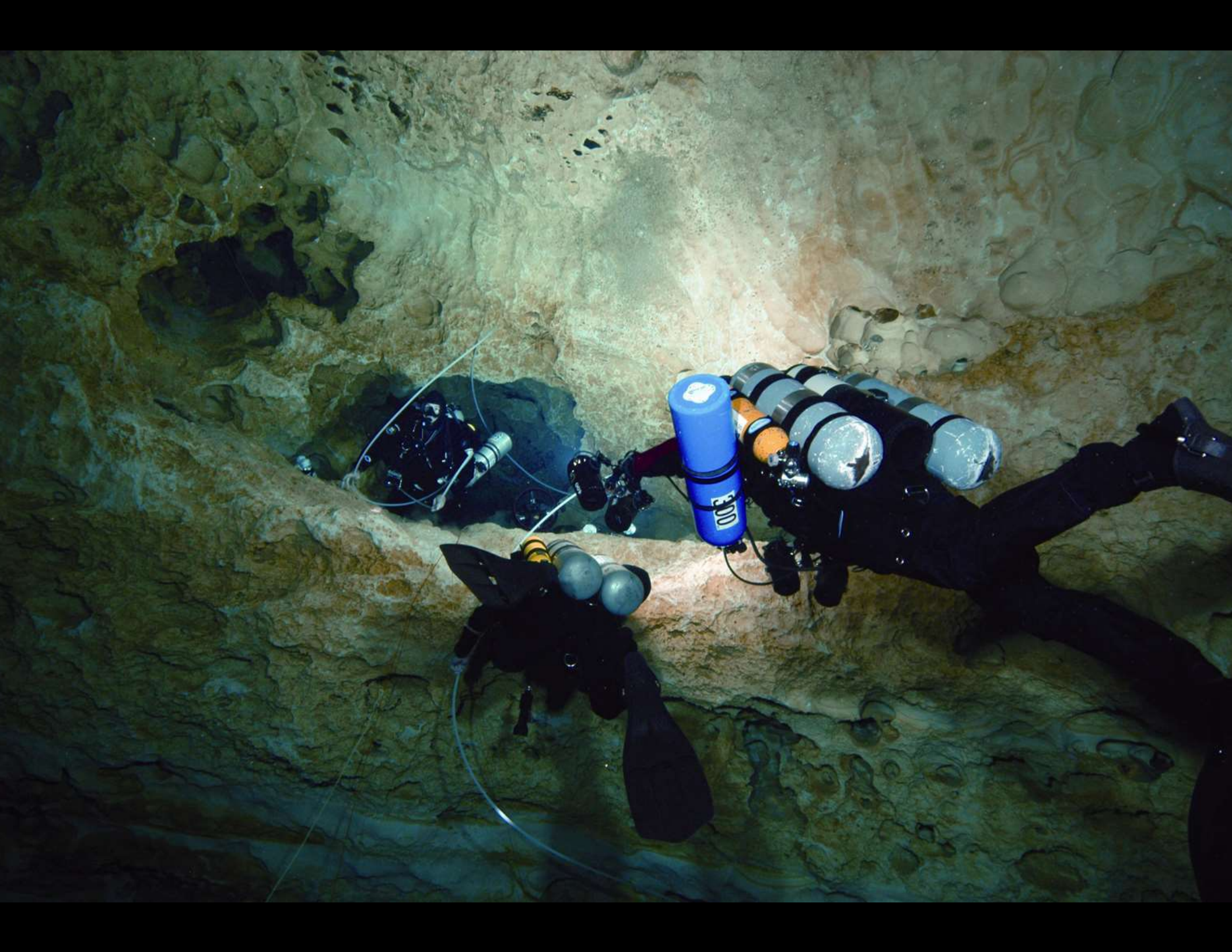


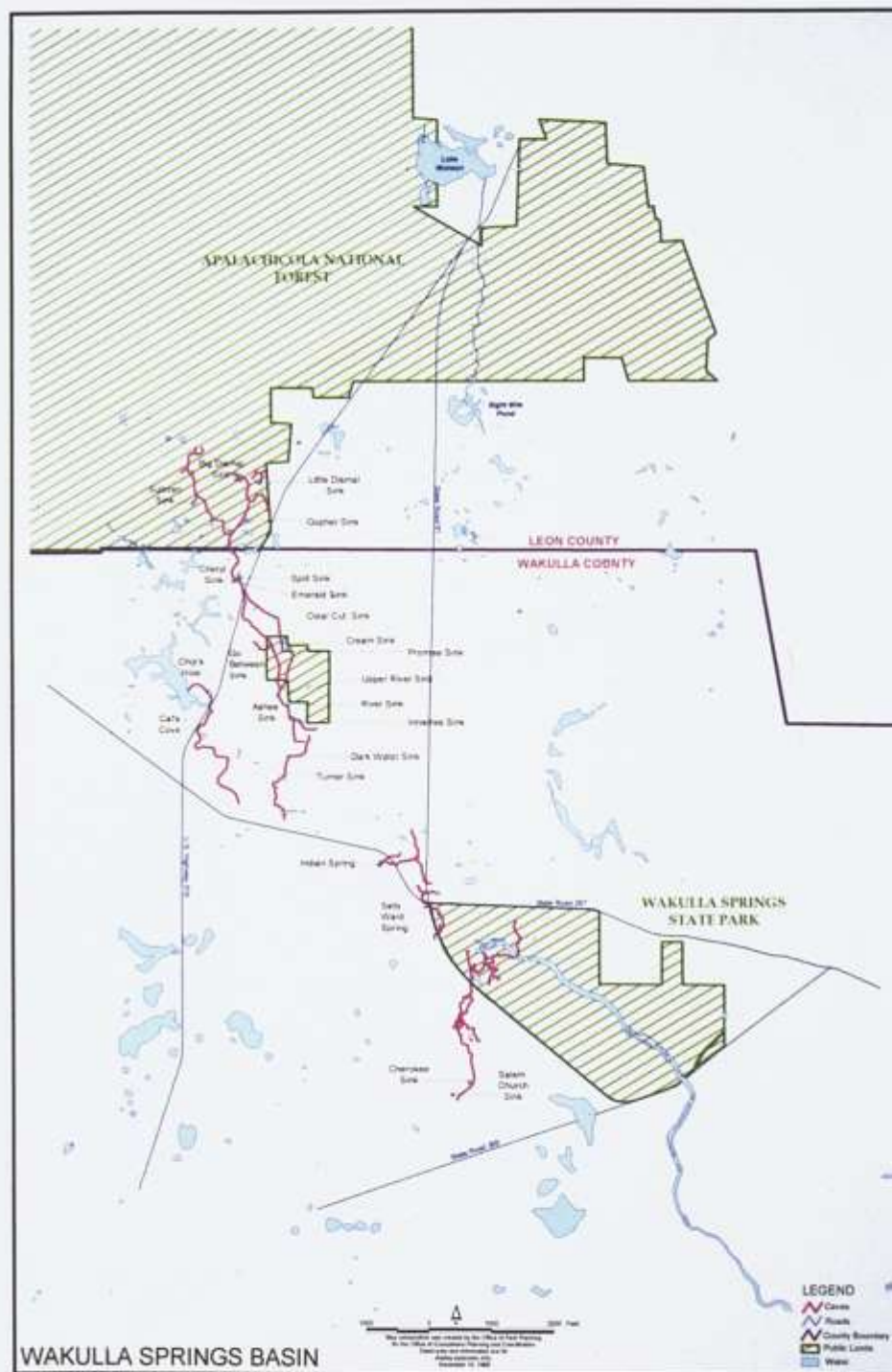


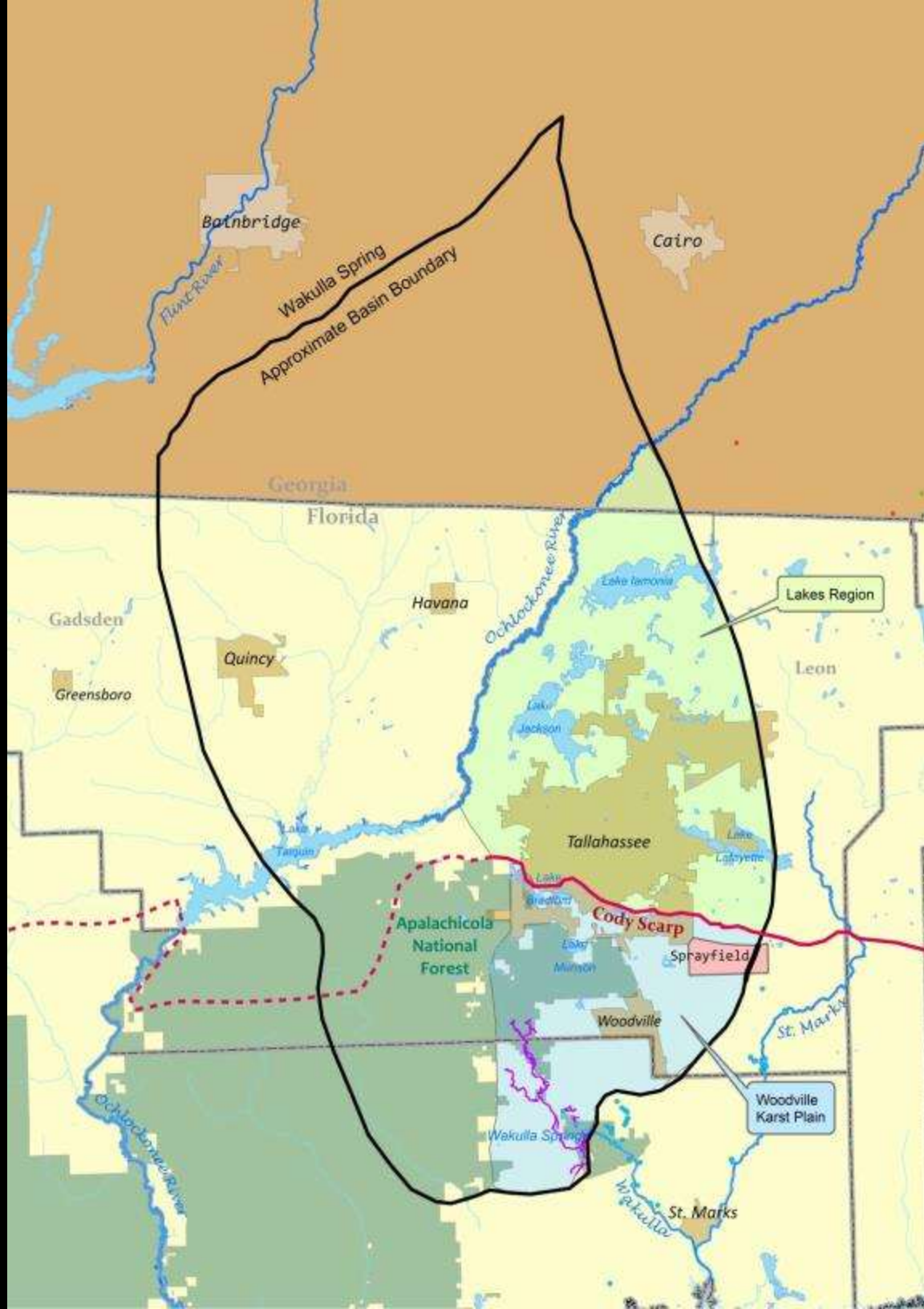


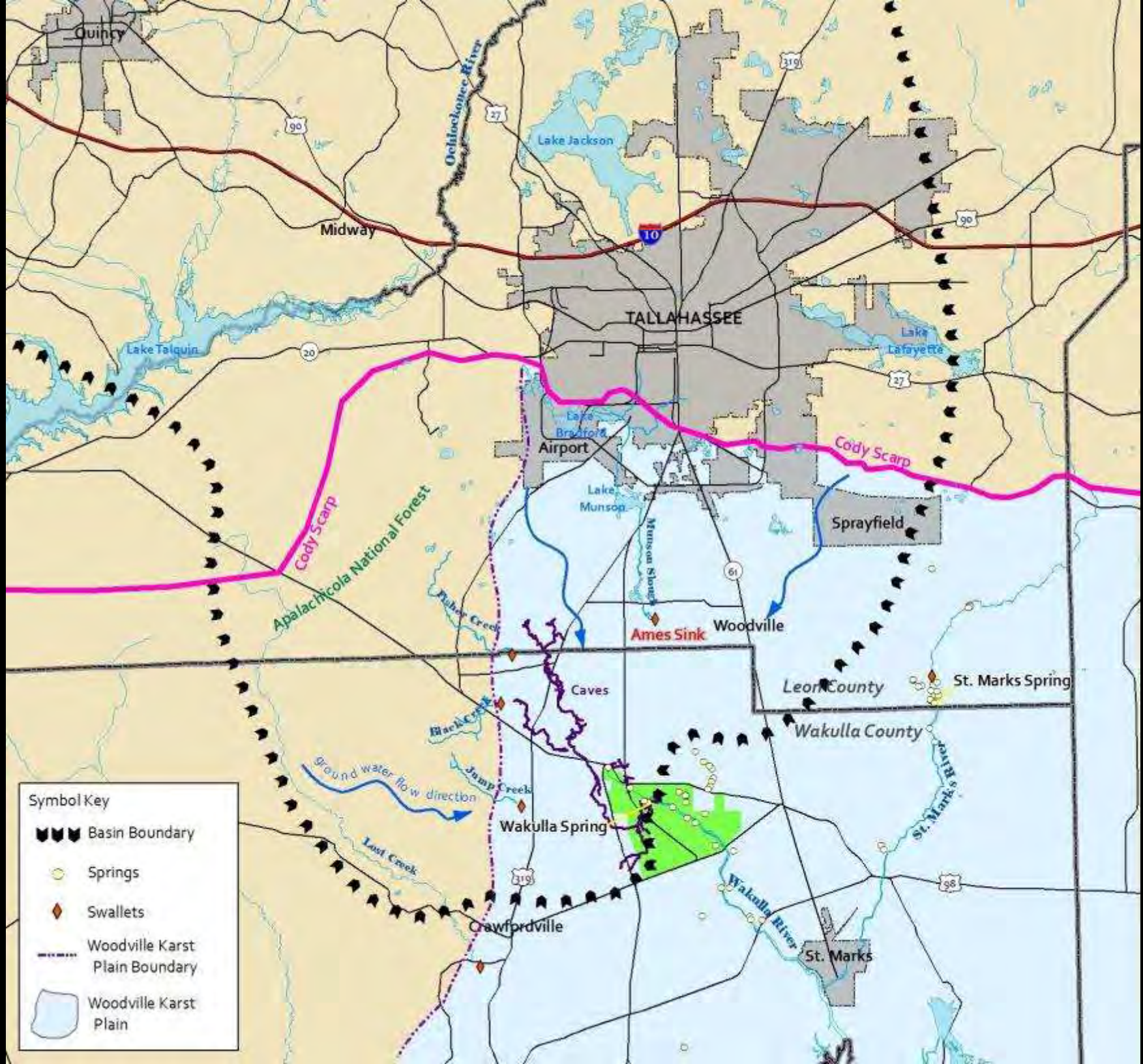
Wakulla Spring Basin Working Group

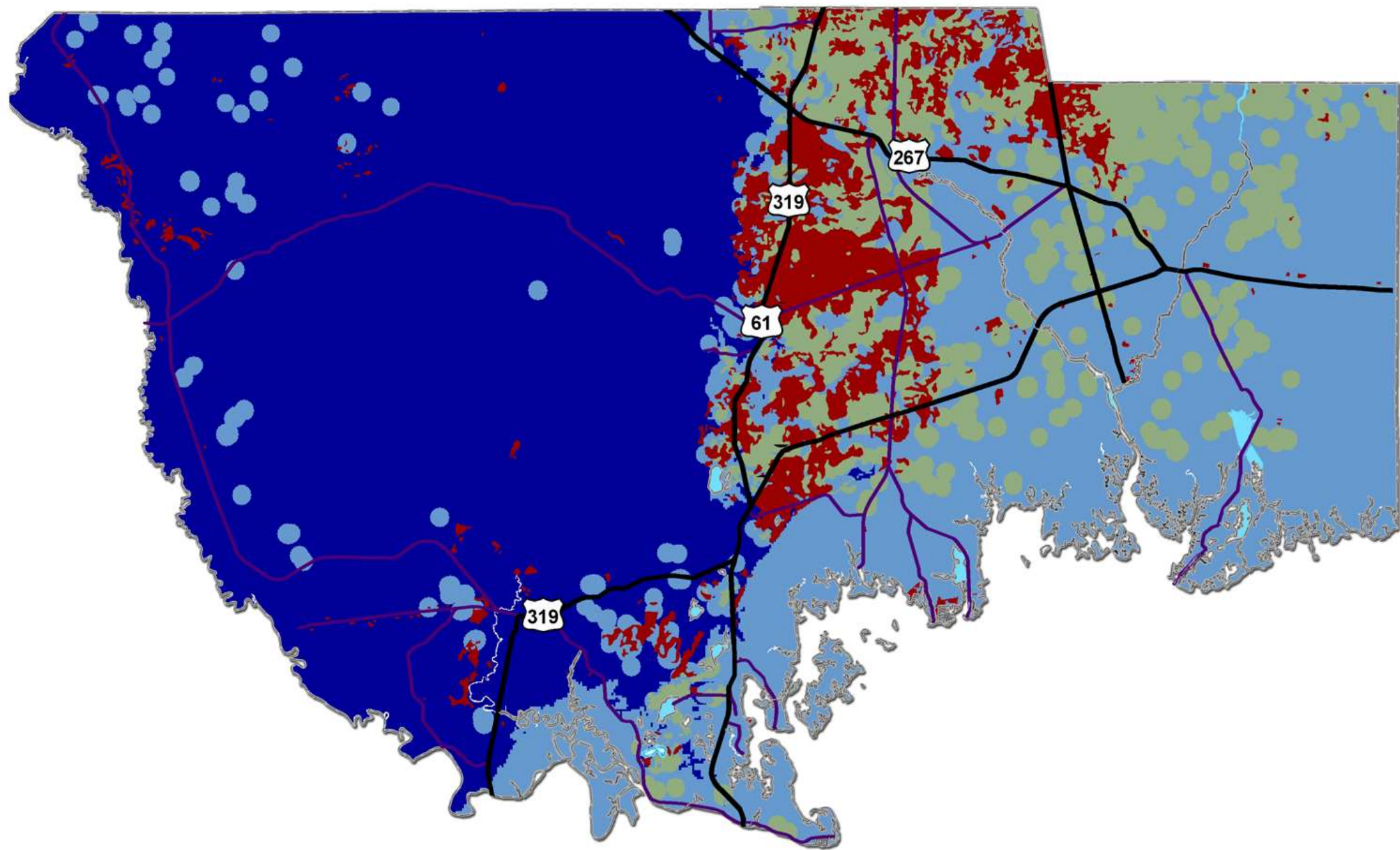
- **Citizens**
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- **Leon County**
- **Wakulla County**
- **Regional Planning Council**
- **Northwest Florida Water Management District**
- **Dept. of Environmental Protection**
- **Department of Health**
- **Dept. of Community Affairs**
- **Dept. of Transportation**
- **Florida State University**
- **U. S. Geological Survey**
- **U. S. Forest Service**
- **Friends of Wakulla Spring**
- **Florida Wildlife Federation**
- **1000 Friends of Florida**
- **Global Underwater Explorers**
- **H2H Associates**
- **Tallahassee Democrat**

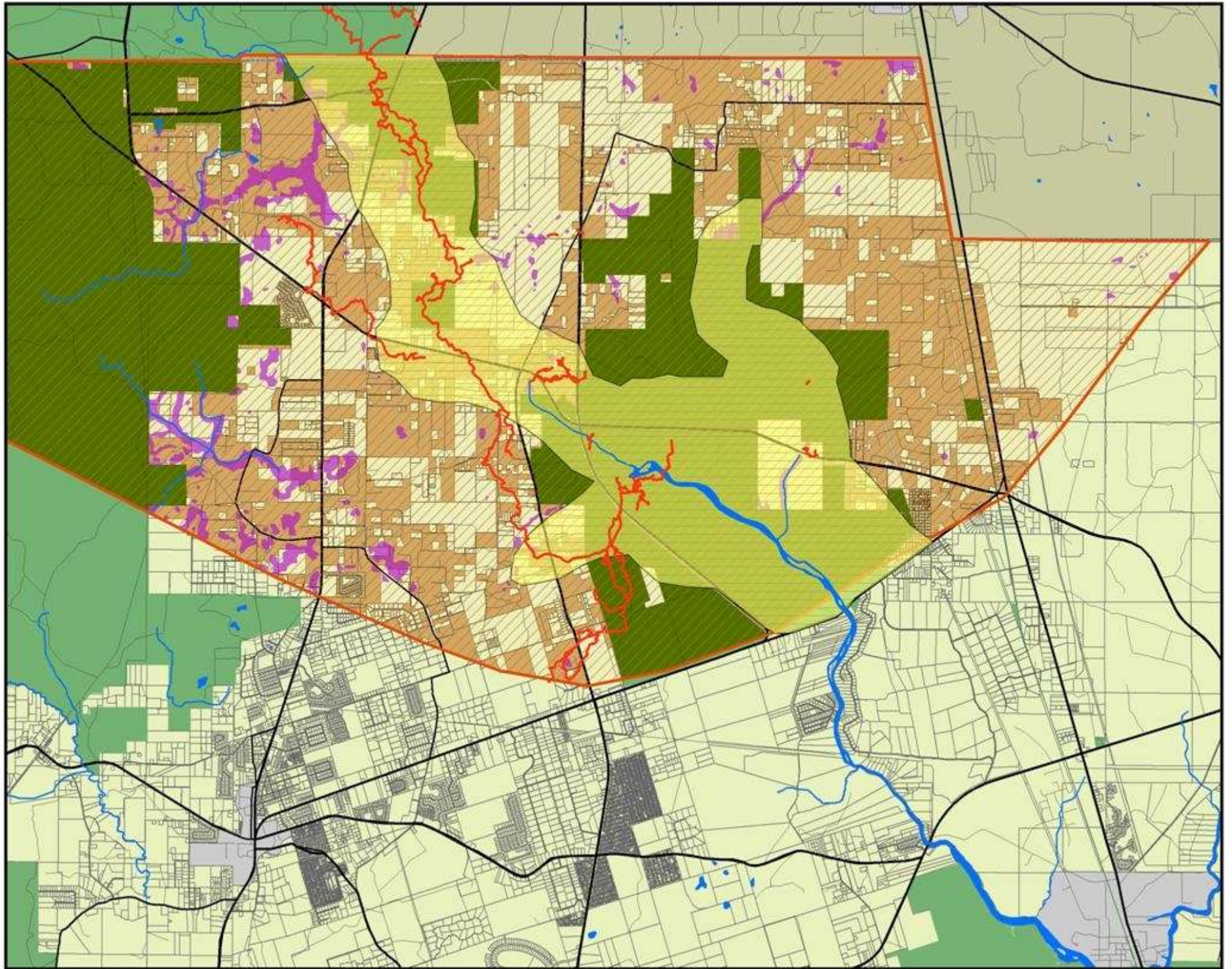




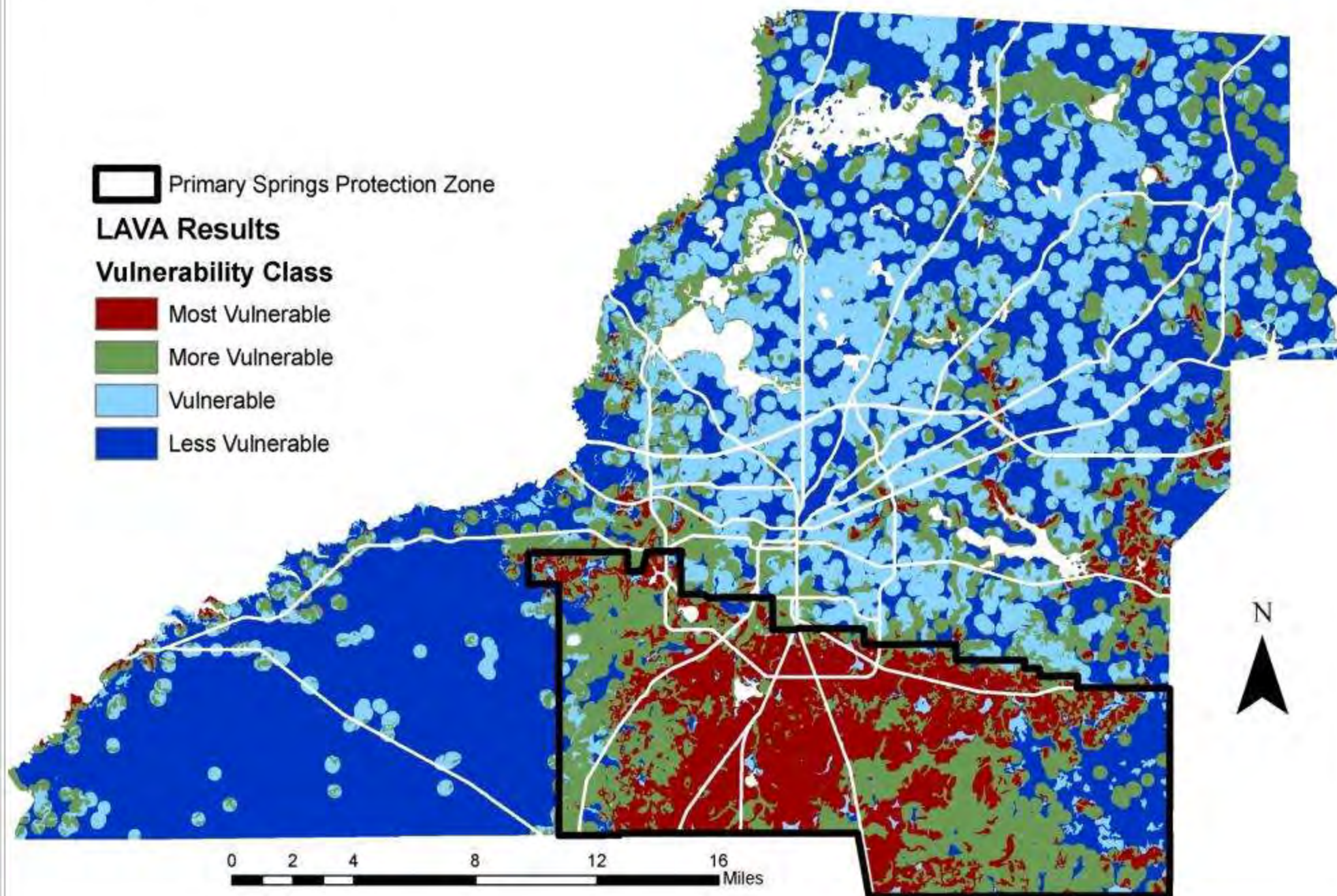




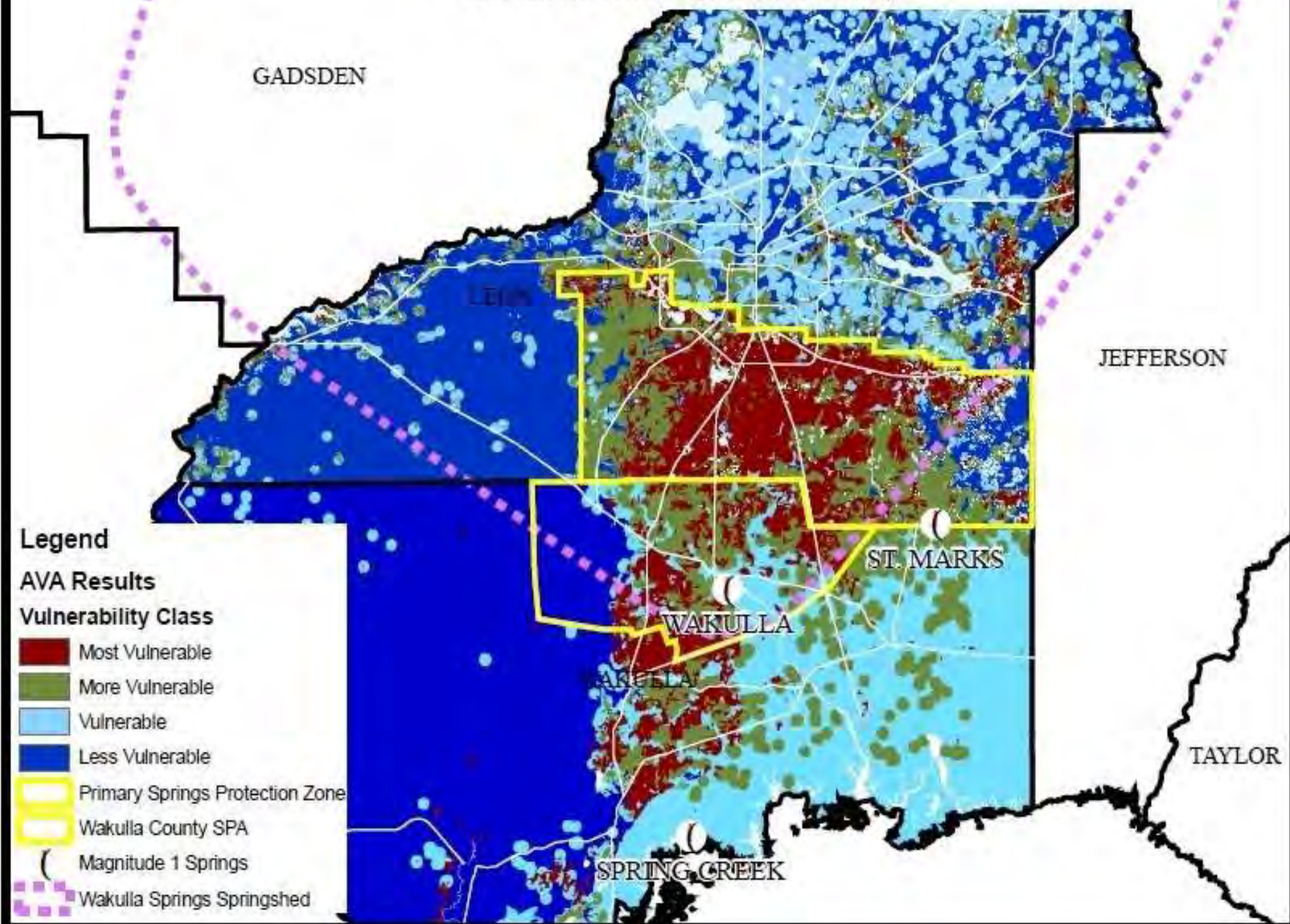




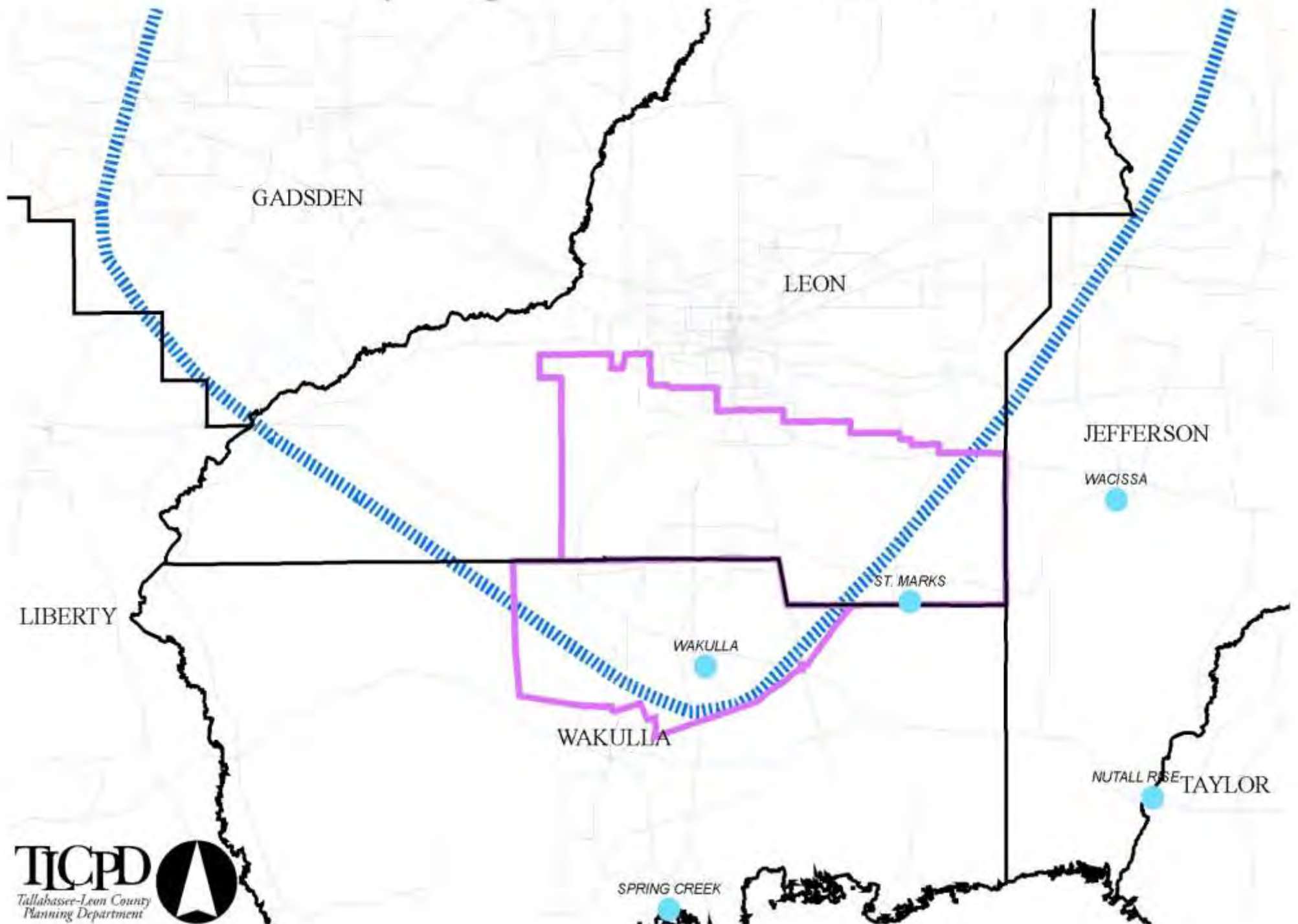
Leon County Aquifer Vulnerability Assessment Map



Aquifer Vulnerability Assessments and Spring Protection Areas for Leon and Wakulla County



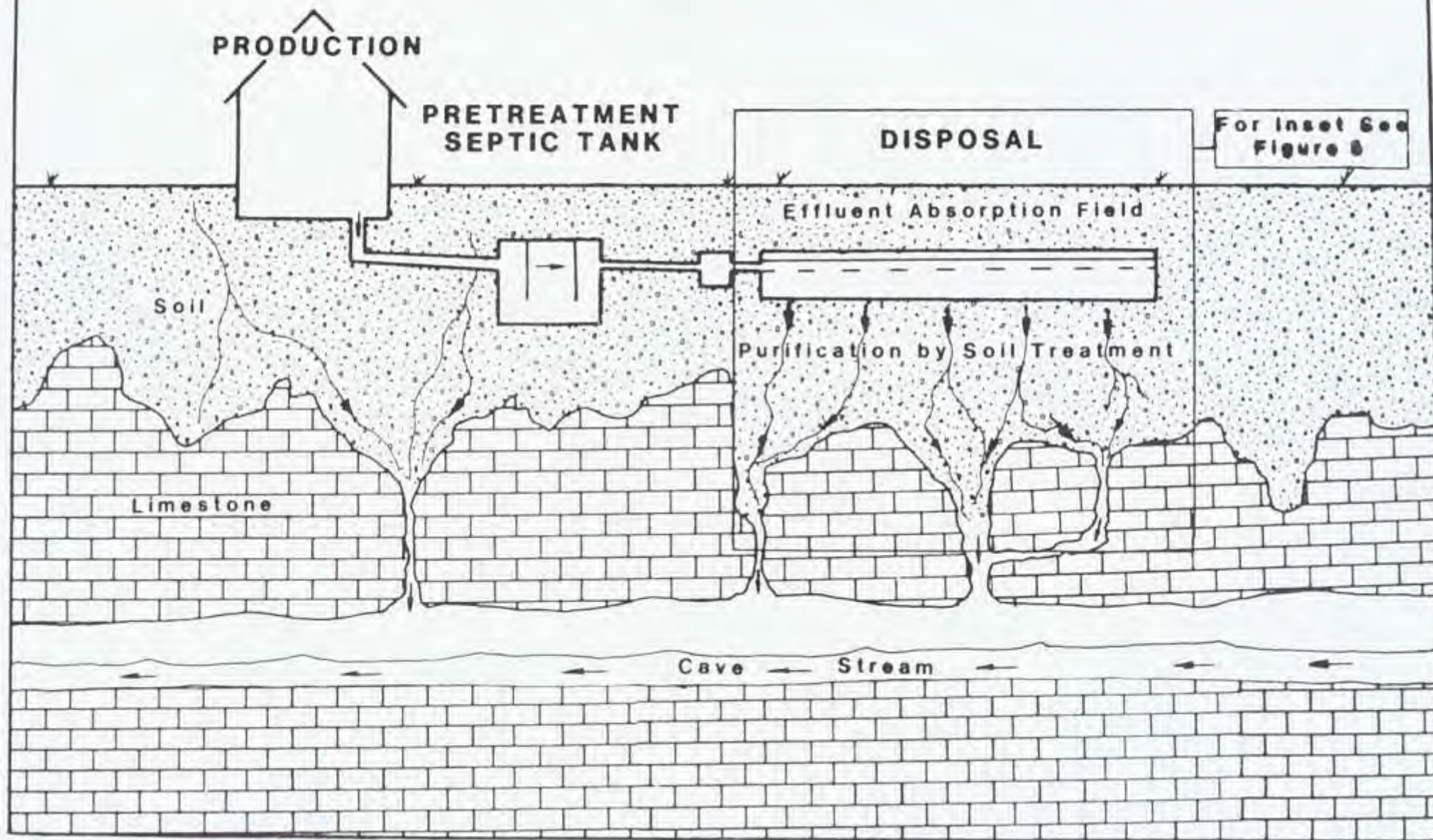
Leon and Wakulla County Springs Protection Zones







SOIL ABSORPTION SYSTEM FOR ONSITE SEWAGE DISPOSAL IN KARST AREAS WITH SOIL MACROPORES















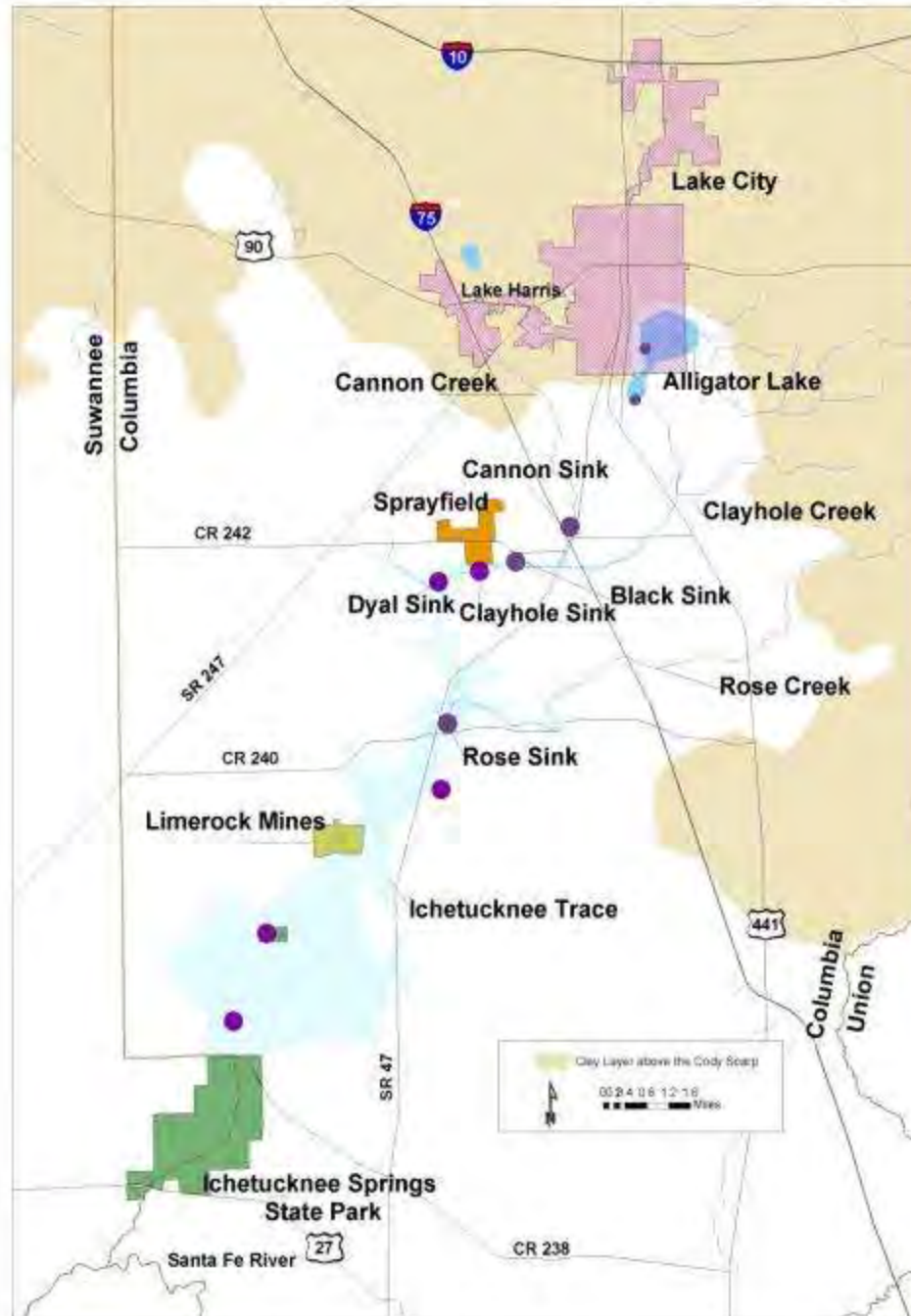
Munson Slough
Drains to
Wakulla Springs

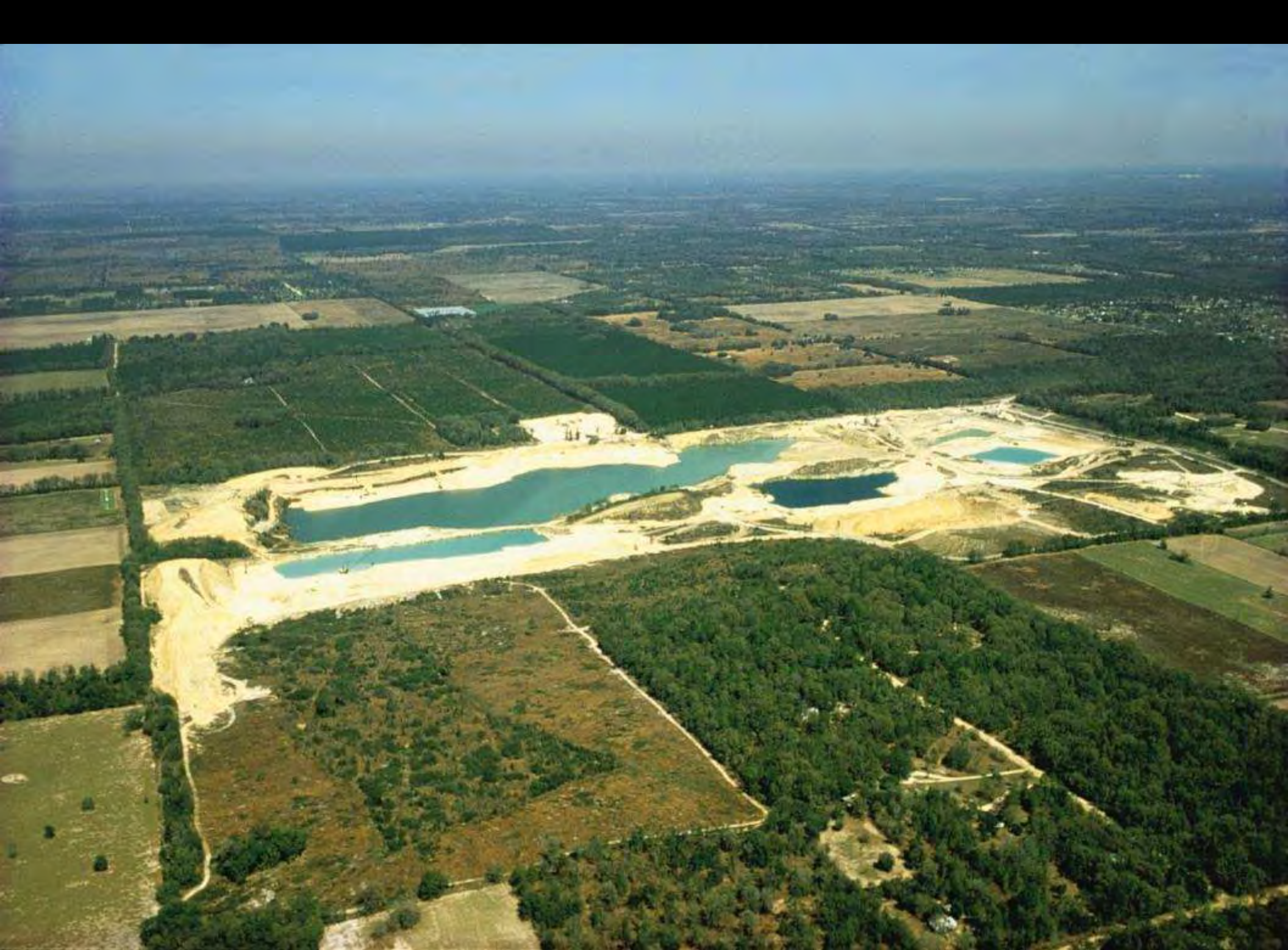






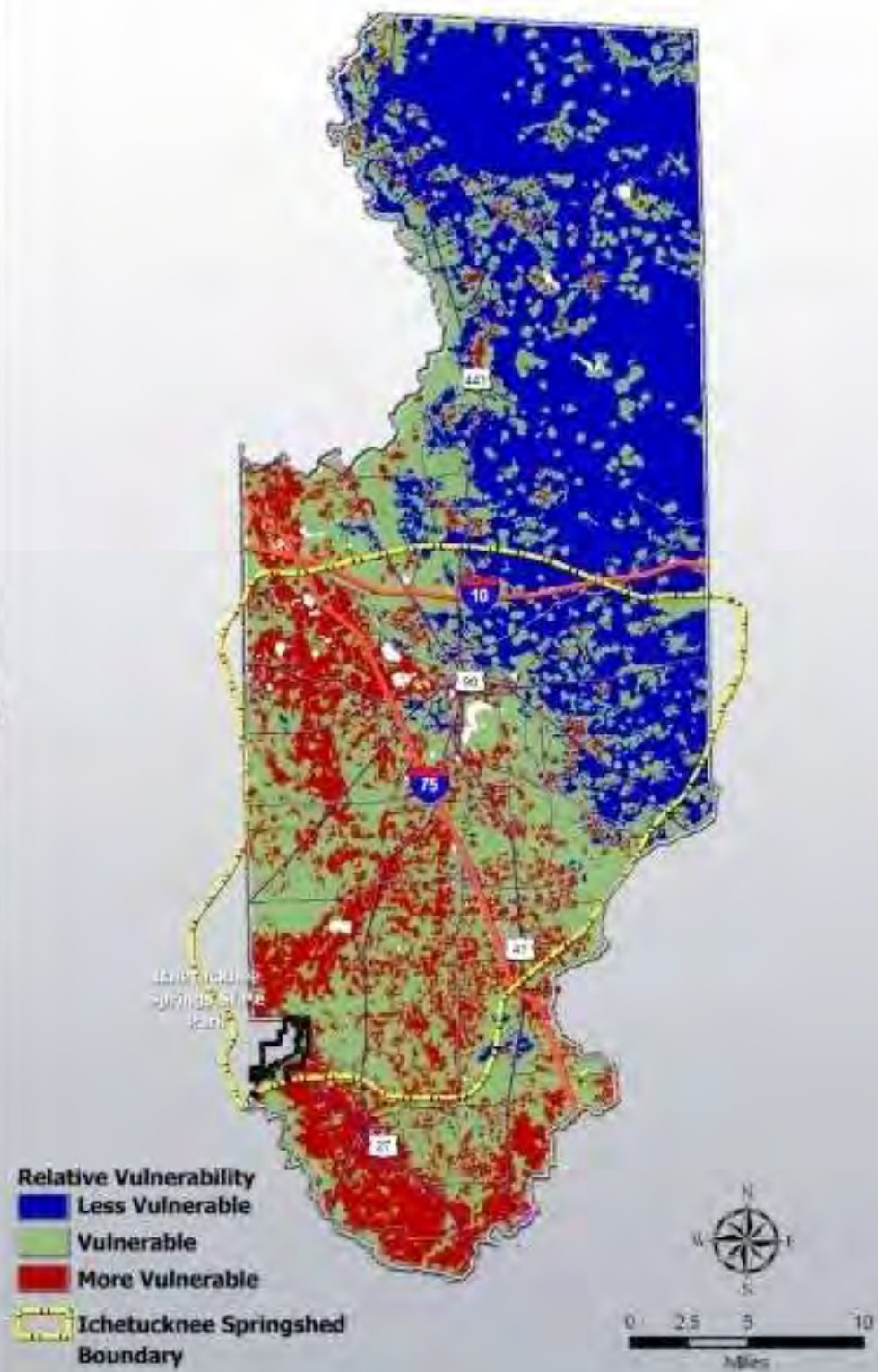
Ichetucknee Springs Basin













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