

April 3, 2012

Silver Springs Alliance Public Forum

The Future of Silver Springs



*Presented by the Silver
Springs Alliance*



The Future of Silver Springs and the Adena Springs Ranch Permit

Agenda

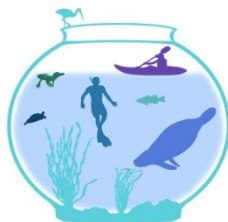
- Welcome and Introductions
- Silver Springs Past and Present
- The Adena Springs Ranch Permit Request
- A Sustainable Future for Silver Springs



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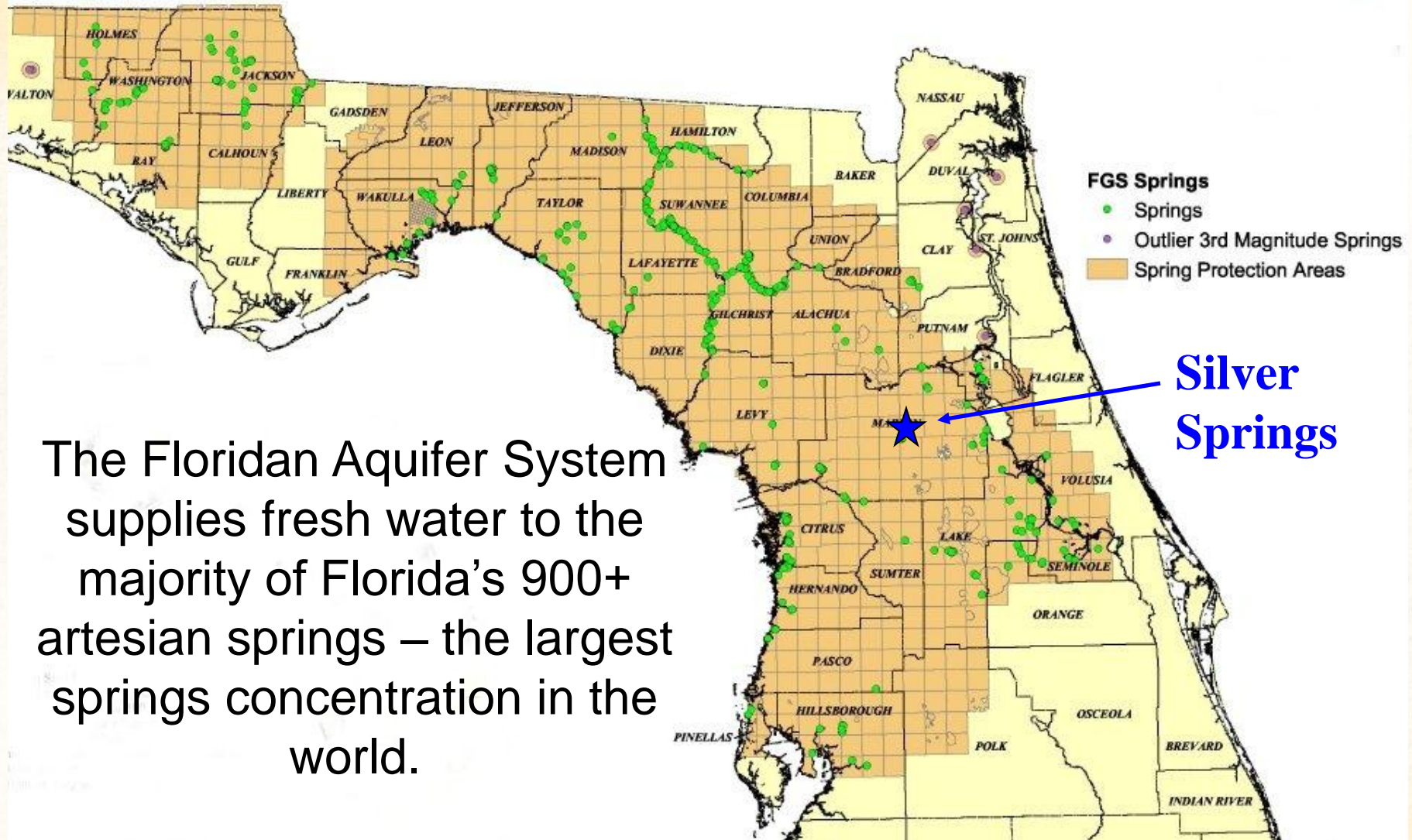
Silver Springs: Past and Present



Howard T. Odum
**FLORIDA
SPRINGS
INSTITUTE**

Robert L. Knight, Ph.D.

Silver Springs Location Map



The Floridan Aquifer System supplies fresh water to the majority of Florida's 900+ artesian springs – the largest springs concentration in the world.

Why is Silver Springs Important?

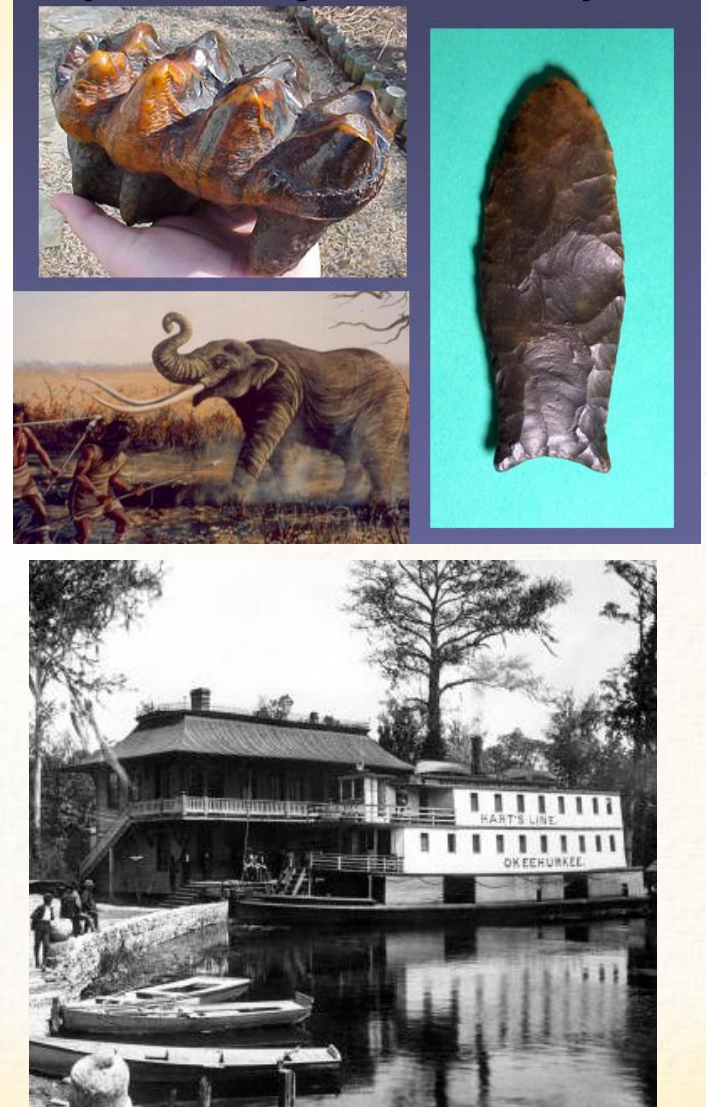
- Highest long-term flow recorded at any spring in the world
- Headwaters of the Silver River and key base flow in the Ocklawaha and St. Johns Rivers
- Oldest tourist attraction in Florida
- Longest history of springs scientific investigation
- Economic engine for Marion County



Silver Springs History

- Springs History

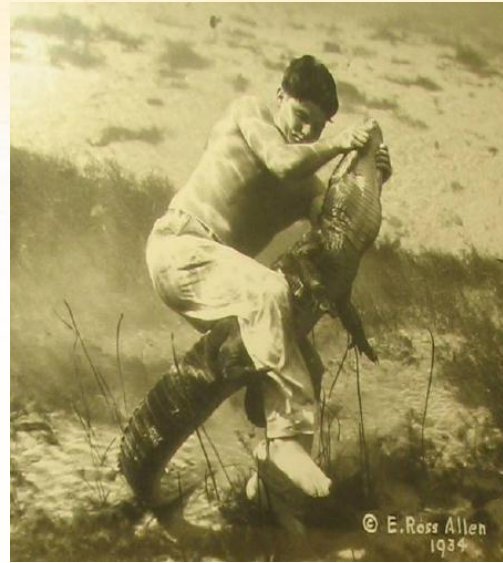
- *Over 12,000 years of pre-history in and around Silver Springs*
- *Brinton and Le Conte at Silver Springs in 1850s*
 - *Brinton (1856) - “a grand hydrographical feature of North America ranked with Niagara Falls and the Mississippi River*
 - *Le Conte (1859) – “extraordinary transparency of the water...surpassing anything that can be imagined”*



Silver Springs History

- Silver Springs History

- 1878 glass-bottom boats
- 1916 to present – movies and TV
- 1924 – W.C. Ray and W.M. Davidson started tourist attraction
- 1931 – Ross Allen's Reptile Institute
- 1962 to present – Nature's Theme Park
- 1987 – Silver River Museum and State Park



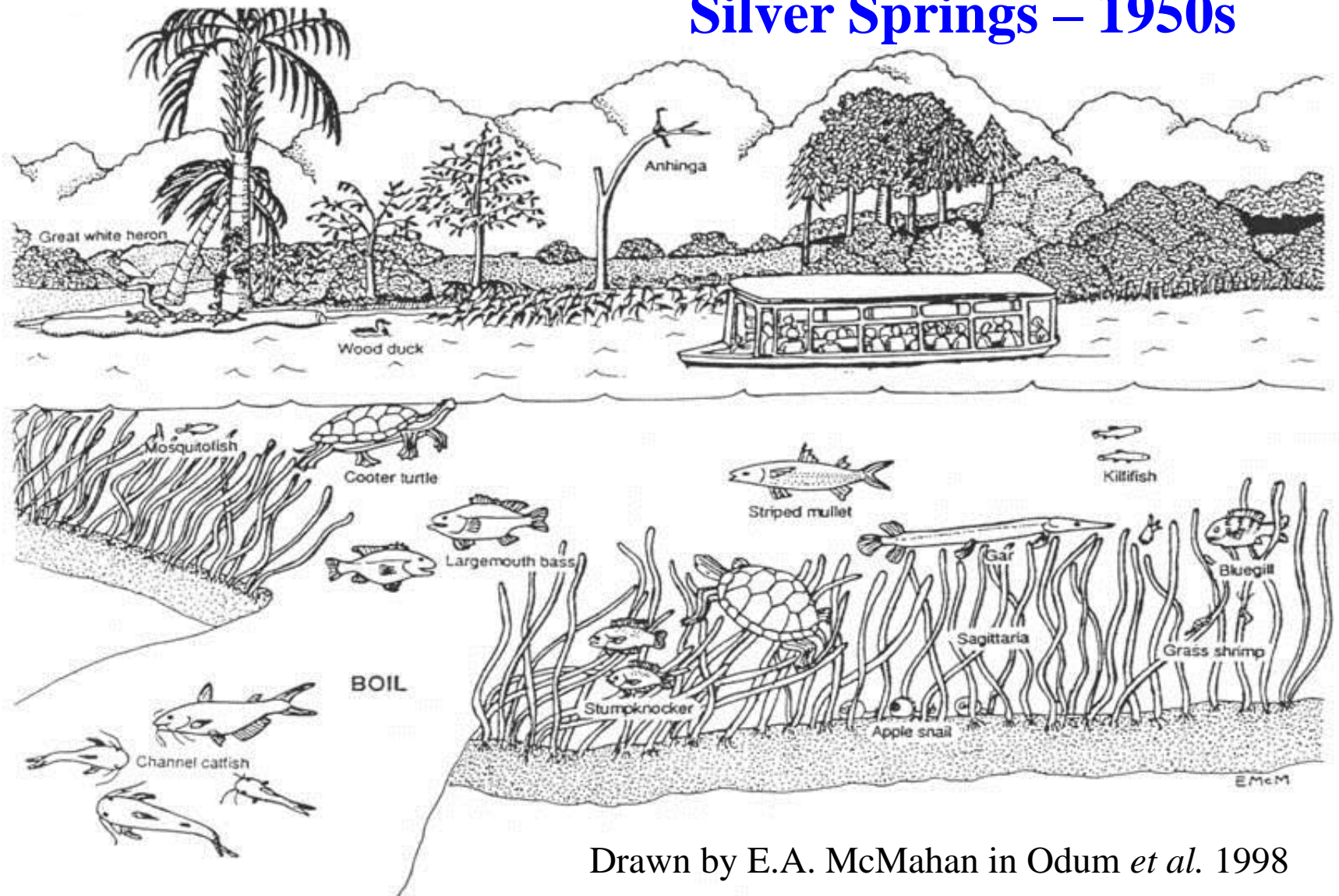
Silver Springs Research

- **Ecosystem studies:**
 - *H.T. Odum (1953-1955)*
 - *Knight and Odum (1979-80)*
 - *SJRWMD, UF, and WSI 50-Year Restudy (2004-2005)*
 - *12 Spring Comparison 2009*
 - *DEP TMDL and SJRWMD MFL studies (ongoing)*



Healthy Springs Structure

Silver Springs – 1950s



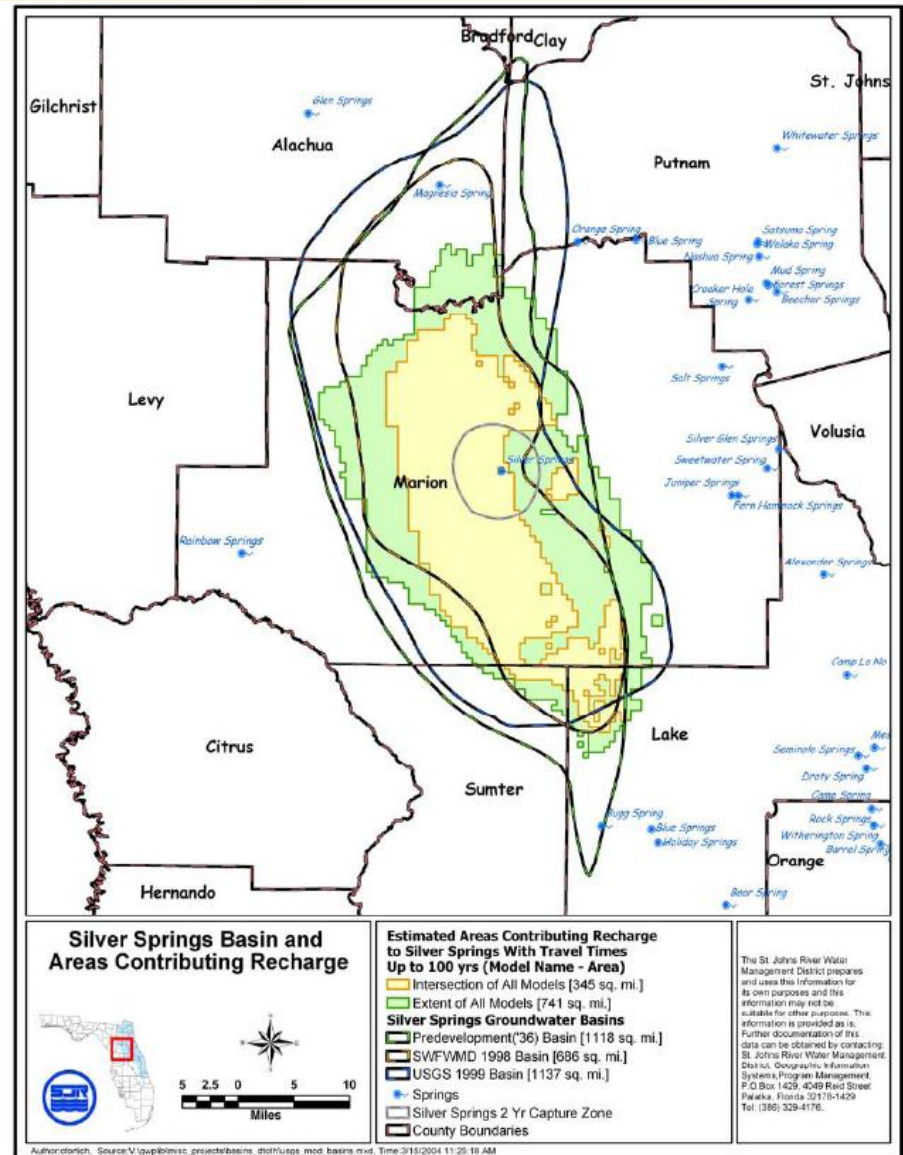
Drawn by E.A. McMahan in Odum *et al.* 1998

Silver Springs Recharge Basin

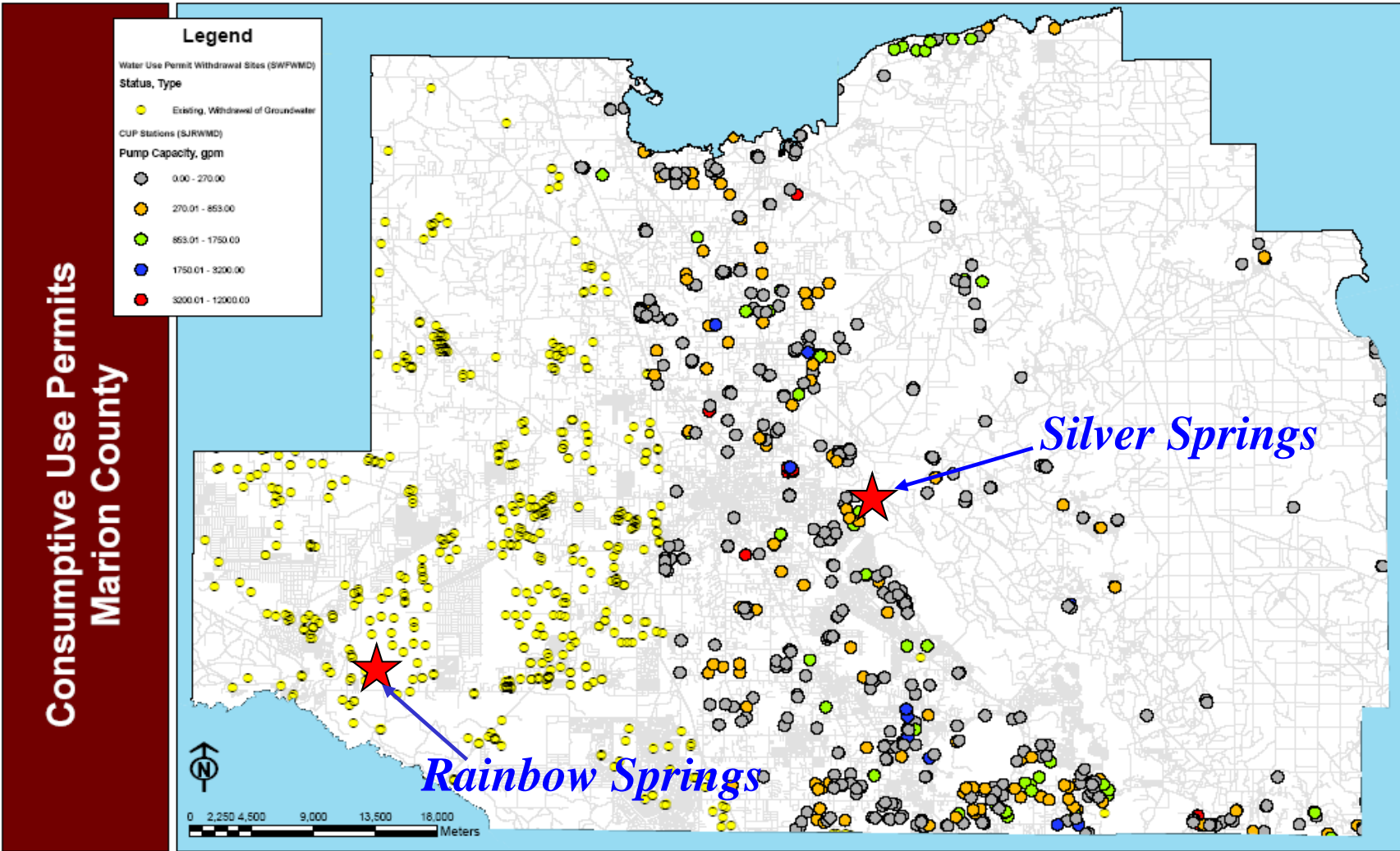
- Spring Recharge Basin Estimate
 - Munch *et al.* (2006)
1,200 sq. mi.



Bruce Mozert, Silver Springs, circa 1950s



Consumptive Use Permits in Marion County



Increasing Groundwater Uses



Agriculture



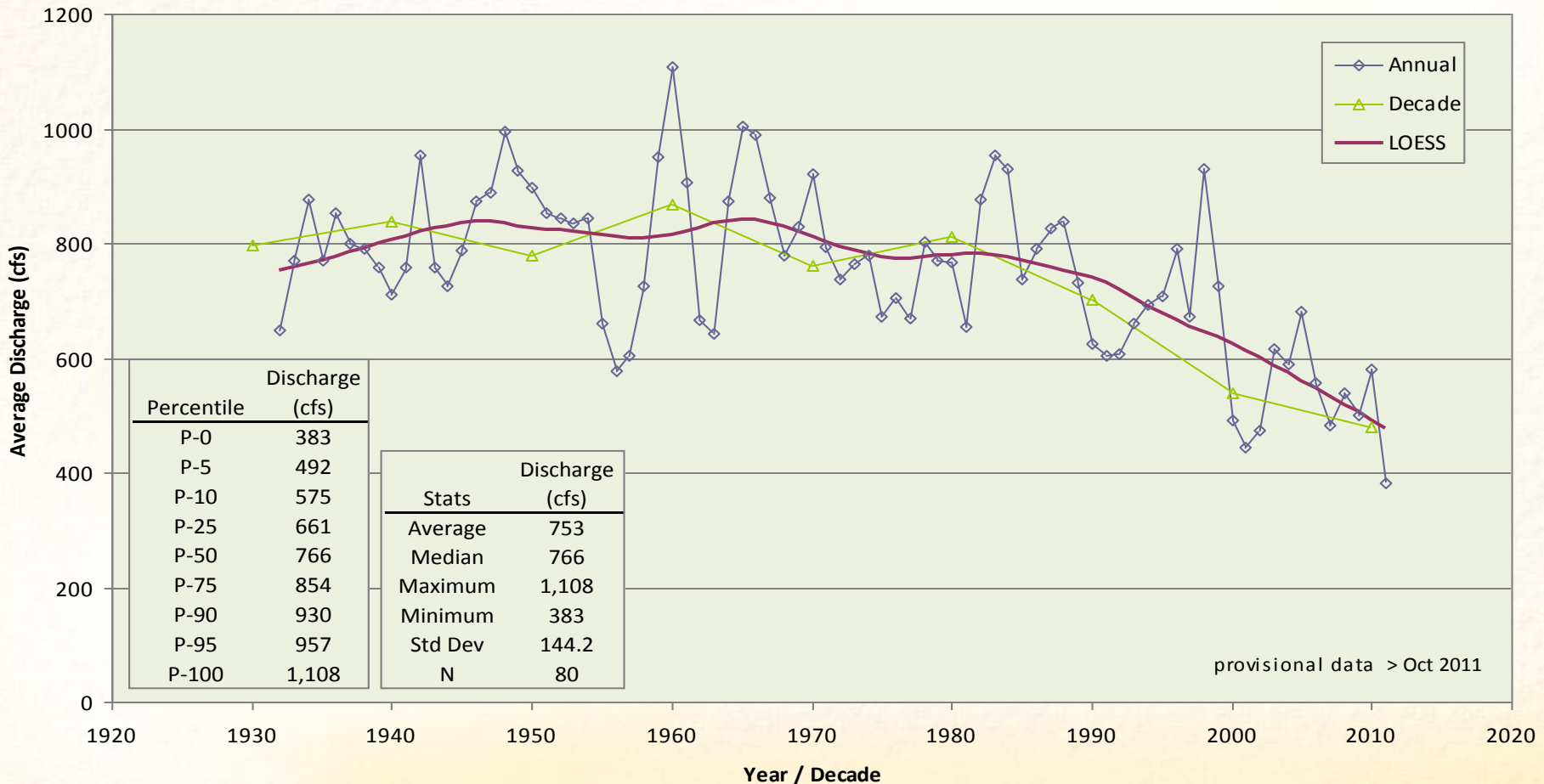
Residential



Golf Course

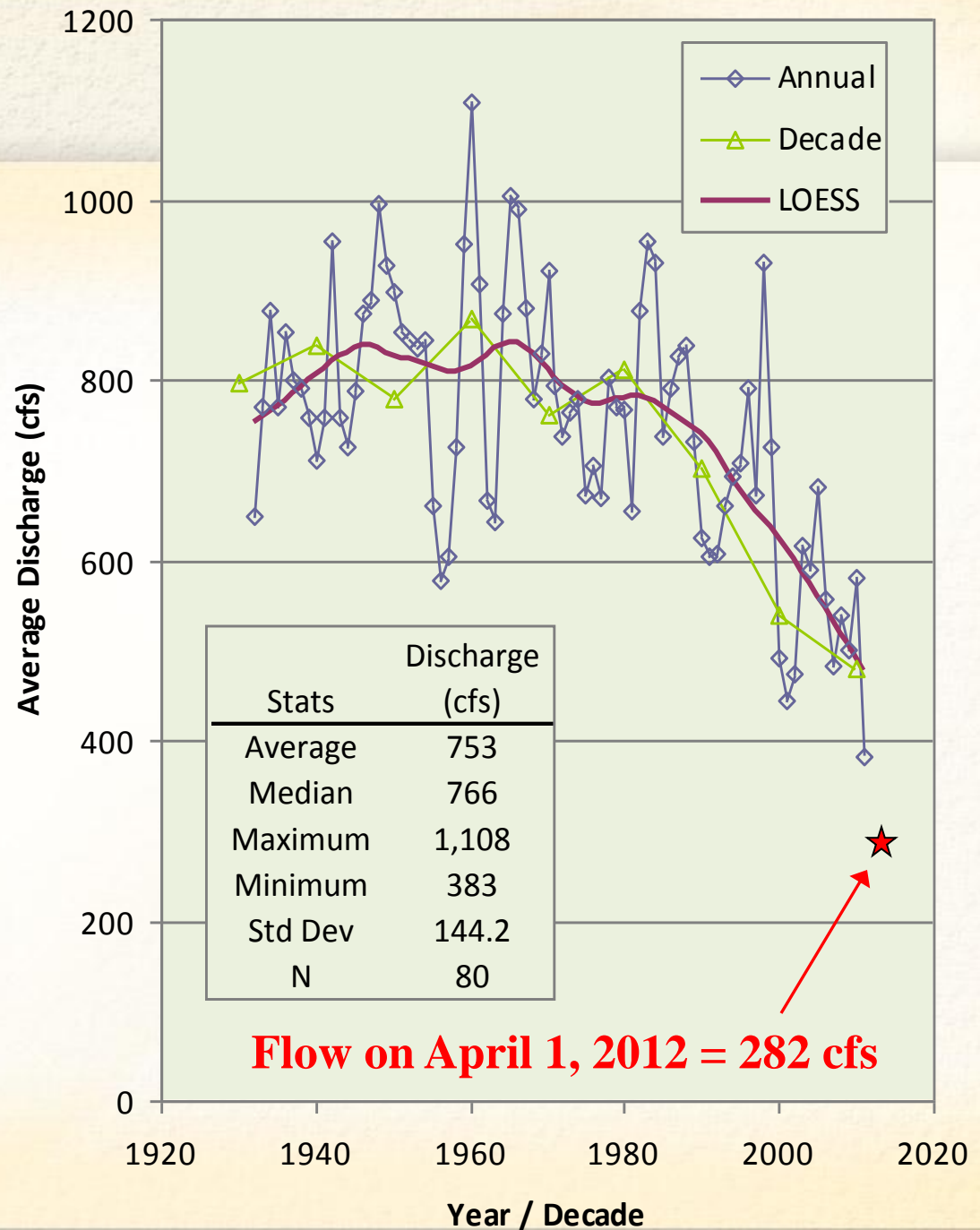
Silver Springs Discharge

Flows declined at the same rate as rainfall until about 1990 and then began to accelerate.

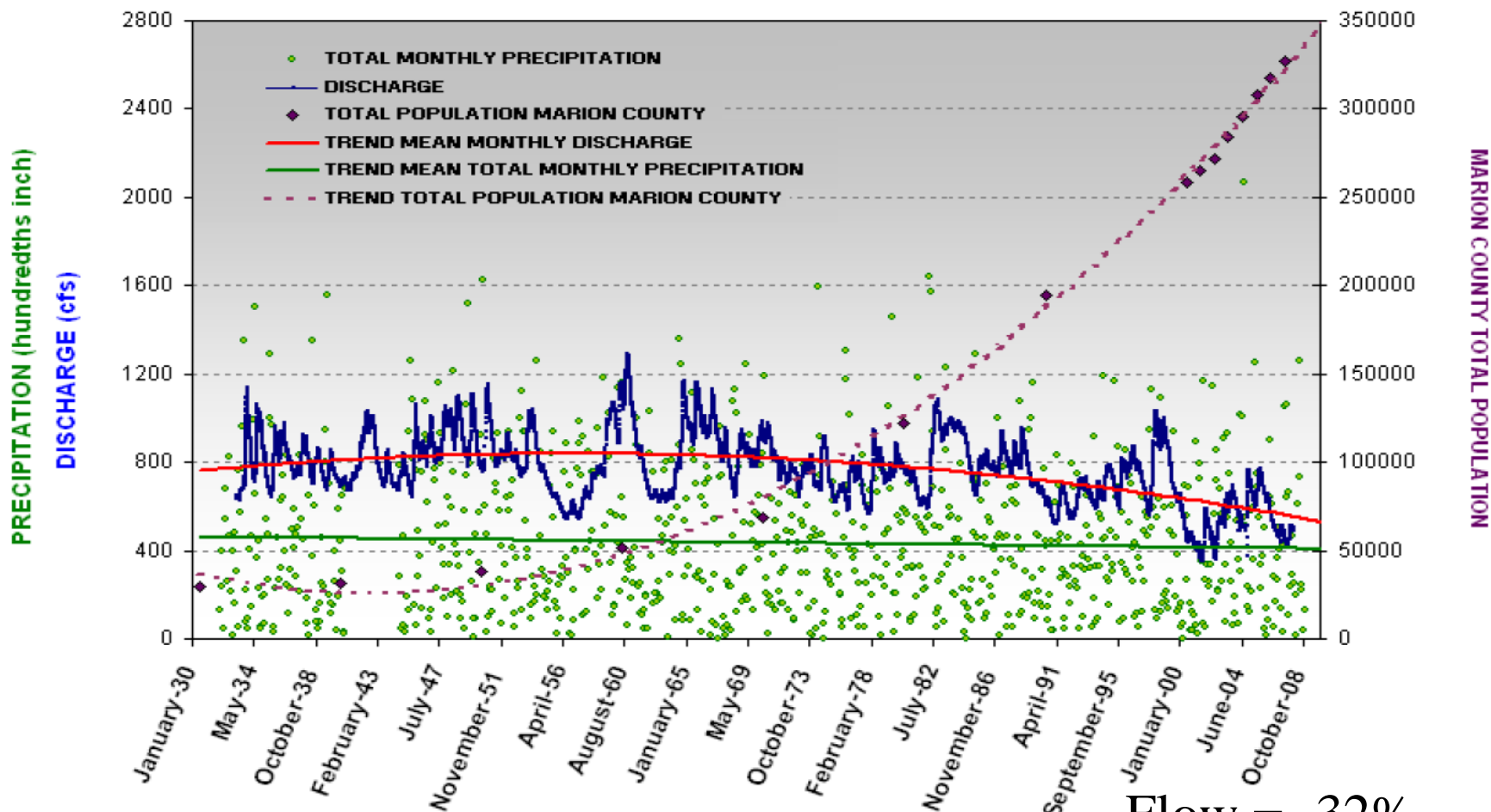


Silver Springs Discharge

Flows declined at the same rate as rainfall until about 1990 and then began to accelerate.



Silver Springs Precipitation, Population, and Discharge



250 cfs flow decline (Harrington *et al.* 2010)

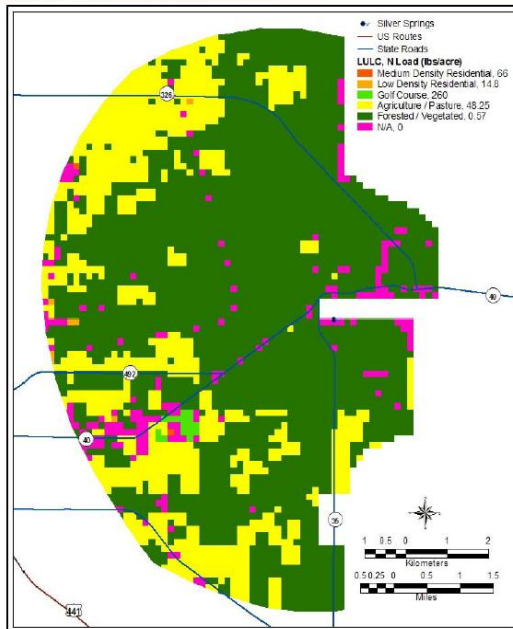
Flow = -32%

Rain = -15%

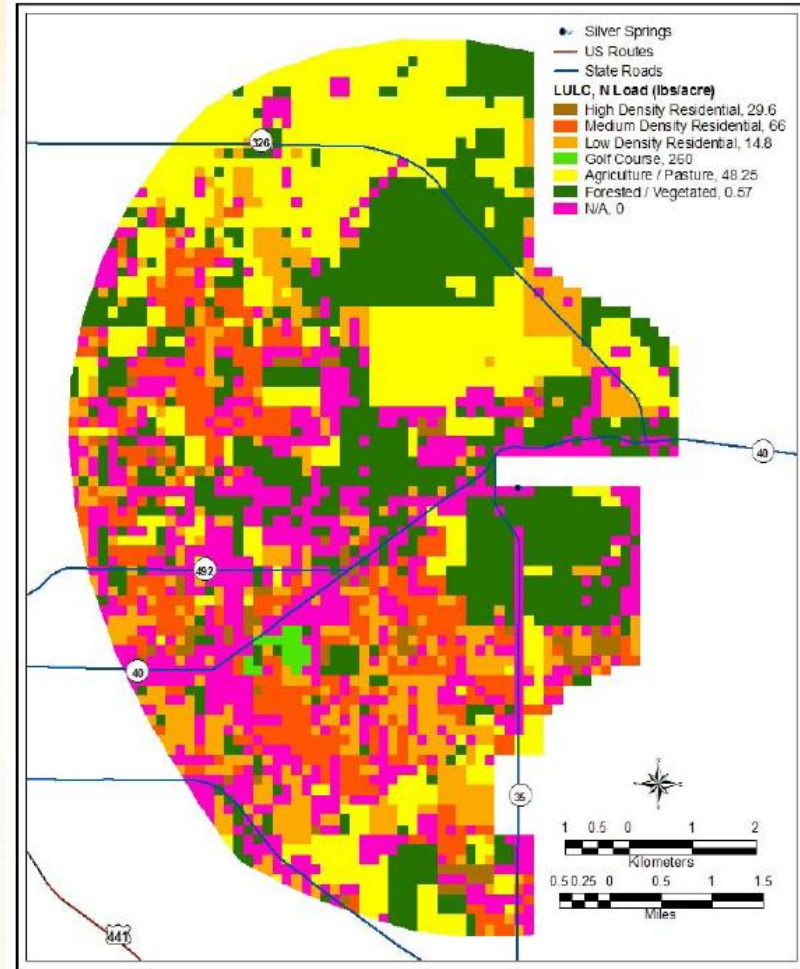
Popl. = + 1,200%

Silver Springs Land Use Nitrate Loading

- Munch *et al.* (2006) quantified nitrogen loading by land use in the springshed and modeled effects at Silver Springs

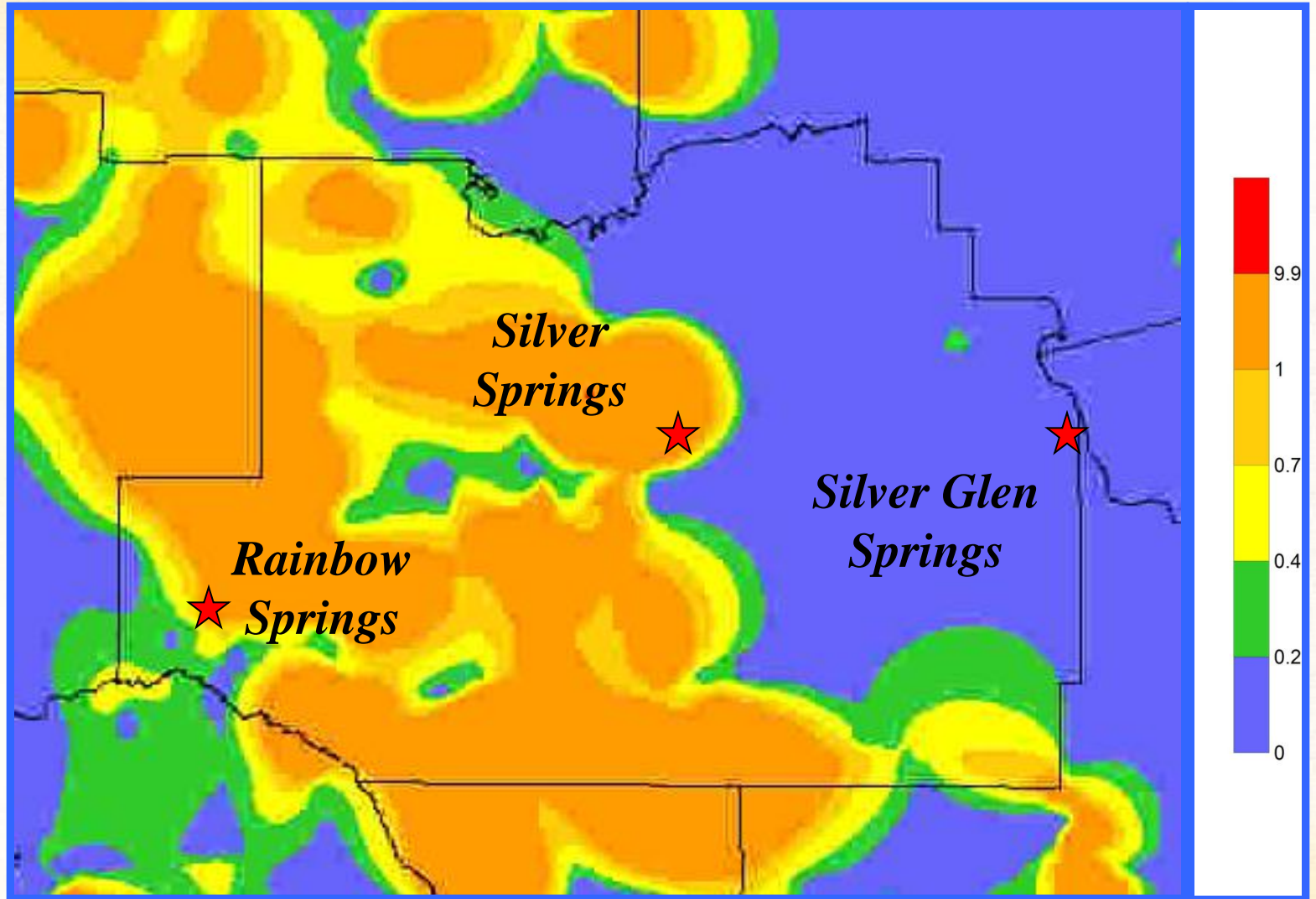


1949 Land Use



2005 Land Use

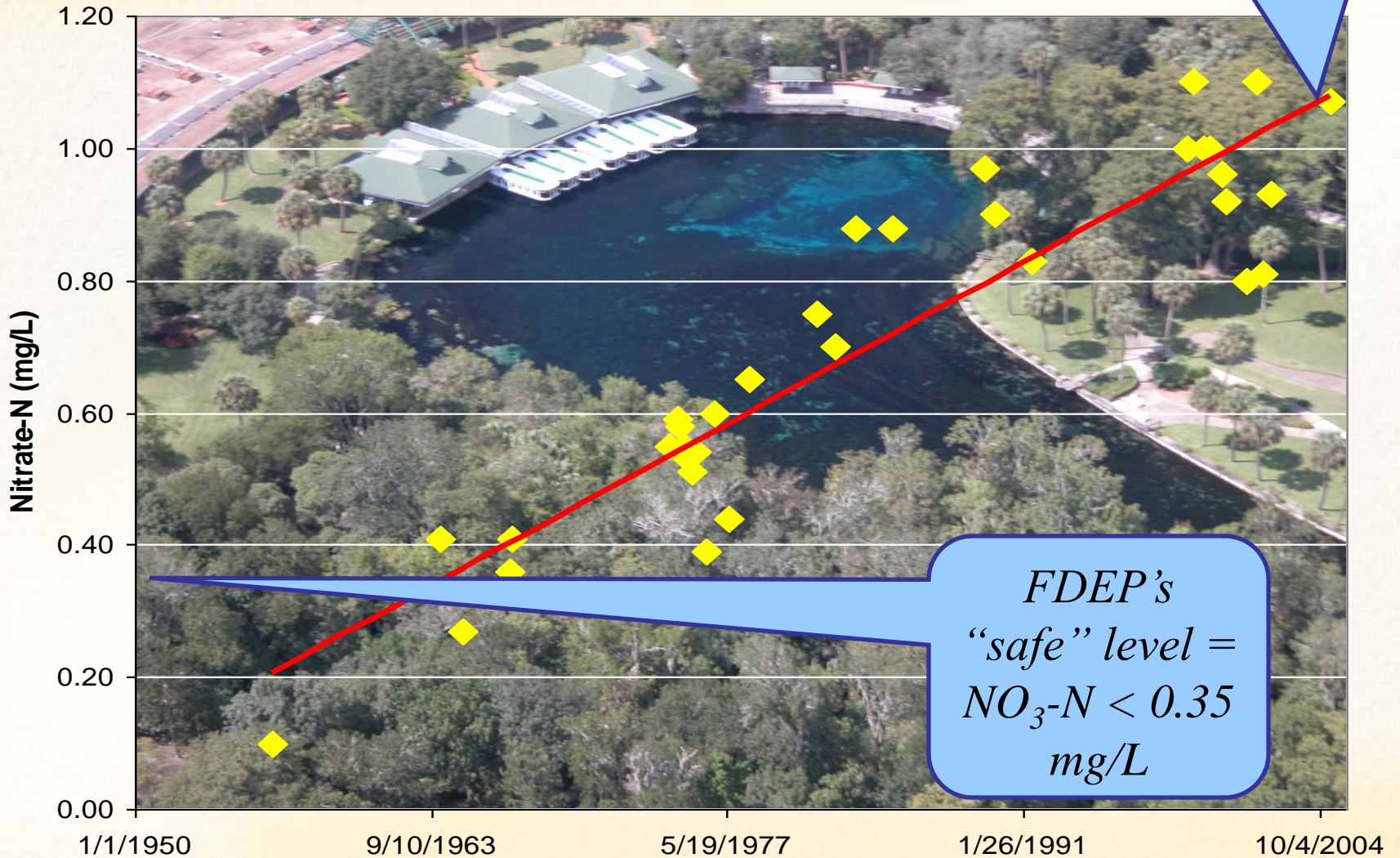
Marion County Groundwater Nitrate Concentrations (mg N/L)



Rising Nitrate

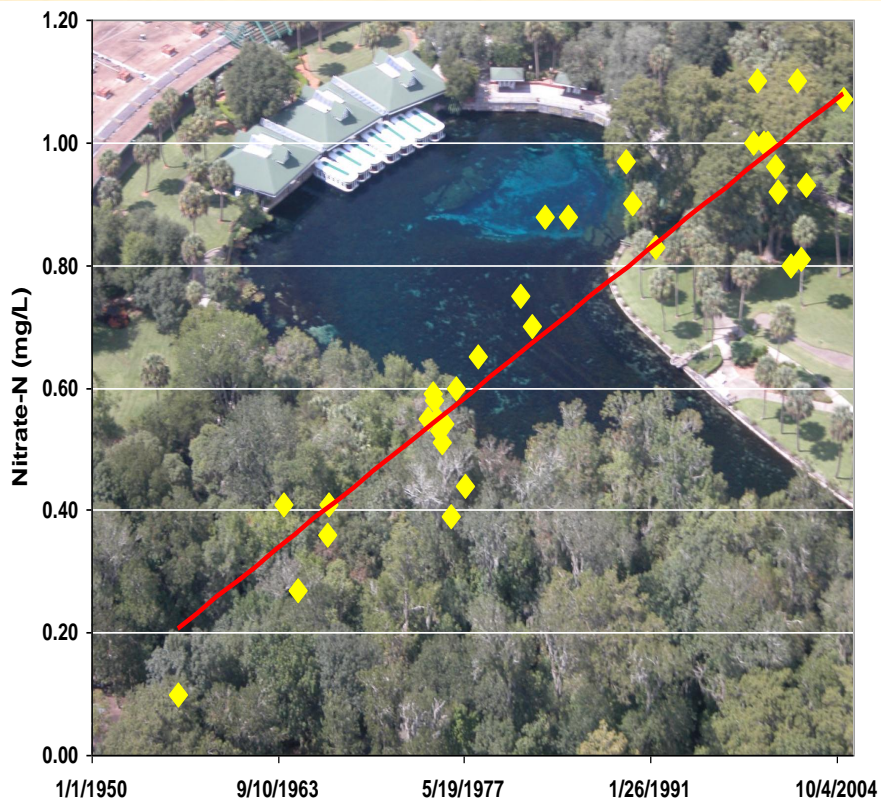
Silver Springs

$NO_3 > 2000\%$
increase since
1907



Silver Springs Ecological Health

Combined Nitrate Load at the Spring Vents



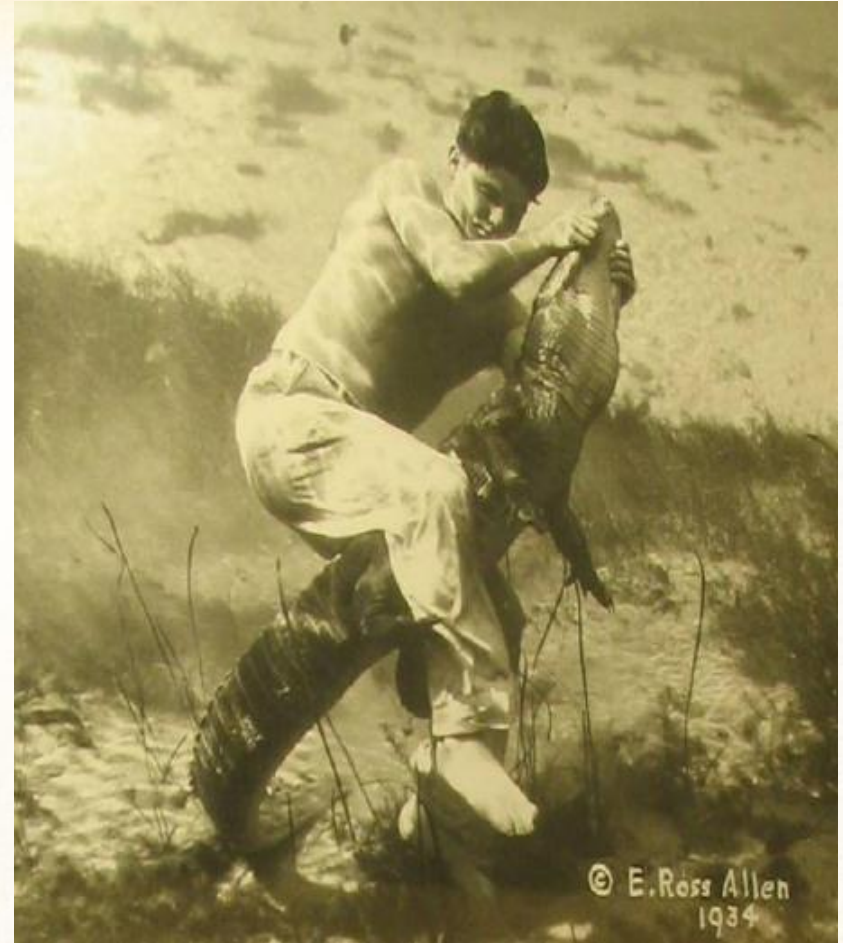
25-fold increase since 1907

(Munch *et al.* 2006)

| Year | Nitrate Load (tons/yr) |
|------------------|------------------------|
| 1957 | 47 |
| 1979 | 407 |
| 1995 | 478 |
| 2005 | 529 |
| 2055 (projected) | 880 |

Silver Springs Impairments

- Spring ecology is changing:
 - Structural alterations
 - Water quality
 - Plant communities
 - Faunal populations
 - Ecosystem productivity

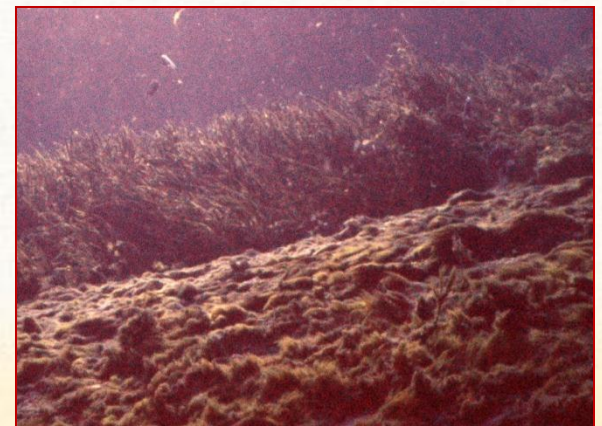
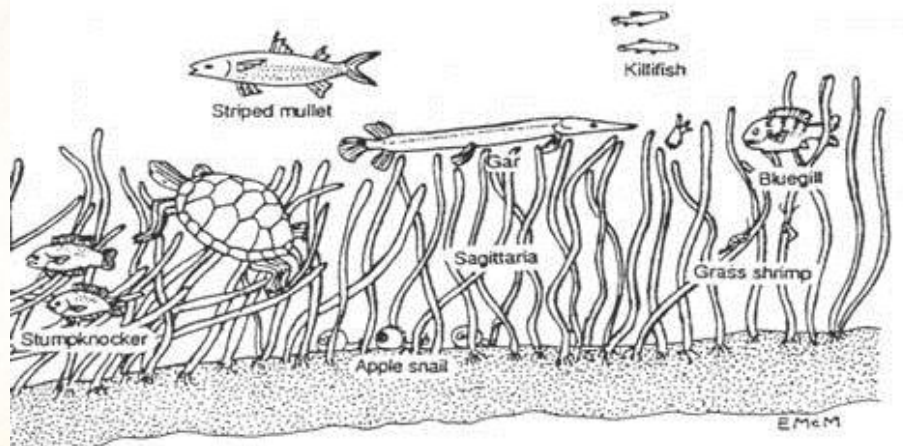


Silver Springs Ecological Health

Average Annual Plant Biomass (g dry wt./m²)

(Munch *et al.* 2006)

| Plant Category | 1952-55 | 2004-05 |
|-----------------|------------|---------|
| Macrophytes | 621 | 491 |
| Epiphytic Algae | 188 | 396 |
| Benthic Algae | negligible | 490 |



Silver Springs Ecological Health Fish Populations

| Year | Biomass (kg/ha wet wt.) |
|---------|-------------------------|
| 1952-55 | 527 |
| 1979-80 | 115 |
| 2004-05 | 42 |

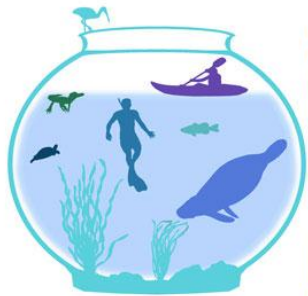


Estimated 92%
reduction

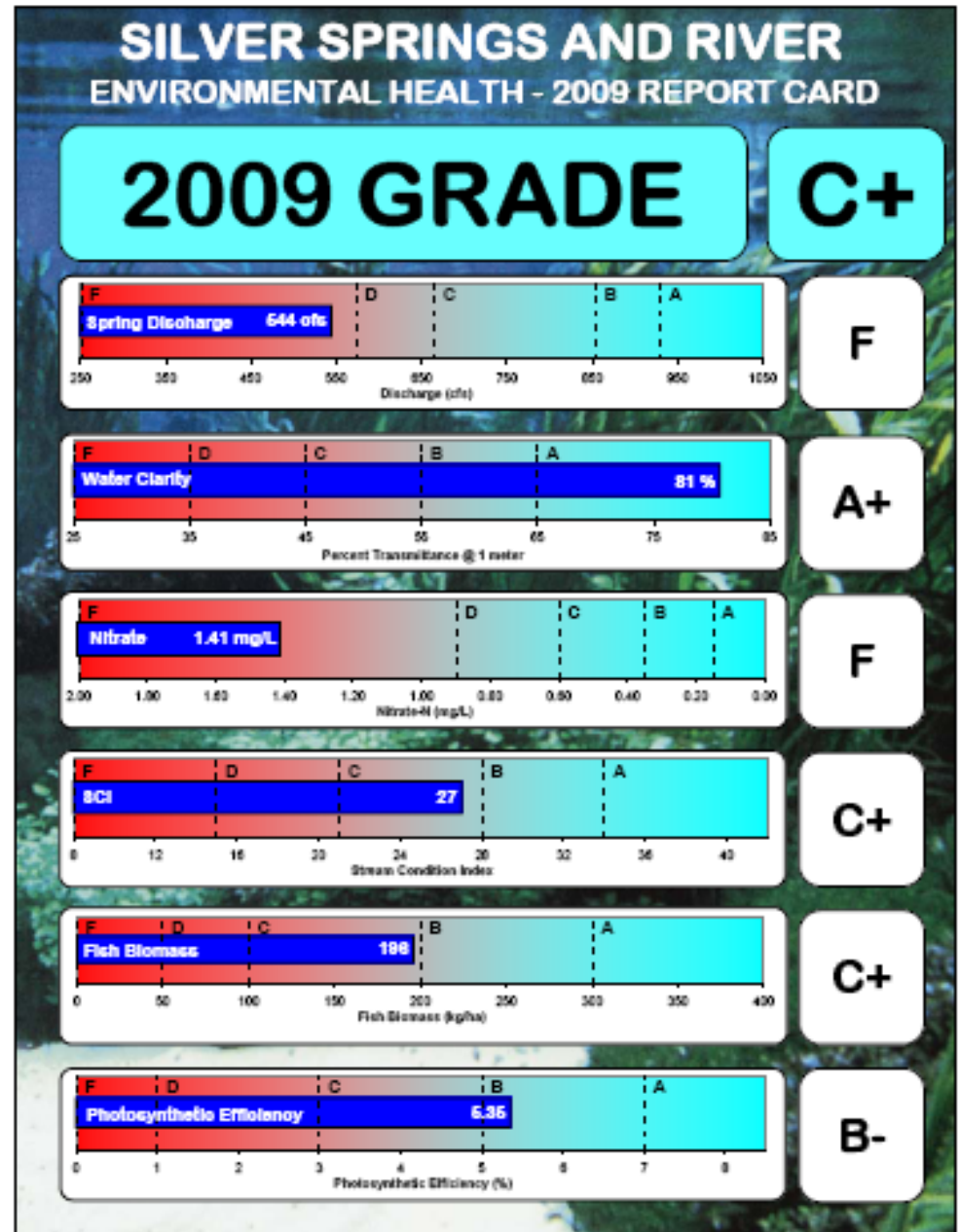
(Munch *et al.* 2006)

Springs Health Report Card

Silver Springs



Howard T. Odum
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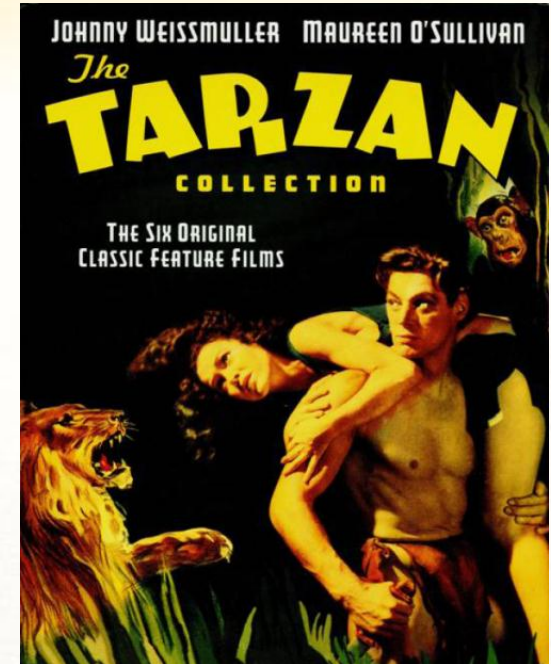
Silver Springs Restoration Issues

- Reduced spring flows due to consumptive uses
- Elevated groundwater nitrate due to land use changes, high fertilizer loads, and wastewater and stormwater management practices
- Physical barriers to wildlife movement



Silver Springs Restoration - Key Challenges

- **Minimum Flows and Levels**
 - Historic or current flows?
 - Definition of significant harm?
 - New Consumptive Use Permits?
- **Total Maximum Daily Load and Basin Management Action Plan**
 - Identification of principal nitrate sources?
 - Surface water vs. groundwater nitrate standard?
 - Agricultural immunity?
 - Effect of reduced spring flows?



Silver Springs Working Group (1999 – 2011)

• Stakeholders

- Environmental advocates
- Marion County
- City of Ocala
- Business leaders
- Silver River State Park
- St. Johns River Water Management District
- Florida Department of Environmental Protection
- Florida Department of Agricultural and Consumer Services

5 things everyone needs to know about....

Silver Springs




Photo courtesy of David Yaff, Ph.D., St. Johns Water Management District

- 1** Silver Springs is one of the world's largest freshwater springs, and has the highest average flow rate of all springs in Florida. Over a 75 year period, the daily discharge at Silver Springs has averaged approximately 500 million gallons of water. That is the equivalent of more than 700 Olympic size swimming pools. Since the 1950's however, flow has decreased about 20 percent. Be mindful of the amount of water you use at home.
- 2** Florida Springs are "windows into the aquifer." What we see coming out of the springs is water that flows through the Floridan aquifer system, the source of 90% of our state's drinking water. The area's karst geology makes the groundwater that flows to Silver Springs vulnerable to contamination from the things we do on the surface of the land. As a result, what you apply to your landscape may eventually appear in Silver Springs as pollution flowing to the surface through spring vents and channels from the aquifer.
- 3** The water feeding into Silver Springs comes from as far as 20 miles away. (The Floridan aquifer system, however, exists beneath the entire state). A springhead is the area contributing water to a spring. Most of the Silver Springs springhead is located in Marion County. Once pollutants enter the groundwater in a springhead, long-lasting damage can occur, including declines in water quality and fisheries, and an increase in the growth of algae and exotic invasive plants which can affect the entire Silver, Ocklawaha and St. Johns Rivers. You may be miles from the springs but your actions at home can directly affect its health.
- 4** Silver Springs was one of Florida's earliest tourist destinations and continues to be an important contributor to the local economy. A 2004 study showed that Silver Springs visitors make a \$60 million dollar direct impact on the Marion County economy each year. Keeping the springs healthy is good for the economic health of Marion County.
- 5** Local efforts are critical to protecting Silver Springs. The Silver Springs Basin Working Group was established in 1999 and meets quarterly to plan and report on actions that protect water quality and quantity. The group includes representatives of state, regional and local agencies, environmental interests and the business community. You can find out more at <http://silverspringsbasin.blogspot.com>. Silver Springs needs your help...

Water you Doing?

Silver Springs Working Group Accomplishments

- Land acquisition in springshed (Avatar and Seldin Tracts)
- Agriculture and horse farm BMPs
- Springs-protection workshops for local govts.
- Improved stormwater mgmt. (“Monster Pipe”)
- Marion County Stormwater Ordinance
- Marion County Springs Festival



Next Steps for Silver Springs Restoration

- Previous Silver Springs Working Group goal was educating and raising awareness of springs issues
- Next phase in this process is to develop consensus among the affected stakeholders concerning what needs to be done to restore Silver Springs



Bruce Mozert, Silver Springs, circa 1950s

Silver Springs Alliance

- A Knowledgeable and Vocal Public Will:
 - *Convince Marion County and Ocala officials to provide greater protection for local water resources*
 - *Insure that state water resource agencies protect the public's best interests*
 - *Shape the future of a restored and protected Silver Springs!*



Conclusion



“Never doubt that a small group of thoughtful committed citizens can change the world; indeed, it’s the only thing that ever has.”

Margaret Mead

April 3, 2012

Silver Springs Alliance Public Forum

Silver Springs: A Sustainable Future

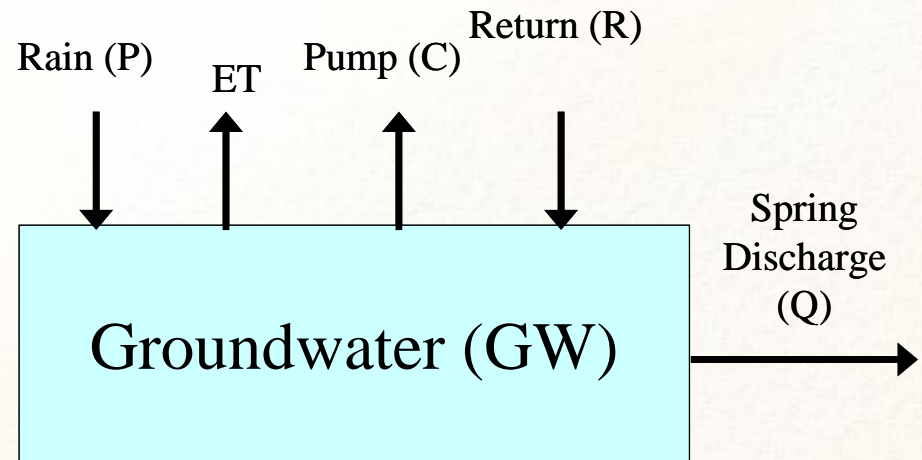


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Springs Water Balance

- Estimated Water Balance
 - Rainfall, ET, surface runoff, and groundwater recharge
 - Pumped groundwater
 - Amount returned
 - Spring flows

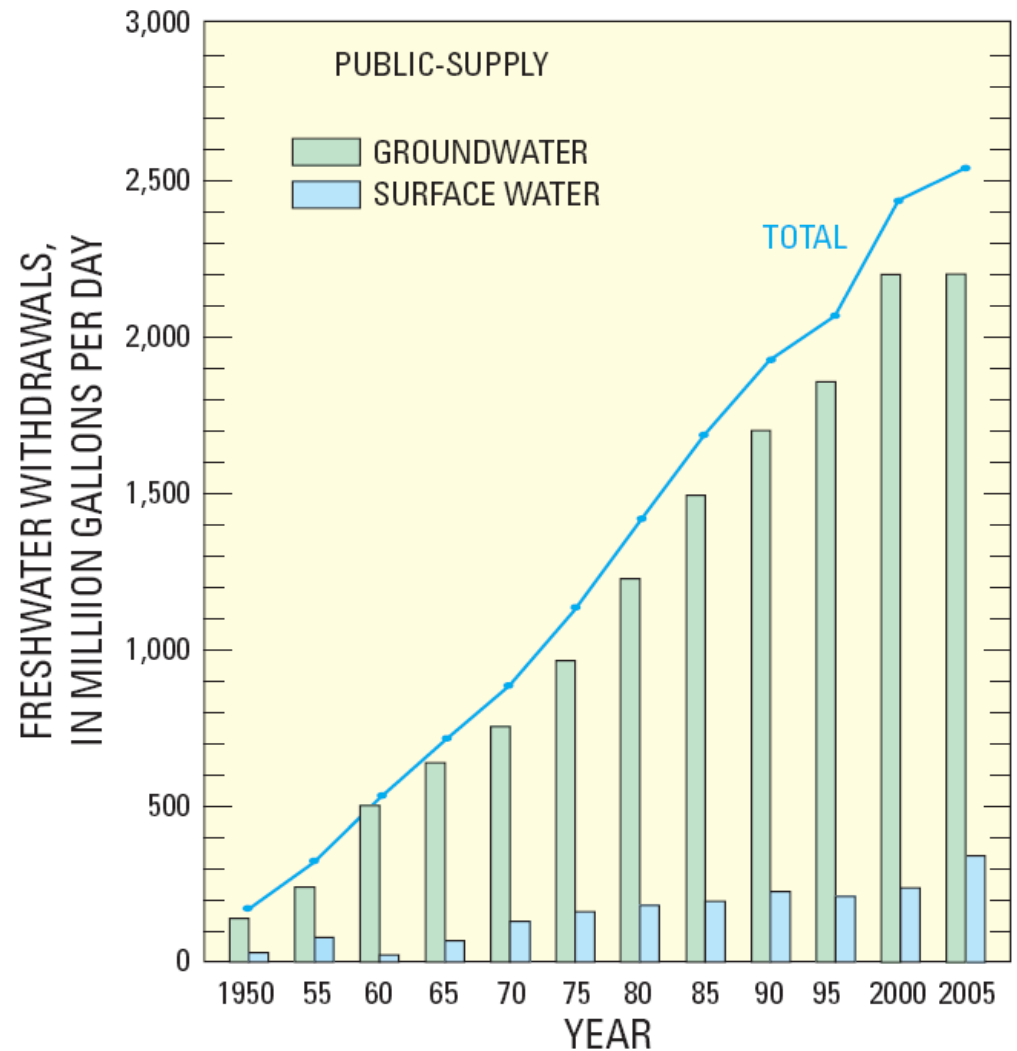


$$\Delta GW = P + R - ET - C - Q$$

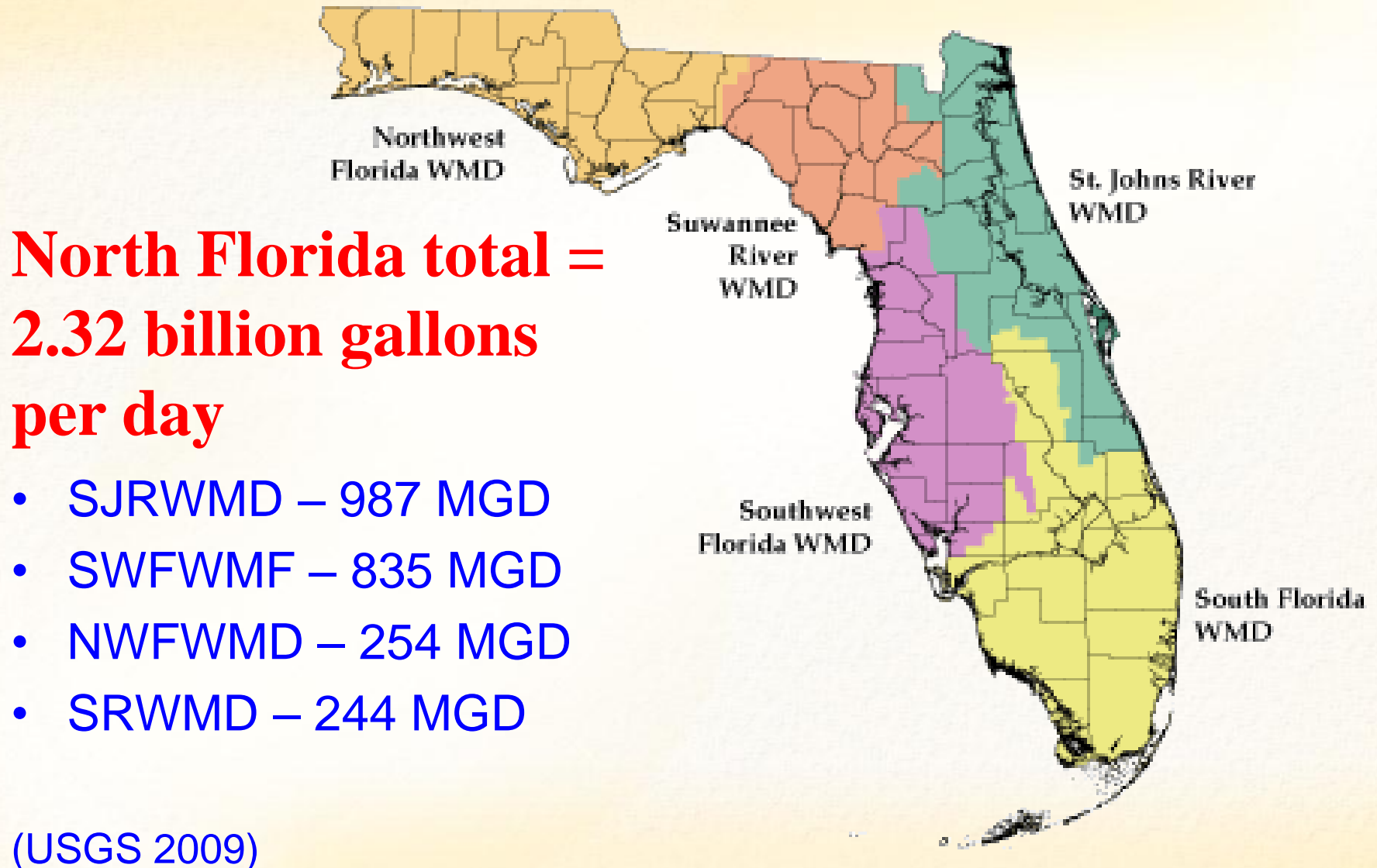
$$Q = P + R - ET - C - \Delta GW$$

Florida Groundwater Use - 2005

- Total estimated groundwater use in Florida in 2005 was 4.2 billion gallons per day
- Public water supply accounted for 2.2 BGD
- Agriculture accounted for 1.3 BGD (USGS 2009)



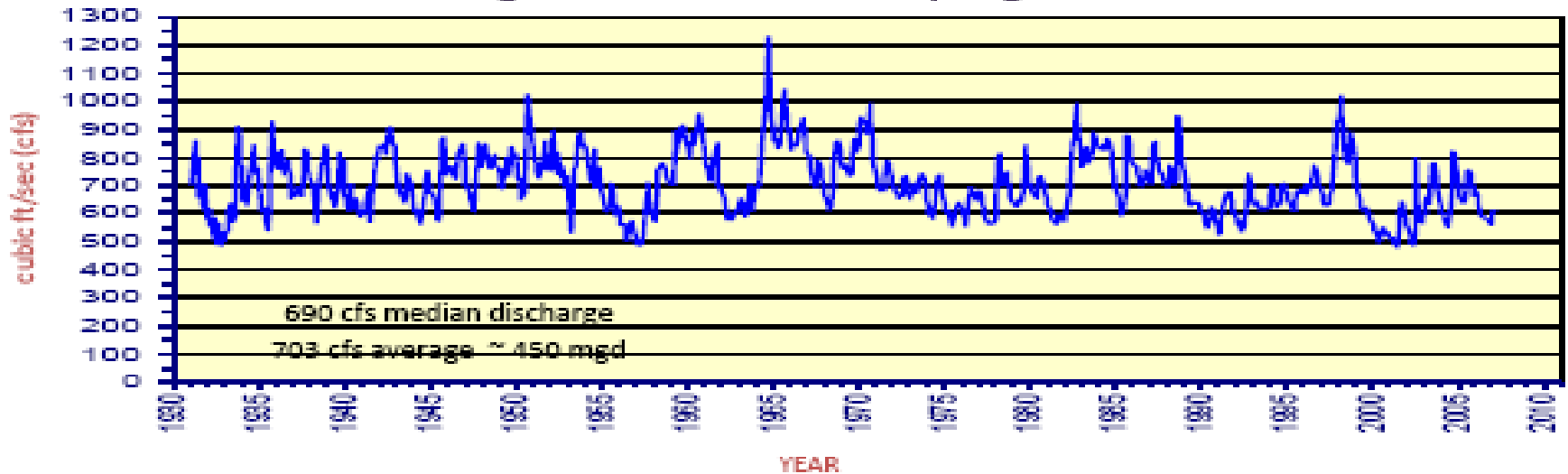
Groundwater Use by Water Management District - 2005



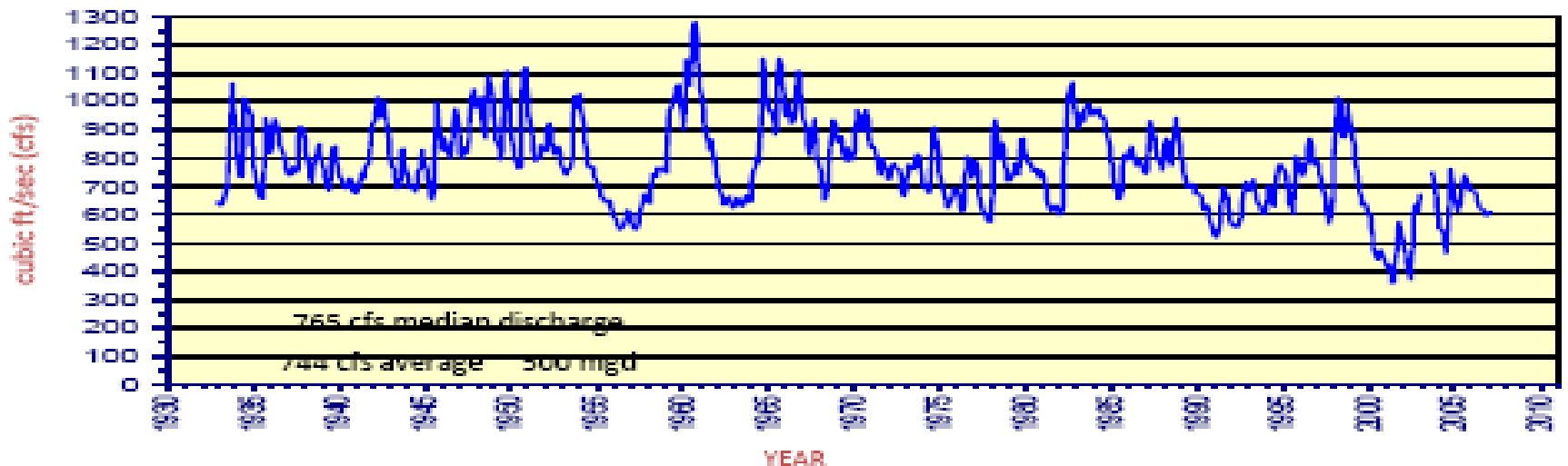
Silver and Rainbow Springs

Combined Discharge = 1,447 cfs (935 MGD)

USGS discharge record for Rainbow Springs



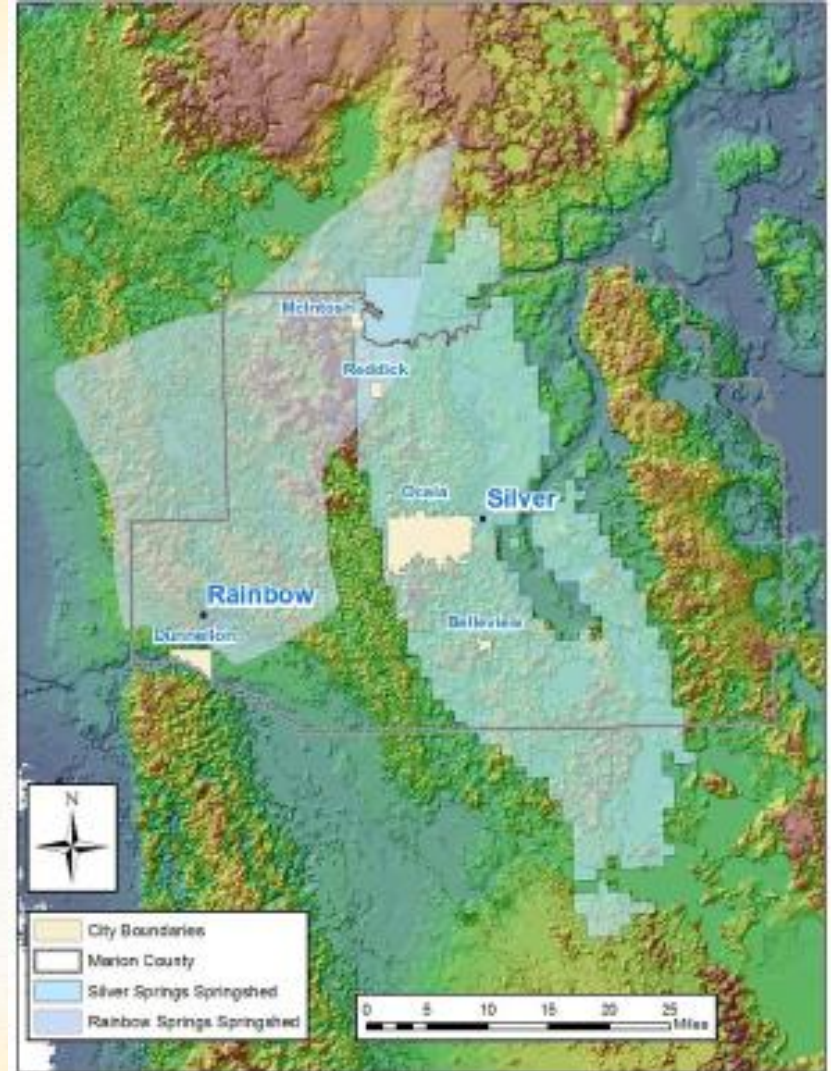
USGS discharge record for Silver Springs



The Marion County Water Balance

Silver and Rainbow Springs

- Combined springshed basin = 2,000 square miles
- Average rainfall = 50 in/y = 4,750 MGD
- Average groundwater recharge = 10 in/y = 935 MGD = 730 gpd/ac
- Estimated decline (2000 to 2010) = 225 MGD (24%)



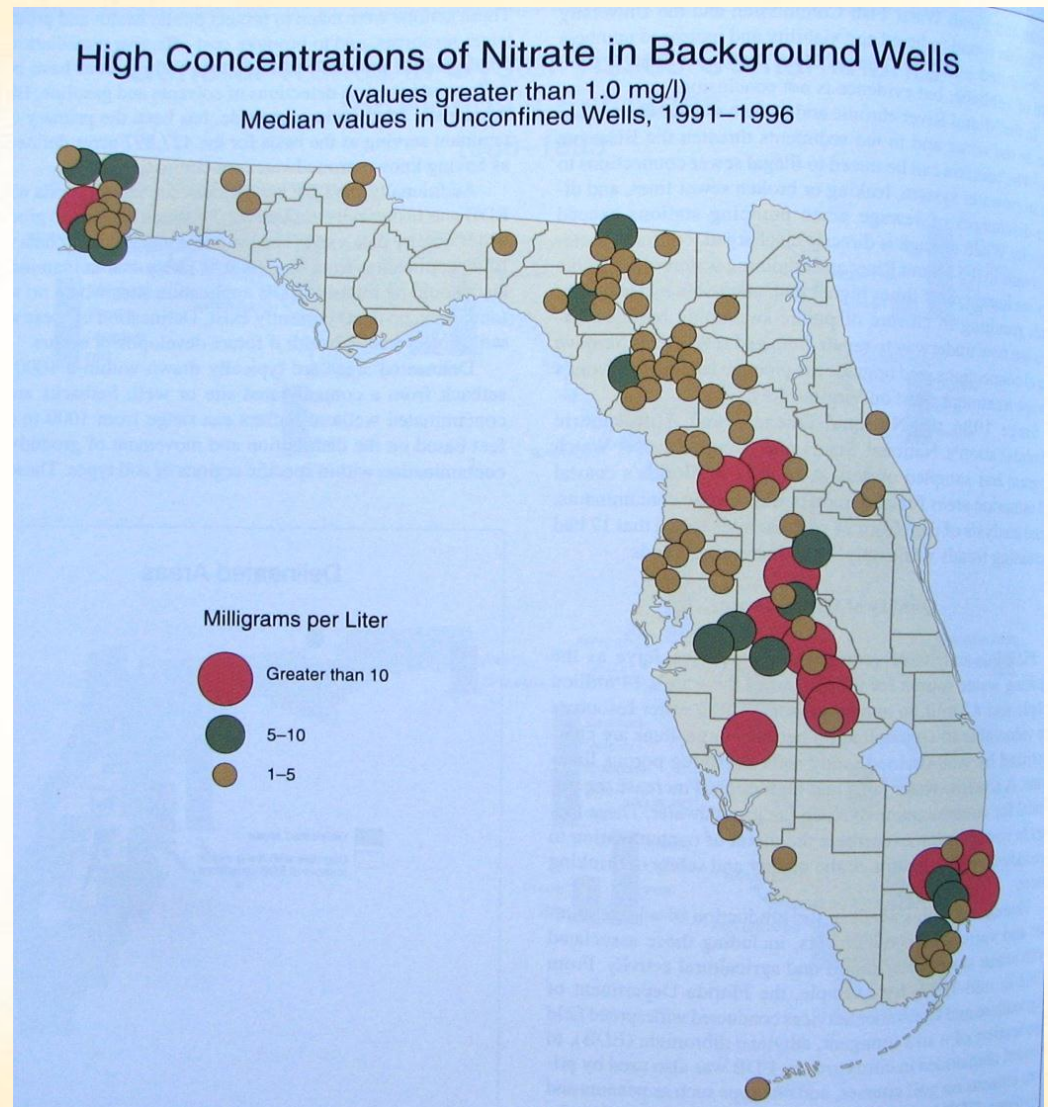
What is a the Sustainable Water Use?

- WMDs have defined significant harm to springs at about 10% average flow reduction
- For Silver and Rainbow Springs 10% = 94 MGD
- This is equal to about 70 gallons per day per acre
- Estimated decline at Silver and Rainbow is currently about 225 MGD or 24% of historic average flow
- Past the point of significant harm – these springs need a recovery plan!



Groundwater Nitrate is Statewide

Agricultural and Urban Development are Resulting in Elevated Groundwater Nitrate Nitrogen Concentrations throughout North Florida (and Many Other Areas)



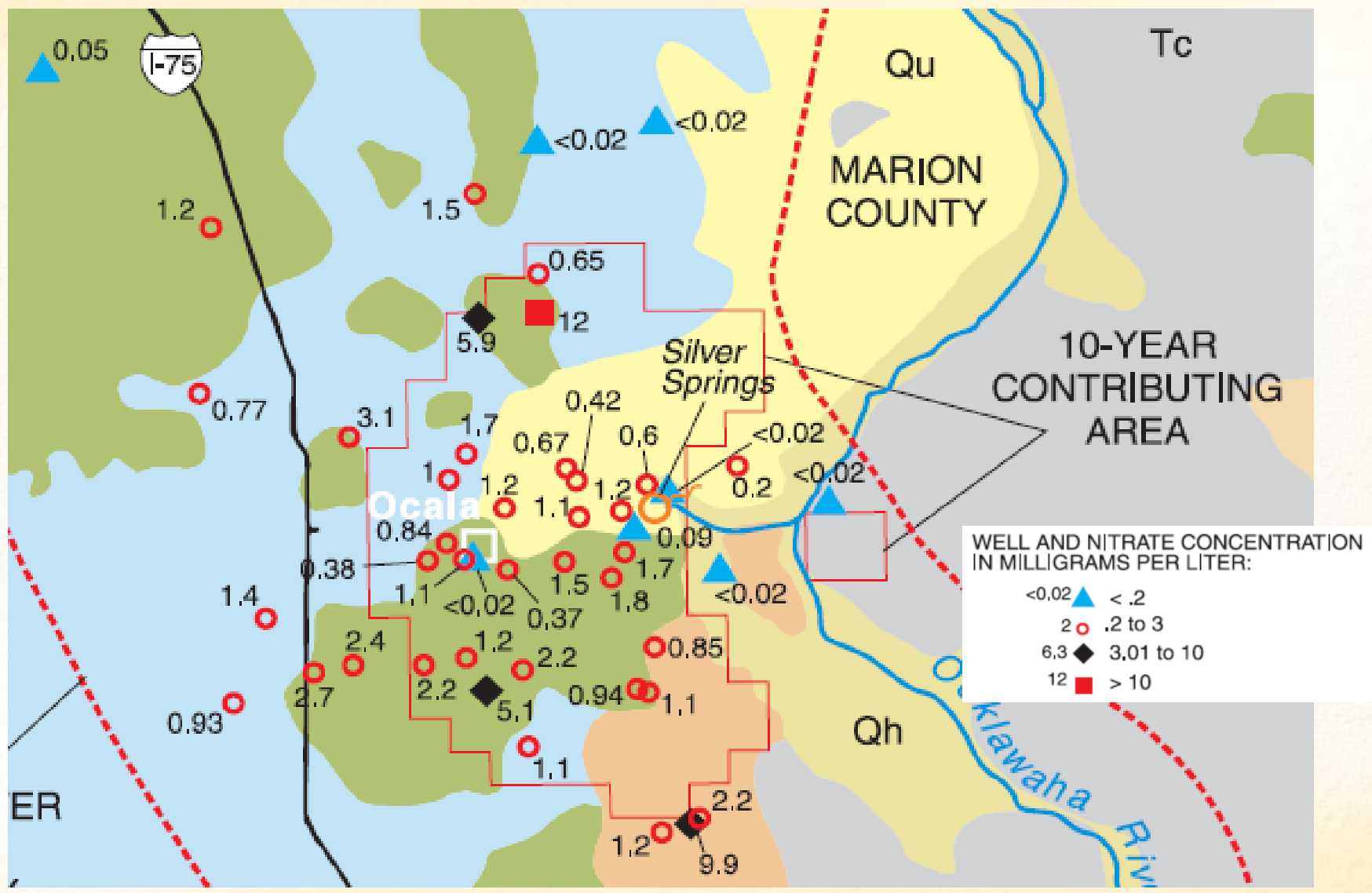
Existing Fertilizer Nitrate Loads

- 100 to 200 lb/ac/yr typical N load
- 50 to 100 lb/ac/yr N to groundwater @ 50% assimilation
- Compare to rainfall input = 3.4 lb/ac/yr (about 0.1 lb/ac/yr N to groundwater)



(adapted from MACTEC 2007)

Well Nitrate Concentrations in Silver Springs Contributing Area



Land Use Nitrogen Loading

Nitrate-N concentration (mg/L) in ground-water samples grouped by land use at well locations (From: Phelps 2004).

| Land use | N | Minimum | Maximum | Median |
|--------------------|----|---------|---------|--------|
| Urban | 29 | <0.02 | 5.9 | 1.15 |
| Agriculture | 13 | 0.05 | 12 | 1.7 |
| Rangeland & forest | 11 | <0.02 | 2.2 | 0.09 |

Forestry is the most protective upland land use

What is a the Sustainable Nitrate Load?

- Existing average nitrate nitrogen concentration at Silver and Rainbow Springs is about 1.6 mg/L
- FDEP has defined 0.35 mg/L nitrate N as a maximum safe concentration
- Meeting this goal will require reducing total nitrogen loads to the land surface by about 78 percent



Unsustainable Agricultural Practices



- Current agricultural practices are intensive users of water and nitrogen
- Fertilizer use and animal wastewater management is resulting in nitrate contamination

Unsustainable Urban Practices



- Urban landscape irrigation practices are intensive users of water and nitrogen
- Fertilizer use and human wastewater management are resulting in nitrate contamination

Alternative Landuse Practices

The Economics of Longleaf Pine Management



*A Road to Making
Dollar\$ and \$ense*

Society needs to provide incentives for a shift to sustainable land uses that protect surface and groundwater resources

A Sustainable Wastewater Management Option

A **Groundwater Recharge Wetland** removes nutrients and pollutants from the water and recharges the aquifer with clean water



Green Cay
Wetland, Palm
Beach Co.

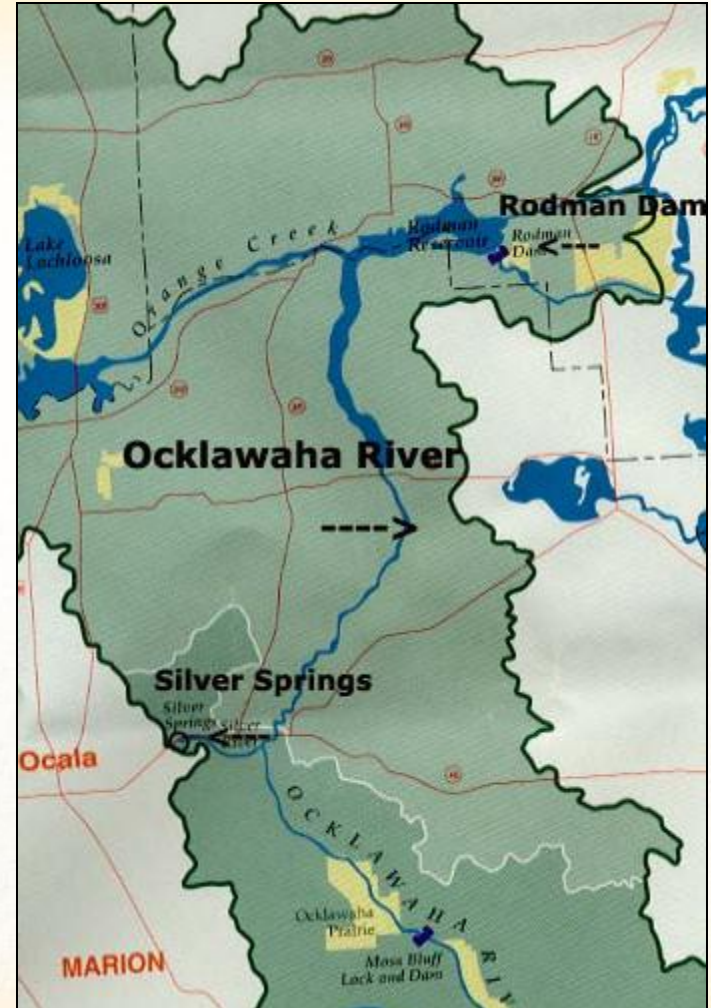
Forests and Wetlands Provide Multiple Benefits



- Groundwater protection
- Surface water protection
- Air quality protection
- Carbon sequestration
- Wildlife habitat
- Economic savings

Summary of Silver Springs Restoration Issues

1. Reduced springs flows due to consumptive uses
2. Elevated groundwater nitrate concentrations due to high fertilizer loads and inadequate wastewater/stormwater treatment
3. Physical barriers to wildlife movement



Silver Springs Restoration Action Plan

- Implement water conservation practices throughout the springshed
- Encourage improvements to wastewater and stormwater practices
- Encourage implementation of more protective agricultural BMPs
- Provide tax incentives for protection of sensitive karst lands



Florida Springs Protection Goal:

Restore and
Protect Springs
Ecology for
Future
Generations



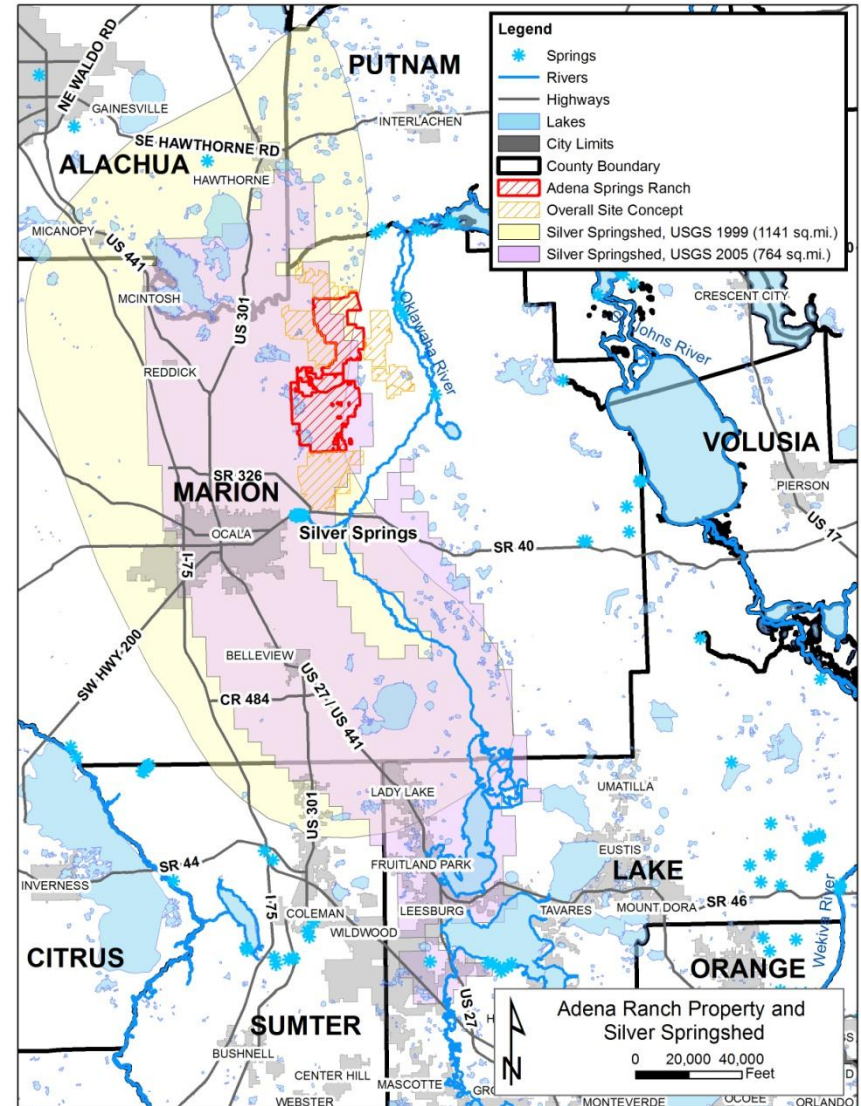
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Karst Productions Inc.

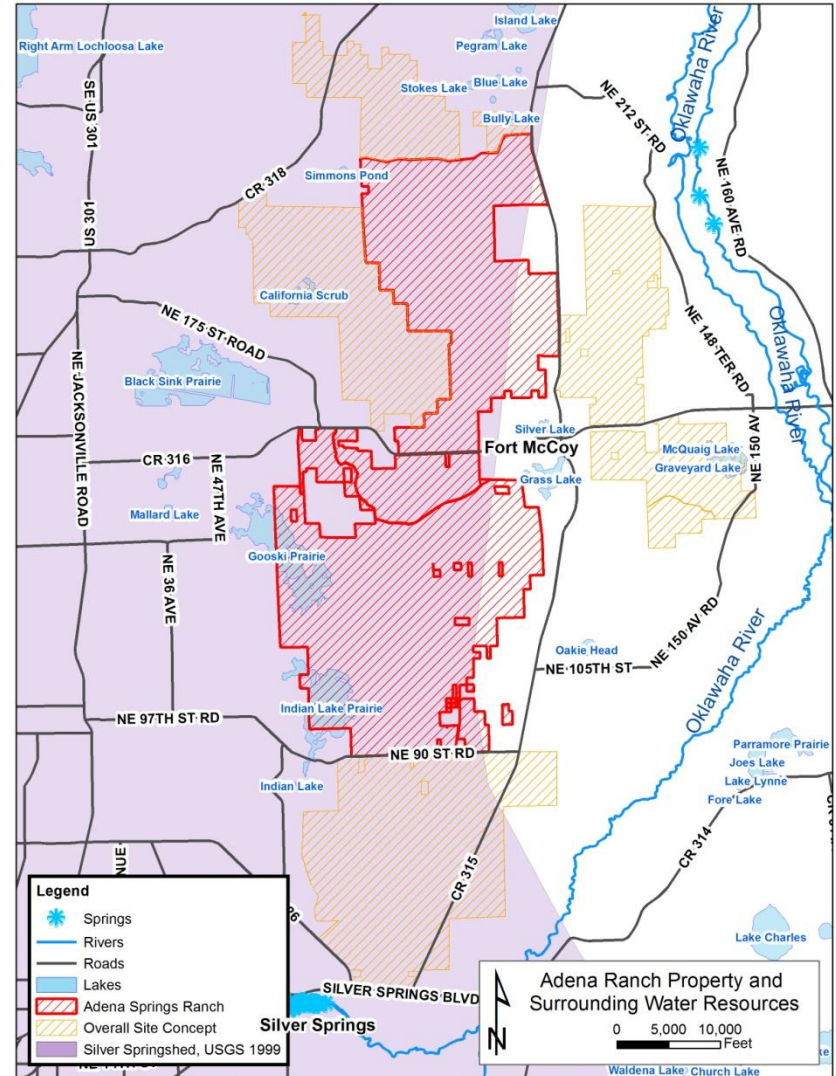
Silver Springs and the Adena Springs Ranch

- Adena Springs Ranch has requested more than 13.2 MGD from 134 wells
- Over 30,000 acres this is an average of 442 gpd/ac or about 60% of total recharge
- A sustainable water use on this property is estimated as less than 70 gpd/ac (<10% of recharge) for a total of less than 2.1 MGD



Silver Springs and the Adena Springs Ranch

- 30,000 cattle on 10,000 acres of pasture is equivalent to a human population of about 240,000 people
- Estimated nitrogen load is more than 1,000 tons of nitrogen per year
- Sustainable nitrogen load is estimated as less than 2 lbs N/ac/yr (<20 tons of nitrogen per year)



Silver Springs and the Adena Springs Ranch

- Anticipated impacts include:
 - Lowering of Floridan Aquifer levels
 - Reduced flow to Silver Springs
 - Increased nitrate load to the aquifer, Silver Springs, the Ocklawaha, and St. Johns Rivers
- What can you do?
 - Stay informed (www.sjrwmd.com/facts/AdenaSpringsRanchCUP)
 - Send comments to the St. Johns River Water Management District
 - Let your local officials know what you think

