Wakulla Springs Restoration

Past and Future

Seán E. McGlynn, President
Wakulla Springs Alliance

Presented: Apalachee Audubon Program Series,
Thursday, April 20, 2017, 7:30 p.m.
At the King Life Sciences Bld, FSU


WAKULLA SPRINGS
LODGE

WAKULLA WILDLIFE FESTIVAL


WOODVILLE KARST PLAIN PROJECT
N
W
E
S
25
YEARS
1990 - 2015


WOODVILLE KARST PLAIN PROJECT
25 YEARS
1990 - 2015

Carl Buchheister, 1967

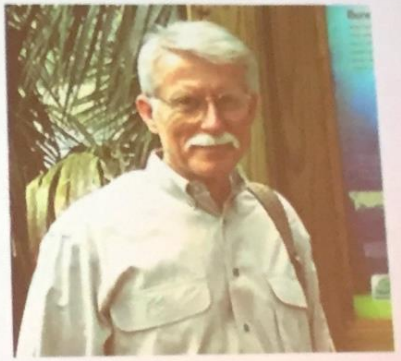
Video: Carl Buchheister, Crying Birds at Wakulla Springs

Too big to email, not available at this time

Wakulla Springs Alliance

Florida Springs Task Force, Springs Initiative, and Springs Basin Working Groups

- 1988 Wekiva Basin
- 1992 Wakulla Spring
- 1995 Ichetucknee Springs
- 1998 Santa Fe Springs
- 1999 Silver Springs,
- 2008 Rainbow Springs
- 2008 Fanning Springs
- 2008 Jackson Blue
- 2008 Volusia Blue Springs

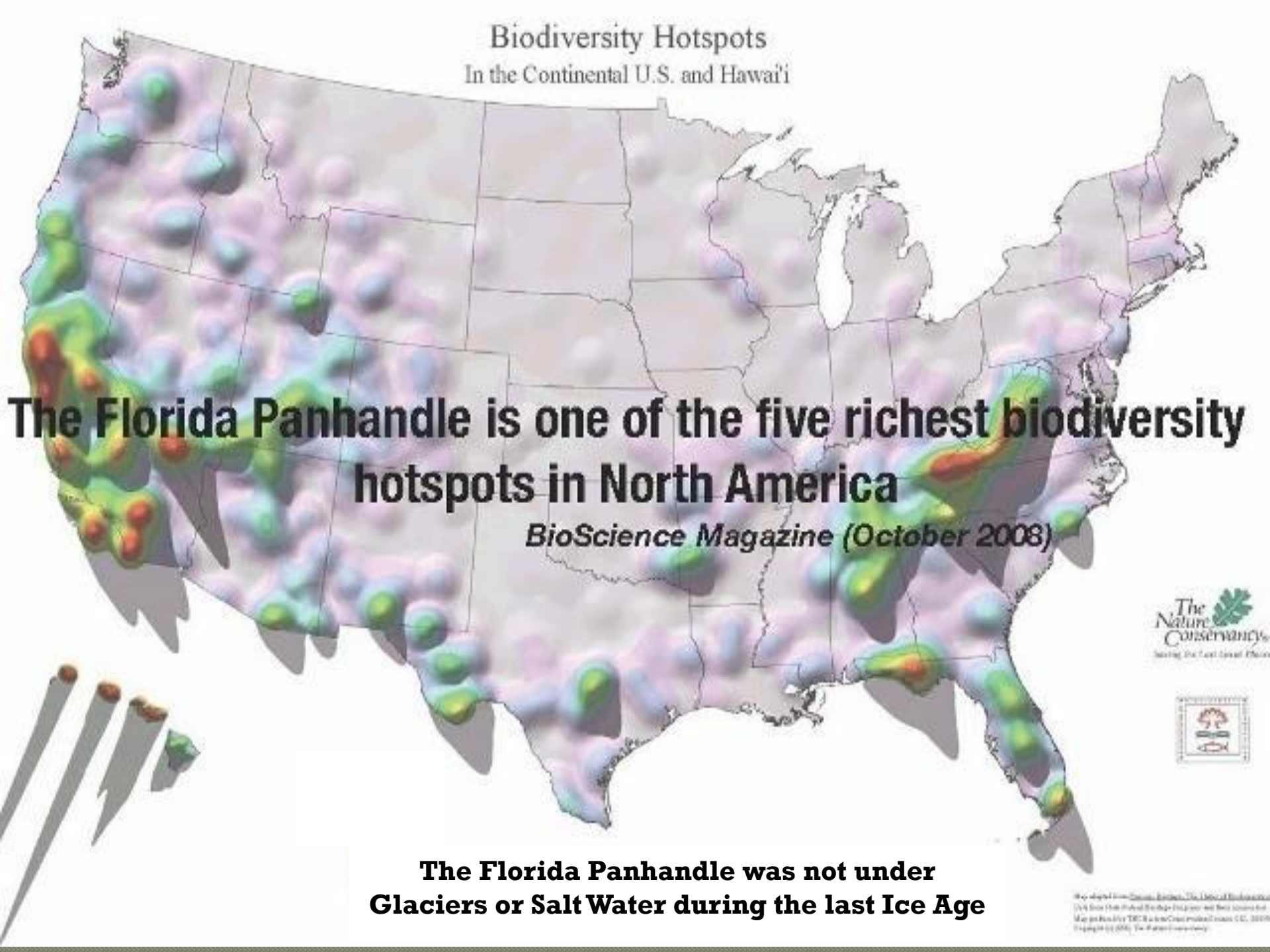


Jim Stevenson
"Father" of Florida
Springs Protection






An Ancient Landscape



The Florida Panhandle was not under Glaciers or Salt Water during the last Ice Age

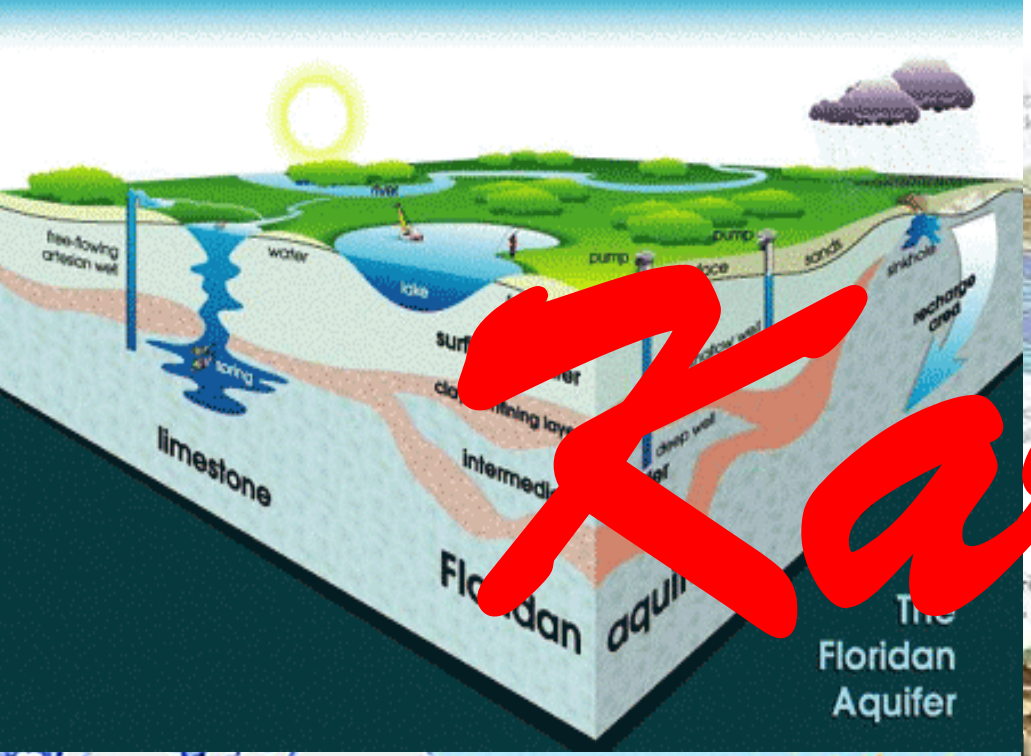
Unique Hydrogeology

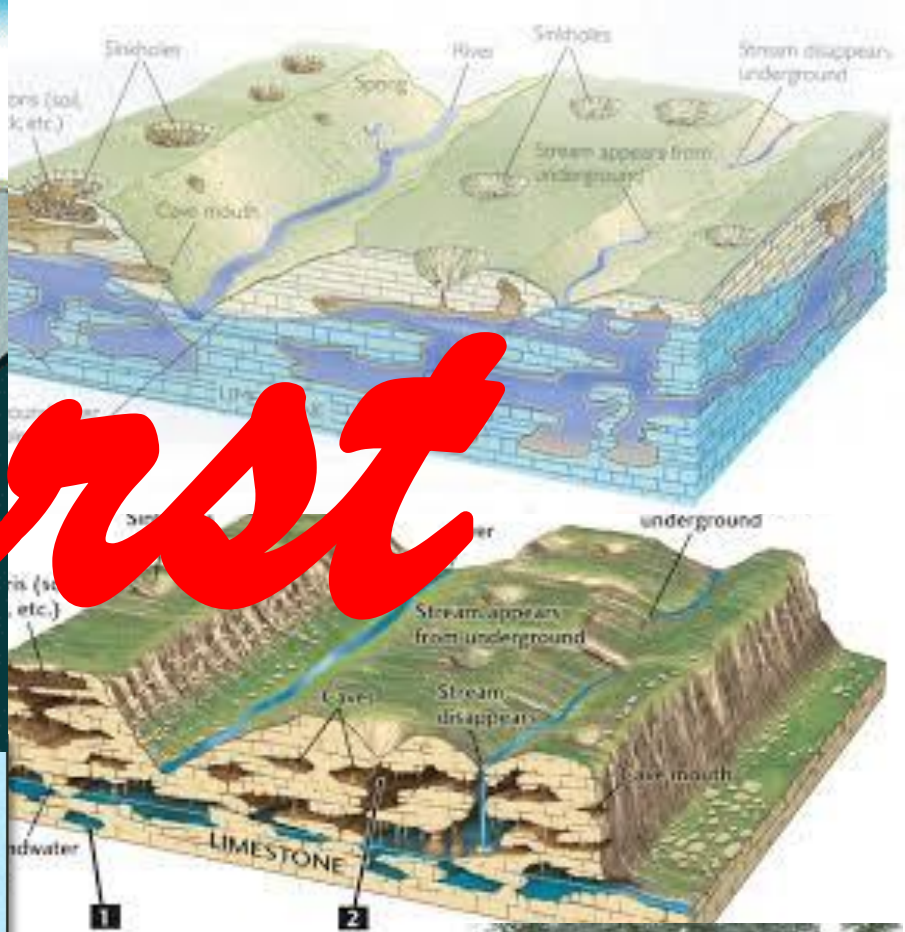
This is not Terra Firma

Only three areas in the world exhibit all the manifestations of Karst Hydrology, and we need to have enough to support:

1) Springs
2) Disappearing Lakes
3) Sinking Streams
4) Underground Rivers

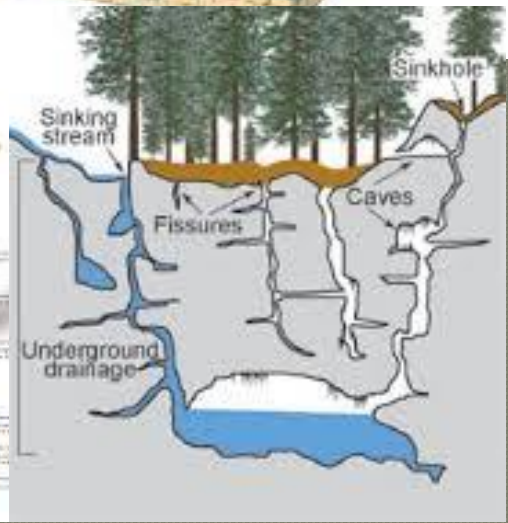
Karst


limestone
The Floridan Aquifer


Sinkholes
Spring
River
Sinkholes
Stream disappears underground
Stream appears from underground
Cave mouth
underground
Stream appears from underground
Stream disappears
Cave mouth
LIMESTONE
1
2


1. Aquifers
2. Springs
3. Disappearing Lakes
4. Sinking Streams
Sinkhole
Spring
Sea
Spring


U.S. Karst Map

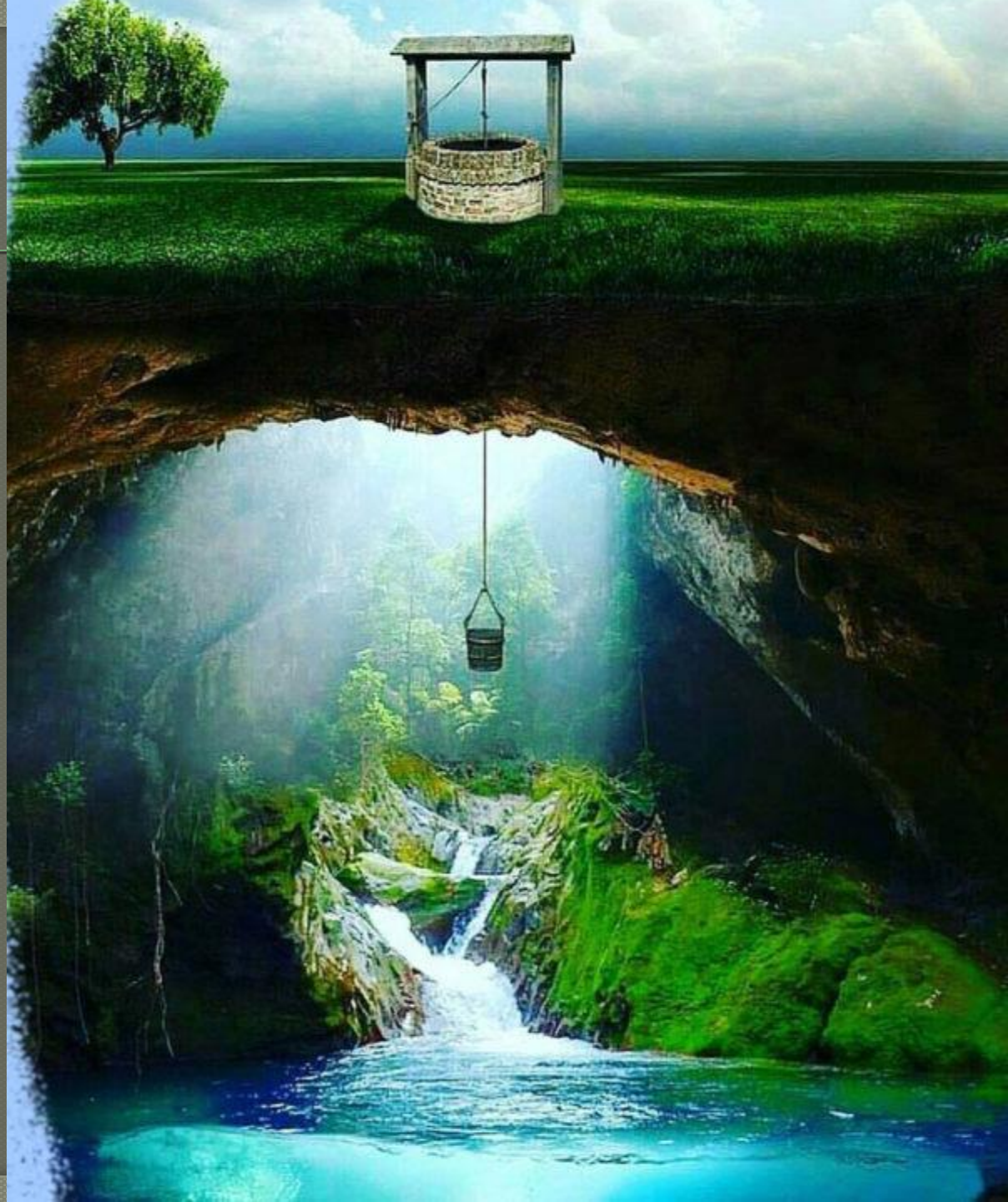

Sinkhole
Sinking stream
Caves
Fissures
Underground drainage

- In Karst

- Surface
- and
Groundwater

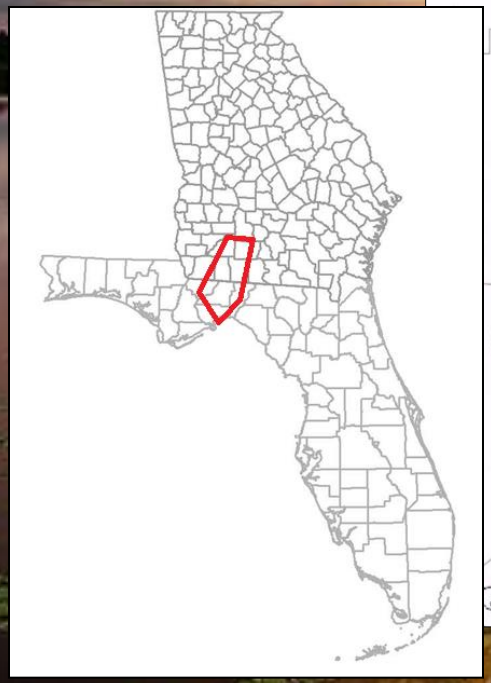
- are

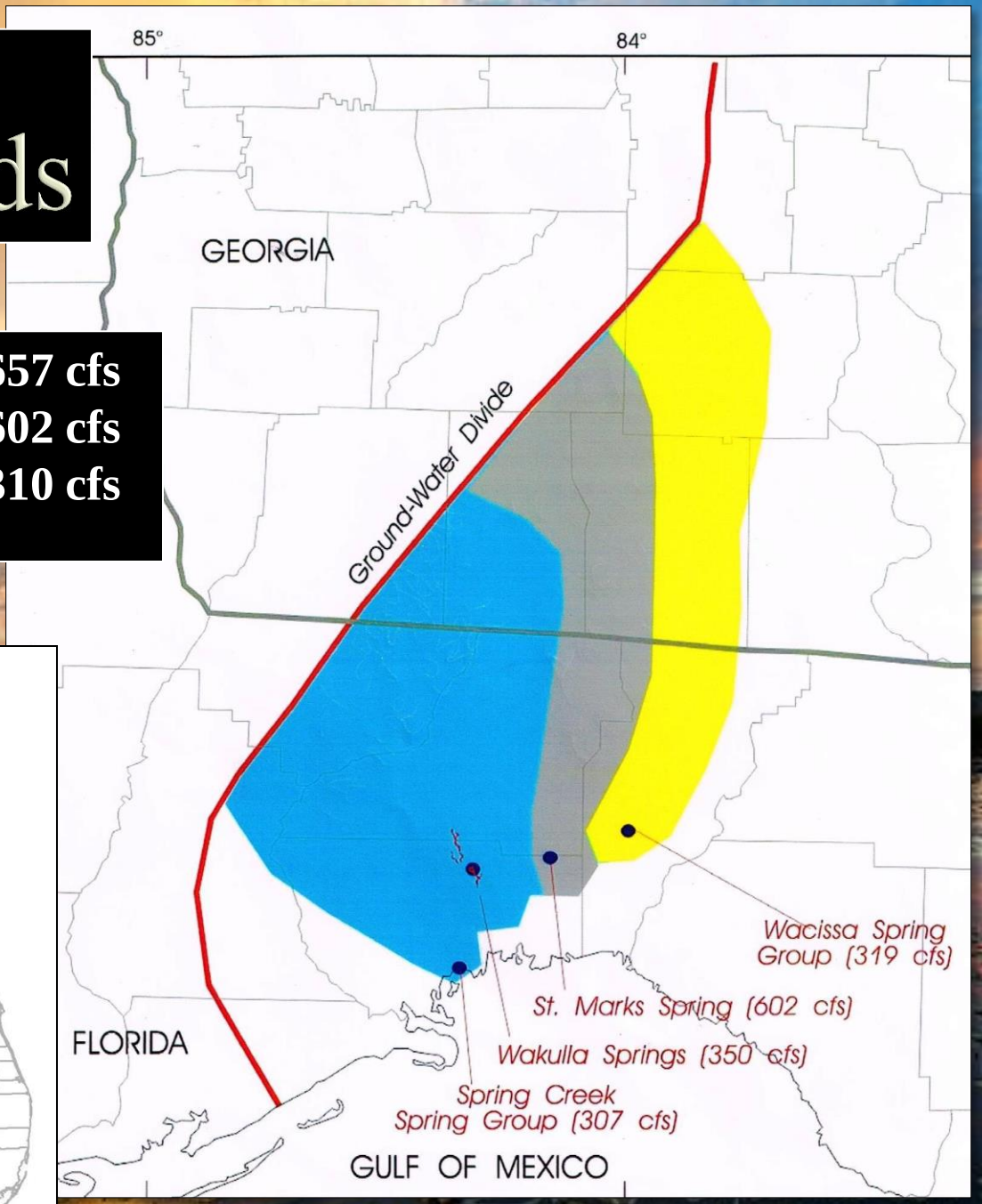
- Intimately
Connected



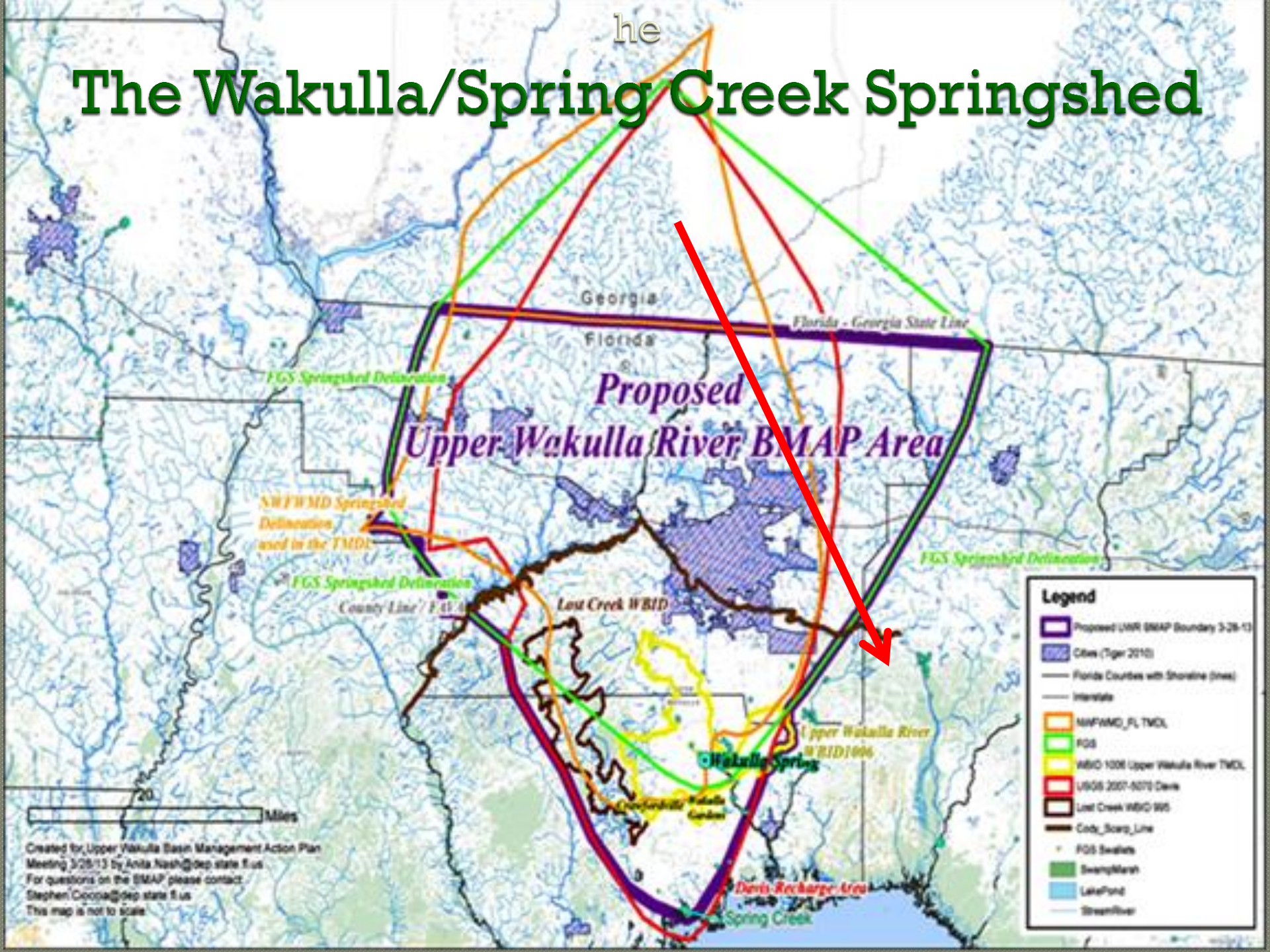
Springsheds

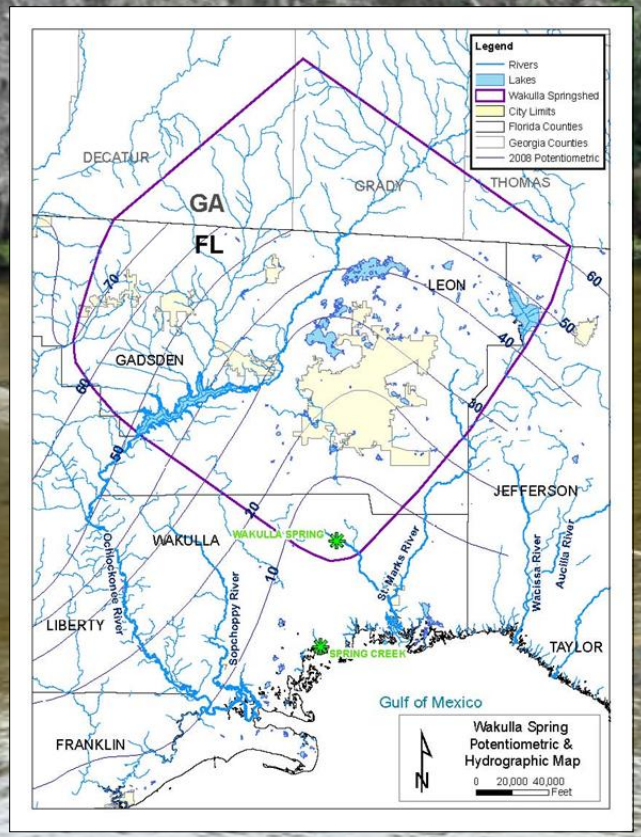
- 1st Wakulla/Spring Creek -657 cfs
- 2nd St Marks -602 cfs
- 3rd Wacissa -310 cfs

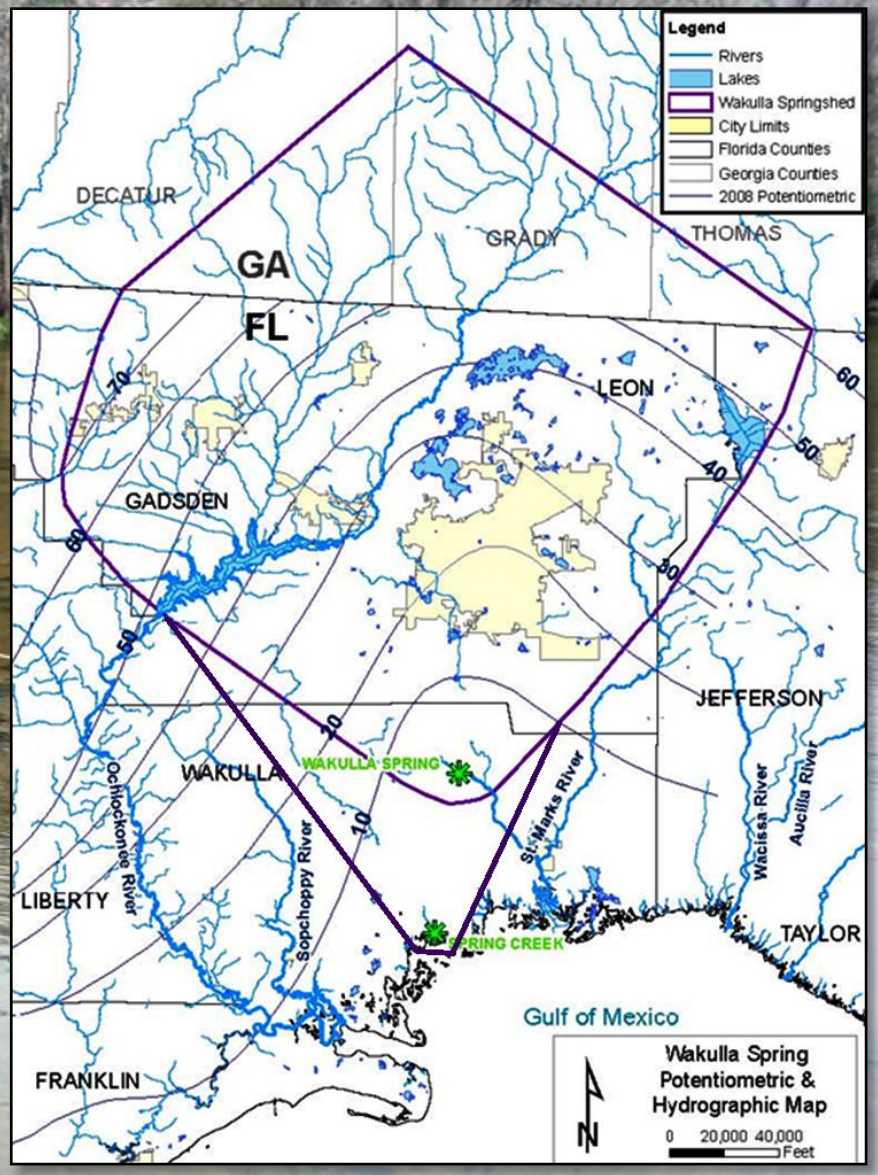




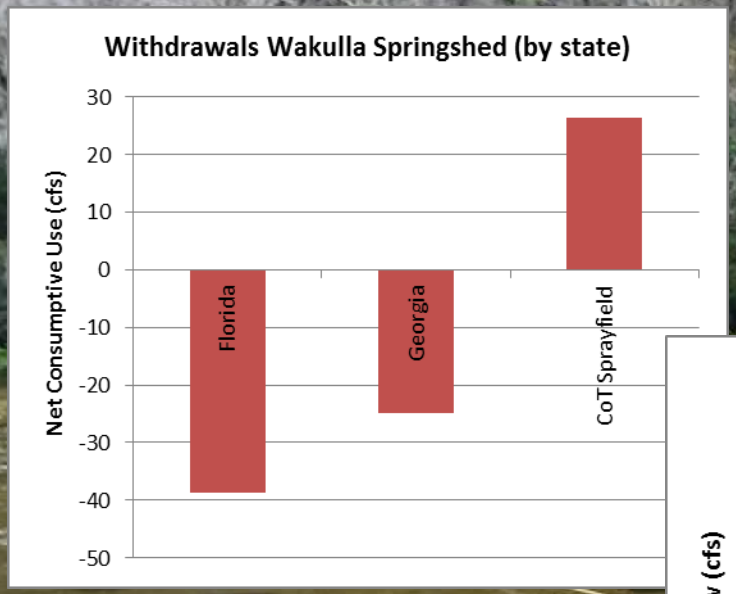
The Wakulla/Spring Creek Springshed

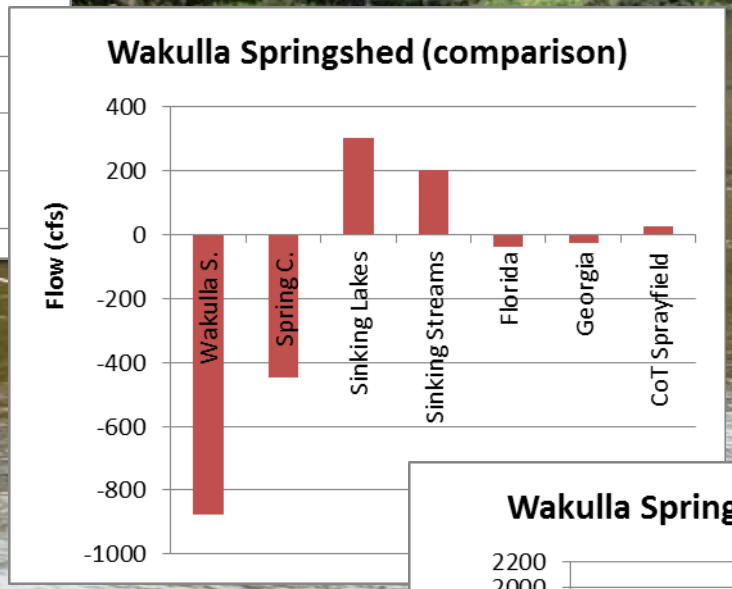


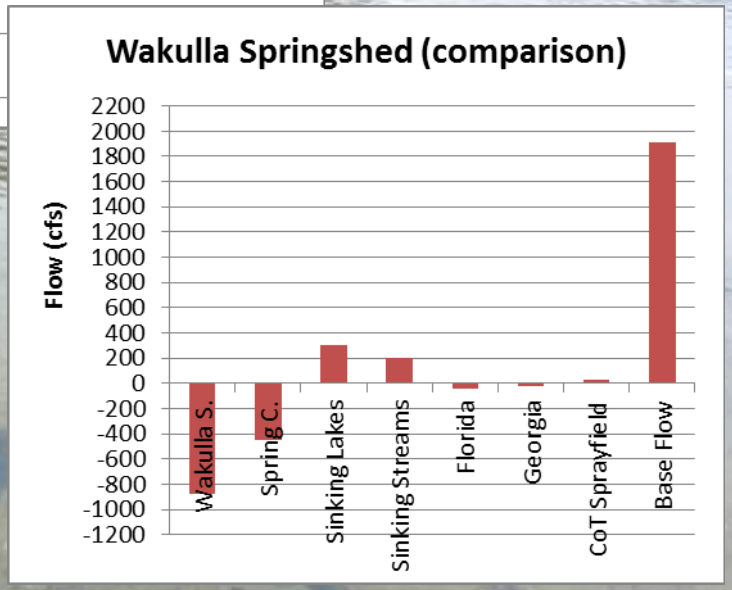




Florida Springs Institute Wakulla Springshed Revised

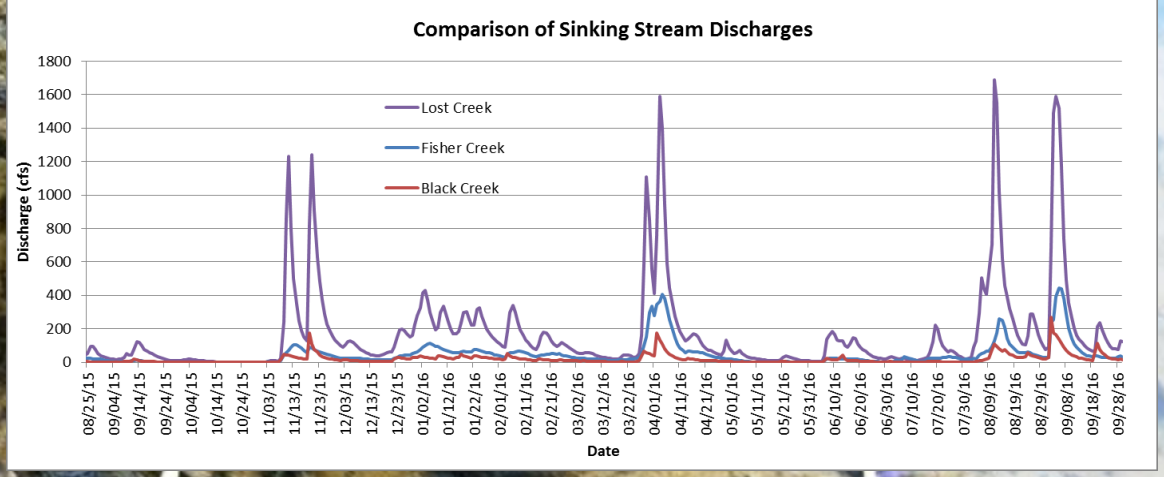


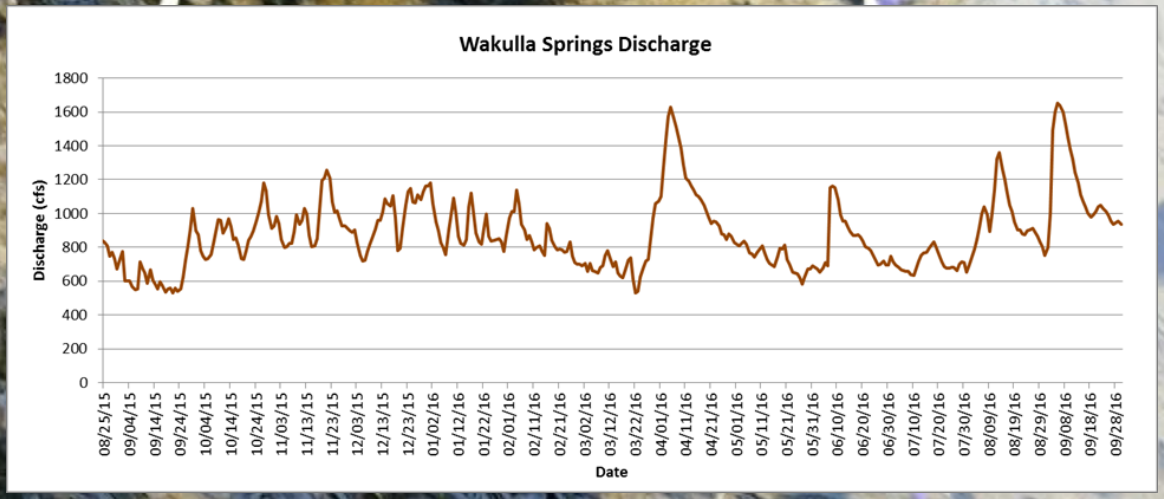


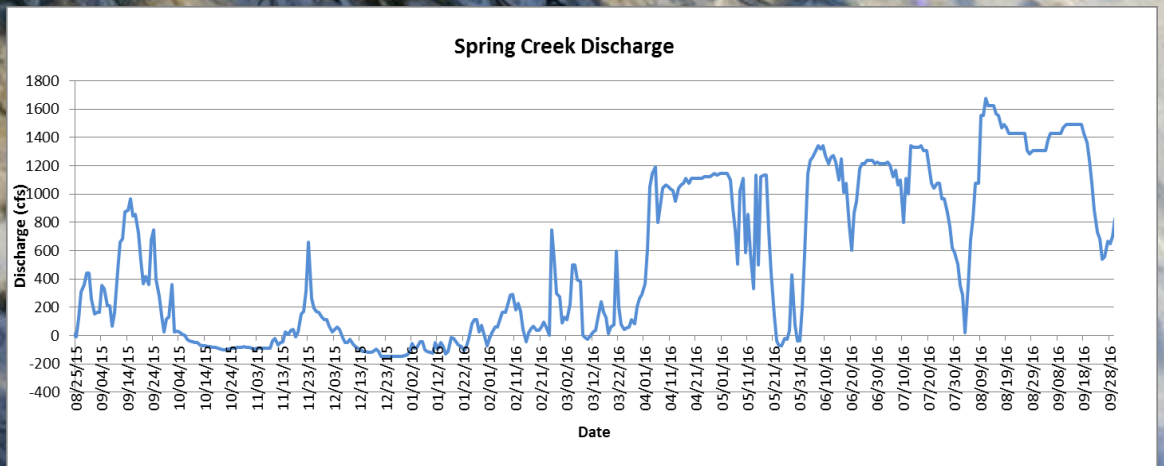


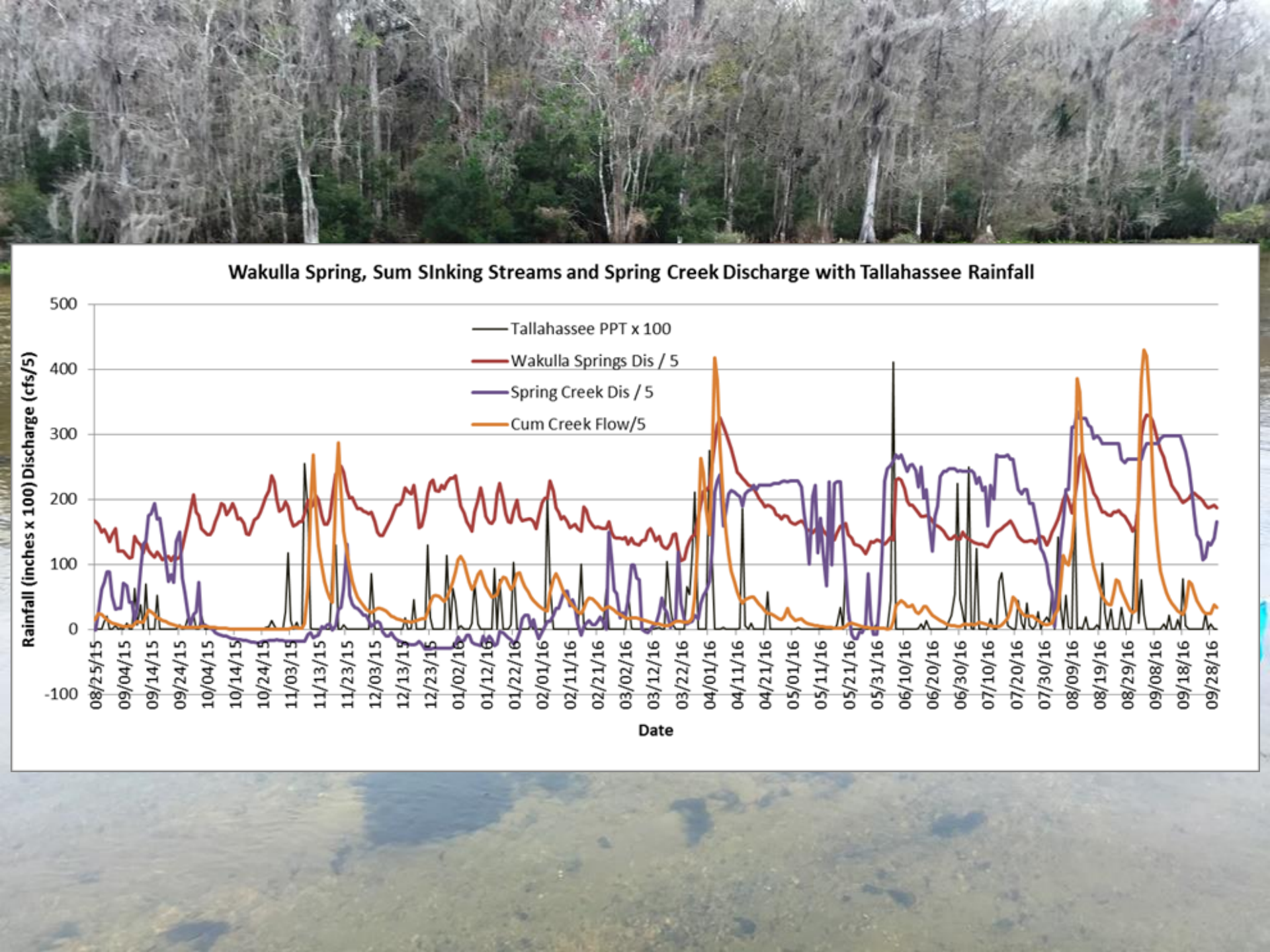
1) *Springs and sinking stream Flows (USGS, 07/01/15-09/30/16 and for Spring Creek, McGlynn, 2017)*
2) *Georgia and Florida flows (2016 data)*
3) *McGlynn, 2016*

The Aquifer


Comparison of Sinking Stream Discharges
Lost Creek
Fisher Creek
Black Creek
Discharge (cfs)
Date


Wakulla Springs Discharge
Discharge (cfs)
Date


Spring Creek Discharge
Discharge (cfs)
Date


Wakulla Spring, Sum SInking Streams and Spring Creek Discharge with Tallahassee Rainfall
Rainfall (inches x 100) Discharge (cfs/5)
500
400
300
200
100
0
-100
Tallahassee PPT x 100
Wakulla Springs Dis / 5
Spring Creek Dis / 5
Cum Creek Flow/5
08/25/15
09/04/15
09/14/15
09/24/15
10/04/15
10/14/15
10/24/15
11/03/15
11/13/15
11/23/15
12/03/15
12/13/15
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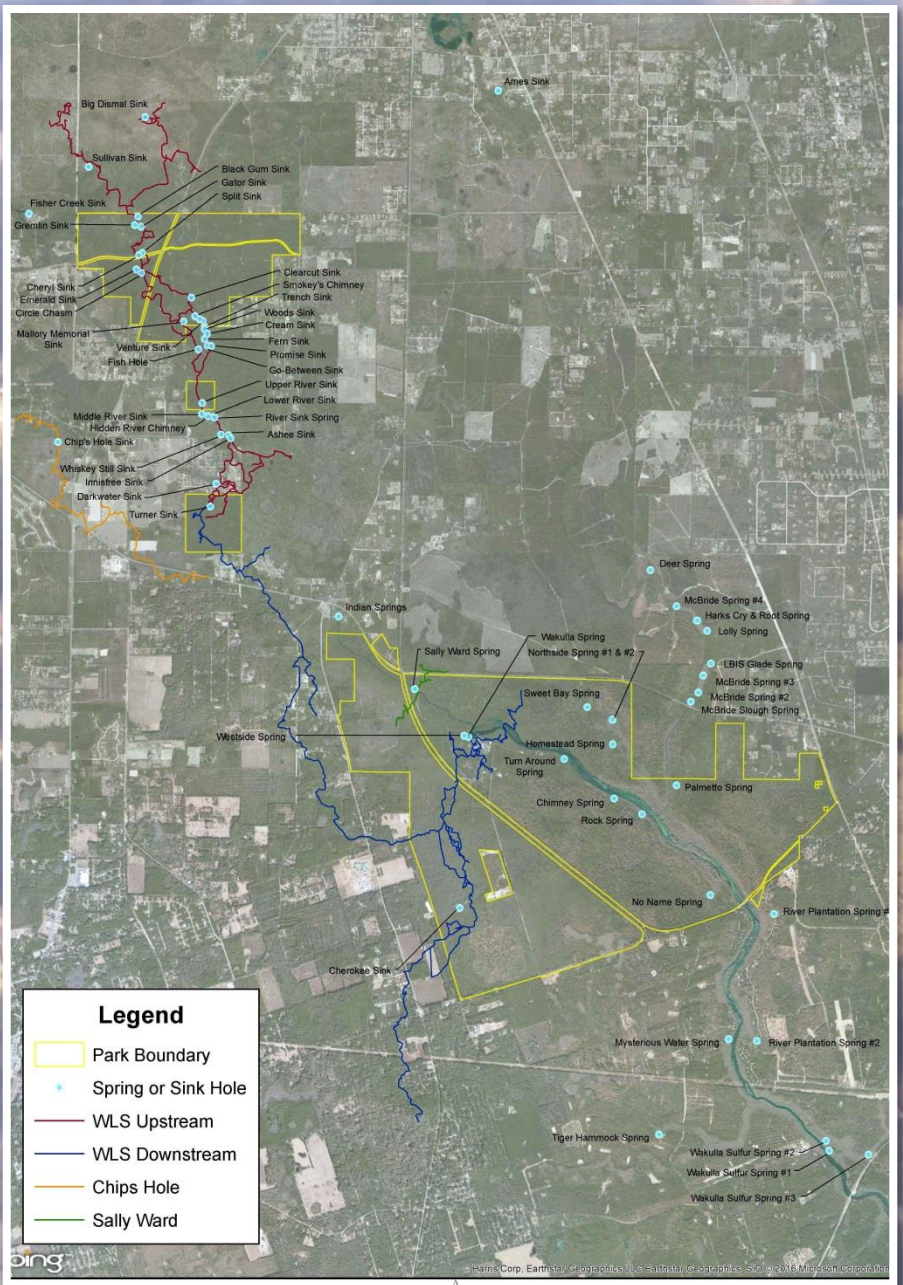
05/11/16
05/21/16
05/31/16
06/10/16
06/20/16
06/30/16
07/10/16
07/20/16
07/30/16
08/09/16
08/19/16
08/29/16
09/08/16
09/18/16
09/28/16
Date



EDWARD BALL WAKULLA SPRINGS STATE PARK

N

0 0.25 0.5 1 Miles

Florida Department of Environmental Protection
Division of Recreation and Parks
Data Provided by: WKPP
Date of aerial: 2011

KARST SYSTEM MAP

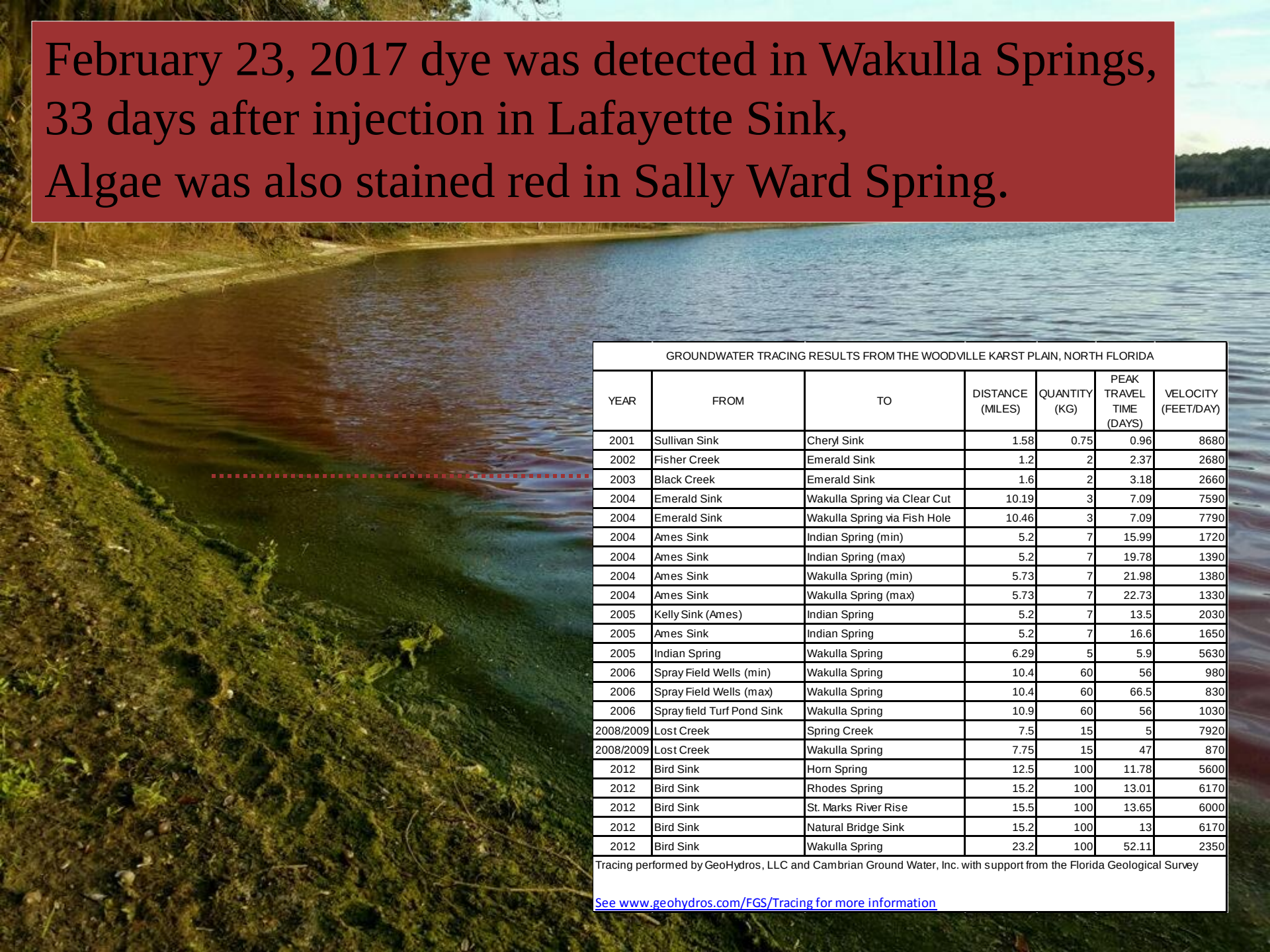
Documented dye trace pathways

to

Wakulla Springs

Lake Lafayette seepage flows to Wakulla Springs

February 23, 2017 dye was detected in Wakulla Springs, 33 days after injection in Lafayette Sink, Algae was also stained red in Sally Ward Spring.



GROUNDWATER TRACING RESULTS FROM THE WOODVILLE KARST PLAIN, NORTH FLORIDA

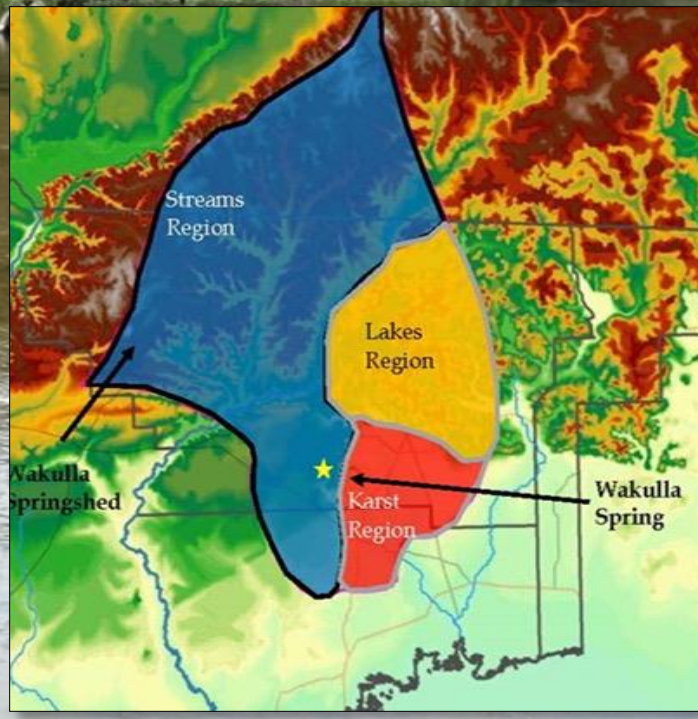
YEAR	FROM	TO	DISTANCE (MILES)	QUANTITY (KG)	PEAK TRAVEL TIME (DAYS)	VELOCITY (FEET/DAY)
2001	Sullivan Sink	Cheryl Sink	1.58	0.75	0.96	8680
2002	Fisher Creek	Emerald Sink	1.2	2	2.37	2680
2003	Black Creek	Emerald Sink	1.6	2	3.18	2660
2004	Emerald Sink	Wakulla Spring via Clear Cut	10.19	3	7.09	7590
2004	Emerald Sink	Wakulla Spring via Fish Hole	10.46	3	7.09	7790
2004	Ames Sink	Indian Spring (min)	5.2	7	15.99	1720
2004	Ames Sink	Indian Spring (max)	5.2	7	19.78	1390
2004	Ames Sink	Wakulla Spring (min)	5.73	7	21.98	1380
2004	Ames Sink	Wakulla Spring (max)	5.73	7	22.73	1330
2005	Kelly Sink (Ames)	Indian Spring	5.2	7	13.5	2030
2005	Ames Sink	Indian Spring	5.2	7	16.6	1650
2005	Indian Spring	Wakulla Spring	6.29	5	5.9	5630
2006	Spray Field Wells (min)	Wakulla Spring	10.4	60	56	980
2006	Spray Field Wells (max)	Wakulla Spring	10.4	60	66.5	830
2006	Spray field Turf Pond Sink	Wakulla Spring	10.9	60	56	1030
2008/2009	Lost Creek	Spring Creek	7.5	15	5	7920
2008/2009	Lost Creek	Wakulla Spring	7.75	15	47	870
2012	Bird Sink	Horn Spring	12.5	100	11.78	5600
2012	Bird Sink	Rhodes Spring	15.2	100	13.01	6170
2012	Bird Sink	St. Marks River Rise	15.5	100	13.65	6000
2012	Bird Sink	Natural Bridge Sink	15.2	100	13	6170
2012	Bird Sink	Wakulla Spring	23.2	100	52.11	2350

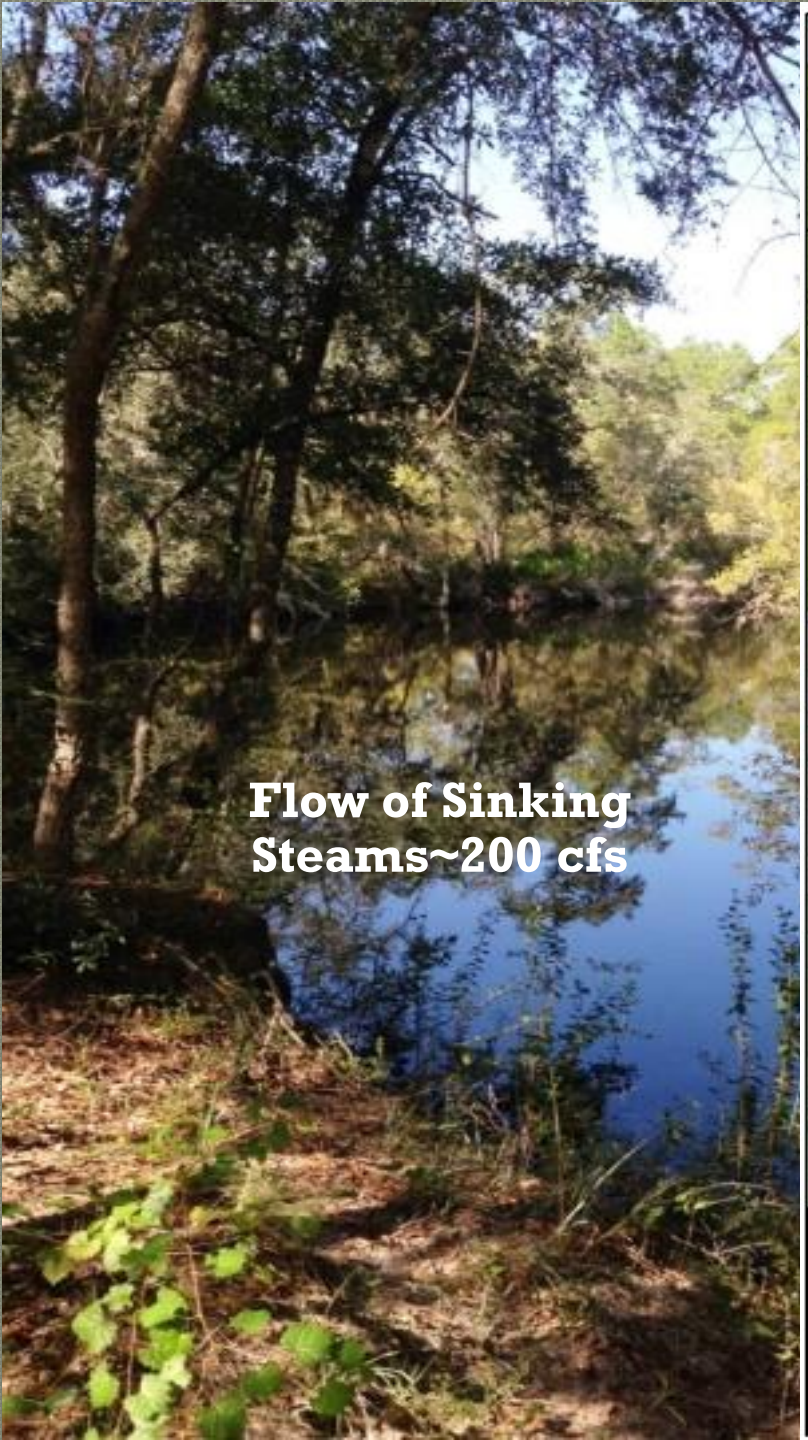
Tracing performed by GeoHydros, LLC and Cambrian Ground Water, Inc. with support from the Florida Geological Survey

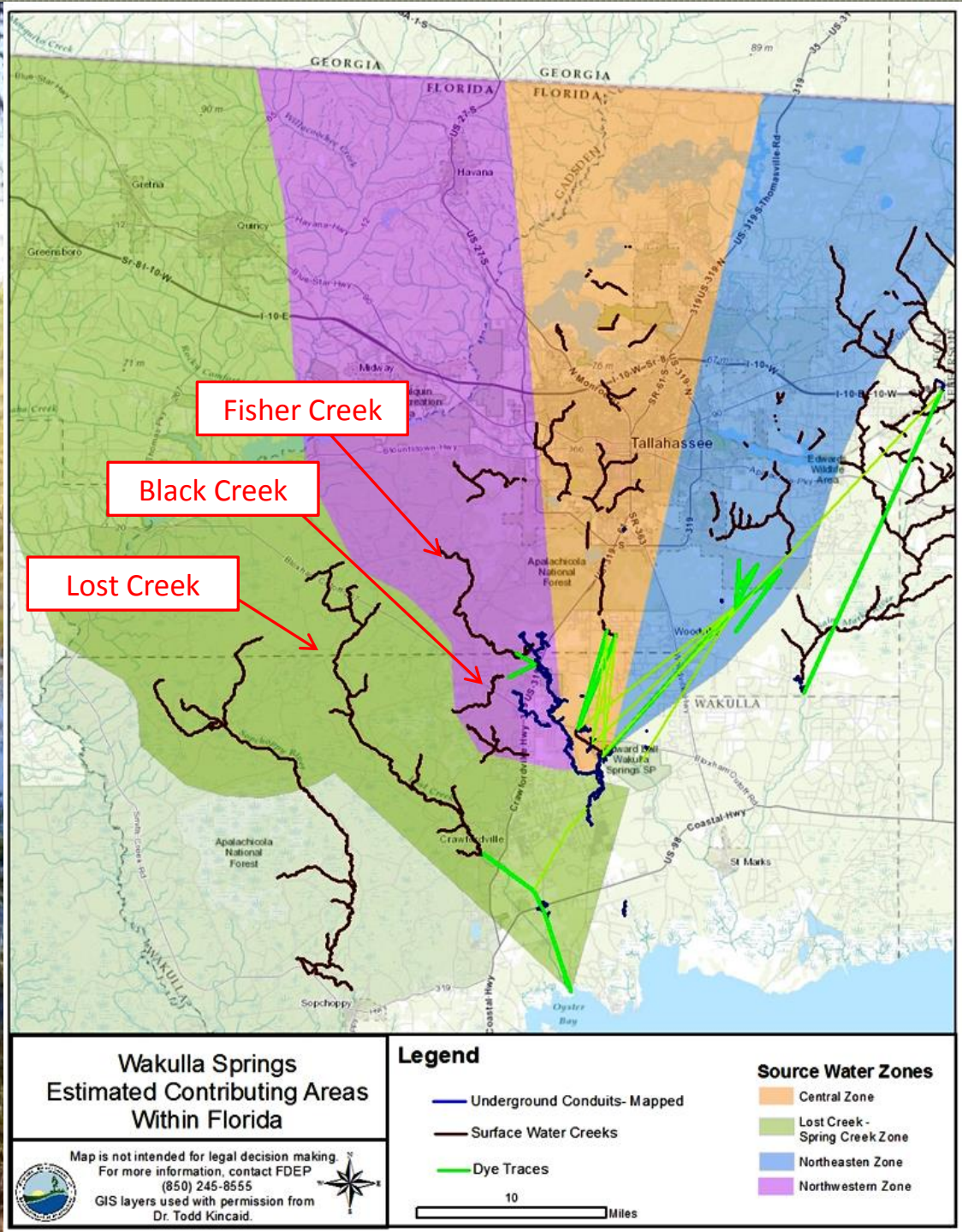
See www.geohydros.com/FGS/Tracing for more information

Physiographic Regions of the Wakulla Springshed

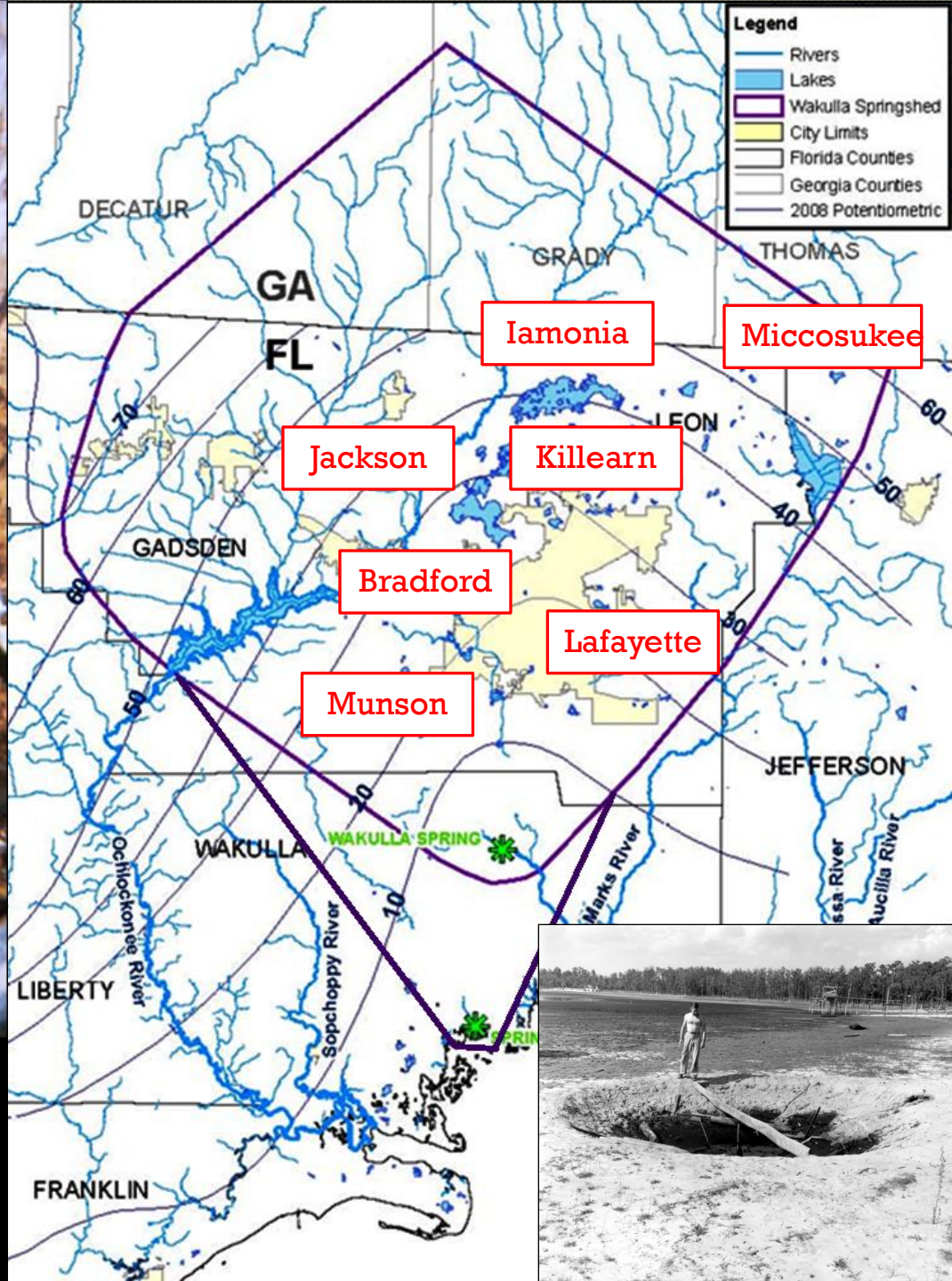
- **Streams and Karst Regions:**
  - Lost Creek
  - Black Creek
  - Fisher Creek
- **Lakes Region:**
  - Lake Iamonia
  - Lake Munson
  - Lake Miccosukee
  - Lake Jackson
  - Lake Lafayette (Lafayette Complex)
  - Bradford Brooks Chain of Lakes (BBCL)
  - Killearn Plantation Chain of Lakes (KPCL)
  - Killearn Chain of Lakes (KCOL)




Flow of Sinking Steams~200 cfs

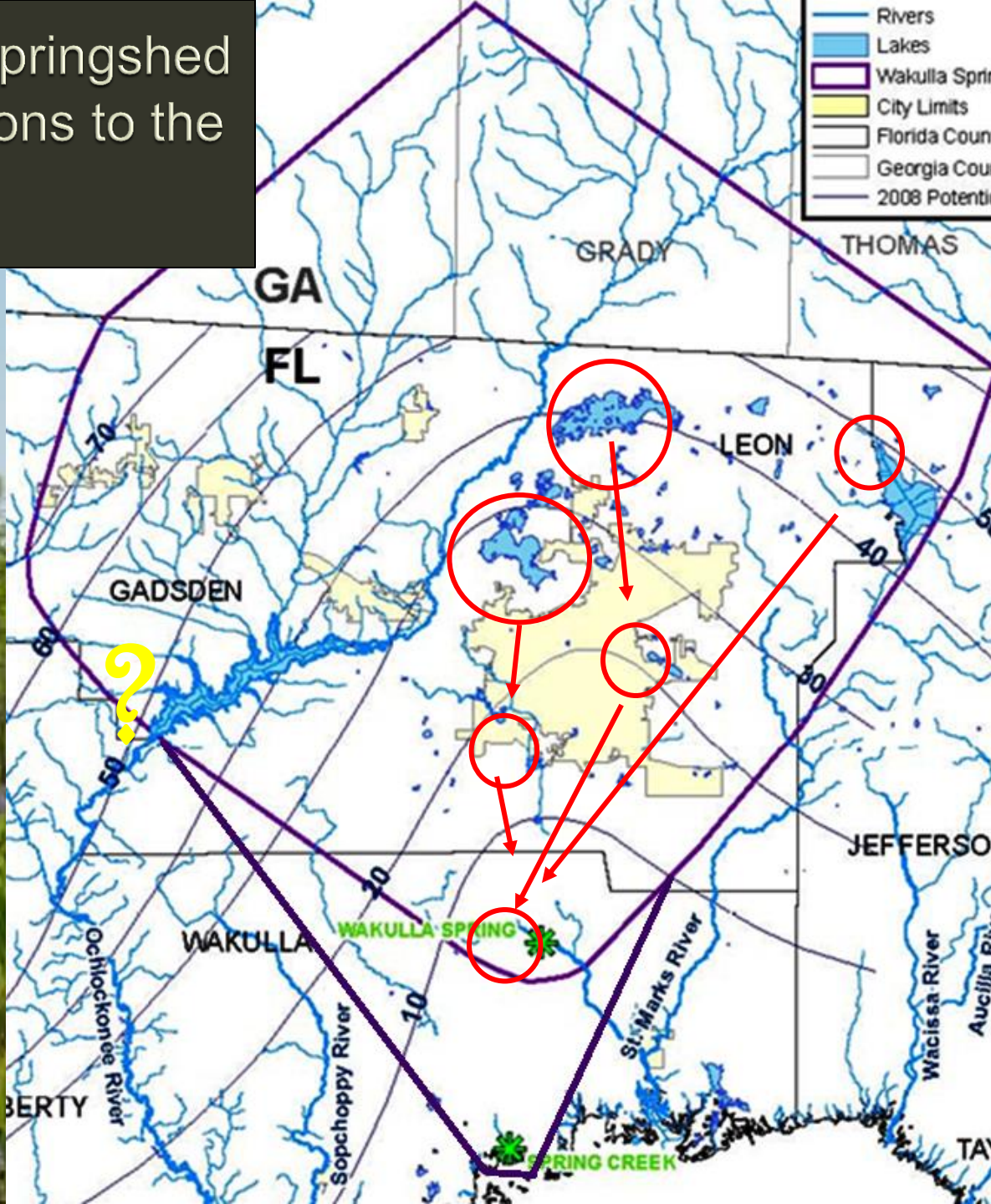

Fisher Creek
Black Creek
Lost Creek
GEORGIA
FLORIDA
Tallahassee
WAKULLA
Havana
Quincy
Greensboro
Gretna
Midway
Apalachicola National Forest
Crawfordville
St Marks
Sopchoppy
Coastal Hwy
Wakulla Springs Estimated Contributing Areas Within Florida
Map is not intended for legal decision making.
For more information, contact FDEP
(850) 245-8555
GIS layers used with permission from
Dr. Todd Kincaid.
Legend
Underground Conduits- Mapped
Surface Water Creeks
Dye Traces
10
Miles
Source Water Zones
Central Zone
Lost Creek - Spring Creek Zone
Northeasten Zone
Northwestern Zone

Sinking Lakes in the Wakulla Springshed



Map of the Wakulla Springshed

Sinkhole Lakes connections to the Wakulla Springshed.



18 million gallons of reported sewage spills

Lake Lafayette: 35.7% of Tallahassee Stormwater

Recharge for the Wakulla Springshed

Lake Jackson: 35.1% of Tallahassee's runoff

Jackson Hourly rainfall data from New Hope Life Church

66.55	rainfall (inches 05/07/10-09/08/11)
5.55	Rainfall (decimal feet)
489	days of time period

Rainfall	20081.46	acre Feet
Evaporation	25784.15	acre Feet
Volume Lost	14882.31	
seepage (calc)	9179.62	acre Feet
Flow from Seepage		18.77 acre-ft/day
SEEPAGE		9.46 cfs

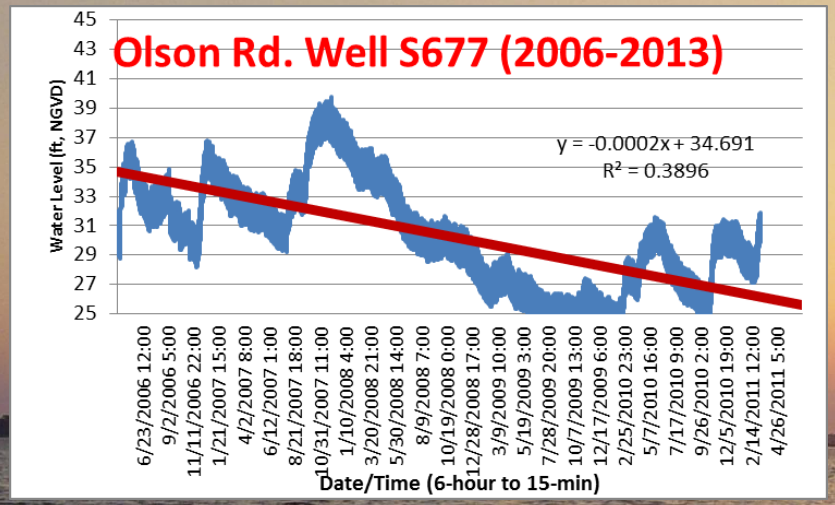
Seepage to Aquifer

- **10 cfs**

38%	percent evapotranspiration
62%	percent seepage
0.26%	seepage per area

- 6.5 million gpd

- **10 Olympic swimming pools per day**



Water Levels

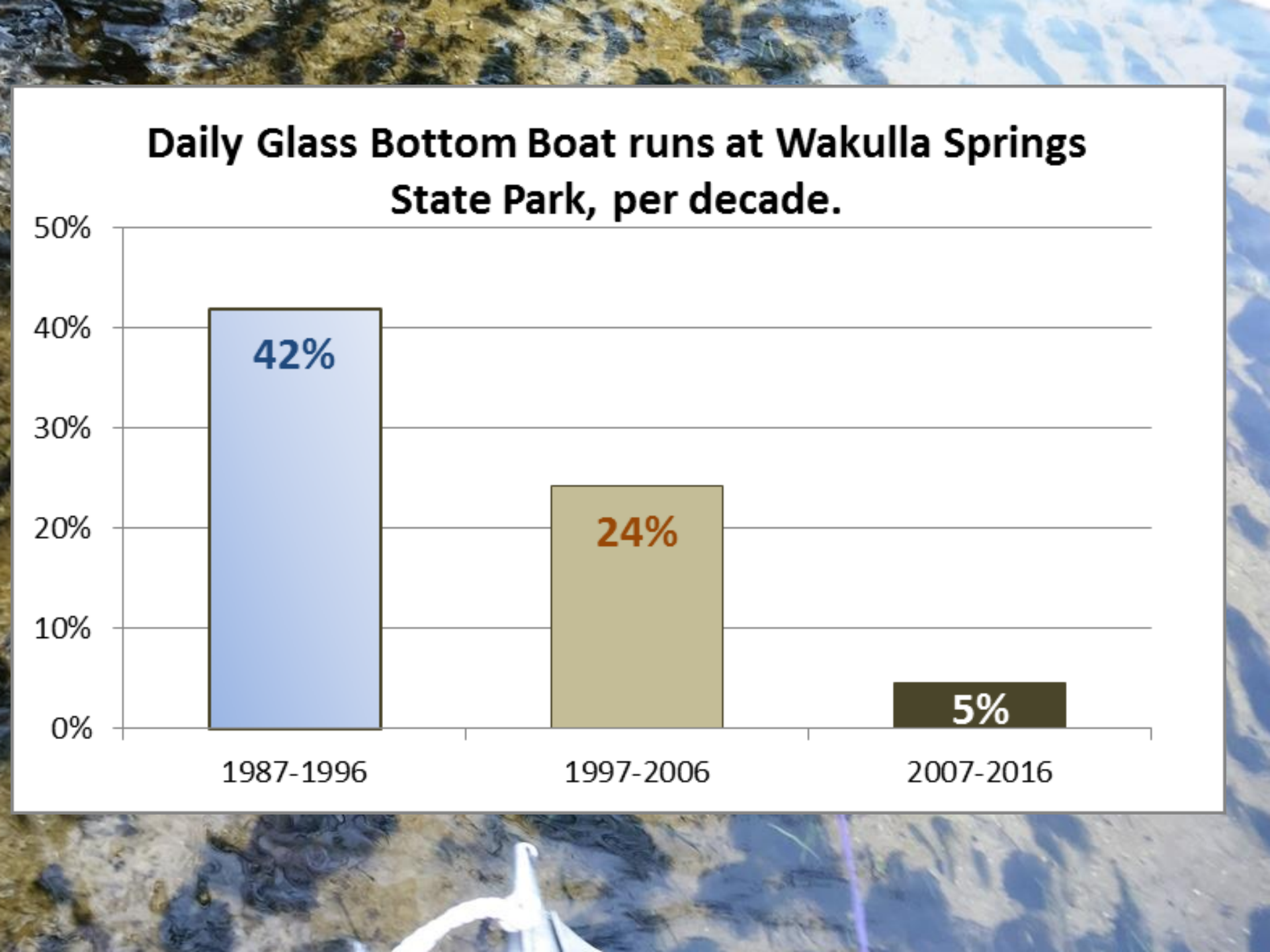
Near Interstate 10 South of Lake Jackson

Tallahassee Well

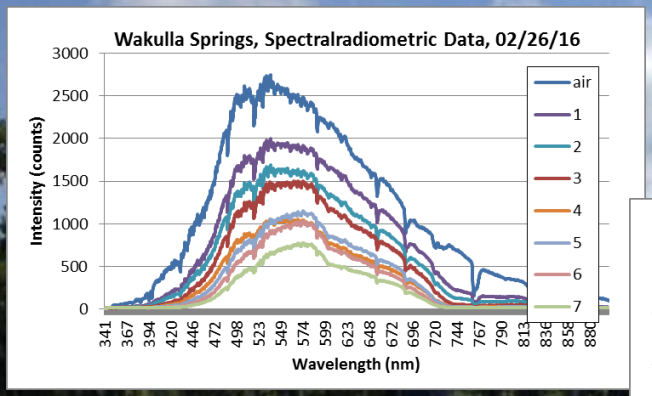
Down 1.4 foot per year

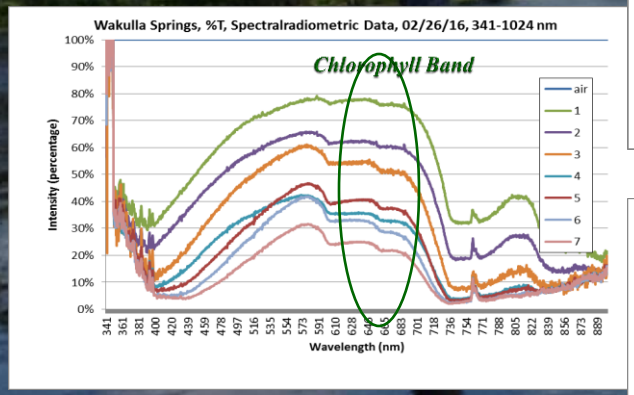
Lake Munson: 29.1% of Tallahassee's runoff

Dark Water

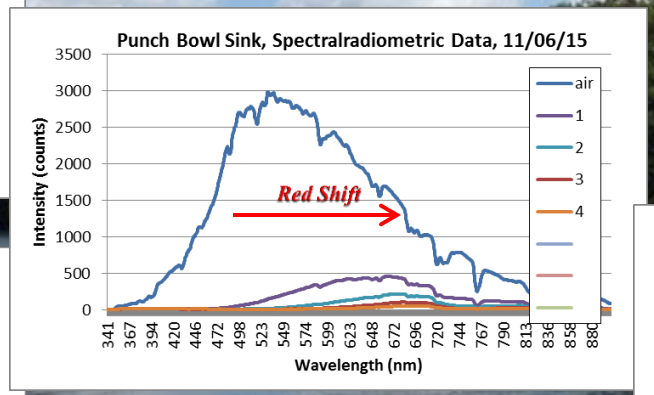

Daily Glass Bottom Boat runs at Wakulla Springs State Park, per decade.
50%
40%
30%
20%
10%
0%
42%
24%
5%
1987-1996
1997-2006
2007-2016

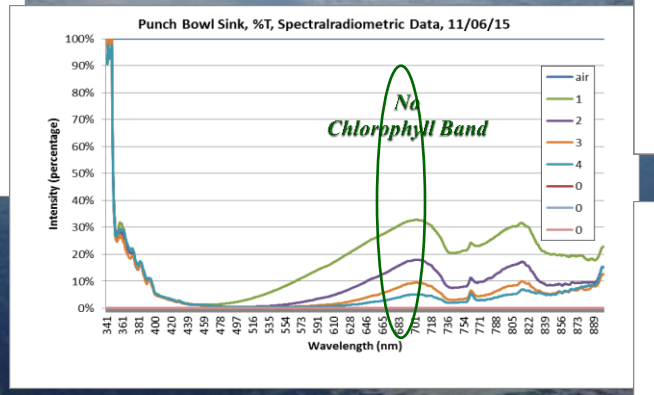
Clear Water



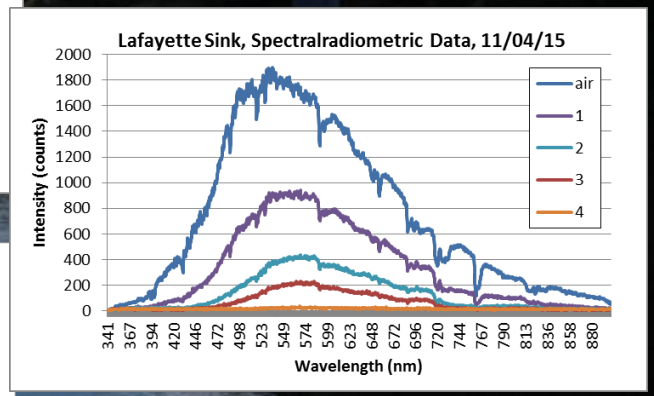


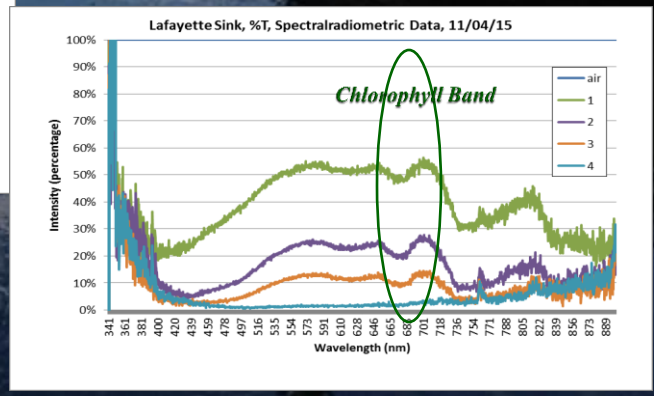
Tannic Water

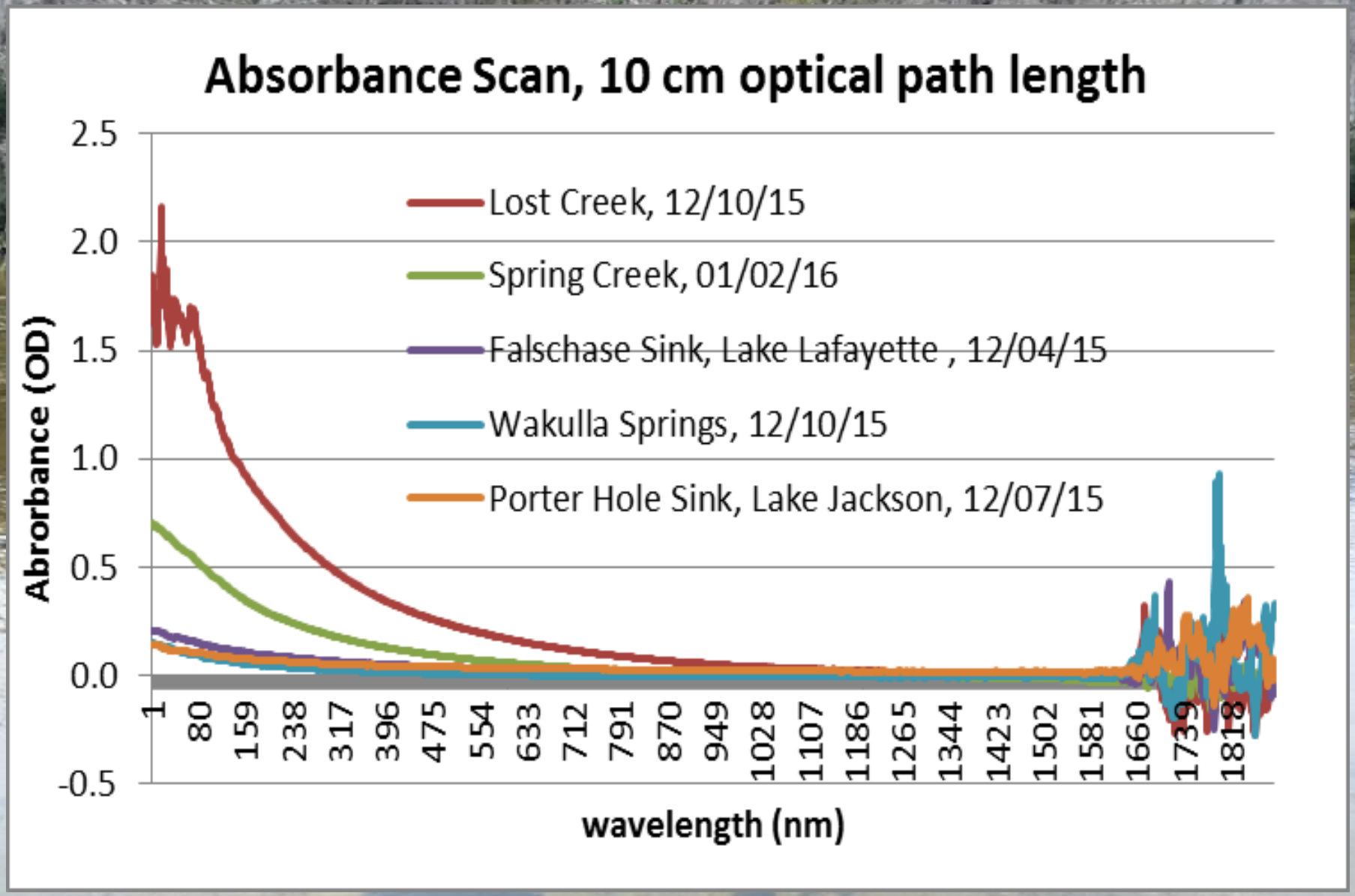


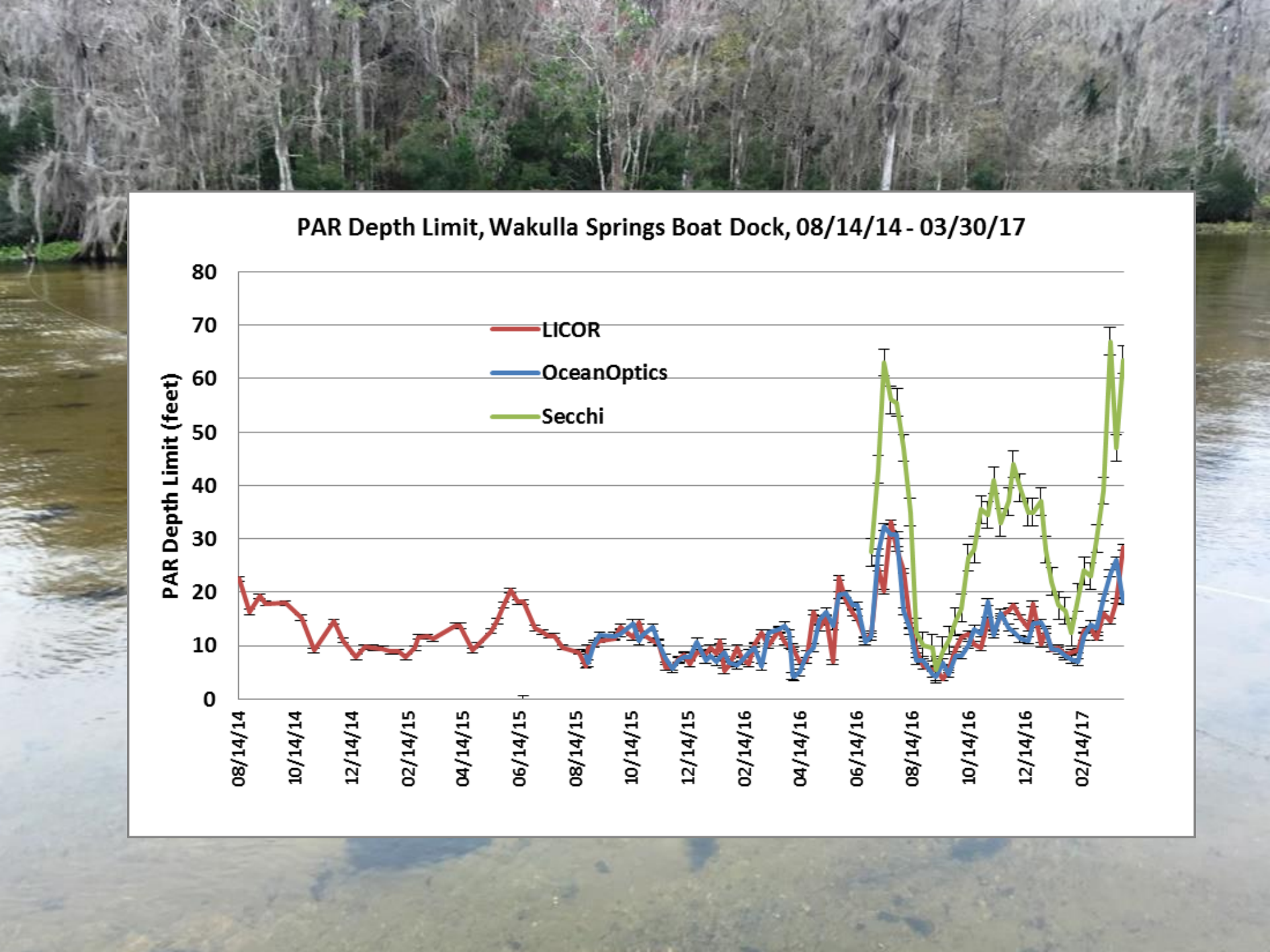


Green Water






Absorbance Scan, 10 cm optical path length
Abrorbance (OD)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
Lost Creek, 12/10/15
Spring Creek, 01/02/16
Falschase Sink, Lake Lafayette , 12/04/15
Wakulla Springs, 12/10/15
Porter Hole Sink, Lake Jackson, 12/07/15
1
80
159
238
317
396
475
554
633
712
791
870
949
1028
1107
1186
1265
1344
1423
1502
1581
1660
1739
1818
wavelength (nm)


PAR Depth Limit, Wakulla Springs Boat Dock, 08/14/14 - 03/30/17
PAR Depth Limit (feet)
80
70
60
50
40
30
20
10
0
LICOR
OceanOptics
Secchi
08/14/14
10/14/14
12/14/14
02/14/15
04/14/15
06/14/15
08/14/15
10/14/15
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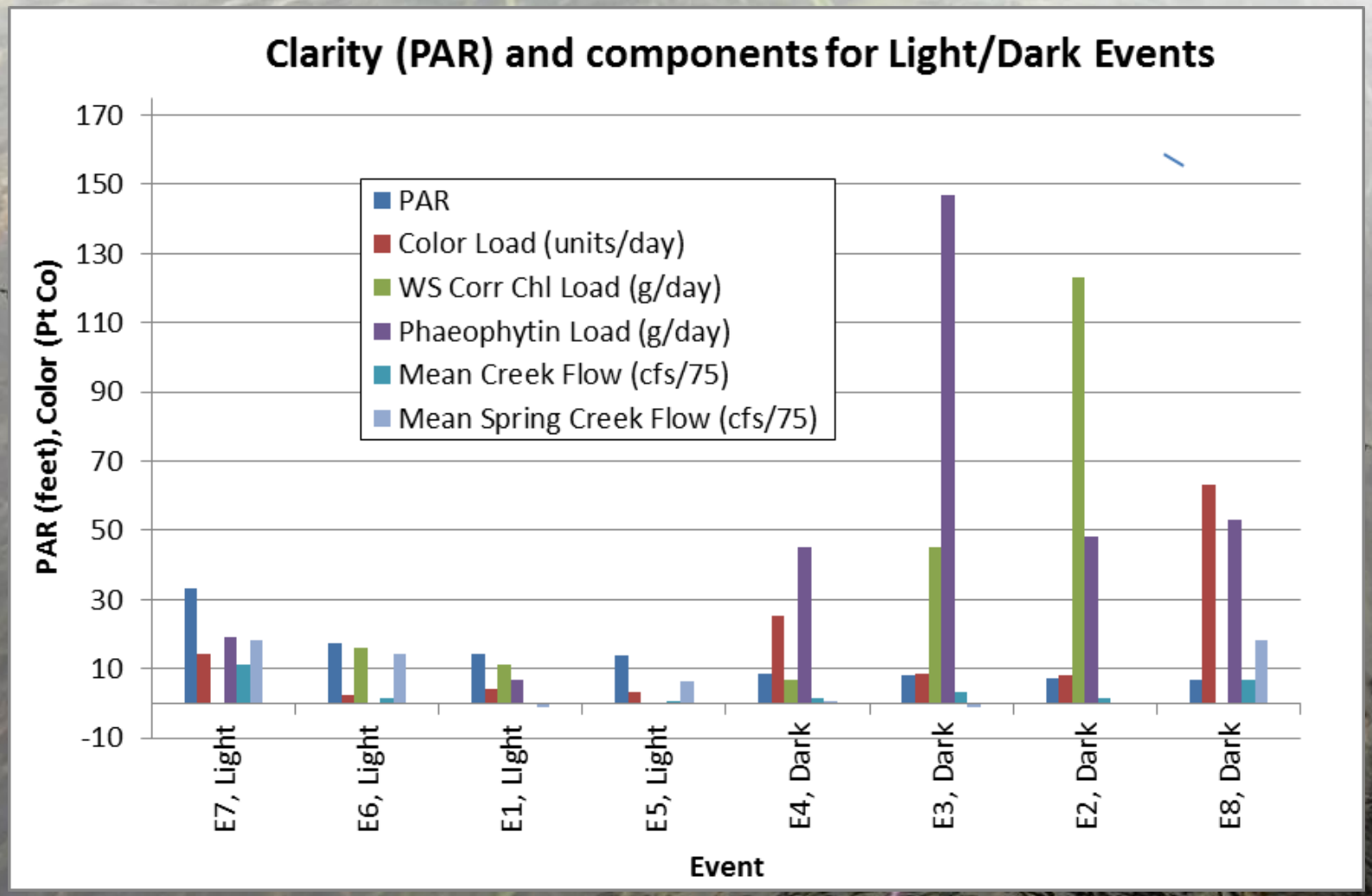
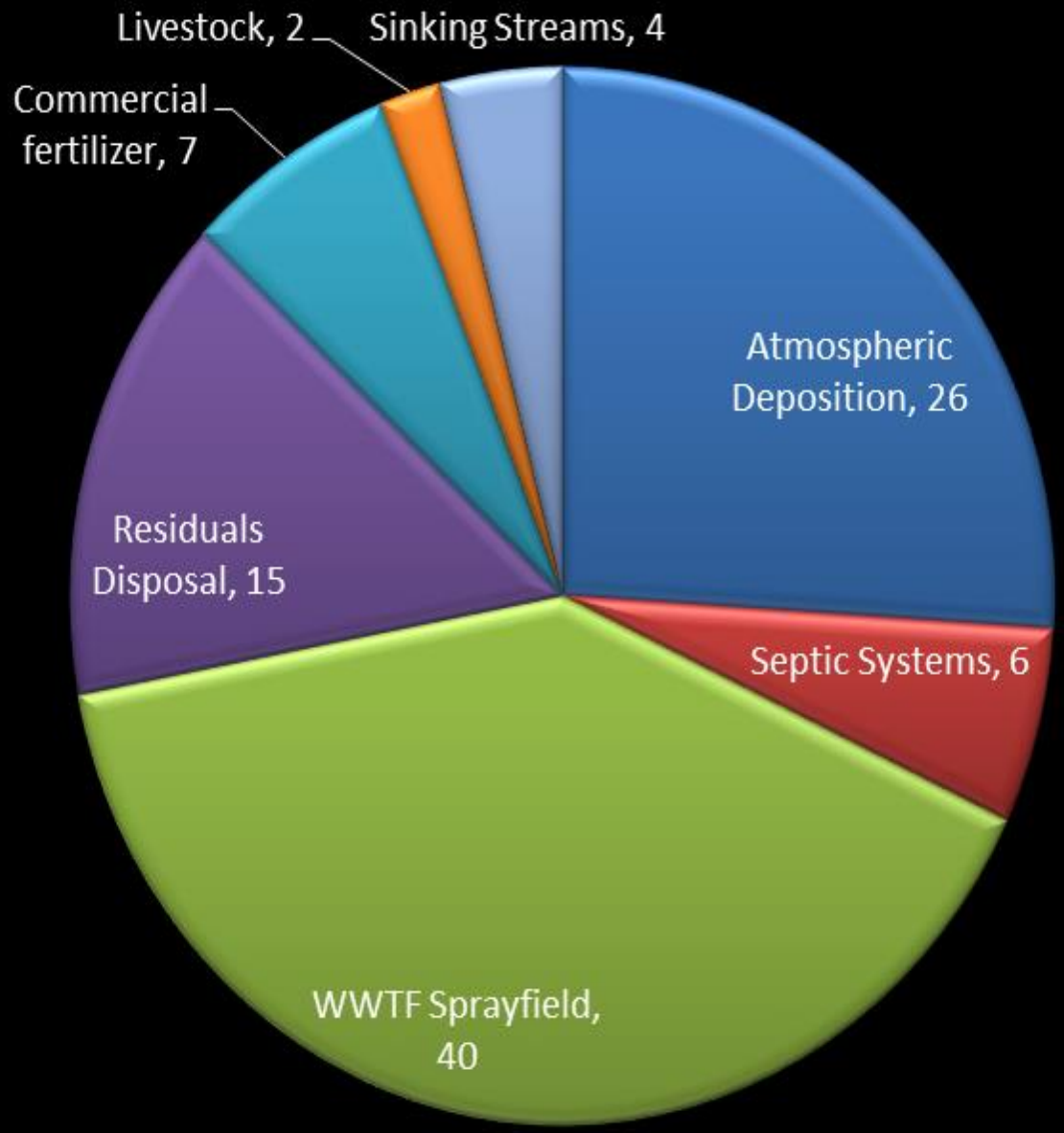
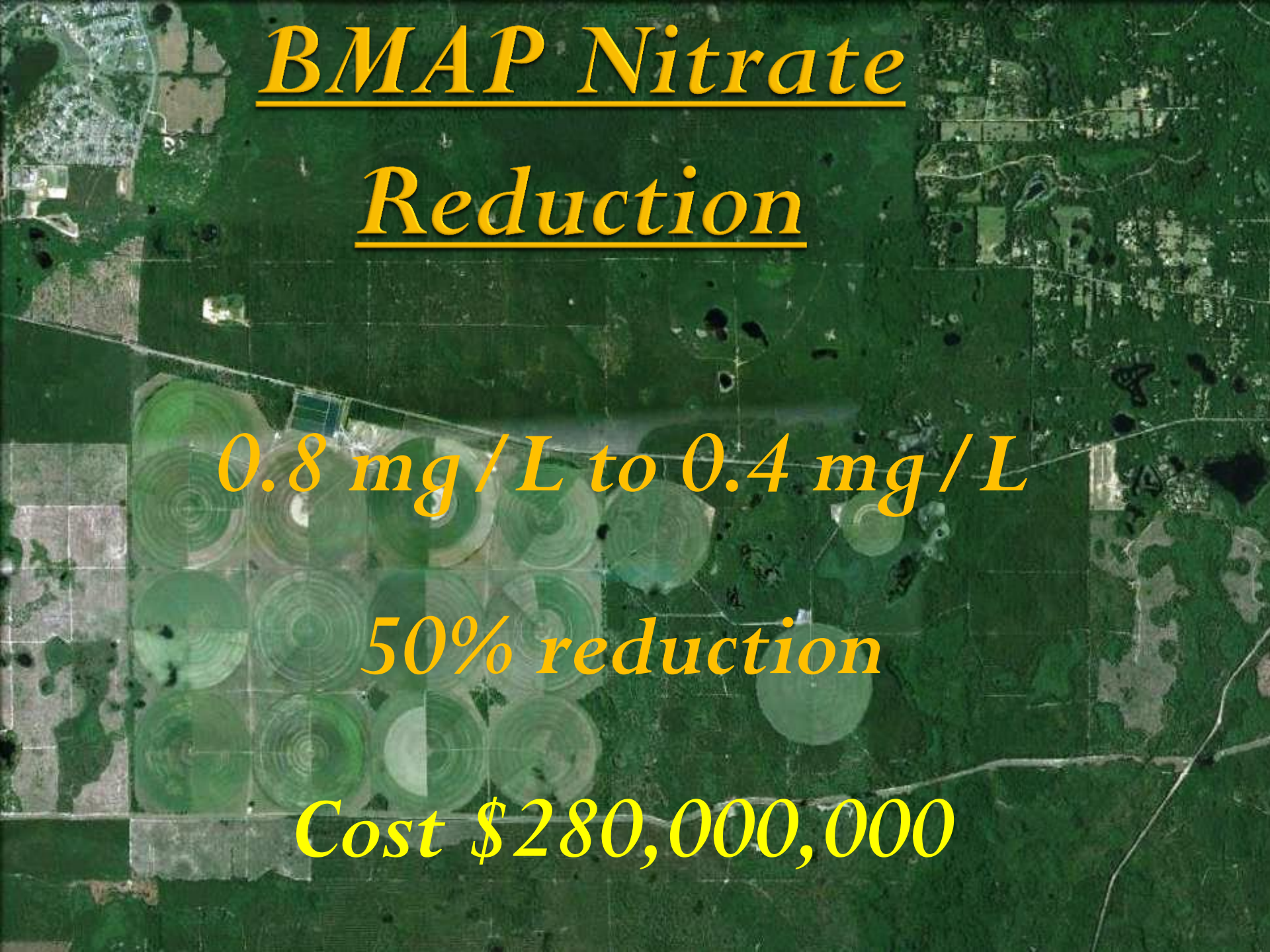
08/14/16
10/14/16
12/14/16
02/14/17


Clarity (PAR) and components for Light/Dark Events
PAR (feet), Color (Pt Co)
170
150
130
110
90
70
50
30
10
-10
PAR
Color Load (units/day)
WS Corr Chl Load (g/day)
Phaeophytin Load (g/day)
Mean Creek Flow (cfs/75)
Mean Spring Creek Flow (cfs/75)
E7, Light
E6, Light
E1, Light
E5, Light
E4, Dark
E3, Dark
E2, Dark
E8, Dark
Event


Clean Aquifer
Total
Maximum
Daily
Load

Phase I, Nitrogen Loading (2011)





BMAP Nitrate Reduction

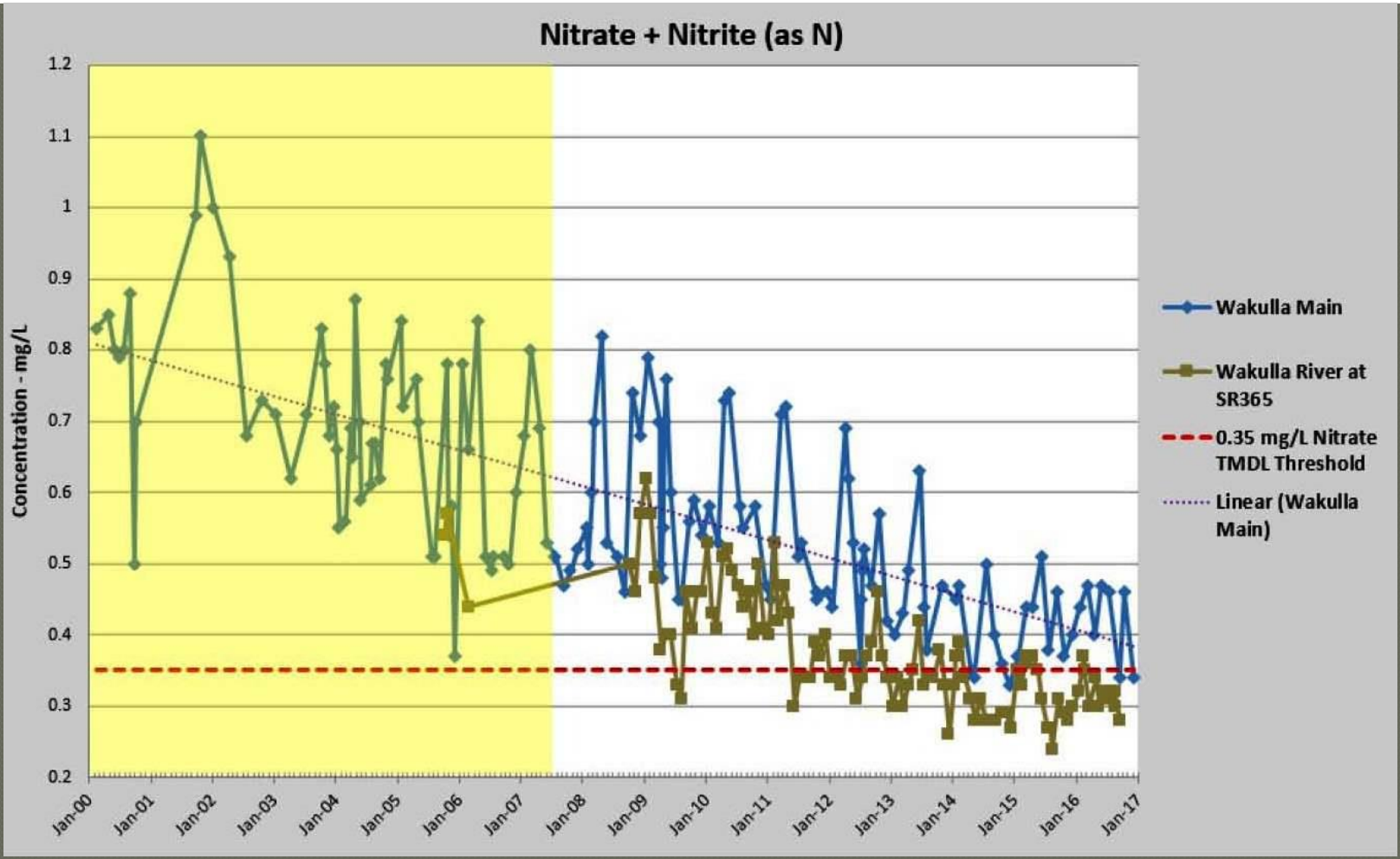
0.8 mg/L to 0.4 mg/L

50% reduction

Cost $280,000,000

Nitrogen reduction, from retrofit at the CoT Sprayfield.

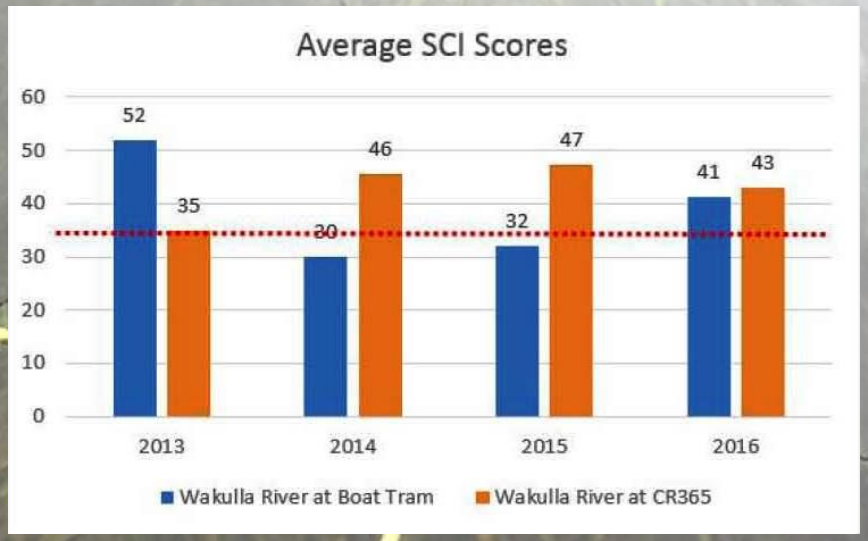
Much improved, but further reduction to meet the goal of 0.35 mg/L.



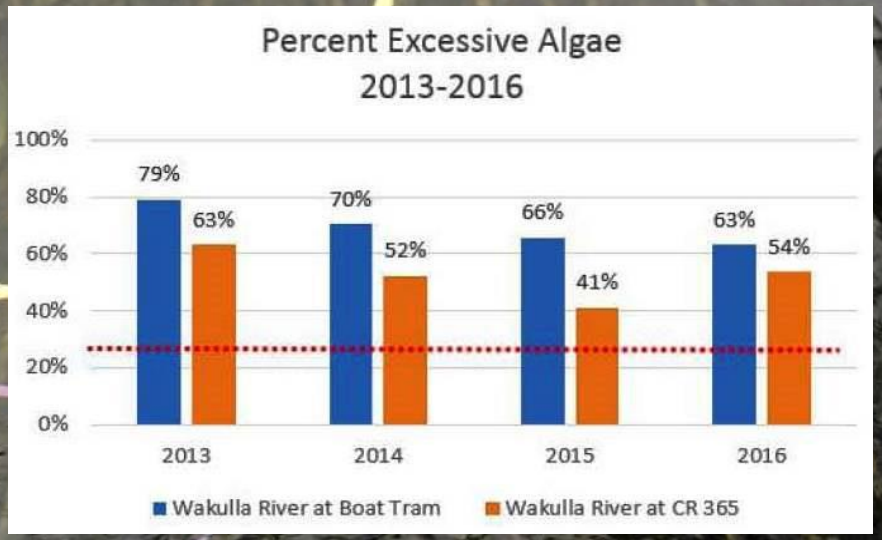
BMAP Chart

FDEP Biology Results

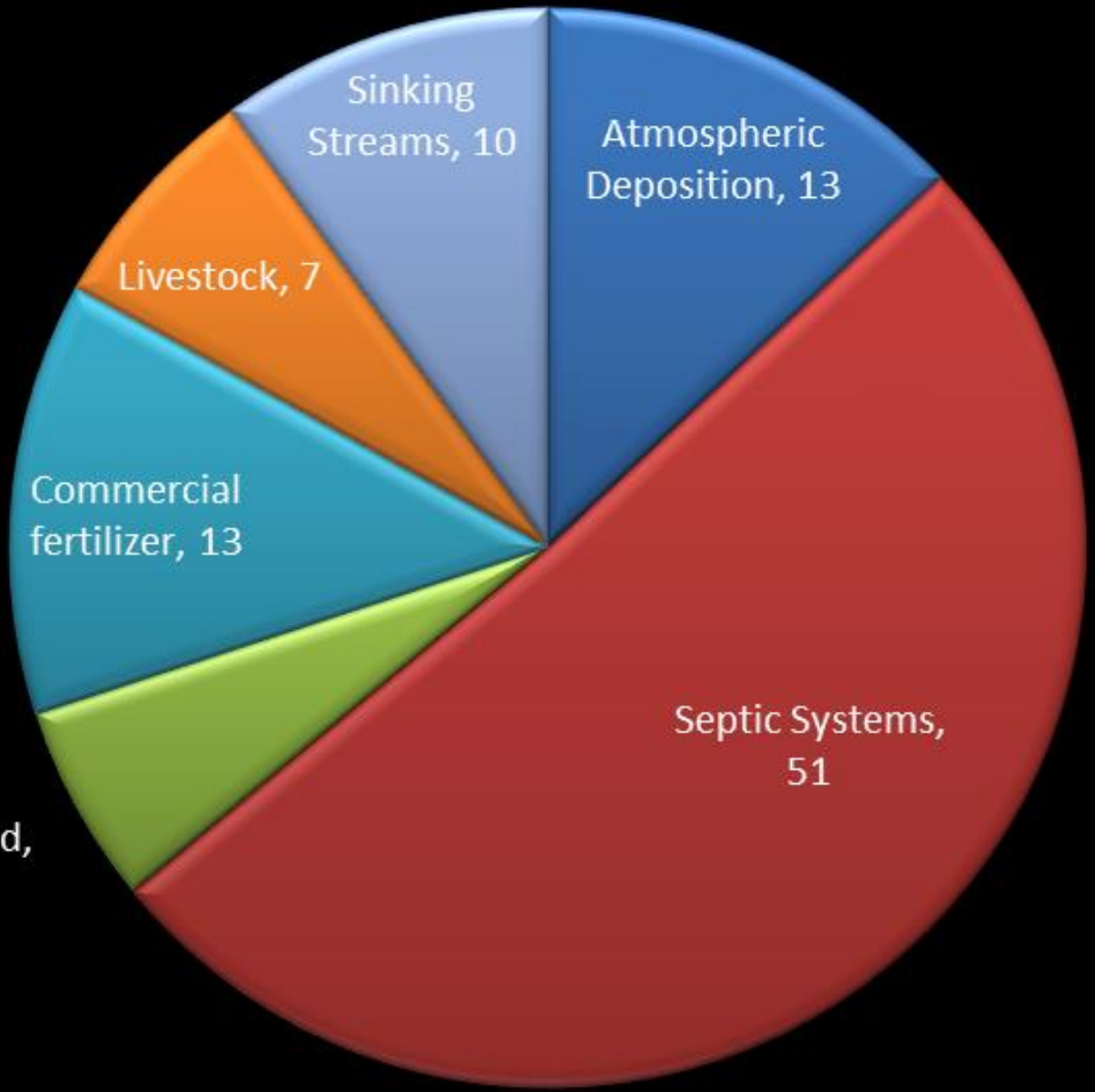
Stream Condition Index: Fails (SCI)



Rapid Periphyton Survey: Fails (RPS)



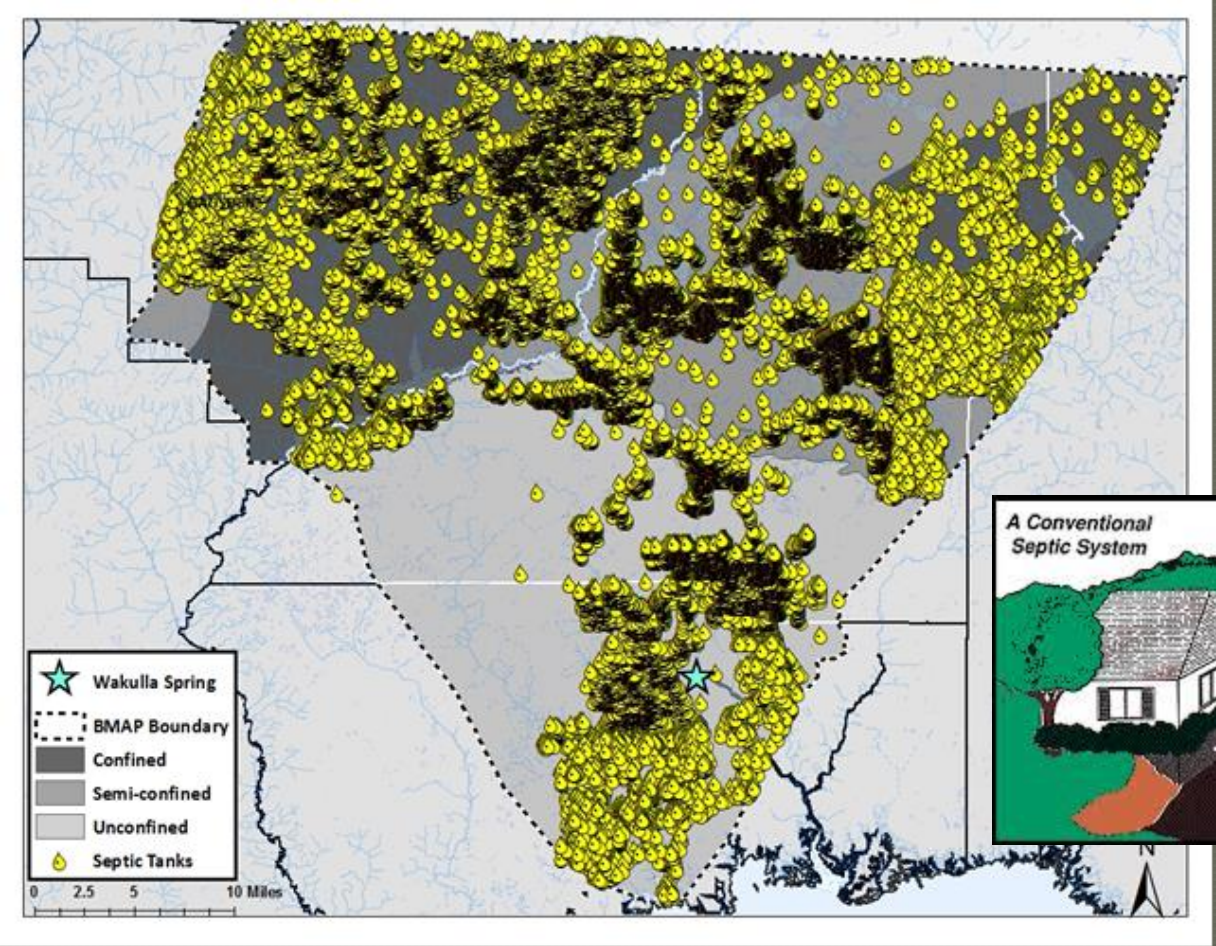
Phase II, Nitrogen Loading (2014)

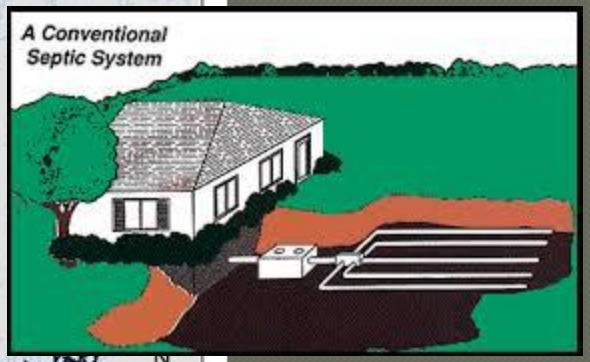


Septic Tanks

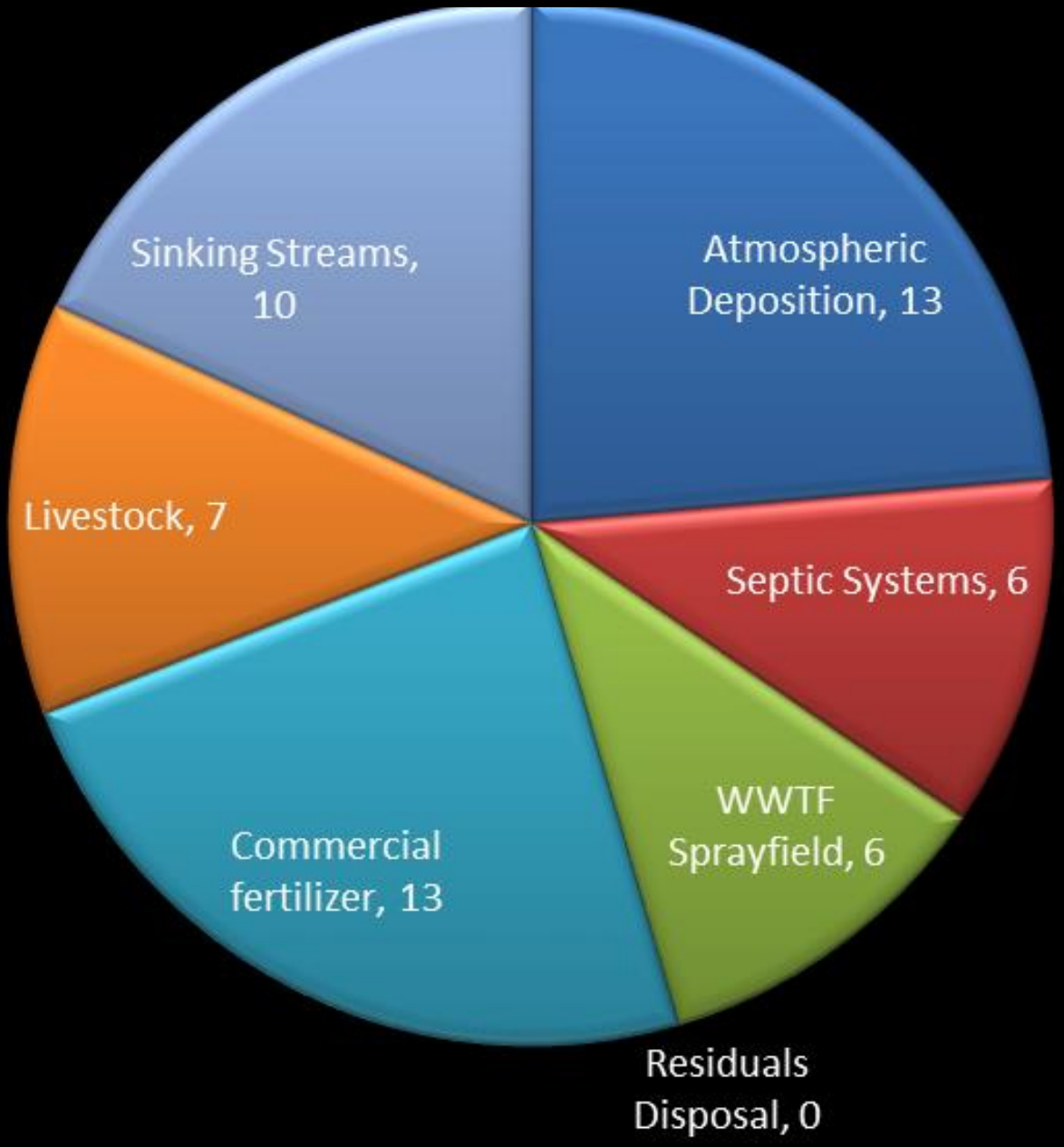
AWT very expensive, complex systems

- Estimate Cost $120,000,000



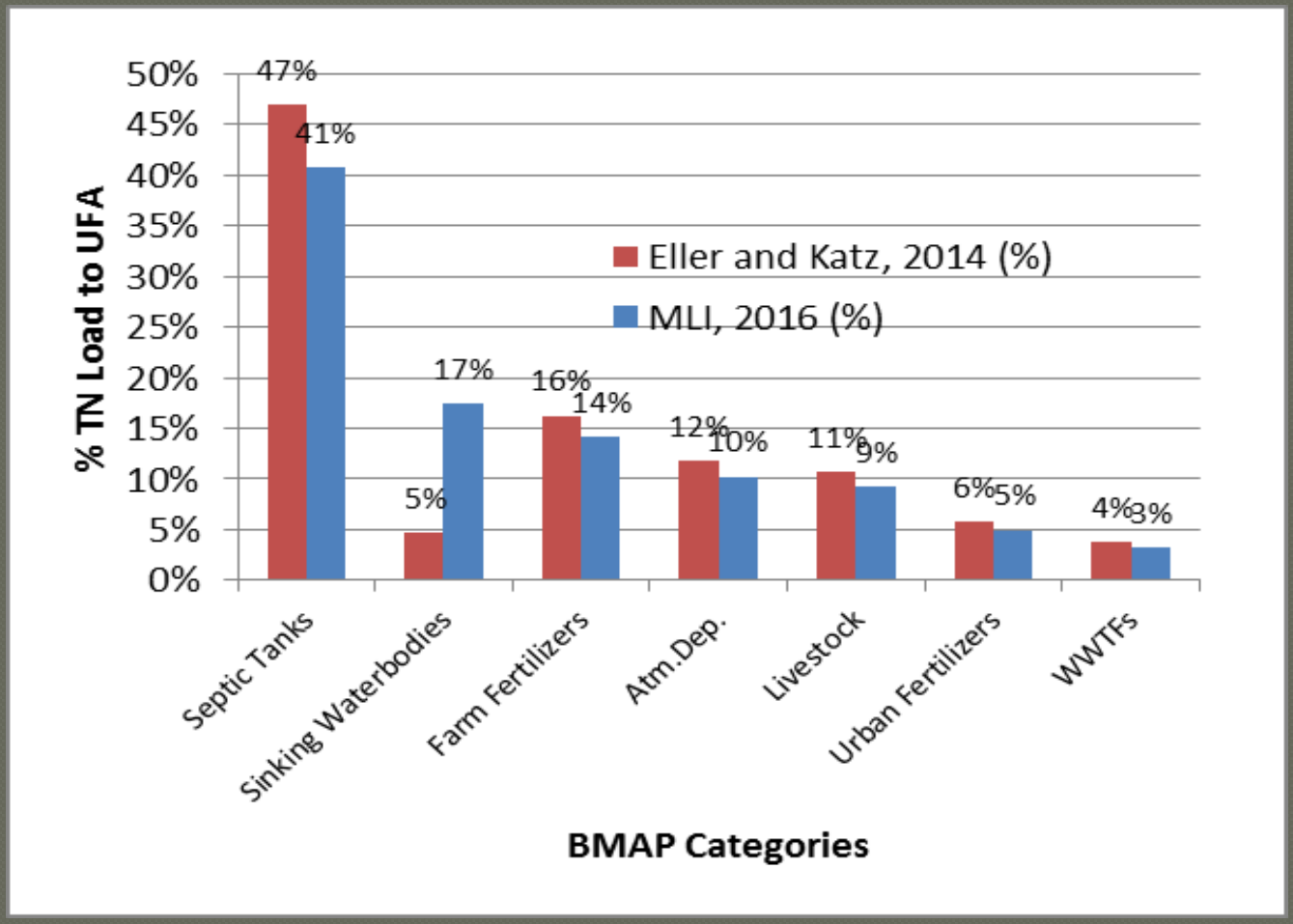


Phase III, Nitrogen Loading (20??)

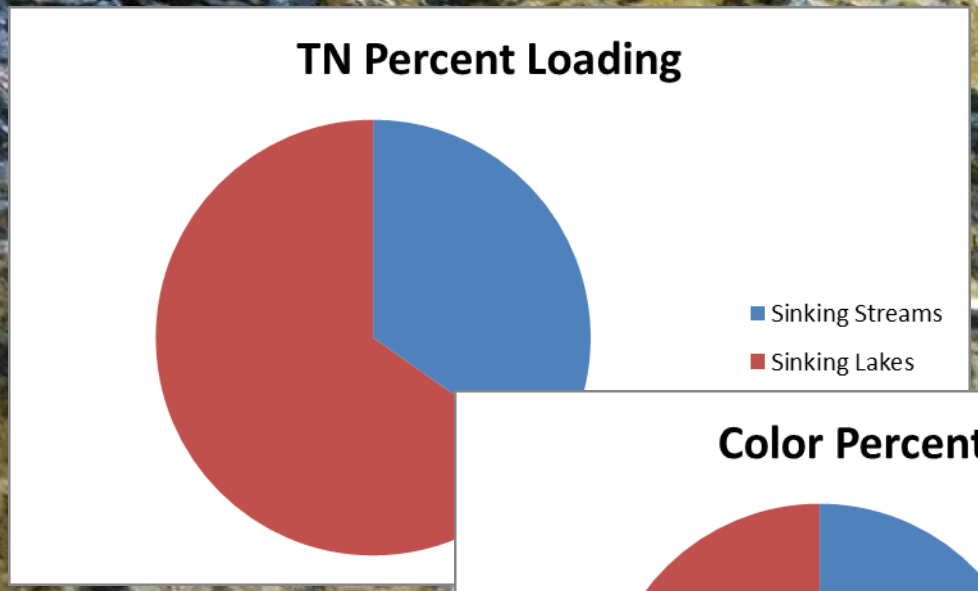


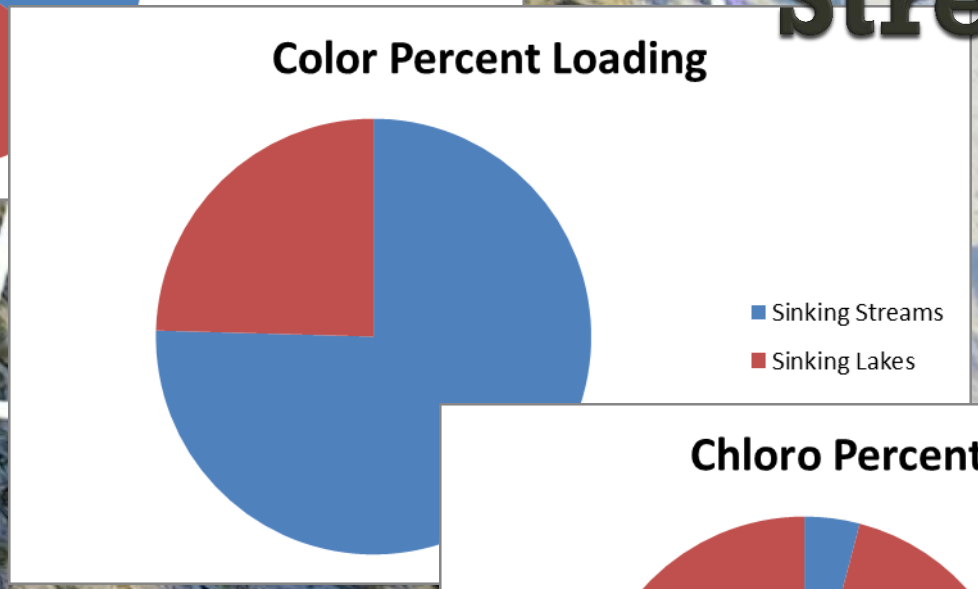
TN Loading the UFF

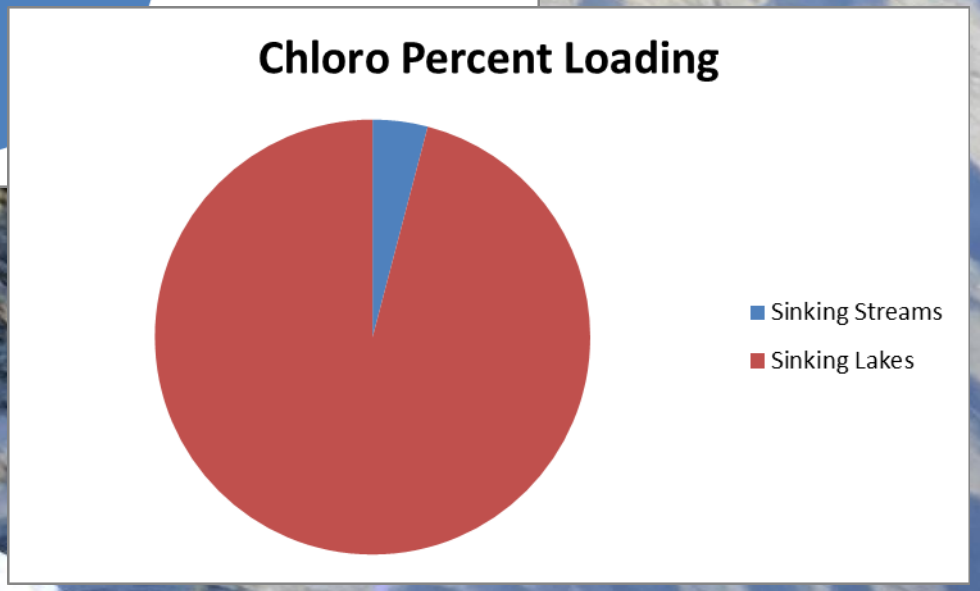
Comparison of relative estimated total nitrogen loadings to the Upper Floridan Aquifer within the Wakulla Spring and River BMAP area after the application of attenuation and recharge factors by source category for the NSILT study (Eller and Katz, (2014) and this study (MLI, 2016).



Sinking Lakes and Streams



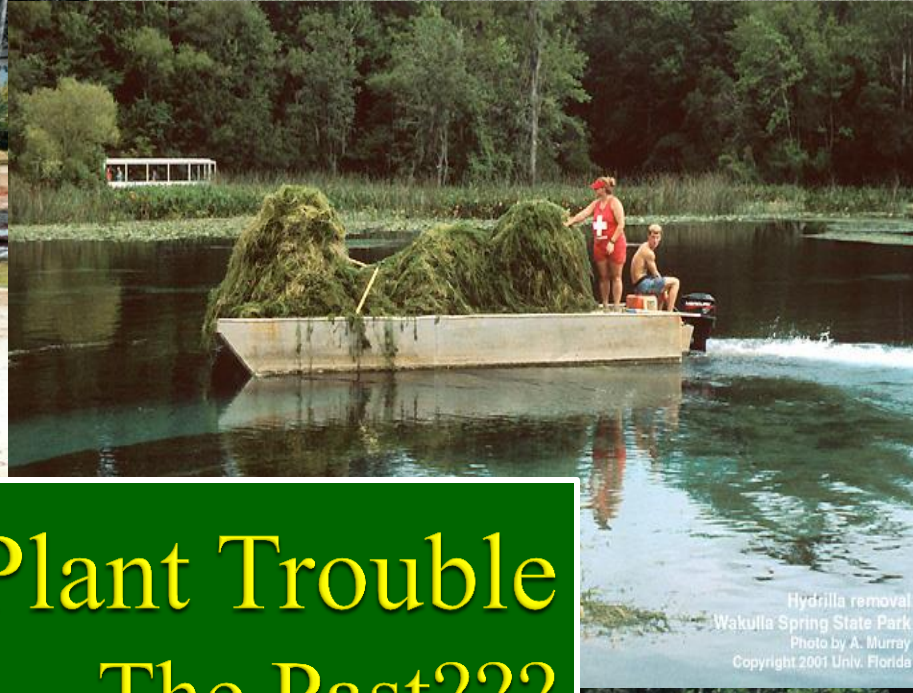





Aquatic Plant Succession
Aquatic Grasses
Aquatic Herbs
Phytoplankton
Rosette
Vittate
Non-Rooted
Low Nutrients
High Nutrients
Oligotrophic
Mesotrophic
Eutrophic
Distrophic

Eliminate Chemical Fertilizers from the Watershed


Crowded Springs



Aquatic Plant Trouble

The Past???

Darker water, lower nitrogen or MANATEES?


1960, Wakulla Spring, Healthy and Pristine
2013, Wakulla Spring, A Biological Desert


Lots of Algae


Alum Trap

- **Construction Cost:**
  - $5.6 Million Dollars
- **Operations Costs:**
  - $60,000 per year

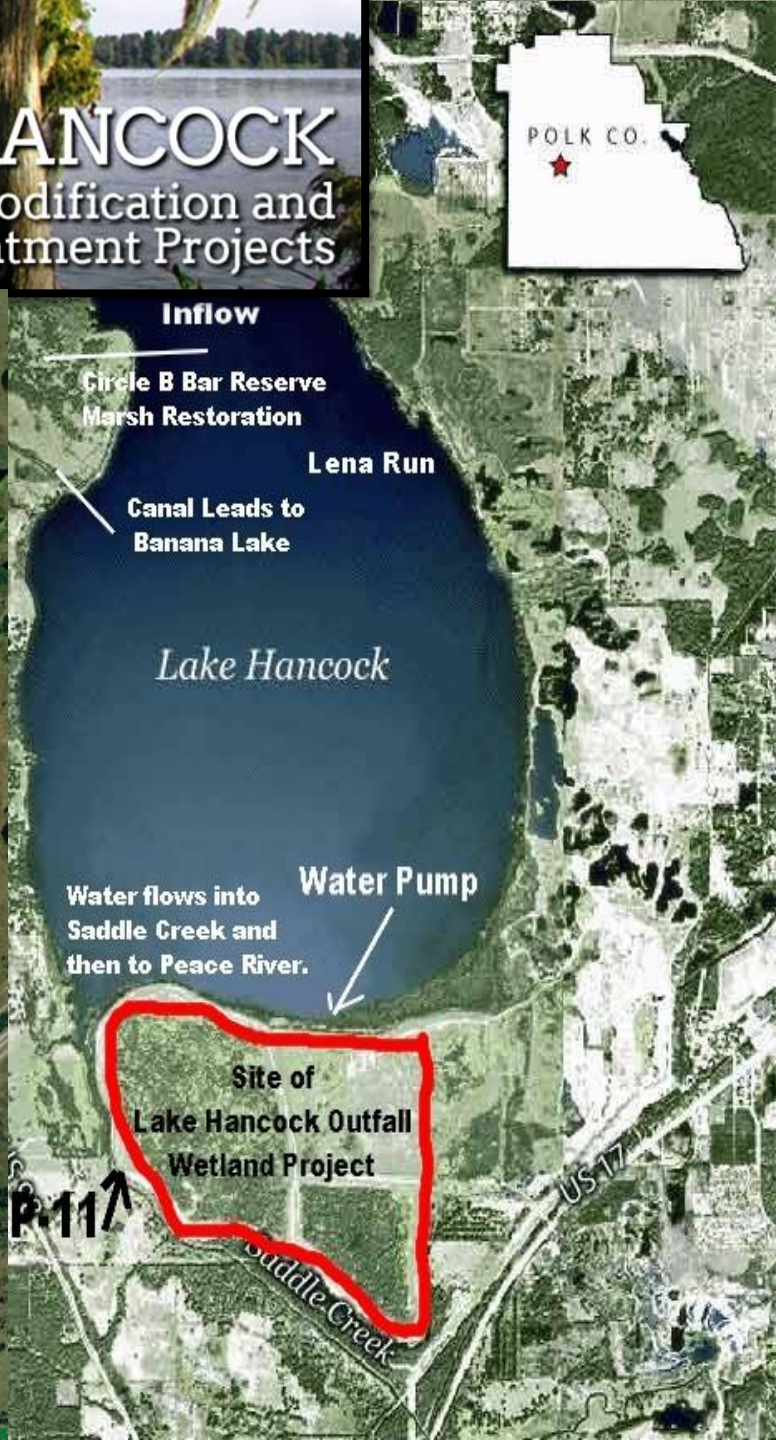
Video: Carl Buchheister, On Limpkins at Wakulla Spring

Too big to email, not available at this time

s

LAKE HANCOCK

Lake Level Modification and Outfall Treatment Projects

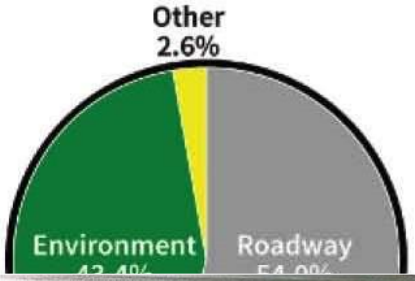


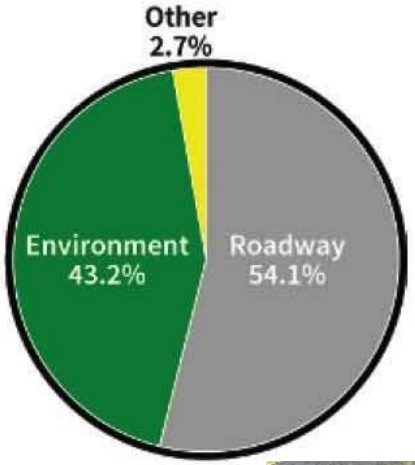
Blueprint Intergovernmental Agency

Sales Tax Revenues from 2020 to 2040 expected to top $756,000,000

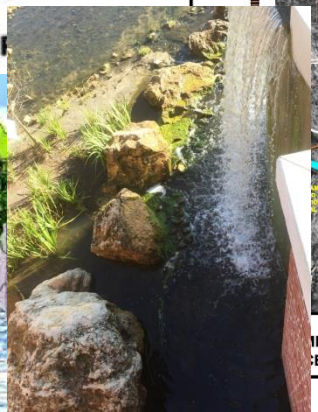
*$37,800,000 per year for 20 years

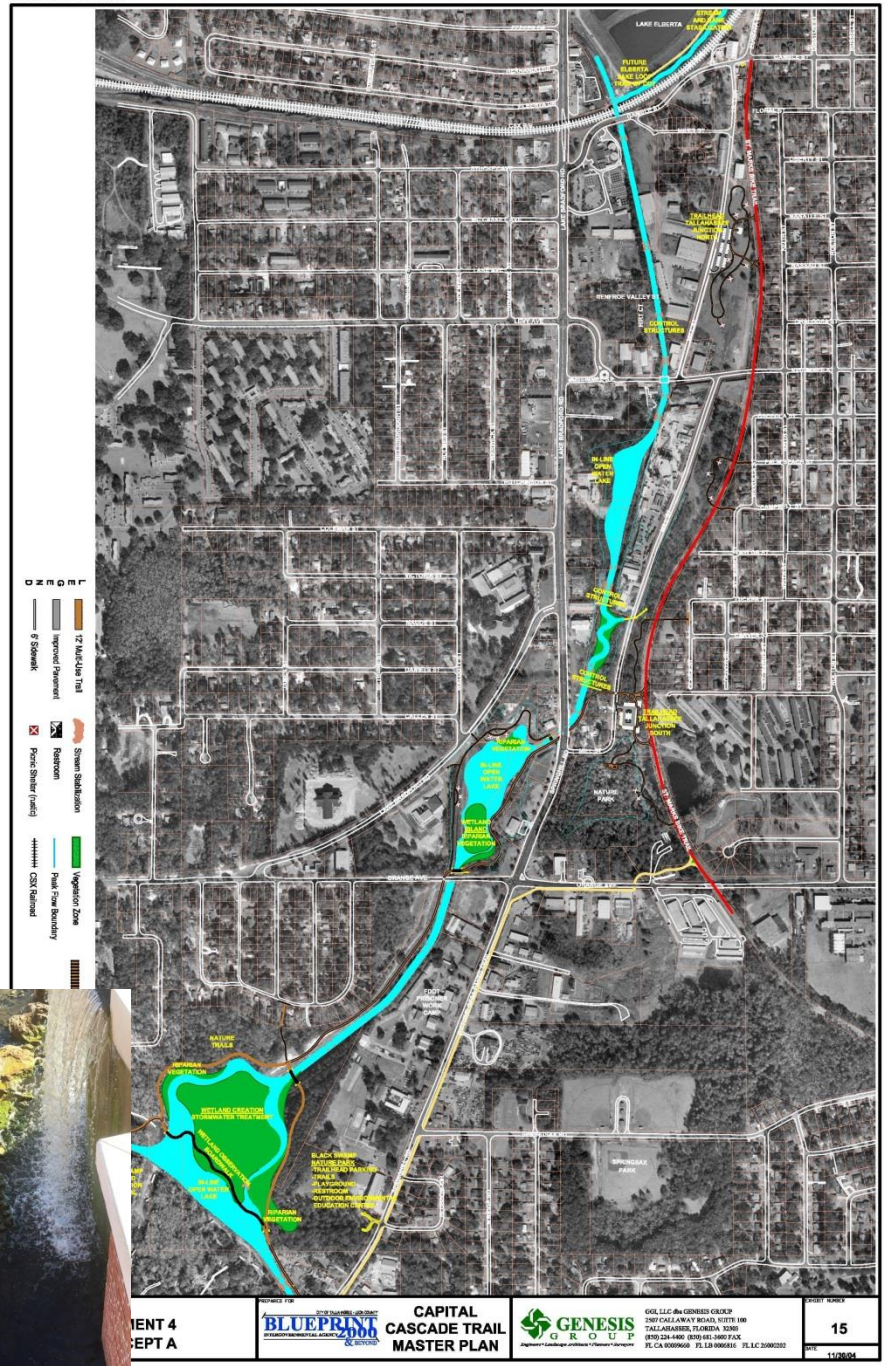
Environment





2010 Master





ENT 4
CEPT A

BLUEPRINT 2000 & BEYOND

CAPITAL CASCADE TRAIL MASTER PLAN

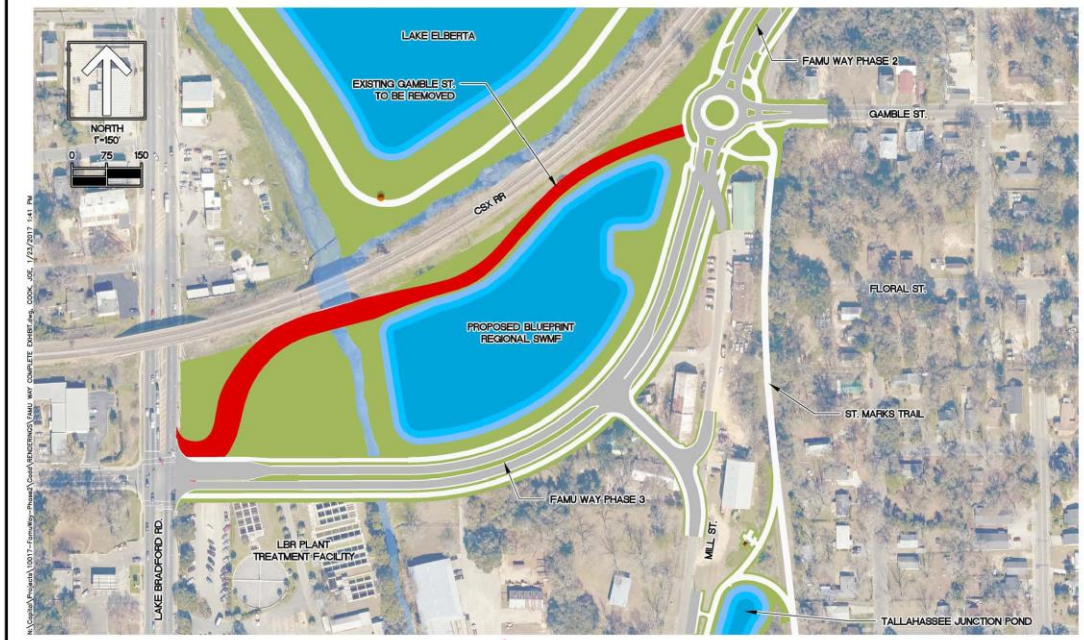
GENESIS GROUP

GGI, LLC dba GENESIS GROUP
2507 CALLAWAY ROAD, SUITE 100
TALLAHASSEE, FLORIDA 32303
(850) 224-1400 (850) 681-3660 FAX
FL CA 00009660 FL LB 00006816 FL LC 26000202

SHEET NUMBER
15

DATE
11/20/04

CITY OF TALLAHASSEE
UNDERGROUND UTILITIES AND PUBLIC INFRASTRUCTURE



CITY OF TALLAHASSEE
UNDERGROUND UTILITIES AND PUBLIC INFRASTRUCTURE

Aero Photo

727.520.8181
www.aerophoto.com

Capital Cascades Park

Image # 1404022076
Date 04.02.14


Cleaner Water
for Tomorrow

Video: Don Gavin, The Voice of Wakulla Springs

Too big to email, not available at this time


UNLESS someone like you
cares a whole awful lot,
nothing is going to get better.
It's not.
—The Lorax

Nitrogen Contributions of Karst Seepage into the Upper Floridan Aquifer from Sinking Streams and Sinking Lakes in the Wakulla Springshed

Final, October 20, 2016

Wakulla Spring Dark Water: Causes and Sources Phase I

Draft, February 21, 2017

Both by

Seán E. McGlynn, Principal Investigator
And Robert E. Deyle, Project Manager

This project was developed for the Wakulla Springs Alliance by McGlynn Laboratories, Inc. with financial assistance provided by the Fish and Wildlife Foundation of Florida, Inc. through the Protect Florida Springs Tag Grant Program, project PFS #1516-02