

Crystal River/Kings Bay State of the Bay

Kings Bay BMAP Kickoff Meeting
April 23, 2014

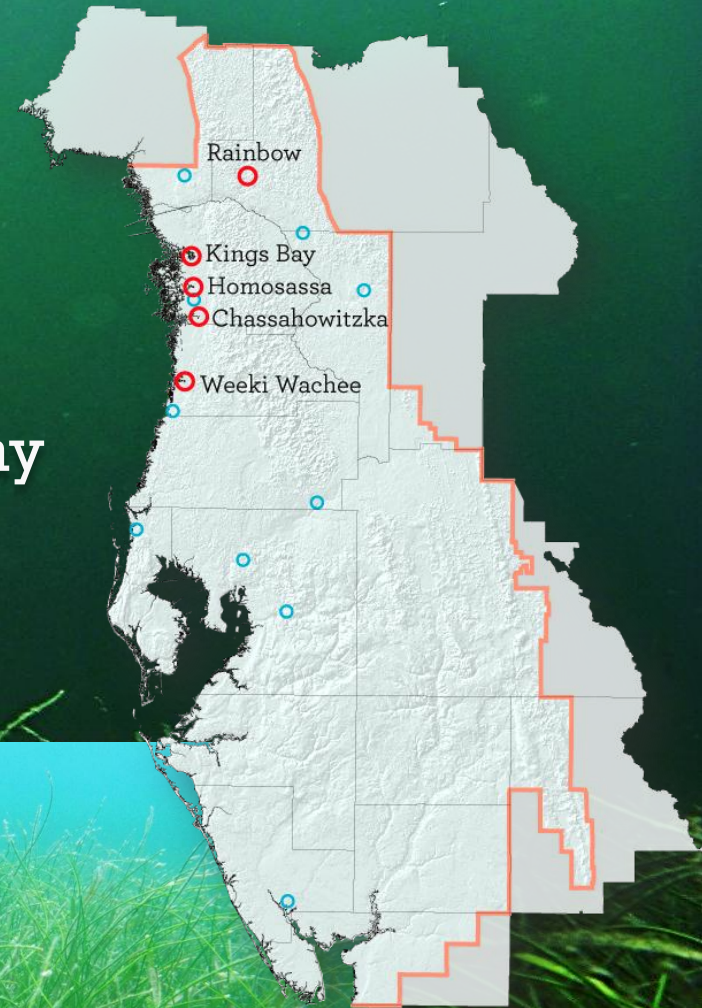
Dr. Chris J. Anastasiou, PhD

Natural Systems and Restoration
Southwest Florida Water Management District

Southwest Florida
Water Management District

District Springs and Spring Groups

- **Over 150 springs**
- **16 Spring Groups**
- **5 First-magnitude groups**
 - Approximately 1 billion gallons/day
 - Springs Coast — 2nd largest seagrass area in the nation



What Makes a Healthy Spring?

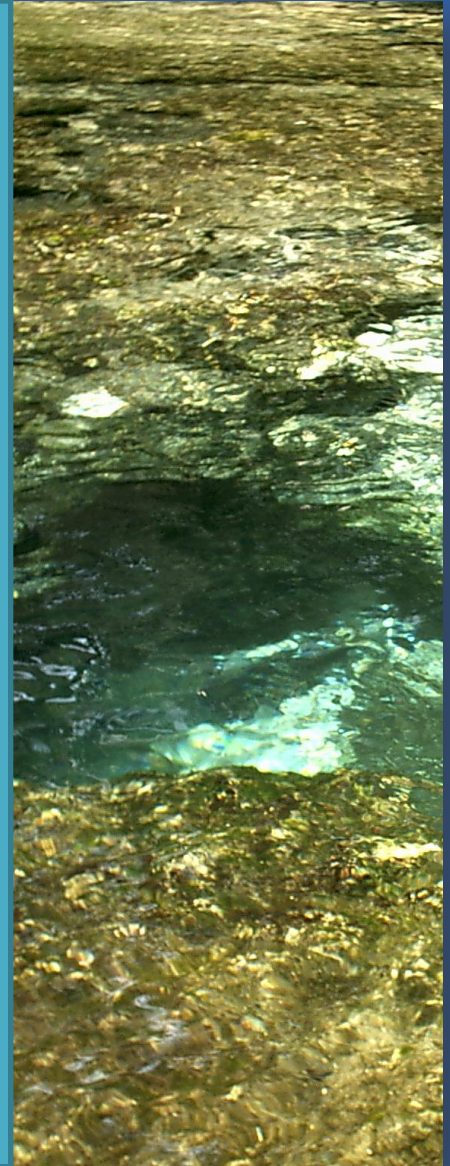
WATER QUALITY



FISH AND WILDLIFE HABITAT



FLOW AND DISCHARGE

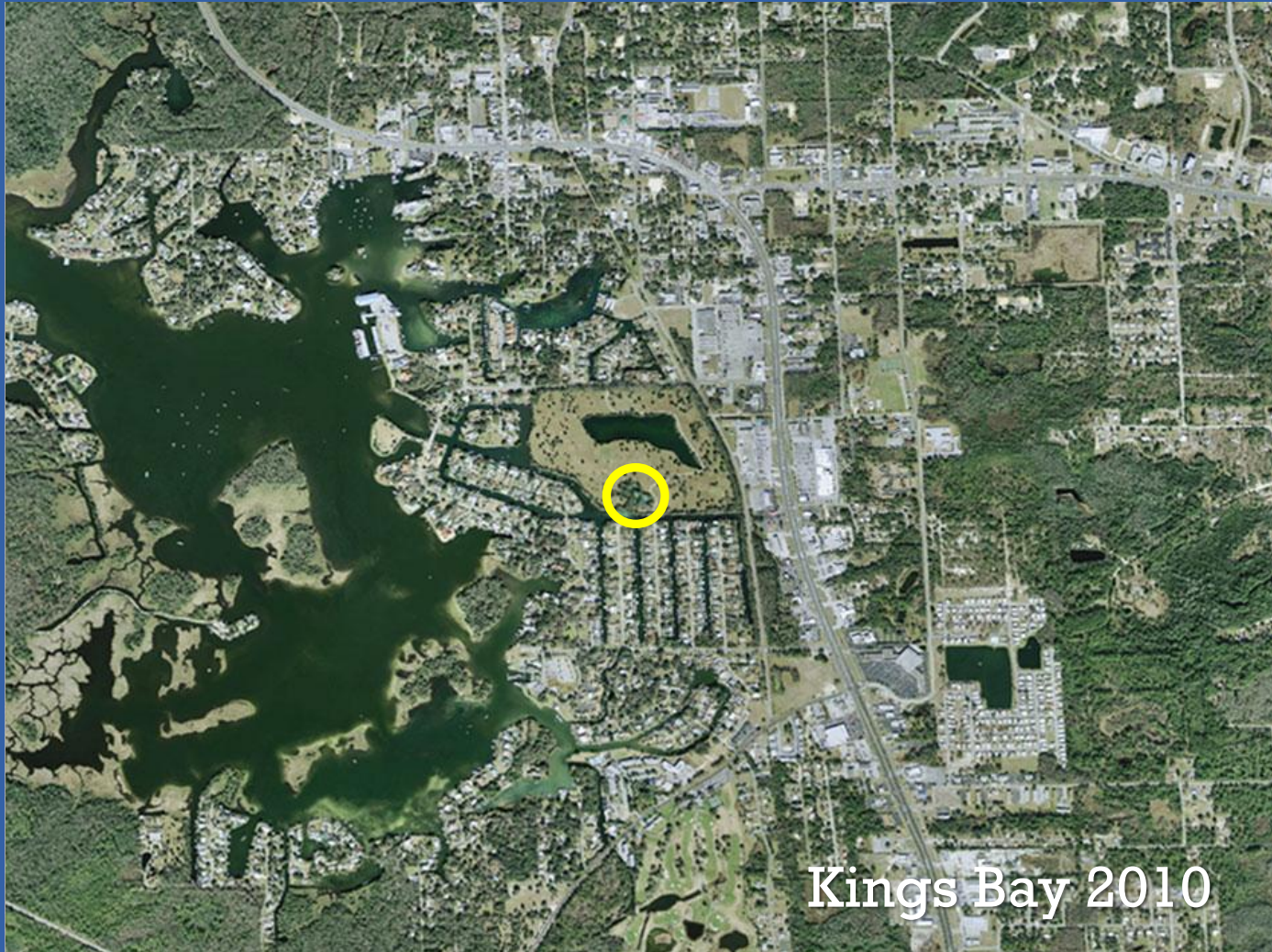


Habitat Loss



Kings Bay 1944

Habitat Loss

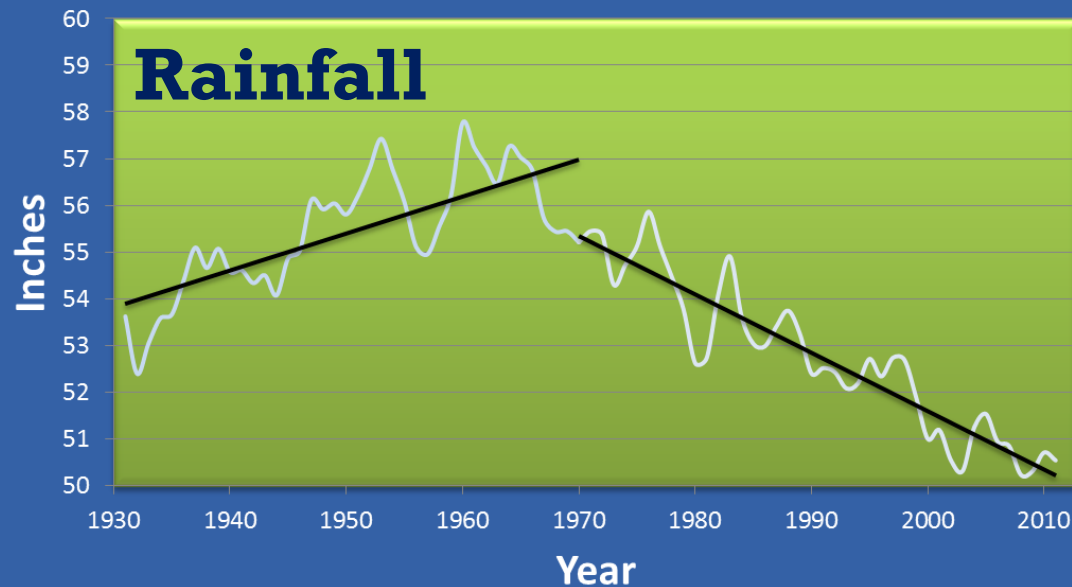
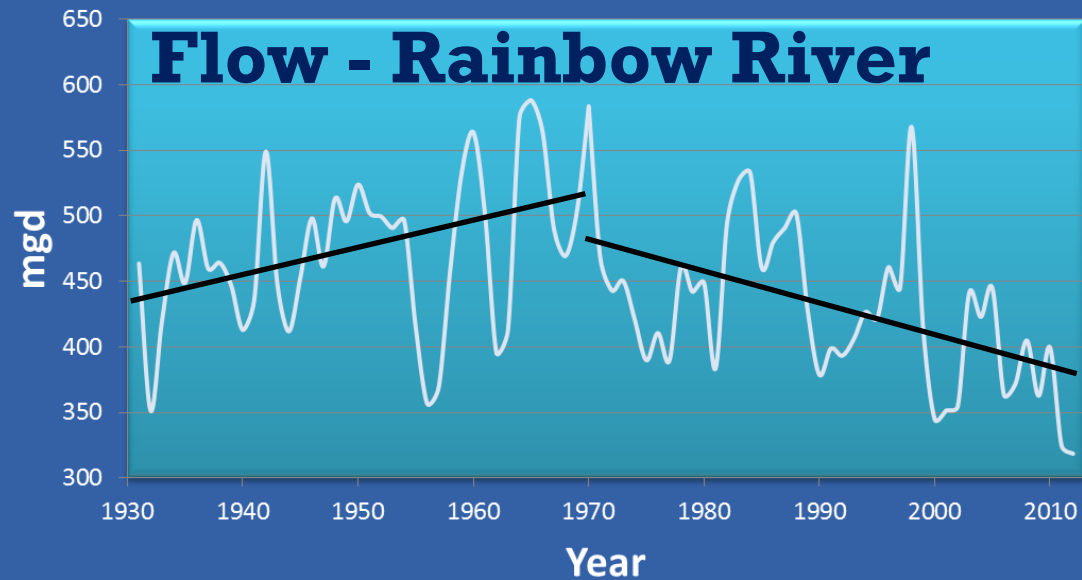


Kings Bay 2010

Recreation and Herbivory

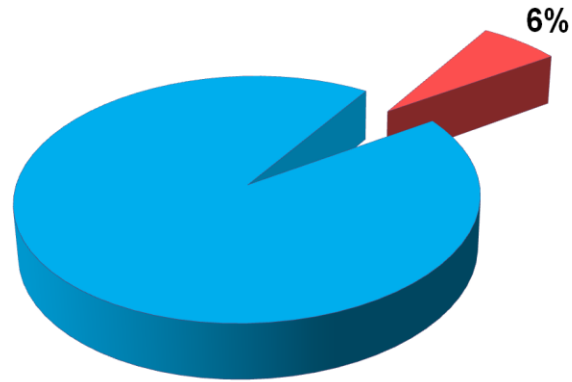


Flow Declines



SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

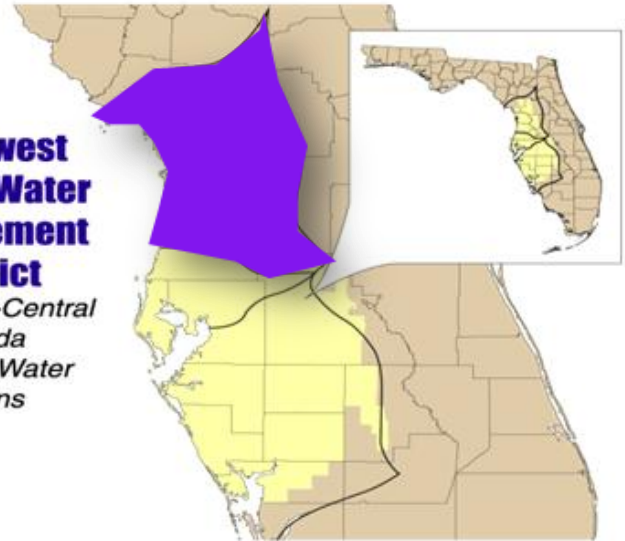
Northern Basin - Groundwater Use as a Percent of Recharge



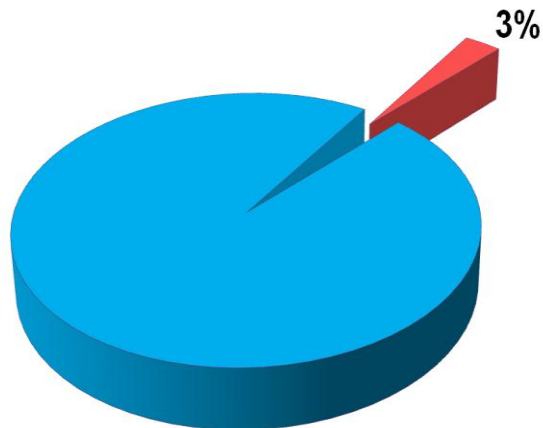
■ Pumping
■ Recharge

Southwest Florida Water Management District

with West-Central Florida Ground-Water Basins

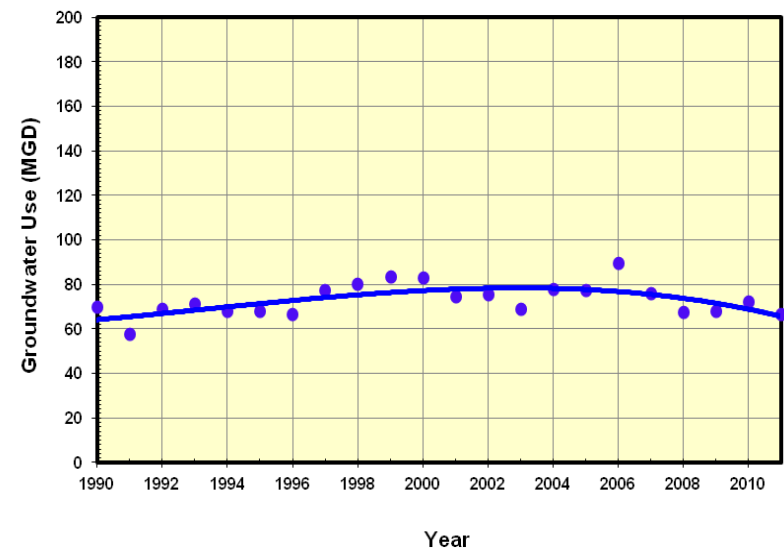


Northern Basin - Consumptive Use as a Percent of Recharge

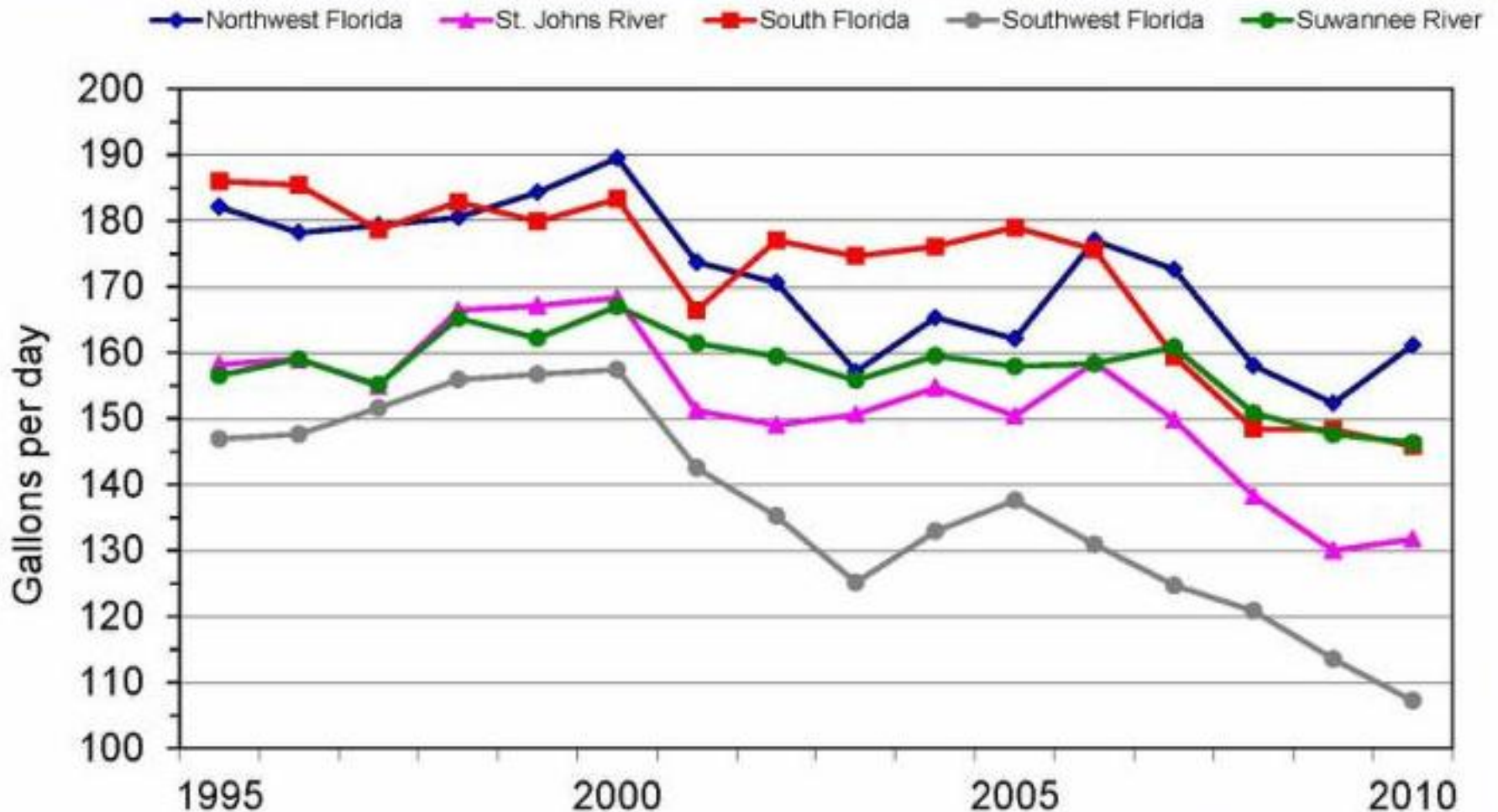


■ Pumping
■ Recharge

Citrus and Hernando County - Groundwater Use

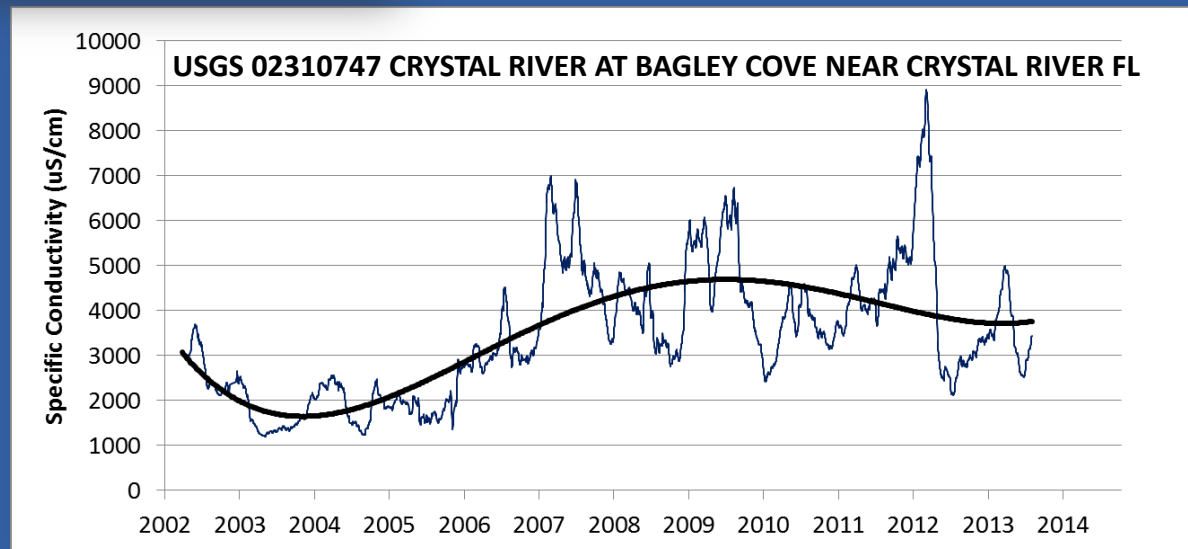
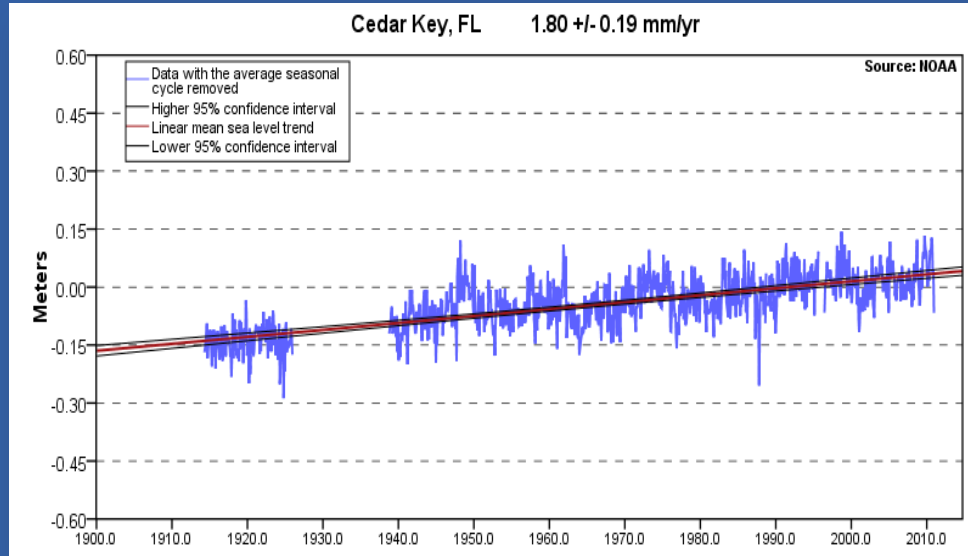


Gross Per Capita Water Use by WMD



Source: University of Florida

Sea-Level Rise



Invasive Aquatic Plants

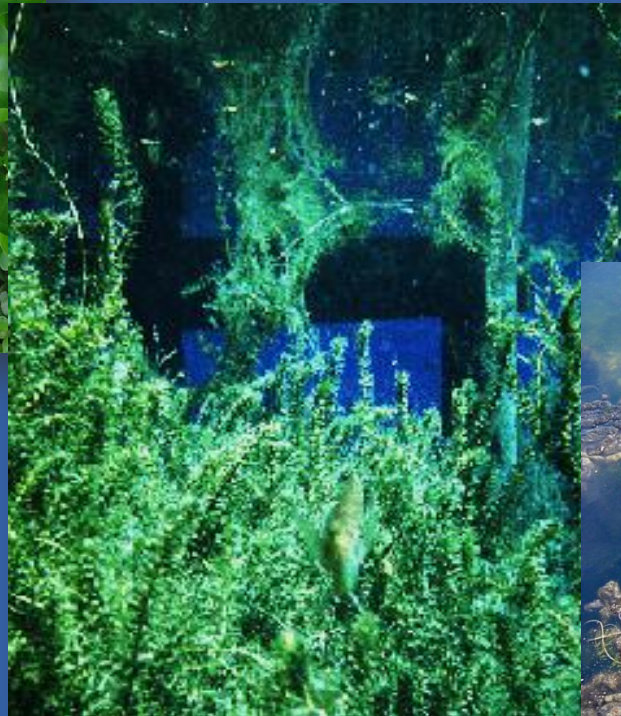
1940s-1950s

Hyacinth



1960s-1970s

Hydrilla - Milfoil



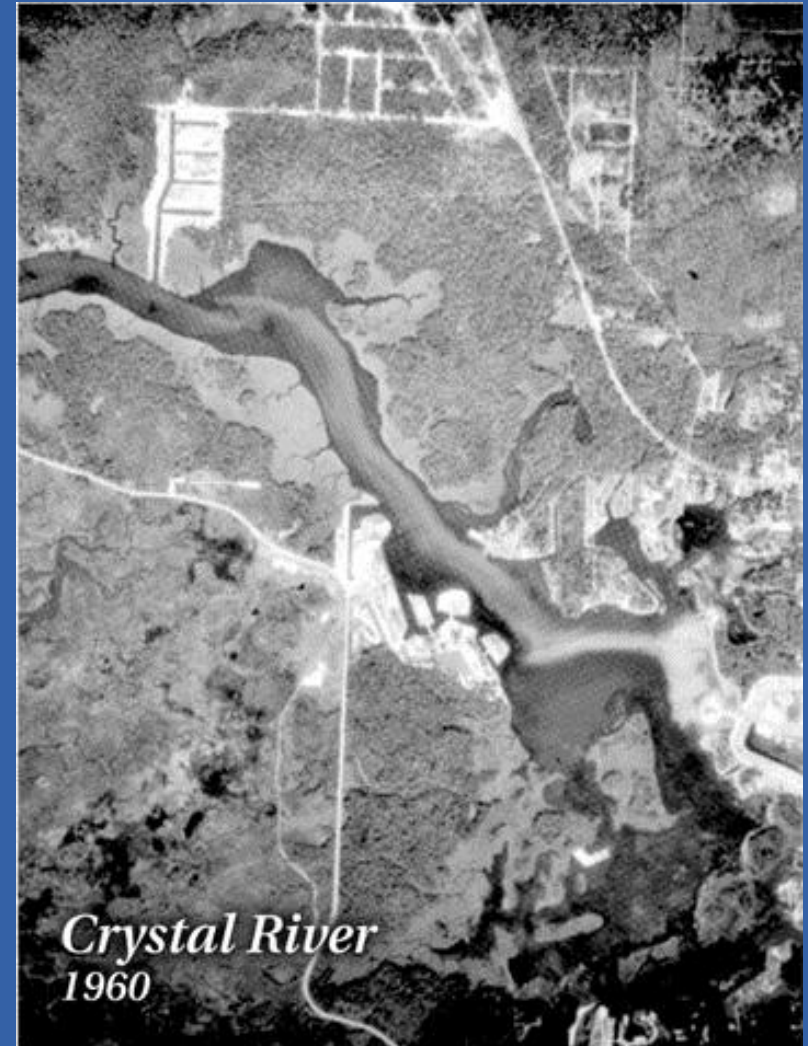
1980s-1990s

Filamentous Algae



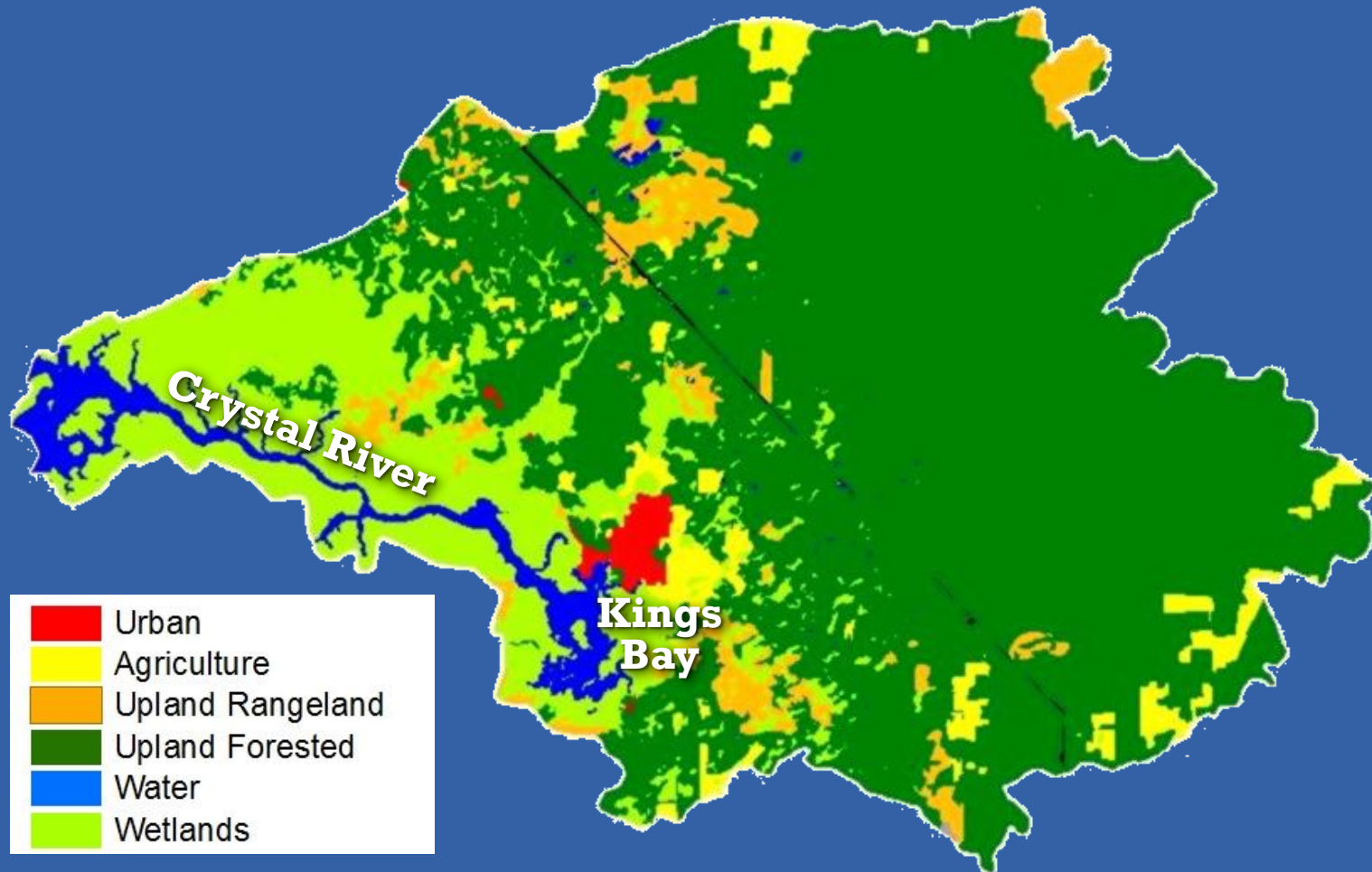
Sedimentation

- Legacy pollutants
 - Cedar Cove
 - Magnolia Cove
- Muck accumulation
- Flocculation
- Re-suspension



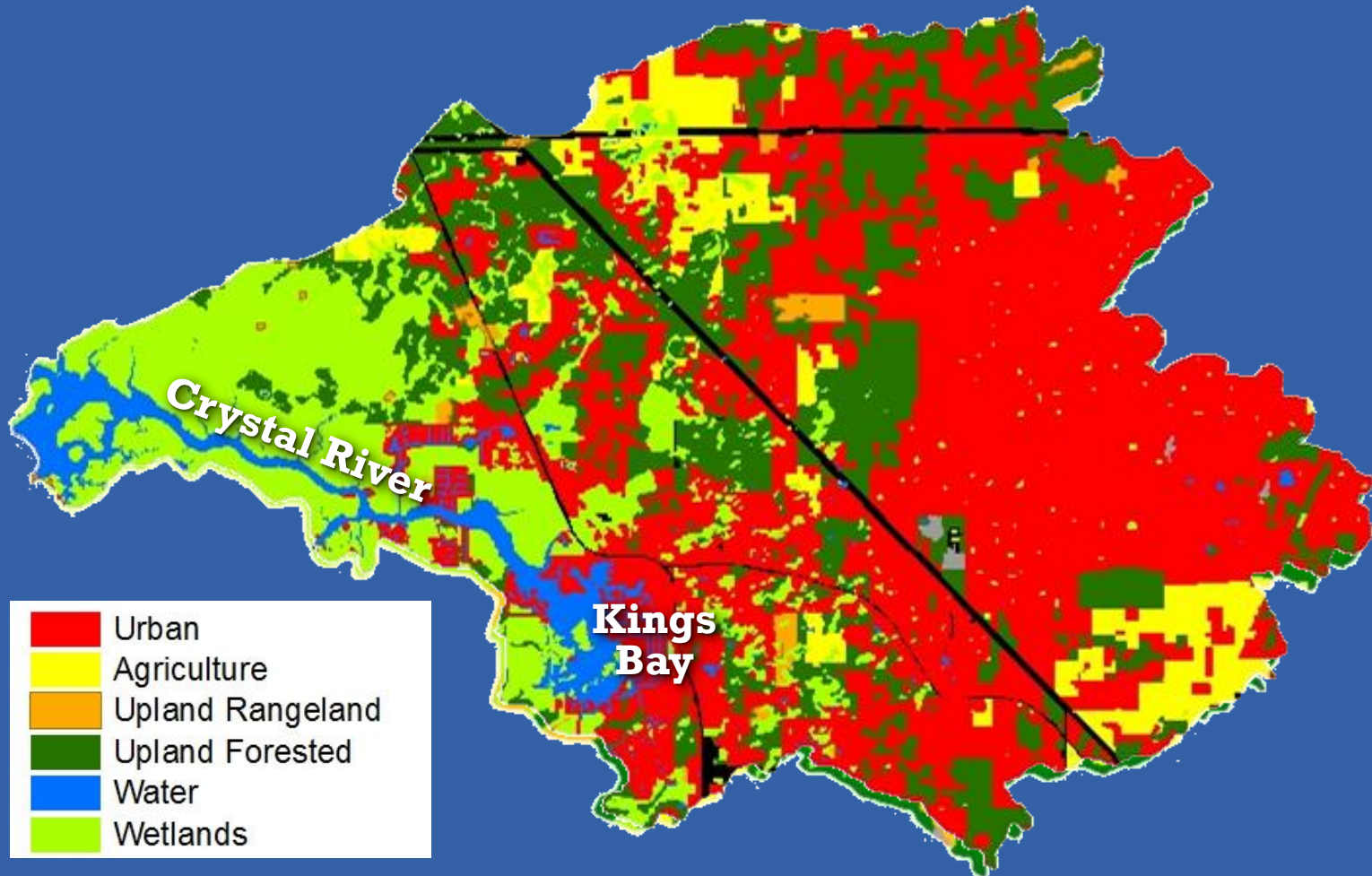
Land-use Change

1944 Crystal River Watershed Land-use



Land-use Change

2010 Crystal River Watershed Land-use

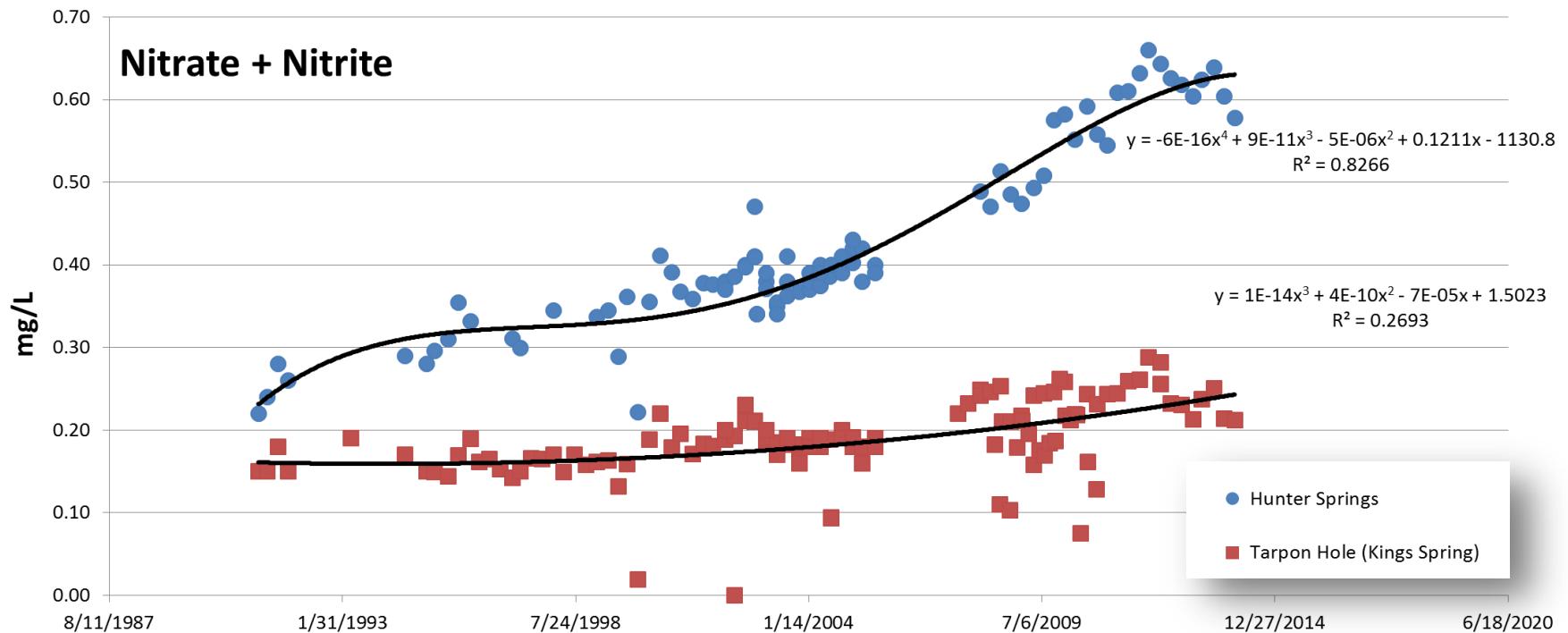


Nitrate Concentrations (mg/L)

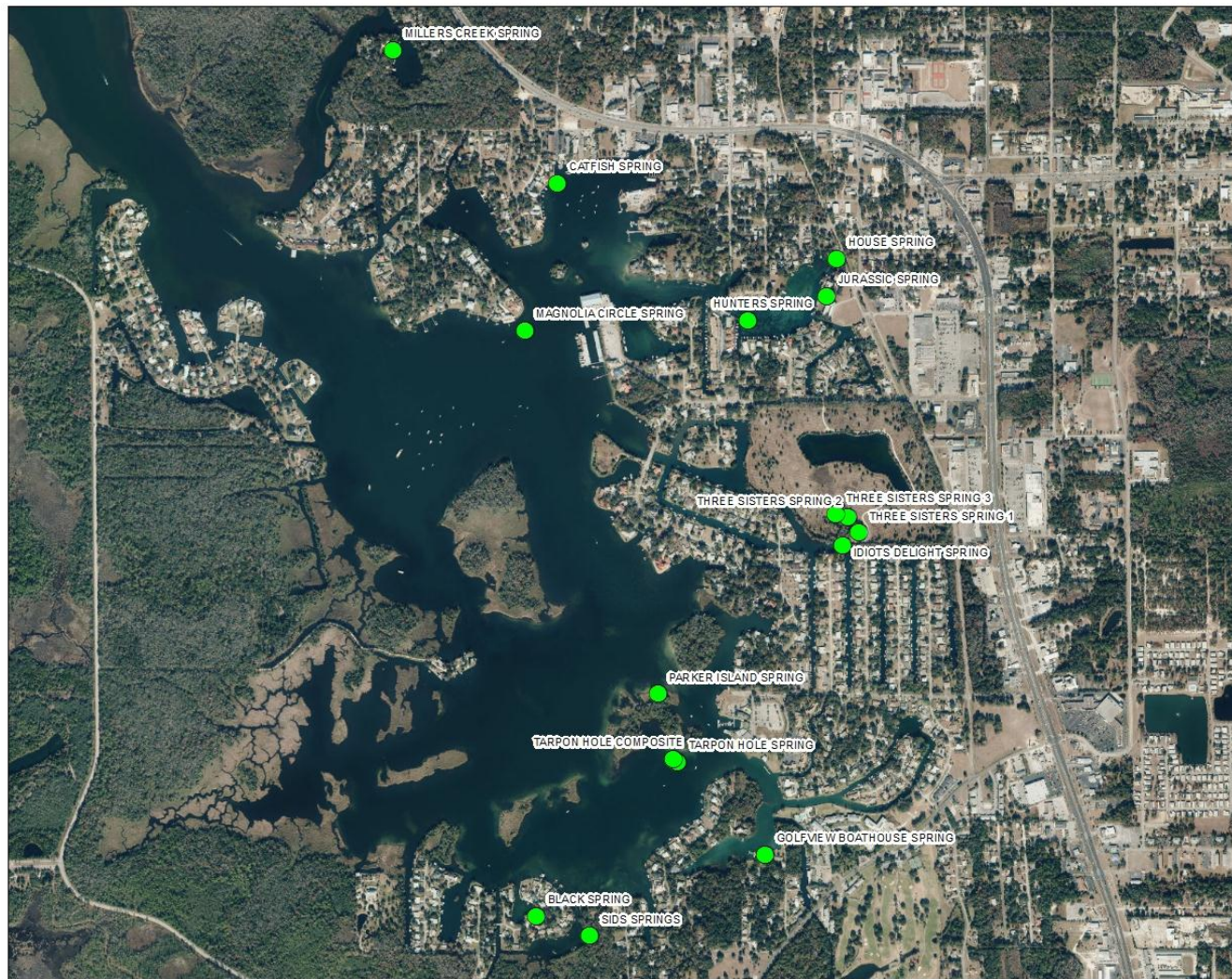


Spring Vent Water Quality

Nitrate + Nitrite (mg/L)



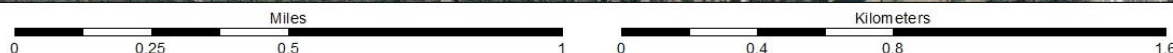
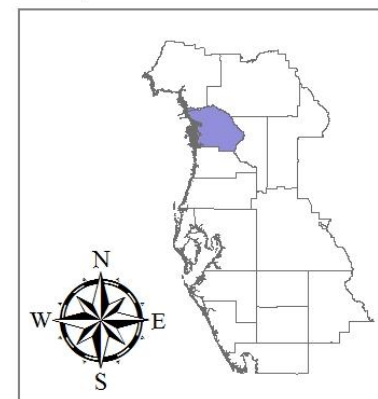
Current Springs Monitoring



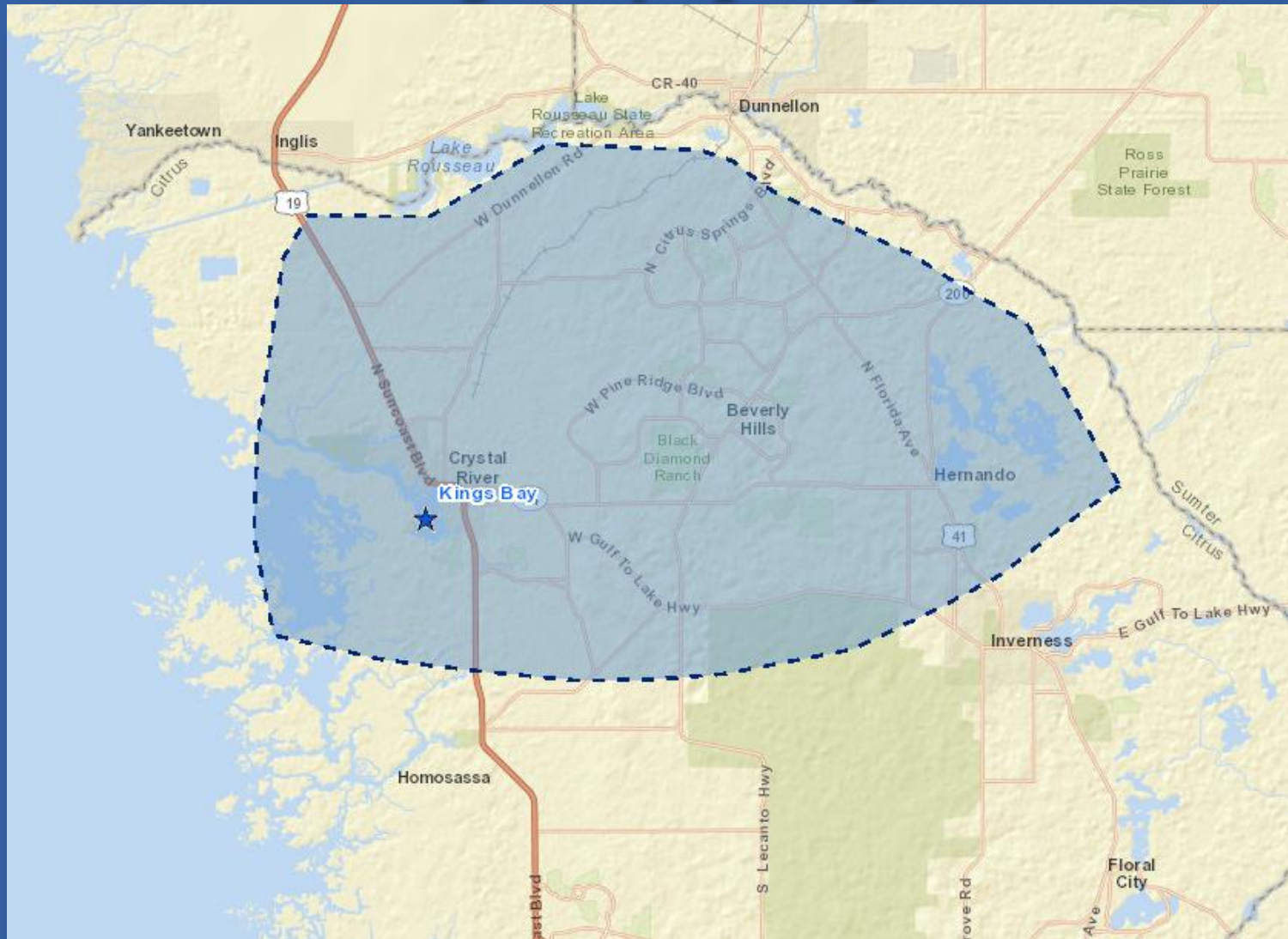
P889 KINGS BAY SPRINGS WATER QUALITY MONITORING STATIONS

Period of record (1991 - Present)
Frequency: Quarterly / Annually

Laboratory Parameters:	Field Parameters:
Alkalinity	Specific Conductivity
Ammonia	pH
Calcium	DO
TOC	Temperature
Chloride	
Color	
Fluoride	
Iron	
Magnesium	
Nitrate-Nitrite	
Total Nitrogen	
Orthophosphorus	
Total Phosphorus	
Potassium	
TDS	
Silica	
Sodium	
Strontium	
Sulfate	
Turbidity	



Kings Bay Springshed



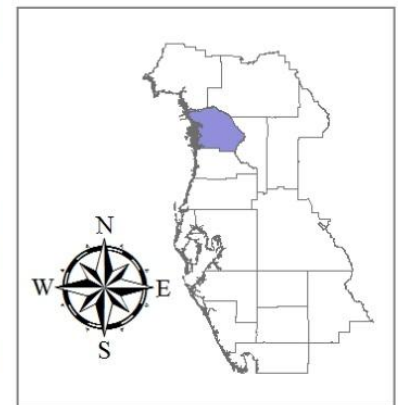
Current Surface Water Monitoring Stations



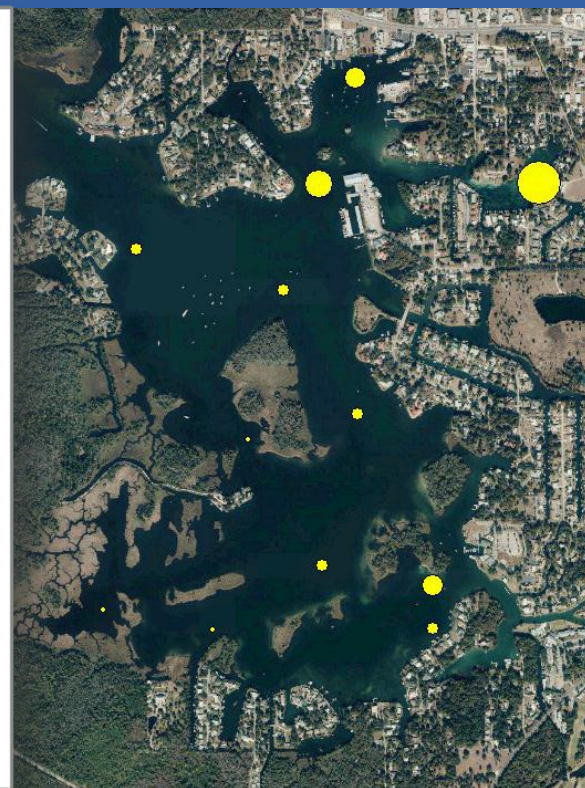
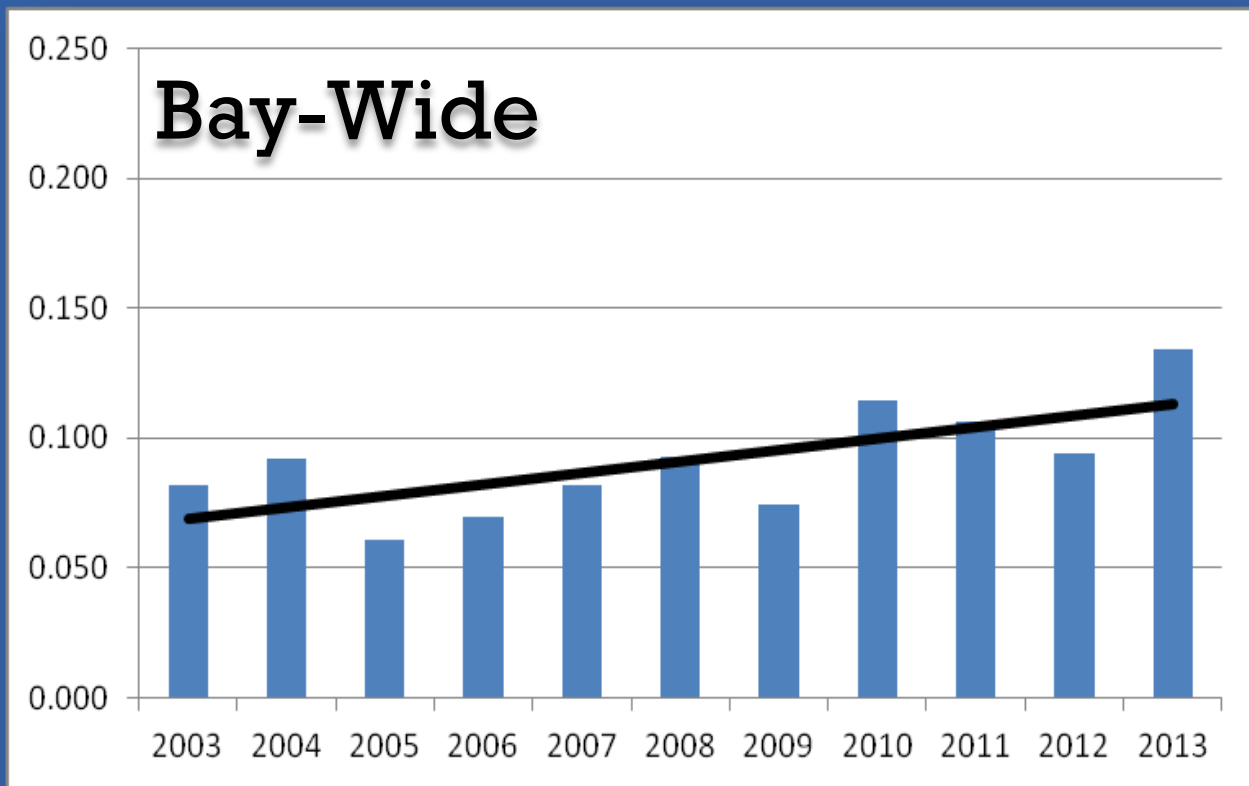
W454/P108 KINGS BAY WATER QUALITY MONITORING STATIONS

Period of record (2003 - Present)
Frequency: Quarterly

Laboratory Parameters:	Field Parameters:
Ammonia	Secchi (Vertical)
Calcium	Secchi (Horizontal)
TOC	Specific Conductivity
Chlorophyll a	pH
Chlorophyll b	DO
Chlorophyll c	Temperature
Pheophytin	Total Depth
Color	
Iron	
Magnesium	
Nitrate+Nitrite	
Total Nitrogen	
Orthophosphorus	
Total Phosphorus	
Potassium	
TSS	
VSS	
Sodium	
Turbidity	

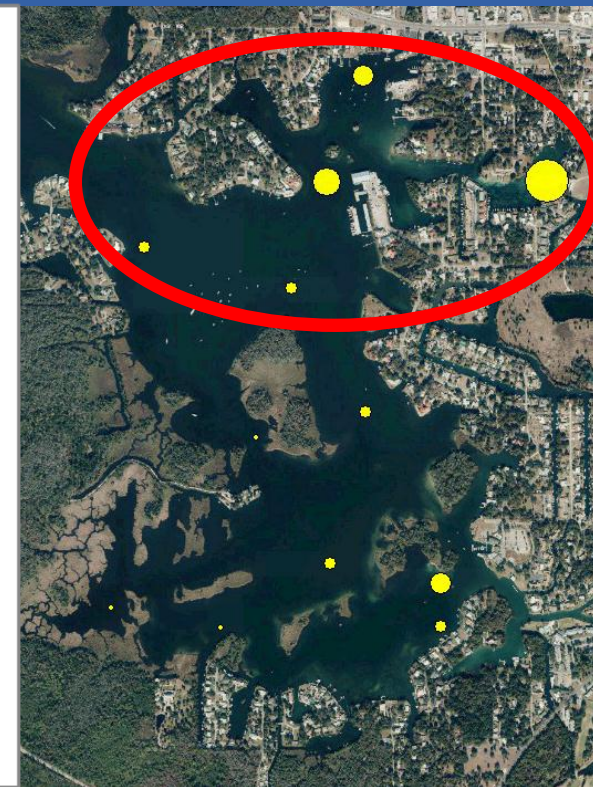
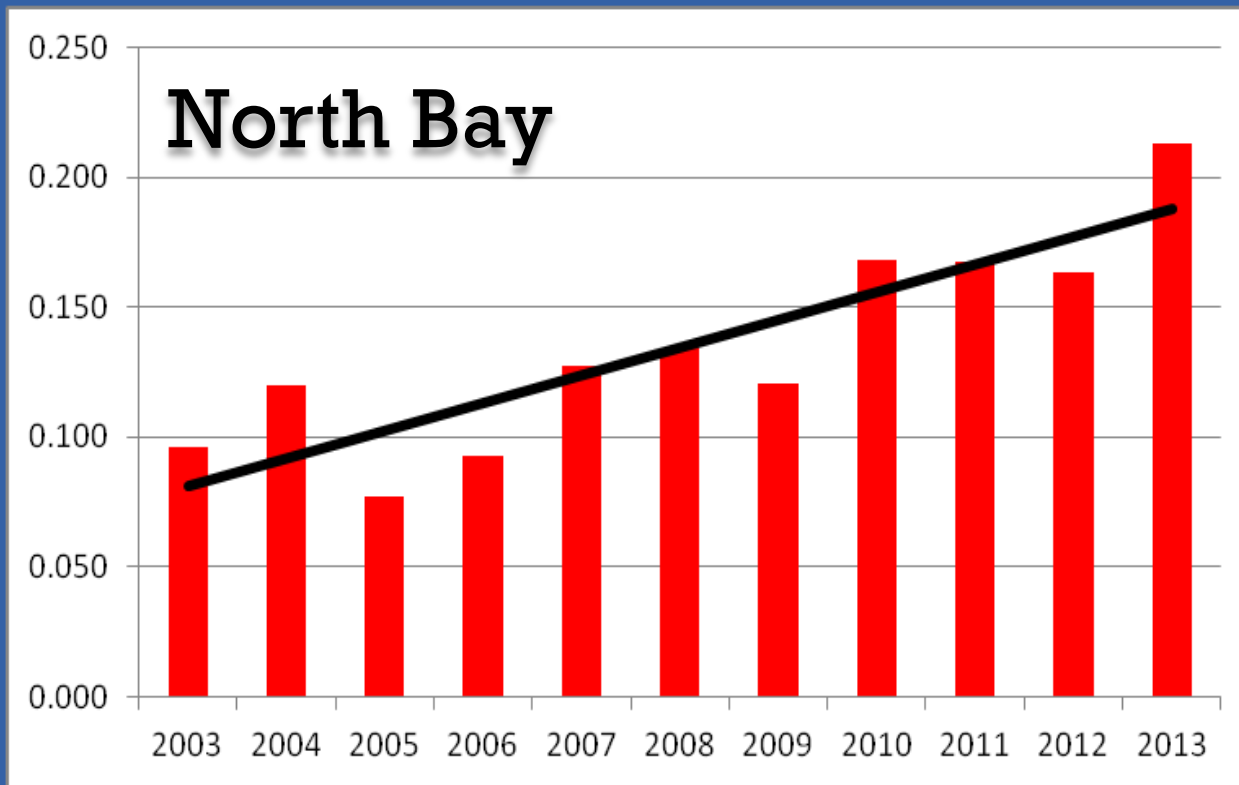


Nitrate + Nitrite (mg/L)



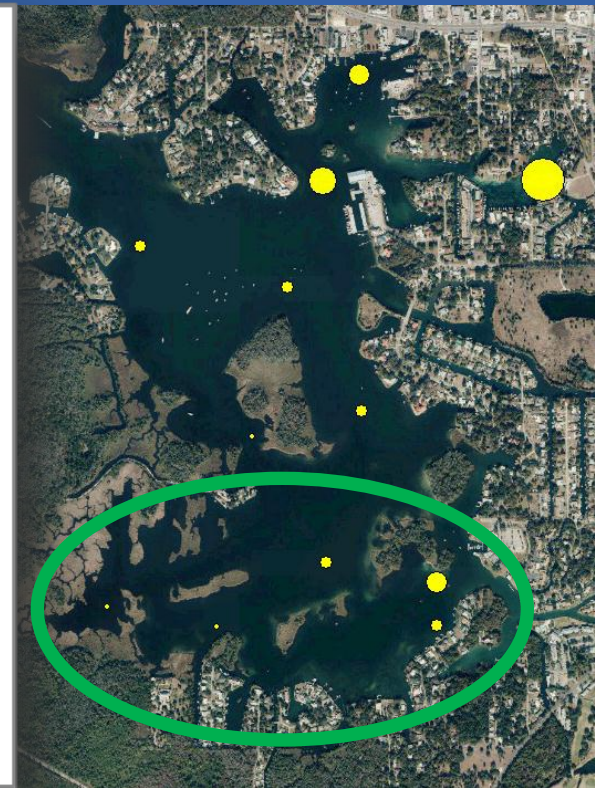
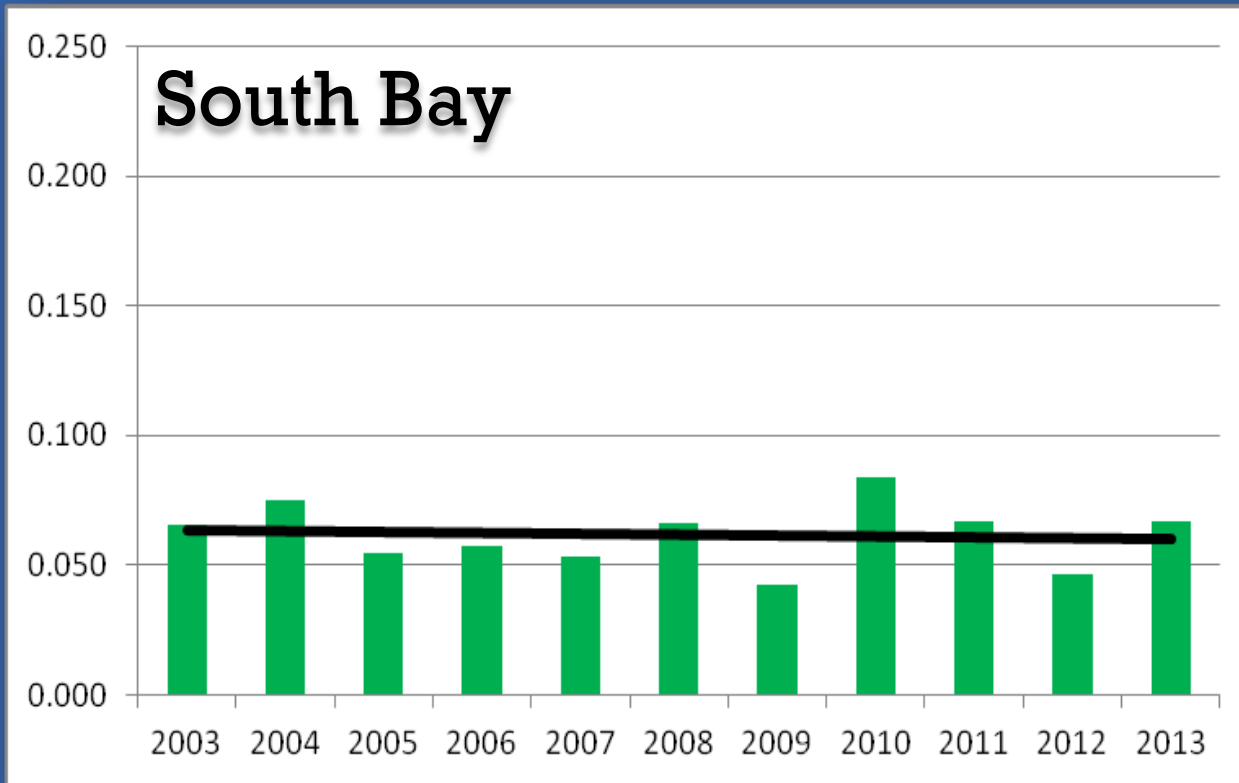
	Bay-wide		
2013	0.134		
2003-2013	0.090		

Nitrate + Nitrite (mg/L)



	Bay-wide	North Bay	
2013	0.134	0.213	
2003-2013	0.090	0.133	

Nitrate + Nitrite (mg/L)

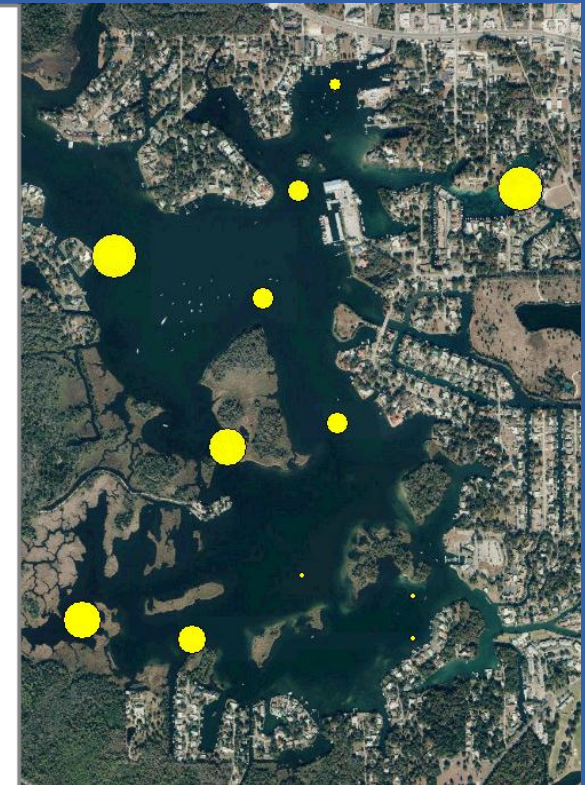
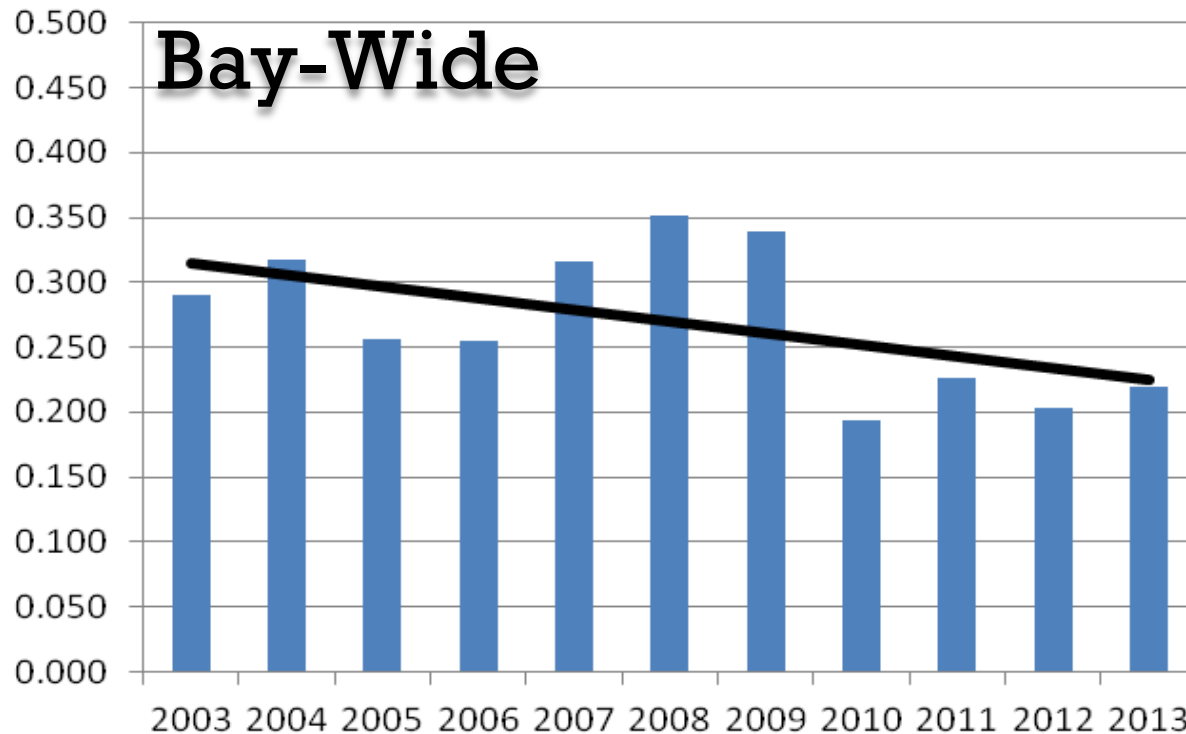


	Bay-wide	North Bay	South Bay
2013	0.134	0.213	0.067
2003-2013	0.090	0.133	0.061

Total Nitrogen (mg/L)

$$TN = NO_3 + NO_2 + NH_3 + ORG\ N$$

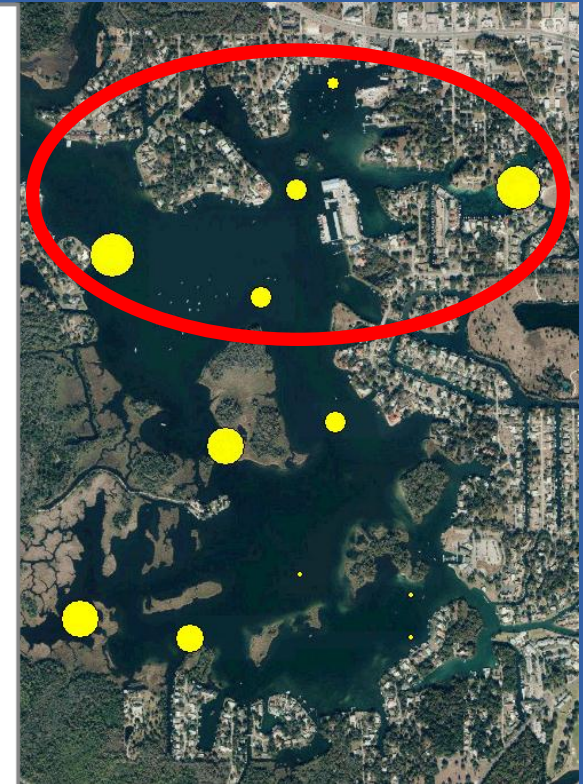
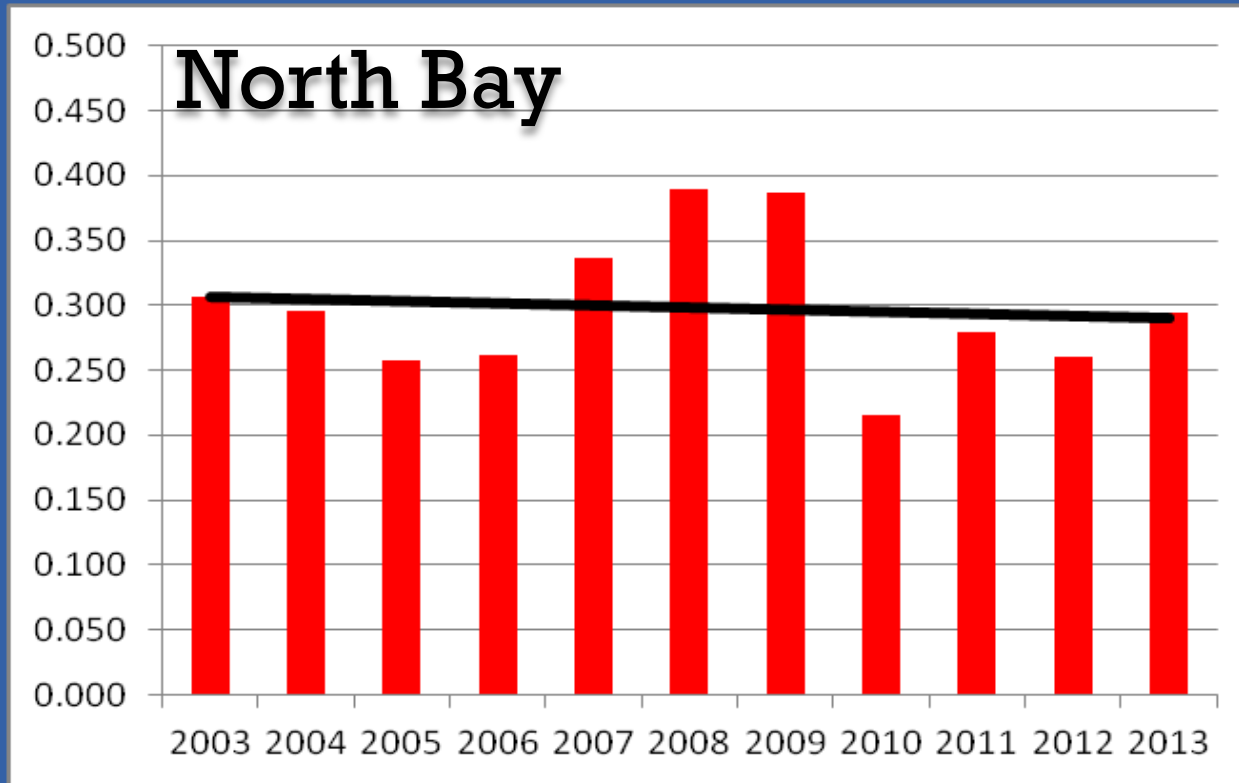
Bay-Wide



	Bay-wide		
2013	0.220		
2003-2013	0.277		

Total Nitrogen (mg/L)

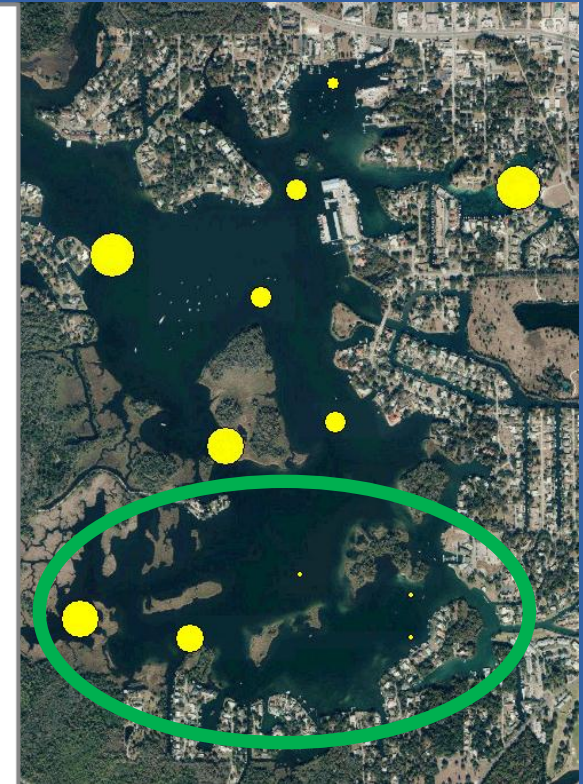
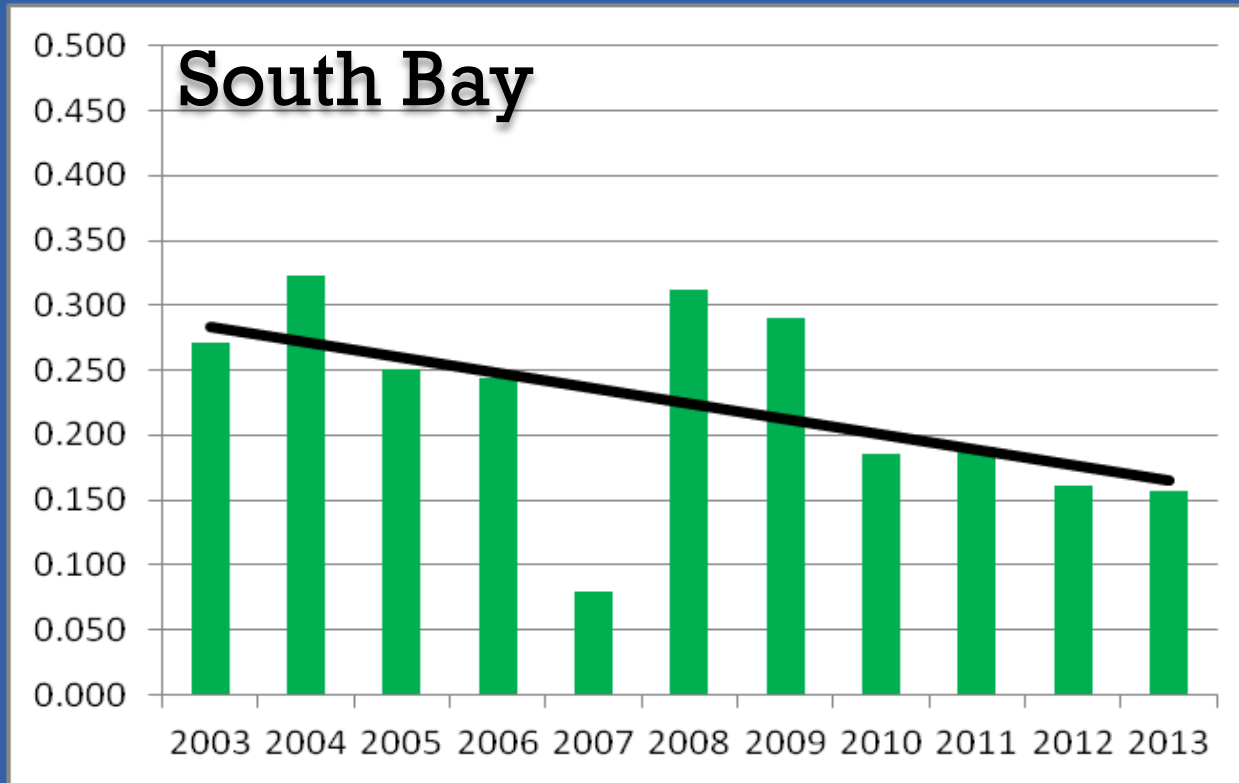
$$TN = NO_3 + NO_2 + NH_3 + \text{ORG N}$$



	Bay-wide	North Bay	
2013	0.220	0.294	
2003-2013	0.277	0.304	

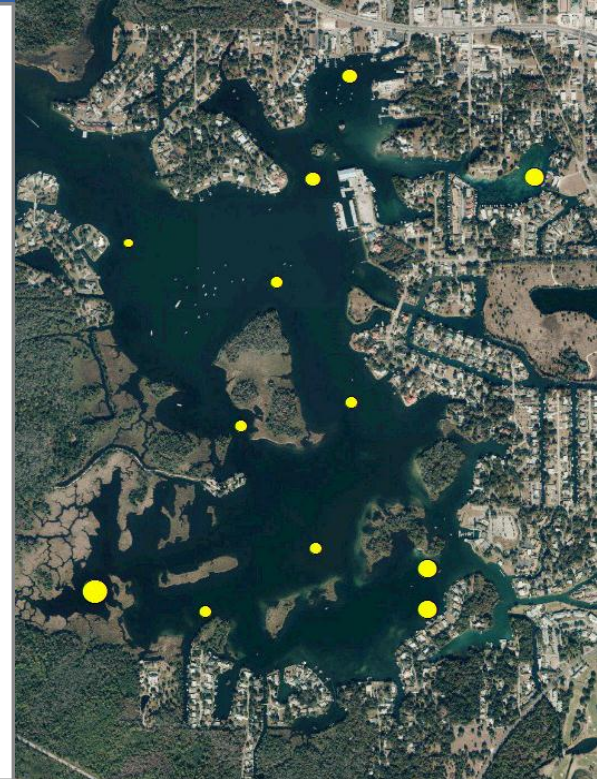
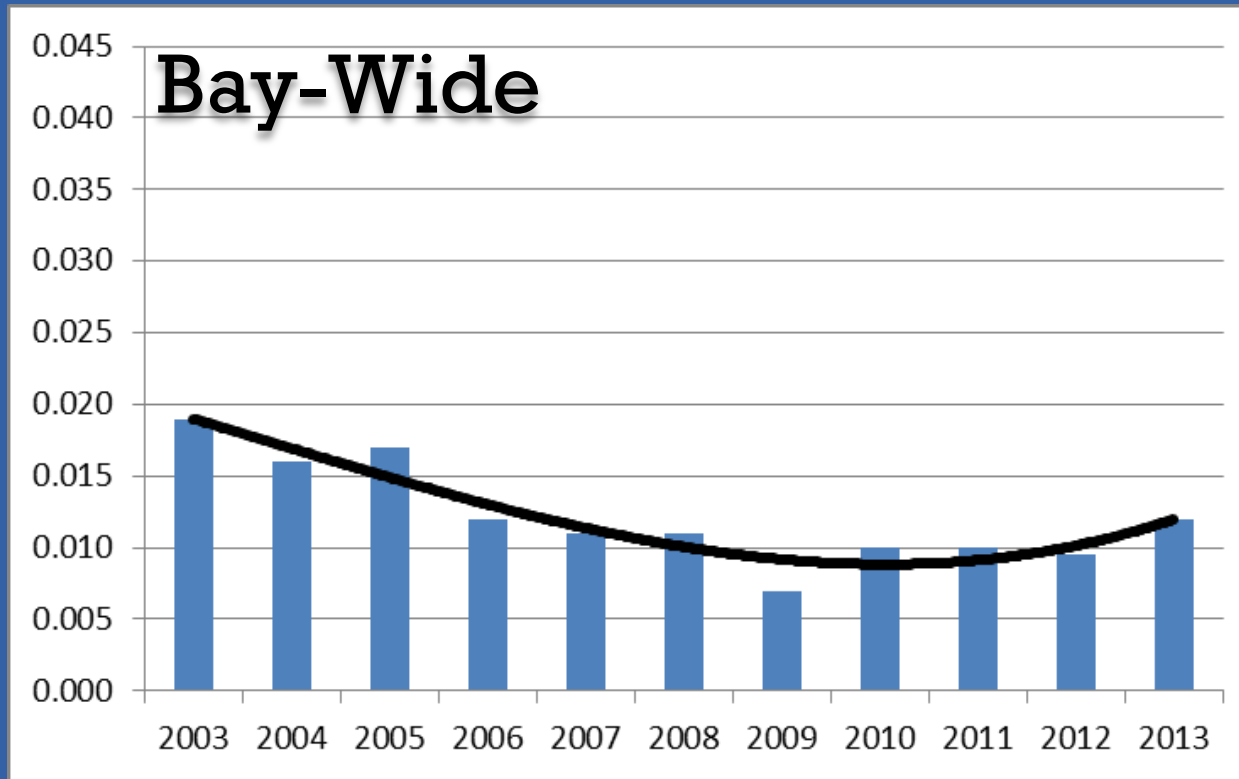
Total Nitrogen (mg/L)

$$TN = NO_3 + NO_2 + NH_3 + ORG\ N$$



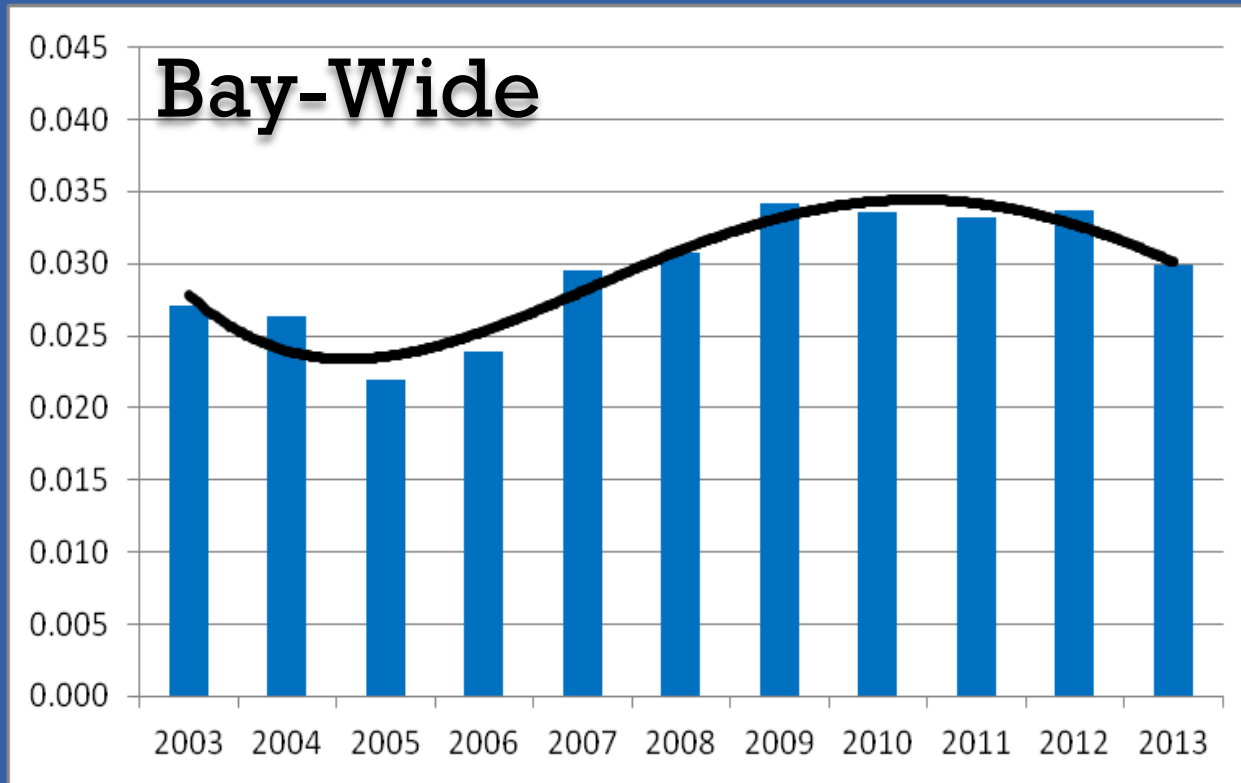
	Bay-wide	North Bay	South Bay
2013	0.220	0.294	0.158
2003-2013	0.277	0.304	0.251

Orthophosphate (mg/L)



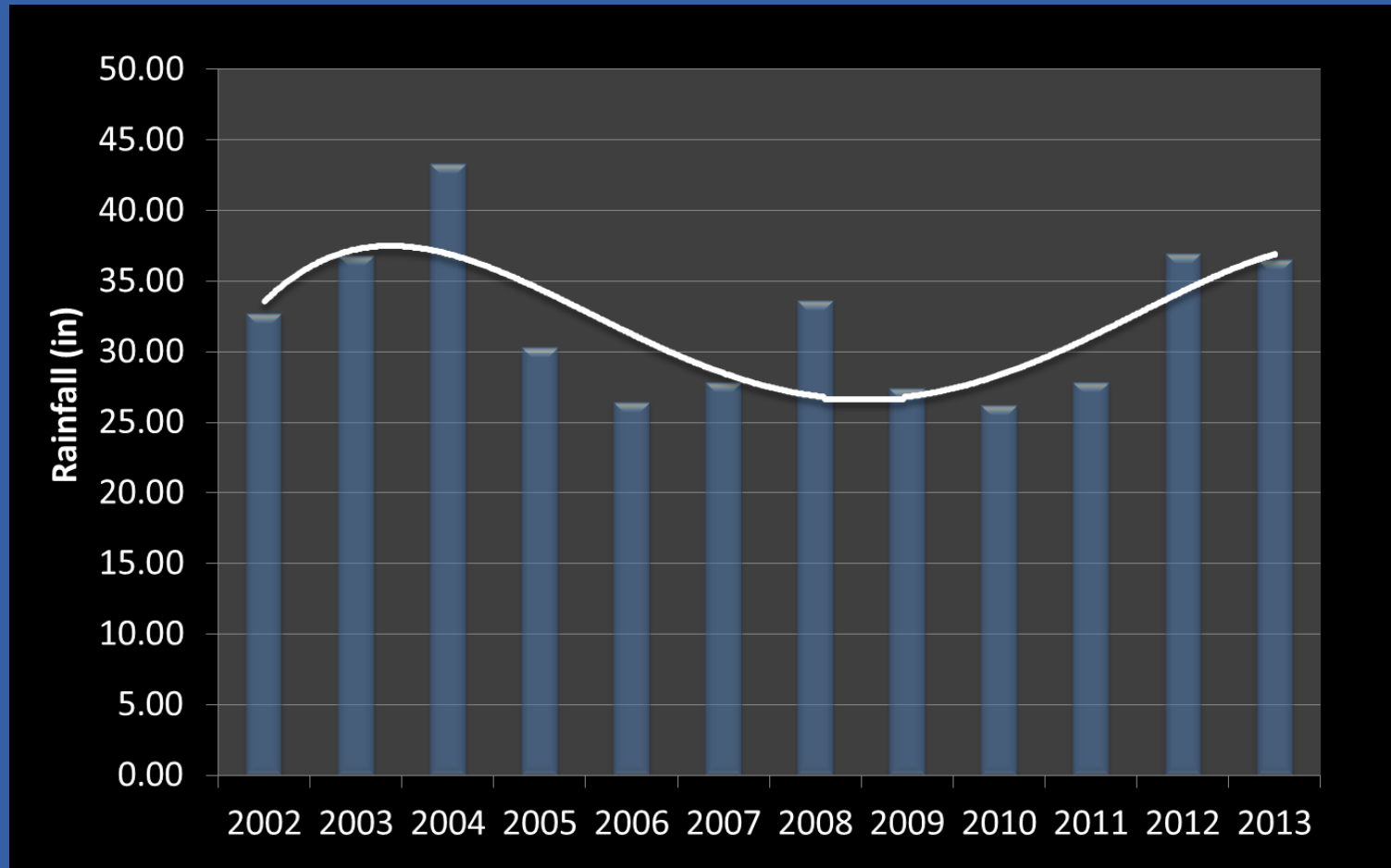
	Bay-wide
2013	0.013
2003-2013	0.015

Phosphorus (mg/L)

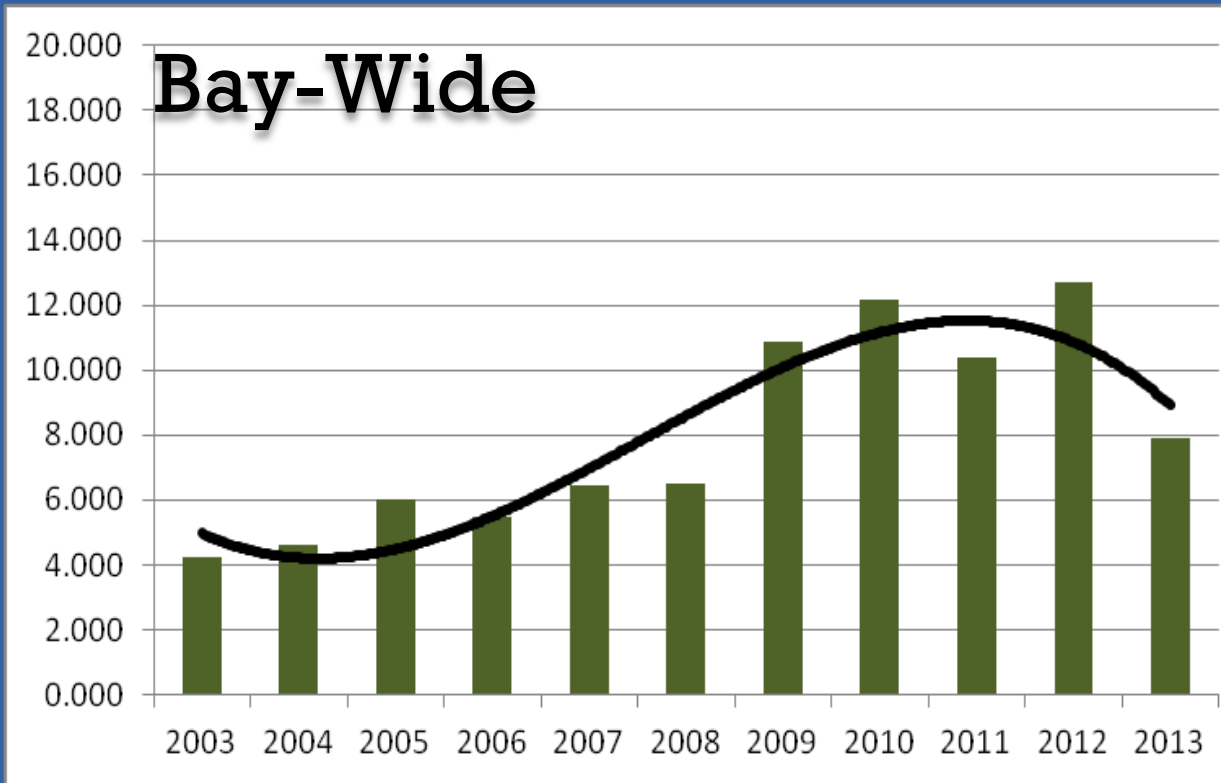


	Bay-wide
2013	0.030
2003-2013	0.029

Wet Season Rainfall

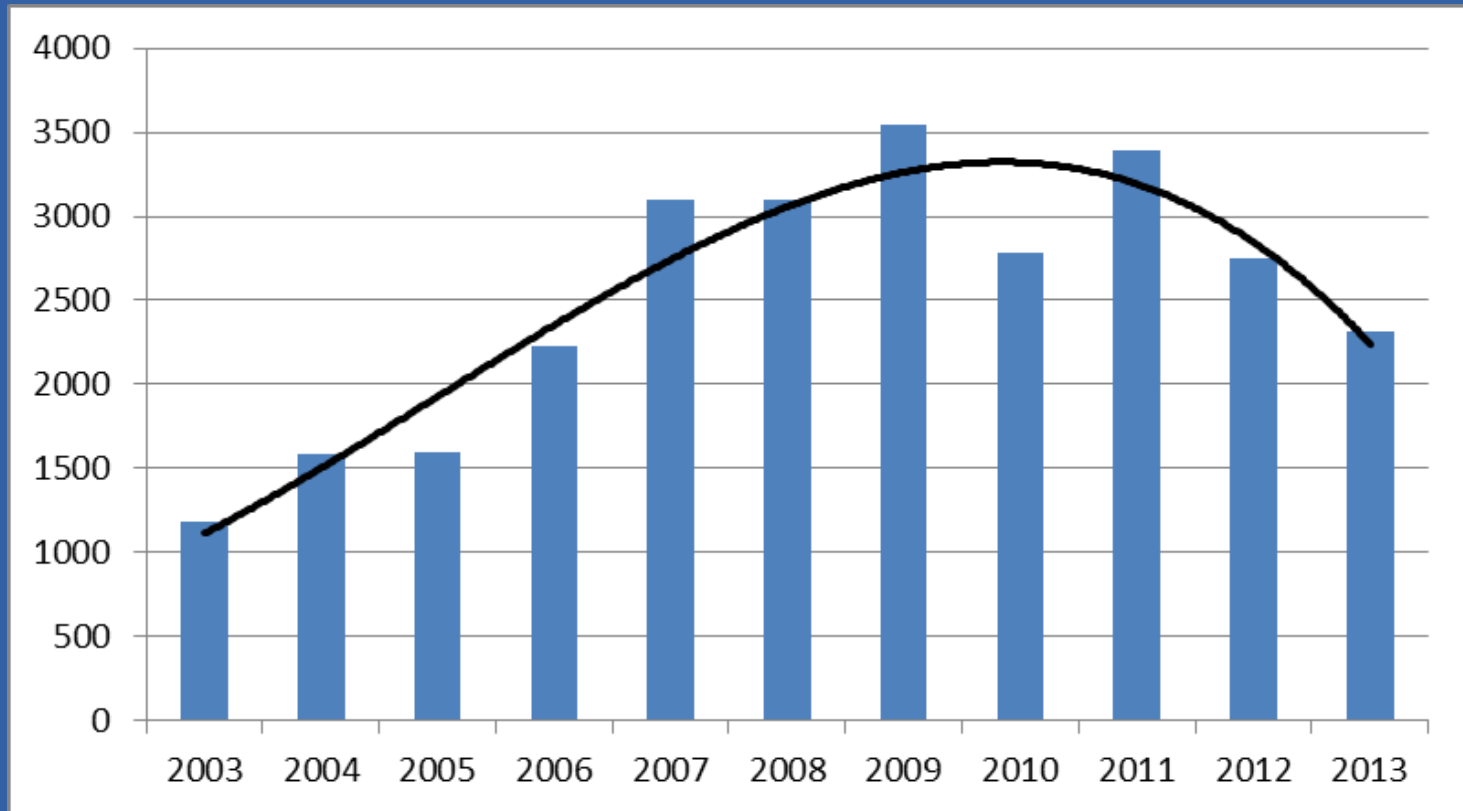


Chlorophyll ($\mu\text{g/L}$)



- Visibility – Secchi Disk
 - Improved in 2013
 - OCT 2013 = 34 Ft (2006-2013 Average = 23 Ft)

Specific Conductivity ($\mu\text{S}/\text{cm}$)



- $3800 \mu\text{S}/\text{cm} \approx 2.0 \text{ ppt Salinity @ } 25\text{C}$

SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT

[Springs Intro](#) [Learn About Springs](#) [Threats to Springs](#) [Protecting Springs](#) [Springs Experts](#) [Events](#) [Springs Resources](#)



Crystal River/Kings Bay

Springshed Dashboard

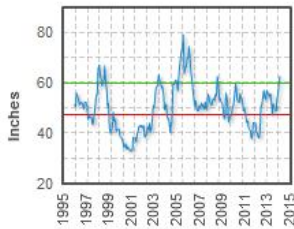
An at-a-glance view of recent water quality and flows, and contributing factors affecting the Crystal River and Kings Bay springs.

Current Conditions

Historical Average Rainfall
for April: **2.65 in**

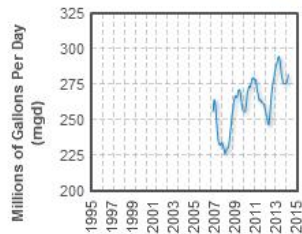
Actual Rainfall Received
for April: **1.90 in**

Springshed Region Rainfall



Data source: SWFWMD

Crystal River/Kings Bay
Stream Flow:
290 mgd (April 22)



Data source: SWFWMD

Nitrate Concentration

Tarpon Hole: **0.21 mg/L** (January 16)

Hunter Spring: **0.58 mg/L** (January 16)

Kings Bay Average: **0.12 mg/L** (October)

Location



View of Three Sisters Springs in Kings Bay. (Inset: State of Florida counties and Crystal River/Kings Bay Springshed location)

Crystal River/Kings Bay

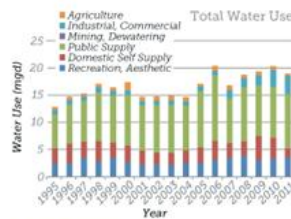


Data source: SWFWMD, Bari

Characteristics

Springshed Water Use

(Hover to pause, click to advance.)



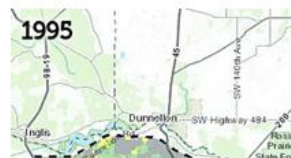
Data source: SWFWMD

Nitrate Loading



Data source: SWFWMD, 1999

Interactive Land Use Map



WATER MANAGEMENT INFORMATION SYSTEM

Welcome AD/CANASTASIOU Apr 22, 2014

Data Warehouse current as of Apr 22, 2014 11:25 AM

[Menu](#)

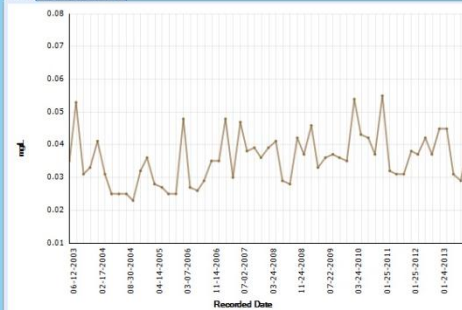
20167 KINGS BAY KBN4 WQ

[Help](#)

[Back to Resource Data Search](#)

Phosphorus- Total (Total)

[Chart](#) [Preview Raw Data](#)



Beginning Ending

Date: 06/12/2003 01/27/2014

☒ Line Chart ☐ Bar Chart [Refresh](#)

[Export Raw Data](#)

[Graph Last 12 Months](#)

[Graph POR](#)

POR Beginning Date: 6/12/2003

POR Ending Date: 1/27/2014

No. of Raw Data Record(s): 59

WATER MANAGEMENT INFORMATION SYSTEM

Welcome AD/CANASTASIOU Apr 22, 2014

Data Warehouse current as of Apr 22, 2014 11:25 AM

[Menu](#)

20167 KINGS BAY KBN4 WQ

[Help](#)

[Back to Resource Data Search](#)

Phosphorus- Total (Total)

[Chart](#) [Preview Raw Data](#)

Date Range: 01/01/2007 01/27/2014 [Refresh](#)

Data exists from 06/12/2003 to 01/27/2014

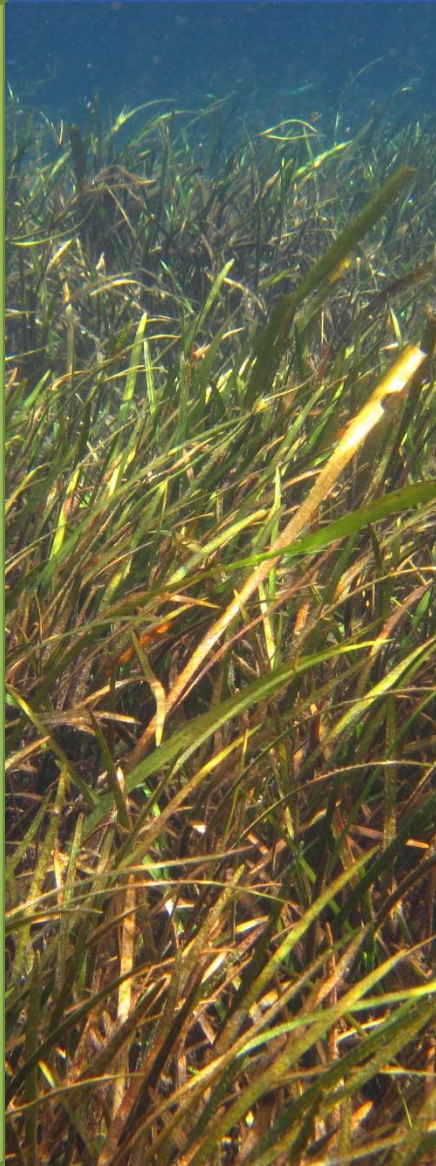
Analyte	Sample Date	Recorded Value	Units	Lab Analysis Method
Phosphorus- Total (Total)	1/24/2007 10:00:00 AM	0.030	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	3/27/2007 11:00:00 AM	0.043	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	5/1/2007 11:12:00 AM	0.025	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	7/2/2007 10:15:00 AM	0.042	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	9/26/2007 10:30:00 AM	0.033	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	11/29/2007 10:10:00 AM	0.034	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	1/29/2008 11:15:00 AM	0.031	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	3/24/2008 11:10:00 AM	0.034	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	5/28/2008 10:10:00 AM	0.036	mg/L	EPA 365.1 (Phosphorus -Total)
Phosphorus- Total (Total)	7/21/2008 10:45:00 AM	0.024	mg/L	EPA 365.1 (Phosphorus -Total)

36 Rows of 36 Returned

WaterMatters.org/springs

Submerged Vegetation in Kings Bay

FISH AND WILDLIFE HABITAT



- Who's who in the zoo:
 - Filamentous Algae (Lyngbya & Chaetomorpha)
 - Vallisneria americana (Eelgrass)
 - Myriophyllum spicatum (Eurasian milfoil)
 - Najas guadalupensis (Southern Naiad)
 - Ceratophyllum demersum (Coontail)
 - Chara species (Musk grass)
 - Hydrilla verticillata (Hydrilla)
 - Ruppia maritima (Widgeongrass)

Invasive Aquatic Plants

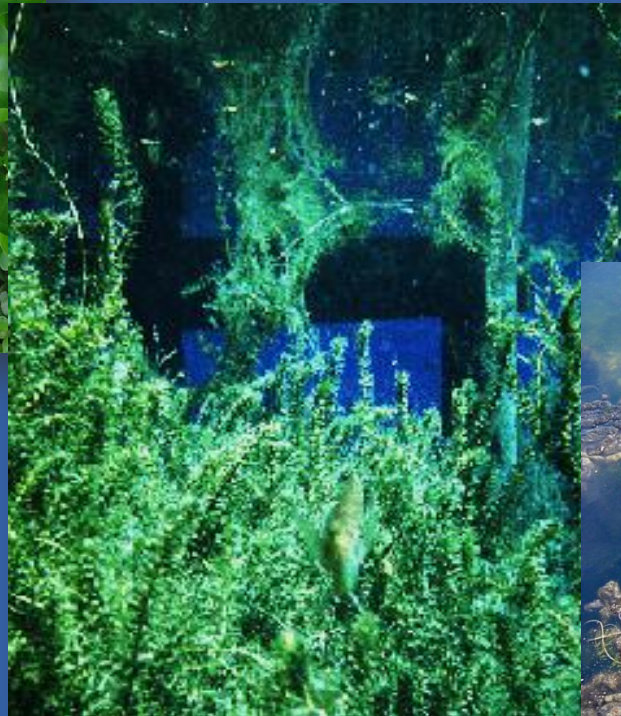
1940s-1950s

Hyacinth



1960s-1970s

Hydrilla - Milfoil



1980s-1990s

Filamentous Algae



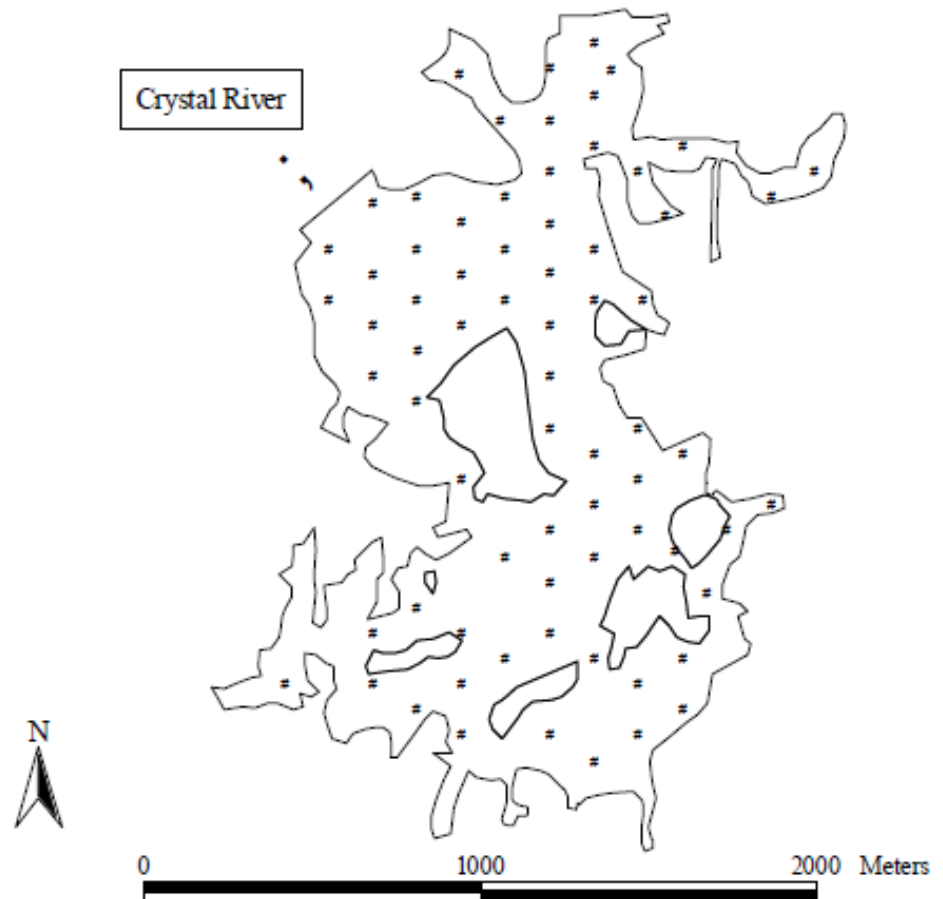
Cedar Cove 2/2/2000

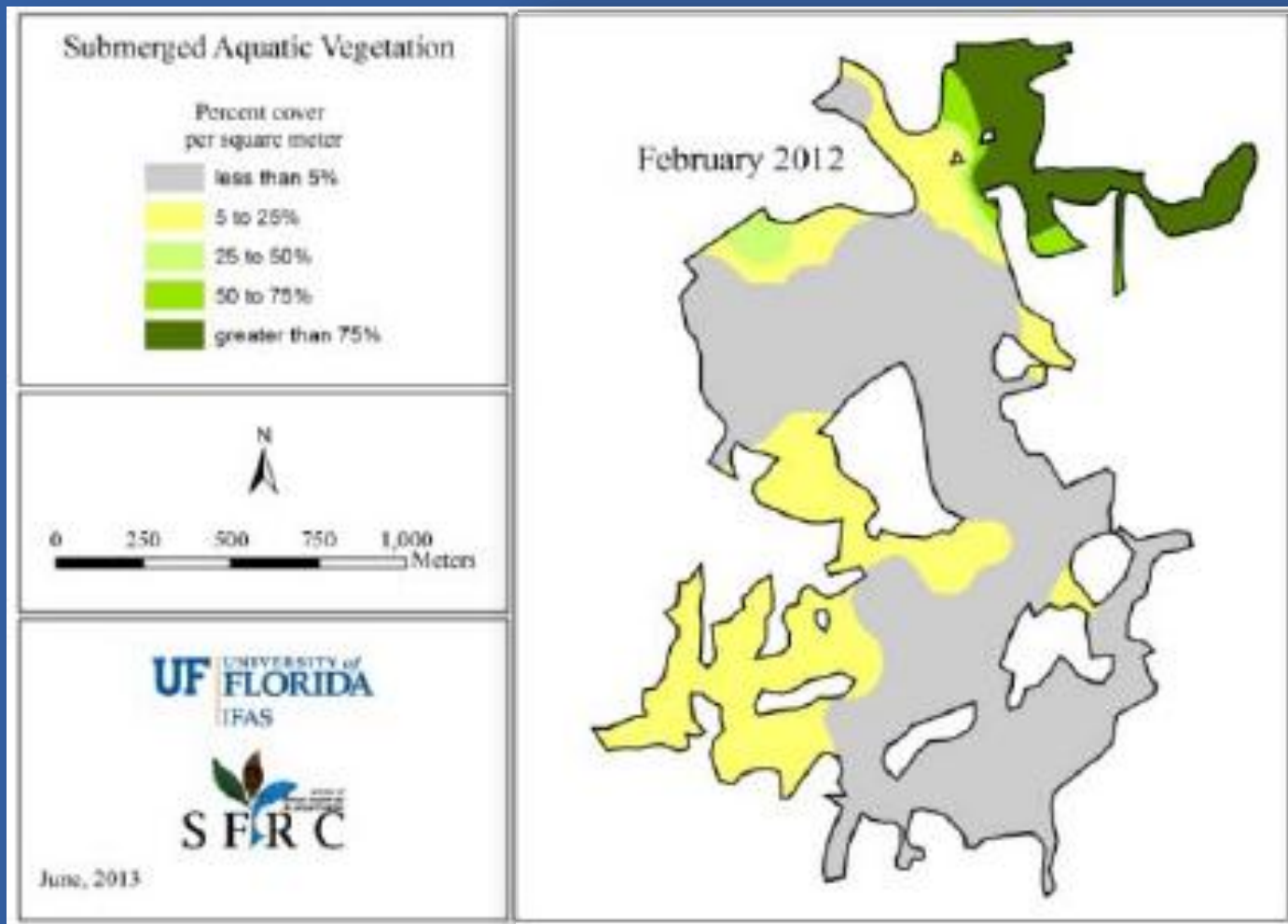


Kings Bay Vegetation Mapping

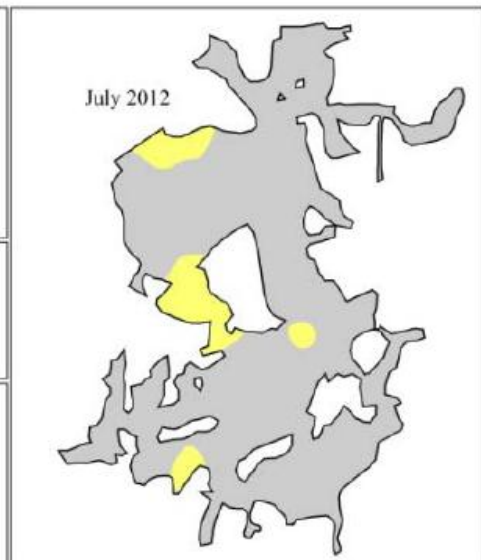
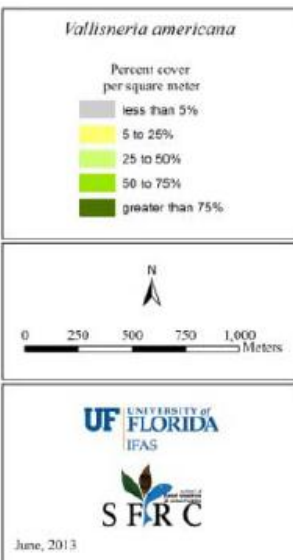
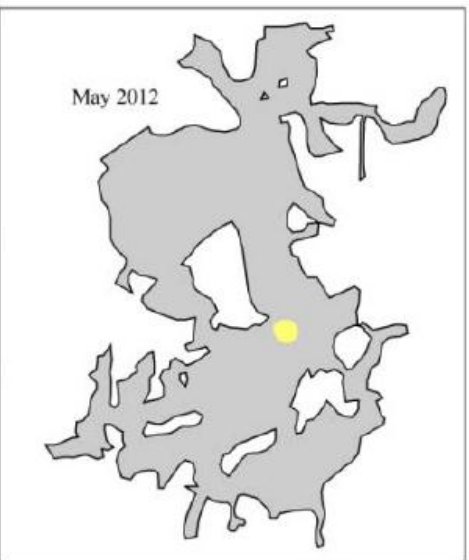
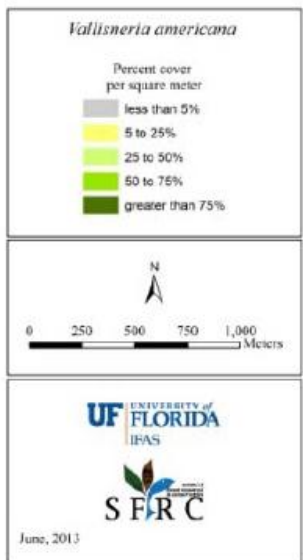
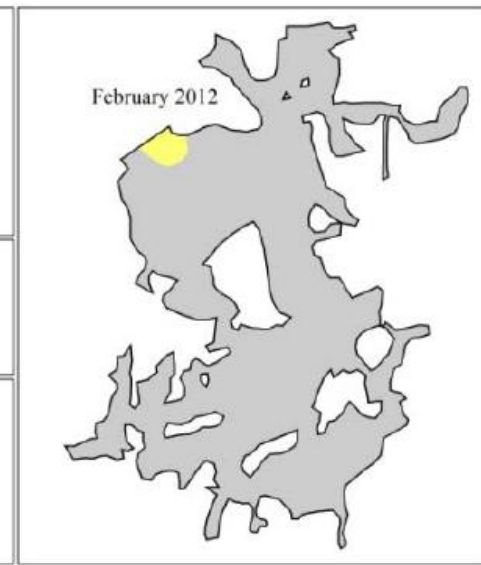
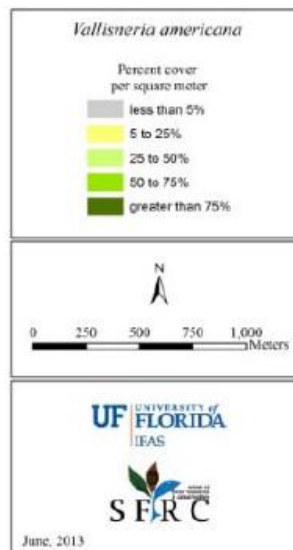
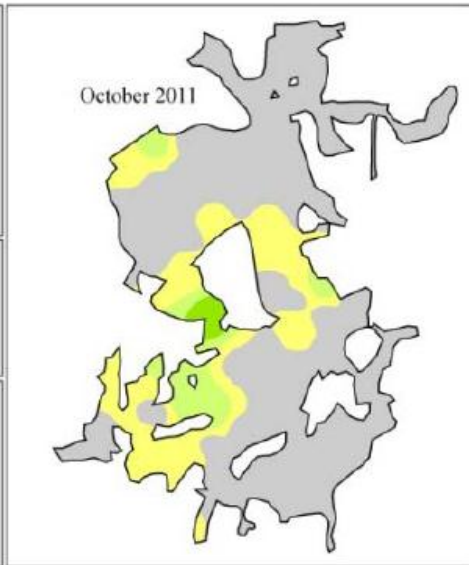
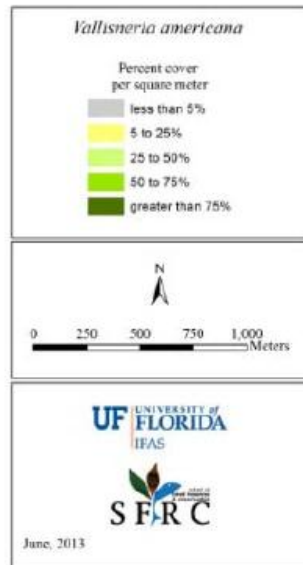


Figure 1. Sampling Stations

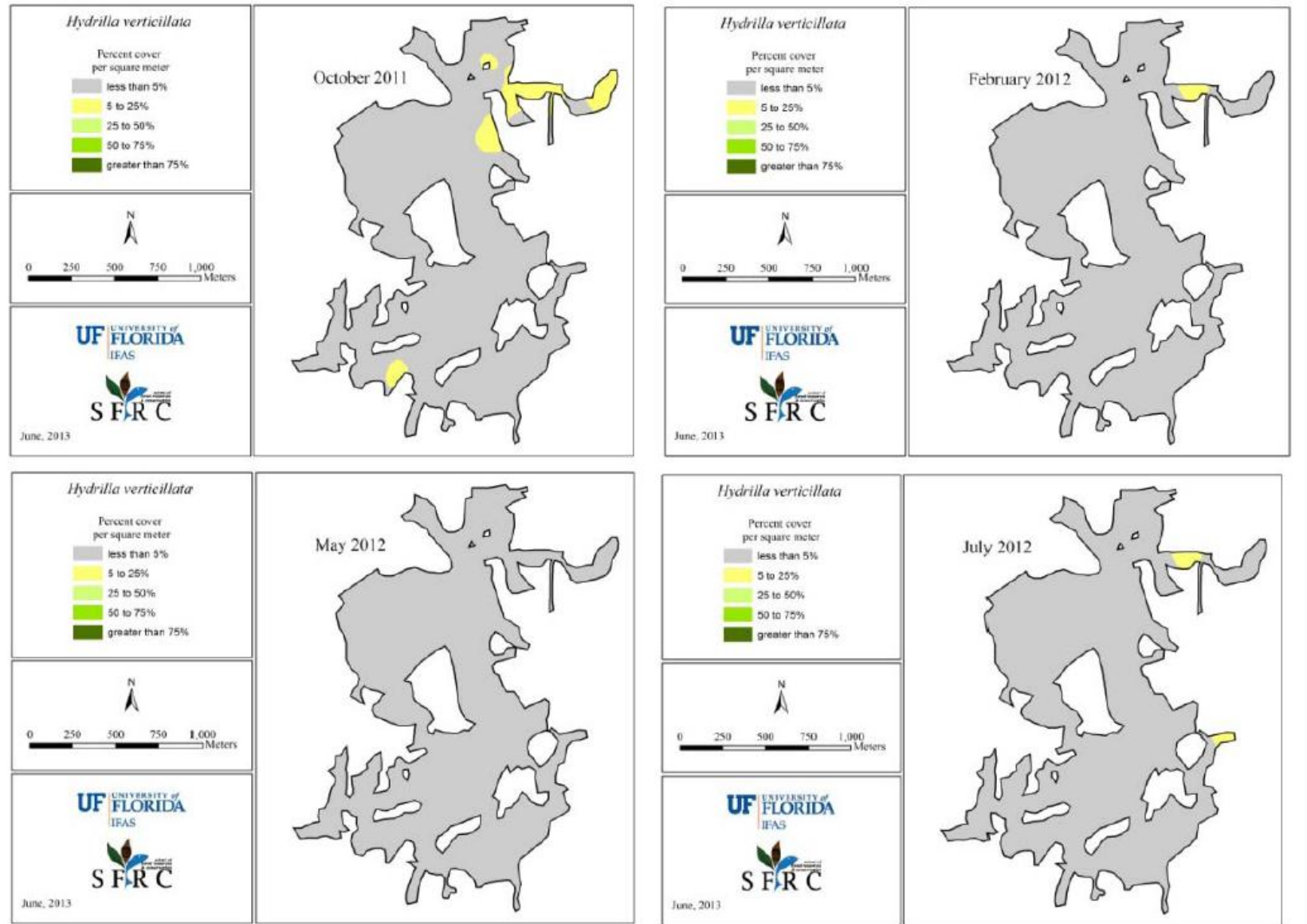




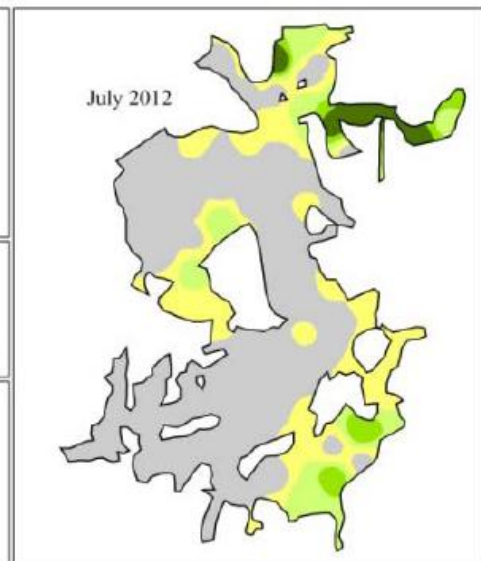
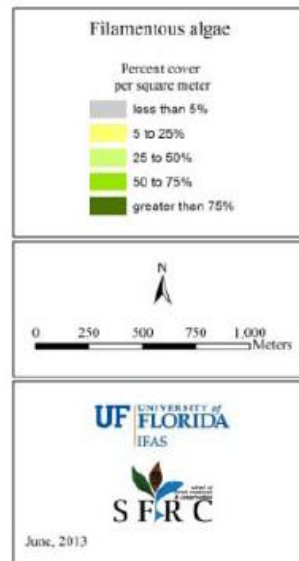
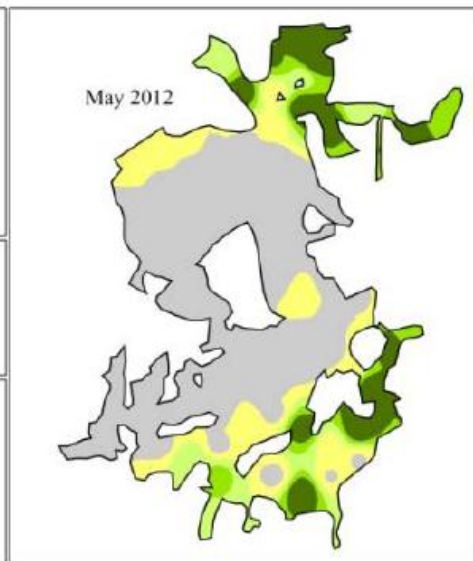
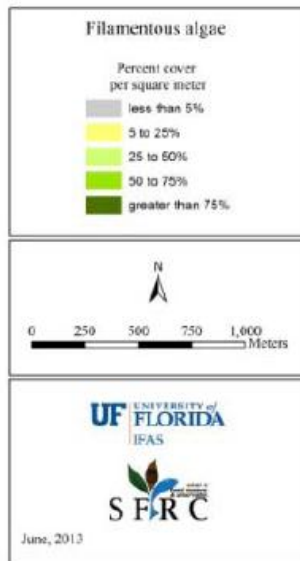
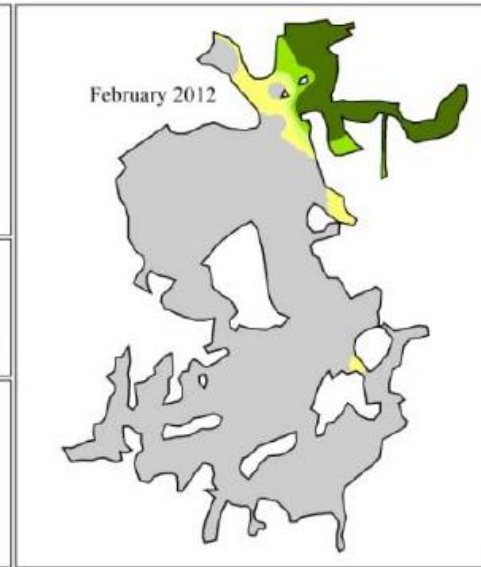
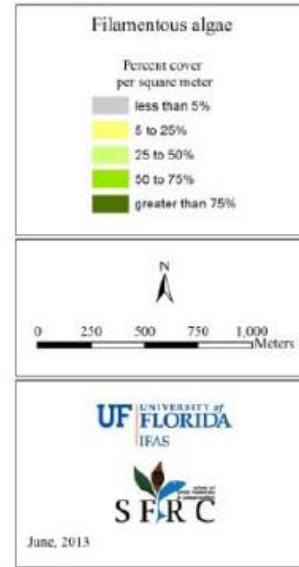
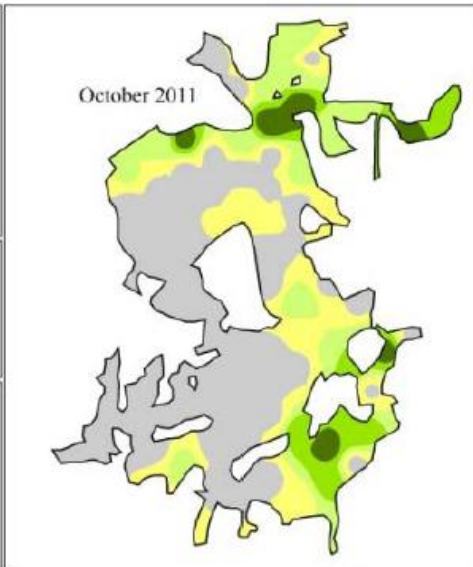
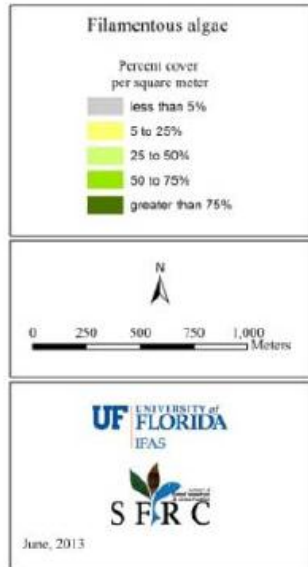
Vallisneria americana



Hydrilla verticillata



Filamentous Algae





Restoration

- Habitat Improvement
- Stormwater Retrofits
- Dredge Projects
- Sinkhole Cleanup
- Reclaimed Projects
- Agriculture BMPs



Hunters Cove Re-vegetation Project



Hunter Springs Park Living Shorelines



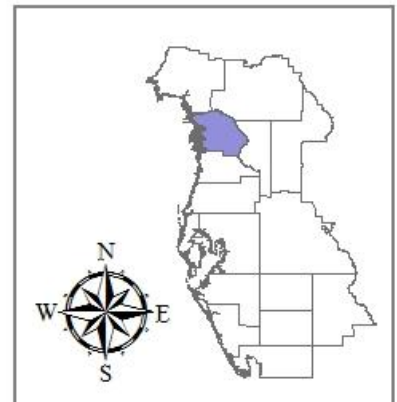
Hunter Springs Stormwater Project



W453 Hunter Springs Water Quality Improvement Project

Legend

- Force_Main
- Existing_Pond
- Land_Acquisition
- Existing_Site



Three Sisters Treatment Wetland Project



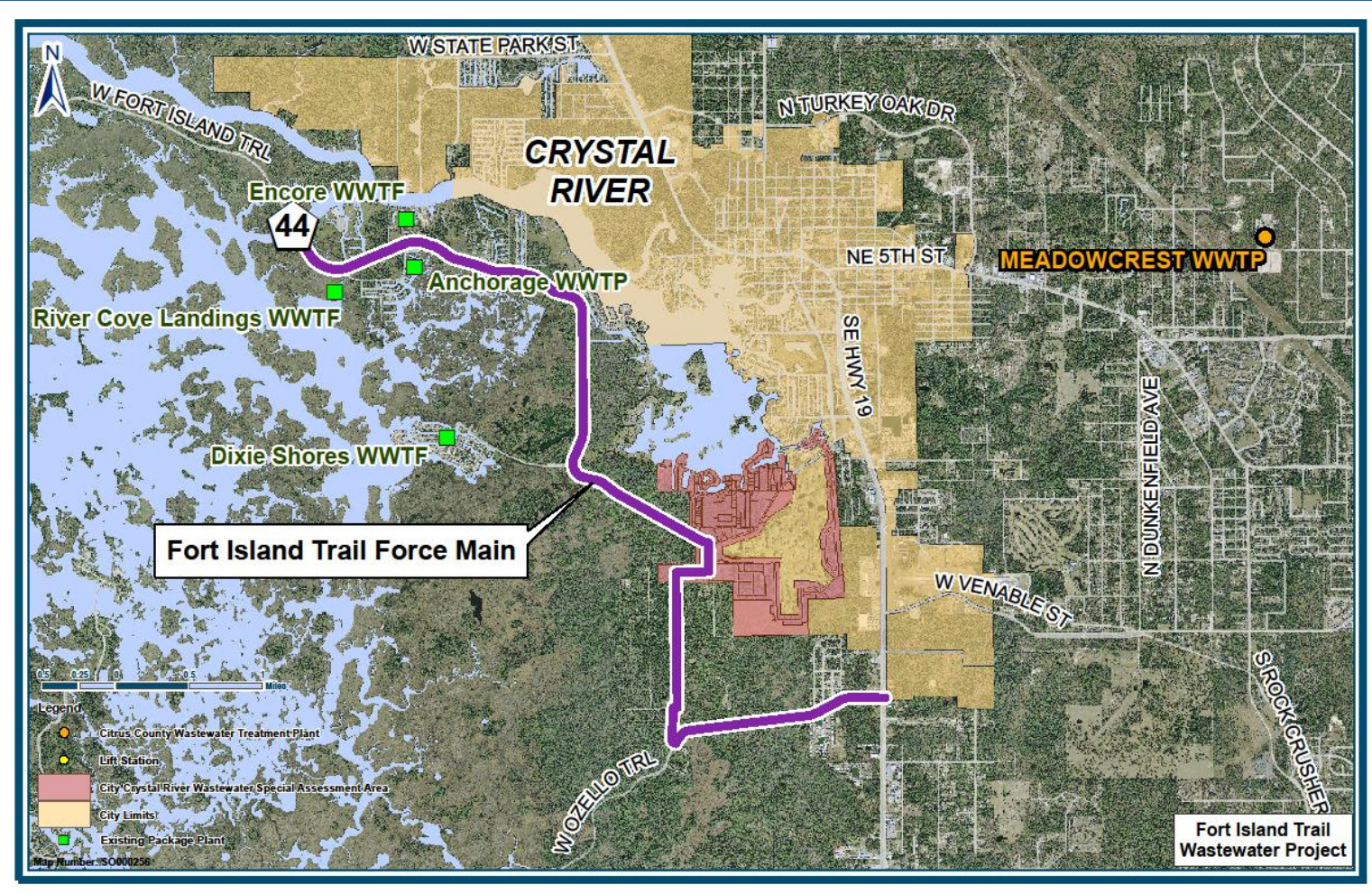
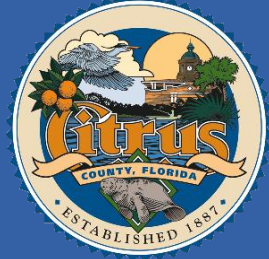
City of Crystal River to Duke Energy Reclaimed Water Project





Fort Island Trail Force Main

Wastewater force main construction to remove up to four package plants and 250 septic tanks



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[Springs Experts](#)

[Events](#)

[Springs Resources](#)



Crystal River/Kings Bay



Weeki Wachee Springs



Chassahowitzka Springs



Crystal River/Kings Bay



Rainbow Springs



Homosassa Springs

Springs in West-Central Florida

Florida has more than 1,000 springs — the largest concentration in the world. Within the Southwest Florida Water Management District, there are more than 150 springs.

They are the liquid jewels that flow through Florida. They are home to mullet, manatees and even mermaids. They are Florida's springs and they need our help.

Over time, these natural treasures have become threatened by human activities, climate change and other factors. But there are solutions and steps we can all take to restore our springs, which support the local economy and quality of life.

To lead this effort, the District put together a team of [springs experts](#) to conserve and restore our spring



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