

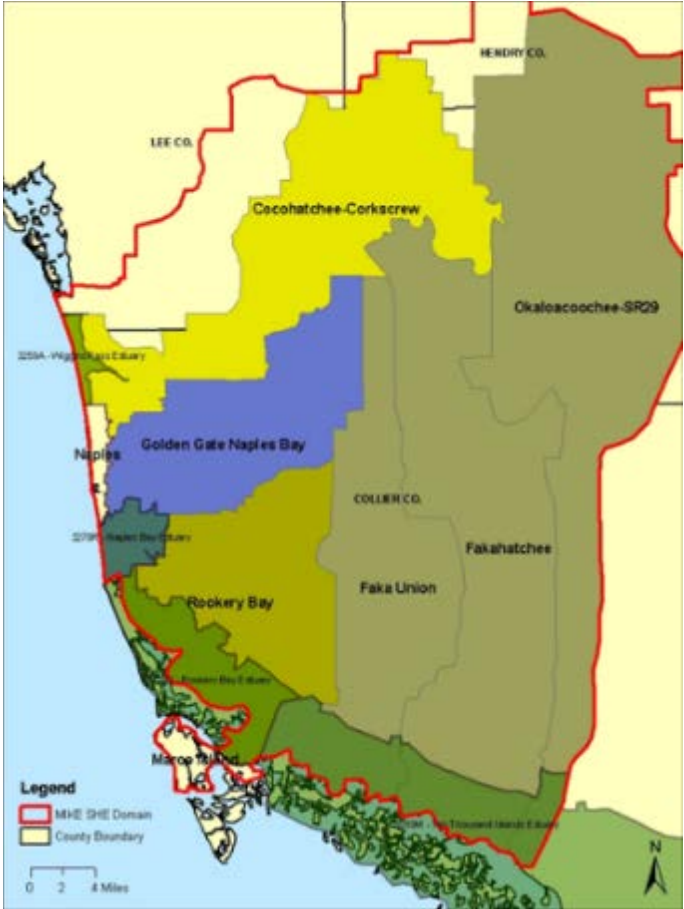
# Collier County Comprehensive Watershed Improvement Plan



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Estuarine Research Reserve

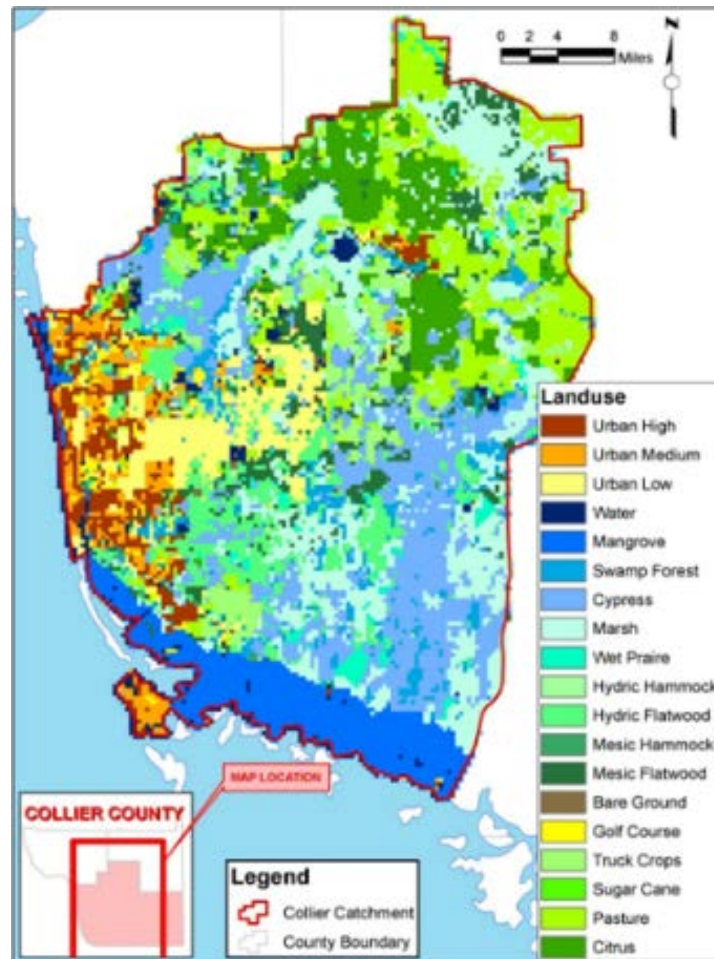


# Project boundaries - Collier County in Southwest Florida



From Atkins (2011)

# Wide variety of land uses within Collier County



From Atkins (2011)

# Highly Altered Watersheds, Habitat and Ecological Systems

Extensive canal network

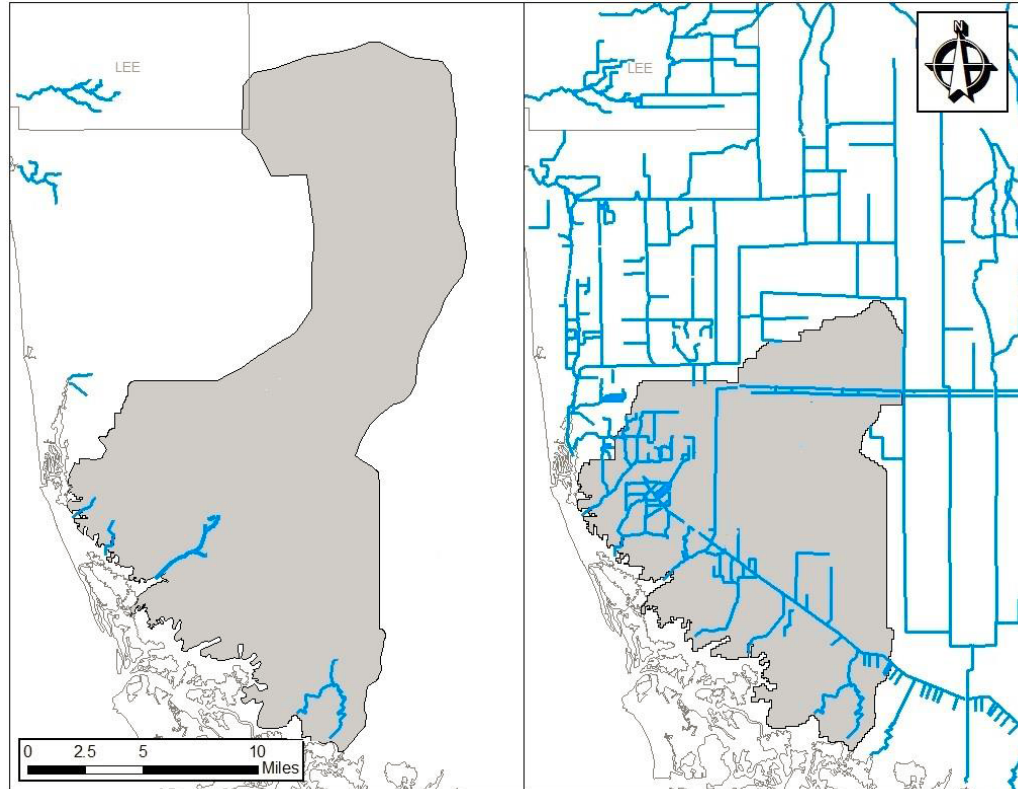


Numerous water control structures



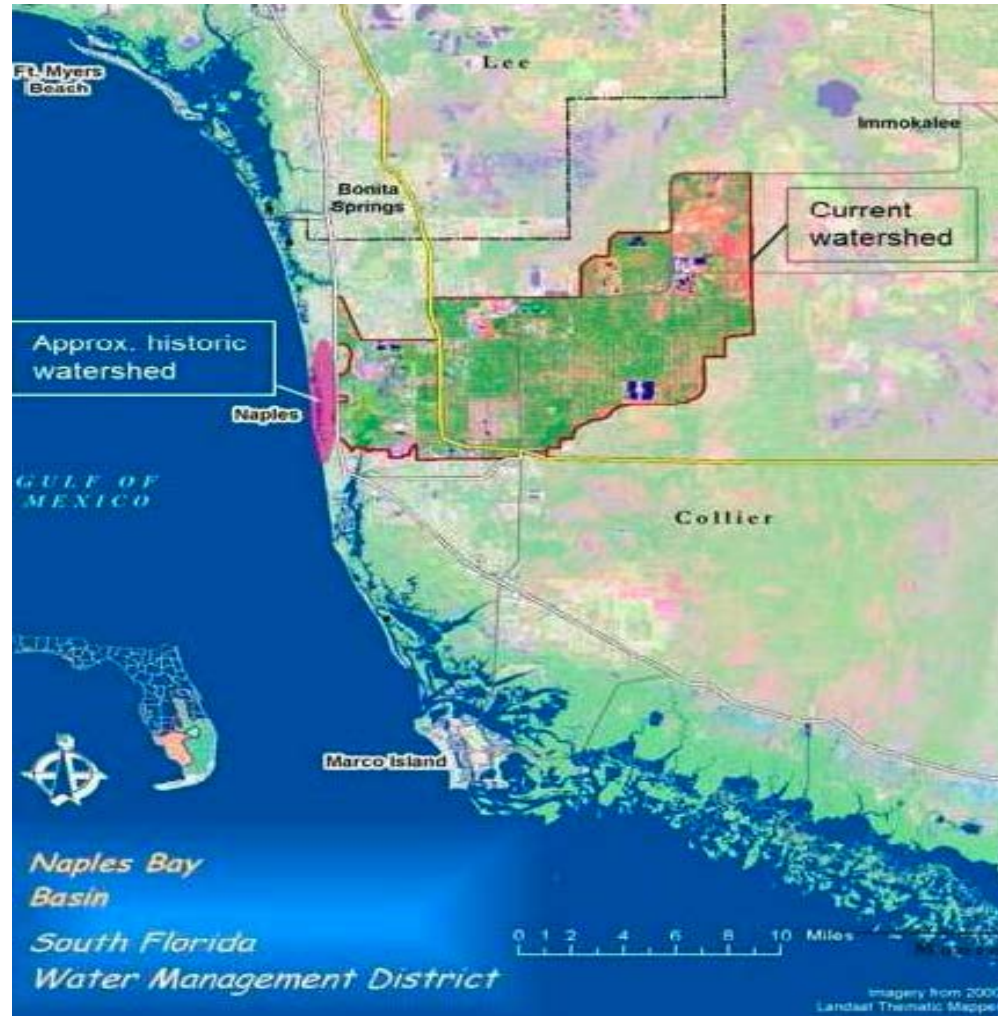
From Atkins (2011)

# Rookery Bay watershed highly modified, and reduced by ca. 80 sq. miles



From Interflow Engineering Inc. and Taylor Engineering (2014)

# Naples Bay watershed highly modified, and increased by ca. 100 square miles



From Cardno (2015)

# Consensus on impacts to watersheds and coastal waters from altered hydrology

- ▶ Impacts to ecology of Naples Bay
  - ▶ (e.g., SFWMD 2007, Atkins 2011, Cardno 2015, and others)
- ▶ Impacts to ecology of Rookery Bay watershed
  - ▶ (e.g., Parsons, 2006, SFWMD and USACE 2010, Atkins 2011, RBNERR 2012, and others)
- ▶ Impacts to ecology of Rookery Bay
  - ▶ (e.g., Shirley et al. 2004, 2005, Rubec et al. 2006, Atkins 2011, and others)

# So, how about retrofitting watersheds?

- ▶ Diversion of flows from Golden Gate Canal to Henderson Creek - developed in many water management plans since 1980
  - ▶ Golden Gate Water Management Plan (Johnson Engineering for SFWMD-BCB, 1980)
  - ▶ Big Cypress Basin Water Management Plan (1998)
  - ▶ SWIM Plan for Naples Bay (SFWMD 2007)
  - ▶ Collier County Watershed Management Plan (Atkins 2011)
  - ▶ Naples Bay Water Quality and Biological Analysis Project (Cardno 2015)
  - ▶ Belle Meade Area Stormwater Management Plan (Parsons 2006)



# However...

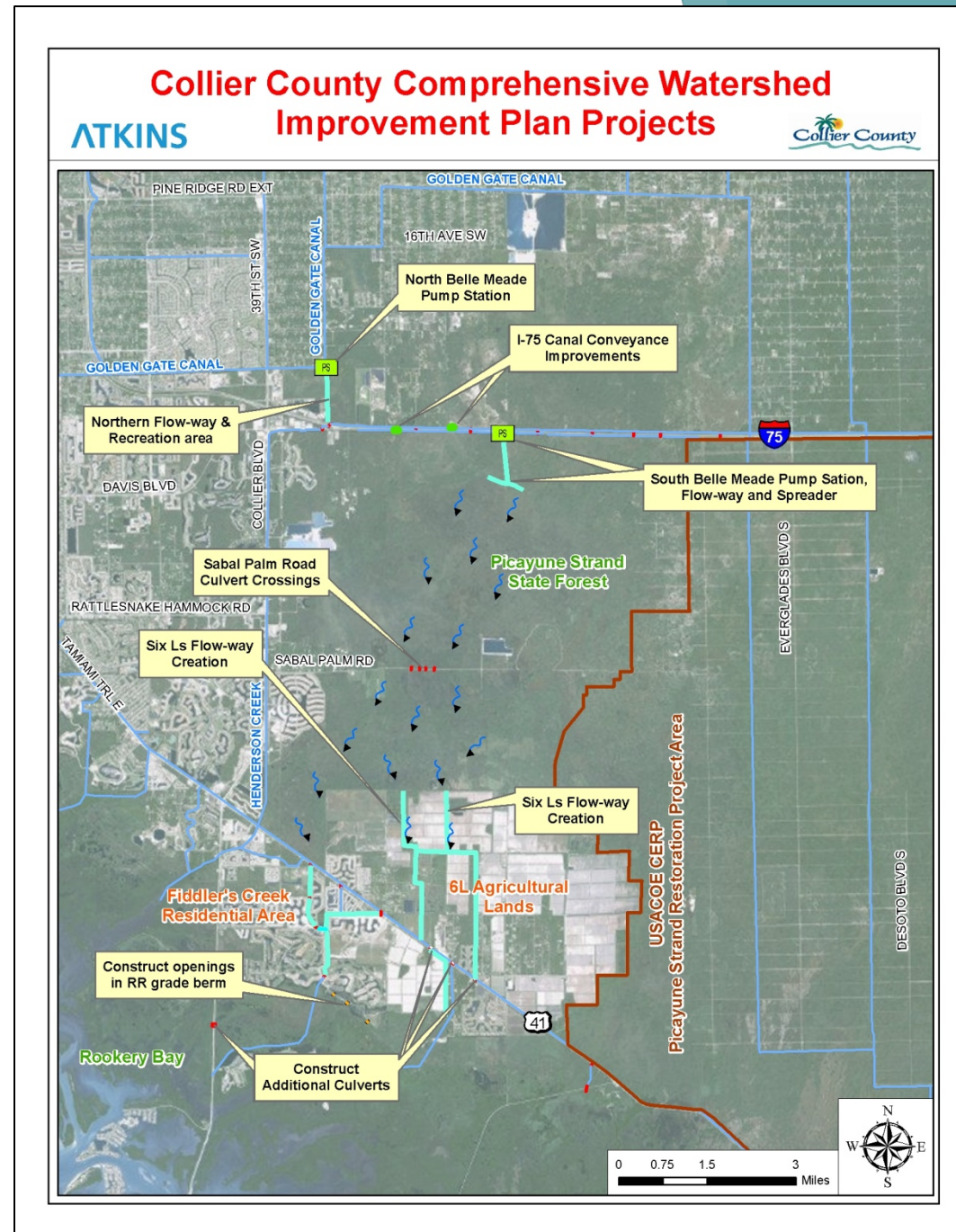
- ▶ Rookery Bay has a wet weather inflow deficit, Henderson Creek does not (Interflow Engineering Inc. and Taylor Engineering, Inc. 2014)
- ▶ Water quality in Golden Gate Canal (GGC) has elevated nitrogen and phosphorous compared to Rookery Bay's watershed
- ▶ Upstream water use limits the amount of water that can be removed from GGC
- ▶ A Naples Bay water bypass via Henderson Creek would not rehydrate the Picayune Strand State Forest or provide wet weather flows to Six L's or Rookery Bay or water quality improvements for the diverted water.
- ▶ Smaller project than those previously envisioned but and more significant in terms of water quality, rehydration and habitat restoration

# Proposed project

- ▶ Divert flows out of GGC when sufficient water is available (June - October) to avoid upstream water user impacts
- ▶ Diversion flows into historic flow-way to south
- ▶ Spreader canal will increase area of Rookery Bay watershed receiving water
- ▶ Protective of threshold for excess inflows to the Rookery Bay watershed
- ▶ Avoids impacts to the Picayune Strand Restoration Project (PSRP)
- ▶ Consistent with latest Management Plan for Picayune Strand State Forest

# Projects by Area

- ▶ Project components are based on previous study concepts
- ▶ Components have been tailored to meet project-specific goals
- ▶ Projects have been (and are still being) vetted in terms of feasibility and permitting.
- ▶ Projects have been (and are still being) coordinated with local agencies, NGOs and other interested parties
- ▶ Projects are consistent with the RESTORE Comprehensive Management Plan



# Project constraints

- ▶ Flows diverted only when sufficient water levels reached in GGC
- ▶ Maximum diversion of 100 cfs (daily average)
  - ▶ Equal to ca. 65 mgd
  - ▶ Estimated to lose 50% via losses to infiltration, evapotranspiration and storage
  - ▶ Inflow to Rookery Bay no more than 50 cfs
  - ▶ Fits within model estimates of wet season inflow deficits for Rookery Bay and hydroperiods of south Belle Meade wetlands

# Operation schedule

- ▶ Based on observed flows and gate levels in the Golden Gate Canal from January 1, 2009 to January 1, 2014
- ▶ Diversions could occur on approximately 11% of days
- ▶ On days when pumping occurs, diverts approximately 19% of flows from Naples Bay
- ▶ Those 11% of days represent approximately 9.5% of wet season inflows and 8% of total yearly inflows
- ▶ 2.7 B gals per year or 8,250 acre-feet
- ▶ Significant benefits to Naples Bay, PSSF/South Belle Meade and Rookery Bay Watershed

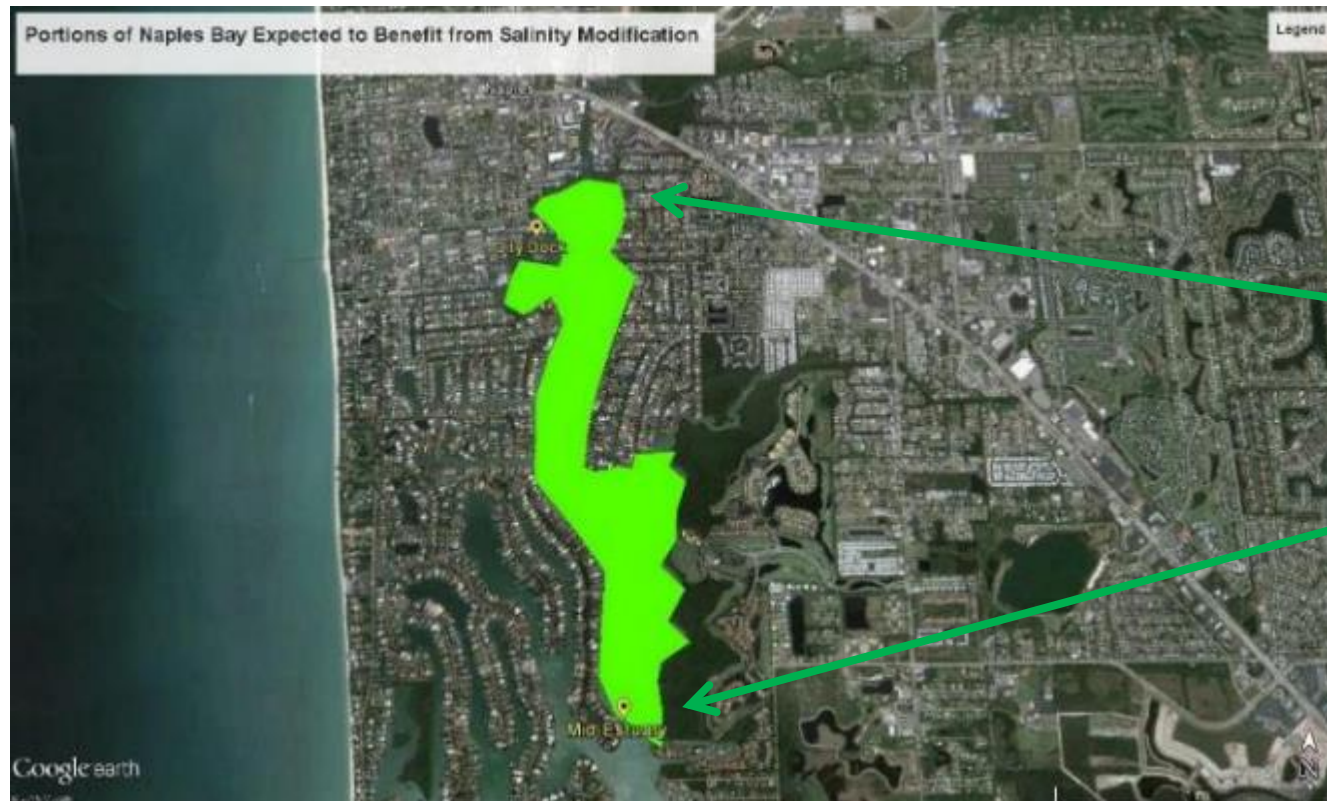
Year	Number of Pumping Days
2009	27
2010	40
2012	18
2013	90
2014	33
<b>Average</b>	<b>42</b>

# Estimating benefits

- ▶ **Naples Bay**
  - ▶ Changes in salinity regimes create positive conditions for habitat development
  - ▶ Expected water quality benefits associated with nutrient load reductions
  - ▶ Turbidity reductions
- ▶ **Picayune Strand State Forest**
  - ▶ Increase water depth and hydro-periods to previously impacted wetlands, without altering species composition
  - ▶ Benefit to ca. 10,000 acres of mostly cypress and hydric flatwoods
- ▶ **Rookery Bay**
  - ▶ Restore freshwater inflows from forest to Rookery Bay
  - ▶ Sufficient combination of water storage and sheet flow to maintain water quality of current watershed

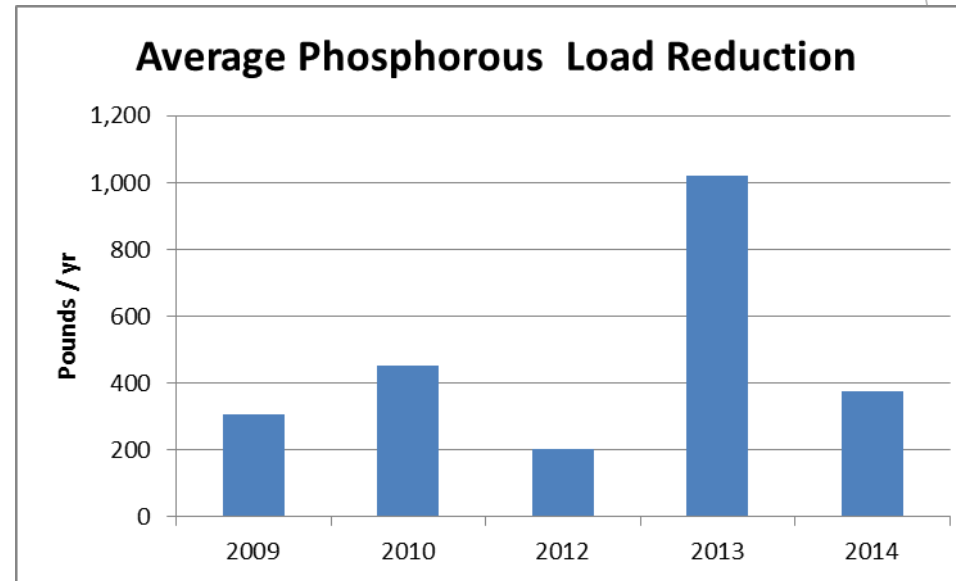
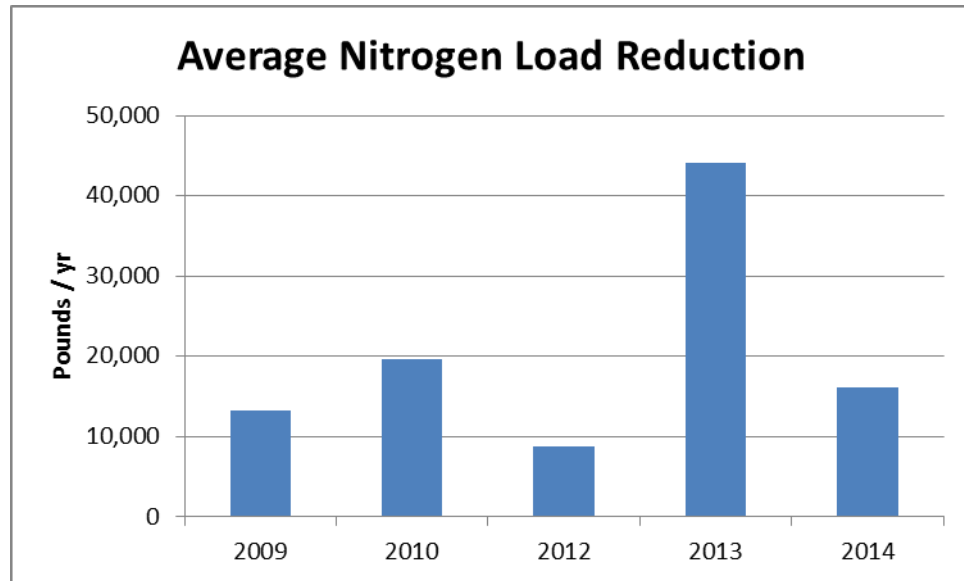
# Naples Bay - area benefited is ca. 400 acres

- Expectation of 20% difference in salinity and an average salinity difference of 2 ppt or higher
- Sets the stage for future sea grass and oyster bed increases



After diversions implemented, potential locations for “jump starting” restoration via seagrass transplanting and oyster reef deployment

# Naples Bay - Reductions in nutrient loads



- ▶ Equivalent to 3,000 20-lb bags of lawn fertilizer (on average) per year over the previous 5 year period
- ▶ Greater benefits to water clarity expected due to reduction in turbidity
- ▶ Likely to create conditions for expanded coverage of seagrass in Naples Bay

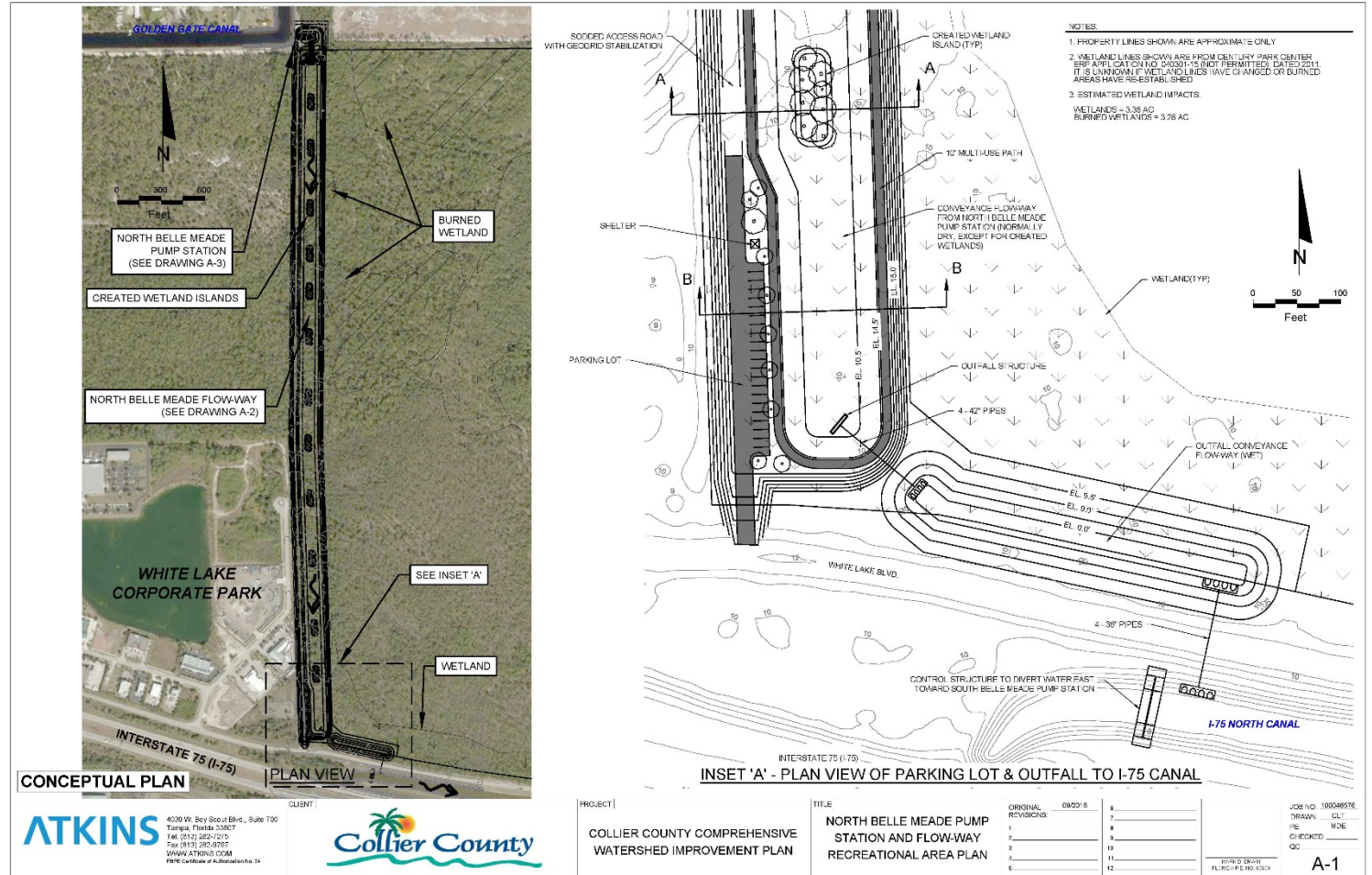




# Project Area A

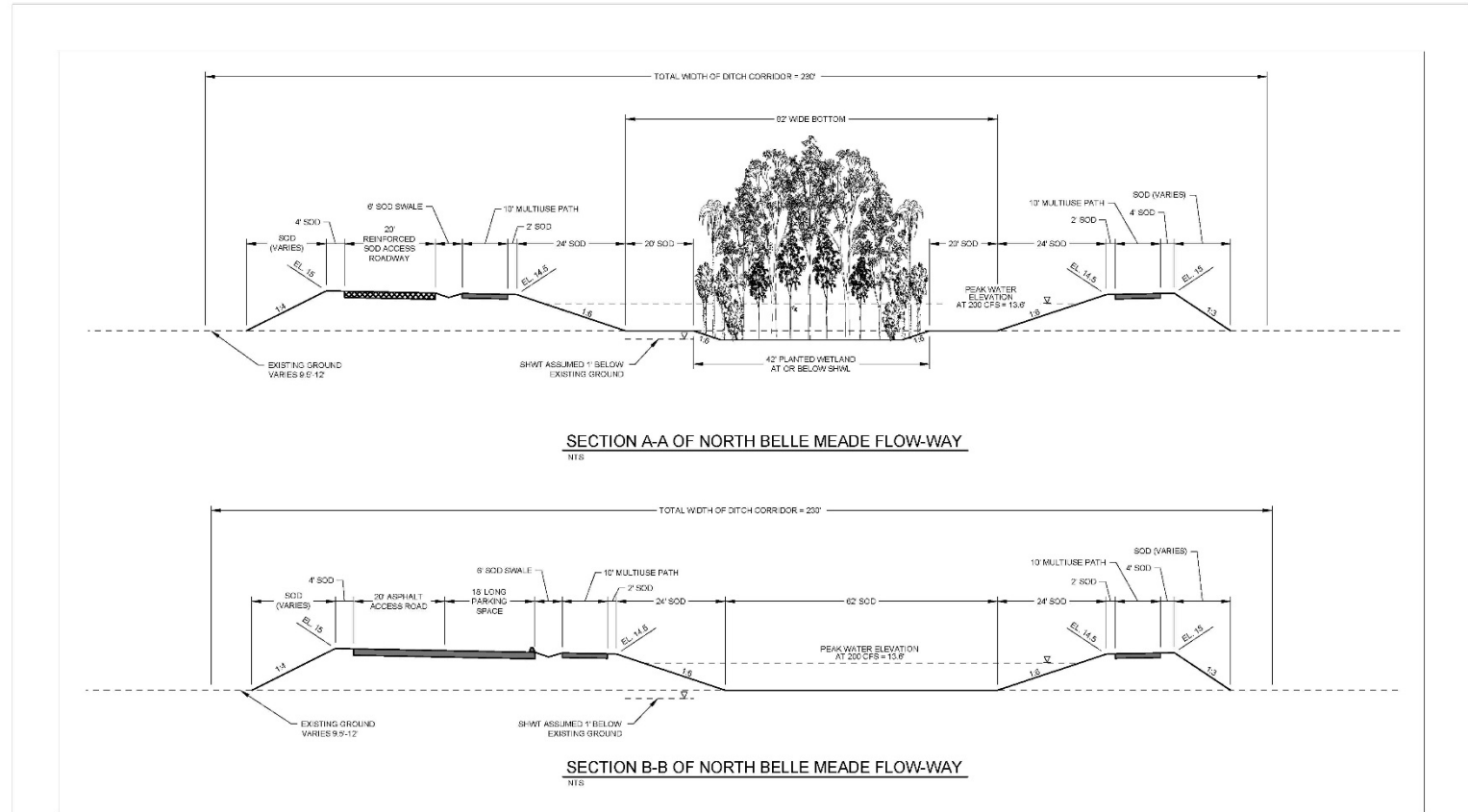
## Project Components

- ▶ 4,500 foot flow-way
- ▶ Includes multi-use recreational trail
- ▶ Constructed on County property
- ▶ Outfall system under Lake Blvd. to the I-75 north canal



# Project Area A

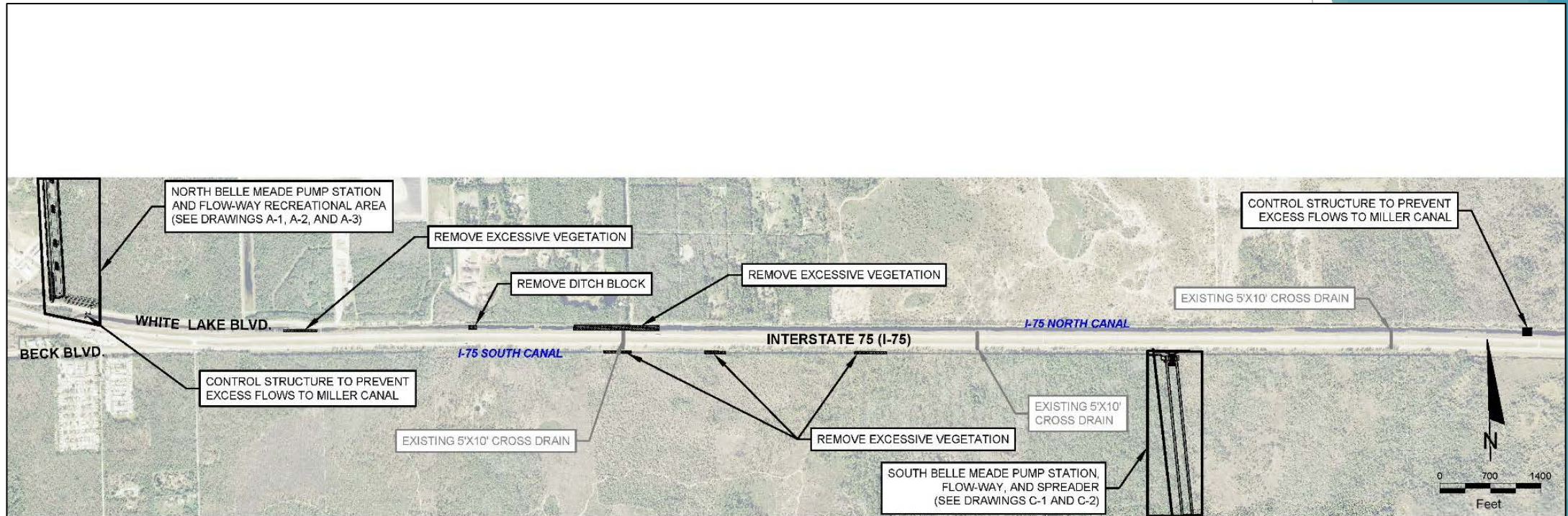
- ▶ Project Components
  - ▶ 110-foot wide flow-way
  - ▶ Flow-way planted with wetland islands to promote habitat and water quality improvements



**CONCEPTUAL PLAN**

<p>4000 W. Boy Scout Blvd., Suite 700 Tampa, Florida 33607 Tel: (813) 282-1215 Fax: (813) 282-9787 WWW.ATKINS.COM FPE Client of Author No. 24</p>	CLIENT	<p>COLLIER COUNTY COMPREHENSIVE WATERSHED IMPROVEMENT PLAN</p>	TITLE	ORIGINAL 09/2015 REVISIONS: 1 _____ 2 _____ 3 _____ 4 _____ 5 _____	JOB NO. 100045576 DRAWN: CLT PE: JDE CHECKED: _____ QC: _____ DATE: 11/14/15 SCALE: 1" = 10'-0"
	PROJECT		NORTH BELLE MEADE FLOW-WAY RECREATIONAL AREA TYPICAL SECTIONS	<b>A-2</b>	

# Project Area B



- ▶ Removal of ditch blocks and vegetation to improve conveyance

- ▶ Operational control structures to control flows to Henderson Creek and the Miller Canal

# How much of a nutrient load from GGC would be delivered to Rookery Bay?

## ▶ Two step process

### ▶ Hunter et al. (2009)

- ▶ Relationship between removal efficiency of nutrient reduction (TN and TP) compared to area-normalized nutrient loads (grams / m<sup>2</sup> / yr)
- ▶ Applied only to Northern Flow-way (4,500 foot length, north of I-75)
- ▶ Output becomes input to rest of the flow path

### ▶ Rudnick et al. (1999)

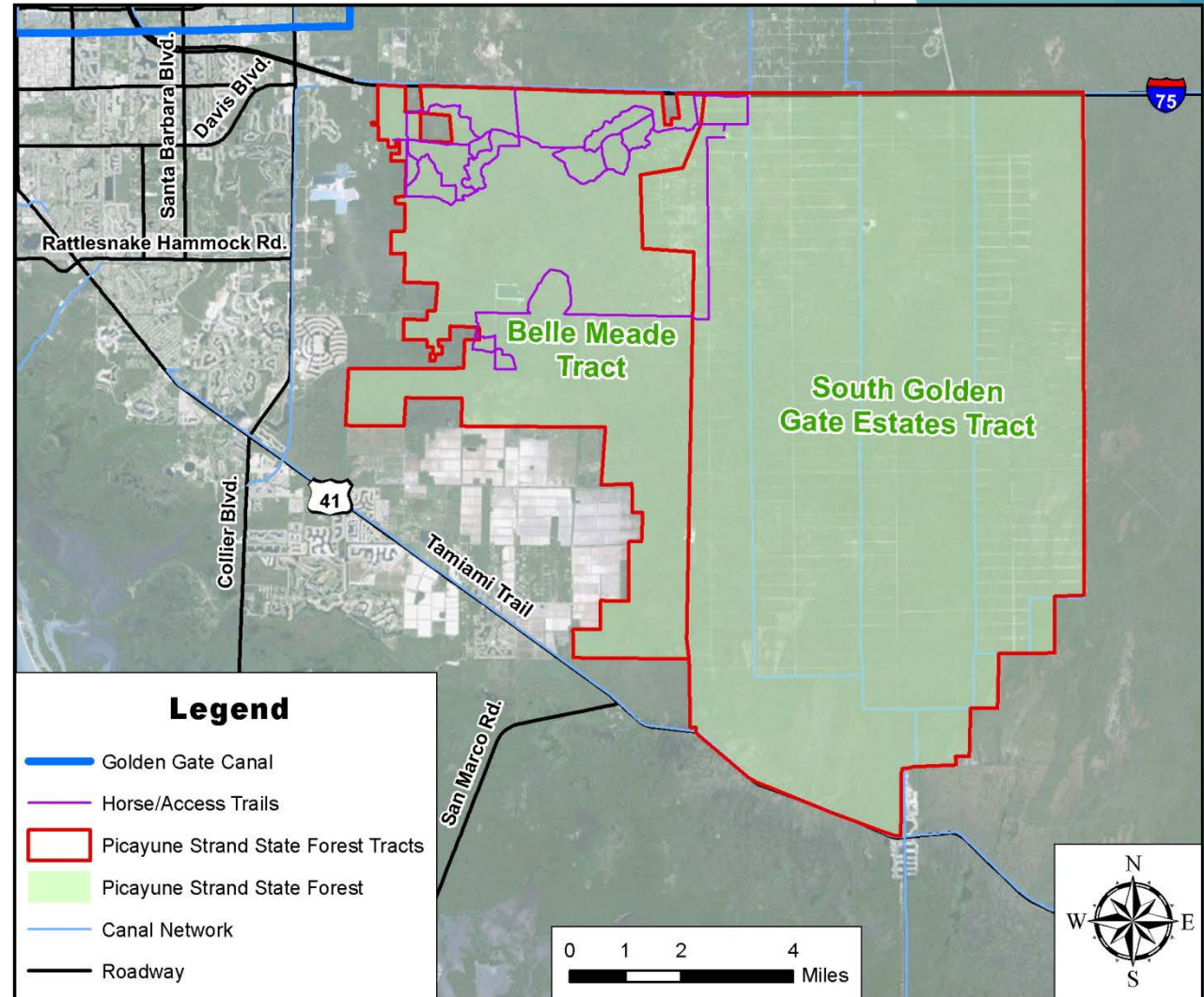
- ▶ Based on transect work in eastern Everglades
- ▶ Further reductions anticipated after water exits Northern Flow-way

# Expected load reductions

- ▶ Exiting Northern Flow-way (above I-75)
  - ▶ 29 % reduction in TN loads
  - ▶ 62 % reduction in TP loads
- ▶ Further reductions anticipated
  - ▶ 85 % further reduction in TN
  - ▶ 46 % further reduction in TP
- ▶ Combined -
  - ▶ 89 % reduction in TN loads
  - ▶ 77 % reduction in TP loads
- ▶ Nutrient loads diverted from Naples Bay do not equal pound for pound nutrient loads entering Rookery Bay (or even Rookery Bay watershed)

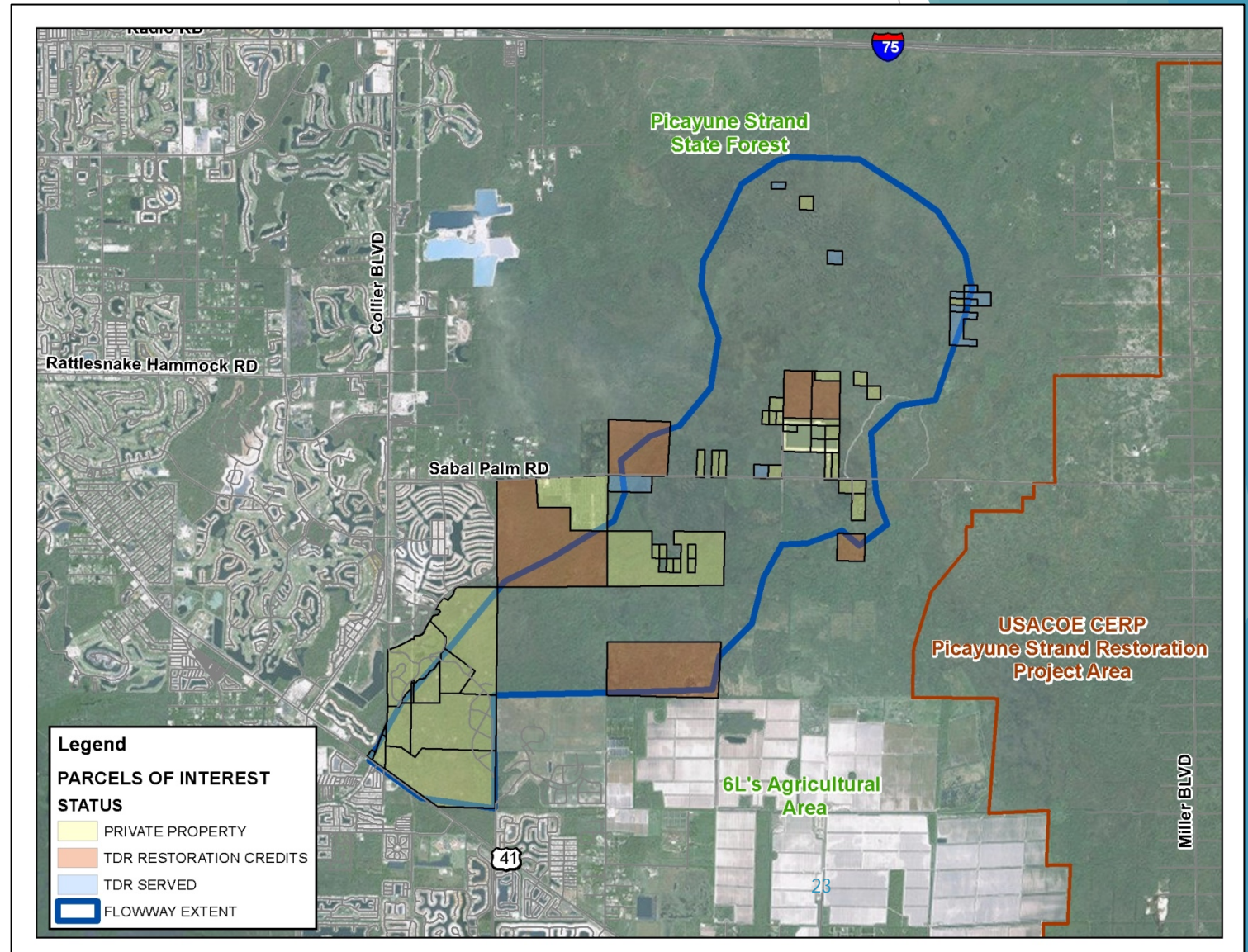
# Picayune Strand State Forest (PSSF)

- ▶ The entire PSSF is about 70,000 acres
- ▶ In 1985 the first parcels were purchased as part of the CARL program
- ▶ Hydrologic and Ecologic restoration for the PSSF was identified as part of the CERP
- ▶ Hydrologic restoration is one of the goals of the PSSF 10-year resource management plan
- ▶ Because of the habitat and recreational changes over the years there are concerns with restoration efforts.
- ▶ FFS concerns with restoration within the PSSF are being addressed as part of the CCCWIP



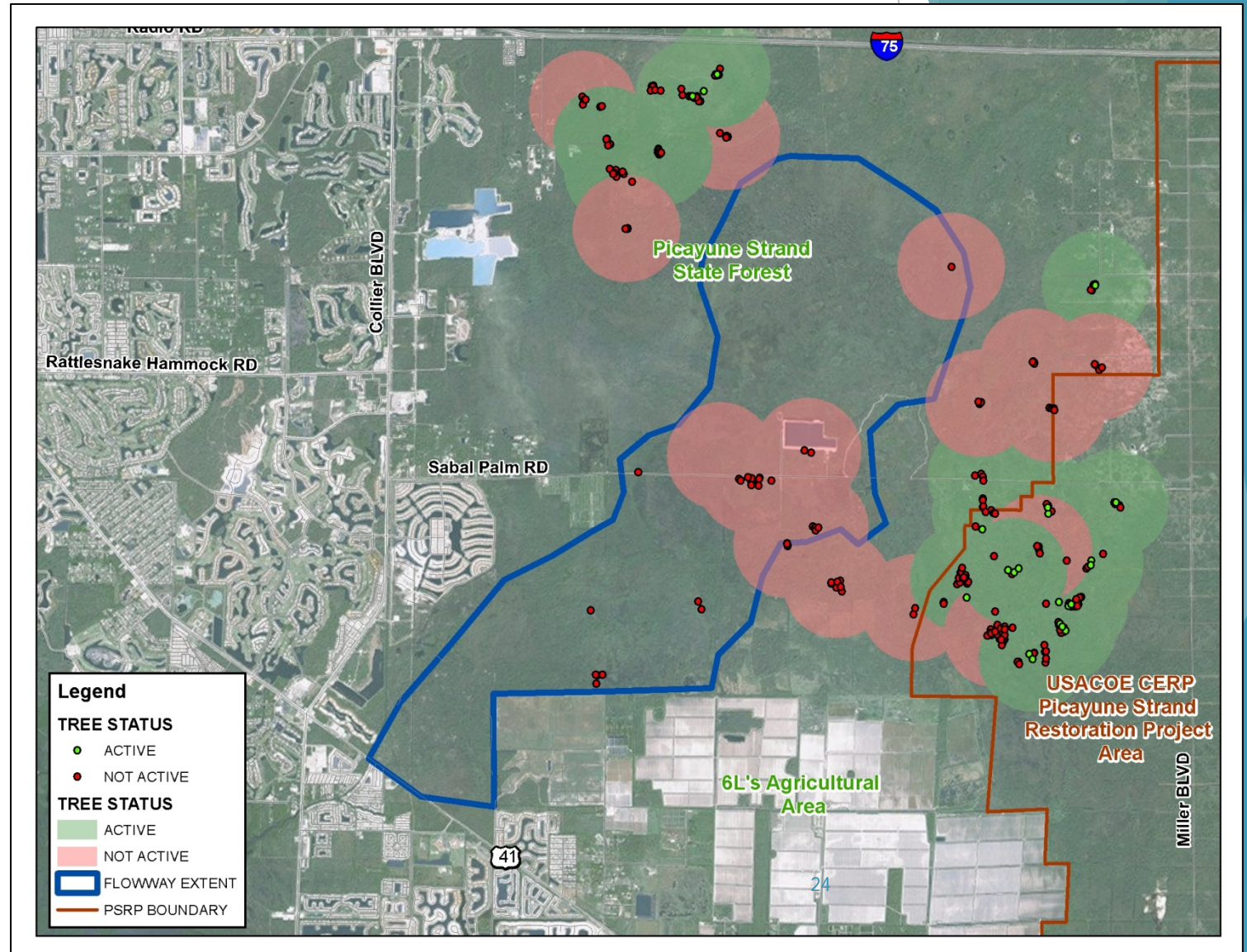
# Rehydration Area – PSSF/South Belle Meade

- ▶ Most of project area (10,000 ac.) is publically owned with approx 61 private parcels in the project area
- ▶ Will address the development rights for 45 privately-owned parcels during design
- ▶ Lot of Flexibility: parcel avoidance; protective measures, TDR program and purchase
- ▶ Parcels in the southwest are either being developed with wetland capacity or are designated wetlands



# PSSF/South Belle Meade Concerns

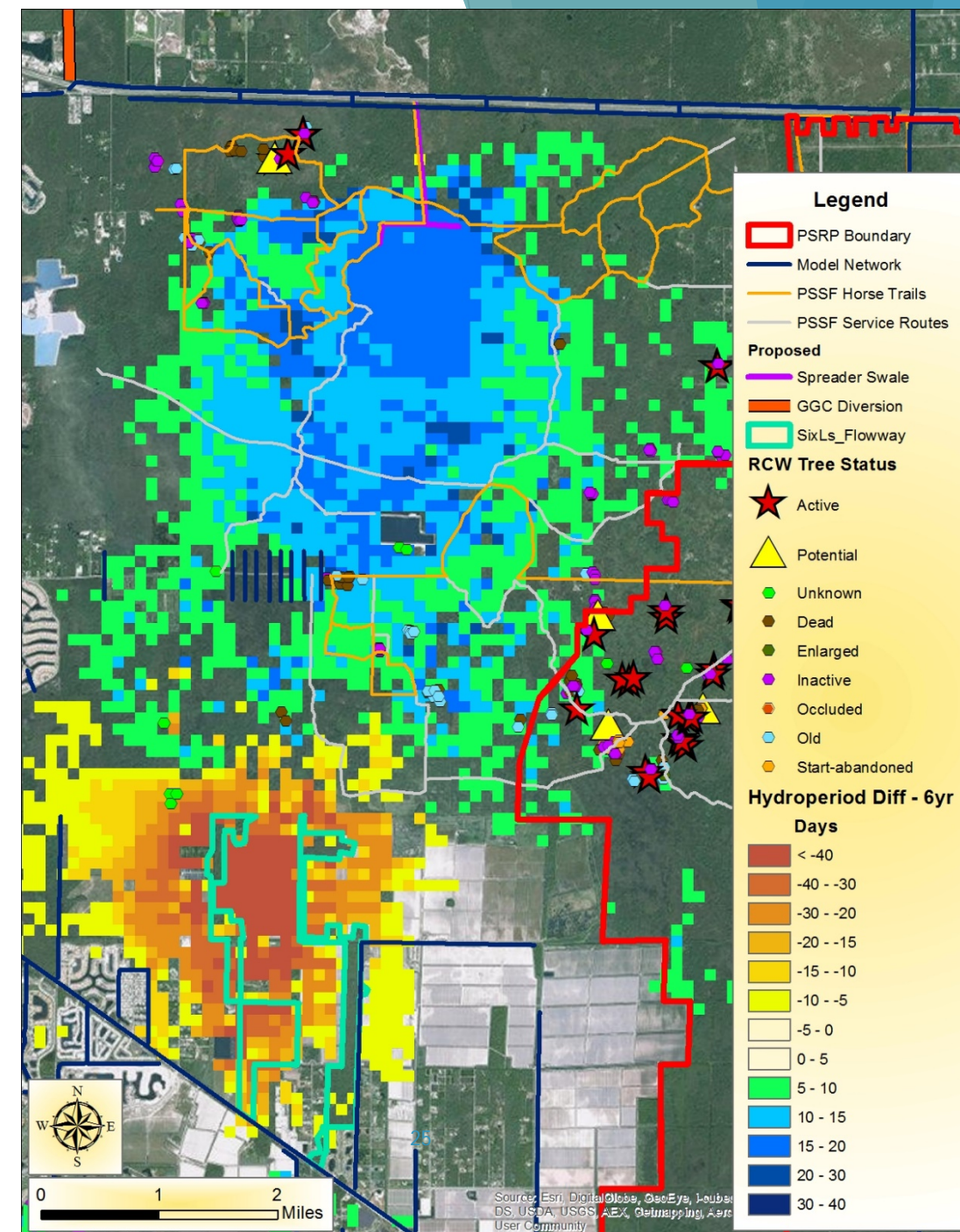
- ▶ No impact to RCW population - Federally endangered species
- ▶ Project flow-way cannot impact RCW current or expansion area habitat
- ▶ No degradation to mesic or hydric flatwoods
- ▶ No functional decrease in recreational features or roads; no permanent earthen features
- ▶ Monitoring and adaptability
- ▶ Invasive species mgt
- ▶ No impacts to Federal project





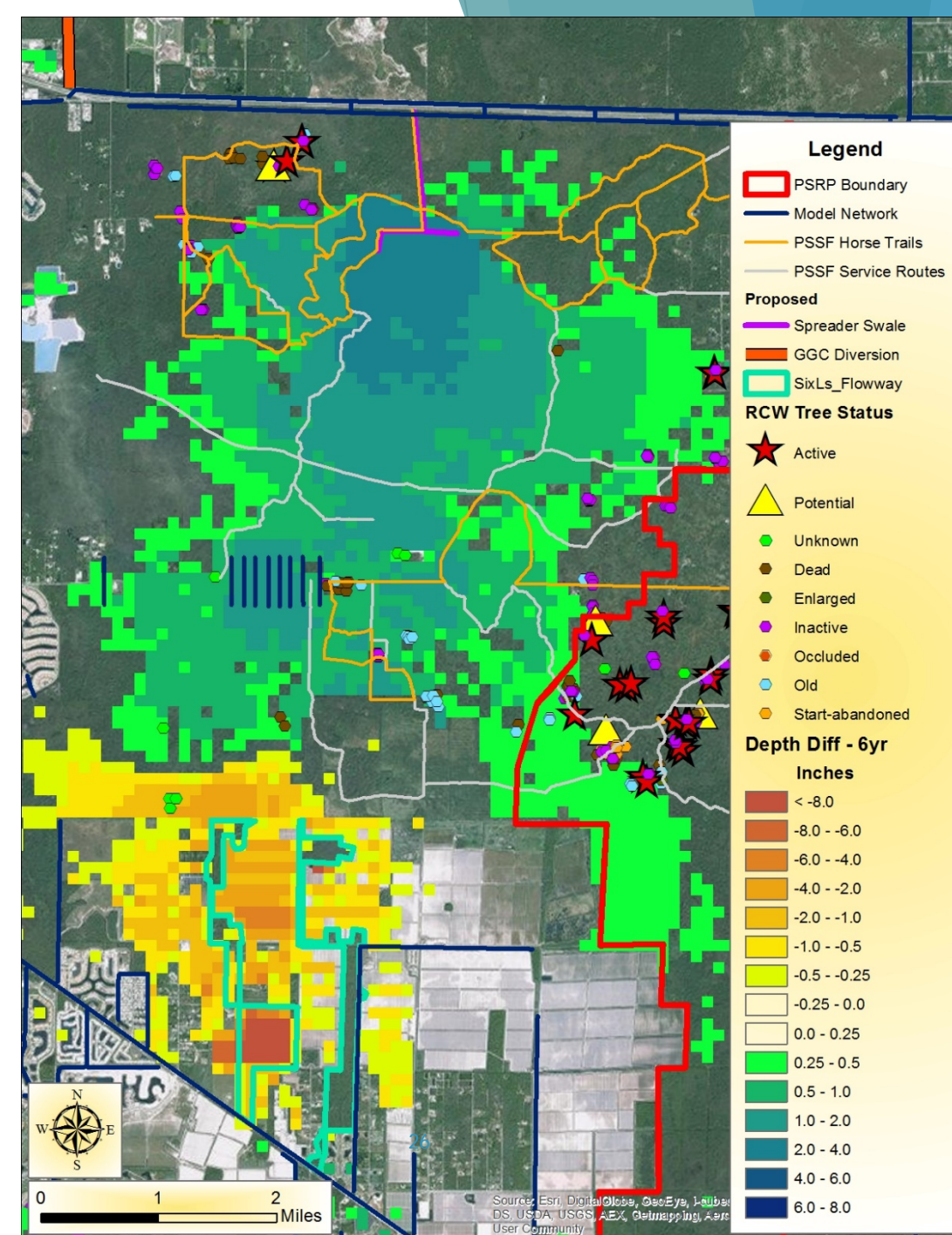
# Preliminary Model Results - Hydroperiod (2009 - 2014)

- ▶ Largest hydroperiod increases in the center of forest near the spreader (cypress)
- ▶ Minimal impacts outside of forest
- ▶ No impacts to RCW habitat
- ▶ Minimal changes to vegetation communities
- ▶ PSRP hydraulic gradient from pumping will prevent flows from PSRP area
- ▶ Water level reductions in Six L's farm area will be resolved with control structures



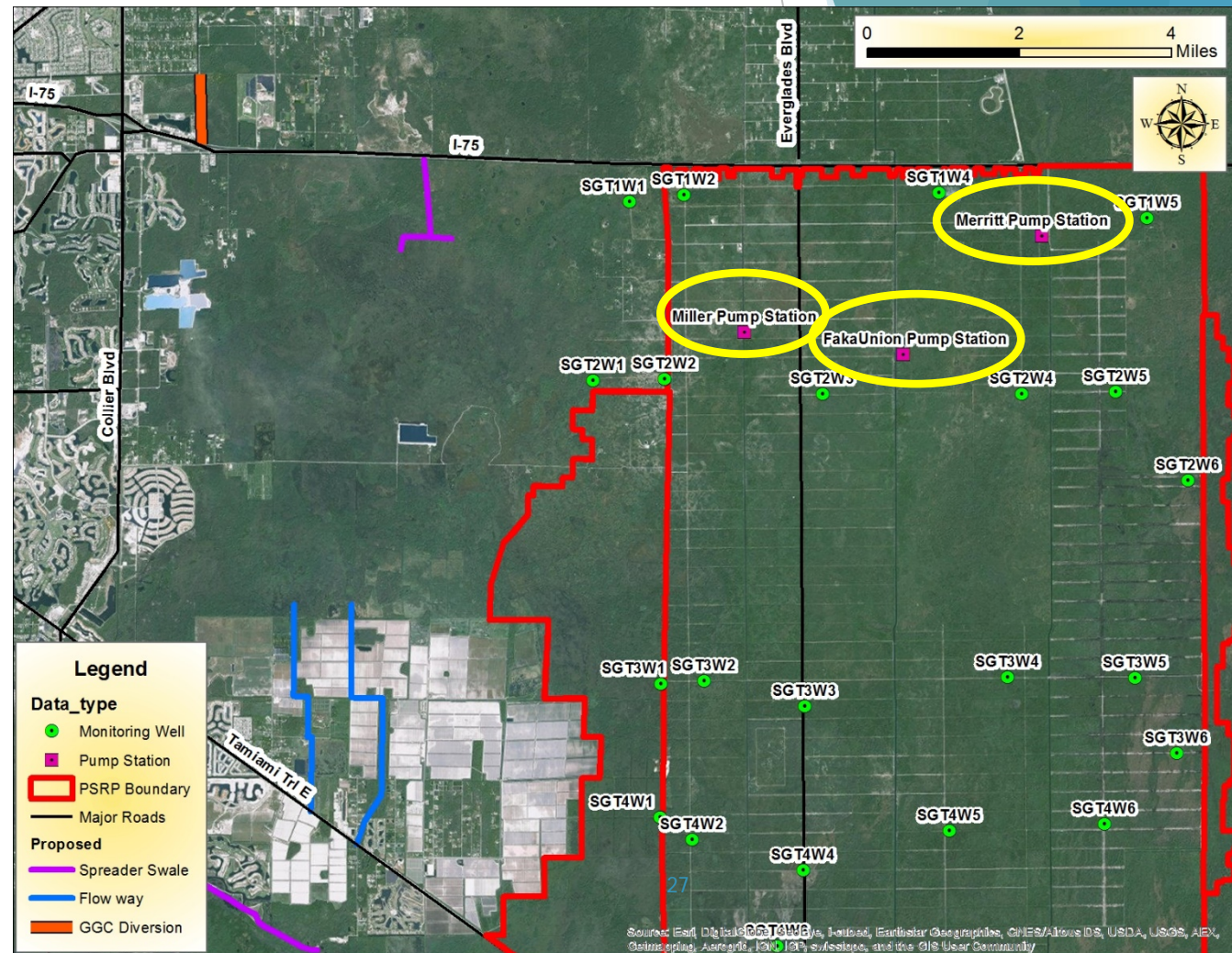
# Preliminary Model Results- Average Depths (2009 - 2014)

- ▶ Largest average depth increases in the center of forest near the spreader (cypress wetland)
- ▶ Average depth increases are less than 1-inch in hydric and mesic flatwood areas
- ▶ Minimal impacts outside of forest
- ▶ No impacts to RCW habitat
- ▶ Minimal changes to vegetation communities
- ▶ Reductions in Six L's will be resolved with control structures
- ▶ PSRP hydraulic gradient from pumping will prevent eastern flow migration

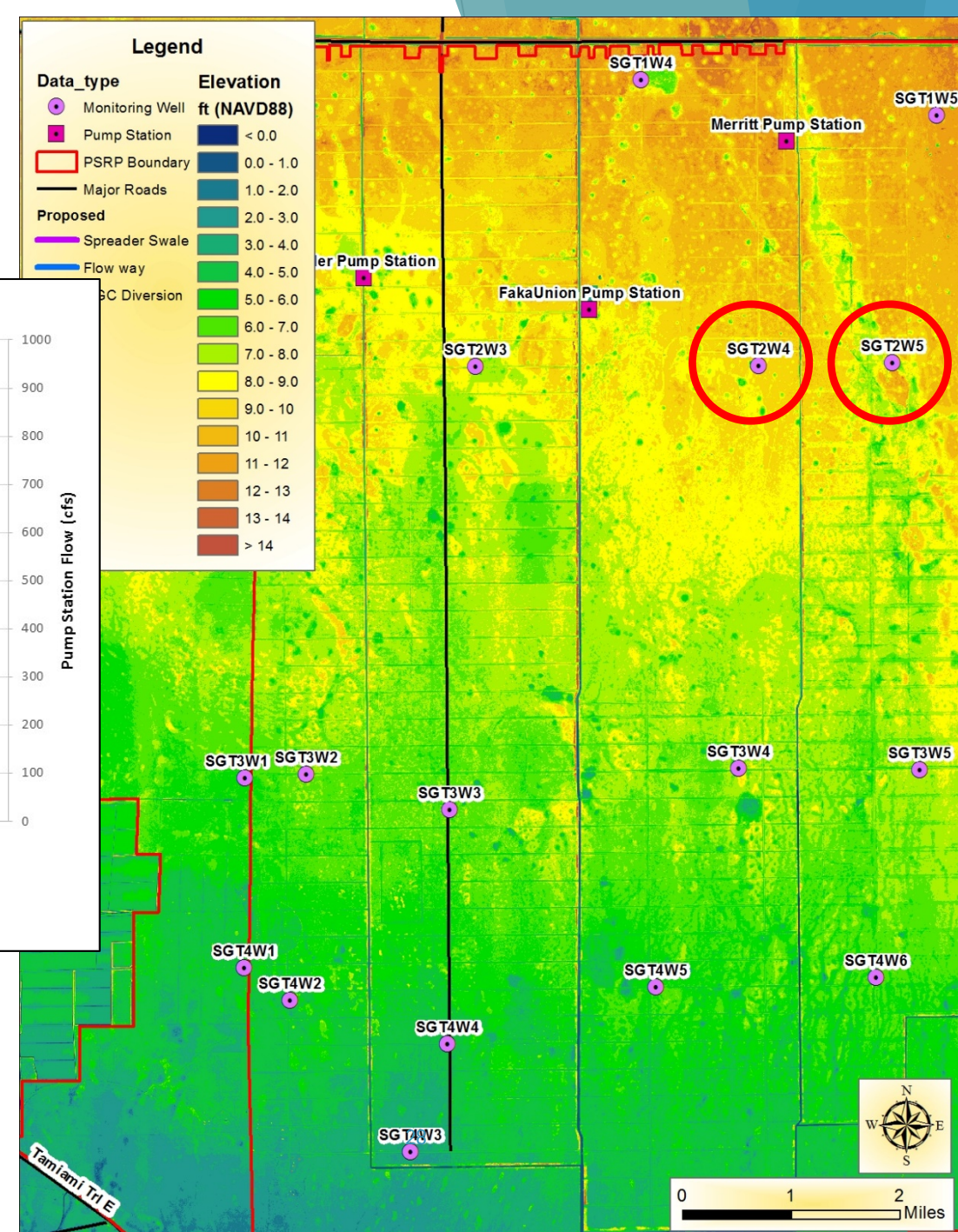
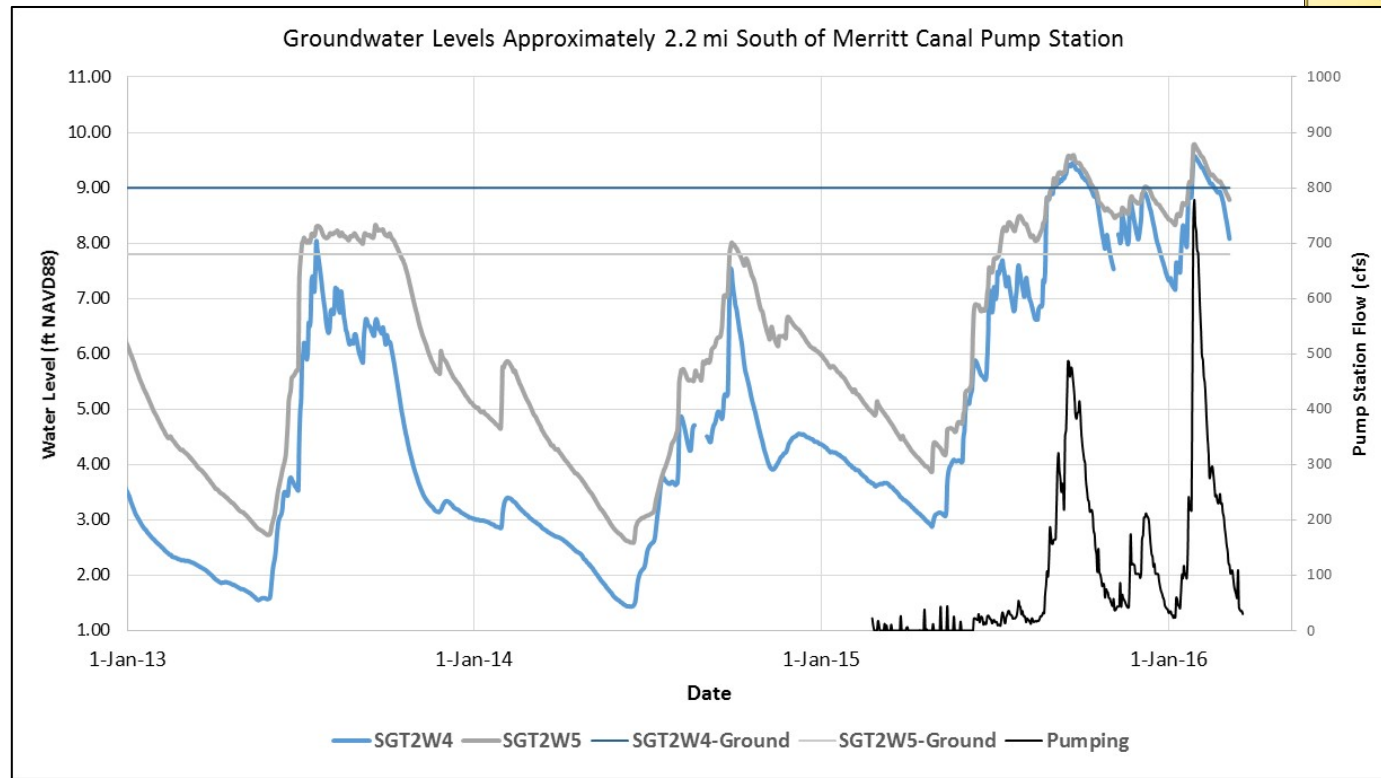


# Potential effects of PSRP east of Six L's

- ▶ Merritt Pump station (810 cfs) - activated in 2015
- ▶ Miller Pump station (1250 cfs) - estimated to open in 2020
- ▶ FakaUnion Pump station (2650 cfs) - estimated to open in 2020



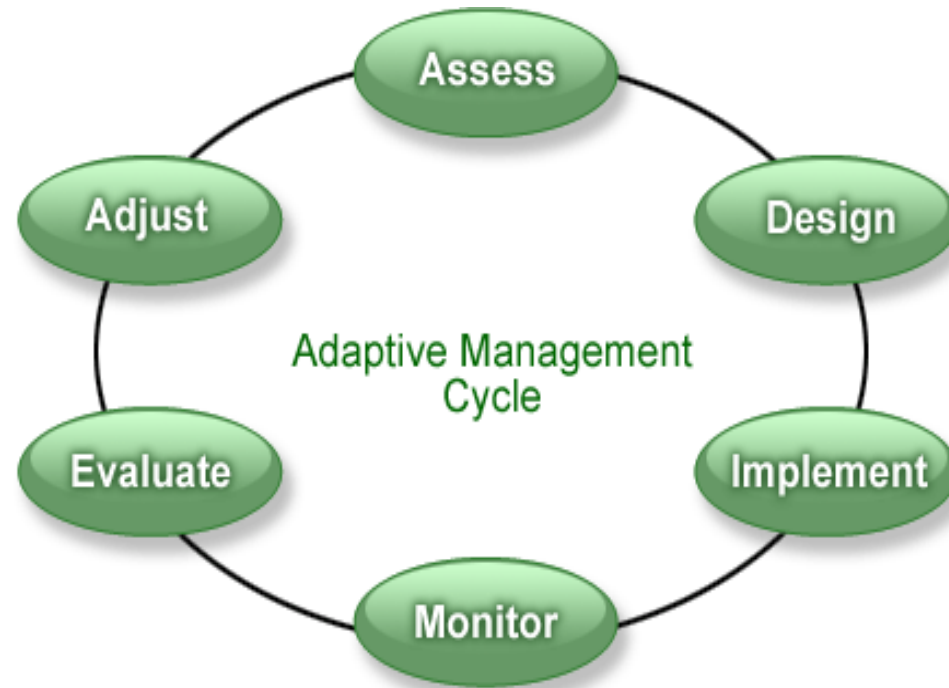
# Effects of PSRP on groundwater levels east of Six L's



► Hydraulic gradient from PSRP pumping will prevent our flows from going to the PSRP

# Preventing adverse impacts to ecology and hydrology

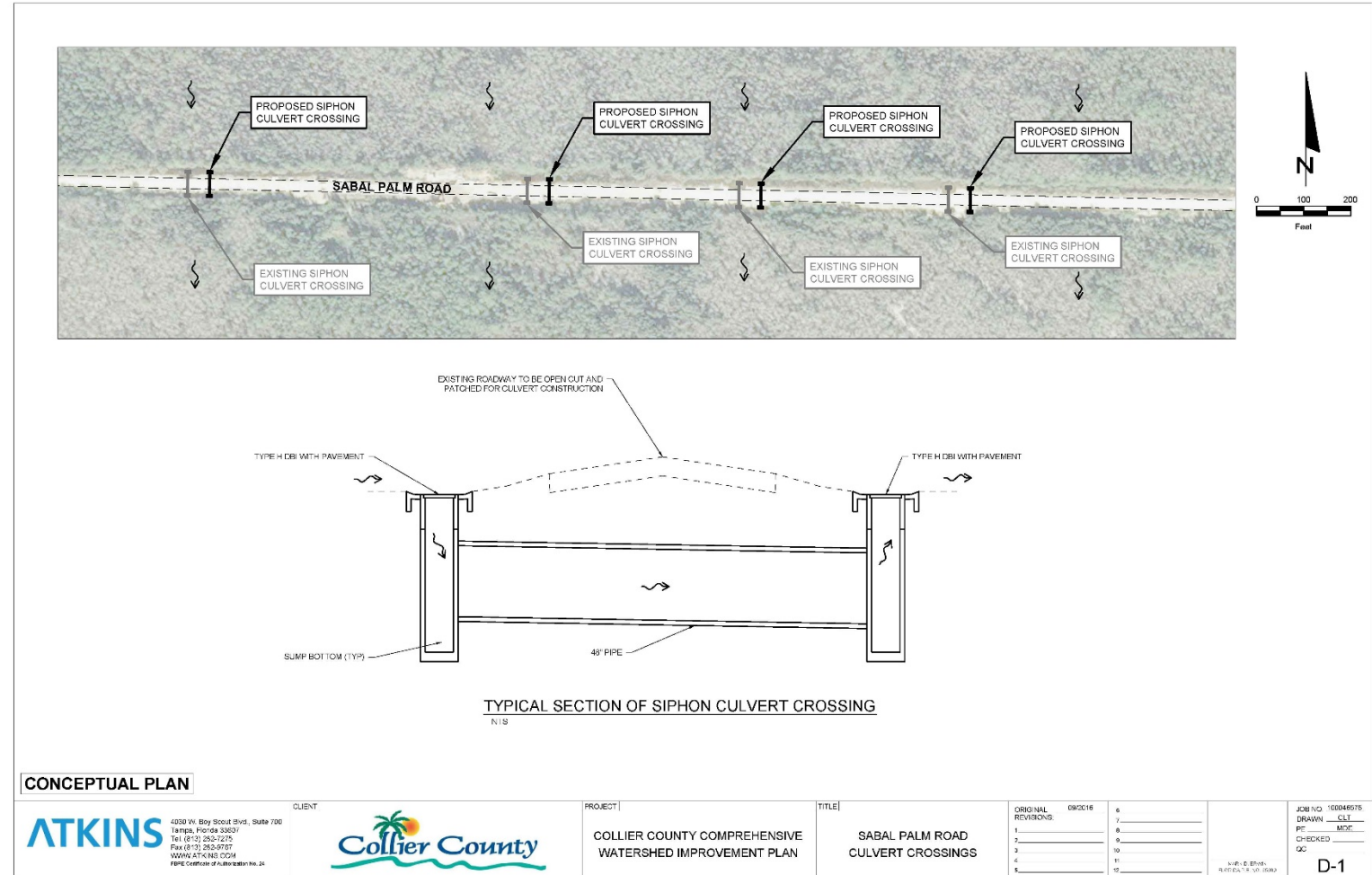
- ▶ Adaptive management approach
- ▶ Hydrologic, wetland and habitat monitoring
- ▶ System will be flexible
- ▶ Diverted flows can be decreased if needed or system capacity could be increased





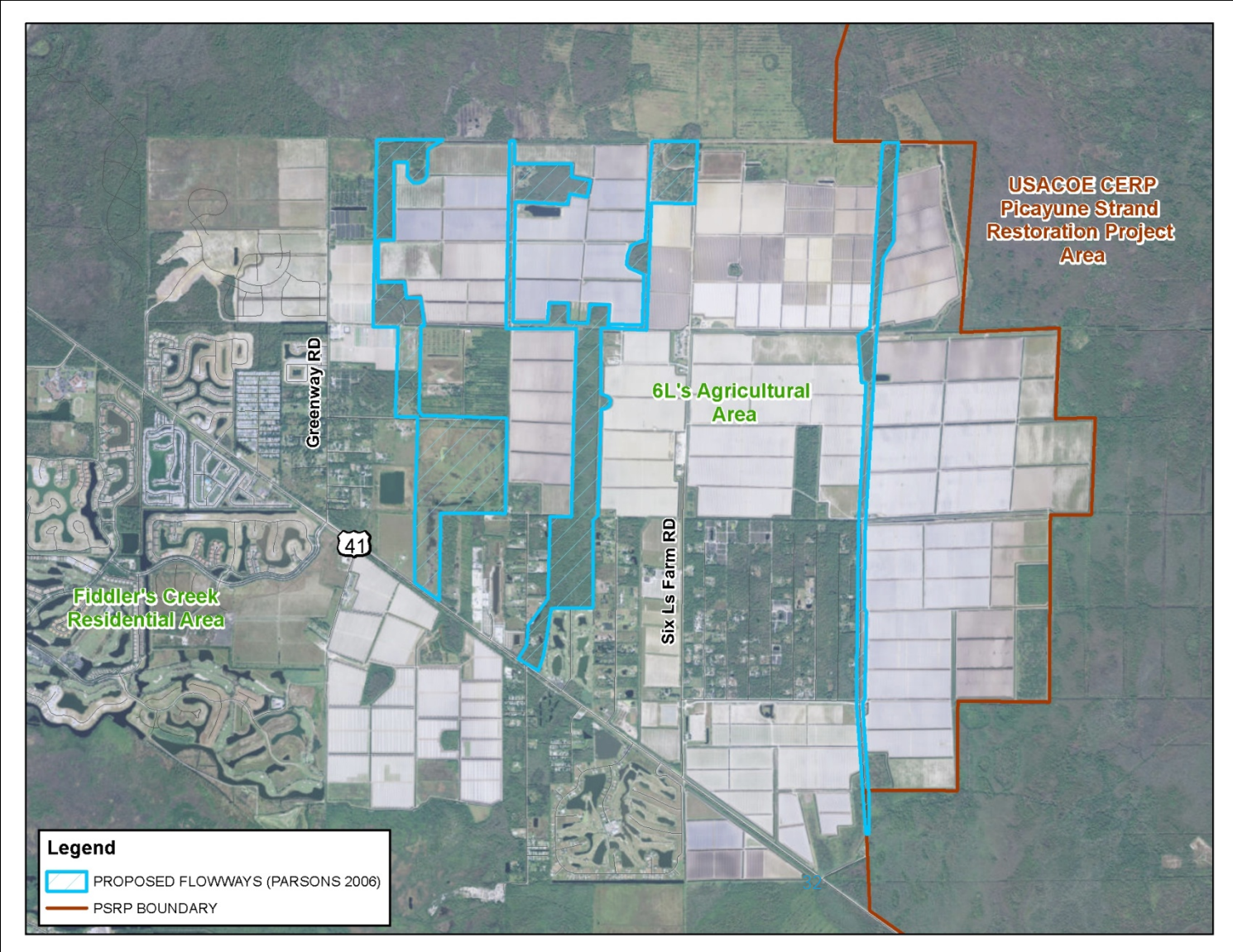
# Project Area D

- ▶ Project Components
  - ▶ 4 new siphon culvert crossings to convey additional flow
  - ▶ Reconstruct road to existing conditions



# Six L's Historical Flow-ways

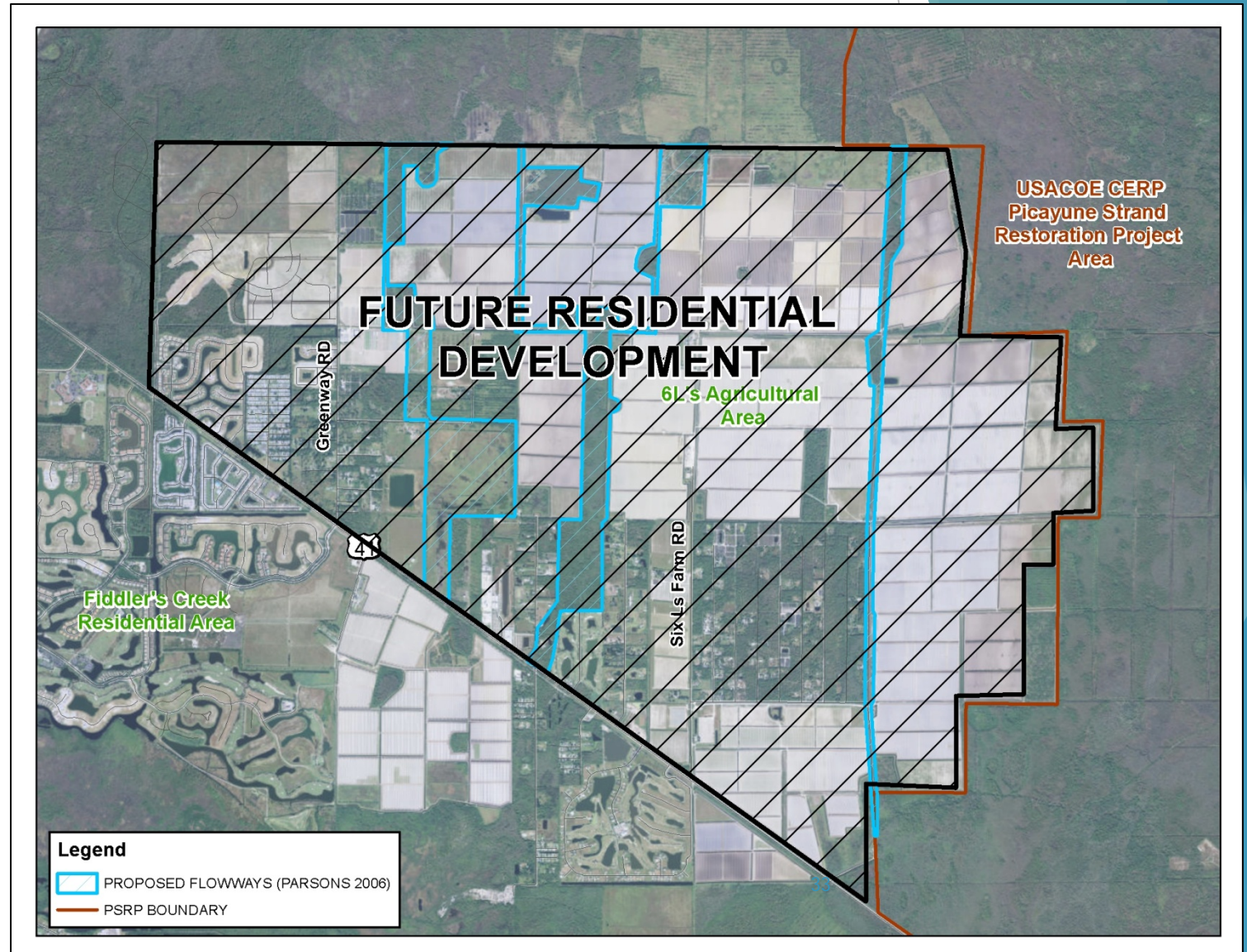
- ▶ Proposed flow-ways from historical analysis (Parsons 2006)



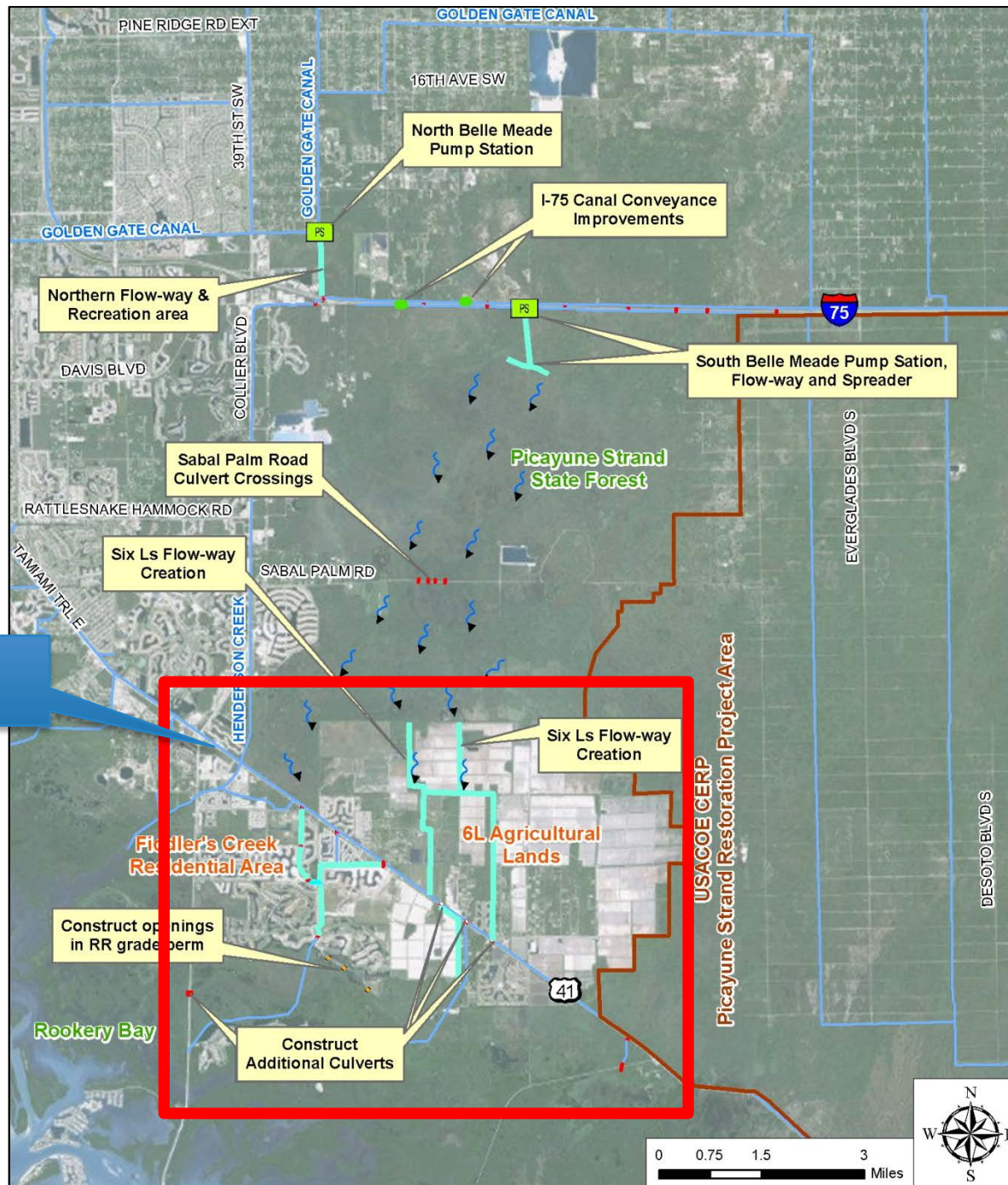


# Six L's Historical Flow-ways

- ▶ Proposed flow-ways from historical analysis (Parsons 2006)
- ▶ This will be coordinated with Six L's if/when the area transitions to residential development in the future

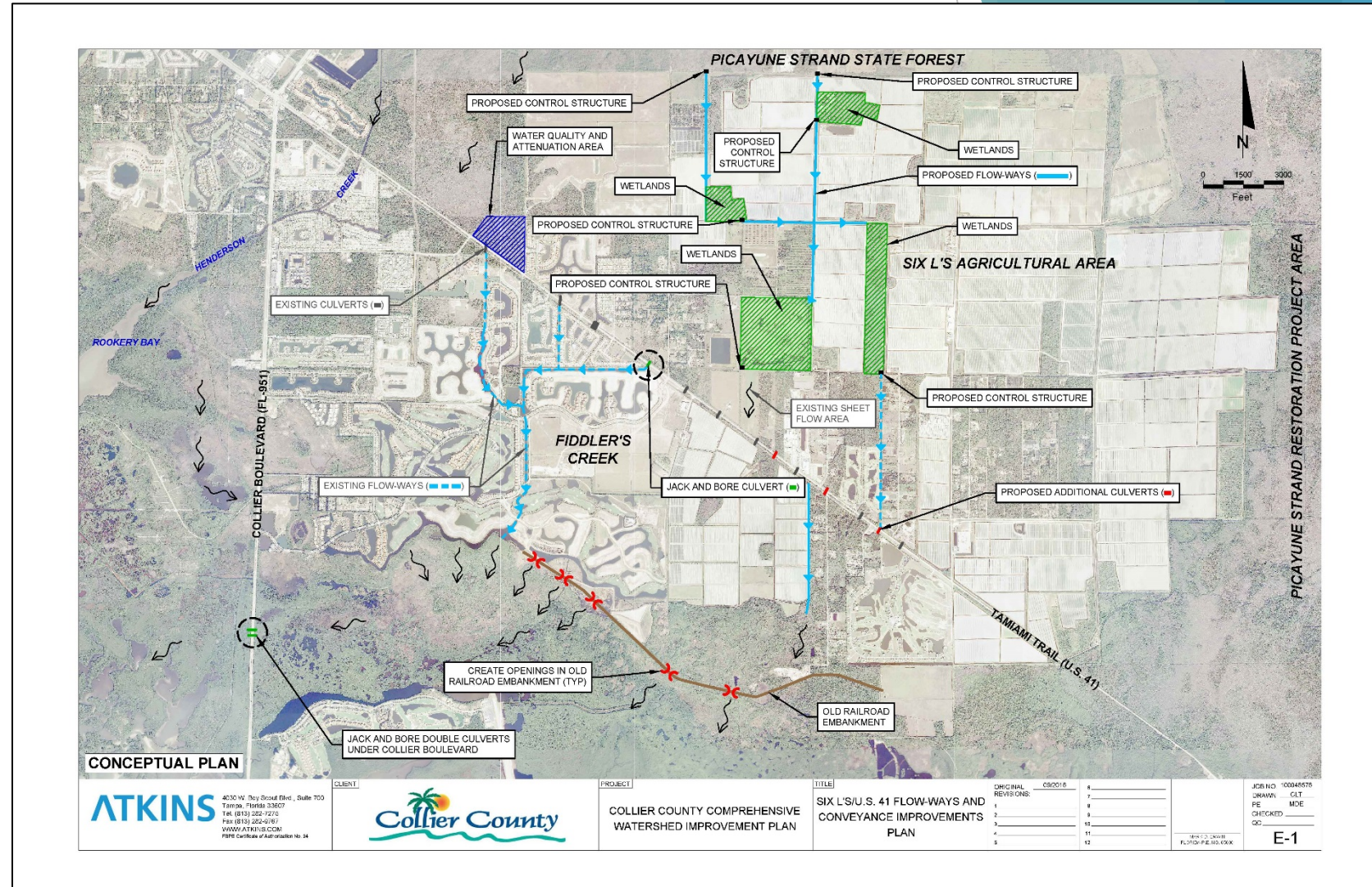


# Project Area E



# Project Area E

- ▶ Project Components
  - ▶ Construct new flow-ways through historical flow-way areas
  - ▶ Construct new culvert crossings under US 41 and SR 951
  - ▶ Create openings in historic RR berm
  - ▶ Create water quality and flow attenuation area on public parcel



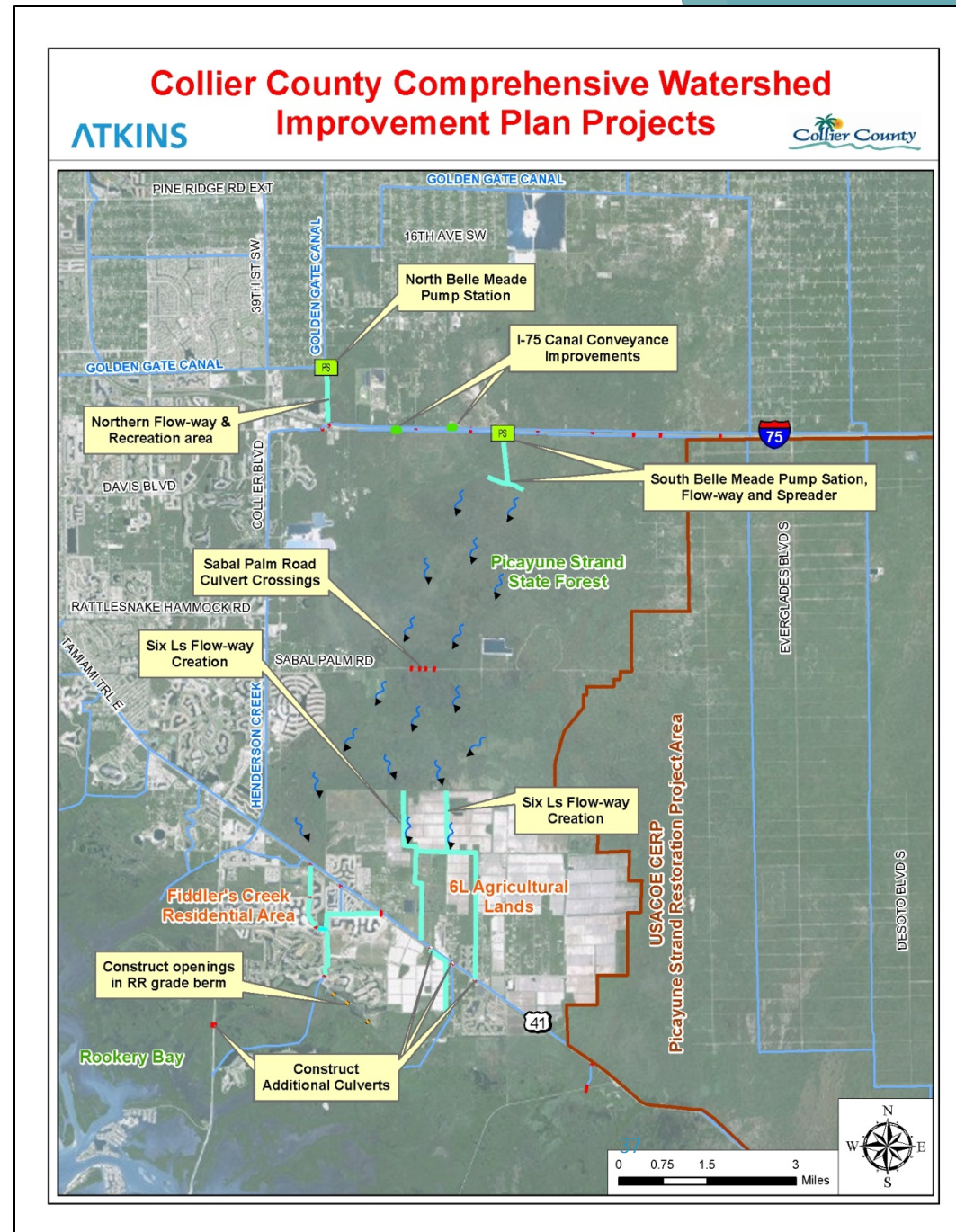


# Critical issues being addressed

- ▶ **Additional Flows to Rookery Bay**
  - ▶ The additional flows from the project supplement the documented existing flow deficits
- ▶ **South Belle Meade property evaluation (TDR program)**
  - ▶ 45 private parcels need development rights evaluated
  - ▶ 16 parcels are already in the TDR program
- ▶ **Preventing adverse impacts to ecology and hydrology**
  - ▶ No impacts to Red-Cockaded Woodpecker (RCW) habitat
  - ▶ Minimal changes to vegetation communities
  - ▶ Use an adaptive management approach
  - ▶ No additional flows to the Picayune Strand Restoration Project (east side)
  - ▶ Project pumping will reduce the probability of damaging fires in the dry season
  - ▶ Restoring hydrology will benefit vegetation: reduce palm encroachment and support historic cypress communities
  - ▶ Consistent with latest Management Plan for Picayune Strand State Forest and addresses Forestry concerns
- ▶ **Bypassing flow through and around the Six L's Agricultural lands**
  - ▶ Historical flow-ways will be re-established through future modifications in the Land development code

# Projects by Area

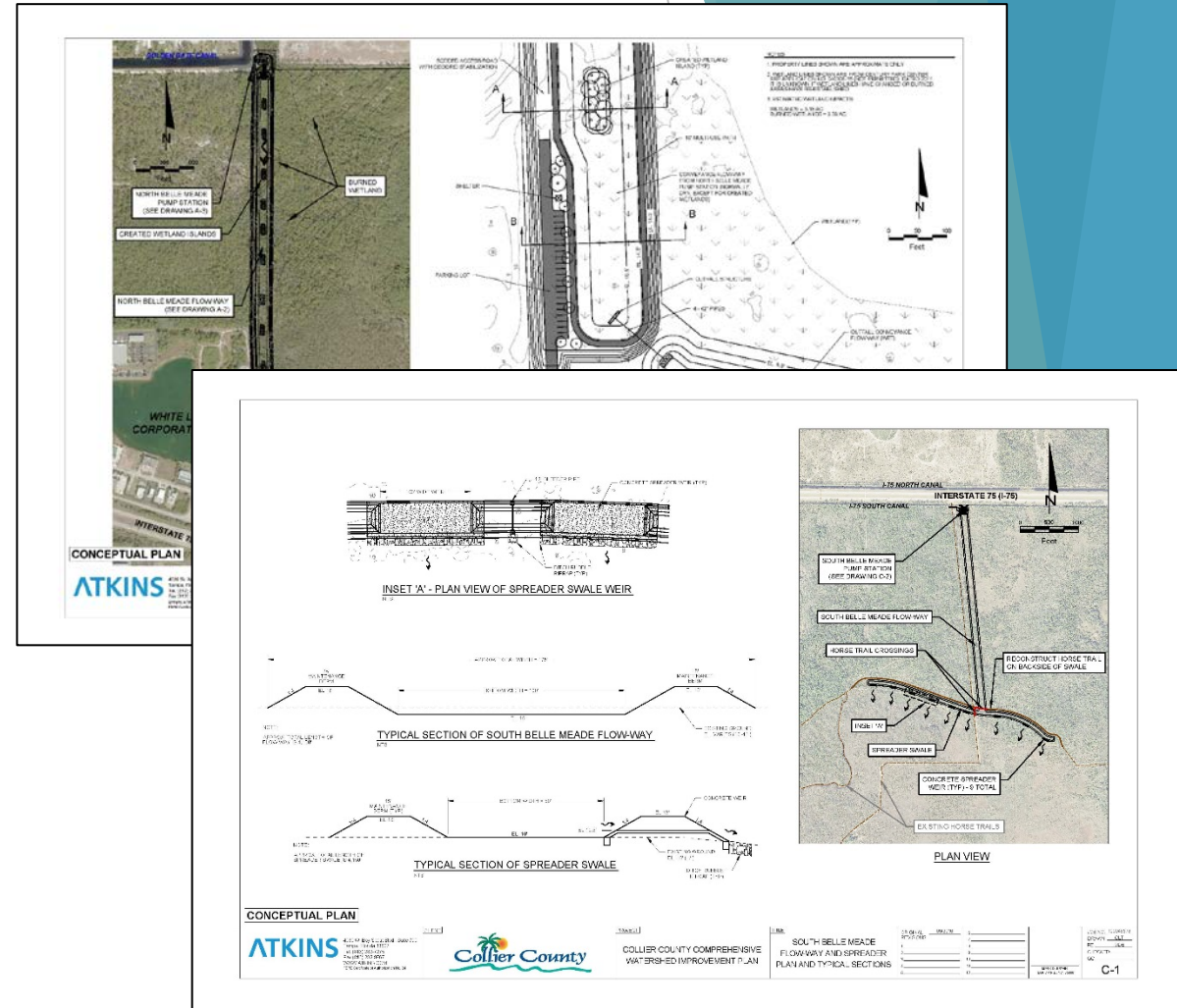
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- ▶ Components have been tailored to meet project-specific goals
- ▶ Projects have been (and are still being) vetted in terms of feasibility and permitting.
- ▶ Projects have been (and are still being) coordinated with local agencies, NGOs and other interested parties
- ▶ Projects are consistent with the RESTORE Comprehensive Management Plan



# Project Development and Estimated Cost

- ▶ Project conceptual plan set (~15% design level and includes a 30% contingency and future cost escalation)

Project Area A (North Pump Station Plan)	6.2M
Project Area B (I-75 Canals Plan)	1.7M
Project Area C (South Pump Station Plan)	5.7M
Project Area D (Sabal Palm Rd. Culverts)	0.2M
Project Area E (Six L's/US 41 Plan)	9.2M
Minor projects	1M
Project Development & Design	3M
Monitoring & SCADA Telemetry	1M
Permitting & Mitigation	2M
<i>(Phase II) North Belle Meade Flow-way</i>	
<i>Preliminary Engineering</i>	1M
<i>(Phase II) Six L's Masterplan</i>	1M
<b>TOTAL</b>	<b>32M</b>

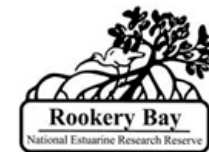




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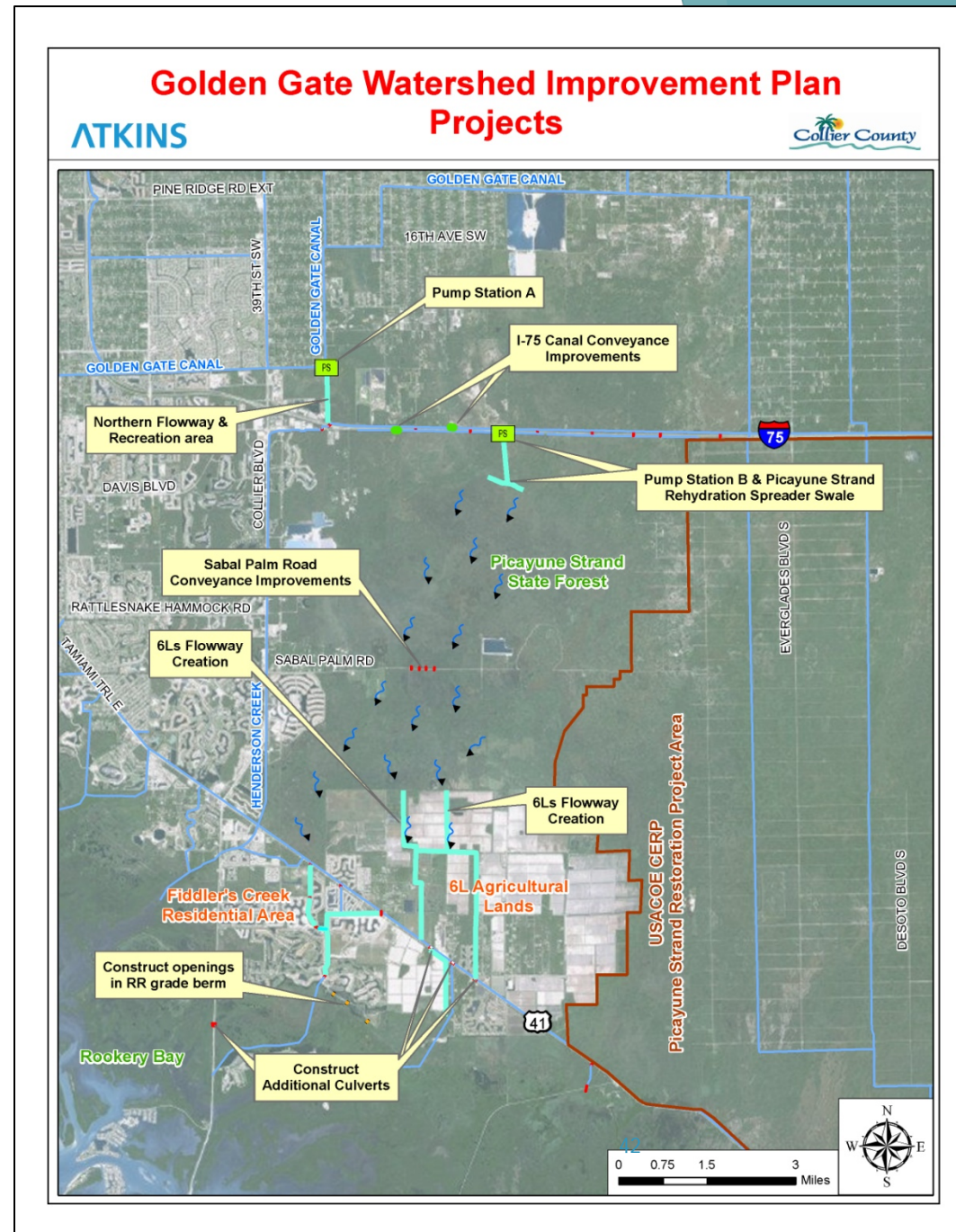


# Key Program Points

- ▶ Highly Altered Watersheds, Habitat and Ecological Systems
- ▶ Rookery Bay watershed highly modified, and reduced by ca. 80 sq. miles
- ▶ Naples Bay watershed highly modified, and increased by ca. 100 square miles
- ▶ Consensus on impacts to watersheds and coastal waters from altered hydrology
- ▶ Divert flows out of GGC when sufficient water is available (June - October) to avoid upstream water user impacts
- ▶ Diversion flows into historic flow-way to south
- ▶ Protective of threshold for excess inflows to the Rookery Bay watershed
- ▶ Avoids impacts to the Picayune Strand Restoration Project (PSRP)
- ▶ Consistent with latest Management Plan for Picayune Strand State Forest
- ▶ Based on observed flows and gate levels in the Golden Gate Canal from January 1, 2009 to January 1, 2014
- ▶ Diversions could occur on approximately 42 days per year (11% of days)
- ▶ On days when pumping occurs, diverts approximately 19% of flows from Naples Bay
- ▶ Those 11% of days represent approximately 9.5% of wet season inflows and 8% of total yearly inflows
- ▶ 2.7 B gals per year or 8,250 acre-feet
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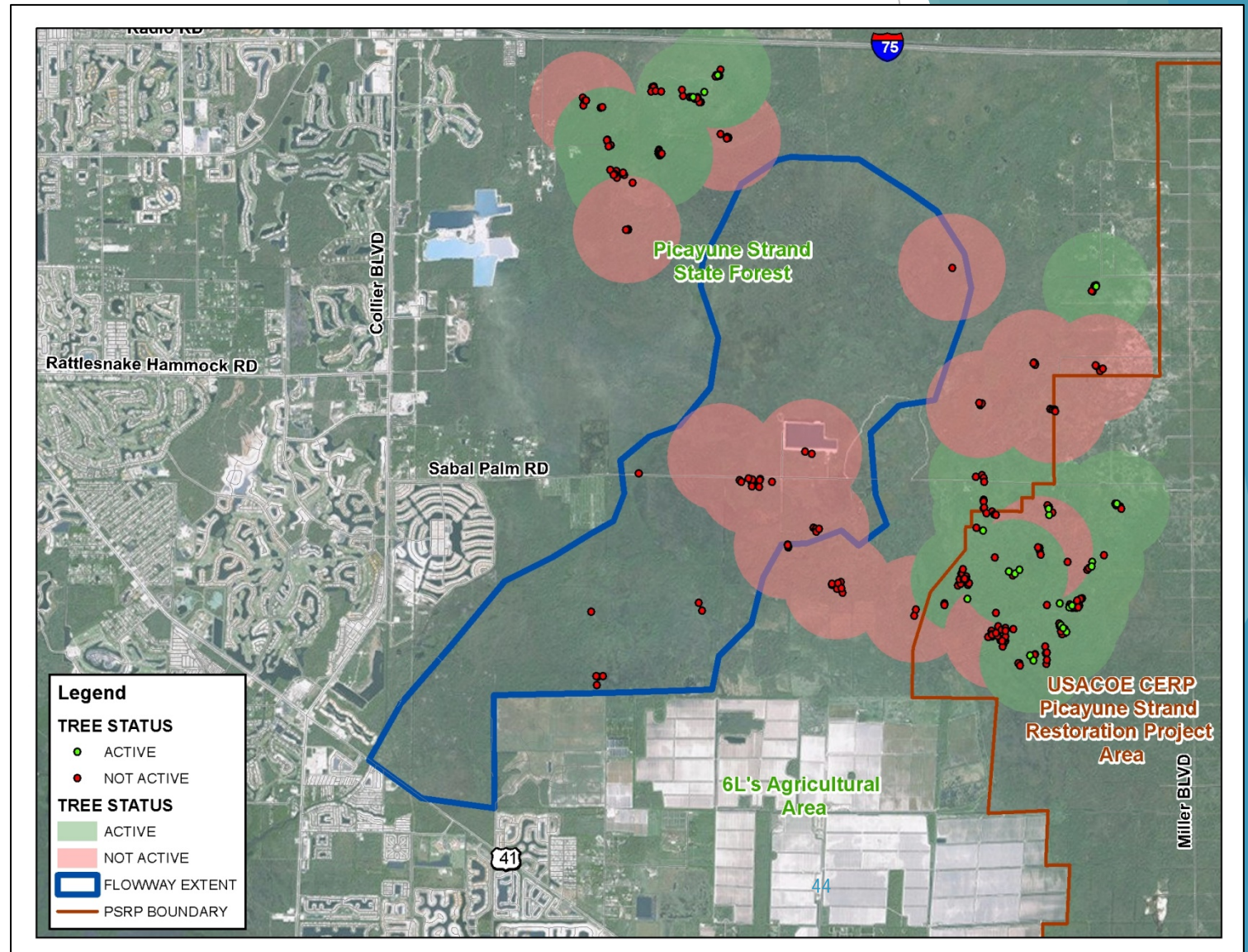


# Estimating benefits

- ▶ **Naples Bay**
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- ▶ **Picayune Strand State Forest**
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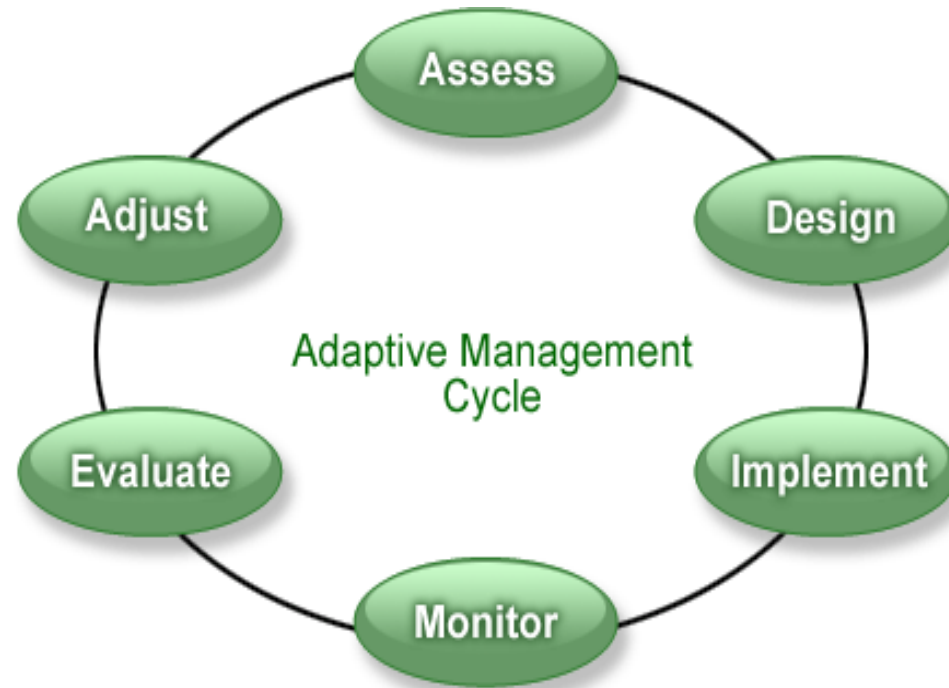
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# Preventing adverse impacts to ecology and hydrology

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# Supporting Organizations

- ▶ Florida Fish and Wildlife Conservation Commission
- ▶ Big Cypress Basin/SFWMD
- ▶ City of Naples
- ▶ Fish and Wildlife Service
- ▶ Florida Wildlife Federation
- ▶ Conservancy of SW Florida
- ▶ Audubon of the Western Everglades
- ▶ Collier County Watershed Technical Advisory Committee
- ▶ Rookery Bay National Estuarine Research Reserve