SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Northern Everglades
Research & Water Quality Monitoring Program
Caloosahatchee Estuary

Aquatic Habitat Monitoring Follow-up
Round 2 – with Strawman Overview

May 2008

sfwmd.gov

Objective: Finalize aquatic habitat monitoring related to the Northern Everglades Initiative objectives.

Aquatic Habitats of Concern:

Oysters (Flows)

Submerged Aquatic Vegetation (Flows and Loads)

May 2008

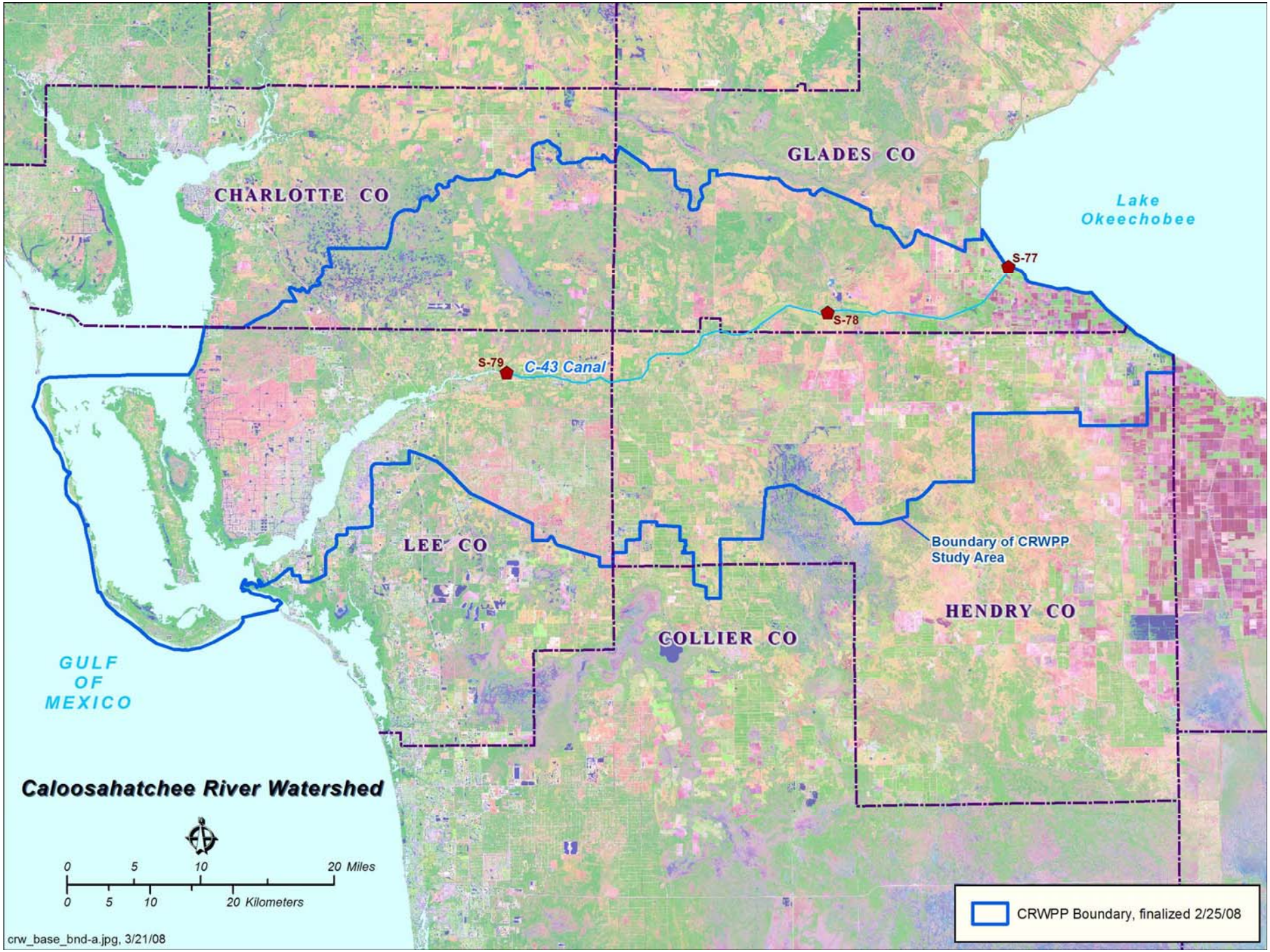
General Monitoring Objectives

- Detect responses of the ecosystem components (Oysters and SAV) within the boundaries of the RWPP to changes resulting from the project **(Changes in Flows, and WQ)**

- Provide information necessary for adaptive management needs

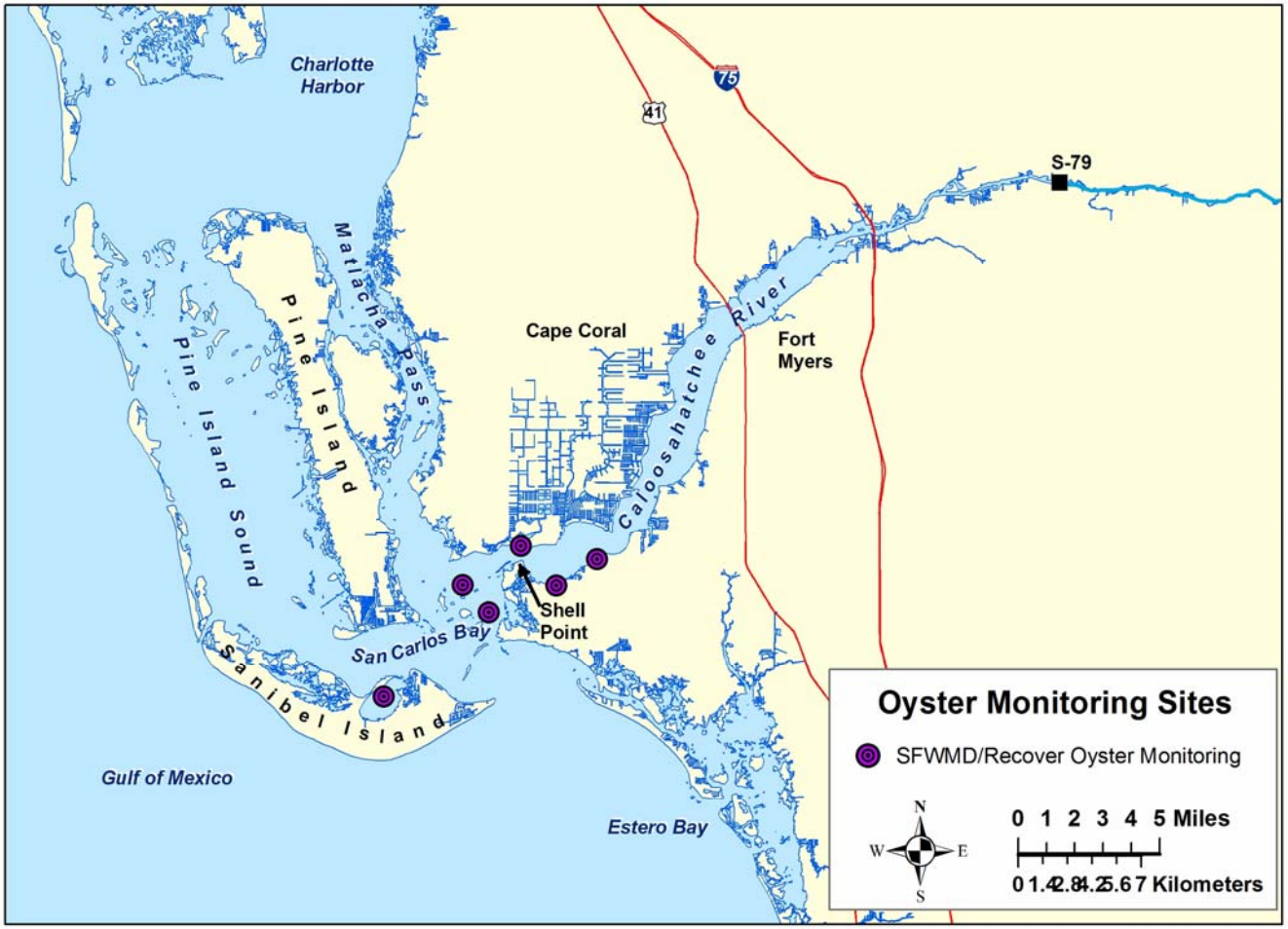
Oyster Monitoring

- Existing Monitoring Locations
- Summary
- Oyster Monitoring Topics
- Recommendations


GLADES CO
CHARLOTTE CO
Lake
Okeechobee
S-77
S-78
S-79
C-43 Canal
LEE CO
Boundary of CRWPP
Study Area
HENDRY CO
COLLIER CO
GULF
OF
MEXICO
Caloosahatchee River Watershed
0 5 10 20 Miles
0 5 10 20 Kilometers
CRWPP Boundary, finalized 2/25/08
crw_base_bnd-a.jpg, 3/21/08

Existing Oyster Monitoring Locations

(Indicator/integrator of water quantity)



Parameters Measured in RECOVER's Oysters Monitoring Program (Volety)

ATTRIBUTRE	PARAMETERS	STATIONS	FREQUENCY	COLLECTION
Water	Dissolved Oxygen, pH, salinity, conductivity and temperature	All	Monthly	YSI/Hydrolab
Oysters-Adults	Density and size of living adults/m^2	All	Winter	Quadrat Counts and *in situ* measurements
Oysters	Gonadal Index, Gonadal conditions	All	Monthly	Histology and image analysis from collected samples
Oysters-Spat	Oyster spat Recruitment and growth upon settlement	All	Monthly	Count Spat on oyster settling apparatus and measure growth
Oyster-Juveniles	Juvenile oyster growth and survival	All	Monthly	Measure 50 random juvenile oysters from wire mesh bag: Examine % survival of all juvenile oysters.

Oyster Monitoring Topics (from April discussion and listed on the board)

- **Adult oyster size –** (a) Do we measure the size of adults?…Should we? It was suggested to report average adult oyster size in the population; (b) Is there an ambient size that can be used as a performance measure and therefore needs monitoring?

  (a) Size *is* being measured when density is sampled.

  (b) Probably not necessary.. Can do if deemed important as part of required program assessment

- **Recruitment –** Do we adequately measure recruitment?

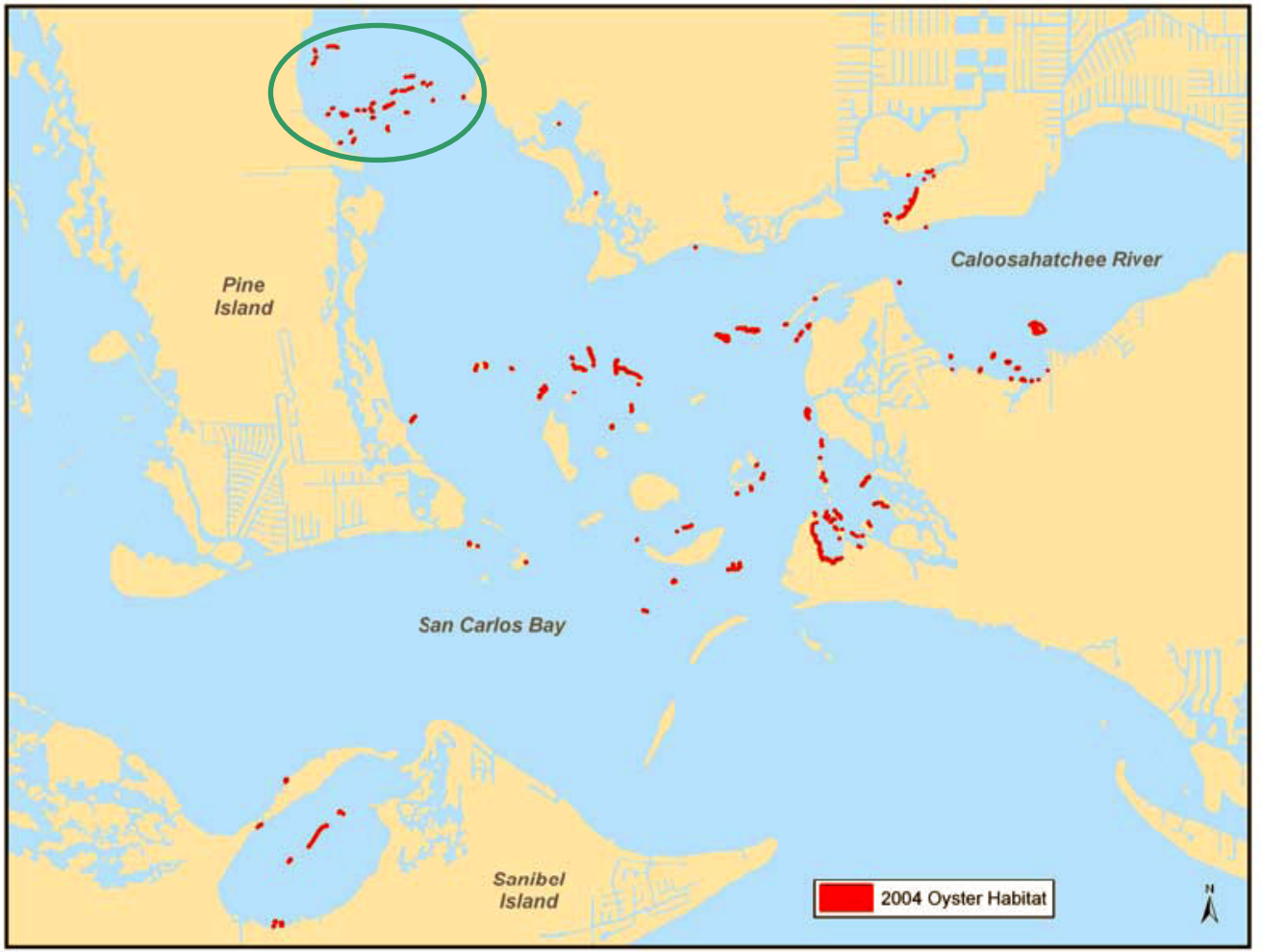
  (a) Generally…YES. Topic is being addressed for NE Initiative by existing monitoring (see handout of research topics for possible additional efforts)

- **The need to map oysters -** Frequency and aerial extent of mapping to detect change in population size and location related to NE (Caloosahatchee Watershed) improvements?

  Last survey done in 2004. RECOVER (2007) proposes/considered surveys every 3-5 years. Volety agrees it is needed at 5 year intervals is adequate (next survey in 2009).

  See following map for aerial extend as example of proposed map coverage.

Oyster Habitat in the Caloosahatchee Estuary (2004)



Monitoring Topics – Oysters (continued)

- **Station Coverage –** Is it adequate...should a station be moved or added to include the lower Matlacha Pass reefs?

  As per Volety (pers. verbal com and e-mail), moving or adding a station is not advised at this time (waiting for written confirmation), because:

  (1) **The current monitoring effort *is* adequate for addressing project objectives;**

  (2) **The current array of stations represents a long term data set that is just now beginning to show spatial changes related to monthly and annual freshwater inflow differences;**

  (3) **Suspects the reefs in lower Matlacha Pass (circled on map) respond to Caloosahatchee flows and the current array of stations are adequate for detecting changes related to these flows.**

Monitoring Recommendations – Oysters

- **Continue existing monitoring**
- **Move forward with plan to conduct aerial mapping in 2009 and every 5 years.**

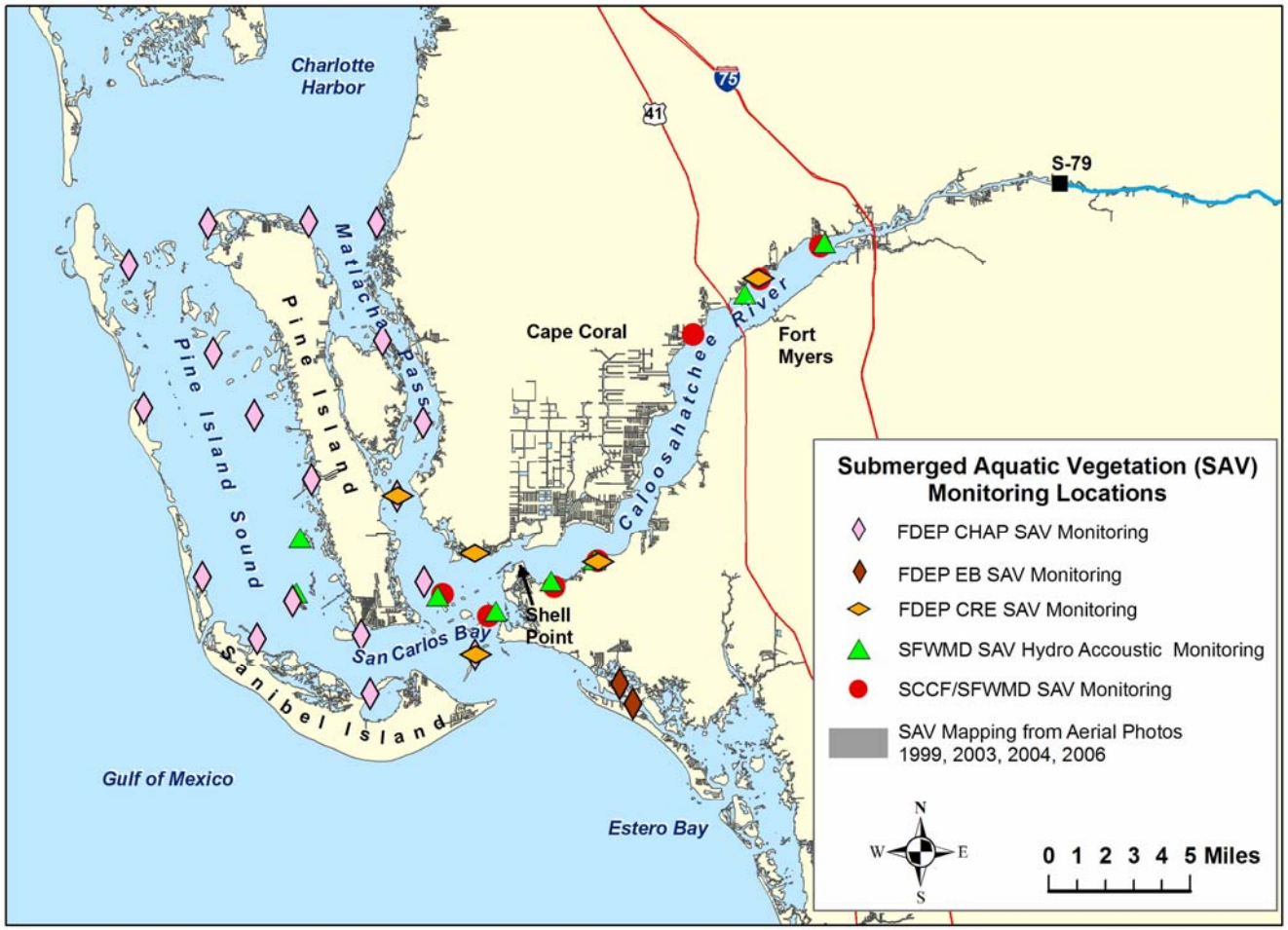
New (Final) Table Summarizing Proposed Oyster Monitoring

ATTRIBUTE	PARAMETERS	STATIONS	FREQUENCY	COLLECTION
Water	Dissolved Oxygen, pH, salinity, conductivity and temperature	All	Monthly	YSI / Hydrolab
Oysters-Adults	Density and size of living adults / m^2	All	Winter	Quadrat Counts and *in situ* measurements
Oysters	Gonadal Index, Gonadal conditions	All	Monthly	Histology and image analysis from collected samples
Oysters-Spat	Oyster spat recruitment & growth	All	Monthly	Count spat on oyster settling apparatus and measure growth during month
Oyster-Juveniles	Juvenile oyster growth and survival	All	Monthly	Measure 50 random juvenile oysters from wire mesh bag: Examine % survival of all juvenile oysters.
Reef - Spatial Coverage	Spatial Coverage (acres)	Lower Estuary and San Carlos Bay area	Every 5 years	Aerial photographs and interpretation of live oyster reefs size & locations, with Ground truthing

SAV Monitoring

- Existing Monitoring Locations
- Summary
- SAV Parameters Discussed from previous meeting
- Recommendations

Existing SAV Monitoring of All 6 Programs



Reminder - Six existing SAV monitoring programs

(Indicator/integrator of both Quantity and WQ)

Organization Conducting Sampling	Sampling Program Name	Purpose of Sampling
Sanibel Captiva Conservation Foundation (**SCCF**) Marine Lab	Caloosahatchee/San Carlos Bay SAV/WQ Monitoring	Typify: changes in plant composition and abundance; range of aerial coverage; influence from freshwater inflow or WQ impacts, provide support information for ecosystem model
FDEP-South District, Environmental Assessment and Restoration (**EAR**)	Quarterly Seagrass Monitoring	Use seagrass as an indicator linking WQ and habitat health by quantifying species type, health, zonation, and light availability relative to water depth of plants
FDEP – Charlotte Harbor Aquatic Preserve (**CHAP**)	Seagrass Transect Monitoring Program	(1)Determine localized smaller scale changes over time in seagrass species, abundance, health and deep edge of bed (2) Link monitoring results to water quality
FDEP – Estero Bay Aquatic Preserve (**EBAP**)	Estero Bay Aquatic Preserve Seagrass Monitoring Program	Document changes in edge of bed, species composition, and abundance over time
South Florida Water Management District (**SFWMD**)	Hydroacoustic Monitoring of Submerged Aquatic Vegetation in the Caloosahatchee Estuary and Downstream Area	Quantify SAV spatial and temporal coverage along the salinity, depth, and water quality gradient of the estuary related to the influence of freshwater discharges
SFWMD	Aerial Mapping of Lower Charlotte Harbor and Tidal Caloosahatchee	Detect trends in area wide (spatially contiguous) SAV coverage, depth, and distribution

SAV parameters discussed (from April meeting) and program address

Biological parameter of concern to measure

METRIC	SCCF	EARS	CHAP	EBAP	SFWMD	AERIAL
*Species Composition	√	√	√	√		
Quantity						
Density (Shoots)	√ *	√ *	√ *	√ *		√ ?
Percent cover	√ *	√ *	√ *	√ *	√	√ ?
Blade Length	√ *	√ *	√ *	√ *	√	
Blade width	√					
Benthic Algae and Epiphytes		√	√	√		√ ?

SAV parameters discussed (from April meeting) and program address

Issues of water quality -
In relationship to SAV and TMDL (and RWPP)

METRIC	SCCF	EARS	CHAP	EBAP	SFWMD	AERIAL
Edge of Bed (TMDL)		√ *	√ *	√ *	√	?
Context (Depth)	**	**	**		*√*	*?*
WQ (TMDL)						
Color (C-DOM)						
Turbidity	√					
Chl-a	√					
PAR (light attenuation)	?		√		√	
Secchi	√		√	√	√	√
Salinity (Conductivity)	√		√	√	√	
Temperature			√		√	
D.O.	√		√	√	√	
pH	√				√	

√ SFWMD permanent staff gages at 8 locations (Upper estuary, lower estuary, San Carlos Bay, and lower Pine Island Sound

** SFWMD gages available for use in these programs

SAV parameters of discussed (from April meeting) and program address

Issues of scale:

- Temporal – long and short term and spatial scale (within and between years)
- Spatial – Estuarine Zone and type of coverage within a zone

METRIC	SCCF	EARS	CHAP	EBAP	SFWMD	AERIAL
Seasonal Fluctuation	√ *	√* ?			√	
Long term	√*	√*	√*	√*	√	√
Type of coverage	√ *	√ *	√ *	√ *		
Transect					√	
Spatially Contiguous						√
Area wide						
Estuarine Zone	√ *	√ *			√ *?	
Upper Estuary	√ *	√ *			√ *?	√
Lower Estuary						
San Carlos Bay	√ *	√ *	√ *		√	√
Influence South				√ *		√
Pine Island Sound			√ *		√	√
Matlacha Pass		√ *	√ *		√	√

Monitoring Recommendations – SAV

- Continue existing monitoring (no new stations, sample times, or parameters required...

  (a) Biological parameters being measured are adequate

  (b) Spatial and temporal scales adequate to meet program objectives

- This aerial photography surveys every 2 years continues

Monitoring Recommendations – SAV

- Encourage all parties using transect methods to:

  (a) Standardize measurements where possible (e.g., percent coverage)

  (b) Include depth readings from existing staff gages where/when possible

  (c) Add turbidity probes to YSIs if possible/affordable

  (d) Measure Chl-a and color if possible

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Caloosahatchee River Watershed Water Quality Monitoring Program Recap

May 2008

sfwmd.gov

Caloosahatchee

Water Quality Monitoring Working Team Assessment Summary

- **East of S-79**
  - Proposed to add eight long-term water quality and flow monitoring sites
    - Selection criteria - monitoring stations upstream and downstream of major tributary basins coming into the River to quantify the load contribution from these tributary basins.
    - Monthly water quality grab samples (Group A parameters) and continuous flow measurements.

Caloosahatchee

Proposed List of Parameters for Long-Term Monitoring

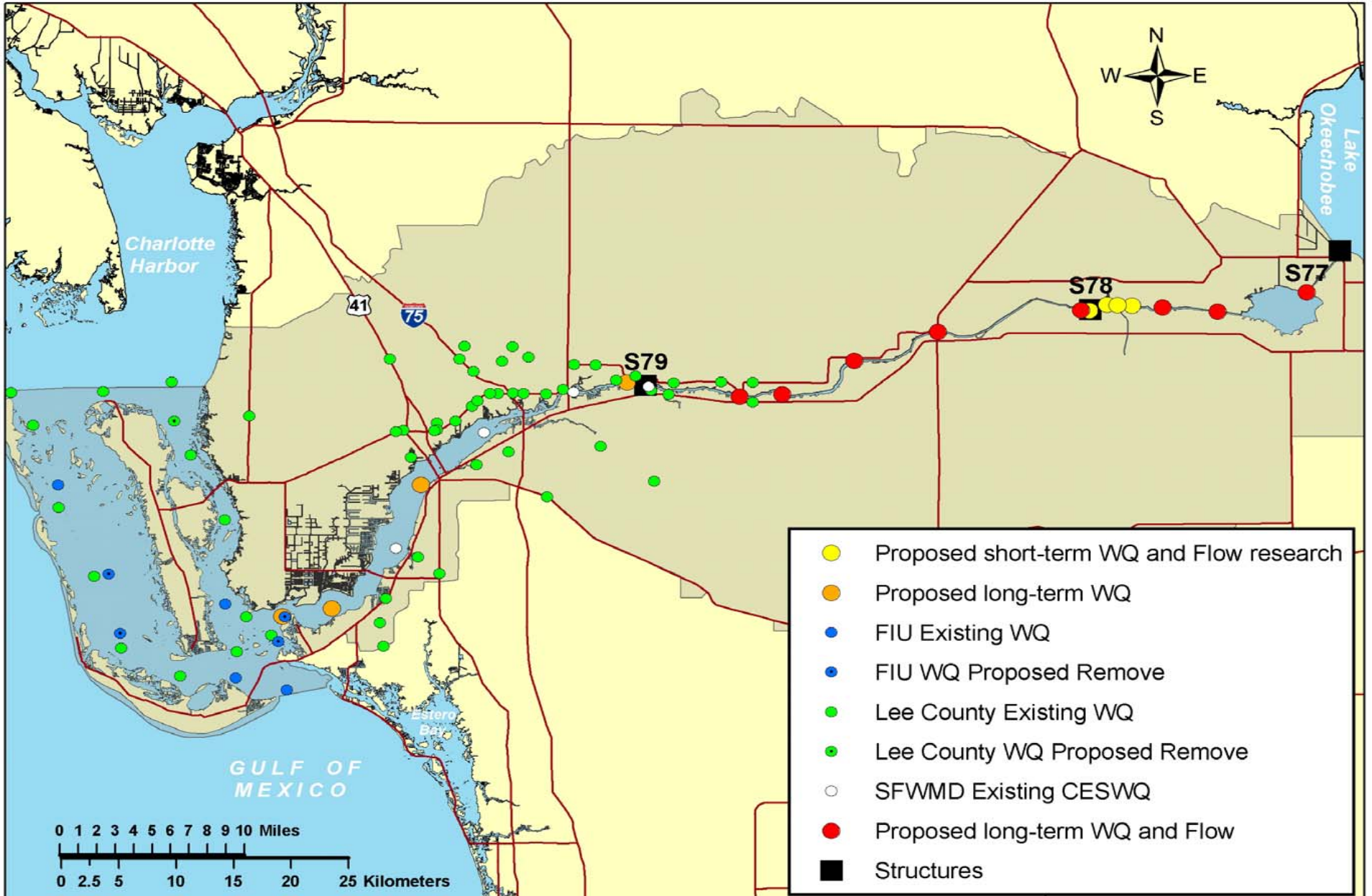
Group A- Priority Parameters for WQ Monitoring

- TN (cal), NH4; NO2; NO3; TKN; DON (cal); DTKN
- TP; OPO4= SRP
- DO; BOD5
- Chl-a
- TSS
- Turbidity
- Color

Caloosahatchee
Water Quality Monitoring Working Team Assessment Summary

- **West of S-79 (see map)**
  - Propose to reinstate four historic CESWQ sites
    - Existing - CES 01; CES03; CES04; CES06
    - Reinstate Caloosahatchee CES sites- CES02, CES05 CES07 CES08
  - Keep the existing long-term monitoring sites with the following exceptions:
    - Propose to remove one Lee County existing site
    - Propose to remove five FIU existing sites

Caloosahatchee Monitoring- Existing and Proposed



Caloosahatchee

Annual Cost Estimate for Proposed Long-Term Water Quality Monitoring (Group A Parameters)

	East of S-79	West of S-79
	Long-Term Stations (8)	Long-Term Stations (4)
Labor	$91,290	$30,076
Vehicle/Equipment Useage	$2,896	$322
Boat Rental/Useage	$32,725	$11,325
Analytical Cost*	$40,639	$24,383
Sub-Total	$167,550	$66,106
Total (10% Contingency)	$184,305	$72,717
TOTAL COST/YR		$257,022

* Cost estimated for 'Group A' constituents

Cost Estimate for Flow Monitoring[1]

		East of S-79	
		Long-Term Stations (8)	
Construction and Instrumentation	Labor	$14,071	
	Gage House construction	$37,177	
	Instrumentation	$107,741	
	Total Direct Cost	$158,989	
	Total Indirect Cost[2]	$43,436	
	Total	$202,425	
Data Collection/ Processing	Labor[3]	$149,763	
	Field Work and Logistics	$8,955	
	Field Supplies	$2,857	
	Total Direct Cost	$161,575	
	Total Indirect Cost[4]	$87,945.27	
	Total	$249,520	
TOTAL Cost (Instrumentation + Data Coll)		**$451,945**	

2008 Annual Monitoring Budget for Existing Stations

Entity/Program	Number of Stations	Frequency	Annual Cost
SFWMD/CR	4	Bi-Monthly	$4,270
SFWMD/CESWQ	4	Monthly	$60,000
SFWMD/FIU	8	Monthly	$32,000
Lee County	58	Monthly	$410,000
City of Ft. Myers	9	Monthly	$55,000
City of Cape Coral	33	Monthly	$220,000
City of Sanibel	12	Monthly	$80,000

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

Caloosahatchee River Watershed Research and Water Quality Monitoring Plan Research Projects

May 2008

sfwmd.gov

Caloosahatchee (in priority)

#1 Estuarine Nutrient Budget

- A well constrained nutrient budget is an important aspect of TMDL/BMAP implementation and assessment.
- Nutrient budgets assist with determining appropriate nutrient reduction approaches and with evaluating and optimizing project effectiveness.
- This project will construct nutrient budgets of nitrogen and phosphorus for the Caloosahatchee Estuary.
- Terms in the nutrient budget will be determined by a variety of methods: Input, Cycling, Output.
- Duration of Project: 3 years
- Cost of Project: TBD

Caloosahatchee
#2 Dissolved Oxygen Dynamics

- In order to determine if proposed TMDLs for nutrients will improve DO concentrations in the Caloosahatchee Estuary it is necessary to identify the important factors that control dissolved oxygen and how they interact to exert that control.
- The Caloosahatchee Estuary has been listed as impaired for dissolved oxygen and nutrients.
- This study will examine the role of internal and external factors in determining the concentration of dissolved oxygen.
- These include stratification, algal blooms, sediment oxygen demand, and BOD loading.
- Duration of Project: 3 years
- Cost of Project: TBD

Caloosahatchee
#3 Low Salinity Zone

- One of the goals of the Caloosahatchee River Watershed Protection Plan is to minimize the occurrence of undesirable salinity ranges in the Caloosahatchee Estuary:
  - Constructing and operating facilities designed to store and subsequently release freshwater to the estuary.
- One of the primary ecological services provided by an estuary is to serve as a nursery area, occurring in low salinity zones, for early life stages of economically important fish and shell fish.
- This project examines the effects of freshwater discharge on production of fish larvae in the low salinity zone of the Caloosahatchee Estuary.
- Results of this study will be used to refine flow and salinity envelopes and to provide guidelines for delivery of freshwater to the Caloosahatchee Estuary.
- Duration of Project: 2 years
- Cost of Project: $100,000 per year

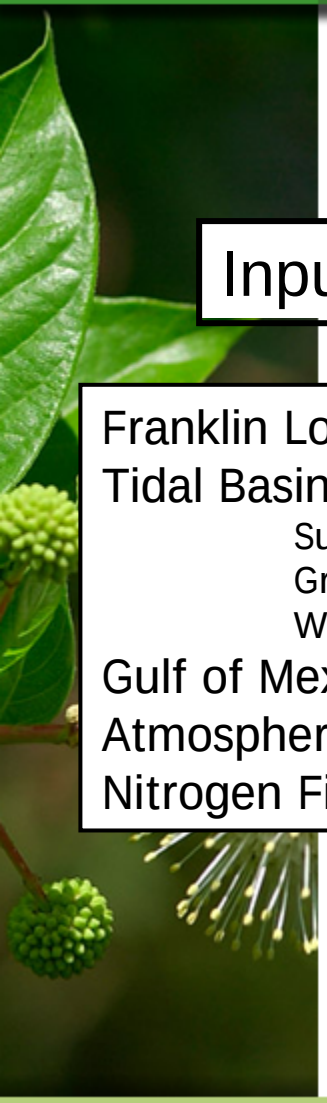
Caloosahatchee
#4 Light Attenuation in San Carlos Bay

- A resource based method is being employed to establish a nutrient TMDL in the Caloosahatchee Estuary.
  - Achieving a water clarity in San Carlos Bay that allows enough light for seagrasses to grow to a depth of 2.2 meters.
- Another major attenuator of light in the Caloosahatchee estuarine system is colored dissolved organic matter (CDOM).
  - Some years CDOM may account for most of the light attenuation, while in other years, chlorophyll may dominate. This suggests that in some years a TMDL might meet its resource goal and in others it would not.
- This study will determine how the relative contributions to total light attenuation of chlorophyll, CDOM and turbidity, vary with season and freshwater inflow in San Carlos Bay.
- Duration of Project: 3 years
- Cost of Project: TBD

Caloosahatchee
#5 Seagrass Model

- A resource based method is being employed to establish a nutrient TMDL in the Caloosahatchee Estuary.
  - Nutrient load reductions will be based on achieving a water clarity in San Carlos Bay that allows enough light for seagrasses to grow to a depth of 2.2 meters.
- A an ecological model that predicts contiguous seagrass density and aerial coverage is required for assessing multiple scenarios for implementation of the CRW Construction Plan and Pollution Control Program.
- Habitat Suitability Index models with graphic user interfaces were developed during the evaluations of the C-43 Basin Storage Reservoir and Southwest Florida Feasibility Study.
- The existing HSI Model for seagrass is a statistically based (regression) that incorporates estimates of salinity, light penetration, temperature, and depth to estimate SAV coverage for nearly the entire NE estuarine boundaries. It provides both: geo-explicit tabular results; and GIS maps/graphs. Starting with seagrasses, this project would build on the HSI model by developing a numerical, time dependent multi-species model.
- Duration of Project: 2 years
- Cost of Project: TBD

Estuarine Nutrient Budget- Nitrogen



Inputs

- Franklin Locks
- Tidal Basin
  - Surface Flows
  - Ground Water
  - WWTF
- Gulf of Mexico
- Atmospheric Deposition
- Nitrogen Fixation

Cycle

- Primary Productivity
- Water Column Respiration
- Benthic Nutrient Flux

Outputs

- Denitrification
- Export to Gulf
- Burial in Sediments
- Biomass
  - Migration
  - Harvesting

INPUTS

Franklin Locks..... Data Available (could be better)

Tidal Basin

Surface Flows.....	Modeling Project
Ground Water.....	Modeling Project
WWTF.....	Data Available

Gulf of Mexico.....Modeling Project

Atmospheric Deposition.... Data May Exist?

Nitrogen Fixation..... New Measurements

CYCLE

Primary Productivity.....	New Measurements
Water Column Respiration.....	New Measurements
Benthic Nutrient Flux.....	Data Exist, Need More

OUTPUTS

Denitrification..... Some Data Exist/ Need More

Export to Gulf..... Modeling Project (USGS Measurements?)

Burial in Sediments.....Some Sedimentation Rate Data Exist

Biomass

- Migration..... Data????
- Harvesting..... Data ???