Existing CHNEP Seagrass Targets

CHNEP Science Forum:
Establishing SAV Targets for the Tidal Caloosahatchee R

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Charlotte Harbor National Estuary Program
And Partners

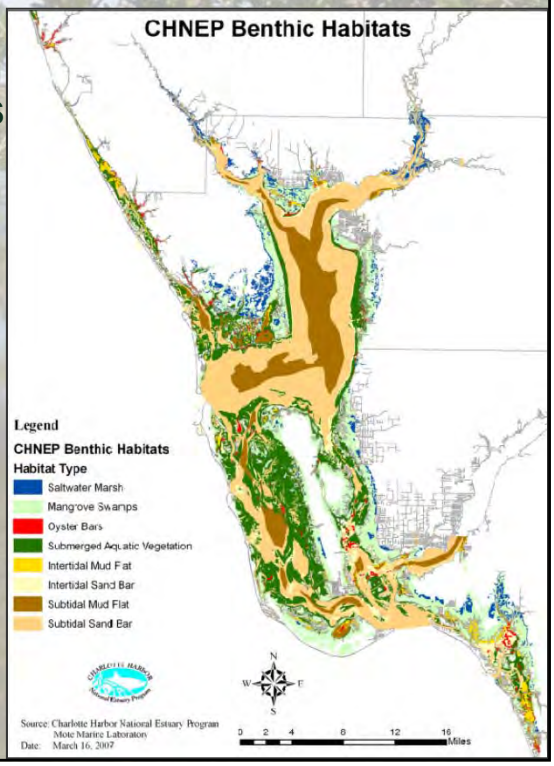
Presentation Overview

- Seagrass Types & Locations in CHNEP
- Seagrass Basis for Water Quality Targets
- Data Used for CHNEP Seagrass Targets
- How CHNEP Seagrass were Developed
- Next Steps for CHNEP Seagrass Targets

General Locations of SAV in CHNEP

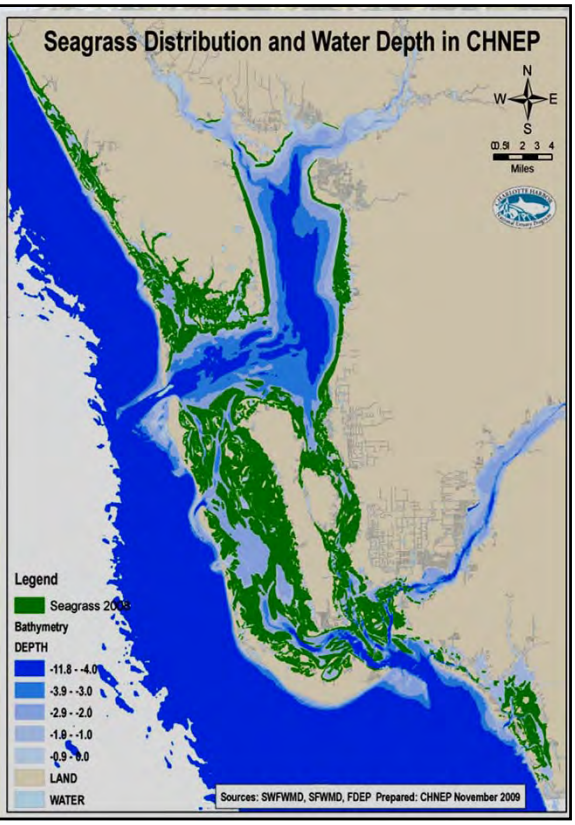
Benthic Habitats in Estuaries & Tidal Creeks

Habitat	Acres	%
Mangrove Swamp	58,873	20%
Saltwater Marsh	12,196	4%
Intertidal Mud & Sand	26,499	9%
Oyster Bars	245	1%
Seagrass	58,665	20%
Subtidal Mud & Sand	131,370	46%
Total	287,847	76%



Seagrass Distribution CHNEP in Estuaries

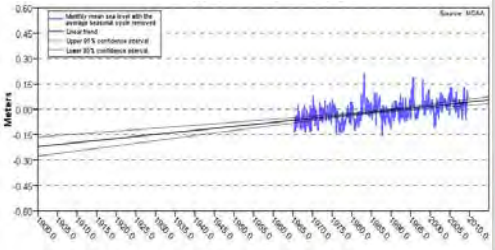
- In estuarine waters < 2 m deep
- Primary submerged habitat
- ± 59,000 acres
- vary by estuary, by year, by season & by species

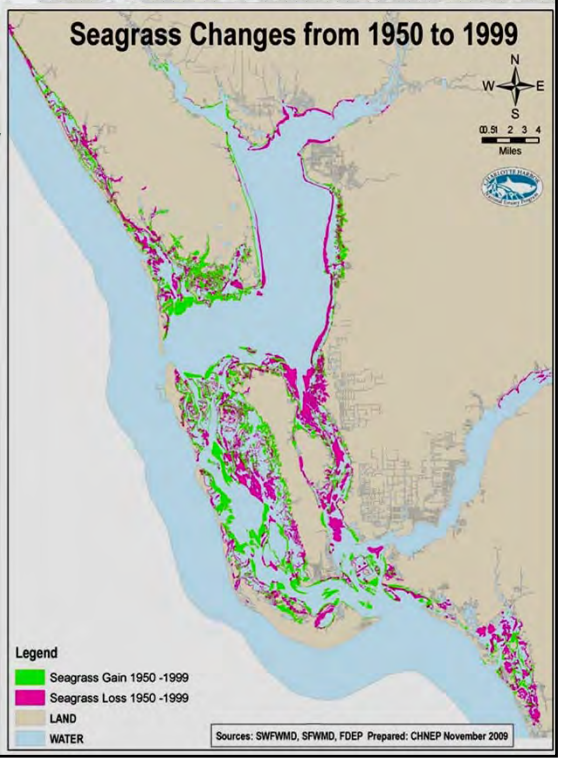


Seagrasses Declined Over the Long Term in CHNEP…

- Seagrass loss from 1950-1999 (± 2,520 ac)
- Seagrass loss affected by dredge & fill activities, decreasing water clarity, hydrologic changes, changing salinity & increasing sea level

Mean Sea Level Trend 1965 – 2006
NOAA Tide Station at Fort Myers
2.4 cm/decade

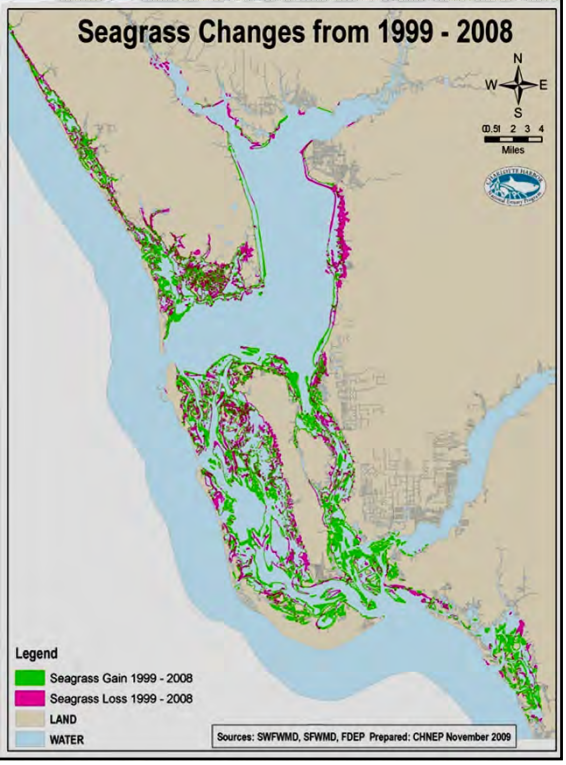




Seagrasses Increased Over the Short Term…

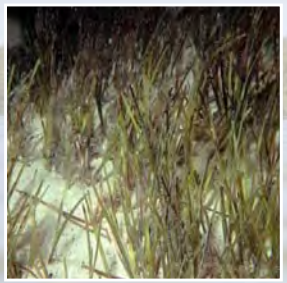
- Seagrass gain from 1999-2008 (± 6,400 ac)
- Seagrass acres relatively stable since 1982
- Acres & density vary by year
- Influenced annually by rainfall

Total Annual Rainfall for Charlotte County	
1948-1949	102 cm
1998-1999	150 cm
2007-2008	94 cm



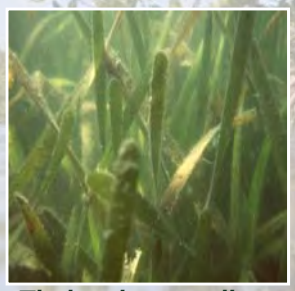
SAV Species in CHNEP

Shoal



Halodule wrightii

Turtle

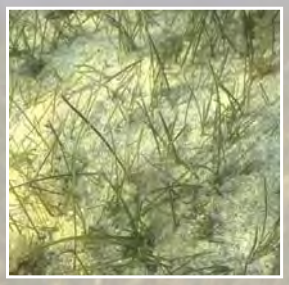


Thalassia testudinum

Manatee

Syringodium filiforme

Widgeon



Ruppia maritima

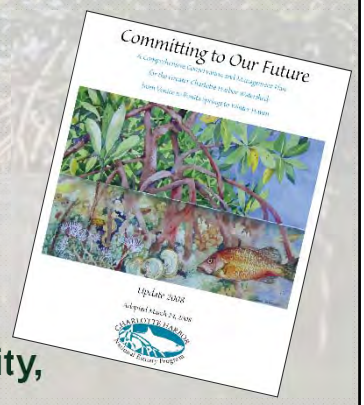
Star

Halophila engelmannii

Tape

Vallisneria americana

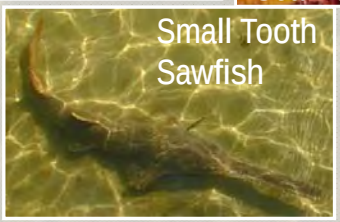
SAV Targets are Important



- Implement CHNEP CCMP
- Guide restoration & maintenance
- SAV is widely distributed
- SAV is quantifiable
- Serve as environmental indicator
- Responsive to changes in water clarity, water quantity, hydrology & salinity
- SAV responses are measurable & “modelable”
- Use to estimate needed pollutant load reductions & effectiveness of management activities

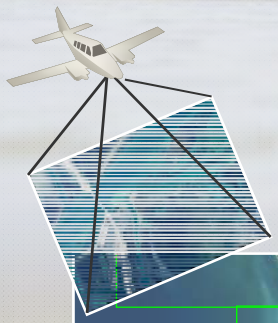
SAV Supports a Great Diversity of Life

- epiphytes (algae & invertebrates)
- macroinvertebrates
- crustaceans
- shellfish
- fisheries
- mammals
- listed species

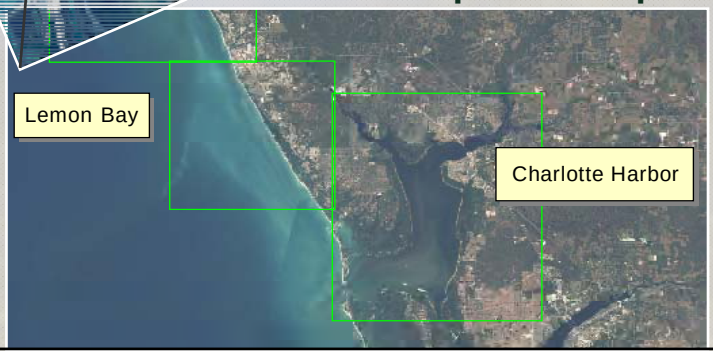


SAV & Water Quality Data Available

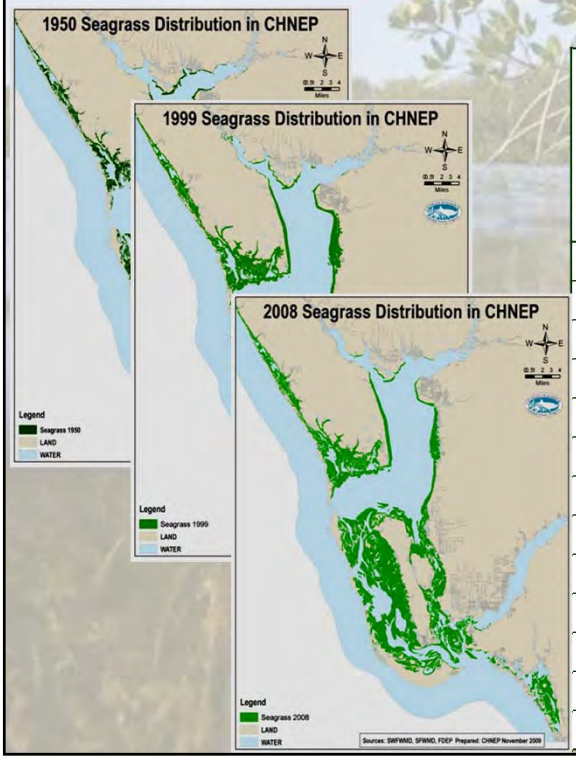
Aerial Photography Collected Regularly by Water Management Districts



- Began in 1988
- True Color (≤2004) & Digital (≥2006)
- 0.5 ac minimum mapping unit (1' pixel)
- 5 FL Land Cover Classifications (FLUCCS)
- Field & interpretation quality assurance



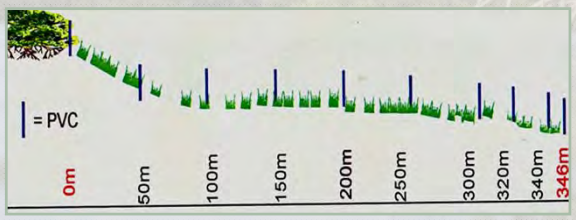
Seagrass Maps are Compiled at Regular Intervals



SWFWMD		SFWMD	
Dona Roberts Lemon Bays	Upper Charlotte Harbor	Lower Charlotte Harbor	Estero Bay
1988	1988	---	---
---	1992	---	---
1994	1994	---	---
1996	1996	---	---
1999	1999	1999	1999
2001	2001	---	---
---	---	2003	2003
2004	2004	2004	2004
2006	2006	2006	2006
2008	2008	2008	2008
2010	2010	---	---
2012	2012	---	---
2014	2014	2014	2014

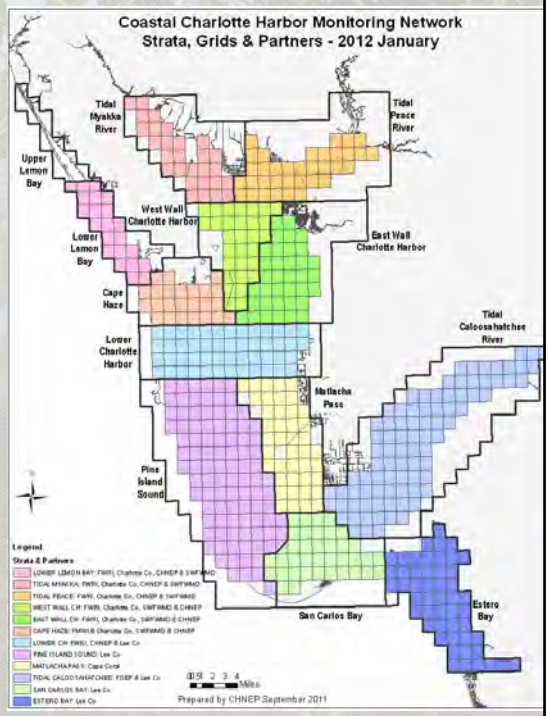
Seagrass Transect are Monitored Annually by FDEP

- Fixed transects from shallow to deep edge of seagrass
- 5 seagrass & 6 physical parameters



Water Quality is Collected Monthly by Partners

- Coastal Charlotte Harbor Monitoring Network-2002
- Probabilistic design with randomly selected grids
- 60 sites each month
- 8 field & lab partners
- Approved SOPs & QA/QC
- 15 parameters including: water clarity, color, turbidity, chlorophyll, dissolved oxygen & nutrients



Original CHNEP Seagrass & Water Quality Targets were Developed in 2005 by Corbett & Hale

- Recognized loss of historic seagrasses & increasing urbanization, pollutant loadings & hydrologic changes
- Based on deep edge of seagrass growth as measured from seagrass transect monitoring conducted by FDEP
- Past studies in Charlotte Harbor were used to determined that 25% of light is needed by SAV at the deep edge
- An optical model was developed based on SAV light requirements which set targets for color, turbidity & chlorophyll *a*

Estuary Segment	# Transects (1999-2005)	Max Depth Mean (m)
Lemon Bay	4-6	1.7
Cape Haze	4-5	1.9
Myakka River Tidal	3-5	0.8
Peace River Tidal	2-4	1.0
Charlotte Harbor West Wall	3-5	1.4
Charlotte Harbor East Wall	1-2	1.4
Charlotte Harbor Lower	3-5	1.5
Pine Island Sound	8-11	1.9
Matlacha Pass	2-4	1.5
San Carlos Bay	3-6	2.0
Caloosahatchee R Tidal		1.2
Estero Bay	4-5	1.0

- Water clarity targets were calculated to determine light attenuation rate needed for 25% light at max SAV depth
- Partial contributions of light attenuation were determined for 3 primary light limiting factors:

Color - dissolved organic matter (13-66% of total)

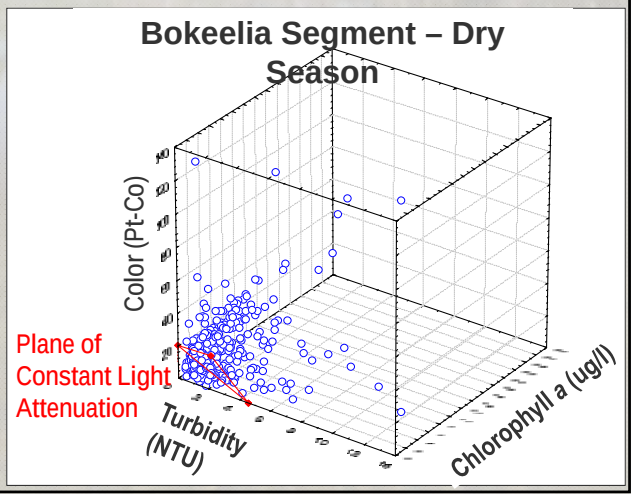
Turbidity - detritus, minerals, cells (30-5% of total)

Chlorophyll *a* – phytoplankton (4-18% of total)

- Concentrations of these 3 constituents were estimated using an optical model derived from McPherson & Miller (1992)

Estuary Segment	Color (Pt-Co)	Turbidity (NTU)	Chl *a* (ug/l)
Lemon Bay	28.6	6.5	8.2
Cape Haze	31.2	7.0	8.9
Tidal Myakka River	89.7	20.3	25.6
Tidal Peace River	78.6	17.7	22.4
Charlotte Harbor West Wall	50.0	11.3	14.3
Charlotte Harbor East Wall	50.0	11.3	14.3
Charlotte Harbor Lower	20.2	4.6	5.8
Pine Island Sound	24.0	5.4	6.9
Matlacha Pass	28.6	6.5	8.2
San Carlos Bay	24.0	5.4	6.9
Tidal Caloosahatchee R	61.9	14.0	17.7
Estero Bay	41.1	9.3	11.7

- Using the SAV light requirements, rate of attenuation & estimated concentrations of color, chl & turbidity, plotted a “plane of constant light attenuation” representing the light needed to support SAV was calculated for each estuary segment
- Using the “planes of constant light attenuation”, water quality data was plotted to show times & locations where water clarity targets weren’t met



Revised Seagrass & Water Quality Targets were Developed in 2011-2011 by Janicki Environmental

- Recognized need to revisit seagrass & water quality targets regularly
- Recognized limitations of original optical model in some tidal river segments & availability of new data
- Recognize value of using consistent approaches as other SW FL NEPs
- Contracted with Janicki Environmental using support from CHNEP FY09 Workplan & partners
- Developed project scope of work with sequence of tasks, each to be approved by CHNEP Management Conference & Technical Working Group

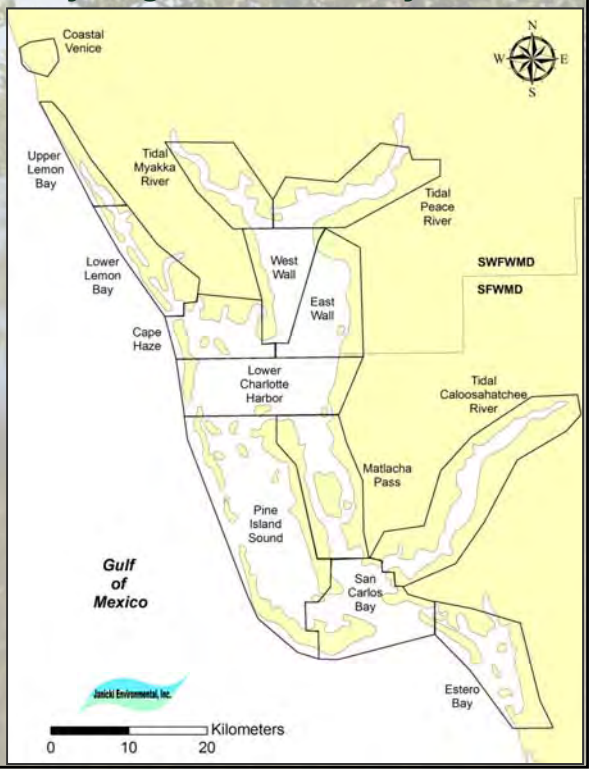
Janicki Environmental, Inc.

First: Verified Estuary Segments for Seagrass & Water Quality Targets

- Reviewed variety estuary segmentation schemes:
  - ~ Coastal Charlotte Harbor Monitoring Network (CCHMN)
  - ~ Water Management District Seagrass Analyzes
  - ~ FL Aquatic Preserves
  - ~ FDEP Waterbody Identifiers
- Reviewed the reasons each estuary segments is unique:
  - ~ physical conditions (bathymetry, watershed:water area)
  - ~ dynamic processes (residence times)
  - ~ seagrass depth & acreage
  - ~ % light available for seagrasses
  - ~ water quality, watershed loads & hydrology

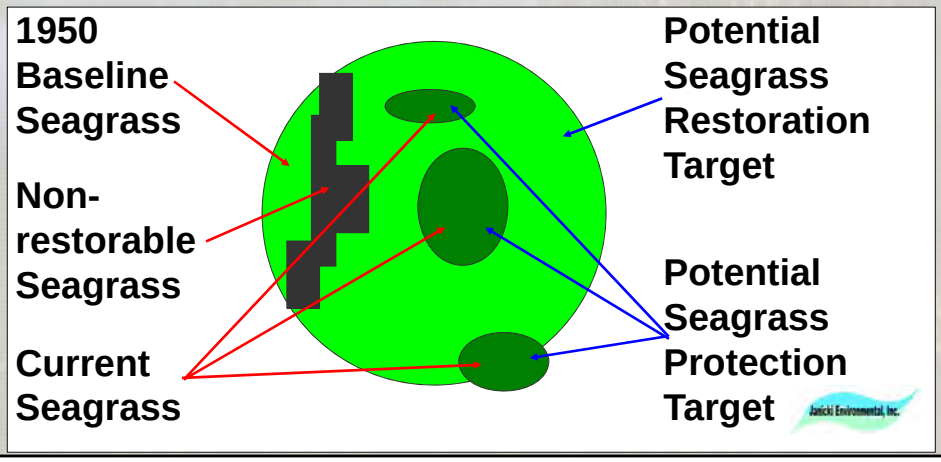
- **Consensus to use 14 estuary segments used by CCHMN**

CCHMN Estuary Segments
Dona & Roberts Bay
Upper Lemon Bay
Lower Lemon Bay
Cape Haze
Myakka River Tidal
Peace River Tidal
Charlotte Harbor West Wall
Charlotte Harbor East Wall
Charlotte Harbor Lower
Pine Island Sound
Matlacha Pass
Caloosahatchee R Tidal
San Carlos Bay
Estero Bay

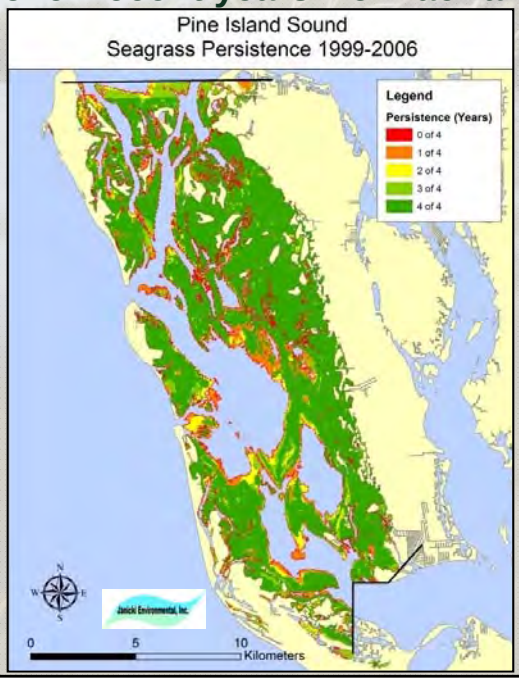


Second: Identified Seagrass Protection & Restoration Targets

- **Identified baseline seagrass areas from 1950 aerials**
- **Subtracted "non-restorable" areas (lost to dredge & fill)**
- **Overlaid current seagrass areas from recent aerials**
- **Identified potential seagrass protection & restoration areas**



- **Because of annual variability in seagrass, "current" seagrass areas were determined by persistence of seagrasses over recent years from aerials**



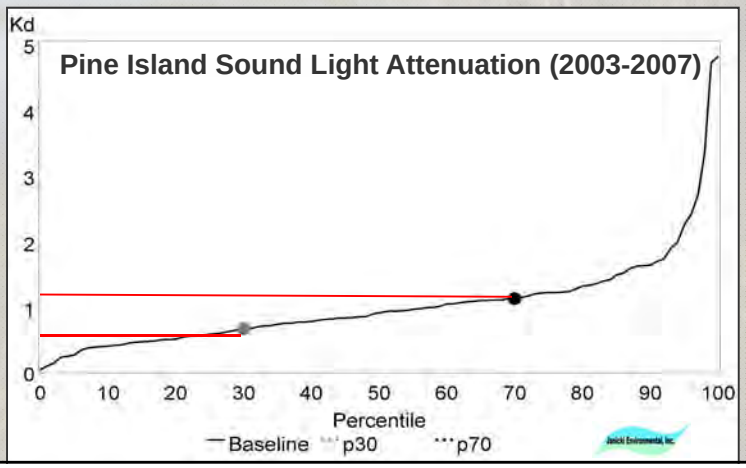
- **Final seagrass protection & restoration acres were determined for each estuary segment****

****Accepted by Mgmt Conference with clarification that research is needed in tidal rivers to re-assess historic & current SAV acres

Estuary Segment	Baseline ac (historic, adjusted)	Mean Annual ac (1988-2006)	Protective Target ac (highest)	Restoration Target ac (difference)	Total Seagrass Target ac
Dona & Roberts Bay	112	91	91	21	112
Lemon Bay Upper	880	1,009	1,009		1,009
Lemon Bay Lower	2,882	2,502	2,502	380	2,882
Cape Haze	5,670	6,998	6,998		6,998
Tidal Myakka River	344	456	456		456
Tidal Peace River	975	384	384	591	975
Charlotte Harbor West	2,106	1,907	1,907	199	2,106
Charlotte Harbor West	3,898	3,465	3,465	433	3,898
Charlotte Harbor Lower	2,964	3,342	3,342		3,342
Pine Island Sound	23,757	26,837	26,837		26,837
Matlacha Pass	9,315	7,582	7,582	1,733	9,315
San Carlos Bay	3,118	4,372	4,372		4,372
Tidal Caloosahatchee R	93	87	87	6	93
Estero Bay	3,662	3,071	3,071	591	3,662
Total	59,776	62,103	62,103	3,954	66,057

Third: Developed Water Clarity Targets

- Evaluated original optical model for reliability
- Reviewed measured light attenuation field data
- Compared predicted & observed light attenuation values
- Estimated % time observed values > established targets
- Plotted cumulative distribution frequency of light attenuation values for each estuary segment

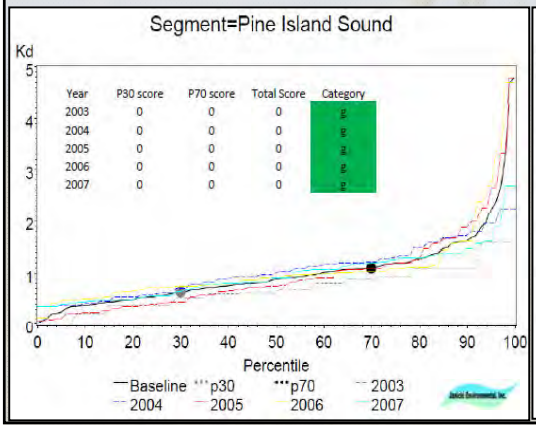


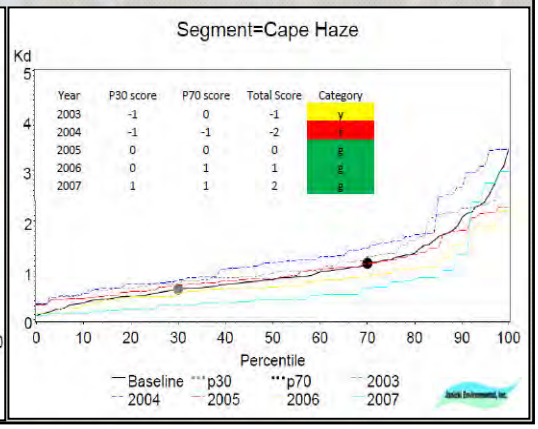
- Used cumulative distribution frequencies of light attenuation values for each estuary to establish targets (low) & thresholds (high) for light attenuation

Light Attenuation Values (2003-2007)		
Estuary Segment	Target 30th percentile (K_d m^{-1})	Threshold 70th percentile (K_d m^{-1})
Dona & Roberts Bay	0.64	1.04
Lemon Bay Upper	0.73	1.18
Lemon Bay Lower	0.73	1.12
Cape Haze	0.63	1.15
Myakka River Tidal	1.30	2.27
Peace River Tidal	1.06	2.40
Charlotte Harbor West Wall	0.73	1.36
Charlotte Harbor East Wall	0.64	1.16
Charlotte Harbor Lower	0.58	1.16
Pine Island Sound	0.64	1.10
Matlacha Pass	0.73	1.63
San Carlos Bay	0.73	1.16
Caloosahatchee R Tidal	1.58	2.93
Estero Bay	0.91	1.58

- Established a "decision rule" to assess if water clarity targets are being met based on annual analysis of water quality data:
  - ~ if >30% of values are <30th percentile, water quality is improving & assigned a value of +1
  - ~ if <30% of values are < 30th percentile, water quality is degrading & assigned a value of -1
  - ~ Otherwise, water quality is stable & assigned a 0
  - ~ Scoring is performed for both endpoints (30th & 70th percentile)
  - ~ Values are summed for each segment & the range of scores is -2 to +2
  - ~ Different grading systems are used for estuary segments with protection vs. restoration targets

- Grading for segments with protection targets, would be:
  - Green = scores > -1 = Stable
  - Yellow = scores ≤ -1 = Caution
  - Red = scores < -1 (consecutive years) = Degrading
- Grading for segments with restoration targets, would be:
  - Green = scores > +1 = Improving towards target
  - Yellow = scores between -1 & +1 = Caution
  - Red = scores < -1 = Degrading





Fourth: Estimated Watershed Pollutant Loadings
Fifth: Developed Chlorophyll Targets & Thresholds Needed to Meet Seagrass Targets

	Seagrass Targets			Reference Period (2003-2007) Chl *a*		
Estuary Segment	Preserve or Restore?	Water Clarity Trends	Seagrass Trends	Chl Target (Mean) (ug/l)	Preservation Threshold (Mean +1 SD)	Restoration Threshold (Mean +1/2 SD)
Dona & Roberts Bay	restore	n/a	n/a	4.3	5.4	4.9
Lemon Bay Upper	preserve	none	improving	6.7	8.9	---
Lemon Bay Lower	restore	none	stable	5.1	7.1	6.1
Tidal Myakka River	preserve	none	n/a	8.9	11.7	---
Tidal Peace River	restore	none	n/a	10.6	14.6	12.6
Charlotte Harbor Proper	both	none	stable	4.9	7.3	6.1
Pine island Sound	preserve	improving	improving	5.1	6.5	---
Matlacha Pass	restore	improving	stable	4.0	8.1	6.1
San Carlos Bay	restore	improving	improving	2.8	3.5	---
Tidal Caloosahatchee R	restore	none	n/a	9.0	TMDL 6.9	??
Estero Bay	restore	improving	improving	4.9	6.9	5.9

Sixth: Developed TP & TN Concentration & Load Criteria Needed to Meet Chlorophyll Targets

Next Steps for CHNEP Seagrass Targets

- Re-assess historic & current SAV conditions in tidal rivers & refine tidal river SAV targets
- Identify & implement pilot SAV restoration projects
- Continue seagrass monitoring & mapping
- Evaluate response of seagrasses to resource management actions regularly
- Re-evaluate water quality targets & criteria regularly
- Implement projects to reduce pollutant loadings & restore natural hydrology to protect & restore seagrass
- Maintain & restore natural shorelines & hydrology to enhance SAV adaptation to SLR & climate change


Thank You to All Our Partners!
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