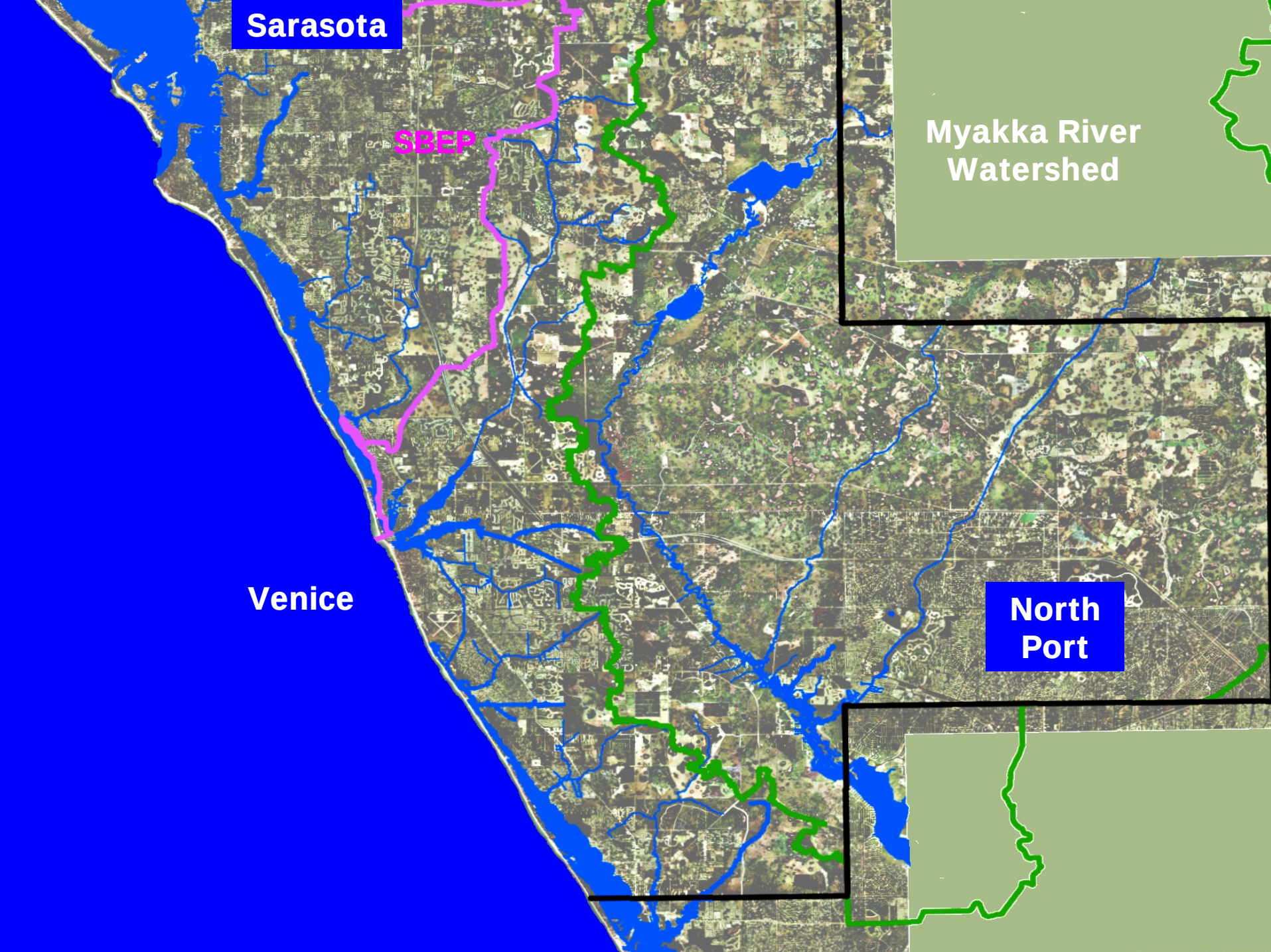
Water Clarity Benchmarks

Greetings !

from

FLA

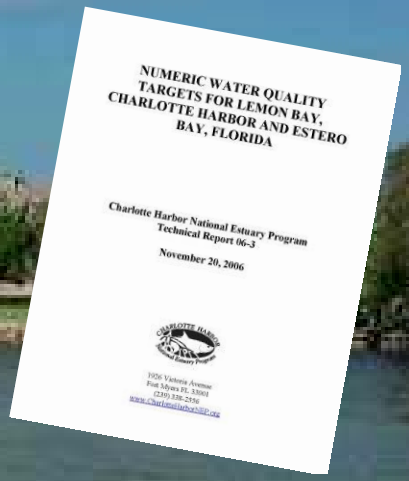

Sarasota
SBEP
Myakka River Watershed
Venice
North Port

Economic Foundation

Watershed Management

- Stormwater Environmental Utility
  - Water Quality Level of Service
  - Pollutant Loading to Bays
  - Implementation Projects, Standards or Practices
- Watershed Plans
  - Report Card
  - Bay Water Clarity
    - Establish a benchmark
    - Action Plan
    - Adaptive Management

Technical Issues


NUMERIC WATER QUALITY TARGETS FOR LEMON BAY, CHARLOTTE HARBOR AND ESTERO BAY, FLORIDA

Charlotte Harbor National Estuary Program
Technical Report 06-3

November 20, 2006

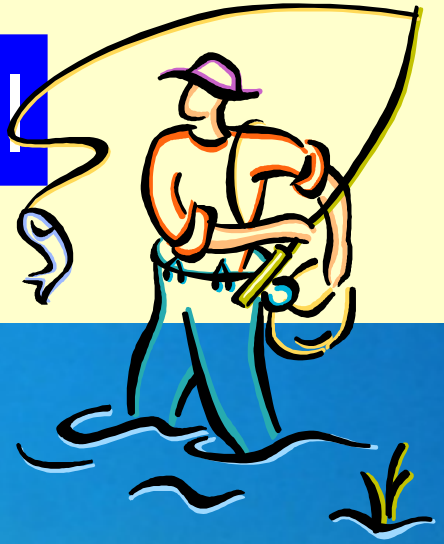
1926 Victoria Avenue
Fort Myers FL 33901
(239) 338-2556
www.charlotteharborbay.org

- Existing Optical Models
- Seagrass Light Requirements
- Blackwater Estuary – Myakka
- Data Insufficiency – Dona & Roberts Bays
- Geographic Variation
- Nutrient Relationships

What Do We Know?

Lower St. Johns River

Seagrass Optical Model



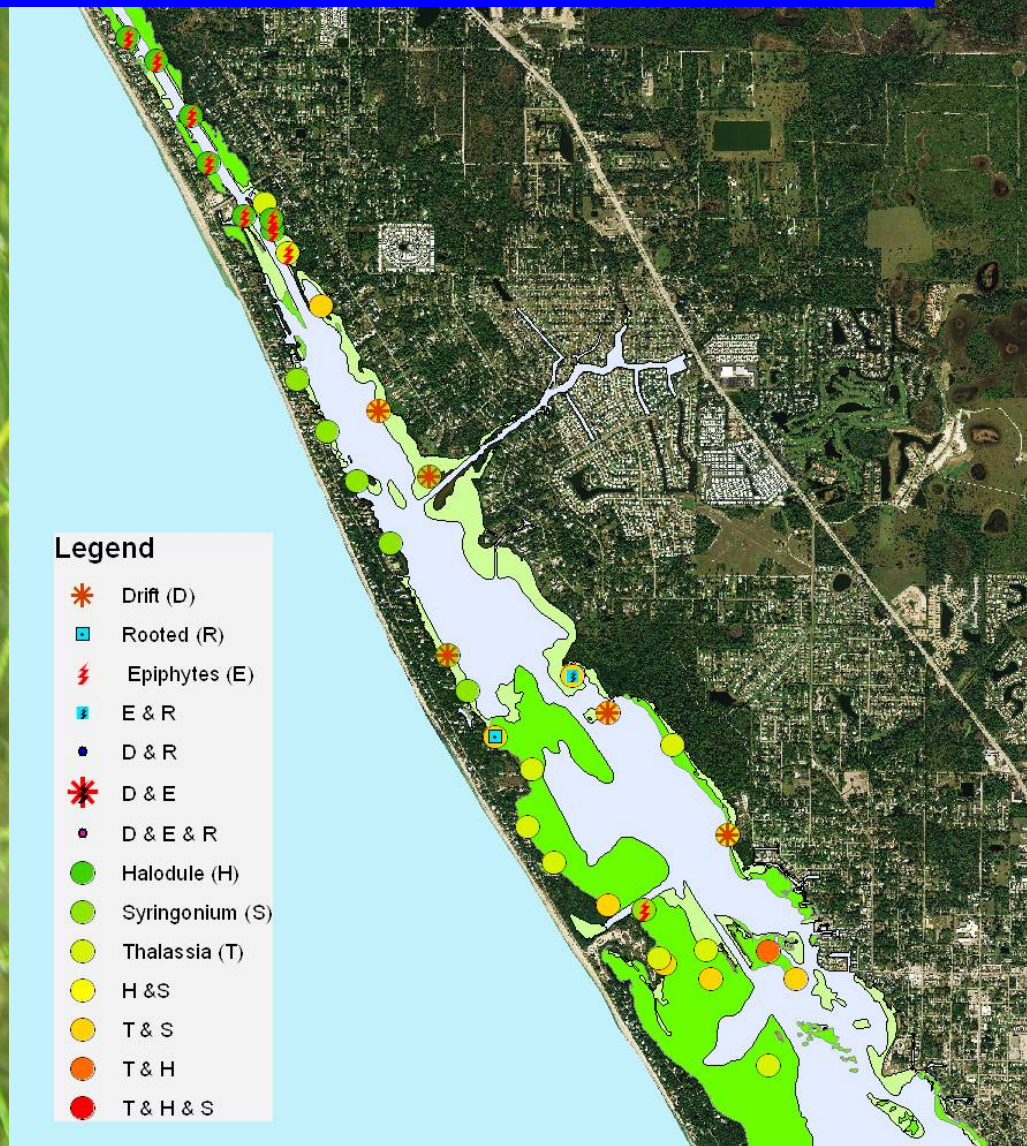
Light Lost by Colored Water

Light Deflected by Particles

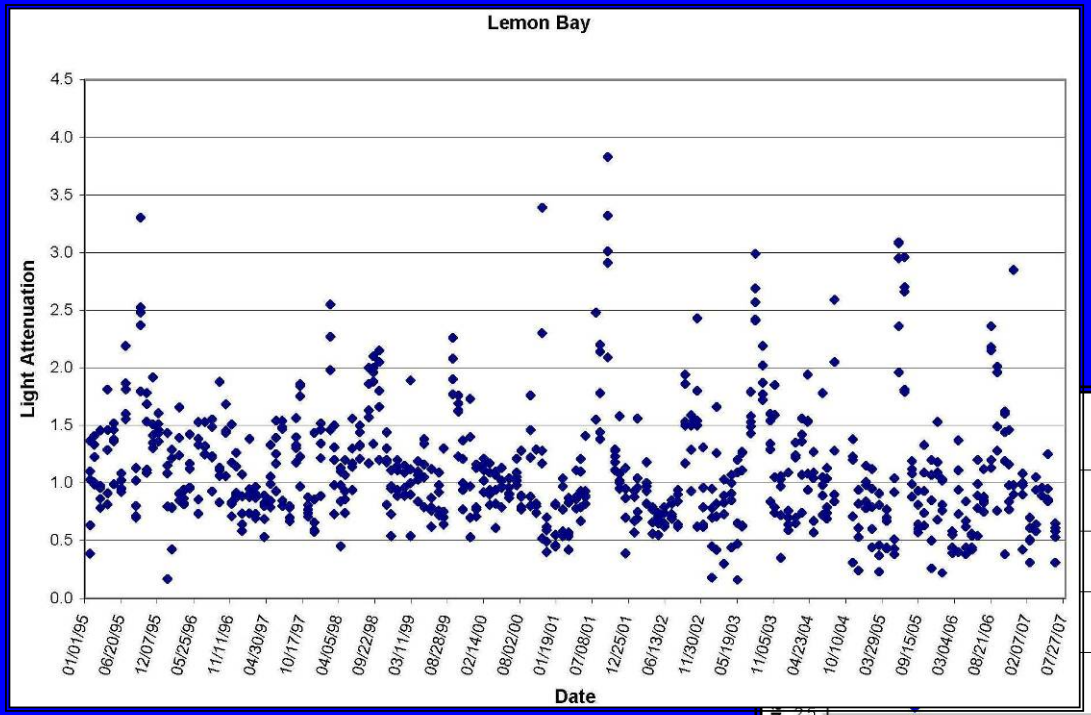
Light Deflected by Algae

Is there enough light left to grow seagrass?

SAV Ground Truthing



Light Data


Lemon Bay
Light Attenuation
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
01/01/95
06/20/95
12/07/95
05/25/96
11/11/96
04/30/97
10/17/97
04/05/98
09/22/98
03/11/99
08/28/99
02/14/00
08/02/00
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11/05/03
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03/04/06
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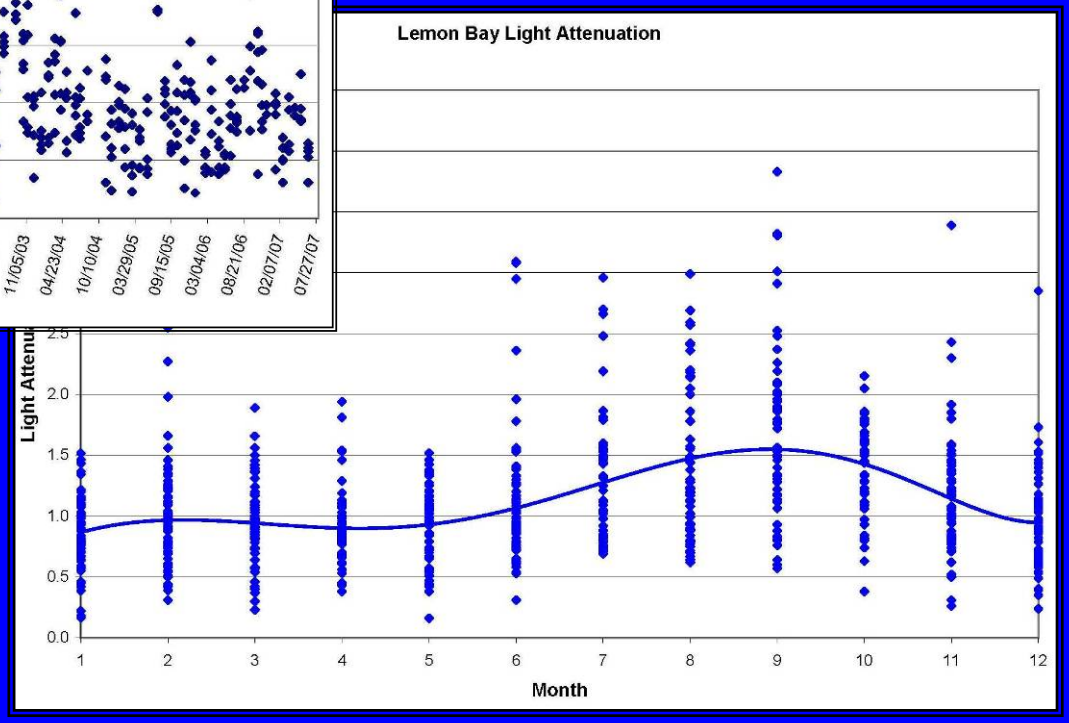
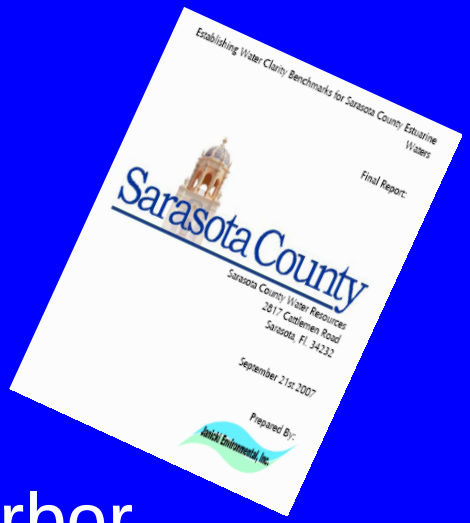
02/07/07
07/27/07
Date


Lemon Bay Light Attenuation
2.5
2.0
1.5
1.0
0.5
0.0
1
2
3
4
5
6
7
8
9
10
11
12
Month

Establishing Water Clarity Benchmarks for Sarasota County Estuarine Waters


Establishing Water Clarity Benchmarks for Sarasota County Estuarine Waters

Final Report

Sarasota County

Sarasota County Water Resources
2817 Cattlemen Road
Sarasota, Fl. 34232

September 21st 2007

Prepared By:
Janicki Environmental, Inc.

Presentation to the Charlotte Harbor National Estuary Program

10-24-07

Sarasota County
scgov.net | 941.861.5000 | TV19

Janicki Environmental, Inc.

Objective

- To develop water clarity benchmarks that were:
  - Geographically specific
  - Scientifically defensible
  - Related to a valued natural resource
  - Linked to a human activity that can be managed

Purpose

- Part of a much larger goal to set objective criteria and implement projects to protect and restore valuable estuarine resources in Sarasota County
- Sarasota County is a partner with the CHNEP, SBEP, EPA and FDEP in instituting Best Management Practices for Sarasota County waters
- Establishing water clarity benchmarks is one component of this more expansive process

Water Clarity Benchmark

Benchmark: Defined as a reference against which future data can be judged

What it is

- Reporting tool
- Science based
- Geographically specific
- Uniformly applied
- Easily understood by public
- Protective

What it is not

- Restoration target
- Optical model
- The answer to all questions about light availability

Approach to Setting Water Clarity Benchmarks

- Step 1. Identify the appropriate geographic scale
- Step 2. Identify a valued natural resource related to water clarity
- Step 3. Identify relationship between water clarity and the valued natural resource
- Step 4. Identify the benchmark that relates water clarity to resource protection

Step 1. Geographic Scale

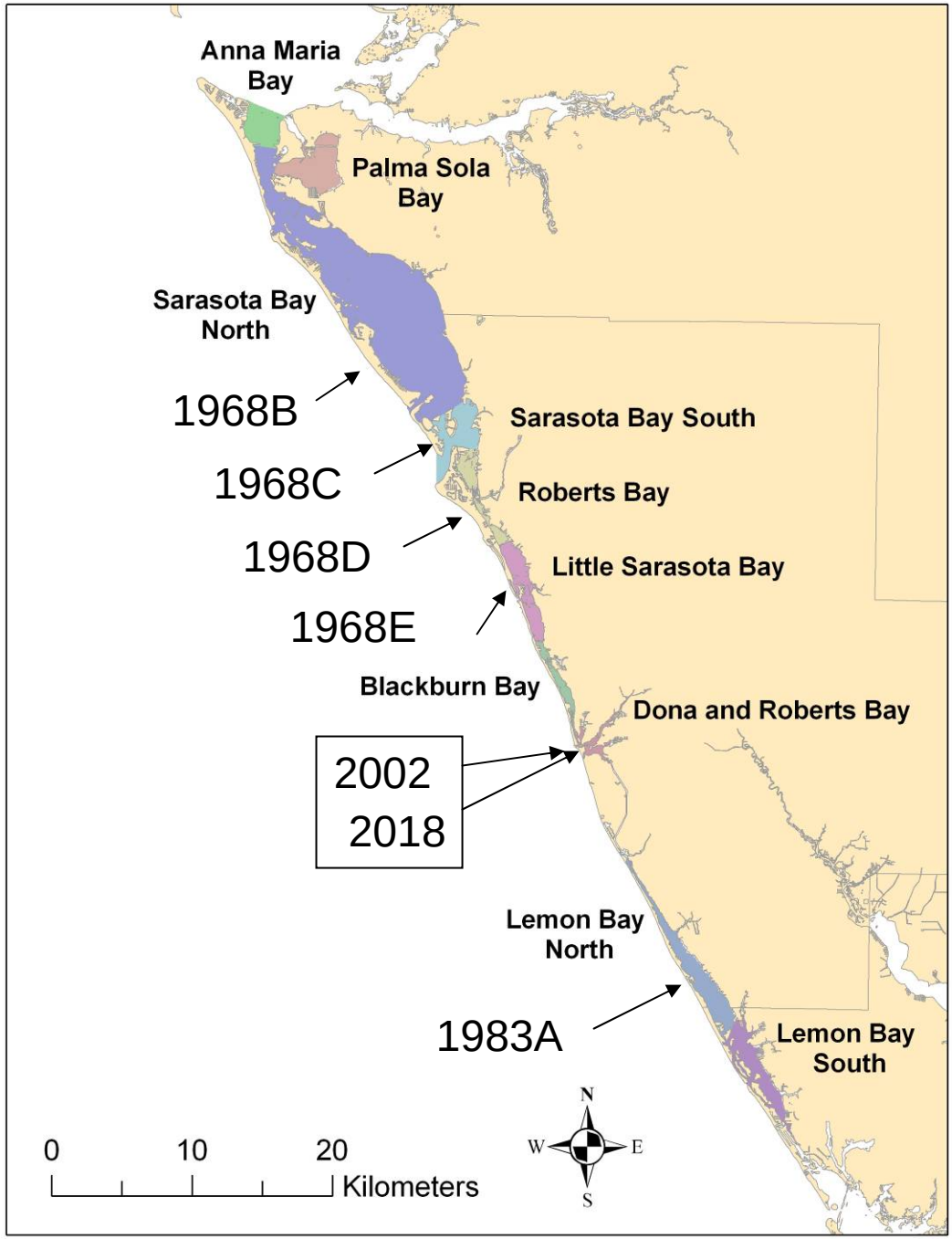
- Sarasota County estuarine waters are differentially influenced by fresh water inputs and marine inlets
- Therefore, geographically specific benchmarks were required
- We used historic data to look for spatial similarities in distribution of WQ parameters

Water Clarity Segments Based on WBID Boundaries

- We concluded that WBIDs reflected variation in hydrologic inputs that contribute to variations in water clarity
- Regulatory evaluation of water quality is performed by WBID and therefore criteria established for water quality and water clarity would be relevant to regulatory assessments
- Maintains continuity with regulatory assessment, sampling design, watershed planning and logistical considerations

Study Area: Sarasota County Estuarine Waters

Similar but not exactly the same as WBID boundaries



Step 2. Identify Valued Natural Resource for Protection

- General consensus that seagrass is a valuable natural resource in Sarasota County estuarine waters that requires protection

- Seagrass has been used in several Florida estuaries for setting water quality targets
  - Tampa Bay
  - Charlotte Harbor
  - Indian River Lagoon

Step 3. Identify Natural Resource Requirement Related to Water Clarity

- Many factors influence the success and health of seagrass communities including; nutrients, sediments, salinity and wave energy
- Thought to be primarily limited by light availability
- Several studies have estimated the light requirements (%PAR) in Florida estuaries

*Light Requirement:

Set at 25% of sub-surface irradiance based on literature and consistency with other southwest Florida estuaries including CH and Tampa Bay

- Tampa Bay (20-23%)
- Sarasota Bay (20-42%)
- Charlotte Harbor (15-30%)
- Indian River Lagoon (24-37%)

Data Requirements to Use Seagrass to Set Water Clarity Benchmarks

- Seagrass coverages:
  - Data provided by SWFWMD SWIM surveys 1988-2004
- Bathymetry:
  - Data provided by National Geophysical Data Center (NGDC)
- Historic water quality data:
  - Data collected from 1998 through 2005 was used to establish a recent historical distribution of PAR

Photosynthetically Active Radiation (PAR)

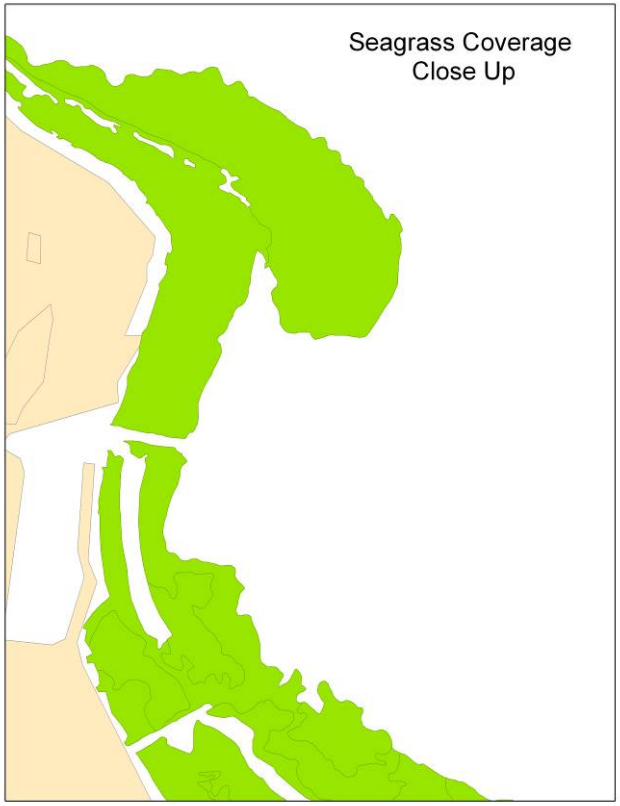
- Amount of light (PAR) penetrating the water surface is attenuated as a function of water depth and water quality

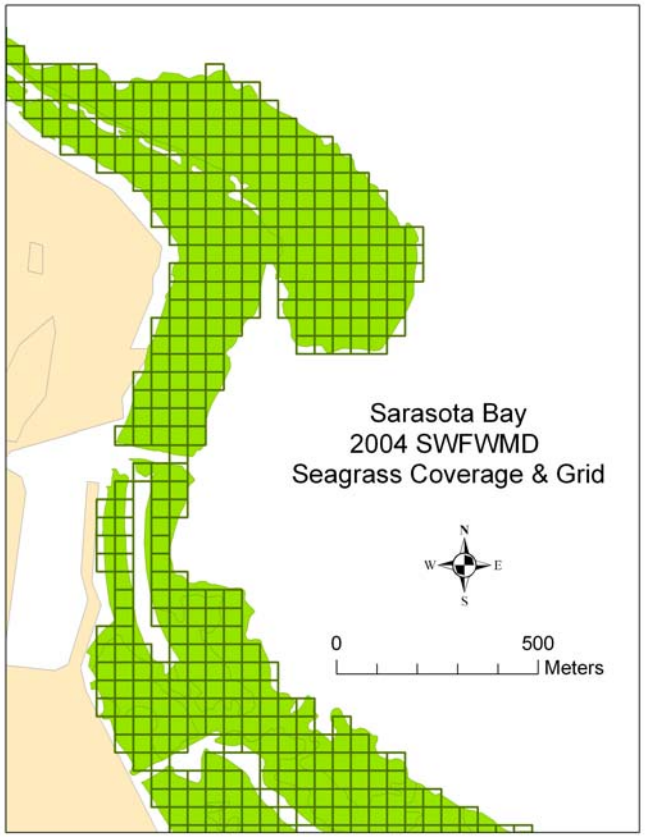
- Light attenuation coefficient (Kd) describes this light loss with depth

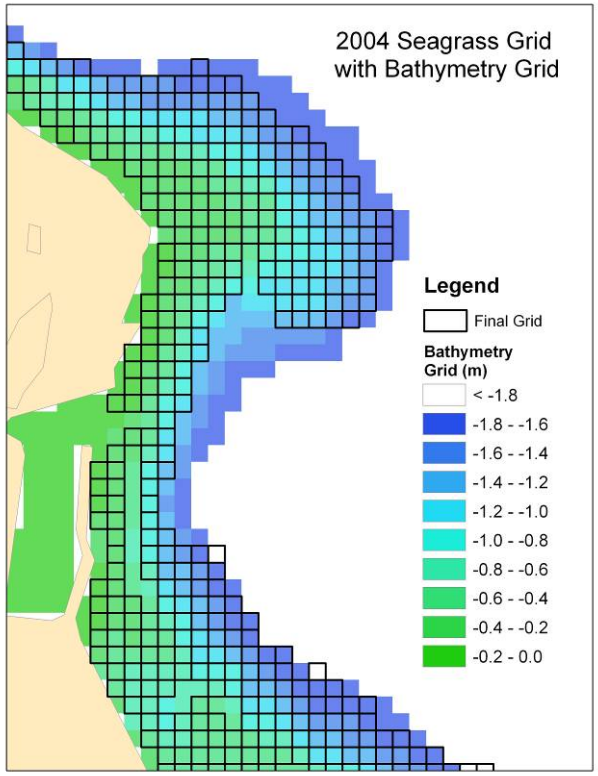
- It is an exponential relationship whose rate varies dependent on water quality condition

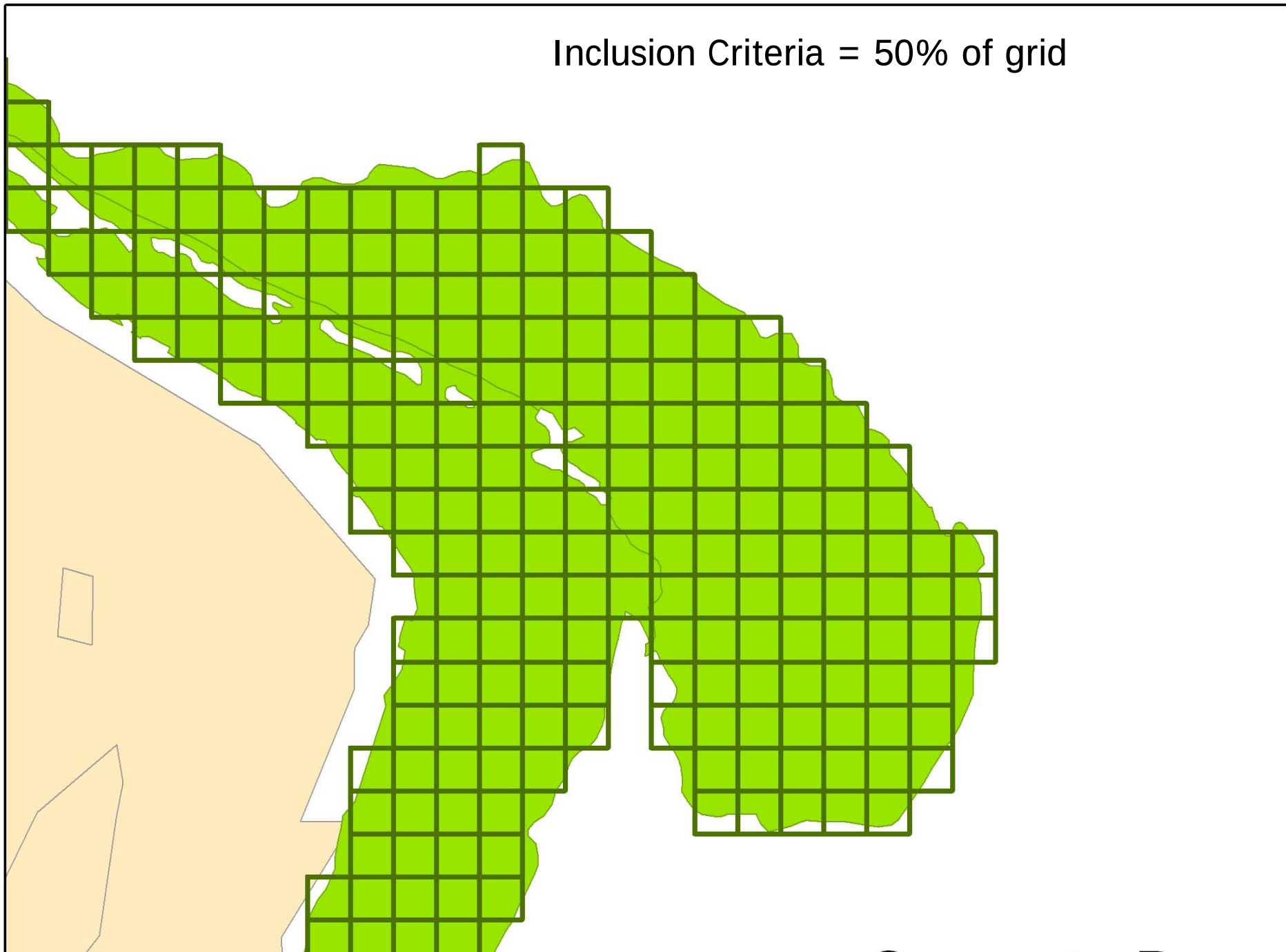
$$Iz = Io^{-Kd*(Z)}$$

Defining Our Resource Needs

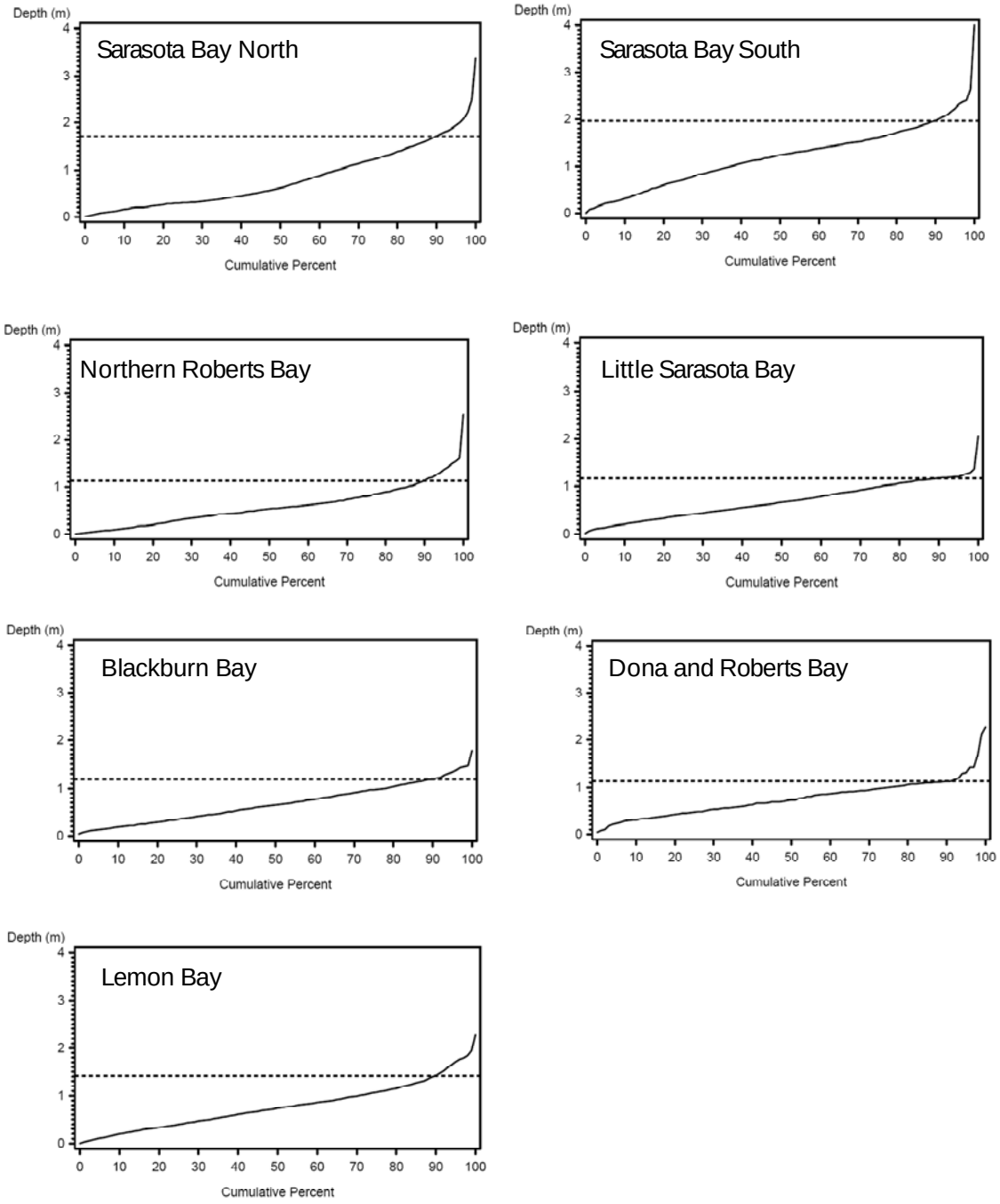







Inclusion Criteria = 50% of grid

Depth Criterion



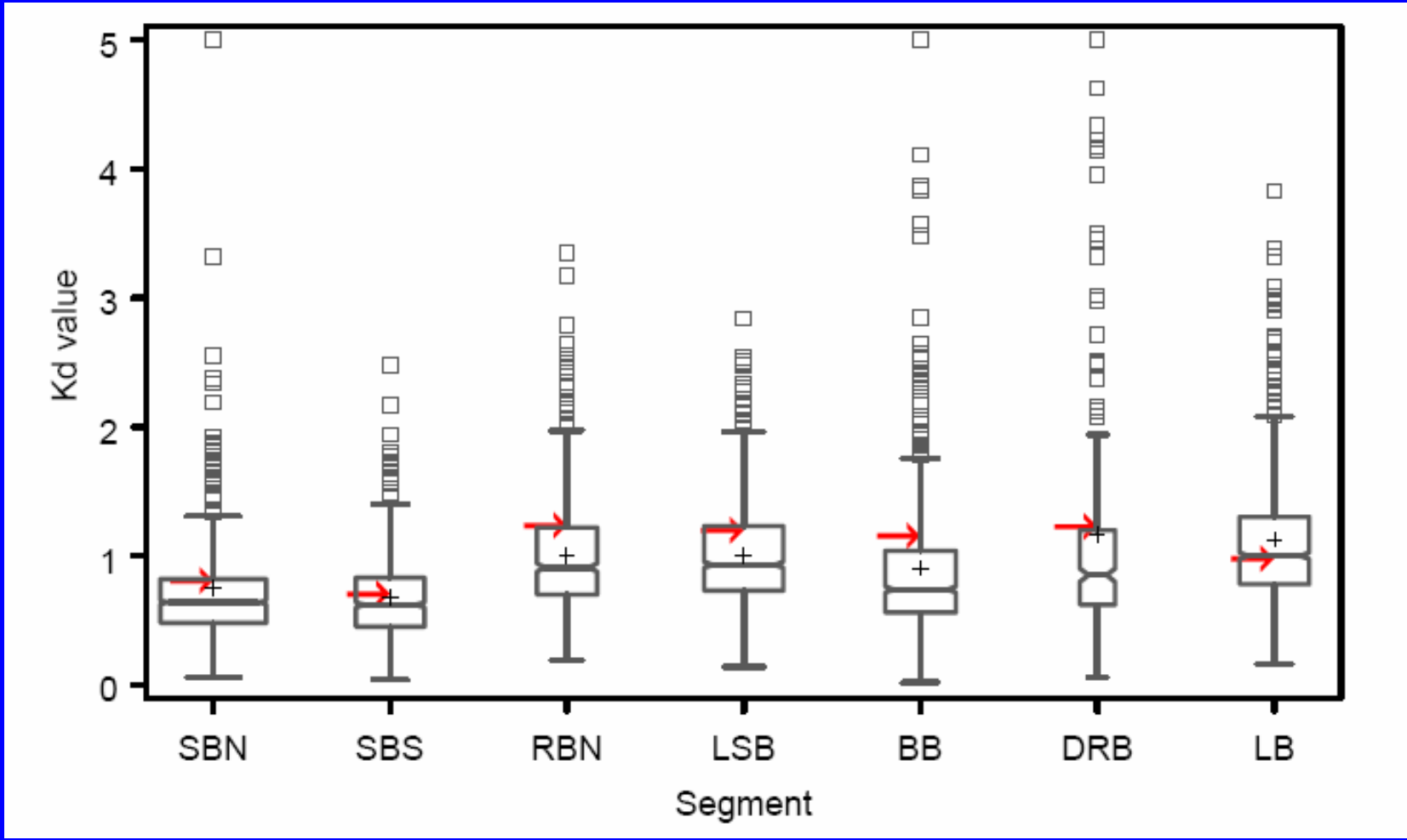
Depth above which 90% Of seagrasses have ever been reported in any SWIM survey year

Eq. for downwelling irradiance $$Iz = Io^{-Kd*(Z)}$$

Re-arranged to solve for Kd $$\frac{Ln(Iz/Io)}{Z} * -1 = Kd$$

Segment	Depth (m)	*Kd*
Sarasota Bay North	1.73	0.81
Sarasota Bay South	1.96	0.71
Roberts Bay North	1.12	1.24
Little Sarasota Bay	1.16	1.20
Blackburn Bay	1.19	1.16
Dona / Roberts Bay	1.13	1.23
Lemon Bay North	1.42	0.98

How Do Derived Kd Values Compare to Empirical Distribution?



Benchmarks

- The exceedance frequency based on the historic data becomes the benchmark against which to judge future data in each segment

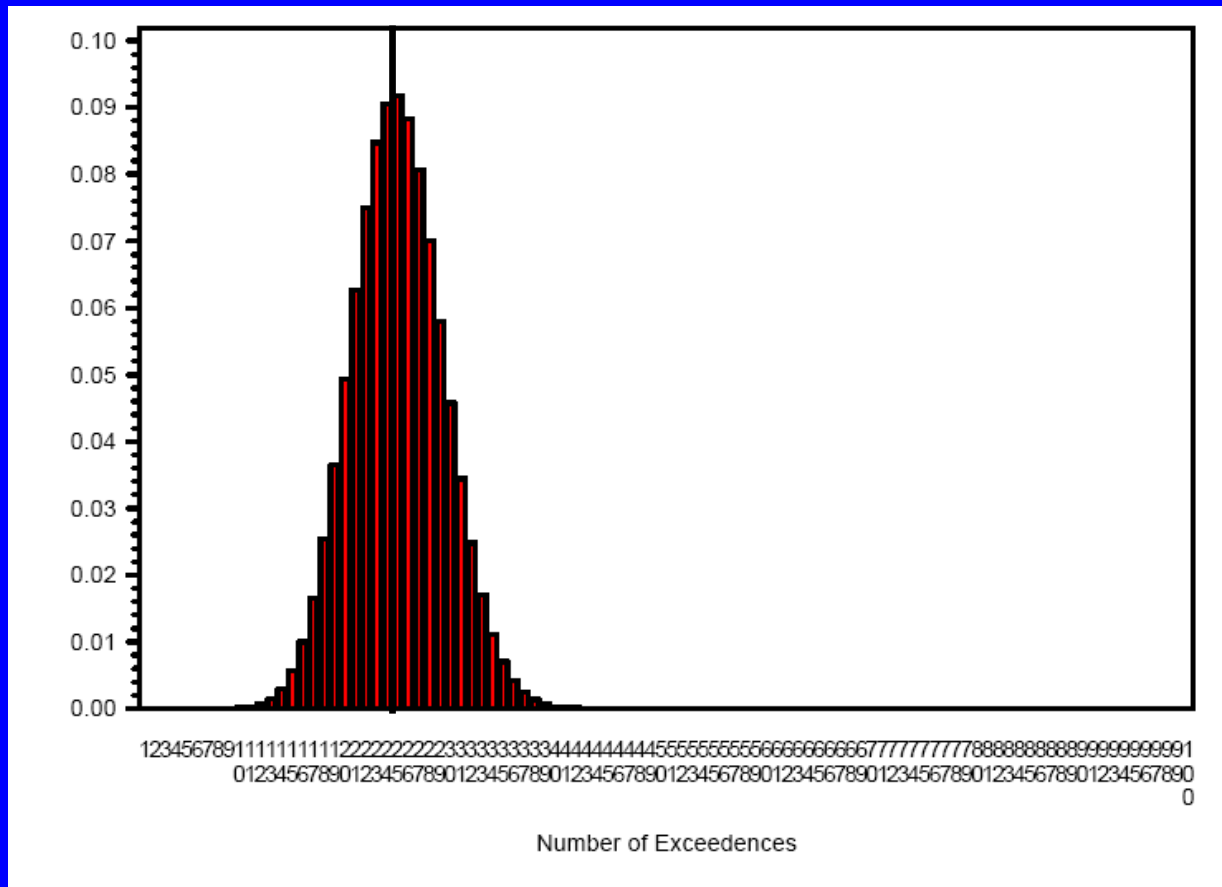
- Binomial test is used to evaluate statistically whether or not the data for a particular year meet the benchmark

Evaluation Strategy

- Binomial test measures the sample exceedance rate against that expected based on the historical distribution of exceedances

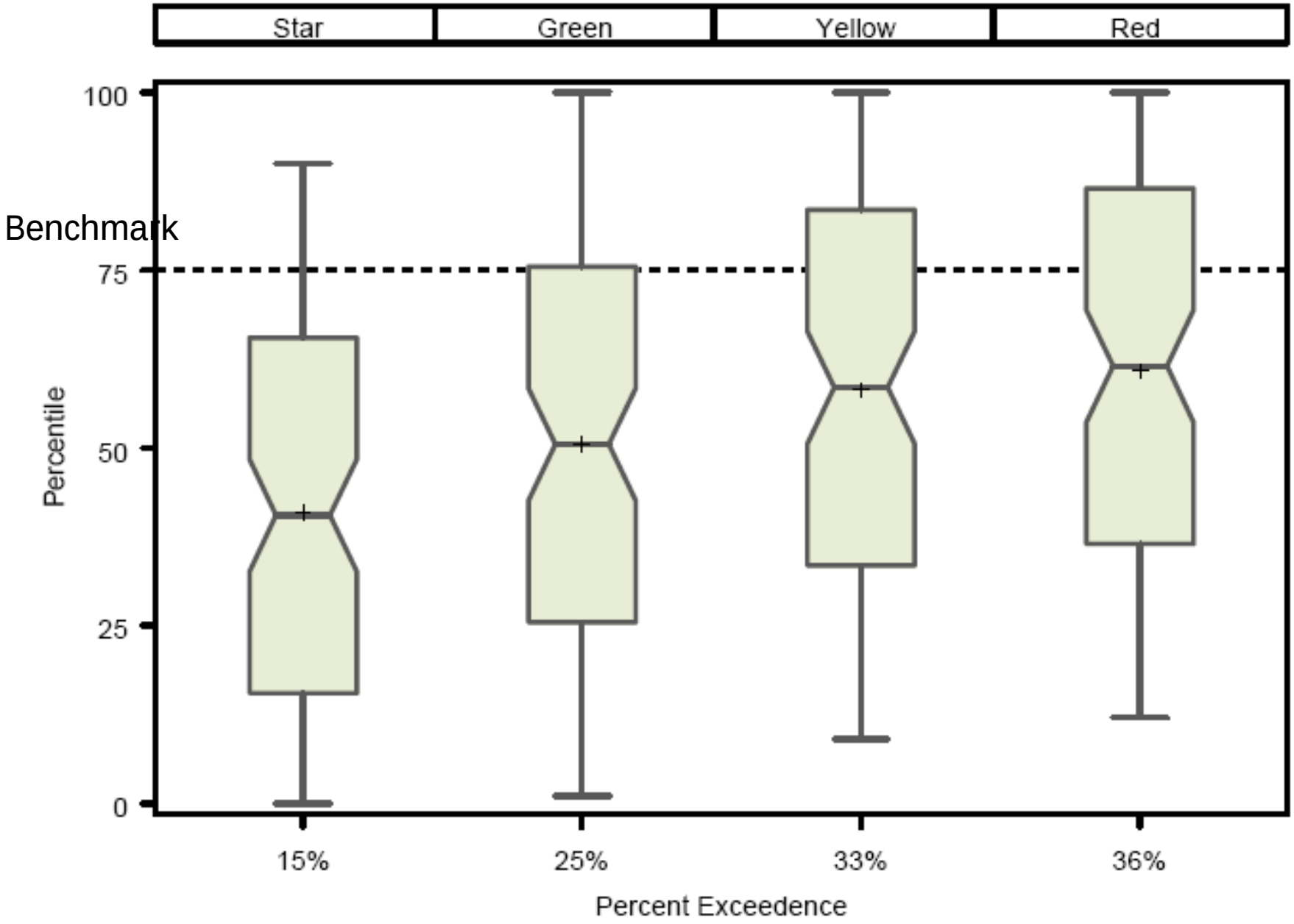
Example:

Probability Distribution
for expected 25% exceedance
based on n=100



Report Card Outcomes

Category	Definition
Green Star	Water clarity is better than benchmark with high statistical certainty (alpha=0.01)
Green	Water clarity meets the benchmark (alpha=0.05)
Yellow	Water clarity is worse than benchmark with statistical certainty (alpha=0.05)
Red	Water clarity significantly worse than benchmark with high statistical certainty (alpha=0.01)


Star
Green
Yellow
Red
Benchmark
100
75
50
25
0
Percentile
15%
25%
33%
36%
Percent Exceedence

Level 1 - Green Star

Water clarity conditions are improved with respect to benchmark levels with high statistical certainty

Action Item:

Identify fluctuations in estuarine inputs (both natural and anthropogenic) which may have contributed to increased water clarity. If management actions have contributed to increased water clarity, recognize those successes

Level 2 - Green

Water clarity conditions are achieving benchmark levels

Action Item:

Guard against future risks to water clarity exceedences. Strategize on future improvements which may results in water clarity improvements

Level 3 – Yellow or Red

Water clarity conditions did not meet benchmarks for a single year

Action Item:

Identify fluctuations in estuarine inputs (both natural and anthropogenic) which may have contributed to the observed increase in water clarity benchmark exceedences. Identify actions which could ameliorate the negative impacts of estuarine inputs causing reduced water clarity

Level 4 -Red

Water clarity conditions did not meet benchmarks for consecutive years

**Early warning that the water clarity segment is out of balance from recent historic conditions

Action Items:

- Kendal Tau trend test analysis to confirm decreasing trend in water clarity (rigorous statistical test for trend)
- Evaluate water quality models to determine influence of estuarine inputs in reduced water clarity
- Prioritize this water clarity segment for action
- Appropriate resources to rectify potential sources of reduced water clarity

Report Card

Red → Level 3

Yellow → Level 3

Green → Level 2

Star → Level 1

Level 3 / Level 3 → Continue

Continue → Do previous report cards indicate a red last year or yellow / red for last 2 consecutive years?

- Yes → Level 4
- No → Level 3

Continue → Do previous report cards indicate yellow or red for last 2 consecutive years?

- Yes → Level 4
- No → Level 3

Water Clarity Benchmarks as a Management Tool

- Objective
- Science based
- Indicative (improving, declining, stable)
- Easily implemented
- Easily incorporated (Water Atlas)
- One of several tools to be used in watershed management

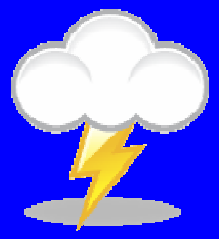
Watershed Planning

Adaptive Management

- 5 Year Rotation
- Report Cards in 2008
- Myakka River Benchmarks?
- Dona & Roberts Bay
- Assemble tools to understand Why
- Seagrass Management Plan

Action Plan

- Respond to declines in Clarity
  - Monitor and Evaluate
  - Acts of God



- Collaborate with Stakeholders
  - Regulations or Development Standards
  - Operational Practices
  - Capital Improvements
  - Wastewater and septic systems
  - Best Management Practices