Water Quality Targets Refinement Project
Task 1: Harbor Segmentation Scheme

Contract # 08-025-003

Interim Report 1

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1.0 Introduction:

1.1 Purpose

The Charlotte Harbor National Estuary Program (CHNEP) is in the process of developing criteria to evaluate management actions using the extent of seagrass in estuarine waters as one indicator of estuarine health. These seagrass protection and restoration “targets” are being developed to meet objectives set forth in the CHNEP Comprehensive Conservation and Management Plan (CCMP). This project helps implement the following CCMP Quantifiable Objectives:

- FW-1: Native submerged aquatic vegetation should be maintained and restored to a total extent and quality no less than caused by natural variation, and
- WQ-2: Develop and meet site-specific alternative criteria that are protective of living resources for dissolved oxygen, chlorophyll *a*, turbidity/total suspended solids, salinity and pesticides.

Therefore, the targets represent management level indicators to track seagrass extent through time to evaluate the effectiveness of management actions in the watershed to minimize watershed impacts on estuarine seagrasses. Seagrasses are known to be primarily limited by the quantity and quality of light available for photosynthesis; therefore, water clarity targets are also being developed to monitor a significant factor in determining the health and productivity of seagrass in Charlotte Harbor and associated estuarine waters.

1.2 Location and Background

The Charlotte Harbor Estuarine system is located in southwest Florida (Figure 1) and includes 224,000 acres (350 square miles) of estuaries downstream from a 3,008,000 acre (4,700 square mile) watershed. The CHNEP is a partnership of citizens, elected officials, resource managers and commercial and recreational resource users working to improve the water quality and ecological integrity of the greater Charlotte Harbor Watershed. A cooperative decision-making process is used within the program to address diverse resource management concerns in the study area.

The Charlotte Harbor estuary is expansive and includes a variety of estuarine habitats with a gradient in water quality from the highly colored tidal Peace River to Pine Island Sound which is influenced largely by the coastal ocean waters of the Gulf of Mexico. Separate reporting units were desired that represented relatively homogeneous conditions relevant to seagrass success within the estuary.

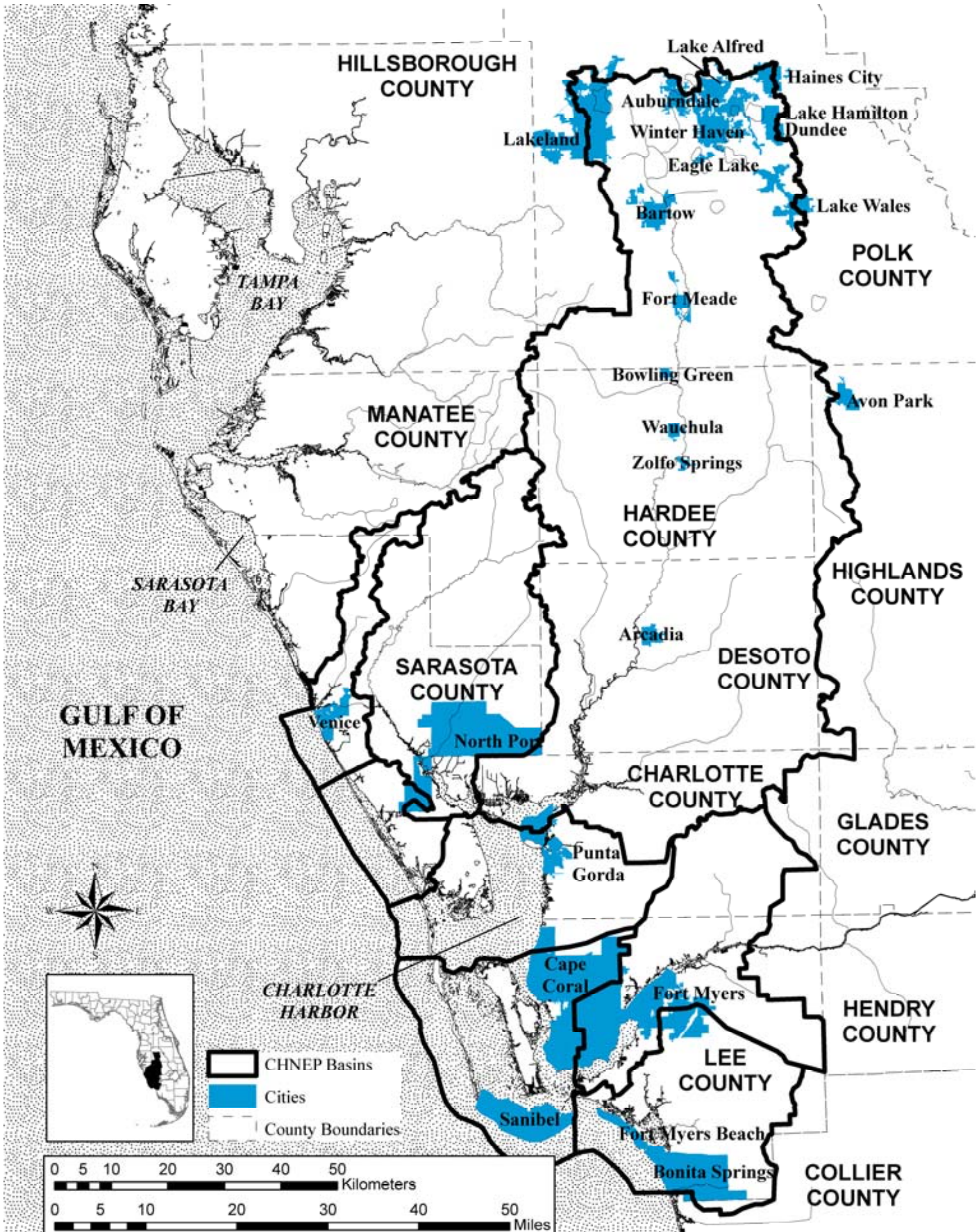

Figure 1. Map of the Charlotte Harbor National Estuary Program study area.

2.0 Methods:

Due to the size and variability in estuarine condition throughout the CHNEP study area a segmentation scheme was necessary for developing and reporting on the seagrass and water clarity targets which will be covered in Interim Report 2 and Interim Report 3 under this scope of work. Identification of a segmentation scheme included the following:

- A review of the various segmentation schemes currently used for management related activities in the estuarine portion of the CHNEP study area.

- A water quality analysis to assess the relative homogeneity of water quality conditions within the study area.

- A meeting with local experts including a CHNEP TAC subcommittee to discuss the advantages, disadvantages, and relevance of each of the segmentation schemes for reporting on seagrass and water clarity.

Several segmentation schemes currently exist to delineate boundaries within the CHNEP estuarine study area for monitoring, reporting and management purposes and a review of these segmentation schemes was seen as a logical place to begin to define a segmentation scheme for the target setting process. Four segmentation schemes are currently used for management related reporting in the CHNEP estuarine study area including:

- Coastal Charlotte Harbor Water Quality Monitoring Network segmentation scheme
- Water Management District seagrass segmentation schemes
- Charlotte Harbor Aquatic Preserve boundaries
- Florida Department of Environmental Protection Waterbody Identifiers

The digital shapefiles for each of the segmentation schemes was acquired from these respective agencies and incorporated into ArcGIS (ESRI 2005). The segmentation schemes were then mapped to identify similarities and differences between them.

A meeting was conducted on January 22nd 2009 to discuss these segmentation schemes and receive input from local scientists on the development of a segmentation scheme to use for reporting on water clarity and seagrass targets. A brief review of the segmentation schemes was given to the meeting members and a discussion followed. The initial discussion focused on: the objectives of each segmentation scheme, how they are used for reporting and resource management purposes, and the need for consensus on a segmentation scheme to use for the development of CHNEP segment specific seagrass and water quality targets (see Appendix 1 for details). The discussion covered the following topics:

- Connectedness to watersheds
- Hydrologic effects on water quality (e.g. gyres, passes, etc.)
- Implications of changing segmentation on current CCHMN sampling design
- Representativeness of the WQ sampling program for evaluating effects on seagrass (i.e. sample depths)

- Recognition that segmentation is a balance of logistical and political considerations with empirical evidence of similarity and professional judgment
- Definition of reporting units need not necessarily be identical for all research related activities

A water quality data analysis was conducted which consisted of gathering data from the CCHMN and examining the heterogeneity in water quality among segments within the study area. First, multivariate principal components analysis (PCA) and Spearman's rank correlation were used to examine the similarities among water quality constituents. The CCHMN data were first normalized by subtracting each value from its grand average and dividing by the standard deviation. This routine scales all environmental variables into analogous units for analysis (Clark and Warwick 2001). PCA is a data reduction technique designed to group variables that tend to describe the same orientation of the data into a singular vector by producing linear combinations of the variables. These vectors are overlain on the PCA plots to identify the direction in which each environmental variable weights the orientation of the data along the plotted PCA axes.

3.0 Results

3.1 Review of Current Segmentation Schemes:

The following summarizes a review of the existing sampling schemes used for various purposes with the CHNEP estuarine study area (Harbor).

3.1.1 Coastal Charlotte Harbor Water Quality Monitoring Network (CCHMN):

The CCHMN is a co-operative agreement established in 2001 between local and state agencies to collect monthly water quality data throughout the estuarine CHNEP study area using consistent methodology under the supervision of the CHNEP. The objective of the program is to serve as a long term monitoring tool for assessing water quality conditions throughout the Harbor over time (Corbett 2004). This program uses a probability based design which allows empirical information to be generalized to characterize the entire sampling area of the program. The Harbor is also stratified into 14 "segments" that were thought to represent generally homogenous estuarine regions within the Harbor. A grid overlay consisting of one square mile grids based on latitude and longitude is used to randomly select 5 grids from each segment each month (see Corbett 2004 for details and standard operating procedures). The grid system is an extension of that used by the Florida Fish and Wildlife Conservation Commissions Fisheries Independent Monitoring program in Charlotte Harbor. The segments and participating agencies of the CCHMN sampling are listed in Table 1 along with the start date for the water quality monitoring within each segment.

Table 1. Harbor segment, participating agency and start date of the CCHMN.

Harbor Segment	Sampling Agency	CCHMN Start Date
Lower Lemon Bay	FDEP Charlotte Harbor Aquatic Preserves	Spring 2001
West Wall Charlotte Harbor	FWRI Fisheries Independent Monitoring	Spring 2001
East Wall Charlotte Harbor	FWRI Fisheries Independent Monitoring	Spring 2001
Tidal Myakka River	FWRI Fisheries Independent Monitoring	Spring 2001
Tidal Peace River	FWRI Fisheries Independent Monitoring	Spring 2001
Gasparilla Sound/Cape Haze	FWRI Fisheries Independent Monitoring	Spring 2001
Lower Charlotte Harbor	FDEP Charlotte Harbor Aquatic Preserves	Spring 2002
Pine Island Sound	Lee County Environmental Lab	Spring 2002
Matlacha Pass	City of Cape Coral	Spring 2002
San Carlos Bay	City of Sanibel, Lee County Environmental Lab	Spring 2002
Tidal Caloosahatchee River	Lee County Environmental Lab, SFWMD	Spring 2002
Estero Bay	Lee County Environmental Lab	Spring 2002

The water quality data collected by the CCHMN serves as the foundation for assessing estuarine water quality throughout the study area to evaluate the effectiveness of management actions in the watershed. The CCHMN segmentation scheme (Figure 2) was initially developed based on logistical considerations, jurisdictional boundaries and expert opinion regarding the hydrologic function of different parts of the estuarine system. The major river systems (Peace, Myakka and Caloosahatchee) as well as the more isolated estuarine systems (i.e. Estero Bay and Lemon Bay) were delineated as separate segments. West Wall was separated from East Wall since most river flow from the Peace and Myakka is thought to travel along the western portion of the upper harbor and mixing with the coastal waters brought into the harbor via Boca Grande Pass.

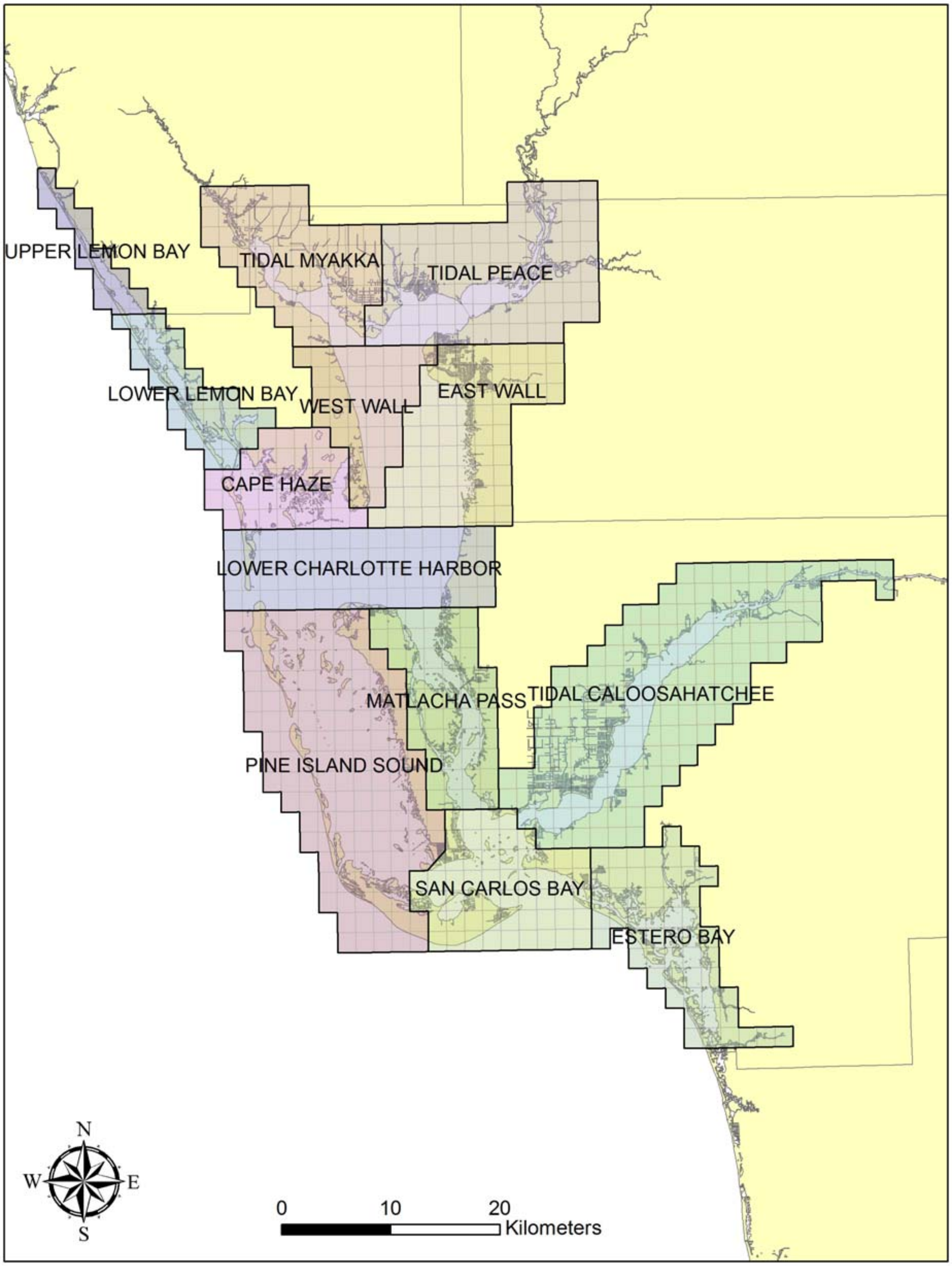

Figure 2. Segmentation scheme used by the Coastal Charlotte Harbor Water Quality Monitoring Network.

3.1.2 South and Southwest Florida Water Management District Seagrass Segmentation

The Water Management Districts' (Districts) use biennial aerial photography to monitor changes in seagrass extents along the southwest coast of Florida. The photographic data are interpreted to report on the areal extent of seagrass. A segmentation scheme was developed to post stratify the photographic data into separate reporting units and report on areal extents for each survey to track changes in extents over time. In the CHNEP study area, the segmentation scheme uses many of the same segments as the CCHMN segmentation scheme (Figure 3). These segments include Lemon Bay, Estero Bay, Pine Island Sound, Matlacha Pass, and San Carlos Bay. The differences in segmentation are principally in Charlotte Harbor Proper where the segmentation scheme was delineated to:

- Specifically define the boundary between the Southwest and South Florida Water Management District jurisdictional boundaries
- Separately define the Turtle Bay/Bull Bay for reporting on changes in seagrass
- Separate the northern and southern portion of the CCHMN Eastern Wall segments

The Lower Caloosahatchee River segment is also more restricted to the east than the CCHMN Tidal Caloosahatchee River segment.

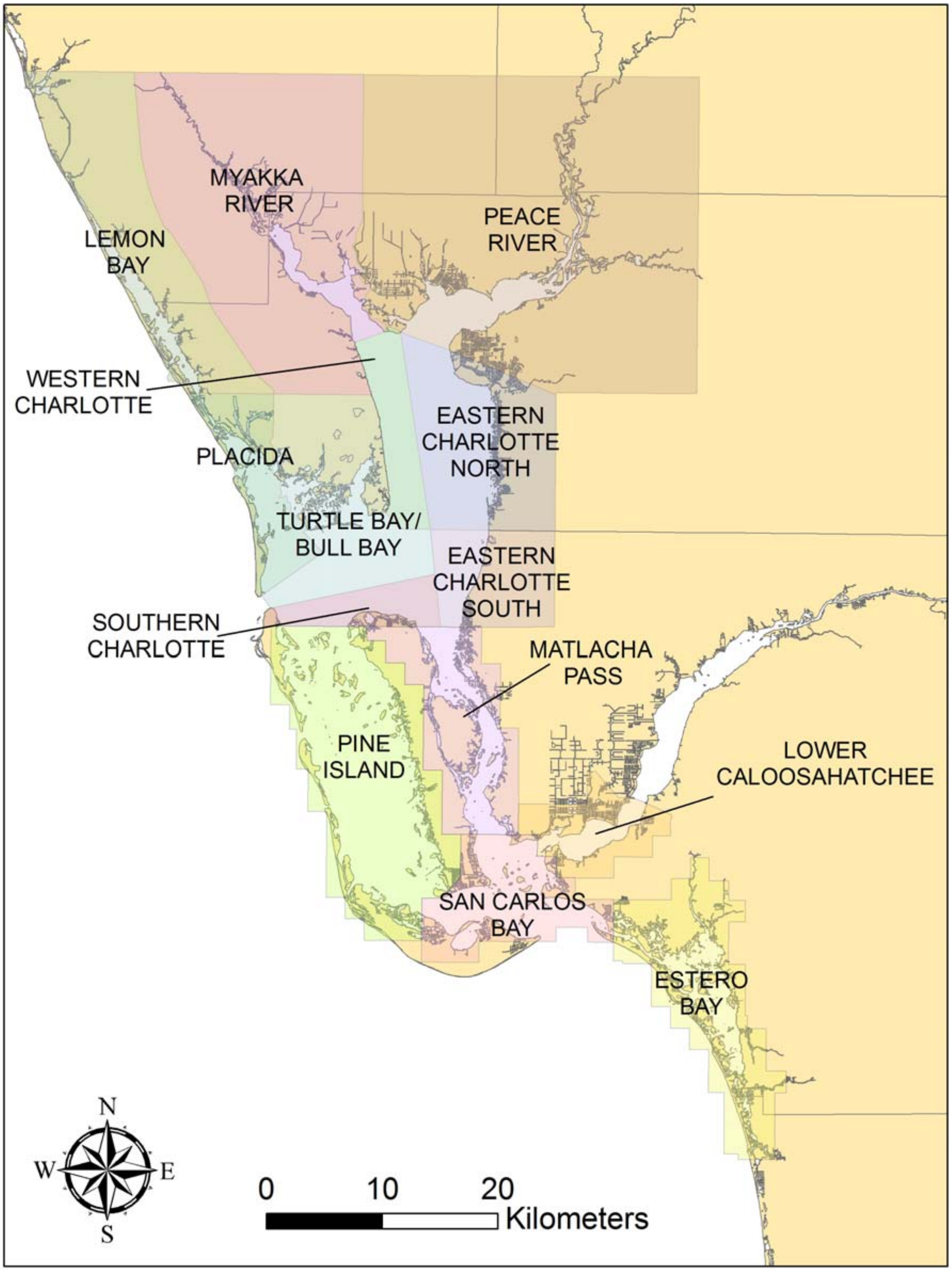

Figure 3. Segmentation scheme used by the Florida water management districts for report seagrass extent in southwest Florida estuarine waters.

3.1.3 The Charlotte Harbor Aquatic Preserve Boundaries:

The CHNEP study area includes six Florida aquatic preserves. The aquatic preserves in the Harbor include; Lemon Bay, Cape Haze, Gasparilla Sound, Matlacha Pass, Pine Island Sound, and Estero Bay (Figure 4). The segment boundaries were defined upon state designation and are managed under the Florida Department of Environmental Protection's Office of Coastal and Aquatic Managed Lands. The aquatic preserve boundaries are somewhat similar to the CCHMN segmentation scheme; however, the boundary definitions between San Carlos Bay and Pine Island Sound and Matlacha Pass are slightly different. The Gasparilla Sound Aquatic Preserve comprises all of Upper Charlotte Harbor other than that included in the Cape Haze Aquatic Preserve and therefore includes several segments including West Wall, East Wall, Charlotte Harbor Proper, and portions of Cape Haze, Tidal Myakka and the Tidal Peace River segments of the CCHMN.

In 1999, the Charlotte Harbor Aquatic Preserves began annual seagrass monitoring at 50 fixed locations throughout the Charlotte Harbor Aquatic Preserves (Charlotte Harbor Aquatic Preserve 2007). Estero Bay Aquatic Preserves began monitoring 5 fixed locations bi-annually in 2002. The purpose of the monitoring was to characterize the species distribution, abundance and maximum depth of growth along transects from the shoreward to waterward edge of seagrass growth at each fixed location.

Table 2. FDEP Aquatic Preserves in the Charlotte Harbor study area including relevance to the CCHMN segmentation scheme, number of transects start date and sampling frequency.

Aquatic Preserve	Harbor Segment	No. of Transects	Start Date	Frequency
Lemon Bay	Upper & Lower Lemon Bay	6	1999	Fall
Cape Haze & Gasparilla Sound/Charlotte Harbor	West & East Walls Charlotte Harbor, Tidal Myakka & Peace Rivers, Gasparilla Sound/Cape Haze, Lower Charlotte Harbor	27	1999	Fall
Pine Island Sound	Pine Island Sound	9	1999	Fall
Matlacha Pass	Matlacha Pass	4	1999	Fall
(not in an Aquatic Preserve)	San Carlos Bay	4	1999	Fall
Estero Bay	Estero Bay	5	2002	Summer & Winter

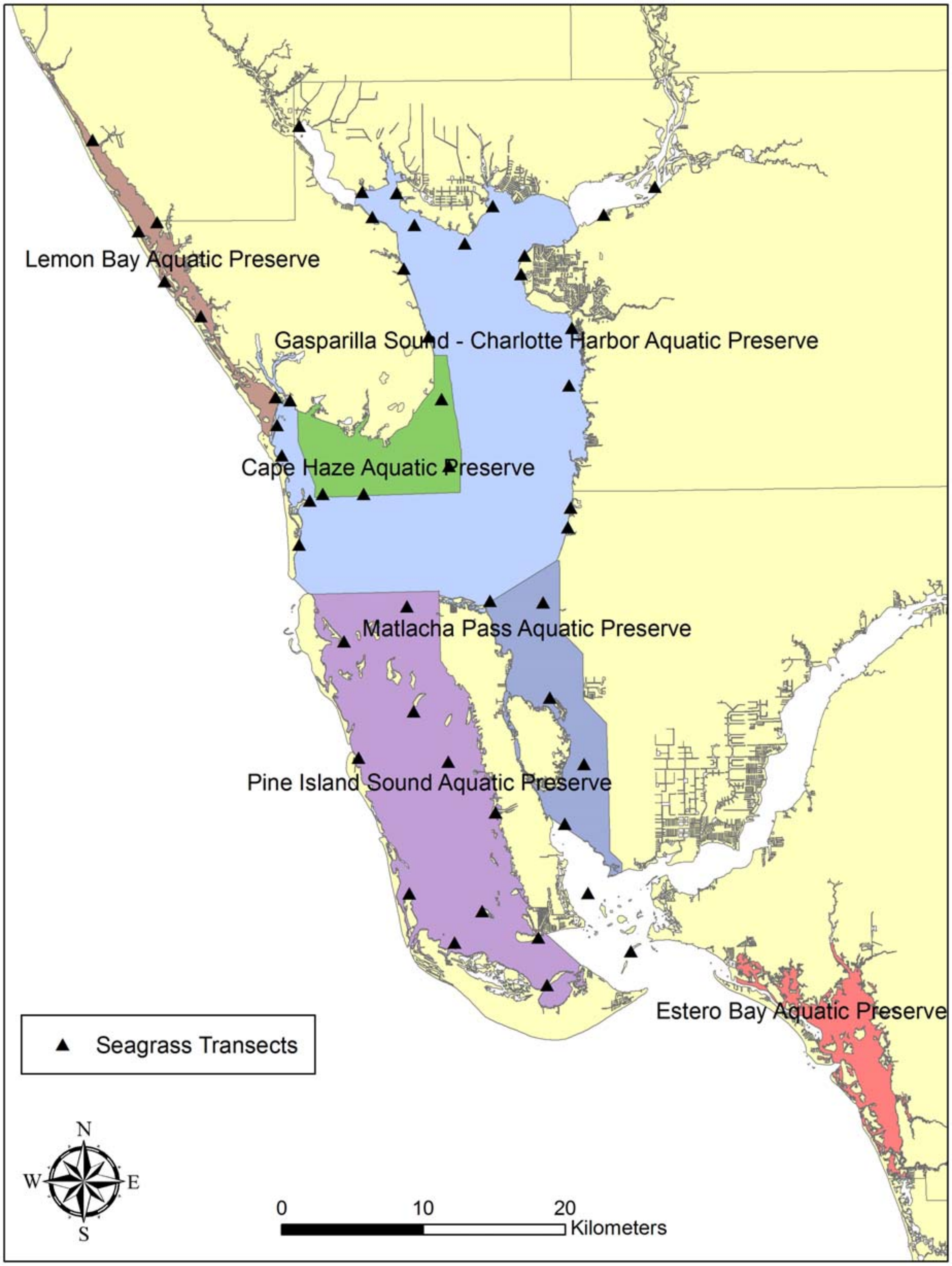

Figure 4. Florida Department of Environmental Protection aquatic preserve boundaries and location of seagrass transects within the CHNEP study area.

3.1.4 The Florida Department of Environmental Protection Waterbody Identifiers

The Florida Department of Environmental Protection has developed a system for assessing water bodies throughout the state using Waterbody identifiers (WBID). These WBIDS were designed to represent hydrologically linked units to assess impairment according to Florida's Impaired Water Rule (F.S. section 403.067) in accordance with mandates of the United States Environmental Protection Agency's Clean Water Act; subsection 303(d). The majority of the estuarine WBIDS are similar to the CCHMN segmentation scheme (Figure 5). Segmentation differences are in Pine Island Sound where the northern and southern portion are divided; in Upper Charlotte Harbor where the WBID boundaries are latitudinally divided rather than longitudinally, and San Carlos Bay which is much smaller than the CCHMN segment.

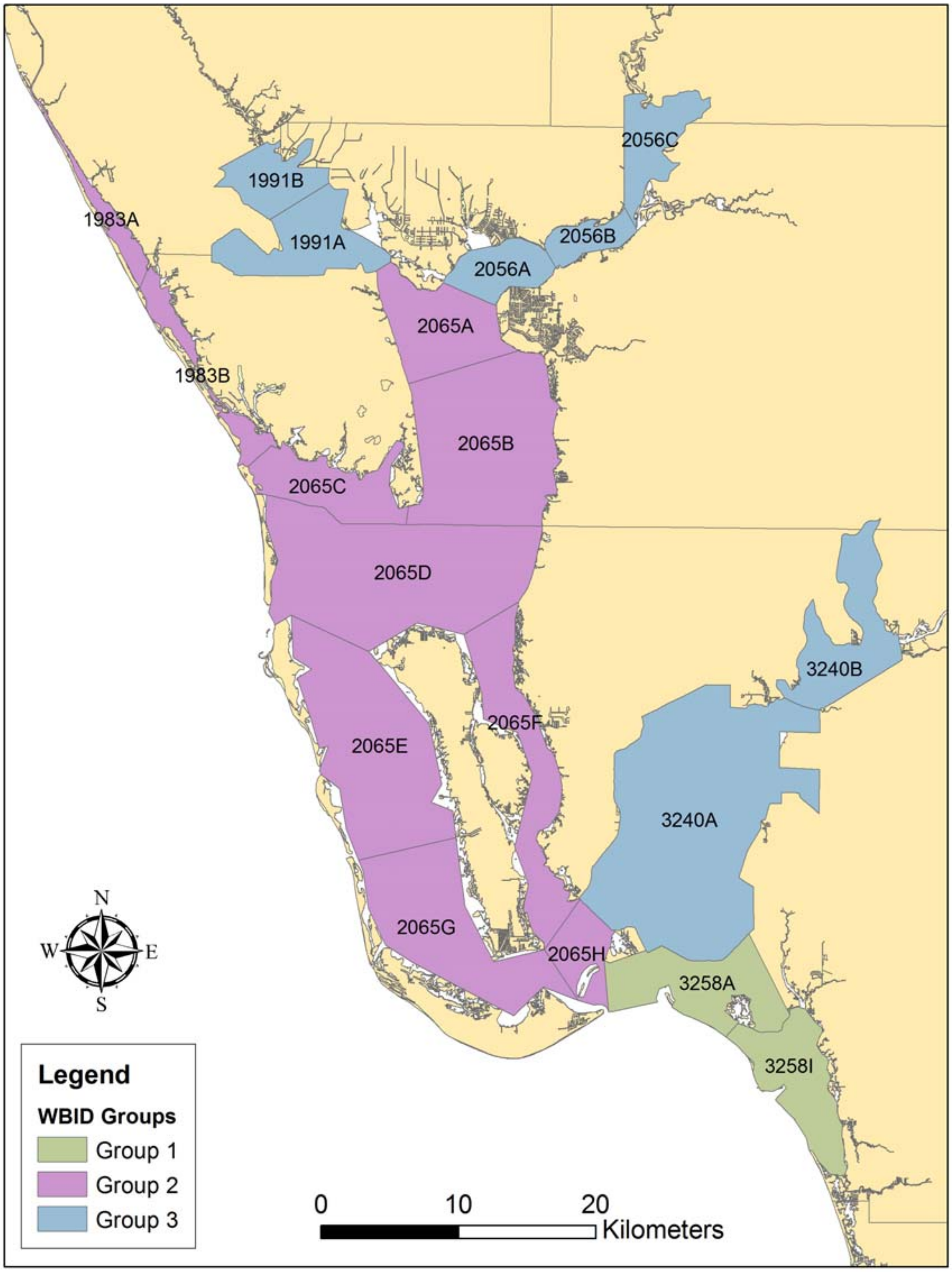

Figure 5. Florida Department of Environmental Protection Waterbody Identifiers.

3.2 Analysis of Water Quality Heterogeneity:

Freshwater inflows from the Peace, Myakka and Caloosahatchee Rivers are the principal driving forces of water quality in the Charlotte Harbor estuary by inputting nutrients, suspended solids and Colored Dissolved Organic Matter (CDOM or Color) (McPherson and Miller 1994; Dixon and Kirkpatrick 1999). The influence of these rivers on water quality, particularly water clarity, diminishes as a function of distance from the river mouth and increasing salinity (Dixon and Kirkpatrick 1999; Tomasko and Hall 1999). Corbett and Hale (2006) used a predictive equation developed by McPherson and Miller (1994) to develop water clarity targets throughout the Charlotte Harbor estuary. This equation used measures of chlorophyll *a* (ug/l), color (PCU) and turbidity (NTU) to predict the light attenuation coefficient (Kd) which describes the rate of exponential light lost as a function of depth.

Results of the principal components analysis confirmed the suggestion that water quality in the Harbor estuarine systems is principally a color – salinity gradient (Figure 6).

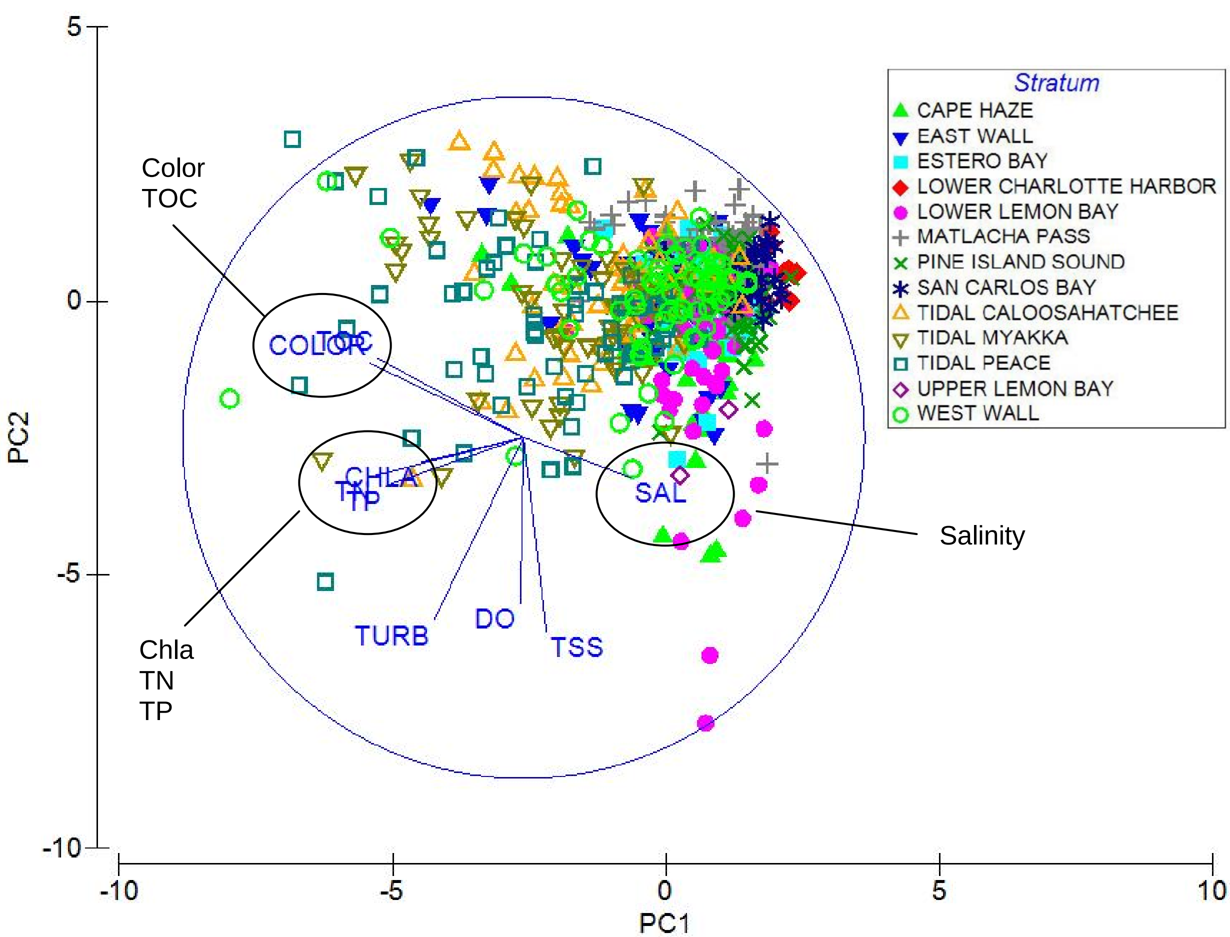

Figure 6. Principal Components Analysis of water quality data collected by the CCHMN in the CHNEP study area.

In this figure samples are represented with symbols denoting the CCHMN segments. The orientation of samples with respect to water quality constituents are denoted by the principal component axes vectors shown as line plots on the figure. It is important to note that the lines represent multidimensional axes compressed onto a two dimensional plot represented by the two PCA axis explaining the greatest variation in water quality. The majority of the samples aligned along a color- salinity gradient with the Tidal Myakka, Tidal Peace, and Tidal Caloosahatchee associated with high color samples. Many samples from the West Wall segment were also associated with the end of this gradient indicating that inputs from the Peace and Myakka rivers likely control water quality conditions in West Wall during periods of high inflows.

A subset of samples from the major rivers (i.e. Peace, Myakka, Caloosahatchee) also oriented towards a PCA axis representing higher chlorophyll *a*, TN and TP. The majority of samples in the remaining segments were higher in salinity and relatively similar along the color - salinity gradient. Another thing to notice about Figure 6 is the grouping of the line vectors. Chlorophyll, total nitrogen and total phosphorus were highly correlated as were color and total organic carbon (TOC). However, chlorophyll, color and turbidity, the constituents used in the optical model, did not appear to be highly correlated but rather represented somewhat independent components of the overall similarity between samples. The correlation among the constituents was tested using Spearman rank correlation and a correlation coefficient (Rho) above 0.70 was chosen to represent a high level of correlation. This analysis confirms that color was highly correlated with TOC and highly negatively correlated with salinity (Table 2). Turbidity and chlorophyll *a* were moderately correlated (i.e. 46%).

Table 2. Spearman rank correlation coefficient matrix for water quality parameters collected by the CCHMN. NS denotes an insignificant correlation. All other correlations are significant at alpha = 0.05. Shaded boxes display highest correlation coefficients.

	COLOR	SAL	DO	TP	TN	TOC	TSS	TURB	CHLA
COLOR	1.00	-0.84	NS	0.55	0.56	0.70	-0.24	0.30	0.50
SAL	-0.84	1.00	NS	-0.49	-0.46	-0.69	0.25	-0.21	-0.38
DO	NS	NS	1.00	NS	NS	NS	NS	NS	NS
TP	0.55	-0.49	NS	1.00	0.47	0.46	NS	0.35	0.34
TN	0.56	-0.46	NS	0.47	1.00	0.40	NS	0.38	0.39
TOC	0.70	-0.69	NS	0.46	0.40	1.00	-0.29	0.27	0.38
TSS	-0.24	0.25	NS	NS	NS	-0.29	1.00	NS	NS
TURB	0.30	-0.21	NS	0.35	0.38	0.27	0.18	1.00	0.46
CHLA	0.50	-0.38	NS	0.34	0.39	0.38	NS	0.46	1.00

Adding the light attenuation coefficient (Kd) to the PCA analysis revealed that the light data aligned along the color-salinity gradient (Figure 7) indicating the close relationship between color and light attenuation.

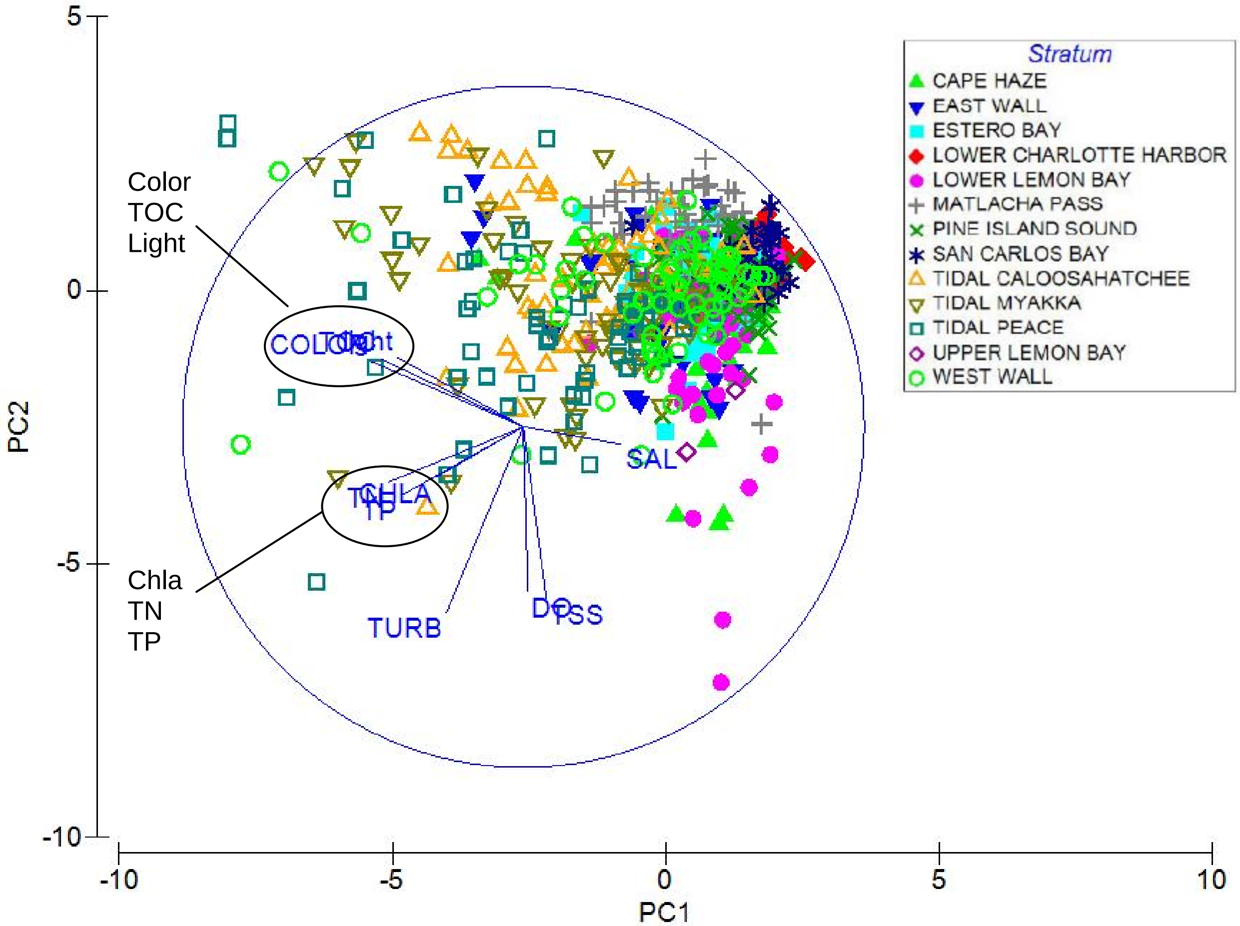

Figure 7. Principal Components Analysis of water quality data collected by the CCHMN in the CHNEP study area including a variable indicating the light attenuation coefficient (Kd).

Removing the major river segments from the analysis and rerunning the PCA did not change the result that the segments were not distinguishable as homogeneous areas but rather reflected a gradient in water quality condition.

With the recognition that water quality is a gradient within an estuarine system governed by dynamics within the system and not by any segmentation scheme developed for management or research purposes, the TAC subcommittee expressed concerns based on professional judgment that four of the CCHN segments may have intra-segment differences in hydrodynamics that may differentially effect seagrass survival. Therefore, an additional analysis was conducted to assess the need for further stratification of these segments. For this analysis Pine Island Sound was divided approximately in half, Matlacha Pass was divided at the Pine Island Bridge and Estero Bay was divided north of Big Carlos Pass. The dividing lines for these strata are displayed in Figure 8 overlaid on the SFWMD seagrass coverage for 2006. In Lemon Bay, while concerns were expressed that area north of the Tom Adams Bridge was distinct in water quality from more southern areas of Lemon Bay, the majority of the samplable area (~80%) lies below the Tom Adams Bridge. Consequently, approximately 80% of the samples in the

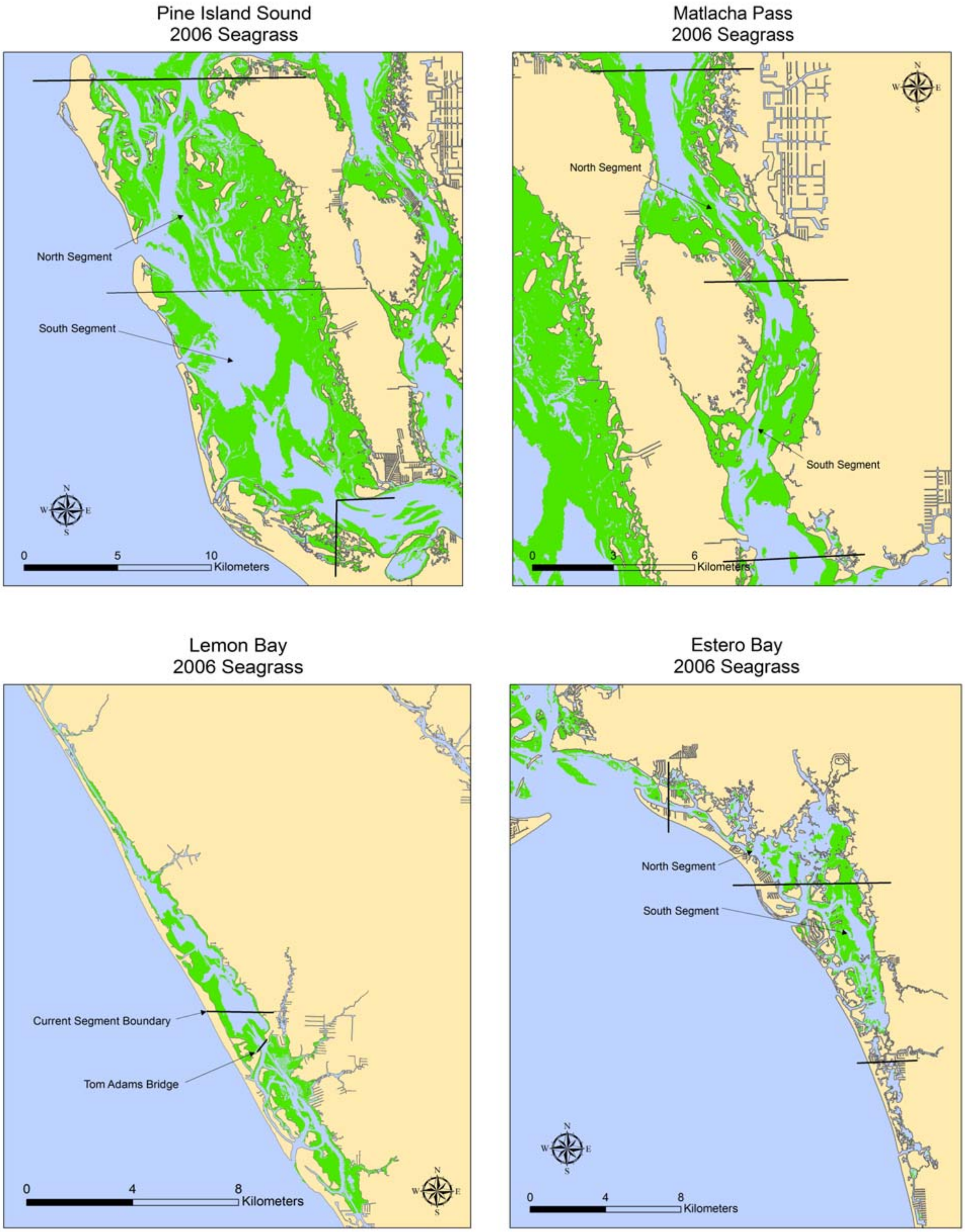

Figure 8. Delineations for the four CCHMN segments identified for possible sub-segmentation.

Lower Lemon Bay segment were collected below the Tom Adams Bridge over the period of record (Table 3). Therefore, the segment is largely representative of the area below the bridge and was not considered for further sub-segmentation. The sampling frequencies between 2002 and 2008 for all segments considered for sub-segmentation are provided in Table 3.

Table 3. Sampling frequency by month for the northern and southern sub-segments of Pine Island Sound, Matlacha Pass, Estero Bay, Lemon Bay.

Segment	Sub-Segment	Month												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
Pine Island	North	5	10	13	4	6	8	11	5	10	7	9	7	95
Pine Island	South	19	15	15	20	19	17	16	16	16	18	17	17	205
Matlacha Pass	North	23	18	15	29	18	25	22	15	17	20	19	20	241
Matlacha Pass	South	15	17	23	16	20	20	22	16	16	15	15	15	210
Lemon Bay	North	6	11	8	5	1	0	6	1	13	5	10	12	78
Lemon Bay	South	30	25	27	33	39	40	36	36	24	29	26	24	369
Estero Bay	North	15	15	12	13	13	13	12	12	11	15	13	11	155
Estero Bay	South	9	10	13	12	12	12	13	8	14	10	12	14	139

The distributions of the constituents used in the optical model were compared for each segment using cumulative distribution function (CDF) plots. Differences in the cumulative distribution highlight difference in the distributions of water quality constituents between the sub-segments.

In Pine Island Sound, three of the four constituents were very similar between sub-segments with the only appreciable difference noted for turbidity (Figure 9). Differences in color were minimal with the exception of the upper 5th percentile where color values were observed in northern Pine Island Sound likely as a function of high inflows from the Peace and Myakka Rivers.

In Matlacha Pass, the distribution of constituents were also consistent between the northern and southern sub-segments with the only exception being some high color values in the upper 5th percentile in the southern sub-segment (Figure 10). These samples were likely collected during periods of extreme inflow conditions from the Caloosahatchee River.

In Lower Lemon Bay, while the sampling allocations were unevenly distributed between the northern and southern sub-segments, the distribution of water quality constituents between sub-segments was similar except for higher turbidity and slightly higher chlorophyll *a* in the southern sub-segment (Figure 11).

In Estero Bay, the distribution of color was vastly different between the northern and southern sub-segments with consistently higher values in the northern sub-segment (Figure 12). Light attenuation was also consistently higher in the northern sub-segment which is consistent with the observation of higher color; however, chlorophyll and turbidity distributions were similar.

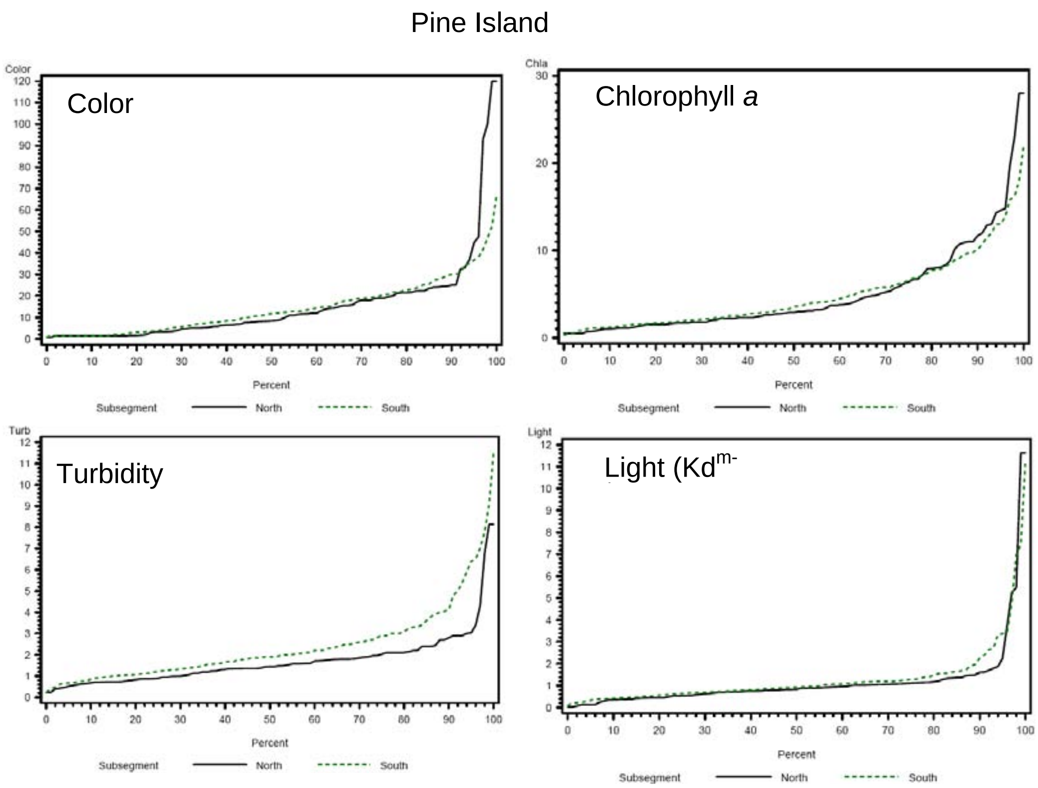

Figure 9. Cumulative distribution plots for water quality constituents in the north (solid line) and south (dotted line) sub-segments of Pine Island Sound.

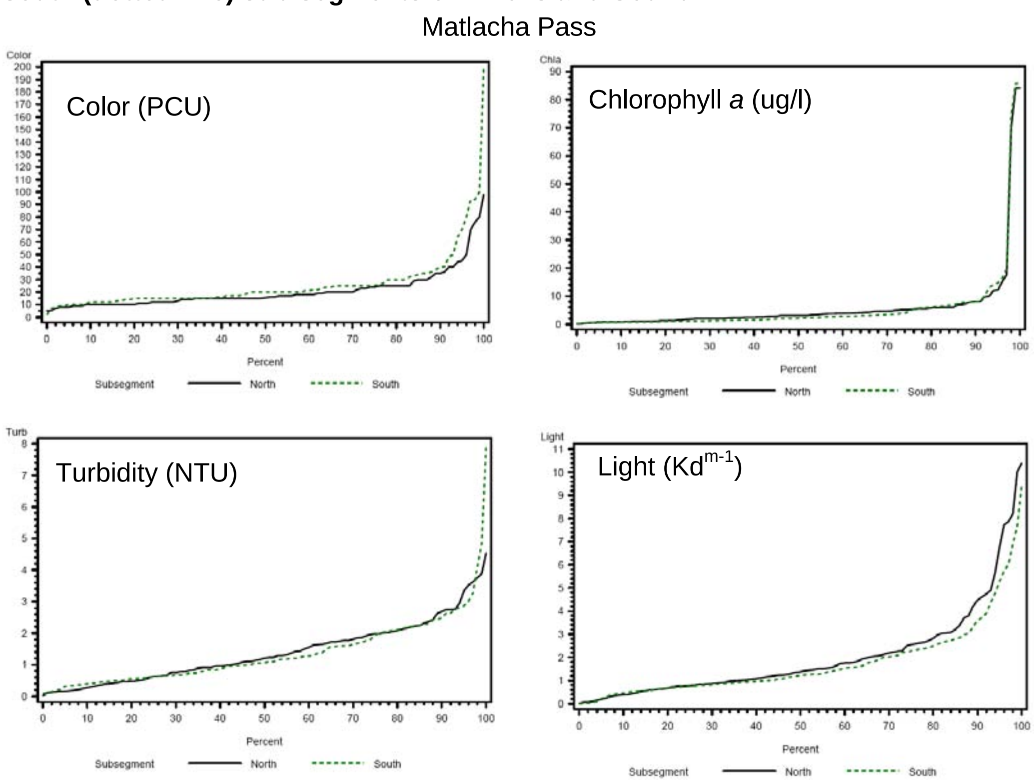

Figure 10. Cumulative distribution plots for water quality constituents in the north (solid line) and south (dotted line) sub-segments of Matlacha Pass.

Lemon Bay

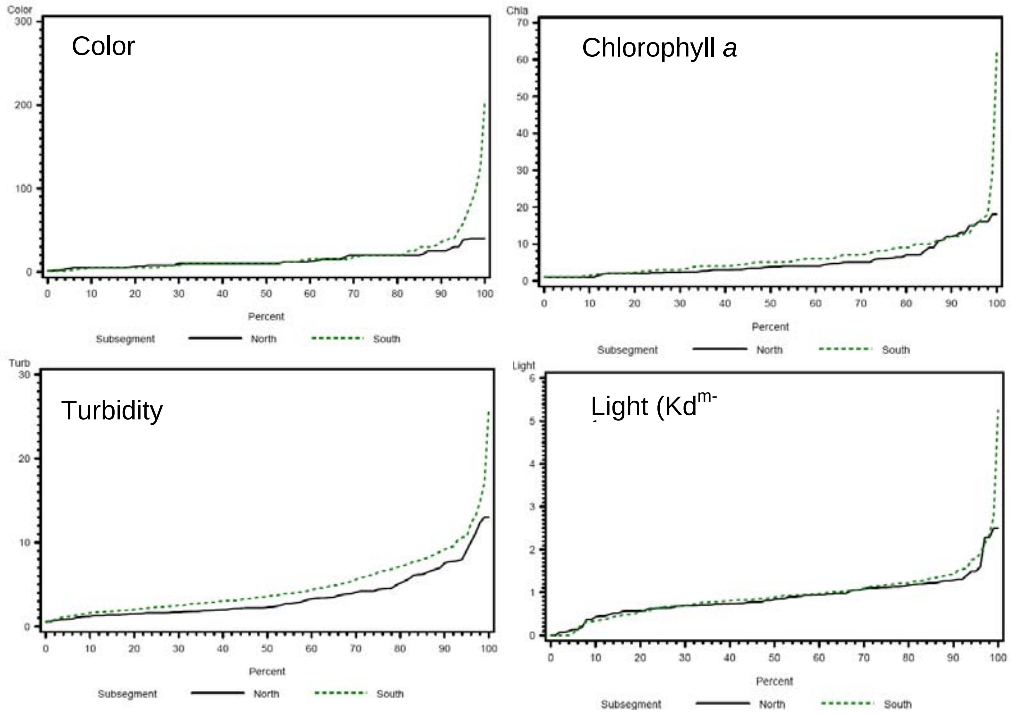

Figure 11. Cumulative distribution plots for water quality constituents in the north (solid line) and south (dotted line) sub-segments of Lower Lemon Bay.

Estero Bay

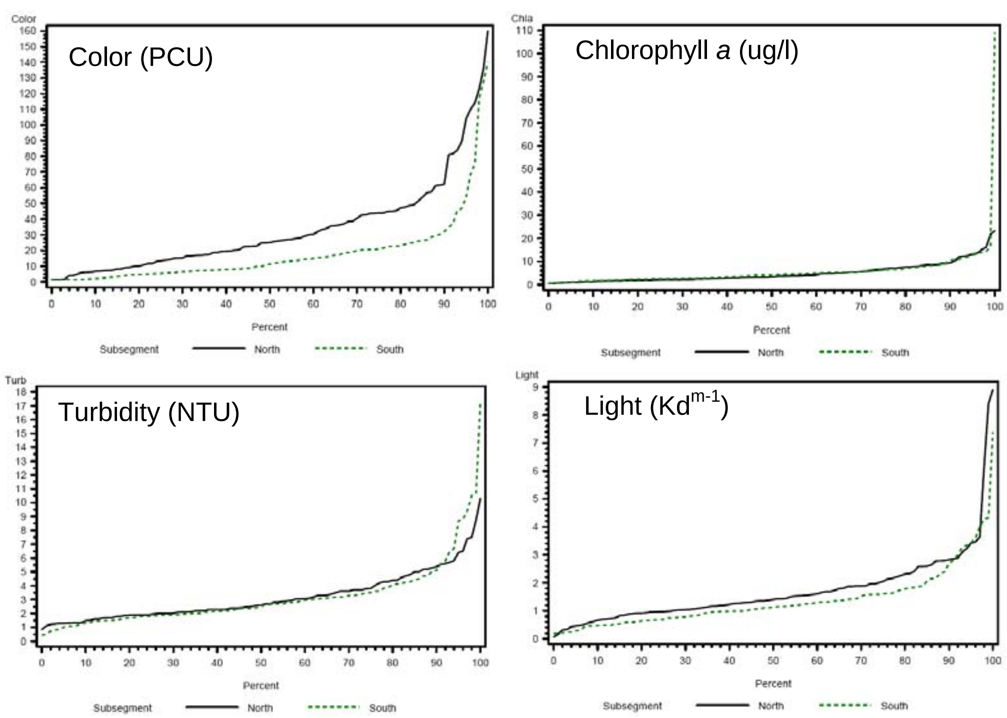

Figure 12. Cumulative distribution plots for water quality constituents in the north (solid line) and south (dotted line) sub-segments of Estero Bay.

Examination of seagrass acreages between sub-segments from 1999-2006 for these three segments suggested that: a) seagrass extents are similar between sub-segments; and, b) that trends in seagrass acreage are similar among years (Figure 13). The exception was Estero Bay where twice the extent of seagrass exists in the southern portion compared to the northern portion. However, trends over time between northern and southern sub-segments were similar.

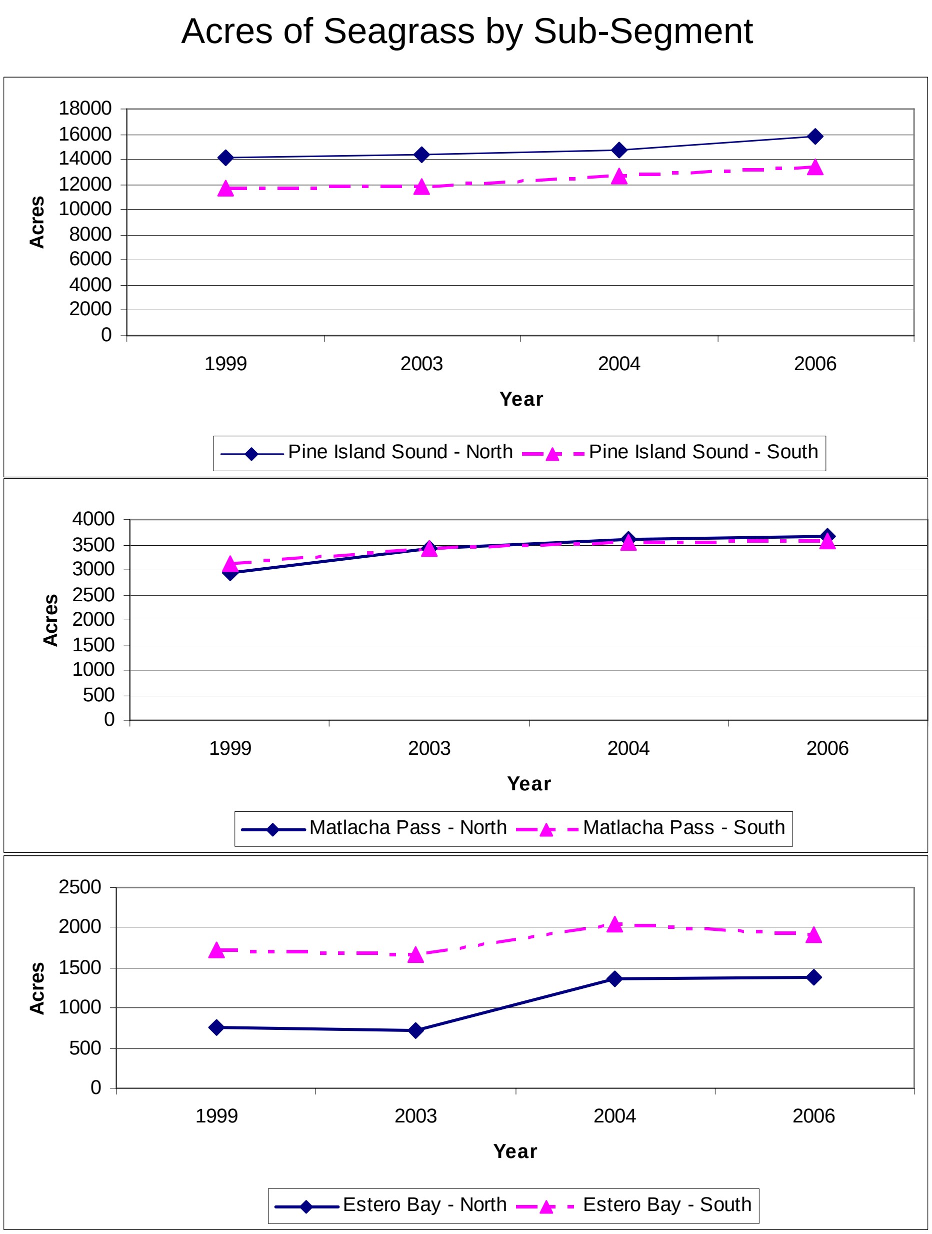

Figure 13. Trends in seagrass acreage for sub-segments of Pine Island Sound (top), Matlacha Pass (middle) and Estero Bay (bottom).

4.0 Discussion and Recommendation:

While several segmentation schemes have been developed in the CHNEP study area to serve various purposes, the CCHMN segmentation scheme was developed specifically for the purpose of monitoring water quality. The current segmentation scheme was developed based on logistical, jurisdictional, and analytical considerations as well as professional judgment. With the recognition that estuarine water quality is dynamic and is not constrained by any management segmentation scheme, a segmentation scheme was desired for reporting and management purposes that reflected relatively homogeneous areas with respect to variation in water quality. There was general consensus among the meeting participates that the CCHMN segmentation scheme could serve as the foundation for reporting on water clarity and seagrass condition over time. Analysis of water quality data from segments identified for further evaluation revealed that the water quality constituents thought to limit light in estuaries were similar between many of the sub-segments. Exceptions were the distribution of color values in Estero Bay where the northern portions tended to have higher color than the southern extent and turbidity values and in Pine Island Sound where the southern extent tended to have higher turbidity values than the northern sub-segment. Seagrass trends and acreage estimates were similar between sub-segments though some noticeable differences exist in Estero Bay. The Lower Lemon Bay segment could be adjusted by including that area below the Boca Grande bridge into Cape Haze but would require an alteration of the water quality sampling scheme in this area as well to link the water quality and seagrass segments.

The outcome of the TAC meeting discussion was that the current CCHMN segmentation scheme was decided to be generally acceptable for development of seagrass and water quality targets The SWFWMD had no objections to use of the CCHMN segmentation scheme for development of CHNEP seagrass and WQ targets and that there was no conflict foreseen between the segmentation schemes used by the CHNEP and SWFWMD. Therefore, it is recommended that the CCHMN be used as the segmentation scheme for development of targets to be used in reporting on water clarity and seagrass changes over time. The segments, segment area and acreage of seagrass from the 2006 water management district survey are listed in Table 4.

Estero Bay is an area worthy of further investigation with respect to differences in water quality and seagrass. Fortunately, the CCHMN design is robust with respect to the ability to post stratify samples as was done for this assessment. The current design provides the means for investigating more research oriented questions related to water quality conditions in particular locations within the study area to compare to seagrass extent and condition and can therefore serve multiple objectives without the costs and encumbrances of altering the current design.

Table 4. Proposed CHNEP segmentation scheme with segment area and seagrass acreage from the latest biannual aerial survey.

Segment Name	Segment Surface Area (acres)	2006 Seagrass (acres)
Cape Haze	25,710	6,911
East Wall	47,623	3,382
Estero Bay	40,966	3,298
Lower Charlotte Harbor	45,398	3,520
Lower Lemon Bay	20,554	2,597
Matlacha Pass	37,110	7,619
Pine Island Sound	96,605	29,204
San Carlos Bay	42,089	5,376
Tidal Caloosahatchee	106,027	56
Tidal Myakka	41,524	375
Tidal Peace	61,915	341
Upper Lemon Bay	10,418	949
West Wall	27,208	2,121

This is the first task of four tasks in contracted in this CHNEP scope of work. The next steps include:

- Task 2 – Developing segment specific seagrass targets for the Harbor
- Task 3 – Developing segment specific water clarity targets for the Harbor
- Task 4 – Developing basin specific pollutant loading estimates for the entire CHNEP study area

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APPENDIX 1
Meeting Minutes

Attendee's:

Mike Wessel	Tony Janicki	Judy Ott	Lisa Beever	Jennifer Nelson	Kris Kaufman	Peter Doering
Beth Orlando	Chris Anastasiou	Keith Kibbey	Emily Hall	Mary McMurray	Dana Moller	Ralph Montgomery
Ray Leary	Stephanie Erickson	James Evans	Mindy Brown	Kim Cressman		

The following summarizes a meeting to discuss a new scope of work that CHNEP has contracted with Janicki Environmental, Inc. to identify a segmentation scheme and develop segment specific seagrass targets, water quality targets, and pollutant load estimates. The objective of the meeting was to discuss the first task of this project which is to evaluate and discuss the different segmentation schemes currently used by CHNEP partners in the hopes of identifying a segmentation scheme to use for reporting on seagrass and water quality. To begin the meeting Mike Wessel gave a presentation that reviewed the different segmentations schemes including:

- Coastal Charlotte Harbor Water Quality Monitoring Network (CCHMN)
- Southwest Florida Water Management District (SWFWMD)seagrass segmentation scheme
- Charlotte Harbor Aquatic Preserve (CHAP) boundaries
- Florida Department of Environmental Protection (FDEP) Waterbody Identifiers

The initial discussion focused on the objectives of each segmentation scheme, how they are used for reporting and resource management purposes, and the need for consensus on a segmentation scheme to use for the development of CHNEP segment specific seagrass and water quality targets.

Discussion included:

- Connectedness to watersheds
- Hydrologic effects on water quality (e.g. gyres, passes, etc.)
- Implications of changing segmentation on current CCHMN sampling design
- Representativeness of the WQ sampling program for evaluating effects on seagrass
- Recognition that segmentation is a balance of logistical and political considerations with empirical evidence of similarity and professional judgment
- Definition of reporting units need not necessarily be identical for all research related activities
- CCHMN sampling design allows for post stratification

Outcome of discussion:

The current CCHMN segmentation scheme was decided to be generally acceptable for development of seagrass and water quality targets. However, analysis of empirical data will be conducted to try and identify spatial distinctions in WQ patterns in Pine Island Sound, Matlacha Pass, Lemon Bay and Estero Bay which may lead to additional segmentation of CCHMN scheme. The SWFWMD had no objections to use of the CCHMN segmentation scheme for development of CHNEP seagrass and WQ targets and there should be no conflict between the segmentation schemes used by the CHNEP and SWFWMD.

The second presentation at the meeting was given by Tony Janicki who outlined the methods used to develop segment specific seagrass targets (Project Task 2) for the CHNEP study area. The goal of the effort was defined to set technically defensible, quantitative restoration and protection targets for seagrass acreage in the CHNEP study area using historic baseline data from 1950's aerial photography and consistent methodology to identify changes in seagrass acreage based on biennial SWFWMD and SFWMD aerial surveys.

Discussion included:

- Non Restorable Areas
- Intra-inter annual variability in seagrass extents
- Natural variability vs water quality degradation
- Seagrass quality(density) vs seagrass extent
- Linking WQ targets –seagrass targets – watershed management actions
- Need for targets to be logical – i.e., not contradictory to what we observe based on empirical evidence

Outcome of discussion:

Janicki Environmental will assess baseline and recent aerial photography to develop segment specific seagrass targets for CHNEP once the segmentation scheme is accepted. The draft seagrass targets will be presented at a subcommittee meeting in March, refined if necessary and then presented again at the April TAC meeting for acceptance.

The following are additional meeting notes supplied by Judy Ott which give additional insight into the dialogue at the meeting.

Judy's Notes from January 22, 2009 Segmentation Scheme Review Meeting

Following are notes from the January 22, 2009 meeting requested by Janicki Environmental as part of their CHNEP FY2009 technical project to up-date water quality targets. The meeting was held at the SWFRPC office in Fort Myers from 9:30 am – 12:30 pm. 17 people were in attendance.

Judy: Welcome. Purpose of meeting was to review harbor segmentation schemes to be used for the seagrass & water quality targets included in the Janicki/CHNEP contract.

Mike: Presentation re: segments. First CH optical model was developed by Corbett & Hale based on seagrass targets & CCHMN segments. New seagrass segments proposed for seagrasses in SWFWMD. Presented at CHNEP 2008 Watershed Summit, but not to TAC yet. Primary change is to split Middle CH segment into W N CH & E N CH & ES CH. SWFWMD plans to apply segments next week. Reasons for dividing CH into segments = Resource Management & Reporting Data, as well as monitoring.

Chris A: Tampa Bay has 35 seagrass mgmt areas = subset of bay segments.

Keith: CCHMN doesn't sample < 1 m deep (except LB & EB sample >.7 m), so may need nearshore sampling of wq to match seagrass sampling.

Tony: For near shore areas, need other mgmt actions for seagrass in addition to wq. Smaller sements increase neighborhood "buy-in" for management. Defining segments depends on purpose. Wq doesn't recognize lines. Can always scale segments down.

James: Can use lat/longs to group sampling by purpose. Could use single data repository.

Mike: CHEC compiles CCHMN data. Can post stratify data.

Kris K: SWFWMD pays FWC for sampling & CHEC for data mgmt. Because of TMDLs & SWFWMD data requirements, in the future SWFWMD will contract with labs to enter both lab & field data into SWFWMD data base (WIMAS?), which will be available to download.

Mike: SFWMD data can be retrieved from DB Hydro.

Lisa: Need to rethink what will happen in the future re: summary maps produced by CHEC.

Kris K: How will watersheds be incorporated into segmentation scheme?

Mike: Need to combine water quality groupings based on salinity & color with watersheds. Goal is to set wq targets to identify & evaluate management practices.

Lisa: Need to consider gyres: LB, Mat Pass, EB, PIS.

Judy: Lemon Bay distinctly divided near Tom Adams Bridge.

Mike: Need to consider reporting; annual/season conditions; for wq – probably annual.

Tony: What does this group think about suggested purpose & locations of segments?

Ralph: Look at existing wq data; consider source of nutrients for management; for management of WW CH depends on Peace R & Myakka R; EW CH depends on Alligator Cr; use combination of sources & gyres. In LB, mgmt activities would be different in different parts. Look at contributions of basins compared to wq.

Chris A: Is there anything intrinsically wrong with CCHMN strata?

Kris K: Intent of seagrass is to tie it to watershed to allow for mgmt; could keep CCHMN strata & use SWFWMD new seagrass strata for reporting to SWFWMD.

Lisa: Would help to use consistent segmentation scheme throughout watershed & needs, so reporting = wq = seagrass segments.

Keith: Could keep existing CCHMN.

Judy: Do these segments have to coordinate with TMDLs?

Group: No.

Chris A: For impaired waters & TMDLs, DEP looks at each region & relies on local knowledge; can use site specific alternative criteria (SSAC); maybe think about transparency targets to fit into developing SSAC.

Tony: DEP can use CHNEP water quality targets when reviewing impaired waters, TMDLs & SSAC.

Ralph: PIS hydrology depends on CH & Caloosahatchee R at high flow; could think about what's driving wq when setting targets; ie: Up/Low PIS, UP/Low Mat Pass, EB.

Peter: Consider who is responsible for mgmt of each segment; where is Cape Coral vs. Caloosahatchee R driving Mat Pass?

Tony: Don't want segments to be too big or too small; in NSEMA, N Mat P = S Mat Pass; salinity is important for central CH. Separate Donna/Roberts Bays from Lemon Bay.

Judy: Ray – did you look at difference in wq & seagrass in Up/Low Mat P, Up/Low PIS, Up/Low LB?

Ray: Yes, but could not find a definite line.

Mike: Logic, ask: Is there a problem? Where? Why? Coastal creeks in LB aren't the same as Stump Pass; local mgmt may be more detailed (geographically) then wq targets.

Tony: Presentation re: setting seagrass targets for CHNEP – draft. Goal = linking seagrass & wq & watershed; identify technically defensible quantitative restoration 7 protection targets fro seagrass in CH; use similar methods as Tampa & Sarasota Bays. Overlay current seagrass on base of 1950s seagrass – non-restorable areas. Assume quality of seagrasses is equal. Restore number of acres – assume amount of acres is the goal.

Chris: Is non-restorable acres important in CH?

Tony: Non-restorable acres are relatively small her; of 10,000 ac of seagrass, only 110s are non-restorable. Caloosahatchee R: 1950s-2006.

Peter: Hard to see seagrasses when color is high.

Ralph: Seagrasses change with we/dry season.

Tony: Is it important to have seagrass targets for Lower Caloosahatchee R?

Lisa: Photo Science uses consistent methods for 1950s – current; so changes are relative; especially important in EB.

Reviewed: LB/DB/RB, Placida, Turtle/Bull Bay, My R, PR, E CH S, W CH, E CH S/Bokeelia, E CH N, Mat Pass.

Ralph: 1950s wetter for a couple of decades, which may affect 1950s photos.

Tony: First need to define what the seagrass trends are, then worry about why.

Mindy: What about prop scars & % cover?

Tony & Lisa: not part of this study.

Judy: Would be interesting to look at all years & find max & min extents of seagrass.

Tony: They will be looking at all years to determine where seagrasses are persistent & make a map.

Reviewed graphs of seagrass extent.

Kris: In 199-2000 was a slight change in methods.

Lisa: Now are seagrasses field checked in SFWMD?

Peter: Seagrass are now in the CRP & RECOVER program; they have the data; originally did transects, then random 1m grids & sometimes random 9 m “quadzillas”.

Jennifer: DEP has a couple of stations in lower Caloosahatchee R based on CHAPs methods, but haven’t’ seen any seagrasses lately.

Reviewed Tables of acres X segment X year.

Tony: Will create new tables based on accepted segmentation scheme. Question: Because some segments are stable, increasing, decreasing, what should be base the seagrass targets on: max year, average, 1950s, recent or sum of all years?

Lisa: CHNE CCMP says “within natural variability” = mean of most recent years.

Ralph: Mean & variability are important because we don’t know the cause.

Chris A: Consider inherent variability, ie use SD or SE.

Tony: Don’t want to overstate technical robustness of data; don’t know if SD is measuring field error, seagrass variability, etc.

Lisa: Consider value of rounding the number of acres.

Tony: Don’t want to overstate precision; use CCMP to drive targets. Any questions?

Ralph: DER did a study in Up Peace R in 1950s; showed loss since compared to 1970s; be careful with drift algae.

Chris A: Look at % light at deep edge; acres vs. transects & min light requirements; look at areas with minimum light requirement & see if seagrass are present or absent.

Tony: Targets will be unique for each segment.

Keith: This is just he beginning; what about quality of seagrass?

Tony: Depends on who’s looking & what the interest is ie: fish vs. benthics, etc.

Group Discussion re: 5 light at deep edge.

Lisa: Could use bottom of SD to represent “natural variability”.

Group Discussion re: optical model. Find shape file for SFWMD bathymetry & new delineations. To estimate pollutant loadings consider loadings from nonpoint source/watershed, point sources & atmospheric deposition; be able to incorporate BMPs.

Tony: Will incorporate agreed on segmentation scheme & present to TAC, then meet with this subcommittee again in early March.