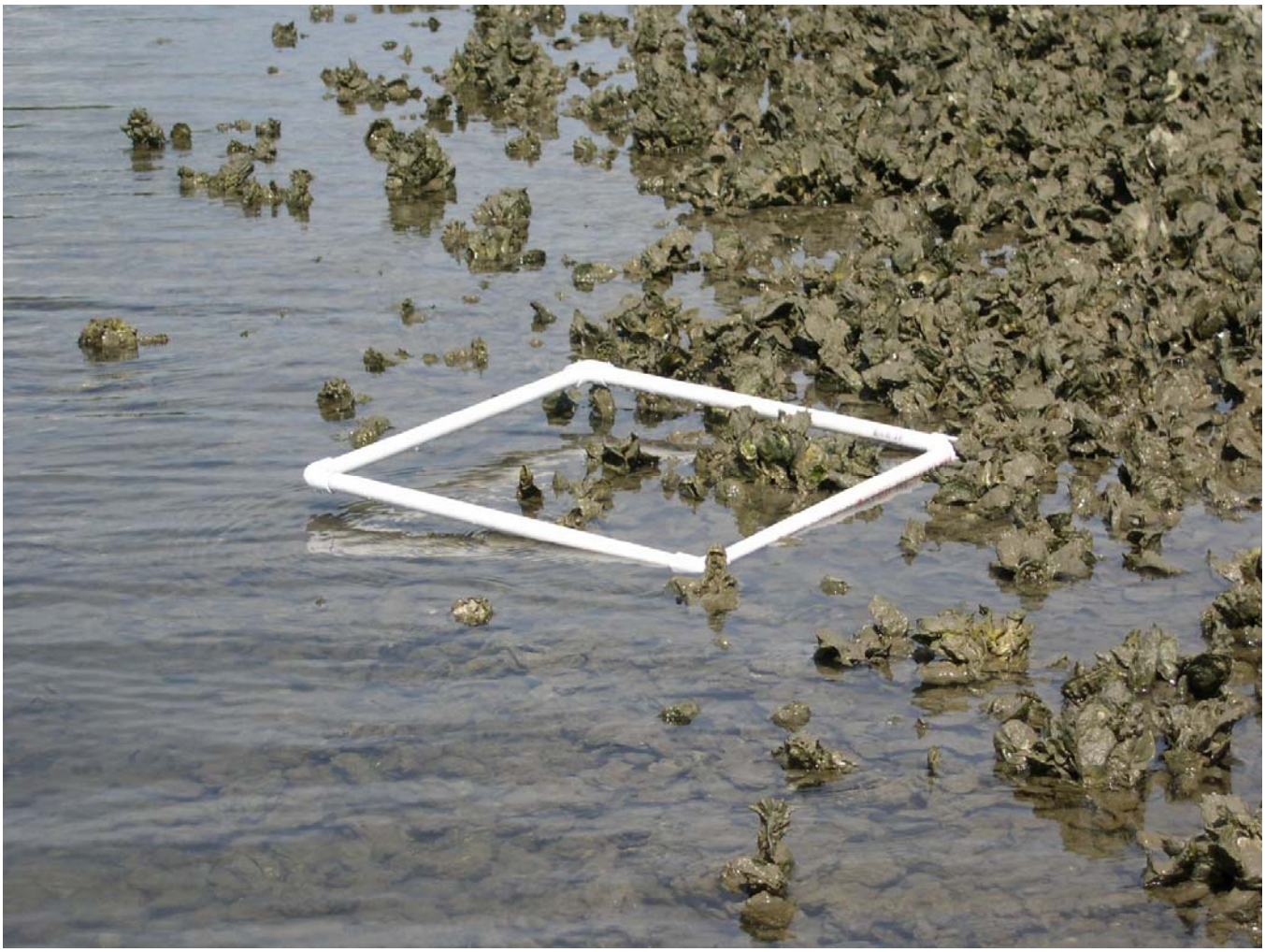
Sarasota County Comprehensive Oyster Monitoring Program
Annual Report 2006



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ACKNOWLEDGEMENTS

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I. EXECUTIVE SUMMARY

The Sarasota County oyster monitoring plan is designed to examine oyster population for use as an environmental indicator of watershed health. In the fall of 2003, Sarasota County began monitoring oysters in the Dona and Roberts Bay watershed as indicators of watershed health. Staff was able to observe the relationship with watershed freshwater in-flows and the decline of the percent of live oysters in sites influenced by high freshwater in-flow. In the fall of 2006, Sarasota County staff began monitoring the oysters in the County's four coastal watersheds in order to expand the use of oysters as an indicator of watershed health and management efforts.

The following report presents the fall 2006 County-Wide oyster monitoring data as well as 2006 rainfall data, salinity data, and discharge flow data where available. The data is presented on a watershed by watershed basis. Oyster data was analyzed and compared to sites within each watershed. Oyster data was also compared and analyzed on a county wide basis in the conclusion section.

Results:
A scoring or grading system was designed to grade each site which can then be rolled up to grade each watershed. Statistical comparisons were also conducted between sites within a watershed and between sites for the county as a whole. Results of watershed comparisons showed that the best watershed score based on percent live oysters was for Lemon Bay with a score of 2.33 followed by Little Sarasota Bay with a 2.2 followed by Sarasota Bay with a 1.8 and the poorest score went to Dona Bay with a 1.5. A comparison of all sites within the county indicated that the top five sites with the highest number of live oysters and the lowest numbers of dead oysters were as follows: #1 the downstream site on North Creek, # 2 the downstream site on Gottfried Creek, #3 The midstream site on Gottfried Creek, #4 the site in Lyons Bay, and #5 the downstream site on Ainger Creek. Three of those top five sites were in Lemon Bay. Those same analyses yielded three very poor sites that had an expected number of live oysters but a very high number of dead oysters. These sites were the downstream site on Curry Creek, The upstream site on Hudson Bayou and the midstream site on Shakett Creek. Note that two of the worst sites were in Dona Bay.

Rainfall data is presented through November 2006 and indicates overall a less than average amount of rain fell this year. July and September rainfall amounts were higher than average for all watersheds except lemon bay that was only above average for July. The Dona Bay watershed had above average rainfall for June through September 2006.

Salinity data examined from this report is relatively sparse and indicates salinity regimes in all watersheds are adequate to support healthy oyster populations. The only exception is the Dona Bay watershed where there are two real time salinity monitoring stations. The downstream station in Dona Bay indicated two prolonged periods (Jul. 23 – Aug. 2. and Aug. 14 – Aug. 22) where salinity remained lower than 10 ppt in Dona Bay and the upstream station on Shakett Creek indicated that Salinity remained below 10 ppt for the entire period of record after July 3. These salinities are not adequate to sustain healthy oyster populations.

Two other sites were found with an unexplained oyster mortality they were the upstream site on Forked Creek in the Lemon Bay Watershed and the upstream site on South Creek in the Little Sarasota Bay Watershed.

II. INTRODUCTION

Oysters as an Environmental Indicator

Oysters create an important environmental niche. Oyster beds provide habitat for many types of marine fauna. They also provide habitat for species that are adapted to oyster beds, such as oyster drills, conch, mud crabs, other bivalves, and specialized fish. An individual oyster can filter between 4 and 40 liters of water per day (Volety et al, 2003), providing a valuable water quality function.

Oysters have specific environmental requirements and are susceptible to environmental fluctuations. For example, salinity is a primary factor that affects oyster status. Optimal salinity range for oysters is 15 ppt - 25 ppt (Kennedy et al., 1996). Salinities below 10 ppt affect reproductive success. Salinity below 3 ppt is lethal to most juvenile oysters (spat). If salinity remains below 2 ppt for more than a month, most adult oysters perish. The growth rate of oysters slows above 30 ppt and they become more susceptible to predators, parasites, and disease. Oysters also provide shoreline stabilization. Due to their wide variety of ecosystem functions and values, oysters are considered a keystone species, or a species that is the foundation on which an entire community is based.

Oysters have a history of being a popular food commodity. Oyster meat is in great demand and an industry has grown around oyster harvesting and cultivation. With some coastal economies depending on oysters, scientific research and study on this species has garnered a great deal of support. Therefore, a wealth of scientific literature exists on this species.

Oysters grow near the mouths of most of the tidal creeks in Sarasota County. Due to their immobility, importance as a habitat, responsiveness to environmental change, and water quality enhancement capabilities, oysters are relatively easy to monitor and an important indicator of estuarine health. Sarasota County Government (SCG) has developed a target of 70% live oysters on oyster reefs. Healthy oyster beds occurring in areas that are not heavily impacted range between 65% and 85% live oysters. Oyster studies further south in areas such as the Caloosahatchee River and Fakahatchee Bay, have healthy oyster populations ranging from 600 to 1400 live oysters per square meter.

Purpose

The Sarasota County oyster monitoring plan is designed to both support and to be easily integrated into other projects that meet County objectives. Oyster colonies are good environmental indicators because of their role in ecological processes and their position in the landscape. Sarasota County has restructured its organization around the comprehensive watershed management principle. Oysters exist at the bottom of Sarasota County watersheds where tidal creeks meet bays and estuaries. The health of those oyster colonies can assist in determining water management problems at the landscape level. A continuous oyster monitoring program is a relatively cost effective and easy way to assist in tracking the success of the County's comprehensive watershed management practices. The scores generated from the monitoring program can be used in the GOVMAX scoring and tracking system (a system used to track how well local governments are meeting the public's objectives), the tidal creek index, and to evaluate the success of other watershed management projects.

Materials

Shallow draft boat
Appropriate boat safety equipment
Appropriate footwear.
(Ankle high booties or equivalent)
0.25m x 0.25m PVC (weighted quadrat)
Mesh gloves
Clipboard
Oyster sampling sheets (Appendix A)
Pencils
2 five gallon buckets
Measuring tape (metric)
Hand-held GPS
Water quality meter (pH, DO, Temp, Salinity)
Needle nose pliers
Flat-head screwdriver
Hydrogen peroxide
Soft bristle scrub brush

Methods

Oysters are monitored at the end of the dry season (spring) and again at the end of the wet season (fall). Oysters at each sampling site are collected from three randomly placed quarter-meter square weighted PVC quadrats. All oysters that fall within the quadrat are collected down to the shell substrate. The collected oysters are placed in five gallon buckets for counting on the boat, where the number of live oysters, dead oysters, and spat are recorded. Spat are juvenile oysters generally smaller than the terminal joint of a human thumb. The five longest live oysters are also recorded. For ongoing monitoring purposes, only recently dead oysters are recorded. Oysters are considered recently dead if both shells of the bivalve are still articulated yet contain no tissue. Physical water quality parameters, GPS position, and field conditions are also recorded at each sampling site. Data are analyzed using a one-way ANOVA analysis as well as three different analyses of variance (Levene's, Brown-Forsythe's, Scheffe's). The statistical analysis is run on the percent of live oysters as well as the number of actual live oysters.

The percent live oysters for each quadrat are assigned a score similar to a grade point average system. Those scores are then averaged to obtain a score for each site. The site scores are then averaged yielding a score for each creek which is rolled up into a score for that particular coastal watershed. The scoring system is summarized in the following table.

Percent Live Oysters	Descriptor	Numerical Score	Letter Score
0% - 19.99%	Very Poor	0	F
> 20% - 49.99%	Poor	1	D
> 50% - 69.99%	Fair	2	C
> 70% - 79.99%	On Target	3	B
> 80% - 100%	Excellent	4	A

Table II-1. Oyster Scoring System

Watersheds, Hydrology, and Salinity

Watershed characteristics drive hydrologic input and water quality. Organisms respond to changes in water quality and the local hydrology of the watershed. For example, a developed watershed with a high impervious area that directly discharges to an estuary contributes higher pollutant and sediment loads, both inorganic and organic, than an undeveloped watershed. In order to better understand the watershed characteristics that contribute to the hydrologic conditions in the oyster study areas, a GIS-based land use evaluation was conducted for the county. Data from a GIS analysis conducted by Jon Perry of Water Core Services Planning and Regulatory Environmental Section were used to determine the land use classifications of the four coastal watersheds. The SWFWMD 2004 GIS Landuse layer was used for this effort. Forty-five different land use classifications were analyzed and grouped into the following five categories: wetlands, naturally vegetated uplands, open water (stormwater management systems), agriculture, and developed. The results of the analysis appear in the watershed description.

In ecologic settings, it is difficult to look solely at estuarine biological indicator status and infer any conclusions or make informed water management decisions. The biology of an estuary is driven by the water quality and hydrology of the system. Therefore, this report also examines available water quality and hydrologic data. Available data from 2006 are compared and evaluated for any evident correlation to observed responses in the status of biological indicators. Hydrological data for this report are collected at SCG's Automated Rainfall Monitoring Stations (ARMS). ARMS sites are located strategically throughout the county and provide stage and precipitation data via a radio telemetry network. Discharge rating curves are calculated using ARMS and flow data. Available data are presented for monitored creeks.

Identifying the current salinity regime is a crucial part of evaluating the health of the oyster reef. As salinity regimes change, biological distribution will follow. Biological health is impaired in systems with sporadic, irregular, and highly variable salinity regimes. Understanding the current salinity and hydrology regimes enable differentiating between watershed effects on oyster population verses other factors. Therefore, available salinity data are also presented for each watershed. For 2006, salinity data were obtained predominantly from the County MS4 monitoring for the County NPDES permit that is conducted on behalf of the County by Mote Marine Laboratory.

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III. SARASOTA BAY WATERSHED

View of Sarasota Bay facing southeast at Ringling Causeway.

Sarasota Bay Watershed Description

Within Sarasota County, the Sarasota Bay watershed generally extends from University Parkway south to Stickney Point/Clark Road. This geographical area includes the entire City of Sarasota, the southern portion of the Town of Longboat Key and the northern portion of Siesta Key. In addition to the barrier islands and the coastal mainland fringe, the Whitaker Bayou, Hudson Bayou and Phillippi Creek drainage basins make up the watershed landmass within the Sarasota Bay watershed.

The Sarasota Bay watershed contains 62,324 acres and is the most populated watershed in Sarasota County (Figure III-0).

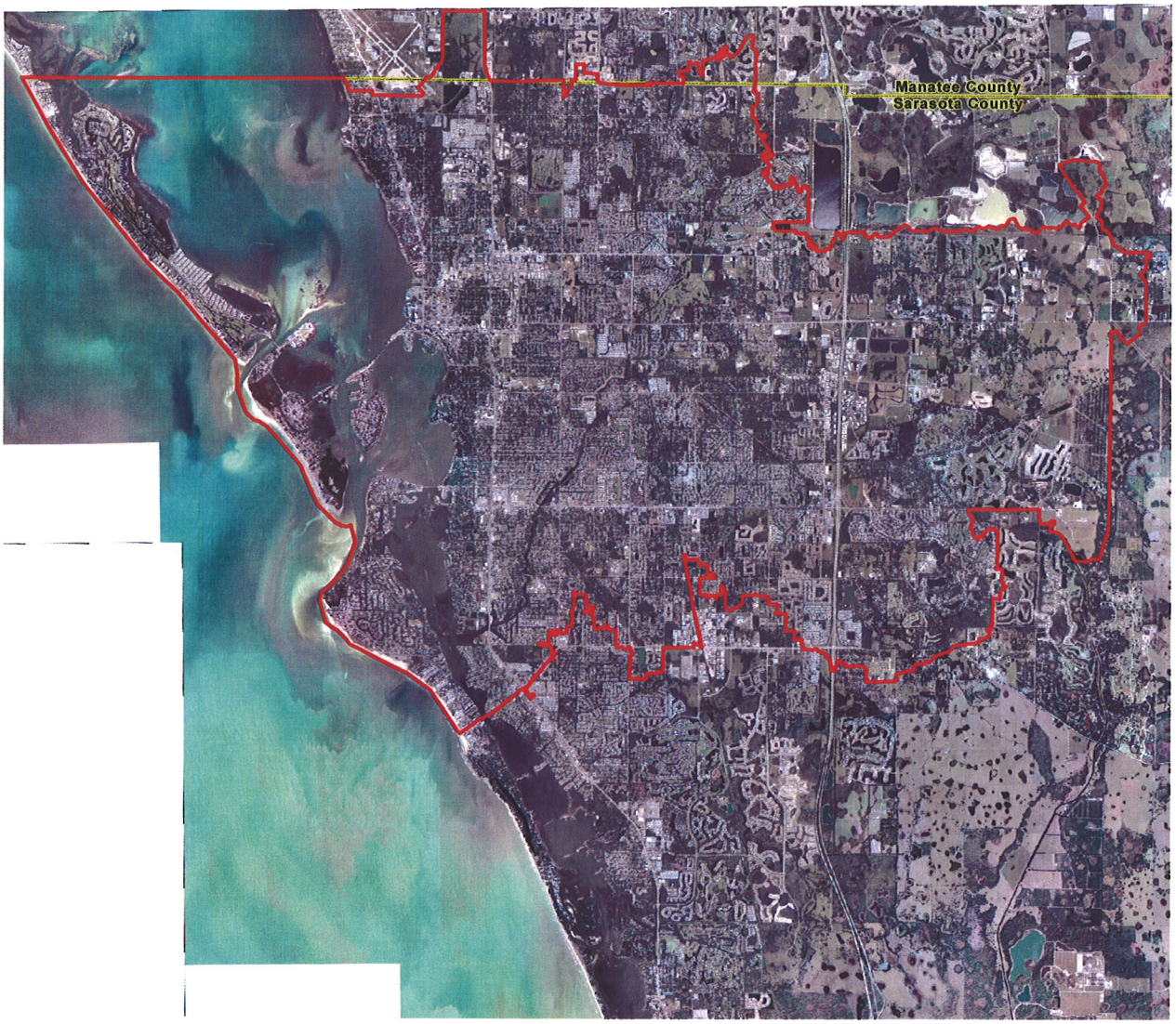
Based on the 1847 survey of Sarasota County, Whitaker Bayou and Hudson Bayou appear to have historically been as their names imply, small coastal inlets. Phillippi Creek, on the other hand, meandered from its mouth to the approximate present-day intersection of Beneva Road and Bahia Vista Road). The remainder of the watershed was frequented by isolated wetlands and sloughs within a landscape mosaic made up of predominately pine flatwoods. The Phillippi Creek basin in particular contained three large isolated sawgrass wetland systems, located approximately in the locations of the present day Bobby Jones golf course, the Celery Fields, and at the far east end of the basin. This latter system was likely located in what is now considered the Cow Pen Slough drainage basin.

In the 1920's, drainage infrastructure in association with mosquito control and agriculture was constructed. Most of this work was performed under the Sarasota County Mosquito Control District, the Hyde Park Drainage District, or the Sarasota-Fruitville Drainage District. A portion of the original Phillippi Creek was deepened and straightened as part of the Sarasota-Fruitville Drainage District works.

These works drained the large sawgrass marsh located just east of I-75, converting these Sarasota Everglades into celery instead of sugarcane production. Part of these works also included the extension of Main A eastward across a natural ridge (i.e. Tatum Ridge) to the large isolated wetland located at the current eastern edge of the Phillippi creek basin. A dike was constructed to prevent waters from the east (i.e. Cow Pen Slough) from entering the system. Today the resulting network of drainage ditches in the Sarasota Bay watershed is extensive and relatively efficient in moving freshwater from throughout the watershed to the bay.

The resulting Sarasota Bay watershed (based on the 2004 SWFWMD land use classification) consists of approximately 23% wetlands, 6% naturally vegetated uplands, 3% open water, 6 % agricultural lands, and 62% developed area (Figure III-1). The Sarasota Bay watershed is the most developed watershed in the County.

Center for Watershed Management
Sarasota Bay Watershed



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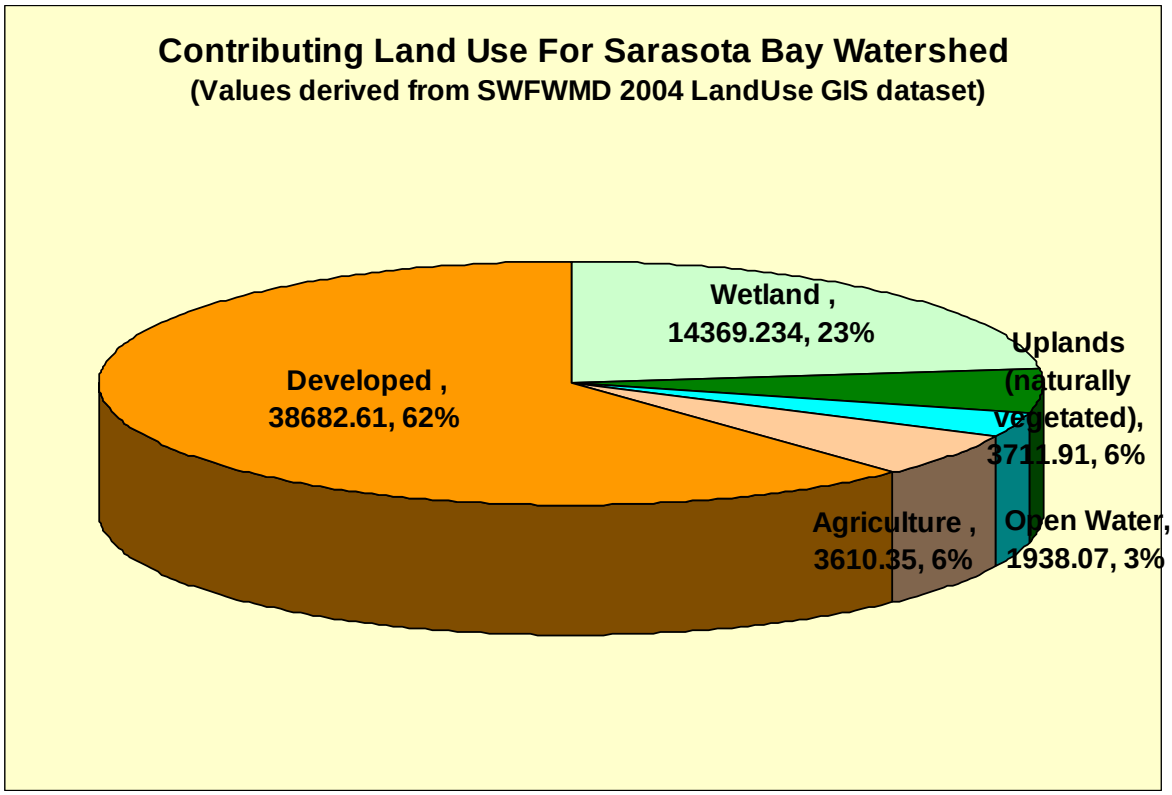

Figure III-1. Sarasota Bay Watershed Land Use, In Acres

The Sarasota Bay Watershed contains two creeks that are sampled for oysters: Hudson Bayou and Phillippi Creek. Hudson Bayou has two sampling sites and Phillippi Creek has three sampling sites. The watershed also has 16 ARMS stations that were used to calculate average 2006 rainfall data. Discharge data were available for two locations in the Phillippi Creek basin and two locations from the Hudson Bayou Basin. Salinity data was available from 18 stations monitored by Mote Marine Laboratory for the Sarasota County NPDES MS4 permit. Figure III-2 has station locations for the Mote Marine Laboratory water quality data collection sites, the oyster monitoring sites, and some of the 16 ARMS site locations.

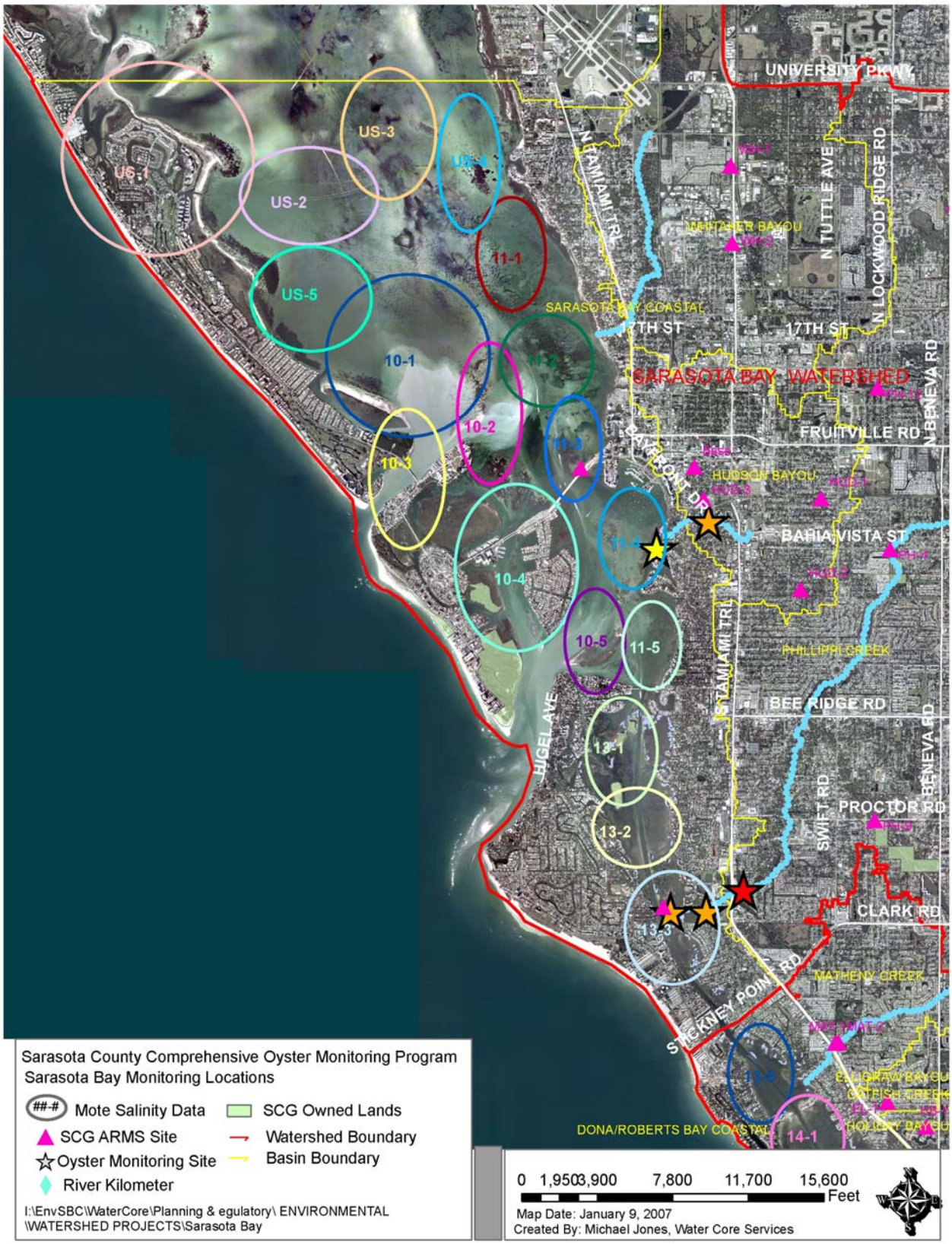

Figure III-2. Monitoring Locations in the Sarasota Bay Watershed

Results

Oysters were monitored in the Sarasota Bay Watershed in November 2006. Figures III-3 and III-4 are graphical depictions of 2006 monitoring results. Stars at monitoring site locations have been color coded according to the scoring system detailed in Table II-1 on page 6.

Figure III-3. Hudson Bayou Oyster Monitoring Site Locations and 2006 Results

Figure III-4. Phillippi Creek Oyster Monitoring Site Locations and 2006 Results

The scores, according to the scoring system based on percent live oysters and described on page 6, for the individual sites for the fall 2006 monitoring event area are as follows: HUD1 ranked "on target" with a 3.0 (B); HUD2, PH1, and PH2 ranked "fair" with a 2.0 (C); and PH3 ranked "very poor" with a 0.0 (F). Scores were combined to come up with a score for each monitored creek in the Sarasota Bay watershed study area and a final score for the watershed. Results indicated that Hudson Bayou ranked "fair" with a 2.5(C) while Phillippi Creek ranked "poor" with a 1.33(D). As a whole the Sarasota Bay watershed ranked on the low end of the fair range "fair" with a average percent live of 51% live oysters and a combined score of 1.8 (C-).

The fall 2006 monitoring event was the first data collection event in the Sarasota Bay watershed for the County wide oyster monitoring program. A statistical means comparison of oysters within the Sarasota Bay watershed indicated the numbers of live oysters at the Hudson bayou sites were not significantly different from each other but they were significantly different than the Phillippi Creek sites. The Phillippi Creek sites (over all) had lower numbers of live oysters than Hudson Bayou. The upstream site PH3 had the lowest numbers of both live and dead oysters. Field observations at the PH3 site revealed heavy sedimentation covering oyster reefs. The statistical analysis for percent live oysters indicated that the PH3 site was the only site significantly different than all other sites monitored in the Sarasota Bay watershed for this effort. Figures III-5 and III-6 are bar graphs of the mean number of live and mean percent live oysters for each site in the Sarasota Bay watershed during the fall 2006 monitoring event.

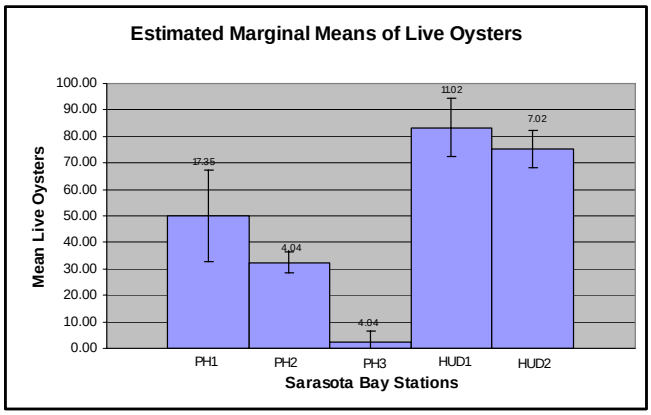

Figure III-5. 2006 No. of Live Oysters

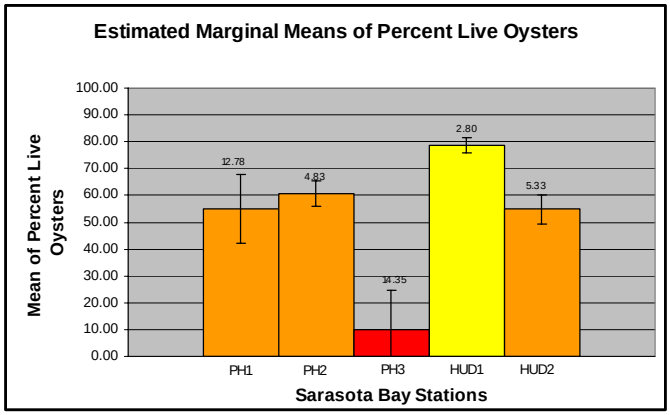

Figure III-6. 2006 Percent Live Oysters

Sarasota Bay Rainfall

To calculate Sarasota Bay watershed rainfall the following 16 ARMS stations were used: 12 Phillippi Creek Basin stations PH-1 through PH-10, PH-12 and, PH-13 (these stations are located throughout the Phillippi Creek basin), CST-1 (at Saprito Pier), WH-1 (at Whitaker Creek), HUD-1 (Hudson Creek Sarasota High School), HUD-2 (near Arlington Park). Average rainfall values used for the Little Sarasota Bay watershed rainfall analyses were obtained from the USGS Sarasota/Lemon Bay basin rainfall database.

A rainfall analysis shows that, from January through December 2006, the Sarasota Bay watershed received 44.42 inches of rain compared to the USGS basin average of 52.25 inches that would be expected during an average calendar. This equates to approximately 7.5 inches below average. The months of January, February, March, April, May, August, October and November experienced significantly lower than average amounts while July and September received an above average amount

of rain. Figure III-7 displays the ARMS measured monthly rainfall against the USGS rainfall database average for January through December 2006.

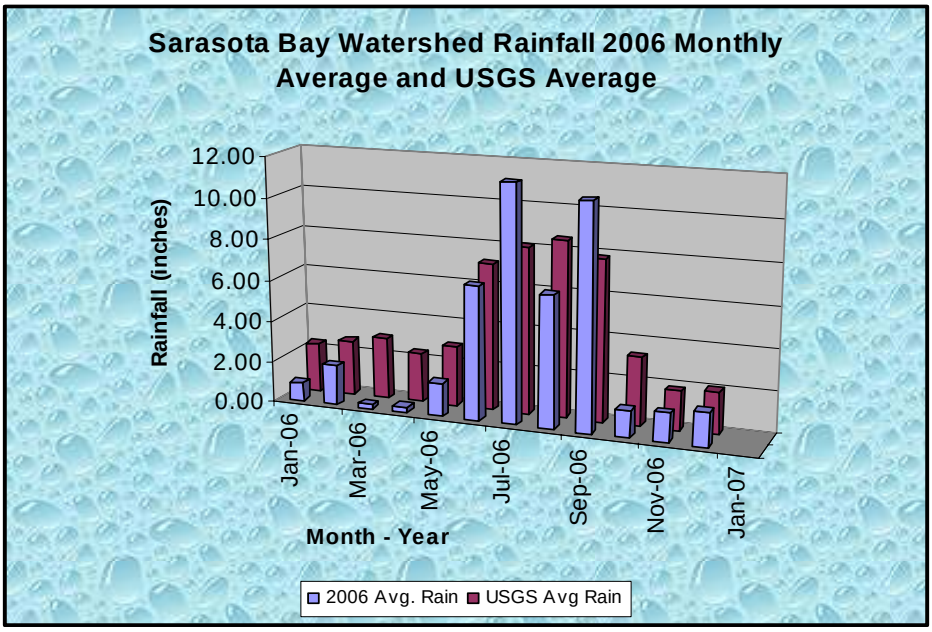

Figure III-7. **ARMS avg. measured monthly rainfall and USGS monthly average.**

Discharge

Hudson Bayou discharge is based on discharge rating curves developed with stage data and flow measurements taken at the HUD-1 and HUD-2 ARMS. The total combined volume of fresh water discharged through these two areas of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 1,728 acre-feet which equates to 18.95 inches of annual runoff or 1.54 million gallons per day. In other words approximately 19 % of the 2006 annual rainfall was converted to runoff. Figure III-8 graphically represents the combined discharge from the drainage basin upstream of the HUD-1 and HUD-2 ARMS stations for the 2006 wet season. These drainage areas comprise about 40 % of the 2406.104 acre Hudson Bayou drainage basin.

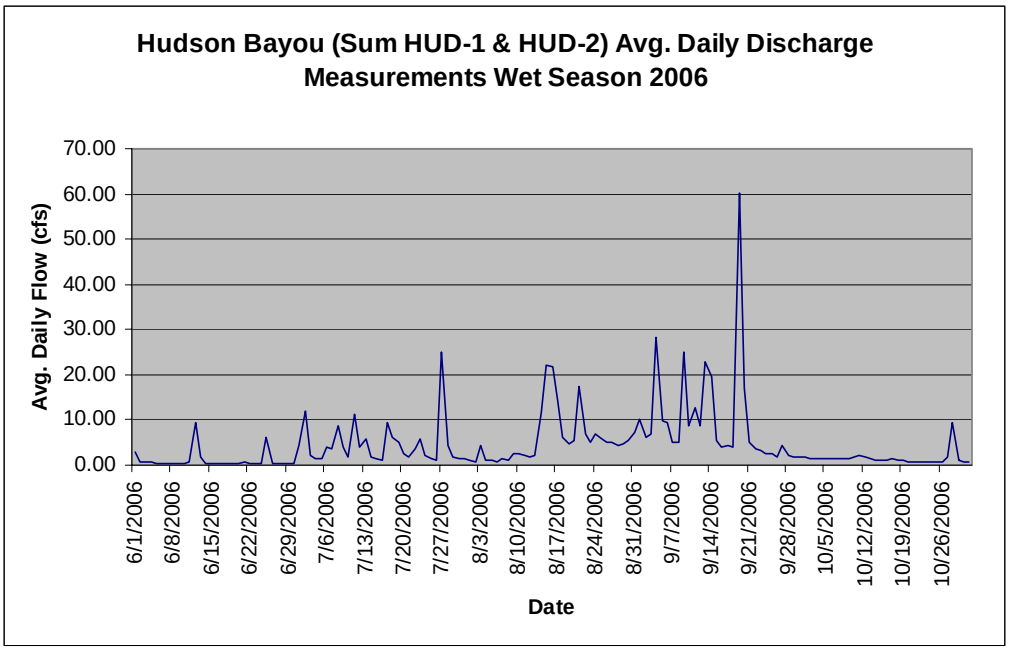

Figure III-8. Combined HUD-1 and HUD-2 2006 wet season discharge.

Phillippi Creek discharge is based on discharge rating curves developed with stage data and flow measurements taken at the PH-5 and PH-9 ARMS stations. The total combined volume of fresh water discharged through these two areas of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 30,443 acre-feet which equates to 16.67 inches of annual runoff or 27.16 million gallons per day. In other words approximately 37 % of the 2006 annual rainfall was converted to runoff. Figure III-9 graphically represents the combined discharge from the drainage basin upstream of the PH-5 and PH-9 ARMS stations for the 2006 wet season. These drainage areas comprise about 61 % of the 35771 acre Phillippi Creek drainage basin.

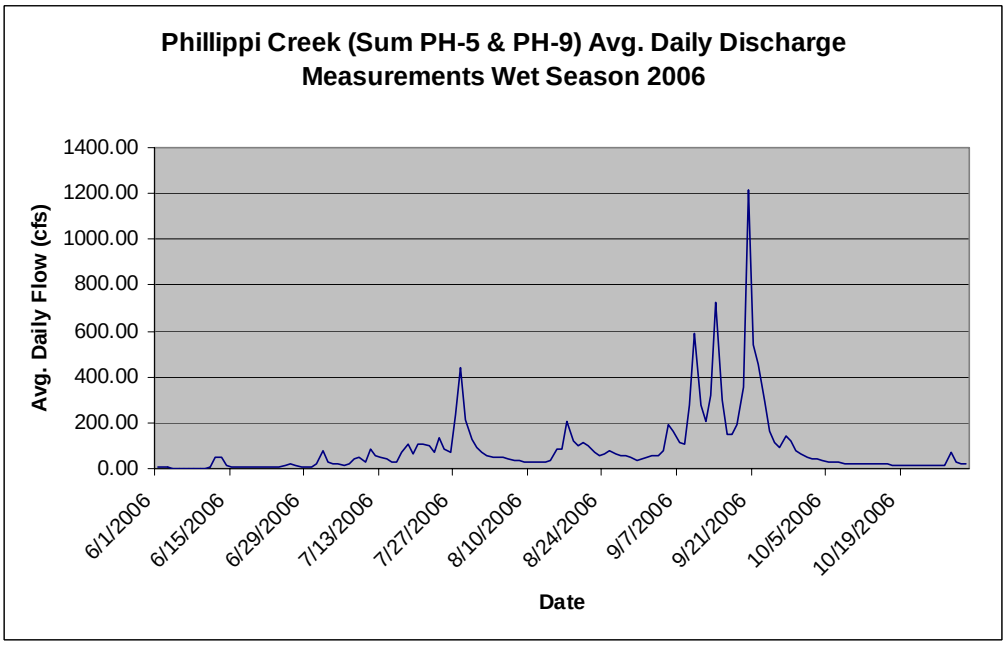

Figure III-9. Combined PH-5 and PH-9 2006 wet season discharge.

Salinity

As part of the County's MS4 permit under the NPDES program, SCG has contracted Mote Marine Laboratory to collect monthly random grab samples throughout the coastal waters of Sarasota County. Other than a spot salinity reading at the time of monitoring at each oyster monitoring site, the MS4 monitoring data are the only salinity data currently included for the Sarasota Bay watershed. The area monitored for each MS4 station is shown on figure III-2. Figure III-10 below is a graphical representation of the data. The MS4 data indicated that salinity in the bay remained at the upper end of the salinity range required to sustain healthy oyster populations. MS4 monitoring station 11-4 is the station closest to the Hudson Bayou oyster monitoring sites and is also relatively close to New Pass. MS4 monitoring station 13-3 is the station closest to the Phillippi Creek oyster monitoring sites. Spot readings at the time of oyster sampling in Hudson Bayou supported the Mote data. Salinity at the downstream site HUD1 was 35.18 ppt. and 34.80 ppt. at the upstream HUD2 site. Conversely, salinity measured at the Phillippi Creek sites was lower than represented by the Mote MS4 data. The values were as follows: PH1 = 14.78 ppt., PH2 = 12.05 ppt., and PH3 = 9.35 ppt. The spot readings indicated that salinity values were much lower at the actual sites in Phillippi Creek than the MS4 data from further out in the bay.

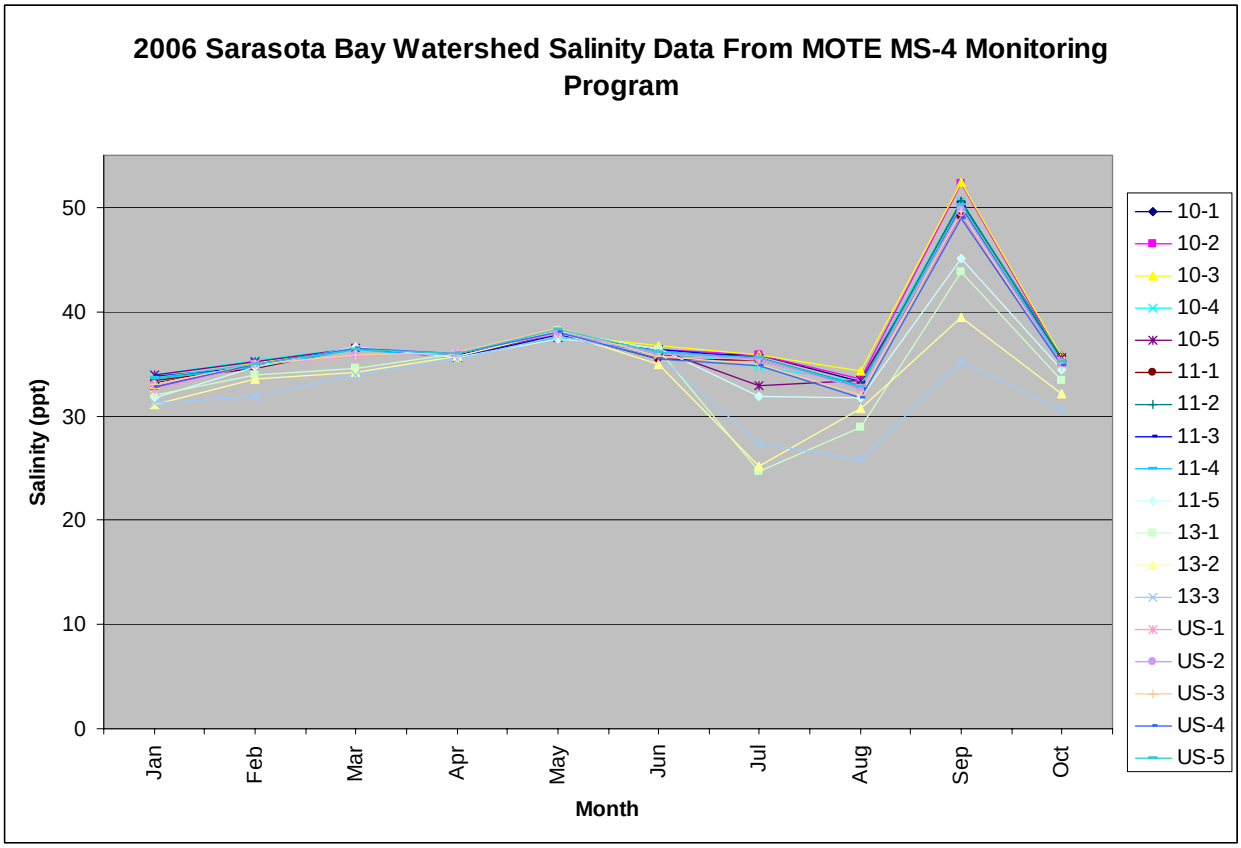

Figure III-10. 2006 Salinity data from MS4 monitoring stations in Sarasota Bay.

IV. LITTLE SARASOTA BAY WATERSHED

View of Little Sarasota Bay

Fall 2006 Oyster Monitoring Program

Little Sarasota Bay Watershed Description

The Little Sarasota Bay watershed extends from approximately Stickney Point/Clark Road, south to State Road 681. The southern portion of Siesta Key and the northern portion of Casey Key are included within this geographical area. In addition to the barrier islands and coastal mainland fringe, the Matheny Creek, Elligraw Bayou, Holiday Bayou, Clower Creek, Catfish Creek, North Creek, and South Creek drainage basins make up the Little Sarasota Bay watershed. The Gulf Gate, Palmer Ranch, Oaks, Vamo and Osprey communities as well as Oscar Scherer State Park and Sarasota Square Mall are all located within this watershed.

The Little Sarasota Bay watershed contains 28,071 acres and, with the exception of the eastern portion of the South Creek drainage basin, most of the watershed has been developed (Figure IV-0).

Based on the 1847 survey of Sarasota County, Elligraw Bayou, Holliday Bayou, Clower Creek, and Catfish Creek were little more than tidal extensions of Little Sarasota Bay. Matheny Creek terminated in the vicinity of present day U. S. 41. North Creek meandered east through the present day Oaks. South Creek meandered approximately 2-1/2 miles inland from its mouth. The historical limits of South Creek area was situated almost entirely within present day Oscar Scherer State Park. The remainder of the watershed was frequented by isolated wetlands and sloughs within a landscape mosaic made up of predominately pine flatwoods. A large band of well-drained scrubby flatwoods existed along the coast and still exists around the historical South Creek in Oscar Scherer State Park.

In the 1950's and 1960's, drainage works associated primarily with mosquito control and land development were constructed. In the mid 1980's and continuing through today, the Palmer Ranch development has undertaken improvements to the systems constructed in the 1960's. These improvements have targeted both the conveyance (Catfish Creek) and the storage of flood waters (South Creek). These later improvements have also provided hydrologic restoration of a large slough system known historically as White Slough through the Palmer Ranch Development of Regional Impact (DRI). Today, the resulting network of drainage ditches in the Little Sarasota Bay watershed is somewhat extensive and relatively efficient in moving freshwater from the watershed to the bay. However, unlike the Sarasota Bay watershed, the Little Sarasota Bay watershed has been developed with a greater percentage of stormwater management systems.

The resulting Little Sarasota Bay watershed (based on the 2004 SWFWMD land use classification) consists of approximately 21% wetlands, 20% naturally vegetated uplands, 5% open water, 11% agricultural lands, and 43% developed area (Figure IV-1). The Little Sarasota Bay watershed is the second most developed watershed in the County.

Center for Watershed Management
Little Sarasota Bay Watershed

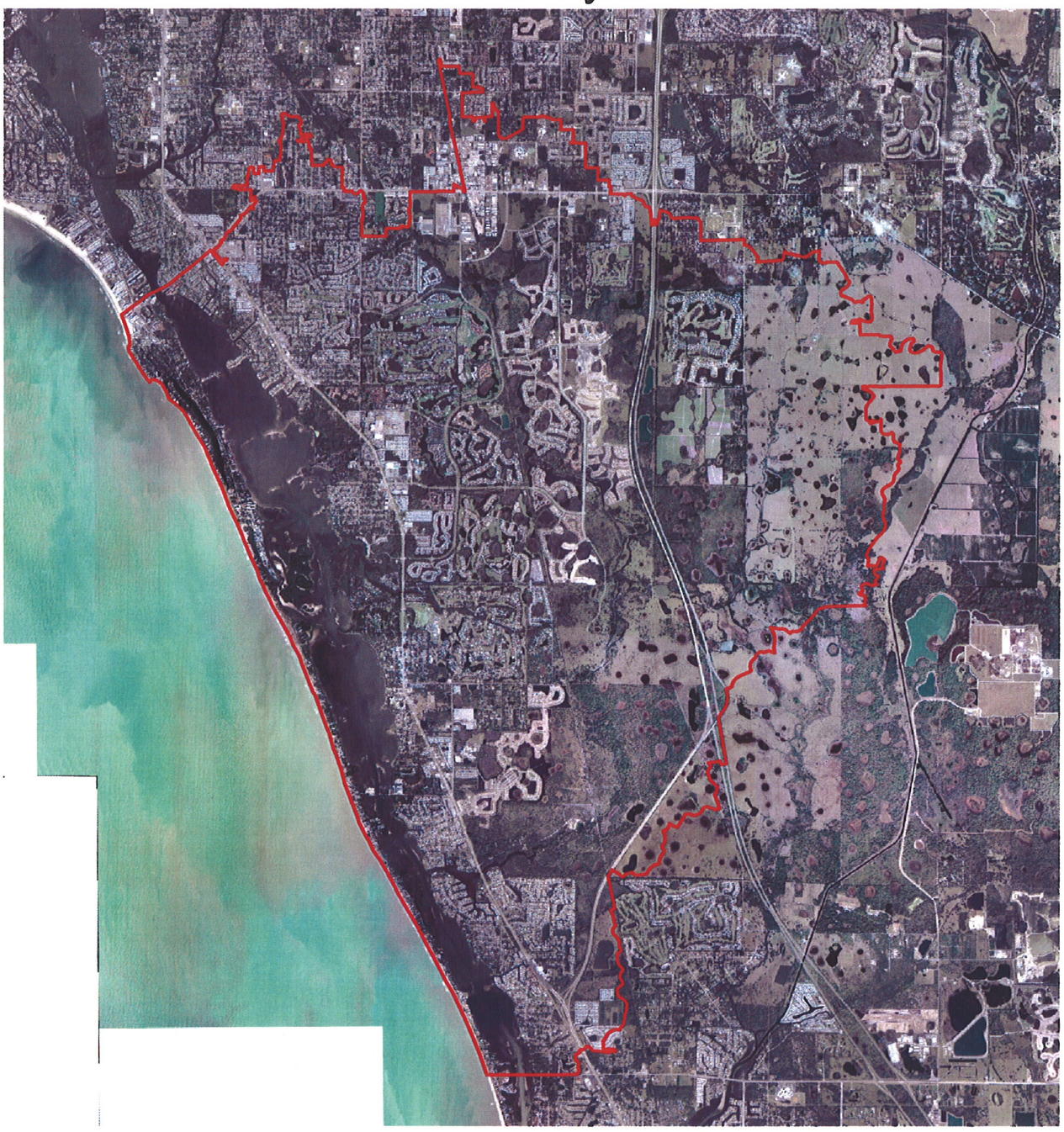

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Figure IV-0. Little Sarasota Bay Watershed

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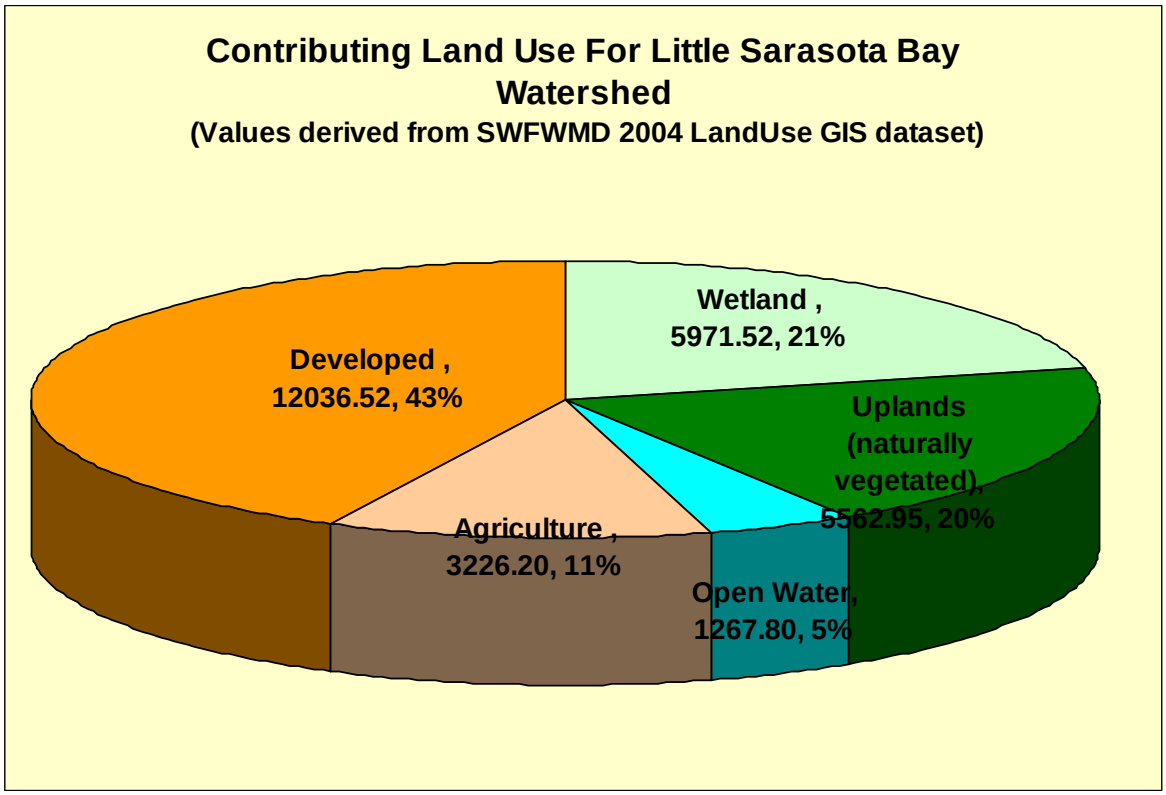

Figure IV-1. Little Sarasota Bay Watershed Land Use, In Acres

The Little Sarasota Bay Watershed contains four sampled creeks: North Creek, Catfish Creek, South Creek, and Matheny Creek. Catfish Creek and Matheny Creek each contain one site. South Creek and North Creek each contain two sites. It is important to note that the downstream South Creek site (SC1) is the only subtidal oyster site monitored during the 2006 monitoring; all other reefs are intertidal. The watershed also has 7 ARMS stations that were used to calculate average 2006 rainfall data. Discharge data were available for the Catfish Creek basin and Matheny Creek basins. Salinity data were available from 9 stations monitored by Mote Marine Laboratory for the Sarasota County NPDES MS4 permit. Figure IV-2 has station locations for the Mote Marine water quality data collection sites, the oyster monitoring sites, and some of the 7 ARMS site locations.

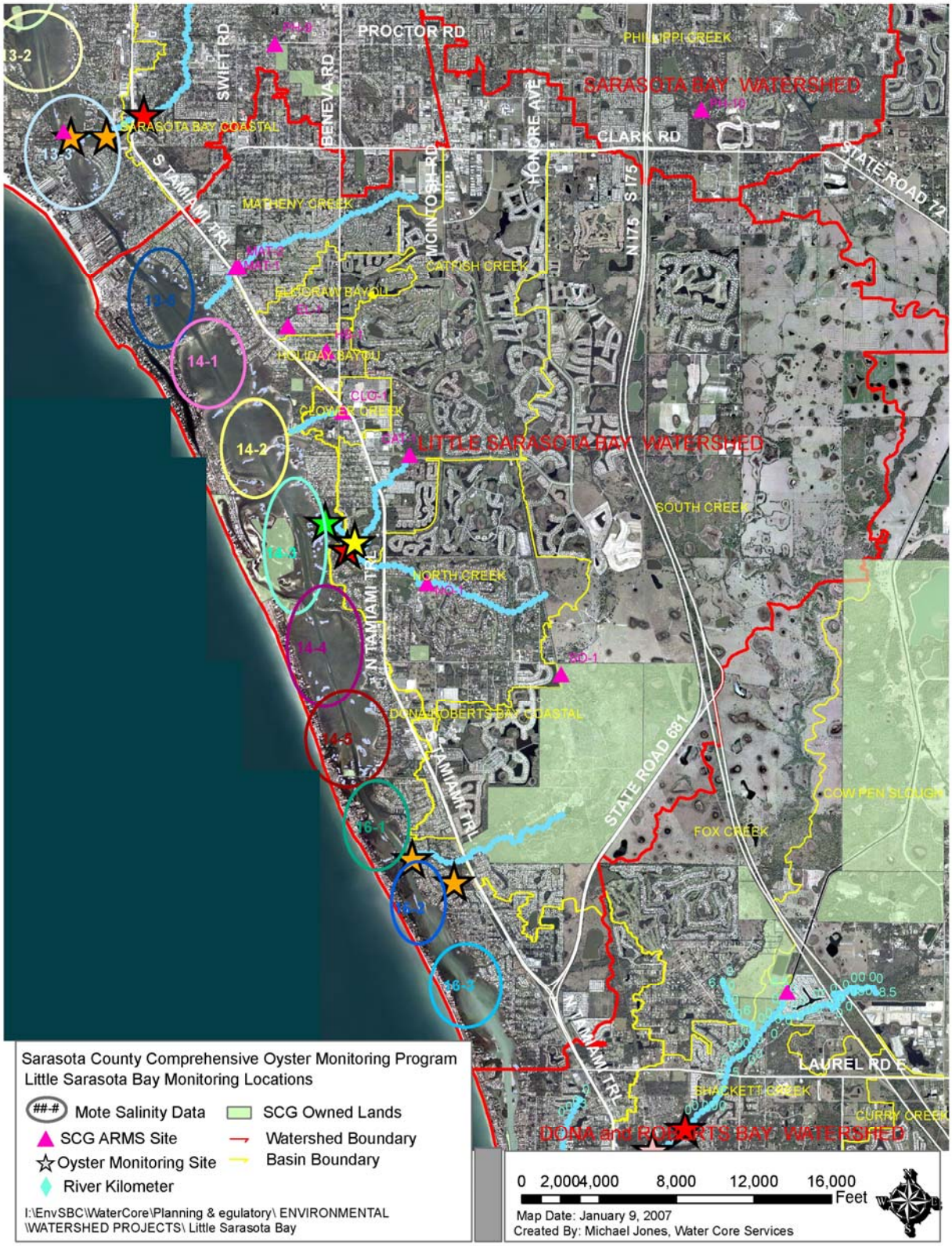

Figure IV-2. Monitoring Locations in the Little Sarasota Bay Watershed

Results

Oysters were monitored in the Little Sarasota Bay Watershed in October 2006. Figures IV-3 and IV-4 are graphical depictions of 2006 monitoring results. Stars at monitoring site locations have been color coded according to the scoring system detailed in Table II-1 on page 6.

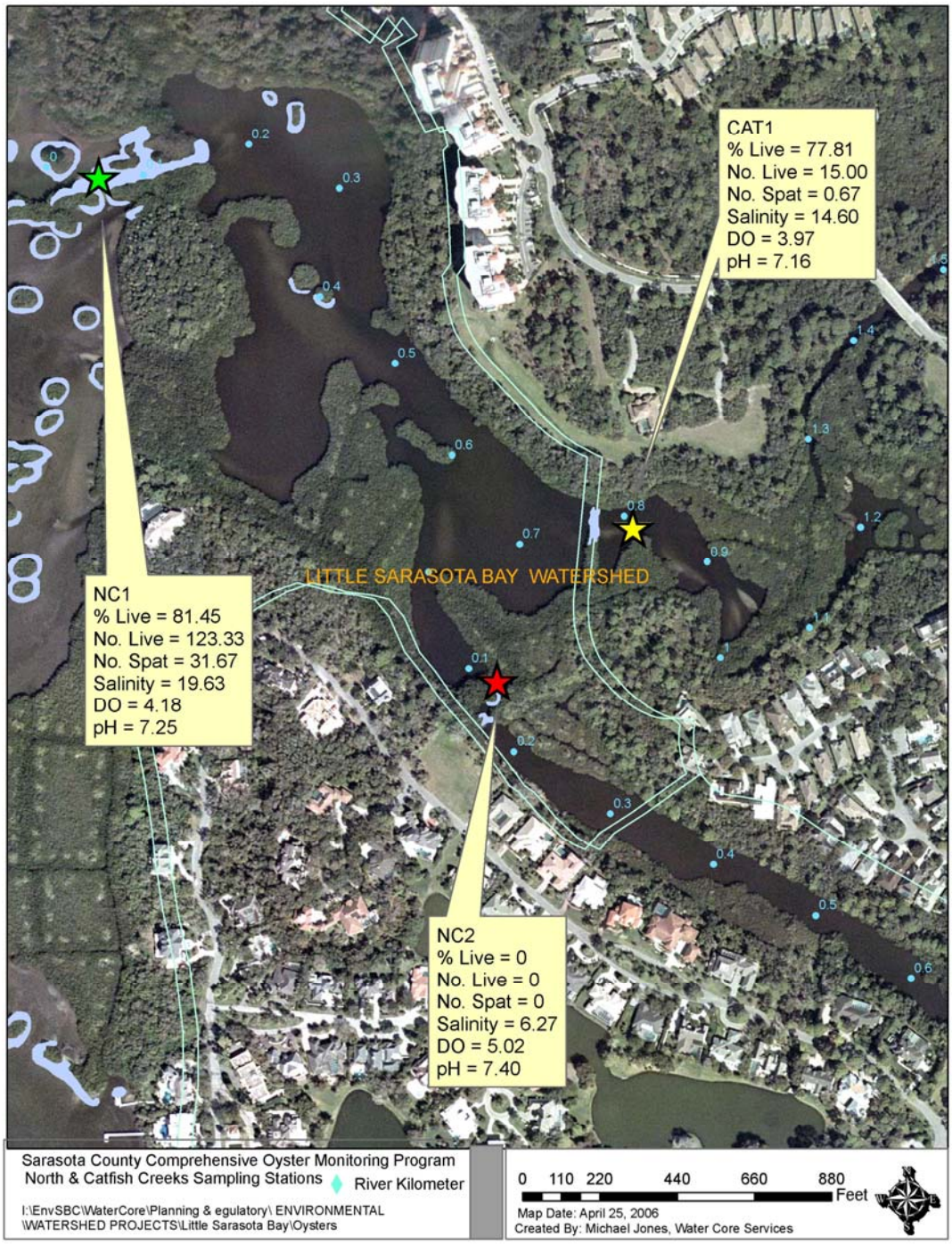

Figure IV-3. North Creek Oyster Monitoring Site Locations and 2006 Results

Figure IV-4. South Creek Oyster Monitoring Site Locations and 2006 Results

The scores, according to the scoring system based on percent live oysters and described in Table II-1on page 6, for the individual sites for the fall 2006 monitoring event area as follows: The downstream North Creek site, NC1, ranked "excellent" with a 4.0 (A); CAT1 ranked "on target" with a 3.0 (B), NC1 ranked "very poor" with a 0.0 (F), The South creek sites SC1, and SC2 both ranked "fair" with a 2.0. Scores were combined to come up with a score for each creek monitored in the Little Sarasota Bay study area and a final score for the watershed. North Creek ranked the highest with a 2.22 (C) while South Creek ranked 2.0 (C) As a whole the Little Sarasota Bay watershed ranked "fair" with a score of 2.13 (C).

The fall 2006 monitoring event was the first data collection event in the Little Sarasota Bay watershed for the County wide oyster monitoring program. A statistical means comparison of oysters within the Little Sarasota Bay watershed indicated the numbers of live oysters at the downstream North Creek site was significantly different from the upstream North Creek site which had no live oysters and the Catfish Creek site as well as the downstream South Creek sites both with observed lower numbers of live oysters It is important to note that the downstream South Creek site (SC1) is the only subtidal oyster site monitored during the 2006 monitoring. The statistical analysis for percent live oysters indicated that the NC2 site with no live oysters was significantly different than all other sites monitored in the Little Sarasota Bay watershed for this effort. Conversely, the analysis indicated that due to the high percent of live oysters, the NC1 was also significantly different than all other sites except the Catfish Creek site. This result is somewhat surprising because although the Catfish Creek site had a significantly low number of live oysters, the ratio of live to dead oysters was high. Figures IV-5 and IV-6 are bar graphs of the mean number of live and mean percent live oysters for each site in the Little Sarasota Bay watershed during the fall 2006 monitoring event.

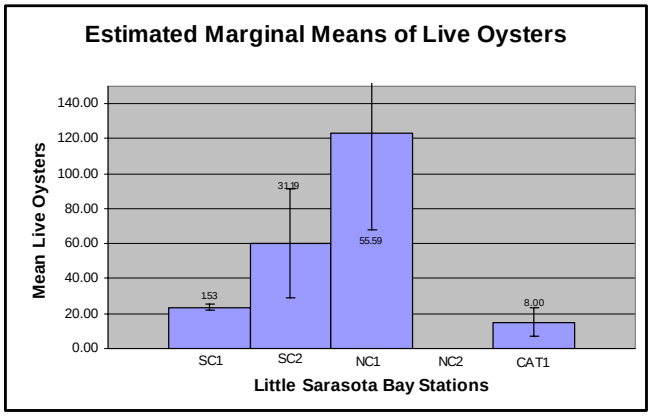

Figure IV-5. 2006 No. of Live Oysters

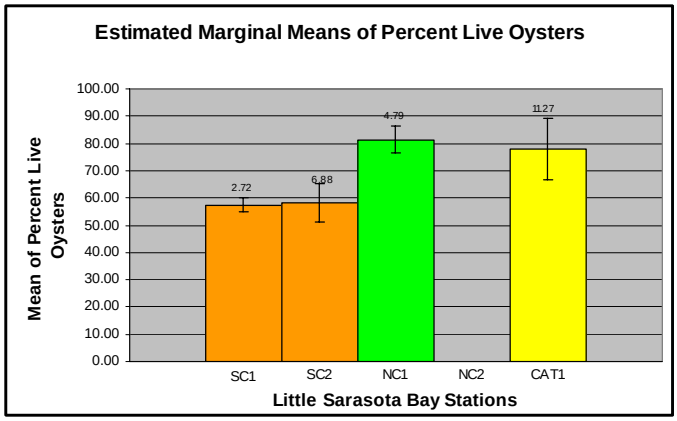

Figure IV-6. 2006 Percent Live Oysters

Little Sarasota Bay Rainfall

To calculate Little Sarasota Bay watershed rainfall the following ARMS stations were used: MAT-1 (on Matheny Creek), CAT-1 (on Catfish Creek), EL-1 (in Elligraw Bayou), CLO-1 (on Clower Creek), HB-1 (in Holiday Bayou), NO-1 (on North Creek), and So-1 (on South Creek) Average rainfall values used for the Little Sarasota Bay watershed rainfall analyses were obtained from the USGS Sarasota/Lemon Bay basin rainfall database.

A rainfall analysis shows that, from January through December 2006, the Little Sarasota Bay watershed received 40.58 inches of rain compared to the USGS basin average of 52.25 inches that would be

expected during an average calendar year. This equates to roughly 11.5 inches below average. The months of January, March, April, May, October and November experienced significantly lower than average amounts while July received an above average amount of rain. Figure IV-7 displays the ARMS measured monthly rainfall against the USGS rainfall database average for January through November 2006.

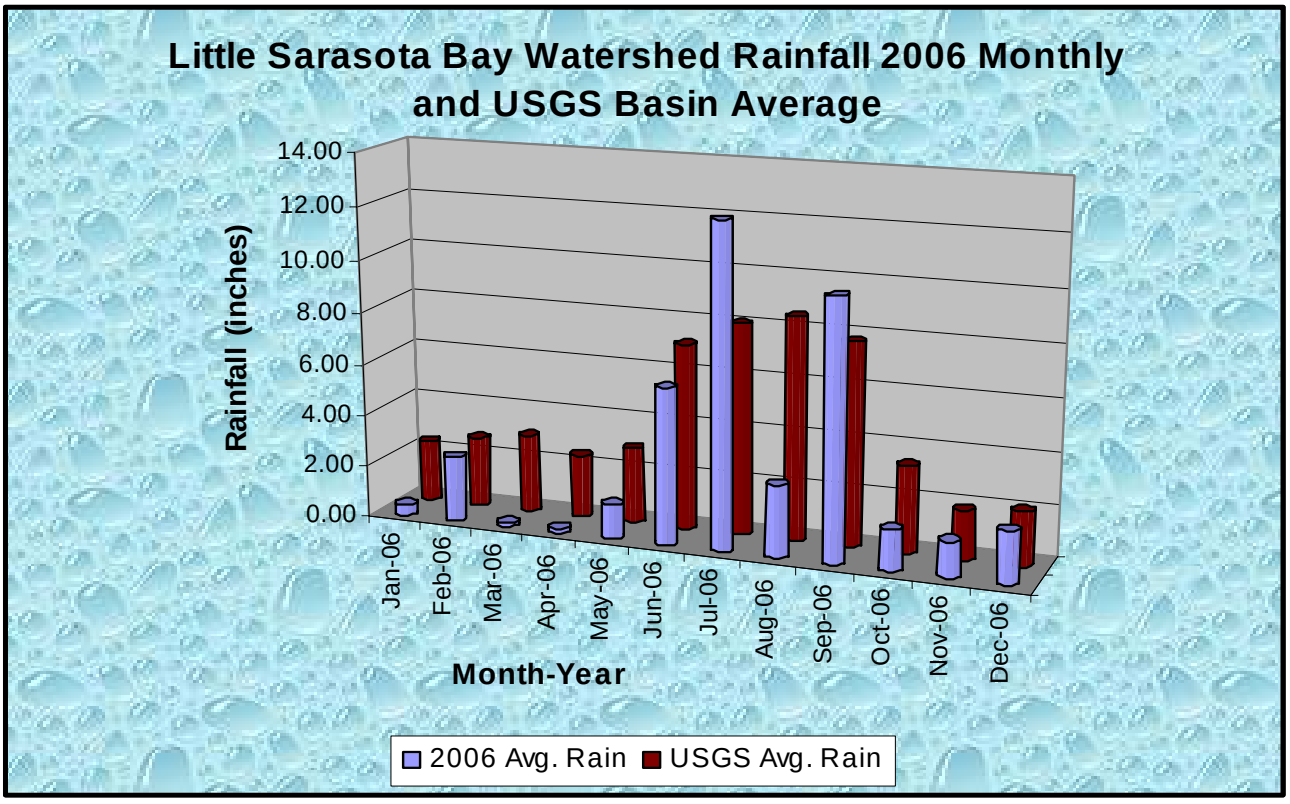

Figure IV-7. ARMS avg. measured monthly rainfall and USGS monthly average.

Discharge

Matheny Creek discharge is based on discharge rating curves developed with stage data and flow measurements taken at the MAT-1-5 and MAT-2 ARMS stations. The total combined volume of fresh water discharged through these two areas of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 1222.71 acre-feet which equates to 13.08 inches of annual runoff or 1.54 million gallons per day. In other words approximately 32 % of the 2006 annual rainfall was converted to runoff. Figure IV-8 graphically represents the combined discharge from the drainage basin upstream of the MAT-1-5 and MAT-2 ARMS stations for the 2006 wet season. These drainage areas comprise about 94 % of the 1,723 acre Matheny Creek drainage basin.

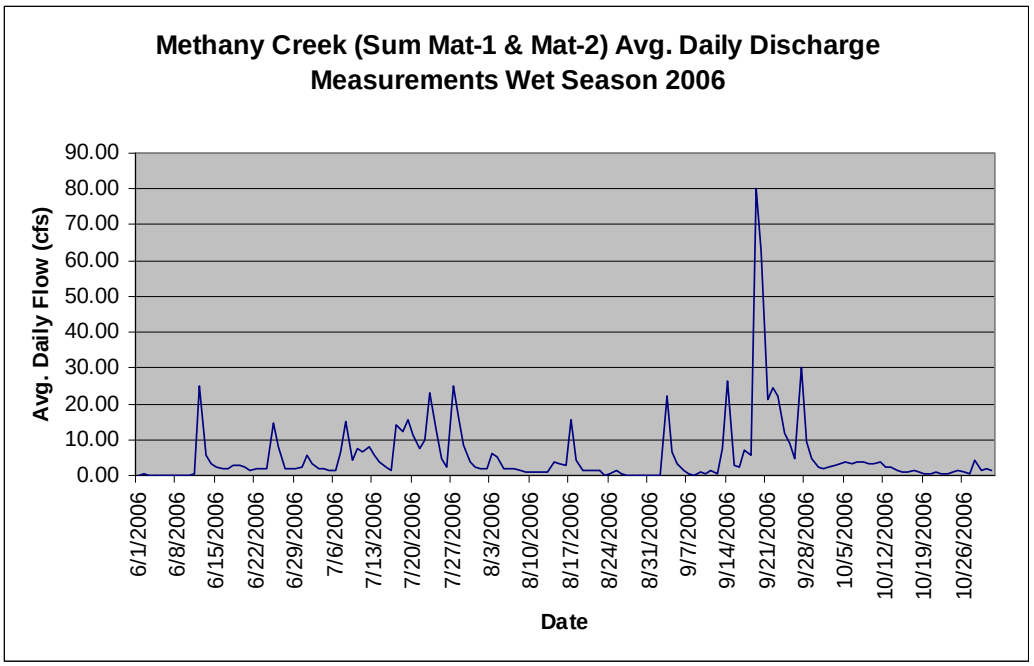

Figure IV-8. **Combined MAT-1 and MAT-2 2006 Wet Season Discharge.**

Catfish Creek discharge is based on a discharge rating curve developed with stage data and flow measurements taken at the CAT-1 ARMS station. The total volume of fresh water discharged through this area of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 8202.50 acre-feet which equates to 22.18 inches of annual runoff or 7.32 million gallons per day. In other words approximately 55 % of the 2006 annual rainfall was converted to runoff. Figure IV-9 graphically represents the discharge from the drainage basin upstream of the CAT-1 ARMS station for the 2006 wet season. This drainage area comprises about 77 % of the 3984.33 acre Catfish Creek drainage basin.

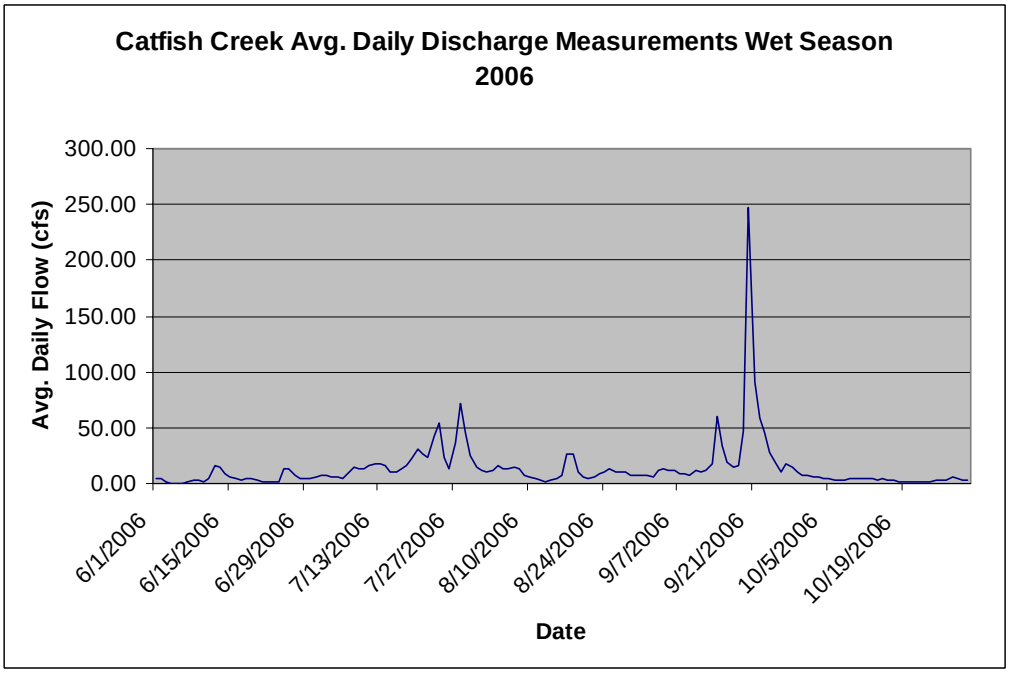

Figure IV-9. **CAT-1 2006 Wet Season Discharge.**

Salinity

As part of the county's MS4 permit under the NPDES program, SCG has contracted Mote Marine Laboratory to collect monthly random grab samples throughout the coastal waters of Sarasota County. Other than a spot salinity reading at the time of monitoring at each oyster monitoring site, the MS4 monitoring data are the only salinity data currently included for the Little Sarasota Bay watershed. The area monitored for each MS4 station is shown on figure IV-2. Figure IV-10 below is a graphical representation of the data. The MS4 data indicated that salinity in the bay remained at the upper end of the salinity range required to sustain healthy oyster populations. MS4 monitoring station 14-3 is the station closest to the North Creek and Catfish Creek oyster monitoring sites. MS4 monitoring stations 16-1 and 16-2 are the stations closest to the South Creek oyster monitoring sites. Spot readings at the time of oyster sampling taken on a high incoming tide in South Creek supported the Mote data. Salinity spot readings at the South Creek oyster site SC1 was 23.00 ppt. and 23.58 ppt. at the upstream SC2 site. Conversely, salinity values measured at the North/Catfish Creek sites during a low incoming tide were lower than represented by the Mote MS4 data. The values were as follows: NC1 = 19.63 ppt., CAT1 = 14.60 ppt., and NC2 = 6.27 ppt. The spot readings indicated that salinity values were lower at the actual sites in the creeks than the MS4 data from further out in the bay especially during low tides.

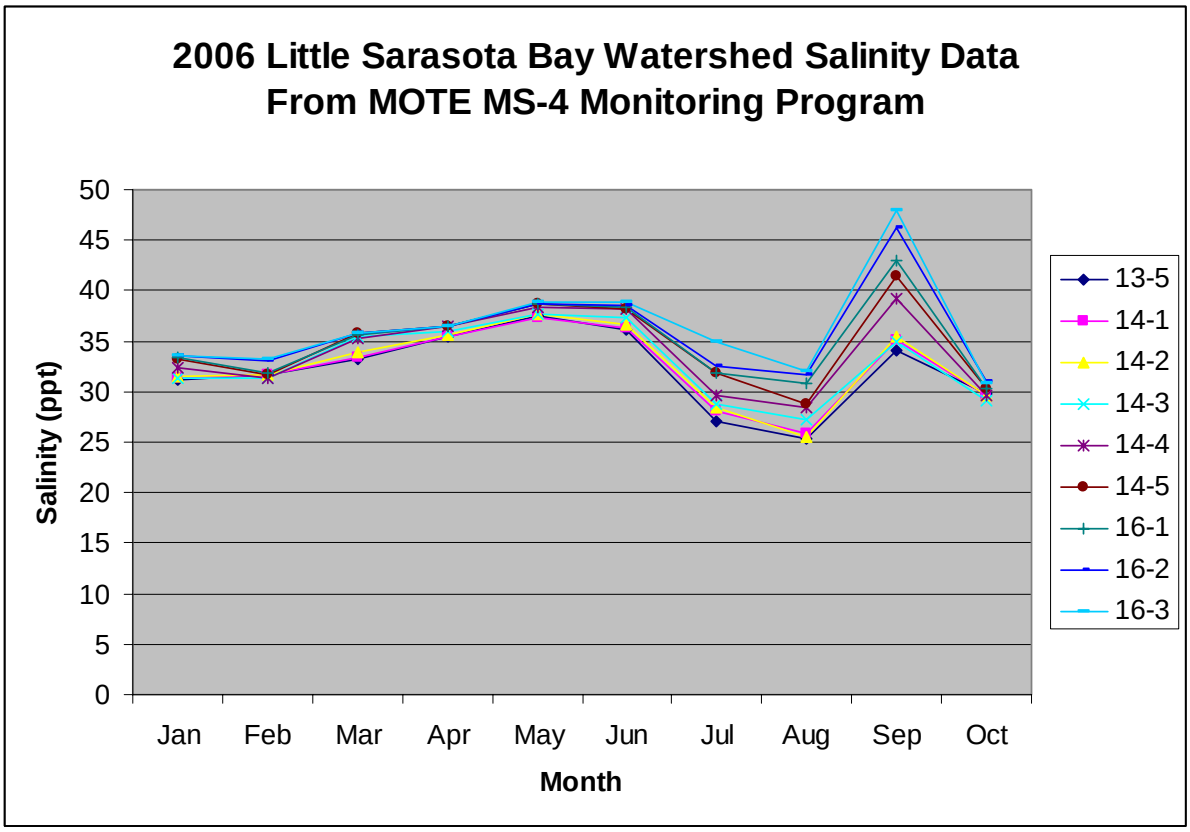

Figure IV-10. 2006 Salinity data from MS4 monitoring stations in Little Sarasota Bay.

V. DONA AND ROBERTS BAY WATERSHED

View of Venice Inlet

Fall 2006 Oyster Monitoring Program

Dona and Roberts Bay Watershed Description

Within Sarasota County, the Dona/Roberts Bay watershed extends from approximately State Road 681, south to Center Road. This watershed also wraps around the east ends of the Little Sarasota Bay and Sarasota Bay watersheds and into Manatee County. Within this geographical area is the City of Venice (including the Island of Venice) as well as the southern portion of Casey Key. In addition to the barrier islands and coastal mainland fringe, the Cow Pen Slough (including Shakett Creek, Fox Creek, and Salt Creek), Curry Creek, and Hatchett Creek drainage basins make up the watershed landmass within the Dona Roberts Bay watershed. The communities of Laurel, Nokomis, Bird Bay, Capri Isles, Pelican Pointe, and Chestnut Creek as well as the Hi-Hatt, LT, and Hawkins ranches are all located within this watershed.

The Dona/Roberts Bay watershed contains 62,376 acres. Most of the Dona Bay watershed is rural in character, while most of the Roberts Bay watershed is currently developed (Figure V-0).

Based on the 1847 survey of Sarasota County, Curry Creek and Hatchett Creek only extended a few miles inland. Shakett Creek eventually split into two creeks, Fox Creek and Salt Creek. Fox Creek appeared much as it does today, but in 1847 it terminated at around the present day I-75. Portions of the original Salt Creek are also still intact. Based upon the 1847 survey, the Dona/Roberts Bay watershed was significantly smaller than it is today. The original Cow Pen Slough appears to have been just that, one of the largest natural slough systems in the County that eventually meandered south and east towards the Myakka River.

The Dona/Roberts Bay watershed has experienced some of the most profound hydrologic alterations since 1847. First, a ditch was constructed to extend Salt Creek to the southern end of Cow Pen Slough. Sometimes known as the original Cow Pen Slough ditch, this introduced greater amounts of freshwater to Dona Bay and effectively increased the normal watershed area.

Next, in the 1950's a canal was extended from Roberts Bay to the Myakka River. Constructed by private property interests, this canal was designed to relieve flooding on the Myakka River. Known as Blackburn Canal, it intercepted flows from the Myakka River just north of the present day I-75 bridge and conducted them west into Curry Creek and Roberts Bay. The entire canal was constructed below sea level and resulted in the deepening and straightening of the east end of Curry Creek. It is estimated that this canal is capable of accommodating 10% of the flood flows of the Myakka River and possibly up to 7% of the total freshwater volumes from the Myakka River.

Finally, in the 1960's the United Stated Department of Agriculture's Natural Resource Conservation Service (now known as the Soil Conservation Service) embarked on one of the most significant drainage works in the history of Sarasota County. The work plan called for the construction of a large canal system with water level control structures from Shakett Creek, north to Manatee County. A large lateral canal was also to be constructed to divert much of the eastern portion of the South Creek basin to Shakett Creek. A spur canal and stormwater pumping station were also to be constructed into the Phillippi Creek basin to relieve flooding in the eastern portion of that basin. While the main canal was constructed to the Phillippi Creek spur (known as the Vegetable Relief Canal), environmental interests halted the remainder of the work including the extension of the main canal to Manatee County, the South Creek lateral, and the Phillippi Creek stormwater pumping operation. This work greatly improved

Center for Watershed Management
Dona/Roberts Bay Watershed

Legend

County Line

WATERSHED

Figure V-0. Dona and Roberts Bay Watershed

N

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drainage for agricultural uses (predominately cattle ranching) and effectively increased the Shakett Creek drainage basin and the Dona Bay watershed.

Today, the resulting network of drainage ditches and canals have effectively enlarged the Dona/Roberts Bay watershed, and in the case of Blackburn Canal, the quantity of freshwater. However, much of the Cow Pen Slough drainage basin is rural in nature and may afford opportunities for hydrologic restoration of the original slough. In fact, a portion of the historical slough is located within the County owned Pineland Reserve and has been restored. Much of the Shakett Creek, Curry Creek, and Hatchett Creek drainage basins have been, or are currently under development.

The resulting Dona and Roberts Bay watershed (based on the 2004 SWFWMD land use classification) consists of approximately 18% wetlands, 22% naturally vegetated uplands, 3% open water, 23% agricultural lands, and 34% developed area (Figure V-1). Although the coastal areas are highly developed, because of the large watershed area, the Dona and Roberts Bay watershed is the second least developed watershed in the County following the Myakka River.

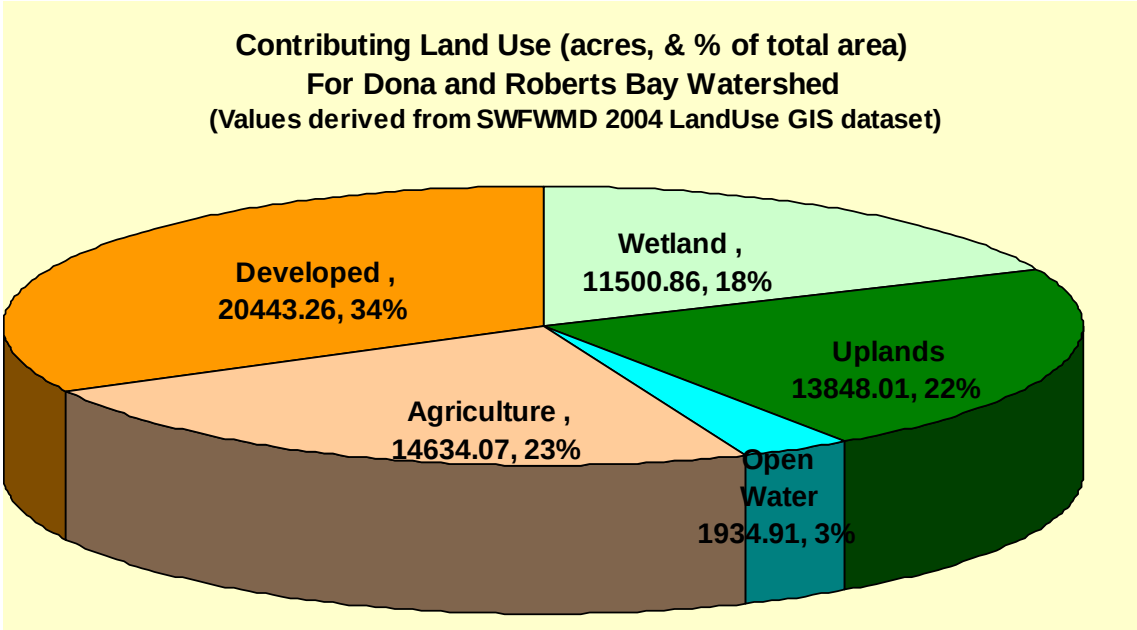


Figure V-1, Dona and Roberts Bay Watershed Land Use

Dona and Roberts Bay Watershed oyster monitoring began in October 2003 as part of the Dona Bay Watershed Management Program. Six permanent oyster-sampling sites were originally selected, one site in each of the three bay segments (Dona-DB1, Lyons-LYB1 and Robert's Bay RB1), two in Shakett Creek (SKC1 and SKC2), and one in Curry Creek (CC1). In 2005 two more sites were added, one upstream site in Shakett Creek and one upstream site in Curry Creek. The watershed also has 10 ARMS stations that were used to calculate average 2006 rainfall data. Discharge data are presented for two locations, the Cow Pen Slough lower weir and Blackburn Canal at Jackson Road.. Salinity data were available from 5 stations monitored by Mote Marine Laboratory for the Sarasota County NPDES MS4

permit. Salinity data are also presented from two USGS automated recording stations, one from Shakett Creek downstream from Laurel road and the other from Dona Bay. Figure V-2 has station locations for the Mote Marine Laboratory water quality data collection sites, the oyster monitoring sites, the USGS stations and some of the 10 ARMS site locations.

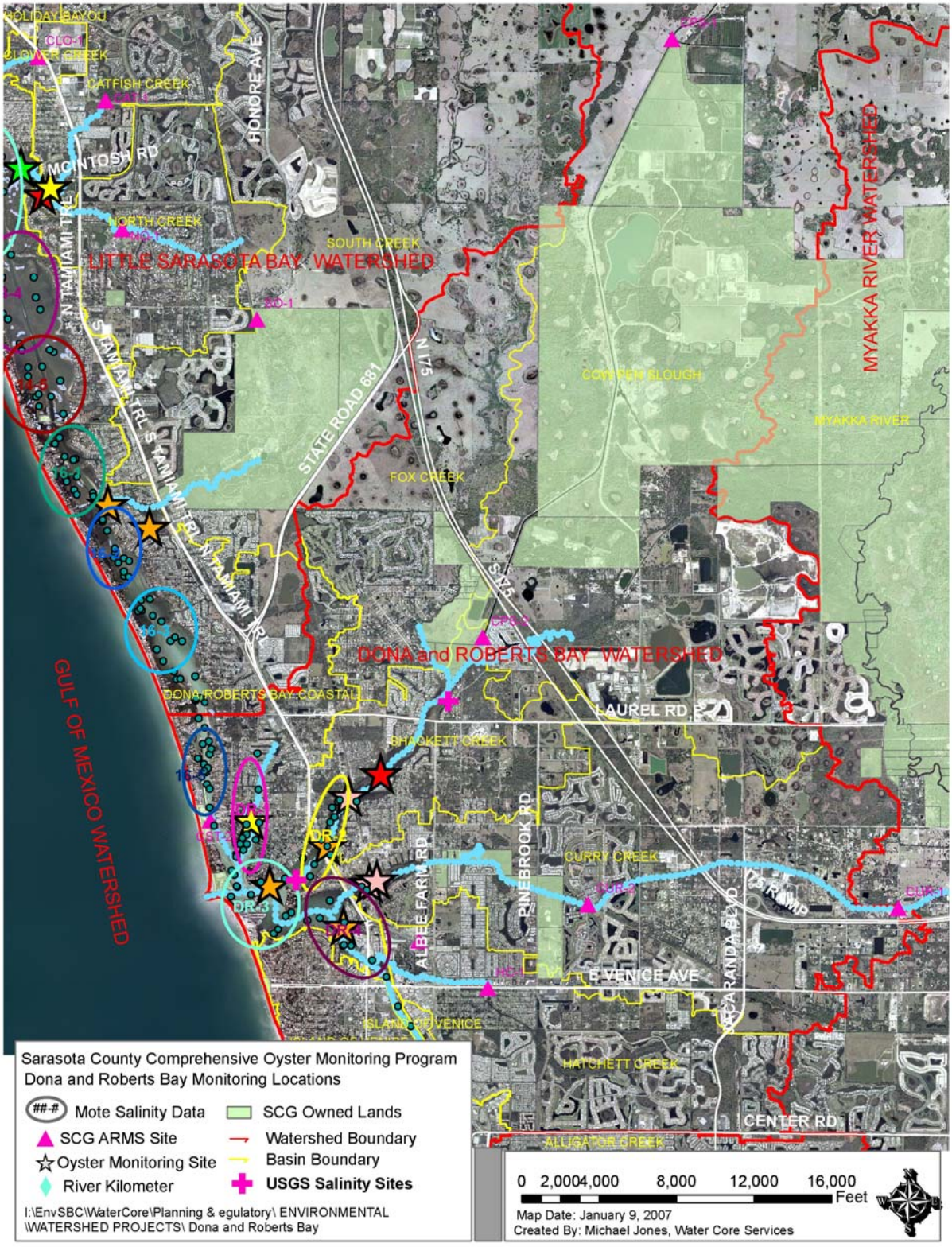


Figure V-2. Monitoring Locations in the Dona and Roberts Bay Watershed

Results

Oysters were monitored in the Dona and Roberts Bay Watershed on September 29, 2006. Figure V-1 is a graphical depiction of 2006 monitoring results. Stars at monitoring site locations have been color coded according to the scoring system detailed in Table II-1 on page 6.

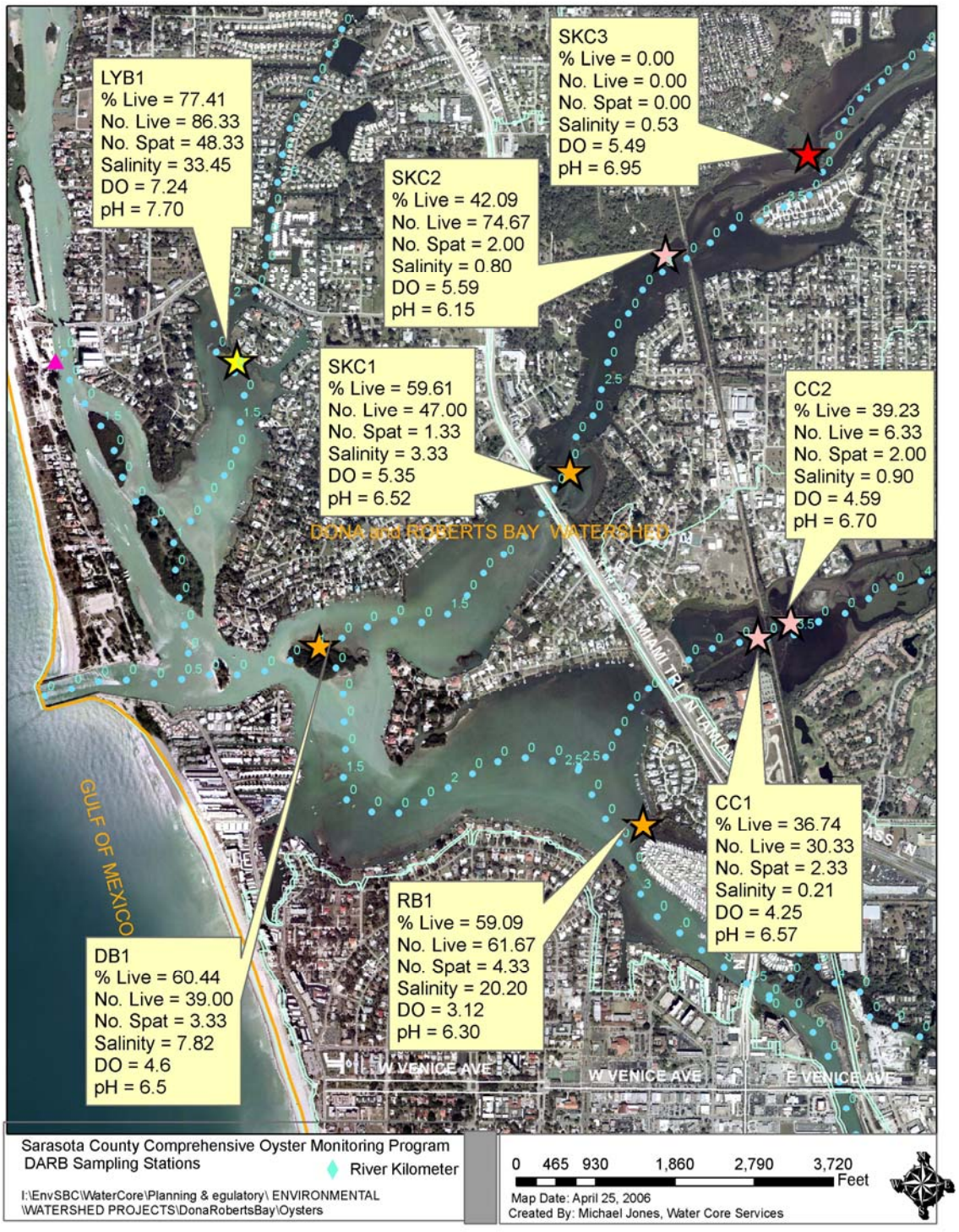


Figure V-3 Dona and Roberts Bay Oyster Monitoring Site Locations and 2006 Results

The scores, according to the scoring system based on percent live oysters and described on page 6, for the individual sites for the fall 2006 monitoring event area as follows: Lyon's Bay scored a 3.0 (B) or "on target"; DB1, SKC1, and RB1 ranked "fair" with a 2.0 (C); SKC2, CC1, and CC2 ranked "poor" with a 1.0 (D), SKC3 ranked "very poor" with a 0.0 (F). No live oysters were found at the upstream Shakett Creek site. An effort was made to combine the scores to come up with a score for each leg of the Dona and Roberts Bay study area and a final score for the watershed. Results indicated that the Lyon's Bay site had the highest score and the highest number of live oysters (86 per 0.25 m^2) and the highest percent live oysters (78.24 per 0.25 m^2) in the watershed study area. Oyster sites in the Dona Bay / Shakett Creek leg and the Roberts Bay / Curry Creek leg of the watershed both ranked poor with a 1.25 (D) and 1.56 (D) respectively. As a whole the Dona Bay watershed ranked poor with a score of 1.625 (D).

Both percentage of live oysters and number of live oysters decreased during the 2006 wet season at all sites except the Lyon's Bay site, where percent live increased slightly from 74% to 77% live even though the average number of live decreased. The Lyon's Bay site remains the most stable site for percent live oysters over the history of monitoring where other sites have had higher fluctuations. Lyon's Bay traditionally stands out from other sites in statistical significance. Both number and percentage of live oysters was significantly different from the two upper Shakket Creek sites and the Curry Creek sites during this monitoring event.

Oysters in Dona Bay and Shakket Creek decreased in both percent live and total live oysters from 2005. Statistical analyses indicated oysters in the upstream Shakkett Creek site were significantly different than all other sites due to no live oysters being encountered. Visual observations indicated that the most robust oyster habitat remains in Shakket Creek between U.S. 41 and the railroad trestle. This season this same area contained large mats of decaying freshwater vegetation as well as an 8 foot alligator at the downstream Shakett Creek site all indicating recent high fresh water flows through the area.

The Robert's Bay site, located in close proximity to the ICW and the historic mouth of Hatchett Creek, decreased in percent of live oysters and number of live oysters. Visual observations at the RB1 site indicated an increase of oyster spat recruitment on available substrate. Statistical analyses indicated that percent of live oysters was significantly different to those found upstream in Curry Creek.

Percent live values and live values also decreased in Curry Creek. The Curry Creek sites remain the site with the most consistent low numbers of live and percent of live oysters. Figures V-4 and V-5 are bar graphs of the mean number of live and mean percent live oysters for the fall 2006 monitoring event.

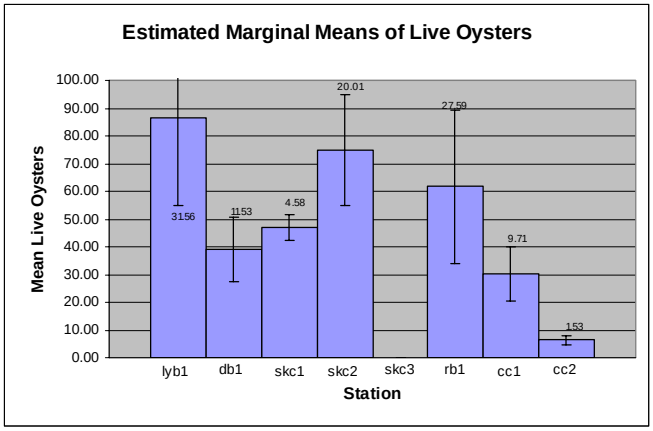


Figure V-4 2006 No of Live Oysters

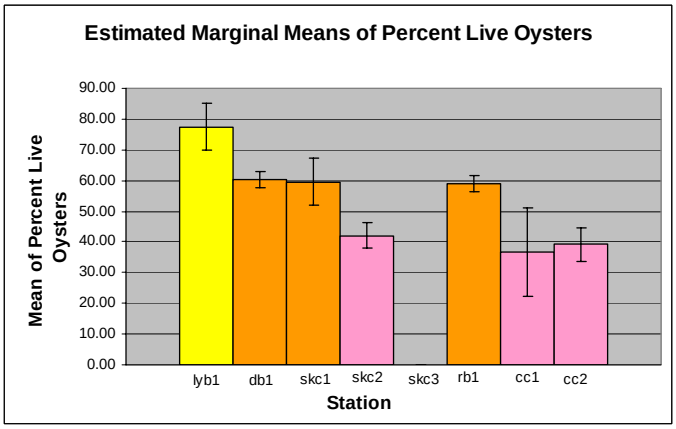


Figure V-5 2006 Percent Live Oysters

Tables V-1 and Table V-2 below contain the results for number of live oysters and percent live oysters over the monitoring history. Figures V-6 and V-7 display bar graphs of the entire data sets for live and percent live oysters.

	lyb1	db1	skc1	skc2	skc3	rb1	cc1	cc2
Oct-03	109.33	14.33	7.00	0.00		37.67	0.00	
Apr-04	91.67	50.67	79.67	81.33		30.00	42.67	
Oct-04	112.67	81.00	125.67	113.00		94.33	41.00	
Apr-05	141.33	50.00	73.00	112.67	12.33	136.33	69.00	4.33
Sep-05	132.33	65.00	116.33	9.00	0.67	119.00	21.67	0.00
Apr-06	111.33	43.67	74.67	81.33	32.67	111.67	93.33	12.67
Sep-06	86.33	39.00	47.00	74.67	0.00	67.67	30.33	6.33
AVG.	**112.14**	**49.10**	**74.76**	**67.43**	**11.42**	**85.24**	**42.57**	**5.83**

Table V-1 No. of Live Oyster Trend

	lyb1	db1	skc1	skc2	skc3	rb1	cc1	cc2
Oct-03	79.28	16.12	7.38	0.00		70.17	0.00	
Apr-04	73.85	50.74	80.04	70.15		76.24	38.85	
Oct-04	83.34	65.08	70.71	80.34		78.53	43.75	
Apr-05	81.88	80.71	89.58	93.09	67.92	77.52	73.12	16.34
Sep-05	77.65952	73.90	86.45	9.66	4.44	68.44	34.92	0.00
Apr-06	74.25972	68.10	77.85	82.84	78.62	83.16	74.65	57.33
Sep-06	77.41	60.44	59.6061	42.09	0	59.09	36.74	39.23
AVG	**78.24**	**59.30**	**67.37**	**54.02**	**37.74**	**73.31**	**43.15**	**28.23**

Table V-1 Percent Live Oyster Trend

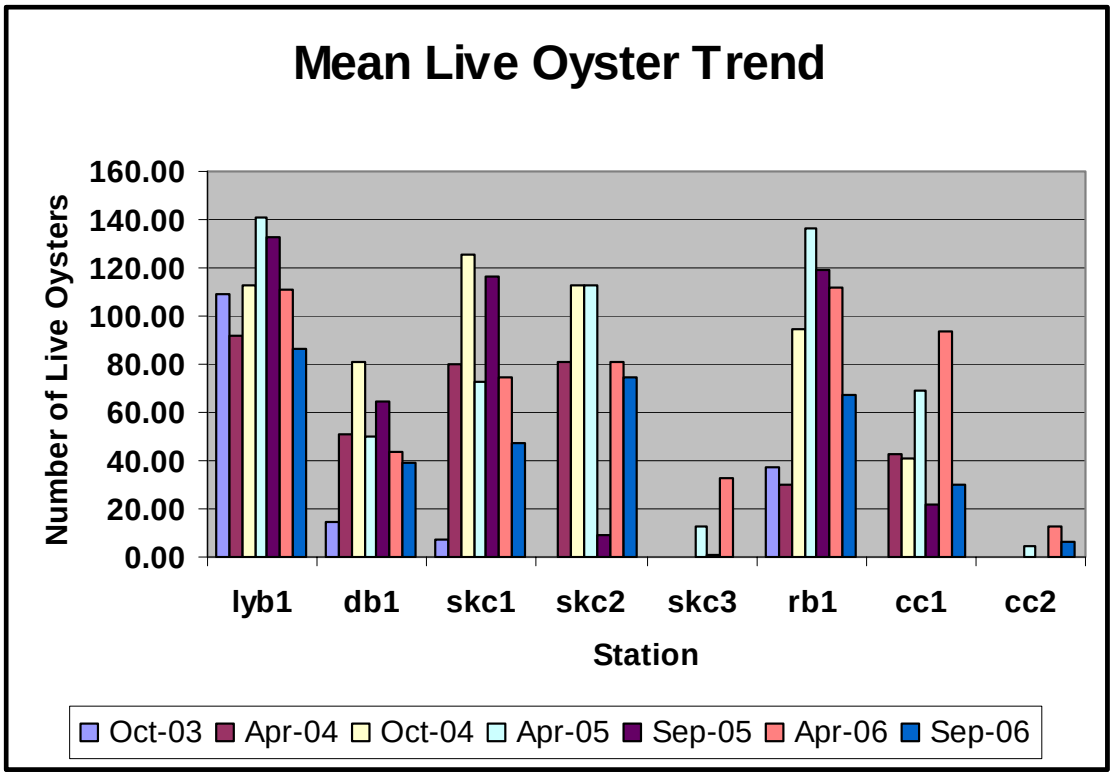


Figure V-6 Mean Live Oyster Trend

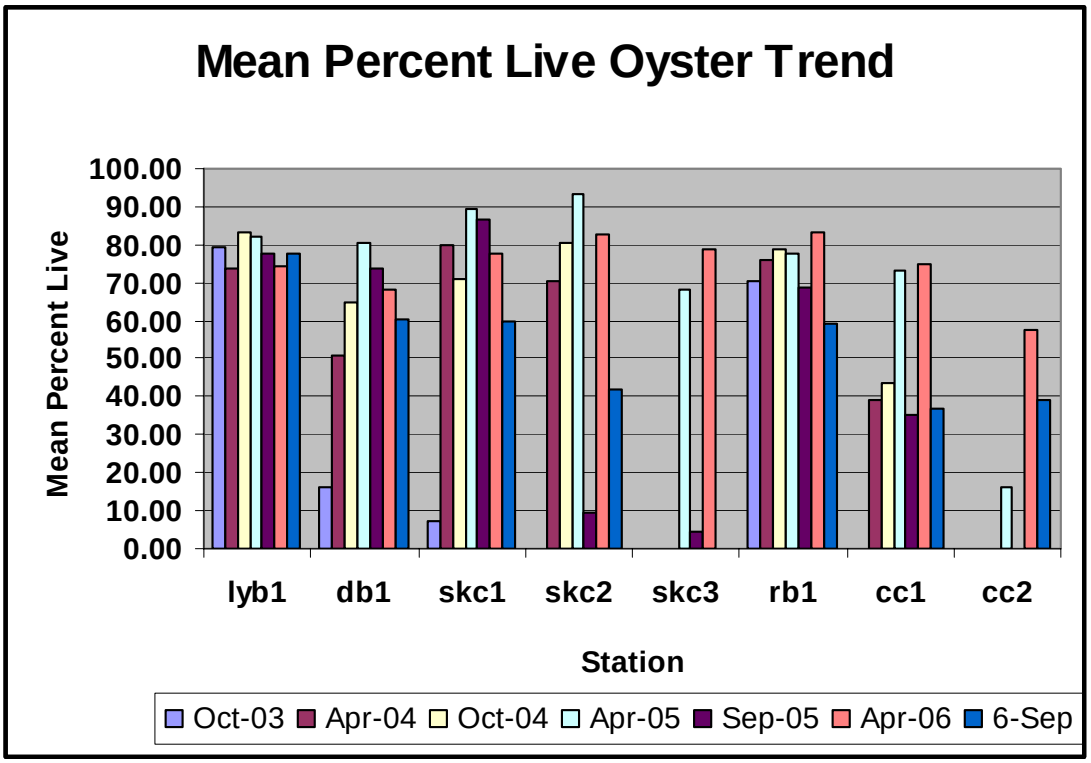


Figure V-7 Mean Percent Live Oyster Trend

Dona and Roberts Bay Rainfall

To calculate DARB watershed rainfall the following ARMS stations were used: CPS1 and CPS2 (the upper and lower weirs on Cow Pen Slough), CC, WM-49, BERM (three stations on the Pinelands Reserve and the central county landfill), CUR1 and CUR2 (Curry Creek at Jackson Road and Capris Isles Blvd.), HC1 and HC2 (Hatchet Creek and Venice Ave. and U.S. Hwy 41 and Albee Farm Rd.) and BRLF (the Bee Ridge Landfill Facility. Average rainfall values used for the DARB rainfall analyses were obtained from the SWFWMD CWM rainfall database for the Cow Pen Slough watershed.

A rainfall analysis shows that, from January through December 2006, DARB received 50.00 inches of rain compared to the SWFWMD CWM basin average of 52.28 inches that would be expected during an average calendar year. In 2006 the DARB watershed received approximately 2 inches less rain than would be expected during an average year. The 2006 rainfall pattern resulted in a drier than average 2006 dry season and a wetter than average 2006 wet season. Figure V-8 displays the ARMS measured monthly rainfall against the SWFWMD CWM rainfall database average for the period of oyster monitoring.

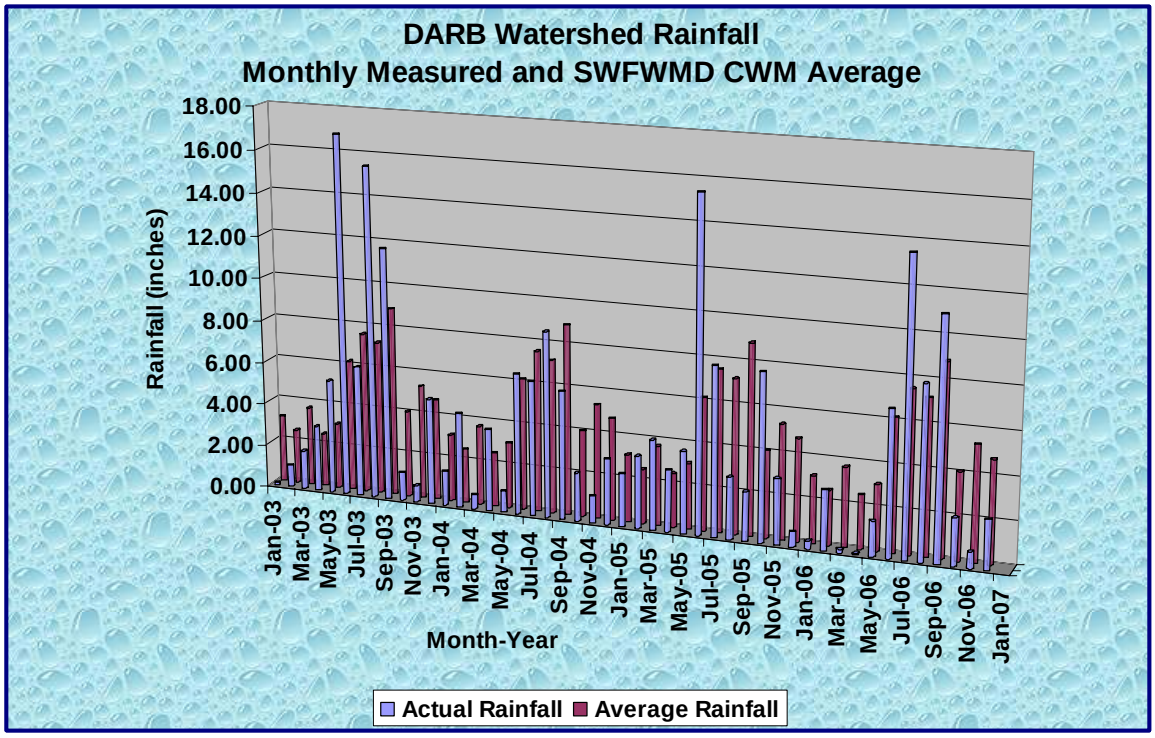


Figure V-8. DARB watershed rainfall for oyster monitoring history and SWFWMD CWM Average.

Discharge

Cow Pen Slough

The construction of the Cow Pen Slough (CPS) canal diverted the entire CPS contributing watershed from the Myakka River basin to Dona Bay. Historically, the CPS may have overflowed to Dona Bay during extreme flood events. Prior to the canal construction, watershed runoff would have either been stored on the land in freshwater marshes and sloughs or have slowly flowed toward the Myakka River. Theoretically, all water discharged over the CPS lower weir is excess runoff that historically would not have drained to Dona Bay.

Cow Pen Slough discharge ratings, based on stage and weir structure, have been studied and refined over the past two years. The total volume of fresh water discharged across the lower weir in from January 1, 2006 through December 31, 2006 was calculated at approximately 34,407 acre-feet which equates to 11.02 inches of annual runoff or 30.7 million gallons per day. In other words approximately 22 % of the 2006 annual rainfall was converted to runoff. A decrease of approximately 9% from the 31% calculated for 2005 as part of the Dona Bay Watershed Management Plan project. Figures V-9 graphically represents the discharge for the lower weir for the 2006 wet season. Please note that the CPS structures remained in the closed position until the last week of July 2006 unlike previous years when the structures were opened traditionally in the first week of June.

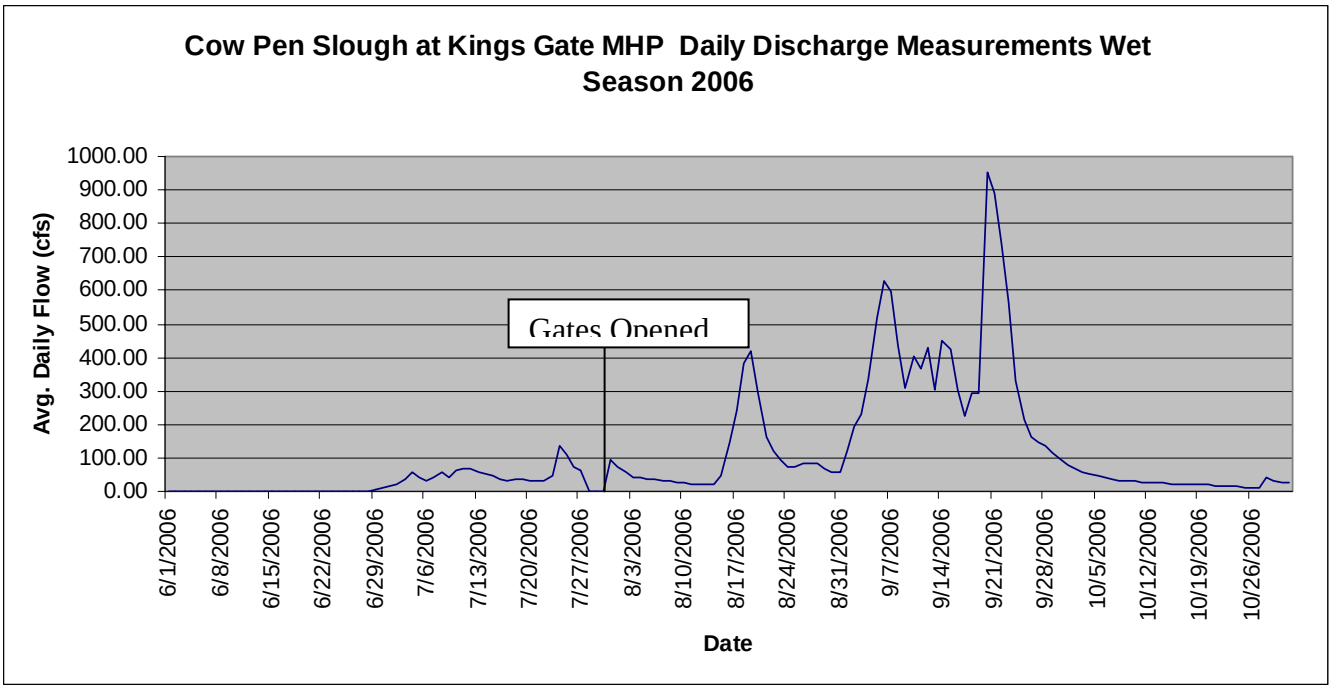


Figure V-9. CPS-1 2006 Wet Season Discharge.

Blackburn Canal

Studies conducted on the Myakka River estimate that discharges to Blackburn Canal are between seven to ten percent of the flow on the Myakka River (USGS, 1992; DeLeuw, Cather and Brill, 1959; Suau, 2005). For the purpose of estimating flow, discharge ratings based on stage and flow measurements at the Sarasota ARMS station CUR-2 located on Blackburn Canal and Capris Isle Blvd was used for volume estimations. The total volume of water that passed the CUR-2 ARMS station from January 1, 2006 through December 31, 2006 was approximately 23,505 acre-feet which, according to the Curry Creek basin size equates to 64.34 inches of annual runoff or 20.98 million gallons per day. In other words these results imply that approximately 128 % of the 2006 annual rainfall was converted to runoff. Of course a basin is highly unlikely to generate more runoff than rainfall. The reason for this discrepancy is that it is difficult to estimate the size or portion of the area in the Myakka River watershed that is diverted through the Blackburn Canal. No attempt was made to estimate that area for this reporting effort. Figure V-10 graphically illustrates the estimated discharge for Blackburn Canal for the 2006 wet season

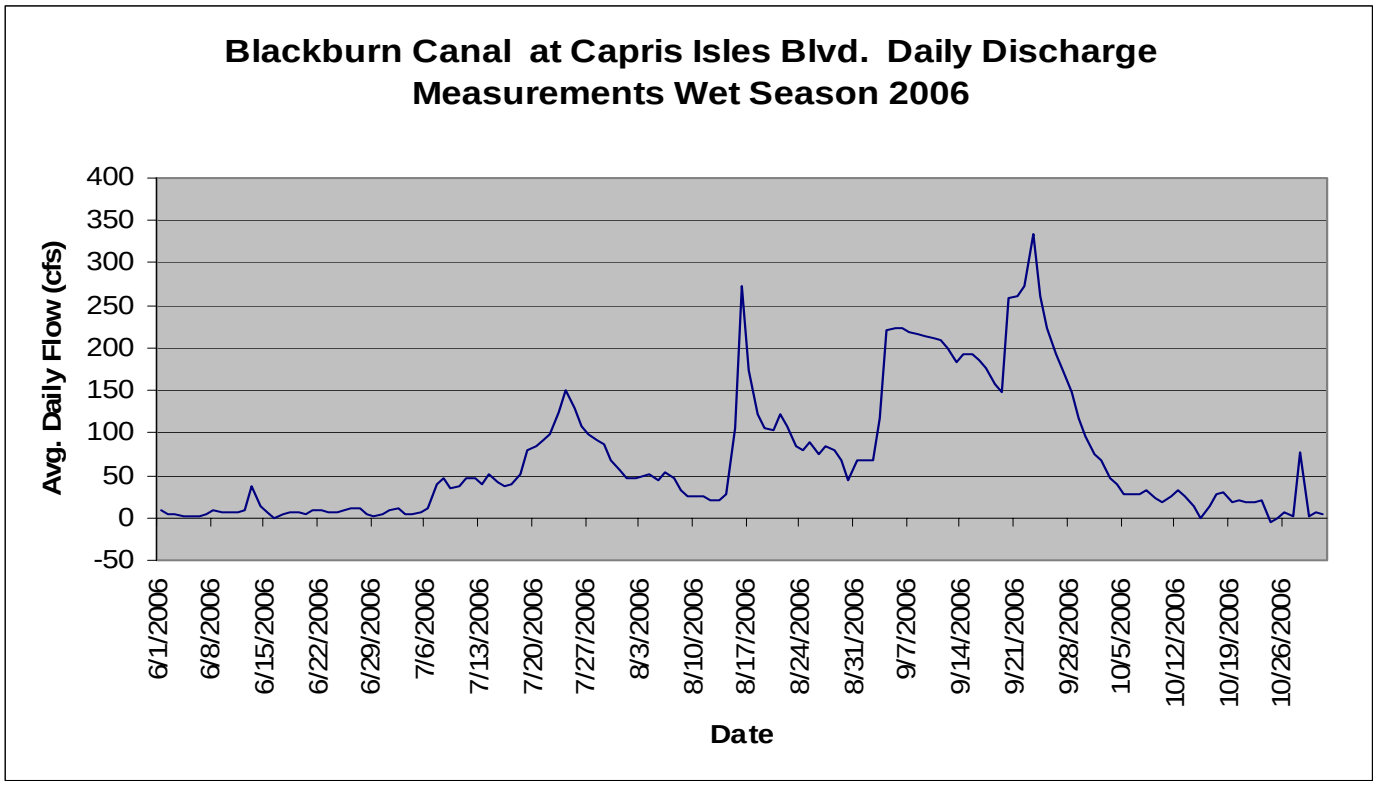


Figure V-10. **CUR-2 2006 Wet Season Discharge.**

Salinity

Data collected by the USGS painted an informative picture due to the time span and amount of data collected. Enough data were available for the 2005-2006 dry season and the 2006 wet season (Figures V-11 and V-12). As expected, the upstream station at Shakket Creek has salinity values consistently lower than values at the downstream Dona Bay station. USGS salinity data indicates that salinity slipped below the 10ppt minimum required to maintain healthy oyster reefs in October 2005 and February 2006 at the upstream station in Shakket Creek. The Dona Bay station indicated that salinity remained at acceptable levels throughout the 2005-2006 dry season. Conversely the wet season data indicated that salinity fell below 10 ppt. around July 1, 2006 at the Shakket Creek station and remained below 10 ppt through at least the end of September. Salinity also fell below 10 ppt at the downstream station in Dona Bay from July 23, 2006 through August 2, 2006; from August 16, 2006 through August 23, 2006; and again from around September 2, 2006 through the end of the data set around the 15th of September 2006.

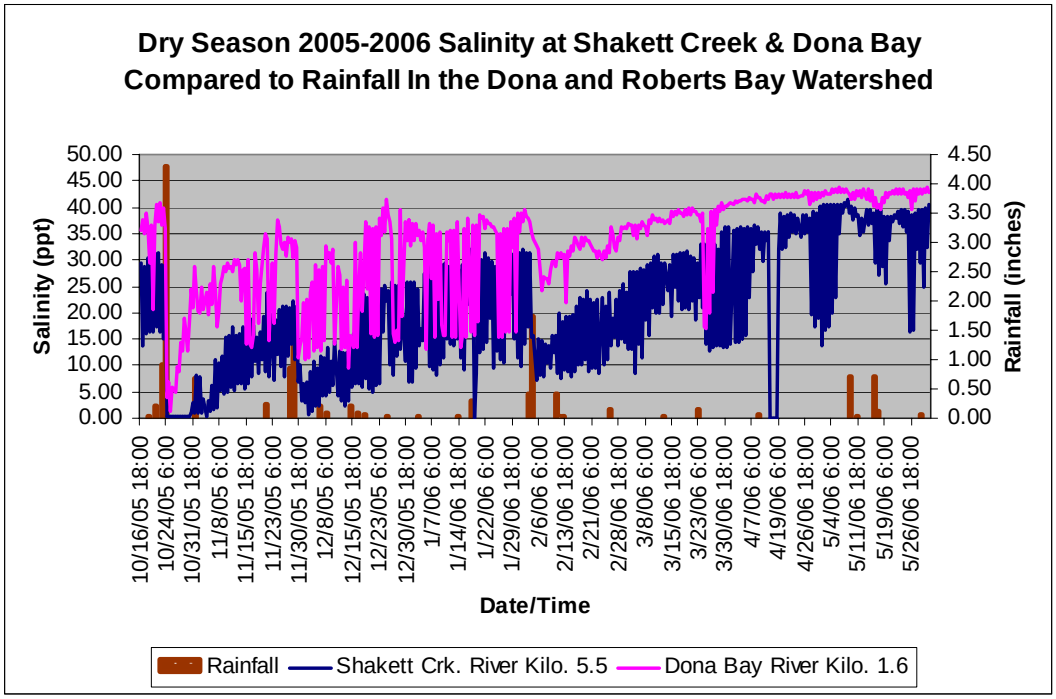


Figure V-11. Dry season 2005-2006 salinity at Shakket Creek and Dona Bay USGS stations with rainfall.

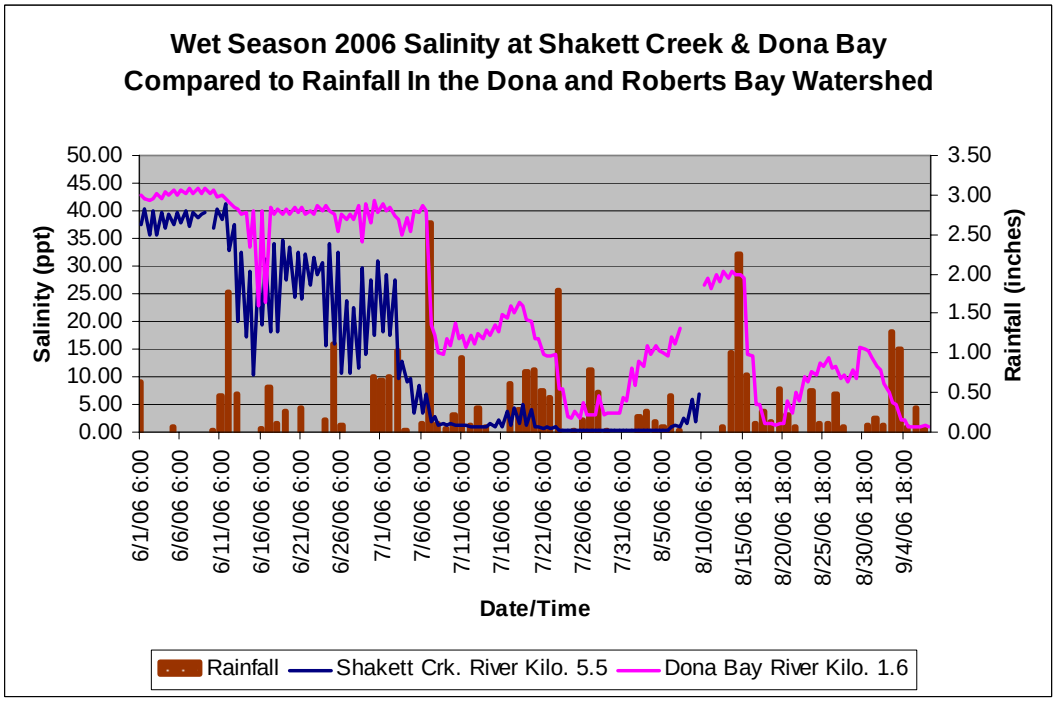


Figure V-12. Wet season 2006 salinity at Shakket Creek and Dona Bay USGS stations with rainfall.

Data collected monthly by Mote Marine Laboratory indicated that salinity in the Dona Bay study area fell below 10 ppt from mid-August 2006 through mid-September 2006 in the vicinity of Dona Bay upstream of the U.S. 41 Bridge (Figure V-13). It is important to note that the salinity data collected once a month by Mote did not capture the low salinity values measured at the USGS station further downstream in Dona Bay.

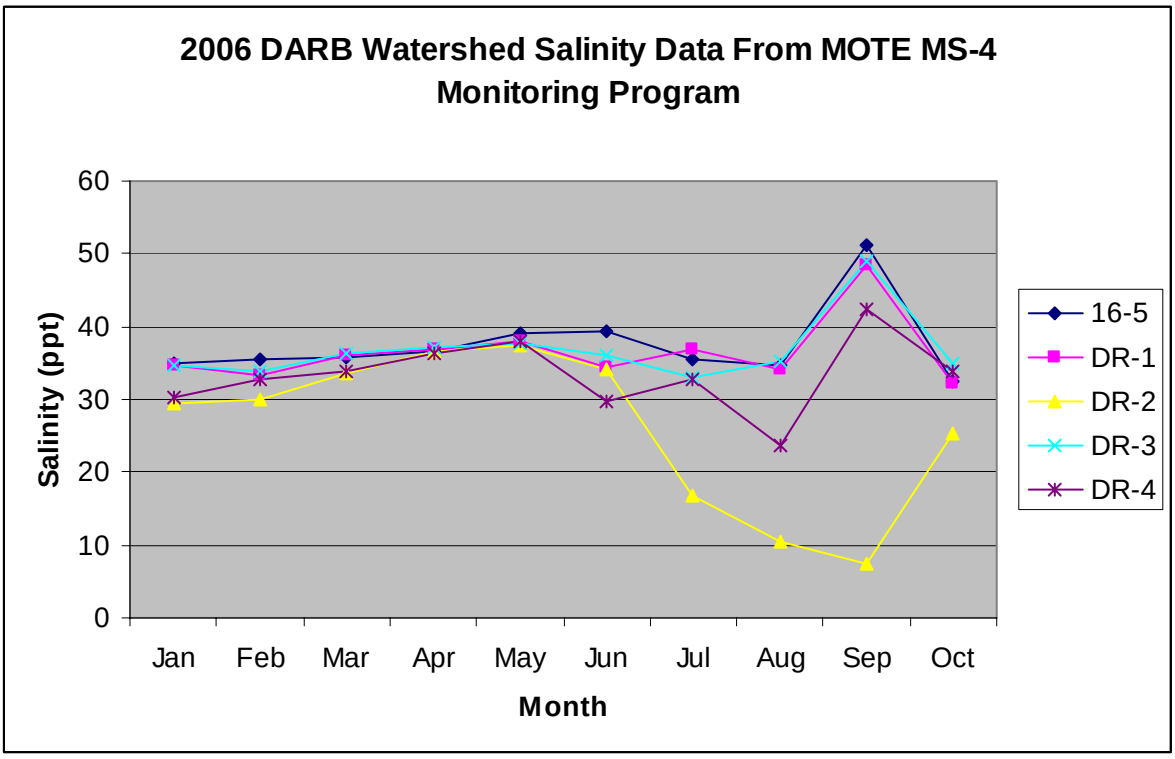


Figure V-13. 2006 Salinity data from MS4 monitoring stations in Dona and Roberts Bay.

VI. LEMON BAY WATERSHED

View of Lemon Bay North from Stump Pass

Fall 2006 Oyster Monitoring Program

Lemon Bay Watershed Description

Within Sarasota County, the Lemon Bay watershed extends from approximately Center Road south to Charlotte County. This geographical area also includes areas recently annexed into the City of North Port as well as the South Venice, Venice Gardens, Jacaranda, Englewood Isles, Boca Royal, Tangerine Woods and Park Forest communities.

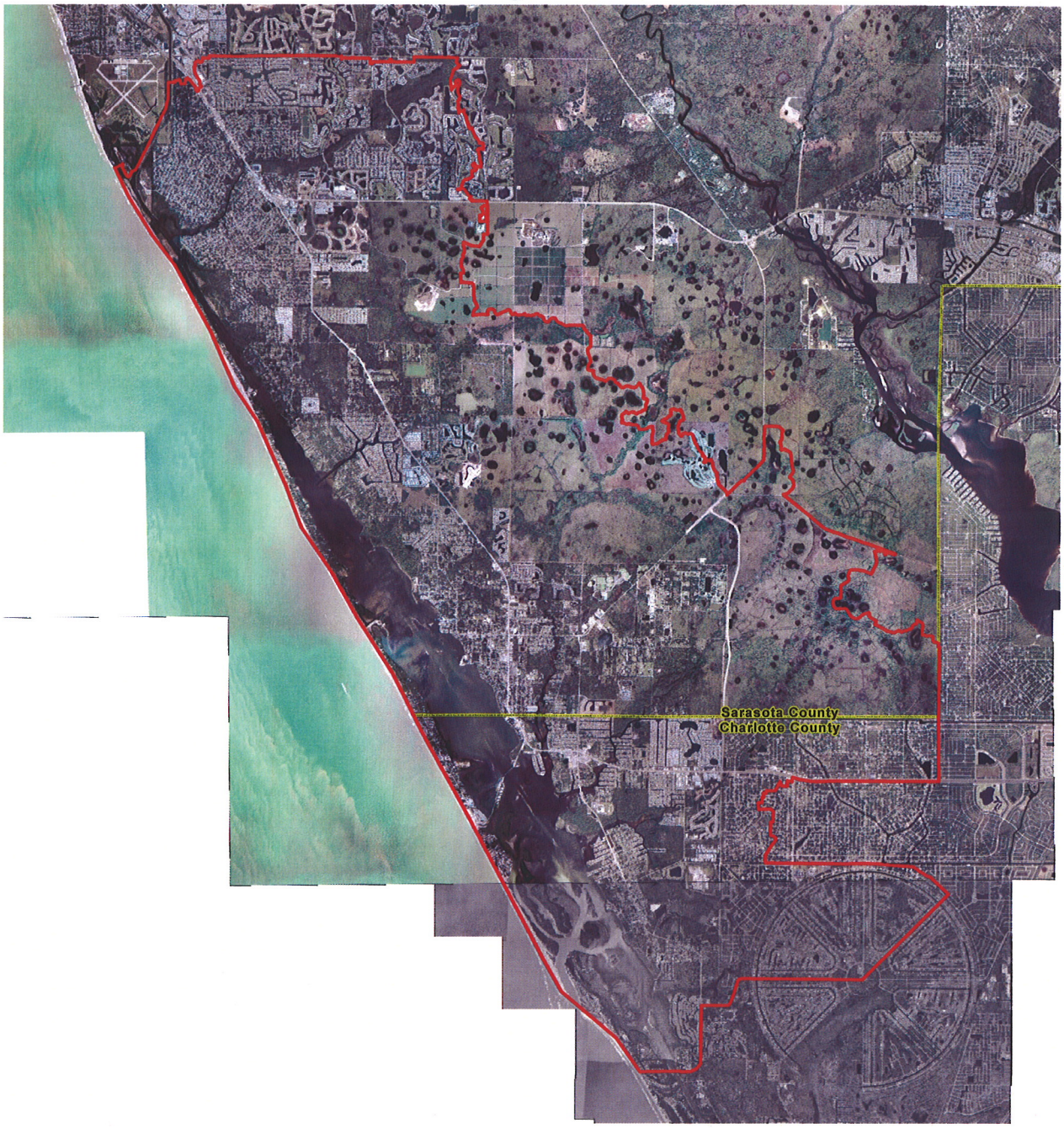
The Lemon Bay watershed contains 47,707 acres and, with the exception of the northern (Alligator Creek drainage basin) and coastal portions, most of the watershed is currently undeveloped. However, the eastern portion has recently been annexed into the City of North Port and much of the watershed will likely be under developed in the next five to ten years.

Based on the 1847 survey of Sarasota County, only Alligator Creek and Forked Creek appear to have been extended significantly inland. Historically, Alligator Creek appears to go from a tidal creek to an elongated slough system somewhere around the present day U.S. 41. Forked Creek appears as a forked system, as the name implies. Both of these forks appear to have been significantly altered by development in the area. Gottfried Creek and Ainger Creek likely existed as tidal extensions, and Woodmere Creek extended inland less than a mile. The remainder of the watershed was frequented by isolated wetlands and sloughs within a landscape mosaic made up of predominately pine flatwoods. However, a large band of scrub flatwoods existed along the coast of what is presently South Venice.

In the 1950's and 1960's, drainage works in association primarily with mosquito control were constructed. Today, the resulting network of drainage ditches in the Lemon Bay watershed is somewhat extensive and relatively efficient in moving freshwater from the watershed to the bay. However, the Lemon Bay watershed is largely undeveloped and affords several opportunities for hydrologic restoration. It will be important to work with landowners and land planners to include restoration opportunities as part of development master plans. In addition, even though the Alligator Creek basin is essentially built-out, the historical slough system/floodplain has largely been set aside and much of it is under public ownership. Although it has been altered by a large drainage ditch, there are opportunities for hydrologic restoration of this corridor.

The resulting Lemon Bay watershed (based on the 2004 SWFWMD land use classification) consists of approximately 23% wetlands, 27% naturally vegetated uplands, 3% open water, 5% agricultural lands, and 42% developed area (Figure VI-1).

Center for Watershed Management
Lemon Bay Watershed



Legend

County Line

WATERSHED

Figure VI-0. Lemon Bay Watershed

N

0 0.5 1 2 3 4
Miles

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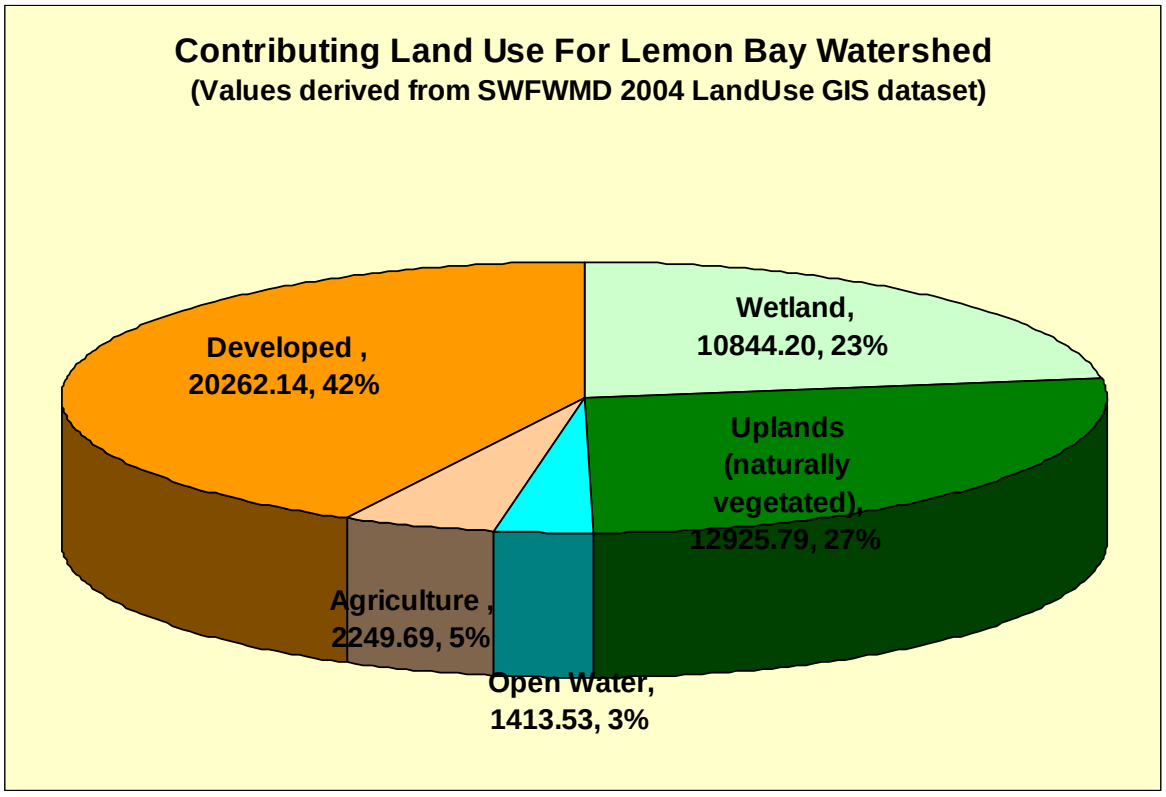

Figure VI-1, Lemon Bay Watershed Land Use, In Acres

The Lemon Bay Watershed contains four sampled creeks: two occur in upper Lemon Bay and two in lower Lemon Bay. The two upper bay creeks are Alligator Creek and Forked Creek each with two sites. The lower bay creeks are Gottfried Creek which has three sites and Ainger Creek which has two sites. The watershed also has 7 ARMS stations that were used to calculate average 2006 rainfall data. Discharge data were available for two locations in the Lemon Bay watershed one from the Forked Creek basin and one from the Gottfried Creek Basin. Salinity data were available from 5 stations monitored by Mote Marine Laboratory for the Sarasota County NPDES MS4 permit. Figure VI-2 has station locations for the Mote Marine water quality data collection sites, the oyster monitoring sites, and the ARMS site locations.

Figure VI-2. Monitoring Locations in the Lemon Bay Watershed

Results

Oysters were monitored in the Lemon Bay Watershed in October 2006. Figures VI-3, VI-4, and VI-5 are graphical depictions of 2006 monitoring results. Stars at monitoring site locations have been color coded according to the scoring system detailed in Table II-1 on page 6.

Figure VI-3. Alligator Creek Monitoring Site Locations and 2006 Results

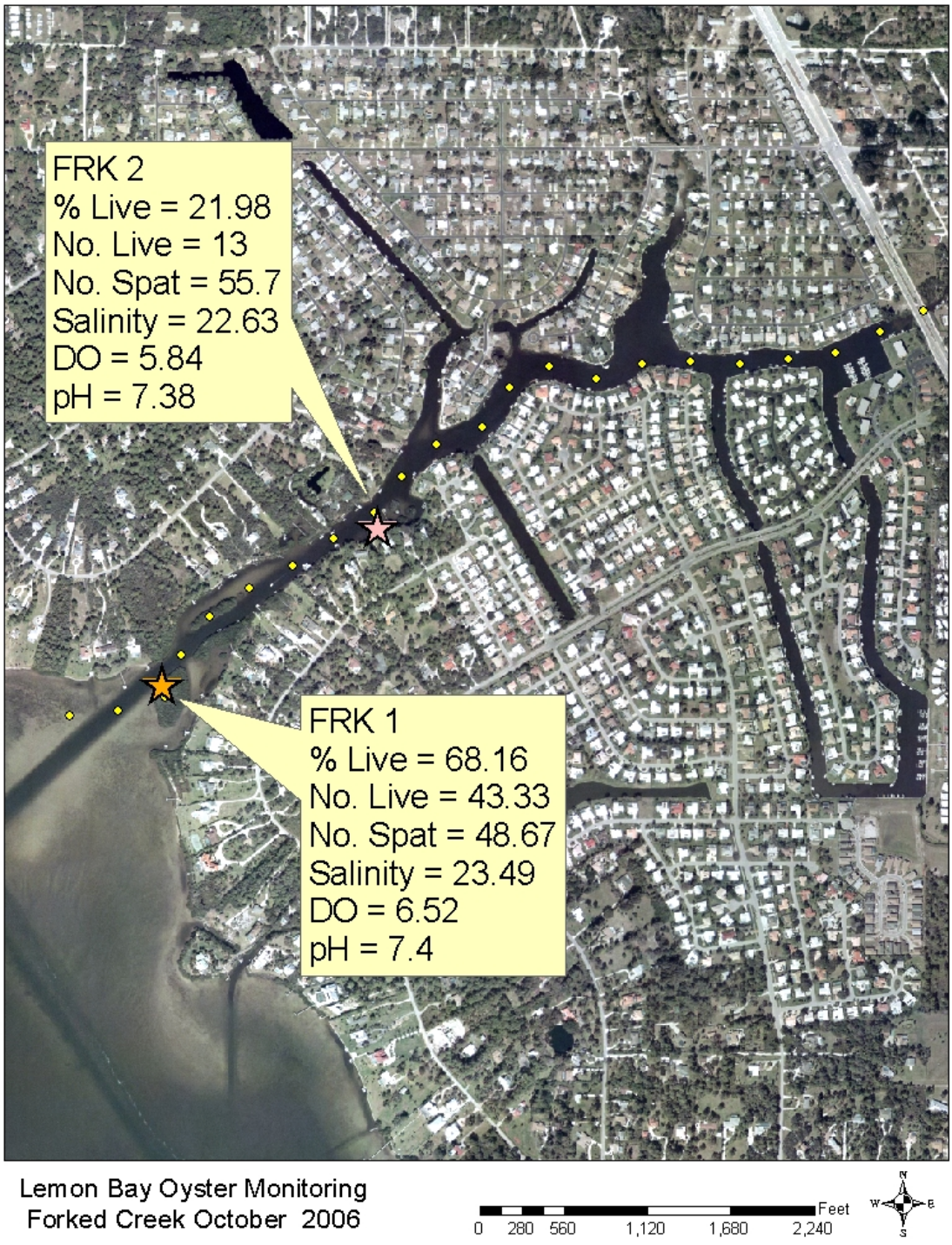

Figure VI-4. Forked Creek Oyster Monitoring Site Locations and 2006 Results

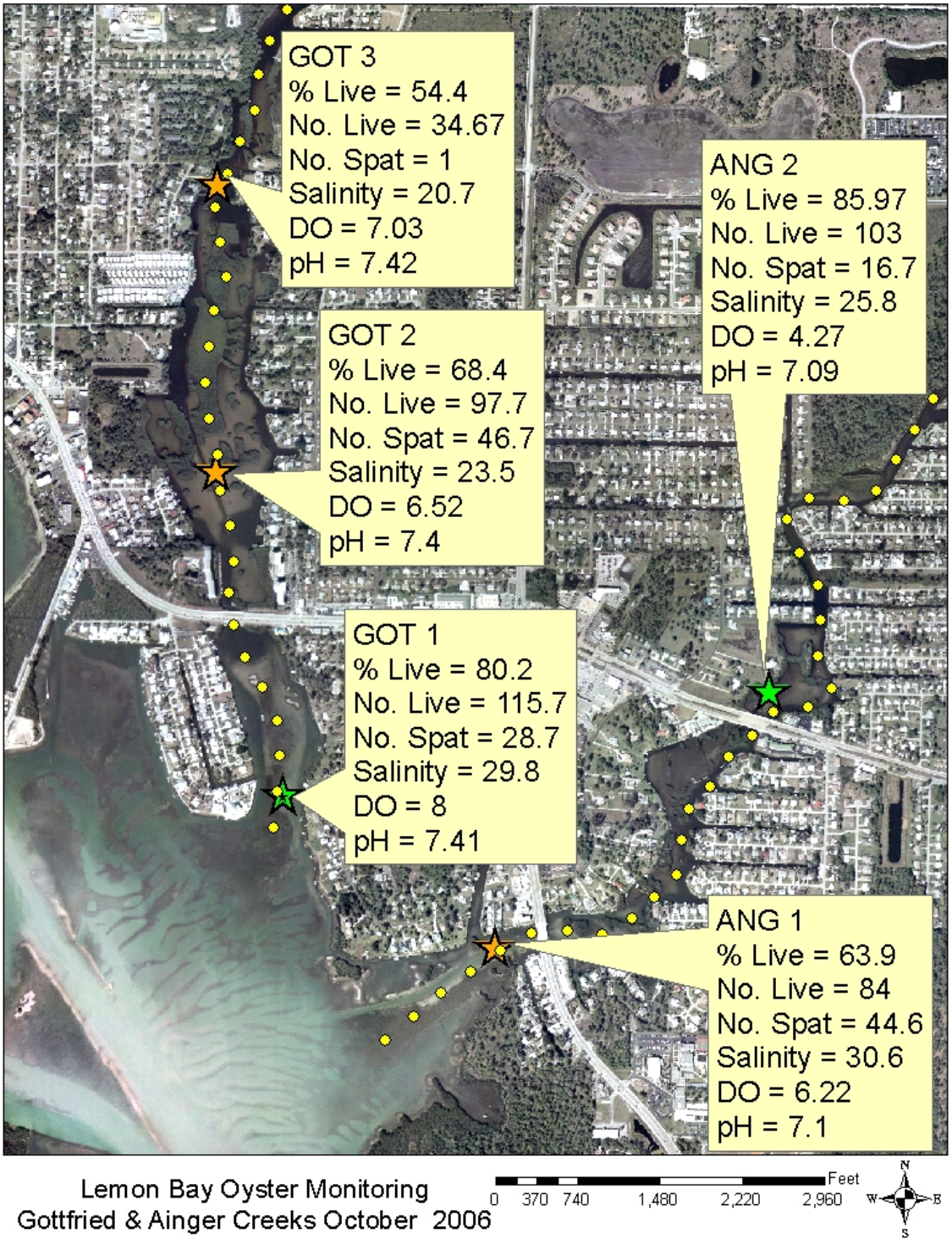

Figure VI-5. Ainger and Gottfried Creek Oyster Monitoring Site Locations and 2006 Results

The scores, according to the scoring system based on percent live oysters and described on page 6, for the individual sites for the fall 2006 monitoring event area as follows: Alligator Creek sites AL1 and AL2 both scored a 2.33 (C) or "fair"; Forked Creek site FRK1 was "Fair" with a 2.33 while FRK ranked "poor" with a 0.67; ANG2 on Ainger Creek ranked excellent with a 4.0 (A) while GOT1; GOT2, GOT3, and ANG1 ranked "fair" in the 2.0 (C) range; Scores were combined to come up with a score for monitored creeks in Lemon Bay as well as a combined final score for the watershed. Results indicated that Ainger Creek was "on target" with a 3.0 (B) followed by Gottfried Creek with a 2.67 (C), Alligator Creek with a 2.33 (C) and Forked Creek with a 1.5 (D). As a whole the Lemon Bay watershed ranked fair with a score of 2.4 (C).

The fall 2006 monitoring event was the first data collection event in the Lemon Bay watershed for the County wide oyster monitoring program. A statistical means comparison of oysters within the Lemon Bay watershed indicated the numbers of live oysters at the upstream Forked Creek (FRK2) site and upstream Gotfried Creek site had significantly lower numbers of live oysters than the other sites in the Lemon Bay study area. The statistical analysis for percent live oysters indicated that the FRK2 site was significantly different than all other sites monitored in the Lemon Bay watershed for this effort. Figures IV-6 and IV-7 are bar graphs of the mean number of live and mean percent live oysters for each site in the Little Sarasota Bay watershed during the fall 2006 monitoring event.

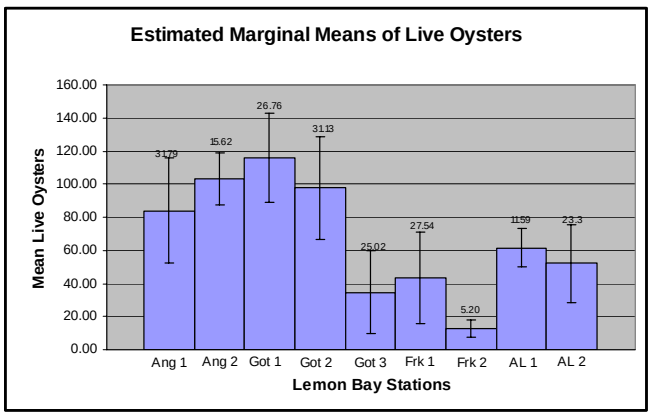

Figure IV-6. 2006 No. of Live Oysters

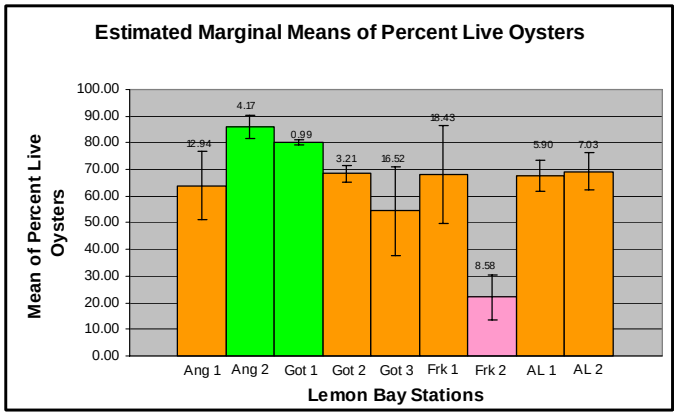

Figure IV-7. 2006 Percent Live Oysters

Lemon Bay Rainfall

To calculate Lemon Bay watershed rainfall the following 7 ARMS stations were used: CST-1 (Indian Mound Park), AL-1 (Alligator Creek), FRK-1 & FRK-2 (on Forked Creek), GOT-1 & GOT-2 (on Gottfried Creek), and LBAY-1 (on Woodmere Creek). Average rainfall values used for the Little Sarasota Bay watershed rainfall analyses were obtained from the USGS Sarasota/Lemon Bay basin rainfall database.

A rainfall analysis shows that, from January through December 2006, the Lemon Bay watershed received 37.98 inches of rain compared to the USGS basin average of 52.25 inches that would be expected during an average calendar year. This equates to approximately 15 inches below average. The months of January, March, April, May, October and November experienced significantly lower than average amounts while July received an above average amount of rain. Figure VI-8 displays the ARMS measured monthly rainfall against the USGS rainfall database average for January through November 2006.

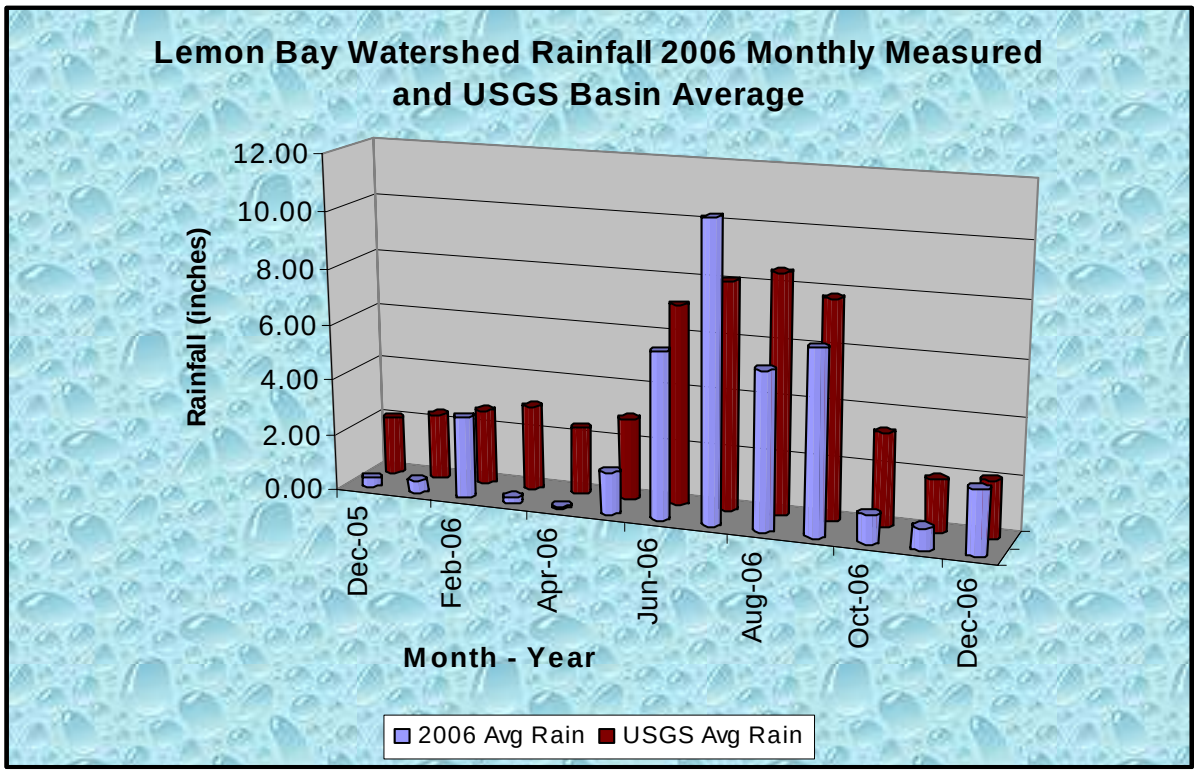

Figure VI-8. 2006 ARMS avg. measured monthly rainfall and USGS monthly average.

Discharge

Forked Creek discharge is based on a discharge rating curve developed with stage data and flow measurements taken at the FRK-1 ARMS station. The total volume of fresh water discharged through this area of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 134.46 acre-feet which equates to 1 inch of annual runoff or 0.12 million gallons per day. In other words approximately 2 % of the 2006 annual rainfall was converted to runoff. These values are quite low and the data are suspect. Figure VI-9 graphically represents the discharge from the drainage basin upstream of the FRK-1 ARMS station for the 2006 wet season. This drainage area comprises about 27 % of the 5862.543 acre Forked Creek drainage basin.

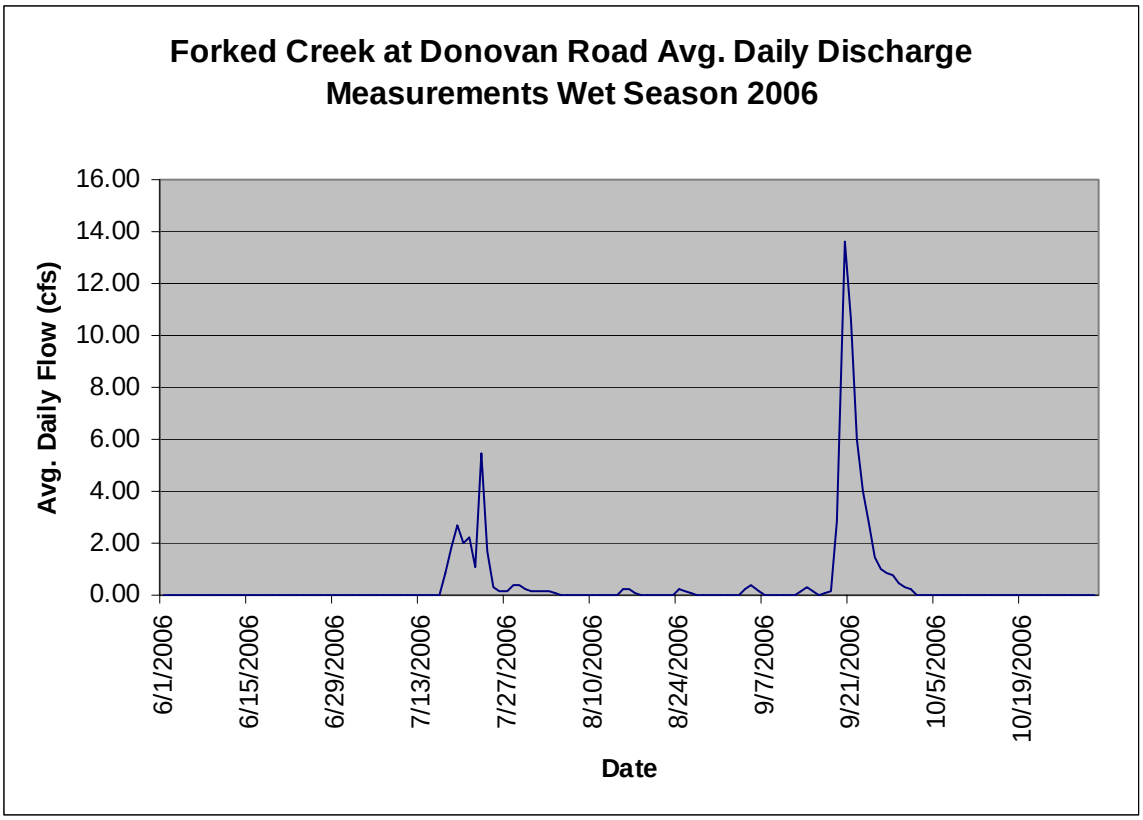

Figure V-9. **FRK-1 2006 Wet Season Discharge.**

Gottfried Creek discharge is based on a discharge rating curve developed with stage data and flow measurements taken at the GOT-2 ARMS station. The total volume of fresh water discharged through this area of the watershed from January 1, 2006 through December 31, 2006 was calculated at approximately 4596.52 acre-feet which equates to 10.79 inches of annual runoff or 4.10 million gallons per day. In other words approximately 28 % of the 2006 annual rainfall was converted to runoff. Figure VI-10 graphically represents the discharge from the drainage basin upstream of the GOT-2 ARMS station for the 2006 wet season. This drainage area comprises about 71 % of the 7198.092 acre Gottfried Creek drainage basin.

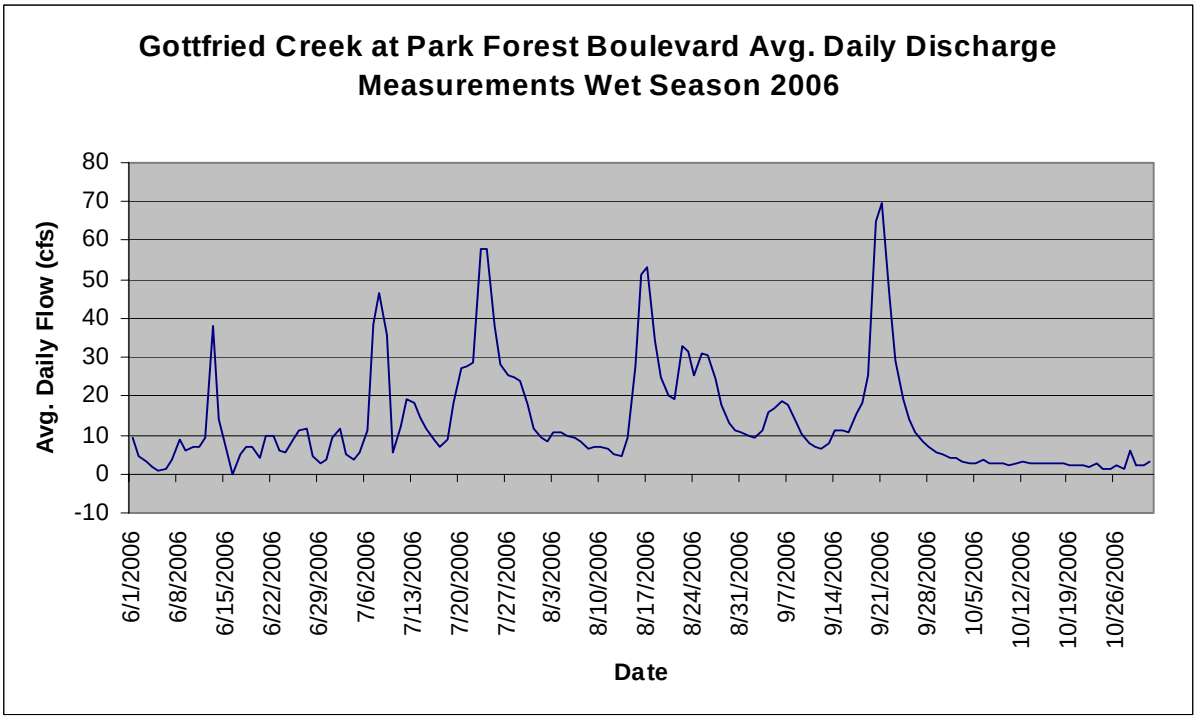

Figure V-10. GOT-2 2006 Wet Season Discharge.

Salinity

As part of the county's MS4 permit under the NPDES program, SCG has contracted Mote Marine Laboratory to collect monthly random grab samples throughout the coastal waters of Sarasota County. Other than a spot salinity reading at the time of monitoring at each oyster monitoring site, the MS4 monitoring data are the only salinity data currently included for the Lemon Bay watershed. The area monitored for each MS4 station is shown on figure VI-2. Figure VI-11 below is a graphical representation of the data. The MS4 data indicated that salinity in the bay remained in the salinity range required to sustain healthy oyster populations. MS4 monitoring station LB-1 is the station closest to the Alligator Creek oyster monitoring sites. MS4 monitoring station LB-3 is the station closest to the Forked Creek oyster monitoring sites. MS4 monitoring station LB-5 is the station closest to the Gottfried and Ainger Creek oyster monitoring sites and also relatively close to Stump Pass. Spot readings at the time of oyster sampling taken on a low incoming tide in Alligator Creek supported the Mote data. Salinity spot readings at the Alligator Creek oyster site AL1 was 30.40 ppt and 20.65 ppt at the upstream AL2 site. Salinity spot readings at the Forked Creek oyster site FRK1 was 22.63 ppt and 23.49 ppt at the upstream FRK2 site. The values at the Gottfried Creek sites were as follows: GOT1 = 29.80 ppt, GOT2 = 23.50 ppt, and GOT3 = 20.70 ppt. Salinity spot readings at the Forked Creek oyster site ANG1 was 30.60 ppt and 25.80 ppt at the upstream ANG2 site.

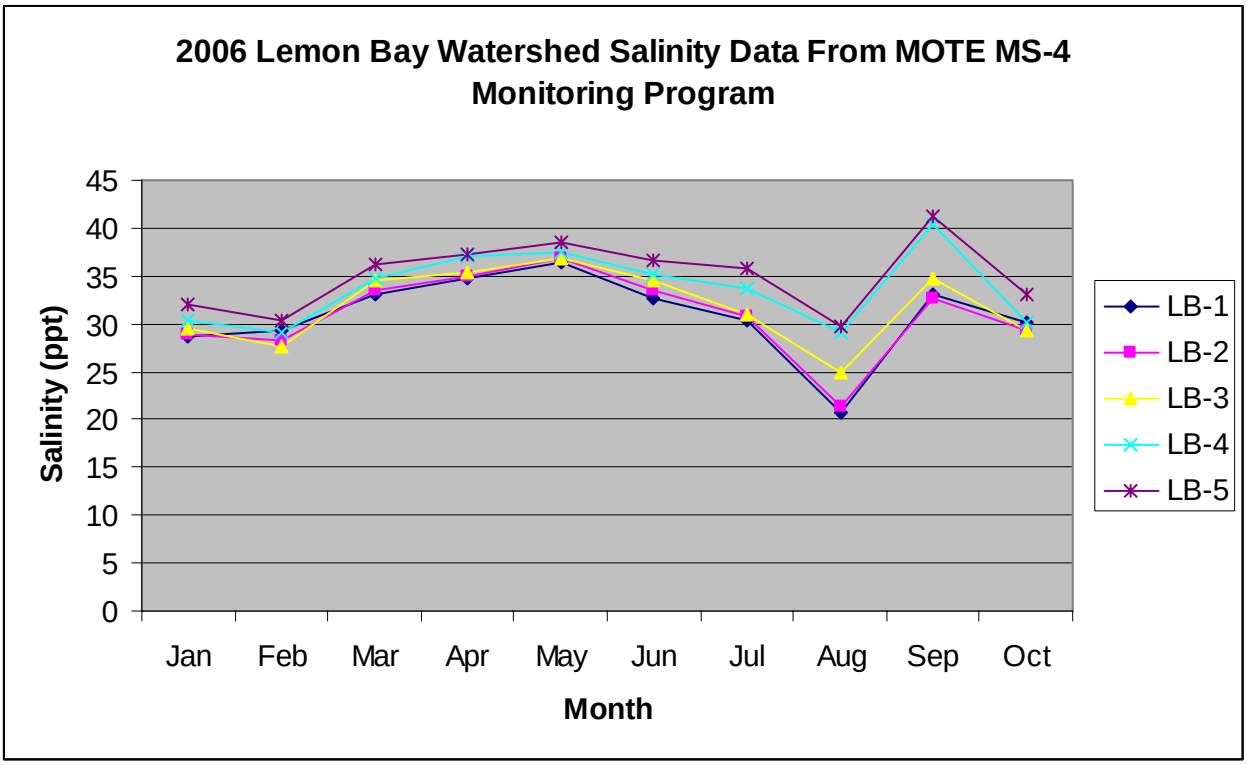

Figure VI-11. 2006 Salinity data from MS4 monitoring stations in Lemon Bay.

VII SUMMARY

Table VII-1 below is a summary of oyster scores based on percent live for each site throughout the County. Scores by creek and watershed are also summarized. The sixth column states whether available data indicate an adequate salinity regime. The seventh column gives the Average Rainfall amount for each watershed. The last column gives the percentage of rainfall converted to runoff for creeks where discharge ratings were evaluated.

Site ID	Percent Live Oysters	Descriptor	Numerical Score	Letter Score	Adequate Salinity (Y/N/?)	Rainfall (inches)	% of Rain to Runoff
PH1	55.01	Fair	2	C	Y		
PH2	60.77	Fair	2	C	Y		
PH3	10.14	Very Poor	0	F	?		
Phillippi Creek Average	41.97	Poor	1.33	D	Y?		38%
HUD1	78.60	On Target	3	B	Y		
HUD2	54.79	Fair	2	C	Y		
Hudson Bayou Average	66.70	Fair	2.5	C	Y		43%
Sarasota Bay Average	51.86	Fair	1.8	C-	Y	44.42 <avg	
SC1	57.45	Fair	2	C	Y		
SC2	58.18	Fair	2	C	?		
South Creek Average	57.81	Fair	2	C	Y?		
NC1	81.45	Excellent	4	A	Y		
NC2	0	Very Poor	0	F	N		
CAT1	77.81	On Target	3	B	Y		54%
North Creek Average	53.08	Fair	2.33	C	Y?		
Little Sarasota Bat Average	54.98	Fair	2.2	C	Y	40.58 <avg	
LYB1	77.41	On Target	3	B	Y		
DB1	60.44	Fair	2	C	Y?		
SKC1	59.61	Fair	2	C	Y?		
SKC2	42.09	Poor	1	D	?		
SKC3	0	Very Poor	0	F	N		
Shakett Creek/ Dona Bay Average	40.53	Poor	1.24	D	?		22%
RB1	59.09	Fair	2	C	Y		
CC1	36.74	Poor	1	D	N		
CC2	39.23	Poor	1	D	N		
Curry Creek / Roberts Bay Average	45.02	Poor	1.33	D	N		129%
Dona Roberts Bay Average	46.83	Poor	1.5	D	N	50 <avg	

Ang 1	63.92	Fair	2	C	Y		
Ang 2	85.97	Excellent	4	A	Y		
Ainger Creek Average	74.95	On Target	3	B	Y		
Got 1	80.23	Excellent	4	A	Y		
Got 2	68.39	Fair	2	C	Y		
Got 3	54.42	Fair	2	C	Y		
Gottfried Creek Average	67.68	Fair	2.67	C	Y		28%
Frk 1	68.16	Fair	2	C	Y		
Frk 2	21.98	Poor	1	D	Y		
Forked Creek Average	45.07	Poor	1.5	D	Y		2%
AL1	67.71	Fair	2	C	Y		
AL2	69.17	Fair	2	C	Y		
Alligator Creek Average	68.44	Fair	2	C	Y		
Lemon Bay Average	64.44	Fair	2.33	C	Y	37.98 <avg	
Sarasota County Average	54.53	Fair	2	C	Y		

Table VII-1 County Oyster Score Summary

Based on available data, most areas in 2006 had an adequate salinity regime to support healthy oyster beds. The exception would be upstream stations in Shakett and Curry Creek and also in upstream North Creek and Phillippi Creek. All areas in the County received a lower than average amount of rainfall during 2006. Overall, the oysters in Sarasota County scored in the C range. Some sites scored excellent and some sites scored poor. At the creek level, the creeks ranked highest to lowest as follows: Ainger Creek, Alligator Creek, Gottfried Creek, Hudson Bayou, South Creek, North Creek, Forked Creek, Curry Creek, Phillippi Creek, and Shakett Creek. Figure VII-1 illustrates percent live oysters by creek from highest to lowest. Figure VII-2 illustrates number of live oysters by creek from highest to lowest. At the watershed scale the ranking from highest to lowest was as follows: Lemon Bay, Little Sarasota Bay, Sarasota Bay, and Dona and Roberts Bay.

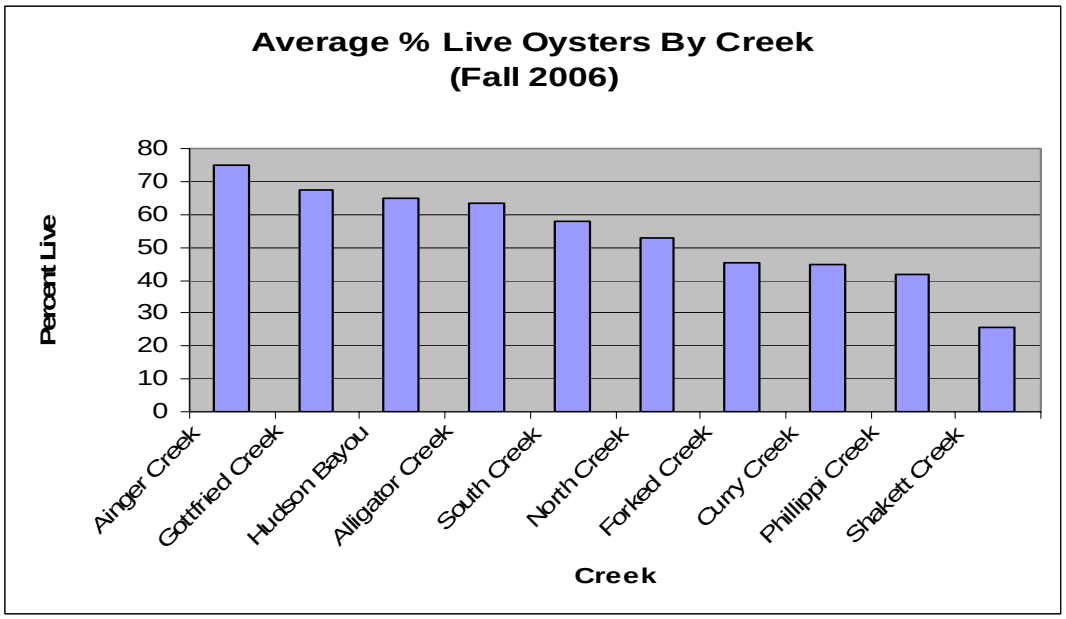

Figure VII-1. Fall 2006 percent live oysters by creek.

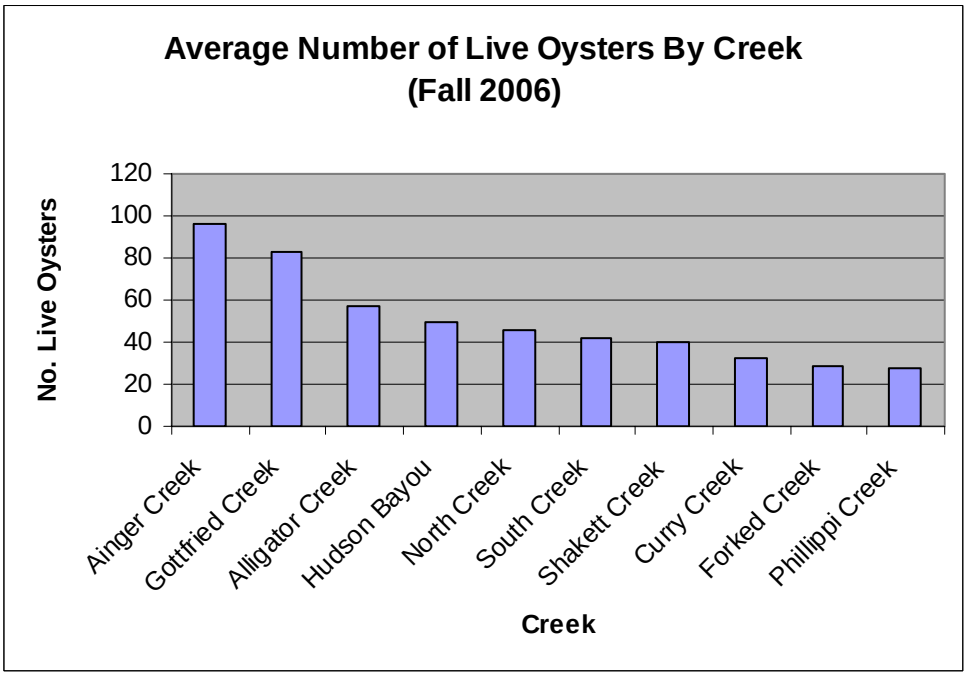

Figure VII-2. Fall 2006 number of live oysters by creek.

An exercise to sort sites into the health categories of above average, average, and below average was conducted using a chi square analysis on the number of live oysters and the number of dead oysters at each site. Table VII-2 presents the Chi square Analysis. Based three categories (high numbers of live, average to low numbers of dead, and high percent live) the following monitoring sites are in the above average health category: HUD1, NC1, LYB1, ANG1, ANG2, and GOT1. Based on low to average numbers of live and high numbers of dead as well as low percent live the following sites are in the below average health category: PH3, HUD2, NC2, SKC2, SKC3, CC1, CC2, and FRK2. All the rest of

the sites fell into the Average Health Category. Some of the sites in the low health category (PH3, SKC3, and CC2) are at the upstream end of the oyster habitat areas which are a factor in their lower scores. Upstream sites were chosen as part of this monitoring program to gage if future restoration activities have any impact on the health of oyster reefs furthest from the bay.

Sarasota County

Location	Live	Dead	Location	Live Observed	Expected	CHI Square X^2	Location	Dead Observed	Expected	CHI Square X^2
PH1	150	119	PH1	150	156.769	0.2922926	PH1	119	99.1538	3.9723101
PH2	97	64	PH2	97	156.769	22.787386	PH2	64	99.1538	12.463388
PH3	7	27	PH3	7	156.769	143.08179	PH3	27	99.1538	52.506057
HUD1	250	69	HUD1	250	156.769	55.444403	HUD1	69	99.1538	9.1701379
HUD2	226	192	HUD2	226	156.769	30.57296	HUD2	192	99.1538	86.939727
SC1	71	53	SC1	71	156.769	46.924775	SC1	53	99.1538	21.483559
SC2	180	128	SC2	180	156.769	3.4424398	SC2	128	99.1538	8.3920153
NC1	370	83	NC1	370	156.769	290.02733	NC1	83	99.1538	2.631736
NC2	0	1	NC2	0	156.769	156.76923	NC2	1	99.1538	97.163931
CAT1	45	14	CAT1	45	156.769	79.686306	CAT1	14	99.1538	73.130572
lyb1	259	71	lyb1	259	156.769	66.665698	lyb1	71	99.1538	7.9940323
db1	117	78	db1	117	156.769	10.088662	db1	78	99.1538	4.5130393
skc1	141	97	skc1	141	156.769	1.5862082	skc1	97	99.1538	0.0467864
skc2	224	316	skc2	224	156.769	28.832037	skc2	316	99.1538	474.2353
skc3	0	144	skc3	0	156.769	156.76923	skc3	144	99.1538	20.283404
rb1	185	126	rb1	185	156.769	5.0837548	rb1	126	99.1538	7.2686638
cc1	91	161	cc1	91	156.769	27.592096	cc1	161	99.1538	38.575879
cc2	19	30	cc2	19	156.769	121.07198	cc2	30	99.1538	48.23065
Ang 1	252	134	Ang 1	252	156.769	57.84872	Ang 1	134	99.1538	12.246166
Ang 2	138	33	Ang 2	138	156.769	2.2471503	Ang 2	33	99.1538	44.136779
Got 1	347	86	Got 1	347	156.769	230.83449	Got 1	86	99.1538	1.7450021
Got 2	293	140	Got 2	293	156.769	118.38307	Got 2	140	99.1538	16.826461
Got 3	104	70	Got 3	104	156.769	17.762361	Got 3	70	99.1538	8.5719998
Frk 1	130	48	Frk 1	130	156.769	4.5709972	Frk 1	48	99.1538	26.390464
Frk 2	39	141	Frk 2	39	156.769	88.47139	Frk 2	141	99.1538	17.66044
AL1	185	88	AL1	185	156.769	5.0837548	AL1	88	99.1538	1.2546995
AL2	156	65	AL2	156	156.769	0.0037744	AL2	65	99.1538	11.764397
SUM	4076	2578				1771.924				1109.598

CHI square analysis with 4076 live and 2578 dead, and 27 sites; expected live = 156.792 & expected dead = 99.154

For a Significance level of 0.05 with 26 degrees of freedom the Chi Square Value was 38.885

Color Code Indicates that Values fall in to the range of what could be expected for a normal random distribution.

Color Code Indicates that Values are significantly **lower** than what could be expected by chance alone.

Color Code Indicates that Values are significantly **higher** than what could be expected by chance alone.

Table VII-2. Chi Square Analysis Table for Live and Dead Oyster Values.

The fall 2006 County wide oyster sampling was the first for the program. Valuable background data was collected for the County and the scoring system appears to be sound and statistically defendable. Comparison and trends, other than for Dona and Roberts Bay are impossible at this time due to lack of data. However the program should work in the long term as a way to monitor Sarasota County watershed management efforts. Salinity data is pertinent and currently the County has a gap in that data for most creeks. Future reporting activities will attempt to evaluate more salinity data in order to better identify tidal creek salinity regimes.