Lemon Bay

WATERSHED MANAGEMENT PLAN

Sarasota County

Southwest Florida Water Management District

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Chapter 3

Natural Systems

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3.0 NATURAL SYSTEMS

Natural systems are self-sustaining living ecosystems that support an interdependent network of aquatic, wetland-dependent, and upland living resources. The natural conditions of Lemon Bay and its watershed are based on complex interactions and interrelationships among natural processes such as hydrology, nutrient loading, erosion and sedimentation, and vegetation coverage. Functionally intact ecosystems provide many valuable services, including flood control, recreation, water quality improvement, and habitat for plants and animals.

While the Lemon Bay Watershed contains valuable upland and wetland areas, the effects of urbanization have diminished the beneficial functions provided by the watershed's natural systems. Over half of the watershed is comprised of forest, open area, parks, wetlands, and water. Designated natural and conservation areas make up 17% of the watershed (See Chapter 1). The County has identified unprotected lands as priorities for future protection.

This chapter divides natural systems into inland (uplands, streams and creeks, and freshwater wetlands, Section 3.1) and estuarine (Section 3.2) systems and describes the watershed's natural resources. These descriptions are followed by recommended actions to restore, preserve, and improve the natural systems within the watershed. Freshwater flow, integral to the health and function of both freshwater and marine wetlands, is described in Section 3.1.1.

3.1 WATERSHED

A *watershed features* a highly evolved series of processes that convey, store, distribute, and filter water that, in turn, sustain terrestrial and aquatic life (Figure 3-1). A healthy watershed is critical for maintaining healthy ecosystems. The Lemon Bay watershed consists of the bay, a network of surface water drainage systems (stormwater pipes, ditches, streams, and creeks), wetlands, and the surrounding uplands. The condition of the watershed network, uplands, wetlands, and drainage systems ultimately affects the health of the bay.

A watershed is an area of land that water flows across as it moves toward a common body of water, such as a stream, river, lake, or coast.

3.1.1 Critical Natural Resources

The natural resources of land and water are inter-connected. The interactions between uplands, wetlands, streams and creeks, and the bay are critical to the health of the watershed. Upland and wetland areas control the quality as well as the timing and volume of freshwater flows to surface water drainage systems and the estuary. Although these flows provide the bay with essential freshwater, they also contain sediment, nutrients, and other pollutants that can be damaging to the bay.

Figure 3-1 Typical Florida Coastal Watershed

3.1.1.1 Uplands

Uplands are the elevated areas of land within the watershed. Uplands include all areas that are not wetlands. Rain runs from this higher land into surface water drainage systems. The type and condition of uplands influence the amount and the quality of water reaching lakes, streams, wetlands, and estuaries. Vegetated uplands provide natural habitat to many species, slow runoff, prevent soil from eroding, and allow infiltration. When uplands are developed, rainfall runs quickly over paved or impervious surfaces and is unable to infiltrate. This decreases recharge, increases freshwater flow and volume, and decreases water quality. With this increased volume and flow comes increased erosion, and more sediment, nutrients, and other pollutants are carried downstream. Lower than natural salinities also result from increased freshwater volume reaching the bay. The condition of the uplands is the driving force behind the health of everything downstream.

3.1.1.2 Wetlands

Wetlands serve a variety of purposes including attenuating flood flows, maintaining water quality, and providing wildlife habitat. Wetlands develop naturally in response to morphological and hydrological features of the landscape. They occur where surface water collects and/or groundwater interacts with land, inundating the area for extended periods. Wetlands are a significant factor in the health and existence of other natural resources of the watershed, such as rivers and streams, inland lakes, groundwater, wildlife, and estuaries. Wetlands exhibit a richer diversity of plants and animals and greater biological productivity than non-wetland areas around them. Wetlands provide many benefits including flood control by storing runoff; wildlife habitat by providing breeding, nesting, and feeding grounds and cover for many forms of wildlife and waterfowl; subsurface water resources protection and recharging groundwater supplies; pollution treatment; and erosion control by serving as sedimentation areas and filtering basins.

Before the surge of development in the Lemon Bay watershed that began in the 1950s, wetlands were extensive, covering about a quarter of the watershed (Section 1.3.8). The prevalence of wetlands was a result of abundant rainfall and a low, flat terrain. Rainfall ponded in wetlands, where it evapotranspired, infiltrated, or moved slowly by sheet flow toward tidal waters. Historically, much of the land surface in the watershed was likely inundated during the wet season and for several weeks afterwards. With urbanization, though, came the loss of valuable wetlands. Many of the wetlands were drained when the Lemon Bay watershed was ditched for mosquito control and agriculture. Wetland coverage in the watershed declined from an estimated 7,423 acres in 1950 to just 3,833 acres in 2007 (Section 1.3.8). Although the overall area of wetlands in the Lemon Bay watershed has significantly decreased, a variety of wetlands still flourish. Through programs such as the Environmentally Sensitive Lands Protection Program (ESLPP), Sarasota County is working toward saving these important natural resources.

3.1.1.3 Streams and Creeks

In an undisturbed watershed, the groundwater level and stream flow, while fluctuating according to the season and amount of rainfall, is maintained within a normal range. Because the stream bank and channel change over time, streams end up following the familiar meandering pattern that flowing water establishes. The floodplain and wetlands along the stream corridor absorb the occasional high waters and support a variety of wildlife unique to such an area. Wetlands, habitats, and riparian life associated with a stream are adapted to this natural flow regime.

Five major creeks (Alligator Creek, Woodmere Creek, Forked Creek, Gottfried Creek, and Ainger Creek) traverse the low flat landscape of the Sarasota County portion of the Lemon Bay watershed. Historical maps and surveys suggest that these five tributaries to Lemon Bay were tidal creeks that did not extend significantly inland into the watershed; however, these naturally occurring tidal creeks were significantly altered by ditching for mosquito control and development. Channelization of naturally meandering creeks results in increased stream velocities and increased bank erosion. Thus channelization can produce large pulses of freshwater, causing a decrease in bay salinity.

3.1.2 Freshwater Inflow

One of the main functions of the Lemon Bay watershed is to temporarily store and transport water from the land surface to Lemon Bay. In addition to transporting water, sediment, and other materials, pollutants and many types of organisms are also conveyed to the bay (Figure 3-2). Temporary retention or storage at different locations in the watershed is important to maintain an appropriate water budget for a healthy and productive system. Estuary ecosystem health and diversity vary dramatically as a function of their water balance.

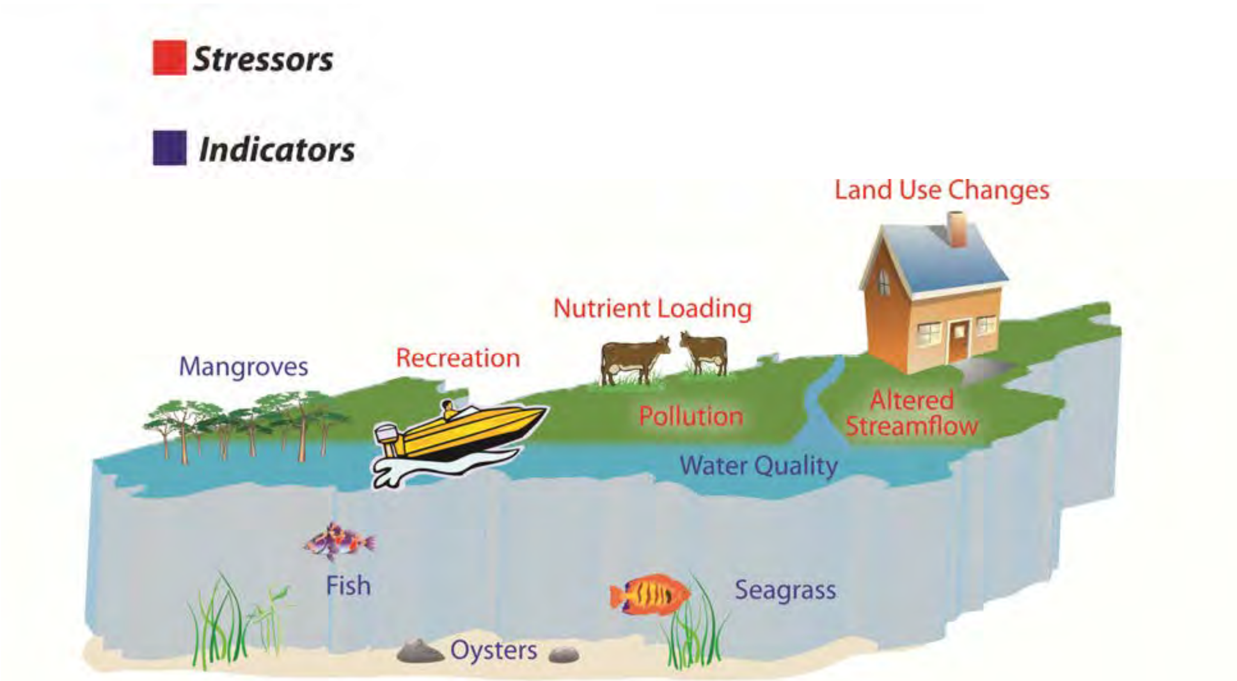


Figure 3-2 Lemon Bay Watershed Stressors and Water Quality Indicators

Activities such as filling and building on floodplains and wetlands and creating ditches and other stormwater conveyances have changed the natural hydrology within the Lemon Bay watershed. This change in hydrology causes stormwater to reach streams, wetlands, and the estuary more quickly and in greater quantity. Higher storm flows can have many effects, such as increased erosion of stream banks, which can disturb riparian vegetation and increase the amount of sediment in the stream. The increased volume also carries with it increased pollutant and nutrient loads. The overall health and productivity of the watershed and its estuary are affected by both the water quantity and quality.

The goals of the Lemon Bay Watershed Management Plan (WMP) are to:

- ❖ Protect, maintain, and improve water quality conditions in estuarine and freshwater environments.
- ❖ Minimize flood risk to human safety and property and protect natural and beneficial functions of the floodplain.
- ❖ Provide adequate and safe water supply to meet existing and future demands.
- ❖ Protect, enhance, and restore natural communities and habitats.

These goals are described in detail in Chapter 2 and are summarized above to emphasize the importance of freshwater flow to the overall management plan for Lemon Bay. To achieve each of these four goals, appropriate water budgets for Lemon Bay and its watershed must be established. The water budgets will make it possible to identify water that may be available for other beneficial uses. Estimating the historical, existing, and future water budgets is the first step toward developing appropriate target water budgets.

This chapter details the historical, current, and future water budgets and identifies increases in surface water volume. A detailed description of hydrologic alterations and recommendations for the target future water budget for Lemon Bay and its basins is also included.

Water resources are increasingly stressed throughout the watershed by urbanization. Urban growth produces an increase in impervious surfaces, greater water withdrawals, and movement of water and wastewater farther away from their sources of origin. Freshwater flow patterns drive physical, chemical, and biological conditions in the estuary. The condition of the freshwater and estuarine ecosystems in the watershed is directly linked to the natural variability in these freshwater flows and volumes that comprise the Lemon Bay watershed water budget. The water budget is the sum of the sources (additions) of freshwater to Lemon Bay minus the sum of the freshwater sinks (losses). There are many sources of freshwater inflows to Lemon Bay, including direct runoff, groundwater discharge, and direct precipitation on the estuary. The primary natural loss of water from the watershed is evapotranspiration (Figure 3-3).

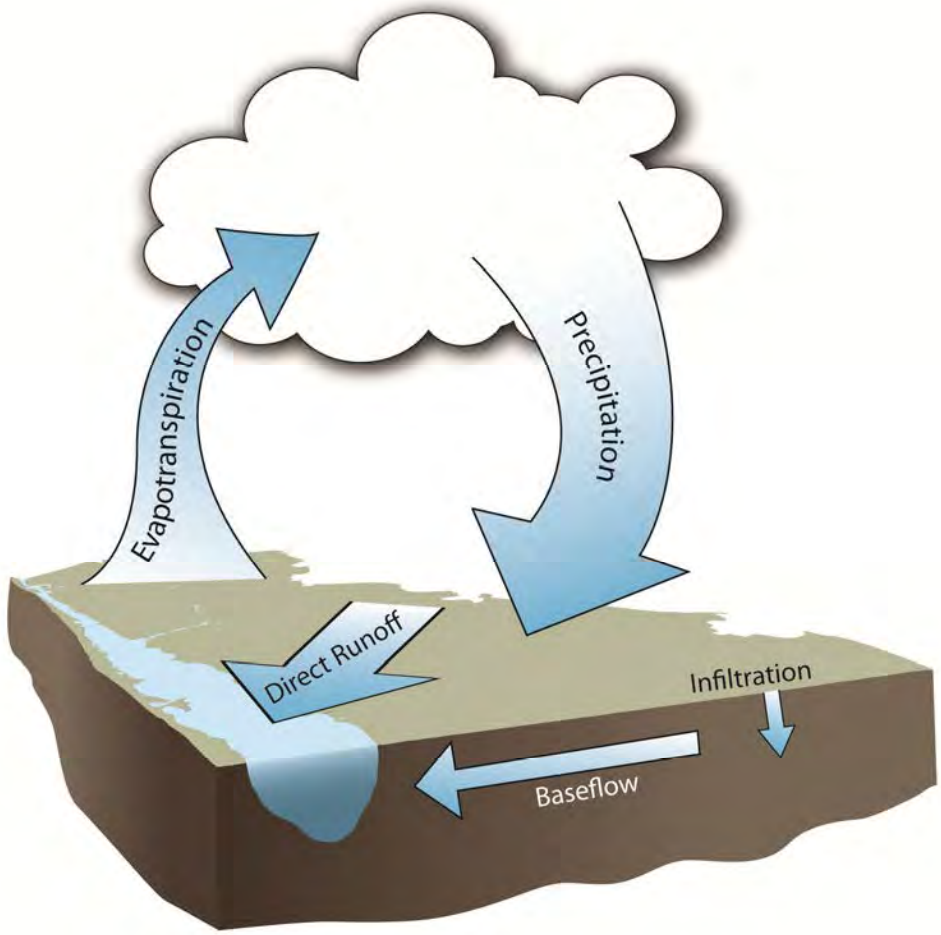


Figure 3-3 Lemon Bay Water Budget Schematic

This Section evaluates the Sarasota County portion of the Lemon Bay watershed to provide a better understanding of watershed hydrology and impacts of land development on the bay. Jones Edmunds developed water budgets for the historical (1948 baseline), current (developed), and future (built-out) conditions of Lemon Bay. A similar analysis of each of the Lemon Bay basins is provided in Appendix E. The water budgets are used to characterize the natural variability in the quantity and timing of freshwater inflows to the bay and to assess how much hydrologic change has occurred or is likely to take place in the future. In conjunction with an investigation of the behavior of ecological indicators, this analysis provides information for a recommended target water budget for Lemon Bay.

3.1.2.1 Water Budget Methodology

Freshwater loads to Lemon Bay were calculated using the *Sarasota County County-Wide Non-Point Source Pollutant Loading Model* (SIMPLE) developed by Jones Edmunds for Sarasota County. SIMPLE is a pollutant-loading model working within a geographic information system

(GIS) framework and capable of simulating runoff, base flow, wet and dry deposition, irrigation, point source, and septic loads. The hydrologic model component is a continuous simulation spreadsheet model designed to feed SIMPLE calculated runoff, calculated base flow, and rainfall volumes using NEXRAD-derived rainfall for the period of interest. The result of the hydrologic engine simulation is a hydrologic lookup table containing monthly rainfall, base flow, and runoff values for all unique combinations of NEXRAD pixel (2-kilometer grid cell), event mean concentration (EMC) land use, and hydrologic soil group (HSG). Complete model development is documented in *Sarasota County County-Wide Non-Point Source Pollutant Loading Model* (Jones Edmunds, August 2005).

The SIMPLE model was used to characterize the hydrological processes throughout the Lemon Bay watershed to provide the watershed's water volume budget on a monthly time-step, summarized as a total volume discharge. Spatial input includes basins, land use, soils, NEXRAD pixels, best management practices (BMPs), irrigation, point sources, non-compliant point sources, and septic input data sets referred to as coverages. Monthly volumes were estimated through three 12-year simulations to address the effect of land-use change for the Lemon Bay basins and watershed. The input coverages were modified to reflect the time series being simulated. The basins coverage and rainfall data for current conditions were used for all three simulations; thus, rainfall was held constant to provide for meaningful comparisons between development conditions, historical, current, and future. In other words, these findings combined with estuarine data were used to recommend a target water budget for the Lemon Bay watershed.

- Historical Conditions simulation
  - For the Simulation Period, 1948 through 1960 was selected to represent historical conditions. This period preceded the development boom, and aerial photographs needed to develop input parameters are available for this time period. Rainfall from 1995 through 2007 (Current Conditions) was used since rainfall was not an independent variable in the water budget analysis; thus, the historical conditions simulation does not seek to hindcast actual freshwater inflows but rather simulate inflows that would have occurred under identical hydrologic conditions as the Current Conditions simulation. The results provide data suitable for a valid comparison.
  - Land-use coverage was developed from 1948 aerials and SCS Soil Survey.
  - BMP, septic, and irrigation coverages were adjusted to reflect the time series:
    - BMPs, septics, and irrigation structures built after 1960 were deleted.

- ❖ Current Conditions simulation
  - For the Simulation Period, 1995 through 2007 was selected to represent current conditions because spatially distributed rainfall data required for the model are available for this entire period.
  - Basins, land use, soils, NEXRAD pixels, BMPs, irrigation, point sources, non-compliant point sources, and septic input data sets generated for the SIMPLE model were used.
- ❖ Future Conditions simulation
  - For the Simulation Period, arbitrary years (2015 through 2027) were selected to represent future conditions. As with historical conditions, the Future Conditions simulation is not a forecast of actual flows. Rainfall from 1995 to 2007 (Current Conditions) was used to provide a valid comparison.
  - For land-use coverage as build-out conditions, all "developable" polygons in the 2006 land-use coverage (SWFWMD) not classified as environmentally sensitive land were considered medium-density residential.
  - BMP, septic, and irrigation coverages were adjusted to reflect the time series:
    - ➢ Septics that went offline as of 2008 were deleted.
    - ➢ BMPs and irrigation in place as of 2008 were incorporated to all future years.

The Automated Rainfall Management System (ARMS) data were not used in the water budget analysis because many of the ARMS gauges are in tidally influenced locations. The volume of freshwater passing the gauges in comparison to tidal water is below the margin of error at the gauges for most cases (e.g., base flow volumes would be well below the noise level of measured flows), making that information not as reliable as needed for a water budget analysis. ARMS gauges not in tidally influenced locations typically only measure a very small portion of the area that contributes to the bay system. Extrapolating these gauges over much larger areas introduces an unknown magnitude of error. In addition, the ARMS gauges have only been collecting data for a relatively short period. Ideally, a water budget analysis will have many years of data on which to base statistics so that a wide range of representative conditions are reflected in the analysis. The hydrologic model was calibrated to eight ARMS gauges using a 3-year period of record that contained wet, dry, and average rainfall years. The results of the calibration for both base flow and storm event conditions were such that we had reasonable confidence in using the model results. Using the model allowed us to examine a much longer time series for the water budget, which is advantageous for that type of analysis.

3.1.2.2 Lemon Bay Watershed Current Water Budget

The current water budget for the Sarasota County portion of the Lemon Bay watershed includes all of the freshwater inputs minus the outputs for the entire watershed and bay area based on current conditions. The primary sources of freshwater inflows to Lemon Bay, based on annual average inflows, are direct runoff and baseflow (Figure 3-4). Direct runoff enters the Sarasota County portion of the bay from the surrounding land or via its tributaries, Alligator Creek, Woodmere Creek, Forked Creek, Gottfried Creek, and Ainger Creek.

Next in order of magnitude, direct rainfall onto the bay contributes a substantial annual flow volume to the overall water budget. Point sources, irrigation, and septic tanks contribute to the hydrologic input to a much lesser extent. The Alligator Creek basin currently contributes over a quarter of the direct runoff, 30 % of the baseflow, almost half of the irrigation, and over 40 % of the septic volume (Figure 3-5 and Table 3-1).

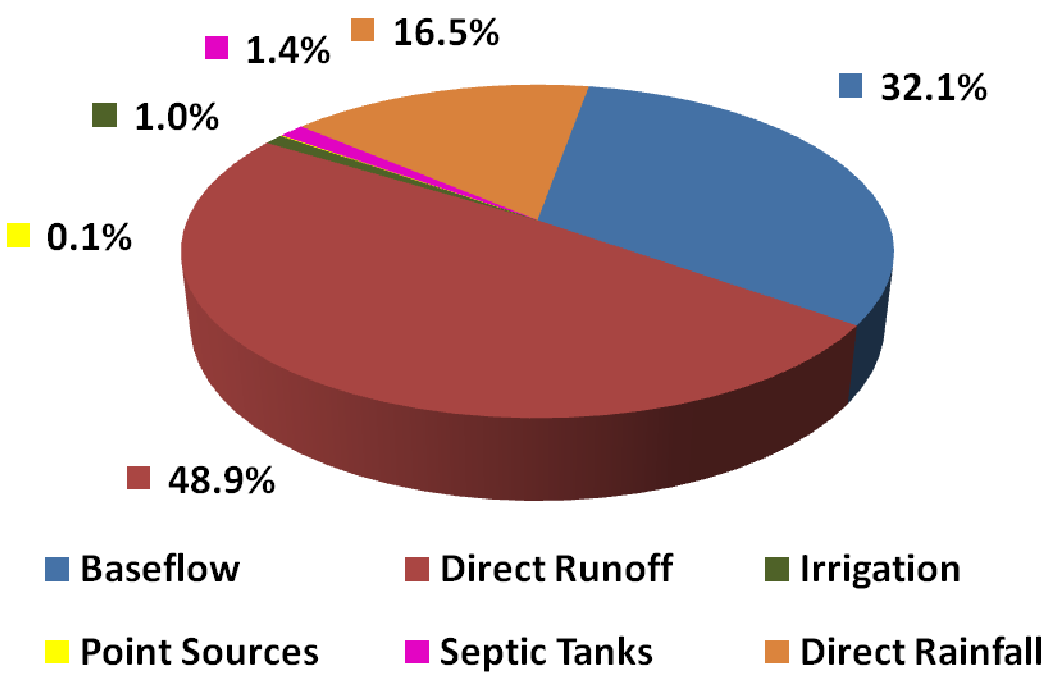


Figure 3-4 Water Budget Components in the Lemon Bay Watershed

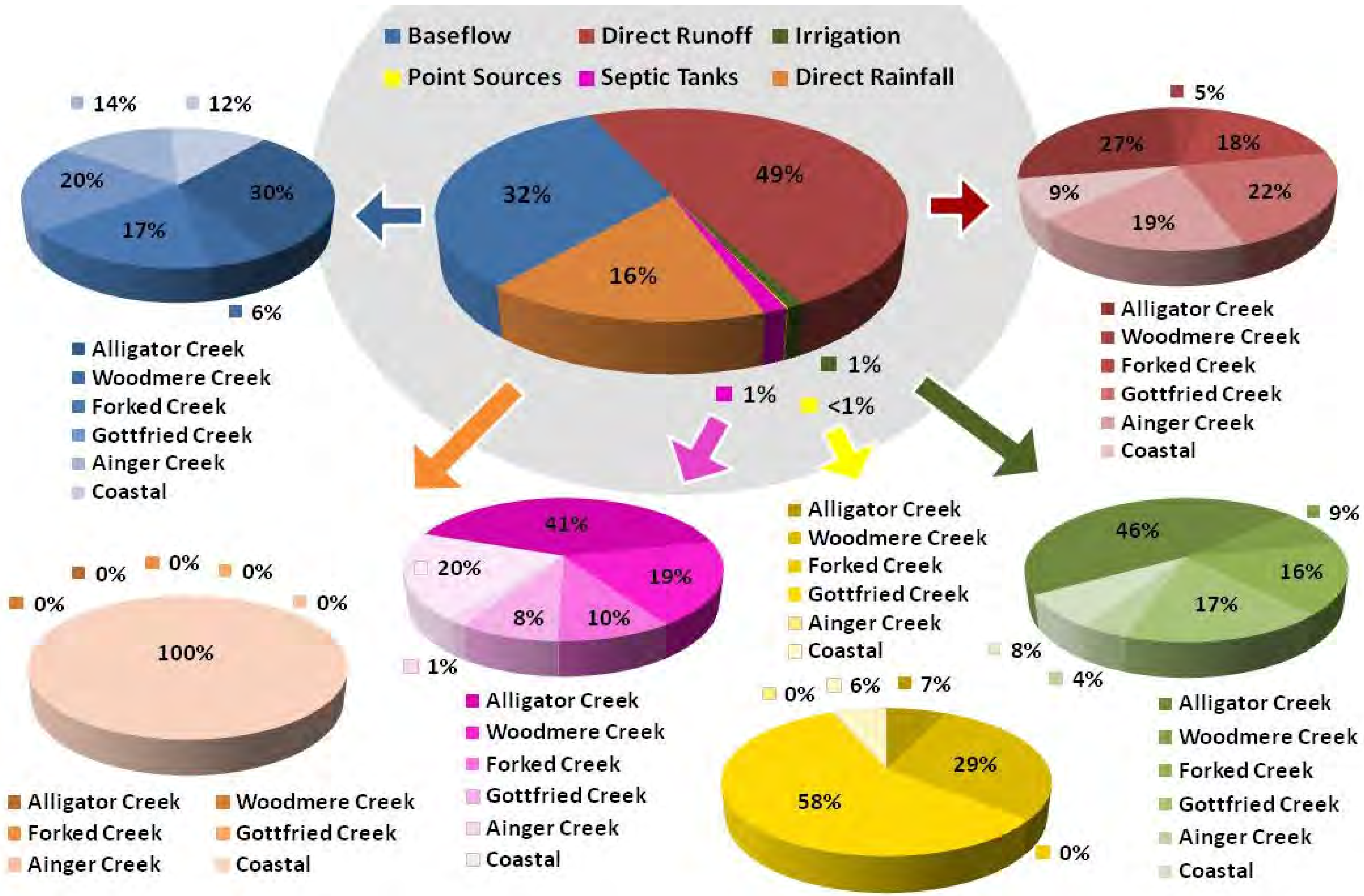


Figure 3-5 Lemon Bay Watershed Water Budget Components by Basin

Table 3-1 Source of Current Total Volume to Lemon Bay

Basin	Source of Volume						
	Direct Runoff	Baseflow	Direct Rainfall	Point Sources	Irrigation	Septic Tanks	Total Volume
Alligator Creek	27%	30%	0%	7%	46%	41%	24%
Woodmere Creek	5%	6%	0%	29%	9%	19%	5%
Forked Creek	18%	17%	0%	0%	16%	10%	15%
Gottfried Creek	22%	20%	0%	58%	17%	8%	18%
Ainger Creek	19%	14%	0%	0%	4%	1%	14%
Coastal	9%	12%	100%	6%	8%	20%	24%

The Coastal and Alligator Creek basins are the primary contributor of freshwater to Lemon Bay. Overall, the Coastal and Alligator Creek basins each contribute 24% of the total volume (Figure 3-6). This large contribution is because the Alligator Creek basin and the Coastal basin are the largest two basins. Further, the Alligator Creek Basin became highly urbanized before many of the existing stormwater regulations were implemented.

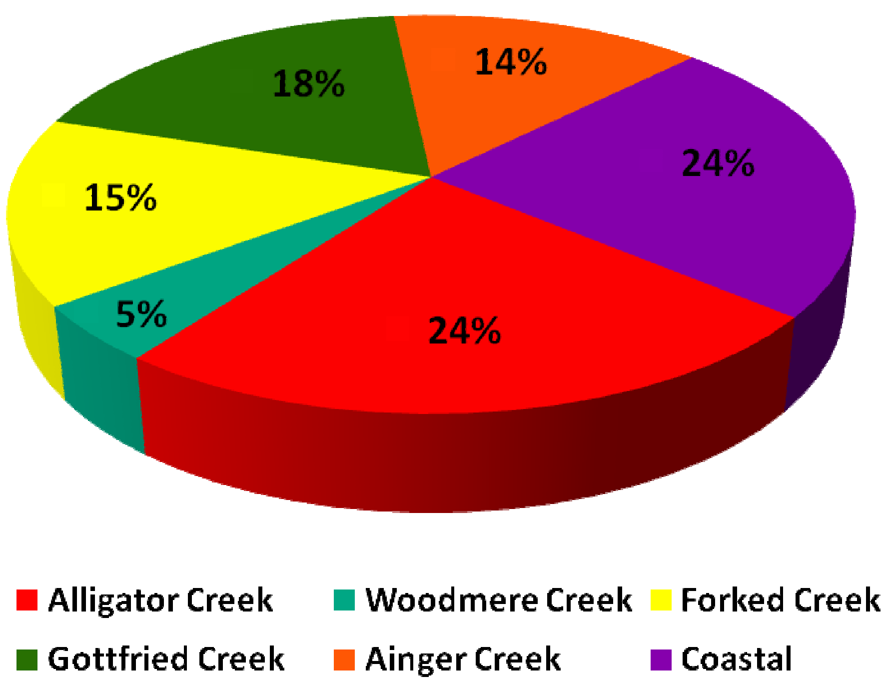


Figure 3-6 Average Annual Current Total Volume Input by Basin

To provide a basin-to-basin comparison of hydrologic loading rate, the average annual volumes were normalized to the basin and subbasin areas. The average normalized total volumes for each basin are shown in Figure 3-7. The Coastal basin has the highest volume per unit area due to the direct rainfall over the bay (100% runoff). The Alligator and Woodmere Creek basins have higher total volumes per area than the Forked, Gottfried, and Ainger Creek basins, likely due the high level of urbanization in these basins. Figure 3-8 shows the average normalized total volumes by subbasin across the watershed. The more developed areas in the north and along US 41 and SR-776 tend to have higher total volumes per acre.

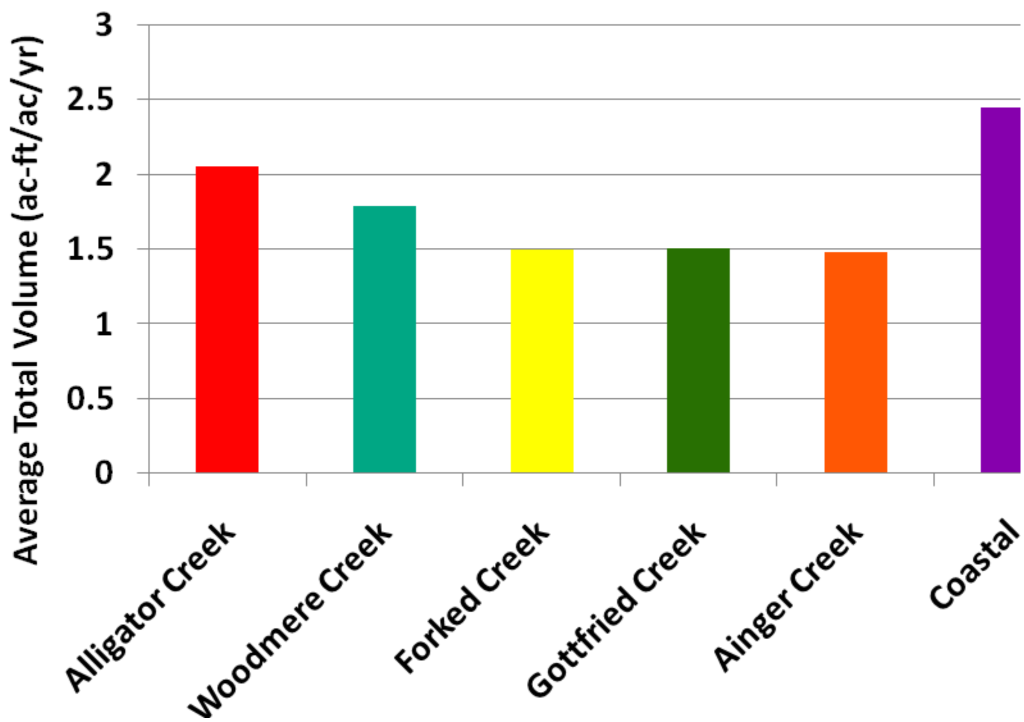


Figure 3-7 Normalized Current Average Annual Volume by Basin

Although it is important to know the sources of flow volume, the total volume and timing of inflows to the bay are important to salinity, sediment, and nutrient loadings in the bay. There is natural variability in the quantity and timing of freshwater inflows to Lemon Bay. Lemon Bay ecosystems have adapted to tolerate a range of conditions; however, water uses and management practices can alter the volume and timing of inflows, causing them to fall outside of this natural range.

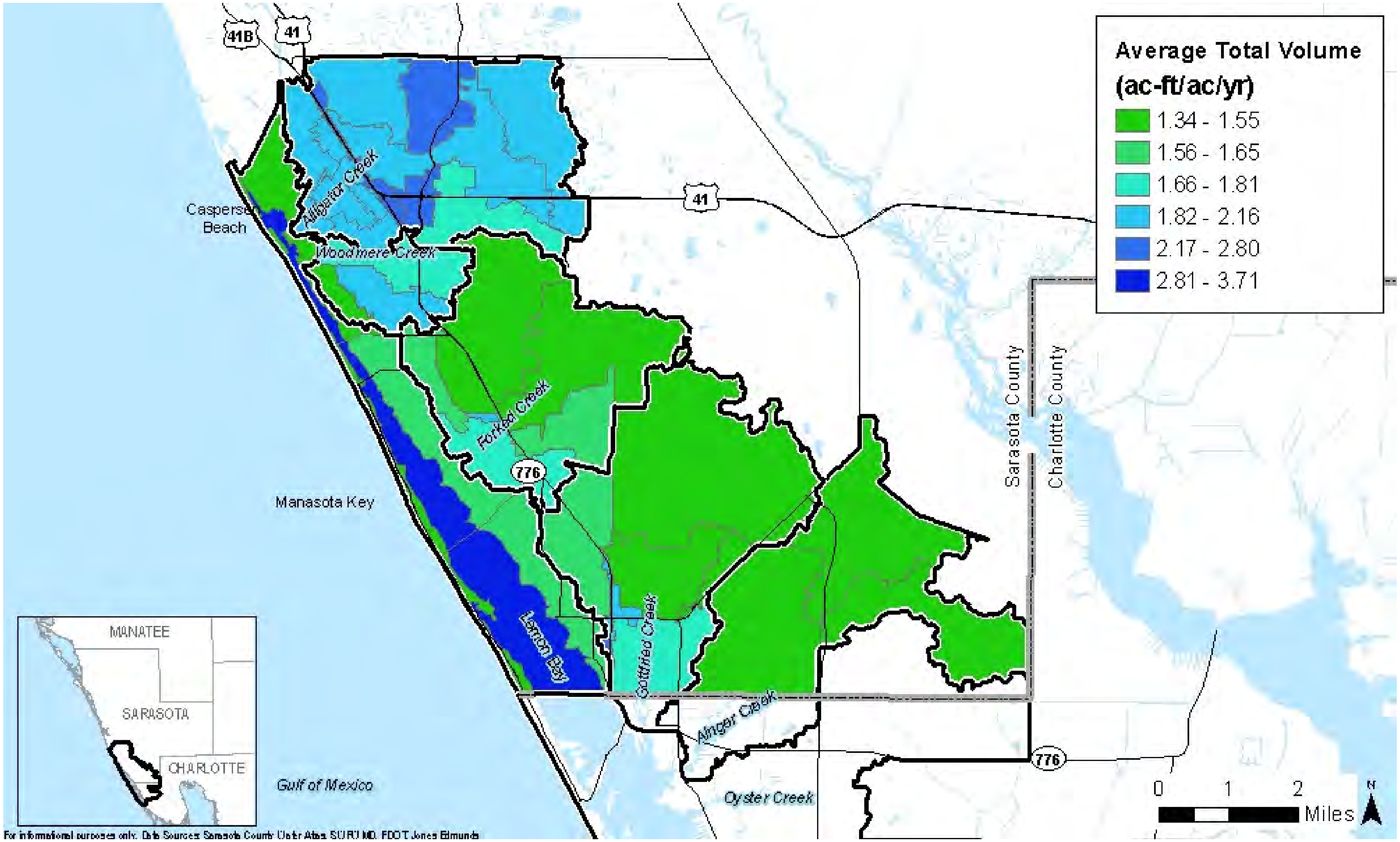


Figure 3-8 Normalized Average Annual Total Volume by Subbasin

The total volume and the overall range of volume fluctuations to Lemon Bay vary substantially from year to year, following the rainfall pattern over the watershed (Figure 3-9). The annual rainfall and freshwater volume totals for the period of record were plotted to more closely examine the inter-annual variations and to determine if a reliable relationship existed between annual rainfall and total volume. The R^2 value in the rainfall to volume plot shows that 96% of the total variation in the current total annual volume is explained by the rainfall (Figure 3-10). The average annual rainfall to total volume conversion factor (for the current simulation period) for the Sarasota County portion of the Lemon Bay watershed is 0.45 (Appendix E).

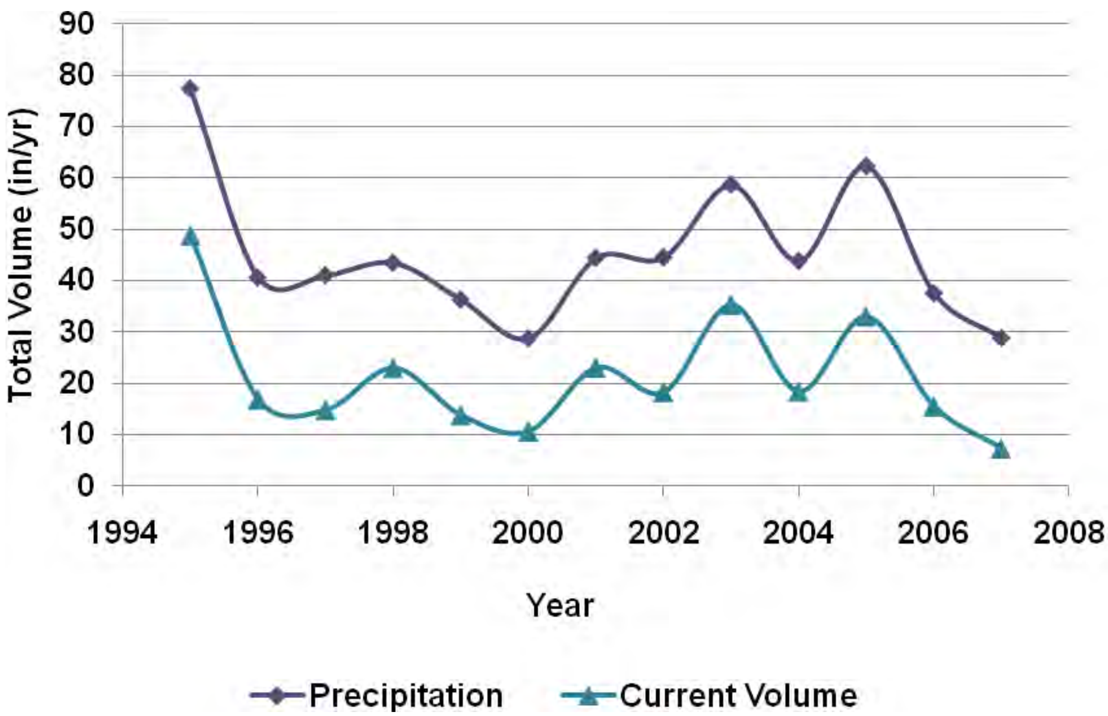


Figure 3-9 Variability of Annual Total Volume and Rainfall in the Lemon Bay Watershed

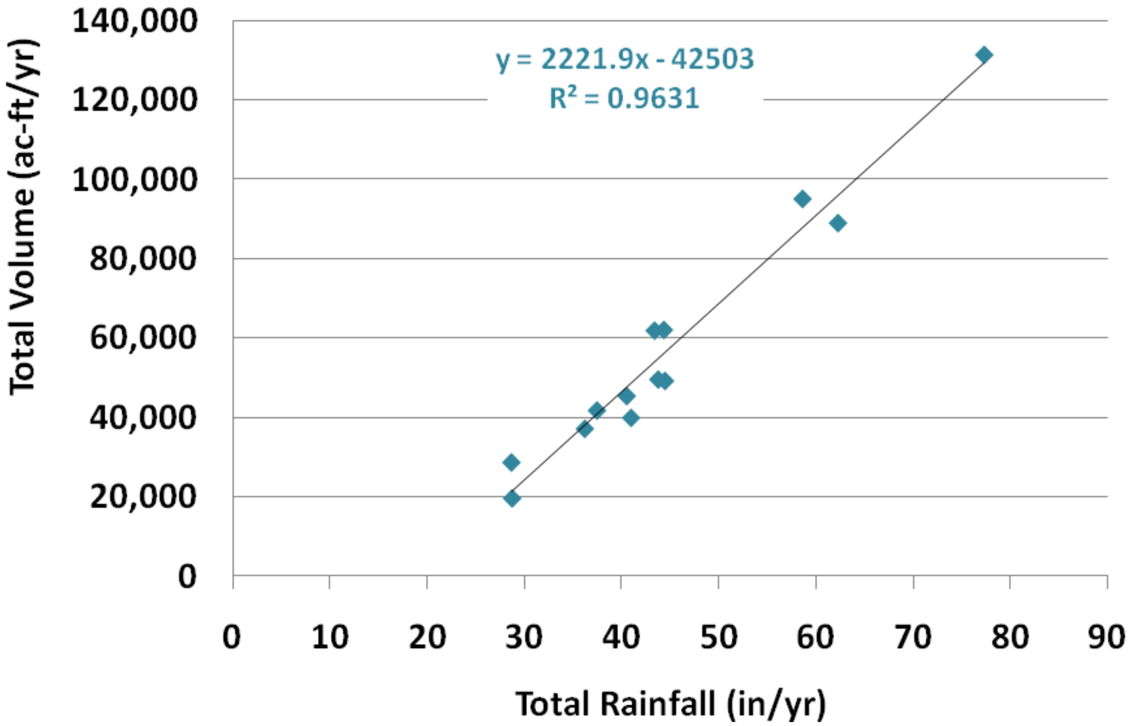


Figure 3-10 Correlation of Annual Total Volume to Rainfall in the Lemon Bay Watershed

The intra-annual timing of the minimum and maximum freshwater volume to the bay demonstrates a distinct seasonal behavior (Figure 3-11). Two distinct inter-annual periods of water-level fluctuation are evident. There is a dry cycle, which generally occurs from November through May, and a wet cycle that takes place from June through October. This is consistent with the seasonal hydrology patterns associated with Sarasota County's subtropical climate. The more dependable relationship between total volume and rainfall occurs during the wet season (Figure 3-12).

Figure 3-11 Variability of Monthly Total Volume in the Lemon Bay Watershed

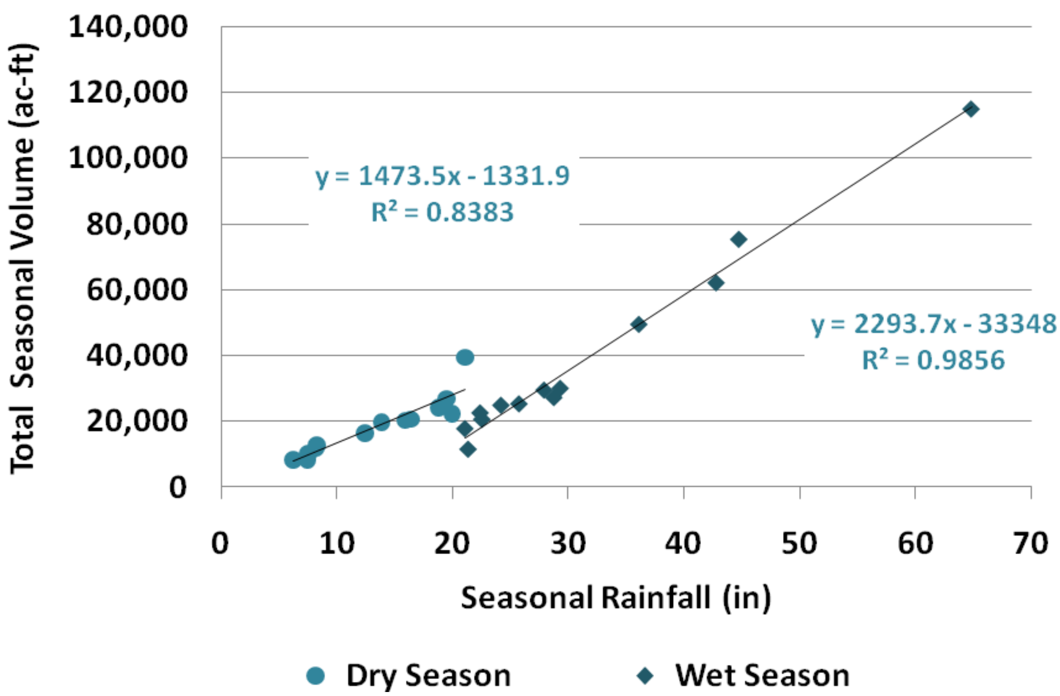


Figure 3-12 Correlation of Seasonal Rainfall to Total Volume in the Lemon Bay Watershed

Using the annual seasonal total volume and rainfall data, the average seasonal total volume to rainfall coefficients were developed for the Sarasota County portion of the Lemon Bay watershed (Table 3-2).

Table 3-2 Seasonal Total Volume Coefficients for the Lemon Bay Watershed

Season	Average Total Volume (in)	Average Rainfall (in)	Average Seasonal Coefficients
Wet	14.58	31.65	0.42
Dry	6.89	13.49	0.51

The relationship between rainfall and total volume at a monthly scale varies. The dependability varies from 0.75 in April up to 0.97 in June (Figures 3-13 through 3-24). The average monthly rainfall to total volume conversion factors for the Sarasota County portion of the Lemon Bay watershed are shown in Table 3-3.

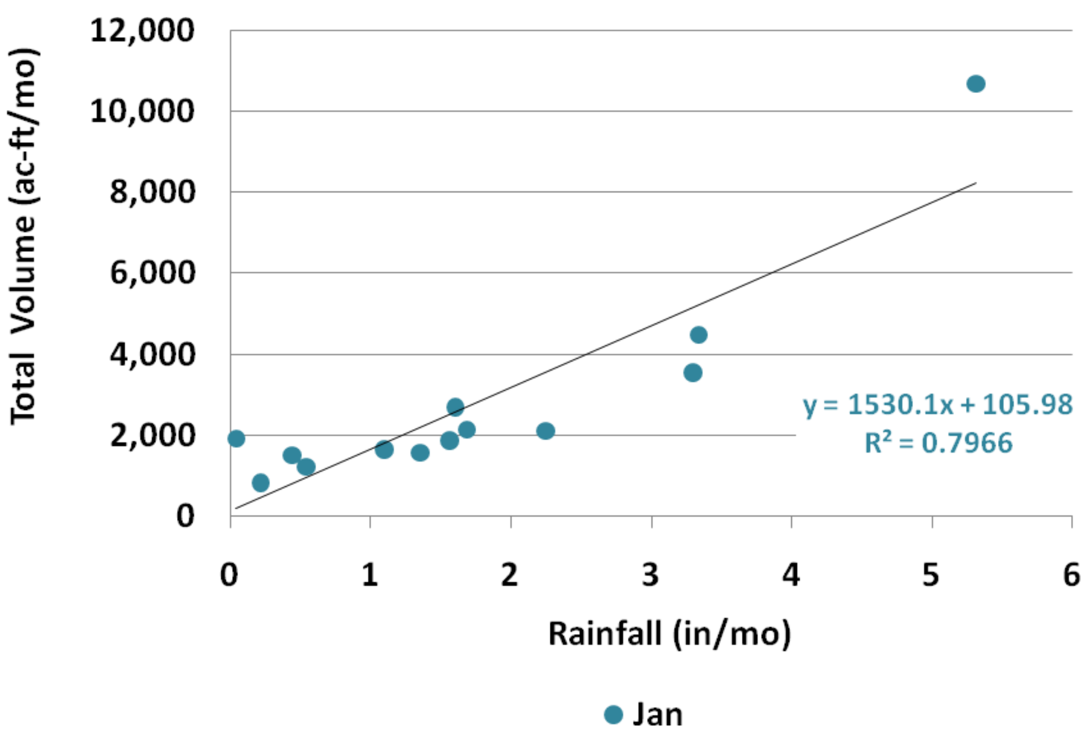


Figure 3-13 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for January

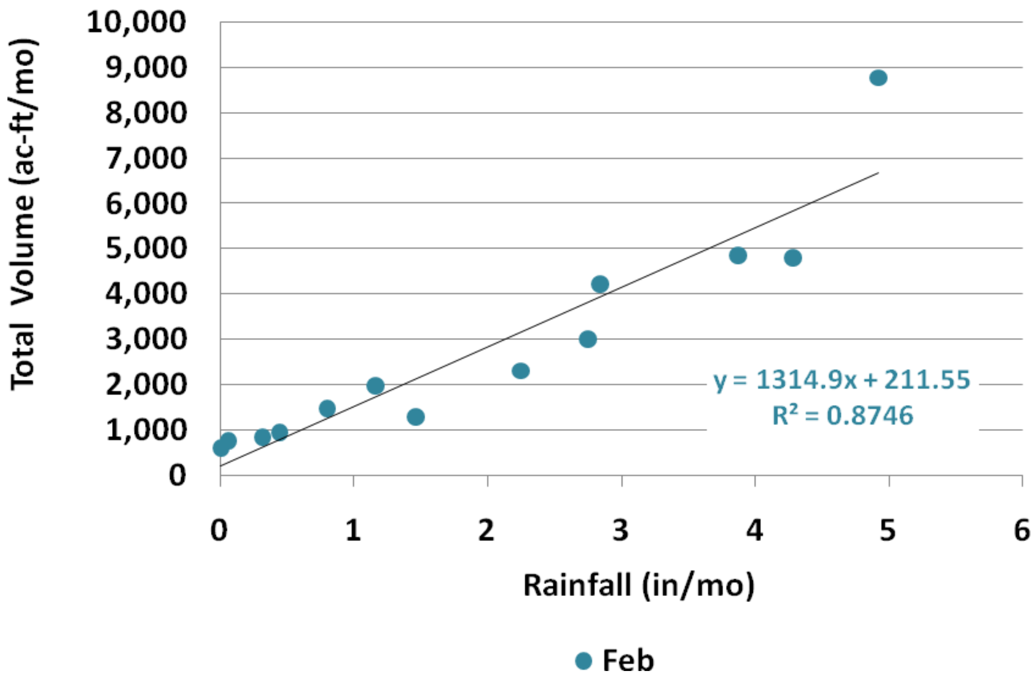


Figure 3-14 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for February

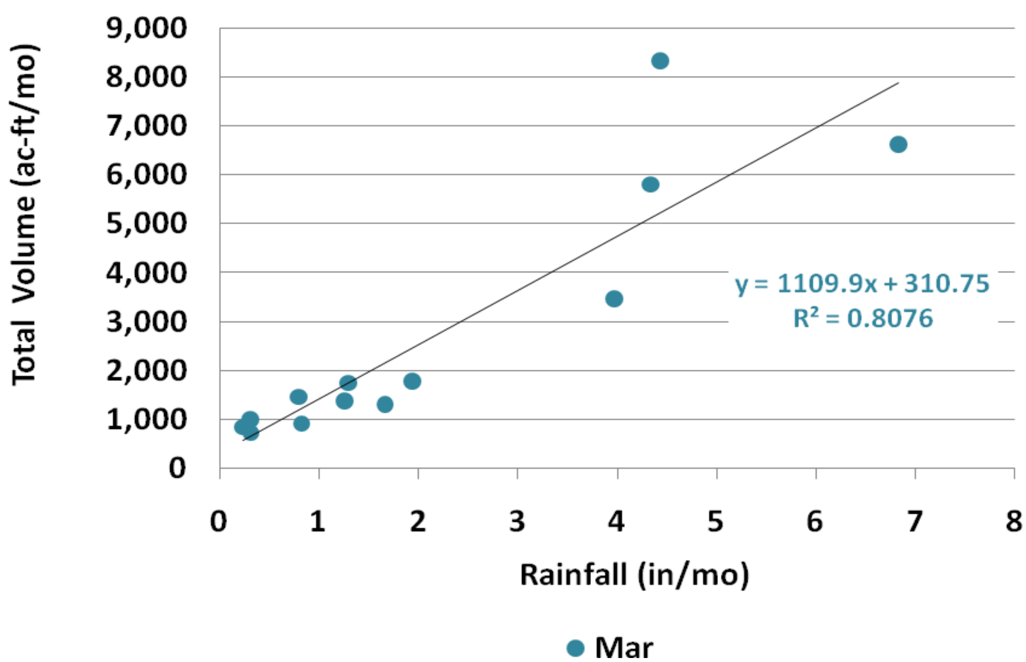


Figure 3-15 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for March

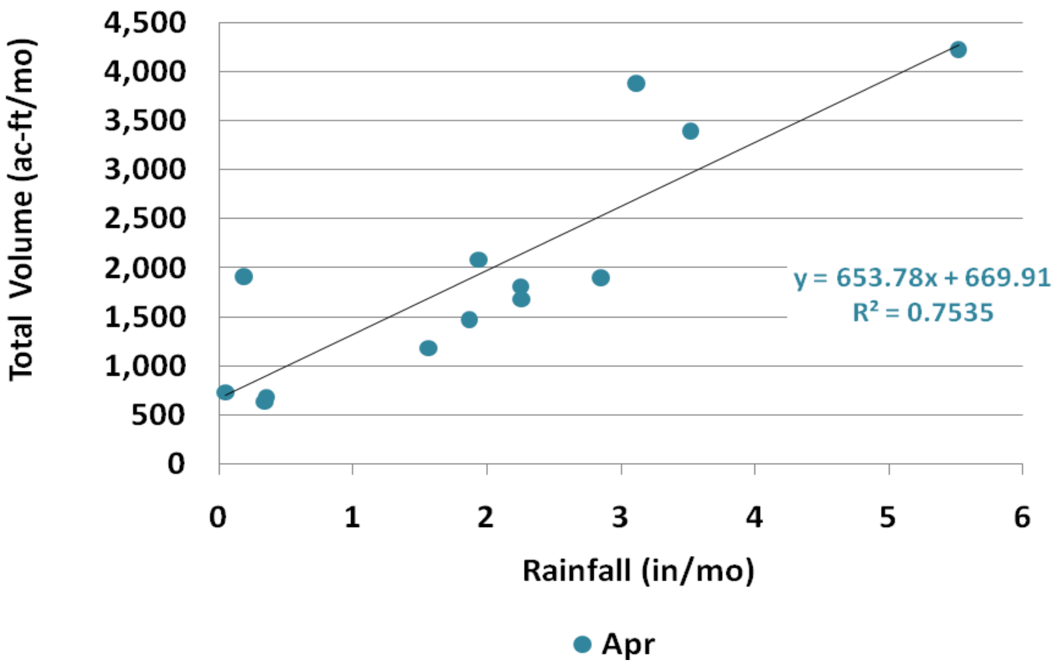


Figure 3-16 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for April

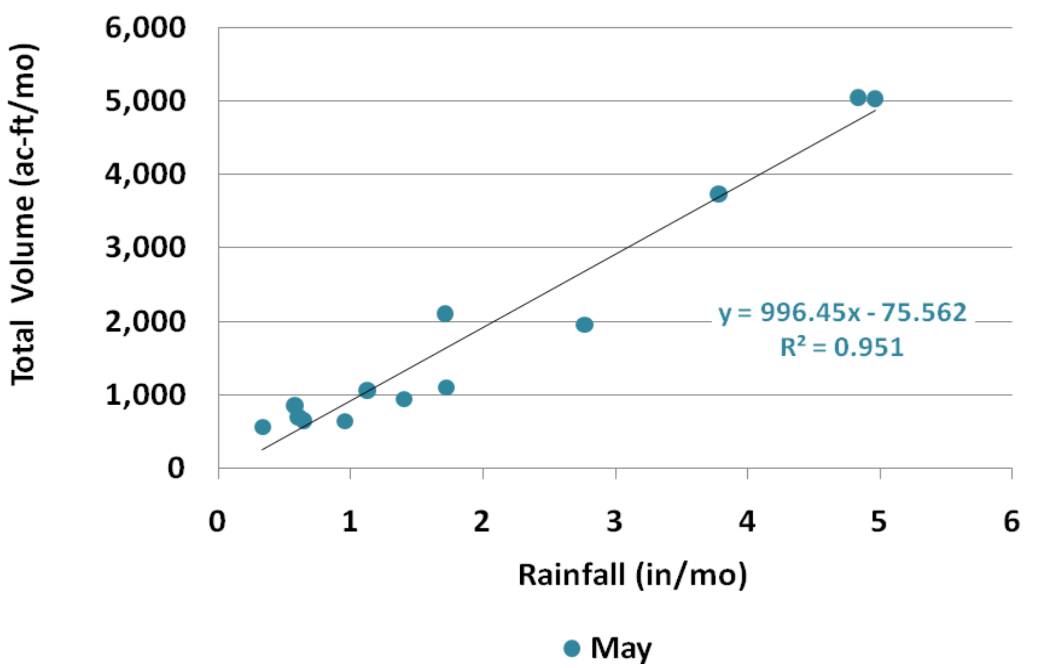


Figure 3-17 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for May

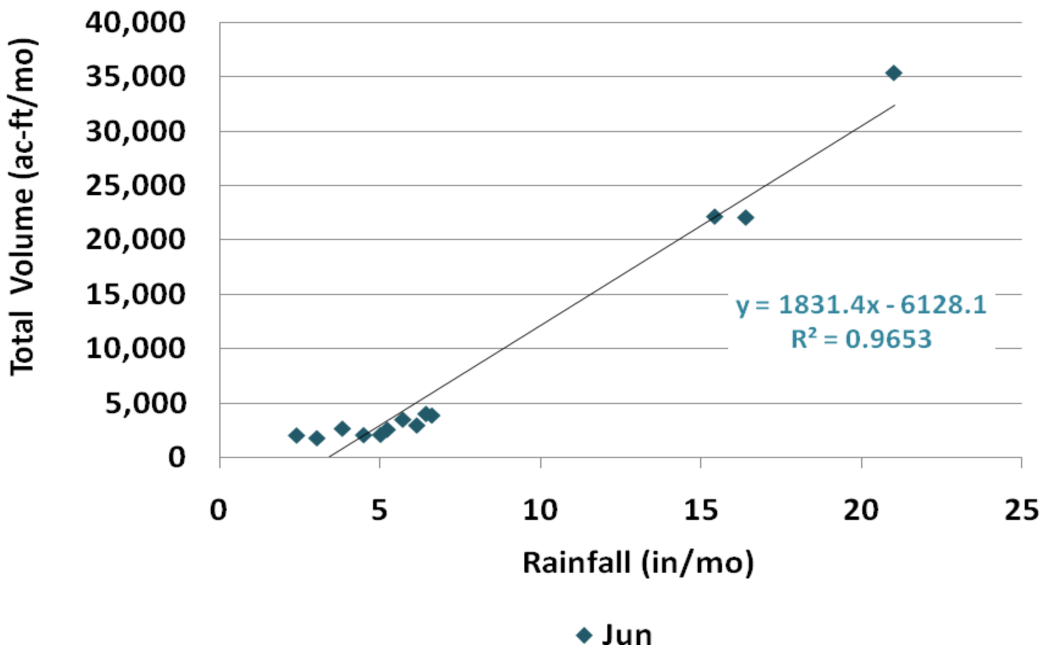


Figure 3-18 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for June

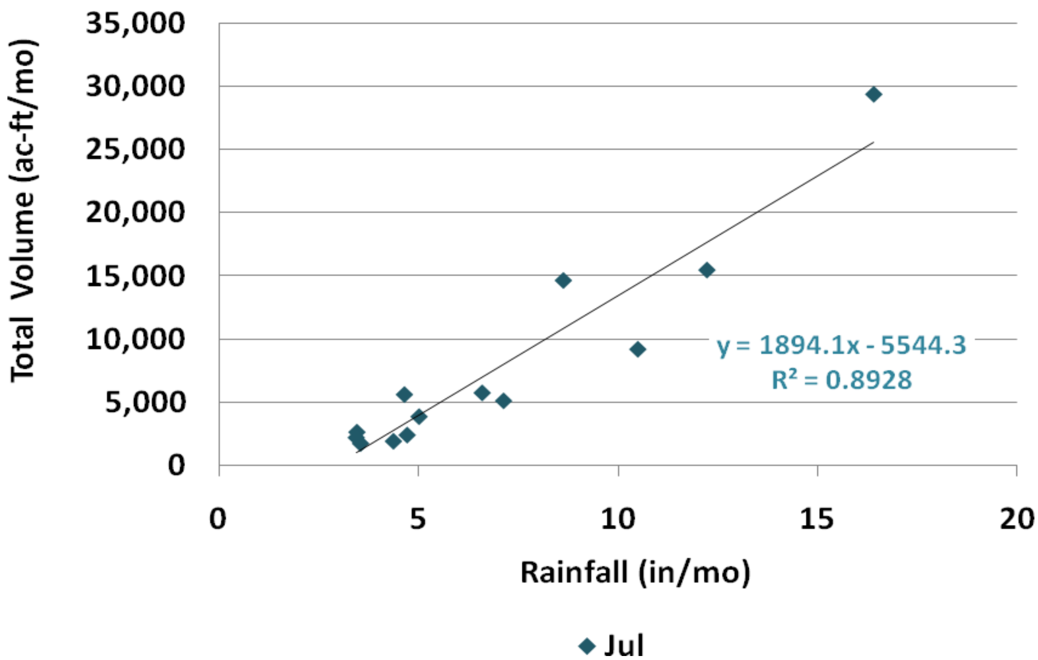


Figure 3-19 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for July

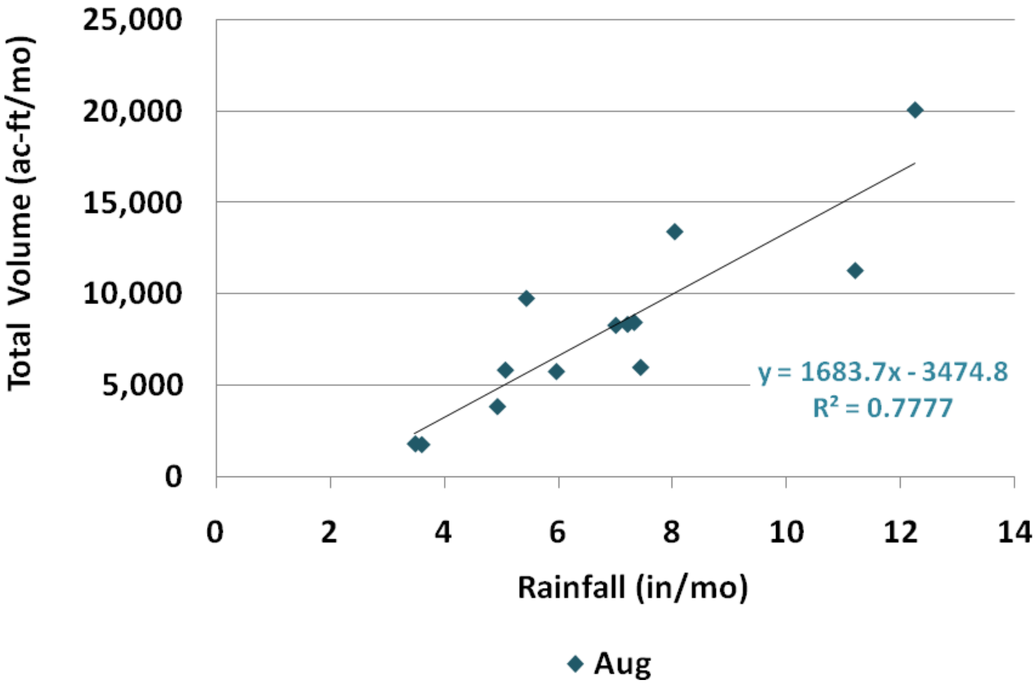


Figure 3-20 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for August

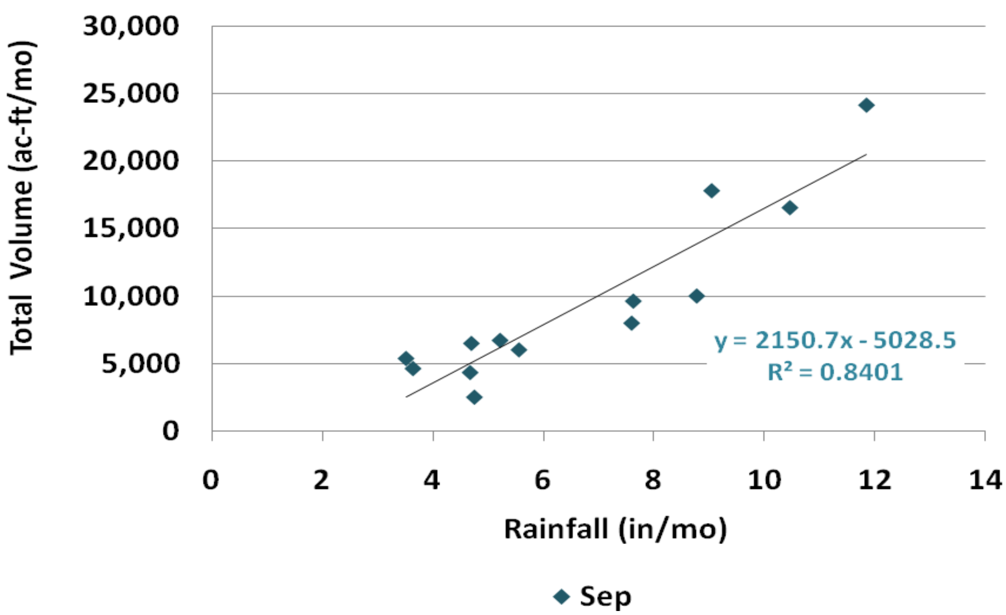


Figure 3-21 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for September

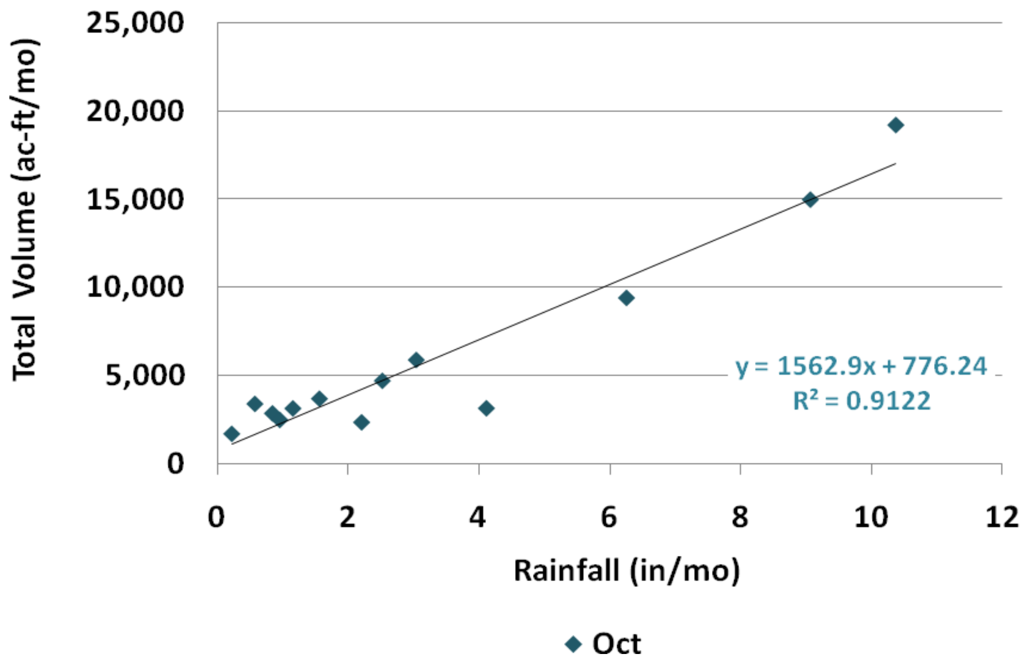


Figure 3-22 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for October

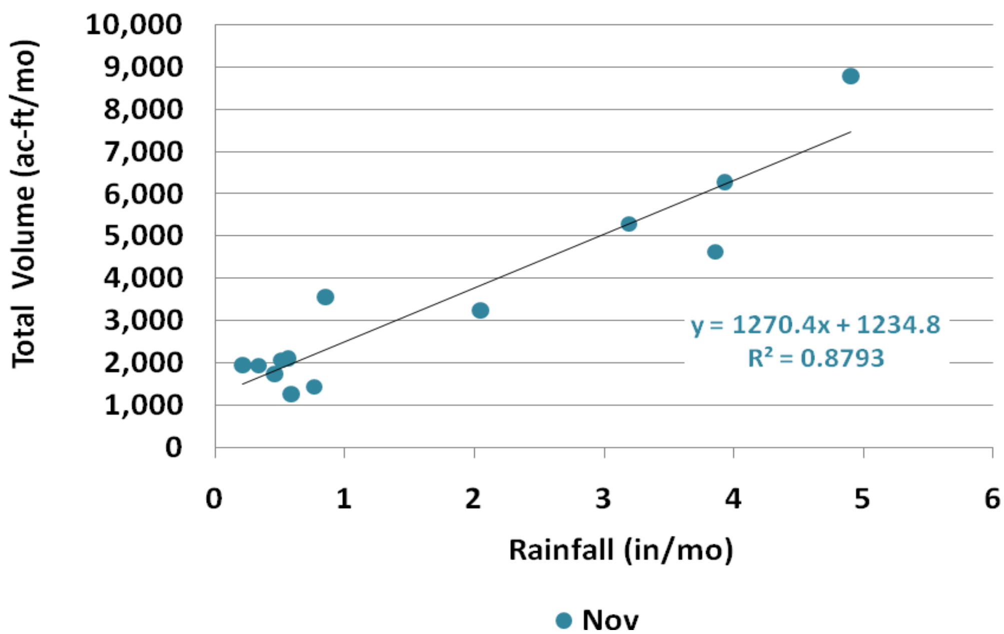


Figure 3-23 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for November

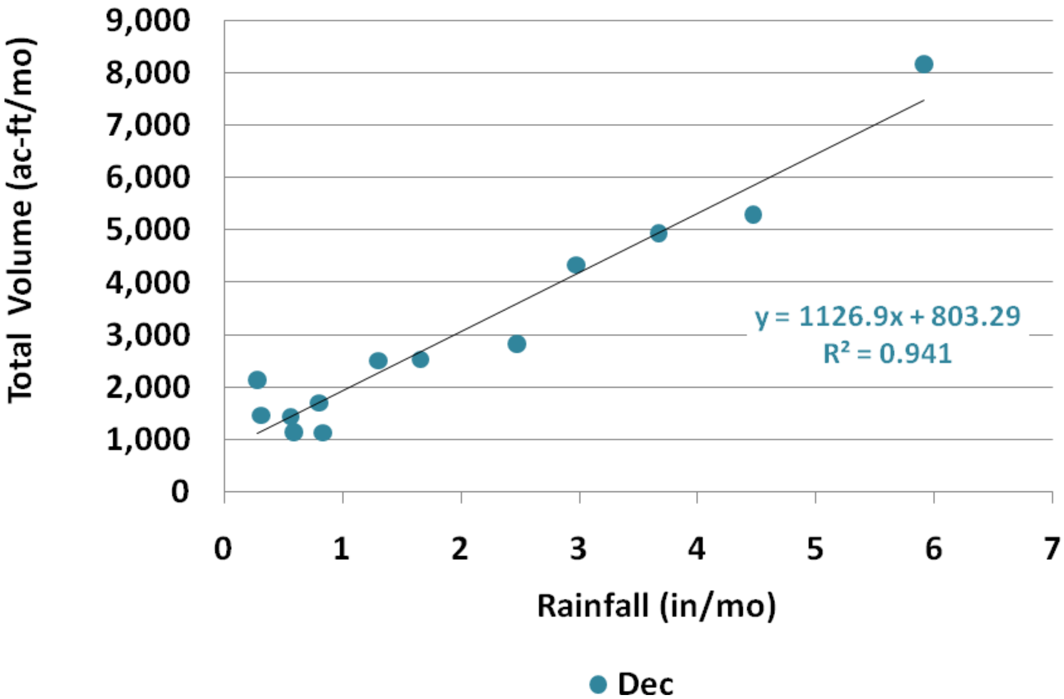


Figure 3-24 Correlation of Rainfall to Total Volume in the Lemon Bay Watershed for December

Table 3-3 Monthly Total Volume Coefficients for the Lemon Bay Watershed			
	Average Total Volume (in)	Average Rainfall (in)	Average Total Volume / Average Rainfall
Jan	1.03	1.75	0.59
Feb	1.02	1.94	0.53
Mar	1.01	2.17	0.47
Apr	0.73	1.98	0.37
May	0.70	1.96	0.36
Jun	3.04	7.82	0.39
Jul	2.85	6.98	0.41
Aug	2.99	6.84	0.44
Sep	3.50	6.72	0.52
Oct	2.20	3.30	0.67
Nov	1.26	1.71	0.74
Dec	1.13	1.99	0.57

The volume and timing of inflows from direct runoff are also very important, as much of the sediment and nutrient loadings flow into the bay in the runoff. As with total volume, the overall direct runoff to Lemon Bay comes primarily from the Alligator Creek basin (Figure 3-25). Unlike the total volume, however, the hydrologic loading rate (normalized volume) of direct runoff is also greatest in the Alligator Creek basin (Figure 3-26). Figure 3-27 illustrates the spatial distribution of the normalized annual average direct runoff across the subbasins.

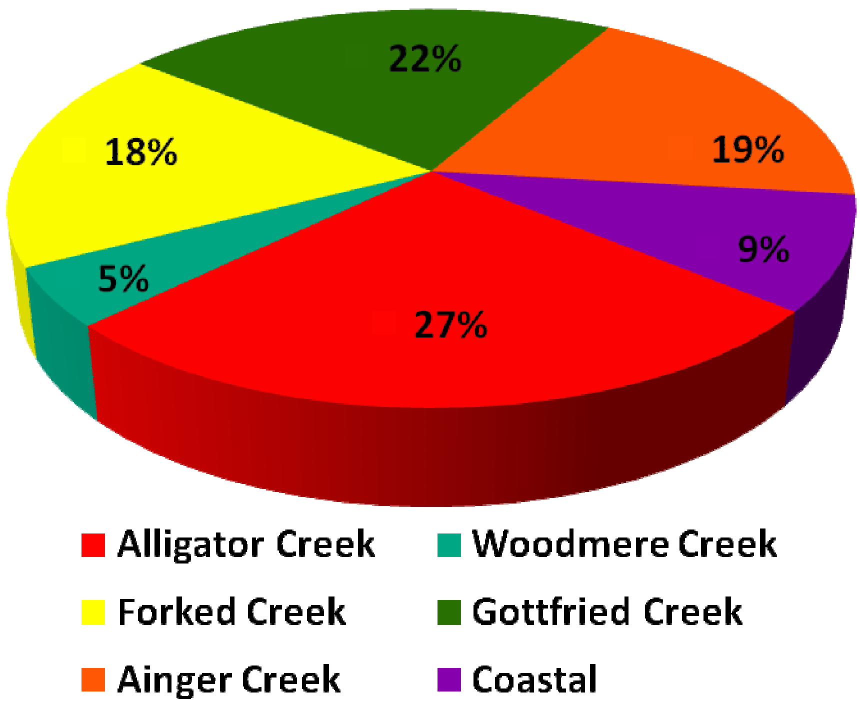


Figure 3-25 Average Annual Current Direct Runoff Input by Basin

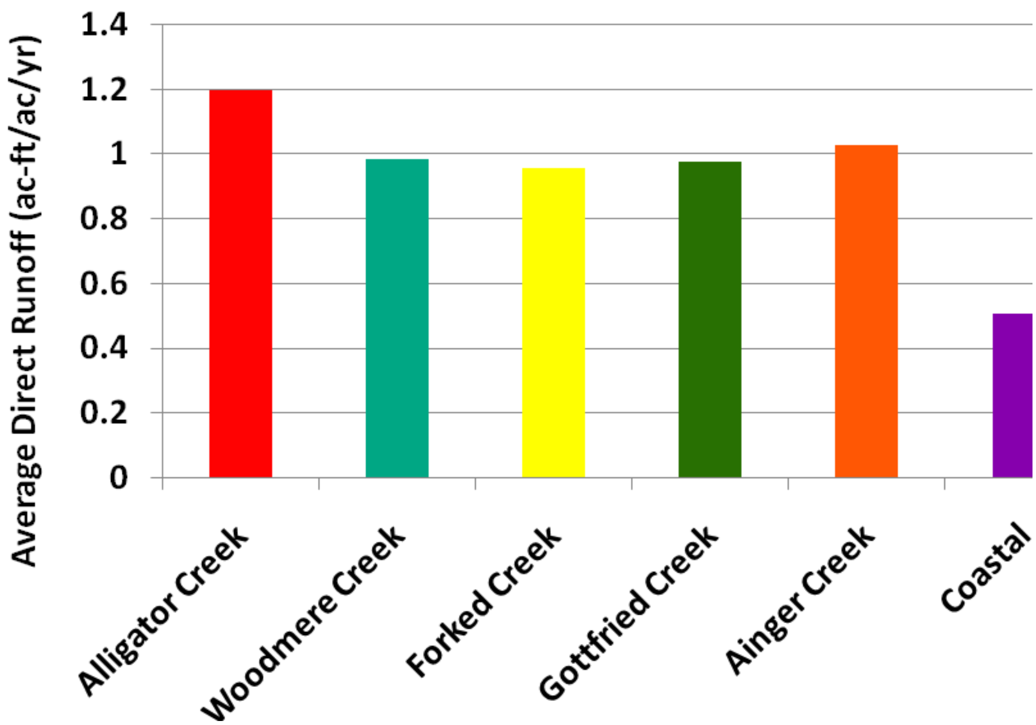


Figure 3-26 Normalized Average Annual Direct Runoff Hydrologic Loading Rate by Basin

Annual variability of total volume, direct runoff, and rainfall are similar (Figure 3-28). The annual rainfall to runoff relationship is also dependable, with an R^2 value of 0.96 (Figure 3-29). From these data, the average annual runoff to rainfall conversion factor for the Sarasota County portion of the Lemon Bay watershed was calculated to be 0.22 (Appendix E).

The intra-annual timing of the minimum and maximum direct runoff volume component of the water budget is consistent, resembling the seasonal behavior observed with total volume (Figure 3-30). There is, though, a more prominent seasonal correlation between direct runoff and rainfall than for total volume and rainfall for the wet and the dry seasons (Figure 3-31). Like with total volume, the strongest correlation between direct runoff and rainfall is during the wet season.

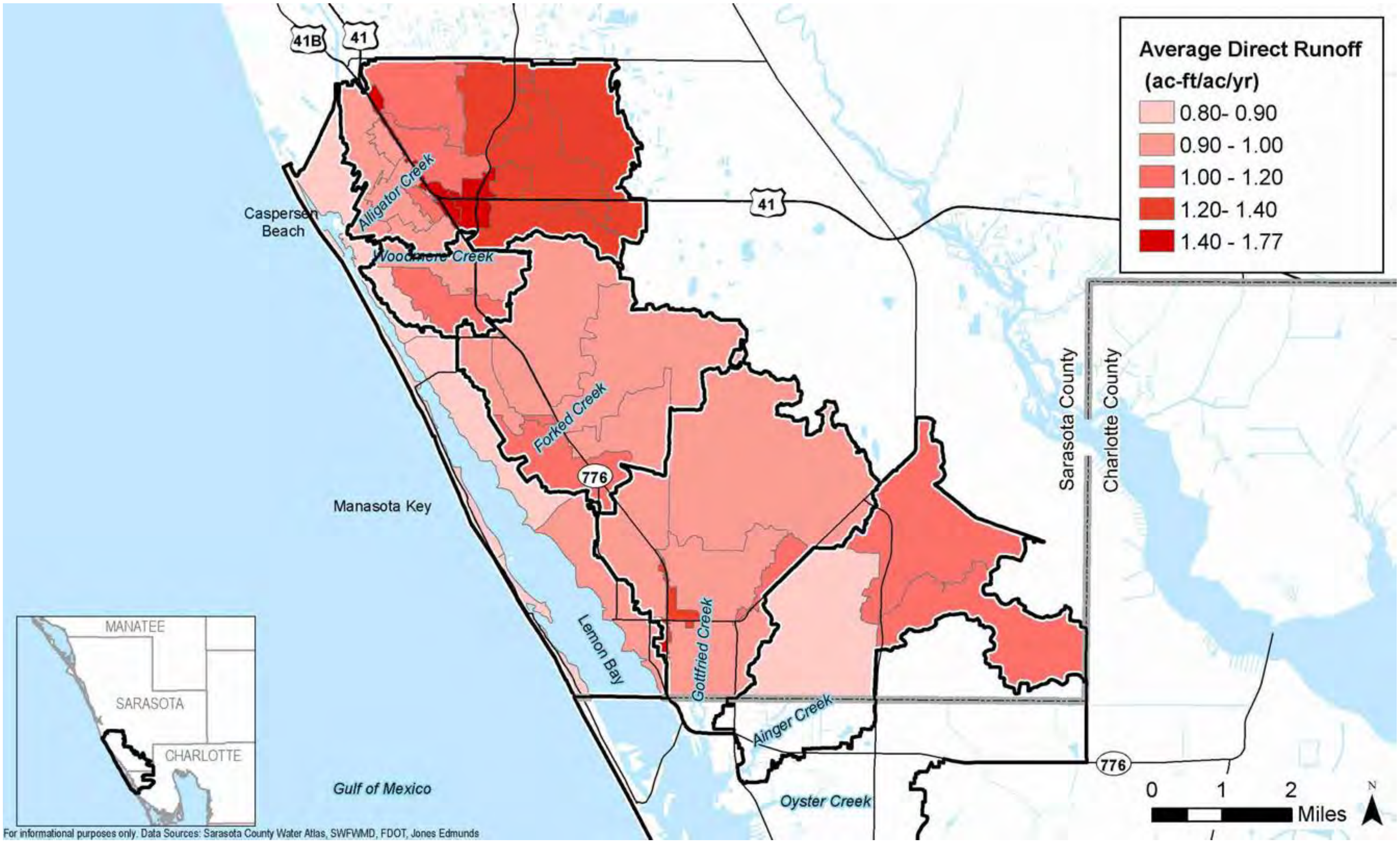


Figure 3-27 Normalized Annual Average Direct Runoff by Subbasin

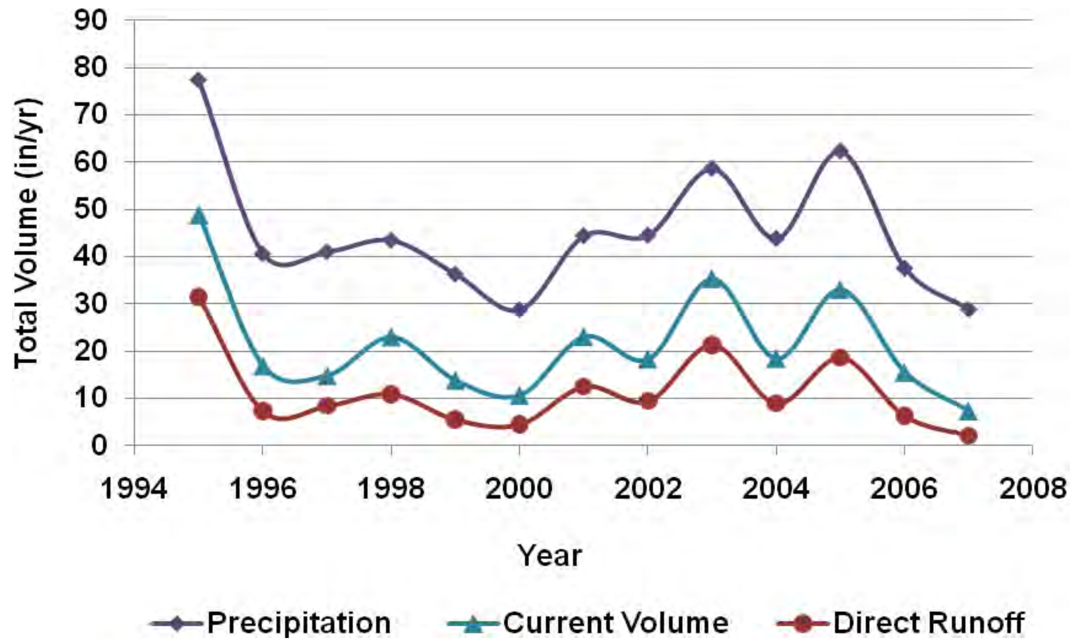


Figure 3-28 Variability of Annual Total Volume, Direct Runoff, and Rainfall in the Lemon Bay Watershed

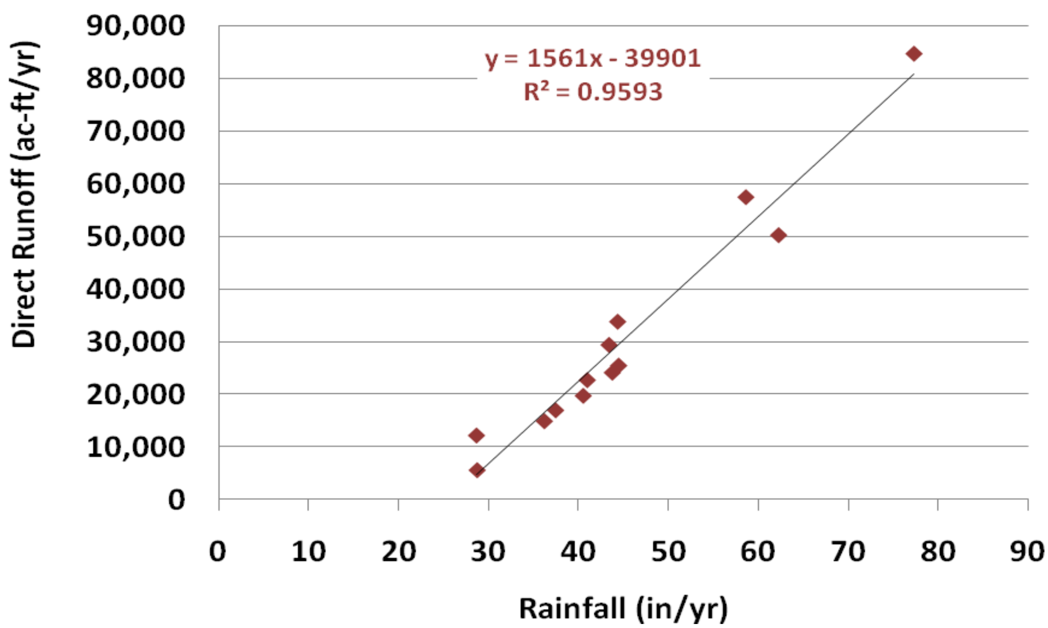


Figure 3-29 Correlation of Annual Rainfall to Direct Runoff in the Lemon Bay Watershed

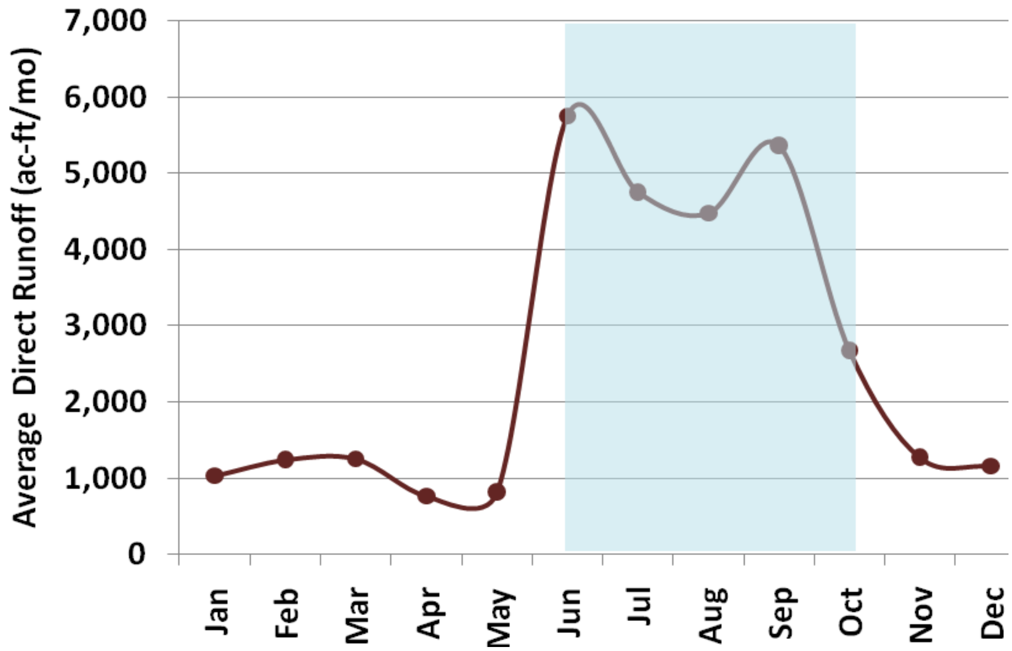


Figure 3-30 Variability of Monthly Direct Runoff in the Lemon Bay Watershed

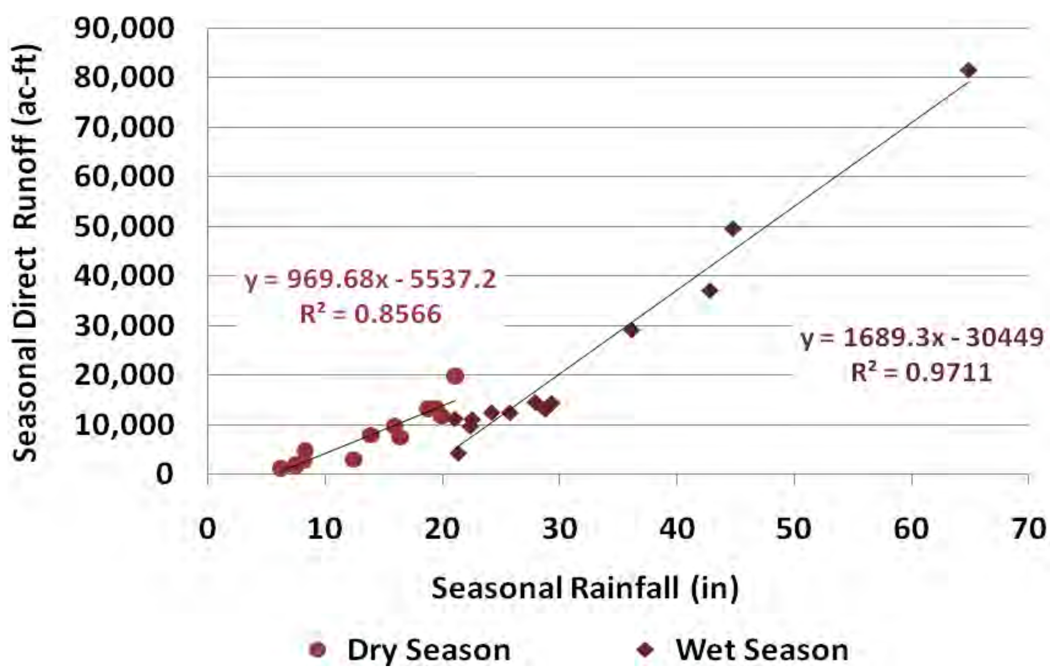


Figure 3-31 Correlation of Seasonal Rainfall to Direct Runoff in the Lemon Bay Watershed

The average seasonal direct runoff to rainfall coefficients for the Sarasota County portion of the Lemon Bay watershed were calculated from the annual seasonal direct runoff and rainfall data (Table 3-4).

Table 3-4 Seasonal Direct Runoff Coefficients for the Lemon Bay Watershed

Season	Average Direct Runoff (in)	Average Rainfall (in)	Average Seasonal Coefficients
Wet	8.55	31.65	0.23
Dry	2.80	13.49	0.18

The relationship between rainfall and runoff at a monthly scale varies. The dependability varies from an R^2 value of 0.75 in April up to 0.95 in June (Figure 3-32 through Figure 3-43). The average monthly direct runoff to rainfall coefficients for the Sarasota County portion of Lemon Bay are shown in Table 3-5. Table 3-6 summarizes these and the total volume to rainfall coefficients.

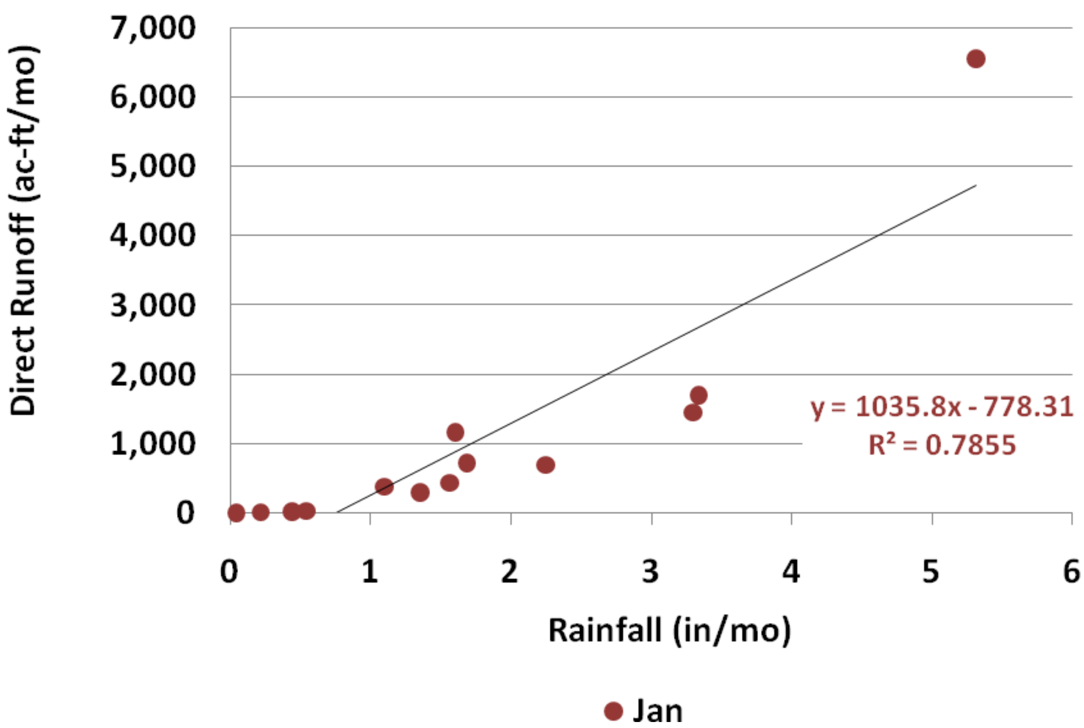


Figure 3-32 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for January

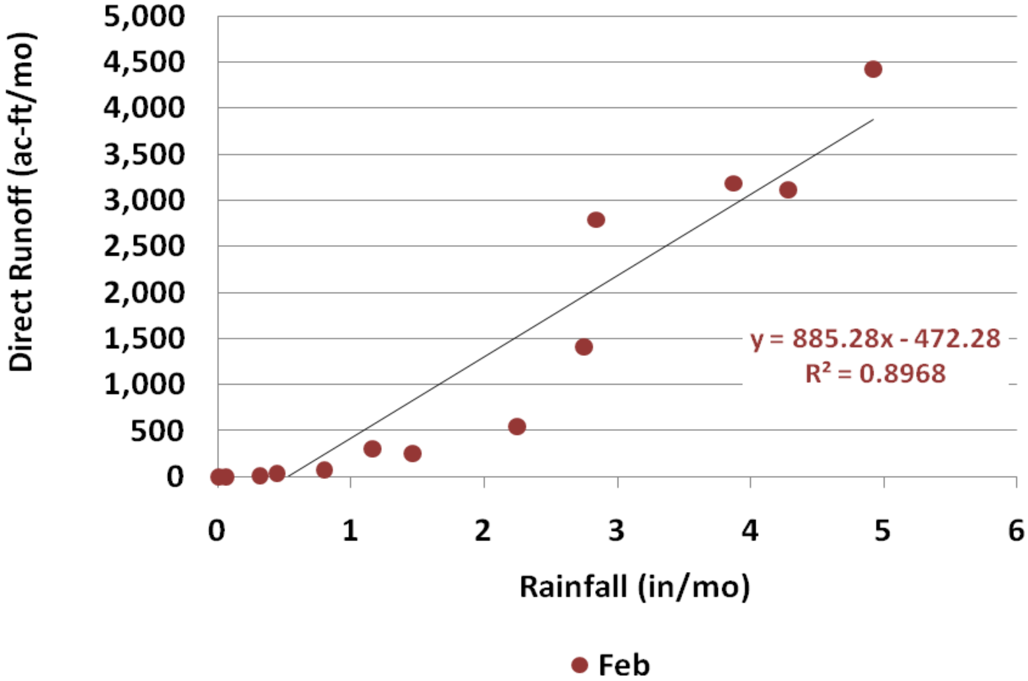


Figure 3-33 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for February

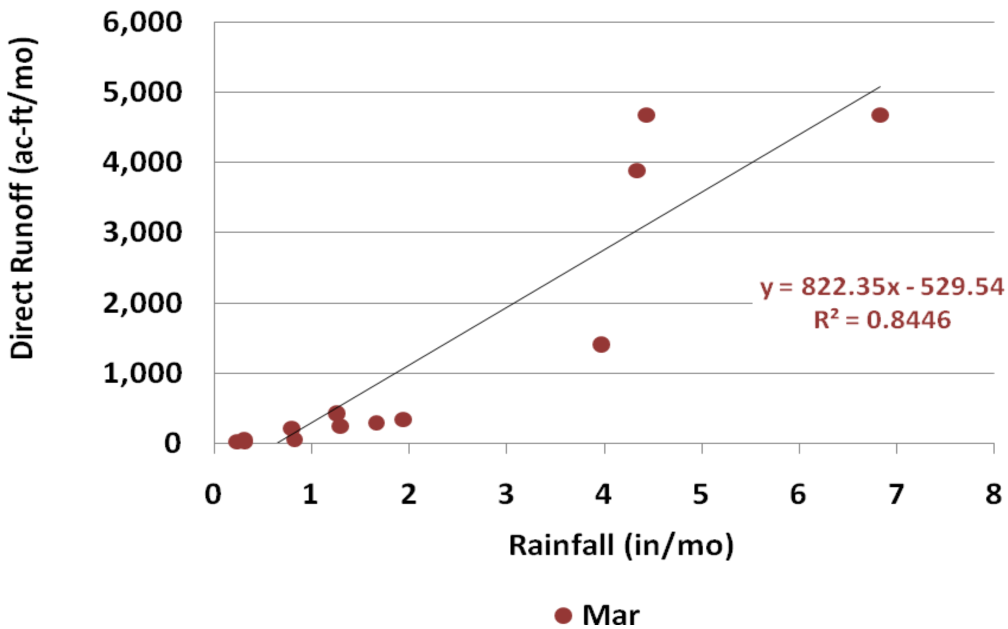


Figure 3-34 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for March

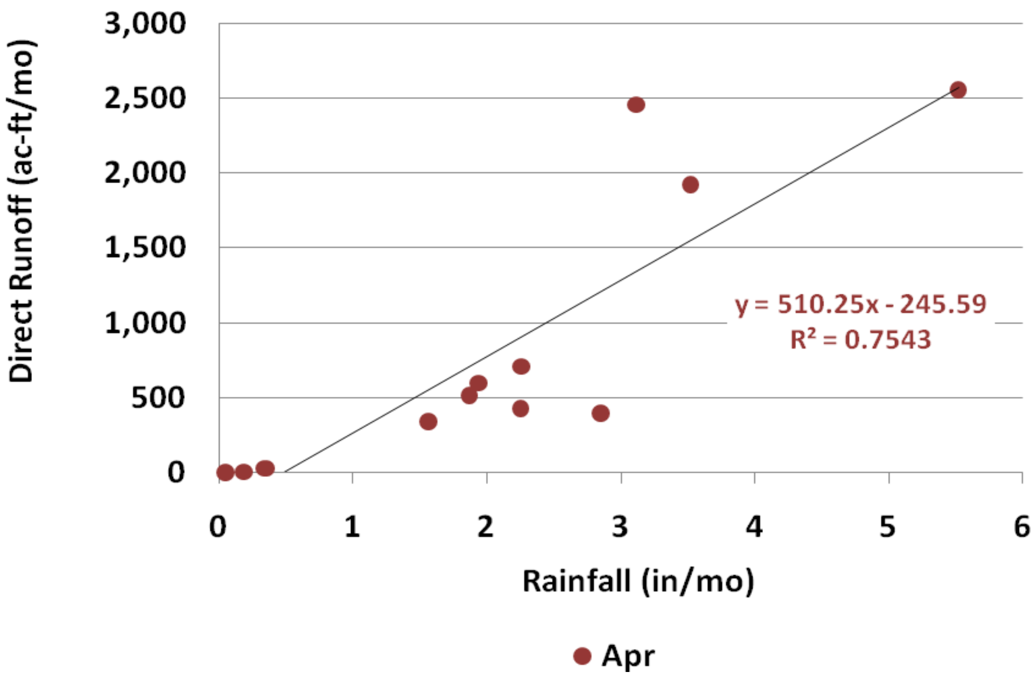


Figure 3-35 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for April

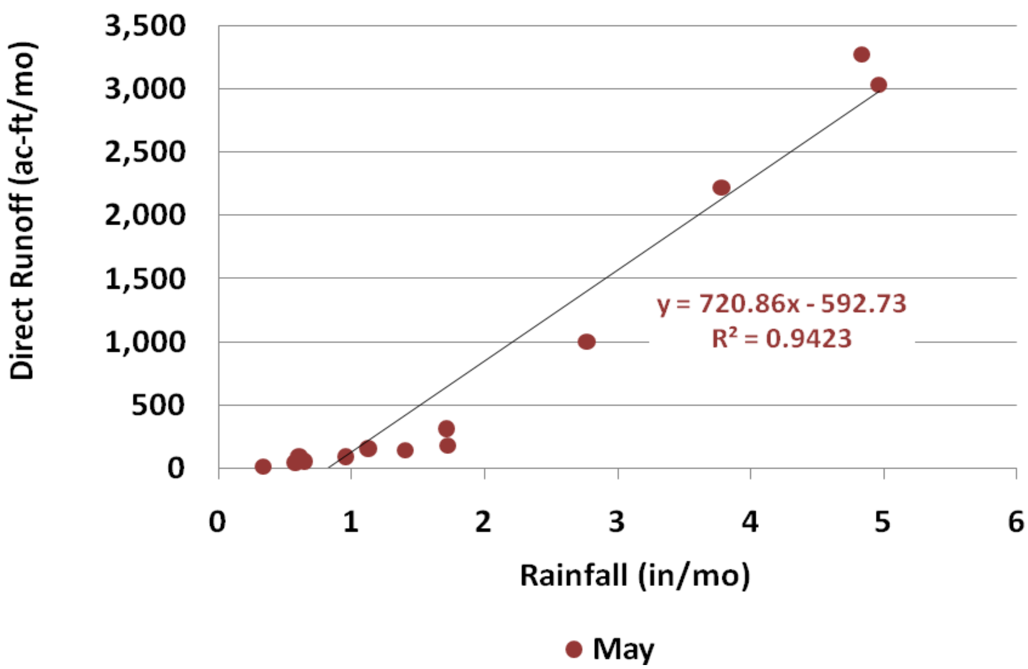


Figure 3-36 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for May

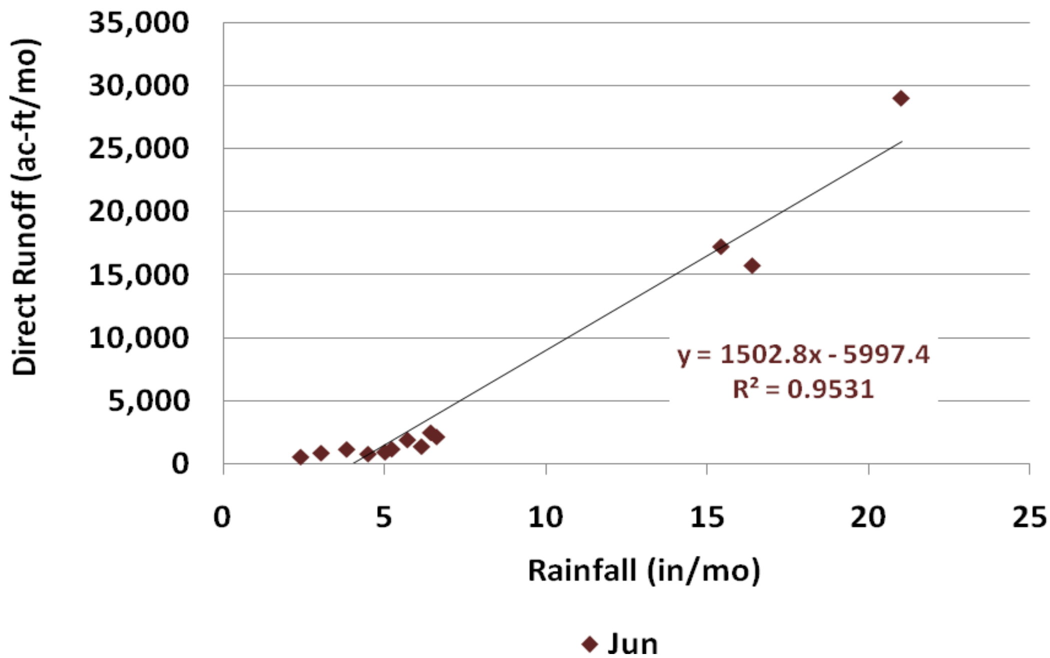


Figure 3-37 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for June

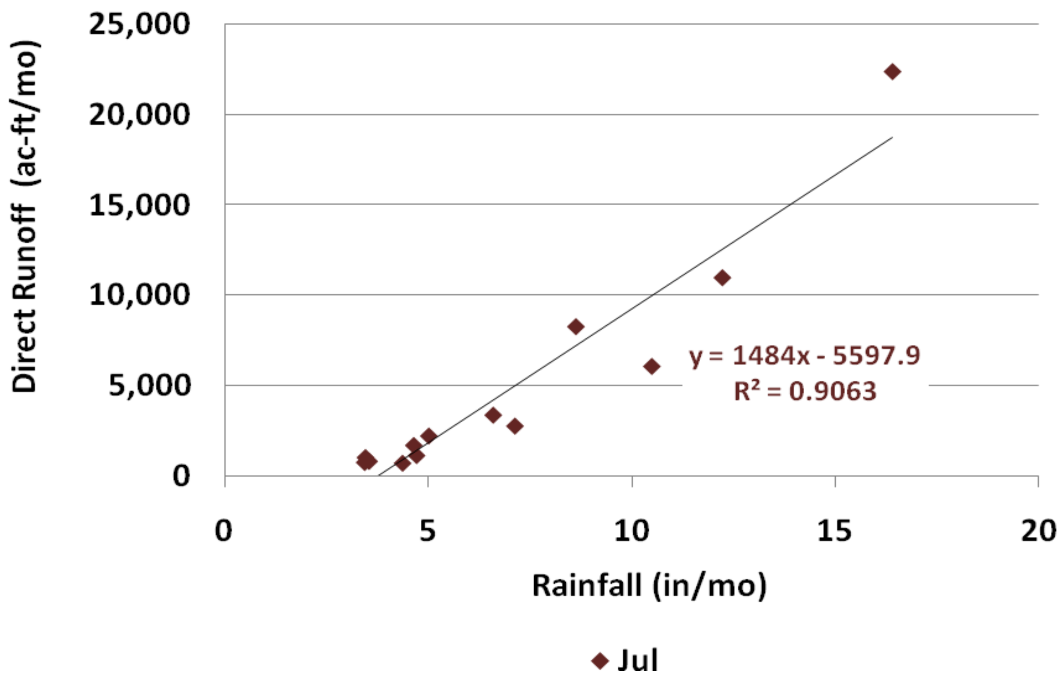


Figure 3-38 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for July

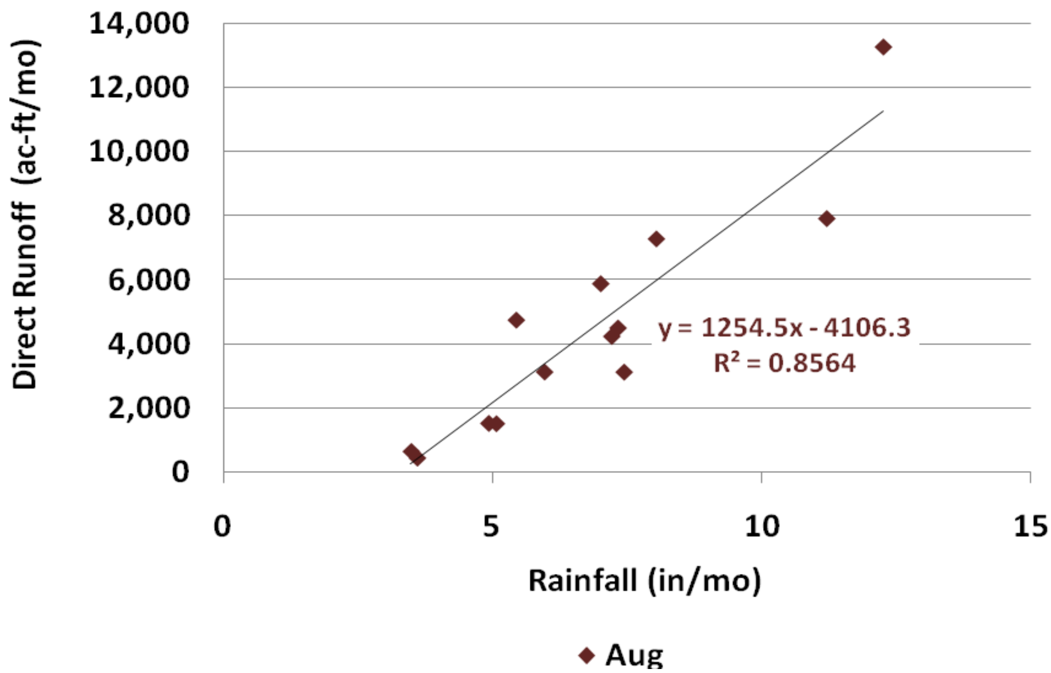


Figure 3-39 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for August

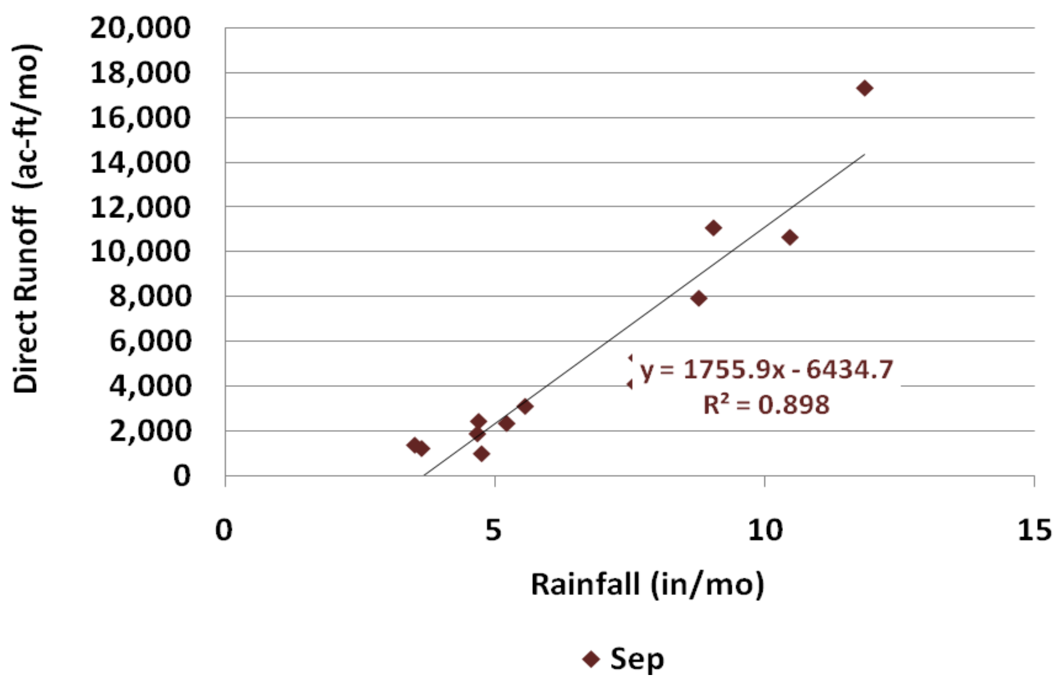


Figure 3-40 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for September

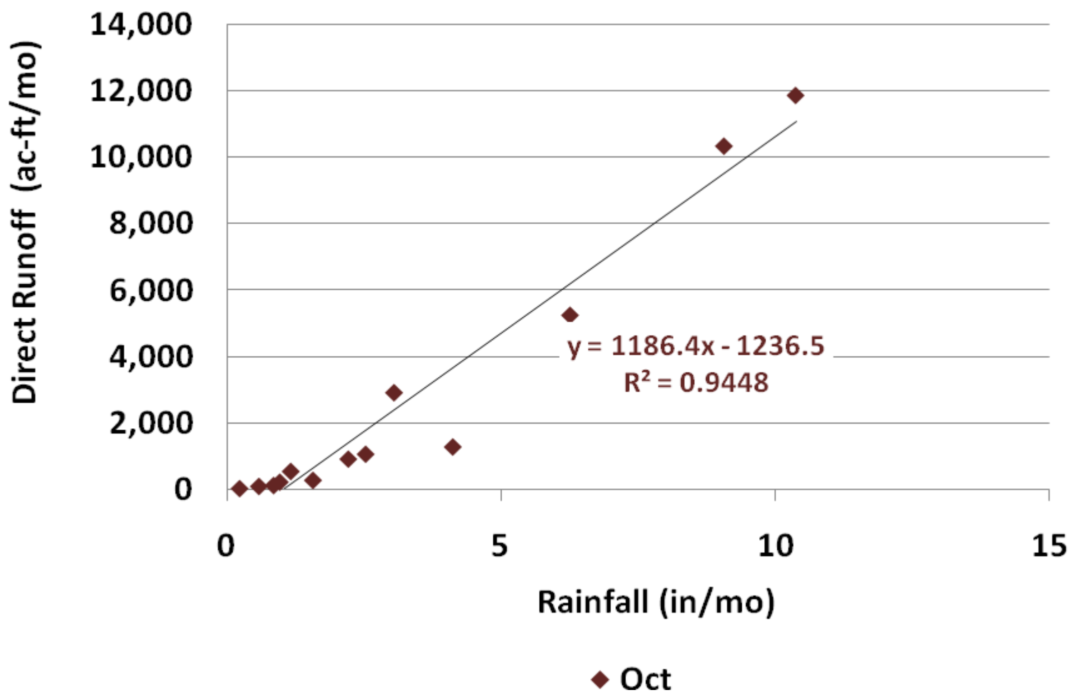


Figure 3-41 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for October

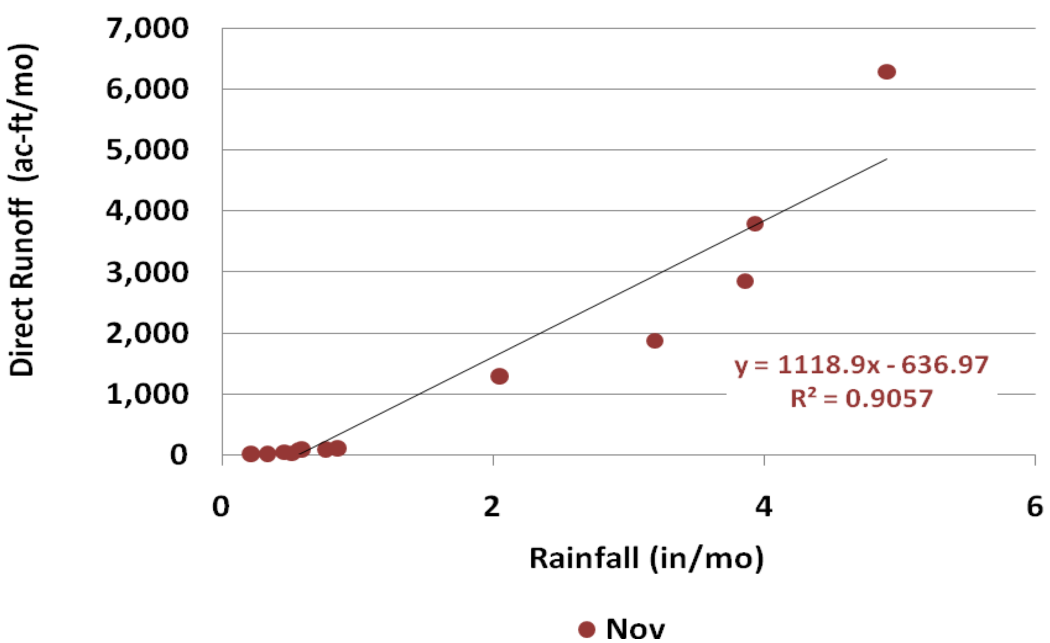


Figure 3-42 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for November

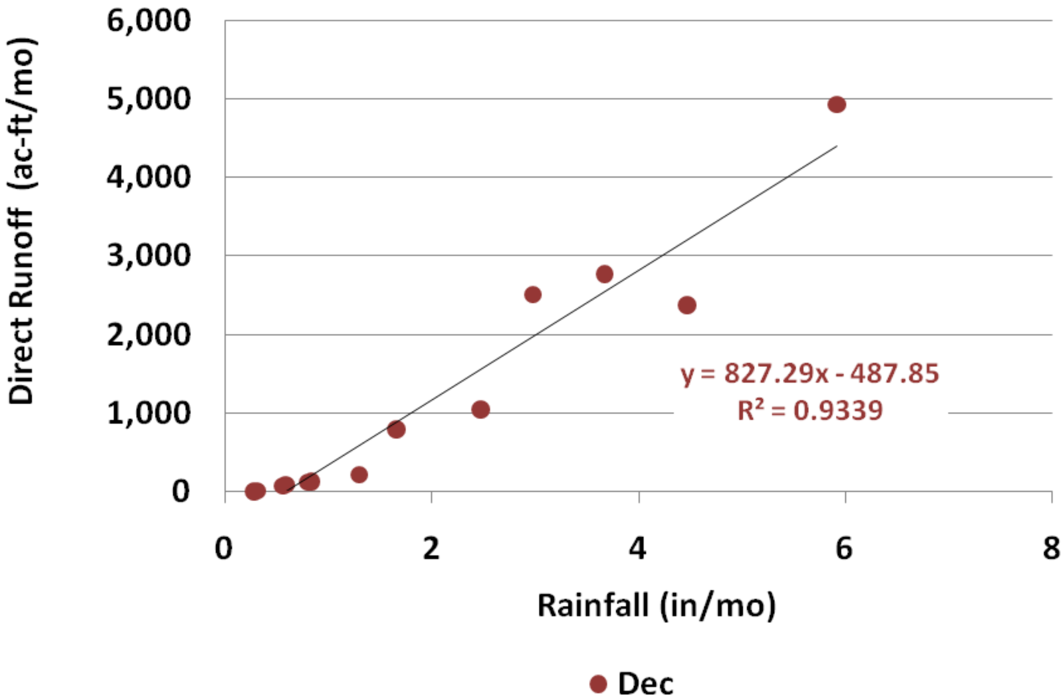


Figure 3-43 Correlation of Rainfall to Direct Runoff in the Lemon Bay Watershed for December

Table 3-5 Monthly Direct Runoff Coefficients for the Lemon Bay Watershed

	Average Direct Runoff (in)	Average Rainfall (in)	Average Direct Runoff / Average Rainfall
Jan	0.38	1.75	0.22
Feb	0.46	1.94	0.24
Mar	0.47	2.17	0.21
Apr	0.28	1.98	0.14
May	0.30	1.96	0.16
Jun	2.14	7.82	0.27
Jul	1.77	6.98	0.25
Aug	1.66	6.84	0.24
Sep	1.99	6.72	0.30
Oct	0.99	3.30	0.30
Nov	0.47	1.71	0.28
Dec	0.43	1.99	0.22

Table 3-6 Monthly Coefficients Summary for the Lemon Bay Watershed

	Average Total Volume to Rainfall Coefficient	Direct Runoff to Rainfall Coefficient	(Total Volume to Rainfall Coefficient) – (Direct Runoff to Rainfall Coefficient)
Jan	0.59	0.22	0.37
Feb	0.53	0.24	0.29
Mar	0.47	0.21	0.25
Apr	0.37	0.14	0.22
May	0.36	0.16	0.20
Jun	0.39	0.27	0.12
Jul	0.41	0.25	0.16
Aug	0.44	0.24	0.19
Sep	0.52	0.30	0.22
Oct	0.67	0.30	0.37
Nov	0.74	0.28	0.46
Dec	0.57	0.22	0.35

3.1.2.3 Lemon Bay Watershed Water Budget Changes

Changes in the natural freshwater inflow to estuaries can have significant impacts on the health and distribution of plants and wildlife. There is natural variability in the total volume, direct runoff, and the overall range of inflow to Lemon Bay fluctuates annually, seasonally, and monthly. The natural hydrologic regimes of the watershed have evolved over the last several decades, though. With increased urbanization have come significant changes in the components of the water budget of the Lemon Bay watershed. There are notable increases in both the overall volume and direct runoff volume entering Lemon Bay from historical to current conditions. The projected future volume and direct runoff are also estimated to increase significantly. Analysis of the future water budget considered a completely built-out scenario of the potential anthropogenic influences that could affect the overall water budget and direct runoff of the watershed in the future.

There is an increasing trend in total volume in the Lemon Bay watershed from historical through future years (Figure 3-44). The total watershed volume increased each year for all years from historical to current and is estimated to increase annually from current to future conditions (Appendix E). There was a 23% increase in the annual average total volume of the historical to the current water budget. The future annual average total volume could potentially increase over 17% (Figure 3-45 and Appendix E). Results for each of the Lemon Bay basins are located in Appendix E.

The historical and current water budgets are used in Chapter 4 to investigate the influence of flows on salinity in Lemon Bay. The quantitative relationship between salinity and flows are used to make recommendations for an appropriate hydrologic regime, i.e., target water budget.

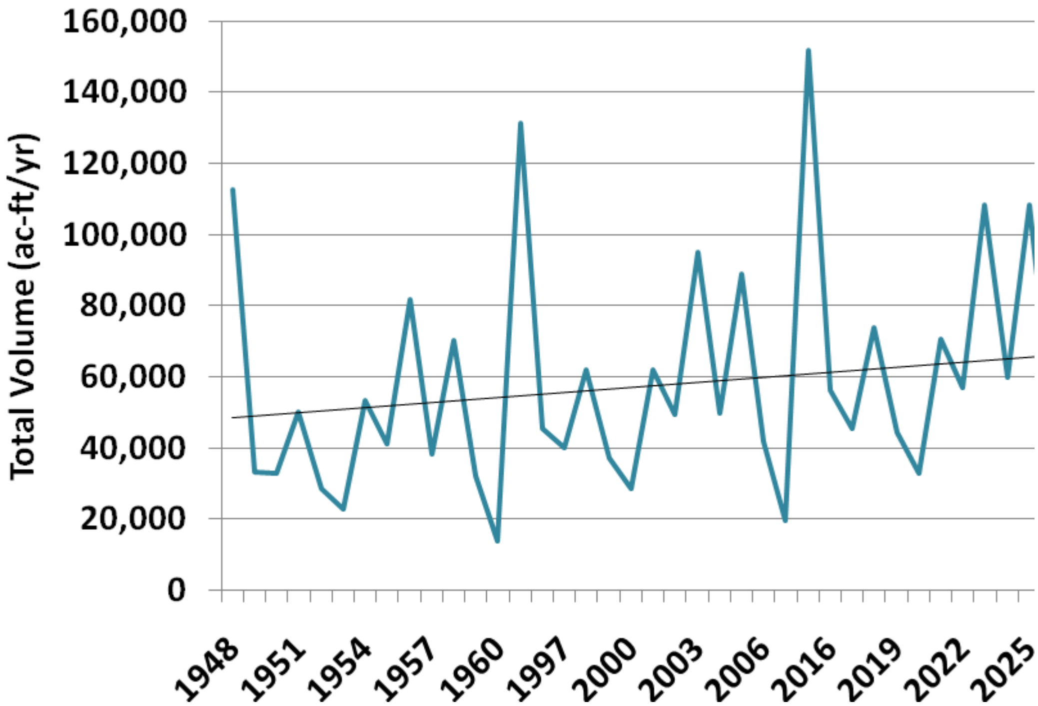


Figure 3-44 Historical through Future – Trend in Total Volume in the Lemon Bay Watershed

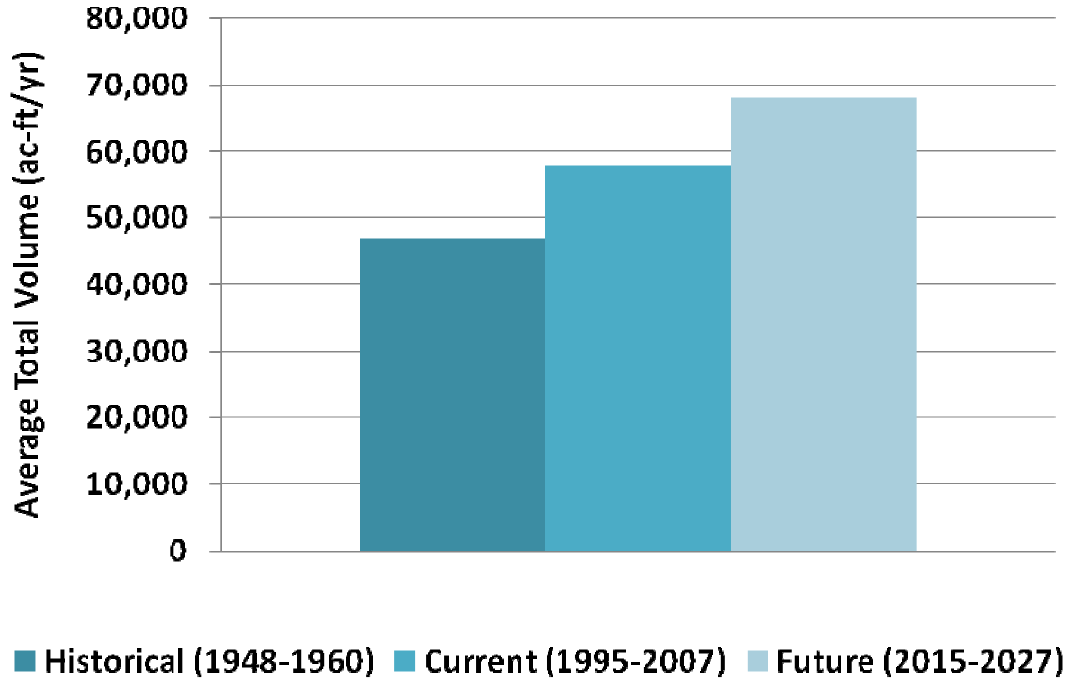


Figure 3-45 Historical, Current, and Future – Average Annual Total Volume in the Lemon Bay Watershed

There is also an annual increase in the normalized (by area) average total volume from historical to current and from current to future conditions (Figure 3-46). Changes in the normalized total volume across the watershed are shown in Figure 3-47. There is a distinct increase in water budget components in the areas of the watershed that became highly urbanized between the historical and current periods of study. Much of this development occurred before Land Development Regulations (LDRs) or Low Impact Developments (LIDs) were implemented.

The current to future normalized average annual change in total volume across the watershed was estimated at a more coarse scale (Figure 3-48). The areas that are currently developed show the smallest change in water budget in the future. Figure 3-48 shows that the areas of the watershed where development could occur in the future have the greatest projected increases in volume. This analysis considered a completely built-out scenario of the potential anthropogenic influences that affect the overall water budget of the watershed in the future and did not take into account LDRs or LID.

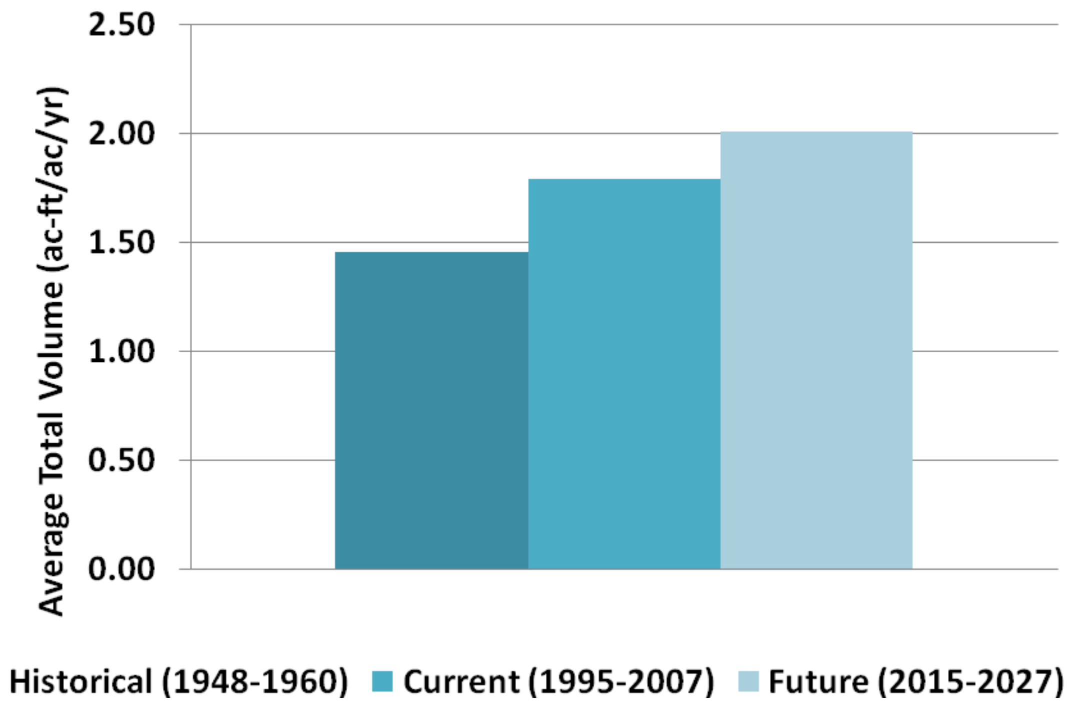


Figure 3-46 Historical, Current, and Future – Normalized Average Annual Total Volume in the Lemon Bay Watershed

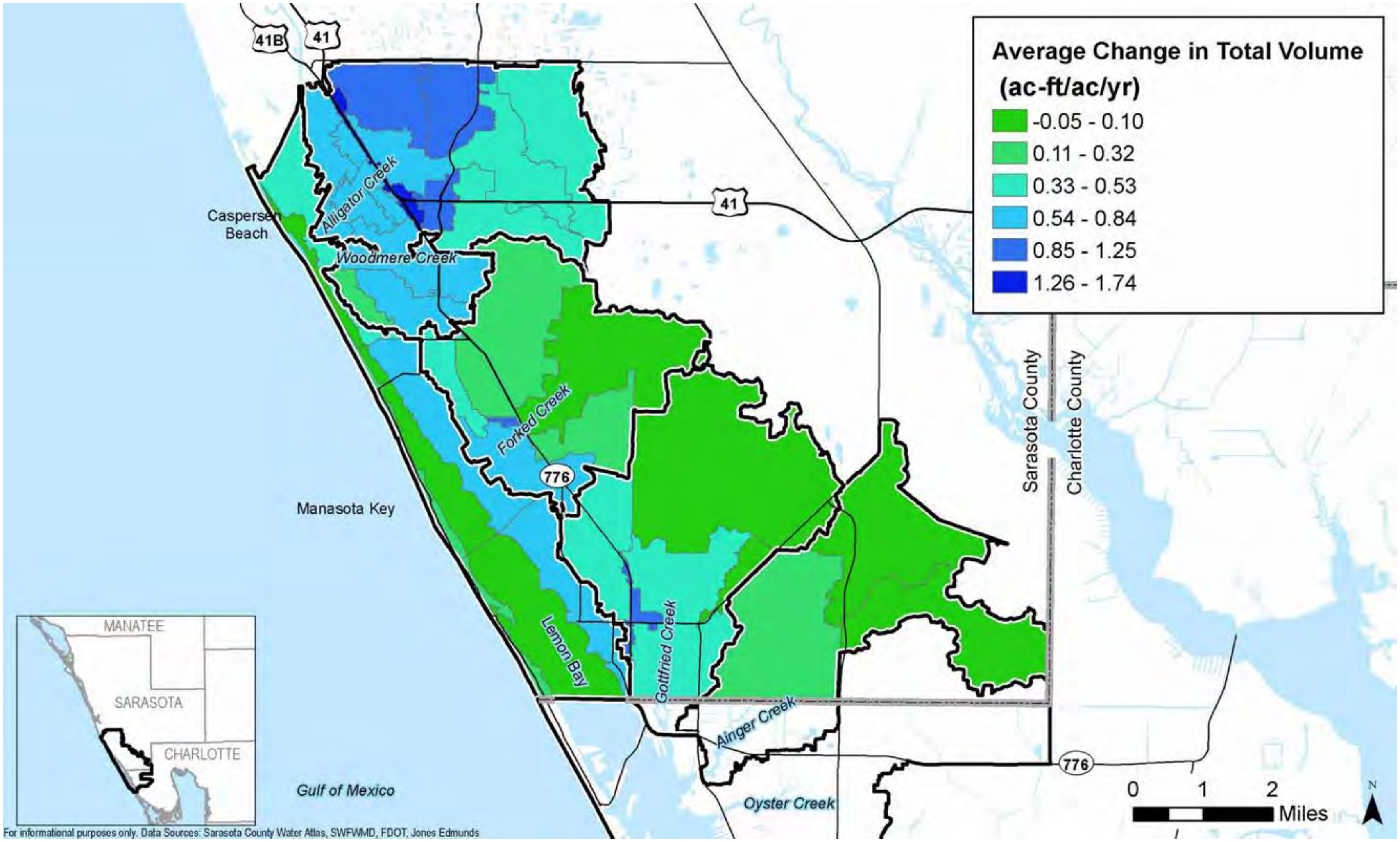


Figure 3-47 Normalized Change in Total Volume (ac-ft/ac) (Current Annual Average Total Volume—Historical Annual Average Total Volume)

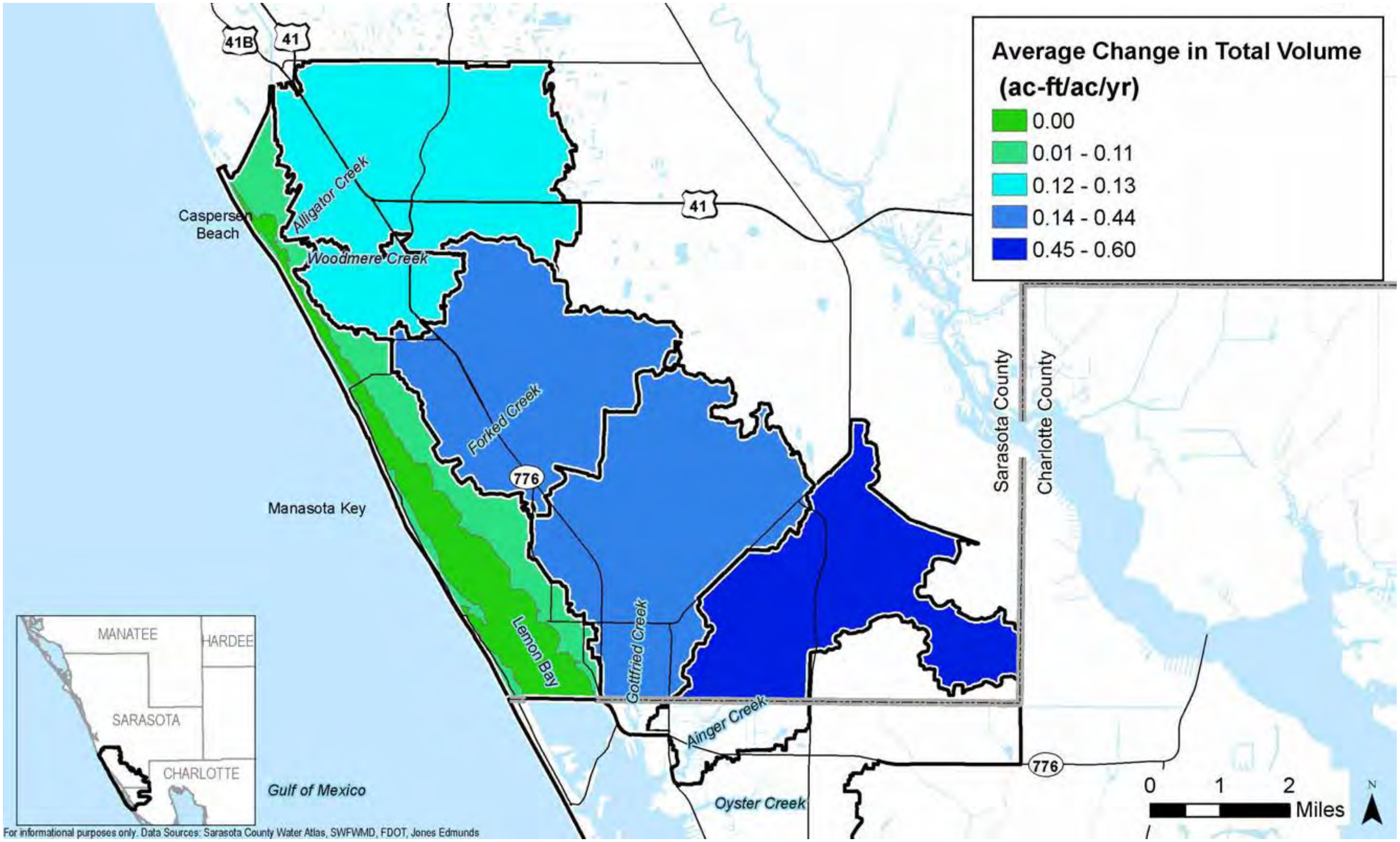


Figure 3-48 Normalized Change in Average Total Volume (ac-ft/ac) (Future Annual Average Total Volume—Current Annual Average Total Volume)

There is also a slight increasing trend in the direct runoff component of the Lemon Bay watershed water budget from historical through future years (Figure 3-49). The direct runoff increased for most years from historical to current and is projected to increase each year into the future (Appendix E). There was an annual average increase of 13% from the historical to current water budget, and this volume s estimated to increase by almost another 12% in the future (Figure 3-50).

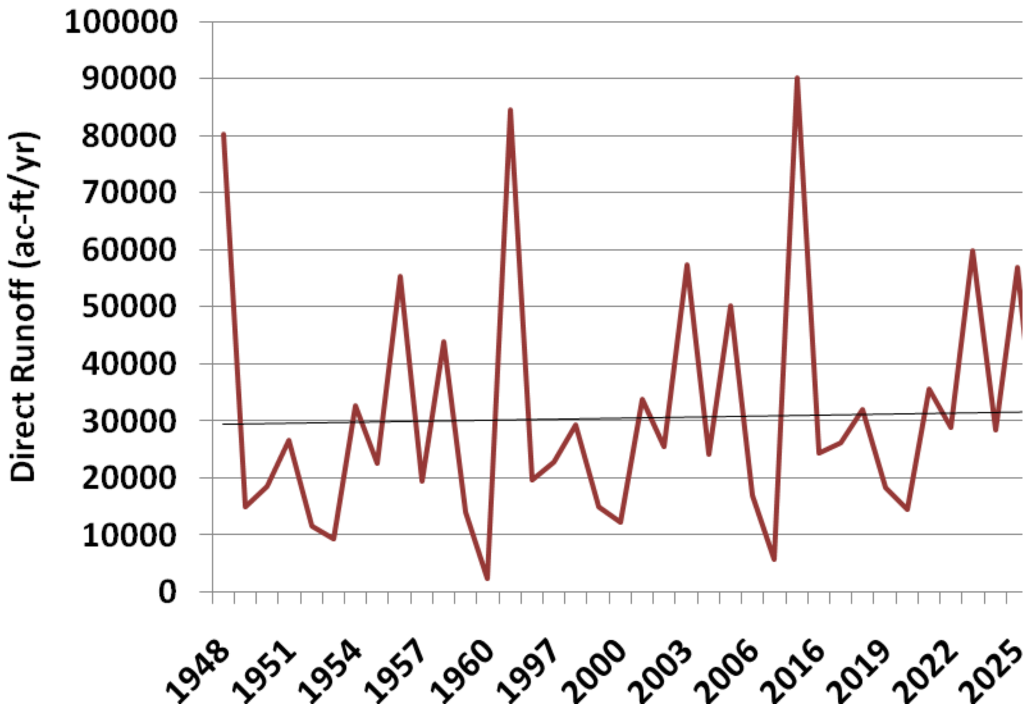


Figure 3-49 Historical through Future – Trend in Direct Runoff in the Lemon Bay Watershed

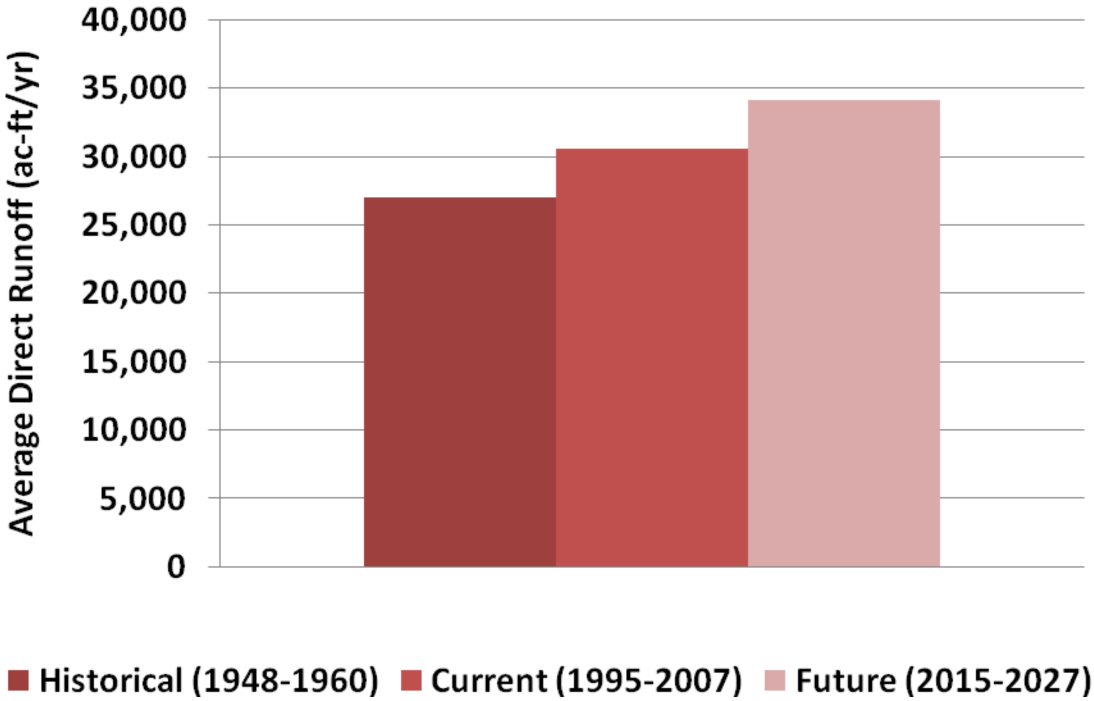


Figure 3-50 Historical, Current, and Future – Average Annual Direct Runoff in the Lemon Bay Watershed

The normalized average direct runoff volume also increases from historical to current and current to future conditions (Figure 3-51). The normalized historical to current average annual change in total direct runoff across the watershed is shown in Figure 3-52. The areas with the largest increases are those that have been developed. The current to future normalized average annual change in direct runoff is shown in Figure 3-53. As with the total volume changes, the areas that are currently developed show the smallest change in direct runoff in the future. Figure 3-53 shows that the areas of the watershed where development could occur in the future are the same areas where the greatest increases in direct runoff are projected.

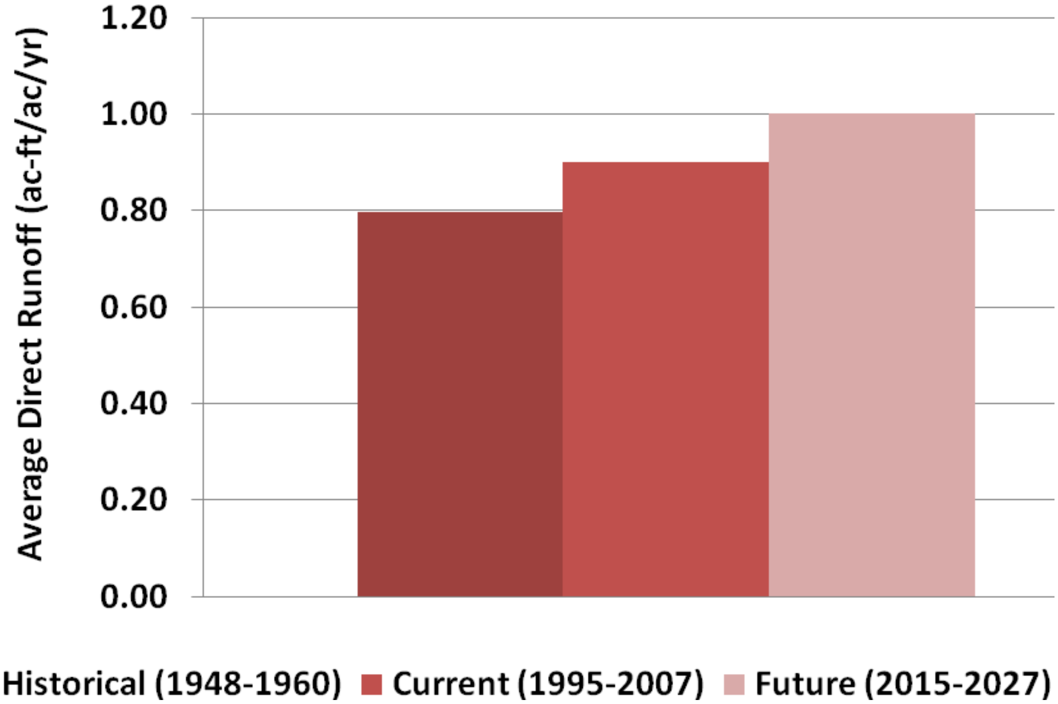


Figure 3-51 Historical, Current, and Future – Normalized Average Annual Direct Runoff in the Lemon Bay Watershed

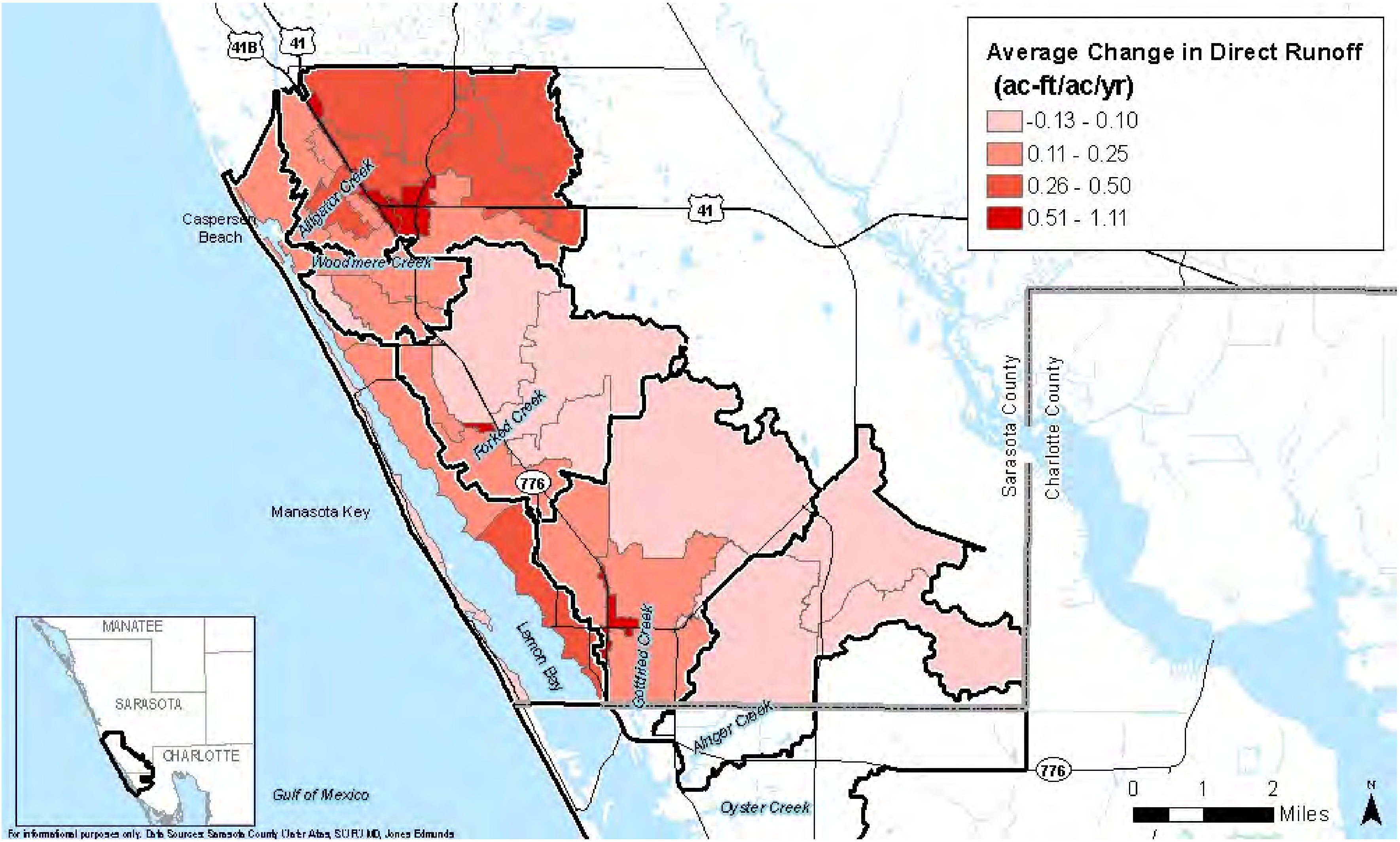


Figure 3-52 Normalized Change in Total Volume (ac-ft/ac) (Current Annual Average Direct Runoff—Historical Annual Average Direct Runoff)

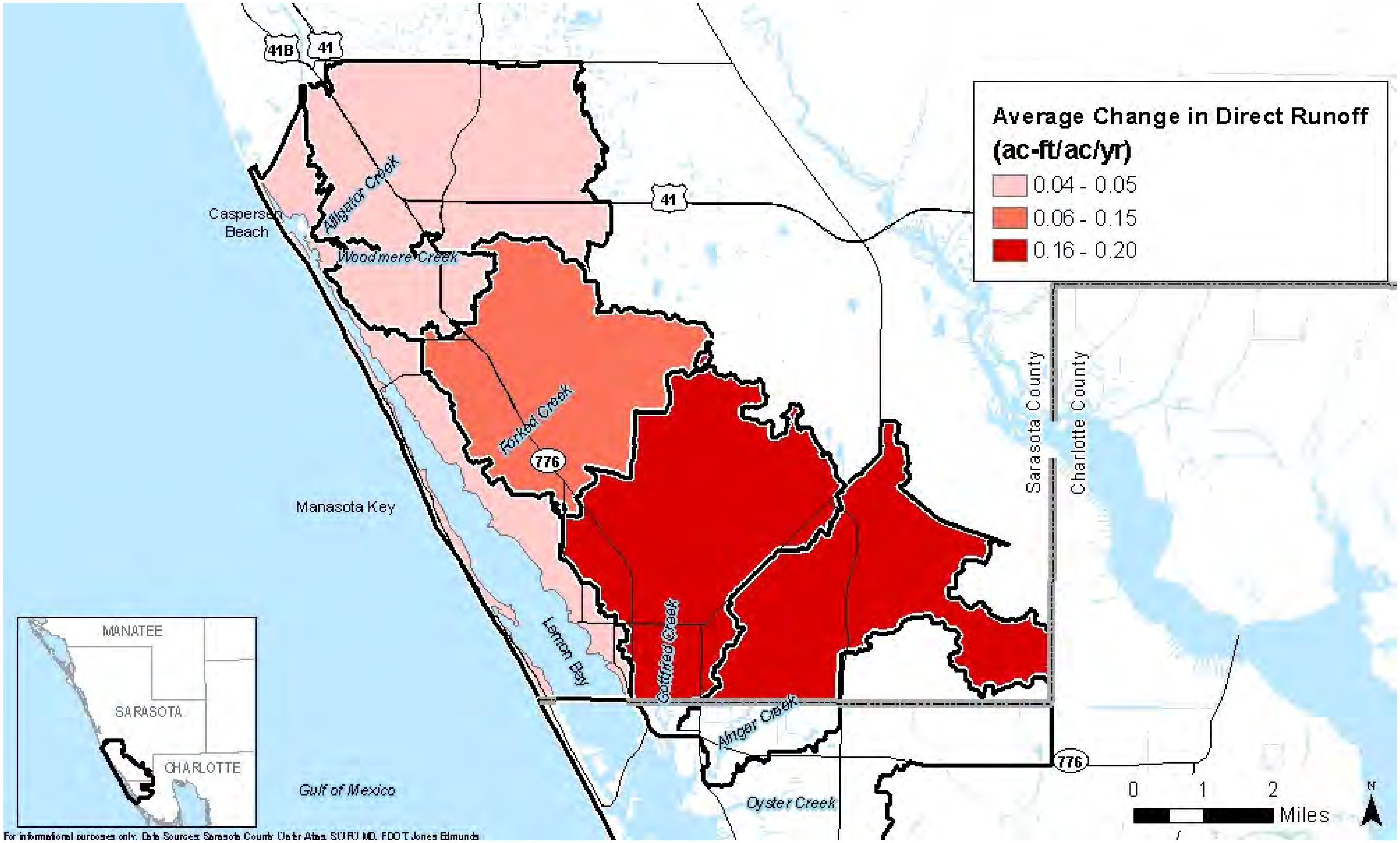


Figure 3-53 Change in Average Total Volume (ac-ft/ac) (Future Annual Average Direct Runoff—Current Annual Average Direct Runoff)

Results of the simulations (historical, current, future) indicate that fluctuations in the total volume and direct runoff volume within each simulation are driven by the rainfall. The changes in total volume and direct runoff between simulations, however, are a result of changes in land use (Figure 3-54). The greatest water budget changes occur in areas of the watershed that were developed before LDRs were implemented in 1981 or were projected to be developed the future.

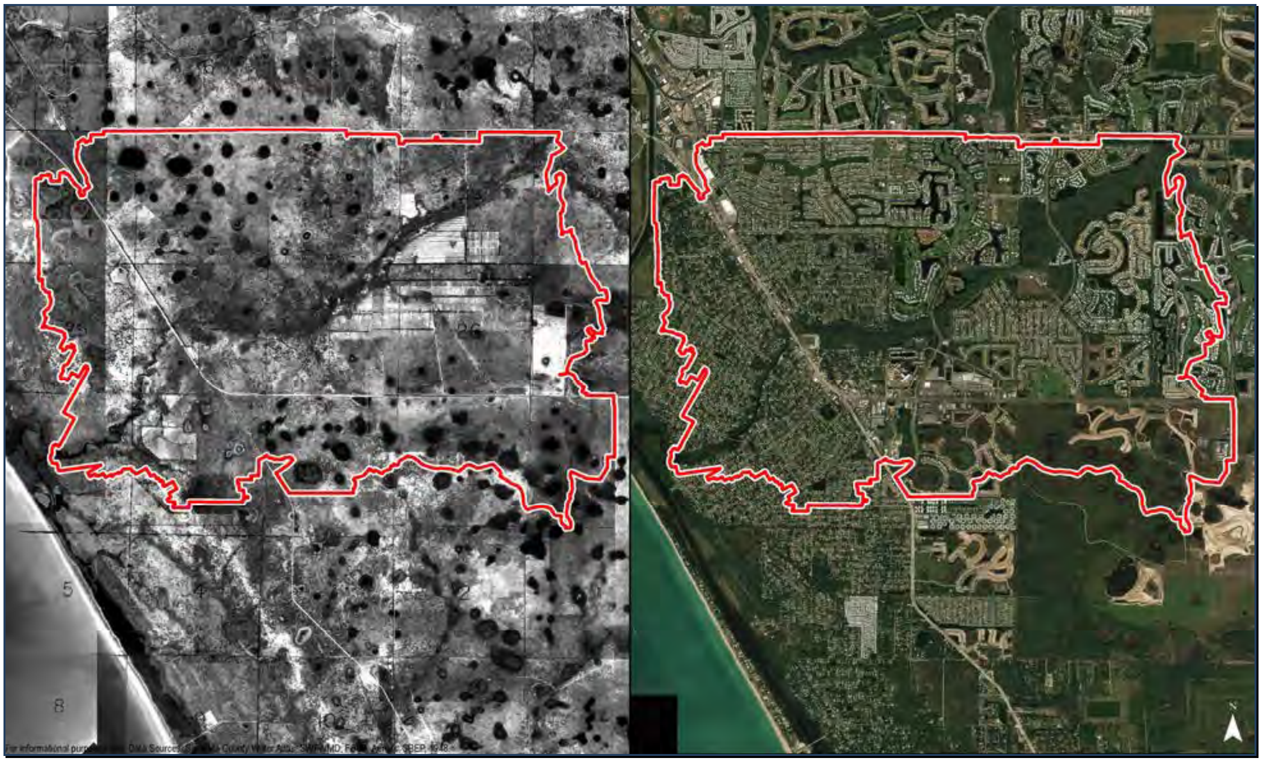


Figure 3-54 Comparison of the Alligator Creek Basin Circa 1948 and 2007

Early development altered the hydrology of the watershed, decreasing storage and infiltration and increasing flows into the bay, which in turn resulted in increased pollutant loading. Although it may not be practical to restore the historical water budget of the Lemon Bay watershed, improvements can be made in developed areas and precautions can be taken to avoid increased flows in the future water budget. Moving forward, LDRs will continue to be enforced and LID projects are recommended for retrofits, redevelopment, and future development to maintain or improve the current Lemon Bay watershed water budget.

3.1.3 Habitat Improvement

3.1.3.1 Introduction

Jones Edmunds completed a desktop GIS analysis and identified potential habitat improvement opportunities on public lands in the Lemon Bay watershed with a focus on improving the watershed's hydrologic, hydraulic, or water quality functions. As a result, an emphasis was placed on public lands that contained wetlands due to their importance and influence on on-site or downstream water quality and quantity. Potential sites were identified by Jones Edmunds based on a GIS desktop assessment using available digital datasets. Data collected at the identified sites during preliminary field assessments and subsequent analysis were used to rank sites based on several factors with an emphasis on improving water quality and quantity on-site or to downstream receiving waters. Any observations of listed wildlife species were recorded but listed wildlife species specific surveys were not part of the preliminary field assessments.

3.1.3.2 Methods

A. Data Compilation and Analysis

Jones Edmunds used GIS to compile and review numerous public lands shapefiles obtained from the Sarasota County GIS library, the Sarasota County Environmentally Sensitive Lands Program (ESLPP), the Charlotte Harbor National Estuary Program (CHNEP), and the Southwest Florida Water Management District (SWFWMD), which included the following:

- ❖ Sarasota County conservation easements and preservation or mitigation areas
- ❖ ESLPP parcels
- ❖ Neighborhood parklands
- ❖ Public- and agency-owned lands
    - SWFWMD
    - Airport Authority
    - Hospital
    - School Board
    - Federal
    - State
    - City

Jones Edmunds selected all public lands greater than 1 acre that contained native wetland communities (FLUCCS_ID = 6XXX) and reviewed them in the GIS. Topography and hydrography data sets were then used to review each potential site for connectivity to downstream receiving waterbodies. In addition, emphasis was placed on those sites that were hydrologically connected to off-site wetlands or surface waters.

B. Field Investigations

Jones Edmunds conducted site visits to the potential habitat improvement sites in March 2009 to characterize the vegetation communities, identify any listed wildlife species currently using the site, and determine if the wetlands were hydrologically impacted. If the on-site wetlands appeared to be hydrologically impacted, site-specific activities were identified that could be proposed to enhance or restore the wetlands. The on-site vegetative communities were categorized according to the 1999 Florida Land Use, Cover and Forms Classification System (FLUCCS) developed by the Florida Department of Transportation.

C. Quantifying Habitat Improvement Ecological Lift

In February 2004, the Florida Department of Environmental Protection (FDEP) and State of Florida Water Management Districts adopted (Ch. 62-345, FAC) the Uniform Mitigation Assessment Method (UMAM). The UMAM provides a "standardized procedure for assessing the functions provided by wetlands and other surface waters, the amount that those functions are reduced by a proposed impact, and the amount of mitigation necessary to offset that loss" (62-345.100(2), FAC).

To evaluate and ultimately rank a proposed habitat improvement project, Jones Edmunds needed a methodology to quantify the ecological functional gain that is expected with the proposed habitat improvement project. The State-mandated UMAM provides such a methodology to quantify the ecological benefit or lift that could result from Roberts Bay North presented in this Chapter.

The UMAM provides a "standardized procedure for assessing the functions provided by wetlands and other surface waters."

Jones Edmunds quantified the degree of ecological benefit that could occur from restoring a particular site using the UMAM. To calculate the potential ecological lift, the UMAM requires scoring the current condition of each site as well as the perceived condition of the site after restoration. UMAM is used to quantitatively score the assessment area for three categories: (1) Location and Landscape Support, (2) Water Environment, and (3) Community Structure. These categories are scored on a scale of 0 to 10 (10 being the highest), summed, and then divided by 30, which yields a unitless composite score. For these sites the habitat improvement value is determined by calculating the Relative Functional Gain (RFG), which represents the amount of wetland functions that will be gained with the proposed mitigation. A "time lag" and "risk factor" are incorporated into the calculations of RFG. Time lag represents the amount of time (in years) required for the proposed mitigation to reach maturity and replace the slowest functional value (e.g., wildlife habitat, vegetation structure) that was lost. Time lag values vary from 1.0 (1-year time lag) to 3.9 (greater than 55 years) (Table 3-7).

Using a GPS unit in combination with a review of 2008 digital ortho quarter quadrangle imagery, Jones Edmunds determined the acreage of habitat that would be restored or enhanced in the field. Based on these reviews, we then digitized the approximated enhancement/restoration acreage in GIS over the imagery to be used in the UMAM calculations. The RFG is then multiplied by this acreage to determine the expected credits that can be achieved based on a given habitat improvement project or component. The County could use these UMAM credits to offset capital improvement (CIP) projects that impact existing wetlands within the same basin as the habitat improvement activities are taking place. However, the County may only receive half of the UMAM credits for restoration projects co-funded by SWFWMD or other agencies.

Table 3-7 Time Lag Values Used in the UMAM Analysis

Year	T-factor
< or = 1	1
2	1.03
3	1.07
4	1.10
5	1.14
6 – 10	1.25
11 – 15	1.46
16 – 20	1.68
21 – 25	1.92
26 – 30	2.18
31 – 35	2.45
36 – 40	2.73
41 – 45	3.03
46 – 50	3.34
51 – 55	3.65
>55	3.91

D. Habitat Improvement Opinions of Probable Cost

The cost of restoration was an important evaluation criterion for each site. Once the type of restoration method was determined, Jones Edmunds calculated the cost to implement the specific type of restoration activity. Some sites were determined to benefit large acreages with minimal cost for restoration, whereas other sites would require more costly restoration methods for a small amount of ecological gain.

Compliance monitoring and maintaining exotic plant species within the habitat improvement areas for 4 years were also included in the cost estimate. This assumes that the sites would be permitted through the U.S. Army Corps of Engineers (USACE) and SWFWMD to obtain wetland mitigation credits for wetland impacts associated with County CIP projects. If wetland mitigation credits are not desired, this cost could be removed.

E. Site Ranking

Jones Edmunds ranked sites on a scale of 1 to 5 based on the following three criteria:

1. Ecological lift expected from habitat improvement activities as defined using UMAM.
2. Water quality and quantity improvement to downstream receiving waterbodies.
3. Conceptual opinion of probable cost for implementation.

For example, a project would be scored a 1 if it provides a high ecological benefit, improved downstream water quality or quantity, and a cost-effective approach to habitat improvement. A project would be scored a 5 if it requires costly methods for habitat improvement with low resulting benefits. A site was ranked high in the habitat improvement ranking process (i.e., rank = 1 or 2) if impacts associated with the disturbance were high, habitat improvement would benefit on-site or downstream wetland or surface water quality/quantity, a large land area would benefit from habitat improvement, and the habitat improvement method was fairly simple and cost effective. In contrast, a site was ranked low during the ranking process (i.e., rank = 4 or 5) if a small land area would benefit from habitat improvement, activities did not improve water quality/quantity to on-site or downstream wetlands or surface waters, the activities were complicated and/or expensive, and results from habitat improvement would be minimal.

3.1.3.3 Results and Discussion

Jones Edmunds identified seven potential habitat improvement sites during the initial GIS desktop assessment. However, the Gottfried Creek property was not included in the field assessment as the County is developing a Regional Off-Site Mitigation Area for this recently-acquired property. As a result, five potential habitat improvement sites were identified and assessed within the Lemon Bay watershed (Figure 3-55 and Table 3-8). The sites are presented in Tables 3-8 and 3-9 in ascending order by rank. The following describes vegetation communities, proposed habitat improvements, and preliminary UMAM analysis results and provides conceptual opinions of probable cost for each site.

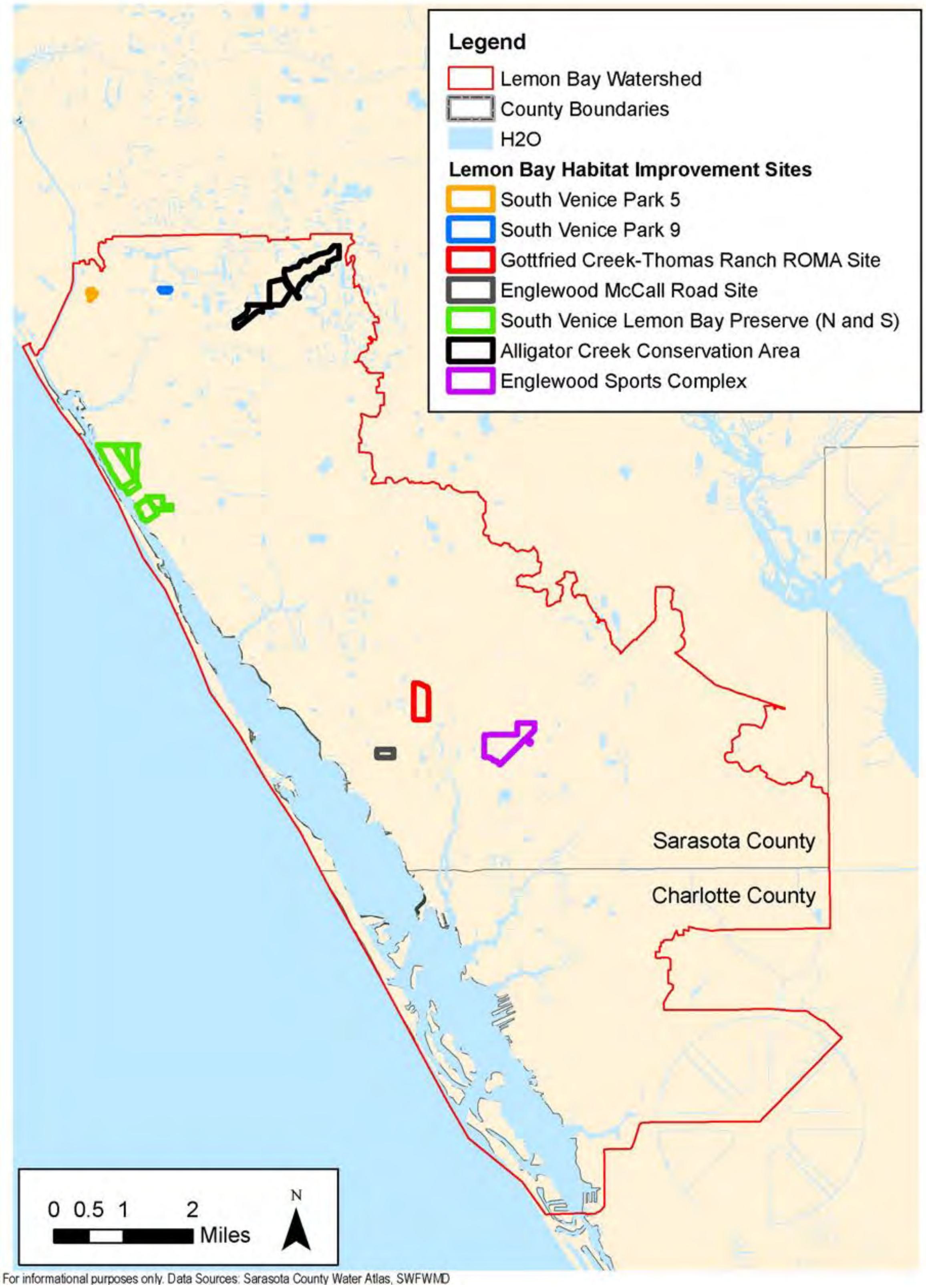


Figure 3-55 Location Map for Habitat Improvement Sites

Table 3-8 Identified and Assessed Lemon Bay Watershed Habitat Improvement Sites

Site	Proposed Activity	Hydrologic Benefit On-Site or to Downstream Waterbody	Potential UMAM Credits	Opinion of Probable Cost (2009 $)	Cost per Credit	Rank
South Venice Park 5	NA	NA	NA	NA	NA	NA
South Venice Park 9	NA	NA	NA	NA	NA	NA
Englewood McCall Road Site	Wetland Enhancement; Wetland Buffer Enhancement	Yes	0.9	$158,100	$175,666	1
South Venice Lemon Bay Preserve – North	Wetland Enhancement; Wetland Restoration	Yes	1.0	$181,600	$181,600	2
Alligator Creek CA – Woodmere Park	Wetland Enhancement	No	3.8	$283,800	$74,684	3
Englewood Sports Complex	Wetland Enhancement	No	0.9	$117,500	$130,555	4
South Venice Lemon Bay Preserve – South	Wetland Enhancement; Wetland Buffer Enhancement; Wetland Restoration	No	0.3	$95,300	$317,666	5

Table 3-9 Conceptual UMAM Analysis Summary Table for Proposed Habitat Improvement Sites in Lemon Bay

Site	Mitigation Activity	Assessment Area Acreage	Habitat Type (FLUCCS)	Location and Landscape Support		Water Environment		Community Structure		Time Lag	Risk Factor	Preservation Adjustment Factor	Relative Functional Gain	Functional Gain Units
				W/Out Mitigation	With Mitigation	W/Out Mitigation	With Mitigation	W/Out Mitigation	With Mitigation					
Englewood McCall Road Site	Wetland Enhancement	6	6170	3	3	5	8	6	9	1.03	1.25	NA	0.155	0.9
													TOTAL	**0.9**
South Venice Lemon Bay Preserve – North	Wetland Restoration	0.9	6400	6	6	0	8	0	8	1.03	1.25	NA	0.414	0.4
	Wetland Enhancement	3.9	3000	6	6	5	8	5	8	1.03	1.25	NA	0.155	0.6
													TOTAL	**1.0**
Alligator Creek CA – Woodmere Park	Wetland Enhancement	74	6300	4	4	7	7	6	8	1.03	1.25	NA	0.052	3.8
													TOTAL	**3.8**
Englewood Sports Complex	Wetland Enhancement	11	6300	7	7	7	7	6	9	1.03	1.25	NA	0.078	0.9
													TOTAL	**0.9**
South Venice Lemon Bay Preserve – South	Wetland Buffer Enhancement	0.6	1100	6	6	NA	NA	1	8	1.46	1.25	NA	0.128	0.1
	Wetland Enhancement	2	6180	6	7	8	8	6	9	1.03	1.25	NA	0.104	0.2
													TOTAL	**0.3**
ALL SITES TOTAL														**6.9**

A. South Venice Park 5

South Venice Park 5 is a small (approximately 5-acre) City of Venice park that fronts Flower Road in the northwest corner of the Lemon Bay watershed (Figure 3-55). This small park is characterized as Temperate Hardwood (FLUCCS Code 4250). The canopy is dominated by laurel oak (*Quercus laurifolia*) and live oak (*Q. virginiana*) while the understory is dominated by sabal palm (*Sabal palmetto*), elderberry (*Sambucus canadensis*), beautyberry (*Callicarpa americana*), grape vine (*Vitis rotundifolia*), wild coffee (*Psychotria nervosa*), and rustweed (*Vernonia* sp.). A few Brazilian pepper (*Schinus terebinthifolius*) are scattered around the site.

Jones Edmunds assessed soils in the center of the site where elderberry was fairly dense. Organic bodies were found within the upper 6 inches of the soil surface, indicating that the site may have had a higher water table in the past. A very wide (30 feet) and deep (6 feet) ditch runs along the west and south side of this site (Figure 3-56) and is likely dewatering this park site. To reduce this effect, a ditch block had been proposed at the south end of the park (Figure 3-57). However, based on a preliminary review of the County's Interconnected Pond Routing (ICPR) hydraulic and hydrologic stormwater model, any structures that obstruct this ditch will likely increase the probability of upstream flooding. Based on the lack of wetlands, the few exotic or nuisance species present, and the probability of increasing flood potential in the immediate area if a ditch block were installed, no habitat improvement activities are proposed for this site.

Figure 3-56 Large Perimeter Ditch at Venice Park 5

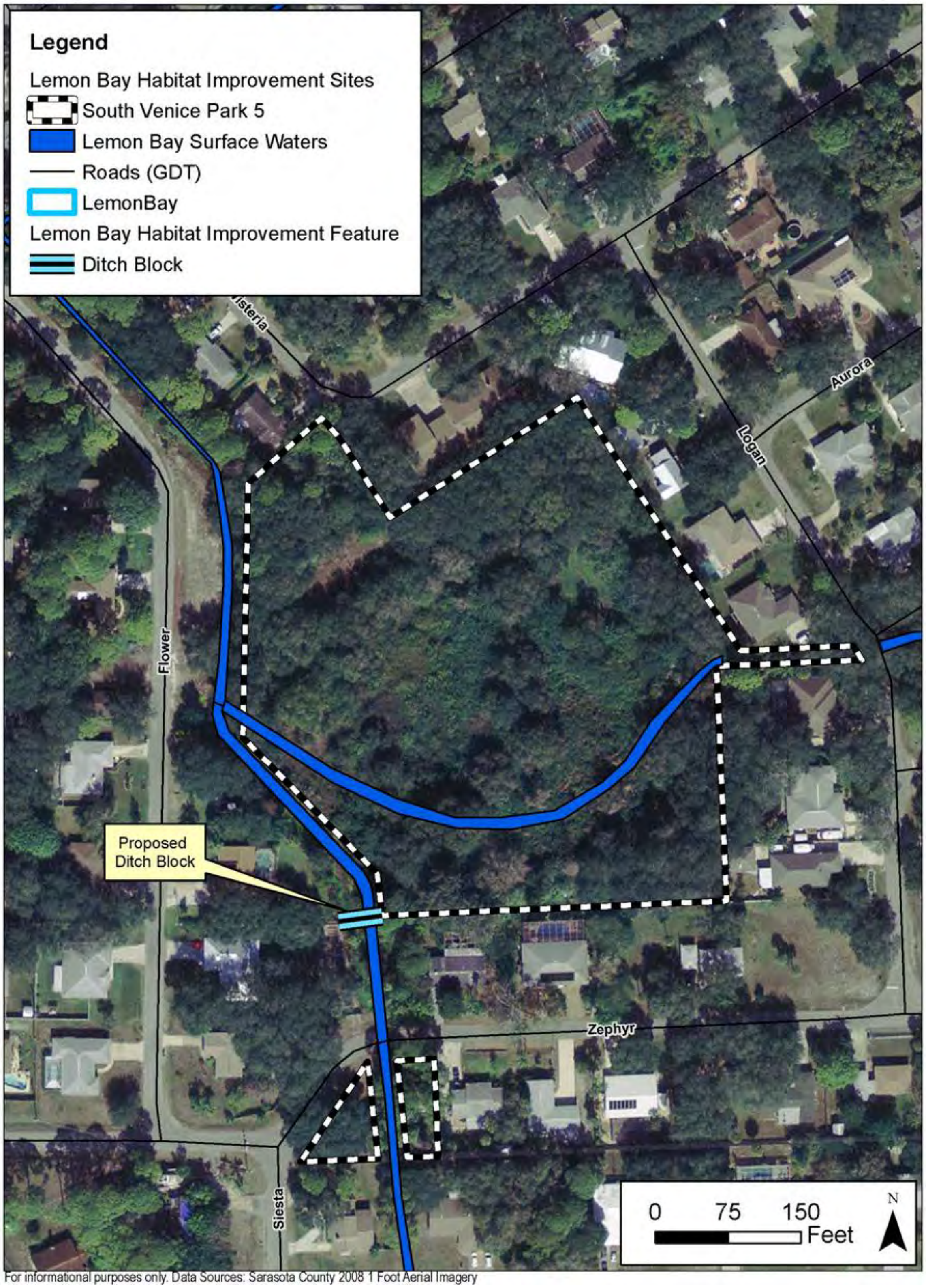


Figure 3-57 South Venice Park 5 Aerial Map

B. South Venice Park 9

South Venice Park 9 is another small urban park in the northwest region of the Lemon Bay watershed (Figure 3-58). The park is between Briarwood Road and Morningside Road east in a neighborhood on the east side of Tamiami Trail South. According to the 2007 Sarasota Native Habitat dataset, a large wetland was present on this site. However, a Jones Edmunds field inspection of the site determined that no jurisdictional wetlands were in the interior portions of the property (Figure 3-59). However, there were two jurisdictional upland cut surface waters, one that runs along the north side of the property and an isolated ditch/pond system on the south side (Figure 3-60). Based on the lack of wetlands, the few exotic or nuisance species present, and the small size of the surface water that could be restored, we propose no habitat improvement activities for this site.

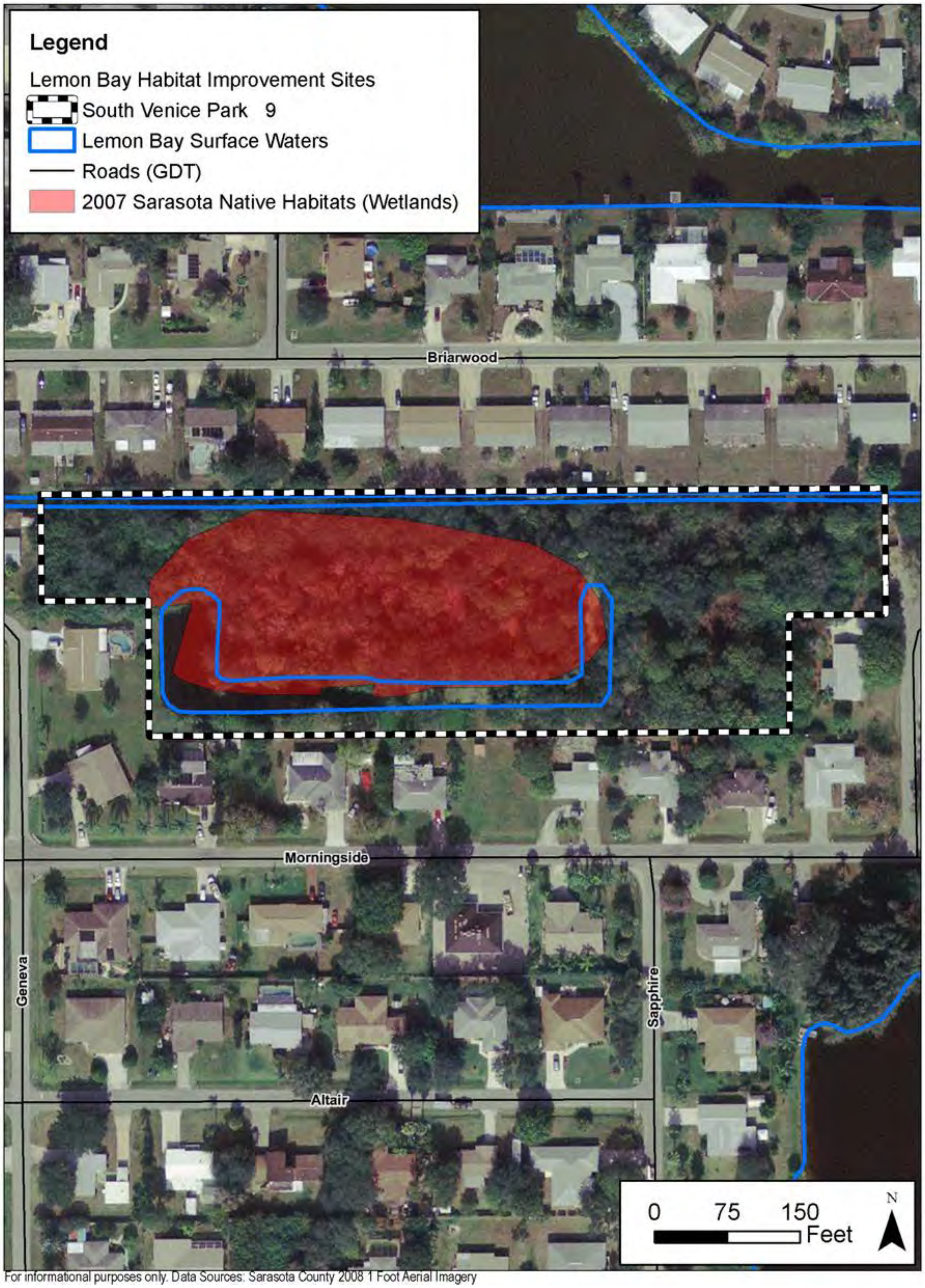


Figure 3-58 South Venice Park 9 Aerial Map

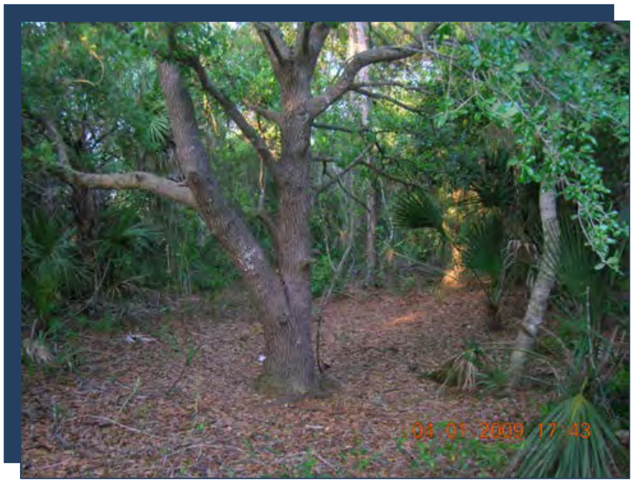


Figure 3-59 Uplands Found throughout South Venice Park 9

Figure 3-60 Ditch found along South Side of South Venice Park 9

C. Englewood McCall Road Site

1. Site Description

The Englewood McCall Road site is an approximately 18-acre County-owned property in the central region of the Lemon Bay watershed (Figure 3-55). It is bound on the west by North Elm Street and the east by North McCall Road (Figure 3-61). The on-site uplands are dominated by Pine Flatwoods (FLUCCS Code 4110) (Figure 3-62). Dominant species include longleaf pine (*Pinus palustris*), saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), bracken fern (*Pteridium aquilinum*), rusty lyonia (*Lyonia ferrunginia*), and grape vine.

An approximately 6-acre medium-quality Mixed Wetland Hardwoods (FLUCCS Code 6170) is located in the central region of the site. This wetland is dominated by red maple (*Acer rubrum*), cabbage palm (*Sabal palmetto*), dahoon holly (*Ilex cassine*), laurel oak, swamp dogwood (*Cornuus foemina*), iris (*Iris* sp.), pepper vine (*Ampelopsis arborea*), and Brazilian pepper seedlings. The exotic and invasive species Australian pine (*Casuarina equisetifolia*), Brazilian pepper, and creeping oxeye (*Wedelia trilobata*) are scattered throughout the wetland. A channelized ditch runs from the southeast corner through this wetland to a stormwater pond in the northwest corner of the property (Figure 3-63). Much pepper vine is encroaching into the wetland, which may indicate that this ditch is affecting the hydrology.

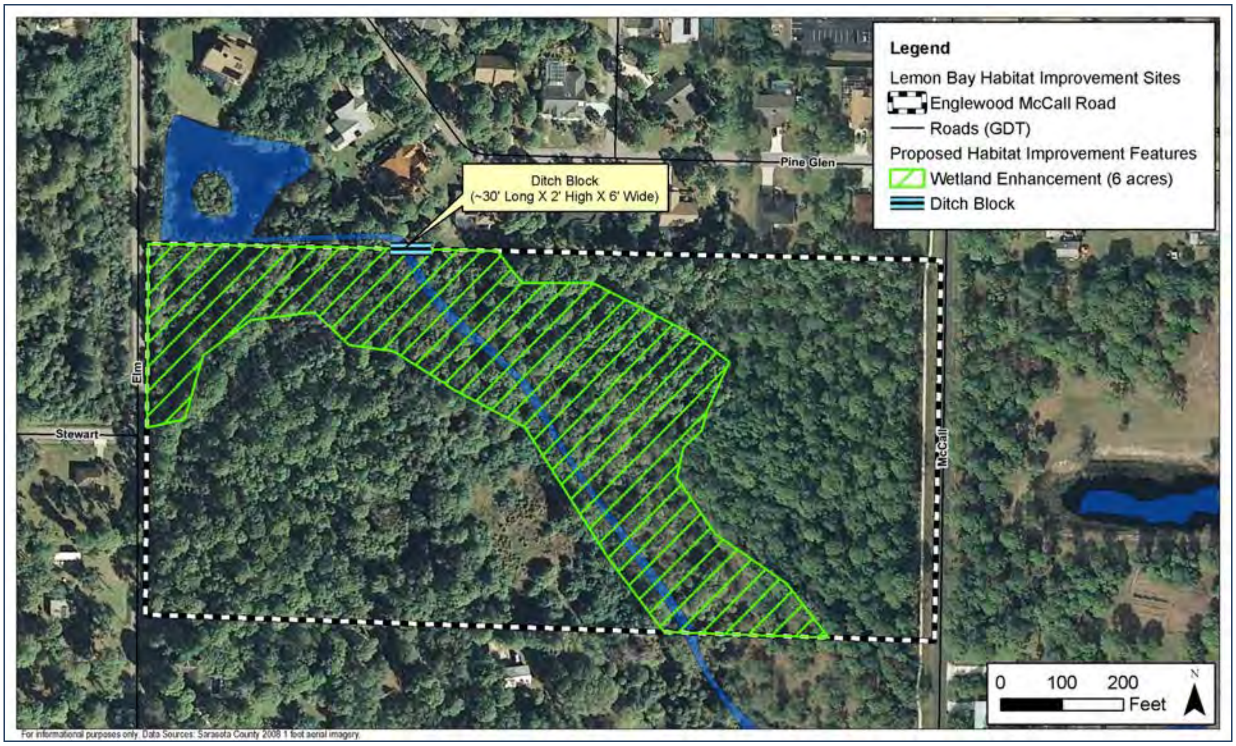


Figure 3-61 Englewood McCall Road Habitat Improvement Conceptual Design

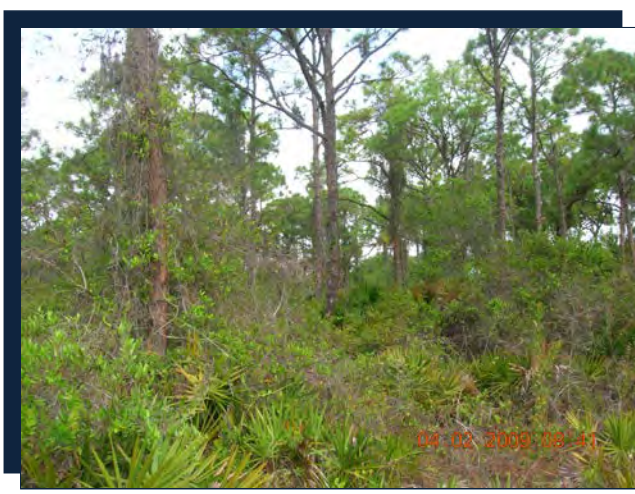


Figure 3-62 Englewood McCall Road Uplands Looking West

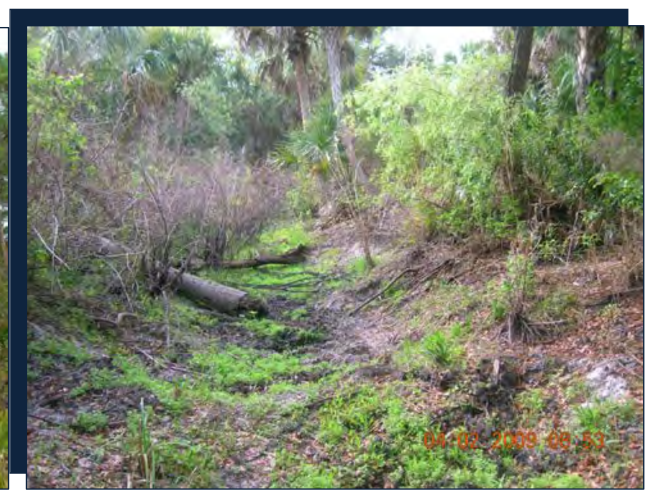


Figure 3-63 Englewood McCall Road Ditch Looking South

2. Proposed Habitat Improvement

Wetland Enhancement—Jones Edmunds proposes exotic species removal and hydrologic enhancement at this site to increase the habitat quality. We propose removing exotic species using a combination of manual removal and herbicide application to ground-cover species such as the abundant Brazilian pepper seedlings and creeping oxeye.

We propose a ditch block at the northern on-site limit of the ditch before it turns west and flows toward the stormwater pond (Figure 3-61). Local residents discussed flooding and high water problems in this area along their backyards during the summer. Installing a ditch block here will help to back water up into the site, rehydrate the on-site wetland and upland areas immediately adjacent to it, and may also reduce these flooding issues downstream of the ditch block. The ditch block will be constructed to span the width of the ditch and tie to existing adjacent grades and will be covered with a geofabric, and rip rap will be placed on both sides. The ditch is contained in the County's ICPR stormwater model. Based on a preliminary review of the model schematic, topography, and the location of the proposed ditch block, it appears that this proposed structure can be designed in such a way that would not increase the probability of upstream flooding of adjacent property owners. However, survey data and modeling of this proposed ditch block would need to be completed to confirm that flooding of adjacent property owners would not occur.

3. UMAM Analysis

Jones Edmunds conducted a preliminary UMAM analysis to quantify the ecological lift expected based on hydrologic enhancement and exotic plant removal discussed above. Wetland enhancement that entails removing exotic and invasive plant species were combined for this analysis because even if they were scored independently they would be scored the same and thus would generate the functional gain. Results of this analysis indicate that approximately 1 UMAM credit may be generated as a result of these activities (Table 3-9).

4. Opinion of Probable Cost

The opinion of probable cost for the proposed activities at the Englewood McCall Road Site is $158,100 (Table 3-10). This cost includes designing and obtaining permitting for the project, up to 4 years of exotic and invasive plant species maintenance, and annual monitoring for 4 years. Based on the preliminary UMAM analysis, this results in a cost per credit of $175,666 (Table 3-8).

5. Ranking

The Englewood McCall Road site ranked 1 due to the relatively low cost per mitigation credit that it would generate. This project will increase the habitat quality for the on-site wetland by removing exotic and invasive species and restoring the hydroperiod of on-site wetlands. The flooding frequency and stage behind homes at the north end of the site may also be reduced.

Table 3-10 Opinion of Probable Cost for McCall Road Habitat Improvement

JONES EDMUNDS — ENGINEERS | ARCHITECTS | SCIENTISTS

Sarasota County

OWNER:		ESTIMATED BY:		
Sarasota County		**JRM**		
CLIENT:		CHECKED BY:		
Sarasota County		**BJ**		
PROJECT TITLE:		APPROVED BY:		
McCall Road Habitat Improvement				
JONES EDMUNDS PROJECT NUMBER:		DATE:		
19006-015-04 Task 4320		**6/12/2009**		
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		CONSTRUCTION OR PROJECT ESTIMATE:		
Conceptual Plan Cost Estimate		**PROJECT ESTIMATE**		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Clearing and Grubbing	LS	0.5	$ 13,600.67	$ 6,800
Rubber Mats	EA	70	$ 80.00	$ 5,600
Earthen Ditch Block	CY**	13	$ 390.00	$ 5,200
Sod	SF	180	$ 30.55	$ 5,499
Riprap	SY	7	$ 120.90	$ 806
Geofabric	SY	7	$ 3.50	$ 23
Silt Fence	LF	84	$ 1.20	$ 100
Turbidity Barrier Floating (Multiple Use)	LF	40	$ 12.00	$ 480
Soil Tracking Prevention Device	EA	1	$ 3,300.00	$ 3,300
Maintenance of Exotic Species (4 Years)	ACRE	6	$ 500.00	$ 12,000
Monitoring (Baseline and 3 Years)	LS	1		$ 55,000
Design and Permitting	LS	1	$ 25,000.00	$ 25,000
Subtotal				$ 119,809
MOBILIZATION AND GENERAL CONDITIONS		10%		$ 11,981
Subtotal				$ 131,790
CONTINGENCY		20%		$ 26,358
OPINION OF PROBABLE CONSTRUCTION COST (ROUNDED)				**$ 158,100**

D. South Venice Lemon Bay Preserve – North

1. North Site Proposed Habitat Improvement

Wetland Restoration—Sarasota County recently completed a restoration project at this park that entailed regrading areas and installing a weir near Woodmere Creek South Branch. However, some areas were not graded down to wetland grade and thus are not sufficiently hydrated and are impounding water upstream of these areas (Figure 3-64 and 3-65). These areas comprise approximately 0.9 acre and will be graded down to the grade of adjacent wetlands. Native herbaceous wetland plant species found in adjacent Freshwater Marsh (FLUCCS Code 6410) communities such as sand cordgrass, soft rush, and maidencane (*Panicum hemitomon*) will be installed on the graded areas.

Wetland Enhancement—The wetland will be enhanced by hydrologically improving approximately 4 acres by grading down the high areas described above. This will restore the hydroperiod to downstream and upstream wetlands.

2. UMAM Analysis

Jones Edmunds conducted a preliminary UMAM analysis to quantify the ecological lift expected based on the proposed wetland enhancement activity. Results of this preliminary analysis indicate that approximately 1.0 UMAM credits may be generated if the County implements the four habitat improvement activities described above (Table 3-9).

3. Opinion of Probable Cost

The opinion of probable cost for the proposed activities at South Venice Lemon Bay Preserve – North is $181,600 (Table 3-11). This cost includes designing and obtaining permitting for the project, up to 4 years of exotic and invasive plant species maintenance, and annual monitoring for 4 years. Based on the preliminary UMAM analysis, this results in a cost per credit of $181,600 (Table 3-8).

4. Ranking

Due to the hydrologic enhancement that will occur at the site rather than just exotic species removal, this site was ranked 2. It could also potentially generate 1 UMAM credit for the County's use (Table 3-9).

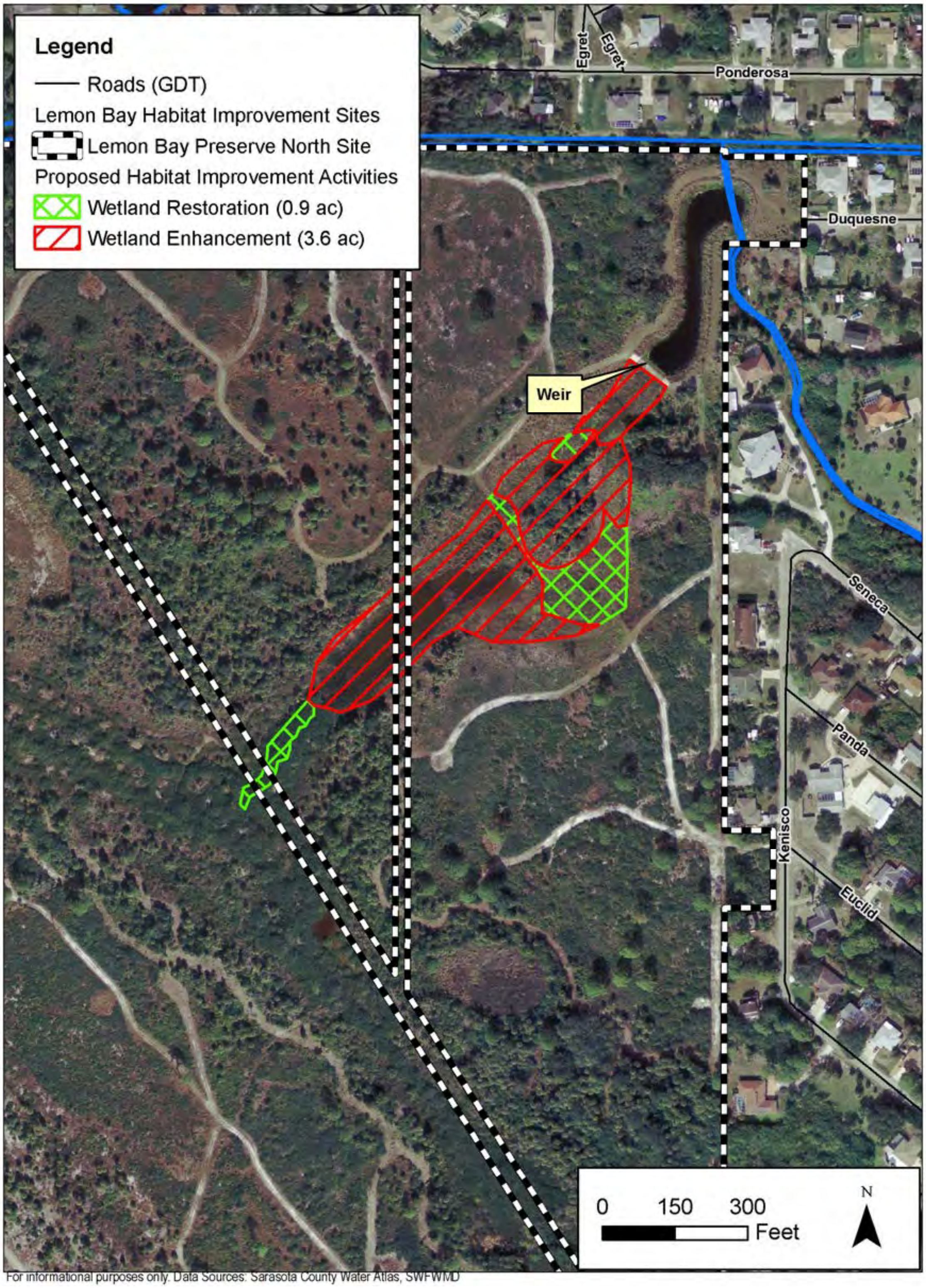


Figure 3-64 South Venice Lemon Bay Preserve North Site Habitat Improvement Conceptual Plan

Figure 3-65 Lemon Bay Preserve North

Table 3-11 Opinion of Probable Cost for South Venice Lemon Bay Preserve – North

JONES EDMUNDS
ENGINEERS | ARCHITECTS | SCIENTISTS

Sarasota County

PROJECT TITLE:				
South Venice Lemon Bay Preserve Habitat Improvement (North)		ESTIMATED B	**JRM**	
JONES EDMUNDS PROJECT NUMBER:		CHECKED BY	**BJB**	
19006-015-05		DATE:	**6/25/2009**	
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):		CONSTRUCTION OR PROJECT ESTIMATE:		
Conceptual Plan Cost Estimate		**PROJECT ESTIMATE**		
DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Excavation	CY	1,452	$ 22.96	$ 33,338
Silt Fence	LF	4,000	$ 1.50	$ 6,000
Turbidity Barrier	LF	200	$ 12.00	$ 2,400
Equipment Matting	EA	250	$ 80.00	$ 20,000
Planting	LS		$ 7,000.00	$ 7,000
Subtotal				**$ 68,738**
MOBILIZATION AND GENERAL CONDITIONS		10%		$ 6,874
Subtotal				$ 75,612
CONTINGENCY		20%		$ 15,122
Survey				$ 3,437
Geotechnical Investigation				$ 3,437
Design and Permitting				$ 25,000
Monitoring (Baseline and 3 Years)				$ 55,000
Maintenance of Exotic Species (4 Years)	ACRE	1	$500	$ 4,000
OPINION OF PROBABLE CONSTRUCTION COST (ROUNDED)				**$ 181,600**

E. Alligator Creek Conservation Area – Woodmere Park

1. Site Description

The Alligator Creek Conservation Area – Woodmere Park property is in the northeast corner of Lemon Bay watershed in the eastern region of the County (Figure 3-55). The County is pursuing the restoration of Alligator Creek in the southwest portion of Woodmere Park by re-creating stream sinuosity. Based on discussions with County staff and that the County was currently pursuing restoration activities in the southwest portion of the park, Jones Edmunds focused the habitat improvement site assessment on the northeast portion of this site where Alligator Creek crosses Venice East Boulevard (Figure 3-66).

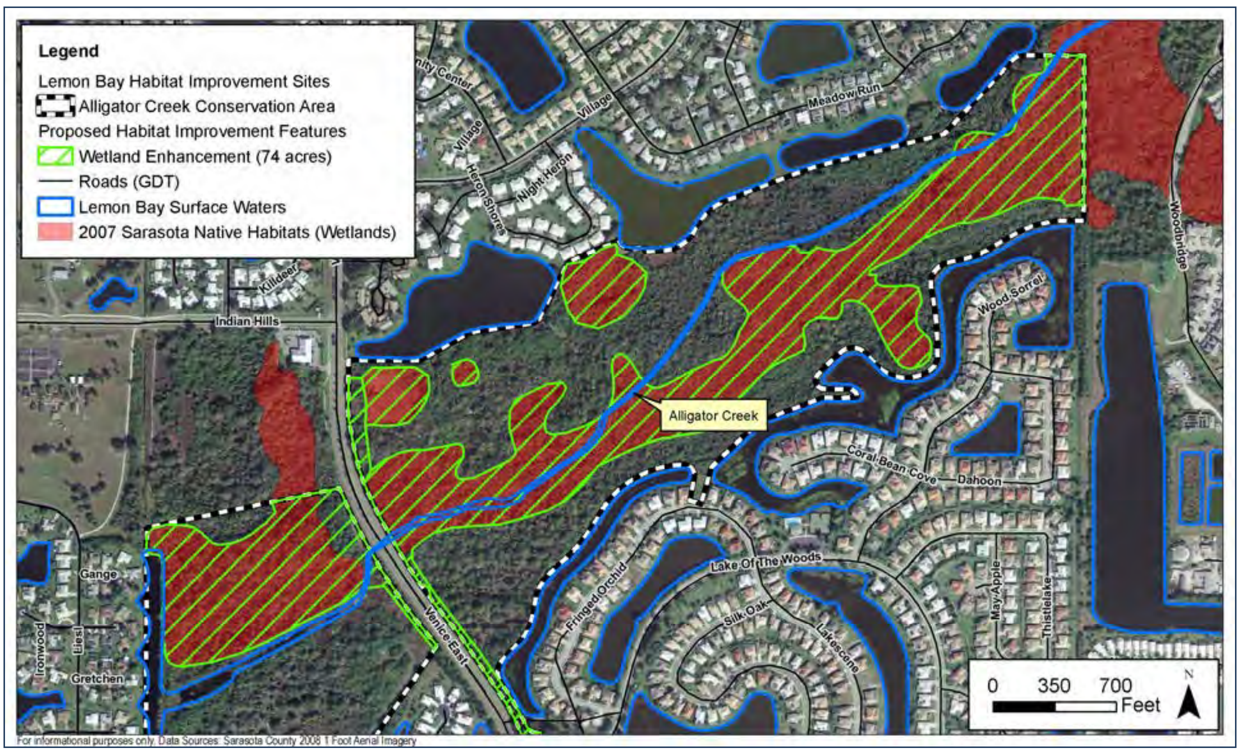


Figure 3-66 Alligator Creek Conservation Area Habitat Improvement Conceptual Plan

Alligator Creek upstream of Center Road is a channelized system with dense Brazilian pepper along the banks. Areas adjacent to the creek are characterized as Mixed Wetland Hardwoods (FLUCCS Code 6170). These wetlands are dominated by red maple, laurel oak, sabal palm, wax myrtle (*Myrica cerifera*), and swamp fern (*Blechnum serrulatum*). Brazilian pepper is also scattered throughout the wetland and along the road frontage. Temperate Hardwood (FLUCCS Code 4250) uplands dominate areas adjacent to wetlands. Even though Alligator Creek has been channelized, no obvious signs of dehydration or hydrologic impacts resulting from this channelization were observed in the wetland. There is a large double box culvert where Alligator

Creek crosses Center Road. No ponding was observed and biotic indicators did not indicate that the wetland around the culvert experienced artificially high stages. Thus, the culvert appears to provide sufficient conveyance capacity based on the lack of upstream ponding.

Wetlands associated with Alligator Creek downstream of Center Road are also characterized as Mixed Wetland Hardwoods (FLUCCS Code 6170). A large ditch runs north- south along the edge of the wetland. This ditch fades out at the north and south ends and thus is not hydrologically connected to any off-site surface water. Dense Brazilian pepper is found along the east side of this ditch. The wetland west of Center Road appears to experience much higher water levels based on the dominance of Carolina willow (*Salix caroliniana*) in several areas that exhibit adventitious roots approximately 2 feet above wetland grade. A large area of cattail (*Typha latifolia*) is on the south side of Alligator Creek.

Based on the lack of biotic indicators indicating hydrologic alteration, ditch blocks or other features are not proposed for Alligator Creek. Recreating sinuosity in the creek would result in considerable damage to the mature canopy on the upstream side of Center Road that has developed since the channelization. Thus, Jones Edmunds proposes no hydrologic habitat improvement projects for this site.

2. Proposed Habitat Improvement

Wetland and Wetland Buffer Enhancement—Jones Edmunds proposes wetland enhancement for approximately 74 acres of wetlands within the Alligator Creek watershed by removing exotic species, primarily Brazilian pepper (Figure 3-66). Exotic species removal will increase the habitat quality of the on-site wetland and reduce the further encroachment of these species.

3. UMAM Analysis

Jones Edmunds conducted a preliminary UMAM analysis to quantify the ecological lift expected based on the proposed wetland enhancement activity. Removing exotic species in this wetland will increase the Community Structure category in the UMAM. We expect that it will take at least 2 years of aggressive treatment to control Brazilian pepper, which is what the time lag factor incorporates and some amount of risk of recolonization by this species will remain. Results of this preliminary analysis indicate that approximately 3.8 UMAM credits may be generated if the County implements the wetland enhancement activity (Table 3-9).

4. Opinion of Probable Cost

The opinion of probable cost for the exotic species maintenance at Alligator Creek Conservation Area is $283,800 (Table 3-12). This cost assumes a cost of $500/acre for manual removal and spraying for the entire on-site wetland acreage. Since not all portions of the wetlands were groundtruthed, a more detailed site assessment should be conducted to determine the total acreage that requires treatment. This cost estimate also assumes 4 years of exotic and invasive plant species maintenance and annual monitoring for 4 years. Based on the preliminary UMAM analysis, this results in a cost per credit of $74,684 (Table 3-8).

Table 3-12 Opinion of Probable Cost for Alligator Creek Conservation Area

JONES EDMUNDS ENGINEERS | ARCHITECTS | SCIENTISTS — Sarasota County

OWNER:	ESTIMATED BY:
Sarasota County	**JRM**
CLIENT:	CHECKED BY:
Sarasota County	**BJ**
PROJECT TITLE:	APPROVED BY:
Alligator Creek Preservation Area Habitat Improvement	
JONES EDMUNDS PROJECT NUMBER:	DATE:
19006-015-04 Task 4320	**6/12/2009**
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):	CONSTRUCTION OR PROJECT ESTIMATE:
Conceptual Plan Cost Estimate	**PROJECT ESTIMATE**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Maintenance of Exotic Species (4 Years)	ACRE	74	$ 500.00	$ 148,000
Monitoring (Baseline and 3 Years)	LS	1		$ 55,000
Design and Permitting	LS	1	$ 12,000.00	$ 12,000
Subtotal				$ 215,000
MOBILIZATION AND GENERAL CONDITIONS		10%		$ 21,500
Subtotal				$ 236,500
CONTINGENCY		20%		$ 47,300
OPINION OF PROBABLE CONSTRUCTION COST (ROUNDED)				**$ 283,800**

5. Ranking

Although this site will generate the most UMAM mitigation credits (3.8) and have the lowest cost per credit, the site was ranked 3, primarily because exotic plant species removal will not provide downstream water quality or quantity improvements.

F. Englewood Sports Complex

1. Site Description

The Englewood Sports Complex is in the central region of the Lemon Bay watershed off South River Road (Figure 3-55). This property is approximately 137 acres and contains four main on-site wetlands: Wetlands A through D (Figure 3-67). Wetland A is an approximately 8.5-acre Wet Prairie (FLUCCS Code 6430) that is being extensively invaded by melaleuca (*Melaleuca alternifolia*) in a majority of the wetland (Figure 3-68). The wetland was extremely dry and loblolly pine (*Pinus taeda*) saplings were observed in the central portions of the wetland. Wetland A is dominated by St. Johns Wort (*Hypericum fasciculatum*), wax myrtle, Indian camphorweed (*Pluchea* sp.), yellow-eyed grass (*Xyris* sp.), spikerush (*Eleocharis* sp.), bog buttons (*Lachnocaulon* sp.), broomsedge (*Andropogon glomeratus*), and slender golden-top (*Euthamia minor*). High-quality pine flatwoods (FLUCCS Code 4110) dominated by longleaf pine (*Pinus palustris*), loblolly pine, sabal palm, saw palmetto, wax myrtle, grape vine, and shiny blueberry (*Vaccinium myrsinites*) are found adjacent to Wetland A.

Although this wetland appears extremely dry and is being encroached upon by more transitional species such as loblolly pine, slender golden-top, and broomsedge, no ditches or surface water features that may be draining this wetland were found. However, the Englewood Water District has numerous wells immediately west, which may be affecting the hydroperiod of these wetlands (Figure 3-67).

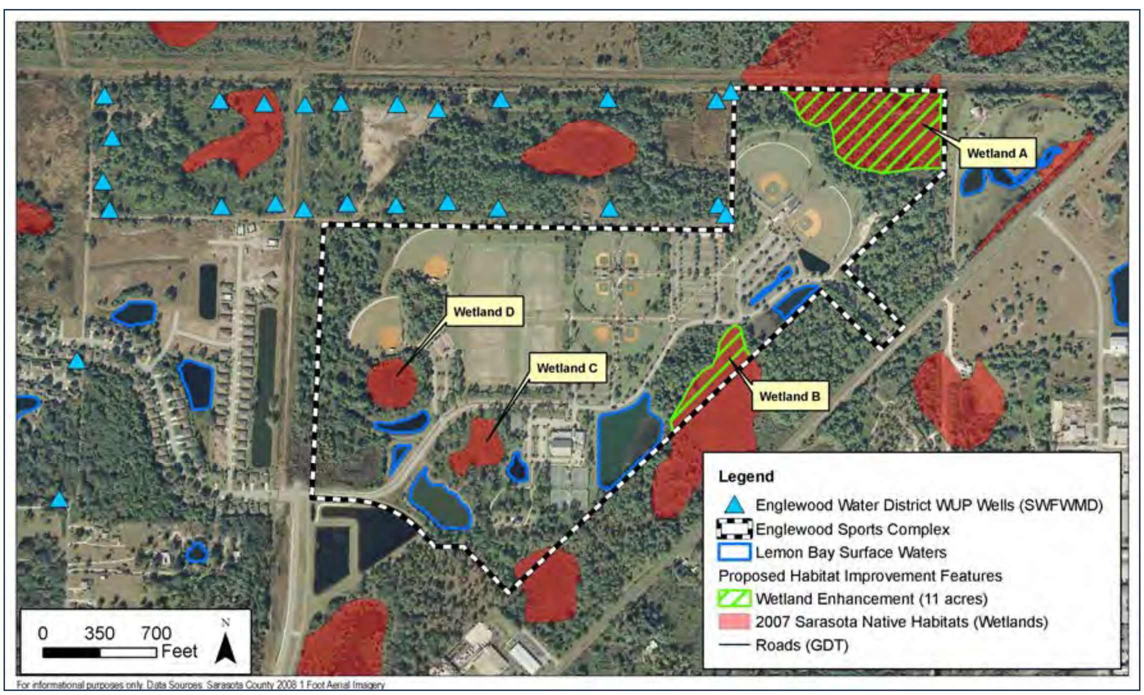


Figure 3-67 Englewood Sports Complex Place Habitat Improvement Conceptual Plan

Wetland B comprises approximately 2.2 acres and is also characterized as a high-quality Wet Prairie (FLUCCS Code 6430). This wetland is dominated by bluestem broomsedge (*Andropogon virginicus*), slender golden-top, sedges (*Cyperus* spp.), soft rush (*Juncus* spp.), and sand cordgrass (*Spartina bakerii*) (Figure 3-69). Melaleuca is in the center of the wetland, and Brazilian pepper is around the perimeter in some areas.

Due to the isolated nature of these wetlands and the lack of drainage features negatively affecting the hydrology, no hydrologic enhancement activities were identified for the on-site wetlands.

Figure 3-68 Englewood Sports Complex Wetland A

Figure 3-69 Englewood Sports Complex Wetland B

2. Proposed Habitat Improvement

Wetland Enhancement

For Wetlands A and B, Jones Edmunds proposes wetland enhancement by removing melaleuca and Brazilian pepper, which comprise approximately 11 acres. Removing these exotic species will increase habitat quality of the on-site wetland and reduce the further encroachment of these species.

3. UMAM Analysis

Jones Edmunds conducted a preliminary UMAM analysis to quantify the ecological lift expected based on the proposed wetland enhancement activity. Removing exotic species in this wetland will only increase the Community Structure category in the UMAM. We expect that it will take at least 2 years of aggressive treatment to control melaleuca, which is reflected in the time lag value. Some amount of risk of recolonization by this species will remain. Results of this preliminary analysis indicate that approximately 0.9 UMAM credits may be generated if the County implements the wetland enhancement activity (Table 3-9).

4. Opinion of Probable Cost

The opinion of probable cost for the proposed activities at Englewood Sports Complex is $117,500 (Table 3-13). This cost includes the design and permitting of the project, up to 4 years of exotic and invasive plant species maintenance, and annual monitoring for 4 years. Based on the preliminary UMAM analysis, this results in a cost per credit of $130,555 (Table 3-8).

5. Ranking

Because of the high cost of implementing the proposed activities and the proposed habitat improvement activities will provide no downstream water quality or quantity improvement, this site was ranked 4. However, these improvements would greatly enhance the habitat value of this park in the areas where they are proposed.

Table 3-13 Opinion of Probable Cost for Englewood Sports Complex Habitat Improvement

JONES EDMUNDS ENGINEERS | ARCHITECTS | SCIENTISTS — Sarasota County

OWNER:	ESTIMATED BY:
Sarasota County	**JRM**
CLIENT:	CHECKED BY:
Sarasota County	**BJ**
PROJECT TITLE:	APPROVED BY:
Englewood Sports Complex Habitat Improvement	
JONES EDMUNDS PROJECT NUMBER:	DATE:
19006-015-04 Task 4320	**6/12/2009**
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):	CONSTRUCTION OR PROJECT ESTIMATE:
Conceptual Plan Cost Estimate	**PROJECT ESTIMATE**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Maintenance of Exotic Species (4 Years)	ACRE	11	$ 500.00	$ 22,000
Monitoring (Baseline and 3 Years)	LS	1		$ 55,000
Design and Permitting	LS	1	$ 12,000.00	$ 12,000
Subtotal				$ 89,000
MOBILIZATION AND GENERAL CONDITIONS		10%		$ 8,900
Subtotal				$ 97,900
CONTINGENCY		20%		$ 19,580
OPINION OF PROBABLE CONSTRUCTION COST (ROUNDED)				**$ 117,500**

G. South Venice Lemon Bay Preserve – South

Two potential habitat improvement sites were identified within the South Venice Lemon Bay Preserve Park. They are referred to as South and North.

1. South Site Description

South Venice Lemon Bay Preserve South site is in the northwest region of the Lemon Bay watershed (Figure 3-55). The approximately 5-acre portion of this preserve that was assessed is at the end of Osprey Road and fronts Raven Road on its east side (Figure 3-70). It was a former homestead and the County recently demolished the home. An open grassed area along the west side of the property was the former maintained yard of the residence (Figure 3-71).

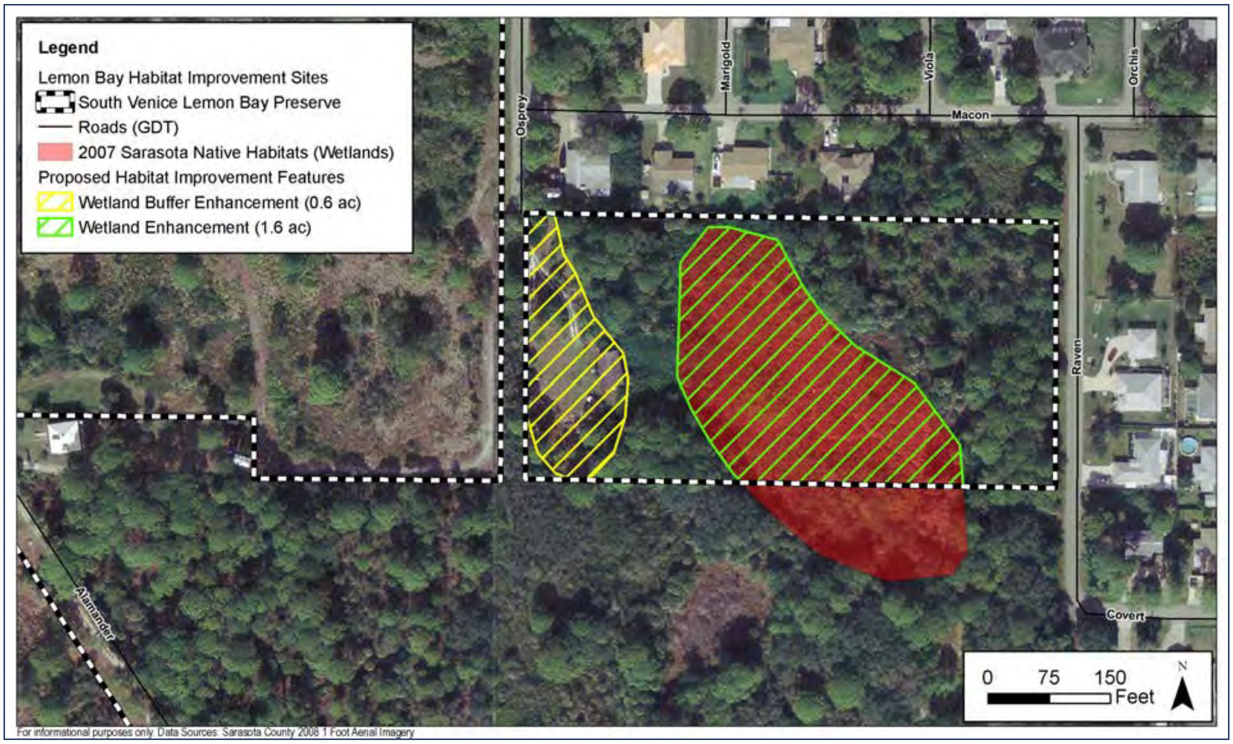


Figure 3-70 South Venice Lemon Bay Preserve South Site Habitat Improvement Conceptual Plan

This property contains an isolated approximately 2-acre wetland characterized as Willow and Elderberry (FLUCCS Code 6180) and is dominated by Carolina willow, saltbush (*Baccharis halimifolia*), primrose willow (*Ludwigia peruviana*), buttonbush (*Cephalanthus occidentalis*), duck potato (*Sagittaria lancifolia*), sand cordgrass, and Virginia chain fern (*Woodwardia virginica*) (Figure 3-72). Several large melaleuca trees are on the east side, Brazilian pepper is on the south side, and extensive areas of creeping oxeye are in the southern and eastern areas of the wetland (Figures 3-72 and 3-74). The adjacent uplands are dominated by high-quality pine flatwoods (FLUCCS Code 4110) (Figure 3-75).

Figure 3-71 Wetland Buffer Enhancement Area at South Venice Lemon Bay Preserve Habitat Improvement Site

Figure 3-72 Wetland Enhancement Area at South Venice Lemon Bay Preserve Habitat Improvement Site

Figure 3-73 Melaleuca at Wetland Enhancement Area at South Habitat Improvement Site

Figure 3-74 Creeping Oxeye at Wetland Enhancement Area at South Habitat Improvement Site

Figure 3-75 Adjacent Upland Habitat at South Venice Lemon Bay Preserve

2. South Site Proposed Habitat Improvement

Wetland Enhancement—Jones Edmunds proposes enhancing the wetland by removing melaleuca, Brazilian pepper, and creeping oxeye from the on-site wetland. Removing these exotic species will increase the habitat quality of the on-site wetland and reduce the further encroachment of these species.

Wetland Buffer Enhancement—We propose wetland buffer enhancement for the former home site along the west side of the parcel. This will improve the habitat quality of this wetland buffer, which will provide greater cover for wetland- and upland-dependent wildlife species and create a naturally vegetated corridor to the remaining portions of the park to the west. These areas are dominated by bahia grass (*Paspalum notatum*) and other ruderal species. The proposed wetland buffer enhancement entails planting native tree, shrub, and herbaceous species found in pine flatwoods. Native pine flatwoods species that could be considered for the wetland buffer enhancement area are listed in Table 3-14.

Table 3-14 Proposed Planting Plan for Honore Trail Park Wetland Buffer Enhancement Area

Common Name	Scientific Name
Longleaf pine	*Pinus palustris*
Wire grass	*Aristida stricta*
Muhly grass	*Muhlenbergia capillaris*
Gallberry	*Ilex glabra*
Saw palmetto	*Serenoa repens*

3. UMAM Analysis

Jones Edmunds conducted a preliminary UMAM analysis to quantify the ecological lift expected based on the proposed wetland enhancement activity. Results of this preliminary analysis indicate that approximately 0.3 UMAM credits may be generated if the County implements the four habitat improvement activities described above (Table 3-9).

4. Opinion of Probable Cost

The opinion of probable cost for the proposed activities at South Venice Lemon Bay Preserve – South is $95,300 (Table 3-15). This cost includes designing and obtaining permitting for the project, up to 4 years of exotic and invasive plant species maintenance, and annual monitoring for 4 years. Based on the preliminary UMAM analysis, this results in a cost per credit of $317,666 (Table 3-8).

Table 3-15 Opinion of Probable Cost for South Venice Lemon Bay Preserve – South

JONES EDMUNDS
ENGINEERS | ARCHITECTS | SCIENTISTS

Sarasota County

OWNER:	ESTIMATED BY:
Sarasota County	**JRM**
CLIENT:	CHECKED BY:
Sarasota County	**BJ**
PROJECT TITLE:	APPROVED BY:
South Venice Lemon Bay Preserve Habitat Improvement (South)	
JONES EDMUNDS PROJECT NUMBER:	DATE:
19006-015-04 Task 4320	**6/2/2009**
ESTIMATE TYPE (ROM, BUDGET, DEFINITIVE):	CONSTRUCTION OR PROJECT ESTIMATE:
Conceptual Plan Cost Estimate	**PROJECT ESTIMATE**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
Maintenance of Exotic Species (4 Years)	ACRE	2.6	$ 500.00	$ 5,200
Monitoring (Baseline and 3 Years)	LS	1		$ 55,000
Design and Permitting	LS	1	$ 12,000.00	$ 12,000
Subtotal				$ 72,200
MOBILIZATION AND GENERAL CONDITIONS		10%		$ 7,220
Subtotal				$ 79,420
CONTINGENCY		20%		$ 15,884
OPINION OF PROBABLE CONSTRUCTION COST (ROUNDED)				**$ 95,300**

3.1.4 Vegetative Buffers

3.1.4.1 Introduction

Vegetated buffers are strips of vegetated land that are ecologically and hydrologically connected to adjacent waterways such as creeks, rivers, marshes, and bays. Studies show that vegetative buffer zones protect, restore, and maintain the chemical, physical, and biological integrity of waterways. Vegetative buffers are highly effective at:

- Removing pollutants delivered in urban stormwater.
- Reducing erosion and controlling sedimentation.
- Protecting and stabilizing stream banks.
- Providing for infiltration of stormwater runoff.
- Maintaining base flow of streams.
- Contributing organic matter that is a source of food and energy for the aquatic ecosystem.
- Providing tree canopy to shade streams and promote desirable aquatic habitat, providing wildlife habitat.
- Furnishing scenic value and recreational opportunity

The effectiveness of a buffer is contingent upon its width and vegetative cover. Scientific literature supports a minimum buffer width of 100 feet (with 2 more feet per 1% slope) of native forest vegetation to provide sediment and contaminant control, quality aquatic habitat, and minimal terrestrial wildlife habitat. Buffers of at least 300 feet are, however, recommended to protect diverse terrestrial wildlife communities (Wegner, 1999). The technical literature is reviewed in *A Review of the Scientific Literature on Riparian Buffer Width, Extent and Vegetation*, which gives extensive scientific support for establishing and maintaining buffers along streams.

3.1.4.2 Established Buffer Regulations

To protect floodplain functions, including conveyance, storage, wildlife habitat, and water quality functions, Sarasota County's Land Development Regulation Subdivision Technical Manual requires the following:

- "No net encroachment will be allowed into a floodplain up to that encompassed by the 100-year event or on floodplain-associated soils defined in Sarasota County Comprehensive Plan Future Land Use Policy 1.1.6.
- Compensating storage shall be equivalently provided between the seasonal high water level and the flood level.

- ❖ Vegetative buffers shall be established between future development and watercourses, including bay waters. Buffer widths shall be measured landward from the top of bank or the landward extent of wetland vegetation.
- ❖ Minimum buffer widths shall be 50 feet.
- ❖ Specific buffer-width standards, or flood plain protection measures, or water quality enhancement measures that are equivalent in water quality treatment and habitat protection to a 50-foot-wide vegetated buffer and the [that] have been imposed or approved through a critical area plan, including a sector plan or corridor plan; a planned development district; a development of regional impact pursuant to Chapter 380, Florida Statutes; a regional watershed plan; or a development permit, as defined in Sarasota County Ordinance [No.] 89-103, as amended, issued by Sarasota County, shall supersede the buffer width standards contained in these regulations.
- ❖ Native vegetation shall not be removed from buffers except as necessary for the following:
    - County maintenance and access
    - Road and utility crossings
    - Nature trails
    - Access to water-dependent uses such as docks
    - Subdivision amenities such as golf course fairways when such crossings are unavoidable"

The Sarasota County Code of Ordinances, Article 4, Zoning Districts states that for parcels zoned as *Open Use Conservation District (OUC):*

- ❖ "The OUC District is intended to retain the open character of the land. This District is further intended to preserve and protect native habitats, wilderness areas, marsh lands, watersheds, water recharge areas, open spaces; park lands (unless otherwise zoned GU), scenic areas, historical and archaeological resources, and beaches. It is to be used to establish wildlife and open space corridors, as buffer areas to lands designated Public Resource Lands on the Future Land Use Map, to protect life and property in areas subject to flooding, and to conserve fish and wildlife. Permitted uses are restricted to conservation and, with certain limitations, recreation and other uses that are not contrary to the open character of the district."
- ❖ "This District is used to implement any designated land use area on the Future Land Use Map of the Comprehensive Plan."

The Special Purpose Overlay Districts *Conservation Subdivision (CS)* section states that for residential development, setback, and buffer requirements:

- "The landscape buffer shall be 20 feet wide. Landscape buffer areas are required as detailed below to protect and maintain the rural and agricultural character of the area. Landscape buffer areas are common facilities and shall be required as part of the open space around the residential development in a Conservation Subdivision. Vegetation within the buffer area shall generally be maintained in its natural condition, but may be modified to restore the overall condition and natural functions of the area. The minimum landscape buffer shall consist of four canopy trees and six understory trees per 100 lineal feet and a continuous hedge with a minimum height of 3 feet at planting."
- "The residential development shall be setback a minimum of 100 feet from all Conservation Subdivision property boundary lines and road rights-of-way. The landscape buffer described above shall be located in the required 100-foot setback and abut the entire perimeter of the residential development."

SWFWMD, in its *Environmental Resource Permitting Information Manual, Part B: Basis of Review for 40-D Rules* (SWFWMD, 2002), includes the following language pertaining to buffer widths:

- "Secondary impacts to habitat functions of wetlands associated with adjacent upland activities will not be considered adverse if buffers with a minimum width of 15 feet and an average width of 25 feet are provided abutting those wetlands that will remain under the permitted design, unless additional measures are needed for protection of wetlands used by listed species for nesting, denning, or critically important feeding habitat."
- "For projects located wholly or partially within 100 feet of an Outstanding Florida Water (OFW) or within 100 feet of any wetland abutting an OFW, applicants must provide reasonable assurance that the proposed construction or alteration of a system will not cause sedimentation in the OFW or adjacent wetlands and that filtration of all runoff will occur before discharge into the OFW or adjacent wetlands. Reasonable assurance is presumed if, in addition to implementation of the requirements in Section 2.8.2, one or more of the following measures are implemented:
    - Maintenance of a vegetative buffer consisting of an area of undisturbed vegetation that is a minimum of 100 feet in width landward of the OFW or adjacent wetlands. During construction or alteration of the system, all runoff, including turbid discharges from dewatering activities, must be allowed to sheet flow across the buffer area. Concentrated or channelized runoff from upstream areas must be dispersed before flowing across the vegetative buffer. Construction activities of limited scope that are necessary for the placement of outfall structures may occur within the buffer area.

- The structures described below must be installed or constructed at all outfalls to the OFW or adjacent wetlands before beginning any construction or alteration of the remainder of the system. These structures must be operated and maintained throughout construction or alteration of the permanent system. Although these structures may be located within the 100-foot buffer described in subparagraph (a) above, a buffer area of undisturbed vegetation that is a minimum of 25 feet in width must be maintained between the OFW or adjacent wetlands and any structure."

Through the Surface Water Improvement and Management (SWIM) program Model Ordinance project (SWFWMD, 1991); SWFWMD put forth the following recommendations with respect to suggested buffer widths:

- ❖ For maintenance of water quality in "municipal conditions," a minimum buffer width of 15 to 20 meters (49 to 66 feet) for low (0 to 3%) land slope conditions, with buffers as high as 80 meters (263 feet) for higher land slopes in the 60% range.
- ❖ For water quantity maintenance, a buffer width that ranged from 30 feet to 550 feet was recommended. The actual buffer within that range would depend on site-specific hydrologic conditions.
- ❖ For water quality maintenance, buffer widths ranging from 75 feet to perhaps as wide as 450 feet, depending on site-specific measurements of particle size for sediments that could be carried to a water body through runoff. Average conditions in East Central Florida were taken to generally represent conditions within the SWFWMD.
- ❖ For protection of wildlife habitat, buffer widths ranging from 322 feet to 732 feet, depending on the type of water body being targeted for protection and the predominant types of indicator species that utilize the water body for sustenance. Lower buffer widths may be possible for water bodies of lesser quality. Site-specific evaluation would be necessary to set an appropriate buffer width for wildlife habitat protection.

3.1.4.3 Methods

Jones Edmunds estimated naturally vegetated buffer zones around water courses to identify areas in compliance with current County setback regulations. To make this estimate, we completed a GIS analysis of spatial coverages, including SWFWMD's 2007 land use and the County's parcels and water features coverages. A 50-foot buffer was added to the major waterways features in the County's water features GIS coverage. A 50-foot buffer width was selected to correspond with the County's existing LDRs. Areas within this 50-foot buffer were classified as developed where the 2007 land use coverages are urban and built up; transportation, communication, and utilities; and disturbed land. Remaining areas were classified as undeveloped. Results of these efforts show that an estimated 49% of the Lemon Bay watershed currently has undeveloped parcels within a 50-foot buffer area adjacent to its waterways. The developed and undeveloped areas around waterways are highlighted in Figure 3-76. Since much of the development within the watershed likely occurred before the County's current setback requirements, many of the developed parcels do not meet the current requirements.

3.1.4.4 Results and Discussions

To calculate a more refined percent compliance, a detailed study is recommended. This study would entail a GIS analysis of spatial coverages including parcels, year built, zoning, and land use. In addition, visual inspection to measure the widths and types of vegetative cover along waterways is necessary for accuracy. With data from this analysis, the County could identify both areas to be maintained in their natural vegetated state and areas to be targeted for improvements. For the latter properties, we recommend restoring and establishing vegetated buffer zones along waterways.

Figure 3-76 Lemon Bay Watershed – Waterway Buffer Zones

3.1.5 Preservation Area Mapping

3.1.5.1 Introduction

Sarasota County incorporates natural resource protection requirements in its LDRs. One of these requirements is a 30% open space requirement for developments that prioritize natural communities such as wetlands, mesic hammocks, and coastal hammocks. Additional requirements include 30-foot wetland buffers, 33% littoral shelf for stormwater treatment ponds, and a 50-foot buffer around all water courses (Section 3.1.4). Most of these preservation and littoral shelf areas scattered throughout the County are primarily inventoried on hardcopy development plans. To consolidate these protected and important resources into a single easily accessible location, the County has been scanning, georectifying, and digitizing these areas from the hard-copy development plans that date back to the 1980s. The intent is to generate a single County-wide GIS dataset that can be used by County staff for numerous purposes such as future development reviews, land acquisition, compliance, etc.

3.1.5.2 Methods

Jones Edmunds obtained hardcopy plan sets from the County for seven developments in or near Lemon Bay watershed and an ESRI® ArcGIS™ geodatabase containing polygons for preservation and littoral shelves in developments previously digitized by County staff (Table 3-16). The plan sets were scanned into TIFF format and georeferenced in ArcMap™ using a second-order polynomial transformation that requires a minimum of four ground control points (GCP). The Sarasota County 2008 parcel dataset was used for all GCPs when available. If parcels in and around the development were not available, other features such as roads or buildings were used. GCPs were placed until the root mean square error for the transformation of the scanned document was less than 1 foot. More details of the rectification process are outlined in the *Preserve Area Mapping SOP* available from the Natural Resources Department.

Table 3-16 Preservation Area Mapping Developments in Lemon Bay Watershed

Development Name
Boca Royale
Englewood Family YMCA
Hidden Palms – Alligator Place
Lemon Bay Estates
Sarasota National
Skip Stasko Park
Stillwater

Jones Edmunds digitized all conservation easements, preservation areas, wetland buffers, and stormwater littoral shelves from the georectified plan documents at a scale of 1:600. The conservation easement and preservation area polygons were snapped to 2008 Sarasota County parcel boundaries. Keeping the conservation and preservation area features relative to the parcel information allows for easier future adjustments if the land base data changes. Jones Edmunds then attributed polygons based on the *Preserve Area Mapping SOP* and correspondence with the Natural Resources Department. However, all polygons digitized by Jones Edmunds were attributed with "Jones Edmunds" in the *SOURCE* field of the geodatabase.

3.1.5.3 Results and Discussions

Jones Edmunds generated 162 polygons representing preservation areas, conservation areas, wetland buffers, wetlands mitigation areas, or littoral shelves for developments that were built within Lemon Bay watershed since the 1990s (Figure 3-77). The polygons will help County staff keep an inventory of preservation areas in the County and help them make more informed decisions regarding developments adjacent to these protected areas. Results of this task were also used in the *Lemon Bay Public Lands Gap Analysis* to identify future acquisition priorities.

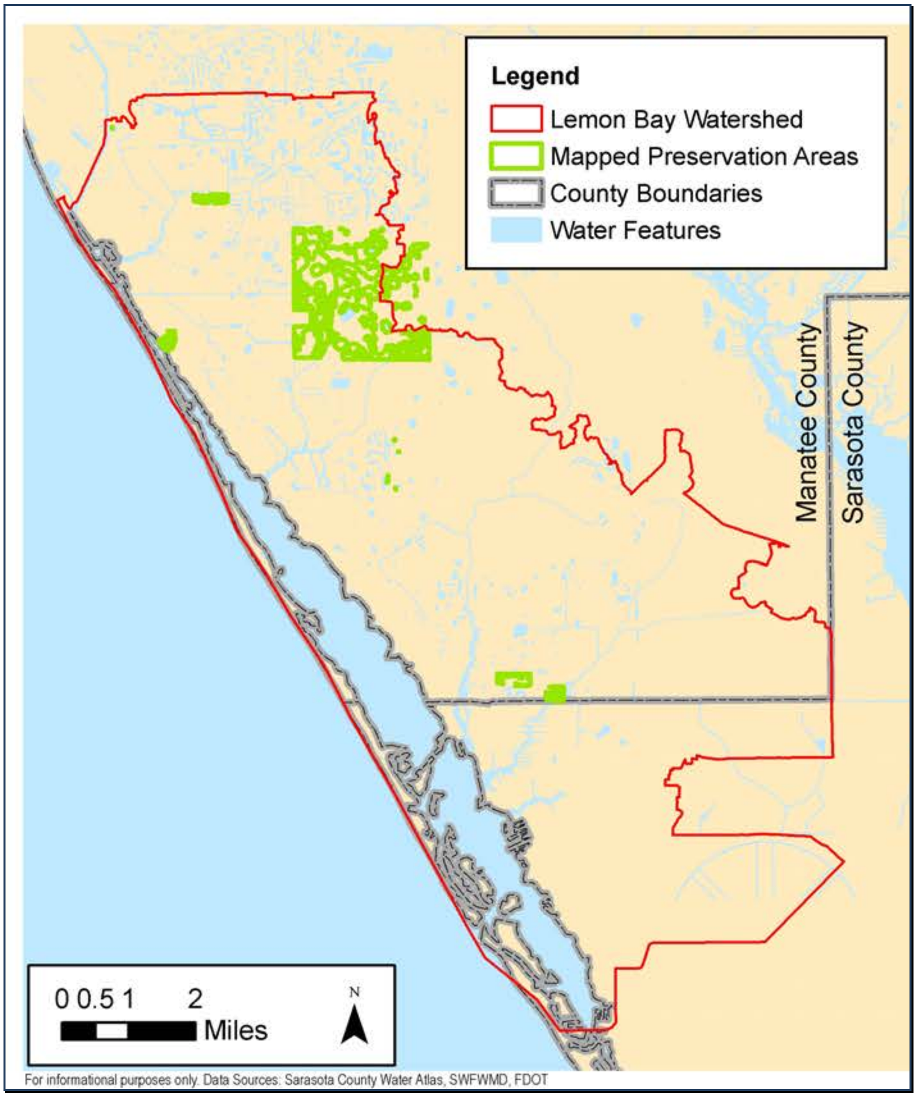


Figure 3-77 Preservation Areas Mapped by Jones Edmunds in Lemon Bay Watershed

3.2 ESTUARY

Estuaries are highly productive natural systems that provide vital habitat for many species of fishes, birds, invertebrates, and plants. Supporting the biodiversity of estuaries is paramount to maintaining estuarine food webs. Natural estuarine systems such as seagrasses, emergent vegetation, oyster reefs, and sediment processes all play an important role in contributing to dynamic estuarine food webs. Healthy estuarine food webs contribute to offshore fisheries production and support valuable economic drivers important to Florida's success.

Estuaries are highly productive natural systems that provide vital habitat for many species of fishes, birds, invertebrates, and plants.

The Lemon Bay watershed includes the Alligator Creek basin, the Woodmere Creek basin, the Forked Creek basin, the Gottfried Creek basin, the Ainger Creek basin, and the Lemon Bay coastal area. The estuarine system is dominated by mangrove, seagrass, and oyster communities and was designated as an aquatic preserve in 1986 (FDNR, 1992). While much of the watershed remains undeveloped, the developed portions of the watershed have impacted estuarine water quality (Tomasko et al., 2005).

The following sections of this chapter identify the valued natural systems found in the Lemon Bay estuary and describe the following aspects of the estuary:

- General ecology.
- Current status with respect to anthropogenic impacts.
- Contributing ecological function.
- Potential use as indicators of estuarine health.

3.2.1 Critical Natural Resources

3.2.1.1 Shorelines

Shorelines define the land-water interface and are ecological transition zones between terrestrial and aquatic life. Shorelines include a littoral zone where diverse habitat types affect the organization of floral and faunal assemblages and the interactions between terrestrial and aquatic plants and animals. Human alteration of estuarine shorelines accompanied the rapid movement of human populations toward coastal environments during the 20th century. Florida's human population expansion in the mid-20th century led to unprecedented shoreline alterations via mechanical dredging and filling of coastal shorelines, which resulted in extensive canalization of coastal areas and hardening of large expanses of previously natural shoreline areas. Shoreline hardening in Florida generally consists of concrete seawalls or bulkheads comprised of concrete or limestone rubble (i.e., riprap). Much of this hardening was intended to define lots for development, increase accessibility to estuarine and coastal waters for recreation, and protect against erosional forces that naturally occur in coastal systems. These shoreline alterations have had profound effects on Florida's natural systems.

In Lemon Bay, shorelines have been altered as a result of natural events and dredge-and-fill projects designed to increase human accessibility to estuarine and coastal waters, primarily for recreation. Characterizing the extent of shoreline modification in Lemon Bay and estimating the change in natural shorelines from historic conditions is important to the WMP. Historical information was available to estimate the extent of historical modified shoreline based on digitized USGS 1:24,000, 7.5-minute quadrangle maps (quad sheets) and aerial photographs from 1948. This information was used to define historic conditions before major shoreline modification occurred in Lemon Bay. Janicki Environmental used GIS (ArcGIS9.1) along with the digitized quad sheets and aerials to delineate modified and natural shorelines as an approximation of historic condition. While the photographs allow for a higher resolution to digitize the location of the shoreline, the quad sheets include a legend that indicates areas known to be mangrove, woods, or brushwood. When combined, these data sources allowed us to estimate the extent of "modified" and "natural" historic shorelines.

Historically, Lemon Bay had 92 kilometers of shoreline, approximately 5.8 kilometers of which were modified (Figure 3-78). To compare this estimate to current conditions, the latest SWFWMD shoreline coverage (2005) was used to visually identify areas that were obviously modified by human activity and also to identify areas where shorelines have naturally been altered. The historical quad sheets are again used here to illustrate the extent of shoreline modification in Lemon Bay. Obvious shoreline modifications in the form of finger-fill canals have taken place along the eastern shoreline in Lemon Bay, notably around Oyster Creek; however, surprisingly much of the canalization along the tidal tributaries occurred before the 1950s (Figure 3-79). Other noteworthy areas of shoreline modification include the bay side of Manasota Key and the southern extension of Manasota Key shoaling the entrance to Stump Pass.

The Charlotte Harbor National Estuary Program (CHNEP) funded a characterization of the existing shoreline in Lemon Bay (Photoscience, 2008). This study provides estimates of the extent of shoreline hardening within the study area. Approximately one-half of the Lemon Bay shoreline is comprised of manmade shoreline in Lemon Bay. The primary classes of manmade shorelines included seawalls and null (indeterminate). Vegetated shorelines in Lemon Bay account for approximately one-half of the total shoreline. Mangroves comprise nearly two-thirds of the vegetated shoreline length in Lemon Bay.

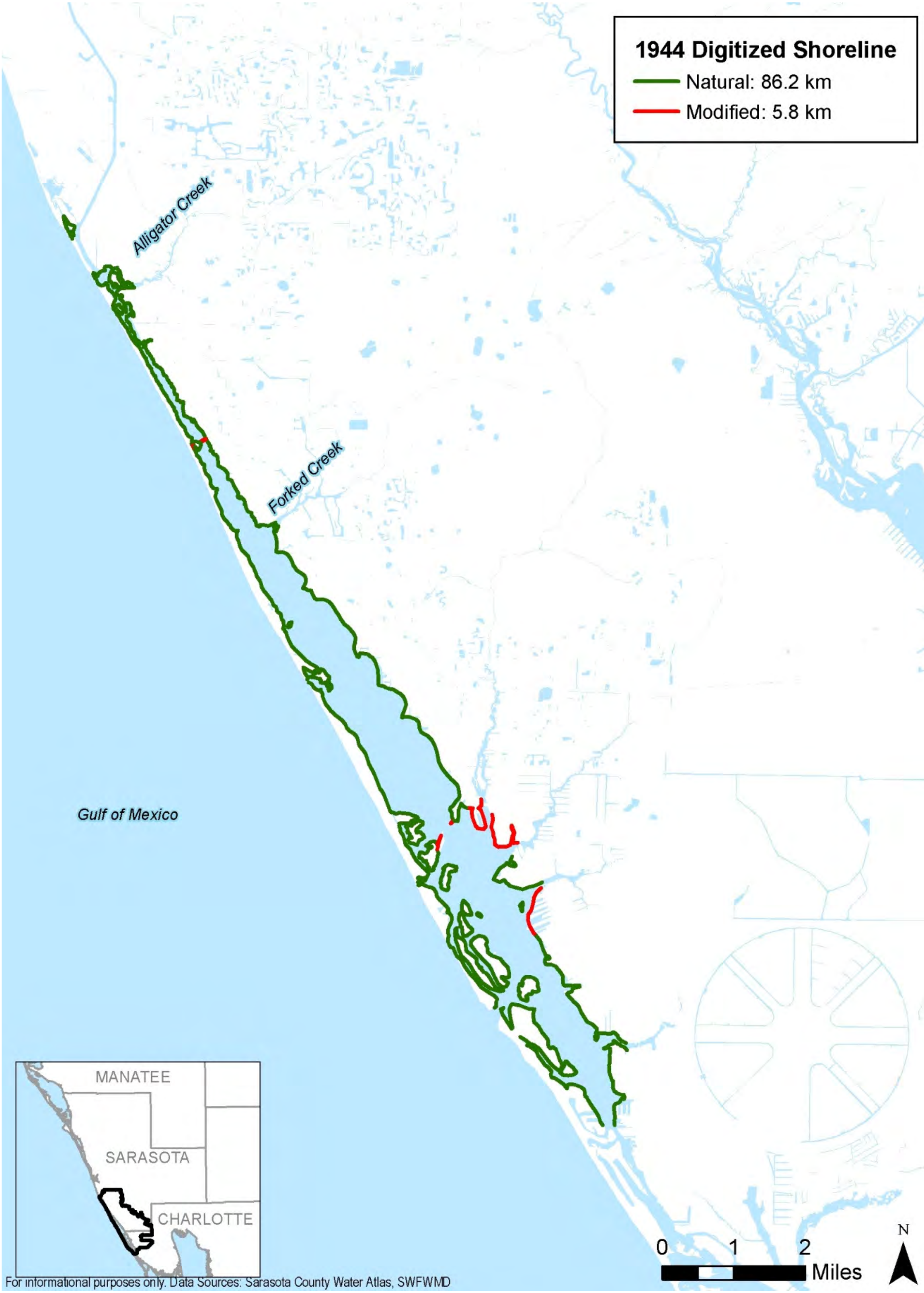


Figure 3-78 Historical Shorelines in Lemon Bay, Florida (1944)

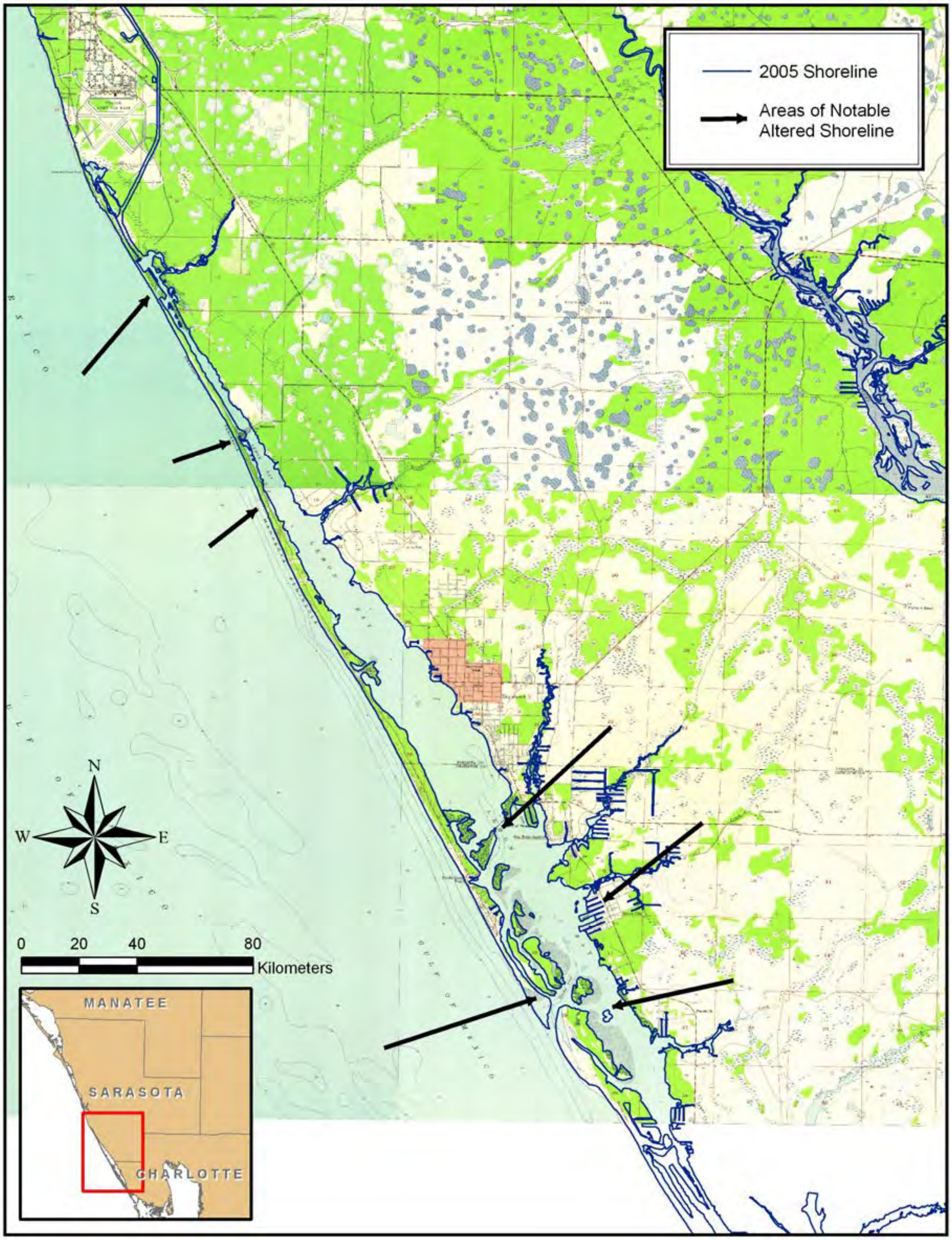


Figure 3-79 SWFWMD 2005 Shoreline Overlaid on 1944 Quad Sheets. Areas of Notable Altered Shoreline Denoted by Black Arrows.

3.2.1.2 Sediments

Sediments are a natural and important part of estuarine processes, and managing sediment accumulation is a large part of the watershed management process in Sarasota County. In fact, as part of the WMP for Lemon Bay, a detailed and specific sediment management plan has been developed (Appendix C). Below is a brief description of how sediments affect the valued natural resources of the Lemon Bay estuary.

Sedimentation creates shoals and substrate for emergent vegetation in estuaries. Sediment characteristics define the types of organisms that inhabit the sediments. For example, animals that build tubes require particular sizes of sediment particles. Some polychaete worms prefer finer-grained sediments while mud-sized sediments generally do not support a healthy benthic community. Amphipod crustaceans that consume bacteria and algae from sand grains are generally not found in muddier sediments. Therefore, sediment characterization is an important part of understanding the estuarine ecosystem functions likely to occur in the estuary. Sediments are also of interest because anthropogenic contaminants (e.g., metals, pesticides, hydrocarbons) can bind to the smaller particles. To the best of our knowledge, there are no sediment contaminant data for Lemon Bay (cf. Seal et al., 1994; Florida Fish and Wildlife Research Institute, unpublished data).

Similar to shorelines, the time scale on which sediment characteristics change in Lemon Bay does not lend itself to routine monitoring but should be understood as a critical element of understanding estuarine system dynamics. Most of the sedimentation in Lemon Bay occurs in the watershed portion rather than the estuary, and therefore discussion of how sediments are managed in the watershed will be addressed elsewhere in this document. The effects of sediments on emergent vegetation and benthos are described in their respective sections in this chapter.

3.2.1.3 Mangroves and Other Emergent Vegetation

Estuaries are often fringed by marshes and, in tropical and subtropical latitudes, mangroves. This emergent vegetation helps to stabilize shorelines; reduces erosion; provides nursery and protective habitat; and can sequester sediments, nutrients, and contaminants that enter the estuary from precipitation and runoff. Emergent vegetation provides habitat for animals that favor estuarine/marine muddy intertidal habitats as well as animals found in terrestrial woodlands (Hutchings and Saenger, 1987). Based on measurements of plant biomass and litter (particularly fallen leaves), mangroves can be highly productive. The litter supports a detritus-based community in the mangrove forest itself and by its export to estuarine and coastal environments (Odum et al., 1982; Hutchings and Saenger, 1987).

Authority for regulating trimming of mangroves by private property owners was established by the 1996 Mangrove Trimming and Preservation Act. Two recent studies of mangroves in Sarasota County have been completed (Sarasota County, 2006 and 2009). The objectives of these surveys included the following:

- Investigating the condition of mangroves in Sarasota County in areas including shorelines open to the bays and some creeks and bayous.
- Determining the level of compliance to the 1996 Act.
- Collecting information requested from the Sarasota County Commissioners to help decide "whether the County should pursue delegation of authority from the FDEP" to regulate trimming and altering mangroves.

The first year of surveys (2004) was limited to inspection of shorelines open to the bays in unincorporated portions of the County. In 2004 the number of sites or parcels inspected was 2,285. Major areas included:

- Roberts Bay North
- Grand Canal
- Little Sarasota Bay
- Blackburn Bay
- Lyons, Dona, and Roberts Bays
- Lemon Bay

County staff inspected parcels of property (a parcel is defined as an individual property listed on County records) where at least 30% of the shoreline was vegetated with mangroves (Figure 3-80). Recent trimming activity was noted, with evidence of cutting within the last year including uniform height across a parcel, obvious cut stems, and comparison with natural vegetation in adjacent areas (Figure 3-81). The height of mangroves was visually estimated and recorded in four categories: <6 ft, 6 to 10 ft, 10 to 20 ft, >20 ft (Figure 3-82). Alleged violations were noted and sent to the FDEP for investigation (Figure 3-83).

Figure 3-80 A Typical Non-Mangrove Shoreline on the Left Compared to a Trimmed Mangrove Shoreline on the Right

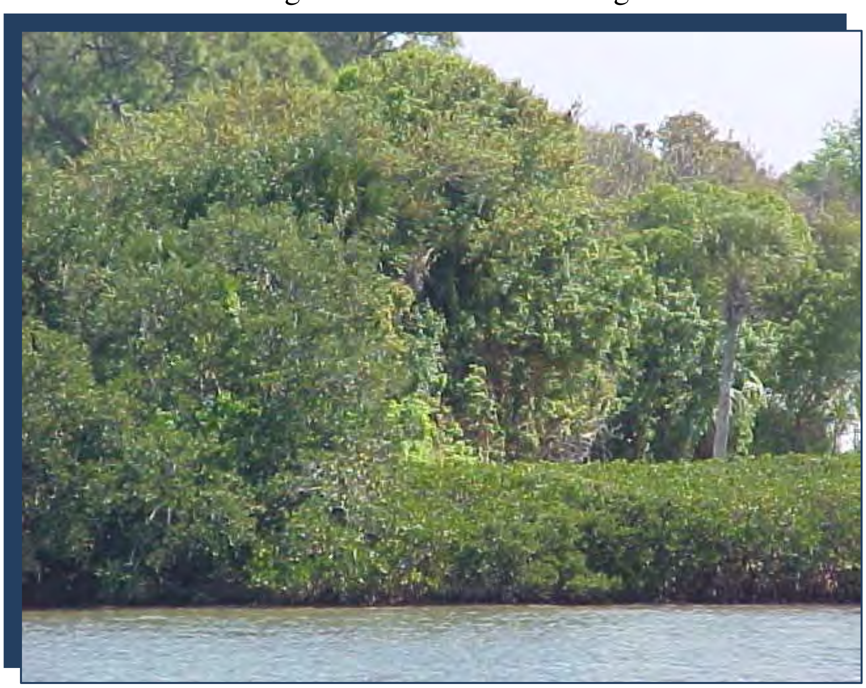


Figure 3-81 Natural Mangrove Shoreline on Left Compared to a Trimmed Mangrove Shoreline on Right

Figure 3-82 Mangrove Shoreline on Left Trimmed to Approximately 6 feet with a Mangrove Shoreline trimmed to < 6 ft. on Right

Figure 3-83 Over-Trimmed Mangroves Showing Signs of Defoliation and Die-back

The following surveys (2005 and 2007) were more comprehensive, expanding the survey area and the information collected. The same methods of surveying were used as in 2004. In addition, parcels with exotic vegetation and parcels with natural shorelines without vegetation that might be candidate areas for establishment of new groves of mangroves were noted (Figure 3-84). Hardened shorelines were not counted in areas considered to have good possibility for establishing new groves. However, established groves that had hardened shorelines on the land-side of the groves were counted in parcels for surveying. The 2005 and 2007 mangrove surveys included all of the shoreline parcels in the 2004 survey, plus additional parcels on shorelines along creeks and bayous in Sarasota County, including Phillippi Creek, Shakett Creek, Alligator Creek, Forked Creek, Gottfried Creek, and others. The 2005 survey included 5,619 sites/parcels and the 2007 study included 5,730 sites/parcels, more than double the amount of sites/parcels in the 2004 study. While an additional 116 sites/parcels were surveyed in 2007, all of those parcels fell within the geographical limits of the 2005 study area.

Figure 3-84 Natural Shoreline Dominated by the Exotic Brazilian Pepper

For a parcel to be considered a mangrove shoreline, mangroves were required to occupy approximately at least 30% of the parcel's shoreline. Fifty-seven percent of the parcels in the Lemon Bay watershed study area met the mangrove coverage criteria to be surveyed in the 2007 Sarasota County Mangrove Trimming study (Figure 3-85). Forty-three percent of the parceled were considered to have non-existent mangrove coverage and were not surveyed in the study.

The results of the 2007 survey are shown in Figure 3-86 and 3-87. Sixty-three percent of the parcels surveyed contained untrimmed mangroves and the other 37% had trimmed mangroves. Ninety-nine percent of the untrimmed mangrove parcels had mangroves over 6 feet (Figure 3-88). Sixty-six percent of the trimmed mangrove parcels contained mangroves trimmed to a height of 6 feet or higher (Figure 3-89). The Lemon Bay watershed study area hosts many opportunities for mangrove enhancement with approximately 400 sites/parcels identified as having planting opportunities and exotic removal (Table 3-17).

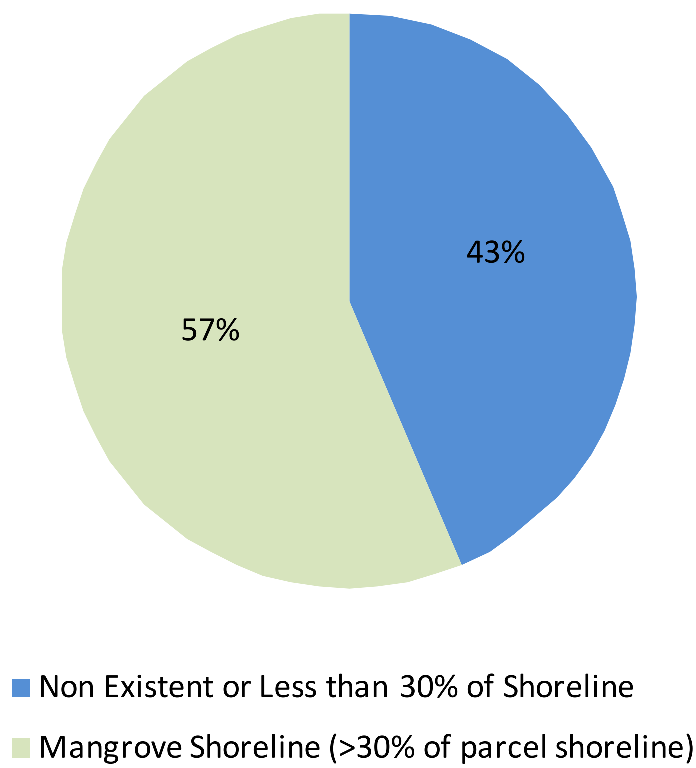


Figure 3-85 Lemon Bay Watershed 2007 Sarasota County Mangrove Trimming Study Shoreline Coverage

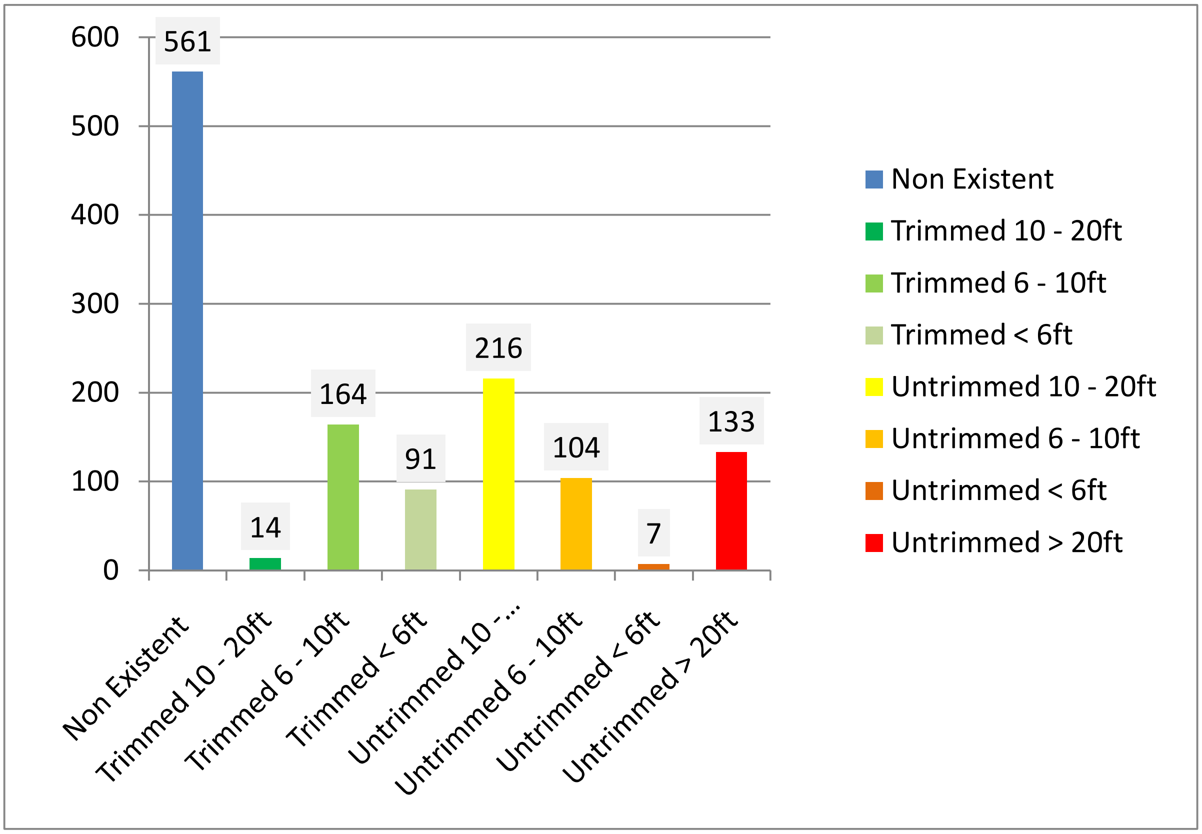


Figure 3-86 Lemon Bay 2007 Sarasota County Mangrove Study Results Summary

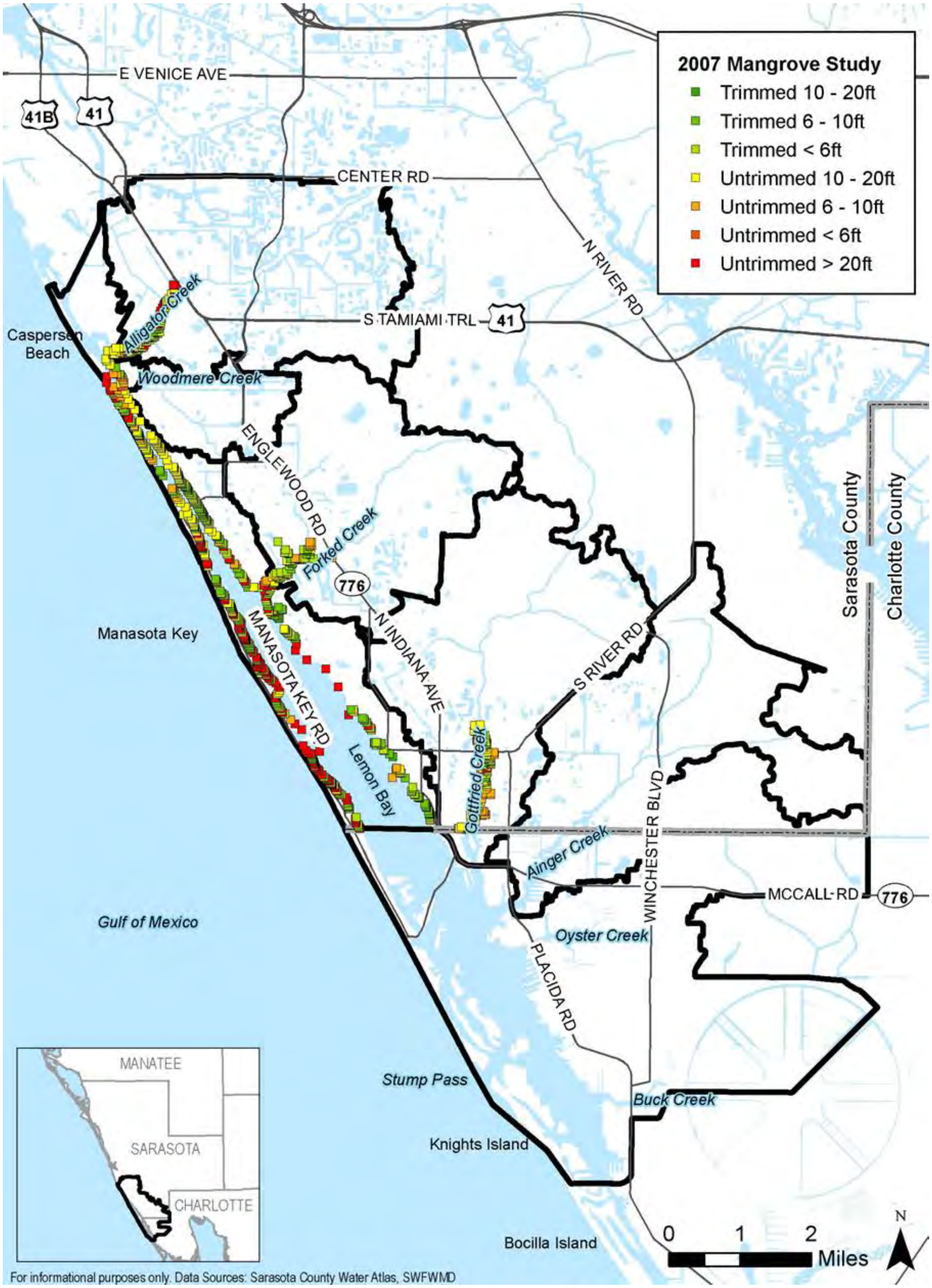


Figure 3-87 Lemon Bay 2007 Sarasota County Mangrove Trimming Study

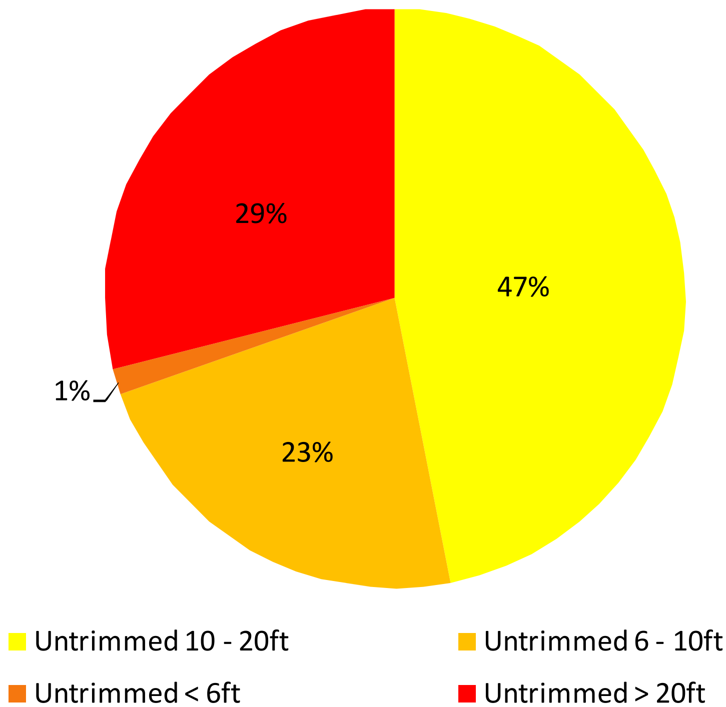


Figure 3-88 Heights of Untrimmed Mangroves

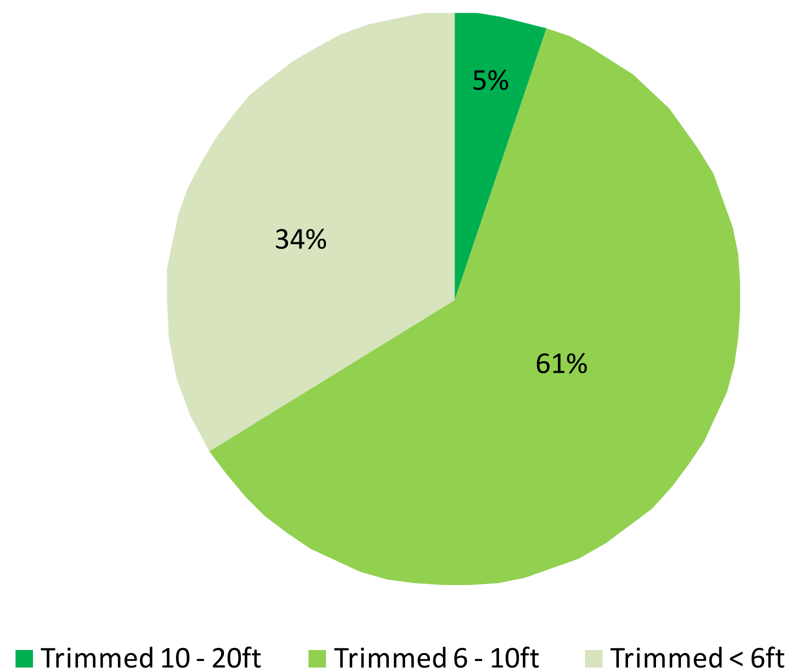


Figure 3-89 Heights of Trimmed Mangroves

Table 3-17 Lemon Bay Mangrove Planting and Exotic Removal Opportunities

	Planting Opportunities	Exotic Removal
Alligator Creek	46	46
Forked Creek	44	44
Gottfried Creek	72	74
Lemon Bay Coastal	240	232
Lemon Bay Watershed Study Area	402	396

*Adapted from the 2007-2008 Sarasota County Mangrove Trimming Study

To estimate the historical extent of mangroves in Lemon Bay for comparison to the current extent, Janicki Environmental used digitized photo-mosaics from the late 1940s to early 1950s along with digitized quad sheets to identify the historic mangrove extent within Lemon Bay. The SWFWMD (FLUCCS) categories for the 2005 land use survey were used to compare current and existing emergent vegetation extents. Aerial photographs of from the 1940s to 1950s were only available for the northern portion of Lemon Bay to approximately Stump Pass (Figure 3-90).

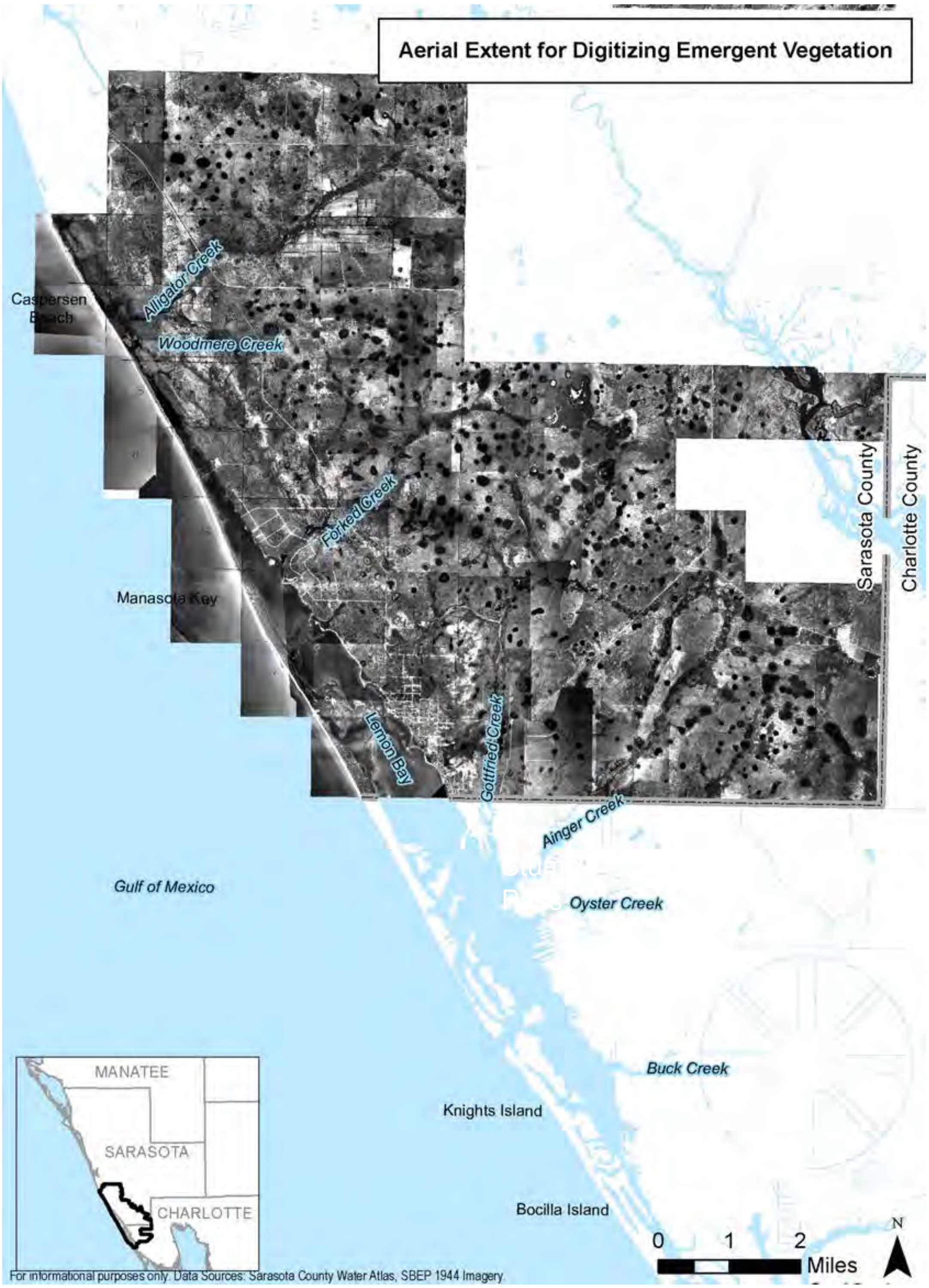


Figure 3-90 Aerial Photographs (1948) Used to Estimate Extent of Emergent Vegetation in Lemon Bay

Note: Aerial Photographs Currently Available Only for North Portion from Stump Pass to Venice Canal

Comparisons of the 1950s estimates of mangrove extents and that classified by the 2005 SWFWMD land use survey, using the extent provided by the 1948 aerial photographs, suggested that much of the mangrove extent that existed in the 1950s still exists. Historical estimates of mangrove extent suggested that 297 acres existed within the study extent, while in 2005 the acreage estimate was 263 acres (Figure 3-91). In the historical extent, the western shoreline of Lemon Bay across from Alligator Creek was designated as mangrove while in 2005 a lesser mangrove extent was documented in this area. Otherwise, the historical and current extents are very similar. Given the uncertainty in photo interpretation of mangrove extents, the difference between historical and current extents suggests that Lemon Bay has not lost substantial mangroves.

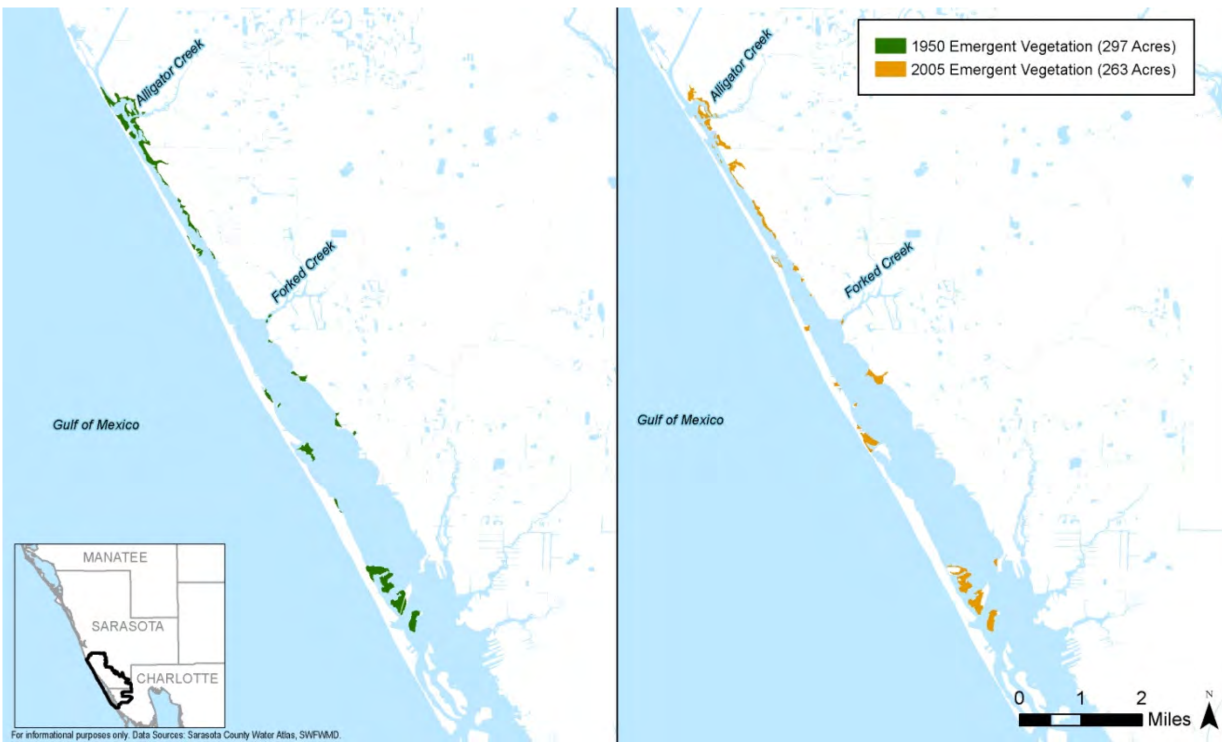


Figure 3-91 Distribution of Mangroves in Lemon Bay, circa 1950 and 2005

Lemon Bay was designated an aquatic preserve with the primary purpose of preserving the biological resources of endangered fringing mangroves and mangrove islands with clam beds, oyster bars, salt marsh, and other habitat (FDNR 1992). The designation of Lemon Bay submerged lands as an aquatic preserve, along with its designation as an OFW and Class II and Class III waterbodies, restricts the types of permitted activities that can take place in the watershed and estuary. While these designations are designed to protect and preserve conditions in the estuary, natural resource monitoring and management activities are required to ensure that natural systems such as the mangroves in Lemon Bay are protected.

3.2.1.4 Tidal Creeks

Tidal creeks are ecologically important because they provide a hydrologic link between uplands and bays and estuaries and provide critical habitat for many organisms including juvenile fishes and blue crabs that utilize the low-salinity habitats and shelter provided by emergent vegetation as nurseries and to avoid predation. In Sarasota County, many of the tidal creeks shorelines have been extensively modified due to anthropogenic activities. Measuring and monitoring the health of tidal creeks are important as an indicator of estuarine natural system function in Lemon Bay.

There are seven major tidal creeks in Lemon Bay: Alligator, Woodmere, Forked, Gottfried, Ainger, Oyster, and Buck Creeks. While the mouths of Gottfried and Ainger Creeks are in Charlotte County, the majority of their watersheds are in Sarasota County. Sarasota County's Environmental Services Business Center sought to develop an easily understood and ecologically valid rapid assessment technique for tidal creeks and, in conjunction with Mote Marine Laboratory, developed a Tidal Creek Condition index (TCCI) (Estevez, 2007). An ecologically-based index of tidal creek ecosystem health is a valuable tool for comparing multiple systems, documenting the ecological condition of a system through time, having independent data for TMDL assessment, and tracking the success of watershed management plans (Estevez, 2007). Five of the seven creeks mentioned above were considered as part of the TCCI.

The TCCI scores of the five Lemon Bay watershed tidal creeks were among the highest of the 15 creeks surveyed. In fact, Forked, Woodmere, and Gottfried creeks had the highest scores of any creek (Figure 3-92). However, multivariate analysis of benthic community structure suggested that the Lemon Bay creeks were not more structurally similar to one another than to other creeks in Sarasota County. Forked Creek and Alligator Creek, both in Lemon Bay had the highest ranking TCCI in 2007, indicating the "best" condition of all Sarasota County creeks.

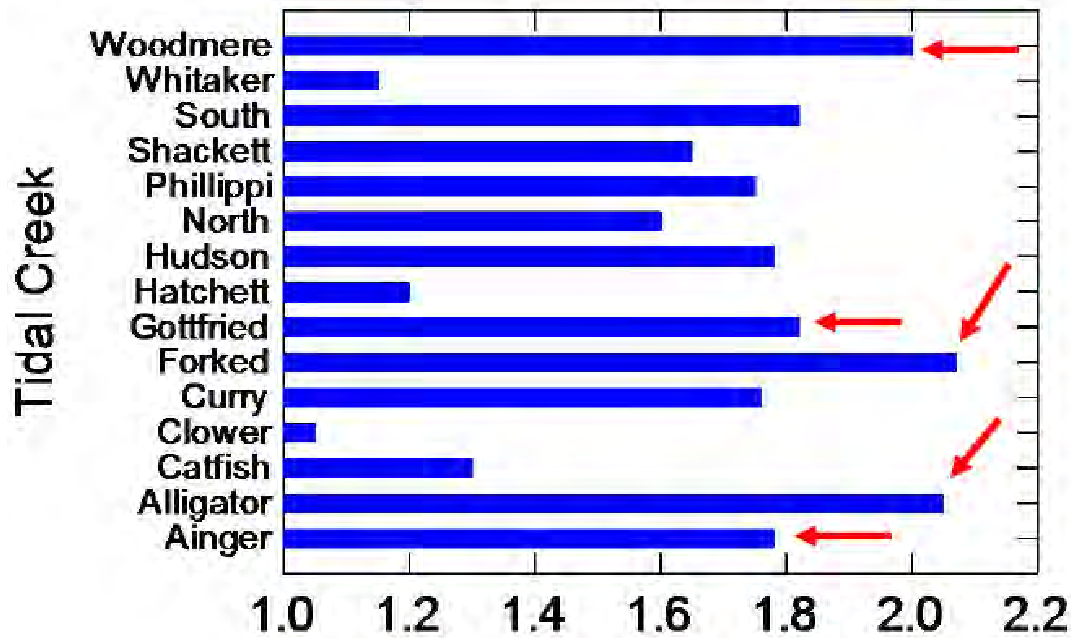


Figure 3-92 Tidal Creek Condition Index (TCCI) Scores for 15 Sarasota County Creeks and Bayous, 2006
Arrows Highlight Creeks in the Lemon Bay Watershed (adapted from Estevez, 2007).

The TCCI has shown to be a robust and beneficial tool to rapidly assess the ecological health of Sarasota County tidal creeks and, as part of the WMP, the TCCI is intended to be incorporated as a watershed management tool to report on the health of the tidal creeks in each of Sarasota County's waterbodies. The index scores will provide a valuable component of the overall assessment criteria for Lemon Bay to ensure its proper stewardship.

3.2.1.5 Oyster Communities

Oysters are an important indicator of estuarine "health" and their status can aid in the identification of water management problems. Oyster reefs serve several valuable ecological functions. They provide habitat for estuarine fauna, including conch, mud crab, fish, and other bivalves (Wells, 1961; Tolley and Volety, 2005) and contribute to improved water quality by filtering between 4 and 40 liters of water per day (Volety et al., 2003).

The oyster's life cycle is illustrated in Figure 3-93. Eggs and sperms are released into the water column, where fertilization occurs. The resulting larval stages (veligers) remain in the water column for about 7 to 10 days. These older larvae then settle out of the water column and attach to other oysters or some other hard surface (hard sand, bridge pilings) (Bahr and Lanier, 1981). These "spat" then grow into adult oysters that may live for up to 10 years. Oysters are suspension (or filter) feeders, and their preferred food is microscopic plants (phytoplankton) (Bahr and Lanier, 1981).

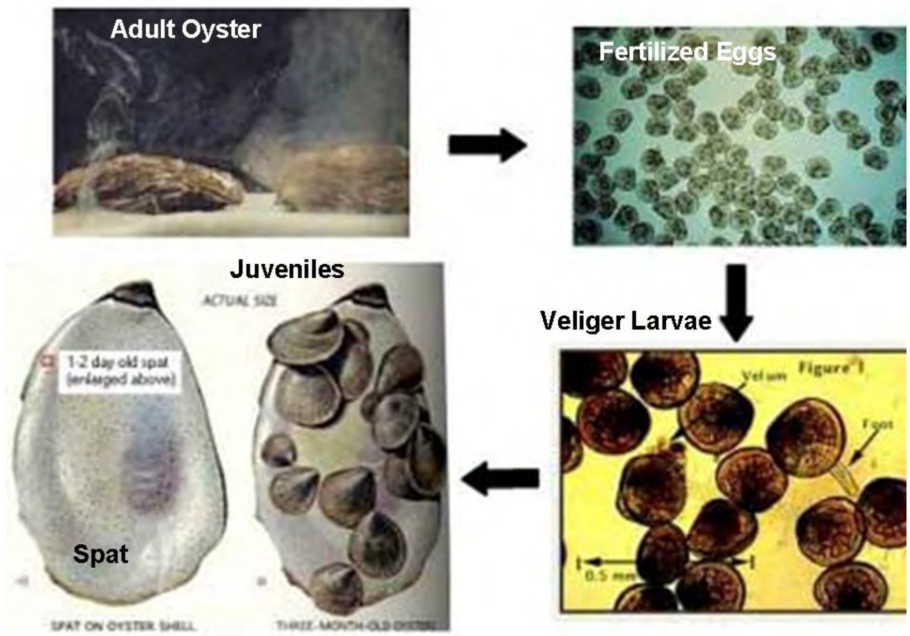


Figure 3-93 Illustration of the Life Cycle of the Eastern Oyster (*Crassostrea Virginica)*

Degradation of oyster habitats includes over-nitrification, which depletes the water of oxygen, hindering the development of oyster larvae; toxic chemicals and metals, which threaten the development of juvenile oysters; and siltation from eroded soil, which smothers oyster beds. Water quality, particularly salinity, can affect the health of oyster beds and control parasitic infestation, which is also detrimental to oyster health and productivity. The location of oyster beds (or reefs) depends on where larvae set and then on the subsequent survival of the spat (i.e., juvenile oysters). Larvae establishment is related to substrate and salinity (Stanley and Sellers 1986). Oysters have specific environmental requirements, including an optimal salinity range of 15 to 25 ppt (Kennedy et al., 1996). Overall salinity ranges have been reported between 10 to 30 ppt, with an ability to tolerate a salinity range of 2 to 40 ppt (Gunter, 1955). However, problems with reproduction can occur with salinities below 10 ppt. Mortality of most spat will occur if salinity falls below 3 ppt. Higher salinity (over 30 ppt) slows the growth rate of oysters and they become more susceptible to predators, parasites, and disease (Stanley and Sellers, 1986).

Oysters are most often found in tidal waters with nearby marshes, mangroves, mudflats, and tidal creeks. The most successful reefs are located in the mid-intertidal zone (Bahr and Lanier, 1981). Oyster reefs provide habitat for a variety of algae as well as vertebrate and invertebrate organisms (Bahr and Lanier, 1981). The oysters themselves may be preyed upon by other animals (e.g., oystercatchers and blue crabs), and the animals and algae that live within and among the oysters contribute to the diets of crabs, fishes, and birds.

Two species of oyster were found in Lemon Bay during a 1992 survey conducted by the Florida Department of Natural Resources (FDNR): the Eastern Oyster (*Crassostria virginica*) and the Flat Tree Oyster (*Isognomon alatus*). Other bivalves found in Lemon Bay included clam species and mussel species, the most common of which was the Atlantic Ribbed Mussel, *Geukensia demissa*. The Oyster Drill Snail, a gastropod, was found to be commonly associated with the oyster bars (FDNR 1992). Surveys of benthic organisms in the Lemon Bay Aquatic Preserve performed by FDNR (1992) showed a wide variety of species in the groups of mollusks, both bivalve and gastropod species, crustaceans, sponges, anemones, jellyfish, and hydra as well as marine polychaetes and nematodes. Oyster bars and reefs were found to be common in the shallow waters of the aquatic preserve, especially near the mouths of the eastern tidal creeks and in scattered locations, including across the Bay from Forked Creek and near the mangrove islands north of Stump Pass. The oyster bars and reefs were found in the middle intertidal zone.

Predation and siltation limit oysters in the subtidal regions of Lemon Bay to small, scattered clumps. In a 1992 survey, the FDNR noted that healthy oyster bars, such as those found in Lemon Bay, could contain more than 50 species of macroinvertebrates, including sponges, Herbst's mud crab (*Panpeus herbstii*), stone crab (*Mennippe mercenaria*), blue crab (*Callinectes sapidus*), and commensal crabs, clams, mussels, anemones, polychaetes, amphipods, and mollusks. Most of the oyster reefs found during the FDNR survey were in waters where shell fish harvesting was prohibited because the concentration of fecal bacteria was very high. At this time no shellfish harvesting is allowed in Lemon Bay, although the area south of Forked Creek is classified by FDEP as a Class II waterbody with a designated use for shellfish propagation and harvesting.

Sarasota County began an oyster monitoring program with annual surveys in 2006. The first survey in Lemon Bay was in fall 2006 at the end of the rainy season. The monitoring program has nine sampling sites in four creeks that flow into Lemon Bay: Alligator Creek (Figure 3-94), Forked Creek (Figure 3-95), and Gottfried and Ainger Creeks (Figure 3-96). These figures, adapted from Jones (2007), illustrate the extensive watershed development that has occurred along the coastal basin in Lemon Bay. The locations of the oyster sampling sites are:

Site	Latitude	Longitude
AL1	27 2 34	82 25 42
AL2	27 2 38	82 25 24
FRK1	26 59 41	82 23 35
FRK2	26 59 52	82 23 19
GOT1	26 56 3	82 20 38
GOT2	26 56 32	82 20 45
GOT3	26 56 58	82 20 45
ANG1	26 59 50	82 20 17
ANG2	26 56 13	82 19 49

Figure 3-94 Alligator Creek Oyster Monitoring Site Locations and 2006 Results (Adapted from Jones 2007)

Figure 3-95 Forked Creek Oyster Monitoring Site Locations and 2006 Results (Adapted from Jones 2007)

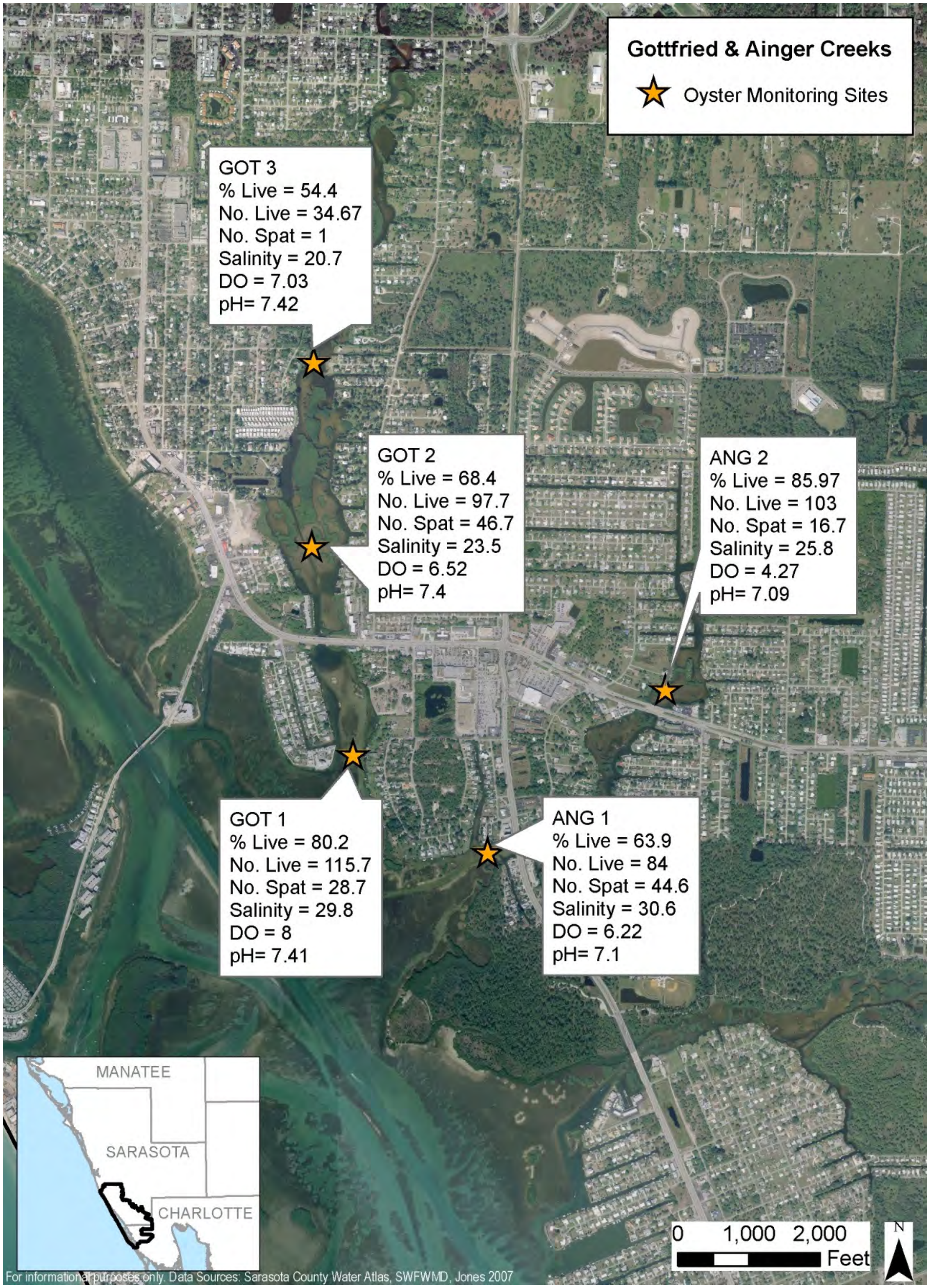


Figure 3-96 Gottfried and Ainger Creeks Oyster Monitoring Site Locations and 2006 Results (Adapted from Jones 2007)

The results of the 2006 sampling showed that the average percent of live oysters ranged from 22% at the lower Forked Creek site to 86% at the lower Ainger Creek. The average percent of live oysters in the southern portion of the Bay was 75% in Ainger Creek and 68% in Gottfried Creek; in the northern portion of the Bay the average percent of live oysters was 45% in Forked Creek and 68% in Alligator Creek. The salinity measured at all of these stations was above 20 ppt during the sampling events (Jones, 2007).

The average number of live adult oysters plus spat ranged from 144 to 580 per square meter in comparison to oyster studies in South Florida, which reported densities of 600 to 1400 live oysters per square meter with 65% to 85% of the community being live oysters.

Jones (2007) developed a scoring methodology to assess the relative health of oyster reefs in Sarasota County. Each site is assigned a numerical score based on the calculated percent live oysters (Table 3-18). All sites within each watershed are then averaged, and a letter score is assigned based on the watershed average numerical scores. Scores for Lemon Bay sites resulted in Ainger Creek being categorized as "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) (Jones, 2007).

Table 3-18 Scoring Method for the Sarasota County Oyster Monitoring Program

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

Estimating areal extents of oysters based on photo-interpretation is difficult due to the tendency for oysters to co-locate with emergent vegetation such as mangroves and marshes or in tidal creeks where highly colored waters may obscure the reefs at the times the photographs are taken.

The County is successfully using community volunteers to validate aerial seagrass mapping efforts in Sarasota County, and a similar effort could be implemented for documenting oyster habitats in Lemon Bay. However, oyster reefs pose potential hazards to volunteers and their vessels and care must be taken to minimize the potential liability associated with using volunteers for this mapping effort. Further, only trained professional biologists should be used in the actual oyster monitoring to ensure consistency in methods and reporting of results.

3.2.1.6 Seagrass

Seagrasses are a dominant feature of most Florida estuaries and provide enormous value as a natural systems component in Sarasota County. Seagrasses stabilize sediments, provide refuge for juvenile fishes and invertebrates, and serve as a food source for manatee and sea turtles. The microscopic algae (epiphytes) that grow on seagrass blades support an extensive community of grazing organisms. Decaying seagrass blades contribute to a detritus-based food web that plays a particularly important role in the transfer of energy in estuarine and coastal communities. Seagrasses support a diverse and productive macroinvertebrate community that lives on or among seagrasses and in the sediments surrounding seagrasses. These organisms are an important food resource for higher trophic levels.

Six species of seagrasses are found along the Florida Gulf Coast, the three most common of which—*Halodule wrightii* (shoal grass), *Thalassia testudinum* (turtle grass), and *Syringodium filiforme* (manatee grass)—have been documented in Lemon Bay. These plants primarily grow by vegetative reproduction (Zieman and Zieman, 1989). Each of the three species produces horizontal stems (rhizomes) up to 25 cm below the sediment. These rhizomes produce vertical branches with leaves. These seagrasses are also capable of flowering and thereby reproducing sexually.

The District's SWIM section has conducted aerial surveys of seagrass meadows throughout Southwest Florida every 2 or 3 years since 1988 (Kristen Kaufman, personal communication). According to these aerial surveys, the total acreage of seagrass meadows in Lemon Bay remained virtually unchanged through 1999. The boundary definitions used by the SWFWMD to define Lemon Bay are geographically different than the watershed boundary used for this WMP. According the SWFWMD boundary, the seagrass meadows were smallest in 1996 with an estimated 2,576 acres, a 47-acre decrease from its highest previous total area of 2,623 acres in 1994 (Figure 3-97). Lemon Bay experienced a significant increase in acreage between 2002 and 2004, rising to a total of 2,751 acres, but dipped again slightly in 2006 to 2,714 acres. The extent of seagrass beds fluctuates seasonally as part of the natural cycles. Despite the short-term fluctuation in acreage present in these data, there has been an estimated net increase of 135 acres between 1988 and 2006.

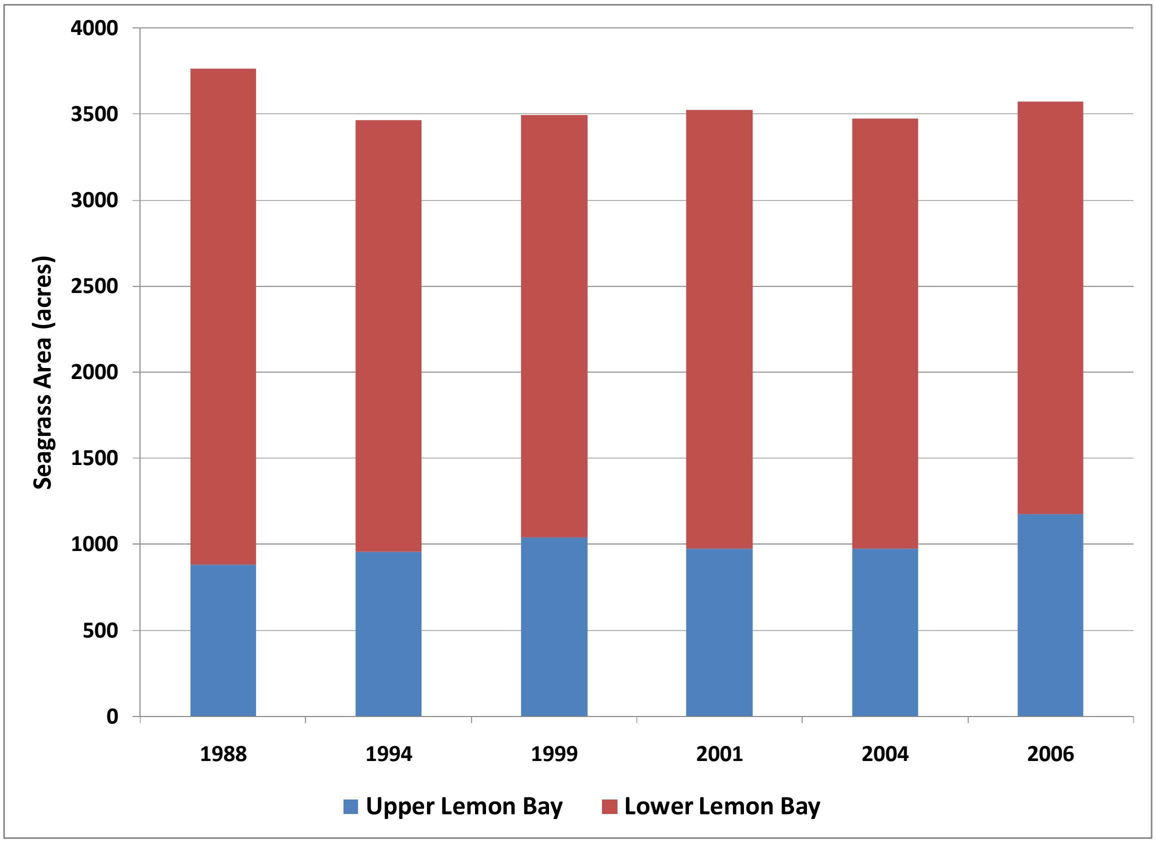


Figure 3-97 Seagrass Acreage Lemon Bay. Source: K. Kaufman, SWFWMD SWIM Program

To estimate the persistence of seagrass from 1998 to 2006, a cartographic grid cell system for Sarasota County estuarine waters was created using 50-m-square cells and overlaid all the SWFWMD seagrass coverages taken since 1988 (Wessel et al., 2007). This grid system allowed the presence or absence of seagrass to be represented within each grid cell by survey year. The persistence of seagrass could then be characterized as to the number of years in which seagrass was present in a particular grid cell. This information is presented for Lemon Bay in Figure 3-98. Seagrasses were most persistent in the larger beds of south-central Lemon Bay. The least-persistent beds occurred from Gottfried Creek north to just above the connection with Forked Creek.

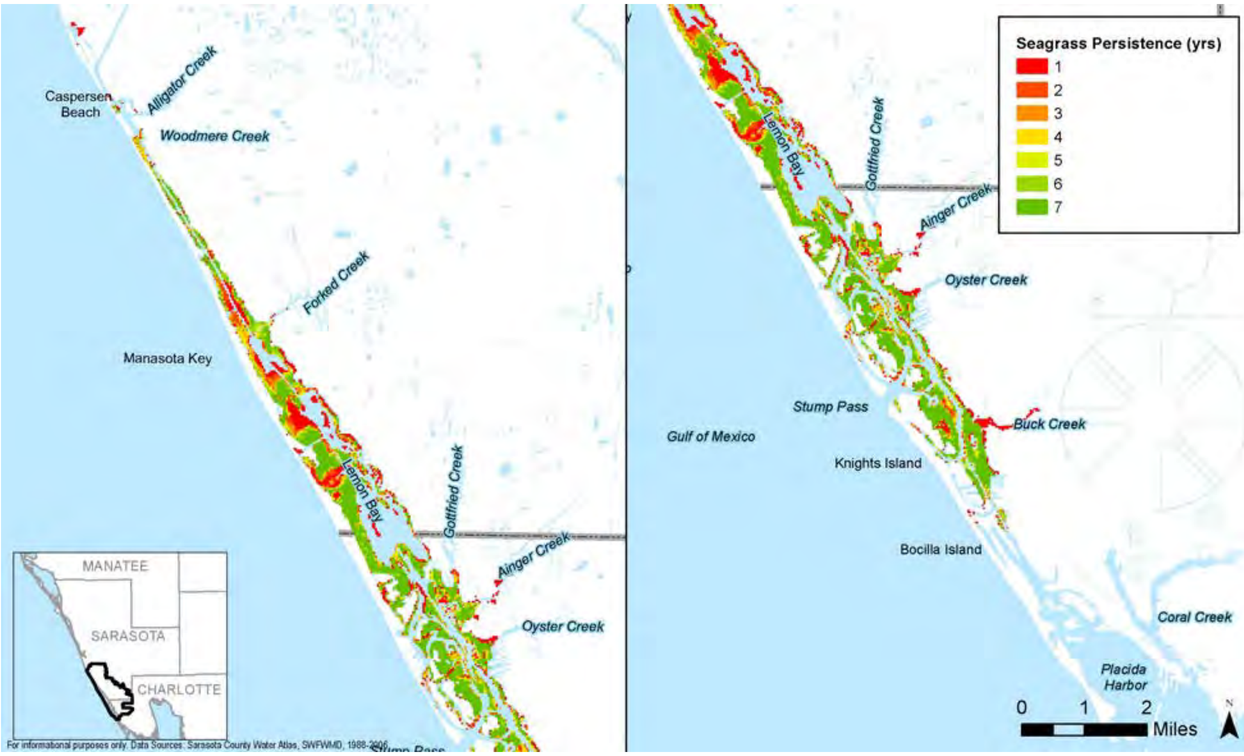
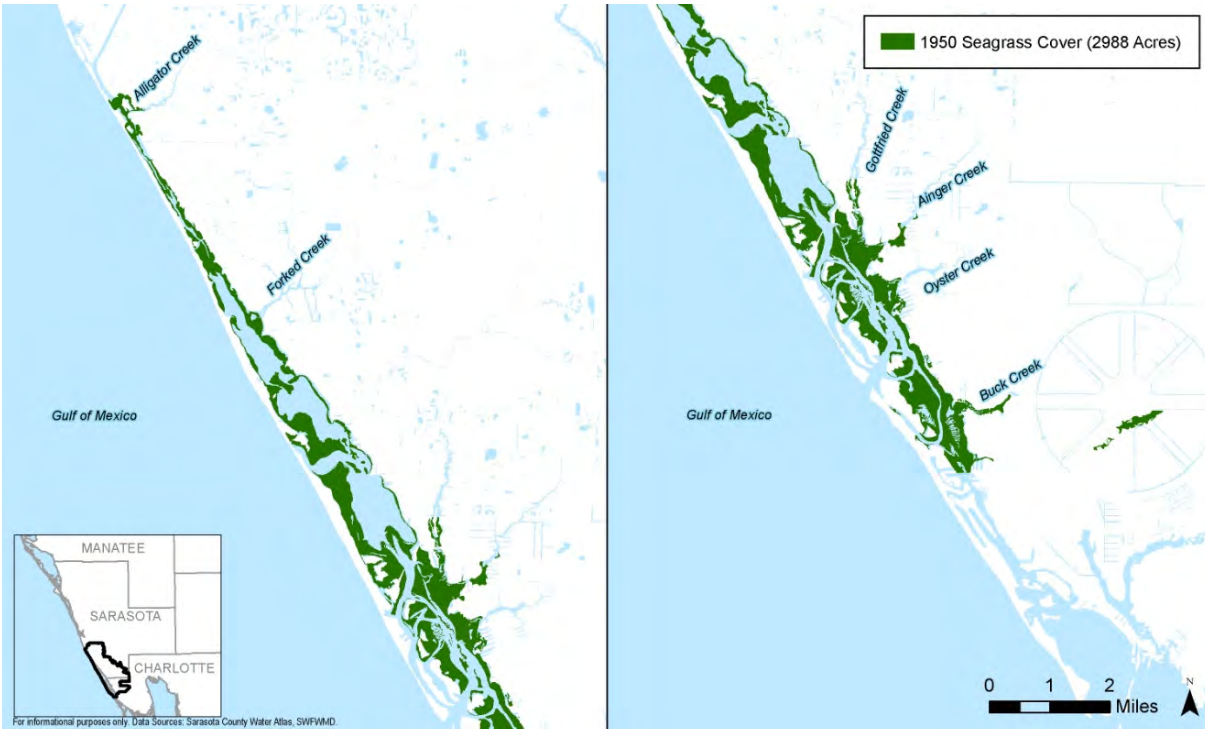


Figure 3-98 Seagrass Distribution and Persistence in Lemon Bay (SWFWMD, 1988-2006)

To directly compare historical seagrass acreage extents to more recent aerial surveys taken by the SWFWMD, we used the watershed management boundary definition to compare current and historic seagrass acreages. The historical seagrass extent was defined by a work product for the CHNEP (PhotosScience, 2007). This study used digitized aerial photographs from the late 1940s and early 1950s to map benthic habitats, including seagrass, oysters, and tidal flats. Historically, seagrasses have been found in all but the deepest channels. Based on a historical seagrass mapping effort, Lemon Bay supported almost 3,000 acres of seagrasses in the early 1950s (Figure 3-99). Seagrass coverage was especially well developed in the central and southern sections of Lemon Bay and less so in deeper waters in the northern portion of the bay north of Forked Creek. The results comparing the historical extent to the 2006 seagrass acreage suggest that the 2006 seagrass extent (2635 acres; Figure 3-99) was 89% of historical estimates, an 11% decrease in acreage.



1950

2006

Figure 3-99 Seagrass Distribution in Lemon Bay, circa 1950 and 2006

Seagrasses have several critical habitat requirements:

- Light
- Salinity
- Tidal amplitude
- Depth
- Wave energy
- Nutrients

The amount and quality of the light reaching seagrass blades are thought to be the primary limiting factor affecting the seagrasses' distribution (Morris and Tomasko, 1993). Different species of seagrass may respond better to specific wavelengths of light (Zieman and Zieman, 1989; Dixon and Leverone, 1991; Dixon and Kirkpatrick, 1995; Dixon and Leverone, 1995; 1997; Dixon and Kirkpatrick, 1999; Dixon, 2000; Dixon, 2002). Without adequate light of the proper wavelengths, photosynthesis is inhibited and plant growth ceases.

The amount of light needed to ensure that seagrasses can grow is expressed as a percentage of the total Photosynthetically Active Radiation (PAR) available just below the water's surface. The decay rate of PAR is exponential with depth and is affected by water quality conditions such as turbidity; suspended solids; water color from humic substances; and the growth of epiphytic algae, bacteria, etc. on the plants themselves.

The specific light requirements of seagrass vary by location and species (Dawes et al., 2004; Lee et al., 2007). For example, the light requirements of *Thalassia* may range from 14 to 24.4%, *Halodule* from 10.0 to 23.0%, and *Syringodium* from 17.2 to 37.0% (Dawes et al., 2004). Note that epiphytes can further reduce the light actually reaching the seagrass blades and are not taken into account in these estimates (Neckles, 1993; Dixon, 2002).

While light is thought to be primarily limiting, other factors contribute to the success of seagrass colonization. Salinities ranging from the mid-20s to mid-30s appear optimum for the species of seagrass commonly found in Lemon Bay. *Halodule* is euryhaline but is intolerant of freshwater or extremely low salinities. *Syringodium* and *Halophila* spp. are more stenohaline, and *Syringodium* is less tolerant of lower salinities. Thalassia prefers relatively high salinities (up to seawater, 35 ppt) and does not do well at salinities in the teens and lower (Zieman and Zieman, 1989). Therefore, excessive freshwater inflows that reduce salinities may adversely affect the health and success of seagrass communities in Lemon Bay. Tidal and wave energies are less of a concern in Lemon Bay as the bay is not exposed to long fetch wind patterns and much of the ICW is a no-wake zone in this area.

Given the ecological requirements of seagrass and their current and historical extents in Lemon Bay, the Lemon Bay WMP incorporates existing information, including current water quality conditions, current depth limits of seagrass in the bay, and current salinity conditions to identify targets for these parameters that optimize the conditions beneficial for seagrass community success in Lemon Bay. Those factors that influence both light attenuation and salinity are discussed in Chapter 4.

3.2.1.7 Benthic Communities

Benthic (bottom-dwelling) organisms live in or on the sediments and other substrates of bays, rivers, etc. The benthos include organisms such as worms, snails, clams, various small crustaceans, and other invertebrate life forms. Unlike the more motile nekton, most benthic invertebrates lack the ability to escape rapid fluctuations in environmental conditions. Because of their generally small size and their abundance, they are an essential component of the diet of many fishes and wading birds.

The benthos include detritivores, suspension feeders, deposit feeders, and predators that process organic material and form an essential link in the transfer of energy to secondary consumers such as fish and birds. Tube-building and burrowing benthic organisms are important in reworking sediments. In this role they may bring suspended sediments into contact with the water column. Nutrients and pollutants are translocated and the sediments can be better oxygenated.

Data on the composition and abundance of soft-sediment infaunal benthos in the Lemon Bay system are limited to only four samples (Florida Fish and Wildlife Research Institute, unpublished data). Sipunculid worms were very abundant in these samples. Mollusks were subdominants and polychaete worms were not among the 10 most abundant taxa. In addition to these quantitative samples, FDNR (1992) provided qualitative observations of epifauna. The only named species were the mollusks *Crassotrea virginica*; *Isognomon alatus*, and *Geukensia demissa*.

The Lemon Bay benthic fauna appears to differ somewhat from other estuarine systems along Florida's West Coast, including Charlotte Harbor (Florida Fish and Wildlife Research Center, unpublished data), Tampa Bay (Grabe et al., 1995), and McKay Bay in Tampa Bay (Grabe et al., 2004). However, the Lemon Bay fauna does share some similarities to that of the northern Indian River Lagoon (Thomas, 1974; Wiederhold, 1976). Lemon Bay shares more structural similarities to a lagoon than to a more open bay system (Emery and Stephenson, 1957)

Amphipods, bivalves, and polychaetes are the most abundant groups in Charlotte Harbor, Tampa Bay, and McKay Bay (Grabe et al., 1995; Grabe et al., 2004; Florida Fish and Wildlife Research Center, unpublished data). Sipunculans, which were very abundant in Lemon Bay and in the northern Indian River Lagoon, are much less abundant in the other west coast estuarine systems (e.g., in Charlotte Harbor the sipunculan Phascolion ranked 88th in abundance) (Florida Fish and Wildlife Research Center, unpublished data).

Estuarine benthic communities are primarily subject to the influences of two habitat variables (salinity and sediment characteristics) and two ecological stressors (dissolved oxygen [DO] and sediment contaminants). The interactions of salinity regime and sediment type ultimately affect the types of animals that can colonize an area of the bay or creek. Low concentrations of DO or high concentrations of sediment contaminants (e.g., metals, pesticides, hydrocarbons) can further restrict the types and numbers of animals that live in the sediments to those that are the most tolerant.

Salinity affects benthic organisms directly and indirectly. Salinity is largely influenced by the amount of freshwater inflow entering the system. During high-flow periods, salinity at a particular location is expected to be lower and may open new habitats for the more motile species that are intolerant of elevated salinities. During low-flow periods, higher salinity waters may facilitate habitat expansion for coastal species.

Many benthic species are limited in range by the physiological challenges and stresses associated with variable salinity environments. Osmotic limitations restrict the ability of many freshwater species from using habitats in downstream portions that are tidally influenced. Marine species also face osmotic problems, which restrict access to upstream freshwater habitats. Estuarine species typically tolerate a wide-range of salinities, although they may have discrete “preferences” for optimal reproduction and growth. In other words, salinity is less of an acute stressor and more a chronic stressor for estuarine invertebrates.

In May 2004, Mote Marine Laboratory conducted a survey of the benthic invertebrate community in Charlotte Harbor, including Lemon Bay, for the Charlotte Harbor National Estuary Program (Mote Marine Laboratory 2007). The purpose of the study was to provide, for each basin within the watershed, a characterization of benthic fauna for each of the principal habitat types within the estuary, including mangrove, saltmarsh, submerged aquatic vegetation (SAV), oyster, and intertidal and subtidal sand and mudflat.

Habitat in Lemon Bay was primarily SAV with several large expanses of intertidal mudflat and subtidal sand. Tributaries to Lemon Bay had SAV habitat at the mouths but were otherwise bare sediments and oyster habitat. Sediments in Lemon Bay were sandy (>70% by volume) with very little clay (≤5%). Salinities in Lemon Bay averaged 36 psu and were typically >34 psu, which is comparable to salinities throughout the watershed, except in the Peace and Myakka Rivers where salinities averaged <20 psu. DO levels in Lemon Bay were relatively high—7.97 mg/L on average compared to 4.0-6.6 mg/L in most of the other basins. Charlotte Harbor (7.04 mg/L) and Peace River (7.65 mg/L) had higher than average DO levels, but only San Carlos Bay was higher (8.1 mg/L) than Lemon Bay.

During the 1-month survey, 390 benthic samples were collected with cores and sweep nets from across the CHNEP watershed. A total of 44,000 benthic invertebrates from 370 taxa were found, though the benthic community was dominated by just eight taxa that comprised just over 50% of all individuals.

Within the CHNEP watershed, Lemon Bay had the highest observed species richness (n=160 taxa) compared to the average of 104 taxa, though coastal Venice, San Carlos, and Estero Bay also had greater than average species richness (n=124-135 taxa). Faunal densities in Lemon Bay, however, were relatively low at 27,591 individuals compared to the average of 47,740 individuals. At the habitat level, species richness in Lemon Bay was substantially higher than that observed of most of the other basins and was, in fact, highest for intertidal sand, subtidal mudflat, oyster, and saltmarsh. Within Lemon Bay, the highest richness was found in subtidal sand and mudflat habitats (n=76 and 62 taxa, respectively), though structured habitats including SAV, saltmarsh, and oyster also supported greater than average numbers of benthic taxa (n=37-42 taxa). More species of benthic invertebrates were collected in these habitats in Lemon Bay than in the same habitats elsewhere in the watershed, with the exception of SAV in Venice (59 taxa) and Pine Island Sound (43 taxa) and subtidal sand habitat in San Carlos Bay (79 taxa). Throughout the CHNEP watershed, the highest abundances were found in oyster, subtidal sand, and subtidal mudflat habitats. This was true for Lemon Bay where faunal abundances in these habitats were approximately twice as high as that observed in the other Lemon Bay habitats; however, compared to the rest of the watershed, these abundances were lower than average. Mangrove and intertidal mudflat and sandbar habitat in Lemon Bay supported very few species and low invertebrate abundances relative to the same habitats in other basins, though intertidal sandbar habitat throughout the CHNEP watershed generally supported low benthic richness and abundance.

Community structure of benthic invertebrates in core samples from most of the Lemon Bay habitats was most similar to that observed for Charlotte Harbor and Venice. The “sweep net” community was also very similar among Lemon Bay, Charlotte Harbor, and Venice, but only for the subtidal bare substrates and SAV habitats. Mangrove and intertidal mud habitats in Lemon Bay had a similar community to that observed in the subtidal mud habitat from Estero Bay; another of the largely enclosed coastal estuaries. The benthic community from oyster habitat throughout the CHNEP watershed was more similar among basins than it was with other habitat types within a basin. Compared to oyster habitat in the other basins, Charlotte Harbor and Venice supported benthic communities that were most similar to those from Lemon Bay.

Since water quality and sediment chemistry conditions are principal driving factors in promoting a diverse and healthy benthic macroinvertebrate community, the goals of the WMP with respect to water quality and sediment management should result in conditions favorable for the success of the macroinvertebrate community in Lemon Bay.

3.2.1.8 Fishes

There is a paucity of fisheries data collected in Lemon Bay proper. However, the mangrove and seagrass communities in Lemon Bay are known to provide shelter and forage for adult and juvenile fish of at least 230 species that depend on these ecosystems (FDNR, 1992). The majority of fish species that are important to commercial and recreational fisheries in Florida depend on estuaries such as Lemon Bay for their juvenile stages. To our knowledge, FDEP, the Florida Fish or Wildlife Conservation Commission, or SWFWMD have not performed any recent fish surveys in Lemon Bay. However, the CHNEP is currently negotiating with the Florida Fish and Wildlife Conservation Commission to perform a synoptic study of Lemon Bay to determine species composition and spatial and temporal variation in community structure (Lisa Beever, personal communication).