Dona Bay Watershed Management Plan

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Southwest Florida Water Management District

SARASOTA COUNTY

DONA BAY
WATERSHED MANAGEMENT PLAN

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TABLE OF CONTENTS

FIGURES AND TABLES

EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION

CHAPTER 2 – DONA BAY WATERSHED DESCRIPTION

CHAPTER 3 – NATURAL SYSTEMS

CHAPTER 4 – WATER SUPPLY

CHAPTER 5 – WATER QUALITY

CHAPTER 6 – FLOOD PROTECTION

Executive Summary

Photo of Cow Pen Canal
Through Pinelands Reserve

Executive Summary

BACKGROUND

In 2002, Sarasota County embarked on an Integrated Water Resource initiative that subsequently embraced the Southwest Florida Water Management District's Comprehensive Watershed Management (CWM) program. The uniqueness of the CWM program is that it considers the science and management of natural systems, water supply, water quality, and flood protection on an integrated basis and within watershed framework.

The Cow Pen Canal which was constructed in the late 1960's and which redirected a significant portion of the Myakka River watershed to Dona Bay (see Figure 1) has dramatically increased freshwater volumes to, and decreased seasonal salinities and dependent biological flora and fauna within, the estuary. Therefore, the Dona Bay estuary/watershed is a prime candidate for the CWM program and obvious outcome of the Integrated Water Resource initiative.

As pre-cursors to the CWM program development, four pro-active activities were undertaken that significantly assisted in subsequent efforts:

First, Sarasota County consulted and memorialized historical watershed maps.

Second, Sarasota County developed a detailed flood prediction model and associated flood maps for the Dona Bay watershed in 2002.

Third, Sarasota County initiated the collection of essential baseline date including freshwater flows from the Cow Pen Canal to the estuary, rainfall within the watershed, and salinities and biological indicators throughout the estuary.

Fourth, Sarasota County acquired several strategic water resource sites situated in the watershed, including the ±500 acre Venice Minerals site and the ±1000 acre Albritton site.

The following general objectives have been established for the Dona Bay CWM program:

1. **Provide a more natural freshwater/saltwater regime in the tidal portions of Dona Bay.**
2. **Provide a more natural freshwater flow regime pattern for the Dona Bay watershed.**
3. **Protect existing and future property owners from flood damage.**
4. **Protect existing water quality**
5. **Develop potential alternative surface water supply options that are consistent with, and support other plan objectives.**

SUMMARY

In 2005, Sarasota County contracted with a multi-disciplinary consultant team to develop the Dona Bay CWM program. Support through the Southwest Florida Water Management District was made possible with funding from the Manasota Basin Board's Cooperative Funding Program. The comprehensive scope of work included data collection and analyses, development and evaluation of restoration proposals with respect to natural system and water quality improvements, flood protection, and alternative water supply development. In addition, a watershed management phasing plan (see Figure 2) and associated preliminary opinions of probable costs were developed along with a recommended monitoring plan and draft water supply watershed protection plan. With respect to the initial objectives, the plan is expected to result in the following outcomes:

1. **Provide a more natural freshwater/saltwater regime in the tidal portions of Dona Bay.**

   Utilizing the general goals of the National Estuary Program to: (1) increase aquatic life and productivity, (2) increase aquatic habitat, (3) increase water quality/clarity, and (4) restore more natural freshwater flow regimes with respect to the timing and volume of flows to the estuaries, the Dona Bay CWM program is estimated to reduce excess freshwater volumes by 14%, 28%, and 41% for the 3 phases evaluated, respectively. As a result, wet season salinity levels in areas of the downstream estuary will generally increase to the extent that natural system biological indicators can become more stabilized and productive. **In conclusion, each proposed phase is expected to incrementally provide a more natural freshwater/saltwater regime in the tidal portions of Dona Bay**.

2. **Provide a more natural freshwater flow regime pattern for the Dona Bay watershed.**

   With the initial Dona Bay CWM program phase, freshwater will be re-directed from the Cow Pen Canal to the historical watershed storage areas that have been drained and acquired by Sarasota County. As a result, 80% or more of the excess freshwater in the watershed is expected to flow through the historical storage and flow path. Subsequent phases propose to increase and enhance the storage capacity of the historical watershed storage areas. **In conclusion, each phase proposed is expected to incrementally provide a more natural freshwater flow regime pattern for the Dona Bay watershed**.

3. **Protect existing and future property owners from flood damage.**

   All 3 program phases were evaluated using the detailed flood prediction model for the Dona Bay watershed. As a result of the increased and reclaimed watershed floodplain storage associated with phases 1 and 2, the model consistently indicated decreases in flood stages on a relatively widespread basis. The third phase involves isolating a portion of the floodplain storage reclaimed in the first 2 phases to accommodate pumping. As a result, although flood stages are expected to decrease when compared to current conditions, the decreases will not be as great as indicated in phases 1 and 2. **In conclusion since each phase proposed is expected to consistently result in decreases in flood stages, existing and future property owners are expected to be protected from flood damage.**

4. **Protect existing water quality.**

   Diversion of 80% or more of all freshwater from the Cow Pen Canal through the proposed chain of wetlands and reservoir lakes will greatly increase residence times which is a key mechanism for reducing pollutant loads. In addition, removal of a portion of the excess freshwater as for water supply will also have a direct impact on reducing pollutant loads to Dona Bay. To quantify the expected reductions in pollutant loads to Doan Bay, all 3 program phases were evaluated using a spreadsheet pollutant loading model to estimate resulting total nitrogen, total phosphorus, and total suspended solids loads. The pollutant loading model indicates that the CWM program phases would reduce total nitrogen loads from 38% to 57%, total phosphorus loads from 56% to 70%, and total suspended solids from 82% to 88%. **In conclusion since each proposed phase is expected to consistently result in decreases in pollutant loads, existing water quality will not only be protected, but significantly improved.**

5. **Develop potential alternative surface water supply options that are consistent with, and support other plan objectives.**

   Somewhat unique to this CWM program, estuarine natural system benefits increase with increased storage and the removal of excess freshwater. Storage is to be facilitated by redirecting freshwater from the man-made canal to the historical watershed storage footprints and flow paths to the extent possible. Removal is to be facilitated by considering a sustainable water supply yield. Each phase of the Dona Bay CWM program could incrementally provide approximately 5 mgd of alternative surface water supplies. **In conclusion, development of an alternative water supply is consistent with and supports other plan objectives. In fact, a whole-system watershed management approach that restores and enhances watershed storage and flow path functions is expected to coincidentally address all general objectives originally established for the Dona Bay CWM program.**

Preliminary estimates of probable cost for each phase that were developed as part of the Dona Bay CWM program are provided below:

Phase	Preliminary Estimate of Probable Cost
1	$ 75,000,000
2	$ 67,000,000
3	$ 34,000,000

Finally, recommendations from the Draft Water Supply Watershed Protection Plan are summarized below:

Purpose of Draft Water Supply Watershed Protection Area Plan:

- In preparing this Plan, existing Comprehensive Plan Watershed Management goals were reviewed relative to water supply. As a credit to Sarasota County government, this review indicated that current regulations address many if not most of these goals. However, additional watershed specific issues and opportunities were identified. For those watershed specific issues, the Plan proposes incentive based protection mechanisms that can be proposed to watershed stakeholders.

- This Plan is not intended to impact the continuance of agricultural activities that are consistent with local, state and federal standards.

- This Plan is not intended to, and may not be used to, inhibit or restrict future development forms that are consistent with comprehensive plan and/or zoning designations.

Incentive Based Protection Mechanisms

- New developments in the WSWPA shall provide 150% times the volume of required by the Sarasota County Land Development Regulations for the selected treatment system or the State requirements for Class III waterbodies, whichever is more strict. As an incentive to provide the additional treatment volume, Sarasota County will support the use of permanent pool volume over littoral zones in stormwater management systems.

- Watercourse greenways in a surface water supply watershed would serve a significant public purpose that should be reflected by the highest possible density bonuses under 2050, conservation subdivisions, and any other incentive-based develop forms that may be created by Sarasota County.

- It is recommended that additional incentives be provided for existing property owners within 100 feet of the banks of the Cow Pen Canal or contributing tributary through the Neighborhoods Grant program to plant and maintain native vegetation within their adjacent property.

- Sarasota County should promote Low Impact Development strategies to more effectively remove pollutants at their source, but not necessarily to reduce runoff volumes in the WSWPA. The intended outcome should be a match of pre and post pollutant loads from new development. Sarasota County should streamline reviews that incorporate LID strategies.

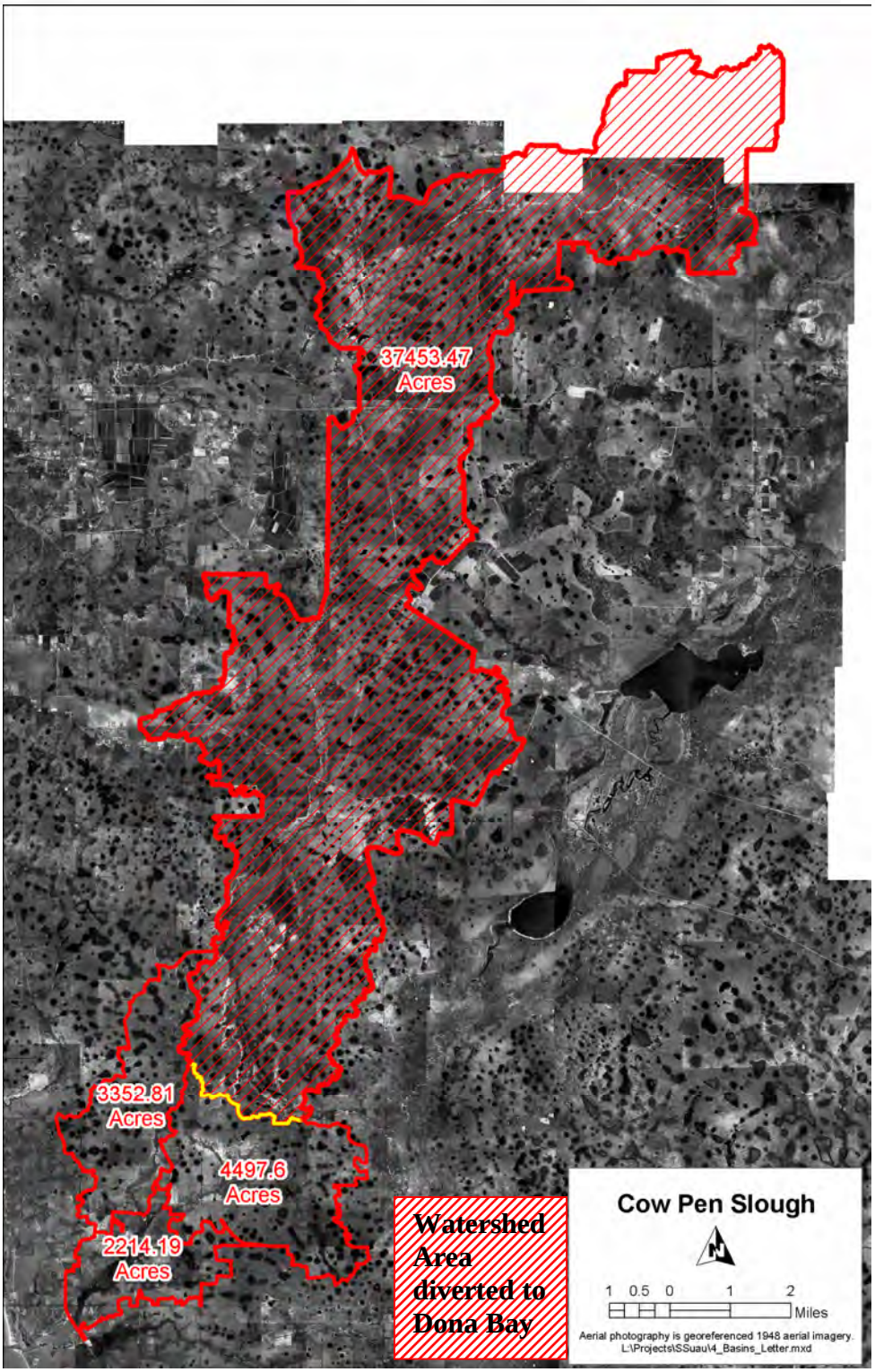

Figure 1 – Dona Bay Watershed

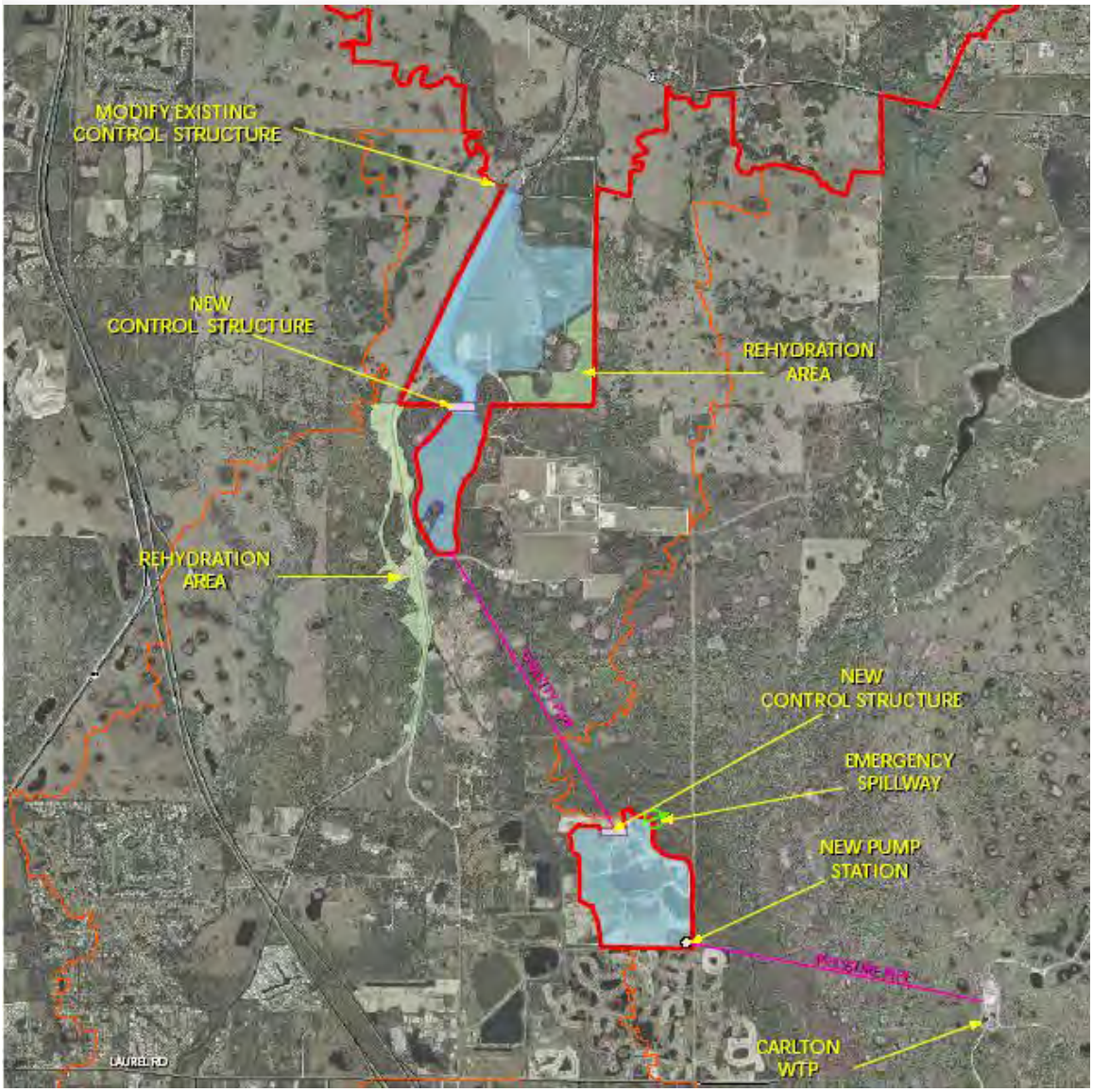

Figure 2 – Dona Bay CWM Program, Phase 2 Concept Schematic

Chapter 1 Introduction

Photo of Venice Inlet

Chapter 1
Introduction

1.1 COMPREHENSIVE WATERSHED MANAGEMENT (CWM)

Sarasota County's Comprehensive Watershed management (CWM) Program is intended to bring together the stakeholders (i.e. water agencies, watershed community) as well as science and technology to implement programs improved processes. The desired outcome is to effectively manage the water resource needs of both people and nature for sustainability. Thee degree that water can be a renewable resource (or sustainable) is dependent upon the effectiveness of this CWM Program. The approach is consistent with federal and state ecosystem management focus and is intended to be an extension of the Southwest Florida Water Management District's (SWFWMD) Comprehensive Watershed management Program. Support of this Plan's development was made possible with funding from the Manasota Basin Board through the District's Cooperative Funding Program. In fact, SWFWMD continues to consider the CWM Program one of their top priorities for both internal resource allocation and cooperative funding proposals and projects.

In the past, Sarasota County has successfully developed Master plans for Stormwater, Water Supply, Wastewater, and Reclaimed Water. Sarasota County has also developed and assisted in the development of several successful programs for the protection of natural systems and the water that sustains them. These programs include the County's Environmentally Sensitive Lands Protection Program and the Charlotte Harbor National Estuary Program (CHNEP). The CWM Program is intended to ties these Plans and Programs together.

In 2002, Sarasota County embarked on an Integrated Water Resource initiative that subsequently embraced the Southwest Florida Water Management District's Comprehensive Watershed Management (CWM) program. The uniqueness of the CWM program is that it considers the science and management of natural systems, water supply, water quality, and flood protection on an integrated basis and within watershed framework.

The Cow Pen Canal which was constructed in the late 1960's and which redirected a significant portion of the Myakka River watershed to Dona Bay (refer to Figure 1.1) has dramatically increased freshwater volumes to, and decreased seasonal salinities and dependent biological flora and fauna within, the estuary. Therefore, the Dona Bay estuary/watershed is a prime candidate for the CWM program and obvious outcome of the Integrated Water Resource initiative.

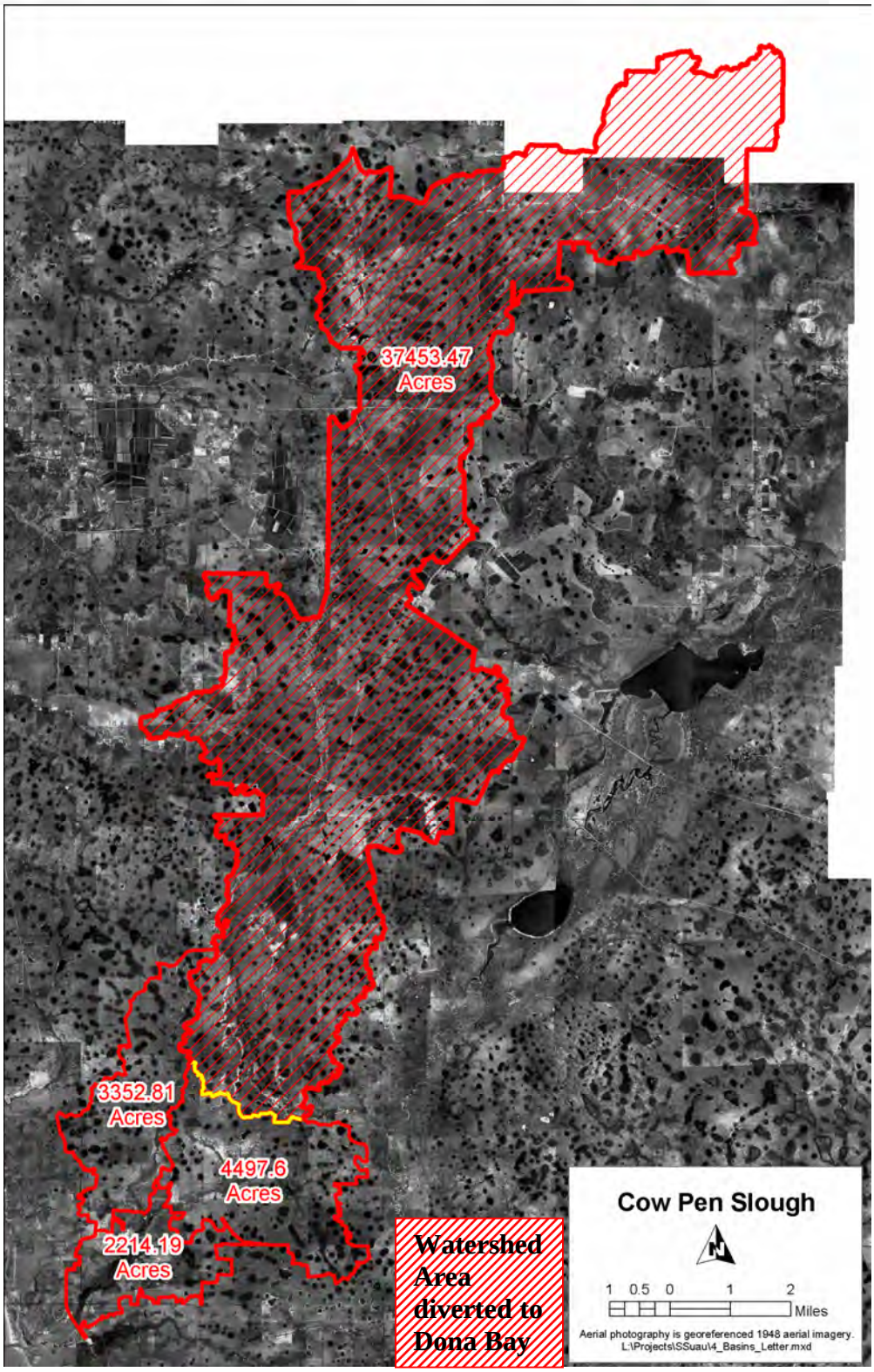

Figure 1.1 – Dona Bay Watershed

1.2 STAKEHOLDER PARTNERSHIPS

As previously acknowledged, stakeholder partnerships and coordination are essential to a successful CWM Program. Towards that end, the following water-related management stakeholders are acknowledged as current and future partners that in some way have contributed to the Dona Bay CWM Program:

- Southwest Florida Water Management District
- Manasota Basin Board
- Charlotte Harbor National Estuary Program
- Peace River/Manasota Regional Water Supply Authority
- U.S. Army Corps of Engineers
- U.S.D.A. Natural Resources Conservation Service
- Florida Department of Environmental Protection

Stakeholder agencies that are located within the watershed that will need to be engaged in the future include:

- Manatee County
- City of Venice

Finally, and most importantly, private property stakeholders in the Dona Bay watershed were engaged in two (2) public workshops hosted by Sarasota County, SWFWMD, and CHNEP. Following a presentation of the finding to date by Stephen Suau, Ernie Estevez and Michael Jones at the first public meeting, the community identified too much fresh water, nutrients, and construction were identified as the major issues. They also identified native planting, education, reduced runoff/pollution, and restoration as key opportunities. At the second public meeting in August of 2006, Steve Suau, Dave Tomasko, Ernie Estevez and Michael Jones presented estuary and watershed restoration concepts that would also provide alternative water supplies. The public comments were overwhelmingly complimentary of these restoration concepts.

In addition, several large properties in the rural, upstream portion of the watershed will need to be engaged, including:

- Hawkins Ranch
- Albritton Groves
- LT Ranch
- Hi-Hat Ranch
- SMR Farms
- Myakka Farms
- Palmer Ranch

1.3 AREAS OF RESPONSIBILITY AND OBJECTIVES

As defined by SWFWMD, the CWM Program consists of four primary areas of responsibility (AOR). These four areas of responsibility and their respective SWFWMD, County CWM, and specific Dona Bay CWM objectives are provided below:

1.3.1 Natural Systems

SWFWMD
To protect, preserve and restore natural Florida ecosystems and to establish minimum water levels and flows necessary to maintain these systems.

COUNTY CWM
To enhance, protect and conserve the hydrologic and ecologic functions of natural systems including estuaries, freshwater, and groundwater systems.

Dona Bay CWM
Provide a more natural freshwater/saltwater regime in the tidal portions of Dona Bay. Provide a more natural freshwater flow regime pattern for the Dona Bay watershed.

1.3.2 Water Quality

SWFWMD
To protect water quality by preventing further degradation of the water resource and enhancing water quality where appropriate.

COUNTY CWM
To protect water quality by preventing further degradation of the water resource and enhancing water quality where appropriate.

Dona Bay CWM
Protect existing water quality.

1.3.3 Flood Protection

SWFWMD
To minimize the potential for damage from floods by protecting and restoring the natural water storage and conveyance functions of flood prone areas. The District shall give preference wherever possible to nonstructural surface water management methods.

COUNTY CWM

To prevent and mitigate the losses, cost, and human suffering caused by flooding; and to protect the natural and beneficial functions of the floodplain.

Dona Bay CWM
Protect existing and future property owners from flood damage.

1.3.4 Water Supply

SWFWMD
To ensure an adequate supply of water resource for all reasonable and beneficial uses, now and in the future, while protecting and maintaining the water and related resources of the District.

COUNTY CWM
To ensure safe, efficient, economical, and sustainable water supplies that provide customers the appropriate water quality for the intended use.

Dona Bay CWM
Develop potential alternative surface water supply options that are consistent with, and support other plan objectives.

1.4 DONA BAY CWM SCOPE

The development of this plan was a cooperative effort between Sarasota County and the Manasota Basin Board. A contract with a diverse, multi-discipline consultant team was approved by the Sarasota Board of County Commissioners in September 2005 to prepare the Dona Bay CWM Plan. This scope for this effort is equally comprehensive, follows the four AORs, and includes research and development of science for natural system restoration/enhancement. In addition, restoration activities were evaluated to assure that they will not have an adverse impact on current flood elevations or pollutant loads within the watershed. Finally, the scope considers natural system and water quality benefits to the watershed that might result from the development of an alternative surface water supply. This CWM Plan presents the product of those efforts. The successful implementation of this plan would include the framework for a restoring the biology of Dona Bay that may include water supply project(s). The link between the watershed and estuary as well between natural system and water supply development in this CWM Plan is an in-depth understanding of the hydrology, how it has changed, and what effects these changes have on natural systems. Therefore, the effort included estimation of the historical water budget for Dona Bay, determination of the existing water budget for Dona Bay, and the identification, prioritization, and implementation of hydrologic restoration and water resource projects based upon their ability to restore a more historic or natural water budget for both the Dona Bay estuary and watershed. It has long been suspected that the Dona Bay estuary likely suffers from too much, not too little freshwater.

The remaining Chapters include a Watershed Description, and overviews of Natural Systems, Water Supply, Water Quality, and Flood Protection. In addition, the various Technical Memorandums prepared to address specific tasks are contained in the Appendices and organized again by the 4 AORs.

Major Task Summary

The following provides a summary of the scope of services relative to TASK 4 (Development of Doan Bay Watershed Management Plan) and generally corresponds to the associated Technical Memorandum numbers contained in the Appendices.

TASK 4.1 - NATURAL SYSTEMS

This element consisted of developing a natural systems chapter for the plan and related natural systems evaluations. Specific issues addressed in this chapter were a mapping of existing shoreline habitats within the Dona and Roberts Bay estuaries, evaluation of existing biological and habitat data (for Dona and Roberts Bays, Shakett Creek, Curry Creek, and Fox Creek), assessment of potential watershed stressors on biological communities, assessment of sediment characteristics and sedimentation rates, development of biological indicators and life history requirements associated with various estuarine salinity regimes, evaluation of Minimum Flows and Levels data collected by the SWFWMD, and an assessment of potential restoration/enhancement sites for the study area. Since one of the alternatives for watershed restoration/enhancement includes surface water withdrawal or diversion from Dona and Roberts Bays, a biological monitoring plan was developed (TM 4.1.1.3).

A critical concept for natural systems enhancement and/or restoration is the restoration of historical freshwater flow regimes to Dona Bay. Man-made drainage activities have resulted in the reduction in the amount of freshwater retained within the watershed and an associated increase in the amount of water discharged to Dona Bay. This freshwater imbalance is reflected in the existing water budget. Therefore, an objective of the Dona Bay Watershed Management Plan was to "re-balance" the water budget to reflect conditions more indicative of pre-drainage activity in order to restore seasonal salinity regimes in the estuary. This restoration would also result in retaining freshwater in the watershed or re-cycling or re-using this freshwater, so that Dona Bay can be restored to a more historical condition. This Task included providing much of the scientific basis needed to quantify various scenarios and benefits for natural system restoration. However, some restoration activities are also intuitive. These include directing and storing more water in historical low-lying and former freshwater wetland areas such as the County's Albritton site. Important to this task, was the development of a restoration phasing plan.

TASK 4.2 - SUSTAINABLE WATER SUPPLY

Re-balancing the freshwater water budget in the Dona Bay watershed could provide opportunities not just for ecological restoration, but sustainable water supply uses that are

consistent with natural system restoration/enhancement. This Task included the continued development and analyses of applicable data needed to determine sustainable yields, integrated water supply scenarios, and preliminary design options.

Scenarios for a potential new integrated and regional potable surface water supply source were evaluated. This evaluation required a broad evaluation that included a configuration of various storage locations, capacities, and methods. Surface water storage methods considered included the Albritton site and the Venice Minerals site. Configurations also considered water treatment plant locations. Preliminary estimates of probable cost for each option were developed as well as phasing plans.

Determination of sustainable yields was considered based on a set of various yields (i.e. 5 mgd, 10, mgd, & 15 mgd,) and storage needs as well as a water budget approach scenario. Scenarios of sustainable yield were developed based upon the difference in existing and historic water budget estimates. Storage requirements were similarly configured through up to three (3) different surface combinations. Preliminary estimates of probable cost for each option were developed. Within this frame, various surface storage capacities (and weir operations) were developed for the Albritton site.

This Task also included reviewing watershed goals relative to water supply. Current regulations that address these goals were identified. For those goals not currently regulated, incentive based protection mechanisms were developed through the watershed stakeholders group and public outreach activities. Since future development is likely to occur within the watershed, and Cow Pen Slough is being considered as a potential water supply source, the sustainable water supply effort also focused on the development of a Draft Water Supply Watershed Protection Plan (TM 4.2.8). The plan focuses on preservation and enhancement of existing water quality within the freshwater portions of the watershed and improving estuarine water quality in Dona Bay.

TASK 4.3 - WATER QUALITY

This scope element included the development of a water quality chapter for the plan and related water quality evaluations. Specifically addressed in this chapter are a summary of existing water quality conditions for various water uses (potable, irrigation, reservoir storage), review of pollutant loading estimates from future County water quality modeling efforts (where available), evaluation of existing salinity data (for Dona and Roberts Bays, Shakett Creek, Curry Creek, and Fox Creek), assistance with the development of a salinity model, and an assessment of TMDL-related issues for the study area. The information gathered and assessed during this task was used to develop water quality targets for both the freshwater and estuarine portions of the watershed.

TASK 4.4 - FLOODPLAIN MANAGEMENT

Because of the relatively flat topography of the region, several hydraulic connections between the Dona and Roberts Bay watershed and adjacent watersheds exist during major flood events. This Task included developing strategies and model adjustments to consider these hydraulic connections. Simulated stage-discharge curves were compared

to stage-discharge measurements at both water level control structures in Cow Pen Slough. Weir coefficients at both structures were adjusted where necessary to more accurately reflect measured stages and discharges. Excess storage created in storage alternatives for the Albritton and Venice Mineral sites were quantified and the radius of effective storage influence (i.e. potential service or benefit areas) was determined.

Chapter 2 Dona Bay Watershed Description

Photo of Dona Bay Estuary

CHAPTER 2
Dona Bay Watershed Description

2.1 LOCATION

Within Sarasota County, the Dona Bay watershed extends from the Venice Jetty northeast, through the center of Sarasota County east of Interstate I-75. This watershed also wraps around the east ends of the Little Sarasota Bay and Sarasota Bay watersheds and into Manatee County. Within this geographical area is a portion of the City of Venice. In addition to Dona Bay and Shakett Creek estuary, the watershed contains two tidal creeks (Fox Creek and Salt Creek) and a man-made canal (Cow Pen Canal). The communities of Laurel and Nokomis are located in the lower, urban portion of the watershed. The upper portion of the watershed is primarily rural consisting of large lot subdivisions and portions of the Palmer, Hi-Hat, LT, and Hawkins ranches are all located within this watershed.

Historically the Dona Bay watershed was significantly smaller and consisted of areas surrounding Shakett Creek, Fox Creek, and Salt Creek. Starting in the mid-1900's and continuing through the early 1970's, ditching activities drained and diverted a large slough system known as Cow Pen Slough from the Myakka River to Shakett Creek and Dona Bay. Prior to the diversion, Cow Pen Slough entered the Myakka River in the vicinity of Rocky Ford. As a result of the watershed alterations, the natural hydrology of Dona Bay has been altered. As a result, the Dona Bay watershed is approximately 74 square miles, or nearly 5 times its original size of approximately 10,065 acres.

The current Dona Bay watershed is located with SWFWMD's Southern Coastal Watershed, and contained within the area of the Charlotte Harbor National Estuary Program.

2.2 CLIMATE

The climate of the Dona Bay watershed is humid and near subtropical. The climate is typically characterized by warm, wet summers and mild, dry winters. The annual average temperature for Venice is 75º F according to the Venice Gondolier, and 72.32 º F according to average values from the NOAA weather station Buoy at Venice Pier. The mean annual air temperature is approximately 73 degrees Fahrenheit (°F), with a mean daily temperature range from 84°F in the summer to 61°F in the winter.

Annual rainfall average between 52.21 inches per year (SWFWMD Southern Coastal Basin CWM average from 1915 through present) and 53.47 inches per year (SWFWMD Manasota Basin Board average from 1915 through present), with approximately 60 percent of the annual precipitation occurring during the four month period from June

through September. April and May are typically the drier months and precede the beginning of the wet season. However, there are dramatic variations to the natural wet and dry seasons that can result in severe floods as well as prolonged droughts. According to the Water Resources Atlas of Florida (E. Fernald and E. Purdam 1998), the Sarasota region has over 125 Thunderstorms per year.

Evapotranspiration (ET) in the region is estimated to be approximately 39 inches per year. Rainfall that is not lost to the atmosphere through ET is available for surface and ground water discharge.

2.3 PHYSIOGRAPHY AND SOILS

The Dona Bay watershed lies within the Gulf Coastal Lowlands and DeSoto Plain subdivisions of the central or mid-peninsular physiographic zone of Florida. Most of the watershed is in the Gulf Coast Lowlands, which are nearly level plains extending the length of Florida's Gulf coast. A small segment of the watershed headwaters lies within the DeSoto Plain, a broad, gently sloping plain extending from central Manatee County into the northwest corner of Glades County.

Elevations in the watershed are generally between 5 and 35 feet above National Geodetic Vertical Datum (1929).

The soils of the Dona Bay watershed are classified into four general groups by the Natural Resource Conservation Service: very poorly drained; poorly drained; somewhat poorly to moderately well-drained; and poorly to moderately well-drained. The soils are generally level and sandy soils and are found in the extensive pine flatwoods and palmetto prairies of the watershed and associated low-lying areas as well as in oak/cabbage palm hammocks. Soils categorized as "depressional" or "frequently flooded" and associated with isolated wetlands and floodplain slough also frequent the watershed.

2.4 HYDROGEOLOGY

The Dona Bay watershed is located within the Southern West-Central Florida Ground-Water Basin (SWCFGWB), one of three distinct ground water basins within west-central Florida. No significant ground water flow crosses the basin boundaries; hence, all ground water is derived primarily from rainfall within the SWCFGWB. Upper Floridan aquifer flow in the SWCFGWB is derived primarily from rainfall recharge that occurs in the Lake Wales Ridge area to the east. Down gradient of the Lake Wales Ridge area, ground water flows west and southwest toward and into the Gulf of Mexico.

Within the SWCFGWB, the ground water system is divided into three main aquifers: the surficial, the intermediate and the Floridian. Each aquifer is separated by a confining layer of variable thickness and areal extent. The uppermost aquifer, the surficial, is largely undeveloped due to its small thickness and low permeability. The surficial

aquifer occurs in the undifferentiated sands that overlie the watershed and generally varies from less than 25 feet in the southern area to 50 feet in thickness in the northeastern areas of Manatee County. These sands yield limited quantities of water, primarily used for lawn irrigation.

Underlying the surficial aquifer is the intermediate aquifer system (IAS). Within the SWCFGWB, the IAS average 700 feet in southern Charlotte County, but thins toward the north. Within the Dona Bay watershed, the IAS is about 300 feet or more thick. The IAS is the primary source for irrigation and domestic supply in the watershed.

The lowermost aquifer is the Floridan aquifer system. In the Dona Bay watershed region, the aquifer consists of two hydrologic units, the Upper and Lower Floridian aquifers, which are separated by a middle confining unit. The Upper Floridian aquifer is the most productive aquifer of the region, but its high mineral content limits the use of this ground water in much of the Dona Bay watershed region. The Upper Florida aquifer varies from about 1300 to 1800 feet in thickness in the watershed area. The Lower Floridan aquifer contains highly mineralized water.

The Doan Bay watershed lies entirely within a region designated by the District as the Southern Water Use Caution Area (SWUCA). This is an area where the Floridan aquifer is well confined and highly transmissive. In addition, the very upper portion of the Dona Bay watershed area is located in or near the Most Impacted Area (MIA) of SWUCA.

2.5 LAND USE

The current Southwest Florida Water Management District (SWFWMD) land use database was used to calculate the difference in the land use types between the 2005 Dona Bay watershed and the 1847 limits of the watershed, as summarized in Table 2.1. The current watershed is approximately five times the size of the historical watershed due to the construction of Cow Pen Canal.

Figure 2.1 provides the current Sarasota County Future Land Use Map for the Dona Bay Watershed. The current Future Land Use Map designates most of the lands as rural. Current zoning within these rural designated areas are either OUR or OUE which would allow 5 to 10 acre lots. Sarasota County recently established a Comprehensive Plan amendment known as the 2050 Plan. The 2050 Plan is intended to be an incentive-based, development option and contains several Resource Management Areas or RMAs. The Village and Greenway RMAs are intended to cluster “Villages” in compact upland areas and preserve large contiguous “Greenways” primarily centered on streams, rivers and watercourses. As currently proposed, these greenway areas would consist of named creeks and flow-ways, wetlands connected to those creeks and flow-ways, and an additional 500-foot buffer from the composite of these areas, or alternative greenway or buffer configuration that provide equivalent or greater net ecological benefit. Figure 2.2 provides the 2050 plan overlay for the Dona Bay Watershed.

FLUCFCS Code	Description	2005 Acreage	1847 Acreage
1100	Residential Low Density	3294.1	549.5
1200	Residential Medium Density	1240.0	959.7
1300	Residential High Density	347.4	307.6
1400	Commercial and Services	160.7	109.5
1500	Industrial	84.5	84.5
1600	Extractive	729.6	478.1
1700	Institutional	112.6	51.4
1800	Recreational	777.9	336
1900	Open Land	2146.1	235.3
2100	Cropland and Pastureland	11266.1	1895.5
2140	Row Crops	905.7	19.2
2200	Tree Crops	1573.5	156.8
2300	Feeding operations	2.3	0
2400	Nurseries and Vineyards	110.5	9.8
2500	Specialty Farms	52.3	23.2
2600	Other Open Lands	236.7	0
3100	Herbaceous	83.9	0
3200	Shrub and Brushland	3649.1	502.1
3300	Mixed Rangeland	158.3	0
4100	Upland Conifer Forest	213.9	0
4110	Pine Flatwoods	6829.6	1449.7
4200	Upland Harwood Forests Pt 1	6.6	0
4340	Hardwood Conifer Mixed	1358.1	249.9
4400	Tree Plantations	379.4	0
5100	Streams and Waterways	153.2	57.9
5200	Lakes	349.0	58.3
5300	Lakes and Reservoirs	887.4	379.1
5400	Bays and Estuaries	153.3	153.3
6100	Wetland Hardwood Forests	12.5	0
6110	Bay Swamps	2.3	0
6120	Mangrove Swamps	19.9	19.9
6150	Stream and lake Swamps (bottomland)	2763.1	68.4
6200	Wetland Conifer Forests	45.9	34.9
6210	Cypress Swamp	81.4	3.3
6300	Wetland Forested Mixed	338.1	128.1
6410	Freshwater Marshes	4794.6	647.6
6420	Saltwater Marshes	32.4	32.4
6430	Wet Prairies	1149.0	240.6
6440	Emergent Aquatic Vegetation	85.0	32.6
7400	Disturbed Land	6.3	4.5
8100	Transportation	220.9	220.9
8200	Communications	2.7	2.7
8300	Utilities	768.9	32.5
	Total	**47,584.8**	**9,534.8**

Table 2.1 – Land Use within the Historical and Current Dona Bay Watershed

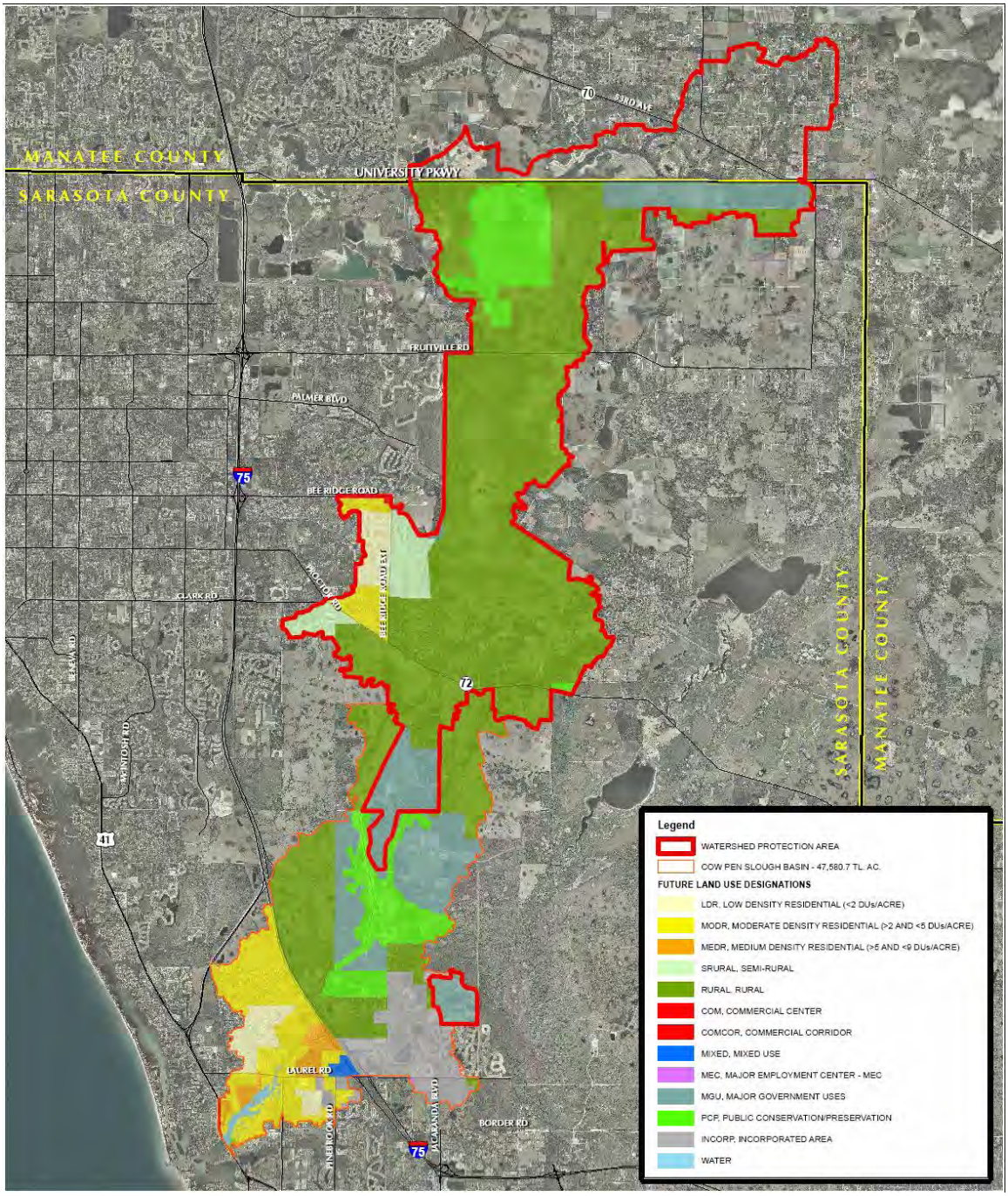

Figure 2.1 – Sarasota County Future Land Use Map

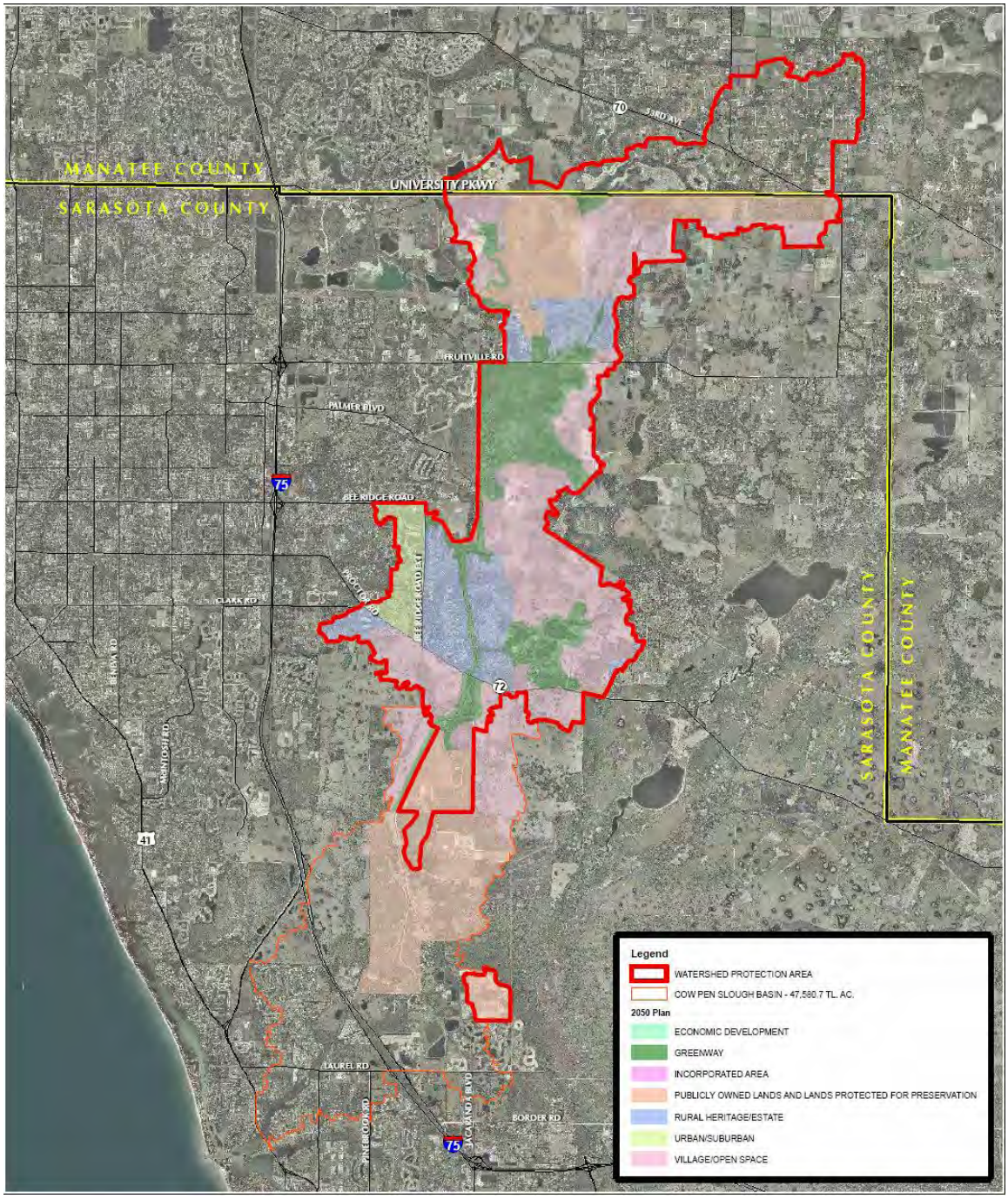

Figure 2.2 – Sarasota County 2050 Plan Overlay

2.6 HISTORICAL PERSPECTIVE

The current Dona Bay watershed has been significantly impacted by man-made drainage activities, which increased the efficiency and volume of freshwater being discharged to its tidal estuary. Based on the 1847 survey of Sarasota County, Shakett Creek historically split into two creeks, Fox Creek and Salt Creek. Fox Creek appeared much as it does today, but in 1847 it terminated at around the present day I-75. Portions of the original Salt Creek are also still in-tact. The original Cow Pen Slough appears to have been just that, one of the largest natural slough systems in the County that eventually meandered south and east towards the Myakka River.

Historical maps indicate that a significant portion of the current watershed has been diverted to the Dona Bay watershed by the man-made Cow Pen Canal, effectively increasing the watershed area from about 10,000 acres to over 74 square miles (refer to Figure 2.3 and Figure 2.4).

Since the 1900s, the Dona Bay watershed has experienced profound hydrologic alterations. First, a ditch was constructed to extend Salt Creek to the southern end of the original Cow Pen Slough. This began an obsession to drain Cow Pen Slough that lasted for about 50 year and introduced greater amounts of freshwater to Dona Bay.

Finally, in the 1960's the United Stated Department of Agriculture's Natural Resource Conservation Service (also known as the Soil Conservation Service) embarked on one of the most significant drainage works in the history of Sarasota County. The work plan called for the construction of a large canal system with water level control structures from Shakett Creek, north to Manatee County. A large lateral canal was also to be constructed to divert much of the eastern portion of the South Creek basin to Shakett Creek. A spur canal and stormwater pumping station were also to be constructed into the Phillippi Creek basin to relieve flooding in the eastern portion of that basin. While the main canal was constructed to the Phillippi Creek spur (known as the Vegetable Relief Canal), environmental interests halted the remainder of the work including the extension of the main canal to Manatee County, the South Creek lateral, and the Phillippi Creek stormwater pumping operation. But the work that had been completed was sufficient to drain the slough for pasture and citrus production. The completed work also included the construction of two (2) operable water level control structures in the canal and several dozen manual drop structures to direct runoff from adjacent properties into the canal. These two structures have typically been operated in an "open" position during the wet season to reduce flood risk and in a "closed" position in the dry season to promote water conservation and presumably augment irrigation demands. Although the City of Sarasota currently provides reclaimed wastewater to the Hi-Hat Ranch, for the most part irrigation demands for more intensive agricultural operations in the watershed have typically been provided by ground water pumping from deeper aquifer systems.

However, much of the Dona Bay watershed is rural in nature and affords opportunities for hydrologic restoration of the original slough. In fact, a 350 acre portion of the historical slough is located on the County owned Pineland Reserve has been restored.

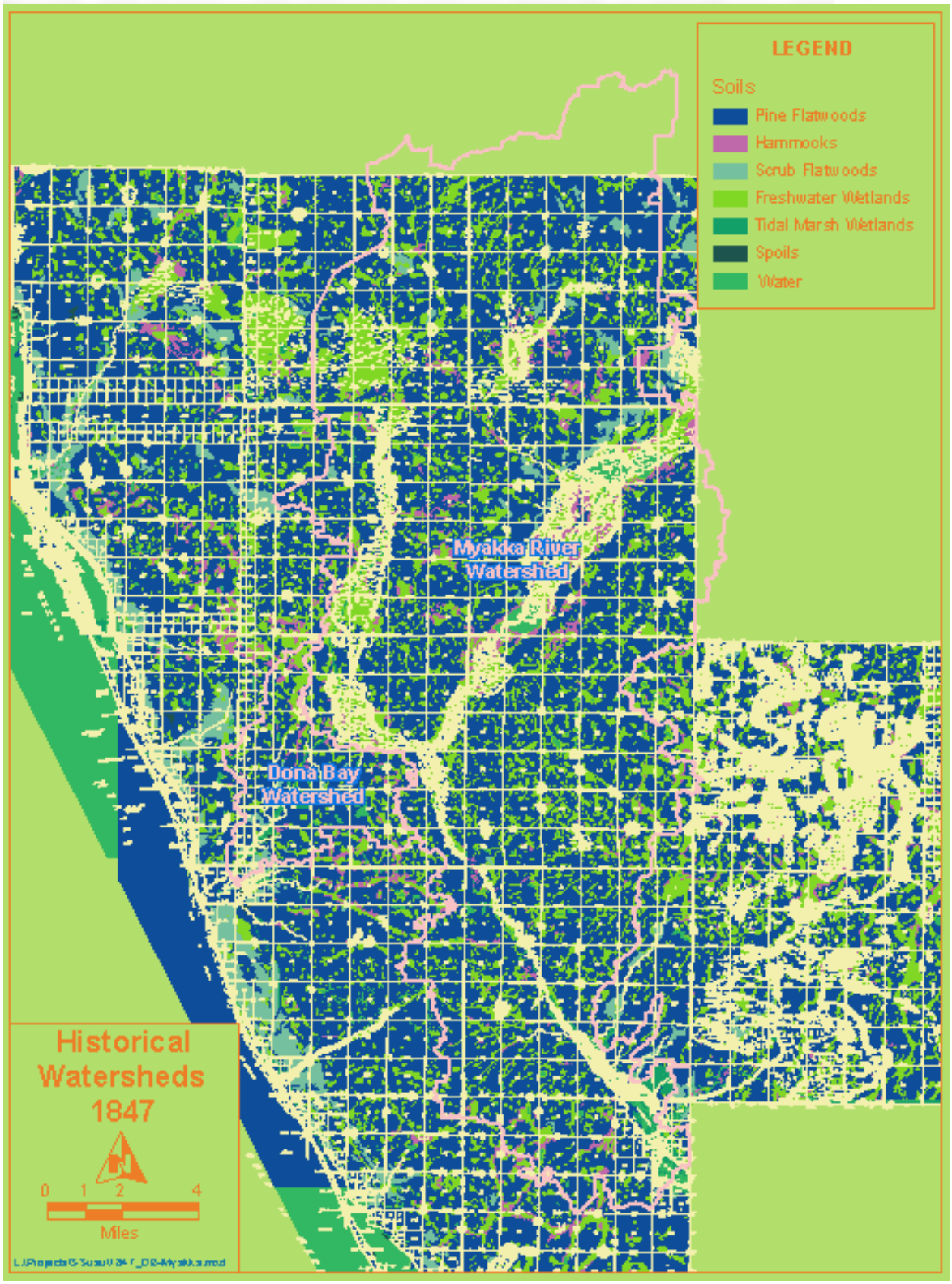

Figure 2.3 – 1847 Survey Map

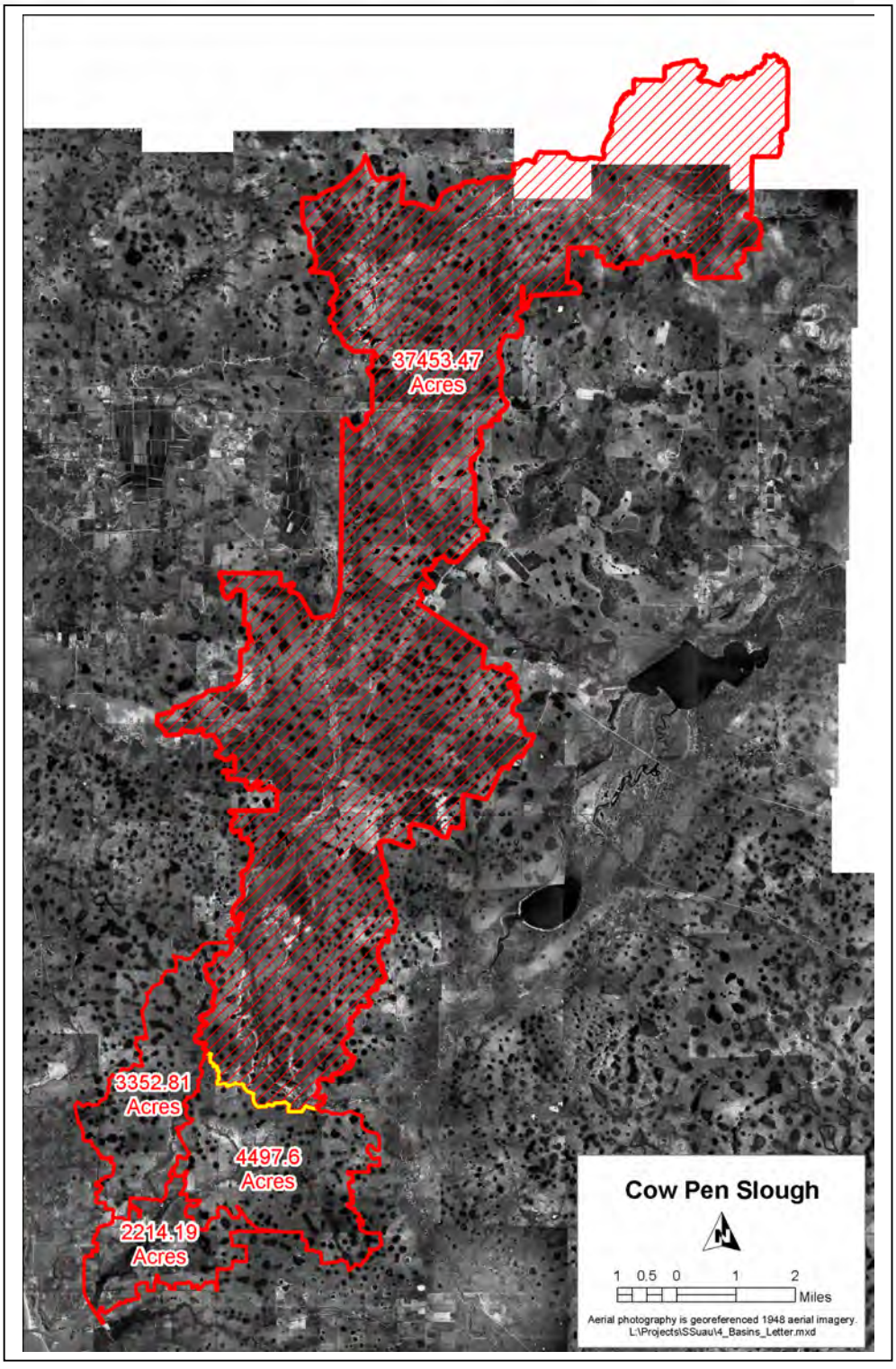

Figure 2.4 – Dona Bay Watershed

2.7 NATURAL ENVIRONMENT AND ECOSYSTEMS

The right mix of salt and freshwater in estuaries is critical to their sustainable productivity. Natural system responses to major hydrologic alterations such as those that have occurred in the Dona Bay watersheds have resulted in lowered salinities and likely, increased sediment and nutrient loads in the downstream estuaries. The productivity, population dynamics, community composition, predator-prey relationships, and food web structure within the estuarine system are significantly impacted by changes in salinity. These impacts may manifest themselves as loss of seagrasses, reduction in live oysters, shifts in benthic community structure, reduced larval recruitment and survival of fisheries species, and increased frequencies of anoxic conditions.

From a watershed perspective, much of the area surrounding Dona Bay has been urbanized while more rural and agricultural land uses exist in the mid and upper portions of the watershed. Historically, these inland areas consisted of large, slow flowing marshes. The excavation of the historical Cow Pen Slough by a series of deeply incised canals, and to a lesser extent the conversion of the landscapes to improved pasture, citrus and rural land subdivisions, has significantly altered the character, function and values of historical watershed and its associated wetlands. Additionally, the diversion of a significant portion of the Myakka River watershed into the Dona Bay watershed has dramatically increased fresh water flows to Dona Bay.

Chapter 3 – Natural Systems

Photo of Southern Coastal Watershed
Myakka River State Park

Chapter 3
Natural Systems

3.1 INTRODUCTION

In addition to the general natural systems information contained herein, the following Technical Memorandums (TMs) relative to natural system in the Dona Bay watershed are provided in the Appendix:

4.1.1.1	Data Collection and Review – GIS Shoreline Mapping and draft Hydrobiological Monitoring Plan (PBSJ)
4.1.1.2	Data Collection and Review (BRA)
4.1.2	Development of Natural Systems Water Budget
4.1.3.1	Data Analysis – Indicators of Hydrologic Alteration
4.1.3.2	Data Analysis – Freshwater Systems
4.1.4	Evaluation of Restoration / Enhancement Value
4.1.5	Alternative Impact Analysis

Consistent with the contract scope of services, these TMs provide preliminary evaluations for (1) the spatial extent and severity of historic changes in shoreline and hydrologic conditions in the Dona Bay watershed, (2) the development of a draft hydrobiological monitoring plan for Dona Bay, (3) the development of a hydrologic modeling approach for restoration plan development for the Dona Bay watershed, (4) an evaluation of permitting issues and potential mitigation bank opportunities associated with implementation of Dona Bay watershed restoration opportunities, and (5) and an impact of various watershed restoration projects on freshwater natural systems.

TM 4.1.1.1 presents a summary of efforts to develop GIS maps and data comparisons for existing and historical shoreline habitats of Dona and Roberts Bays (from Blackburn Bay to northern Lemon Bay). Also, this TM summarizes efforts to produce a draft Hydrobiological Monitoring Program (HBMP) for Dona Bay, based on both the unique characteristics of the Cow Pen Slough – Dona Bay watershed, and a review and comparison with existing hydrobiological monitoring plans currently in place for the Tampa Bay Desalination Plant and the Peace River / Manasota Regional Water Supply Authority's Peace River withdrawals. It was found that there have been significant losses of ecologically valuable shoreline features (e.g., mangrove forests, salt marshes) between 1948 and 2004, mostly as a result of the conversion of these landscapes into hardened shorelines for residential development and the construction of the Intracoastal Waterway. A draft HBMP was developed for Dona Bay, which recognizes the somewhat unique impact (in this area, at least) of a dramatic increase in freshwater inflows. The draft

HBMP would focus on both water quality collection and analysis, and also the collection and analysis of GIS-based maps of seagrass and oyster reef coverage. GIS data would need to be supplemented with field-based verification of coverage classifications, as well as more detailed assessments of health of these proposed bio-indicators.

TM 4.1.1.2 outlines the data sets and techniques used to evaluate the natural systems within the freshwater portions of the Dona Bay watershed, with a focus on four sites: (1) Albritton, (2) West Pinelands, (3) Myakka Connector, and (4) Venice Minerals. This TM mostly is a compilation of data sources and techniques used for documenting the presence and relative health of freshwater wetland resources in the Dona Bay watershed.

TM 4.1.2 summarizes techniques and results from a water budget analysis of historical hydrologic data collected in the Deer Prairie watershed. This data set was used to estimate rainfall and runoff relationships from a nearby and representative natural watershed. Results from this effort have been used to estimate the quantity and timing of runoff delivered to Dona Bay from its natural and historic watershed. This information was used to estimate historical flows into Dona Bay, using long-term rainfall data sets from nearby rain gages.

TM 4.1.3.1 presents a summary of efforts to develop an analysis of flow data based on an Indicators of Hydrologic Alteration (IHA) approach. The IHA technique was used to develop statistical descriptions of stream flow variables, and to compare seasonal and annual variability in stream flow parameters with data generated from other less-impacted systems. Results from this assessment suggest that a potential ecologically relevant minimum flow for the Dona Bay watershed could be one of no flow conditions, at least during the driest months of the year (e.g., April and May). While these results should be viewed as preliminary, they are consistent with findings that coastal streams in Southwest Florida probably did not contribute significant amounts of freshwater inflow into adjacent estuarine systems during the driest times of the year.

TM 4.1.3.2 summarizes the hydrologic modifications of the Dona Bay watershed, the extensive field assessments, the results of the GIS exercises, and the results of the UMAM analyses for the upper, freshwater portions of the watershed. This effort summarizes the substantial impacts to freshwater wetlands that have occurred as a result of the numerous and substantial drainage improvements that have occurred throughout the Dona Bay watershed. This report also indicates that the Florida Scrub Jay is not nesting within the Dona Bay watershed.

TM 4.1.4 estimates the wetland mitigation credit potential and associated costs of three potential projects associated with implementation of potential hydrologic restoration activities in the Dona Bay watershed. This analysis was undertaken to determine if any of the potential projects would be appropriate as a mitigation bank and further, to determine the overall feasibility of establishing a mitigation bank in the Southern Coastal

Basin. This assessment concluded that proposed hydrologic restoration projects in the Dona Bay watershed do not present significant permitting challenges, other than the need for water withdrawal permits. In addition, it appears that there is the potential for establishment of a regional mitigation bank, to be coordinated with the need for any potential mitigation requirements that might arise during the permitting process for proposed hydrologic restoration projects.

TM 4.1.5 was prepared to rank and prioritize assessed tracts in the freshwater portion of the Dona Bay watershed based on project cost-benefit assessments and overall enhancement to water resources subsequent to restoration, to summarize the natural system improvements or degradation that would occur as a result of implementing any of the alternatives, and to describe the permitting issues/constraints related to each alternative. As in TM 4.1.4, there do not appear to be permitting issues that would be potentially able to stop or significantly interfere with potential hydrologic restoration activities in the Dona Bay watershed.

3.1.1 Overview of Dona Bay Watershed

Alterations to the historical Dona Bay watershed have resulted in significant impacts such as diversion of historical watersheds thus altering historical hydrologic regimes, conversion of native habitats for agricultural and residential development, as well as the ditching, excavation, and filling of historical wetland and slough systems. These activities have affected the functions and values of historical wetlands such as water quality treatment, attenuation of stormwater runoff, and fish and wildlife habitat values. These activities have also affected the estuarine values and functions historically provided by Dona Bay as a result of a significant increase in the freshwater runoff, as well as the alteration of the periodicity of these freshwater inputs into the estuary.

Historically, The Dona Bay Watershed probably consisted of a watershed approximately 16 square miles in size. Starting in the early 1900's and continuing into the early 1970's, periodic but incrementally more serious efforts were expended to drain and divert the original Cow Pen Slough from the Myakka River to Dona Bay. Culminating with the completion of the Cow Pen Canal (CPC) in the early 1970's, the watershed was increased to approximately 74 square miles (Figure 3.1).

Conversion of historical landscapes, primarily for agricultural uses such as improved pastures, citrus, and the excavation of the historical Cow Pen Slough system by a deeply incised canal, has efficiently drained and significantly altered the character, function and values of historical wetlands. Additionally, the diversion of a significant portion of the Myakka River watershed into the Dona Bay watershed has increased fresh water flows downstream into Dona Bay.

The predominant land use in the Dona Bay watershed is pastureland and both low and medium density residential, with the majority of the medium residential land uses being

located in the lower portions of the watershed, where the Cow Pen Canal discharges to tide at the headwaters of Shakett Creek via a gated water level control structure just west of Kingsgate Mobile Home Park.

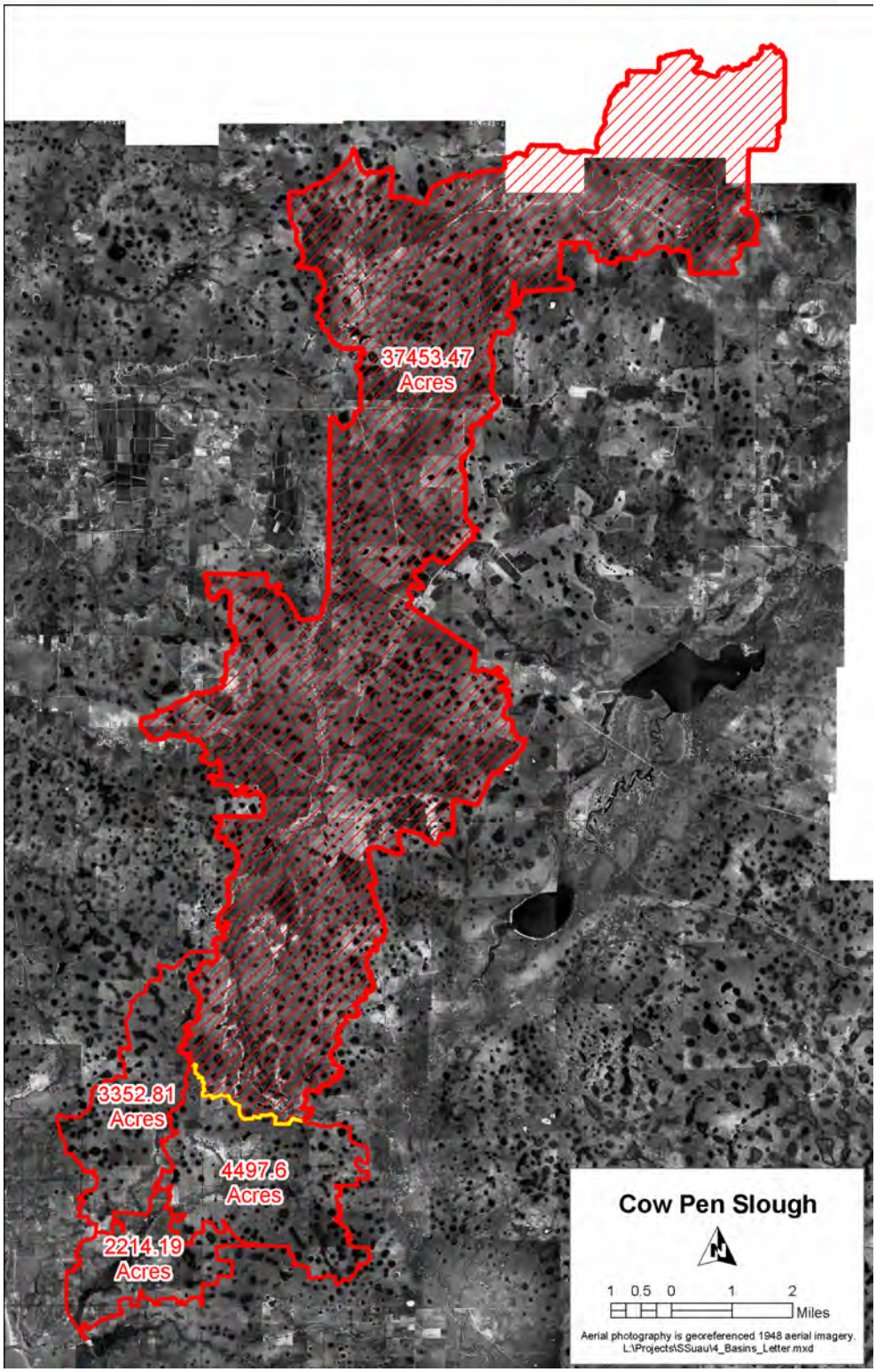

Figure 3.1 – Existing and Historical Watershed for Cow Pen Slough

The Dona Bays system is comprised of and/or contiguous to, the following estuaries and their watersheds as shown in Figure 3.2:

- Blackburn Bay – located north of Venice Inlet. At its northern limit, it adjoins Little Sarasota Bay
- Lyons Bay – located adjacent to Dona Bay, to the north.
- Dona Bay – its western terminus is Venice Inlet. To the east, Dona Bay narrows considerable east of U.S. 41 as it connects with Shakett Creek.
- Shakett Creek – source of freshwater inflow into Dona Bay. Further east and north, Shakett Creek "proper" ends at the southernmost weir on Cow Pen Slough.
- Cow Pen Canal – the name of that portion of the watershed that discharges freshwater inflow into Dona Bay via Shakett Creek.
- Roberts Bay – located just south of Dona Bay. To the east, southern Roberts Bay narrows considerable east of U.S. 41 as it connects with Curry Creek.
- Curry Creek – source of freshwater inflow into southern Roberts Bay. Further east, Curry Creek "proper" is contiguous with the Blackburn Canal.
- Blackburn Canal – a drainage feature that artificially connects the lower Myakka River with Curry Creek.
- Hatchett Creek – a drainage feature that flows into the southern Roberts Bay. It also has been expanded in size, and deepened as well (Jones 2005).

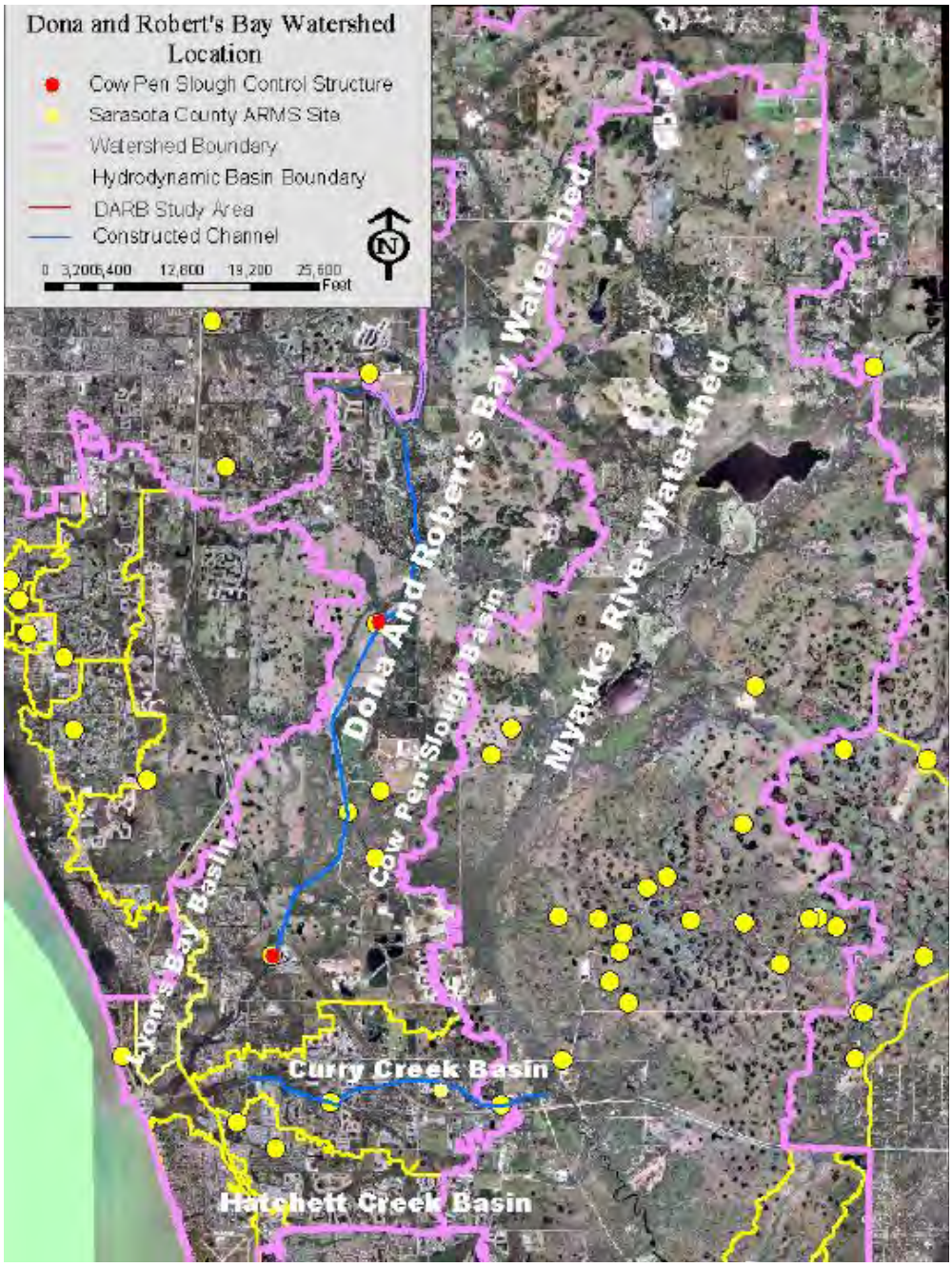

Figure 3.2 – Dona Bay Watershed and Location Map

3.2 OVERVIEW OF NATURAL SYSTEMS ISSUES

As has been outlined in the Water Quality Chapter, the biggest impact to the Dona Bay system was the expansion of the watershed facilitated by Cow Pen Canal drainages system in the 1940's through the early 1970's.

Large influxes of freshwater inflow from the expanded watershed are associated with reductions in salinity, increases in the variability of salinity, decreases in average oxygen conditions, decreases in the minimum dissolved oxygen values experienced, and a significant increase in loads of nitrogen, phosphorus and total suspended solids to Dona Bay (see Water Quality Chapter). The combination of these impacts is most probably responsible for the reduced abundance and health of various estuarine habitats in DARB. The most impacted systems are most likely benthic communities (e.g., seagrass, oysters and clams) that are unable to migrate away from stressful conditions. For this reason and others, these communities have been previously used as "bio-indicators" of the health of various estuaries.

Figure 3.3 – Seagrass Coverage in DARB in 2003

The percentage of the bottom Lyons Bay covered with seagrass meadows (based on SWFWMD mapping efforts) is considerably higher than the percent coverage of Dona

Bay with seagrasses (Figure 3.3). Seagrass coverage in Lyons Bay is a fairly even mix of both "patchy" and "continuous" meadows. In Dona Bay, the only seagrass coverage category present is that of patchy seagrass meadows. Seagrass coverage in Dona Bay is also restricted to those portions of the bay closest to Venice Inlet, even though there is considerable shallow water habitat in areas farther east. In contrast, seagrass meadows in Roberts Bay extend all the way to U.S. 41.

When considered together, this information suggests that conditions in Dona Bay are more stressful than those in Roberts Bay, and considerably more stressful than in the contiguous estuary of Lyons Bay. While other factors cannot be ruled out, it would seem reasonable to conclude that the biggest impact to seagrasss meadows in Dona Bay would be the reduced salinities, increased variation in salinity, and reduced water clarity in Dona Bay associated with excessive inputs of freshwater inflow via the Cow Pen Canal.

Another useful bio-indicator of estuarine health is the extent of oyster reefs. Figures 3.4 and 3.5 illustrates the distribution of oyster reefs, delineated via aerial photography, presently found in Lyons, Dona and Roberts Bays, and then classified as to whether they were dead or alive.

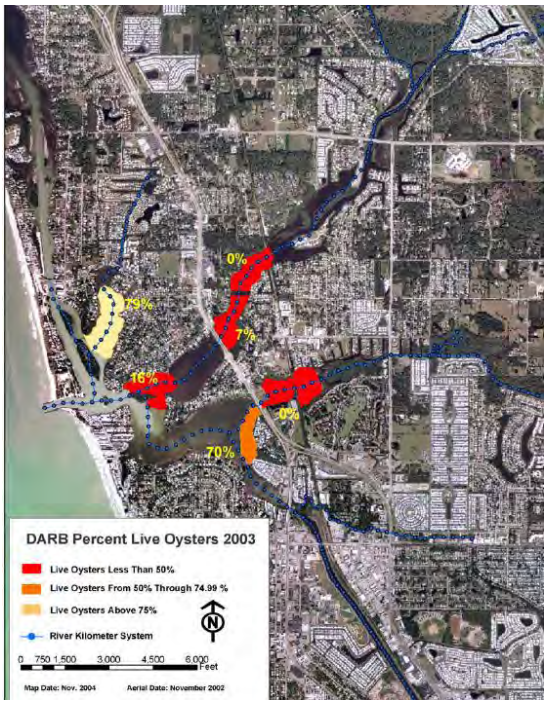

Figure 3.4 – Oyster Health in 2003

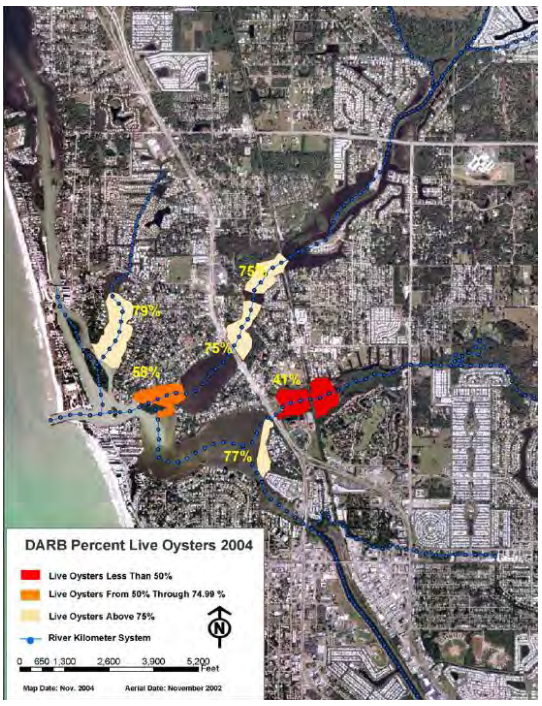

Figure 3.5 – Oyster Health in 2004

In both years, oyster coverage in Lyons Bay was constant, and more than 75 percent of the oysters found in Lyons Bay were alive. In Dona Bay, the percentage of live oysters varied between 16 percent in 2003 and 58 percent in 2004. Further upstream in Shakett

Creek, live oysters were found to comprise 0 to 7 percent of total oysters in 2003, but more than 75 percent of oysters in 2004. In Roberts Bay, more than 70 percent of oysters were living in both years, while further upstream in Curry Creek, no live oysters were found in 2003 and 41 percent of the oysters were alive in 2004.

Prior oyster monitoring efforts have also reported large variation in the health of oysters in Dona and Roberts Bays. Sauers (1983) reported finding no live oysters in Curry Creek, Shakett Creek and Dona Bay in the fall of 1982, but live oysters at many locations in the Dona and Roberts Bay system in the early spring of 1983.

These data suggest that oysters have the potential to grow and reproduce in Dona Bay and Shakett Creek, but that they are killed off on a fairly regular basis both here and in Roberts Bay / Curry Creek.

Using aerial photography from 1948, probable oyster reef distribution in Dona Bay was mapped by staff from Sarasota County (Figure 3.6).

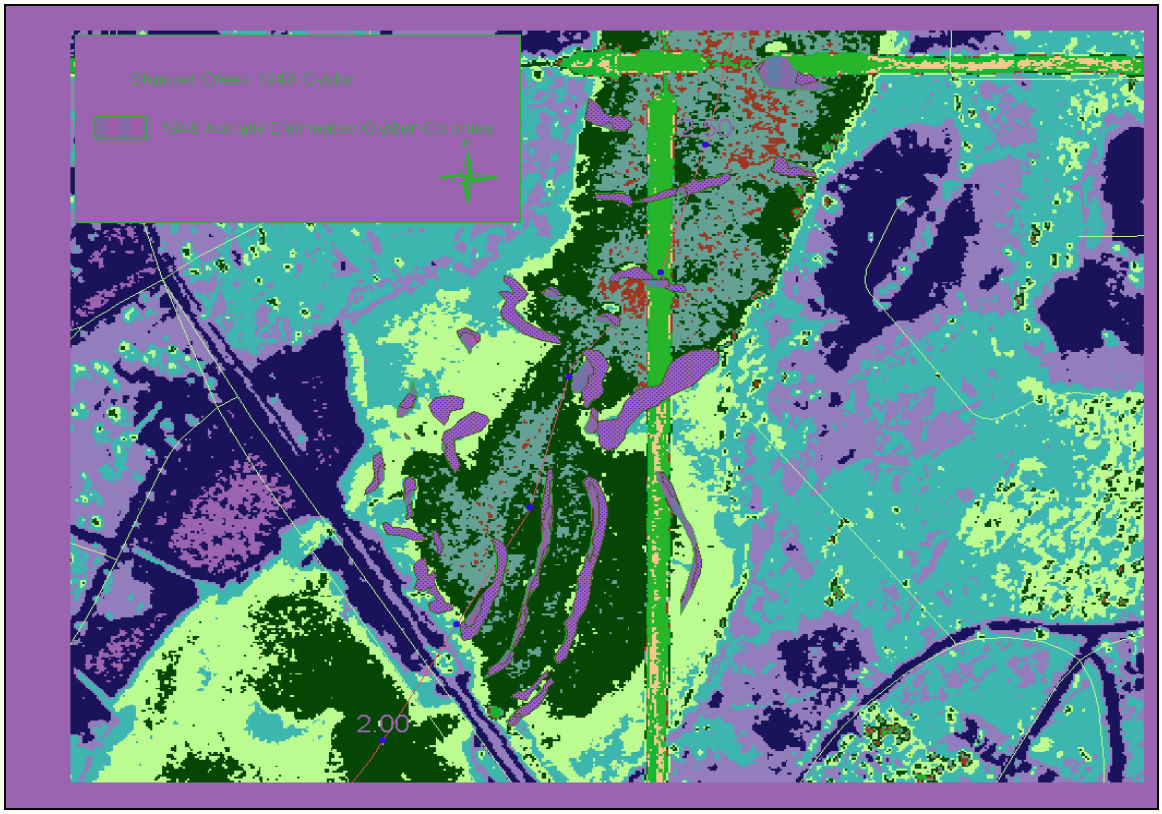

Figure 3.6 – Probable Oyster Reef Distribution in 1948 (source – Sarasota County)

While this map was not produced with the aid of ground-truthing, and while no information is available on whether or not mapped oyster reefs were likely dead or alive,

this information does suggest that oyster reefs were a feature of the Dona Bay system prior to the expansion of the watershed, and that the CPC drainage system did not cause oysters to establish in an area that they weren't previously found. Consequently, oyster reef distribution might be a useful "target" for tracking the health of Dona Bay and Shakett Creek.

As part of the fulfillment of the Natural Systems Tasks for the Dona Bay Watershed Management Plan, maps were produced for the dominant shoreline features in the DARB system.

For the shoreline features map, the following shoreline types were mapped:

- Beach
- Cleared land
- Fringing deep wetlands
- Fringing patchy wetlands
- Exposed banks
- Rip rap
- Seawalls
- Upland shorelines

To produce these maps, crews surveyed the entire stretch of shoreline, from Blackburn Bay to northern Lemon Bay, as well as the extent of Shakett Creek up to the Cow Pen Canal water level control structure and Curry Creek. Using GPS, created maps and aerial photography, site survey information was relayed to a GIS specialist, who used this information to create GIS-based maps of these features (Figure 3.7).

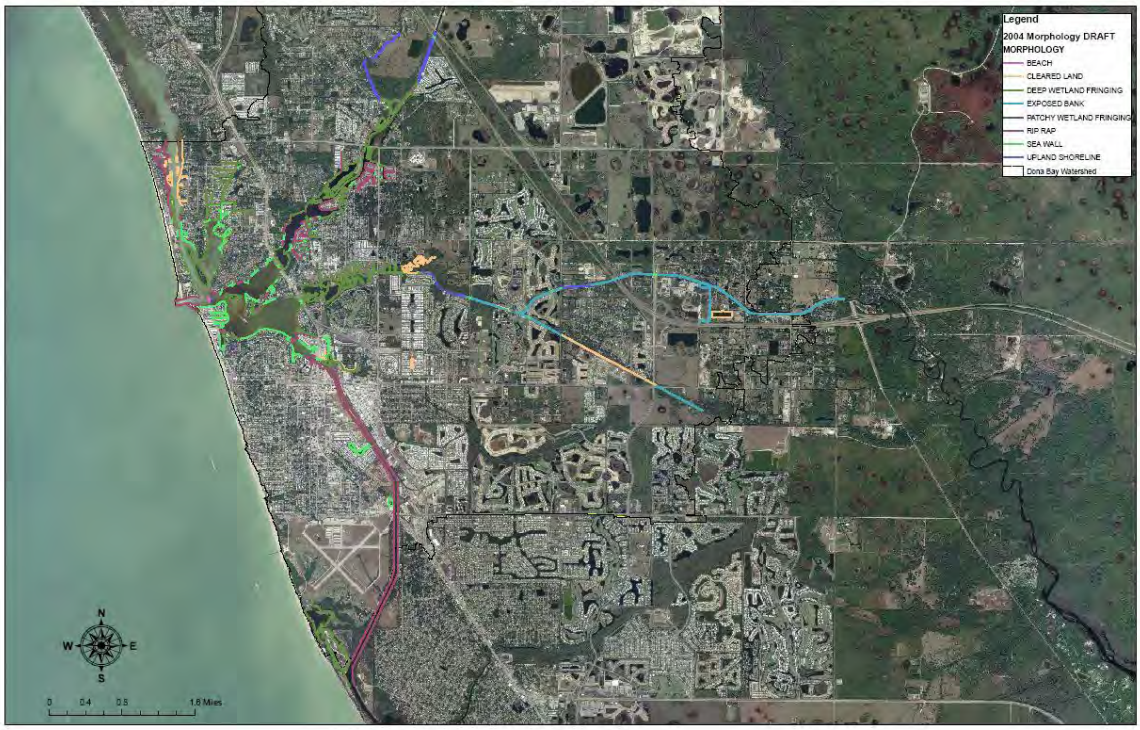

Figure 3.7 – Shoreline Features in 2004

In the areas closest to Venice Inlet, the dominant shoreline type is either rip rap or seawalls. Seawalls are the dominant shoreline feature for the residential neighborhoods in this area, while rip rap is the dominant shoreline feature along both the inlet itself, and also along the Intracoastal Waterway. Most of natural shorelines in the both Dona and Roberts Bays are classified as "fringing deep wetlands" indicating that these wetland areas (mostly mangroves or mangroves and Spartina mixed together) are fairly robust systems, with the potential to perform the expected wetland functions of providing habitat for fish and wildlife and also treating surface water runoff from immediately adjacent uplands. These wetland areas are mostly located east of U.S. 41, in upper Dona and Roberts Bays as well as in Shakett and Curry Creeks.

In contrast the shoreline map created using 1948 aerial photography is of a much less impacted system (Figure 3.8).

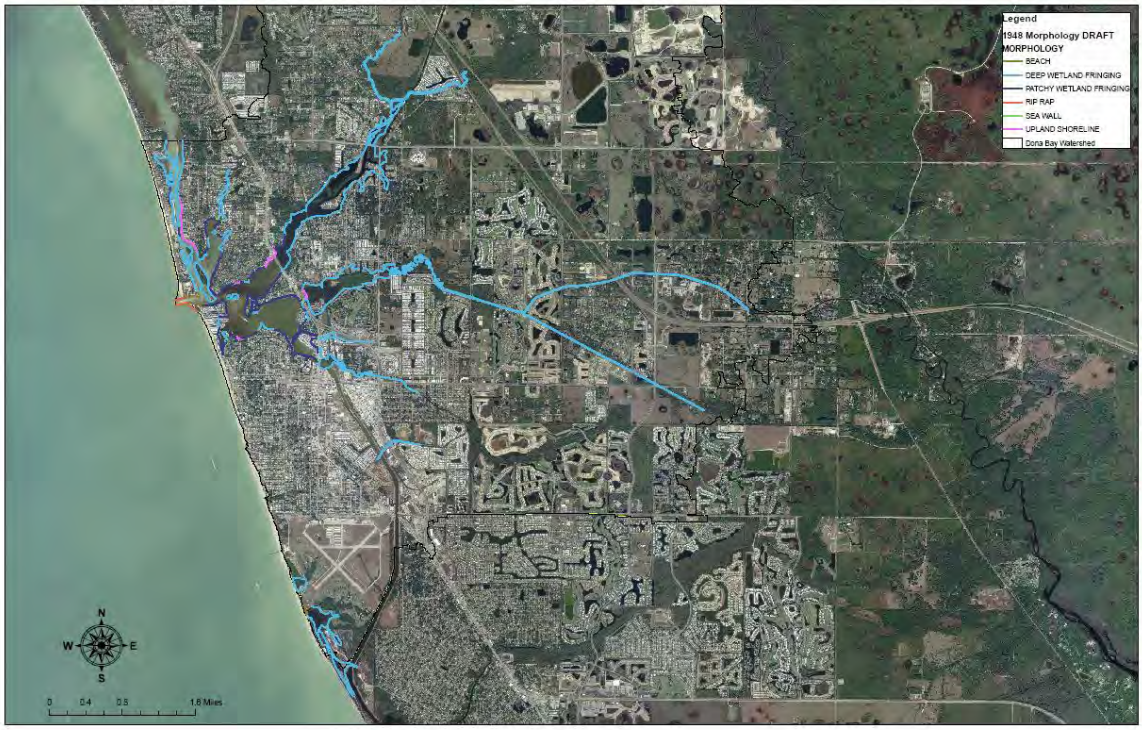

Figure 3.8 – Shoreline Features in 1948

In 1948, the dominant shoreline feature was that of a fringing deep wetland – most probably a shoreline dominated by mangroves. While rip rap was in place in the area of Venice Inlet, most of the areas now dominated by residential neighborhoods with seawalls was instead dominated by either deep or patchy fringing wetland.

Upon comparing the 1948 with 2004 shoreline features, the major modifications of the watershed become clear (Figure 3.9).

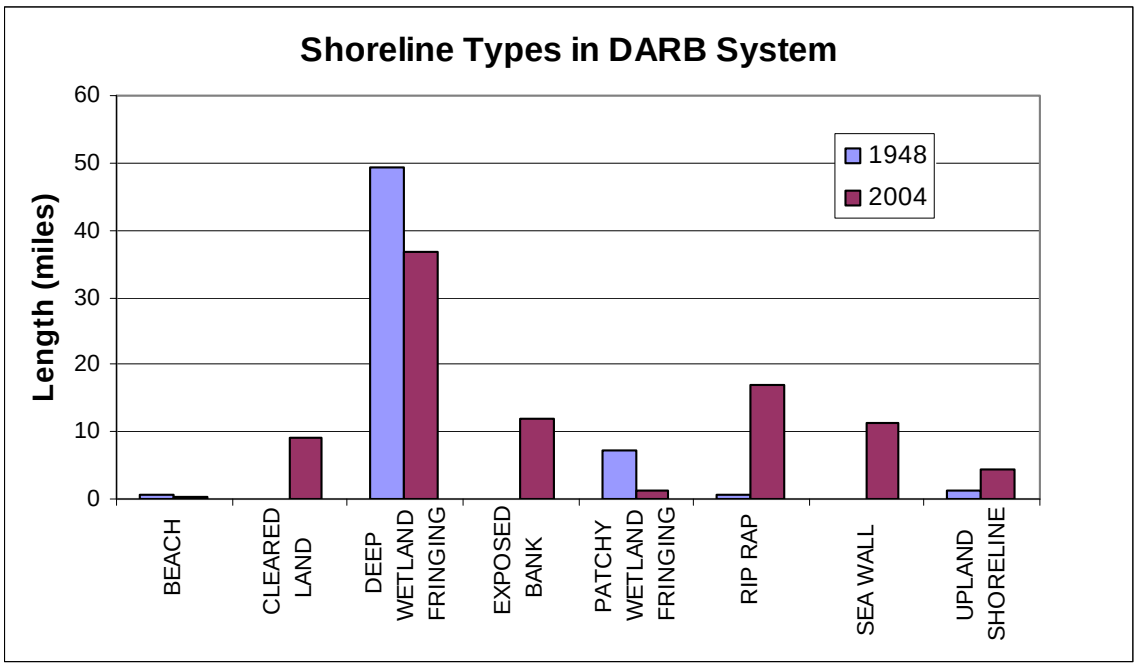

Figure 3.9 – Comparison of 1948 vs. 2004 Shoreline Features

The length of shoreline in the Dona Bay area has increased from 59.4 miles in 1948 to 91.8 miles in 2004. Unfortunately for the ecology of Dona Bay area, most of this increase has been due to increases in the categories of rip rap and seawall. For the more "valuable" shoreline features (ecologically speaking) there have been reductions. The greatest loss of valuable shoreline, in terms of length of shoreline, was that of a loss of fringing deep wetlands. The greatest loss of valuable shoreline, in terms of a percent decline, was that of a loss in fringing patchy wetlands, which were mostly restricted to areas west of U.S. 41 in 1948.

3.3 NATURAL SYSTEMS ISSUES AND PRIORITY ACTIONS

As has also been identified in the Water Quality Chapter that the largest negative influence on the ecology of Dona Bay is the increase in freshwater resulting from the increase in watershed area through drainage diversion activities associated with the Cow Pen Canal.

Excessive freshwater inflow has reduced salinities in Dona Bay to levels that are incompatible with long-term establishment of oysters in Shakett Creek and hard clams in Dona Bay (Estevez 2006).

The damaging effects of the excess freshwater inflow extend beyond impacts to water quality alone. In a study of the classification and distribution of sediments in Dona Bay, Wang and Kelso (2006) concluded that most of the sediments associated with the significant shoals in lower Shakett Creek / eastern Dona Bay region were the result of storm-driven events, rather than daily loading. As the watershed increase has substantially increased both hydrologic and sediment loading to Dona Bay, it can be safely assumed that storm-driven sediment loads have been artificially increased as well.

A number of prior studies and reports on Dona Bay have come to the same conclusion – excessive inflows of freshwater into Dona Bay from the expanded watershed have had serious impacts on both water quality and natural systems in Dona Bay, (e.g., Mote Marine Lab 1975, SWFWMD 2000a, 2000b, Charlotte Harbor National Estuary Program 2000).

Although Peebles et al. (2006) found both Dona Bay and Shakett Creek were providing habitat for larval, juvenile and adult stages of valuable fish and invertebrate species, they also found that the Dona Bay system was somewhat dysfunctional, ecologically. In their report, Peebles et al. (2006) concluded that "Freshwater inflows appear to be serving as an attractant to estuarine fish and crustaceans in the DARB estuary, but perhaps without providing the usual trophic benefits. A less erratic inflow regime may therefore result in more efficient production of estuarine fish and crustaceans."

A consistent recommendation in these numerous and diverse assessments is the need to substantially reduce the excessive freshwater inflows into Dona Bay coming from the Cow Pen Canal. The remaining portion of this chapter will focus on potential responses of natural systems to such an action.

3.4 POTENTIAL RESPONSES TO HYDROLOGIC RESTORATION

3.4.1 Seagrass Meadows

As also outlined in the Water Quality Chapter, the potential percent reduction in nitrogen loads associated with the implementation of the Phase 1, 2, or 3 watershed/hydrologic restoration scenarios are estimated at between 38 and 57 percent. A load reduction of this magnitude would be similar to the percent load reductions for nitrogen that were experienced by Tampa Bay and Sarasota Bay in recent years (Tomasko et al. 2005). Both Tampa and Sarasota Bays have experienced dramatic increases over the past two years, due mostly to the significant reductions anthropogenic nitrogen loads to their nearshore waters (Tomasko et al. 2005).

It is likely that a similar degree of improvement in seagrass coverage might be possible for Dona Bay, should the hydrologic regime be restored to the extent anticipated under the watershed/hydrologic restoration scenarios being investigated (see also Technical Memorandum 4.2.7 – Development of Phasing Plan).

3.4.2 Oyster Reefs

Adult oysters can tolerate salinities as low as 6 ppt for up to 2 weeks, but they cannot tolerate salinities below 2 ppt for more than a single week. Juvenile oysters are less tolerant of low salinities than adults, and the most successful spawning events occur when salinities are above 10 ppt (Estevez 2006).

The highly variable salinity regimes found in Shakett Creek and Dona Bay results in a system where year to year survival of oysters is unlikely. Instead, it appears that oysters are killed off on a regular basis by extended periods of reduced salinity. However, the fact that live oysters are also found on occasion suggests that there is considerable potential for reestablishment of healthy oysters in the Dona Bay system, should salinities be maintained at a more natural (thus higher) level.

Figures 5.10, 5.11 and 5.12 in the Water Quality Chapter illustrate the potential changes in salinity regimes that would be possible with the implementation of, for example, implementation of the Phase 3 watershed/hydrologic restoration scenario.

The results from these analyses suggest that substantial improvements in the salinity regimes are possible in portions of Shakett Creek, based on implementation of the watershed/hydrologic restoration projects under consideration.

In the upper reaches of Shakett Creek, such as at Station 25, salinity values would less likely to drop below 10 ppt with inflow reduction scenarios being considered, which would mean that these locations would be more likely to be able to support the long-term health of oyster meadows than the current situation.

At locations closer to Venice Inlet, possible changes in salinity would be minimal or absent. Habitats in this area that are currently dependent upon the existing salinity regimes in Dona Bay would not likely be impacted.

For locations between upper Shakett Creek and lower Dona Bay, the benefits to biological communities from possible reductions in freshwater inflow might be more strongly related to a reduction in the variability of salinity values, rather than responses to changes in mean values.

In addition to benefits to oyster health associated with a moderated salinity regime, oysters might also benefit from the reduced storm-driven sediment load likely to occur with implementation of the watershed/hydrologic restoration projects, as suggested by finding from Wang and Kelso (2006).

Chapter 4 - Water Supply

Photo of Cow Pen Canal
Lower Water Level Control Structure

Chapter 4
Water Supply

4.1 INTRODUCTION

In addition to the general water supply information contained herein, the following Technical Memorandums (TMs) relative to the development of an alternative surface water supply source in the Dona Bay watershed are provided in the Appendix:

TM 4.2.1 – Water Quality Analysis and Water Treatment Option Evaluation
TM 4.2.2 – Water Quantity | Water Budget Approach
TM 4.2.3 – Water Quantity | Flow Diversion Approach
TM 4.2.4.1 – Evaluation of Surface Storage Options (Venice Minerals site)
TM 4.2.4.2 – Evaluation of Surface Storage Options (Albritton site)
TM 4.2.4.3 – Evaluation of Subsurface Storage Options
TM 4.2.5 – Determination of Surface Water Treatment Plant Location(s)
TM 4.2.7 – Development of Phasing Plan
TM 4.2.8 – Draft Water Supply Watershed Protection Plan

Numbered to be consistent with the Dona Bay Watershed Management Plan contract scope of service tasks, these TMs provide preliminary evaluations for (1) existing water quality and water supply treatment options, (2) various long term hydrologic scenarios with respect to water supply storage/yields and estuary flow restoration, (3) surface and subsurface storage options for water supply within the watershed area, (4) water treatment plant locations, (5) project phasing, water supply yields, and estimates of probable costs, and (6) protection of the watershed that will provide the source water for water supply. A brief summary of each TM is provided below:

TM 4.2.1 recommends that bench scale testing and pilot testing be performed for two alternatives that have comparable life cycle costs. The alternatives include a combined membrane system and a system that employs chemical coagulation followed by membrane treatment. Both membrane treatment systems provide a greater barrier to pathogens and pesticides than other alternatives and will be more effective in the removal of organic compounds that cause odor and color and are the precursors to disinfection byproducts.

TM 4.2.2 provides comprehensive analyses to quantify the amount of excess freshwater that is discharged to Dona Bay via the Cow Pen Canal and to Roberts Bay via the Blackburn Canal. Historical, long-term hydrological information from the relatively natural Deer Prairie Creek watershed was analyzed to estimate the volume of runoff, given the volume of rainfall on a natural watershed. This natural watershed rainfall to runoff volume relationship was applied to the historical watersheds for Dona Bay and

Roberts Bay to estimate the natural water budgets to each estuary. To estimate the amount of excess runoff diverted to Dona Bay by the Cow Pen Canal, transfer equations developed by SWFWMD for the long-term record in the Myakka River State Park were reviewed, adjusted, and utilized. Based upon these analyses, the amount of freshwater added to Dona Bay by the Cow Pen Canal is between 3.5 to 4 times the estimated amount of freshwater which would have naturally occurred. Additionally, monthly water budgets were developed utilizing the amount of excess water estimated at the upper water level control structure and the storage volumes for various configurations (i.e. phases) in the Albritton and Venice Minerals sites. Based upon these water budgets, it was estimated that each configuration or phase could generate an incremental water supply yield of approximately 5 mgd, with a reliability of 97% or greater. In addition, each phase would incrementally reduce the amount of excess freshwater to Dona Bay by approximately 14%.

To estimate the amount of excess runoff diverted to Roberts Bay by the Blackburn Canal, a limited amount of gage from Blackburn Canal was correlated and applied to the long-term record in the Myakka River State Park. Based upon these analyses, the amount of freshwater added to Roberts Bay by the Blackburn Canal is approximately twice the estimated amount of freshwater which would have naturally occurred. To reduce the amount of excess freshwater, several low-head weirs were considered with elevations of 2.0, 2.5, and 3.0 ngvd. Based upon the analyses, these three low-head weirs are estimated to reduce the amount of excess freshwater to Roberts Bay from Blackburn Canal by 16%, 27%, and 38%, respectively.

TM 4.2.3 provides analyses of the water supply yield and reliability for each phase based upon flow diversions of 10%, 30%, 50%, and 100% at the upper water level control structure for the Cow Pen Canal. For a reliability of 97%, these analyses result in similar water supply yields as those generated in TM 4.2.2.

TMs 4.2.4.1, 4.2.4.2, and 4.2.4.3 provide preliminary evaluations of the surface and subsurface storage options in the Dona Bay/Cow Pen Canal watershed. Based upon these preliminary analyses and dependent on the alternative considered, it was estimated that the Venice Minerals and Albritton sites could independently sustain yields between 6 to 9 mgd and 7 to 20 mgd, respectively. These alternatives were subsequently configured into 3 phases considered in more detail in TM 4.2.2, 4.2.3, and 4.2.7. The preliminary subsurface storage analyses estimates that up to 20 mgd could be stored in as many as 10 ASR wells. An initial test well is recommended.

TM 4.2.5 evaluates various surface water treatment plant locations including near the Albritton and Venice Minerals sites, and the existing Carlton groundwater treatment site. Based upon all considerations including the lowest probable cost, it is recommended that the new surface water treatment plant be constructed adjacent to the Carlton facility.

TM 4.2.7 provides descriptions, concept plans, and preliminary estimates of probable cost for each of the recommended three project phases. Based upon these assessments,

each of the three phases is estimated to generate an incremental water supply of 5 mgd, for a total of 15 mgd. Estimated probable costs for each incremental phase are approximately $75,000,000, $67,000,000, and $34,000,000, respectively.

TM 4.2.8 provides preliminary incentive-based framework to protect the source surface water in the watershed. Recommendations from the Consultant are provided below:

Purpose of Draft Water Supply Watershed Protection Area Plan:

- In preparing this Plan, existing Comprehensive Plan Watershed Management goals were reviewed relative to water supply. As a credit to Sarasota County government, this review indicated that current regulations address many if not most of these goals. However, additional watershed specific issues and opportunities were identified. For those watershed specific issues, the Plan proposes incentive based protection mechanisms that can be proposed to watershed stakeholders.

- This Plan is not intended to impact the continuance of agricultural activities that are consistent with local, state and federal standards.

- This Plan is not intended to, and may not be used to, inhibit or restrict future development forms that are consistent with comprehensive plan and/or zoning designations.

Incentive Based Protection Mechanisms

- New developments in the WSWPA shall provide 150% times the volume of required by the Sarasota County Land Development Regulations for the selected treatment system or the State requirements for Class III waterbodies, whichever is more strict. As an incentive to provide the additional treatment volume, Sarasota County will support the use of permanent pool volume over littoral zones in stormwater management systems.

- Watercourse greenways in a surface water supply watershed would serve a significant public purpose that should be reflected by the highest possible density bonuses under 2050, conservation subdivisions, and any other incentive-based develop forms that may be created by Sarasota County.

- It is recommended that additional incentives be provided for existing property owners within 100 feet of the banks of the Cow Pen Canal or contributing tributary through the Neighborhoods Grant program to plant and maintain native vegetation within their adjacent property.

- Sarasota County should promote Low Impact Development strategies to more effectively remove pollutants at their source, but not necessarily to reduce runoff volumes in the WSWPA. The intended outcome should be a match of pre and post pollutant loads from new development. Sarasota County should streamline reviews that incorporate LID strategies.

Strategic Watershed Management Opportunities

- Based upon their strategic, on-line locations, it is recommended that Sarasota County discuss potential partnership opportunities with either the private property interests associated with the LT Ranch site and the Hi Hat Old Grove site for regional stormwater facilities that could be incorporated into the WSWPA.

- It is recommended that Sarasota County consider providing adequate traffic barriers along each side of State Road 780 (Fruitville Road) and State Road 72 (Clark Road) where they cross the Cow Pen Canal and that the roadside stormwater drainage should be crowned away from the canal.

- It is recommended that Sarasota County engage Manatee County and property owners just south of the Manatee/Sarasota County line to see if the easterly extension of University Parkway can be aligned to minimize the extent of its crossing of the headwater floodplain.

- Sarasota County should consider a surcharge on the potable water rates to fund watershed restoration and water quality enhancement activities within the WSWPA.

4.1.1 Hydrologic Setting

The Dona Bay watershed is located in SWFWMD's larger Southern Coastal Watershed. Rainfall averages about 54 inches per year with approximately 60% occurring in the June-October wet season. Surface waters within the Dona Bay watershed include fresh and salt water wetlands and several coastal streams and sloughs. The creeks and sloughs found in the Dona Bay watershed primarily serve as drainage features for the coastal region, however, and do not currently represent significant water supplies for agricultural or domestic use, with the possible exception of the Cow Pen Canal.

The Dona Bay watershed is located in the Southern Coastal Watershed and the Southern West-Central Florida Ground-Water Basin (SWCFGWB), one of three distinct ground water basins within west-central Florida. Within the SWCFGWB, the ground water system is divided into three main aquifers: the surficial, intermediate and Upper Floridan. Each aquifer is separated by a confining layer of variable thickness and areal

extent.

4.1.1.1 Historical Perspective

Historically the Dona Bay watershed was significantly smaller and consisted of areas surrounding Shakett Creek, Fox Creek, and Salt Creek. Starting in the mid-1900's and continuing through the early 1970's, ditching activities drained and diverted a large slough system known as Cow Pen Slough from the Myakka River to Shakett Creek and Dona Bay (refer to **Figure 1**). Prior to the diversion, Cow Pen Slough entered the Myakka River in the vicinity of Rocky Ford. As a result of the watershed alterations, the natural hydrology of both Dona Bay and the Myakka River has been altered by the diversion of Cow Pen Slough to Dona Bay. Today the Dona Bay watershed is approximately 74 square miles, or nearly 5 times its original size of approximately 10,065 acres.

4.1.1.2 Hydrologic Alterations

The most significant hydraulic alteration was the channelization and diversion of the Cow Pen Slough system from the Myakka River to Shakett Creek and Dona Bay. The diversion dramatically increased the volume of freshwater flows through Shakett Creek and into Dona Bay. The most significant drainage efforts were undertaken by the Soil Conservation Service and resulted in a large canal through the center of the historical Cow Pen Slough with several water level control structures. This project was originally intended to extend from Dona Bay/Shakett Creek, north through Cow Pen Slough and into Manatee County. However upon completion of the work from Dona Bay/Shakett Creek, north through Cow Pen Slough, the work was halted due to concerns from local residents that the work had had negative ecological impacts on Dona Bay. But the work that had been completed was sufficient to drain the slough for pasture and some citrus production. The completed work also included the construction of two (2) operable water level control structures in the canal and several dozen manual drop structures to direct runoff from adjacent properties into the canal. These two structures have typically been operated in an "open" position during the wet season to reduce flood risk and in a "closed" position in the dry season to promote water conservation and presumably augment irrigation demands. Although the City of Sarasota currently provides reclaimed wastewater to the Hi-Hat Ranch, for the most part irrigation

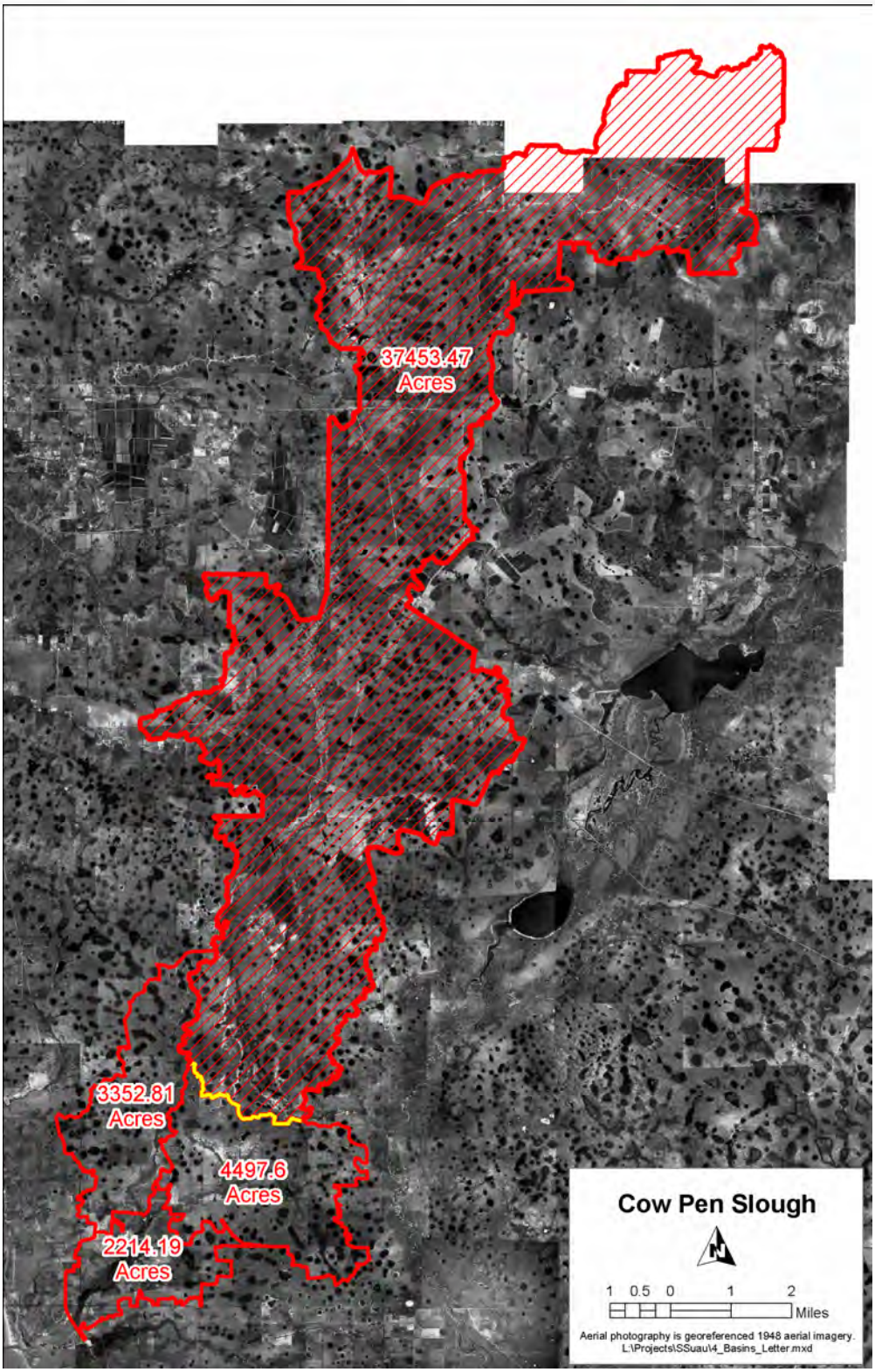

Figure 4.1 – Dona Bay Watershed

demands for more intensive agricultural operations in the watershed have typically been provided by ground water pumping from deeper aquifer systems.

4.1.1.3 Ground Water Aquifers

The Upper Floridan Aquifer System (UFAS) is the deepest potential source of ground water in the Dona Bay watershed. Under natural conditions the UFAS is well confined and poorly connected to the surface water systems. Natural recharge to the UFAS within the Dona Bay watershed is almost non-existent. The principal recharge area for the UFAS in this region is located in Highlands and Polk counties to the east and northeast.

From north to south, water quality in the UFAS declines and the Intermediate Aquifer System (IAS) becomes a preferable and alternative source of water. The IAS lies between the UFAS and the Surficial Aquifer System (SAS) and can have up to 3 different confined permeable zones. While the confining units between the intermediate zones and the SAS may vary, there is typically a thick clay unit, known as the Venice Clay Layer between the SAS, or where it exists, permeable zone 1 of the IAS and permeable zone 2 of the IAS.

Water quality, primarily total dissolved solids (TDS), is the principal constraint on the ground-water supplies in the Dona Bay watershed and typically deteriorates from north to south as well as with depth. For this reason, public water suppliers are typically the only entities able to afford the extraordinary treatment that is required for ground water from the UFA and in some cases, permeable zone 3 of the IAS.

The City of Sarasota's Verna well fields are located in the northeastern portion of the Dona Bay watershed. Most domestic ground water wells in the Dona Bay watershed are located with in production zone 2 of the intermediate aquifer.

Sarasota County provides potable water service to the southern and western edge of the Dona Bay watershed. Sarasota County is supplied with water from a diverse set of water sources including: (1) the Manatee River (surface water) blended with the University Well Field (ground water); (2) the Carlton Plant and Well Field (ground water); (3) the Jacaranda Water Treatment Plant (ground water); and (4) the Peace River Water Treatment Plant (surface water with aquifer storage and recovery). This diverse set of water sources currently provides 28.6 million gallons per day (mgd) to meet an average daily demand of around 19 mgd. Contract extensions with Manatee County and an expansion of the Peace River Plant are currently underway to provide water supplies through at least 2015.

4.1.2 Overview of Sarasota County's Current Water Sources

The following information is based upon the Watershed Management Chapter of the Sarasota County Comprehensive Plan.

4.1.2.1 Manatee County

Since 1973, Sarasota County has contracted with Manatee County to purchase potable water supply. The current contract includes a reduction in Sarasota County's purchase of water from Manatee as the Peace River Plant increases capacity. The allocation of water capacity is 10 mgd through spring 2008; 8 mgd through spring 2015, and 6 mgd through spring 2020.

4.1.2.2 University Well field

The University Well field is located near the northern boundary of Sarasota County and supplies an average of 1.0 mgd ground water for blending with potable water received from Manatee County. The University Well field consists of seven permitted production wells that vary in depth from 580 feet to 640 feet.

4.1.2.3 Carlton Well field and Treatment Plant

The Carlton Well field is located in central Sarasota County, east of the Myakka River. This well field consists of 14 production wells, with depths varying from 400 feet to 715 feet. Currently, the permitted ground water withdrawals from the well field are 7.303 mgd, average daily and 9.625 mgd, peak monthly daily average.

The brackish ground water from the Carlton tract is treated by a plant which utilizes a desalination process called electrodialysis reversal, or EDR. The treatment plant process has an 85% efficiency and a design capacity of 12 mgd. However, the plant is currently limited to an average annual production of 5.8 mgd.

4.1.2.4 Jacaranda Well field and Treatment Plant

The County also has a brackish well field and water treatment plant in the Jacaranda area. The plant uses reverse osmosis membranes and is currently configured to produce 600,000 gallons per day.

4.1.2.5 Peace River Manasota Regional Water Supply Authority

The Peace River Manasota Regional Water Supply Authority (Authority) is an independent special district of the State of Florida. The Authority operates an 18 mgd regional surface water facility on the Peace River near Fort Ogden in DeSoto County. The members of the Authority include Charlotte, DeSoto, Manatee and Sarasota counties. Water currently is supplied to three of the member governments – Charlotte,

DeSoto, and Sarasota counties, as well as the City of North Port. The Authority is currently planning an expansion of the water treatment plant and reservoir capacity that are scheduled to begin about 2007.

4.1.3 Regional Coordination of Future Water Supply

In addition to being part of the Authority, Sarasota County is part of the Southwest Florida Water Management District. It is essential that planning for future water supply be coordinated with these lead agencies. As an active member of both of these regional planning agencies, Sarasota County has decided to proactively collect and coordinate the development of the appropriate data that will be needed to make wise water resource decisions, within the Dona Bay watershed.

4.1.4 Irrigation

Key to a sustainable water supply is using the right water for the right use. As the cost of treating and providing potable drinking water increases in the future, developing alternative sources for non-potable uses, such as irrigation, will become more and more critical. In fact, irrigation water offers significant opportunities for wise and more sustainable water use. Since natural landscapes in Florida are capable of withstanding both the annual and extreme wet-dry cycles (i.e. floods and droughts), they require less artificial irrigation. However, more water intensive irrigation has typically been the outcome of the built environment. Ironically, over-irrigation can lead to shallower root zones and greater drought susceptibility. Water irrigation guidelines (commonly called restrictions) are intended to prepare landscapes for droughts as well as not to reduce waste water. Making a distinction between potable water and irrigation water is an essential prerequisite for developing more sustainable water supply resource strategies, consistent with “the right water for the right use” concept.

4.1.4.1 Demand Management/Water Conservation

To reduce water irrigation demands, Sarasota County has developed and implemented a number of strategies including: (1) inverted rate structure, (2) use of automatic shut off devices for irrigation systems, (3) landscape ordinance, (4) once-a-week watering restrictions, (5) golf course ordinance, and (6) outreach and education.

4.1.4.2 Reclaimed Water

Reclaimed water for irrigation is the primary means of effluent disposal for Sarasota County. Utilizing reclaimed water for irrigation reduces the amount of potable water and ground water that would otherwise be utilized for irrigation purposes. Projected reclaimed water demand and available supply in the year 2015 is 16 mgd. The County's reclaimed water system is also interconnected with the City of Sarasota, and the City of Venice.

4.1.4.3 Surface Waters

Surface waters are currently an underutilized resource within the County's water resource management strategies. Throughout the past century, significant ditching and dredging of the landscape was required for mosquito management and agriculture needs. This dramatically altered the volume and timing of flow to the receiving water bodies such as bays and estuaries. The volume of flow has further increased with urbanization. Rebalancing the natural water volume, or water budget, to the bays and estuaries can also help restore the natural productivity of juvenile fish habitat.

As opposed to other areas of the state where too much freshwater is being removed from large river systems, many of the County's tidal creeks are believed to have too much freshwater from upstream dredging and filling activities of the past. The County and SWFWMD are cooperatively funding monitoring projects of the tidal creek systems. Part of re-balancing freshwater inflows to the bays and estuaries will lead to restoration of drained wetlands in the watershed and potentially beneficial uses such a stormwater recycling.

4.1.4.4 Ground Water

The County's unique geologic system, including the IAS, plays a significant role in the County's sustainable water supply strategy. Many domestic and irrigation wells utilize Permeable Zones 1 and 2 (PZ1 and PZ2) of the IAS. Public supply systems will typically not utilize these zones within the IAS due to their limited yield. In 2000, SWFWMD conducted a study of the IAS in Sarasota County and concluded that the IAS is a sustainable aquifer system for its current uses as long as the resource is used judiciously. The study did recommend a more dense system of monitoring wells in the IAS to better characterize local effects. SWFWMD and the County are cooperatively funding installation of these monitoring wells, two of which were preliminarily to be located within the Dona Bay watershed.

4.2 STUDIES, REPORTS AND DATA

A number of studies and technical reports concerning water supply have been generated relevant to water supply in the Dona Bay watershed area. The following section provides a list and brief description/excerpts from some of the more relevant studies.

4.2.1 Previous Studies and Reports

United States Geological Survey, 1968 - *Low Streamflow in the Myakka River Basin Area in Florida*

This report investigated using surface water in the Myakka River basin area as a water supply source and concluded that water quality was good subject to quality limitations of shallow reservoirs in sub-tropical regions including high temperature, high color, high dissolved iron content and occasionally suspended organic matter. This investigation included a review of water quality and quantity data within the Cow Pen Canal near Laurel Road and at State Road 72.

Hydroscience Research Group, Inc., 1980 – *Preliminary Evaluation of the Surface-Water Supplies in the Cow Pen Slough Area*

This report was prepared for the Southwest Florida Water Management District to conduct a preliminary evaluation for water quality, water quantity, and the potential yield of water from Cow Pen Slough, Phillippi Creek, and the Myakka River. With respect to Cow Pen Slough the report concluded:

"*From the existing U.S.G.S. water quality data, the waters of Cow Pen Slough and Phillippi Creek, together or independently, appear to be of suitable quality for use as a water supply. The existing data on parameters that could be problems such as color, pH, etc., are treatable.*

A more detailed sampling program, along with current discharges, is highly recommended before any new development is initiated. The sampling program should include trace elements, nutrient loading, coliform bacteria, toxins, and viruses, because of the potential influence of sewage discharges and sanitary landfills in the area of both streams.

The evaluation of Cow Pen Slough and Phillippi Creek as potential water supply sources required the development of statistics based upon actual, extended, or transferred data. These data show the two streams to certainly be qualified as potential sources for surface-water supply development, especially during the wet season (June through December)."

SWFWMD 1981 – *Cow Pen Slough Watershed Management Investigation, Phase 1*

This report evaluated the partially completed U.S. Department of Agriculture, Soil Conservation Service (SCS), Public Law 566 Watershed Work Plan prepared in 1961 for the Cow Pen Canal. Known originally as the Sarasota Coast Watershed Project, work initiated in the early 1960's was suspended after the first 3 construction phases in 1972 due to environmental problems in Dona Bay. These problems were associated with excess freshwater discharges resulting from the diversion of the Cow Pen Slough by the canal construction and included siltation, water quality degradation, and aquatic weed transport. In 1979, the Manasota Basin Board of SWFWMD decided to assist with a re-evaluation of the project. This Phase 1 investigation identified the following specific analytical objectives:

- Adjustments of the Cow Pen Slough (CPS) hydroperiod to reduce detrimental impacts to Dona and Robert's Bays.
- Development of the municipal water supply potential of CPS including the use of Phillippi Creek and Myakka River.
- Drainage and flood control in CPS watershed.
- Flood control in the agriculturally productive muck lands east of Sarasota.
- Resolution and disposition of the partially completed Public Law 566 Sarasota Coast Watershed Work Plan.

It is noted that, in general, drainage and flood control is currently not a serious problem in the Dona Bay watershed and the referenced agriculturally productive muck lands east of Sarasota are the Celery Fields which have subsequently been purchased by Sarasota County and restored to their original floodplain function. In addition, in 1979 it was decided by the Sarasota County Commissioners and the Sarasota Water and Soil Conservation District that the project should not be completed as planned. Therefore, the objectives essentially come down to reducing detrimental impacts to Dona Bay and developing the potential for water supply. As demonstrated in this Comprehensive Watershed Management Plan for Doan Bay, these two objectives are not mutually exclusive.

This report evaluated several alternatives including three alternatives that incorporated a reservoir in the vicinity of present day Venice Minerals. A relevant conclusion from the Phase 1 investigation included:

"*There is water supply potential in the watershed areas from surface water sources*"

The report also provided the following relevant recommendations:

"*The diversion of CPS, which would mainly be for water supply purposes probably should be investigated as part of the Regional Water Supply Program being undertaken by the Manasota Basin Board of SWFWMD, and Manatee and Sarasota Counties.*"

"*The water supply potential of surface water sources should receive further investigation, especially in the area of water quality.*"

SWFWMD 1988 - *SWFWMD Water Supply Assessment*

During its 1997 session, the Florida Legislature amended Chapter 373, Florida Statutes to clarify the Water Management Districts' responsibilities relating to water supply planning and water resource development. The legislation required the Water Management Districts to prepare a District-wide Water Supply Assessment. The purpose of the assessment was to determine the adequacy of water sources to meet anticipated demands and sustain natural systems. For areas where sources are not adequate to meet projected needs, a detailed regional water supply plan is required.

In 1988, the SWFWMD completed its assessment of water demand projections and available sources through the year 2020 for four planning areas. At that time, existing and future water sources were found to be inadequate to meet the projected demand in three of the four planning areas. Consequently, the SWFWMD began work on a Regional Water Supply Plan for these areas, including the entire SWUCA, which contains the Dona Bay watershed.

SWFWMD 1995 - *SWFWMD Water Management Plan*

The District Water Management Plan (DWMP) is a broad-based planning document that addresses activities related to water supply, flood protection, water quality, and natural systems. The plan identifies current programs, issues, and strategies for regional water management. The water supply element of the DWMP comprises two sub-elements: (1) needs and sources and (2) source protection.

To address the first element, the District developed a Needs and Sources Plan. The initial Needs and Sources Plan was adopted in 1992 and was incorporated in the DWMP. The objective of the plan was to examine water demands and sources for the period 1990-2020 to provide a framework for water supply management. The 1992 Needs and Sources Plan recognized that groundwater resources are stressed in the west-central and southern portions of the District (including all of the Dona Bay watershed). Reuse, conservation, desalination, surface water, and limited groundwater development were identified as potential sources to meet future needs in this area.

Water supply issues identified in the DWMP include: (1) water allocation strategies, (2) linkage of water use planning to local government comprehensive planning, (3) compliance and enforcement, (4) alternative supplies, (5) additional data collection, (6) watershed water budget approach to water management, and (7) water use fees.

SWFWMD 2000 - *Southern Coastal Watershed Comprehensive Watershed Management Plan*

The Cow Pen Canal and the Dona Bay watershed are located within the SWFWMD's Southern Coastal Watershed. This Plan report recommended investigating the water source potential of Cow Pen Slough and with respect to water supply, determined that there was a need to:

(1) seek inclusion of water resource/land use planning as a consistency requirement for Local Government Comprehensive Plans,
(2) improve compliance with water shortage restrictions and year-round conservation measures,
(3) develop alternative water sources,
(4) adopt minimum aquifer levels for the Intermediate Aquifer,
(5) improve coordination between land and water planners, and
(6) promote conservation and reuse.

SWFWMD 2001 - *SWFWMD Regional Water Supply Plan*

The SWFWMD's Regional Water Supply Plan (RWSP) covers a ten county area from Pasco in the north to Charlotte in the south, including the Dona Bay watershed. It contains an assessment of projected water demands and potential sources of water to meet these demands for the period 1995 to 2020. The 2001 RWSP provided a framework for future water management decisions and anticipated that future additional supplies will be met by other than groundwater supplies. The RWSP is updated every five years.

Cow Pen Slough was identified as a potential alternative water supply source for public supply and irrigation in the 2001 RWSP. It was estimated that an average annual yield of 4.4 mgd could potentially be developed by diverting flows from the Cow Pen canal to a 500 mg surface water reservoir. It was also estimated that if used for a potable water supply, three ASR wells, each with 2 to 3 mgd capacity, would be needed.

Greeley and Hansen 2003 - *Regional System Planning and Engineering Study: Phase I – Assessment of Existing Supplies* (Prepared for the Water Planning Alliance through the Peace River Manasota Regional Water Supply Authority)

The four members of the Authority (Charlotte, DeSoto, Manatee and Sarasota counties) and nine local governments and water suppliers joined together to sponsor a major regional water supply planning study for the four county Authority area. The Phase 1 report assesses future water supply needs and inventories existing water supplies in the planning area. Phase II is expected to be completed by the end of 2006 and will identify and prioritize specific source options to meet future needs.

Sarasota County 2004 - *Cow Pen Slough Water Quality Monitoring Study*

In 2003, Sarasota County conducted field testing and sampling at four locations in the Cow Pen canal and one location in the Vegetable Relief canal. The purpose of the effort was to determine water quality within CPS as a potential for irrigation or drinking water resource. The results of this monitoring program indicate that the water quality in the Cow Pen canal is generally good. A summary of this report is provided in more detail in Section 4.5 of this Chapter and Technical Memorandum 4.2.1.

SWFWMD 2005 - *Sarasota County Comprehensive Plan*

The 1981 Sarasota County Comprehensive Plan provided policy direction for the County to develop a centralized, County-owned water supply. At present, only the west-central fringe and southern portions of the Dona Bay watershed are within central water and sewer service areas.

The current Comprehensive Plan includes a water supply (primarily public supply) and Ten-Year Water Supply Work Plan, as required pursuant to 2002 legislation. Potable water demands for the Sarasota County's Utility were calculated based upon population projections completed as part of the county's 2050 Comprehensive Plan Amendment. Population projections based on the service area for Sarasota County totaled 227,552; 241,071; and 254,218 for 2005, 2010, and 2015, respectively. These population projections resulted in average daily demands for 2005, 2010, and 2015 of 20.44 mgd, 21.97 mgd, and 23.47 mgd, respectively.

The projected available capacity for average daily demands from the County's diverse sources were determined to be 25.03 mgd, 32.76 mgd, and 30.76 mgd for 2005, 2010, and 2015, respectively. Therefore, Sarasota County has sufficient permitted sources to meet demands through 2015. The primary water supply sources include ground water from the UFA and PZ3 of the IAS at the County's Carlton well fields, surface water from the Manatee River in Manatee County, and surface water from the Peace River in DeSoto County.

Sarasota County's Potable Water Level of Service essentially has two components, water quantity and water quality. For potable water quantity, the Level of Service establishes that the system capacity is based upon 250 gallons per Equivalent Dwelling Unit per day based on peak flow plus the maintenance of minimum fire flow standards. For water quality, the established level of service is that the "minimum potable water quality shall be as defined by the U.S. Environmental Protection Agency, except where the County may impose stricter standards."

Sarasota County 2006 - *Sarasota County Water Supply Master Plan Update*

The purpose of this document was to update the 2001 Water Supply Master Plan for Sarasota County (which was originally intended to address the County's needs through 2030) and to outline future water demand projections and current water supplies, as well as describe and evaluate potential new ground water and surface water sources, technologies, options, and associated costs. The major objectives of the Water Supply Master Plan Update included:

- Compile future demand projections for Sarasota County and all Regional Water Alliance members.
- Prepare an inventory of all existing County water facilities, including water treatment plants, tanks, reservoirs, well fields, pump stations, and major transmission lines.
- Identify and document specific problems in the system, water supply weaknesses, and planned future capital improvement projects through interviews with County personnel, including water treatment plant supervisors, maintenance managers, and other pertinent staff.
- Identify evaluation criteria for preliminary assessment of potential water supply projects.
- Screen potential projects according to these criteria and work with County staff to identify the ten most promising water supply projects.
- Develop a 10-year Capital Improvements Program (CIP) to best satisfy the County's future water supply needs.

Specifically, the WSMPU contained preliminary evaluations of the Dona Bay watershed as a potential surface water supply source in Technical Memorandum 3 – Water Supply Projects, Technical Memorandum 4 – 2050 Water Supply Scenarios, and Technical Memorandum 5 – 10-year Water CIP.

SWFWMD 2006 - *SWUCA Recovery Strategy*

The Southern Water Use Caution Area (SWUCA) encompasses approximately 5,100 square miles, including all of Sarasota County and the Dona Bay watershed. It also roughly corresponds to the Southern West-Central Florida Ground Water Basin. In general, the SWUCA Recovery Strategy is intended to comprehensively manage the existing and potential adverse impacts of ground water withdrawals in the UFAS. Specifically, the SWUCA Recovery Strategy looks to address the three primary symptoms of these withdrawals including coastal saltwater intrusion, reduced flows in the upper Peace River, and lowered lake levels in the upland areas Polk and Highlands counties. Key elements of the SWUCA Recovery Strategy include:

- Development of a regional water supply plan

- Use of existing rules
- Enhancements to existing rules, the most significant of which is the adoption of minimum flows and levels
- Provide financial incentives to encourage water conservation and the development of alternative supplies (non-Floridan fresh ground water)
- Development and implementation of watershed storage/restoration projects to aid in reestablishing flows and recharge
- Resource monitoring, reporting and cumulative impact analyses

Of particular significance to the Dona Bay watershed, are the following elements:

- development of a regional water supply plan
- provide financial incentives to encourage the development of alternative supplies to the UFAS
- implementation of watershed storage projects

SWFWMD 2006 - *SWFWMD Regional Water Supply Plan*

This plan is an update to the SWFWMD's 2001 Regional Water Supply Plan (RWSP) and provides an assessment of projected water demands and potential sources of water to meet those demands through 2025. The RWSP indicates that there are sufficient alternative water sources (other than fresh ground water) to meet future demands while reducing current areas of stress. Potential options and associated costs for developing these water sources are also identified in the RWSP.

With respect to the Dona Bay watershed, the RWSP identifies Cow Pen Slough as a surface-water/stormwater Water Supply Development Option and describes it as follows:

This option consists of capturing excess flow from Cow Pen Slough for storage in an off-stream reservoir. It would provide a significant environmental benefit by reducing downstream flooding and fresh water/salt water imbalances in the Dona Bay estuary. The reservoir would have a 500 million gallon capacity and would be located in an existing borrow pit in the vicinity of the proposed withdrawal point. The water would be treated at a new water treatment plant with a capacity of 10 mgd then sent to potable water ASR wells for storage or directly to a regional distribution system. Projected components include a pump station, reservoir, water treatment plant and five ASR wells (1 mgd each) and piping to the proposed regional distribution system.

The preliminary evaluation further indicates that a quantity of 5 mgd would be available at a cost of $63,000,000.

Based upon the more recent evaluation that is part of this Dona Bay Comprehensive Watershed Management Plan, the following clarifications are provided to this preliminary evaluation:

- All water discharged to Dona Bay by the Cow Pen canal is excess water since it diverted an area that historically was in the Myakka River watershed.
- Surface storage would ultimately be provided in two, on-line reservoirs.
- There is currently no downstream flooding (however, there is a significant fresh water/salt water imbalance in the Dona Bay estuary).
- The project could be phased in three, 5 mgd increments, for an ultimate potential total of 15 mgd. The incremental reservoir storage and costs would be 5,600 acre-feet at an approximate cost of $75,000,000; 11,300 acre-feet at a total cost of approximately $142,000,000; and 16,800 acre-feet at a total cost of approximately $176,000,000.
- It is recommended that the Carlton plant location be expanded to treat surface waters, as opposed to a new treatment plan location.
- ASR wells are currently not envisioned, but perhaps the ASR wells at the Peace River plant location could be used, if needed.

4.2.2 Available Data

A variety of local, regional, and state agencies compile data regarding the health of ground and surface water resources in the Dona Bay watershed. Sarasota County and SWFWMD have a comprehensive hydrologic conditions monitoring program. Conditions that are monitored include rainfall, groundwater levels, various water quality parameters, and Cow Pen Canal discharges and stage elevations.

Sarasota County operates continuous rainfall and stage recorders at the two operable water level control structures in the Cow Pen canal as part of their Automated Rainfall Monitoring Systems (ARMS). With cooperative funding assistance from SWFWMD, Sarasota County has also contracted to develop stage-discharge rating curves at both of these water level control structures. All water use permits located in the Dona Bay watershed must report ground and surface water withdrawals where permitted withdrawals exceed 0.1 mgd. Selected water use permittees are also required to report water levels and water quality data. The United States Geological Survey also maintains a data base of stage, flow, and water-quality measurements which includes monitoring sites within, and surrounding the Dona Bay watershed.

4.3 REGULATORY FRAMEWORK

Water supply is primarily regulated by the SWFWMD. Water quality is regulated by the US Department of Environmental Protection, the Florida Department of Environmental Protection (FDEP) and the Sarasota County Board of Health.

4.3.1 Applicable Legislation

Under Public Law 93-523, the "Safe Drinking Water Act," the federal government established water quality standards for the protection of water for public use, including operating standards and quality controls for public water supply systems. This law directed the Environmental Protection Agency (EPA) to establish minimum drinking water standards which are divided into "primary" standards, or those required for public health, and "secondary" standards, those recommended for aesthetic qualities.

In accordance with federal requirements, the Florida Legislature adopted Chapter 403.850, Florida Statutes, the "Florida Safe Drinking Water Act." The Florida Department of Environmental Protection (FDEP) is the state agency responsible for implementing this act and has established rules classifying and regulating public water systems under Chapter 62-550, Florida Administrative Code. The primary and secondary standards of the "Federal Safe Drinking Water Act" are mandatory in the State of Florida.

Drinking water quality standards furthering federal and state legislation are enforced and records are maintained by the Sarasota County Public Health Unit, a Division of the State Department of Health and Rehabilitative Services.

The Southwest Florida Water Management District (SWFWMD) has adopted rules under Chapter 40D-2, Florida Administrative Code, and is responsible for the management of water resources within a sixteen-county region to protect the supply necessary to meet existing and future demands. Additional regulations relating to the operation of community and non-community public water supply systems are set forth within Chapter 10D-4, Florida Administrative Code.

Chapter 62-521, Florida Administrative Code, provides criteria for delineating wellhead protection areas; restrictions, including prohibition and regulation of certain substances, activities and facilities in wellhead protection areas; and, establishes permitting requirements, compliance review inspections and enforcement procedures.

Legislature approved in 2002 expanded the local government comprehensive plan requirements to strengthen coordination of water supply planning and local land use planning. The most significant new requirement is a 10-year Water Supply Facilities Workplan, coordinated with the SWFWMD Regional Water Supply Plan (RWSP), which addresses the water supply facilities necessary to serve existing development and new growth for which the County is responsible.

The requirements for regional water supply planning are specified in s. 373.0361, F.S., and include the following key elements:

- Designation of one or more water supply planning regions within the District
- Preparation of a District wide Water Supply Assessment
- Preparation of a RWSP for areas where existing and reasonably anticipated sources of water were determined to be inadequate to meet future demand, based upon the results of the Water Supply Assessment.

Regional water supply planning requirements were again amended as a result of the passage of Senate Bill 444 during the 2005 legislative session. The bill substantially strengthens requirements for the identification and listing of water supply development projects. In addition, the legislation is intended to promote better communications among water planners, city planners, and local utilities. Finally, a trust fund was created that provides the Districts with state matching funds to support the development of alternative water supplies by local governments and water supply authorities.

4.3.2 State of Florida Regulations

The authority to regulate the withdrawal, use, and transport of water is reserved exclusively to FDEP and the water management districts (Sections 373.217 and 373.223, F.S.).

4.3.2.1 Department of Environmental Protection

To manage surface waters of the state, Florida has developed a surface water quality standards system. The components of this system include: classifications criteria, an anti-degradation policy, and special protection of certain waters. The federal Clean Water Act provides the statutory basis for state water quality standards programs. The regulatory requirements governing these programs (Water Quality Standards Regulation) are published in 40 CFR 131(PDF).

The FDEP has the primary role of regulating public water systems in Florida. The State's Safe Drinking Water Act (sections 403.850-403864, F.S.) is the basis for FDEP's programs in this area. FDEP rules adopt the national primary and secondary drinking water standards of the Federal Government and create additional rules to fulfill state requirements. They are contained in Chapters 62-550, 62-555, and 62-560, F.A.C. addressing drinking water standards and monitoring, permitting and construction of public water supply systems, and requirements for systems that are out of compliance, respectively. FDEP has delegated permitting and enforcement responsibilities for the drinking water program to Sarasota County's Health Department.

Another important regulatory role for FDEP in the water supply arena involves its underground injection control program. The program regulates the underground disposal or storage of appropriately treated fluids in order to protect underground sources of water supply. This includes the regulation of aquifer storage and recovery (ASR) wells, which represent an important component of the regional water supply system operated by the Authority.

In addition, the FDEP has initiated the Source Water Assessment and Protection Program (SWAPP) as part of the federal Safe Drinking Water Act (SDWA) to ensure that drinking water is safe, not just at the tap, but at its source. The SDWA

was passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The law was amended in 1986 and 1996 and requires many actions to protect drinking water and its sources. The SDWA authorizes the United States Environmental Protection Agency (USEPA) to set national health-based standards for drinking water to protect against both naturally occurring and man-made contaminants that may be found in drinking water. The USEPA, states, and water systems then work together to make sure that these standards are met. The authorization of SWAPP was one of eight amendments made to the SDWA in 1996. The SWAPP is devoted to evaluating potential threats to Florida's "Public Water Systems" and providing the state and local governments with tools to make decisions to better protect those systems.

4.3.2.2 Southwest Florida Water Management District

The SWFWMD's water use permitting rules are codified in Chapter 40D-2, F.A.C. The SWFWMD generally requires permits for withdrawals that average 100,000 gallons per day or greater. Permit applicants must demonstrate that their proposed water use is reasonable and beneficial, in the public interest, and will not interfere with any existing legal use of water. District rules specify thirteen conditions of issuance that must be met in order to satisfy these criteria (Rule 40D-2.301, F.A.C.).

Special strategies and criteria have been developed for water use permits within Water Use Caution Areas. The Dona Bay watershed is entirely within the Southern Water Use Caution Area (SWUCA). These strategies are designed to slow the inland movement of the freshwater/saltwater interface, commonly referred to as saltwater intrusion. Another standard proposed is to limit public supply permittees to a maximum per capita use rate of 150 gallons per capita per day for the entire SWUCA.

Some of the key existing rules applicable to the entire SWUCA include the following:

- Public supply utilities must adopt water-conserving rate structures to encourage conservation.
- Permittees for all use types must assess the feasibility of reuse and implement reuse where economically, environmentally and technically feasible.
- Alternative sources (e.g., reclaimed water) must be metered and their use reported to the SWFWMD.
- Coastal applicants for large quantities in the industrial and public supply categories must investigate the feasibility of using desalinated water.
- Most agricultural users are permitted for average rainfall conditions with an allowance of additional quantities during drought conditions and freezes. This provides an incentive to conserve and helps to reduce the large gap between permitted quantities and actual use.
- All uses greater than 100,000 gallons per day must be metered and usage reported to the District.

- Water conservation plans are required for all permits in the Industrial, Mining/Dewatering, and Recreational/Aesthetic categories, including, all golf courses.

The SWFWMD also has year-round water conservation rules to promote the long term sustainability of water resources through water efficiency, pursuant to Chapter 40D-22, F.A.C. Measures contained in the rule are aimed at reducing wasteful irrigation practices and encouraging lawn and landscape drought conditioning. The rules apply to all water users in the SWFWMD. The key provisions in the rules prohibit irrigation between the hours of 10:00 am and 4:00 pm and limit irrigation to a maximum of two days per week, which are specified based upon address numbers. Exceptions are provided for new plantings and special rules apply to golf course and agriculture.

Pursuant to Chapter 40D-21, F.A.C., each water management district in the State of Florida is required to have a water shortage plan. The plan is implemented when the SWFWMD Governing Board determines that insufficient water is available to meet permitted demand or when a temporary reduction in water use is necessary to protect water resources from serious harm. The plan provides for a variety of measure that may be implemented, depending on the severity of the water shortage. Measures are specific to various classes of water use.

The SWFWMD's well construction permitting program ensures both the protection of ground and surface water resources and the protection of water quality for potable uses. SWFWMD rule, Chapter 40D-3, FAC., regulates well construction practices and water well contractor licensing. In addition, selected Florida Department of Environmental Protection rules incorporated into Chapter 40D-3, FAC., by reference, are intended to ensure that all water wells and test or foundation holes within the SWFWMD are located, constructed, maintained, used and abandoned in a manner that protects water resources.

Sarasota County has its own well construction regulation program. In Sarasota County, the SWFWMD has delegated its authority for well permitting by formal agreement to the County Health Department.

Regional water supply plans also include establishment of minimum flows and levels (MFLs) for priority water bodies pursuant to Florida Statute 373.042. A minimum flow for a watercourse is the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area. The term "minimum flow" refers to the limit at which further withdrawals would be significantly harmful to the watercourse or receiving water ecology. Similarly, "minimum water level" is statutorily defined as the level of ground water in an aquifer or surface water at which further withdrawals would be significantly harmful to the water resources of an area.

Within the Dona Bay watershed, three MFLs are relevant: (1) the Upper Floridan Aquifer (minimum aquifer level), (2) the Intermediate Aquifer (minimum aquifer level), and (3) the Cow Pen Canal (minimum flow).

Minimum levels for the Upper Floridan Aquifer are addressed as part of the recently adopted SWUCA Recovery Strategy. Since the Dona Bay watershed is part of the SWUCA, the provisions of this Recover Strategy are applicable.

Minimum levels for the Intermediate Aquifer were scheduled to be established in 2006. Due to its localized nature, and because it is sustainable if managed judiciously, SWFWMD decided that establishing minimum levels for the intermediate aquifer was not practical. Instead, continued implementation of management strategies as recommended in their Intermediate Aquifer System (IAS) study for Osprey was considered to be a more effective management approach.

SWFWMD placed Cow Pen Slough on the 2005 Priority List and Schedule for the establishment of MFLs. However, due to a limited amount of flow data and the planned development of the Dona Bay Comprehensive Watershed Management Plan, the establishment of an MFL for the Cow Pen Canal was delayed to 2007 by SWFWMD. Determination of an MFL for Cow Pen Slough may be problematic since man-made drainage diversions have significantly increased fresh water flows and adversely impacted the biological and ecological functioning of the natural system.

Once established, MFLs are implemented through a variety of means, including the application of these flows and levels through the SWFWMD's water use permitting program. The SWFWMD's water use permitting rules, which include criteria to prevent adverse impacts from occurring as a result of withdrawals, effectively establish MFLs for specific sources throughout the District.

4.3.3 Sarasota County Regulations

Sarasota County has several ordinances that regulate water supply and usage issues:

- **Sarasota County Resolution No. 82-200** requires a Water Conservation Program to reduce demand in connection with the acquisition of the Carlton Reserve and the establishment of a water production program.

- **Sarasota County Ordinance No. 89-103** establishes Sarasota County's level of service, or concurrency analysis. For potable water, all development orders are analyzed to determine adequate capacity of potable water and distribution capacity exists to meet level of service standards. As a result, proposed development plans are reviewed at every stage of the development process, including Comprehensive Plan Amendments, Rezone Applications, Site and Development Plans and finally

the Building Permit for concurrency with the County's established level of service for Potable Water.

- **Sarasota County Ordinance No. 90-58** prohibits outdoor watering during certain declared water shortages and provides for penalties. It may be amended to impose more stringent water hours during severe water shortages.

- **Sarasota County Resolution No. 90-252** established the Outdoor Water Conservation Task Force, an ad hoc group formed to discuss and urge conservation and citizen involvement outdoors.

- **Sarasota County Ordinance No. 90-38** amends the Building and Plumbing Codes to require ultra-low flow plumbing fixtures in construction.

- **Sarasota County Resolution No. 90-294** established the Retrofit Committee, an ad-hoc pro-conservation citizens committee that urges studies of water conservation techniques relating to indoor plumbing.

- **Sarasota County Resolution No. 90-36** established a Water Budget for managing the growth of the Sarasota County Utilities Department and related franchise demands.

- **Sarasota County Resolution No. 90-37** established franchise connection requirements for impact fees.

- **Sarasota County Resolution No. 91-239** established water conservation rates, fees, and charges for Sarasota County Utilities customers.

- **Sarasota County Ordinance No. 94-001** requires low-volume plumbing fixtures in all new construction. This includes low-flow toilets with no more than 1.6 gallons per flush, low-flow showerheads, and faucet aerators. It also requires the installation of automatic rain shut-off devices on new automatic irrigation systems.

- **Sarasota County Ordinance 96-021** requires all automatic irrigation systems to have an automatic rain shut-off device. This ordinance was retroactive to include all automatic systems.

- **Sarasota County Ordinance 00-15** permanently increased the penalties for water restriction violations to:
  Warning notice – no civil penalty
  First offense - $100
  Second offense - $300
  Third offense - $500

It also requires any person who owns and operates an automatic lawn sprinkler/irrigation system to have an automatic rain sensor device or switch in operational condition at all times.

- **Sarasota County Ordinance 01-081** focuses on two elements: (1) irrigation system efficiency and (2) limiting plants requiring the most supplemental irrigation. It applies only to landscape areas irrigated by a permanent in-ground system. Some highlights are grass and annual flowers are limited to 50 percent or less of the irrigated area, separate irrigation zones are required for grass and tree/scrub/groundcover beds, and no plant root balls or spray irrigation is permitted under roof overhangs.

- **Sarasota County Ordinance 03-069** amended Sarasota County Ordinance 00-74 and requires new golf courses to meet or exceed Audubon International Signature Program including but limited to, utilizing native species in landscaping, minimizing irrigation and irrigation areas, and minimizing turf areas.

- **Sarasota County Ordinance 06-053** amended Sarasota County Ordinance 00-15 to requiring automatic rain sensor devices for automatic irrigation systems and established irrigation days and hours for lawns and landscaping.

4.4 OTHER RESOURCE INITIATIVES & ISSUES

An overview of other current water supply initiatives and issues relevant to the Dona Bay watershed is provided below.

4.4.1.1 Peace River/Manasota Regional Water Supply Authority (Authority)

The Authority is an independent special district of the State of Florida charged with providing its members - Charlotte, DeSoto, Manatee and Sarasota counties with reliable supplies of high-quality water in a way that both protects and preserves the environment. The Authority Board of Directors is comprised of one representative from each member county. Each board member is a county commissioner elected to serve on his or her Board of County Commissioners.

To promote regional coordination, the State of Florida and SWFWMD provide priority to funding new water supply development that is are endorsed by, and a part of, a regional water supply authority.

4.4.1 Peace River/Manasota Water Planning Alliance (Alliance)

The Alliance is a voluntary planning body formed to work collectively on water issues facing the region. Governance is established by a board with representation by one elected official from each participating local entity — Charlotte, DeSoto, Manatee and Sarasota counties; the cities of Arcadia, Bradenton, North Port, Palmetto, Punta Gorda,

Sarasota and Venice; the Town of Longboat Key; the Englewood Water District, the West Villages Improvement District and the Lakewood Ranch Stewardship District.

The Alliance is sponsoring a two-phase regional system planning and engineering study. Phase 1 involved a compilation of available data on water resources, supply infrastructure, demand projections for a 20 year planning horizon (2003-2023), conservation, and reuse.

4.4.2 SWFWMD Potential Water Supply Funding Sources

The SWFWMD provides several funding assistance programs for water supply-related projects.

New Water Source Initiative (NWSI)
NWSI is a financial incentive program initiated by the SWFWMD in 1994 to help develop sustainable, non-traditional alternatives to ground-water use. The SWFWMD Governing Board has budgeted $10 million annually and this amount is matched collectively by the basin boards for a total of $20 million per year. NWSI funding is currently committed through 2007. Projects are typically funded on a cost-share, 50-50 basis.

Cooperative Funding Program
Since 1987, the SWFWMD's basin boards have offered funding assistance to local governments and other entities for a variety of projects deemed to benefit the water resources of the SWFWMD. This program has been instrumental in promoting the development of reclaimed water systems throughout the SWFWMD. Several types of water conservation projects have also received cost-share funding.

Water Supply and Resource Development (WSRD) Program
The SWFWMD established the WSRD program in 2000 to provide funding for projects of regional significance on a matching, flexible basis to complement the NWSI and Cooperative Funding programs. It is anticipated that the Governing Board and basin boards will collectively contribute at least $6 million annually to this fund.

Florida Forever
The Florida Forever Act, passed in 1999, makes funding accessible to the SWFWMD for land acquisition, water resources development, ecosystem restoration, and related purposes.

4.4.3 Issue: Constraints on Ground Water Supplies

Background: Since the 1980s, the SWFWMD has been studying the effects of declining ground-water levels in the UFAS within the SWUCA. These declines have caused saltwater intrusion into the UFAS (particularly within the Most Impacted Area), reduced flows in the upper Peace River, and lowered lake levels along the Lake Wales Ridge. Of

these three major resource problems, salt water intrusion is the primary concern associated with ground-water withdrawals in the Most Impacted Area (MIA) which extends into the upper portion of the Dona Bay watershed. The recent adoption of the SWUCA Recovery Strategy is intended to limit the inland movement of the salt water/fresh water interface over the next 50 years and minimize the number of wells at risk of water quality degradation. The proposed minimum level is a key standard in the overall SWUCA Recovery Strategy, which will guide the management of ground-water withdrawals throughout SWUCA.

Strategy: Implementation of the SWFWMD's SWUCA Recovery Strategy.

Actions:

- Implement water use permitting rule enhancements as described in the SWUCA Recovery Strategy to meet future water demand while achieving established minimum flows and levels.
- Develop alternative water sources to meet the needs of growth, reserving limited ground water for users that have no other feasible options.
- Continue to expand water conservation programs in all use sectors.
- Expand the use of reclaimed water with an emphasis on effectively offsetting potable use, particularly the use of ground water.

Strategy: Management of the IAS.

The IAS is a unique hydro geologic system. The aerial extent of the IAS is all of Sarasota County extending outward to include portions of the surrounding Counties in much of the southern region of the SWFWMD. In 2000, the SWFWMD completed a ground water model and report in response to domestic well concerns in the Osprey area of Sarasota County. The report concluded; if managed, the IAS is a sustainable water resource. The report provided several short-term and long-term management recommendations, in addition to proposing several additional monitoring well locations. Sarasota County is working to implement many of the District's recommendations and specifically is looking to partner with the District on the installation of the additional strategic monitoring wells, two of which are located within the Dona Bay watershed.

Recognizing that the IAS is complex, ranges through many jurisdictions, and has a large number of users with a wide range of expectations, SWFWMD, Sarasota County, and other users of the IAS took a proactive step in 2004 by establishing a Technical IAS working group. This group meets 3 or 4 times a year to discuss issues relative to the IAS and includes, but is not limited to, SWFWMD, Sarasota County, City of Sarasota, City of Venice, Englewood Water District, City of North Port, Health Department, and others. As the primary agencies with regulatory responsibility in permitting agricultural, industrial and residential wells, this coordination is expected to be mutually beneficial in managing the resource. This approach will also provide a consistent basis that all agencies will be able to rely on in further regulatory actions and community involvement

that may be instituted. This was also envisioned as a practical and effective strategy in managing the IAS.

In January 2002, the SWFWMD established a time frame to set minimum aquifer levels for the Intermediate Aquifer System in the Most Impacted Area (MIA) of the Southern Water Use Caution Area (SWUCA). This effort was scheduled to be completed (where technically feasible) by the SWFWMD in 2005. However, because the impacts of withdrawals from the IAS are relatively localized, the SWFWMD has determined that the establishment of a minimum level for the IAS is not technically feasible.

Actions:

- Continue the implementation of the recommendations of the SWFWMD-sponsored IAS study.
- Continue coordination of IAS users through the Technical IAS work group.

Strategy: Develop alternative water sources to the UFAS.

Recognizing the limited availability of groundwater resources, the SWFWMD has developed a water supply policy which states that the SWFWMD will "encourage, assist in, and where appropriate require, the development and efficient use of alternative sources of water". Alternative water sources to the UFAS are sources other than traditional groundwater such as surface water, the IAS, reclaimed water, stormwater reuse, aquifer storage and recovery, and brackish water or seawater desalination. The Dona Bay watershed has long been identified as a potential alternative water source. The IAS is also a potential alternative water source.

Actions:

- Continue seeking New Water Sources Initiative and Cooperative Funding Program to assist in developing alternative supplies in the Dona Bay watershed, particularly excess surface water, and possibly the IAS.
- Take advantage of regulatory requirements/incentives for alternative water sources.
- Optimize the use of aquifer storage and recovery for reclaimed and surface water sources.

4.4.4 Issue: Linking Land and Water Planning

Background: One of the key concerns relative to growth management in Florida is that planning for water supplies has not been adequately integrated with planning for land development. Over the years, various initiatives have been aimed at improving this linkage, most recently the 2002 legislation that requires local governments to prepare water supply work plans and consider the Regional Water Supply Plans of the water management districts in the development of such plans. Planning for water supply on a regional basis can also help to ensure the availability of water to meet growing demand.

The SWFWMD has previously funded water planning activities by the Authority and is currently contributing to the Water Planning Alliance water supply plan.

Strategy: Enhance coordination between the SWFWMD, the Authority, and Sarasota County Government.

Actions:

- Continue participation in regionally coordinated water supply planning efforts such as the Water Planning Alliance.
- Continue to coordinate the development of an alternative water supply with the SWFWMD, and the Authority.
- Seek to better interconnect water supply systems in the region to enhance reliability and efficiency.
- Continue to implement conservation and reuse programs to reduce the need for costly water supply development projects.

Strategy: Improve compliance with water shortage restrictions and year-round conservation measures.

Coordination between Sarasota County Government and SWFWMD is necessary to achieve effective enforcement in the year-round water conservation measures and water shortage restrictions.

Actions:

- Educate the public on how year-round water conservation measures and water shortage restrictions affect them.
- Improve coordinate between SWFWMD and Sarasota County to identify means of enforcing watering restrictions.

4.4.5 Issue: Protection of the Water Supply Watershed

Background: In the likely event that the Dona Bay watershed becomes a surface water supply source, special consideration should be given to how the contributing watershed to the source water will be managed. At present, the contributing watershed located upstream of the likely reservoir locations(s) is primarily rural. Although development is occurring in Manatee County, it appears that the stream corridors have been set aside. The portion of the watershed in Sarasota County is rural in nature and consists of agriculture or 5 and 10 acre residential lots. The current land use map for the area would result in essentially the entire area being developed in 5 to 10 acre residential lots. As an alternative, Sarasota County has developed an incentive-based, voluntary overlay for the area known as the 2050 Plan. The 2050 Plan designated Villages and Hamlets with accompanying greenways that are largely centered on watercourses. Floodplains, to a large extent are encompassed in the greenway set asides. Although current surface and stormwater management regulations in the State of Florida and Sarasota County have led the nation, it would still be advisable to proactively develop a Water Supply Watershed Protection Plan.

Strategy: Develop a Draft Water Supply Watershed Protection Plan for the portion of Dona Bay that may contribute to surface water supply. This Plan should focus on incentives.

Actions: A Draft Water Supply Watershed Protection Plan has been prepared and is provided in Technical Memorandum 4.2.8.

4.5 WATER QUALITY ISSUES

Public water systems are required to periodically test the water served to the public for contamination. The Florida Department of Environmental Protection divides different types of contaminants into contaminant groups.

FDEP Contaminant Groups

- Inorganic Contaminants
- Volatile Organic Contaminants
- Synthetic Organic Contaminants
- Radionuclides
- Microbiological Contaminants
- Secondary Drinking Water Standards

Evaluating existing water quality is a worthwhile effort in determining potential contaminant issues that may currently exist relative to water supply sources. Sarasota County completed a year long sampling and testing program in 2003 to evaluate the water quality in the Cow Pen Canal and the potential for use of the water for irrigation or

as a potable water source. The sampling program included monthly testing for pollutants listed in the National Primary and Secondary Drinking Water Regulations and selected additional parameters. The National Primary and Secondary Drinking Water Standards were established by the Environmental Protection Agency for all public potable water supply systems and relate to the finished water distributed to users. It should be noted that the test results are for a raw water source prior to treatment.

With the exception of pathogens, none of the contaminants exceeded the primary drinking water standards. Total coliform and fecal coliform counts exceeded the Criteria for Surface Water quality in several of the samples. The parameters that exceeded the Secondary Drinking Water Standards and Surface Water Quality Standards are aluminum, iron, color, odor, and bacteria. Pesticides were found to be present in minor concentrations in three of the samples, but did not exceed the maximum contaminant level (MCL) required by the drinking water standards. Standards were sampled monthly at the upper water level control structure. A summary of the results of the sampling follows.

4.5.1 Inorganic Contaminants

Inorganic contaminants, such as salts and metals can be naturally-occurring or result from stormwater runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.

Barium was the only inorganic compound detected in all samples but was found at very low levels. Given the land-uses in the watershed, possible sources of the barium are well-drilling wastes, diesel fuel combustion from agricultural equipment, paints (chrome yellow), and rat poison. All sample values for Barium and all other organic compounds were below their drinking water Maximum Contaminant Levels (MCLs). Lead and selenium were not detected in any samples for the entire sampling period.

4.5.2 Volatile Organic Contaminants

Organic chemical contaminants, including synthetic and volatile organic chemicals, which are by-products of industrial processes and petroleum production, can come from gas stations, urban stormwater runoff, and septic systems.

No Volatile Organic Compounds (VOCs) were detected in any sample during the entire monitoring period.

4.5.3 Synthetic Organic Contaminants

Organic chemicals regulated in drinking water include human-made chemical compounds which are components of a variety of pesticides and herbicides. Also included are industrial and commercial products, including degreasers, paints, and petroleum distillates.

The source water samples yielded traces of two synthetic organic compounds for pesticides, but neither exceeded their respective MCLs for drinking water.

Glyphosate was detected at a level of 16 micrograms/L in the March 2003 source water sample. The MCL for Glyphosate is 0.7 mg/L. It is a chemical found in herbicides such as Roundup®, Rodeo®, and Accord®. Diquat® was detected at a level of 0.46 micrograms/L in the April 2003 source water sample. The MCL for Diquat® is 0.02 mg/L.

4.5.4 Radionuclides

There are two sources of radioactive contamination in drinking water. The first is naturally occurring radionuclides that are contained in the soil that water moves through. Some areas in Florida are susceptible to contamination from phosphate rich soils and rock. The second source of radioactive contamination comes from man-made sources.

Radium 226, Radium 228 and the Gross Alpha particle activity in the source water monitoring samples were well below the Maximum Contaminant Levels.

4.5.5 Microbiological Contaminants

Microbial contaminants, such as viruses and bacteria may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.

Coliform bacteria are common in the environment and are generally not harmful. However, the presence of these bacteria in drinking water is usually a result of a problem with the treatment system or the pipes which distribute water, and indicates that the water may be contaminated with germs that can cause disease.

Fecal Coliform and ***E coli*** are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Microbes in these wastes can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms.

Sarasota County conducted source water quality sampling monthly for Total Coliform and Fecal Coliform at five locations, four locations in the Cow Pen Canal and one location in Vegetable Relief Canal.

Total Coliform values for the source water samples exceeded the maximum (MCLs) of ≤ 2400 colonies per 100 milliliters (ml) per sample at two sites in September, four sites in October and three sites in December.

Fecal Coliform values for the source water samples exceeded the MCLs of ≤ 800 colonies per 100 ml at one site in March and three sites in December.

Giardia lamblia is a parasite that enters lakes and rivers through sewage and animal waste. It causes gastrointestinal illness (e.g. diarrhea, vomiting, and cramps).

Cryptosporidium is a parasite that enters lakes and rivers through sewage and animal waste. It causes cryptosporidiosis, a mild gastrointestinal disease. However, the disease can be severe or fatal for people with severely weakened immune systems.

Sampling of the source water was conducted quarterly for Giardia and Cryptosporidium. Giardia and Cryptosporidium were detected in very low levels in the April and June samples and were not detected in September. Cryptosporidium organisms were detected in the December sample.

Giardia and Cryptosporidium are pathogens and the Maximum Contaminant Level Goal (MCLG) is zero. Special treatment is required to kill or inactivate 99.9% of the organisms in the source water.

4.5.6 Secondary Drinking Water Standards

National Secondary Drinking Water Regulations (NSDWRs or secondary standards) are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. EPA leaves the regulatory discretion to the states for setting compliance standards. The FDEP's position is that there are no adverse health effects generally associated with the secondary drinking water contaminants. At considerably higher concentrations than those listed in the standards, health implications may exist as well as aesthetic degradation.

Aluminum is the most abundant metallic element in the earth's crust. However, it is highly reactive and is never found free in nature. It combines with other elements like oxygen, silicon and fluorine. These compounds are commonly found in soil, minerals, rocks, and clays. Small amounts of aluminum can be found in water in dissolved or ionic form. Most aluminum-containing compounds do not dissolve in water unless the water is acidic. Since the pH for the samples tested were not significantly acidic, the elevated aluminum levels do not appear to be from natural sources. Possible sources from the aluminum are animal feed and pesticides. The source water sampling exceeded the Secondary Drinking Water Standard for aluminum of 0.2 mg/L in July (0.42 mg/L), August (0.25 mg/L) and December (0.23 mg/L). The value for aluminum was the highest in July after the June rains.

Iron is the fourth most abundant element in the earth's crust. Natural waters contain variable amounts of iron depending on the geological area. The recommended MCL is 0.3 mg/L and the source water samples exceeded this level in every month except June. The highest level was 2 mg/L and the average level was 0.97 mg/L or three times the recommended standard.

Total Hardness in the source water samples ranged from a low of 66 mg/L in July to a high of 210 mg/L in March. This range falls within the American Waterworks Association scale of Very Soft to Hard (25 mg/L to 300 mg/L).

pH levels in the source water ranged from slightly acidic to slightly alkaline (7.56) in October – within the 6.5-8.5 Drinking Water Standard range. ***Color*** in the source water exceeded the MCL of 15 color units every month sampled. This can be attributed to the naturally occurring tannins. ***Odor*** in the source water exceeded 3 units during the months of February, May, November and December. ***Foaming Agents*** in the source water were either detected below the 0.5 mg/L or not detected.

4.5.7 Other Potential Sources of Water Pollution

Other potential sources of water pollution within the proposed Water Supply Watershed Protection Area such as reuse water, stormwater, sludge, mining, on-site sewage treatment and disposal systems, etc, are discussed in Technical Memorandum 4.2.8 – Water Supply Watershed Protection Plan.

4.6 IDENTIFICATION OF WATER SUPPLY PROJECTS

This information is provided and incorporated into Technical Memorandum 4.2.7 – Development of Phasing Plan.

4.7 WATER SUPPLY WATERSHED PROTECTION PLAN

This information is provided and incorporated into Technical Memorandum 4.2.8 – Water Supply Watershed Protection Plan.

Chapter 5 - Water Quality

Photo of Dona Bay at Venice Jetty
submitted to Sarasota County

Chapter 5
Water Quality

5.1 INTRODUCTION

In addition to the general water quality information contained herein, the following Technical Memorandums (TMs) relative to water quality in the Dona Bay watershed are provided in the Appendix:

TM 4.3.1 - Data Collection and Review
TM 4.3.2 - Data Analysis
TM 4.3.3 - Alternative Impact Analysis

Consistent with the contract scope of services, these TMs provide preliminary evaluations for (1) existing water quality data sets, (2) predicted responses of salinity in Dona Bay to potential hydrologic restoration activities, and (3) predicted responses of nutrient loads to potential hydrologic restoration activities. A brief summary of each TM is provided below:

TM 4.3.1 summarizes the techniques used to develop a comprehensive and relational database for the Dona Bay Watershed Management Plan (DBWMP). A relational data base with information on flows, salinity, oyster health, seagrass distribution, etc. was created from existing data sources. This exercise showed that such a data management system can be developed and modified, as needed, based on both prior and ongoing monitoring efforts.

TM 4.3.2 presents a summary of efforts to develop a statistically robust and scientifically valid relationship between salinity and flows in Dona Bay. The results from these analyses suggest that while substantial changes in salinity are possible in some of the locations in the Shakett Creek, with implementation of the watershed/hydrologic restoration plans envisioned, other locations are not likely to be strongly affected. In the upper reaches of Shakett Creek salinities might be expected to increase such that salinities would be less likely to drop below 10 ppt, with implementation of the Phase 3 watershed/hydrologic restoration plan. Based on data from Estevez (2006) these locations might be likely to produce salinity regimes more supportive of successful spawning events for oysters. At locations closer to Venice Inlet, results indicate changes in salinity would be minimal to the point of perhaps not being detectable. Habitats in this area dependent upon the existing salinity regimes in Dona Bay would not likely be impacted.

TM 4.3.3 summarizes efforts to develop a statistically robust and scientifically valid estimate of pollutant load reduction estimates to Dona Bay associated with the implementation of potential flow diversion scenarios. In general, responses of benthic habitats to pollutant load reductions associated with potential flow diversion calculations are likely to be significant. There is no information that would suggest a deleterious impact to benthic communities, should potential flow reduction scenarios be implemented. In percent reduction in nitrogen loads possible (40 to 59 percent) would be similar to the percent load reductions for nitrogen that were experienced by Tampa Bay and Sarasota Bay in recent years (Tomasko et al. 2005). It would not be overly simplistic to suggest that a similar level of improvement in estuarine health, such as seagrass recovery, might be possible for Dona Bay, should freshwater flow reductions be as significant as those possible with implementation of the proposed Phase 3 watershed/hydrologic restoration plan

5.1.1 Overview of Dona Bay and its Watershed

The Dona Bay system has generally not received the same level of attention as the adjacent Sarasota Bay and Charlotte Harbor estuaries (SWFWMD 2000a). However, Mote Marine Laboratory (1975) conducted a thorough investigation of the hydrology, water quality and basic ecology of Dona and Roberts Bays, which were summarized in the report "The Ecological Status of Dona and Roberts Bays and its Relationship to Cow Pen Slough and Other Possible Perturbations."

As outlined by Mote Marine Laboratory (1975) the most significant impact to the Dona Bay system has been the substantial alteration to the watershed associated with the construction of the Cow Pen Canal (CPC) drainage system (Figure 5.1).

This modification not only substantially increased the size of the contributing watershed for Dona Bay, but the volume of freshwater entering Shakett Creek and Dona Bay.

As a result, freshwater flows have changed the salinity regimes in Shakett Creek and Dona Bay, which is immediately downstream of the gated water level control structure at the south end of the Cow Pen canal, (Mote Marine Lab 1975).

Two functioning control structures are located on CPC – one located south of State Road 72, and one located just west of the Kings Gate Mobile Home Park. Flows discharge over the lower weir flow directly to tide, into the upper reaches of Shakett Creek. At present, both control structures are closed during the dry season (November to late May) and opened during the beginning of the wet season (approximately early June). At the upper structure, weir elevations when the gates are open and closed are 14 and 18 feet (NGVD), respectively. At the lower structure, weir elevations when the gates are open

and closed are 7 and 11 feet (NGVD), respectively. This operation schedule was initially established as part of the West Sarasota Coastal Project and therefore was primarily intended to meet the needs of agricultural interests in the watershed, with little consideration of the impacts on estuarine resources (Jones 2005).

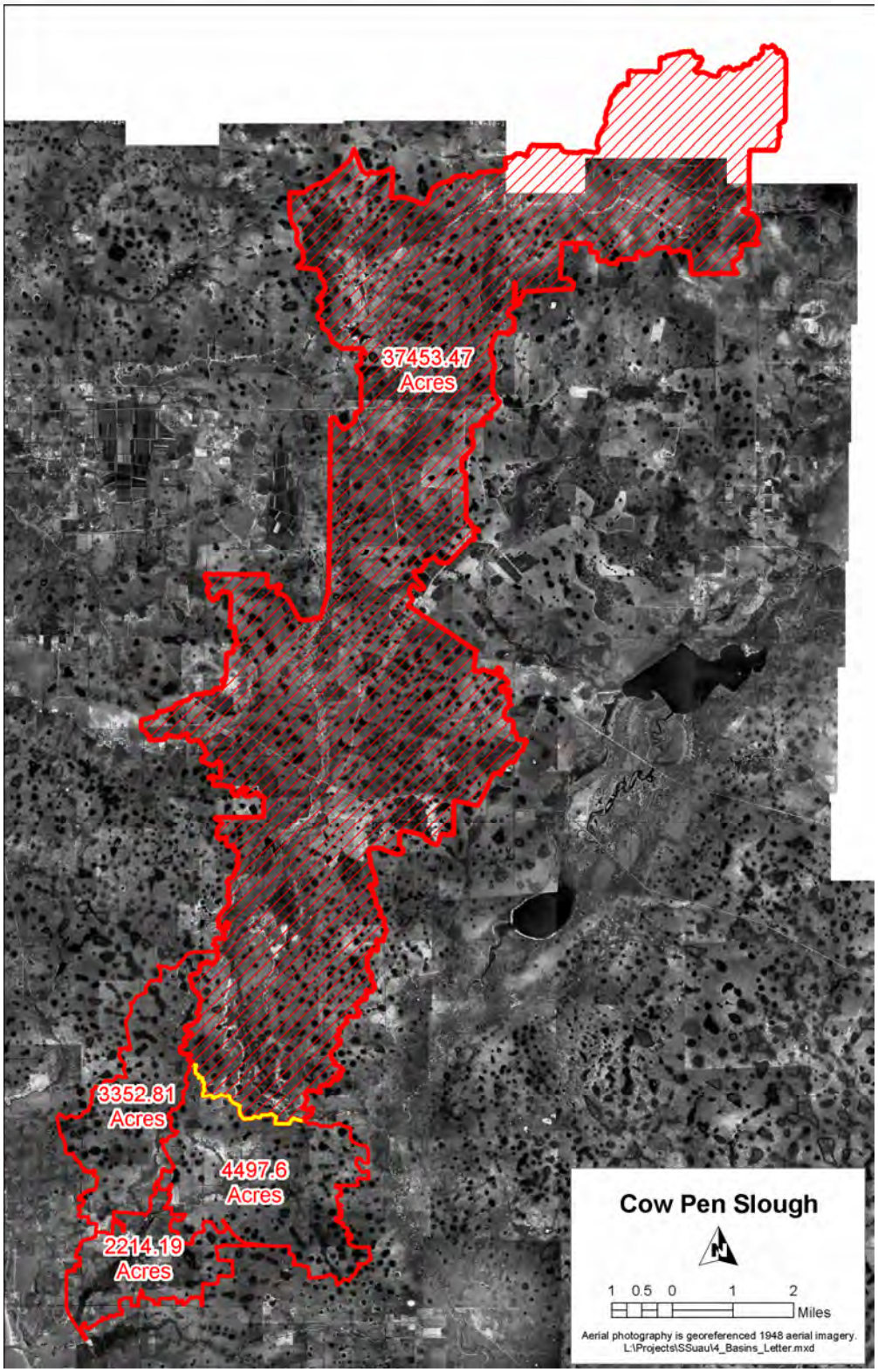

Figure 5.1 – Delineation of Present and Historical Dona Bay Watershed

5.2 RECENT AND ONGOING MONITORING PROGRAMS

In its report on the status and trends in water quality for the Charlotte Harbor National Estuary Program (which includes Dona Bay) Coastal Environmental, Inc. (1997) concluded that there was insufficient information available to determine if trends in water quality had occurred in Dona Bay. More recently, there has been a tremendous increase in the amount of water quality collected in this region, as shown in Figure 5.2.

Figure 5.2 – Locations of Water Quality Stations in Lyons, Dona, and Roberts Bays

Water quality data are collected on a monthly basis at five locations in the study area by Mote Marine Laboratory, in part to fulfill obligations of Sarasota County under its MS-4 permit under the National Pollutant Discharge Elimination System (NPDES) program (Jones 2005). Data have been collected by researchers from the University of South Florida, as part of the SWFWMD's Minimum Flows and Levels monitoring program, in addition to monthly water quality collections by staff from the SWFWMD.

The water quality collected as part of the SWFWMD effort was collected from 25 stations located throughout the study area (Figure 5.3). Data from these stations were collected during the period of August 2003 to September 2005. This data set forms the basis for efforts to develop salinity-flow relationships that are discussed in greater detail later in this chapter.

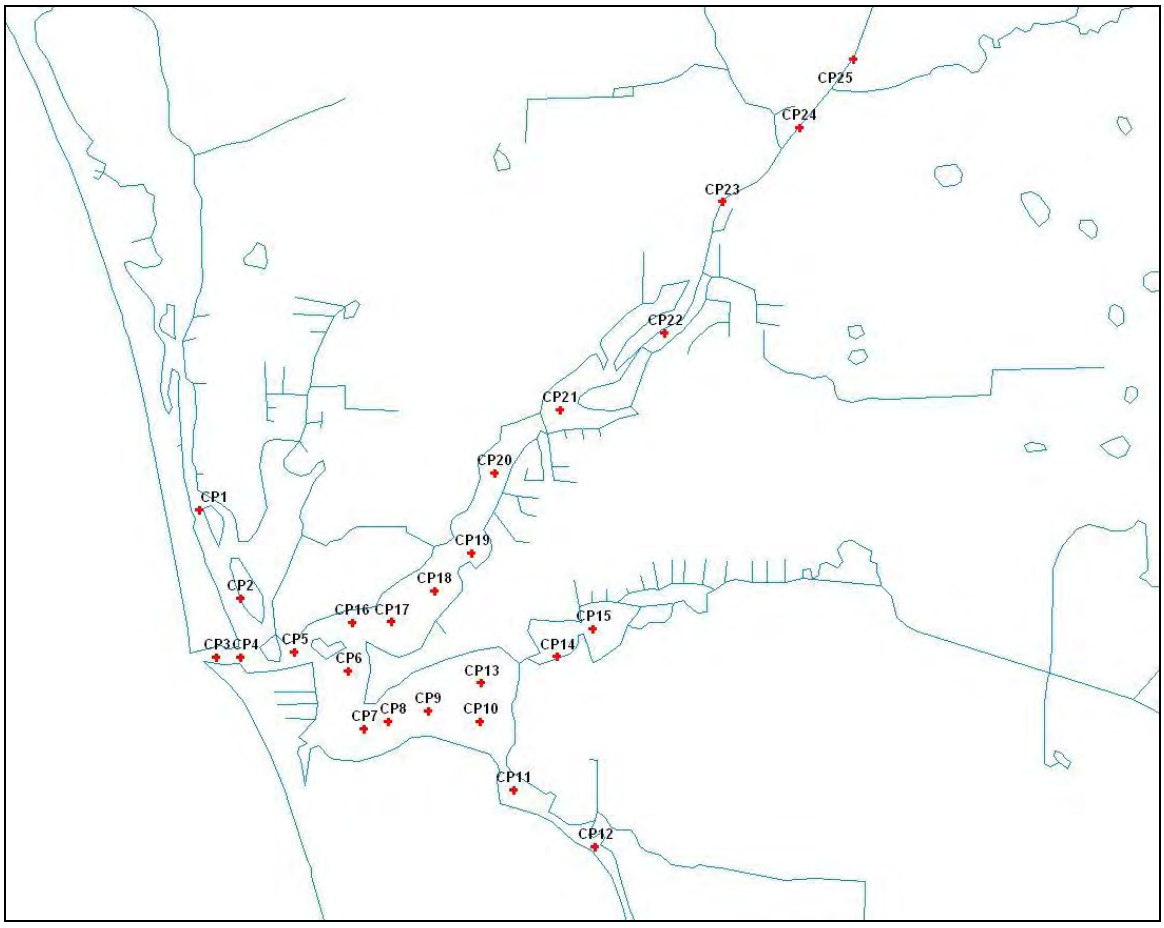

Figure 5.3 – Location of SWFWMD Monitoring Stations

5.3 OVERVIEW OF WATER QUALITY CONDITIONS

In the report on DARB by Mote (1975) and also in the report "Southern Coastal Watershed Comprehensive Watershed Management Plan" (SWFWMD 2000a) the main conclusion reached was that the primary impact to the Dona and Roberts Bay system is that of an excess of freshwater inflow. Figures 5.4 and 5.5 (from Jones 2005) illustrate the overall salinity regimes experienced in Dona and Roberts Bay during a typical dry season, and a typical wet season, respectively.

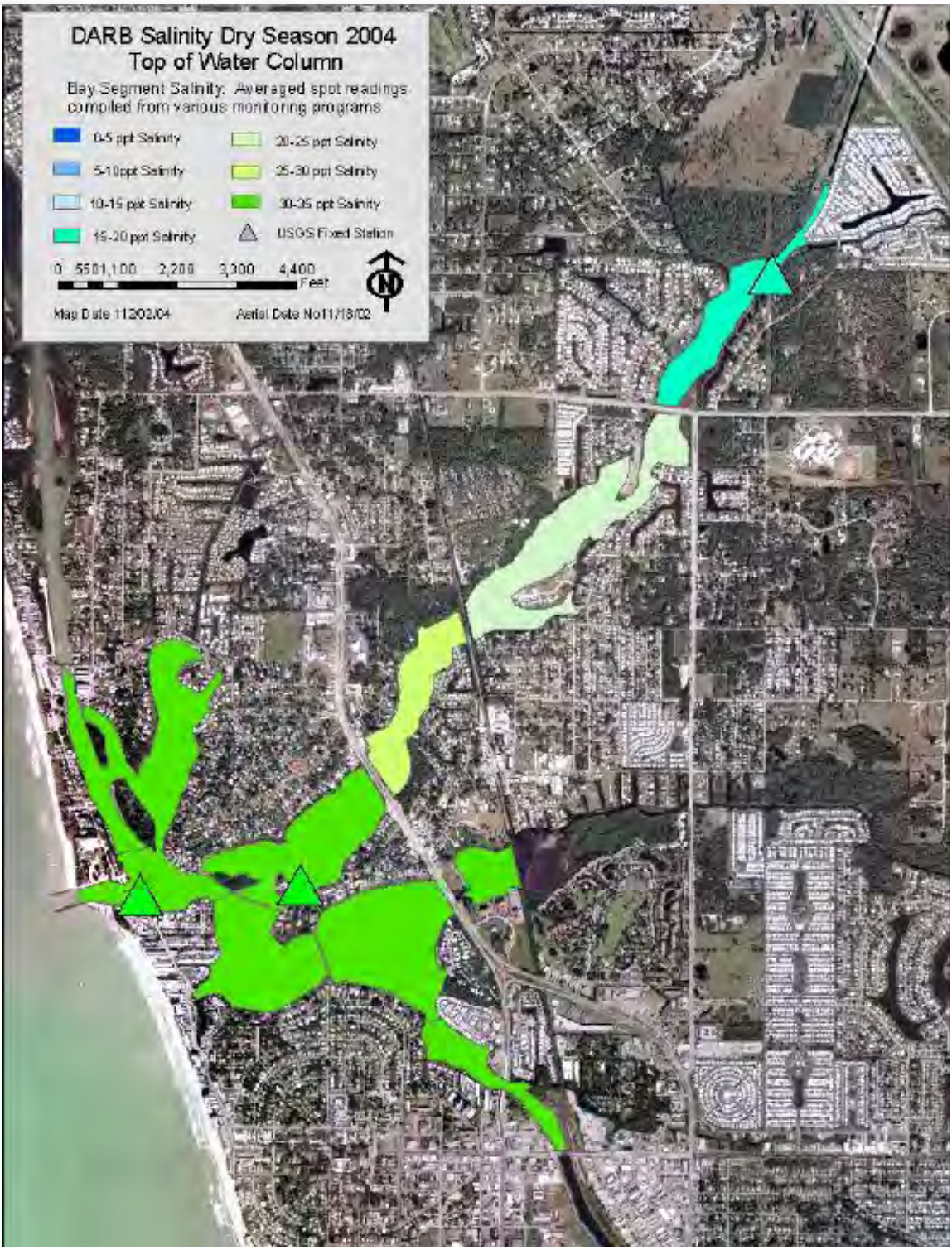

Figure 5.4 – Salinity Regimes in Lyons, Dona, and Roberts Bays during the Dry Season (from Jones 2005)

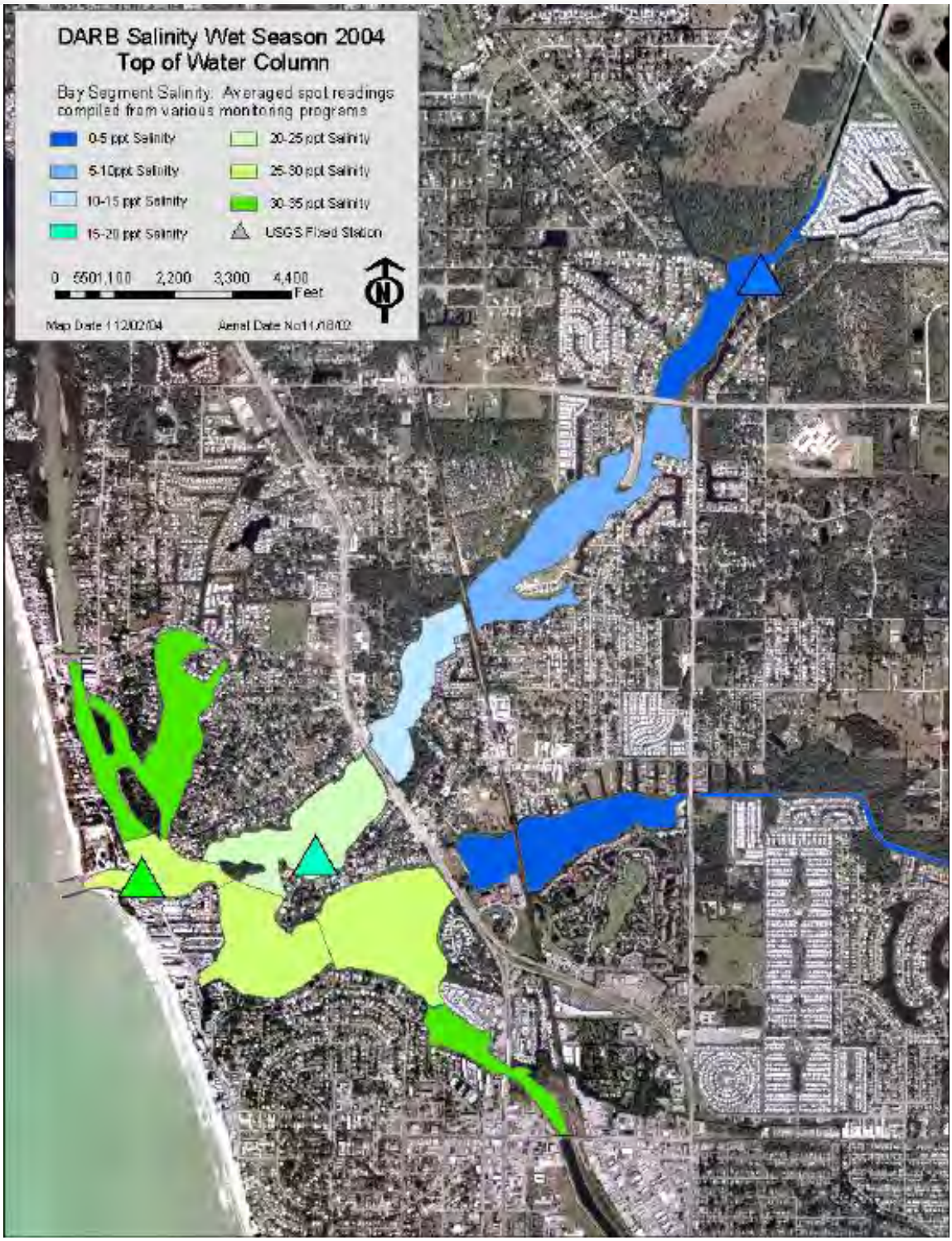

Figure 5.5 – Salinity Regimes in Lyons, Dona, and Roberts Bays during the Wet Season (from Jones 2005)

During the dry season, that portion of Dona Bay west of U.S. 41 typically experiences salinities in the range of 30 to 35 ppt. Salinities increase with distance from Venice Inlet, with values at the base of the downstream water level control structure on CPC ranging between 15 and 20 ppt.

During the wet season, salinities in lower Blackburn Bay and Lyons Bay range between 30 and 35 ppt, but salinities in Dona and Roberts Bays typically range between 20 and 30 ppt. This finding is consistent with the original study by Mote (1975) which found that salinities in Dona and Roberts Bays were considerably lower than those found in adjacent Lyons Bay, and that the reduced salinities were related to the increased inflow of freshwater into Dona Bay due to the expansion of the watershed via the CPC.

However, another major feature of the Dona Bay system is the highly variable salinities within the estuary. As an example, Figure 5.6, from Jones (2005) illustrates both the average salinities in Dona Bay during the 2003 wet season, and also the range in salinities experienced within a single day at this same location.

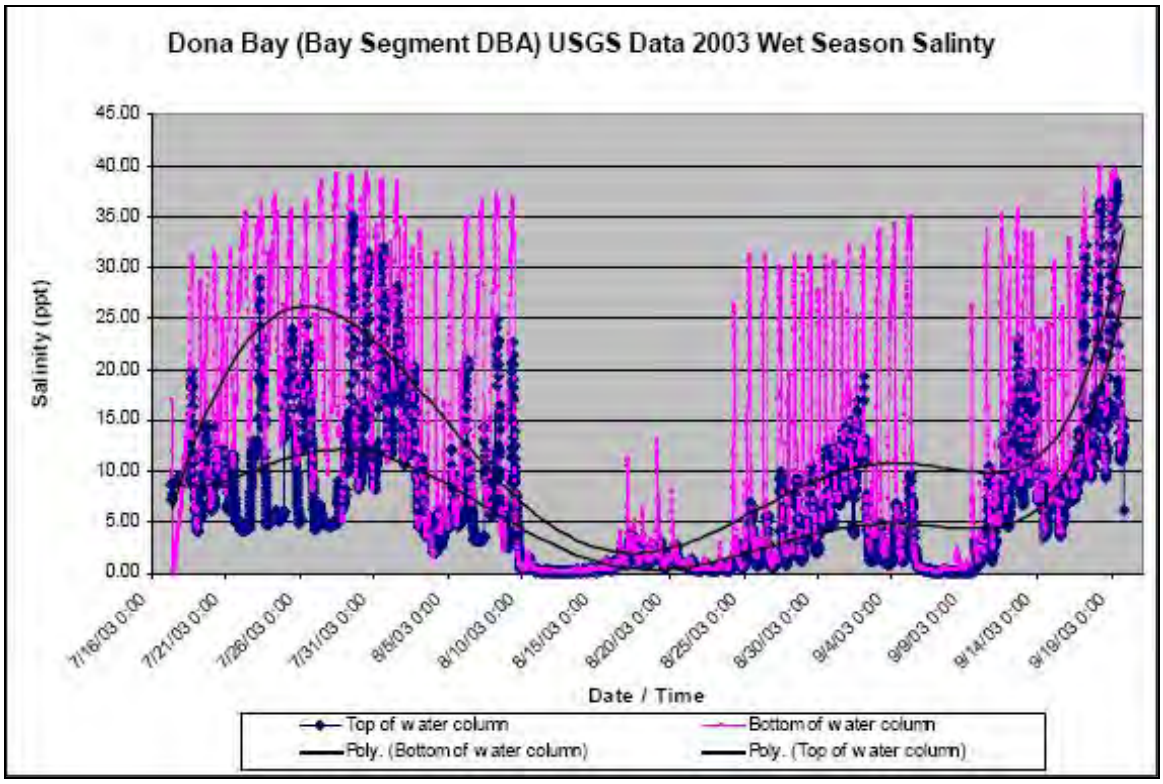

Figure 5.6 – Salinities Recorded in Dona Bay During 2003 Wet Season (from Jones 2005)

These data show that while seasonal ranges in salinity do follow a pattern consistent with expectations from an estuary in Southwest Florida, there is considerable variation within a single day. From late July to early August, the data in Figure 5.6 illustrate daily

salinities in Dona Bay varied roughly between 10 and 35 ppt. During mid to late August, rainfall within the watershed not only lowered the salinities to less than 15 ppt, but the daily variation in salinity decreased as well. A later rain event in early September had the same impact – a reduction in both salinities and variation in salinity values. These data also indicate that salinity-based stratification of the water column occurs in Dona Bay as surface salinities are often lower than salinities in the bottom layer. This has important implications as to the potential for the development of stratification-induced hypoxia (DO < 2 mg / liter) as was suggested by Mote (1975). Such a phenomenon is known to exist in Charlotte Harbor as well (Turner et al. 2006).

The impacts of anthropogenically-derived reductions in salinities in Dona Bay extend beyond considerations of salinity alone. Using data collected through the ongoing ambient water quality monitoring program in Dona Bay (5 stations randomly chosen per month), it can be seen that there is a positive relationship between dissolved oxygen and salinity (Figure 5.7). The data shown are all collected at 0.2 m depth, which is at a level that is not influenced by stratification-driven oxygen reductions (e.g., Turner et al 2006).

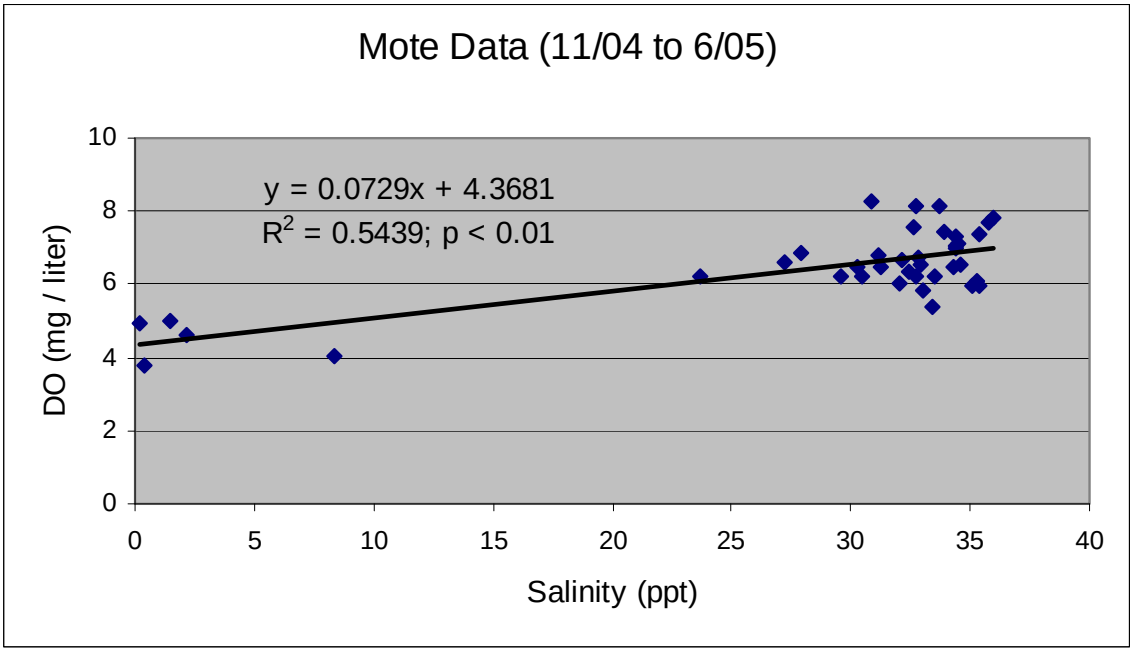

Figure 5.7 – Plot of Dissolved Oxygen vs. Salinity in Dona Bay (data from Ambient Monitoring Program)

These results illustrate that freshwater diverted to Dona Bay from the Cow Pen canal typically has lower dissolved oxygen levels than waters from the nearby Gulf of Mexico. While this finding is not unexpected, it is important to remember that Dona Bay is impacted by an excessive amount of freshwater inflow; Dona Bay is also potentially influenced by an unnaturally low level of dissolved oxygen.

Another potential influence on dissolved oxygen levels is that of the negative influence of variation in salinity on minimum dissolved oxygen levels. Using data from the SWFWMD's monitoring program, Figure 5.8 illustrates the relationship between minimum dissolved oxygen levels at each of the 25 stations visited in Dona Bay and the "coefficient of variation" of salinity at those same sites. The term coefficient of variation refers to a measure of variability of data that is "normalized" for differences in mean values. Values of CV are calculated as the standard deviation for a data set divided by the mean value from that same data set, the product of which is then multiplied by 100. This term describes the standard deviation of a data set in terms of its percentage of the mean value from that same data set. This data set was compiled from a bi-weekly sampling program, at the same water depth (0.5 m), during the period of January 2005 to January 2006. As such, each data point represents a data set that experienced both warm and cold water temperatures – the pattern of response is not biased by a site-specific temperature regime.

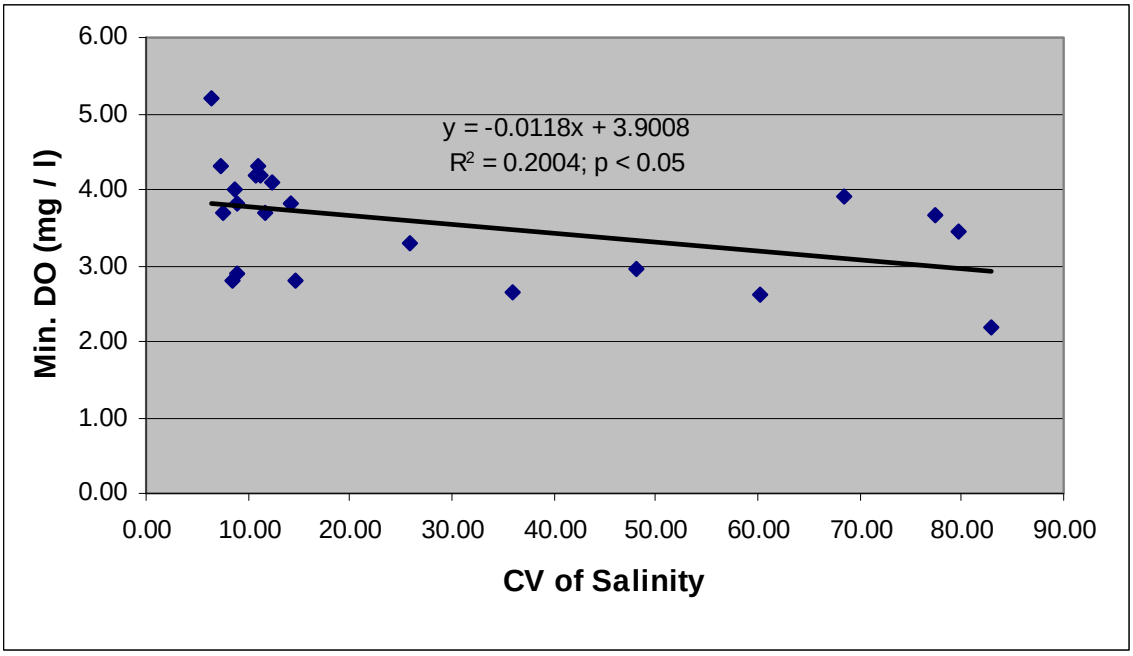

Figure 5.8 – Minimum Dissolved Oxygen Values vs. Coefficient of Variation of Salinity (data from SWFWMD)

These results suggest that the high variability of salinity values within Dona Bay are doubly stressful to estuarine organisms – not only must these organisms tolerate a wider range of salinities than a less impacted system, but they also experience lower levels of minimum dissolved oxygen values than would occur in a less impacted system.

The combination of lower than "normal" salinities, greater variability in salinity values, and lower dissolved oxygen levels have been known to impact the health of Dona Bay for more than 30 years (i.e., Mote Marine Lab [1975]). Efforts to reduce the amount of excessive freshwater inflow would likely result in positive impacts to the estuarine resources of the Dona Bay system.

5.4 WATER QUALITY ISSUES AND PRIORITY ACTIONS

As has been identified previously, the largest adverse impact on the ecology of Dona Bay is the increase in the watershed and corresponding freshwater flows resulting from the drainage and diversion of the historical Cow Pen Slough from the Myakka River to Dona Bay. This modification has resulted in substantial impacts to water quality and even circulation features (Mote Marine Lab 1975).

Excessive freshwater inflow has reduced salinities in Dona Bay to levels that are incompatible with long-term establishment of oysters in Shakett Creek and hard clams in Dona Bay (Estevez 2006). In addition, excessive variation in salinity values has also negatively affected minimum dissolved oxygen levels, adding further stress to organisms already stressed by unnaturally low salinity and unnaturally high variability in salinity.

There are, at present, at least four reports that have made recommendations related to the impacts to Dona Bay from excessive freshwater inflow. These studies include the comprehensive assessment of Dona Bay by Mote Marine Lab (1975), the SWFMWD's Southern Coastal Watershed Comprehensive Watershed Management Plan (2000a), the Charlotte Harbor Surface Water Improvement and Management (SWIM) Plan (SWFWMD 2000b), and the Charlotte Harbor National Estuary Program's Comprehensive Conservation and Management Plan (CHNEP 2000).

In all these plans and studies, a consistent recommendation is to substantially reduce the excessive freshwater inflows into Dona Bay from the Cow Pen Slough watershed. While other issues exist that also negatively impact water quality and natural systems in Dona Bay, it is unlikely that fixing these other issues would result in a noticeable improvement in Dona Bay unless the excessive freshwater inflows were removed as well (Ernie Estevez, personal communication).

5.5 POTENTIAL RESPONSES TO HYDROLOGIC RESTORATION

Most estuarine organisms are classified as "euryhaline" meaning they can tolerate a broad range of salinities. Salinities are important not only in terms of the "average" salinity value, but also in terms of the minimum, maximum, and variation in salinity that is experienced. The salinity regimes considered appropriate for the long-term survival of various organisms found in Dona and Roberts Bays were summarized by Estevez (2006). The salinity requirements derived by Estevez (2006) vary by species.

Hard clams do best in areas where the mean bottom salinity is maintained above 20 ppt, while oysters do best within a range of salinities between 10 and 28 ppt.

For oysters, while adults can tolerate salinities as low as 6 ppt for up to 2 weeks, they cannot tolerate salinities below 2 ppt for much longer than a single week. Juvenile oysters are less tolerant of low salinities than adults, and the most successful spawning events occur when salinities are above 10 ppt.

For successful spawning and larval recruitment (based on data from red drum, seatrout and snook) salinities should be within the range of "seasonally appropriate levels." Red drum and seatrout larvae can tolerate salinities between 15 and 35 ppt.

In contrast, juvenile snook require freshwater for successful development. The need for freshwater habitats for juvenile snook is not due to a lethal impact of salt on the fish themselves; rather, it is related to lethal impacts of salinity on the preferred prey of juvenile snook (Estevez 2006).

5.5.1 DEVELOPMENT OF SALINITY VS. FLOW DATA SETS, AND COMPARISON TO "TARGET" SALINITY VALUES FOR DONA BAY

As part of the process for developing the Dona Bay Watershed Management Plan, KHA developed an historical flow record for Cow Pen Slough, using techniques outlined in the Water Budget Development portion of the DBWMP contract (Technical Memorandum 4.2.2). These data were supplied to PBS&J as a record of monthly flow values for the period between November 1966 and December 2005.

During the period of August 2003 to September 2005, the SWFMWD recorded salinities at 25 stations located throughout the Lyons, Dona, and Roberts Bay areas (See Figure 5.3).

Salinity data from these locations and flow data from the Cow Pen Canal were then compared to determine if there was a relationship between flows (monthly averages) and salinity values collected during that same month. To reduce the possibility of including

confounding errors, salinity data were normalized for sampling depths (0.5 meters below the surface). Also to avoid the inclusion of confounding influences, data were restricted to that time period when salinity data were available from all locations (March 2004 to September 2005). At several locations (stations 4, 8, and 15) there was insufficient data to allow for a statistically valid comparison of flows vs. salinities (at least at depths of 0.5 m for the period of March 2004 to September 2005) – these stations were excluded from further analysis.

A comparison of various potentially significant regression types was run for all stations except 4, 8, and 15 using StatGraphics©. This software package allows for a comparison of more than 20 mathematical regression techniques. The regression equation with the highest R-squared value (the best fit) was then selected, as illustrated in Figure 5.9 using data from Station 25.

For Station 25, the best-fit equation for the relationship between flow (as the independent variable) and salinity (as the potentially significant independent variable) was that of a logarithmic-X vs. non-transformed Y. The relationship was highly statistically significant ($p < 0.01$).

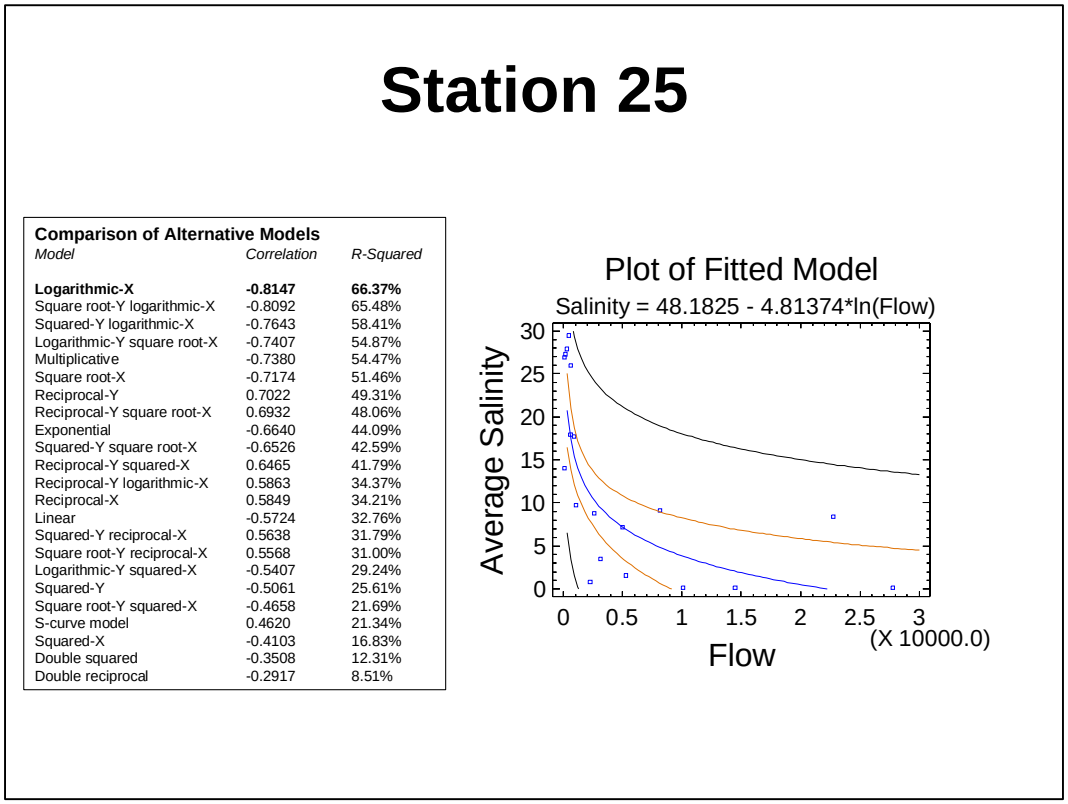

Figure 5.9 - Regression Output for Flow vs. Salinity for Station 25

For stations located in Roberts Bay or Curry Creek/Blackburn Canal, regressions were compared between salinity and flows from the Cow Pen Canal vs. salinity and flows from Blackburn Canal. Not surprisingly, at all these stations (7, 9, 10, 11, 12, 13, and 14) there was a similarly strong relationship between salinity and flows in Blackburn Canal as

there was between salinity and flows down Cow Pen Canal. At station 8, there was not a similar data set at the same water depth and time period (described above). As the intent of this effort was to examine the potential for altered flows to affect salinities, and as the only flows likely to be altered via freshwater diversion is that of flows from Cow Pen Canal, flow-salinity relationships were further developed only for those stations in Shakett Creek and Dona Bay.

For each station, the regression equation developed (as in Figure 5.9) was then used to calculate the predicted salinity for each of the months from November 1966 to December 2005, using the monthly flow data set. This allowed for the production of approximately 480 monthly salinity estimates (12 months per year times 40 years). Monthly salinities were then re-calculated using estimates of Cow Pen Canal flows anticipated by the Phase 3 watershed/hydrologic restoration project. These flows represent the downstream flows that would be delivered into Shakett Creek after implementation of the Phase 3 watershed/hydrologic restoration.

The average salinities for each month (e.g., January, February, etc.) over the period of record were then calculated for each scenario – existing vs. potential. The following figures represent differences in existing vs. potential salinity regimes at stations 25, 19, and 5. These stations represent potential changes in salinity regimes just downstream of the water level control structure on the Cow Pen Canal, at Shakett Creek at U.S. 41, and in Dona Bay close to Venice Inlet, respectively.

The results from these analyses suggest that while substantial changes in salinity are possible in some of the locations in the Shakett Creek, with implementation of the flow restoration envisioned, other locations are not likely to be strongly affected.

In the upper reaches of Shakett Creek, such as at Station 25, salinities might be expected to increase such that salinities would be less likely to drop below 10 ppt, with implementation of Phase 3 watershed/hydrologic restoration plan. Based on data from Estevez (2006) these locations might be likely to produce salinity regimes more supportive of successful spawning events for oysters.

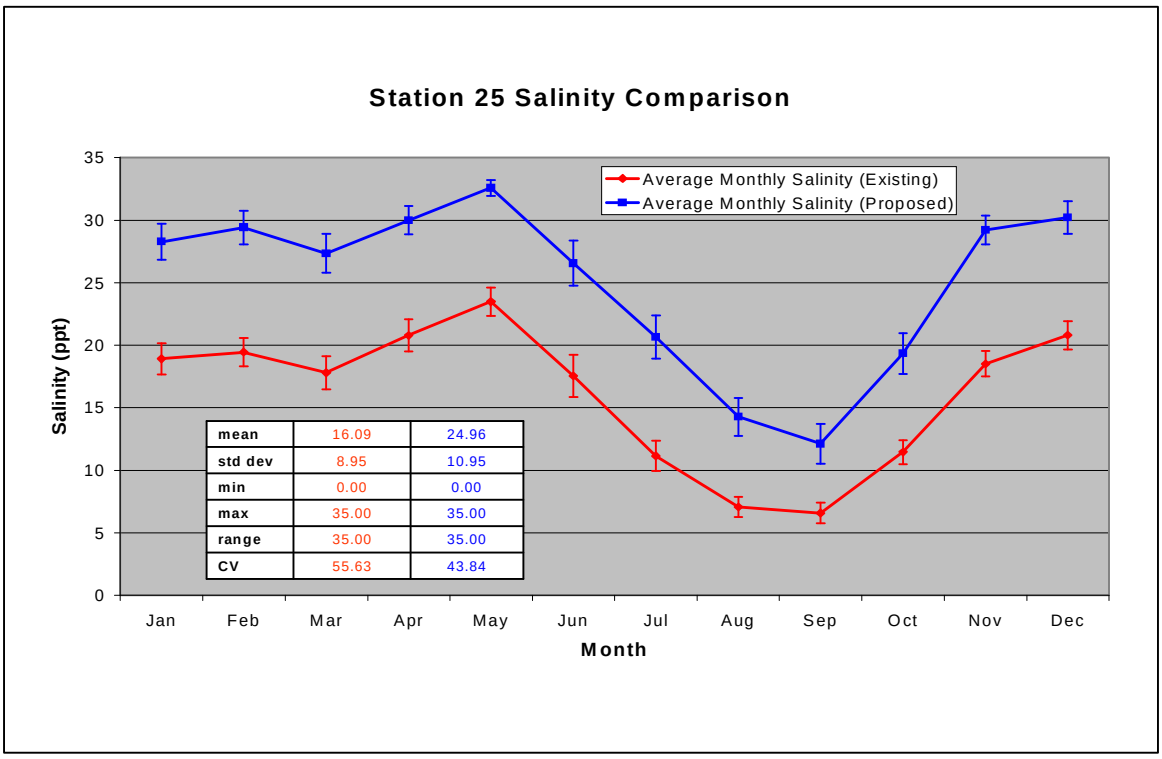

Figure 5.10 – Existing vs. Potential Salinity Regimes at Station 25 (means + s.e.)

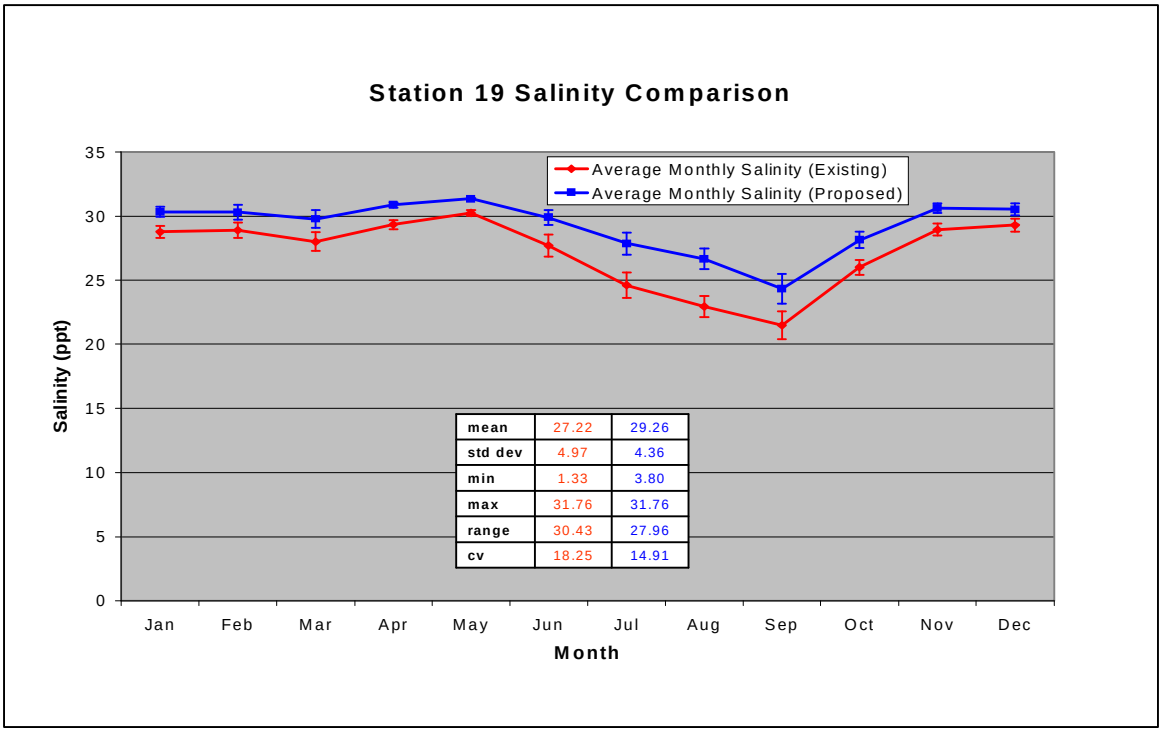

Figure 5.11 – Existing vs. Potential Salinity Regimes at Station 25 (means ± s.e.)

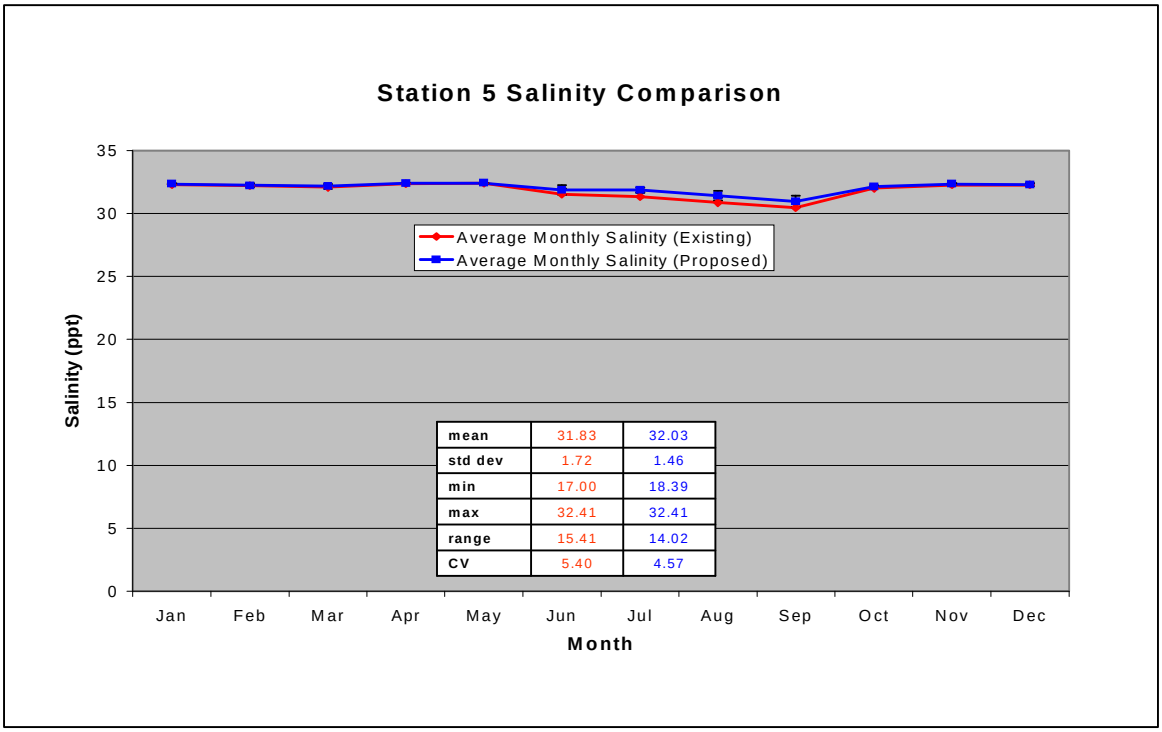

Figure 5.12 – Existing vs. Potential Salinity Regimes at Station 5 (means ± s.e.)

At locations closer to Venice Inlet, such as Station 5, results indicate changes in salinity would be minimal to the point of perhaps not being detectable. Habitats in this area dependent upon the existing salinity regimes in Dona Bay would not likely be impacted.

For those locations in the lower reaches of Shakett Creek down to the upper portions of Dona Bay, potential changes in salinity regimes are likely to be intermediate between those found for Stations 25 and 5. In these locations, benefits to biological communities might be more strongly related to a reduction in the variability of salinity values, rather than responses to changes in mean values.

In general, responses of benthic habitats to altered salinity regimes associated with potential flow diversion calculations are likely to be either positive (upper Shakett Creek), intermediate (lower Shakett Creek and upper Dona Bay) or minimal to absent (lower Dona Bay). There is no information that would suggest a deleterious impact to benthic communities, should potential flow reduction scenarios be implemented.

5.5.2 DEVELOPMENT OF POTENTIAL POLLUTANT LOAD REDUCTION ESTIMATES FOR DONA AND ROBERTS BAYS

An estimate of the potential load reduction into Dona Bay from the Cow Pen Canal was constructed using the historical flow record developed for the Cow Pen Canal. The techniques used are outlined in Technical Memorandums 4.2.2 and 4.2.3). The period of record considered for this analysis was between November 1966 and December 2005.

These monthly flow estimates were then re-calculated using Cow Pen Canal flows remaining after Phases 1, 2 and 3 of proposed watershed/hydrologic restoration projects. These Phases represent the diversion of an annual average of 5, 10 and 15 mgd of water from Cow Pen Slough / Shakett Creek. These flows represent those that would remain and be delivered into Shakett Creek even after the implementation of each of these phases of the proposed the Phase 3 watershed/hydrologic restoration plan.

A standard technique for developing pollutant loading models is to estimate nonpoint source loads based on a combination of flows and pollutant concentrations. This technique has been used for Tampa Bay (e.g., Pribble et al. 2001), Lemon Bay (Tomasko et al. 2001) and Charlotte Harbor (Squires et al. 1998). For this task, flows into Dona Bay were based on estimates for the period November 1966 to December 2005. These flows were then multiplied by “event mean concentration” values for the land use of “rangeland” used for the Charlotte Harbor watershed, and contained within the report conducted for the SWFWMD’s Charlotte Harbor SWIM program (Coastal Environmental, Inc. 1995). The land use category of rangeland was thought to be an appropriate one to use, based on the low-density agricultural activities that characterize most of the watershed. Although there is a substantial amount of urbanization located in the coastal area that immediately surrounds Dona Bay, these areas do not contribute to

the flows measured at the lower water level control structure at the Cow Pen Canal gage site. Event mean concentrations, or EMC values, are the concentration required to account for a measured load; they are synonymous with the term "flow-weighted average." Measured flows were multiplied by EMC values for total nitrogen (1.24 mg / liter), total phosphorus (0.01 mg / liter), and total suspended solids (11.0 mg / liter) as found in Coastal Environmental, Inc. (1995).

Monthly loads were calculated over the period of record, and then summed to create an annual load for each calendar year. This resulted in an average of 40 annual load estimates (1966 to 2005) for each of the four scenarios examined – current conditions vs. potential load reductions associated with implementation of Phases 1, 2, and 3 of the proposed watershed/hydrologic restoration project.

An additional effort was conducted to determine the potential for pollutant load reductions not directly associated with the volume of water redirected through the historical flow path and storage of the original and enhanced Cow Pen Slough anticipated under each of the phases of the watershed/hydrologic restoration plan.

One of the potential configurations for developing a linked habitat restoration – water supply augmentation scenario for flow diversions is the creation or enhancement of significant wetland features in the Cow Pen Slough watershed. If such a system was to involve re-routing water from the Cow Pen Canal through a series the original slough flow path that would now consist of marshes and deep ponds / reservoirs. The load reduction associated with routing water through such a system, as opposed to the channelized delivery of water that now occurs, is expected to have significant pollutant removal potential.

As a means of developing an "upper boundary" of pollutant load reductions, load reduction efficiencies associated with a typical wet detention system were applied to the quantity of water not re-directed to the Cow Pen Slough flow path. The load reduction efficiencies used were 30, 50 and 80 percent for total nitrogen, total phosphorus, and total suspended solids, respectively. These load reduction efficiencies are either equal to or lower than values used by the SWFWMD to estimate reductions in pollutant loads for the Melburne Pond Stormwater Retrofit project (SWFWMD 2003).

The figures shown below contain estimates of loads for nitrogen, phosphorus and total suspended solids for each of four scenarios: 1) existing conditions, 2) loads after Phase I implementation, 3) loads after Phase II implementation, and 4) loads after Phase III implementation.

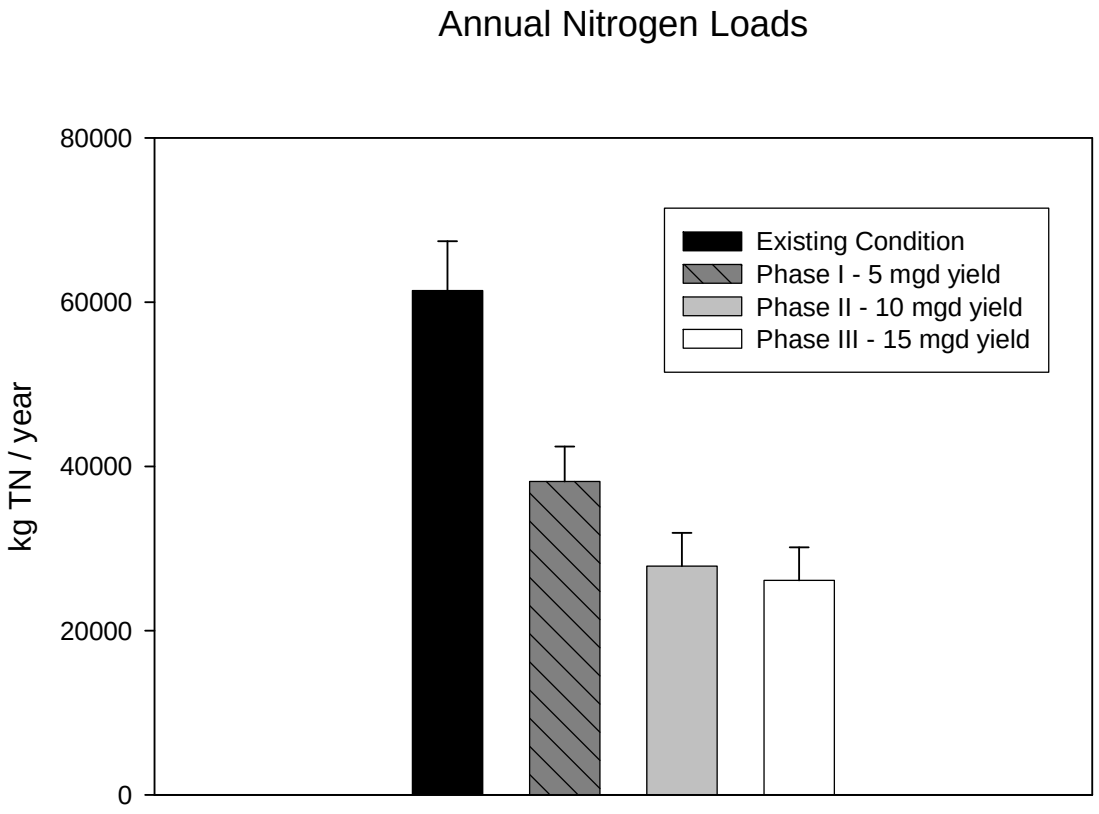

Figure 5.13 – Loads of Total Nitrogen from the Cow Pen Canal for Four Scenarios (means ± s.e.)

Results suggest that nitrogen loads to Shakett Creek and Dona Bay from the Cow Pen Canal could be reduced by 38 to perhaps 57 percent.

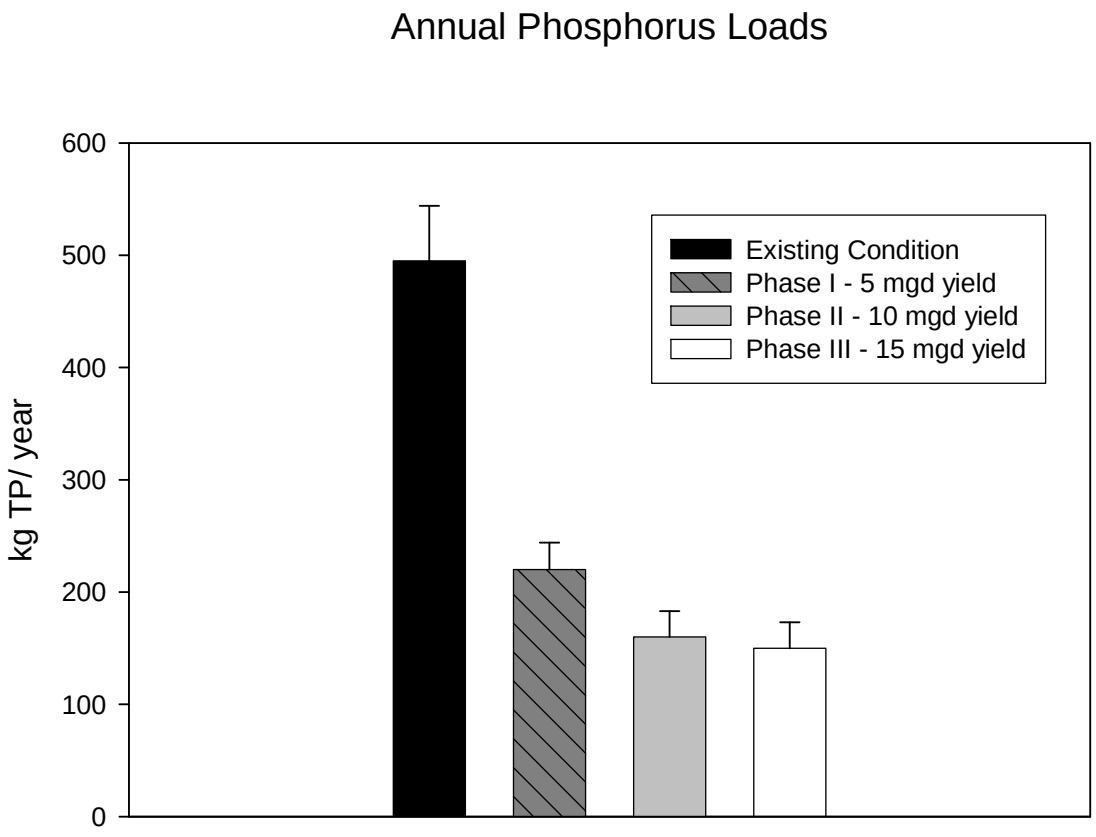

Figure 5.14 – Loads of Total Phosphorus from Cow Pen Canal for Four Scenarios (means ± s.e.)

For phosphorus, results suggest that loads to Shakett Creek and Dona Bay from the Cow Pen Canal could be reduced by 56 to 70 percent, reflecting the relatively higher load reduction expected for phosphorus, compared to nitrogen, with wetland treatment systems.

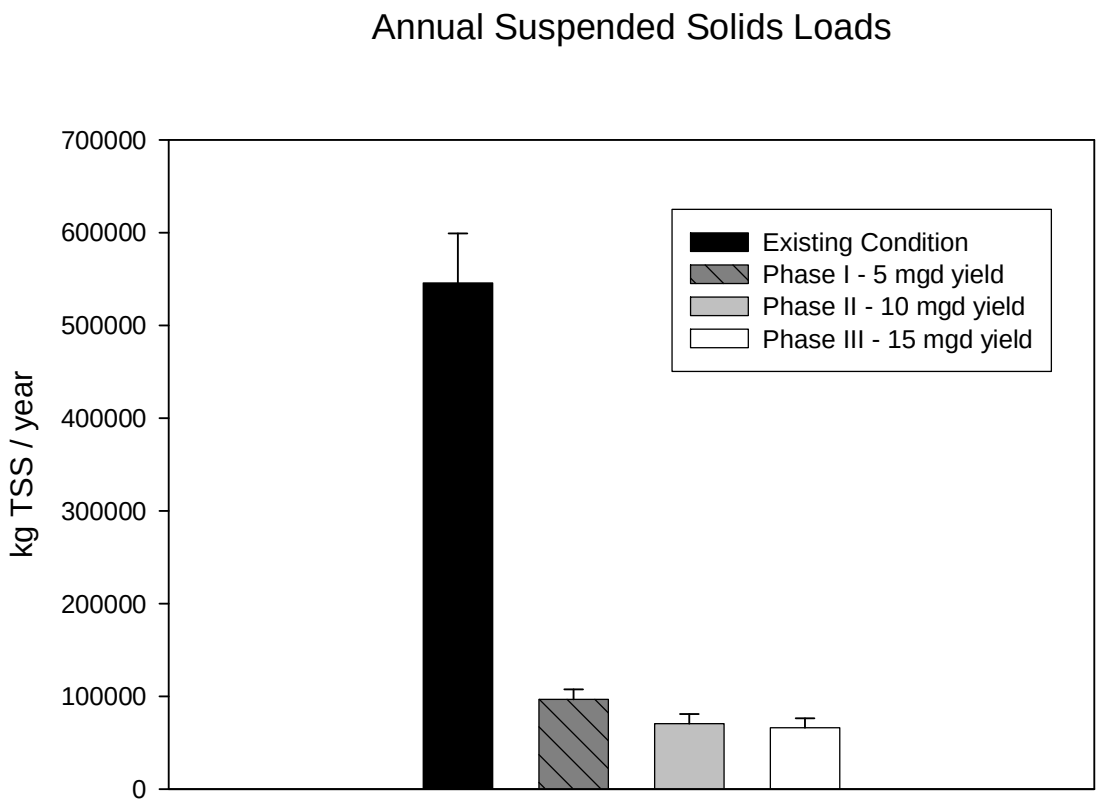

Figure 5.15 – Loads of Total Suspended Solids from the Cow Pen Canal for Four Scenarios (means ± s.e.)

Load reduction estimates for total suspended solids range between 82 and 88 percent. The load reduction estimate for total suspended solids contains the highest percent reduction calculated, which is based on the extremely efficient reduction in suspended materials that occurs with most stormwater runoff treatment systems.

In general, responses of benthic habitats to pollutant load reductions associated with potential flow diversion scenarios are likely to be significant. This analysis suggests that all three phases of the proposed watershed/hydrologic restoration project would have a beneficial effect to benthic communities. The percent reduction in nitrogen loads possible (38 to 57 percent) would be similar to the percent load reductions for nitrogen that were experienced by Tampa Bay and Sarasota Bay in recent years (Tomasko et al. 2005).

Therefore it is likely that a similar degree of improvement in estuarine health, such as seagrass recovery, might be possible for Dona Bay, should the watershed/hydrologic restoration project be implemented.

Chapter 6 – Flood Protection

View of Flood Waters in
Myakka River State Park

Chapter 6
Flood Protection

6.1 INTRODUCTION

In addition to the general flood protection information contained herein, the following Technical Memorandums relative to the floodplain management in the Dona Bay watershed are provided in the Appendix:

TM 4.4.1 – Inclusion of Watershed Connections
TM 4.4.2 – Continued Model Validation
TM 4.4.3 – Regional Stormwater Feasibility Study
TM 4.4.4 – Development of SCS Drainage Plan for Pinelands Area
TM 4.2.5 – Alternative Impact Analysis

Numbered to be consistent with the Dona Bay Watershed Management Plan contract scope of service tasks, these TMs provide preliminary evaluations for (1) inclusion of specific hydraulic model connections between the Dona Bay and Myakka River watersheds, (2) stormwater model validation analysis using measured rainfall and flow information, (3) evaluation of regional stormwater sites feasibility within the watershed, (4) mapping of the historic drainage plan for the Pinelands Reserve area within the watershed, (5) Analysis of floodplain benefit/impact from water supply storage facility site phase configurations. A brief summary of each TM is provided below:

TM 4.4.1 presents work updating the flood prediction model to connect portions of the Lower Myakka River to the Dona Bay watershed in order to quantify potential watershed interconnections with the Lower Myakka River watershed from the northern limits of the Pinelands Reserve south to the confluence of the Blackburn canal. Model simulation camparisons are mapped for the 2-yr, 5-yr, 10-yr, 25-yr and 100-yr/24-hr storm events identifying areas of flood level changes resulting from inclusion of the hydraulic connections.

TM 4.4.2 overviews continued model validation on the Dona Bay flood protection model. The validation analysis compares the model's prediction of runoff hydrographs against two (2) measured rainfall events occurring within the watershed. The location of runoff hydrographs were compare at each of the flood control gates within the Cow Pen canal. Additional model validation efforts include comparing model predicted flows at each gate structure against actual field discharge measurements. The analysis indicates that the flood protection model reasonably predicts key components of single storm hydrographs given a defined rainfall event and antecedent moisture condition.

TM 4.4.3 evaluates the study of three sites within the watershed for feasible regional stormwater facilities and the effectiveness for flood protection benefit. The three sites evaluated are located within the Albritton grove site, the LT ranch site and the Hi Hat old

grove site. Results of the study provide overlay mapping of the potential benefit area on the Future Land Use Map and 2050 Plan Map for each of the sites studied.

TM 4.4.4 overviews the mapping development of the historical SCS drainage plan on the Pinelands Reserve area within the watershed. The completed mapping effort indicates historical flow patterns as well identification of flow pattern alterations as a result of land use changes in the study vicinity

TM 4.4.5 evaluates the Albritton site reservoir Phase 1, 2 and 3 configurations within the Dona Bay flood protection model. Results of the alternative analysis indicate flood level reductions significant throughout the watershed for each phase configuration. General flood level reductions are shown mapped for each of the alternatives studied.

6.2 BACKGROUND

A primary goal of Flood Protection initiatives is to avoid flood damage and losses. In addition to pursuing safeguards that protect life and property, strategies should also protect the values and functions of natural floodplain areas.

Floods, like droughts, are naturally occurring events and often result from extreme hydrologic conditions. Areas prone to flooding occur in historical low-lying areas typically associated with and adjacent to wetlands, streams and rivers. Natural floodplains convey runoff, provide water storage, regulate flow velocity, attenuate flood discharges, absorb nutrients, and filter other pollutants. In addition to these functions, floodplain areas provide habitat for fish and wildlife. Flooding within the Dona Bay watershed occurs from overflow of natural and man-made watercourses as well as wetlands, resulting from sustained and significant rainfall events.

6.2.1 Watershed History of Changes

Historically the Dona Bay watershed was significantly smaller and consisted of areas surrounding Shakett Creek, Fox Creek, and Salt Creek. Starting in the mid-1900's and continuing through the early 1970's, ditching activities drained and diverted a large slough system known as Cow Pen Slough from the Myakka River to Shakett Creek and Dona Bay (area shown as cross-hatched on **Figure 6.1**). Prior to the diversion, Cow Pen Slough entered the Myakka River in the vicinity of Rocky Ford. As a result of the watershed alterations, the natural hydrology of both Dona Bay and the Myakka River has been altered by the diversion of Cow Pen Slough to Dona Bay. Today the Dona Bay watershed is approximately 74 square miles, or nearly 5 times its original size of approximately 10,065 acres.

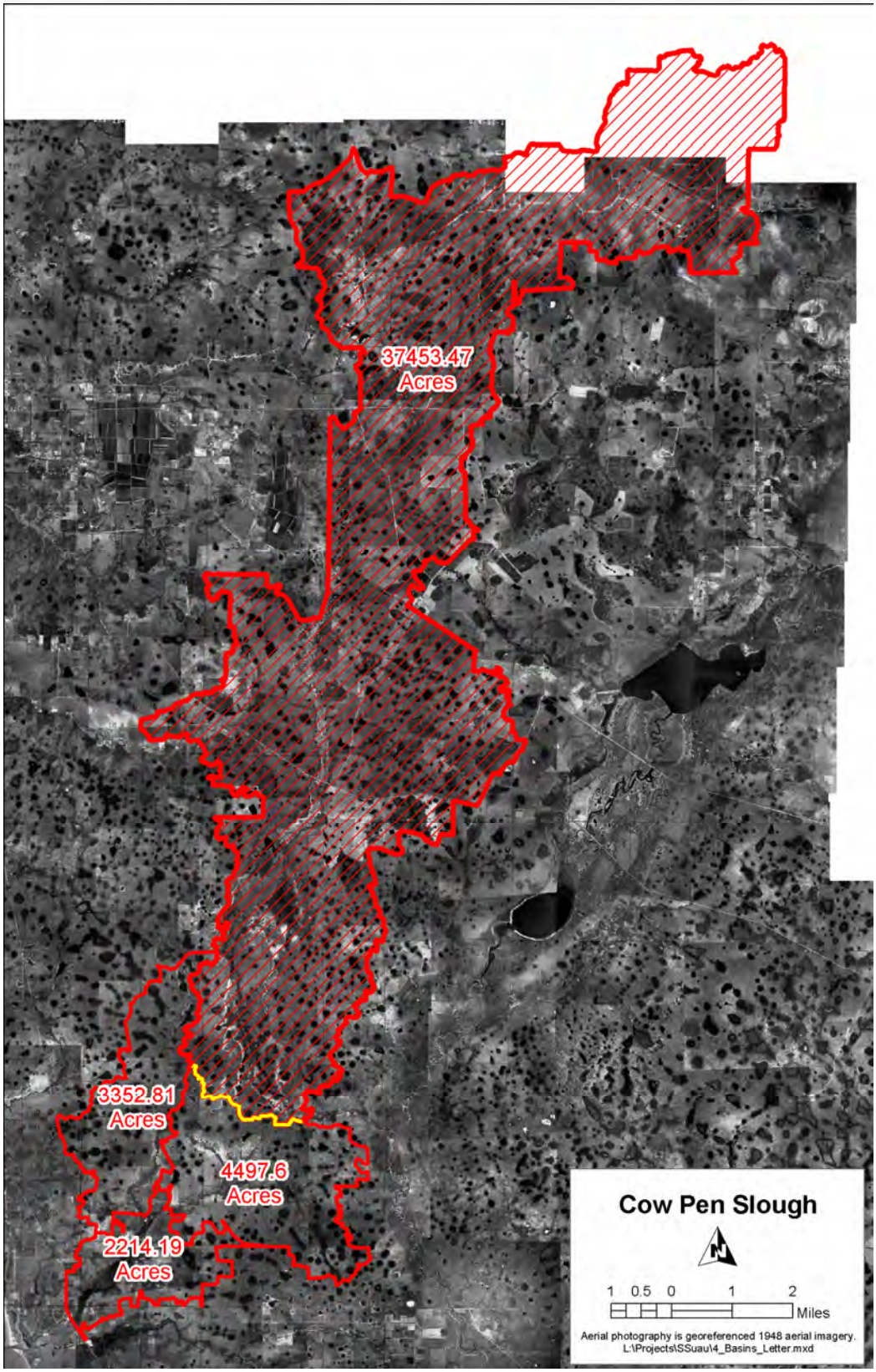

Figure 6.1 – Sarasota County 1948 Aerial with watersheds limits.

In the 1960s, the United States Department of Agriculture (USDA) Natural Resource Conservation Service (fka Soil Conservation Service, SCS) developed a work plan consisting of a large canal system and water level control structures throughout the Cow Pen Slough watershed to drain and further divert the slough to Shakett Creek and Dona Bay. Approximately 14 miles of the canal and 2 operable water level control structures were completed from Shakett Creek north to approximately the south end of the present day Bee Ridge Landfill vicinity. The lower water level control structure acts as a barrier to the interface of salt and fresh water. It is located adjacent to the King's Gate mobile home park. The upper water level control structure is located approximately 6 miles further north, and south of State Road 72. A third water level control structure was constructed at the northern terminus of the canal. However, upstream floodwaters eroded a bypass around this water level control structure shortly after its installation. Numerous attempts to correct this erosion have not been successful, rendering the water level control structure non-operational. Currently, this water level control structure remains non-operational and water flows around it.

The Cow Pen Canal work plan was halted, re-evaluated and subsequently abandoned due to concerns raised relative to environmental impacts resulting in the Dona Bay estuary. In 1979, the Sarasota Board of County Commissioners officially abandoned the incomplete elements of the project. However, the drainage and diversion of the slough had been effectuated.

Through the mid 1980's much of the historical slough system was converted to pasture for cattle ranching or citrus. The citrus operation lies within one of the more significant floodplain areas of the historical Cow Pen Slough and was effectuated by the construction of a perimeter levee which isolates the grove operation from the Cow Pen Slough system. Additionally, three stormwater pump stations were installed for the removal of excess stormwater from the site. In 2004, approximately 1000 acres of the 1200 acre Albritton citrus operation was purchased by Sarasota County for landfill cover.

In the early to mid 1990's, Sarasota County purchased a large tract of land known as the Pinelands (fka the Walton Tract) containing another significant portion of the historical Cow Pen Slough. Although the land was purchased primarily to construct a landfill operation for the County, much of the land was set aside in its natural state. Hydrologic alterations associated with the Landfill construction include the construction of an elevated access road along the east side of the Cow Pen Canal and the enhancement of a portion of historical slough with the construction of berms and elevated control structures.

In addition, two borrow pits have been constructed in the Pinelands tract as well several others near the Pinlands tract east of the canal. Originally associated with mining activities, some of the pits adjacent to the Pinlands tract have subsequently been incorporated within land development activities such as the Lake Awesome RV Park. Another sand, shell and rock mining operation located just south of the historical east-west connection of Cow Pen Slough to the Myakka River, Venice Minerals, was

purchased by Sarasota County in 2005. This area was leased back to Venice Minerals to complete the excavation.

6.2.2 Existing Flooding

It is not unusual for areas corresponding to soils defined as either "depressional" or "frequently flooded" by the Sarasota County Soils Survey to be subject to flooding. In fact, this is often true even in developed areas that were built over these historical soils. Within in the Dona Bay watershed, most of the land uses are presently rural agriculture with some low density residential subdivisions, occurring as 5 to 10 acre lots. These low density residential areas are primarily located north of Clark Road (SR #72).

In 2002, the Cow Pen Slough/Shakett Creek Flood Study Update was completed which included the development of a detailed flood map and model. Existing Flood Protection Level of Service (FPLOS) deficiencies were also identified and inventoried in the watershed. FPLOS deficiencies were determined based upon identifying homes/businesses and streets that are within the horizontal limits of the floodplain and below the base flood elevation. Roadway FPLOS deficiencies were verified by comparing roadway spot elevations from the SWFWMD aerials (or, if available, engineering roadway plans) to the computed flood levels. Finished floor elevations of structures horizontally located in the 100-year floodplain were verified through field survey to determine those that constitute FPLOS deficiencies (i.e. have their finished floor elevation below the flood stage). The Sarasota County Comprehensive Plan includes the FPLOS objectives identified in **Table 6.1**.

	Rainfall Event Return Period Depth of Flooding			
	5-year	**10-year**	**25-year**	**100-year**
Structure	None	None	None	None
Roadways:				
Evacuation Route	None	None	None	None
Arterial	None	None	None	6 inches
Collector	None	None	6 inches	9 inches
Neighborhood	None	6 inches	9 inches	12 inches

Table 6.1 - Sarasota County Comprehensive Plan Flood Protection Level of Service

The 2001 Flood Study Update indicated that there were no home or business structure FPLOS deficiencies in the Dona Bay watershed. The assessment did find that several street segments are susceptible to flooding in excess of the FPLOS criteria. Identified existing roadway FPLOS deficiencies are presented in **Table 6.2**.

Public Street Location	Edge of Pavement Elevation	Node No.	10-Year Stage	25-Year Stage	100-Year Stage
Cow Pen Slough					
Fruitville Road (arterial)	38.35	99105	37.94	38.30	39.10
Fruitville Road (arterial)	38.75	95338	37.95	38.44	39.24
Dove Street (local)	32.30	91521	33.19	33.36	33.70
Curlew Road (local)	32.30	91525	33.46	33.58	33.61
Rustic Road (local)	11.75	93066	12.88	12.93	13.02
Rustic Road (local)	13.00	93051	13.51	13.54	13.60
Private Street Location	**Edge of Pavement Elevation**	**Node No.**	**10-Year Stage**	**25-Year Stage**	**100-Year Stage**
Cow Pen Slough					
King Arthur Drive (local)	9.30	93028	10.06	10.12	10.21
Camelot Drive (local)	9.10	93028	10.06	10.12	10.21
Duchess Avenue (local)	9.10	93028	10.06	10.12	10.21
Cowpen Lane (local)	37.65	99220	38.25	38.33	39.09
Cowpen Road (local)	39.65	99225	40.11	40.14	40.16
Vic Edwards Road (local)	38.34	99184	39.42	39.60	39.75
East Vic Edwards Road (local)	38.48	99183	39.38	39.56	39.69
Bern Creek Loop (ne)	48.03	98398			
Bern Creek Loop (nw)	47.57	99024			
Bern Creek Loop (s)	42.79	95368			
Public Street Location	**Edge of Pavement Elevation**	**Node No.**	**10-Year Stage**	**25-Year Stage**	**100-Year Stage**
Shakett Creek					
Albee Farm Road (arterial)	4.71	90044	3.51	4.21	5.42
Orange Grove Avenue (local)	10.57	90059	11.18	11.23	11.35
Aquila Street (local)	10.97	90024	12.20	12.28	12.41
Pine Street (local)	4.57	90046	5.08	5.34	5.55
Maple Street (local)	6.27	90048	6.78	6.84	7.02
Bonito Avenue (local)	4.57	90020	5.91	6.16	6.49
Dona Bay Way (local)	5.77	90022	6.42	6.50	6.61
Private Street Location	**Edge of Pavement Elevation**	**Node No.**	**10-Year Stage**	**25-Year Stage**	**100-Year Stage**
Shakett Creek					
Truman Street (local)	9.79	90203	9.38	9.84	10.83

(Shaded flood stages indicate street flood depths exceed LOS criteria)

Table 6.2 – Existing Roadway FPLOS Deficiencies

6.3 STUDIES, REPORTS AND DATA

6.3.1 Previous Studies and Reports

The Dona Bay watershed including the Cow Pen Canal, Fox Creek, Salt Creek and Shakett Creek has been the subject of several previous flood related studies. A discussion of some of these previous studies is provided below:

March 1961 – West Sarasota Watershed Work Plan
This work plan was developed under the United States Department of Agriculture, Natural Resource Conservation Service, formerly known as the Soil Conservation Service (SCS). This work resulted in the construction of Cow Pen Canal and water level control structures. The intent of the plan was to reduce the duration of inundation on adjacent farm and pasture areas for benefit to agricultural operations. In fact, it completed the diversion of the historical Cow Pen Slough from the Myakka River watershed to Dona Bay, dramatically increasing the volume of freshwater and the size of the Dona Bay watershed. The project was abandoned due to environmental concerns/impacts within the Dona Bay estuary.

1985 – Floodplain Management Study - Cow Pen Slough Watershed
This study was prepared in cooperation with the Florida Department of Community Affairs and the Natural Resource Conservation Service (NRCS). The study was limited to the main Cow Pen Canal from Laurel Road to State Road 780 (Fruitville Road) encompassing about 77 square miles. This study estimated flows and flood levels for the Cow Pen Canal for the 10-year and 100-year storm events. However, it was not adopted by Sarasota County or FEMA. **Table 6.3** summarizes peak flows and stages at several key locations in the Cow Pen Canal.

1985 Study – Summary of Peak Flows and Flood Stages (ft)		
Location	**10-yr Q/Stage**	**100-yr Q/Stage**
Upstream of Laurel Road	3078 cfs / 5.5	6346 cfs / 8.0
Upstream of Structure No. 1	2453 cfs / 8.3	5094 cfs /11.6
Downstream of I-75	2451 cfs / 9.2	5090 cfs /12.5
Upstream of I-75	2449 cfs / 9.6	5086 cfs /13.2
Upstream of south wood bridge	2136 cfs /17.0	4456 cfs /19.7
Upstream of north wood bridge	2087 cfs /19.0	4358 cfs /21.5
Upstream of Structure No. 2	1984 cfs /19.2	4149 cfs /21.7
Upstream of Clark Road bridge	1923 cfs /21.8	4025 cfs /24.6
Confluence with Vegetable Relief Canal	1637 cfs /26.0	3444 cfs /28.2

Table 6.3 – Peak Flows and Stages in Cow Pen Canal

September 1997 – Cow Pen Slough Basin Master Plan, Final Report
Sarasota County authorized the NRCS to prepare the Cow Pen Slough Basin Master Plan. This study considered the Cow Pen Slough Basin north of its confluence with Fox Creek. Including the Salt Creek drainage basin, approximately 64.2 square miles in total were

considered. Fox Creek and Shakett Creek were not included. The hydrodynamic UNET model was used for the analysis. Peak flood stages at key locations in the Cow Pen Canal estimated by this study are provided in **Table 6.4**. Sarasota County adopted the report for an initial Basin Master Plan but authorized continued studies to be conducted. The report was not submitted to FEMA for adoption.

1997 Study – Summary of Peak Flood Stages (ft.)					
Location	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**100-yr**
Upstream of Laurel Road	4.3	4.5	4.7	4.8	5.0
Upstream of Structure No. 1	10.7	13.0	13.4	13.6	13.8
Downstream of I-75	11.7	13.6	14.3	14.6	14.7
Upstream of I-75	11.8	13.8	14.5	14.7	15.0
Upstream of south wood bridge	15.2	16.5	16.9	17.1	17.8
Upstream of north wood bridge	16.3	17.5	17.8	18.1	18.9
Upstream of Structure No. 2	17.1	18.0	18.3	18.6	22.3
Upstream of Clark Road bridge	20.8	22.4	22.8	23.4	24.2
Confluence with Vegetable Relief Canal	22.9	24.6	25.6	26.2	27.5
Upstream of Fruitville Road	38.9	39.3	39.4	39.5	39.8

Table 6.4 – Peak Stages in Cow Pen Canal

January, 2002 – Cow Pen Slough/Shakett Creek Flood Study Update

This flood study update was prepared by Stormwater Management Resource Technologies, Inc. and included a detailed floodplain analysis and an identification of FPLOS deficiencies. The study considered the entire Dona Bay watershed including the Cow Pen Canal, Fox Creek, Salt Creek and Shakett Creek. The hydrodynamic ICPR model was used for the analysis. **Table 6.5** provides peak stages predicted by this study at key locations in the Cow Pen Canal. The Sarasota Board of County Commissioners adopted the study in 2002. FEMA and SWFWMD are cooperatively incorporating this work into the FEMA Map Modernization Program.

2002 Study - Summary of Flood Stages (ft.)					
Location	**2-yr**	**5-yr**	**10-yr**	**25-yr**	**100-yr**
Upstream of Laurel Road	2.8	3.1	3.3	3.5	4.0
Upstream of Structure No. 1	10.8	12.1	12.9	13.8	14.4
Downstream of I-75	10.9	12.2	13.0	14.0	14.6
Upstream of I-75	11.1	12.8	13.3	14.2	15.1
Upstream of south wood bridge	11.2	13.0	13.8	14.8	15.4
Upstream of north wood bridge	12.0	14.1	15.0	16.2	17.0
Upstream of Structure No. 2	20.1	21.1	21.4	21.7	22.2
Upstream of Clark Road bridge	20.4	21.7	22.5	22.6	23.5
Confluence with VR canal	22.2	23.7	25.1	25.9	27.4
Upstream of Fruitville Road	36.1	37.2	37.9	38.3	39.1

Table 6.5 – Peak Stages in Cow Pen Canal

It should be noted that topographic aerials were not available for the upstream area of the Dona Bay watershed during this study. Therefore, detailed modeling and flood mapping were not performed for this area. SWFWMD in cooperation with Sarasota County has subsequently completed topographic aerials covering the region which would now allow this vicinity to be incorporated into a future model update. SWFWMD and Sarasota County should pursue cooperative partnership opportunities with Manatee County to complete the upper headwater regions located within Manatee County.

6.3.2 Current Studies

Inclusion of Watershed Connections

Because of the relatively flat topography of the region, several hydraulic connections exist between the Dona Bay and adjacent watersheds during major flood events. These connections can allow floodwater diversions to move between adjacent watershed areas. Recent and on-going work is being conducted to connect adjacent models so that these potential connections can be quantified. Specifically, the Dona Bay watershed will be connected and analyzed with adjacent portions of the Lower Myakka River, Roberts Bay, Phillippi Creek and South Creek watersheds to quantify flood flows and volumes at these interconnections.

Work completed includes connection of portions of the Lower Western Myakka River watershed located between the northern limits of the Pinelands Reserve to the confluence of the Blackburn Canal. Hydrographs developed for the Myakka River nodes in this segment were used with available stage/discharge information from the 1978 USGS report to develop time-stage rating curves at each node along the Myakka River. Model simulations were conducted for the 2-yr, 5-yr, 10-yr, 25-yr and 100-yr storm events simulations. Technical Memorandum 4.4.1 presents a more detailed overview of this effort.

Continue Model Validation

This current work utilized the County's Automated Rainfall Monitoring System (ARMS) data as available for 2003 to 2005 within the Cow Pan Canal as well as stage-discharge measurements to perform model verification simulations. The rainfall, stage and discharge data are available at the two Cow Pen Canal water level control structures. Several discrete storm events were simulated and simulated results were compared with measured observations. In addition, the actual stage-discharge measurements at the 2 water level control structures were plotted against the simulated stage-discharge relationships. Technical Memorandum 4.4.2 provides a more detailed overview of this effort.

Regional Stormwater Feasibility Study

This effort evaluated the feasibility of several sites to provide regional "excess" floodplain storage or capacity. Excess flood storage capacity created in each of these

sites and the potential service or benefit areas were determined. Land uses within each benefit area were determined to estimate the potential value of such floodplain storage. Technical Memorandum 4.4.3 presents a more detailed discussion of this effort.

Development of SCS Drainage Plan for Pinelands Area

This effort developed a digital GIS layer of the original SCS drainage plan for the Pinelands area and includes an overlay of this plan on a current aerial photograph. The developed overlay has been submitted to Sarasota County. The completed overly may be useful for identifying potential corrective actions, if necessary. Technical Memorandum 4.4.4 presents the results of this effort.

Alternative Impact Analysis

The Dona Bay flood model was used to simulate each of the 3 phase configurations for watershed/hydrologic restoration. Existing peak flood stages were used as the baseline comparison. Peak flood stages for each phase configuration were compared to this baseline condition. In addition, a preliminary evaluation was conducted to determine the impact, if any, on flood stages in the Myakka River resulting from the installation of a low-head weir in Blackburn Canal. Technical Memorandum 4.4.5 provides a more detailed discussion of this effort.

6.3.3 Future and On-going Work

Update Dona and Roberts Bay Watershed Model

Sarasota County has authorized on-going work for performing updates to both the Dona and Roberts Bay stormwater models and maps to reflect up to 10 (ten) new developments that have occurred in the unincorporated portion of Sarasota County since the completion of the original basin master plans. These updates are being prepared by KHA in accordance with the *Sarasota County Model Maintenance Procedure Manual* dated October, 2002.

City of Venice Watershed Model Updates

This work is currently on-going and includes activities to expand the Dona and Roberts Bay watershed model and floodplain maps pursuant to the Joint Project Agreement (JPA) with the City of Venice and Sarasota County. The JPA includes performing up to seventeen (17) model updates to reflect developments over 35 acres in total area or 8 acres of total impervious area and approved within the City of Venice since the completion of the Dona and Roberts Bay watershed models. These updates are being prepared by KHA in accordance with the *Sarasota County Model Maintenance Procedure Manual* dated October, 2002.

Connect Dona & Roberts Bay Watershed Models

At present, the Shakett Creek, Fox Creek, Salt Creek and Cow Pen Slough drainage basins are contained within a single ICPR model, known as the Dona Bay watershed model. Hatchett Creek and Curry Creek are also contained within a single ICPR model known as the Roberts Bay watershed model. Sarasota County has authorized the

integration of the Dona and Roberts Bay watersheds into a single model. Upon completion of the watershed model updates for Dona and Roberts Bay, the separate ICPR models for Dona Bay and Roberts Bay will be combined into a single model. Upon completion of the combined model, a floodplain QA/QC will be performed to determine if the floodplain maps warrant revision.

Dona Bay and Roberts Bay Coastal (including Lyon's Bay) Model Development
Sarasota County has authorized preparation of a detailed watershed model for the area identified as the Dona/Roberts Bay Coastal basin including Lyons Bay. Development of a detailed model for this portion of the watershed is being prepared by KHA and will be consistent with the level of detail adopted for the Cow Pen Slough/Shakett Creek flood study update. Data Standards will be expanded to meet SWFWMD guidelines.

Inclusion of Additional Watershed Connections
This on-going work is being performed by KHA and will evaluate additional model connections where overflows are possible during major flood events with the adjacent South Creek and Phillippi Creek Watersheds.

6.3.4 Information and Additional Data

Flood Control Structures in the Watershed
As previously discussed, the SCS work plan resulted in the installation of two, operable water control structures. These structures were generally designed for grade stabilization but allow for water conservation during dry conditions. The water control structures consist of concrete drop spillways with three radial gate openings to control water levels in the Cow Pen Canal.

The lower water control structure is located north of Laurel Road near the King's Gate MHP and has 3-gate openings which are 14 ft in width each totaling 42 ft.. The gates can be opened and closed to control water levels between elevations 7.0 NGVD and 11.0 NGVD. The upper water level control structure is located about a mile south of SR 72 near the north end of the Albritton site and also has 3-gate openings which are 12 ft in width each totaling 36 ft.. The gates can be opened or closed to control water levels between elevations 14.0 NGVD and 18.0 NGVD.

Gaining a public access corridor to the 3rd, non-operable water control structure location has been identified by Sarasota County Stormwater Operation and Maintenance personnel as a priority to provide for needed bank stabilization. Additionally, effectuating the operation of this structure could be investigated in cooperation with upstream properties for potential flood protection benefit.

Stream Gage and Rainfall Stations in the Watershed
Sarasota County maintains two automated rainfall monitoring stations (ARMS) located at the lower and upper water level control structures within the Cow Pen Canal. With cooperative funding assistance from SWFWMD, periodic measurements of stages and

flows to develop rating curves have been underway since 2003. The SWFWMD maintains two active rainfall stations in the area identified as site 419, Laurel Park and site 539, Knights Trail. This data provides site specific information that was used to assist in developing a water budget for the Cow Pen Canal as presented in Technical memorandum 4.2.2. It also provides storm hydrograph data that was used for the continued model validation effort presented in Technical Memorandum 4.4.2.

Aerial and Topographic Mapping

Topographic mapping is an essential tool for the review, evaluation and development of sustainable flood protection initiatives. Aerial mapping visually quantifies areas of change with land use in the watershed. It also provides historical documentation of the alterations that have occurred to the watershed's conveyance and natural systems. Topographic maps are invaluable in defining watershed characteristics and delineating the extent of flood prone areas. Sarasota County and SWFWMD maintain an extensive inventory of aerial photography in sporadic intervals from 1948 through the present. There are multiple aerial imagery products with different sources for each:

Hard Copy Aerial Photography (usually non-orthorectified):

For the past few decades, aerial imagery has been flown by the Florida Department of Transportation (FDOT) under a contract with the Florida Department of Revenue. The imagery is acquired by the County's Survey & Mapping Department in reproducible mylar format. Traditionally this imagery is flown with a film camera and is not orthorectified, or positioned to a specific mapping coordinate system. FDOT now has a digital camera system which they may use for future mapping efforts. Future imagery from FDOT may be orthorectified and available in digital format and based on flights flown every four to six years.

Digital Imagery (orthorectified):

Sarasota County has digital aerial imagery for 1995, 1998, 2001, 2002, 2004, and 2006. The County has no regular schedule for updating this imagery. The County is dependant upon contractors and external agencies, such as SWFWMD, for funding. SWFWMD is looking to establish a program with a re-flight interval goal of two years.

Topographic Mapping (elevation contours)

Topographic maps provide invaluable information for watershed planning and detailed floodplain studies. Their use can characterize the watershed's elevation ranges and assist in quantifying storage locations for volumetric parameters. Various sources of topographic maps are available but can vary in the accuracy of terrain intervals represented.

The United States Geologic Survey (USGS) publishes quadrangle maps indicating terrain contours of 5-ft intervals. These maps should be limited in their use to general purposes of flood protection studies since detail in defining the flat topography and natural depressions typically is not captured.

SWFWMD initiated mapping efforts in the early 1970's and publishes aerial contour maps for use by local governments and private entities. These topographic maps delineate contours at 1 ft intervals and also provide periodical ground point references at 0.1 ft values. The maps provide water level elevation for wetlands and other water-bodies depending on the date of photography. These maps were used extensively for the Sarasota County Cow Pen Slough/Shakett Creek Flood Study Update. Specifically, the topographic information from these maps provided essential information in defining watershed and subbasin ridge lines as well stage-storage relationships throughout the watershed. In addition, it was used to then delineate the limits of the 100-year floodplain. Through cooperative funding efforts between SWFWMD, FEMA and Sarasota County, LiDAR (Light Detection Aerial Response) for the entire County has been obtained. The LiDAR data provides digital information that can be manipulated to automate the determination of basin ridge lines and watershed storage through the use of current technologies such as Digital Elevation Modules (DEM) and Digital Terrain Models (DTM). This LiDAR dataset is currently in quality review for use with these digital terrain applications.

Floodplain Information

The Cow Pen Slough/Shakett Creek Flood Study Update included mapping of the 100-year riverine floodplain, as presented in **Figure 6.2**. The floodplain map includes designations consistent with FEMA's flood zone definitions. Specifically, the FEMA "AE" zones, identified in dark blue, correspond to areas in the 100-year floodplain typically associated with moving and/or deep water. The FEMA "AH" zones, identified in light blue, correspond to areas of shallow or ponded water, where average depths are between 1 and 3 feet. The adoption of the Shakett Creek/Cow Pen Slough Flood Study Update assures that floodplain areas within the Dona Bay watershed will be recognized and that the floodplain functions will be preserved when new development proposals are considered. In addition, the detailed hydrodynamic model provides a valuable tool for evaluating the effects of proposed land use changes and other watershed alterations on existing flood stages.

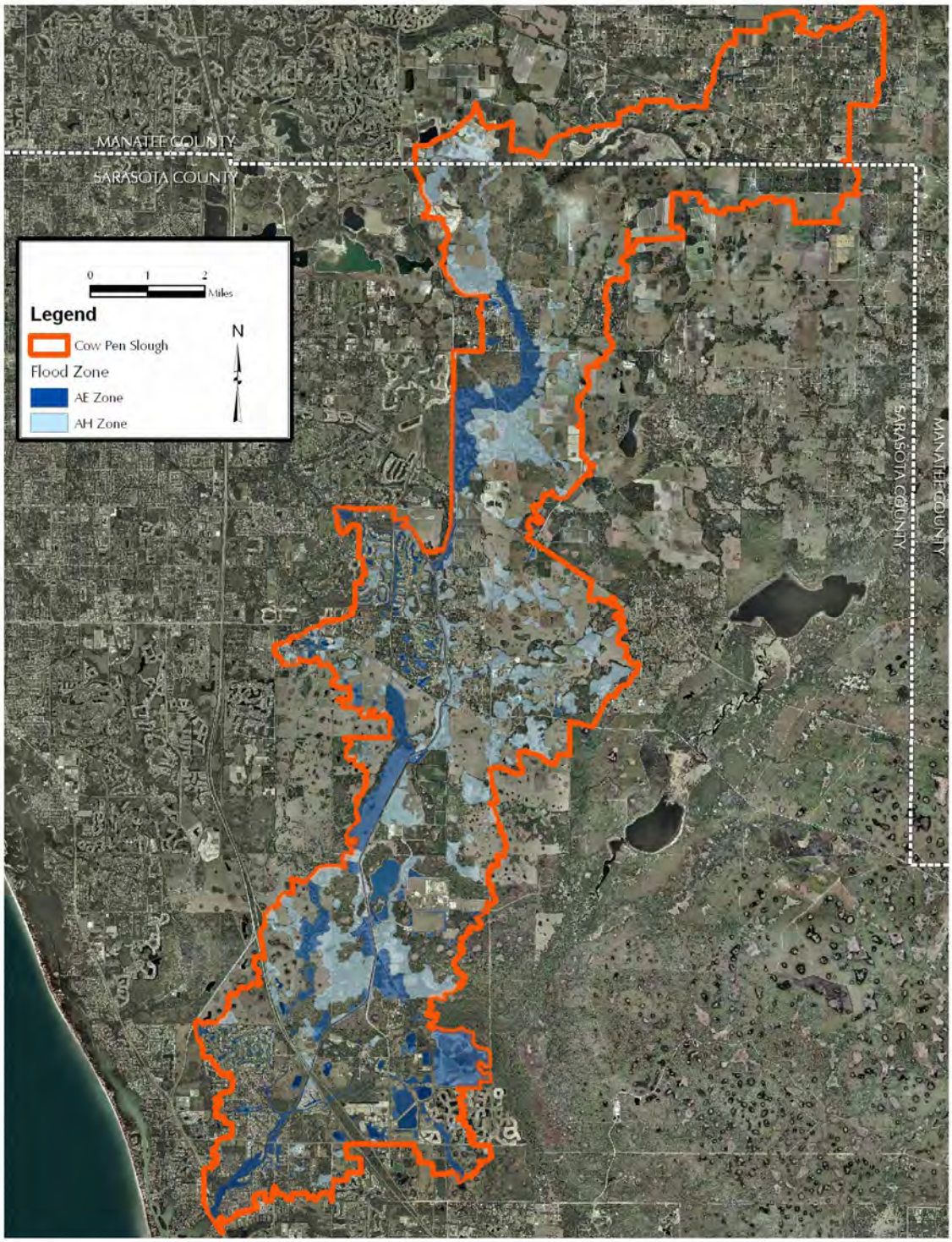

Figure 6.2 – Dona Bay Watershed, 100-Year Floodplain

6.4 REGULATORY FRAMEWORK

The management of surface water for flood protection in the Dona Bay watershed is governed by various rules and regulations at various Federal, State and local municipal levels of government. For the Dona Bay watershed, the primary agencies involved would include the Federal Emergency Management Agency (FEMA), US Depatment of Army Corps of Engineers (ACOE), Florida Department of Environmental Protection (FDEP), Southwest Florida Water Management District (SWFWMD), Sarasota County Government (SCG), Manatee County Government (MCG), and the City of Venice (CV).

Table 6.3 Regulatory Framework

US Federal Emergency Management Agency (FEMA) **National Flood Insurance Program (NFIP)**	This program was created by Congress in 1968 to reduce the loss of life and property caused by flooding (44CFR, Chapter 1). The purpose of the program was designed to achieve 3 primary goals. (1) to require new and substantially improved buildings be constructed to resist flood damages; (2) guide future developments away from flood hazard areas; and (3) transfer the costs of flood damage from American taxpayers to floodplain property owners with flood insurance premiums. The program is voluntary and requires a mutual agreement between the federal government and local community. The agreement requires the community to adopt and enforce a floodplain management ordinance in order to receive federally-backed flood insurance coverage. Sarasota County Participates in the NFIP.
Flood Insurance Study (FIS)	These studies provide a compilation and presentation of hydrologic and hydraulic determinations made for specific watercourses within a community. The FIS delineates flood hazard areas and establishes flood elevations to serve as the basis for regulating floodplain development and providing flood insurance. Flood Insurance Rate Map (FIRM) panels delineate the resulting flood hazard areas and regulatory flood zones.
Letter of Map Amendment/Revision (LOMA/LOMR)	Provides an administrative procedure where FEMA will review information submitted on behalf of a property owner to modify a mapped or designated within a special flood hazard area.
Elevation Certificate	An elevation certificate provides record of the lowest floor elevation.
US Department of Army, Corps of Engineers (ACOE) **Dredge & Fill permit**	The Agency regulates Federal Acts for classified navigable waters of the States. Section 404 of the Clean Water Act, regulates the discharge of dredged or fill material into the navigable waters. Section 10 of the Rivers and Harbors Act of 1899 (33 U.S. Code 403), which regulates the obstruction of the navigable capacity of any of the waters of the US.

Florida Department of Environmental Protection (FDEP) **Dredge & Fill permit**	The Agency regulates the excavation and placement of fill in wetlands and floodplains for projects having an indirect influence on stream flow rates and flood levels. The Agency has delegated regulatory authority to the Southwest Florida Water Management District (SWFWMD) for projects proposing commercial, residential and borrow pit land uses.
Southwest Florida Water Management District (SWFWMD) **Environmental Resource Permits**	The District Rules published as Chapter 40D of the Florida Administrative Code (F.A.C.) Basis of Review require new development to control post-developed peak discharge rate at pre-developed discharge rate for a 25-year, 24-hour design storm. The District also regulates floodplain encroachments requiring new developments to provide compensatory storage for fill placed within a regulatory 100-year floodplain. Rules require that development activity within floodplains and floodways not create adverse impact. The District also regulates impact to wetland functions including that of flood storage.
Sarasota County Government (SCG) **Construction Permit**	SCG regulates flood protection level of service through its Comprehensive Plan and land Development Regulations. New buildings are required to be above the 100-year flood elevation. New developments are required to demonstrate no adverse impact to the 100-year floodplain. For new developments with land area greater than 35 acres, or creating 8 acres or more new impervious surface, the development proposal must be incorporated within the appropriate watershed model to demonstrate no adverse impact. Flood protection level of service standards are also adopted through a tiered level relating the allowable depth of flooding to road category and flood frequency.
SCG Roadway Flood Protection Level of Service	
Evacuation Routes	No flooding for the 5, 10, 25 or 100-year storm.
Arterial	No flooding for the 5, 10 or 25-year storm. 6” maximum flooding for the 100-year storm.
Collector	No flooding for the 5, or 10-year storm. 6” maximum flooding for the 25-year storm. 9” maximum flooding for the 100-year storm.
Neighborhood	No flooding for the 5-year storm. 6” maximum flooding for the 10-year storm. 9” maximum flooding for the 25-year storm. 12” maximum flooding for the 100-year storm.
Parking Area	3” maximum flooding for the 5-year storm. 9” maximum flooding for the 10-year storm. 9” maximum flooding for the 25-year storm. 12” maximum flooding for the 100-year storm.

City of Venice **Construction Permit**	The City has discharge level of service requiring new development to control post-developed peak discharge rates not exceeding, or less than, their pre-developed discharge rate for a 25-year frequency, 24-hour duration storm event.
Manatee County Government (MCG) **Construction Permit**	MCG has peak discharge level of service requiring new development to control post-developed peak discharge rates not exceed the pre-developed discharge rate for a 25-year frequency, 24-hour design storm event. Additional criteria for internal or on-site drainage facilities require any project to accommodate runoff from a 10-year frequency, critical duration storm event. For projects located in a known flooding area or a restrictive outfall condition, MCG requires reduced discharge criteria.

Both Sarasota County and the City of Venice are coordinating the incorporation of local floodplain studies in the Dona Bay watershed area into the state (SWFWMD) and federal (FEMA) floodplain management programs. As part of this effort, SWFWMD is conducting an independent review of the Sarasota County hydrodynamic floodplain computer models and GIS support databases for the Dona Bay watershed. The outcome is expected to be the use of this information in SWFWMD's Environmental Resource Permitting process. In addition, Sarasota County, the City of Venice and SWFWMD are participating as Cooperative Technical Partners with FEMA to incorporate the Dona Bay flood study into FEMA's Map Modernization Program.

6.5 FLOOD PROTECTION ISSUES

The following flood protection issues have been identified for the Dona Bay watershed.

6.5.1 Complete Detailed Flood Studies

Issue:
The flood studies completed to date for the Dona Bay watershed do not include detail analyses for the coastal fringe area or the upper Cow Pen Canal watershed including the Gum Slough system and Manatee County.

Actions:

The coastal fringe area is currently being conducted by KHA.

A cooperative funding partnership between SWFWMD, Sarasota County, and Manatee County for the upper Cow Pen Canal watershed should be pursued.

6.5.2 Maintenance of Flood Study Model

Issue:
The detailed flood protection model and flood maps must be continuously maintained to evaluate and reflect on-going changes within the watershed.

Actions:

KHA is currently conducting model maintenance for land development improvements which have occurred since 2002 in the unincorporated areas of Sarasota County and the City of Venice.

Cooperative funding support for the model maintenance process should continue from both SWFWMD and FEMA.

6.5.3 Implementation of Stormwater Improvement Projects

Issue:
Sarasota County has not developed specific projects to address existing street FPLOS deficiencies in the watershed.

Actions:

Future projects and programs should be developed to address these identified FPLOS deficiencies.

6.5.4 Primary Drainage System Maintenance

Issue:
Sediment Accumulation

A comparison of the original 1962, SCS "as-built" canal invert for the Cow Pen Slough canal and surveyed cross-sections taken during the Flood Study Update indicated that several feet of sediment has accumulated in the bottom of the canal. It is suspected that this reflects approximately 40 years of sediment accumulation in the bottom of the canal.

Action:
Sediment accumulation in the Cow Pen Slough canal should be removed.

6.5.5 Secondary Drainage System Maintenance

Riser Structure Replacement/Repair/Modifications

The original "as-built" plans for the Cow Pen Slough canal included over 30 riser structures to accommodate drainage from lands adjacent to the canal. These structures are contained within public drainage maintenance easements. The *January, 2002 – Cow Pen Slough/Shakett Creek Flood Study Update* provided an inventory of these structures and indicated if they were missing, altered or severely deteriorated.

Action:
The recommendations for replacing and maintaining these structures that are provided in the *January, 2002 – Cow Pen Slough/Shakett Creek Flood Study Update* should be implemented.

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