Dona Bay Watershed Management Plan

Technical Memorandums

Prepared by: Kimley-Horn and Associates, Inc.

Southwest Florida Water Management District

SARASOTA COUNTY

DONA BAY
WATERSHED MANAGEMENT PLAN

Final Report Appendices
Technical Memorandums
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LIST OF TECHNICAL MEMORANDUMS

Chapter 4 - Water Supply Appendices

Photo of Cow Pen Canal
Lower Water Level Control Structure

TM 4.2.1. – WATER QUALITY ANALYSIS AND WATER TREATEMENT OPTIONS ANALYSIS

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and the Southwest Florida Water Management District (SWFWMD) are currently completing the necessary, pre-requisite data collection and analysis as well as the comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marine Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the SWFWMD, to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (CHNEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and Sarasota County's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

Pursuant to Task 4.2.1 of the DBWMP contract, PBS&J prepared this technical memorandum to present the results of a review of existing water quality data to determine if additional sampling and testing is needed for evaluation of water treatment alternatives and to present an evaluation of alternatives for a water treatment facility using surface water from the Dona Bay watershed as a raw water source.

2.0 WATER TREATMENT ALTERNATIVES

The water in the Cow Pen Canal is similar to typical Florida streams, with high color and dissolved organic carbon, and seasonal variations in quality with changes in rainfall amounts. The alternatives for treatment of the water to drinking water standards include conventional treatment processes and more recently developed membrane technology. Four treatment alternatives using conventional and membrane systems were evaluated and compared.

3.0 WATER QUALITY

Cow Pen Canal, the primary tributary to Dona Bay, is a Class III stream (fishing and recreation) and is not protected for the purpose of providing a potable water source. The Dona Bay watershed is primarily undeveloped, with citrus groves, pasture, and other agriculture being the predominant land uses. However, the conversion of agricultural property to residential development will likely influence the future water quality in the watershed.

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.

The high color level suggests a high dissolved organic carbon content which increases the likelihood of disinfection bi-product (DBP) formation unless removed prior to application of chlorine based disinfectants.

This water source has the potential for blue-green algae growth. Blue-green algae, echnically known as **cyanobacteria**, are microscopic organisms that are naturally present in lakes and streams. While normally present in low numbers, blue-green algae can become very abundant in warm, shallow, undisturbed surface water receiving sunlight. Blue-green algae are easily controlled by applying oxidizing biocides to the water. However, as the blue-green algae die they produce geosmin and MIB (2-methylisoborneol). These compounds are responsible for creating earthy, musty odors and tastes in water. Geosmin can be sensed by the nose at very low concentrations (on the order of 10 parts per trillion). The effects of MIB and Geosmin are controlled by application of additional oxidants and/or activated carbon (granular or powdered).

The hardness of the water varies seasonally from soft to very hard dependent upon the percentage of the flow resulting from groundwater infiltration into the stream. Hard water requires more soap and synthetic detergents for home laundry and washing, and contributes to scaling in boilers and industrial equipment. Hardness is caused by compounds of calcium and magnesium, and by a variety of other metals. General guidelines for classification of waters are: 0 to 60 mg/L (milligrams per liter) as calcium carbonate is classified as soft; 61 to 120 mg/L as moderately hard; 121 to 180 mg/L as hard; and more than 180 mg/L as very hard.

The Langelier Saturation Index (LSI; also called Langelier Stability Index) is a calculated number used to predict the calcium carbonate stability of water. Langelier developed a method for predicting the pH at which water is saturated in calcium carbonate (called pHs). The LSI is expressed as the difference between the actual system pH and the saturation pH or:

LSI = pH – pHs

The water's calcium hardness, alkalinity, temperature and dissolved solids content are used to calculate LSI.
If the actual pH of the water is less than the calculated saturation pH, the LSI is negative and the water has a very limited scaling potential and may actually dissolve calcium carbonate deposits. If there are no calcium carbonate deposits to dissolve, the water will begin dissolving iron from the pipe walls. If the actual pH exceeds pHs, the LSI is positive, and being supersaturated with CaCO3, the water has a tendency to form scale. At increasing positive index values, the scaling potential increases.

A target LSI for the treated water delivered to the system is general in the range of 0 to <+0.5; a negative LSI is not desirable.

4.0 TREATMENT REQUIREMENTS

Table 1 summarizes the water quality parameters that were identified in the Cow Pen Water Quality Monitoring Report that are of concern.

Pollutant	Tested	Exceeds MCL	Comment
Pesticides	Y	N	Present in 3 samples
Iron	Y	Y	
Color	Y	Y	
Odor	Y	Y	
Hardness	Y		High
Coliforms	Y	Y	Present
Giardia	Y		Present
Cryptosporidium	Y		Present

Table 1: Cow Pen Water Quality Concerns

Pathogens, such as *Giardia* and *Cryptosporidium*, can cause gastrointestinal illness (e.g., diarrhea, vomiting, cramps) and other health risks, which may be severe in people with weakened immune systems (e.g., infants and the elderly) and sometimes fatal in people with severely compromised immune systems (e.g., cancer and AIDS patients). *Cryptosporidium* is a significant concern in drinking water because it contaminates surface waters used as drinking water sources, it is resistant to chlorine and other disinfectants, and it has caused waterborne disease outbreaks.

Current regulations require filtered water systems to reduce source water *Cryptosporidium* levels by 99 percent (2-log). Recent data on *Cryptosporidium* indicate that this treatment is sufficient for most systems, but additional treatment is necessary for certain higher risk systems. These higher risk systems include filtered water systems with high levels of *Cryptosporidium* in their water sources and all unfiltered water systems, which do not treat for *Cryptosporidium*.

The treatment process must reduce these parameters to acceptable levels or remove them. The microorganisms, *Giardia* and *Cryptosporidium* have been found to be present in the Dona Bay watershed. The drinking water standards require that the treatment technology must remove or inactivate the microorganisms.

Softening of the water to remove hardness may be required to provide aesthetically acceptable water. Because the source water is coming from a drained watershed with many potential sources of pollution, the level of total suspended solids (TSS) and total organic carbon (TOC) are assumed to be high for the purpose of this evaluation and must be reduced by any alternative processes. The current and future drinking water requirements will mandate that the treatment technology:

- Meet primary and secondary drinking water standards
- Provide multiple barriers to pathogens
- Minimize the interaction of organic carbon compounds with chlorine disinfectant in the treatment of water and in the treated water
- Provide disinfection of pathogens in the treatment process and residual disinfection in the drinking water distribution system
- Provide an aesthetically satisfactory water for consumption

5.0 TREATMENT PROCESSES

The following water treatment unit processes were evaluated for treatment of surface water from the Dona Bay watershed.

5.1 Rapid Rate Mixed Media Filtration

Filtration is a physical process that removes impurities from water by percolating it downward through a filter media such as garnet, sand, and anthracite installed in layers. The water flows through the media and particulates are entrapped and removed from the water. The treated water is then disinfected. Filtration is the next to last process in the traditional water treatment train. It is generally effective in removing particles 10 microns and larger as well as pathogens.

5.2 Coagulation/Precipitation/Clarification (Lime Softening)

Coagulation/Flocculation/Precipitation is a process of adding chemicals to water to produce a chemical reaction which forms particles. After the chemical coagulant is added, the water is gently agitated to cause the particles to collide and form larger particles. Following the agitation, the water enters a quiescent zone and the particles settle out (clarification) due to the difference in specific gravity between the solid particles and the water.

Lime softening is a variation of this process that uses a strongly basic chemical such as lime or caustic to precipitate calcium carbonate and magnesium hydroxide. This process is general used as an initial treatment stage in a traditional water surface treatment train and is effective in the removal of hardness, alkalinity, suspended solids, and pathogens from the source water.

5.3 Ion Exchange

Ion exchange is a reversible, solution phase chemical reaction where an ionic constituent (i.e. either an atom or molecule with either a positive or negative electrical charge) is exchanged for a similarly charged ion attached to an immobile solid particle. These solid ion exchange particles may be either a naturally occurring inorganic zeolite or synthetically produced organic resin. The synthetic organic resins were developed to mimic the natural zeolites with improved performance and are the predominant type used today because their characteristics can be tailored to specific applications.

An organic ion exchange resin is composed of high-molecular-weight polymer that can exchange their mobile ions for ions of similar charge from the solution. These resins are generally made from a styrene-divinylbenzene co-polymer but acrylic polymers are also used in certain situations. Each resin has a distinct number of ion exchange sites that set the maximum quantity of exchanges per unit of resin. Once a resin is exhausted it is chemically regenerated for reuse.

Cation exchange resins have an affinity for ions with a positive charge such as calcium, magnesium, sodium and potassium. Anion exchange resins have an affinity for ions with a negative change such as bicarbonate, chloride, sulfate, and ortho-phosphate. Anion exchange resins will also remove dissolved organic carbon (DOC) from water. In pure water applications, organic loading is not desired as it reduces the ion exchange capacity of the resin.

However, this phenomenon is a useful unit process for reducing the DOC content from a water supply if disinfection byproducts are a concern. When an anion resin is used to remove DOC it is referred to as an organic trap and is regenerated with a dilute caustic (≈2%) and salt (≈10%). Organic traps are most commonly housed in pressure vessels. The MIEX process uses a proprietary acrylic anion resin that is smaller than standard to improve reaction kinetics. The resin is impregnated with iron to make it magnetic. Because of this feature, the resin beads behave as small magnets and assists in the resin recovery stage of the process. Additional details of this process will be found further within this section.

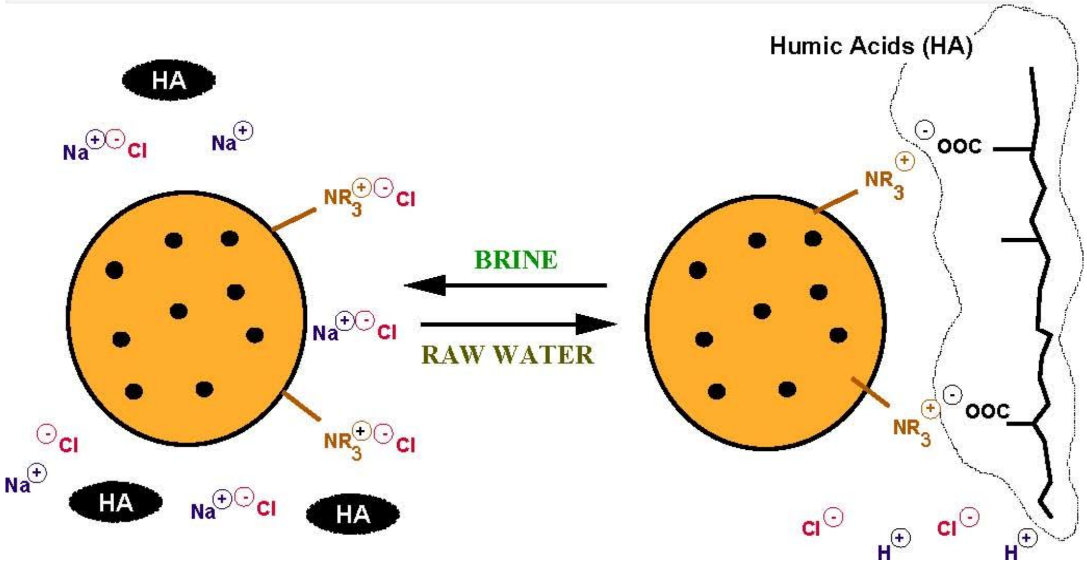

Figure 1 - DOC Removal by Ion Exchange

5.4 Activated Carbon

Granular and powdered activated carbon removes taste and odor producing substances through similar chemistry. Granular activated carbon (GAC) is typically used in gravity filter beds or pressure filter columns and is sometimes incorporated in mixed media filters as a replacement for anthracite. Powdered activated carbon (PAC) is generally fed into the raw water stream as it enters the mixing tanks at the start of the treatment process. The PAC is removed in the coagulation/sedimentation process. The effectiveness of the process depends on "adsorption", a process where a particle or molecule adheres to the surface of a substance, usually due to molecular-level electrical forces. Because the adsorption process depends on surface area, the more surface area the carbon has the more contaminants it can adsorb. A contaminant that is highly soluble in water tends to stay in the water and avoids adsorbing onto the activated carbon particles. Activated carbon filtration is very effective at removing many, but not all, organic molecules, such as fuels, pesticides, and solvents. It is also effective at removing some non-organic compounds and metals from water, such as chlorine, arsenic, chromium, and mercury. GAC must be replaced or regenerated periodically as the media loads and adsorption efficiency of the particles decreases.

5.5 Membrane Treatment

Membrane technology utilizes a semi-permeable membrane for the separation of suspended and dissolved solids from water. The process uses hydraulic pressure to force water molecules through the semi-permeable membrane. Impurities are retained and concentrate in the feed water, which becomes the reject water or concentrate stream. Permeate the water that passes through the membrane, is recovered as product water. Membrane technologies in order of decreasing permeability are:

- Microfiltration (MF)

- Ultrafiltration (UF)
- Nanofiltration (NF)
- Reverse Osmosis (RO)

The range of sizes of selected constituents in water and the performance capabilities of the different membranes are illustrated in Figure 2.

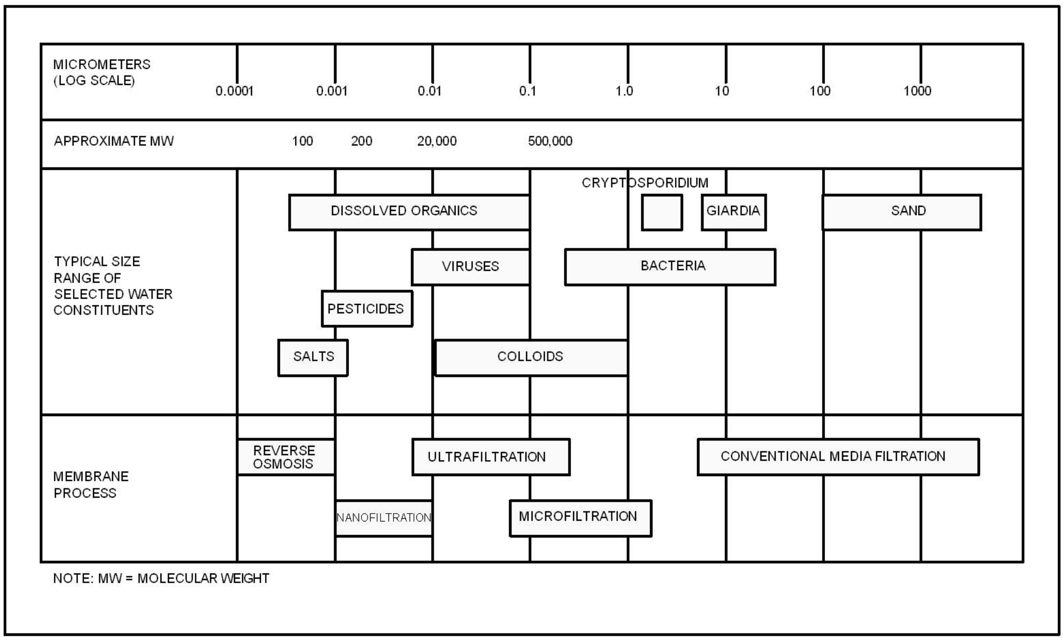

Figure 2 – Filtration Spectrum

Microfiltration (MF) and ultrafiltration (UF) are used to remove larger particles, colloids, and many microorganisms. MF performs as a semi-permeable barrier to reduce turbidity and some types of colloidal suspensions. UF offers higher removals than MF, but operates at higher pressures. Nanofiltraton (NF) technology is positioned between reverse osmosis and ultrafiltration and is applicable where the level of dissolved solids removal is less than the levels normally encountered with brackish water or seawater sources. NF is used to remove pesticides and other organic contaminants, hardness, bacteria and viruses, and organic-related color. Membranes of varying permeability are available to match the type and level of contaminants that must be removed.

Also, membrane filtration systems provide a physical barrier that removes Cryptosporidium, Giardia, bacteria, and viruses.

5.6 ACTIFLO (Ballasted Clarification)

ACTIFLO is a trade name for a proprietary ballasted Coagulation/Precipitation /Sedimentation process that utilizes microsand (100 to 150 µm particle size) to add weight to chemically formed flocculation particles in conjunction with lamella settling tubes to aid in clarification. There are similar products available from other manufacturers. This is not a filtration process and must be followed by filtration. The greatest advantage of the ACTIFLO system is that it requires much less space than conventional coagulation-sedimentation, which makes it useful for sites with limited space or for increasing the capacity of existing facilities that have limited area for construction. The smaller footprint is due to reduced rapid mix and flocculation residence time. Also, the clarifier section operates at much higher overflow rates than conventional clarifiers. Exceptions to the Ten State requirements would be required during the permitting process.

5.7 Oxidation Pre-Treatment

This unit process would begin the oxidation of organic compounds by applying a powerful oxidant and disinfectant to the raw water. Oxidants that could be used in this step are chlorine dioxide (ClO_2), potassium permanganate ($KMnO_4$), ozone (O_3), or hydrogen peroxide (H_2O_2). $KMnO_4$ is a solid and must be mixed with water prior to application. H_2O_2 s a liquid and would be diluted with water prior to application. ClO_2 and O_3 must be generated near the point of application. All of these are effective against pathogens and effective in removing taste, odor, and color from water. These oxidants will oxidize iron and manganese aiding in their removal from the water. They also break down the organic precursors to trihalomethanes (THM) and haloacetic acids (HAAC).

5.8 Disinfection

The disinfection of drinking water prior to distribution is achieved through the use of a form of chlorine. Chlorine is an element found combined in nature and is associated with many manufactured products. When in a free state, it is a powerful disinfectant, effective in destroying many types of pathogens. The advantage of chlorine disinfectant is the presence of a chlorine residual in the distribution system. Because chlorine reacts with organic carbon compounds to form disinfection byproducts which have been identified with some health concern, most treatment plants that have surface water sources use a combination of chlorine and ammonia to minimize the formation of these compounds. In the chloramination process, stoichiometric ratios of ammonia and chlorine are mixed to promote the formation of monochloramine (NH_2Cl). It is very important to control the ratios to prevent the formation of dichloramine ($NHCl_2$) and trichloramine (NCl_3) as they may cause odor issues. Ultraviolet (UV) light is effective in the deactivation of *Giardia* and *Cryptosporidium* and should be considered as an additional treatment for alternatives that do not have a positive barrier.

6.0 TREATMENT ALTERNATIVES

The traditional process for water treatment is coagulation, clarification, filtration, and disinfection. Because of the presence of pathogens, pesticides, dissolved organic compounds, color, and odor, additional treatment processes will be required. The traditional process for water treatment is generally credited with a 2.5 log removal of pathogens, which is not sufficient for the source water being used. Because of the quality of the source water, additional treatment processes would be required to supplement the traditional process.

Using various combinations of the unit treatment processes described above, four alternatives were developed to meet the requirements for treatment of water from the Dona Bay watershed for use as a potable water supply.

6.1 Alternative 1 - Lime Softening/Filtration

Under this alternative, lime is used as to precipitate hardness and as a coagulant to form particles that by settling, physically remove suspended solids, hardness, and pathogens. Pre-oxidation treatment is included to oxidize organic compounds that are precursors to disinfection byproducts, and to break down organic compounds that cause taste and odor problems. Mixed media filtration is utilized to remove particulate matter, including suspended solids and pathogens. A granular activated carbon filter could be added to absorb organic compounds and pesticides or powdered activated carbon could be used following the pre-oxidation. The disinfection process is used to kill pathogens and provide a disinfection residual in the drinking water. UV treatment is included to provide deactivation of *Giardia* and *Cryptosporidium*. Table 2 provides the treatment effectiveness of Alternative 1. Figure 3 provides a schematic of Alternative 1.

Parameter	Tested	Exceeds MCL	Comment	Pre-oxidaton	Coagulation/Precipitation (Lime Softening)	Rapid Rate Mixed Media Filtration	Granular-activated Carbon	Disinfection	Check
Pesticides	Y	N					X		X
Color	Y	Y		X			X		X
Odor	Y	Y		X			X		X
Hardness	Y		High		X				X
Coliforms	Y	Y	Present	X	X	X		X	X
Giardia	Y		Present	X	X	X		X	X
Cryptosporidium	Y		Present	X	X	X		X	X
TSS	N				X				X
DOC/TOC	N			X			X		X

Table 2 – Lime Softening/Filtration

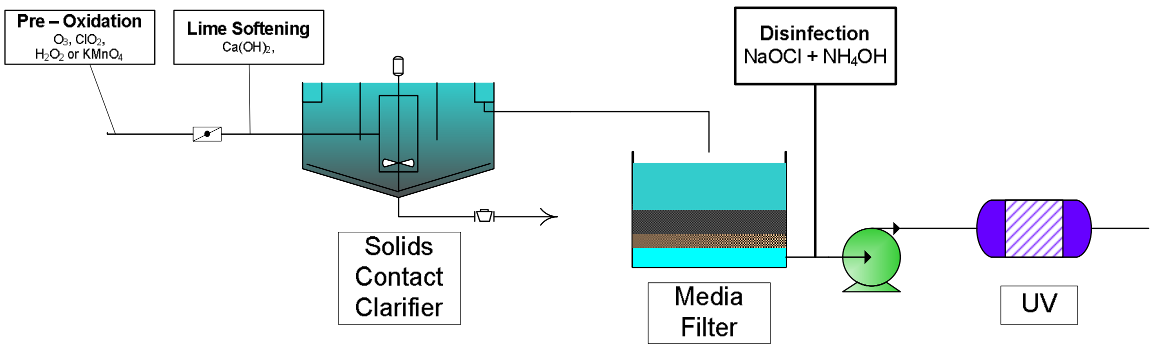

Figure 3 – Lime Softening and Filtration Schematic

6.2 Alternative 2 - Ballasted Clarification/Filtration

This alternative is similar to Alternative 1 except that the coagulation, precipitation, clarification process uses the ballasted clarification system. The remaining processes are the same as in Alternative 1. As in Alternative 1, pre-oxidation would be the first step in the process. Table 3 provides the treatment effectiveness of Alternative 2. Figure 4 presents a schematic of the Actiflo Process/Filtration clarification process. Figure 5 presents a schematic of the clarified water.

Parameter	Tested	Exceeds MCL	Comment	Pre-Oxidation	ACTIFLO (Ballasted Clarification)	Rapid Rate Mixed Media Filtration	Granular-activated Carbon	Disinfection	Check
Pesticides	Y	N					X		X
Color	Y	Y		X			X		X
Odor	Y	Y		X			X		X
Hardness	Y		High		X				X
Coliforms	Y	Y	Present	X	X	X		X	X
Giardia	Y		Present	X	X	X		X	X
Cryptosporidium	Y		Present	X	X	X		X	X
TSS	N				X				X
DOC/TOC	N			X			X		X

Table 3 – Actiflo Clarification/Filtration

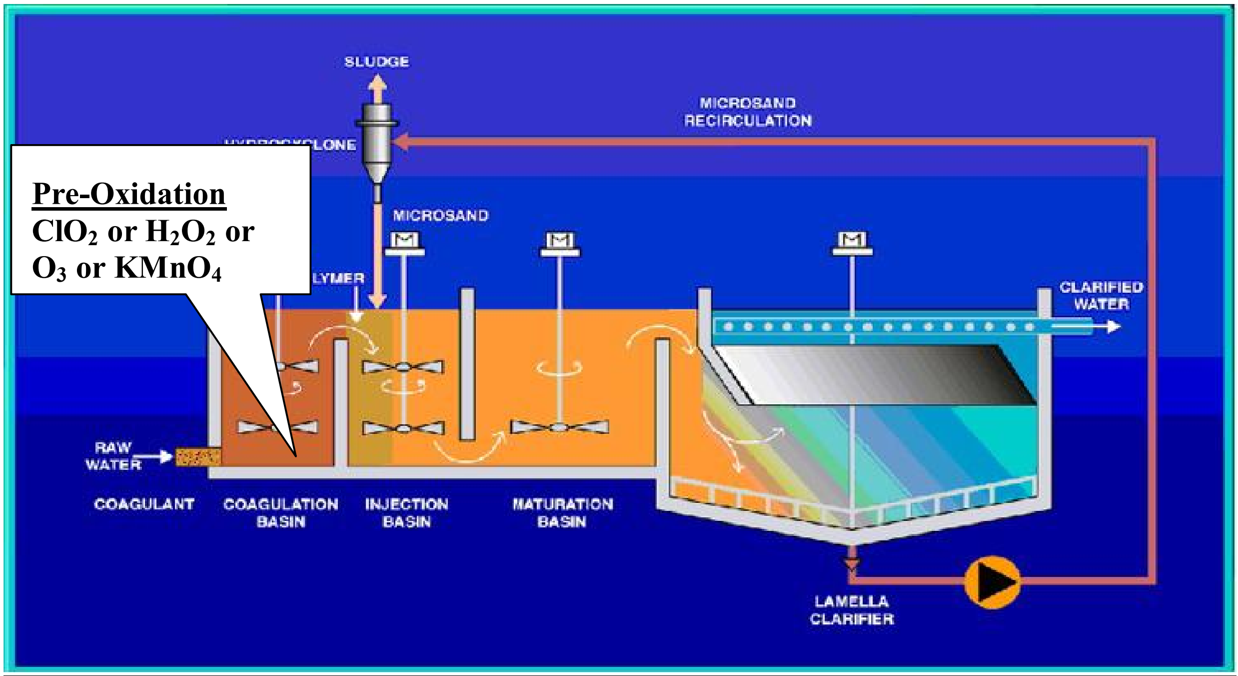

Figure 4 – Actiflo Process/Filtration Schematic

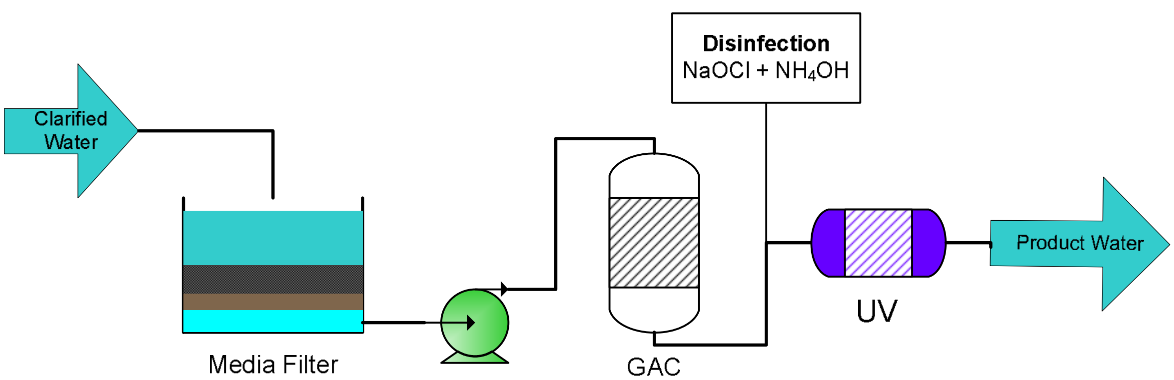

Figure 5 – Ballasted Clarification/Filtration Schematic

A strong oxidizing agent is used for pre-oxidation to start the destruction of disinfection byproducts. The ballasted clarification process will remove raw water turbidity, color, TOC, algae, cryptosporidium, iron, manganese, arsenic and other typical undesirable water contaminants. The mixed media filtration is utilized to remove particulate matter from the water, including suspended solids and pathogens that are not captured in the clarification process. The granular activated carbon is utilized to absorb organic compounds and pesticides. The disinfection process using chloramination is used to kill pathogens and provide a disinfection residual in the drinking water.

Solids produced during the ballasted sand process will be dewatered with the solids being disposed of in an approved landfill.

6.3 Alternative 3 - Combined Membrane Treatment

Under this Alternative, chemicals are added to precipitate suspended solids, calcium, magnesium and other ions into small particles. The microfiltration membrane is utilized to separate particles that are in the macro molecular range, 0.1 to 1 micrometers, which would include bacteria and Giardia cysts as well as suspended solids. The nanofiltration membrane is utilized to separate molecules and particles in the molecular range, 0.01 to 0.001 micrometers, from the water. Molecules and particles in this size range would include viruses and pesticides, hardness and sulfates. If RO is selected, a portion of the MF/UF permeate will bypass the RO to blend with the RO permeate. The blend ratio will be selected to achieve a high quality drinking water. The chloramination disinfection process is used to kill pathogens and provide a disinfection residual in the drinking water. Table 4 provides the treatment effectiveness for Alternative 3. Figure 6 presents a schematic of the Alternative 3 treatment process.

Parameter	Tested	Exceeds MCL	Comment	Pre-Oxidation	Chemical Precipation	Microfiltation Membrane Treatment	Nanofiltration Membrane Treatment	Disinfection	Check
Pesticides	Y	N					X		X
Color	Y	Y		X			X		X
Odor	Y	Y		X			X		X
Hardness	Y		High		X	X	X		X
Coliforms	Y	Y	Present	X	X	X	X	X	X
Giardia	Y		Present	X	X	X	X	X	X
Cryptosporidium	Y		Present	X	X	X	X	X	X
TSS	N				X	X	X		X
DOC/TOC	N			X		X	X		X

Table 4 – Combined Membrane Treatment

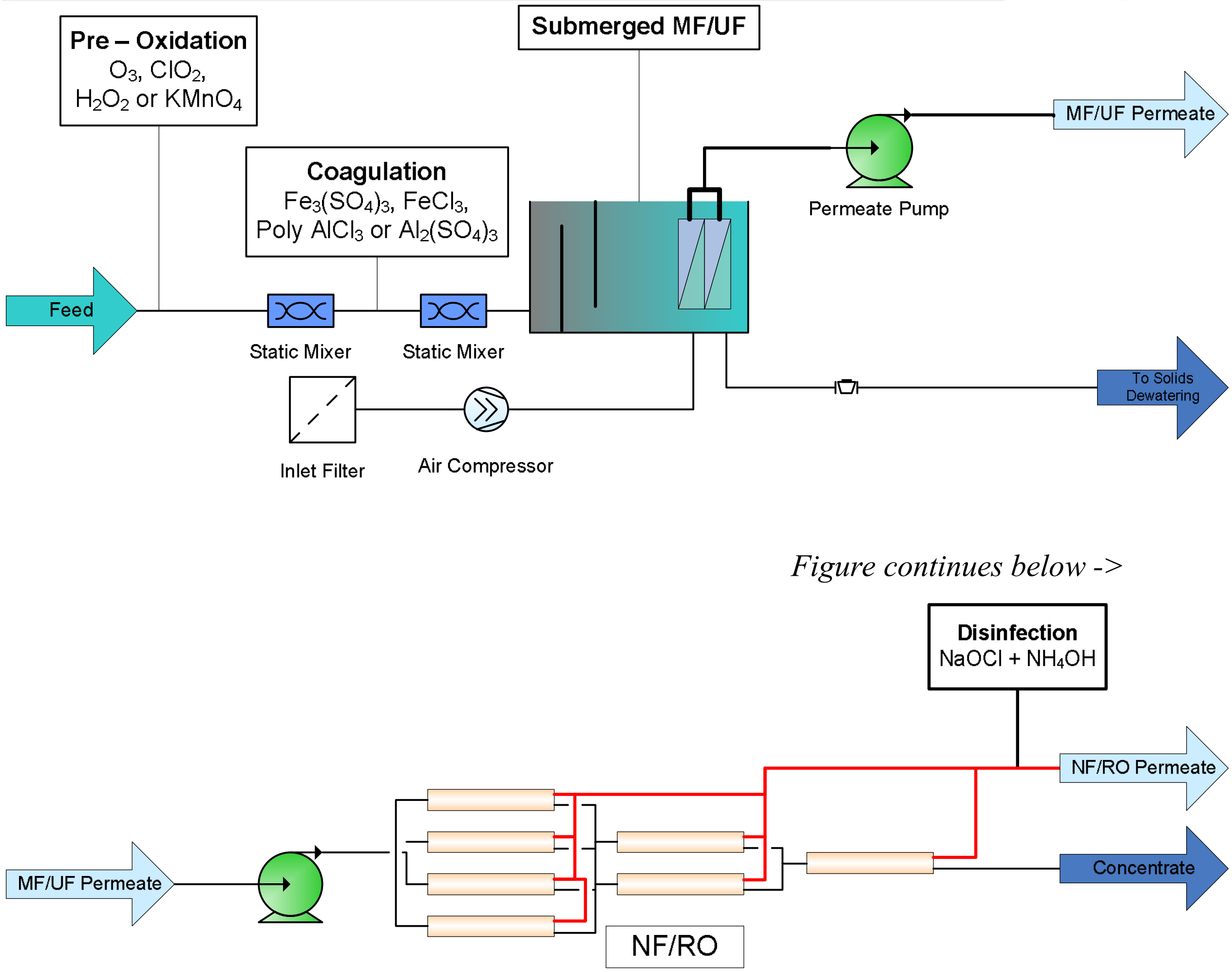

Figure 6 – Combined Membrane Treatment Schematic

6.4 Alternative 4 - Ballasted Clarification/Membrane

Pre-oxidation followed by the ballasted clarification process is utilized to remove turbidity (high and low), color, TOC, algae, particle counts, cryptosporidium, iron, manganese, arsenic and other typical undesirable water contaminants. The nanofiltration membrane is utilized to separate molecules and particles in the molecular range, 0.01 to 0.001 micrometers, which would include viruses and pesticides. The chlorine disinfection process is used to kill pathogens and provide a disinfection residual in the drinking water.

The ballasted clarification process is utilized to remove raw water turbidity, color, TOC, algae, particle counts, cryptosporidium, iron, manganese, arsenic and other typical undesirable water contaminants. Dual media filtration is required to reduce the suspended solids levels further before application on the nanofiltration membrane. The nanofiltration membrane is utilized to separate molecules and particles in the molecular range, 0.01 to 0.001 micrometers, from the water. Molecules and particles in this size range would include viruses and pesticides. The disinfection process is used to kill pathogens and provide a disinfection residual in the drinking water. Table 5 provides the treatment effectiveness of Alternative 4. Figure 7 presents a schematic of the Actiflo Process/Filtration clarification process. Figure 8 presents a schematic of the treatment process for the clarified water.

TM 4.2.2 – WATER QUANTITY | WATER BUDGET APPROACH

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and SWFWMD are currently completing the necessary, pre-requisite data collection and analysis as well as comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marin Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the Southwest Florida Water Management District (SWFWMD), to prepare the Dona Bay Watershed Management Plan (DBWMP).

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

This Technical Memorandum has been prepared by KHA to present analyses of historical hydrologic data collected in the Cow Pen Canal, Blackburn Canal and Myakka River watersheds, consistent with Task 4.2.2 of the DBWMP contract. Specifically, hydrologic data bases have been developed to reflect current conditions for the Dona Bay and Roberts Bay watersheds. These data bases will then be used to develop existing water budget estimates for natural systems, water quality, and alternative water supply scenario analyses for the Dona Bay watershed.

2.0 DONA BAY AND COW PEN SLOUGH

2.1 Historical Perspective

As reflected on the 1847 survey of Sarasota County and presented on **Figure 1**, a large slough once dominated the landscape in Sarasota County west of the Myakka River. This slough ran from north to south and eventually turned eastward to the Myakka River. Since this large slough was dependent upon the Myakka River for drainage, it receded very slowly. During the dry season, it likely became a large isolated retention area below a certain elevation and receded primarily by evapotranspiration.

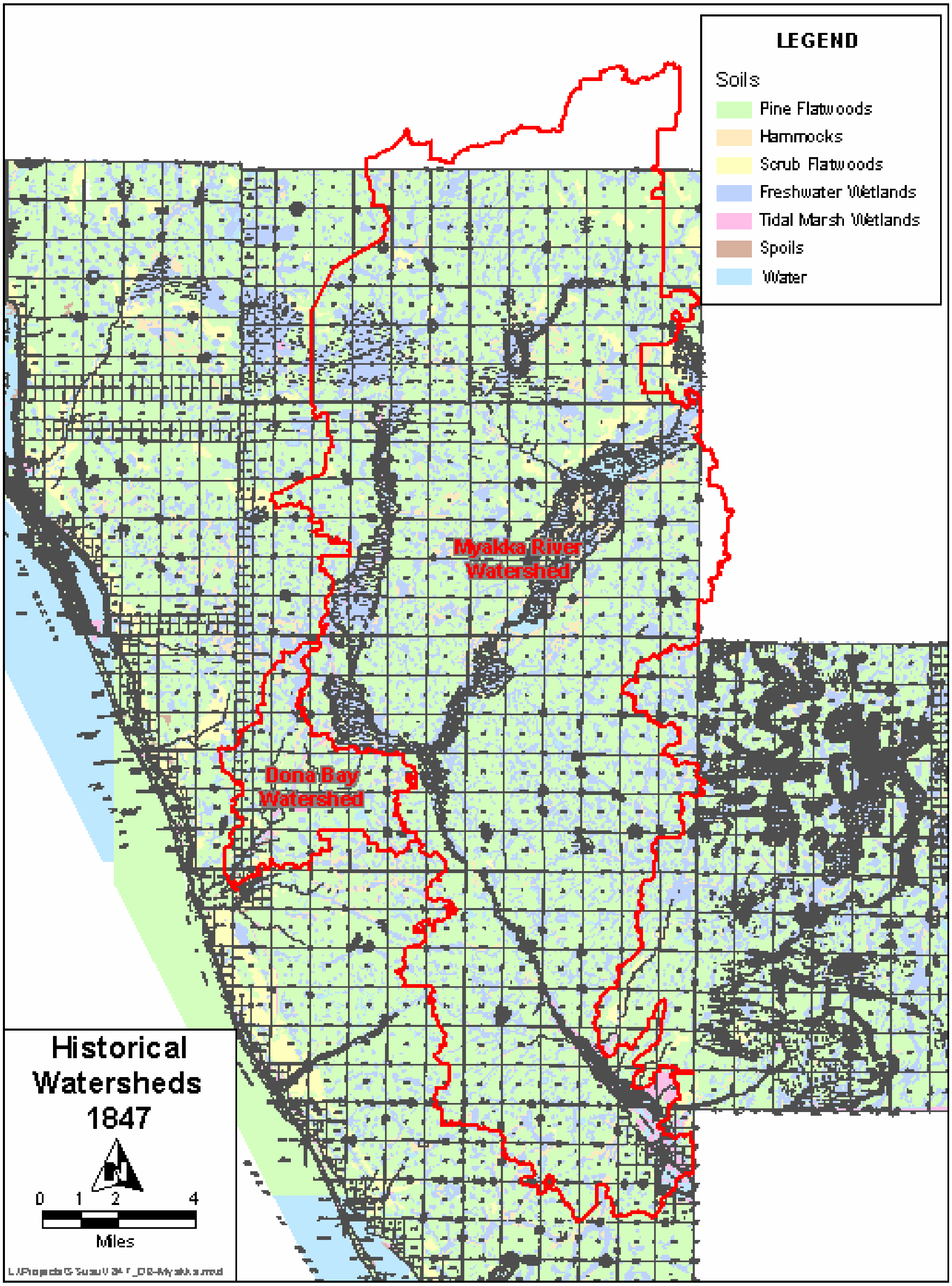

Figure 1 - 1947 Land Survey of Sarasota County

Between 1916 and 1920, as part of the Sugar Bowl Drainage District, a drainage ditch was cut through this slough. This man-made ditch was then extended south of the slough where it was connected to a small tidal creek, known as Salt Creek. Salt Creek meandered southwest where it subsequently enters Shakett Creek and Dona Bay. These activities initiated the diversion of approximately 37,453 acres from the Myakka River watershed to Dona Bay. Presumably performed for mosquito control and/or pasture conversion, this work effectively drained and diverted flows from the Myakka River to Dona Bay. However, this area was also still very prone to flooding following large storm events. Around 1950, a group of nine ranchers, with technical assistance from the Soil Conservation Service, constructed 7.5 miles of channel excavation along the lower reaches of Cow Pen Slough.

In 1961 the Sarasota Soil Conservation District, Sarasota County, and the Manatee River Soil Conservation District, with assistance from the Soils Conservation Service, developed the "Watershed Work Plan for the Sarasota West Coast Watershed". Areas that once drained to the Myakka River via Cow Pen Slough had already been drained and diverted to Phillippi Creek by the Sarasota Fruitville Drainage District in the 1920's and put into vegetable production. However, these vegetable producing areas were still subject to flooding during large events. The objectives of the 1961 Plan were: (1) to reduce flood damage frequency in the vegetable producing area to about once in 10 years; and (2) to provide adequate drainage and flood protection in the pasture lands to permit the production of improved pastures in the lower-lying areas along the stream channels. As a result, a larger canal was excavated through the slough, extended west of the "old cow pen slough" ditch through an upland ridge, and connected directly to Shakett Creek. In addition to the canal work, three large water level control structures were constructed. Only two of these structures are still operational. **Figure 2** presents a map from the original Work Plan.

Due to environmental concerns relative to changes in freshwater volumes being diverted to Dona Bay, upon completion of the first and second phases of the Plan in 1964 and 1966, respectively, the work was halted. The third phase which included a pumping station to divert addition flows from Phillippi Creek to the Cow Pen Canal (and Dona Bay) was not initiated. The 1961 Plan was formally abandoned in 1979, although the objective of reducing flood damage to the vegetable production areas was not accomplished. Much of the historical Cow Pen Slough has been converted and used for either pasture or citrus production. However, much of the historical slough signature still exists. **Figure 3** presents the natural and man-made drainage system as it exists today in dark blue with the historical wetland and slough systems identified in light blue.

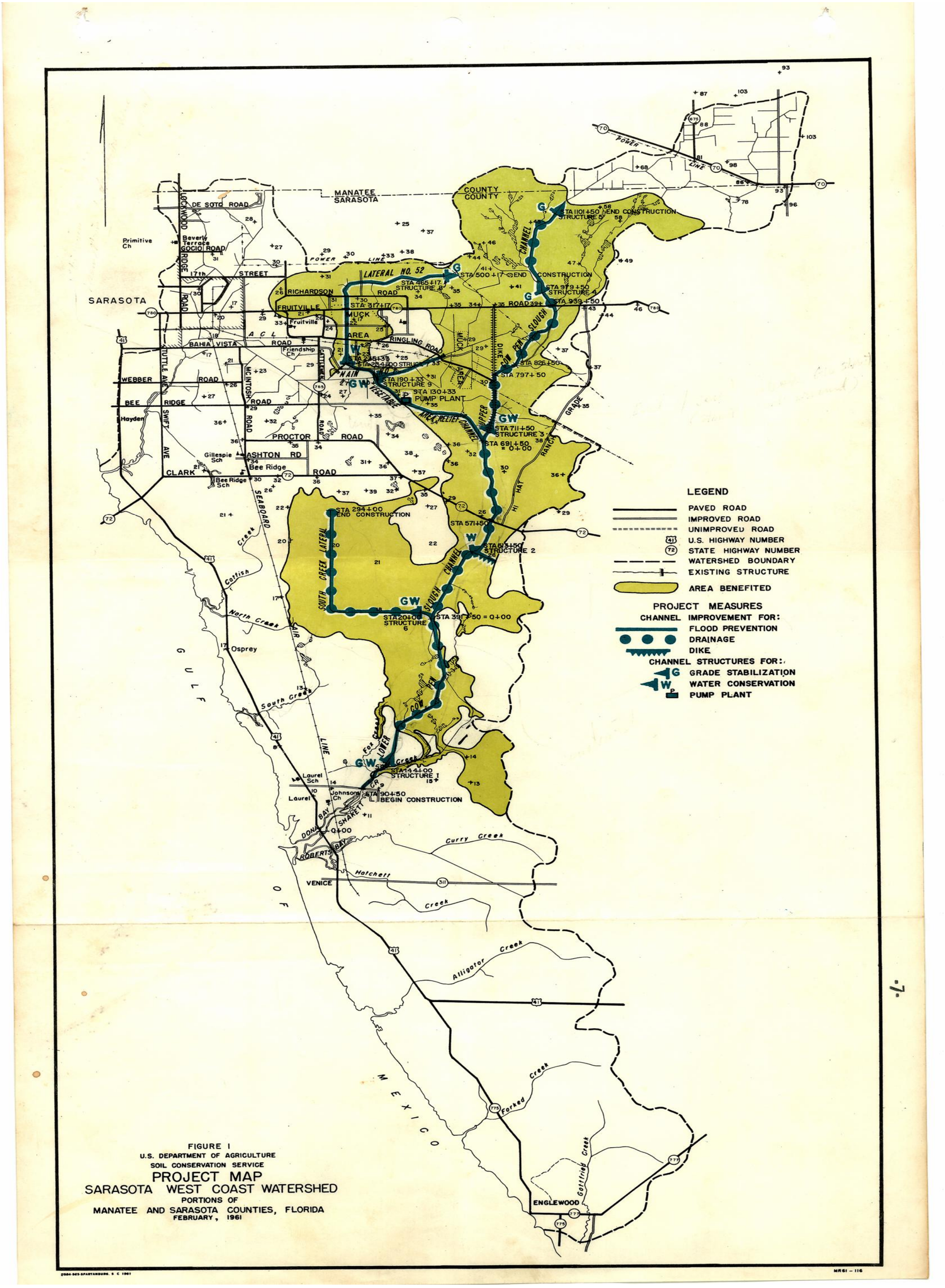

Figure 2 – 1961 Cow Pen Slough Work Plan

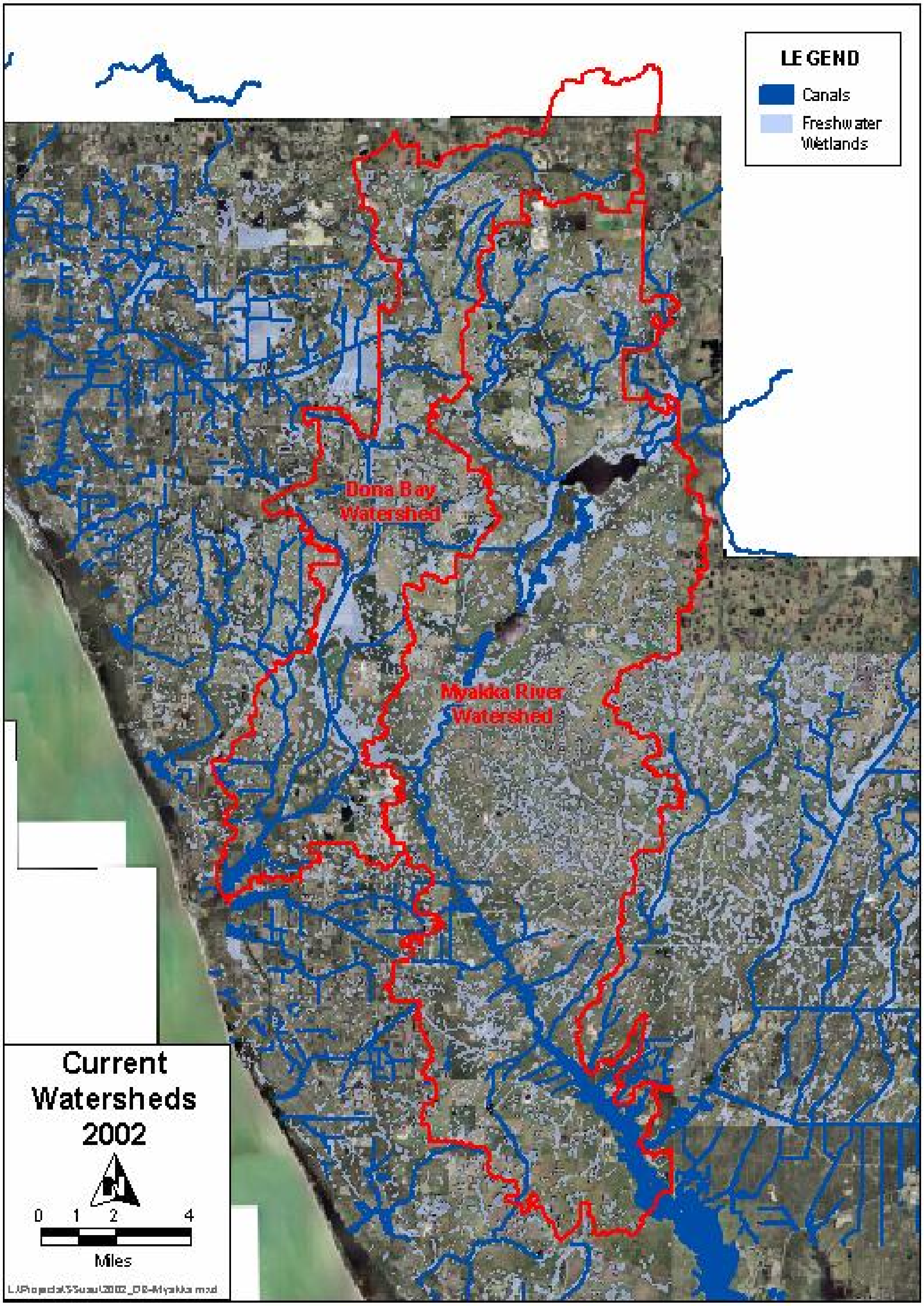

Figure 3 – Existing Drainage Network in Sarasota County

With the public acquisition of the Pinelands Reserve and the Albritton tract, much of the historical slough is currently under public ownership. Portions of the historical slough in the southern portion of the Pinelands Reserve have already been restored to some degree through re-hydration. In addition, SCG in cooperation with SWFWMD is monitoring stream stages and flows at both operable weirs on the canal. Rating curves have been developed by Hydrologic Data, Inc. and KHA has reduced the flow data from 2003 through 2005 to develop monthly, seasonal, and annual water budgets.

Flood stages determined by the USGS at the historical confluence of the Cow Pen Slough with the Myakka River are 13.6, 14.7, 15.4, 16.0, 16.1, 16.4, 16.7, and 17.1 NGVD, for the 2, 5, 10, 25, 50, 100, 200, and 500 year floods, respectively. Under current conditions, the 10-year or greater floodplain associated with the Myakka River extends westward into the Cow Pen Slough watershed when flood stages exceed 15.0 NGVD.

2.2 Determination of Existing Cow Pen Canal Water Budget

The approach for determining the amount of "excess" surface water diverted to Dona Bay by the Cow Pen Canal is consistent with that presented in the report prepared by KHA entitled "*Dona Bay Watershed Management Plan - Determination of Excess Runoff and Development of Water Budgets for 2003 and 2004"*. The Dona Bay monthly water budgets for 2005 has been completed and incorporated into the updated report prepared by KHA entitled "*Dona Bay Watershed Management Plan - Determination of Excess Runoff and Development of Water Budgets for 2003 and 2005"*. **Table 1** provides a summary of the 2005 water budget for Dona Bay, upstream of the Cow Pen diversion canal.

	2005 DONA BAY WATER BUDGET				
	1	2	3	4	5
	MEAN	2005	2005	R/P	2005
2005	RAINFALL	RAINFALL	RUNOFF		ET + STORAGE
MONTH	Inches	inches	inches		Inches
JAN	2.38	2.16	0.45	0.21	1.71
FEB	2.67	3.81	0.42	0.11	3.39
MARCH	3.01	4.37	3.03	0.69	1.34
APRIL	2.42	2.74	0.44	0.16	2.30
MAY	2.94	3.78	0.23	0.06	3.55
JUNE	7.16	15.44	6.98	0.45	8.46
JULY	8.04	7.45	4.19	0.56	3.26
AUG	8.56	3.36	0.83	0.25	2.53
SEPT	7.93	3.28	0.17	0.05	3.11
OCT	3.34	7.91	0.62	0.08	7.29
NOV	1.89	3.11	0.50	0.16	2.61
DEC	2.07	0.72	0.17	0.24	0.55
TOTAL	52.41	**58.10**	**18.03**	**0.31**	**40.07**

Table 1 – 2005 Dona Bay Water Budget Summary

Where:

1 = Mean Annual Rainfall for Southern Coastal Watershed (SWFWMD)
2 = Average Rainfall from Lower and Upper Weir Monitoring Sites for 2005
3 = Average Runoff from Lower and Upper Weir Monitoring Sites for 2005
4 = Average Runoff divided by Rainfall (Column 3 divided by Column 2)
5 = Evapotranspiration plus Change in Storage (Column 2 minus Column 3)

2.3 Development of Long-Term Flow Data for Cow Pen Slough

Other than the hydrologic data recently collected in Cow Pen Slough by SCG from 2003 though 2005, the only other available flow information is from USGS gaging station 02299700 recorded between 1963 and 1966. Therefore, a continuous, long-term data base does not exist for the Cow Pen Slough watershed. However, in 1980 transfer equations were developed to relate average daily flows from the Myakka River at USGS gaging station 02298830 (1936 to present) to average daily flows in Cow Pen Slough using the data period common to both sites (i.e. 1963 through 1966). In so doing, the entire data base at the Myakka River site can theoretically be transferred to generate a continuous, long-term data base for Cow Pen Slough. These previous transfer equations were developed by Hydroscience Research Group, Inc. for the Manasota Basin Board of the Southwest Florida Water Management District in 1980 and are contained in the report entitled *Preliminary Evaluation of the Surface-Water Supplies in the Cow Pen Slough Area*. These original transfer equations are provided in **Table 2**.

Myakka River Average Daily Flow (cfs)	Cow Pen Slough (transferred) Average Daily Flow (cfs)	Transfer Equation
0.00	0.00	
0.10	0.25	y = 0.4000x^0.20412
1.00	0.40	y = 0.4000x^0.20412
10.00	0.70	y = 0.4000x^0.24304
21.90	1.10	y = 0.1856x^0.57658
36.30	2.00	y = 0.02855x^1.1831
66.10	4.00	y = 0.03141x^1.1565
100.00	6.50	y = 0.02934x^1.1727
219.00	18.00	y = 0.01638x^1.2994
468.00	60.00	y = 0.003505x^1.5854
646.00	92.00	y = 0.01726x^1.3261
1000.00	180.00	y = 0.004439x^1.5360
1570.00	340.00	y = 0.01060x^1.4099
2130.00	614.00	y = 0.0002184x^1.9376
8750.00	4550.00	y = 0.01175x^1.4175

Table 2 – Transfer Equations (based upon Hydroscience, 1980)

The transfer equations presented in **Table 2** were applied to the entire Myakka River data base from USGS gage site 02298830. To verify the current applicability of the transfer equations, the transferred results were converted to monthly inches of runoff and compared to the actual monthly inches of runoff measured in Cow Pen Slough from January 2003 through December 2005. A summary of the results are presented graphically in **Figure 4**.

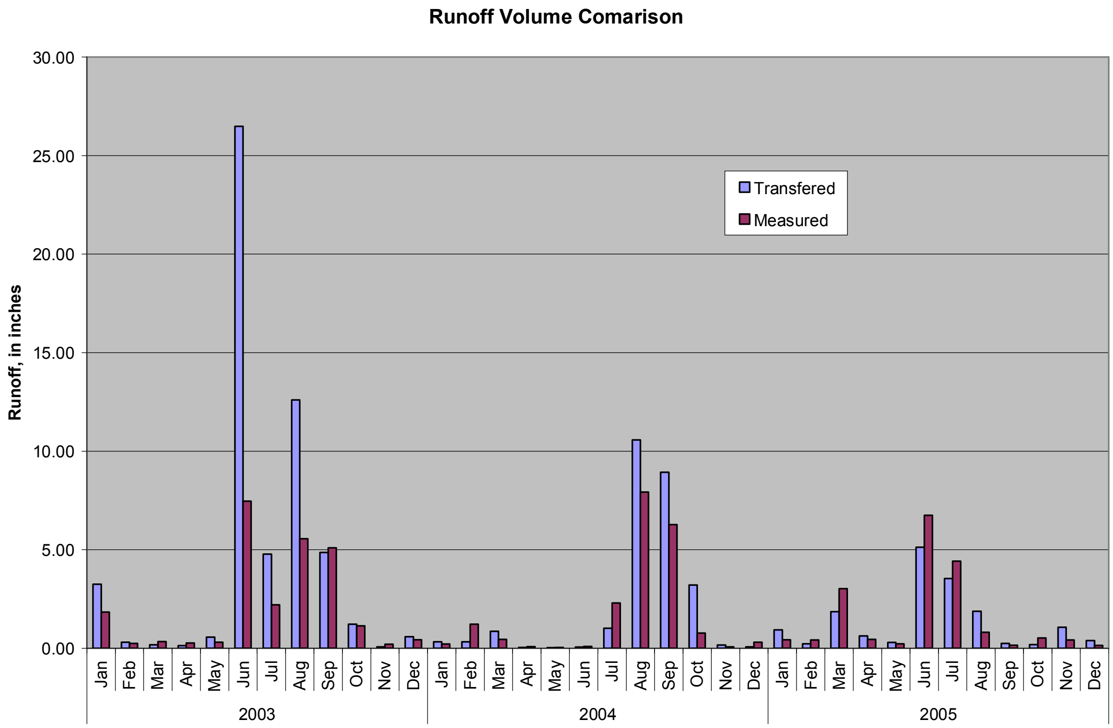

Figure 4 – Transferred and Measured Flows in Cow Pen Slough (2003- 2005) (based upon original transfer equations)

A comparison of the transferred and measured data revealed a couple of items of note. First, both the transferred and measured runoff exceeds the transferred and measured rainfall for January 2003. A review of antecedent conditions indicates that this can be explained by the fact that much of this runoff occurred at the beginning of January as a result of rainfall at the end of December.

The second anomaly is not as easy to explain. Specifically in June of 2003, the transferred runoff volume of 26.48 inches is significantly greater than the actual measured runoff volume in the Dona Bay watershed of 8.14 inches. This can be partially explained in that the 22.73 inches of total rainfall in June from the transferred watershed (Myakka River) exceeds that in the measured watershed (Dona Bay) of 16.54 inches. But the fact that the transferred runoff is greater than the transferred rainfall indicates that the transfer equations themselves may be problematic during periods of high flow. In fact the original transfer equations developed for various flow regimes, include a single equation for high daily flows (i.e. between 2,130 cfs and 8,750 cfs). Not only is this a large spread to be represented by a single transfer equation, but a review of the mean daily flows in late June indicate that they actually exceeded the upper range of the transfer equation (i.e. 8,750 cfs) for 2 days. In addition, the mean daily flows exceeded 2,130 cfs for 9 days. This period is responsible for 99% of the transferred runoff volume for June and is the most pronounced example of monthly flow deviations between the transferred and measured data during periods of high flows/rainfall. Therefore, it was concluded that the transfer equations do not perform accurately during periods of high flows conditions. Since subsequent water budget and flow diversion analyses will be dependent upon the long term transfer data set, this anomaly bears further consideration.

On the one hand, periods of high flow may not have a significant impact on water withdrawal predictions since excess water will by-pass or overflow the storage systems and withdrawal capacity will be limited. However, an over-estimate of high flows will likely result in an overestimate of freshwater entering Dona Bay. Therefore, it was considered worthwhile to reconcile the transferred and measured data sets during high flow regimes. Because of rainfall variations between the 2 watersheds during 2003-2005, a direct correlation and development of a new transfer equation(s) for high flows was not expected to be practical. An alternative approach was selected that involved simulating one or more of the high flow storms in the Dona Bay watershed with the 2003 Myakka River rainfall. Comparison of the measured Myakka River flows to the simulated Dona Bay flows for the same rainfall event(s) could provide the basis for the development of a new transfer equation(s) for high flow regimes.

Table 3 presents the rainfall gages in the upper Myakka River where daily rainfall totals were reviewed to develop a representative rainfall volume and duration for the June 2003 storm event. Also included in **Table 3** are the rainfall totals at each gage site for the 3-day, 7-day, and 10-day durations. For the purposes of the transfer analysis, the 3-day and 7-day rainfall events were simulated. The 10-day event was not considered since the incremental increase in the rainfall volume at sites 409 and 490 between the 7-day and 10-day periods was not significant. In fact, sites 409 and 490 actually reported more rainfall in the 7-day period than was reported at sites 194 and 336 in the 10-day period. In addition, sites 409, 490 and 507 are located upstream of the Myakka River USGS stream flow station and sites 409 and 490 had relatively comparable rainfall distributions. Therefore, the total 3-day and 7-day rainfall totals at sites 409, 490 and 507 were averaged as 14.32 inches and 16.92 inches, respectively, for use in the simulation. By way of comparison, the maximum 3-day and 7-day rainfall totals measured in Cow Pen Slough during this period were only 7.76 inches and 11.22 inches, respectively.

Rainfall Site	3-day Rainfall	7-day Rainfall	10-day Rainfall
194	10.79 inches	13.78 inches	16.70 inches
336	10.91 inches	13.93 inches	16.73 inches
409	15.03 inches	17.57 inches	17.70 inches
490	14.82 inches	17.33 inches	17.69 inches
507	13.07 inches	15.86 inches	17.63 inches

Table 3 – Myakka River Rainfall in June 2003

The dimensionless rainfall distributions for the 3-day and 7-day storms were developed from NOAA hourly rainfall data in the upper Myakka River (Myakka River at Myakka City FL, MKAF1 and Myakka River at Myakka State Park near Myakka City, MKCF1 - http://precip.fsl.noaa.gov/hourly_precip.html) and are presented in **Table 4** and **Table 5,** respectively. The 3-day rainfall distribution was compiled in 4 hour increments from hour 20 on June 19, 2003 through hour 20 on June 22, 2003. The 7-day rainfall distribution spanned from hour 0 on June 16, 2003 through hour 24 on June 23, 2003.

Time (hrs)	Time (dimensionless)	Rainfall (dimensionless)
0	0.000000	0.000000
4	0.055556	0.028592
8	0.111111	0.030021
12	0.166667	0.030021
16	0.222222	0.034310
20	0.277778	0.072194
24	0.333333	0.150822
28	0.388889	0.335239
32	0.444444	0.461758
36	0.500000	0.468906
40	0.555556	0.468906
44	0.611111	0.497498
48	0.666667	0.583274
52	0.722222	0.850608
56	0.777778	0.861330
60	0.833333	0.861330
64	0.888889	0.861330
68	0.944444	0.923517
72	1.000000	1.000000

Table 4 – 3 Day Distribution

Time (hrs)	Time (dimensionless)	Rainfall (dimensionless)
0	0.000000	0.000000
8	0.047619	0.000000
16	0.095238	0.000000
24	0.142857	0.016718
32	0.190476	0.019195
40	0.238095	0.019195
48	0.285714	0.019195
56	0.333333	0.024768
64	0.380952	0.025387
72	0.428571	0.065635
80	0.476190	0.113313
88	0.523810	0.133746
96	0.571429	0.158514
104	0.619048	0.159752
112	0.666667	0.196285
120	0.714286	0.424149
128	0.761905	0.539938
136	0.809524	0.564706
144	0.857143	0.870588
152	0.904762	0.879876
160	0.952381	0.933746
168	1.000000	1.000000

Table 5 – 7 Day Distribution

Figure 5 presents the 7 day dimensionless rainfall distribution developed for the upper Myakka River. In addition, cumulative dimensionless daily rainfall totals from the Cow Pen Slough watershed are plotted on **Figure 5** for comparison. This comparison of dimensionless rainfall distributions during June 2003 indicates that the rainfall in the Cow Pen Slough watershed was generally more gradual and that the majority of the rainfall in the upper Myakka River watershed occurred in the last 3 days of the 7 day period.

Figure 6 presents the hydrographs from the 3-day and 7-day rainfall events corresponding to the upper Myakka River rainfall, simulated in the Cow Pen Slough watershed. As indicated in **Figure 6**, the 7-day rainfall duration consistently resulted in a larger magnitude hydrograph and was therefore used to develop average daily flow estimates for comparison and correlation to the Myakka River average daily flows.

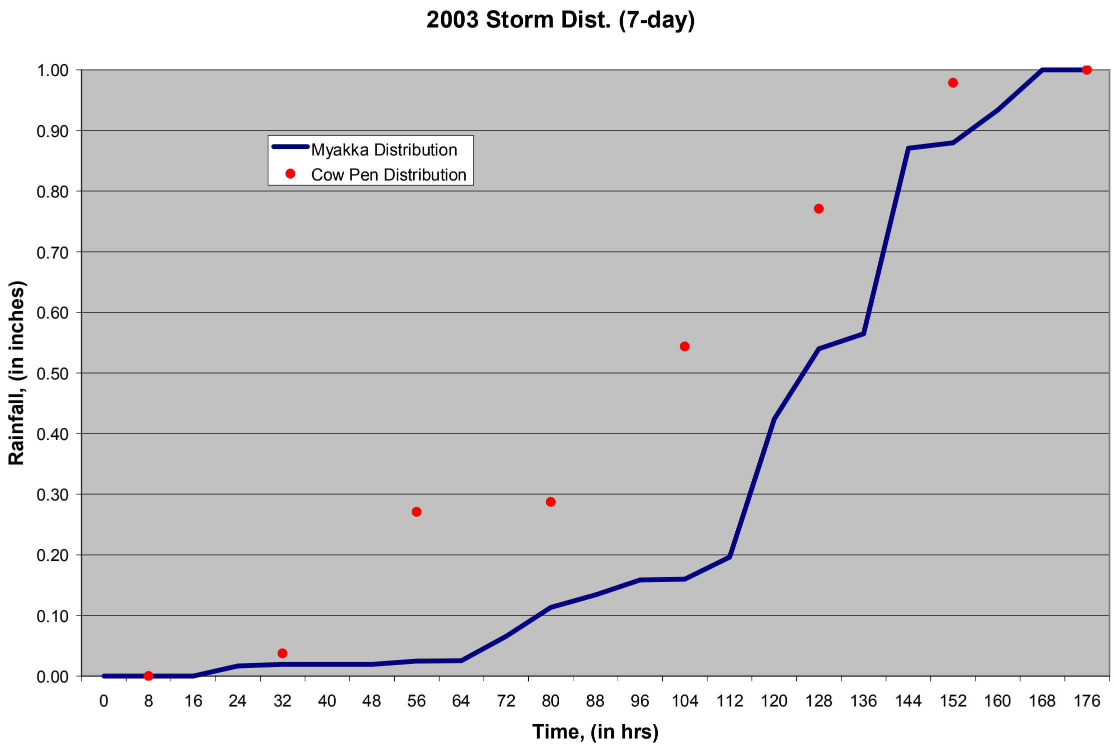

Figure 5 – Comparison of Dimensionless Rainfall Distributions

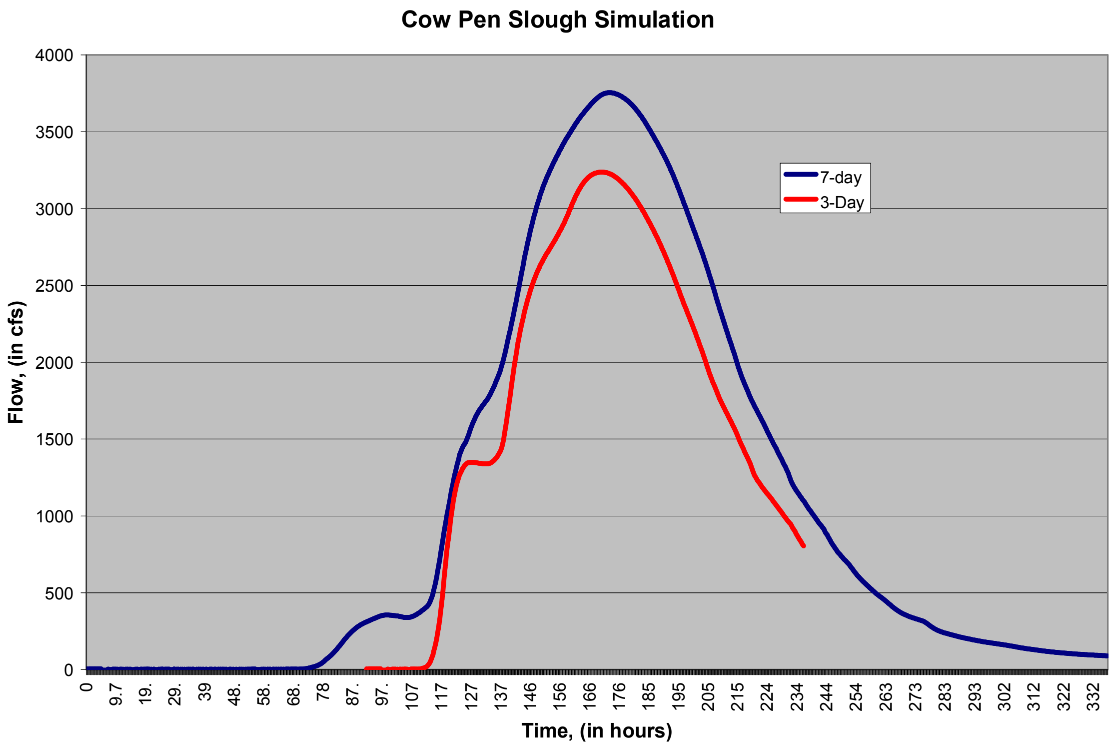

Figure 6 – Comparison of 3-day and 7-day Rainfall Durations

Table 6 compares the average daily flows generated from the 7-day duration storm event simulation for Cow Pen Slough to those measured at the Myakka River USGS gage site 02298830. **Figure 7** presents a graph of the average daily flows based upon the original transfer equations (in red) and those values presented in **Table 6** (in blue). A linear equation shown as a dashed line was fitted to the "blue" points and intersects the original transfer equations around a flow rate of 2000 cfs for the Myakka River.

Date	Myakka River (Average Daily Flow)	Cow Pen Slough (Average Daily Flow)
June 20, 2003	482 cfs	174 cfs
June 21, 2003	1120 cfs	483 cfs
June 22, 2003	3910 cfs	1841 cfs
June 23, 2003	8700 cfs	3335 cfs
June 24, 2003	10800 cfs	3598 cfs
June 25, 2003	9540 cfs	2590 cfs
June 26, 2003	7490 cfs	1391 cfs
June 27, 2003	5820 cfs	667 cfs
June 28, 2003	4530 cfs	301 cfs
June 29, 2003	3630 cfs	166 cfs
June 30, 2003	2850 cfs	105 cfs

Table 6 – Comparison of Average Daily Flows

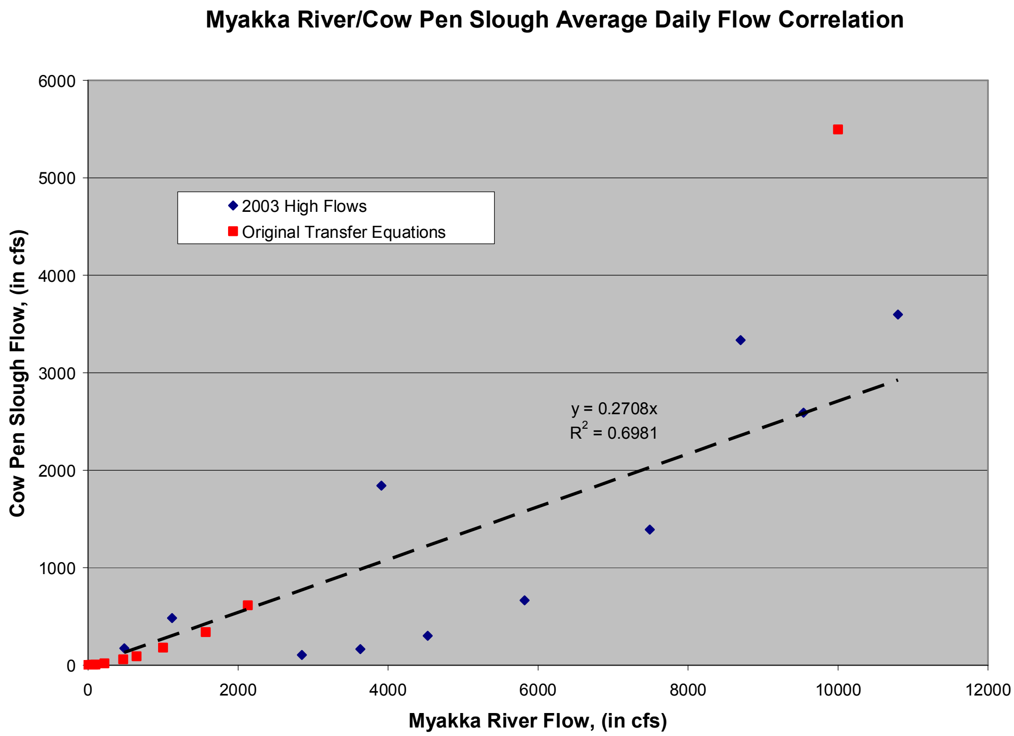

Figure 7 – Myakka River/Cow Pen Slough Flow Correlation

In terms of the validity of the remainder of the transferred data during the 2003 to 2005 period, deviations in runoff generally tracked deviations in rainfall. An attempt was made to compare transferred and measured data on a monthly basis. This information is summarized in **Table 7** through **Table 10**.

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
2003	0.11	1.37	2.16	3.52	3.61	22.73	4.76	12.50	8.08	0.79	0.98	5.09	65.70
2004	2.02	4.32	0.89	2.80	0.79	7.73	11.36	11.90	9.10	1.81	1.28	3.74	57.74
2005	2.51	3.80	4.42	3.61	3.47	11.93	9.30	4.09	2.16	6.32	3.68	0.57	55.85
Ave	**1.55**	**3.16**	**2.49**	**3.31**	**2.62**	**14.13**	**8.47**	**9.50**	**6.45**	**2.97**	**1.98**	**3.13**	**59.76**

Table 7 – Upper Myakka River (Transferred) Rainfall (in inches)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
2003	3.11	0.30	0.17	0.14	0.55	15.69	4.16	11.02	4.79	1.14	0.07	0.62	41.76
2004	0.31	0.39	0.80	0.04	0.03	0.06	1.11	9.92	8.12	2.91	0.15	0.09	23.92
2005	0.93	0.21	1.89	0.59	0.30	5.17	3.60	1.78	0.23	0.24	1.02	0.38	16.36
Ave	**1.45**	**0.30**	**0.96**	**0.25**	**0.29**	**6.97**	**2.96**	**7.57**	**4.38**	**1.43**	**0.41**	**0.36**	**27.35**

Table 8 – Cow Pen Slough Transferred Runoff (in inches)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
2003	0.15	0.91	1.46	2.96	4.58	16.54	5.56	15.93	11.23	1.43	0.72	5.21	66.67
2004	1.76	4.22	0.62	4.36	0.97	5.81	5.58	9.76	5.38	2.29	1.67	3.44	45.85
2005	2.16	3.81	4.37	2.74	3.78	15.44	7.45	3.36	3.28	7.91	3.11	0.72	58.10
Ave	**1.36**	**2.98**	**2.15**	**3.35**	**3.11**	**12.60**	**6.20**	**9.68**	**6.63**	**3.87**	**1.83**	**3.12**	**56.87**

Table 9 – Cow Pen Slough Measured Rainfall (in inches)

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	SUM
2003	1.84	0.25	0.34	0.27	0.31	8.14	2.58	6.18	4.97	1.09	0.34	0.36	26.67
2004	0.17	1.05	0.46	0.09	0.06	0.12	2.18	7.75	6.25	0.91	0.09	0.27	19.39
2005	0.45	0.42	3.03	0.44	0.23	6.98	4.19	0.83	0.17	0.62	0.50	0.17	18.03
Ave	**0.82**	**0.57**	**1.28**	**0.27**	**0.20**	**5.08**	**2.98**	**4.92**	**3.80**	**0.87**	**0.31**	**0.27**	**21.36**

Table 10 – Cow Pen Slough Measured Runoff (in inches)

Figure 8 provides an updated graph comparing the transferred and measured runoff in Cow Pen Slough between 2003 and 2005 based upon the updated transfer method.

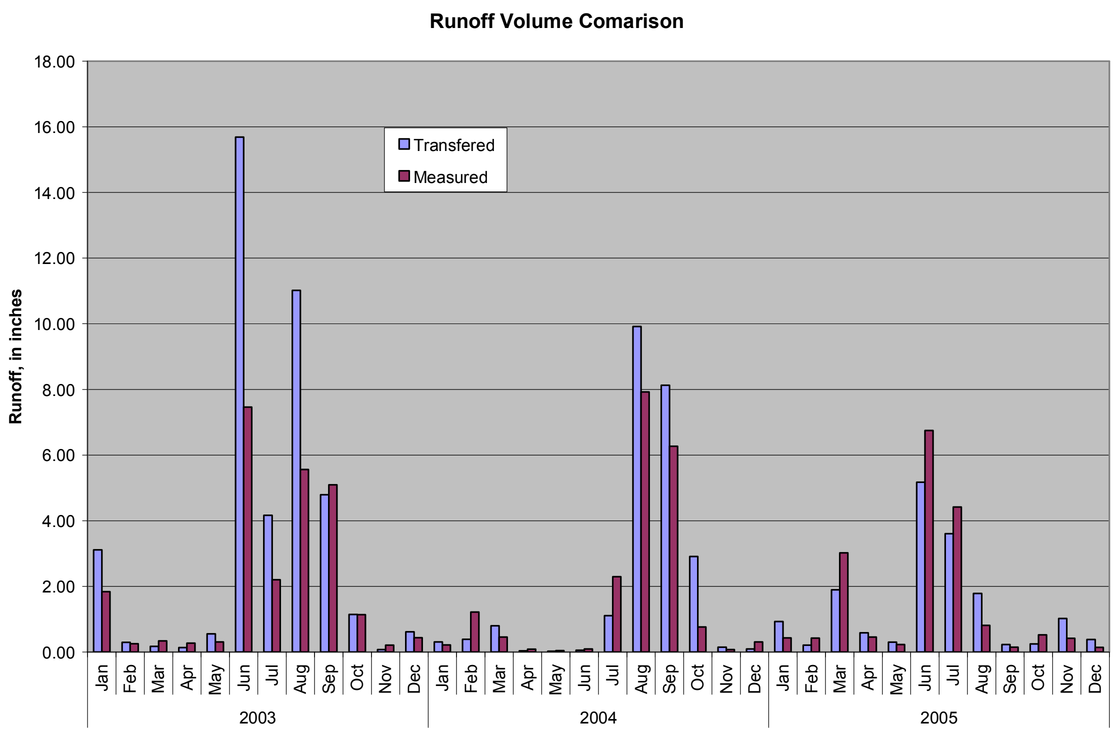

Figure 8 – Transferred and Measured Flows in Cow Pen Slough (2003- 2005) (based upon updated transfer method)

Next, the measured data was evaluated to determine if monthly runoff prediction was possible, given monthly rainfall. However with only 3 years of measured data points for each month, it was not possible to reach any definitive conclusions relative to the relationship between rainfall and runoff. While comparing transferred and measured data on an annual basis may be too broad of a time period, making such a comparison on a monthly basis may be too narrow of a window.

Recent work conducted by the Southwest Florida Water Management District on the Upper Myakka River identified three seasonal blocks that may be better suited for comparing the hydrologic trends and therefore the transferred and measured data. These three seasonal blocks periods are defined as:

Block 1 – April 20^{th} through June 24^{th}
Block 2 – October 28^{th} through April 19^{th}
Block 3 – June 25^{th} through October 27^{th}

A comparison of the measured and transferred seasonal block analyses are summarized in **Table 11** and **Table 12,** respectively. As indicated in the cells highlighted in red (corresponding to seasonal block periods with complete rainfall and runoff data records) in **Table 11** and **Table 12**, the measured and transferred runoff-to-rainfall ratios are very comparable. In fact, the transferred ratios are consistently slightly below the measured or actual ratios, so that the transferred data should provide a slightly conservative estimate of actual flows. This may be desirable since the transferred data is to be used to predict the reliability of available water.

Block 2			
2003	Rainfall (inches)	Runoff (inches)	%
Block 1	21.88	6.26	0.29
Block 3	14.05	17.18	1.22
Block 2	15.80	2.43	0.15
Total	**51.73**	**25.87**	**0.50**
2004	Rainfall (inches)	Runoff (inches)	%
Block 1	8.56	0.18	0.02
Block 3	25.30	17.07	0.67
Block 2	17.23	4.66	0.27
Total	**51.09**	**21.91**	**0.43**
2005	Rainfall (inches)	Runoff (inches)	%
Block 1	16.72	6.35	0.38
Block 3	23.48	6.64	0.28
Block 2			
Total			

Table 11 – Block Analysis Summary (Measured)

Block 2	16.58	7.13	0.43
2003	Rainfall (inches)	Runoff (inches)	%
Block 1	28.53	7.30	0.26
Block 3	30.58	30.07	0.98
Block 2	15.58	2.23	0.14
Total	**74.69**	**39.60**	**0.53**
2004	Rainfall (inches)	Runoff (inches)	%
Block 1	7.82	0.08	0.01
Block 3	35.91	21.99	0.61
Block 2	17.68	3.87	0.22
Total	**61.41**	**25.94**	**0.42**
2005	Rainfall (inches)	Runoff (inches)	%
Block 1	15.92	5.17	0.32
Block 3	22.58	6.06	0.27
Block 2			
Total			

Table 12 – Block Analysis Summary (Transferred)

2.4 Estimation of Excess Freshwater Volume to Dona Bay from the Cow Pen Canal

To estimate the magnitude of additional freshwater that has been added to the Dona Bay estuary by the Cow Pen canal diversion, the estimated natural water budget for the historical Dona Bay watershed contained in Technical Memorandum 4.1.2 was compared with the flows projected by the transfer equations. Although earlier drainage works began diverting flows from the Myakka River to Salt Creek and Dona Bay in the early 1900's, the primary canal diversion by the SCS was not completed until 1966. Therefore for sake of comparison, only the area diverted by this later project and this date were considered to illustrate the beginning of the introduction of additional flows. The estimated amount of historical and existing freshwater runoff from the Cow Pen Canal to Dona Bay are presented on **Figure 9**. The historical estimates are based upon the seasonal block analyses presented in TM 4.1.2. The additional runoff estimates are based upon the transferred data for Cow Pen Slough aggregated by month. Therefore, to approximate the historical time frames, the monthly Cow Pen Slough data was summed for May through June (Block 1), July through October (Block 3), and November through April (Block 2). To provide a more direct comparison, a cumulative volume comparison was also prepared and is provided in **Figure 10**.

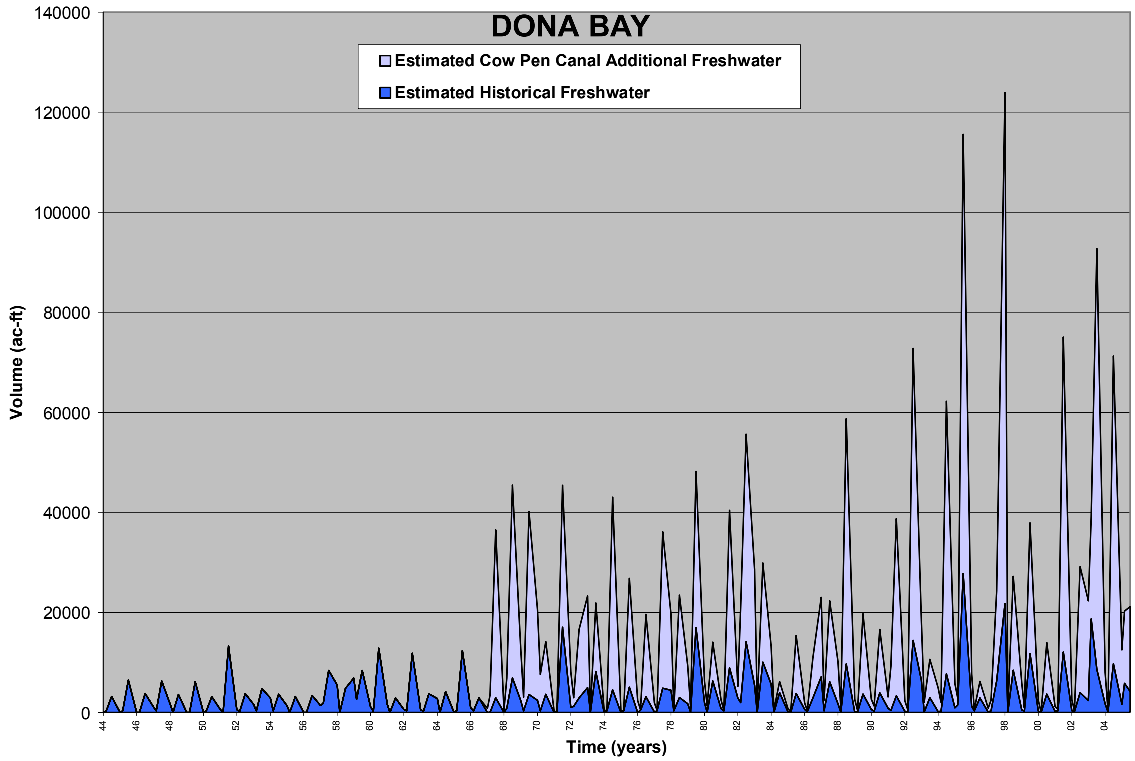

Figure 9 – Dona Bay, Estimated Historical and Excess Freshwater

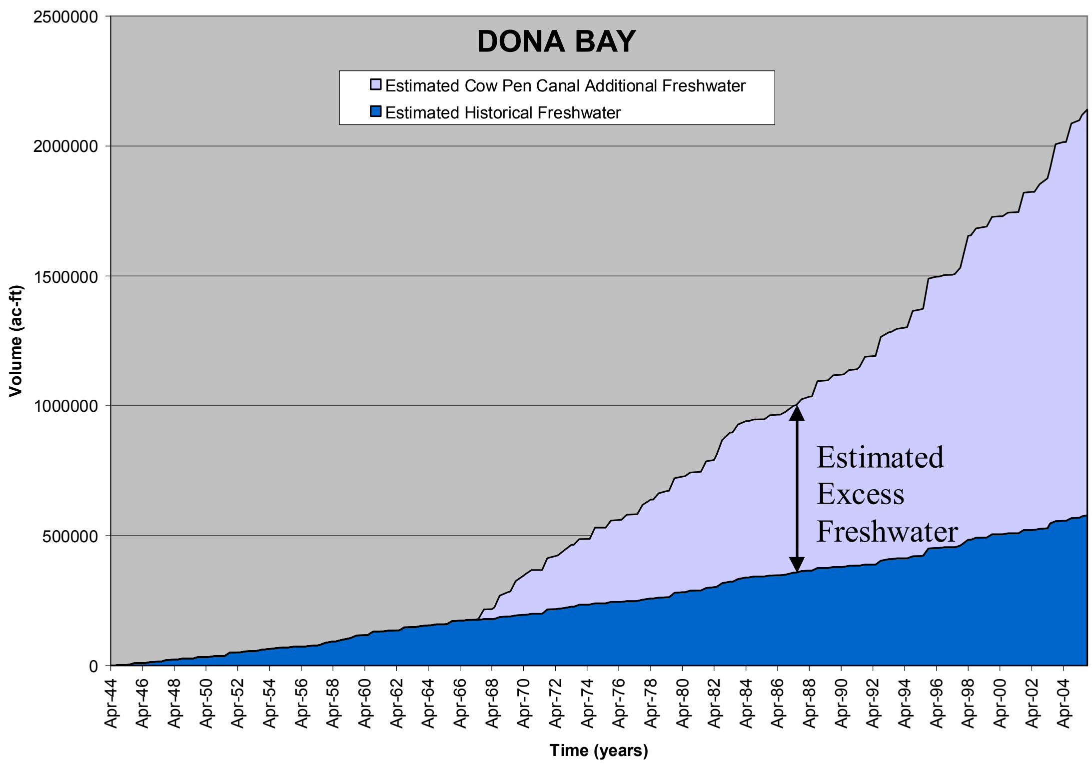

Figure 10 – Dona Bay, Estimated Historical and Excess Freshwater (Cumulative)

2.5 Alternative Water Supply Options for Dona Bay

Using the transferred data for Cow Pen Slough, an analysis was performed for the three (3) phases presented in Technical Memorandum 4.2.7. Generally, Phase 1 includes the utilization of the Venice Minerals site as a gravity fed surface water supply reservoir pursuant to Alternative 2 of Technical Memorandum 4.2.4.1. Phase 2 includes Venice Minerals plus the Albritton site as a gravity fed surface water supply reservoir pursuant to Alternative 3 of Technical Memorandum 4.2.4.2. Phase 3 adds an intake pumping facility to provide additional above ground storage in the Albritton site pursuant to Alternative 5 of Technical Memorandum 4.2.4.2.

Each phase was evaluated by creating monthly water budgets using the transferred runoff data base (70 years). Monthly rainfall was taken from the SWFWMD web site for the Myakka River. Monthly ET is based upon published potential evapotranspiration rates for southwest Florida by the University of Florida, Institute of Food and Agricultural Sciences (IFAS). Based upon the net monthly inflow (inputs minus outputs), the monthly reservoir storage was adjusted and excess water accounted for as outflow.

A range of yields were considered and corresponding reliabilities were determined. The reliability is defined as the estimated percentage of the time that the source water would be sufficient to meet the corresponding yields. It is calculated as the time that the supply is sufficient to meet the associated yield divided by the entire time period of the analysis. **Table 13** provides the yields and associated reliabilities for each phase.

Phase 1 Yield	Reliability	Phase 2 Cumulative Yield	Reliability	Phase 3 Cumulative Yield	Reliability
5 mgd	100 %	10 mgd	99.2 %	15 mgd	97.8 %
6 mgd	99.3 %	11 mgd	98.7 %	16 mgd	97.3 %
7 mgd	98.4 %	12 mgd	97.7 %	17 mgd	95.7 %

Table 13 – Phase Yields and Reliabilities

Based upon these evaluations, it is estimated that each of the 3 phases could yield an increment of 5 mgd, for a total of 15 mgd.

2.6 Dona Bay Water Supply Options on Reducing Excess Freshwater

To estimate the potential ability of each of phase of the Dona Bay Water Supply Option presented in Section 2.5 to reduce excess freshwater volumes to Dona Bay, the period of flow from 1966 to present was considered. **Figure 11** illustrates the cumulative reduction of excess freshwater in 5 mgd increments, corresponding to each potential phase. If all phases consisting of 15 mgd had been implemented, over 40% of the excess freshwater diverted by the Cow Pen canal could theoretically be reduced. Although what has occurred in the past cannot be undone, this analysis does indicate what could be expected in the future if the water supply option was implemented as part of the DBWMP.

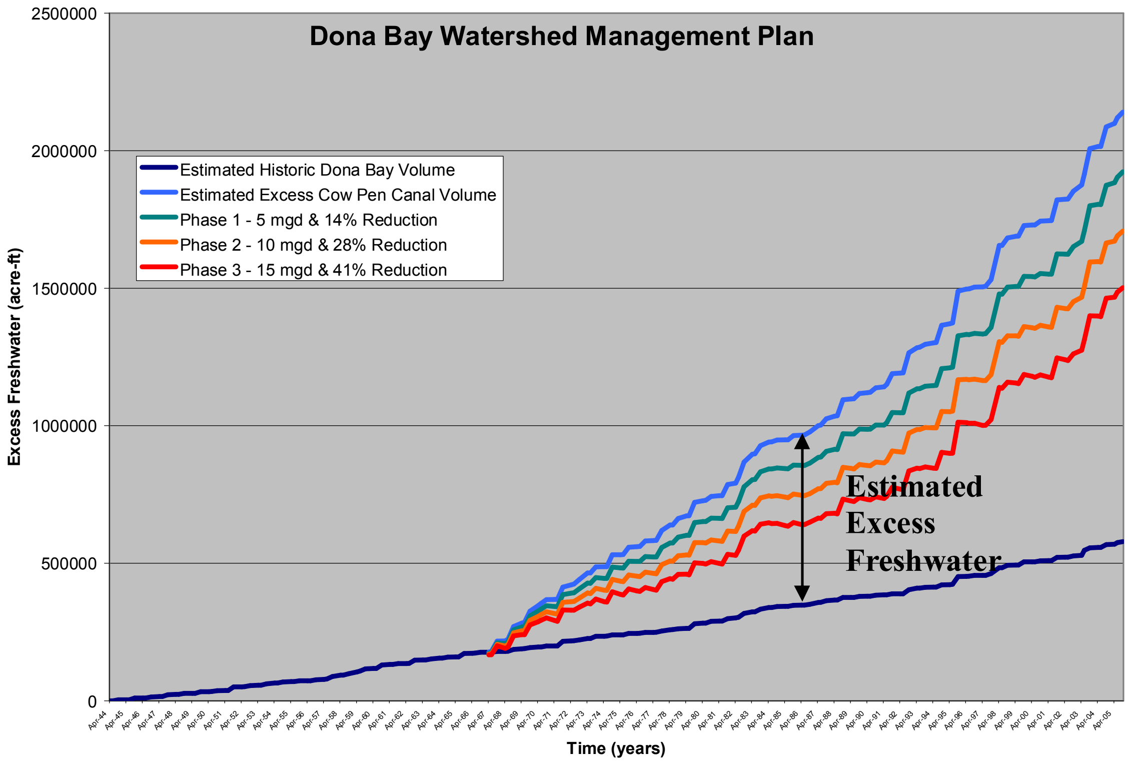

Figure 11 – Potential Benefit of Water Supply Options on Reducing Cumulative Excess Freshwater to Dona Bay

3.0 ROBERTS BAY AND BLACKBURN CANAL

3.1 Historical Perspective

The Blackburn Canal was constructed in the late 1950's and early 1960's by private property interests to relieve flooding on the Myakka River. Blackburn Canal intercepts the Myakka River between the present day Border Road and I-75 bridges. It extends approximately 6 miles from its confluence with the Myakka River to Roberts Bay and according to the original engineering report prepared by DeLew, Cather, and Brill, the Blackburn Canal was designed to convey approximately 800 cfs for the 50-year frequency flood event. This canal was excavated at or below sea level from the Myakka River, west to Curry Creek. Curry Creek, once a relatively short, natural coastal creek, was straightened and deepened to provide for an adequate hydraulic connection with the Blackburn Canal. **Figure 12** shows the east end of the Blackburn Canal at its confluence with the Myakka River.

The USGS has estimated flood stages at the confluence of the Myakka River and Blackburn Canal of 5.8, 7.9, 9.2, 10.4, 11.2, 11.9, 12.5, and 13.0 msl for the 2, 5, 10, 25, 50, 100, 200 and 500-year frequency flood, respectively. Since it is excavated at or below sea level for its entire length, this canal has the potential to accept a portion of all freshwater flows from the Myakka River.

Figure 12 – Blackburn Canal at Confluence with Myakka River

3.2 Development of Long-Term Flow Data for Blackburn Canal

In previous work performed by KHA in association with the Curry Creek Floodplain Study Update, it was estimated that approximately 7% of the freshwater flows by volume in the Myakka River were diverted to Curry Creek and Roberts Bay by the Blackburn Canal. With a contributing area of approximately 278.2 square miles and an average annual runoff of 15.26 inches, the estimated average annual volume of freshwater diverted to Roberts Bay from the Myakka River would be 15,851 acre-feet. However, as is the case with rainfall, this annual runoff volume may vary significantly from year to year.

The USGS began monitoring flows in Blackburn Canal at Jackson Road in 2004. This information was reviewed to verify the actual flow volumes diverted by Blackburn Canal. The measured flows in Blackburn Canal were plotted against the corresponding flows in the Myakka River and USGS gage 02298830 and are presented in **Figure 13**. The data presented in **Figure 13** plots the average daily flows measured by the USGS between March 6, 2004 and October 1, 2005. Based upon these measurements, the actual volume of runoff diverted from the Myakka River by Blackburn Canal during this period of record equated to 55,830.84 acre-feet.

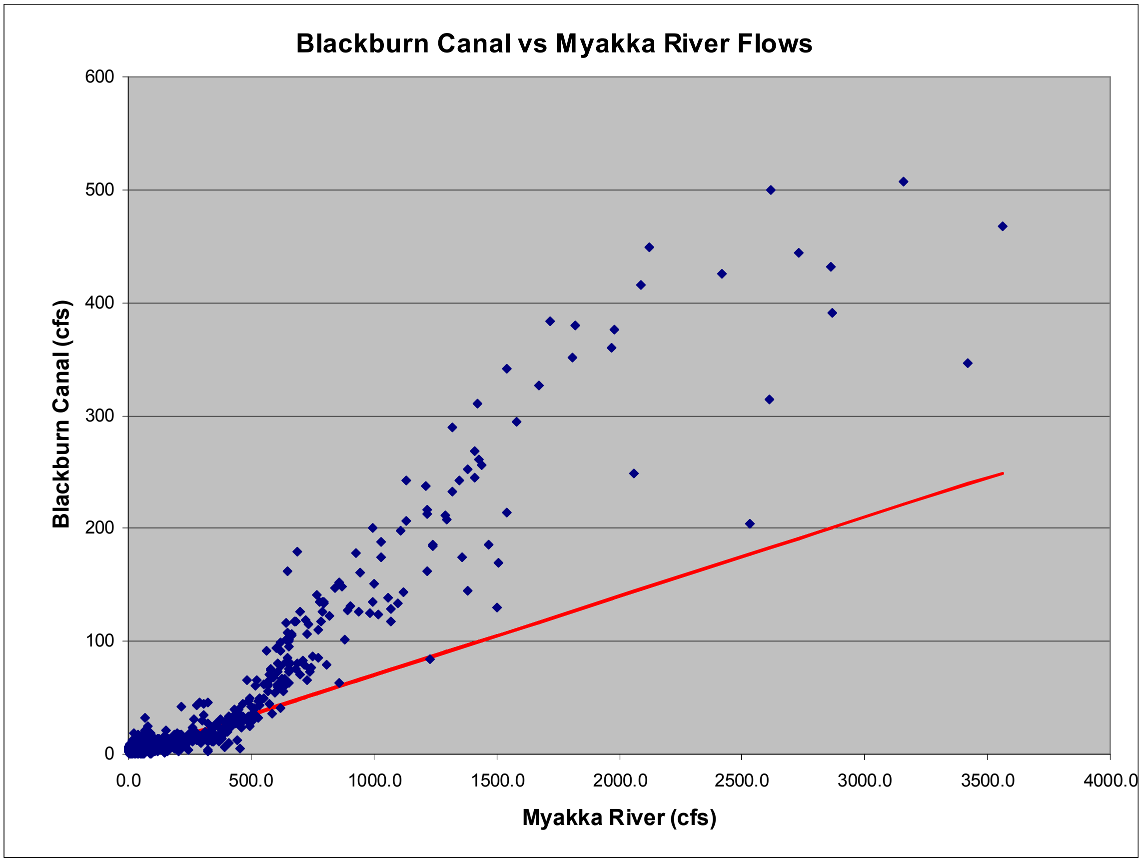

Figure 13 – Myakka River vs. Blackburn Canal (measured flows)

A line corresponding to 7% of the Myakka River flows is also presented on **Figure 13** and indicates that flows in Blackburn Canal correspond to approximately 7% of the flow in the Myakka River at USGS gage 02298830 up to approximately 500 cfs. However, when flows in the Myakka River exceed 500 cfs, flows in Blackburn Canal are consistently above the 7% line. For the period of actual flow measurements (March 6, 2004 through October 1, 2005), 7% of the total runoff volume from the Myakka River would have equated to 30,822.20 acre-feet or only 55% of the actual runoff volume.

Figure 14 presents the same Myakka River/Blackburn Canal flow data set fitted with a 4^{th} order polynomial curve having an R "squared" of 0.93. However, during the period of record (March 6, 2004 through October 1, 2005) high flows in the Myakka River did not exceed 3560 cfs. In order to develop a flow relationship between the Myakka River and Blackburn Canal when flows in the Myakka River exceed 3500 cfs, the flood flows developed by the USGS in their 1977 report entitled *Magnitude and Frequency of Flooding on the Myakka River, Southwest Florida* were considered. This report provided the flood flow relationships between the Myakka River (at the State Park) and Blackburn Canal as presented in **Table 14**. Interestingly, it is noted that with the exception of the 2-year frequency event, flood flows in the Blackburn Canal are consistently 8% of those in the Myakka River. For the 2-year frequency event, the Blackburn Canal flood flow is only 4% of that in Myakka River.

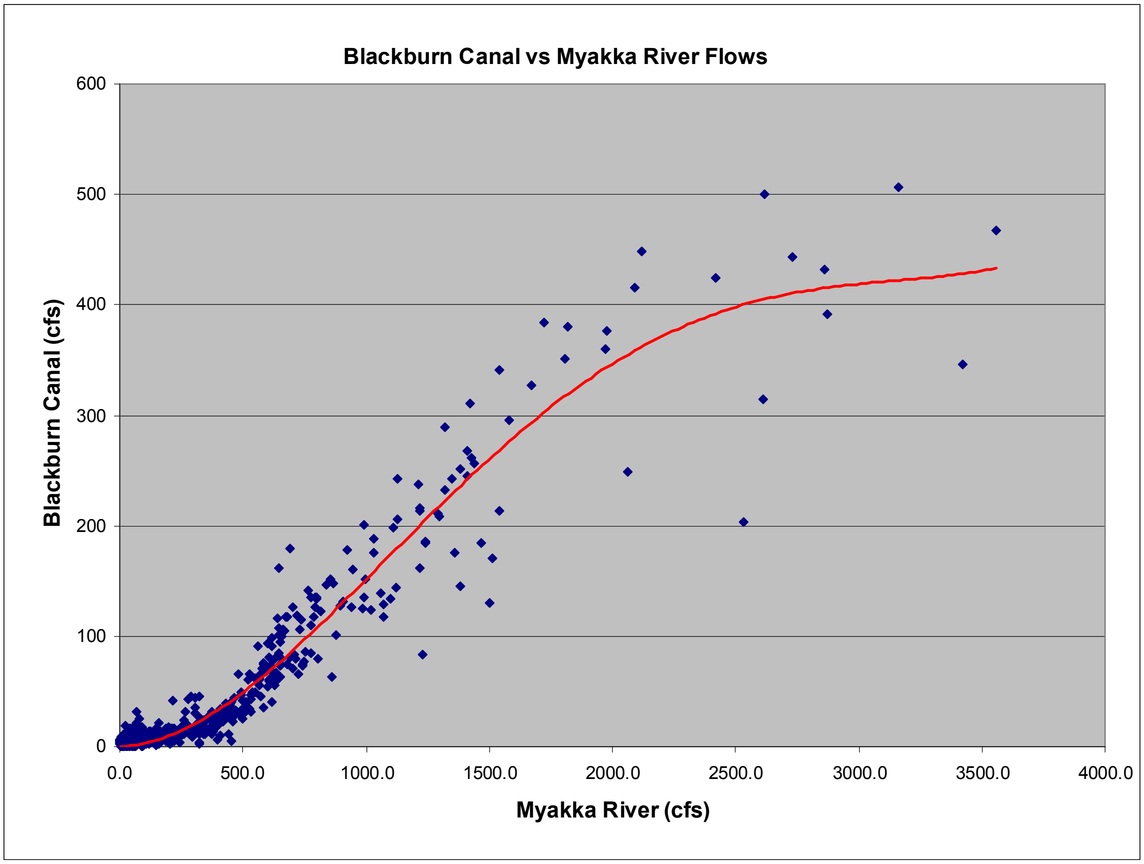

Figure 14 – Myakka River vs. Blackburn Canal (measured flows)

Site	2-yr (cfs)	5-yr (cfs)	10-yr (cfs)	25-yr (cfs)	50-yr (cfs)	100-yr (cfs)	200-yr (cfs)	500-yr (cfs)
Myakka	2070	3480	4640	6340	7750	9350	11200	13500
Blackburn	86	270	361	494	609	735	882	1085

Table 14 – Myakka River & Blackburn Canal Flood Flow Relationship (based upon USGS, 1977)

As previously indicated, the USGS report provides a relationship between flood discharges. **Table 15** provides a comparison between these flood discharges and the measured average daily discharges where an overlap between the data sets exist. This comparison indicates that where an overlap exists, the flood discharges are consistently less than the measured average daily discharges. However, lacking actual flow measurements in excess of 3560 cfs, the flood flow relationship appears reasonable, with the possible exception of the 2-year flood flow relationship.

Myakka River - Average Daily Flow	Blackburn Canal - Average Daily Flow
2060 cfs	249 cfs
2070 cfs	**86 cfs**
2090 cfs	416 cfs
2120 cfs	449 cfs
2420 cfs	425 cfs
2530 cfs	204 cfs
2610 cfs	314 cfs
2620 cfs	500 cfs
2730 cfs	444 cfs
2860 cfs	432 cfs
2870 cfs	391 cfs
3160 cfs	507 cfs
3420 cfs	346 cfs
3480 cfs	**270 cfs**
3560 cfs	468 cfs
4640 cfs	**361 cfs**

Table 15 – Comparison of Average Daily and Flood Discharges

Figure 15 presents a graph the flow relationship using both the average daily and instantaneous flows for the Myakka River and the Blackburn Canal (with the exception of the 2-year flood flow) when flows in the Myakka River exceed 1000 cfs. A 4^{th} order polynomial equation with and R "squared" of 0.86 was also fitted to this high flow data set. **Table 16** presents the flow regime equations developed to define the relationship between flows in the Myakka River and Blackburn Canal. Since 1400 cfs resulted in comparable flows in Blackburn Canal using both equations, it was used to form a smooth transition between these 2 equations. Application of these flow regime equations to the measured data set (March 6, 2004 through October 1, 2005) yielded a total runoff volume of 52,660.30 acre-feet, or 94% of that actual runoff volume. These flow regime equations were applied to the entire USGS average daily flow data set for the Myakka River (September 1936 through December 2005). However, it should be noted that Blackburn Canal was not constructed until the late 1950's, or early 1960's.

Flow Regime	Regression Equation	R "squared"
$0 < y < 1400$ cfs	$y = 0.00000000001127x^4 – 0.000000095x^3 + 0.000229x^2 + 0.0063x$	0.93
$y > 1400$ cfs	$y = -0.00000000001201x^4 + 0.000000004x^3 – 0.000043x^2 + 0.2245x$	0.86

Table 16 – Myakka River/Blackburn Canal Flow Relationship Equations

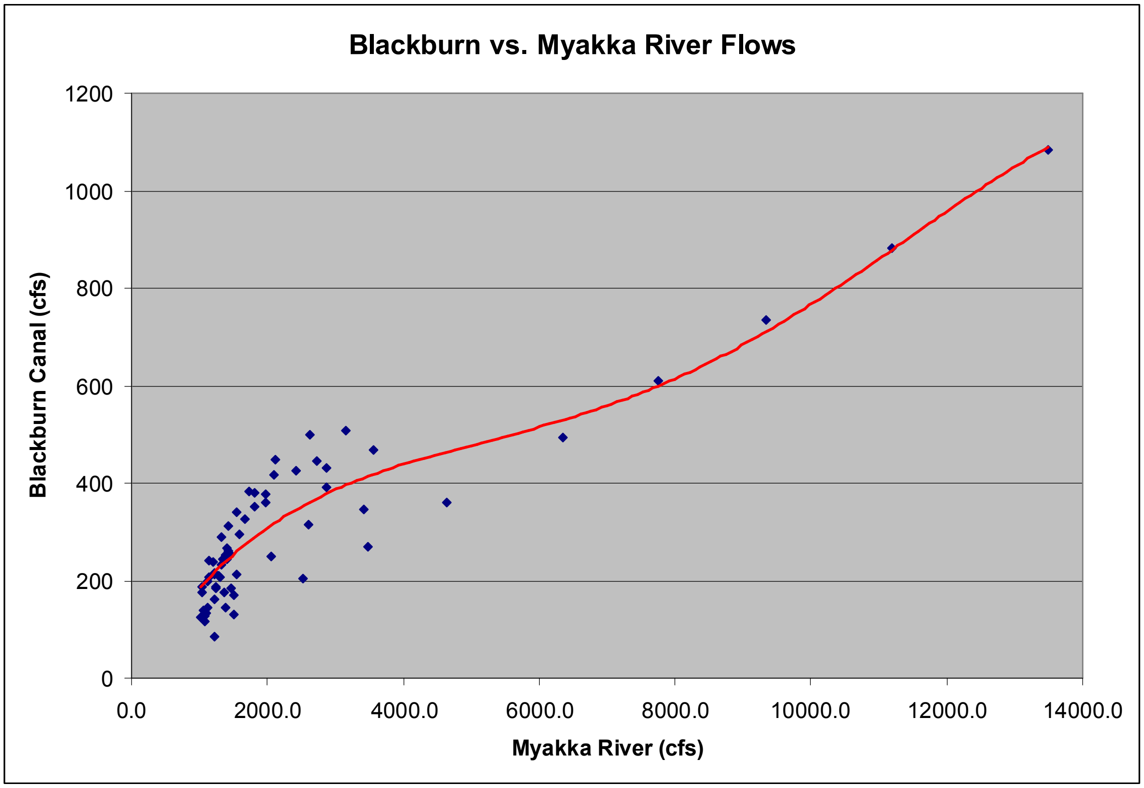

Figure 15 – Myakka River vs. Blackburn Canal (measured flows w/high flows)

3.3 Estimation of Excess Freshwater Volume to Roberts Bay from Blackburn Canal

To estimate the magnitude of additional freshwater that has been added to the Roberts estuary by the Blackburn Canal diversion, the estimated natural water budget for the historical Roberts Bay watershed contained in Technical Memorandum 4.1.2 was compared with the with the flows projected by the equations contained in Table 16. Based upon the original engineering report, it was assumed that the Blackburn Canal was completed by 1960. Therefore for sake of comparison, this date was used to illustrate the beginning of the introduction of additional flows. The amount of estimated historical and existing freshwater runoff to Roberts Bay is presented on **Figure 16**. The historical estimates are based upon the seasonal block analyses presented in TM 4.1.2. The additional runoff estimates are based upon the monthly volume estimates developed for Blackburn Canal. Therefore, to approximate the historical time frames, the monthly Blackburn Canal data was summed for May through June (Block 1), July through October (Block 3), and November through April (Block 2). To provide a more direct comparison, a cumulative volume comparison was also prepared and is provided in **Figure 17**.

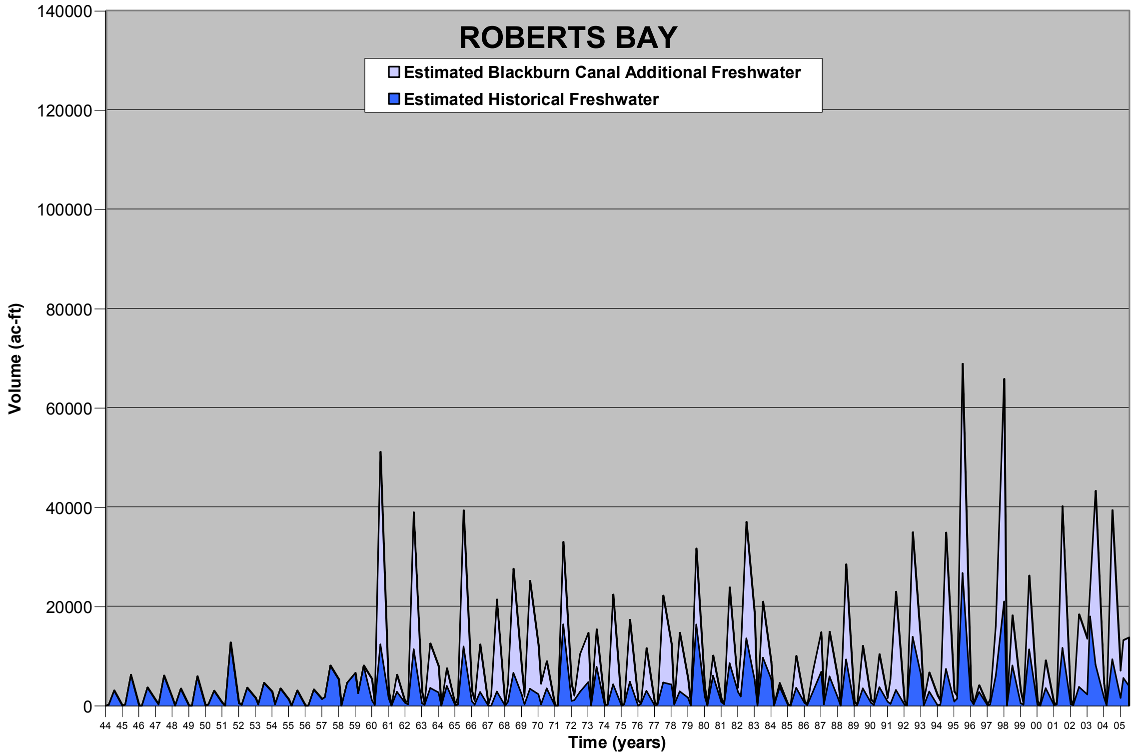

Figure 16 – Roberts Bay, Estimated Historical and Excess Freshwater

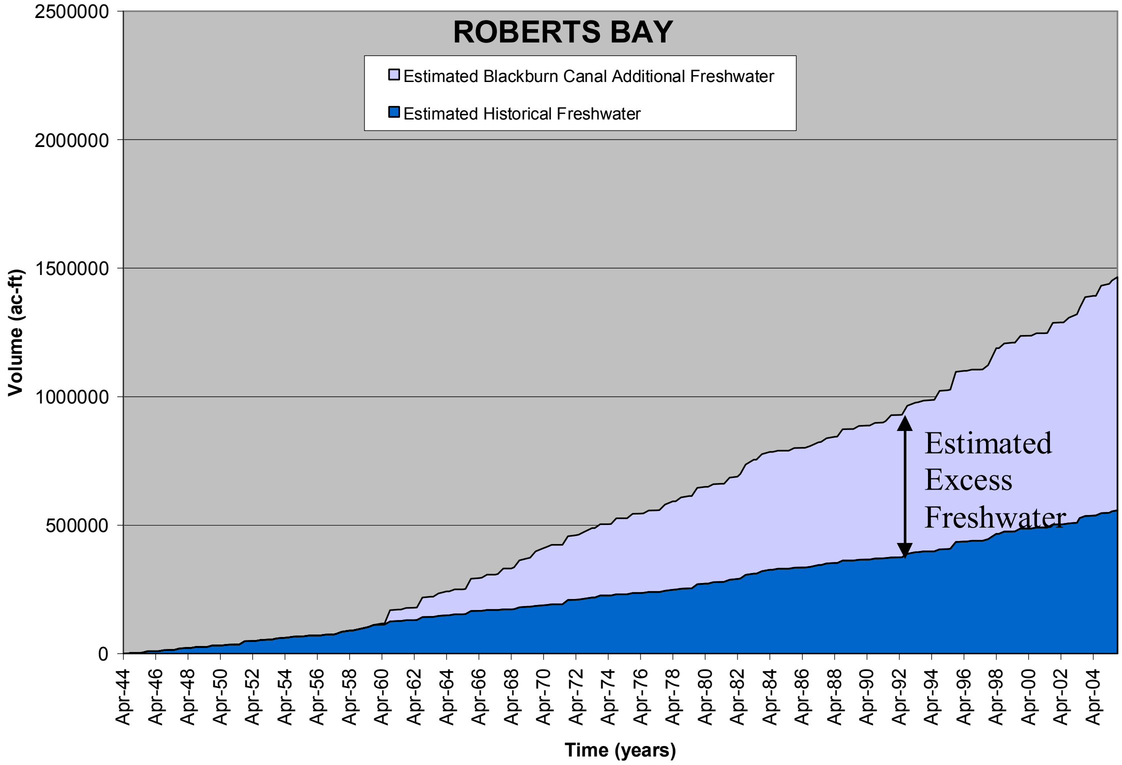

Figure 17 – Roberts Bay, Cumulative Historical and Excess Freshwater

3.4 Roberts Bay Low Head Weir Impact on Reducing Excess Freshwater

To estimate the potential impact of a low head weir in Blackburn Canal on reducing excess freshwater flows to Roberts Bay, it was first necessary to establish a stage-discharge relationship for the Blackburn Canal. Stage-discharge information collected by the USGS between March 6, 2004 and August 29, 2005 was analyzed. **Figure 18** provides a plot of the reported stage-discharge information for the Blackburn Canal.

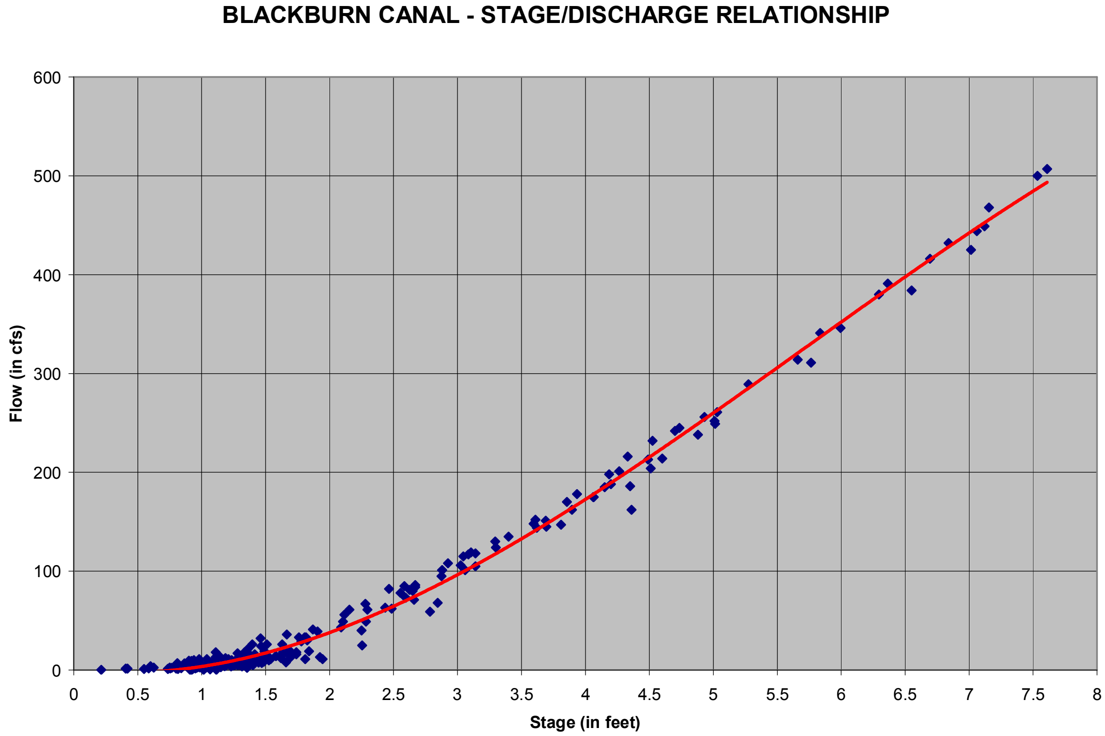

Figure 18 – Blackburn Canal Stage/Discharge Relationship

A third order polynomial equation with an R "squared" of 0.99 was fitted to the stage-discharge data and is provided in **Table 17**.

Blackburn Canal Stage-Discharge Regression Equation	R "squared"
$y = -1.0885x^3 + 18.644x^2 - 14.005x$	0.99

Table 17 – Blackburn Canal Stage/Discharge Equation

The potential impact on reduction of cumulative excess freshwater flows to Roberts Bay from Blackburn Canal was evaluated using three (3) low head weir elevations: 2.0, 2.5, and 3.0 ngvd. Based upon the stage-discharge regression equation, the corresponding discharges for weir inverts of 2.0, 2.5, and 3.0 are approximately 38 cfs, 64.5 cfs, and 96 cfs, respectively. The long-term Blackburn Canal discharge data base was then evaluated relative to the potential reduction in discharges to Roberts Bay for each low head weir option. Using the cumulative flow analyses presented in Figure 17, **Figure 19** illustrates the theoretical effectiveness of each low head weir in reducing excess freshwater flows to Roberts Bay if they had been installed when the Blackburn Canal was constructed.

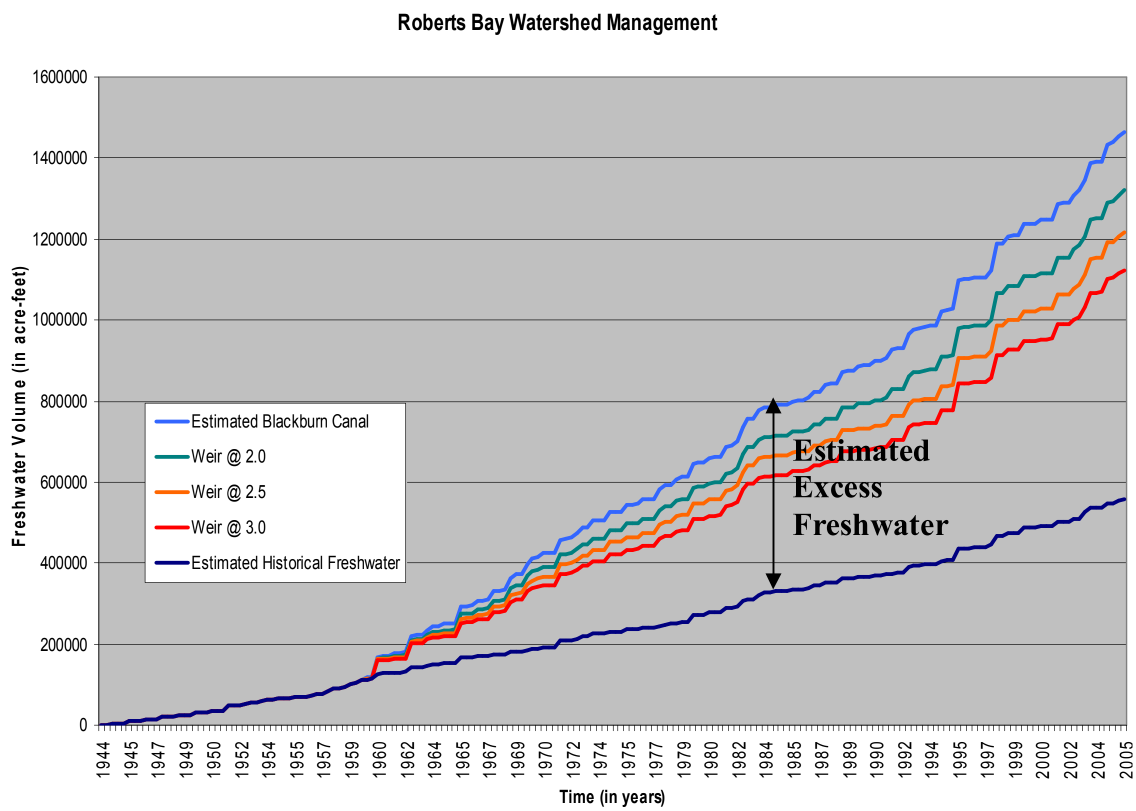

Figure 19 – Potential Cumulative Excess Freshwater Reduction to Roberts Bay

Although what has occurred in the past cannot be undone, this analysis does indicate what could be expected in the future if a low head weir was installed in Blackburn Canal east of Jackson Road. Of course, assurance would need to be provided that a low-head weir would not adversely increase flood stages in the Myakka River.

TM 4.2.3 – WATER QUANTITY | FLOW DIVERSION APPROACH

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and the Southwest Florida Water Management District (SWFWMD) are currently completing the necessary, pre-requisite data collection and analysis as well as the comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marine Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the SWFWMD, to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (CHNEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and Sarasota County's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

This Technical Memorandum has been prepared by PBS&J to present a summary of efforts to develop a statistically robust and scientifically valid flow diversion and system reliability analysis. This effort is consistent with Task 4.2.3 of the DBWMP contract.

2.0 INTRODUCTION AND DATA SOURCES

The objective of the flow diversion analysis was twofold: (1) to estimate the sustainable amount of water that would be available for water supply, and (2) to assess the characteristics of the Cow Pen Canal flows in the area of the upper water level control structure, as well as at those occurring at the lower water level control structure that discharges to Shakett Creek and Dona Bay.

The two factors that determine flow availability are total water demand and system reliability. Total water demand was defined as the maximum daily average amount of water that could be withdrawn from the reservoir for a given reliability. Reliability is the percent of time that the system would be able to deliver a given water demand.

The analysis was conducted to assess the 3 project phases described in TM 4.2.7 – Development of Phasing Plan. The geometric characteristics of the reservoir (area and volume) associated with each project phase are listed below:

Project Phase	Reservoir Area (acres)	Reservoir Volume (acre-ft)
1	388	5,634
2	978	11,488
3	978	17,342

Table 1 – Reservoir Characteristics

In addition to reservoir geometry, the input data used in the analysis included flow, precipitation, and potential evapotranspiration. Sources are described below.

- Flow data was derived from Myakka River to Cow Pen Slough transfer equation analysis, as discussed in Technical Memorandum 4.2.2. Transfer data were available from 1936 to the present.
- Daily precipitation data was available from USGS Station 349. This station is located approximately 2.2 miles from the reservoir site and includes the longest set of continuous daily rainfall records in the area from 1956 to 2004.
- Potential evaporatranspiration (PET) data based upon "Potential Evapotranspirtion Probabilities and Distributions in Florida" published by the University of Florida, Institute of Food and Agricultural Sciences.

3.0 FLOW DIVERSION AND SYSTEM RELIABILITY ANALYSIS

The flow diversion and reliability analysis was conducted using a spreadsheet model that performed the calculations based on the following equation:

$$S_F = S_I + Q + P - E - D - E_x$$

Where:
S_F = Final storage volume
S_I = Initial storage volume
Q = Runoff
P = Direct precipitation on the reservoir area
E = Evaporation losses
D = Water demand
E_x = Reservoir excess (overflow continuing downstream)

The model was setup to assess system performance using a 49-year period of flow, precipitation and evaporation records (January 1, 1956 and December 31, 2004). That period was selected because it is the longest available for daily input of all variables. System reliability was calculated as the ratio (in percent) of days when the water demand would be met during the period of analysis to the total number of days in that simulation period.

4.0 SIMULATION MODEL RESULTS

A number of scenarios were simulated assuming flow diversions of 10, 30, 50 and 100 percent of the total flow into the reservoir. The model simulates the system performance on a daily basis over the simulation period (January 1, 1956 to December 31, 2004). Results are shown in Figures 1 through 3. The water demands associated with the alternative flow diversion amount for 90 and 95-percent system reliabilities are shown below. Reliability is calculated as the percent of the time in days that the system is capable of meeting the water demand. The 90 and 95-percent reliabilities are generally considered acceptable range of minimum values for appropriate operation of the water withdrawal system. An 85 percent flow diversion scenario was also considered for the Phase 3 analysis as an additional piece of information because the 15th percentile flow is often used to represent minimum flow conditions for minimum flows and levels analysis.

Flow Diversion	Water Demand (mgd) for 90-Percent Reliability			Water Demand (mgd) for 95-Percent Reliability		
(%)	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
10	2.5	2.8	2.9	2.2	2.2	2.3
30	5.6	7.1	7.6	4.7	6.2	6.7
50	7.5	10.1	11.7	6.3	8.6	10.3
85	9.7	13.6	16.5	8.0	11.5	14.2
100	10.4	15.0	18.2	8.6	12.6	15.4

Table 2 – Flow Diversion / Reliability

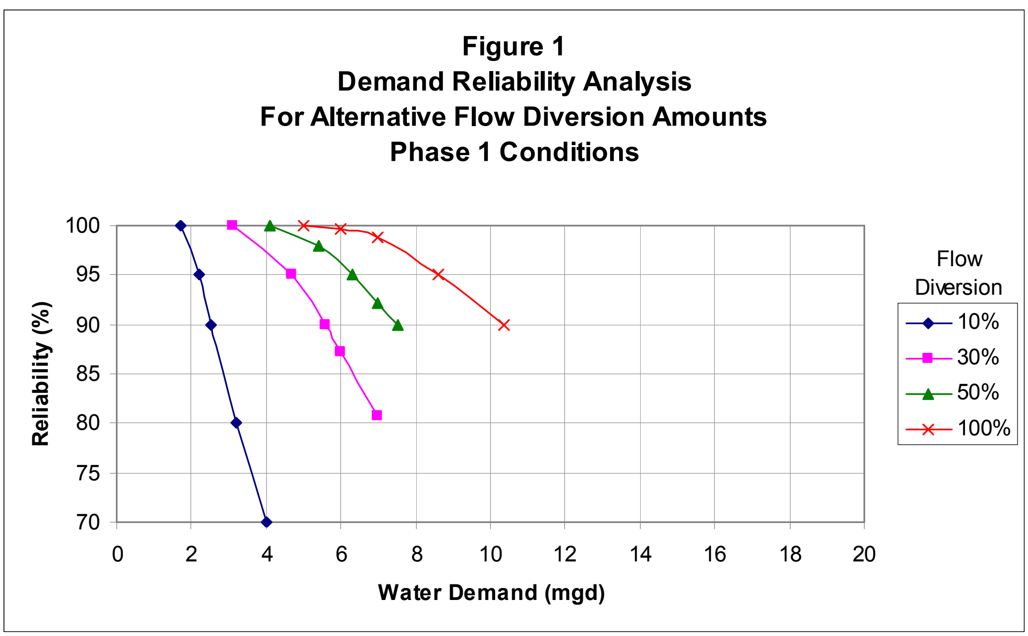

Figure 1 – Phase 1, Demand vs. Reliability

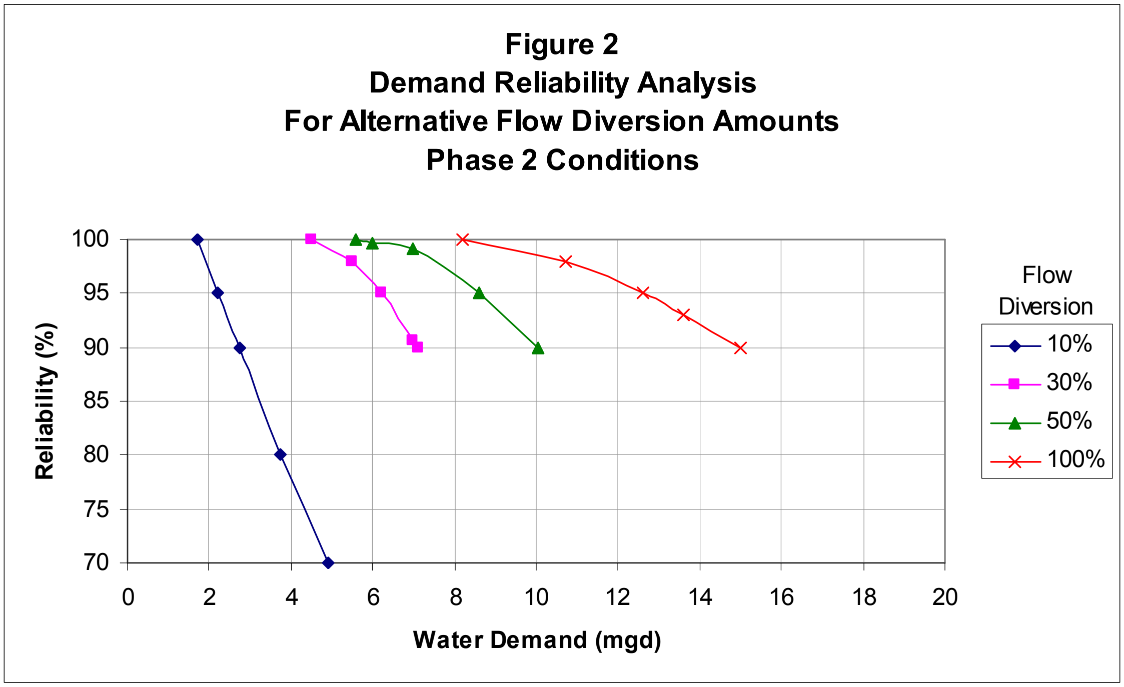

Figure 2 – Phase 2, Demand vs. Reliability

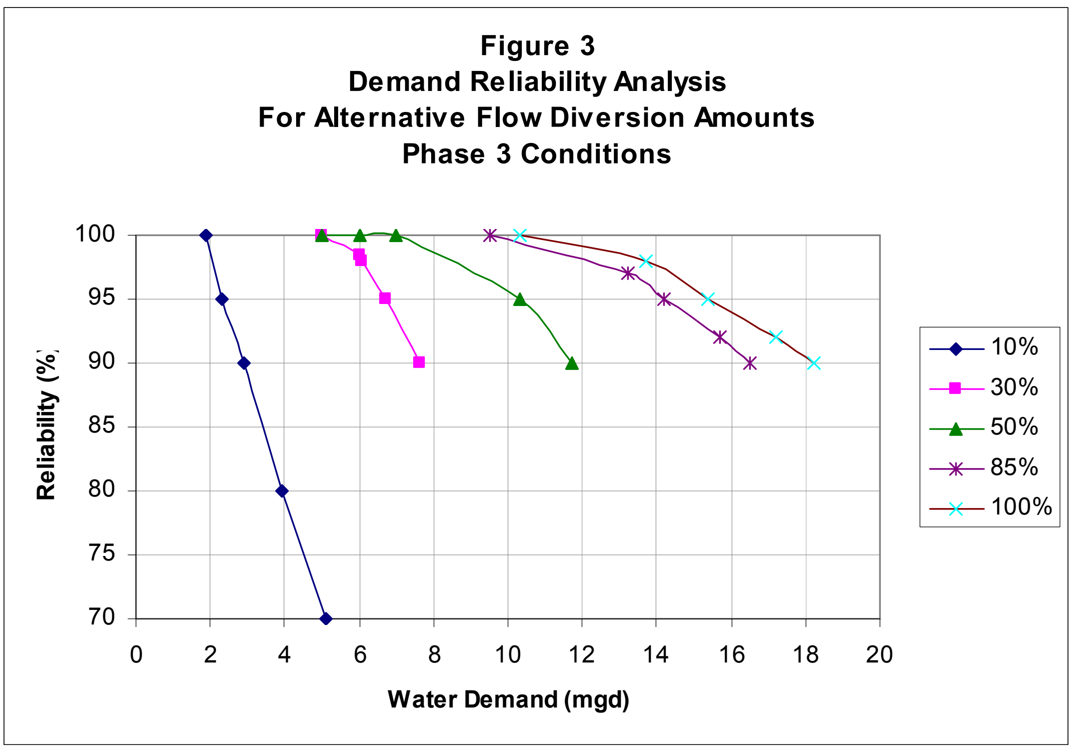

Figure 3 – Phase 3, Demand vs. Reliability

5.0 FLOW CHARACTERISTICS DOWNSTREAM OF THE PROPOSED RESERVOIR

Excess flows that either overflow or bypass the reservoir would continue downstream to the lower water level control structure on the Cow Pen Canal. An assessment of the quantity of these flows is necessary to help assess potential benefits in terms of flow reductions to Dona Bay. These flow quantities were determined at two locations in the watershed, downstream of the reservoir and between the upper and lower water level control structures. This quantity represents the reduced flows from the Cow Pen Canal discharging to Shakett Creek and Dona Bay resulting from the various watershed/hydrologic restoration plans corresponding to Phases 1 through 3.

Two water withdrawal scenarios were considered for this assessment, both associated with Phase 3 of the project plan.

1. A 100-percent flow diversion at a water demand of 15 mgd and 95% reliability
2. A 100-percent flow diversion at a water demand of 18 mgd and 90% reliability

Figure 4 shows the flow characteristics associated with both existing conditions and the two scenarios in the area immediately downstream from the proposed reservoir. As shown, both scenarios result in capturing all the available flow (88.5 percentile for Scenario 1 and 90.5 percentile for Scenario 2). Both proposed scenarios are believed to better represent historical characteristics of the watershed in terms of freshwater volumes to Dona Bay.

Figure 5 shows the estimated flow characteristics at the lower water level control structure where the Cow Pen Canal discharges to Shakett Creek and Dona Bay. The location considered in Figure 5 reflects the addition discharges from the watershed located between the upper and lower water level control structures. Due to the lack of measured data, flows from this portion of the watershed were estimated by a simple ratio of drainage areas. As the area downstream of the reservoir is approximately 20 percent of the area upstream of the reservoir, the total daily flow at the Dona Bay discharge for existing conditions was calculated as 120 percent of the flow indicated by the Myakka River/Cow Pen Slough transfer equations. For the two water withdrawal scenarios, the flow was calculated as 20 percent of the transfer equations flow plus the reservoir excess determined from the spreadsheet model. Both scenarios reflect an average reduction of fresh water discharges of about 77 percent and a median reduction of 83 percent. Those reductions are believed to be consistent with restoration goals.

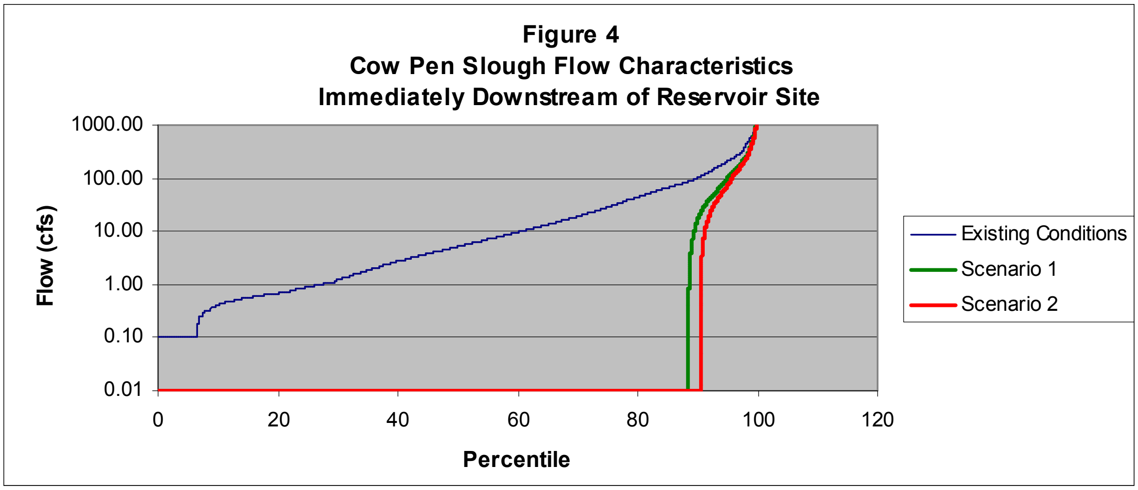

Figure 4 – Upstream Flow Percentiles

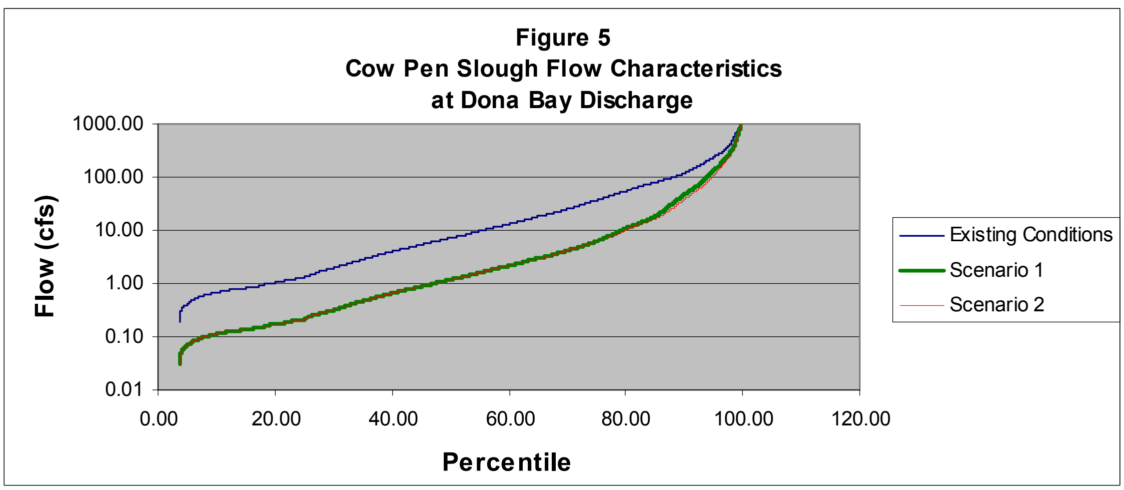

Figure 5 – Downstream Flow Percentiles

TM 4.2.4.1 – EVALUATION OF SURFACE STORAGE (Venice Minerals Site)

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and SWFWMD are currently completing the necessary, pre-requisite data collection and analysis as well as comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marin Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the Southwest Florida Water Management District (SWFWMD), to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (NEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and SCG's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

This Technical Memorandum has been prepared by KHA to provide a preliminary storage evaluation for the Venice Minerals site, consistent with Task 4.2.4 of the DBWMP contract. In addition a comparison of yields and opinions of probable capital costs are provided for three conceptual surface storage configurations.

2.0 DESCRIPTION OF VENICE MINERALS SITE

In 2004, Sarasota County purchased approximately 548 acres from Venice Minerals and Mining LLC (VM). In turn, Sarasota County leased approximately 402 acres back to VM to complete the on-going mining of sand, shell, and rock. The on-going mining operation is expected to be complete in 2 to 3 years.

The remaining un-mined 146 acres consists of natural and man-made wetlands as well as pine flatwoods. This area was acquired by Sarasota County's Environmentally Sensitive Lands Protection Program (ESLPP).

For the purpose of this analysis, the Venice Minerals site was evaluated in conjunction with the Albritton facility. However, it is anticipated that it may even be used in conjunction with other storage components in the Dona Bay watershed or within the Peace River Manasota Regional Water Supply Authority's (Authority) integrated regional water supply system. Such an integrated system would likely provide greater reliability than that available as a stand alone system.

3.0 ESTIMATE OF POTENTIAL YIELD

3.1 Alternatives Evaluated

Preliminary evaluations of three (3) surface water storage alternatives were performed for the Venice Minerals site. For the purposes of this analysis, it was assumed that the reservoir would be used in conjunction with the Albritton Site and filled by gravity to an elevation of approximately 18 NGVD with a total operating range of approximately 15 feet.

Each of the alternatives would have the following common features:

- A berm constructed to approximately elevation 28.0 NGVD around the entire reservoir.
- An emergency overflow to the historical Cow Pen Slough located in the northeast corner of the reservoir
- An additional setback from the east and south property lines to accommodate the existing recharge/drainage ditch.
- A freeboard of 10 feet above the maximum operating range.

Alternative 1 - Alternative 1 considered using the entire 548 acre area footprint (mining operation and the un-mined area) for a water storage reservoir (see **Figure 1**). This alternative assumed a top of berm elevation of 28 NGVD and is intended to provide an operating range of approximately 15 feet with a total surface area of approximately 490 acres.

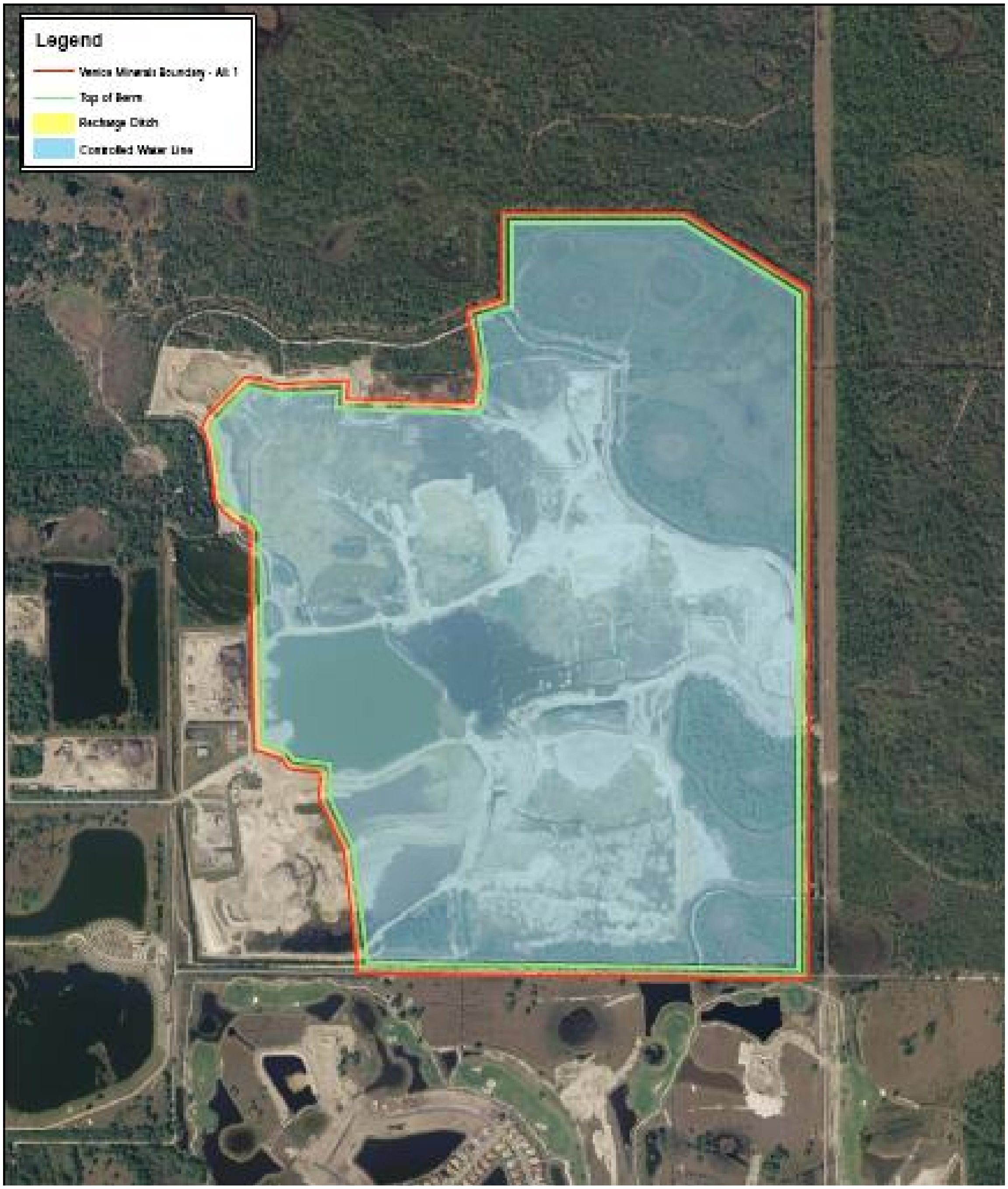

Figure 1 – Venice Minerals, Alternative 1

Alternative 2 - Alternative 2 considered using the existing 402 acre mining area as well as approximately 34 of the 146 acres of un-mined area located along the southeast boundary of the mining operation (see **Figure 2**). This alternative assumed a top of berm elevation of 28 NGVD and is intended to provide an operating range of approximately 15 feet with a total surface area of approximately 388 acres.

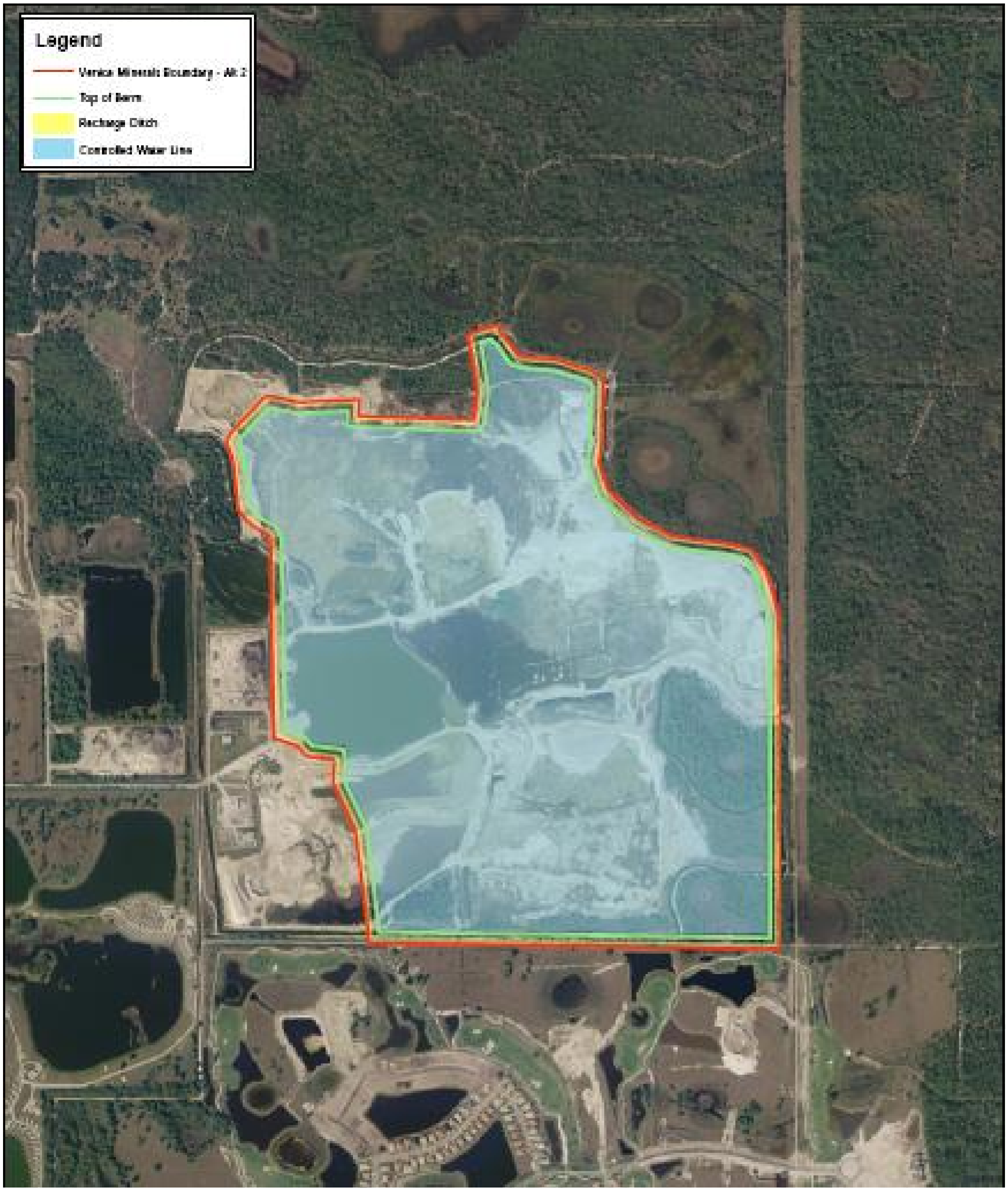

Figure 2 – Venice Minerals, Alternative 2

Alternative 3 – Alternative 3 considered using only the 402 acre existing mining operation area (see **Figure 3**). This alternative assumed a top of berm elevation of 28

NGVD and is intended to provide an operating range of approximately 15 feet with a total surface area of approximately 345 acres.

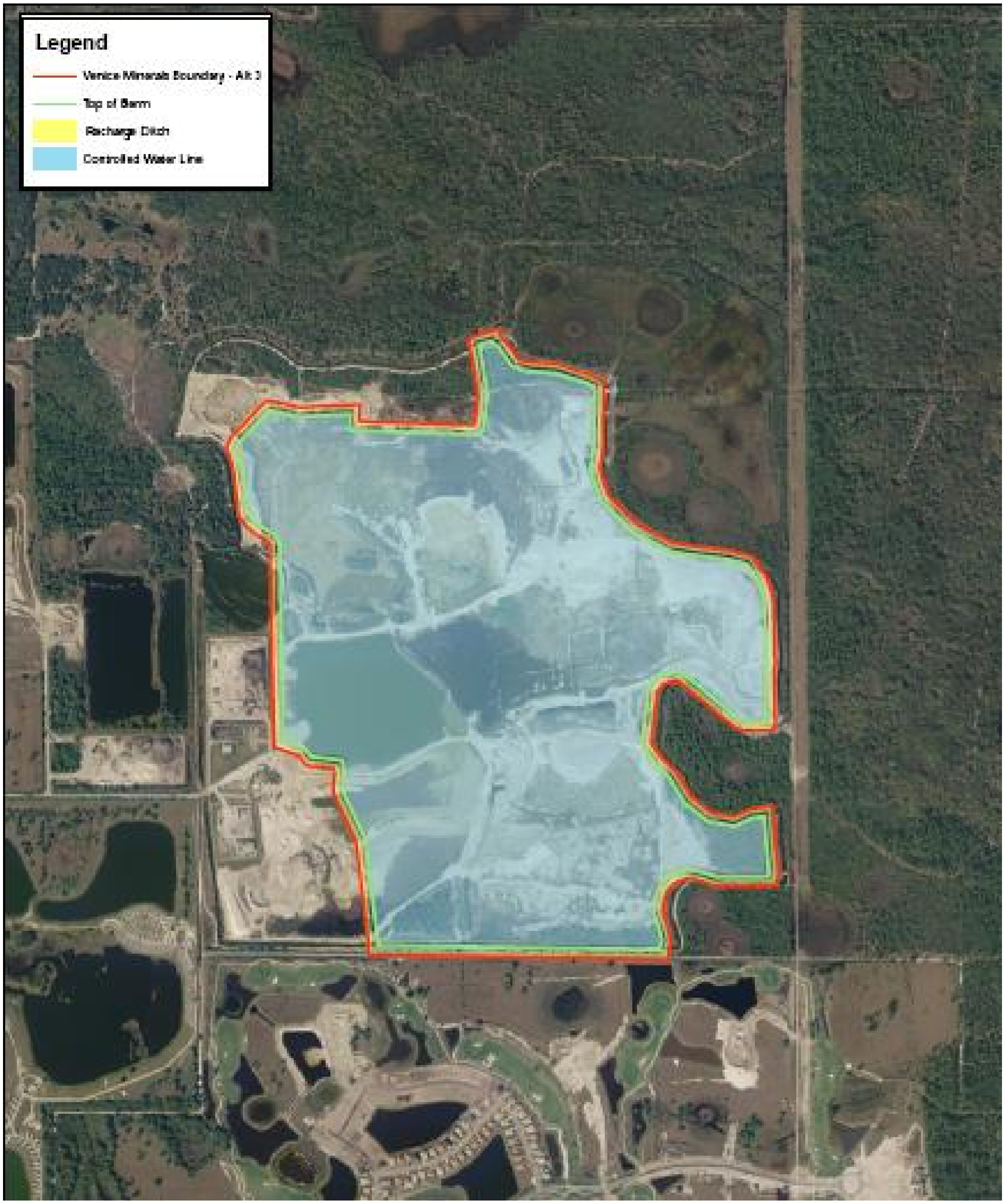

Figure 3 – Venice Minerals, Alternative 3

3.2 Preliminary Berm Sections

The preliminary berm section provides for retainage of the existing perimeter recharge ditch along the west and south property boundary (although it may need to be relocated or reconfigured). **Figure 4** provides a typical section assumed for the perimeter berms and recharge/drainage ditch, as applicable. The berm section was incorporated into digital topographic maps based upon 2004 LiDAR information provided by Sarasota County. It should be noted that the Venice Minerals mining operation has been on-going since 2004, but the 2004 LiDAR represent the best available information at the current time. More recent topographic information should obtained for final design.

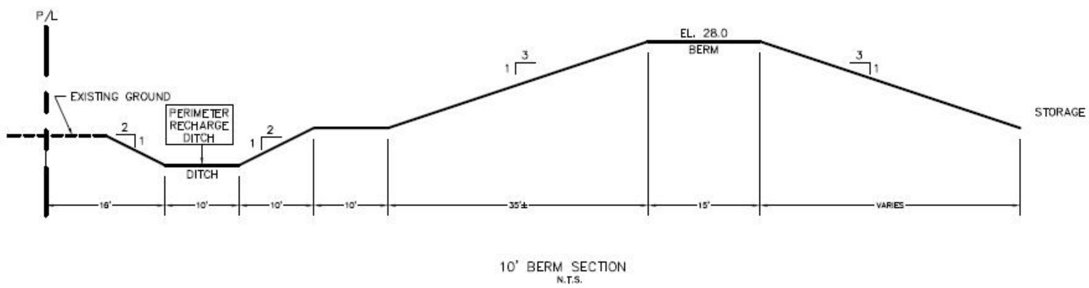

Figure 4 – Typical Berm Section

3.3 Preliminary Yield Evaluations

For the purpose of this preliminary evaluation, a design drought period of at least 250 days was assumed and evaporation loses were not considered. In general, annual evaporation approximates annual rainfall, but during a drought, it could exceed rainfall by approximately 40 inches. The design drought period will be fine tuned through the course of this project based upon other on-going and concurrent analyses. Results of the preliminary evaluations for each alternative are provided in **Table 1** through **Table 3**. For each depth of storage (represented as the operating range) the corresponding storage in both acre-feet (ac-ft) and million gallons (mg) are provided as well as the number of days it would take to deplete the available reservoir storage corresponding to various withdrawals (yield). The yield, operating range and time to deplete the storage are highlighted in the tables.

Venice Minerals		Alternative 1 - 490 acres				
Operating	Storage		Yield			
Range (ft)	Ac-Ft	mg	9 mgd	10 mgd	11 mgd	12 mgd
1	475.98	155	17	16	14	13
5	2379.88	775	86	78	70	65
6	2855.86	931	103	93	85	78
7	3331.83	1086	121	109	99	90
10	4759.76	1551	172	155	141	129
14	6663.66	2171	241	217	197	181
15	7139.64	2326	258	233	211	194

Table 1 – Alternative 1 Preliminary Storage Evaluation

Venice Minerals		Alternative 2 - 388 acres				
Operating	Storage		Yield			
Range (ft)	Ac-Ft	mg	7 mgd	8 mgd	9 mgd	10 mgd
1	375.58	122	17	15	14	12
5	1877.89	612	87	76	68	61
6	2253.47	734	105	92	82	73
7	2629.05	857	122	107	95	86
9	3380.21	1101	157	138	122	110
10	3755.79	1224	175	153	136	122
15	5633.68	1836	262	229	204	184

Table 2 – Alternative 2 Preliminary Storage Evaluation

Venice Minerals		Alternative 3 - 345 acres				
Operating	Storage		Yield			
Range (ft)	Ac-Ft	mg	5 mgd	6 mgd	7 mgd	8 mgd
1	330.59	108	22	18	15	13
5	1652.97	539	108	90	77	67
6	1983.56	646	129	108	92	81
8	2644.75	862	172	144	123	108
10	3305.94	1077	215	180	154	135
11	3636.53	1185	237	197	169	148
12	3967.12	1293	259	215	185	162
14	4628.31	1508	302	251	215	189
15	4958.90	1616	323	269	231	202

Table 3 – Alternative 3 Preliminary Storage Evaluation

Preliminary estimated yields for each alternative are summarized in **Table 4** below.

Alternative	Approximate Yield	Operating Range	Drought Period	Volume of Storage
1	9 mgd	15 feet	258 days	2.3 bg
2	7 mgd	15 feet	262 days	1.8 bg
3	6 mgd	15 feet	269 days	1.6 bg

Table 4 - Estimated Yield for each Alternative

4.0 BASIS FOR OPINION OF PROBABLE COST

To further evaluate each alternative, preliminary engineer's opinions of probable cost were developed. To develop these estimates, opinions of probable cost from the Authority's proposed reservoir expansion were reviewed as a recent and comparable example. As a basis of comparison, many of the design features of the Peace River reservoir were conservatively considered applicable to the design of the Venice Minerals reservoir. Other than the unit costs for earthwork which are discussed separately, unit costs for Venice Minerals were increased 10% over those used for the Peace River reservoir. Continued value engineering through the final design process should be undertaken. Components of the Peace River reservoir not included at this time in the opinions of probable cost included the intake and outlet piping and professional design services. The opinions of probable cost for each alternative are provided at the end of this report.

4.1 Earthwork

One of the primary capital cost considerations is earthwork. Approximate estimates of fill volumes needed for each alternative are provided in **Table 5**. Each volume has been increased by 10% to account for shrinkage of borrow material.

Alternative	Top of Berm Elevation	Berm Perimeter	Approximate Fill for Berm
1	28 NGVD	20,567 feet	760,701 cy
2	28 NGVD	18,692 feet	740,228 cy
3	28 NGVD	20,960 feet	1,173,193 cy

Table 5 - Approximate Estimate of Fill Needed

Based upon information provided by Venice Minerals (VM) in April of 2006, there are approximately 740,800 cubic yards of remaining sand/fill material. VM representatives also estimate 212,000 cubic yards of shell currently remaining on-site. It may also be possible to mix some of the shell material as well as an un-quantified amount of screened organic material with the 740,800 cubic yards of fill material for the berm construction. For purposes of this evaluation, it is assumed that there are only approximately 740,800 cubic yards of fill material that that could be available on-site for the construction of the berm.

There is also material situated along the perimeter of the site that would need to be reserved from being "mined" to provide the base for the berm construction. As additional surveying is completed to quantify the potential perimeter reservation, the opinion of probable cost can be updated.

VM has also indicated that they would consider selling on-site fill material to the County for approximately $2.00 per ton. Based upon the Geotechnical Engineering Services Report prepared by Professional Services Industries, Inc. (PSI), a unit weight of 100 pcf was assumed for material in this area. This would result in an equivalent unit price of $2.70/cubic yard (cy). While this price is still negotiable, it was used for this evaluation. For alternatives that were estimated to have a shortage of on-site fill, it may be more economical to purchase available on-site fill as opposed to hauling in fill material from off-site.

Under Alternatives 1 and 2, fill for the berm was presumed to be generated by excavation associated with the inclusion of the ESLPP lands to the depths and quantities specified in the PSI report. A preliminary fill balance for each alternative is provided in **Table 6**, respectively.

Alternative	Fill Needed	ESLPP Lands (based PSI report)	Purchased from VM	Balance
1	760,701 cy	1,300,000 cy	0 cy	539,299 cy
2	740,228 cy	475,000 cy	265,228 cy	0 cy
3	1,173,193 cy	0 cy	740,800 cy	(432,393) cy

Table 6 – Preliminary Fill Balance

The opinions of probable earthwork cost for each alternative were determined based upon the following assumptions:

On-site material purchase price = $2.70/cy
On-site handling costs = $3.00/cy
Excavation and handling of ESLPP fill material = $3.00/cy
Hauling and handling of off-site material = $10.00/cy (assumes material is free from another County source such as the Celery Fields or Albrittons)

Other earthwork elements included in the opinion of probable cost include slope protection, and filer drains. 2004 unit prices for the Authority reservoir were adjusted (increased) for the Venice Minerals reservoir.

4.2 Mitigation

Alternatives 1 through 4 would require off-site wetland mitigation. The acreage and limits of wetlands in the non-mined areas has been field determined and quantified as follows:

Wetlands within ESLLP (total) = 22 acres
Wetlands within ESLLP (southern parcels only) = 2.3 acres

In addition, the non-mined lands would need to be acquired from the ESLPP. The purchase price of these lands was assumed to be equal to the original price of $2,795/acre and the creation of off-site mitigation was considered at a cost of $60,000/acre (based upon input from Biological Research Associates, Inc.)

4.3 Seepage Control

Consistent with the Peace River reservoir project, seepage control design features were considered in the preliminary opinion of probable cost estimate for Venice Minerals. Specifically, a soil-bentonite slurry wall to an average depth of 45 feet was considered reasonable for preliminary purposes. At the time of final design, the actual needed depth for the slurry wall can be determined. In addition, a 60 mil polyethylene, geosynthetic membrane was also included as a necessary component in the opinion of probable cost.

4.4 Water Quality Control Features

Similar to the Peace River reservoir, aeration towers and a bubbler system were included in the preliminary opinion of probable cost to address potential water quality issues associated with stratification.

4.5 Mobilization/Demobilization

Based upon a review of the Peace River reservoir estimates for mobilization/demobilization, the Opinion of Probable Cost for the VM reservoir was estimated at 5% of the reservoir costs for all alternatives.

4.6 Site Preparation

To estimate clearing and grubbing, acreages used included both the non-mined area (where applicable) and the area around the perimeter where the berm is to be placed. In addition, for the non-mined area, it was assumed that 50% of the area would need tree clearing.

4.7 Care and Handling of Water

Since the existing mining area has already been excavated, only the non-mined areas (where applicable) were considered as requiring dewatering during excavation activities. However, water treatment for sediment control during construction activities was considered applicable for all alternatives.

4.8 Additional Minor Items and Contingency

To account for additional minor items that might be identified during the final design stage, a 10 percent allowance was added to the total of the reservoir item costs.

In addition, a 16% contingency was added to the total capital opinion of probable cost.

5.0 RESULTS

In order to estimate the relative cost effectiveness of each alternative, opinions of probable cost were divided by the approximate estimated yield. Results are summarized in **Table 7**. In addition, opinions of probable cost for each alternative were divided by the estimated storage associated with the estimated yields. This information is presented in **Table 8**.

Alternative	Opinion of Probable Cost	Approximate Yield	Yields/Cost
1	$19,746,484	9 mgd	$2.19/gal
2	$16,376,697	7 mgd	$2.34/gal
3	$24,523,839	6 mgd	$4.09/gal

Table 7

Alternative	Opinion of Probable Cost	Storage	Yields/Cost
1	$19,746,484	7,140 acre-feet	$2,766/ac-ft
2	$16,376,697	5,640 acre-feet	$2,904/ac-ft
3	$24,523,839	4,965 acre-feet	$4,939/ac-ft

Table 8

Based upon the above analysis, Alternative 1 would be the most cost effective. Alternative 1 includes the incorporation of the entire ESLPP lands with a 15 ft. operating range. The estimated yield is 9 mgd for a design drought period of approximately 258 days.

6.0 RECOMMENDATIONS

The following recommendations are provided as next steps to further the design of the Venice Mineral reservoir site:

- Install continuous stage recorders at the two outfall weirs. Field survey the dimensions and inverts of the existing weirs.
- Quantify the amount of on-site material that should be reserved around the perimeter of the Venice Minerals property.
- Obtain recent a topographic survey for the Venice Minerals property.
- In coordination with the PRMRWSA, explore pertinent design considerations and feasibility analyses related to the potential integration of the Venice Minerals site and the Dona Bay Watershed project into the regional system.

Venice Minerals Reservoir – Alternative 1
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
RESERVOIR				
Mobilization/Demobilization	LS	$ 665,000	1	$ 665,000
Site Preparation: Clearing & Grubbing	AC	$ 5,280	204	$ 1,077,120
Stripping	CY	$ 1.21	123,420	$ 149,338
Care and Handling of Water				
Control of Groundwater	AC	$ 1,760	146	$ 256,960
Water Treatment for Sediment Control	LS	$ 275,000	1	$ 275,000
Earthwork				
Fill Placement	CY	$ 3.00	760,701	$ 2,282,103
Bedding, Filters and Drains	CY	$ 28.60	45,250	$ 1,294,150
Second Stage Drains	CY	$ 49.50	11,800	$ 584,100
Slope Protection - Soil Cement	CY	$ 38.50	88,750	$ 3,416,875
Seepage Control				
Cut Off Slurry Wall	SF	$ 3.08	925,515	$ 2,850,586
Geomembrane Composite Lining	SF	$ 0.55	461,000	$ 253,550
Reservoir Water Quality Features				
Aeration Towers & Bubbler System	LS	$ 860,000	1	$ 860,000
Additional Minor Items	LS	10%	1	$ 1,329,978
Subtotal Reservoir:				**$ 15,294,761**
MITIGATION				
Mitigation	LS	$ 1,728,070	1	$ 1,728,070
Subtotal Mitigation:				**$ 1,728,070**
SUBTOTAL - CAPITAL COSTS				**$ 17,022,831**
Contingency		16%		**$ 2,723,653**
TOTAL COST WITH CONTINGENCY				**$ 19,746,484**

Venice Minerals Reservoir – Alternative 2
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
RESERVOIR				
Mobilization/Demobilization	LS	$ 604,000	1	$ 604,000
Site Preparation: Clearing & Grubbing	AC	$ 5,280	73	$ 385,440
Stripping	CY	$ 1.21	44,165	$ 53,440
Care and Handling of Water				
Control of Groundwater	AC	$ 1,760	34	$ 59,840
Water Treatment for Sediment Control	LS	$ 275,000	1	$ 275,000
Earthwork				
On-Site Borrow Purchase	CY	$ 2.70	265,228	$ 716,116
Fill Placement	CY	$ 3.00	740,228	$ 2,220,684
Bedding, Filters and Drains	CY	$ 28.60	41,150	$ 1,176,890
Second Stage Drains	CY	$ 49.50	10,700	$ 529,650
Slope Protection - Soil Cement	CY	$ 38.50	80,660	$ 3,105,410
Seepage Control				
Cut Off Slurry Wall	SF	$ 3.08	841,140	$ 2,590,711
Geomembrane Composite Lining	SF	$ 0.55	418,700	$ 230,285
Reservoir Water Quality Features				
Aeration Towers & Bubbler System	LS	$ 730,000	1	$ 730,000
Additional Minor Items	LS	10%	1	$ 1,207,347
Subtotal Reservoir:				**$ 13,884,812**
MITIGATION				
Mitigation	LS	$ 233,030	1	$ 233,030
Subtotal Mitigation:				**$ 233,030**
SUBTOTAL - CAPITAL COSTS				**$ 14,117,842**
Contingency		16%		**$ 2,258,855**
TOTAL COST WITH CONTINGENCY				**$ 16,376,697**

Venice Minerals Reservoir – Alternative 3
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
RESERVOIR				
Mobilization/Demobilization	LS	$ 919,200	1	$ 919,200
Site Preparation: Clearing & Grubbing	AC	$ 5,280	57	$ 300,960
Stripping	CY	$ 1.21	34,485	$ 41,727
Care and Handling of Water				
Water Treatment for Sediment Control	LS	$ 275,000	1	$ 275,000
Earthwork				
On-Site Borrow Purchase	CY	$ 2.70	740,800	$ 2,000,160
Fill Placement	CY	$ 3.00	740,800	$ 2,222,400
Off-Site Borrow, Placement and Hauling	CY	$ 10.00	432,393	$ 4,323,930
Bedding, Filters and Drains	CY	$ 28.60	46,150	$ 1,319,890
Second Stage Drains	CY	$ 49.50	12,000	$ 594,000
Slope Protection - Soil Cement	CY	$ 38.50	90,450	$ 3,482,325
Seepage Control				
Cut Off Slurry Wall	SF	$ 3.08	943,200	$ 2,905,056
Geomembrane Composite Lining	SF	$ 0.55	469,500	$ 258,225
Reservoir Water Quality Features				
Aeration Towers & Bubbler System	LS	$ 660,000	1	$ 660,000
Additional Minor Items	LS	10%	1	$ 1,838,367
SUBTOTAL - CAPITAL COSTS				**$ 21,141,240**
Contingency		16%		**$ 3,382,598**
TOTAL COST WITH CONTINGENCY				**$ 24,523,839**

TM 4.2.4.2 – EVALUATION OF SURFACE STORAGE (Albritton Site)

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and SWFWMD are currently completing the necessary, pre-requisite data collection and analysis as well as comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marin Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the Southwest Florida Water Management District (SWFWMD), to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (NEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and SCG's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

This Technical Memorandum has been prepared by PBSJ to provide preliminary storage evaluation for the Albritton site, consistent with Task 4.2.4 of the DBWMP contract. In addition a comparison of yields and opinions of probable capital costs are provided for five conceptual surface water configurations.

2.0 DESCRIPTION OF ALBRITTON SITE

In 2004 Sarasota County purchased 1,000 acres of property to the north of the Central County Solid Waste Disposal Complex (CCSWDC) for the purpose of obtaining cover material for the landfill. The CCSWDC landfill will require approximately 12 million cubic yards of material for daily cover, closure, and construction of new cells over the remaining life of the landfill. The Albritton site will provide that quantity of material. Sarasota County Solid Waste Department obtained a permit for the excavation of a shallow borrow pit in the southwest area of the property and has excavated approximately 90,000 cubic yards of material to date. A permit has been secured for a second phase borrow pit, which will also be shallow so that de-watering is not required for the excavation.

The purpose of this preliminary storage evaluation is to evaluate alternatives for excavation of the borrow pit to allow the site to be used for storage of surface water. Although the Albritton site is evaluated as a stand alone facility in this analysis, storage on this site may be used in conjunction with previously excavated borrow pits on the landfill site and the Venice Minerals site to the south.

3.0 ESTIMATE OF POTENTIAL YIELD

Five alternatives were evaluated for the configuration of a water storage reservoir on the Albritton property. The alternatives included variations in the area excavated, the operating range of the storage reservoir, and the construction of berms around the excavated area.

3.1 Alternatives Evaluated

The alternatives considered included three plans for the borrow pit and resulting reservoir that provided for storage of the water below the existing grade of the site. The assumed operating range for the three reservoirs would be 10 feet. Two additional alternatives would have an operating range that would extend from 10 feet below grade to 10 feet above grade.

Each of the alternatives provided for water to enter the site from Cow Pen Canal at the northwest corner of the property. This is immediately adjacent to the upper water level control structure in the canal. This structure controls the water elevation at 18 feet in the dry season and 14 feet in the wet season. For the three alternatives that store water below grade an operating range of 10 feet will allow the reservoir to be filled by gravity. Pumping will be required for an operating range that extends above existing grade. Each of the initial alternatives included excavation of the entire area of the borrow pit to a depth of 15 feet below existing grade.

Common features of the four alternatives are:

- An emergency overflow to return water to Cow Pen Slough located in the southwest corner of the reservoir
- A setback from the east and south property line to allow for a future roadway
- A recharge ditch on the north, east, and south boundaries to limit impacts to the groundwater elevation on adjacent property
- Provisions for transporting off-site stormwater runoff around the site
- Continued flow into the old Cow Pen Slough ditch to maintain wetland areas
- A freeboard of 10 feet above the maximum operating range

Alternative 1 – Alternative 1 (see Figure 1) includes a settling pool and biological filtration area to remove some of the suspended solids and other pollutants as water enters the reservoir. If the volume of water removed from the Cow Pen Canal during peak flow periods is maximized, the effectiveness of the treatment zones may be limited. The potential effectiveness of these treatment areas will be evaluated as the design proceeds.

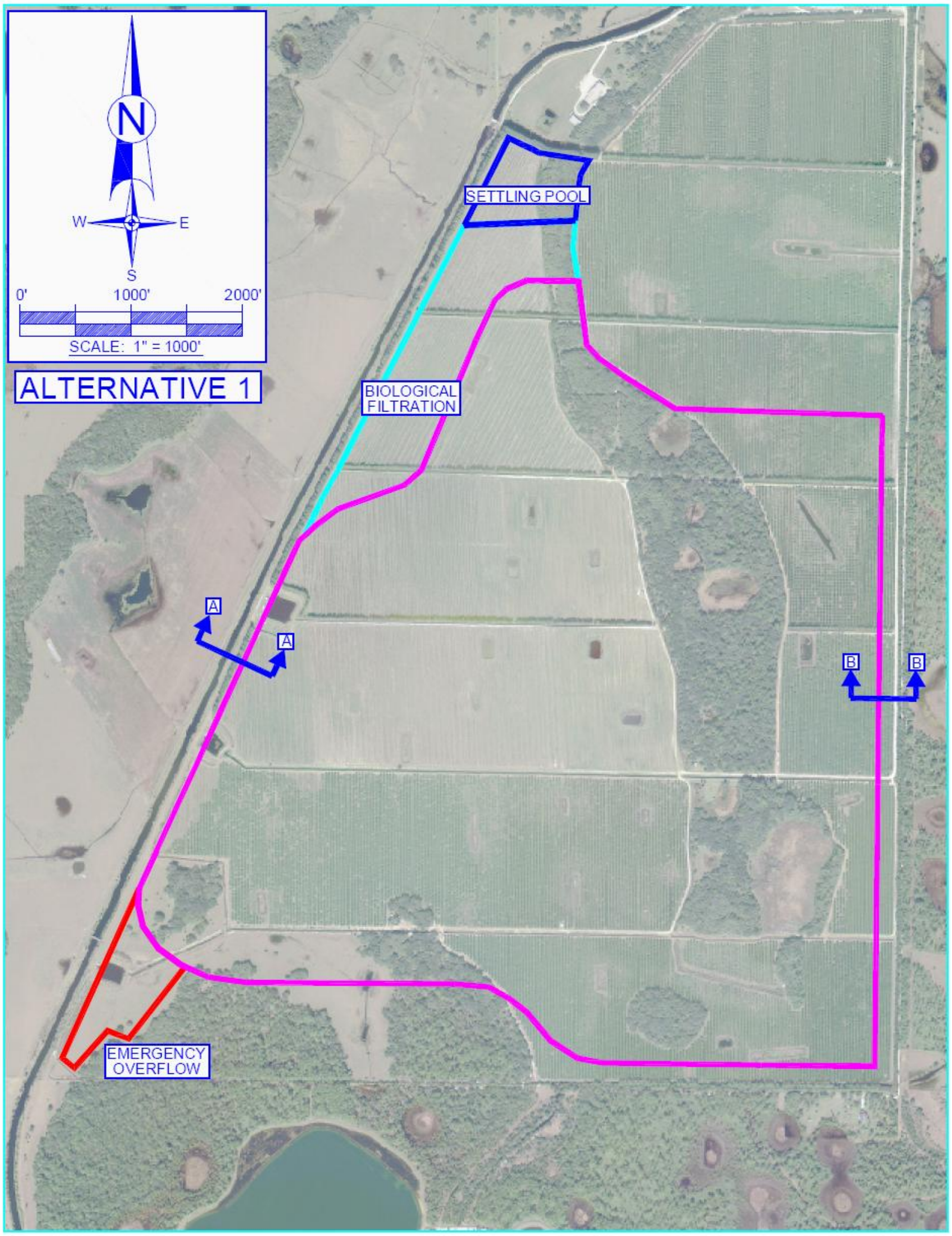

Figure 1 – Alternative 1

Alternative 2 – The Albritton site has a hammock area that extends from the north to the southeast across the site. The hammock is approximately 150 acres and includes herbaceous wetlands. Alternative 2 has the same outside boundary as Alternative 1 but excludes the hammock area from the reservoir excavation (see Figure 2). A recharge ditch around the hammock area will be required to maintain groundwater conditions and the hydroperiod for the wetlands. The reservoir berm will not extend around the limits of the hammock area. Since the normal operating range for the reservoir will be below the existing grade at the hammock, the hammock should not be inundated except in large storm events.

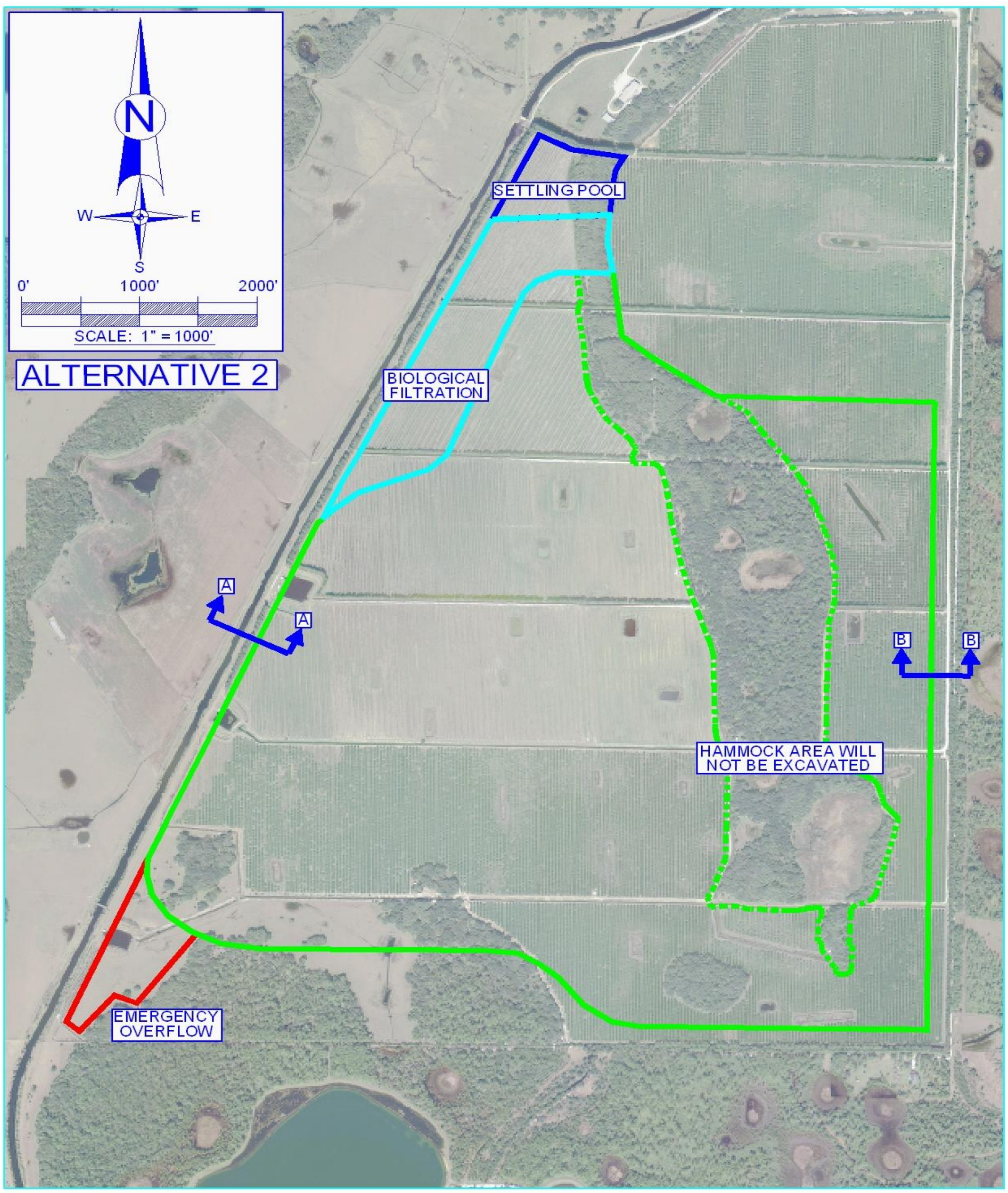

Figure 2 – Alternative 2

Alternative 3 – Alternative 3 (Figure 3) includes construction of marsh areas on the south side of the reservoir area. The marsh areas could serve as mitigation for environmental impacts and would improve water quality flowing into the downstream areas. One drawback of this borrow pit plan is that the soils in the southeast part of the site designated as marshland are some of the better quality soils on the property.

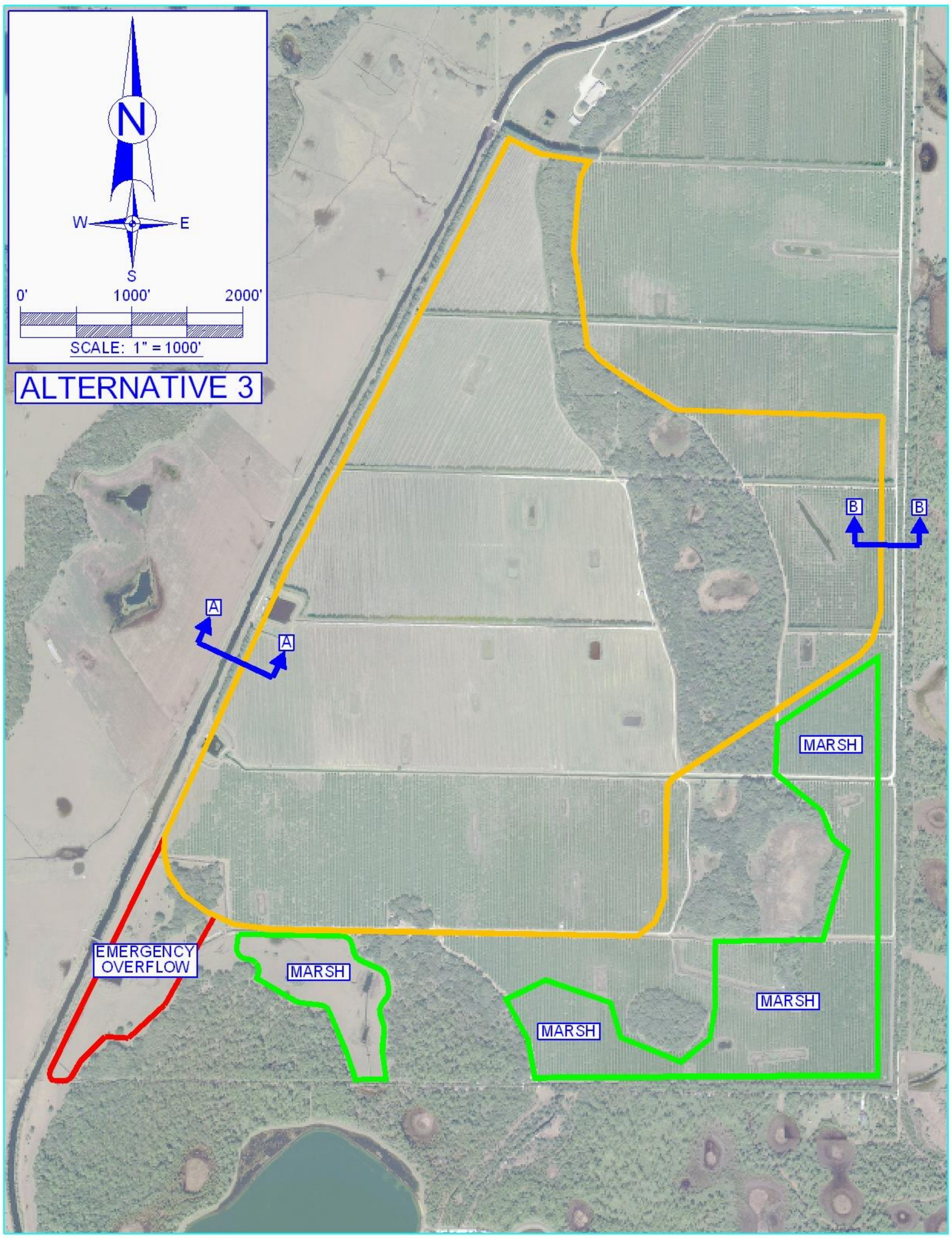

Figure 3 – Alternative 3

Alternative 4 – Alternative 4 provides for an operating range in the reservoir from 10 feet below grade to 10 feet above grade. The configuration of the berms are the same as Alternative 1 without the settling pond and biological filtration zones (see Figure 4). The treatment zones within the reservoir would be difficult to construct with the greater operating range in this alternative. The control structure for diverting water into the reservoir will allow water to fill the reservoir by gravity up to elevation 18.0. Water stored above that elevation will have to be pumped into the reservoir.

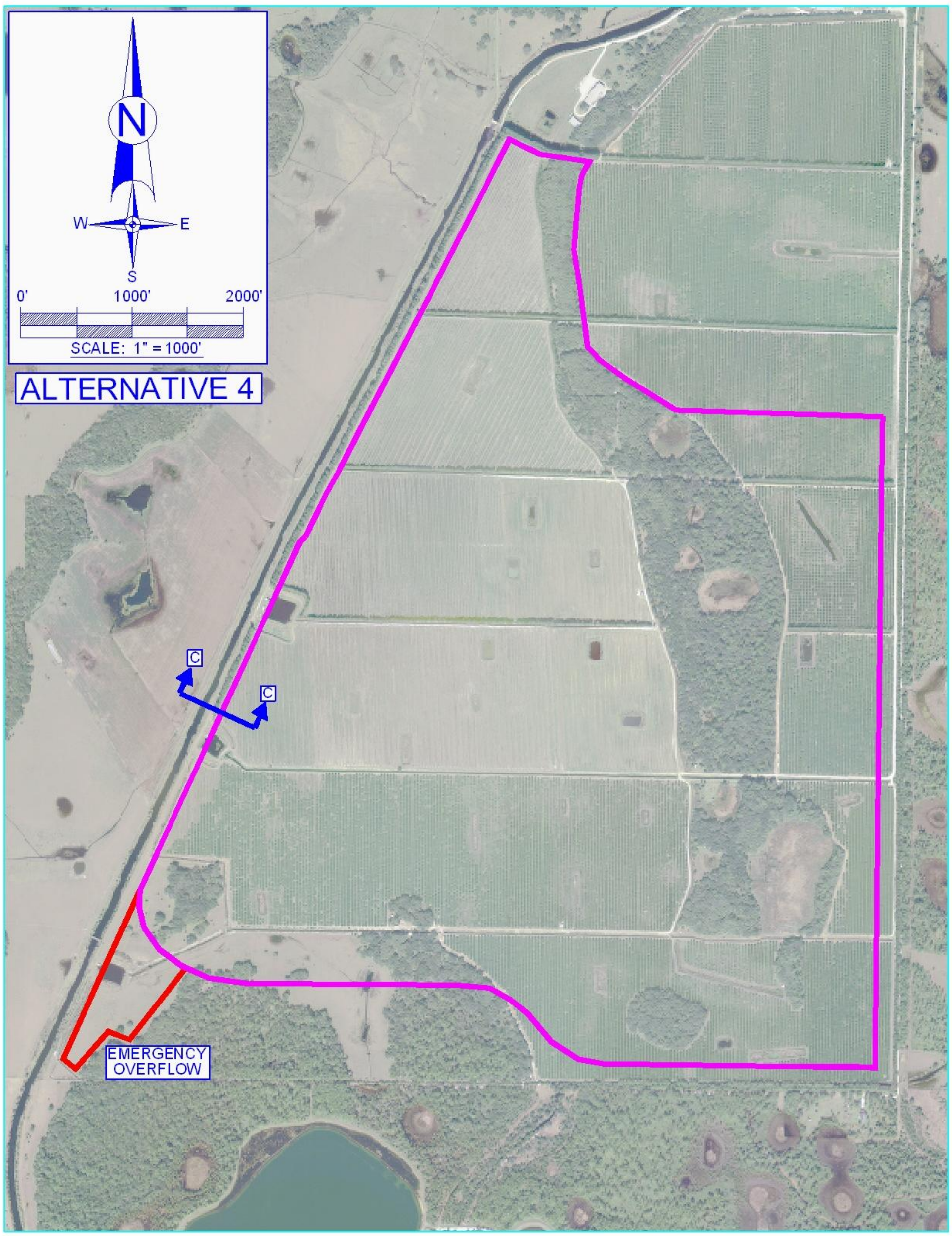

Figure 4 – Alternative 4

Alternative 5 – Alternative 5 uses the same footprint for the reservoir as Alternative 3 and provides for an operating range in the reservoir from 10 feet below grade to 10 feet above grade. As in Alternative 4, the control structure for diverting water into the reservoir will allow water to fill the reservoir by gravity up to elevation 18.0. Water stored above that elevation will have to be pumped into the reservoir.

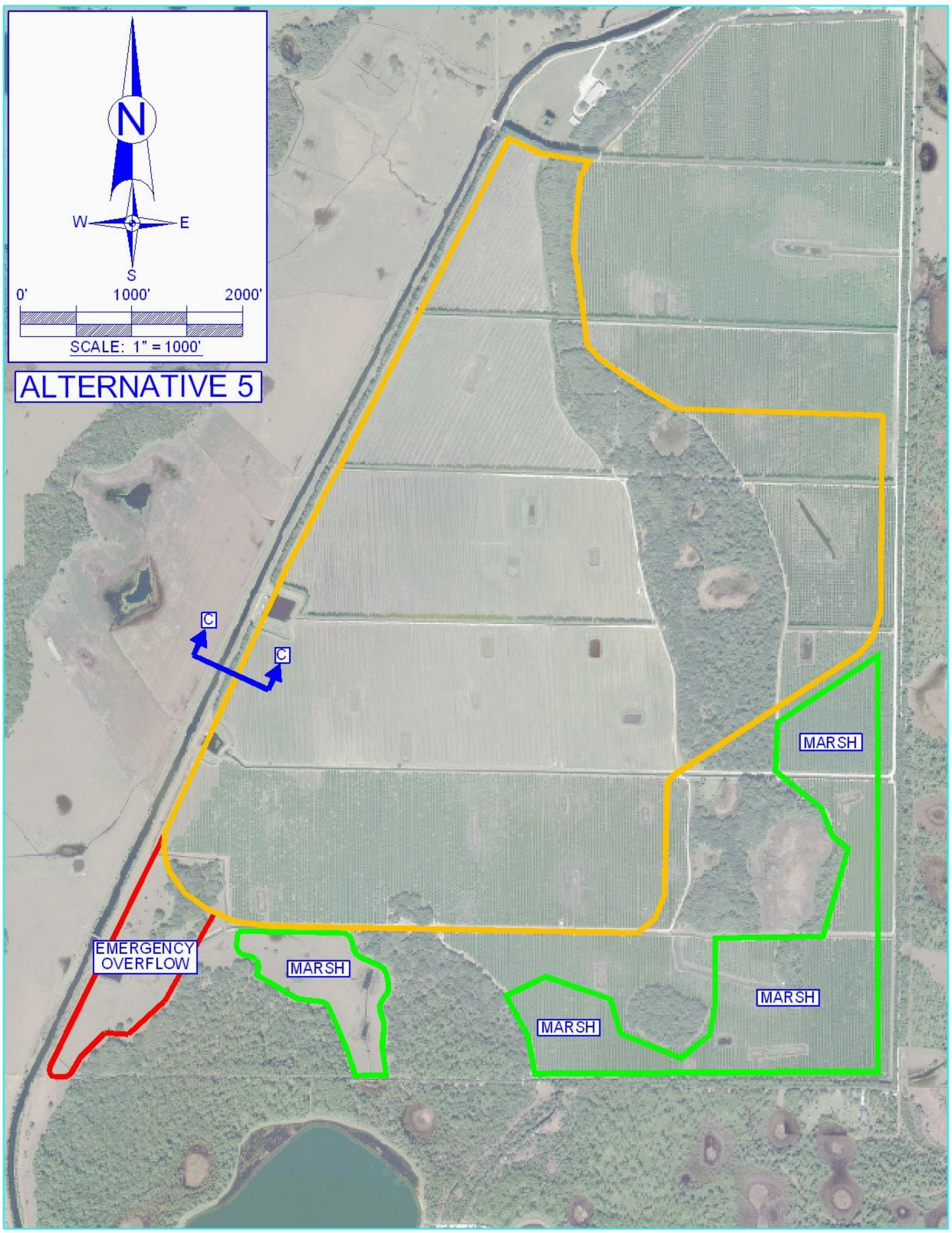

Figure 5 – Alternative 5

The volume of borrow material that would be excavated, the surface area of the reservoir, and the water storage capacity that would be created in each alternative are shown in Table 1. The estimated volumes of borrow material are based upon excavation of the entire site within the reservoir boundaries to a depth of 15 feet below existing grade. The borrow material within the site varies in quality and will need to be handled carefully to segregate good fill material from clayey soils. Since only 12 million cubic yards of material is needed for the remaining life of the landfill, each of the alternatives fulfills the landfill needs and could provide surplus material. The excavation of the material should be monitored closely to segregate the better material from the less desirable soil.

Alternative	Average Reservoir Area, ac	Operating Range, ft	Water Storage, acre-ft	Available Borrow Material, cy[1]
1	735	10	7,265	18.6 million
2	580	10	5,677	14.9 million
3	580	10	5,714	13.7 million
4	772	20	15,458	17.8 million
5	580	20	11,272	12.9 million

Table 1 – Alternatives Borrow Volumes and Reservoir Areas

[1]Total available borrow material less the volume needed to construct a berm around the reservoir.

3.2 Preliminary Berm Sections

Section A-A in Figure 5 is the berm along the Cow Pen Canal for Alternatives 1, 2, and 3. The water elevation in the canal is controlled by a weir structure located downstream of the site. The overflow elevation of the weir is at elevation 7.0 during the wet season and at elevation 11.0 during the dry season. The canal has a berm along both sides that was created when the canal was excavated. The berms are used for maintenance access by county vehicles. The elevation of the western side of the Albritton site adjacent to the maintenance berm varies from elevation 14.0 to elevation 18.0. In order to provide for an operation range of up to 18.0 and a freeboard of 10.0 feet a new berm would be constructed to an elevation of 28.0.

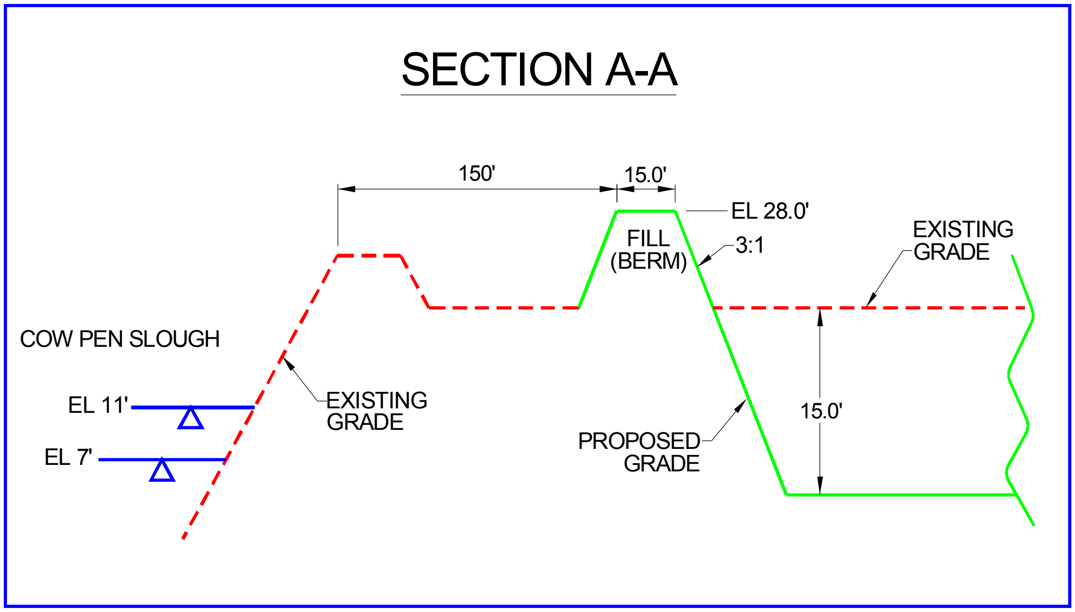

Figure 5 – Typical Berm Section

Section B-B shown in Figure 6 is the east and south boundaries of the property for Alternatives 1, 2 and 3. The section includes space for a future four-lane roadway, a recharge ditch, and a stormwater ditch to intercept offsite drainage. The existing grade along the east property boundary is approximately elevation 21.0.

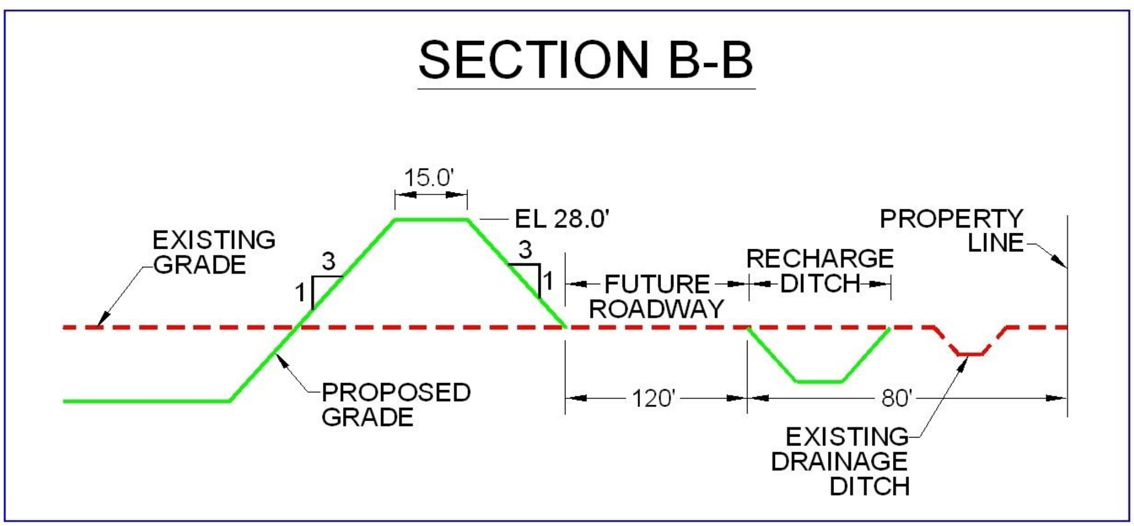

Figure 6 - Typical Berm Section

The preliminary design for the higher berm for Alternatives 4 and 5 is shown in Section C-C. (Figure 7). The berm for this alternative is approximately 18 feet above existing grade on the west side of the site.

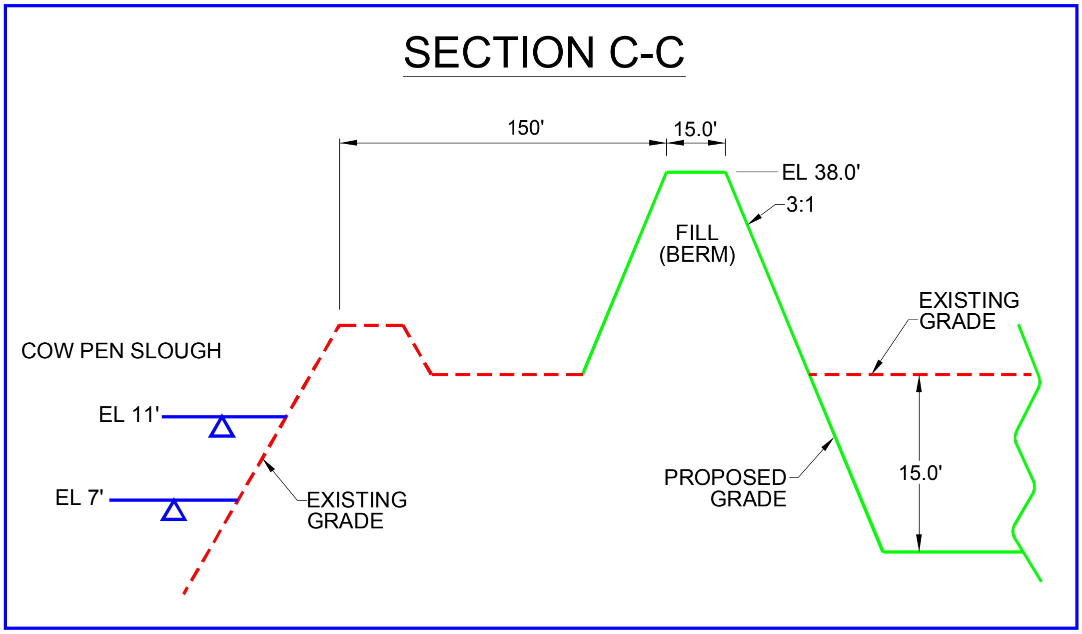

Figure 7 – Typical Berm Section

3.3 Preliminary Yield Evaluations

The basis for calculation of the preliminary design yield for the Venice Minerals site was followed for the five alternatives evaluated for the Albritton property, and a design drought period of 250 days was used. Tables 2 through 6 show the time required to deplete the storage for each operating range at the withdrawal rates or yield rates indicated.

OPERATING RANGE	STORAGE		YIELD			
(FT)	(AC-FT)	(MG)	(7 MGD)	(8 MGD)	(9 MGD)	(10 MGD)
2	1,443	470	67	59	52	47
4	2,888	941	134	118	105	94
6	4,341	1,414	202	177	157	141
8	5,799	1,889	270	236	210	189
10	7,265	2,366	338	296	263	237

Table 2 – Alternative 1 Preliminary Storage Evaluation

OPERATING RANGE	STORAGE		YIELD			
(FT)	(AC-FT)	(MG)	(5 MGD)	(6 MGD)	(7 MGD)	(8 MGD)
2	1,120	365	73	61	52	46
4	2,244	731	146	122	104	91
6	3,378	1,100	220	183	157	138
8	4,523	1,473	295	246	210	184
10	5,677	1,849	370	308	264	231

Table 3 – Alternative 2 Preliminary Storage Evaluation

OPERATING RANGE	STORAGE		YIELD			
(FT)	(AC-FT)	(MG)	(5 MGD)	(6 MGD)	(7 MGD)	(8 MGD)
2	1,133	369	74	62	53	46
4	2,269	739	148	123	106	92
6	3,411	1,111	222	185	159	139
8	4,559	1,485	297	248	212	186
10	5,714	1,861	372	310	266	233

Table 4 – Alternative 3 Preliminary Storage Evaluation

OPERATING RANGE	STORAGE		YIELD			
(FT)	(AC-FT)	(MG)	(5 MGD)	(10 MGD)	(15 MGD)	(20 MGD)
2	1,517	494	99	49	33	25
4	3,038	990	198	99	66	49
6	4,566	1,487	297	149	99	74
8	6,101	1,987	397	199	132	99
10	7,643	2,490	498	249	166	124
12	9,192	2,994	599	299	200	150
14	10,748	3,501	700	350	233	175
16	12,311	4,010	802	401	267	201
18	13,881	4,521	904	452	301	226
20	15,458	5,035	1007	504	336	252

Table 5 – Alternative 4 Preliminary Storage Evaluation

OPERATING RANGE	STORAGE		YIELD			
(FT)	(AC-FT)	(MG)	(10MGD)	(12 MGD)	(14 MGD)	(16 MGD)
2	1,102	359	36	30	26	22
4	2,208	719	72	60	51	45
6	3,319	1,081	108	90	77	68
8	4,437	1,445	145	120	103	90
10	5,561	1,811	181	151	129	113
12	6,691	2,179	218	182	156	136
14	7,827	2,549	255	212	182	159
16	8,969	2,921	292	243	209	183
18	10,117	3,296	330	275	235	206
20	11,272	3,672	367	306	262	230

Table 6 – Alternative 5 Preliminary Storage Evaluation

Table 7 is a summary of the preliminary estimates of yield for each alternative for a drought period of 250 days.

Alternative	Approximate Yield	Operating Range	Drought Period	Volume of Storage
1	9 mgd	10 feet	250 days	2.4 bg
2	7 mgd	10 feet	250 days	1.8 bg
3	7 mgd	10 feet	250 days	1.9 bg
4	20 mgd	20 feet	250 days	5.0 bg
5	14 mgd	20 feet	250 days	3.7 bg

Table 7 – Estimated Yield for Each Alternative

4.0 OPINION OF PROBABLE COST

Estimates of probable costs for each alternative are included at the end of this memorandum.

4.1 Earthwork

The Albritton site was purchased for the purpose of providing approximately 12 million cubic yards of cover material for the landfill. The most economical process for excavation of the borrow pit for the landfill operation is to mine the material over the remaining life of the landfill as it is needed. In order to excavate the material over a short time frame to create the reservoir, the material will have to be excavated and stored offsite. An evaluation of alternatives for excavation of the borrow pit and storage of the soil demonstrated that 12.0 million cubic yards of soil could be stored on the landfill site and used from the stockpile as needed. The stockpile on the landfill could be designed to be consumed as the landfill is expanded. The capital cost for the excavation would be incurred in a short period of time rather than spread over many years.

Alternatives 1, 2, and 3 each have the same preliminary design for the berm around the reservoir. The only variables are the length of the berms and the existing grade along the alignment of the berms. Alternatives 4 and 5 require a berm approximately 29 feet above existing grade and a much greater quantity of fill. Table 8 is a summary of the quantities available for each alternative. The available quantity is the total volume that could be excavated less the amount of material that would be required for construction of the berms.

Alternative	Average Berm Height, ft.	Berm Perimeter, ft.	Approximate Berm Fill, cy	Available Borrow Material, cy[1]
1	8.8	23,800	437,000	18.6 million
2	8.8	23,800	426,000	14.9 million
3	8.7	23,100	303,000	13.7 million
4	18.9	26,150	1,311,000	17.8 million
5	18.7	23,800	1,132,000	12.9 million

Table 8 – Estimate of Berm Fill Needed and Borrow Material Available

[1] Total volume of material that could be excavated less the material required for berm construction.

The projected quantity of cover and construction soil needed for the remaining life of the landfill is approximately 12.0 million cubic yards. Each of the alternatives will provide more soil than needed if the excavation is to a depth of 15 feet below existing grade. The quantity of soil in excess of the landfill needs could be sold or the depth of the excavation can be reduced to limit the volume of soil removed. The depth of the excavation can be reduced without reducing the water storage capacity of the reservoir. Another option is to limit the excavation to the areas that have the better soils for landfill uses.

The opinion of probable cost for earthwork is based upon the following unit costs:

On-site material handling costs = $3.00/cy
Excavation and hauling to a stockpile on the landfill = $5.00/cy

Other earthwork costs include slope protection, dewatering, filter drains, etc. The unit costs for these items are based upon costs estimated for the Peace River Manasota Regional Water Supply Authority reservoir, with an adjustment of 10% for inflation.

4.2 Mitigation

Alternatives 1, 3, 4 and 5 each will require mitigation for wetland and hammock impacts. Alternative 2 leaves the existing hammock area and wetlands in place, and will require less mitigation. There may be sufficient area within the county owned property to mitigate by creating new areas or enhancing existing environmental areas. An estimated cost of $50,000 per acre was used for determining probable mitigation costs.

4.3 Other Costs

Other costs included in the opinion of probable costs for the reservoir construction are:

Site preparation – Clearing and grubbing
Sodding – Cover of disturbed areas and outside face of the berm
Seepage control – A soil-bentonite slurry wall to an average depth of 45 feet
Water quality control - Aeration towers and bubbler system for mixing
Mobilization/demobilization – 5% of probable construction cost
Dewatering – Removal and sediment control for the borrow pit mining operation

5.0 RESULTS

Table 9 is a comparison of the opinion of probable cost for construction of the reservoir divided by the approximate yield for each alternative based upon a drought period of 250 days and Table 10 is the probable cost divided by the volume of storage provided for each alternative. Based upon these comparisons, Alternative 4 is the least cost per gallon for construction of the reservoir and the least cost per unit of storage.

However, Alternative 4 includes an operating range that extends above grade. The probable cost for that alternative does not include a pumping system to transport water from Cow Pen Slough into the reservoir or any modifications to the existing weir structure in the slough. Alternative 4 also involves the construction of a large storage reservoir above grade, which creates a public safety concern. The design of the above grade storage will have to meet stringent requirements.

Alternative	Probable Cost	Approximate Yield, MGD	Cost/Gal
1	$ 25,435,000	9	$ 2.83
2	$ 22,915,000	7	$ 3.27
3	$ 22,277,000	7	$ 3.18
4	$ 31,312,000	20	$ 1.57
5	$ 26,127,000	14	$ 1.87

Table 9

Alternative	Probable Cost	Storage, acre-feet	Cost/Ac-ft
1	$ 25,435,000	7265	$ 3,501
2	$ 22,915,000	5677	$ 4,036
3	$ 22,277,000	5714	$ 3,899

4	$ 31,312,000	15458	$ 2,026
5	$ 26,127,000	11272	$ 2,318

Table 10

Albritton Site Reservoir – Alternative 1
Preliminary Opinion of Probable Cost

ITEM	UNIT	UNIT PRICE	QUANTITY	TOTAL AMOUNT
MOBILIZATION/DEMOBILIZATION	LS	5%		$ 940,317
RESERVOIR				
Earthwork				
Clearing and grubbing	AC	$ 5,280.00	760	$ 4,012,800
Stripping	CY	$ 1.21	459,800	$ 556,358
Dewatering	AC	$ 1,760.00	735	$ 1,293,600
Sediment control	LS	$ 990,809	1	$ 990,809
Fill placement for berms	CY	$ 3.00	436,659	$ 1,309,977
Bedding, filters, and drains	CY	$ 28.60	52,363	$ 1,497,582
Second stage drains	CY	$ 49.50	13,655	$ 675,917
Slope protection - soil cement	CY	$ 38.50	102,701	$ 3,953,986
Slurry wall	SF	$ 3.08	952,023	$ 2,932,231
Geomembrane liner	SF	$ 0.55	533,466	$ 293,406
Aeration towers and bubbler system	LS	$ 1,290,000	1	$ 1,290,000
Additional Minor Items	LS	10%	1	$ 1,880,667
Subtotal Reservoir:				**$ 20,687,000**
MITIGATION	LS	$ 300,000.00	1	**$ 300,000**
SUBTOTAL - CAPITAL COSTS				**$ 21,927,000**
Contingencies	LS	16%	1	$ 3,508,000
SUBTOTAL RESERVOIR CONSTRUCTION				**$ 25,435,000**
EXCAVATION/HAULING TO LANDFILL	CY	$ 5.00	18,608,341	**$93,041,705**
TOTAL PROBABLE COST				**$ 118,476,705**

Albritton Site Reservoir – Alternative 2
Preliminary Opinion of Probable Cost

ITEM	UNIT	UNIT PRICE	QUANTITY	TOTAL AMOUNT
MOBILIZATION/DEMOBILIZATION	LS	5%		$ 854,502
RESERVOIR				
Earthwork				
Clearing and grubbing	AC	$ 5,280.00	605	$ 3,194,400
Stripping	CY	$ 1.21	366,025	$ 442,890
Dewatering	AC	$ 1,760.00	580	$ 1,020,800
Sediment control	LS	$ 781,863	1	$ 781,863
Fill placement for berms	CY	$ 3.00	426,189	$ 1,278,567
Bedding, filters, and drains	CY	$ 28.60	52,363	$ 1,497,582
Second stage drains	CY	$ 49.50	13,655	$ 675,917
Slope protection - soil cement	CY	$ 38.50	102,701	$ 3,953,986
Slurry Wall	SF	$ 3.08	952,023	$ 2,932,231
Geomembrane liner	SF	$ 0.55	533,466	$ 293,406
Aeration towers and bubbler system	LS	$1,017,959	1	$ 1,017,959
Additional Minor Items	LS	10%	1	$ 1,708,960
Subtotal Reservoir:				**$ 18,799,000**
MITIGATION	LS	$100,000	1	**$ 100,000**
SUBTOTAL - CAPITAL COSTS				**$ 19,754,000**
Contingencies	LS	16%	1	$ 3,160,640
SUBTOTAL RESERVOIR CONSTRUCTION				**$ 22,915,000**
EXCAVATION/HAULING TO LANDFILL	CY	$ 5.00	14,900,000	**$ 74,500,000**
TOTAL PROBABLE COST				**$97,415,000**

Albritton Site Reservoir – Alternative 3
Preliminary Opinion of Probable Cost

ITEM	UNIT	UNIT PRICE	QUANTITY	TOTAL AMOUNT
MOBILIZATION/DEMOBILIZATION	LS	5%		$ 821,907
RESERVOIR				
Earthwork				
Clearing and grubbing	AC	$ 5,280.00	605	$ 3,194,400
Stripping	CY	$ 1.21	366,025	$ 442,890
Dewatering	AC	$ 1,760.00	580	$ 1,020,800
Sediment control	LS	$ 781,863	1	$ 781,863
Fill placement for berms	CY	$ 3.00	303,500	$ 910,500
Bedding, filters, and drains	CY	$ 28.60	50,779	$ 1,452,277
Second stage drains	CY	$ 49.50	13,242	$ 655,469
Slope protection - soil cement	CY	$ 38.50	99,594	$ 3,834,369
Slurry wall	SF	$ 3.08	923,222	$ 2,843,525
Geomembrane liner	SF	$ 0.55	517,328	$ 284,530
Aeration towers and bubbler system	LS	$ 1,017,959	1	$ 1,017,959
Additional Minor Items	LS	10%	1	$ 1,643,858
Subtotal Reservoir:				**$ 18,082,000**
MITIGATION	LS	$ 300,000	1	**$ 300,000**
SUBTOTAL - CAPITAL COSTS				**$ 19,203,907**
Contingencies	LS	16%	1	$ 3,072,625
SUBTOTAL RESERVOIR CONSTRUCTION				**$ 22,277,000**
EXCAVATION/HAULING TO LANDFILL	CY	$ 5.00	13,700,000	$ 68,500,000
TOTAL PROBABLE COST				**$ 90,777,000**

Albritton Site Reservoir – Alternative 4
Preliminary Opinion of Probable Cost

ITEM	UNIT	UNIT PRICE	QUANTITY	TOTAL AMOUNT
MOBILIZATION/DEMOBILIZATION	LS	5%		$ 1,160,543
RESERVOIR				
Earthwork				
Clearing and grubbing	AC	$ 5,280.00	797	$ 4,208,160
Stripping	CY	$ 1.21	482,185	$ 583,444
Dewatering	AC	$ 1,760.00	772	$ 1,358,720
Sediment control	LS	$ 1,040,686	1	$ 1,040,686
Fill placement for berms	CY	$ 3.00	1,311,400	$ 3,934,200
Bedding, filters, and drains	CY	$ 28.60	57,533	$ 1,645,453
Second stage drains	CY	$ 49.50	15,003	$ 742,656
Slope protection - soil cement	CY	$ 38.50	112,842	$ 4,344,400
Slope protection - lower slope	SF	$ 1.10	413,223	$ 454,545
Slurry wall	SF	$ 3.08	1,046,025	$ 3,221,758
Geomembrane liner	SF	$ 0.55	586,140	$ 322,377
Aeration towers and bubbler system	LS	$ 1,354,939	1	$ 1,354,939
Additional Minor Items	LS	10%	1	$ 2,321,134
Subtotal Reservoir:				**$ 25,532,000**
MITIGATION	LS	$ 300,000	1	**$ 300,000**
SUBTOTAL - CAPITAL COSTS				**$ 26,993,000**
Contingencies	LS	16%	1	$ 4,318,880
SUBTOTAL RESERVOIR CONSTRUCTION				**$ 31,312,000**
EXCAVATION/HAULING TO LANDFILL	CY	$ 5.00	17,838,000	$ 89,190,000
TOTAL PROBABLE COST				**$151,814,000**

Albritton Site Reservoir – Alternative 5
Preliminary Opinion of Probable Cost

ITEM	UNIT	UNIT PRICE	QUANTITY	TOTAL AMOUNT
MOBILIZATION/DEMOBILIZATION	LS	5%		$ 966,227
RESERVOIR				
Earthwork				
Clearing and grubbing	AC	$ 5,280.00	605	$ 3,194,400
Stripping	CY	$ 1.21	366,025	$ 442,890
Dewatering	AC	$ 1,760.00	580	$ 1,020,800
Sediment control	LS	$ 781,863	1	$ 781,863
Fill placement for berms	CY	$ 3.00	1,311,800	$ 3,395,400
Bedding, filters, and drains	CY	$ 28.60	50,779	$ 1,452,277
Second stage drains	CY	$ 49.50	13,242	$ 655,469
Slope protection - soil cement	CY	$ 38.50	99,594	$ 3,834,396
Slope protection - lower slope	SF	$ 1.10	364,710	$ 401,182
Slurry wall	SF	$ 3.08	923,222	$ 2,843,525
Geomembrane liner	SF	$ 0.55	517,328	$ 284,530
Aeration towers and bubbler system	LS	$ 1,017,959	1	$ 1,017,959
Additional Minor Items	LS	10%	1	$ 1,932,466
Subtotal Reservoir:				**$ 21,257,000**
MITIGATION	LS	$ 300,000	1	**$ 300,000**
SUBTOTAL - CAPITAL COSTS				**$ 22,523,000**
Contingencies	LS	16%	1	$ 3,603,680
SUBTOTAL RESERVOIR CONSTRUCTION				**$ 26,127,000**
EXCAVATION/HAULING TO LANDFILL	CY	$ 5.00	12,900,000	$ 64,500,000
TOTAL PROBABLE COST				**$116,754,000**

TM 4.2.4.3 – EVALUATION OF SUBSURFACE STORAGE

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and the Southwest Florida Water Management District (SWFWMD) are currently completing the necessary, pre-requisite data collection and analysis as well as the comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marine Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the SWFWMD, to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (NEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and SCG's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

Reducing the amount of surface water flow in the Cow Pen Canal will reduce overall freshwater discharge quantities to Dona Bay and provide an alternative raw water supply that can be used to supplement regional water supply. The key components for this new alternative water supply will be withdrawal location and diversion intake options, source water quality, storage, piping and water treatment. As part of the storage component, both above ground reservoirs and underground storage using Aquifer Storage and Recovery (ASR) are being evaluated. This Technical Memorandum (TM) focuses on ASR as a storage component while taking into consideration the impacts of the aforementioned key components of the new surface water supply. A review of the Stormwater Resource Feasibility and Site Screening Analysis prepared by ASR Systems in 2004 will be discussed as it relates to the current project. In addition, a review of the hydrogeologic framework in Sarasota County will be summarized and evaluated in regards to ASR regulatory and operational constraints. Preliminary estimates of probable cost for the ASR storage option will be presented.

2.0 ASR CLASSIFICATION AND REGULATIONS

ASR in the State of Florida is regulated by the Florida Department of Environmental Protection (FDEP) under the Underground Injection Control (UIC) program. The rules and regulations governing the permitting, construction and operation of ASR wells are primarily contained in Chapter 62-528 of the Florida Administrative Code (FAC). In addition, the Southwest Florida Water Management District (SWFWMD) is also responsible for the issuance of well construction permits for ASR well facilities and issuing water use permit (WUP's) for the source water allocation and operation of ASR wells. In some cases, the local Department of Health also is responsible for the issuance of well construction permits.

3.0 CLASS V ASR WELL

Class V, Group 7 ASR wells are designed and permitted for the subsurface storage, and later recovery, of partially treated surface water. The ASR systems primary function is to store excess surface water, in subsurface formations, during periods when it is available, and later recover that same water, from the same well, to provide an alternative water supply during periods when there are customer demands. ASR systems are essentially a cost effective subsurface storage mechanism that can be utilized to extend total production capabilities beyond the design treatment capacity of a water treatment plant.

ASR wells also require a subsurface injection zone that demonstrates hydraulic characteristics (transmissivity) capable of accepting injection rates and volume, and providing acceptable recovery rates. In the west central portion of Florida, typically recharge and recovery rates are on the order of 1 to 2 million gallons per day per ASR well, however can be higher based on the hydraulic characteristics of the targeted storage zone. The current rules allow for the injection of partially treated surface water directly into aquifers with ambient total dissolved solids (TDS) concentrations in the receiving zone are at or above 1,000 mg/L. Partial treatment requires filtration and high level disinfection. Surface water that receives treatment at a water treatment plant with an FDEP operating permit can be injected into aquifers with ambient TDS concentration less than 1,000 mg/L.

Each ASR facility will also require the construction of a comprehensive monitoring well system to monitor operations and ensure injection operations are in compliance with the rules and regulations governing injection wells as well as being in compliance with individual injection well permit stipulations. These wells monitor the storage zone at two separate locations, and selected units immediately overlying the storage zone and are monitored for water level and selected water quality parameters, which are used to evaluate injection well operations and compliance.

Recharged water quality for Class V ASR wells essentially needs to meet all Federal and State primary and secondary drinking water standards (PDWS) along with supplemental minimum water quality criteria established by FDEP. There is some regulatory relief in the form of a Water Quality Criteria Exemption (WQCE) for secondary standards, which are not health based but aesthetic in nature. This is a separate permit application and processing fee and is issued for each constituent receiving a WQCE. A WQCE is issued for each constituent and is good for the duration of the Class V operating permit (typically for a five year period). The WQCE will require renewal along with the operating permit. There is no regulatory relief for primary standards. Recharge water for ASR wells (Class V) must meet Federal and State Primary's at all times.

It should be noted that data collected from some reclaimed water ASR facilities under construction and operational testing have raised regulatory concerns and issues regarding water quality changes that occur following recharge, specifically the occurrence of arsenic in the groundwater regime. The occurrence of arsenic in groundwater is further complicated by EPA reducing the arsenic standard from 50 ppb to 10 ppb, which took effect in January of 2006. The FDEP elected to implement the new standard a year earlier, in January of 2005.

This is currently being studied by a multitude of agencies; however, the outcome is uncertain at this time as to how the regulatory agencies will deal with some of the current regulatory hurdles. Previously, FDEP issued a position paper (white paper) indicating that through extensive monitoring to ensure no migration of arsenic off site and post treatment to remove arsenic from recovered water, a facility could continue to operate while investigating arsenic generation and remedial activities. That position is no longer held by FDEP. Most recently, FDEP stated that any ASR facility (under a construction and testing permit or operational permit) that has a chronic occurrence of arsenic will be required to enter into a consent order (CO) with FDEP. The CO will not be punitive in nature but will establish a plan and timeline to address the arsenic generation and bring the facility back into compliance.

It should be noted that each reclaimed water ASR facility is reviewed on a case by case basis. In some cases, additional monitor wells are required to observe and monitor water quality changes in the formation as a result of ASR operations. There are some ASR facilities that do not have water quality issues. A pilot study has been proposed for the removal of DO at a potable water ASR facility in Manatee County. Funding has been requested and is currently being considered by the SWFWMD. However; as of December 2006 no funding has been allocated. Other operational approaches, such as Targeted Storage Volume (TSV), are also being considered to address arsenic generation. The TSV approach is currently being reviewed and discussed in Tallahassee by FDEP to determine if this is a viable operational approach in dealing with arsenic.

4.0 PERMITTING

The FDEP is the lead permitting agency for Class V injection wells although SWFWMD issues some well construction permits and requires water use permits for ASR wells (Class V). The time required for permitting varies greatly depending on Districts, project location, available supporting data and type of injection facility (surface water, groundwater or reclaimed water). In some cases, the FDEP may require a feasibility study or an exploratory drilling program, prior to any permitting efforts, especially in those areas where insufficient hydrogeologic data exists or in areas where FDEP may have some environmental or regulatory concerns. This could lengthen the permitting process and subsequently the overall project duration.

Normally 6 to 12 months are required to complete the permitting process to secure a well construction and testing permit which allows for the construction and testing of the ASR facility. The construction permit is issued for a five year period during which the facilities are constructed and cycle tested under FDEP-approved operational cycle testing scenarios. An ASR operating permit is issued following successful demonstration of cycle testing which typically encompasses 4 to 5 separate recharge and recovery events over a two year period. The permitting sequence for the construction permit typically follows the sequence below and encompasses the entire 5 year permit window:

- Pre-application meeting to solicit input from the regulatory agencies for incorporation into the permit application package
- Preparation of the permit application package, supporting documentation and application process fee (application fee for Class V--$750.00)
- Issuance and response to Requests for Additional Information (RAI's) issued by FDEP to address questions or concerns.
- FDEP issues a notice of draft permit (requires publication)
- FDEP issues a notice of intent to issue a construction and testing permit and a notice of a public hearing to address the permit (requires publication)
- FDEP issues a construction and testing permit along with all of the permit conditions and stipulations
- Final design completed on the ASR facility, technical specification and bidding package prepared and issued for bid
- Construction and testing of the ASR well facility under taken and completed.
- Engineering report prepared summarizing construction and testing completed on the wells and proposed cycle testing plan. Engineering report submitted to FDEP for approval
- Cycle testing initiated following approval of the engineering report. Cycle testing of the ASR well system can be conducted for a period of two or more years (but not beyond the construction permit duration without applying for another construction and testing permit).

- Cycle testing report completed summarizing all testing activities, analysis and providing appropriate recommendations. This report is submitted as part of the operating permit application package.
- In conjunction with an operating permit obtained from FDEP, a water use permit will be required in order to allow withdrawal of the source water and to monitor for environmental impacts caused by groundwater pumping during ASR recovery.

The sequence described above encompasses a 5 year period and does not take into consideration possible public or private opposition to the project. In the event that opposition is encountered during the initial permitting process, permitting and/or project completion could be delayed from months to years depending on the degree of opposition and if an administrative hearing is conducted.

5.0 HYDROGEOLOGIC FRAMEWORK

The hydrogeologic system in Sarasota County consists of a thick sequence of carbonate rocks overlain by clastic deposits. Beds of carbonate rock units dip to the south and thicken to the southwest. Freshwater bearing units are approximately 2,000 feet thick in the eastern portion of the County. Below 2,000 feet, evaporites occur which restrict groundwater flow resulting in degraded groundwater quality. In areas approaching the coastline (western portion of the County), the bottom extent of freshwater occurs at shallower depths due to saltwater intrusion resulting from lateral and vertical groundwater movement.

Permeable formations that comprise the fresh-water bearing units within the hydrogeologic framework in Sarasota County in descending order are the surficial deposits, Hawthorn Formation, Tampa Limestone, Suwannee Limestone, Ocala Limestone, and the Avon Park Formation (SWFWMD, GWRAI, 1988). Groundwater in Sarasota County is obtained from the Surficial Aquifer System, the Intermediate Aquifer System, and the Floridan Aquifer System. The Surficial Aquifer System is composed of sand, phosphorite, and undifferentiated deposits and is mainly used for lawn irrigation and livestock watering. Individual well yields from the Surficial Aquifer are less than 50 gallons per minute which is not sufficient to pursue as a storage zone for ASR. The Intermediate Aquifer System lies below the Surficial Aquifer and consists of discontinuous sand, gravel, shell and limestone, and dolomite beds. Three separate water permeable zones, PZ-1, PZ-2, and PZ-3 occur in the Intermediate Aquifer System. Groundwater from the Intermediate Aquifer System is generally potable, but TDS concentrations increase in the western parts of the County. The permeability of PZ-3 may be sufficient to sustain an operating ASR well; however, PZ-3 has not been utilized for ASR in west-central Florida primarily due to heavy competition of other PZ-3 irrigation wells, water quality concerns related to Arsenic generation and public perception.

The Floridan Aquifer System (FAS) is the most productive aquifer in Sarasota County and includes carbonates below the Intermediate Aquifer System. The FAS is divided into upper and lower permeable units separated by a middle confining unit. The Upper Floridan Aquifer (UFA) is used for water supply. In Sarasota County, the top of the UFA generally occurs at the top of the Suwannee Limestone and extends through the Ocala Limestone and Avon Park Formation. TDS and sulfate generally exceed potable use limits in the UFA throughout the entire County; however, can be treated to drinking water standards and/or agricultural irrigation standards. Within the study area, TDS concentrations are typically between 1,000 and 10,000 mg/L in the Suwannee Limestone and Ocala Limestone. The Avon Park Formation contains TDS concentrations that exceed 10,000 mg/L and even approach sea water quality in coastal areas. Due to the very high hydraulic permeability and TDS concentrations encountered, which would likely result in low recovery efficiencies of ASR wells, the Avon Park Formation has not been actively pursued for ASR well development. The Ocala Limestone typically has low permeability, which has also limited ASR well development of this unit throughout west-central Florida. The Suwannee Limestone typically has the proper combination of hydraulic permeability and ambient groundwater quality that can sustain a 1 to 2 mgd ASR well with recovery efficiencies greater than 70%. An ASR test well was recently constructed into the Suwannee Limestone at the Sarasota County Central Water Reclamation Facility located several miles west of the CPSC. Hydrogeologic data from this ASR test well indicates that the Suwannee Limestone can sustain a flow rate of approximately 2 mgd with ambient groundwater quality of approximately 2,000 mg/L TDS.

6.0 WITHDRAWAL LOCATIONS & DIVERSION INTAKE OPTIONS

As part of the Stormwater Resource Feasibility and Site Screening Analysis Study (Site Screening Study), four sites (Fox Creek, Albritton, Myakka and Pinelands) were identified from which up to 20 to 25 mgd freshwater could be diverted. As part of the current study, the focus of surface water diversion was further limited to the CPC, which further limited the study area to two diversion/storage sites: Fox Creek and Albritton (northward extension of the Pinelands site). According to a review of flow data presented in the Site Screening Study, there was 25 mgd of surface water available for diversion at the Fox Creek site for at least 102 days and 20 mgd at the Albritton site for at least 97 days. Based on our review of flow data, both sites have sufficient quantities of surface water available to sustain a surface water ASR system of at least 10 ASR wells. However, since some of the water upstream will be stored in the proposed surface storage reservoirs, these flow quantities may be reduced appropriately. There is sufficient land available to construct as many as 10 ASR wells apiece at both sites at a spacing of approximately 300 to 400 feet apart. Final ASR well spacing will be dependent upon results of cycle testing of the initial ASR test well and groundwater modeling if required by regulatory agencies.

The Site Screening Study identified two primary methods of surface water diversion, these being a diversion intake structure and bank filtration utilizing deep trench horizontal wells or horizontal directionally drilled wells. Large diameter and relatively shallow Ranney Wells have also been used successfully with bank filtration technology.

Selection of a particular surface water diversion method for a potential ASR site is influenced heavily by the fact that filtration and high level disinfection is a requirement of state regulations for the storage of surface water in an ASR well. Additionally, Federal and State Primary Drinking Water Standards also have to be met prior to injection at the ASR well. A discussion of specific water quality data is included in the following section.

Diversion intake structures are common throughout the United States and Florida with various design types based primarily on the quantity of water to be diverted, depth of the water body, existing flow rates in the water body and proximity of water diversion area to treatment/storage point. Intake structures may be driven by gravity flow but in most settings are associated with a pumping system, especially those systems requiring the movement of up to 25 mgd of water. Construction permitting of intake structures located on non-navigable waterways such as the CPC is less complex than intake structures on navigable waterways. The ability to withdraw water from a diversion intake structure is permitted by SWFWMD through issuance of a water use permit.

Bank filtration wells are constructed near the banks of rivers and canals at relatively shallow depths to pump and supply large amounts of surface water. The pumping action of these wells creates a pressure head difference between the canal and the shallow aquifer with the higher head at the canal ("Riverbank Filtration", 2003). The higher head of the river/canal water and lower head in the aquifer induces the canal water to flow downward through the porous sands into the pumping wells. The water from these wells is a combination of groundwater originally present in the shallow aquifer and filtered surface water from the canal. Ideally, bank filtration wells will pull >50% of water from the canal with the remaining portion contributed by groundwater. During movement of this water through the canal bed sediments, dissolved and suspended contaminants plus various pathogens are reduced or removed due to the combination of physical, chemical, and biological processes. Some European countries use this technology to augment the removal of natural organic matter (NOM), organic contaminants, and pathogenic microbes from as much as 80% of their drinking water. Outside of Europe, bank filtration systems are not widespread because surface water and groundwater of adequate quality are readily available (Environmental Science and Technology, 2002). However, recent and forthcoming changes to state and federal rules regulating drinking water supplies have made bank filtration technology a more viable alternative to conventional intake and treatment systems.

Construction and water use permitting for bank filtration wells is more complex than diversion intake structures. Due to inclusion of groundwater into the supply of diverted water, potential environmental impacts caused by the bank filtration wells will need to be addressed as part of the SWFWMD permitting and compliance process.

A detailed evaluation to determine which type of diversion intake option is feasible or would be recommended for either the Fox Creek or Albritton sites was not performed for this study, although a diversion intake structure can likely be constructed at either of the two sites for relatively the same costs (to be discussed in later section of TM). Site specific pilot testing and data evaluation is necessary to confirm the feasibility of using bank filtration or any of the horizontal or directionally drilled ASR well technology at either of the project sites.

7.0 SOURCE WATER QUALITY

As previously stated in this TM, all water stored in an ASR well must meet primary drinking water standards with some regulatory relief available for secondary drinking water standards. The Site Screening Study presented monthly water quality data from the Cow Pen Slough Water Quality Monitoring Study for the period between February and July, 2003. For this study, monthly water quality data from the CPC collected between February and December, 2003 and a single event in June 2006 were reviewed. These water samples were collected from the CPC in close proximity to the Albritton site and upstream of the Fox Creek site.

A review of all the water quality data indicates that there were no exceedances of any primary drinking water standards and therefore, no fatal flaws are identifiable in terms of the feasibility of storing CPC water underground in an ASR well. As many as four secondary drinking water standards (iron, color, odor and aluminum) were detected in water samples from multiple sampling events. Iron concentrations regularly exceeded the state standard of 0.3 mg/L and ranging up to 2.0 mg/L. Color levels also regularly exceeded the state standard of 15 color units ranging up to 400 color units with levels generally between 70 and 140 color units. Odor was detected above the state standard of 3.0 units in four samples ranging up to 40 units. Aluminum concentrations were detected above the state standard of 0.2 mg/L in 4 samples ranging up to 0.42 mg/L.

For ASR well systems, compliance with secondary drinking water standards is based on a rolling annual average, thus, aluminum is not likely to exceed the state standard limitations. Also, ambient groundwater within the Suwannee Limestone is likely to contain odor levels greater than the annual average odor level detected in the CPC and therefore, compliance with the state standard will not be required. Regulatory relief in the form of the WQCE will likely be required for iron and color.

The water quality parameters, total suspended solids (TSS) and total organic carbon (TOC) which were analyzed in the June 2006 water sample. In addition to the color analyses addressed previously, have significant implications to the treatment requirements for an ASR well system. The TSS concentration of 8.89 mg/L indicates that the design of an aboveground filtration system or a bank filtration system must be effective in lowering the TSS concentration to less than 5.0 mg/L as part of the regulatory requirement for filtration. The TOC concentration of 12.9 mg/L is consistent with surface water sources and suggests that if chlorine disinfection were to be used as part of the treatment process, disinfection byproducts such as total trihalomethanes (THMs) and haloacetic acids could be generated at levels exceeding the primary drinking water standards, which would then preclude injection into an ASR well. Color impacts the ability to provide effective ultraviolet disinfection of the source water and pilot testing of ultraviolet treatment systems is recommended to determine the disinfection system requirements.

8.0 PIPING & WATER TREATMENT

Piping systems as related to piping material types generally do not directly impact ASR feasibility determination. However, due to the high cost of piping water from one location to another, piping and associated pumping costs on both the recharge and discharge side of the ASR well do affect overall ASR project feasibility. For the purpose of comparing the Fox Creek and Albritton sites as part of this study, it is assumed that the potential ASR wells at both sites will be located in relatively close proximity (less than 2,500 feet) to the potential diversion intake along CPC. Discharge side piping size and lengths are dependent upon the ultimate location of the ASR recovered water, which has not been clearly defined for the purpose of this ASR feasibility study. Therefore, piping and pumping systems were not evaluated as part of this study.

For a diversion intake structure, typically filtration would be provided through an aboveground treatment system such as a sand filtration media or high pressure disk filters. Either system can be effective for removal of particulates so that compliance with total suspended solids (TSS) limitations can be achieved. However, sand filtration, especially deep bed filters are more effective in the removal of pathogens and viruses which is becoming a more prominent issue in treatment system considerations. The primary options for high level disinfection of surface water for ASR well systems include chlorination, chloramination, ultraviolet radiation, and ozonation. Each disinfection system option is not without drawbacks that would make it exclusively preferable to the other listed disinfection systems when an ASR well system is involved. A detailed analysis of the potential treatment system options is beyond the scope of this limited ASR feasibility study, however, a brief synopsis of various pros and cons of each disinfection system is provided hereafter:

Chlorination – Use of a chlorination system tied directly to a conventional diversion intake structure and filtration system is not likely to be feasible based on the existing CPC water quality and the likely generation of disinfection by products. If bank filtration were utilized for source water supply and filtration, reduction in TOC may allow use of chlorine disinfection without generating levels of disinfection by products that would prohibit injection at an ASR well.

Chloramination – Is similar to a chlorination treatment system in design except uses the addition of ammonia to suppress the formation of disinfection by products. It is more labor intensive and costly than standard chlorine treatment systems and may not be as effective in the treatment of pathogens and viruses.

Ultraviolet Radiation – Is increasingly being used to provide disinfection at facilities ranging from large scale treatment plants down to inline treatment at individual ASR wellheads because disinfection by products are not generated. High color concentrations as those found in CPC can affect ultraviolet radiation system efficiency and ultimately costs. If bank filtration were utilized for source water supply and filtration, reduction in color may increase effectiveness of the ultraviolet radiation system and lower treatment costs.

Ozonation – A treatment process that uses ozone gas produced by subjecting oxygen molecules to electrical current in order to inactivate pathogens and naturally occurring bacteria. Disinfection by products such as THMs and haloacetic acids are not formed by this treatment process but the treated water stream contains elevated dissolved oxygen concentrations. Dissolved oxygen levels are suspected of causing water quality and geochemical changes in the storage zone of an ASR well, which may lead to further treatment and also regulatory compliance issues.

In addition to being a surface water diversion intake option, bank filtration offers the potential of meeting the state filtration requirements for surface water recharged to an ASR well. Bank filtration, as mentioned previously, can substantially improve source water quality that can make all of the above disinfection systems more effective and less costly. The effectiveness of a bank filtration system at either of the two potential ASR well sites needs to be verified through a comprehensive pilot testing program.

9.0 ESTIMATED ASR COSTS

For this study, a probable cost estimate for implementing the storage option of a surface water supply ASR well system has been prepared that is applicable to both the Fox Creek and Albritton sites. This cost estimate is tied specifically to the permitting of the ASR well system, well construction and ASR cycle testing and includes both engineering and construction costs. Costs related to the surface water diversion intake system, conveyance piping and aboveground pumping, water treatment systems and water use permitting are outside the scope of this study and not addressed in this TM.

Based on the evaluation performed as part of this study, a conceptual ASR well system has been developed consisting of a 17.5-inch (outer diameter) ASR well cased to the top of the Suwannee Limestone with approximately 100 feet of open borehole, two storage zone monitor wells that are 6-inches in diameter with casing and borehole depths similar to the ASR well and an upper zone monitor well with 6-inch casing completed into PZ-3 of the Intermediate Aquifer System. It is expected that a single ASR well completed into the Suwannee Limestone will accept and yield up to 2 mgd and that as many as 10 wells may be necessary to capture and store up to 20 mgd. The cost estimate is detailed in the table below with a breakdown of various tasks for completing one ASR well system and also for completing the remaining 9 ASR wells:

TASK	Cost for 1 ASR Well	Cost for 9 ASR Well
FDEP Construction/Testing Permit	$75,000	$100,000
Well Drilling	$1,200,000	$8,500,000
Wellhead Infrastructure	$800,000	$5,400,000
ASR Cycle Testing	$200,000	$400,000
ASR Operational Permit	$100,000	$200,000
Totals	**$2,375,000**	**$14,600,000**

Table 1

Note: Costs for the 9 ASR wells are based on a single permitting/construction effort which provides for economy of cost savings.

10.0 SUMMARY AND RECOMMENDATIONS

The following provides a summary of findings based on the available information reviewed to date. The findings are predicated on the current rules and regulations in place governing Class V ASR wells and are applicable to both sites

Findings

- The Suwannee Limestone of the UFA contains suitable transmissivity, storage capacity and confinement for ASR operations.
- Water quality in the Suwannee Limestone of the UFA is conducive to the permitting, construction and operational testing of an ASR system.
- There are current regulatory issues that may arise with the installation and testing of a Class V ASR well that could prevent the ASR facility from obtaining an operating permit in the future.
- The estimated probable cost for a 2 mgd ASR well system completed into the Suwannee Limestone is $2.375 million.

Recommendations

- The County should proceed with a preliminary design study for the surface water diversion intake system, treatment system and conveyance piping systems that should include pilot testing as is applicable for the selected site.

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TM 4.2.5 - DETERMINATION OF SURFACE WATER TREATMENT PLANT LOCATION

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and the Southwest Florida Water Management District (SWFWMD) are currently completing the necessary, pre-requisite data collection and analysis as well as the comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marine Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the SWFWMD, to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (CHNEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and Sarasota County's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

Pursuant to Task 4.2.5 of the DBWMP contract, PBS&J has prepared this technical memorandum to present a comparison of possible water treatment plant locations. Specifically, the 3 locations considered include in the vicinity of the planned water storage reservoirs (Albritton borrow site and the Venice Minerals site) as well as the existing Carlton water treatment plant site.

2.0 WATER TREATMENT PLANT ALTERNATIVE LOCATIONS

Two large, publicly owned areas within the Dona Bay Watershed are currently being excavated. The Venice Minerals site is a sand and shell mining operation that was purchased by Sarasota County and leased back to Venice Minerals and Mining. Excavation by the lessee is expected to be completed in the next 2 to 3 years. The Albritton site was purchase by Sarasota County for cover material for their adjacent landfill operation. Excavation of this site was initiated in the past year and could continue for some time. Both sites provide opportunities to store excess surface water from the Cow Pen Canal to achieve the Dona Bay watershed objectives. Both of the excavations could be completed to form reservoirs for source water storage that could be subsequently treated to provide a potable water supply.

Since mining of the Venice Minerals site will be complete within a few years, it will likely be the first phase of development of the reservoir system. Water will be transported across the Albritton site through a surface channel into the existing borrow pits on the landfill site and may flow through an underground pipe to connect to the reservoir at the Venice Minerals site. Figure 1 shows the locations of the potential reservoir sites.

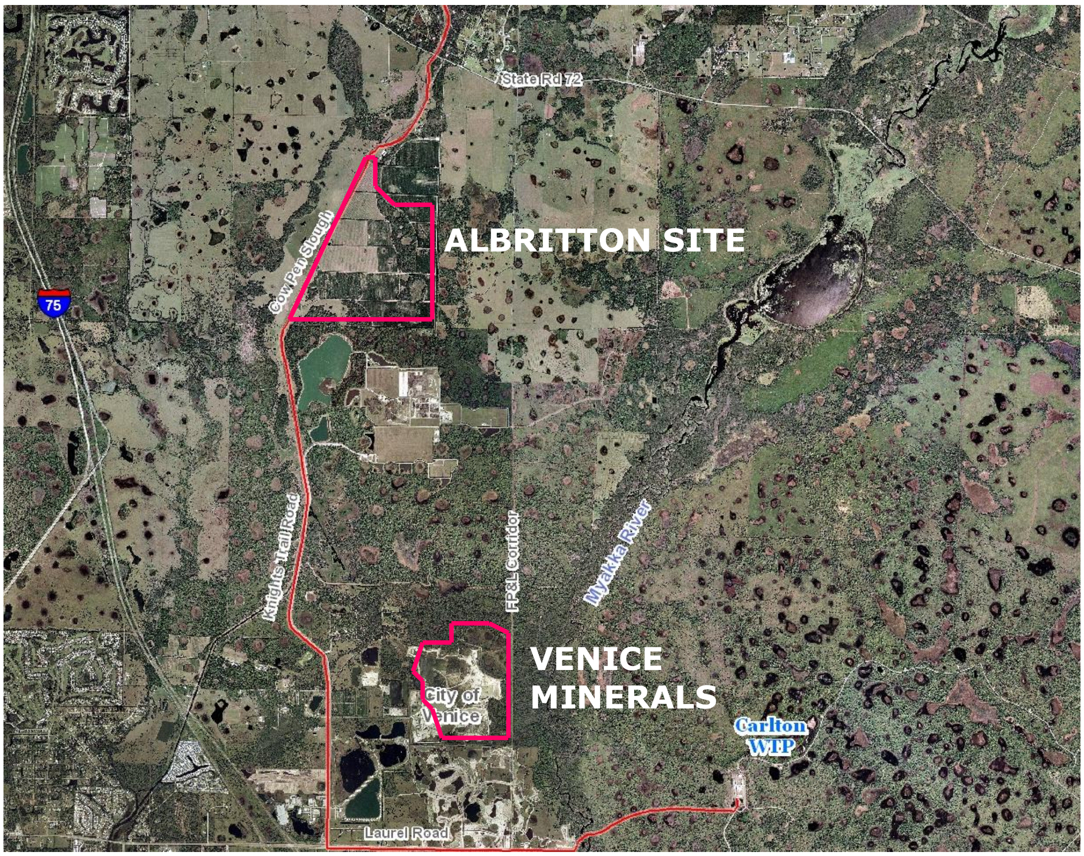

Figure 1 – Potential Reservoir Sites

Figure 2 shows the boundary of the property owned by Sarasota County at the Venice Mineral site. The excavation of the borrow pit will occupy almost all of the county-owned area, and there is not sufficient land available for construction of a new water plant. The purchase of additional property would be required, and the most favorable location would be southwest of the existing property on land currently occupied by the processing equipment for the borrow pit. This area is still owned by Venice Minerals and Mining and is located within the incorporated limits of the City of Venice.

Figure 2 – Venice Minerals Site

As previously indicated, the Albritton site was purchased to provide cover material for the adjacent landfill at the Central County Solid Waste Disposal Complex (CCSWDC). Excavation of the Albritton site has begun to provide the cover material needed on an annual basis and is planned to occur over the remainder of the life of the landfill. Excavation of the material could be accelerated and the material could be stored on the landfill to create a reservoir at an earlier date. Figure 3 shows the Albritton property and the surrounding area. The most efficient locations for a water treatment plant would be at the north end or at the south end of the site. The southwest corner of the property is preferable because it requires the least access road construction and is near a planned connection of the regional water transmission main and a planned County water transmission main extended from Preymore Street.

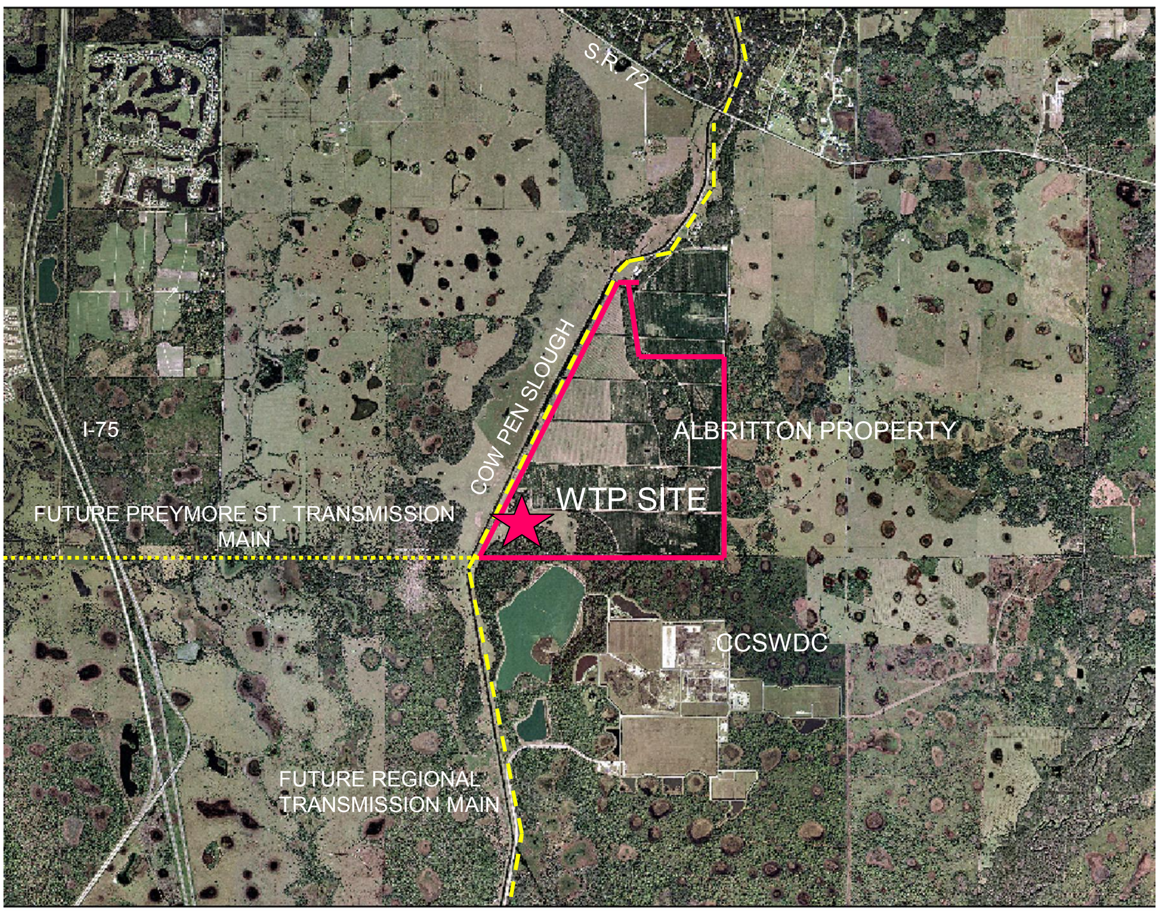

Figure 3 – Albritton Property

Construction of a water treatment plant at either of the borrow pit sites would place the facility near the source of water. A third possible site for a new water treatment plant is the existing Carlton Water Treatment Plant. This location offers a number of advantages, but would require the construction of a raw water main from the Venice Minerals site to the treatment plant (see Figure 4). Figure 4 shows the route of raw water across the Albritton site into the existing borrow pits and an underground pipe to connect to the Venice Minerals reservoir.

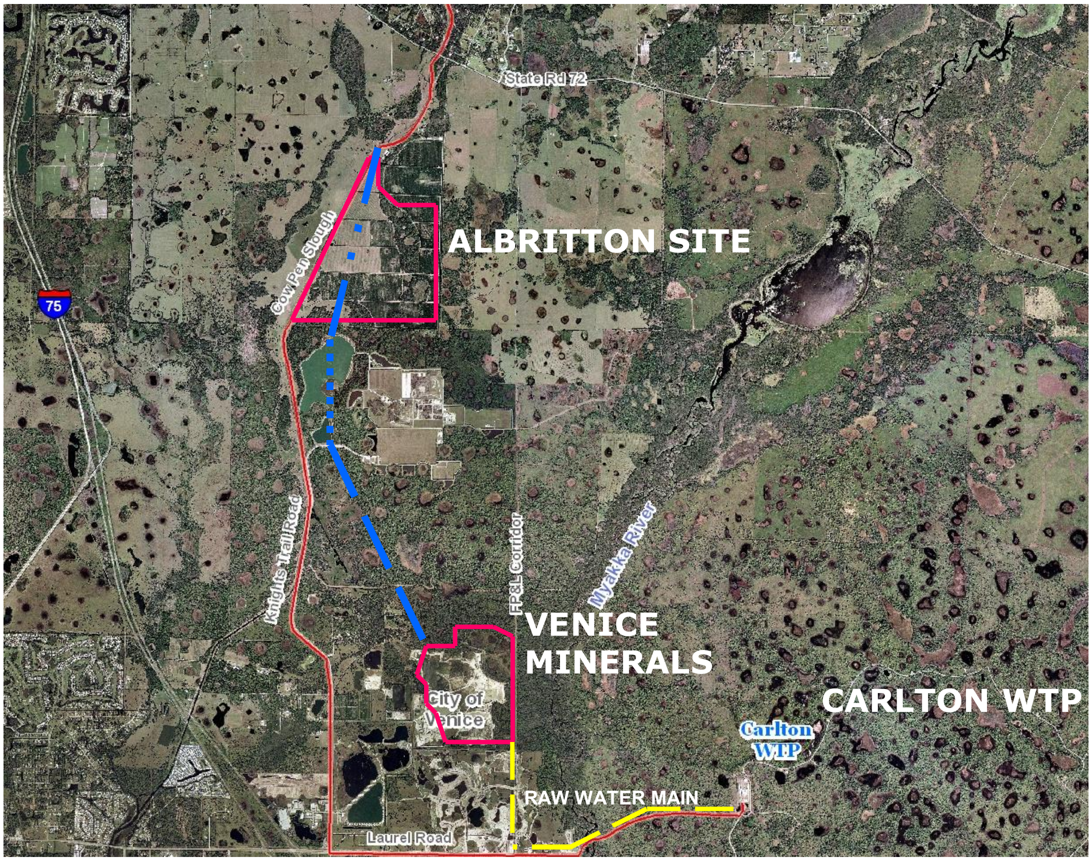

Figure 4 – Carlton WTP

Although most of the costs for construction of a water treatment plant generally will be the same for any of the three locations, there are items that will be specific to each location. The additional costs for the three locations are:

<u>Albritton Site</u>

This site does not have existing vehicular access. The probable cost for an access road to the site from Knights Trail Road is $4,888,000. The finished water from a treatment plant at this location could be pumped into the regional water transmission main that is planned to be adjacent to the site or into a County water transmission main planned to be constructed in an extension of Preymore Street.

Venice Minerals Site

The existing property owned by Sarasota County at the Venice Minerals site does not have vacant property that could be used for construction of a water treatment plant. The probable cost for 30 acres of additional property located to the southwest of the reservoir site, within the City of Venice, is $3,600,000, based upon an estimated value of $120,000/acre. The probable cost for a finished water main that would connect to the future regional water transmission main in Knights Trail Road is $655,000. If a connection to the existing County water transmission is required, a 24-inch pipe would be constructed to connect to the existing main in Laurel Road. The probable cost for a connection at Laurel Road is $1,747,200.

Carlton WTP

The probable cost for a 24-inch raw water main from the Venice Minerals site to the Carlton WTP is $3,400,000 including a crossing of the Myakka River.

3.0 CONCLUSIONS

The Carlton facility has the lowest probable cost for site specific features. In addition, construction of the new treatment plant adjacent to the Carlton facility offers the following advantages and is recommended:

- Water from the Peace River Water Authority is blended at the Carlton WTP with water produced at the site. Blending of water from a third source could be handled more effectively at the treatment plant.
- Coordination of treatment operations and high service pumping would be facilitated.
- Water could be pumped into the regional system to go north or south or could be pumped into the County's transmission system.
- Fewer additional operators likely would be needed.
- Security at the Carlton WTP is already in place.

TABLE 1 – ALTERNATIVE TREATMENT PLANT SITE LOCATIONS

	ALBRITTON SITE	VENICE MINERALS SITE	CARLTON WTP SITE
Coordination with phasing of development of reservoir system	• This location would be acceptable if it is the first phase of the reservoir	• This location would be acceptable if it is the first phase of the reservoir	• Could work with either phase • Raw water main required from reservoir • Shorter raw water line from Venice Minerals
Proximity to the water source	• Adjacent	• Adjacent	• Distance of 3.5 miles to the Venice Minerals site
Proximity to the planned regional water transmission system	• Adjacent • Near the planned connection to a Sarasota County transmission main in Preymore Street	• Distance 0.7 miles	• Adjacent
Proximity to the Sarasota County water transmission system	• Distance 5.4 miles to Laurel Road • Near the planned Preymore Street connection to the regional system	• Distance 2.0 miles to Laurel Road	• Adjacent
Power availability	• New service required	• Existing	• Existing
Vehicular access	• New access road required 1.3 miles	• Existing	• Existing
Available County-Owned property	• Existing	• Additional property required	• Existing
Staff requirements	• 24 hrs/7 days for capacity of 5.0 mgd or greater. Class A lead operator, Class C staff	• 24 hrs/7 days for capacity of 5.0 mgd or greater. Class A lead operator, Class C staff	• Existing staff could share responsibilities • Additional operators required
Coordination of operations with the Sarasota County water system and the regional water system	• Adds an additional facility to be operated and coordinated with the systems • Coordination of pumping, blending, timing of operations, etc. required	• Adds an additional facility to be operated and coordinated with the systems • Coordination of pumping, blending, timing of operations, etc. required	• Existing facilities are already a part of the systems • Provides capability of blending potable water from three sources
Coordination with planned modifications of the Carlton WTP	• Pumping and hydraulics • Chemical additions, disinfection, and corrosion control	• Pumping and hydraulics • Chemical additions, disinfection, and corrosion control	• The Dona Bay water source could be incorporated into the design of the modified Carlton process
Probable costs for site specific items	• Access Road - $4.9 million	• Property - $3,600,000 • Potable water main - $655,000	• Raw water main - $3.4 million

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TM 4.2.7 – DEVELOPMENT OF PHASING PLAN

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and the Southwest Florida Water Management District (SWFWMD) are currently completing the necessary, pre-requisite data collection and analysis as well as the comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marine Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the SWFWMD, to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (CHNEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and SCG's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

This Technical Memorandum has been prepared by KHA to present a preliminary phasing plan to provide a logical implementation sequence for the Dona Bay comprehensive watershed management program elements, consistent with Task 4.2.7 of the DBWMP contract.

2.0 DESCRIPTION OF PROGRAM ELEMENTS

SCG in coordination with the SWFWMD, CHNEP, and the Peace River Manasota Regional Water Supply Authority (Authority) has embarked on the implementation of a comprehensive watershed management program for Dona Bay. As part of this program, SCG has acquired numerous sites that are strategically located for water resources and watershed management. SCG has also contracted with KHA and a team of subconsultants to evaluate alternatives and develop a program to restore natural system functions in Dona Bay and its watershed while protecting or improving water quality, maintaining or improving existing flood protection, and to the extent that it supports these program goals, develop alternative surface water sources for beneficial uses.

Key to the Dona Bay comprehensive watershed management program is the recognition that the volume of freshwater flow to the Dona Bay estuary has been dramatically altered by the diversion of approximately 37,453 acres from the Myakka River watershed with the construction of the Cow Pen Canal. Therefore, two effective management strategies include the restoration of watershed storage and the recycling of the excess surface water that could be stored in the strategic sites located in the watershed and owned by SCG. Additional opportunities exist on private properties that could be investigated as future public-private partnerships in watershed management. Based upon preliminary evaluations and an inventory of opportunities within the watershed, the a phasing plan has been developed that considers the incremental and gradual timing of restoration of the Dona Bay water budget and the estimated future demand for regional water supply. **Table 1** inventories the various potential program elements. **Figure 1** provides a map of the watershed which identifies the various potential program elements.

Element ID	Potential Site	Restoration	Preservation	Ownership
1	Fox Creek Site	X		SCG
2	West Pinelands	X		SCG
3	Venice Minerals	X		SCG
4	Pinelands Pits	X		SCG
5	Albritton Site	X		SCG
6	Gum Slough		X	SCG
7	LT Ranch Pasture	X		Private
8	Hi-Hat Old Grove	X		Private
9	Hi-Hat Floodplain		X	Private

Table 1 – Potential Dona Bay Watershed Management Program Elements

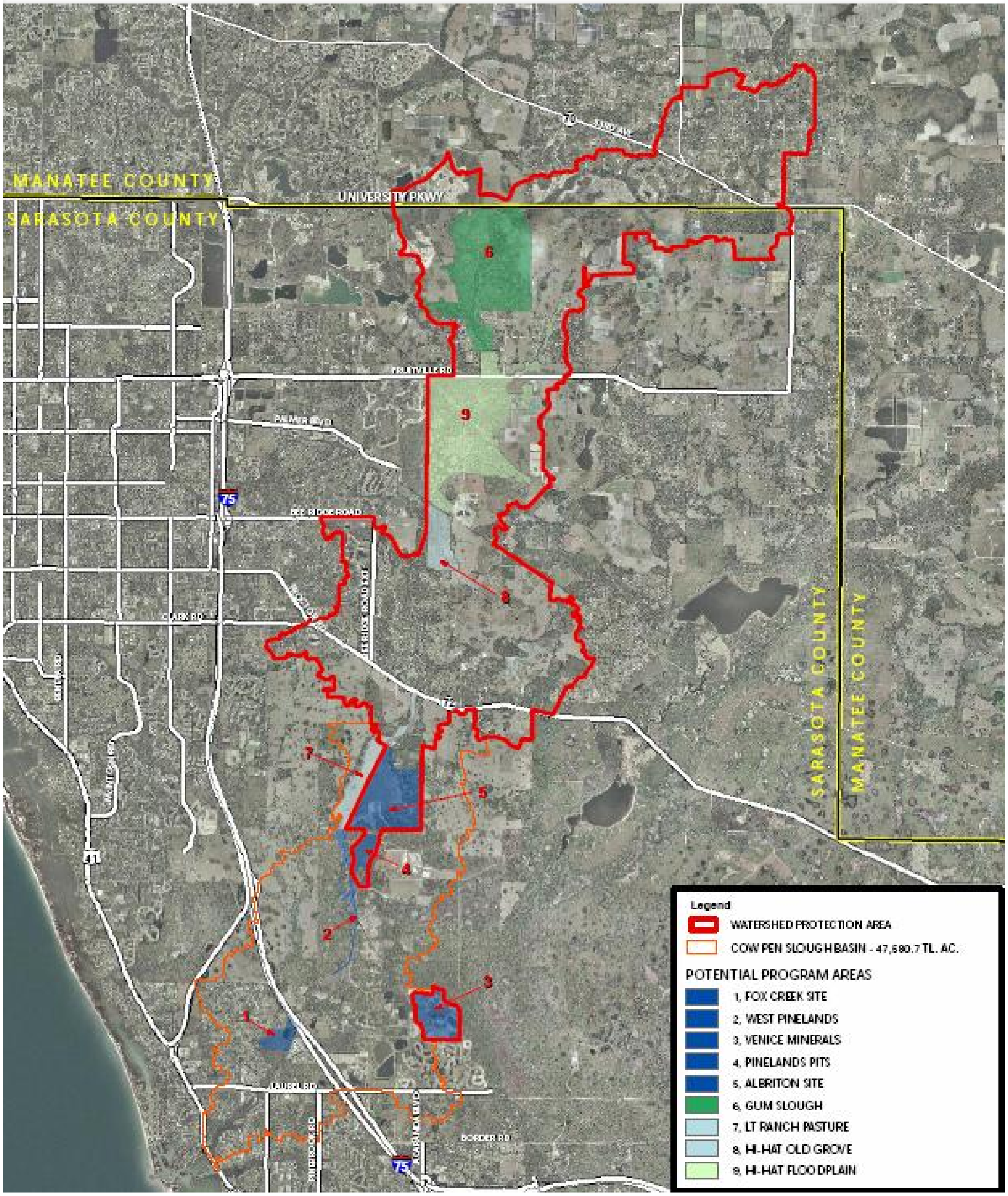

Figure 1 – Potential Watershed Management Sites

3.0 PHASE 1 CONFIGURATION

The initial phase of the Dona Bay Comprehensive Watershed Management program includes several elements that will initiate the restoration of the Dona Bay water budget, by increasing the watershed hydroperiod and storage capacity as well as enhancing water retention and stormwater attenuation. In the process, the volume of excess freshwater flow to Dona Bay will be reduced while providing wetland re-hydration and reservoir storage for approximately 5 mgd of alternative surface water supply. In addition, the timing of excess freshwater flows will be more naturally lagged by the diversion to the historical slough flow path. Pursuant to Technical Memorandum 4.2.2, this phase is estimated to reduce the excess freshwater currently being discharged from the Cow Pen Canal to Shakett Creek and Dona Bay by 14%. This initial phase will include comprehensive watershed program elements 2, 3, 4, and to some extent, 5. Specifically, the following program elements are proposed as part of the initial phase:

3.1 Element 2 – West Pinelands

This program element proposes to re-hydrate the historical cow pen slough corridor located adjacent to the canal within the public lands of the Pinelands reserve. This could be accomplished in a number of ways including raising the water level in the canal (not practical), lowering the historical slough corridor (costly), or recycling surface water from the canal to the historical slough corridor with pumping. Therefore, re-hydration of the west pinelands slough is proposed by using solar powered pump(s) to pump water from the adjacent Cow Pen Canal.

3.2 Element 3 – Venice Minerals

This program element proposes the completion of mining activities at Venice Minerals and the construction of perimeter ±15'high berms around the excavated borrow pit to create a reservoir for storage of excess freshwater flow from the Cow Pen Canal, as proposed under Alternative 2 of Technical Memorandum 4.2.4.1.

3.3 Element 4 – Pinelands Pits

This program element proposes (1) the construction of approximately 13,000 linear feet of 72" diameter (or hydraulic equivalent) gravity pipe from the southerly Pinelands borrow pit to Venice Minerals, (2) connection of the southern Pinelands borrow pit to the northern Pinelands borrow pit, and (3) connection of the northern Pinelands borrow pit to the southern property line of the Albritton tract to provide a system to transport water from the Albritton site to the reservoir created at the Venice Minerals site. However, the installation of a valve box or operable sluice gate between the Albritton site and the northern Pinelands borrow pit is also proposed to allow the hydrologic isolation during wet season and flood conditions when water levels in the Albritton site exceed elevation 18.0 ngvd. In addition, a grate box at an elevation of approximately 15.5 ngvd is proposed at the downstream end of the gravity pipe in the Venice Minerals reservoir to prevent the Pinelands pits from receding below 15.5. If determined at the design stage, it may also be advantageous to augment the Venice Minerals reservoir up to elevation 15.5 with a second gravity pipe (not shown) from the existing south Pinelands restoration area. The existing south Pinelands restoration area may in turn be enhanced by overflows from the Pinelands pits. The exact configuration can be finalized at the design stage.

3.4 Element 5 – Albritton Site

Element 5 includes the excavation of a ± 500 ft. wide waterway (with a 5 ft. minimum permanent pool depth) along the west side of the Albritton tract between the northwest portion of the site and the southern portion of the site, where it would tie into the northern Pinelands borrow pit. It is also proposed that the upper Cow Pen Canal water control structure, located at the northwest corner of the Albritton tract, would be reconfigured/reconstructed to have operable gates on both sides as well as the main canal gates (as is currently the case). The east side gates would allow the diversion of low and moderate flows into the Albritton tract while the main gates would serve as an emergency spillway to the downstream Cow Pen Canal. In the event that a future phase includes a private partnership with the LT Ranch, it is recommended that gates also be constructed but not operated on the west side of the reconfigured/constructed control structure and that an equalizer culvert be constructed beneath and parallel to the control structure spillway. The invert on the side gates when open would be at or below elevation 14.0 ngvd. The gates and spillway on the face of the reconfigured/reconstructed structure would allow for flows to discharge to the Cow Pen Canal when the Albritton or the LT Ranch Pasture sites were full.

To assure no adverse increase in flood stages on private properties adjacent to the Albritton site, the Phase 2 re-hydration area shown in the southeast portion of the Albritton site and perimeter berms may also be warranted in this initial phase. This can be determined and finalized at the design phase.

3.5 Alternative Water Supply Element

This water supply element would include construction of a surface water treatment plant at the existing Carlton Water Treatment Plant site as well as a pump station and 24-inch pressure pipe from the reservoir system to the treatment plant.

Using the long-term Cow Pen Canal flow data transferred from the Myakka River gage, monthly water budgets and routing analyses were performed for the Phase 1 configuration as presented in Technical Memorandum 4.2.2. As indicated in **Table 2**, the Phase 1 configuration is estimated to result in a yield between 5 mgd and 7 mgd with reliabilities between 100% and 98.4%, respectively. Reliability was determined as the estimated percentage of the time that the reservoir will be able to provide the specified yield.

Phase 1 - Yield	Reliability
5 mgd	100 %
6 mgd	99.3 %
7 mgd	98.4 %

Table 2 – Phase 1 Configuration, Estimated Yields and Reliability

Based upon the estimated 2 to 3 year completion date of the Venice Minerals excavation operations, it is estimated that the Phase 1 configurations could be completed as early as

2012, although it may not be needed until as late as 2025. The preliminary opinion of probable cost for the program elements in Phase 1 is estimated at $75,000,000. **Figure 2** provides a conceptual schematic of the phase 1 configuration.

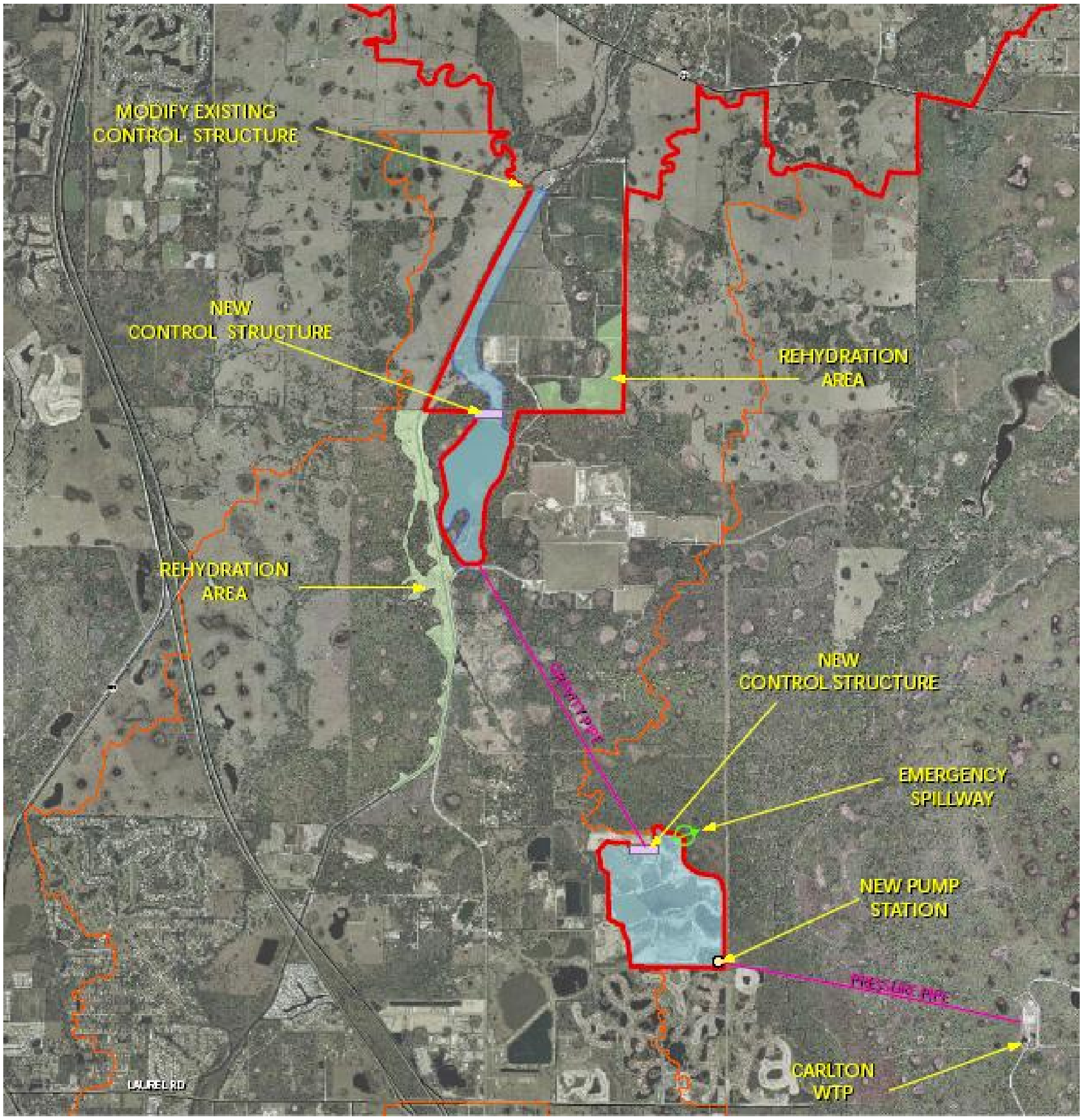

Figure 2 – Dona Bay Watershed Management Program, Phase 1 Configuration

4.0 PHASE 2 CONFIGURATION

The phase 2 configuration of the Dona Bay Comprehensive Watershed Management program will establish the framework for this and subsequent phases. This phase will further restore the Dona Bay water budget, by increasing the watershed hydroperiod and storage capacity as well as by enhancing water retention and stormwater attenuation. In the process, the volume of excess freshwater volume to Dona Bay will be reduced while providing wetland re-hydration and reservoir storage for an additional 5 mgd of alternative surface water supply. When combined with the program elements in the phase 1 configuration, this would provide a total of approximately 10 mgd of alternative surface water supply. In addition, the timing of freshwater flows will continue to be more naturally lagged by the creation of additional storage within the historical slough flow path. Pursuant to Technical Memorandum 4.2.2, this phase when combined with phase 1 configuration is estimated to result in a 28% reduction of the excess freshwater currently being discharged from the Cow Pen Canal to Shakett Creek and Dona Bay.

The phase 2 configuration will essentially include the ultimate excavation of the Albritton site (i.e. comprehensive watershed program element 5). Specifically, the following program elements are proposed as part of the phase 2 configuration:

4.1 Element 5 – Albritton Site

This program element proposes the completion of excavation activities at the Albritton site and construction of a 25' high perimeter berm around the resulting reservoir, presented as Alternative 3 in Technical Memorandum 4.2.4.2. Incidental to the construction of the berm should be the installation of the necessary conduit to accommodate a subsequent pump intake pipe proposed in Phase 3.

4.2 Alternative Water Supply Element

This program element proposes the expansion of the surface water treatment plant, presumably at the Cartlon Water Plant site as presented in Technical Memorandum 4.2.5.

Using the long-term Cow Pen Canal flow data transferred from the Myakka River gage, monthly water budgets and routing analyses were performed for Alternative 2 of the Venice Minerals site and Alternative 3 of the Albritton site. As indicated in **Table 3,** the program elements associated with the phase 2 configuration (inclusive of the phase 1 configuration) are estimated to result in a yield between 10 mgd and 14 mgd with reliabilities between 99.2% and 94.9%, respectively. Reliability was determined as the estimated percentage of the time that the reservoir will be able to provide the specified yield.

Phase 2 (inclusive of Phase 1) - Cumulative Yield	Reliability
10 mgd	99.2 %
11 mgd	98.7 %
12 mgd	97.7 %
13 mgd	96.4 %
14 mgd	94.9 %

Table 3 – Phase 2 Configuration, Estimated Yields and Reliability

Based upon meeting the medium to long range fill cover needs for the Central County Waste Disposal Complex (CCWDC), the second phase could be completed in the 2030 to

2035 timeframe. The preliminary opinion of probable cost for the program elements in the phase 2 configuration is estimated at $67,000,000. **Figure 3** provides a conceptual schematic of the phase 2 configuration.

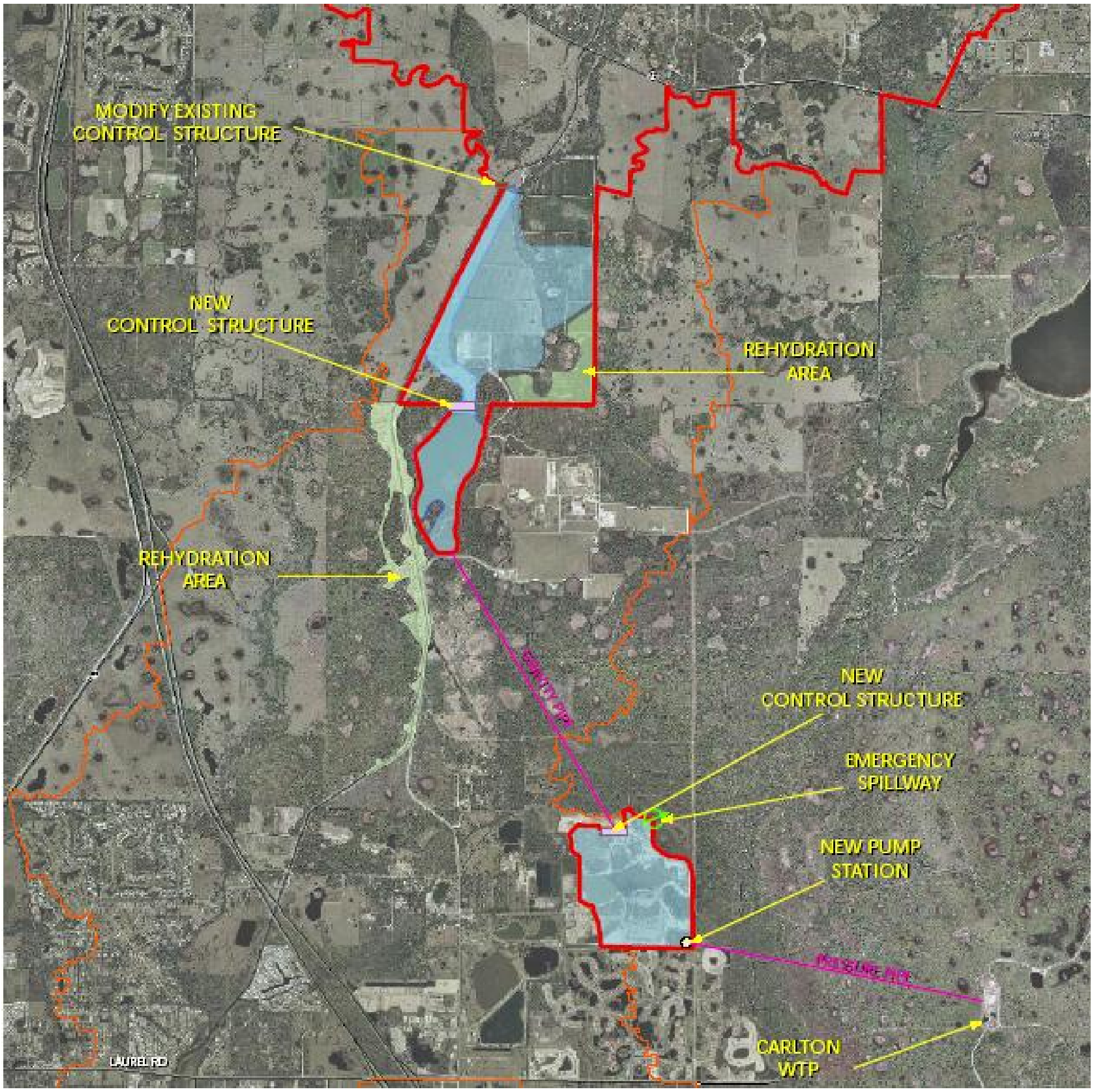

Figure 3 – Dona Bay Watershed Management Program, Phase 2 Configuration

5.0 PHASE 3 CONFIGURATION

The phase 3 configuration of the Dona Bay Comprehensive Watershed Management program would include utilizing the Albritton site for additional storage. While the first two phases rely upon gravity to fill and operate the reservoir storage, the phase 3 configuration would require a pump station located in the Cow Pen Canal, upstream or downstream of the upper control structure to obtain an additional 10 feet of vertical operating range above grade. Activities completed in the phase 1 configuration to hydraulically isolate the Albritton tract and in the second stage to build the perimeter berm to a height of 25 feet will facilitate the implementation of the phase 3 configuration. This subsequent phase will further restore the Dona Bay water budget, by increasing the watershed hydroperiod and storage capacity as well as enhancing water retention. Pursuant to Technical Memorandum 4.2.2, the phase 3 configuration (inclusive of phases 1 and 2) is estimated to result in a total reduction of 41% of the excess freshwater currently being discharged from the Cow Pen Canal to Shakett Creek and Dona Bay. However, it could result in a reduction of some of the storm attenuation gained through the first two phases.

In addition to reducing the volume of excess freshwater volume to Dona Bay, the phase 3 configuration would provide for an additional 5 mgd of alternative surface water supply. The phase 3 configuration, when combined with the phase 1 and 2 configuration, would provide a total of approximately 15 mgd of alternative surface water supply. Program elements included in the phase 3 configuration include the construction of a surface water pumping station in the adjacent Cow Pen Canal, as briefly described below:

5.1 Element 5 – Albritton Site

This program element proposes the construction of a surface water intake in the adjacent Cow Pen Canal and a pressure pipe to the Albritton site.

5.2 Alternative Water Supply Element

This program element proposes the expansion of the surface water treatment plant, presumably at the Cartlon Water Plant site as presented in Technical Memorandum 4.2.5.

Using the long-term Cow Pen Canal flow data transferred from the Myakka River gage, monthly water budgets and routing analyses were performed for Alternative 2 of the Venice Minerals site (refer to Technical Memorandum 4.2.4.1) and Alternative 5 of the Albritton site (refer to Technical Memorandum 4.2.4.2). As indicated in **Table 4**, the phase 3 configuration (inclusive of phase 1 and phase 2) is estimated to result in yields between 15 mgd and 20 mgd with reliabilities between 97.8% and 92.1%, respectively. Reliability was determined as the estimated percentage of the time that the reservoir will be able to provide the specified yield.

Phase 3 (Inclusive of Phase 1 and 2) - Cumulative Yield	Reliability
15 mgd	97.8 %
16 mgd	97.3 %
17 mgd	95.7 %
18 mgd	94.6 %
19 mgd	92.7 %
20 mgd	92.1 %

Table 4 – Phase 1, 2 and 3 Estimated Yields and Reliability

Based upon the long term water supply demands of the region, the phase 3 configuration could be completed in the 2035 timeframe. The preliminary opinion of probable cost for the program elements in Phase 3 is estimated at $34,000,000. **Figure 4** provides an conceptual schematic of the phase 3 configuration.

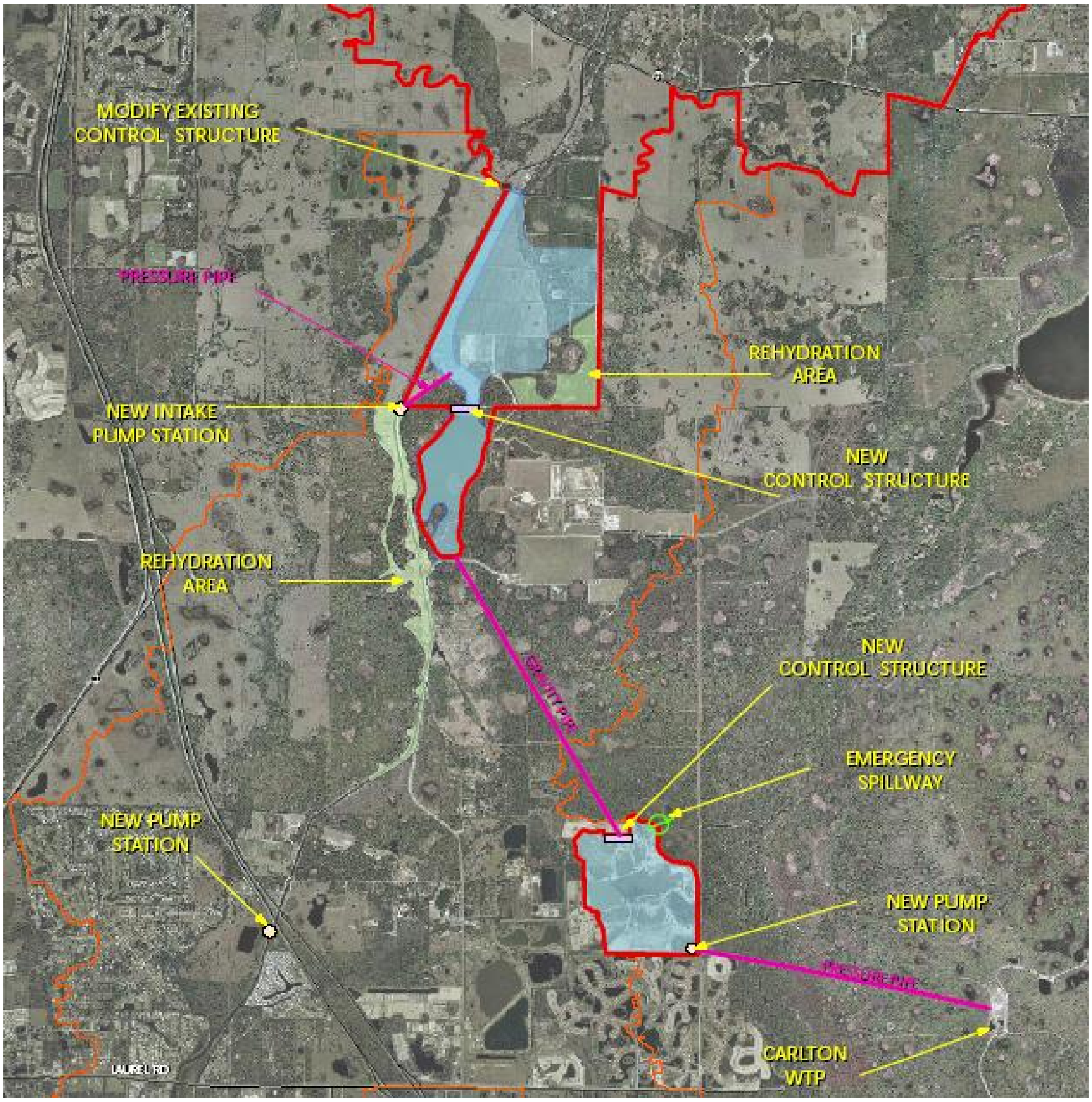

Figure 4 – Dona Bay Watershed Management Program, Phase 3 Configuration

6.0 FUTURE PHASES AND OPPORTUNITIES

Several additional potential program elements have been identified in **Table 1** and are discussed briefly in this section. Specifically, program element 1 could be investigated as an Aquifer Storage and Recovery (ASR) site since it is currently in public ownership and is strategically located adjacent to the lower control structure, where the Cow Pen Canal diversion ends and empties into the upstream tidal portion of Shakett Creek. Program Elements 7, 8, and 9 would require the voluntary partnership with private property interests. At this point, they are conceptual and their inclusion in the program is subject to additional investigations and discussions.

6.1 Element 1 – Fox Creek Site

This site is currently under public ownership and includes an existing borrow pit. It was acquired by SCG to serve as a regional mitigation site and has been designed and permitted accordingly. Among other things, this regional mitigation plan calls for the partial diversion of flows from the Cow Pen Canal, upstream of the lower control structure number to a network of created freshwater wetlands within the site. This partial diversion would occur through a proposed 18" diameter pipe when stages in the Cow Pen Canal exceed elevation 7.0 NGVD (invert of the pipe).

As part of a future phase that could provide additional excess freshwater flow reduction to the Dona Bay estuary as well as increased alternative water supply reliability, a pump station could be installed within the adjacent Cow Pen Canal to pump surface water to the existing borrow pit and into horizontal wells adjacent to the east and north sides of the borrow pit for pre-treatment. This is discussed in more detail in Technical Memorandum 4.2.4.3 – Evaluation of Subsurface Storage. It should be noted that the current state of the art for ASR technology and regulations continues to evolve. This evolution is expected to continue and should be tracked closely as it may cause current concepts to be rethought.

6.2 Element 4 – Pinelands Pits

If excess and/or unsuitable fill is available, it could be disposed of in the large northern borrow pit. If sufficient excess and/or unsuitable fill exists, the resulting depth in the existing borrow pit could be shallowed to have low water depths between 2 and 3 feet. Sump areas would need to remain at points of inflow and outflow.

6.3 Element 7 – LT Ranch Pasture

This program element would involve working with private property interests located on the west side of the Cow Pen Canal adjacent to the Albritton site. As such, it may require a public-private partnership. It is envisioned that this site of approximately 592 acres could be restored as a wetland marsh and may accept initial waters diverted from the upstream Cow Pen Canal as a pre-treatment facility prior to diverting water into the Albritton reservoir. It could also provide regional stormwater/mitigation and flood storage compensation for the LT Ranch and surrounding areas. Increasing the storage potential in this area could also off-set the otherwise resulting increase in local and regional flood stages associated with the transition of the Albritton site from a gravity to gravity/pumped storage facility. It is envisioned that funding assistance would be available from such programs as the United States Department of Agriculture - Natural Resources Departments' (USDA-NRCS) Wetlands Reserve Program.

6.4 Element 8 – Hi-Hat Old Grove

This program element would involve what is currently private property located within the Hi-Hat Ranch upstream of the Cow Pen Canal. The site is known as the Hi-Hat Old Grove and is approximately 421 acres that are currently in citrus production. However, it is strategically located such that it could be a potential regional stormwater management facility, further buffering the downstream Cow Pen Canal from upstream areas. It could also be constructed in association with the restoration of the non-operational water level control structure at the northern terminus of the Cow Pen Canal. Approximately 19,160 acres drain to this location. Although this area has been hydraulically altered, it is located in a historical low-lying area, making it strategically located to manage surface water. From a stormwater management perspective, it is also strategically located immediately upstream of numerous existing developments and downstream of the presently undeveloped lands in the Hi-Hat Ranch. Therefore, it could help fulfill the stormwater needs of future upstream development while assuring that flood stages are not adversely increased downstream.

6.5 Element 9 – Hi-Hat Floodplain

Sarasota County's 2050 Plan, if implemented would result in the permanent protection of the large natural floodplain area located south of State Road 780 within the Hi-Hat Ranch. This is an important watershed feature that should be protected. In the event that the 2050 Plan is not implemented, the County should prioritize protection of the area through a variety of means, including public acquisition through the County's Environmentally Sensitive Lands Protection Program.

Dona Bay Watershed Management Plan – Phase 1
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
Phase 1				
Element 2 – West Pinelands				
Solar Pumps	Each	$ 50,000.00	5	$ 250,000
Element 3 - Venice Minerals				
Reservoir	LS	$ 16,376,697	1	$ 16,376,697
Spillway	LS	$ 250,000	1	$ 250,000
Element 4 - Pinelands Pits				
72" Gravity Pipe	LF	$ 350	13,000	$ 4,550,000
Valve Box/Sluice Gate	LS	$ 100,000.00	1	$ 100,000
Miscellaneous	LS	$ 100,000.00	1	$ 100,000
Element 5 - Albritton Site				
On-Line Gated Control Structure	LS	$ 500,000.00	1	$ 500,000
Alternative Water Supply Element				
Water Treatment Plant	gpd	$ 5.00	5,000,000	$ 25,000,000
Pump Station to Water Treatment Plant	LS	1,000,000	1	$ 1,000,000
24" Pressure Pipe	*			$ 3,400,000
SUBTOTAL - CAPITAL COSTS				**$ 51,526,697**
Contingency		16%		$ 8,244,272
TOTAL				$ 59,770,969
Engineering, Administration		25%		$ 14,942,742
TOTAL COST WITH CONTINGENCY				**$ 74,713,711**

* - based upon probable cost (including Myakka River crossing) provided by PBSJ in Technical Memorandum 4.2.5 – Determination of Surface Water Treatment Plant Location

Dona Bay Watershed Management Plan – Phase 2
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
Phase 2				
Element 5 - Albritton Site				
Reservoir	LS	$ 26,127,000	1	$ 26,127,000
Alternative Water Supply Element				
Water Treatment Plant Upgrade	gpd	$ 4.00	5,000,000	$ 20,000,000
SUBTOTAL - CAPITAL COSTS				**$ 46,127,000**
Contingency		16%		$ 7,380,320
TOTAL				$ 53,507,320
Engineering, Administration		25%		$ 13,376,830
TOTAL COST WITH CONTINGENCY				**$ 66,884,150**

Dona Bay Watershed Management Plan – Phase 3
Preliminary Opinion of Probable Cost

ITEM:	UNIT	UNIT PRICE	QUANTITY	TOTAL PRICE
Phase 3				
Element 5 - Albritton Site				
Surface Water Intake Pump Station	gpd	0.70	5,000,000	$ 3,500,000
Alternative Water Supply Element				
Water Treatment Plant Upgrade	gpd	$ 4.00	5,000,000	$ 20,000,000
SUBTOTAL - CAPITAL COSTS				**$ 23,500,000**
Contingency		16%		$ 3,760,000
TOTAL				$ 27,260,000
Engineering, Administration		25%		$ 6,815,000
TOTAL COST WITH CONTINGENCY				**$ 34,075,000**

TM 4.2.8 – WATER SUPPLY WATERSHED PROTECTION PLAN (DRAFT)

1.0 BACKGROUND

Sarasota County in cooperation with the Peace River Manasota Regional Water Supply Authority and SWFWMD are currently completing the necessary, pre-requisite data collection and analysis as well as comprehensive watershed management plan for the Dona Bay Watershed. Kimley-Horn and Associates, Inc. (KHA), PBS&J, Biological Research Associates (BRA), Earth Balance, and Mote Marin Laboratory have been contracted by Sarasota County Government (SCG), with funding assistance from the Southwest Florida Water Management District (SWFWMD), to prepare the Dona Bay Watershed Management Plan (DBWMP).

This regional initiative promotes and furthers the implementation of the Charlotte Harbor National Estuary Program (NEP) Comprehensive Conservation Management Plan, SWFWMD's Southern Coastal Watershed Comprehensive Watershed Management Plan; and SCG's Comprehensive Plan. Specifically, this initiative is to plan, design, and implement a comprehensive watershed management plan for the Dona Bay watershed that will address the following general objectives:

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

As part of the formation of the Dona Bay Comprehensive Watershed Management Plan, the development of alternative surface water supply options was found to support other plan objectives relative to providing a more natural freshwater/saltwater regime in the tidal portions of Dona Bay. In the likely event that a surface water supply source is developed in the Dona Bay watershed, this Technical Memorandum was prepared to provide a Water Supply Watershed Protection Plan for the portion of Dona Bay that may contribute to surface water supply. Specifically, watershed goals within the Sarasota County Comprehensive Plan were reviewed relative to Water Supply. For those goals not currently regulated, incentive based protection mechanisms were identified that should be further developed through the watershed stakeholder group and public outreach. It is recognized that incentives may not be sufficient in all cases to address shortcomings in the regulations.

2.0 WATER SUPPLY WATERSHED PROTECTION AREA DELINEATION

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 from the developed areas.

For the purposes of this effort, the Water Supply Watershed Protection Area (WSWPA) was delineated as the upstream watershed area that contributes to water supply reservoir(s). This WSWPA is presented on **Figure 1**. It essentially represents the entire watershed located upstream of the upper water level control structure for the Cow Pen Canal, the Albritton site, and the Venice Minerals site.

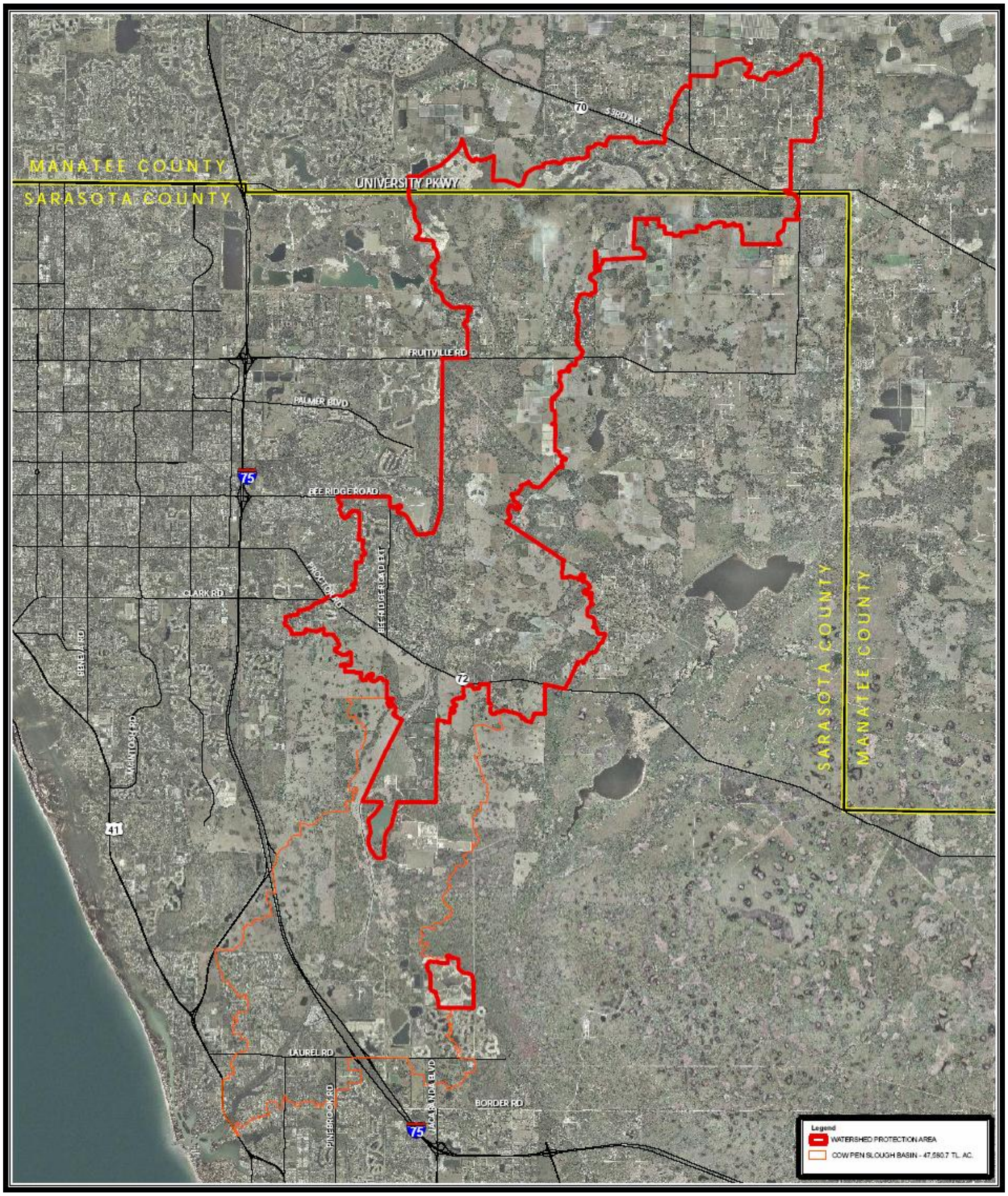

Figure 1 – Water Supply Watershed Protection Area

2.1 Existing and Future Land Use

Within Manatee County, the WSWPA consists primarily of older low density residential density suburban development. The recent moderate density subdivisions are located along the Sarasota-Manatee County line and have set backs from the headwaters tributaries that traverse through them and discharge to Sarasota County.

Within Sarasota County, the WSWPA is rural in nature consisting of agricultural uses and low density residential. The agricultural uses include some row crops as well as pasture (ranching). The low density residential areas are 5 to 10 acre lots with several golf course communities, including Misty Creek, Saddle Creek, Saddle Oaks Estates, Gator Creek, and Heritage Oaks.

Figure 2 provides the current Future Land Use Map for Sarasota County for the WSWPA. The current Future Land Use Map designates most of the lands within the WSWPA as rural. Current zoning within these rural designated areas are either Open Use Rural (OUR) or Open Use Estate (OUE) which allows 5 to 10 acre lots. Although these current zoning designations are all low density, they would result in the proliferation of domestic wells and on-site sewage treatment and disposal systems (septic tanks). In addition, lots developed under existing zoning designations could be platted over environmentally sensitive areas and floodplains.

However, any proposals to rezone existing areas to a more dense zoning classification (i.e. from 10 acre to 5 acre lots) if granted, would need to be developed as conservation subdivisions. Conservation subdivisions are required to cluster the granted density out of, and preserve environmentally sensitive areas. This would result in the density granted by 1 unit to 5 acres (or 1 unit to 10 acres), but the lots would not necessarily be 5 acres (10 acres) in size.

2.2 2050 Plan Overlay

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. Code requirements have included the AE flood zone as one of the key elements to be incorporated within the greenways. This is an important strategy as it is intended to prevent the encroachment of flood waters into homes and businesses by keeping the homes and businesses out of the floodplain, but it also provides for a valuable strategy for protecting the water courses.

Figure 3 provides the 2050 Plan within the WSWPA. From a water supply watershed protection perspective, the 2050 Plan overlay provides for numerous planning benefits from a watershed management perspective such as central water and wastewater, clustered and compact development, and permanent greenway/watercourse protection.

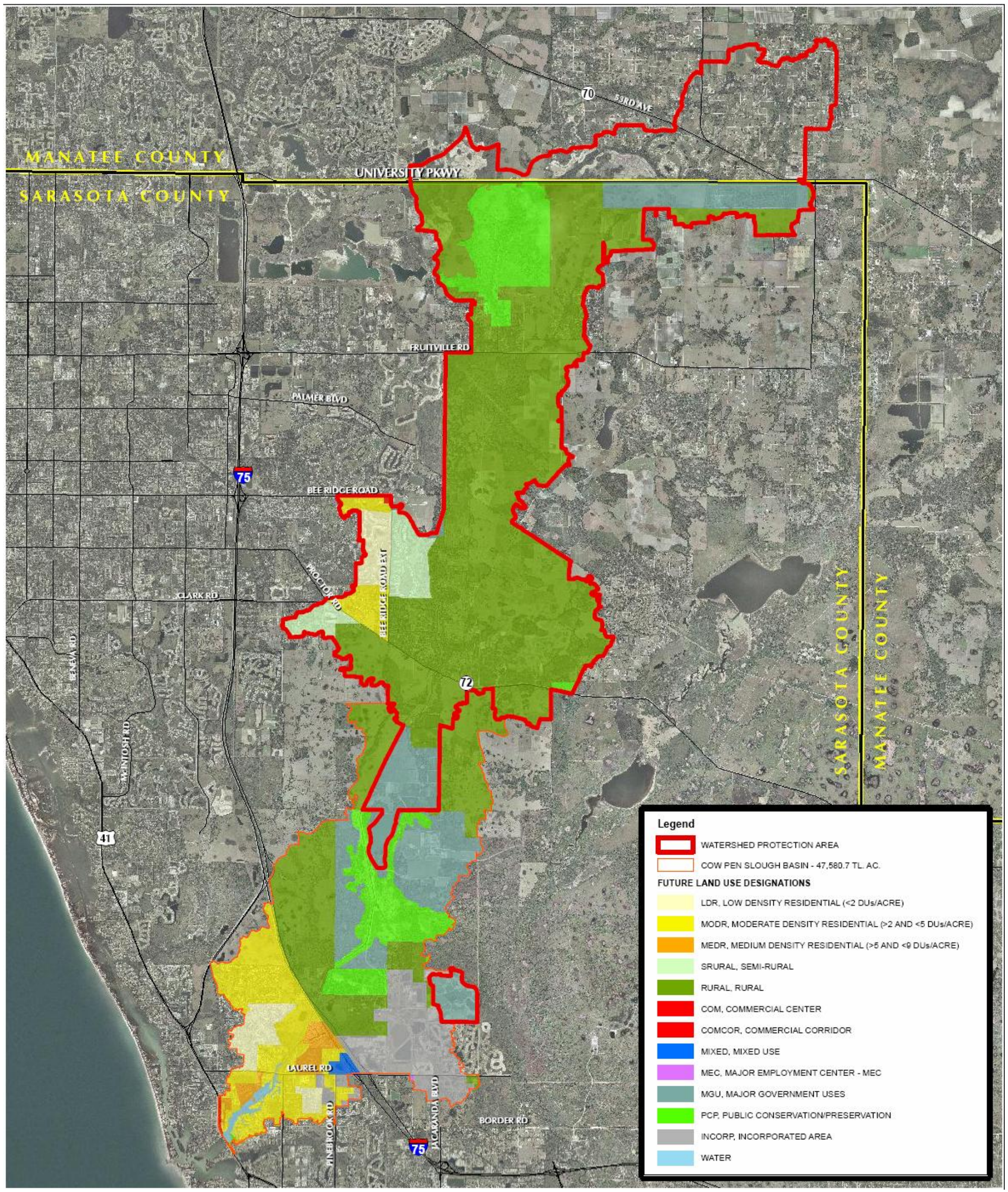

Figure 2 – Future Land Use Map

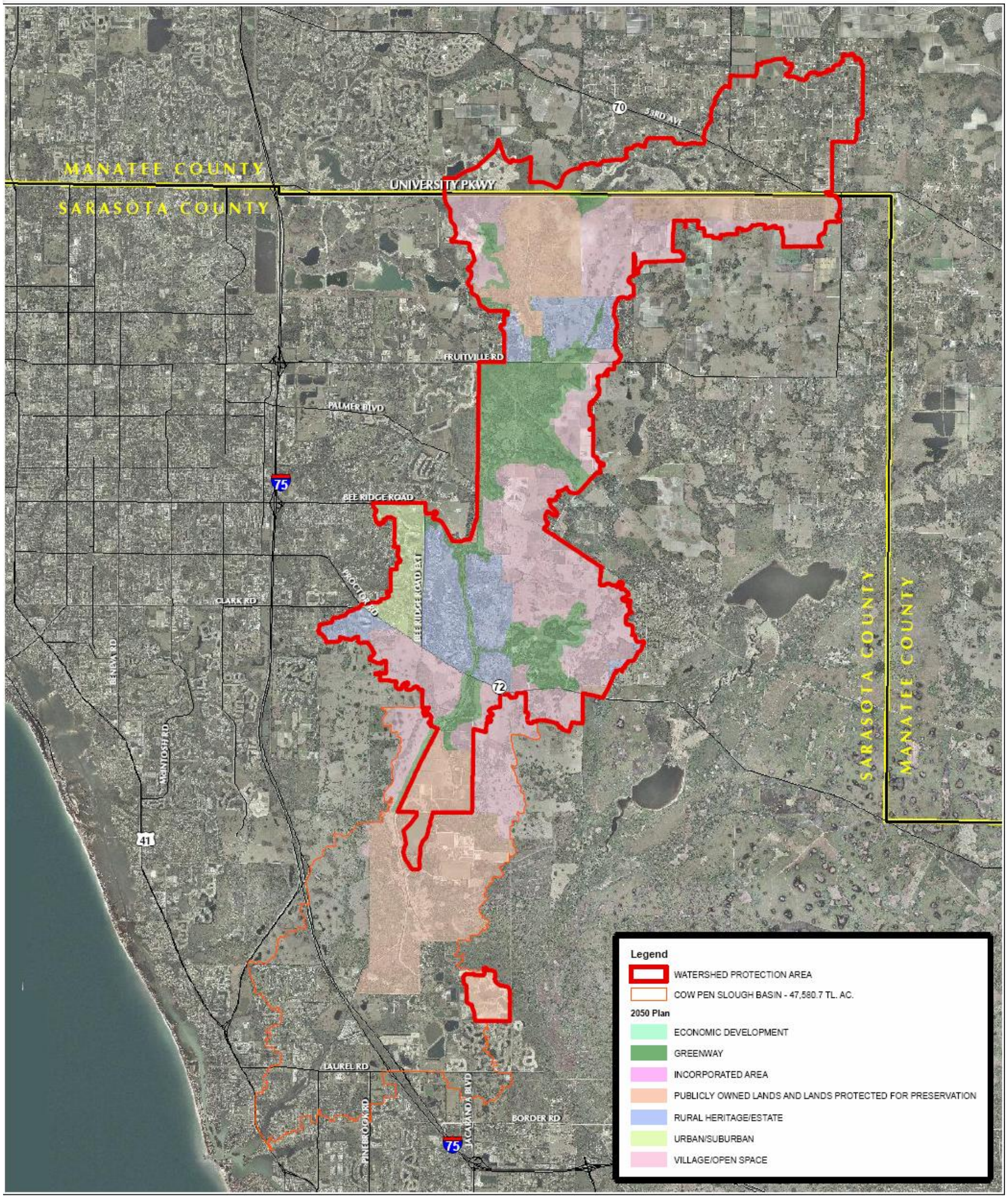

Figure 3 – Sarasota County 2050 Plan Overlay

Table 1 provides a matrix of entitlement and development requirements associated with three land use scenarios: (1) 10-acre lots, (2) 5-acre lots, and (3) the 2050 Plan overlay with villages and greenways resource management areas.

Land Use Scenario	Comp Plan Amendment Needed	Rezone Change Needed	Central Water	Central Wastewater	Clustered Development & Greenway
Existing Zoning	No	No	No	No	No
Rezoning to 5-acre and 10-acre lots	No	Yes	No	No	Yes
Village	Yes	Yes	Yes	Yes	Yes

Table 1 – Matrix of Land Use Scenarios in the WSWPA

3.0 NATIONAL WATER PROTECTION LEGISLATION

In 1972 the United States passed the Federal Clean Water Act, committing to achieve fishable and swimmable waters. Of specific relevance are Sections 303, 319 and 320 of the Clean Water Act.

Section 303(C)(1) defines water quality goals for a water body by designating the use of the water, setting criteria to protect those uses, and setting anti-degradation provisions for the water body. States must update their water quality standards every three years. New and revised water quality standards "shall be submitted" to EPA for review. Under Section 303(c)(2) of the Act, water quality standards "shall consist of" designated uses and water quality criteria. In setting water quality standards, states shall consider the use and value of public water supplies.

Section 303 also provides for apportioning pollutant loads among sources, where loadings must be reduced to achieve established water quality standards. This is currently being administered by the U.S. Environmental Protection Agency (EPA) as the Total Maximum Daily Load (TMDL) program in coordination with the Florida Department of Environmental Protection (FDEP). Section 319 serves to promote and financially support State programs to address diffuse pollution; the salient cause, from a national perspective of water quality degradation in the U.S. Finally, Section 320 establishes the National Estuary Program (NEP) to protect the nation's estuaries. The WSWPA is located within the Charlotte Harbor NEP.

Public Law 92-500, the "Federal Water Pollution Control Act" was amended in 1987 to cover stormwater runoff into the Waters of the United States. In 1990 the Federal Environmental Protection Agency issued regulations for implementation of the amendment. Sarasota County was required to obtain a National Pollution Discharge Elimination System (NPDES) permit to discharge stormwater into Waters of the United States.

4.0 STATE OF FLORIDA – WATER PROTECTION LEGISLATION

Chapter 403, Florida Statutes, "Water Resources Act", provides the Department of Environmental Protection with the authority to establish water quality guidelines and recognizes stormwater runoff as an important resource. Chapter 17-25, Florida Administrative Code, "Regulation of Stormwater Discharge", implements this statute by providing minimum criteria for discharge into surface waters and groundwater of the State. The rule's basic objective is to achieve 80-90 percent removal of stormwater pollutants before discharging into receiving waters. The rule states that facilities must treat the runoff from the first one inch of rainfall, or as an option for projects with drainage areas less than 100 acres, the first one-half inch of runoff.

4.1 Water Quality Classifications

Florida's Water Quality Standards Program, the foundation of the state's program of water quality management, has five Water Quality Classifications based on designated use or functional classification:

- Class I - Potable water supplies
- Class II - Shellfish propagation or harvesting
- Class III - Recreation, propagation, and maintenance of a healthy, well-balanced population of fish and wildlife
- Class IV - Agricultural water supplies (large agricultural lands, located mainly around Lake Okeechobee)
- Class V - Navigation, utility, and industrial use (there are no state waters currently in this class)

Class I waters generally have the most stringent water quality criteria and Class V the least. However, Class I, II, and III surface waters share water quality criteria established to protect recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife. All waters of the state are considered to be Class III, except for those specifically identified in Section 62-302.600, F.A.C. All waters of the state are required to meet the "Minimum Criteria for Surface Waters," as identified in Section 62-302.500, F.A.C.

The Cow Pen Canal is designated as a Class III water body and currently meets its use as a recreational (fishable and swimmable) water body. It is not classified as impaired according to the Impaired Waters Rule. The Florida Department of Environmental Protection (FDEP) issues permits for drinking water treatment facilities to draw water from Class III water bodies for potable water use so it is not necessarily required that waters in the WSWMA be designated as a Class I or II water body to be used as source water for potable water supply.

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.

Class I and Class III Standards for Total and Fecal Coliform are the same, except Class I sampling requirements are more stringent.

In Florida, the default Class III designation is commonly used as an example of the need for refinement. Class III is a broad brush category that applies equally to the diverse types of waterbodies in the state, including rivers, lakes, streams, springs, wetlands, estuaries, and marine waters. Though a distinction does exist between Class III freshwater and marine, the designation does not otherwise account for variations that may exist due to differences in physical, chemical, and biological characteristics between surface water types. These characteristics may affect the different uses that each water body type may support, both from human (e.g., different types of recreation) and aquatic life (e.g., different community types) perspectives.

If a potable water supply is developed from the excess freshwater in the WSWPA, re-designation of the source water from Class III to Class I should be considered for the WSWPA.

4.2 Stormwater Regulations

Chapter 17-25, Florida Administrative Code, emphasizes that "no discharge from a stormwater discharge facility shall cause or contribute to a violation of water quality standards in waters of the state" and continues by stating that erosion and sediment control "best management practices" shall be used as necessary during construction to retain sediment on-site. Further, stormwater discharge facilities which receive stormwater from areas which are a potential source of oil and grease contamination shall include mechanisms suitable for preventing the contaminants from leaving the stormwater discharge facility in concentrations which would cause or contribute to violations of applicable water quality standards in the receiving water. Chapter 17-3, Florida Administrative Code, "Water Quality Standards", provides minimum criteria which govern stormwater drainage necessary to protect the designated uses of State waters. This legislation provides detailed criteria for both surface water and groundwater protection.

In 1982, Florida became the first state in the country to implement statewide regulations to address the issue of nonpoint source pollution by requiring new development and redevelopment to treat stormwater before it is discharged. The responsibility for regulating stormwater from development activities was delegated to the SWFWMD in 1984. The Governing Board of the SWFWMD assumes its responsibilities as authorized in Chapter 373 and other chapters of the Florida Statutes by directing a wide-range of programs, initiatives, and actions. With respect to flood protection, water quality, and natural systems, respectively, SWFWMD's goals are:

To minimize the potential for damage from floods by protecting and restoring the natural water storage and conveyance functions of floodprone areas. The District shall give preference whenever possible to non-structural surface water management methods.

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

To preserve, protect and restore natural systems in order to support their natural hydrologic and ecologic functions.

Chapter 40D-2, Florida Administrative Code (FAC), "Basis of Review," includes stormwater system design criteria as well as technical and administrative information for applicants and permits.

Chapter 40D-4 and Chapter 40D-40 FAC, "Management and Storage of Surface Waters" (MSSW) states that the SWFWMD governs surface water permitting and stormwater runoff. Chapter 40D-4's Basis of Review specifies that post-development peak discharge rates for new development not exceed pre-development peak discharge rates for the 25-year, 24-hour event. In addition to regulating discharge, the District also restricts floodplain encroachment. District regulations require compensating storage be provided for fill placed within the 100-year floodplain. Rules also stipulate that activities affecting floodplains and floodways will not cause adverse impacts, i.e., increase flooding. Technical guidelines further clarify how to analyze and minimize impacts from activities in the floodplain.

5.0 SARASOTA COUNTY GOALS, OBJECTIVES, AND POLICIES

A review of the Watershed Management Goals, Objectives, and Policies contained in Sarasota County's Comprehensive Plan was performed relative to Water Supply Watershed Protection. Based upon this review, the following goals, objectives, and policies were selected and are reprinted from the Watershed Management Chapters for reference.

Watershed Management Goal 1 - Sanitary sewer service shall be provided to Sarasota County residents through the continual evolution of a centralized regional wastewater collection and treatment system, and shall be provided in a safe, clean, efficient, economical, and environmentally sound manner, concurrent with urban development.

Watershed Management Objective 1.1 - Continue to correct existing wastewater facility deficiencies, and coordinate the acquisition, extension, and construction of, or increase in the capacity of, facilities to meet future needs.

Watershed Management Policy 1.1.4 - The County shall continue implementation of the Franchise Acquisition, Consolidation, Implementation Plan - Wastewater Collection, Treatment, and Reuse Master Plan, which provides an engineered master plan for providing wastewater service to the unincorporated areas of Sarasota County concurrent with urban development and land use planning, a master priority listing and preliminary consolidation plan for the acquisition of private and franchised utilities, and an implementation plan for these activities. Priority shall be given to providing centralized service to areas experiencing septic tank failure and areas where water quality has been adversely affected by current disposal methods.

Watershed Management Policy 1.1.7 - The County shall prohibit the installation of onsite wastewater treatment and disposal systems in the areas designated as Urban Service Area and Barrier Island on the Future Land Use Map Series, unless the installation and use shall not adversely affect the quality of groundwater or surface water or adversely affect the natural function of floodplains as required by the provisions of the County Land Development Regulations (Ordinance No. 81-12, as amended); Ordinance No. 83-83 and Chapter 10D-6 F.A.C, regulating design, construction, installation, utilization, operation, maintenance and repair of individual onsite wastewater treatment and disposal systems, as amended; and any more stringent regulations applicable. Further, the County shall require that all buildings served by onsite wastewater treatment and disposal systems, except approved onsite grey water systems, connect to a publicly-owned or investor-owned sewerage system within one year of notification by the County that such a system is available as defined in Chapter 10D - Section 6.042, Florida Administrative Code. The County shall establish procedures for the notification of sewer availability.

Watershed Management Objective 1.2 - Maximize the use of existing and available central wastewater facilities and new facilities when they are constructed, and discourage urban sprawl.

Watershed Management Policy 1.2.1 - The County shall continue to require new development to connect to central wastewater systems consistent with the requirements contained in the Land Development Regulations based on the size of the development and distance to the existing system, the available capacity in the system, and the utility's rules allowing connection to the system.

Watershed Management Objective 1.3 - Continue to explore and use alternative and supplemental water resources to conserve and replace the use of traditional potable water supplies.

Watershed Management Policy 1.3.1 - The County shall continue implementation of the reuse component of the Franchise Acquisition, Consolidation, Implementation Plan - Wastewater Collection, Treatment, and Reuse Master Plan, which contains regulatory, engineering, public education and marketing, and financial strategies for the development of a regional distribution and storage system to provide reclaimed water and treated stormwater, to customers where it is needed and available in order to reduce the demand on potable water supplies and withdrawals from ground water aquifers.

Watershed Management Policy 1.3.3 - The County shall develop and adopt guidelines for the construction and management of golf courses to reduce or eliminate the use of sub-surface wells as irrigation sources and encourage the use of secondary treated wastewater for irrigation.

Watershed Management Objective 1.4 - Protect the functions of natural ground water recharge areas, natural drainage features, and surface water bodies.

Watershed Management Policy 1.4.2 - The County shall continue to provide a program to ensure that septage and sludge are received and disposed of in an environmentally sound manner.

Watershed Management Policy 1.4.4 - Sarasota County regulations for the disposal and use of septage and sludge shall provide for their efficient and beneficial use and prevent adverse environmental impacts. Land spreading and disposal of sludge shall be allowed only in areas that will not adversely impact groundwater resources and watersheds that drain into surface water supplies (which are used to meet potable water supply needs), recharge areas of a public water system and/or Outstanding Florida Waters. The land spreading of septage shall be prohibited within the County.

Watershed Management Policy 1.5.2 - Issuance of development orders for any site proposing to utilize an onsite wastewater treatment and disposal system shall be contingent upon demonstration of compliance with applicable federal, State and local permit requirements. Soil surveys shall be required for onsite wastewater treatment and disposal system permits. No individual onsite systems shall be permitted where soil conditions indicate that the system would not function without degrading water quality or where land alterations necessary to accommodate the system would interfere with drainage or floodplain functions.

Watershed Management Goal 2 - Sarasota County shall provide a Comprehensive Watershed Management (CWM) Plan which prevents and mitigates the losses, cost, and human suffering caused by flooding; protects natural and beneficial functions of the floodplain; protects water quality by preventing further degradation of the water resources; enhances water quality where appropriate; enhances, protects and conserves the hydrologic and ecological functions of natural systems including estuaries, freshwater and groundwater systems; and ensures safe, efficient, economical, and sustainable water supplies that provides customers the appropriate water quality for the intended use.

Watershed Management Policy 2.1.3 - The County shall continue to fund the continuous maintenance of watershed maps and models for each drainage basin in the County through the CWM Planning Program to provide a basis of review for new development and other watershed alteration proposals as well as assure that stormwater management facilities are developed to attain the adopted level of service. Implementation of all detailed master plans shall be completed by 2005. Each detailed master plan shall be developed, in accordance with the Basin Master Plan Schedule, as a Sarasota County inter-department effort to ensure consideration of natural drainage functions. Basin master plans shall be developed in cooperation with the municipalities and adjacent Counties to address stormwater quality and quantity problems in basins crossing more than one political boundary. Each plan shall be designed to protect downstream and estuarine water from degradation by stormwater runoff. Each basin plan shall define the level of service and a cost-effective capital improvements program shall be developed. As each basin plan is completed, the comprehensive plan, including the Capital Improvements Plan, shall be amended to incorporate and reflect the stormwater management facility improvements identified in the basin plan.

Watershed Management Policy 2.2.1 - The County shall implement its CWM Plan consistent with the National Pollutant Discharge Elimination System (NPDES) permit issued to the County by the U.S. Environmental Protection Agency. The Comprehensive Stormwater Quality Program shall provide for management and control of stormwater runoff to reduce pollution at the source and discharge of pollutants into receiving waters from the County's stormwater system to the maximum extent possible.

Watershed Management Policy 2.2.2 - The County shall require that the treatment of stormwater discharge meets standards which will ensure that there will not be adverse impacts on the quality of potable public surface water supplies.

Watershed Management Policy 2.2.3 - New development in the 100-year floodplains shall be consistent with all other Goals, Objectives, and policies of the Sarasota County Comprehensive Plan.

Watershed Management Objective 2.3 - To ensure that development and redevelopment provides for adequate stormwater management.

Watershed Management Policy 2.3.1 - No permit shall be issued for new development which will result in an increase in demand upon deficient facilities prior to the completion of improvements needed to bring the facility up to adopted level of service standards.

Watershed Management Policy 2.3.2 - Stormwater Level Of Service:

1) Stormwater Quality: no discharge from any stormwater facility shall cause or contribute to a violation of water quality standards in waters of the State as provided for in County Ordinances, Federal Laws and State Statutes. Water quality levels of service shall be set consistent with the protection of public health, safety and welfare and natural resources functions and values. To protect water quality and maintain stormwater quality level of service standards:

a) The County shall implement a CWM plan consistent with the federal NPDES requirements. The plan shall be adopted by the County after approval by the EPA.

b) New and existing industrial activities (as defined in the National Pollutant Discharge Elimination System regulations for storm water) shall develop and implement a Storm Water Pollution Prevention Plan (SW3P) for such activity.

c) No discharge from any stormwater facility shall cause or contribute to a violation of water quality standards in waters of the State as provided for in County Ordinances, Federal Laws and State Statutes. To meet this requirement:

(i) All stormwater systems for new development and re-development shall include features to minimize pollution from oil, suspended solids, and other objectionable materials. Such features shall be designed to treat the runoff resulting from the first one (1") inch of rainfall. Stormwater systems shall include additional measures designed to reduce floating and suspended solids to a minimum. Higher design criteria for water treatment shall apply if such criteria are necessary to meet and maintain the level of service or to protect water bodies (such as potable surface waters or Florida Outstanding Waters) which require higher levels of protection. The higher design criteria shall be based on a treatment system which treats 1.5 times the volume required for the selected treatment system or equivalent.

(ii) New development and re-development shall provide mitigation measures and best management practices to control pollutants specific to the pollutant characteristics of the proposed land use consisting of Best Management Practices shown to be effective in controlling the specific pollutants characteristic of the type of new development.

(iii) All development shall meet and be consistent with requirements in the Basin Master Plans.

(iv) Mitigation measures and best management practices relating to drainage shall be taken during construction activities to ensure that water quality is not degraded during the land clearing and construction of development. No cutting, clearing, grading or filling shall be accomplished on any site under development unless appropriate devices have been installed to minimize pollution from objectionable materials, to control erosion, and to remove sediment from surface water runoff. Appropriate techniques shall also be utilized to stabilize and revegetate disturbed areas as soon as possible.

d) Best management practices shall be encouraged for intensive agricultural land use practices that negatively impact water quality.

e) The County's Basin Master Plans shall include evaluation of pollutant loading.

2) Stormwater Quantity: Stormwater management systems shall provide for adequate control of stormwater runoff. The Stormwater Quantity Level of Service shall be …

The requirements to maintain stormwater quantity level of service standards are stated below:

a) New developments shall be designed to maintain the water quantity level of service standard and to minimize adverse stormwater impacts. Stormwater runoff shall not be diverted or discharged in such a way as to cause an adverse increase in off-site flood stages or have an adverse impact upon natural system values and functions. Stormwater management plan designs shall provide for the attenuation/retention of stormwater from the site. Water released from the site shall be in such a manner as to ensure that no adverse increases in off-site flood stages will result for up to and including a 100-year, 24-hour storm. The County shall pursue opportunities for off-site public or private regional stormwater attenuation/retention facilities to be used to accomplish stormwater attenuation requirements.

b) Until drainage improvements are made to upgrade the level of service, developments in basins identified through Basin Master Plans as not meeting the Level of Service shall limit the rate of runoff after development to the drainage system capacity by limiting the 100-Year, 24-Hour post-development runoff rates to the apportioned downstream flow capacities which do not cause flooding of residential structures.

c) Best management practices shall be encouraged for intensive agricultural land use practices which substantially increase runoff rates.

d) All new development and stormwater management systems shall meet and be consistent with the requirements in the Basin Master Plans, and ComprehensiveWatershed Management Plans.

e) By 2007, Sarasota County shall provide design standards for low impact design (LID) measures to mitigate the effect of impervious surfaces and stormwater pollutants on increased runoff volumes. LID design measures may include, but are not limited to, bio-retention areas, porous pavement, roof gardens, rainwater/stormwater recycling, etc.

Watershed Management Policy 2.3.2A - Consistent with the National Pollutant Discharge Elimination System (NPDES) permit, the County's Comprehensive Watershed Management Plan shall establish water quality design criteria for each drainage basin. In establishing these criteria, the County shall consider recommendations from the Sarasota Bay and Charlotte Harbor National Estuary Programs and the drainage basin pollutant load reduction goals to be established by the Southwest Florida Water Management District, and the State Surface Water Ambient Monitoring Program.

Watershed Management Policy 2.3.2B - The County shall work with the Southwest Florida Water Management District (SWFWMD) in an effort to coordinate approaches to planning and permitting of stormwater management and shall specifically request SWFWMD comment on a volume based approach to regulating stormwater management in addition to the common peak discharge rate approach.

Watershed Management Goal 3 - Potable water service shall be provided to Sarasota County residents through the continual evolution of a centralized regional supply, treatment, and distribution system, and shall be provided in a safe, clean, efficient, economical, and environmentally sound manner, concurrent with urban development.

Watershed Management Objective 3.1 - Continue to correct existing potable water facility deficiencies, and coordinate the acquisition, extension, and construction of, or increase in the capacity of, facilities to meet future needs.

Watershed Management Policy 3.1.1 - Sarasota County Utilities shall maintain up to date inventories indicating the available capacity and present demand for potable water facilities in the Sarasota County Utilities System service area.

Watershed Management Policy 3.1.5 - Continue to extend water lines to those portions of unincorporated Sarasota County developed with private wells utilizing the County's Line Extension Policy through the Sarasota County Utilities Capital Improvement Program and utilizing other mechanisms such as Municipal Service Benefit Unit non-ad valorem assessments.

Watershed Management Policy 3.1.6 – Sarasota County will continue to explore alternative water resources in cooperation with regional water supply authorities and other local entities. Additional water supply sources will need to be identified and developed to supplement the amounts from the T. Mabry Carlton Memorial Reserve, including wastewater and stormwater recycling systems developed by the County.

Watershed Management Policy 3.1.7 – As the County consolidates and develops potable water facilities, all facilities shall be developed with consideration for aesthetics and the possibility of incorporation into the County park system.

Watershed Management Objective 3.2 - Maximize the use of existing and available central potable water facilities and new facilities when they are constructed, and discourage urban sprawl.

Watershed Management Policy 3.2.1 - Until such time as the Sarasota County Utilities System can expand its distribution system to provide centralized potable water service, individually owned platted lots of record located within the designated Urban Service Area, as adopted pursuant to Sarasota County Ordinance No. 81-30, may be provided potable water with a private well provided all other legislative and regulatory requirements are met.

Watershed Management Policy 3.2.2 - The County shall mandate hookup to a centralized potable water system, where available, in accordance with State and County laws.

Watershed Management Policy 3.2.3 - The County shall continue to require new development to connect to central water systems consistent with the requirements contained in the Land Development Regulations, based on the size of the development and distance to the existing system, if the capacity is available in the system and the Utility's rules allow connection to the system.

Watershed Management Objective 3.3 - Continue to implement programs to conserve potable water resources.

Watershed Management Policy 3.3.1 - Sarasota County shall continue its efforts to implement water conservation programs, including such initiatives as the existing inverted water rate structure, low flow toilet rebates and showerhead exchange and outreach educational programs. Water conservation programs shall operate in cooperation with the Southwest Florida Water Management District, Manasota Basin Board, and other appropriate entities, both public and private.

Watershed Management Policy 3.3.2 - The County will continue to abide by the Southwest Florida Water Management District's (SWFWMD) emergency water shortage plan, and when necessary, the County may implement more restrictive water conservation measures, as may be required to protect and maintain the utility system.

Watershed Management Policy 3.3.3 - The County will continue, in partnership with the Southwest Florida Water Management District (SWFWMD) to ensure through a variety of educational and enforcement activities, the proper abandonment of unused water wells. SWFWMD Quality of Water Improvement (QWIP) incentive funding will be utilized to the greatest extent possible to realize the goal of measurable aquifer water quality upgrading.

Watershed Management Policy 3.3.4 - New development shall prioritize meeting irrigation needs through (1) demand management strategies, (2) reclaimed water, if available, (3) rain water or stormwater, and finally, (4) community ground water wells.

Watershed Management Objective 3.4 - Protect the functions of natural groundwater recharge areas and natural drainage features.

Watershed Management Policy 3.4.1 - Sarasota County will protect its potable water supply system, contributing recharge areas, and related open space benefits through implementation of its Wellhead Protection Ordinance which shall identify inappropriate land uses and facilities including, but not limited to, underground fuel storage tanks, landfills, hazardous materials storage, and certain commercial and industrial uses. The County's Wellhead Protection Ordinance will be amended, as needed, for consistency with the Florida Department of Environmental Protection's rule governing wellhead protection adopted in May 1995. The protection effort may include requests to the Southwest Florida Water Management District for cooperative funding or technical assistance to further identify zones of protection and cones of influence around individual wellheads or well fields.

Watershed Management Objective 3.5 - To ensure that the issuance of development permits shall be conditioned upon adequate potable water capacity.

Watershed Management Policy 3.5.2 - The County Public Health Unit shall enforce potable water quality standards in accordance with the Federal Safe Drinking Water Act, Chapter 403, Part VI, Florida Statutes, "Florida Safe Drinking Water Act", and Chapter 62-550, 62-551, 62-555, 62-560, or 10D-4, Florida Administrative Code, and as prescribed by the U.S. Environmental Protection Agency. However, the County may adopt more stringent standards if it deems necessary.

Watershed Management Policy 3.5.3 - Issuance of development orders will be contingent upon demonstration of compliance with applicable federal, State, and local permit requirements for onsite potable water systems.

Watershed Management Policy 3.5.4 - Potable Water Level Of Service:
1) System capacity shall be based on 250 gallons per Equivalent Dwelling Unit per day based on peak flow plus the maintenance of minimum fire flow standards.

2) Minimum potable water quality shall be as defined by the U.S. Environmental Protection Agency, except where the State or County may impose stricter standards.

Solid Waste Objective 2.3 - To protect the functions of natural groundwater recharge areas and natural drainage features.

Solid Waste Policy 2.3.1 - The Central County Solid Waste Disposal Complex shall minimize, to the greatest extent possible, potential environmental impacts consistent with the adopted stipulations contained within Ordinance No. 90-54 and Resolution No. 91-149. Development of the Central County Solid Waste Complex shall be consistent with the Land Management Plan, the "Principles for Evaluating Development Proposals in Native Habitats", and all other relevant policies in the Environment Chapter.

Solid Waste Policy 2.3.2 - All known public sanitary landfill sites, as determined by the Board of County Commissioners, shall undergo inspection and/or monitoring procedures to ensure that they do not create a public health hazard.

Solid Waste Policy 2.3.3 - The County shall support State legislation aimed at reducing the amount and toxicity of waste, such as limiting excess packaging, limiting the use of heavy metals in household batteries, reducing the level of pesticides, reducing mercury content in fluorescent bulbs, and the like.

Solid Waste Policy 2.3.4 - The County shall continue to seek mechanisms for the collection of domestic hazardous waste and transfer that waste to permitted hazardous waste disposal sites, thus avoiding disposal in the County's sanitary landfill. The program shall include public education about what hazardous waste should not be land filled.

Solid Waste Policy 2.3.5 - The disposal of hazardous waste generated by commercial entities shall remain the responsibility of said entities. The County shall assess and verify that such proper handling, storage, transportation, and disposal of hazardous waste by commercial entities occurs. The Florida Department of Health and Rehabilitative Services and the Florida Department of Environmental Protection shall regulate and be responsible for the proper handling, storage, transportation, and disposal of biomedical waste.

Solid Waste Policy 2.3.6 - The location of any new collection and/or storage areas for hazardous and acutely hazardous materials in commercial or industrial uses shall be prohibited within the 100 year floodplain of any in flowing watercourse within the watershed of an existing public potable surface water supply, or within 200 feet of the Florida Department of Environmental Protection jurisdictional line associated with any such in flowing watercourse, whichever is greatest. "Hazardous" and "acutely hazardous" materials shall be as defined and listed in 40 CFR 261, and as adopted within Chapter 1730, Florida Administrative Code, and Section 403.7, Florida Statutes.

Environmental Policy 5.2.4 - Mining activities (as defined by County Ordinance) are not permitted or permissible under the County zoning regulations within the designated areas of special environmental significance and/or sensitivity. The watersheds of Cow Pen Slough and the Myakka River, including the tributaries of the Myakka River, are designated areas of special environmental significance.

Based upon the review of relevant Comprehensive Plan Goals, Objectives, and Policies, the following potential sources were identified for consideration in the Water Supply Watershed Protection Plan: (1) reuse water, (2) stormwater runoff, (3) sludge, (4) mining, (5) on-site sewage treatment and disposal systems, and (5) other miscellaneous sources.

6.0 REUSE WATER

Reclaimed wastewater or reuse water is used throughout Sarasota County for residential, commercial and agricultural irrigation, including in the WSWPA. The EPA (Region 4), FDEP, the Florida Department of Health, SWFWMD and others issued a joint statement in support of water reuse that affirms that Florida's wastewater treatment standards and Florida's extensive experience with reuse ensure that Florida law and regulations are fully protective of public health and environmental quality. Sarasota County's Comprehensive Plan clearly promotes reuse as a key strategy to off-set potable water demands and as a sustainable disposal method for treated wastewater. However, there have been concerns relative to the application of reuse water in other nearby water supply watersheds that have prohibited its use. While there is little data to support the prohibition of reuse water, there has been recognition nationally that pollutants of "emerging" concern associated with pharmaceuticals and personal care products (PPCDs) are appearing in source water for water supply. These include an array of chemicals used internally or externally by humans as well as domestic animals and plants. As a result, it is expected that more stringent and expensive potable water treatment requirements will be mandated by EPA.

There are two primary recipients of reuse water land application in the WSWPA. These include the Hi-Hat Ranch which receives reuse water from the City of Sarasota. The other recipients are golf courses located in part or in total within WSWPA which receive reuse water from Sarasota County Utilities.

The Hi-Hat Ranch is located in the WSWPA, upstream of Clark Road and downstream of Fruitville Road. It also extends eastward into the Myakka River watershed. Pursuant to an agreement, the Hi-Hat Ranch has received reuse water from the City of Sarasota since 1990. The reuse water storage facility is located within the Myakka River watershed portion of the Ranch. In addition, most of the area where reuse water is applied is located in the Myakka River watershed portion of the Hi-Hat Ranch. There are four (4) areas within the Hi-Hat Ranch that receive the reuse water: (1) the Row and Furrow area, (2) the Old Grove, (3) the Utopia Grove, and (4) Site III. **Table 2** inventories the annual quantity of reclaimed wastewater applied in the Hi-Hat Ranch since 1990. **Figure 4** identifies the area within the Hi-Hat Ranch where reuse water is applied.

Year	Average Annual Reuse
1990	3.21 mgd
1991	3.34 mgd
1992	3.39 mgd
1993	2.39 mgd
1994	1.51 mgd
1995	0.82 mgd
1996	1.23 mgd
1997	1.30 mgd
1998	1.37 mgd
1999	1.34 mgd
2000	1.94 mgd
2001	2.15 mgd
2002	1.44 mgd
2003	1.28 mgd
2004	1.34 mgd

Table 2 – Hi-Hat Annual Average Reuse

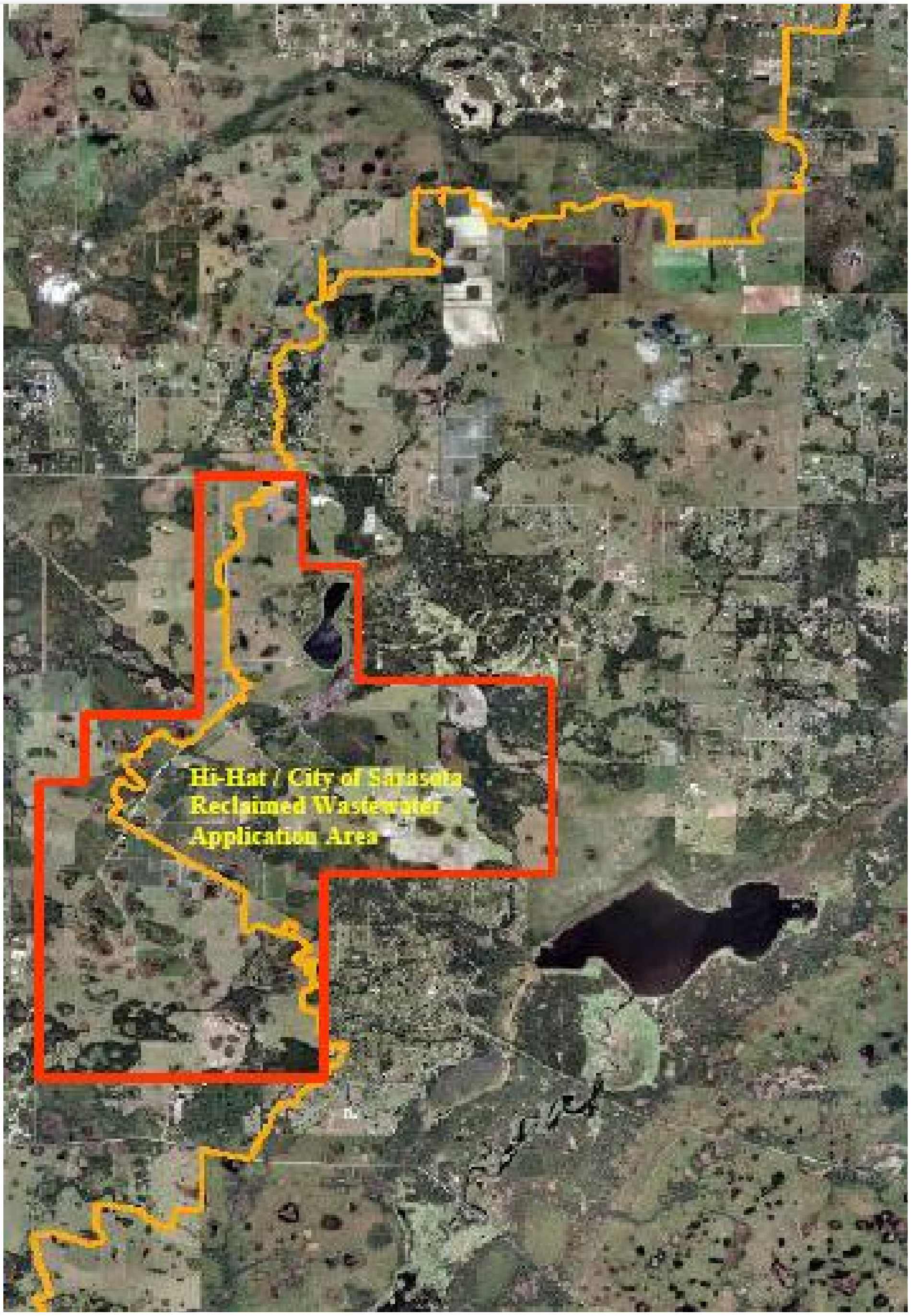

Figure 4 – Hi-Hat/City of Sarasota Reuse Water Application Area

In addition to the Hi-Hat Ranch, there are five (5) golf courses located totally or partially within the WSWPA that currently receive reuse water from Sarasota County for irrigation. **Table 3** lists the respective golf courses and their total average annual quantity of reclaimed wastewater. It should be noted that the Bent Tree golf course is primarily located in the adjacent Phillippi Creek watershed. Together, these golf courses average almost 1 million gallons of reuse water per day.

Golf Course Community	Average Annual Reuse
Bent Tree Country Club	194,423 gpd
Heritage Oaks Golf and Country Club	311,868 gpd
Misty Creek Country Club	139,869 gpd
Gator Creek Country Club	172,000 gpd
The Founder Club	178,515 gpd
Total	**996,675 gpd**

Table 3

Existing Sarasota County Watershed Management Goals/Policies relative to reuse water include: Policy 1.3.1, Policy 1.3.3, and Policy 3.3.4. These policies all promote the use of reclaimed or reuse water.

Relevant to the continued use of reuse water within the WSWPA, a distinction was made between potable and non-potable uses as well as between the existing/future land use plan and the 2050 plan overlay. First with respect to potable water, under the existing/future land use scenario, it is assumed that individual 5 and 10 acre lots would develop with individual wells for both domestic indoor and outdoor water use. Since these domestic wells would be used for individual irrigation, it is assumed that reuse water would not be used under the existing land use scenario, unless new golf courses were included.

On the other hand, if the 2050 plan is implemented, it is assumed that central water will be provided. In this case, it is also assumed that any surface water treatment will incorporate the latest technologies including those needed to address PPCDs. This assumption is made independent of whether or not reuse is used within the WSWPA and is considered even more likely if this alternative water supply becomes part of, or is incorporated into, the regional water supply system.

For the 2050 plan scenario, reuse was considered within the context of an irrigation strategy in the WSWPA. Given the need for the use of surface water as a source for potable water, it is recommended that the County consider the following irrigation hierarchy which would re-prioritize ground water over rain water or stormwater within the WSWPA.

(1) Demand Management – as a first priority, Sarasota County should implement incentives for state-of-the-art outdoor demand management and water conservations strategies, particularly for potential high water users.

(2) Reclaimed Water – as a second priority, Sarasota County should be willing to provide bulk service reuse water for irrigation needs. Reuse storage ponds

should be located at least 500 feet from any watercourse in the WSWPA and be designed to be self contained with liners.

(3) Community Wells – as a third priority, Sarasota County should support conducting necessary aquifer tests in coordination with private property owners and existing permit holders to determine a sustainable configuration and yield for a series of community wells in the Intermediate Aquifer System within the WSWPA. This aquifer investigation should characterize the Intermediate Aquifer System in the WSWPA in terms of quantity and quality as a function of depth. This effort could also look at the possibility of utilizing the Intermediate Aquifer as an augmentation to the potable supply for the region during droughts.

(4) Rain Water or Stormwater Recycling – since rain and stormwater is the source for the potable water supply in the WSWPA, this source should probably be the last source to be used to meet outdoor irrigation needs within the WSWPA.

7.0 STORMWATER RUNOFF

Stormwater runoff is the primary source of excess freshwater within the WSWPA. Accordingly, it can also be expected to be the primary source of pollutant loads, by volume. Stormwater runoff can carry litter, animal wastes, fertilizers, pesticides, heavy metals (e.g., chromium, cadmium, copper, lead, mercury, nickel, zinc), herbicides and synthetic organic compounds such as fuels, waste oils, solvents, lubricants and grease. Surface waters that receive runoff from agricultural areas often are subject to pollution associated with concentrations of fertilizers, pesticides, and animal wastes. As a result, water quality problems are often found in transmitting and receiving waters.

7.1 NPDES Program

Sarasota County received a National Pollution Elimination Discharge (NPDES) permit from the U.S. Environmental Protection Agency. The objective of this permit is to outline a Stormwater Management Program that will improve the quality of surface waters in Sarasota County by improving the quality of stormwater runoff through implementation of the many elements outlined as part of the plan. The Program Elements include (1) maintenance of structural controls, (2) development planning and regulations, (3) roadway maintenance, (4) management of discharges from municipal facilities, (4) reduction in the usage of pesticides, herbicides, and fertilizers, (5) inspection and enforcement, prioritize an inventory of all high-risk facilities, regulate erosion control for earth moving activities. The only known NPDES permit facilities in the WSWPA are the Verna Wellfield and the Venice Minerals operation.

This program is further supported by the following existing Sarasota County Watershed Management Goals/Policies: Policy 2.2.1 and Policy 2.3.2A.

7.2 Stormwater Regulations for New Development

Sarasota County Ordinance No. 81-12, as amended, "Land Development Regulations", provides regulations which guide development as it pertains to attenuation and treatment of stormwater runoff. These regulations require that off-site flood stages resulting from post-development conditions cannot exceed those under pre-development conditions for the 100-year, 24-hour design storm. Additionally, Ordinance No. 81-12, as amended, requires that new development provide for the treatment of the first 1" of runoff. These SCG regulations are more stringent then the State and SWFWMD regulations which only require flood attenuation for the 25-year, 24-hour storm and which only require the runoff from the first inch of rainfall to be treated. Both Sarasota County Government (SCG) and SWFWMD regulations are also intended to protect the values and functions of the 100-year floodplain. It is fortunate that much of the 100-year floodplain within the WSWPA has been determined and delineated so that its protection is covered by these regulations.

Although subdivisions platted prior to the adoption of Ordinance No. 81-12 were not bound to incorporate such mitigation techniques into their development, SCG has effectively been able to required stormwater management facilities for new development since the mid to late 1970's. As a result, even pre -1981 subdivisions such as Bent Tree and Gator Creek have stormwater management lakes.

Both SWFWMD and SCG impose an increase of 50% in the stormwater treatment volume if discharges are to areas designated by the State of Florida as Outstanding Florida Waters (OFW). SCG also requires a 50% increase in the stormwater treatment volume if the discharge is to saltwater tidal systems, bays, or the Gulf, even if they are not designated as OFW. It should also be noted that the Lakewood Ranch Development of Regional Impact (DRI) requires the treatment of an additional 50% of the volume as a means to protect the downstream Cooper Creek potable supply watershed.

While current Sarasota County regulations are probably very effective in addressing floodplain management issues, the current regulations for water quality treatment are currently being re-evaluated. The State of Florida through FDEP is in the process of updating the State Water Policy which is expected to result in significant changes in the treatment criteria of stormwater runoff. For example, it is expected that research conducted over the past several decades will be utilized to determine if stormwater treatment systems have been effective in achieving the required 80-90 percent removal of stormwater pollutants before discharging into receiving waters. If not, additional or alternative criteria may be required. In addition, it has been recognized that current SWFWMD and SCG stormwater do not address the total runoff volume which can also increase with land development and cause more subtle impacts to downstream water bodies. As a result SCG has recently adopted a Policy in their Comprehensive Plan to develop low impact development (LID) standards. LID strategies could typically include, but nor be limited to, bio-retention areas, roof gardens, porous pavement, swales, re-forestation, and rain water and stormwater recycling. It is expected that subsequent changes to State Water Policy may also promote if not stipulate the need for LID standards.

In the case of the Dona Bay WSWPA, the excess freshwater is the source of the alternative potable water supply. Therefore, LID should be promoted to more effectively remove pollutants at their source but not necessarily to reduce runoff volumes in the WSWPA.

Existing Sarasota County Watershed Management Goals/Policies that support these existing and proposed programs include Policy 2.1.3, Policy 2.2.2, Policy 2.2.3, Policy 2.3.2, and Policy 2.3.2B.

7.3 Agricultural Activities

Agricultural activities are currently a dominant land use within the WSWPA. Agricultural activities that cause pollution include poorly located or managed animal feeding operations; overgrazing; improper soil stabilization; and improper, excessive, or poorly timed application of pesticides, dipping vats, irrigation water, and fertilizer. Pollutants that result from farming and ranching include sediment, nutrients, pathogens, pesticides, metals, and salts. Impacts from agricultural activities on surface water and ground water can be minimized by using best management practices that are adapted to local conditions.

Additional Sarasota County Watershed Management Goals/Policies specific to managing stormwater discharges include Policy 2.3.2(1)(d) and Policy 2.3.2(2)(c). However, these are voluntary policies. As an additional incentive, it is recommended that SCG consider re-establishing a cooperative extension agent to coordinate the management of agricultural operations within the WSWPA. Another strategy that could be considered for the rural areas of the WSWPA, is for it to be a designated receiving area for water quality trading and watershed restoration. However, water quality or watershed restoration trading would only be suitable for pollutants or habitat for which there is a market (supply and demand) within the watershed. Watershed restoration and water quality enhancement activities within the WSWPA could also be funded through a surcharge on potable water rates.

7.4 Regional Stormwater Management Opportunities

As part of the Dona Bay Watershed Management Plan, several opportunities to provide regional stormwater at strategic locations in the watershed were considered. The results of this effort are provided within Technical Memorandum 4.4.3 – Regional Stormwater Feasibility Study. This effort indicates that the Albritton site (through the phase 2 configuration), the LT Ranch site (privately owned) and the Hi-Hat Old Grove area (privately owned) would all be very effective as regional stormwater facilities from a floodplain management standpoint. However based upon their strategic, on-line locations, it is anticipated that the LT Ranch site and the Hi-Hat Old Grove areas would also be very effective in pollutant removal by providing increased residence times. These opportunities should be explored as a partnership with the private property owners.

8.0 LAND SPREADING AND SLUDGE DISPOSAL

Sludge is the residual by-product of sewage treatment plants. This residual is primarily water and digested wastewater solids. The State of Florida regulates sludge according to the degree of stabilization, and the nitrogen and metals content. The standards of Chapter 62-640, Florida Administrative Code, regulate this residual product, and require all wastewater treatment plant residuals destined for disposal by landspreading in Sarasota County to meet Class B stabilization as defined in that Chapter. The sludge is required to meet minimum standards for pathogen and vector attraction reduction, and cannot exceed a certain level of heavy metal content as specified in Chapter 62-640, Florida Administrative Code. The regulations also include requirements for land spreading, which stipulate certain minimum setback distances from inhabited structures, surface-water bodies, and wells, and prohibit land application when the water table is less than 2 feet from the surface. There are also annual and lifetime caps on the amount of heavy metals that may accumulate on any parcel as a result of land application of sludge.

Existing Sarasota County Watershed Management Goals/Policies relevant to septage and sludge disposal include Policy 1.4.2 and Policy 1.4.4. In particular, Policy 1.4.4 would severely limit if not prohibit land spreading of septage and sludge within the WSWPA. There are currently no active sludge spreading sites within the WSWPA.

9.0 MINING OPERATIONS

Other than sand and shell excavation operations, there are no known mining operations in the WSWPA. Pursuant to the Sarasota County Comprehensive Plan, Environmental Policy 5.2.4, mining operations are not permitted or permissible in the Cow Pen Slough watershed, which includes the WSWPA.

10.0 ONSITE SEWAGE TREATMENT AND DISPOSAL SYSTEMS (OSTDS)

OSTDs including septic tanks are commonly used where providing central sewer is not available, such as in the majority of the WSWPA. When properly sited, designed, constructed, maintained, and operated, OSTDs are a safe means of disposing of domestic waste. The effluent from a well-functioning OSTD is comparable to secondarily treated wastewater from a sewage treatment plant. When not functioning properly, OSTDs can be a source of nutrient (nitrogen and phosphorus), coliform bacteria, pathogens, and other pollutants to both ground water and surface water. OSTDs are typically associated with rural low density residential lots such as those that currently exist (and what could be expected under the Sarasota County future land use map) within the WSWPA.

The regulations that govern the installation of onsite sewage disposal systems were strengthened by amendments to Section 381.272, Florida Statutes, and Chapter 10D-6, Florida Administrative Code. These amendments, in conjunction with County regulations governing the installation and spacing of onsite sewage disposal systems adopted during the 1980s, have significantly strengthened the ability of the County to safeguard the environment from the adverse impacts of improperly constructed systems.

A continuing problem is the presence of existing areas served by aging onsite sewage treatment and disposal systems that were, in many cases, installed to lesser standards than are presently in effect. These systems are prone to malfunction, and have the potential for degrading surface and ground water supplies.

In 1997, the EPA recommended to Congress that state and local authorities should manage OSTDs based on performance goals. At the state level, the Florida Water Environment Association Utility Council (FWEAUC) has recommended that the Florida Department of Health should pursue legislative changes to increase its oversight of the performance of OSTDs by requiring performance-based operating permits for all systems.

Existing Sarasota County Watershed Management Goals/Policies relevant to OSTDs include: Policy 1.1.7, Policy 1.2.1, and Policy 1.5.2. Consistent with these existing policies, it is recommended that existing OSTDs in the WSWPA be monitored for failure rates. It may be necessary to expand central sewer services into areas along the western edge of the WSWPA if high OSTD failure rates are observed.

11.0 OTHER POTENTIAL SOURCES

11.1 Mosquito Control Spray Application Areas

Lyman Roberts, Ph.D., Director of the Sarasota County Mosquito Control District indicated that spraying is not conducted on a set schedule but by sampling the mosquito population with traps. When numbers of person-biting species exceed thresholds, the subject area is sprayed with Naled (Dibrom) or permethrin (Biomist 4-4). Naled is applied by air at 0.6 ounce per acre to rural areas east of I-75. This insecticide breaks down to undetectable levels within 7 hours. Permethrin is applied by truck at 0.00175 ounce of actual ingredients per acre and has a half life of about 6 hours.

11.2 Hazardous Waste/Spills

Because of its relatively rural nature, there is limited potential for sources of hazardous waste being generated within the WSWPA. However, there are three major roadways that currently traverse the WSWPA. State Road 70 in Manatee County traverses the watershed at its headwaters but doesn't cross a major stream or tributary. However, Sate Road 780 (Fruitville Road) which crosses a wide floodplain in the upper end of the watershed and State Road 72 (Clark Road) which crosses the Cow Pen Canal just upstream of the proposed Abritton storage area pose potential opportunities for hazardous spills to occur from vehicles traversing the watershed. These two latter crossings area both located in Sarasota County. It is recommended that Sarasota County consider providing adequate traffic barriers along each side of the roads at these two locations and that the roadside stormwater drainage should be crowned away from the canal.

In addition, University Parkway is to be extended eastward to State Road 70 by Manatee County just north of the County line. This alignment will cause significant impacts to the wide headwater tributaries in the WSWPA. It is recommended that Sarasota County engage Manatee County and property owners just south of the Manatee/Sarasota County line to see if the extension can be aligned to minimize the extent of the crossing of the headwater floodplain. Fortunately, there are no Interstate Highways that traverse the WSWPA.

Existing Sarasota County Solid Waste Goals/Policies that are relevant to hazardous waste include Policy 2.3.3, Policy 2.3.4, Policy 2.3.5, and Policy 2.3.6. In particular Policy 2.3.6 prohibits the location of any new hazardous collectionor storage areas within the 100 year floodplain within the watershed of a public potable surface water supply, or with 200 feet of the wetland jurisdictional line, whichever is greater.

11.3 Wastewater Treatment Facilities

There are no public or private wastewater treatment facilities in the WSWPA. However, Sarasota County's Bee Ridge Water Reclamation Facility (BRWRF) is located adjacent to the WSWPA, approximately 0.34 mile from the drainage way. The BRWRF is a 1.5 million gallon per day (mgd) wastewater treatment facility. It was placed in service in August 1995 and is adjacent to, and north of the Bee Ridge Landfill. It is located totally within the Phillippi Creek Watershed and it is likely that any spills would be contained on the parcel and not adversely impact water quality in the WSWPA.

Existing Sarasota County Watershed Management Goals/Policies that are relevant to wastewater treatment facilities include Objective 1.2. There are currently no wastewater treatment facilities in the WSWPA. Therefore, this objective and other related policies would likely only be applicable if a new wastewater treatment facility was constructed in the WSWPA in association with a 2050 Plan village.

11.4 Solid Waste Facilities

There are two solid waste facilities located just outside of the WSWPA. The first is the Sarasota County Bee Ridge Landfill which has been closed but is located just north of the Vegetable Relief canal and the WSWPA. The second site is the active Central County Solid Waste Disposal Complex on Knight's Road in the Pinelands Reserve. It is a Class I landfill that is situated outside of the WSWPA but geographically between the potential future reservoir sites for Albritton and the Venice Minerals.

Existing Sarasota County Solid Waste Goals/Policies that are relevant to solid waste facilities include Policy 2.3.1 and Policy 2.3.2. In particular Policy 2.3.1 addresses the adjacent Central County Solid Waste Disposal Complex. Policy 2.3.2 requires that all public landfill sites undergo inspection and/or monitoring. It is recommended that this is done routinely for both landfills that are adjacent to the WSWPA.

12.0 WATERSHED PROTECTION PROGRAMS

12.1 Protection and Restoration Projects

Protection and restoration projects refer to a suite of site-specific projects that protect and restore watersheds by conserving and enhancing existing watershed resources, or correcting specific problems identified through stream and upland assessments. Protection and restoration projects generally fall into the following categories: stormwater retrofit, stream repair, reforestation, wetland restoration, discharge prevention, pollution source control, municipal operations, sensitive area conservation, and agricultural best management practices. **Table 4** inventories the potential program elements being contemplated in the WSWPA (highlighted) and the lower Dona Bay watershed. **Figure 5** identifies the potential Dona Bay Watershed Management Program Elements.

Element ID	Potential Site	Restoration	Preservation	Ownership
1	Fox Creek Site	X		SCG
2	West Pinelands	X		SCG
3	Venice Minerals	X		SCG
4	Pinelands Pits	X		SCG
5	Albritton Site	X		SCG
6	Gum Slough		X	SCG
7	LT Ranch Pasture	X		Private
8	Hi-Hat Old Grove	X		Private
9	Hi-Hat Floodplain	X		Private

Table 4 – Potential Watershed Restoration Program Elements

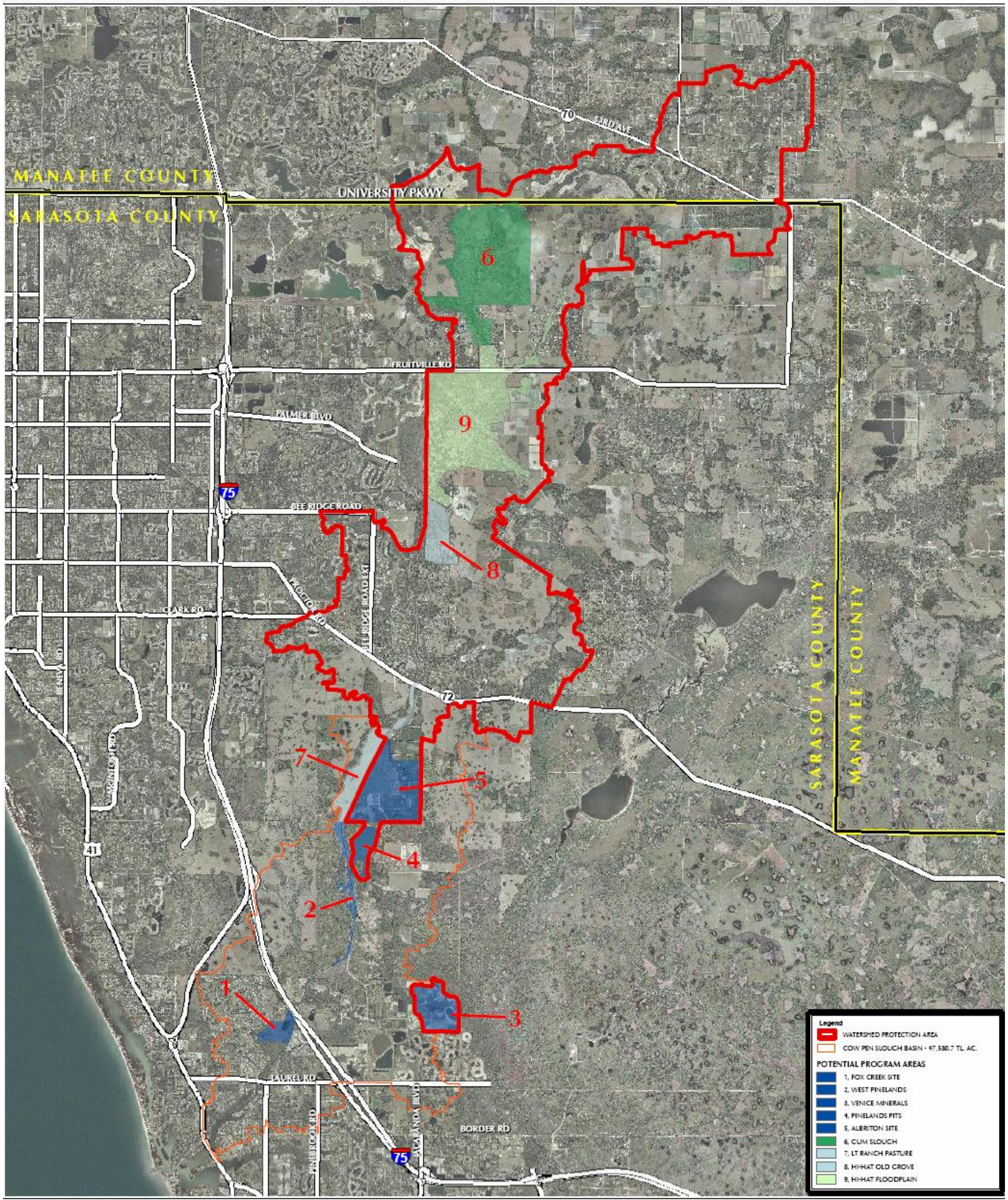

Figure 5 – Potential Dona Bay Watershed Management Program Elements

12.2 Land Use Planning

Land use planning may be the single most important tool in protecting the watershed for future generations. Florida state law requires cities and counties plan for the future by adopting comprehensive plans, which outline how they will manage the environmental, residential, economic, and transportation requirements as the communities change over time. In 1981, Sarasota County's adopted its first Comprehensive Plan which acknowledged the importance of maintaining the ecological integrity of the Cow Pen Slough Basin. The County prohibited mining activities within designated areas of special environmental significance and/or sensitivity. The watersheds of Cow Pen Slough, the Myakka River, and the Braden River are designated areas of special environmental significance.

In October 2000, the Board of County Commissioners, based on recommendations from the Urban Land Institute, called for crafting a growth management policy with a 50-year outlook.

The final product was the Sarasota 2050 plan. The plan establishes an incentive-based approach to managing growth within the WSWPA and across the unincorporated county during the next five decades.

Much of the WSWPA is designated within the Greenway Resource Management Area (RMA). This RMA designates a network of riverine systems, floodplains, native habitats, storm surge areas and uplands as priority resources for the County in order to implement programs, which are designed to protect these lands in perpetuity. The plan also identifies incentives for planners and decision-makers to use to ensure that both designated areas and private property rights are protected. These incentives provide for the purchase of development rights, the Transfer of Development Rights, the purchase of Conservation Easements and the protection of agricultural uses as appropriate.

12.3 Land Acquisition

Sarasota County has a voter-approved and taxpayer-funded *Environmentally Sensitive Lands Protection Program* (ESLPP). The program is designed to acquire and protect natural lands. Priority sites within the county are ranked on environmental criteria including connectivity, water resources, habitat rarity, diversity, and manageability. Areas within the designated Greenway RMA are automatically assigned a higher priority. The County coordinates and pursues joint programs with and seeks, where available, funding from regional, state and federal resources for the purchase of conservation lands. In addition, private not-for-profit entities such as the Nature Conservancy provide assistance in land acquisition.

In January 2004, Sarasota County acquired a 1,972 conservation easement from the Schroeder-Manatee Ranch that stipulates no future development on a parcel that is located at the headwaters of the WSWPA. The parcel is known as the Gum Slough site. The Nature Conservancy had acquired an adjoining 200-acre easement from a private landowner in 2000. These conservation easements will provide valuable wildlife habitat and help protect the water resources of Cow Pen Slough. **Figure 6** identifies all lands currently under public ownership or private protection within the Dona Bay watershed.

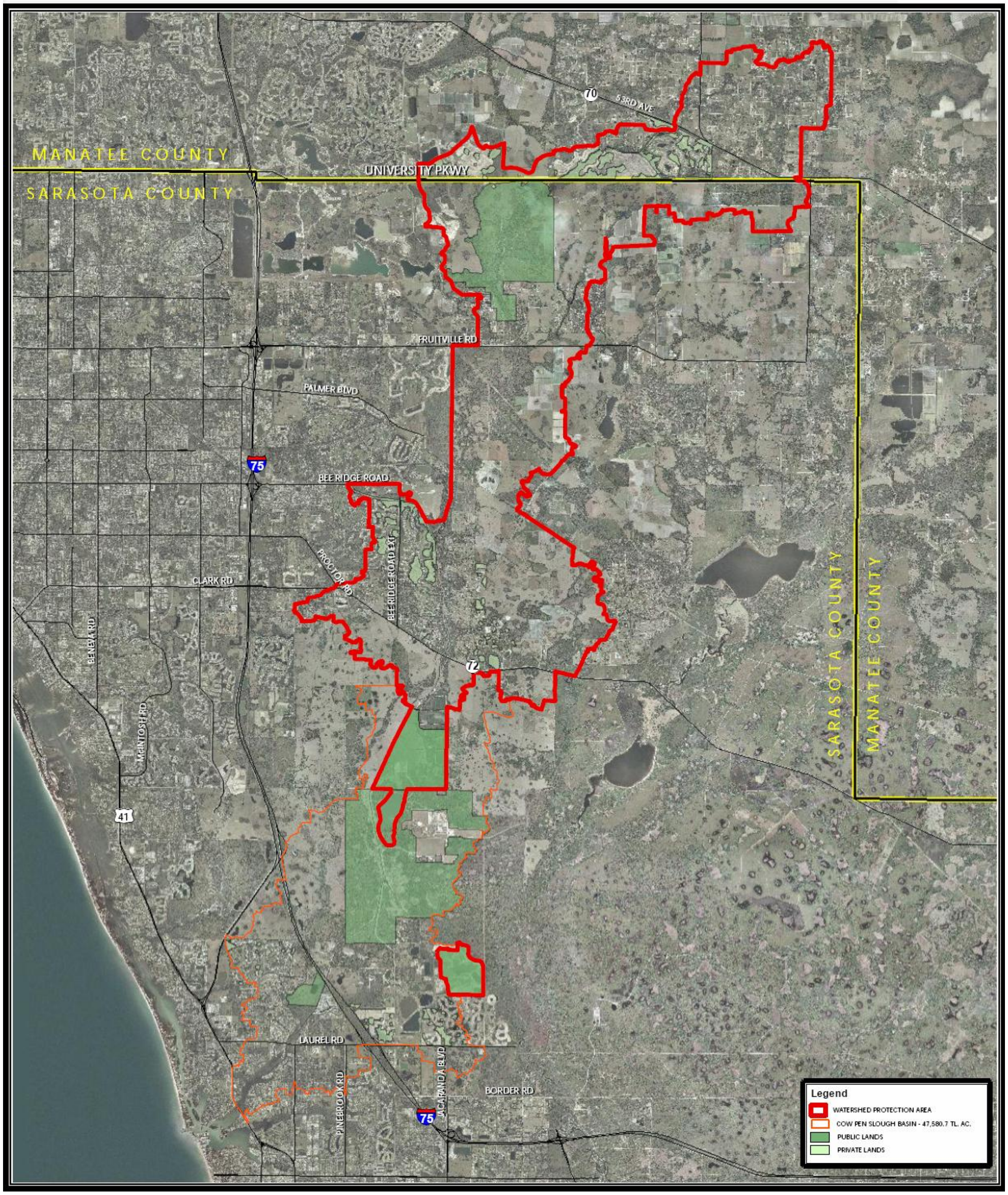

Figure 6 – Publicly Owned Lands and Private Owned Protected Lands

12.4 Aquatic Buffers

The 2050 Plan provides up to 500-foot aquatic buffer from named creeks and flow-ways. If the 2050 Plan is not implemented and in areas along the Cow Pen Canal that are already developed, it is recommended that additional incentives be provided for property owners within 100 feet of the banks of the Cow Pen Canal or contributing tributary to receive grants such as those provided by the SCG Neighborhoods Grant program, to plant and maintain native vegetation within their adjacent property.

12.5 Site Design

In its most recent Comprehensive Plan update Sarasota County has committed to develop low impact design (LID) standards by 2007. Low impact design standards are site specific measures that mitigate the effect of impervious surfaces and stormwater pollutants.

12.6 Erosion and Sediment Control

SWFWMD, Sarasota County and FDEP regulatory standards and policies for Erosion and Sediment Control during construction activities should reflect the state-of-the-art of evolving technologies. In addition, BMPs for all construction projects within the WSWPA should be inspected daily for compliance.

12.7 Watershed Stewardship

Aside from Sarasota County, there are three watershed stewardship constituencies within the WSWPA: large agricultural landowners, developers and existing residents.

Each audience has an identifiable set of concerns and interests that can shape a common strategy for ensuring water quality within the watershed.

For large land-owners
The large private landowners within the WSWPA are generally not absentee owners. They are families that have a long-history within the community and a deep love and respect for the watershed. The County currently encourages landowners to work with the Soil and Conservation District and Sarasota County Cooperative Extension to implement Best Management Practices for agricultural uses, production and range management.

For developers
For new developments, Sarasota County has a robust set of goals, objective, policies and standards with respect to watershed management,

For existing residents
Sarasota County Cooperative Extension has an outreach program – the Florida Yards and Neighborhoods Program - to encourage the reduction in the use of pesticides and fertilizers and the adoption of Florida-friendly landscaping and

Florida Yards & Neighborhoods
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native habitat. The County's commitment to the encouragement of active civic engagement in watershed stewardship is covered in the previous Stakeholder Involvement section of this report.

The County has an on-going effort to reduce the potential for excess nutrient input to watercourses through better management practices associated with the application of fertilizers.

Strategies that have been identified for this initiative include:

- Establishment of a waterway lot setback
- Establishment of non-fertilizing zones
- Establishment of native vegetation buffers
- Establishment of low-head berms along seawalls
- Use of low phosphorous fertilizers
- Use of slow release fertilizers, particularly during the wet season
- Require soil testing before fertilization
- Education (making fertilizer bags easier to understand, development of green industries best management practices, neighborhood environmental report card)

13.0 STAKEHOLDER INVOLVEMENT

A comprehensive watershed management plan needs to effectively coordinate the efforts and resources of a complex and overlapping array of agencies, organizations and institutions within and across several level of government. Each entity has a distinct role to play in understanding how to protect the WSWPA.

Aligning the efforts and resources of stakeholders towards common goals is critical to the adoption and implementation of any watershed plan. Undoubtedly Sarasota County will play the lead role in organizing the regulatory, technical and financial stakeholders and partners – the FDEP, the SWFWMD, the Authority, the Charlotte Harbor NEP, and non-profit and public agencies – to appropriately define the necessary roles and distinct and shared responsibilities for meeting the objectives of the watershed plan.

It is just as necessary to actively engage the large property owners, businesses and residents that are within the WSWPA itself since their decisions, activities and investments will have a significant impact on water quality and the health and vitality of the watershed.

Sarasota County has a well-established track record of engaging watershed stakeholders, particularly civic and business leadership. Sarasota County's strong interest and support in water quality and watershed protection is reflected in the fact that it is encompassed by two National Estuary Programs – Sarasota Bay and Charlotte Harbor.

Sarasota County Government (SCG) has continually demonstrated strong support for public involvement in watershed issues. Several years ago SCG held workshops in each watershed – the Watershed Story: Connecting every Home to the Bay.

Neighbors with the assistance of Sarasota County started a grassroots movement known as NEST (Neighborhood Environmental Stewardship Team) to restore and protect natural habitat in their neighborhood. The group enlisted school science teams, businesses and community organizations to work together to restore the native ecosystem for the neighborhood to enjoy. The County has expanded NEST into other neighborhoods and built more partnerships with homeowner associations, civic groups, environmental groups and schools to educate the residents, promote community ownership and create advocates for a healthy environment. The NEST program can provide a tool for initial and continued watershed stakeholder involvement and stewardship.

The Science and Environmental Council of Sarasota County (SEC) created a series of workshops designed to create a common understanding across a diverse group of stakeholders regarding the interrelationship of the vitality of estuaries and watersheds, water conservation strategies, and the value of regional water supply coordination. To this end, the SEC invited a broad group of local government decision-makers in land use planning and water management, local water utility operators, civic leaders, developers, builders and private land use planners to participate in a well-attended and well-received series of dialogs. This program provided a transferable template for initial stakeholder engagement.

The Lemon Bay League is a consortium of homeowners, businesses and not-for-profit groups spanning the two counties which touch Lemon Bay. Following the development of the Lemon Bay Watershed Management Plan, the group is moving forward to develop a community plan around the Lemon Bay Watershed. The plan is designed to coordinate existing neighborhood and area plans, develop an area land use plan, and develop criteria for sustainable development. This watershed-based stakeholder organization could provide a model to sustain watershed stewardship.

In January 2006, Sarasota County hosted a Dona and Roberts Bay public watershed workshop. Over 100 people attended and approximately 35 attendees then participated in small group discussions. A follow-up community update was held on August 26th. These workshops have proven effective in generating a strong sense of public ownership and civic involvement in watershed issues.

14.0 CONSULTANT RECOMMENDATIONS

The following draft recommendations and potential incentives are provided to add value to the existing Sarasota County Watershed Management Goals. A reference is also provided to the Catalog of Federal Funding Sources for Watershed Protection

Purpose of 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.

Federal Funding Sources for Watershed Protection

Catalog of Federal Funding Sources for Watershed Protection

The Catalog of Federal Funding Sources for Watershed Protection Web site is a searchable database of financial assistance sources (grants, loans, cost-sharing) available to fund a variety of watershed protection projects.

Searchable Catalog of Federal Funding Sources for Watershed Protection epa.gov/watershedfunding

Agricultural Management Assistance Database www.nrcs.usda.gov/programs/ama
Clean Water Act Section 319(h) funding (epa.gov/nps/ 319hfunds.html) is provided to designated state and tribal agencies to implement approved nonpoint source management programs.

Environmental Quality Incentives Program (www.nrcs.usda. gov/programs/eqip) offers financial, technical, and educational assistance to install or implement structural, vegetative, and management practices designed to conserve soil and other natural resources.

Conservation Reserve and Conservation Reserve Enhancement Programs (www.fsa.usda.gov/dafp/cepd/default. htm) implemented by the U.S. Department of Agriculture provide financial incentives to encourage farmers and ranchers.

National Management Measures to Control Nonpoint Source Pollution from Agriculture epa.gov/nps/agmm This technical guidance and reference document is for use by state, local, and tribal managers in the implementation of nonpoint source pollution management programs. It contains information on effective, readily available, and economically achievable means of reducing pollution of surface and ground water from agriculture.

National Agriculture Compliance Assistance Center epa.gov/agriculture or call toll-free: 1-888-663-2155 EPA's National Agriculture Compliance Assistance Center is the "first stop" for information about environmental requirements that affect the agricultural community.