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THE FLAGLER COUNTY WATER SUPPLY PLAN

The Flagler County
Water Supply Plan

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Prepared For:

City of Beverly Beach
City of Bunnell
City of Flagler Beach
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Towne of Marineland
St. Johns River Water Management District

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FLAGLER COUNTY WATER SUPPLY PLAN

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FLAGLER COUNTY WATER SUPPLY PLAN

INTRODUCTION/BACKGROUND

Flagler County and surrounding areas are experiencing rapid development and population growth that has led to increasing demands on water resources and the related natural environment. The potential for saltwater intrusion and environmental harm are limiting and will limit future withdrawals from the groundwater resource. The St. Johns River Water Management District (District) predicts that, within 20 years, traditional groundwater supplies will not be adequate to meet demands in many areas of Flagler County, and that alternative source development will be needed. Recognizing the importance of water supply planning as a tool to more clearly identify and understand projected groundwater shortfalls and to identify alternative water supply sources and projects that could provide adequate water for projected growth, the District, in cooperation with Flagler County, the municipalities of Bunnell, Flagler Beach, Marineland, Palm Coast, and Beverly Beach, and the Dunes Community Development District (the Cooperators), have entered into a Memorandum of Understanding (MOU) that provides for development of this document, the Flagler County Water Supply Plan (Plan).

The District contracted with ARCADIS U.S., Inc., to develop the Plan, which is to summarize existing and projected public water supply demands and to identify preferred alternatives for ensuring that future demands are met while preserving and protecting environmental resources. ARCADIS began its work in March 2006.

Planning Process

SJRWMD and all governments with water supply systems in the county signed a Memorandum of Understanding (MOU) for developing a countywide water supply plan. The group of participating water supply entities was called the Cooperators. The MOU was recorded with Flagler County on July 1, 2005. The Cooperators met in April 2005 and authorized SJRWMD to move forward with the consultant selection process. A consultant (ARCADIS) was selected and entered into a contract with SJRWMD on behalf of the Cooperators in February 2006, to provide technical support in the preparation of the Flagler County Water Supply Plan.

The Cooperators met 13 times between April 2005 and September 2007. Each of the meetings was held in a public meeting place and public comment was solicited. In addition, SJRWMD held two meetings specifically oriented towards receiving input from the agricultural community in Flagler County. During these meetings SJRWMD staff and consultants requested feedback from the Cooperators on the direction and content of draft planning documents and recommendations. Input and guidance gathered during all of the meetings was critical to the successful completion of the Flagler County Water Supply Plan.

Objectives

The following primary objectives were the focus of development of the Plan:

- Identify the quantities of water necessary to supply projected growth in the service areas of the Cooperators.
- Estimate the amount of groundwater potentially available to the Cooperators.
- Identify the quantities of alternative water supplies necessary to supply projected growth in the service areas of the Cooperators in combination with available groundwater.
- Identify alternative water-supply development projects available to the Cooperators.

WATER USE PROJECTIONS

ARCADIS reviewed the water use projections for the Cooperators as reported in the 2003 District Water Supply Assessment and as described in consumptive use permits (CUPs) issued by the District. In addition, ARCADIS reviewed independent water use projections, available Cooperators' water conservation and reclaimed water plans, and related information provided by the Cooperators (Appendices A, B, C, D, and E).

Based on comparison of the District's water use projections for 2025 with those provided by the Cooperators, ARCADIS concluded that the District's projections were suitable for use as the basis of developing the Plan.

Following collection and evaluation of this information, the Cooperators decided that updated population and water use projections being prepared for the District by its consultant GIS Associates, Inc., would be a better basis for development of the Plan (Table 1) than the information previously developed. Based on these updated projections, the population of Flagler County is expected to reach 245,800 people in 2025 and total public supply and domestic self-supply water use is projected to reach 40.76 million gallons per day (mgd).

Table 1: Flagler County Population Projections and Water Demand Projections, 2010-2030

Flagler County Population Projections, 2010-2030					
UTILITY	**2010**	**2015**	**2020**	**2025**	**2030**
BUNNELL, CITY OF	4,739	7,930	16,319	24,358	39,803
DUNES COMMUNITY DEVELOPMENT DISTRICT	1,506	4,284	5,651	5,741	5,745
FLAGLER BEACH, CITY OF	5,000	6,420	6,453	6,460	6,467
PALM COAST, CITY OF	85,086	109,533	136,233	164,591	174,581
PLANTATION BAY UTILITY	1,262	1,901	2,741	4,064	9,203
VOLUSIA COUNTY UTILITIES	1,016	1,060	1,093	1,098	1,195
DOMESTIC SELF-SUPPLY	21,091	27,873	32,810	39,488	56,106
COUNTY TOTALS	119,700	159,000	201,300	245,800	293,100

Flagler County Water Demand Projections, 2010-2030 (mgd)					
UTILITY	**2010**	**2015**	**2020**	**2025**	**2030**
BUNNELL, CITY OF	0.55	0.92	1.90	2.83	4.63
DUNES COMMUNITY DEVELOPMENT DISTRICT	0.34	0.96	1.26	1.28	1.28
FLAGLER BEACH, CITY OF	0.60	0.77	0.78	0.78	0.78
PALM COAST, CITY OF	14.25	18.59	23.34	28.38	30.15
PLANTATION BAY UTILITY	0.24	0.37	0.53	0.78	1.78
VOLUSIA COUNTY UTILITIES	0.15	0.16	0.16	0.16	0.18
DOMESTIC SELF-SUPPLY	3.45	4.63	5.45	6.55	9.19
COUNTY TOTALS	19.58	26.40	33.42	40.76	47.99
Subtract Domestic Self Supply	3.45	4.63	5.45	6.55	9.19
Subtract Existing Groundwater PWS CUPs	11.80	11.80	11.80	11.80	11.80
Public Water Supply Deficit	**4.33**	**9.97**	**16.17**	**22.41**	**27.00**

Source: Rich Doty,GIS Associates, Inc., May 2007

FEASIBILITY OF DEVELOPING ADDITIONAL GROUNDWATER SUPPLIES

ARCADIS and the District staff worked together to evaluate the feasibility of developing additional groundwater to meet projected future water supply needs. The potential for additional groundwater withdrawals from the confined surficial aquifer and the Floridan aquifer were examined using the District's Palm Coast Groundwater Flow Model and the District's Northeast Florida Regional Groundwater Flow Model (Appendix F). The primary conclusions of this analysis are:

- No areas of the County appear to be able to support additional large groundwater withdrawal capacity beyond 2011 permitted quantities without further increasing the potential for harm to wetlands.
- It will be extremely difficult to identify and develop a substantial source of future groundwater supply in Flagler County without mitigating the potential harm to wetlands.

Based on the assumption that the groundwater withdrawal allocations authorized by current CUPs reasonably represent the maximum quantities that can be allocated without resultant unacceptable impacts to water resources and related natural systems, a total of 22.41 mgd in alternative water supplies needs to be developed collectively by the Cooperators by 2025 (Table 1).

Use of Wetland Hydration to Extend Groundwater Availability

Upon review of these conclusions, the Cooperators indicated an interest in determining if water from the extensive drainage canal network in northeastern Flagler County could be used to mitigate the potential for harm to wetlands, which would allow local utilities (primarily Palm Coast) to withdraw more water from the confined surficial aquifer. In response to this expressed interest, the District tasked its consultants, Watershed Connections, Inc. and Water Supply Solutions, Inc., to perform a preliminary evaluation of the feasibility of this concept. Based on this evaluation, unacceptable wetland impacts identified as being "likely to occur" by 2011, could be avoided through the design and construction of wetland hydration projects. Planning-level construction cost estimates for this effort range from $0.44 million to $7.45 million (Appendix G).

ALTERNATIVE WATER SUPPLIES

Based on the conclusion that an estimated 22.41 mgd of alternative water supplies needs to be developed to meet projected needs in 2025 (Table 1), the Cooperators identified potential alternative water supply sources for investigation by ARCADIS. Based on the review of available water resources information, ARCADIS identified a preliminary list of potential alternative water supply sources for consideration by the Cooperators. This preliminary list was reviewed and refined by the Cooperators, resulting in the final list of potential alternative water supply sources evaluated by ARCADIS. This list included the following surface-water bodies.

- Crescent Lake
- Lake Disston
- Lehigh Canal
- Pellicer Creek
- Palm Coast Park
- Town Center
- St. Johns River near Lake George
- St. Johns River near SR 40
- Lower Ocklawaha River

ARCADIS evaluated the feasibility of developing these sources to meet projected 2025 Cooperators' demands. Potential capacity, water quality, accessibility, and treatment requirements were addressed in this evaluation. The Cooperators reviewed the results of the evaluation performed by ARCADIS and identified four sources (Crescent Lake, St. Johns River near Lake George, St. Johns River near SR 40, and the Lower Ocklawaha River) as sources that appeared to have adequate potential yield and water quality to be considered as a long-term, high volume source of supply for the Cooperators.

ARCADIS performed more detailed analysis of these four surface-water alternatives. In January 2007, ARCADIS presented to the Cooperators a siting analysis of the facilities (intake site, plant site, treatment requirements, pipeline routing) needed for each of these four alternatives. In addition, ARCADIS provided technical information about four additional alternatives (Lehigh Canal [essentially the same as the "Palm Coast canal system" discussed above], Pellicer Creek, Palm Coast Park, and Town Center) near existing utility service areas that might serve as sources for potential constructed reservoirs. A summary of these analyses is included in a technical memorandum titled *Review of Surface-Water Supply Alternatives* (Appendix H).

Each of the four alternatives that can deliver the 2025 demand has associated uncertainties.

- Crescent Lake appears to be vulnerable to seasonal high tides in the St. Johns River, which cause flow reversal in Dunns Creek, the Crescent Lake outlet to the St. Johns River. If the reverse flows cannot be managed, a means of storing water

through the reverse flow periods or utilizing a conjunctive groundwater/surface-water system would be needed to create reliability at all times. For the purposes of the preliminary cost analysis, an aquifer storage and recovery (ASR) system to store the water has been included, although it has not been determined if ASR is feasible in the vicinity of Crescent Lake or along the planned raw water main route in Flagler County.

- Desalination of St. Johns River water will be needed at the two sites that rely on the St. Johns River source. Desalination generates a drinking water by-product (concentrate or brine) that needs to be managed in an environmentally acceptable manner. Disposal of the by-product back into the St. Johns River is a possible option, which would require additional investigation. In addition, these sources are located beyond the boundaries of Flagler County, which could present additional risks because of the "local sources first" provisions in Chapter 373, *Florida Statutes*.
- Although the Ocklawaha River can easily provide the needed quantity, it is not known how proposed restoration efforts by the State of Florida might impact the water withdrawals. In addition, this source is also located beyond the boundaries of Flagler County, which could present additional risks because of the "local sources first" provisions in Chapter 373, *Florida Statutes.*

Estimated unit production costs for these potential projects range from $4.92 per 1000 gallons for the Lower Ocklawaha River Project to $5.61 per 1000 gallons for the St. Johns River near SR 40 Project (Appendix H and Table 2).

Subsequent to these evaluations and at the request of the Cooperators, the District assessed the feasibility of developing seawater as a source of supply to meet projected demands through 2025. Two seawater options were included in this assessment: an offshore, ship-based option proposed by Water Standard Company and a land-based option (Appendix I). This assessment indicated that the estimated unit production cost for the Water Standard Company, ship-based option is $3.87 per 1000 gallons (which includes the transmission main and storage tanks) and the estimated unit production cost of a comparable land-based facility is $3.94 per 1000 gallons (Table 2). (Note: the Water Standard Company revised its original cost estimates (Appendix I) in an effort to make them more comparable to the land-based option costs.) The following six alternative water supply project options have been identified for consideration by Flagler Cooperators.

- Crescent Lake
- St. Johns River near Lake George
- St. Johns River near SR 40
- Lower Ocklawaha River
- Ship-based Seawater Desalination
- Land-based Seawater Desalination

Table 2: Cost of Water Supply Project Options

PROJECT	UPC* - $/KGAL
SEAWATER OPTIONS	
SHIP-BASED	$ 3.87
LAND-BASED	$ 3.94
SURFACE WATER OPTIONS	
LOWER OCKLAWAHA RIVER	$ 4.92
CRESCENT LAKE	$ 4.96
SJR AT LAKE GEORGE	$ 5.58
SJR NEAR SR-40	$ 5.61

*** Unit Production Cost**

[Note: costs vary from Water Standard Company original cost estimates in an effort to make them comparable to land-based options. Additionally, all costs are developed at the conceptual-planning, pre-design level - actual costs may vary. Total project planning cost estimates are generally accurate to within 35% (+/-) of actual costs.]

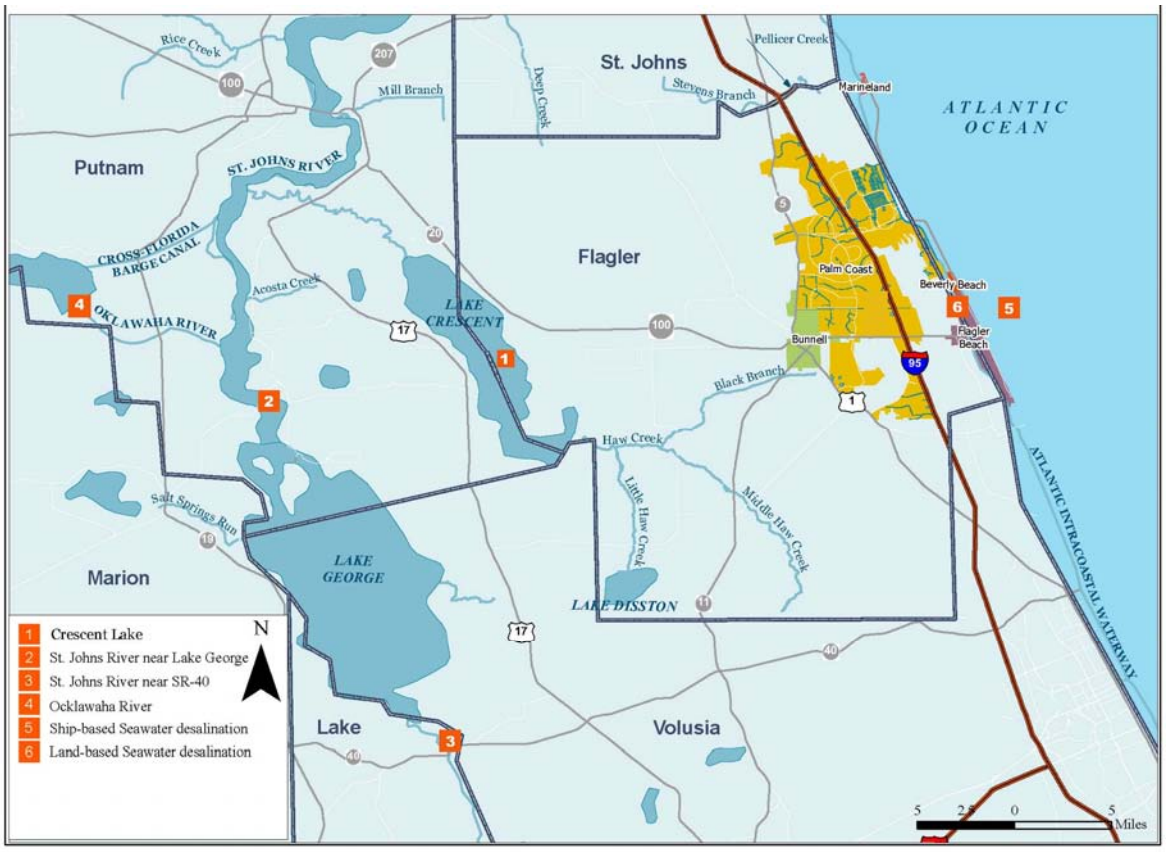

Figure 1: Alternative Water Supply Project Options

ROLE OF POLITICAL BOUNDARIES IN WATER SUPPLY PROJECT SELECTION

The withdrawal locations for three of the identified potential water supply projects (St. Johns River near Lake George, St. Johns River near SR 40, and the Lower Ocklawaha River in Putnam County) are beyond the boundaries of Flagler County. Therefore, development of these projects would require the transfer of water across county boundaries. Section 373.223(3), F.S., commonly referred as the "local sources first" provision, identifies several factors to be considered by Florida's water management districts in the consumptive use permitting process, when evaluating whether a potential transport and use of groundwater or surface water across county boundaries is consistent with the public interest. To date, there has not been a significant legal test of the statutory requirements related to "local sources first." Regardless, these provisions should be carefully considered when deciding between a project that utilizes a source located within the county where it is proposed for use and a source that is outside the county where it is proposed for use.

The "local sources first" provision does not prohibit the transfer of water across county boundaries, but provides a list of factors which must be considered when evaluating whether a potential transport and use of surface water across county boundaries is consistent with the public interest: The considerations are:

1. The proximity of the proposed water source to the area of use or application.
2. All impoundments, streams, groundwater sources, or watercourses that are geographically closer to the area of use or application than the proposed source, and that are technically and economically feasible for the proposed transport and use.
3. All economically and technically feasible alternatives to the proposed source, including, but not limited to, desalination, conservation, reuse of nonpotable reclaimed water and storm water, and aquifer storage and recovery.
4. The potential environmental impacts that may result from the transport and use of water from the proposed source, and the potential environmental impacts that may result from use of the other water sources identified in 2 and 3.
5. Whether existing and reasonably anticipated sources of water and conservation efforts are adequate to supply water for existing legal uses and reasonably anticipated future needs of the water supply planning region in which the water source is located.
6. Consultations with local governments affected by the proposed transport and use.
7. The value of the existing capital investment in water-related infrastructure made by the applicant.

The Legislature has directed that the basis for a District's consideration of the above factors is the districtwide water supply assessment and regional water supply plan. The information, which has been developed during the Flagler county-level planning process has demonstrated that, except for seawater projects, there is only one adequate source of

potable water within Flagler County which will meet the needs of its citizens over the next 20 years. That source is Crescent Lake. The District plans to add the Crescent Lake project, a ship-based seawater project, a land-based seawater project, and the surface water projects with sources that are located outside the County to an updated version of its regional water supply plan.

Development and transport of water from projects using a source of water outside of the county where it is proposed for use may increase the risk that a permit will be challenged, and will require additional supporting information that would not be required if the source were located in the county where the water is to be used. This increased risk could manifest itself as legal, resulting in other professional consulting fees associated with litigation in the permitting process, delays in permit issuance, permit denial, and strained relations with neighboring counties.

RECOMMENDED COURSE OF ACTION

The following potential alternative water supply projects should be further considered by the Cooperators.

- Crescent Lake
- St. Johns River near Lake George
- St. Johns River near SR 40
- Lower Ocklawaha River
- Ship-based seawater desalination
- Land-based seawater desalination

This consideration, at a minimum, should address the uncertainties associated with:

- Cost
- Availability of funds
- Political boundaries
- Permittability
- Potential partnership opportunities
- Long term source availability

APPENDICES

APPENDIX A

Technical Memorandum Task B
Review of Existing Plans

Review of Existing Plans – Task B

for the

Flagler County Water Supply Plan

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June 2006

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INTRODUCTION

Flagler County and surrounding areas are experiencing rapid development and population growth that has led to increased demands on water resources and the related natural environment. The St. Johns River Water Management District (SJRWMD) predicts that within 20 years, traditional groundwater supplies will not be adequate to provide for demands in many areas of Flagler County, and that alternative source development will be needed.

The SJRWMD in conjunction with Flagler County, the municipalities of Bunnell, Flagler Beach, Palm Coast, Beverly Beach, and Marineland, and the Dunes Community Development District (Cooperators) entered into a Memorandum of Understanding to develop the Flagler County Water Supply Plan.

This document represents the deliverable identified under Task B, which is a "List and summary of existing water supply plans and other reports related to needs and sources including date of report, purpose, and planning years". The documents reviewed consist of the SJRWMD 2005 District Water Supply Plan, the 2003 District Water Supply Assessment, and other commissioned studies by the District, and the Cooperators that identify water supply needs and water supply sources. The documents represent those provided by the Cooperators and the District. They will be used as a reference for the Plan.

DOCUMENTS REVIEWED

Cooperator Documents

Flagler County

- *Bulow Water and Wastewater Master Plan, July 2005.*
  - This plan was prepared to determine potable water, wastewater, and public access reuse water service requirements for the service area.
  - Water Supply
    - The existing water supply system consists of five 4-inch diameter raw water supply wells, three which are active and two which are inactive.
    - The three main water sources in Flagler County are the surficial, intermediate, and Floridan aquifers.
    - The proposed water supply 10-year master plan includes a proposed 2,570 equivalent residential connections (ERCs) within the service area. Considering the value of 0.77 million gallons per day (MGD) as the average daily demand determined from the average level of service (LOS) of 300 gpd/ERC, the anticipated build-out is in 2014.
    - Two alternatives have also been proposed for emergency backup supply. The first alternative includes the construction of a water supply and treatment facility, to be funded by Flagler County. A second alternative would be the construction of a water supply and treatment facility, to be funded by an investor-owned utility.
  - Wastewater Supply
    - The two existing wastewater treatment plants in the Bulow Service Area have a combined maximum capacity of 0.088 MGD and are each comprised of an aeration tank and a chlorine disinfection tank. The effluent from the tanks is discharged into three percolation ponds.
    - A third aeration "package" plant is proposed to be completed with a maximum capacity of 0.083 MGD. This plant will have three aeration tanks, a chlorine tank and digester. Two additional percolation ponds will be constructed to handle the additional effluent.
    - The value established for the wastewater system is 240 gpd/ERC; with 2,570 proposed ERCs, the projected average daily wastewater flow is 0.62 MGD.
    - The first alternative with regards to wastewater includes the construction of a wastewater transmission system, treatment facilities, and a reuse water system to be funded by the County. A second alternative involves the same construction as the first alternative, except the facilities would be funded by investor-owned utilities.

  - Reuse Water
    - Flagler County is proposing to implement a reuse water system in the Bulow Service Area. Reuse water systems typically reduce potable water demand and wastewater effluent disposal requirements.
    - Preliminary irrigation demand values have been projected at 1.7 MGD for the Bulow Service Area.

- *Hunter's Ridge Water and Wastewater Master Plan, November 2005.*
  - This plan was prepared to determine the potable water, wastewater, and public access reuse water service requirements of the service area.
  - Water Supply
    - Hunter's Ridge Service Area (HRSA) currently receives its potable water supply, as well as its fire protection and irrigation supply, from the City of Ormond Beach. A future interconnection with the City system and the Flagler County facility is proposed.
    - The City's water treatment plant has a capacity of 8.0 MGD and the major processes utilized by this plant are aeration to remove volatile solids and the addition of lime for softening.
    - It is projected that, with the anticipated growth rate, ultimate build-out will be in 2016.
  - Wastewater Supply
    - The City of Ormond Beach operates the wastewater system for HRSA. The permitted capacity of the City's wastewater treatment plant (WWTP) is 6.0 MGD, based on average annual daily flow. The wastewater effluent is disposed of by either surface-water discharge or by land application. These disposal methods combine for a capacity of 11.0 MGD.
    - The 10-year master plan estimates 2,147 ERCs when projecting an average daily flow of 0.515 MGD and a LOS of 240 gpd/ERC.
  - Reuse Water
    - Currently the HRSA does not have a reuse water service, but Flagler County is proposing a reuse water system within HRSA North.

- *Regional Alternative Water Supply Plan Update Executive Summary, May 2006.*
  - The Executive Summary outlines Flagler County's regional alternative water supply plan which includes entities outside of the County's service areas. Flagler County has interlocal agreements with the City of Palm Coast, the City of Flagler Beach, the City of Bunnell, the City of Ormond Beach, and Volusia County. The interconnected system provides for both raw and potable water transfers as the need arises. Flagler County is currently having discussions with St. Johns County about a potential interconnection through the Town of Marineland.

- The County's alternative water supply program is focused on three primary sources of alternative water supply, including reclaimed water reuse, stormwater reuse, reverse osmosis from groundwater sources, and reject water from membrane technologies blended into reuse systems. Improvements are identified for the Beverly Beach Water and Wastewater System, Bulow Service Area, Hunter's Ridge MSTU/Service Area, Plantation Bay, and Special Water District #4 with a total capital cost estimate of $13,025,000.

Palm Coast

- *City of Palm Coast Water System Updated Capacity Analysis Report, August 2005.*
  - The City of Palm Coast currently operates two water treatment plants (WTPs). WTP No. 1 is a lime-softening treatment plant that has a permitted capacity of 6.0 MGD. WTP No. 2 is a membrane-softening plant with a permitted capacity of 6.384 MGD.
  - Proposed improvements to WTP No. 1 include adding additional wells and/or improving existing wells, improving the existing electrical system, and increasing the plant's high service pumping capacity.
  - In order to meet system water demands, WTP No. 2 needs to be expanded and WTP No. 3 will be constructed. By 2025, the water demand is projected to be 23 MGD; therefore, the future capacities for WTP No. 1, WTP No. 2, and WTP No. 3 will be 6.0 MGD, 9.576 MGD, and 9.0 MGD, respectively.

- *Wastewater Management System Facilities Plan, April 2004.*
  - Wastewater is collected from the City through gravity sewers, sanitary, and pretreatment effluent pumping (PEP) systems. The WWTP is an activated sludge facility with a permitted capacity of 4.0 MGD. Effluent disposal is through restricted access spray irrigation, rapid infiltration, and public access irrigation.
  - The WWTP capacity is proposed to be increased to 6.83 MGD to meet the immediate needs of the City. Future expansion, to begin in 2007, will increase the capacity again to 9.1 MGD.

- *Palm Coast Reuse Service Area Report, July 2005.*
  - The Reuse Service Area for Palm Coast covers the same land as the WWTP Service Area. Reuse demands depend on the weather; it is proposed to add portions of the Florida Light and Power right-of-way onto the irrigation system. The right-of-way will be irrigated during wet weather periods when reuse water demands decrease.
  - A preliminary investigation is underway to develop a non-potable Aquifer Storage and Recovery System (ASR). The ASR would store water during wet weather periods and distribute it during dry weather when reuse demands are increased.

SJRWMD Documents

- *2004 Interim Update to Special Publication SJ2000-SP1 District Water Supply Plan, 2004.*
    - The Interim Update identifies potential water supply development projects that were not identified in the District Water Supply Plan of 2000. The update includes the potential water supply development projects identified as of 2004 as a result of the East-Central Florida Water Supply Planning Initiative (ECFWSPI). There are no projects located in Flagler County identified in this document.

- *Affordability Analysis of Alternative Water Supply, February 2004.*
    - This analysis assists in identifying viable and affordable alternative water supply resources in order to allow the time necessary to bring an alternative water supply option into production. This Study was limited geographically to Seminole and Volusia Counties; however, it could prove beneficial to determine the size and cost of required surface-water treatment facilities, to determine the effect of the cost of surface water upon the cost of water at the retail level, and to assess the affordability of the increased cost of water at the retail level.

- *Environmental Evaluations for the Development of Minimum Flows and Levels for the St. Johns River Near DeLand at State Road 44, Volusia County, May 2003.*
    - This document provided an environmental assessment and determined whether the preliminary minimum flow and level (MFL) for the St. Johns River near DeLand at State Road 44 protects specified natural resource and environmental values.
    - The report concluded that the preliminary MFL for the St. Johns River near Deland will protect the natural resources and environmental values. These conclusions are made with varied degrees of certainty ranging from high to medium certainty.

- *District Water Supply Plan, 2005.*
    - The District Water Supply Plan (DWSP) identifies Flagler County as the fastest growing county in the nation (US Census Bureau 2005). Public supply in Flagler County is currently from fresh groundwater withdrawn from the surficial and Upper Floridan aquifers.
    - Public supply water use is projected to increase in the area by approximately 17.0 MGD or nearly 400%. This raises the 1995 average day demand of 4.4 MGD to 21.4 MGD in 2025. If these projected demands are withdrawn from the surficial and Floridan aquifers, it will likely result in unacceptable impacts to wetlands, lakes, and groundwater quality.
    - The 2025 projected wastewater flows in Flagler County are 22.98 MGD.

  - The *St. Johns River Near Lake George Project* was identified as a multi-jurisdictional project that could benefit the Flagler area. The following single entity projects in Flagler County were identified to achieve a water resource benefit using additional reclaimed water projected to be available in 2025:
    - *Dunes Community Development District Brackish Groundwater Project*
    - *Beverly Beach Integrated Reclaimed Water and Stormwater Reuse Project, Phase II*
    - *Flagler County Bulow Reclaimed Water System Project*
    - *Palm Coast Reclaimed Water System Expansion Project*
  - SJRWMD proposed to complete the steady-state version and the transient version of the Flagler/Palm Coast Subregional Groundwater Flow Model and simulate hydrologic conditions for water supply planning and water use permitting purposes.

- *Lower St. Johns River Salinity Regime Assessment: Effects of Upstream Flow Reduction near DeLand, July 2002.*
  - This document evaluates whether the preliminary minimum flows and levels established by the St. Johns River Water Management District for the St. Johns River near DeLand will provide protection to the estuarine resources, as required by Rule 62040.471(1)(c), Florida Administrative Code.
  - Based on the results of the salinity assessment in the Lower St. Johns River, the document suggests that the MFL regime recommended by SJRWMD *will* provide protection of the estuarine resources.

- *Population Projection Methodology of the SJRWMD's 2003 District Water Supply Assessment and 2005 District Water Supply Plan, 7 August 2003.*
  - The District's GIS-based model projects growth based on historical and spatial elements, growth calculations at the census block level, and aggregation to utility service areas and traffic analysis zones.
  - The population projections determined by the District are used as a part of the Flagler County Water Supply Plan.

- *SJRWMD Water Management Plan, 2005.*
  - Planning Years: 2005-2025
  - The purpose of this document is to provide long-term guidance for Water Management District activities and present a compilation of water resource information that forms the basis for water management. The Plan is to provide goals, issues, objectives, and strategies for the Water Management District areas of responsibilities, such as water supply, flood protection and floodplain management, water quality, and natural systems.

  - The plan offers direction on the regional water supply plans, water conservation, conservation rate structures, the use of reclaimed water, water shortage planning, and cost-effectiveness of water supply alternatives to ensure the availability of an adequate and affordable supply of water.

- *St. Johns River Water Supply Project: Literature Review of Surface Water Treatment Technologies, 2002.*
  - This Study quantifies the treatment requirements and costs for a potential surface-water treatment facility to be located along the reach of the St. Johns River between the southern end of Lake Monroe in Sanford and DeLand. Public supply utilities currently rely on groundwater source. Groundwater treatment requirements and technology differ significantly from that of surface-water treatment. This report provides a general overview and basic summary of the different types of treatment technology that could potentially be applied to a specific surface-water source. The report also references recent studies that are applicable to treatment of surface water from the St. Johns River.
  - The technologies described are coagulation and flocculation, clarification, filtration, membrane desalting, integrated membrane systems, and oxidation and disinfection.

- *Style Guide for Written Communication, 2001.*
  - This manual is a guide for the SJRWMD and its contractors in preparing reports for the District. This guide identifies correct grammar, punctuation, and word usage, and for consistency in documents. To be consistent with other SJRWMD water-supply planning efforts, this manual will be used as a guideline for all documents, graphs and figures for the Flagler County Water Supply Plan.

- *Technical Feasibility of Artificial Recharge of Reclaimed Wastewater and Its Hydrologic Impacts on the Regional Ground Water Systems, 2000.*
  - This study investigates the technical feasibility and hydrologic impacts of artificial recharge of reclaimed wastewater through rapid infiltration basins (RIBS) into the groundwater system. Twenty-one potential new RIB sites were identified within the study area, located in Seminole and Orange Counties. The study determined that up to 22.5 MGD of additional reclaimed water may be recharged. The study concluded that RIBs can increase the potentiometric surface elevations in the surficial aquifer and can also augment spring flow.

- *Technical Memorandum: Cost Estimating and Economic Criteria for 2005 District Water Supply Plan, 16 June 2004.*
  - This Technical Memorandum provides cost estimating and economic criteria to ensure that all costs are directly comparable. The criteria include: peak flow ratio, cost index, non-construction capital cost, land

cost, land acquisition cost, interest rate, economic life of facilities, and present worth. This document will be used as a guide for the Flagler County Water Supply Plan during the evaluation of the alternative water supply projects identified in the Plan to be consistent with the District's Water Supply Plan.

- *Technical Memorandum Financial Impact of Alternative Water Supply, 2005.*
  - This Technical Memorandum provides guidance regarding the determination of the cost of alternative water facilities for the typical utility evaluated.
  - The objective of this analysis was to determine the relative comparative impact of using an alternative water-supply source upon the cost of delivered potable water for typical local utilities in east/central Florida. The supply source evaluated was surface water from the St. Johns River. This report includes a projection of the cost of delivered water over a 20-year period. The report concludes that, by the end of the 20-year projection period, the impact of the cost of surface water as an alternative to groundwater will require cumulative rate increases to a high of about 135% compared to about 35% projected if groundwater were available throughout of the projection period.
  - The analysis did not focus on utilities specifically in Flagler County, but can serve as a guide for a typical moderate-sized water utility. Due to the effects of economies of scale, the impact of cost of alternative water facilities upon the cost of delivered water may be somewhat more for a smaller utility and somewhat less for a larger utility.

- *Water 2020 Constraints Handbook, September 1998.*
  - This document describes water resource constraints and defines thresholds (for planning purposes) beyond which unacceptable impacts to water quality and to wetland and aquatic systems are expected to occur. The water resource constraints reviewed in this document are minimum flows and levels, native wetland vegetation, and groundwater quality.

- *Water Supply Assessment, 2003.*
  - This document defines the limits and projects the water-resource impacts that could occur in 2025 as a result of projected changes in water use, and identifies priority water-resource caution areas (PWRCA).
  - The report identifies that some public water supply areas in Flagler County have a high likelihood of experiencing unacceptable impacts to groundwater quality.
  - Flagler County is projected to have a population increase from 1995 to 2025 of 257%. The percent change in 2025 projected total water use for an average rainfall year is 109%.
  - Flagler County is projected to have a decrease in domestic self-supply and small public supply systems.

  - The Flagler Beach wellfield is one of the twelve public supply wellfields with the highest likelihood of unacceptable impacts to groundwater quality (saltwater intrusion) due to projected groundwater withdrawals.

- *Water Supply Needs and Sources Assessment: Alternative Water Supply Strategies Investigation: Brackish Groundwater: Planning-level Cost Estimates, 2001.*
  - This report is the third in a series addressing the feasibility of developing brackish groundwater sources to help meet municipal water supply needs within the St. Johns River Water Management District, and presents a cost analysis. Cost equations were developed to be used as the basis for estimating the cost of brackish groundwater supply evaluations. There were no brackish groundwater withdrawal sites located in Flagler County identified in this document. The sites selected were based on relative water supply development potential and proximity to demand centers.

- *Water Supply Needs and Sources Assessment: Alternative Water Supply Strategies Investigation: Brackish Groundwater: Source Identification and Assessment, 2001.*
  - This document addresses the availability of lower-quality or brackish groundwater as an alternative water supply source within the priority water-resource caution areas of the St. Johns River Water Management District. This is the first in a series addressing the feasibility of developing brackish groundwater supplies to augment existing and future public water supply needs. Each site was analyzed to identify long-term changes in water quality due to pumping.

APPENDIX B

Technical Memorandum Task C
Data Collection, Compilation and Reduction

Task C: Data Collection, Compilation, and Reduction

Technical Memorandum

For The

Flagler County Water Supply Plan

By

ARCADIS U.S., Inc.
4307 Vineland Road H-20
Orlando, Florida

November 2006

Table of Contents

INTRODUCTION

Background

Flagler County and surrounding areas are experiencing rapid development and population growth that have led to increased demands on water resources and the related natural environment. The St. Johns River Water Management District (SJRWMD) indicates that traditional groundwater supplies will not be adequate to provide for future demands in many areas of Flagler County, and that alternative sources will be required.

SJRWMD in conjunction with Flagler County, the municipalities of Bunnell, Flagler Beach, Palm Coast, the Town of Beverly Beach, Marineland and the Dunes Community Development District (Cooperators) entered into a Memorandum of Understanding to develop the Flagler County Water Supply Plan. ARCADIS was contracted to prepare the Plan and coordinate with the Cooperators to ensure that future demands are met while preserving and protecting environmental resources.

This document represents the deliverable under "Task C: Data Collection, Compilation, and Reduction of Exhibit "B" Statement of Work in the contract between St. Johns River Water Management District dated January 16, 2006."

Scope of Services

The project team developed this document and an associated database to fulfill the requirements of Task C of the Scope of Services for development of the Flagler County Water Supply Plan. This task requires the following deliverables:

- Summary of present water resources (water and wastewater) and identified future supply in a GIS format and Access database
- A technical memo summarizing the relevant sections of the District's Water Supply Assessment Report data for Flagler County and any recommended changes
- Tabulation of confirmed population and demand projections in a GIS format and Access database

In addition, this task requires:

- Compilation of present and future water sources and their treatment requirements, including surface water, groundwater, stormwater, wastewater, and reclaimed water throughout the County; and amount, reliability, and cost for each source. Actual capacity, permitted capacity and long-term planned capacity have been included to the extent the information was available;

- Use of GIS to identify each source of supply and its level of treatment in the study area through the creation of an interactive database and maps;

- Review of the District's Water Supply Assessment Report data, including projected demands and permitted users, and recommend any updates and/or changes;

- Compilation of consumptive water use permit information in GIS format in order to identify the relationship between water supply and water demand;

- Tabulation, correlation and adjustment as necessary of existing population and water demand projections through 2025 using data from the Cooperators. Data will be confirmed by comparing SJRWMD demand projections with projections of each of the Cooperators;

- A composite map of water lines, reuse lines, and interconnects, based on existing information. Viable locations for bulk and centralized delivery will also be identified; and

- Collect data regarding intercounty water use (source in one county; use in another county).

In the following sections, this technical memorandum discusses the content of the database and how it was compiled. This information is presented in the following sections.

- Summary of SJRWMD Water Supply Assessment Report

- Data Collection

- Content of the Database

- GIS Data Compilation

- User's Guide

SJRWMD WATER SUPPLY ASSESSMENT REPORT SUMMARY

SJRWMD prepared a Water Supply Assessment (2003) for the purpose of identifying future water supply needs. Water supply plans are developed by SJRWMD to assure adequate water supply will be available to meet future water supply needs without impacting any priority water resource caution areas (PWRCA).

Although the District Water Supply Assessment Report encompasses all counties in the District, our current focus is on Flagler County. The report identified some public water supply service areas in Flagler County that have a high likelihood of experiencing unacceptable impacts to groundwater quality. Other issues addressed in the report are summarized below.

- Future water use and population projections in Flagler County were tabulated; both are expected to increase dramatically through 2025.
    - Future public supply water use is anticipated to increase by 387% [(21.44-4.4)/4.4] between 1995 and 2025, based on average rainfall conditions.
    - Population is expected to increase by 257% [(140,200-39,267)/39,267] between 1995 and 2025.
- 2025 water use projections (in million gallons per day) were based on the water supply data, separated by supply type, provided in Table 1 at the end of this document.
- Hydrologic impact assessments were performed to estimate impacts from the projected 2025 water use on both surface-water and groundwater resources.
    - These impacts include the decrease in elevation of the potentiometric surface of the Floridan Aquifer.
    - Potentiometric surface elevation is projected to decline up to 10 feet in Flagler County due to groundwater withdrawals.
    - Projected water levels in the surficial aquifer system could decline up to 2.5 feet.
- SJRWMD has identified Flagler County as a PWRCA based on projected water use and groundwater and surface-water assessments. PWRCA are areas where existing and anticipated sources of water may not be capable of supplying water for all uses through 2025.
- Additional data collection by SJRWMD is recommended in order to provide better evaluation of potential future water resource problems. Additional relevant data include:
    - Reuse data and areas of applied reuse
    - Actual golf course water use data
    - Agriculture trend data for specific crops and counties
    - Development of Agricultural Field Scale Irrigation Requirements Simulations (AFSIRS) crop model
    - Transient groundwater monitoring investigations
    - Water quality monitoring investigations
    - Improved groundwater quality data
    - Residential irrigation data

Task C requires that ARCADIS should include in the memorandum any recommended changes or updates to data in the Water Supply Assessment Report. Limited data provided to date (primarily only population projections for the City of Palm Coast and limited water demand data from the Cooperators) are nearly identical to that provided by SJRWMD. Therefore, no changes or updates are recommended at this time. ARCADIS will continue to identify and seek additional data and recommend changes and/or updates as warranted.

DATA COLLECTION PROCESS

A data request was sent to SJRWMD on April 5, 2006. ARCADIS has continually worked with the SJRWMD to collect additional information as needed. Water and wastewater treatment facility information was collected from the FDEP website. Copies of the available wastewater treatment plant permits also were provided by FDEP.

An initial data request was sent to the Cooperators on June 13, 2006. ARCADIS requested that the data be provided in georeferenced ESRI-shapefiles and/or georeferenced AutoCAD files where possible. ESRI is the GIS and mapping software. A general list of the requested information follows:

- Demand Projections
- Master Plans
- Water Treatment Plant Data
- Wastewater Treatment Plant Data
- Service Area Maps and Utility Main Locations
- Septic Areas
- Reclaimed Water Users
- Water Supply Sources

ARCADIS requested that information be submitted by June 23, 2006.

Of the seven Cooperators, only the City of Palm Coast has submitted the complete data requested by ARCADIS, which was received on June 23, 2006. The GIS data received by ARCADIS was also incomplete due to the lack of information provided by the Cooperators. The attached Table 4 indicates the data provided and the remaining data gaps. Critical data needs are listed.

ARCADIS will continue to collect and compile data as they are made available.

CONTENT OF THE DATABASE

This section summarizes all data collected from the Cooperators, FDEP, and SJRWMD. The database was compiled using the information collected and organized into four sections.

- Wastewater Treatment/Reclaimed Water
- Water Supply
- Status of Consumptive Use Permits (CUPs)
- Demand Projections

The wastewater treatment plant Access database is provided in Appendix A and the water treatment plant Access database is provided in Appendix B.

Wastewater Treatment/Reclaimed Water

The information collected by the project team and entered into the database regarding wastewater treatment and reclaimed water includes:

1. General Information
    a. Name of wastewater treatment plant (WWTP);
    b. FDEP identified WWTP ID;
    c. Owner and address of facility;
    d. Location by latitude and longitude;
    e. Treatment process;
    f. Effluent quality.
2. Permit Information
    a. Permitted capacity, mgd;
    b. Current average daily flow (ADF), mgd;
    c. Permit status;

d. Other conditions relating to storage or reuse;

e. Planned capacity.

3. Reclaimed Water

    a. Total effluent disposal capacity available for reuse; and

    b. Rapid Infiltration Basins (RIBs) including WWTP, location in latitude and longitude, permitted capacity, and current flow.

This information was collected from FDEP primarily.

Water Supply

The information collected by the project team and entered into the database regarding water supply includes:

1. Name of water treatment plant (WTP);
2. FDEP identified WTP ID;
3. Owner and address of facility;
4. Location by latitude and longitude;
5. Water source;
6. Treatment process;
7. Permitted capacity, current flow, total well capacity, total storage capacity, future planned capacity; and
8. Permit status.

This information was obtained from FDEP primarily, with supplemental information from the Cooperators.

Status of Consumptive Use Permits

All domestic supply consumptive water use permits in Flagler County in excess of 100,000 gallons per day (gpd) were entered in the database. An estimate of the domestic water use for all groundwater users below the 100,000 gpd threshold was calculated and entered as “Small Utilities”. The information collected by the project team and entered into the database regarding the consumptive use permits are:

1. CUP name;
2. CUP number;
3. Water source and aquifer;
4. Permitted allocation; and
5. Expiration date.

This information was gathered primarily from the SJRWMD and the Cooperators.

Demand Projections

The information collected by the project team and entered into the database regarding the 2005 through 2025 demand projections are:

1. Potable water projections;
2. Reuse water projections;
3. Wastewater flow projections; and
4. Population projections.

Information provided by SJRWMD as well as information obtained from the Cooperators was entered into the database. SJRWMD provided potable water and population projections, which will be reviewed and compared to the projections received from each Cooperator. Currently, ARCADIS has received population projections from the City of Palm Coast and potable water demand projections from the City of Palm Coast, Dunes Community Development District (DCDD) and Flagler County. These projections are provided in Tables 2 and 3 at the end of this document. Reuse water and wastewater flow projections through 2025 were also requested from the Cooperators.

Water Use Outside of Flagler County

Information has been collected regarding water use outside of Flagler County that is impacting the County. SJRWMD has provided information for Hunter's Ridge wells supporting Ormond Beach and Plantation Bay wells supplying Volusia County. Population and water demand projections for both Hunter's Ridge and Plantation Bay are included in Tables 2 and 3.

GIS DATA COMPILATION

This section summarizes the methodology of the compilation of the GIS database. It also describes the data collection, data processing, spatial analysis, and data review quality assurance/quality control (QA/QC) procedures.

1. Data Collection

   The utility data were provided in varying formats.

   a. AutoCAD, DXF or DWG format

      A number of methods were used to make the AutoCAD data usable in a GIS format.

      - If the file was properly spatially referenced, it was imported directly into a single central ESRI personal geodatabase, based on layer selection criteria for individual features (i.e. sewer lines, sewer valves, water lines, water valves).

      - AutoCAD data that were not spatially referenced were reprocessed and exported out to ESRI shapefiles. The shapefiles were then loaded into a single central ESRI personal geodatabase.

   b. ESRI personal geodatabase or shapefiles.

      - Data received in an ESRI format required minimal processing and were loaded into a single central ESRI personal geodatabase.

   c. Microsoft Access and Excel tables

      Data received in these formats were typically handled by one of two methods.

      - If the data contained coordinate information, an event feature class was created using the coordinates and loaded into the common ESRI personal geodatabase.

      - If data contained an address, it was geocoded to produce a feature class of points, which was then loaded into the common ESRI personal geodatabase.

   d. Other GIS Data such as city boundaries, service areas, lakes, rivers, wetlands, agricultural land, conservation lands, resource protection areas, population, land use, and zoning, etc. were collected and loaded into the common ESRI personal geodatabase.

2. Data Processing

    a. Data that was loaded to the common ESRI personal geodatabase was translated into a common coordinate system.

    b. The ESRI ArcGIS Utilities data models were set up in the common ESRI personal geodatabase.

        - Data that were loaded into the common ESRI personal geodatabase was analyzed to determine if redundant or missing data existed. Much of the data received had incomplete information (i.e. line attributes, valve types, etc).

        - After combining and/or deleting redundant columns in the database, data from the various Cooperators was loaded into the ArcGIS data models.

        - After data were loaded into the data model, a geometric network was generated to check for spatial integrity of features. Errors noted were corrected.

3. Data Review QA/QC

    The Cooperators will be provided with a scaled-down version of the data for consistency review. Data will be provided in digital map format using ESRI ArcReader. The Palm Coast water service area boundary provided by SJRWMD varied considerably compared to the water service area provided by the City of Palm Coast. Both service areas are shown in the GIS database for comparative purposes.

    a. ArcReader was chosen because it is free, easy to use, and allows one to browse, zoom, print, and query data.

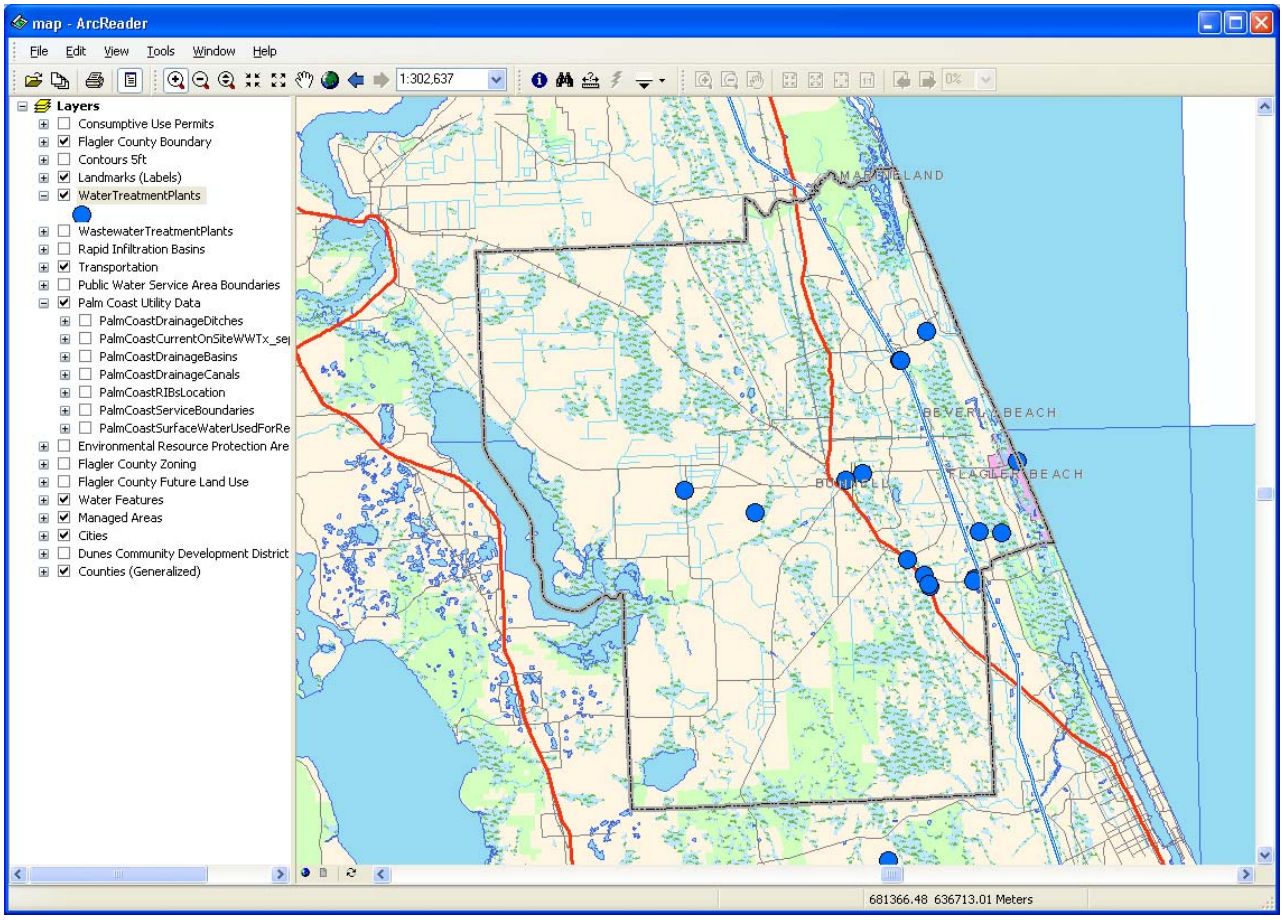
USER'S GUIDE

The steps below outline how to access the GIS database file and view the various aspects of the database.

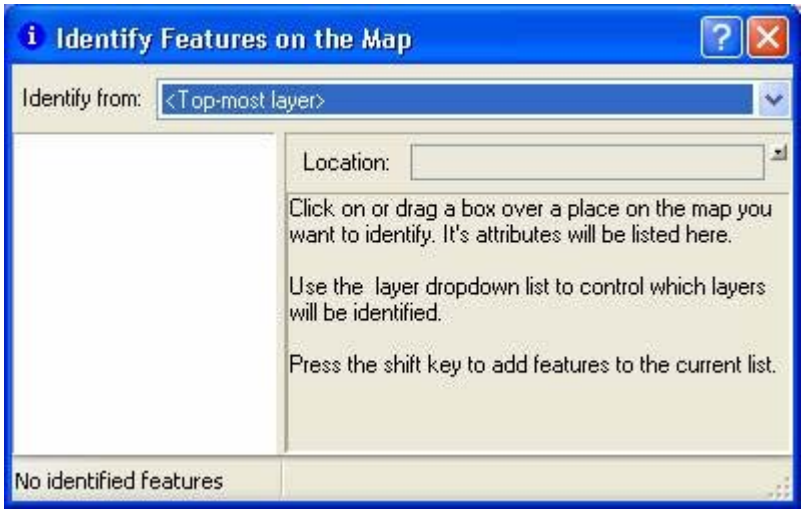
1. First, if not already installed, install ArcReader. To do this, navigate to the "ArcReader 9.1" folder on the CD-ROM drive. Double-click the "Setup.msi" file and follow the instructions on the screen.

2. After ArcReader is installed, the map file can be launched by navigation to the "Maps" folder and then to the "pmf" folder on the CD-ROM drive. Double-click on the "map.pmf" file to open the map in ArcReader.

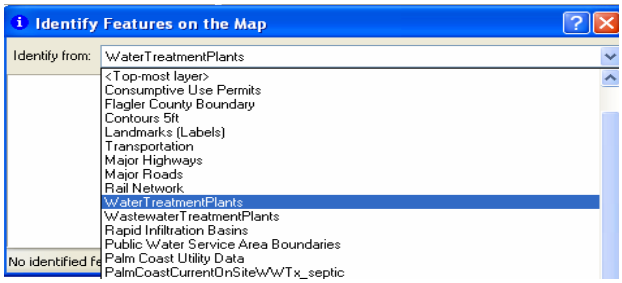
3. To view detailed information, click the box next to "Water Treatment Plants" to check it and make it visible.



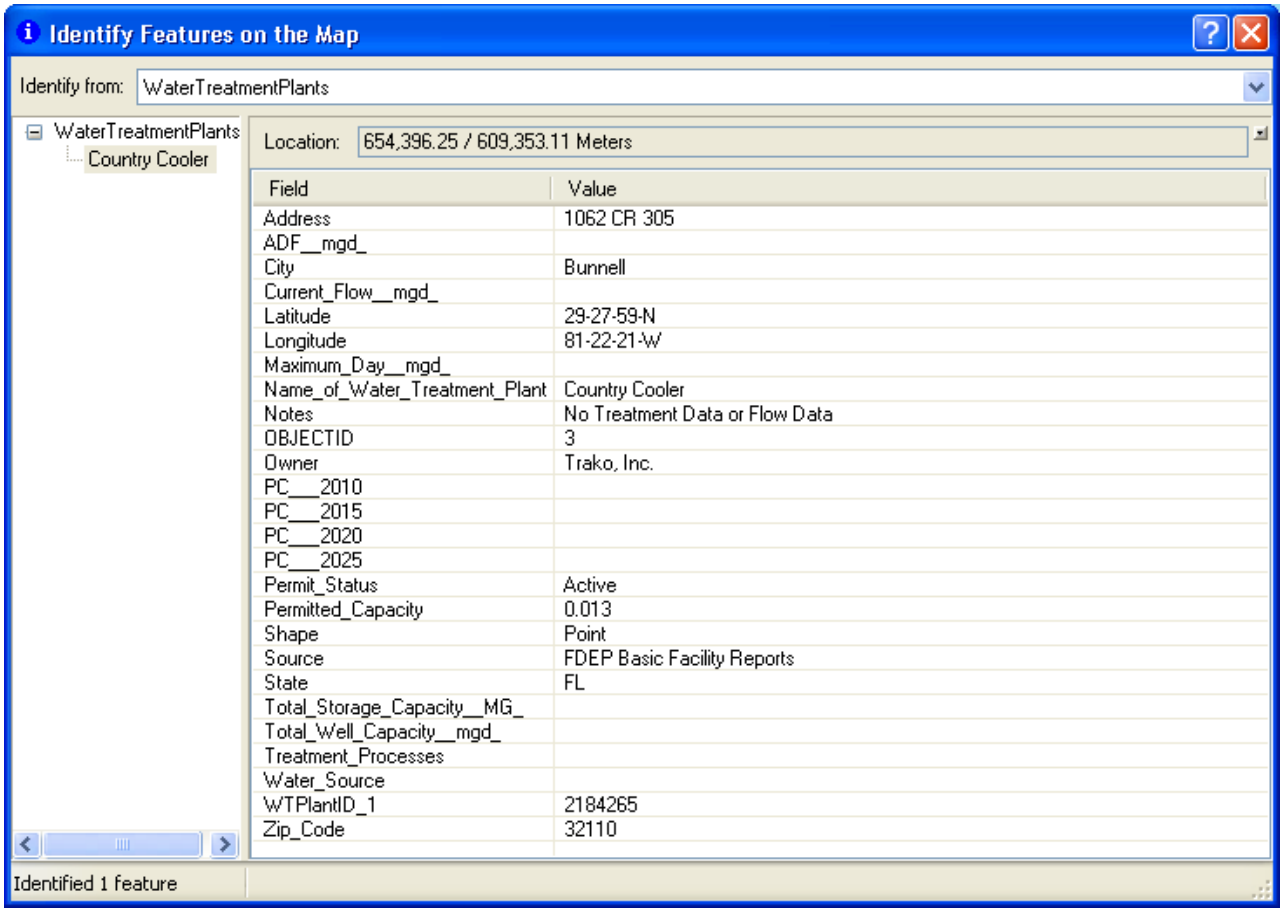
4. Next, click on the “Identify” button; it looks like the letter “I” in a blue circle toward the middle of the toolbar. A new dialog box will appear in the format below:



5. Select “Water Treatment Plants” from the “Identify From” pick list:



6. Now click on the water treatment plant that you want to see and all of the associated information should appear:



The same process can be repeated for any layer in the map.

TABLES

Table 1: Flagler County Water Supply Summary

Water Supply	1995	2000	2025
Public Water Supply	4.40	5.94	21.44
Domestic Self-Supply	1.19	0.83	0.78
Agricultural Self-Supply	8.93	15.70	7.56
Recreational Self-Supply	1.22	5.34	2.79
Commercial/Institutional Self-Supply	0.18	0.27	0.72
Thermoelectric Self-Supply	0.00	0.00	0.00
TOTAL	**15.92**	**28.08**	**33.29**

Source: Water Supply Assessment Report 2003, SJRWMD

Quantities in "million gallons per day" (mgd).

Table 2: Population Projection Comparison

	SJRWMD					% Increase	Cooperator					% Increase	2025 Difference (Coop. - SJRWMD)	Total 2025 Population [1]
Utility	2005	2010	2015	2020	2025	2005 - 2025	2005	2010	2015	2020	2025	2005 - 2025		
City of Bunnell	2,253	3,201	3,877	3,899	3,921	74	-	-	-	-	-	-	-	3,921
City of Flagler Beach	5,559	6,054	6,489	6,895	7,305	31	-	-	-	-	-	-	-	7,305
City of Palm Coast [2]	52,516	68,263	84,581	102,135	122,853	134	53,089	68,278	84,356	102,220	122,110	130	-743	122,110
Dunes Community Development District	978	1,384	1,784	2,202	2,577	163	-	-	-	-	-	-	-	2,577
Plantation Bay	658	692	724	742	764	16	-	-	-	-	-	-	-	-
Flagler County - Bulow Village Campground	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flagler County - Hunter's Ridge	0	465	1,698	3,407	3,492	-	-	-	-	-	-	-	-	3,492
Marineland	15	164	318	325	325	2,067	-	-	-	-	-	-	-	325
Town of Beverly Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUB-TOTAL	**61,979**	**80,223**	**99,471**	**119,605**	**141,237**	**128**	**53,089**	**68,278**	**84,356**	**102,220**	**122,110**	**130**	**-743**	**139,730**
Domestic Self Supply and Utilities <0.1 mgd	6,256	6,924	7,141	7,357	7,574	-	-	-	-	-	-	-	-	7,574
TOTAL	**68,235**	**87,147**	**106,612**	**126,962**	**148,811**	**118**	**53,089**	**68,278**	**84,356**	**102,220**	**122,110**	**130**	**-743**	**147,304**

Notes:

1. If Cooperator projections were not provided, the Total 2025 Population is equal to the SJRWMD projection.
2. Palm Coast service area includes portions of unincorporated Flagler County

Table 3: Potable Water Demand Projection Comparison

	SJRWMD					% Increase	COOPERATOR					% Increase	2025 Difference (Coop. - SJRWMD)	Total 2025 Water Demand [1]
Utility	**2005**	**2010**	**2015**	**2020**	**2025**	**2005 - 2025**	**2005**	**2010**	**2015**	**2020**	**2025**	**2005 - 2025**		
City of Bunnell	0.28	0.45	0.58	0.59	0.59	111	-	-	-	-	-	-	-	0.59
City of Flagler Beach	0.82	0.90	0.96	1.02	1.08	32	-	-	-	-	-	-	-	1.08
City of Palm Coast [2]	7.46	9.93	12.53	15.35	18.64	150	7.27	8.65	10.67	13.02	15.71	116	-2.93	15.71
Dunes Community Development District	0.26	0.36	0.47	0.58	0.68	162	0.00	0.71	0.89	0.98	1.02	-	0.34	1.02
Plantation Bay	0.08	0.09	0.09	0.09	0.10	25	-	-	-	-	-	-	-	0.10
Flagler County - Bulow Village Campground [3]	-	-	-	-	-	-	0.32	0.47	0.57	0.57	0.57	76	-	0.57
Flagler County - Hunter's Ridge [3]	0.00	0.06	0.22	0.44	0.45	-	0.15	0.23	0.41	0.64	0.64	316	0.19	0.64
Marineland	0.00	0.02	0.04	0.04	0.04	-	-	-	-	-	-	-	-	0.04
Town of Beverly Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUB-TOTAL	**8.90**	**11.81**	**14.89**	**18.11**	**21.58**	**142**	**7.75**	**10.06**	**12.53**	**15.22**	**17.94**	**131**	**-2.40**	**19.75**
Domestic Self Supply and Utilities <0.1 mgd	0.53	0.58	0.60	0.62	0.64	-	-	-	-	-	-	-	-	0.64
TOTAL	**9.43**	**12.39**	**15.49**	**18.73**	**22.22**	**136**	**7.75**	**10.06**	**12.53**	**15.22**	**17.94**	**131**	**-2.40**	**20.39**

Notes:

1. If Cooperator projections were not provided, the Total 2025 Water Demand is equal to the SJRWMD projection.

2. Palm Coast service area includes portions of unincorporated Flagler County

Table 4: Flagler County Data Needs

	City of Bunnell	City of Flagler Beach	City of Palm Coast	DCDD	Flagler County	Marineland	Town of Beverly Beach
Data Requested	**Data Received**						
Population Projections for Water Service Areas			x				
Population Projections for Sewer Service Areas			x				
Potable Water Demand Projections by Service Area			x	x	x		
Reclaimed Water Demand Projections by Service Area			x				
Potable System Infrastructure			x				
Wastewater System Infrastructure			x				
Reclaimed System Infrastructure			x				
Potable System Interconnects			x				
Wastewater System Interconnects			x				
Reclamed System Interconnects			x				

APPENDIX A

Wastewater Treatment Plant Reports

Wastewater Treatment Plant: Beverly Beach Wastewater Treatment Facility

Plant ID: FL0039756

General Information

Owner

Address 217 Starboard Drive

City Beverly Beach

Latitude 29-31-08-N

Longitude 81-09-00-W

Treatment Process Activated Sludge Process Followed By Secondary Clarifiers, Sand Filters, Chlorine Disinfections, And Dechlorination Prior To Discharge. Sludge Residuals Are Treated By Aerobic Digestion And Disposed Of By Land Application.

Permitted Capacity (mgd) 0.099

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

Reclaimed Water User Shelter Cove

Permitted Capacity (mgd) 0.069

Current Flow (mgd):

Notes

Latitude 29-31-08-N

Longitude 81-09-00-W

Reclaimed Water User Surfside Estates

Permitted Capacity (mgd) 0.061

Current Flow (mgd):

Notes

Latitude 29-31-08-N

Longitude 81-09-00-W

Wastewater Treatment Plant: Bunnell Wastewater Treatment Facility

Plant ID: FL0020907

General Information

Owner

Address Tolman Street

City Bunnell

Latitude 29-27-39-N

Longitude 81-15-49-W

Treatment Process Activated Sludge Sewage Treatment Plant With Effluent To Polishing Pond To Canal

Permitted Capacity (mgd) 0.3

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

Reclaimed Water User Austin Outdoors Nursery

Permitted Capacity (mgd) 0.1

Current Flow (mgd):

Notes

Latitude 29-27-39-N

Longitude 81-15-49-W

Reclaimed Water User Oak Branch Golf Course and Residential Development

Permitted Capacity (mgd) 0.5

Current Flow (mgd):

Notes

Latitude 29-27-39-N

Longitude 81-15-49-W

Wastewater Treatment Plant: Dunes Community District WWTF

Plant ID: FLA011602

General Information

Owner

Address 101 Jungle Hut Road

City Palm Coast

Latitude 29-36-04-N

Longitude 81-11-10-W

Treatment Process Sequential Batch Reactor (SBR) Activated Sludge Wastewater Treatment Facility With High Level Disinfection. The Facility Consists Of An Influent Pump Station, A Mechanical Screen And A Manual Bar Rack, Two 0.125-Mgd And One 0.25-Mgd Treatment Capacity Continuous Feed SBR Basins, Three Filter Units, Three Chlorine Contact Chambers, A Three-Basin Aerobic Digester, And Sludge Drying Beds. The Palm Coast WWTF Is Introduced Into The Facility For Filtration And High Level Disinfection.

Permitted Capacity (mgd) 0.5

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

Reclaimed Water User Dunes Residential Service Area

Permitted Capacity (mgd) 1

Current Flow (mgd):

Notes

Latitude

Longitude

Reclaimed Water User Hammock Dunes Golf Course

Permitted Capacity (mgd) 0.35

Current Flow (mgd):

Notes

Latitude 29-36-04-N

Longitude 81-11-10-W

Reclaimed Water User Ocean Hammock Golf Course

Permitted Capacity (mgd) 0.75

Current Flow (mgd):

Notes

Latitude 29-36-04-N

Longitude 81-11-10-W

Wastewater Treatment Plant: Flagler Beach WWTF

Plant ID: FL0026611

General Information

Owner		***Latitude***	29-28-20-N
Address	2000 Avenue A	***Longitude***	81-08-33-W
City	Flagler Beach		

Treatment Process WWTF Consisting Of An Influent Structure, Manually Cleaned Bar Screen, One Oxidation Ditch, One Secondary Clarifier, One Chlorine Contact Chamber, One Dechlorination Chamber, One Sludge Holding Tank, Eight Sludge Drying Beds, And One Parshall Flume Effluent Flow Meter. The Final Effluent Is Discharged To The Intracoastal Waterway.

Permitted Capacity (mgd) 1

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

Wastewater Treatment Plant: Matanzas Shores WWTF

Plant ID: FLA011599

General Information

Owner

Address 66 San Juan Drive

City Palm Coast

Latitude 29-39-6-N

Longitude 81-12-39-W

Treatment Process Extended Aeration Activated Sludge WWTF. The Facility Consists Of One Aeration Basin, One Clarifier, One Chlorine Contact Chamber, One Effluent Pumping Station, And One Digester. The Effluent Is Discharged To Three Percolation Ponds.

Permitted Capacity (mgd) 0.322

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

RIBs Rapid Inflitration Basin R-001

Permitted Capacity (mgd) 0.322

Current Flow (mgd)

Notes

Latitude 29-39-6-N

Longitude 81-12-39-W

Wastewater Treatment Plant: Matanzas Shores WWTF

Plant ID: FLA011599

General Information

Owner		***Latitude***	29-39-6-N
Address	66 San Juan Drive	***Longitude***	81-12-39-W
City	Palm Coast		

Treatment Process Extended Aeration Activated Sludge WWTF. The Facility Consists Of One Aeration Basin, One Clarifier, One Chlorine Contact Chamber, One Effluent Pumping Station, And One Digester. The Effluent Is Discharged To Three Percolation Ponds.

Permitted Capacity (mgd)	0.322	***Planned Capacity***	
Average Flow (mgd)		***2010***	
Permit Status	Active	***2015***	
Other Conditions Relating to Reuse		***2020***	
		2025	

Effluent Disposal Available

Permitted Capacity (mgd)	1.7
Current Total Reclaimed Flow (mgd)	0.54

Wastewater Treatment Plant: Palm Coast WWTF

Plant ID: FL0116009

General Information

Owner

Address 26 Utility Drive

City Palm Coast

Latitude 29-32-58-N

Longitude 81-12-25-W

Treatment Process AADF Activated Sludge WWTF Effluent After Final Treatment To Land Application (Part Ii, Part Iv, Part Iii {After Getting Additional Treatment At Grand Haven & Hammock Dunes}) The Residuals Are Transported To Lake Monroe Rmf. Effluent Is Also Limited Wet Weather Discharge

Permitted Capacity (mgd) 4.55

Average Flow (mgd)

Permit Status Active

Other Conditions Relating to Reuse

Planned Capacity

2010

2015

2020

2025

Effluent Disposal Available

Permitted Capacity (mgd) 4.43

Current Total Reclaimed Flow (mgd) 3.35

Reclaimed Water User Grand Haven

Permitted Capacity (mgd) 1

Current Flow (mgd)

Notes

Latitude

Longitude

Wastewater Treatment Plant: Plantation Bay WWTF

Plant ID: FLA011597

General Information

Owner		***Latitude***	29-24-05-N
Address	Old Dixie Highway, west of I-95	***Longitude***	81-10-23-W
City	Ormond Beach		

Treatment Process Extended Aeration Sewage Treatment Plant With Effluent To Golf Course Sprayfield

Permitted Capacity (mgd)	0.475	***Planned Capacity***
Average Flow (mgd)		***2010***
Permit Status	Active	***2015***
Other Conditions Relating to Reuse		***2020***
		2025

Effluent Disposal Available

Permitted Capacity (mgd)	0.47
Current Total Reclaimed Flow (mgd)	0.12

APPENDIX B

Water Treatment Plant Reports

Water Treatment Plant: Beverly Beach Water System

Plant ID: 2180002

Owner	Flagler Board of County Commissioners	***Latitude***	29-28-48-N
Address	Post Office Box 1559	***Longitude***	81-07-38-W
City	Flagler Beach		

Water Source

Treatment Process

FDEP Permitted Plant Capacity (mgd)	0.15	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, Basic Facility Reports

Notes Insufficient Data

Water Treatment Plant: Bull Creek Fish Camp

Plant ID: 2184250

Owner	Charlie & Marjorie McCraney	***Latitude***	29-27-04-N
Address	Post Office Box 313	***Longitude***	81-19-17-W
City	Bunnell		

Water Source

Treatment Process Disinfect

FDEP Permitted Plant Capacity (mgd)	0.014	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source Treatment Data, Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Bulow Plantation

Plant ID: 2180132

Owner	Gatorland Vistas	***Latitude***	29-26-06-N
Address	2801 John Anderson Highway	***Longitude***	81-09-22-W
City	Flagler Beach		

Water Source

Treatment Process Disinfect, Taste/Odor Control

FDEP Permitted Plant Capacity (mgd)	0.273	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, Basic Facility Reports

Notes

Water Treatment Plant: Bulow Ruins State Hist. Site

Plant ID: 2180133

Owner	Dept. Environmental Protection	***Latitude***	29-26-03-N
Address	Post Office Box 655	***Longitude***	81-08-21-W
City	Bunnell		

Water Source

Treatment Process Disinfect, Soften

FDEP Permitted Plant Capacity (mgd)	0.021	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Bunnell Water Plant

Plant ID: 2180134

Owner	Lyndon L. Bonner	***Latitude***	29-28-27-N
Address	Post Office Box 756	***Longitude***	81-14-26-W
City	Bunnell		

Water Source

Treatment Process Disinfect, ParticleRemoval, Taste-odor Control, Soften

FDEP Permitted Plant Capacity (mgd)	0.698	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, FDEP Basic Facility Reports

Notes

Water Treatment Plant: Country Cooler

Plant ID: 2184265

Owner	Trako, Inc.	***Latitude***	29-27-59-N
Address	1062 CR 305	***Longitude***	81-22-21-W
City	Bunnell		

Water Source

Treatment Process

FDEP Permitted Plant Capacity (mgd)	0.013	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Basic Facility Reports

Notes No Treatment Data or Flow Data

Water Treatment Plant: Country Store

Plant ID: 2184257

Owner	Prindor Foods, Inc.	***Latitude***	29-28-14-N
Address	Post Office Box 1940	***Longitude***	81-15-13-W
City	Bunnell		

Water Source

Treatment Process Disinfect

FDEP Permitted Plant Capacity (mgd)	0.005	***Planned Capacity (mgd)***
Total Well Capacity (mgd)		***2010***
Current Flow (mgd)		***2015***
Permit Status	Active	***2020***
Total Storage Capacity (MG)		***2025***

Source FDEP Treatment Data, Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Coyote II

Plant ID: 2184256

Owner	Bob Davis	***Latitude***	
Address	Post Office Box 1416	***Longitude***	
City	Flagler Beach		

Water Source

Treatment Process Disinfect, Iron Removal

FDEP Permitted Plant Capacity (mgd)	0.021	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Treatment Data, Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Dunes Community Development District

Plant ID: 2184259

Owner	Dunes Community Development District	***Latitude***	29-33-55-W
Address	5000 Palm Parkway, SE	***Longitude***	81-11-28-N
City	Palm Coast		

Water Source

Treatment Process Disinfect

FDEP Permitted Plant Capacity (mgd)	0.494	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Treatment Data, Basic Facility Reports

Notes Insufficient Flow Data

Water Treatment Plant: Evershine Flagler

Plant ID: 2184255

Owner	Evershine Flagler, LLC	***Latitude***	29-24-02-N
Address	6701 US 1, South	***Longitude***	81-11-36-W
City	Bunnell		

Water Source

Treatment Process Disinfect

FDEP Permitted Plant Capacity (mgd)	0.028	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Treatment Data, Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Flagler Beach WTP

Plant ID: 2180349

Owner	City of Flagler Beach	***Latitude***	29-25-06-N
Address	Post Office Box 70	***Longitude***	81-12-33-W
City	Flagler Beach		

Water Source

Treatment Process Disinfect, Particle Removal, Soften

FDEP Permitted Plant Capacity (mgd)	1.08	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, FDEP Basic Facility Reports

Notes

Water Treatment Plant: Holiday Travel Park

Plant ID: 2181288

Owner	Holiday Travel Park, Inc.	***Latitude***	29-24-17-N
Address	2261 South Old Dixie Highway	***Longitude***	81-09-38-W
City	Bunnell		

Water Source

Treatment Process Disinfect, Taste-odor Control

FDEP Permitted Plant Capacity (mgd)	0.122	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, Basic Facility Reports

Notes

Water Treatment Plant: Palm Coast Utility - Lime Softening

Plant ID: 2180863-1

Owner	City of Palm Coast	***Latitude***	29-32-48-N
Address	2 Utility Drive	***Longitude***	81-12-42-W
City	Palm Coast		

Water Source

Treatment Process Lime Softening

FDEP Permitted Plant Capacity (mgd)	6	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, FDEP Basic Facility Report

Notes

Water Treatment Plant: Palm Coast Utility

Plant ID: 2180863-2

Owner	City of Palm Coast	***Latitude***	29-32-48-N
Address	2 Utility Drive	***Longitude***	81-12-41-W
City	Palm Coast		

Water Source

Treatment Process Membrane softening (RO)

FDEP Permitted Plant Capacity (mgd)	6.384	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow data, FDEP Basic Facility Reports

Notes

Water Treatment Plant: Plantation Bay WTP

Plant ID: 2184251

Owner	Plantation Bay Utility Company	***Latitude***	29-13-30-N
Address	100 Plantation Bay Drive	***Longitude***	81-13-42-W
City	Ormond Beach		

Water Source

Treatment Process Disinfect, Particle removal, Taste/Odor Control, Softening

FDEP Permitted Plant Capacity (mgd)	0.756	***Planned Capacity (mgd)***
Total Well Capacity (mgd)		***2010***
Current Flow (mgd)		***2015***
Permit Status	Active	***2020***
Total Storage Capacity (MG)		***2025***

Source FDEP Treatment Data, Basic Facility Reports

Notes

Water Treatment Plant: Plantation BP Station

Plant ID: 2184261

Owner	Paresh Pachigar	***Latitude***	29-24-14-N
Address	HCR Box 54-B	***Longitude***	81-09-39-W
City	Bunnell		

Water Source

Treatment Process Disinfect, Taste-odor Control

FDEP Permitted Plant Capacity (mgd)	0.021	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Treatment Data, Basic Facility Reports

Notes No Flow Data

Water Treatment Plant: Ponderosa MHP

Plant ID: 2184249

Owner	Guist Properties, Inc.	***Latitude***	29-24-08-N
Address	Star Route 122	***Longitude***	81-11-39-W
City	Bunnell		

Water Source

Treatment Process Disinfect

FDEP Permitted Plant Capacity (mgd)	0.036	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Flow Data, Basic Facility Reports

Notes

Water Treatment Plant: White Eagle Lounge

Plant ID: 2184252

Owner	Dave Zaslavsky	***Latitude***	29-24-30-N
Address	5533 South US Highway 1	***Longitude***	81-11-51-W
City	Bunnell		

Water Source

Treatment Process Disinfect, Softening, Iron Removal

FDEP Permitted Plant Capacity (mgd)	0.028	***Planned Capacity (mgd)***	
Total Well Capacity (mgd)		***2010***	
Current Flow (mgd)		***2015***	
Permit Status	Active	***2020***	
Total Storage Capacity (MG)		***2025***	

Source FDEP Treatment Data, Basic Facility Reports

Notes No Flow Data

APPENDIX C

Technical Memorandum Task D
Water Conservation and Reuse

Water Conservation and Reuse - Task D

For The

Flagler County Water Supply Plan

By

ARCADIS U.S., Inc.
4307 Vineland Road H-20
Orlando, Florida

Technical Memorandum

June 7, 2006

Table of Contents

SCOPE OF TECHNICAL MEMORANDUM

This Technical Memorandum addresses one of eight major tasks that will be completed in development of the Flagler County Water Supply Plan. Two of the elements considered within this task are water conservation and water reuse. Water conservation includes methods to reduce the amount of water used through enhancements in efficient use of water. Water reuse entails the capture of water discarded from one user for use by another. Water reuse involves the use of treated wastewater effluent as a resource for irrigation and other non-drinking water purposes.

The optimum use of water resources can reduce the need for future water supply source development and treatment facility construction. Therefore, efficient water use must be one of the first considerations when planning to meet future water demands.

Task D of the Flagler County Water Supply Plan includes:

- A description of each water conservation measure currently being implemented or scheduled for implementation by the Cooperators in Flagler County.
- Preparation of a Technical Memorandum identifying a summary of findings and recommendations for water conservation and reuse.

As part of Task D, ARCADIS conducted a workshop to help identify practical means of water conservation and reuse measures that may be implemented within Flagler County. This technical memorandum also serves as a summary of the strategies that were discussed at the workshop.

The information regarding specific strategies used by the Cooperators was provided by the Cooperators. We wish to thank the Cooperators for providing information regarding their specific programs.

WATER CONSERVATION AND REUSE WATER STRATEGIES

Cooperator Water Conservation and Reuse Water Strategies

Information was gathered from each of the Cooperators regarding current and proposed water conservation and reuse water measures. A data request was sent to each of the Cooperators requesting identification and a description of each specific strategy. The data request is presented in **Appendix A**. This section represents a summary of these strategies reported.

Table 1
Conservation Summary by Cooperator

Water Conservation and Reuse Water Strategies	City of Beverly Beach	City of Bunnell	Dunes Community Development District	City of Flagler Beach	Flagler County	City of Marineland	City of Palm Coast
Water Restrictions	•	•	•	•	•	•	•
Conservation Rate Structure			•		•		•
Meter Replacement Program					•		•
Low Volume Plumbing Programs					•	•	•
Audits			•		•		•
Reuse Water Program			•		•		•
Xeriscape™ Projects/Codes					•		•
Public Education/Outreach			•		•		•
Residential Plumbing Water Conservation							•
Shallow Irrigation Wells					•		
Individual Metering			•		•		
Storm water As Supplemental Fire Protection					•		
Pressure Regulation					•		

City of Beverly Beach

The City of Beverly Beach identified the following water conservation/ water reuse measures.

City of Bunnell

The City of Bunnell identified the following water conservation measures.

- Water Restriction Enforcement

A description of these measures is as follows:

1. **Water Restriction Enforcement**

    - (No other information was provided)

Dunes Community Development District

The Dunes Community Development District identified the following water conservation measures.

- Water Restrictions
- Conservation Rate Structure
- Audits
- Reuse Water Program
- Public Education/Outreach
- Individual Metering

A description of these measures is as follows:

1. **Water Restrictions**

    - According to the Dunes Community Development District's Irrigation Rules, watering is prohibited between the hours of 10 a.m. to 4 p.m., even addresses can water on Tuesdays, Thursdays, and Sundays; odd addresses can water on Mondays, Wednesdays, and Saturdays and watering of public medians.

2. **Conservation Rate Structure**

    - In June 2002, the Irrigation Rate Schedule of the Dunes Community Development District was changed. Changes that were made to the Community were as follows: a two-step rate structure was implemented and replaced the previous flat rate structure and all

irrigation water users were given a subclass based on their irrigable area.

3. **Audits**

   - The Community provides audits only for residential customers requesting the service.

4. **Reuse Water Program**

   - Approximately 99% of residential and golf course irrigation is supplied by reclaim water.

5. **Public Education/Outreach**

   - Dunes Community Development District has implemented a large number of public education tools. These include bill stuffers, special mailings, and other public service announcements to inform customers of water conservation.

   - The Community also gives public tours of their facilities and seek ideas from their employees to continue the public education of water conservation.

6. **Individual Metering**

   - The Dunes Community Development District is currently equipped with individual in-line disk flow meters. Master meters are limited to multi-family homes.

City of Flagler Beach

The City of Flagler Beach identified the following water conservation measures.

- Water Restrictions

A description of these measures is as follows:

1. **Water Restrictions**

   - (No other information was provided)

Flagler County

Flagler County identified the following water conservation measures.

- Water Restrictions and Enforcement
- Conservation Rate Structure
- Meter Replacement Program
- Low Volume Plumbing Programs
- Audits
- Reuse Water Program
- Xeriscape™/Irrigation
- Public Education/Outreach
- Shallow Irrigation Wells
- Individual Metering
- Pressure Regulations
- Storm Water as Supplemental Fire Protection

A description of these measures is as follows:

1. **Water Restrictions and Enforcement**

   - Irrigation restrictions have been implemented through the SJRWMD.

   - Overwatering has decreased and public awareness of water conservation has increased due to the implementation of the irrigation restrictions.

2. **Conservation Rate Structure**

   - In April 2006, the conservation rate structure in Flagler County was implemented. The cost of water and the equivalent ERC charge per meter size in Flagler County has been changed. The cost of water is currently $6.54/1000 gallons

3. **Meter Replacement Program**

   - The County provides replacement meters for any meters that are slow or non-responding in order to ensure proper accountability. This results in more accurate meter readings.

4. **Low Volume Plumbing Programs**

   - (No other information was provided.)

5. **Audits**

   - Water audits are expected to commence during the 2007 fiscal year by request of the County. Cooperative support with the Rural Water Association is anticipated.

6. **Reuse Water Program**

   - The County has a water reuse program that is largely used in the Beverly Beach area along with the Bulow service area. The reclaimed water is used primarily for irrigation purposes and is currently expanding throughout the County.

   - The reclaimed water reuse program incorporates stormwater reuse and treatment through biofiltration along with the limited supply of reclaimed water. The stormwater reuse program is used in coordination with the University of Florida Stormwater Management Academy.

   - Great successes of the water reuse program include: reuse water is adequate for irrigation, discharge no longer enters the Intercoastal Waterway, and wholesale costs are no longer an issue.

7. **Xeriscape™/Irrigation**

   - Flagler County sees a reduction of irrigation water demand with the use of this implemented program, Xeriscape, which promotes water wise landscaping.

   - Flagler County distributes literature from the district and AWWA to all utility customers informing them of the benefits of xeriscape landscaping.

8. **Public Education/Outreach**
   - The County has made available Water Conservation Education newsletters, flyers, and brochures. These materials are provided by the SJRWMD, AWWA, and RWA and are available at the Utilities Office.

9. Shallow Irrigation Wells

- Throughout the County, homeowners, HOA's, and POA's have implemented shallow irrigation wells. Positive results in water conservation included peak dampening on the system and more customers averaging a lower flow per customer.

10. Individual Metering

- Flagler County requires individual metering on behalf of the utility instead of the use of master meters.

- It has been shown that individual meters conserve a greater amount of water and will be reflected on the customer's water bill.

11. Pressure Regulations

- Flagler County has incorporated a pressure regulation system through system interconnections with pressure sustaining valves. In 2006, Flagler County entered an agreement with Volusia County to interconnect with their water systems. Interconnections with Flagler County and the City of Ormond Beach and with Flagler County and the City of Palm Coast, as well as others, have already been implemented.

- Because of these implementations, the County has seen a reduction in main/service break, a reduction in water loss, and a reduction in use per orifice over that duration of use.

- Pre-disaster mitigation measures, peak dampening, and more efficient capacity utilization are results of this program. Also during the first year in operation, the County saw an average ERC reduction of 403 gallons per month.

12. Stormwater as Supplemental Fire Protection

- The stormwater reuse program provides a great amount of irrigation quality water, a larger amount than from other sources, such as reclaimed water sources.

- The County provides stormwater as emergency protection. Instead of using the abundant ponds for fire service, the stormwater would minimize system fire demands. This program benefits both the customer and water conservation goals.

City of Marineland

The City of Marineland identified the following water conservation measures.

- Low Volume Plumbing Programs

Where provided, a description of these measures follows:

1. **Low Volume Plumbing Programs**

    - (No other information was provided)

City of Palm Coast

The City of Palm Coast identified the following water conservation measures.

- Water Restrictions and Enforcement
- Conservation Rate Structure
- Meter Replacement Program
- Low Volume Plumbing Fixture Programs
- Audits
- Reuse Water Program
- Xeriscape™/Irrigation
- Public Information/Outreach
- Residential Plumbing Water Conservation

A description of these measures is as follows:

1. **Water Restrictions and Enforcement**

    - The City of Palm Coast follows the watering restrictions recommended by SJRWMD and are listed in the city ordinance 2005-21 amending ordinance 2001-06.

    - Under the City of Palm Coast City Code, watering is prohibited between the hours of 10 a.m. to 4 p.m., even or no addresses can water on Thursdays and Sundays, odd addresses can water on Wednesdays and Saturdays and watering of public medians and right-of-ways are limited to Tuesdays and Fridays.

2. **Conservation Rate Structure**

   - A conservation rate structure was implemented in 2005 with changes in the rates of gallonage charges to domestic and irrigational water uses.

3. **Meter Replacement Program**

   - Individual meters are replacing master meters in the City of Palm Coast. Master metering is no longer allowed in the City without written approval from the City. Promotion of water conservation is achieved through more effective and accurate metering.

4. **Low Volume Plumbing Programs**

   - The City of Palm Coast is following the requirements of the Florida Building Code-Plumbing and the low volume plumbing programs have been in effect since 2005.

   - Table 604.4 of the Florida Building Code-Plumbing list the maximum flow rates allowable.

5. **Audits**

   - Irrigation system audits are used for high volume users and are sponsored by the SJRWMD under the Northeast Florida Irrigation Audits and Education Grant P037421.

   - 20 high volume users agreed to be audited, however, only 12 of the customers were available at the time of the audit.

   - The IRRI-SAVE program was distributed to the homeowners prior to the auditing process for educational purposes. Due to the IRRI-SAVE program, homeowners were educated and made water conservation changes for the better. The Audits increased consumer knowledge and increased water conservation.

   - Homeowners in the City who obtained audits found that the amount of water used on a daily basis was incorrect and quantities were changed in accordance with the City's desired limits.

6. **Reuse Water Program**

   - Two developments in the City have a combined total of 3.1 MGD permitted for reuse water. The wastewater treatment plant is currently expanding to add filtration and disinfection. This expansion will have the power to distribute water for irrigation purposes to any area with public access.

   - Developers are required to install reuse water lines; and customers are prohibited from irrigating with potable water when reclaimed water becomes available.

7. **Xeriscape™/Irrigation**

   - The City of Palm Coast is currently developing landscaping that incorporates Xeriscape. This demonstration will significantly increase public awareness.

8. **Public Information/Outreach**

   - The City promotes public awareness through water conservation education. The city distributes newsletters, brochures, and flyers.

   - Palm Coast recognizes April as Water Conservation Month and extends this knowledge to citizens through newspaper articles and water conservation materials displayed at the public library as well as the previously mentioned methods.

9. **Residential Plumbing Water Conservation**

   - The city is distributing Residential Plumbing Water Conservation Kits for $10, which includes one showerhead, bath and kitchen faucet aerators, one toilet tank bag, leak detection tablets, Teflon tape, and installation instructions.

   - This conservation method promotes public awareness to conserve water.

SJRWMD METHODOLOGIES USED TO DERIVE WATER SAVINGS AND COSTS FOR INDIVIDUAL CONSERVATION PRACTICES

SJRWMD is very adamant about water conservation strategies. The District has developed multiple strategies to save water in the District at little cost. Each of the water

conservation methods performed in Flagler County have had a large impact on water conservation in the County.

The water conservation methods are as follows:

- Water Restrictions
- Conservation Rate Structure
- Meter Replacement Program
- Individual Metering
- Low Volume Plumbing Programs
- Audits
- Reuse Water Program
- Xeriscape™/Irrigation
- Public Education/Outreach
- Residential Plumbing Water Conservation
- Shallow Irrigation Wells
- Stormwater as Supplemental Fire Protection
- Pressure Regulations

A description of these water and cost saving measures are as follows:

1. **Water Restrictions**

    - To achieve greater irrigation system efficiency, Flagler County, in accordance with SJRWMD, has made water restrictions mandatory throughout the County.
    - Encouraging better irrigation practices increases water savings. Typical existing irrigation systems only operate at between 25-50% efficiency. This leaves significant room for improvement. Since between forty and sixty percent of Florida's water supply is used for irrigation purposes, an increase in efficiency is indeed important.
    - For calculating irrigation water system efficiency savings, the following equation is used:
        - Water use = gpd of water use x .5 x .15 x .5
    - SJRWMD allots $200 per homeowner to replace their sprinkler system and to make minor repairs to their entire system. The calculation below shows the total cost of the project.
        - Cost of practice = dwelling units x .5 x $200
    - When irrigation is limited to two days per week, an additional 15% water savings is added.

2. **Conservation Rate Structure, Meter Replacement Program, Individual Metering**

    - These three water conservation measures are grouped together since they all relate to customer billing.
    - Water demand would be reduced by 5% on average with these implementations.
    - The following equations shows the amount of water saved:
        - Water saved = public water supply * .05

RESULTS AND RECOMMENDATIONS FOR IMPROVED EFFICIENCIES INCLUDING WATER CONSERVATION AND REUSE

To improve water use efficiencies it is necessary to implement certain water conservation measures. In a typical residential unit, an irrigation system is only about 40% efficient. If the better management and proper maintenance was implemented, water demand could be reduced by 15%. SJRWMD has agreed to allot $200 per household for additional upgrades such as sprinkler head replacement and minor adjustments. Table 5, Water Conservation Results, shows that if every household in its respective city in Flagler County were to upgrade their irrigation system, SJRWMD would spend $2,351,760. This would save 330,825 gallons per day by just making small changes. Allowing irrigation only two days per week saves an additional 15% of water. This change will save an overall 49,624 gpd.

By increasing the current rate structures, a significant decrease in water demand would result. The total amount of water saved would be 441,110 gpd. This would be at no cost to the City since it is assumed that they are associated with normal utility costs. With regards to water conservation, a strong argument can be made to implement these two measures. With a one time cost of $2,351,760 from SJRWMD, a significant amount of water is saved.

The cities of Beverly Beach, Bunnell, Flagler Beach, and Marineland could all include a conservation rate structure into their water conservation plan. At no cost to the City itself, thousands of gallons can be saved per day. An updated irrigation system would cost nothing to the City and again would save an enormous amount of water. Currently only the City of Palm Coast and Dunes Community Development District enforce the irrigation system limitation of 2 days of watering per week. To limit irrigation to two days per week can save 15% of water demand and should be implemented as well.

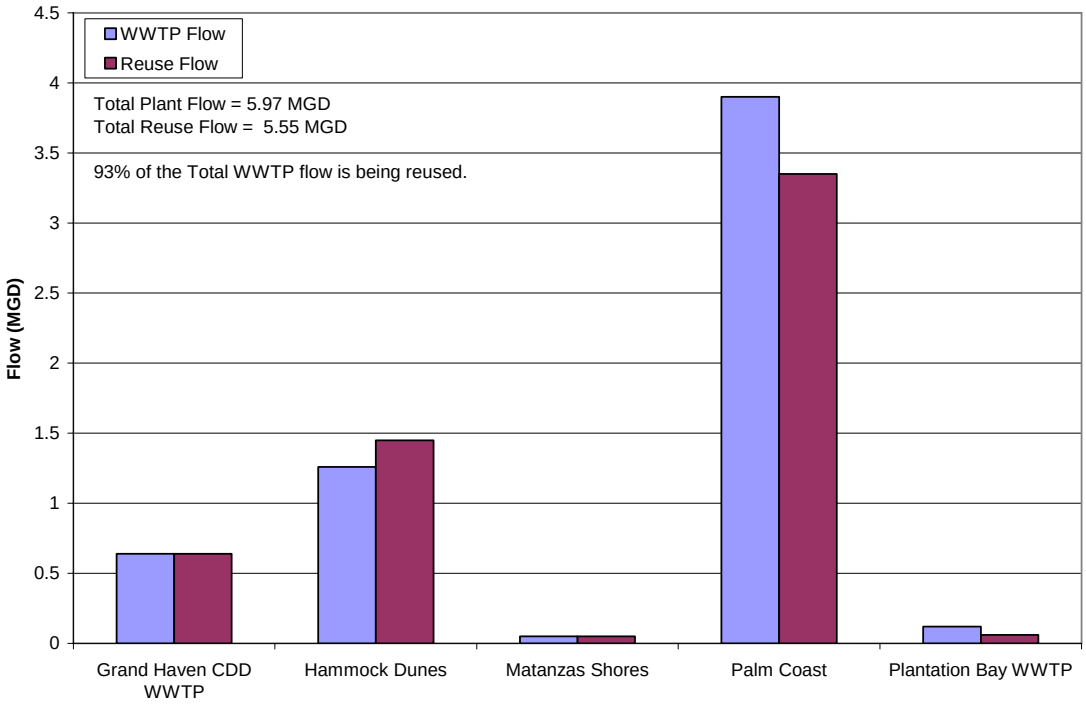
Table 2 Water Conservation Results

Conservation Practice	Indoor Existing Rate Structure		Outdoor Existing Irrigation System		Outdoor Existing Irrigation Limits	Totals	
City	gpd saved	cost	gpd saved	cost	gpd saved	gpd saved	cost
Beverly Beach	NA	$0	NA	$0	NA	NA	$0
Bunnell	14,000	$0	10,500	$90,120	1,575	26,075	$90,120
DCDD	13,000	$0	9,750	$39,120	1,463	24,213	$39,120
Flagler Beach	41,000	$0	30,750	$222,360	4,613	76,363	$222,360
Marineland	100	$0	75	$600	11	186	$600
Palm Coast	373,000	$0	279,750	$1,999,560	41,963	694,713	$1,999,560
Totals	**441,100**	**$0**	**330,825**	**$2,351,760**	**49,624**	**821,549**	**$2,351,760**

Results show how many gallons per day can be saved if each city implemented the rate structure and the irrigation system set forth by SJRWMD. The total costs are also shown above in **Table 2**.

REUSE WATER IN FLAGLER COUNTY

Figure 1
2004 WWTP Flow vs Reuse Flow



Source: 2004 FDEP Reuse Inventory

Table 3
Current Reuse Water Summary

WWTP	Location	WWTP Capacity	WWTP Flow	Supplemental Groundwater Supplies Flow	Reuse Capacity	Reuse Flow	% of WWTF Flow that is Reused
Grand Haven CDD WWTP	Palm Coast	1.00	0.64		0.88	0.64	100
Hammock Dunes	Palm Coast	4.80	1.26	0.18	3.48	1.45	100
Matanzas Shores	Palm Coast	0.32	0.05		0.32	0.05	100
Palm Coast	Palm Coast	4.00	3.90		4.43	3.35	86
Plantation Bay WWTP	Ormond Beach	0.47	0.12		0.47	0.06	50
TOTAL		10.59	5.97	0.18	9.58	5.55	93

Source: 2004 FDEP Reuse Inventory

APPENDIX A

Data Request

April 11, 2006 Cooperator: _____

Flagler County Water Supply Plan
Task D: Water Conservation/Reuse Data Request Form

Please complete this form for **EACH** water conservation method currently being used or proposed.

Examples of water conservation methods in Flagler County:

- Irrigation Restrictions
- Increasing potable and reclaimed water rate structure
- Meter replacement program
- Low volume plumbing fixture requirements
- Audits
- Reclaimed water use
- Future reclaimed water expansions
- Xeriscape
- Water conservation education
- Newsletters, flyers, brochures
- Rain Sensors

Description of conservation method:

When was this implemented?

How was it implemented? (phases, limited group, all at once)

Cost of implementation:

Success that may be attributed to the strategy?

Demand reduction that can be attributed: (results)

Intangible results:

Implemented in the entire system?

Examples of the program implemented, including brochures, regulations: (Please submit copies of each.)

Other comments:

APPENDIX D

Technical Memorandum Task E
Flow Projections

Task E: Flow Projections

Technical Memorandum

For The

Flagler County Water Supply Plan

By

ARCADIS U.S., Inc.
4307 Vineland Road H-20
Orlando, Florida

November 2006

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INTRODUCTION

Background

Flagler County and surrounding areas are experiencing rapid development and population growth that have led to increased demands on water resources and the related natural environment. The St. Johns River Water Management District (SJRWMD) predicts that within 20 years, traditional groundwater supplies will not be adequate to provide for future demands in many areas of Florida, and that alternative sources will be required.

Flagler County and the municipalities of Beverly Beach, Bunnell, Flagler Beach, Marineland, and Palm Coast, and Dunes Community Development District, (Cooperators) have formed a coalition, in cooperation with the SJRWMD, to prepare a Flagler County Water Supply Plan (Plan). ARCADIS was contracted by SJRWMD to prepare the Plan and coordinate with the Cooperators to ensure that future demands are met while preserving and protecting environmental resources. This document represents the deliverable under "Task E: Flow Projections."

Objective

The basic objective of the Plan is to meet Cooperators' current and future water demands with traditional and alternative water sources while sustaining water quality and protecting wetland and aquatic systems.

Scope of Services

Task E of the Plan requires an evaluation of flow projections. ARCADIS was requested to review the Cooperators' projected water needs and to evaluate whether the projected uses are reasonable. ARCADIS was also requested to review the provided SJRWMD projections and determined if they are consistent with the Cooperators' anticipated plans and population projections. ARCADIS also performed an analysis of the effects of declining agricultural water use and the associated increased availability of groundwater for public use.

DEMAND/FLOW PROJECTIONS AND REASONABLE USE

Population and potable water demand projections were provided by SJRWMD in five-year increments through the year 2025 for the following entities: Bunnell, Dunes Community Development District (DCDD), Flagler Beach, Palm Coast, the Hunter's Ridge area of Ormond Beach, Plantation Bay, and Marineland. ARCADIS requested demand and population projections from each Cooperator. Palm Coast provided ARCADIS with water demand and population projections and DCDD provided water demand projections. Flagler County provided water demand projections for Bulow Village Campground and Hunter's Ridge and population projections for Hunter's Ridge. The population projections are presented in **Table 1** and the potable water demand projections are presented in **Table 2**. Per capita potable water demand was calculated from the population and potable water demand projections. Wastewater flow projections have been provided by the City of Palm Coast and by Flagler County only. Reuse demand projections were not provided.

Potable water demand projections and population projections provided by SJRWMD and by the Cooperators were reviewed for consistency. The CUP allocations through 2025 are summarized in **Table 3**, along with the Cooperator potable water demand projections and water treatment plant capacities. The projected CUP allocations assume that after the CUP expiration date, there is no increase in permitted allocation. For example, if a CUP expired today at a permitted amount of 10 mgd, the projected allocations for the next twenty (20) years would remain at 10 mgd. CUP allocations could also be subject to decreases by SJRWMD. The projections for each Cooperator are summarized in the following sections.

City of Bunnell

Bunnell did not provide independent population or water demand projections so population projections provided by SJRWMD were utilized. SJRWMD provided population projections in five-year increments through 2025. The City of Bunnell is expected to have a population of 3,921 in the year 2025, up from 2,253 in 2005, an increase of 74%.

Potable water demand for Bunnell has been projected by SJRWMD to increase steadily between 2005 and 2025. SJRWMD projects an increase between 2005 and 2025 of 0.31 million gallons per day (mgd), a 111% increase during the planning period. Figure 1 shows Bunnell's anticipated water demand and CUP allocation.

The projected potable water demand per capita is based on both population projections and water demand projections. The population increase and water demand projections have an impact on the increase in per capita potable water demand. In 2005, the per capita demand was around 124 gallons per day (gpd); in 2025; it is anticipated to be around 150 gpd.

City of Flagler Beach

Flagler Beach did not provide independent population or water demand projections so population projections provided by SJRWMD were utilized. SJRWMD provided projections in five-year increments through 2025. The City of Flagler Beach is expected to have a population of 7,305 in 2025, an anticipated increase of 31% from the 2005 population estimate of 5,559.

SJRWMD has projected potable water demand for Flagler Beach to increase between 2005 and 2025. An increase of 0.26 mgd (32%) between 2005 and 2025 has been estimated by SJRWMD. **Figure 2** shows Flagler Beach's anticipated water demand and CUP allocation.

The projected increases in population and water demand have had little effect on the per capita potable water demand. Because the population projection over the next 20 years is about a 31% increase and the water demand projections show an increase of 32%, the per capita value increases only by 0.2% over the 20-year period. In 2005, the per capita water demand was about 147.51 gpd and is projected to be about 147.84 gpd in 2025.

City of Palm Coast

Population projections were again provided by both Palm Coast and SJRWMD in five-year increments through 2025. Projections by Palm Coast ranged from 53,089 in 2005 to 122,110 in 2025. SJRWMD projections in 2005 were slightly lower at 52,516 in 2005, but increased faster to 122,853 in 2025. SJRWMD anticipates an increase of 134% over the 20-year period compared to Palm Coast's expectation of an increase of 130%.

The City of Palm Coast serves finished water to the Flagler County Beverly Beach Service Area, Matanzas Shores, and DCDD. Projections for potable water demand have been provided by both the City of Palm Coast and SJRWMD. Potable water demand for Palm Coast has been projected to increase steadily in both cases, although the City projects the increase to occur much more slowly (lower increase per year). Projections by Palm Coast were consistently lower than SJRWMD through 2025. The difference is about -0.19 mgd or 2.5% in 2005 but increases to -2.93 mgd or 19% in 2025 (a negative difference indicates that the SJRWMD projection is higher). **Figure 3** shows Palm Coast's anticipated water demand and CUP allocation.

The population increase and water demand projections have an impact on the increase in per capita potable water demand. In 2005, the per capita demand was around 142 gpd; in 2025, it is anticipated to be around 152 gpd.

The City of Palm Coast has provided wastewater flow projections for 2005 through 2025. The projected flow from 2005 is 4.45 mgd and increases by 57% to 10.24 mgd in 2025. Wastewater flow projections are provided in **Table 4**.

Dunes Community Development District

DCDD did not provide independent population projections so population projections provided by SJRWMD were utilized. SJRWMD provided projections in five-year increments through 2025. DCDD is expected to have a population around 2,577 in the year 2025, an increase of 163% from 978 in 2005.

DCDD is served by the City of Palm Coast so the City of Palm Coast, as well as SJRWMD, has provided projections for potable water demand. Potable water demand for DCDD has been projected to increase steadily in both cases, although Palm Coast projects the increase to occur much more rapidly (greater increase per year). SJRWMD projections for 2005 were greater than Palm Coast. In 2025, SJRWMD projects the potable water demand will be 0.68 mgd, much lower than the projection of 1.02 mgd by Palm Coast. The difference is about 0.26 mgd in 2005 but increases to 0.34 mgd in 2025. **Figure 4** shows the water demand and the CUP allocation for DCDD.

The population and water demand projections have an impact on the per capita potable water demand. In 2005, the per capita demand was around 470 gpd; however, in 2025 the demand is expected to be significantly lower at only 264 gpd.

Flagler County

Unincorporated areas of Flagler County are served by the City of Palm Coast, Bulow Village Campground (BVC), and Hunter's Ridge. Portions of projected water demand and population from Palm Coast include Flagler County along with the following data from BVC and Hunter's Ridge. BVC is expected to reach build-out in 2014 and Hunter's Ridge is expected to reach build-out in 2016.

Population projections for BVC have not been provided by SJRWMD or Flagler County. However, ARCADIS has received population projections for Hunter's Ridge from Flagler County. Flagler County projects that the population in Hunter's Ridge will increase in 2025 to 3,492 from 0 in 2005. This population projection for 2025 indicates a per capita potable water demand of 163 mgd.

Potable water demand projections for BVC have been provided by Flagler County, but not from SJRWMD. In 2025, potable water demand is expected to be 0.57 mgd, up 76% from 0.32 mgd in 2005.

Potable water demand projections for Hunter's Ridge have been provided by both SJRWMD and Flagler County. Projections by Flagler County in 2025 increased to 0.64, or 77%, from 2005. SJRWMD projected a water demand of 0.45 mgd in 2025,

up from 0 mgd in 2005. SJRWMD projections were slightly lower than projections provided by Flagler County.

Wastewater projections for BVC and Hunter's Ridge have been provided by Flagler County. BVC projected wastewater flows for 2025 are expected to increase by 58%, up to 0.62 mgd and Hunter's Ridge wastewater flows are expected to increase to 0.52 mgd or 77% in 2025.

Town of Beverly Beach

The water service area for the City of Palm Coast includes the Town of Beverly Beach. Demands for Beverly Beach are included in the projections for the City of Palm Coast.

Town of Marineland

Marineland did not provide independent population or water demand projections so population projections provided by SJRWMD were utilized. SJRWMD provided projections in five-year increments through 2025. Marineland is expected to have a population of 325 in 2025, up from 15 in 2005.

Potable water demand for Marineland has been projected by SJRWMD to increase slightly between 2005 and 2025. SJRWMD projects an increase to 0.04 mgd in 2025, an increase from 0 mgd in 2005.

The per capita potable water demand is expected to increase through 2025. The per capita demand in 2025 is estimated to be around 123 gpd.

Conclusions

The total SJRWMD and Cooperator population projections were tabulated and compared as presented in **Table 1**. SJRWMD population projections were relied upon where no independent population projections were provided by the Cooperators. The total 2025 population is projected to be 139,730.

The total SJRWMD and Cooperator potable water demand projections were tabulated and compared as presented in **Table 2** and **Figure 5**. The total 2025 public supply water demand for all utilities greater than 0.1 mgd is 17.9 mgd. The projected total 2025 CUP allocation is 21 mgd. SJRWMD demand projections are expected to exceed CUP allocations in 2024.

The wastewater treatment plant capacities, wastewater projections and reuse projections are summarized in **Table 6**. Projections were not provided for each facility. The total reported wastewater flow projection for 2025 is 11.37 mgd and 4.83 mgd in 2005.

The following represents an overview of Flagler County projections over the time period of 2005 through 2025. A flow summary is presented in Figure 5.

- In 2005, the County's population is estimated at 61,979.
- In 2025, population is projected to be around 139,730.
- Population will increase 114% over the 20-year planning period.
- In 2005, water use demand is expected to be 7.75 mgd.
- In 2025, water use demand will be 17.94 mgd.

Overall, the County will experience increased population growth and water use demand. The SJRWMD projections show all utilities increasing in population and water use demand, and most increasing their per capita water demands.

CHANGES IN AGRICULTURAL WATER USE AND RESULTING AVAILABILITY OF GROUNDWATER FOR PUBLIC USE

Historical agricultural water use and agricultural acreage and projections to 2025 have been tabulated in the District's Water Supply Assessment (2003). The data indicate that agricultural water use will reduce from 8.9 mgd in 1995 to 7.6 mgd for an average rainfall year and to 8.7 mgd in a 1 in 10-year rainfall year in 2025. A predicted decrease in agricultural acreage (from 7,235 acres to 6,261 acres) is expected during the same time period. The reduction in water use amounts to 1,335 gallons per day per acre ([8.9 – 7.6]/ [7,235 – 6,261]).

TABLES

Table 1: Population Projection Comparison

	SJRWMD					% Increase	Cooperator					% Increase	2025 Difference (Coop. - SJRWMD)	Total 2025 Population [1]
Utility	2005	2010	2015	2020	2025	2005 - 2025	2005	2010	2015	2020	2025	2005 - 2025		
City of Bunnell	2,253	3,201	3,877	3,899	3,921	74	-	-	-	-	-	-	-	3,921
City of Flagler Beach	5,559	6,054	6,489	6,895	7,305	31	-	-	-	-	-	-	-	7,305
City of Palm Coast [2]	52,516	68,263	84,581	102,135	122,853	134	53,089	68,278	84,356	102,220	122,110	130	-743	122,110
Dunes Community Development District	978	1,384	1,784	2,202	2,577	163	-	-	-	-	-	-	-	2,577
Plantation Bay	658	692	724	742	764	16	-	-	-	-	-	-	-	-
Flagler County - Bulow Village Campground	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Flagler County - Hunter's Ridge	0	465	1,698	3,407	3,492	-	-	-	-	-	-	-	-	3,492
Marineland	15	164	318	325	325	2,067	-	-	-	-	-	-	-	325
Town of Beverly Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUB-TOTAL	**61,979**	**80,223**	**99,471**	**119,605**	**141,237**	**128**	**53,089**	**68,278**	**84,356**	**102,220**	**122,110**	**130**	**-743**	**139,730**
Domestic Self Supply and Utilities <0.1 mgd	6,256	6,924	7,141	7,357	7,574	-	-	-	-	-	-	-	-	7,574
TOTAL	**68,235**	**87,147**	**106,612**	**126,962**	**148,811**	**118**	**53,089**	**68,278**	**84,356**	**102,220**	**122,110**	**130**	**-743**	**147,304**

Notes:

1. If Cooperator projections were not provided, the Total 2025 Population is equal to the SJRWMD projection.
2. Palm Coast service area includes portions of unincorporated Flagler County

Table 2: Potable Water Demand Projection Comparison (mgd)

	SJRWMD					% Increase	COOPERATOR					% Increase	2025 Difference (Coop. - SJRWMD)	Total 2025 Water Demand [1]
Utility	**2005**	**2010**	**2015**	**2020**	**2025**	**2005 - 2025**	**2005**	**2010**	**2015**	**2020**	**2025**	**2005 - 2025**		
City of Bunnell	0.28	0.45	0.58	0.59	0.59	111	-	-	-	-	-	-	-	0.59
City of Flagler Beach	0.82	0.90	0.96	1.02	1.08	32	-	-	-	-	-	-	-	1.08
City of Palm Coast [2]	7.46	9.93	12.53	15.35	18.64	150	7.27	8.65	10.67	13.02	15.71	116	-2.93	15.71
Dunes Community Development District	0.26	0.36	0.47	0.58	0.68	162	0.00	0.71	0.89	0.98	1.02	-	0.34	1.02
Plantation Bay	0.08	0.09	0.09	0.09	0.10	25	-	-	-	-	-	-	-	0.10
Flagler County - Bulow Village Campground [3]	-	-	-	-	-	-	0.32	0.47	0.57	0.57	0.57	76	-	0.57
Flagler County - Hunter's Ridge [3]	0.00	0.06	0.22	0.44	0.45	-	0.15	0.23	0.41	0.64	0.64	316	0.19	0.64
Marineland	0.00	0.02	0.04	0.04	0.04	-	-	-	-	-	-	-	-	0.04
Town of Beverly Beach	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUB-TOTAL	**8.90**	**11.81**	**14.89**	**18.11**	**21.58**	**142**	**7.75**	**10.06**	**12.53**	**15.22**	**17.94**	**131**	**-2.40**	**19.75**
Domestic Self Supply and Utilities <0.1 mgd	0.53	0.58	0.60	0.62	0.64	-	-	-	-	-	-	-	-	0.64
TOTAL	**9.43**	**12.39**	**15.49**	**18.73**	**22.22**	**136**	**7.75**	**10.06**	**12.53**	**15.22**	**17.94**	**131**	**-2.40**	**20.39**

Notes:

1. If Cooperator projections were not provided, the Total 2025 Water Demand is equal to the SJRWMD projection.
2. Palm Coast service area includes portions of unincorporated Flagler County

Table 3: Potable Water Demand Summary

Owner	Permitted WTP Capacity	2025 Planned WTP Capacity	CUP Number	CUP Expiration Date	CUP Allocation (mgd)					Potable Water Demand Projections (mgd) [1]				
					2006	2010	2015	2020	2025	2005	2010	2015	2020	2025
City of Bunnell	0.99	-	1982	3/8/2001	0.29	0.29	0.29	0.29	0.29	0.28	0.45	0.58	0.59	0.59
City of Flagler Beach	1.52	-	59	4/7/2003	0.69	0.69	0.69	0.69	0.69	0.82	0.90	0.96	1.02	1.08
City of Palm Coast	12.88	24.58	1947	12/13/2015	9.51	9.51	9.51	9.48	9.51	7.27	8.65	10.67	13.02	15.71
Dunes Community Development District [2]	-	-	51136	10/12/2024	1.31	1.31	1.31	1.31	1.31	0.00	0.71	0.89	0.98	1.02
Plantation Bay	0.76	-	1960	-	-	-	-	-	-	0.08	0.09	0.09	0.09	0.10
Flagler County - Bulow Village Campground [4]	-	-	2002	3/14/2022	0.12	0.15	0.18	0.21	-	0.32	0.47	0.57	0.57	0.57
Flagler County - Hunter's Ridge	-	-	8932	5/11/2024	6.97	7.53	8.36	8.79	8.96	0.15	0.23	0.41	0.64	0.64
Marineland [3]	-	-	-	-	-	-	-	-	-	0.00	0.02	0.04	0.04	0.04
Town of Beverly Beach [2]	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SUBTOTAL	**16.14**	**24.58**	**-**	**-**	**18.89**	**19.48**	**20.34**	**20.77**	**20.76**	**8.93**	**11.52**	**14.20**	**16.96**	**19.75**
Domestic Self Supply and Utilities <0.1 mgd	-	-	-	-	-	-	-	-	-	0.53	0.58	0.60	0.62	0.64
TOTAL	**16.14**	**24.58**	**-**	**-**	**18.89**	**19.48**	**20.34**	**20.77**	**20.76**	**9.46**	**12.10**	**14.80**	**17.58**	**20.39**

Notes:

1. If 2025 year projection was not provided by the Cooperator, SJRWMD 2025 projection was used.
2. Municipality is served by Palm Coast
3. No CUP information has been provided for Marineland
4. Bulow Village Campground CUP Allocation includes only groundwater for household use and groundwater for utility type use

Table 4: Wastewater and Reuse Summary

Owner or Operator	Facility Name	Permitted Capacity (mgd)	2004 Average Flow (mgd)	2025 Planned WWTP Capacity [1]	Projected Reuse Demands, mgd [3]					Projected Wastewater Flows, mgd				
					2005	2010	2015	2020	2025	2005	2010	2015	2020	2025
City of Palm Coast	Grand Haven CDD WWTP	1.00	0.64	1.00	-	-	-	-	-	-	-	-	-	-
Dunes Community Development District	DCDD WWTP	0.50	1.26	0.50	-	-	-	-	-	-	-	-	-	-
Matanzas Shores Owner's Association, Inc.	Mantanzas Shores WWTP	0.32	0.05	0.32	-	-	-	-	-	-	-	-	-	-
City of Palm Coast	Palm Coast WWTP	5.30	3.90	9.10	-	-	-	-	-	4.45	5.72	7.07	8.57	10.24
Plantation Bay Utility Company	Plantation Bay WWTP	0.48	0.12	0.48	-	-	-	-	-	-	-	-	-	-
Flagler County	Beverly Beach WWTP	0.07	-	0.07	-	-	-	-	-	-	-	-	-	-
City of Bunnell	Bunnell WWTP	0.60	-	0.60	-	-	-	-	-	-	-	-	-	-
City of Flagler Beach	Flagler Beach WWTP	1.00	-	1.00	-	-	-	-	-	-	-	-	-	-
Flagler County	Bulow Village WWTP	0.09	-	0.09	-	-	-	-	-	0.26	0.54	0.62	0.62	0.62
Flagler County	Hunter's Ridge WWTP	6.00	-	6.00	-	-	-	-	-	0.12	0.19	0.33	0.52	0.52
Town of Marineland	Marineland WWTP [2]	-	-	-	-	-	-	-	-	-	-	-	-	-
TOTAL		**15.35**	**5.97**	**19.16**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.83**	**6.45**	**8.02**	**9.70**	**11.37**

Notes:

1. If a build-out capacity was not provided, assume current permitted capacity = build-out capacity
2. No information was provided for Marineland
3. Reuse Demand projections were not provided

Table 5: SJRWMD Potable Water Demand Per Capita Comparison

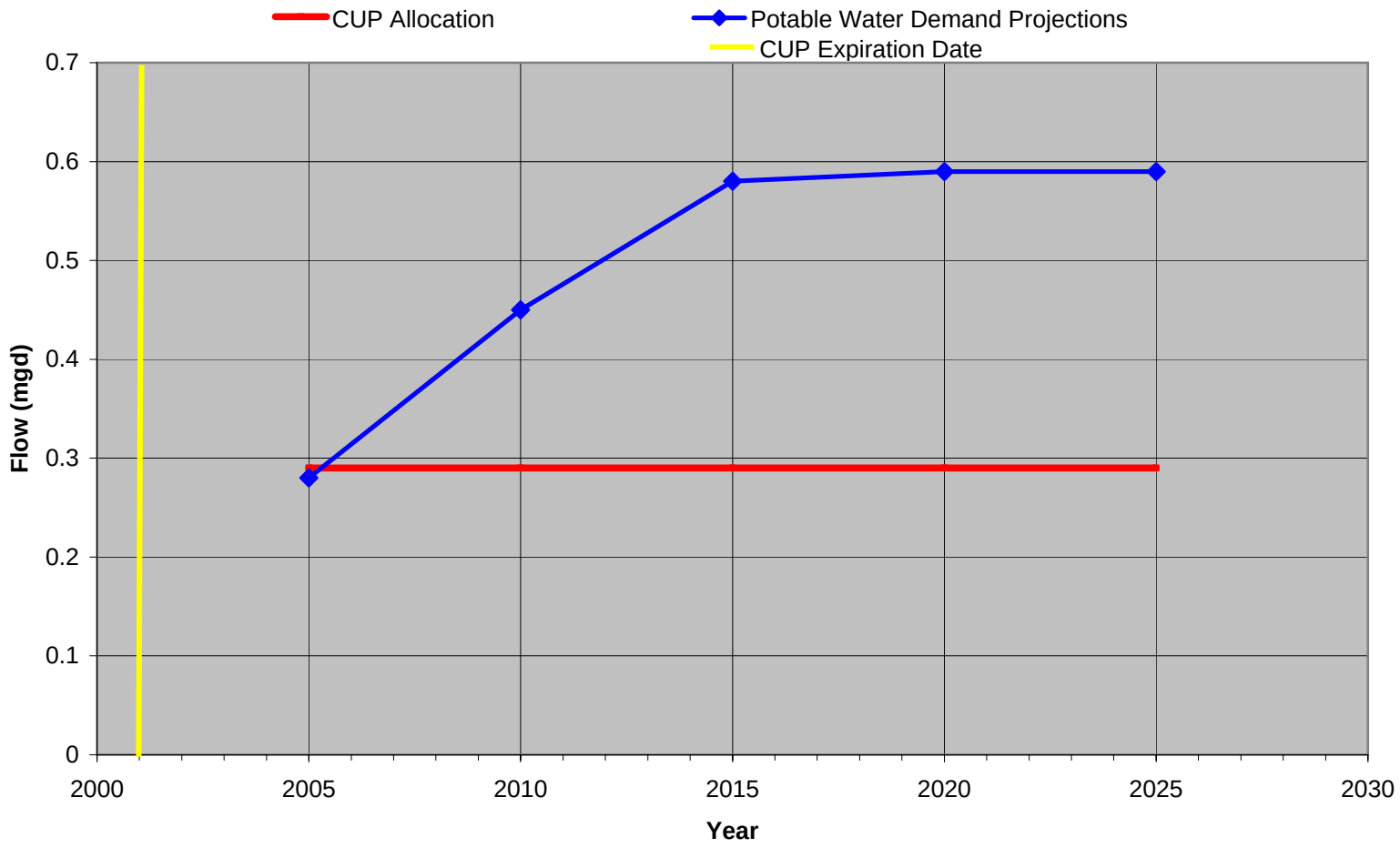
Utility	2005 Per Capita (gpd)	2025 Per Capita (gpd)	Population Projections		Water Use Projections (mgd)		Wastewater Generation Potential at 100 gallons per day per capita (mgd)		Increase over period of projection (mgd)
			2005	2025	2005	2025	2005	2025	
City of Bunnell	124.28	150.47	2,253	3,921	0.28	0.59	0.20	0.35	0.15
City of Flagler Beach	147.51	147.84	5,559	7,305	0.82	1.08	0.50	0.66	0.16
City of Palm Coast	142.05	151.73	52,516	122,853	7.46	18.64	4.73	11.06	6.33
Dunes Community Development District	265.85	263.87	978	2,577	0.26	0.68	0.09	0.23	0.14
Plantation Bay	121.58	130.89	658	764	0.08	0.10	0.06	0.07	0.01
Flagler County - Bulow Village Campground	-	163.23	0	3,492	0.32	0.57	0.00	0.31	0.31
Flagler County - Hunter's Ridge	-	-	-	-	0.00	0.45	-	-	-
Marineland	0.00	123.08	15	325	0.00	0.04	0.00	0.03	0.03
Town of Beverly Beach	-	-	-	-	-	-	-	-	-
TOTAL	**148.76**	**156.83**	**61,979**	**141,237**	**9.22**	**22.15**	**5.58**	**12.71**	**7.13**

Notes:

1. Information not provided was left blank.
2. SJRWMD did not provide water use projections for Bulow Village and therefore, Cooperator data was used.

FIGURES

Figure 1: City of Bunnell - Water Demand vs CUP Allocation (ADF)



ARCADIS

Figure 2: City of Flagler Beach - Water Demand vs CUP Allocation (ADF)

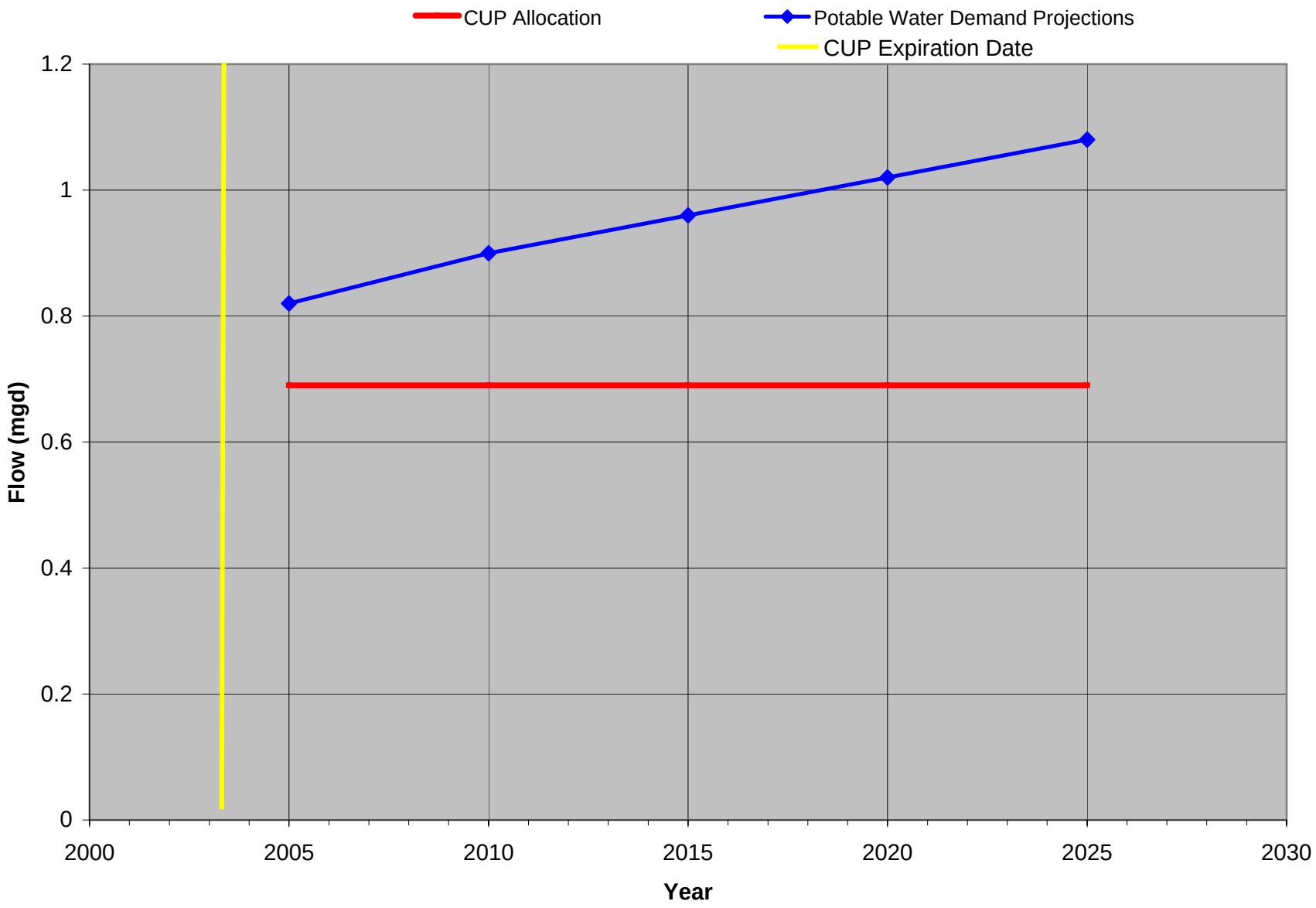


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Figure 3: City of Palm Coast - Water Demand vs CUP Allocation (ADF)

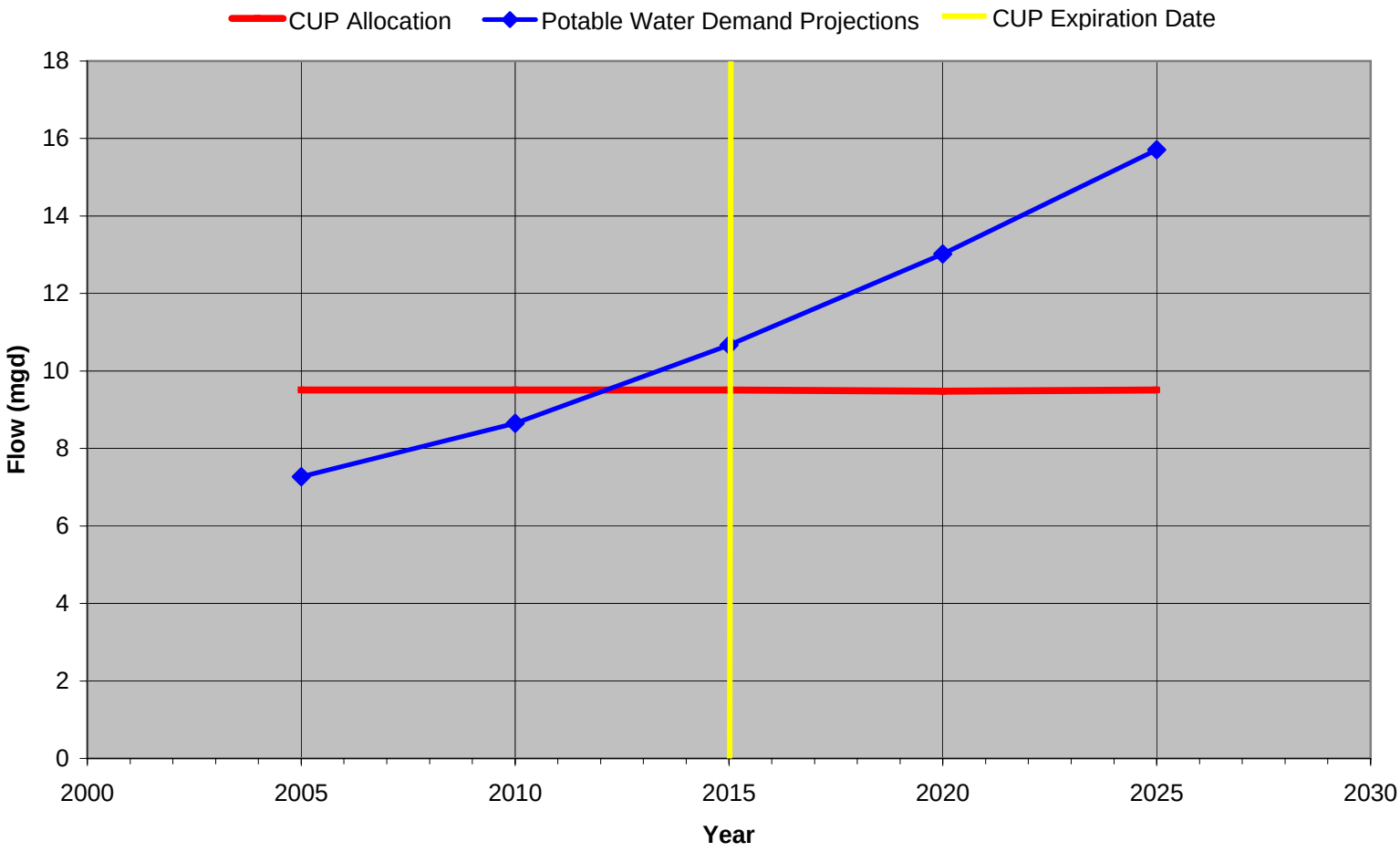

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Figure 4: Dunes Community Development District - Water Demand vs CUP Allocation (ADF)

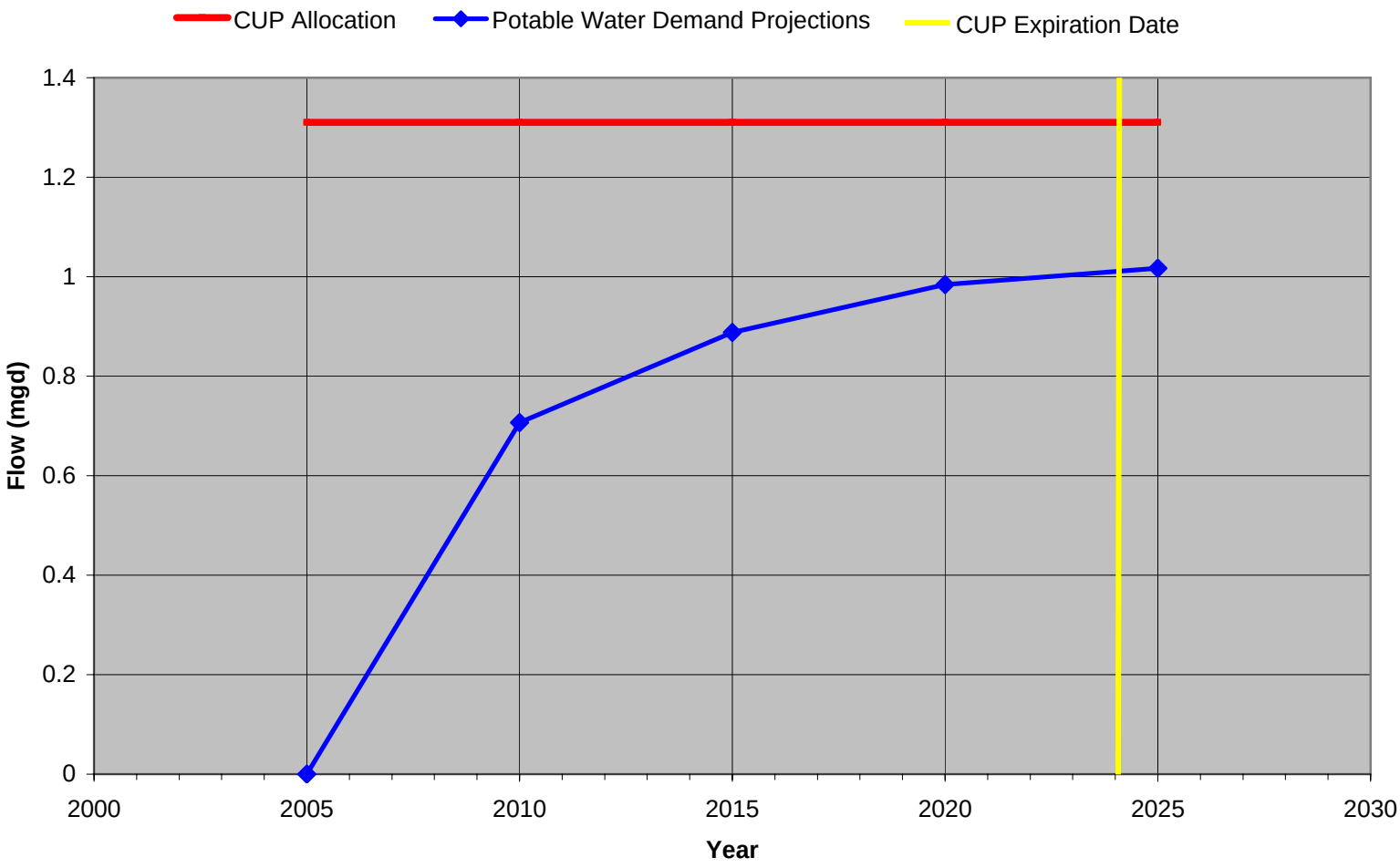

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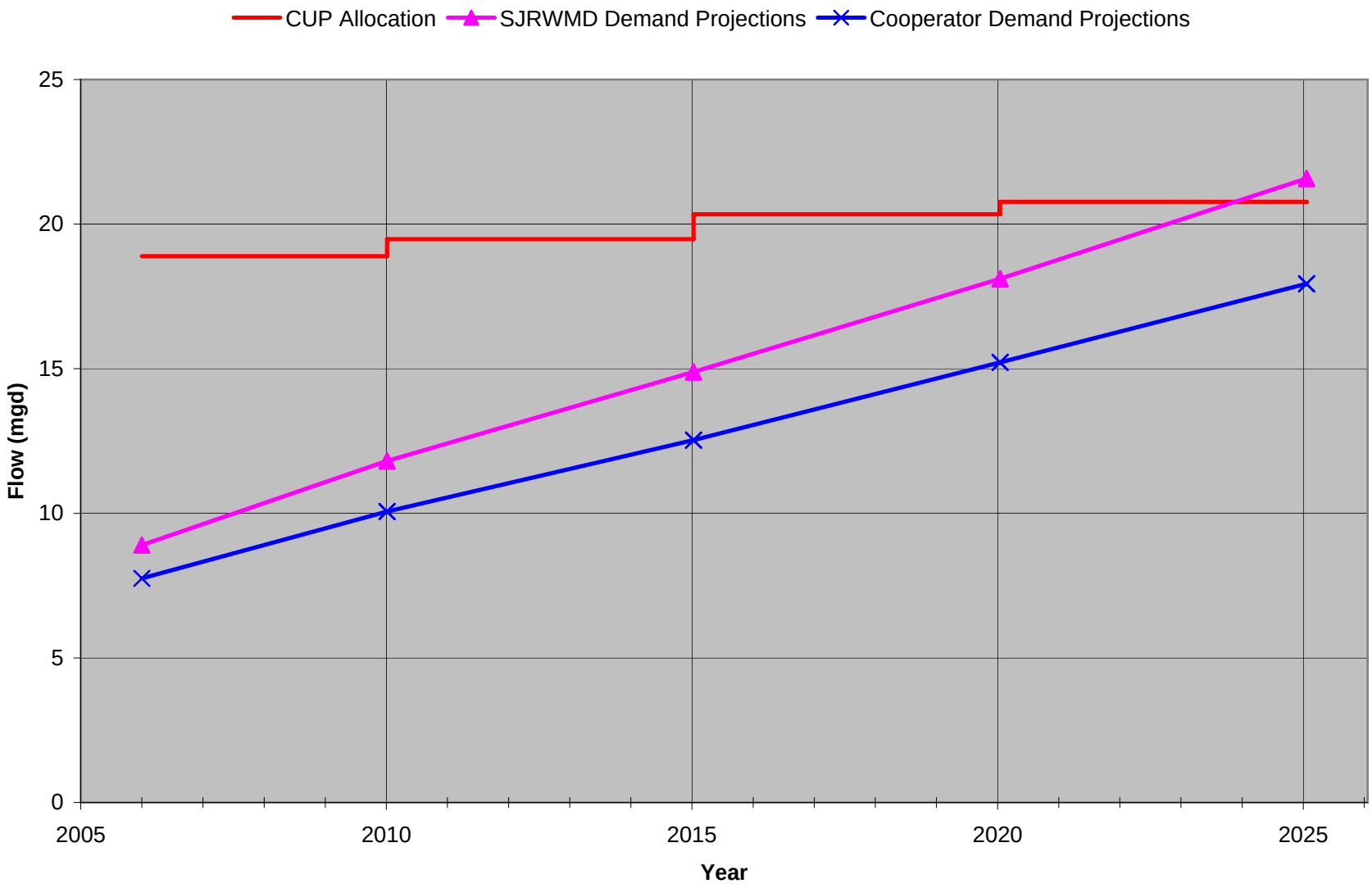
Figure 5: Total Water Demand vs CUP Allocation (ADF)



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APPENDIX E

Meeting Minutes Task F
Meeting Report, Alternative Projects Workshop, June 6, 2006

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MEETING REPORT

Subject:
Alternative Projects Workshop – Flagler County Water Supply Plan

Department:
Water Resources

ARCADIS Project No.:
OR248

Place/Date of Meeting:
City of Palm Coast/ 06.06.06, 9:00 a.m.

Minutes by:
Nicole Quinby

Issue Date:
06.12.06

Participants:
See attached

Copies:
Meeting Attendees

The following represents a summary of the meeting held on June 6, 2006. The meeting attendee list is attached to this document.

Welcome and Introductions

Linda Shelley (Fowler & White) encouraged everyone to introduce themselves. She indicated that the main purpose of the meeting was to identify and review alternatives for future water supply sources. A package was handed out to each Cooperator containing the Meeting Agenda, an updated project schedule, and a copy of the Powerpoint presentation to be presented at this meeting.

Review Status of Data Collection

John Hermann (ARCADIS) discussed the ongoing data collection efforts and the data obtained from St. Johns River Water Management District and from the Cooperators. ARCADIS needs to determine if its requests have been addressed. Cooperators were encouraged to continue to provide updated information.

Review Alternative Water Supply Projects

John Hermann (ARCADIS) made a Powerpoint presentation that identified local alternative water supply projects identified in the SJRWMD Water Supply Plan, plus other projects identified in a meeting conducted among ARCADIS, Terry Clark, and SJRWMD staff in Palatka. Additional projects were solicited from the Cooperators. The complete list included:

Alternatives Identified in District Water Supply Plan and Palatka Meeting

Bank canal wells

- § Concept: take groundwater from wells to maximize groundwater use and reduce freshwater discharge into brackish waters
- § Concerns included seasonal issues, elevation issues, and homeowner issues.
- § For more information on Palm Coast canals, contact John Moden.

Floridan Aquifer as a water source

- § Concept: to use the Floridan Aquifer as a water source.
- § Concerns included increased treatment costs, high chlorine levels, and limited amount of freshwater.

Series of reservoirs to capture peak surface water flows to drinking water

- § Concept: interconnection of reservoirs to capture peak surface water flows that would otherwise be lost.
- § Related projects to review: Tampa Bay project or the Georgia Pacific option in Putnam County.
- § Questions regarding this alternative are as follows:
  - Is evaporation a major concern?
  - Should there be a liner?
  - Where is this a reasonable option?
  - Where would land be obtained and how much is necessary for what costs?

Surface water sources

- Lake George, St. Johns River near SR-40, Crescent Lake, and Lake Ocklawaha.
- § Concept: treat surface water from any of these sources to use as a water source.
- § Many Cooperators felt that these sources are too far from the problem source and may present issues with the water distribution.
- § Not necessary to deal outside of Flagler County because of possible resistance.

Stormwater ponds

- § Concept: use water from stormwater ponds as a water source.
- § Possible concerns of location, water level regulations, current amounts of available water. It doesn't appear as though it would work on the grand scale.

Seawater desalination

- § Concept: desalinate seawater to use as a water source.
- § Concerns include location, costs, and disposal.

Alternatives Identified During June 6 Workshop

Wetland rehydration

- § Increase water supply to Surficial Aquifer.
- § Concerns include water chemistry, regulations and high costs.

Tidal energy from Matanzas Inlet

Identifying closer lakes as potential sources such as Lake Disston, Lake Deston, and Lake Black.

- Lower distribution costs if lakes are closer to Palm Coast.

After discussion of all the alternatives, the Cooperators ranked the alternatives. The top 7 alternatives were identified for more detailed evaluation. Below are the ranking results.

Highest Ranked Alternatives:

1. Crescent Lake as a water source
2. Other, closer lakes as a water source
3. Constructed reservoirs
4. Lake George
5. Floridan aquifer
6. St. Johns River near SR-40
7. Lake Ocklawaha as a water source

The Cooperators ranked these alternatives most highly because they were seeking long-term solutions and most of the proposed groundwater alternatives did not fulfill their needs. The highest ranked alternatives were most closely related to their initial project objectives.

ARCADIS has been requested to review the top 7 alternatives as ranked by the Cooperators prior to the next workshop. ARCADIS will present technical information on these alternatives at the next Cooperator meeting, tentatively scheduled for October 31, 2006.

APPENDIX F

Technical Memorandum Task G, Subtask G2
Review of Options for Evaluating Alternative Water Supply Projects by Increasing Groundwater Supply

Task G: Evaluation of Alternative Water Supply Development Projects

Subtask G2: Review of Options for Evaluating Alternative Water Supply Projects by Increasing Groundwater Supply

Technical Memorandum
For The
Flagler County Water Supply Plan

By

ARCADIS G&M, Inc.
4307 Vineland Road H-20
Orlando, Florida
407-835-0266

May 2007

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INTRODUCTION

St. Johns River Water Management District (SJRWMD) predicts that, within 20 years, traditional groundwater sources will not be adequate to meet future demands while preserving the natural environment in many areas of coastal Florida, and that alternative sources will be required.

Flagler County along with municipalities of Bunnell, Flagler Beach, Palm Coast, Marineland, and Beverly Beach and the Dunes Community Development District have formed a coalition (Cooperators) in cooperation with the SJRWMD to prepare a Flagler County Water Supply Plan (Plan). ARCADIS was contracted to prepare the Plan and coordinate with the Cooperators to ensure that future demands are met while preserving and protecting environmental resources.

Background

Flagler County and nearby coastal counties are experiencing rapid development and population growth that have led to increased demands on water resources and the related natural environment. Previous task efforts in the development of the Plan included review of existing plans, data collection, compilation and reduction, review of water conservation and reuse programs, verification and comparison of flow projections, and identification of alternatives. Involved in these efforts were workshops, development of technical memoranda and a GIS database. This document represents the deliverable for "Subtask G2: Review of Options for Evaluating Alternative Water Supply Projects by Increasing Groundwater Supply."

Objective

The objective of this Subtask is to evaluate whether future public water supply demands of the Cooperators can be supplied by traditional or alternative groundwater sources while sustaining water quality and protecting wetland and aquatic systems.

Scope of Services

Task G of the Plan requires an evaluation of alternative water supply development projects. In June 2006, the Cooperators conducted an Alternatives Project Workshop and identified and ranked alternatives for further evaluation. Six of the 7 highest ranked alternatives were existing or potential surface-water supplies. One high-ranked alternative was the Floridan aquifer and the Cooperators directed ARCADIS to include this source as an alternative for further examination.

The Floridan aquifer and the confined surficial aquifer (CSA) are the 2 principal sources of public water supply in Flagler County. During refinement of the scope of Task G, ARCADIS was requested to include the CSA as well as the Floridan aquifer in its alternatives analysis.

HYDROGEOLOGIC FRAMEWORK

Three primary water-bearing units exist in Flagler County. In descending order, they are the unconfined surficial aquifer (USA), the confined surficial aquifer (CSA), and the Floridan aquifer. To date, the principal sources of water for public supply have been the fresh portions of the CSA and the Upper Floridan aquifer (UFA), which is the upper part of the Floridan aquifer. The hydrogeology of each of these aquifers is described below, based primarily on descriptions by Birdie (July 2006) and Navoy and Bradner (1987). **Figure 1** presents a conceptual cross section of the units.

Unconfined Surficial Aquifer (USA)

The USA (also described as the water-table aquifer) is a source of domestic self-supply and consists of sand, shell and some finer material, deposited in the Pleistocene and Halocene age. The aquifer ranges in thickness from about 20 feet in south and central Flagler County to more than 50 feet in north Flagler County. Fine-grained material in the western portion of the County results in low well yields (often less than 2 gallons per minute [gpm]). In east-central Flagler County where higher yielding sands exist, and along the east coast of the County where shell and coquina (cemented shell) are found, well yields of 10 to 50 gpm are common. Among the 3 aquifers of interest in Flagler County, water-level fluctuations in the USA are most influential on environmental features such as wetlands, streams and lakes.

Confined Surficial Aquifer (CSA)

The CSA (also described as the intermediate aquifer) consists of more permeable lenses of shell (with sand and limestone) within a matrix of finer-grained, less permeable sand, silt and clay. Clay at the base of the USA and upper Miocene-age clay, marl and dolomite overlying the Hawthorn Group provide confinement to the aquifer, as do the finer-grained material found above and below the lenses. The overlying clays comprise the top confining unit and the underlying fine-grained (Hawthorn Group) sediments are known as the intermediate confining unit. The permeable lenses range from less than 1 to more than 10 feet thick, produce well yields of less than 5 to more than 50 gpm, and are found at depths of 40 to 90 feet below land surface in the eastern half of Flagler County. Where these lenses are present and contain fresh water in east and northeast Flagler County, they are an important source of public supply, as the underlying Floridan aquifer contains brackish water.

Upper Floridan Aquifer (UFA)

The UFA is extensive beneath Flagler County and consists of dolomite and limestone, including Ocala Limestone, underlying upper Avon Park carbonates of late Eocene age, and, where present, overlying limestones at the base of the Hawthorn Group. Wells tapping the UFA yield from 50 to more than 1000 gpm, but much of the UFA is brackish beneath Flagler County, which has discouraged its use for public supply. The intermediate confining unit and the fine-grained sediments of the CSA provide overlying

confinement to the UFA. Low permeability, soft chalky limestone and hard dolomitic limestone provide separation and confinement between the Upper and Lower Floridan aquifers. The Lower Floridan aquifer, although productive, contains brackish water beneath all of Flagler County so its use for public supply has been limited.

METHODOLOGY

Using regional groundwater models and environmental "likelihood of harm" models, SJRWMD had concluded that some areas of the County were vulnerable to increased use of the groundwater resource. During the period of the Flagler County Water Supply Plan project, SJRWMD contracted for the development of an improved and more locally focused groundwater flow model than had been previously developed. The modeled area can be generally described as the northeastern portion of the County where major future growth and water supply demand are likely and proposed. Figure 2 shows the model boundaries. The model and report (Birdie, July 2006) generally referred to as the "Palm Coast Groundwater Model" are still in draft form, subject to peer review. However, the model is still useful in its draft form, as it can be utilized to compare various future groundwater supply scenarios by showing comparative or relative changes.

ARCADIS and SJRWMD staff met on August 9, 2006, to discuss the status of groundwater model development, availability of data and general water resource issues in Flagler County. At that meeting, it was collectively decided that the most efficient way of assessing the future availability of the groundwater resource in a limited amount of time would be to utilize the draft Palm Coast Groundwater Model to test several alternative wellfield sites and to compare the results of those scenarios against scenarios wherein future increases in groundwater use would come from existing wellfield areas. In order to identify potential future wellfield areas, the meeting attendees decided that a "screening and scoring" process would be most useful to evaluate the hydrogeologic data and the land use constraints. It was decided to use a "Geographic Information System (GIS) Overlay Analysis" for this process.

Following the meeting, SJRWMD staff developed a list of available hydrogeologic data that staff felt would be most useful. ARCADIS staff reviewed the list, suggested changes, and applied weighting percentages to each type of hydrogeologic data. SJRWMD and ARCADIS staffs generally agreed on other criteria (land use, water quality) that could be used to further screen the data and find the best options for wellfield sites. Then, appropriate data sets were obtained from SJRWMD's GIS coverages, from regional databases, and from the groundwater models including the area of interest so that the overlay and screening process could be applied. Because time was limited and the hydrogeologic data sets developed for the Palm Coast Groundwater Model were the most current and complete, it was decided that this study should focus on the Palm Coast Groundwater Model area. The Palm Coast Groundwater Model area also generally coincides with the extent of the freshwater portion of the confined surficial aquifer. As a result of this process, it was apparent that some areas of Flagler County had a higher potential for future wellfield development than others. Finally, utilizing the experience of the SJRWMD staff, specific wellfield sites were selected that appeared to

be reasonably available for future wellfield development and were close to utilities that would potentially need the water. This same general procedure was followed for both the CSA and the UFA.

The most favorable sites in the CSA and the UFA were selected for additional analysis using the Palm Coast Groundwater Model; the Northeast Florida Groundwater Flow Model also was used to evaluate areas of the UFA that fell outside the area of the Palm Coast Groundwater Model.

EVALUATION – SCORING AND SCREENING

CSA Overlay Analysis

Multiple data sets had been created to use in the development of the Palm Coast Groundwater Model and it was convenient to utilize those data sets in this evaluation of potential future well sites. Four different sets of hydrogeologic data were identified as being most valuable to the evaluation process.

- Natural Resources Conservation Service stormwater runoff curve numbers are indicative of the potential for rainfall to recharge the surficial aquifer. **Figure 3** shows the curve numbers database used in the Palm Coast Groundwater Model. The runoff curve data were separated into 2 data domains around the midpoint of the data. Low values represent low runoff and high recharge potential, and high values represent high runoff and low recharge potential.
- Surficial aquifer system (SAS) thickness (Davis 2006) is an indicator of the ability of the surficial aquifer to store water, to provide a thick section of permeable material within which wells can operate, and make available a greater thickness for well drawdown. The SAS includes the USA and CSA as well as the intervening (top) confining unit. **Figure 4** shows the thickness of the surficial aquifer system from the SJRWMD GIS database. The aquifer thickness values were separated into 2 data domains around the average thickness of 17.9 feet.
- Leakance of the top confining unit (confining layer between the USA and CFA) is an indicator of the potential for water to move between the USA and the CSA. Leakance is a calculated value composed of the vertical hydraulic conductivity of the confining unit divided by its thickness. The data were derived from aquifer performance tests of wells and geophysical surveys of wells and borings in Flagler County. **Figure 5** shows the leakance of the CSA database used in the Palm Coast Groundwater Model. A low leakance value is indicative of better isolation between the USA and the CSA. Leakance values were separated into 2 data domains around the mean leakance value of 0.001497/day.
- Transmissivity of the CSA is an indicator of the ability of the aquifer to transmit water and an indicator of the potential production of water supply wells. Transmissivity data sets are compiled from aquifer performance tests and specific- capacity tests in Flagler County. **Figure 6** shows the transmissivity of the CSA database used in the Palm Coast Groundwater Model. Transmissivity

values were separated into 2 data domains around the mean value of 2659 sq ft/day.

The 4 sets of hydrogeologic data were assigned weighted percentages, depending upon the perceived importance of the data set in identifying future well sites. The curve number and the transmissivity were assigned 31.6% each, as it was determined by the hydrogeologists from ARCADIS and SJRWMD that these were the most relevant data in selecting future well sites in the CSA. Surficial aquifer thickness was given 20.9% weight and leakance was given 15.8% weight, as it was determined that these were less significant to selection of future well sites.

Figure 7 is the map resulting from the CSA hydrogeologic overlay analysis. The most favorable areas are shown in dark color.

Additional filtering was performed based on land use, presence of wetlands and proximity to existing public supply wellfields. Open, agricultural, forested and barren lands shown on **Figure 8** were assumed to be available for future wells. Wetlands shown on **Figure 9** were excluded as sites for future wells. A half-mile buffer around existing public supply wells, as shown on **Figure 10,** was established as an excluded zone. The composite map of this land filtering analysis is shown as **Figure 11**.

The CSA hydrogeologic overlay analysis and the land filtering analysis were combined into a map of potential new well sites in the CSA as shown as **Figure 12**. As can be seen, there are a limited number of potential "high score" sites near Interstate 95 at Palm Coast, north of State Road 100 east and west of Interstate 95, in the southeast portion of the study area east and west of US Highway 1, and northwest of Bunnell.

UFA Overlay Analysis

Multiple data sets had been created districtwide in SJRWMD and it was convenient to utilize those data sets in this evaluation of potential future well sites. Three different sets of hydrogeologic data were identified as being most valuable to the evaluation process.

- Recharge to the UFA is based on the water level gradient (head difference) between the water table elevation of the USA and the UFA potentiometric elevation combined with the leakance of the intermediate confining unit (Hawthorn semi-confining unit). **Figure 13** shows the map of recharge to the UFA developed by a SJRWMD GIS overlay process (Boniol, Williams and Munch 1993). The data were separated into 2 data domains, lower and higher than 3 inches per year. Negative values or low positive values indicate low recharge potential, which result in less potential downward vertical flow between the USA and the UFA.
- UFA thickness has been determined throughout SJRWMD as the difference between the elevation of the top of the Ocala Limestone (generally the top of the UFA) and the elevation of the 250 milligrams per liter (mg/L) isochlor. **Figure 14** shows the thickness of fresh water in the UFA in the SJRWMD GIS database.

The aquifer thickness values were separated into 2 data domains around the thickness of 256 feet.

- Transmissivity of the UFA is an indicator of the ability of the aquifer to transmit water and an indicator of the potential production of water supply wells. Transmissivity data sets are compiled from aquifer performance tests and specific capacity tests for use in the Northeast Florida Regional Groundwater Flow Model. The data set was calibrated during the development of the Northeast Florida Regional Groundwater Flow Model. **Figure 15** shows the transmissivity of the UFA database. Transmissivity values were separated into 2 data domains around the mean value of 2659 sq ft/day.

The 3 sets of hydrogeologic data were assigned weighted percentages, depending upon the perceived importance of the data set in identifying future well sites. The UFA recharge and the transmissivity were assigned 27.3% each; UFA thickness was assigned 45.4% weight, as it was determined that the thickness of fresh water was the most important hydrogeologic factor in considering the UFA.

Figure 16 shows the map resulting from the UFA hydrogeologic overlay analysis. The same filtering methodology was applied to the UFA in order to limit the number of well sites to those with the proper land use, no wetlands, and at least a buffer between the prospective new well sites and existing wells. The UFA hydrogeologic overlay analysis and the land filtering analysis were combined into a map of potential new well sites in the UFA as shown as **Figure 17**. Potential "high score" sites are located west of State Road 100 north of Bunnell and across much of southern Flagler County.

EVALUATION OF POTENTIAL WELL SITES

Many simulations were conducted to evaluate the potential for additional withdrawals from either the CSA or the UFA or both in the vicinity of service areas of the Cooperators. These simulations were conducted in anticipation that the results could be presented to the Cooperators at an October 31, 2006, public meeting attended by representatives of the Cooperators and SJRWMD. The Palm Coast Groundwater Model was utilized for these simulations as it included most of the areas served or potentially served by public water supply wellfields. Three simulations were conducted that incorporated pumpage or projected future pumpage only from existing wellfields. These simulations were previously performed using an earlier version of the Palm Coast Groundwater Model and serve to represent reference conditions, which could be compared to simulations of withdrawals from new potential wellfields in order to determine if withdrawals from new wellfields would cause less harm, primarily to wetlands that are extensive in Flagler County. "Harm" was evaluated by determining the number of acres of wetlands potentially impacted by a particular simulation. The 3 initial simulations were:

Simulation 1 – Projected 2011 allocations for Palm Coast, Bunnell, Flagler Beach, and Flagler County. All other individual users were simulated at their 2025 permitted allocations. **Figure 18** shows the wetlands potentially harmed under this simulation.

Simulation 2 – Fifty percent (50%) of the projected 2025 increase in the withdrawals from the CSA wells and the UFA wells at Palm Coast was simulated. All other users were simulated at their projected 2025 withdrawals.

Simulation 3 – Seventy percent (70%) of the projected 2025 increase in CSA withdrawals and 60% of the projected 2025 increase in UFA withdrawals by Palm Coast were simulated. The projected withdrawal represents a shortfall of 8 mgd below the projected 2025 withdrawals. All other users were simulated at their 2025 withdrawals. This simulation reproduced a previous modeling attempt by SJRWMD staff to minimize harm to wetlands.

Eight additional simulations of potential future groundwater withdrawals were conducted to evaluate new prospective well sites selected by the "screening and scoring" process. The goal was to determine if one or more well sites were available that could make up the 8-mgd shortfall in 2025 anticipated by Simulation 3 and result in reduced potential harm to wetlands.

Simulation 4 – Simulation 3 was re-run with the addition of a 4-mgd withdrawal from the CSA from each of 2 sites. The two sites are shown on **Figure 19**.

Simulation 5 – Simulation 3 was re-run with the addition of a 4-mgd UFA withdrawal from each of 2 "Scenario A" locations, one south of Bunnell near County Road 304 and one west of Interstate 95 near Old Dixie Highway. These 2 sites were anticipated to be in the freshwater portion of the UFA and are shown on **Figure 20**.

Four potential sites were selected where the UFA contains brackish water, which would result in the need to remove salt from the water (probably by reverse osmosis treatment). Withdrawal from each of these sites was simulated (Simulations 6 through 8, Simulations 10 and 11), as was a combined withdrawal from 3 of the 4 sites (Simulation 9). The sites are shown on **Figure 21**.

Simulation 6 – Simulation 3 was re-run with the addition of an 8-mgd withdrawal from the UFA at "Site 1", located east of US Highway 1 about 1½ miles north of Palm Coast Parkway (**Figure 21**).

Simulation 7 - Simulation 3 was re-run with the addition of an 8-mgd withdrawal from the UFA at "Site 2", located about 1 mile southeast of the Palm Coast Parkway interchange of Interstate 95 (**Figure 21**).

Simulation 8 - Simulation 3 was re-run with the addition of an 8-mgd withdrawal from the UFA at "Site 3", located in the Black Creek area about 2 miles southwest of Bunnell (**Figure 21**).

Simulation 9 – This was an attempt to distribute UFA withdrawals among several potential well sites. Simulation 3 was re-run with the addition of an 8-mgd withdrawal distributed equally among UFA Sites 1, 2 and 3 (**Figure 21**).

Simulation 10 – Simulation 3 was re-run with the addition of a 4-mgd withdrawal from Site 4 (**Figure 21**). Site 4 is located northeast of Interstate 95 near Old Kings Road.

Simulation 11 – Simulation 3 was re-run with the addition of an 8-mgd withdrawal from Site 4 (**Figure 21**).

An outcome of the October 31, 2006, meeting was interest by some Cooperators to evaluate additional groundwater supply potential in other areas of Flagler County. These areas were close to or outside the boundaries of the Palm Coast Groundwater Model. ARCADIS and SJRWMD staff reviewed the areas of interest and determined that the evaluation could best be made by using the Northeast Florida Regional Groundwater Flow Model to compare the results of 4 additional simulations. The sites are shown on **Figure 22.**

Simulation 12 – Because the Northeast Florida Regional Groundwater Flow Model boundaries encompass a much larger area than the Palm Coast Groundwater Model and included many more users within Flagler County, as well as outside Flagler County, this simulation allowed for a comparison with the conditions established by Simulation 3. The public water supply pumpage included in Simulation 3 (2011 anticipated and permitted) along with anticipated 2025 withdrawal rates for all other Flagler County groundwater users and all other groundwater users outside Flagler County were simulated. It also established Simulation 12 as a baseline for comparison with results of subsequent simulations using the Northeast Florida Regional Groundwater Flow Model.

Simulation 13 – Simulation 12 was re-run, with the addition of an 8-mgd withdrawal from a potential brackish UFA, North Flagler County Wellfield.

Simulation 14 – Simulation 12 was re-run, with the addition of an 8-mgd withdrawal from a potential fresh UFA, South Flagler County Wellfield.

Simulation 15 – Simulation 12 was re-run, with the addition of a 4-mgd withdrawal from a potential fresh CSA, North Flagler County Wellfield and a 4-mgd withdrawal from potential extension of Ormond Beach's fresh UFA Wellfield.

Table 1 indicates the number of acres of wetlands predicted to be impacted by each simulation performed and the percentage increase in the acreage of impacted wetlands.

FINDINGS

A hydrogeologic overlay analysis was conducted to identify prospective wellfield sites within eastern Flagler County. The databases for the analysis consisted of GIS database coverages and input files to groundwater models available for the area. A "screening and

scoring" process was used to identify and rank the sites that had the best potential as wellfields with the least possibility of affecting wetlands. Sites for CSA withdrawals and UFA withdrawals were separately identified. Previous modeling by SJRWMD had indicated that a substantial reduction in projected withdrawals in 2025, by the City of Palm Coast, in order to try to reduce wetland impacts, would result in an 8-mgd shortfall in 2025. The recently developed Palm Coast Groundwater Model was used to evaluate the identified wellfield locations in order to determine if the shortfall could be met by withdrawals from major wellfields.

- The projected 2011 withdrawals from existing wellfields potentially harm more than 3500 acres of wetlands in eastern Flagler County.
- Simulations proposed that would reduce projected 2025 withdrawals from existing wells by 50% of the anticipated increase would still potentially harm more wetland acres than in 2011.
- A simulation with pumpage from the City of Palm Coast reduced below 2025 projected withdrawals (70% of CFA withdrawals; 60% of UFA withdrawals; total reduction about 8 mgd) resulted in 119% more wetland acres potentially harmed (more than double) than in 2011.
- Simulated withdrawals of 4 mgd each from 2 potential CSA wellfields that would make up the 2025 shortfall resulted in 162% more wetland acres potentially harmed than in 2011.
- Simulated withdrawals of 4 mgd each from 2 potential UFA wellfields southeast and southwest of Bunnell resulted in 136% more wetland acres potentially harmed than in 2011.
- Simulated withdrawals of 8 mgd from each of 3 different wellfields (Sites 1 and 2 near Palm Coast; Site 3 southwest of Bunnell) resulted in around 200% (3 times) more wetland acres potentially harmed than in 2011. Splitting the 8 mgd withdrawal evenly among the 3 wellfield sites resulted in around 300% (4 times) more wetlands potentially harmed than in 2011.
- A simulated withdrawal of 4 mgd from a wellfield site in the northeastern part of the County resulted in less potentially harmed wetland acreage (133%). When the simulated withdrawal was increased to 8 mgd, the wetland acreage harmed was about the same (157%) as the harm from 4 mgd withdrawals from potential wellfields southeast and southwest of Bunnell but still more than 1 ½ times greater than the wetland acreage potentially harmed in 2011.
- The Northeast Florida Regional Groundwater Flow Model was used to evaluate potential wellfields near the boundaries or outside the boundaries of the Palm Coast Groundwater Model. In order to compare the relative potential harm with the results of the Palm Coast Groundwater Model, data adjustments had to be made.
- Simulations run using the Northeast Florida Regional Groundwater Flow Model still show increases in potential harm to wetlands. They appear to show less incremental potential harm to wetlands because they are more distant from the center of the Palm Coast Groundwater Model. However, these same simulations show that additional wetlands outside the Palm Coast Groundwater Model boundaries are potentially harmed by the withdrawals.

CONCLUSIONS

Projected 2011 withdrawals are predicted to sufficiently impact wetlands as to cause the SJRWMD to classify Flagler County as a "Priority Water Resource Caution Area" and encourage users to utilize alternative sources of supply.

Based on this study to identify and evaluate most favorable prospective wellfield sites, there does not appear to be any areas of the County where large withdrawal capacity could be developed without further increasing the potential for harm to wetlands. None of the prospective wellfield sites selected in this study area resulted in reduced potential harm to wetlands. This conclusion should not preclude existing or future users from identifying individual well sites or small wellfield areas to capture small quantities of water for domestic self-supply, commercial/industrial self-supply, agricultural irrigation self-supply, or small community or public supply use. These, however, would likely be "infill" uses causing "*de minimis*" impacts.

It will be extremely difficult to identify and develop a substantial source of future groundwater supply in Flagler County without mitigating the potential harm to wetlands.

REFERENCES

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FIGURES

Stratigraphic Unit	Lithology	Hydrogeologic Unit
Pleistocene and recent deposits	Discontinuous beds of loose sand, clayey sand, sandy clay, clay, marl, and shell	Unconfined surficial aquifer Top confining unit
Pleistocene and recent deposits	Clay, clayey sand, sandy clay, sand, shell and carbonate rock	Confined surficial aquifer
Hawthorn Group	Interbedded clay, quartz sand, carbonate, and phosphate	Intermediate confining unit
Ocala Limestone	Limestone	Upper Floridan aquifer
Avon Park Formation	Interbedded limestone and dolomite	Middle semi-confining unit
Oldsmar Formation	Interbedded limestone and dolomite	Lower Floridan aquifer
Cedar Keys Formation	Interbedded dolomite and anhydrite	

Figure 1. Geologic and hydrogeologic units in Flagler County (modified from Birdie, 2006).

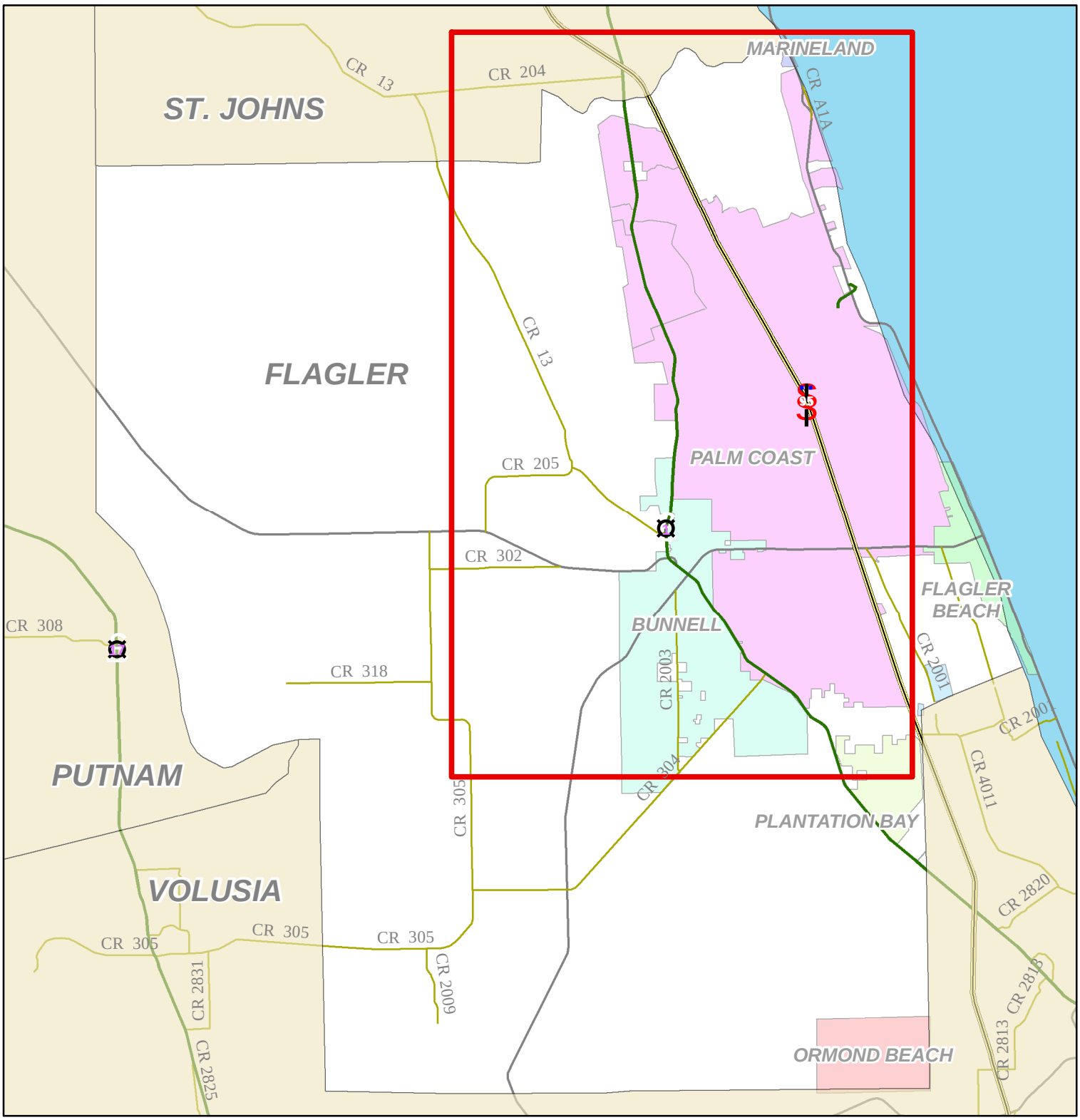
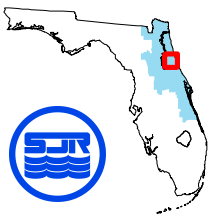


Figure 2. Boundaries of Palm Coast Groundwater Model



2 1 0 2 Miles

1:231451

Legend

Palm Coast Groundwater Model Boundary

Water Service Area Boundaries

- BUNNELL
- FLAGLER BEACH
- MARINELAND
- ORMOND BEACH
- PALM COAST
- PLANTATION BAY
- VOLUSIA COUNTY

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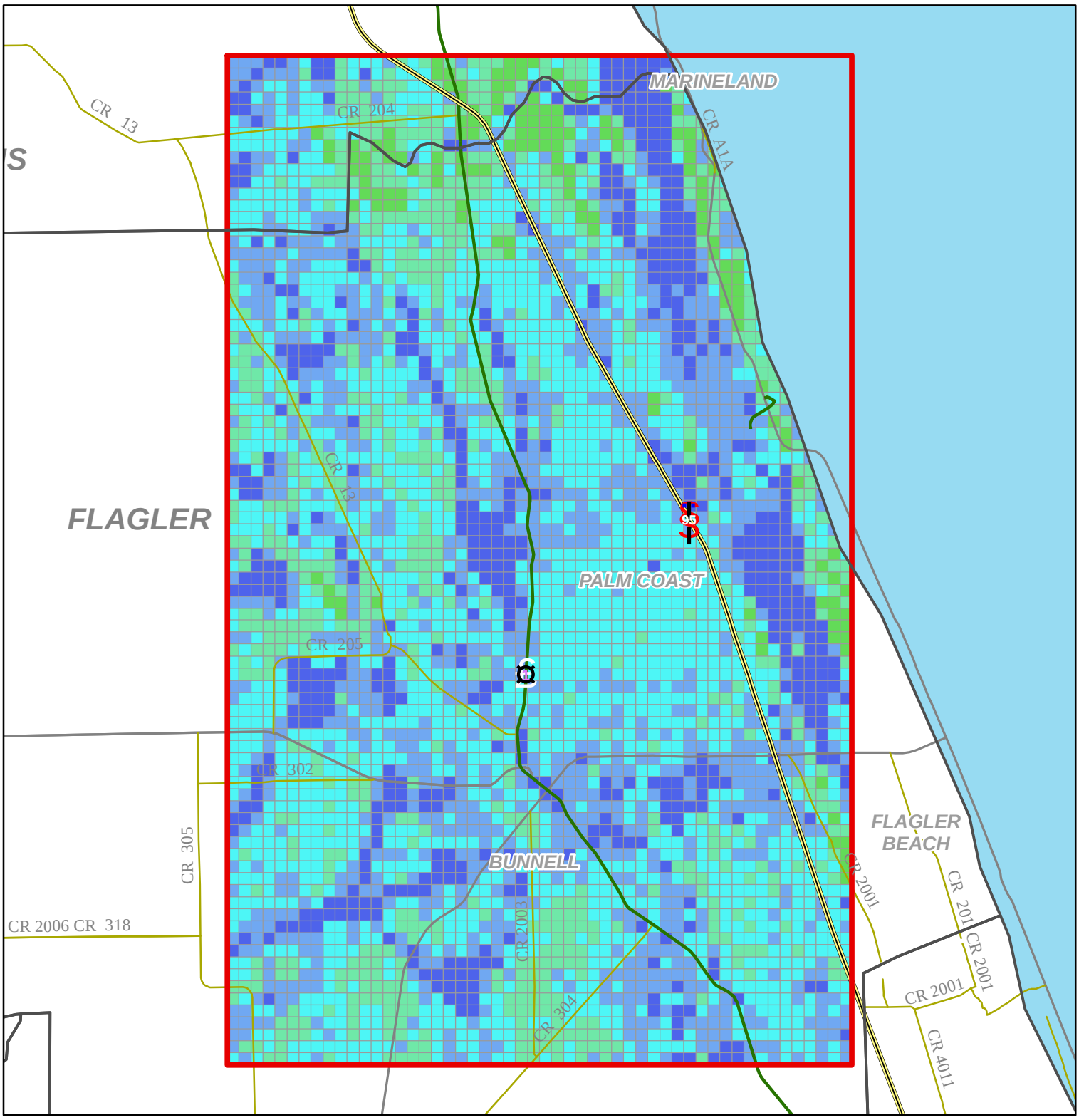
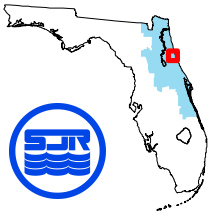


Figure 3. Natural Resource Conservation Service stormwater runoff curve numbers



1 0.5 0 1 Miles

1:170731

Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary

NSCS curve numbers

- 36 - 61
- 62 - 74
- 75 - 80
- 81 - 86
- 87 - 95

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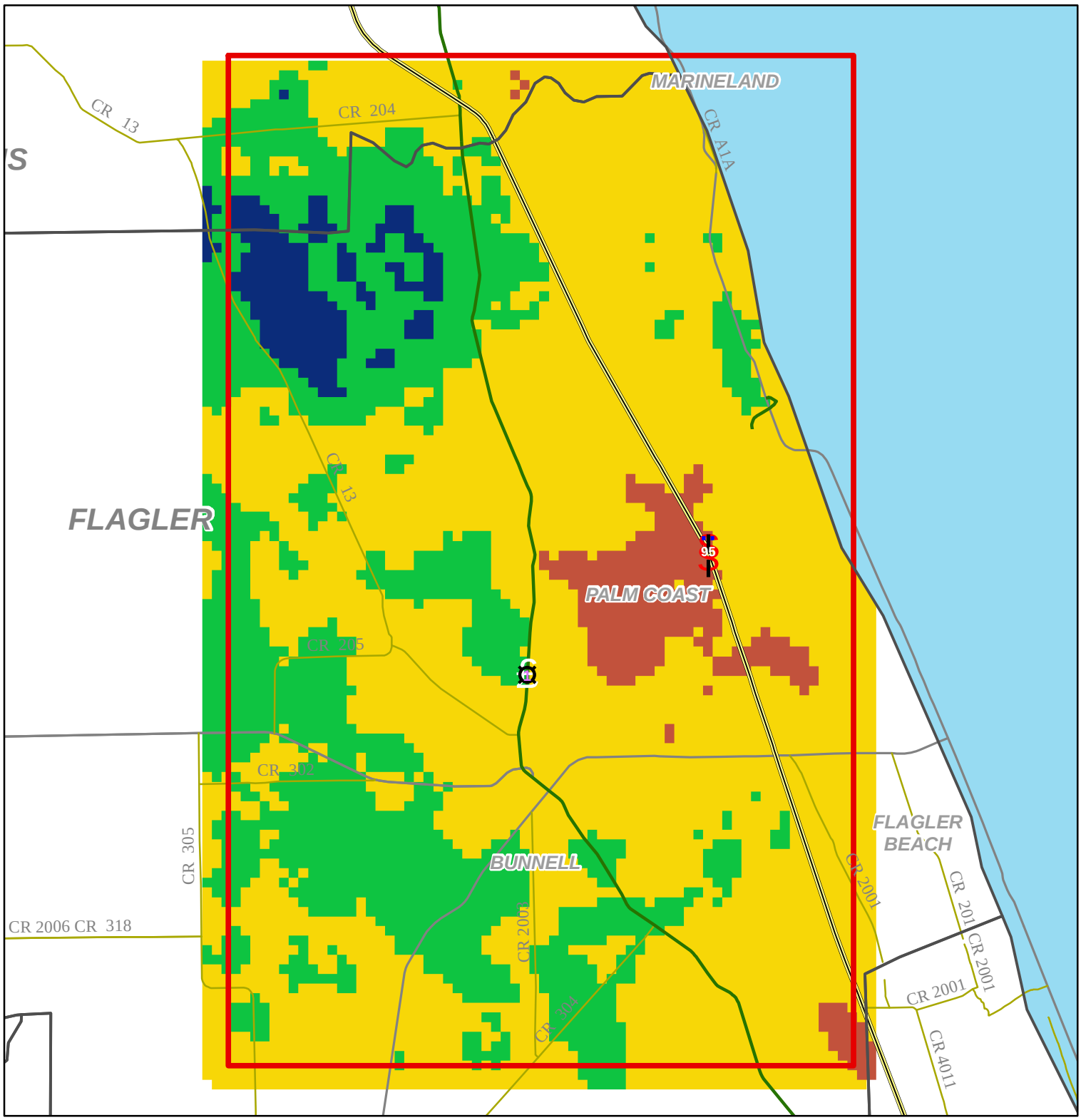
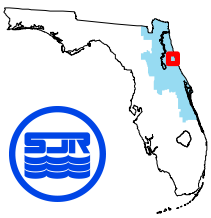


Figure 4. Thickness of surficial aquifer system



1 0.5 0 1 Miles

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Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary

SAS thickness (ft)

- 8 - 10
- 11 - 20
- 21 - 30
- 31 - 40

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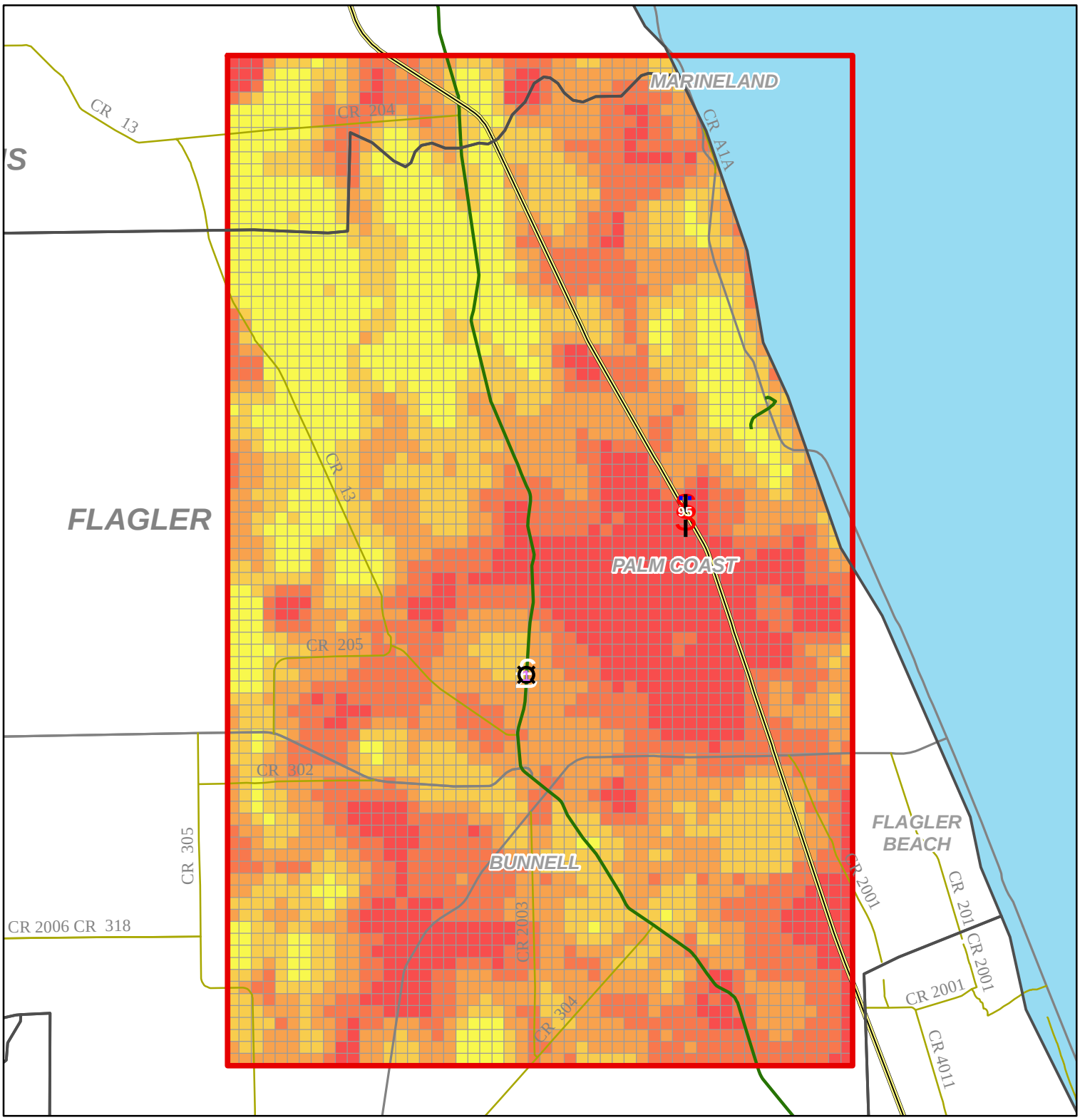
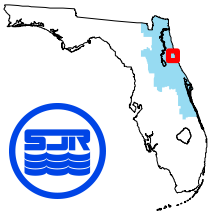


Figure 5. Leakance between the water-table and confined surficial aquifers



1 0.5 0 1 Miles

1:170731

Legend

Confined surficial leakance (1/d)

- 0.000363 - 0.000936
- 0.000937 - 0.001324
- 0.001325 - 0.001670
- 0.001671 - 0.002054
- 0.002055 - 0.002689
- Palm Coast Groundwater Model Boundary
- County Boundaries

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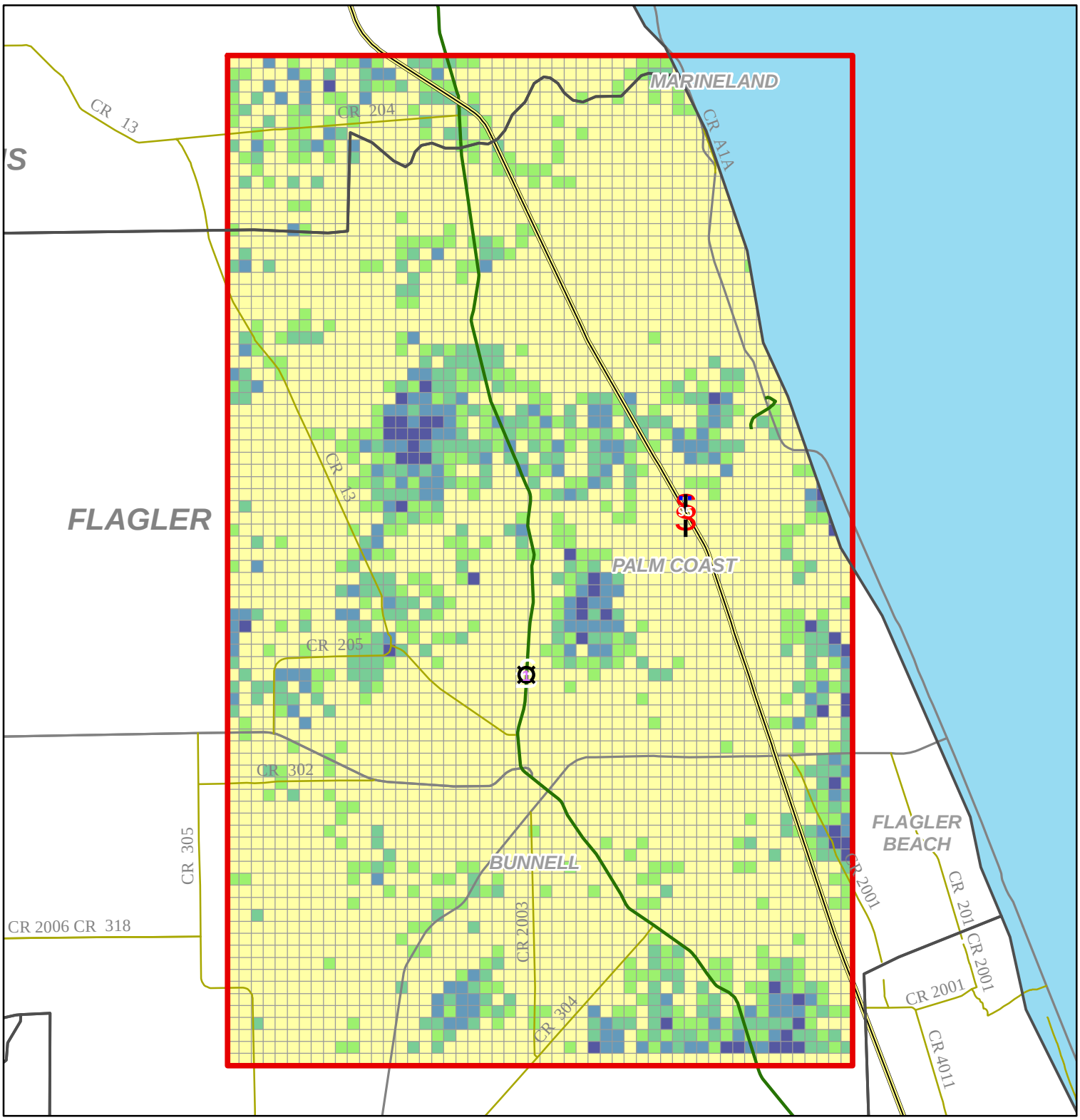
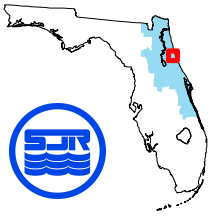


Figure 6. Transmissivity of the confined surficial aquifer



1 0.5 0 1 Miles

1:170731

Legend

Confined surficial transmissivity (ft^2/d)

- 0.00 - 2610.00
- 2610.01 - 3560.00
- 3560.01 - 4870.00
- 4870.01 - 6780.00
- 6780.01 - 11200.00
- Palm Coast Groundwater Model Boundary
- County Boundaries

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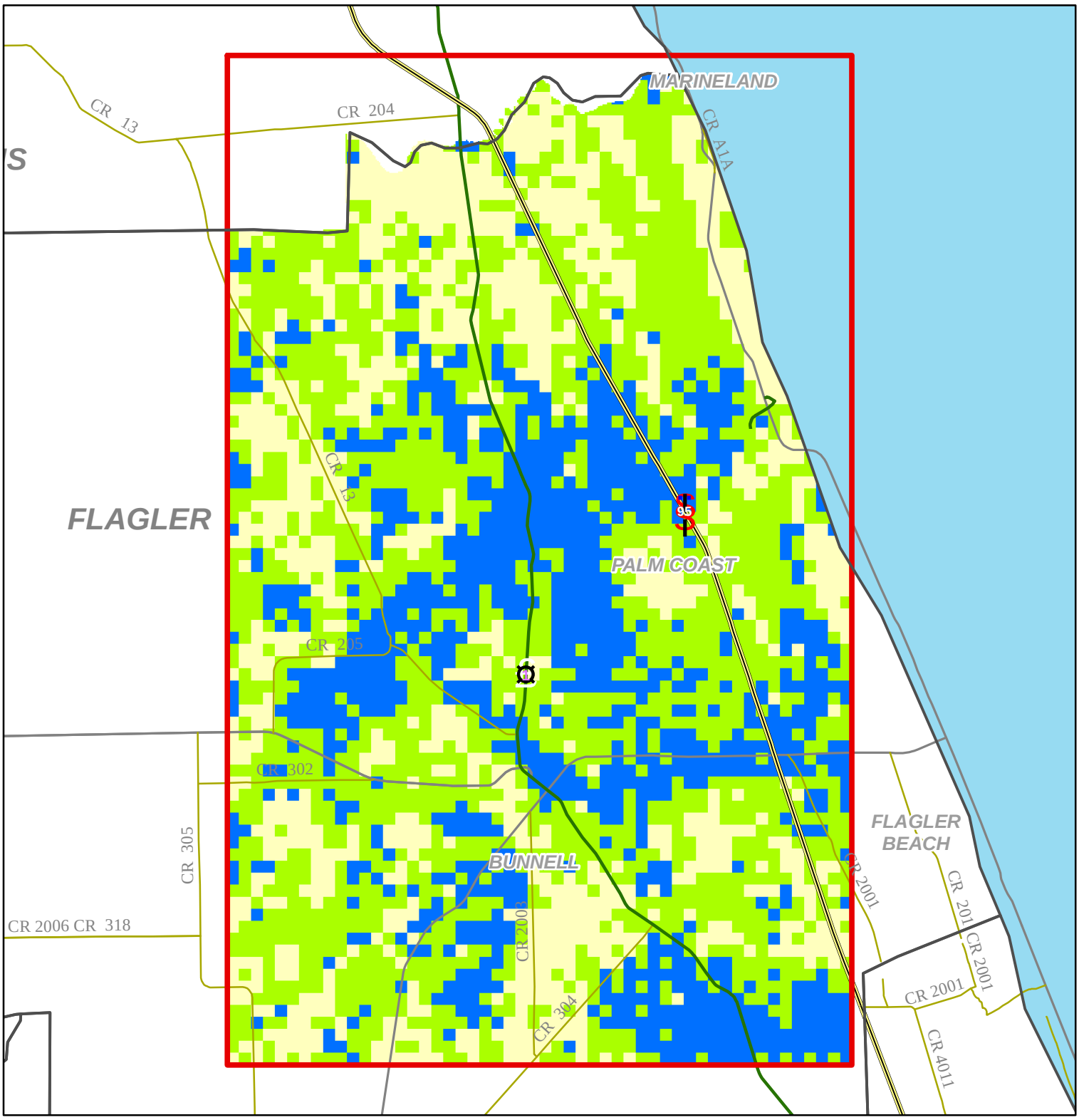
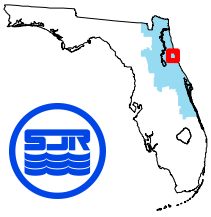


Figure 7. Results of the confined surficial aquifer hydrogeology overlay analysis



1 0.5 0 1 Miles

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Legend

Palm Coast Groundwater Model Boundary

County Boundaries

Hydrogeology overlay - results

0.50 - 0.60

0.61 - 0.76

0.77 - 1.00

Note: The areas in blue show the most favorable locations for potential new wellfield based on the hydrogeologic input layers and their weighting.

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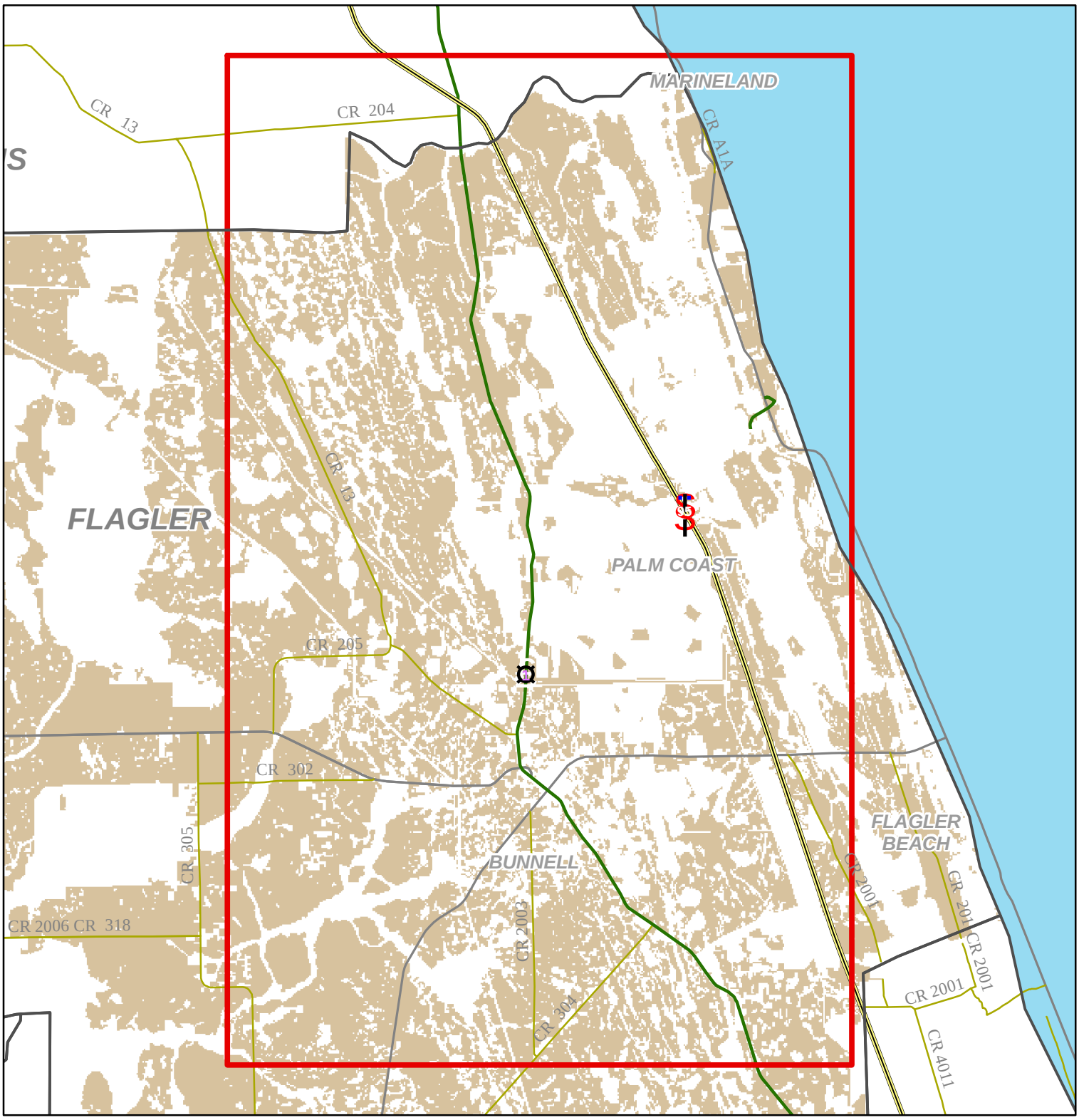
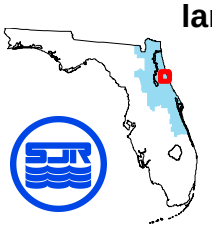


Figure 8. Areas available for potential new wells in the confined surficial aquifer based on land use



1 0.5 0 1 Miles

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Legend

Land use 2000

- Not Available
- Available
- County Boundaries
- Palm Coast Groundwater Model Boundary

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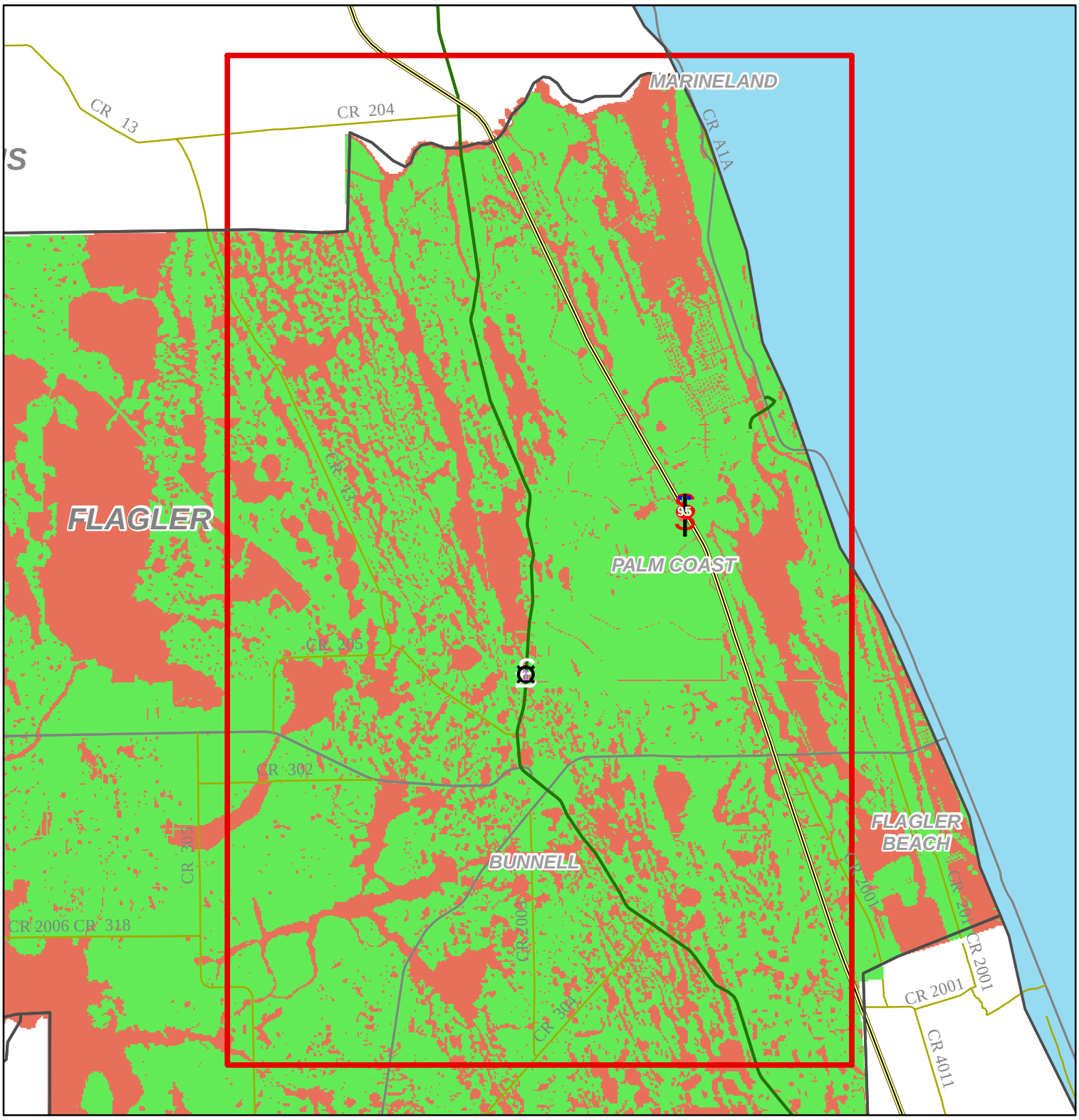
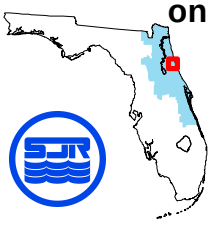


Figure 9. Areas available for potential new wells in the confined surficial aquifer based on wetlands



1 0.5 0 1 Miles

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Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary
- Not Available
- Available

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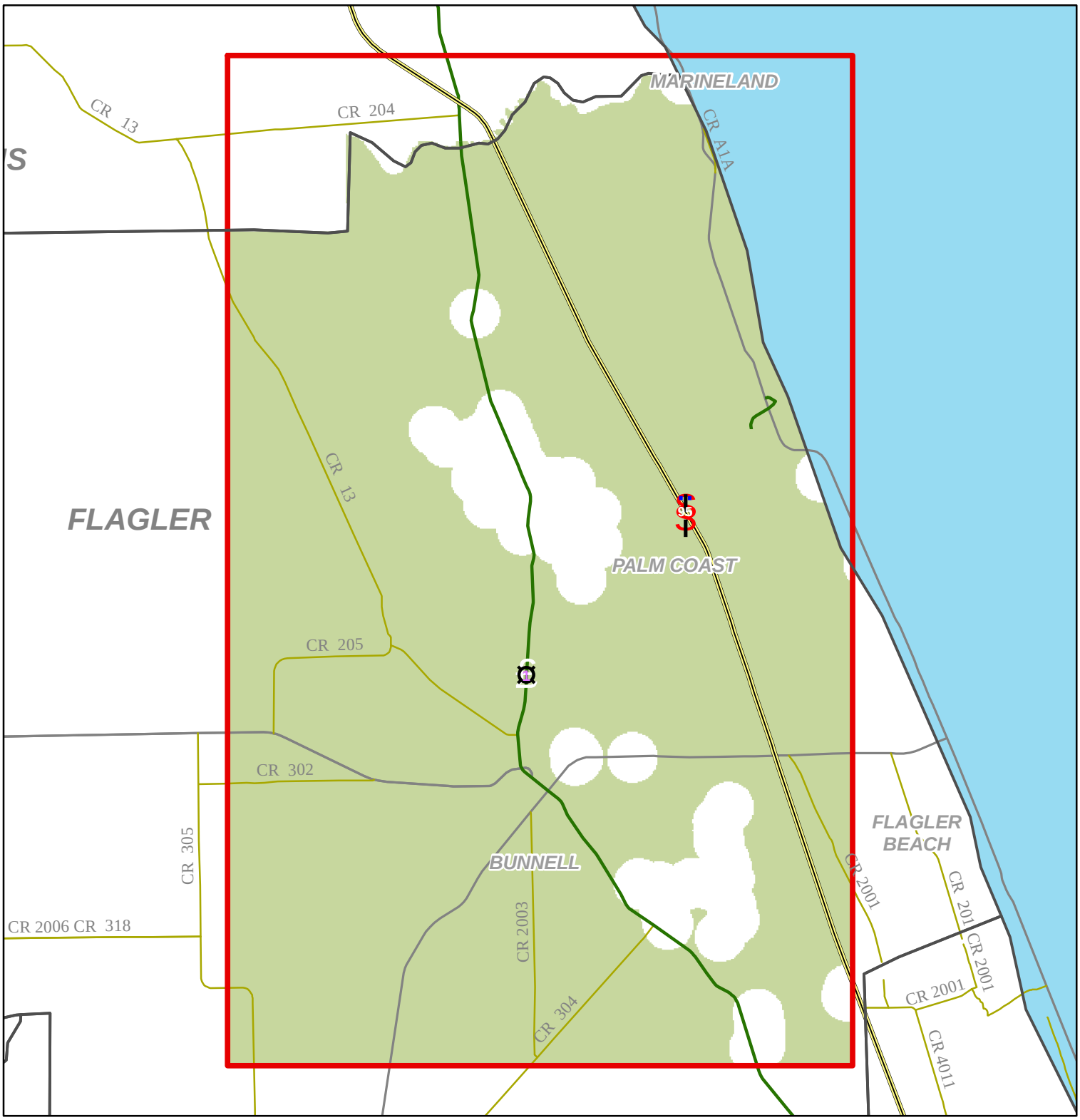
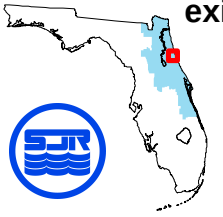


Figure 10. Areas available for potential new wells in the confined surficial aquifer based on existing wells



1 0.5 0 1 Miles

1:170731

Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary
- Available

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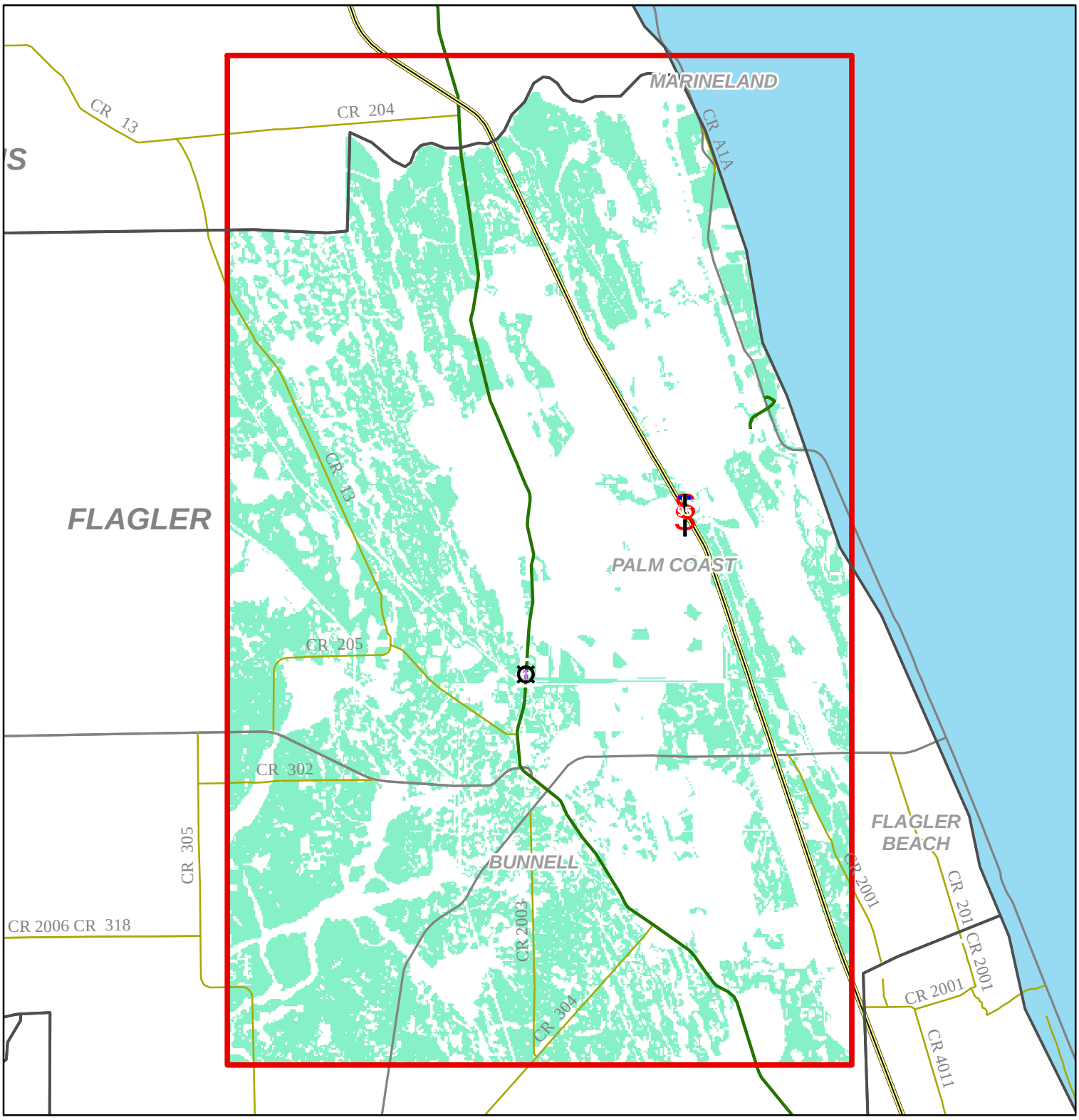
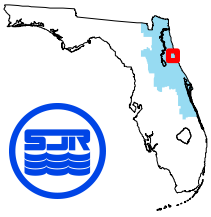


Figure 11. Composite filtering for confined surficial aquifer



1 0.5 0 1 Miles

1:170731

Legend

Results of filtering analysis

- Available areas for new wells
- County Boundaries
- Palm Coast Groundwater Model Boundary

Note: The filtering layers were combined to exclude areas based on the location of unsuitable features. Areas in green may be available for the location of potential new wellfields.

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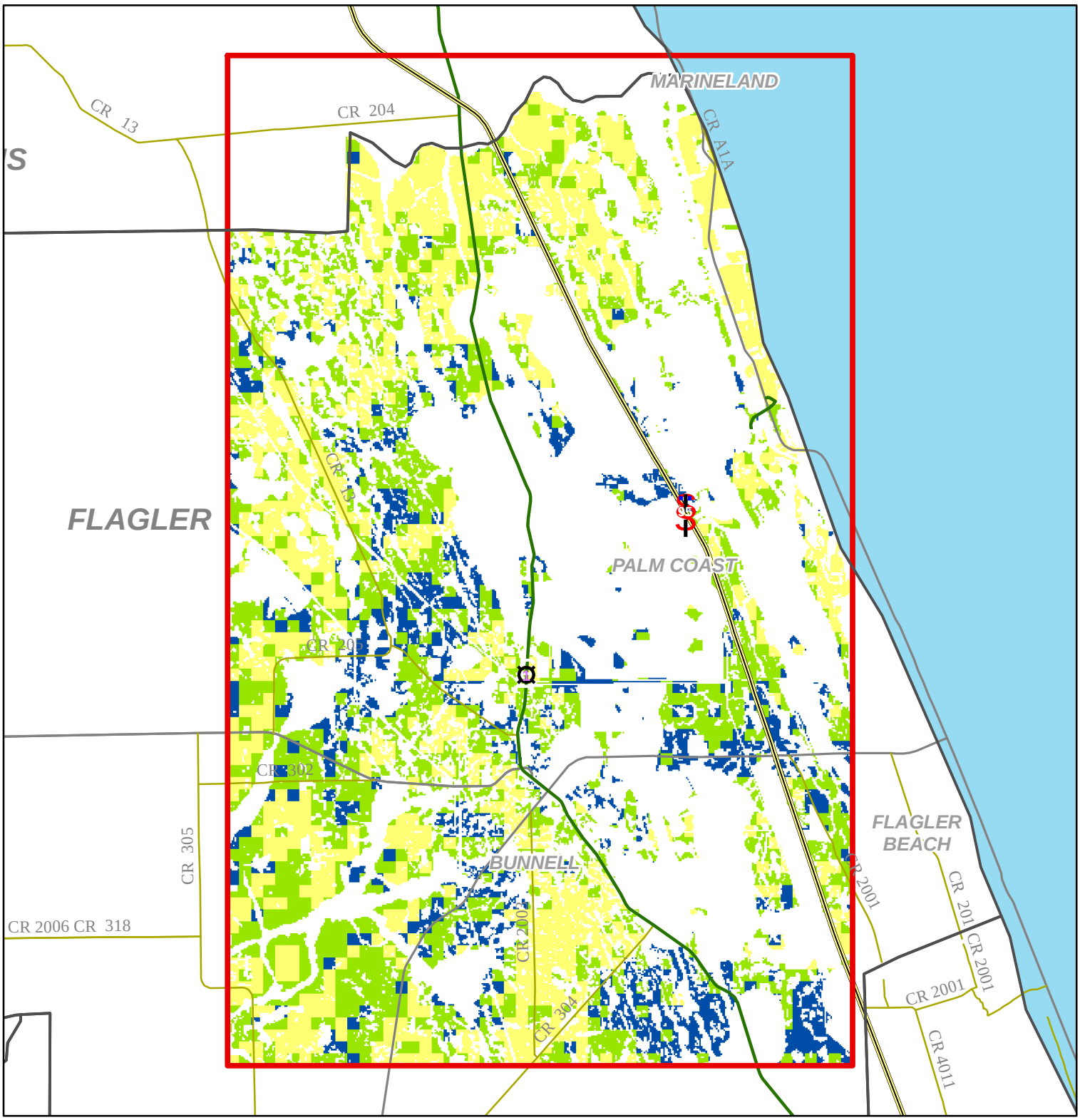
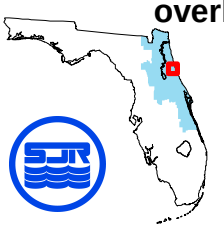


Figure 12. Potential new well sites of the confined surficial aquifer after combining hydrogeologic overlay and filtering analyses



1 0.5 0 1 Miles

1:170731

Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary

Potential confined surficial new wells sites

- 0.50 - 0.60
- 0.61 - 0.76
- 0.77 - 1.00 Best

Note: Most desirable potential new wellfield sites are shown in blue.

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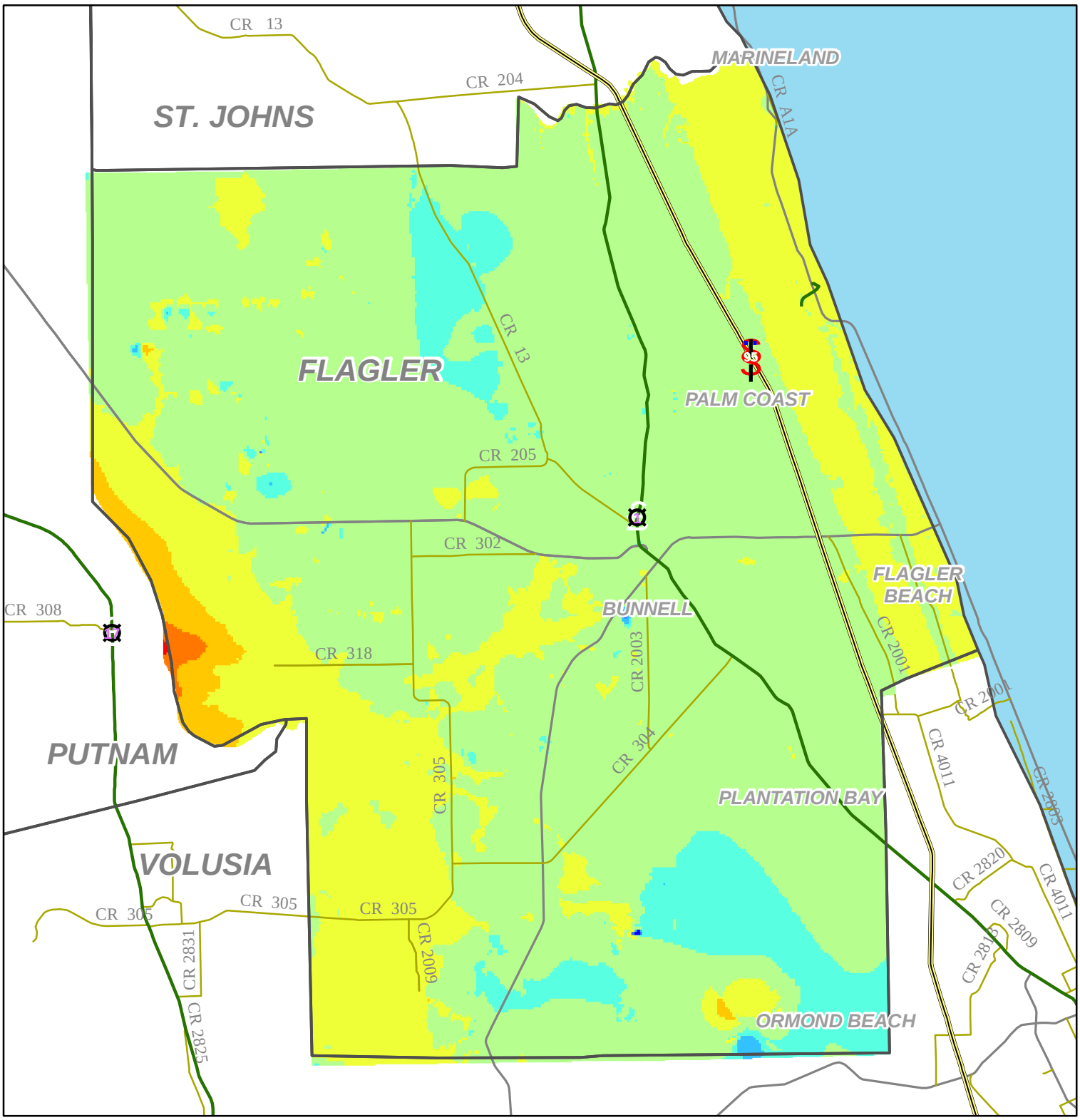
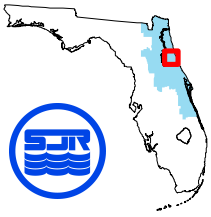


Figure 13. Recharge to the Upper Floridan aquifer



2 1 0 2 Miles

1:241868

Legend

County Boundaries

Upper Floridan aquifer recharge (in./yr)

- -16 - -15
- -14 - -10
- -9 - -5
- -4 - 0
- 1 - 5
- 6 - 10
- 11 - 15
- 16 - 20
- 21 - 25

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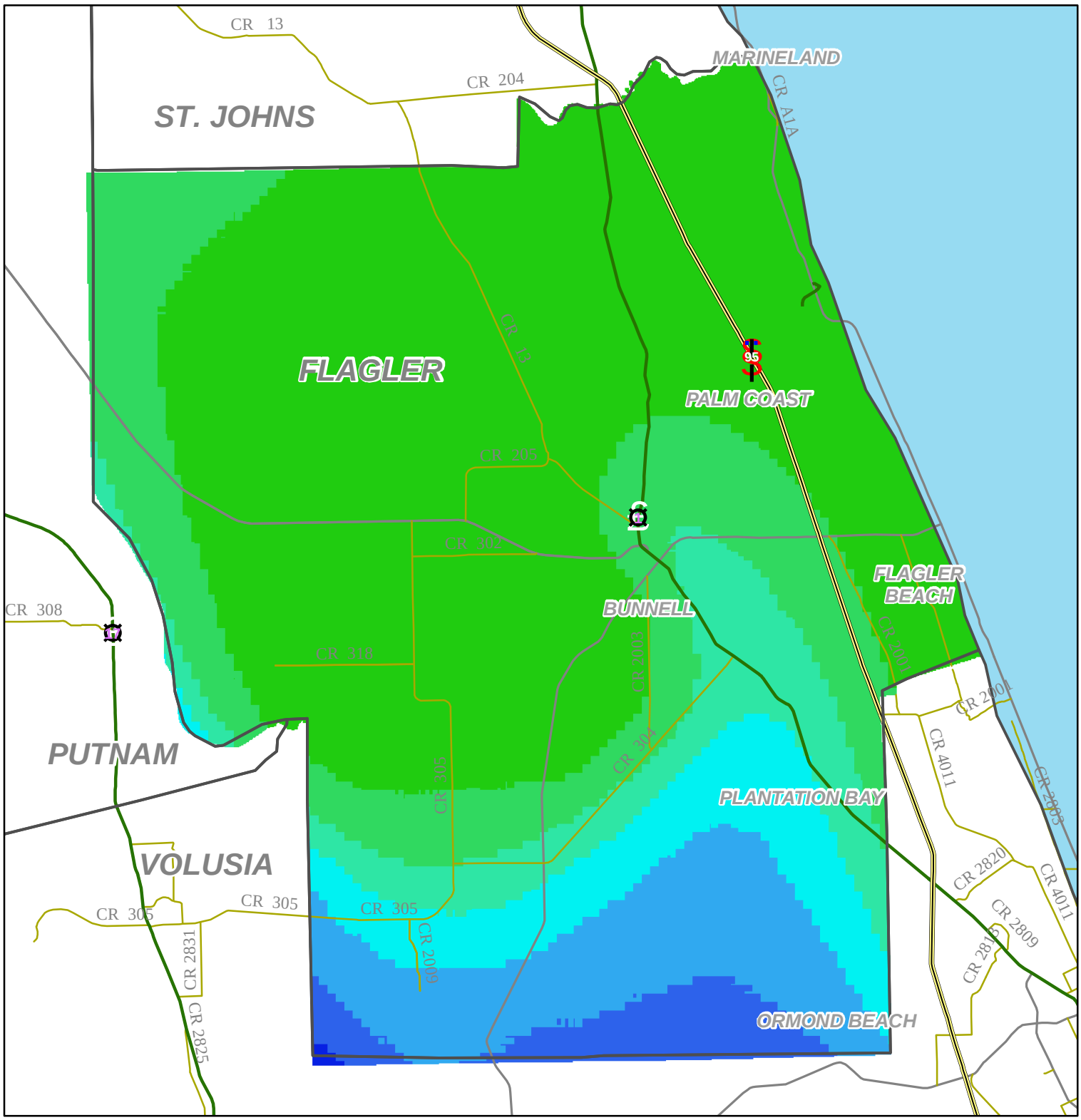
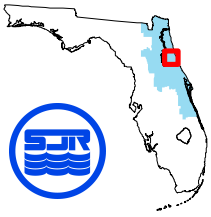


Figure 14. Thickness of fresh water in the Upper Floridan aquifer



2 1 0 2 Miles

1:241868

Legend

County Boundaries

Thickness of fresh water in UFA (ft)

- -3 - 150
- 151 - 300
- 301 - 450
- 451 - 600
- 601 - 750
- 751 - 900
- 901 - 1,050

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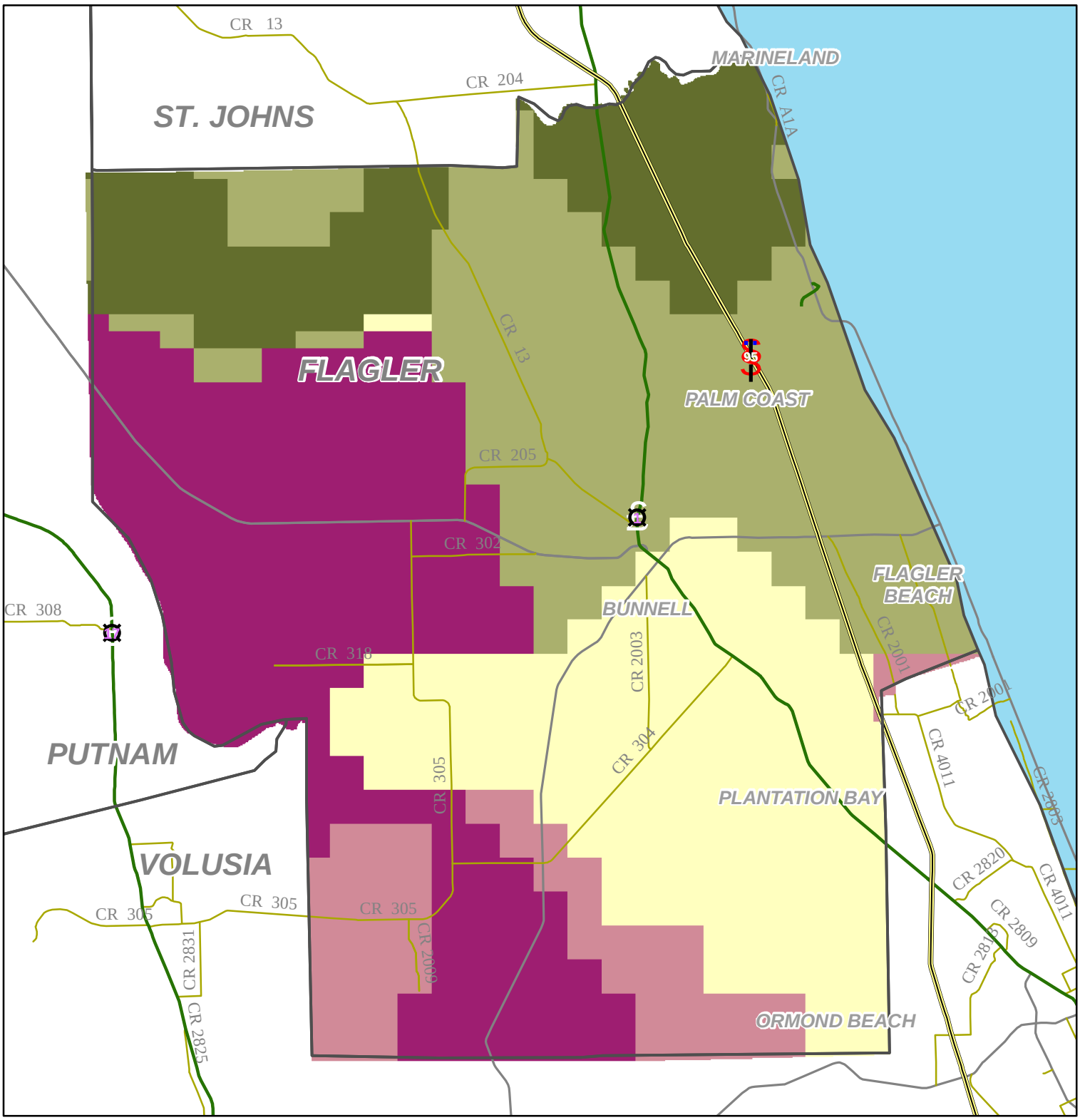
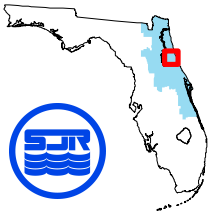


Figure 15. Transmissivity of the Upper Floridan aquifer



2 1 0 2 Miles

1:241868

Legend

County Boundaries

UFA transmissivity (sq ft/d)

- 17,249 - 22,765
- 22,766 - 30,579
- 30,580 - 42,071
- 42,072 - 77,007
- 77,008 - 134,468

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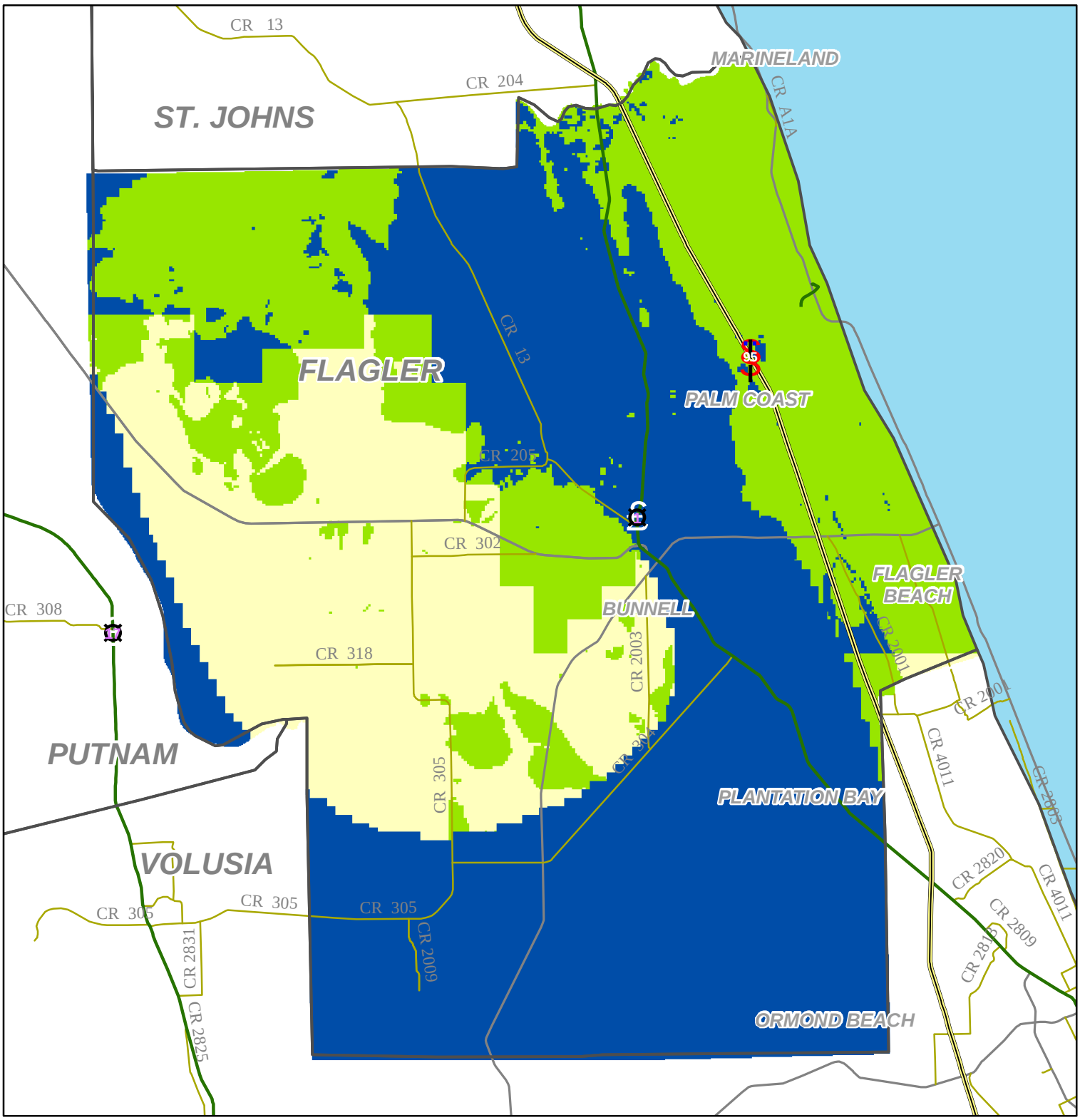
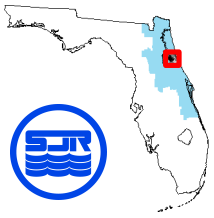


Figure 16. Results of the Upper Floridan aquifer hydrogeologic overlay analysis



2 1 0 2 Miles

1:242324

Legend

County Boundaries

UFA Overlay Results

- 0.5
- 0.5 - 0.67
- 0.67 - 1

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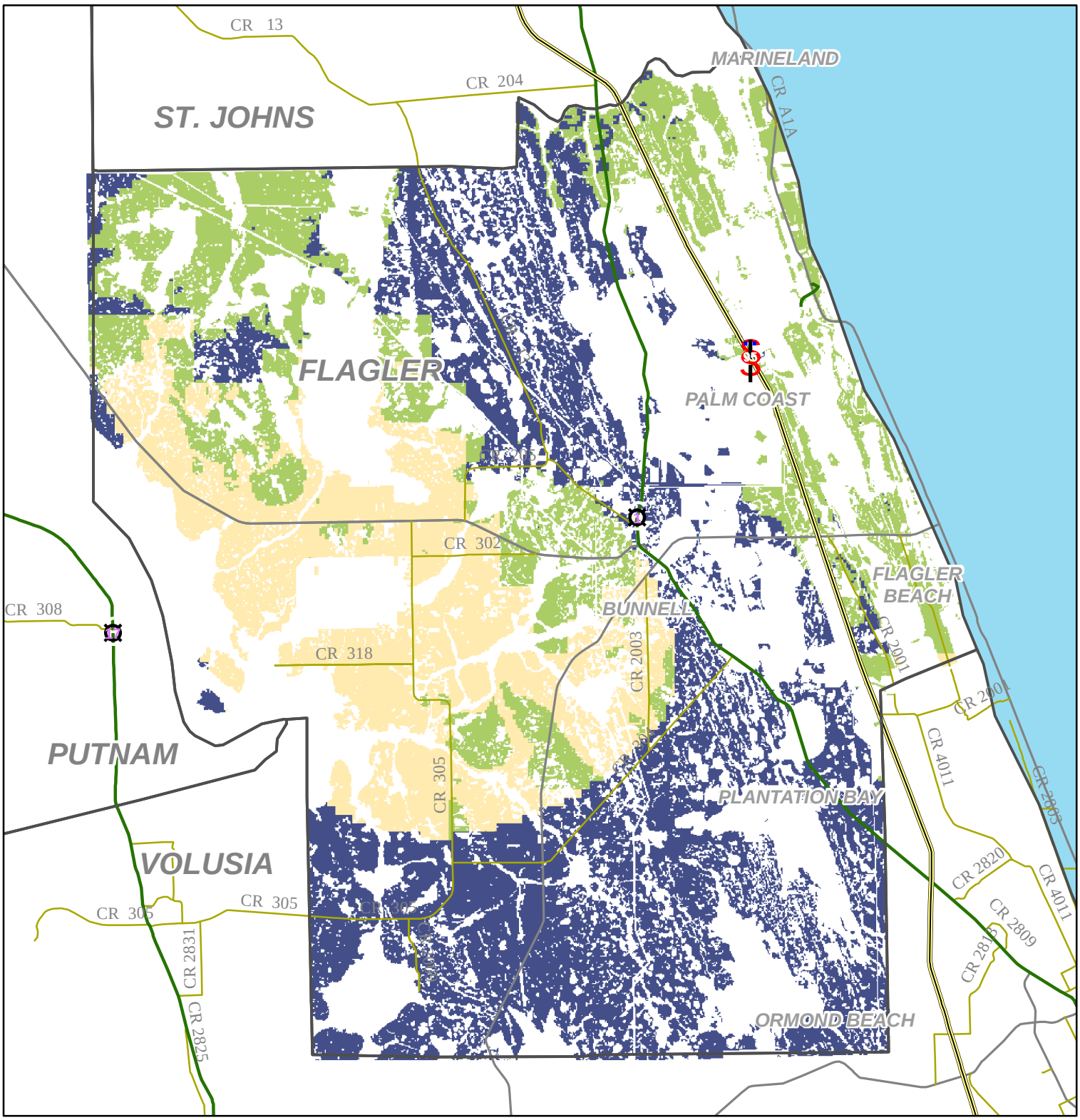
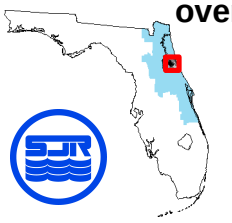


Figure 17. Potential new wells sites of the Upper Floridan aquifer after combining hydrogeologic overlay and filtering analyses



2 1 0 2 Miles

1:242324

Legend

County Boundaries

UFA overlay filter results

- 0
- 0 - 0.5
- 0.5 - 0.67
- 0.67 - 1

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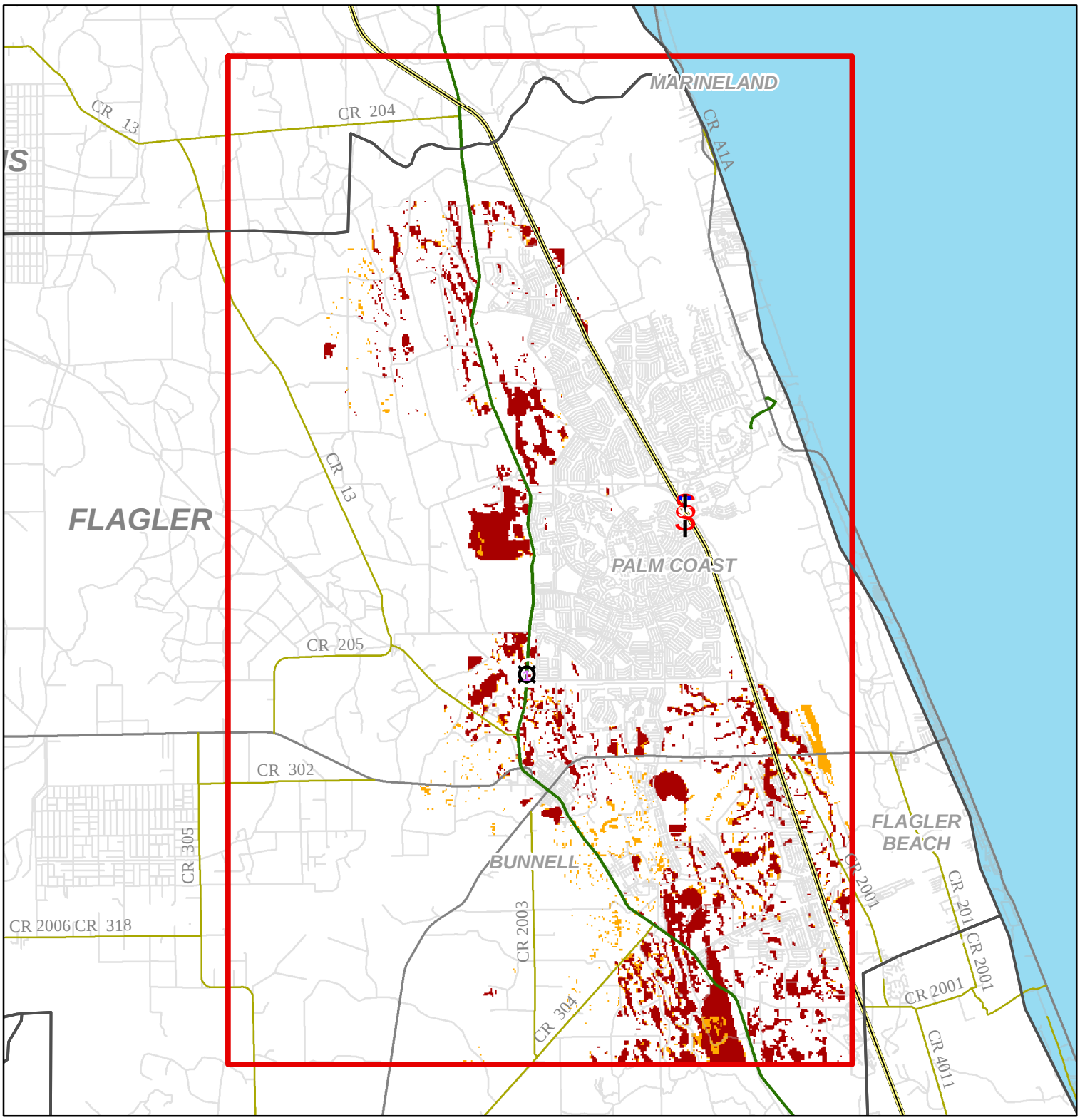
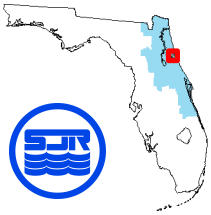


Figure 18. Extent of wetlands potentially harmed by public water supply withdrawals through 2011



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County Boundaries

Palm Coast Groundwater Model Boundary

Potential 2011 harm to wetlands

Low

Moderate

High

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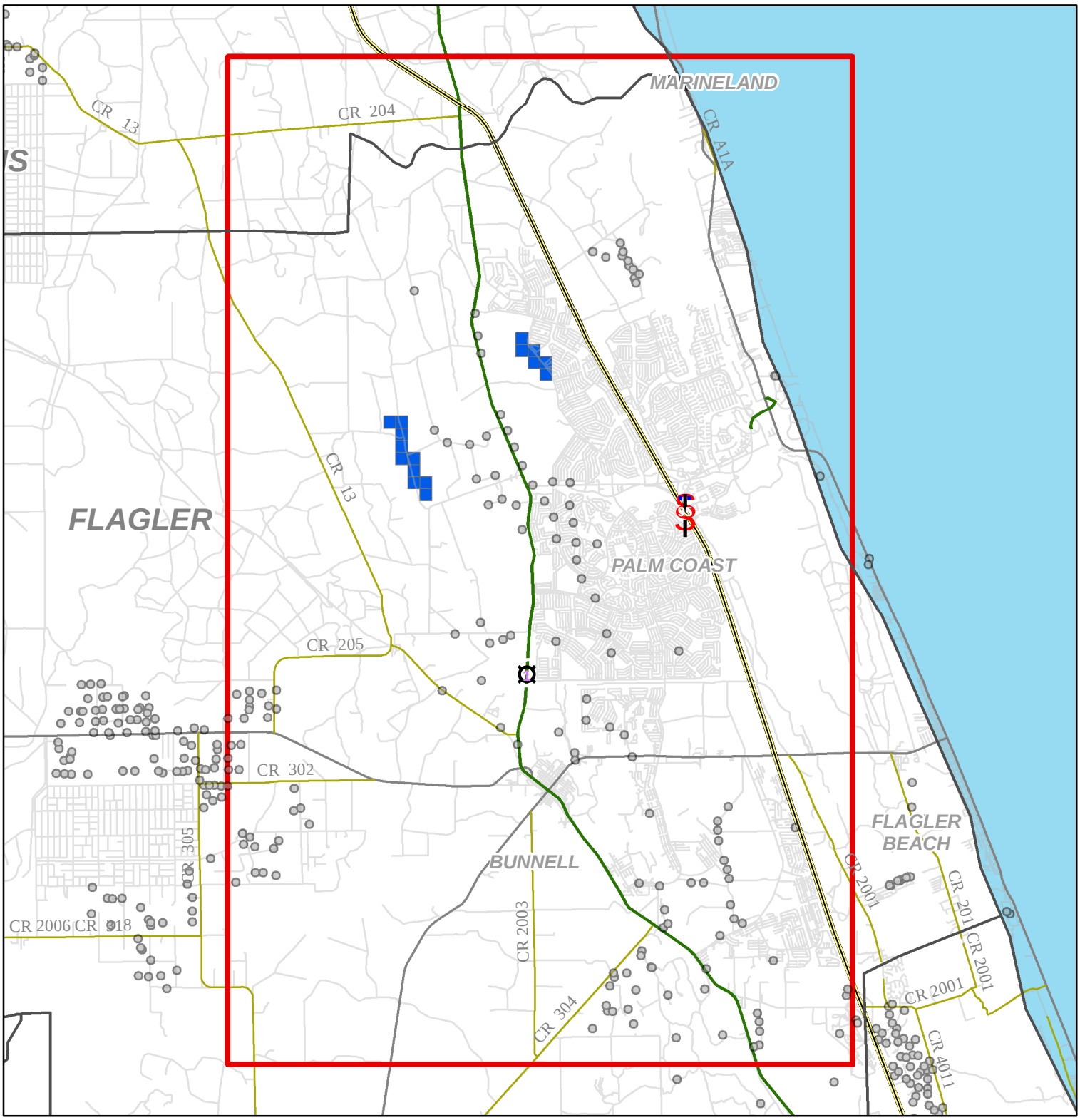
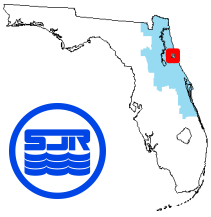


Figure 19. Potential wellfield areas in the confined surficial aquifer (Simulation 4)



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Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary
- Existing wells
- Proposed new confined surficial wells

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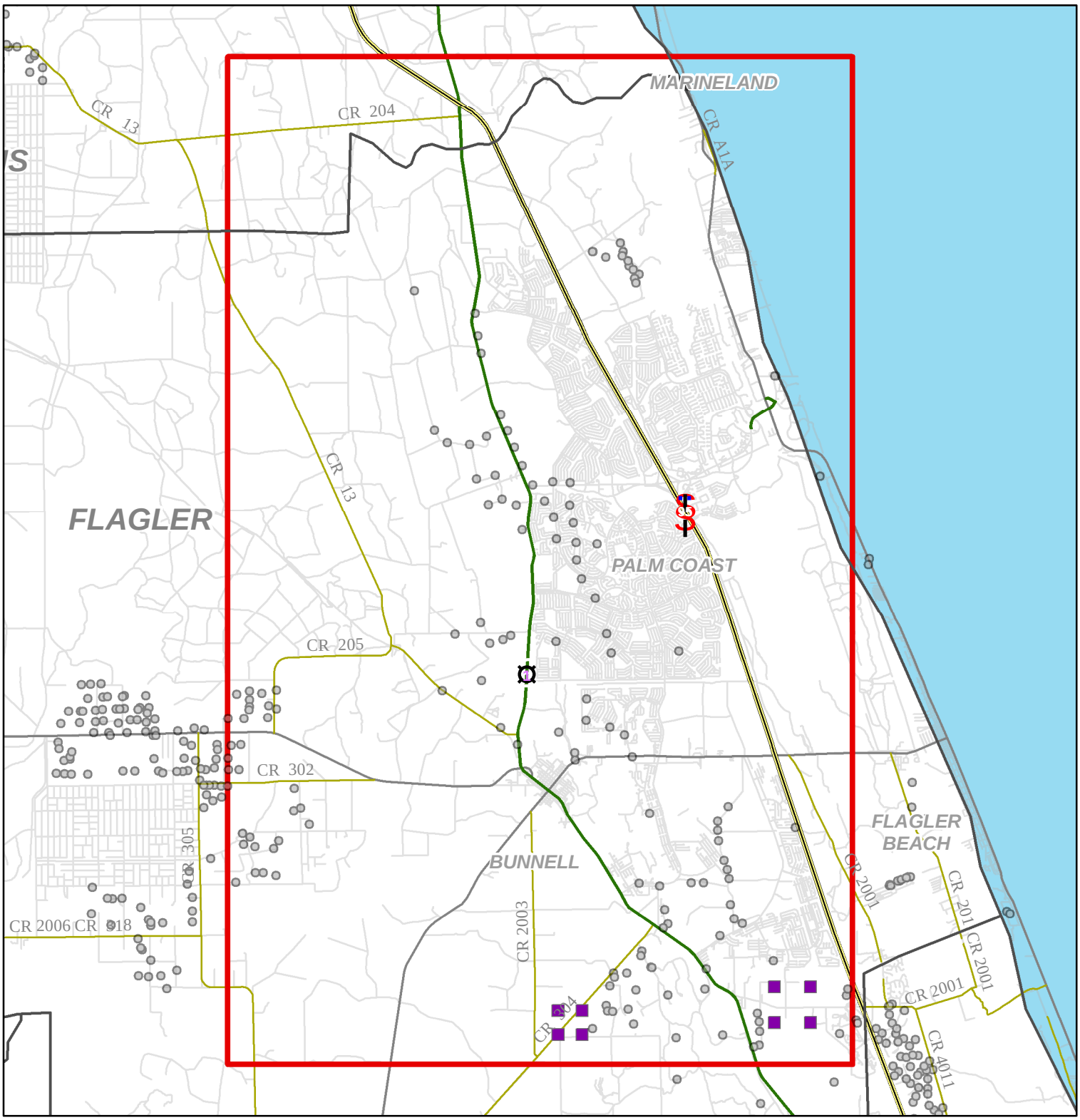
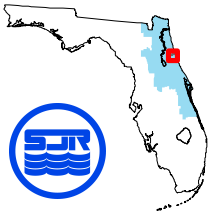


Figure 20. Potential wellfield areas in the Upper Floridan aquifer (Simulation 5)



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Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary
- Existing Wells
- Proposed Upper Floridan aquifer wells

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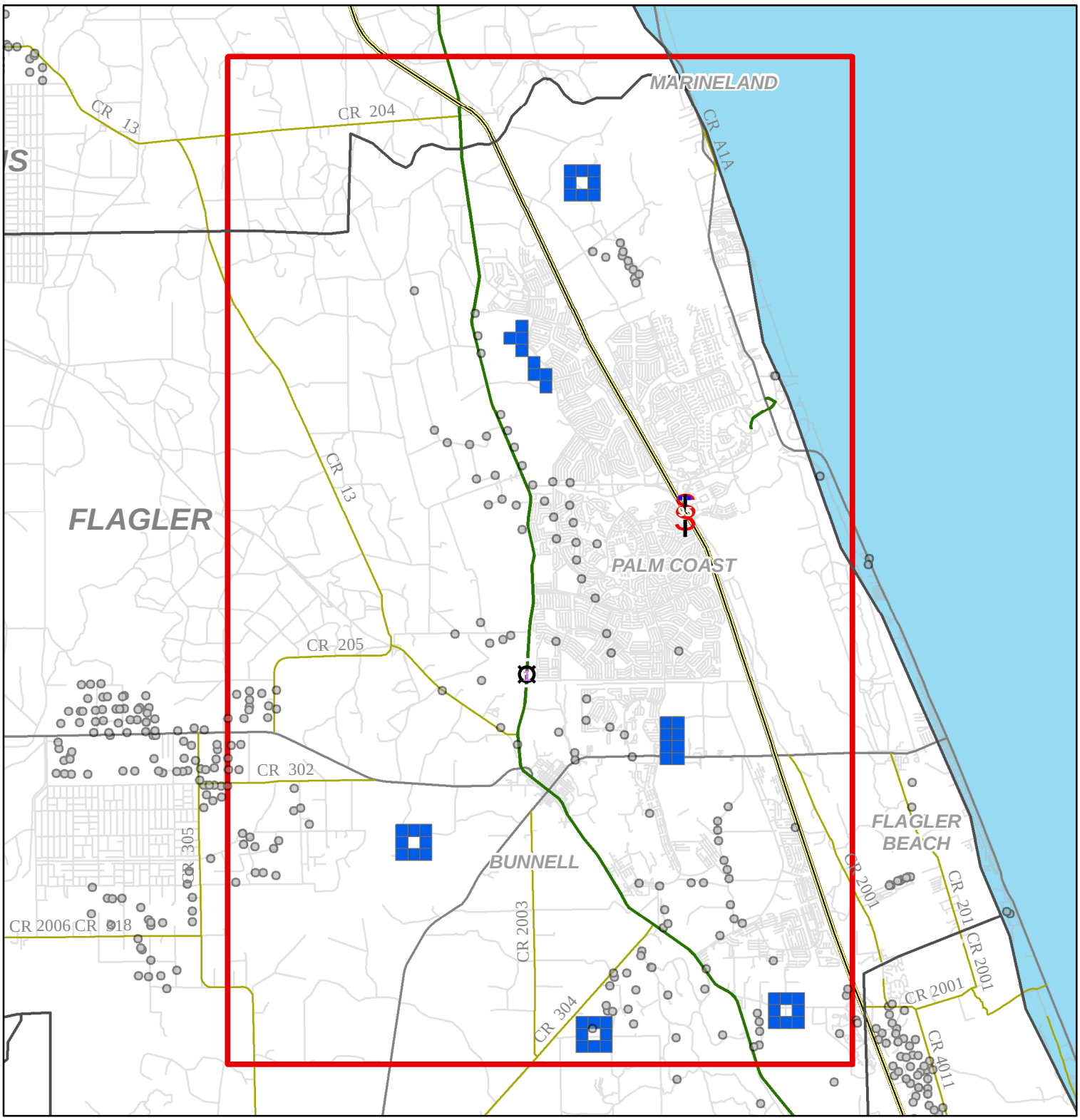
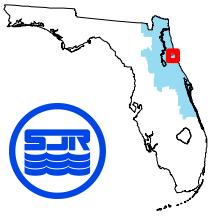


Figure 21. Potential wellfield areas in the Upper Floridan aquifer (Simulations 6 through 11)



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Legend

- County Boundaries
- Palm Coast Groundwater Model Boundary
- Existing Wells
- Proposed Upper Floridan aquifer well field sites

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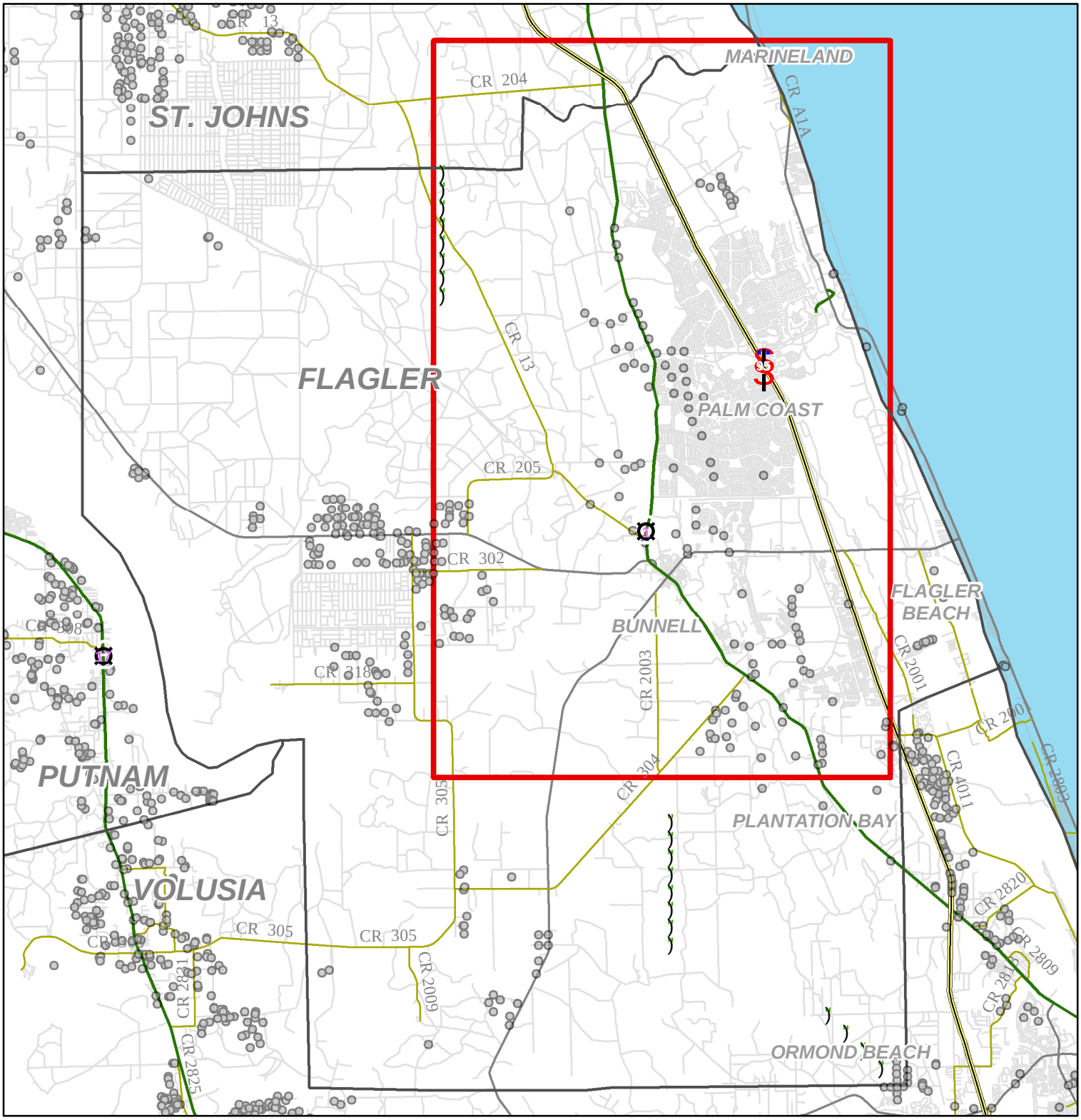

Figure 22. Potential wellfield areas in the confined surficial and Upper Floridan aquifers (Simulations 13 through 15)

Legend

- County Boundaries
- Palm Coast Ground Water Model Boundary
- Existing wells
- Proposed well field areas

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TABLES

Table 1. Comparison of Potential Wetland Harm with Palm Coast and NE Florida Models

SIMULATION	PS Withdrawals from existing locations CS/UF (mgd)	New Alternative PS Withdrawals (mgd)	Total PS Water Developed	Future PS Needs Met	Wetland Acres Impacted Within Palm Coast Model Boundary	Wetland Acres Impacted within Flagler County (NEF Model)	Wetland Acres Impacted Above Baseline	Rank of Scenario
Palm Coast Model Simulations								
Projected 2025 water use for all categories (Using Palm Coast Model)	5.38/15.95	0	21	Yess	9217		5657	6
1: Public water supply in Palm Coast Model domain at 2011 permitted and anticipated rates (Base Line for Palm Coast Model Boundary)	5.92/5.91	0	12	No	3560			
2: Palm Coast, Flagler Beach and Bunnell increased to 50% of 2025 demand	2.69/7.98	0	11	No	5063		1503	
3: Palm Coast increased to 70% of 2025 demand for Confined Surficial and 60% for Upper Floridan	3.76/9.23	0	13	No	7779		4219	
4: Sim 3 plus 4 mgd from each of 2 Confined Surficial Sites	3.76/9.23	4	17	No	9323		5763	
5: Sim 3 plus 4 mgd from each of 2 Fresh Upper Floridan Sites (Scenario A Locations)	3.76/9.23	8	21	Yes	8389		4829	4
6: Sim 3 plus 8 mgd from Brackish Upper Floridan Site 1	3.76/9.23	8	21	Yes	10430		6870	7
7: Sim 3 plus 8 mgd from Brackish Upper Floridan Site 2	3.76/9.23	8	21	Yes	10919		7359	8
8: Sim 3 plus 8 mgd from Brackish Upper Floridan Site 3	3.76/9.23	8	21	Yes	11013		7453	9
9: Sim 3 plus 8 mgd from Brackish Upper Floridan split among Sites 1, 2 and 3	3.76/9.23	8	21	Yes	14146		10586	10
10: Sim 3 plus 4 mgd from Brackish Upper Floridan Site 4	3.76/9.23	4	17	No	8308		4748	
11: Sim 3 plus 8 mgd from Brackish Upper Floridan Site 4	3.76/9.23	8	21	Yes	9155		5595	5
NEF Model Simulations								
12: Same as Sim 1 using NE Florida Model (Base Line for Flagler County using NEF Model)	5.92/5.91	0	12	No	3560*	5587*		
13: Sim 1 pumpage plus 8 mgd from Northern Wellfield in Brackish Upper Floridan Aquifer	5.92/5.91	8	20	Yes	6497*	9650*	4063*	3
14: Sim 1 pumpage plus 8 mgd from Southern Wellfield in Fresh Upper Floridan Aquifer	5.92/5.91	8	20	Yes	3972*	8336*	2749*	1
15: Sim 1 pumpage plus 4 mgd from Northern Wellfield in fresh Surficial Aquifer and 4 mgd from Ormond Beach Wellfield extension in Fresh Upper Floridan	5.92/5.91	8	20	Yes	4388*	8795*	3208*	2

Notes:

* NEF Model wetland acreage have been adjusted for differences in conceptual model

APPENDIX G

Use of Wetland Hydration to Extend Groundwater Availability

Watershed Connections, Inc.

TECHNICAL MEMORANDUM

Use of Wetland Hydration to Extend Groundwater Availability

PREPARED FOR: SJRWMD

PREPARED BY: Bill Dunn and Ron Wycoff

DATE: July 10, 2007

Introduction

The contributors of the Flagler County Water Supply Planning process have asked ARCADIS and the St. Johns River Water Management District (SJRWMD) to investigate the potential for using surface water to mitigate or avoid unacceptable adverse impacts to wetland vegetative communities from the withdrawal of groundwater for current and future public water supply needs. This technical memo presents part of a step-wise analysis to identify strategies to provide for public water supply while avoiding potential environmental impacts. The three components of the overall analyses are as follows: 1) determine the potential location and magnitude of expected impacts (presented in ARCADIS' Subtask G2 Memo), 2) estimate anticipated rehydration or augmentation rates and volumes, and 3) identification of potential sources and volumes of water available for rehydration.

Purpose

This investigation is a conceptual, planning level analysis of the technical and economic feasibility of using canal water as a source to augment water levels in wetlands that are projected to be adversely affected by increased groundwater withdrawals. If one or more wetland rehydration option is determined to be technically feasible, then planning level cost estimates will be developed based on a conceptual design of the project.

Technical Approach

This feasibility analysis proceeded in the following steps:

1. Define the extent of the management problem: Identify areal extent of wetlands projected to experience moderate to higher likelihood of vegetative harm due to groundwater withdrawal scenarios for 2011 and 2025.
2. Estimate the amount of water needed for wetland rehydration based on the areal extent of wetland projected to be harmed.

3. Estimate the amount of surface water that can be diverted from the Lehigh Canal system, then determine whether supply will meet or exceed the rehydration demand.

4. If augmentation is determined to be technically feasible (i.e., supply exceeds demand), then develop a conceptual design and planning level cost estimate for a wetland hydration system for comparison to other water supply options developed in the Flagler Water Supply Plan (WSP).

The feasibility assessment proceeded sequentially, an early Go/No Go decision was to determine whether available supply would meet or exceed the 2011 rehydration demand. If supply cannot meet the projected rehydration demand, then there is no need to develop conceptual project design and planning level cost.

Identification of Wetlands Projected to Experience Moderate to High Likelihood of Harm

The wetlands with a moderate to high likelihood of experiencing unacceptable harm to vegetative communities due to additional groundwater withdrawals were identified using the Kinser-Minno (KM) method developed by SJRWMD staff (Kinser et al. 1995, 2003, and 2006). The KM method uses modeled estimates of drawdown in the surficial aquifer system (SAS) coupled with a GIS analysis to identify wetland areas most vulnerable to impacts from groundwater withdrawals. The likelihood for vegetative harm was projected for the 2011 and 2025 pumping scenarios.

Estimate of the Wetland Rehydration Demand

The actual volume and application rate needed for wetland rehydration in the Palm Coast area was estimated in several ways. First using the SJRWMD Palm Coast Model an estimate of the recharge from the SAS induced by the additional groundwater pumping under the 2011 scenario was made. Next, a brief literature review was done to compile application rates used for a number of existing and past wetland rehydration projects in SJRWMD and SWFWMD.

Estimate of Amount of Water Available from the Palm Coast Canal System

Arcadis' (2007) evaluation of potential surface water supply sources in Flagler County included an assessment of the Lehigh Canal. The mean discharge from the canal system was determined to be 24 cfs (15.5 MGD). The analysis projected that a mean daily flow of 3 MGD can be diverted from the canal system; this value was used as the upper limit of flow that could be diverted for wetland augmentation. Surface water discharge in the canal is controlled by a series of structures that were designed to maintain groundwater levels after the canals were built. Therefore, the canal network provides surface water storage as well as stormwater conveyance and flood protection.

Development of Conceptual Design and Planning Level Cost Estimate

If wetland hydration proves to be technically feasible from the supply end, then a conceptual design and schematic layout of the component facilities will be done. A preliminary, planning level cost for construction and operations and maintenance (O&M) of the rehydration system will also be developed. Costing will be done using protocols

developed by SJRWMD for regional and districtwide water supply planning. The systems' design, layout and costing will be done as a desktop exercise; no site-specific investigations, ground truth, or siting surveys will be done at this point in the evaluation process.

Results

Projection of Harm

Flagler County has an extensive system of wetlands (102,053 acres mapped in 1995 by SJRWMD) that may potentially be impacted by the continuing development of groundwater resources, (Figure 1). Potential impacts to wetland communities were estimated using SJRWMD's ground-water flow model for Palm Coast area and the District's KM method for estimating the likelihood of harm to native vegetation from groundwater withdrawals (Kinser, Minno 1995 – SJ95-8). The projected surficial aquifer drawdown was incorporated in the KM method for identifying the wetlands likely impacted due to these drawdowns, with consideration for the underlying soils and wetland types and there relative sensitivity to these declines.

Based on this analysis, areas in and around Palm Coast were identified as having the likelihood of experiencing unacceptable levels of vegetative harm in wetlands.(Figures 2 and 3). Table 1 provides a summary of the affected areas. For the 2011 pumping scenario approximately 800 acres are projected to experience moderate to higher likelihood of vegetative harm.

Table 1. Estimated Wetland Harm for 2011 and 2025 groundwater pumping scenarios.

Withdrawal Scenario	Lower Harm (ac)	Moderate Harm (ac)	Higher Harm (ac)
2011	42,734	220	567
2025	61,928	972	3,410

Rehydration Demand

The actual volume and application rate needed for wetland rehydration in the Palm Coast area was estimated in several ways. First, using the Palm Coast Model an estimate of the recharge from the surficial aquifer system (SAS) induced by the additional groundwater pumping under the 2011 scenario was made. Next, a brief literature review was performed to compile application rates used on existing and past wetland rehydration projects in SJRWMD and SWFWMD.

Patrick Burger/SJRWMD used the Palm Coast Model coupled with GIS analysis to estimate the rehydration requirement. Following is a description of this analysis.

First, the surficial aquifer drawdown was calculated using the Palm Coast Model with the 2011 and 2025 projected public supply withdrawals. The projected surficial aquifer drawdown was then incorporated in the KM method for identifying the wetlands likely impacted due to these drawdowns, with consideration for the underlying soils and wetland types and there relative sensitivity to these declines (Figures 2 and 3).

Assumptions:

1. Annual volume of water removed from the surficial aquifer (i.e., increased recharge) is equivalent to the water required for hydration.
2. Wetland systems in Port Orange are roughly similar to systems in Flagler County and would require similar rehydration schedules
3. Wetland systems present in 1995 are representative of existing systems needing rehydration.
4. Majority of impacts to wetlands take place within the boundary of the Palm Coast Model (Palm Coast Model total wetland acres = 43,574).

Then using GIS and the location of the potentially impacted wetlands, the surficial aquifer drawdowns were intersected with the impacted wetlands to calculate a volume of water past the minimum allowable drawdown of 0.35 feet identified by KM. This volume was further reduced by the estimated porosity of the aquifer matrix material because the removal of water was actually taking pace in the aquifer system.

Table 2 provides a summary of the range of potential hydration rates for the target wetlands in Flagler County. The first two rows in Table 2 are related. The first row contains the rehydration demand calculated by Patrick Burger using the Palm Coast Model. Based on model results, approximately one foot of water per unit area of wetland would be lost as induced seepage due the 2011 additional groundwater pumping. This estimate is based on several assumptions and has a degree of uncertainty. Due to the uncertainty the second row adds a safety factor of 2 to the modeled hydration estimate. The three entries in the table list hydration rates used on rehydration projects in SJRWMD and SWFWMD. The Tillman Ridge and Port Orange projects are wetland rehydration pilot projects sponsored and funded by SJRWMD (CH2M HILL 2006a and 2006b). The final entry in the table is for Tampa Bay Water (TBW) projects. TBW through its predecessor the West Coast Regional Water Supply Authority began wetland rehydration projects on well fields in the northern Tampa Bay area in the 1980's. Several of the TBW rehydration projects were inspected when SJRWMD was developing its pilot projects (CH2M HILL 1997). The value listed for TBW projects, 4 feet per year, is at the upper end of the application rates used by TBW.

These rehydration rates cover a very wide range with the upper end being approximately equal to the annual rainfall in north and central Florida. The high rates would be expected to be needed for wetlands known to be very leaky due to a lack of any significant confining layer. The target wetlands are not assumed to be highly leaky so the high rate of application is not expected to be needed. For design purposes it is expected that an application rate of 2 feet per year will be adequate to meet the rehydration demand. For 800 acres of wetlands this rate translates to a flow of 1.43 million gallons per day (MGD), and 521 MG per year.

Table 2. Estimated rehydration rates and projected demand for 800 acres of wetlands.

Source for Augmentation Rate Estimate	Water Application Rate		Supply Needed for 800 acres of Wetlands	
	Ft/ac/yr	Million Gallons/ac/yr	Average Yearly (MGY)	Average Daily (MGD)
SJRWMD Flagler Wetlands	**1**	**0.33**	**261**	**0.71**
Flagler Hydration with 2X Safety Factor	**2**	**0.65**	**521**	**1.43**
Tillman Ridge Project	**1**	**0.33**	**261**	**0.71**
Port Orange Project	**4**	**1.30**	**1043**	**2.86**
Tampa Bay Water Projects	**4**	**1.30**	**1043**	**2.86**

Lehigh Canal Water Supply Yield

Surface water discharge in the Lehigh Canal system is controlled by a series of structures that were designed to provide flood protection as well as maintain groundwater levels after the canals were built. USGS gage no. 02247258 is located on Lehigh Canal east of Interstate 95 with records from May 1998 to the present.

Arcadis' (2007b) evaluation of potential surface water supply sources in Flagler County included an assessment of the Lehigh Canal. The average flow (according to gage records) is 24 cfs, or 15.6 mgd. Arcadis projected that a mean daily supply of 3 MGD can be obtained from a diversion of about 20% of the canal system's annual flow with a 200-acre storage reservoir. For this analysis, however, it is assumed that flow diversion from the canal is not limited to 20% of mean annual flow, and that 3 MGD is available from the canal system without the need for additional storage. That is, it was assumed that existing in-system canal storage would be sufficient to supply the desired rehydration water. The 3 MGD value was used as the upper limit of annual flow that could be diverted for wetland rehydration.

Conceptual Design of Wetland Rehydration System

The conceptual design and layout of the rehydration system was developed with several starting assumptions:

- Because the target wetlands are spread over a large area, several pump station and conveyance systems will be needed to deliver water to all clusters of wetlands.
- Surface water will be pumped from withdrawal points in the canal system directly into the conveyance system.
- Canal withdrawal points will be located as close as possible to the clusters of wetlands.

- Conveyance system will consist of primary piping to convey water from the withdrawal point to the vicinity of a given wetland cluster. A secondary set of small pipes will be used as headers to distribute water within the wetlands.
- Pipeline routes will generally follow roadways. No ground-truthing of the routes will be done at this stage of the feasibility evaluation.
- A storage reservoir will not be required to operate the rehydration system.
- No treatment will be required for the water discharged into target wetlands.
- Component facilities will be sized to carry peak flows.

Conceptual Design and Schematic Layout of Component Facilities

The wetlands identified in the 2011 harm analysis are spread throughout the project area (Figure 2), although there are several major clusters. As a preliminary design step the target wetlands were grouped into eight clusters (Figure 4). Using aerial photos and maps of the canal system, potential canal withdrawal points and conveyance system routes were identified for each cluster. It was then determined that the withdrawal and conveyance systems for some adjacent clusters could be combined providing for greater efficiency. The eight wetland clusters were subsequently grouped into four projects (Figure 5). Table 3 provides a summary of the wetlands clusters grouped into the four projects (A, B, C, and D), the total wetland area and the estimated hydration rate.

Table 3 . Wetlands grouped into four augmentation projects, A, B, C and D. The wetland area, annual average re-hydration rate, and conveyance system design capacity is provided for each wetland area and project.

Project	Area Designation	Approximate Impacted area in acres	Required re-hydration Rate	
			Annual Average _ ADF - mgd	Design delivery capacity – mgd
A	1	200	0.357	0.714
	2	200	0.357	0.714
	3	162	0.289	0.578
	Project subtotals	**562**	**1.003**	**2.007**
B	4	30	0.054	0.107
	Project subtotals	**30**	**0.054**	**0.107**
C	5	21	0.037	0.075
	6	64	0.114	0.229
	Project subtotals	**85**	**0.152**	0.304
D	7	33	0.059	0.118
	8	52	0.093	0.186
	Project subtotals	**85**	**0.152**	**0.304**
	System Totals	**762**	**1.360**	**2.721**

ADF = 24 inches per year =	1,785	gpd/ac
MDF = 48 inches per year =	3,571	gpd/ac

Figures 6 and 7 show the schematic layout for the four rehydration projects; Figure 6 shows the facilities configuration for projects A and B, while Figure 7 shows configurations for projects C and D. The component facilities for each project include a pump station, and piping for conveyance and distribution.

Planning level Cost Estimate

Conceptual, planning level opinions of probable costs were developed for the pumping and conveyance facilities required for each of the four rehydration projects. Costs estimates were developed using the protocols used by SJRWMD for regional and districtwide facilities costing in its water supply planning program (SJRWMD 2002). Table 4 summarizes costs for the four rehydration projects. Highlights of the cost estimate include:

- Estimated construction costs range from $0.44 M to $7.45 M with a total of $11.50 M for all four projects.
- The four projects require over 16 miles of piping and four pump stations to deliver water to 762 acres of wetlands.
- Total estimated capital cost for four projects is $14.3 M.
- Estimated annual O&M costs range from $5,000 to $55,000 per year for the individual projects with a total O&M $75,500/yr for the four projects.
- Unit production cost for the total rehydration system is estimated to be $2.02/Kgal with a range of $1.80 to $3.18 per Kgal for the individual projects.

Table 4 . Estimated rehydration system costs by project.

Project	Re-hydration Area in acres	Pipe Length in miles	Construction Cost $M	Capital Cost $M	O&M Cost $K/yr.	Unit Production Cost $/Kgal
A	562	8.79	$7.45	$9.32	$54.3	$1.80
B	30	0.77	$0.44	$0.55	$5.3	$2.09
C	85	3.72	$2.10	$2.63	$8.0	$3.18
D	85	2.74	$1.51	$1.88	$8.0	$2.33
TOTALS	762	16.02	$11.50	$14.37	$75.5	$2.02

Summary

The rehydration of approximately 800 acres of wetlands projected to experience unacceptable levels of vegetative harm under the 2011 groundwater withdrawal scenario is found to be technically feasible; the desktop assessments indicate that the available supply from the canal system exceeds the 2011 rehydration demand. Because the target wetlands are spread over most of the project area it was determined that a single hydration system was not feasible. Four separate hydration systems are proposed to provide a more efficient water delivery network to the eight clusters of wetland identified. For each of the four

rehydration projects a conceptual design, schematic layout, and cost estimate were developed.

This feasibility analysis should now be reviewed by the water supply utilities participating in the development of the Flagler WSP. If the utilities decide to move forward with further assessment of a wetland rehydration project then the next level of assessment should include, but not be limited to the following:

- Begin a series of meetings with the utilities to develop a preliminary design for the rehydration projects.
- Conduct additional investigations to confirm the location of withdrawal and conveyance facilities.
- Begin coordination with SJRWMD CUP permitting staff on how to implement a rehydration program within the CUP process.
- Confirm that the rehydration withdrawals will not affect the existing use of the canal system for golf course irrigation.
- Develop an annual water delivery schedule that provides a seasonal water discharge schedule defining targets for daily and weekly discharges for each month of the year.

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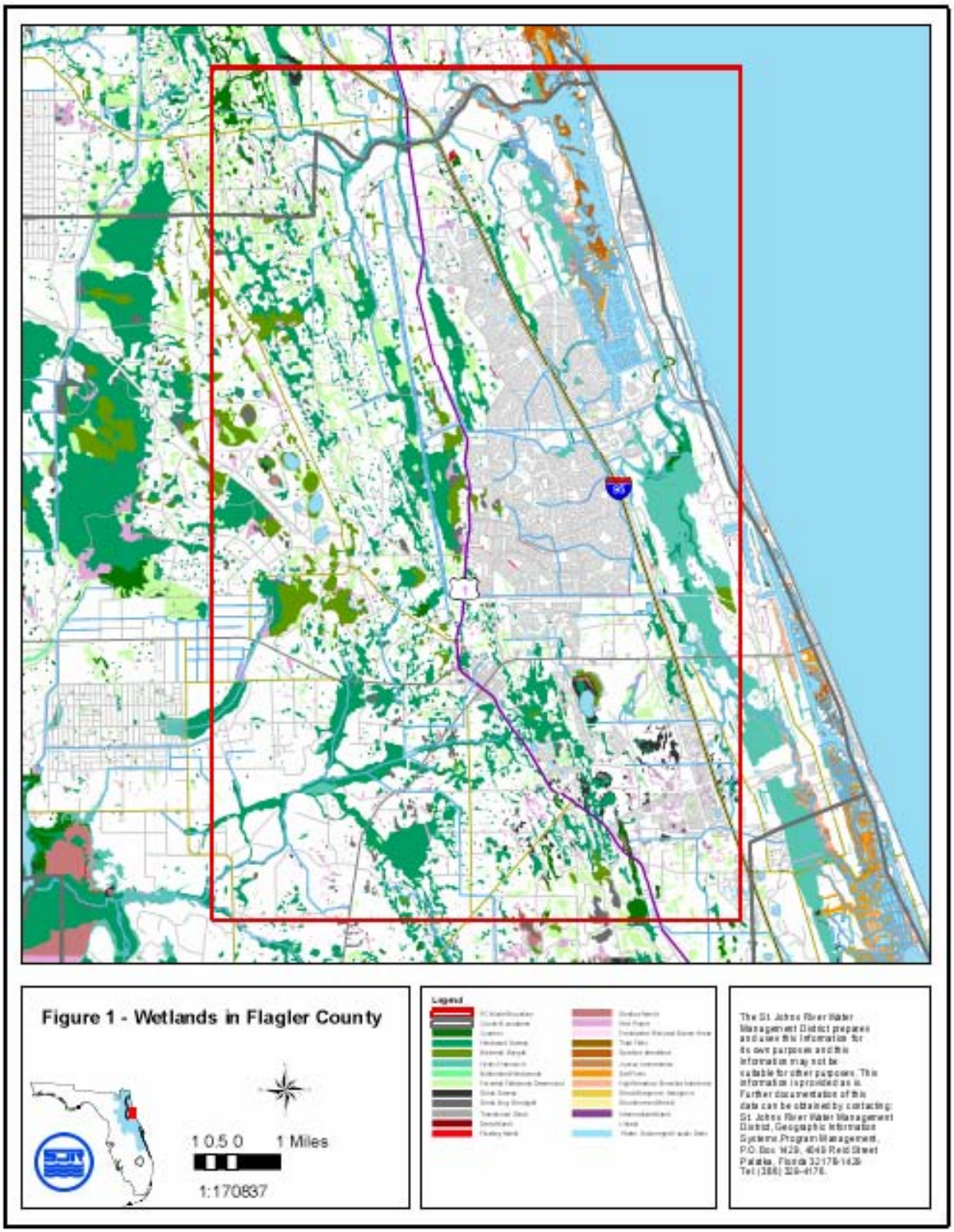

Figure 1. Extent and Distribution of Wetlands within Project Area in Flagler County.

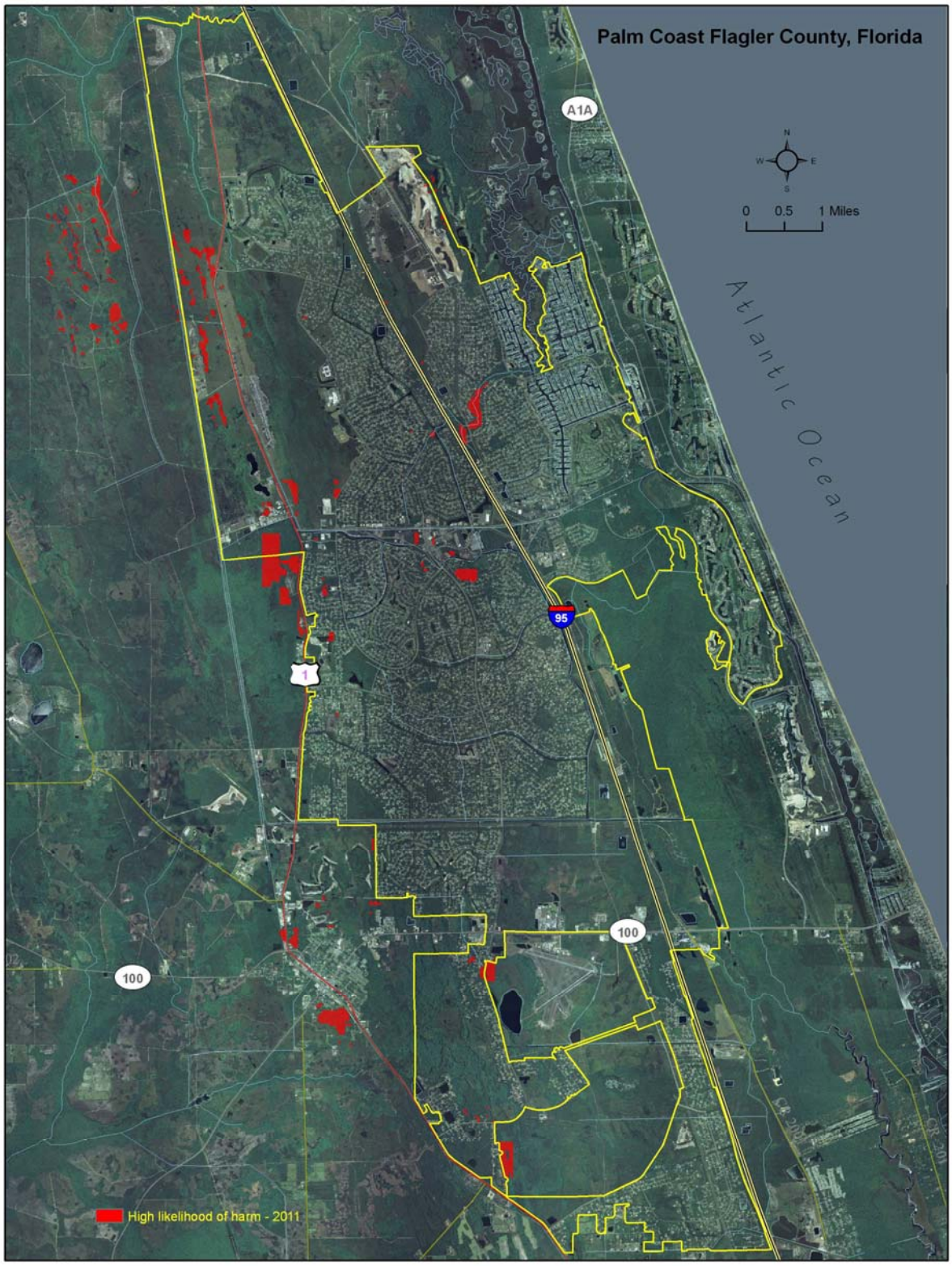

Figure 2. Wetlands projected to experience vegetative harm under the 2011 groundwater pumping scenario.

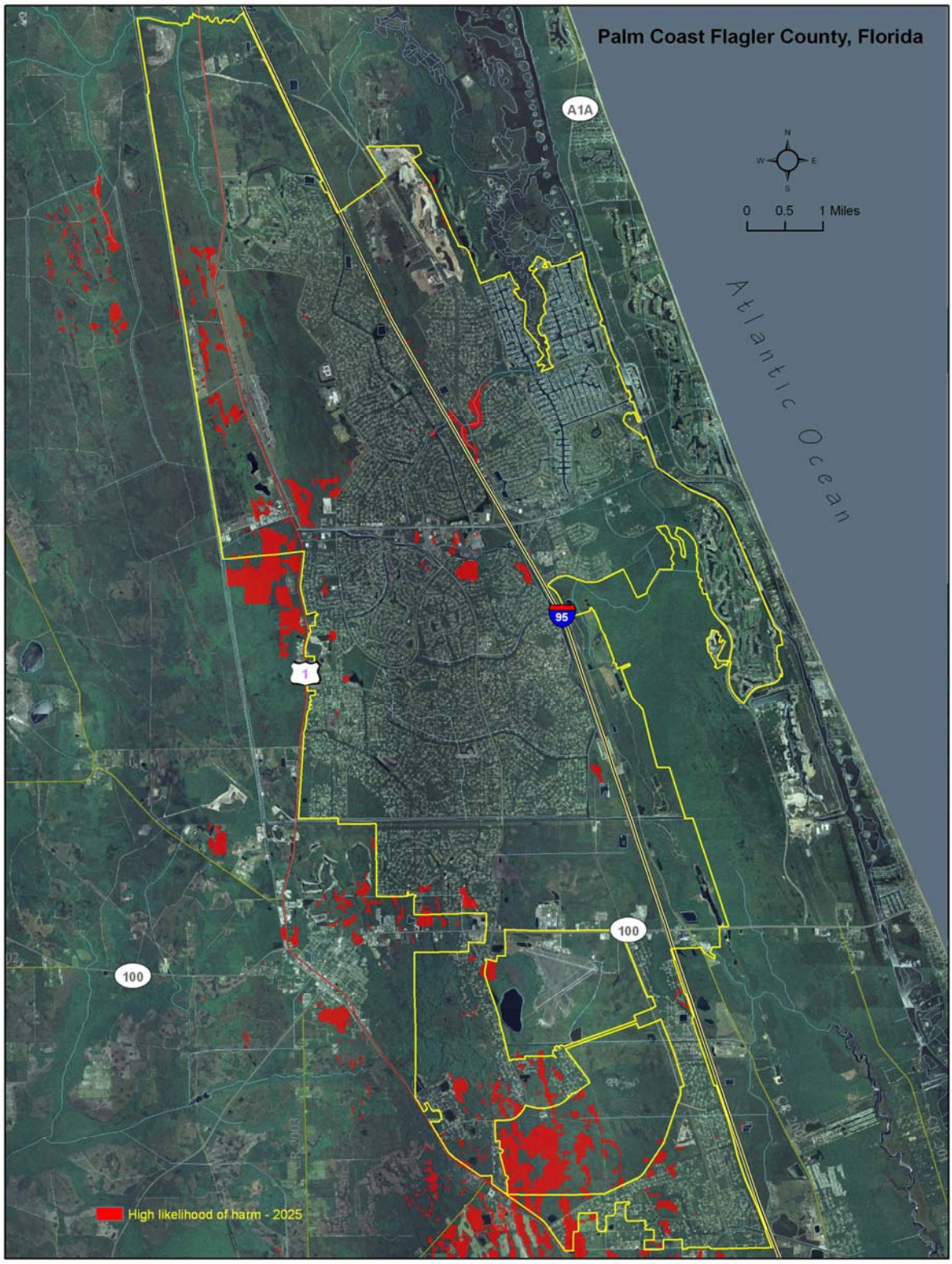

Figure 3. Wetlands projected to experience vegetative harm under the 2025 groundwater pumping scenario.

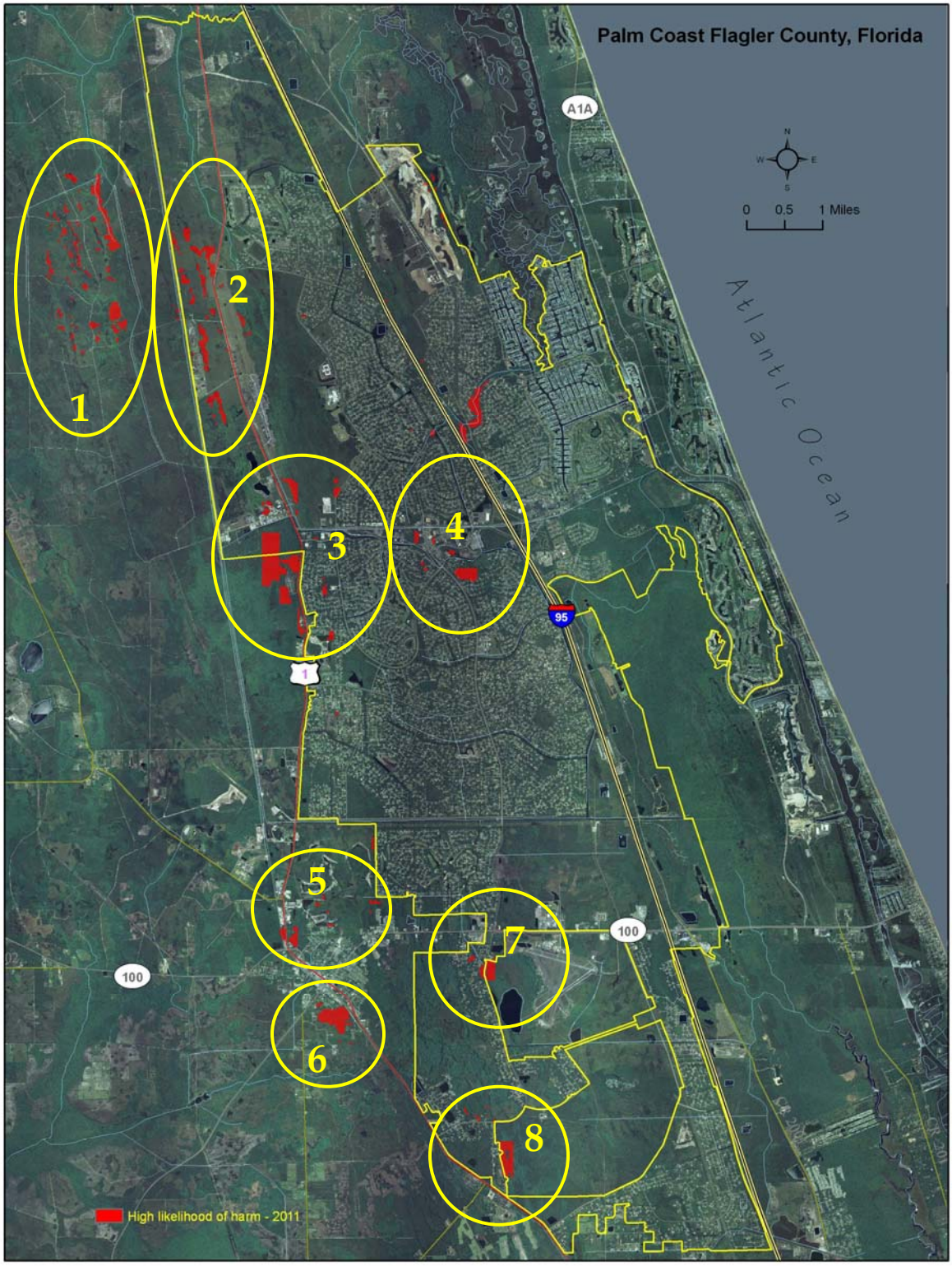

Figure 4. Wetlands for the 2011 vegetative harm projection clustered by proximity to other wetlands and a canal source.

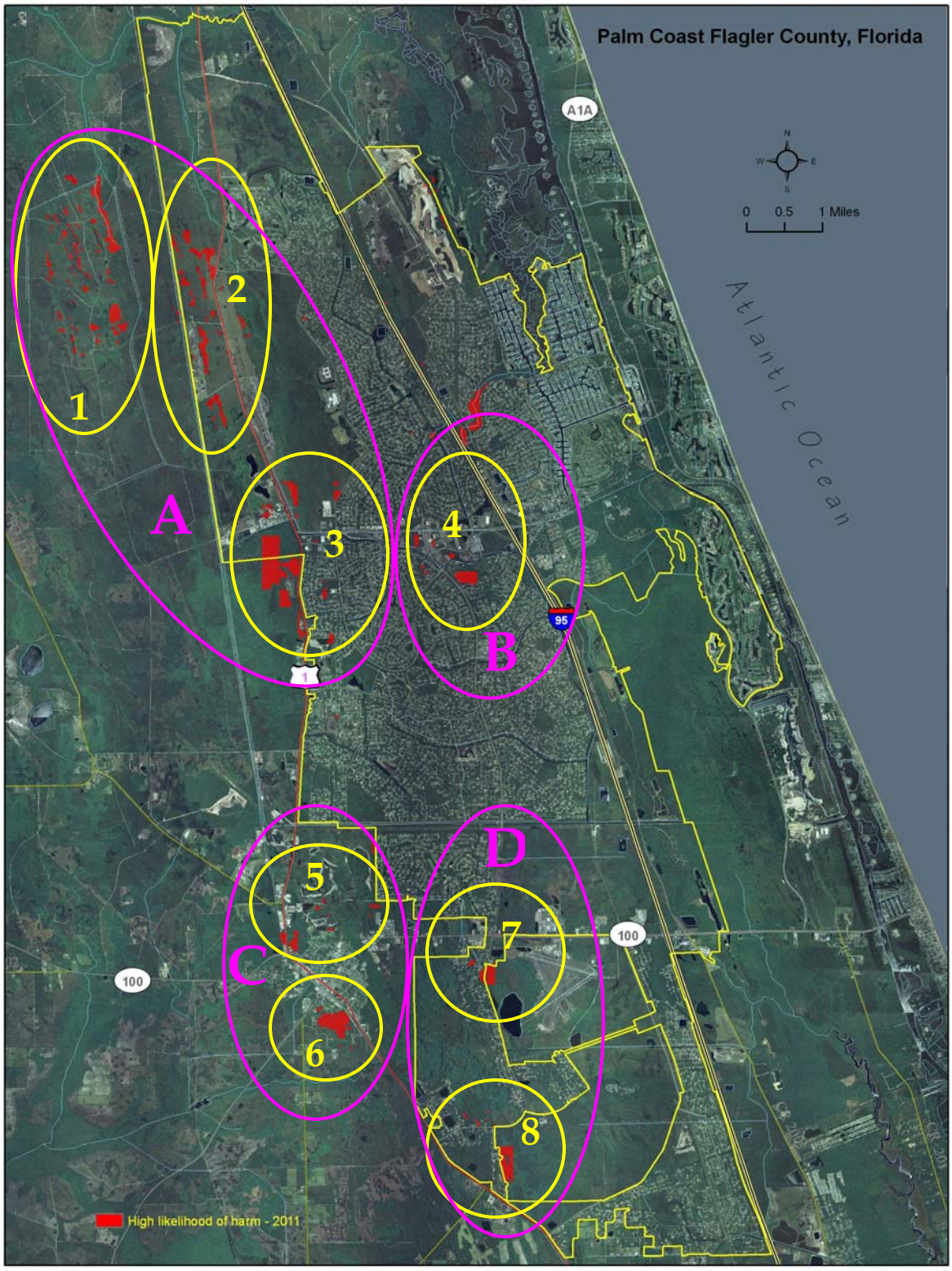

Figure 5. Wetland clusters grouped into 4 augmentation projects (A, B, C, and D) based on proximity to canal source.

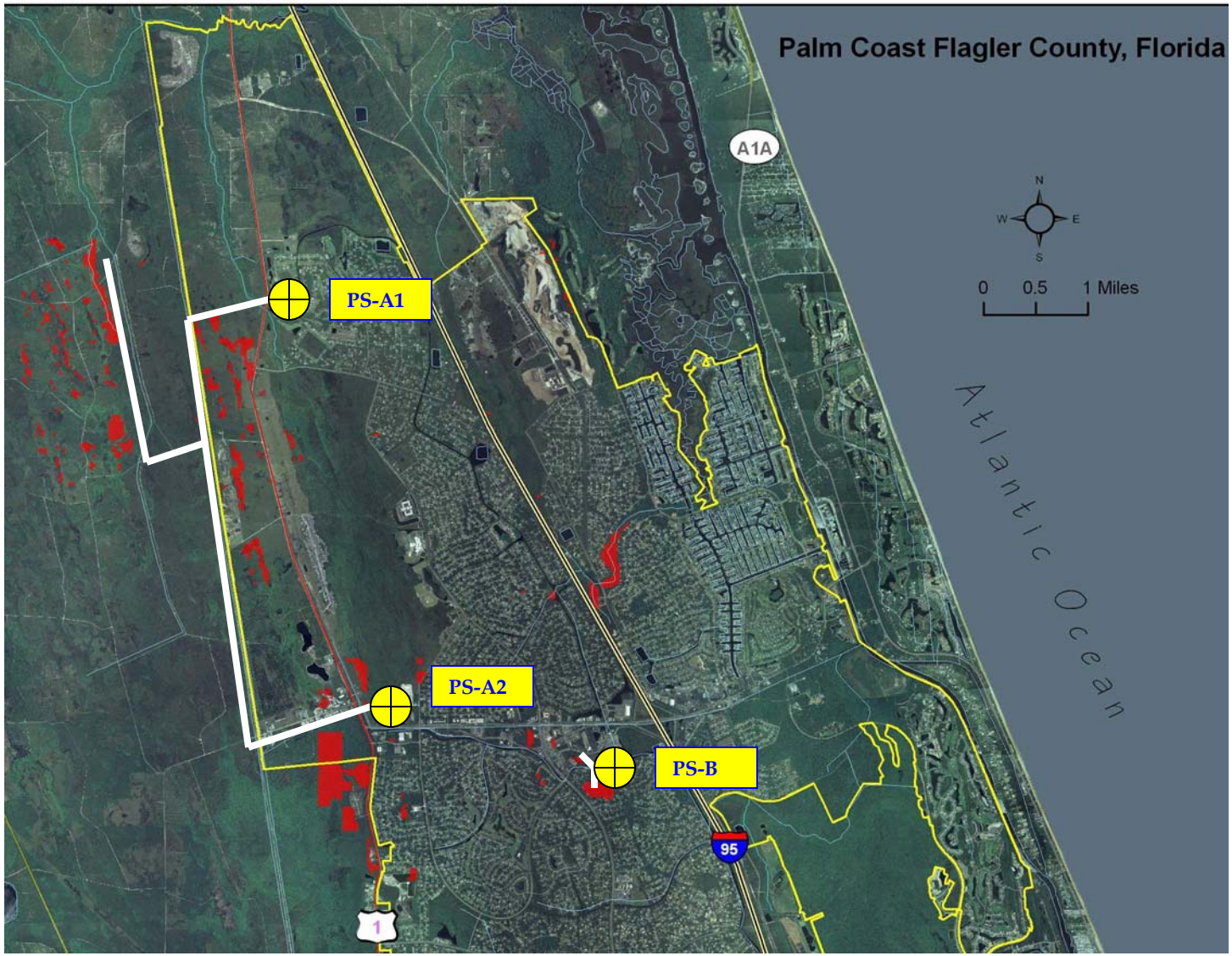

Figure 6. Schematic design of northern section of wetland rehyration system for Projects A and B. Pump stations are indicated by the yellow circles and major distribution pipes are white lines.

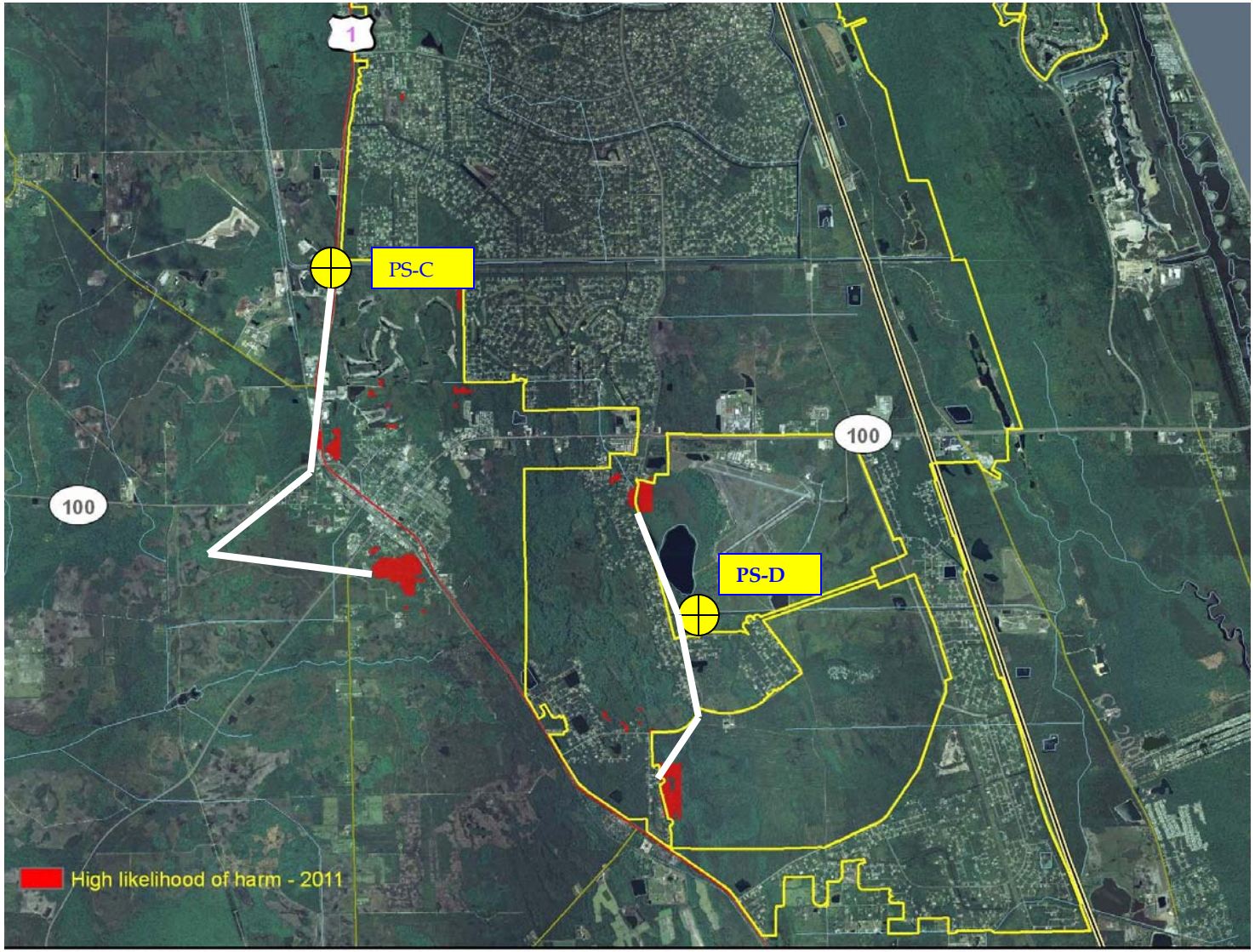

Figure 7. Schematic design of southern section of rehydrationation system (Projects C and D). Pump stations are indicated by the yellow circles and major distribution pipes are white lines.

APPENDIX H

Technical Memorandum Task G, Subtasks G1, G3, G4: Review of Surface Water Supply Alternatives

Task G: Evaluation of Alternative Water Supply Development Projects

Subtasks G1, G3, and G4: Review of Surface Water Supply Alternatives

Technical Memorandum

For The

Flagler County Water Supply Plan

By

ARCADIS U.S., Inc.
4307 Vineland Road H-20
Orlando, Florida
407.835.0266

July 2007

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INTRODUCTION

Background

As part of the overall evaluation of alternative water supply projects, ARCADIS has completed a preliminary assessment of surface water alternatives for future water supply in Flagler County, Florida. Flagler County currently relies primarily on groundwater for its water supply. Surface water is being considered as an alternative water source to meet the growing water demand in Flagler County.

Objective

The purpose of this task is to examine the availability of surface water to meet future water demands in Flagler County. Specifically, this task focuses on the surface water sources listed below:

1. Crescent Lake
2. Lake Disston
3. Lehigh Canal
4. Pellicer Creek
5. Palm Coast Park
6. Town Center
7. St. Johns River near Lake George
8. St. Johns River near SR 40
9. Ocklawaha River

Alternative Nos. 1, 7, 8, and 9 were ranked in the order above by the cooperators at the cooperators workshop held on June 6, 2007. In the June workshop, "other closer lakes" and "constructed reservoirs" were ranked immediately after Crescent Lake. Lake Disston (Alternative No. 2) was identified by the cooperators in the June workshop as a potential water source and is evaluated in this document. Subsequent to the workshop and after discussions with District staff and Mr. John Moden, City of Palm Coast stormwater engineer, the Lehigh Canal, Pellicer Creek, Palm Coast Park, and Town Center (Alternative Nos. 3, 4, 5, and 6) were identified by ARCADIS and the District as potential water sources. A constructed reservoir was examined as part of the Lehigh Canal alternative for reliability. Alternative water source locations are shown on Figure 1.

METHODOLOGY

To evaluate and determine the reliability of each surface water source, estimates of potential yield or safe yield and water quality assessments developed by the St. Johns River Water Management District (SJRWMD) were considered. U.S. Geological Survey (USGS) stream gage records and drainage areas were used to develop preliminary yield estimates for the surface water sources for which safe yield had not previously been estimated (Alternative Nos. 1, 3, 4, 5, and 6). USGS gage locations referenced in this memorandum are shown on Figures 2 through 8. Estimated potential yield or safe yield for each alternative was compared to future demands to determine which surface water sources can best meet present and future water demands in Flagler County.

Future public water demand forecasts developed under Task C include 2025 public water demands, which are projected to be 34.2 million gallons per day (mgd) on an annual basis for Flagler County according to Rich Doty of GIS Associates, Inc. Aggregate existing consumptive use permits (CUPs) for Flagler County total 11.8 mgd (SJRWMD). A 22.4-mgd shortfall is the amount required from surface water sources, assuming groundwater continues to supply 11.8 mgd.

The second phase of the analysis was a preliminary water quality assessment of potential surface water sources with respect to treatability in accordance with Florida drinking water quality standards. Water quality data for each water source were provided by SJRWMD for the following monitoring stations:

- GF33 – Middle of Crescent Lake between Salt Branch Canal and Union Avenue
- MSJFGF – Middle St. Johns River near Fort Gates Ferry Road
- 20010002 – St. Johns River at SR 40 near Astor
- OR006 – Orange Creek at SR 21

The locations of these monitoring stations are shown on Figures 2, 7, and 8. Water quality assessments for locations on the St. Johns River and Ocklawaha River are provided in SJRWMD Technical Publications SJ2004-3 and SJ2006-6, “Status and Trends in Water Quality at Selected Sites in the St. Johns River Water Management District” and SJ2004–SP20 and SP22, “Surface Water Treatment and Demineralization Study.”

Geographic information system (GIS) data for Flagler and Putnam counties were used to develop an understanding of the locations of alternative water sources and their proximity to the service areas. Aerial photographs were used to identify a potential water main route for each alternative. Proposed water mains follow existing roads/rights-of-way where possible to minimize impacts to existing development and wetlands. The orange numbered marks on Figures 1 through 8 identify the general location of each alternative water source.

ALTERNATIVE SURFACE WATER SOURCES

After the data described above were collected for each surface water alternative, the potential yield or safe yield was compared to the 2025 water deficit. Below is a brief description and summary of the yield analysis performed for each water source. The results of this analysis are summarized in Table 1. The safe yield for the St. Johns River and Ocklawaha River evaluated in this analysis was provided by SJRWMD staff in various technical reports and studies as listed in Table 1. To evaluate natural surface water sources where no safe yield was available, 10 percent of the mean annual flow was estimated as the potential yield. The minimum flow or level (MFL) criteria set by the SJRWMD would likely limit withdrawals to less than 10 percent based on similar water sources in Florida, according to SJRWMD staff. The MFL criteria do not apply to manmade canals. Therefore, potential yield estimates from manmade canals were based on engineering judgment and guidance from SJRWMD staff. A withdrawal from Lehigh Canal of 20 percent is discussed below.

Table 1: Flagler County Surface Water Alternatives Evaluation

Surface Water Source	Safe Yield (mgd)	Potential Yield (mgd)	Distance to Service Area (miles)	Comment	Safe/Potential Yield Data Source	Water Quality Data Source
Crescent Lake		22.4 (needs further analysis)	18.0	Further analysis recommended	USGS Flow Data 1978 – 2005	GF33 Monitoring Station
Lake Disston		0.60	24.0	Does not meet the Flow Required Criteria*	SJRWMD	CLD Monitoring Station
Lehigh Canal		3.00	5.0	Does not meet the Flow Required Criteria*	USGS Flow Data 1998 – 2005	
Pellicer Creek		2.00	5.0	Does not meet the Flow Required Criteria*	USGS Flow Data 2001 – 2005	
Palm Coast Park		0.90	5.0	Does not meet the Flow Required Criteria*		
Town Center		0.20	5.0	Does not meet the Flow Required Criteria*		
St. Johns River near Lake George	155 (at SR 44)		42.0	Meets the Flow Required Criteria	SJ2006-2	SJ2004-3 SP20 SP22, SJ2006-6, MSJFGF
St. Johns River near SR 40	155 (at SR 44)		42.0	Meets the Flow Required Criteria	SJ2006-2	SJ2004-3 SP20 SP22, SJ2006-6, and 20010002
Ocklawaha River	107		59.0	Meets the Flow Required Criteria	SJ2006-2	SJ2004-3 SP20 SP22, SJ2006-6, and OR006

Notes:

*Selection Criteria

Water Demand Year 2025 (mgd) = 34.2

Groundwater – CUPs (mgd) = 11.8

Public Water Supply Deficit (mgd) = 22.41

Crescent Lake

Crescent Lake is located between State Highway 100 and U.S. Highway 17 on the boundary between Putnam and Flagler counties, just east of Crescent City, Florida (see Figure 2). The lake is fed by Haw Creek, which collects surface water from a portion of the Lower St. Johns River Basin south of Crescent Lake. The drainage area at the point where Crescent Lake discharges to Dunns Creek is approximately 500 square miles. The surface area of Crescent Lake is reported to be 26.8 square miles. The average depth of the lake is 8.12 feet based on National Oceanic and Atmospheric Administration navigation charts, with some areas along the lower west shoreline measuring 12 to 14 feet deep.

USGS gage 02244440 is located on Dunns Creek downstream of Crescent Lake. The flow records begin in 1978 and continue to the present. The average flow at this station, based on months with complete records, is 529 cubic feet per second (cfs) (341 mgd). These flow records indicate frequent reverse flows as a result of backwater from St. Johns River.

A withdrawal of 22.4 mgd would represent 6.6 percent of the total watershed yield. A preliminary analysis of the effect of a 26.4-mgd withdrawal on mean summer Chlorophyll-a (Chl-a) concentrations ("Estimated Impact of Water Supply Withdrawals on Expected Chl-a Concentrations in Crescent Lake" by Ron Wycoff of Water Supply Solutions, Inc.) shows that the estimated increase in Chl-a concentrations would be 4.0 percent in summer. The mean Chl-a concentrations were estimated to increase from 49.5 milligrams/cubic meter (mg/m^3) to 51.9 mg/m^3 (equivalent units mg/l). Mr. Wycoff recommended further analysis of the water quality in Crescent Lake to take into account the hydrodynamics of reverse flow from St. Johns River. He also recommended a finished water aquifer storage and recovery facility be included in the cost estimate for this alternative because of the intermittent nature of the source.

Lake Disston

Lake Disston is located south of Crescent Lake and west of U.S. Highway 17 as shown on Figure 3. The lake collects surface water from a 64.3-square-mile portion of the Lower St. Johns River Basin.

Based on modeling results provided by the District (Sonny Hall, SJRWMD), the overall yield of Lake Disston is 1.6 mgd. Of that 1.6 mgd, Skinner Nursery is currently permitted to withdraw 1.0 mgd, leaving 0.6 mgd for municipal water supply.

Lehigh Canal

The Lehigh Basin is located between Palm Coast Parkway and State Highway 100. The Lehigh Canal, located on the southern end of the basin just north of the Florida

East Coast Railway, is the primary conveyance of surface water in the basin (see Figure 4). The canal bottom width is 120 feet.

Surface water flow in the canal is controlled by a series of structures designed to maintain groundwater levels. USGS gage 02247258 is located on Lehigh Canal east of Interstate 95 with records from May 1998 to the present. Average recorded flow is 24 cfs, or 15.6 mgd.

For dependable supply during periods of low flow, an off-channel pumped storage reservoir would be required. A mass curve was developed to estimate the storage requirements for a 20 percent average flow withdrawal (approximately 3.1 mgd). Assuming a 10-foot reservoir depth, the analysis indicates that a 196-acre reservoir (1,960 acre-feet of storage) would be required. This volume is based on review of the cumulative flow in the canal over the period of record to identify the critical drawdown period. The critical drawdown period occurs during drought or low-flow periods. A reservoir under this scenario would provide up to 103 days of storage with a 3.1 mgd withdrawal.

Pellicer Creek

Pellicer Creek begins in the wetlands of southern St. Johns County and runs east into the Matanzas River as shown on Figure 5. The creek collects surface water from the Hominy, Hulett, Pringle, and Dave basins in Flagler County. The drainage area for Pellicer Creek is reported by the SJRWMD to be 64.3 square miles. The portion of Pellicer Creek that is east of U.S. Highway 1 to the confluence with the Matanzas River is part of the Pellicer Creek Aquatic Preserve.

USGS gage 02247222 is located on the creek near Espanola, Florida, 1.8 miles downstream of Interstate 95. This gage is located within the Pellicer Creek Aquatic Preserve within an estuary that is tidally influenced. The gage records begin in December 2001 and continue to the present. The average flow is 39.7 cfs (25.7 mgd). Freshwater inflow to the preserve above U.S. 1 is unknown but would be less than 25.7 mgd. Based on previous work performed by the District for other surface water systems, the District recommended that withdrawals of approximately 10 percent be considered for planning purposes for surface water sources, with no available calculation of safe yield. The amount of surface-water that could be developed for water supply is likely less than 10 percent of the total estuary flow, or less than 2 mgd.

Future development within the Pellicer Creek Basin may create hydrologic and hydraulic conditions that deserve further investigation for surface storage of stormwater runoff. Topography in the basin may allow for cost-effective surface storage of runoff.

Palm Coast Park

Palm Coast Park is located just south of Pellicer Creek and west of Interstate 95. The total area of the development is 4,740 acres (7.4 square miles). The northern side of the development is in the Hulett Basin. Surface water from this portion of the development drains into Pellicer Creek. The southern portion of the development is in the Lehigh Basin. Surface water from this portion of the site drains into St. Joe Canal (see Figure 5). The drainage areas for both the Hulett and Pellicer portions of the site total 13.4 square miles.

Based on Map I-2 from the West Palm Coast Development of Regional Impact application, a series of 20 areas, most of which are existing swamps/wetlands, will serve as detention facilities for surface water. Analyses of the Lehigh Basin and other basins in the area indicate that an average flow of approximately 1 cfs can be expected for every square mile of drainage area. Based on this estimate, an average flow of 13.4 cfs (8.7 mgd) can be expected. A 10 percent withdrawal would supply 0.9 mgd.

Town Center

The Town Center development is located on the northern side of State Highway 100, between Belle Terre Parkway and Interstate 95 (see Figure 6). The development encompasses a total of 1,557 acres (2.4 square miles). The northern side of the development is in the Lehigh Basin, and the southern side is in the Little Basin. Based on the same factor of 1 cfs per square mile, an average flow of 2.4 cfs can be expected from the site. A 10 percent withdrawal would supply approximately 0.2 mgd.

St. Johns River Near Lake George, St. Johns River Near SR 40

Two locations on the St. Johns River were considered in this study as potential surface water sources. The first is north of Lake George (see Figure 7). Water mains in this study are proposed to follow existing rights-of-way along existing roadways where possible. For this alternative, the intake was assumed to be located at Fort Gates Ferry Road on the St. Johns River, approximately 5.5 miles north of Lake George.

The second location considered on the St. Johns River is on SR 40, approximately 2 miles south of Lake George. USGS gage 02236125 is located at the SR 40 bridge over the St. Johns River in Astor, Florida. Gage records are from 1994 to the present. The average flow for the period of record is 3,685 cfs (2,382 mgd). Figure 7 shows the location of the Fort Gates Ferry Road and SR 40 sites.

The District Water Supply Plan 2005, SJ2006-2, shows the safe yield at the St. Johns River near DeLand to be 155 mgd.

Ocklawaha River

The Rodman Reservoir, located in Putnam and Marion counties on the Ocklawaha River, was developed in 1968 by impounding the Ocklawaha River as part of the now-defunct Cross Florida Barge Canal (CFBC) project. Rodman Dam is located approximately 8 miles west of the confluence of the Ocklawaha and St. Johns rivers (see Figure 8).

USGS gage 02243960, located at Rodman Dam, has been in operation since October 1968. Average discharge at the dam is 1,325 cfs (856 mgd). According to the District Water Supply Plan 2005, SJ2006-2, the safe yield is 107 mgd.

WATER QUALITY

Water quality data were available for four of the surface water alternatives (Nos. 1, 7, 8, and 9) being considered for this evaluation as identified in the Methodology section of this memorandum. The available water quality data provides adequate information to generally characterize the water chemistry at each of the surface water sources during the respective sampling periods. Based on these data, the four surface water sources appear to be amenable for treatment and use as a potable water supply. Table 2 provides a summary of the concentrations of chloride (Cl) and total dissolved solids (TDS) at each of the four source alternatives and compares them with their respective EPA drinking water standards.

A review of the data summarized in Table 2 indicates that the concentrations of Cl and TDS in one or more of the samples collected from both Crescent Lake and St. Johns River exceeded their respective drinking water standard. Based on the available analytical data it is anticipated that source water from each of these locations will require treatment through membrane filtration (i.e. nano-filtration, reverse osmosis, etc.), in order to meet the applicable EPA drinking water standards. Membrane filtration will most likely be required because conventional treatment through coagulation, sedimentation and/or filtration are generally not effective treatment methodologies to reduce TDS concentrations.

A review of the data summarized in Table 2 indicates that the concentrations of Cl and TDS in the samples collected from Ocklawaha River were reported below the respective maximum drinking water standards. Based on the available analytical data for the water quality samples collected from the Ocklawaha River, it is anticipated that surface water from this alternative could reliably meet the EPA drinking water standards through conventional treatment technologies. These technologies could conceivably include coagulation, sedimentation and/or filtration. A cost to treat each of these four sources is included in Tables 9.1 and 9.2.

Table 2: Flagler County Preliminary Water Quality Evaluation

Surface Water Source	Parameter	Sampling Period	Mean Value (mg/L)	Range (mg/L)	Drinking Water Standard (mg/L)	Safe/Potential Yield Data Source	Water Quality Data Source
Crescent Lake	Cl	10/1999 to 11/2005	115	29 to 230	250	USGS Flow Data 1978-2005	GF33 Monitoring Station
	TDS	10/1999 to 11/2005	328	143 to 551	500		
	TOC	10/1999 to 11/2005	26	14 to 41	Report Only		
St. Johns River near Lake George	Cl	12/1997 to 9/2004	256	109 to 414	250	SJ2006-2	MSJFGF Monitoring Station
	TDS	12/1997 to 9/2004	643	296 to 1100	500		
	TOC	12/1997 to 9/2004	17	9 to 41	Report Only		
St. Johns River near SR 40	Cl	6/1995 to 8/2006	215	78 to 380	250	SJ2006-2	20010002 Monitoring Station
	TDS	6/1995 to 8/2006	536	240 to 1026	500		
	TOC	6/1995 to 8/2006	17	7 to 31	Report Only		
Ocklawaha River	Cl	5/1993 to 8/2006	10	5 to 20	250	SJ2006-2	OR006 Monitoring Station
	TDS	5/1993 to 8/2006	115	37 to 250	500		
	TOC	5/1993 to 8/2006	30	2 to 90	Report Only		

As discussed, the proposed treatment technology for each source water alternative may be through either conventional technologies or through membrane filtration (ultrafiltration and/or reverse osmosis). The technology selected will be dependent upon the completion of additional source water analysis at the selected withdrawal point. Each of the treatment processes will include disinfection. The selected disinfection methodology will be determined upon analysis of additional water quality samples from the selected withdrawal point and will be selected to mitigate the potential formation of disinfection byproducts. Available disinfection technologies include free chlorine, monochloramines, ozone and ultraviolet light.

To properly select the appropriate treatment process and components, a full-scale pilot study will be necessary to identify the most economical and effective treatment process. Furthermore, the pilot study will be a critical in obtaining approval from the appropriate State regulatory agencies.

COST ESTIMATE

ARCADIS has estimated capital costs and operating costs for the four surface water alternatives that meet the 2025 demand of 22.4 mgd (see Table 1) as described in Subtask G3. Following is a brief analysis of the methodology used to derive the capital cost and operating cost estimates.

Flagler County projected surface water demands (Rich Doty GIS Associates, Inc.) are based on GIS population models developed by the SJRWMD. These demand projections include planning year horizons 2010, 2015, 2020, 2025, and 2030 (Table 3). Using the District's projected flows for each planning year, the future water demands were used to determine the appropriate pipe size required to carry 125 percent of the 2025 demand of 22.4 mgd, or 28 mgd. A 42-inch-diameter pipe was selected to convey this flow.

The cost for a 42-inch-diameter pipe is included for each alternative. Refer to Table 10 for a summary of the pipe length, projected county water demand, construction cost, total capital cost, and operating cost for each project alternative. In general, the proposed water main alignment for each alternative is located within public right-of-way. Therefore, for the purposes of this estimate, land acquisition costs for each identified source alternative were not considered when determining capital costs. Figure 9 shows the locations of the four proposed routes. Other associated costs include excavation, backfill, boring, plant, and pump station costs, as shown in Tables 6 through 9.

The resulting capital cost and operating cost for each project route alternative is listed in Table 10. The proposed pipe length for each alternative is shown along with the projected water demand for planning year horizon 2010, 2015, 2020, and 2025. In accordance with the SJRWMD Cost Estimating and Economic Criteria technical memorandum, the non-construction capital cost is equal to 45 percent of the planning-level estimated constructed cost. Non-construction capital cost includes construction contingency, engineering design, permitting, and administration relating to construction of the proposed structures. Unit production costs are also included in Table 10. Unit production cost is the equivalent annual cost divided by the annual water production.

CONCLUSIONS

Of the nine alternatives examined in this study, the following four have sufficient capacity to meet the 2025 demand of 22.4 mgd:

Crescent Lake
St. Johns River near Lake George
St. Johns River near SR 40
Ocklawaha River

Of these four alternatives, Crescent Lake is the closest to the service area, is the only alternative within Flagler County, and has the lowest total capital cost, as shown in Table 10. However, as described in the Alternative Surface Water Sources section of this memorandum, further analysis of backwater effects from St. Johns River is recommended to fully evaluate this alternative.

There are uncertainties involved with development of each of these four surface water projects that should be addressed in greater detail in a facilities planning process prior to selection of a preferred alternative. The identified uncertainties are described as follows.

Crescent Lake

Water may not be available from Crescent Lake on a continuous basis. Development of an environmentally acceptable withdrawal location and schedule should be among the first items of further investigation. If the conclusion of this investigation is that sufficient quantities of raw water can be withdrawn at all times, additional storage will not be required, and the water supply system will include only treatment and transmission facilities. However, if withdrawal rates are limited during certain hydrologic or environmental conditions, storage or conjunctive use systems will be required.

For this conceptual planning analysis, a finished water aquifer storage recovery (ASR) system is envisioned and included in the preliminary cost estimates to provide the required storage and water supply system reliability. However, the use of ASR may or may not be feasible, depending on local hydrogeologic conditions and/or U.S. Environmental Protection Agency permitting limitations. Local hydrologic investigations would be necessary to determine the feasibility of this storage approach. Determining the feasibility of ASR may require several years of permitting, testing, and evaluation.

If ASR proves not to be feasible, surface reservoirs or conjunctive use (groundwater/surface water systems) could be evaluated.

A tide gate structure that would prevent St. Johns River backwater from entering Crescent Lake is another alternative that may be considered. This gate structure may help reduce the fluctuation of chloride levels in Crescent Lake which might lower the

cost to treat water from Crescent Lake. Further analysis of hydrologic conditions, permitting, and evaluation would be necessary to determine the feasibility of this concept.

St. Johns River Near Lake George , St. Johns River Near SR 40

The quality of water in the river at these project locations will require demineralization through membrane filtration technology. The concentrated byproduct of the demineralization process must be managed based on Florida Department of Environmental Protection rules for concentrate discharge. Although return of the demineralization concentrate to the river is expected to be an acceptable and permittable management approach, it may pose significant challenges. Therefore, concentrate management alternatives should be fully evaluated early in the facilities planning process.

Ocklawaha River

The Ocklawaha River in Putnam County is the subject of a proposed restoration effort by the state of Florida. Although the river can easily provide the needed quantities of water for Flagler County's projected growth with or without the existing reservoir, matters surrounding this restoration effort may complicate the planning and permitting of this project.

Figure 1: Alternative Surface Water Sources

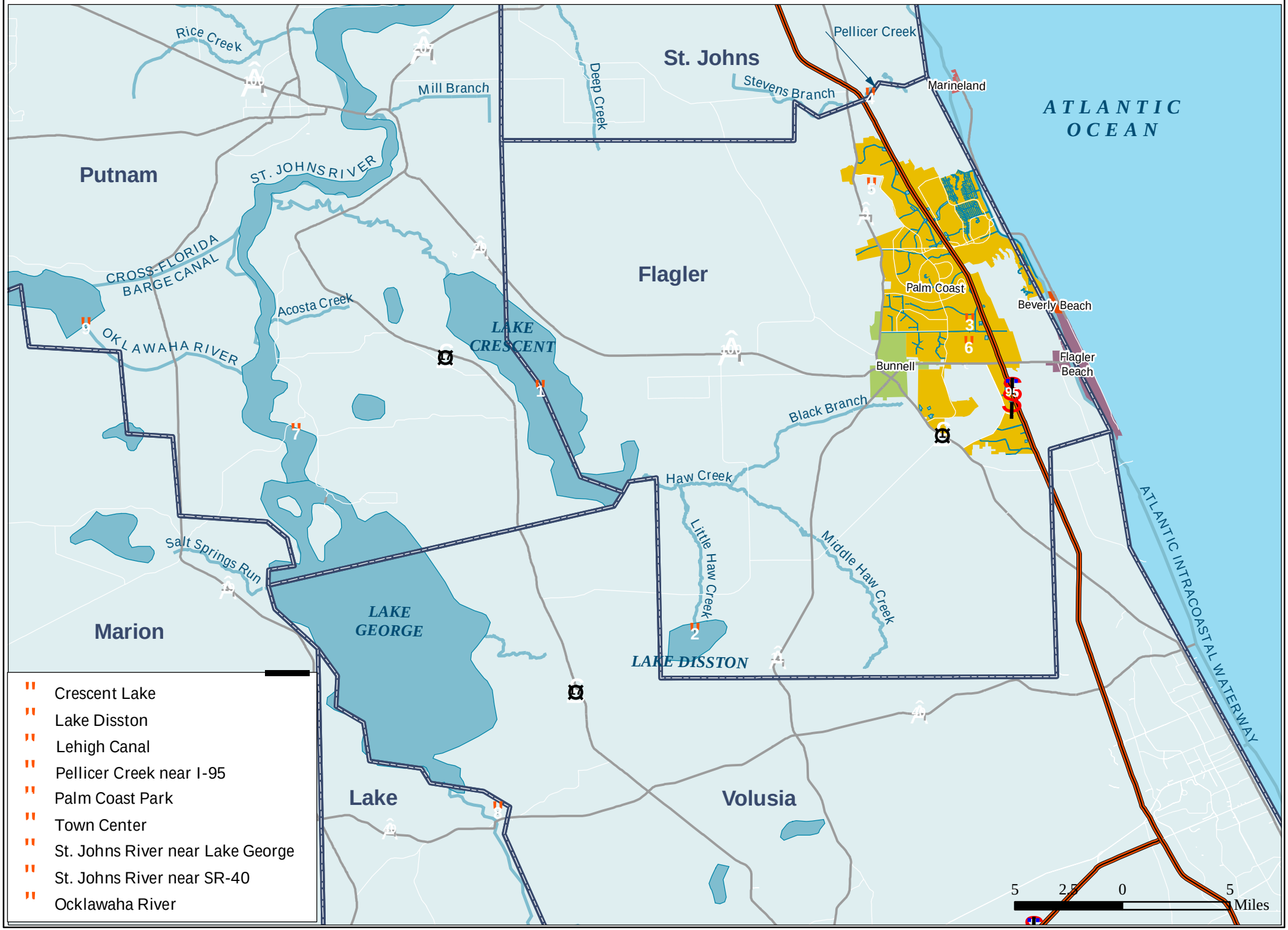


Figure 2: Crescent Lake

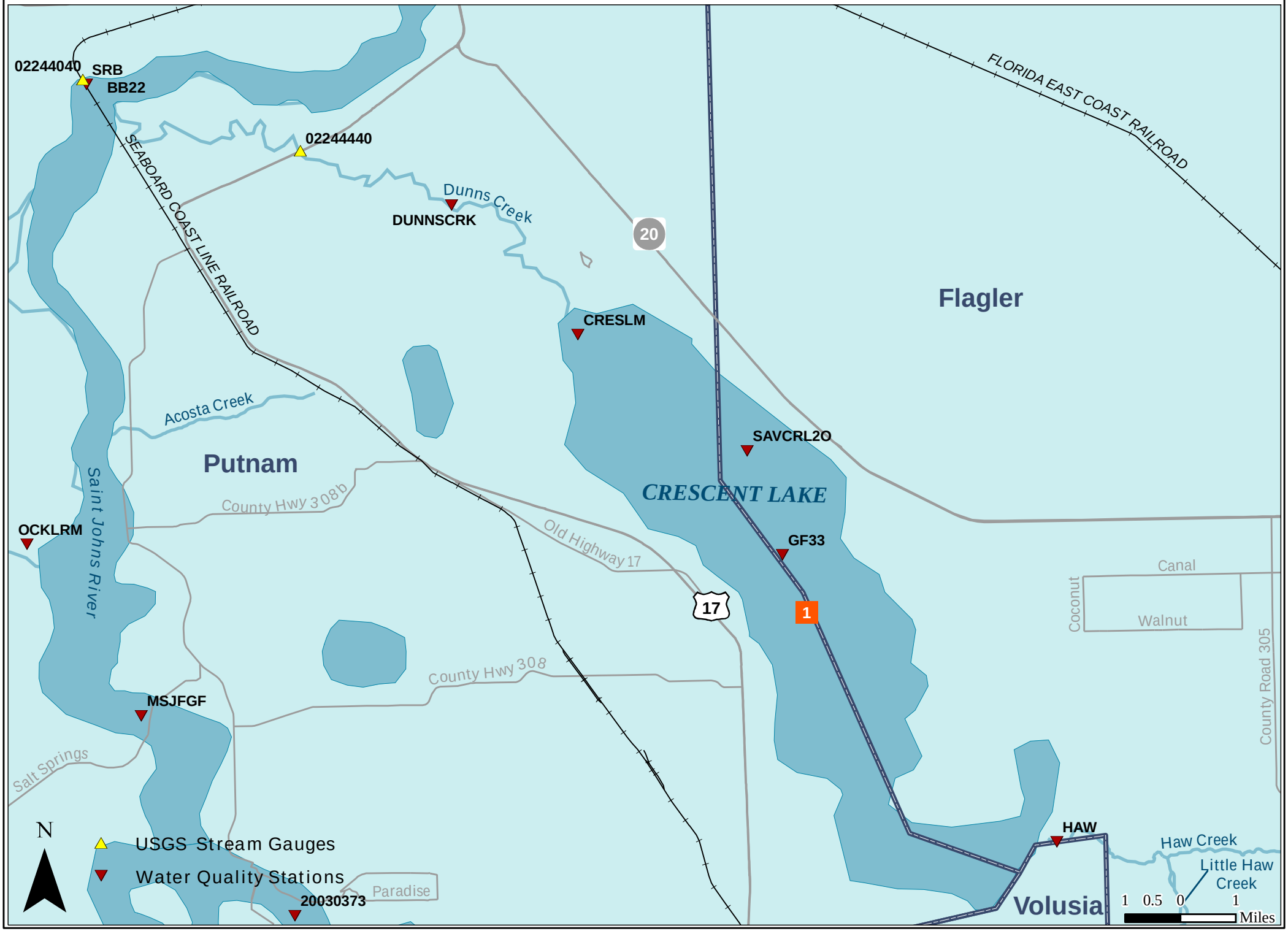


Figure 3: Lake Disston

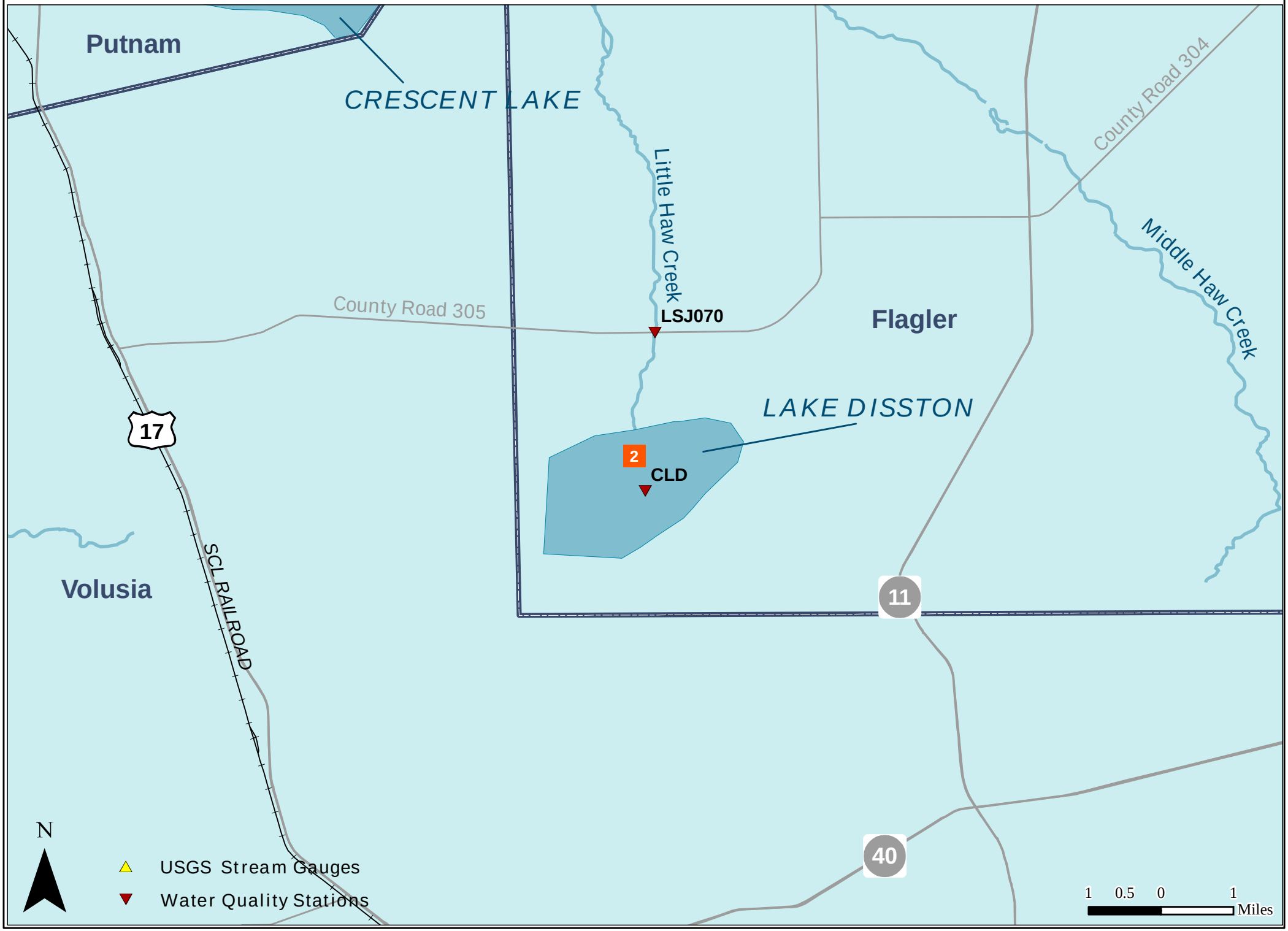


Figure 4: Lehigh Canal

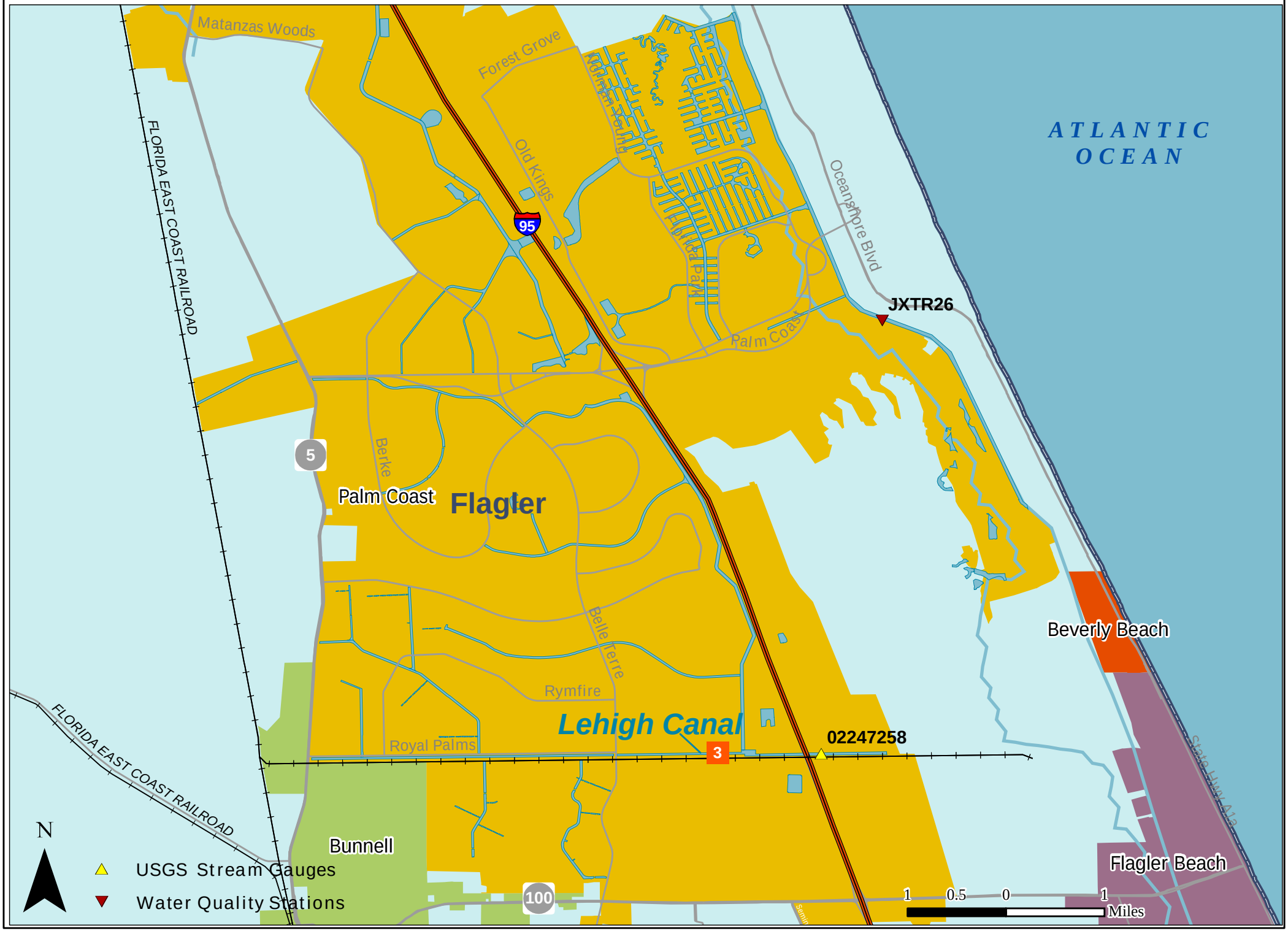


Figure 5: Pellicer Creek, Palm Coast Park

Figure 6: Town Center

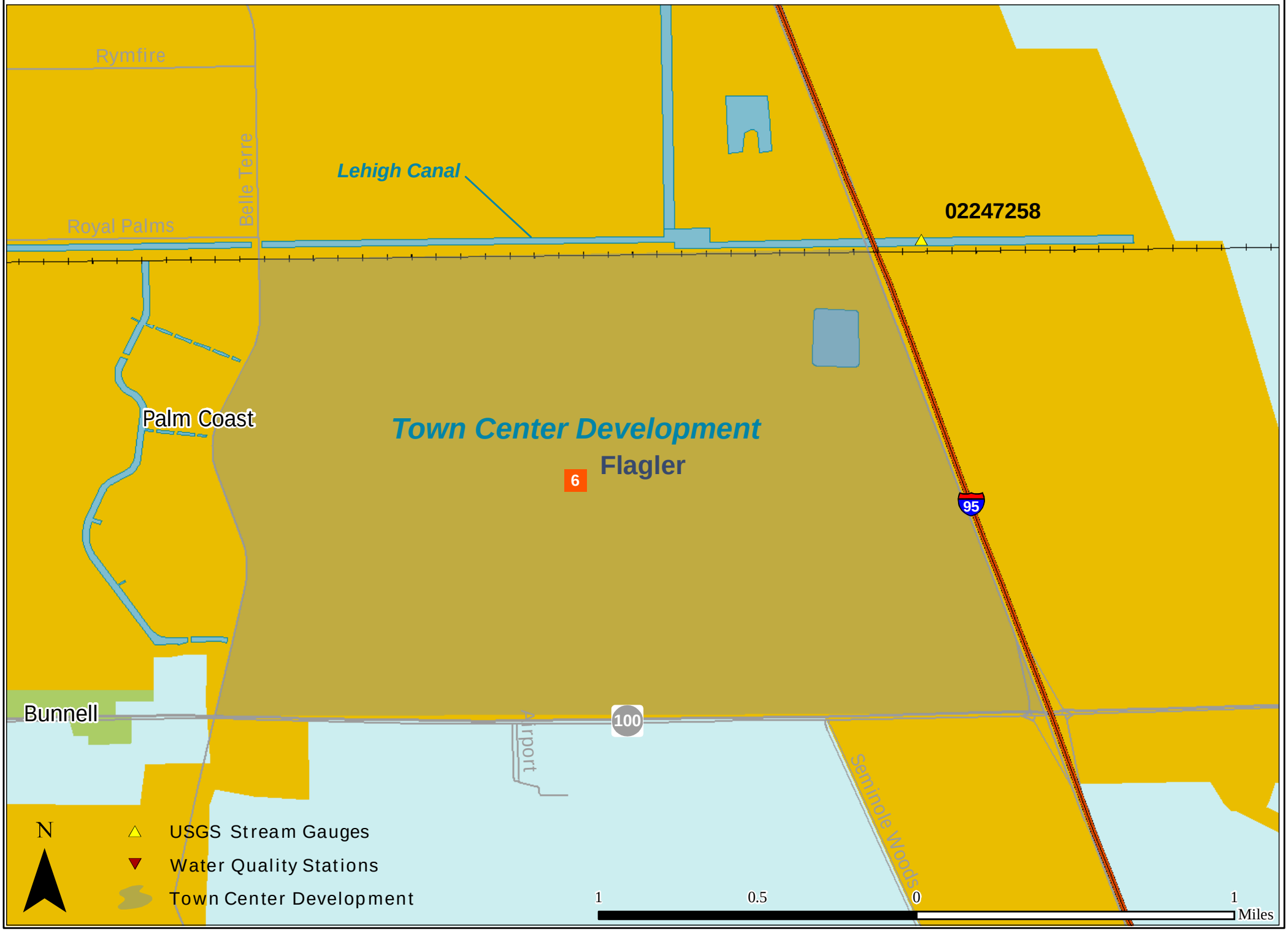


Figure 7: St Johns River near Lake George, St Johns River near SR - 40

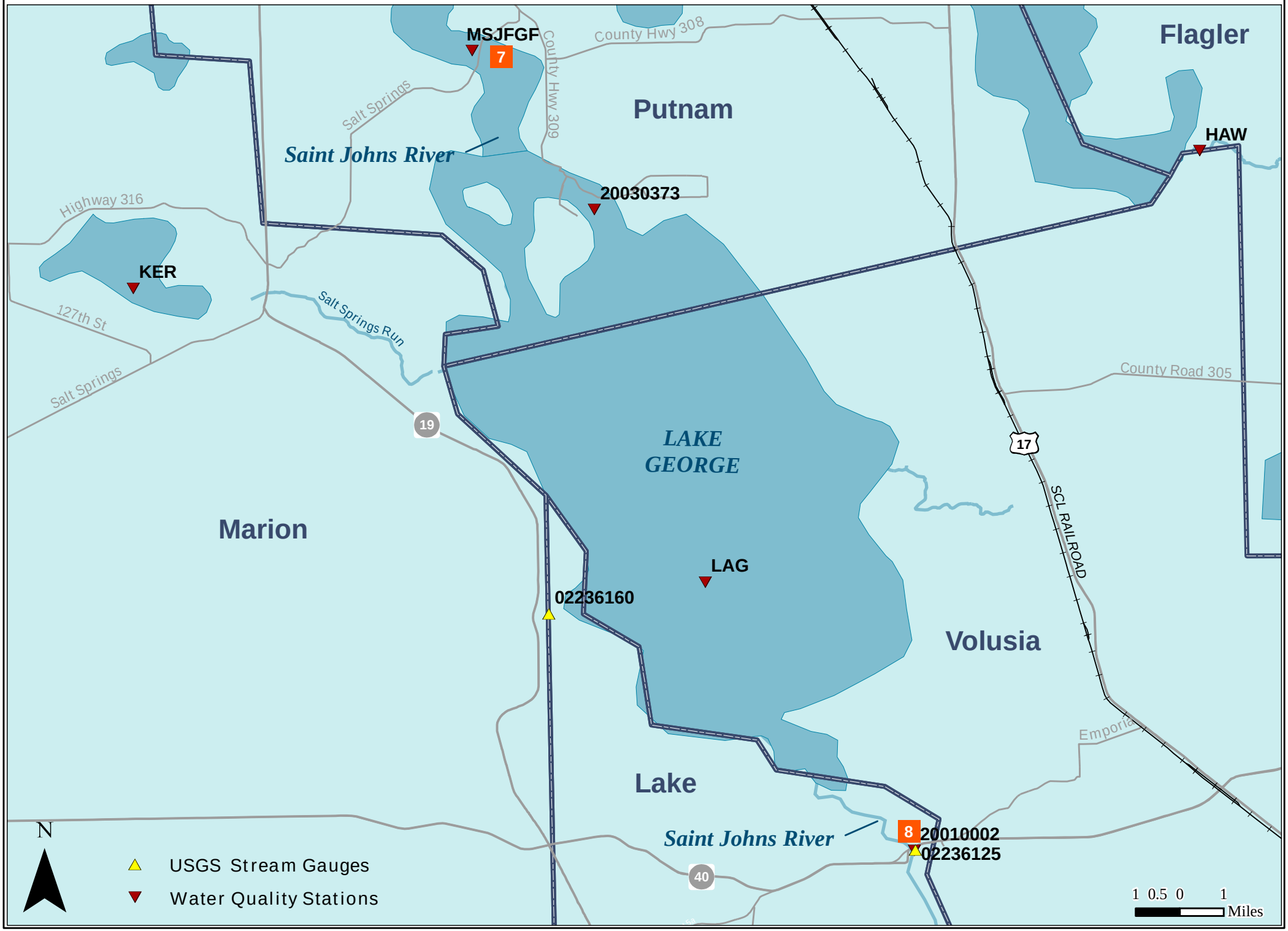


Figure 8: Ocklawaha Lake

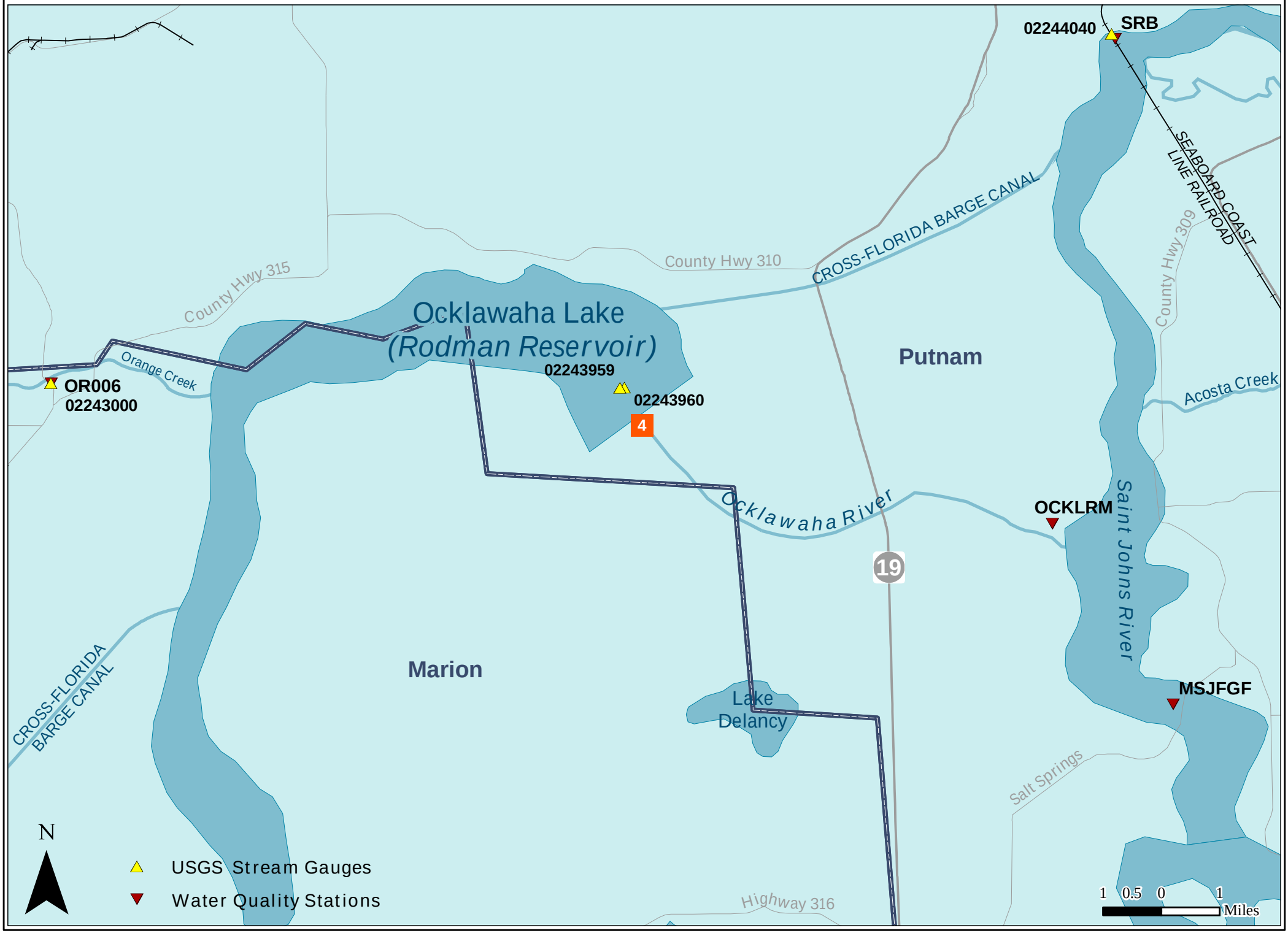
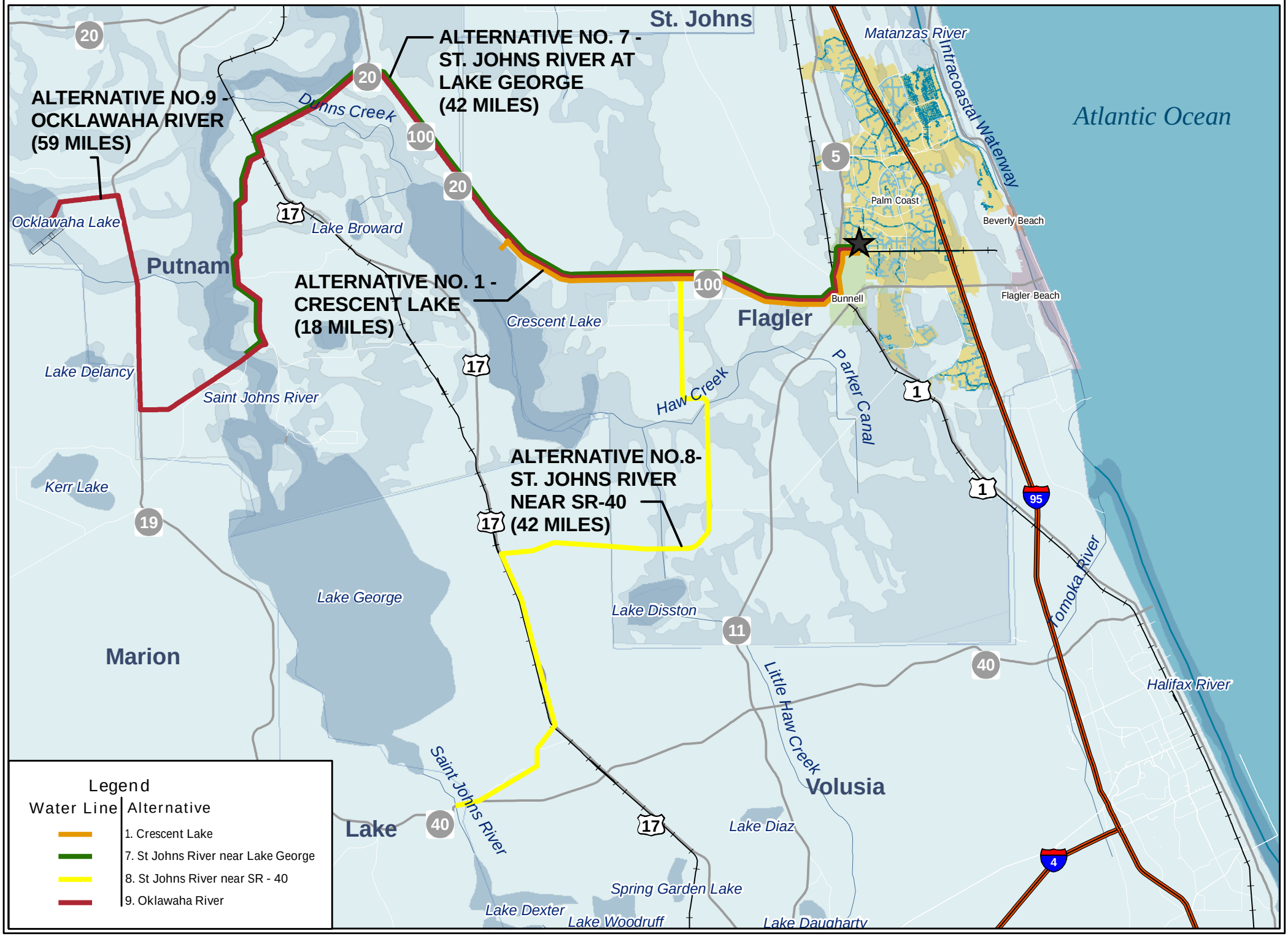


Figure 9: Conceptual Waterline Routes



MAP I-2

SINGHOFEN & ASSOCIATES, INC.
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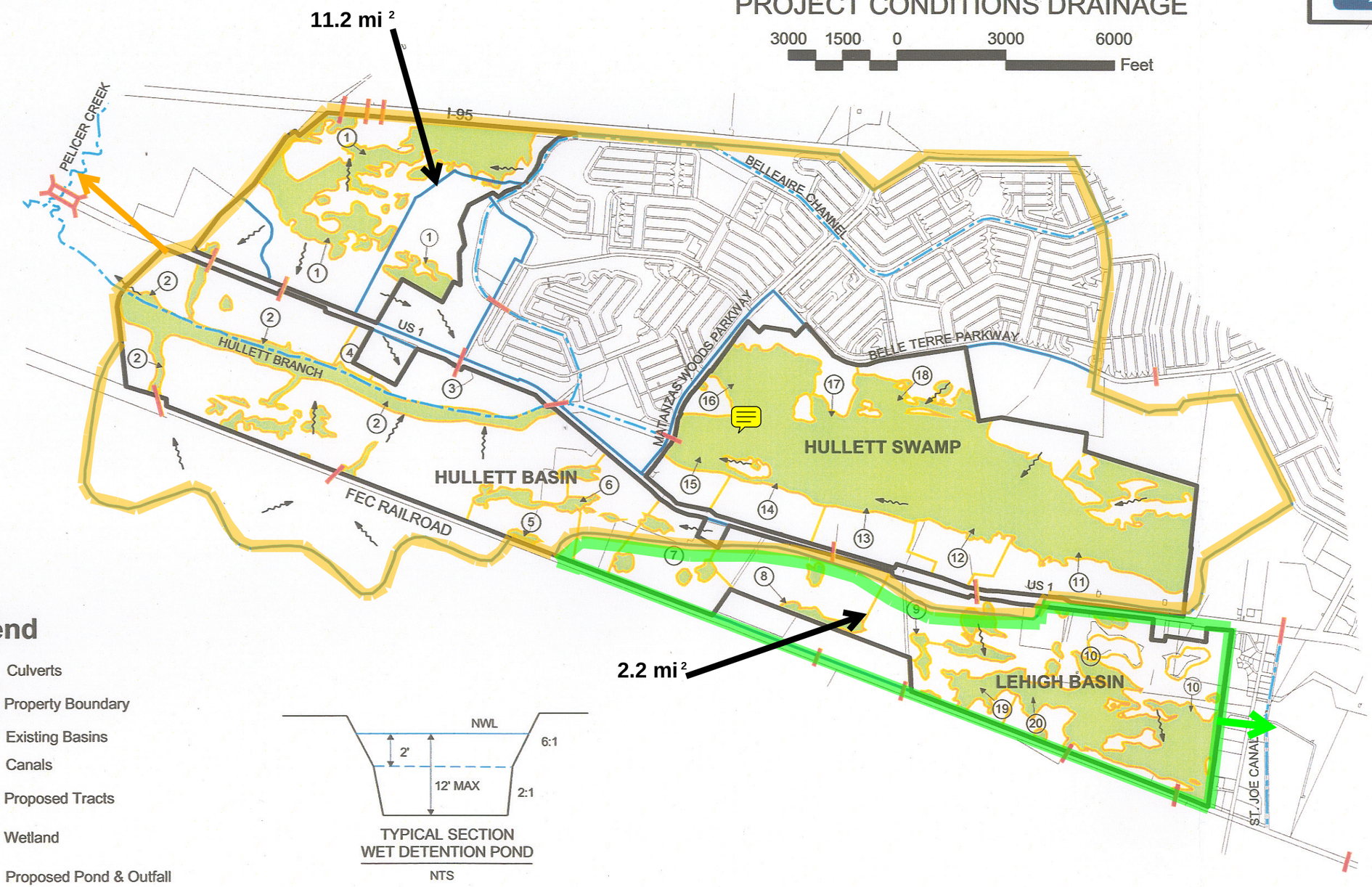
AND CIVIL ENGINEERING
6961 University Boulevard
Winter Park, Florida 32792
Phone: 407-679-3001
Fax : 407-679-2691
DBPR NO. 5112

West Palm Coast

PROJECT CONDITIONS DRAINAGE

3000 1500 0 3000 6000
Feet



Legend

- Culverts
- Property Boundary
- Existing Basins
- Canals
- Proposed Tracts
- Wetland
- (10) Proposed Pond & Outfall

TYPICAL SECTION
WET DETENTION POND
NTS

TABLE 3: FLAGLER COUNTY POPULATION AND WATER DEMAND PROJECTIONS

Flagler County Population Projections, 2010-2030					
UTILITY	**2010**	**2015**	**2020**	**2025**	**2030**
BUNNELL CITY OF	4,739	7,930	16,319	24,358	39,803
DUNES COMMUNITY DEVELOPMENT DISTRICT	1,506	4,284	5,651	5,741	5,745
FLAGER BEACH CITY OF	5,000	6,420	6,453	6,460	6,467
PALM COAST CITY OF	85,086	109,533	136,233	164,591	174,581
PLANTATION BAY UTILITY	1,262	1,901	2,741	4,064	9,203
VOLUSIA COUNTY UTILITIES	1,016	1,060	1,093	1,098	1,195
DOMESTIC SELF-SUPPLY	21,091	27,873	32,810	39,488	56,106
COUNTY TOTALS	119,700	159,000	201,300	245,800	293,100

Flagler County Water Demand Projections, 2010-2030 (mgd)					
UTILITY	**2010**	**2015**	**2020**	**2025**	**2030**
BUNNELL CITY OF	0.55	0.92	1.90	2.83	4.63
DUNES COMMUNITY DEVELOPMENT DISTRICT	0.34	0.96	1.26	1.28	1.28
FLAGER BEACH CITY OF	0.60	0.77	0.78	0.78	0.78
PALM COAST CITY OF	14.25	18.59	23.34	28.38	30.15
PLANTATION BAY UTILITY	0.24	0.37	0.53	0.78	1.78
VOLUSIA COUNTY UTILITIES	0.15	0.16	0.16	0.16	0.18
DOMESTIC SELF-SUPPLY	3.45	4.63	5.45	6.55	9.19
COUNTY TOTALS	19.58	26.40	33.42	40.76	47.99
Subtract Domestic Self Supply	3.45	4.63	5.45	6.55	9.19
Subtract Existing Groundwater PWS CUPs	11.80	11.80	11.80	11.80	11.80
Public Water Supply Deficit	**4.33**	**9.97**	**16.17**	**22.41**	**27.00**

PIPE CAPACITY

TABLE 4
FLAGLER COUNTY SURFACE WATER SUPPLY DEMAND

Year	Capacity (GPM)	Capacity Including Factor of Safety (GPM)
2010	3,007	N/A
2015	6,923	8,654
2020	11,228	N/A
2025	15,562	19,452

* Factor of Safety = 125 percent of average daily flow

TABLE 5
SINGLE 42" PIPE

Year	Capacity (GPM)	Pipe Velocity (fps)	Pipe Head Loss per 100' (ft)
2010 & 2015	9,000	2.08	0.026
2020 & 2025	20,000	4.63	0.114

EARTHWORK COST

TABLE 6.1
EARTHWORK - CUT (SINGLE 42" DUCTILE IRON PIPE)

Alternative Number	Project Name	Pipe Length (ln ft)	Earthwork - Cut (cu yd)	Unit Cost ($/cu.yd)	Estimated Cost $M
1	Crescent Lake	92,236	192,158	$60.00	$11.53
7	St. Johns River at Lake George	219,765	457,844	$60.00	$27.47
8	St. Johns River Near SR-40	223,807	466,265	$60.00	$27.98
9	Ocklawaha River	312,302	650,629	$60.00	$39.04

** Assumed 7.5' x 7.5' trench to be dug to place single 42" pipe.*

TABLE 6.2
EARTHWORK - FILL (SINGLE 42" DUCTILE IRON PIPE)

Alternative Number	Project Name	Pipe Length (ln ft)	Earthwork - Fill (cu yd)	Unit Cost ($/cu.yd)	Estimated Cost $M
1	Crescent Lake	92,236	159,308	$37.00	$5.89
7	St. Johns River at Lake George	219,765	379,573	$37.00	$14.04
8	St. Johns River Near SR-40	223,807	386,554	$37.00	$14.30
9	Ocklawaha River	312,302	539,400	$37.00	$19.96

** Fill = Trench Volume - Pipe Dimension*

PROJECTED PIPE COST

TABLE 7.1
ALTERNATIVE NO. 1 - CRESCENT LAKE

Value	42" Ductile Iron Pipe
Quantity	1
Pipe Length (ln ft)	92,236
Pipe Unit Cost ($/ln ft)	$125.00
Labor Unit Cost ($)	$175.00
Estimated Cost $M	**$27.67**

TABLE 7.2
ALTERNATIVE NO. 7 - ST. JOHNS RIVER AT LAKE GEORGE

Value	42" Ductile Iron Pipe
Quantity	1
Pipe Length (ln ft)	219,765
Pipe Unit Cost ($/ln ft)	$125.00
Labor Unit Cost ($)	$175.00
Estimated Cost $M	**$65.93**

TABLE 7.3
ALTERNATIVE NO. 8 - ST. JOHNS RIVER NEAR SR-40

Value	42" Ductile Iron Pipe
Quantity	1
Pipe Length (ln ft)	223,807
Pipe Unit Cost ($/ln ft)	$125.00
Labor Unit Cost ($)	$175.00
Estimated Cost $M	**$67.14**

TABLE 7.4
ALTERNATIVE NO. 9 - OCKLAWAHA RIVER

Value	42" Ductile Iron Pipe
Quantity	1
Pipe Length (ln ft)	312,302
Pipe Unit Cost ($/ln ft)	$125.00
Labor Unit Cost ($)	$175.00
Estimated Cost $M	**$93.69**

BORING COST

TABLE 8
BORING COST*

Pipe	Quantity (ea)	Unit Cost ($)	Approximate Length of Bore (ln ft)	Estimated Construction Cost (M)
(3) 24" Ductile Iron Pipe	1	$1,008.00	1,800	$1.81

** Boring cost for Alternative No.9 - at the St. Johns River crossing. An additional 200 ln ft of boring was assumed as a safety factor*

PLANT, STORAGE FACILITY, & PUMP STATION COSTS

TABLE 9.1
REVERSE OSMOSIS / NANOFILTRATION TREATMENT PLANT*

Plant Capacity (mgd)	Membranes / Pretreatment / Ancillary Equipment / HSP / Storage Unit Cost ($/gal)	Estimated Construction Cost (M)	Operations and Maintenance Unit Cost ($/kgal)	Estimated Yearly Operations and Maintenance Cost (M / yr)
28	$2.80	$78.40	$2.50	$25.55

** A reverse osmosis and/or a nanofiltration treatment plant facility will be required for Alternative No. 1, 7, and 8.*
Estimated construction and operations and maintenance unit costs were obtained from recent Florida project costs.

TABLE 9.2
CONVENTIONAL TREATMENT PLANT*

Plant Capacity (mgd)	Filters / HSP / Equipment / Storage Unit Cost ($/gal)	Estimated Construction Cost (M)	Operations and Maintenance Unit Cost ($/kgal)	Estimated Yearly Operations and Maintenance Cost (M / yr)
28	$1.75	$49.00	$1.80	$18.40

** A conventional treatment plant facility is assumed for Alternative No. 9.*
Estimated construction and operations and maintenance unit costs were obtained from recent Florida project costs.

TABLE 9.3
RESERVOIR STORAGE*

Reservoir Capacity (MG)	Unit Cost ($/gal)	Estimated Construction Cost (M)
15	$0.50	$7.50

** Each alternative will require a reservoir*

TABLE 9.4
AQUIFER STORAGE RECOVERY FACILITY COST - CRESCENT LAKE*

Estimated Construction Cost (M)	Estimated Yearly Operations and Maintenance Cost ($M / yr)
9.40	$0.24

** Withdrawl capacity is equal to 125 percent of the year 2025 demand. Aquifer storage reservoir cost are from the St. Johns River Water Management District DWSP cost. A contingency is not included in the construction cost.*

TABLE 9.5
PUMP STATION*

Number of Stations	Estimated Construction Cost (M)
1	$5.50

** Pump station cost includes intake and is a lump sum value*

TABLE 10
TOTAL COST SUMMARY

Alternative Number	Project Name	Pipe Length (ln ft)	Capacity (mgd)						Construction Cost $M	Total Capital Cost $M	Operating Cost / Year $M	Unit Production Cost $/1000 gallon
			YR 2010	YR 2015	YR 2015 (FOS)*	YR 2020	YR 2025	YR 2025 (FOS)*	42" Ductile Iron Pipe	42" Ductile Iron Pipe	42" Ductile Iron Pipe	42" Ductile Iron Pipe
1	Crescent Lake	92,236	4.33	9.97	12.46	16.17	22.41	28.01	$145.89	$211.55	$25.79	$4.96
7	St. Johns River at Lake George	219,765	4.33	9.97	12.46	16.17	22.41	28.01	$198.84	$288.32	$25.55	$5.58
8	St. Johns River Near SR-40	223,807	4.33	9.97	12.46	16.17	22.41	28.01	$200.82	$291.19	$25.55	$5.61
9	Ocklawaha River	312,302	4.33	9.97	12.46	16.17	22.41	28.01	$216.50	$313.93	$18.40	$4.92

* FOS = Factor of safety is equal to YR 2025 Capacity * 125 percent
Total Capital Cost = construction, non-construction capital cost
Construction Cost = Earthwork (cut), Earthwork (fill), Pipe cost, Boring Cost (Alternative No.9), Plant Cost, Reservoir Cost, Pump Station Cost
Non-Construciton Capital Cost = 45% of planning level estimated construction cost. Includes 20% allowance for construction contingency and 25% allowance for engineering design, permitting, and admin.

APPENDIX I

Powerpoint Presentation, June 27, 2007
Seawater Desalination

Flagler County Water Supply Plan Cooperators Meeting

June 27, 2007

St. Johns River Water Management District

Agenda

- Welcome and Introductions
- AWS Project Descriptions
- Project Selection Process
- Next Steps
- Next Cooperator Meeting
- Public Comment

Meeting Purpose

- Describe seawater desalting projects
- Identify preferred AWS project(s)
- Identify next steps for participating entities

Seawater Desalination Alternative Water Supply Options for Flagler County

June 27, 2007
Bunnell, Florida
Ron Wycoff, P.E.

Flagler County Conceptual Seawater Desalination Options

- Land Based
  - Based on adjusting and scaling Swoope Project (New Smyrna Beach) developed by RW Beck (2004) for SJRWMD
    - Seawater feed water
    - Concentrate outfall
- Offshore
  - Based on price information provided by *Water Standard Company* to SJRWMD – June 2007

Common Criteria

- Base loaded options comparable to surface water supply options previously prepared by Arcadis, Inc.
  - ADF = 22.4 mgd (2025 deficit)
  - Installed capacity = 23.8 mgd
  - Same point of delivery

Land Based Option Facilities Required

- Seawater desalination WTP – 23.8 mgd installed capacity
  - Includes intake and open ocean concentrate outfall
- Finished water transmission main (approx. 7 miles)
- Transmission system diurnal storage (11.2 mgd)

Offshore Facilities Required

- Ship based seawater desalination WTP – 23.8 mgd installed capacity – provided by Water Standard Company
  - Includes onshore delivery of product water
- Finished water transmission main (approx. 7 miles)
- Transmission system diurnal storage (11.2 mgd)
- Landside pumping station

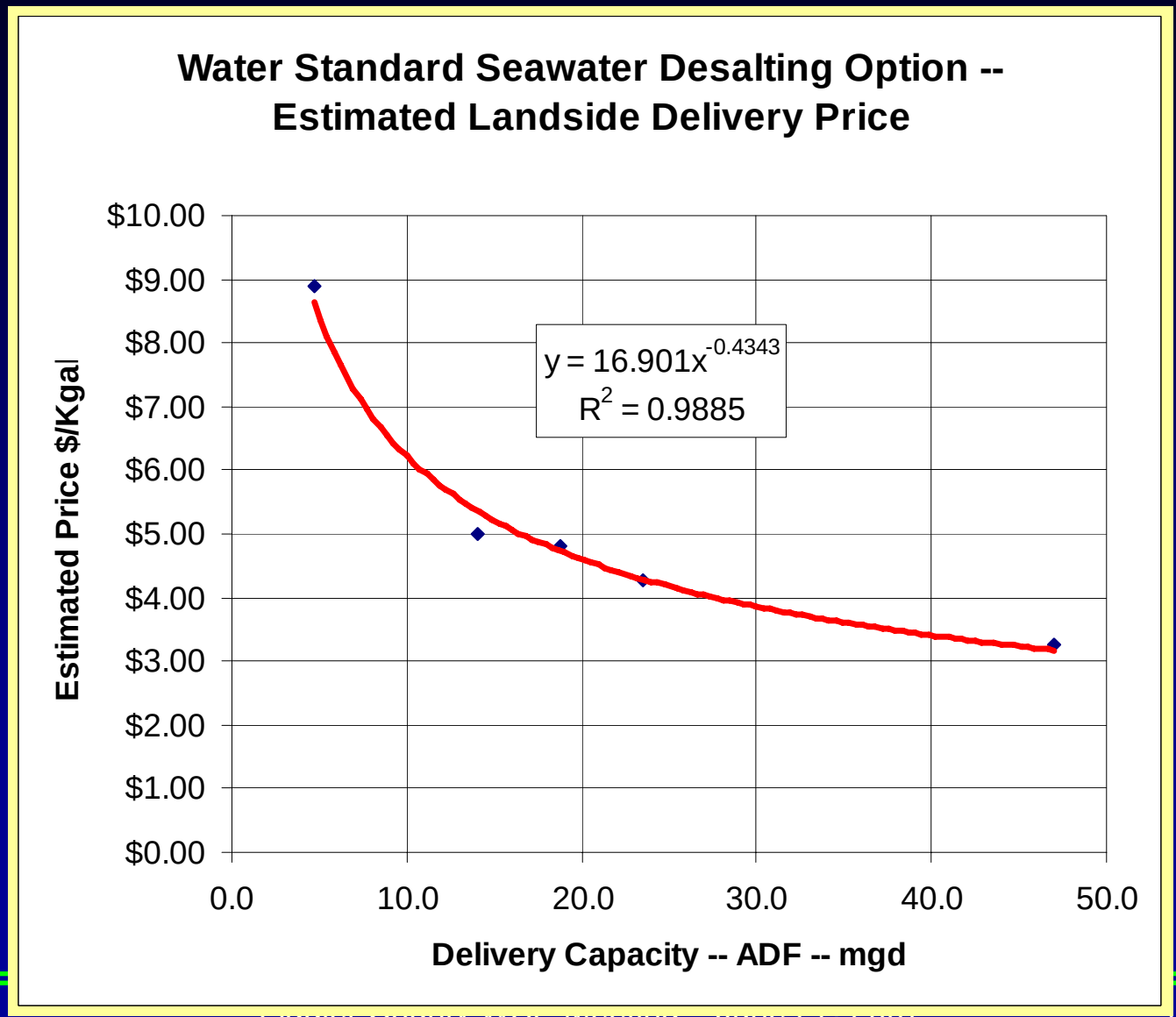
Land Based Option Cost Adjustments

- Adjust and Scale Published Swoope Project Conceptual Cost Estimates to better represent Flagler County Conditions
  - Cost basis – 2002 to 2007
  - Outfall length increased from 2.5 to 4.0 miles
  - Power cost increased from 6.3 to 10 cents per KWH.
  - Construction and O&M regression equations developed to estimate costs at desired capacities

Land Based Option Conceptual Planning Level Cost Estimate

Cost Element	Treatment	Transmission	Total	Units
Construction	$161.8	$18.8	$180.6	$M
Total Capital	$202.8	$23.5	$226.3	$M
O&M	$15.42	$0.02	$15.44	$M/yr.
Unit Production	$3.76	$0.19	$3.94	$/Kgal.

Offshore Option Approximate Onshore Delivery Price (Water Standard Company)



Offshore Option Conceptual Planning Level Cost Estimate

Cost Element	Treatment	Transmission	Total	Units
Construction	$0.0	$22.4	$22.4	$M
Total Capital	$0.0	$28.0	$28.0	$M
O&M	$0.00	$0.64	$0.64	$M/yr.
Unit Production	$4.38	$0.30	$4.68	$/Kgal.

Flagler County Alternative Water Supply Projects Estimated Unit Production Cost Summary

Project	UPC -- $/Kgal
Seawater Options	
Land Based	$ 3.94
Offshore	$ 4.68
Surface Water Options	
Lower Ocklawaha River	$ 4.92
Crescent Lake	$ 4.96
SJR at Lake George	$ 5.58
SJR near SR-40	$ 5.61


Questions
Photo by Means & Meegan

Project Selection Process

- Now that you have reviewed the desalting projects it is time to decide how to move forward:
  - Identify preferred project today, or
  - Short list the projects today, or
  - Retain a consultant to review and rank the projects, and
  - Enter into an interlocal agreement to prepare a Preliminary Design Report

Next Cooperator Meeting

- Proposed - Wednesday, July 25, 2007, 9:30am-Noon
  - Review water supply plan deliverables
  - Develop process for ranking AWS projects
  - Begin discussing interlocal agreement language with participating entities
  - Identify process for rolling out water supply plan

Public Comment

Questions?