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PUTNAM COUNTY
WATER SUPPLY PLAN

PUTNAM COUNTY WATER SUPPLY PLAN

Prepared for the Putnam County Water Supply Plan Cooperators:
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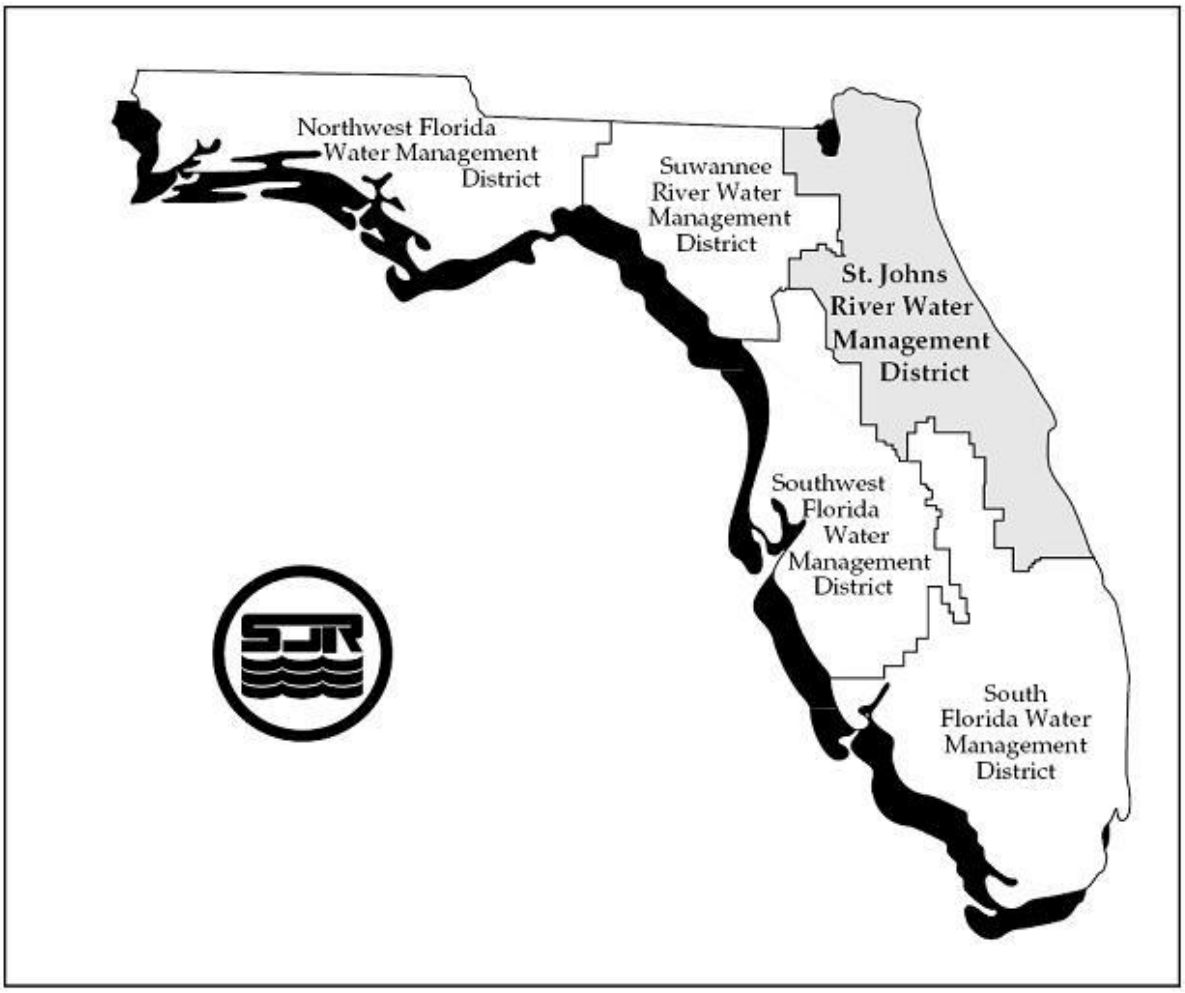

The St. Johns River Water Management District (SJRWMD) was created by the Florida Legislature in 1972 to be one of five water management districts in Florida. It includes all or part of 18 counties in northeast Florida. The mission of SJRWMD is to ensure the sustainable use and protection of water resources for the benefit of the people of the District and the state of Florida. SJRWMD accomplishes its mission through regulation; applied research; assistance to federal, state, and local governments; operation and maintenance of water control works; and land acquisition and management.

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EXECUTIVE SUMMARY

Established in 1849, Putnam County consists of approximately 827 square miles, 105 of which are surface water. Putnam County's total permanent population in 2005 was 74,204 and is projected to increase by 26% to 93,518 by 2030. Total water demand is projected to increase from 11.58 million gallons per day (mgd) in 2005 to 15.09 mgd in 2030. This translates into an increase of 3.5 mgd of additional water supply needed to support projected growth by the year 2030. Long-term projections for Putnam County indicate that by 2050, total population will be 113,447 with a total water demand of 18.06 mgd.

The Putnam County Board of County Commissioners (county) and the municipalities in Putnam County chose to take a proactive approach towards meeting their future water demands. In 2006, the county and municipalities asked the St. Johns River Water Management District (SJRWMD) to work with them in producing a water supply plan for Putnam County that would identify alternatives for meeting their future water demands. SJRWMD invited representatives of the county, Crescent City, Interlachen, Palatka, Pomona Park and Welaka (Cooperators' representatives) to an organizational meeting on January 19, 2007. The Cooperators' representatives, at that meeting, asked SJRWMD's facilitator, Jacob D. Varn, with the law firm of Fowler White Boggs Banker P.A., to address the Putnam Local Government in Cooperation (LOGIC) group to discuss a proposed organizational and decision-making format with the participating elected officials. That meeting resulted in support for development of a water supply plan for Putnam County. In addition, the participants agreed that no formal agreement between the Cooperators and SJRWMD would be needed and also agreed to roles and responsibilities for the Cooperators and SJRWMD. The Cooperators' representatives met periodically throughout 2007 and 2008 to set priorities and review draft materials prepared by SJRWMD in support of the Putnam County Water Supply Plan (Plan).

The Plan provides specific conclusions and identifies a series of recommended actions and projects for meeting Putnam County's projected water demands for the year 2030. The Cooperators' representatives accepted the final Plan on October 24, 2008. SJRWMD staff presented the final Plan to the Putnam LOGIC group on October 29, 2008, with an offer to make a presentation concerning the Plan, upon request, to any of the Cooperators' elected bodies.

An analysis conducted by SJRWMD in support of the Plan indicates that unacceptable impacts to water resources and related natural systems would likely occur in response to projected water use increases from 1995-2030 in the northeast Florida area if these increases were realized. Projected unacceptable impacts identified for Putnam County would be due to cumulative impacts of withdrawals that occur largely outside of Putnam County. Because of these projected impacts, the District staff expects to recommend that all of Putnam County and the areas outside of Putnam County that contribute to the impacts be designated as a priority water resource caution area (PWRCA) in the 2008 District Water Supply Assessment. PWRCAs are areas where existing and reasonably anticipated sources of water and conservation efforts will not be adequate (1) to supply water for all existing legal uses and reasonably anticipated future needs and (2) to sustain the water resources and related natural systems. SJRWMD identifies PWRCAs in its districtwide water supply assessments based on water resource constraints and the results of water use, groundwater, and surface water assessments. Based on the expected PWRCA designation for Putnam County, potential alternative water supply (AWS) sources and projects, and recommended future actions have been identified.

POTENTIAL WATER SUPPLY SOURCES AND PROJECTS

Potential Water Supply Sources

Traditional, fresh groundwater and non-traditional brackish groundwater could likely be developed to supply projected future water supply needs in Putnam County through 2030, if projected water supply needs in other areas of northeast and north-central Florida are met largely with alternative water supply sources other than brackish groundwater. Although brackish groundwater is considered an alternative water supply source, the development of brackish groundwater sources has the potential of causing the same types of impacts to wetlands, lakes, and springs as the development of traditional, fresh groundwater sources.

Based on a review of available water resources information, the following potential alternative water supply sources (other than reclaimed water and brackish groundwater) have been identified as sources that appear to have an adequate potential yield and water quality to be considered as long-term, viable sources of water supply for public supply utilities in Putnam County.

- Lower Ocklawaha River
- Crescent Lake
- St. Johns River
- Seawater

ARCADIS U.S., Inc., recently investigated these same sources as possible sources to supply public supply utilities in Flagler County in association with development of the Flagler County Water Supply Plan. SJRWMD used information included in the Flagler County Water Supply Plan to support the identification of potential alternative water supply sources for public supply utilities in Putnam County. SJRWMD has published the Flagler County Water Supply Plan as Special Publication SJ2007-SP16. Analyses that are more detailed would be required before any of these sources could be developed. Each of these alternative water supply sources has associated uncertainties as follows:

- Lower Ocklawaha River – Although existing water resources information indicates that the Ocklawaha River could support withdrawals of approximately 107 mgd (Hall 2005), it is not known how proposed restoration efforts by the State of Florida and establishment of minimum flows and levels by SJRWMD might impact the water withdrawals.
- Crescent Lake – Crescent Lake appears to be vulnerable to seasonal high tides in the St. Johns River, which cause flow reversal in Dunns Creek, the lake's outlet to the St. Johns River. If 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 water supply reliability at all times. In addition, water in Crescent Lake typically exceeds federal and state public drinking water standards for total dissolved solids (500 mg/ L) and, therefore, is considered brackish for water supply planning purposes. This brackish surface water source will require demineralization. The demineralization process would generate a by-product (concentrate) that would have to be managed in an environmentally acceptable manner.
- St. Johns River – Water in the St. Johns River in Putnam County typically exceeds federal and state public drinking water standards for total dissolved solids (500 mg/ L) and, therefore, is considered brackish for water supply planning purposes. This brackish surface water source will require demineralization. The demineralization process would generate a by-product (concentrate) that would have to be managed in an environmentally acceptable manner.

- Seawater – Seawater has not been developed as a source of public water supply along the Atlantic Coast in an area reasonably accessible to Putnam County. Therefore, numerous uncertainties are associated with this source. The most significant of these uncertainties concern environmental and regulatory acceptability, treatment technology, and energy costs.

Potential Alternative Water Supply (AWS) Projects

The Cooperators asked for further details on the following two conceptual AWS projects: Lower Ocklawaha River in Putnam County Project and the Crescent Lake Project. SJRWMD staff and consultants met with the Cooperators and the public on August 14, 2008, to better define the conceptual projects to meet the needs of utilities within Putnam County. SJRWMD staff and consultants took the input received during this meeting and prepared preliminary descriptions and cost estimates of these conceptual projects with the following results.

- Lower Ocklawaha River in Putnam County Project – A project with this name is currently identified in SJRWMD's 2005 District Water Supply Plan. The Cooperators asked that the conceptual design of this project be redesigned to meet needs within Putnam County, that it be called the Lower Ocklawaha River (LOR) near Rodman Reservoir project, and that it be defined as follows.
    - The intake would be at the north end of Rodman Reservoir and include a pumping station. The intake would be positioned in the channel of the river and therefore would function with or without the reservoir.
    - This project would provide 6 million gallons per day (mgd) peak capacity with 3 mgd average daily flow (adf) of untreated water to Palatka.
    - This project would provide 6 mgd peak capacity with 3 mgd adf of treated potable water to Putnam County using conventional surface water treatment.
    - This project would provide 60,000 gallons per day adf of treated potable water to Interlachen from Putnam County with inclusion of facilities adequate to provide for fire protection.
    - Cost estimates:

        - Construction cost - $56.15 million
        - Total capital cost - $71.5 million
        - Operations and maintenance - $1.39 million per year
        - Annual cost - $5.77 million per year
        - Unit production cost for Putnam County (treated water) – $3.64 per 1,000 gallons
        - Unit production cost for Palatka (raw water) - $1.63 per 1,000 gallons
        - Putnam County will provide treated water to Interlachen at a cost to be determined. The affordability of this project to the Town of Interlachen is dependent on cooperation between Putnam County and the Town of Interlachen.
    - Cost estimates at increments of 2 mgd were calculated for incremental construction costs for the water treatment plant (WTP):
        - Phase 1 – initial 2 mgd - $17.06 million
        - Phase 2 – 2 mgd expansion - $4.13 million
        - Phase 3 – 2 mgd expansion – $4.13 million
        - Total WTP - $25.32 million
- Crescent Lake Project –A project based on withdrawals of water from Crescent Lake was identified in the Flagler County Water Supply Plan and the Putnam County Cooperators asked that this project be scaled to provide 0.5 mgd of treated potable water to Crescent City. Conventional surface water treatment plus membrane treatment would be required. A design capacity of 0.5 mgd and an average production capacity of 0.25 mgd was assumed.
    - Cost estimates:
        - Construction cost - $19.72 million
        - Total capital cost - $23.56 million
        - Operations and maintenance - $0.45 million per year
        - Annual cost - $1.96 million per year
        - Unit production cost for Crescent City – $21.52 per 1,000 gallons

- This project is probably infeasible due the relatively high unit production cost.

The following two AWS projects, which have already been examined in other water supply planning processes, may have potential to provide water to public supply utilities in Putnam County.

- St. Johns River near Lake George – A project with this name is currently identified in SJRWMD's 2005 District Water Supply Plan. This project was conceptually planned as a 33 mgd project that would deliver water to public supply utilities in Flagler County and to the Town of Pierson. This project was further investigated as part of the Flagler County water supply planning process. It is identified in the Flagler County Water Supply Plan as a potential alternative water supply project. To date, no decision has been made to pursue implementation of this project. This project could be a viable alternative for public supply utilities in Putnam County and other areas of northeast and north-central Florida.
- Coquina Coast Seawater Desalination Project – This project is identified in SJRWMD's 2005 District Water Supply Plan, Third Addendum. A group of governments has agreed to prepare a preliminary design document to further identify the technical and financial characteristics of the potential project. Governments in Flagler, Lake, Marion, St. Johns, and Volusia counties are participating in the study. The Putnam County Board of County Commissioners declined to participate, but participation in this project is still possible.

RECOMMENDATIONS

The following actions should also be pursued by the Putnam County Cooperators.

- Water conservation – Utilities in Putnam County are required to meet conservation standards as part of the District's consumptive use permitting program. Governments in Putnam County should aggressively pursue compliance with these requirements.
- Use of reclaimed water - The use of reclaimed water to achieve a water resource benefit should be aggressively pursued by utilities in Putnam County to the extent environmentally, economically, and technically feasible.

- Development of additional quantities of traditional, fresh groundwater and non-traditional brackish groundwater – Governments in Putnam County should actively participate in SJRWMD's regional water supply planning process in 2009-2010 to support the development of alternative water supply sources by public supply utilities in other areas of northeast and north-central Florida. The goal of this participation should be to identify water supply strategies that, if implemented, could provide for the continued development of groundwater in Putnam County through 2030.
- Development of alternative surface water sources – Governments in Putnam County should actively participate in SJRWMD's regional water supply planning process in 2009-2010 to identify strategies for the cooperative development of the alternative surface water supply sources and projects identified in this plan and other projects that may be identified through SJRWMD's planning process.
- Development of seawater sources – Governments in Putnam County should closely follow the development of the Coquina Coast Seawater Desalination Project. These governments should consider participation in this project should other water supply strategies identified through SJRWMD's regional water supply planning process in 2009-2010 prove less advantageous.
- Continuation and limited expansion of existing brackish groundwater sources – Putnam County should work closely with SJRWMD in pursuing limited and reasonable expansion of its existing wellfield and reverse osmosis (RO) treatment facilities.

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INTRODUCTION

PLANNING INITIATIVE

In 2006, representatives of the Putnam County Board of County Commissioners (county) contacted the St. Johns River Water Management District (SJRWMD) to request the development of a water supply plan for Putnam County. SJRWMD staff and consultants held a meeting on January 19, 2007, and invited representatives of the county, Crescent City, Interlachen, Palatka, Pomona Park, and Welaka (Cooperators' representatives) to discuss the preparation of the Putnam County Water Supply Plan (Plan). Representatives from the county, Pomona Park, Crescent City, and Palatka attended. It was the consensus of the attendees that SJRWMD should facilitate the development of the Plan under the guidance and review of county and municipal representatives.

The Cooperators' representatives, at that meeting, asked SJRWMD's facilitator, Jacob D. Varn, with the law firm of Fowler White Boggs Banker P.A., to address the Putnam Local Government in Cooperation (LOGIC) group to discuss a proposed organizational and decision-making format with the participating elected officials. That meeting resulted in support for development of the Plan. In addition, the participants agreed that no formal agreement between the Cooperators and SJRWMD would be needed and also agreed to roles and responsibilities for the Cooperators and SJRWMD (Table 1). The Cooperators' representatives met with SJRWMD and consultants periodically throughout 2007 and 2008 to set priorities and review draft materials prepared by SJRWMD in support of the Plan.

The Plan provides specific conclusions and identifies a series of recommended actions and projects for meeting Putnam County's projected water demands for the year 2030. The Cooperators' representatives accepted the final Plan on October 24, 2008. SJRWMD staff presented the final Plan to the Putnam LOGIC group on October 29, 2008, with an offer to make a presentation concerning the Plan, upon request, to any of the Cooperators' elected bodies.

Table 1. Planning groups roles and responsibilities

Group	Roles and Responsibilities
Elected Officials	• Ultimate decision makers regarding scope, scheduling and deliverables • Interface with other elected officials within their local government
Technical Advisory Group	• Provide technical input and review of data, draft documents, and implementation recommendations • Advisory to elected officials
SJRWMD Staff and Consultants	• Conduct project management, facilitation, data collection, analysis, and report writing services to Technical Advisory Group and Elected Officials • Responsible for preparation of draft and final planning documents

LOCATION AND GOVERNMENTAL ENTITIES

Located in the north central portion of SJRWMD, Putnam County covers approximately 827 square miles (about 529,000 acres), or about 6.7% of SJRWMD's total area (Figure 1). Approximately 105 square miles or 13% of Putnam County's area is surface water.

Municipalities in Putnam County include the City of Crescent City, Town of Interlachen, City of Palatka, Town of Pomona Park, and Town of Welaka (Figure 2).

PUTNAM COUNTY WATER RESOURCES

Groundwater Resources

Three aquifer systems supply groundwater in Putnam County: the surficial, the intermediate, and the Floridan. The Southeastern Geological Society (1986) described the hydrogeologic nature of these aquifer systems.

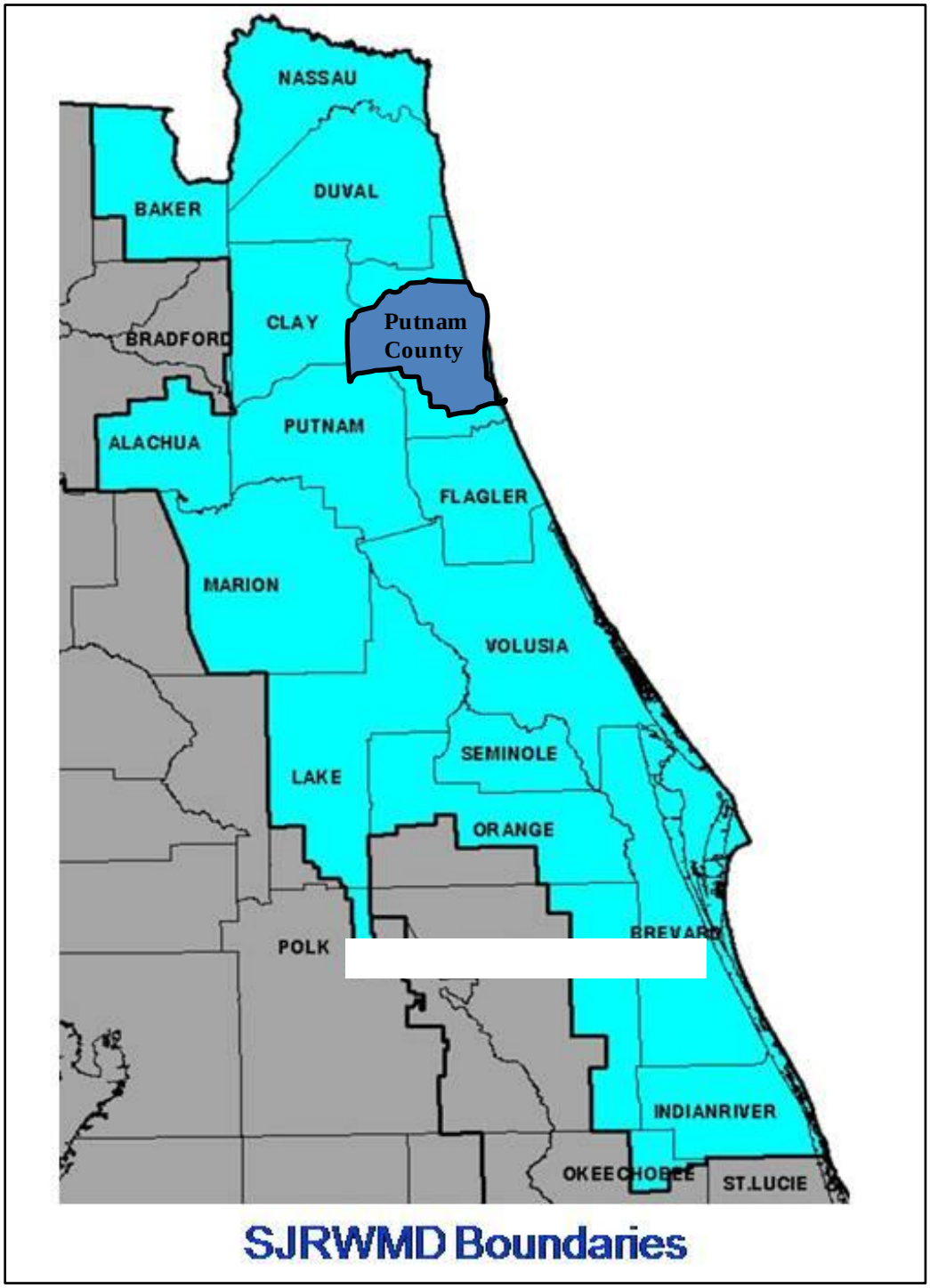

Figure 1. Boundaries of SJRWMD

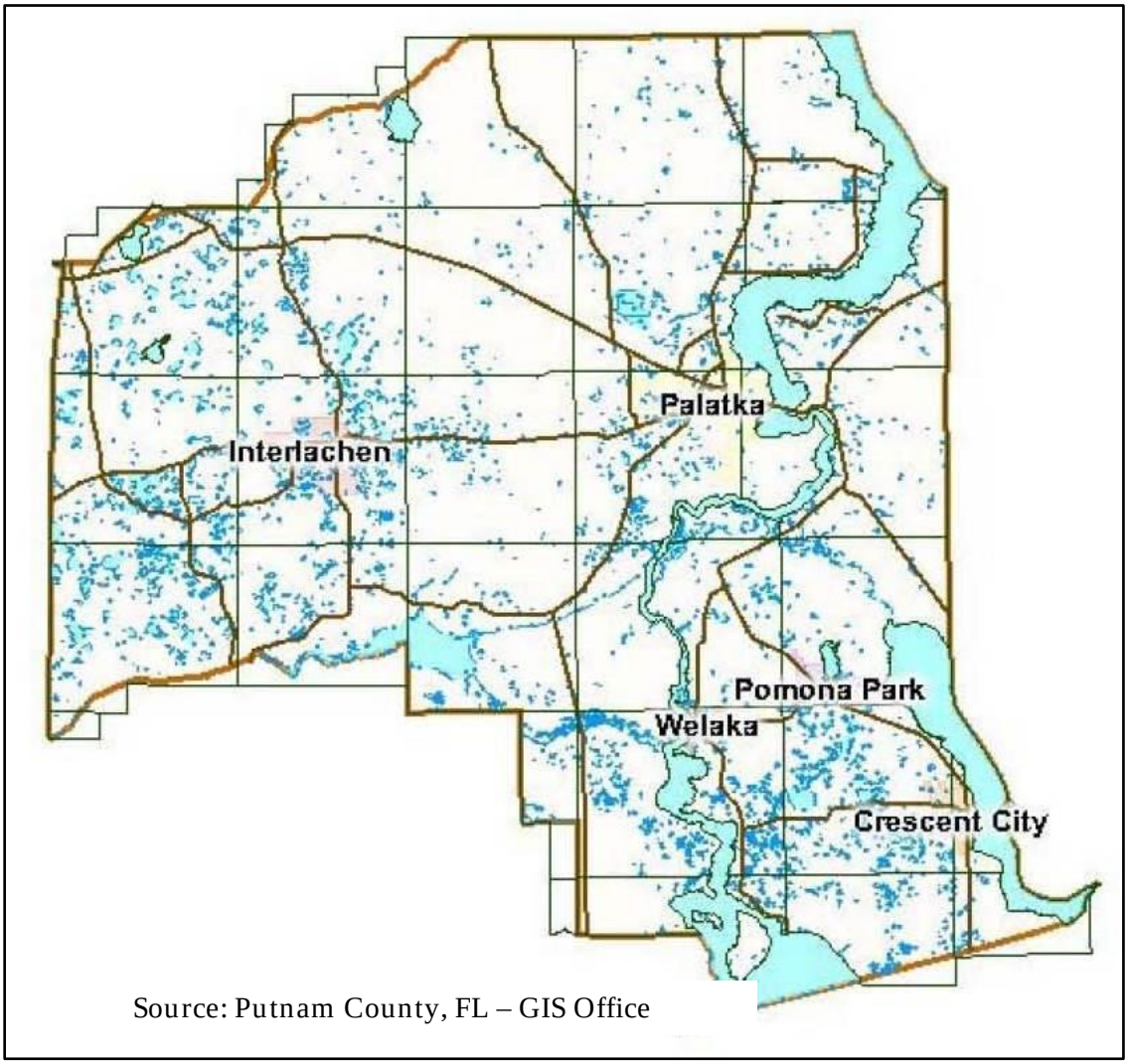

Figure 2. Putnam County

Surficial Aquifer System

System Components. The surficial aquifer system consists primarily of sand, silt, and sandy clay. It extends from land surface downward to the top of the confining unit of the intermediate aquifer system. The surficial aquifer system contains the water table, which is the top of the saturated zone within the aquifer. Water within the surficial aquifer system occurs mainly under

unconfined conditions, but beds of low permeability cause semi-confined or locally confined conditions to prevail in its deeper parts.

Water Quality. Water in the surficial aquifer system is generally of acceptable quality for domestic use throughout most of Putnam County. Based on a review of U.S. Geological Survey (USGS) and SJRWMD data, chloride, sulfate, and total dissolved solids (TDS) concentrations generally meet the secondary potable drinking water standards of 250, 250, and 500 milligrams per liter (mg/ L), respectively (Subsection 62-550.320(1), *F.A.C.*). However, chloride, sulfate, and TDS concentrations often exceed these standards in lowland areas along the St Johns River. Iron concentrations in many places throughout the county do not meet the secondary drinking water standard of 0.3 mg/ L (Subsection 62-550.320(1), *F.A.C.*).

Intermediate Aquifer System/Intermediate Confining Unit

System Components. Regionally, the intermediate aquifer system/ intermediate confining unit consists of fine-grained clastic deposits of clayey sand to clay interlayered with thin water-bearing zones of sand, shell, and limestone (Southeastern Geological Society 1986). In most of Putnam County, the intermediate yields little or no significant amounts of water and can therefore be referred to locally as simply the intermediate confining unit

Water Quality. Available USGS and SJRWMD data indicate that the salinity of water in the intermediate confining unit is generally of acceptable quality for domestic use in Putnam County; chloride, sulfate, and TDS concentrations generally meet secondary drinking water standards. As with water in the surficial aquifer system however, salinity often does not meet potable drinking water standards in lowland areas along the St Johns River.

Floridan Aquifer System

The Floridan aquifer system is one of the world's most productive aquifers. The rocks, primarily limestone and dolomite, that compose the Floridan aquifer system underlie the entire state. However, this aquifer system does not contain potable water at all locations. Water in the Floridan aquifer system occurs under confined conditions throughout Putnam County.

Ground water from the surficial aquifer system recharges the Floridan aquifer system throughout the county's upland areas where surficial water levels are higher than the potentiometric surface of the Floridan aquifer system. Rates

of recharge are functions of the magnitude of the water level difference between the aquifers and of the vertical permeability of the intermediate confining unit separating the aquifers. In addition, significant local recharge may occur where sinkholes have breached the intermediate confining unit.

Discharge from the Floridan aquifer occurs in areas where the elevation of the Floridan aquifer potentiometric surface is higher than water levels within the surficial aquifer system. In these areas, water moves from the Floridan aquifer in an upward direction through the intermediate confining unit to the surficial aquifer system. Where the elevation of the Floridan aquifer potentiometric surface is higher than land surface, springs and free-flowing artesian wells occur.

The Floridan aquifer system is subregionally divided on the basis of the vertical occurrence of two zones of relatively high permeability (Miller 1986). These zones are called the Upper and Lower Floridan aquifers. A less permeable limestone and dolomitic limestone sequence, referred to as the middle semiconfining unit, generally separates the Upper and Lower Floridan aquifers.

USGS and SJRWMD data indicate that salinity (as represented by chloride and TDS concentrations) in both the Upper Floridan aquifer and the Lower Floridan aquifer varies areally within Putnam County. Salinity is generally low in the portions of Putnam County north and west of the St Johns River and the Ocklawaha River, as well as upland areas in southeastern Putnam County. Chloride and TDS concentrations in the Upper Floridan aquifer generally exceed the secondary drinking water standards in the lowlands along the rivers. Water in the Lower Floridan aquifer within these lowland areas is very brackish or saline.

The Upper Floridan aquifer is the primary source of water for public supply water use in Putnam County. However, water in the Upper Floridan aquifer in northeastern Putnam County east of the St Johns River generally does not meet primary and secondary drinking water standards and may require treatment by reverse osmosis (RO) for use by public water supply systems.

Surface Water Resources

Putnam County contains several large surface water systems the largest of which is the St. Johns River. The St. Johns River flows northward through Putnam County from Lake George in the southern portion of the county,

through Palatka, and exiting through the northeast portion of Putnam County where it is over three miles wide.

The Ocklawaha River, a major tributary to the St. Johns River, flows through the south-central part of Putnam County. Its base flow is supplied largely by groundwater discharge from Silver Springs in Marion County. The Ocklawaha River in Putnam County was structurally altered as part of the Cross Florida Barge Canal Project, which was deauthorized in 1990. As part of the project, the river was routed into the Rodman Reservoir. Rodman Reservoir also receives inflow from Orange Creek, the last major tributary to the river before it discharges to the St. Johns River. Flows from the reservoir are discharged to the St. Johns River through a water control structure known as the George C. Kirkpatrick Dam and through Buckman Lock.

Crescent Lake is in the extreme southeast portion of Putnam County. It discharges through Dunns Creek to the St. Johns River. Numerous other lakes and freshwater wetland and marsh systems dominate western and southern Putnam County.

RESOURCE ANALYSES

The methodology for analyzing the potential impacts of water demands in Putnam County involved two major components:

- Water use estimates and projections
- Identifying groundwater resource limitations

WATER USE ESTIMATES AND PROJECTIONS

SJRWMD staff and consultants developed water supply projections for the public supply utilities in Putnam County in consultation with water suppliers. Water supply projections were prepared by GIS Associates, Inc., consultant to SJRWMD, for the year 2030 for each utility service area and included estimates for the following use categories:

- Public supply
- Domestic self-supply and small public supply systems
- Commercial/ industrial/ institutional self-supply
- Thermoelectric power generation self-supply
- Agricultural irrigation self-supply
- Recreational self-supply

Table 2 presents the projections for all water use categories in Putnam County through the year 2050. Total water demand is projected to increase by approximately 15% between 2005 and 2050 increasing from 51.16 mgd in 2005 to 58.58 mgd in 2050.

In order to insure consistency with other SJRWMD planning efforts, 2030 demands were used as the basis of evaluating the water resources impacts of projected water use. Total water demand in Putnam County is expected to increase by 7%, from 51.16 mgd in 2005 to 54.80 mgd in 2030 (Table 2).

Table 3 presents the population estimates and projections for the public water use in Putnam County through the year 2050. Public use is the total of water provided by public supply utilities and domestic self-supply. Total public use water demand is projected to increase by approximately 56% between 2005 and 2050, increasing from 11.58 mgd in 2005 to 18.06 mgd in 2050 (Table 3).

Table 2. Putnam County water use projection**s** by use category (mgd)

Category	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Public Supply	2.83	3.27	4.01	4.52	4.97	5.53	6.11	6.63	7.17	7.68
Domestic Self-Supply and Small Public Supply	8.75	8.87	8.98	9.28	9.21	9.56	9.94	10.08	10.23	10.38
Agricultural Irrigation	8.86	8.85	8.85	8.84	8.83	8.83	8.83	8.82	8.82	8.81
Recreational Irrigation	0.27	0.29	0.31	0.33	0.35	0.37	0.39	0.40	0.42	0.44
Commercial /Industrial/ Institutional	28.58	28.31	28.31	28.31	28.31	28.31	28.31	28.31	28.31	28.31
Thermoelectric Power Generation	1.87	1.99	2.11	2.24	2.36	2.48	2.60	2.72	2.85	2.97
County Totals	51.16	51.58	52.57	53.51	54.03	55.08	56.17	56.96	57.79	58.58

Table 3. Putnam County population and public use water demand projections, 2005-2050

Water Supplier	Population									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Crescent City[3]	1,765	1,957	2,101	2,221	2,249	2,343	2,494	2,605	2,716	2,827
Interlachen	1,492	1,656	1,827	1,985	2,040	2,220	2,365	2,507	2,648	2,790
Melrose [1]	457	461	471	499	527	548	561	581	600	619
Palatka	11,154	12,275	13,396	14,517	15,638	16,759	17,880	19,001	20,122	21,243
Putnam County	-	560	2,648	3,852	4,799	6,175	7,485	8,765	10,045	11,325
Welaka	877	949	989	1,018	1,028	1,062	1,106	1,140	1,174	1,208
Domestic Self Supply and Small Utilities[2,4]	58,459	60,176	60,839	62,484	62,266	64,411	68,449	70,111	71,773	73,435
County Totals	74,204	78,034	82,271	86,576	88,547	93,518	100,340	104,710	109,078	113,447

Table 3—*continued*

Water Supplier	Water Demand (mgd)									
	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
Crescent City [3]	0.22	0.45	0.47	0.49	0.49	0.51	0.53	0.55	0.57	0.58
Interlachen	0.09	0.12	0.13	0.14	0.14	0.15	0.16	0.17	0.18	0.19
Melrose[1]	0.12	0.11	0.11	0.11	0.11	0.12	0.16	0.16	0.17	0.17
Palatka	2.31	2.33	2.59	2.81	3.06	3.28	3.5	3.72	3.94	4.16
Putnam County	0	0.12	0.56	0.82	1.02	1.31	1.59	1.86	2.13	2.4
Welaka	0.09	0.14	0.15	0.15	0.15	0.16	0.17	0.17	0.18	0.18
Domestic Self Supply and Small Utilities[2,4]	8.75	8.87	8.98	9.28	9.21	9.56	9.94	10.08	10.23	10.38
County Totals	11.58	12.14	12.99	13.8	14.18	15.09	16.05	16.71	17.4	18.06

Notes for Table 3:

1. Includes Alachua County portion
2. Includes private wells, small utilities (< 0.1 mgd), former Mariposa DRI area, and possibly large utilities TBD
3. Includes 0.155 mgd for new Wal-Mart Service Center
4. Domestic self supply water use demands and population projections differ from the water use demands and population projections presented in draft 2008 District Water Supply Assessment due to Interlachen not be included in domestic self supply category for the Putnam County Water Supply Plan.

Total public use water demands in Putnam County are expected to increase from 11.58 mgd in 2005 to 15.09 mgd in 2030, which represents a 30% increase (Table 3).

There are 15 public water supply service areas in Putnam County (Figure 3). Public supply utility demand projections were distributed within the appropriate utility service areas. Projected demands associated with new development outside of utility service areas were identified as domestic self-supply and small public supply. During preparation of this plan, a development of regional impact (DRI) called Mariposa was proposed for Putnam County. Mariposa was ultimately not approved for implementation by the county. However, demand projections for the land area originally designated as the Mariposa proposed DRI have been included in this plan and analyses.

Projected 2030 water withdrawals from the Floridan aquifer for public supply were located at existing or proposed wells (Figure 3). This information supported the groundwater modeling that was the basis of the evaluation of water resource impacts related to proposed water use increases.

IDENTIFYING GROUNDWATER RESOURCE LIMITATIONS

In order to estimate the potential impacts to water resources in Putnam County due to projected future water use increases, SJRWMD has developed several tools to evaluate the impacts of groundwater withdrawals on environmental resources. These include:

- The Northeast Florida Regional Groundwater Flow Model (Birdie 2006)
- Geographic Information System (GIS) based models that can be used to assess the likelihood of harm to native vegetation and lakes as a result of projected groundwater level declines (Kinser et al. 1995, Kinser et al. 2003, Kinser et al. 2006, and Dunn et al. 2008)
- Water resource constraints (SJRWMD 2006)

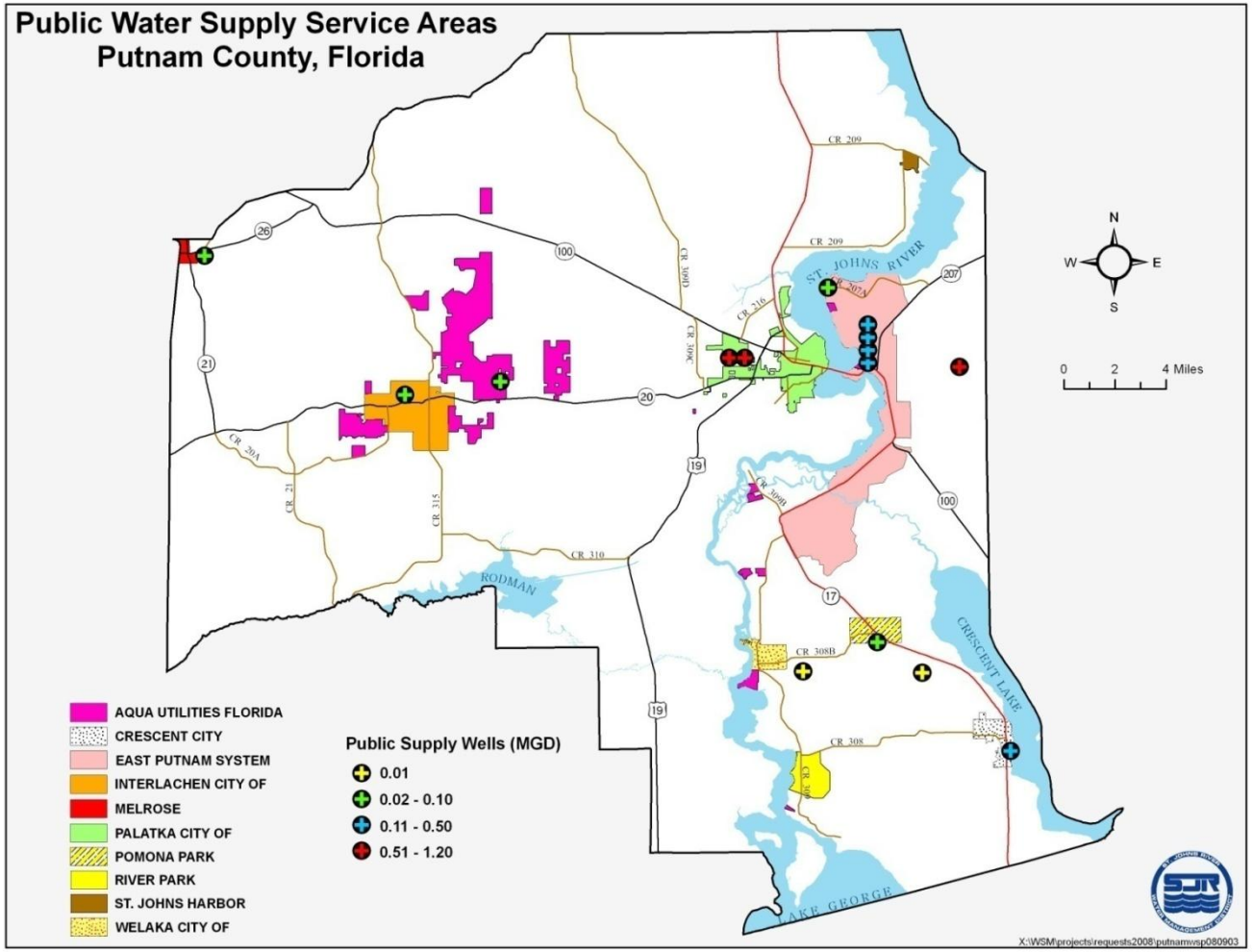

Figure 3. Public water supply service areas and wells in Putnam County

Groundwater Modeling Results

The Northeast Florida Regional Groundwater Flow Model (NEF model) was used to simulate changes in the potentiometric surface of the Upper Floridan aquifer and water levels in the surficial aquifer in response to projected changes in groundwater withdrawals from 1995-2030 throughout the model domain. The NEF model encompasses, in whole or part, thirteen northeast Florida and six southern Georgia counties. Physiographic regions within the 11,658 square mile domain vary, ranging from swamp and meandering plane to uplands and ridges.

Calibrated to 1995 data, the current NEF model version incorporates updated recharge, evapotranspiration (ET), and 2030 water use/ reuse projections (SJRWMD 2008) as compared to data in the earlier version of the model (Birdi 2006). The NEF model simulated the Floridan aquifer system's hydrologic response to projected 2030 water use.

Results indicate that the potentiometric surface of the Upper Floridan aquifer is projected to decline by up to 10 ft in the model domain area and up to three ft in portions of Putnam County if projected changes in water use throughout the model domain are realized (Figure 4). Water levels in the surficial aquifer in Putnam County are projected to decline up to 2.5 ft (Figure 5).

Much of the projected decline in the Upper Floridan aquifer in Putnam County is due to increased withdrawals outside of Putnam County. Projected declines in the potentiometric surface of the Upper Floridan aquifer due to withdrawals in Nassau, Duval, and Clay counties and to a lesser extent St. Johns County affect projected declines in Putnam County (Figure 6).

The surficial aquifer is also projected to experience water level declines largely related to increased withdrawals from the Floridan aquifer in areas outside of Putnam County (Figure 7).

Water Resource Impact Analysis

The groundwater modeling results were used as the basis of evaluation of the likelihood of harm to native vegetation and lakes. The projected declines in water levels in the surficial aquifer were used as input to SJRWMD's likelihood of harm to native vegetation and likelihood of harm to lakes models. A screening analysis of impacts to springs was also conducted.

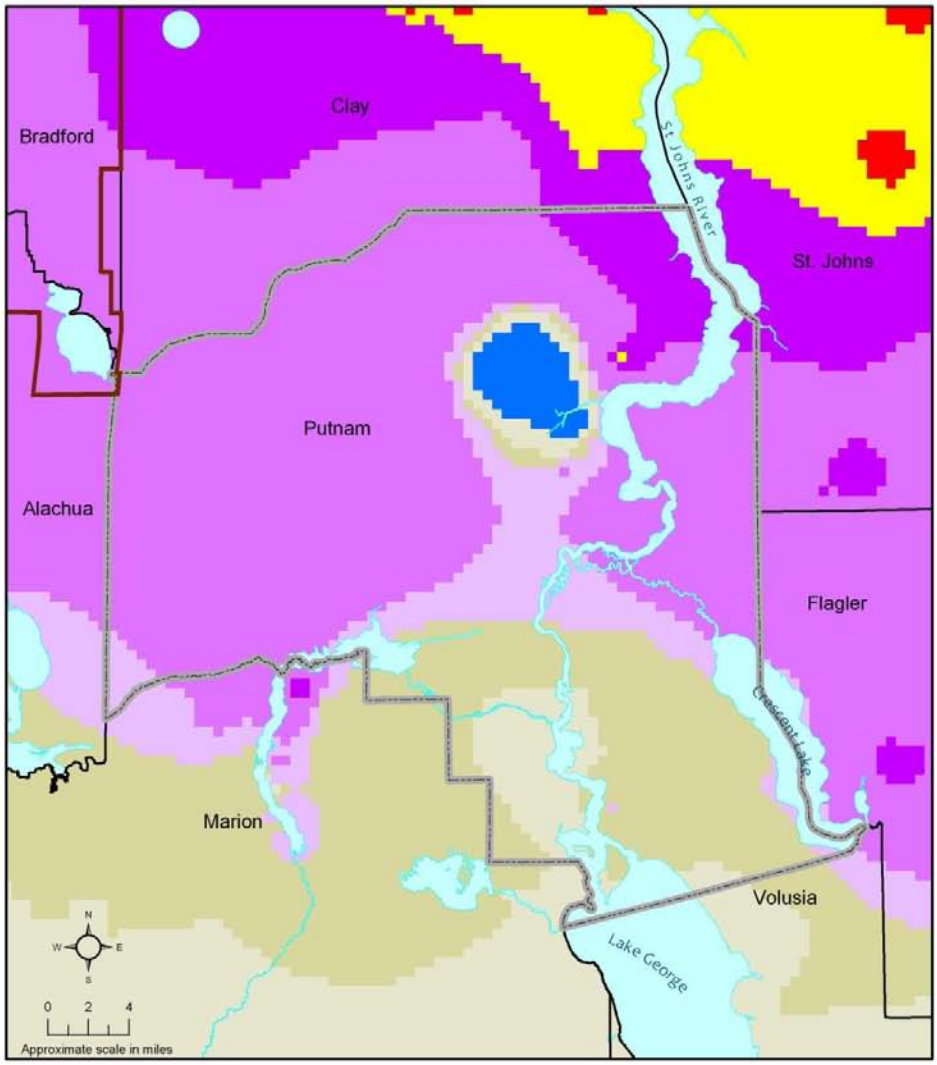

Figure 4. Projected changes in the elevation of the potentiometric surface of the Floridan aquifer system in response to projected increases in groundwater withdrawals,1995 - 2030

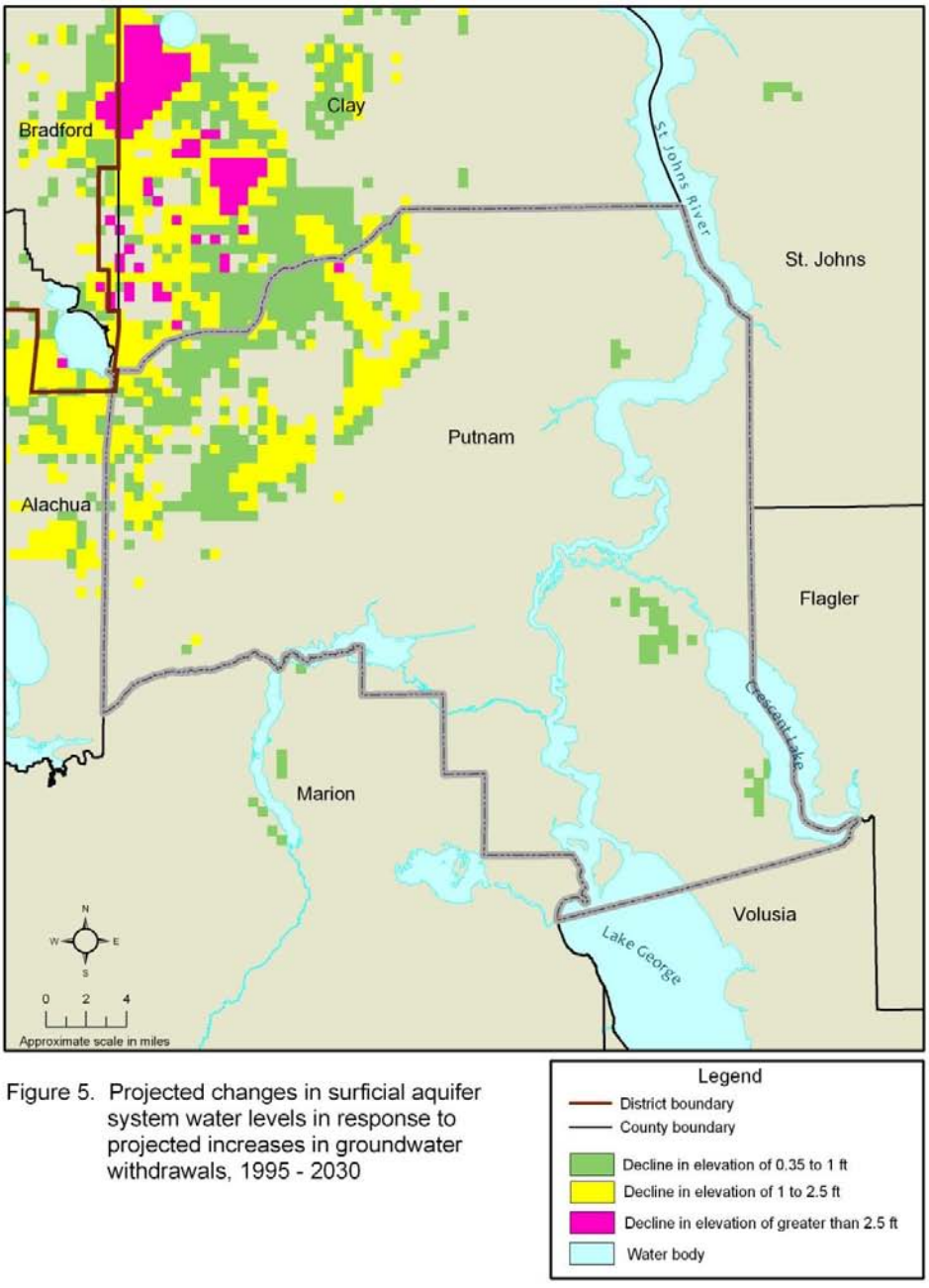

Figure 5. Projected changes in surficial aquifer system water levels in response to projected increases in groundwater withdrawals, 1995 - 2030

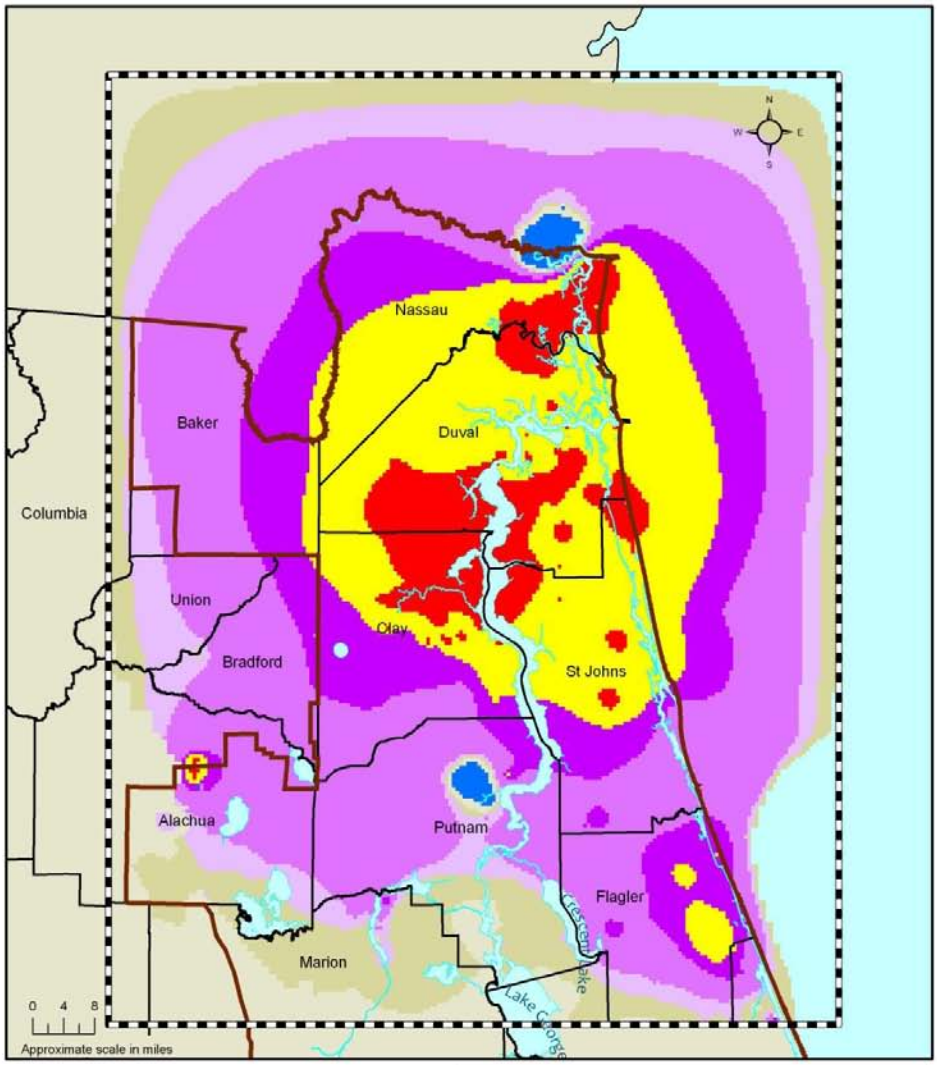

Figure 6. Projected changes in the elevation of the potentiometric surface of the Floridan aquifer system in response to projected increases in groundwater withdrawals,1995 - 2030

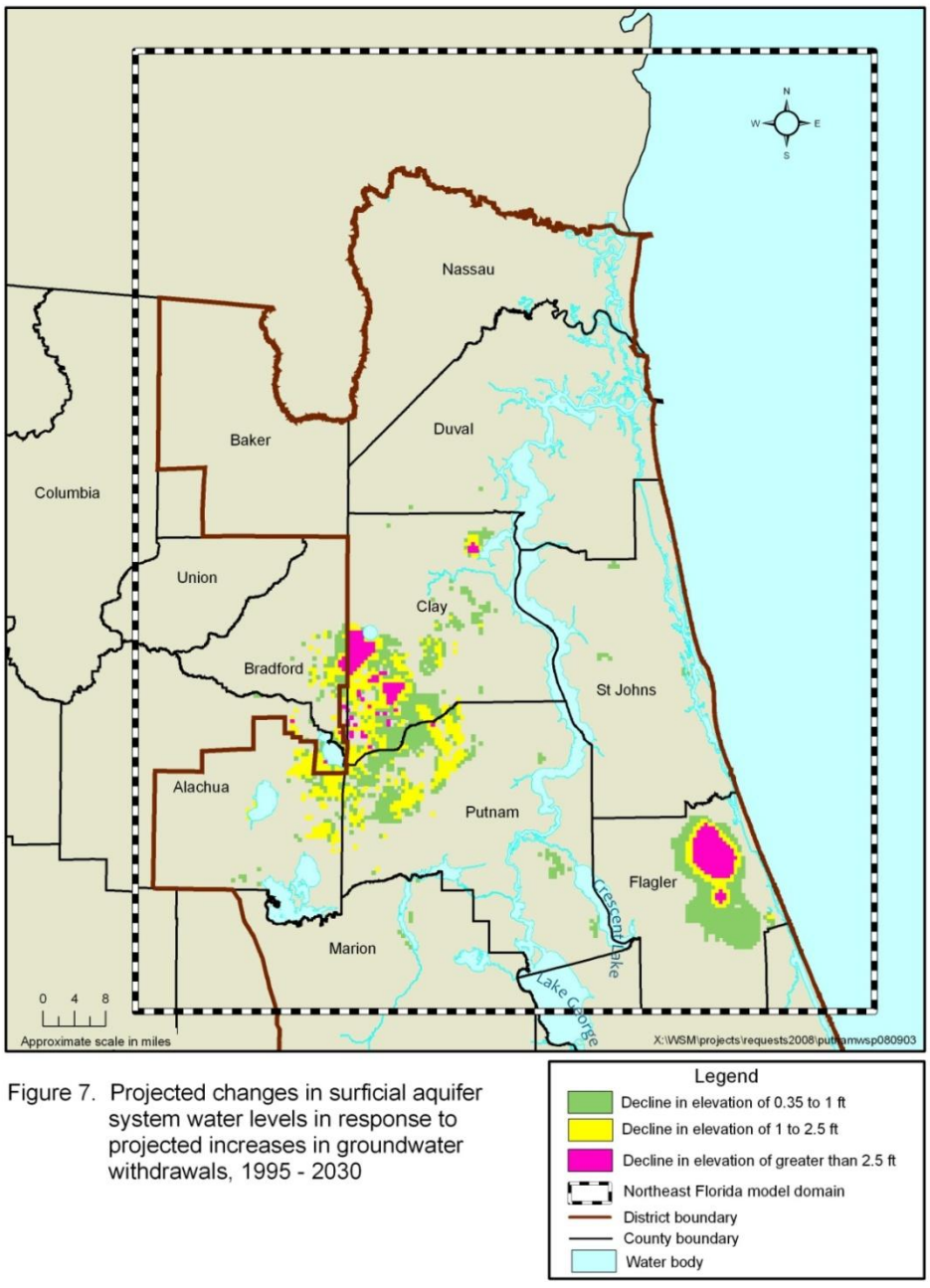

Figure 7. Projected changes in surficial aquifer system water levels in response to projected increases in groundwater withdrawals, 1995 - 2030

Likelihood of Harm to Native Vegetation

SJRWMD's process for assessing impacts to native vegetation is described in Kinser and Minno (1995) and Kinser et al. (2003). A recent modification was added to the vegetative harm assessment process to account for areas within SJRWMD with an unconfined Floridan aquifer (Dunn et al. 2008). The relative likelihood of harm to wetland vegetation due to projected 2030 groundwater withdrawals was assessed using a GIS model. The GIS model integrated soil permeabilities, sensitivity of wetlands to dewatering, and projected declines in the water levels of the surficial aquifer system to predict the likelihood of harm to wetland plant communities. The wetland constraints as described in Kinser et al. (2003) are as follows:

- Lower likelihood of harm (<0.35 ft surficial drawdown)
- Moderate likelihood of harm (surficial drawdown >0.35 to <1.2 ft)
- Higher likelihood of harm (surficial drawdown >1.2 ft)

Results of this analysis indicate that 12,811 acres within the NEF model domain are projected to experience a higher to moderate likelihood of harm to native vegetation if projected increased groundwater withdrawals from 1995-2030 are realized. Putnam County includes 6,040 of these acres (Figure 8).

SJRWMD has identified areas within Putnam County and the NEF model domain with a moderate-to-higher likelihood of harm to wetland vegetation, areas where projected changes in the elevation of the potentiometric surface of the Floridan aquifer system would contribute to this condition (declines $\geq$0.5 ft), and areas served by public supply utilities with projected groundwater withdrawals that will contribute to these projected declines to be in PWRCAs.

The general areas within which there is moderate-to-higher likelihood of harm to native vegetation related to projected groundwater withdrawals covers most of the SJRWMD. Putnam County, with the exception of the central area of the county, is designated as having a moderate-to-higher likelihood of harm to native vegetation related to projected groundwater withdrawals.

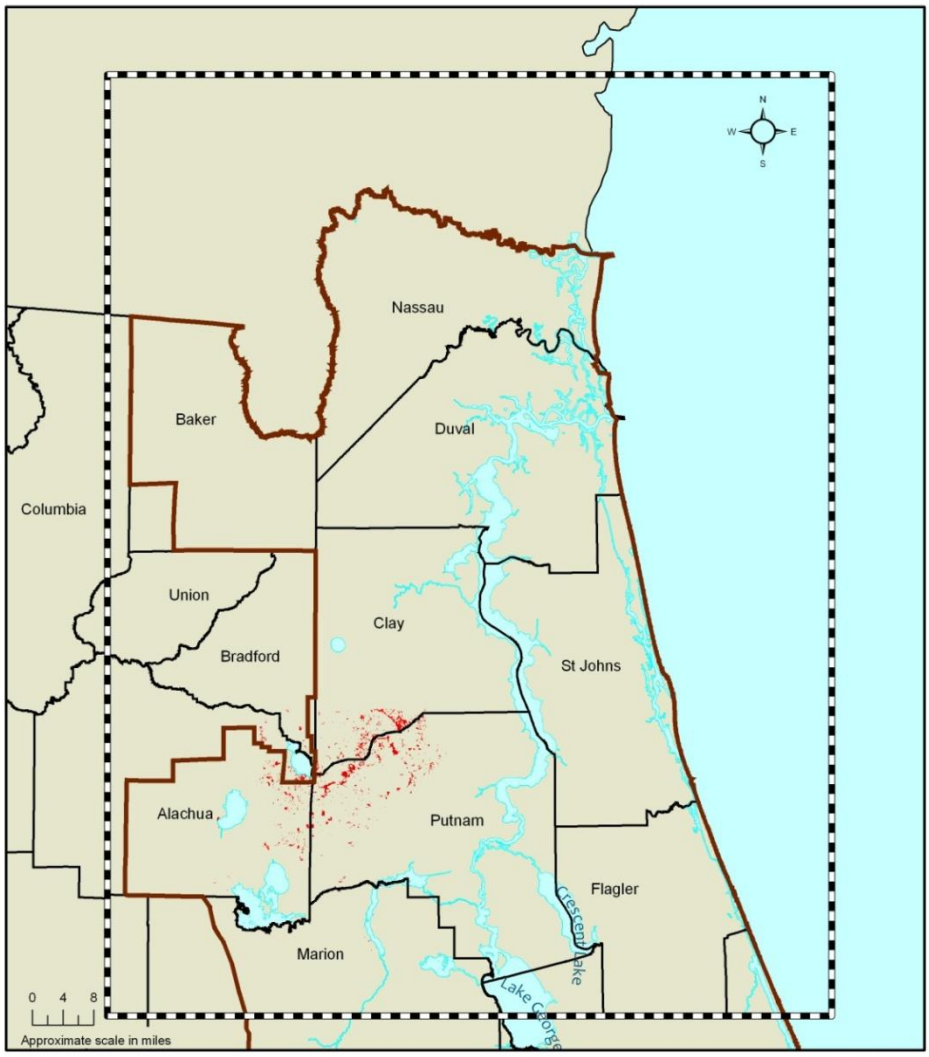

Figure 8. General areas within which anticipated water sources are not adequate to supply projected 2030 demands based on projected impacts to native vegetation

Likelihood of Harm to Lakes

SJRWMD assessed the relative likelihood of harm to lakes due to projected changes in groundwater withdrawals (1995–2030) using a GIS model developed by Kinser et al. (2003). A recent modification was added to the lake harm assessment process to account for areas within SJRWMD with an unconfined Floridan aquifer (Dunn et al. 2008). Six GIS data layers, each influencing or expressing groundwater-surface water interactions, were chosen as input to the model. These data layers are:

- Thickness of the upper confining unit separating the surficial and Floridan aquifer systems
- Head difference between surficial and Floridan aquifer systems
- Soil permeability
- Wetlands
- Topographic curvature
- Topographic deviation

These GIS layers were overlaid to identify regions susceptible to harm due to projected 2030 groundwater withdrawals. The output is a map representing the relative likelihood of harm to lakes produced by overlaying the lake susceptibility and modeled surficial aquifer drawdown layers (Figure 9). Susceptible areas are those identified as having a surficial drawdown of $\geq$0.5 ft. This value is based on the lakes constraint identified in the *Water 2020 Constraints Handbook* (SJRWMD et al. 2005).

SJRWMD has identified areas with a high likelihood of harm to lakes, areas where projected changes in the elevation of the potentiometric surface of the Floridan aquifer system would contribute to this condition (declines $\geq$0.5 ft), and areas served by public supply utilities with projected groundwater withdrawals that will contribute to these projected declines to be in PWRCAs.

In addition, SJRWMD has assessed the degree to which lakes with established minimum flows and levels (MFLs), for which water budget models are available, would be affected by the projected declines in the potentiometric surface of the Floridan aquifer. The methodology for this assessment is described in SJRWMD's draft 2008 water supply assessment (SJRWMD 2008).

Based on this analysis five lakes in Putnam County (Banana, Como, Grandin, Little Como, and Tarhoe) are currently not meeting established MFLs. Two additional lakes (Cowpen and Silver) would experience water levels that would fall below established MFLs if projected 2030 water use is realized (Table 4 and Figure 10).

Potential Impacts to Springs

For water supply planning purposes, SJRWMD considers a projected decrease of greater than 15% in the median of annual median spring flows for the period of record to be enough decrease to pose a reasonable likelihood of unacceptable natural systems impacts to springs (Rao and Clapp 2006).

Table 4. Lakes with established minimum flows and levels and water budget models

No.	Lake Name	County	Predicted 2030 Floridan Aquifer Drawdown	Significant Connection to Floridan Aquifer	Notes
1	Banana	Putnam	0.3	Yes	*
2	Bell	Putnam	0.3	Yes	
3	Broward	Putnam	0.3	Yes	
4	Como	Putnam	0.3	Yes	*
5	Cowpen	Putnam	0.7	Yes	*
6	Dream Pond	Putnam	0.3	Yes	
7	English / Nettles	Putnam	0.3	No	
8	Georges	Putnam	2.0	Yes	
9	Grandin	Putnam	1.1	Yes	**
10	Little Como	Putnam	0.3	Yes	*
11	Melrose	Putnam	1.4	No	
12	Silver	Putnam	0.3	Yes	***
13	Stella	Putnam	0.4	Yes	
14	Swan	Putnam	1.8	Yes	
15	Tarhoe	Putnam	0.3	Yes	*

Notes:

* Under re-evaluation

** Revised levels, not adopted

*** Maximally allocated with surface water

Currently not meeting MFLs

Projected to be not meeting MFLs in 2030

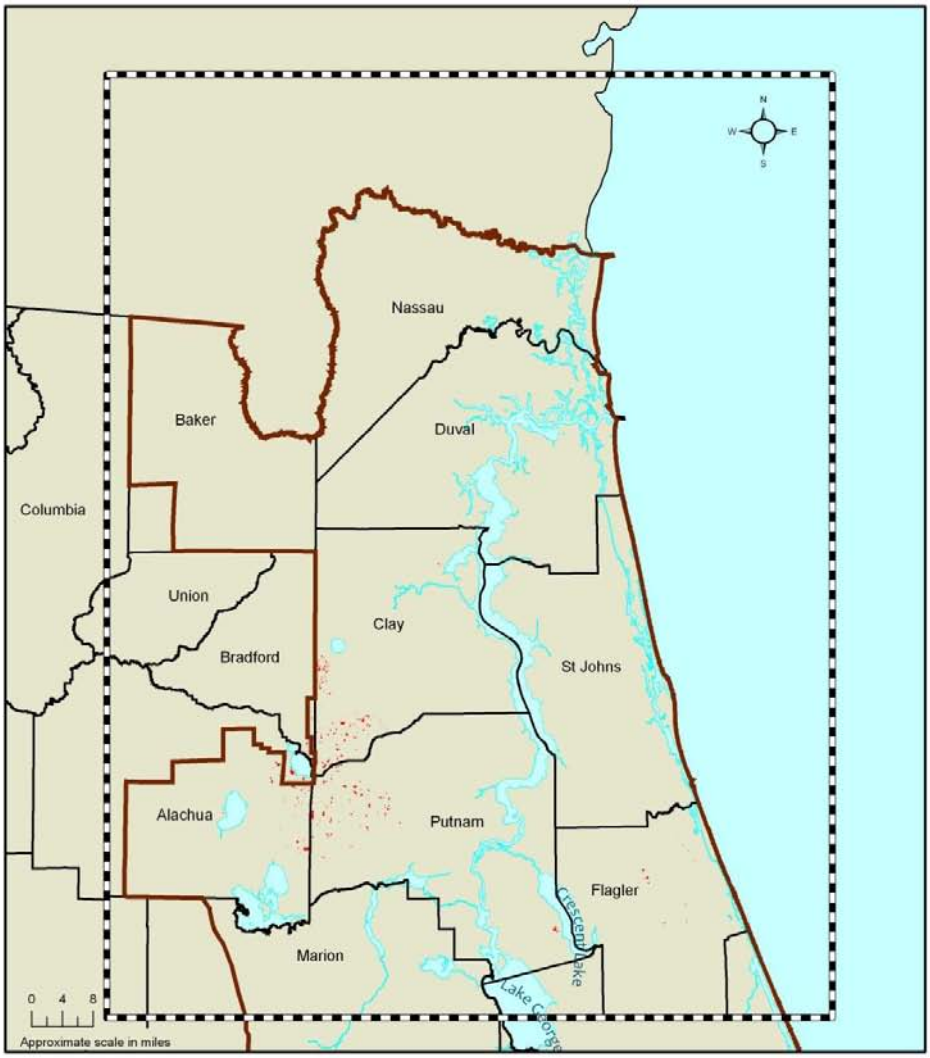

Figure 9. General areas within which anticipated water sources are not adequate to supply projected 2030 demands based on projected impacts to lakes

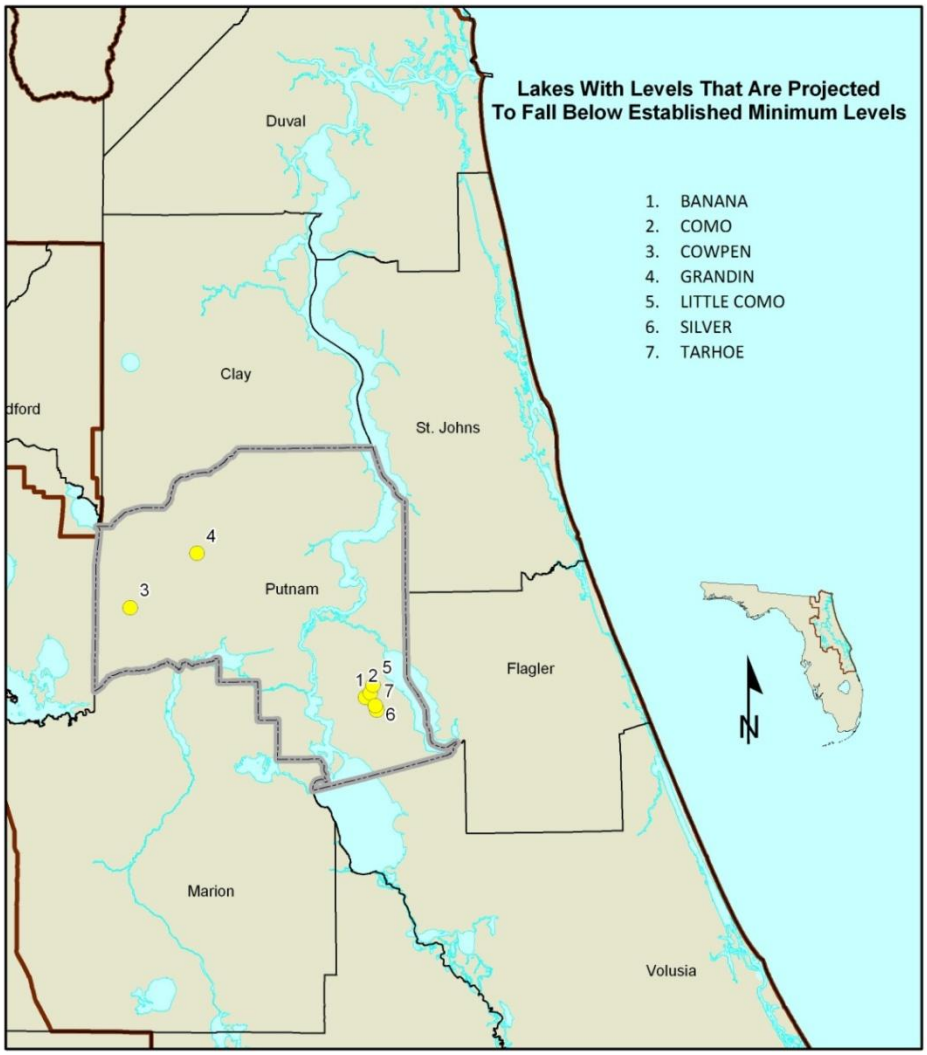

Figure 10. Lakes in Putnam County with established MFLs that would not be met if projected water use increases from 1995 -2030 are realized

SJRWMD has identified springs with projected decreases in the median of the annual median flows of greater than 15%, areas where projected changes in the elevation of the potentiometric surface of the Floridan aquifer system would contribute to this condition (declines $\geq$0.5 ft), and areas served by public supply utilities with projected groundwater withdrawals that will contribute to these projected declines to be in PWRCAs.

SJRWMD used the NEF regional groundwater flow model to evaluate the potential impacts of 2030 projected increases in Floridan aquifer withdrawals on flows from springs or spring groups with an adequate record of flow data to support this analysis. Only one spring in Putnam County (Croaker Hole Spring) was evaluated. Croaker Hole Spring is located in the bottom of Little Lake George. This spring is projected to experience only a 0.2% reduction in flow if projected 2030 groundwater withdrawals are realized

POTENTIAL WATER SUPPLY SOURCES AND PROJECTS

POTENTIAL WATER SUPPLY SOURCES

Traditional, fresh groundwater and non-traditional brackish groundwater could likely be developed to supply projected future water supply needs in Putnam County through 2030, if projected water supply needs in other areas of northeast and north-central Florida are met largely with alternative water supply sources other than brackish groundwater. Although brackish groundwater is considered an alternative water supply source, development of brackish groundwater sources has the potential of causing the same types of impacts to wetlands, lakes, and springs as the development of traditional, fresh groundwater sources.

Based on review of available water resources information, the following potential alternative water supply sources (other than reclaimed water and brackish groundwater) have been identified as sources that appear to have adequate potential yield and water quality to be considered as long-term, viable sources of supply for public supply utilities in Putnam County.

- Lower Ocklawaha River
- Crescent Lake
- St. Johns River
- Seawater

ARCADIS U.S., Inc., recently investigated these same sources as possible sources to supply public supply utilities in Flagler County in association with development of the Flagler County Water Supply Plan. SJRWMD used information included in the Flagler County Water Supply Plan to support the identification of potential alternative water supply sources for public supply utilities in Putnam County. SJRWMD has published the Flagler County Water Supply Plan as Special Publication SJ2007-SP16. Analyses that are more detailed would be required before any of these sources could be developed. Each of these alternative water supply sources has associated uncertainties as follows.

- Lower Ocklawaha River – Although existing water resources information indicates that the Ocklawaha River could support withdrawals of approximately 107 mgd (Hall 2005), it is not known how proposed restoration efforts by the State of Florida and establishment of minimum flows and levels by SJRWMD might impact these water withdrawals.
- Crescent Lake – Crescent Lake appears to be vulnerable to seasonal high tides in the St. Johns River, which cause flow reversal in Dunns Creek, the lake's outlet to the St. Johns River. If 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 water supply reliability at all times. In addition, water in Crescent Lake does not always meet federal and state public drinking water standards for total dissolved solids (500 mg/ L) and, therefore, is considered brackish for water supply planning purposes. This brackish water source will require demineralization. The demineralization process would generate a by-product (concentrate) that would have to be managed in an environmentally acceptable manner.
- St. Johns River – Water in the St. Johns River in Putnam County typically exceeds federal and state public drinking water standards for total dissolved solids (500 mg/ L) and, therefore, is considered brackish for water supply planning purposes. This brackish surface water source will require demineralization. The demineralization process would generate a by-product (concentrate) that would have to be managed in an environmentally acceptable manner.
- Seawater – Seawater has not been developed as a source of public water supply along the Atlantic Coast in an area reasonably accessible to Putnam County. Therefore, numerous uncertainties are associated with this source. The most significant of these uncertainties concern environmental and regulatory acceptability, treatment technology, and energy costs.

POTENTIAL ALTERNATIVE WATER SUPPLY (AWS) PROJECTS

The Cooperators asked for further details on the following two conceptual AWS projects: Lower Ocklawaha River in Putnam County Project and the Crescent Lake Project. SJRWMD staff and consultants met with the Cooperators and the public on August 14, 2008, to better define the conceptual projects to meet the needs of utilities within Putnam County. SJRWMD staff and consultants took the input received during this meeting

and prepared preliminary descriptions and cost estimates of these conceptual projects with the following results:

- Lower Ocklawaha River in Putnam County Project – A project with this name is currently identified in SJRWMD's 2005 District Water Supply Plan. The Cooperators asked that the conceptual design for this project be revised to meet needs within Putnam County, that it be called the Lower Ocklawaha River (LOR) near Rodman Reservoir project, and that it be defined as follows (Appendix A, Figure A1 and Table A1).
    - The intake would be at the north end of Rodman Reservoir and include a pumping station. The intake would be positioned in the channel of the river and therefore would function with or without the reservoir.
    - Provide 6 million gallons per day (mgd) peak capacity with 3 mgd average daily flow (adf) of untreated water to Palatka.
    - Provide 6 mgd peak capacity with 3 mgd adf of treated potable water to Putnam County using conventional surface water treatment.
    - Provide 60,000 gallons per day adf of treated potable water to Interlachen from Putnam County with inclusion of facilities adequate to provide for fire protection.
    - Cost estimates:
        - Construction cost - $56.15 million
        - Total capital cost - $71.5 million
        - Operations and maintenance - $1.39 million per year
        - Annual cost - $5.77 million per year
        - Unit production cost for Putnam County (treated water) – $3.64 per 1,000 gallons
        - Unit production cost for Palatka (raw water) - $1.63 per 1,000 gallons
        - Putnam County will provide treated water to Interlachen at a cost to be determined. The affordability of this project to the Town of Interlachen is dependent on cooperation between Putnam County and the Town of Interlachen.
    - Cost estimates at increments of 2 mgd were calculated for incremental construction costs for the water treatment plant (WTP):

- Phase 1 – initial 2 mgd - $17.06 million
- Phase 2 – 2 mgd expansion - $4.13 million
- Phase 3 – 2 mgd expansion – $4.13 million
- Total WTP - $25.32 million

- Crescent Lake Project –A project based on withdrawals of water from Crescent Lake was identified in The Flagler County Water Supply Plan and the Putnam County Cooperators asked that this project be scaled to provide 0.5 mgd of treated potable water to Crescent City. Conventional surface water treatment plus membrane treatment would be required. A design capacity of 0.5 mgd and an average production capacity of 0.25 mgd was assumed (Appendix A, Table A2).
    - Cost estimates:
        - Construction cost - $19.72 million
        - Total capital cost - $23.56 million
        - Operations and maintenance - $0.45 million per year
        - Annual cost - $1.96 million per year
        - Unit production cost for Crescent City – $21.52 per 1,000 gallons

The following two additional water supply projects that may be worthy of consideration are currently identified in SJRWMD's 2005 District Water Supply Plan.

- St. Johns River near Lake George – A project with this name is currently identified in SJRWMD's 2005 District Water Supply Plan. This project was conceptually planned as a 33 mgd project that would deliver water to public supply utilities in Flagler County and to the Town of Pierson. This project was further investigated as part of the Flagler County water supply planning process. It is identified in the Flagler County Water Supply Plan as a potential alternative water supply project. To date no decision has been made to pursue implementation of this project, this project could be a viable alternative for public supply utilities in Putnam County and other areas of northeast and north-central Florida.

- Coquina Coast Seawater Desalination Project – This project is identified in SJRWMD's 2005 District Water Supply Plan, Third Addendum. A group

of governments have agreed to prepare a preliminary design document to further identify the technical and financial characteristics of the potential project. Governments in Flagler, Lake, Marion, St. Johns, and Volusia counties are participating in the study. The Putnam County Board of County Commissioners declined to participate, but participation in this project is still possible.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Analysis conducted by the SJRWMD in support of the Putnam County Water Supply Plan indicates that unacceptable impacts to water resources and related natural systems are likely to occur in response to proposed water use increases from 1995-2030 in the northeast Florida area if this projected water use is realized. Projected unacceptable impacts identified for Putnam County would be due to cumulative impacts of withdrawals that occur largely outside of Putnam County. Because of these projected impacts, the District staff expects to recommend that all of Putnam County and the areas outside of Putnam County that contribute to the impacts be designated as a priority water resource caution area (PWRCA) in the draft 2008 District Water Supply Assessment (SJRWMD 2008). PWRCAs are areas where existing and reasonably anticipated sources of water and conservation efforts will not be adequate (1) to supply water for all existing legal uses and reasonably anticipated future needs and (2) to sustain the water resources and related natural systems. SJRWMD identifies PWRCAs in its districtwide water supply assessments based on water resource constraints and the results of water use, groundwater, and surface water assessments. Based on the expected PWRCA designation for Putnam County, potential alternative water supply (AWS) sources and projects, and recommended further actions have been identified.

RECOMMENDATIONS

The following actions should be pursued by the Putnam County Cooperators.

- Water conservation – Utilities in Putnam County are required to meet conservation standards as part of the District's consumptive use permitting program. Governments in Putnam County should aggressively pursue compliance with these requirements.
- Use of reclaimed water - The use of reclaimed water to achieve a water resource benefit should be aggressively pursued by utilities in Putnam County to the extent environmentally, economically, and technically feasible.

- Development of additional quantities of traditional, fresh groundwater and non-traditional brackish groundwater – Governments in Putnam County should actively participate in SJRWMD's regional water supply planning process in 2009-2010 to support the development of alternative water supply sources by public supply utilities in other areas of northeast and north-central Florida. The goal of this participation should be to identify water supply strategies that, if implemented, could provide for the continued development of groundwater in Putnam County through 2030.
- Development of alternative surface water sources and projects – Governments in Putnam County should actively participate in SJRWMD's regional water supply planning process in 2009-2010 to identify strategies for the cooperative development of the alternative surface water supply sources and projects identified in this plan and other projects that may be identified through SJRWMD's planning process.
- Development of seawater sources – Governments in Putnam County should closely follow the development of the Coquina Coast Seawater Desalination Project. These governments should consider participation in this project should other water supply strategies identified through SJRWMD's regional water supply planning process in 2009-2010 prove less advantageous.
- Continuation and limited expansion of existing brackish groundwater sources – Putnam County should work closely with SJRWMD in pursuing limited and reasonable expansion of the existing wellfield and reverse osmosis treatment facilities.

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Appendix A – Conceptual Alterative Water Supply Project Options—Components and Costs

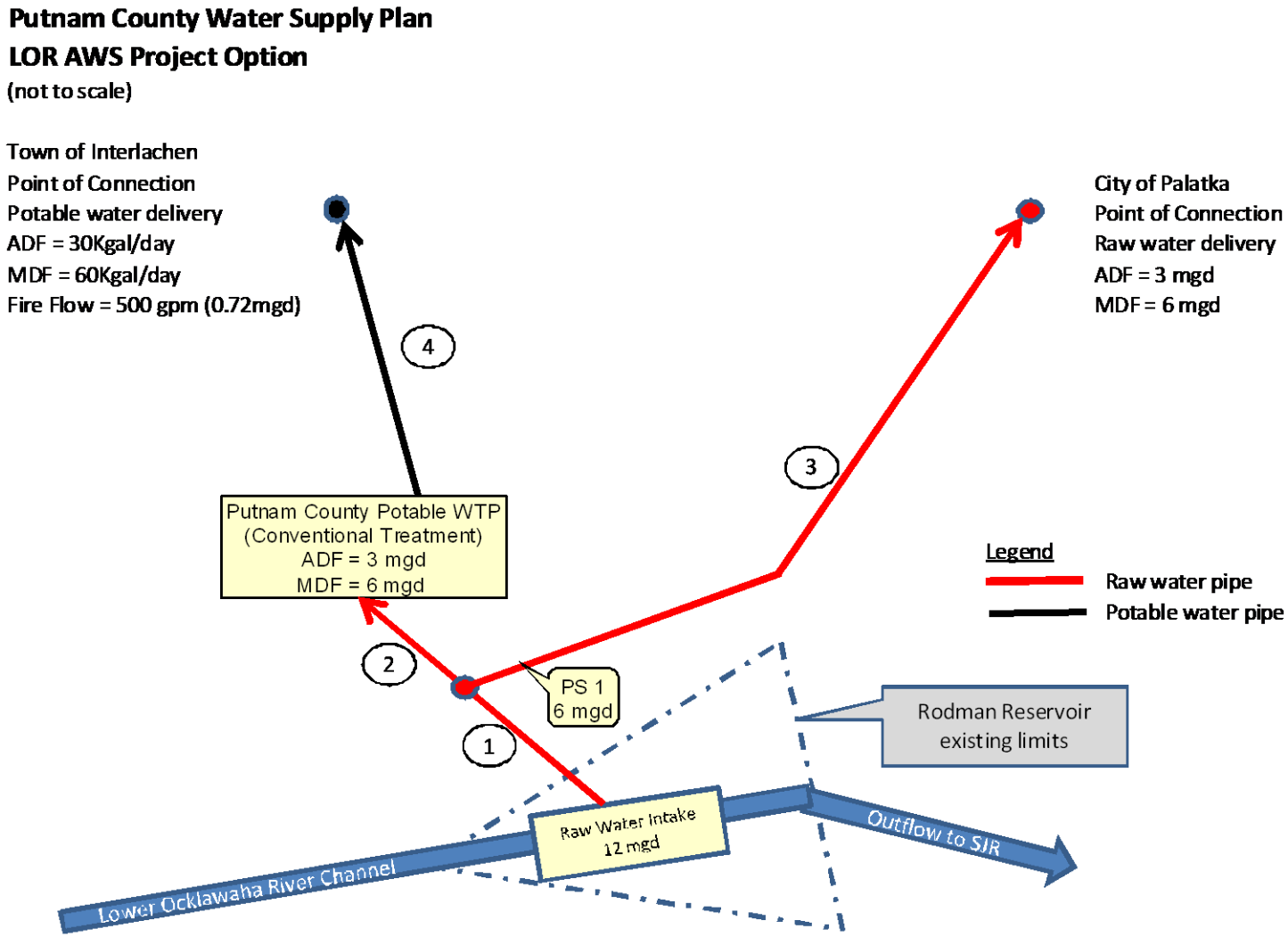

Figure A1. Schematic of Lower Ocklawaha River Alterative Water Supply Project Option

Table A1. Lower Ocklawaha River Alterative Water Supply Project Option Costs

Component	MDF -- mgd	ADF -- mgd	Construction Cost -- $M	Total Capital Cost -- $M	O&M cost -- $M/yr	Annual Cost -- $M/yr.	Unit Production Cost $/Kgal.	Ownership Percentage	
								Putnam County	City of Palatka
Raw Water Intake	12	6	$8.36	$9.98	$0.037	$0.68	$0.31	50%	50%
WTP	6	3	$25.32	$30.86	$1.270	$3.24	$2.96	100%	0%
Booster Pump Station	6	3	$1.17	$1.40	$0.081	$0.18	$0.16	0%	100%
Pipe Seg. 1	12	6	$2.96	$3.70	$0.00	$0.21	$0.10	50%	50%
Pipe Seg. 2	6	3	$0.11	$0.15	$0.00	$0.01	$0.01	100%	0%
Pipe Seg. 3	6	3	$14.73	$20.26	$0.00	$1.16	$1.06	0%	100%
Pipe Seg. 4	0.72	0.03	$3.49	$5.14	$0.00	$0.29	$26.90	100%	0%
TOTALS			$56.15	$71.50	$1.39	$5.77			
Breakout									
Putnam County			$34.58	$42.99	$1.29	$3.99	$3.64	Finished water	
City of Palatka			$21.57	$28.51	$0.10	$1.78	$1.63	Raw water	
TOTALS			$56.15	$71.50	$1.39	$5.77			
Construction and O&M Conceptual Cost Estimates Based on B&V Report -- May 2008 -- SJ2008-SP10.									

Note: The affordability of this project is dependent on cooperation between Putnam County and the Town of Interlachen.

Table A2. Crescent Lake Alterative Water Supply Project Option Costs

Project Component	Construction Cost -- $	Capital Cost -- $	Annual O&M Cost $/yr.	Economic Life -- years	CRF	Equivalent Annual Cost $/yr	Unit Production Cost -- $/Kgal
Raw Water Withdrawal and Pumping	$ 2,673,879	$ 3,195,285	$ 2,293	30 yr.	0.06412747	$ 207,198	$ 2.27
WTP	$ 17,045,115	$ 20,368,912	$ 450,516	30 yr.	0.06412747	$ 1,756,723	$ 19.25
Total	$ 19,718,993	$ 23,564,197	$ 452,809			$ 1,963,921	$ 21.52
WTP Construction Cost Eq (Based on 2, 5 and 10 mgd WTP cost data from B&V Report -- May 2008 -- SJ2008-SP10)							