

## **Appendix G**

### **Recovery Strategy: Lower Santa Fe River Basin**



Recovery Strategy:

## **Lower Santa Fe River Basin**



Lower Santa Fe and Ichetucknee Rivers and  
Priority Springs  
Minimum Flows and Levels

**April 8, 2014**

# **Recovery Strategy:**

## Lower Santa Fe River Basin



### **Lower Santa Fe and Ichetucknee Rivers and Priority Springs Minimum Flows and Levels**

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**April 8, 2014**

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## 1.0 INTRODUCTION

This Recovery Strategy for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs presents the methods and approaches intended to recover and maintain the streamflows and springflows in the Lower Santa Fe River Basin to the Minimum Flows and Levels (MFLs) adopted by the Florida Department of Environmental Protection (Department) in coordination with the Suwannee River Water Management District (SRWMD or District) and the St. John's River Water Management District (SJRWMD) on **DATE**. This introductory chapter provides the statutory background relevant to establishing MFLs, a general description of the Lower Santa Fe River Basin, and the basis for creating the Recovery Strategy.

### 1.1 MFL PROGRAM OVERVIEW

The State of Florida's Water Resource Act of 1972 requires the five Water Management Districts (WMDs) of the State to establish MFLs to ensure that water bodies do not experience significant harm as a result of water withdrawals. Specifically, Section 373.042, Florida Statutes [F.S.], states that minimum flows are to be established at "the limit at which further withdrawals would be significantly harmful to the water resources and ecology of the area." Once established, MFLs provide a metric to guide the WMDs water use planning and permitting processes for the protection and sustainable use of Florida's water resources.

Subsection 373.0421(2), F.S., specifies that an MFL Prevention or Recovery Strategy be undertaken under the following conditions concerning an established MFL:

*(2) If the existing flow or level in a water body is below, or is projected to fall within 20 years below, the applicable minimum flow or level established pursuant to s. 373.042, the department or governing board, as part of the regional water supply plan described in s. 373.709, shall expeditiously implement a recovery or prevention strategy, which includes the development of additional water supplies and other actions, consistent with the authority granted by this chapter, to:*

- (a) Achieve recovery to the established minimum flow or level as soon as practicable; or*
- (b) Prevent the existing flow or level from falling below the established minimum flow or level.*

*The recovery or prevention strategy shall include phasing or a timetable which will allow for the provision of sufficient water supplies for all existing and projected reasonable-beneficial uses, including development of additional water supplies and implementation of conservation and other efficiency measures concurrent with, to the extent practical, and to offset, reductions in permitted withdrawals, consistent with the provisions of this chapter.*

The Lower Santa Fe and Ichetucknee Rivers and Priority Springs MFLs and Recovery Strategy were developed by the SRWMD, in conjunction with the Department and SJRWMD, pursuant to these statutory directives.

## **1.2 ESTABLISHMENT OF THE BASIN RECOVERY STRATEGY**

In May 2013, the SRWMD presented a draft technical report to establish MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs, (see **Table 2-3**. MFLs for Priority Springs on the Lower Santa Fe and Ichetucknee Rivers, for a listing of priority springs). The District elected to have the proposed MFLs voluntarily peer reviewed by the University of Florida Water Institute, and in November 2013, the District utilized the findings and recommendations of the peer review panel to develop the final proposed MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs. The MFLs are briefly summarized in Section 2 of this report, and are discussed in detail in “Minimum Flows and Levels for the Lower Santa Fe and Ichetucknee Rivers,” published by the District, and dated November 22, 2013. The SRWMD assessed the streamflows observed in the recent historical record and recent trends in the flow regime, and concluded that the Lower Santa Fe River MFL as measured at the Fort White Gage and Ichetucknee River MFL as measured at the US Highway 27 Gage are not currently being met. Based on this circumstance and the legislative directive established in Section 373.0421, F.S., the SRWMD and the Department have determined that the Lower Santa Fe and Ichetucknee Rivers and their priority springs are in recovery and will require a Recovery Plan to restore their stream and springflows to the proposed MFLs.

To fulfill the legislative directive to restore the stream and springflows on the Lower Santa Fe and Ichetucknee Rivers to the proposed MFLs, the SRWMD, in conjunction with the Department and the SJRWMD, has developed this Recovery Strategy for the Lower Santa Fe River Basin. This Recovery Strategy is designed to implement preliminary regulatory measures to initiate the MFL recovery process, and provide a path forward to implement long-term water management strategies to restore and maintain minimum flows in the Lower Santa Fe and Ichetucknee Rivers and their priority springs while providing for adequate water supplies to meet current and future water use needs.

## **1.3 BACKGROUND**

This Section provides a brief summary of the recent water resource analysis and planning actions that preceded the development of the MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs.

### **Water Supply Planning**

In December 2010, the SRWMD Governing Board accepted the District’s 2010 Water Supply Assessment (Assessment) in accordance with Section 373.036, F.S. The Assessment concluded that groundwater levels in the Upper Floridan aquifer had declined significantly during the past 75 years as a result of regional groundwater withdrawals in both the Suwannee River and St. Johns River Water Management Districts, and southeast Georgia. The Assessment also concluded that the water resources in the northeastern portion of the SRWMD are declining, or predicted to decline, during the 2010–2030 planning period. As a result, the northeast portion of the SRWMD was subdivided into four Water Supply Planning Regions, which included the Lower Santa Fe River Basin planning region. The analysis conducted in the Assessment indicated that unacceptable impacts to flows in the Lower Santa Fe River and springs were predicted for the 2010–2030 planning period. Pursuant to Rule 62-40.520(2), Florida Administrative Code [F.A.C.], the SRWMD Governing Board designated the four Water Supply Planning Regions (including the Upper and Lower Santa Fe River Basins) as Water Resource Caution Areas (WRCAs) on October 11, 2011.

Rule 62-40.531, F.A.C., specifies that a Regional Water Supply Plan should be developed for each Water Supply Planning Region. Based on the unique geology of the District, and the fact that the

impacts to springflows and springfed rivers are linked to regional groundwater trends, both within and outside of the SRWMD, District staff concluded that water supply planning for the Lower Santa Fe Basin should be conducted as part of a broader multi-region planning effort with the SJRWMD.

## **Upper Santa Fe River MFLs**

On December 10, 2007, the SRWMD established and adopted MFLs for the Upper Santa Fe River. At that time, the SRWMD determined that streamflows in the Upper Santa Fe River had not fallen below the established MFL. For the purpose of establishing that MFL, the SRWMD defined the Upper Santa Fe as the Santa Fe River upstream of the USGS Worthington Springs Gage. The SRWMD currently monitors the status of streamflows in the Upper Santa Fe River, and continues to evaluate its status with regard to its established minimum flows.

## **Existing Agreements**

To better protect and manage the shared water resources of north Florida, on September 13, 2011 the SRWMD, SJRWMD, and the Department entered into an agreement to formalize the coordination of regional water resource management. This Interagency Agreement (IAA) resulted in the creation of the North Florida Regional Water Supply Partnership (NFRWSP), which includes the two water management districts, the Department, the Florida Department of Agriculture and Consumer Services (FDACS), as well as local elected officials and area stakeholders. The NFRWSP works to develop joint water resource protection strategies and focuses on communication with stakeholders across district boundaries during the preparation of a joint regional water supply plan between the SRWMD and SJRWMD.

A major element of the IAA is the North Florida Regional Water Supply Plan (Plan), which is scheduled for draft completion in late 2015. The Plan study area includes the four WRCAs in the SRWMD and the northern nine counties of the SJRWMD. Observed impacts to water resources in the Lower Santa Fe and Ichetucknee Rivers and their priority springs will be discussed in the Plan, as well as solutions to mitigate those impacts and recover the region's water resources. The Plan is discussed in greater detail in Section 5 of this report.

## **Recent Legislative Developments**

In the 2013 Florida Legislative Session, the State Legislature passed Senate Bill 244 (SB244), which primarily relates to the adoption of MFLs and the associated Recovery and Prevention strategies. SB244 was approved by the Governor of Florida on June 28, 2013, and subsequently adopted into law as Chapter 2013-229, Laws of Florida. This law amended s. 373.042, F.S. so that any MFL and related recovery or prevention strategy adopted by the Department shall be applied by all relevant WMDs without the need for further rulemaking. Additionally, Chapter 2013-229 expands the ability of the WMDs to coordinate management efforts and jointly fund recovery strategies and projects to address regional water resource issues. The addition of this legislation to the MFL program provides an important mechanism for the State's WMDs to establish MFLs in a manner that addresses regional impacts to water resources. This is particularly significant in the protection of groundwater-based resources, such as springs and springflow dominated rivers, as the impacts to these systems can be regional in nature, and may extend across district boundaries. This legislation provides a basis to further expand the partnership between the SRWMD and SJRWMD to better address regional trends in the Upper Floridan aquifer and to achieve MFL targets where cross-boundary effects have been identified. This will also achieve water supply goals in the joint planning area of both districts.

## MFL and Recovery Strategy Rule Adoption

In light of the new provisions provided in SB244, now codified in 373.042, F.S., and the regional nature in the management of groundwater systems, the SRWMD Governing Board requested in June 2013 that the Department adopt both the Lower Santa Fe and Ichetucknee Rivers and Priority Springs MFLs and the Lower Santa Fe and Ichetucknee Rivers and Priority Springs Recovery Strategy. As such, the Department will adopt the MFLs, as well as the regulatory portion of the Recovery Strategy by rule, which will thereafter be implemented by the WMDs with no further rulemaking required. The remaining non-rule portions of the Recovery Strategy will then be implemented jointly and cooperatively by the WMDs.

### 1.4 SANTA FE RIVER BASIN

The following sections provide a brief overview of the Santa Fe River Basin's general setting, hydrogeology, and the regional and local water use regime, which form the foundation upon which the Recovery Strategy was developed. The information contained in these sections is generally derived from the District's Technical Report, "Minimum Flows and Levels for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs" (SRWMD, 2013).

#### General Setting

The Santa Fe River Basin is located in the easternmost portion of the SRWMD, and primarily lies in Alachua, Columbia, Union, Bradford, and Gilchrist Counties, as well as smaller portions of Suwannee, Baker, Clay, and Putnam Counties. These areas are mostly rural in nature, with several small municipalities and communities located within the basin. The more developed and populated communities of Lake City and Gainesville, which are located to the north and south of the watershed boundaries, play a significant role in regional water demand and hydrology. The City of Gainesville and the associated metropolitan area have experienced significant growth and development in recent decades, driven by the presence of the University of Florida and its associated institutions.

The Santa Fe River Basin features several popular recreational areas containing springs, swallets, and river rises, including Ichetucknee Springs State Park, O'Leno State Park, and River Rise State Park. Several significant springs are also present in the basin, including Ichetucknee Head Springs, Blue Hole, Cedar, Mission, Grassy, Mill Pond, and Coffee Springs on the Ichetucknee River, and Ginnie, Poe, Hornsby, Rum Island, Devil's Eye, and Gilchrist Blue Springs along the Santa Fe River. Recreational uses of the Santa Fe and Ichetucknee Rivers and their associated springs, which include tubing, snorkeling, fishing, cave diving, and the use of small watercraft, represent an important economic resource in the region.

For the development of the proposed Lower Santa Fe and Ichetucknee MFLs, the Lower Santa Fe River Basin study area was defined as: Olustee Creek, the Santa Fe River downstream from the mouth of Olustee Creek, the Ichetucknee River, and the watersheds associated with these streams, as shown in **Figure 1-1**. This area includes the Lower Santa Fe River and its tributaries downstream of the USGS Worthington Springs Gage, which was the lower extent of the presently adopted Upper Santa Fe River MFLs.



**Figure 1-1. Location and Extent of the Lower Santa Fe River Basin MFL Study Area**

## Hydrogeology

The Santa Fe River Basin straddles two major physiographic provinces which greatly affect the hydrology of the area: the Northern Highlands and the Gulf Coastal Lowlands, separated by the Cody Escarpment (Upchurch, 2007);(White, 1970). These features, along with the underlying Upper Floridan aquifer, dominate the local hydrologic regimes of the Santa Fe River Basin. A generalized description of the hydrogeology of the basin is provided in this section, and a detailed description of the geology of the Santa Fe Basin can be found in the Lower Santa Fe and Ichetucknee Rivers MFL document (SRWMD, 2013).

### NORTHERN HIGHLANDS

The Northern Highlands (White, 1970) are present in the eastern and northern portions of the Lower Santa Fe River Basin in parts of Columbia, Union, and Alachua Counties. The Northern Highlands consist of a plateau made up of a thick sequence of relatively low-permeability Miocene Hawthorn Group sediments, which are capped in some areas by undifferentiated Pleistocene-age sandy sediments. Due to the relatively low permeability sediments at or near the surface, local rainfall

drainage in the Northern Highlands is dominated by surface water features, with numerous lakes, swamps, and streams present. The Upper Santa Fe River and its tributaries (such as Olustee Creek) convey surface water runoff from the Northern Highlands as evidenced by the drainage patterns illustrated in **Figure 1-2**.

## GULF COASTAL LOWLANDS PROVINCE

The Gulf Coastal Lowlands extend inland from the Gulf of Mexico shoreline, a distance of approximately 50 miles, terminating in the western portion of the Lower Santa Fe River Basin. The Gulf Coastal Lowlands are characterized by broad and flat marine plains blanketed by thin Pleistocene sands, which overlie the porous Ocala Limestone of the Upper Floridan aquifer (Rupert, 1988).

As a result of the thin sediment cover over porous limestone, karst features are numerous in the Gulf Coastal Lowlands, and the Lower Santa Fe Basin is punctuated by various depressional features, such as sinkholes. This extensive karst development creates a groundwater-dominated drainage pattern; consequently, the Lower Santa Fe River Basin in the Gulf Coastal Lowlands is largely devoid of stream channels. Furthermore, surface water features in this area of the Lower Santa Fe Basin, including the Santa Fe and Ichetucknee Rivers, generally exhibit a high degree of connectivity to the Upper Floridan aquifer.

## CODY ESCARPMENT

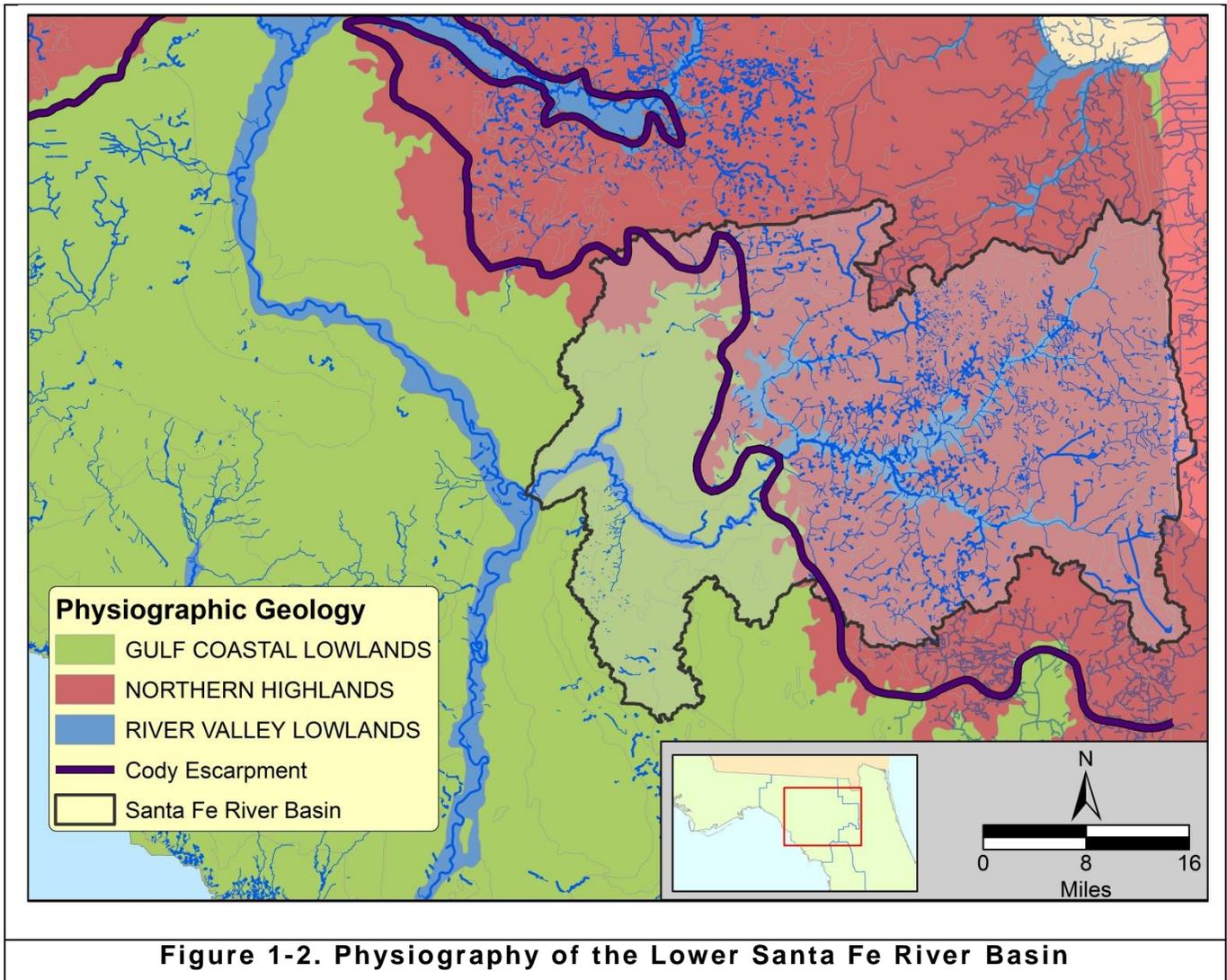
The Cody Escarpment (Scarp) is a physiographic feature that represents the largest continuous topographic break in Florida. The Cody Scarp generally separates the Northern Highlands from the Gulf Coastal Lowlands, as shown in **Figure 1-2**. The geomorphologic features of the Cody Scarp and similar physiographic features are unique, and developed due to a combination of headward erosion by streams and dissolution of carbonate rocks by streams and groundwater. The land surface along the Cody Scarp typically contains sinkholes, sinking streams, and other large and well-developed karst features.

The hydrology of the Lower Santa Fe River Basin is markedly influenced by the karst terrain. In the vicinity of the Cody Scarp, the Santa Fe River flows into a swallet (a sinkhole where streams go underground) at O'Leno State Park (north of High Springs) and reappears (resurges) approximately three miles south-southwest at River Rise Preserve State Park. The flows in the Santa Fe River consist of a combination of stormwater runoff and groundwater discharge. The upper portion of the Santa Fe River (above Worthington Springs) is dominated by stormwater runoff. Downstream of this reach the river flows through a transitional area of increasing groundwater influence, with the lower portion of the Santa Fe River and the entirety of the Ichetucknee River dominated by springflow.

## UPPER FLORIDAN AQUIFER

The Upper Floridan aquifer is the primary source of water supply for all water use types in the Lower Santa Fe River Basin, and also provides the baseflow in the Lower Santa Fe and Ichetucknee Rivers and priority springs. The primary Upper Floridan aquifer production zone in the Lower Santa Fe Basin is the upper portion of the Ocala Limestone, where dissolution processes have greatly increased the porosity and productivity of the limestone. The Upper Floridan aquifer is generally well confined or semi-confined by Hawthorn Group sediments in the Northern Highlands, and is generally unconfined in the Gulf Coastal Lowlands. In the Lower Santa Fe River Basin, the Upper Floridan aquifer discharges to the Santa Fe and Ichetucknee Rivers and their springs under most conditions (with the exception of flood events). As a result, maintaining Upper Floridan aquifer water levels in the Lower Santa Fe River

Basin is critical to maintaining flow in the springs and baseflow in the Lower Santa Fe and Ichetucknee Rivers.



**Figure 1-2. Physiography of the Lower Santa Fe River Basin**

## 1.5 REGIONAL WATER USE

In the Santa Fe Basin and throughout the north Florida region, the Upper Floridan aquifer remains the primary source of water for all uses by a wide margin. Presently, within the SRWMD and the nine northernmost counties of the SJRWMD, groundwater withdrawals make up an estimated 581 Million Gallons per Day (MGD) of a total estimated water use of 753 MGD (data compiled by Marella, USGS Florida Water Science Center). Historically, the majority of groundwater use in this region was centered in the more developed areas along the east coast, but in recent years, agricultural water uses have increased significantly in the inland areas, particularly in the Suwannee River Basin. This groundwater-based water use regime has persisted in north Florida for much of the twentieth century to the present, and has contributed to significant regional groundwater declines (Grubbs, 2007). These regional groundwater level declines have been identified in the Upper Floridan aquifer throughout the north Florida region, and have impacted groundwater-based water resources in this area, including freshwater springs and their contributions to baseflow in streams and rivers.

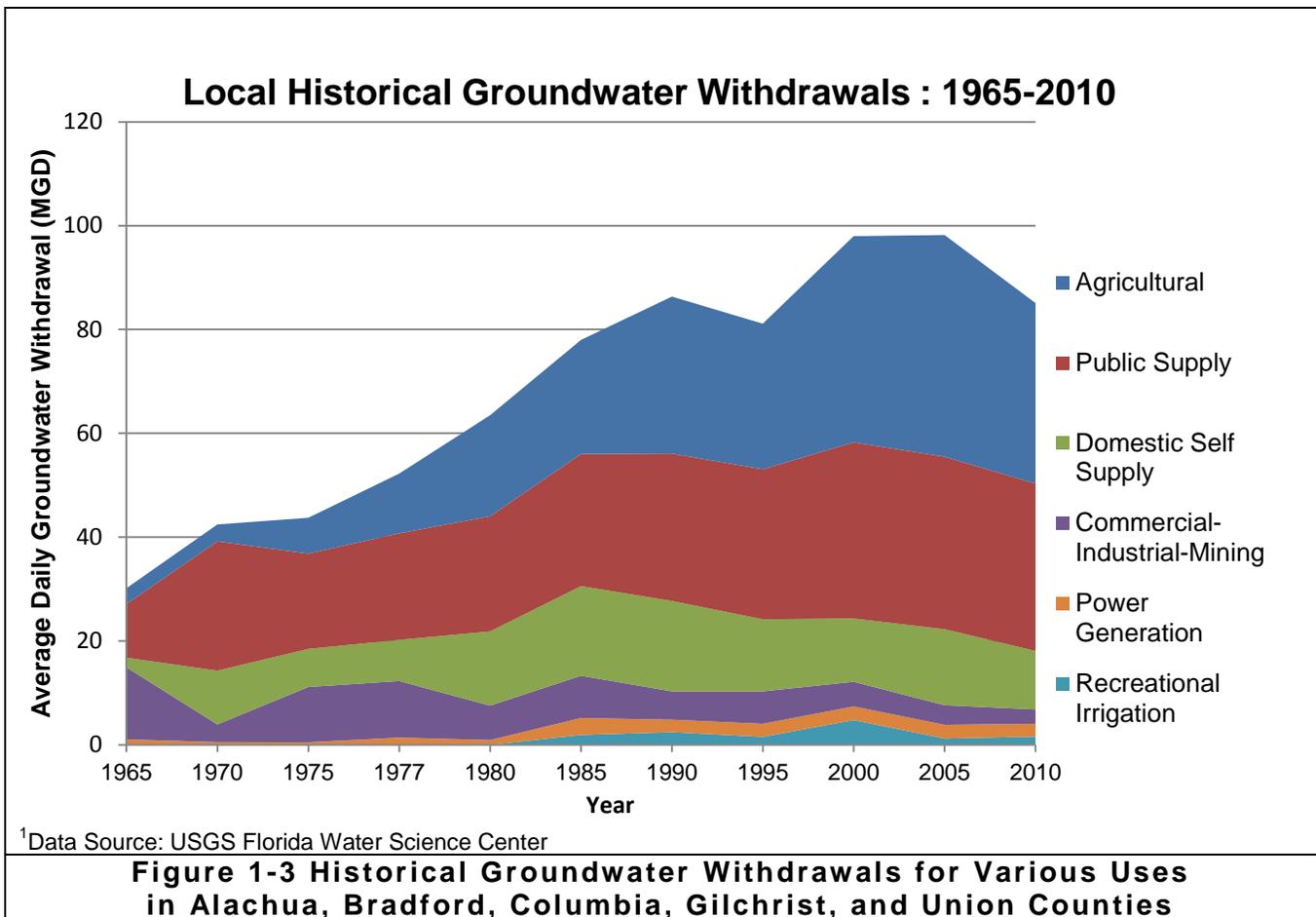
Although climatologic trends have affected the hydrologic regime, analyses conducted by SRWMD during the development of the Lower Santa Fe Basin MFLs indicated that regional groundwater use had contributed to observed stream and springflow impacts within the Santa Fe Basin. Regional impacts to the Lower Santa Fe Basin are discussed in Section 3.0 of this report.

## Historical Water Use

This section provides a brief overview of the historical local water use regime in the Santa Fe River Basin. Although regional drivers have contributed to water resource impacts in the Santa Fe Basin, an understanding of local water use patterns is critical to the implementation of a successful Recovery Strategy. To examine historical trends in water use in the Santa Fe River Basin, the District utilized historical estimated water use data compiled by the United States Geological Survey (USGS) Florida Water Science Center for Alachua, Bradford, Columbia, Gilchrist, and Union Counties, which comprise the majority of the Santa Fe River Basin. The historical water use data record extended from 1965 to 2010, with records available for every fifth calendar year. The records utilized in this analysis can be found as an appendix in the MFL document, and are also available from the USGS Florida Water Science Center. It should be noted that at the time of this publication, the 2010 records are still preliminary and subject to future revision by the USGS.

In 1965, total water use in the five county area of the Santa Fe River Basin was approximately 31.4 MGD. Groundwater withdrawals accounted for 96% of this use. The major water use groups were commercial-industrial-mining and public supply, which utilized approximately 13.9 MGD and 10.4 MGD respectively. Self-supplied agricultural irrigation accounted for a relatively low percentage of total use, at approximately 4.3 MGD, or 14% of total use. It is noteworthy that in 1965 over one quarter (1.2 MGD) of agricultural demand was satisfied by surface water withdrawals.

Since 1965, water use has changed significantly in this five county area. Based on 2010 preliminary water use estimates, total water use in this area has increased to 85.9 MGD, with groundwater usage constituting 99% of all withdrawals. To date, several of the counties in this area have relatively little overall water use, namely Union, Bradford, and Gilchrist Counties, which used only an estimated 3.1 MGD, 5.3 MGD, and 9.2 MGD of fresh groundwater in 2010. Among the various user groups, agricultural use within the Santa Fe River Basin has increased significantly since the late 1970s due to advances in irrigation technology. Currently, self-supplied agriculture is the largest user of water in the Santa Fe Basin, accounting for approximately 41% of total freshwater withdrawals in 2010 at an estimated 35.3 MGD. Water withdrawals for public supply have also grown significantly in association with increasing population in this five county area, now totaling approximately 32.2 MGD. Domestic self-supply experienced similar growth in this period, but has remained relatively steady since the 1980s, now totaling approximately 11.3 MGD. It should also be noted that commercial-industrial-mining uses have decreased significantly since 1965, and now account for only 2.7 MGD, or 3% of total withdrawals in this five county area. These reductions have been offset by growth in other areas, with agriculture and public supply increasing greatly in this period.



In summary, agriculture, public supply, and domestic self-supply currently exert the greatest demand for water in the Santa Fe River Basin region. Together, these three water use groups account for nearly 91% of estimated freshwater withdrawals. Based on current data, the vast majority of these demands are expressed in the form of groundwater withdrawals from the Upper Floridan aquifer, such that all demands are from fresh groundwater sources. Therefore, the strategies developed by the SRWMD to recover and maintain stream and springflows in the Lower Santa Fe and Ichetucknee Rivers, in accordance with the proposed MFLs, will be designed to address and ameliorate the effects of these local withdrawals.

### Local Land Use

The dominant land cover of the Santa Fe Basin is forest and rangeland, which makes up approximately 57% of the basin land cover (based on SRWMD generalized Florida Land Use, Land Cover Classification System, FLUCCS, data from 2008). **Figure 1-4** depicts the generalized land use in the Santa Fe River Basin. Much of the forested land in the basin has been modified or managed for silviculture, although this is believed to have a minimal impact on the overall basin water use. Approximately 19% of the land cover of the basin is agricultural, and is generally utilized for rowcrop production such as peanut and corn operations, as well as some cattle and dairy operations and plant nurseries. Together, agriculture and silviculture account for much of the economic activity in the basin. Urban and transportation land uses make up a small but significant portion (approximately 9%) of the basin land cover. The largest concentrations of urban land within the Santa Fe River Basin are located

near Lake City and near the eastern boundary of the District (the US Highway 301 corridor including the City of Starke in Bradford County).

**Table 1-1. Historical Land Use within the Santa Fe River Basin**

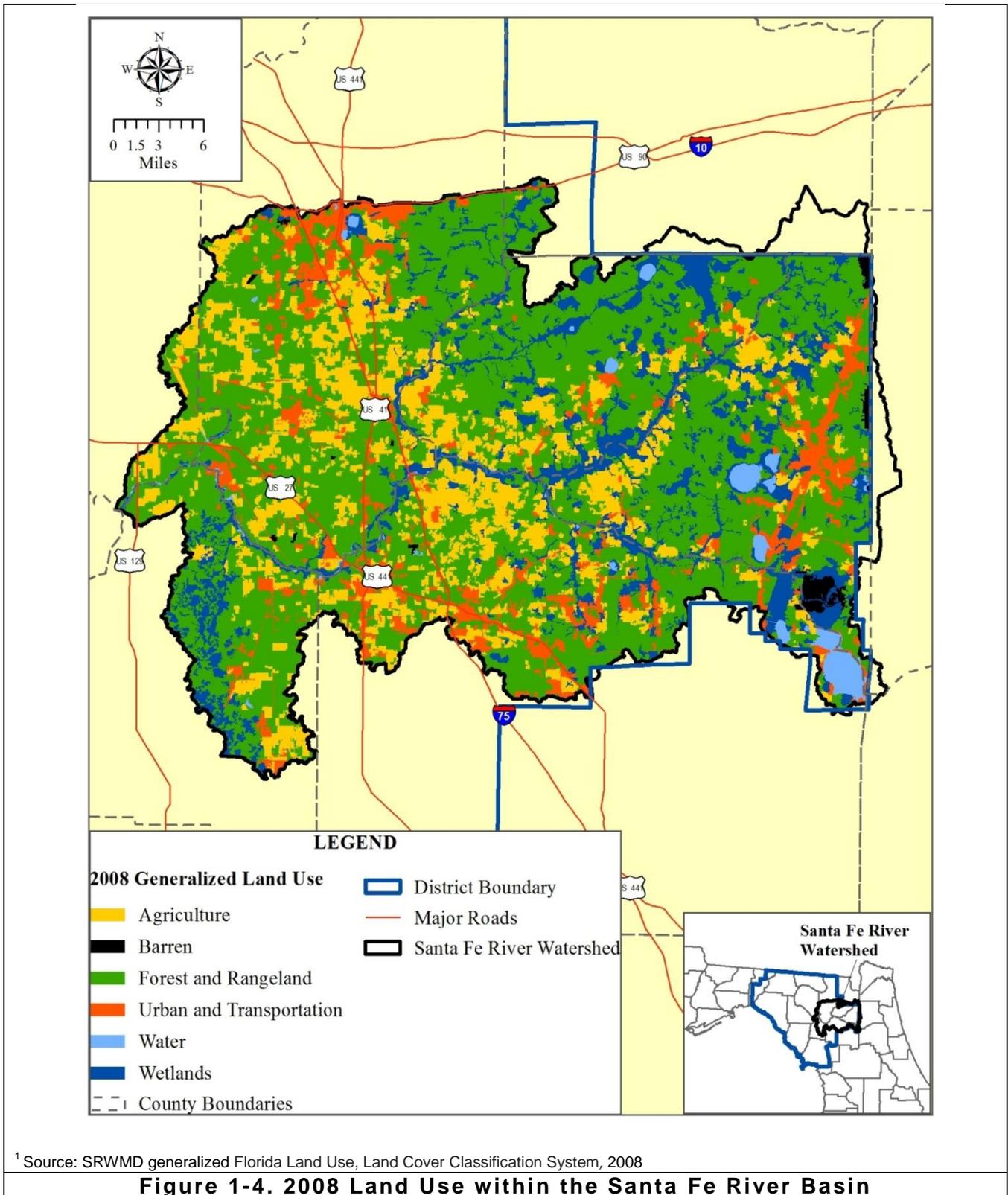
FLUCCS <sup>1</sup> Code	Land Use Description	1970s		1988		2008	
		Area (ac)	Percent	Area (ac)	Percent	Area (ac)	Percent
1000	Urban and Transportation	16,655	1.9	26,218	3.1	80,710	9.4
2000	Agriculture	252,836	29.5	212,803	24.8	159,420	18.6
3000 and 4000	Forest and Rangeland	489,689	57.2	516,860	60.3	488,384	57.0
5000	Water	11,935	1.4	14,731	1.7	14,485	1.7
6000	Wetlands	80,983	9.5	85,040	9.9	107,531	12.6
7000	Barren	4,468	0.5	907	0.1	6,071	0.7
	Total	856,567	100.0	856,558	100.0	856,601	100.0

<sup>1</sup> Florida Land Use and Cover Classification System

The Santa Fe Basin has also experienced shifts in historical land use in recent decades. **Table 1-1**, provides a summary of the historical land use coverages in the Santa Fe Basin. The amount of land in agricultural production decreased significantly in recent decades, shifting from approximately 30% of the basin area in the 1970s, to only 19% of land cover by 2008. This trend lies in sharp contrast to the trend in self-supplied agricultural water use, which has increased greatly since the 1970s. This inverse relationship partially reveals the increased water demand created in the Lower Santa Fe region subsequent to the introduction of more intensive irrigation practices since the late 1970s. It should be noted that a minor portion of the changes in land use acreages in the Florida Land Use and Cover Classification System may be attributed to uncertainty in the development of this data from aerial photography; however, this data provides the best available information about the general historical changes in land use in the Santa Fe Basin over the last several decades.

The Santa Fe Basin has also experienced a significant increase in urban and transportation land use in recent years (**Figure 1-4**). In the 1970s, residential, commercial, industrial, and transportation land uses collectively comprised approximately 2% of the basin area. By 2008, it had risen to approximately 9%. Part of this increase in urban land use was associated with increased development in Lake City and Columbia County, as well as along the Interstate 75 corridor. This increase in urban land corresponds to increased water withdrawals for both the public supply and domestic self-supply water use groups.

In summary, the dominant land cover in the Santa Fe Basin, forest and rangeland, has remained relatively constant over the last several decades. Additionally, the basin has experienced a trend toward the smaller agricultural acreage totals, which are managed at higher irrigation intensity, while urban areas have experienced modest but steady growth. These trends in land use within the Santa Fe Basin provide a basis for formulating local recovery measures, and also illustrate the need to plan for future changes in the types and quantities of the water use in implementing the Recovery Strategy.



## 2.0 SUMMARY OF PROPOSED MFLS

The following sections provide a brief overview of the MFLs proposed for the Lower Santa Fe and Ichetucknee Rivers and their Priority Springs. For a complete description of the development of the proposed MFLs, refer to “Minimum Flows and Levels for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs,” published by the District, and dated November 22, 2013.

State policy guidance established in Rule 62-40.473, F.A.C., lists ten environmental and water resource values that must be considered in establishing MFLs. These values, referred to in this report as Water Resource Values or WRVs, are specific aspects or specific uses of the natural system to be considered during MFL development. Two WRVs were relevant to the study area and had sufficient available information to allow for an evaluation of the relationship between the WRVs and system hydrology: (1) Recreation in and on the water, and (2) Fish and wildlife habitats and the passage of fish. The predominant metrics used for these values include:

- Santa Fe River near Fort White:
  - Fish and wildlife habitat and the passage of fish: fish passage, floodplain vegetation inundation, floodplain hydric soils, bankfull flows, in-stream habitat;
- Ichetucknee River at US Highway 27:
  - Fish and wildlife habitat and the passage of fish: fish passage, bankfull flows, floodplain hydric soils, in-stream habitat.
  - Recreation in and on the water: recreational tubing

The District developed a continuous MFL flow regime that incorporated the available information relating to these values. During the establishment of the MFL, District staff utilized the historical streamflow record prior to 1990 as a historical baseline, since significant streamflow reductions due to anthropogenic impacts were not readily discernable in the flow record during that timeframe. This historical baseline flow regime was utilized to develop the MFL flow regime, and also provided a mechanism for evaluating the compliance status of the rivers. Given the characteristics of the rivers and the available flow data, MFLs were developed at two river gages, the Fort White Gage on the Lower Santa Fe River and the US Highway 27 Gage for the Ichetucknee River. Based on flow records, District staff determined that the Lower Santa Fe River is in recovery with an estimated streamflow deficit of 17 cubic feet per second (cfs) as of 2010. Likewise, District staff also determined that the Ichetucknee River is in recovery, with an estimated streamflow deficit of 3 cfs.

### 2.1 PROPOSED MFL CRITERIA

The following tables provide a numerical summary of the proposed MFL flow regime for the Lower Santa Fe and Ichetucknee Rivers, on a percent exceedance basis (the percentage of time that each flow listed is expect to be exceeded). The baseline (built on the historical flow record prior to 1990) flows from the MFL analysis are provided for comparison.

**Table 2-1. MFL Flow Values and Baseline Flows for the Lower Santa Fe River near Fort White**

Flow Duration Curve	Discharge Exceedance Amounts (cfs)						
	5%	10%	25%	50%	75%	90%	95%
Baseline	3,230	2,630	1,860	1,320	1,050	885	810
MFL	3,101	2,523	1,768	1,214	920	749	672

**Table 2-2. MFL Flow Values and Baseline Flows for the Ichetucknee River at US Highway 27**

Flow Duration Curve	Discharge Exceedance Amounts (cfs)						
	5%	10%	25%	50%	75%	90%	95%
Baseline	483	457	395	354	328	304	280
MFL	473	448	386	343	318	282	246

In addition to developing MFLs for the Lower Santa Fe and Ichetucknee Rivers, the District also established MFLs for each of the priority springs associated with these rivers. The Priority Springs MFLs were expressed as a cumulative allowable percent reduction in baseline springflow discharge for each listed spring. The allowable reduction was developed based on the allowable reduction in streamflow from the associated river flow at median conditions (i.e., at the 0.5 exceedance probability). This method ensures that the maximum change at any individual priority spring contributing to flow in either river will continue to provide the same proportional flow contribution to the river under the MFL regime that it did under baseline conditions.

**Table 2-3. MFLs for Priority Springs on the Lower Santa Fe and Ichetucknee Rivers**

Spring	Allowable Reduction from Baseline at Median Springflow
<b>Santa Fe Rise</b>	8%
<b>ALA112971 (Treehouse)</b>	
<b>Hornsby</b>	
<b>Columbia</b>	
<b>Poe</b>	
<b>COL101974</b>	
<b>Rum Island</b>	
<b>July</b>	
<b>Devil’s Ear (Ginnie Group)</b>	
<b>Siphon Creek Rise</b>	
<b>Ichetucknee Head</b>	3%
<b>Blue Hole</b>	
<b>Mission</b>	
<b>Devil’s Eye</b>	
<b>Grassy Hole</b>	
<b>Mill Pond</b>	

## 2.2 PEER REVIEW

As previously stated, the SRWMD elected to conduct voluntary, independent, scientific peer review of the technical analysis used to develop the MFLs. In accordance with Section 373.042, F.S., SRWMD contracted with the University of Florida's Water Institute to conduct the peer review of the initial draft MFL technical report in July 2013. During the peer review period the District also solicited comments on the draft MFLs from stakeholders. The draft peer review report was submitted to the SRWMD on September 11, 2013, and the final peer review report, entitled "Peer Review of the Proposed Minimum Flows and Levels for the Lower Santa Fe and Ichetucknee Rivers and Associated Priority Springs," was submitted to the SRWMD on October 11, 2013.

According to the Peer Review Report, the peer review panel "supports the general approach that the SRWMD has adopted to develop MFLs for the Lower Santa Fe and Ichetucknee Rivers" and further concluded that "the panel believes that, with relatively minor and easily reconcilable exceptions noted in the report, the SRWMD utilized the best available data and information in their analyses." The peer review report further provided a number of comments, recommendations, and suggestions for SRWMD staff to consider or evaluate in finalizing the proposed MFLs. The SRWMD addressed the comments of the peer review and utilized the findings and recommendations to develop the final proposed MFL to ensure that MFLs are based on the best available information. Additionally, as the stakeholder comments were received, SRWMD staff worked to incorporate those comments into the final MFL report to the extent practical. A complete summary of the District's response to the peer review and other public comments received can be found in "The Minimum Flows and Levels for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs Peer Review and Public Comment Resolution Document," published on December 17, 2013, which is available on the SRWMD's website ([www.mysuwanneeriver.com](http://www.mysuwanneeriver.com)).

## 2.3 MFL COMPLIANCE STATUS

To evaluate the current regulatory status of the Lower Santa Fe and Ichetucknee Rivers with respect to the MFL flow regimes, the District utilized several physical and empirical hydrologic models; observed streamflow and climate data were used to assess the degree of historic impacts to the water resources. By examining several metrics for impacts to streamflows, the District built a body of scientific evidence to ascertain the compliance status of the priority water bodies. By comparing this weight of evidence of estimated impacts to streamflows in the Lower Santa Fe and Ichetucknee Rivers to the MFL flow regimes, the District assessed whether the Lower Santa Fe and Ichetucknee Rivers are currently meeting their MFLs. A full technical description of these analyses is provided in the MFL report.

Comparison of the weight of evidence of streamflow impacts for the Lower Santa Fe River with the proposed MFL indicated that the Lower Santa Fe River had an estimated flow deficit of 17 cfs in 2010. Thus the MFL being proposed for the Lower Santa Fe River is not currently being met. *Based on the estimated streamflow deficit of 17 cfs (approximately 11 MGD) below the proposed MFL, the SRWMD has determined that the Lower Santa Fe River is not currently meeting the MFL, and requires a Recovery Strategy to achieve the restoration of minimum flows.*

Similar comparison of the weight of evidence of streamflow impacts for the Ichetucknee River with the proposed MFL indicated that the Ichetucknee River currently has an estimated streamflow deficit of 3 cfs (approximately 2 MGD). *Based on the estimated streamflow deficit of 3 cfs (approximately 2 MGD)*

*below the proposed MFL, the SRWMD has determined that the Ichetucknee River is not meeting the MFL, and requires a Recovery Strategy to achieve the restoration of minimum flows.*

Chapter 373.0421(2), F.S., provides clear direction in the event the existing flow in a water body is below the applicable minimum flow. Consistent with Section 373.0421, F.S., these circumstances necessitate the development of a Recovery Strategy for the Lower Santa Fe and Ichetucknee Rivers and their associated priority springs.

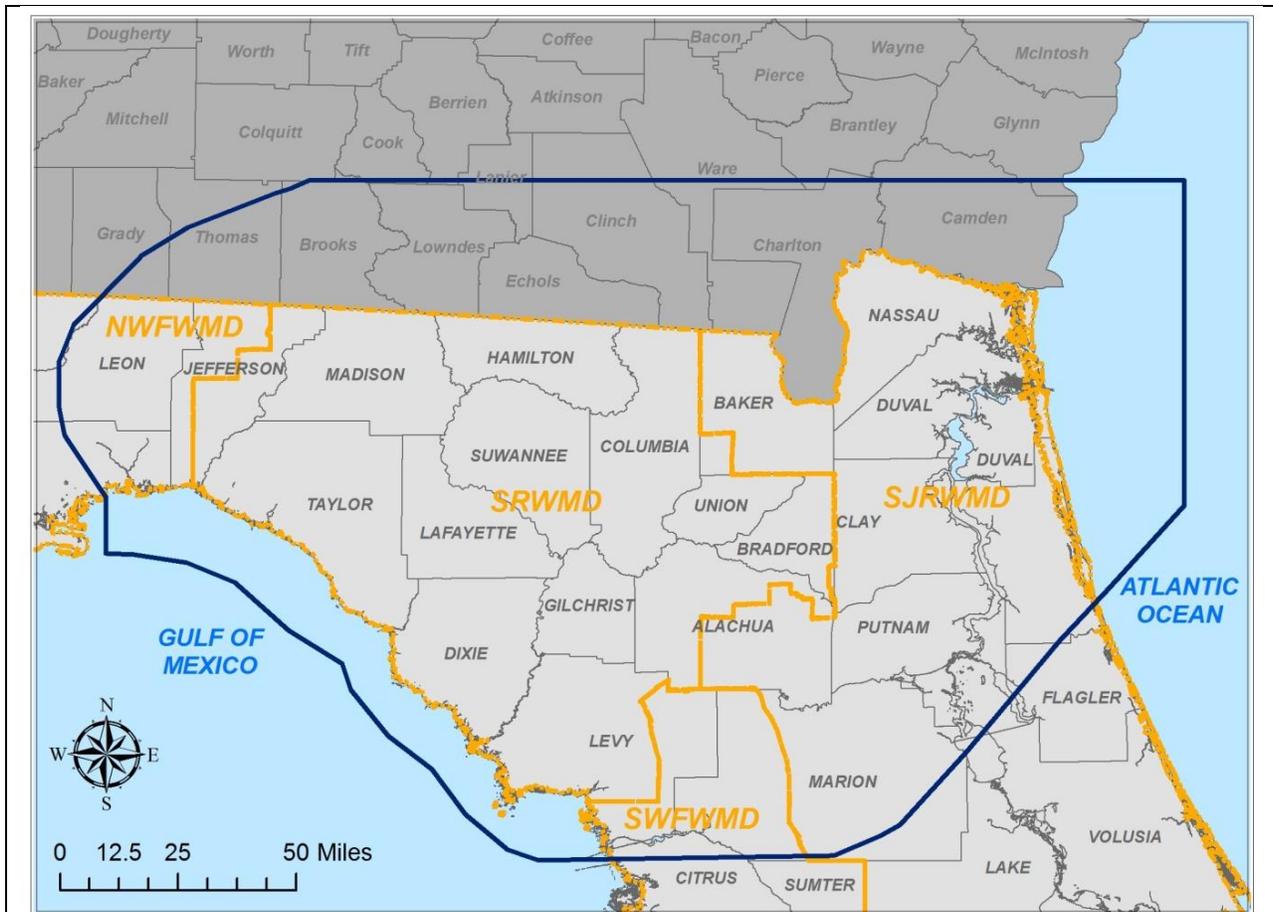
### **3.0 ASSESSMENT OF REGIONAL HYDROLOGIC INFLUENCE**

In order to effectively develop and direct the components of the Recovery Strategy, the origins and causes of the impacts to streamflows and springflows must be examined. Previous work conducted in the 2010 Water Supply Assessment indicated that groundwater withdrawals throughout the north Florida and southeast Georgia region were contributing to trends in regional groundwater levels. To assess the potential effects of regional groundwater withdrawals on streamflow reductions in the Lower Santa Fe Basin, the SRWMD conducted an analysis to examine the effects of groundwater withdrawals outside of the SRWMD boundaries on the flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs. A detailed summary of this analysis is included in the MFL document. The results of the District's analysis indicated that a significant portion of the stream and springflow impacts to the Lower Santa Fe and Ichetucknee Rivers and priority springs are the result of groundwater withdrawals originating outside of the SRWMD's boundaries.

#### **ANALYSIS APPROACH AND METHODOLOGY**

The primary tool the District employed to examine the effects of regional groundwater withdrawals on the Lower Santa Fe River and Ichetucknee River streamflows and springflows was the District's North Florida Model (NFM). The NFM is a finite difference, numerical groundwater flow model which the District developed for the north Florida region. The geographic extent of the NFM is shown in **Figure 3-1**. The NFM can be used to examine the effects of various groundwater withdrawals on regional groundwater levels and flows in springs and baseflows in groundwater dominated rivers. The model can also be used to estimate the benefits of proposed recovery projects and programs within the District. The WMDs intend to continue to utilize the best available modeling tools within their respective boundaries to direct the development and implementation of recovery measures until a joint model is available for use throughout the planning area.

To develop an understanding of the impact of existing groundwater withdrawals within the north Florida region on Lower Santa Fe Basin streamflows and springflows, District staff used the NFM to evaluate several theoretical groundwater conditions. Initially, the current flows of the Lower Santa Fe and Ichetucknee Rivers were examined with current estimated groundwater use included in the model (the "pumps on" condition). District staff then evaluated several hypothetical "pumps-off" scenarios, which were created by removing various groundwater withdrawals from the model. Initially, the District established several theoretical predevelopment flow scenarios by removing groundwater pumping from the model across the entire model domain. Staff then created comparable scenarios in which only groundwater withdrawals within SRWMD boundaries were removed from the model. This allowed the District to examine the theoretical impact of groundwater withdrawals outside of SRWMD boundaries on the Lower Santa Fe River and Ichetucknee River streamflows if no local withdrawals were present. By comparing the theoretical streamflows from the various "pumps-on" and "pumps-off" modeling scenarios, the District was able to assess the potential for regional groundwater uses both within and outside of the SRWMD to impact streamflows in the Lower Santa Fe and Ichetucknee Rivers.



**Figure 3-1. Geographic Extent of the North Florida Model.**

## REGIONAL IMPACTS

Although there are some technical limitations associated with this type of analysis, the use of the District’s current groundwater model can provide qualitative insight into general regional hydrologic effects on the Lower Santa Fe River Basin. Current findings and modeling results indicate that impacts to streamflows and springflows in the Lower Santa Fe Basin are the result of groundwater withdrawals both within and outside of SRWMD boundaries. This conclusion mirrors the findings of the 2010 Assessment.

Based on these findings, it is clear that groundwater use in both the SWRMD and SJRWMD contribute to the current status and thus, the cross boundary MFLs and Recovery Strategies are appropriate to achieve long-term recovery and maintenance of minimum flows in the Lower Santa Fe Basin. This emphasizes the importance of continuing to work with other regional water agencies and user groups, particularly the SJRWMD. As previously mentioned, the passage of new legislation in Chapter 2013-229 of the Laws of Florida will further increase the ability of the SRWMD and SJRWMD to coordinate recovery efforts to address these regional groundwater trends and achieve MFL recovery in the Lower Santa Fe Basin and other priority water bodies.

The SRWMD and SJRWMD are currently working on the development of broader, regional groundwater modeling tools, particularly the North Florida Southeast Georgia Model (NFSEG). Once completed, the WMDs will continue to utilize the best available tools to further assess regional water use and hydrologic trends.

## **4.0 RECOVERY STRATEGY GOALS AND APPROACH**

Based on the findings in the proposed MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs, streamflows and springflows on the Lower Santa Fe and Ichetucknee Rivers have fallen below the proposed MFLs. This circumstance has necessitated the development of a Recovery Strategy, consistent with Section 373.0421, F.S. The purpose of this Recovery Strategy is to develop near-term managerial practices to address these streamflow impacts, and provide a framework to identify long-term water management strategies, water resource development projects, and conservation measures, which can be implemented to recover and maintain the flows in these water bodies at the proposed minimum flow criteria.

### **GUIDING PRINCIPLES**

To maximize the effectiveness of the Recovery Strategy, the SRWMD, in conjunction with the Department and SJRWMD, developed the following principles to guide the design and execution of the Recovery Strategy:

- Use the best available information.
- Strategy components and projects should contribute significantly to resource management and recovery.
- Ensure the Recovery Strategy is implemented as expeditiously as practicable.
- Seek consistency with other prevention or recovery strategies, the NFRWSP, and other state and regional water management programs.
- Recovery strategies should not adversely impact water bodies in adjacent basins and counties of north Florida.
- Protect the investment of existing water use permit holders.
- Provide the flexibility needed to allow economic growth.
- Provide incentives to maximize the benefits of public/private partnerships.

These guiding principles support the creation and implementation of an effective and practical strategy for the recovery and maintenance of minimum flows in the Lower Santa Fe and Ichetucknee Rivers and Priority Springs, as defined by the proposed MFLs.

### **RECOVERY GOALS**

To further guide the development of this Recovery Strategy and ensure clarity of its intent, the SRWMD, in conjunction with the Department and SJRWMD, enumerated the following goals:

1. Achieve the restoration of the Lower Santa Fe and Ichetucknee Rivers and their priority springs to their proposed minimum flows.
2. Develop measures to provide sufficient water supplies for existing and projected reasonable-beneficial uses as practical.

### **TIME-TABLE FOR STRATEGY IMPLEMENTATION**

In coordination with the SJRWMD and the Department, the SRWMD has established a timeframe for implementation of the Recovery Strategy, which extends from rule adoption through 2035. This schedule coincides with the planning timeframe of the North Florida Regional Water Supply Plan, and

will be divided into two phases of implementation. A brief summary of the recovery measures to be conducted in the two phases of the Recovery Strategy is provided in **Table 4-1**, and the components of the Recovery Strategy are detailed in Sections 5 and 6 of this document. The focus of the first phase will be the implementation of the preliminary regulatory strategies to protect the MFL water bodies from additional harm, creation of water resource development project concepts, and the implementation of water conservation measures. Phase I will extend from rule adoption until the development of the long-term recovery measures with the completion of the North Florida Regional Water Supply Plan, expected to be finalized in late 2015.

Phase II of the Recovery Strategy will focus on the implementation of the recommendations in the North Florida Regional Water Supply Plan, the adoption of long-term regulatory measures, and the identification and execution of any necessary water resource development and alternative water supply projects. Phase II will be divided into five-year project cycles, beginning in 2015. After each five-year period, a general assessment of water resource conditions and program efficacy will be conducted in cooperation with the SJRWMD. These five-year cycles will include assessment of the success of the recovery measures implemented to date, and will provide a basis for continuing refinement of the Recovery Strategy and for adaptive management to new hydrologic conditions and water use patterns, as detailed in Section 7 of this document.

**Table 4-1. Prevention and Recovery Strategy Implementation**

	<b>Action</b>	<b>Regulatory Action Required</b>
<b>Phase I (2013-2015)</b>	<b>FDEP will adopt preliminary Recovery Strategy Regulatory Measures:</b> <ul style="list-style-type: none"> <li>• Implement supplemental review criteria for individual water use permit applicants: offset of new impacts to recovering MFL water bodies and limited duration permits for existing impacts</li> <li>• Implement special condition to ensure uses comply with future recovery measures.</li> <li>• Implement special water use permit condition for MIL evaluation every five years for applicable agricultural uses.</li> </ul>	FDEP adopt regulatory measures into Rule 62-42 F.A.C.
	<b>Work with user groups to implement water conservation measures and ensure public participation in the planning process.</b>	No regulatory action required for implementation
	<b>Direct SRWMD agricultural cost-share funding to implement enhanced agricultural conservation practices based on MIL evaluations.</b>	No regulatory action required for implementation
	<b>Planning:</b> <ul style="list-style-type: none"> <li>• Complete NFSEG model.</li> <li>• Examine impacts of regional user groups on MFLs throughout the north Florida region (Keystone-area, Ichetucknee, Lower Santa Fe, or other).</li> <li>• Identify and investigate potential water resource development projects and water supply projects that can contribute to resource recovery</li> <li>• Use regional model analysis, MFLs constraints, project concepts, and related information to establish regional water availability for existing and new quantities, concurrently with the North Florida Regional Water Supply Plan.</li> <li>• Develop long-term regulatory measures to address regional impacts to MFLs and achieve regional water supply goals of the North Florida Regional Water Supply Plan.</li> </ul>	No regulatory action required for implementation
<b>Phase II (2015-forward)</b>	<b>Based on results of regional model analysis, assessment for major users/groups, and magnitude of prevention/recovery needed, identify water supply measures needed to achieve MFLs.</b>	No regulatory action required
	<b>Use regional model analysis, MFLs constraints, project concepts, and related information to determine regional water availability for existing and new sources. Implement long-term regulatory measures as required to achieve MFLs.</b>	FDEP adopt rules in 62-42 F.A.C.
	<b>Further develop and implement water resource development projects and water supply projects throughout the north Florida region to restore and maintain MFLs and to provide sufficient water supplies for existing and projected reasonable-beneficial uses.</b>	No regulatory action anticipated for implementation

## 5.0 RECOVERY STRATEGY COMPONENTS

In order to restore and maintain streamflows to the proposed MFLs, the SRWMD, with support from the Department and SJRWMD, identified five strategic components to be evaluated and incorporated into the Recovery Strategy. The components are:

- **Planning Component:** Development of the North Florida Regional Water Supply Plan.
- **Water Conservation Component:** Increase the Efficiency of Existing Water Use.
- **Water Supply Development Component:** Projects to Implement Alternative Water Supplies.
- **Water Resources Development Component:** Projects to Enhance or Protect the Water Resources of the Lower Santa Fe River Basin.
- **Regulatory Component:** Utilizing Existing Rules to Ensure Compliance with the Proposed MFLs.

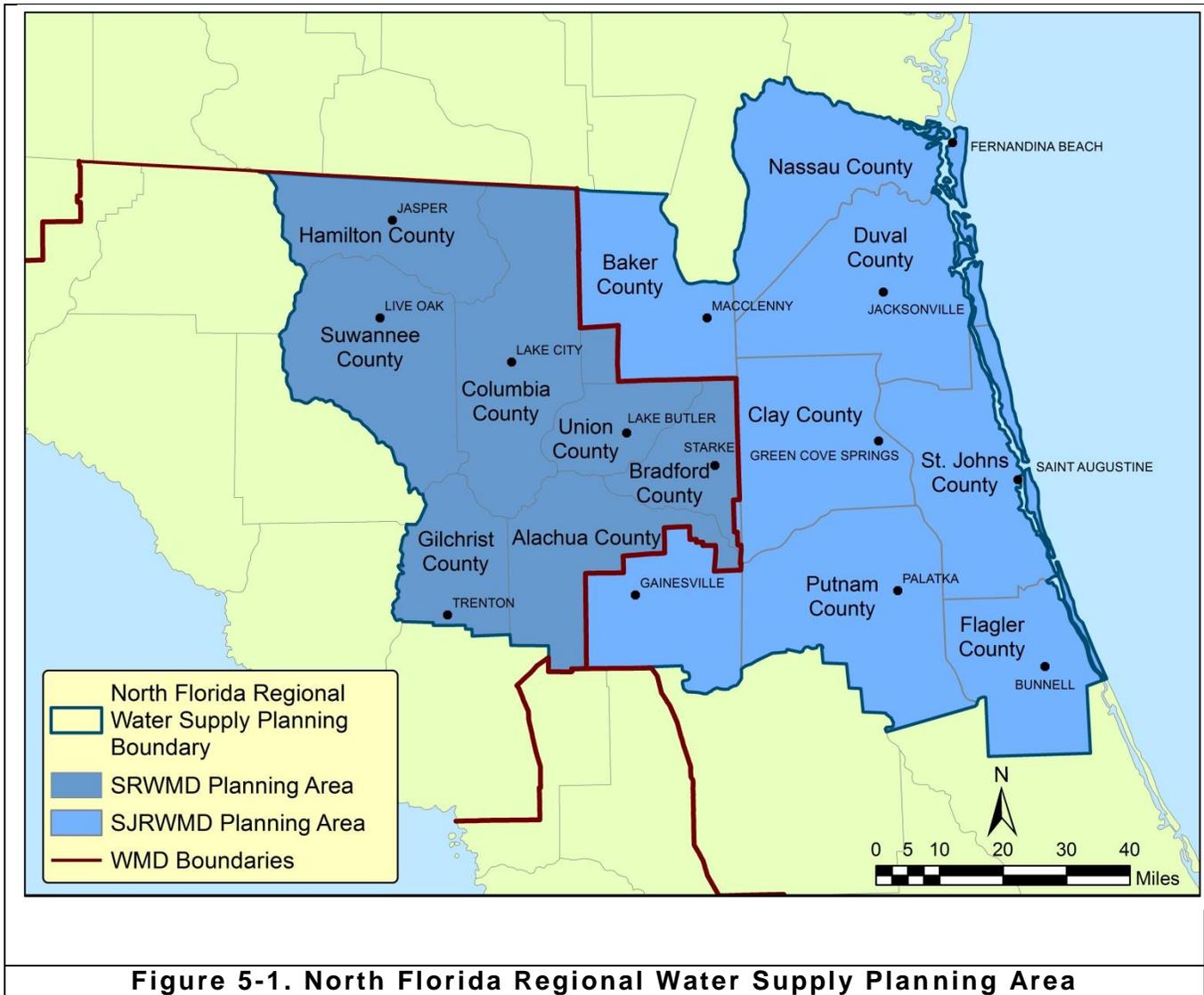
Based on the recent publication of the proposed MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs, the SRWMD considers these strategy components to represent a basic foundation for minimum flows recovery in the Lower Santa Fe River Basin. A list of current and conceptual regional projects currently being assessed for each component is provided in Appendix A. A preliminary timeline for implementing these components is provided as Appendix B.

### 5.1 PLANNING COMPONENT: DEVELOPMENT OF THE NORTH FLORIDA REGIONAL WATER SUPPLY PLAN

As previously discussed, there have been significant impacts to the water resources of the Lower Santa Basin from water uses both within and outside of the SRWMD. The reductions in streams and springflows in the Lower Santa Fe River Basin are the result of both the local impacts within the Santa Fe Basin and regional declining trends in Upper Floridan aquifer groundwater levels that have occurred throughout north Florida. As such, projects, conservation measures, and regulatory strategies to achieve recovery of the Lower Santa Fe and the Ichetucknee Rivers and priority springs must address regional impacts. These measures are best considered in a regional water supply planning context. To create effective programs and measures to achieve recovery, the Planning Component of the Recovery Strategy is being conducted concurrently and as a component of the North Florida Regional Water Supply Plan.

The SRWMD and SJRWMD are working together to draft the North Florida Regional Water Supply Plan (Plan), under the IAA. The planning region, shown in **Figure 5-1**, will address the projected regional water use demand for the 2015–2035 planning horizon, as well as the water resource impacts that could occur based on future projected population growth and estimated increased water demands. Upon completion, the Plan will also identify potential water conservation initiatives, water supply development projects, including alternative water supply projects, and water resource development projects that collectively will provide sufficient water to meet all existing and future reasonable-beneficial needs while sustaining the water resources and natural systems, which includes offsetting predicted water resource impacts. The Plan will provide guidance to effectively manage the water resources of the Lower Santa Fe Basin in a holistic manner, and provide the framework to create long-term strategies to address regional impacts to the Lower Santa Fe River Basin.

In addition to the current North Florida Regional Water Supply Plan initiative, the SRWMD will continue to pursue future agreements and partnerships with federal, state, and local agencies, and resource stakeholders for participation in planning efforts.



## 5.2 WATER CONSERVATION COMPONENT

Increased emphasis on water conservation programs is one of the primary tools the District will employ to meet the requirements for MFL Recovery in the Lower Santa Fe River Basin. These programs will focus on increasing the efficiency of water use throughout the Lower Santa Fe River Basin, and will be tailored to the various water use categories. Legislative findings provided in Subsection 373.227(1), F.S. state: *“The Legislature recognizes that the proper conservation of water is an important means of achieving the economical and efficient utilization of water necessary, in part, to constitute a reasonable-beneficial use.”* As such, it should be noted that water conservation is expected of all users, and that successful conservation practices among specific users as part of the Recovery Strategy, will not preclude the responsibility for other users to maintain sound water conservation practices. The success of the Recovery Strategy will be contingent upon maintaining present conservation practices and continued improvement of conservation practices and programs throughout the north Florida region.

### Agricultural Water Conservation

Currently, agricultural groundwater use accounts for an estimated 40% of the total water use in the Santa Fe River Basin. Although the historical impacts to Santa Fe Basin streamflows and springflows are the result of both regional and local water use, local agricultural water conservation practices will be an essential component towards achieving MFL Recovery in the Lower Santa Fe River Basin. There are currently several existing agricultural water conservation programs within the SRWMD, and the District plans to utilize these programs and also explore new strategies to reduce agricultural groundwater consumption within the Lower Santa Fe River Basin.

The primary approach to water conservation amongst agricultural water users is to minimize water use to what the producer needs to meet product requirements for their operation. Several strategies to optimize agricultural water use processes are:

- Continual improvement of Best Management Practices maintained by FDAC and DEP in conjunction with the industry to minimize water use needs for agricultural operations.
- Irrigation technology improvements to improve water use efficiency.
- Supporting implementation of water conservation practices among agricultural water users with Mobile Irrigation Labs and WMD agricultural outreach programs.
- Support continued refinement of science based modeling of water use requirements for agricultural commodities to efficiently apply water only on an as needed basis per the BMP process. These efforts could be coordinated with such entities as the SRP, IFAS, the UF Water Institute, and industry to maintain and continuously improve the model(s). Support efforts to improve real-time water use efficiencies through the use of Weather/Eco stations which could incorporate on site rainfall, ET and soil moisture into individual producers irrigation practices.

This section provides a brief summary of the estimated potential for agricultural water conservation, and how the District has implemented these water conservation strategies and intends to utilize them in support of the Lower Santa Fe and Ichetucknee Rivers and Priority Springs Recovery Strategy.

**AGRICULTURAL WATER CONSERVATION POTENTIAL**

During the development of this Recovery Strategy, the District conducted a local assessment of water conservation potential within the five counties comprising the majority of the Santa Fe Basin. Current USGS water use data estimated that annual irrigation demand accounts for approximately 30.3 MGD of water use in these counties (note that the values in this section only include the portions of these counties located within the SRWMD). Using potential water savings data compiled by Mobile Irrigation Labs (MILs) and 2010 agricultural acreage data, the District developed an estimate of total agricultural conservation potential in this area based on crop type. This information is summarized in **Table 5-1**.

**Table 5-1 Potential Agricultural Water Savings by Crop Type for Alachua, Bradford Columbia, Gilchrist, and Union Counties**

<b>Crop Type</b>	<b>2010 Irrigated Acres</b>	<b>Use per Acre (MGD)</b>	<b>Total Irrigation Use (MGD)</b>	<b>Savings per Acre (MGD)</b>	<b>Potential Total Savings (MGD)</b>
Vegetables (Mixed Vegetables, Melons)	6,617	0.00098	6.51	0.00010	0.66
Nursery (Fern and Ornamentals)	1,369	0.00942	12.90	0.00083	1.14
Blueberries and Grapes	1,231	0.00096	1.18	0.00025	0.31
Field Crops (Corn, Soy, etc.)	6,282	0.00105	6.62	0.00038	2.37
Sod, Pasture, Grass	3,649	0.00086	3.12	0.00027	1.00
<b>Total</b>	<b>19,148</b>		<b>30.33</b>		<b>5.48</b>

<sup>1</sup>Analysis based on 2010 USGS Water Use Estimate Data

The results of this analysis indicate that of the approximately 30.3 MGD of water use for agricultural irrigation in these counties, up to 5.5 MGD of water use could be saved by implementing standard measures to increase irrigation efficiency for existing irrigation systems. Typical practices which would be implemented to achieve this potential water savings include: center-pivot retrofits, replacement of worn irrigation nozzles, and other measures that improve the efficiency of existing irrigation systems. In order to achieve these water savings, it is essential that agricultural users within the Santa Fe Basin undergo MIL evaluations, providing a quantitative basis to direct District cost-share funding, and for area farmers to optimize their irrigation practices. Presently, the SRWMD estimates that the two MILs currently operating in this area have sufficient capacity to conduct evaluations for the permitted agricultural operations in this area within a five year window.

It should be noted that the data presented here on potential irrigation efficiency is only based on the potential efficiency improvements of existing irrigation systems, as evaluated previously by the MILs. As such, this analysis does not take into account other potential water conservation practices aside from improving the delivery of water in existing systems. The District recognizes that there is considerable additional potential for water conservation beyond the efficiency data supplied by the MIL evaluations and intends to continue to pursue increases in agricultural irrigation conservation through future programs. Conservation practices which the District has encouraged in the past or is currently evaluating include switching to more efficient irrigation systems (i.e. replacing overhead irrigation with drip irrigation), adjusting agricultural practices to less water intensive methods (i.e. conservation tillage), and utilizing alternative water supplies (such as farm ponds or tailwater recovery).

## **AGRICULTURAL WATER CONSERVATION COST-SHARE PROGRAMS**

One of the primary tools the SRWMD will utilize to achieve increases in water conservation among agricultural users is the use of cost-share programs. The SRWMD has recently implemented several successful cost-share programs for agricultural water conservation practices, in conjunction with FDEP and FDACS. Conservation practices for which the SRWMD has offered cost-share funds include: center pivot irrigation retrofits, installation of subsurface drip irrigation, installation of soil moisture probes and weather stations, and upgrades to irrigation pumps and irrigation control systems. In October 2012, the SRWMD initiated a cost-share program with a value of \$1.5 million. During the first four phases of this cost-share program, over \$1.2 million were distributed, resulting in the implementation of conservation projects that are projected to save an estimated 5.2 MGD in agricultural water use district-wide. This program was administered throughout the District. Based on the results of current cost-share programs, the typical cost of achieving and maintaining these water conservation practices over a twenty-year cycle would be approximately \$0.20 per 1,000 gallons of water savings, representing an efficient cost recovery program when compared to infrastructure improvements or other large projects. In order to achieve increases in agricultural water conservation in the Santa Fe Basin as expeditiously as possible, the SRWMD intends to prioritize its current agricultural efficiency cost-share programs to the most sensitive areas of the Santa Fe Basin.

## **SRWMD AGRICULTURAL ASSISTANCE TEAM**

The SRWMD Agricultural Assistance Team (“Ag Team”) is an agricultural outreach program that was created to assist agricultural operations with water use and environmental resource permits, Best Management Practices (BMPs), and cost-share programs. The Ag Team implements the SRWMD’s cost-share programs for agricultural water conservation projects and acts as a liaison for agricultural cost-share programs operated by other state agencies.

The District envisions Ag Team participation as a critical component of MFL recovery in the Lower Santa Fe River Basin. As the MFL Recovery Strategy is implemented, the Ag Team will assist agricultural operators in compliance with recovery measures and their water use permit conditions. Furthermore, the Ag Team will work with agricultural users within the basin to achieve higher participation rates in water conservation practices. When dispensing cost-share funding, the Ag Team will prioritize projects that offer the greatest contributions to priority water bodies in the MFL Recovery areas.

## **SUWANNEE RIVER PARTNERSHIP**

Another partner the District will rely on to assist in the ongoing implementation of the MFL Recovery Strategy is the Suwannee River Partnership (Partnership). The Partnership is a coalition of state, federal, and regional agencies, local governments, and private industry representatives formed in 1999 to address nitrate levels in the surface waters and groundwater of the Middle Suwannee River Basin. The District, FDACS, and the Department are members of the Partnership. One of the hallmarks of the Partnership is its history of voluntary or incentive-based programs for water quality protection in the local agricultural industry. The Partnership works to increase agricultural participation in these voluntary and incentive-based nutrient reduction BMP programs, as an alternative to regulatory enforcement.

Based on the Partnership’s past success in increasing BMP enrollment and the use of environmental management plans, the District will continue to work with the Partnership to increase participation in agricultural water conservation measures in the Lower Santa Fe River Basin.

## COORDINATION WITH OTHER AGENCY PROGRAMS AND GRANTS

One method which the District has employed in the past to reduce agricultural water use is coordinating involvement between agricultural producers and other state and regional agencies. For example, in February 2012, the Department established a Basin Management Action Plan (BMAP) to reduce nutrient loadings to the Santa Fe River, under the Total Maximum Daily Loads (TMDL) program. The Department subsequently made cost-share funding available for BMP implementation within the Santa Fe River Basin. The District shares regulatory authority for the BMAP, and is administering the BMP cost-share program. As the BMPs implemented address both water quality and water conservation, the District was able to achieve an estimated 1.2 MGD potential reduction in agricultural water use, in addition to a significant reduction in fertilizer use.

In addition to the BMAP program, the District coordinated with agricultural users to participate in cost-share programs offered by FDACS and the Environmental Quality Incentives Program (EQIP), administered by the US Department of Agriculture's Natural Resource Conservation Service (NRCS). By continuing to coordinate with other agencies and water quality programs, the District can provide access to cost-share funds for the implementation of conservation practices to reduce agricultural water use in the Lower Santa Fe River Basin.

## WORK WITH IFAS AND USER GROUPS

Many of the water conservation practices currently employed by agricultural users were developed years ago and may not fully account for the advances in agricultural technology and research that have taken place in the last few decades. As such, the University of Florida's Institute of Food and Agricultural Sciences (IFAS) continues to do research on new agricultural conservation practices. The District may partner with IFAS and other agencies to ensure that new and innovative water conservation practices are implemented as they are developed. The District will also explore opportunities for cost-sharing between IFAS and producers in the Lower Santa Fe River Basin as part of research or pilot study efforts to improve water conservation.

## Non-Agricultural Water Conservation

In order to achieve restoration and maintenance of minimum flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs, the District will also implement water conservation measures for non-agricultural water user groups. This section provides a brief overview of the potential conservation measures that can be implemented with publicly supplied domestic users, self-supplied users, utilities, and commercial, industrial, and institutional users. The District anticipates working with local municipalities and utilities to implement these conservation programs and encourages adoption by the residents and water users of the affected areas.

## NON-AGRICULTURAL WATER CONSERVATION POTENTIAL

To provide a general estimation of the recovery potential for non-agricultural water conservation, the District relied on the results of the 2010 Assessment. The Assessment included District-wide projected water demands for the 2030 timeframe, as well as estimations of potential conservation for each user group. It should be noted that the water use estimates in this section represent total District-wide use, and do not include permitted uses in the SJRWMD portion of Alachua County. The data are summarized in **Table 5-2**.

Based on the 2010 estimates, under a no-action scenario, demand for water for public supply, domestic self-supply, and recreational irrigation uses within the SRWMD would increase by an

estimated 9.4 MGD. However, estimates of water conservation potential for these uses indicate that up to 8.8 MGD of this projected demand could be offset by potential water conservation. Thus, if the estimated conservation potential for public supply, domestic self-supply, and recreational irrigation uses is realized in the 2030 timeframe, increases in new withdrawal for these uses would be limited to minor increases (approximately 0.6 MGD cumulatively). This analysis indicates that achieving the maximum potential water conservation among these user groups is likely an important strategy to reduce the need to increase groundwater withdrawals within the SRWMD, thus minimizing additional impacts to the water resources of the Lower Santa Fe River Basin.

Additionally, the results of the 2010 Assessment indicate that among commercial, industrial, and institutional users, there is a potential for a net reduction in water use of nearly 4 MGD, if the estimated water conservation potential is achieved. It should also be noted that the commercial, industrial, and institutional conservation potential was estimated as 5% of total projected use for individual users, and the potential for conservation or water reuse could be significantly higher among commercial, industrial, and institutional users than indicated by this analysis. Based on these results and current initiatives with existing commercial, industrial, and institutional operations, the District believes that achieving improved water conservation and reuse among this user group could provide significant reductions in groundwater use to aid the recovery of the water resources of the Lower Santa Fe Basin. As such, the District intends to continue to work with commercial, industrial, and institutional users to achieve improvements in water conservation to benefit the water resources of the Lower Santa Fe Basin.

**Table 5-2. Non-Agricultural Water Conservation Potential within the SRWMD**

	2010 Estimated Water Use	2030 Projected Water Use	Projected Increase	2030 Conservation Potential	Net Water Use Change after Conservation
<b>Public Supply</b>	23.30	27.37	4.07	3.70	0.37
<b>Commercial/Industrial/Institutional</b>	84.72	85.70	0.98	4.94	-3.96
<b>Domestic Self Supply</b>	18.87	23.76	4.89	4.75	0.14
<b>Recreational Irrigation</b>	1.81	2.20	0.39	0.31	0.08
<b>Total</b>	128.70	139.03	10.33	13.70	-3.37

<sup>1</sup>All values provided in MGD

The SRWMD and SJRWMD are currently developing improved estimates of water conservation potential as a part of the North Florida Regional Water Supply Plan. As these estimates are developed, they will be incorporated into the Recovery Strategy to improve the direction and implementation of conservation measures.

**EDUCATIONAL PROGRAMS AND PUBLIC AWARENESS**

One of the primarily challenges in implementing water conservation programs is encouraging resident participation. As such, the District will implement educational programs aimed at increasing the public’s general knowledge about water conservation and its ecological and economic benefits. In particular, the District will reach out to local municipalities and schools to provide a forum for conservation education presentations. Additionally, the District will seek to form working relationships with local interest groups and charities, such as the Ichetucknee Partnership, to aid in the dissemination of water conservation educational materials. The educational programming will not only provide information about water conservation, but also provide specific information about the ecological health and economic importance of the Lower Santa Fe and Ichetucknee Rivers and priority springs, as well as their MFL recovery status. This will aid in linking the water conservation measures being implemented

to specific community natural resources, with the goal of increasing public participation in water conservation programs.

To further increase public participation in domestic and commercial water conservation, the District will issue water conservation notices during periods of drought in the Santa Fe River Basin. These conservation notices will primarily serve as a form of public outreach, seeking to inform water users about water conservation measures the District is recommending, or temporary rules restricting irrigation for lawns and ornamental landscape and other outdoor water uses. The water conservation notices will include practical water conservation recommendations for domestic and commercial users.

### **HIGH EFFICIENCY FIXTURES AND APPLIANCES**

High efficiency fixtures and appliances can potentially save hundreds of gallons of water per month per application. The District will examine the potential to work with local utilities and local plumbing and home improvement retailers to implement rebate programs for high efficiency fixtures and appliances. Where practicable, rebate programs can result in significant reductions in domestic water use at a minimal cost to the District, while increasing business for local retailers. The District will also examine the feasibility of high-efficiency fixture (such as showerheads) giveaways which achieve material reductions in water use, and can also spur public interest and participation in other domestic water conservation practices.

### **SRWMD LAWN AND LANDSCAPE IRRIGATION RULE**

In many areas of Florida, home landscape irrigation is estimated to make up roughly 50% of domestic water use. Although the proportion of water use for home irrigation in the District is generally considered to be lower due to the rural nature of the region, landscape irrigation still contributes significantly to groundwater withdrawals.

To address landscape irrigation, on January 6, 2010, the District implemented a lawn and landscape irrigation rule which limits irrigation to two days per week during Daylight Savings Time and one day per week during Standard Time. The rule also requires that watering not be conducted between 10 AM and 4 PM, when evaporation is greatest. During periods in which a Water Shortage Order was declared by the District, additional irrigation restrictions were implemented, such as limiting irrigation to one day per week during Daylight Savings Time and assigning specified lawn watering days based on home address, as was the case in the summer of 2012. As demonstrated by the Southwest Florida Water Management District, adjusting watering restrictions from two days to one day per week can achieve public supply water use reductions of 9% to 20% (Whitcomb, 2005). To aid in MFL Recovery, the District will continue to implement the lawn and landscape irrigation rule. The District will work with local governments and utilities to develop a long-term enforcement plan to ensure stakeholders are informed of and comply with the landscape irrigation rule.

### **FLORIDA FRIENDLY LANDSCAPE AND LOW IMPACT DEVELOPMENT**

In addition to water conservation via watering restrictions, lawn and landscape irrigation demand can also be reduced by the use of Florida Friendly Landscaping. Florida Friendly Landscaping is defined in the Florida Statutes as “landscapes that conserve water, protect the environment, are adaptable to local conditions, and are drought tolerant...” To date, many guidance documents and techniques for maintaining Florida Friendly Landscaping have been developed by IFAS. In accordance with legislative directive, the District will continue to encourage local municipalities and county governments to enact ordinances that promote Florida Friendly Landscape practices.

Although residential development in Florida has slowed since the economic downturn in 2008, it is expected to continue in the region for the foreseeable future. In order to minimize the impact that future development may have on groundwater resources in the Lower Santa Fe River Basin, the District will work with local municipalities and county governments to promote Low Impact Development. Low Impact Development is a set of design principles for new construction which seek to conserve water and natural resources, minimize impervious area, and manage stormwater in a manner that maintains natural hydrologic patterns. The principals of Low Impact Development sometimes require amendments to local building ordinances, but if implemented, can assist in maintaining water resources and reducing water demand from future growth within the Lower Santa Fe Basin.

## **PUBLIC SUPPLY INFRASTRUCTURE IMPROVEMENT**

One method of reducing water withdrawals for public supply is addressing water losses within public distribution systems. Previous studies have indicated some North American utilities are impacted by water losses of 20-50% (Brothers, 2001). Identifying sources of water loss within public distribution systems can not only significantly reduce withdrawals by utilities, but also significantly reduce utilities operating costs, while causing little to no impact to public supply users. The District is currently working with the cities of Newberry, Alachua, and High Springs to address leakage and losses through the SRWMD's RIVER cost-share program. Some of the projects being implemented to assess and reduce water losses in these public supply systems include metering efforts to identify locations of water losses, and the replacement of aging valves and leaky distribution infrastructure. The District will continue to work with local utilities within the Lower Santa Fe River Basin to determine if significant water losses are occurring in public water supply systems, and work to identify sources of funding or cost-sharing mechanisms to remedy these losses.

## **WATER CONSERVING RATE STRUCTURES**

Another tool which can be implemented by area utilities to reduce water consumption is a water conservation rate structure. Water conservation rate structures typically utilize a block pricing approach, with water rates increasing with increasing water use. This incentivizes water conservation by encouraging users to restrain water consumption to maintain a lower billing rate. Studies in Florida have shown that increasing the water rate from \$1.20 to \$2.00 per thousand gallons can lead to a decrease in water demand of up to 17% among public supply users (although some of this reduction can be attributed to use of an alternative water supply rather than conservation). Block rate structures can be set up in such a way as to reward low demand water users for conservation, while using higher rates among less conservative users, to maintain the utility's current average billing rate and revenue stream (Whitcomb, 2005).

Currently, Gainesville Regional Utilities (GRU), and the Cities of Archer, Newberry, Alachua, High Springs, and Lake City have implemented water conservation rate structures. The District will build upon this effort by working with other local utilities within the Lower Santa Fe River Basin to implement water conservation rate structures where practicable.

## **COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL WATER CONSERVATION PLANS**

Based on 2010 water use estimates from the USGS Florida Water Science Center, self-supplied commercial, industrial, and mining uses make up just over three percent of estimated water use in the five county area comprising the Lower Santa Fe River Basin, although several significant industrial uses are present in the north Florida region. In addition to self-supplied withdrawals, commercial, industrial, and institutional users may also contribute significantly to public supply demand through connection to a local utility. To reduce water demand from commercial, industrial, and institutional

users, the District has required water conservation plans for all new commercial, industrial, and institutional water use permittees or permit renewals (including mining) since 2010. In addition to this requirement, the District may consider requiring certain existing users to implement water conservation plans. As with other user groups, the District will seek to identify sources of funding or cost-sharing to assist with water conservation programs for commercial, industrial, and institutional users.

In many cases, water use can represent a significant cost to commercial, industrial, and institutional users. As such implementing water conservation measures not only reduces water consumption, but also reduces operating cost. One commercial water conservation program currently administered by the District in Lake City is the Water Conservation Hotel and Motel Program (CHAMP). By enrolling in CHAMP, area hotels agree to implement various water conservation measures in their operations, such as reusing towels and linens for multiple-day stays, and replacing old fixtures with water efficient fixtures when possible. These measures not only reduce water consumption, but also result in cost savings for the hotels, via reduced water, detergent, and energy costs. The District will continue to expand CHAMP to other areas of the District and work with local industries and businesses to identify new and practical water saving measures that can be implemented in business operations.

### **5.3 WATER SUPPLY DEVELOPMENT COMPONENT (ALTERNATIVE WATER SUPPLIES)**

As previously discussed, the primary source for freshwater supplies within the north Florida region is the Upper Floridan aquifer. Due to the high degree of connectivity between the Lower Santa Fe and Ichetucknee Rivers and the Upper Floridan aquifer, regional declines in groundwater levels have led to streamflow declines in these rivers and their associated springs. Finding methods to replace groundwater withdrawals with alternative water supplies can aid in recovery of water levels in the Upper Floridan aquifer and flows in the Lower Santa Fe and Ichetucknee Rivers and their associated springs. To meet this goal, the SRWMD and SJRWMD will assess, promote, and implement (as practicable) various water supply development projects to reduce reliance on groundwater withdrawals.

#### **Reclaimed Water**

The District believes that there is potential for additional development of reclaimed wastewater or reuse water within the Lower Santa Fe River Basin and throughout the north Florida region. The rural nature and small size of many wastewater utilities in this region create distinct challenges to the development of wastewater reclamation systems. Namely, the cost of enhanced treatment and conveyance of reclaimed water from rural wastewater treatment plants to potential users (electrical utilities, farms, etc.) can prove cost prohibitive for small local utilities. The District will work with small utilities and potential reclaimed water users to identify practical reuse projects which can be implemented practicably in the Lower Santa Fe River Basin.

Presently, the District is working with the City of High Springs, in northwestern Alachua County, to develop a reuse plan for the City's secondary treated wastewater effluent. The effluent is currently discharged to a sprayfield; the proposed plan will utilize this water source to offset groundwater withdrawals. Groundwater recharge will also occur within the project. The proposed project components consist of constructing a storage facility and installing transmission lines. Although this project was already under consideration prior to the creation of the Recovery Strategy, it would provide benefits to the Lower Santa Fe River by offsetting groundwater withdrawals, and provides an excellent

example of the types of alternative water supply projects the District will seek to identify and implement as the Recovery Strategy is developed.

### **Alternative Groundwater Sources**

The intermediate aquifer system is currently utilized as a local source of groundwater, albeit at relatively low yields. Due to the area geology, the highest potential for use of the intermediate aquifer is in the Upper Santa Fe River Basin; however, offsetting demand for Upper Floridan aquifer withdrawals in the upper reaches of the river can have beneficial impacts on spring and streamflows within the Lower Santa Fe River Basin. The District can provide incentives and exercise its regulatory process to encourage new water use permit applicants and existing permit holders to utilize the intermediate aquifer system for low-yield applications where practical, reducing potential demand on the Upper Floridan aquifer.

Limited investigation has been conducted regarding use of the Lower Floridan aquifer as a potential alternative water supply in the SRWMD; furthermore, hydrogeological studies to date have not identified the presence of the Lower Floridan aquifer in the Lower Santa Fe River Basin. As such, the District believes that the current potential for utilizing the Lower Floridan aquifer as an alternative water supply is limited. The District will continue to assess its presence and potential for water supply as opportunities and available funding permit.

### **Surface Water Sources**

Another option which the District will examine is utilizing surface water to replace existing fresh groundwater uses. Due to proposed and future MFLs, it is unlikely that surface water can provide a year-round water supply; however, there is some potential for the diversion, storage, treatment, and distribution of excess surface water during moderate to high flow periods.

Agricultural users are one group that may have some ability to utilize moderate to high streamflows for seasonal irrigation requirements. Where agricultural uses are located near appropriate surface water bodies, agricultural users would be encouraged to draw irrigation water from local rivers and streams during moderate to high flows, and utilize traditional groundwater sources during the remainder of the year, where feasible. Additionally, many area farms maintain private ponds on their property which may provide another potential surface water source. The use of surface water is generally more viable in the Upper Santa Fe River Basin, where the clayey soils of the Hawthorn Group are more conducive to building off-stream storage reservoirs and ponds than in the Lower Santa Fe River Basin, where the Hawthorn Group is absent and recharge rates to the Upper Floridan aquifer are high. Regardless, the replacement of groundwater withdrawals with seasonally available surface water in the Upper Santa Fe River Basin can have beneficial effects on the potentiometric surface of the Upper Floridan aquifer and stream and springflows in the Lower Santa Fe River Basin.

A final list of water supply development projects will be included in the Regional Water Supply Plan proposed to be completed in 2015.

## **5.4 WATER RESOURCE DEVELOPMENT COMPONENT**

Water resource development projects will be another critical component of the MFL Recovery Strategy for the Lower Santa Fe River Basin. The District has identified several potential water resource development programs which can contribute to the re-establishment and maintenance of MFLs. The goal of these programs is to enhance groundwater levels to restore flow to rivers and contributing

springs and to augment streamflows within the Lower Santa Fe River Basin to meet MFLs. The District is also working with local businesses and stakeholders to identify potential future water resource development projects which can be implemented as public-private partnerships.

### **Aquifer Recharge**

The District is currently pursuing several strategies for aquifer recharge to the Upper Floridan aquifer. Some of these potential projects are expected to offer benefits to the Lower Santa Fe River Basin by raising the potentiometric surface of the Upper Floridan aquifer. The aquifer recharge strategies currently being studied include:

- Capture and recharge of wet season streamflows
- Capture and recharge of excess stormwater runoff
- Treatment and recharge of reclaimed water

These recharge strategies can be implemented via either direct recharge (wells to the Upper Floridan aquifer), or indirect recharge methods (rapid infiltration basins, floodplain, ponds). Depending on the recharge method, source, and receiving aquifer, differing levels of treatment may be required prior to recharge, which can greatly impact the cost and feasibility of individual projects. In addition to these initiatives, the District will also examine other potential aquifer recharge sources and strategies as opportunities arise.

### **Off-Stream Storage**

As previously stated, excess stormwater and seasonally available streamflows represent a potential source of water within the District. In certain areas of the Lower Santa Fe River Basin, there may be potential for off-stream storage of excess streamflows during flood stages or large rain events. The potential for off-stream storage in the Lower Santa Fe Basin is limited by the relatively pervious soils throughout much of this area; however, storage of excess surface waters can provide a source for augmenting dry season streamflows in the Upper Santa Fe Basin. Increases in flows of contributing streams in the Upper Santa Fe Basin can potentially contribute significant improvements to the Lower Santa Fe Basin streamflows. Off-stream storage of excess surface waters can also aid in the alleviation of localized flooding problems in some areas of the basin, providing a basis for potential cooperation and cost-sharing with other agencies and local governments. As such, the District will examine the feasibility of creating off-stream storage projects for excess surface waters within the Santa Fe River Basin.

### **Dispersed Water Storage**

In some areas of the Santa Fe Basin and north Florida region, the historical loss or modification of natural wetland systems has significantly reduced local surface water storage and consequently reduced the potential for aquifer recharge. Re-establishment of wetland and floodplain storage within a river basin can increase aquifer recharge and the stored water can be used to augment dry season streamflows. The District will assess the potential for programs to create dispersed water storage in the Santa Fe Basin to recover groundwater levels and minimum flows. One area which has already been identified for wetlands storage or restoration projects is Middle Suwannee River and Springs Restoration and Aquifer Recharge project, located in Mallory Swamp, Lafayette and Dixie Counties. The District continues to evaluate District properties for such projects.

## DISPERSED STORAGE ON PRIVATE LANDS

Another management strategy the SRWMD will consider is public-private partnerships for dispersed water storage. With the large quantity of agricultural and silvicultural land present in the Lower Santa Fe River Basin, there may be opportunities for dispersed water storage cooperative projects with local landholders. Geologic conditions for potential locations would have to be assessed in order to evaluate the recharge potential of local soils and to determine project viability.

## 5.5 REGULATORY COMPONENT

Achieving the restoration and maintenance of minimum flows for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs will require careful management of local and regional water consumption patterns. As such, a regulatory component of the Recovery Strategy will be necessary to ensure that local water use is consistent with the recovery and maintenance of MFLs in the Lower Santa Fe and Ichetucknee Rivers and Priority Springs. As previously discussed, recent legislation allows the five WMDs to implement MFLs and Recovery and Prevention Strategies that the Department adopts to ensure that impacts to water resources across WMD boundaries are addressed. The SRWMD has requested that the Department adopt the proposed MFLs for the Lower Santa Fe and Ichetucknee Rivers and Priority Springs, as well as the regulatory portion of the Recovery Strategy. The regulatory component of the Recovery Strategy will be developed and adopted concurrently with the proposed MFL. This section provides a brief summary of the current, proposed, and future regulatory tools which the WMDs will employ to aid in the recovery of the Lower Santa Fe River Basin MFLs, and Section 6.0 of this document provides the additional rule language which the Department will adopt by reference to implement the proposed regulatory recovery measures.

In order to ensure that regulatory strategies are implemented in an expedient manner, while also allowing the Districts the ability to develop regulatory tools in an ongoing and adaptive manner, the regulatory portion of the Recovery Strategy will be developed and adopted in a phased manner. Initially, the Districts will enforce existing rules in light of the adopted MFLs, particularly with regard to water use. The SRWMD and SJRWMD have also created several near-term regulatory strategies which will be adopted by the Department concurrently with the proposed MFL, and will focus on implementing measures which can immediately be taken to protect the resources from additional harm, and provide a basis for establishing long-term recovery programs. Long-term regulatory strategies will be developed in conjunction with SJRWMD in the context of the North Florida Joint Regional Water Supply Plan to address regional impacts and trends that have impacted the Lower Santa Fe Basin.

### Current Rules

Presently, the SRWMD and SJRWMD possess a comprehensive system of rules which regulate the consumptive use of water. This section provides a brief overview of existing rules and regulatory authority that are applicable to the implementation of the Recovery Strategy.

### PERMIT CRITERIA

Presently, there are a number of criteria that must be met for the issuance of a water use permit within each district. These water use permit criteria are listed in the applicable rules codified in Florida Administrative Code, and expanded upon in the applicable Applicant's Handbook. Several of the existing general permit requirements will be especially effective in ensuring that water use permits within the Planning Region are consistent with criteria for issuance:

- Reasonable-beneficial water uses must utilize the *lowest quality water sources* environmentally, technologically and economically feasible. Lower quality water sources include reclaimed water, recycled irrigation return flow, storm water, saline water and other alternative water supplies.
- Reasonable-beneficial uses *may not cause harm to the water resources of the area*. According to the definition of an MFL, withdrawals that can be shown to result in decreased flows in rivers or springs in MFL Recovery cause significant harm to that water body. More detailed criteria for harm to wetlands and surface waters are found in the Water Use Permitting Guide.
- Reasonable-beneficial uses must be *in accordance with any minimum flow or level and implementation strategy*.

These requirements, in addition to the other criteria set forth in each Districts water use permitting rules, will provide a foundation for the Districts to assess and issue water use permits in a manner that is compatible with recovery and maintenance of MFLs in the Lower Santa Fe Basin.

### **SPECIAL PERMIT CONDITIONS**

Each of the WMDs has the ability to condition water use permits as necessary to ensure that the permitted consumptive use continues to meet the conditions for issuance and are consistent with the Recovery Strategy. Special conditions will vary among use classes, source classes, and geographic locations, and may be project-specific.

Special conditions which may be utilized for new water use permits or permit renewals in the Planning Region include requirements for water conservation measures or measures to ensure participation in the Recovery Strategy, such as monitoring and reporting requirements. The District intends to incorporate these measures into permittees' water conservation plans on an individual basis, based on the intended water use. The District may also utilize special permit conditions to incorporate the completion of specific projects agreed upon by the permittee into their water use permit, and condition allocations based on the completion of those projects. Special permit conditions provide the District a method to ensure that projects to offset water resource impacts, conservation measures, use of alternative water supplies, and other practices proposed by the user to protect the recovering resource are implemented expeditiously and maintained for the duration of the water use permit.

### **REVOCATION OF UNUSED WATER USE PERMITS**

In order to better quantify and allocate existing water supplies, District staff currently has the ability to request that the Governing Board revoke existing unused water use permits. As stated in subsection 40B-2.341, F.A.C., "The Governing Board may revoke a permit permanently and in whole for non-use of the water for a period of two years or more..." The District also has the ability to revoke unused water use permits at the request of the permittee. Although the revocation of existing permits does not directly reduce water consumption, periodically removing unused permits from the water use allocations allows the District to re-allocate existing unused water supplies, potentially preventing the need for additional water resource development projects that would be identified in the regional water supply planning process. Maintaining an up-to-date and accurate account of allocated water uses greatly aids in planning for future demand.

## **WATER SHORTAGE ORDERS**

Existing rules and Florida statutes (373.175) allow the Districts' Governing Boards to declare a water shortage for the affected source class, if the District determines there is a possibility that "insufficient ground or surface water is available to meet the needs of the users or when conditions are such as to require temporary reduction in total use within the area to protect water resources from serious harm." Extended periods of lower than average precipitation in the District can greatly exacerbate low groundwater levels, as there will typically be an increase in irrigation pumpage to offset the rainfall deficit. Water Shortage Orders, such as the declaration issued by the SRWMD in May of 2012, provide a mechanism to reduce impacts to water resources during periods of water deficit. As necessitated by local climatic patterns and hydrologic conditions, the District may utilize Water Shortage Orders to implement water conservation and management practices to prevent or reduce impacts to the Lower Santa Fe and Ichetucknee Rivers and priority springs during periods of drought. The Districts, as a part of the joint regional water supply planning effort, may develop hydrologic thresholds for declaration of water shortage orders.

### **Phase I Regulatory Strategies**

In addition to rules currently in place, the Department will adopt additional regulatory measures designed to provide protection to the water resources of the Lower Santa Fe River Basin in the near term, while long-term recovery strategies are developed to address the resource recovery in a regional manner. The rule language to implement these regulatory strategies is contained in Section 6.0 of this document, entitled "Supplemental Regulatory Measures", which will be incorporated by reference by the Department.

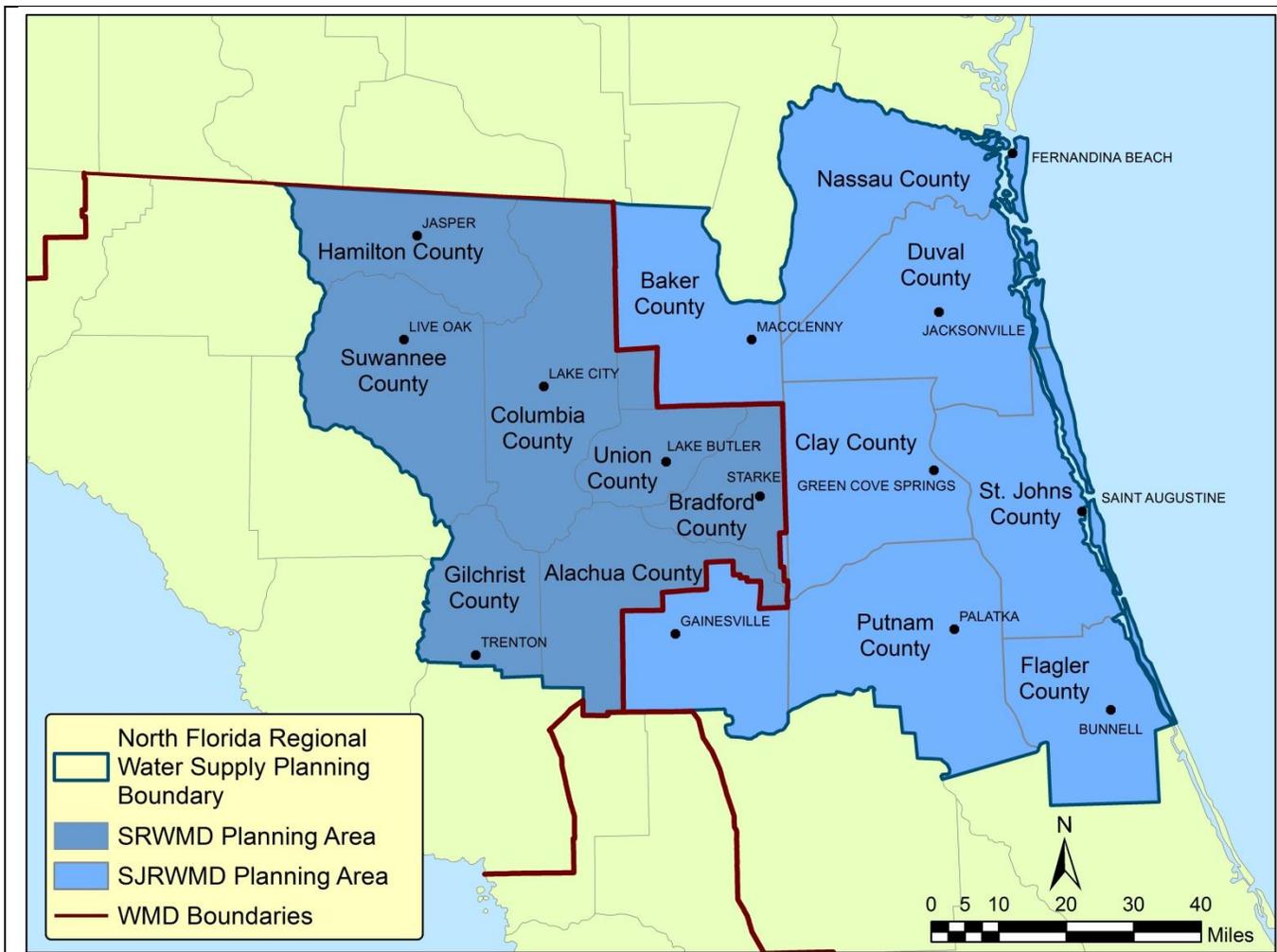
Collectively, these Phase I rules provide an important interim mechanism for the prevention of additional harm to the recovering MFL water bodies, while also providing protections to existing legal uses. These rules also define how the existing requirements that proposed water uses not cause harm to water resources will be addressed in the water use permitting review process with regard to the proposed MFLs. The language contained in these rules was crafted to provide the WMDs the opportunity for adaptive management of allocated water uses, and the implementation of long-term recovery measures subsequent to the completion of the North Florida Regional Water Supply Plan. The WMDs and the Department expect that these rules will likely be revised after the North Florida Regional Water Supply Plan and associated recovery strategies are developed.

### **Phase II Regulatory Strategies**

The development of long-term strategies to address the impacts of regional groundwater trends and water use patterns is critical to achieving the recovery of minimum flows in the Lower Santa Fe Basin. As such, the Department, SRWMD, and SJRWMD, will develop long-term recovery measures concurrently with the development of the North Florida Regional Water Supply Plan. This will assist the Districts and the Department in refining the Recovery Strategies and future regulatory measures to address regional groundwater impacts to the Lower Santa Fe and Ichetucknee Rivers.

## 6.0 SUPPLEMENTAL REGULATORY MEASURES

1. Section 6.0 entitled “Supplemental Regulatory Measures” shall be adopted by the Department of Environmental Protection by rule pursuant to Section 373.042(4), F.S., as a component of the overall recovery strategy for the Lower Santa Fe and Ichetucknee Rivers and Associated Priority Springs MFLs. These rules shall be applicable within the boundaries of the SRWMD and that portion of the North Florida Regional Water Supply Planning Area (see Figure 6-1,) within the SJRWMD.



**Figure 6-1. North Florida Regional Water Supply Planning Area**

2. These rules provide additional criteria for review of consumptive use permit applications prior to the completion of the North Florida Southeast Georgia Regional Groundwater Flow Model and development of long-term recovery measures in the North Florida Regional Water Supply Plan (NFRWSP). Prior to the completion of the North Florida Southeast Georgia Regional Groundwater Flow Model, each District shall apply the best available modeling tools to evaluate permit applications and their potential impact to the MFLs in the Lower Santa Fe River Basin. Upon completion of the North Florida Southeast Georgia Regional Groundwater Flow Model, the

MFLs and these additional regulatory criteria shall be re-evaluated pursuant to Rule 62-42.300(1)(e), F.A.C.

3. In view of the statutory recognition in section 373.709(2)(a)2., F.S., that "...alternative water supply options for agricultural self-suppliers are limited," the Department recognizes that the districts may participate in developing offsets for proposed uses for the purposes of protecting the MFL water bodies consistent with the goals of the Recovery Strategy.
4. "MFL water bodies," when used in this section, shall mean the MFLs established for the Lower Santa Fe and Ichetucknee Rivers and Associated Priority Springs adopted in subparagraph 62-42.300(1)(a)–(c), F.A.C. "MFL water body" shall mean any one of the MFL water bodies described in this definition.
5. Additional Review Criteria for all Individual Permit Applicants:
  - a) Evaluation of Potential Impacts: All applications, including applications for renewals, modifications, and new uses, shall be evaluated for their potential impact on the MFL water bodies utilizing best available information. Potential impacts to the MFL water bodies shall be assessed based on potential changes to flow at the Lower Santa Fe River Ft. White Gage and the Ichetucknee River US Highway 27 Gage.
  - b) New Permits:
    - i. Applications that do not demonstrate a potential impact to the MFL water bodies shall be issued provided the applicant meets the conditions for issuance.
    - ii. Applications that demonstrate a potential impact to the MFL water bodies shall provide reasonable assurance of elimination or offset of the potential impact. Such applications shall be considered consistent with the Recovery Strategy, provided the applicant meets all other existing conditions for issuance.
  - c) Renewals and Modifications with Increased Allocations:
    - i. Applications that do not demonstrate a potential impact to the MFL water bodies based on the total requested allocation shall be issued provided the applicant meets the conditions for issuance.
    - ii. Renewal and modification applications that demonstrate a potential impact to the MFL water bodies based on the total requested allocation shall provide reasonable assurance of elimination or offset of that portion of the requested allocation that exceeds the existing allocation and that results in potential impacts to the MFL water bodies. Such applications shall be considered consistent with the Recovery Strategy and shall be issued a permit for a duration of no more than five years provided the applicant meets all other existing conditions for issuance. If the potential impacts of the total requested allocation to the MFL water bodies will be eliminated or offset, the five year permit duration limitation under this subparagraph shall not apply. Permits issued for a duration longer than five years must include the necessary actions to provide for elimination or offset of impacts of the total requested allocation to the MFL water bodies, and a schedule for implementation.
  - d) Renewals with No Increase in Allocations:
    - i. Applications that do not demonstrate a potential impact to the MFL water bodies based on the total requested allocation shall be issued provided the applicant meets the conditions for issuance.

- ii. Renewal applicants that demonstrate a potential impact to the MFL water bodies based on the requested allocation shall be considered consistent with the Recovery Strategy and shall be issued a permit for a duration of no more than five years provided the applicant meets all other existing conditions for issuance. If potential impacts to the MFL water bodies will be eliminated or offset, the five year permit duration limitation under this subparagraph shall not apply. Permits issued for a duration longer than five years must include the necessary actions to provide for elimination or offset of impacts to the MFL water bodies, and a schedule for implementation.
- e) Existing permitted uses: Existing permitted uses shall be considered consistent with the Recovery Strategy provided the permittee does not exceed its permitted quantity. Such permits shall not be subject to modification during the term of the permit due to potential impacts to the MFL water bodies unless otherwise provided for in rule revisions pursuant to Rule 62-42.300(1)(e), F.A.C. Nothing in this section shall be construed to alter the District's authority to enforce or modify a permit under circumstances not addressed in this provision.
- f) Nothing contained in this Section shall be construed to require a permittee in Florida to be responsible for recovery from impacts to an MFL water body from water users in Georgia, or in any case to be responsible for more than its proportionate share of impacts to an MFL water body that fails to meet the established minimum flow or level.

6. Additional Individual Permit Conditions:

- a) Permits within the boundaries of the SRWMD and that portion of the North Florida Regional Water Supply Planning Area within the SJRWMD that are issued for a duration of greater than five years shall be issued with the following permit condition:

Following the effective date of the re-evaluated Minimum Flows and Levels adopted pursuant to Rule 62-42.300(1)(e), F.A.C., this permit is subject to modification during the term of the permit, upon reasonable notice by the District to the permittee, to achieve compliance with any approved MFL recovery or prevention strategy for the Lower Santa Fe River, Ichetucknee River, and Associated Priority Springs. Nothing herein shall be construed to alter the District's authority to modify a permit under circumstances not addressed in this condition.

- b) Permits for agricultural use located within Columbia, Suwannee, Union, and Gilchrist Counties, and the portions of Baker, Bradford, and Alachua Counties within the boundaries of the SRWMD, shall include the following condition:

The permittee agrees to participate in a Mobile Irrigation Lab (MIL) program and allow access to the Project Site for the purpose of conducting a MIL evaluation at least once every five years.

## **7.0 MEASURING SUCCESS AND ADAPTIVE MANAGEMENT**

Due to the regional nature of the declining groundwater trends in the Upper Floridan aquifer, and their impact on the flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs, implementation of this Recovery Strategy will take place within the context of the existing IAA between the SRWMD, SJRWMD, and the Department. The Districts will coordinate implementation of this Recovery Strategy. By addressing local water resource impacts, in addition to regional groundwater trends, the Districts intend to achieve recovery and maintenance of minimum flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs in an expeditious and effective manner.

### **7.1 ASSESSMENT OF RECOVERY PROGRESS**

One of the most important parts of the Recovery Strategy is measurement of the results. Both the SRWMD and SJRWMD operate monitoring programs in conjunction with the USGS to monitor and analyze hydrologic data, including aquifer levels, streamflows, spring discharges, and lake levels. The WMDs will utilize existing monitoring networks to evaluate trends in the Lower Santa Fe and Ichetucknee Rivers and springs, and in groundwater levels in the region to measure the success of Recovery Strategy programs and projects. To assess the progress of the Recovery Strategy, the SRWMD will develop and use a set of metrics to measure hydrologic trends and the impacts of the Recovery Strategy components in the Lower Santa Fe River Basin.

#### **TRACKING RESOURCE RECOVERY**

Analysis of published flow data as a measurement of recovery progress provides a consistent method that can be repeated without the use of models as new flow data are published. However, as the MFLs were developed as flow duration curves based on streamflow data from the baseline period of 1933 to 1990, it can be problematic to compare a single year's streamflow data directly to the MFL flow duration curves which include 57 years of data. To better account for annual climatic variation, the SRWMD has developed a hydrologic screening method to evaluate trends in streamflows in the Lower Santa Fe and Ichetucknee Rivers using annual flow duration curves. This method is presented in **Appendix C**, which develops a MFL screening threshold that can be used on an annual basis to assess if flow trends are moving toward recovery. Utilizing the methodology presented in Appendix C and available hydrologic assessment tools, and the SRWMD will annually evaluate the recovery progress of the Lower Santa Fe and Ichetucknee Rivers and Priority Springs with regard to their MFLs.

#### **MEASUREMENT OF EFFICACY OF INDIVIDUAL RECOVERY PROGRAMS AND PROJECTS**

As water resource and water supply development projects are implemented as part of the Recovery Strategy, local hydrologic monitoring stations will be utilized, along with current modeling tools, to examine the hydrologic benefits of projects, particularly with regard to groundwater levels and streamflows. The WMDs will establish metrics to evaluate the efficacy of individual recovery programs and projects prior to implementation. Due to the hydrogeologic characteristics of the Lower Santa Fe River Basin, and year to year weather patterns, the effects of individual recovery programs and projects may not be immediately discernible in hydrologic readings at the streamflow gaging stations on the Lower Santa Fe and Ichetucknee Rivers. Furthermore, the fact that many recovery projects will be focused on improvements in regional or local groundwater levels means that there may be a lag time after implementation before improvements in streamflows can be assessed. As such, project performance metrics will be tailored to individual projects prior to implementation to assess their efficacy over time. This will allow the Districts to periodically gauge the success of individual

implemented projects as well as the direction of the overall Recovery Strategy; thereby providing a basis for targeting future funds and programs.

## **PERIODIC RECOVERY STRATEGY ASSESSMENT**

During the implementation of the Recovery Strategy, the Districts will conduct periodic general assessments of the Recovery Strategy and of the water resources within the Planning Region and the Lower Santa Fe River Basin. This periodic assessment will typically be conducted on a five-year timetable, and likely be included as a component of the District's Water Supply Assessments. These periodic assessments will assess the efficacy of the Recovery Strategy components implemented to date, and also examine regional trends in the potentiometric surface of the Upper Floridan aquifer, springflow and streamflow trends, and regional water use trends. The goal of these periodic assessments will be to provide direction and guidance to future recovery projects and programs, by incorporating new hydrologic assessment tools and examining trends in regional hydrologic conditions. For example, by the end of the first five-year Water Supply Assessment cycle (circa 2020), the metering programs for agricultural water users in SRWMD should provide sufficient data to re-examine agricultural use patterns, and may provide additional direction to new agricultural conservation programs. As such, periodic assessment of the Recovery Strategy will also provide an opportunity for the WMDs to examine the Recovery Strategy components with regard to future water use patterns within the Planning Region. Periodic assessment of Recovery Strategy components and resource recovery will enable the Districts to evaluate the efficacy of implemented regulatory approaches and recovery measures, and also provide a basis for adapting future recovery measures, water management decisions, and regulatory approaches to current hydrologic conditions and water use patterns.

## **7.2 ADDITIONAL INFORMATION GATHERING/FUTURE RESEARCH**

In addition to assessing the hydrologic status of the Lower Santa Fe and Ichetucknee River and priority springs, the SRWMD will continue to collect scientific and ecological data relating to these water bodies. The SRWMD recognizes that in some cases during MFL development, insufficient data was available to assess the relationship between streamflows and springflows and some biological characteristics of the river system. As such, the SRWMD will continue to identify potential data needs, and work with other agencies and organizations to develop additional scientific and biological data relating to these systems, to strengthen any future revisions to these MFLs. The SRWMD will continue to assess the latest scientific research to ensure that the adopted MFLs are protective of the Lower Santa Fe and Ichetucknee Rivers and their priority springs.

## **7.3 PUBLIC AND STAKEHOLDER PARTICIPATION**

Throughout the development and implementation of MFL recovery measures, the Department and the WMDs will seek input and participation from the interested stakeholders. As the planning component of this strategy is centered on the North Florida Regional Water Supply Plan, the NFRWSP will provide an excellent forum for stakeholder engagement. The WMDs also intend to engage the public and provide opportunity for comment and participation in the creation of long-term recovery strategies.

## **7.4 ADAPTIVE MANAGEMENT**

This Recovery Strategy is intended to provide general overview of the current initiatives the WMDs intend to implement and establish a path forward to develop long-term measures required to achieve

the recovery and maintenance of minimum flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs. Presently, numerous potential approaches that can contribute to resource recovery have been identified, and the Districts understand that flexibility will be an ongoing element of the Recovery Strategy process. New feasibility and pilot studies, updates to groundwater models, changes in funding programs, and the effectiveness of existing projects will guide implementation of the Recovery Strategy over time. Furthermore, the implementation of the North Florida Regional Water Supply Plan with the SJRWMD will provide more detailed strategies that will aid in the full recovery of the MFL water bodies and address the regional water supply issues which have impacted the Lower Santa Fe Basin.

The annual hydrologic evaluations and periodic Recovery Strategy assessments described in Section 7.1 will provide opportunities for the Districts to adapt to changing water resource and water use conditions. These evaluations will provide the opportunity to re-focus the components of the Recovery Strategy, prioritize projects and programs with successful outcomes and established funding sources, and minimize or end less successful efforts. The Districts will also update modeling tools, when feasible, to more accurately predict the anticipated effects and flow recovery for the various executed projects. Moreover, the continued coordination between the SRWMD, SJRWMD and the Department will facilitate the implementation of broader, regional water resource projects in the Planning Region. This recurring process of evaluation, coordination, and planning will allow the Districts to adapt to changes in water use patterns and needs throughout the Recovery Process, thereby meeting the goal of recovering and preserving minimum flows in the Lower Santa Fe and Ichetucknee Rivers and priority springs.

## 8.0 REFERENCES

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**TABLE A1: Estimated Streamflow Recovery Required for LSFR Basin MFLs**

Project Name	Location	Est. Project Volume (MGD)	Est. Impact to Santa Fe River Flow (MGD, at Fort White Gage)	Est. Impact to Ichetucknee River Flow (MGD, at Hwy 27 Gage)
Estimated Streamflow Recovery Required to Meet MFLs based on current water use patterns (2010)		NA	11.0	2.0
Projected Public Supply Water Use Increase SJRWMD Region 1 2030	SJRWMD	NA	6.5	0.6
Projected Non-Public Supply Water Use Increase SJRWMD Region 1 2030	SJRWMD	NA	1.3	0.1
City of Alachua Public Supply Demand Increase	Alachua County, FL	0.40	0.3	0.0
Archer Public Supply Demand Increase	Alachua County, FL	0.03	0.02	0.0
High Springs Public Supply Demand Increase	Alachua County, FL	0.11	0.08	0.0
Lake Butler Public Supply Demand Increase	Union County, FL	0.00	0.00	0.0
Lake City Public Supply Demand Increase	Columbia County, FL	0.72	0.14	0.06
Live Oak Public Supply Demand Increase	Suwannee County, FL	0.20	0.01	0.02
Newberry Public Supply Demand Increase	Alachua County, FL	0.19	0.14	0.0
Starke Public Supply Demand Increase	Bradford County, FL	0.09	0.01	0.0
SRWMD AG Increase	SRWMD	~ 0.0	~ 0.0	~ 0.0
SRWMD DSS Increase	SRWMD	~ 5.0	~ 1.0	~ 0.5
SRWMD CII Increase	SRWMD	~ 0.97	~ 0.02	~ 0.0
SRWMD REC Increase	SRWMD	~ 0.40	~ 0.07	~ 0.0
<b>TOTAL Recovery Targets (Est. Current Recovery + Future Demand)</b>		<b>NA</b>	<b>20.6</b>	<b>3.3</b>

Notes:

1. SRWMD Water Use Projections here represent the low range projections from the 2010 SRWMD Water Supply Assessment
2. SJRWMD Water Use Projections here represent the 5-in-10 year water use projections from the SJRWMD's 2013 Draft Water Supply Plan

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<b>TABLE A2: Conceptual Lower Santa Fe Basin Recovery Projects/Programs**</b>							
<b>Project Name</b>	<b>Location</b>	<b>Project Type</b>	<b>Est. Project Volume (MGD)</b>	<b>Est. Benefit to Santa Fe River Flow (MGD, at Fort White Gage)</b>	<b>Est. Benefit to Ichetucknee River Flow (MGD, at Hwy 27 Gage)</b>	<b>Est. Cost</b>	<b>Est. Cost-Benefit (\$/1000gal water savings)</b>
<b>Agricultural Water Conservation Potential: Efficiency Improvements ("Farms" - Row crops, irrigated pasture, fruit crops, etc.)</b>	Alachua, Bradford, Columbia, Gilchrist, Union, and Suwannee counties	Water Conservation	2.2 - 4.3	1.2 - 2.3	1.1 - 2.1	\$3,910,000	\$0.20
<b>Agricultural Water Conservation Potential: Efficiency Improvements (Plant Nurseries)</b>	Alachua, Bradford, Columbia, Gilchrist, Union, and Suwannee counties	Water Conservation	0.6 - 1.1	0.3 - 0.7	0.2 - 0.4	\$9,610,000	\$1.92
<b>Agricultural Water Conservation Potential: Phase II Irrigation Improvements ("Farms" - Row crops, irrigated pasture, fruit crops, etc.)</b>	Alachua, Bradford, Columbia, Gilchrist, Union, and Suwannee counties	Water Conservation	0.9 - 1.7	0.5 - 0.9	0.4 - 0.9	\$15,110,000	\$1.92
<b>Agricultural Water Conservation Potential: Phase II Irrigation Improvements (Plant Nurseries)</b>	Alachua, Bradford, Columbia, Gilchrist, Union, and Suwannee counties	Water Conservation	0.6 - 1.3	0.4 - 0.8	0.2 - 0.5	\$11,270,000	\$1.92
<b>Bradford Timberlands Flood Control and Water Resource Development Project</b>	Bradford County, Florida	Excess Streamflow Capture, Aquifer Recharge, Flood Control, potential Dispersed Water Storage Wetlands	0.5 - 0.9	0.1 - 0.9	0.0 - 0.01	\$1,690,000	\$0.33
<b>Bradford County Rayonier South Flood Control and Water Resource Development Project</b>	Bradford County, Florida	Stormwater Storage, Aquifer Recharge, Streamflow Augmentation, Dispersed Water Storage Wetlands	1.0 - 2.0	0.1 - 2.0	0.0 - 0.02	\$3,500,000	\$0.33
<b>Bradford County Dispersed Water Storage and Aquifer Recharge Projects</b>	Bradford County, Florida	Stormwater Storage, Aquifer Recharge, Dispersed Water Storage Wetlands	1.5	0.4	~ 0.0	\$750,000	\$0.10
<b>Lake Harris Aquifer Recharge Project</b>	Lake City, Columbia County, Florida	Aquifer Recharge, Flood Mitigation	0.3 - 0.6	0.03 - 0.06	0.1	\$250,000	\$0.08
<b>Conceptual Dispersed Water Storage Public-Private Partnerships</b>	Alachua, Gilchrist, Columbia, Suwannee, Bradford, Union Counties	Surface Water sources, Reclaimed Water	~ 4	~ 1.1	0.4	\$1,430,000	\$0.07
<b>Optimization of Regional Water Balance through Modified Silviculture Practices (Pilot Scale)</b>	Alachua, Gilchrist, Columbia, Suwannee, Bradford, Union Counties	Land Management Practices	~ 6	~ 1.8	0.3	\$2,440,000	\$0.07
<b>City of Alachua Reclaimed Water Aquifer Recharge Project</b>	City of Alachua, Alachua County, Florida	Reclaimed Water, Aquifer Recharge	0.5	- 0.02	0.001	\$800,000	\$0.31
<b>Alachua County Conceptual Reclaimed Water Recharge Projects</b>	Alachua County	Reclaimed Water, Aquifer Recharge	7.7	1.6	0.1	\$3,800,000	\$0.09
<b>Future Water Resource Development Concepts</b>	SRWMD	Water Resource Development	~ 4.0	~ 1.2	~ 0.2	\$36,390,000	\$2.00
<b>Subtotal</b>			<b>35.1</b>	<b>13.7</b>	<b>4.97</b>	<b>\$90,940,000</b>	<b>\$0.49</b>

\*\* Users seeking to develop offsets for proposed uses may elect to participate in the above listed recovery conceptual projects and programs.

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**TABLE A3: Future Potential Water Conservation: 2030\*\*\***

Project Name	Location	Project Type	Est. Project Volume (MGD)	Est. Benefit to Santa Fe River Flow (MGD, at Fort White Gage)	Est. Benefit to Ichetucknee River Flow (MGD, at Hwy 27 Gage)	Est. Cost	Est. Cost-Benefit (\$/1000gal water savings)
City of Alachua Public Supply Conservation	Alachua County, FL	Water Conservation	0.11 - 0.33	0.2	0.0	\$1,870,000	\$1.87
Archer Public Supply Conservation	Alachua County, FL	Water Conservation	0.03 - 0.03	0.02	0.0	\$20,000	\$0.27
High Springs Public Supply Conservation	Alachua County, FL	Water Conservation	0.04 - 0.11	0.08	0.0	\$590,000	\$1.96
Lake Butler Public Supply Conservation	Union County, FL	Water Conservation	0.03 - 0.04	0.01	0.0	\$40,000	\$1.77
Lake City Public Supply Conservation	Columbia County, FL	Water Conservation	0.32 - 0.66	0.13	0.05	\$3,930,000	\$2.67
Live Oak Public Supply Conservation	Suwannee County, FL	Water Conservation	0.10 - 0.20	0.01	0.02	\$50,000	\$0.10
Newberry Public Supply Conservation	Alachua County, FL	Water Conservation	0.05 - 0.15	0.11	0.0	\$610,000	\$1.39
Starke Public Supply Conservation	Bradford County, FL	Water Conservation	0.08 - 0.09	0.02	0.0	\$0	\$0.08
SRWMD CII Conservation Potential	SRWMD	Water Conservation	TBD	TBD	TBD	TBD	TBD
Agricultural BMPs - SJRWMD	SJRWMD portion of Alachua County	Water Conservation	0.3	0.14	0.0	\$1,500,000	\$0.96
Water-wise Florida Landscape - Inground: Alachua County	Alachua County, FL	Water Conservation	1.9	1.3	0.1	\$10,030,000	\$1.44
Targeted Residential Water Conservation BMPs: LDR Modifications - Alachua County	Alachua County, FL	Water Conservation	1.8	1.1	0.1	\$32,000	\$0.00
SJRWMD Region 1 Public Supply Conservation Potential	SJRWMD	Water Conservation	~ 20.0	1.4	0.0	\$36,690,000	\$1.28
SJRWMD Region 1 DSS and Small Public Supply Conservation Potential	SJRWMD	Water Conservation	3.0	0.21	0.0	TBD	TBD
SJRWMD Region 1 AG Conservation Potential	SJRWMD	Water Conservation	8.2	0.4	0.1	\$71,610,000	\$1.92
SJRWMD Region 1 CII Conservation Potential	SJRWMD	Water Conservation	1.6	0.11	0.0	TBD	TBD
<b>Subtotal</b>			<b>38.4</b>	<b>5.3</b>	<b>0.3</b>	<b>\$120,980,000</b>	<b>NA</b>

\*\*\* These and other water supply/restoration projects under development or consideration are a part of the water supply planning process or other MFL constraints, and may reduce groundwater withdrawals or provide ancillary benefits to the Upper Floridan Aquifer in the North Florida region and the Lower Santa Fe Basin. These and other concepts under development are not a component of the Recovery Strategy for the Lower Santa Fe Basin, but are provided here to demonstrate their potential ancillary benefits to the Lower Santa Fe MFL recovery efforts.

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**TABLE A4: Current Projects and Concepts with Benefits to Lower Santa Fe Basin: SRWMD\*\*\***

Project Name	Location	Project Type	Est. Project Volume (MGD)	Est. Benefit to Santa Fe River Flow (MGD, at Fort White Gage)	Est. Benefit to Ichetucknee River Flow (MGD, at Hwy 27 Gage)	Est. Cost	Est. Cost-Benefit (\$/1000gal water savings)
City of Waldo Water Meter Replacement	Alachua County, FL	Infrastructure Improvements	0.01	0.002	0.0	\$150,000	\$2.18
City of Alachua Water Conservation RIVER cost-share Project	Alachua County, FL	Water Conservation	0.05	0.038	0.0	\$60,000	\$0.22
City of High Springs Water Conservation RIVER cost-share project	Alachua County, FL	Water Conservation	0.02	0.012	0.0	\$60,000	\$0.68
Live Oak Golf Course Reuse Connection RIVER cost-share project	Suwannee County, FL	Reclaimed Water	0.1	0.004	0.008	\$20,000	\$0.04
City of Archer Wastewater Collection, Treatment & Reuse RIVER cost share project	Alachua County, FL	Reclaimed Water	0.14	0.09	0.004	\$14,400,000	\$19.66
Lake City Sprayfield Treatment Wetlands Project	Lake City, Columbia County, Florida	Reclaimed Water, Aquifer Recharge	3.0	~ 0.04	~ 0.06	\$4,600,000	\$0.30
Middle Suwannee Springs Restoration Project: Mallory Swamp Improvements - Phase II	Lafayette County, Florida	Aquifer Recharge, Dispersed Water Storage	~ 5.0	~ 0.25	~ 0.5	\$1,900,000	\$0.07
Lake City Municipal Airport Modification	Columbia County, FL	Stormwater Improvements, Increased soil percolation	~ 1.9	~ 0.4	~ 0.4	No Additional Cost - Existing Project	NA
Starke By-pass	Bradford County, Florida	Stormwater Improvements, Indirect Aquifer Recharge	TBD	TBD	TBD	No Additional Cost - Existing Project	NA
<b>Subtotal</b>			<b>10.2</b>	<b>0.8</b>	<b>1.0</b>	<b>\$21,190,000</b>	<b>\$0.40</b>

\*\*\* These and other water supply/restoration projects under development or consideration are a part of the water supply planning process or other MFL constraints, and may reduce groundwater withdrawals or provide ancillary benefits to the Upper Floridan Aquifer in the North Florida region and the Lower Santa Fe Basin. These and other concepts under development are not a component of the Recovery Strategy for the Lower Santa Fe Basin, but are provided here to demonstrate their potential ancillary benefits to the Lower Santa Fe MFL recovery efforts.

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**TABLE A5: Current Projects Concepts with Benefits to Lower Santa Fe Basin: SJRWMD\*\*\***

Project Name	Location	Project Type	Est. Project Volume (MGD)	Est. Benefit to Santa Fe River Flow (MGD, at Fort White Gage)	Est. Benefit to Ichetucknee River Flow (MGD, at Hwy 27 Gage)	Est. Cost	Est. Cost-Benefit (\$/1000gal water savings)
<b>Clay County Utilities: Postmaster Wellfield - Lower Floridan Aquifer Water Supply Wells***</b>	Clay County, Florida	Alternative Groundwater Supply	0.7	0.01	0.0	\$1,000,000	\$0.63
<b>Grandin Sand Mine - LFAS***</b>	Putnam County, Florida	Alternative Groundwater Supply	3	0.1	0.0	\$1,500,000	\$0.11
<b>Mid-Clay Reservoir project***</b>	Clay County, Florida	Reclaimed Water	NA	NA	0.0	\$5,500,000	NA
<b>Keystone Area Rapid Infiltration Basin System***</b>	Clay County, Florida	Aquifer Recharge, Reclaimed Water, Alternative Water Supplies	3 - 5	0.5	0.1	\$113,000,000	\$4.32
<b>GRU Smart Meter Program</b>	Alachua County	Water Conservation	0.1	0.07	0.0	\$100,000	\$0.19
<b>GRU – Innovation District</b>	Alachua County	Reclaimed Water	0.1	0.07	0.0	\$400,000	\$0.76
<b>GRU – Finely Woods</b>	Alachua County	Reclaimed Water	0.1	0.03	0.0	\$250,000	\$0.96
<b>GRU – Celebration Pointe</b>	Alachua County	Reclaimed Water	0.1	0.07	0.0	\$700,000	\$1.34
<b>Subtotal</b>			<b>8.6</b>	<b>0.8</b>	<b>0.1</b>	<b>\$123,650,000</b>	<b>\$2.74</b>
<b>TOTAL Benefits (Tables A2-A5)</b>			<b>92.3</b>	<b>20.6</b>	<b>6.4</b>		

\*\*\* These and other water supply/restoration projects under development or consideration are a part of the water supply planning process or other MFL constraints, and may reduce groundwater withdrawals or provide ancillary benefits to the Upper Floridan Aquifer in the North Florida region and the Lower Santa Fe Basin. These and other concepts under development are not a component of the Recovery Strategy for the Lower Santa Fe Basin, but are provided here to demonstrate their potential ancillary benefits to the Lower Santa Fe MFL recovery efforts.

Notes:

1. Costs presented represent estimated project costs at time of publication.
2. Costs presented were obtained from current project proposals or estimated based on unit rates of similar district projects.

## Appendix B

### Timeline for Recovery Strategy Implementation

	<i>Phase I</i>				<i>Phase II</i>				
<b>Planning</b>	2010 Water Supply Assessment	Formation of NFRWSP	<b>Create North Florida Regional Water Supply Plan.</b> Concurrently develop long-term recovery strategies to address regional impacts.		Continue Developing Long Term Recovery Strategies and Projects based on Current Hydrologic Conditions and Water Supply Needs				
<b>Projects</b>			Project Identification and Feasibility Analysis		Implement Alternative Water Supply and Water Resource Development Projects				
<b>Conservation</b>			Implement Preliminary Conservation Measures and Programs		Continue Implementing Programs to Achieve Long Term Conservation Goals				
<b>Regulatory</b>			Implement Preliminary Regulatory Measures		Implement Long Term Regulatory Measures				
<b>Funding/Cost Share Programs</b>			Implement Cost-Share Programs in Lower Santa Fe Basin. Seek Funding Sources and Cost-Share Partnerships		Seek Funding Sources and Cost-Share Partnerships. Utilize Cost Share Programs to Achieve Conservation Goals				
<b>Water Resource Monitoring</b>	Use Monitoring Data from Lower Santa Fe Basin Water Resources to Direct Recovery Measures				Maintain and Expand Monitoring Program as Needed in Lower Santa Fe Basin to Direct Recovery Measures				
	2010	2011			2015				

	<b><i>Phase II, continued</i></b>								
<b>Planning</b>	<b>5 Year Water Supply Assessment &amp; Strategy Evaluation</b>	Continue Developing Long Term Recovery Strategies and Projects based on Current Hydrologic Conditions and Water Supply Needs			<b>5 Year Water Supply Assessment &amp; Strategy Evaluation</b>	Continue Developing Long Term Recovery Strategies and Projects based on Current Hydrologic Conditions and Water Supply Needs			
<b>Projects</b>	Implement Alternative Water Supply and Water Resource Development Projects				Implement Alternative Water Supply and Water Resource Development Projects				
<b>Conservation</b>	Continue Implementing Programs to Achieve Long Term Conservation Goals				Continue Implementing Programs to Achieve Long Term Conservation Goals				
<b>Regulatory</b>	Implement Long Term Regulatory Measures				Implement Long Term Regulatory Measures				
<b>Funding/Cost Share Programs</b>	Seek Funding Sources and Cost-Share Partnerships. Utilize Cost Share Programs to Achieve Conservation Goals				Seek Funding Sources and Cost-Share Partnerships. Utilize Cost Share Programs to Achieve Conservation Goals				
<b>Water Resource Monitoring</b>	Maintain and Expand Monitoring Program as Needed in Lower Santa Fe Basin to Direct Recovery Measures				Maintain and Expand Monitoring Program as Needed in Lower Santa Fe Basin to Direct Recovery Measures				
	2020				2025				

	<b><i>Phase II, continued</i></b>									
<b>Planning</b>	<b>5 Year Water Supply Assessment &amp; Strategy Evaluation</b>	Continue Developing Long Term Recovery Strategies and Projects based on Current Hydrologic Conditions and Water Supply Needs			<b>5 Year Water Supply Assessment &amp; Strategy Evaluation</b>	Continue Developing Long Term Strategies and Projects to Maintain Water Resources based on Current Hydrologic Conditions and Water Supply Needs				
<b>Projects</b>	Development Projects				Supply Needs and MFL Requirements					
<b>Conservation</b>	Conservation Goals					Conservation Goals				
<b>Regulatory</b>	Implement Long Term Regulatory Measures				Implement Long Term Regulatory Measures					
<b>Funding/Cost Share Programs</b>	Seek Funding Sources and Cost-Share Partnerships. Utilize Cost Share Programs to Achieve Conservation Goals				Maintain Funding and Partnerships for ongoing Conservation Efforts					
<b>Water Resource Monitoring</b>	Maintain and Expand Monitoring Program as Needed in Lower Santa Fe Basin to Direct Recovery Measures				Maintain and Expand Monitoring Program as Needed in Lower Santa Fe Basin to Direct Recovery Measures					
	2030					2035				

## APPENDIX C

### Annualized Flow Duration Curves: Methods for Assessing MFL Recovery

#### Introduction

In order to assess if flow trends are moving towards recovery, there is a need for a tool that allows comparison of different flow regimes during different periods of record, yet retains measures of the intra-annual variability in the systems. Flow Duration Curves, as described below, are one such tool. The SRWMD will utilize Flow Duration Curves (FDCs), based on the method described in this appendix, for tracking recovery of the Lower Santa Fe and Ichetucknee rivers and as a statistical tool in assessing if flow trends are moving toward recovery of MFLs. This appendix describes the background and development of this assessment tool for these two rivers.

#### Traditional Flow Duration Curves

Traditional FDCs are a convenient tool for visualization, simplification, and comparison of streamflow data. Searcy (1959) notes that the curves are cumulative frequency curves “combining in one curve the flow characteristics of a stream throughout the range of discharge.” FDCs have had “wide-spread application” and a “long history” in a variety of hydrologic studies including in-stream flow assessments (Vogel & Fennessey, 1995).

The vertical axis of a FDC is the streamflow rate in cubic feet per second (cfs) and the horizontal axis is the proportion of time flow is equaled or exceeded, sometimes termed the exceedance. The calculation of exceedance commonly used (and used here) is the Weibull plotting position (Jacobs & Ripo, 2002) expressed as a decimal. As can be observed in Figures 1 and 2, FDCs are constructed by sorting all of the daily data, from highest to lowest and assigning the exceedance. The highest flow in the record corresponds to the lowest exceedance probability flow; the lowest flow in the record corresponds to the highest exceedance probability flow.

FDCs show the proportion of time specified discharges were equaled or exceeded for a continuous record in a given period. For example, **Figure 1** provides the hydrograph and FDC of the daily mean flow of the Santa Fe River near Fort White during the period 1932 to 2012. From that FDC, it can be shown that the daily mean flow at that point on the river was at least 885 cfs, 90 percent of the time during the period of record. (**Figure 2** similarly provides the hydrograph and FDC for the Ichetucknee River at the Highway 27 gage). However, flow duration curves are influenced by the period of record used in their creation, exhibiting sensitivity to the period of record in the “tails,” but they are useful for comparison purposes between different scenarios over the same time period.

Flows and/or exceedances of interest can be plotted on the FDC. For example, the magnitude of a spring is of common interest to the public and is used in MFL priority list development. An exceedance probability of 0.5 (the median) is used to determine spring magnitude (Florida Geological Survey, 2005).

Given the characteristics of the rivers and the available flow data, MFLs have been developed at two USGS gages and plotted as FDCs (see MFL Technical Report). These gages are the Santa Fe River near Fort White (Fort White) and the Ichetucknee River at Highway 27 near Hildreth (HWY27).

## Period of Record Flow Duration Curve vs. Annual Flow Duration Curve

*Note: The following section is adapted from Jacobs and Ripo (2002).*

Traditionally, FDCs have been constructed by simply ranking all streamflows  $q_i$  over the period-of-record (Searcy 1959) from largest to smallest,  $q_1, q_2, \dots, q_S$  where  $S$  is the total number of streamflows and  $q_i > q_{i+1}$ . Each streamflow quantity has a corresponding exceedance  $p_i = i/(S+1)$  using the Weibull plotting position. If an FDC is constructed using period-of-record streamflows (termed here a PFDC), then one interprets the exceedance as the reliability of streamflow exceeding some level over the period of record.

Alternatively, one can construct an annual-based FDC (AFDC) that represents the exceedance probability or reliability of streamflow exceeding some minimum level in a design year (see Vogel and Fennessey, 1994). The AFDC provides a different graphical tool to illustrate the quantity and frequency of streamflow available in a river basin. The AFDC, as compared to the traditional period-of-record (POR) flow duration curve, has a robust statistical interpretation of streamflow that allows for the determination of high and low flow AFDCs and their annual yield with a specified recurrence interval  $T$  ( $T$ -year return period). The AFDC is constructed by developing a FDC for each of the  $N$ -years of data by rank ordering each year's 365 discharge values. The AFDC is constructed from the  $N$ -year series of annual FDCs using a specified probability (e.g., the mean or the median) for each of the 365 sets of values.

**Figures 1 and 2** show the PFDCs and the median AFDCs for Fort White and HWY27, respectively. **Figures 3 and 4** show the 2-year (median) and 10-year flood and drought AFDC curves for Fort White and HWY27, respectively. The 10-year flood curve corresponds to the  $p = 0.10$  probability. The 10-year drought curve corresponds to the  $p = 0.90$  probability.

## Use of Annual Flow Duration Curves to Assess Flow Trends

The SRWMD selected a 20-year moving AFDC statistic for use in MFL trend assessment. Using a 20-year moving AFDC statistic provides a methodology for District staff to compare annual streamflow data to the MFL, and evaluate the trends in streamflow recovery on an annual basis, while minimizing year to year climate variations. Based on assessment of multiple "windows" in time, including 5- and 10-year estimates, SRWMD staff determined that a 20-year period is long enough to provide a stable estimate without significant potential for "false positives" the shorter periods produced, due to short term climate fluctuations.

The assessment tool is constructed by first obtaining the 20-year moving median AFDCs of the Baseline period (Water Years 1933-1990) from the MFL time series. Figures 5 and 6 show these AFDCs for the Fort White and HWY27 respectively (gray lines). Then, the  $T$ -year AFDCs (from the complete baseline individual year data, not the 20-year medians) were found that completely bound the set of 20-year median AFDCs (the median AFDC for the Baseline period is also shown for completeness). These  $T$ -year AFDCs which are the lower bound for Baseline MFL data represent the lower limit beyond which the AFDC for any subsequent 20-year period in the flow record should not fall if the river is meeting the MFL (assuming similar climatological conditions). These lower bound AFDCs for the MFL data, represent a hydrologic threshold, hereafter referred to as the lower MFL screening threshold, for annual comparison of streamflow data to the MFL.

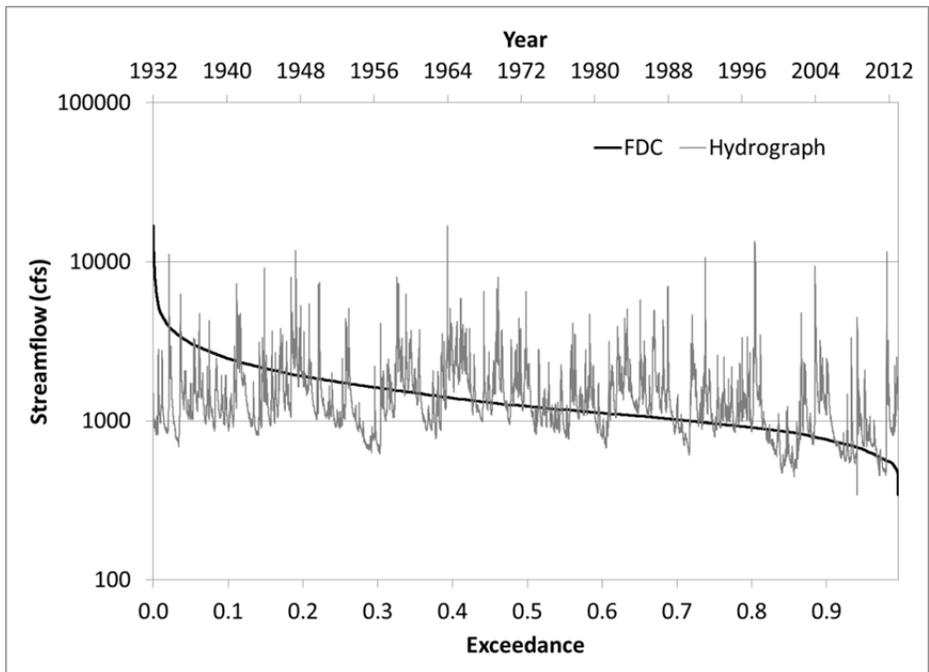
SRWMD staff utilized this method to develop the lower MFL screening threshold for the Lower Santa Fe and Ichetucknee Rivers, as shown in **Figures 5 and 6**. In this case, the return period

for the lower MFL screening threshold AFDC was the 2.7-year AFDC for the Lower Santa Fe River, and the 3.8-year AFDC for the Ichetucknee River. These lower MFL screening thresholds are illustrated by the red line in Figures 5 and 6, which demonstrate how the lower MFL screening threshold AFDC for each river provides a lower bound for the 20 year AFDCs for the MFL Baseline data. As previously stated, in subsequent years after the baseline period, it would be expected that the 20-year AFDC of observed streamflows for each year after the Baseline period would be above the lower MFL screening threshold if the river is meeting the MFL, assuming similar long term climate conditions. Similarly if several years of new 20-year AFDCs fall below the lower MFL screening threshold, and exhibit a declining trend, then there is potential that the river is not meeting the MFL, and further assessment of streamflows and climate conditions would be required to determine the river's status.

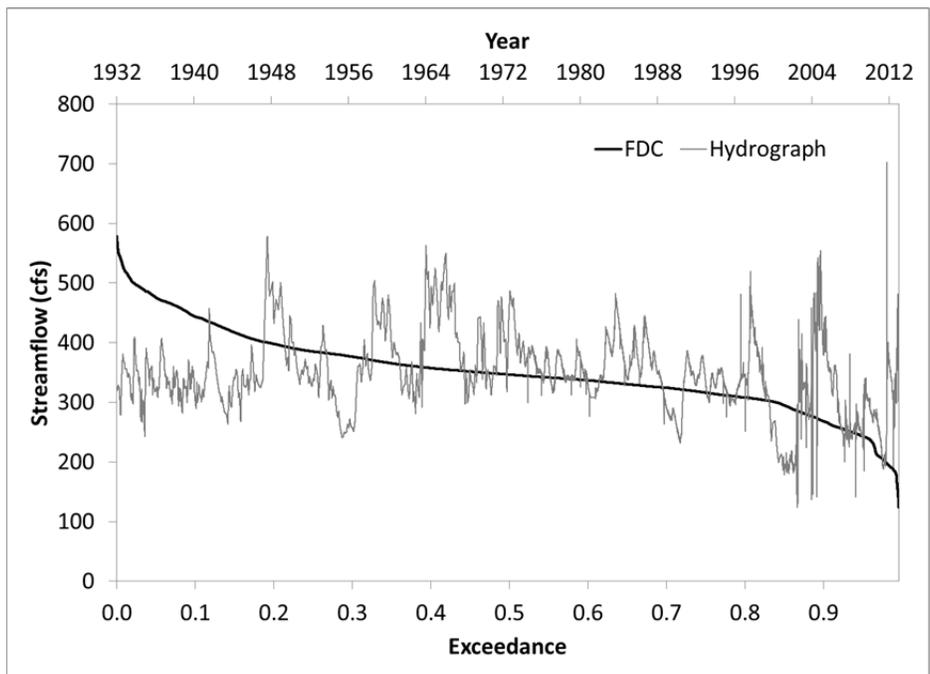
To illustrate how the SRWMD will use the lower MFL screening threshold, Figures 7 and 8 show the lower MFL screening threshold for the Lower Santa Fe and Ichetucknee Rivers, respectively, along with one 20-year AFDC from the post-Baseline period (in this case 1991 to 2010). Each of these 20-year AFDCs is below the lower MFL screening threshold, indicating that there is potential that the rivers are not meeting their MFLs. This matches the conclusion of the assessment of the status of these rivers in the establishment of the MFLs. When evaluating these rivers with regard to their MFLs, the District will examine multiple, sequential 20-year AFDCs, to gage the overall trends in streamflows with regard to the MFLs. When the 20-year condition increases to the MFL metric AFDC, the system is trending toward recovery. Similarly, when recovery is achieved in the future, it is expected that each 20-year AFDC will be above this screening threshold.

In addition to examining the overall ADFC, the District will also examine various exceedances along the ADFCs to assess trends in low flows, median flows, and high flows over time. As an example, **Figures 7 and 8** illustrate the 0.5 (median) and 0.9 (a low flow) exceedance conditions over several consecutive 20-year AFDCs. The horizontal lines are 0.5 and 0.9 exceedance flows taken from the lower MFL screening threshold, and the plotted points illustrate the overall trend in the 0.5 and 0.9 exceedance flows for several 20-year AFDCs ending in recent years. These points exhibit a slight declining trend for both rivers, as would be expected considering that the rivers are not meeting their MFLs. As recovery projects are implemented and hydrologic conditions in the Lower Santa Fe basin improve, it would be expected that these points would gradually begin to trend upward toward the flow metric taken from the lower MFL screening threshold.

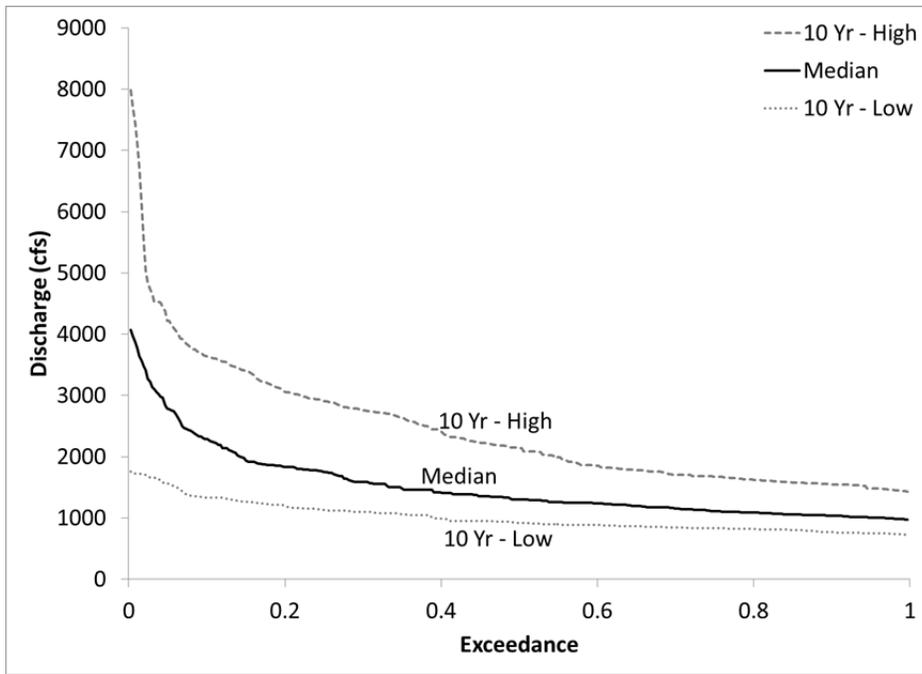
Utilizing AFDCs to create the lower MFL screening thresholds provides an important tool for the SRWMD to assess the status of the Lower Santa Fe and Ichetucknee River on a recurring annual basis. The method is based on actual data as opposed to modeling, and provides a simple metric to compare the trends in streamflows to the MFL. It should be noted that one limitation of this method is that it assumes that future climate conditions will be similar to the baseline period of 1933-1990. As discussed in the MFL Technical Document, this baseline data represents the best available information, and the duration of hydrologic data records is a limitation of nearly all hydrologic analysis. The SRWMD intends to utilize this AFDC tool as a hydrologic screening threshold and a method to evaluate trends in future streamflows with regard to the MFL. The SRWMD will also continue to utilize the best available tools, streamflow data, and climate records to evaluate the status of the Lower Santa Fe and Ichetucknee Rivers and associated priority springs with regard to their MFLs.



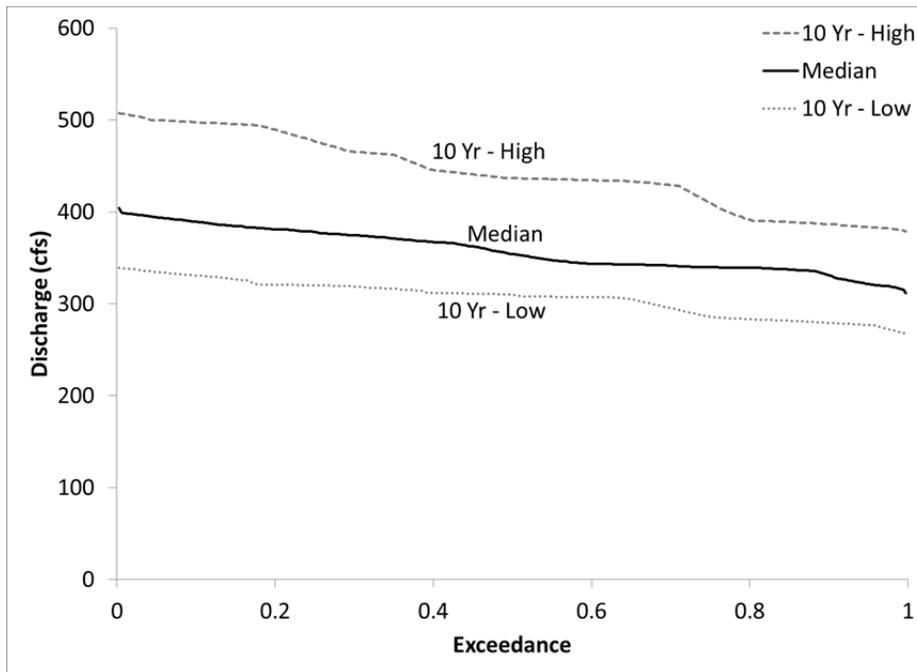
**Figure 1. Comparison of the period-of-record hydrograph of the Lower Santa Fe River near Fort White with its period-of-record flow duration curve.**



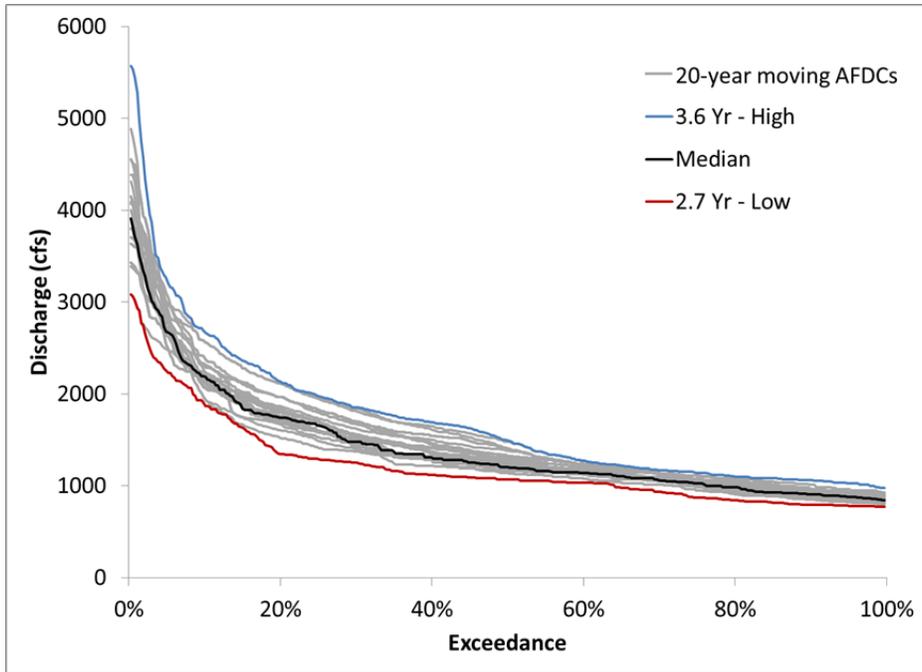
**Figure 2. Comparison of the period-of-record hydrograph of the Ichetucknee River at Highway 27 Hildreth with its period-of-record flow duration curve.**



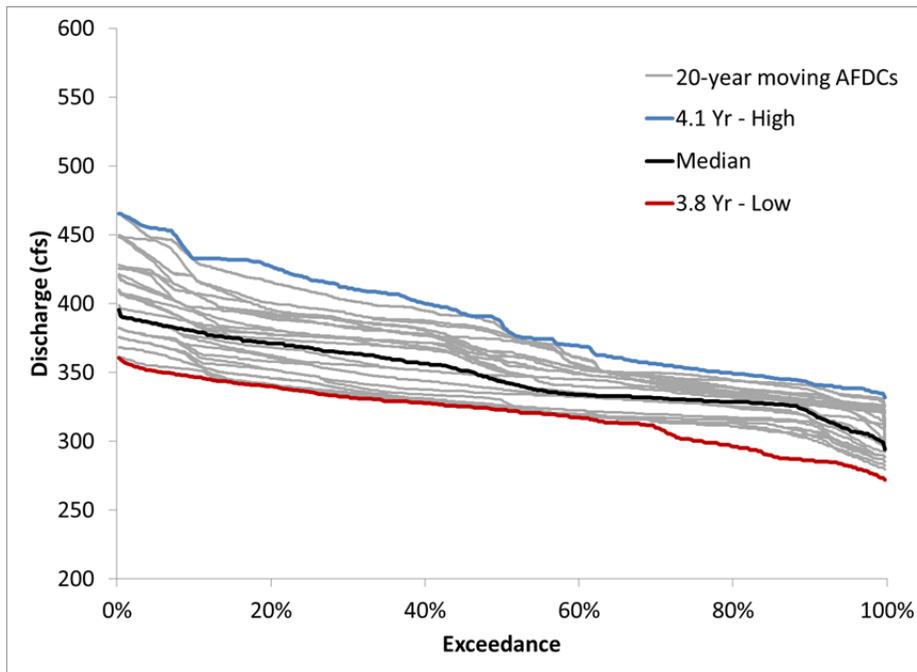
**Figure 3. Annual Flow Duration Curves for the Lower Santa Fe River near Fort White.**



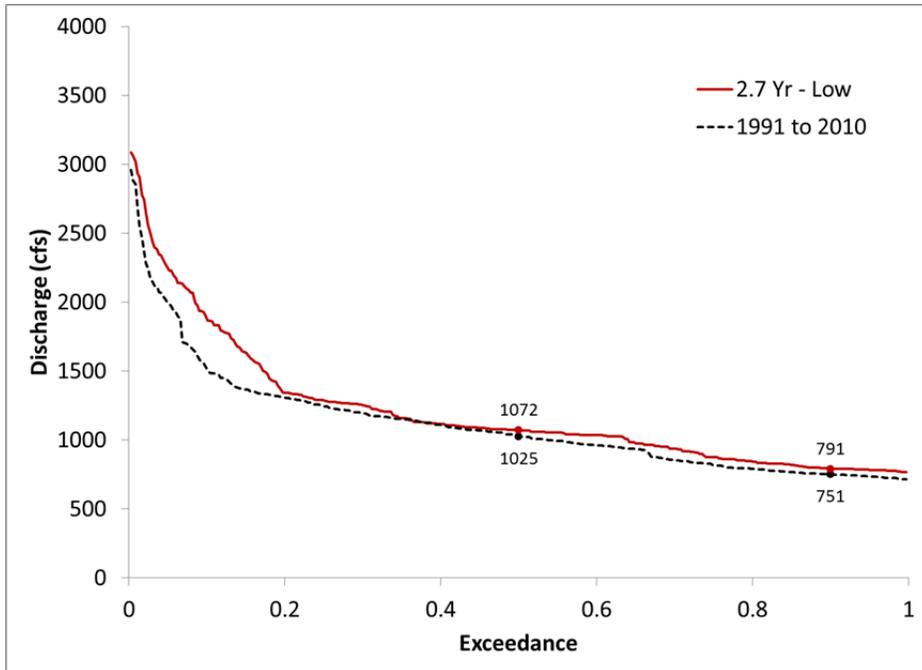
**Figure 4. Annual Flow Duration Curves for the Ichetucknee River at Highway 27.**



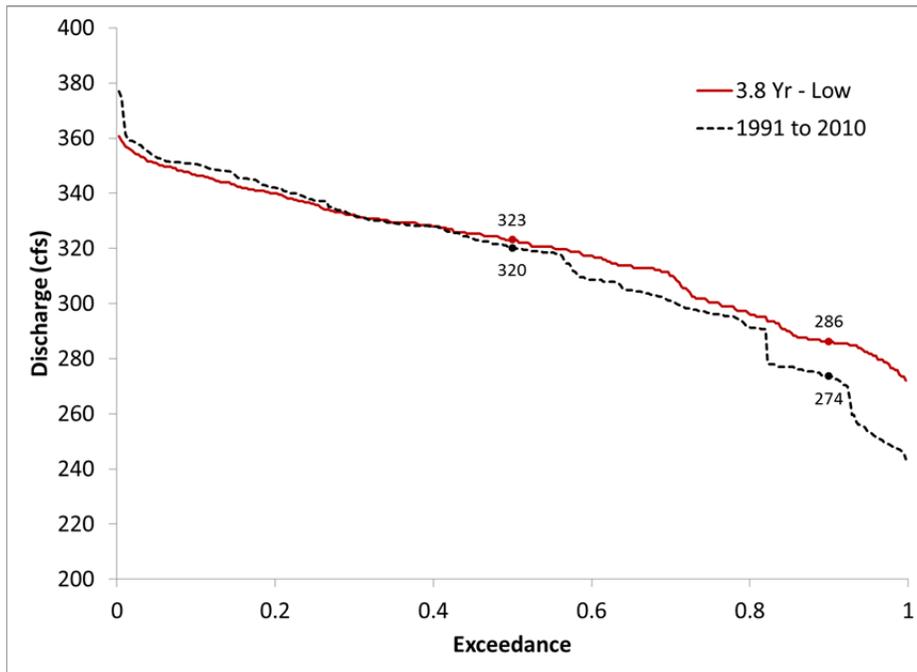
**Figure 5. Median and Bounding T-year Annual Flow Duration Curves superimposed on the Individual 20-Year moving Annual Flow Duration Curves for the Lower Santa Fe River near Fort White.**



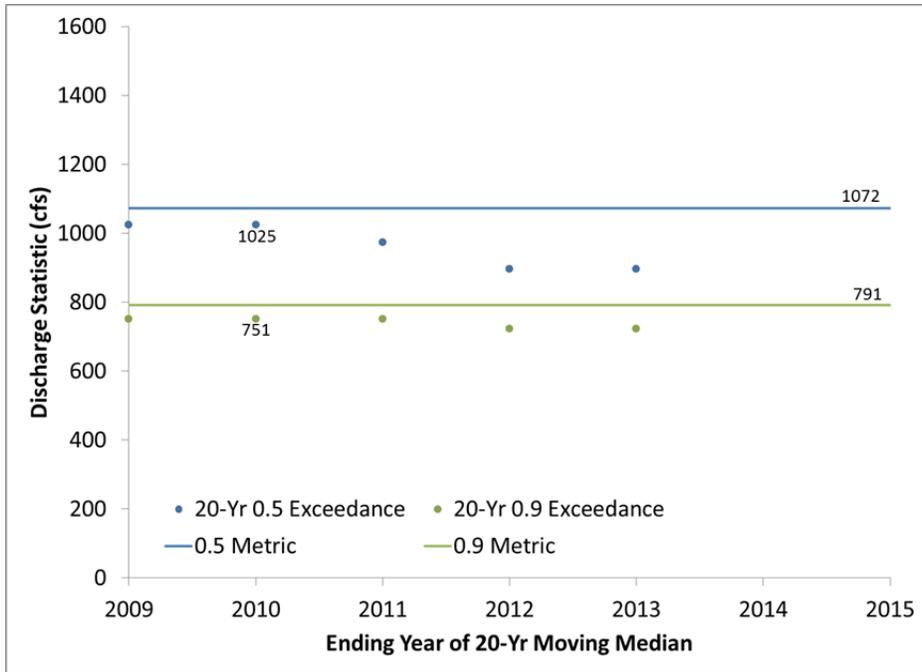
**Figure 6. Median and Bounding T-year Annual Flow Duration Curves superimposed on the Individual Annual Flow Duration Curves for the Ichetucknee River at Highway 27.**



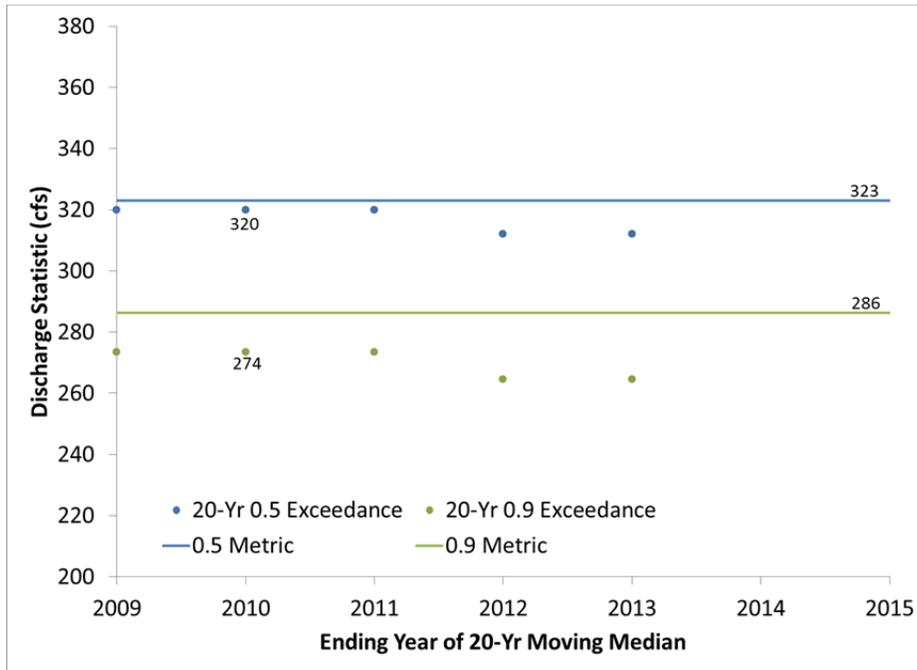
**Figure 7. Lower MFL Screening Threshold and 20-Year moving Annual Flow Duration Curve for the Lower Santa Fe River near Fort White.**



**Figure 8. Lower MFL Screening Threshold and 20-Year moving Annual Flow Duration Curve for the Ichetucknee River at Highway 27.**



**Figure 9. Assessment Tool for the Lower Santa Fe River near Fort White.**



**Figure 10. Assessment Tool for the Ichetucknee River at Highway 27.**