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UPPER ST. JOHNS RIVER BASIN PROJECT
INTERIM ENVIRONMENTAL WATER MANAGEMENT PLAN

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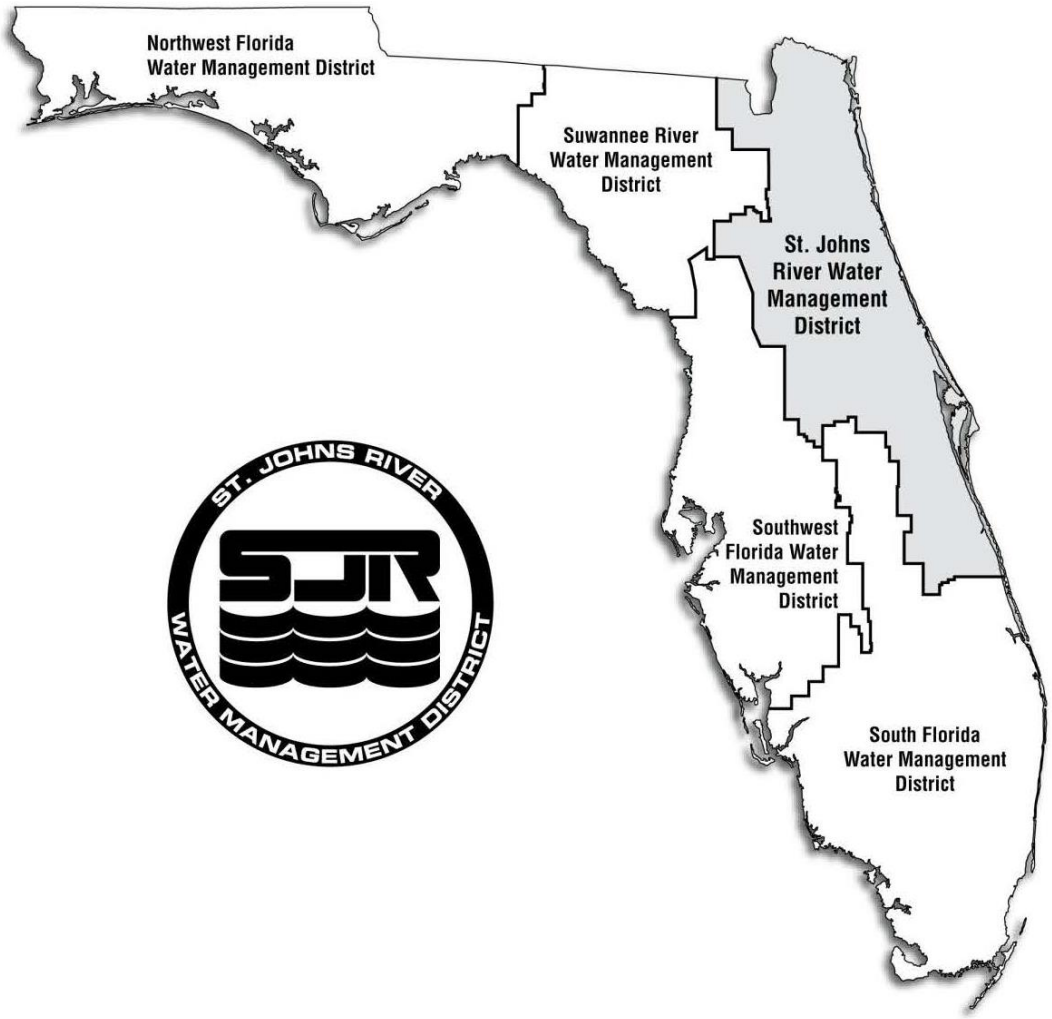

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EXECUTIVE SUMMARY

The Upper St. Johns River Basin Project (USJRBP), a federal flood control project funded jointly by the U.S. Army Corps of Engineers (USACE) and the St. Johns River Water Management District (SJRWMD), extends approximately 40 miles from Indian River County north of the Florida Turnpike to Lake Washington in central Brevard County. The project includes over 100 miles of federal and SJRWMD flood protection levees, seven major gated spillway structures, and numerous, smaller water control structures. While the primary purpose of the USJRBP is flood control, the project also improves basin water quality, provides a water supply source, protects basin natural resources, and provides outdoor recreational opportunities.

Project features of the USJRBP include two water management areas, four marsh conservation areas, and two water retention/detention areas. All project areas store stormwater runoff to provide flood protection. However, when not being used for stormwater storage, individual project area purposes vary. For example, water management areas primarily segregate and improve poor quality runoff and discharges from adjacent agricultural and urbanized lands and provide water supply for irrigation and freeze protection. Marsh conservation areas preserve and protect extant basin wetland habitats and provide water to augment dry season flows in the river. Retention/detention areas are managed by other state agencies as wildlife habitat. Adjacent to the USJRBP, SJRWMD also constructed, or is planning to construct, four new water management areas that lie outside the federal levee system. These areas will serve to improve the quality of runoff water diverted to the basin and provide water supply benefits. All management areas, both within and outside the federal project footprint, provide valuable fish and wildlife habitat and support outdoor recreational opportunities (e.g., fishing, hunting, boating, birding) and contribute to USJRBP goals.

Flood control regulation schedules developed by USACE delimit the amount of stormwater that can be stored in the USJRBP[1]. When water levels exceed a project area regulation schedule (known as Zone A), downstream discharges must be initiated. These discharges occur until water levels fall below the regulation schedule (Zone B). When water levels are below the regulation schedules in Zone B, USACE has given SJRWMD authority to modify discharges to meet other project purposes. Zone B discharges can be made entirely at the discretion of SJRWMD. However, to describe operational guidelines that will regulate baseline Zone B discharges, SJRMWD has developed this Environmental Water Management Plan (EWMP). The EWMP will be attached as an appendix to the U.S. Army Corps of Engineers St. Johns River Upper Basin Master Water Control Manual (MWCM), which is the federal document that guides flood control operations. The EWMP is important because it provides the basis for predicting environmental impacts of the USJRBP, which is a

[1] USACE 1985. Central and Southern Florida Project for flood control and other purposes. Part III. Upper St. Johns River Basin and related areas Supplement 2. General design memorandum, Upper St. Johns River Basin. Jacksonville, Florida,

requirement of the National Environmental Policy Act (NEPA). Given the magnitude of changes that have occurred in the USJRB since the original General Design Memorandum and Environmental Impact Statement (EIS) was released in 1986, the need for updated NEPA documentation is anticipated after the release of the final MCWM and will include either a final post-project construction environmental assessment, or an updated EIS.

The EWMP describes Zone B discharges that optimally meet water supply, water quality, and environmental goals of the USJRBP. SJRWMD, however, retains the flexibility to modify these Zone B discharges to accommodate future water supply needs or to further protect water quality or the environment. Environmental goals of the USJRBP center on preserving and protecting extensive basin wetland habitats, which in turn, should protect overall plant and animal species diversity and abundance. Ninety-four endangered, threatened, or rare species have been documented to occur within the project area. To meet SJRWMD's core mission of protecting and enhancing natural systems, including basin wetland habitats, the EWMP focuses on re-creating natural hydrologic conditions under which these systems evolved. Water quality goals are achieved primarily by sequestering nutrients in water management and designated wetland treatment areas, while water supply objectives are currently met by providing for surface water withdrawals from the water management areas and, through dry season low-flow discharges to the river, from both water management and marsh conservation areas.

An interim EWMP, which was initially completed in 1996 and revised in 2003, guided Zone B operations in the USJRBP through 2016. However, in recent years, hydrologic models used to set Zone B discharges have significantly improved, additional non-federal project areas have been added, water supply demands have shifted, and new information has become available on how hydrology affects water quality and basin ecology. To reflect updated information, a revised EWMP was drafted and used to guide Zone B operations beginning in 2017. USACE is scheduled to complete its final MWCM within the next several years. This version of the EWMP will be attached as an appendix to the final MWCM. The EWMP will be attached as an appendix, rather than being incorporated into the overall manual, to allow Zone B management changes to be made without necessitating extensive federal review and authorization to modify the MWCM. The EWMP is meant to be an adaptive document that can be easily modified as new information becomes available and basin water management activities in non-federal project areas evolve. Although this document provides brief physical descriptions of new SJRWMD-funded water management areas that lie outside the federal project footprint, Zone B operational plans and environmental performance assessments are provided only for federal project areas.

To describe hydrologic goals, numerical environmental hydrologic criteria (EHC) have been established for each federal project area. Due to differences in topography, soils, perimeter levee configurations, plant communities, and project area purposes, a single set of EHC cannot be applied to all project areas. The EHC provide optimal flooding depths and durations, details on the timing and extent of annual water level fluctuations, desired return frequencies of extreme flooding and drying events, minimum water levels for lakes, and limits on water level recession rates. To best meet environmental goals, hydrologic

conditions should fall within the boundaries delineated by all the various EHC, simultaneously. The EHC should be viewed with a long-term (30+ year) perspective to account for the natural variability inherent in the long-term hydrologic cycles to which the ecosystem has adapted. The EHC are like Minimum Flows and Levels (MFLs) with two important differences: 1) MFLs define a level associated with significant ecological harm whereas, EHC attempt to delimit optimal hydrologic conditions to serve as targets for water management and, 2) violation of the EHC do not initiate regulatory actions. Given the multiple purposes of many project areas, it is expected that not all EHC for a project area will necessarily be met in their entirety. However, comparing observed hydrologic conditions to the EHC provides a valuable tool for assessing the ecological performance of the USJRBP and for evaluating effects of future proposed deviations in Zone B discharges.

Zone B discharge schedules for each federal project area were developed using simulated hydrologic data derived from the Upper Basin Hydrologic Model. The model primarily used historic daily rainfall data for a 34-year period (1975–2008) to calculate simulated daily water levels. Through an iterative process, numerous discharge scenarios were modeled to derive a Zone B discharge schedule for each project area that resulted in predicted water levels that most closely met the EHC, while still meeting water supply and water quality goals. Those discharge schedules are included in this plan. All elevations in this report are presented in feet relative to the North American Vertical Datum of 1988 (NAVD88). The EWMP is intended to be used in an adaptive management framework and should be routinely updated to reflect new information. Project water levels should be monitored closely to ensure the accuracy of hydrologic model predictions considering the inherent uncertainty associated with the use of hydrologic modeling to predict dry season water levels. Inaccuracies in model predictions, new information on ecosystem responses to hydrology, changing water supply demands, or a need for further water quality improvements could necessitate future modifications to this plan.

Flood control and Zone B structure operations are the responsibility of the SJRWMD Projects Division, Bureau of Operations and Maintenance. Zone B operations are also coordinated with various other staff in the Divisions of Water and Land Resources and Water Supply Planning and Assessment. Staff in the Water and Land Resources Division, Bureau of Water Resources, are responsible for tracking performance of the USJRBP toward meeting hydrologic targets presented in the EWMP and for coordinating any future proposed long-term changes to Zone B operation schedules. In addition, Water Resource Bureau staff are responsible for tracking day-to-day Zone B operations in cooperation with the Operations Engineer.

ZONE B STRUCTURE OPERATIONS FOR USJRBP PROJECT AREAS

FORT DRUM MARSH CONSERVATION AREA (FDMCA) – All downstream discharges through the FDMCA S-252 structures A, B, and C, will occur as per the MWCM. During the months of February, March, April, and May, structure S-252D will be fully open to allow discharges from the FDMCA to the BCWMA. In all other months, S-252D will be closed. Should rainfall during the months February–May create conditions that warrant discharges from the St. Johns River Improvement District (SJID) reservoir to the BCWMA, S-252D will

be closed. S-252D will re-open after discharges from the SJID cease. Occasionally, water levels in the C-52 canal may exceed water levels in the FDMCA causing backflow through S-252D. Generally, backflow conditions are indicated whenever water level in the C-52 canal is at least 0.2 ft. higher than water levels in the FDMCA. If backflow conditions exist, S-252D will be closed.

BLUE CYPRESS MARSH CONSERVATION AREA (BCMCA) – The S-250 (A-E) culvert structures will provide for Zone B flows to the SJMCA without supplemental discharges through major discharge structure S-96C. To reduce the risk of fish kills downstream of S-96C following cessation of flood control releases, S-96C will be closed 20% per day for five consecutive days after, or just before, the regulation schedule is reached.

KENANSVILLE LAKE – Zone B discharges from Kenansville Lake to the SJMCA occur through structure S-250D. Additional Zone B discharges from Kenansville Lake could occur through culvert structures S-250E, however, none are proposed at this time.

BLUE CYPRESS WATER MANAGEMENT AREA (BCWMA) – Structure S-251 is open except when stage in BCWMA-West is higher than stage in BCWMA-East. When water levels in the St. Johns Water Management Area (SJWMA) fall to 19.8 ft or below and water levels in the BCWMA exceed 21.7 ft, 300 cubic feet per second (cfs) will be discharged from the BCWMA into the SJWMA through S-96D. This 300 cfs discharge will continue until water levels in the SJWMA rise to 21.3 ft or water levels in the BCWMA fall to 21.6 ft. When either of these conditions occurs, S-96D will be closed. If after S-96D is closed, water levels in the BCWMA continue to decline and subsequently fall below 21.4 ft, then S-96D will be re-opened to discharge 300 cfs for an additional 25 days or until water levels in BCWMA fall below 20.0 ft. When either of these conditions are met, all discharges from S-96D will cease. If after the primary, but no secondary, release has been made and water levels recover to exceed 21.7 ft in BCWMA and 20.5 ft in SJWMA, then the releases are "re-set", and no secondary release will be considered until such time that the trigger for the primary release has been reached again.

ST. JOHNS WATER MANAGEMENT AREA (SJWMA) – No Zone B discharges through S-96B are proposed. This optimizes the use of the SJWMA both as a water supply source and as a water quality treatment area. However, to reduce the risk of fish kills downstream of S-96B following flood releases, S-96B will be closed 20% per day for five consecutive days after or just before the regulation schedule is reached.

THREE FORKS MARSH CONSERVATION AREA (TFMCA) – One of the two, 60-inch culverts at S-257 will be fully opened whenever water levels in the TFMCA exceed 18.6 ft and water is flowing over the S-257 weir. Discharge through the S-257 culvert will continue until water levels in the TFMCA fall to 17.6 ft, at which time discharges through the culvert will be reduced 20% per day over a period of five days until the culvert is closed. The culvert will remain closed until water, once again, rises above 18.6 ft and overflows the weir. Low flow augmentation to Lake Washington through S-257 may occur when three conditions are met simultaneously: 1) water levels in the TFMCA are less than 17.6 ft, but greater than 12.6 ft;

2) water levels in Lake Washington are less than 12.1 ft, and; 3) discharge at U.S. 192 (USGS Gauge #02232000) is less than 30 cfs. When these conditions are met, a supplemental 30 cfs will be discharged through one of the 60-inch culverts at S-257 until either: 1) the average daily discharge at U.S. 192 exceeds 100 cfs for seven consecutive days; 2) water levels in Lake Washington exceed 12.3 ft; or 3) the water levels in the TFMCA fall below 12.6 ft. Upon meeting these conditions, the S-257 culvert will be closed.

MARY A – Mary A is primarily operated in isolation from the rest of TFMCA. However, it is hydrologically connected by a spillway at 19.6 ft and a 30-inch culvert at 15 ft. During high water levels (>19.6 ft) there is a passive connection with water flowing over the spillway. The culvert connecting Mary A to the TFMCA will be fully open from April through June and closed the rest of the year.

ST. JOHNS MARSH CONSERVATION AREA (SJMCA) – The culvert in the E-7 canal plug will be open annually from April 1 through June 30 and closed the rest of the year.

JANE GREEN DETENTION AREA – Structure S-161A and the box culverts through S-161 will remain fully open when not closed for flood control purposes.

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS /ABBREVIATIONS

BCMCA	Blue Cypress Marsh Conservation Area
BCWMA	Blue Cypress Water Management Area
BO	USFWS 1996 Biological Opinion log number 4-1-96-2146 (amended) for the BCWMA
Broadmoor	Broadmoor Marsh Restoration Area
C-10 WMA	C-10 Water Management Area
C-54 (RA)	C-54 Retention Area
CCE	Central critical elevation
cfs	Cubic feet per second
DO	Dissolved oxygen
EHC	Environmental hydrologic criteria
EIS	2003 Environmental Impact Statement for USJRBP Features North of the Fellsmere Grade (Levee L-74)
EWMP	Interim Environmental Water Management Plan
FDMCA	Fort Drum Marsh Conservation Area
FWC	Florida Fish and Wildlife Conservation Commission
ft	Feet/foot
FWMA	Fellsmere Water Management Area
Jane Green	Jane Green Detention Area
LCE	Lower critical elevation
MFLs	Minimum flows and levels
mgd	Million gallons per day
MOU	Memorandum of Understanding
MTWCD	Melbourne Tillman Water Control District
MWCM	USACE St. Johns River Upper Basin Master Water Control Manual
NAVD88	North American vertical datum of 1988
NEPA	National Environmental Policy Act
NGVD29	National geodetic vertical datum of 1929
SJID	St. Johns Improvement District
SJMCA	St. Johns Marsh Conservation Area
SJRWMD	St. Johns River Water Management District
SJWMA	St. Johns Water Management Area
SLWMA	Sawgrass Lake Water Management Area
SR	State road
TAC	SJRWMD Technical Advisory Committee
TFMCA	Three Forks Marsh Conservation Area
UCE	Upper critical elevation
US	United States road
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

INTRODUCTION

The Upper St. Johns River Basin Project (USJRBP) is a joint effort between the U.S. Army Corps of Engineers (USACE) and the St. Johns River Water Management District (SJRWMD). The primary goal of the USJRBP is to provide flood protection for agricultural and urban lands adjacent to the uppermost reaches of the St. Johns River. Secondary goals are to provide for water supply, improve water quality, protect and maintain basin wetlands and their associated flora and fauna, reduce stormwater discharges to the Indian River Lagoon, and provide resource-based recreational opportunities. The USJRBP provides flood protection by capturing and storing excessive rainfall and runoff during storm events in historic basin wetlands within project areas that have been enclosed by extensive perimeter levees. Stormwater from project areas is released downstream after flood peaks pass or is retained for release during the dry season to provide environmental and water supply benefits.

Flood control regulation schedules, developed by USACE and presented in the St. Johns River Upper Basin Master Water Control Manual (MWCM), regulate the amount and depth of water than can be stored within different project areas (**Figure 1**). When water levels within a project area are equal to or above the flood control schedule (Zone A), water storage capacity has been reached and downstream discharges from the area must occur to ensure water levels fall below the regulation schedule within 15 days. These "Zone A" discharges (e.g., structure openings, discharge rates) are described in detail for each project area in the MWCM. When water levels are below the flood control schedule (Zone B) no discharges are required by the MWCM. Instead, USACE has given SJRWMD exclusive authority to make Zone B discharges from the project areas to meet secondary water supply, water quality, or environmental goals. To describe the Zone B discharges and when they should occur, SJRWMD developed this Environmental Water Management Plan (EWMP). The EWMP will be attached as an appendix to the final MWCM. Making the EWMP an appendix rather than a section within the MWCM allows greater flexibility in changing Zone B operations in an adaptive, timely fashion.

History of the EWMP

In 1989, the SJRWMD Governing Board (Governing Board) created an Upper Basin Technical Advisory Committee (TAC) to develop recommendations concerning water management activities in the USJRBP. The TAC included representatives from local county governments, cooperating state agencies, local agricultural entities, and concerned citizens. The main task of the TAC was to serve in an advisory capacity to the Governing Board and assist SJRWMD staff in developing more flexible water management plans for the federal project. It was through the work of the TAC that the concept of Zone B discharges, to meet other project purposes (e.g., water supply and environmental), was conceptualized and developed. In fall 1995, a draft EWMP outlining desirable hydrologic conditions as well as proposed Zone B discharges from each federal project area was endorsed by the TAC and sent to the Governing Board for approval. Based on the TAC's recommendation, the

Governing Board adopted the EWMP on June 12, 1996. On June 18, 1997, the interim EWMP was formally approved by USACE which agreed to attach the document as an appendix to its final MWCM. USACE recommended, however, the document remain an "Interim" EWMP until compliance with the National Environmental Policy Act (NEPA) has been documented for the MWCM.

The 1996 draft of the EWMP guided Zone B operations in the USJRBP until 2003, when it was replaced by a second draft that presented slightly revised Zone B discharges derived from an improved hydrologic model. The 2003 EWMP guided Zone B discharges until 2016. However, due to recent improvements in the hydrologic model, the addition of non-federal project areas, shifts in water supply demands, and new information on how hydrology affects water quality and basin ecology, this third edition of the EWMP was drafted and used to guide Zone B operations beginning in 2017. USACE is scheduled to complete another preliminary MWCM in the next several years. USACE requested the latest version of the EWMP for attachment as an appendix to the preliminary plan. Attachment as an appendix allows Zone B management changes to be made without having to go through the extensive federal review and authorization process it takes to either deviate from, or modify, discharge schedules presented in the main body of the MWCM. The EWMP provides an adaptive document that can be quickly and easily modified as new information becomes available and basin water management activities in non-federal project areas evolve.

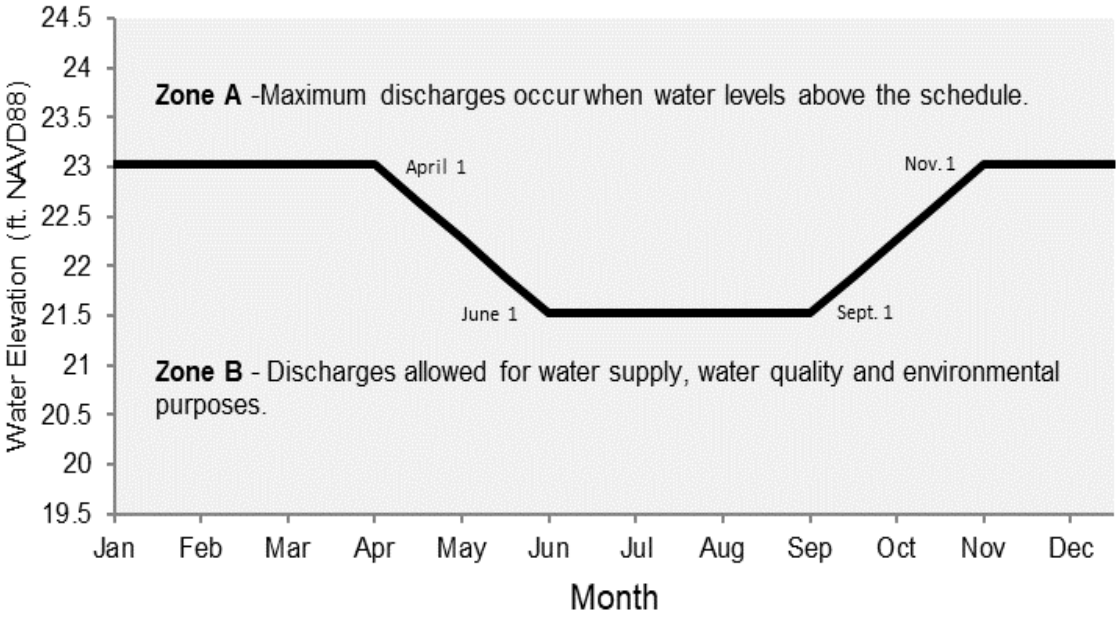

Figure 1. Flood control regulation schedule for Blue Cypress Marsh Conservation Area showing Zones A and B. When water levels are in Zone A, discharges are regulated by the MWCM. When water levels are in Zone B, discharges are regulated by the EWMP. Dates show when regulation schedule changes between the dry and wet seasons.

PROJECT DESCRIPTION

The USJRBP extends approximately 40 miles from the northeast corner of Okeechobee County south of the Florida Turnpike, to U.S. 192 just south of Lake Washington in Brevard County (**Figure 2**). The USJRBP totals approximately 140,000 acres and drains an area greater than 2,000 square miles. The USJRBP includes over 100 miles of flood protection levees, seven major gated spillway structures, and 15 smaller culvert and/or weir water control structures.

Federal USJRBP features include four marsh conservation areas, two water management areas, and two water retention/detention areas (**Table 1; Figure 2**). The purposes of the marsh conservation areas are to temporarily retain floodwater, provide for long-term water storage, and to restore and preserve historic floodplain wetlands. Water management areas provide floodwater storage and segregate poor quality runoff, that is discharged from adjacent agricultural and urbanized lands, from the marsh conservation areas. By retaining agricultural discharges in the water management areas, which are generally deeper reservoirs, water quality improves before these waters re-enter the river. Water management areas also provide water for irrigation, freeze protection, and other uses. The purpose of the retention/detention areas is to retain floodwater only under extreme rainfall conditions. All the marsh conservation, water management and retention/detention areas provide valuable fish and wildlife habitat and support outdoor recreational opportunities (e.g., fishing, hunting, air boating, birding).

In addition to the federal USJRBP project areas, there are five non-federal project areas that lie outside the original USJRBP footprint (areas surrounded by federal flood protection levees; **Table 1; Figure 2**). These areas, totaling approximately 23,000 acres, will receive water from and/or discharge water into the USJRBP. Three of the four non-federal project areas are either complete or nearing completion, while one project area is still in the design phase. All non-federal project areas were built by SJRWMD without federal funding and their goals are to provide additional water storage, enhance water supply, further improve water quality, and create additional fish and wildlife habitat. Water management activities in the non-federal project areas are not addressed in the EWMP.

Following is a brief description of each project area in the USJRB. For a more detailed description of specific USJRBP federal project components and structure discharge rating curves see the MWCM. All elevation data is presented as feet relative to the North American Vertical Datum of 1988 (NAVD88). Project documents drafted prior to 2015 are presented with elevation data relative to the National Geodetic Vertical Datum 1929 (NGVD29). Conversion factors for converting NAVD88 to NGVD29 for individual project area structures are available in Appendix A of this document. Conversion factors were derived from benchmarks closest to the structures where both NAVD88 and NGVD29 were measured.

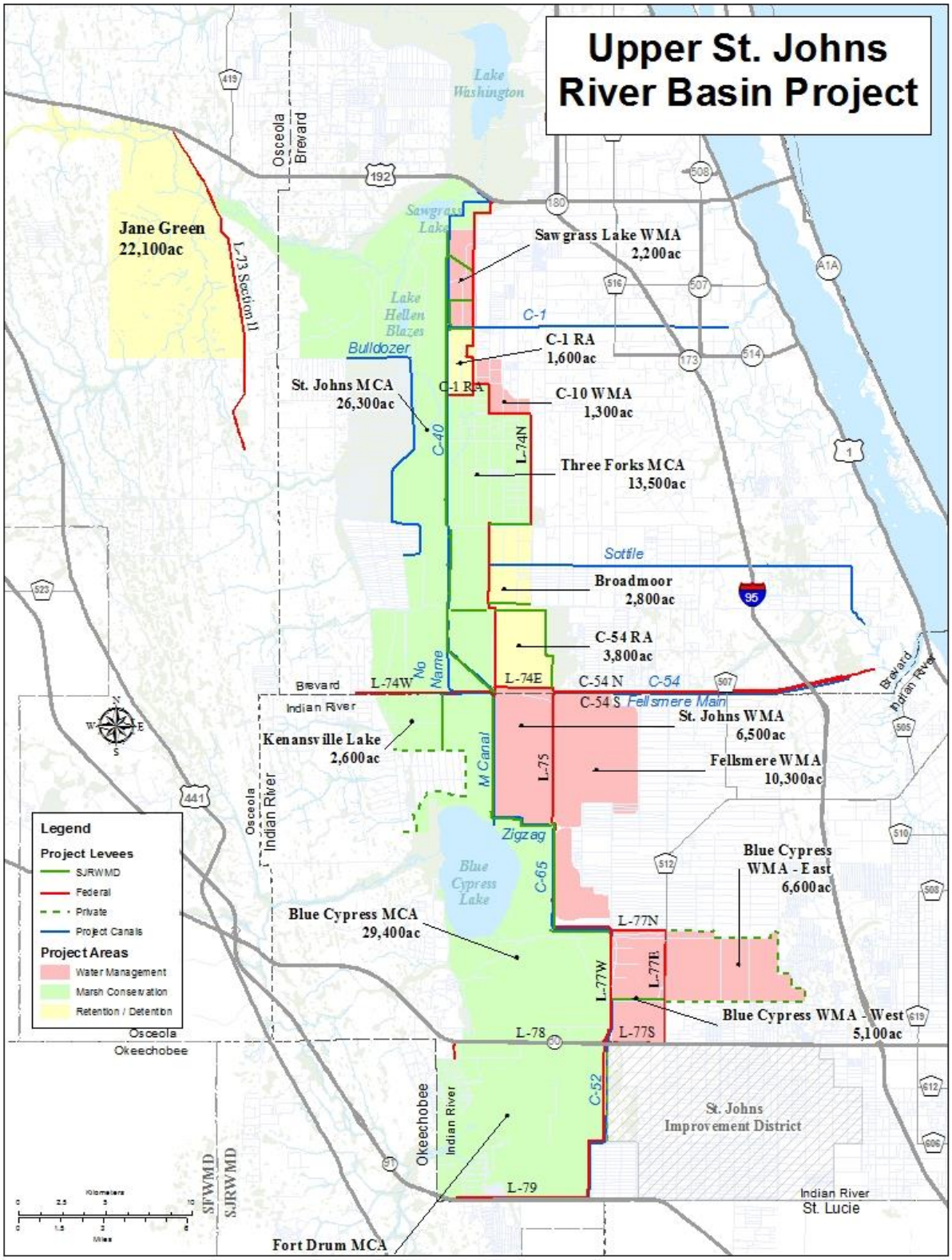

Figure 2. Map of project areas in the USJRB. Acreages have been rounded to the nearest 100 acres for each project area.

Table 1. Federal project areas and existing or planned non-federal project areas in the vicinity of the Upper St. Johns River Basin Project.

Project Area	Acres	Federal USJRBP Project Feature
Fort Drum Marsh Conservation Area (FDMCA)	20,792	Yes
Blue Cypress Marsh Conservation Area (BCMCA)	29,425	Yes
- Sub-Unit Kenansville Lake	2,561	
Blue Cypress Water Management Area (BCWMA)	11,646	Yes
- Sub-Units BCWMA-East BCWMA-West Ansin West Lake Miami Ranch		
St. Johns Water Management Area (SJWMA)	6,511	Yes
St. Johns Marsh Conservation Area (SJMCA)	26,342	Yes
Three Forks Marsh Conservation Area (TFMCA)	13,455	Yes
- Sub-Unit Mary A (Mary A)		
Jane Green Detention Area (Jane Green)	22,133	Yes
Fellsmere Water Management Area (FWMA)	10,275	No
C-54 Retention Area (C-54 RA)[1]	3,846	No
Broadmoor Marsh Restoration Area[1]	2,761	No
Sawgrass Lake Water Management Area (SLWMA)	3,792	No
- Sub-Unit C-1 Retention Area (C-1 RA)	1,578	
C-10 Water Management Area (C-10 WMA)[2]	1,267	No

[1] Operated by Florida Fish and Wildlife Conservation Commission as a waterfowl management area

[2] Project area is proposed – currently in design phase

Fort Drum Marsh Conservation Area (FDMCA)

The FDMCA encompasses approximately 20,792 acres located between the Florida Turnpike, on the south, and State Road (SR) 60 to the north (**Figure 3**). The area contains diverse habitats of freshwater marshes, forested wetlands, former improved pastures, and native range. General habitat types present include pasture, pine flatwoods, live oak hammock, cabbage palm hammock, mixed hardwood swamp, cypress swamp, dry prairie, and freshwater marsh. Within the central portion of the FDMCA is a 3,000-acre forested hardwood swamp having an elevated live oak hammock at its center. Herbaceous freshwater floodplain marshes cover approximately 11,000 acres of the FDMCA.

Project infrastructure, that regulates water levels in the FDMCA, was completed in 1998. Levee L-79 borders the FDMCA to the south and east, while levee L-78 borders the area to

the north. There is no flood control schedule for the FDMCA; water flows freely from the FDMCA into the BCMCA through structures S-252A, B, and C (**Figure 3**). As a result, water levels in the FDMCA are regulated by downstream water levels in the BCMCA. Under the initial design, the operable culvert in S-252A was only opened when water levels in the FDMCA exceeded 24.5 ft. However, under current operating procedures, this culvert is now open continuously. The culverts in structures S-252B and S-252C are un-gated.

Drainage into the FDMCA from agricultural lands to the west occurs unregulated via Fort Drum Creek and through flap-gated culverts at Structure S-252E which prevent backflow from FDMCA to the west (**Figure 3**). When water levels in the FDMCA exceed 28.5 ft, the culverts at S-252F (Hydron #14332574) are opened and discharges are made into the flow-way between L-78 and SR 60 that drains under the highway into the BCMCA west of S-252A. To the east, water from the FDMCA can be discharged into the C-52 canal and ultimately to the BCWMA through operable screw gate structure S-252D (**Figure 3**).

When not storing excessive floodwater, the FDMCA is a shallow wetland system (average depths < 3 ft) that provides limited water supply benefits. The availability of water during the dry season is inconsistent due to dense marsh vegetation and lack of conveyance canals, which impede surface water flow to potential withdrawal points. Because of sheet flow through the extensive wetlands, maximum water quality benefits of the FDMCA are currently being achieved.

Blue Cypress Marsh Conservation Area (BCMCA)

The BCMCA encompasses approximately 29,425 acres bounded by SR 60 to the south and levee L-74W (formerly the Fellsmere Grade) to the north **(Figure 3)**. Levees L-77 and L-76 border the area to the east. The BCMCA includes the 6,500-acre Blue Cypress Lake. The BCMCA is the most extensive freshwater, emergent marsh in the project area and is probably the least impacted by human activities. The BCMCA contains a mosaic of freshwater marsh plant communities dominated mainly by sawgrass (*Cladium jamaicense*) and maidencane (*Panicum hemitomon*). The entire area is underlain by organic peat soil.

Recently, Carolina willow (*Salix caroliniana*) has expanded its distribution and has become a more dominant plant community in many areas. A deeper slough, interspersed with cypress heads and tree islands, runs north-south along the eastern portion of the area. Blue Cypress Lake supports a quality sport fishery and is surrounded by a cypress tree fringe. Historical sources indicated that, before extensive diking and draining, much of the USJRB had vegetation like the BCMCA.

Discharge downstream from the BCMCA occurs through a combination of weir/culvert structures (S-250A, B, and C) and a gated structure (S-96C). Culverts provide for low daily downstream discharges when stages exceed the riser crest of 20.5 ft; flood flows discharge over fixed weirs (crest elevation = 23.5 ft). Flood waters are primarily discharged from the BCMCA by structure S-96C, which has a discharge capacity of 1,500 cfs. Under the MWCM design conditions, maximum required discharges from S-96C will occur when water levels equal or exceed 23.0 ft during the dry season, and 21.5 ft during the wet season (**Figure 1**).

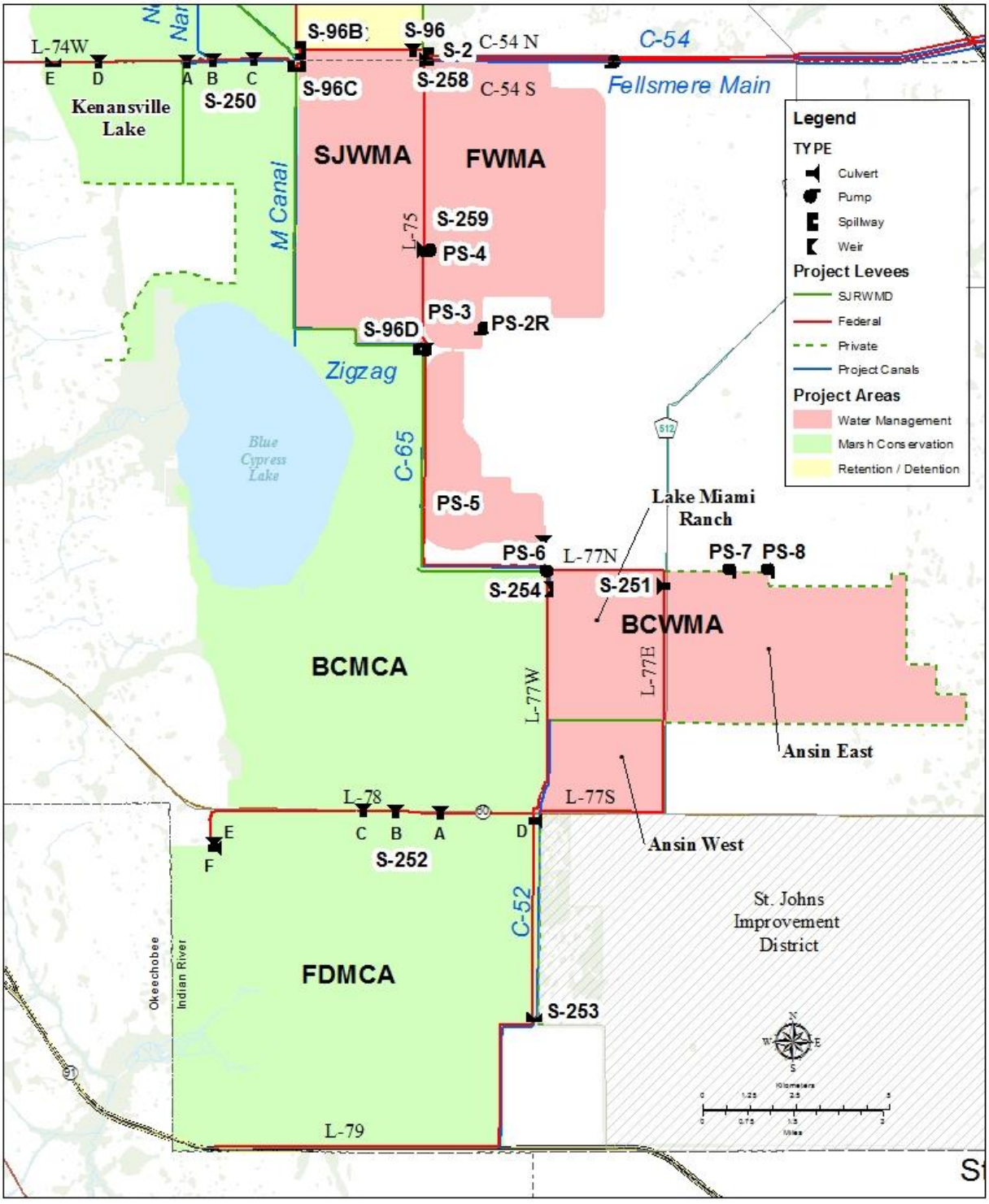

Figure 3. USJRBP features located within Indian River County.

Currently, water supply benefits from the BCMCA are continuous downstream discharges through the S-250 (A-C) structures that augment dry season river flows. Water management areas to the east meet most agricultural water supply needs. Additional water supply benefits of the BCMCA are possible if the current flood control regulation level is raised so that more water could be stored in the area. Water quality goals for the BCMCA center around maintaining adequate hydroperiods to prevent nutrient release caused by excessive oxidation of peat soils and maintaining sheet flow through BCMCA wetlands. In the past few years, phosphorus concentrations in Blue Cypress Lake have increased significantly. Factors causing this increase are under investigation, with the thought that the land application of Class B biosolids within the watershed is responsible. Increasing phosphorus storage in BCMCA soils would amplify the need to prevent soil oxidation and concomitant phosphorus mobilization.

Kenansville Lake

Kenansville Lake (formerly S.N. Knight) is a 2,561-acre tract located on the west side of the BCMCA (**Figures 2** and **3**). Historically, the site was part of the upper St. Johns River floodplain, but it was diked and drained in the 1960s. A portion of the property was originally tilled for row crops until the entire area was converted to pasture. There has been significant soil subsidence on the property. On average, the property has subsided 4 to 5 ft, with a maximum of 7 ft of subsidence on the eastern boundary. SJRWMD purchased the property as part of the USJRBP and flooded it in March 1993.

Originally, Kenansville Lake drained through structure S-250D into the SJMCA and was isolated from the BCMCA. In October 1997, a cut was made in the eastern levee to hydrologically connect the area to the BCMCA. Due to adverse drainage conditions affecting lands to the west, resulting from slightly higher water levels in BCMCA, the gap connecting Kenansville Lake to the BCMCA was plugged in August 2006. In September 2006, a new structure (S-250E; **Figure 3**) that discharges from Kenansville Lake to the north was completed. S-250E consists of a weir structure (crest elevation = 22.0 ft) and a gated culvert. The gated culvert provides management flexibility, but normally remains closed. A set of three temporary additional ungated culverts at S-250D, originally installed in 1994, were removed in 2014, and the one ungated culvert remains. Currently Kenansville Lake is a shallowly flooded impoundment with limited emergent vegetation which contains large expanses of *Hydrilla*, a nonnative and invasive submersed plant. However, the lake currently supports a quality sport fishery. Additionally, in 2016–2017, a majority of the endangered snail kites (*Rostrhamus sociabilis plumbeus*) using the USJRBP as foraging habitat were found in Kenansville Lake, with nearly 40 birds observed in January 2017.

Currently, there are limited water supply benefits to Kenansville other than minimal downstream discharges to the SJMCA that augment dry season river flows. Maximum water quality benefits are obtained by retention of runoff from lands to the west. Localized water quality problems and blue-green algal blooms periodically occur within Kenansville Lake because of dense *Hydrilla*, shallow water depths, and long water retention times.

Blue Cypress Water Management Area (BCWMA)

The BCWMA encompasses 11,646 acres located north of SR 60 and east of the BCMCA (**Figure 3**). It is bisected by CR 512 into two areas, BCWMA-East and BCWMA-West which are connected by Structure S-251(**Figure 3**). BCWMA-East consists of approximately 4,900 acres of extant emergent marsh with no project levee improvements. The area receives agricultural discharge from citrus groves and pastures located both to the south and to the north. BCWMA-West is approximately 5,100 acres of freshwater marsh enclosed by perimeter levees L-77W to the west and L-77S to the south, east, and north (**Figure 3**). BCWMA-West receives agricultural discharges from areas to the south via the C-52 canal. Water discharges from the BCWMA to the SJWMA via the C-65 flow-way and structures S-96D and S-3 (**Figure 3**). Together the two structures can release a combined discharge up to 1,600 cfs. Structure S-251 has been operated to allow drainage to occur from east to west and to prevent reverse flow occurring from BCWMA-West to BCWMA-East. BCWMA-West is separated by a continuous berm between the Ansin West and the Lake Miami Ranch properties (**Figure 3**). Ansin West was never drained and has extensive marsh plant communities dominated by sawgrass, cattail (*Typha spp.*) and shrubs. The area is dotted with several large cypress tree islands. The eastern half of the area contains extensive aquatic slough communities dominated by water lilies (*Nymphaea odorata*) intermixed with sawgrass and tree islands. Lake Miami Ranch was drained and farmed prior to project construction. Because of soil subsidence, this area is now a more open, deep-water habitat that supports a popular sport fishery and ecotourism industry. In the shallower areas, cattail is the dominant emergent plant.

The BCWMA was built to segregate agricultural discharges from more pristine USJRB project areas and provide irrigation water supply. Original water management plans for the BCWMA focused on water quality improvement as opposed to preservation or enhancement of existing wetland habitats. However, these priorities had to be modified when the BCWMA began providing significant nesting and foraging habitat for the endangered snail kite. During 1991 statewide surveys, approximately 140 snail kites were observed nesting and foraging in the BCWMA. Because of the relatively small area being utilized, actual snail kite densities (number of birds per acre) in the BCWMA in 1991 were among the highest in Florida. Snail kites have continued to both nest and/or forage in the BCWMA for the past 30 years supporting the designation of this area as critical snail kite habitat by the U.S. Fish and Wildlife Service (USFWS). The USFWS Biological Opinion log number 4-1-96-2146 (BO) provides guidelines regulating water levels and water withdrawals in the BCWMA to prevent adverse impacts to snail kites in return for allowing for limited incidental takes (mortality), that may occur because of project operation.

Under the MWCM design conditions, maximum required discharges through S-96D will occur when water levels in the BCWMA equal or exceed 24.0 ft during the dry season, and 23.0 ft during the wet season (**Figure 4**). When stages in the BCWMA exceed 25.1 feet, discharge will also occur from the BCWMA into the BCMCA via a 1,500 ft weir (S-254 [Hydron #01120520]; **Figure 3**).

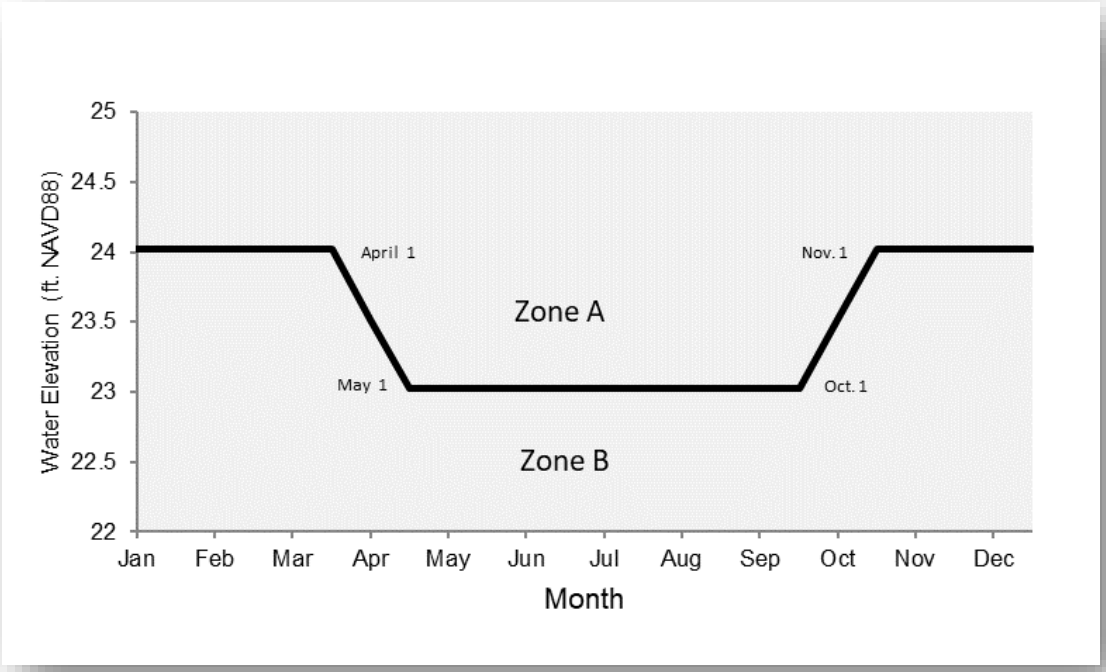

Figure 4. Flood control regulation schedule for the BCWMA outlined in the MWCM. Dates are shown when changes in the regulation schedule between the wet and dry season begin and end.

The BCWMA serves as a retention reservoir to treat agricultural runoff before the water is released downstream. Improving water quality is a primary purpose of the BCWMA. Under the terms and conditions of the BO, water supply withdrawals from the BCWMA for irrigation are not allowed. However, temporary water withdrawals for freeze protection are permitted. In addition, constraints in the BO require periodic extreme drying events of the BCWMA to rejuvenate snail kite nesting and foraging habitat. When the BCWMA is being actively drawn down to meet BO objectives, usually during droughts, water from the BCWMA, that would normally be discharged downstream, will be available for water supply withdrawals.

St. Johns Water Management Area (SJWMA)

The SJWMA consists of approximately 6,511 acres located northeast of Blue Cypress Lake (Figures 2 and 3). Most of the SJWMA was farmed prior to project construction. Because of soil subsidence, this area is now an open, deep-water environment that supports a quality sport fishery, known locally as the Stick Marsh.

The SJWMA receives inflows from the BCWMA through Structure S-96D in addition to pump discharges from the Fellsmere Water Management Area (FWMA; **Figure 3**). Water levels in the SJWMA are controlled by structure S-96B which allows downstream discharge to the Three Forks Marsh Conservation Area (TFMCA). Under the MWCM design

conditions, maximum discharges of up to 1,000 cfs through S-96B occur when water levels in the SJWMA exceed 21.5 ft during the dry season and 20.5 ft during the wet season (**Figure 5**). Additional discharges from the SJWMA, during extreme flood events, can be made into the C-54 Retention Area via structure S-258 and into the Indian River Lagoon via structure S-96 (up to 6,000 cfs capacity).

The SJWMA was designed to improve water quality through retention of agricultural discharges and provide a reliable agricultural surface water supply. Since 1990, the SJWMA has provided a dependable irrigation water supply source to agricultural lands in the surrounding area. In addition, it is estimated that enough water is available in the SJWMA to irrigate more than 25,000 additional acres.

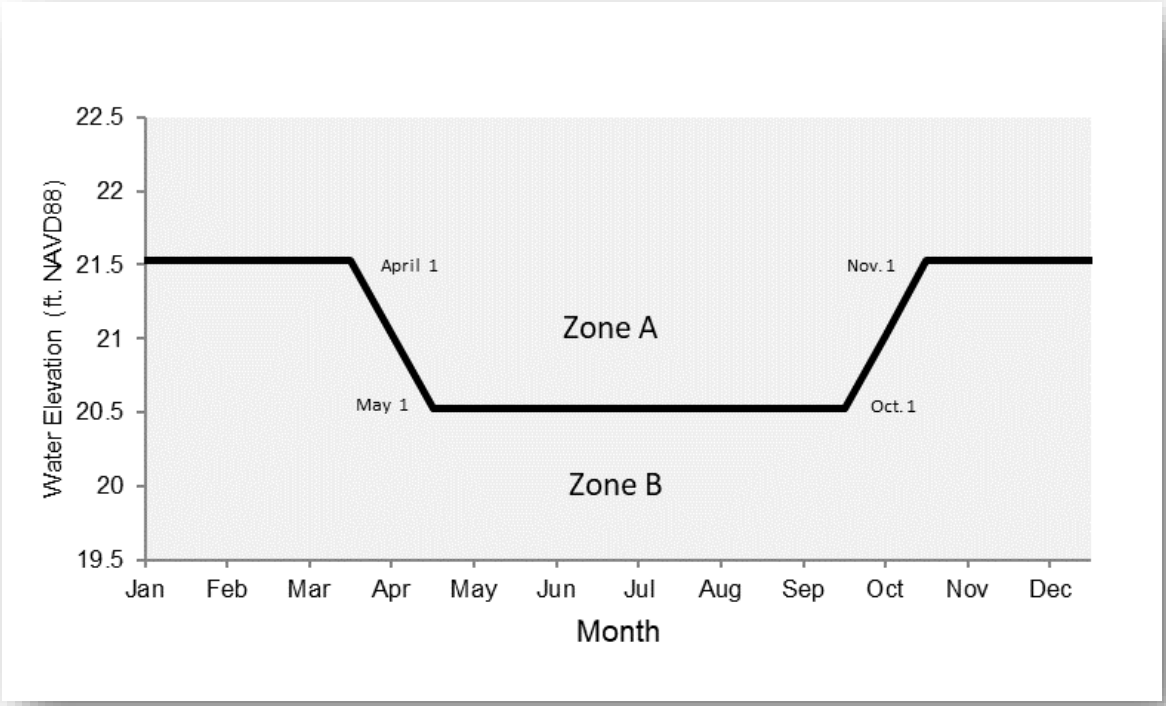

Figure 5. Flood control regulation schedule for the SJWMA outlined in the MWCM. Dates show when changes in the regulation schedule between the wet and dry season begin and end.

Fellsmere Water Management Area (FWMA)

The 10,275-acre FWMA is in Indian River County just west of Fellsmere and east of the SJWMA (**Figure 3**). The FWMA is former floodplain that was drained and farmed prior to being purchased and re-flooded by SJRWMD and the area is not part of the federal project. The FWMA is surrounded by levees and was built as a reservoir to provide additional water quality treatment for agricultural discharges from the east, which also provides flood

protection, water supply, and aquatic habitat. The Florida Fish and Wildlife Conservation Commission (FWC) worked closely with SJRWMD to diversify the habitat in the FWMA during construction and prior to flooding to optimize potential fish and wildlife benefits of the area.

The FWMA receives surface runoff pumped from more than 20,000 acres of agricultural lands to the east. During wet conditions, when water levels in the BCWMA are more than 0.5 ft above the flood control regulation schedule, some water from the BCWMA may be routed to the FWMA.

St. Johns Marsh Conservation Area (SJMCA)

The SJMCA consists of approximately 26,342 acres of freshwater marsh, forested wetlands, and shallow lakes lying between the levee L74W (formerly the Fellsmere Grade) to the south and U.S. 192 to the north (**Figure 6**). The SJMCA is bordered to the east by the TFMCA and the Sawgrass Lakes Water Management Area (SLWMA) and to the west by agricultural lands, primarily improved pasture and some row crops. Canals (C-40 and Outside Mormon) border the SJMCA to the east and west, respectively, and drain water to Lake Hell ’n Blazes. Downstream discharge from the SJMCA is not controlled. Bulldozer Canal also drains water from the Jane Green watershed to the lake **(Figure 6)**.

The principal habitats of SJMCA are freshwater marsh dominated by sawgrass, maidencane, willow, sand cordgrass (*Spartina bakeri*), cypress, and mixed hardwoods. Recently, willow encroachment has caused substantial area of the SJMCA to convert to willow swamp. Most of the SJMCA is underlain by organic soils that, in southern areas, are greater than 12 ft in depth. In addition to Lake Hell 'n Blazes (381 acres), Sawgrass Lake (481 acres) lies in the northern end of SJMCA just south of U.S. 192.

The hydrology of the SJMCA was dramatically altered by perimeter levees and canals that significantly reduced the original floodplain acreage and enhanced downstream conveyance. In addition, regulated discharges from areas upstream of the SJMCA by water control structures changed the intensity, timing, and duration of seasonal flooding and drying events. Under current conditions, the southern third of the SJMCA remains nearly completely dewatered for several months of the year.

Overdrainage has resulted in substantial oxidation of peat soils. From 2000 to 2014, peat soils in the southern SJMCA subsided on average more than 1.1 ft. In turn, soil oxidation has contributed to water quality problems in downstream lakes. For decades prior to construction of the USJRBP, the SJMCA received untreated agricultural runoff. Consequently, there was a significant accumulation of nutrients (particularly phosphorus) in the organic soils in the southern half of the SJMCA. While wetland soil-bound nutrients are generally unavailable for export to the water column under flooded anaerobic conditions, nutrients re-mineralize and become available for export when the soils are exposed to air and oxidized. Thus, prolonged drying facilitates release of excess nutrients bound in the soils of the SJMCA, while the rapid re-flooding that occurs when flood control discharges are made allows for

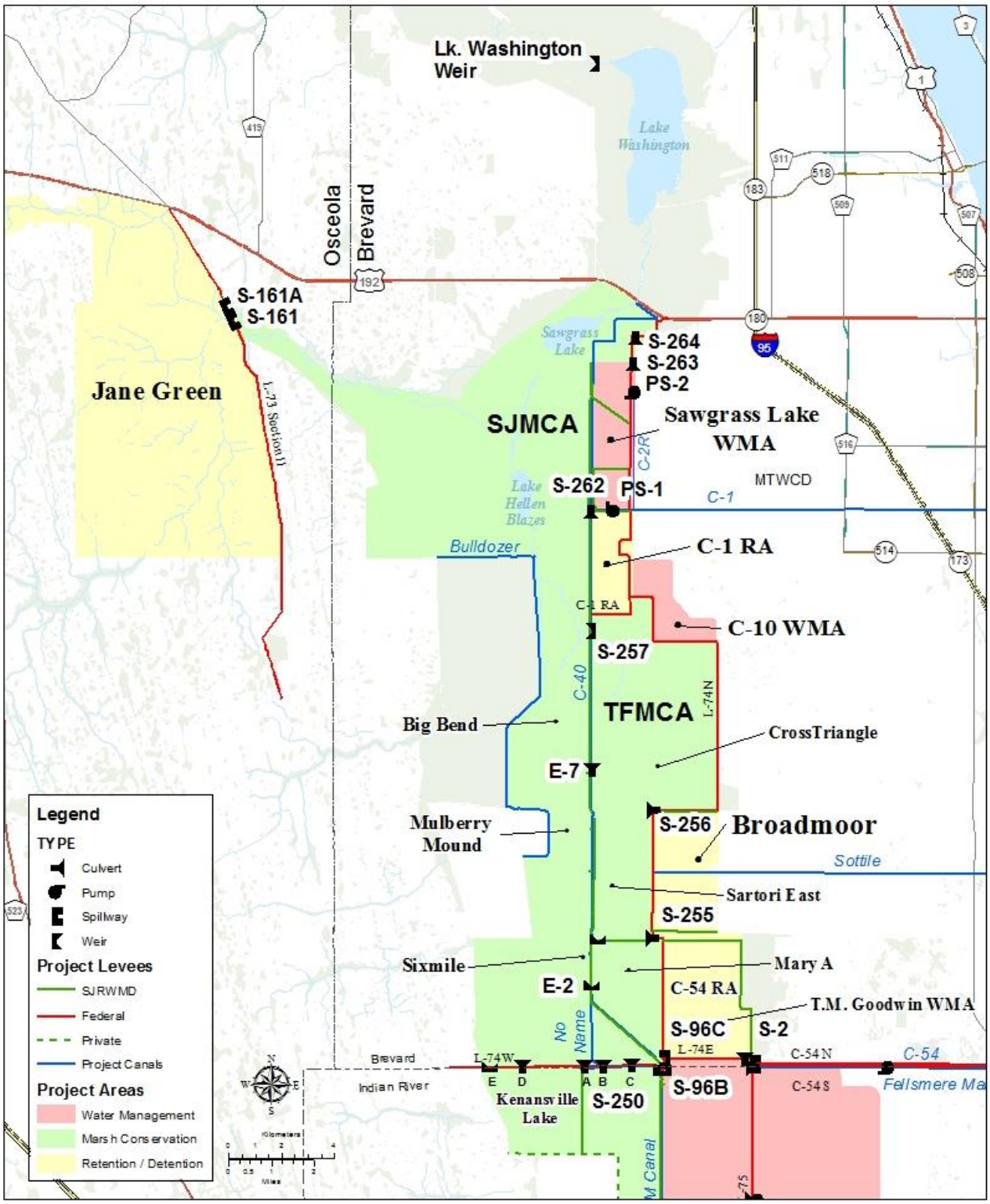

Figure 6. USJRBP features in Brevard County.

rapid transport of these nutrients downstream. In addition, oxidation of peat soils also allows for downstream transport of a significant volume of organic matter that can negatively affect water quality. Finally, drier conditions, that usually occur throughout the spring in the SJMCA, create ideal conditions for willow expansion. Several plugs, to create sheet-flow and limit overdrainage of the marsh during the dry season, were constructed in 2016 in the C-40 canal. One of the plugs (E7) has an operable culvert structure capable of discharging up to 100 cfs.

Primary inflows to the SJMCA occur from the BCMCA and Kenansville Lake through structures S-96C and S-250 (A-E) (**Figure 6**). The SJMCA also receives inflow from the TFMCA through structure S-257 and from the Sawgrass Lake Water Management Area (SLWMA) through structure S-262. The Jane Green Detention Area also discharges to the SJMCA near Lake Hell 'n Blazes through structures S-161 and S-161A (**Figure 6**).

Restoring longer hydroperiods to SJMCA wetlands will have significant downstream water quality and environmental benefits. Floodplain water storage in the SJMCA benefits water storage in Lake Washington, the primary potable water supply for the City of Melbourne.

Three Forks Marsh Conservation Area (TFMCA)

The TFMCA encompasses approximately 13,455 acres of former agricultural lands located east of the SJMCA C-40 canal and north of levee L-74E (**Figure 6**). The TFMCA is surrounded by levees. Final construction of all TFMCA project features was completed in June 2016. The northernmost third of the TFMCA (known as Cross-Triangle) contains a mixture open water, emergent marsh, and slough. Because of long-term drainage activities prior to re-flooding, organic soil throughout the TFMCA has subsided several feet. Because of this subsidence, a substantial portion of the northern third of the TFMCA converted to open water, although emergent marsh/slough communities are still prominent habitat features. The middle third of the TFMCA (known as Sartori East) was farmed until the early 1980s until it was re-flooded in 1985. This area currently contains open water, slough, and emergent marsh habitats.

The southern 2,500 acres of the TFMCA (known as the Mary A property) has the highest ground elevations in the conservation area (**Figure 6**). Mary A was drained in the 1960s and used for pasture and row crops. After SJRWMD purchased the property, Mary A was re-flooded in 1985. Currently, Mary A remains partially isolated from the rest of the TFMCA by a levee to prevent subsidence of the organic soil. A weir in the levee with a crest elevation of 19.6 ft allows water from the TFMCA to flood Mary A during storm events. A culvert in the levee also allows for seasonal drying. Mary A currently contains a mixture of slough and emergent marsh habitats.

Design features of the TFMCA, including an analysis of the various design options considered are available in the 2003 TFMCA Federal Environmental Impact Statement (EIS) for Project Features North of the Fellsmere Grade.

Primary inflows to the TFMCA are discharged from the SJWMA through structure S-96B (**Figure 6**). Flows are routed from S-96B directly to Sartori East via a channel excavated along the eastern border of Mary A. A berm along the western edge of the channel prevents these flows from entering Mary A. Inflow from the C-54 Retention Area to Sartori East occurs via a pump station while inflows from the Broadmoor Marsh Restoration Area and other areas to the east of the project occurs through culvert structures S-255 and S-256 (**Figure 6**).

An overflow weir and culvert structure (S-257) connect the TFMCA to the SJMCA at the point where an identifiable channel of the St. Johns River first begins (**Figure 6**). S-257 consists of a 600-ft weir with a crest elevation of 18.6 ft along with two, gated 60-inch culverts capable of discharging up to 250 cfs each. These culverts will allow for: 1) water level fluctuations to enhance wetland plant communities, 2) low flow augmentation to downstream lakes, and 3) a smooth transition to low flow conditions immediately after flows over the weir cease.

Sheet flow through the extensive wetlands maximizes water quality benefits of the TFMCA. Water supply benefits of the TFMCA are significant because dry season releases from the TFMCA augment water levels in Lake Washington, a major municipal water supply for the city of Melbourne.

C-54 Retention Area (C-54 RA) and Broadmoor Marsh Restoration Area (Broadmoor)

The C-54 RA and Broadmoor are not part of the federal project but may be used for stormwater storage. The C-54 RA consists of 3,846 acres located immediately north of the SJWMA (**Figure 6**). The C-54 RA is used to store stormwater from the SJWMA during major rainfall events prior to discharges being released to the Indian River Lagoon. Stormwater is routed to the C-54 RA from the SJWMA through structure S-258. Discharges from the C-54 RA to the TFMCA occur via culverts in the northwest corner of the retention area that discharge into the S-255 flow-way.

The C-54 RA, which was formerly drained floodplain, was restored to wetlands in 1991 by SJRWMD. FWC currently manages the area, also known as the T.M. Goodwin Waterfowl Management Area, for waterfowl habitat. The waterfowl management area has been expanded to include an additional 2,761 acres known as Broadmoor (**Figure 2**). Both the C-54 RA and Broadmoor contain several impoundments managed intensively by FWC for waterfowl hunting. When needed, water may be pumped into Broadmoor from the S-255 flow-way. Broadmoor also discharges to the TFMCA via this flow-way through S-256 (**Figure 6**). Agricultural areas located to the east of Broadmoor (**Figure 2**) also discharge to the TFMCA via structure S-256.

Sawgrass Lake Water Management Area (SLWMA) and C-1 Retention Area (C-1 RA)

The Sawgrass Lake Water Management Area (SLWMA; **Figure 6**) is a major component of the C-1 Re-diversion Project, a project designed to reduce freshwater discharges from the Melbourne-Tillman Water Control District (MTWCD) into the Indian River Lagoon. The C-1 Re-diversion Project captures that portion of the surface water runoff from MTWCD that previously discharged into the Indian River Lagoon and redirects it west to the St. Johns River. The SLWMA covers an area of approximately 3,792 acres and includes the C-1 RA (1,578 ac) in the southern portion, that is used only to retain large storm peak flows. The SLWMA operates as a treatment wetland to improve water quality before water is discharged to the St. Johns River.

Water quality treatment in the SLWMA occurs in three treatment cells separated by levees and connected by culverts. The cells are flooded by pump stations that draw water from C-1 to the south and C-2R to the east. Water then flows through the cells to structure S-262, which discharges to the St. Johns River (**Figure 6**). Large storm peaks are captured in the southern C-1 RA and temporarily retained before being pumped through the treatment wetlands. Because the SLWMA operates strictly as a treatment wetland, environmental goals for the area are to maintain wetland vegetation to maximize removal of nutrients and suspended solids. However, there are fish and wildlife benefits associated with the area. Water management goals in the SLWMA are to maintain average water depths in each of three treatment cells between 1 and 2 ft. Average water depths should not exceed 4.5 ft to prevent excessive flooding stress on the plant communities. Drying events may be necessary at times to rejuvenate the wetlands, but these will occur at irregularly spaced intervals based upon the treatment efficacy of the wetlands. Since the SLWMA is intensively managed for water quality and is not part of the federal project, hydrologic management within the SLWMA and the C-1 RA will not be addressed further by this plan.

C-10 Water Management Area (C-10 WMA)

The 1,267-acre C-10 WMA, currently in the planning phase, will be built to provide additional stormwater storage for the C-1 Re-diversion Project and provide water quality treatment for flows diverted from canals currently draining to the Indian River Lagoon. The location for C-10 WMA is along the western boundary of the MTWCD, north of the TFMCA and east of the SLWMA **(Figure 6)**. The footprint of this project may change during design and affect overall project size. Perimeter levees will surround the entire C-10 WMA, which is expected to be a large reservoir with little emergent vegetation. Based on preliminary designs, the C-10 will likely discharge into the TFMCA through a weir/culvert system.

Jane Green Detention Area (Jane Green)

Jane Green consists of approximately 22,133 acres located south of U.S. 192 (**Figure 2**). FWC currently manages the area as the Bull Creek Wildlife Management Area. Jane Green is biologically diverse and contains eight major habitats including dry prairie, pine flatwood, scrub, hardwood hammock, freshwater marsh, cypress swamp, and hardwood swamp. Jane Green is designed to retain runoff to Jane Green Creek during a major storm event and delay

discharge to the St. Johns River until the flood peak in the river recedes. When not being operated to provide flood protection, water control structures discharging from Jane Green are open to best mimic natural flow conditions.

Jane Green is impounded by levee L-73 (**Figure 2**) and floodwater storage is available between the elevations of 20.7 and 40.0 ft. Water levels in Jane Green are regulated by structures S-161 and S-161A. Structure S-161 was originally constructed as part of the 1960 Upper St. Johns River Basin Plan for Flood Control and Water Conservation and was designed to regulate water levels in the detention area between 41 and 45 ft. Because the crest elevation of S-161 is 33.6 ft, this structure will only pass flows during extreme flood conditions. Structure S-161 has been decommissioned. Structure S-161A was constructed to allow for more continuous discharge to Jane Green Creek. The crest elevation of the main overflow weir of S-161A is 24.8 ft. Low flow box culverts constructed in the sidewalls of the spillway of S-161A allow for continuous flow to occur when water elevations are below the weir crest. The invert elevation of the box culverts is 20.2 ft. Estimated ground elevations in the swamp immediately upstream are estimated to be around 19.7 ft, whereas the bottom of the creek is estimated to be around 17.7 ft. To facilitate drainage to the box culverts at S-161A, a drainage ditch running parallel to L-73, that connects S-161 and S-161A, was constructed in 2002.

Despite the enhanced ability to lower water levels using S-161A, flooding of Jane Green in the 1990s still caused extensive damage to the hardwood swamp upstream of the structures. Consequently, in August 2008, S-161 was modified by the addition of two 8 ft x 8 ft gated box culverts with invert elevations of 17.7 ft to further reduce flooding. As a result, S-161 functions as the main outlet for Jane Green Detention Area when water levels are below an elevation of 24.8 ft.

Under the MWCM, S-161A will only be operated under extreme flood conditions. During the remainder of the time, the main structure gates remain open. According to the MWCM, S-161A will be closed when the St. Johns River elevation at highway U.S. 192 (United States Geological Survey (USGS) gauge #02232000) is 18.2 ft or greater. Floodwater will be impounded behind L-73 until the St. Johns River flood peak passes downstream at which time the S-161A gates will be reopened. The gated box culverts in S-161 will remain open during flood events.

ENVIRONMENTAL HYDROLOGIC CRITERIA

Ecosystem Description and Environmental Goals

The USJRB is a complex and diverse ecosystem comprised of a mosaic of interconnected habitat types including freshwater marsh, forested wetland, shallow lake, river channel, and upland plant communities. The wide diversity of habitats supports abundant plants and animals, including several threatened or endangered species. The ecology of the basin was shaped primarily by topography, the subtropical climate, and seasonal rainfall patterns. Rainfall averages greater than 50 inches per year, and more than 60% of this annual total

generally falls between June and October. In its pristine condition, the floodplain wetlands of the Upper St. Johns River Basin covered more than 400,000 acres. In addition to providing important habitat for fish and wildlife, the extensive wetlands historically enhanced river water quality, attenuated downstream flood peaks by retaining stormwater, and stored water during dry periods.

Beginning in the early 1900s, large areas of the USJRB's wetlands were drained, ditched, and diked to provide land for agricultural development. Many of these ditches diverted freshwater runoff and its associated sediments and nutrients into the Indian River Lagoon. Drainage activities not only directly reduced the area (and storage volume) of remaining wetlands in the USJRB, but they also altered the natural hydrology by reducing water retention times and accelerating flows. By 1983, conversion to agricultural uses had reduced total floodplain acreage by over 60%. Impacts of wetland loss and altered hydrology on fish and wildlife resources were dramatic as significant declines in game fish, waterfowl, and wading bird populations occurred throughout the basin.

Environmental goals of the USJRBP center on preserving and protecting extensive basin wetland habitats, which in turn, should protect overall plant and animal diversity and abundance. To date, 94 endangered, threatened, or rare species have been documented to occur within the project area. To protect and enhance basin wetland habitats, Zone B discharge schedules attempt to re-create the natural hydrologic conditions under which these ecosystems evolved. By creating a hydrologic regime that mimics natural conditions, optimal wetland plant community characteristics are maintained. This, in turn, provides other environmental benefits such as enhanced fish and wildlife habitat and improved water quality. Environmental hydrologic goals are quantitatively described by a suite of hydrologic statistics termed environmental hydrologic criteria (EHC). Zone B discharges that best meet EHC must also simultaneously meet flood control, water supply, and water quality objectives. Currently, water quality goals are achieved primarily by sequestering nutrients in water management and designated wetland treatment areas, while water supply objectives are met by providing for surface water withdrawals from the water management areas and, through dry season low-flow discharges to the river, from both water management and marsh conservation areas. SJRWMD has complete authority to modify Zone B discharges to accommodate new water supply needs or provide additional water quality treatment. In addition, freshwater runoff that was historically diverted to the Indian River Lagoon is now being treated to improve water quality and rerouted back to the St. Johns River.

Development of Environmental Hydrologic Criteria (EHC)

The EHC are a series of hydrologic statistics that form the boundaries of a natural hydrologic regime. EHC focus on optimal flooding depths and durations, timing and extent of annual water level fluctuations, return frequencies of extreme flooding and drying events, water level recession rates, and minimum water levels for lakes. To best meet environmental goals, hydrologic conditions should fall within the boundaries delineated by all the various EHC, simultaneously. The EHC are also viewed with a long-term (30+ year) perspective which helps account for natural variability inherent in the long-term hydrologic cycles to which the ecosystem has adapted. The EHC, in a sense, are like Minimum Flows and Levels (MFLs),

but there is one important difference. MFLs define a level associated with significant ecological harm, whereas EHC attempt to define optimal hydrology given existing topographic conditions.

Due to differences in topography, soils, perimeter levee configurations, plant communities, and project area purposes, one consistent set of EHC cannot be applied to all project areas. For example, EHC for the FDMCA are designed to protect and enhance the extensive emergent wetlands that dominate this project area. However, for the BCMCA, EHC protect both the extensive emergent wetlands as well as the sport fishery in Blue Cypress Lake. For water management areas, such as the SJWMA, whose main project goals, outside of flood protection, are water supply and water quality, EHC describe hydrologic conditions that best protect its sport fishery. In this plan, EHC are presented only for USJRB federal project areas. In the future, the same concepts for developing EHC can be applied to new water management areas constructed by SJRWMD that lie adjacent to the federal project (e.g., FWMA) to evaluate their environmental performance during, or after, the development of those operational plans.

EHC were developed from observed or documented relationships between hydrologic variables and various environmental responses, such as changes in spatial vegetation patterns, individual plant species responses, loss of organic soils, and changes in fish and wildlife abundance and distribution. Relationships were determined from studies conducted in the USJRBP over the last 30 years and from the scientific literature. The EHC were further refined through discussions between SJRWMD staff and representatives of FWC, USFWS, USACE, and various university experts.

Up to seven ecologically important hydrologic statistics derive numerical EHC for each project area. The number of EHC for an area reflect water supply and water quality, as well as other environmental goals for that area. Hydrologic statistics used to establish EHC may include inundation frequency, mean depth, maximum depth, minimum depth, timing of water level fluctuation (both annual highs and lows), water level recession rates, and minimum water levels for lakes. For wetland dominated project areas, most, but not all, EHC relate to what are termed “critical elevations” derived from stage-area or wetted-perimeter curves. The three critical elevations are termed upper (UCE), central (CCE), and lower (LCE) critical elevations (**Figure 7**). In wetland areas, a central critical elevation (CCE) reflects the highest marsh elevation underlain by deep organic soil (**Figure 7**). Organic soils need to be flooded at least 60% of the time to prevent oxidation and loss which releases nutrients that may have on-site and downstream impacts. An upper critical elevation (UCE) relates to the elevation where wet prairies, that require only periodic annual flooding of a much shorter duration, transition to uplands (**Figure 7**). A lower critical elevation (LCE) relates to the level of drying that should periodically occur to maintain many emergent wetland plant species, particularly those that require dry-down and moist soil conditions for seed germination. Generally, the LCE corresponds to the elevation of the transition zone between emergent marsh and deeper slough communities (**Figure 7**).

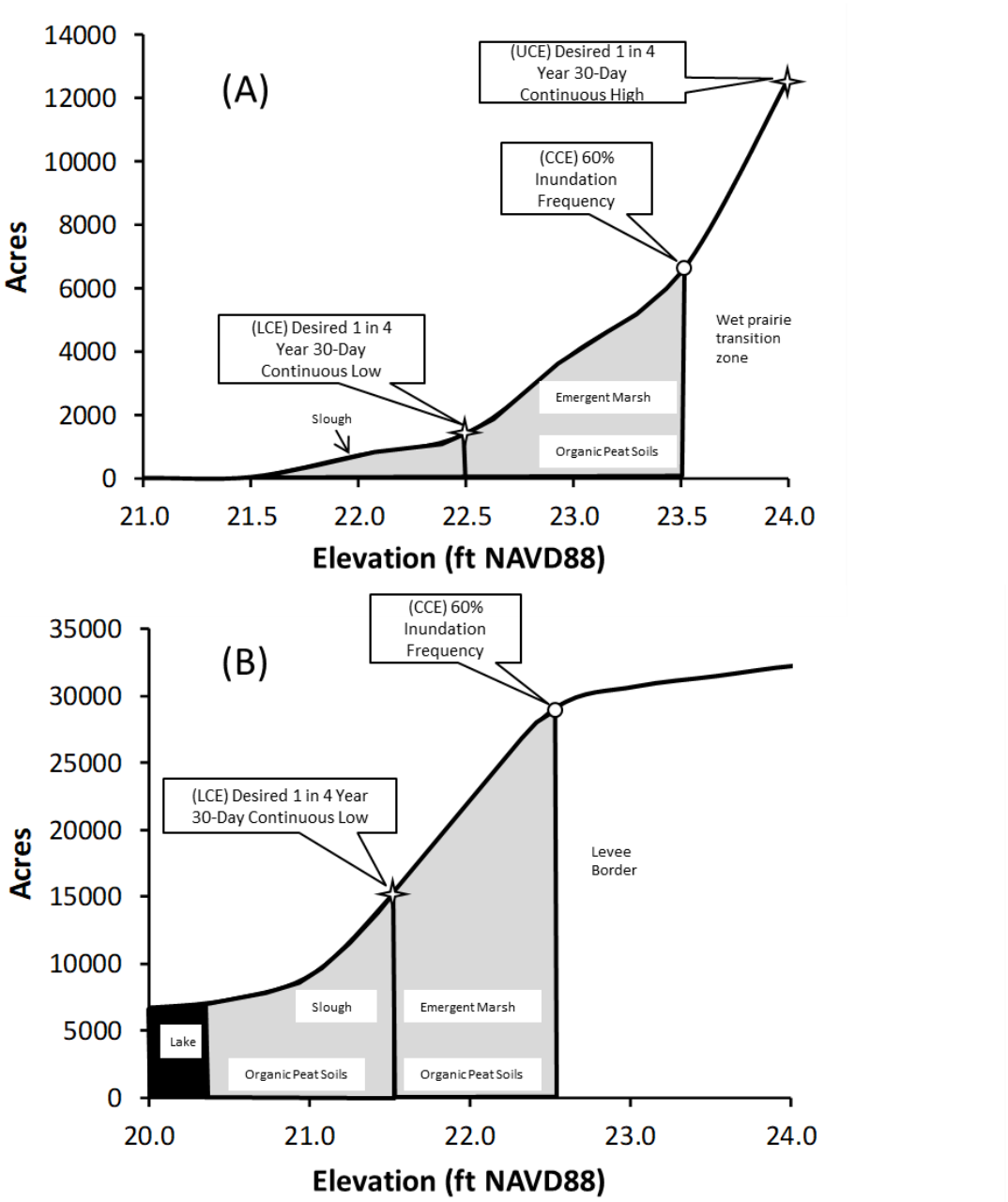

Figure 7. Stage-area curves for (A) FDMCA and (B) BCMCA showing lower (LCE), central (CCE), and upper (UCE) critical elevations and their relationships to the distribution of organic soils (shaded in gray) and elevations of slough and emergent marsh communities. The BCMCA does not have a UCE because the deep marshes of the BCMCA are bordered almost entirely by levees causing the area to lack a significant wet prairie to upland transition zone. Elevations in the graphs may differ slightly from the actual EHC due to water level adjustments that were made to account for slopes in the water levels between the marsh and the water level gauging stations where EHC performance will be evaluated.

Fort Drum and Blue Cypress Marsh Conservation Areas EHC

Stage-area curves for the Fort Drum (FDMCA) and the Blue Cypress Marsh Conservation Areas (BCMCA), showing the concept of critical elevations for each area, are presented in **Figure 7** and EHC for these project areas are presented in **Table 2**. The EHC for the FDMCA and the BCMCA are similar except for 1) special BCMCA criteria to protect the sport fishery of Blue Cypress Lake, and 2) the BCMCA lacks a UCE because levees surround most of the area and there is no transitional habitat grading from wet prairie to uplands. Following is a description of the EHC and a brief discussion of the basis for their selection as an ecologically important component of the natural hydrologic regime. For monitoring success in meeting hydrologic targets, the EHC are calibrated to specific water level gauges. The EHC account for differences in water surface elevations between the marsh where the critical elevations were established and the gauge where water levels are measured. Consequently, the critical elevations on stage-area graphs may not necessarily correspond to elevations specified by the EHC. For the FDMCA, the water level gauge to monitor hydrologic conditions is at structure S-252C (SJRWMD Hydron gauge #01210437), and in the BCMCA, the gauge is at Blue Cypress Lake (SJRWMD Hydron gauge #00540103). The EHC presented here are criteria calibrated specific to those gauges.

1. <u>Frequency of Inundation</u> –

The long-term (30-year) 60% inundation frequency should equal or exceed 23.0 ft in the FDMCA and 22.0 ft in the BCMCA.

One of the ecological consequences of agricultural development and intensive water level management in USJRB wetlands has been a shift from deposition to oxidation loss of organic soils. The loss of organic soils due to oxidation has caused ground elevations to subside up to several feet in some areas. In addition, as soils oxidize, nutrients are released which may contribute to water quality degradation on-site or downstream. Studies conducted in the USJRB demonstrate that to prevent soil oxidation and subsidence, peat soils should be flooded, on average, no less than 60% of the time. To meet the goal of no net soil oxidation, CCE targets for the FDMCA and BCMCA were established at the highest marsh elevations in each area that are underlain by organic soil. In the FDMCA and the BCMCA, these elevations were 23.5 ft and 22.5 ft, respectively (**Figure 7**). Values adjusted to the appropriate water level gauges are 23.0 ft for the FDMCA and 22.0 ft for BCMCA. Measured water levels at these gauges should exceed these elevations greater than 60% of the time to prevent organic soil oxidation (**Table 2**).

2. <u>Maximum Water Levels</u> –

<u>14-day</u> — Water elevation should not exceed 26.5 ft in the FDMCA and 25.5 ft in the BCMCA for more than 14 continuous days more frequently than once every 10 years.
<u>30-day</u> — Water elevation should not exceed 26.0 ft in the FDMCA and 25.0 ft in the BCMCA for more than 30 continuous days more frequently than once every 10 years.

These criteria describe flooding above the LCE that may damage emergent marsh plant communities because the water is too deep for too long (**Table 2**). Although wetland plants can tolerate flooded conditions, prolonged submergence of the plants can cause mortality by preventing the transfer of oxygen from the leaves and stems to the plant roots. Characteristics of the hydrologic tolerances of wetland plants were developed by analyzing the historical distribution of dominant emergent plant species in BCMCA (sawgrass, maidencane, etc.), along an elevation gradient in relation to historic stages.

Table 2. The EHC for the FDMCA and BCMCA. For a more complete description of the EHC, see text.

EHC	FDMCA (S-252C)	BCMCA (BCL)
Frequency of Inundation	23.0 ft should be flooded ≥ 60% of the time	22.0 ft should be flooded ≥ 60% of the time
Maximum Water Levels 4 ft. for 14 days 3.5 ft. for 30 days	Should not exceed 26.5 26.0 more frequently than 1/10 years	Should not exceed 25.5 25.0 more frequently than 1/10 years
Low and High Water Levels	Desirable 30-Day Low Should fall below 22.5 ft for at least 30 continuous days at least once every 4 years	Desirable 30-Day Low Should fall below 21.3 ft for at least 30 continuous days at least once every 4 years
	Desirable 30-Day High Should equal or exceed 24.0 ft for at least 30 continuous days at least once every 4 years	Desirable 30-Day Highs Not applicable
	Undesirable 60-Day Low Should not fall below 21.5 ft for more than 60 continuous days more frequently than once every 10 years	Undesirable 60-Day Low Should not fall below 20.2 ft for more than 60 continuous days more frequently than once every 10 years
Timing of Fluctuation 1-Day Yearly Min. 1-Day Yearly Max. Seasonal Flooding Requirements	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 - Nov. 30 Average monthly water levels to be equaled or exceeded in at least 30% of years: Apr. (70% of marsh) > 23.2 ft May (50% of marsh) > 22.9 ft Jun. (50% of marsh) > 22.9 ft Jul. (68% of marsh) > 23.2 ft Aug. (88% of marsh) > 23.4 ft Sep. (88% of marsh) > 23.4 ft	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 - Nov. 30 Average monthly water levels to be equaled or exceeded in at least 30% of years: Apr. (70% of marsh) > 22.2 ft May (50% of marsh) > 21.7 ft Jun. (50% of marsh) > 21.7 ft Jul. (68% of marsh) > 22.0 ft Aug. (88% of marsh) > 22.5 ft Sep. (88% of marsh) > 22.5 ft
Recession Rates **7-Day** **30-Day**	When water levels are ≤ 25.0 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	When water levels ≤ 23.1 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time
Minimum Water Levels for Blue Cypress Lake	Not applicable	Water levels should not fall below: 18.5 ft more often than once every 5 years 16.7 ft more often than once every 10 years 16.2 ft more often than once every 25 years

3. Low and High Water Levels –

Desirable 30-Day Low — Water levels should be at or below 22.5 ft in the FDMCA and 21.5 ft in the BCMCA for 30 continuous days at least once every 4 years.
Desirable 30-Day High — Water levels should exceed 24.0 ft in the FDMCA for at least 30 continuous days at least once every 4 years. No desirable 30-day high was established for BCMCA.
Undesirable 60-Day Low — Water levels should not be less than 21.5 ft in the FDMCA and 20.2 ft in the BCMCA for more than 60 continuous days more frequently than once every 10 years.

Fluctuations in water level that relate to the LCE and the UCE are critical to establishing and maintaining both spatial and temporal aspects of habitat heterogeneity in marsh ecosystems. Water level fluctuations and durations affect wetland chemical and physical properties such as nutrient availability, degree of substrate anoxia, soil properties, and pH. These, in turn, directly affect the biotic attributes such as plant species composition, diversity, productivity, and fish and wildlife habitat values. Even slight alterations in wetland hydropatterns can cause changes in plant community distributions. In addition, reproductive strategies of many wetland plants and animals are dependent upon water fluctuation cycles. Most wetland plants require moist soil conditions for seed germination and nesting success of many wading birds is linked to dry season drawdowns that concentrate fish and invertebrate prey items.

The LCE for the BCMCA and the FDMCA reflect the estimated elevation break that separates emergent marsh and slough communities in these areas (**Figure 7**). A 30-day continuous low-water level allows emergent marsh plant communities to experience nearly complete drying at least once every 4 years (**Table 2**). The UCE for the FDMCA reflects the estimated elevation break that separates emergent marsh from transitional wetlands. The desirable 30-day high water level allows flooding of transitional wetlands to occur for 30 days at least once every 4 years. Because the BCMCA lacks transitional wetlands, a desirable 30-Day high water level is not applicable to this area.

Deeper slough communities need to experience less frequent drying to prevent conversion to drier community types. The 60-day low was established at one foot below the LCE to prevent over-drying of existing slough communities and to prevent the extreme drying of the emergent marsh from occurring more frequently than once every 10 years (**Table 2**). The return interval of once every 10 years does allow for extreme drying to occur infrequently as a natural drought-induced disturbance.

4. Timing of Fluctuations–

1-Day Yearly Minimum — Should occur between April 1 and June 30 in more than 60% of the years.
1-Day Yearly Maximum — Should occur between August 1 and November 30 in more than 60% of the years.

Temporal aspects of water level fluctuations are as important as the magnitude of the fluctuations themselves. For example, breeding cycles of many wading birds occur toward the end of the dry season to coincide with the concentration of aquatic prey. In contrast, breeding cycles of alligators are timed so hatching generally occurs during the middle of the wet season, when food is most abundant.

Seasonal Flooding Requirements — Monthly average water levels for the months April through September that should be equaled or exceeded in at least 30% of years.

Soil oxidation is influenced by drying intensity, duration, and timing of drying events. When exposed, organic soils begin to oxidize rapidly and total oxidation (soil loss) is based on the length of exposure. In addition, exposing organic soils during the heat of the summer can cause oxidation to occur at more than twice the rate that it occurs in the spring or late winter. Additionally, dry-down early in the spring is suspected to cause willow expansion by promoting seed germination and reducing the flooding mortality of newly established willow seedlings that would normally occur with the onset of the rainy season.

To evaluate how the USJRBP has altered the timing of flooding and drying events, historical pre-project (1957–1989) and post-project (1990–2014) water levels for Blue Cypress Lake were compared. While post-project drying did not occur earlier in the year or for longer durations, re-flooding that normally began in June and July pre-project was shifted to September and October. Criteria to prevent delayed and prolonged dry-down events were set by calculating average monthly water levels from April–September that were exceeded in a minimum of 30% of the years in BCMCA during the pre-project phase. These levels are applied as EHC for the BCMCA (Table 2). For each of these levels, the BCMCA stage-area curve was used to approximate the percent of the marsh that was inundated. Since an appropriate history of water levels in the FDMCA was not available, those marsh percentages from the BCMCA were then applied to the FDMCA stage-area curve to derive average water levels that should be exceeded in at least 30% of the years for each of these months and these levels were then set as EHC for the FDMCA (**Table 2**).

5. Water Level Recession Rates –

7-day — When water levels are at or below 25.0 ft in the FDMCA or 23.1 ft in the BCMCA, recession rates should not exceed 0.5 ft during any continuous 7-day interval more than 5% of the time.
30-day — When water levels are at or below 25.0 ft in the FDMCA or 23.1 ft in the BCMCA recession rates should not exceed 1.2 ft during any continuous 30-day interval more than 5% of the time.

Water level recession rates can have a dramatic impact on wetland animals. Studies in the Florida Everglades have documented a correlation between rate of recession during the spring and numbers of wading birds nesting, and overall nesting success. Rapid recession rates were also related to earlier nest initiation. Recession rates that are too rapid can have potentially detrimental impacts on aquatic biota by degrading water quality, most notably

dissolved oxygen (DO) concentrations. Rapid recession rates during late summer caused massive fish kills in the Kissimmee River Restoration Demonstration Project, when nearly 60% of the floodplain drained over a period of three days. During flood events, rapid recession rates are normal as flood peaks move downstream. Therefore, recession rate EHC apply only in the situations where water depths on the highest elevations occupied by organic soils and emergent marsh are ≤ 1.0 ft. The values we used to set optimal recession rate criteria for the USJRBP are derived from recession rates from historical data from several natural wetlands in south Florida, including the Everglades.

6. **Minimum Water Levels for Blue Cypress Lake –**

   5-Year Low — Water levels should not fall low enough to exclude fish from the vegetated littoral zone (18.5 ft) more frequently than once every 5 years.
   10-Year Low — Water levels should not fall low enough to result in a mean lake depth of less than 3 ft (16.7 ft) more frequently than once every 10 years.
   25-Year Low — Water levels should not fall low enough to result in a mean lake depth of less than 2.5 ft (16.2 ft) more frequently than once every 25 years).

The 5- and 10-year minimum water level EHC were initially proposed by FWC staff to prevent frequent, extreme dry-downs that could adversely affect sport fish by reducing access to suitable vegetated spawning and nursery habitats. However, drawdowns can benefit lake ecosystems by causing consolidation and oxidation of organic sediments, increasing primary and secondary production, enhancing vegetated littoral zone habitats, and helping control nuisance vegetation. However, if drawdowns are extreme enough, oxygen depletion can cause widespread fish kills resulting in major faunal changes. Fish kills, caused by low DO concentrations, reduce species diversity and favor undesirable species such as Bowfin (*Amia calva*) and Gar (*Lepisosteus platyrhincus*), which are adapted to survive these conditions. If fish kills occur frequently enough, long-term decline in game fish populations and overall biodiversity may occur. Based on recommendations by FWC biologists, the 5-,10-, and 25-year low EHC for Blue Cypress Lake are set at 18.5, 16.7, and 16.2 ft, respectively (**Table 2**).

Kenansville Lake EHC

The 2,526-acre Kenansville Lake is west of the BCMCA (**Figure 1**). The lake has been flooded since 1997 and has developed a recreational fishery. Since outflow modifications in 2007, the average water elevation has been 21.2 ft. At this elevation, the average water depth in the lake is about 3.5 ft. Currently, Kenansville Lake has approximately 300 acres of peripheral emergent wetlands (at elevations above 21.5 ft) and 780 acres of vegetated littoral zone. Water levels in Kenansville Lake are monitored by SJRWMD Hydron gauge #01310555.

1. **Mean Water Levels –**

   The long-term (30-year) average water elevation should be equal to or greater than 21.2 ft.

As a general guideline, the mean elevation to protect recreational fisheries should have at least 50% of the impounded area with depths exceeding 5.0 ft. To meet this requirement, however, the average water elevation in Kenansville Lake would have to be 23.5 ft. This is not possible because the crest of the overflow weir for the lake is set at 22.0 ft. At a water elevation of 21.2 ft, Kenansville Lake has an average water depth of approximately 3.5 ft, while greater than 36% and 8% of the area is flooded to depths exceeding 4 and 5 ft, respectively.

2. Low Water Levels –

Desirable 30-Day Low — Water levels should fall to or below 20.5 ft for 30 continuous days at least once every 4 years.

At a water elevation of 20.5 ft, about 20% of Kenansville Lake will be exposed. This low-water level should help rejuvenate the shoreline wetland plant communities. At 20.0 ft, the mean depth of the lake will be 3.0 ft, but 53% of the remaining inundated area will be deeper than 3 ft and 23% will be deeper than 4 ft.

3. Minimum Lake Water Levels –

Undesirable 10-Year Low — Water levels should not fall below 19.5 ft more frequently than once every 10 years.
Undesirable 25-Year Low — Water levels should not fall below 19.0 ft more frequently than once every 25 years.

At a water elevation of 19.5 ft, the average depth of Kenansville Lake will be about 2.2 ft and only about 0.2% of the area will have depths exceeding 4 ft. At an elevation of 19.0 ft, the average depth of Kenansville Lake will be about 1.8 ft and none of the remaining inundated area will have depths exceeding 4 ft. Kenansville Lake is shallow and has extensively vegetated littoral areas. These areas provide valuable spawning and nursery habitat that should help maintain the sport fishery in the lake. However, due to the lack of significant deep-water refugia, sport fish abundance may fluctuate widely, and the Kenansville Lake may experience fish kills during droughts.

Blue Cypress Water Management Area EHC

Managing the BCWMA to maintain snail kite nesting habitat entails establishing a hydrologic regime that maintains a balance between prolonged hydroperiods, which are optimal for the Florida apple snail (*Pomacea paludosa)*, the primary prey of snail kites, and periodic dry-downs which maintain shrubs and emergent vegetation for nesting and foraging habitat. Optimal nesting habitat for snail kites is provided when at least half the marsh dries at a minimum of every 4.5 years, while total dry-down of the marsh should not occur more frequently than once every 2.5 years. To maximize nesting success, water depths of at least 1.5 ft need to be maintained under nest sites throughout nesting season. Optimal foraging habitats for snail kites (slough intermixed with emergent marsh) may have longer

hydroperiods than optimal nesting habitats, although these habitats are not considered to be exclusive of each other.

Most of the marsh acreage in the BCWMA, excluding Lake Miami Ranch, lies between 20.5 and 22.0 ft (**Table 3**). In Lake Miami Ranch, most of the acreage (approx. 2,850 acres) lies between 18.5 and 21.0 ft. Most of the acreage in BCWMA-East, which has historically been the most important area of the BCWMA for snail kite nesting lies between 21.0 and 22.5 ft (**Table 3**).

Table 3. Stage-area relationships (in cumulative acres) for the BCWMA. This table does not include Lake Miami Ranch in BCWMA-West which has 2,850 acres lying below the 21.0 ft contour.

Elevation (ft)	BCWMA-West (acres)	BCWMA-East (acres)	Total acres	Percent of Total Acreage
20.5	8.1	77.0	85.1	1.2%
21.0	459.1	1,723.3	2,182.4	30.9%
21.5	1,451.7	3,893.0	5,344.7	75.7%
22.0	1,605.3	4,657.5	6,262.8	88.7%
22.5	1,662.5	4,926.6	6,589.1	93.3%
23.0	1,720.1	5,042.4	6,762.5	95.8%
23.5	1,776.4	5,146.2	6,922.6	98.0%
24.0		5,249.2	7,025.6	99.5%
24.5		5,286.1	7,062.5	100.0%

Water management in the BCWMA is dictated by measures outlined the 1996 USFWS BO. Managing water within these constraints allows SJRWMD to have incidental take protection without violating the Endangered Species Act. The EHC for BCWMA incorporate the conditions outlined in the BO, but also contain provisions to maintain natural seasonal fluctuations, limit water level recession, and protect against fish kills in Lake Miami Ranch. EHC are applicable to the entire BCWMA.

Each sub-unit of the BCWMA operates as a flat pool. Thus, only one water level gauge is needed to assess how well EHC are met within each of the sub-units. For BCWMA-East (Ansin East) and BCWMA-West (Lake Miami Ranch), the gauges used to assess EHC are 440 (SJRWMD Hydron gauge #01100440) and 441 (SJRWMD Hydron gauge #01100441), respectively. Both gauges are located at Structure S-251. For Ansin West, which is isolated from Lake Miami Ranch, EHC are monitored at gauge 530 (SJRWMD Hydron #01260530).

The water management plan developed for the BCWMA will create hydrology that has extended hydroperiods and infrequent dry downs below an elevation of 21.5 ft. The elevation of 21.5 ft was established based on documented snail kite use of the area in conjunction with analysis of stage-area curves and on-site visits by SJRWMD and USFWS staff. In the BCWMA, a CCE elevation was not established based on the distribution of organic soils as it is in other project areas. A major concern of the USFWS was that dry-downs below 21.5 ft could cause a population collapse of the Florida apple snail. Apple snail populations generally

remain low for approximately two years following an extreme drying event. Extreme drying events that occur with a return frequency greater than once every two years may have the potential to prevent apple snail populations from recovering and reaching levels that will support snail kites.

The environmental hydrologic criteria for the BCWMA and the basis for their selection as ecologically important components of the natural hydrology are:

1. **Mean Water Elevation –**

   The long-term (30-year) average water elevation should equal or exceed 22.5 ft.

The BO specifies a mean water level elevation criterion of 22.5 ft to sustain extensive areas of shallow, frequently inundated marsh. Water levels at 22.5 ft will inundate approximately 4,800 acres of the BCWMA to depths between 1.5 and 2.0 ft (**Table 3**).

2. **Frequency of Inundation –**

   The mean long-term (30-year) inundation frequency of the 22.5 ft elevation should equal or exceed 75%.

A frequency of inundation criterion was created in conjunction with a mean depth criterion to ensure that strongly skewed or bimodal depth frequency distributions do not occur. An inundation frequency of 75% is specified in the BO to ensure prolonged hydroperiods for this elevation.

3. **Maximum Water Level –**

   Water elevations should not exceed 24.5 ft for more than 30 continuous days more frequently than once every 10 years.

Water levels at or above 24.5 ft, which occurred for an extended interval during 1991, severely stressed less flood tolerant trees in the eastern half of the BCWMA, many of which were used by snail kites for nesting. At this elevation, greater than 75% of the BCWMA is flooded to depths exceeding 3 ft. This criterion is specified in the BO. In addition, water levels above 24.5 ft violate flood control constraints of the BCWMA.

4. **Low Water Levels –**

   Desirable 1-Day Drying Event — A 1-Day low-water elevation of 21.5 ft should occur more frequently than once every 4.5 years, but less frequently than once every 2.5 years.

This criterion, specified in the BO, ensures that occasional extreme dry-downs will occur, but prevents extreme drying events from occurring too frequently. At a water elevation of 21.5 ft, approximately 1,700 acres in the BCWMA (excluding Lake Miami Ranch) will be dry.

Approximately 3,162 acres will have water depths of 0.5 ft or less and 2,180 acres will have depths greater than 0.5 ft. This is expected to provide adequate refugia to ensure survival of apple snail populations throughout the dry season. The return frequency of 2.5 years and 4.5 years corresponds to the lower and upper limits of the optimal dry-down intervals for maintaining snail kite nesting habitat.

Desirable 30-Day Continuous Lows –

Desirable 5-7-Year Low — Water levels should fall below 21.5 ft for at least 30 continuous days at least once every 5 to 7 years.
Desirable 10-Year Low — Water levels should fall below the 21.0 ft elevation for at least 30 continuous days once every 10 years.
Desirable 15-Year Low — Water levels should fall below the 20.5 ft elevation for at least 30 continuous days once every 15 years.

These criteria are intended to allow for more extreme drying events of sufficient duration to rejuvenate the exposed marsh habitat. Dry-down durations of 30 days correspond to the estimated minimum exposure interval needed to allow for seed germination of many species of herbaceous vegetation such as sawgrass and maidencane. Only the dry-down criterion for the 21.5 ft elevation is specified in the BO.

Undesirable 60-Day Low — Water levels should not fall below 21.0 ft for more than 60 continuous days more frequently than once every 10 years.

This criterion, not specified in the BO, prevents more extensive dry-downs from occurring for extended durations.

5. Timing of Fluctuations –

1-Day Yearly Minimum — Should occur between April 1 and June 30 in more than 60% of the years.
1-Day Yearly Maximum — Should occur between August 1 and November 30 in more than 60% of the years.

These criteria ensure a natural wet-dry season in the hydrologic cycle is maintained so that plant communities and animal populations that have adapted to those conditions will be sustained.

6. Water Level Recession Rates –

7-Day — When water levels are at or below 23.0 ft, recession rates should not exceed 0.5 ft during any continuous 7-day interval more than 5% of the time.
30-Day — When water levels are at or below 23.0 ft, recession rates should not exceed 1.2 ft during any continuous 30-day interval more than 5% of the time.

This criterion, not specified in the BO, ensures that water level recession rates are slow enough to protect ecological communities and prevent abandonment of snail kite nests by breeding adults.

7. <u>Minimum Water Levels for Lake Miami Ranch</u> — Water levels should exceed 20.5 ft at least 95% of the time, never falling below 18.5 ft.

To maintain the integrity of the sport fishery in Lake Miami Ranch, maximum depths should rarely fall below 2.5 ft (D. Cox, FWC pers. comm.). Below 20.5 ft, the lake will have approximately 600 acres with a depth of 2.5 ft or greater. If water levels fall to 18.5 ft, only a small area in the BCWMA will provide suitable sport fish habitat. Low DO concentrations, resulting in fish kills, would be likely.

St. Johns Water Management Area EHC

The 6,280-acre SJWMA was built to segregate stormwater from agricultural lands from the marsh conservation areas, improve water quality, and provide a water source for farm irrigation. Original plans for the SJWMA did not focus on environmental goals other than improving water quality and meeting irrigation needs. As with the BCWMA, the SJWMA was designed for nutrient retention. However, after flooding, the SJWMA developed into a trophy fishery for Largemouth Bass (*Micropterus salmoides*). Therefore, EHC for the SJWMA provide guidelines for protecting this valuable sport fishery. It must be emphasized that since the SJWMA is a "water management area", the EHC have second priority to any future goals that may be established to enhance the water quality and water supply benefits of the project area. The water level gauge to be used for monitoring is upstream of structure S-96B (SJRWMD Hydron gauge #00960390).

1. <u>Mean Water Level</u> –

The long-term (30-year) average water elevation should be equal to or greater than 19.0 ft.

As a general guideline to protect fisheries in impoundments that lack shoreline vegetation, the mean water elevation should ensure that at least 50% of the impounded area has depths exceeding 5.0 ft. A mean water elevation of 19.0 ft in SJWMA will result in an average depth of 5.2 ft. In comparison, from 1994–2014, the average water elevation in the SJWMA, was 20.5 ft resulting in an average water depth of 6.7 ft in the impoundment.

2. <u>Minimum Lake Water Levels</u> –

<u>Undesirable 5-Year Low</u> — Water levels should not fall low enough to result in a mean water depth of less than 3.5 ft more frequently than once every 5 years (17.0 ft).
<u>Undesirable 10-Year Low</u> — Water levels should not fall low enough to result in a mean water depth of less than 3 ft more frequently than once every 10 years (16.5 ft).

<u>Undesirable 25-Year Low</u> — Water levels should not fall low enough to result in a mean water depth of less than 2.5 ft more frequently than once every 25 years (16.0 ft).

Water fluctuations can be beneficial to native sport fishes because drying events revitalize vegetated shoreline spawning and nursery habitats and increase primary and secondary production. Large year-classes of Largemouth Bass are generally produced after such drying events. For most reservoirs in the USJRB, water level fluctuations are addressed by the EHC. However, desirable drying events are not addressed in the EHC for the SJWMA for two reasons: 1) the area is surrounded by levees and vegetated shoreline habitat is sparse and, 2) drying events can exacerbate water quality issues by causing nutrient release from exposed soil. Because emergent wetland vegetation is sparse in the SJWMA, the minimum lake water level criteria only address average water depths.

Three Forks Marsh Conservation Area EHC

Because of the wide range of ground elevations that occur in the TFMCA (10.5–18.0 ft), the entire area will not be managed as a single unit. The main outflow structure (S-257) has a weir crest at 18.6 ft. Hydrologic modeling indicated that with this crest height, deep organic soil in the southern Mary A parcel will experience severe overdrainage resulting in substantial soil oxidation. Therefore, Mary A has been isolated from the rest of the TFMCA by a levee along its northern border with Sartori East (**Figure 6**) and is operated independently of the other units. The Sartori East and Cross Triangle parcels will be completely hydrologically reconnected and operate as a single unit and will be jointly referred to as the TFMCA in discussion of the EHC.

TFMCA Mary A EHC

When water levels in Mary A are higher than 19.6 ft, water will flow into the TFMCA via an earthen spillway located at the western terminus of the northern levee. An adjacent, 30-inch gated culvert, with an invert elevation of 15.0 ft, will allow for additional drainage from Mary A. The stage-area curve for Mary A is presented in **Figure 8**. The gauge for monitoring water levels in Mary A is SJRWMD Hydron gauge #35425324.

1. **<u>Frequency of Inundation</u> –**

   The long-term (30-year) inundation frequency of the 18.5 ft elevation should be no less than 60%.

EHC for Mary A focus on protecting organic soils from oxidation. Since greater than 99% of Mary A lies below the 18.5 ft elevation **(Figure 8)**, this elevation should be flooded no less than 60% of the time. This is consistent with EHC for other project areas where protecting organic soils is a priority.

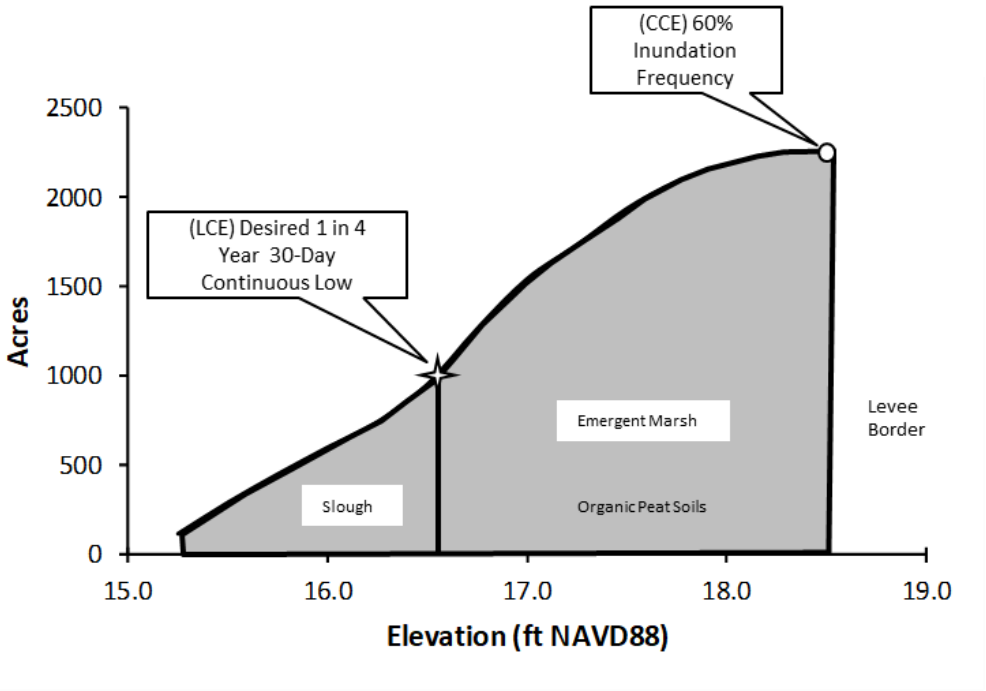

Figure 8. Stage-area curve for Mary A.

2. <u>Maximum Water Levels</u> –

<u>14-Day</u> — Water elevation should not exceed 20.5 ft for more than 14 continuous days more frequently than once every 10 years.
<u>30-Day</u> — Water elevation should not exceed 20.0 ft for more than 30 continuous days more frequently than once every 10 years.

These durations correspond to the time water levels are 4.0 ft and 3.5 ft above the LCE of 16.5 ft and are intended to protect emergent plant communities at the lower elevations from excessive flooding stress. At a water elevation of 20.5 ft, 1,937 acres of Mary A are flooded to depths > 3 ft. Greater than 42% of the area would be flooded to depths > 4 ft. At 20.0 ft, greater than 68% of the area would be flooded to depths > 3.0 ft.

3. <u>Minimum Water Levels</u> –

<u>Desirable 30-Day Low</u> — Water levels should fall to or below 16.5 ft for at least 30 continuous days at least once every 4 years.

The LCE of 16.5 ft should be exposed for 30 continuous days in at least 25% of the years. A maximum critical elevation is not needed since a transition zone between wetlands and uplands does not exist. At 16.5 ft, about 58% of Mary A will be exposed. This low-water level provides critical drying events needed to allow seed germination of emergent marsh plants.

4. <u>Timing of Fluctuations</u> –

1-Day Yearly Minimum — Should occur between April 1 and June 30 in more than 60% of the years.
1-Day Yearly Maximum — Should occur between August 1 and November 30 in more than 60% of the years.

These criteria ensure that natural wet-dry season water level fluctuations are maintained.

Seasonal Flooding Requirements — Monthly average water levels for the months January, February, March, September, and October should equal or exceed 18.0 ft during greater than 90% of the years.

To discourage willow establishment via seed germination, average water levels during the months of January, February, and March should exceed 18.0 ft during > 90% of the years. Rapid re-flooding, to the extent possible, should occur in July and August and average water levels in both September and October should also exceed 18.0 ft. At a water elevation of 18.0 ft about 97% of Mary A will be flooded to depths sufficient to discourage germination of willow seeds in January to March and to submerge and kill saplings in September to October.

5. **Water Level Recession Rates –**

7-Day — When water levels are at or below 19.5 ft, recession rates should not exceed 0.5 ft during any continuous 7-day interval more than 5% of the time.
30-Day — When water levels are at or below 19.5 ft, recession rates should not exceed 1.2 ft during any continuous 30-day interval more than 5% of the time.

Water level recession rates that are too rapid can cause fish kills and degrade water quality in receiving water bodies.

TFMCA Sartori East and Cross Triangle EHC

Because of soil subsidence, it was not possible to restore the entire TFMCA to emergent marsh using only gravity drainage through S-257. Instead, the northern half of the TFMCA (ground elevations below 15.0 ft) has been permanently inundated and converted to shallow open water, with an abundance of water lilies and spatterdock (*Nuphar advena*). Emergent marshes developed in the southern third and eastern half of the TFMCA. The EHC developed for the TFMCA attempt to balance the health of both the emergent marsh and prevent fish kills in the deeper, open water areas during dry periods. The criteria were set to minimize short-term fluctuations in the depth of the lake, while allowing for dry-down of the marsh at appropriate frequencies. The EHC for the TFMCA are identical to those reported in the 2003 EIS for Project Features North of the Fellsmere Grade. The stage-area curve for the TFMCA is presented in **Figure 9**. Water level gauges to be used for monitoring are located upstream of Structure S-257 (SJRWMD Hydron gauge #32334067) and SJRWMD Hydron gauge #35415322 in Sartori East.

1. **<u>Frequency of Inundation</u> –**

   The long-term (30-year) inundation frequency of the 16.6 ft elevation should be no less than 60%. The 15.1 ft elevation should be flooded at least 95% of the time.

The EHC for the TFMCA focus on protecting peat soils from oxidation and creating hydrologic conditions suitable for supporting emergent marsh, while preventing fish kills. At 16.6 ft, average water depths in the TFMCA will be approximately 2.7 ft. However, given the large extent of marsh habitat, average depth of the entire area is not necessarily a useful metric for analyzing suitable minimum depths needed to prevent fish kills. At an elevation of 16.7 ft, approximately 4,000 acres of the TFMCA will have average depths exceeding 3 feet, with nearly 1,500 and 1,000 acres having average depths exceeding 4 and 5 ft, respectively.

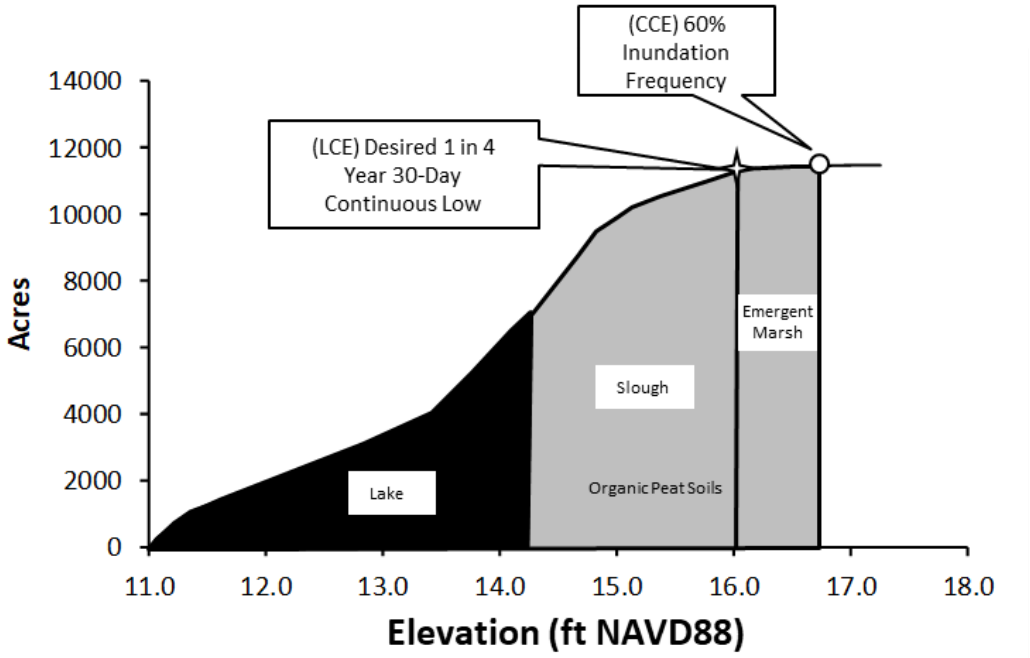

Figure 9. Stage–area curve for the TFMCA, not including Mary A.

To protect the sport fishery, water levels in the TFMCA should exceed 15.1 ft at least 95% of the time. At this elevation, approximately 1,400 acres (20%) of the lake will have depths exceeding 3 ft. The TFMCA is similar to Kenansville Lake in that it will be shallow with extensively vegetated littoral zones.

2. **<u>Minimum Water Levels</u> –**

   <u>Desirable 30-Day Low</u> — Water levels should fall to or below 16.1 ft for 30 continuous days at least once every 4 years.
   <u>Desirable 60-Day Low</u> — Water levels should fall to or below 15.6 ft for 60 continuous days at least once every 10 years.

At a water elevation of 16.1 ft, approximately 800 acres of the TFMCA soils will be exposed. This low-water level will help rejuvenate emergent plant communities along the shoreline. The mean depth of the area will be approximately 2.3 ft, although nearly 1,300 acres in the shallow lake will have depths exceeding 4 ft, which should protect the sport fishery that has developed there. At a 15.6 ft elevation, approximately 1,300 acres of the TFMCA soils will be exposed.

3. Minimum Lake Water Levels –

Undesirable 10-Year Low — Water levels should not fall below 14.6 ft more frequently than once every 10 years.

At a water elevation of 14.6 ft, the average depth in the TFMCA will be approximately 1.4 ft and only 300 acres will have depths exceeding 3 ft. Due to the lack of significant deep-water refugia at this water elevation, DO concentrations may fluctuate widely, and fish kills may occur.

4. Timing of Fluctuations –

1-Day Yearly Minimum — Should occur between April 1 and June 30 in more than 60% of the years.
1-Day Yearly Maximum — Should occur between August 1 and November 30 in more than 60% of the years.

These criteria ensure that natural wet-dry seasons are maintained.

5. Water Level Recession Rates –

7-Day — When water levels are at or below 17.6 ft, recession rates should not exceed 0.5 ft during any continuous 7-day interval more than 5% of the time.
30-Day — When water levels are at or below 17.6 ft, recession rates should not exceed 1.2 ft during any continuous 30-day interval more than 5% of the time.

Water level recession rates that are too rapid can cause undesirable decreases in DO concentrations and result in fish kills in receiving water bodies.

St. Johns Marsh Conservation Area EHC

The SJMCA is mostly underlain by deep organic soils. Since the construction of C-40 canal (prior to 1940s) and L-74W (1980s), much of the SJMCA has been severely over-drained and soil oxidation and subsidence has been a recurrent problem. The historic floodplain area of the SJMCA was severely truncated by the construction of south to north perimeter levees resulting in little east-west variability in current ground surface elevations. However, moving downstream, in a south to north direction, there is a significant drop in ground elevations of the SJMCA over a short distance. This vertical drop (> 5 ft.) is the most extreme gradient of any stretch of the entire St. Johns River and helps contribute significantly to the overdrainage

of the area, particularly within upstream reaches. Because of the relatively steep elevation gradient from south to north, a single set of EHC cannot be used to determine if hydrologic targets are being met over the entire SJMCA. Therefore, EHC were developed for three sites located along the south to north gradient using cross-sectional survey data **(Figure 10).** Water level gauges are located along each transect. From south to north, the sites where EHC are applied are Six Mile (SJRWMD Hydron gauge #18323731), Mulberry Mound (SJRWMD Hydron gauge #00560240), and Big Bend (SJRWMD Hydron gauge #00570250) **(Figure 6)**.

A primary environmental goal of the SJMCA EHC is to reduce overdrainage that will reduce soil oxidation and subsidence, help limit willow expansion, and preserve herbaceous emergent marsh habitat. EHC for the SJMCA were originally presented in the 2003 federal EIS. The EHC presented here are revised to reflect current ground elevations in the SJMCA, which in some instances are up to a foot lower than the elevations used to establish the

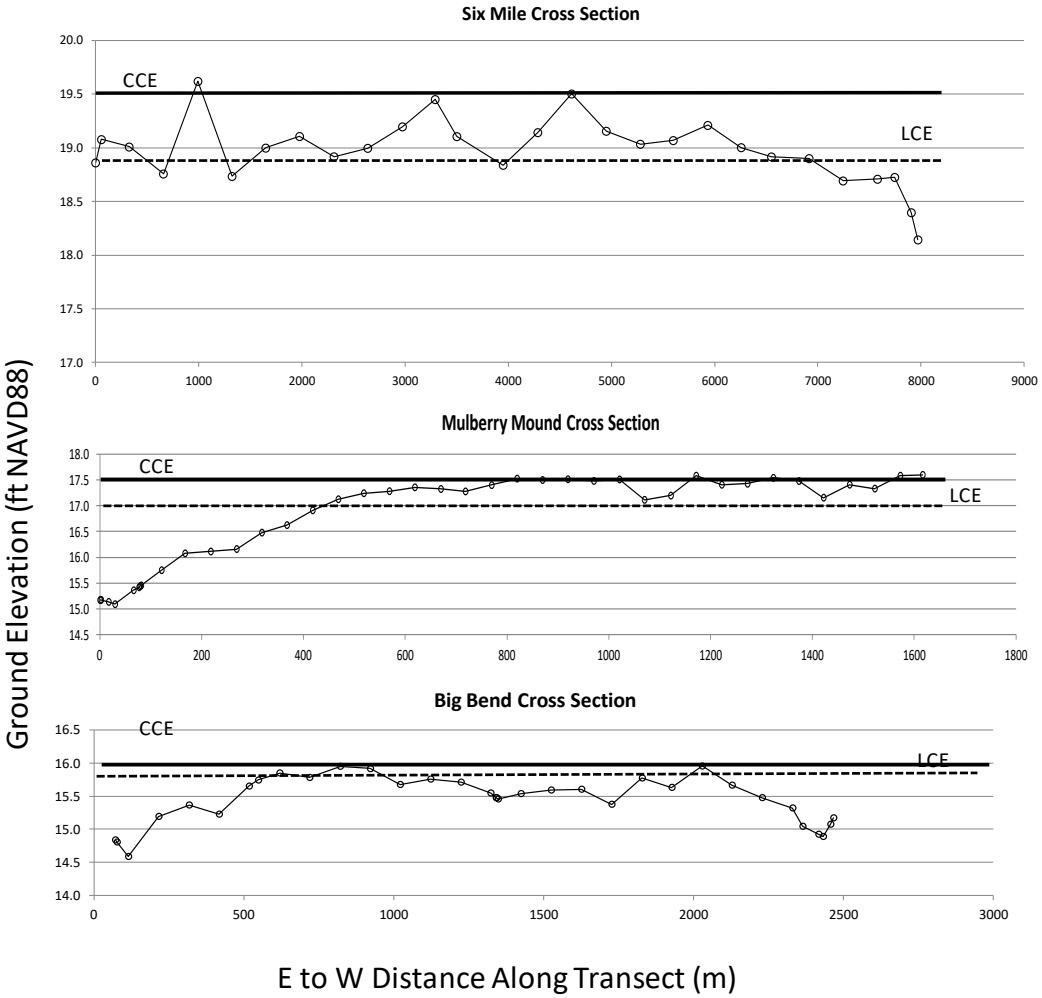

Figure 10. Cross sectional survey data in 2013 for three SJMCA transects showing central critical elevations (CCE; solid line) and lower critical elevations (LCE; dashed line).

original EHC in 2003. EHC for all transects in the SJMCA are presented in **Table 4**. Since water levels in the SJMCA are not regulated by a downstream water control structure, maximum water level EHC are not applicable for this area.

Table 4. EHC for the Six Mile, Mulberry Mound and Big Bend transects in the SJMCA.

EHC	Six Mile	Mulberry Mound	Big Bend
Frequency of Inundation	19.5 ft should be flooded ≥ 60% of the time	17.5 ft should be flooded ≥ 60% of the time	16.0 ft should be flooded ≥ 60% of the time
Low Water Levels	Desirable Low Should fall below 18.8 ft for at least 30 continuous days at least once every 4 years	Desirable Low Should fall below 17.0 ft for at least 30 continuous days at least once every 4 years	Desirable Low Should fall below 15.5 ft for at least 30 continuous days at least once every 4 years
Timing of Fluctuation **1**-Day Minimum 1-Day Maximum Seasonal Flooding Requirements	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 – Nov. 30 Average monthly water level of 19.5 ft equaled or exceeded ≥ 90% of years in Jan-Mar and Sep-Oct	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 – Nov. 30 Average monthly water level of 17.5 ft equaled or exceeded ≥ 90% of years in Jan-Mar and Sep-Oct	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 – Nov. 30 Average monthly water level of 16.0 ft equaled or exceeded ≥ 90% of years in Jan-Mar and Sep-Oct
Recession Rates 7-Day 30-Day	When water levels are ≤ 20.5 ft, they should recede at a rate no greater than: -0.5 ft in 7days -1.2 ft in 30 days	When water levels are ≤ 18.5 ft, they should recede at rate no greater than: -0.5 ft in 7days -1.2 ft in 30 days	When water levels are ≤ 17.0 ft, they should recede at a rate no greater than: -0.5 ft in 7days -1.2 ft in 30 days

1. **Frequency of Inundation –**

   The long-term (30-year) inundation frequency of the CCE's should be no less than 60%.

To ensure there will be no net loss of organic soil through oxidation, maximum elevations along each transect should be flooded at least 60% of the time. Based upon recent survey data, CCE for the Six Mile, Mulberry Mound, and Big Bend transects are 19.5 ft, 17.5 ft, and 16.0 ft, respectively (**Figure 10**).

2. **Minimum Water Levels –**

   Desirable 30-Day Low — Water levels should fall to or below the LCE's for at least 30 continuous days at least once every 4 years.

The LCE should be exposed for 30 continuous days at least once every 4 years. A UCE is not needed since a transition zone between wetlands and uplands does not occur in the SJMCA.

3. **Timing of Fluctuations –**

   1-Day Yearly Minimum — Should occur between April 1 and June 30 in more than 60% of the years.

1-Day Yearly Maximum — Should occur between August 1 and November 30 in more than 60% of the years.

Seasonal Flooding Requirements — Monthly average water levels for the months January through March and September through October should equal or exceed the CCE's in 90% of years.

To discourage willow establishment through seed germination and seedling establishment, the EHC specify that average water levels during the months of January, February, and March should exceed the CCE in more than 90% of the years (**Table 4**). Rapid re-flooding, to the extent possible, should occur in July and August and average water levels in both September and October should also exceed the CCE.

4. **Water Level Recession Rates –**

7-Day — When water levels are at or less than one foot above the CCEs, recession rates should not exceed 0.5 ft during any continuous 7-day interval more than 5% of the time.
30-Day — When water levels are at or less than one foot above the CCEs, recession rates should not exceed 1.2 ft during any continuous 30-day interval more than 5% of the time.

Jane Green Detention Area EHC

Flooding imposes severe stress on many plants mainly due to anoxic conditions that inhibit the transport of oxygen from the leaves/stems to the roots of the plant. To prevent deleterious effects of prolonged flooding on the forested riparian ecosystem of Jane Green Creek, EHC for this area are based on reported flood tolerances of the dominant tree species found there (e.g., bald cypress [*Taxodium distichum*] and Carolina ash [*Fraxinus caroliniana*]). Originally, ECH were set for the Jane Green Creek Detention Area (Jane Green) in 1980. These updated EHC were developed with more recent data to determine appropriate flood constraints. Water levels in Jane Green are monitored at structure S-161A (SJRWMD Hydron #00600280).

1. **Frequency of Inundation –**

The long-term (30-year) inundation frequency of the 21.8 ft elevation should be less than or equal to 60%.

Hardwood swamp communities in Jane Green occur between ground elevations of 21.8 and 23.8 ft. According to the original EHC, these elevations should be flooded no more than 120 days during the dormant season (November 1–March 15) and 90 days during the growing season (March 15–October 31). Combining these two durations (120 Days + 90 Days = 210 Days) equates to 57% of a year. Therefore, we established a more simplified criterion that the 21.8 ft elevation should be inundated ≤ 60% of the time.

The long-term (30-year) inundation frequency of the 23.8 ft elevation should be less than or equal to 30%.

The transition zone between hardwood swamp and mesic and hydric hammocks in Jane Green occurs between the 23.8 and 24.8 ft contours. The original EHC suggest these elevations should be flooded no more than 90 days during the dormant season and 60 days during the growing season (150 days or 41% of a year). Based on updated flooding tolerance data for the dominant tree species in mesic and hydric hammock, a more appropriate maximum flood duration criterion is that the 23.8 ft elevation should not be flooded ≥ 30% of the time.

2. <u>Maximum Water Levels</u> –

<u>14-Day</u> — Water levels should not exceed 28.8 ft for more than 14 continuous days more frequently than once every 10 years.
<u>1-Day</u> — Water elevation should not exceed 33.8 ft for more than one day more frequently than once every 25 years.

Deep flooding of varying intensity can cause extensive tree mortality, even if it only occurs for short durations. The original EHC proposed that the 28.8 ft elevation should be flooded no more than 14 continuous days once every 10 years. At this water elevation, nearly 1,600 acres of the hardwood swamp and hammock communities in Jane Green will experience depths > 4 ft with nearly 900 acres experiencing depths > 6 ft. In addition, the original EHC proposed that the elevation of 33.8 ft should not be flooded for more than 2 continuous days. This is an extreme flooding event at which over 1,200 acres of Jane Green will be flooded to depths > 10 ft. At this elevation, high mortality of less flood tolerant species will occur in all communities. This EHC was modified by reducing the duration to one day, even though this water level is likely to be exceeded during infrequent major storm events when floodwaters are held in Jane Green to alleviate downstream flooding under flood control operational protocol.

Given that water levels in Jane Green will directly reflect seasonal rainfall patterns and discharge from the area is constant, except when the structures are operated for flood control, seasonal criteria for annual low and high-water levels were not established. In addition, recession rate EHC are not necessary given the slow recession that will occur when water levels are below the weir crest of S-161A and flow only occurs through the uncontrolled box culverts and the gated low flow discharge culverts in S-161.

ZONE B DISCHARGE SCHEDULES

Hydrologic Modeling

Zone B discharge schedules were developed through an iterative process using simulated water level data generated from the Upper St. Johns River Basin Hydrologic Model. Simulated water levels for each project area were derived for various Zone B discharge scenarios using historic rainfall records and calculated runoff. Simulations for the water management areas included projected irrigation withdrawals. Water levels generated by the hydrologic model were summarized and compared to the EHC. Through this iterative process, Zone B discharge schedules that best met all EHC simultaneously, for all project areas, were selected for inclusion in the EWMP. Since EHC represent optimal hydrologic targets for evaluating environmental performance in each project area, factors such as flood control regulation schedules, impediments to sheet-flow during the dry season, and channelized flows, are expected to make it difficult to meet EHC for all project areas simultaneously.

Unless otherwise stated, the EWMP was based upon simulated hydrologic data derived from 33 years (1975–2008) of historic rainfall data. Because these data may not reflect future rainfall conditions and because of the degree of uncertainty inherent in this type of modeling effort, hydrologic model simulations may not accurately represent actual post-project hydrologic conditions. Therefore, these management plans may be modified if post-project monitoring indicates the EHC are not being met due to differences between observed and modeled water levels or changes in rainfall or other climatic variables.

Fort Drum Marsh Conservation Area Zone B Discharges

The following Zone B discharge condition best met the EHC for the FDMCA, while preventing potential interference with St. Johns Improvement District (SJID) discharges:

Normal discharges through FDMCA S-252 project structures will occur as per the MWCM. Structure S-252D will be opened during the dry season months of February through May and remain closed during the rest of the year. If rainfall conditions warrant the SJID to make discharges during the months S-252D is open, then S-252D will be closed until SJID discharges cease. Occasionally, water levels in the C-52 canal may exceed water levels in the FDMCA causing backflow through S-252D. Generally, backflow conditions occur whenever the water level in the C-52 canal at SR 60 is at least 0.2 ft higher than water levels in the FDMCA. If backflow conditions exist, S-252D will be closed.

Table 5. Predicted EHC related performance summary for the FDMCA (1975- 2008).

FDMCA	EHC (S252C)	Model S-252D Open Feb-May
Frequency of Inundation	23.0 ft should be flooded ≥ **60%** of the time	89%
Maximum Water Elevations	Not to exceed	Occurred:
14-Day	26.5 ft	1/33 Years
30-Day	26.0 ft	1/17 Years
	more than once every 10 years	
Low and High Water Levels	Desirable 30-Day Low Should fall below 22.5 ft for 30 continuous days at least once every 4 years	Occurred: 1/7 Years
	Desirable 30-Day High Should equal or exceed 24.0 ft for 30 continuous days at least once every 4 years	Occurred: 1/1.1 Years
	Undesirable 60-Day Low Should not fall below 21.5 ft for more than 60 continuous days more frequently than once every 10 years	Occurred: 1/33 Years
Timing of Fluctuation	During ≥ **60%** of years occurs between:	% of years met:
1-Day Yearly Minimum	Apr. 1 – Jun. 30	85%
1-Day Yearly Maximum	Aug. 1 - Nov. 30	68%
Seasonal Flooding Requirements	Average monthly water levels equaled or exceeded ≥ **30%** of years:	% of years met:
	Apr. (70% of marsh) > 23.2 ft	71%
	May (50% of marsh) > 22.9 ft	71%
	Jun. (50% of marsh) > 22.9 ft	82%
	Jul. (68% of marsh) > 23.2 ft	91%
	Aug. (88% of marsh) > 23.4 ft	88%
	Sep. (88% of marsh) > 23.4 ft	94%
Recession Rates	When water levels are ≤ 25.0, they should not recede at a rate greater than:	% of time criteria are met:
7-Day	-0.5 ft in 7 days	100%
30-Day	-1.2 ft in 30 days	100%
	more than 5% of the time	

Hydrologic model simulations revealed that discharges through S-252D into the BCWMA are needed to best meet the FDMCA EHC (**Table 5)**. Otherwise, desirable drying events will not occur often enough, and flooding durations will be excessive. However, discharges through S-252D during the rainy season may create tail-water conditions that restrict discharges from the SJID when they need to make discharges from their reservoir into the BCWMA.

Under this discharge schedule, modeling indicated nearly all the EHC are met, except for 30-day drying events to 22.5 ft (**Table 5**) which are predicted to occur once every 7 years instead of the desired once every 4 years.

Blue Cypress Marsh Conservation Area Zone B Discharges

The EHC for the BCMCA were best met by the following:

The S-250 culvert structures will provide for Zone B flows to the SJMCA without supplemental discharges through S-96C. To prevent fish kills downstream of S-96C

following flood releases, S-96C will be closed 20% per day for five consecutive days after or just prior to reaching the regulation schedule.

Under this best-case scenario, loss of organic soil may occur at elevations above 21.8 ft because the inundation frequency of these higher elevations is less than 60% (**Table 6)**. In addition, hydrologic conditions may facilitate willow expansion by promoting seedling survival during early spring months due to lower than desirable water levels and delaying re-flooding that could potentially drown newly emergent seedlings. Several scenarios have been investigated to store more water in the BCMCA by adjusting the Zone A flood control schedule to: 1) delay the timing of the seasonal drawdown and 2) store more water during the wet season. SJRWMD plans to initiate discussions with USACE about potential changes and their positive environmental and water supply impacts. Future changes to the flood control schedules may be possible if the flood control objectives for the USJRBP continue to be met entirely under the revised schedules.

Table 6. Predicted EHC related performance summary for the BCMCA (1975-2008).

BCMCA	EHC (BCL)	Model (1975–2008)
Frequency of Inundation (IF)	22.0 ft should be flooded **≥ 60%** of the time	47% 21.8 = 60% IF
Maximum Water Elevations 14-Day 30-Day	Not to exceed 25.5 ft 25.0 ft more than once every 10 years	Occurred: 0/33 Years 0/33 Years
Low and High Water Levels	Desirable 30-Day Low Should fall below 21.3 ft for 30 continuous days at least once every 4 years	Occurred: 1/2 Years
	Undesirable 60-Day Low Should not fall below 20.2 ft for more than 60 continuous days more frequently than once every 10 years	Occurred: 1/33 Years
Timing of Fluctuation 1-Day Yearly Minimum 1-Day Yearly Maximum Seasonal Flooding Requirements	During ≥ 60% of years occurs between: Apr. 1 – Jun. 30 Aug. 1 - Nov. 30 Average monthly water levels equaled or exceeded ≥ 30% of years: Apr. > 22.2 ft May > 21.7 ft Jun. > 21.7 ft Jul. > 22.0 ft Aug. > 22.5 ft Sep. > 22.5 ft	% of years met: 71% 53% % of years met: 27% 29% 29% 21% 3% 12%
Recession Rates 7-Day 30-Day	When water levels are ≤ 23.1 ft, they should not recede more than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time.	% of time criteria are met: 100% 100%
Minimum Water Levels for Blue Cypress Lake	Water level should not fall below: 18.5 ft more frequently than 1 out of 5 years 16.7 ft more frequently than 1 out of 50 years 16.2 ft more frequently than 1 out of 100 years	Occurred: 0/33 Years 0/33 Years 0/33 Years

During the early years of project operation, rapid closure of S-96C after flood water releases caused numerous fish kills downstream of the structure. Although exact causal mechanisms are unknown, the fish kills occurred consistently when discharges fell from 1,000 cfs to 0 cfs in less than 24 hours. To prevent further fish kills, a strategy to close S-96C was implemented whereby discharges through the structure was reduced 20% per day for five consecutive days instead of closing the structure immediately when the flood control schedule was reached. Since the implementation of this 5-day closure strategy, no downstream fish kills have occurred in association with closure of any large flood control structures throughout the USJRBP.

Blue Cypress Water Management Area Zone B Discharges

The EHC for the BCWMA were best met by basing Zone B discharges through S-96D on downstream water levels in the SJWMA according to the following conditions:

When water levels in the SJWMA fall to 19.8 ft or below and water levels in the BCWMA exceed 21.7 ft, 300 cfs will be discharged from the BCWMA into the SJWMA through S-96D. This 300 cfs discharge will continue until water levels in the SJWMA rise to 21.3 ft or, water levels in the BCWMA fall to 21.6 ft. When either of these conditions occurs, S-96D will be closed. If, after S-96D is closed, water levels in the BCWMA continue to decline and subsequently fall below 21.4 ft, then S-96D will be re-opened to discharge 300 cfs for an additional 25 days or until water levels in BCWMA fall below 20.0 ft. When either of these conditions are met, all discharges from S-96D will cease. If, after the primary (but no secondary) release has been made, water levels recover to exceed 21.7 ft in BCWMA and 20.5 ft in SJWMA, then the releases are "re-set", and no secondary release will be considered until such time that the trigger for the primary release has been reached again. S-251 is open only when water levels are higher in BCWMA-East than in BCWMA-West.

Currently, Ansin West is connected to Lake Miami Ranch (**see Figure 3 for area locations)** by a weir having a crest elevation of 22.5 ft. Therefore, hydrologic conditions for the two areas were analyzed separately (**Table 7**). Water releases from the BCWMA were initiated based on water levels in the SJWMA to maintain natural stochastic variability in the hydrologic regime. Regulating S-96D discharges, based on water levels in the BCWMA alone, stabilizes water levels between allowable seasonal highs and lows. Most EHC for both Lake Miami Ranch and BCWMA-East were met by basing the S-96D discharge on water levels in the SJWMA, except for the return frequencies of the desirable 30-Day drying event of the 20.5 ft elevation (**Table 7**). In addition, the timing of maximum water levels shifted toward the winter with 44–50% of the predicted maximum average levels occurring during the months of January, February, and March. Ansin West did not dry frequently enough for all of the low-water targets. Conditions in the BCWMA should be closely monitored and a more proactive role in forcing more extreme drying events may be necessary. The installation of an operable culvert in the levee isolating Ansin West from Lake Miami Ranch may also be considered.

Table 7. Predicted EHC related performance summary for the BCWMA (1975–2008).

BCWMA	EHC	Model BCWMA-East (S-251E)	Model Lake Miami Ranch (S-251W)	Model Ansin-West (Gauge 530)
Mean Water Level	22.5 ft	23.06 ft	23.09 ft	23.13 ft
Frequency of Inundation	22.5 ft ≥ 75%	82.0%	81.9%	84.4%
Maximum Water Levels 30-day	Not to exceed 24.5 ft more than once every 10 years	0/33 Years	0/33 Years	0/33 Years
Low Water Levels	Desirable 1-Day Low Should fall below 21.5 ft for 1 day once every 2.5 to 4.5 years	Occurred: 1/5 Years	Occurred: 1/5 Years	Occurred: 1/11 Years
	Desirable 30-Day Low Should fall below 21.5 ft for at least 30 continuous days once every 5 to 7 years	Occurred: 1/5 Years	Occurred: 1/5 Years	Occurred: 1/17 Years
	Desirable 30-Day Low Should fall below 21.0 ft for at least 30 continuous days at least once every 10 years	Occurred: 1/7 Years	Occurred: 1/7 Years	Occurred: 1/17 Years
	Desirable 30-Day Low Should fall below 20.5 ft for at least 30 continuous days at least once every 15 years	Occurred: 1/33 Years	Occurred: 1/33 Years	Occurred: 0/33 Years
	Undesirable 60-Day Low Should not fall below 20.5 ft for at least 60 continuous days more frequently than once every 10 years	Occurred: 1/33 Years	Occurred: 1/33 Years	Occurred: 0/33 Years
Timing of Fluctuation 1-Day Yearly Minimum 1-Day Yearly Maximum	Should occur **≥ 60%** of Years between: Apr. 1 – Jun. 30 Aug. 1 - Nov. 30	% of years met: 65% 32%	% of years met: 65% 32%	% of years met: 53% 21%
Recession Rates 7-Day 30-Day	When water levels are ≤ 23.0 ft they should not recede greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 99% 96%	% of time criteria are met: 99% 98%	% of time criteria are met: 100% 100%
Minimum Water Levels for Lake Miami Ranch	Should exceed 20.5 ft **≥ 95%** of time Water levels should not fall below 18.5 ft	Not applicable	% of time exceeded: 99% Occurred: 0/33 Yrs.	Not applicable

St. Johns Water Management Area Zone B Discharges

Discharges from the SJWMA will be controlled entirely by the flood control schedule and Zone B discharges from S-96B, for environmental purposes, are not proposed. However, guidelines have been developed for closure of S-96-B following flood control discharges to prevent fish kills immediately downstream of the structure:

To reduce the risk of fish kills downstream of S-96B following flood releases, discharges from S-96B will be reduced by 20% per day for five consecutive days after or just prior to reaching the regulation schedule.

Without Zone B discharges, all the recommended EHC for the SJWMA were met (**Table 8**). Since the SJWMA is a "water management area", the EHC are secondary to any future goals that may be established to enhance the water quality and water supply benefits of the project area.

Table 8. Predicted EHC performance summary for the SJWMA (1975-2012).

SJWMA	EHC (S-96B)	Model (1975-2012)
Mean Water Level	19.0 ft	20.8 ft
Minimum Lake Water Levels	Undesirable 1-Day Low Should not fall below 17.0 ft more frequently than once every 5 years	Occurred: 0/37 Years
	Undesirable 1-Day Low Should not fall below 16.5 ft more frequently than once every 10 years	Occurred: 0/37 Years
	Undesirable 1-Day Low Should not fall below 16.0 ft more frequently than once every 25 years	Occurred: 0/37 Years

Kenansville Lake Zone B Discharges

Water levels in Kenansville Lake are regulated by the weir and culvert structure S-250E. Currently, Kenansville Lake is not included in the most recent HSPF hydrologic model as a separate hydrologic sub-unit. Therefore, daily water levels from 2007 through 2020 were evaluated to determine if additional discharge through S-250E may be needed to meet the EHC. With outflows occurring over the weir alone and no additional discharges through the culvert, water levels in Kenansville Lake met the recommended mean and low-water level EHC over this period (**Table 9**). Given existing conditions over the past 13 years, no additional discharges through the S-250 culvert structure are recommended. Future hydrologic models for the USJRBP will include Kenansville Lake as a separate manageable hydrologic unit.

Table 9. Measured EHC performance summary for the Kenansville Lake (2007–2020).

Kenansville Lake	EHC (S-96B)	Measured Data (2007-2020)
Mean Water Level	21.0 ft	21.4 ft
Low Water Levels	Desirable 30-Day Low Should fall below 20.5 ft for 30 continuous days at least once every 4 years	Occurred: 1/3 Years
Minimum Lake Water Levels	Undesirable 1-Day Low Should not fall below 19.5 ft more frequently than once every 5 years	Occurred: 1/13 Years
	Undesirable 1-Day Low Should not fall below 19.0 ft more frequently than once every 25 years	Occurred: 0/13 Years

Three Forks Marsh Conservation Area Zone B Discharges

The TFMCA does not have a flood control regulation schedule; instead, high water levels that may cause flooding are prevented by the S-257 weir crest height (18.6 ft). Zone B management of the S-257 structure is as follows:

One of the two, 60-inch culverts at S-257 will be opened fully whenever water levels in the TFMCA > 18.6 ft and water is flowing over the S-257 weir. Discharge through the S-257 culvert will continue until water levels in the TFMCA fall to 17.6 ft, at which time discharges through the culvert will be reduced 20% per day over a period of 5 days until the culvert is closed. The culvert will remain closed until water once again rises above 18.6 ft. Low flow augmentation of Lake Washington through S-257 will occur when three conditions are all met: 1) water levels in the TFMCA are less than 17.6 ft but greater than 12.6 ft, 2) water levels in Lake Washington are less than 12.1 ft and, 3) discharge at U.S. 192 (USGS Gauge #02232000) is less than 30 cfs. When these three conditions are met simultaneously, 30 cfs will be discharged through the S-257 culvert.

This 30 cfs supplemental discharge will occur until either: 1) the average daily discharge at U.S. 192 exceeds 100 cfs for seven consecutive days, 2) water level in Lake Washington exceed 12.3 ft, or 3) the water level in the TFMCA falls below 12.6 ft. If any of these conditions occur, the S-257 culvert will be closed in the manner described above.

Hydrologic modeling indicates that the desirable minimum water level EHC may not occur frequently enough under the operational plan presented in the EIS (**Table 10**). The low elevation of 16.1 ft for 30 continuous days will only be reached once every 8 years, rather than every 4 years or less. The desirable 30-day low will only be reached once every 17 years as opposed to the desirable frequency of once every 5–10 years (**Table 10**).

The EHC for the TFMCA attempt to protect the recreational fisheries that have developed in the TFMCA, as well as maintain existing emergent wetland plant communities. To protect emergent wetlands from the adverse effects of prolonged flooding, periodic drying events are needed. These dry downs may be exacerbated by low flow discharges to augment Lake Washington during droughts. While low-water events will help protect emergent marsh plant communities, by creating conditions that enhance their reproduction and survival, low-water levels may also cause lower DO concentrations that adversely impact sport fish populations in those areas that remain flooded. It will be imperative to monitor biological conditions in the TFMCA to refine water management strategies. Modeling results suggest water levels in the TFMCA may reach extremely low levels. During the simulated drought of 1981–82, predicted water levels in the TFMCA fell below 13.6 ft, a level at which only 3,400 acres (29%) of the TFMCA would be inundated with only 300 acres having maximum depths > 2 feet. Under these conditions, fish kills in the TFMCA are likely.

Table 10. Predicted EHC performance summary for the TFMCA (1975–2008).

TFMCA	EHC (S-257)	Model (1975-2008)
Mean Water Level	16.6 ft	17.7 ft
Frequency of Inundation	16.6 ft should be flooded **≥ 60%** of the time 15.1 ft should be flooded ≥ **95%** of the time	91% 97%
Low Water Levels	Desirable 30-Day Low Should fall below 16.1 ft for at least 30 continuous days at least once every 4 years	Occurred: 1/8 Years
	Desirable 30-Day Low Should fall below15.6 ft for at least 30 continuous days at least once every 5 to 10 years	Occurred: 1/17 Years
Timing of Fluctuation 1-Day Yearly Minimum 1-Day Yearly Maximum	During **≥ 60%** of years occurs between: Apr. 1 – Jun. 30 Aug. 1 - Nov. 30	% of years met: 56% of years 56% of years
Recession Rates 7-Day 30-Day	When water levels are ≤ 17.6 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 100% 100%
Minimum Lake Water Level	Undesirable 1-Day Low Should not fall below 14.6 ft more frequently than once every 10 years	Occurred: 1/17 Years

Mary A Culvert Operations

The EHC for Mary A were best met by the following:

The culverts connecting Mary A to the rest of the TFMCA will be opened during April, May, and June and closed the rest of the year.

Although drying did not occur as frequently as desirable, hydrologic conditions in Mary A should prevent soil oxidation and help control willow seedling establishment (**Table 11**).

St. Johns Marsh Conservation Area Culvert Operations

Under the current scenario, the only environmental discharges occur through operation of the culvert in the E-7 plug:

The E-7 culvert will be opened during the months of April, May, and June and closed during all other months of the year.

Hydrologic modeling indicates that with the current canal configuration, the SJMCA will remain severely over-drained (**Tables 12, 13, and 14**). The CCE at the Six Mile, Mulberry Mound and Big Bend transects will only be inundated 7%, 23%, and 38% of the time, respectively. Higher inundation frequencies at the Big Bend transect reflect the effects of the E-7 canal plug. SJRWMD is actively exploring options to restore appropriate hydroperiods to the SJMCA. Several additional plugs in the C-40 canal have recently been constructed and more plugs are being considered to reduce potential soil oxidation.

Table 11. Predicted EHC performance summary for the Mary A Property (1975–2008).

Mary A	EHC	Model (1975-2008)
Frequency of Inundation	18.5 ft should be flooded **≥ 60%** of the time	71%
Maximum Water Levels 14-Day 30-Day	Not to exceed 20.5 ft 21.0 ft more than once every 10 years	 1/33 Years 0/33 Years
Low Water Levels	Desirable 30-Day Low Should fall below 16.5 ft for at least 30 continuous days at least once every 4 years	Occurred: 1/11 Years
Timing of Fluctuation 1-Day Yearly Minimum 1-Day Yearly Maximum Seasonal Flooding Requirements	During **≥ 60%** of years occurs between: Apr. 1 - Jun. 30 Aug. 1 - Nov. 30 Average monthly water levels equaled or exceeded **≥ 90%** of years: Jan. > 18.0 ft Feb. > 18.0 ft Mar. > 18.0 ft Sep. > 18.0 ft Oct. > 18.0 ft	% of years met: 68% 53% % of years met: 94% 94% 94% 82% 94%
Recession Rates 7-Day 30-Day	When water levels are ≤ 19.5 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 100% 100%

Table 12. Predicted EHC performance summary for the Six Mile transect (1975–2008).

SJMCA Six Mile	EHC	Model (1975-2008)
Frequency of Inundation	19.5 ft should be flooded **≥ 60%** of the time	7%
Low Water Levels	Desirable 30-Day Low Should fall below 18.8 ft for at least 30 continuous days at least once every 4 years	Occurred: 1/1 Years
Timing of Fluctuation Minimum Levels Maximum Levels Seasonal Flooding Requirements	During **≥ 60%** of years occurs between: Apr. 1 - Jun. 30 Aug. 1 - Nov. 30 Average monthly water levels equaled or exceeded **≥ 90%** of years: Jan. > 19.5 ft Feb. > 19.5 ft Mar. > 19.5 ft Sep. > 19.5 ft Oct. > 19.5 ft	% of years met: 100% 59% % of years met: 0% 3% 3% 12% 12%
Recession Rates 7-Day 30-Day	When water levels are ≤ 20.5 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 97% 93%

Table 13. Predicted EHC performance summary for the Mulberry Mound transect (1975–2008).

SJMCA Mulberry Mound	EHC	Model (1975-2008)
Frequency of Inundation	17.5 ft should be flooded **≥ 60%** of the time	23%
Low Water Levels	Desirable 30-Day Low Should fall below 17.0 ft for at least 30 continuous days at least once every 4 years	Occurred: 1/1 Years
Timing of Fluctuation Minimum Levels Maximum Levels Seasonal Flooding Requirements	During **≥ 60%** of years occurs between: Apr. 1 - Jun. 30 Aug. 1 - Nov. 30 Mean monthly water levels equaled or exceeded **≥ 90%** of years Jan. > 17.5 ft Feb. > 17.5 ft Mar. > 17.5 ft Sep. > 17.5 ft Oct. > 17.5 ft	% of years met: 91% 59% % of years met: 9% 3% 15% 35% 29%
Recession Rates 7-Day 30-Day	When water levels are ≤ 18.5 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 99% 98%

Table 14. Predicted EHC performance summary for the Big Bend transect (1975–2008).

SJMCA Big Bend	EHC	Model (1975-2008)
Frequency of Inundation	16.0 ft should be flooded **≥ 60%** of the time	38%
Low Water Levels	Desirable 30-Day Low Should fall below 15.5 ft for at least 30 continuous days at least once every 4 years	Occurred: 1/2 Years
Timing of Fluctuation Minimum Levels Maximum Levels Seasonal Flooding Requirements	During **≥ 60%** of years occurs between: Apr. 1 - June 30 Aug. 1 - Nov. 30 Mean monthly water levels equaled or exceeded **≥ 90%** of years Jan. >16.0 ft Feb. >16.0 ft Mar. >16.0 ft Sep. >16.0 ft Oct. >16.0 ft	% of years met: 32% 65% % of years met: 29% 18% 21% 71% 56%
Recession Rates 7-Day 30-Day	When water levels are ≤ 17.0 ft, they should not recede at a rate greater than: -0.5 ft in 7 days -1.2 ft in 30 days more than 5% of the time	% of time criteria are met: 95% 93%

Jane Green Detention Area Culvert Operations

When water levels in the St. Johns River at U.S. 192 (USGS Gauge #02232000) reach 18.2 ft, the gates of structure S-161A will be closed to retain flood water in the Jane Green Detention Area. Flood waters will continue to be retained until the St. Johns River flood peak passes downstream. Once water levels in the St. Johns River start to recede, S-161A will gradually be re-opened. During all other times, water is continuously discharged through S-161A and the culvert installed in S-161. Maximum water level EHC for the Jane Green Detention Area were not met (**Table 15).**

Table 15. Predicted EHC performance summary for the Jane Green Detention Area (1992–2007).

Jane Green Detention Area	EHC (S-161A)	Model (1992-2007)
Frequency of Inundation	21.8 ft should be flooded ≤ **60%** of the time 23.8 ft should be flooded ≤ **30%** of the time	47% 14%
Maximum Water Levels	Undesirable 14-Day High Should not exceed 28.8 ft for more than 14 continuous days more frequently than once every ten years	Occurred: 1/5 Years
	Undesirable 1-Day High Should not exceed 33.8 ft for more than 1 day more frequently than once every twenty-five years	Occurred: 1/5 Years

PROJECT PERFORMANCE

Flood Control

Management of the USJRBP for flood protection is detailed in the MCWM. Zone B discharge schedules presented in the EWMP will have no effect on the flood control performance of the USJRBP.

Water Supply

It is estimated in the MCWM that compared to pre-project conditions, the USJRBP could provide up to an additional 43,000 acre-feet of available water for agricultural irrigation during droughts having a return frequency of 1–5 years or longer. In recent years, the demand for agricultural water has declined due to discontinuation of citrus grove operations, improved irrigation techniques, and the construction of FWMA which reflooded more than 10,000 acres of former agricultural land. While irrigation withdrawals from the BCWMA have been curtailed due the BO restrictions for protecting snail kite habitat, water from the BCWMA can still be withdrawn for freeze protection. In addition, constraints in the USFWS BO require periodic extreme drying events of the BCWMA to rejuvenate snail kite nesting and foraging habitat. Periodic Zone B discharges from the BCWMA to meet these objectives are presented in the EWMP. When conditions that trigger Zone B discharges from the BCWMA are met, usually during droughts, water from the BCWMA will be made available for water supply withdrawals if these withdrawals do not cause total discharges from the area to exceed those levels detailed in the EWMP.

The SJWMA remains the primary agricultural water supply source of the project. Since the SJWMA became operational in the early 1990s, all water supply demands from this project area have been met. Because the main purposes of the SJWMA, other than flood control, are water quality and water supply, EHC for this project area only provide guidelines for protecting the area from fish kills. No annual Zone B discharges to prevent the SJWMA from experiencing fish kills are proposed. Thus, the water supply benefits of the SJWMA are unaffected by the EWMP. In the past, short-term deviations from the no discharge schedule have been made to provide irrigation water for agricultural interests adjacent to the C-54 canal and to investigate potential water flow under Structure S-157 which regulates water flow from the C-54 canal to the Sebastian River and the Indian River Lagoon.

Zone B discharges from the TFMCA also supplement flows in the St. Johns River and water levels in Lake Washington during drought. More than 20,000 acre-feet of water in the TFMCA are available for this supplemental discharge when conditions warrant.

Water Quality

Segregation of agricultural discharges into water management areas has prevented significant additional nutrient loading to the marsh conservation areas and the St. Johns River. The water management areas together retain about 10.3 metric tons of phosphorus annually through

sedimentation. The BCWMA removes about 6.1 metric tons of phosphorus annually, whereas the SJWMA, removes about 4.1 metric tons. Water retention times and water quality benefits are maximized in the SJWMA by the absence of Zone B discharges. Similarly, except for the periodic drying events specified in the BO, water retention times are also maximized in the BCWMA. Routing SJWMA discharges through extensive marshes in the TFMCA before they flow into the river, will also provide additional water quality benefits.

The EWMP attempts to optimize water quality in the FDMCA, BCMCA, and SJMCA by specifying water levels that will inundate organic peat soils in these areas more than 60% of the time. This inundation frequency prevents peat soil oxidation and the release of nutrients bound in the soils. Currently the SJMCA is severely over drained. The EHC for the SJMCA will provide the inundation frequency targets that will guide future restoration efforts in this area using canal plugs and other techniques.

Environmental

A summary of how the EWMP Zone B discharges meet EHC for the various project areas is presented in **Table 16.** As expected, not all EHC were met.

Table 16. Summary of predicted or measured project area success in meeting EHC under Zone B discharges. In each category, green cells indicate all EHC are being met, yellow cells indicate some EHC for that category are being met or are close to being met, red cells indicate that all EHC are not being met, and gray cells indicate criteria were not applicable for that project area. KL* = Kenansville Lake.

	FDMCA	BCMCA	KL*	BCWMA	SJWMA	TFMCA	MARY A	SJMCA	JANE GREEN
Mean Water Level									
Inundation Frequency									
High Water Levels									
Low Water Levels									
Timing of Fluctuation									
Seasonal Flooding									
Water Recession Rates									
Minimum Lake Levels									

For the FDMCA, 30-day continuous drying did not occur frequently enough, indicating the area is slightly too wet. Inundation frequencies for the BCMCA indicate there may be some soil subsidence at the highest elevations (>21.8 ft) while the seasonal flooding EHC suggest willow and woody shrub encroachment may be an on-going problem. Hydrologic conditions that may facilitate willow seedling establishment will also occur in Mary A and the SJMCA. For the most part, all hydrologic conditions specified in the BO for the BCWMA will be met. However, seasonal high-water levels occur slightly outside the normal August through November months. Water levels in the SJWMA, BCWMA, Kenansville Lake, and the TFMCA should support sport fisheries in these areas to the greatest extent possible. The greatest potential for fish kills occurs in Kenansville Lake, due to flooding constraints that keep water levels shallower than desirable, and the TFMCA, where extremely shallow water may occur during prolonged droughts. The SJMCA remains severely over drained. This will be addressed by future restoration activities involving a suite of canal plugs. Jane Green will suffer some tree loss during extreme flood events that occur when structures are closed for flood control purposes. However, hydrologic conditions in Jane Green have improved dramatically since USACE installed lower elevation flow culverts through structure S-161.

SHORT-TERM DEVIATIONS IN ZONE B WATER MANAGEMENT

It is probable that not all water management needs will be met by the Zone B discharge schedules presented in this plan. At times, Zone B discharges may need to be modified to manage short-term, unanticipated problems. For example, in 2017, low-flow discharges from the SJWMA were passed into the C-54 Canal to provide irrigation water in response to drought conditions. Prior to a major hurricane threat later in the year, large Zone B discharges from both the BCWMA and the SJWMA were made to create additional storm storage. On several occasions, water has been held in the BCWMA at the request of the USFWS. The request to cancel or delay scheduled discharges was made so that the area might provide potential drought refugia for the snail kite. When short-term modifications to Zone B discharges are being considered, other federal, state, and local (e.g., USACE, FWC, USFWS) will be consulted as appropriate. However, SJRWMD has the exclusive authority to make Zone B discharge decisions.

AMENDING THE EWMP

Meeting the water supply, water quality, and environmental goals of the USJRBP is an adaptive process. Not only is there inherent uncertainty associated with hydrologic models, there is uncertainty in predicting biological responses to hydrology. As new information becomes available and water supply, water quality, and ecological goals change or evolve, it is important that Zone B management be flexible so that timely changes in discharge schedules or the EHC can be implemented. To achieve this flexibility, the EWMP is attached as an appendix to the MWCM rather than being incorporated into the overall USACE MCWM. This allows SJRWMD to more quickly modify Zone B management without the

extensive federal review and authorization which is necessary to modify the MWCM. When amendments to the EWMP, including modifications to Zone B discharges, are being considered, other federal, state, and local entities (e.g., USACE, FWC, USFWS) will be consulted as appropriate.

APPENDIX A. NAVD88 TO NGVD29 CONVERSION FACTORS

NGVD29 = NAVD88 + Offset (rounded to nearest 0.1 ft)		
Area	Location	Offset
FDMCA	S-252D	-1.5
	S-252A	-1.5
	S-252B	-1.5
	S-252C	-1.5
	FD Center	-1.5
	S-252E	-1.5
	S-252F	-1.5
	FD South	-1.4
BCMCA	S-96C	-1.5
	Kenansville Lake	-1.5
	Blue Cypress Lake	-1.5
BCWMA	SR60	-1.5
	S-251	-1.5
	S-254	-1.5
SJWMA	S-96D	-1.5
FWMA		-1.4
SJMCA	Six Mile	-1.5
	Mulberry Mound	-1.4
	Big Bend	-1.4
	C-40 E7	-1.4
TFMCA	S-96B	-1.5
	S-257	-1.4
SLWMA	S-262	-1.4
Jane Green	S-161A	-1.3
US192	USGS gauge #02232000	-1.4