TECHNICAL DOCUMENT SUPPORTING RULEMAKING TO PROTECT WATER MADE AVAILABLE BY THE LOXAHATCHEE RIVER WATERSHED RESTORATION PROJECT

Draft Report

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South Florida Water Management District

West Palm Beach, FL

EXECUTIVE SUMMARY

This technical document supports amending the South Florida Water Management District (SFWMD or District) consumptive use permitting criteria to protect water made available by the Loxahatchee River Watershed Restoration Project (LRWRP), a component of the Comprehensive Everglades Restoration Plan (CERP). CERP is the framework to restore the Greater Everglades ecosystem, and the LRWRP aims to improve the quantity, quality, timing, and distribution of water flows to the Northwest Fork of the Loxahatchee River. The LRWRP is also a component of the Northwest Fork of the Loxahatchee River minimum flow and minimum water level (MFL) recovery strategy [Subsection 40E-8.421(6), Florida Administrative Code].

The SFWMD will design and construct the LRWRP as the non-federal sponsor of the project. The United States Army Corps of Engineers (USACE) and SFWMD plan to execute a project partnership agreement by September 2022. Project design is scheduled to begin in 2022, with construction occurring between 2023 and 2029. The operational testing and monitoring periods are expected to end in 2031.

The need to protect water for CERP projects arises from the Water Resources Development Act of 2000 (Public Law 106-541) and Section 373.470(3)(c), Florida Statutes, which require the SFWMD to allocate or reserve the increase in water for the natural system resulting from a CERP project. The SFWMD fulfills this requirement by adopting water reservations, consumptive use permitting rules, or both.

Specific rule development to protect water made available by the LRWRP involves amending the existing Lower East Coast Regional Water Availability restricted allocation area (RAA) criteria to expand the definition of North Palm Beach County/Loxahatchee River Watershed Waterbodies to include the project components identified in the LRWRP. Including the project components increases the areal extent of the RAA approximately 10%.

The rule development effort will also adopt new rules to protect the groundwater associated with the LRWRP aquifer storage and recovery (ASR) wells. The ASR wells are anticipated to be constructed along the western perimeter of the C-18W Reservoir. However, the final locations of the ASR wells have yet to be determined. To account for this contingency, a conservative distance of 1 mile from the perimeter of the reservoir is proposed to protect the project water stored via ASR wells. Existing legal users of surface water and groundwater shall be protected so long as such use is not contrary to the public interest.

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ACRONYMS, ABBREVIATIONS, AND UNITS OF MEASURE

ac-ft	acre-foot
APPZ	Avon Park permeable zone
ASR	aquifer storage and recovery
bls	below land surface
C&SF Project	Central and Southern Florida Flood Control Project
CERP	Comprehensive Everglades Restoration Plan
cfs	cubic feet per second
District	South Florida Water Management District
F.A.C.	Florida Administrative Code
F.S.	Florida Statutes
FAS	Floridan aquifer system
ft	foot
LRWRP	Loxahatchee River Watershed Restoration Project
MFL	minimum flow and minimum water level
mg/L	milligrams per liter
mgd	million gallons per day
NGVD29	National Geodetic Vertical Datum of 1929
PIR-EIS	Project Implementation Report and Environmental Impact Statement
PPA	project partnership agreement
RAA	restricted allocation area
RM	river mile
SAS	surficial aquifer system
SFWMD	South Florida Water Management District
UFA	Upper Floridan aquifer
USACE	United States Army Corps of Engineers
WRDA	Water Resources Development Act

1 INTRODUCTION

The South Florida Water Management District (SFWMD or District) is a regional governmental agency charged with safeguarding the water resources in 16 counties, from Orlando to the Florida Keys. With a population of approximately 9 million permanent residents, the District covers 17,930 square miles (31% of the state) and includes vast areas of urban development, agricultural lands, and conservation areas. The SFWMD is responsible for protecting water supplies and supporting water quality improvement in close collaboration with the Florida Department of Environmental Protection and the Florida Department of Agriculture and Consumer Services. The SFWMD also operates and maintains the Central and Southern Florida Flood Control Project (C&SF Project) system. One of the world's largest water management systems, the C&SF Project is an extensive network of canals, levees, water storage areas, pump stations, and other water control structures. The highly engineered system was built through one of the most diverse ecosystems in the world: the interconnected Greater Everglades ecosystem, which the SFWMD is working to restore and protect (SFWMD 2021a).

Located in Martin and Palm Beach counties, the Loxahatchee River is in the northern part of the Everglades ecosystem and flows into the Atlantic Ocean through the Jupiter Inlet. Approximately 7.6 miles of the river's Northwest Fork were designated as Florida's first Wild and Scenic River in 1985. Downstream segments of the Northwest Fork floodplain contain dense red mangrove forest, while the upper segment contains one of the last native cypress river swamps in southeastern Florida. Over the past century, downstream floodplain wetlands once dominated by swamp hardwoods and bald cypress have changed to mangrove-dominated swamp. This change in vegetation is believed to have occurred because of saltwater intrusion into freshwater areas of the river, caused primarily by human-induced alteration of the watershed and river. The restoration and protection of the Loxahatchee River and its associated ecosystems have been the focus of several District projects, including the Loxahatchee River Watershed Restoration Project (LRWRP; **Section 1.5**), which is part of the Comprehensive Everglades Restoration Plan (CERP; **Section 1.4**).

1.1 Overview and Purpose

This technical document supports amending the existing Lower East Coast Regional Water Availability restricted allocation area (RAA) criteria [Subsection 3.2.1.E of the *Applicant's Handbook for Water Use Permit Applications within the South Florida Water Management District* (Applicant's Handbook); SFWMD 2021b] and adopting new rules to protect groundwater components of the LRWRP. The existing RAA boundaries for the North Palm Beach County/Loxahatchee River Watershed Waterbodies include most, but not all, areas needed to complete the LRWRP. This rulemaking would modify the existing RAA boundary to encompass all necessary surface water components identified in the Final Integrated Project Implementation Report and Environmental Impact Statement (PIR-EIS) for the LRWRP [United States Army Corps of Engineers (USACE) 2020]. Additionally, the LRWRP design includes four aquifer storage and recovery (ASR) wells associated with the C-18W Reservoir. Therefore, new RAA criteria are being developed to protect upper Floridan aquifer system (FAS) water associated with those ASR wells (**Section 1.5.1**). This rulemaking effort fulfills the SFWMD's state and federal obligations to protect the water made available by the LRWRP (**Section 2.1.1**).

1.2 Identification of the Existing Restricted Allocation Area

In 2007, an RAA was established for the North Palm Beach County/Loxahatchee River Watershed Waterbodies [part of the Lower East Coast Regional Water Availability criteria, Subsection 3.2.1.E of the Applicant's Handbook (SFWMD 2021b)]. The current RAA includes surface water and groundwater bodies, such as the City of West Palm Beach Water Catchment Area, Pal-Mar property, J.W. Corbett Wildlife Management Area, Loxahatchee Slough, Loxahatchee River, Riverbend Park, Dupuis Reserve, Jonathan Dickinson State Park, Kitching Creek, Moonshine Creek, Cypress Creek, and Hobe Grove Ditch (**Figure 1-1**). The RAA also includes the integrated conveyance systems that are hydraulically connected to and receive water from the waterbodies, such as C&SF Project primary canals and the secondary and tertiary canals that receive water from those primary canals. Net increases in volume or changes in timing on a monthly basis of direct surface water and indirect groundwater withdrawals from the RAA are prohibited over that resulting from base condition uses permitted as of April 1, 2006. Allocations over the base condition water use are only allowed through sources detailed in Subsection 3.2.1.E.5 of the Applicant's Handbook (SFWMD 2021b), such as certified project water, implementation of offsets, alternative water supply, terminated or reduced base condition water use that existed as of April 1, 2006, or available wet season water. The RAA is part of the MFL recovery strategy for the Northwest Fork of the Loxahatchee River.

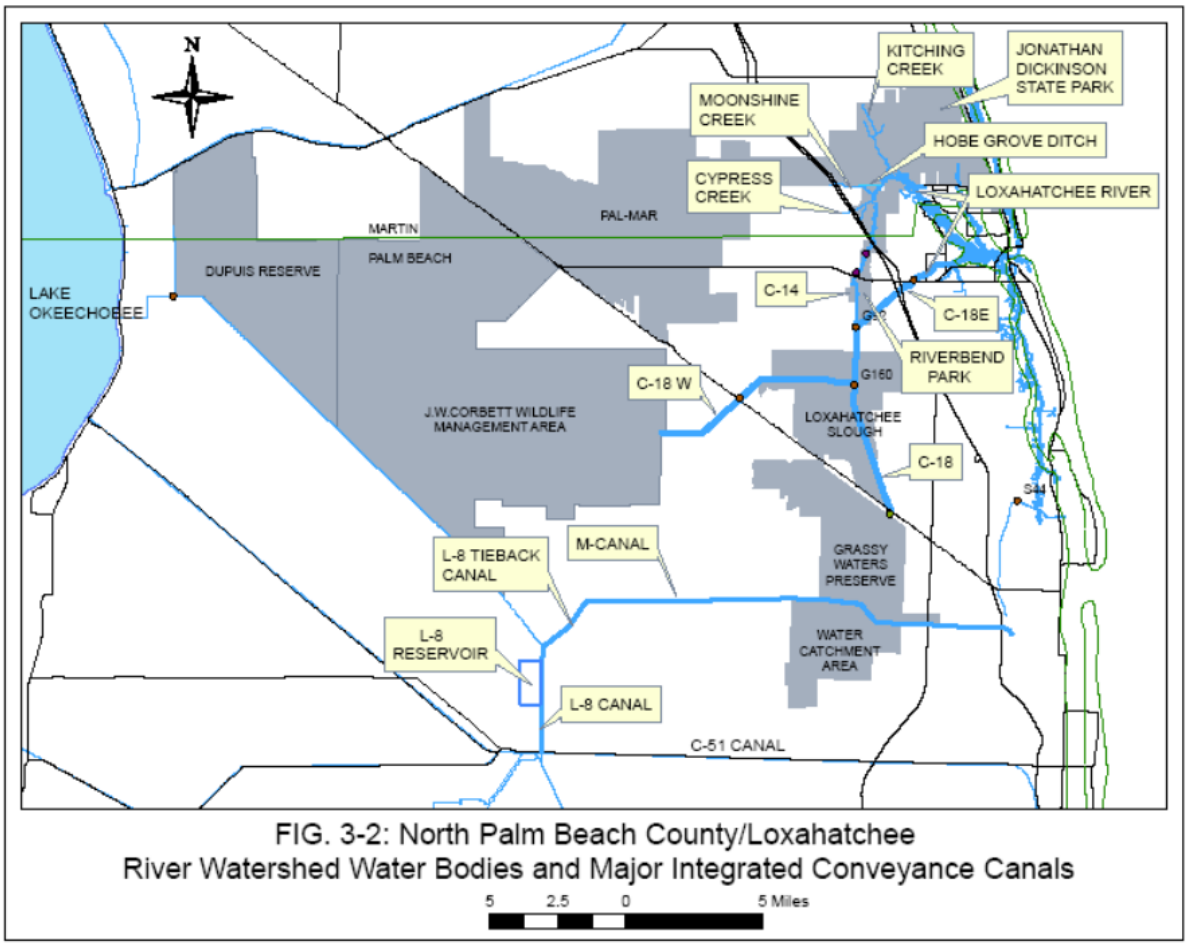

FIG. 3-2: North Palm Beach County/Loxahatchee River Watershed Water Bodies and Major Integrated Conveyance Canals

Figure 1-1. Current extent of the North Palm Beach County/Loxahatchee River Watershed Waterbodies and major integrated conveyance canals (From: SFWMD 2021b).

1.3 Northwest Fork of the Loxahatchee River MFL

MFL criteria are flows or levels at which water resources, or the ecology of the area, would experience significant harm from further withdrawals. Significant harm is defined in Subsection 40E-8.021(31), F.A.C., as the temporary loss of water resource functions, which results from a change in surface water or groundwater hydrology, that takes more than 2 years to recover, but is considered less severe than serious harm. As of 2021, the SFWMD has adopted nine MFLs. Additional information about MFLs can be found in the *Support Document for the 2021-2024 Water Supply Plan Updates* (SFWMD 2021c) and at www.sfwmd.gov/mfls.

The Northwest Fork of the Loxahatchee River was designated as a Wild and Scenic River in 1985. An MFL was adopted for the Northwest Fork of the Loxahatchee River in 2003 to protect the remaining floodplain swamp community and downstream estuarine resources against significant harm [Subsection 40E-8.221(4), F.A.C.]. An MFL exceedance occurs when 1) flows at Lainhart Dam decline below 35 cubic feet per second (cfs) for more than 20 consecutive days; or 2) salinity, expressed as 20-day rolling average, is greater than 2 at river mile 9.2 (**Figure 1-2**). An MFL violation occurs when an exceedance occurs more than once in a 6-year period.

Pursuant to Section 373.0421, F.S., recovery strategies [Subsection 40E-8.021(25), F.A.C.] must be adopted for waterbodies where MFLs currently are violated. The goal of a recovery strategy is to achieve the established MFL as soon as practicable. The Northwest Fork of the Loxahatchee River was not meeting the MFL criteria at the time of adoption. Therefore, an MFL recovery strategy [Subsection 40E-8.421(6), F.A.C., and Appendix C of the *2018 Lower East Coast Water Supply Plan Update* (SFWMD 2018)] was adopted simultaneously with the MFL adoption. As stated earlier, the RAA for the Lower East Coast Everglades Waterbodies and North Palm Beach County/Loxahatchee River Watershed Waterbodies is part of the MFL recovery strategy. The MFL criteria are anticipated to be met when the recovery strategy projects are completed and fully operational.

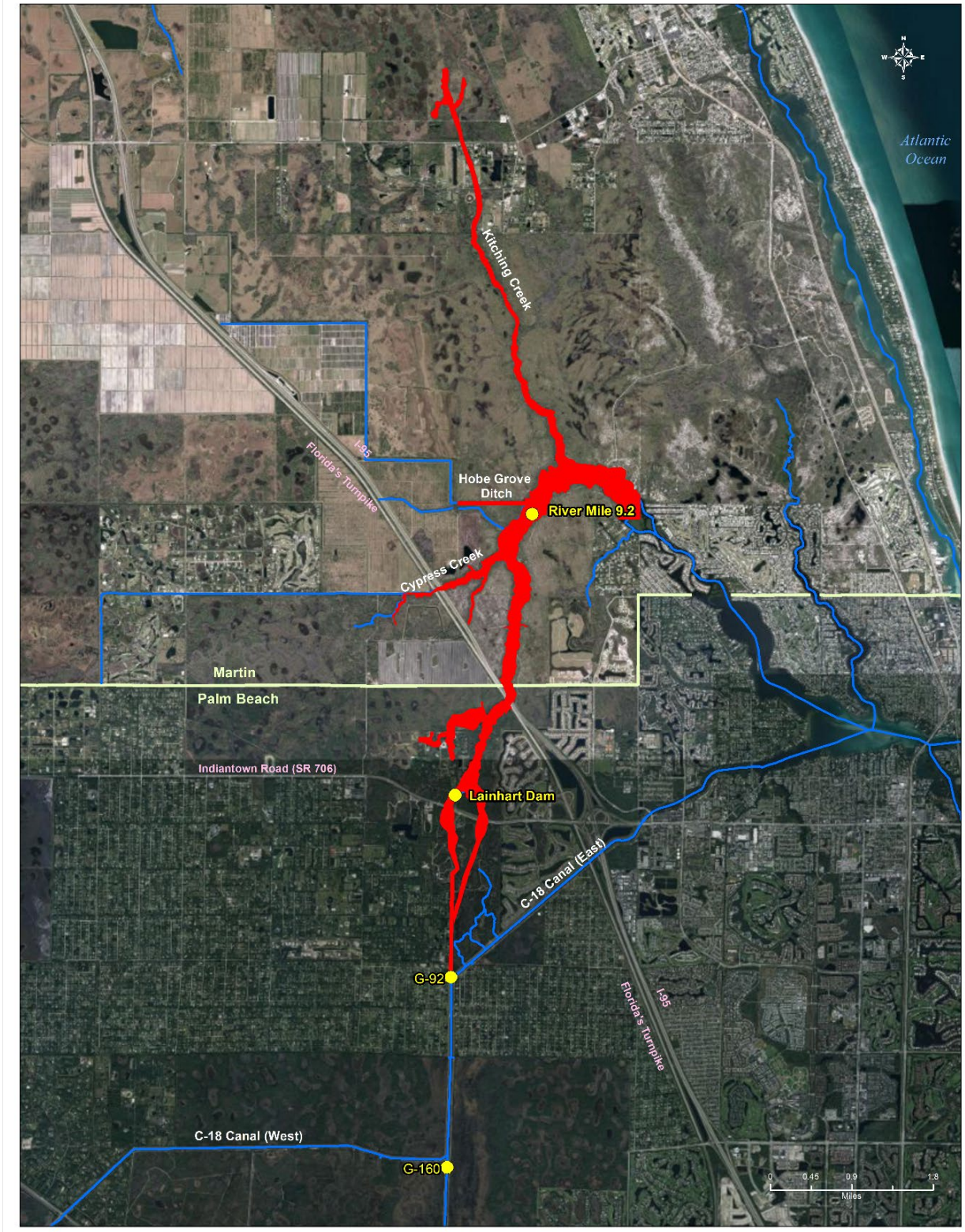

Figure 1-2. Northwest Fork of the Loxahatchee River MFL area (shown in red).

1.4 Comprehensive Everglades Restoration Plan

CERP is one of the largest environmental restoration programs undertaken that builds upon and complements other state and federal initiatives to revitalize South Florida's ecosystem. The plan, submitted to Congress in 1999, comprises a series of projects designed to address four major characteristics of water flow: quantity, quality, timing, and distribution. Further information about CERP can be found at https://www.evergladesrestoration.gov.

Upon congressional authorization in 2000, the Federal Government and the State of Florida entered into a 50/50 partnership to restore, protect, and preserve water resources in central and southern Florida, including the Everglades. The USACE is the lead federal agency, and the SFWMD is the non-federal sponsor. A status summary of CERP is provided by the secretaries of the Army and the Interior in the jointly submitted Five-Year Report to Congress per the Water Resources Development Act (WRDA) of 2000, Section 601(l), and as required by the Programmatic Regulations for the Comprehensive Everglades Restoration Plan [33 C.F.R. § 385.40(d)(1)] (USACE and United States Department of the Interior 2020).

Legal protection of water for the natural system provided by CERP projects is required for the SFWMD and USACE to execute project partnership agreements (PPAs). The SFWMD protects water through the adoption of water reservations, consumptive use permitting criteria, or a combination of the two. The SFWMD's water reservation rules are found in Chapter 40E-10, F.A.C. Chapter 40E-2, F.A.C., contains the SFWMD's consumptive use permitting rules, including 1) regulatory components of an adopted MFL prevention or recovery strategy, 2) implementation criteria for water reservations, and 3) RAA criteria.

1.5 Loxahatchee River Watershed Restoration Project

One of 68 CERP projects and the focus of this document, the LRWRP aims to improve the quantity, quality, timing, and distribution of water flows to the Northwest Fork of the Loxahatchee River and restore hydrologic conditions and connectivity of wetlands and watersheds that form the historical headwaters of the river (USACE 2020). Project planning was completed with the signing of the Chief's Report in April 2020, which included the PIR-EIS completed in January 2020 (USACE 2020). The LRWRP was authorized by Congress in WRDA 2020. The PIR-EIS identified the authorized plan for meeting the objectives to capture, store, and treat surface water currently lost to tide and use that water to increase flows to the Northwest Fork of the Loxahatchee River to meet restoration goals of the river and the natural communities within the watershed. The LRWRP will achieve the intended hydrologic and ecologic restoration goals without impacting existing legal water users or reducing the level of service for flood protection. This fulfills WRDA 2000 and Section 373.470, F.S., Savings Clause requirements (further discussed in **Section 5.3.1**).

The SFWMD is the lead agency responsible for the design and construction of the LRWRP. A PPA between the USACE and SFWMD is planned for execution by September 2022. Completion of the rule development process to protect water generated by the LRWRP is a condition precedent to executing the PPA. The 2021 CERP Integrated Delivery Schedule (USACE 2021) contains the implementation schedule for the project. Project design is scheduled to begin in 2022, with construction occurring between 2023 to 2029. The operational testing and monitoring periods are expected to end in 2031. Most of the real estate acquisition for the project is complete; however, some acquisition of land, canals, and easements in the northern portion of the project area remains.

1.5.1 Project Components and Authorized Plan

The project area encompasses approximately 481,920 acres of central and northern Palm Beach County and southern Martin County, including Jonathan Dickinson State Park, Dupuis Wildlife and Environmental Management Areas, J.W. Corbett Wildlife Management Area, the City of West Palm Beach Water Catchment Area, and Loxahatchee Slough (**Figure 1-3**). The LRWRP project area is bound on the north by the C-44 Canal, on the south by the C-51 Canal, on the west by the L-8 Canal and Lake Okeechobee, and on the east by the Loxahatchee River Estuary and Lake Worth Lagoon. All of the Loxahatchee River watershed and limited portions of the St. Lucie River watershed are included in the project area.

Multiple restoration plan alternatives were modeled during the plan formulation and evaluation process as described in the PIR-EIS (USACE 2020). Each alternative plan was evaluated according to the USACE's four "Principles and Guidelines" criteria: completeness, acceptability, efficiency, and effectiveness. Project benefits and planning level costs were calculated for each alternative plan, and analyses were completed to identify the alternative plans that maximized environmental benefits compared to costs. The evaluation and comparison of alternative plans led to the selection of Alternative 5R, the Authorized Plan, for the LRWRP.

The project components of the Authorized Plan are grouped into three flow-ways based on geographic area (**Figure 1-4**). Structural components of the Authorized Plan include a 9,500-acre-foot (ac-ft) reservoir, four ASR wells, a flow-through marsh, and new pump stations, canals, culverts, weirs, and ditch plugs. Structural components, along with other management measures and water control modifications, will increase volume and improve timing of water deliveries to the Northwest Fork of the Loxahatchee River while restoring hydrology and ecological connectivity in the surrounding natural areas and over-drained wetlands within the watershed. The Authorized Plan will achieve 91% of the dry season target restoration flows and 98% of the wet season restoration target flows to the Northwest Fork as measured at Lainhart Dam (USACE 2020). In addition, the Authorized Plan will restore a total of approximately 27,000 acres of disturbed wetlands (**Section 1.5.2**).

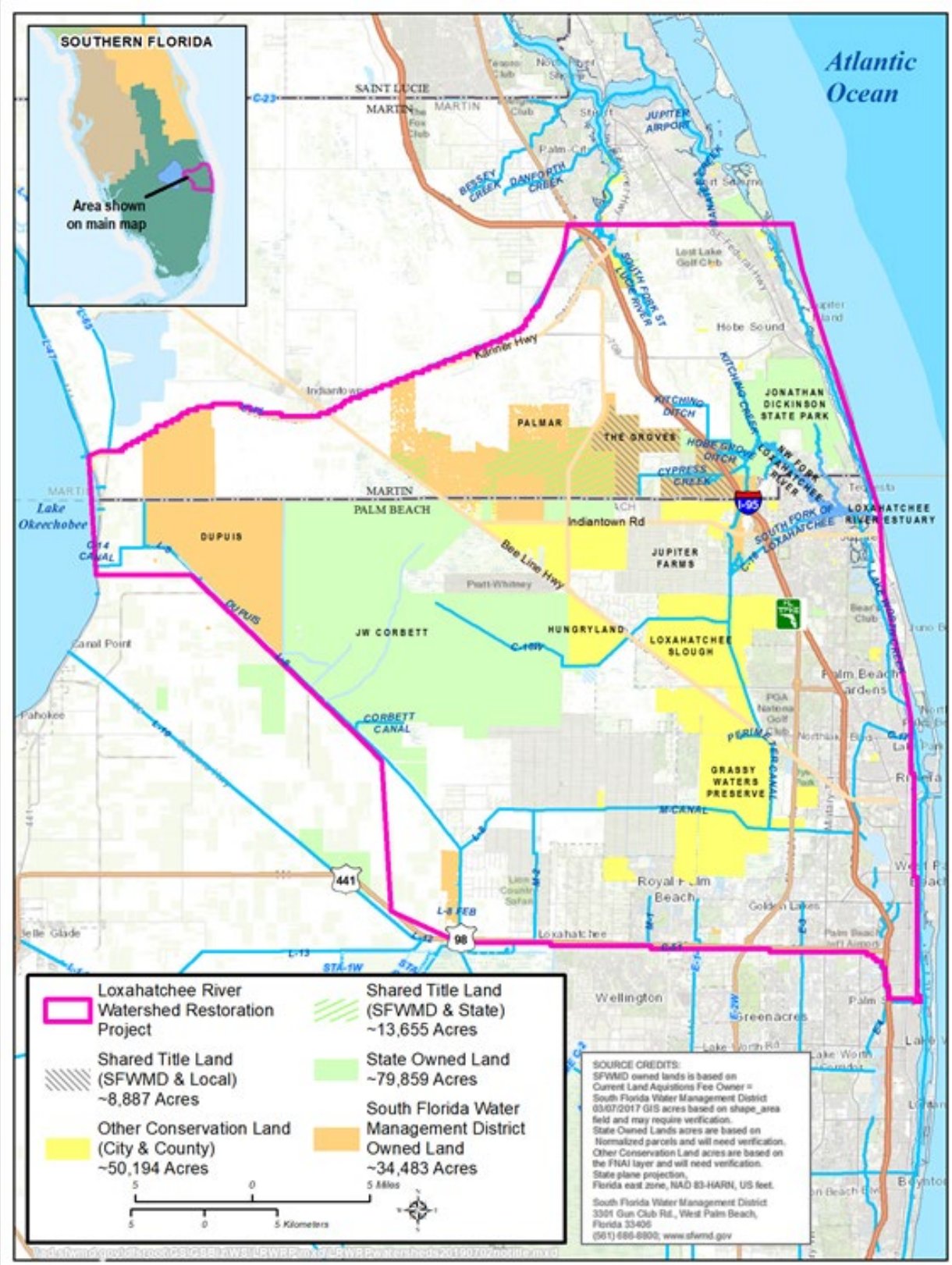

Figure 1-3. Map of the Loxahatchee River Watershed Restoration Project and natural lands included in the project (From: USACE 2020).

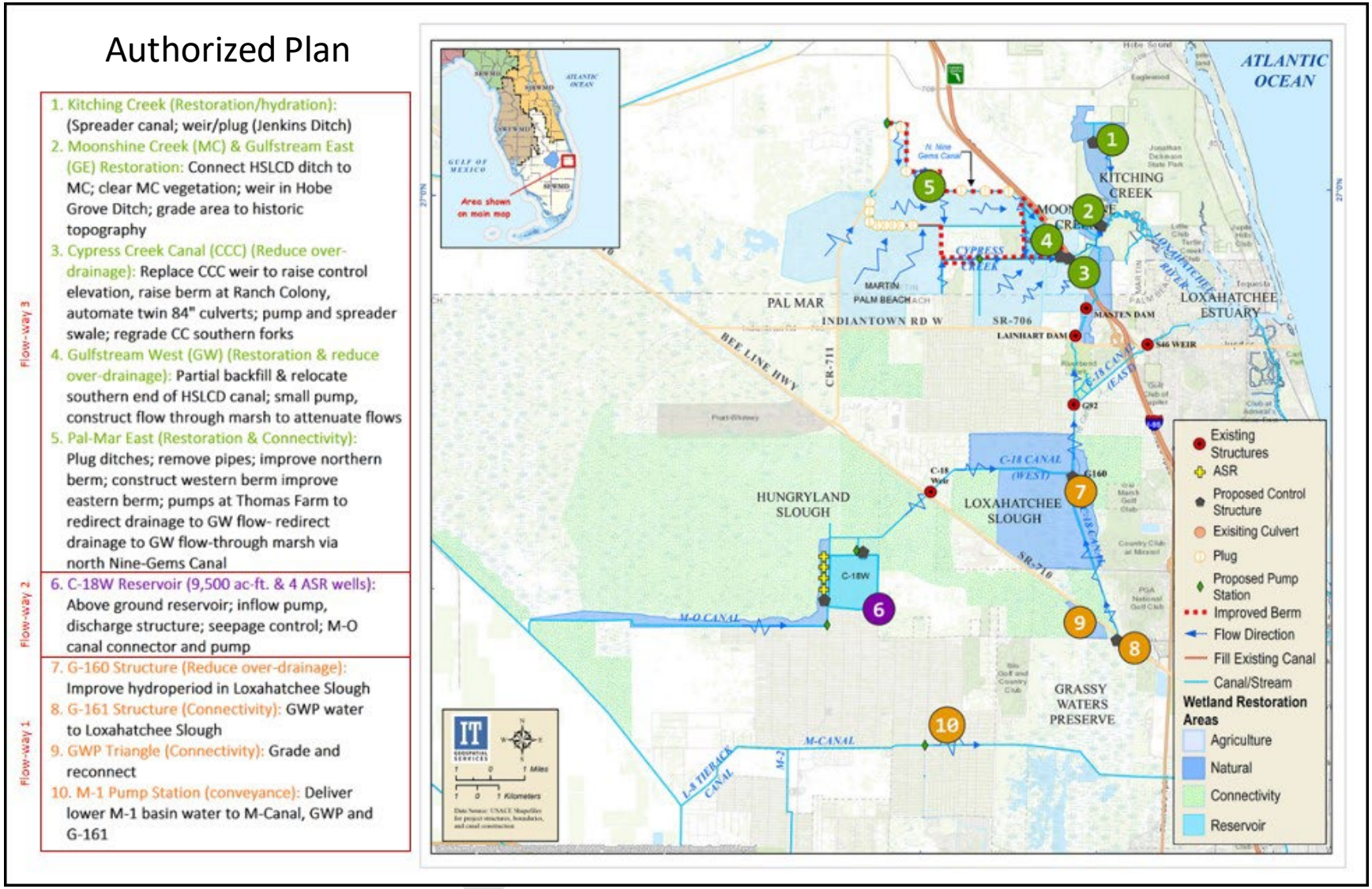

Figure 1-4. Project components and flow-ways of the Authorized Plan for the Loxahatchee River Watershed Restoration Project (From: USACE 2020).

Surface Water Components (Flow-ways 1, 2, and 3)

Flow-way 1 is in the southernmost portion of the LRWRP (**Figure 1-4**). Surface water from upstream basins within flow-way 1 will be routed toward the Northwest Fork via three primary canal conveyances: M-1 Canal, M-Canal, and C-18 Canal. The following provides an overview of the surface water components for flow-way 1, which are described in further detail in the PIR-EIS (USACE 2020).

- **M-1 Pump Station**: A new pump station (S-100) will be constructed along the M-1 Canal to deliver up to 75 cfs of water to the M-Canal when specific dry and wet season canal stages permit. Excess water deliveries from the Indian Trail Improvement District Lower M-1 Basin will supplement the City of West Palm Beach Water Catchment Area before the water is ultimately conveyed north to the Northwest Fork.
- **G-161 Structure**: The G-161 structure was constructed in 2007 concurrent with the LRWRP planning process to provide early and essential benefits to the Northwest Fork and its historical headwaters. Benefits include increased base flows to the river as well as hydrologic connectivity and improved hydroperiods for the City of West Palm Beach Water Catchment Area and Loxahatchee Slough. G-161 is the primary structure through which water flows from the City of West Palm Beach Water Catchment Area to the Northwest Fork. The structure is composed of two 60-inch culverts, with a total length of 240 feet (ft), and can discharge up to 150 cfs.
- **Grassy Waters Preserve (GWP) Triangle**: Although no structural surface water components are planned for the GWP Triangle, hydrologic restoration will be achieved through earthwork and construction of a shallow swale designed to improve hydrologic conditions within the property. Water discharged from the G-161 structure will be distributed across the shallow swale to promote hydrologic connectivity between the eastern and western portions of the property and to improve the hydroperiod of the area. Surface water will flow from the GWP Triangle to the C-18 Canal, then north toward the Northwest Fork through an existing culvert that passes under Beeline Highway.
- **G-160 Structure**: The G-160 structure, completed in 2004, provides the dual purpose of flood control and environmental restoration. Like the G-161 structure, G-160 was constructed concurrent with the LRWRP planning process to achieve early benefits to the Northwest Fork and its historical headwaters. Benefits include enhanced delivery of restoration flows to the river while maintaining specific water levels for the Loxahatchee Slough. The G-160 structure is a reinforced concrete spillway with two vertical lift gates; each spillway bay is 25 ft in length. The structure can discharge up to 2,000 cfs to maintain flood control capability.

Flow-way 2 is in the western and central portion of the LRWRP (**Figure 1-4**). The M-O and C-18W canals are the two primary canal conveyances for flow-way 2. The main surface water component for flow-way 2 is the C-18W Reservoir, which is designed to capture, store, and release water to improve seasonal timing of water deliveries to the river. The following is an overview of the C-18W Reservoir and some of its supporting infrastructure; further details about flow-way 2 surface water components can be found in the PIR-EIS (USACE 2020).

- **C-18W Reservoir**: The C-18W Reservoir will be built on the former Mecca citrus grove property, covering approximately 1,600 acres (including the perimeter embankment) and storing 9,500 ac-ft of water. The reservoir embankment will be 20 ft high with a normal pool design depth of 7.5 ft. The reservoir will receive excess surface water from the adjacent C-18W Canal, J.W. Corbett Wildlife Management Area, and the upper Indian Trail Improvement District basin. A 150-cfs intake pump will deliver water from the C-18W Canal to the northern portion of the reservoir, while three 72-inch gated culverts and three 78-inch culverts will deliver water from the J.W. Corbett

Wildlife Management Area and the new M-O connector canal (C-101W), respectively, to the western portion of the reservoir. The reservoir will be surrounded by a seepage canal and managed by a seepage control system. The new 3,500-ft long M-O connector canal (C-101W) will be constructed to convey water north from the eastern end of the existing M-O Canal toward the west side of the reservoir. A new 175-cfs pump station (S-109) will be constructed at the intersection of the M-O Canal and new M-O connector canal to pump surface water north.

Flow-way 3 is in the northern portion of the LRWRP (**Figure 1-4**), crossing the Palm Beach-Martin county boundary. Flow-way 3 includes the Northwest Fork and its historical tributaries (Kitching Creek, Moonshine Creek, and Cypress Creek). Primary conveyance canals in flow-way 3 include Jenkins Ditch, Hobe Grove Ditch, Cypress Creek Canal/Ranch Colony Canal, C-18 Canal, Nine Gems canals, and various canals within the Hobe St. Lucie Conservatory District and South Indian River Water Control District service areas. The following is an overview of the surface water components for flow-way 3, which are described in further detail in the PIR-EIS (USACE 2020).

- **Pal-Mar East (Nine Gems)**: Interior drainage canals will be filled, and small drainage pipes and culverts will be removed to reduce drainage and restore hydrology to the property. Berm improvements (L-111) along the northern and eastern portion of the property will be required to retain onsite surface water. Additional discharge capacity for the property will be provided by three water control structures (S-114A, B, and C) discharging into a canal that runs along the southern property boundary, which ultimately discharges to the Cypress Creek Canal. An existing canal in the western and southwestern portion of Pal-Mar East will be plugged or backfilled to improve hydrologic connectivity between the Nine Gems and Culpepper tracts. This canal currently provides drainage to a farm west of the property and Seminole Pratt Whitney Road. This canal is proposed to be taken out of service and its water rerouted to an existing canal that runs along the northern boundary of Pal-Mar East. A new pump station, likely to be located on the farm property, and a new culvert installed under Seminole Pratt Whitney Road will be required to reroute surface water to the canal bordering the northern boundary of Pal-Mar East.
- **Cypress Creek Canal/Ranch Colony Canal**: Three existing water control structures (S-115A, B, and C) will be modified with telemetry controls to improve hydrologic conditions within the Culpepper tract of Pal-Mar East while reducing discharges into the Cypress Creek Canal. Berm improvements along the eastern boundary of the Culpepper tract and the Cypress Creek Canal will improve water flow and provide flood protection to adjacent residential developments. At the east end of the Cypress Creek Canal, a new water control structure (S-112) will be constructed to reduce over-drainage and improve water level management in the Cypress Creek Canal during the wet and dry seasons. The structure will be a telemetry-operated concrete spillway with two 16-ft wide bays. Perpendicular to the Cypress Creek Canal, a new 20-cfs pump station and spreader swale will be constructed parallel to Mack Dairy Road. The Mack Dairy spreader swale will extend roughly 4,900 ft south of the Cypress Creek Canal to improve sheetflow across the Cypress Creek Natural Area and restore historical flows to the Northwest Fork. The eastern forks of the historical Cypress Creek will be regraded to reduce flow velocities entering the river and restore/promote the growth of native vegetation.
- **Gulfstream West**: A shallow flow-through marsh will be constructed on the Gulfstream West property to restore wetlands, reduce over-drainage, and attenuate water flow. Existing drainage ditches within the property will be removed, and the site will be regraded with a slight southerly gradient to promote sheetflow across the constructed marsh. Water from the Hobe St. Lucie Conservatory District, Pal-Mar East, and the farm west of Pal-Mar East will be pumped into the northern end of the flow-through marsh via a new 150-cfs pump station (S-110). Water will be routed through the marsh by a series of collection ditches and spreader berms. A perimeter levee (L-111) will be constructed to contain surface water, which will be controlled at an average depth

of 3 ft. The discharge structure (S-111S) will consist of a notched weir with variable rates of flow depending on marsh depth. Discharges from the flow-through marsh will be downstream of the new Cypress Creek Canal structure (S-112).

- **Moonshine Creek and Gulfstream East**: Restoration of the Gulfstream East property involves earthwork to regrade the property to historical topography and backfill existing drainage ditches. This project component also includes Moonshine Creek and Hobe Grove Ditch restoration efforts, which involve creating a hydrologic connection between the two features by clearing and removing heavy vegetation and sedimentation. A new weir (S-117) will be constructed at the eastern end of Hobe Grove Ditch to increase surface water and groundwater levels within the ditch. Increased water elevations will promote additional flow to Moonshine Creek, which is a historical tributary to the Loxahatchee River.
- **Kitching Creek**: Kitching Creek restoration will occur within Jonathan Dickinson State Park. A new east-west spreader swale (C-116) will be constructed perpendicular to an interior ditch (Jenkins Ditch) located near the upstream portion of Kitching Creek. The spreader swale will redistribute water to the upstream portions of Kitching Creek. To facilitate dispersion across the spreader swale, a new gated culvert will be constructed in Jenkins Ditch upstream of Kitching Creek.

Aquifer Storage and Recovery Component

Four clustered ASR wells are planned to work in conjunction with the C-18W Reservoir to provide additional water storage capacity and operational flexibility to the reservoir system. The ASR wells will be installed in the upper FAS and are anticipated to be capable of pumping 5 million gallons per day (mgd) for surface water storage and recovery (USACE 2020). The ASR wells will provide the C-18W Reservoir with additional water for deliveries to the Northwest Fork (via the C-18W Canal) to meet downstream restoration flows. Benefit calculations assumed 70% of the stored water in the ASR wells could be recovered (USACE 2020). The four ASR wells, and the associated water treatment facility, will be located along the western perimeter of the reservoir adjacent to Seminole Pratt Whitney Road and the J.W. Corbett Wildlife Management Area. This location will provide partial institutional control of the ASR groundwater "bubble" (i.e., water stored) due to its close proximity to public lands and a very low likelihood that any new or additional ASR wells would be installed by public water supply utilities or municipalities near this location in the future.

1.5.2 Benefits of the Loxahatchee River Watershed Restoration Project

The LRWRP will provide direct hydrologic and ecologic benefits to the Northwest Fork of the Loxahatchee River. The project will achieve 91% of the dry season target restoration flows and 98% of the wet season target restoration flows, as measured at Lainhart Dam (USACE 2020). Restoration of seasonal flows will improve salinity levels in the river and conserve freshwater habitat. Restored flows will help maintain the last remaining riverine cypress habitat in southeastern Florida, riverine tapegrass habitat, oligohaline salinity zones that support juvenile sportfish, mesohaline salinity zones that support oysters, and specific riverine and estuarine conditions that support threatened Florida manatee and federally managed fish species (USACE 2020).

The LRWRP will restore approximately 27,000 acres of disturbed wetlands: 17,000 acres of former wetlands that were improved for agriculture and 10,000 acres of existing disturbed wetlands in the J.W. Corbett Wildlife Management Area, Loxahatchee Slough, Hungryland Slough, Pal-Mar natural area complex, Cypress Creek Natural Area, City of West Palm Beach Water Catchment Area, and Jonathan Dickinson State Park (USACE 2020). These 27,000 acres of restored wetlands will connect to 51,000 acres of other wetland communities for a total of 78,000 acres of connected habitat (USACE 2020). Wetland restoration efforts will contribute to the recovery of threatened and endangered animal species, such as the

snail kite and wood stork. The project will also improve native habitat for recreational species, such as white-tailed deer and ducks.

The LRWRP will provide recreational and economic opportunities to the local area, such as hunting, boating, fishing, and tourism. Construction of recreational facilities are included in the Authorized Plan, which will improve public access and connectivity to natural areas and regional trail systems, such as the Ocean to Lake Trail. Public use facilities will be constructed at Moonshine Creek, the Cypress Creek Natural Area, and the C-18W Reservoir. These facilities will include parking areas, boat/kayak launches, trailheads, bridges, a fishing platform, and dry vault toilets.

Implementation of the LRWRP will boost numerous ecosystem services throughout the Loxahatchee River watershed and downstream Loxahatchee River Estuary. Ecosystem services can be defined as the benefits human beings receive from resources and processes supplied by ecosystems (Murray et al. 2013). Some ecosystem services are material (e.g., food, timber, water), while others are derived from ecological processes (e.g., carbon sequestration). The LRWRP will benefit ecosystem services through ecological restoration efforts. The ecosystem services that are expected to improve as a result of the project include wildlife-associated activities in the form of wildlife photography, nature tours, and environmental education, which can facilitate mental health and wellbeing; ecological connectivity of landscapes; biodiversity and species composition; commercial and recreational fishing; outdoor recreational opportunities such as biking, hiking, and kayaking; water quality nutrient and sedimentation assimilation; and atmospheric carbon sequestration (USACE 2020).

The LRWRP will provide the aforementioned benefits to the watershed while meeting the requirements of the WRDA 2000 Savings Clause by maintaining current levels of service for flood protection and water supply to existing legal users within the project area.

2 BASIS FOR THE RESTRICTED ALLOCATION AREA RULES

2.1 Definition and Statutory Authority

Section 373.044, F.S., authorizes the governing board of a water management district to adopt rules to implement the various provisions of Chapter 373, F.S. Section 373.216, F.S., requires the water management districts to implement a consumptive use permitting program. The consumptive use permitting program is designed to protect water resources of the area from harm. *See* § 373.219(1), F.S. The District's consumptive use permitting rules include RAAs designed to address a specific water resource concern and protect the water resource from harm.

RAAs are defined geographic areas where use of specific water supply sources (e.g., lakes, rivers, wetlands, canals, aquifers) is restricted due to concerns regarding water availability or other water resource concerns. RAAs are adopted for a variety of reasons, including 1) where there is insufficient water to meet the projected needs of a region, 2) to protect water for natural systems and future restoration projects (e.g., CERP), or 3) as part of MFL recovery or prevention strategies. RAAs are listed in Section 3.2.1 of the Applicant's Handbook (SFWMD 2021b), which is incorporated by reference in Rule 40E-2.091, F.A.C. Requests for water allocations in these regions must comply with the region-specific criteria in addition to all other applicable criteria listed in the Applicant's Handbook.

As of 2021, six RAAs have been adopted for the following geographic areas within the District (**Figure 2-1**):

- C-23, C-24, and C-25 Canal System
- Floridan Aquifer Wells in Martin and St. Lucie Counties
- L-1, L-2, and L-3 Canal System
- Lake Istokpoga/Indian Prairie Canal System
- Lake Okeechobee Service Area
- Lower East Coast Everglades Waterbodies and Northern Palm Beach County/Loxahatchee River Watershed Waterbodies

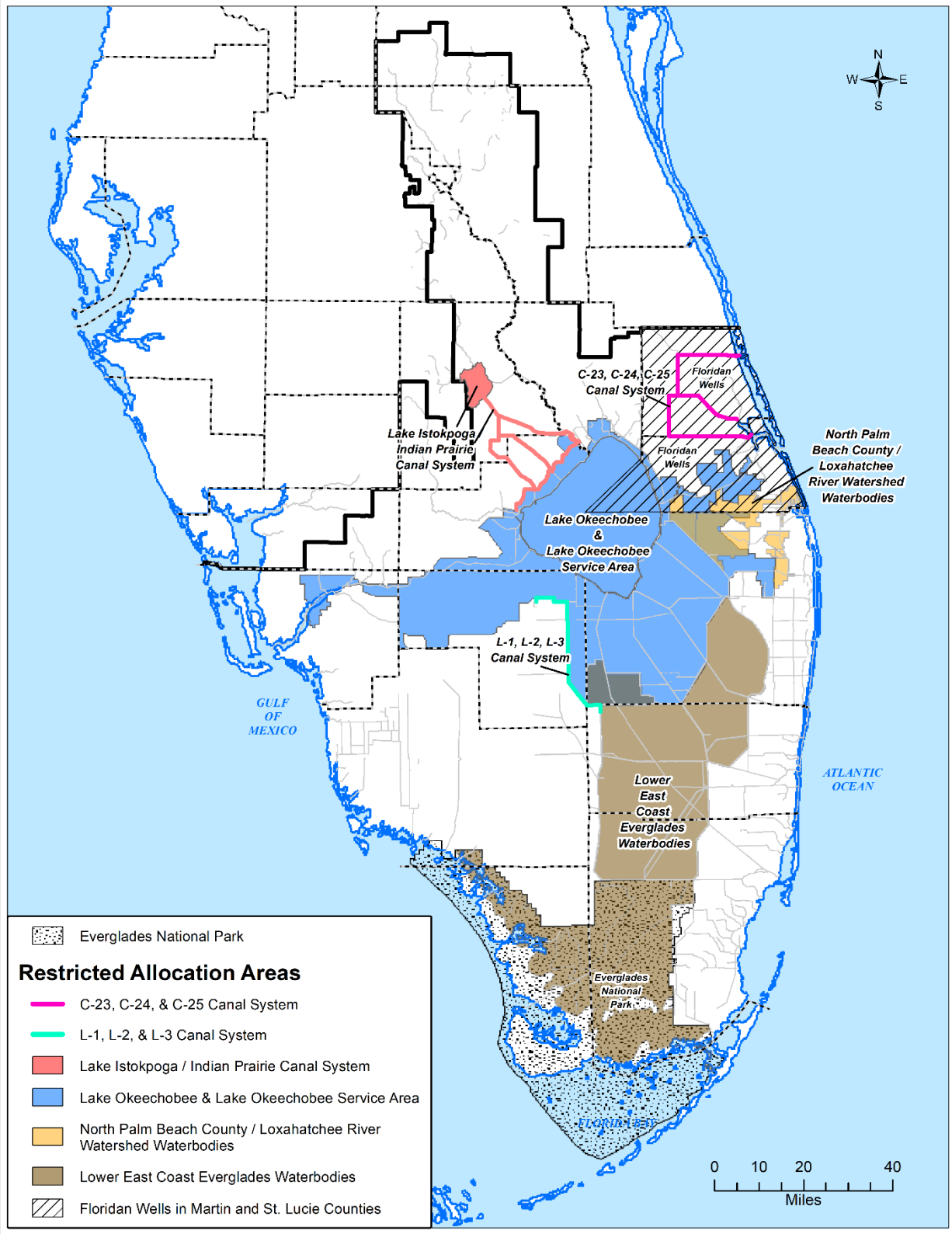

Figure 2-1. Restricted allocation areas within the South Florida Water Management District.

2.1.1 Protecting Water for CERP Projects

WRDA 2000 and Section 373.470(3)(c), F.S., require the SFWMD to allocate or reserve water for the natural system resulting from a CERP project before executing a cost-share agreement with the USACE to construct the project. The SFWMD fulfills this requirement by adopting water reservations, consumptive use permitting rules, or both. The USACE has previously verified that these mechanisms meet the federal requirements for several CERP projects. Together, these measures protect water resources across substantial portions of the District. Any water made available by a CERP project beyond that needed for the natural system may be certified by the District's Governing Board as available to be allocated for consumptive uses to meet the CERP goal of water made available for other water-related uses.

2.2 Rulemaking Process

General rulemaking requirements and procedures are described in Chapter 120, F.S., consistent with state law and SFWMD policy. The general rulemaking process includes many steps (**Figure 2-2**). On December 9, 2021, the District's Governing Board authorized publication of a Notice of Rule Development for Rulemaking to Protect Water Made Available by the Loxahatchee River Watershed Restoration Project. The Notice of Rule Development was published in the Florida Administrative Register on December 21, 2021. Building on the analyses conducted for the PIR-EIS, this technical document and the proposed rules and revisions to applicable sections of the Applicant's Handbook (SFWMD 2021b) were drafted.

Two rule development workshops will be held on January 25 and February 22, 2022, to gain public input on the rulemaking. The SFWMD encourages stakeholder review and comment on the draft rules. Public comments, questions, and SFWMD responses given during and after the workshops will be provided as appendices to the final technical document. Once the public comment has been appropriately considered and incorporated, District staff will seek authorization to publish a Notice of Proposed Rule from the District's Governing Board.

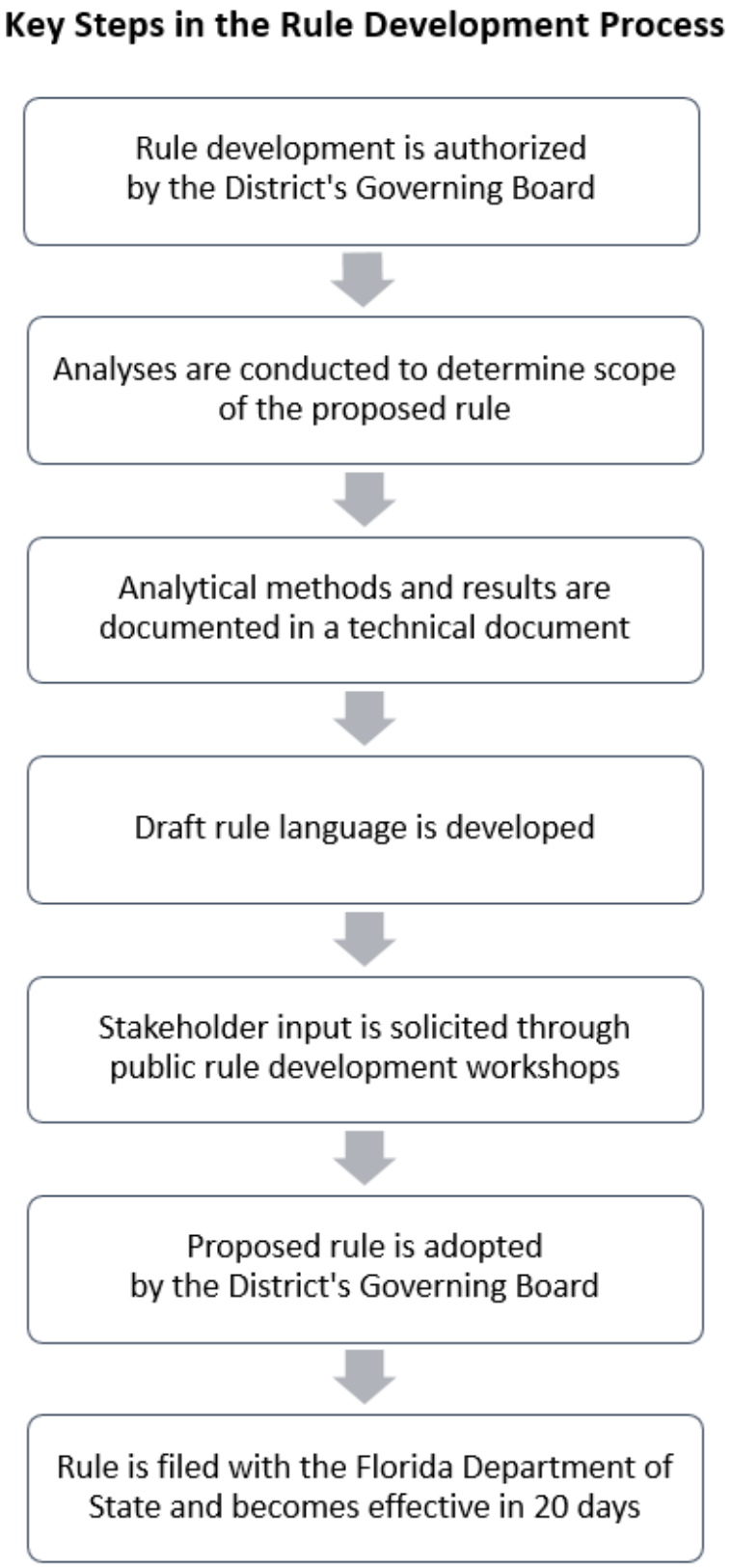

Figure 2-2. Key steps in the rule development process.

3 EXISTING CONDITION OF THE LOXAHATCHEE RIVER WATERSHED

3.1 Description of Watershed

3.1.1 Hydrology

The Loxahatchee River watershed historically spanned more than 216 square miles and primarily comprised pine flatwoods interspersed with cypress sloughs, hardwood swamps, marshes, and wet prairies (USACE 2020). The three forks of the Loxahatchee River—Northwest, North, and Southwest—discharge into the Loxahatchee River Estuary where freshwater from the river meets saltwater flowing in from the Atlantic Ocean through the Jupiter Inlet. The Loxahatchee River Estuary's central embayment is located at the confluence of the river's three forks. There are eight major subwatersheds within the Loxahatchee River watershed: Kitching Creek basin, Grove basin, Pal-Mar basin, Jupiter Farms basin, Historic Cypress Creek basin, Loxahatchee Estuary, C-18/Corbett basin, and L-8 basin (USACE 2020).

The Hungryland and Loxahatchee sloughs are located upstream and provide significant freshwater input to the Loxahatchee River, including the Northwest Fork. The C&SF Project, authorized by Congress in 1948 primarily for flood control, altered the hydrology of the Loxahatchee Slough and River by redirecting freshwater that naturally flowed out of the Northwest Fork to the Southwest Fork and then out to tide (McVoy et al. 2011). The primary canal conveyances constructed as part of the C&SF Project include the L-8 Canal, the east and west legs of the C-18 Canal, and the C-51 Canal, all of which impacted the hydrology of the watershed to varying degrees. Dry season flows to the Northwest Fork were limited by altered drainage patterns and lowered groundwater levels due to the construction of canals, levees, and supporting water control infrastructure. Other types of development activities that followed the C&SF Project, such as road construction and urbanization, further limited dry season flows to the Northwest Fork. The permanent opening and management of the Jupiter Inlet post 1947 allowed more saltwater entry to the Loxahatchee River estuary. The original C&SF Project resulted in changes to the watershed hydrology as the landscape was fragmented while the Loxahatchee River estuary has also experienced more Atlantic Ocean connectivity through Jupiter Inlet management.

Land development over the last century has altered the natural hydrology of the watershed, resulting in community-wide changes to aquatic vegetation (freshwater and estuarine), including productivity and function. Collectively, the hydrologic changes have promoted the upstream movement of saltwater. As a result, cypress and other freshwater vegetation intolerant of elevated salinity conditions have been replaced by mangroves and other estuarine plant communities. If freshwater dry season flows are not increased to improve riverine system resilience, the salinity cline will continue to extend farther upriver than under historical conditions, thereby converting more freshwater habitat to estuarine habitat. These effects are likely to be exacerbated by potential sea level rise effects (USACE 2020). Additionally, the hydrologic impacts have had repercussions throughout the food web (USACE 2020). Under the current hydrologic conditions, further reduction in habitat function is possible, resulting in a decrease in the abundance and diversity of fish and wildlife resources throughout the watershed.

3.1.2 Habitats

The land within the Loxahatchee River watershed can be grouped into three broad land use categories: natural areas, agricultural lands, and residential/commercial space. Approximately 63% of the watershed is natural area (USACE 2020). This includes eight major natural areas: Jonathan Dickinson State Park, the Northwest Fork, Loxahatchee River Estuary, Pal-Mar, J.W. Corbett Wildlife Management Area, Loxahatchee Slough Natural Area, City of West Palm Beach Water Catchment Area, and Dupuis Wildlife

and Environmental Area (USACE 2020). The 10 major freshwater and saltwater habitats that make up the Loxahatchee River watershed are cypress swamp, pine uplands, scrub, freshwater marshes, hardwood hammock, mangrove swamp, seagrass beds, oyster reef and beds, estuary (lagoons and inlets), and coastal dunes (USACE 2020). Although the C&SF Project altered hydrology and fragmented the landscape into variously sized habitat patches, the watershed still supports diverse ecological communities that provide food, cover, and roosting and nesting habitats used by a wide range of wildlife.

3.1.3 Fish and Wildlife Resources

The fish and wildlife resources within the Loxahatchee River watershed comprise many taxonomic groups of aquatic macroinvertebrates, freshwater and saltwater fish, amphibians, reptiles, birds, and mammals. Because the Northwest Fork of the Loxahatchee River is a federally designated Wild and Scenic River, area-specific regulations affect the management of fish and wildlife resources.

Shellfish

The Loxahatchee River Estuary supports a variety of shellfish, including crabs, clams, shrimp, and oysters. Of commercial importance, the estuary is home to blue crabs and stone crabs. Oyster reefs within the estuary have been monitored for the past 30 years and shown decreased abundance due to flood control measures that have altered freshwater flows of the river (USACE 2020). South of the Loxahatchee River Estuary, the Lake Worth Lagoon was also impacted by the C&SF Project and has experienced changes in the magnitude and duration of saline conditions, which has prohibited the establishment of oyster communities.

Fish

Christensen (1965) identified more than 250 species of fish within the Loxahatchee River and Estuary. The abundance, distribution, and diversity of fish are affected by season, salinity, and habitat availability. The upstream area of the river is characterized by freshwater fish species, and the lower portion is characterized by marine and estuarine species. The freshwater marshes, creeks, and river reaches include many species of small and large fish. Small fish provide an important food source for wading birds, reptiles, and amphibians. Common small freshwater fish include the golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), oscar (*Astronotus ocellatus*), eastern mosquitofish (*Gambusia holbrookii*), and small sunfishes (*Lepomis* spp.) (USACE 2020). Larger freshwater fish occur in deeper ditches, canals, and the upper river reaches where tapegrass occurs in widespread beds on the river bottom. This includes largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), yellow bullhead (*Ameiurus natalis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (USACE 2020). Larger fish are prey for birds, alligators, and mammals and serve as a recreational and commercial fishery resource.

Seagrass and mangrove habitat within the estuarine and marine portions of the river provide important habitat and nursery grounds for many fish species. Common recreational and commercial fish species found within the estuarine and marine reaches of the Loxahatchee River include mutton snapper (*Lutjanus analis*), yellowtail snapper (*Ocyurus chrysurus*), lane snapper (*Lutjanus synagris*), yellowtail parrotfish (*Sparisoma rubripinne*), gag grouper (*Mycteroperca microlepis*), pinfish (*Lagodon rhomboids*), tarpon (*Megalops atlanticus*), common snook (*Centropomus undecimalus*), crevalle jack (*Cranx hippos*), spotted sea trout (*Cynoscion nebulosus*), redfish (*Sciaenops ocellatus*), sheepshead (*Archosargus probatocephalus*), mullet (*Mugil* spp.), threadfin shad (*Dorosoma petenense*), and gizzard shad (*Dorosoma cepedianum*) (USACE 2020).

Amphibians and Reptiles

The freshwater wetland complex of the watershed supports a diverse assemblage of amphibians and reptiles. Amphibians are an important food source for wading birds, alligators, and larger predatory fish. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Rana grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirela*), and green tree frog (*Hyla cinerea*) (USACE 2020). Common reptiles include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snakes (*Nerodia* spp.), mud snake (*Francia abacura*), eastern ratsnake (*Pantherophis obsoletus*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 2020). Protected species such as the eastern indigo snake (*Drymarchon corais coupieri*), gopher tortoise (*Gopherus polyphemus*), and gopher frogs (*Lithobates capito*) are also present in the watershed.

Birds

Wading birds and marsh birds are frequently observed in depressional marshes and littoral zones of ditches, canals, and stormwater detention ponds within the watershed. Common wading birds include white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Aredea albus*), snowy egret (*Egretta thula*), great blue heron (*Ardea herodias*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), green heron (*Butorides virescens*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Platalea ajaja*), and wood stork (*Mycteria americana*) (USACE 2020). Common marsh birds include the common gallinule (*Gallinula galeata*), purple gallinule (*Porphyrio martinicus*), least bittern (*Ixobrychus exilis*), limpkin (*Aramus guarauna*), king rail (*Rallus elegans*), and black rail (*Laterallus jamaicensis*).

Additional protected bird species found in the watershed include bald eagles (*Haliaeetus leucocephalus*), northern crested caracaras (*Caracara cheriway*), sandhill cranes (*Antigone canadensis*), and red-cockaded woodpeckers (*Picoides borealis*). The red-cockaded woodpecker has a small population in the J.W. Corbett Wildlife Management Area, where it tends to nest in mature pine trees.

Mammals

A variety of mammal species are found throughout the Loxahatchee River watershed from the uplands to the estuary. The rice rat (*Oryzomys palustris natator*), round-tailed muskrat (*Neofiber alleni*), river otter (*Lontra canadensis*), marsh rabbit (*Sylvilagus palustris*), and raccoon (*Procyon lotor*) are common mammal species that inhabit the upland and wetland plant habitats. White-tailed deer (*Odocoileus virginianus*), black bear (*Ursus floridanus*), bobcat (*Lynx rufus*), and the federally endangered Florida panther (*Puma concolor coryi*) also use portions of the watershed as part of their home ranges.

3.2 Description of Northwest Fork of the Loxahatchee River

The Northwest Fork of the Loxahatchee River naturally originates in the Loxahatchee and Hungryland sloughs, which are south and west of the river. The C&SF Project cut off these hydrologic connections to the Northwest Fork and diverted freshwater flow to the Southwest Fork and out to tide through construction of canals (e.g., C-18) and water control structures (e.g., G-92). Downstream from the Loxahatchee and Hungryland sloughs, the Northwest Fork also receives input from other major tributaries of the Loxahatchee River, such as Cypress Creek/Cypress Creek Canal, Hobe Grove Ditch, Moonshine Creek, Wilson Creek, and Kitching Creek. Three distinct reaches (riverine, lower tidal, and upper tidal) and four major forest

community types (swamp, bottomland hardwood, hydric hammock, and upland) are found in the floodplain of the Northwest Fork. The following descriptions of the river reaches and dominant vegetative communities were summarized from the *Restoration Plan for the Northwest Fork of the Loxahatchee River* SFWMD (2006).

- The riverine reach of the Northwest Fork primarily consists of freshwater canopy forest that generally is unaffected by salinity. This area ranges from just north of the G-92 structure to river mile (RM) 9.5 (**Figure 3-1**). Vegetative communities in this reach are dominated by bald cypress (*Taxodium distichum*), pop ash (*Fraxinus caroliniana),* red maple (*Acer rubrum*), pond apple (*Annona glabra*), and water hickory (*Carya aquatica*).
- The upper tidal reach between RM 9.5 and RM 8.13 (**Figure 3-1**) consists of mixed freshwater/brackish canopy forest that has experienced some saltwater intrusion due to tidal influences and lack of freshwater flow during the dry season. Upper tidal reach communities are dominated by pond apple, red and white mangrove (*Rhizophora mangle* and *Laguncularia racemosa*), and cabbage palm (*Sabel palmetto*), with some communities of bald cypress located in the inner floodplain away from the riverbed.
- The lower tidal reach from approximately RM 8.13 to RM 5.5 (**Figure 3-1**) includes salt-tolerant species and is highly influenced by tides and salinity in the water and soils. The lower tidal reach is dominated by red and white mangrove.

Among other contributing factors—including widening and dredging of the Jupiter Inlet, groundwater drawdown in Jupiter and Tequesta, and sea level rise—decreased freshwater input to the Northwest Fork of the Loxahatchee River has led to an increase in upstream salinity, which has caused a decline in rare riverine cypress and an encroachment of mangroves. Restoration target flows developed in the *Restoration Plan for the Northwest Fork of the Loxahatchee River* (SFWMD 2006) identified dry season and wet season flows at Lainhart Dam (located between RM 14 and RM 15; **Figure 3-1**). The restoration target flows would provide preferred seasonal flows to the Northwest Fork and reduce saltwater intrusion in the tidal plain, while maintaining appropriate environmental conditions in the riverine floodplain for aquatic-dependent species, communities, and wildlife (USACE 2020). The target flows developed in 2006 were re-examined in 2012 using new flow, salinity, and biological monitoring data and were found to be valid. Those target flows were used to develop the LRWRP (USACE 2020). Salinity target zones or "envelopes" were also developed in 2006 for the four major salinity zones: freshwater, oligohaline, mesohaline, and polyhaline (SFWMD 2006). Ecological indicators such as tapegrass, fish larvae and juveniles, oysters, and seagrass are monitored within each respective salinity zone to track the health, abundance, and distribution of native riverine and estuarine species.

Sea level rise is a concern for all coastal areas of South Florida. The PIR-EIS reported sea levels relative to the Loxahatchee River and Estuary could rise 0.4 to 2.4 ft over the next 50 years (USACE 2020). This rise in sea level could result in saltwater migration upstream in the Loxahatchee River. The additional freshwater flows resulting from the LRWRP may help mitigate this saltwater migration. Modeling was performed as part of the project and details can be found in the PIR-EIS (USACE 2020).

Figure 3-1. River mile designations for the Loxahatchee River (From: SFWMD 2006).

3.3 Geology and Hydrogeology of Aquifer Systems in the Vicinity of the C-18W Reservoir

The geological framework of South Florida has been studied by numerous investigators, including Miller (1990), Meyer (1989), and Reese and Richardson (2008). Most of the following is summarized from Reese and Richardson (2008), supplemented with more recent data. Florida is underlain by a thick sequence of carbonate and clastic sedimentary rocks ranging in age from Paleocene to recent. There are three principal hydrogeologic units present in the study area: the surficial aquifer system (SAS), intermediate confining unit, and Floridan aquifer system (FAS). In this area, the SAS consists of fine- to medium-grain quartz sand with varying amounts of silt, clay, and shell deposits. It is unconfined and produces small quantities of good to fair quality water. The intermediate confining unit generally consists of the fine-grained sediments of the Hawthorn Group. The Hawthorn Group generally acts as a regionally extensive confining unit overlying the FAS in southeastern Florida. In the area of the C18-W Reservoir, the Hawthorn Group is approximately 700 ft thick.

3.3.1 Floridan Aquifer System

The FAS consists of the Upper Floridan aquifer (UFA), middle confining unit, and Lower Floridan aquifer (Miller 1990). Reese and Richardson (2008) refined these units and provided a more consistent hydrogeologic framework using multiple methods for identifying hydrostratigraphic units, including lithologic and geophysical methods.

Generally located about 1,000 ft below land surface (bls), the UFA occurs at the base of the Hawthorn Group and includes the Suwannee Limestone and upper portions of the Avon Park Formation and Ocala Limestone. In the study area, it generally consists of several thin, highly permeable water-bearing zones interbedded with thicker zones of lower permeability. Because of good confinement above the UFA and artesian pressure within it, the top of the UFA is marked by a large increase in hydraulic head. Drilling characteristics, such as a lost-circulation zone, also help identify the top of the UFA. The thickness of the UFA varies between less than 100 ft in central Florida to more than 700 ft in some areas of southern Florida. The bottom of the UFA tends to be gradational in nature and its elevation is difficult to define precisely. The UFA is the target horizon for implementation of ASR at the C-18W Reservoir.

The middle confining unit is divided into three units: upper middle confining unit, Avon Park permeable zone (APPZ), and lower middle confining unit (Miller 1986). As stated above, the boundary between the UFA and middle confining unit is gradational and difficult to define precisely; therefore, the altitude of the top of the upper middle confining unit has a significant degree of variability. The thickness of the upper middle confining unit varies between less than 100 ft to more than 800 ft. The APPZ is a productive unit in the study area. The APPZ is present throughout most of South Florida, although it thins and may pinch out along the southeast coast of Florida and may be absent in portions of Collier and Monroe counties. In other portions of South Florida, it can be up to 500 ft thick. Permeability of the APPZ is mainly associated with fracturing. Transmissivity of the APPZ ranges from less than 100,000 ft^2/day in the southern portions of southern Florida to 1,600,000 ft^2/day in west-central Florida.

The Lower Floridan aquifer consists of a sequence of permeable zones separated by semi-confining units. The first permeable zone is somewhat contiguous throughout South Florida. It is located near the base of the Avon Park Formation at elevations between -1,400 and -2,600 ft National Geodetic Vertical Datum of 1929 (NGVD29). Its thickness ranges from near absent to more than 150 ft. Reported transmissivities range between 10,000 and 50,000 ft^2/day, with some localized higher values. Water quality within the first permeable zone is generally saline throughout South Florida. The first permeable zone is generally above the glauconitic limestone marker bed (**Figure 3-2**). Below the first permeable zone is a series of confining units with localized permeable zones in the upper portion of this deeper unit. The spatial extent of the thin permeable zones has not been fully mapped or identified in the deeper wells that penetrate this unit and would be difficult to treat as distinct hydrostratigraphic units. As a result, these lower confining units and the thin permeable zones within them are treated as a single semi-confining unit referred to as the Lower Floridan confining unit. Below the Lower Floridan confining unit is an extremely transmissive zone of cavernous and fractured dolomites and limestones of the Oldsmar Formation locally referred to as the Boulder Zone. The Boulder Zone occurs at elevations of approximately -2,100 to -3,500 ft NGVD29 and can be several hundred feet thick in some areas (Reese and Richardson 2008), with extremely high transmissivity values. The Boulder Zone represents the base of the FAS in South Florida as it is underlain by the massive impermeable anhydrite beds of the Cedar Keys Formation (**Figure 3-2**).

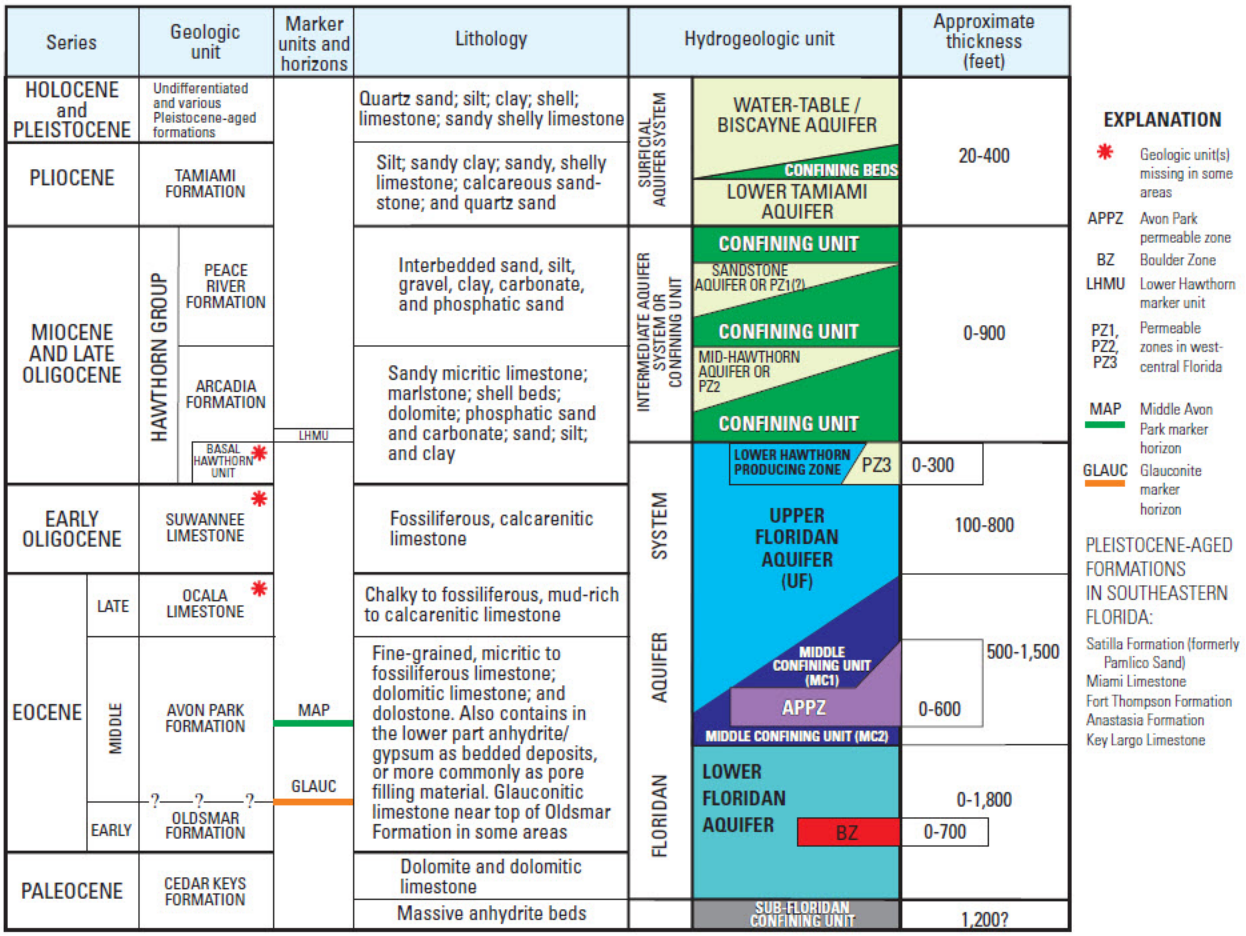

Figure 3-2. Generalized geologic and hydrogeologic framework of South Florida (From: Reese and Richardson 2008).

3.3.2 Hydrogeology at Nearby FAS and Aquifer Storage and Recovery Wells

There are several wells in Palm Beach County that provide information pertinent to the ASR well component of the C-18W Reservoir (**Figure 3-3**). The deep injection wells provide hydrostratigraphic and some water quality information, but generally do not provide information regarding aquifer characteristics in the UFA and APPZ. The FAS supply wells, ASR test wells, and SFWMD exploratory wells have more robust data sets that typically provide this information.

The hydrostratigraphic units most associated with water supply are the UFA and APPZ. Permeable zones within the upper portions of the Lower Floridan aquifer are too brackish to expect reasonable ASR recovery rates. For the UFA and APPZ, chloride and total dissolved solids (TDS) concentrations of 2,000 and 4,000 milligrams per liter (mg/L) are typical in Palm Beach County. The base of the underground source of drinking water, defined as the depth where ambient water quality is 10,000 mg/L total dissolved solids, is encountered between depths of 1,700 ft bls (Geraghty & Miller 1986, 1987) and 1,920 ft bls (PBF-15 at L-8 flow equalization basin; Anderson 2008). The transition to poorer water quality typically occurs over a short interval (approximately 100 ft) based on water quality samples obtained during reverse-air drilling at these sites.

Pratt & Whitney Injection Well: The closest wells to the C-18W Reservoir site that penetrate the entire FAS are located at the Pratt & Whitney deep injection well facility, approximately 4 miles north. The wells at this facility are completed within the Boulder Zone (approximately 3,000 ft bls). The Pratt & Whitney investigation revealed the top of the UFA occurs within the Suwannee Limestone at approximately 800 ft bls (CH2M HILL 1985). Additionally, there are deeper, permeable dolomitic portions of the aquifer that may also be available for storage.

Seacoast Injection Well: The stratigraphy at the Seacoast Utility Authority deep injection well system, 9 miles east of the C-18W Reservoir site, is similar to that at the Pratt & Whitney deep injection well facility. Investigation at this location showed there are several potential storage zones within the upper portions of the FAS, the uppermost of which is at 900 ft bls (CH2M HILL 1989).

C-18 Test ASR Well: In 1976, the Florida Department of Natural Resources constructed and tested an ASR system along the C-18 Canal, approximately 11 miles northeast of the C-18W Reservoir site (Palappert 1977). A 12-inch diameter test ASR well drilled within the UFA underwent four short test cycles at recharge rates of 3 mgd at relatively low pressures. During the fourth cycle, the system exhibited a recovery efficiency of 36% after recharging for only one month and a storage period of 120 days. Testing indicated the UFA would be conducive to future implementation of larger-capacity ASR wells at this site at rates of 5 mgd, with high recovery efficiency.

West Palm Beach ASR Well: The City of West Palm Beach is currently operating an ASR system approximately 11 miles southeast of the C-18W Reservoir site (CH2M HILL 1998). The ASR system is operating at recharge rates in excess of 7 mgd within the UFA and is currently conducting test cycles using filtered surface water. The City has obtained a water quality criteria exemption from the Florida Department of Environmental Protection that allows the ASR system to operate without a disinfection treatment process.

US Sugar ASR Test Well: In 1992, the United States Sugar Corporation constructed a test well system approximately 11 miles west of the C-18W Reservoir site. A 6-inch diameter test well, cased to the top of the FAS at a depth of 925 ft bls, was constructed with an open-hole extending to 1,690 ft bls. The well was hydraulically tested, and results indicated the UFA exhibited a transmissivity of 540,000 gallons/day/ft (Missimer & Associates, Inc. 1993). These attributes indicate a larger-diameter ASR well at this location could be pumped at a rate of 5 mgd, while exhibiting reasonable drawdowns and recharge pressures. Additionally, the water within the UFA exhibited chloride concentrations between 1,100 and 1,800 mg/L, which are similar to other ASR facilities in southern Florida that have had high recovery efficiencies.

Royal Palm Beach Injection Well: The stratigraphy at the Royal Palm Beach deep injection well, located 7 miles south of the C-18W Reservoir site, confirms that the UFA is present at a depth of 900 ft bls, and artesian limestone and dolomitic intervals are present to depths greater than 2,500 ft bls. A lost circulation zone at 950 ft bls indicates a permeable zone corresponding to the top of the UFA, with a total dissolved solids concentration of 4,000 mg/L. These findings indicate that multiple, vertically stacked zones may be available for high-capacity water recharge and storage in the area (CH2M HILL 1988).

L-8 Flow Equalization Basin Site (PBF-15): The SFWMD constructed a tri-zone monitor well to measure groundwater levels continuously in FAS permeable zones at the northeast corner of the L-8 flow equalization basin. Two permeable zones suitable for storage were identified between 890 and 1,100 ft bls. While drilling through this interval, numerous lost circulation zones were encountered, indicating highly fractured or otherwise permeable strata within the UFA that would be capable of accommodating high-capacity recharge and recovery rates (Anderson 2008).

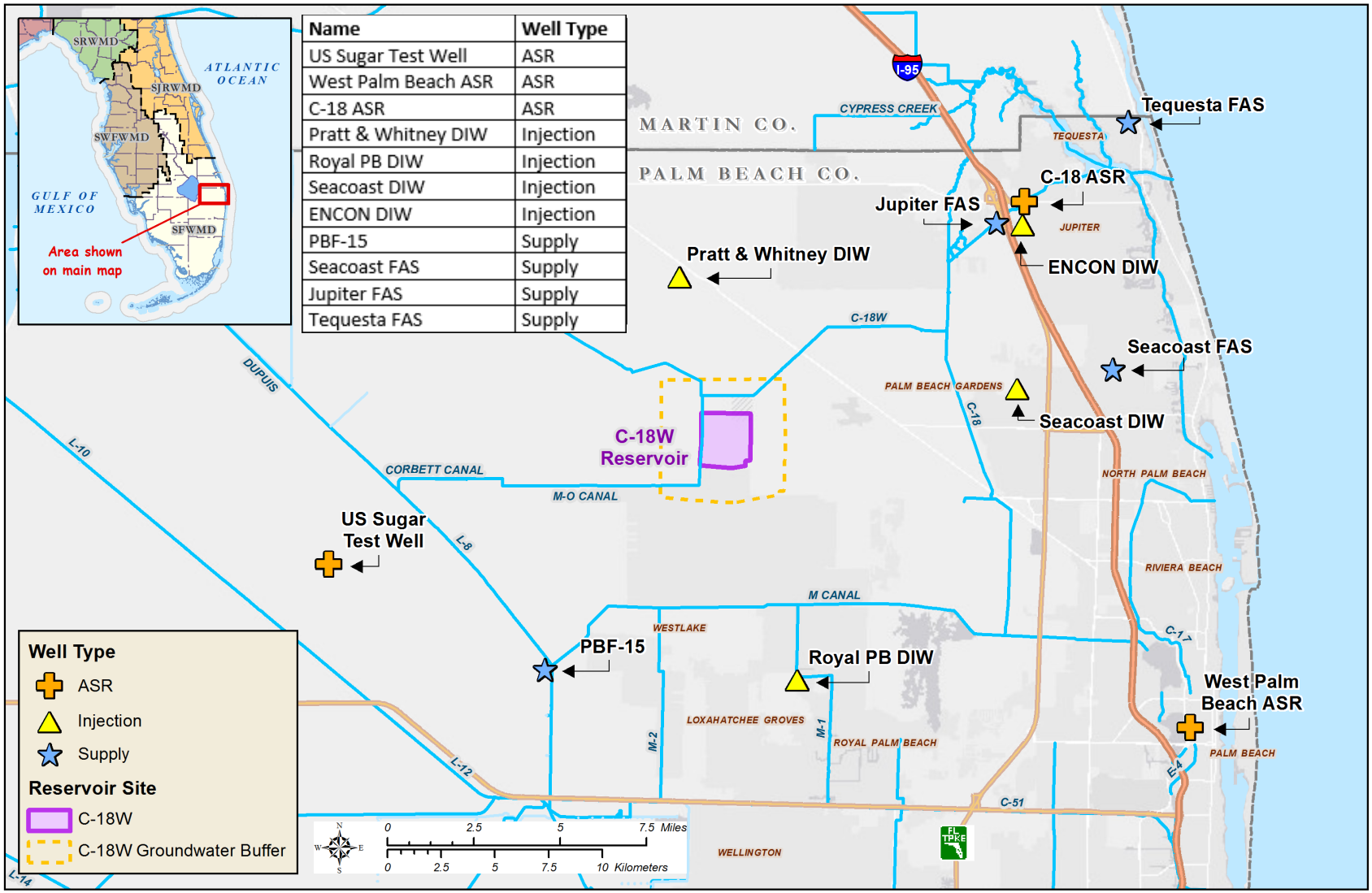

Figure 3-3. The C-18W Reservoir and nearby Floridan aquifer system wells.

3.3.3 Conclusions

Review of hydrogeologic data in the vicinity of the C-18W Reservoir site was based on consultant reports and United States Geological Survey and SFWMD water resource investigations. Based on this review, it appears that subsurface conditions in the general depth range of the UFA (the target zone) are suitable for ASR implementation. The UFA's hydrogeology, background water quality, aquifer characteristics, regional hydraulic gradient, and anticipated pumping rates are all within reasonable ranges associated with other successful ASR systems. There is no specific information in the area that precludes the C-18W Reservoir site from being considered for ASR.

4 IMPROVEMENTS TO HYDROLOGY, HABITATS, AND FISH AND WILDLIFE RESOURCES

4.1 Hydrology

One of the five planning objectives of the LRWRP is to restore wet and dry season flows to the Northwest Fork of the Loxahatchee River and the river's floodplain (USACE 2020). The Authorized Plan will improve the quantity, quality, timing, and distribution of freshwater flow to the Northwest Fork by achieving 91% of the dry season target restoration flows and 98% of the wet season target restoration flows as measured at Lainhart Dam (USACE 2020). To improve seasonal flows, freshwater currently lost to tide (via the Southwest Fork) will be captured and redirected to the Northwest Fork to meet restoration flows before being discharged into the Loxahatchee River Estuary. These improvements will be realized through the construction of structural project components, including a 9,500-ac-ft reservoir, four ASR wells, a flow-through marsh, pump stations, canals, and water control structures, in addition to management and operational modifications to existing water control infrastructure. Fewer high-discharge events (from the Northwest Fork) and low-flow days will improve salinity along the river, which will conserve the river's unique blend of freshwater and estuarine habitats. The LRWRP will also improve the timing and distribution of flows to the Northwest Fork's tributary creeks (Kitching Creek, Moonshine Creek, and Cypress Creek).

Beyond the Northwest Fork of the Loxahatchee River, the LRWRP will provide significant hydrologic improvements to wetlands through restoration of sheetflow and increased hydroperiods. Specific restoration actions include removal of berms, filling of ditches, connecting surface water and groundwater flows between natural areas, and moving water through spreader canals and natural flow-ways. Although hydrology to the watershed and Northwest Fork will be improved, the LRWRP will not fully restore hydrology to pre-drainage conditions (USACE 2020).

4.2 Habitats

The spatial extent and quality of wetland resources within the Loxahatchee River watershed have been impacted by drainage, conversion to agriculture, and urban development. The LRWRP proposes to restore approximately 27,000 acres of disturbed wetlands within the watershed: 17,000 acres of former wetlands that were improved for agriculture and 10,000 acres of existing disturbed wetlands in the J.W. Corbett Wildlife Management Area, Loxahatchee Slough, Hungryland Slough, Pal-Mar natural area complex, Cypress Creek Natural Area, City of West Palm Beach Water Catchment Area, and Jonathan Dickinson State Park (USACE 2020). These 27,000 acres of restored wetlands will connect to 51,000 acres of other wetland communities for a total of 78,000 acres of connected habitat (USACE 2020). Restoration and connectivity in these areas will result in habitat improvements for a mix of ridge-and-slough, pine flatwoods, wet prairie, cypress floodplain, cypress strand, dome swamps, depression marsh, and mesic and hydric hammock plant communities (USACE 2020). The LRWRP will also improve conditions for aquatic vegetation and seagrass communities through decreases in the number of high-discharge events and increases in dry season flows to the Northwest Fork and Loxahatchee River Estuary. While the spatial extent of natural plant communities will not be restored to their historical extents and proportions, the quality and quantity of vegetative communities will be greatly improved (USACE 2020).

4.3 Fish and Wildlife Resources

Alterations to historical drainage patterns and modifications to water management practices have impacted aquatic vegetation communities within the watershed, resulting in disrupted aquatic productivity and function throughout the food web (USACE 2020). The LRWRP will provide habitat improvements benefitting a wide range of fish and wildlife resources through implementation of project components that improve the timing, quantity, quality, and distribution of freshwater flow to the Loxahatchee River and Estuary. The project will also provide habitat connectivity between natural areas and patches of fragmented habitat as lands are committed to the project. This increase in the spatial extent of suitable habitats will provide additional foraging and nesting opportunities for fish and wildlife, including threatened and endangered species.

In the estuarine environment, oysters will benefit from the project as a result of fewer high-discharge events to the Loxahatchee River and Estuary. Commercially and recreationally important species of fish, such as snapper and grouper, will benefit from improved seagrass habitat and an increase in forage prey availability as the project re-establishes a more natural salinity regime to the river and downstream estuary. Increased freshwater flows to the river and estuary will improve habitat for other estuarine wildlife species such as manatees, sea turtles, and wading birds. In the freshwater environment, fish and wildlife will benefit from expansion of the riparian fringe due to implementation of project components that restore flow to the river and its historical tributaries. Restoration efforts for natural areas and hydrologically impacted lands throughout the project area will increase stages and hydroperiods of wetlands. Such wetland improvements will provide better habitats for crayfish and small fish, thus increasing prey and foraging opportunities for amphibians, reptiles, birds, and small mammals.

Currently degraded populations of listed species are expected to improve after the restoration and enhancement of suitable habitat. Nine federally listed species are either known to exist or potentially exist within the project area (USACE 2020). Those that would benefit from the LRWRP include the Florida manatee, Florida bonneted bat, snail kite, and wood stork. Twelve state-listed species are also potentially present in the project area (USACE 2020). Those that will benefit from the LRWRP include beach-nesting bird species (e.g., American oystercatcher, black skimmer, least tern), wading birds (e.g., reddish egret, little blue heron, roseate spoonbill, tricolored heron), and sandhill cranes. The LRWRP will contribute to the ongoing monitoring and management of threatened and endangered species, which will help maintain or enhance existing populations.

5 IDENTIFICATION OF WATER TO BE PROTECTED

The purpose of amending the Lower East Coast Regional Water Availability RAA rule to expand the boundaries of the North Palm Beach County/Loxahatchee River Watershed Waterbodies is to ensure water associated with the operation of the LRWRP is protected from consumptive use. Expansion of the RAA will protect surface waterbodies that deliver water to the Loxahatchee River or its tributaries. New rules are needed to protect the water stored in the upper FAS via ASR wells included in the LRWRP's Authorized Plan.

5.1 Surface Water

The RAA for the Lower East Coast Everglades Waterbodies and North Palm Beach County/Loxahatchee River Watershed Waterbodies is a component of the MFL recovery strategy for the Northwest Fork of the Loxahatchee River, as set forth in Chapter 40E-8, F.A.C. The RAA helps implement the SFWMD's objective to ensure that water necessary for restoration of the Loxahatchee River watershed is not allocated for consumptive use upon permit renewal or modification under this rule. Any evaluation of water withdrawn from the North Palm Beach County/Loxahatchee River Watershed Waterbodies shall address the impacts of the proposed use on surface water and groundwater from: a) integrated conveyance systems hydraulically connected to the North Palm Beach County/Loxahatchee River Watershed Waterbodies and are tributary to or receive water from such waterbodies; and b) the North Palm Beach County/Loxahatchee River Watershed Waterbodies. Integrated conveyance systems hydraulically connected to the North Palm Beach County/Loxahatchee River Watershed Waterbodies include primary canals used for water supply, including, but not limited to, C&SF Project canals and secondary and tertiary canals that derive water from primary canals for supply purposes. Canals used strictly for drainage are not considered part of the North Palm Beach County/Loxahatchee River Watershed Waterbodies.

The LRWRP is a CERP project designed to restore the Loxahatchee River and meet part of the Northwest Fork of the Loxahatchee River MFL recovery strategy. As discussed previously, a condition of CERP projects is the legal protection of project water for the natural system prior to entering a cost-share agreement with the federal government. Most, but not all, the areas included in the LRWRP are already within the existing definition of the North Palm Beach County/Loxahatchee River Watershed Waterbodies and, therefore, protected under the existing RAA. However, to fully protect the water needed for the LRWRP, the existing RAA needs to be amended to include the remaining project areas. **Figure 5-1** shows the proposed, expanded RAA boundaries for the North Palm Beach County/Loxahatchee River Watershed Waterbodies under the Lower East Coast Regional Water Availability rule. Added areas are shown with dashed outlines.

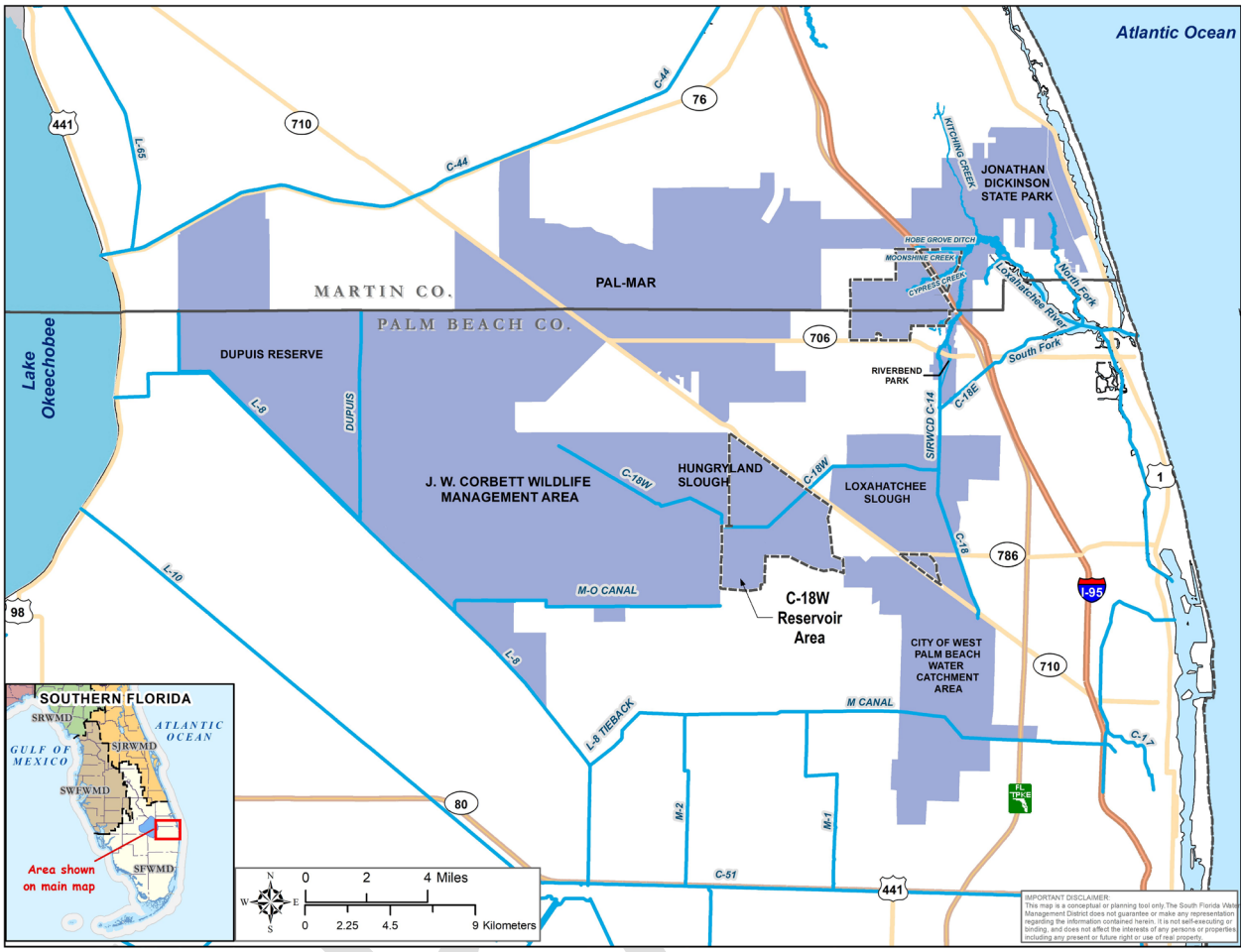

Figure 5-1. The proposed, expanded restricted allocation area boundaries for the North Palm Beach County/Loxahatchee River Watershed Waterbodies under the Lower East Coast Regional Water Availability rule. Dashed lines indicate new areas added to the existing restricted allocation area.

5.2 Groundwater

5.2.1 Surficial Aquifer System

Under the Lower East Coast Regional Water Availability RAA rule, groundwater withdrawals from the unconfined surficial aquifer system (SAS), including the Biscayne aquifer, are limited to the extent that they induce seepage from the North Palm Beach County/Loxahatchee River Watershed Waterbodies above an established base condition (maximum annual average use for a 5-year period ending on April 1, 2006). The current rule applies to the areas shown in **Figure 5-1**. The same base condition will apply to consumptive use permits within the expanded areas in this update to the Lower East Coast Regional Water Availability RAA rule (the areas shown with dashed outlines in **Figure 5-1**).

5.2.2 Floridan Aquifer System

The LRWRP ASR component will store excess surface water in the upper FAS via four ASR wells adjacent to the C-18W Reservoir, as described in the Authorized Plan. To protect the water stored in the upper FAS, the SFWMD will implement a new RAA and modify the current criteria pertaining to existing legal users. The proposed rule will prohibit direct withdrawals from the upper FAS within the RAA boundary identified in **Figure 5-2** to protect the groundwater storage zone associated with the project's ASR wells. This RAA is narrowly defined to continue to encourage water users to utilize the FAS outside the boundary as an alternative water supply source. Consideration of withdrawals that induce seepage across the groundwater RAA boundary will be evaluated as described in Subsection 3.2.1.G of the Applicant's Handbook (SFWMD 2021b). Based on information from previous ASR investigations and modeling performed for the LRWRP, a 1-mile buffer from the boundaries of the C-18W Reservoir parcel was determined as the area necessary to protect the project water stored via ASR (**Figure 5-2**).

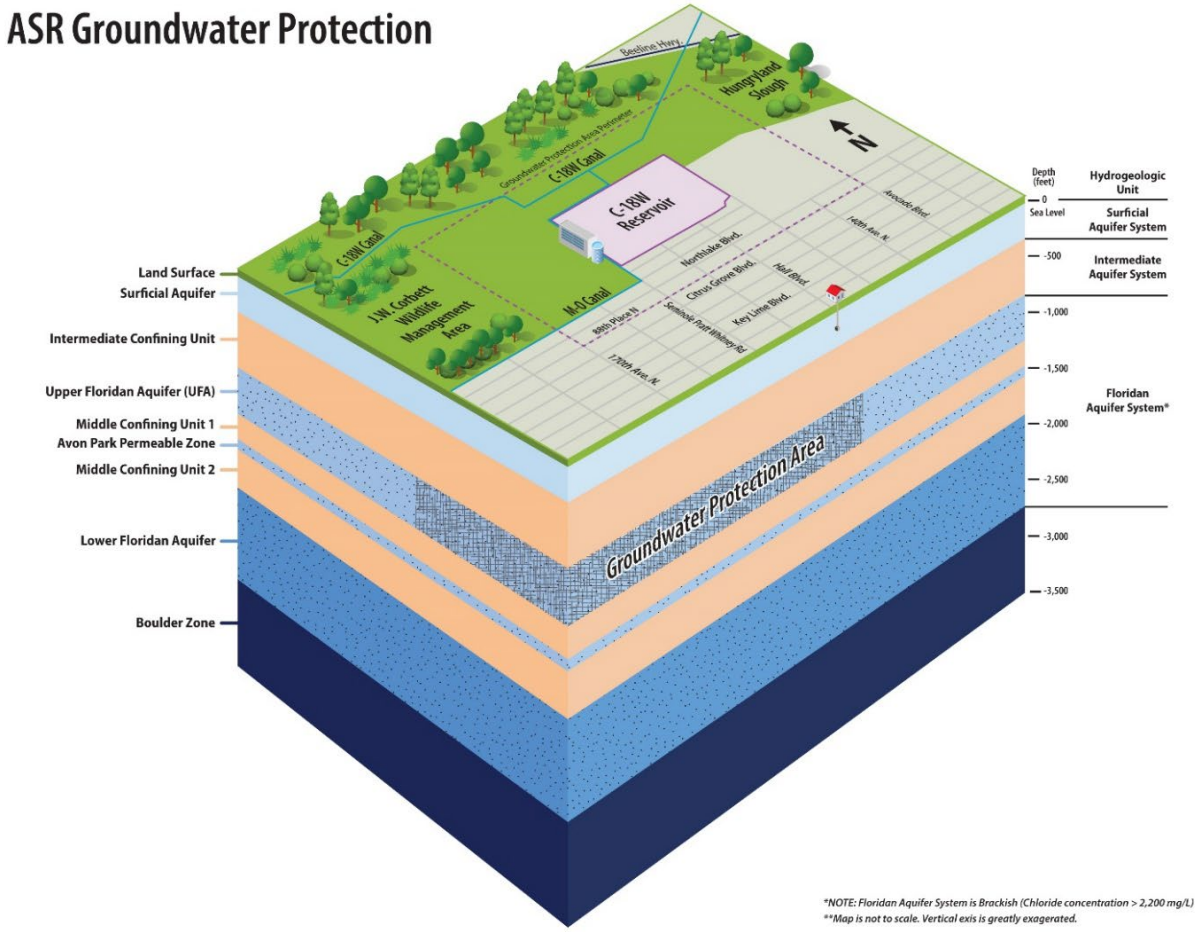

Figure 5-2. Graphic representation of the hydrogeology beneath the C-18W Reservoir (not to scale). The Upper Floridan aquifer (and possibly the Avon Park permeable zone) are anticipated to be utilized for storage and recovery of treated surface water beneath the C-18W Reservoir.

Groundwater Modeling of Aquifer Storage and Recovery at the C-18W Reservoir

During development of the LRWRP PIR-EIS, four ASR wells were simulated as part of the C-18W Reservoir operation. In the model, the minimum and maximum volumes of the ASR storage bubble were 8,700 and 30,000 ac-ft, respectively. Inflow and outflow capacities were limited to a combined flow rate of 30 cfs. The ASR system assumed a 70% recovery efficiency. Results from the Kissimmee River ASR Pilot Project system (nearly 100% recovery efficiency during each cycle over a 4-year testing period; SFWMD and USACE 2013) give some assurance that the 70% recovery efficiency assumed in the LRWRP model is conservative.

To achieve high recovery efficiencies, the brackish water in the storage zone must be displaced away from the ASR well, so a freshwater target storage volume (i.e., the bubble) can be established. To accomplish this, the initial recharge volumes/durations should be large and the recovery volumes purposefully limited. The operational model simulation assumed a minimum bubble volume of 8,700 ac-ft would always be maintained within the aquifer.

The ASR wells are anticipated to be constructed along the western perimeter of the C-18W Reservoir (**Figure 5-3**). Assuming a maximum bubble volume of 30,000 ac-ft, the radial extent of the bubble was estimated using a calculation developed by Warner and Lehr (1981) (**Figure 5-4**). The calculation assumed the upper FAS storage zone was 200 ft thick, with an effective porosity of 20%, and used a dispersivity coefficient of 65 to account for mixing, diffusion, and dispersion within the storage zone. The radial edge of the bubble was estimated to extend 4,280 ft from the injection (recharge) point. The ASR well locations will be determined during preconstruction engineering and design and may be positioned at alternative locations adjacent to the reservoir. To account for this contingency, a conservative distance of 1 mile (5,290 ft) around the perimeter of the reservoir is proposed to protect the project water stored via ASR (**Figure 5-2**).

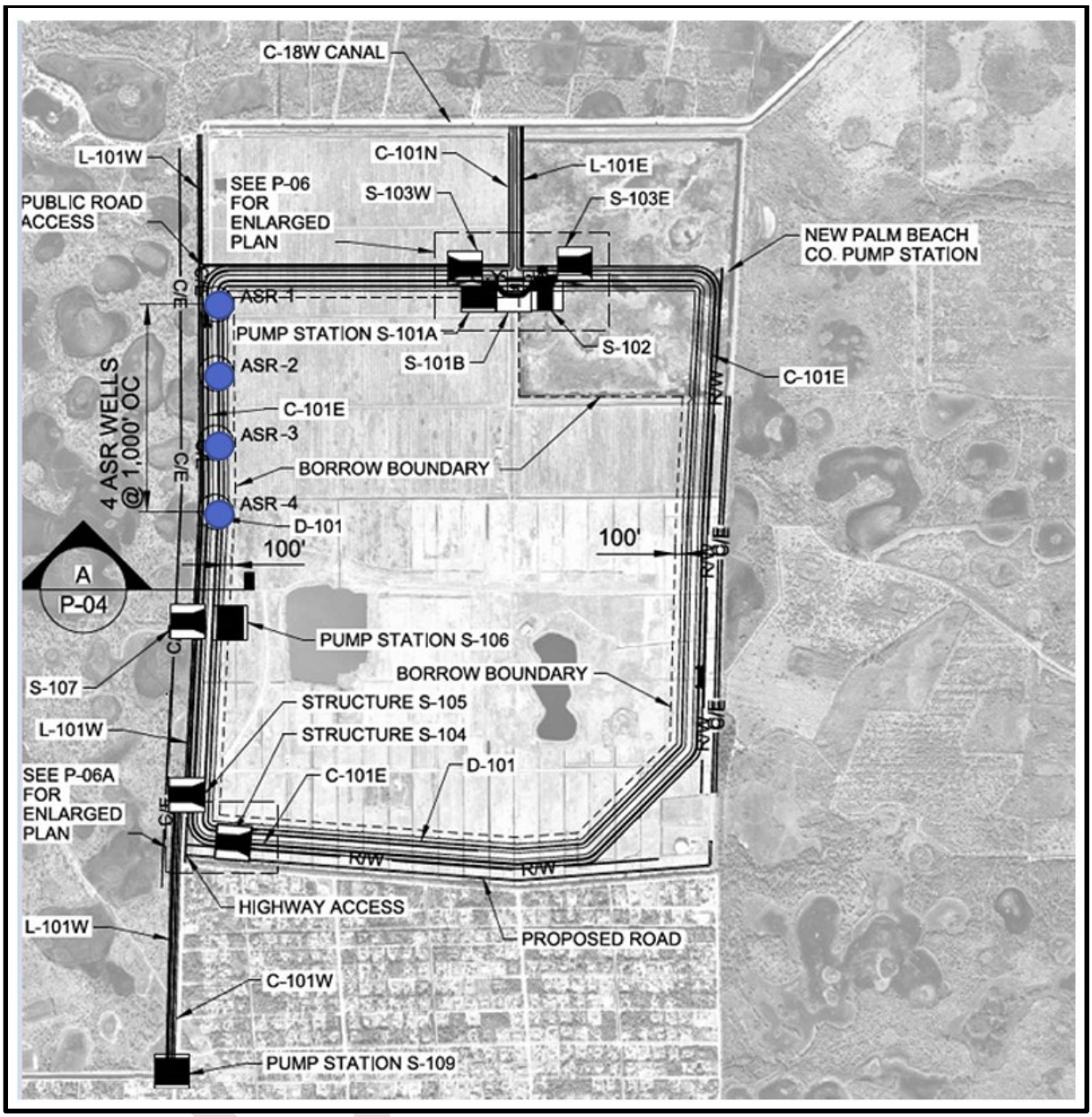

Figure 5-3. Conceptual design of the C-18W Reservoir and aquifer storage and recovery (ASR) wells (From: USACE 2020).

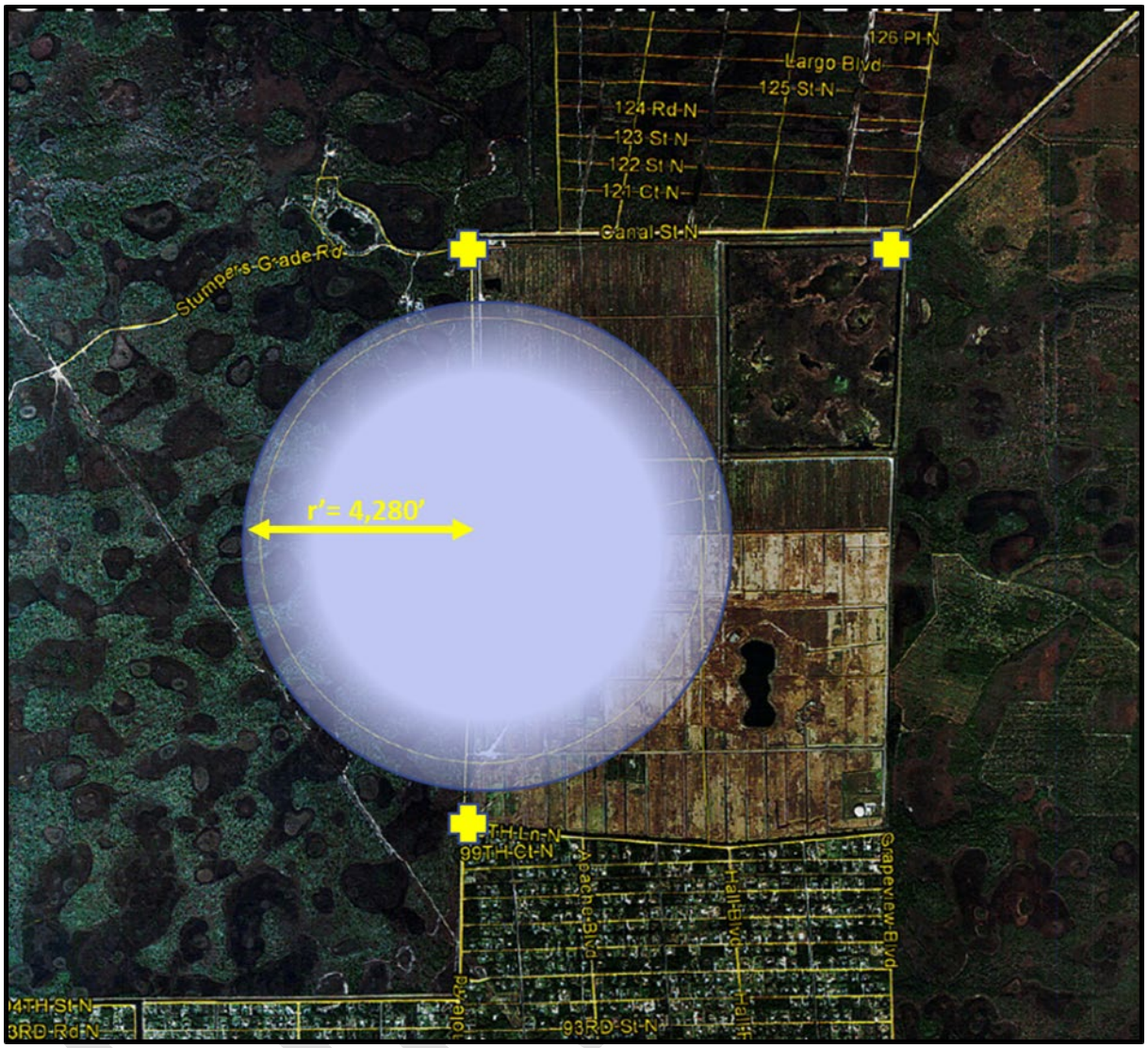

Figure 5-4. Estimated lateral extent of a 30,000-acre-foot groundwater bubble (light blue) in the upper Floridan aquifer system beneath the western border of the C-18W Reservoir parcel where four ASR wells are planned for construction. Yellow crosses are potential monitor well locations.

The effects of operating the ASR wells at the C-18W Reservoir were estimated using WinFlow groundwater modeling software. WinFlow is an interactive, analytical model that simulates two-dimensional steady--state and transient groundwater flow (in confined and unconfined aquifers) with wells, uniform recharge, circular recharge/discharge areas, and line sources or sinks. The model depicts the flow field using streamlines, particle traces, and water-level contours. The steady-state module simulates groundwater flow in a horizontal plane using analytical functions developed by Strack (1989). The transient module uses equations developed by Theis (1935) and Hantush and Jacob (1955) for confined and leaky aquifers, respectively.

The results of an exploratory/test well would provide the best data to derive site-specific aquifer hydraulic properties such as transmissivity, storativity, and leakance. These properties play a role in determining the effects of operating the ASR wells. Transmissivity is the rate at which water passes through a unit width of the aquifer under a unit hydraulic gradient. Storativity is a dimensionless measure of the volume of water

discharged from an aquifer per unit area of the aquifer and per unit reduction in hydraulic head. For a confined aquifer, storativity results only from the rock and fluid compressibility and is typically very small ($\sim 10^{-4}$ to 10^{-5}). Leakance is the volume of water that flows through a unit area of a semi-confining layer separating two aquifers per unit head difference per unit time. At this time, an exploratory well has not been constructed at the project site. In the absence of measured values for these parameters, the reported values from nearby wells described in the previous section include transmissivities of 46,000 to 221,925 ft^2/day, storativity of 0.0004, and leakance 0.007 ft.

A WinFlow simulation at the C-18W Reservoir was conducted by using the Hantush-Jacob solution to assess the potential drawdown that could result from the four proposed ASR wells, each pumping at a rate of 5 mgd (3,500 gallons per minute). ASR wells were spaced 1,000 ft apart, as shown in the conceptual design plans (**Figure 5-3**). Aquifer parameters for the WinFlow model were estimated from review of aquifer performance tests conducted at wells in proximity to the project site. A conservative approach to the analysis was conducted using a low range of transmissivity (74,866 ft^2/day) and leakance (0.0003 ft) and a porosity of 20% for the UFA. Pumping withdrawals from the four ASR wells were simulated for 90 days with no recharge. The resulting model 1-ft drawdown contour lines are shown in **Figure 5-5**. Model results indicate the 1-ft drawdown contour would extend to a maximum of approximately 1 mile beyond the western boundary of the reservoir. Based on this analysis, a 1-mile buffer around the C-18W Reservoir would be reasonable and not overly protective for operation of the ASR system.

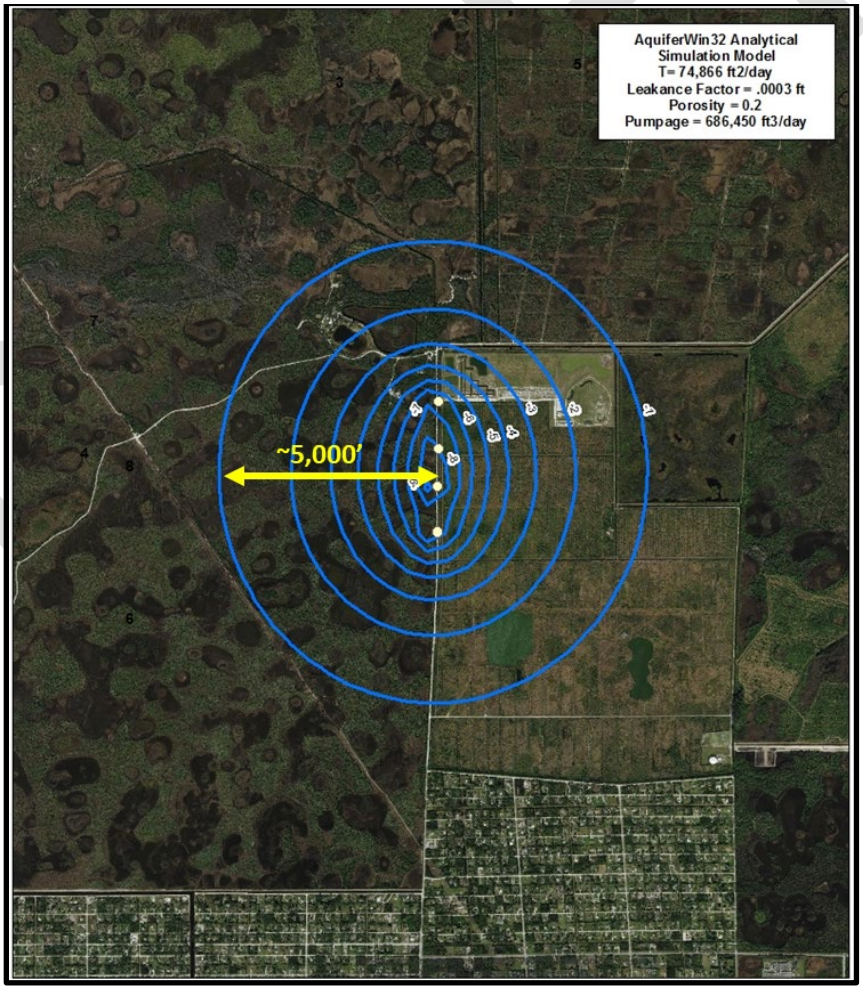

Figure 5-5. The estimated lateral extent of 1-foot drawdown contour lines from simulated withdrawals from the four aquifer storage and recovery (ASR) wells for 90 days with no recharge.

5.3 Effects of the Amended and New Rules on Existing Legal Users

An existing legal use of water is defined as a water use authorized under a SFWMD water use permit or existing and exempt from permit requirements. The LRWRP maintains existing water supply performance for agricultural and municipal water users in the Lake Okeechobee Service Area (LOSA) and North Palm Beach Service Area within the LRWRP project area.

Table 5-1 lists the active existing permitted users (as of October 31, 2021) in northern Palm Beach County and southern Martin County, from Lake Okeechobee to the west to the Atlantic Ocean to the east. The first and second columns of **Table 5-1** list the water use permit numbers and permittee names. The remaining columns show the water sources for each permit.

5.3.1 Surface Water Use Permits

Implementation of the LRWRP will not diminish water supplies for existing users, as required by the Savings Clause. The Savings Clause analysis is listed in WRDA 2000 as a means to protect users of legal sources of water supply (and to protect the levels of service for flood protection) that were in place at the time of enactment. Specifically, Section 601(h)(5) of WRDA 2000, titled "Savings Clause," requires, in part, an analysis of each project's effects on legal sources of water that were in existence on the date of enactment of WRDA 2000. Existing legal sources provide water to permitted users, as shown in **Table 5-1** at the end of this chapter. For a full discussion on the LRWRP's compliance with the Savings Clause and Section 373.1501, F.S., see the PIR-EIS (USACE 2020).

Existing water use permits were reviewed to determine the surface water withdrawal locations and volumes within the expanded North Palm Beach County/Loxahatchee River Watershed Waterbodies boundary. Permit selection included direct withdrawals of surface water from a regional waterbody. Of the existing permits (**Table 5-1**), 81 were identified as withdrawing from a surface waterbody within 0.5 mile of the expanded North Palm Beach County/Loxahatchee River Watershed Waterbodies area. Surface water withdrawals are used for multiple use classes (**Table 5-1**). Stakeholders can search for water use permits through the SFWMD's online maps (https://apps.sfwmd.gov/WAB/SFWMDMapping/index.html).

The waterbodies proposed to be added to the definition of North Palm Beach County/Loxahatchee River Watershed Waterbodies are located on publicly owned lands that have minimal potential for future water use permitting. Water needs for future uses will continue to be met by public water supply utilities, on-site surface water storage, domestic wells, and reclaimed water systems. In homeowners' associations and community development districts, a combination of on-site waterbodies, off-site waterbodies, and the SAS are used for landscape and recreation irrigation and will remain available.

Any domestic self-supply water users can continue to use surface water as their source of water. Over time, potable water, reclaimed water, and wastewater utility service areas will expand into the unincorporated areas of Martin and Palm Beach counties. The Palm Beach County Water Utility Department projects 60% of the domestic self-supply population will eventually convert to public utility use. This population is included in the *2018 Lower East Coast Water Supply Plan Update* (SFWMD 2018); therefore, it is considered an existing water use.

Most existing legal users in the region will not be affected by the amended Lower East Coast Regional Water Availability rule. The existing surface water use permits are already complying with the Lower East Coast Regional Water Availability rule. Any existing legal user within the RAA seeking an increase in allocation will need to perform modeling to demonstrate the cone of depression from the increased withdrawal. If the 0.1-ft cone of depression reaches one of the defined North Palm Beach

County/Loxahatchee River Watershed Waterbodies, the user will need to identify one of the sources in Subsection 3.2.1.E.5 to meet the difference between the base condition and the proposed increase. The user may incur additional costs related to the new source. If the user is located in area with plans for reclaimed water expansion, the user would experience increased water source costs regardless of the proposed RAA amendments.

5.3.2 Groundwater Use Permits

Surficial Aquifer System

Existing water use permits were reviewed to determine the withdrawal locations and volumes of groundwater from the SAS within the expanded North Palm Beach County/Loxahatchee River Watershed Waterbodies boundary. Permit selection included withdrawals of groundwater from the SAS that could cause drawdown in a protected surface waterbody. Of the existing permits (**Table 5-1**), 189 were identified as having at least one well completed in the SAS within the vicinity of the expanded North Palm Beach County/Loxahatchee River Watershed Waterbodies boundary. Groundwater withdrawals from the SAS are used for multiple use classes (**Table 5-1**). Existing SAS water use permits are complying with the Lower East Coast Regional Water Availability rule. Stakeholders can search for water use permits through the SFWMD's online maps (https://apps.sfwmd.gov/WAB/SFWMDMapping/index.html).

Many residential properties south of the C-18W Reservoir site have domestic SAS wells that are permitted by rule and are not required to submit consumptive use permit applications. The cone of depression from these wells is small, generally not extending beyond the property boundaries. The SAS and FAS are hydrogeologically separated by an intermediate confining unit that prevents cross-aquifer interference.

The C-18W Reservoir site is surrounded by natural areas, including J.W. Corbett Wildlife Management Area to the west and Hungryland Slough to the north. Further development of SAS wells in these natural areas is unlikely.

Floridan Aquifer System

Existing water use permits were reviewed to determine the withdrawal locations and volumes of groundwater from the FAS within 1 mile of the C-18W Reservoir site (**Figure 5-4**). Of the existing permits (**Table 5-1**), none were identified as having at least one well completed in the FAS within 1 mile of the C-18W Reservoir site. Groundwater withdrawals from the FAS are primarily used for public water supply by larger utilities such as the Town of Jupiter, Village of Tequesta, and Seacoast Utility Authority northeast of the C-18W Reservoir site (**Table 5-1**). Some utilities also use FAS water for blending with SAS withdrawals. For example, Palm Beach County Water Utility Department has proposed FAS/SAS blending in its recent permit modification (application 210924-3/permit 50-00135-W). Expanded use of brackish groundwater from the FAS for public water supply requires planning and wellfield management to prevent undesirable changes in water quality. In addition to public water supply, the FAS is used for some power generation activities in the vicinity of the project. The FPL West County Energy Center has three FAS wells that are used as needed for cooling water.

The SFWMD encourages water users to utilize the FAS as an alternative water supply source where possible. However, to protect the water stored in the upper FAS, the SFWMD will implement a new RAA rule and modify the criteria pertaining to existing legal users. The proposed rule will prohibit direct withdrawals from the upper FAS within the RAA boundary. Consideration of withdrawals that induce seepage across the groundwater RAA boundary will be evaluated as described in Subsection 3.2.1.G of the Applicant's Handbook (SFWMD 2021b). There are no existing FAS users within the RAA boundary. Any

FAS users seeking to modify their consumptive use permit allocation will have to model the proposed use to determine if it will impact the area of protected water in the upper FAS.

Future use of the FAS would require an applicant to provide reasonable assurances that the proposed withdrawal of water, together with other exempt or permitted uses within the cone of influence of the proposed withdrawal, will not result in interference with existing legal uses, pursuant to Section 373.223(1)(b), F.S. The definition of interference with an existing legal use is provided in Section 3.7.2 of the Applicant's Handbook (SFWMD 2021b). In regard to the C-18W Reservoir ASR waters, future requested allocations should not interfere with the ASR wells or result in 1 ft or more of drawdown to the portion of the upper FAS that underlies the C-18W Reservoir groundwater buffer zone delineated in **Figure 5-2**. The groundwater buffer zone must be maintained to allow stored water to be recovered when needed for the benefit of the LRWRP. Any action causing the groundwater bubble to move away from the recovery zone or reducing the quality of recovered water would impact project water reserved for natural systems. It is proposed that, for an ASR system, interference includes the movement of stored ASR waters away from the delineated project area by changing or accelerating the flow velocity or flow direction, or a change in the concentration of total dissolved solids.

The proposed Applicant's Handbook rules for the FAS do not increase water use permitting fees or regulation (e.g., additional licensure, continuing education requirements). Water use permit applications from the FAS already require staff time and specialized knowledge (e.g., legal, technical). The current rules require existing and future FAS users to model proposed withdrawals to determine potential impacts to the FAS. *See* Section 3.1.2 of the Applicant's Handbook (SFWMD 2021b). Under the proposed rules, if the modeling results show interference or a cone of depression touching the delineated zone in **Figure 5-2**, users/applicants will need to modify the proposed water allocation, which could include reducing the volume sought from the well or relocating the well.

Due to high costs of constructing an FAS well and the treatment needed to make the water potable, domestic wells typically are drilled into the SAS (100 to 120 ft bls maximum compared to approximately 1,000 ft bls to reach the UFA). Therefore, the new proposed rule to protect water in the upper FAS for the ASR wells at the C-18W Reservoir site is not likely to affect any domestic self-supply water users in the region. Additionally, domestic SAS wells will not affect the ASR water protected in the upper FAS.

Table 5-1. Existing legal users and sources in the vicinity of the Loxahatchee River Watershed Restoration Project footprint. Note: primary source – 1°; secondary source – 2°; tertiary source – 3°.

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
Martin County								
Agricultural								
43-00436-W	Armstrong Property	1°						
43-02552-W	Hobe Sound Farms		1°		2°			
43-00200-W	Jack Martin Farms/Shiloh Farms		1°		2°			
43-00045-W	Hobe Tree Farm				1°			
Diversion & Impoundment Secondary User								
43-02339-W	Harmony Ranch	1°						
43-02340-W	The Burg Farm	1°						
Diversion & Impoundment								
43-00087-W	Box Ranch of Martin County D & I	1°						
43-00057-W	Hobe St Lucie Conservancy District		2°	1°	3°			
Golf Course								
43-00138-W	Cypress Links Golf		1°		2°			
43-00221-W	Jonathans Landing at Old Trail		1°		2°			
43-00054-W	Jupiter Hills Club				1°			
43-00091-W	Riverbend Golf Club		1°		2°			
43-00140-W	Turtle Creek Club				1°			
Industrial								
43-00764-W	Girl Scout Camp Welaka				1°			
Landscape								
43-01726-W	Bridge Water Estates				1°			
43-01072-W	Coastal Waste & Recycling of Martin				1°			
43-02790-W	Corner Pine Ranch				1°			
43-01822-W	County Line Park				1°			
43-02228-W	Daystar Storage				1°			
43-00679-W	Florida Power & Light - Martin County				1°			
43-01696-W	Gille Residence		1°		2°			
43-02485-W	Hair Designer				1°			
43-01760-W	Hemingway Estates				1°			
43-01371-W	Hobe Sound Commerce Lot No 9				1°			
43-02045-W	Island Country Estates HOA Inc				1°			
43-01805-W	Jupiter Equestrian Estates				1°			
43-01995-W	Jupiter Hills		1°		2°			
43-00722-W	Jupiter Hills Homeowners Association		1°		2°			
43-01414-W	Lot 23 Ranch Colony - Landscape Irrigation		1°		2°			
43-02984-W	Martin County Fire Rescue Station 36				1°			
43-00877-W	Nichols Sanitation Inc (Hobe Sound Site)		1°		2°			
43-01633-W	North Passage HOA				1°			
43-01890-W	Old Cypress				1°			

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
43-02680-W	Old Trail Entrance Feature Landscape Irrigation				1°			
43-02042-W	Pennock Preserve				1°			
43-01905-W	Pennock Preserve PUD		1°		2°			
43-01179-W	Public Works Facility Irrigation Well				1°			
43-02410-W	Ranch Colony				1°			
43-01763-W	Ranch Colony Lot 16				1°			
43-01744-W	Ranch Colony Property Owners Association				1°			
43-02199-W	River Ridge – New Well				1°			
43-01372-W	Sharma Residence Ranch Colony Lot 1				1°			
43-02921-W	T Asplundh Project				1°			
43-02686-W	Tennis Court Irrigation				1°			
43-00813-W	Tequesta Park				1°			
43-00603-W	The Little Club Condominium Association Incorporated		1°		2°			
43-01602-W	The Prado				1°			
43-01444-W	Tranquility				1°			
43-02803-W	Turtle Creek Common Areas				1°			
43-02679-W	Turtle Creek East				1°			
43-01994-W	Turtle Creek Village POA				1°			
43-01970-W	Waters Edge Property Owners Association Phase Two				1°			
43-01765-W	YZ Ranch		1°		2°			
Livestock								
43-02738-W	Armstrong Property				1°			
43-01599-W	Funny Farm		2°		1°			
43-02645-W	HB10E-004 - Cypress Creek				1°			
43-02378-W	Indiantown Property				1°			
43-01679-W	Kitchen Creek Ranch				1°			
43-02852-W	Mancils Cattle Grazing Lease				1°			
43-02919-W	Powerline Road				1°			
43-03067-W	SS Farms, LLC				1°			
Nursery								
43-02142-W	Alfred M Levy Nursery				1°			
43-02753-W	Jenkins Landscape		1°		2°			
43-02146-W	Toms Tropical Trees				1°			
Public Water Supply								
43-01982-W	Bridge Water Estates				1°			
43-01745-W	Equestrian Camp Sites				1°			
43-02971-W	Fernlea Nursery				1°			
43-02732-W	Hummingbird Substation				1°			
43-00782-W	Jonathan Dickinson State Park - Trapper Nelson & Stop Camp				1°			
43-02256-W	Oblivious Land LLC Private Helistop				1°			
43-02017-W	Old Trail at Jonathans Landing				1°			

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
43-00609-W	Payson Park Thoroughbred Training Center				1°			
43-00066-W	South Martin Regional Utility				1°	2°		
43-01284-W	St Lucie Mobile Home Village				1°			
43-02101-W	State Road No 9 I -95 Weigh-in Motion Station				1°			
43-00498-W	Tanah Keeta Scout Reservation				1°			
Palm Beach County								
Agricultural								
50-04659-W	Moules Nursery		1°					
50-08980-W	Riverbend Park				1°			
Diversion & Impoundment								
50-00793-W	Lake Worth Drainage District	1°		2°				
50-01584-W	Town of Jupiter Recharge System	1°						
Golf Course								
50-00203-W	Breakers West Development		1°		2°			
50-00941-W	Eastpointe Country Club Irrigation System		1°		3°		2°	
50-02831-W	Golf & Racquet Club at Eastpointe		1°		3°		2°	
50-02120-W	Ibis Golf and Country Club		1°		2°			
50-01906-W	Iron Horse Lake Wells				1°			
50-01905-W	Ironhorse Country Club Irrigation		1°					
50-00537-W	Mayacoo Lakes Country Club		1°		2°			
50-01443-W	Old Marsh Golf Club		1°		2°			
50-00617-W	PGA National Golf Club and Sports Center		1°		2°			
50-00223-W	Tequesta Country Club		1°		2°			3°
50-07881-W	The Resort at Jupiter Country Club		1°					2°
Industrial								
50-01849-W	Jupiter Ready-Mix Concrete Plant				1°			
50-03722-W	Matheson Tri Gas West Palm Beach				1°			
50-05185-W	Pratt & Whitney, A Div. of Raytheon Tech Fire & Cooling	1°						
50-08888-W	Pratt & Whitney, A Div. of Raytheon Tech Aquifer Remediation				1°			
50-06015-W	Walgreens Distribution Center				1°			
Landscape								
50-07721-W	15835 Corp. Rd. L.L.C.				1°			
50-02446-W	Acreage Substations		2°	1°				
50-09412-W	Adult Quality Care				1°			
50-06316-W	All About Storage				1°			
50-08665-W	Alloy Cladding			1°				
50-05714-W	Alta Terrace-Phase Ii		1°					
50-02788-W	Amoco Food Mart				1°			
50-07042-W	Andros Isle				1°			
50-04149-W	Andros Isle Oakton Lakes		1°					

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
50-11742-W	Avenir Ph. 2 Spine Rd No. 2 Streetscape Common Irr.			1°				
50-11769-W	Avenir Pod-5			1°				
50-04494-W	Baywinds		1°		2°			
50-05628-W	Baywinds Rpd Pod F Lots 1-68		1°					
50-08880-W	Beacon Baptist Church		1°		2°			
50-11331-W	Bella Villaggio				1°			
50-05434-W	Bimini Twist Plaza				1°			
50-03597-W	Breakers Pointe Lake		1°					
50-09266-W	Breakers West Association				1°			
50-06192-W	Briggs Equipment				1°			
50-11905-W	Calvary Church of Jupiter				1°			
50-02314-W	Caribbean Villas Apartments				1°			
50-05727-W	Chase Bank				1°			
50-04336-W	Church of God of Prophecy				1°			
50-06713-W	Cobblestone Village			1°				
50-05757-W	Costco Wholesale of West Palm Beach		1°		2°			
50-07883-W	Cvt Properties LLC			1°				
50-03735-W	Devonshire at PGA National		1°					
50-10422-W	Discovery Village at Palm Beach Gardens				1°			
50-05200-W	Donald Ross Land Owners Association				1°			
50-05618-W	Donald Ross Road Beautification				1°			
50-11301-W	Dunbar Woods		1°		2°			
50-08766-W	Dunkin Donuts				1°			
50-03282-W	Eastpointe Homeowners Association		1°		2°			
50-05598-W	Eckerd Drugs 31				1°			
50-03122-W	Elementary School E		1°					
50-11938-W	FPL Avenir Substation				1°			
50-06268-W	FAS Well Irrigation (Town of Jupiter)				1°			
50-08213-W	Fimco Manufacturing Inc				1°			
50-08830-W	First Park South Florida-Entry Irrigation				1°			
50-03288-W	Flagler Manor				1°			
50-05615-W	Florida Power and Light Ryder Substation			1°	2°			
50-08576-W	Fox Parcel 4c				1°			
50-08776-W	Foxhall Homeowners Association				1°			
50-06792-W	Golden Corral				1°			
50-10667-W	Gramercy Park				1°			
50-12022-W	Ground F X Equipment and Hauling				1°			
50-06060-W	Hamilton Bay Recreation Center				1°			
50-09892-W	Haverhill Affordable Housing L T D				1°			
50-11967-W	Homesafe				1°			
50-07966-W	Ibis Isle		1°					
50-07991-W	Ibis Lakes Homeowners Association Inc		1°					
50-09050-W	Ibis Property Owners Association		1°		2°			

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
50-01664-W	Irrigation (Pratt & Whitney, A Div. of Raytheon Tech Corp)		1°					
50-09403-W	Jupiter 7th Day Adventist Church		1°		2°			
50-07320-W	Jupiter Country Club		1°					2°
50-07348-W	Jupiter Country Club				1°			
50-10557-W	Jupiter/Palm Beach RV Motorcoach Resort		1°		2°			
50-02315-W	Landscape Irrigation for Administration Building				1°			
50-07093-W	Loxahatchee Reserve		1°					
50-07356-W	Mirasol Irrigation System		2°	1°			3°	
50-06863-W	New Frito-Lay DC				1°			
50-03139-W	North Palm Beach County Aviation Airport				1°			
50-05331-W	North River Plantation		1°		2°			
50-03247-W	Northlake Boulevard Landscape Improvements			1°				
50-09128-W	Oceanside Masonary				1°			
50-06494-W	PDD BE Group Irrigation				1°			
50-07503-W	PM Group				1°			
50-06202-W	Palazzo Grande				1°			
50-06069-W	Palisades PUD		1°					
50-08788-W	Palm Beach County Fire Station No. 14				1°			
50-08991-W	Palm Beach Park of Commerce Lot 35G				1°			
50-11899-W	Palm Beach Park of Commerce Parcel 7				1°			
50-12117-W	Palm Coast Sales				1°			
50-11954-W	Park of Commerce - Building 26				1°			
50-11935-W	Park of Commerce - Project Energy				1°			
50-06257-W	Parkwood Estates PUD				1°			
50-07161-W	Portosol		1°					
50-08943-W	Portosol Okeechobee Blvd Median				1°			
50-08873-W	Precision Contracting Services				1°			
50-06373-W	Premier Park of Commerce		1°					
50-11281-W	Project Beach Ball		2°	1°				
50-04161-W	Publix Shoppes At Ibis 651				1°			
50-02238-W	R and M Management Co LLC				1°			
50-06405-W	Riverside Oaks				1°			
50-03425-W	Riverwalk		1°		2°			
50-03454-W	Royal Palm Beach High School				1°			
50-09166-W	S & K Sales Office				1°			
50-06254-W	Shirley Investment Properties				1°			
50-10724-W	Shoppes At Andros Isle Publix No 0653				1°			
50-10187-W	Sierra Square Irrigation Well				1°			
50-10916-W	Sikorsky D F C		1°					
50-09162-W	Sikorsky Sloped Landing Area		1°					
50-09162-W	Sikorsky Sloped Landing Area		1°					

Permit	Permittee Name	SFWMD Canal	On-site Lake	Other Off-site Surface Water	Surficial Aquifer System	Floridan Aquifer System	Public Water Supply Utility	Reclaimed Water
50-11672-W	Sisson				1°			
50-10703-W	Sonoma Isles		1°					
50-05642-W	South Florida Donuts				1°			
50-09600-W	SR 704 Okeechobee Blvd Beautification				1°			
50-10261-W	State Road 7 - Irrigation Conversion				1°			
50-06518-W	Suntrust Bank at Baywinds Commercial				1°			
50-06300-W	Super Target at Royal Palm Beach		1°					
50-06223-W	T.M. Russell Inc				1°			
50-06947-W	Tangelo Substation				1°			
50-07757-W	TDSI West Palm		1°					
50-09902-W	The Big Green Egg Building				1°			
50-04642-W	The Reserve at Ibis			1°				
50-10578-W	Thousand Pines				1°			
50-05847-W	Tribute Boats				1°			
50-05442-W	Village Shoppes LLC				1°			
50-07504-W	Walgreens Distribution Center				1°			
50-06496-W	West Palm Commerce Park		1°					
50-05706-W	West Palm Commerce Park and Haverhill Commerce Park		1°		2°			
50-06889-W	Western Repump				1°			
Livestock								
50-09293-W	Riverbend Park- Equestrian				1°			
50-09781-W	Rocky Pines Rd				1°			
Nursery								
50-08594-W	Hammock Tropical Garden			1°				
50-11658-W	Ibis Nursery				1°			
50-04449-W	Lidonni Nursery and Landscape		1°		1°			
50-09747-W	Terracon Nursery Tree Farm				1°			
50-08340-W	The Bushel Stop				1°			
Public Water Supply								
50-09534-W	Bushel Stop				1°			
50-02825-W	Church 12265 Indiantown Rd Jupiter Farms		1°		2°			
50-00615-W	City of West Palm Beach Public Utilities	3°		1°		2°		
50-02654-W	Everglades Youth Camp				1°			
50-09243-W	Firestation 14				1°			
50-10610-W	Jupiter/Palm Beach RV Motorcoach Resort				1°			
50-06546-W	Palm Beach County Research Park Temp Construction				1°			
50-11198-W	Palm Beach County Shooting Sports Park				1°			
50-00135-W	Palm Beach County Water Utilities Department				1°			
50-00460-W	Riviera Beach Public Water Supply				1°			
50-07662-W	Sandhill Crane Access Park				1°			
50-00365-W	Seacoast Utility Authority				1°	2°		

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50-05234-W	Storage Facility at J W Corbett Preserve				1°			
50-00010-W	Town of Jupiter Water Utilities				2°	1°		
50-00046-W	Village of Tequesta - Public Water Supply				2°	1°		
50-00046-W	Village of Tequesta - Public Water Supply				2°	1°		

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