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Final Draft

A Critique of the Comprehensive Everglades Restoration Plan

Restoration of Rivers
Term Project

By Eliza Breder

Abstract

The Everglades ecosystem is a part of a large 4,000 square mile watershed that historically drained the Kissimmee River catchment; flowed into Lake Okeechobee and there southward into the Everglades as broad sheet flow of water. In the late 1800s, the Everglades were drained to develop the Everglades Agricultural Area, and a levee was constructed at the southern part of Lake Okeechobee control outflow and thereby keep the agricultural area dry. Many parts of the Everglades are actively drained and what is considered the Everglades today is half of its original size after drainage. I critique the Comprehensive Restoration Plan for the Everglades, which was finalized in 2000. Projects in the restoration plan prioritize water control over floodplain reconnection and ecological recovery. The floodplain restoration literature indicates that effective floodplain restoration has three principal attributes: flow regime, connectivity, and sufficient, large, spatial scale. I found that only eight of the seventeen projects in the restoration plan meet the criteria that focus on restoring flow-regime and connectivity and none involved removing the levee south of Lake Okeechobee. And ten projects focus on water storage to continue water management for urban and agricultural land uses. The continued operation of levees and reservoirs impedes water flow and limits the spatial scale needed in floodplain restoration. It is critical to examine restoration plans and their direct benefit to river ecosystems.

Introduction: The Everglades

The Everglades is a hydrologic system that drains 4,000 square miles in central and south Florida, including the Kissimmee Basin. Lake Okeechobee and the “river of grass” known as the Everglades, which flows southward, between the Atlantic coastal ridge and the Big Cypress Swamp into the Florida Bay (Figure 1) (Chimney et al., 2001). Levees and canals built throughout the Everglades and Kissimmee River catchment in the late 1800s and early 1900s significantly disrupted the natural water flow throughout the system and are responsible for persistent pollution today. And while portions of the system have been restored, much of this flood plain remains fragmented by canals and levees.

The Everglades is a freshwater wetland with a wide range of habitats, all dependent on the slow sheet flow that would enter from Lake Okeechobee and drain into the Florida Bay. The ecosystem has a foundation of deep-water sloughs and sawgrass ridges on a porous limestone geology. These features create a low-flow floodplain, gradual topography, and organic peat soils. This ridge-and-slough ecosystem supports wild fish and birds in various habitats, including sloughs, wet prairies, cypress swamps, mangrove swamps, periodically flooded and non-flooded tree islands, and non-flooded pinelands (Figure 2 & 3) (Harvey et al., 2017). Without the slow water flow across the low-gradient flood plain, these habitats have been impaired.

In the late 1800s, levees were constructed south of Lake Okeechobee obstructing the natural water flow into the Everglades (Figure 4). The drainage was carried out to transform the wetland into an area for agricultural production, and eventually urban development. To reduce flooding at the lake, engineers created canals from the lake to either side of the peninsula to drain runoff from the surrounding region and the Kissimmee River (Grunwald, 2006). The St. Lucie River is a natural river that once drained Lake Okeechobee but did not connect directly to the Atlantic Ocean to the east. The St. Lucie River was engineered and canaled to drain the lake waters into the ocean. The Caloosahatchee is a river that connects the Gulf of Mexico to inland wetlands, but did not historically connect to Lake Okeechobee (Grunwald, 2006). In 1937, it was also engineered to connect the lake to the Gulf for drainage. Four additional canals were constructed to actively drain Lake Okeechobee and the Everglades Agricultural

Area (EAA) to the south (Figure 5). These canals include West Palm Beach Canal, Hillsboro Canal, North New River, and Miami Canal. The EAA was established in 1948 by the Central and Southern Florida (CSF) Project, an entity that constructs flood-control devices in the Everglades (Figure 3). 71% of the EAA is controlled by sugar companies like Florida Crystals and U.S. Sugar who use levees and canals for agricultural irrigation and drainage (Sklar et al., 2019).

Introduction: Impacts on the Ecosystem

The levee and canal systems in the Everglades affect the water flow and levels throughout the catchment area and enable phosphorus pollution. The water-control structures in the EAA disrupt water flow to the Everglades Conservation Area downstream, impairing the natural ecosystem (Figure 6) (Sklar et al., 2019). The seasonal pulsing sheet flow in the floodplain is important for connecting water and organic matter to the sloughs to foster habitats for various species. These interdependencies make the hydrologic flow and quality of the water in the Everglades a vital aspect of a unique ecosystem that supports endemic species (Williams et al., 2006). The large change in hydrology by agriculture affects vegetation, water depth and thereby fish habitats. As water levels decrease and vegetation changes, fish become vulnerable to predation by wading birds (Sklar et al., 2019). The changes in hydrology have disrupted fish population cycles, which depend on the presence of deeper pools in the wet season and ridges in the dry season. Historic water levels were 2-3 feet during the wet season, which are now 1-2 feet. These lower water levels result in subsidence and the disturbance of natural sediment processes vital for slough and ridge habitats (Figure 6) (Harvey et al., 2017). Existing hydrology no longer functions on a natural cycle due to its dependency on water management releases from the EAA water treatment areas.

The South Florida Water Management District (SFWMD) controls and maintains the canals to transport water and agricultural runoff into water treatment areas, affecting water quality throughout the Everglades. The Everglades ecosystem was shaped by a low-phosphorus environment, and increased phosphorus in this system has had detrimental impacts on plant and animal life (Figure 7). The main cause of eutrophication is the high amounts of phosphorus coming off surface water from agricultural and urban land uses. The EAA drainage canals are the primary source of this pollution. In the EAA, agricultural chemicals and the oxidation of organic soils affect the overall phosphorus levels in the water column (Das et al., 2012). The EAA has further disrupted this ecosystem by altering hydrologic levels and cycles and by adding large amounts of phosphorus to a low-phosphorus ecological system. Water treatment areas were installed south of the EAA to reduce phosphorus loads, but these areas have not been effective enough to return the southern Everglades water quality to its original state (Sklar et al., 2019).

Introduction: The Comprehensive Everglades Restoration Plan

The first restoration efforts in the larger Everglades included four projects on the Kissimmee River : Modified Water Deliveries in 1989, the Kissimmee River Restoration Project in 1992, the South Date Project in 1996, and the Central & Southern Florida Comprehensive Review Study in 1999. These projects restored a large portion of the Kissimmee River north of Okeechobee (US Army Corps of Engineers, 2022).

In 2000, the Comprehensive Everglades Restoration Plan (CERP) was authorized by Congress to restore, preserve, and protect south Florida ecosystems while meeting water-supply and flood-protection needs (Figure 8) (National Park Service, 2022). The plan is the largest restoration project in U.S. history, with a cost of $7.8 billion dollars (Gonzalez, 2005). It involves several projects over a 35-year timeline to restore the ecosystem's hydrology. To date, seventeen projects have been undertaken, spread across four phases, and nine have been completed (US Army Corps of Engineers, 2022). The overall aim of these projects is to improve the ecosystem health of more than 2.4 million acres in south Florida and Lake Okeechobee, reduce the release of damaging freshwater to into Florida Bay estuaries, improve water deliveries to Florida and Biscayne Bay, improve water quality, enhance the water supply, and maintain flood mitigation.

The various projects (Figure 8) are organized into a Foundational Phase, Generation 1, Generation 2, and Planning Study phases. A major criticism is the conflicting goals of the restoration plan and the fact that it does not reconnect the floodplain, and in many cases adds canals, levees, and stagnant reservoirs for continued water storage and management of urban and agricultural areas. The Foundation Phase included five projects, and each added water storage, water quality treatment, conveyance, and groundwater seepage. The Generation 1 phase included four projects focused on groundwater seepage, water storage and treatment, conveyance, and invasive species control. Generation 2, which is still under construction, focuses on conveyance, storage, distribution, and groundwater seepage management. The Planning Studies Phase was proposed in 2020 and will focus on water storage, conveyance, water treatment, groundwater seepage management, and water distribution (US Army Corps of Engineers, 2022).

Methods: Floodplain Restoration Literature

To understand how well the Everglades restoration plan reconnects the floodplain, I examined the CERP projects and compared them to the literature on ecologically functional floodplains, Everglades specific flow recommendations, and known impaired locations in the Everglades according to a 2017 study. The attributes of ecologically functional restoration include hydrologic connectivity, flow regime, and sufficient spatial area (Opperman et al., 2010). Hydrologic and geomorphic processes create responses in the ecosystem that provide ecological benefits.

Hydrologic connectivity refers to the ability of water to flow freely between areas within the larger watershed, reducing obstruction in the watershed. Ecological restoration is reached when floodplains are connected with adjacent rivers for the exchange of flow, sediment, nutrients, and organisms (Opperman et al., 2010). Flow-regime refers to a set flow level in a river or watershed which can be used as a standard goal for ecological restoration, reached when the floodplain experiences a variable water flow required for specific habitats. Spatial area in restoration projects should be large and thereby sufficient to enable vital hydrodynamic processes such as erosion and deposition (Opperman et al., 2010). The restoration of a floodplain must encompass both flow regime and connectivity, and land use and water management must also be addressed (Opperman et al., 2010).

Everglades specific flow recommendations are from a study on the factors that influence the origin and maintenance of stable slough and ridge habitats. The study used 134 model simulations to demonstrate that flow velocities between 2.5 and 5 cm/s over several weeks can support stable slough and ridge landscapes (Larsen et al., 2010). Known impaired locations in the Everglades came out of 2017 study mapping areas in the Everglades that are too dry and too wet to support slough and ridge habitats (Harvey et al., 2017).

Each project from the CERP were compared to the literature on ecologically functional flood plains, examining them for the existence of restoration goals around flow-regimes standards, connectivity, and a large spatial scale. If a flow-regime was specified in the restoration project, it was compared to flows velocities that support slough and ridge habitats. Locations of CERP projects were compared to the dry and wet areas mapped in the Everglades and critiqued for how well they addressed water level discrepancies.

Results

Foundation Project Phase

The Foundational Phase projects focus on water storage, water treatment, conveyance, flow restoration, connectivity, and flood protection. In this phase, five different locations in the Everglades were selected for restoration. The first project was near the Big Cypress Seminole Reservation (Figure 12). The project restored 1,500 acres of wetlands where water was conveyed through canals and levees to a specific location. A benefit of this project was water storage at wetlands to improve water quality and to "provide stormwater protection for agriculture" (US Army Corps of Engineers, 2022). This project met the connectivity requirement of floodplain restoration, moving water to a wetland area but lacked an overall consideration for flow and spatial scale. The second project was the construction of a Stormwater Treatment Area (STA) (Figure 13) south of the EAA to provide 6,000 acres of water treatment and storage. The project did not meet any of the flow, connectivity, or spatial scale requirements (Table 1). These two initial projects store water in wetlands but lack flow recommendations and natural hydrologic processes in the restoration.

The third project is the Modified Water Deliveries project in the Everglades National Park (Figure 14), which reconnects 4,320 acres of the L-29 canal to the Everglades under the Tamiami Road by removing a levee. The plan considers water flow and connectivity to one of the main Everglades sloughs; However, the project does not specify a flow velocity as a restoration standard and did not occur on a large spatial scale (US Army Corps of Engineers, 2022). The fourth project is the Kissimmee River Restoration Plan (Figure 15), completed in 2020, restored 130,000 acre-feet of natural floodplain flow and storage. The criterion used was continuous flow with variable regimes at an average of 0.2–0.6 m/s or 0.8-1.8 ft/s (US Army Corps of Engineers, 2022). The flow velocity standard used is .7 ft/s higher than what is recommended for Slough and Ridge habitat but may be more appropriate for the Kissimmee River system. Overall, this project was constructed to maximize flood protection through flow restoration, connectivity, and spatial scale restoring 44 miles of historic river channel and 25,000 acres of wetlands (Table 1).

The fifth project, the C-111 South Dade Restoration Project constructed 9,500 acre-feet of water storage to reduce canal discharge into Barnes Sound (Figure 14). This project focuses on improving water flows to Taylor Slough in the Everglades and assisted with reducing the flood risk to South Miami-Dade. The project required the removal of two pumps and portions of the western side of the canal, an important consideration for floodplain reconnection (US Army Corps of Engineers, 2022). The project restored 41,000 acres of wetlands and distributes water through a spreader canal and a pump station that moves water at 50 cfs. While the project functions on a sufficient spatial scale, and focuses on flow and connectivity, it fails to incorporate a flow velocity in a restoration and adds canals and pumps to move water (Table 1).

Overall, the first phase of the project re-stablishes water connectivity in the Everglades and its headwaters on the Kissimmee River. However, some of the projects continue to accommodate existing land uses, such as industrial sugarcane farms in EAA by treating polluted runoff in the STAs. This continued accommodation reduces restoration plans to a small area, impeding overall connectivity and spatial scale as seen in the Seminole Big Cypress project, the STA project, and the Modified Water Deliveries Project.

Generation 1 Project Phase

The Generation 1 phase has three projects that focus on water storage, levees, flow restoration and connectivity. The sixth CERP project is the Site 1 Impoundment project which rehabilitated a levee to store water on 1,600 acres for groundwater seepage for aquifer recharge (Figure 16). Similarly, the eighth CERP project, the Indian River Lagoon South Reservoir (Figure 17) added 60,500 acre-feet of water storage to treat runoff before it flows into the nearing St. Lucie Estuary. These two projects focused on water storage and did not meet any of the flow, connectivity, or spatial scale requirements (Table 2).

While the two main projects lacked an ecological focus, the Picayune Strand Restoration restored 55,000 acres of natural habitat and the region's historic sheet flow (Figure 18) (US Army Corps of Engineers, 2022). Restoration was done by adding a spreader canal, removing a canal, and adding a 810 cfs pump. This project accomplished restoration at a large scale, considers flow and connectivity, but lacked an natural flow standard for restoration process (Table 2). Two out of the three Generation 1 projects focused on constructing water storage and remediating levees; However, the restoration of historic sheet flow in the Picayune Strand is a significant addition to floodplain restoration and ecological recovery. While this project focuses on restoring flow regime, the upstream EAA obstruction limits the restoration's spatial scale.

Generation 2 Project Phase

Generation 2 projects focus on water storage, water discharge, flow restoration, and connectivity. The tenth CERP Project is the C-111 Spreader Canal Western Project that created 590 acres of water storage in the Everglades National Park in the Taylor Slough (Figure 19). This project focuses on restoring the flow and connectivity of Everglades sheet flow to the Florida Bay through the construction of a hydraulic ridge, or water storage, adjacent to the national park (US Army Corps of Engineers, 2022). Although flow regimes and connectivity are considered, the restoration itself is largely a water conveyance construction project and does not rely on flood adaptation interventions (US Army Corps of Engineers, 2022). Connectivity is accomplished with two 225 cfs pump stations. Overall, this project lacks a natural flow regime and spatial scale relying on built structures to increase water flows in the Everglades (Table 3). Similarly, the Biscayne Bay Coastal Wetlands Project distributes freshwater flow to coastal wetlands with the objective of improving the ecology in the Florida Bay (Figure 20). This project requires the construction of the Deering Estate Flow-Way and five 40-100 cfs pumps to divert water to this portion of the Everglades. The Additional construction used to convey water limits the spatial scale that the restoration efforts can impact meeting only the connectivity requirement without a focus on flow velocity or large spatial scale (US Army Corps of Engineers, 2022). The C-43 Western Basin Storage Corridor project on the Caloosahatchee River is a 10,700-acre reservoir to store water for Lake Okeechobee's agricultural runoff releases (Figure 21) (South Florida Water Management District, 2022). This project does not focus on flow, connectivity, or spatial scale (Table 3). Such projects demonstrate that the Everglades continues to be used as water storage for agricultural development. The 13th CERP project is the Broward County Water Preserve Areas Project, a 10,800 acre-feet water-storage area that captures stormwater from urban development, treat the water quality in a wetland, and distribute it as surface water runoff (Figure 22) (US Army Corps of Engineers, 2022). The ecological benefit of this project is the surface water runoff for improved flow-regime but due to its urban development source the stormwater is controlled and absent of river restoration elements. The water is distributed with two pumps, meeting the connectivity requirement but lacking in flow velocity and spatial scale (Table 3).

While all Generation 2 phase projects aim to restore flow in the Everglades, each project includes the creation of water storage and conveyance through additional construction of canals and levees. The lack of river restoration elements impedes long-term restoration and large-scale ecological benefits.

Planning Studies Phase

The Planning Studies Phase, approved in 2018, focuses on water storage, water discharge, treatment, flow restoration, and connectivity. The Central Planning Project was approved to convey 200,000 acre-feet of water over 10,500 acres south from Lake Okeechobee to Wetlands in the Everglades. This project plans to add additional infrastructure and water treatment (Figure 23). The large reservoir holds water from urban runoff to improve flood control for nearby urban areas (US Army Corps of Engineers, 2022). This water storage project does not focus on flow regimes, connectivity, or spatial scale and limits downstream water flow needs (Table 4). The Loxahatchee River Watershed Restoration, still in its planning phase, is to focus on the distribution of water to reconnect the area's wetlands through additional canals for conveyance (Figure 24) (US Army Corps of Engineers, 2022). The intention is to restore 753 square miles of the Eastern Everglades. As the project plans are still being devised, meeting the requirements of flow and connectivity are unknown; However, the project should meet a large and sufficient spatial scale (Table 4).

The Lake Okeechobee project focuses on improving conditions north of Lake Okeechobee and enhancing the system's flexibility (Figure 25) (US Army Corps of Engineers, 2022). The objectives of this project are to increase storage capacity, lower water levels, improve the timing of water discharges to the St. Lucie and Caloosahatchee estuaries, restore wetlands, and improve water supply (South Florida Water Management District, 2022). The project plan for North Lake Okeechobee is continued management of water levels, and it gives no attention to flow regimes and overall connectivity of the historic waterflow from Central Florida to the Everglades. The Lake Okeechobee project continues to be limited by its southern levee, depending on a pump station to convey water to a storage area of 5,900 acres (Table 4).

The Western Everglades Restoration focuses on restoring the quantity, quality, timing, and distribution of water. The project alters canals and levees to establish ecological and hydrologic connectivity, lacking an overall emphasis on flood restoration elements (Figure 26) (US Army Corps of Engineers, 2022). It focuses on a large spatial scale of 440,000 acres with goals of improving flow and connectivity that are limited by a lack of flow velocity recommendations and pumps and canals used to convey water (Table 4). Overall, the Planning Studies Phase project focuses on restoring large areas west and east of the Everglades but lacks sufficient goals on velocities and connectivity that does not depend on canals and pumps.

Discussion

The majority of the seventeen CERP projects focused on water storage and continued water management for urban development and agriculture water use. 8/17 projects focus on flow in their objectives, and only one specified a flow velocity in their objective, while others used pumps. 10/17 projects focus on connectivity of water to other parts of the Everglades, however 8/17 projects connected water to the Everglades using pumps and canals. 5/17 projects occurred on a large spatial scale including

25,000 acres on the Kissimmee River, 55,000 acres on the Picayune Strand, 440,000 acres in the Western Everglades, and 753 square miles in the Loxahatchee River Watershed (Figure 9).

According to a 2017 study on the Everglades habitat conditions, results showed that some areas are too wet and some are too dry to support slough and ridge habitats. When comparing these areas to overlapping projects. The Seminole Big Cypress Project in the North Everglades restored 1,500 acres of wetlands in an area reported as too dry and the South Dade Restoration Project restored connectivity by removing a canal structure in the south Everglades where it is also considered too dry. Both projects were completed in 2017 in those dry areas, demonstrating short comings of a splintered restoration project that addresses small areas instead of the entire Slough and ridge ecosystem as a whole (Figure 10).

The CERP set goals of flow and connectivity but due to EAA obstruction, these restoration efforts continue the use of levees and canals where only the Kissimmee Project specified a flow velocity in restoration. Existing remediation efforts are limited by the EAA and continued use of the Everglades for Agriculture. Restoration efforts do not use natural floodplain processes due to the EAA and Herbert Hoover Dike obstruction of natural flow from Lake Okeechobee to the Everglades where only 8/17 projects meet both flow and connectivity restoration goals in project plans. Additionally, Project 14, for the Central Planning/ South Okeechobee Reservoir is graphically depicted by water management as a large introduction of water flow into the Everglades, but when project 14 is read in detail, it is specified as a spatially limited water storage projected (Figure 11).

Conclusion

Many of the CERP projects have been able to reduce pollution and recover some of the historic flow pathways and connectivity, but the ecosystem’s impact from surrounding land uses is insurmountable, as water management governing bodies continue to manage the system for surrounding urban and agricultural land uses—specifically, in the continued use of the Okeechobee levee, which impedes the historic flow from central Florida to the Everglades so that unsustainable agriculture can continue in the region. Nine out of the seventeen projects limited floodplain reconnection on a large spatial scale by storing water in constructed reservoirs in the floodplain. Ultimately, the Comprehensive

Everglades Restoration Plan seeks to control water by increasing storage capacity for regional economic interests such as industrial agriculture and urban development (Gonzalez, 2005).

Future solutions depend on the continued existence of the EAA. Removing levee and canal systems between lake Okeechobee and the Shark River Slough would restore ecological habitats using natural floodplain processes. A solution would be a large agricultural buy out, it would cost 4,000 per acre for land worth or 7,000 for asking price at a total of 150,000 acres. The direct cost to the government of purchasing this land plus associated restoration costs would be $1,301.5 - $1,751.5 million, less than the cost of restoration (Schmitz et al., 2012) (Gonzalez, 2005). My recommendation is to remove the EAA through an agricultural buy out and to collaborate with communities living around South Lake Okeechobee and in Big Cypress to manage water around existing livelihoods and residences.

Figures

Figure 1. Greater Everglades Ecosystem

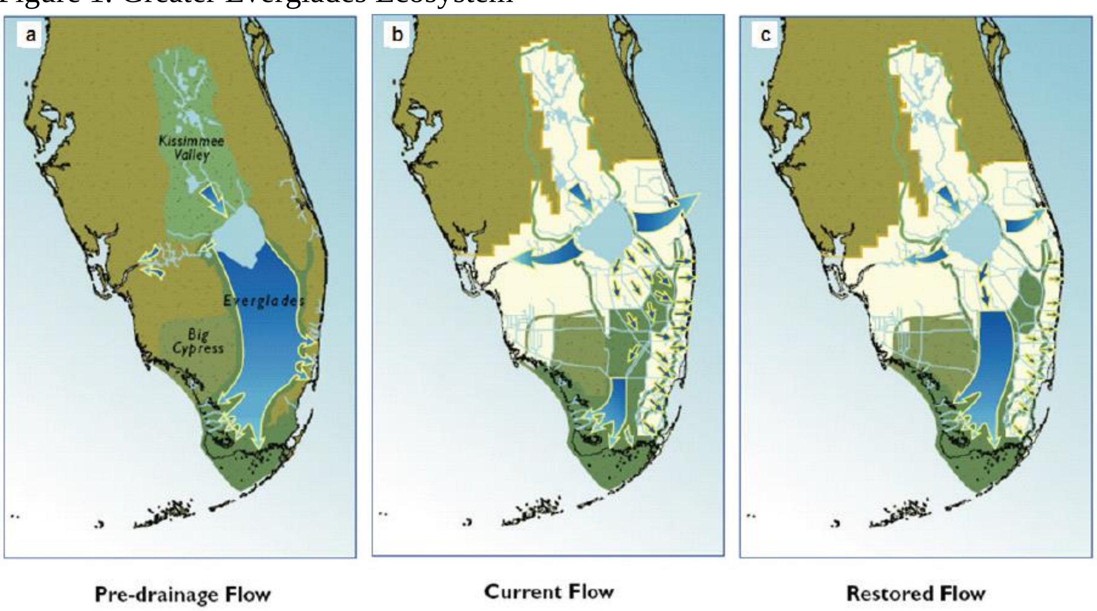


Figure 2. South Florida Water Management District Restoration Plan showing historic hydrology

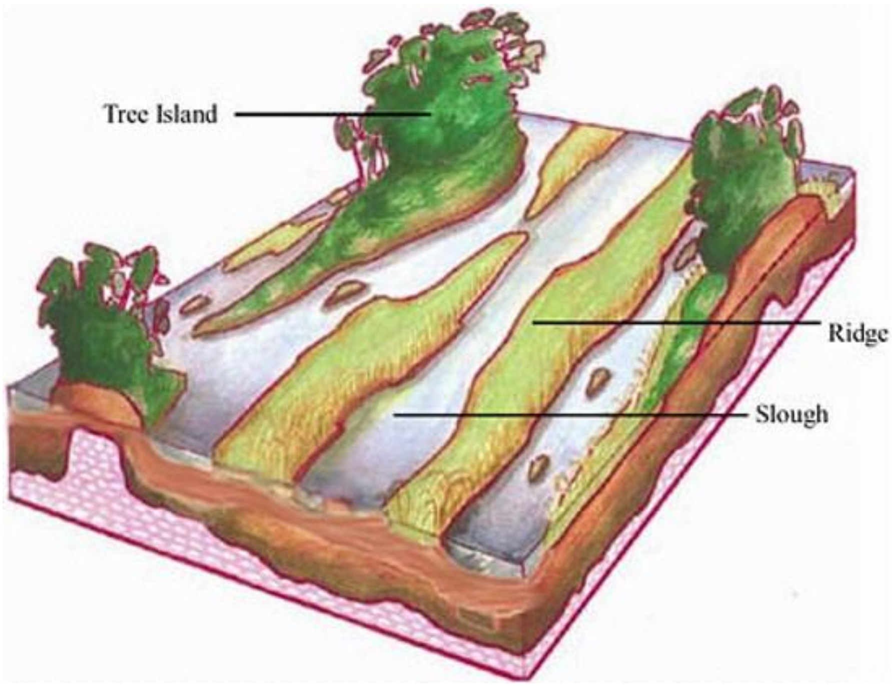


Figure 3. Ridge and slough ecosystem in the Everglades

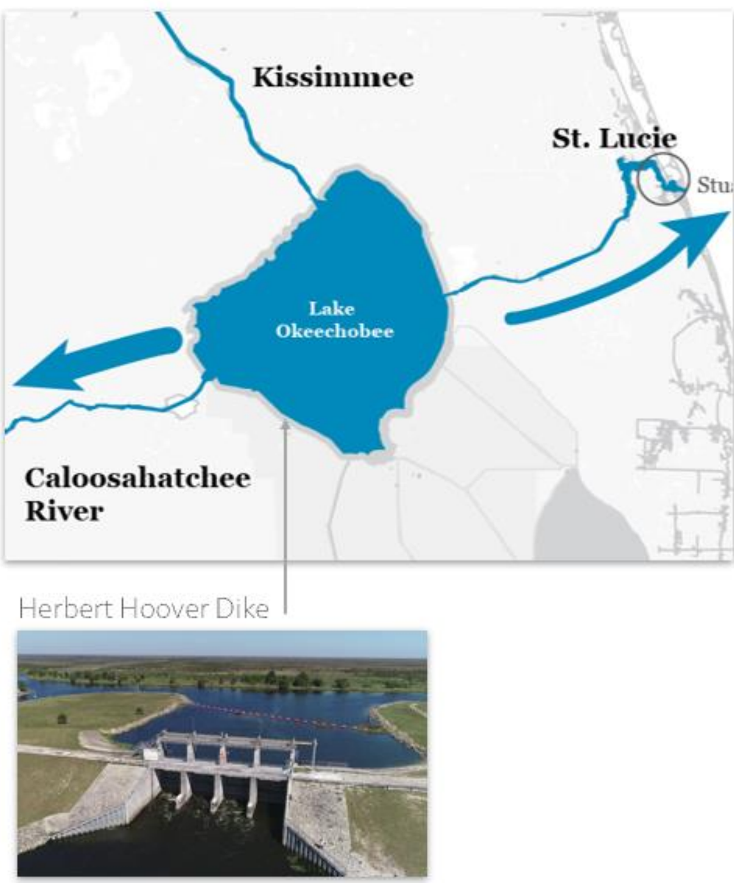


Figure 4. Herbert Hoover Dike South of Lake Okeechobee

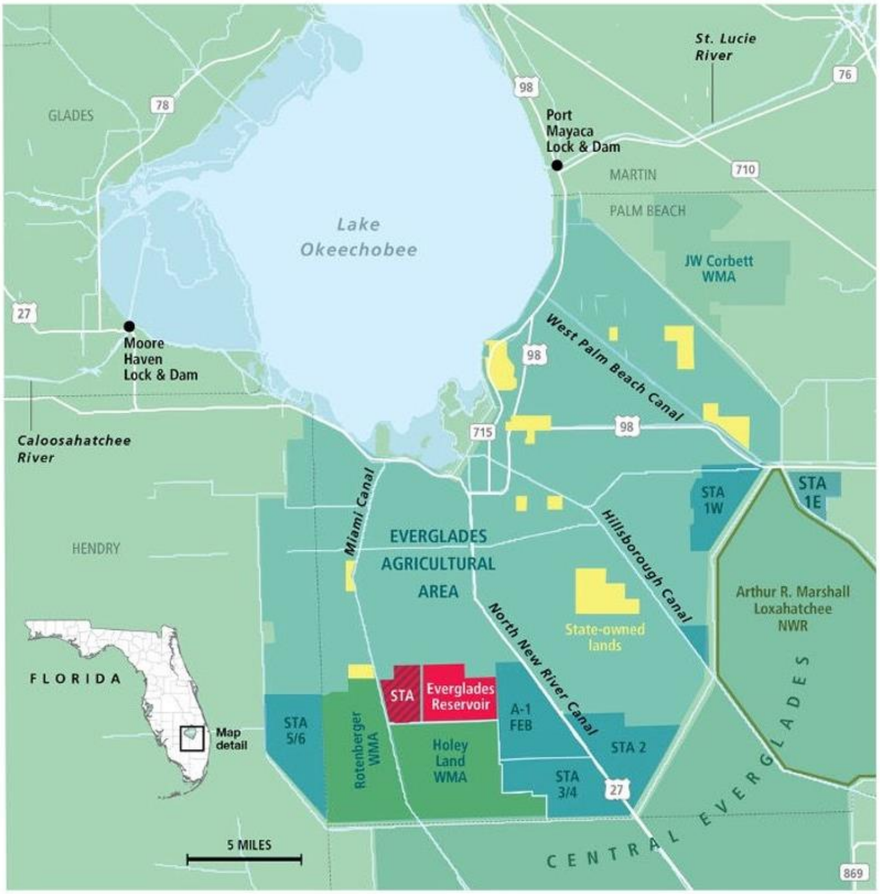


Figure 5. Everglades Agricultural Area. Photo Credit: Everglades Foundation


Figure 6. Drought in the Everglades. Photo Credit: Vivian Guzman

Figure 7. Lake Okeechobee Algae Bloom from Phosphorus Pollution. Photo Credit: Miami Herald, 2022

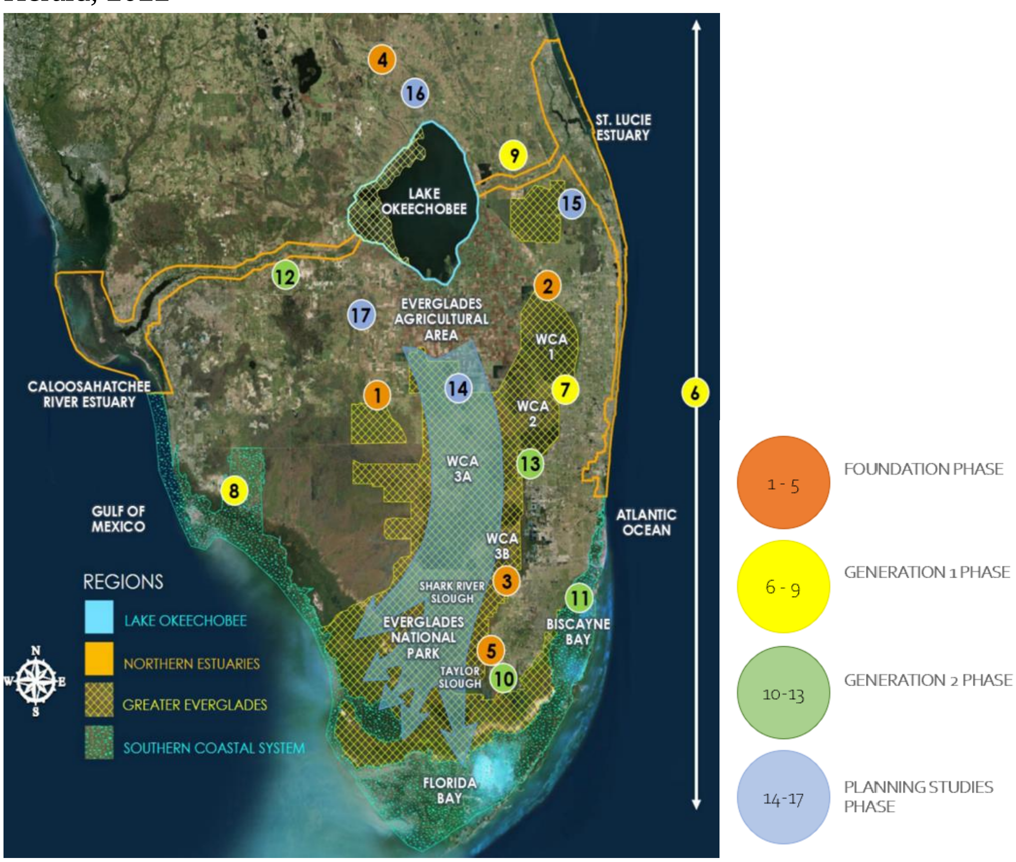


Figure 8. CERP Project Map

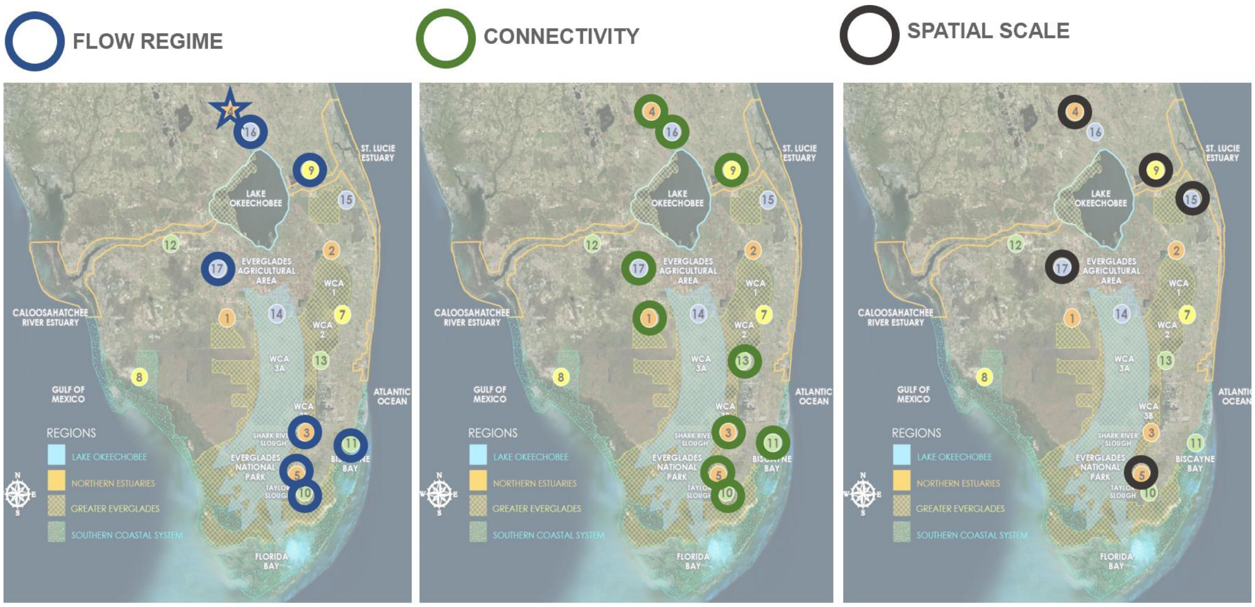


Figure 9. Diagram of the projects that focused on flow, connectivity, and spatial scale.

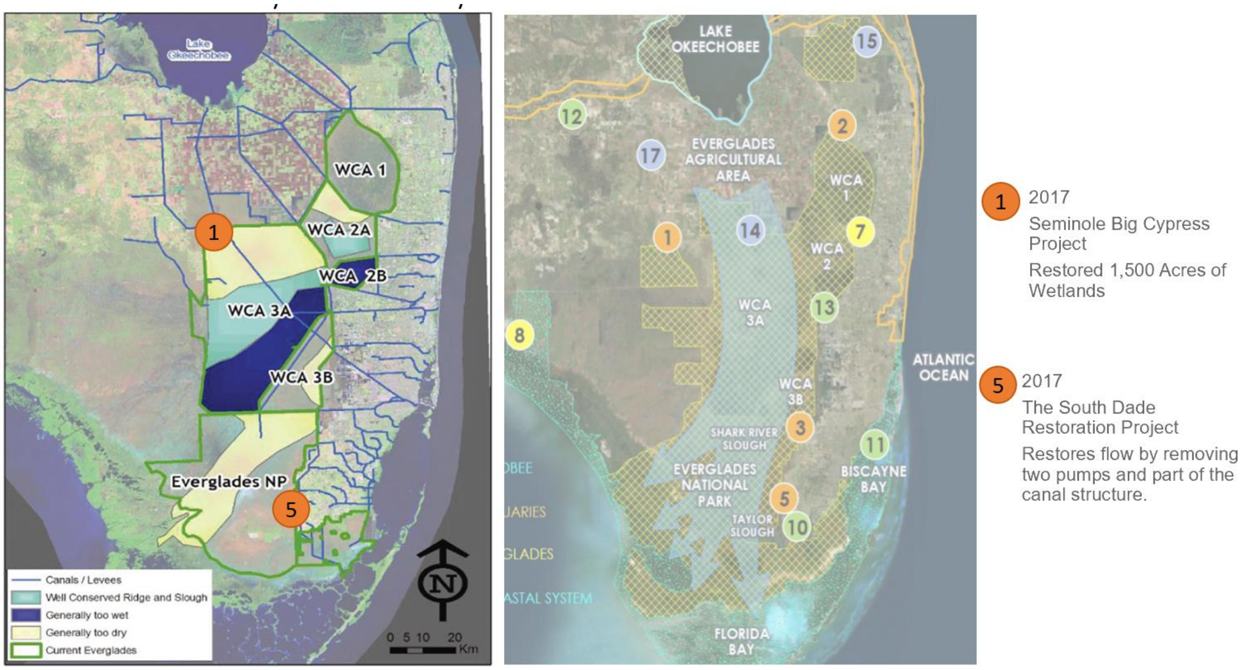


Figure 10. Comparison of the CERP Projects to the 2017 study on dry and wet areas

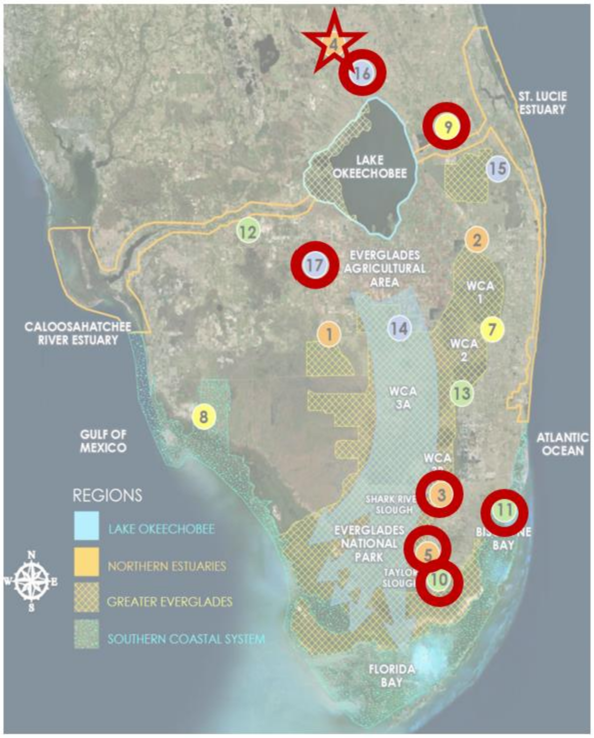


Figure 11. CERP Projects that meet the Flow and Connectivity requirements.

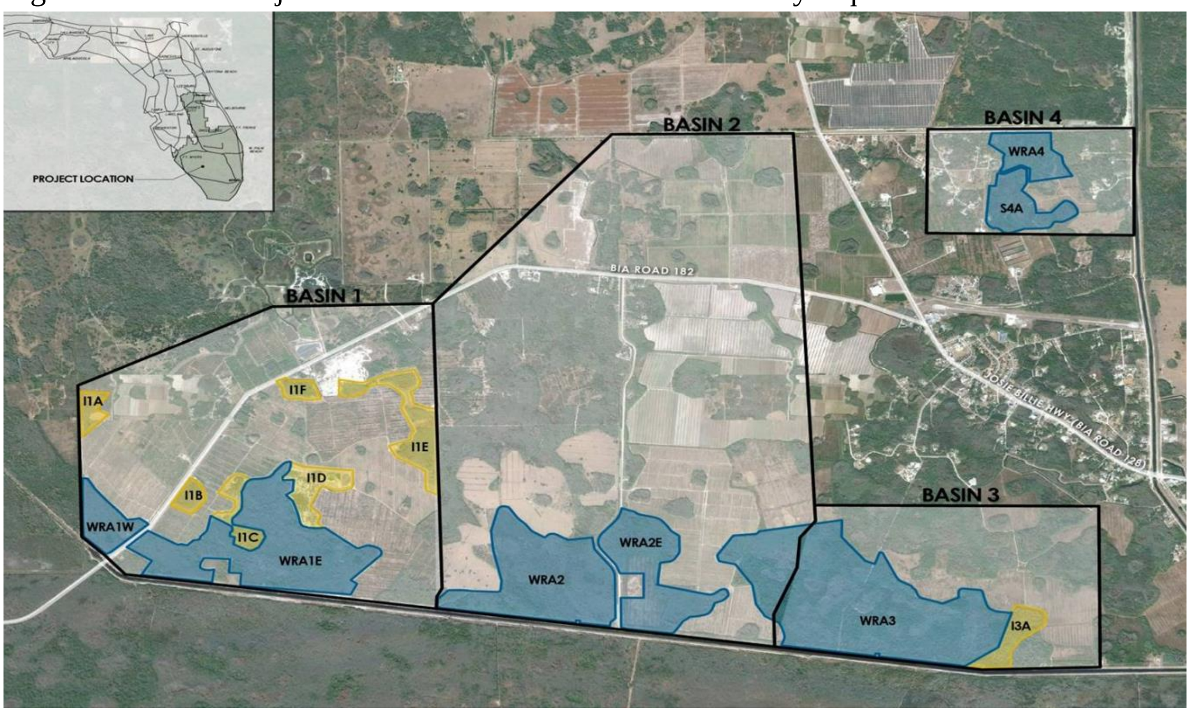


Figure 12. Map of the Seminole Big Cypress Project from the Foundation Phase.

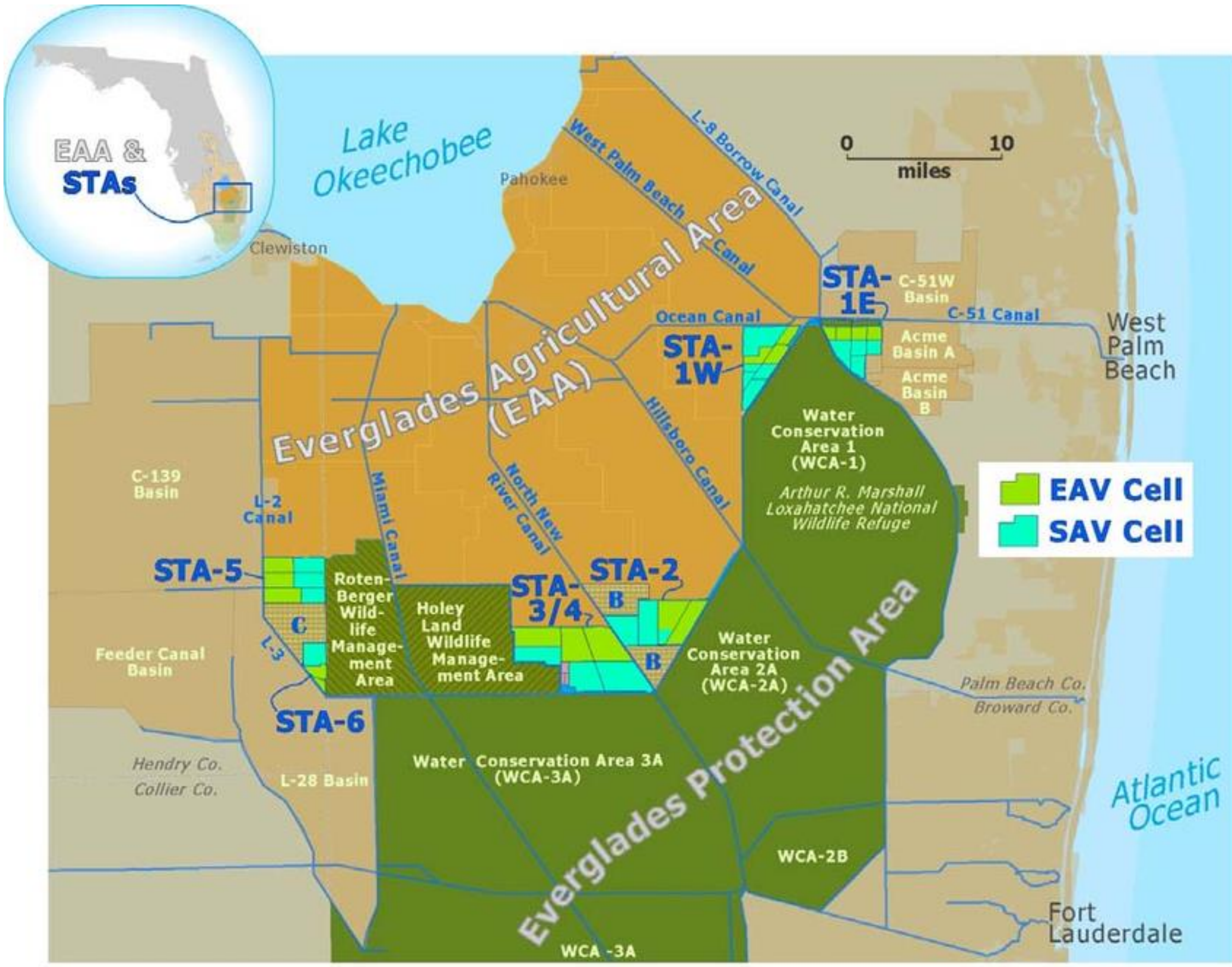


Figure 13. Map of the C-51 Stormwater Treatment Area (STA) from the Foundation Phase.

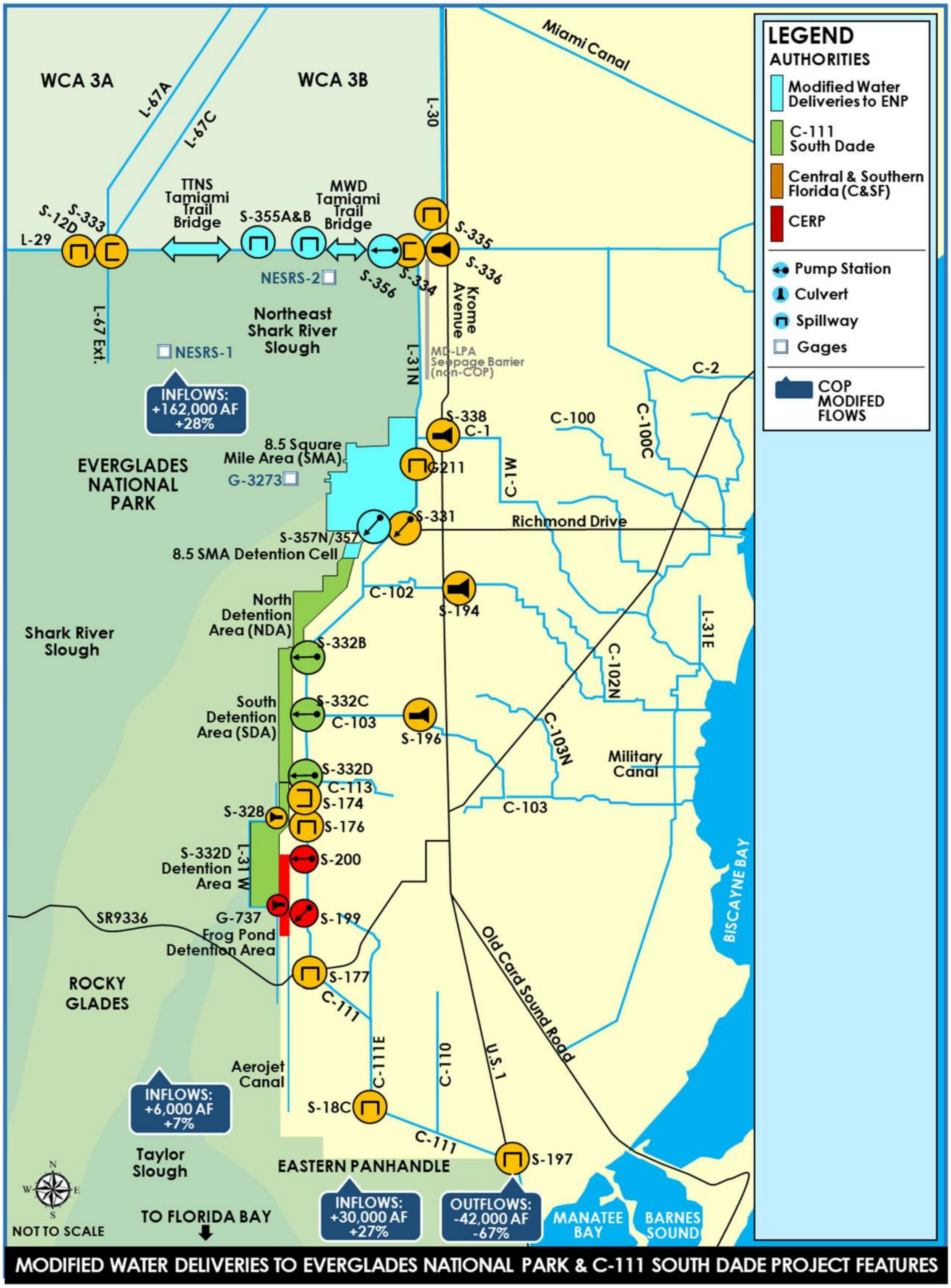


Figure 14. Map of the Modified Water Deliveries project and the C-111 South Dade Project in the Everglades National Park from the Foundation Phase.

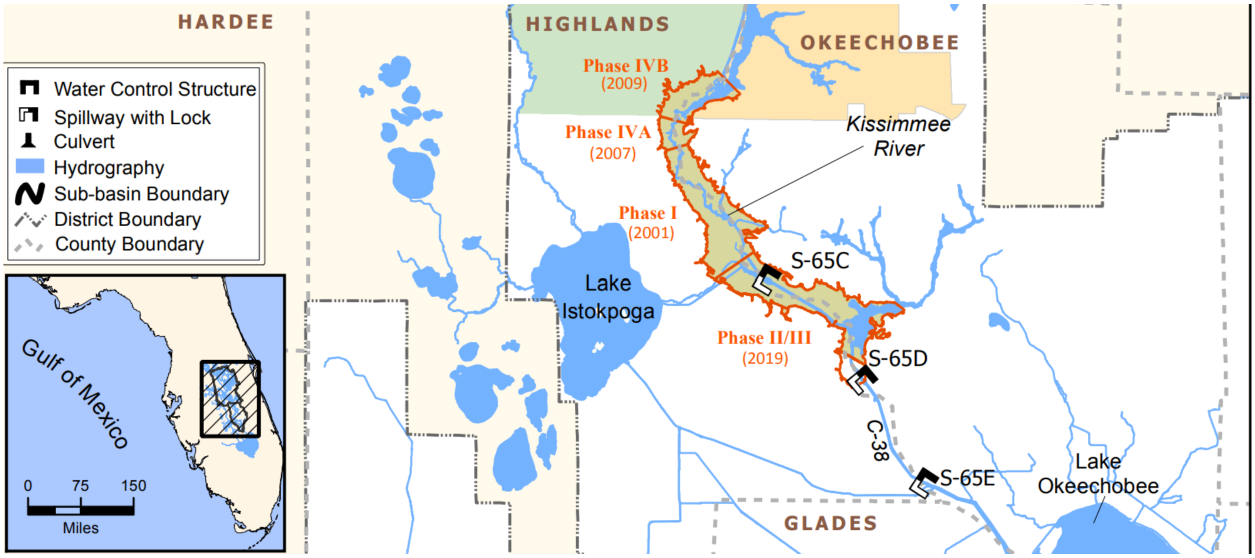


Figure 15. Map of the Kissimmee River Restoration Project construction features from the Foundation Phase

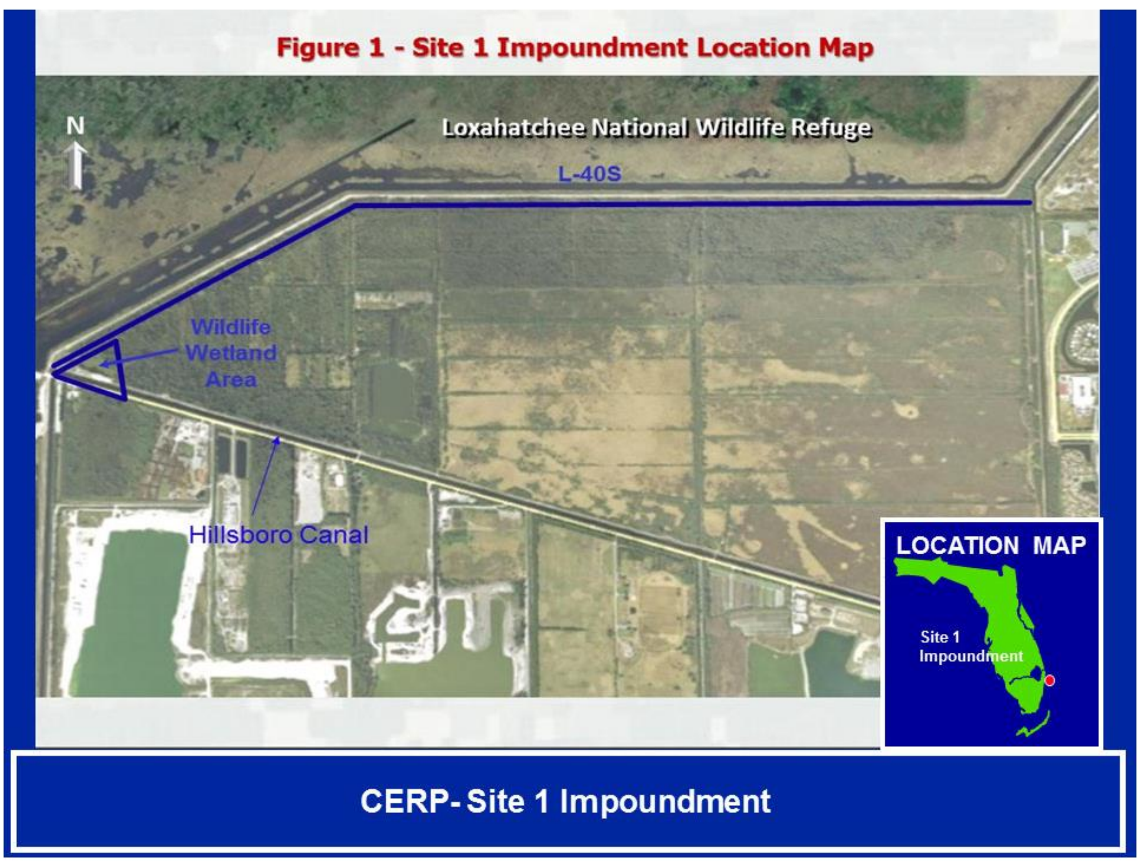


Figure 16. Map of the Site 1 Impoundment Project from the Generation 1 Phase.

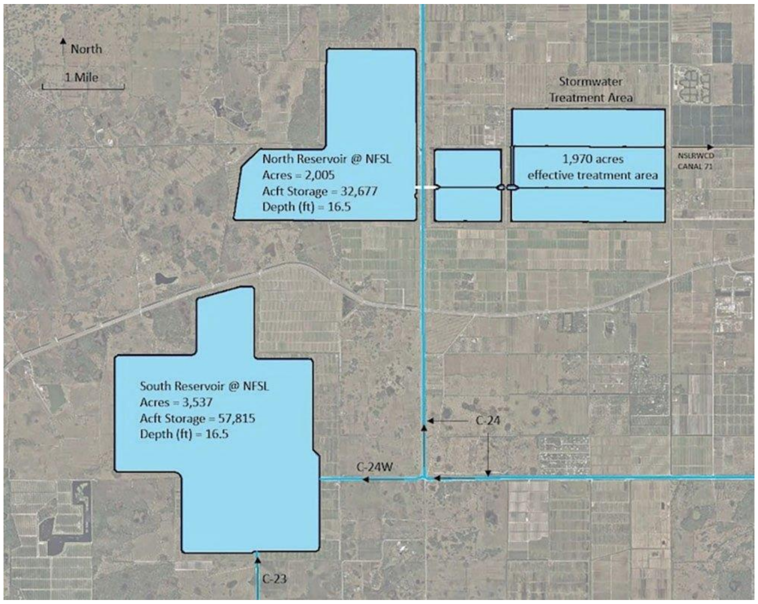


Figure 17. Map of the Indian River Lagoon South Reservoir from the Generation 1 Phase.

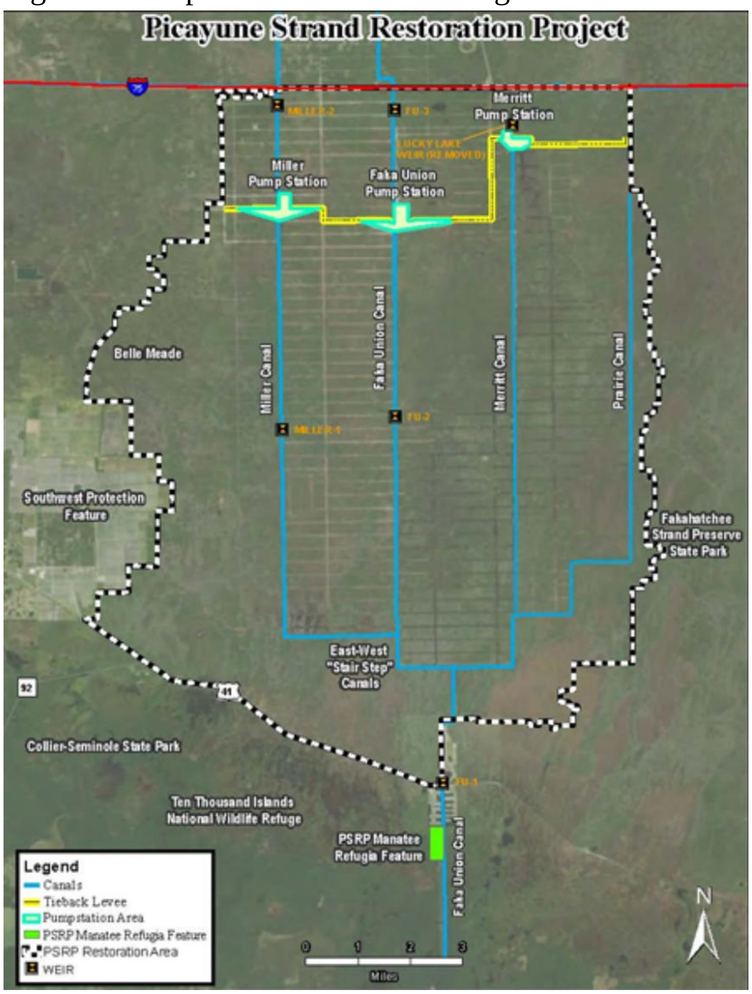


Figure 18. Map of the Picayune Strand Restoration from the Generation 1 Phase.

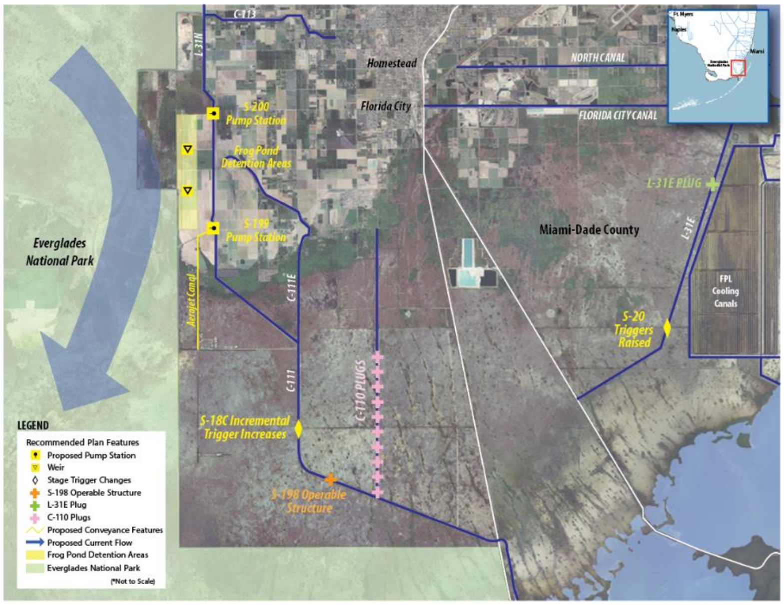


Figure 19. Map of the C-111 Spreader Canal Western Project from the Generation 2 Phase.

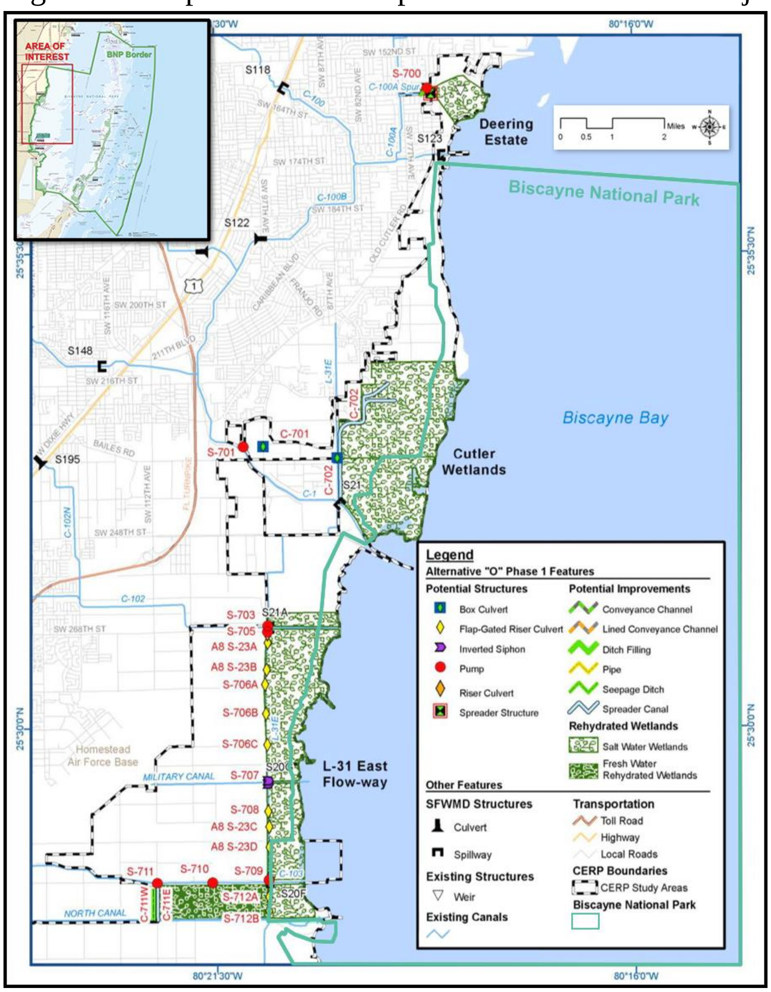


Figure 20. Map of the Biscayne Bay Coastal Wetlands Project from the Generation 2 Phase.

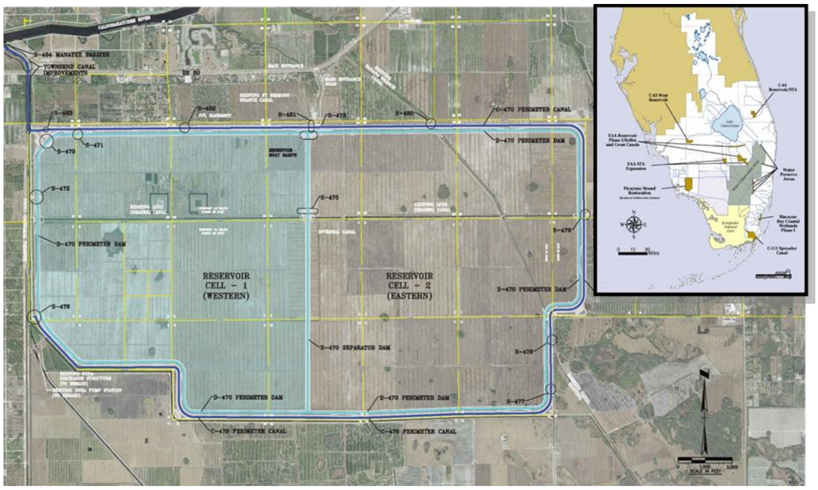


Figure 21. Map of the C-43 Western Basin Storage Reservoir Project from Generation 2 Phase.

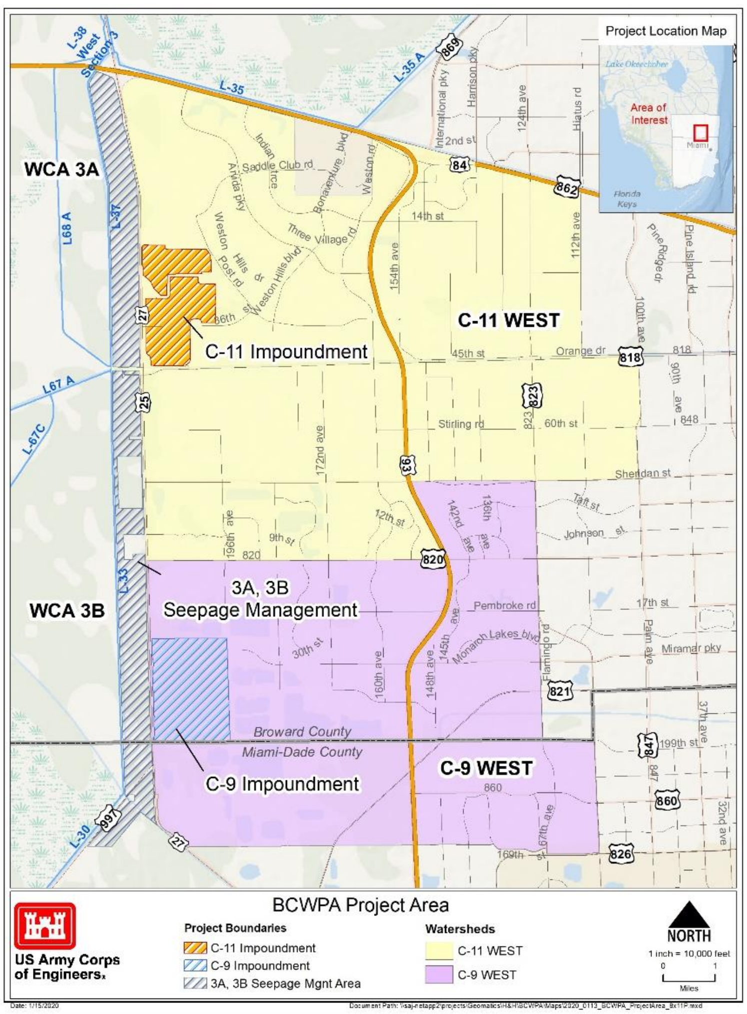


Figure 22. The Broward County Water Preserve Areas Project from Generation 2 Phase.

Figure 23. Map of the Central Planning Project / South Lake Okeechobee Reservoir from the Planning Phase.

Figure 24. Map of the Loxahatchee River Watershed Restoration from the Planning Phase.

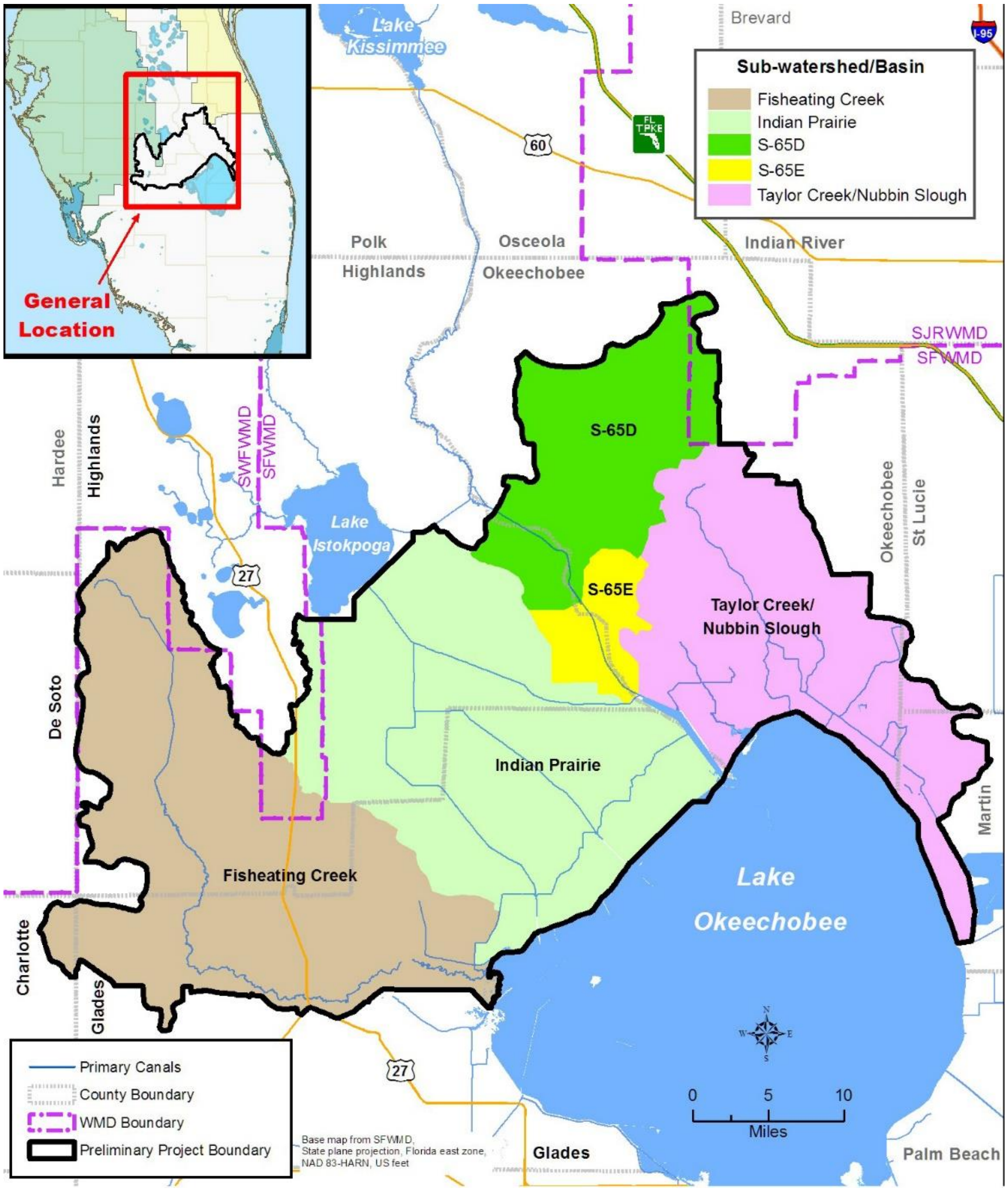


Figure 25. Map of the Lake Okeechobee Watershed Project from the Planning Phase.

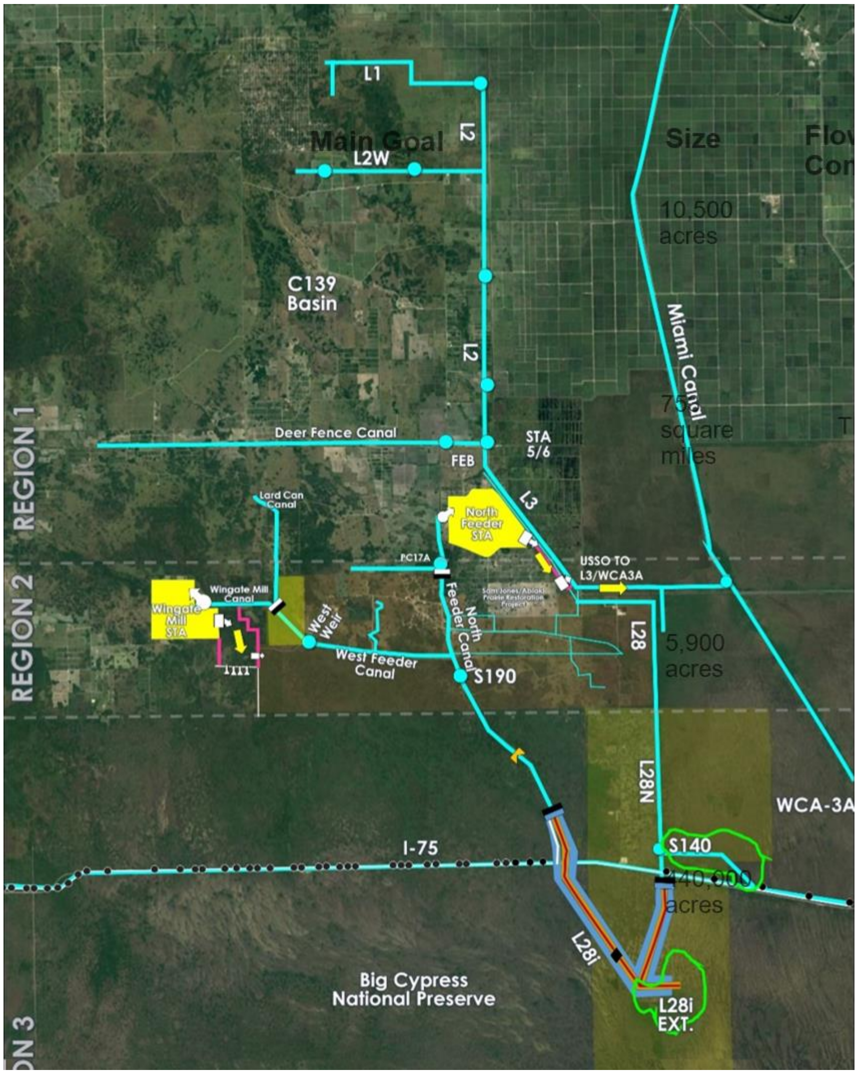


Figure 26. Map of the Western Everglades Restoration Project from the Planning Phase.

Tables

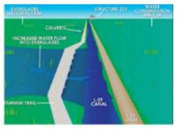
	Project	Photo	Main Goal	Size	Flow Considered	Flow Velocity	Connectivity	Spatial Scale
1	Seminole Big Cypress		Water storage as wetlands	1,500 acres			✓ Canals & Levees	
2	C-51 Stormwater Treatment Area (STA)		Water storage and water quality treatment as stormwater treatment areas	6,000 acres				
3	The Modified Water Deliveries project in the Everglades National Park		Reconnecting water flow from canal to the Shark River Slough	4,320 acres	✓		✓ Removes the levee between the L-29 canal and the Everglades under the Tamiami Road	
4	The Kissimmee River Restoration Plan		Maximizes flood protection through flow restoration and connectivity	Restore 25,000 acres of wetland	✓	Continuous flow with an average of 0.8 to 1.8 ft/s	✓ Removed significant portions of the canal for natural meandering river & floodway	✓ 44 miles of historic river channel
5	The South Dade Restoration Project		Restores flow by removing two pumps and part of the canal structure.	41,000 acres	✓		✓ Spreader Canal and 50 cfs pump station	✓ 41,000 acres

Table 1. Analysis of the Foundation Phase in the CERP

	Project	Photo	Main Goal	Size	Flow Considered	Flow Velocity	Connectivity	Spatial Scale
6	Site 1 Impoundment		Rehabilitated a levee to store water for groundwater seepage to recharge the aquifer.	1,660 acres				
8	The Indian River Lagoon South Reservoir		Added water storage to treat runoff before it flows into the nearing St. Lucie Estuary	3,600 acres				
9	Picayune Strand Restoration		Restored natural habitat and the region's historic sheet flow	55,000 acres	✓		✓ 810 cfs pump spreader canal remove levee	✓ 55,000 acres

Table 2. Analysis of the Generation 1 Phase in the CERP

	Project	Photo	Main Goal	Size	Flow Considered	Flow Velocity	Connectivity	Spatial Scale
10	The C-111 Spreader Canal Western Project		Increases water flows to the center of the Everglades by building a 6-mile hydraulic ridge to keep rainfall and water flows within Taylor Slough. The hydraulic ridge will be created by constructing a 590-acre aboveground detention area.	590-acre Detention area	✓		✓ Two 225 cubic-feet-per-second pump stations	
11	The Biscayne Bay Coastal Wetlands Project		Distributes freshwater flow to coastal wetlands, requiring the construction of the Deering Estate Flow-Way to divert water to this portion of the Everglades.	3,761 acres	✓		✓ Culverts, Canals, and 5 pumps (40-100 cfs)	
12	The C-43 Western Basin Storage Corridor project		Project is a reservoir to store water needed for Lake Okeechobee's agricultural runoff releases	10,700 acres				
13	The Broward County Water Preserve Areas Project		Project is a water-storage area to capture stormwater from urban development, treat the water quality in a wetland, and distribute it as surface water runoff	4,353 acre			✓ Two pump stations	

Table 3. Analysis of the Generation 2 Phase in the CERP

	Project	Photo	Main Goal	Size	Flow Considered	Flow Velocity	Connectivity	Spatial Scale
14	Central Planning / South Okeechobee Reservoir		The large reservoir holds water from urban runoff to improve flood control for nearby urban areas	10,500 acres				
15	The Loxahatchee River Watershed Restoration		Restoration focuses on the distribution of water to reconnect the area's wetlands and watersheds through additional canals for conveyance.	753 square miles	TBD	TBD	TBD	✓ 753 square miles
16	The Lake Okeechobee Watershed project		Increase storage capacity, lower water levels, improve the timing of water discharges to the St. Lucie and Caloosahatchee estuaries, restore wetlands, and improve water supply	5,900 acres	✓		✓ Pump station	
17	The Western Everglades Restoration		Restoration focuses on restoring the quantity, quality, timing, and distribution of water. The project alters canals and levees to establish ecological and hydrologic connectivity.	440,000 acres	✓		✓ Pump & Canals	✓ Over 1,000 square miles

Table 4. Analysis of the Planning Phase in the CERP

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