APPENDIX C
ENVIRONMENTAL AND CULTURAL RESOURCES

Part 1: Existing and Future Without Project Conditions
Part 2: Effects of the Alternatives and Optimized Tentatively Selected Plan

C ENVIRONMENTAL AND CULTURAL RESOURCES

This appendix consists of two parts:

1. Existing and Future Without Project Conditions
2. Effects of the Alternatives and Optimized Tentatively Selected Plan

Each part has a cover page with its own table of contents.

PART 1: EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

Part 1 Table of Contents

Part 1 List of Tables

Part 1 List of Figures

C.1 Existing and Future Without Project Conditions

This appendix provides a detailed discussion of the existing conditions baseline (ECB) and considers the environmental conditions in the affected regions without the Proposed Action, known as the Future Without Project (FWO). The resource conditions that were evaluated include climate; geology; soils; vegetation; wildlife; hydrology; water quality; flood control; air quality; hazardous, toxic, and radioactive waste (HTRW); noise; aesthetics; land use; agriculture; socioeconomics; environmental justice; recreation; cultural resources; and invasive species.

C.1.1 Existing Conditions of Resources

The Study Area of the Lake Okeechobee Storage Reservoir Section 203 Study (LOCAR or Project) covers a portion of the Lake Okeechobee Watershed (LOW), Lake Okeechobee, and the Caloosahatchee and St. Lucie Estuaries (collectively known as the Northern Estuaries).

The LOW, as defined hydrologically, spreads over approximately 8,687 square miles (mi^2), almost 13 times the area of the lake itself (Flaig and Havens 1995). The LOW is a shallow trough that drains south from Orlando to the Florida Everglades and is bounded by sand hills of the Lake Wales Ridge on the west and upland marshes of the Osceola Plain to the east (Parker et al. 1955). Characterized by low-gradient, poorly drained landscapes with many marshes and sloughs, it includes all major basins and sub-watersheds that are direct tributaries to the lake, including those that are hydrologically upstream and/or those from which water is released or pumped into the lake on a regular basis. Four distinct tributary systems (basins) drain naturally into Lake Okeechobee: the Kissimmee River Valley, Lake Istokpoga-Indian Prairie/Harney Pond, Fisheating Creek, and Taylor Creek/Nubbin Slough. Except for Fisheating Creek, all major inflows to Lake Okeechobee are controlled by gravity fed or pump-driven water control structures. The four major basins of the LOW are generally bounded by the drainage divides of the major waterbodies and are further divisible into smaller sub-basins based on hydrology and geography. The existing conditions are presented in a regional or area-specific content, depending on the nature of the resource or the anticipated effect of that resource. Existing conditions are summarized in **Section 2.0** of the main report.

Lake Okeechobee, a central part of the South Florida watershed, is the largest lake in the southeastern U.S. The lake provides water supply to urban areas, agriculture, and downstream estuarine ecosystems during the dry season (i.e., November to May) and is used for flood control during the wet season (i.e., June to October). In the Lake Okeechobee Service Area (LOSA), the Okeechobee Utility Authority is the only remaining public water supply (PWS) utility using water directly from the lake. The towns of Clewiston, South Bay, Belle Glade, and Pahokee discontinued the use of Lake Okeechobee as their supply source. Since 2008, they use the Floridan Aquifer water, treated by reverse osmosis, for all of their PWS. The Okeechobee Intercoastal Waterway provides economically and politically important commerce between the eastern and western coasts of Florida. A congressionally authorized project, the Okeechobee Intercoastal Waterway connects the Atlantic Intracoastal Waterway to the Gulf Intracoastal Waterway, with depths and operations required for efficient navigation on the system. The authorized Central and Southern Florida (C&SF) Project depths for Lake Okeechobee navigation are based on 11.36-foot (ft) North American Vertical Datum of 1988 (NAVD88).

C.1.1.1 Climate

The LOW is in the transition zone between a tropical (to the south) and humid subtropical (to the north) climate. Both climates are dominated by hot humid summers and mild to warm winters. The subtropical climate of South Florida, with its distinct wet and dry seasons, high rate of evapotranspiration, and climatic extremes of floods, droughts, and hurricanes, represents a major physical driving force that sustains the Everglades, while creating water supply and flood control issues in the agricultural and urban segments.

Global climate change and variability, particularly at regional levels, were not understood several years ago. Over the last two decades, South Florida Water Management District (SFWMD) scientists have investigated how natural, global climatic patterns, such as the El Niño/La Niña Southern Oscillation and the Atlantic Multidecadal Oscillation, are linked to South Florida's weather and climate.

Since 1900, there have been two cool phases and two warm phases of the Atlantic Multidecadal Oscillation cycle; each phase lasted approximately 20 to 40 years. The exact year of the phase start and finish is an estimate, as each phase goes through a "transition period" of a few years. South Florida was in a much drier regime from 1965 to the early 1990s when the Atlantic Multidecadal Oscillation transitioned from the cool phase to the warm phase. South Florida experienced more droughts and dry weather during the cool phase. High-water events (some extreme) have been more frequent during the current warm phase. South Florida has been in a "wetter" regime since the early 1990s, mostly due to the Atlantic Multidecadal Oscillation. With the Atlantic Multidecadal Oscillation phases lasting typically 20 to 40 years, the current warm phase has likely peaked. Thus, the generally wetter than normal conditions that Florida has experienced since the early 1990s should begin to slowly decline, and we will see continually cooler conditions over the next 10 to 20 years, with an increase in dry years compared to wet years as we move into the next cool phase. However, low-frequency dry years can still occur during this warm phase due to other events, such as La Niña, which can occur every 2 to 7 years on average.

Seasonal rainfall patterns in South Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes. Recorded annual rainfall averages 53 inches per year in South Florida. Recorded extremes range from 37 to 106 inches. Of the average annual rainfall that South Florida receives, 75 percent falls during the wet season, May through October. During the wet season, thunderstorms that result from easterly trade winds and land-sea convection patterns occur almost daily. Wet-season rainfall follows a bimodal pattern, with peaks during mid-May through June and September through mid-October. Tropical storms and hurricanes also provide major contributions to wet season rainfall, with a high level of interannual variability and low level of predictability. During the dry season (i.e., November to April), rainfall is governed by large-scale winter weather fronts that pass through the region approximately weekly. However, due to the variability of climate patterns (e.g., La Niña and El Niño), dry periods may occur during the wet season and wet periods may occur during the dry season. Multi-year high and low rainfall periods often alternate on a time scale approximately on the order of decades. These interannual extremes in rainfall result in frequent years of flood and drought (Corps 1999).

Mean annual temperatures for the South Florida ecosystem range from 72 degrees Fahrenheit (°F; 22 degrees Celsius [°C]) in the northern Everglades to 76°F (24°C) in the southern Everglades (Thomas 1974). Mean monthly temperatures range from a low of 63° F (17°C) in January to a high of 85°F (29°C) in August (Thomas 1974).

High evapotranspiration rates in South Florida approximately equal annual precipitation. Evapotranspiration removes approximately 70 to 90 percent of the rainfall in undisturbed South Florida wetlands (Duever et. al. 1994). Evaporation from open water surfaces peaks annually in the late spring when temperatures and wind speeds are high and relative humidity is low. Evaporation is lowest during the winter when the temperatures and wind speeds are low (Duever et. al. 1994).

Regional climate studies of observed air temperature trends show an increase in temperature with a consensus in an increase in minimum and maximum temperatures. Observed precipitation shows no discernible trends in annual/seasonal precipitation but shows an increase in the frequency and intensity of extreme precipitation events. Heavy precipitation events in most parts of the U.S. have increased in both intensity and frequency since 1901. Extreme precipitation events are generally observed to increase in intensity by about 6 to 7 percent for each degree Celsius of temperature increase (U.S. Global Change Research Program 2017). The annual frequency of hurricanes has remained relatively stable throughout the twentieth and early twenty-first centuries; however, hurricane rainfall is expected to increase for Florida as the climate continues to warm.

No trend in observed streamflow was found.

Sea level change has been a persistent trend for decades in the U.S. and throughout the world. Observed and reasonably foreseeable global sea level rise means that local sea levels will continue to rise beyond the end of this century. This trends evaluation is further discussed in **Subsection C.1.3.1**.

C.1.1.2 Physical Landscape

The most common landscapes of the LOW are wet prairies that occur near Lake Okeechobee in areas of lower elevations and the dry prairies and pine flatwoods that occur in upland settings (McVoy et al. 2011). Aerial imagery of the Indian Prairie and Istokpoga landscapes show relict ridge-and-slough geomorphology that characterizes the Greater Everglades topography. Depressional wetlands also appear in areas that are not over drained. The Canal 41A (C-41A) and Canal 40 (C-40) and the Kissimmee River are the primary drainage mechanisms of the Project Area. Elevations in the LOW generally range 12 to 54 ft North American Vertical Datum (NAVD) and gradually decrease in a southeasterly direction to approximately 12 ft NAVD.

The shallow subsurface geology of the LOW consists of unconsolidated fluvial sediments of the Kissimmee River floodplain and freshwater wetland soils of Holocene age, which overlie Quaternary marine sediments, primarily sand and silt with clay lenses (Klein et al. 1964). These sediments are underlain by a thick (i.e., greater than 1,000 ft) sequence of Cenozoic marine limestones.

Geology

The deepest lithologic unit of interest is the Avon Park Formation (mid- to late Eocene), encountered at depths of 1,140 ft below land surface (bls) near the Project Area, and dips to approximately 1,220 ft in the southeast near Lake Okeechobee (Campbell 1990; CH2MHill 2004, 2008). The Avon Park Formation consists of fine-grained, micritic to fossiliferous limestone, dolomitic limestone, and dolostone (Reese and Richardson 2008).

The Ocala Limestone (late Eocene) overlies the Avon Park Formation. This unit is a chalky to fossiliferous, mud-rich to calcarenite limestone. Near the Project Area, the top of the Ocala Limestone is encountered at depths of approximately 540 ft bls and generally dips to the south. The upper contact of the Ocala limestone shows significant—as much as 200 to 300 ft—topographic variation. The Ocala Limestone thickness ranges from approximately 200 to 400 ft in the Project Area (Reese and Richardson 2008).

Hawthorn Group (late Oligocene-Miocene) sediments overlie the Suwannee and Ocala Limestones throughout South Florida, including Glades County (Scott 1988; Missimer 2002). The Hawthorn Group consists of two formations: the Arcadia Formation and the overlying Peace River Formation. Hawthorn Group sediments are distinguished from underlying limestones by their high and variable siliciclastic and phosphatic content, gray-green coloration, and gamma-ray log response (Reese and Richardson 2008). The basal Hawthorn unit is phosphate rich and shows pronounced gamma-ray log responses that contrast with low response in the phosphate-poor Ocala Limestone. Clays occur within the Arcadia Formation; dolomite is the primary carbonate mineral (Scott 1988). The Arcadia Formation/basal Hawthorn Group lies unconformably on the Ocala Limestone in the Project Area.

The Peace River Formation overlies the Arcadia Formation throughout South Florida. The Peace River Formation consists of interbedded quartz sands, clays, and carbonates, with quartz sands dominating the formation (Scott 1988). Undifferentiated Hawthorn Group sediments occur at depths of 178 ft to 650 ft at the Brighton Reservation (Missimer Groundwater Science 2007).

Undifferentiated shelly marine sands (Pliocene-Pleistocene) overlie Hawthorn Group sediments throughout the Project Area (Scott et al. 2001). West of the Kissimmee River alluvial floodplain, nearshore marine sediments are exposed at the surface. During the Holocene (starting at approximately 10,000 years Before Common Era), the Kissimmee River floodplain developed, initiating deposition of fluvial and freshwater wetland sediments on surficial marine sands. The thickness of the unconsolidated marine and freshwater sediments is 178 ft at the Brighton Reservation (Missimer Groundwater Science 2007).

Soils

Surface soils in the Lake Okeechobee region are grouped based on distinctive patterns of composition, relief, drainage, and natural landscape. These soils developed in response to climate and drainage during the Holocene Epoch. Holocene soils developed on Quaternary marine sands and silts that serve as parent material. Sandy marine sediments are clearly identified at relatively shallow depths beneath the Holocene soils and alluvium of the Kissimmee River. Two general soil types characterize the Project Area: upland flatwoods soils and slough and freshwater marsh soils.

Upland flatwoods soils in the Project Area are primarily fine sands and are mapped as Immokalee sand, Basinger fine sand, and Piñeda fine sand (**Figure C.1-1;** Natural Resources Conservation Service [NRCS] 2018).

- The Immokalee sand is the most widely occurring soil in the Project Area. This soil occurs in upland flatwoods environments on marine terraces (light green units in the figure).
- The Basinger fine sand commonly occurs in depressions on marine terraces (yellow and light blue units in the figure).
- The Piñeda fine sand occurs in upland drainages in flatwoods environments and marine terraces (dark blue units in the figure).

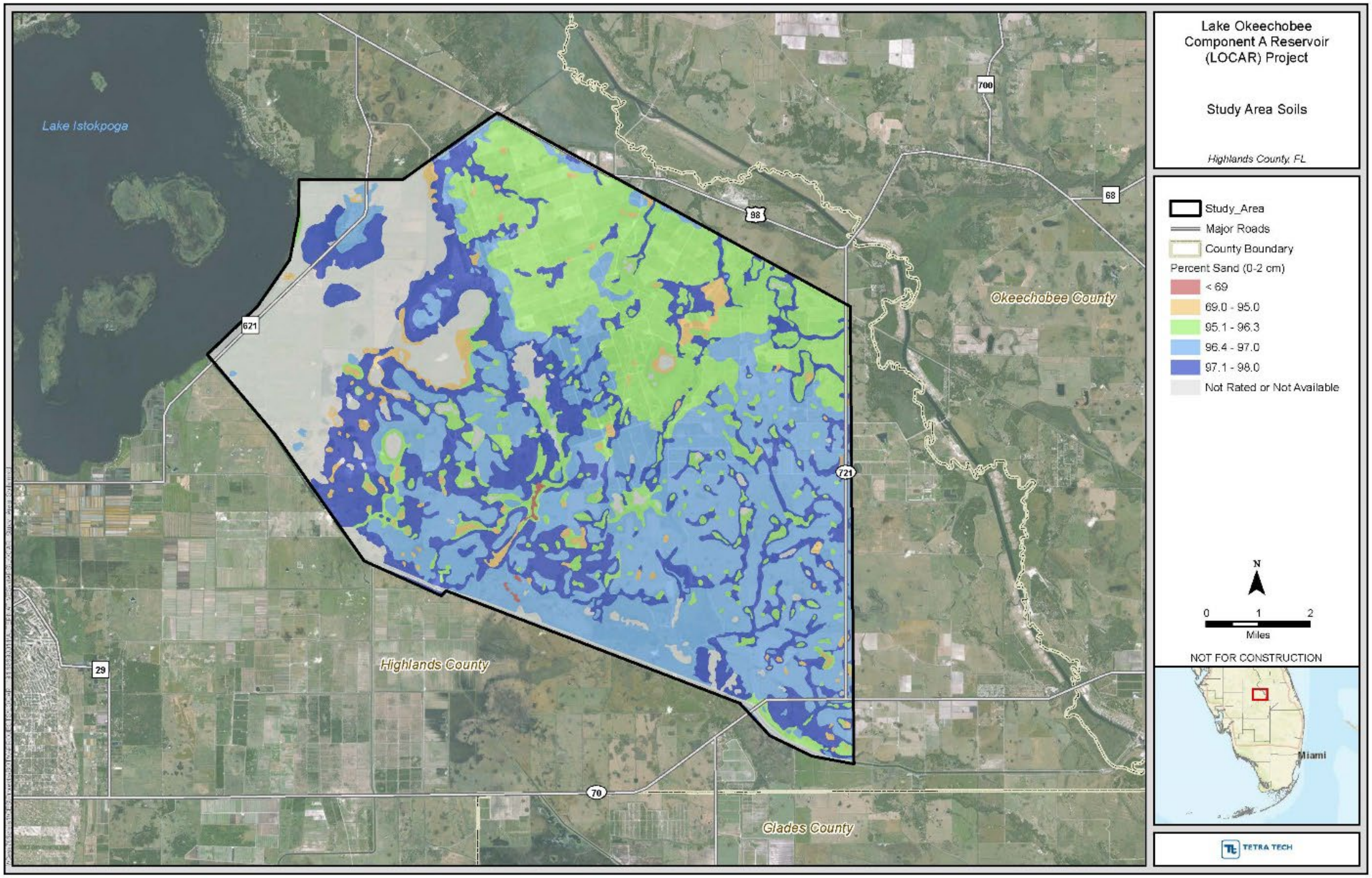

Figure C.1-1. Soil map showing percent sand in surface soils (NRCS 2022).

The slough and freshwater marsh soils consist of fine sand and are often organic rich. These hydric soils develop in depressional wetlands, sloughs, and the Kissimmee River alluvial floodplain. They are mapped as Tequesta muck and Floridana fine sand (NRCS 2018).

- The Tequesta muck is an organic-rich soil of the Kissimmee River alluvial floodplain (red units in the figure).
- The Floridana fine sand is found in low-lying areas that are ponded frequently, or in former natural drainages (also light green units in the figure, generally in depressional wetlands).

Slough and freshwater marsh soils consist of fine sands, silts, and organics. These soils generally are poorly drained and frequently ponded. These are hydric soils, found in areas with longer hydroperiods (typically 9 to 12 months) and greater maximum depths of flooding.

Aquifers

The lithologic units described in the Geology section include permeable zones known as aquifers and low-permeability zones that are confining units. The aquifer systems are the Surficial Aquifer System (SAS), the Intermediate Aquifer System (IAS), and the Floridan Aquifer System (FAS) (Miller 1990). The SAS (or water table aquifer) in the Project Area is unconfined and is included in the Pliocene-Pleistocene marine sands. The base of the SAS corresponds with the upper surface of the Hawthorn Group sediments, which also serves as the upper surface of the Intermediate Confining Unit (ICU).

The ICU may include one or more permeable zones that qualify as aquifers. Lithologic heterogeneity of Hawthorn Group sediments results in permeable zones in quartz sand units, bounded by clay rich confining units. The Sandstone Aquifer and the Mid-Hawthorn Aquifer together comprise the IAS in west-central Florida (Reese and Richardson 2008). An exploratory borehole at the Brighton Reservation yielded a productive coarse sand aquifer at depths of 250 to 340 ft bls, but it is not clear if this permeable zone is correlative with the Sandstone Aquifer defined farther west (Missimer Groundwater Science 2007).

The FAS, one of the most productive aquifers on Earth, consists of highly permeable zones and confining units in a thick sequence of marine limestones. In the Project Area, the FAS consists of the Upper Floridan Aquifer (UFA), a middle confining unit, the Avon Park Permeable Zone (APPZ) (Reese and Richardson 2008), and the Lower Floridan Aquifer (LFA).

The UFA is included in the Ocala Limestone throughout the Project Area. A preferential flow zone is often observed at the unconformable contact between the Arcadia Formation/basal Hawthorn unit and the uppermost Ocala Limestone (Reese 2014). The preferential flow zone occurs at or near the top of the UFA and is a regional feature, as it appears in the Brighton exploratory well and farther eastward from the Project Area (Reese 2014).

The Middle Confining Unit 1 (MCU1) separates the UFA from the underlying APPZ. In the Project Area, the MCU1 is regarded as a "leaky" confining unit that separates the lower portions of the UFA from the APPZ. The top of the MCU1 occurs at depths of approximately 550 ft (Reese and Richardson 2008).

The APPZ occurs between the MCU1 and the deeper Middle Confining Unit 2 (MCU2), within the upper portions of the Avon Park Formation throughout South Florida. The APPZ is primarily fracture dominated, resulting in a confined aquifer that shows high transmissivity (Reese and Richardson 2008). The APPZ is tentatively identified throughout the Project Area (Reese and Richardson 2008; Reese 2014), with the deepest occurrence in western Glades County (i.e., Brighton exploratory borehole [1,700 ft]; Missimer Groundwater Geoscience 2007).

C.1.1.3 Vegetative Communities

The vegetation within the Lake Okeechobee region has been greatly altered during the last century. Historically, the natural vegetation was a mix of wet and dry prairies, freshwater marshes, hardwood swamps, cypress swamps, mesic temperate hammock, and pine flatwoods. Although some of these natural areas still exist, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of land cover types. North of Lake Okeechobee, improved pasture and rangeland comprises about half of the Study Area. Other agricultural uses include citrus, cropland, dairies, silviculture, and sugarcane. Natural lands and open water occupy approximately 34 percent of the landscape. Urban and residential land areas occupy about 5 percent of the Study Area. Today's native vegetative communities in the watershed include primarily cabbage palm and oak hammocks, pine flatwoods, and freshwater marsh. Lesser amounts of wet prairie, cypress, and other swamps are also present.

Lake Okeechobee Watershed

The conversion of natural areas for urban and agricultural uses and the network of C&SF Project canals have altered the natural system, causing complete shifts in vegetative communities. Historically, the Study Area was composed of approximately 40 percent wetlands, consisting of cypress and bay tree forests, inland swamps, freshwater marsh, wet prairie, and sawgrass marsh (Davis 1943). Currently, only 15 percent of the original habitat remains within the Study Area. This substantial reduction in the spatial extent of watershed wetlands (approximately 330,000 acres [ac]) is exacerbated by a reduction in the function of the remaining wetlands, as many of them have lost vital hydrologic connections. The result is reduced water storage capacity in the remaining natural system and an unnatural mosaic of impounded, fragmented, over-inundated, and over-drained marshes.

Upland Communities

In this subsection, five types of upland communities that are in the Study Area are discussed.

Mesic Temperate Hammock: Mesic temperate hammocks (also known as upland hardwood forest, upland mixed forest, prairie hammock, and xeric and hydric hammock) are temperate, broad leaved, evergreen forests. These forested communities are common throughout the Project watershed. They are floristically transitional between the tropical forest of southern Florida and the southern mixed hardwood forest of north Florida (Greller 1980). Mesic temperate hammocks are generally closed-canopy forests, dominated primarily by live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*). Moist soils have a dense litter layer but are seldom inundated. They are naturally protected by fire because of their transitional position in the landscape. They occur as generally small islands in expanses of dry prairie composed of saw palmetto (*Serenoa repens*) and graminoid species (FNAI 1995; Hilsenbeck and Hedges 1994).

No Endangered Species Act (ESA) federally listed plant species inhabit the mesic temperate hammocks, but two state listed species, wild coco (*Eulophia alta)* and twisted air plant (*Tillandsia Flexuosa*), may be present. The wild coco is a terrestrial orchid occurring primarily in the dry prairies and mesic temperate hammock islands. The twisted air plant is an epiphytic bromeliad that grows on trees in mesic hammocks, swamps, hydric pine flatwoods, and xeric hammocks.

Mesic Pine Flatwoods: The mesic pine flatwoods (also known as pine savanna, cabbage palm savanna, and pine barrens) are open canopied forests of pines with a dense groundcover of herbs and shrubs. Within the LOW, this community type is found primarily in portions of Glades and Highlands Counties. They provide essential forested upland habitat, furnishing refuge and cover in the form of tree canopy, tree cavity, and nesting. The Florida Natural Areas Inventory (FNAI) characterizes mesic flatwoods as flatland with a sand substrate visited by annual or frequent fires. Characteristic vegetation includes a slash pine (*Pinus elliotti*) or longleaf pine (*Pinus palustris*) overstory with an understory/groundcover consisting of saw palmetto , gallberry (*Ilex glabra*), and/or wiregrass (*Aristida stricta*) or cutthroat grass (*Panicum abscissum*). These flatwoods provide the principal dry ground in the watershed.

One federally and state listed endangered plant, Carter's mustard (*Warea carteri*), occurs in the watershed in Highlands County primarily in dry, shrub-dominated habitat. It is a fire-dependent, annual, fall-flowering herb. Additional state listed plant species include pinewood bluestem (*Andropogon arctatus*), hartwrightia (*Hartwrightia floridana*), thick-leaved water willow (*Justicia crassifolia*), southern red lily (*Lilium catesbaei*), and yellow fringeless orchid (*Platanthera ciliaris*).

Hydric Pine Flatwoods: The hydric pine flatwoods (also known as low flatwoods, moist pine barren, hydric flatwoods, and cabbage palm/pine savanna) are seasonally inundated wet flatwoods that function as both a wetland and an upland. Hydric pine flatwoods contain the highest plant species diversity of any habitat in South Florida. They are dominated by a slash pine (*Pinus elliottii*) overstory with a wetland plant understory.

Dry Prairie: The dry prairie community (also known as palmetto prairie, saw-palmetto prairie, and wiregrass prairie) is endemic to central peninsular Florida. The loamy to clayey subsoils are saturated in the wet season, providing substrate for both upland and wetland plant species. This treeless, fire-maintained landscape is dominated by wiregrass, saw palmetto, and runner oak (*Quercus minima*). Harshberger (1914), Harper (1927), and Davis (1943) identified extensive areas of dry prairie in the south-central peninsula, encompassing portions of the lower Kissimmee River, Fisheating Creek, and lower Peace River watersheds. No federally listed plant species are known from the dry prairie; the many-flowered grass-pink (*Calopogon multiflorus*) is the only state endangered plant species that may occur.

Cutthroat Grass Communities: Cutthroat grass communities (also known as cutthroat seeps, cutthroat grass seasonal ponds, and cutthroat grass flatwoods, and swale) are dominated by cutthroat grass and exist almost exclusively within Polk and Highlands Counties in association with the sideslope seepages of the central Florida ridges. These diverse communities vary by topography, hydrology, soils, and vegetation, but they are all fire dependent, graminoid-dominated communities (Abrahamson et al. 1984). Cutthroat grass is a state listed endangered species and is ranked as imperiled at the global and state levels by FNAI (Marois 1997). The Highlands County soil survey (Carter et al. 1989) recognizes the Basinger-St. Johns-Placid complex as a specific soil-mapping unit corresponding to cutthroat seeps in the county. The greatest extent of cutthroat grass communities on the Lake Wales Ridge is on the eastern slope of the ridge in the northwestern fringe of the LOW. It is also present to a lesser degree along Bootheel Creek in the Fisheating Creek Basin. A diverse array of state listed plant species is quite common in the cutthroat grass community, including cutthroat grass, many-flowered grass-pink, Edison's ascyrum, southern red lily, blue butterwort (*Pinguicula caerulea*), yellow passionflower (*Passiflora Lutea*), large frite fringed orchid (*Platanthera blephariglottis* var. *conspicua*), yellow fringeless orchid (*Platanthera Integra*), yellow fringed orchid (*Platanthera ciliaris*), crested fringed orchid (*Platanthera Cristata*), and hooded pitcherplant (*Sarracenia minor*).

Wetland Communities

In this subsection, five types of wetland communities are discussed.

Freshwater Marshes and Wet Prairies: In the LOW, freshwater marshes and wet prairies are found as zones along topographical gradients throughout the entire watershed. The higher-elevation wetlands, with shorter hydroperiods and shallower flooding, are classified as wet prairies. The lower-elevation wetlands, with long hydroperiods, are designated as freshwater marshes. Freshwater marshes include the sawgrass marshes, cattail marshes, flag marshes, sloughs, mixed emergent grass/sedge marshes, open-water marshes, submerged vegetation marshes, and floating vegetation marshes. Freshwater marshes are vegetated primarily with sawgrass (*Cladium jamaicense*) and scattered clumps of Carolina willow (*Salix caroliniana*). The wet prairies include sawgrass prairies, wiregrass prairies, and savannas. The distribution of dominant vegetative species in wet prairies and freshwater marshes is dependent on soil type, depth, and hydrological conditions (Kushlan 1990). Most of these plant associations are found in the Kissimmee River floodplain and Lake Okeechobee perimeter marshes. These Lake Okeechobee communities are frequently the littoral zones associated with lakes, creeks, and rivers. Soils have changed with shifts in water management practices in Lake Okeechobee; this is reflected in variations in hydrology and vegetative decomposition rates (Brown et al. 1990).

Flowing Water Swamps: Flowing water swamp communities (also known as floodplain swamp, slough, and strand swamp) are seasonally inundated, forested wetlands associated with drainage channels. These communities are generally deep swamps with long-term flooding. They are often degraded by silviculture/agriculture drainage control activities and agricultural/urban runoff pollution. Exotic species control is also a major concern. Kissimmee River, Fisheating Creek, Taylor Creek, and Nubbin Slough are lined with floodplain swamps.

Pond Swamps: Pond swamps (also known as basin swamps, dome swamps, cypress swamp, and cypress ponds) are seasonally inundated forested wetland depressions. This includes the swamps associated with lake borders as well as smaller cypress domes and gum ponds. Dome swamps typically appear in sinkhole depression landscapes with peat soils, while larger basin swamps are common in landscape depressions with acidic, nutrient-poor peats with an overlying clay lens or other impervious layer. Sugarcane planting destroyed the pond apple (*Annona glabra*) swamp that historically bordered the southern edge of Lake Okeechobee. Continuing soil oxidation has further degraded this system. Many other systems have been destroyed and/or degraded by silviculture, drainage, impoundment, or pollution. The Cypress Creek/Trail Ridge is another example of pond swamp mosaic in the watershed. Typical dome swamp plants include pond cypress (*Taxodium ascendens*), red maple (*Acer rubrum*), dahoon holly (*Ilex cassine*), swamp bay (*Persea palustris*), sweetbay magnolia (*Magnolia virginiana*), wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), St. John's wort (*Hypericum* spp.), chain fern (*Woodwardia* spp.), and fireflag (*Thalia geniculata*). Basin swamp plants include blackgum (*Nyssa sylvatica*), cypress, slash pine, red maple, swamp bay (*Persea palustris*), sweet bay, loblolly bay (*Gordonia lasianthus*), and Virginia willow (*Itea virginica*). A federally endangered plant species, the Okeechobee gourd (*Cucurbita okeechobeensis* ssp.

okeechobeensis), was once common in the pond apple swamp along the southern edge of Lake Okeechobee. This gourd now occurs sporadically inside the levee that encircles Lake Okeechobee (southern end and western littoral marsh) (USFWS 1995).

Seepage Swamps: Seepage swamps (also referred to as hydric hammock, baygall, bog, wetland hardwood hammocks, shrub bog, and sweetbay swamp) are characterized by their saturated soils. They include baygalls and hydric hammocks on low sand or limestone rises within ephemeral wetland systems. These systems burn only every 50 to 100 years because of their hydrology. Baygalls once fringed the Lake Wales Ridge but were cleared for caladium and gladiola farms. Seepage swamps are degraded by hydrological alterations and agricultural and urban runoff. Cabbage palms (*Sabal palmetto*) in hydric hammocks have been removed in large numbers for use in landscaping. Baygalls occur at the base of a slope that has a saturated peat substrate. Bog bayheads occur in peat soil depressions. Hydric hammocks occur on flat, wet, limestone-surfaced sandy lowlands. Baygalls and bayheads are composed of evergreen hardwoods, including sweetbay, swamp bay, red bay (*Persea borbonia*), and loblolly bay with sphagnum moss and fern groundcover. Hydric hammocks are dominated by cabbage palms, laurel oaks (*Quercus laurifolia*), and other hardwoods with minimal groundcover. Some important seepage slopes in the Okeechobee watershed include Cypress Creek/Trail Ridge at State Route (SR) 70, the Bluefield Road area, and the seepage swamps of Fisheating Creek. Imperiled plants include star anise (*Illicium parviflorum*) and hand fern (*Ophioglossum palmatum*).

Open Water: Open-water habitats in the Study Area consist primarily of the aquatic communities in the Kissimmee Waterway (C-38), Fisheating Creek, Taylor Creek, Harney Pond Canal (C-41), Indian Prairie Canal (C-40), and the many other canals in the Project watershed. The invasion of exotic vegetation has rapidly expanded throughout these areas. Included among these troublesome species are water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*) and hydrilla (*Hydrilla verticillata*).

Lake Okeechobee

Most of the surface of Lake Okeechobee (approximately 450,000 ac) is not vegetated; it provides open water (i.e., limnetic and nearshore) habitat. Open-water habitat within Lake Okeechobee covers about 75 percent of the lake’s surface area.

An approximately 100,000 ac (157-mi^2) littoral zone is found mostly along Lake Okeechobee's northwestern and western edges and on the islands of its southern shore (i.e., Kraemer Island, Torry Island, and Ritta Island, which together encompass 4,000 ac). There also is a small amount of littoral zone on the northeastern edge of the lake. Record low water levels in 2001 and again in 2007 and 2008 resulted in littoral expansions in parts of South Bay, Fisheating Bay, and Eagle Bay Marsh, increasing the size of the emergent and submerged vegetated zones. Periods of higher water levels (greater than 14 ft NAVD88) in 2016, 2017, and from 2020 to 2023, along with two hurricanes (Irma and Ian) reduced the areal and lakeward extent back to pre-2001 conditions in many areas of the lake, constituting substantial losses of littoral habitat over the last 10 years. The littoral zone supports more than 50 species of emergent, submerged, and floating-leaf plants. Emergent vegetation within the littoral zone is dominated by herbaceous species, such as cattail (*Typha* spp.), spike rush (*Eleocharis cellulosa*), and the invasive exotic torpedo grass (*Panicum repens*). Other emergent vegetation includes giant bulrush (*Schoenoplectus californicus*), sawgrass, pickerelweed (*Pontederia cordata*), duck potato (*Sagittaria* spp.), beakrushes (*Rhynchospora* spp.), wild rice (*Zizania aquatica*), arrowhead (*Sagittaria latifolia*), buttonbush

(*Cephalanthus occidentalis*), sand cordgrass (*Spartina bakeri*), umbrella-grass (*Fuirena scirpoidea*), southern cutgrass (*Leersia hexandra*), maidencane (*Panicum hemitomon*), white vine (*Funastrum clausum*), dogfennel (*Eupatorium capillifolium*), and mikania (*Mikania scandens*). Woody vegetation consists of primrose willow (*Ludwigia* spp.), Carolina willow, and the invasive exotic melaleuca (*Melaleuca quinquenervia*). Over the years, there has been an ongoing effort to eradicate melaleuca in the Lake Okeechobee region, which has been extremely effective at keeping this exotic plant species at minimum levels for over 20 years.

Submerged vegetation within Lake Okeechobee is composed primarily of eelgrass (*Vallisneria americana*), southern naiad (*Najas* spp.), pondweed (*Potamogeton illinoensis*), bladderwort (*Utricularia* spp.), muskgrass (*Chara* spp.), coontail (*Ceratophyllum demersum*), and the invasive exotic hydrilla (*Hydrilla verticillata*). However, coverage is minimal on the lake due to frequent and prolonged high water (>14ft NAVD88) events, occurring in only a few sheltered bays at the outer edges of the littoral zone in most years.

The floating component of the littoral zone vegetation consists of lotus lily (*Nelumbo lutea*), fragrant water lily (*Nymphaea odorata* and *N. mexicana*), the invasive exotic water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), duckweed (*Lemna* spp.), coinworts (*Hydrocotyle* spp.), and primrose willow (*Ludwigia* spp.).

Northern Estuaries

Submerged aquatic vegetation (SAV), which includes freshwater and oligohaline macrophytes and marine seagrass and macroalgae, is one of the most important vegetation communities of the St. Lucie River, Indian River Lagoon, and the Caloosahatchee River and Estuary (Indian River Lagoon Comprehensive Conservation and Management Plan 1996). These communities are highly productive, providing food and habitat for fish, sea turtles, manatees, a myriad of invertebrates, and other species. Seagrass meadows improve water quality by removing nutrients, dissipating the effects of waves and currents, and stabilizing bottom habitats (thereby reducing suspended solids). Seagrass beds support some of the most abundant and diverse fish populations. Many commercial and recreational fisheries (e.g., clams, shrimp, lobster, and fish) are associated with healthy seagrass beds (USFWS 1999). Currently, many SAV beds are stressed. Where not lost, they have been reduced by extreme salinity fluctuations, increased turbidity, sedimentation, dredging, damage from boats, and nutrient enrichment, which causes cyanobacteria blooms that restrict light penetration.

Upper Caloosahatchee River and Estuary

In terms of distribution and abundance, tape grass (*Vallisneria americana*) is present in the upper Caloosahatchee River and Estuary, colonizing freshwater and oligohaline littoral zones in water less than 1 meter deep (Chamberlain and Doering 1998a; South Florida Environmental Report [SFER] 2022). Tape grass can typically tolerate salinities up to 10 with few long-term effects if light conditions are sufficient (Haller et al. 1974; 2003; Jarvis and Moore 2008). Declines in tape grass began in 2000 salinities due to changes in salinity in the upper Caloosahatchee River and Estuary (CRE; Doering et al. 2001). There was some recovery by 2006; however, dramatic declines were observed beginning in late 2006 as a result of high salinities (Restoration Coordination and Verification [RECOVER] 2009). During this period, widgeon grass (*Ruppia maritima*) was the dominant species (Burns et al. 2007). For the upper CRE permanent SAV monitoring site CRE 2, from water year (WY) 2019-WY2021, only widgeon grass was observed. In the wet

WY2022, tape grass was observed, but at low percent cover, even though the low salinity (optimum) conditions were present (SFER2023).

<u>Lower Caloosahatchee River Estuary</u>

Historically, several species of SAV have been routinely reported during surveys in the lower Caloosahatchee River Estuary upstream of Shell Point. These include shoal grass (*Halodule wrightii*) and turtle grass (*Thalassia testudinum*) (Chamberlain and Doering 1998a; Wilzbach et al. 2000; Burns et al. 2007. Shoal grass coverage, described as abundant, has been at 300 ac; approximately 75 percent of this occurred between 2 and 8 kilometers upstream of Shell Point (Chamberlain and Doering 1998b). Hurricane effects lowered SAV abundance in 2005 and 2006, during which time there were hyposaline events. The seagrass community in the lower CRE observed from WY2019-WY2022 was comprised primarily shoal and turtle grasses, with occasional occurrence of manatee grass, paddle grass and star grass (SFER 2023).

At Iona Cove, mean oyster density following Hurricane Irma was 2 oysters/square meter (m^2) (WY2018 dry season) and increased to 523 oysters/m^2 by the WY2020 wet season (Figure 8D-14). At the downstream Bird Island site, average density was 248 oysters/m^2 during the wet season of WY2021, increasing to 1184 oysters/m^2 during the WY2022 dry season (SFER 2023). In the CRE, the first spring recruits were primarily observed in May with recruitment through the summer months with a peak in late fall (Parker and Radigan 2020). In WY2022, recruitment occurred during all months.

<u>St. Lucie Estuary</u>

The outer St. Lucie Estuary (SLE) and Southern Indian River Lagoon support six species of seagrass: shoal grass, manatee grass (*Syringodium filiforme)*, turtle grass (*Thalassia testudinum*), paddle grass (*Halophila decipi*ens), star grass *(Halophila engelmannii*), and Johnson's seagrass (*Halophila johnsonii*). While all these species are most successful in salinities greater than 20 parts per thousand (ppt), *s*hoal grass can tolerate a range of salinity and salinity variability. However, manatee grass is not as tolerant of low or variable salinities (Irlandi 2006).

This region was impacted by hurricanes and associated freshwater high-flow events in 2004 and 2005. Following the hurricanes, observed impacts to southern Indian River Lagoon SAV communities included large coverage and density declines, and smaller direct impacts due to burial by shifting bottom sediments. Lush manatee grass beds were documented through 2004; however, low salinities and associated poor water column light quality following the 2004 and 2005 hurricanes greatly impacted manatee grass in the area. The hurricanes also altered bathymetry on the east and west edges of the lagoon, covering seagrasses. Johnson's seagrass, followed by shoal grass, colonized the former manatee grass habitat and recruited throughout the site. In 2007, very sparse SAV (less than 10 percent cover in most areas) was present in the lower and middle estuary (RECOVER 2009) and the dominant species was Johnson's seagrass.

In the mid SLE from WY2019 to WY2022, shoal grass, Johnson's seagrass, and addle grass were observed. Wet season sampling of the last three years (WY2019 to WY2022) observed a transition from shoal grass dominant to mixed stands of shoal grass and Jonson seagrass mix (SFER 2023). In the lower estuary sites, near the St. Lucie Inlet, seagrass average percent cover decreased from the wet to dry season of WY2020, after which time cover remained low, but consistent, due primarily to a decline in shoal grass cover. When present, manatee and turtle grasses were extremely sparse, as neither species contributed more than 1 percent to total seagrass cover (SFER 2023).

Between WY2018 and WY2022, the highest mean density of live adult oysters (786 live oysters/m^2) was observed in the WY2020 wet season, which followed an extended period in WY2019 when salinities were 10-25 (optimum). Counts of less than 1 live oyster/m^2 were observed post Hurricane Irma (National Hurricane Center 2018) when salinities were less than 10 ppt for more than three months. In WY2022 live adult oyster density was greater 200 live oyster/m^2, when salinity was in the optimum range (10 to 25 ppt) for 79 percent of the water year. Recruitment rates in WY2022 were and average of 18.4 spat/shell in April 2022, which was one of the highest rates recorded since monitoring began in 2005.

C.1.1.4 Threatened and Endangered Species

The U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and State of Florida have designated certain species of fish, amphibians, reptiles, birds, mammals, gastropods, and plants and lichens in Okeechobee, Highlands, Glades, Lee, Martin, and St. Lucie Counties as threatened or endangered. Several of these listed species have been observed within the Project Area.

Federally listed threatened and endangered species are either known to exist or potentially exist within the Study Area; subsequently, they may be affected by the proposed Project. Many of these species have been previously affected by habitat impacts resulting from uplands conversion, wetland drainage, alteration of hydroperiods, wildfire, and water-quality degradation.

The U.S. Army Corps of Engineers (Corps) has prepared a Biological Assessment (BA) for the Project included in Annex A, and was submitted to USFWS on August 16, 2023. The USFWS reviewed the BA and prepared a Biological Opinion (BO) for the proposed Project, that was received on November 30, 2023. The complete BO and attachments can all be found in **Annex A**. For a complete list of federally threatened and endangered species, their critical habitat, and candidate species, refer to the BA included in **Annex A**. The BA also includes descriptions for each species. Below are species descriptions for species in the BA that were carried forward for further analysis.

Eastern Indigo Snake

The threatened Eastern indigo snake (*Drymarchon couperi*) is the largest native non-venomous snake in North America. It is an isolated subspecies occurring in southeastern Georgia and throughout peninsular Florida. The Eastern indigo snake prefers drier habitats but may be found in a variety of habitats from xeric sandhills to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin 1990). The species has also been found in citrus groves and sugar cane. Eastern indigo snakes need relatively large areas of undeveloped land to maintain their population. In warm months, indigo snakes use a variety of natural areas and have large home ranges (Moler 1992; USFWS 1999). Eastern indigo snakes occupy larger home ranges in the summer than the winter. Information on snakes in Florida indicates adult males have home ranges as high as 224 hectares (553 ac) in the summer (Moler 1992). Because it is such a wide-ranging species, the eastern indigo snake is especially vulnerable to habitat fragmentation that makes travel between suitable habitats difficult. The main reason for its decline is habitat loss due to development. Further, as habitats become fragmented by roads, eastern indigo snakes become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin 1990).

In South Florida, the Eastern indigo snake is thought to be widely distributed. Given their preference for upland habitats, eastern indigo snakes are not commonly found in great numbers in wetland complexes, although they have been found in pinelands, tropical hardwood hammocks, and mangrove forests in extreme South Florida (Duellman and Schwartz 1958, Steiner et al. 1983). Within the range of the gopher tortoise, tortoise burrows are favorite refugia for indigo snakes. They are known to use burrows made by cotton rats and land crabs, hollows at bases of trees and stumps, ground litter, trash piles and rock piles lining banks of canals, and pipes or culverts.

Sexual maturity appears to occur around 3 to 4 years of age. Breeding occurs from November to April with females laying 4 to 12 eggs in May through June (Moler 1992). Most hatching of eggs occurs from August to September, with yearling activity peaking in April and May (USFWS 1999).

Florida Grasshopper Sparrow

The Florida grasshopper sparrow (*Ammodramus savannarum floridanus*) is federally listed as endangered and is one of four subspecies of grasshopper sparrows in North America. The Florida grasshopper sparrow is a year-round resident of Florida and is endemic to the dry prairie of central and southern Florida. This subspecies is extremely habitat specific and relies on fire every 2 to 3 years to maintain its habitat. Florida grasshopper sparrow is named for one of its calls, a quiet buzz that sounds much like a grasshopper. Male sparrows sing only a few months of the year during the nesting season, for a few hours each day. Florida grasshopper sparrow nests in spring (April to July) on the ground, under palmettos, or in grass clumps. The female lays three to five eggs, and young fledge within 9 to 10 days. The male sings from a low perch to defend its territory—about the only time they are readily visible--and helps raise the young. Diet includes seeds and invertebrates. It is thought that most individuals live their entire lives within a few miles of their place of birth.

Florida grasshopper sparrow habitat consists of large (greater than 50 hectares [123 ac]), treeless, relatively poorly drained grasslands that have a history of frequent fires (Delany et al. 2007, USFWS 1988). The dry prairie habitats where grasshopper sparrow occurs are typically characterized by the presence of bluestem grasses, St. John’s wort, and wiregrasses (*Aristida* spp.; Delany et al. 1985) and interspersed with saw palmetto and dwarf live oaks (*Quercus minima*) ranging from 30 to 70 centimeters (cm; 12 to 28 inches) in height. These dry prairies are relatively flat and are moderately to poorly drained. Thus, dry prairies may become flooded for short periods during the rainy season but remain dry for the remainder of the year. The water table in these prairies is normally found between several centimeters and a meter below the soil surface.

Grasshopper sparrows cannot tolerate tree densities as high as one tree per acre. Some dry prairies may be artifacts of clearcutting, unnaturally frequent burning, livestock grazing, and alteration of hydrology (Abrahamson and Hartnett 1990). Prairie habitat may also have disappeared due to infrequent burn regimes from fire prevention and from planting of slash pine.

When compared with habitat of other grasshopper sparrows, habitat used by Florida grasshopper sparrow is characterized by a larger percentage of shrub and bare ground, a smaller percentage of tall vegetation, and less litter (Delany et al. 1985). Because the sparrows are ground-dwelling birds, they usually require at least 20 percent bare ground for unrestricted movement and foraging but need enough vegetation to provide nesting cover (Whitmore 1979, Vickery 1996). Large areas of prairie habitat between 240 to 1,348 hectares are needed to maintain populations of 50 breeding pairs (Delany et al. 2007). Florida grasshopper sparrows are also documented to be reproductively successful in pastures that are overgrown or un-grazed. As pastures become more heavily grazed, however, sparrow populations have been documented to decrease or disappear.

Historically Florida grasshopper sparrows were distributed across Collier, Miami-Dade, DeSoto, Glades, Hendry, Highlands, Polk, Okeechobee, and Osceola counties (USFWS 1999). As reported in the species 5-year status review in 2023 the subspecies range had become restricted to Highlands, Okeechobee, Osceola, and Polk counties (USFWS 2023b). Notably in recent years the number of locations where the species was known to occur has increased. Previously the species had been documented at three discrete locations: the Three Lakes Wildlife Management Area, Kissimmee Prairie Reserve State Park, and Avon Park (USFWS 2023b). In recent years, the DeLuca Preserve and Corrigan Ranch were protected for the species, both of which share a common border with Kissimmee Prairie Preserve State Park (USFWS 2023b). These areas are approximately five miles north of the LOCAR location.

In 2010, the Project Area was evaluated for potential habitat that could support Florida grasshopper sparrow as part of the Highlands Ethanol, LLC, Farm Lease Site (Kautz et al. 2010) project. The habitat assessment evaluated desktop data sources and included field surveys to characterize the Farm Lease Site and identify potential habitat for Florida grasshopper sparrow. A total of four parcels were evaluated that overlap with the current Project Area. Habitat suitability was characterized by evaluating several criteria, including quality of dry prairie, contiguous size of dry prairie habitat, treeless habitat, vegetation height, bare or litter-covered open ground, and fire frequency. Secondary assessment criteria included presence of fencing, cattle grazing, and hydrologic management. Among the four parcels overlapping the Project Area, only Parcel 1, which aligns with the northwestern corner of the Project Area, was found to have any characteristics suitable for Florida grasshopper sparrow, but lacked all the other important habitat features necessary for Florida grasshopping sparrow (Kautz et al. 2010). The area does not undergo any prescribed burning, and land managers confirmed that grazing is the only vegetation management tool currently used.

Bald Eagle

Bald eagles (*Haliaeetus leucocephalus*) are federally protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald eagles typically nest near large bodies of open water with adequate prey and tall trees for nesting and roosting, such as lakes, marshes, seacoasts, and rivers (Buehler 2022). Bald eagles are opportunistic foragers that prey primarily on fish but also feed on other aquatic and terrestrial vertebrates and carrion (Buehler 2022). Florida has one of the densest concentrations of nesting bald eagles in the lower 48 states, and their nesting territories are concentrated around inland lake and river systems. Foraging habitat for bald eagles has a diversity and abundance of prey, including access to shallow water and tall trees or structures for perching. Bald eagles on a wide variety of prey, including catfish but also on birds and small mammals. Nesting occurs from December or early January through late April or May. Most of Florida's breeding bald eagles remain in the state year-round.

Potentially suitable nesting and foraging habitat for bald eagles occur within the Project Area. There are known bald eagle nests located near the Study Area, with the closest nest located approximately 2.13 miles to the east.

Eastern Black Rail

The eastern black rail (*Laterallus jamaicensis* ssp. *jamaicensis*) was federally listed as threatened by the ESA on November 9, 2020 (85 *Federal Register* [FR] 63764 63803). Eastern black rail is a sparrow-sized bird and is the rarest and smallest of all rail species. Eastern black rail is a highly secretive bird that resides in marsh habitats, is rarely seen in flight, and will walk or run throughout their marsh habitat along narrow paths created by rodents. No critical habitat has been designated for the eastern black rail.

Eastern black rail range in the U.S. extends along the coastal areas of the eastern states, from New Jersey to the southern tip of Florida, along the gulf coast from Florida to Texas, and in the midwestern states, extending from Michigan to eastern Colorado (USFWS 2023c). Within its range, the species has historically been most concentrated along the Atlantic Coast, along coastal salt marshes from Connecticut to Florida.

In Florida, eastern black rail is a year-round resident throughout the coastal areas and the full southern half of the state. Habitat for the species is characterized by shallow, densely vegetated, marshes in salt, brackish, and freshwater environments (USFWS 2023c). The species appears to be limited to specific habitat characteristics in marsh environments, including persistent water coverage and depth, very dense herbaceous vegetation, and topographic variation (Atlantic Coast Joint Venture [ACJV] 2020). Habitats supporting black rail typically have water levels around 3 cm in depth, which is persistent. If water levels pool up seasonally or become too low or dry up in the summer months, the species will abandon the site. Vegetation structure is also an important habitat characteristic, and typically includes greater than 80 percent grasses, and also includes bulrushes, sedges, and cattails. Topographic variation is an important characteristic in black rail habitat to allow for escape when water levels rise and to allow greater foraging opportunity for invertebrate food sources that rails depend on. Small numbers of black rails have also been documented in impoundments, freshwater wetlands, coastal prairies, and grassy fields, where there are suitable habitat conditions present.

Nesting occurs from mid-March through August, and the species constructs their nests on or near the ground in very dense vegetation over water or moist soil or in shallow water (Watts 2022). Clutch size is typically around seven eggs, and the eggs are incubated for 17 to 20 days. The nestlings leave the nest within 1 day and the parents are believed to care for the young and feed them.

The Project Area was evaluated for potential habitat to support Eastern black rail during a site visit on May 3, 2023. The entire site is composed of a mixture of managed grasslands (e.g., pastures and grazing), dry prairie, oak scrub, and wetland habitats. The wetland habitats observed within the Project Area are predominantly a mixture of emergent vegetation, such as sawgrass and shrub-dominated wetlands, including species such as buttonbush. Water levels varied across the site from very shallow areas less than 8 inches in depth to deep pools of 1 to 2 ft in depth. Water levels are likely variable throughout the year, but those with less than approximately 3 inches would be suitable for nesting (Watts 2022). Shrubby vegetation often bordered many of the wetlands and was saturated or had standing water in some areas, and beyond that was improved pasture. Wetlands within the Project Area could provide potentially suitable habitat for eastern black rail.

Wood Stork

The wood stork (*Mycteria americana*) is a large, white, long-legged wading bird that relies on shallow freshwater wetlands for foraging. It primarily uses shallow wetlands where prey is concentrated and movements during the breeding and non-breeding seasons are typically in response to the availability of such shallow wetlands. As a wading bird, wood storks are a wetland dependent species and rely on a mosaic of wetlands for nesting, roosting, and foraging (USFWS 2021b). This species was federally listed as endangered under the ESA on February 28, 1984. In February 2023, the USFWS proposed to delist the southeast district population segment of wood stork (88 Fed Reg. 9830, February 15, 2023). No critical habitat has been designated for the wood stork.

In the U.S., wood storks were historically known to nest in all coastal states from Texas to South Carolina (Bent 1926). Dahl (1990) estimates these states lost about 38 million ac, or 45.6 percent of their historic wetland habitat between the 1780s and the 1980s. However, it is important to note that wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million ac of the wetlands lost in the southeastern U.S. between the mid-1970s and mid-1980s were located in the Gulf-Atlantic coastal flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina from March to late May. However, in South Florida, wood storks lay eggs as early as October and fledge in February or March. Breeding colonies of wood storks are currently documented in all southern Florida counties except for Okeechobee County. Wood stork Core Foraging Areas are shown in **Figure C.1-2**.

The wood stork population in the southeastern U.S. appears to be increasing. Preliminary population totals indicate that the wood stork population has reached its highest level since it was listed as endangered in 1984. In 2019, 17,398 wood stork pairs were recorded across Florida, Georgia, South Carolina, and North Carolina (USFWS 2021b). Wood stork nesting was first documented in North Carolina in 2005 and wood storks have continued to nest in this state since (USFWS 2021b). This suggests that the northward expansion of wood stork nesting may be continuing.

The primary cause of the wood stork population decline in the U.S. is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, either through local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year; however, only a small portion of the available wetlands support foraging conditions (i.e., high prey density and favorable vegetation structure) that wood storks need to maintain growing nestlings. Browder et al. (1976) documented the distribution and the total acreage of wetland types occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973. They combined their data for habitat types known to be important foraging habitat for wood storks (e.g., cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and sawgrass marshes) and found these habitat types have been reduced by 35 percent since 1900.

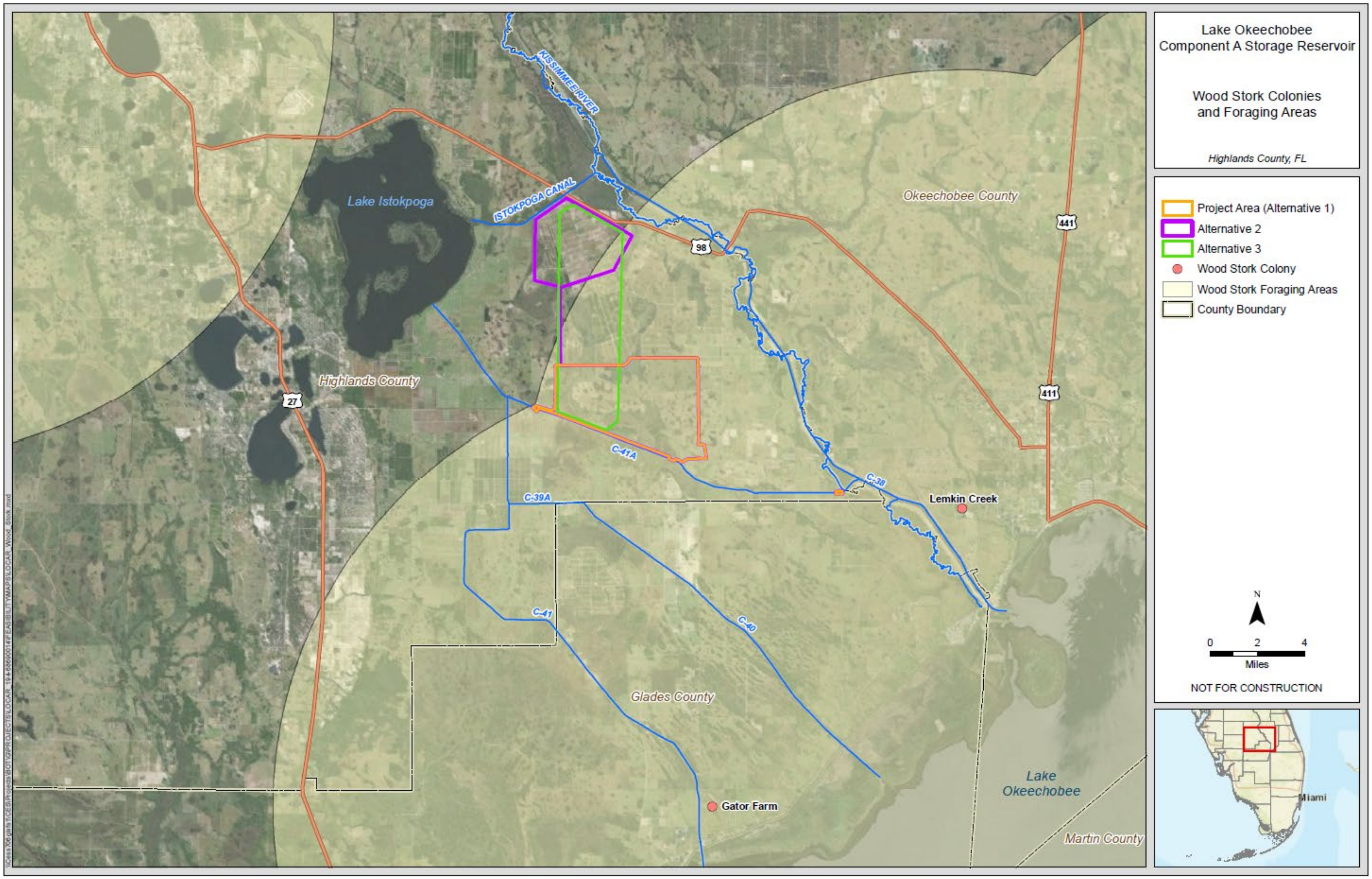

Figure C.1-2. Wood stork colonies and foraging areas.

Wood storks forage primarily within freshwater marsh and wet prairie vegetation types but can be found in a wide variety of wetland types, as long as prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Coulter 1987; Gawlik et al. 2004). Calm water, approximately 5 to 25 cm in depth, and free of dense aquatic vegetation is ideal; however, wood storks have been observed foraging in ponds up to 40 cm in depth (Coulter and Bryan 1993; Gawlik et al. 2004). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands, such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993). During nesting, these areas must also be sufficiently close to the colony to allow wood storks to efficiently deliver prey to nestlings.

Audubon's Crested Caracara

The threatened Audubon's crested caracara (*Polyborus plancus audubonii*) is a unique raptor scavenger in the family *Falconidae* that reaches the northern limit of its geographic range in the southern U.S. In Florida, this raptor occurs as an isolated population in the south-central region of the state. Changes in land use patterns throughout central Florida have resulted in this population becoming a subject of concern. This raptor has been documented to occur almost exclusively in cabbage palms on privately owned cattle ranches in the south-central part of the state.

Currently, much of the caracara population is found on improved or semi-improved pastures on private cattle ranches. Available evidence suggests that the most serious threat to Florida's caracara population is loss or degradation of nesting and feeding habitat. Such loss is most commonly due to conversion of pasture and other grassland habitats and wetlands to citrus, sugar cane, other agriculture, and urban development.

Adult caracaras exhibit high site and mate fidelity; therefore, extensive loss of habitat within the home range, particularly of the nesting site itself, may cause the pair to abandon that home range, or at least the nesting site (Morrison et al. 2001). Egg laying has been documented as early as September and as late as June; peak activity occurs from late December through February (Morrison et al. 2001). Clutch size is two to three eggs, with an incubation period of 32 to 33 days. Double brooding can occur if a nest is lost early in the season. Fledging occurs at 8 weeks. Young are dependent on parents for at least 2 months post-fledging and may remain in the natal territory for up to 10 months. Most young in Florida leave natal territory after 4 to 6 months and form groups of up to 30 individuals.

The caracara is an opportunistic feeder, taking prey items such as insects, small reptiles and amphibians, and small mammals. Eggs and carrion are also included in the diet of caracaras. Foraging for food takes place in early morning and late afternoon. Caracaras often walk through pastures searching for prey items, particularly after disturbance, such as mowing or plowing. Caracaras have also been observed feeding in recently burned areas. Hunting takes place from conspicuous perches or while in flight. Once prey is sighted, the caracara flies to the ground and walks up to prey item (Morrison 1996, 2001). Caracara range, habitat, and occurrences data is shown in **Figure C.1-3**.

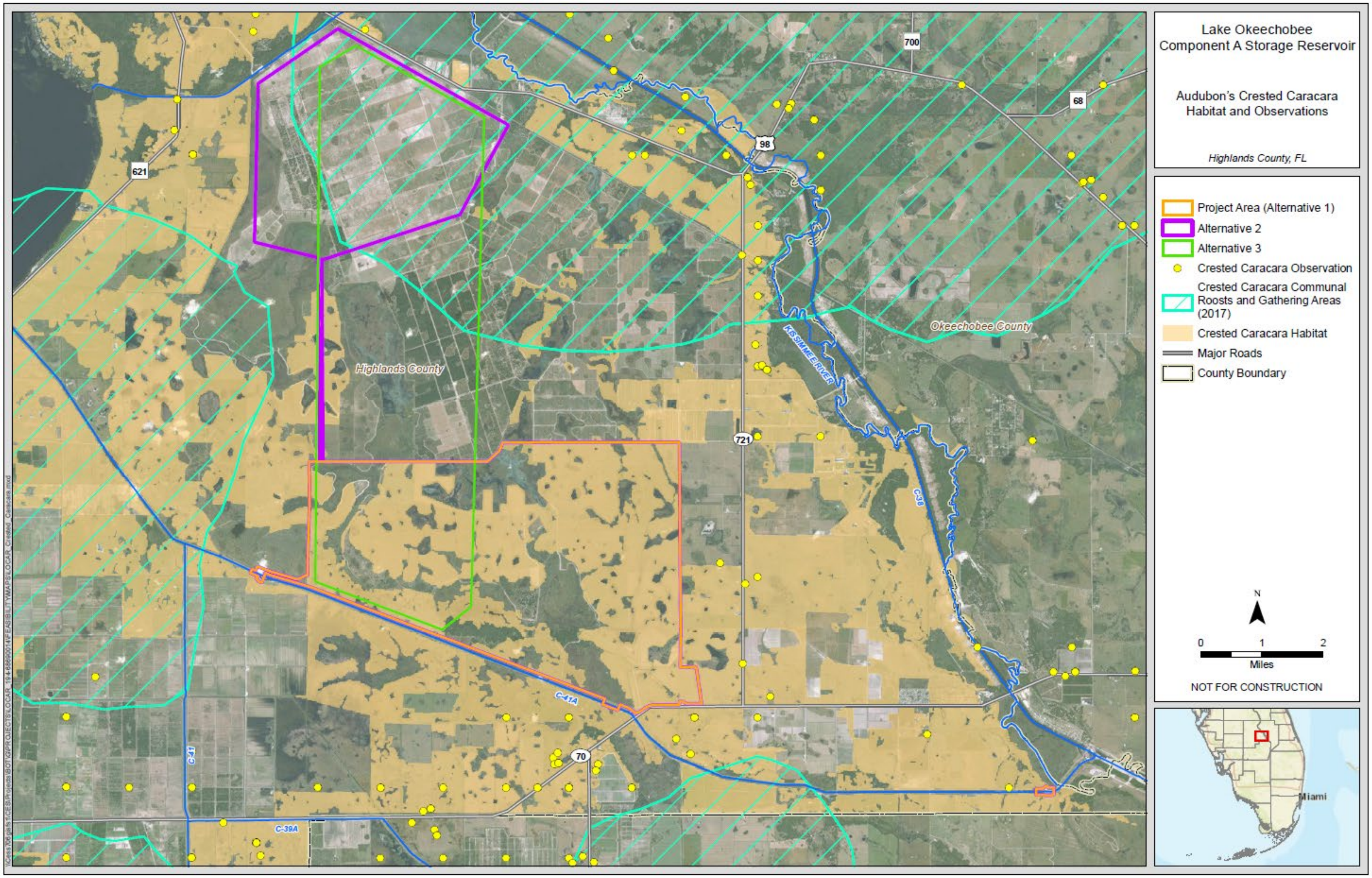

Figure C.1-3. Audubon's crested caracara range, habitat, and occurrences data in the vicinity of the Study Area.

Everglade Snail Kite

The Everglade snail kite (*Rostrhamus sociabilis plumbeus*) is listed as an endangered species by the USFWS. Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is now limited to central and southern portions of Florida. Six large freshwater systems are located within the current range of the snail kite: Upper St. Johns marshes, Kissimmee Chain of Lakes, Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin.

Lake Okeechobee and surrounding wetlands represent significant snail kite nesting and foraging habitats that have historically supported snail kites. Lake Okeechobee is of particular importance since it serves as a critical stopover point as snail kites traverse the network of wetlands within their range. A loss of suitable habitat and refugia, especially during droughts in the lake, may have significant demographic consequences. Lake Okeechobee is critical to the snail kite's long-term population persistence, especially given the susceptibility of juvenile snail kites in the Kissimmee River Valley to an increased frequency of local disturbance events due to cold weather and the treatment of hydrilla.

The Everglade snail kite's apple snail diet is dependent on the hydrology and water quality of the watersheds. Foraging habitat requires shallow open-area ponds with low marsh areas; nesting/roosting sites are located over water. Foraging conditions have expanded recently due to the increase in exotic apple snail population (since about 2010). As a result, the Everglade snail kite breeding season has lengthened (sometimes into fall) and some previous unsuitable foraging areas now have the more robust exotic apple snail and are being used by kites. Snail kites nest in both woody and herbaceous vegetation in the Lake Okeechobee littoral zone. Mapped habitat for Everglade snail kite is shown in **Figure C.1-4**.

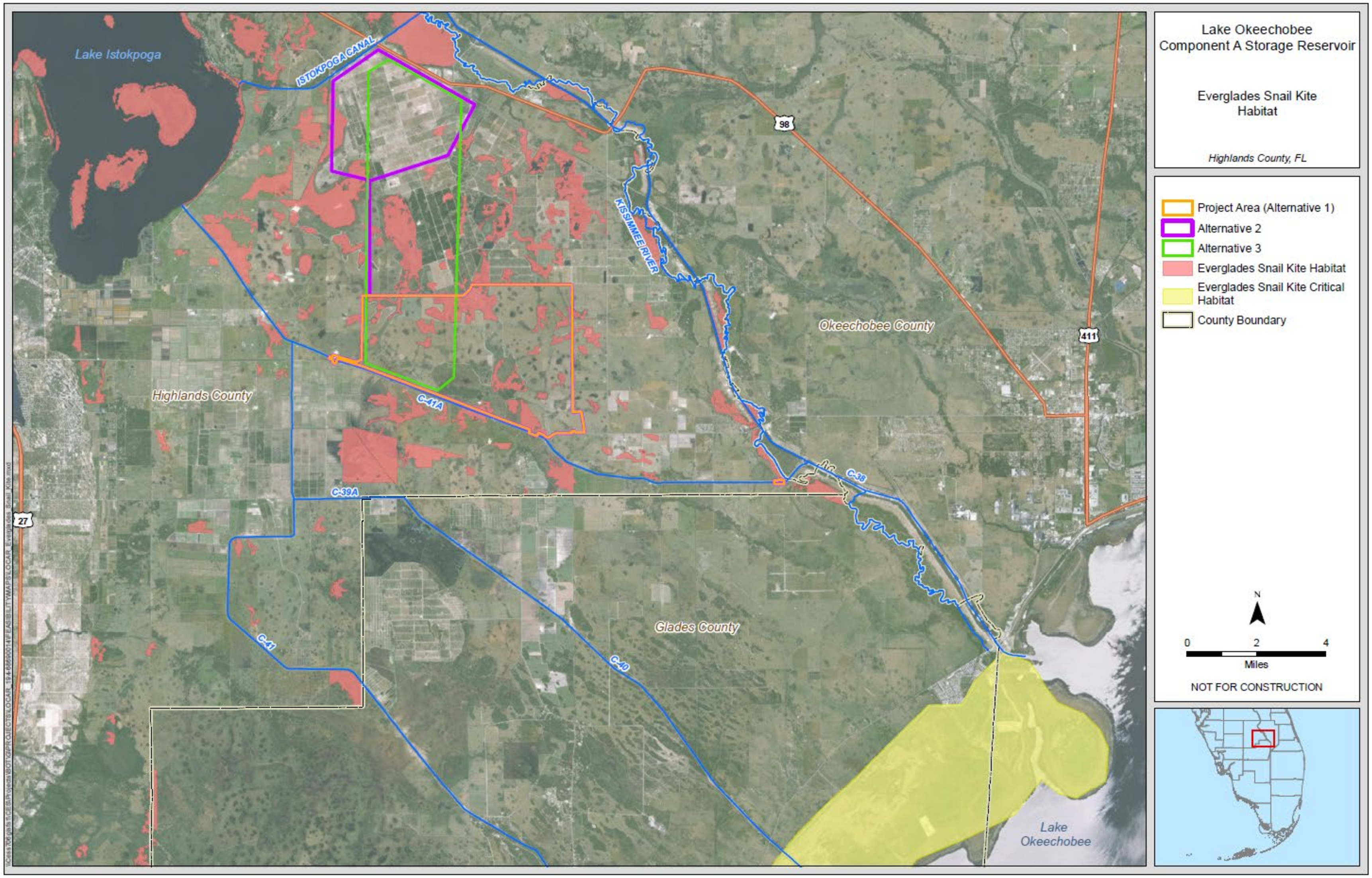

Figure C.1-4. Everglades snail kite range, habitat, and occurrences data.

Florida Bonneted Bat

The endangered Florida bonneted bat (*Eumops floridanus*) is Florida's largest bat, weighing approximately 1.1 to 2.0 ounces, with a 19- to 21-inch wingspan and a body length of 5.1 to 6.5 inches. The species has dark brown fur and large broad ears that join together and slant forward over the eyes. Roosting habitat in central and southern Florida include pine rocklands (South Florida rockland, rockland pine forest, rockland hammock); cypress communities (cypress swamps, strand swamps, domes, sloughs, ponds); hydric pine flatwoods (wet flatwoods); mesic pine flatwoods; and high pine (87 FR 71466-71501). Florida bonneted bats roost in tree cavities, rocky outcrops, and dead palm fronds. In residential communities, the bats roost in Spanish tile roofs, but have also been found in attics, rock or brick chimneys, and fireplaces of old buildings (FFWCC 2011). Colonies are small, with the largest reported as just a few dozen individuals. Diverse, open foraging habitats (e.g., prairies, riverine habitat) are also important. This large bat relies on swarms of larger insects for feeding; thus, foraging habitat for the Florida bonneted bat consists of areas that hatch and concentrate insects of this size, including vegetated areas and waterways (87 FR 71466-71501). These bats also frequently feed on insects from agricultural areas and golf courses (Bailey et al. 2017). Female bats give birth to a single pup from June through September (FFWCC 2011); however, limited data suggests that a female may undergo a second birthing season possibly in January or February.

The Florida bonneted bat is Florida's only endemic bat. Based upon the results of numerous surveys conducted across southern Florida since 2003, this species appears to occur predominately in central, southwest, and extreme south (mainland) Florida, with the core range primarily consisting of habitat within Polk, Charlotte, Lee, Collier, Monroe (mainland), and Miami-Dade Counties. Recent data also indicate use of portions of Highlands, Okeechobee, Glades, Palm Beach, and Broward Counties and possible use of areas within Osceola, Sarasota, and De Soto Counties (USFWS 2018). Loss of suitable habitat is believed to be the primary cause of population declines. Other perceived threats include pesticide and herbicide use, which decrease populations of insects, the bat's primary prey. **Figure C.1-5 s**hows the Florida bonneted bat range and USFWS Florida bonneted bat Consultation Area, both of which overlap the Project Area.

Due to the species' small range, the greatest threats to Florida bonneted bats are loss of habitat, including the destruction of natural roost sites, and natural disasters, such as hurricanes, since the impact could occur throughout its entire range. Other perceived threats include pesticide and herbicide use, which decreases the population of insects, the bat's primary prey. Critical habitat has not yet been designated for this species.

Tricolored Bat

On September 14, 2022, the USFWS proposed to list the tricolored bat (*Perimyotis subflavus*) as endangered under the Endangered Species Act (87 FR 56381). That proposal was out for public review at the time of this writing. Designation of critical habitat was deemed not prudent at the time of the proposed listing. Not knowing the timing of the final listing decision, the Corps has decided to assume that tricolored bat habitat is present in the Project Area and that removal of habitat will occur as the result of the Project.

The tricolored bat is a small insectivorous bat that ranges across the eastern and central United States and portions of southern Canada, Mexico and Central America. In Florida, the species is found throughout the entire state except for the Keys, but the species is rarely encountered and therefore considered uncommon in the state. Limited knowledge exists about tricolored bat typical home ranges, but different study sites generally found that tricolored bats restricted their movements to a few kilometers or less (Perry and Thill 2007, O'Keefe et al. 2009). A study in Kentucky and Tennessee found that tricolored bats remained within 2.5 kilometers of their original capture site (Schaefer 2017).

During the winter, tricolored bats are often found in caves and abandoned mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in road-associated culverts where they exhibit shorter torpor bouts and forage during warm nights. Like other species, tricolored bats face extinction due primarily to the rangewide impacts of white-nosed syndrome (WNS). Compared with various other North American bat species, the hibernation preferences of the tricolored bat for warm cave areas and higher humidity are thought to increase susceptibility for WNS as these reflect ideal conditions for *Pseudogymnoascus destructans* (the fungi that causes WNS; Fujita and Kunz 1984, Briggler and Prather 2003, Quinn and Broders 2007, CBD and DW 2016).

During the spring, summer, and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves of live or recently dead deciduous hardwood trees, but may also be found in Spanish moss, pine trees, and occasionally human structures. Historically, the tricolored bat has been observed in tree and foliage roosts (Findley 1954, Jennings 1958, Davis and Mumford 1962). Recent summer telemetry studies have shown that tricolored bats commonly use tree roosts during the summer and most of the roost substrates are foliage. Thus, the tricolored bat is currently considered a foliage roosting species (IUCN 2008). Many bats, including tricolored bats, are known to share roost trees or use the same tree over successive days before roost switching (Owen et al. 2002, Perry and Thill 2007).

Analyses of foliage roosting bat studies across many foliage roosting species, including the tricolored bat, showed a preference by bats for roost trees with a larger diameter at breast height, greater height, and more closed canopy compared with random trees (Kalcounis-Rüppell et al. 2005). In most of the range of the tricolored bat where tree foliage was used as the roost substrate, the species of tree had a significant effect on tree use by bats (Veilleux 2001, Perry and Thill 2007, O'Keefe 2009). In addition, tricolored bats are thought to prefer areas near water and riparian zones, more so than other sympatric bat species (Fujita and Kunz 1984, Owen et al. 2004, Ford et al. 2005, Menzel et al. 2005).

Florida Panther

The endangered Florida panther (*Puma concolor coryi*) was once the most widely distributed mammal in North and South America, but it is now virtually exterminated in the eastern U.S. Habitat loss had driven this subspecies south of the Caloosahatchee River. Only recently have adult female panthers been recorded north of the Caloosahatchee River. The Florida panther has been found in almost all Lake Okeechobee watershed ecological communities, including mesic temperate hammocks (Humphrey and Jodice 1992). The Florida panther uses mesic pine flatwoods in combination with other forested communities. Foraging, breeding, and wildlife corridors are provided for the panther and its prey. Mesic flatwoods are associated with natural drainage patterns defining travel corridors.

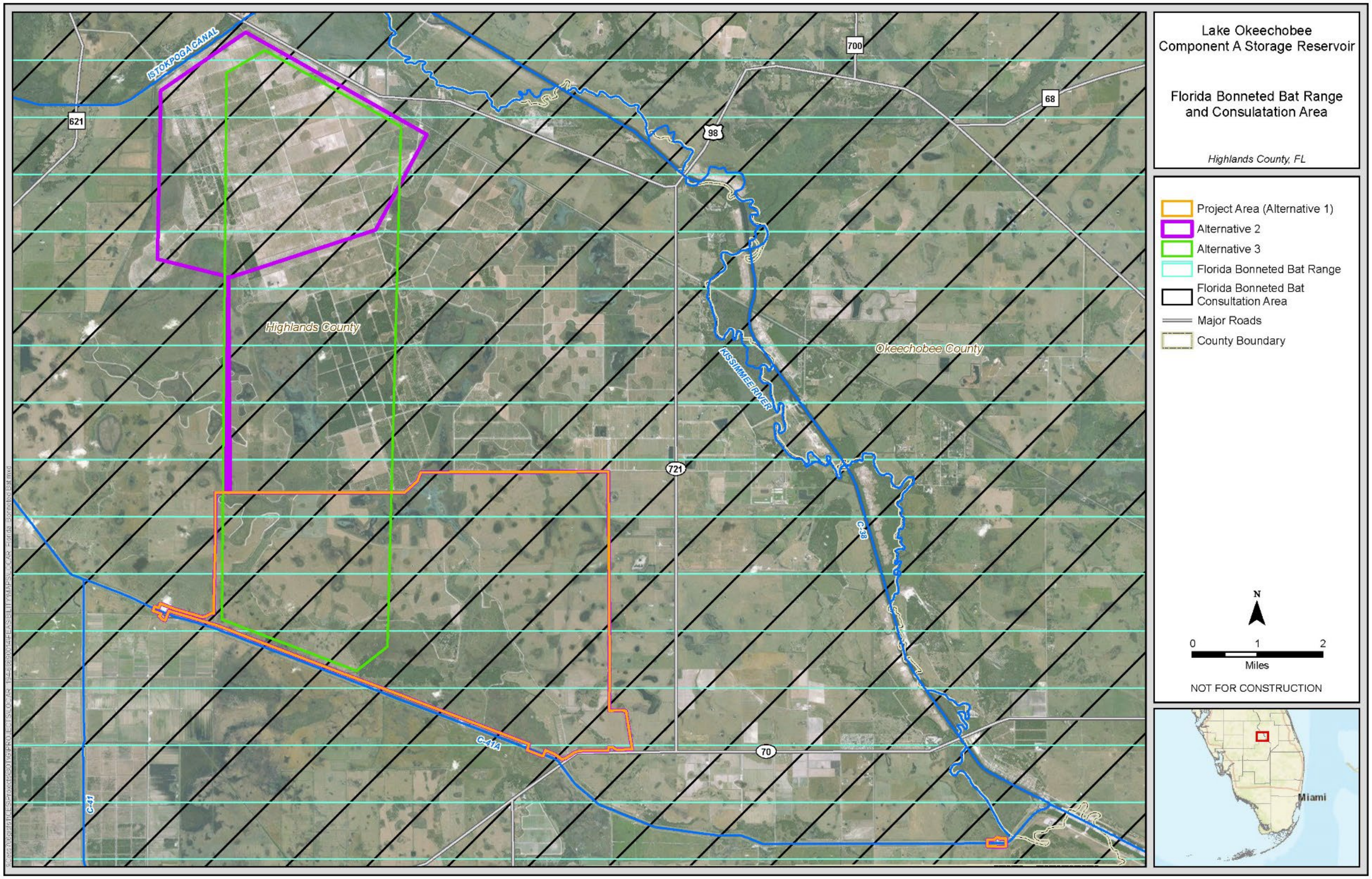

Figure C.1-5. Florida bonneted bat range, habitat, and occurrences data.

Florida panther is one of 30 cougar subspecies. It is tawny brown on the back and pale gray underneath, with white flecks on the head, neck, and shoulders. Male panthers weigh up to 130 pounds and females reach 70 pounds. Preferred habitat consists of cypress swamps and pine and hardwood hammock forests. The main diet of the Florida panther consists of white-tailed deer (*Odocoileus virginianus*), sometimes wild hog (*Sus scrofa*), rabbit, raccoon (*Procyon lotor*), armadillo (*Dasypus novemcinctus*), and birds. Present population estimations range from 80 to 100 individuals. Florida panthers are solitary, territorial, and often travel at night. Male panthers have a home range of up to 400 square miles and females about 50 to 100 square miles. The project is located within the Thatcher Dispersal Pathway of the Panther Focus Area as shown in **Figure C.1-6;** however, the Project Area is outside of the USFWS Consultation Area for the species.

Female panthers reach sexual maturity at about 3 years of age. Mating season is December through February. Gestation lasts about 90 days and females bear two to six kittens. Juvenile panthers stay with their mother for about 2 years. Female panthers do not mate again until their young have dispersed. The main survival threats to the Florida panther include habitat loss due to human development and population growth, collision with vehicles, parasites, feline distemper, feline alicivirus (an upper respiratory infection), and other diseases (USFWS 1999).

The Florida panther has been found in almost all Lake Okeechobee watershed ecological communities. The Florida panther uses mesic pine flatwoods in combination with other forested communities. Mesic flatwoods are associated with natural drainage patterns defining travel corridors.

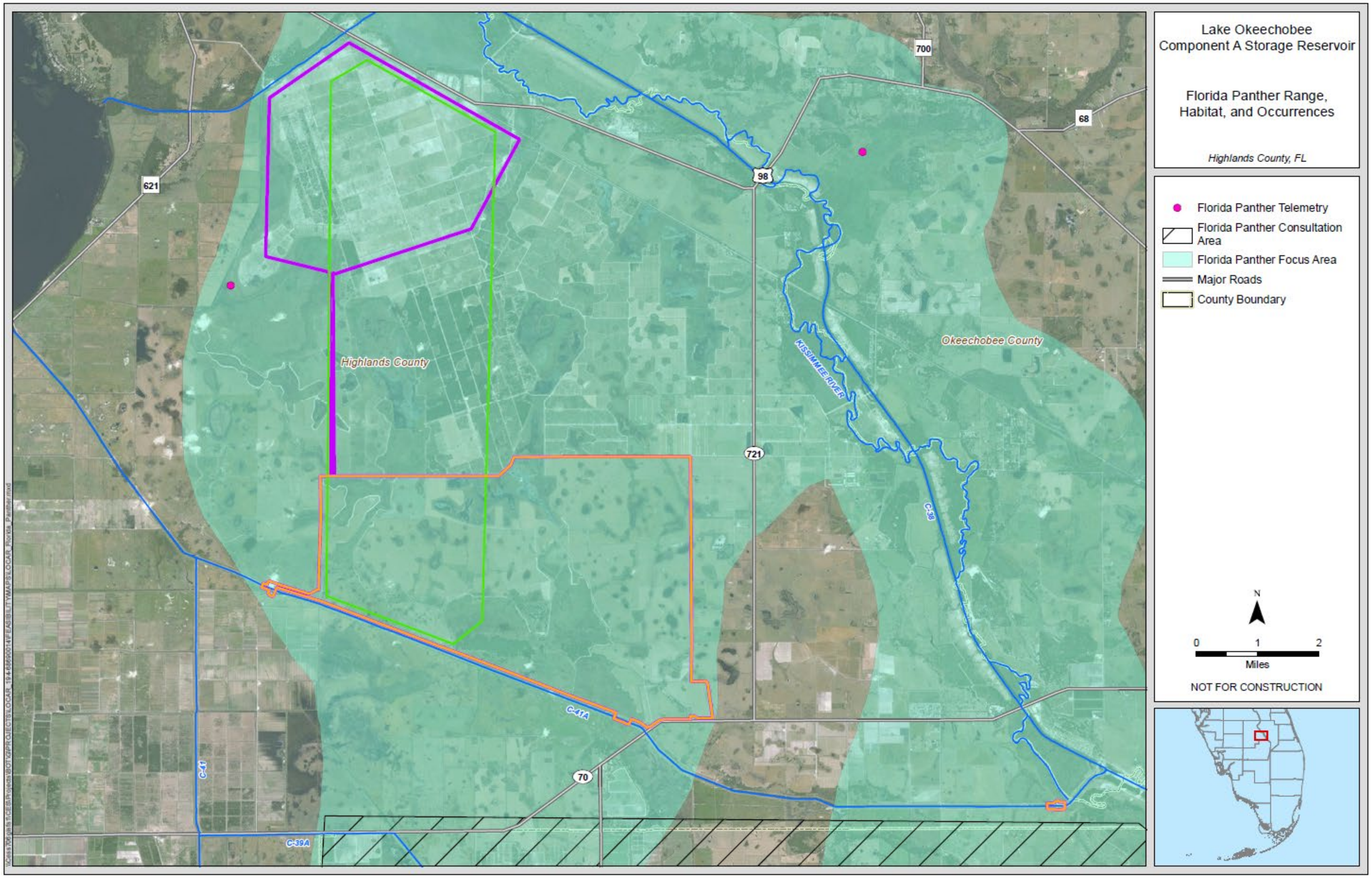

Figure C.1-6. **Florida panther range, habitat, and occurrences data.**

West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. The West Indian (Florida) manatee was listed as endangered throughout its range for both the Florida and Antillean subspecies (*T. manatus latirostris* and *T. manatus manatus*) in 1967 (32 FR 4061) and received federal protection with the passage of the ESA in 1973. Because the manatee was designated as an endangered species prior to enactment of the ESA, there was no formal listing package identifying threats to the species, as required by ESA Section 4(a)(1).

Florida manatees can be found throughout the southeastern U.S.; however, within this region, they are at the northern limit of their range (Lefebvre et al. 2000, USFWS 2001). Because they are a subtropical species with little tolerance for cold, they remain near warm water sites in peninsular Florida during the winter. During periods of intense cold, Florida manatees will remain at these sites and will tend to congregate in warm springs and outfall canals. During warm interludes, Florida manatees move throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida and are usually found in small groups. During warmer months, Florida manatees may disperse great distances. Florida manatees have been sighted as far north as Massachusetts and as far west as Texas and in all states in between (Rathbun et al. 1983; Fertl et al. 2005). Warm weather sightings are most common in Florida and coastal Georgia. They will once again return to warmer waters when the water temperature is too cold (Hartman 1979, Stith et al. 2006). Florida manatees live in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. They can be found in both clear and muddy water. Water depths of at least 3 to 7 ft (1 to 2 meters) are preferred and flats and shallows are avoided unless adjacent to deeper water.

Okeechobee Gourd

The Okeechobee gourd (*Cucurbita okeechobeensis*) is federally listed as an endangered species. The Okeechobee gourd is an annual or perennial, fibrous rooted, high-climbing vine with tendrils. The Okeechobee gourd possesses heart- to kidney-shaped leaf blades, with five to seven angular shallow lobes and irregularly serrated margins. Young leaves are covered with soft hairs, and the cream-colored flowers are bell shaped. The light green gourd is globular or slightly oblong, with 10 indistinct stripes, and hard shelled with bitter flesh. The seeds are gray-green and flat (USFWS 1999). The Okeechobee gourd was historically found on the southern shore of Lake Okeechobee, in Palm Beach County, and formerly in the Everglades (USFWS 1999). Now both Lake Okeechobee and St. Johns River populations of Okeechobee gourd persist (USFWS 2021a). The species is limited to the shoreline and island around the southern and northwestern parts of the lake (USFWS 2021a).

Around Lake Okeechobee, the gourd relies on pond apple trees to support its vines above rising water levels during the wet season. Other trees and shrubs, such as willow and bald cypress (*Taxodium distichum*), may also provide suitable support for the vines. Along the St. Johns River, Okeechobee gourds are most typically found growing on elderberry (*Sambucus nigra*) and common reed (*Phragmites* spp.). The Okeechobee gourd also seems to readily germinate on alligator nests around Lake Okeechobee, which provide suitably elevated soil berms in full sun, with no competition from other plants. These disturbed sites provide areas where competition is reduced and elevated areas that promote the growth of elderberry, button bush, and other erect bushes and shrubs (USFWS 1999).

C.1.1.5 State-listed Species

The Study Area contains habitat suitable for the presence, nesting, and/or foraging of eight state- listed threatened and endangered species.

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is a state listed threatened species. It occurs throughout the state although its distribution is considered local and spotty. The presence of burrowing owls is primarily dependent upon habitat. Humans have created new habitat for burrowing owls by clearing forests and draining wetlands. Burrowing owls inhabit open native prairies and cleared areas that offer short groundcover, including pastures, agricultural fields, golf courses, airports, and vacant lots in residential areas. Historically, they occupied the prairies of central Florida. The drainage of wetlands, although detrimental to many organisms, increases the areas of habitat for the burrowing owl. Recently, central Florida populations have decreased because of disappearing habitat, while populations in South Florida coastal areas have increased due to modification of habitat by humans creating new habitat.

Burrowing owls live as single breeding pairs, or in loose colonies consisting of two or more families. They use burrows year-round: for roosting during the winter and for raising young during the breeding season (February–July). Burrows extend 4 to 8 ft underground and are lined with materials such as grass clippings, feathers, paper, and manure (FWC 2014). Although they typically dig their own burrows, they will also use gopher tortoise or armadillo burrows. Potential habitat for burrowing owl occurs in the Project Area (Alternative 1) and the other alternatives (**Figure C.1-7**).

Florida Sandhill Crane

The Florida sandhill crane (*Grus canadensis pratensis*), a state listed threatened species, is a non-migratory that inhabits prairies, improved pastures, and freshwater marshes. They occur throughout peninsular Florida and north to the Okefenokee Swamp in southern Georgia. Degradation or direct loss of habitat due to wetland drainage or conversion of prairie for development or agricultural use is the primary threat that they face. The prairies, improved pastures, and freshwater marshes on which the species depends are especially vulnerable to overgrowth, development, and alteration. Predation and road mortality are exacerbated by habitat fragmentation as cranes travel farther between breeding and foraging areas. The proximity of wetlands to upland areas is key to crane survival. Potential habitat for Florida sandhill crane occurs in the Project Area (Alternative 1) and the other alternatives (**Figure C.1-8**).

State-listed Wading Birds (little blue heron and tricolored heron)

The state listed, threatened wading bird species in the Project Area include the little blue heron (*Egretta caerulea*) and tricolored heron (*Egretta tricolor*). These wading birds prey on small fishes, aquatic crustaceans, amphibians, snakes, and insects. Though their diets are diverse, they do require shallow wetlands for foraging. Threats to these species include habitat degradation, including diversion of natural water flow, altered levels of water fluctuation, lower water tables, and nutrient enrichment in waters; loss of suitable foraging and breeding areas due to human disturbance, especially during key phases of reproduction (e.g., continued disturbance near nesting colonies); increased presence of predators that cause nest failure; and magnified vulnerability to pesticides, heavy metals, and other environmental contaminants. Potential habitat for wading birds occurs in the Project Area (Alternative 1) and the other alternatives (**Figure C.1-9**).

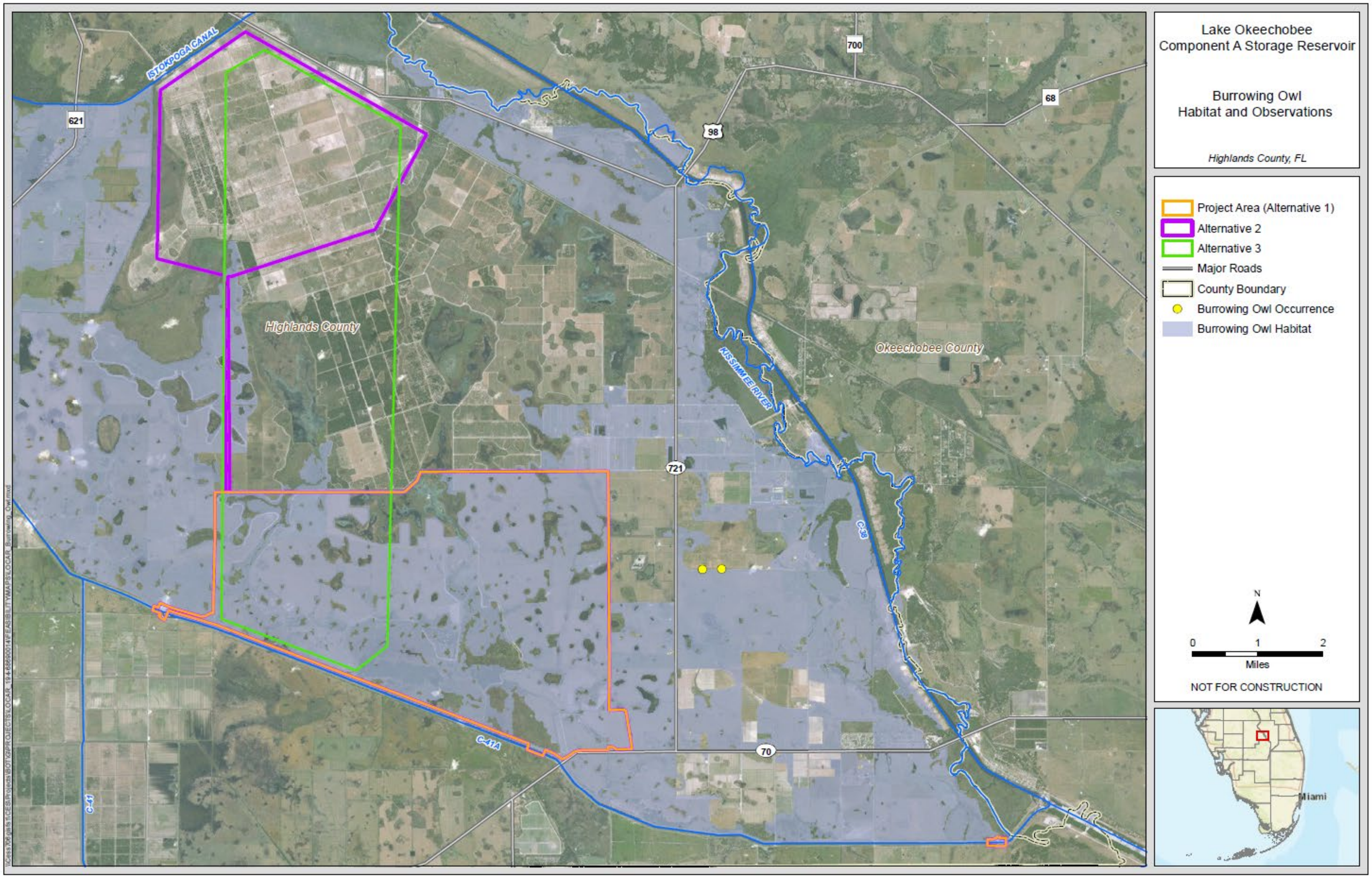

Figure C.1-7. Burrowing owl habitat and occurrences data.

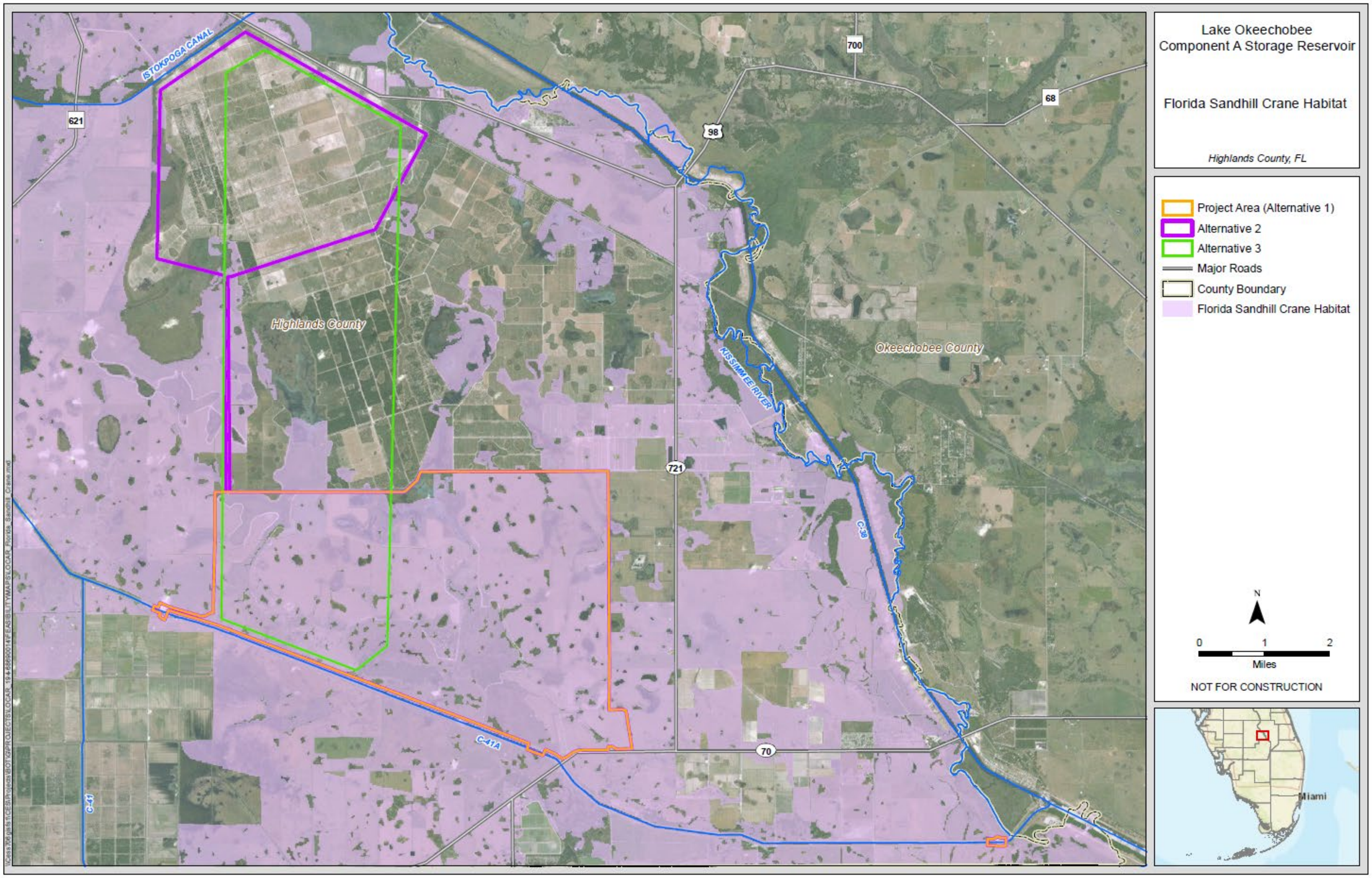

Figure C.1-8. Florida sandhill crane habitat.

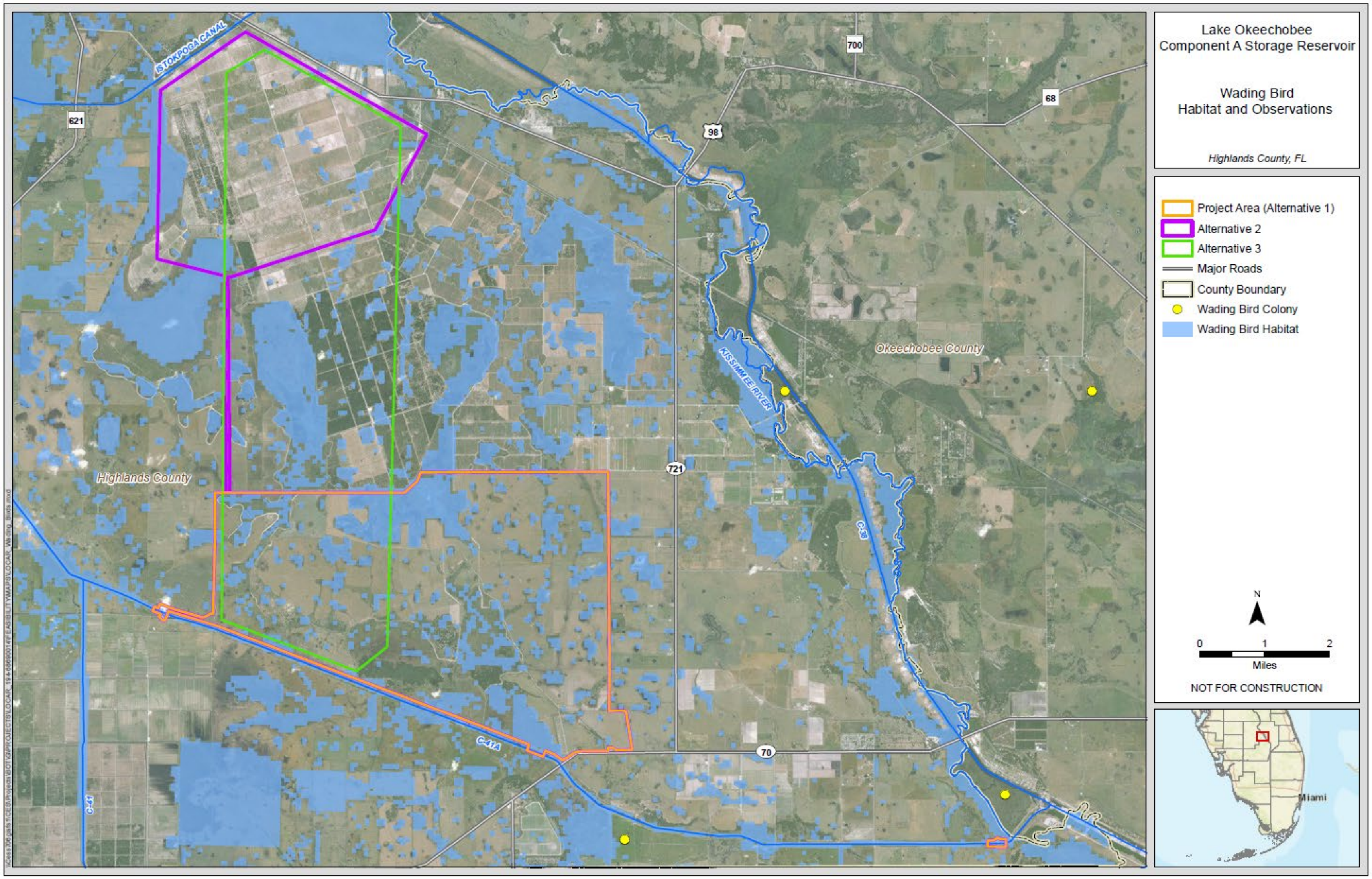

Figure C.1-9. Wading bird habitat.

Southeastern American Kestrel

The southeastern American kestrel (*Falco sparverius paulus*), a threatened state listed species, is a non-migratory subspecies of the American kestrel closely tied to sandhills in the southeastern U.S with preferred habitat consisting of open fields, grasslands, savannas, or other habitats that contain widely scattered trees or similar perches. Population declines of southeastern American kestrels in Florida have been largely attributed to clearing of older pine forests and conversion of sandhill and other upland habitats for agriculture and urban development. Kestrels are secondary cavity nesters, and suitable nest sites can be a limiting factor for kestrel populations (Smallwood and Collopy 2009). In addition to a lack of natural nesting sites and loss of suitable foraging habitat, environmental contaminants also pose a threat to the species. Potential habitat for southeastern American kestrel occurs in the Project Area (Alternative 1) and the other alternatives (**Figure C.1-10**).

Gopher Tortoise

The gopher tortoise (*Gopherus polyphemus*), an upland dwelling reptile that is a dark brown to grayish-black terrestrial turtle with large hind feet, shovel-like forefeet, and a shell that measures from 5.9 to 14.6 inches long (Ernest and Barbour 1972). In Florida, individuals from coastal areas are generally darker than those from more central populations. Gopher tortoises excavate deep burrows that provide shelter from weather extremes and refuge from predation (Diemer 1989). The gopher tortoise commonly occupies habitats with a well-drained sandy substrate, ample herbaceous vegetation for food, and sunlit areas for nesting. Diemer (1992) found that gopher tortoise activity increased in April, peaked in July, and remained high through October. Many vertebrate and invertebrate species are known to seek refuge in gopher tortoise burrows, including protected species like the Eastern indigo snake.

Florida Pine Snake

The Florida pine snake (*Pituophis melanoleucus mugitus*) is found in the Project Area. The state listed threatened species prefers habitats with well-drained, sandy soils and moderate to open canopy cover (Franz 1992; Ernst and Ernst 2003). The most common natural habitat of pine snakes in Florida is sandhill, but they also are found in scrub, xeric hammock, scrubby flatwoods, and mesic pine flatwoods and dry prairie with dry soils (Allen and Neill 1952; Enge 1997; Franz 2005). Florida pine snakes are fossorial, spending approximately 80 percent of their time in underground retreats, primarily burrows of the southeastern pocket gopher (*Geomys pinetis*) (Franz 2005; Miller 2008), as well as other retreats such as stumpholes, mole runs, and burrows of gopher tortoises (*Gopherus polyphemus*), nine-banded armadillos (*Dasypus novemcinctus*), and mice (Franz 2005; Miller 2008). Threats to the Florida pine snake include habitat loss, fragmentation, and degradation from the loss of dry uplands and fire suppression; roads, which fragment habitat and may contribute to reduced genetic diversity and mortality; operations that result in stump removal, soil compaction, and root removal; predation by domestic pets and other nonnative species; and intentional killing by humans. Potential habitat for Florida pine snake occurs in the Project Area (Alternative 1) and the other alternatives (**Figure C.1-11**).

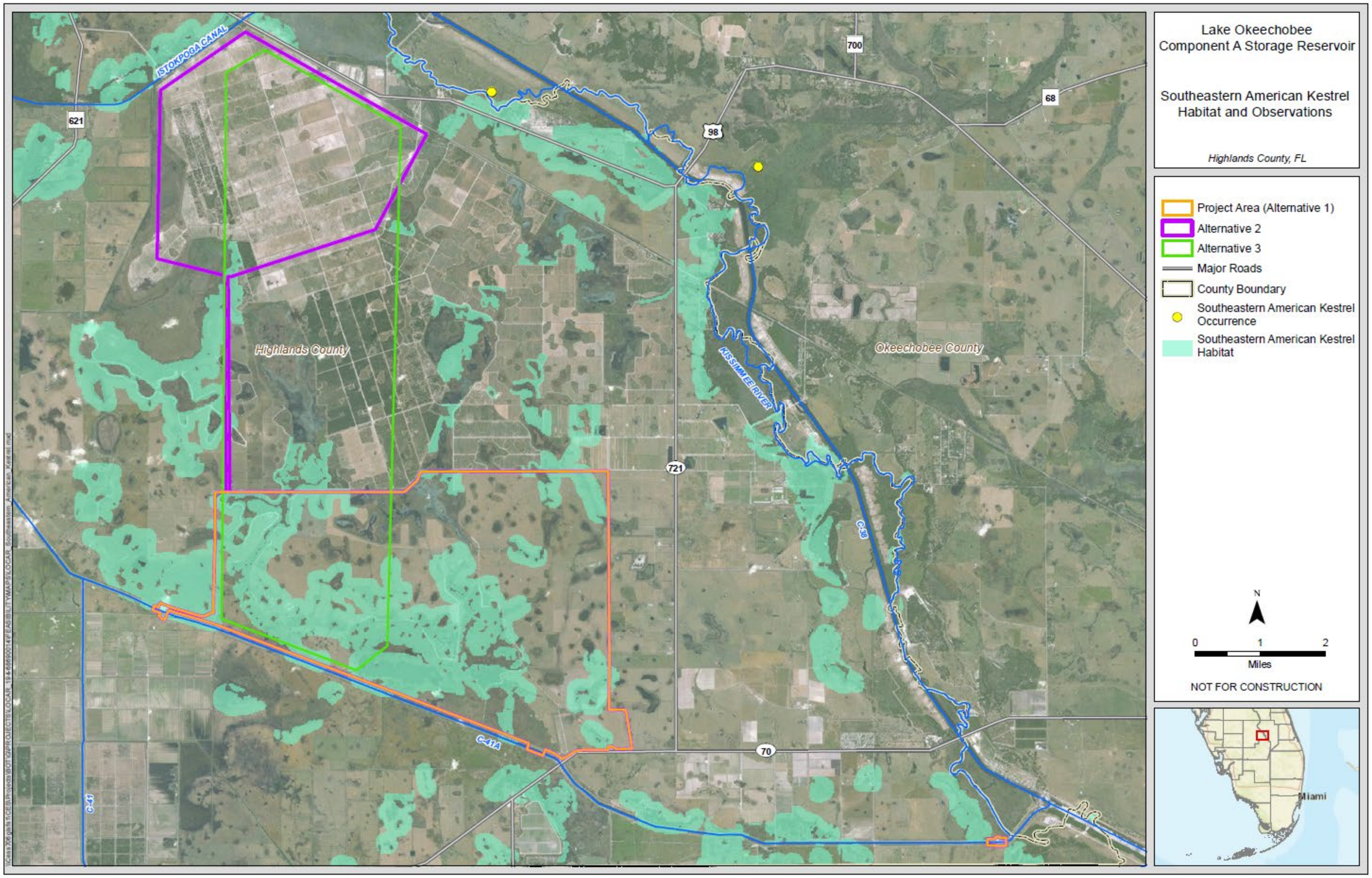

Figure C.1-10. Southeastern American kestrel habitat.

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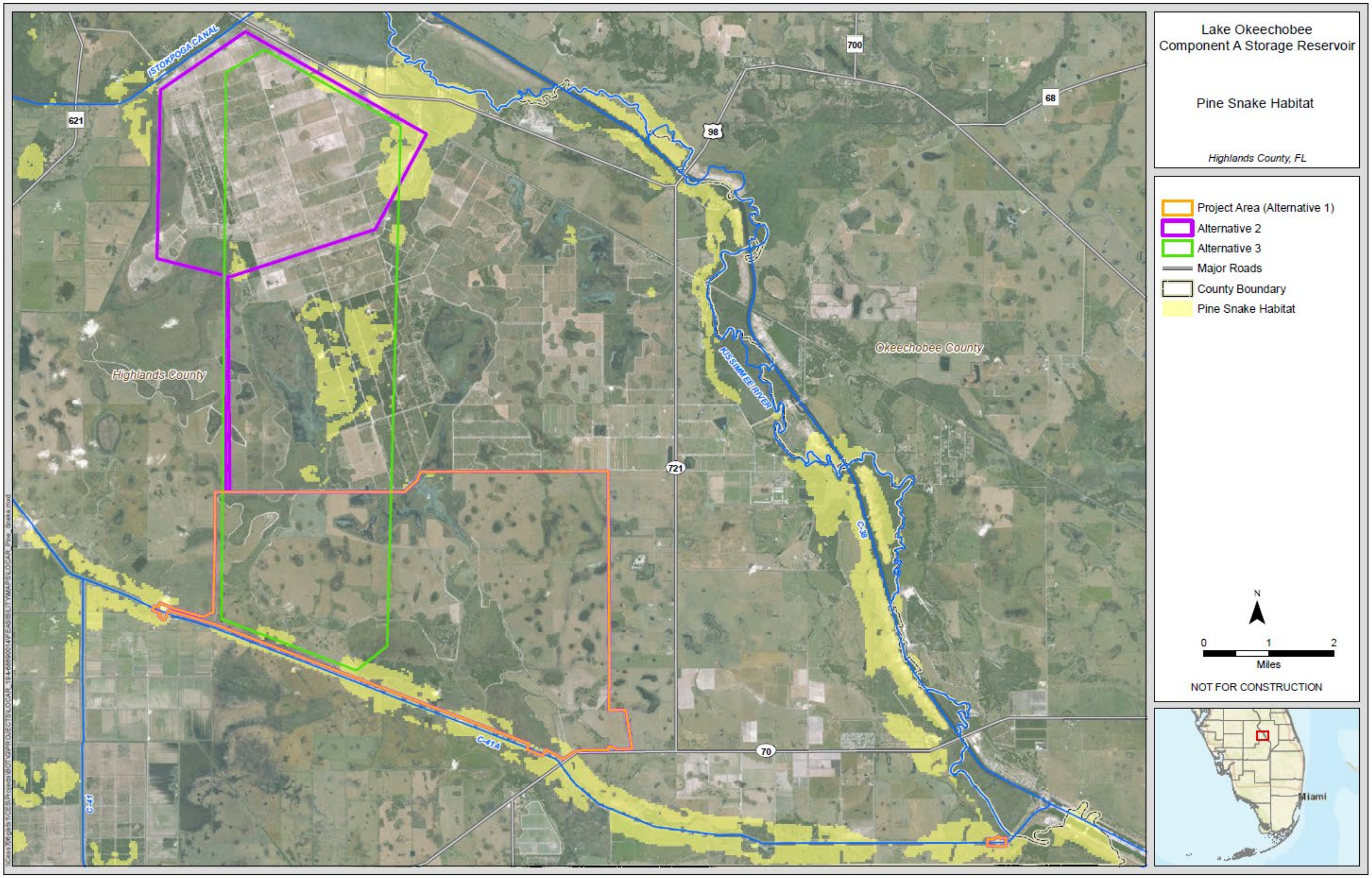


2 **Figure C.1-11. Pine snake habitat.**

Short-tailed Snake

Short-tailed snake (*Lampropeltis extenuata*) is a small, slender-bodied snake that reaches 20 inches in length and is gray in color with brown splotches that cover its back. Short-tailed snakes are endemic to Florida and found primarily within the north-central peninsular region, west of St. Johns River. Habitat includes dry, sandy uplands including sandhills (long-leaf pine-turkey oak sandhills), xeric oak hammocks, and rosemary-sand pine scrub. The species is a secretive burrower and is rarely seen above ground, therefore little is known about the ecology and behavior of the species.

C.1.1.6 Fish and Wildlife

A great diversity of fish and wildlife species occur throughout the LOW and in Lake Okeechobee. Important fish and wildlife resources in the Study Area include aquatic macroinvertebrates, small freshwater marsh fishes, larger sport fishes, amphibians and reptiles, birds, including raptors and wading birds, and mammals. Much of the native habitats in the watershed has been replaced by agricultural uses; approximately 65 percent of historic wetland habitats have been converted. The creation of ditches, canals, and the flooding of fallow agricultural fields provides some lower quality habitat for fish and wildlife, particularly during the rainy season. The ecological character of the watershed is the sum of its diverse mosaic of ecological communities and the variety of wildlife species for which the communities provide food, cover, roosting, and nesting. Some communities are inherently rich in wildlife diversity and also differ broadly according to community quality and size just as species vary diversely in community use; some species are extremely narrowly habitat-specific (e.g., the Florida grasshopper sparrow uses only the wet and dry prairies), while others (e.g., Florida panther, Florida black bear, and bald eagle) use a broad array of habitats as they move through their extensive ranges.

Freshwater Fish

Small freshwater marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Marsh fishes are also important processors of algae, plankton, macrophytes, and macroinvertebrates. Common species include the native and introduced 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.) (Corps 1999). The density and distribution of marsh fish populations fluctuate with seasonal changes in water levels. Populations of marsh fishes increase during extended periods of continuous flooding during the wet season. As marsh surface waters recede during the dry season, marsh fishes become concentrated in areas that hold water through the dry season. Concentrated dry season assemblages of marsh fishes are more susceptible to predation and provide an important food source for wading birds (Corps 1999).

Within Lake Okeechobee, numerous sport fishes and larger predatory fishes occur. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), speckled perch (black crappie, *Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), yellow bullhead (*Ameiurus natalis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (Corps 1999). Larger fishes are an important food source for wading birds, alligators, otters, raccoons, and mink.

Amphibians and Reptiles

The freshwater wetland complex supports a diverse assemblage of amphibians and reptiles. 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*). Amphibians represent an important forage base for wading birds, alligators, and larger predatory fishes (Corps 1999).

Common reptiles of freshwater wetlands 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 snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (Corps 1999).

Birds

Wading and secretive marsh birds frequent the littoral zone in the lake, and migratory birds heavily use Lake Okeechobee throughout the year, as well as during the migratory season as a resting and foraging stop. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green-backed heron (*Butorides striatus*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), and roseate spoonbill (*Ajaia ajaja*) (Corps 1999). Common secretive marsh birds include moorhen (recently renamed common gallinule: (*Gallinula chloropus*), purple gallinule (*Porphyrio martinicus*), least bittern (*Ixobrychus exilis*), limpkin (*Aramus guarauna*), and king rail (*Rallus elegans*).

Migratory birds and waterfowl use the marsh zone and adjacent wetlands as a major resting area along the Atlantic flyway (SFWMD 1997). Bald eagles are commonly found in the watershed nesting near open water areas where they feed primarily on fish and water-dependent birds. Nesting is prevalent along the Kissimmee River Valley. Distribution is influenced by availability of suitable nest and perch sites near open water bodies, but eagles clearly adapt to a wide variety of habitat conditions and use most of the upland and wetland ecological communities in the watershed.

Mammals

Mammals that are well-adapted to the aquatic and wetland conditions of the freshwater marsh complex include the rice rat (*Oryzomys palustris natator*), round-tailed muskrat (*Neofiber alleni*), and river otter (*Lutra canadensis*). Additional mammals that may use freshwater wetlands on a temporary basis include the white-tailed deer (*Odocoileus virginianus*), bobcat (*Lynx rufus*), and raccoon (*Procyon lotor*). The Northern Estuaries are also home to marine mammals such as the Atlantic bottlenose dolphin (*Tursiops truncatus*).

The upland habitats provide food, cover, roosting, and nesting sites to a wide variety of wildlife. Hardwood mast (e.g., acorns, fruit, or nuts) makes the island hammocks attractive to birds and mammals, including a number of rare, threatened, and endangered animal species described in **Section C.1.1.4**. White-tailed deer and feral pigs, the primary prey of Florida panthers, are abundant in these hammocks. The Florida black bear also uses large tracts of land that include cabbage palm and mixed hardwood hammocks, particularly those adjoining large, forested wetlands. These hammocks provide the black bear diet of berries, acorns, saw palmetto, and cabbage palm. Large, relatively undisturbed tracts of pine flatwoods, in combination with other upland forested communities and major wetland systems, provide the principal habitat of the Florida black bear. Bears have seasonal preferences for available foods, much of which is produced in the mesic flatwoods community. The mesic flatwoods and mixed flatwoods- hardwood riverine forests are primary habitats for the Southern fox squirrel, where they forage on pinecones, acorns, cabbage palm fruits, bromeliad buds, and insects. Nesting also occurs here.

Aircraft Wildlife Strike Hazard Assessment

Aircraft-wildlife strikes pose risks to safe aviation and wildlife conservation. The 2013 Memorandum of Agreement (MOA) between the Federal Aviation Administration (FAA), the U.S. Air Force, Corps, U.S. Environmental Protection Agency (EPA), USFWS, and the U.S. Department of Agriculture – Wildlife Services established procedures necessary to coordinate their agency missions to more effectively address existing and future environmental conditions contributing to aircraft-wildlife strikes throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety, while protecting the nation’s valuable environmental resources (FAA 2013). The National Plan of Integrated Airport Systems (NPIAS) encompasses approximately 3,400 airports in the national network of airports and the national airport plan, which identifies existing and proposed new airports to serve commercial and general aviation needs. The NPIAS contains all commercial service airports, all reliever airports, and selected general aviation airports. Specific criteria were established to meet national aviation needs at a reasonable cost. These criteria considered the number of based aircraft and annual operations, scheduled air carrier service, and proximity to other airports in the national plan. Airports that met special needs, such as access to remote populations, could also be included.

There are three airports within the Study Area. Of these, the Okeechobee County Airport (Okeechobee Jet Center; KOBE) is a NPIAS airport. Because the other two airports, River Acres Airport (FAA ID FD70) and River Oak Airport (FAA ID OOFL) are not in the NPIAS system, they do not require analysis pursuant to the MOA. River Acres Airport and River Oak Airport are both private, short, grass landing strips within airpark neighborhoods; both are general aviation or civilian airports that handle private aircraft and small-aircraft charter operations rather than scheduled passenger service.

Estuarine and Riverine Fish and Invertebrates

The Northern Estuaries are also home to fish and wildlife species found in estuarine and marine habitats. Seagrasses and other submerged aquatic vegetation within the Northern Estuaries provide important habitat and nursery grounds for several fish species. Many fish species spend part or all of their life in the estuary. Common recreational and commercial fish species include mutton snapper (*Lutjanus analis*), yellowtail snapper (*Ocyurus chrysurus*), lane snapper (*Lutjanus synagris*), yellowtail parrot fish (*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*), mullet (*Mugil* spp.), and sheepshead (*Archosargus probatocephalus*).

In addition to finfish, the estuaries support a variety of shellfish. Blue crabs (*Callinectes sapidus*), stone crabs (*Menippe mercenaria*), hard clams (*Mercenaria mercenaria*), and oysters (*Crassostrea virginica*) are important estuarine commercial species. The open bottom habitats in the tidal CRE and SLE are composed of mixtures of sand, mud, shell, and bedrock. Mollusks compose one the larger groups of macroinvertebrates within the Northern Estuaries ecosystems. The wedge clam (*Rangia cuneata*) and marsh clam (*Polymesoda carolineata*) are commonly found associated with mud and sandy bottoms in the Northern Estuaries. The common oyster (*Crassostrea virginica*) is the dominant species in the oyster reef community. Oyster bars serve as a food source and provide habitat for many estuarine species, including other mollusks, polychaete worms, decapod crustaceans, and various boring sponges. The more common shrimp species include the pistol (*Alpheus* spp.), ghost (*Palaemonetes* spp.), grass (*Hippolyte* spp.), and broken-back (*Hippolyte pleuracantha*). The fisheries for the blue crab (*Callinectes sapidus*) are the largest year-round fisheries in the upper and middle portion of the Caloosahatchee River. Other crab species occurring within the region are the spider (*Libinia emarginata*), fiddler (*Uca* spp.), horseshoe (*Limulus polyphemus*), stone (*Menippe mercenaria*), and hermit (*Pagurus* spp.). Sand dollar (*Echinarachnius* spp.) and starfish (*Solaster* spp., *Crossaster* spp., and *Ophioderma* spp.) are predatory invertebrates also found within the Northern Estuaries.

C.1.1.7 Essential Fish Habitat

Essential fish habitat (EFH) located within the Study Area occur within the SLE and CRE (NMFS 2000).

Caloosahatchee River and Estuary

This portion of the Study Area is within the jurisdiction of the Gulf of Mexico Fishery Management Council (GMFMC) and is located in areas designated as EFH for juvenile brown shrimp, juvenile gray snapper, juvenile pink shrimp, adult and juvenile redfish, adult and juvenile Spanish mackerel (*Scomberomorus maculatus*), and juvenile stone crab. Downstream habitats include oyster reefs and seagrass.

St. Lucie River and Indian River Lagoon

This portion of the Study Area is within the jurisdiction of the South Atlantic Fishery Management Council (SAFMC) and is located in areas designated as EFH for wormrock, live bottom habitat, American oyster, pink shrimp (*Penaeus duorarum*), white shrimp (*Penaeus* sp.), brown shrimp (*Penaeus aztecus*), redfish , grouper (*Epinephelus* spp.), gray snapper (*Lutjanus griseus*), white grunt (*Haemulon plumieri*), red porgy (*Pagrus pagrus*), spiny lobster (*Panulirus argus*), and the snapper-grouper complex. In addition, the nearshore hardbottom habitat outside of the SLE is designated as EFH-Habitat Areas of Particular Concern (EFH-HAPC) for the snapper-grouper complex.

C.1.1.8 Hydrology

The major characteristics of South Florida’s hydrology are (1) local rainfall, (2) evapotranspiration, (3) canals and water control structures, (4) flat topography, and (5) highly permeable surficial aquifer along a 30- to 40-mi-wide coastal strip. Local rainfall is the source of all South Florida’s fresh water. The surface water that is not removed from the land by evapotranspiration and seepage to the underlying aquifer is drained to the Atlantic Ocean, Florida Bay, or the Gulf of Mexico by very slow, shallow sheetflow through wetlands or relatively quickly through humanmade canals.

The LOW portion of the Study Area can be hydrologically divided into four drainage basins: Fisheating Creek, Indian Prairie, Lower Kissimmee (S-65D and S-65E), and Taylor Creek/Nubbin Slough (**Figure C.1-12**). Each basin has a major tributary that historically drained south into the Lake Okeechobee via meandering rivers and extensive floodplains. The introduction of ditches, berms, and canals into this rain-driven system disrupted the natural flow path of water, leading to current restoration efforts. The subsections that follow focus on the Project Area, which includes the Indian Prairie Basin, Lower Kissimmee River Basin, Lake Okeechobee, and the Northern Estuaries.

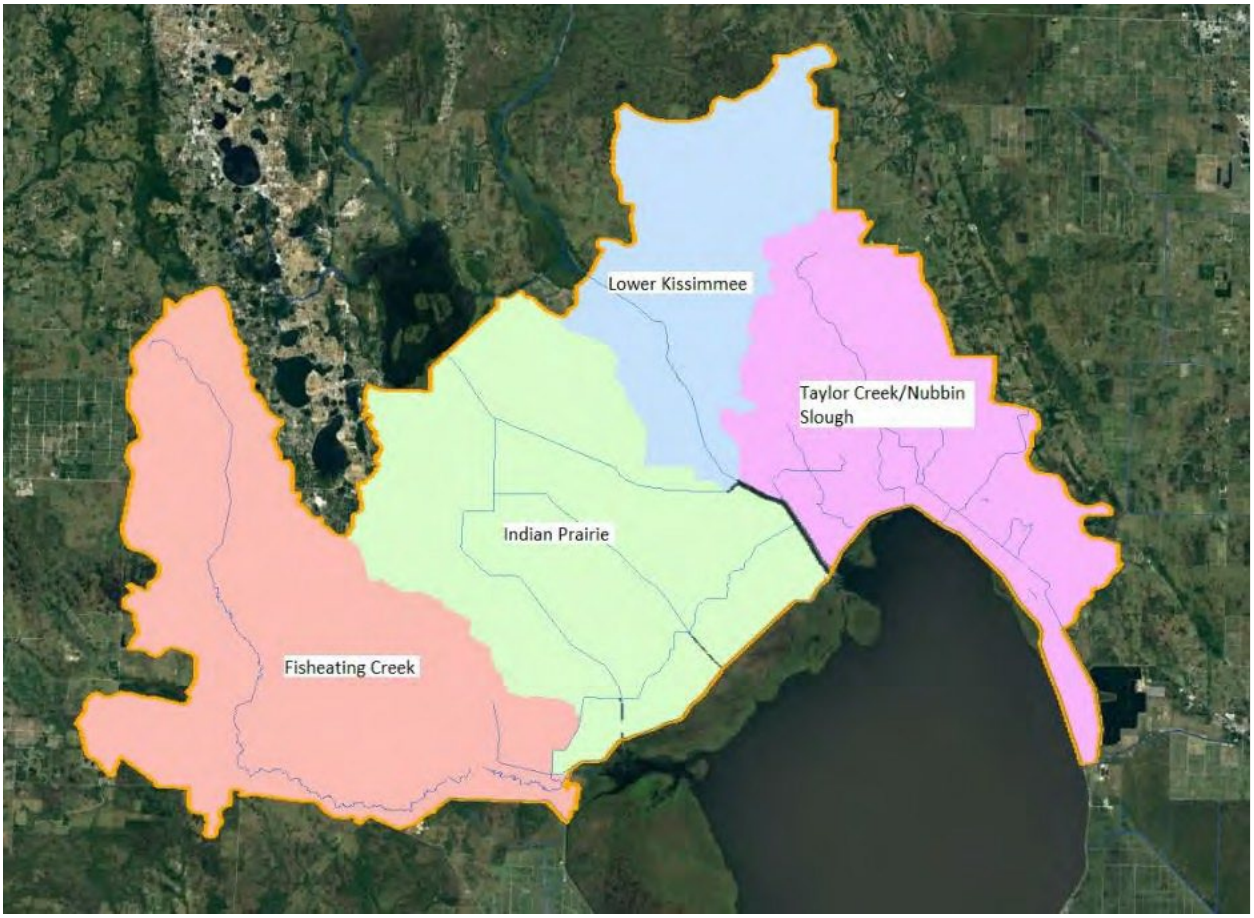


Figure C.1-12. Study Area four major drainage basins: Fisheating Creek, Indian Prairie, Lower Kissimmee (S-65D and S-65E), and Taylor Creek/Nubbin Slough.

Indian Prairie

The Indian Prairie drainage basin borders the northwest shore of Lake Okeechobee from Kissimmee River (C-38) to Fisheating Creek, encompassing about 622 mi^2. Levees isolate the two main canals, Indian Prairie Canal (C-40) and Harney Pond Canal (C-41), from the watershed. The outflow from Lake Istokpoga enters C-41A at the S-68 structure. After approximately 4 mi, the flow divides into three canals (C-40, C-41, and C-41A). C-41A flows southeast to the Kissimmee River and joins it near S-65E. The Indian Prairie Canal (C-40) lies in the middle. The Harney Pond Canal (C-41) flows to the west, entering Lake Okeechobee midway between C-40 and Fisheating Creek. Outflow from Lake Istokpoga also occurs in the Istokpoga Canal that connects to the Kissimmee River upstream of S-65C.

Annual average flows for canals C-40, C-41, and C-41A at SFWMD respective control structures S-75, S-82, and S-83 are recorded daily. Flow data from 2002 to November 2017 indicates that the average outflow from Lake Istokpoga to C-41A (through control structure S-68) for the 15-year period was 438 cfs, and the combined flow from the three canals to Lake Okeechobee was 6,433 cfs. These data indicate that, during the 15-year period, 70 percent of the flow from the canal system to Lake Okeechobee originated in Lake Istokpoga, while 30 percent of the flow was from runoff in the intervening basins.

Lower Kissimmee

The Lower Kissimmee drainage basin encompasses about 1,805 mi^2 and extends from the S-65A location southward to Lake Okeechobee at the mouth of the Kissimmee River (C-38). The basin handles the largest source of surface water flow to Lake Okeechobee, with the inflow from C-38 controlled at SFWMD structure S-65E.

The Kissimmee River (C-38) flows south to Lake Okeechobee through basins S-65A, S-65D, and S-65E. The overall average flows for 1998 to November 2017 at monitoring stations S-65A, S-65D, and S-65E are 1,234 cfs, 1,377 cfs and 1,564 cfs, respectively.

Note that the estimation of runoff in this analysis does not take into account additional sources, such as evapotranspiration.

Lake Okeechobee and the Northern Estuaries

Lake Okeechobee is managed as part of the C&SF Project. The Herbert Hoover Dike (HHD) and several water control structures allow management of Lake Okeechobee to meet Project purposes, which are flood control (now referred to as “flood risk management”), navigation, water supply, recreation, and enhancement of fish and wildlife. Inflows to Lake Okeechobee average 2.1 million acre-feet (ac-ft per year. Nearly half the inflow to Lake Okeechobee is through the Kissimmee River. The Upper and Lower Kissimmee River watersheds cover more than 2,300 mi^2 of central Florida. The remaining inflow to Lake Okeechobee is received from Lake Istokpoga, Fisheating Creek, the Taylor Creek/Nubbin Slough Basin, and reverse flows from the Caloosahatchee River, the St. Lucie Canal, and the Everglades Agricultural Area (EAA).

The primary outflows from Lake Okeechobee are east to the St. Lucie Canal and west to the Caloosahatchee River. The main outflows south are through the L-8 Canal, Miami Canal, North New River Canal, Hillsborough Canal, and the West Palm Beach Canal. Inflows to Lake Okeechobee frequently exceed total outflow capacity.

The approximately 35-mi St. Lucie Canal, part of the Okeechobee Waterway, is the main eastern flood control outlet for Lake Okeechobee. The St. Lucie Estuary is located within portions of both Martin and St. Lucie Counties on the southeast coast of Florida. The two forks of the St. Lucie Estuary, the North Fork and South Fork, flow together near the Roosevelt Bridge at the City of Stuart, and then flow eastward approximately 6 mi to the Indian River Lagoon and Atlantic Ocean at the St. Lucie Inlet. The Caloosahatchee River, part of the Okeechobee Waterway, is the only flood control outlet leading west from Lake Okeechobee. Extending approximately 70 mi from Lake Okeechobee, through the Caloosahatchee Estuary, to the lower Charlotte Harbor Basin at San Carlos Bay, the Caloosahatchee River passes through parts of Glades, Hendry, and Lee Counties. Combined with the St. Lucie Canal and Lake Okeechobee, it completes the only navigable passage between the Gulf of Mexico and the Atlantic Ocean.

C.1.1.9 Regional Water Management (Operations)

Water management in the region is defined by the Kissimmee-Istokpoga Regulation Schedule as well as Lake Okeechobee operations.

Kissimmee-Istokpoga Regulation Schedule

A general plan for flood damage prevention in the Kissimmee Basin was incorporated into the comprehensive plan that was presented to Congress in 1948. Project works in the basin were authorized for construction by Congress in 1954. The inclusion of the Kissimmee Basin in the comprehensive plan was directly pursuant to Public Law No. 534.1947. However, earlier congressional acts in 1937, 1939, and 1946 had directed studies on regulating the Kissimmee River and its tributaries be made at the request of state interests. It is important to mention that all the project works located within the Kissimmee River and Lake Istokpoga Basins are operated and maintained by the SFWMD. The Corps serves in an advisory capacity regarding the inspection, operation, regulation, maintenance, improvements, or alterations to any of the structures or facilities within the Kissimmee River and Lake Istokpoga basins.

The purpose of the general plan was to relieve flooding and minimize flood damages, largely in the upper Kissimmee basin. This was to be accomplished partially by flood storage in the lakes of the upper basin and partially by providing the capability to more rapidly remove the floodwater from the basin, when necessary. The report to Congress clearly stated that complete flood protection could not be provided, but that reasonable flood protection would result from such a plan.

The project (C-38) also provides the congressionally authorized 3-ft navigation project (PL-56-154) and now permits year-round navigation from Lake Kissimmee to Lake Okeechobee. The regulation schedule essentially represents the seasonal and monthly limits of storage, which guides the regulation of the project for the plan purposes. The regulation schedule varies from high stages in the late fall and winter to low stages at the beginning of the wet season. **Figure C.1-13** shows a map of the Kissimmee River Basin. **Figure C.1-14** shows the current Kissimmee regulation schedule**.**

The Lake Istokpoga Project works were primarily designed to protect lands adjacent to the lake from flooding by lake waters and provide water supply for agricultural use in areas around the lake and in the Indian Prairie Basin (**Figure C.1-15**). At the same time, project works maintain the lake at a desirable level for fish and wildlife, navigation, and recreational purposes. The Lake Istokpoga Project generally consists of an outlet canal (C-41A), S-66, S-68, and three associated downstream canals: Indian Prairie (C-40), Slough Canal (C-41A), and Harney Pond Canal (C-41). Lake Istokpoga is regulated in accordance with the regulation schedule shown in **Figure C.1-16**.

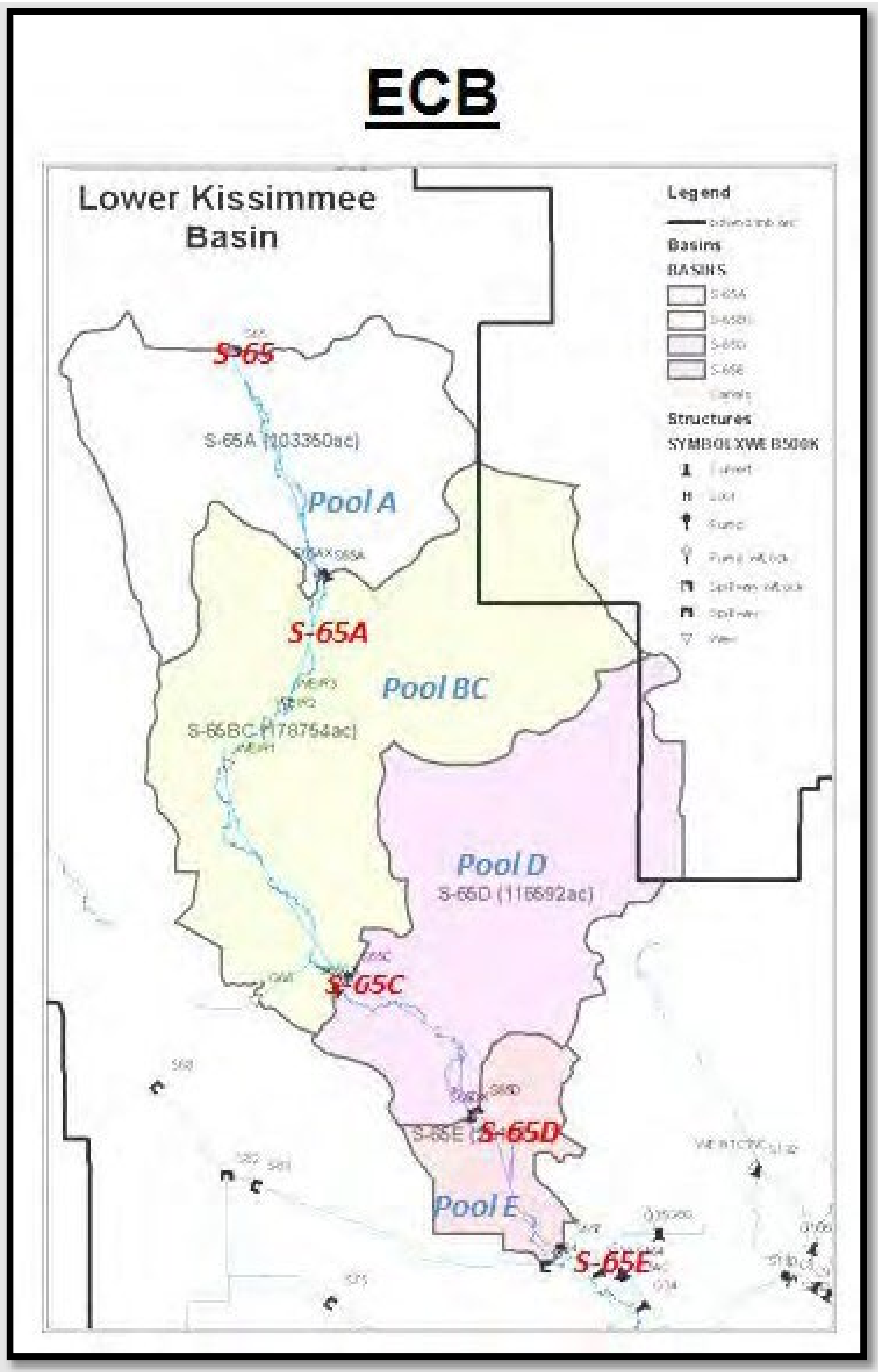
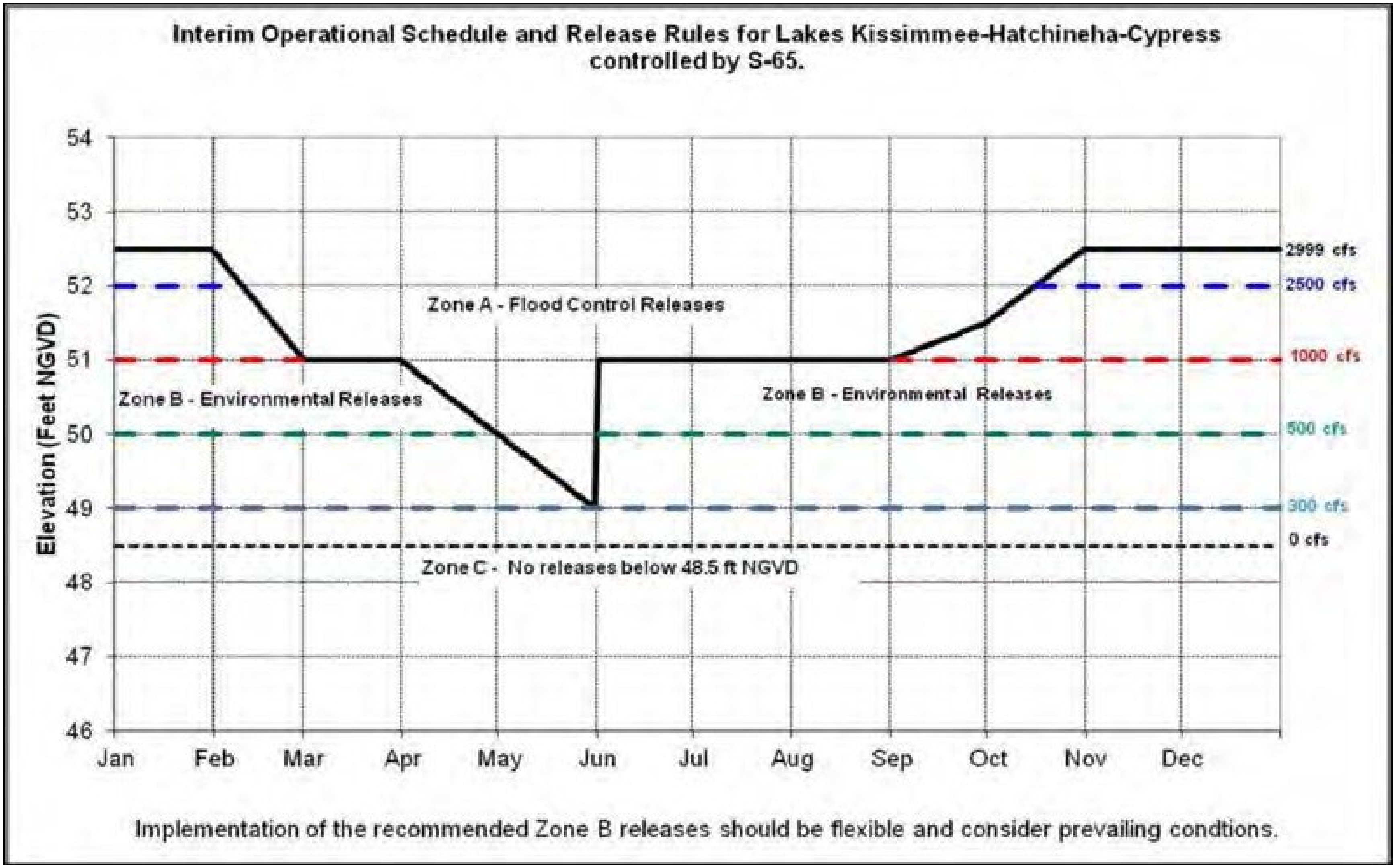


Figure C.1-13. Lower Kissimmee River Basin.

1 

2 *Note*: Updated by water managers to improve the zoned release schedule in Zone B to address floodplain inundation needs for the Kissimmee River Restoration Project until
3 Headwaters Revitalization Schedule implementation.

4 **Figure C.1-14. Interim operational schedule and release rules for S-65 (circa 2006).**

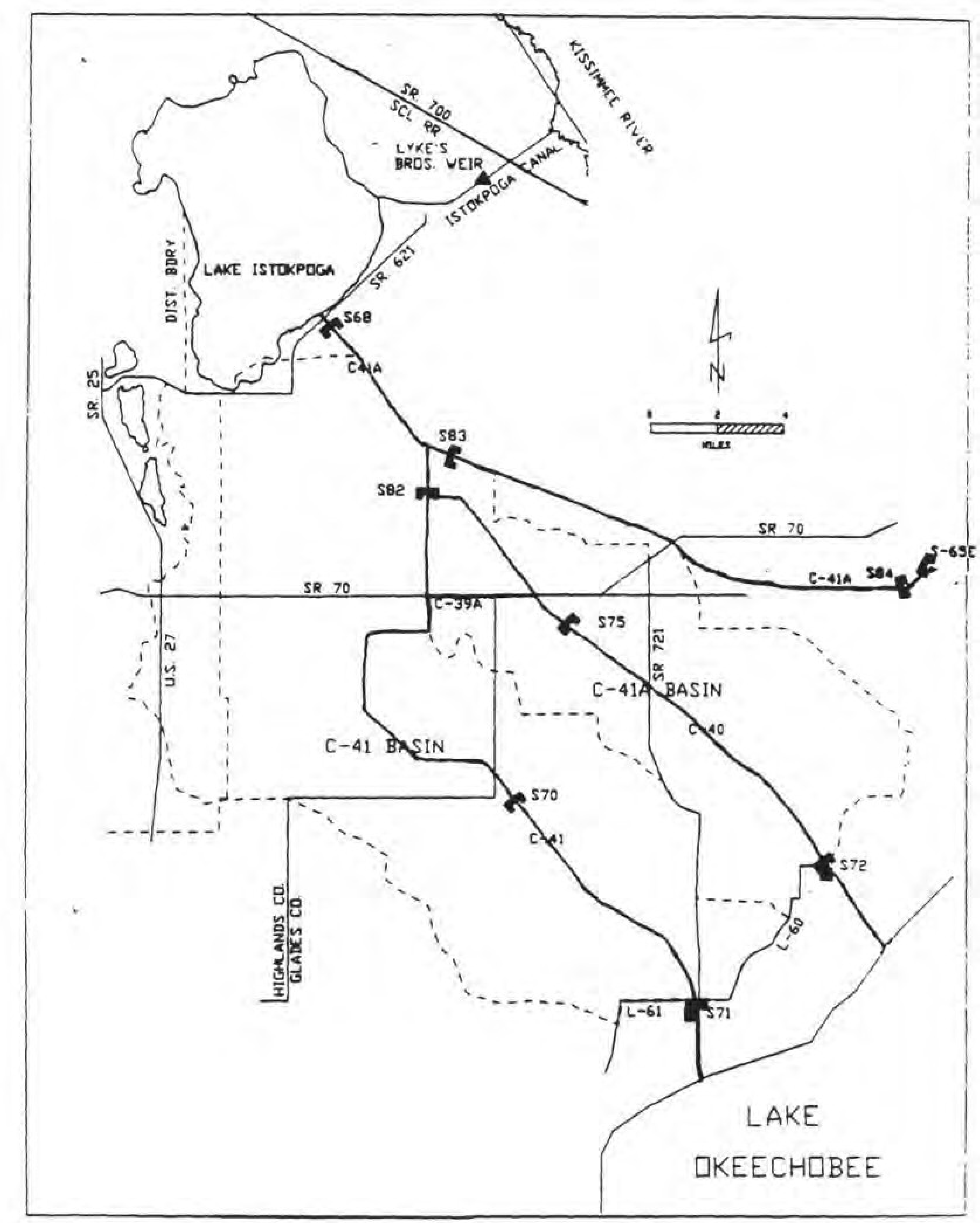


Figure C.1-15. Indian Prairie Basin.

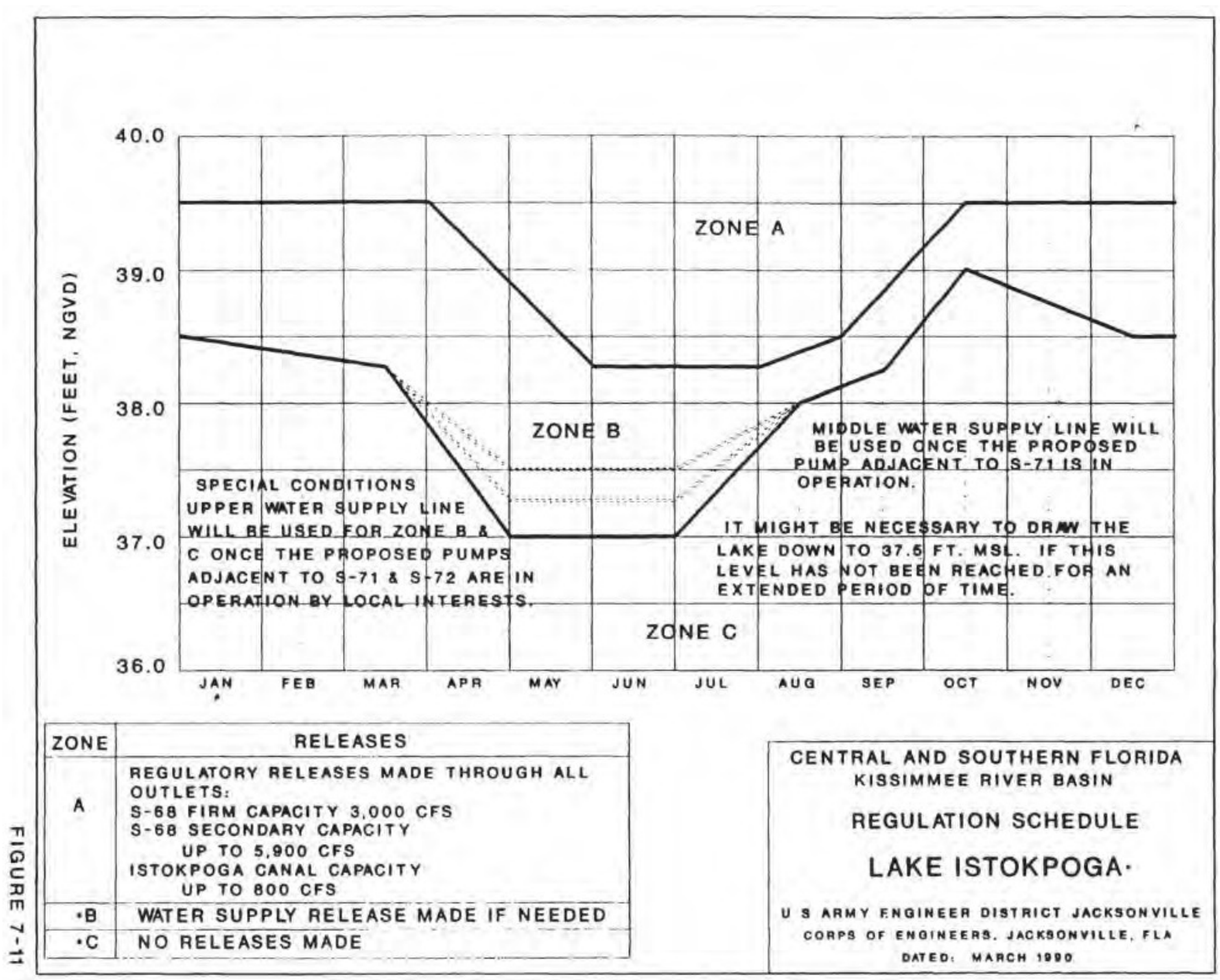


Figure C.1-16. Istokpoga Regulation Schedule.

Lake Okeechobee

The Corps is responsible for management of the water resources contained within HHD and for the development of regulations concerning operation of Lake Okeechobee's outlet structures. Water management operations at Lake Okeechobee are performed to ensure that congressionally authorized project purposes are met. Since April 2008, Lake Okeechobee has been operated in accordance with the 2008 Lake Okeechobee Regulation Schedule (2008 LORS; refer to **Figure C.1-17** through **Figure C.1-21)**and included in the revised March 2008 Corps Lake Okeechobee and EAA Area Water Control Plan (WCP). The WCP defines allowable flows to the Water Conservation Areas (WCAs) and to tide (estuaries). From July 2000 to March 2008, Lake Okeechobee operations were managed under the "Water Supply and Environment (WSE) Regulation Schedule." **Table C.1-1** summarizes the history of the different LORS.

Table C.1-1. Lake Okeechobee Regulation Schedules Throughout History.

Year	Water Levels in ft NGVD29	Water Levels in ft NAVD88
1948	12.56 to 15.56	11.26 to 14.26
1974	14.5 to 16	13.2 to 14.7
1978	15.5 to 17.5	14.2 to 16.2

Year	Water Levels in ft NGVD29	Water Levels in ft NAVD88
1994-2000 Run25/WSE	Max. stage 17-18.5	Max. stage 15.7-17.2
2008 LORS	Max. stage 17.25	Max. stage 15.95

The regulation schedule is a tool used by water managers to meet congressionally authorized project purposes. The regulation schedule has been, and will continue to be, designed to balance multiple, and often competing, project purposes and objectives. Managing for better performance of one objective often lessens the effectiveness of performance of competing objectives. For example, higher regulation schedules tend to benefit water supply, but may increase the risk to public health and safety and can harm the ecology of the lake. Lower lake schedules may produce lake levels more desirable for the lake ecology and improved flood protection but reduce water supply potential. Lower lake schedules may also harm the ecology of the lake during extended dry periods and downstream estuaries during extended wet periods. The regulation schedule contains bands that vary with the time of year. High volume flows from Lake Okeechobee are outlined by flowcharts that define the allowable flows by structure within each band.

Though water supply is a Project purpose, water supply flow volumes are not prescribed by this regulation schedule. However, water supply flows are made to meet downstream demands that can include agricultural irrigation, municipal and industrial needs, estuary needs, and other environmental water supply needs.

The 2008 LORS operational study was initiated to address high lake levels, high estuarine flows, estuary ecosystem conditions, and lake ecology conditions that occurred during the 2003 to 2005 time period. The study considered the consecutive, historically significant, 2004 and 2005 hurricane seasons' effects on the recognized structural integrity issues of HHD, along with effects to other project purposes. The 2008 LORS was identified to be effective at decreasing the risk to public health and safety, reducing the number of high-volume flows to the estuaries, and providing critical flexibility to perform water management operations (Corps 2008).

Under the 2008 LORS, management of Lake Okeechobee water levels and determination of Lake Okeechobee flows to the WCAs and to tide (estuaries) is based on seasonally varying lake elevations divided into three bands, as shown on the proposed 2008 Lake Okeechobee Interim Regulation Schedule Part A (**Figure C.1-17**). These bands include "High Lake Management," "Operational," and "Water Shortage Management." The High Lake Management Band is meant to address public health and safety, especially related to the structural integrity of HHD, by providing the ability to make flows up to the maximum capacity lake outlets will allow; Lake Okeechobee outlet canals may be maintained above their optimum water management elevations. The Operational Band is meant to facilitate authorized project purposes by providing the ability to make freshwater flows of various volumes, including no flow; Lake Okeechobee outlet canals should be maintained within their optimum water management elevations. The Water Shortage Management Band pertains to low lake levels, which necessitate rationing water supplies; Lake Okeechobee outlet canals may be maintained below their optimum water management elevations. The water supply freshwater flows made within this band are made according to the SFWMD's Lake Okeechobee Water Shortage Management Plan (LOWSM). The 2008 Lake Okeechobee Interim Regulation Schedule Part B (**Figure C.1-18**) further defines the bands of the regulation schedule. In Part B, the Operational Band is further subdivided into sub-bands that are directly related to defining allowable Lake

Okeechobee flows to the WCAs and to tide (estuaries). In general, as lake levels rise through the higher sub-bands, the allowable flow rates increase. Refer to **Figure C.1-19** through **Figure C.1-21** for more details.

The 2008 LORS analysis demonstrated that the then-proposed regulation schedule flows to the WCAs and estuaries would reduce the likelihood of lake levels that could increase the probability of a breach of the HHD and also contribute to poor ecological conditions within Lake Okeechobee. For Lake Okeechobee, a high lake level can lead to the decline of emergent and submerged vegetation, which is essential habitat for the lake's fish and wildlife populations. The 2008 LORS provides the ability to make long-term, low-volume flows to the Caloosahatchee Estuary, St. Lucie Estuary, and WCAs. These flows include low-volume pulse flows and base flows to the Northern Estuaries, which allow Lake Okeechobee to be maintained at more desirable levels throughout the year. A pulse flow attempts to simulate a natural rainstorm event within the basins. The receiving body would respond to the pulse flow in a similar fashion as if a rainstorm had occurred in the upstream watershed. Although an average flow rate is targeted for the duration of the pulse flow, daily flows vary. The pulse flow and base flows are intended to regulate lake levels and reduce the potential for future prolonged high-volume flows to the estuaries. The base flows also provide a benefit of maintaining desirable salinity levels in the estuaries.

In July 2022, the Corps issued a Draft EIS for the Lake Okeechobee System Operating Manual (LOSOM). LOSOM would be a new regulation schedule and operating criteria for Lake Okeechobee and the EAA. LOSOM would aim to meet the congressionally authorized project purposes for Lake Okeechobee and the Okeechobee Waterway, using four zones (i.e., Zone A, Zone BC, Zone D, and the Water Shortage Management Zone). The upper part of the LOSOM Regulation schedule, Zones A and BC, represent where Lake Okeechobee stages are higher than desired and releases are needed to rapidly control and reduce lake stage. In the middle part of the regulation schedule (Zone D), LOSOM would optimize beneficial uses of water within the Lake and from the Lake to the environment and water supply users. In Zone D, releases to the west would be capped at volumes which provide optimal salinity in the Caloosahatchee River Estuary, there would be no releases east to the St. Lucie Estuary, and there would be up to 1,100 cfs releases south with a focus on releasing water during the mid to late dry season to the greater Everglades. Zone D operations include system-wide consideration of past, current, and projected conditions while including system-wide consideration of where water is the most beneficial including for flood risk management, water supply, navigation, recreation, and enhancement of fish and wildlife. The operational intent of the Water Shortage Management Zone is to manage the amount of water available in the system as needed for water supply.

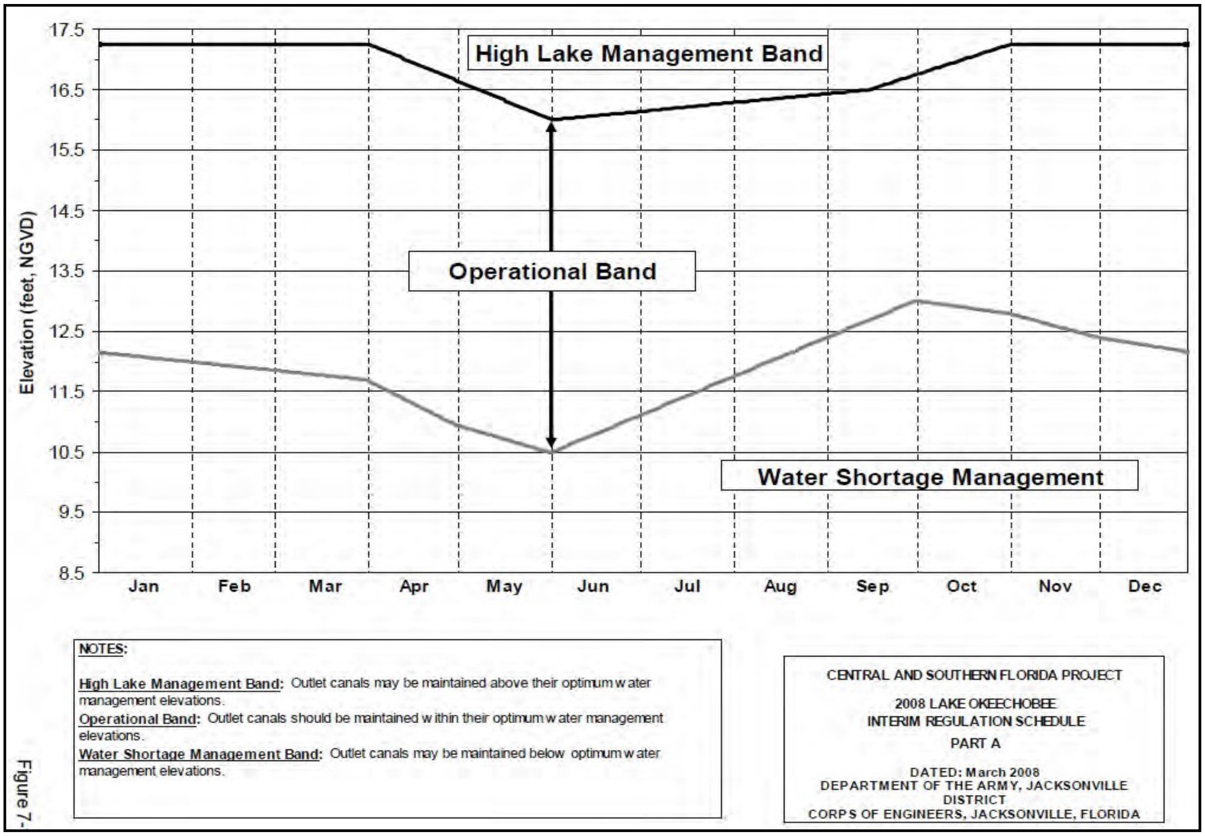
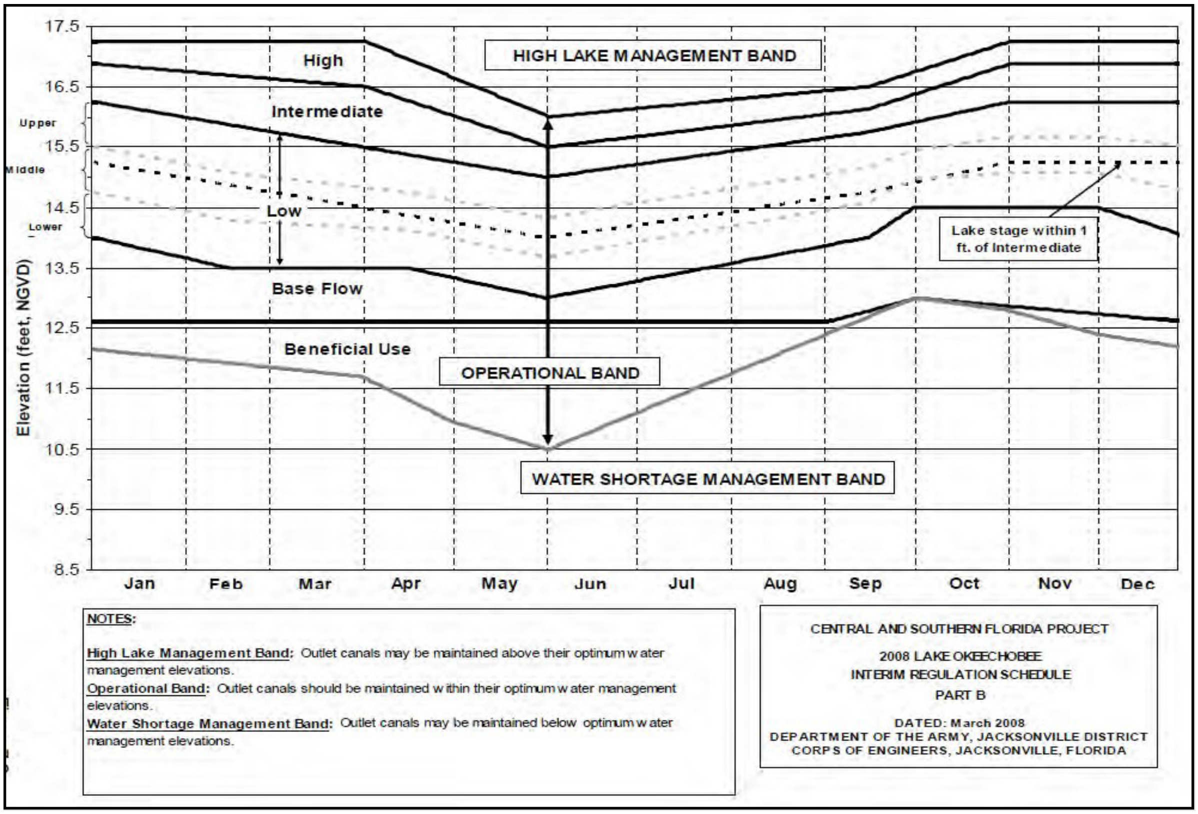


Figure C.1-17. 2008 Lake Okeechobee Regulation Schedule Part A.

1 

2 **Figure C.1-18. 2008 Lake Okeechobee Regulation Schedule Part B.**

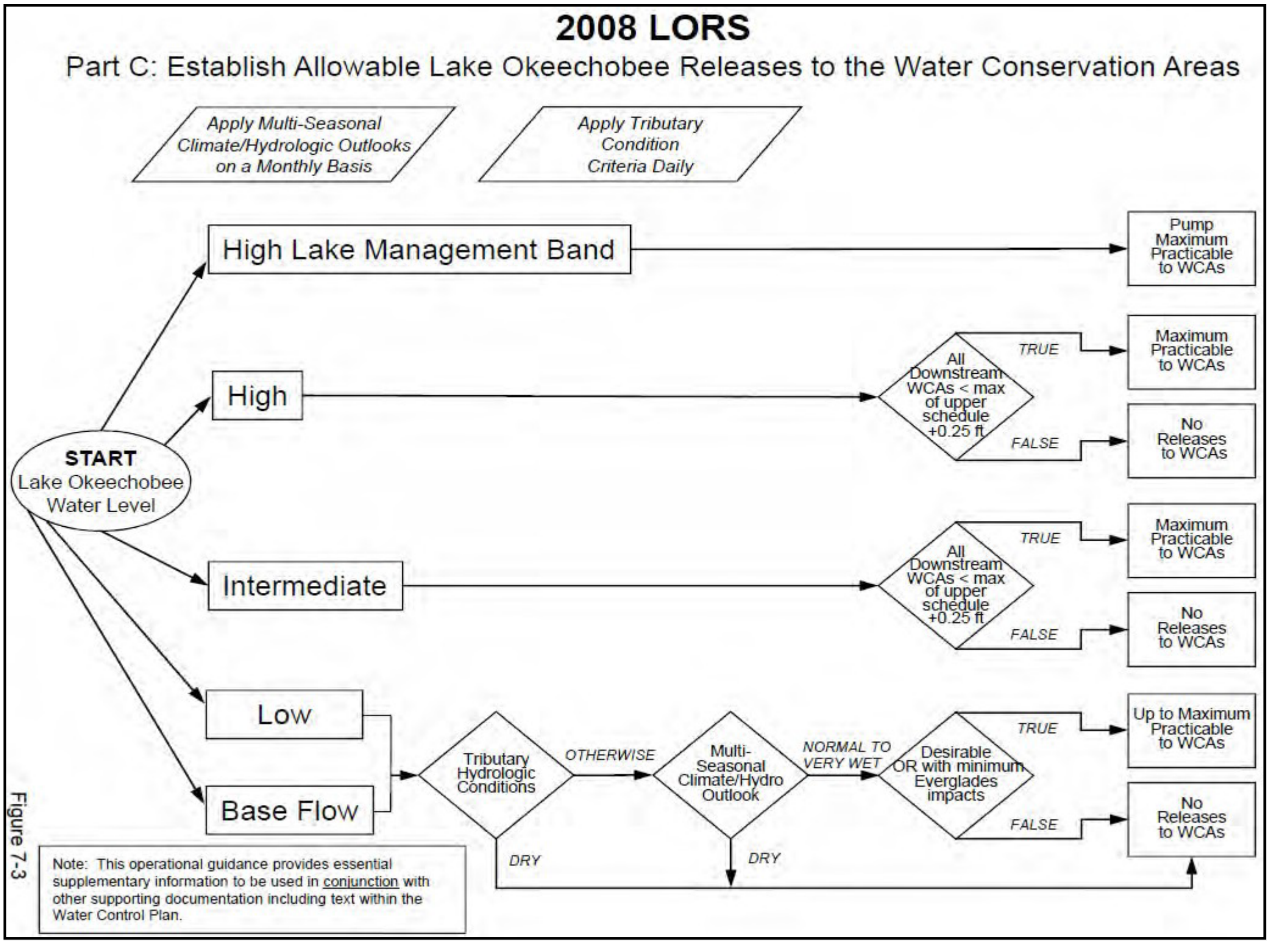


Figure C.1-19. 2008 Lake Okeechobee Regulation Schedule Part C.

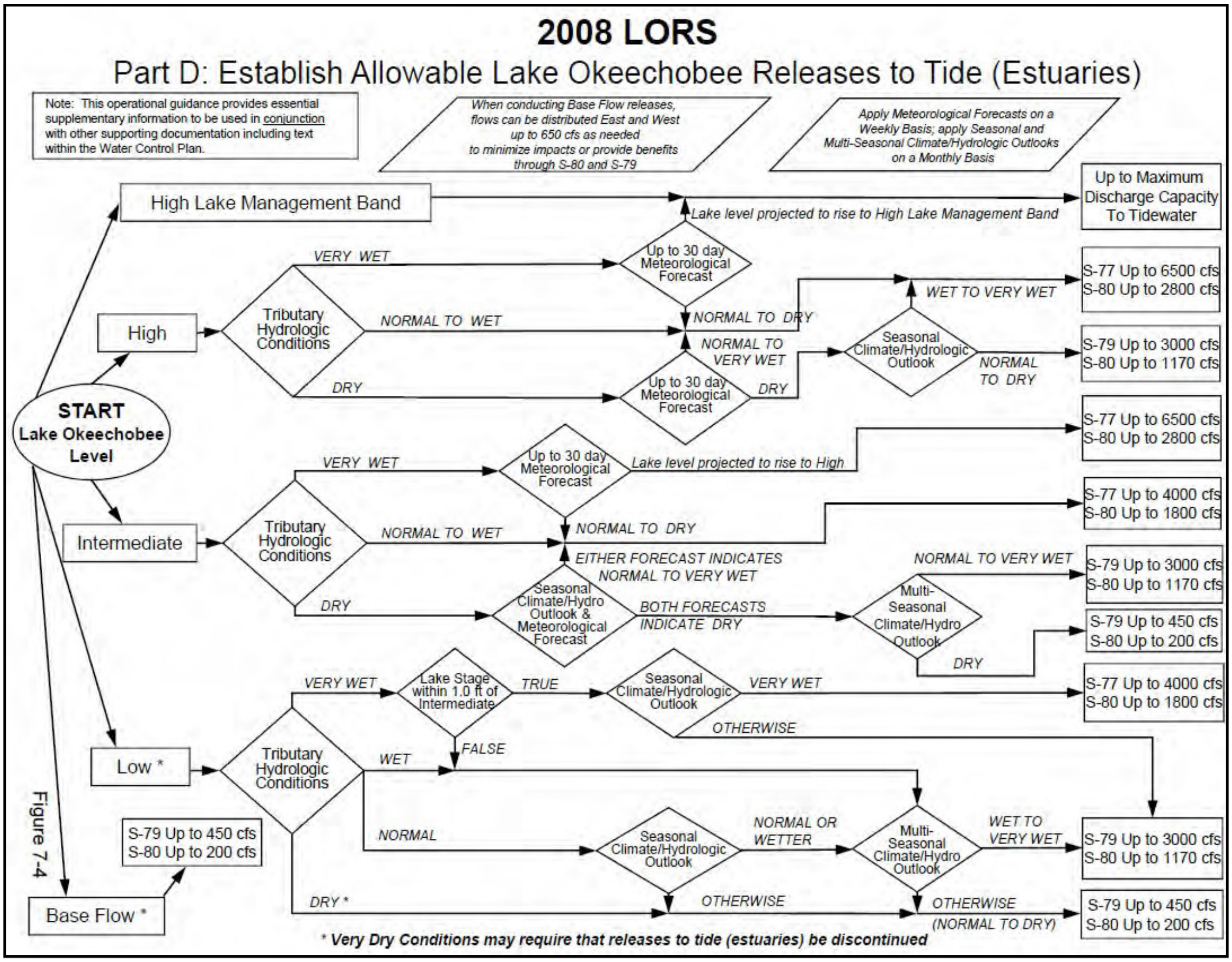
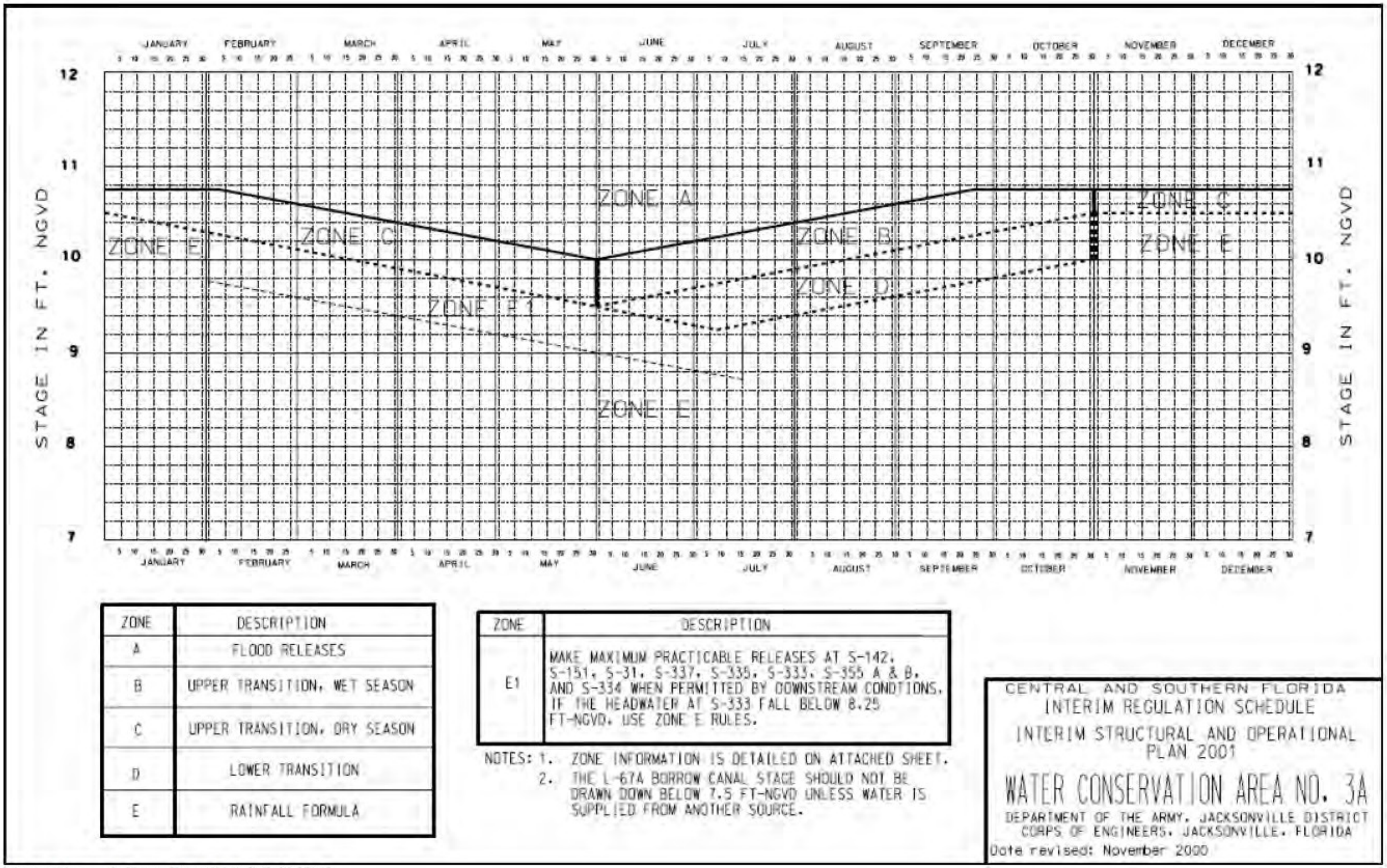


Figure C.1-20. 2008 Lake Okeechobee Regulation Schedule Part D.



Note: Figure 9 from 2002 IOP Final SEIS.

Figure C.1-21. Water Conservation Area 3A Interim Regulation Schedule Part A.

C.1.1.10 Groundwater Resources

Groundwater resources that underlie the Project Area are the unconfined SAS and the confined FAS. These two aquifers are separated by a thick sequence of marine sediments of the Hawthorn Group, which serves as a laterally extensive confining unit (Reese and Richardson 2008). Both aquifer systems are used for irrigation and drinking water supply in the Project vicinity, primarily for self-supply agricultural demands (SFWMD 2019). The primary drinking water supply source after treatment by reverse osmosis and membrane softening at the Brighton Reservation.

The SAS (or water table aquifer) is included in the marine and alluvial deposits that overlie Hawthorn Group sediments in the Project Area. Recharge of the SAS in the Project Area is from local rainfall. Flows occurs locally as outflow to drainage canals, or regionally from Lake Istokpoga to Lake Okeechobee via the Indian Prairie Canal System.

A generalized hydrogeologic diagram is shown in **Figure C.1-22.**

Hawthorn Group (late Oligocene-Miocene) sediments overlie the Suwannee and Ocala Limestones throughout South Florida, including Highlands County (Scott, 1988; Missimer, 2002). The group consists of two formations: the Peace River Formation, which overlies the Arcadia Formation. The Peace River Formation consists of interbedded quartz sands, clays, and carbonates, of which quartz sands dominate the formation composition (Scott 1988). Undifferentiated Hawthorn Group sediments occur at depths of 178 ft to 650 ft at the Brighton Reservation (Missimer Groundwater Science 2007), from 140 ft to 550 ft at Paradise Run (CH2MHill 2008), and 170 ft to 562 ft bls at Kissimmee River aquifer storage and recovery (ASR) system (KRASR; CH2MHill 2004).

Hawthorn Group sediments are distinguished from underlying limestones by their high and variable siliciclastic and phosphatic content, gray-green coloration, and gamma-ray log response (Reese and Richardson 2008). The basal Hawthorn unit is phosphate-rich and shows pronounced gamma-ray log responses that contrast with low response in the phosphate-poor Ocala Limestone. Clays occur within the Arcadia Formation, and dolomite is the primary carbonate mineral (Scott 1988). The Arcadia Formation/basal Hawthorn Group lies unconformably on the Ocala Limestone in the Project Area. Hawthorn Group sediments serve as a thick, laterally extensive confining unit (CU; **Figure C.1-22**). Southwest of the Project, Hawthorn Group sediments are more permeable and include the Intermediate Aquifer (IA; **Figure C.1-22**).

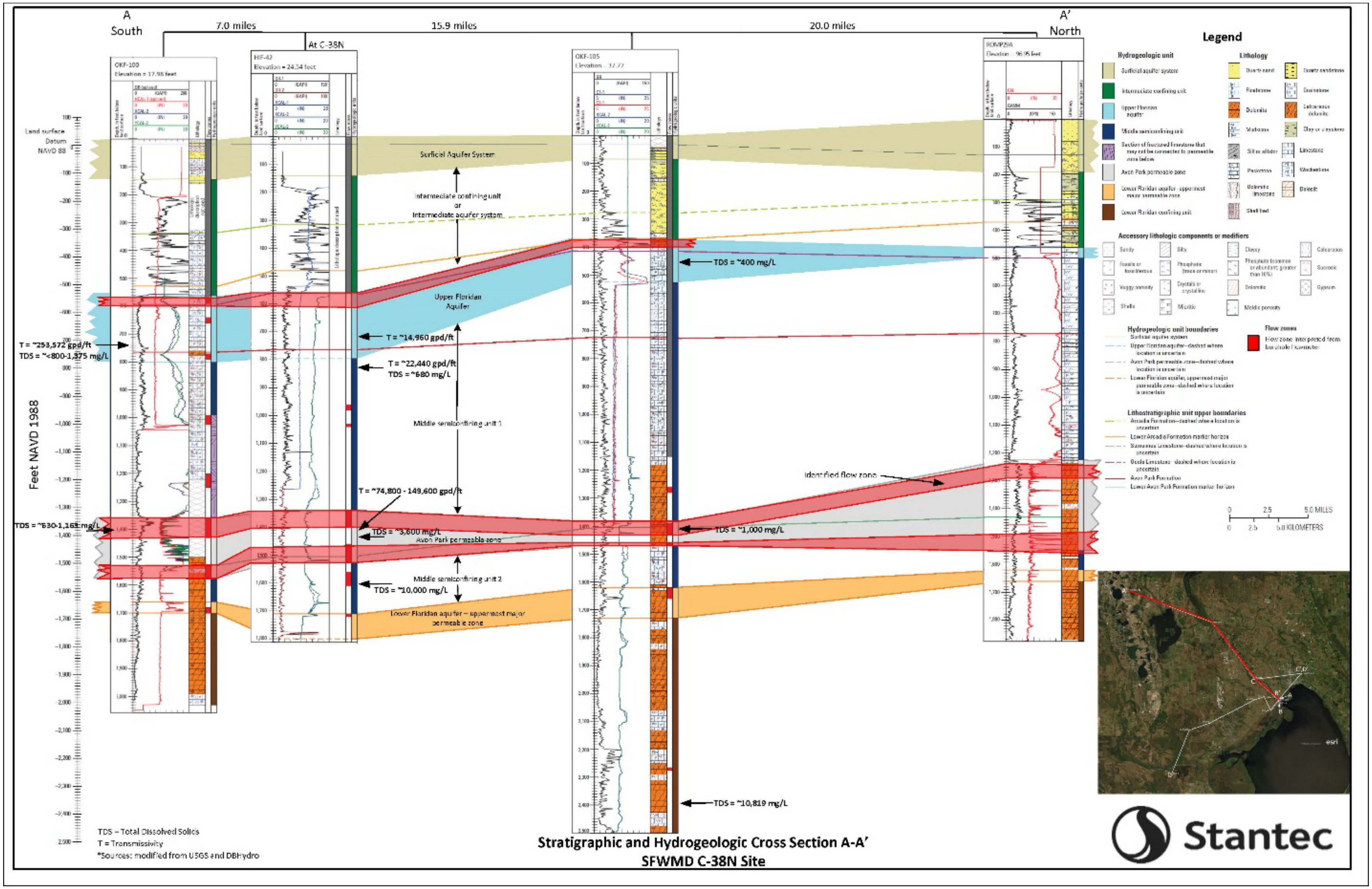


Figure C.1-22. Generalized Hydrogeologic Framework for the Project Area (Stantec 2020).

The Ocala Limestone (late Eocene) overlies the Avon Park Formation in Highlands County. This unit is a chalky to fossiliferous, mud-rich to calcarenite limestone (Reese and Richardson 2008). Near the Project Area, the top of the Ocala Limestone is encountered at depths that range between 540 ft bls (KRASR; Corps 2013; CH2M Hill 2004) and 650 ft bls (Paradise Run, CH2M Hill 2008; Brighton Reservation, Missimer Groundwater Science 2007), and generally dips to the south. The upper contact of the Ocala Limestone shows significant topographic variation (as much as 200 to 400 ft; Reese 2014). The Ocala Limestone thickness ranges approximately 200 to 400 ft in the Project Area.

The Suwannee Limestone (early Oligocene) is a pale orange to tan, fossiliferous, medium-grained calcarenite. This formation occurs at depths of 750 to 950 ft bls (Reese and Richardson 2008) and thins to the east. The Suwannee Limestone is not easily recognized in cores east of Glades County and is absent in exploratory boreholes at the Brighton Reservation (Missimer Groundwater Science 2007) and KRASR (CH2MHill 2004). However, the Suwannee Limestone was shown at depths of approximately 850 to 950 ft bls in an exploratory borehole at Moore Haven (GLF-6, south of the Project Area; Reese and Richardson 2008), and at 550 to 610 ft in exploratory borehole for HIF-42 at Paradise Run (Highland County; CH2MHill 2008). The uppermost permeable zone of the FAS is the UFA and occurs primarily in the Ocala Limestone in the LOW Project Area.

The deepest lithologic unit of interest in southern Highlands and Glades Counties is the Avon Park Formation (mid- to late Eocene). This unit is encountered at a depth of 750 ft bls in the Project Area, and dips to approximately 900 ft in the southeast near Lake Okeechobee (Campbell, 1990; CH2MHill 2004, 2008). The Avon Park Formation consists of fine-grained micritic to fossiliferous limestone, dolomitic limestone, and dolostone (Reese and Richardson 2008). The Avon Park Permeable Zone (APPZ), known formerly as the Middle Floridan Aquifer, occurs within the Avon Park Formation approximately 1,400 ft bls in the Project Area (Reese and Richardson 2008). A leaky confining unit separates the lower portion of the UFA from the APPZ. A geologic map of the thickness of the APPZ is presented in **Figure C.1-23**.

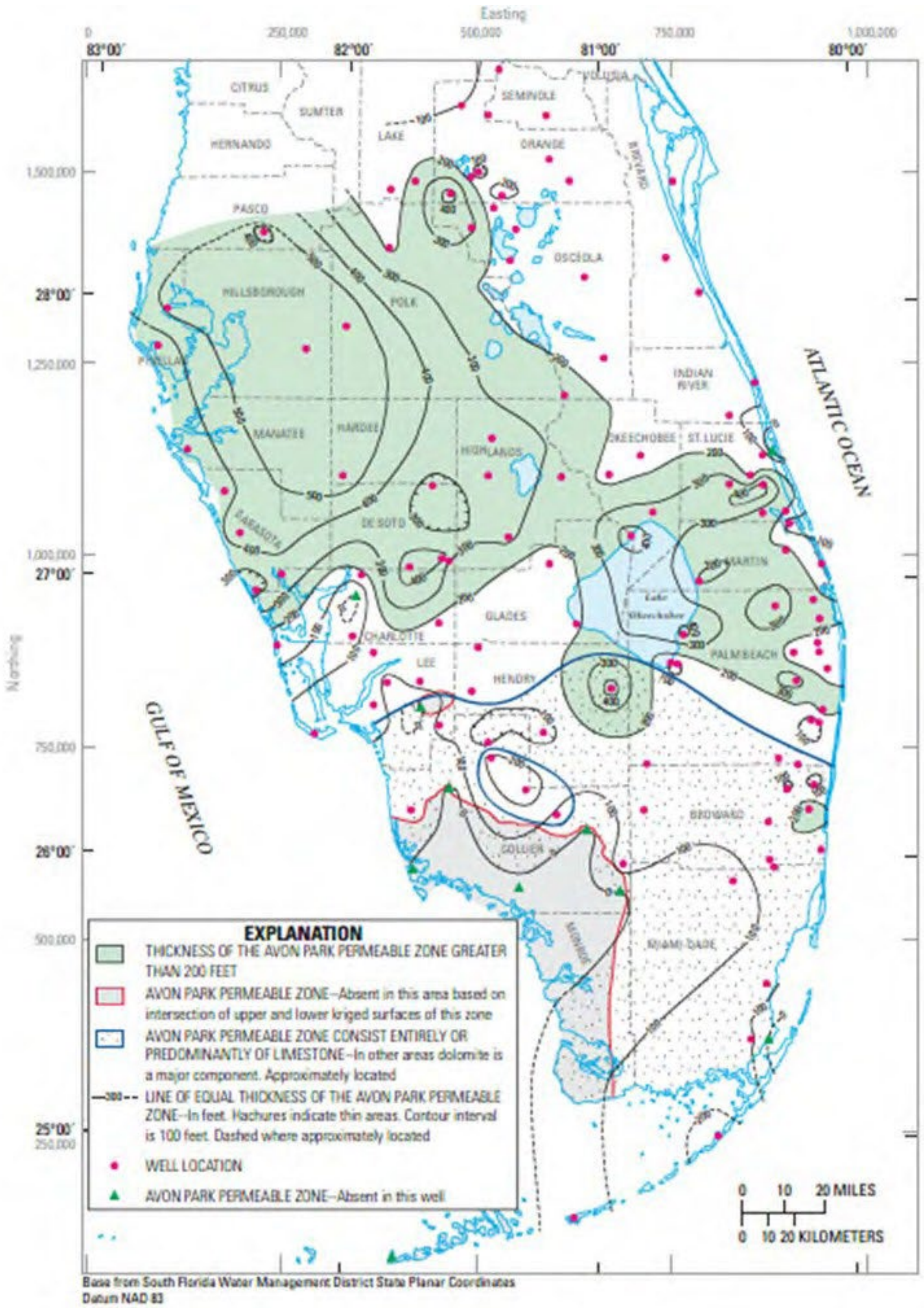


Figure C.1-23. Geologic map of the thickness of the Avon Park permeable zone (Reese and Richardson 2008).

Groundwater quality in the upper portions of the SAS is fresh because recharge infiltrates primarily from rainfall. Southeast of the Project near Lake Okeechobee, groundwater quality becomes increasingly saline toward the base of the SAS due to mixing of fresh groundwater with relict seawater (Reese and Wacker 2009). SAS groundwater quality (approximately 130 ft to 140 ft bls) at the Kissimmee River ASR system is brackish, showing chloride concentrations that range between 630 and 720 milligrams per liter mg/L, and total dissolved solids concentrations ranging from 1,700 to 2,000 mg/L.

Groundwater quality characteristics of the UFA are defined using data from exploratory boreholes. At the Brighton Reservation, chloride concentrations in the UFA (634 to 1,200 ft bls) actually decreased with depth, from 1,700 mg/L (640 to 936 ft bls) to 655 mg/L (640 to 1,216 ft bls), indicating fresher groundwater in lower portions of the UFA (Missimer Groundwater Science 2007). The APPZ is a thick transmissive aquifer that occurs below the UFA throughout South Florida (Reese and Richardson 2008). Groundwater quality characteristics of the APPZ are defined from the same exploratory boreholes used for UFA characterization. Native groundwater in the APPZ generally is more saline than UFA groundwater. At the Brighton Reservation, chloride was measured during aquifer performance testing range of 740 to 1,040 mg/L. To the west of the Study Area, the APPZ occurs at greater depths. At Well GLF-6 near Moore Haven, the APPZ shows chloride concentrations that range from 1,711 to 1,811 mg/L, and total dissolved solids concentrations that range from 3,549 to 4,164 mg/L.

C.1.1.11 Surface Water Quality

Water quality in the Study Area is significantly influenced by development. The C&SF Project led to considerable changes in the landscape by opening large land tracts for urban development and agricultural uses and constructing extensive drainage networks. Natural drainage patterns in the region have been disrupted by the array of levees and canals, which has resulted in further water quality degradation. The surface water quality of the Study Area is largely controlled by inflows from the Kissimmee River, Lake Istokpoga, and Lake Okeechobee. Lake Okeechobee feeds downstream sub-basins, such as the Northern Estuaries, including Indian River Lagoon and Charlotte Harbor. Water quality impairment within the Study Area can generally be attributed to nutrients and bioavailable forms of mercury. A short discussion of each of these water pollutants is provided below followed by a geographically referenced review of surface water quality within the Study Area.

Nutrients

Nutrients, such as phosphorus and nitrogen compounds, are a concern in the estuaries, LOW, and Lake Okeechobee since they result in an imbalance of flora and fauna. To address nutrients, the Florida Department of Environmental Protection (FDEP) established surface water quality numeric nutrient criteria statewide and Total Maximum Daily Loads (TMDL) for many specific waterbodies with excessive nutrient pollution. A total phosphorus (TP) TMDL has been adopted by FDEP for Lake Okeechobee, total nitrogen (TN) and TP TMDLs have been adopted for the SLE, and a TN TMDL has been adopted for the CRE. The Study Area is subject to the requirements of the Lake Okeechobee TP TMDL, and this TMDL is routinely exceeded by a factor of approximately three to four times due to nutrient contributions from sources throughout the LOW. Additional information about adopted TMDLs within the Study Area can be found on the FDEP website at http://www.dep.state.fl.us/water/tmdl/.

To implement measures to address these TMDLs and meet water quality standards, FDEP worked with local stakeholders to adopt basin management action plans (BMAP) for the Lake Okeechobee, Caloosahatchee River and Estuary, and St. Lucie River and Estuary watersheds. The BMAPs outline projects and programs for nutrient reductions, implementation milestones to achieve reductions, and monitoring plans to evaluate water quality trends to determine progress and adjust the plan. The Study Area falls within the Lake Okeechobee BMAP. This BMAP was originally adopted by FDEP in 2014 and an update was adopted in 2020. Additional information about the Lake Okeechobee BMAP can be found on the FDEP website at https://floridadep.gov/dear/water-quality-restoration/content/basin-management-action-plans-bmaps.

Land use and system hydrology changes have contributed to increased nutrient concentrations in the LOW. As improvements to drainage were made, nutrient-enriched runoff from agriculture and urban activities within the watershed flowed to the lake. TP is the limiting nutrient for Lake Okeechobee; TN is generally considered to be the limiting nutrient for the marine waters of South Florida. Prior to 1970, the background TP in-lake concentration was less than 0.040 mg/L, while the 5-year average (WY2018 to WY2022) was 0.158 mg/L, and the WY2022 value was 0.142 mg/L (SFWMD 2023).

TN is generally not considered to be a problem within the Everglades landscape but is elevated in Lake Okeechobee and its watershed. The 5-year average TN concentration (WY2018 to WY2022) for the pelagic area of Lake Okeechobee was 1.42 mg/L (SFWMD 2023). In the Northern Estuaries, excess nutrients may contribute to cause cyanobacteria blooms and depressed oxygen conditions. The Northern Estuaries are generally considered to be nitrogen-limited with inorganic forms of nitrogen, such as nitrate, causing the most harm. The TN concentration in the freshwater flows from Canal 43 (C-43) and Canal 44 (C-44) into the Northern Estuaries is approximately 1.5 mg/L, with about 0.5 mg/L provided by the highly bioavailable inorganic forms, such as nitrate and nitrite. Lake Okeechobee provides approximately 1/3 of the freshwater flows to the Caloosahatchee Estuary measured at the S-77 structure (S-77) connecting Lake Okeechobee to the Caloosahatchee River. Detailed information on Lake Okeechobee's contribution to the CRE can be found below in **Subsection C.1.1.11.5**. In the SLE, 31.9 percent of the historic TN load comes from the lake and 17.9 percent of the historic TP load comes from the lake (SFER 2019). Detailed information on Lake Okeechobee's contribution to the SLE can be found below in **Subsection C.1.1.11.6**.

Mercury

Mercury (Hg) in South Florida aquatic systems, including Lake Okeechobee, is 90 to 95 percent from global atmospheric deposition (Vijayaraghavan and Pollman 2019) as inorganic Hg. Significant local sources include coal-burning power plants, cement kilns, and incinerators (FDEP 2013). In the Everglades, the conversion of inorganic Hg to organic methylmercury (MeHg) is facilitated by naturally occurring anaerobic bacteria. This conversion of inorganic Hg to MeHg is one of the important steps in the bioaccumulation of Hg, as it greatly increases toxicity and potential for accumulation in aquatic biota. Mercury has been monitored in the lake from 1990 to 2000, Kissimmee River S65E structure from 1979 to 2000, and Taylor Creek stormwater treatment area (STA) from 2007 to 2016.

STAs are monitored for mercury based on A Protocol for Monitoring Mercury and Other Toxicants (Protocol; FDEP and SFWMD 2018) and the Comprehensive Everglades Restoration Plan Guidance Memorandum 42.02 (CGM-42.02; Corps and SFWMD 2018), which serve as guides for the monitoring design and assessment plans for mercury, pesticides, and other toxicants for SFWMD and Corps projects permitted by FDEP. Data collection consists of surface water, fish tissue, and sediment.

The Protocol uses a phased, multi-tiered approach and covers two phases of a project: (1) Baseline Collection and Assessment, and (2) Monitoring during the 5-year Stabilization and Routine Operational Period. The Protocol includes decision criteria and adaptive management strategies to respond to different scenarios. If an identified threshold of concern is exceeded, then Tier 2 expanded monitoring and risk assessment would be triggered to determine the cause and guide appropriate adaptive management decision making regarding short-term corrective actions and long-term operational optimization. The intent of this approach is to allow monitoring efforts to smoothly ramp down or up, as appropriate.

Results from the monitoring and assessment plan are intended to provide state and federal regulatory and trust oversight agencies with reasonable assurance that the project will not cause or contribute to an unacceptable increase in the risk of toxic effects to aquatic or terrestrial resources.

Human exposure to Hg is primarily through the consumption of fish and shellfish containing MeHg. Exposure to Hg causes neurodevelopmental delays in children. Wildlife exposure to MeHg through the consumption of fish results in reproductive, neurological, and immune system problems (Fleming et al. 1995; Tchounwou et al. 2003). However, contaminated fish is not the only pathway for bioaccumulation of Hg.

The EPA has established that a Hg concentration in fish tissue in excess of 0.3 milligrams per kilogram (mg/kg) is detrimental to human health. Airborne mercury is deposited through precipitation and accumulates in the aquatic food web (EPA 1997). Water quality impairment for Hg is also measured by the incidence of gamefish tissue with Hg more than 0.3 mg/kg.

MeHg also poses a threat to fish-eating wildlife and species that prey on them, such as wading birds, ospreys, eagles, otters, and panthers. The elevated MeHg concentrations in fish have been correlated with elevated concentrations in wildlife, including state and federally listed endangered species. Total Hg concentrations in panther hair ranged from 0.092 to 67 mg/kg; in wood stork chicks ranged from 5.2 to 10.8 mg/kg, at coastal ENP colonies; and in great egrets ranged from 2.5 to 20 mg/kg, from several colonies in the Everglades Protection Area (SFER 2013, SFER 2014). Three types of Florida gar fish tissues (i.e., gonads, muscle, and liver) were monitored at three locations in Lake Okeechobee between 1998 and 2000: (1) near the mouth of the Kissimmee River, (2) in Moonshine Bay on the western side, and (3) near Torry, Kreamer, and Ritta Islands at the south end. The amount of Hg was significantly higher in the fish tissues at the northern site, with a decreasing north to south gradient. The highest level at the northern site may have been caused by runoff from cattle ranches into the Kissimmee River (Burger et al. 2004). Like many of Florida's freshwater lakes, Lake Okeechobee is impaired for Hg due to elevated levels of Hg found in fish. The 2017, Florida Department of Health (FDOH) guidelines call for not eating any fish from the Kissimmee River near Lake Okeechobee and from the lake more than once or twice per week or once per month, depending on gender, age, and type of fish and for Largemouth bass, depending on the fish size. In 2013, FDEP adopted a statewide Hg TMDL for fresh and marine waters to address waterbody impairments from elevated Hg levels in fish tissue. Impaired waterbodies are those where Hg in fish tissue exceeds FDOH thresholds for fish consumption, which include one threshold for the general population and another for women of child-bearing age and young children.

Lake Okeechobee Watershed

Water quality conditions have continued to exceed the TP TMDL of 140 metric tons (MT) annually by a factor of approximately three to four times. The TMDL includes 105 MT per year of TP for surface water inflow and 35 MT for rainfall. During WY 2022, the watershed TP loading to the lake was 285 MT, including the assumed 35 MT of rainfall contribution, which was 45 percent less than the WY 2021 amount, but still 145 MT higher than the TMDL target. The lower load was attributed to a 40 percent decrease of total inflows, and below average rainfall in WY 2022 (SFWMD 2023). The 5-year average TP loading to the lake over WY 2018 to 2022 was 531 MT, including the rainfall contribution, which is 391 MT higher than the TMDL target.

The watershed-wide TP load averaged 0.16 pounds per acre (lb/ac or 0.18 kilogram per hectare [kg/ha]) in WY2022, which is 50 percent lower than the 5-year average value of 0.32 lb/ac (0.36 kg/ha). The drainage basin with the highest unit area load of TP in WY2022 was the S-135 Basin (1.04 lb/ac or 1.16 kg/ha), followed by the S-154C Basin (1.03 lb/ac or 1.15 kg/ha), and the S-154 Basin (0.86 lb/ac or 0.96 kg/ha), all of which are in the Taylor Creek/Nubbin Slough Sub-watershed. The S-154C Basin had the highest flow-weighted mean TP concentration value (696 ppb), followed by the S-191 (534 ppb) and S-154 (412 ppb) basins in the Taylor Creek/Nubbin Slough sub-watershed during WY2022 (SFWMD 2023).

Lake Okeechobee

Lake Okeechobee is often referred to as the hydrologic heart of South Florida; it is a multipurpose reservoir that is used to provide drinking water for urban areas, irrigation water for agricultural lands, recharge for aquifers, freshwater for the Everglades, habitat for fish and waterfowl, flood control, navigation, and many recreational opportunities. Lake Okeechobee has been designated by FDEP as a Class I waterbody (i.e., drinking water supply). The surface water in the HHD toe ditch and nearby canals meets most Class III water quality standards (recreation and maintenance of healthy fish and wildlife populations). However, the water in Lake Okeechobee and canals has elevated concentrations of nutrients (primarily phosphorus and nitrogen). The Clean Water Act requires states to classify their surface waters according to designated uses and to develop water quality standards. If waterbodies are not meeting the standards, states are required to develop TMDLs. The TMDLs establish the maximum amount of a pollutant that a waterbody can assimilate without causing an exceedance of water quality standards. FDEP has established a TP TMDL for Lake Okeechobee of 140 MT per year and a target in-lake TP concentration of 40 ppb. The 40 ppb TP target was established as the level of phosphorus necessary to reduce algal blooms to less than 10 percent of the time (Havens and Walker 2002).

Nutrient loads within the LOW are regulated under the Northern Everglades and Estuaries Protection Program (NEEPP). The NEEPP specifies the implementation in BMAPs. The Lake Okeechobee BMAP was originally adopted in December 2014 and updated in January 2020. The BMAP allocated the TMDL to the entire LOW, which includes all nine sub watersheds to the north, south, east, and west. The plans contain a schedule for subsequent phases of TP load reduction consistent with the TMDL, with milestones to achieve reductions. Florida Statutes require agricultural and non-agricultural nonpoint source releases located in areas within a BMAP to implement best management practices (BMP) or monitor to demonstrate compliance with state water quality standards. Revisions to the NEEPP were enacted in January 2016 and became effective July 1, 2016. Over the past 30 or more years, state and federal agencies have been working to reduce nutrient loading associated with agricultural operations in the LOW and downstream. Water quality in the lake has been greatly impacted over the long term by agricultural operations in the Kissimmee River Basin to the north and the EAA to the south, storing an estimated 30,000 MT of TP in the lake sediments and the large watershed inflow north of the lake. Back-pumping agricultural stormwater runoff into the lake has been significantly curtailed and that has also improved lake water quality. A reduction in Lake Okeechobee phosphorus is desired, in part, to reduce the occurrence of blue-green cyanobacteria blooms in the lake, and to reduce the adverse effects of phosphorus on downstream systems, including the Caloosahatchee River and St. Lucie River Watersheds. During high lake stages conditions, large volumes of water flow from Lake Okeechobee to the Northern Estuaries. These large flow events reduce the salinity in the downstream estuaries (Corps 2007d).

In the preceding 10-year period, in-lake TP concentrations ranged between a low of 96 µg/L (WY2012) and a Hurricane Irma-induced high of 203 µg/L (WY2018) (Jones et al. 2023). In WY2022, the in-lake TP concentration was 142 µg/L, which is 3 percent lower than the WY2021 value of 147 µg/L. These in-lake TP concentration values exceed the TP in-lake goal of 40 µg/L (FDEP 2001). The current 5-year (WY2018 to WY2022) moving average TP concentration is 158 µg/L, which is higher than the pre-hurricane (pre-2004) range of 57 to 127 µg/L.

Caloosahatchee River and Estuary

Water quality conditions are degraded in the upper and lower areas of the Caloosahatchee River Watershed due to agricultural and urban runoff, respectively. The channelized section of the river also shows degraded water quality conditions, due to agricultural inputs, as compared to tributaries in less developed areas of the watershed. Problems associated with the degraded areas are typified by low dissolved oxygen levels, elevated conductivity, decreased biodiversity, and Hg methylation/ bioaccumulation. Conditions in the urbanized sections are influenced by nonpoint stormwater flows and are manifested in the river by elevated chlorophyll levels, cyanobacteria blooms, periodic fish kills, and low dissolved oxygen levels. Although wastewater releases remain a problem, the estuary is presently more seriously affected by high nutrient waters from the river and tributaries and stormwater runoff from cities. Nutrient and chlorophyll can be elevated, and small cyanobacteria blooms occur regularly.

Lake Okeechobee provides approximately 1/3 of the freshwater flows to the Caloosahatchee Estuary measured at the S-77 structure connecting Lake Okeechobee to the Caloosahatchee River. The remaining volume of freshwater comes from Caloosahatchee River Watershed runoff. FDEP has identified Hg in fish tissue, nutrients, and dissolved oxygen as verified impairments to the CRE and several tributaries. Approximately two-thirds of the nutrient load to the Caloosahatchee Estuary is contributed from sources within the watershed with the remaining fraction coming from Lake Okeechobee. Given that the estuary is nitrogen-limited, FDEP has focused on controlling nitrogen loads to improve water quality. FDEP has developed a TN TMDL for the estuary, which is being implemented through the 2020 BMAP. FDOH has a fish Hg consumption advisory for the CRE.

St Lucie River and Estuary

Water quality conditions along the St. Lucie River are rated as good in less developed areas of the watershed. However, conditions are degraded in urbanized areas and along the extensive network of canals that drain this area. The worst water quality conditions in Martin and St. Lucie Counties are reported in the St. Lucie River and the canals leading from the EAA. Approximately 33 percent of total freshwater flow to the St. Lucie Estuary is provided by flows from Lake Okeechobee through the C-44 Canal. In the St. Lucie Estuary, 31.2 percent of the historic TN load and 17.4 percent of the historic TP load comes from the lake (SFER 2018). FDEP has determined that the St. Lucie River is impaired for biochemical oxygen demand (BOD), TP, and TN. FDEP established TMDLs for BOD, TP, and TN, which are being implemented through the BMAP. Upstream portions of the St. Lucie River (i.e., north and south forks) are impaired for Hg; however, the main portion of the St. Lucie Estuary is not included in the FDOH list of fish consumption Hg advisories.

C.1.1.12 Flood Protection for Savings Clause Analysis

Water management and flood control is achieved in southern Florida through a variety of canals, levees, pumping stations, and control structures. This is also true within the Study Area. The regulation schedules for Lake Okeechobee, Kissimmee, and Istokpoga Basins contain instructions and guidance on how to protect infrastructure within their area of influence. The regulation schedules represent the seasonal and monthly limits of storage, which guides project regulation for the authorized purposes. In general, the schedules vary from high stages in the late fall and winter to low stages at the beginning of the wet season.

In the Kissimmee River Basin, the net hydrologic effect of the canal and control structures was to shorten the residence time of water in the basin during periods of high water (i.e., floods) and to increase the residence time during low-flow (i.e., drought) periods.

Based upon a review of historical U.S. Geological Survey Data, under similar hydrologic conditions, the overall volume of waters delivered to Lake Okeechobee from the Lower Kissimmee River Basin via the completed project was found to be relatively the same as those volumes experienced under pre-project conditions. The timing of those water deliveries has been changed, however, which is reflective of the current water management practices for flood control and water conservation purposes within the basin. Although the project achieved flood reduction benefits, it also harmed the river-floodplain ecosystem.

After extensive planning, construction for the Kissimmee River Restoration Project began in 1999 and was completed in July 2021. The Kissimmee River Restoration Project restores more than 40 mi^2 of the floodplain ecosystem, 20,000 ac of wetlands, and 44 mi of the historic river channel. The response of the natural system has exceeded expectations.

In the Lake Istokpoga area, the Project design does not prevent County Road 621 from being overtopped by floodwaters from Lake Istokpoga during large events. Flooding of County Road 621 during large events is expected and provides Lake Istokpoga with additional outlet capacity. The best method for the reduction of flood hazard in this area is the modification of flood damage susceptibility and the regulation of the use of the zone of potential flooding. Such a measure could promote optimum economic use of the Lake Istokpoga shores.

C.1.1.13 Water Supply

Lake Okeechobee

The primary consumptive water uses of Lake Okeechobee are irrigation of adjacent agricultural lands, water supply for the Seminole Tribe of Florida’s (STOF) Brighton and Big Cypress Reservations, Okeechobee Utility Authority and City of West Palm Beach, and to serve as a backup water supply for the Lower East Coast Service Area (LECSA) when rainfall and WCA storage are insufficient, primarily during dry periods (**Figure C.1-24**).

Lake Okeechobee and its connected conveyance system are the most significant surface water sources for the LOSA, which includes the EAA. Surface water from the lake and runoff from the EAA supply water to the regional system via canals and provide recharge to the SAS. Agriculture in the LOSA covered approximately 255,500 ac outside of the EAA and the 460,000 ac within the EAA in 2010 (most recent data available) and is the predominate user of lake water. Agricultural water supply demands equate to approximately 480,000 ac-ft per year for LOSA, which includes 303,000 ac-ft per year for just the EAA.

In 2008, the Corps implemented the 2008 LORS. The 2008 LORS provides operational flexibility to make Lake Okeechobee freshwater flows to meet project purposes, as specified in the Water Control Plan. The SFWMD also provides recommendations for Corps consideration regarding high volume flows to the Everglades or the Northern Estuaries for Lake Okeechobee water levels within the LOW, base-flow, or beneficial use sub-bands of the 2008 LORS.

The right to use water must be authorized by a permit issued by the SFWMD. The conditions of permit issuance are more specifically enumerated in Chapter 40E-2 of the Florida Administrative Code (F.A.C.), which also incorporates by reference the current SFWMD Applicant's Handbook (SFWMD 2022). To provide reasonable assurances that the conditions of permit issuance are met, applicants must meet consumptive use permitting criteria. Technical criteria are used to evaluate the purpose, quantity, and source of proposed water to prevent harm including the following: (1) saltwater intrusion, (2) wetland and other surface water body impacts, (3) pollution, (4) impacts to off- site land uses, (5) interference with existing legal users, and (6) minimum flows and levels.

Water supplies allocated from Lake Okeechobee and its connected conveyance systems are primarily for supplemental irrigation to the LOSA agricultural areas. In the LOSA, the Okeechobee Utility Authority is the only remaining PWS utility using water directly from Lake Okeechobee. The Okeechobee Utility Authority relies on Lake Okeechobee for part of its PWS supply, with the balance coming from a surficial aquifer wellfield. Clewiston, South Bay, Belle Glade, and Pahokee discontinued the use of Lake Okeechobee as their supply source in 2005 and now use Floridan Aquifer water treated by reverse osmosis to meet their PWS demand.

Water shortages are declared by the SFWMD Governing Board when available groundwater or surface water is not sufficient to meet users' needs or when conditions require temporary reduction in total use within the area to protect water resources from serious harm. The SFWMD's Water Shortage Plans are contained in F.A.C. Chapters 40E-21 and 40E-22. The purposes of the plans are to protect the water resources of the state from serious harm; assure equitable distribution of available water resources among all water users during times of shortage, consistent with the goals of minimizing adverse economic, social, and health related impacts; provide advance knowledge of the means by which water apportionments and reductions will be made during times of shortage; and promote greater security for consumptive use permittees.

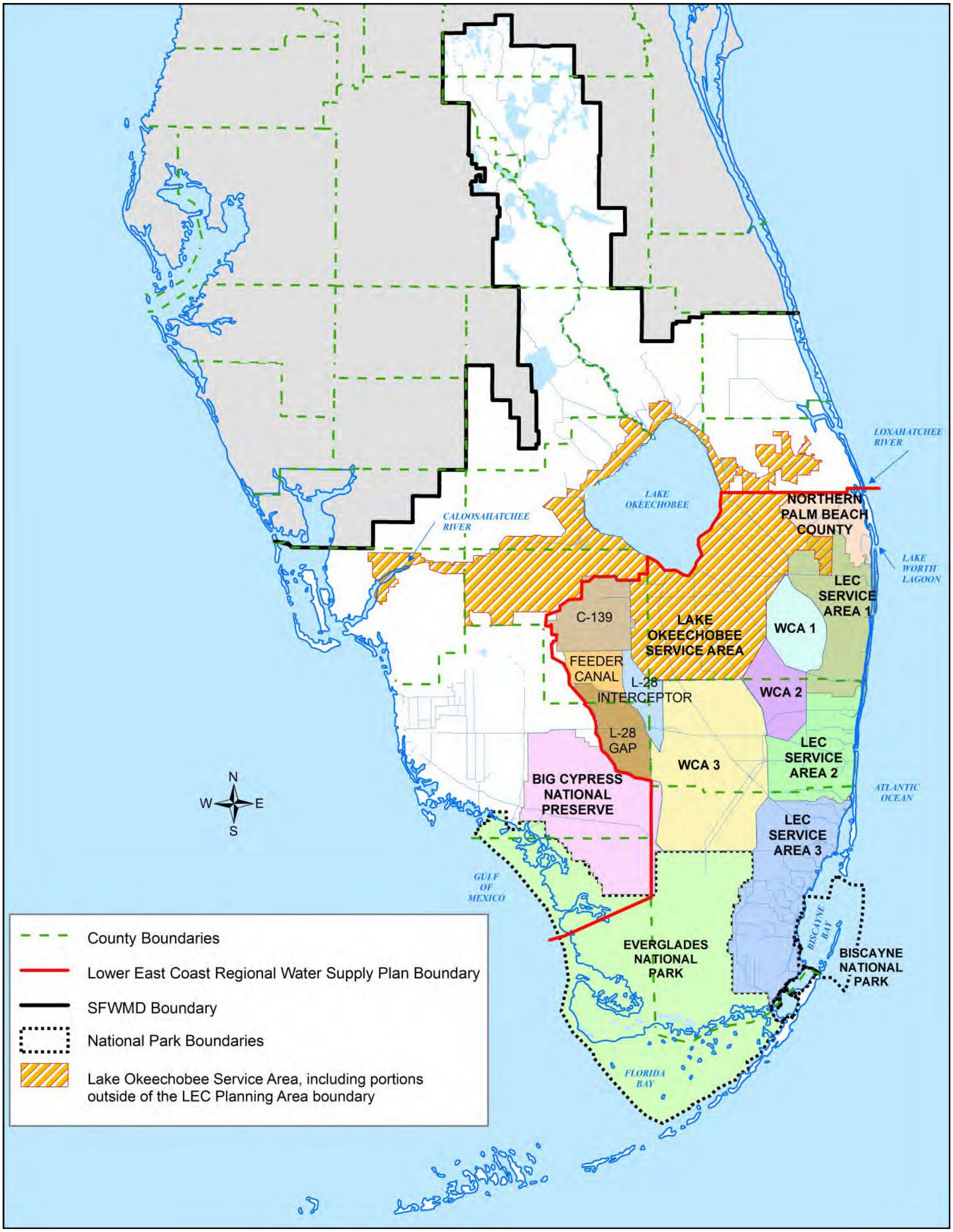


Figure C.1-24. Map of SFWMD Lower East Coast Service Area.

In October 2008, the SFWMD adopted Restricted Allocation Area criteria for the LOSA as part of the Minimum Flow and Minimum Water Level (MFL) recovery strategy for Lake Okeechobee following an extended drought and Corps implementation of the 2008 LORS, which generally lowered the water levels by 1 ft in Lake Okeechobee. According to the SFWMD, without modification to the current regulation schedule, surface water users in LOSA will continue to have a reduced level of certainty and require additional sources, such as groundwater, to obtain the permitted 1-in-10-year drought level of certainty. Because of the impacts to water supply, the SFWMD enacted rules to limit future additional withdrawals from Lake Okeechobee to prevent further degradation of the level of certainty for existing legal users and avoid exceeding the MFL criteria. Also, based on MFLs, Florida Statutes (F.S.) Section 373.709 requires development of water supply plans, which include MFL recovery strategies, water resource development, and water supply development projects necessary to achieve compliance with the MFLs during project planning phases. Implementing these projects will enable the replacement or an increase in current water sources with other supplies to help provide sufficient water amounts for beneficial use as stated in F.S. Section 373.0421. When these projects are finished, the SFWMD will certify the amount of available water as defined in F.A.C. Subsection 40E-8.021(5). The SFWMD permitting rules also ensure that water necessary for Everglades restoration is not allocated for consumptive use. The regulatory criteria limit allocations from Lake Okeechobee and connected surface waters, including the Caloosahatchee River and St. Lucie River (C-44 Canal), to base condition water uses as defined within the SFWMD *Applicant's Handbook for Water Use Permit Applications* for the period from April 1, 2001, to January 1, 2008 (SFWMD 2022).

Lake Istokpoga and Indian Prairie Canal System

Lake Istokpoga covers 27,692 ac, making it the fifth largest lake in Florida. The lake is shallow, averaging 4 to 6 ft in depth. It is fed by two creeks, Arbuckle Creek and Josephine Creek, and is connected to Lake Okeechobee through the Indian Prairie Canal System. The water level in Lake Istokpoga is controlled by operation of the G-85 (replaced by S-67) and S-68 water control structures in accordance with the Lake Istokpoga Regulation Schedule adopted by the Corps and implemented by the SFWMD. Lake Istokpoga is defined in F.A.C. Subsection 40E-8.021(11) as the lands and waters contained within the lake below 39 ft NAVD88, the top of the Lake Istokpoga Regulation Schedule.

Surface water from Lake Istokpoga and its associated canals traditionally has been used to meet irrigation demands in the Indian Prairie Basin between Lake Istokpoga and Lake Okeechobee in Highlands and Glades Counties. This area includes the Seminole Tribe of Florida's (STOF) Brighton Reservation and the Istokpoga Marsh Watershed Improvement District, both of which receive water from Lake Istokpoga and the canal system through agreements with the SFWMD. Additionally, approximately 10,000 ac of agricultural lands within the IMWID have separate SFWMD individual water use permits for various reasons, including use of groundwater wells not covered by the surface water agreement.

Historically, most irrigation demands in these areas have been met with water from Lake Istokpoga and the canal system. However, a lack of water storage capacity in the watershed and the challenges of flood control do not allow significant storage of water for use during periods of drought, when rainfall has been insufficient to maintain the lake above Zone C of the Lake Istokpoga Regulation Schedule. During such periods, the SFWMD may implement water restrictions to limit water use from the lake and canal system. For instance, multiple water restrictions were implemented in the Indian Prairie Basin from before 2006 through 2011.

To protect water levels in Lake Istokpoga, an MFL of 35.3 ft NAVD88 was adopted in 2006 (F.A.C. Subsection 40E-8.351). Significant harm criteria are based on the relationship between water levels in the lake and the health of littoral zone wetlands, which provide habitat for ecologically and economically important fish and wildlife; navigational and recreational access; and maintenance of historical runoff from Lake Istokpoga through the Indian Prairie Basin and canal system to Lake Okeechobee (SFWMD 2005). An MFL violation occurs in Lake Istokpoga when surface water levels fall below 35.3 ft NAVD88 for 20 or more weeks, within a calendar year, more often than once every 4 years.

A Restricted Allocation Area (RAA) for Lake Istokpoga/Indian Prairie Canal System was established in 1981 (Subsection 3.2.1.A of the Applicant's Handbook [SFWMD 2015]) that prohibits additional surface water allocations from the lake and canal system above existing allocations and any increases in surface water pump capacity. The RAA reduces the potential for SFWMD-declared water shortages in the basin during dry periods and prevents new users from reducing the level of certainty for existing permitted users and Tribal entitlements.

Seminole Tribe of Florida Water Supply

The STOF has six reservations located in Florida. The reservations include Brighton, Tampa, Fort Pierce, Immokalee, Hollywood, and Big Cypress. Hollywood is the headquarters location for the STOF.

Two STOF reservations rely on Lake Okeechobee as a secondary supplemental irrigation supply source for their surface water, with specific volumes of water identified for this purpose for the STOF's Big Cypress Reservation and an operational plan addressing drought-water shortage operations for the Brighton Reservation. The Brighton Reservation also relies on Lake Istokpoga and the Indian Prairie Basin Canal System for water supply.

The STOF has surface water entitlement rights pursuant to the 1987 Water Rights Compact between the STOF, State of Florida, and SFWMD (Public Law No. 100-228; 101 Statute 1556 and Chapter 87-292 Laws of Florida as codified in F.S. Section 285.165). Additional agreement documents addressing the Water Rights Compact entitlement provisions have since been executed. These documents include agreements between the Tribe and the SFWMD and an SFWMD Final Order. Of particular interest in this regard is the 1996 agreement, which commits the SFWMD to mitigate impacts to the Tribe's ability to obtain surface water supplies at both the Brighton and Big Cypress Reservations, which may be diminished as a result of various activities.

For the Big Cypress Reservation, the SFWMD has installed forward pumps in the past to deliver water from Lake Okeechobee at lower stages to the Miami Canal. This option remains a part of drought management alternatives. Also, real-time operational decisions made during a declared drought event include recognition of the Tribe's water rights. These decisions remain a part of the SFWMD drought management operations.

For the Brighton Reservation, various options of securing both short and long-term water supply deliveries to agricultural operations in the Southern Indian Prairie Basin are being evaluated extensively and implemented where possible. For example, other water source and conveyance options, including deviations to the Lake Istokpoga Regulation Schedule (Corps 1994) to provide for additional water supply and modifications to the C-40 canal to augment the pump station G-208 capability, have been implemented.

C.1.1.14 Air Quality

The EPA Region 4 and FDEP regulate air quality in Florida. The Clean Air Act (42 United States Code [U.S.C.] 7401-7671q), as amended, assigns the EPA responsibility to establish the primary and secondary National Ambient Air Quality Standards (NAAQS) (40 Code of Federal Regulations [CFR] Part 50) that specify acceptable concentration levels of six criteria pollutants: particulate matter (measured as both particulate matter less than 10 microns in diameter [PM_{10}] and particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), and lead (Pb) (**Table C.1-2**). Short-term NAAQS (1-, 8-, and 24-hour periods) have been established for pollutants contributing to acute health effects, while long-term NAAQS (annual averages) have been established for pollutants contributing to chronic health effects. While each state has the authority to adopt standards stricter than those established under the federal program, the State of Florida has accepted the federal standards.

Federal regulations designate Air Quality Control Regions (AQCR) in violation of the NAAQS as nonattainment areas. Federal regulations designate AQCRs with levels below the NAAQS as attainment areas. The entire state of Florida is in attainment for all criteria pollutants (EPA 2023).

Table C.1-2. National Ambient Air Quality Standards.

Pollutant	Primary/Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)	Primary	8-hour	9 ppm	Not to be exceeded more than once a year
Carbon Monoxide (CO)	Primary	1-hour	35 ppm	Not to be exceeded more than once a year
Lead (Pb)	Primary and Secondary	Rolling 3-month average	0.15 $\mu g/m^3$	Not to be exceeded
Nitrogen Dioxide (NO_2)	Primary	1-hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Nitrogen Dioxide (NO_2)	Primary and Secondary	Annual	53 ppb	Annual mean
Ozone (O_3)	Primary and Secondary	8-hour	0.070 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
Particulate Matter ($PM_{2.5}$)[a]	Primary	Annual	12 $\mu g/m^3$	Annual mean, averaged over 3 years
Particulate Matter ($PM_{2.5}$)[a]	Secondary	Annual	15 $\mu g/m^3$	Annual mean, averaged over 3 years
Particulate Matter ($PM_{2.5}$)[a]	Primary and Secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
Particulate Matter (PM_{10})	Primary and Secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years

Pollutant	Primary/Secondary	Averaging Time	Level	Form
Sulfur Dioxide (SO_2)	Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
Sulfur Dioxide (SO_2)	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: 40 CFR 50.1-50.12, EPA 2023.
ppb–parts per billion; ppm–parts per million;µg/m^3–micrograms per cubic meter

C.1.1.15 Hazardous, Toxic, or Radioactive Wastes

Engineering Regulation (ER) 1165-2-132 states that “construction of Civil Works projects in HTRW contaminated areas should be avoided where practicable.” Compliance with the requirements of ER 1165-2-132 for the planning phase is demonstrated in this report. The Corps and SFWMD will continue to document HTRW conditions on the Project Area, such that the Project will be in compliance with the ER and other applicable HTRW policies. To comply with the requirements of ER 1165-2-132, human health risks are typically evaluated by comparing chemical concentrations in all media (e.g., soil, groundwater, surface water, sediment) to human health-based cleanup target levels (CTL) promulgated by FDEP in F.A.C. Chapter 62-777. Ecological risks are typically evaluated by comparing chemical concentrations to the Sediment Quality Assessment Guidelines (SQAG) developed by FDEP for inland waters and to ecological restoration targets established by the USFWS. If warranted, lands within the Project footprint are investigated in accordance with the jointly developed (FDEP, USFWS, and SFWMD) protocol entitled “Protocol for Assessment, Remediation and Post-remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects” (SFWMD 2008). The protocol, which is commonly referred to as the Ecological Risk Assessment (ERA) Protocol, is intended to provide guidance on conducting ESAs on agricultural lands proposed for use in projects to be inundated with water, such as for conversion to STAs, wetlands, reservoirs, and other aquatic features.

The ERA Protocol requires that relevant data collected during the Phase II Environmental Site Assessment (ESA) initially be compared to the human health Soil Cleanup Target Levels (SCTL) from F.A.C. 62-777and the ecological risk SQAG thresholds. While the SCTL’s are promulgated standards under Florida law, the SQAG guidelines are not standards as defined in Section F.S. 403.803; where the results exceed the SCTLs, a risk-based approach is used by the regulator to determine if corrective action is required or if an alternative target level is appropriate based on projected exposure. Where the results exceed the SQAG screening criteria, a Screening Level Ecological Risk Assessment (SLERA) is performed as part of the Phase II ESA. The purpose of the SLERA is to evaluate potential ecological risks to benthic invertebrates and higher trophic species, particularly USFWS trust species protected under the Endangered Species Act or the Migratory Bird Treaty Act, associated with exposure to the chemicals present in the soils, after the project is constructed and the property is inundated.

The SFWMD reviewed available data and documentation associated with the parcels contained within the Project footprint. At a minimum for screening and budgetary purposes, a desktop screening-level ESA should be conducted for each parcel to identify activities or conditions adverse to the Project’s water quality. The desktop review includes the analysis of current and historical aerial photography, a regulatory database search as listed in ASTM-E1527-13 and 40 CFR Part 312, *Standards and Practices for all Appropriate Inquiries*, and a review of available regulatory records on the FDEP OCULUS database management system. Emphasis should be given to identification of potential “point sources” of contamination such as current/former agricultural areas, including agricultural fields, pump stations, maintenance areas, fueling facilities, and pesticide/herbicide mix/load/rinse/storage areas. The regulatory database search includes the following:

- Federal National Priorities List (NPL)(1-mi radius);
- Federal Delisted National Priorities List (0.5-mi radius);
- Federal Superfund Environmental Management System (SEMS) (former Comprehensive Environmental Response, Compensation, and Information System [CERCLIS] list) (0.5-mi radius);
- Federal SEMS–Archive (former CERCLIS NFRAP list) (0.5-mi radius);
- Federal Resource Conservation and Recovery Act (RCRA) Corrective Action Report (CORRACTS) list (1-mi radius);
- Federal RCRA non-CORRACTS Treatment, Storage, and Disposal (TSD) list (0.5-mi radius);
- Federal RCRA Generators list (property and adjoining properties only);
- Federal institutional control/engineering control registries (property only);
- Federal Emergency Response Notification System (ERNS) list (property only);
- State and Tribal equivalent cleanups (1-mi radius);
- State and Tribal equivalent CERCLIS (0.5-mi radius);
- State and Tribal landfill and/or solid waste disposal site lists (0.5-mi radius);
- State and Tribal equivalent Leaking Underground Storage Tank (LUST) list (0.5-mi radius);
- State and Tribal registered storage tank lists (property and adjoining properties only);
- State and Tribal institutional control/engineering control registries (property only);
- State and Tribal voluntary cleanup sites (0.5-mi radius); and
- State or Tribal Brownfield sites (0.5-mi radius).

If HTRW issues are identified in the desktop screening-level ESA, then a Phase I and possibly a Phase II ESA should be completed to understand the nature and extent of any contaminants of concern. Should remediation of HTRW contamination be required, it is the responsibility of the SFWMD, the non-federal sponsor, and is not a creditable cost to the Project. Regardless of whether a parcel has been assessed to date, the SFWMD practice is to conduct ESAs, or updates to ESAs, to confirm historical conditions and ensure all HTRW conditions have been identified and resolved prior to Project construction.

The LOCAR footprint contains parcels of land that are privately owned, and there are no available ESAs or environmental documentation from the SFWMD regarding the HTRW status of these parcels. The SFWMD has no available environmental documentation describing the presence or non-presence of HTRW conditions on these parcels.

C.1.1.16 Noise

Noise levels are associated with surrounding land use. Within the major natural areas of South Florida, external sources of noise are limited and of low occurrence. Wilderness ambient sound levels are typically in the range of 35 decibels (dB) and should not be an issue for wildlife.

There are no significant noise generating land users within the Project Area. Existing sources of noise are limited to the vehicular traffic travelling on roads adjacent to and cutting through the Project Area and an adjacent substation. Sound levels are typically in the range of 85 to 100 dB for heavy duty trucks passing 15 ft away (Berger et al. 2023).

No known ambient noise monitoring has been conducted in the Project Area; consequently, no quantitative data on noise levels within the Project Area are available for analysis.

C.1.1.17 Aesthetics

Existing visual aesthetics are marginal. The visual characteristics of South Florida can be described according to the three dominant land use categories: natural areas, agricultural lands, and urban areas. The natural areas consist of a variety of upland and wetland ecosystems, including lakes, ponds, vast expanses of marsh and wet prairie, with varying vegetative components. Uplands are often dominated by pine, although other sub-tropical and tropical hardwoods, such as Brazilian pepper, fig, gumbo limbo, oak and cypress, do occur. These areas are more fully described in **Subsection C.1.1.2**. Overall, the land is extremely flat, with few natural topographic features, such as hills or other undulations. Much of the visible topographic features within the natural areas are humanmade, including canals and levees. Additional humanmade features include pump stations, navigation locks, secondary and primary roads, highways, electrical wires, communication towers, occasional buildings, borrow pits, and other features that may or may not detract from the regional aesthetic. Visual aesthetics from a high perspective, such as atop a levee, offer pleasant and unspoiled perspectives of numerous birds and other wildlife. Agricultural lands are cultivated for cattle ranching, citrus, and greenhouse/nursery. Development is typically immediately adjacent to or nearby protected natural areas. These areas are more fully described in **Subsection C.1.1.18**.

There are many public access points to view Lake Okeechobee from the HHD elevated vantage point and scenic trail (LOST), which runs atop the HHD approximately 110 mi around the entire lake. The HHD crest affords panoramic views of the flat agricultural fields. The extensive littoral zone on the west side of the Lake Okeechobee can also be viewed from HHD. The littoral zone plant community is composed of a mosaic of emergent and submerged plant species. Emergent vegetation within the littoral zone is dominated by cattail, beak rush/spike rush, and willow.

C.1.1.18 Land Use

The Study Area is approximately 1,450,000 ac and is comprised of portions of the Lake Okeechobee, St. Lucie, and Caloosahatchee River Watersheds. The Project Area is comprised of approximately 920,000 ac and includes four major drainage basins: Fisheating Creek, Indian Prairie, Taylor Creek/Nubbin Slough, and Lower Kissimmee (S-65D and S-65E). The Project Area is a portion of the Study Area where Project feature placement was considered (**Figure C.1-25**). The land use categories for the Study Area are summarized in **Table C.1-3. Table C.1-4** summarizes land use in the preliminary Project Area. Most of the lands in the preliminary Project Area are cropland and pastureland, tree crop, and vegetated non-forested wetlands.

The Study Area contains Lake Okeechobee and peripheral lands collectively, equating to 450,000 ac (approximately 720 mi^2). Lake Okeechobee is comprised of approximately 350,000 ac of fresh water and 100,000 ac of wetlands, freshwater marshes, and wetland forests. The remaining 3,299 ac of land in this basin are a combination of barren lands, parks and recreational areas, and commercial land use. Lake Okeechobee acts as a reservoir that provides drinking water for nearby urban areas, is a source for multiple fisheries, and is used for recreation.

The Fisheating Creek Drainage Basin consists of approximately 298,379 ac. Over 56 percent of the lands are used as pasture predominantly for cattle grazing, and 24 percent of the land in this area is composed of freshwater marshes and wetlands. Less than 2 percent of the lands in this area are used for residential, commercial, and industrial purposes. This drainage basin contains a stream that is the only remaining natural-flowing watercourse feeding into Lake Okeechobee.

The Project Area is in the Indian Prairie Drainage Basin. The Indian Prairie Drainage Basin consists of approximately 276,507 ac. The lands in this sub-watershed are used primarily for pasture (60 percent) and citrus (11 percent). Less than 2 percent of the lands in this sub-watershed are categorized as residential, commercial, and industrial land uses. The Brighton Indian Reservation belonging to the STOF consists of 36,000 ac and is located within this sub- watershed. The lands belonging to the STOF are used for various purposes, including residential, cattle operations, and agricultural purposes, and commercial businesses, including restaurants and a casino.

The S-65D and S-65E basins of the Lower Kissimmee Drainage Basin are comprised of approximately 145,586 ac. The S-65D basin is approximately 116,590 ac, where 65 percent of the lands are used for pasture and rangeland. Nearly 20 percent of this area is classified as fresh water, marshes, and wetland forests. S-65E is the smallest basin, with approximately 28,997 ac of land. Over 66 percent of the land use is pasture and rangeland, 15 percent is used for agricultural purposes, such as row crops, citrus, and dairies, and the remaining land use is a mix of residential, forests, freshwater marshes, and wetlands. Both basins have less than 2 percent residential land use. These basins were specifically named in the Northern Everglades and Estuaries Protection Program (NEEPP) statute (F.S. 373.4595) as priority basins for the Lake Okeechobee Watershed Construction Project.

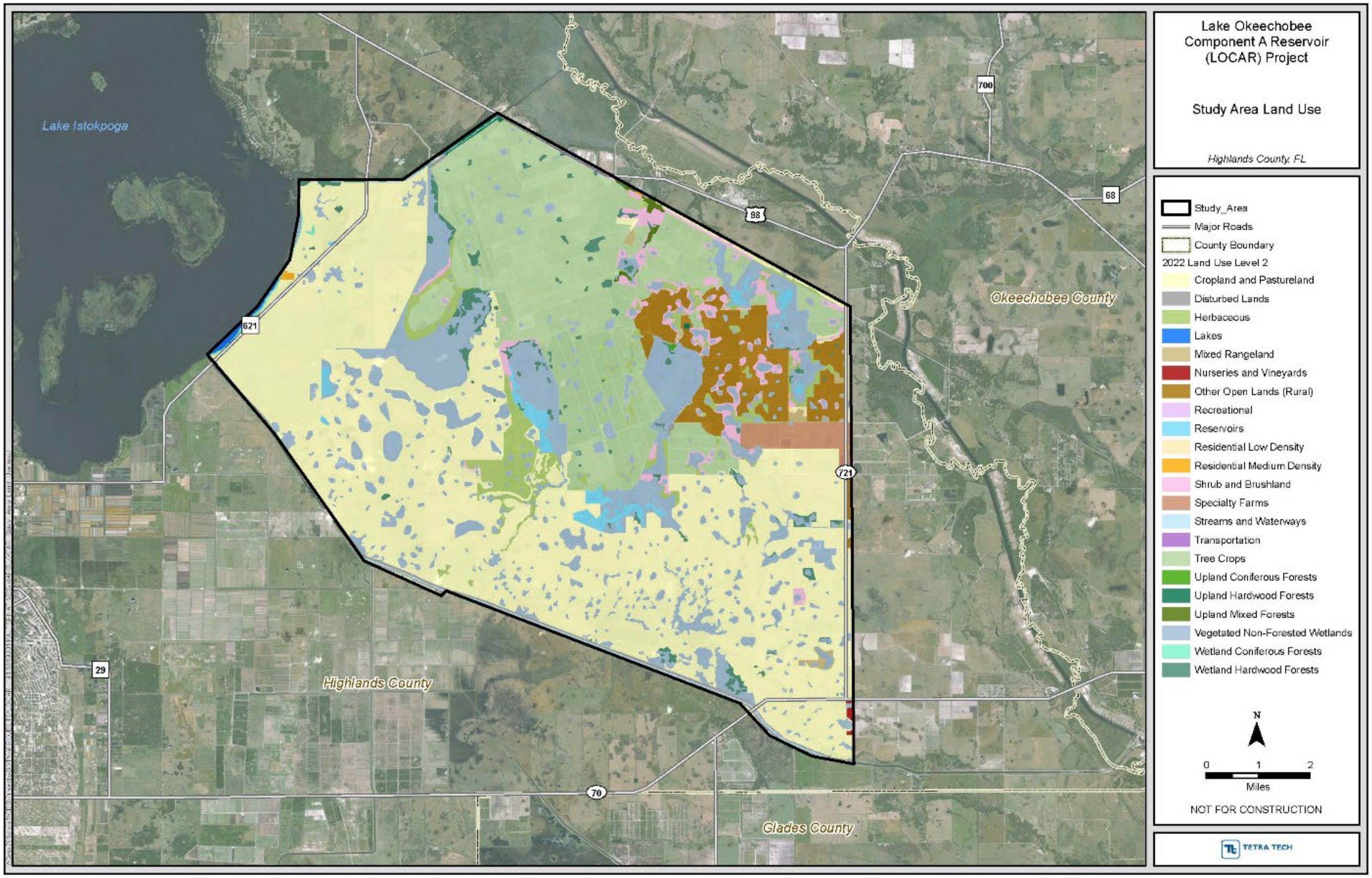


Figure C.1-25. Project Area land use.

Table C.1-3. Summary of land use (by acreage) in the Study Area.

Land Use Category	Caloosahatchee River	Fisheating Creek	Indian Prairie	Lake Okeechobee	S-65D	S-65E	St Lucie River	Taylor Creek/ Nubbin Slough	Total Acreage for each Land Use Category
Agricultural Other	6	830	1,636	0	4,264	1,884	12	6,249	14,881
Barren, Spoil	47	1,100	3,680	2,448	486	152	6	1,587	9,505
Commercial and Services	13	221	205	230	37	0	4	1,435	2,146
Extractive, Borrow, Holding Ponds	0	0	0	0	0	0	0	537	537
Field and Row Crops, Sugar Cane	1	1,489	20,769	0	5,894	1,706	3	11,665	41,526
Fresh Water	18,037	808	2,887	350,000	1,145	716	2,067	2,469	377,983
Freshwater Marsh, Wet Prairie	0	42,714	28,573	100,000	13,502	2,373	0	10,335	142,609
Industrial	0	4	18	0	0	0	0	171	193
Institutional	0	30	93	5	0	0	0	860	989
Mangrove, Saltwater Marsh	998	0	0	0	0	0	20	0	1,017
Parks, Recreation, Golf	54	0	0	70	10	0	6	467	607
Pasture	2	153,639	166,737	0	59,784	18,417	6	124,615	523,200
Rangeland	21	13,608	5,691	290	16,482	738	27	2,882	39,740
Residential High Density	23	0	0	0	17	0	6	60	107
Residential Low Density	70	2,275	1,874	0	1,446	545	38	8,218	14,465
Residential Medium Density	229	168	1,048	11	73	124	31	4,965	6,648
Salt Water	54,354	0	0	0	0	0	11,779	0	66,134
Transportation, Communications, Utilities	8	624	146	0	28	0	4	831	1,641
Tree Crops, Citrus	2	8,109	30,453	0	1,963	748	8	6,076	47,359
Tree Plantations	0	19,718	404	0	9	18	0	55	20,204
Upland Coniferous Forests	0	8,713	969	0	105	84	4	1,325	11,200
Upland Hardwood Forests	20	14,703	2,407	240	1,715	196	76	3,478	22,837
Urban Other	10	575	1,764	5	2,092	0	2	1,594	6,041
Wetland Forest	13	28,914	6,588	3,779	7,270	1,270	77	7,763	55,674
Wetland Other	1,504	137	566	45,321	270	25	619	156	48,598
Total Acreage for each Basin	75,412	298,379	276,507	450,000	116,590	28,997	14,794	197,796	1,455,840

Table C.1-4. Summary of 2022 Land Use (by Acreage) in the Project Area.

Land Use Category	Project Area
Cropland and Pastureland	28,566
Disturbed Lands	578
Herbaceous	2,048
Lakes	97
Mixed Rangeland	192
Nurseries and Vineyards	34
Other Open Lands <Rural>	2,842
Recreational	0.14
Reservoirs	716
Residential Low Density	21
Residential Medium Density	32
Shrub and Brushland	1,417
Specialty Farms	752
Streams and Waterways	267
Transportation	77
Tree Crops	12,521
Upland Coniferous Forests	14
Upland Hardwood Forests	74
Upland Mixed Forests	103
Vegetated Non-forested Wetlands	9,542
Wetland Coniferous Forests	74
Wetland Hardwood Forests	888
Total Area	**60,853**

The Taylor Creek/Nubbin Slough Drainage Basin consists of approximately 197,796 ac, where 63 percent of the lands are used for pasture cattle grazing. Of the four sub-watersheds, Taylor Creek/Nubbin Slough has the most residential land use of 8 percent, as is contains the city of Okeechobee. Additionally, this drainage basin contains a large portion of wetlands and freshwater marshes, comprising almost 10 percent of the landscape. The Taylor Creek/Nubbin Slough Drainage Basin also contains the S-191 and S-154 basins, which were also identified as priority basins per the NEEPP statute.

The Caloosahatchee River and its associated estuaries included in the Study Area consist of approximately 75,412 ac, with over 95 percent saltwater and freshwater bodies. The remaining area is comprised of a mix of wetlands, marshes, residential, and commercial land use.

The St. Lucie River and its associated estuaries included in the Study Area are comprised of 14,794 ac, consisting of approximately 94 percent saltwater and freshwater bodies, and nearly 5 percent are wetlands, mangroves, and marshes. The remaining acres are a mix of pasture, citrus and row crops, upland forests, residential, and urban land use.

C.1.1.19 Recreation

There are many recreational opportunities throughout South Florida; however, with the dense urban surroundings, demand often exceeds availability. Recreational resources in the Lake Okeechobee region are primarily water based. Lake Okeechobee and the Okeechobee Waterway provide approximately 154 mi of navigable waterway for commercial navigation and many more for recreational boating. Lake

Okeechobee is recognized as supporting one of the best recreational fisheries in the nation. Several major sport-fishing tournaments are held on the lake annually, bringing significant revenues to the surrounding area. Recreational areas are located around Lake Okeechobee offering day use facilities, campgrounds, hiking and biking trails, and boat ramps. The LOST is designated as a segment of the Florida National Scenic Trail, encompassing 110 mi of the lake atop HHD. Heavy seasonal waterfowl use of Lake Okeechobee attracts hunters and recreational enthusiasts as well. Lake Okeechobee has also been a popular destination for airboat rides. Lake Okeechobee offers alligator hunting and is subdivided into four Alligator Harvest Units.

Recreation opportunities in the Northern Estuaries include easy access to fresh, estuarine, and marine resources for fishing, boating, swimming, diving, camping, and sightseeing. Numerous recreation areas, such as the Ortona Lock Recreation Area, Caloosahatchee Regional Park, and W.P. Franklin Lock Recreational Area, are extensively used.

Recreational opportunities are also present within the Kissimmee River Public Use Area (PUA) and are open to public access year-round. Primary recreational opportunities include hunting, fishing, camping, hiking, and bicycling. Game species occurring in the PUA include white-tailed deer, Wilson's snipe, feral hog, marsh rabbit, blue-winged teal, mottled ducks, and others. Alligator hunting is also currently administered by the FWC in the Kissimmee River area. The FWC divides the river and adjacent lakes into multiple Alligator Harvest Units.

The 2019 State Comprehensive Outdoor Recreation Plan (SCORP) is a reliable source to determine if Florida residents and tourists need additional facilities to support outdoor recreation. Household and individual surveys were conducted to determine participation in 35 outdoor recreation activities. Florida's top 10 outdoor recreational activities are illustrated in **Figure C.1-26**.

Figure C.1-26. Florida's top outdoor recreation activities (FDEP 2019).

C.1.1.20 Socioeconomics

This section describes the socioeconomics in the Study Area, which includes Glades, Highlands, Martin, Okeechobee, and Palm Beach Counties.

Economic Activities In and Around Lake Okeechobee

One of the primary economic activities throughout the Study Area is agriculture and agribusiness. Highlands County annually ranks as one of the top three counties in cattle production and in the top five counties for citrus production in the state, is home to the second largest nursery in Florida, and is the top fertilizer producer in the state (Florida Heartland Economic Region of Opportunity [FHERO] 2023a). Glades County's economy has historically been agriculture and expanded into manufacturing with citrus processing and sugarcane refining (WTC Palm Beach 2023). Martin County is ranked top 10 in the state for citrus and vegetable production, sugarcane, ornamentals, and cattle production, and is home to the Armellini Express Lines corporate headquarters, a produce and floral trucking company (Stuart/Martin County Chamber of Commerce [SMCCC] 2023). Okeechobee County is home to dairy farms and a livestock market (Okeechobee County 2023). Palm Beach County is 1 of the 10 largest county agricultural industries in the U.S., leading the nation in the production of sugarcane, sweet corn, and sweet bell peppers (Central Palm Beach County Chamber of Commerce [CPBCCC] 2023).

Agriculture is an important industry in south-central Florida, with agriculture and agribusiness being a major employer in the Study Area and nearby Desoto, Hardee, and Hendry Counties (FHERO 2023b). The EAA, located around and south of the southern portion of Lake Okeechobee, consists of approximately 500,000 ac of highly productive agricultural land, most of which is under active sugarcane cultivation. In addition to sugarcane, crops grown in the EAA include an array of winter vegetables, including cabbage, celery, green beans, lettuce and other leafy greens, radishes, rice, sweet corn, and sod. The EAA is the nation's top producer of sweet corn and radishes and is Florida's top producer of celery and the state's only rice growing region. Florida is the nation's top producer of sugarcane. The majority of the EAA lies within Palm Beach County, where agricultural sales generate more than $11 billion annually and provide more than 118,000 jobs. The agricultural operations are vertically integrated and there are 4 raw sugar mills, 2 sugar refineries, 1 sugar packaging and distribution center, 1 rice mill, 10 fresh vegetable packing houses and distribution centers, and 1 renewable energy facility (EAA Farmers 2018). Other agricultural activities in the Lake Okeechobee watershed include citrus, dairy, livestock, and pasture operations.

A second major economic activity in the Study Area is recreation and tourism. Lakes, rivers, the Atlantic Ocean, and the adjacent waterfront land provide opportunities for birding, biking, boating, hiking, paddling, and swimming. Highlands County is home to the Sebring International Raceway (auto racing), and Palm Beach County has the Palm Beach International Equestrian Center. Lake Okeechobee and its associated waterways, shoreline, and the LOST on top of the dike provide a variety of water-based recreation activities for local residents and tourists. Recreation facilities associated with Lake Okeechobee include: 20 picnic sites, 13 camping areas, 9 play areas, a public swimming area, 9 marinas, 33 public boat ramps, 9 fishing piers, general recreation areas, hundreds of acres open to hunting, and walking trails (SFWMD n.d.). More than 3 million recreational visitors come to the lake each year and spend an estimated $125 million, directly supporting more than 1,300 local jobs (FWC 2022).

Additionally, Lake Okeechobee supports an active commercial and recreational fishing industry. This includes several different types of commercial fishing operations and landside support activities, such as marinas and wholesale and retail distribution facilities. Recreational fishing tournaments are held on the lake multiple times per year. FWC manages several alligator harvest programs to manage the lake's alligator population. Alligators can be harvested from the lake population only by persons with proper licenses and permits (FWC 2022).

The depth of Lake Okeechobee also makes commercial navigation on the lake possible. The Okeechobee Waterway (OWW) allows passage of boats between the Atlantic Ocean and the Gulf of Mexico through Lake Okeechobee. There are two navigation routes in Lake Okeechobee, including Route 1 through the center of the lake and Route 2 along the south shore of the lake. Only Route 1 is fully maintained at its authorized depth for commercial navigation. In 2013, there were 1,021 tons of cargo reported shipped on the OWW, and these tons were for the movement of machinery and primary manufactured goods (FDOT 2016). Other commercial navigation includes fleets of day/dinner cruise vessels that operate from Pahokee during the tourist season.

In addition to agriculture, commercial fishing, navigation, recreation, and tourism, secondary economic activities in the Study Area include services (i.e., banking, insurance, etc.), healthcare, education, and government activities. Examples of these industries in Highlands County include Advent Health, Avon Park Air Force Range, Central Florida Healthcare, Highlands Regional Medical Center, South Florida State College, and the Avon Park Correctional Institute (FHERO 2023a; HCED 2023). Other examples in the Study Area include the Florida Community Health Center, Glades County Regional Training Center, and Suncoast Trucking Academy in Glades County (FHERO 2023c); Indian River State College, Chapman School of Seamanship, Cleveland Clinic Indian River Hospital, and a U.S. Customs and Border Patrol Agency facility in Martin County (SMCCC 2023); HCA Florida Raulerson Hospital in Okeechobee County; and Lakeside Medical Center, the University of Florida-Everglades Research and Education Conference Center, Palm Beach State College Belle Glade Campus, and the Dolly Hand Cultural Arts Center in Palm Beach County. There are also public school districts and city, county, and state government administrative and law enforcement offices in the Study Area.

Population centers in the Study Area include Avon Park, Sebring, Moore Haven, Buckhead Ridge, STOF Brighton Reservation, Stuart, Palm City, Indiantown, Okeechobee, Taylor Creek, Pahokee, Belle Glade, and South Bay. Avon Park and Sebring are in Highlands County northwest of Lake Okeechobee. The cities are adjacent to each other and are the largest population centers in the county. Sebring is home to the Sebring International Raceway and is the Highlands County seat. Moore Haven, Buckhead Ridge, and STOF Brighton Reservation, on the west side of Lake Okeechobee, are in Glades County. Moore Haven is the county seat, and Buckhead Ridge caters to outdoor enthusiasts with boat charters, an outfitter, and recreational vehicle (RV) parks. STOF Brighton Reservation has the Seminole Casino Brighton and the Fred Smith Rodeo Arena. Stuart, Palm City, and Indiantown are in Martin County, east of Lake Okeechobee. Martin County's largest population centers are concentrated on the Atlantic Coast, including Stuart (the county seat) and Palm City. Indiantown is an inland rural community in Martin County, approximately 14 mi east of the lake, with a golf and country club, and a marina and a park on the OWW. Okeechobee and Taylor Creek are on the north side of the lake in Okeechobee County and have hotels, restaurants, retail stores, and a hospital. Okeechobee is also the county seat. Pahokee, Belle Glade, and South Bay, on the southeast side of Lake Okeechobee in Palm Beach County, are a cluster of farming communities known as "The Glades," and are a major hub of Florida's agricultural heartland (The Palm Beaches 2023). Belle Glade is also home to post-secondary education centers and a hospital. Moore Haven and Buckhead Ridge, on the west side of the lake, are in Glades County. Moore Haven is the county seat, and Buckhead Ridge caters to outdoor enthusiasts with boat charters, an outfitter, and RV parks.

Demographics

Demographically, the communities around Lake Okeechobee are highly diverse. The demographic characteristics in most communities of the Study Area include the following (U.S. Census Bureau [USCB] 2023).

- Below-average income levels;
- Lower than average levels of formal education;
- Relatively high percentage of people of color populations (people of color include those who identify their racial status as other than white alone or their ethnicity as Hispanic or Latino, and are identified in USCB data as Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and other Pacific Islander, persons of two or more races, and persons of Hispanic or Latino origin);
- Relatively high percentage of persons below the poverty line; and
- Relatively large number of households for which English is not the first language.

Notable exceptions to the above are Palm Beach City and Stuart, which are cities on the Atlantic Coast in Martin County, with higher-than-average income and education levels and lower percentages of people in poverty (USCB 2023).

In addition to the above listed characteristics, which were measured in the 2020 American Community Survey, two other characteristics are not captured in the census data:

- Relatively high number of undocumented residents; and
- Relatively high seasonal population (i.e., “snowbirds”).

The undocumented residents are associated with migrant labor camps that support citrus, sugarcane, and other agricultural production. The seasonal population is associated with recreational opportunities in the tourist season. Many seasonal residents spend the winter months in these communities due to mild winter climate. Some mobile home RV parks cater to seasonal residents, and several of these parks are adjacent to HHD.

Most of the Project Area is rural and agricultural. However, there are a number of towns and cities located in the Study Area in proximity to Lake Okeechobee (see **Figure C.1-27** and **Table C.1-5**). In most of these communities, homes, businesses, and public buildings can be found within 100 ft of the dike. The largest of the communities is Belle Glade, located near the Hillsboro Canal, with a population of almost 19,830 people. The Study Area also includes the STOF Brighton Reservation in Glades County, which is home to approximately 560 people (USCB 2023).

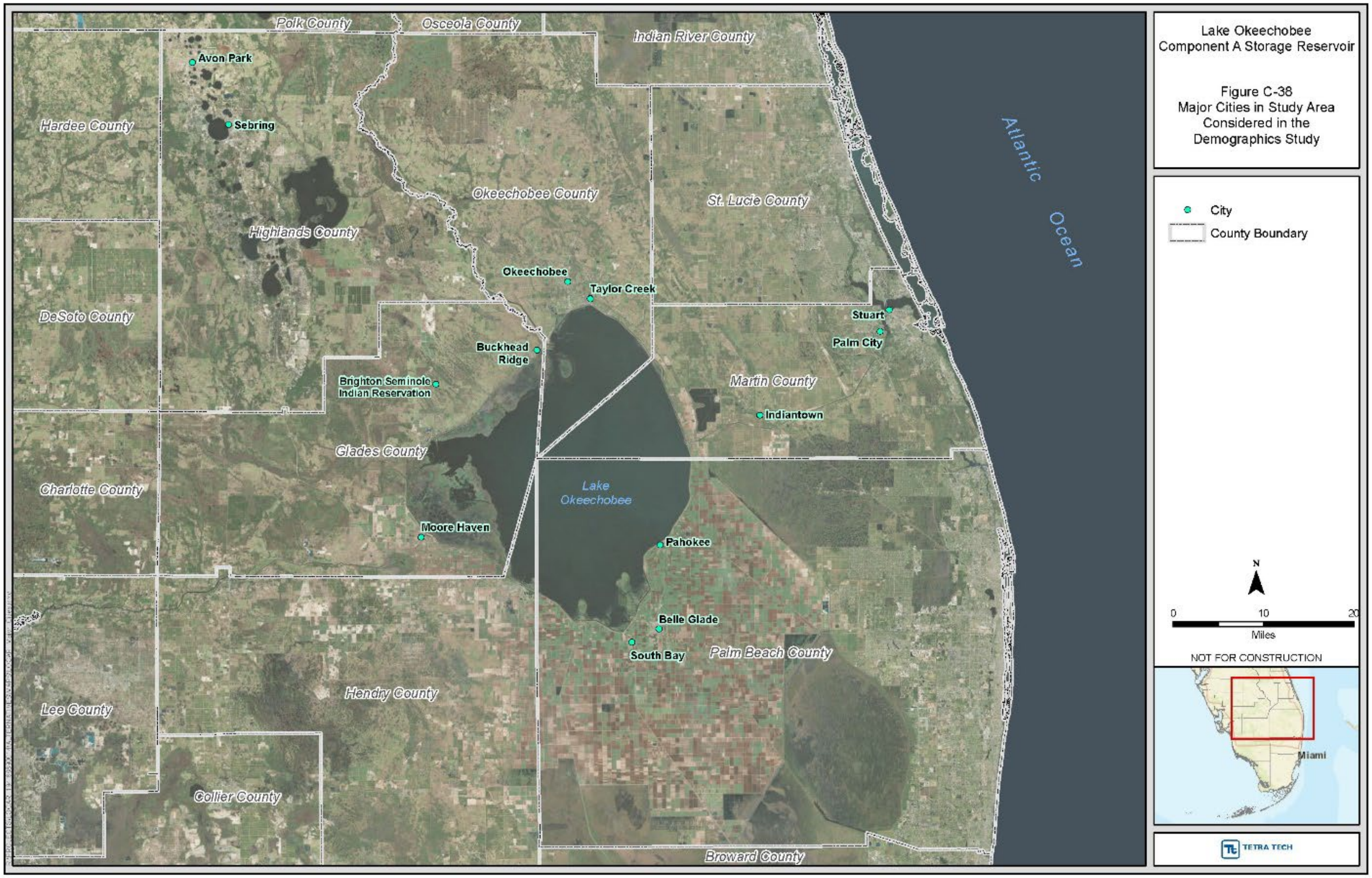


Figure C.1-27. Major cities in the Study Area considered in demographics study.

Table C.1-5. Major Population Centers in the Study Area.

City/Town/Reservation	County	2020 Population
STOF Brighton Reservation	Glades	557
Buckhead Ridge	Glades	1,455
Moore Haven	Glades	2,302
Avon Park	Highlands	10,539
Sebring	Highlands	10,454
Indiantown	Martin	7,125
Palm City	Martin	25,038
Stuart	Martin	16,279
Okeechobee	Okeechobee	5,574
Taylor Creek	Okeechobee	4,337
Belle Glade	Palm Beach	19,829
Pahokee	Palm Beach	6,286
South Bay	Palm Beach	6,665

Source: USCB 2023.

In general, these are diverse, relatively low-income communities, with the previously mentioned exception of Palm City and Stuart in Martin County. Glades, Highlands, and Okeechobee Counties all have median household incomes that are less than the state average. They also have a relatively high proportion of households below the poverty line (**Table C.1-6**). Martin and Palm Beach Counties have above average median household incomes, but the communities in these counties near Lake Okeechobee (i.e., Belle Glade, Indiantown, Pahokee, and South Bay) have socioeconomic characteristics much more similar to Glades, Highlands, and Okeechobee Counties (USCB 2023).

Table C.1-6. Demographic and Economic Characteristics of Counties in the Study Area.

Geographic Area	2020 Population	Median Household Income (in 2020 Dollars)	People of Color	Persons below Poverty Line
United States	326,569,308	$64,994	39.9%	12.8%
State of Florida	21,216,924	$57,703	46.6%	13.3%
Glades County	13,777	$39,709	40.1%	17.1%
Highlands County	104,574	$43,708	33.9%	16.0%
Martin County	160,420	$65,821	22.0%	10.3%
Okeechobee County	41,611	$46,097	37.4%	17.8%
Palm Beach County	1,482,057	$65,015	46.1%	11.6%

Source: USCB 2023.

C.1.1.21 Environmental Justice

Environmental justice (EJ) is addressing, as appropriate, disproportionate and adverse human health or environmental or climate-related effects of federal programs, policies, and activities on communities with EJ concerns, which includes communities with a significant proportion of people in poverty, or with a significant proportion of minority populations in Executive Order (EO) 12898. EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, EO 14008, *Tackling the Climate Crisis at Home and Abroad*, and EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All,* require an analysis of environmental effects, including human health, economic, social, and climate-related effects, of federal actions on communities with EJ concerns, when such analysis is required by NEPA. The intent of EJ is that no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental, and commercial operations or policies. This section identifies minority, low- income, and Native American Tribal populations that exist within the LOCAR area of potential effect. See **Section C.1.2**, ***Existing Conditions of Native Americans***, for a detailed description of Tribal history, and **Section C.1.1.22, *Cultural Resources*** for additional discussion of other cultural, Tribal, and religious freedom issues. See **Subsection C.1.3.14** for a discussion of water rights in the area of analysis.

This section examines, consistent with NEPA regulations and guidelines, the Proposed Action's potential impacts on communities with environmental justice concerns. Impacts were assessed to determine if any community would bear a disproportionate share of the potentially adverse environmental consequences resulting from the Proposed Action.

Per the Council on Environmental Quality's (CEQ's) 2023 *Environmental Justice Guidance under the National Environmental Policy Act*, minority populations should be identified where either the minority population of the affected area exceeds 50 percent or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis. Following the guidance in the 2016 *Promising Practices for EJ Methodologies in NEPA Reviews* (Promising Practices) authored by the Federal Interagency Working Group on Environmental Justice and NEPA Committee, a 50-percent analysis and meaningfully greater analysis were conducted to identify minority populations. Under this methodology, percentages of minority populations within selected geographic areas are screened to determine where minority populations exceed 50 percent of the total. Percentages are then compared to those of a reference community. For this study, the percentage of minority populations of the State of Florida is used for comparison, which is a lower threshold than the 50 percent threshold. The Project Area or Study Area is determined to contain an environmental justice community if the minority percentage exceeds the state average. Additional comparisons are made at the county level. It is noted here that the 2016 and earlier guidance and EOs used the term minority, but the more recent EO 14096 uses the terminology "people of color." People of color will be used going forward in this document.

Per CEQ guidance, poverty thresholds established by the U.S. Census Bureau are used to identify low-income populations. To identify low-income populations, the low-income threshold criteria from the Promising Practices document is used. The poverty rate for the State of Florida is used as the threshold. Like the analysis for people of color populations, additional comparisons are made at the county-level.

U.S. Census Bureau 2020 American Community Survey data and USEPA's EJSCREEN (which uses the U.S. Census Bureau's American Community Survey data) were used to identify minority and low-income populations. EPA developed the EJSCREEN environmental justice mapping and screening tool and published it on the internet, to provide a nationally consistent dataset and approach.

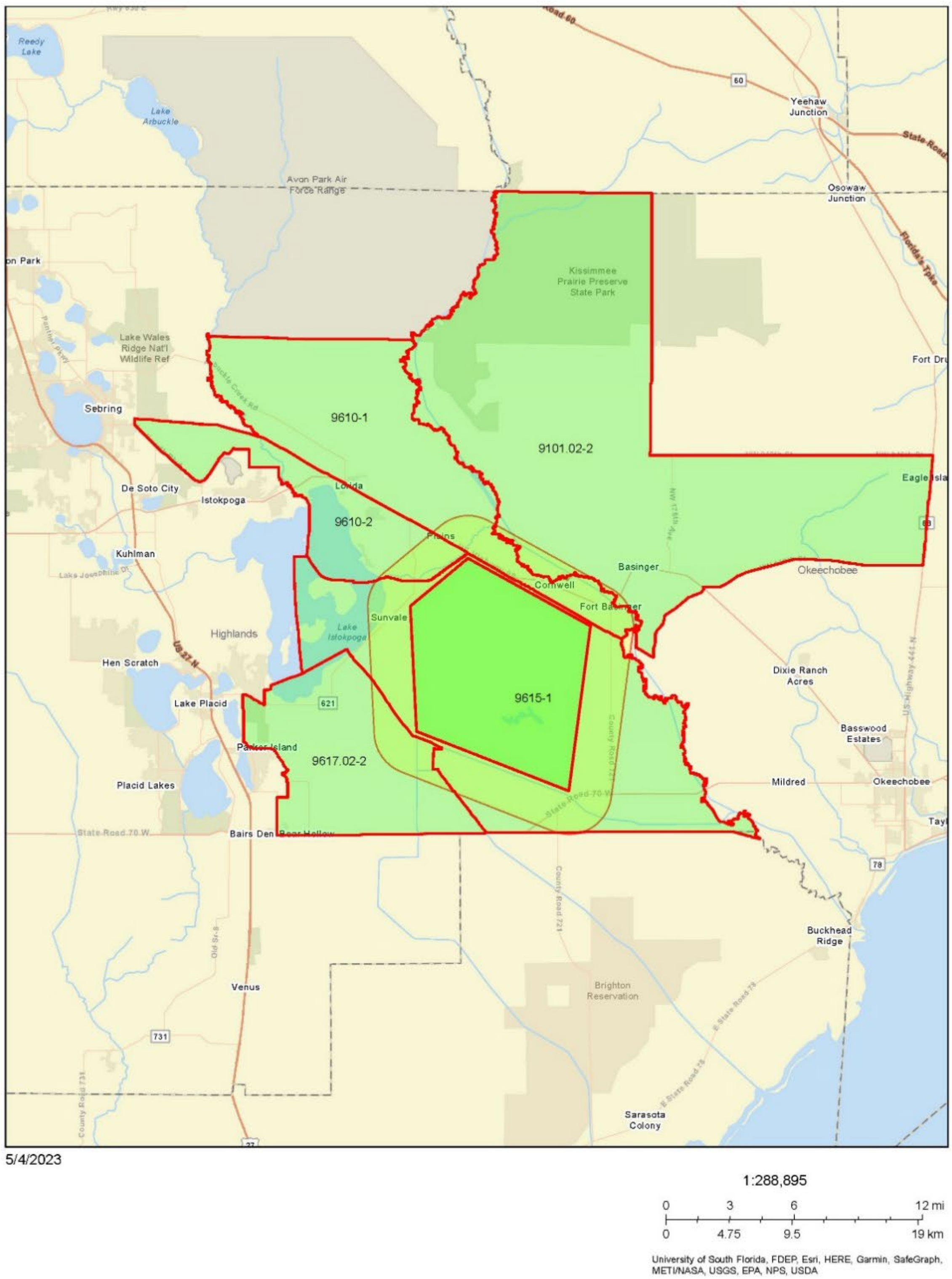
Area of Analysis

For the EJ analysis, data from all 2020 census block groups within a 2-mi radius of proposed LOCAR features in the focused array are included. A 2-mi radius was chosen as an initial estimate of Project siting and potential effects to facilitate the EJ analysis. The three proposed sites for the reservoir are in Highlands County. Although there are no Project features proposed within the STOF Brighton Reservation, it is included in this analysis due to the proximity to the LOCAR features and potential impacts to the Tribal reservation. The Project Area (in census Tract 9615, Block Group 1) and adjacent census tracts and block groups are listed in **Table C.1-7** and shown on **Figure C.1-28.** Data pertaining to these block groups were identified and used as available. In cases where block group information has not been compiled by the U.S. Census Bureau, data pertaining to census tracts to which they belong will be substituted. Data from the counties, state, and nation are presented for comparative purposes.

Table C.1-7. Census Tracts and Block Groups in or Adjacent to the Project Area.

County	Census Tract	Block Group
Highlands	9610	1
Highlands	9610	2
Highlands[1]	9615	1
Highlands	9617.02	2
Okeechobee	9101.02	2

1/ Census Tract 9615, Block Group 1, includes proposed reservoir site.



Source: EJScreen, EPA 2023.
Note: The bright green polygon in the center covers the proposed Project Area site. A 2-mi buffer is drawn around the site. The census tracts and block groups are outlined in red.

Figure C.1-28. Census tracts and block groups in or adjacent to the Project Area.

Scoping to Identify Environmental Justice and Socioeconomic Issues

Numerous methods of engagement were employed as part of the LOCAR study to engage people of color, low-income individuals, and Native American Tribes. **Table C.1-8** summarizes overall engagement efforts with stakeholders on the Project.

Table C.1-8. Summary of LOCAR Stakeholder Engagement Meetings.

Engagement Type	Date	Stakeholders
SFWMD Press Releases	April 10, 17, 20, and 26, 2023	Press releases issued to announce upcoming public meetings.
Tribal Meetings	April 19, 2023	SFWMD held meetings a meeting with the STOF to discuss the scope of the study. A meeting with MTI was also scheduled but was postponed.
Corps *Federal Register* Notice of Intent	April 23, 2023	All interested agencies, Tribes, and parties in area were notified about the public scoping meetings.
Scoping Meetings	April 27, 2023	Presentations on scope of study
Community Meeting	May 4, 2023	Met with community members to answer questions about information presented at the scoping meeting.

LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study; MTI–Miccosukee Tribe of Indians of Florida; SFWMD–South Florida Water Management District; STOF–Seminole Tribe of Florida

Existing Conditions/Affected Environment

This section provides a description of existing conditions within the Study Area as they relate to issues of environmental justice.

- **Unique Characteristics of the Geographic Area.** According to CEQ's regulation on EJ (40 CFR Section 1508.27), unique characteristics of the geographic area could include proximity to distinctive features, such as historic or cultural resources, prime farmlands, wetlands, and ecologically critical areas. The STOF Brighton Reservation falls under this category and has been given special consideration when assessing the intensity of impacts listed below.
- **Aesthetics.** Current aesthetics reflect a pastoral and rural landscape viewshed in most of the landscape that is farm and ranchland. Communities, roads, and canals are throughout the Study Area, with the nearest urban area to the proposed Project site being the city of Sebring.
- **Noise.** Noise is relatively low in rural pastoral areas. Noise is loudest near roads and canals used for boat traffic. Agricultural and ranching activities also increase noise periodically to manage lands with heavy machinery. Average background noise for agricultural lands is approximately 40 dB but can range up to 90 dB near working machinery (e.g., tractor).
- **Light Pollution.** Light pollution is minimal from lights marking existing roads, existing water management infrastructure, rural houses, trailer parks, and other residential developments. Most light pollution would be in nearby cities and towns, such as Sebring, Avon Park, and Okeechobee, near the main streets.
- **Air Quality.** Minor, short-term air quality issues occur from burning of agricultural material or land management activities. Otherwise, air quality is relatively good. Per the EPA, the entire state of Florida is in attainment for all criteria pollutants (see **Subsection C.1.1.14**).
- **Cultural and Historic Resources.** Unrecorded archeological sites are highly likely located within the Project Area, as most of the lands within the Project Area have not been previously surveyed

for the presence of cultural resources. Several known prehistoric mounds and earthworks complexes are also located within or in proximity to the Study Area (see **Subsection C.1.1.22**).

- **Economic Impacts.** Socioeconomic statistics of the human population in this area are described in the next sections of the EJ analysis. The following are key issues that will need to be considered in the EJ analysis with respect to potential socioeconomic impacts.
- **Displacement of Listed Threatened and Endangered Species.** To local properties and potential for increased compliance costs and/or loss of economic use of lands.
- **Maintain Water Supply.** For agriculture, Tribes, and utilities as it relates to surficial aquifer wells, canals, and Lake Okeechobee. Hydrologic modeling is used to explain comparison of water supply existing conditions .
- **Seepage and Restricted Drainage.** Groundwater and surface water levels can be affected by water storage features seepage. Excess seepage from Project features and canals can affect agricultural land productivity by limiting drainage from farmlands and, in extreme cases, limit drainage from home and residential areas, which could lead to risk of flooding.
- **Land Acquisition.** The land being considered for Project features is owned by one private landowner. It is unknown if the landowner is a willing seller or unwilling seller. No land acquisition is needed within the C-41A right-of-way; the non-federal sponsor holds fee simple and easement interests over the right-of-way.
- **Human Health and Safety**. An EJ analysis of human health and safety must consider the following key issues.
- **Drinking Water Quality.** Drinking water for many residents in the Study Area is obtained from the surficial aquifer (land surface to 170 ft bls) in the Study Area. Surface water quality in the Kissimmee Basin and Lake Okeechobee is sufficient to meet drinking water standards with minimal treatment.
- **Subsistence and Recreational Fishing and Hunting.** Recreational fishing is plentiful in the Kissimmee River, canals, and Lake Okeechobee. Hunting is limited to those who have access to private lands in the area, with some hunting in Lake Okeechobee. Hunting is available to the STOF hunting on Tribal reservation lands for subsistence, and public lands like Lake Okeechobee are available for hunting waterfowl and fishing under applicable state regulations. Project features that convert land to built environment, or change upland to deep water, can limit types of terrestrial based hunting.
- **Life Safety.** Project features that store large amounts of water with levees determined to be high hazard dams can pose a risk to immediate residential communities downstream of potential dam breaks. The incremental life loss risk from a reservoir failure will be evaluated to ensure lower than the tolerable risk limits described in ER 1110-2-1156, *Safety of Dams-Policy and Procedures.*

Race and Ethnicity–Identification of People of Color Populations

2020 American Community Survey 5-year estimates concerning population, race, or Hispanic origin are presented in **Table C.1-9**, **Table C.1-10**, **Table C.1-11**, **Figure C.1-29,** and **Figure C.1-30**. Data for the Project Area is related via the census tracts and block groups identified in **Table C.1-7.** People of color includes people who list their racial status as other than white alone and non-Hispanic.

Table C.1-9. Racial Composition of Census Tracts in or Adjacent to the Project Area.

Category	Census Tract 9610	Census Tract 9615	Census Tract 9617.02	Census Tract 9101.02
Total Population	4,998	4,870	1,473	3,153
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White Alone	4,091	4,263	762	2,472
	81.9%	87.5%	51.7%	78.4%
Black or African American Alone	26	20	0	122
	0.5%	0.4%	0.0%	3.9%
American Indian or Alaska Native Alone	0	1	0	0
	0.0%	0.01%	0.0%	0.0%
Asian Alone	0	59	0	0
	0.0%	1.2%	0.0%	0.0%
Native Hawaiian or Other Pacific Islander Alone	0	0	0	0
	0.0%	0.0%	0.0%	0.0%
Some Other Race Alone	0	0	0	0
	0.0%	0.0%	0.0%	0.0%
Two or More Races	34	57	0	32
	0.7%	1.2%	0.0%	1.0%
Hispanic or Latino (of any race)	847	470	711	527
	16.9%	9.7%	48.3%	16.7%
People of Color	907	607	711	681
	18.1%	12.5%	48.3%	21.6%

Source: USCB 2023.

1 **Table C.1-10. Racial Composition.**

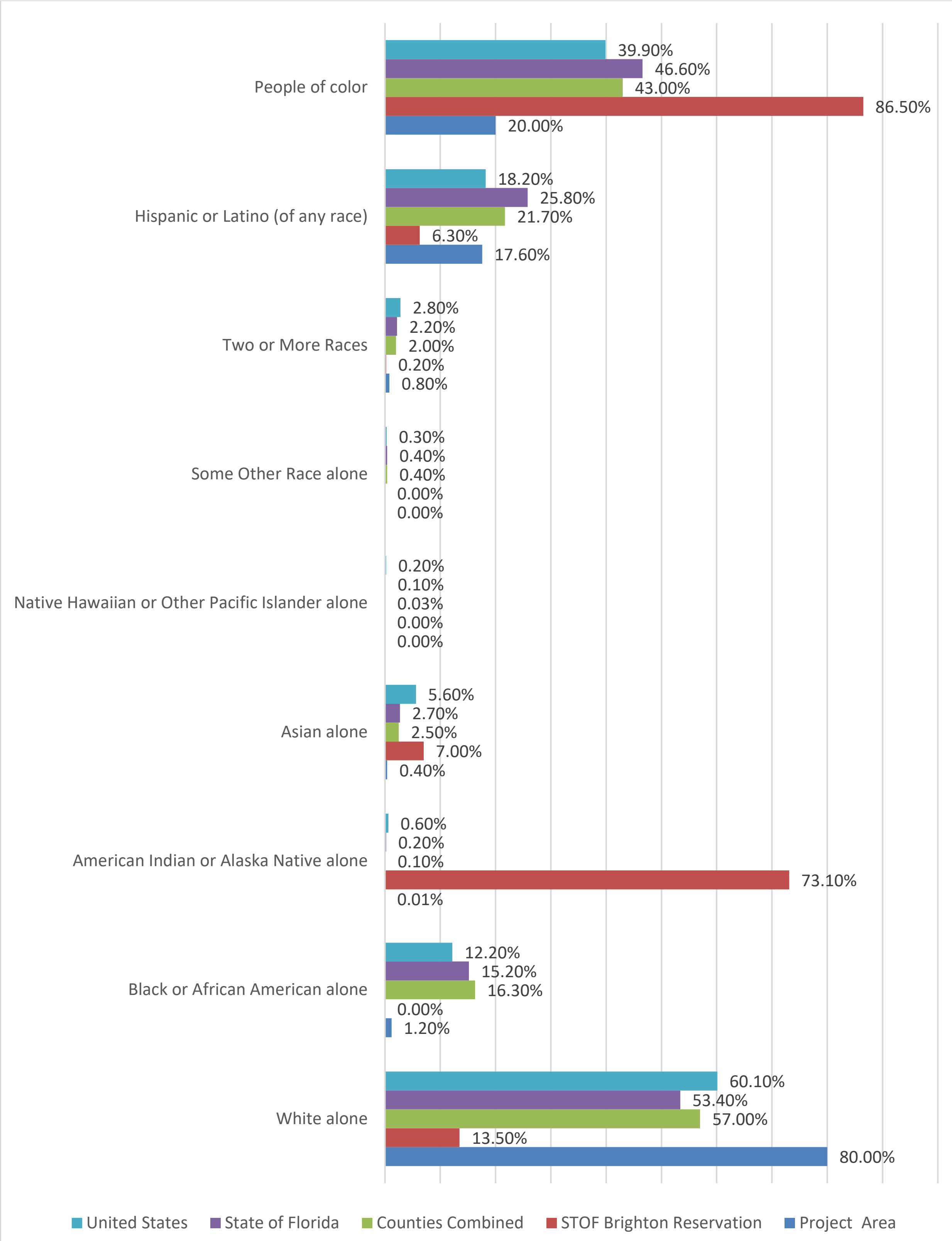
Category	Project Area and Adjacent Census Tracts Combined	STOF Brighton Reservation	Glades County	Highlands County	Martin County	Okeechobee County	Palm Beach County
Total Population	14,494	557	13,777	104,574	160,420	41,611	1,482,057
White Alone	11,588	75	8,255	69,153	125,077	26,036	799,163
	80.0%	13.5%	59.9%	66.1%	78.0%	62.6%	53.9%
Black or African American Alone	168	0	1,793	9,677	8,405	3,373	269,684
	1.2%	0.0%	13.0%	9.3%	5.2%	8.1%	18.2%
American Indian or Alaska Native Alone	1	407	535	124	322	233	1,123
	0.01%	73.1%	3.9%	0.1%	0.2%	0.6%	0.1%
Asian Alone	59	39	91	1,527	2,320	393	40,532
	0.4%	7.0%	0.7%	1.5%	1.4%	0.9%	2.7%
Native Hawaiian or Other Pacific Islander Alone	0	0	0	0	128	74	270
	0.0%	0.0%	0.0%	0.0%	0.1%	0.2%	0.02%
Some Other Race Alone	0	0	47	456	329	109	6,775
	0.0%	0.0%	0.3%	0.4%	0.2%	0.3%	0.5%
Two or More Races	123	1	132	2,272	1,852	638	30,303
	0.8%	0.2%	1.0%	2.2%	1.2%	1.5%	2.0%
Hispanic or Latino (of any Race)	2,555	35	2,924	21,365	21,987	10,755	334,207
	17.6%	6.3%	21.2%	20.4%	13.7%	25.8%	22.6%
People of Color	2,906	482	5,522	35,421	35,343	15,575	682,894
	20.0%	86.5%	40.1%	33.9%	22.0%	37.4%	46.1%

2 Source: USCB 2023.
3 STOF–Seminole Tribe of Florida

Table C.1-11. Racial Composition–Combined Counties, State, and National Figures.

Category	Counties Combined (Study Area)	State of Florida	United States
Total Population	1,802,439	21,216,924	326,569,308
White alone	1,027,684	11,331,222	196,251,375
	57.0%	53.4%	60.1%
Black or African American alone	292,932	3,231,108	39,994,653
	16.3%	15.2%	12.2%
American Indian or Alaska Native alone	2,337	39,070	2,075,852
	0.1%	0.2%	0.6%
Asian alone	44,863	579,476	18,184,182
	2.5%	2.7%	5.6%
Native Hawaiian or Other Pacific Islander alone	472	10,889	550,080
	0.03%	0.1%	0.2%
Some Other Race alone	7,716	90,892	1,017,604
	0.4%	0.4%	0.3%
Two or More Races	35,197	465,441	9,134,542
	2.0%	2.2%	2.8%
Hispanic or Latino (of any race)	391,238	5,468,826	59,361,020
	21.7%	25.8%	18.2%
People of color	774,755	9,885,702	130,317,933
	43.0%	46.6%	39.9%

Source: USCB 2023.



Source: USCB 2023.

Figure C.1-29. Racial composition.

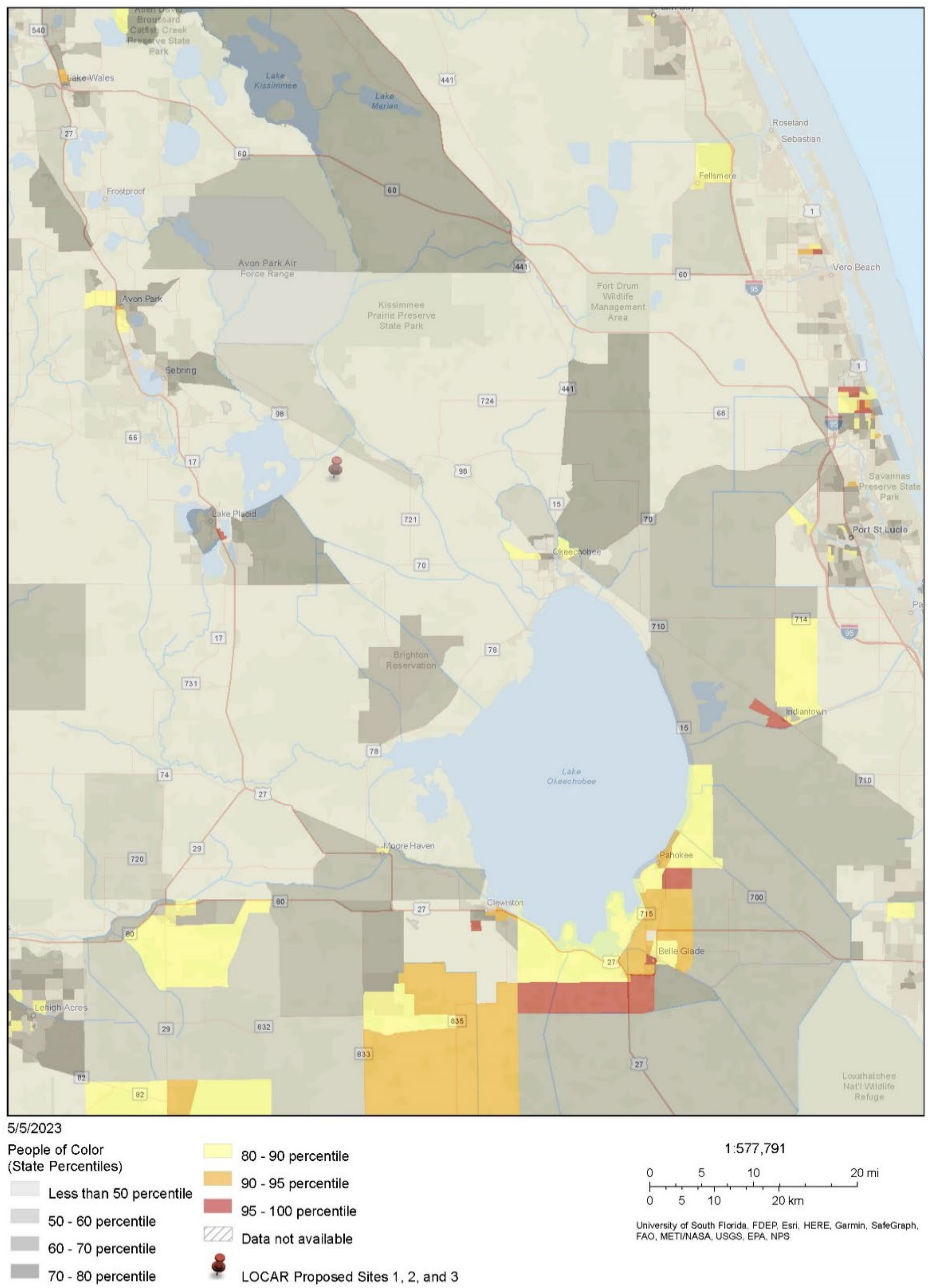
The largest racial group in the Project Area and adjacent census tracts was White alone, with an estimated 11,588 people, or 80.0 percent, of the population claiming ancestry. This is well above the national and state respective averages of 53.4 percent and 60.1 percent. In the Study Area, White alone was likewise the largest racial group in Glades, Highlands, Martin, Okeechobee, and Palm Beach Counties, where it was estimated to constitute 59.9 percent, 66.1 percent, 78.0 percent, 62.6 percent, and 53.9 percent of the population, respectively.

The second largest racial group in the Project Area and adjacent census tracts was Black or African American alone, which had an estimated 168 people, or 1.2 percent, of the population claiming ancestry. This is below the national and state respective averages of 12.2 percent and 15.2 percent. Black or African American alone was likewise the second largest racial group in the Study Area in Glades, Highlands, Martin, Okeechobee, and Palm Beach Counties, constituting 13.0 percent, 9.3 percent, 5.2 percent, 8.1 percent, and 18.2 percent of the population, respectively.

Hispanic or Latino ancestry is non-specific in terms of race. In the Project Area and adjacent census tracts as a whole, an estimated 2,555 people, or 17.6 percent, of the population fell into this group. This falls below the national and state respective averages of 18.2 percent and 25.8 percent. However, in one census tract adjacent to the Project Area, Tract 9617.02 in Highlands County, an estimated 711 people, or 48.3 percent, of the population in that tract is of Hispanic or Latino origin. In the Study Area in Glades, Highlands, Martin, Okeechobee, and Palm Beach Counties, people of Hispanic or Latino origin constitute 21.2 percent, 20.4 percent, 13.7 percent, 25.8 percent, and 22.6 percent of the population, respectively.

In the STOF Brighton Reservation, the largest racial group was American Indian or Alaska Native alone, where 407 people, or 73.1 percent, of the population claimed ancestry.

In summary, in the Study Area, there are two communities that have a higher percentage of people of color than the state average (**Figure C.1-30)**, including the previously mentioned Census Tract 9617.02 in Highlands County with a Hispanic or Latino population, and the STOF Brighton Reservation in Glades County.



Source: EJScreen, EPA 2023.
Note: This analysis uses any percentiles over 70 percent representing a higher degree of people of color population compared to state average.

Figure C.1-30. People of color population compared to the state percentiles.

Unemployment

Table C.1-12 provides labor force characteristics concerning employment status, as estimated by the 2020 American Community Survey. Data for the Project Area is related via the census block groups identified in **Table C.1-7**. The unemployment rate is an economic indicator that is commonly used to describe an area. It is calculated as the percentage of the civilian labor force that is unemployed.

Table C.1-12. Labor Force Characteristics.

Location	Civilian Labor Force	Employed	Unemployed	Unemployment Rate
Project Area and Adjacent Census Tracts Combined	5,461	5,281	180	3.30%
STOF Brighton Reservation	130	103	27	20.80%
Glades County	4,247	3,798	449	10.60%
Highlands County	37,504	34,339	3,165	8.40%
Martin County	70,302	67,052	3,250	4.60%
Okeechobee County	16,519	15,648	871	5.30%
Palm Beach County	730,247	686,067	44,180	6.10%
Counties Combined Unemployment Rate	-	-	-	6.0%
State of Florida Unemployment Rate	-	-	-	5.4%
United States Unemployment Rate	-	-	-	5.4%

Source: USCB 2023.
STOF–Seminole Tribe of Florida

The Project Area and adjacent census tracts had a labor force of 5,461, which represents 44.0 percent of the population aged 16 years and over. This is above the percentage of the population above 16 years in the labor force in Glades County at 35.7 percent, Highlands County at 42.3 percent, and STOF Brighton Reservation at 35.3 percent. It is below that same percentage for Martin, Okeechobee, and Palm Beach Counties, which came to 51.4 percent, 48.6 percent, and 59.3 percent, respectively. At 58.9 percent for Florida, the state average exceeded all locations except Palm Beach County. At 63.4 percent for the U.S., the national average exceeded all locations examined.

A total of 180 members of the civilian labor force in the Project Area and adjacent census tracts were unemployed in 2020, amounting to an unemployment rate of 3.3 percent. This is lower than the national and state unemployment rate of 5.4 percent during that same time period. Unemployment rates in STOF Brighton Reservation and in Glades, Highlands, and Palm Beach Counties exceeded state and national averages. In STOF Brighton Reservation, 27 people, or 20.8 percent, of the civilian labor force were unemployed.

Per Capita and Mean Household Income

Table C.1-13, Table C.1-14, and **Figure C.1-31** provide 2020 per capita income characteristics estimated by the 2020 American Community Survey. National, state, and surrounding county information is included for the purpose of comparison. Data for the Project Area is related via the census tracts and block groups identified in **Table C.1-7**.

Table C.1-13. Per Capita Income of Census Tracts in or Adjacent to the Project Area (2020 Inflation-adjusted Dollars).

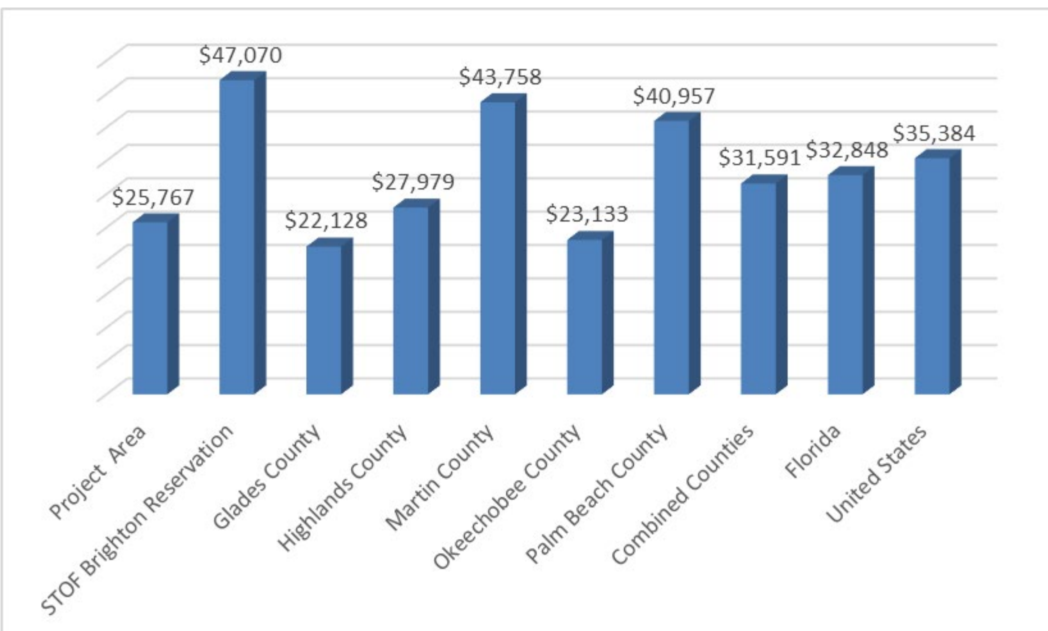
Category	Census Tract 9610	Census Tract 9615	Census Tract 9617.02	Census Tract 9101.02
Population	4,998	4,870	1,473	3,153
Per Capita Income	$27,852	$29,855	$19,725	$25,637

Source: USCB 2023.

Table C.1-14. Per Capita Income (2020 Inflation-adjusted Dollars).

Location	Population	Per Capita Income[1]
Project Area and Adjacent Census Tracts Combined	14,494	$25,767
STOF Brighton Reservation	557	$47,070
Glades County	13,777	$22,128
Highlands County	104,574	$27,979
Martin County	160,420	$43,758
Okeechobee County	41,611	$23,133
Palm Beach County	1,482,057	$40,957
Counties Combined Average Per Capita Income	-	$31,591
State of Florida Per Capita Income	-	$32,848
United States Per Capita Income	-	$35,384

1/ Per capita income is a combined average for the census tracts in and adjacent to the Project Area.
Source: USCB 2023.



Source: USCB 2023.

Figure C.1-31. Per capita income (2020 inflation-adjusted dollars).

For the census tracts in or adjacent to the Project Area, the per capita income ranged from a low of $19,725 in Tract 9617.02 to a high of $29,855 in Tract 9615. All of the tracts had a lower per capita income compared to the combined counties, state, nation, and STOF Brighton Reservation.

Average per capita income for the combined Project Area and adjacent census tracts was $25,767 in 2020 inflation-adjusted dollars. This is $9,617, or 27 percent, below the national average of $35,384. Compared to the per capita income for the state of Florida, the per capita income for the Project Area and adjacent census tracts is 22 percent, or $7,081, below the state average of $32,848.

Of the counties examined, Martin had the highest per capita income at $43,758, followed by Palm Beach County at $40,957. Glades, Highlands, and Okeechobee Counties each fell within about $5,800 of one another, and all had per capita income lower than the state and the nation.

At $47,070, STOF Brighton Reservation had the largest per capita income of any area examined. STOF Brighton Reservation's per capita income was 45.3 percent above that of the Project Area and adjacent census tracts, 24.8 percent above the national average, 30.2 percent above the Florida state average, and 32.9 percent above the combined average of the counties comprising the Study Area.

Table C.1-15 and **Table C.1-16** provide 2020 mean household income characteristics estimated by the 2020 American Community Survey. National, state, and surrounding county information is included for the purpose of comparison, as is data concerning STOF Brighton Reservation. Data for the Project Area is related via the census block groups identified in **Table C.1-7**.

Table C.1-15. Mean Household Income of Census Tracts in or Adjacent to the Project Area (2020 Inflation-adjusted Dollars).

Category	Census Tract 9610	Census Tract 9615	Census Tract 9617.02	Census Tract 9101.02
Total Households	2,244	1,966	457	1,150
Mean Household Income	$58,589	$73,244	$50,116	$65,543

Source: USCB 2023.

Table C.1-16. Mean Household Income (2020 Inflation-adjusted Dollars).

Location	Total Households	Mean Household Income[1]
Project Area and Adjacent Census Tracts Combined	5,817	$61,873
STOF Brighton Reservation	177	$134,907
Glades County	4,859	$55,574
Highlands County	42,721	$63,700
Martin County	64,870	$102,035
Okeechobee County	14,601	$63,077
Palm Beach County	565,598	$101,670
Counties Combined Average Mean Household Income	-	$77,211
State of Florida Mean Household Income	-	$83,104
United States Mean Household Income	-	$91,547

1/ Mean household income is a combined average of the Project Area and adjacent census tracts.
Source: USCB 2023.
STOF–Seminole Tribe of Florida

For the census tracts in or adjacent to the Project Area, the mean household income ranged from a low of $50,116 in Tract 9617.02 to a high of $73,244 in Tract 9615. All of the tracts had a lower mean household income compared to the combined counties, state, nation, and STOF Brighton Reservation. Mean household income for the Project Area and adjacent census tracts was $61,873 in 2020 inflation-adjusted dollars. This is $29,674, or 32.4 percent, below the national average of $91,547. It is below the mean household income of the state of Florida of $83,104 by $21,231, or 25.5 percent.

Martin County had the highest mean household income of any county examined. At $102,035, Martin County's mean household income was 10.3 percent above the national average and 18.6 percent above the Florida state average. Palm Beach County had the second highest income of the counties, at $101,670. Glades, Highlands, and Okeechobee Counties mean household incomes fell within approximately $8,100 of one another, and all were lower compared to the state and the nation. At $134,907, STOF Brighton Reservation has the highest mean household income of any area examined. STOF Brighton Reservation's mean household income was 54.1 percent above that of the Project Area and adjacent census tracts, 32.1 percent above the national average, 38.4 percent above the Florida state average, and 42.8 percent above the combined averages of the counties.

Poverty

Table C.1-17 and **Table C.1-18** display the poverty characteristics estimated by the 2020 American Community Survey. **Figure C.1-32** is included for the purpose of comparison. Data for the Project Area is related via the census block groups identified in **Table C.1-7**.

Table C.1-17. Individual Poverty of Census Tracts in or Adjacent to the Project Area.

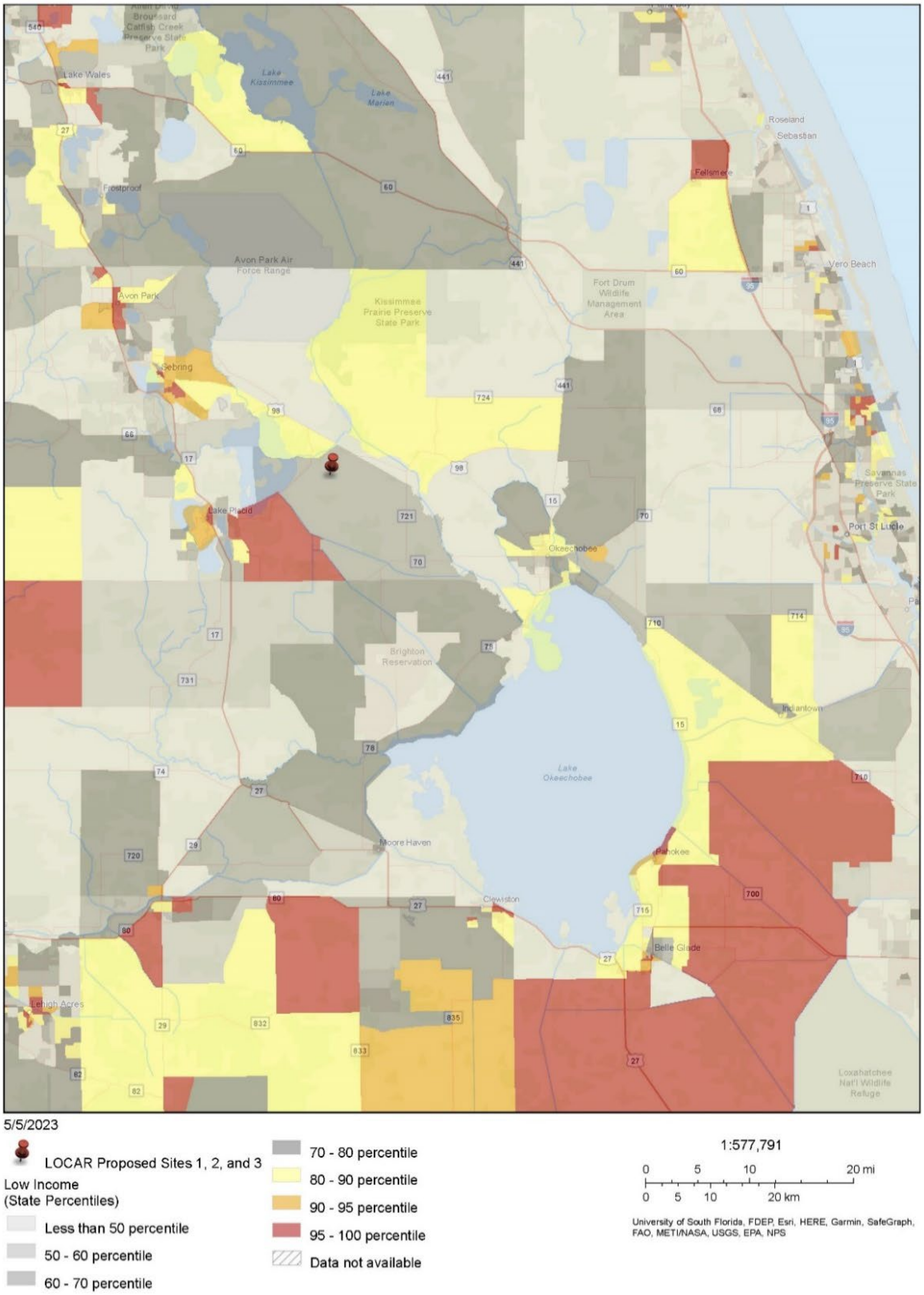
Category	Census Tract 9610	Census Tract 9615	Census Tract 9617.02	Census Tract 9101.02
Eligible PSD Population[1]	4,998	4,870	1,447	4,591
Total below Poverty Threshold	910	329	308	1,146
Percent below Poverty Threshold	18.2%	6.8%	21.3%	25.0%

1/ Population eligible for poverty status classification under U.S. Census guidelines.
Source: USCB 2023.
PSD–poverty status determined.

Table C.1-18. Individual Poverty.

Location	Eligible PSD Population[1]	Total Below Poverty Threshold	Percent Below Poverty Threshold
Project Area and Adjacent Census Tracts Combined	15,906	2,693	16.90%
STOF Brighton Reservation	541	61	11.30%
Glades County	12,452	2,127	17.10%
Highlands County	102,883	16,511	16.00%
Martin County	157,211	16,141	10.30%
Okeechobee County	38,243	6,818	17.80%
Palm Beach County	1,461,191	169,844	11.60%
Counties Combined Percent below Poverty Threshold	-	-	11.9%
State of Florida Percent below Poverty Threshold	-	-	13.3%
United States Percent below Poverty Threshold	-	-	12.8%

Source: USCB 2023.
1/ Population eligible for poverty status classification under U.S. Census guidelines.
PSD– poverty status determined; STOF–Seminole Tribe of Florida



Source: EPA 2023.
Note: This analysis uses populations with in the 70th percentile of the state average to represent vulnerable populations.

Figure C.1-32. Low-income population compared to state percentiles.

For the census tracts in and adjacent to the Project Area, the percent below poverty ranged from a low of 6.8 percent in Tract 9615 to a high of 25 percent in Tract 9101.02. All of the tracts except 9615 had a higher percent below poverty compared to the combined counties, state, nation, and STOF Brighton Reservation.

A total of 2,693 people in the combined Project Area and adjacent census tracts fell below the poverty threshold. This constitutes 16.9 percent of the combined Project Area and adjacent census tracts population eligible for poverty status classification under U.S. Census guidelines. This is higher than the percent below poverty level within Highlands, Martin, and Palm Beach Counties, which were respectively estimated to be 16.0 percent, 10.3 percent, and 11.6 percent. It is also above the 11.3 percent estimated for STOF Brighton Reservation. The combined Project Area and adjacent census tracts percent below poverty of 16.9 percent was just below the percent below poverty in Glades and Okeechobee Counties, which were respectively estimated to be 17.1 percent and 17.8 percent.

The 16.9 percent below poverty level in the combined Project Area and adjacent census tracts is higher compared to the 11.9 percent below poverty level for the combined counties.

The 16.9 percent below poverty in the combined Project Area and adjacent census tracts, and the 17.1 percent below poverty in Glades County, 16.0 percent in Highlands County, and 17.8 percent in Okeechobee County were considerably higher than state and national figures, which came to 13.3 percent and 12.8 percent, respectively.

In summary, in the Study Area, there are several low income populations, populations whose income is below the poverty level, that have a higher percentage of people below poverty than the state average. The low-income populations include those in the Census Tracts 9101.02, 9610, and 9617.02. Glades, Highlands, and Okeechobee counties all show poverty rates that are greater than the state-level.

Climate and Economic Justice

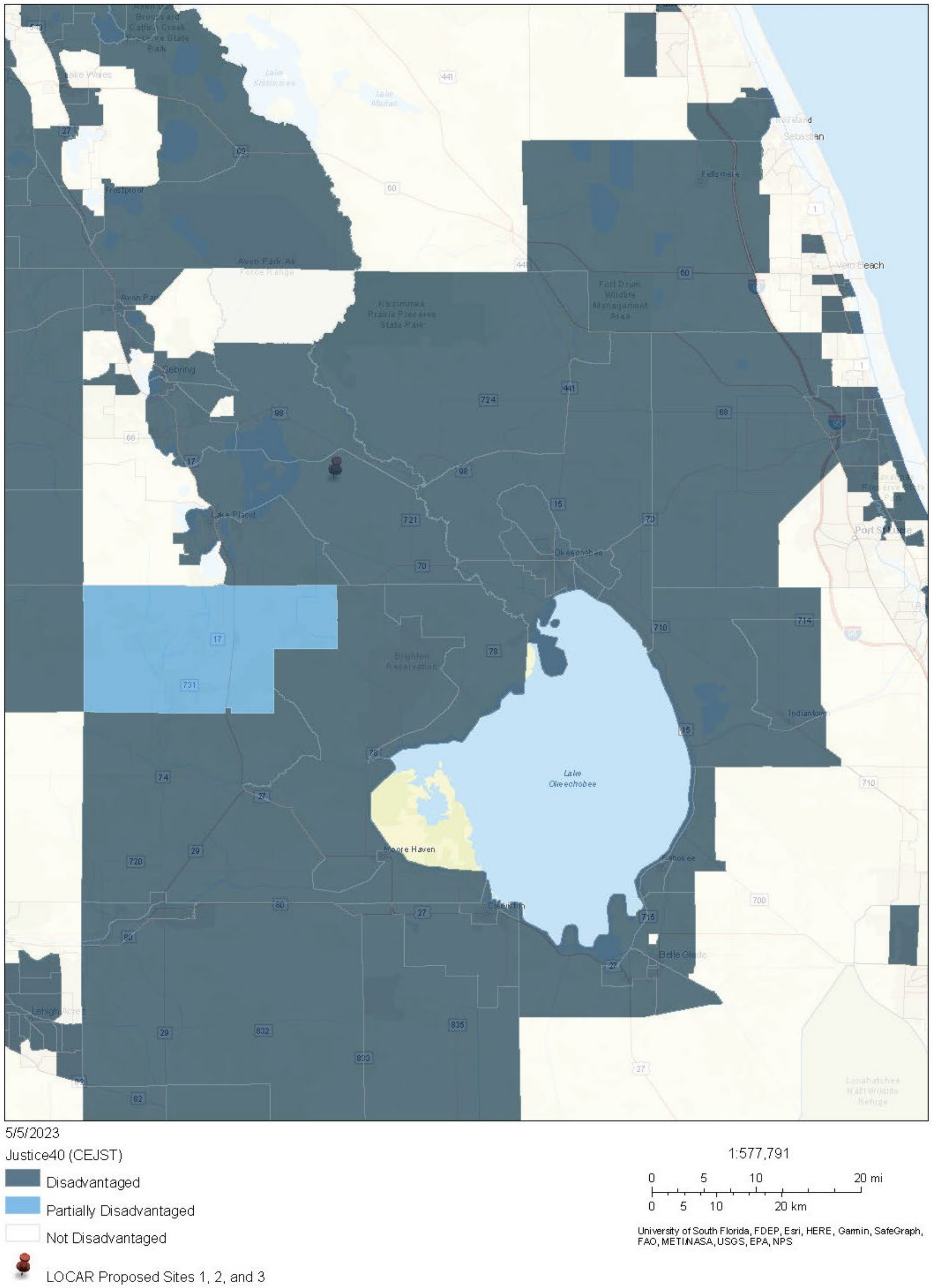
CEQ's Climate and Economic Justice Screening Tool (CEJST) was used to identify disadvantaged communities per EO 14008, *Tackling the Climate Crisis at Home and Abroad*. The EO seeks to seeks to secure EJ and spur economic development through,

> *…investing and building a clean energy economy that creates well-paying union jobs, turning disadvantaged communities – historically marginalized and overburdened – into healthy, thriving communities, and undertaking robust actions to mitigate climate change while preparing for the impacts of climate change across rural, urban, and Tribal areas.*

Disadvantaged communities have been historically marginalized and overburdened by pollution and underinvestment in health care, housing, transportation, and water and wastewater infrastructure. This EO also established President Biden's Justice40 initiative, which has a goal to have 40 percent of the overall benefits of certain federal investments (i.e., clean energy, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and development of critical clean water infrastructure) flow to disadvantaged communities.

The CEJST identifies communities as disadvantaged if they are in census tracts that meet the threshold for at least one of the tool's categories of burden and the associated socioeconomic threshold, or if they are completely surrounded by disadvantaged communities and meet the low-income threshold, or if they are on land within the boundaries of federally recognized Tribes. The categories of burden are climate change, energy, health, housing, legacy pollution, transportation, water and wastewater, and workforce development, and their associated socioeconomic thresholds are either low income or education (CEQ 2023).

Figure C.1-33 shows the communities in the Study Area identified as disadvantaged by the CEJST. All of the Project Area and adjacent census tracts and block groups identified in **Table C.1-7** are considered disadvantaged because they meet the CEJST climate and health burden categories plus the low-income threshold, and Census Tract 9101.02 also meets the legacy pollution and transportation burdens. Many of the communities in the surrounding counties are considered disadvantaged for these and other burden categories (EPA 2023).



Source: EPA 2023.

Figure C.1-33. CEJST disadvantaged communities.

Summary of Environmental Justice Communities

In summary, in the Study Area, there are two communities that have a higher percentage of people of color than the state average (Census Tract 9617.02 in Highlands County and the STOF Brighton Reservation in Glades County), and several communities that have a higher percentage of people below poverty than the state average (Census Tracts 9101.02, 9610, and 9617.02, and Glades, Highlands, and Okeechobee counties). EJ community concerns associated with the Project relate to human health and safety, susceptibility to climate change impacts, potential loss of affordable housing, loss of recreational fishing/hunting, and loss of job opportunities in the area where they live.

Tribal Environmental Justice Concerns

Today most of the MTI lives within the confines of the reservation located along the 40-mi bend of Tamiami Trail, more commonly known as the Miccosukee Reserve Area (MRA) in Miami-Dade County, Florida. In addition to the federal reservation, the MTI has also established a perpetual lease agreement to a large portion of the WCA 3A area. The STOF members live on various reservations properties, with the largest being those of Big Cypress, Hollywood, and Brighton Reservations. The STOF has an easement within the northwestern portion of WCA 3A. Members of the Tribe maintain a traditional lifestyle that is intricately connected to the Everglades. Traditional practices of hunting, fishing, frogging, trapping, and general living are still maintained, along with modern entrepreneurship through various enterprises, such as cattle ranching and with tourism related businesses along Tamiami Trail. Today, the Tribe have a vibrant thriving culture based within the Everglades region. These practices continue to tie the Tribe to the Everglades in such a way that careful consideration of effects on Tribal cultural well-being and way of life is warranted.

Members of the Tribe continue to rely upon the Everglades to support their cultural, medicinal, subsistence, and commercial activities. The specific issues impacting the Tribe have been different over the last few decades, but they are all related to impacts from humanmade changes to the Everglades ecosystem. The MTI's focus has been on the detrimental ponding of water on Tribal leased lands in WCA 3A, which affects subsistence practices and increases inundation risks to islands that it uses. The MTI has also voiced concerns with regards to the impacts of nutrient pollution in the natural system both above and below ground. The STOF's focus has been on the detrimental drainage of water from the western basin and its Big Cypress Reservation, in addition to the impacts of nutrient pollution on the delicate Everglades system.

Numerous government-to-government consultations, along with other outreach efforts, were conducted with the STOF to solicit input from the Tribal governments regarding their assessment of effects on Indian trust resources, Tribal rights to use those resources, other resources traditionally used by Tribes, and cultural values related to those resources and rights within the area resulting from the implementation of the proposed Project. (The reader should note that inclusion of any claims and assertions put forth by these Tribes does not necessarily imply that the federal government endorses those views.) The STOF was also engaged in presenting alternative plans to meet Project objectives.

C.1.1.22 Cultural Resources

Within the larger region that includes the Everglades and the Study Area, there are numerous recorded archeological sites indicative of Native American habitation. Prior to European contact, the Everglades were a heavily populated area. Native Americans traveled via canoe and on foot through the sawgrass and inhabited many of the tree islands that dot the landscape. The earliest known habitation sites date to the Early Archaic period (7500 Before Christ [BC]), when the Everglades were much drier. However, within the larger area of South Florida, evidence of Paleo-Indian (12,000 to 7500 BC) habitation has also been recorded (e.g., Warm Mineral Springs [8SO18] and Little Salt Spring [8SO79]) (Griffin 1988). During the Archaic period (ca. 7500 BC to ca. 500 BC), a wider range of resources was exploited and may have led to a more sedentary existence. Some of the Early Archaic habitation sites have only recently been rediscovered as the result of managed drainage programs in South Florida. As the climate warmed and sea level rose, many Native Americans abandoned the lowest of the tree islands as they became submerged. This process continued through what is known as the Middle Archaic, until climate conditions stabilized around 300 BC at the start of the Late Archaic. Today many sites from both the Early and Middle Archaic periods are no longer submerged and may have more modern Native American use.

After the Archaic period, the Okeechobee Basin became incorporated into what is known as the Glades region and remained inhabited until European contact, when Old World diseases and slave raiding heavily reduced the Native populations from the late 1500s to 1700s. Many of the tree islands through this portion of the Everglades have sites associated with the Glades period. This period has been broken down into successive stages starting with Glades I, which dates from 500 BC to 750 Anno Domini (AD), Glades Period II dating from 750 to 1200 AD, and Glades Period III dating from 1,200 AD to European contact in the 1500s. Bell Glades sites include black earth middens, low sand mounds, and circular and linear earthworks.

During the early historic period, beginning with the first Spanish colonial period (1513 to 1763), the Calusa, a Native Tribe, inhabited southern Florida. Its population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida. After European contact, Native American populations in the region continuously declined and remained at low levels until Miccosukee and Seminole Tribal groups moved into the area while fleeing the U.S. Army and U.S. government’s forced relocation program. Many sites associated with both the Miccosukee and Seminole Tribes are known to exist throughout the region. The Miccosukee and the Seminole migrated into Florida in the eighteenth and nineteenth centuries from Georgia and Alabama. Throughout the mid-1800s, the U.S. relentlessly pursued a policy of Native American removal in Florida, and the Seminole Tribe, resisting removal, eventually established themselves in the Everglades, Big Cypress Swamp, and Ten Thousand Islands. Today, many sites associated with the MTI and STOF are known to exist throughout the region.

Several important battles of the Seminole Wars occurred around Lake Okeechobee, including the largest and bloodiest battle of the Second Seminole War, the Battle of Okeechobee, on December 25, 1837. The Okeechobee Battlefield site is located at the north end of Lake Okeechobee and is a National Historic Landmark site. Other Seminole battle and habitation sites, predominantly on tree islands, are located near Lake Okeechobee. Numerous tree island sites have been identified on the nearby Brighton Reservation. Similar tree island sites may also be present within several of the proposed Project alternatives. Many tree islands are midden sites, which represent the accumulation of daily life activities. Material on these sites stretches from the surface to well over 1 meter below the surface on certain islands. Native American burials can also be found on these sites (Milanich 1994).

American settlement around Lake Okeechobee began in earnest in the late nineteenth century, when efforts to drain and reclaim the Everglades began. Agriculture began in the Everglades, south of Lake Okeechobee, after drainage projects of the 1906 to 1927 era. By 1921, there were 16 settlements on or near Lake Okeechobee, with a total estimated population of 2,000 people. By the 1940s, a number of homes had been built in this area, forming historic districts that are potentially eligible for listing in the National Register of Historic Places (NRHP).

Areas around Lake Okeechobee and the Brighton Reservation have been subjected to cultural resources surveys; however, few investigations have focused on the area of the proposed alternatives. A review of the Florida Master Site File (FMSF) lists both prehistoric and historic archeological sites located in the vicinity of Lake Okeechobee. Prehistoric Native American sites consist of middens, mounds, and earthworks. Historic sites include buildings, shipwrecks, canoes, and cemeteries. Most lands within the Project Area have not been previously surveyed for the presence of cultural resources. There is a high probability that a number of unrecorded archaeological sites are located within each of the proposed alternatives. Several known prehistoric mounds and earthworks complexes are also located within or in proximity to the Study Area.

C.1.1.23 Invasive and Exotic Species

EO 13112, *Invasive Species*, states an "invasive species means an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." Alien species (i.e., exotic) means, with respect to a particular ecosystem, any species, including its seeds, eggs, spores or other biological material capable of propagating that species, which is not native to that ecosystem. Invasive species are broadly defined and can be a plant, animal, fungus, plant disease, livestock disease, or other organism. A native species is defined as a species that historically occurred or currently occurs in a particular ecosystem and is not the result of an introduction.

Significant scientific evidence and research document invasive non-native plants are degrading and damaging South Florida natural ecosystems (Doren and Ferriter 2001). Many species are causing significant ecological impacts by crowding out and displacing native plants, altering soil types and soil/water chemistry, altering ecosystem functions, such as carbon sequestration, nutrient cycling, and fire regimes, and reducing gene pools and genetic diversity. Non-native invasive animal distribution, extent, and impacts are not well understood; however, implications of invasive animals are apparent in South Florida. In addition to environmental impacts, invasive species impact human health, reduce agricultural production and property values, degrade aesthetic quality, decrease recreational opportunities, and threaten the integrity of human infrastructure, such as waterways/navigation channels, locks, levees, dams, and water control structures.

Florida is particularly vulnerable to the introduction, invasion, and naturalization of non-native species. This is due to several factors, including a subtropical climate, dense human population centers, major ports of entry, and the pet, aquarium, and ornamental plant industries. Major disturbance to the landscape has also increased Florida's vulnerability to invasive species. Alteration of the landscape for urban development, flood control, and agricultural uses has exacerbated non-native plant and animal invasions. On average, 10 new organisms per year are introduced into Florida that are capable of establishing and becoming invasive and causing environmental harm. Approximately 90 percent of the plants and animals that enter the continental U.S. enter through the Port of Miami (Cuda 2009). Stein, Kutner, and Adams (2000) estimated that over 32,000 exotic species (25,000 plants and 7,000 animals) have been introduced into Florida. There are approximately 4,000 to 5000 native species of plants and animals in Florida. The number of non-native species that have been introduced is eight times the total number of native species in the entire state.

The Guide to the Vascular Plants of Florida (Wunderlin 1998) documented 3,834 plant species in Florida. Of the 3,834 plant species, 1,180 were considered non-native and were naturalized (i.e., freely reproducing) populations. The Florida Exotic Pest Plant Council (FLEPPC) identifies 81 of the 1,180 species of non-native plants as Category I species and 87 as Category II species in the 2017 Invasive Plant List. Searches through existing data and resources indicate 74 non-native plant species have been documented to occur within the Project Area (See **Annex F, Table 1**). Other non-native species are probably present; however, documented citations could not be located. Of the 74 species of plants documented to occur within the Project Area, there are 44 FLEPPC Category I species, 12 FLEPPC Category II species, and 15 Florida Noxious Weed species.

Within the Study Area, non-native invasive plant species of concern include Australian pine, Old World climbing fern, melaleuca, Brazilian pepper, cogongrass, water hyacinth, water lettuce, Cuban bulrush, and creeping water primrose. Other non-native plant species of concern within the larger Project Area include torpedo grass, tropical American watergrass, and Wright's nutrush.

A primary native nuisance species within the Study Area is cattail. Many areas within the project area have been invaded by cattails. This is attributed to water with increased phosphorus being delivered to these areas, which began in the late 1950s. Areas where water control structures, conveyance features, and levees exist provide a suitable habitat for invasion and expansion of cattail.

Searches through existing data and resources indicate 51 animal species have been documented to occur within the Study Area (See **Annex F**). Other non-native animal species are probably present; however, documented citations could not be located. Information regarding species presence and distribution is largely incomplete for most taxonomic groups of animals. Not all of the 51 non-native animal species identified and documented to occur in the Study Area will have a significant impact on the ecosystem.

Key species of carnivorous reptiles, such as the Burmese python and the Nile monitor, have been located within the Study Area. At present time, these occurrences have been isolated, but there is concern regarding further spread of these species from south of the Project Area. These species have potential to cause significant impacts to the ecosystem and are among South Florida's most threatening invasive animals. These species are considered top predators and increase additional pressures on native wildlife populations, particularly threatened and endangered species (SFER 2013). Other exotic species of concern include the various apple snail species, gray-headed swamphen, wild hog, and redbay ambrosia beetle and associated fungus, which serves as a food source for the beetle and is the cause of the disease called "laurel wilt."

C.1.2 Existing Conditions of Native Americans

There are two federally recognized Tribes, MTI and STOF, who currently live adjacent to the Study Area and have a long history of occupying the region (**Figure C.1-34**). Both Tribes have historically used the Project Area and maintain a strong connection to the region through continued use and regard the Indigenous populations of Florida as their ancestors. Both Tribes moved into the region during the eighteenth and nineteenth centuries from Georgia and Alabama.

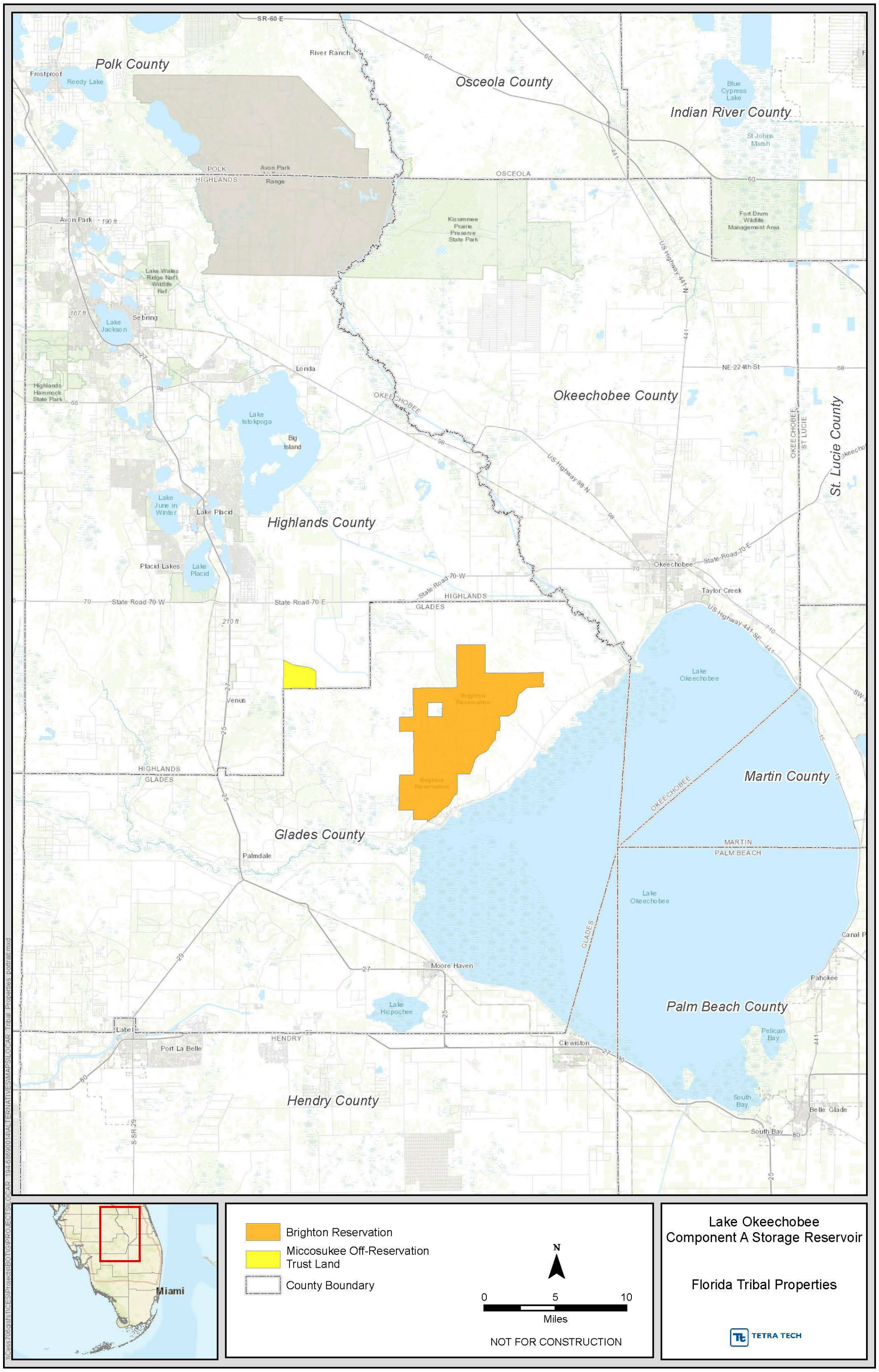


Figure C.1-34. Reservations in the Study Area.

Fleeing the U.S. Army and the forced relocation policies of the Indian Removal Act (1830), the Miccosukees and Seminoles were part of Native American groups commonly referred to as "Seminoles"; however, there are references to some of the groups involved in the conflict at Mikasuki, which supports the later reasons for separations of the two groups (Weisman 1999). Many of these groups fled into the swamp areas of South Florida and made their homes within the Everglades and other remote areas of region. The coming of the Civil War led to the abandonment of the removal efforts and the various Native American groups were largely left alone until the late nineteenth century. In 1928, the Tamiami Trail opened, cutting through the Everglades and bringing along with it tourists and explorers into the region, and, for the first time, bringing complete access for the various Tribes to participate in the larger economy that was growing in South Florida.

Before the 1930s, the Seminoles inhabited camps scattered across Florida where the federal government started to bring services. Between 1935 and 1938, 35,279 ac of land were set aside to begin consolidating the Seminole camps into a reservation at Brighton. Some of the groups relocated and started to receive federal aid, while some groups resisted government intrusion into their lives and remained in various traditional areas that now include sites along Tamiami Trail (Weisman 1999). Today, Brighton is one of six Seminole reservations; approximately 637 people live there. They continue to rely on the water from Lake Okeechobee as a water supply and a secondary irrigation supply for water shortages on the reservation. The STOF also has access to and uses the HHD and Lake Okeechobee for hunting, fishing, and recreational activities.

C.1.3 Future Without Project Conditions of Resources

The FWO condition for the 50-year planning horizon assumes the construction and implementation of authorized CERP and non-CERP projects, including federal, state and local projects constructed or approved under existing governmental authorities that occur in the Study Area (**Table C.1-19**). Under NEPA, the No Action Alternative (herein called the FWO) needs to be evaluated. This subsection describes the projected physical, ecological, and socioeconomic conditions within the Study Area in the year 2072. The FWO conditions are also summarized in **Section 2** of the main report. Refer to **Appendix A** for further information on how Project features in **Table C.1-19** were represented in the hydrologic model simulation of the LOCAR FWO baseline, where applicable.

Table C.1-19. Status of Related Reports, Projects, and Operational Plans Affecting Plan Formulation.

Feature	ECB	FWO	Relationship to LOCAR
Lake Okeechobee Operations	LOSOM	Lake Okeechobee Regulation Schedule per CEPP/EAA Reservoir Operation	Lake Okeechobee stage is influenced by a lake regulation schedule.
Herbert Hoover Dike	Complete with features operational.	Complete with features operational.	LOCAR would be expected to alleviate some risk associated with high lake levels during peak water years.
Kissimmee River Restoration	Construction complete with operations implemented.	Construction complete with operations implemented.	Kissimmee River Restoration will restore portions of the historic floodplain and oxbows, thereby slowing flows from the Kissimmee River into Lake Okeechobee,

Feature	ECB	FWO	Relationship to LOCAR
			as well as restore timing and volume of flows.
Indian River Lagoon	C-44 complete	Ten Mile Creek Reservoir and STA: 1,001 ac with 3.6 ft operating depth	Provides alternate storage downstream from Lake Okeechobee, partially protecting the St. Lucie Estuary from freshwater flows from the C-44, C-23, C-24, and C-25 basins. The IRL-S C-44 reservoir may receive limited inflows from Lake Okeechobee if capacity is available.
C-43 West Basin Storage Reservoir	Under construction.	Complete; features operational.	Provides alternate storage downstream from Lake Okeechobee, partially protecting the Caloosahatchee Estuary from high-volume flows from the lake.
CEPP Authorization	A-2 STA and A-1 FEB. The A-2 STA is assumed/modeled as operational under grow-in conditions only. As of 2023, SFWMD does not have 404/408 permits or an approved federal Water Control Plan (supported by NEPA) for flow-through operations.	370,000 ac-ft represents the increase in the quantity of freshwater flowing into the historic Everglades flow path on an average annual basis with the authorized CEPP EAA project.	CEPP components would allow approximately 370,000 ac-ft average annual of water to be delivered to the Everglades that would otherwise be retained within Lake Okeechobee or flow to the St. Lucie and Caloosahatchee Estuaries.

ac–acre; ac-ft–acre-foot; CEPP–Central Everglades Planning Project; EAA–Everglades Agricultural Area; FEB–Flow Equalization Basin; ft–foot; LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study; LOSOM–Lake Okeechobee System Operating Manual; NEPA–National Environmental Policy Act; SFWMD–South Florida Water Management District; STA–stormwater treatment area.

C.1.3.1 Climate

During the period between the present and 2072, South Florida should experience a full multi-decadal cycle of Atlantic hurricane activity. Currently, the area is in an active phase of this cycle that started in 1995. This active phase followed a 25-year period of low hurricane activity. This suggests that between the present and year 2072, the area would complete this active phase, pass through another low-activity period, and begin another active phase. There is now evidence of anthropogenic changes to global climate patterns that will likely have an impact on South Florida in terms of rainfall, evapotranspiration, and temperature (Intergovernmental Panel on Climate Change 2007). Climatologists predict air temperatures will increase, with projections of summer temperatures being up to 3 to 7°F warmer by 2100 (Twilley et.al. 2001; Union of Concerned Scientists 2008). Increases in air temperature, solar radiation, and water vapor deficit due to climate change are expected to increase evapotranspiration. Models used by Calanca et al. (2006) predict a 20 percent increase in evapotranspiration if summer temperatures increase from 4 to 7°F.

Other sources of climate modeling predict a 1.5°C increase of temperatures in the Everglades and plus or minus 10 percent change in precipitation by 2060 (Obeysekera et al. 2011). The temperature change equates to a 7 percent increase in evapotranspiration. Unless precipitation increases similarly (i.e., plus 7 percent to plus 10 percent), then drought frequency is expected to increase in the Everglades. As a peat soil ecosystem, increasing drought would reduce available water to keep the soils wet, resulting in higher peat oxidation and loss of soil elevations in the freshwater wetlands (Florida Atlantic University 2013). Hydrological modeling indicates that surface water duration may decrease by 10 to 50 percent in the Everglades by 2060 (Florida Atlantic University 2013). In parts of northern WCA 3A, peat depths are less than 10 cm above bedrock (Johnson 2012), so loss of peat may produce bedrock protrusions in these areas within this timeframe.

Regional surface water storage systems (e.g., lakes, rivers, canals, reservoirs, WCAs) will most likely experience more rapid water loss when compared to current levels, ultimately impacting availability of water supplies. Increased evapotranspiration may increase water demand for irrigation and natural wetlands areas. In addition, accelerated evaporation losses from stormwater treatment areas could impact their phosphorus removal performance, increasing the need for supplemental water for these facilities.

The Florida Oceans Council (2009) predicts more frequent intense rainfall events will occur coupled with longer dry periods in between. The SFWMD data indicate that there has been an increase in heavy downpours in many parts of the region, while the percentage of the region experiencing moderate to severe drought increased over the past three decades. While periodic heavy downpours may increase overall precipitation totals, much of the water may be runoff that is eventually lost to the Atlantic Ocean and Gulf of Mexico. The environmental impact of changes to floods and droughts depends on the relationship between the climate extremes. If flooding and drought frequency increase together, the Everglades may return to a more natural slough-ridge-island landscape because the floods would redistribute soils and sediments onto ridges and the droughts would allow recruitment of trees on islands. More droughts, without an increase in flooding conditions, pose a threat to the entire South Florida system. They would likely cause large shifts in community structure due to saltwater intrusion into freshwater habitats, drying of inland wetlands, disappearance of ridge-slough microtopography, and an increase in frequency of fires (both terrestrial and wetland). Without the ability to maintain minimum flows and water levels in South Florida, agriculture and public water supply well fields may not be able to function as designed. In addition, well fields may be contaminated by saltwater intrusion and higher salt levels in coastal waters may limit the usefulness of currently installed desalinization plants. More flooding may be good for the Everglades ecosystem because it would stimulate ridge-slough development and restore historic salinity regimes in the Biscayne Bay and Florida Bay. However, increasing flooding alone may also create more frequent water level reversals during critical wading bird foraging periods, thus causing further declines in nesting success for wading birds.

Current research indicates overall storm frequency may decrease, while the number of strong hurricanes (due to warmer temperatures) is expected to increase. Tropical storms and hurricanes provide huge amounts of rain for the area. The loss of storm-associated rainfall could have significant implications for the SFWMD regional water supplies. If a decrease in the number of storms does occur, there may be significant changes to the distribution of rainfall, which will affect the water supply and natural ecology of South Florida. Less rainfall may mean the region is under drought conditions more often. If tropical storms and hurricanes become more intense, the potential damage to levees, canals, and other water control structures may also increase, resulting in an increased likelihood of flooding on a local and regional scale. Water supply and water quality may also be adversely affected by this extreme.

Sea level change is one of the more certain consequences of climate change and, because it affects the land/ocean interface, it has the potential for environmental impacts on coastal areas. Various sites along the east coast of Florida indicate that the sea level is rising at a rate above the global average (Maul and Martin 1983). The Corps sea level change projections for the period from 2015 to 2065 for Daytona Beach Shores, Florida (Tailwater of S-80), and Fort Myers, Florida (Tailwater of S-79), area for historic, intermediate, and high rates of future sea level rise are described in **Table C.1-20**.

Table C.1-20. Estimated Corps Low, Intermediate, and High Sea Level Change Projections at Fort Myers, Florida, and Daytona Beach Shores, in ft Relative to NAVD88 for Years 1992, 2028, 2078, and 2128.

Year	Fort Myers Low	Fort Myers Intermediate	Fort Myers High	Daytona Beach Shores Low	Daytona Beach Shores Intermediate	Daytona Beach Shores High
1992	-0.41	-0.41	-0.41	-0.79	-0.79	-0.79
2028	-0.13	-0.01	0.35	-0.52	-0.40	-0.04
2078	0.27	0.93	3.01	-0.14	0.52	2.61
2128	0.66	2.31	7.52	0.25	1.89	7.10

Note: Fort Myers, Florida, Gauge: 8725520, Rate: 0.00787 ft/yr, NAVD88 (S-79 Tailwater in the Caloosahatchee Canal); Daytona Beach Shores, Florida, Gauge: 8721120, Rate: 0.00761 ft/yr, NAVD88 (S-80 Tailwater in the St. Lucie Canal)
ft–foot

The regional hydrologic models used to simulate FWP and FWO conditions require climatic and tidal data as boundary conditions. Given the uncertainty in future climatic conditions, the historic climate conditions used in the period of record are assumed to represent conditions that are expected to occur in the Study Area in the future. Simulation model tidal boundary conditions that reflect future sea level change were not available for the range of potential sea level change expected. However, the impact of sea level change on Project benefits is assessed for the FWO and FWP conditions per Corps guidance ER 1110-2-8162, *Incorporating Sea Level Change in Civil Works Programs* and Engineer Technical ETL 1100-2-1, *Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*. Future rates of sea level change are expected to result in significant impacts on coastal canals and communities, with loss of flood protection and increased saltwater intrusion being the primary effects. Additionally, coastal ecosystems and estuaries are expected to be adversely affected and require additional deliveries of freshwater to maintain desirable salinity patterns and healthy ecosystems. Sea level change is discussed in more detail in **Annex H**.

C.1.3.2 Physical Landscape

During the period between the present and 2083, lands within the Study Area would be disposed and developed consistent with surrounding land use patterns. Within the Greater Everglades, continued loss of organic soils would continue as a result of oxidation. It has been observed throughout the Greater Everglades that peat loss is associated with changes in water deliveries that reduce water depths and hydroperiods. Canal construction and drainage have led to increased drought intensity and a resultant loss of peat soils. As soil subsides, a minor lowering of topography would be expected. Characteristics of the physical landscape are not expected to change significantly from existing conditions.

Geology

There are no active mining operations in the LOCAR Study Area. The only active mine within proximity to the Study Area is the CEMEX Palmdale Sand Mine, which is located in western Glades County near Palmdale, Florida. The CEMEX plant supplies materials for ready mix concrete. Mining activities are not expected to change significantly from existing conditions in the LOW.

Soils

Soils within the Study Area are primarily sands in the upland dry prairies, and fine sands and silt in the alluvial floodplain and depressional wetland areas. Without the Project, the landscape and soils are likely to remain over drained until converted from ranch and agricultural lands to developed areas.

Aquifers

Agricultural and ranchland water supply represent the primary water use category in the Study Area. As population increases with development, there will be an additional need to develop alternate water supply sources. Use of brackish groundwater coupled with reverse osmosis treatment is a method already in use at coastal municipalities and may be applied in the interior of the state to augment surface water supplies.

C.1.3.3 Vegetative Communities

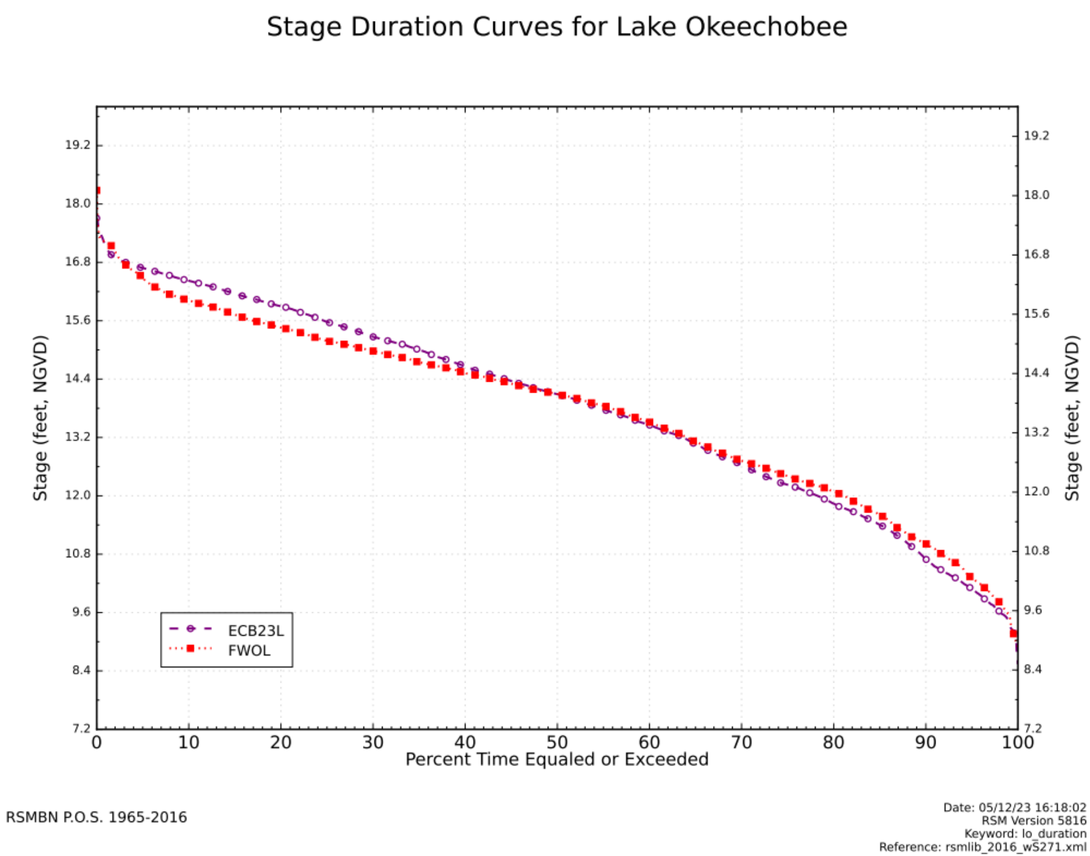
The once vast, naturally connected landscape has been cut into a mosaic of various-sized habitat patches. Canals present throughout the Study Area will likely continue to serve as an effective barrier to wildlife movement, interfering with or preventing the life functions of many native wildlife species. Possible future development, changes in the availability and distribution of freshwater, and further disruption of natural sheet flow from discontinuities in hydrology due to construction of levees, roads, canals, etc., could exacerbate the fragmentation of wetland communities. However, ongoing restoration activities within the watershed, including the KRR, Natural Resources Conservation Service (NRCS) wetland restoration projects, and the USFWS Refuge Project, are restoring functionality to historic wetlands.

Lake Okeechobee Watershed

Based on the 2060 Florida Report (Zwick and Carr 2006), between 2005 and 2060, Florida's population is projected to double from approximately 18 to 36 million people. However, due to the relative remoteness to the coasts and the presence of the STOF's Brighton Reservation, the LOCAR Study Area (specifically Glades, Highlands, and Okeechobee Counties) is expected to retain its rural and agricultural characteristics under FWO conditions. Some areas (e.g., City of Okeechobee and along SR 78, which runs along the northwest shoreline of Lake Okeechobee) are predicted to experience a small increase in residential land uses (Zwick and Carr 2006). Upland and wetland areas that are currently under conservation (e.g., portions of Fisheating Creek and along the Kissimmee River) are expected to stay in conservation. As agriculture and improved pasture occupies a large percentage of the existing watershed, we do not anticipate a substantial change to land use or vegetation communities under FWO conditions. One uncertainty is the future degree of agricultural land use change. Conversion to different agricultural uses could affect vegetative patterns. Another potential change in the watershed under FWO conditions is the conversion of agricultural lands to dispersed water storage areas. At this time, it is unclear which vegetative communities would colonize these water storage features, which we expect to have an annual hydroperiod that varies from dry to 4 ft deep.

Lake Okeechobee

Most of Lake Okeechobee consists of open water (i.e., limnetic) habitat. Littoral vegetation occurs along the perimeter and is most extensive along the southern, western, and northwestern borders. Under FWO conditions, the continued use of Lake Okeechobee to store water for agricultural and flood control needs and to reduce harmful discharges to the coasts would likely continue to result in high water levels (e.g., greater than 14 ft NAVD88) within the lake. High water levels adversely affect shallow, high-elevation, littoral zone habitat by converting them to longer hydroperiod communities and reducing coverage of ephemeral marshes; and replace lower elevation littoral zones with unvegetated, open-water habitat. In addition, even with state BMPs and other projects to improve water quality within the watershed, effects of legacy nutrients would likely maintain poor water clarity that adversely affects nearshore emergent and SAV vegetation. However, relative to existing conditions, which are modeled under the LOSOM schedule, vegetative communities in Lake Okeechobee would be expected to improve under FWO conditions, primarily due to lower duration of stages between approximately 14 and 16 ft NAVD88 (**Figure C.1-35**).



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

Figure C.1-35. Lake Okeechobee ECB and FWO stage duration curves.

Northern Estuaries

The SAV is one of the most important vegetation communities of the CRE and SLE (including the Indian River Lagoon). Currently, SAV beds have been reduced or eliminated from their former areas by extreme salinity fluctuations, increased turbidity, sedimentation, dredging, damage from boats, and nutrient enrichment which causes cyanobacteria blooms that, in turn, restrict light penetration. Continued flood control freshwater flows from Lake Okeechobee to the Northern Estuaries would continue to cause salinities to drop below preferred ranges for estuarine biota. High-level freshwater flows during the wet season would continue to result in increases in nutrient inflows and turbidity to the estuaries, thereby adversely affecting seagrasses. Some level of improvement is expected to occur during the period between the present and 2083 as a result of implementation of projects within the Study Area, with the capability of improving the timing, quantity, and quality of freshwater flow to the Northern Estuaries. Improvements in water quality and salinity levels within the estuaries as a result of the C-43 West Basin Storage Reservoir Project (Corps 2010), Indian River Lagoon South Project (Corps 2004a), and CEPP (Corps 2013) would reduce stress to SAV and aid in long-term health of estuarine habitat and biota.

C.1.3.4 Threatened and Endangered Species

Federally listed threatened and endangered (T&E) species are either known to exist or potentially exist within the Study Area. Under FWO conditions, we predict that the Study Area's rural and agricultural nature will remain largely intact. We expect an increase in water management features (i.e., dispersed water projects) that are not part of the LOCAR as water supply become scarcer or, at least, less reliable. The potential conversion from pasture to other types of agriculture (e.g., sugarcane or other crops) may result in a loss of habitat for species like the crested caracara. In the Northern Estuaries, benefits to Florida manatees from a more natural hydroperiod would not be realized under FWO conditions. Future federal actions unrelated to the Proposed Action, but located in the Study Area, will require separate consultations pursuant to Section 7 of the Endangered Species Act. For further information pertaining to potential impacts to federally listed T&E species as a result of changes that occur between the present and the FWO condition, please see the BA and USFWS BO included in **Annex A.**

C.1.3.5 State-listed Species

State-listed threatened species and species of special concern are either known to exist or potentially exist within the Study Area. Under FWO conditions, we predict that the Study Area's rural and agricultural nature will remain largely intact. We expect an increase in water management features (i.e., dispersed water projects) that are not part of LOCAR as water supply become scarcer or, at least, less reliable. The potential conversion from pasture to other types of agriculture (e.g., sugarcane or other crops) may result in a loss of habitat for state-listed species, like the Florida burrowing owl.

C.1.3.6 Fish and Wildlife

The Study Area supports a variety of fish and wildlife resources. Disruption of the natural hydrology has resulted in aquatic vegetation community changes and a resultant disruption of aquatic productivity and function that has had repercussions through the food web, including effects on wading birds, larger predatory fishes, reptiles, and mammals. Under FWO conditions, a further reduction in habitat function is possible, albeit to a lesser rate than in the past. In this event, it would likely result in a decrease in the abundance and diversity of fish and wildlife resources on non-protected lands.

In the FWO, continued artificial high-water levels within Lake Okeechobee would reduce the availability of bedding habitat for fishes and change the extent and composition of the emergent and submergent vegetation communities. Lower water levels could provide opportunities for foraging for wading birds and other birds dependent upon aquatic prey species by concentrating prey and exposing additional shallow water habitat; however, under FWO conditions, drought conditions would be ecologically worse without additional water storage to offset low lake levels.

Fish and wildlife resources inhabiting the Northern Estuaries would continue to be impacted by high-volume freshwater flows from Lake Okeechobee. Annual variability in flow would lead to salinity extremes outside the tolerance ranges of many fish and wildlife resources, resulting in decreased species diversity. Further declines in estuarine habitat (e.g., SAV and oysters) would continue to result in additional declines in the species that use these habitats. Seagrass communities within the Northern Estuaries provide critical refugia for juvenile fish. The long-term loss of nursery habitat will result in population declines for many species of estuarine and marine fishes and macroinvertebrates, including those species whose young use fresher habitats. Waterfowl and wading birds are also expected to decrease under FWO conditions as estuarine habitat quality continues to decline. Some level of improvement is expected to occur as a result of implementation of projects within the Study Area with the capability of improving the timing, quantity, and quality of freshwater flow to estuarine systems and coastal areas (i.e., C-43 West Basin Storage Reservoir Project [Corps 2010], Indian River Lagoon South Project [Corps 2004a], and CEPP [Corps 2013]).

C.1.3.7 Essential Fish Habitat

Estuarine systems and coastal areas within the Study Area support fishery resources of recreational and commercial importance. At least 70 percent of Florida’s recreationally or commercially sought fishes depend on estuaries for at least part of their life histories. Current disruptions caused by flood control, high-volume freshwater flows would continue to reduce salinities in the estuarine systems and coastal areas during the period between the present and 2072. The absence of freshwater flow into estuarine systems and coastal areas would continue to promote conditions that are likely to result in a decrease in the abundance and diversity of species within those habitats. High-volume freshwater flows during the wet season would continue to negatively impact species using essential fish habitat. Some level of improvement is expected to occur as a result of implementation of projects within the Study Area with the capability of improving the timing, quantity, and quality of freshwater flow to estuarine systems and coastal areas (i.e., C-43 West Basin Storage Reservoir Project [Corps 2010], Indian River Lagoon South Project [Corps 2004a], and CEPP [Corps 2013]).

C.1.3.8 Hydrology

Hydrologic modeling simulations of the existing conditions baseline (ECB) and the FWO condition were developed with the RSM-BN sub-regional modeling tool, to provide baseline conditions for plan formulation, the assessment of LOCAR project benefits (comparisons against FWO), and the assessment of LOCAR alternative performance for the level-of-service for flood protection and water supply (comparisons against ECB). The ECB was developed to represent the systemwide infrastructure and operations that were in place at the time LOCAR plan formulation was initiated, approximately in year 2016. The FWO for LOCAR assumes the construction and implementation of currently authorized CERP and non-CERP projects, and other federal, state, or local projects constructed or approved under existing governmental authorities that occur in the LOCAR Study Area. The LOCAR FWO therefore included first-generation CERP projects already authorized and under construction (i.e., Indian River Lagoon South Project, Picayune Strand Restoration Project, and Site 1 Impoundment Project), second-generation CERP projects that are authorized (i.e., Biscayne Bay Coastal Wetlands Project, Broward County Water Preserve Areas Project, Caloosahatchee River [C-43] West Basin Storage Reservoir, C-111 Spreader Canal Western

Project, Ten Mile Creek Reservoir and STA Preliminary Operation Plan, Holey Land G200 structure, CEPP including the EAA Reservoir and non-CERP projects currently in progress [i.e., SFWMD Restoration Strategies, C&SF C-51 West End Flood Control Project, the C-111 South Dade Project, the KRR Project, Modified Water Deliveries, and the DOI Tamiami Trail Modifications Next Steps Project]). Note RSM-BN model domain south of the lake is spatially limited and some of the projects listed above might have no influence on the LOCAR Project Area. Refer **to Appendix A, *Engineering Appendix,*** for more details about model domain.

Lake Okeechobee and the Northern Estuaries

The FWO assumption for the operation of Lake Okeechobee is the 2008 LORS, plus refinements to the LORS in anticipation of implementing authorized projects, such as CEPP, by 2050 were included in the model runs. Independent of LOCAR implementation, there is an expectation that revisions to the 2008 LORS will be needed following the execution of other CERP projects and HHD infrastructure remediation.

As modeled, the FWO follows the expected trend of increasing stages due to the incorporation of projects, such as Indian River Lagoon-South, C-43, and A1-FEB, as well as completed repairs to the HHD infrastructure, allowing for higher stages with less risk to the dike. Notice criteria like reduction on high-flow durations per event results in an improvement toward the Caloosahatchee Estuary baseflow but increases lake stage from ECB. **Figure C.1-35** shows increases in stage of approximately 0.3 ft, primarily between 14 and 16.5 ft NGVD, or 12.8 and 15.3 ft NAVD, though slight increases also occur between 10 and 13.5 ft NGVD, or 8.8 and 12.3 ft NAVD as well. Overall, lake stages in both the ECB and the FWO are within the ecologically beneficial envelope for almost the same amount of time (57.4 percent versus 56.6 percent, respectively), though the FWO exceeds the upper boundary more frequently and the ECB exceeds the lower boundary more frequently. Ecologically, higher stage exceedances are considered more detrimental than lower stage exceedances.

Overall, there is marked improvement in all high and damaging flow metrics triggered by Lake Okeechobee regulatory releases when compared to the ECB and FWO. Across all alternatives, low flows (SLE biweekly flows less than 150 cfs; and CRE biweekly flows less than 750 cfs) perform worse than the ECB and the FWO due to Lake Operations decisions. High and stressful flow events triggered by basin runoff, rather than Lake Okeechobee regulatory releases, improve across all alternatives compared to the ECB, but are worse than the FWO. Finally, across alternatives, extreme high flows in the estuaries (SLE biweekly flows 1,700 to 4,000 cfs and greater than 4000 cfs; and CRE biweekly flows 2,600 to 4,500 cfs, 4,500 to 6,500 cfs, and greater than 6,500 cfs) show overall improvements, but degree of improvement depends on the estuary and on the flow category in question. For more information on environmental effects of the Recommended Plan, see **Section 6, *The Recommended Plan.***

C.1.3.9 Regional Water Management (Operations)

The FWO for LOCAR assumes the construction and implementation of currently authorized CERP and non-CERP projects, and other federal, state, or local projects constructed or approved under existing governmental authorities that occur in the LOCAR Study Area; the LOCAR FWO therefore included first-generation CERP projects already authorized and under construction (i.e., Indian River Lagoon-South Project), second- generation CERP projects that are authorized (i.e., CEPP, including the EAA Reservoir and Caloosahatchee River [C-43] West Basin Storage Reservoir), and non-CERP projects currently in progress (i.e., the KRR Project, NRCS Wetland Reserve Program-Wetland Reserve Easement, and USFWS Refuge Project).

For the LOCAR modeling of the FWO with the RSM-BN model, operations protocols for the first- and second-generation CERP projects were modeled consistent with the draft Project operating manuals. The completed KRR project includes the Headwaters Revitalization Schedule for the Kissimmee Chain of Lakes as defined for the UKISS modeling conducted by the Kissimmee River project team. The FWO assumes 2008 LORS with the CEPP EAA Phase optimized release guidance.

C.1.3.10 Lake Okeechobee Regulation Schedule

The LOCAR FWO modeling assumed operation of Lake Okeechobee with the other specified adjacent FWO projects (i.e., Kissimmee River Restoration, Caloosahatchee River [C-43] West Basin and St. Lucie River [C-44] Storage Reservoirs, Indian River Lagoon-South project, and EAA Reservoir) in place and operational. Lake Okeechobee FWO operations assume the 2008 LORS regulation schedule with modifications developed during CEPP for future flows, including operations of the EAA Reservoir. Effects on Lake Okeechobee are described in **Appendix C, Part 2, Subsection C.2.3.3.**

C.1.3.11 Groundwater Resources

Planning for future groundwater supply demands in the LOW is described in the Lower Kissimmee Basin water supply plan (SFWMD 2019). Total water demand is expected to increase by 5 percent to 257 million gallons per day by 2040, of which agricultural self-supply is the largest water use category. This demand is met using both surface and groundwater resources. The Intermediate Aquifer/Confining Unit is not a significant water supply source in the Study Area. However, a permeable quartz sand unit was described at depths of 250 to 340 ft bls at the Brighton Reservation (Missimer Groundwater Science 2007). If sufficiently productive, this aquifer could serve as a limited groundwater supply source.

The UFA serves as the most reliable source for agricultural water supply and some public water systems in the LOW. The UFA groundwater is fresh to slightly brackish in the Study Area but becomes more brackish toward Moore Haven and Port Mayaca on Lake Okeechobee (Corps 2013). Estimated future demands on the UFA groundwater may be limited near the Lake Wales Ridge to maintain minimum flows and levels in adjacent lakes (SFWMD 2019). However, sufficient confinement separates Lake Istokpoga and Lake Okeechobee from the UFA, so increased demands are unlikely to affect water levels in these lakes.

The APPZ is not a water supply source due to greater salinity compared to the UFA and greater depth. It is unlikely that the APPZ will provide drinking water or agricultural irrigation supplies in the future.

C.1.3.12 Water Quality

The two most significant water quality issues within the Study Area are associated with nutrient pollution and the bioaccumulation of mercury by fish and birds. General discussion of the phosphorus issues within the basin are provided here. Details of the nutrient issues were discussed in **Subsection C.1.1.11**.

Lake Okeechobee Watershed

Watershed nutrient runoff is being addressed by an BMAP set of projects. These projects are designed to reduce nutrient loading from the runoff at individual properties in the sub-basins. The goal is to meet the

TMDL of 140 MT of phosphorus loading into the lake on an annual basis, which is currently being exceeded by a factor of approximately three to four times the TMDL.

Lake Okeechobee

Water quality in Lake Okeechobee should improve under the FWO condition relative to the existing conditions as a result of implementation of TMDLs and associated BMAPs within the Upper Kissimmee River Basin and lake basin, as well as treatment and diversion projects. The State of Florida has committed to achieving the phosphorus TMDL for the lake by implementing a series of source controls and treatment facilities within the basin. Achieving the TP load TMDL for the lake of 140 MT/year will result in improved dissolved oxygen conditions and reduced incidence of cyanobacteria blooms after internal TP loading events start to decrease. Mercury methylation conditions within the lake should improve due to the implementation of the proposed mercury TMDL for Florida; however, the greatest reduction in total mercury due to atmospheric deposition will only come about through international controls on atmospheric emissions of mercury related to the combustion of coal and other fuels. Although atmospheric loading is often the dominant proximate source of inorganic Hg to many waterbodies, the complication lies in the relationship between influx of inorganic Hg and the amount that is converted to MeHg by sulfate-reducing bacteria (SRB) and other groups of bacteria, such as iron-reducing bacteria and methanogens, following deposition.

Northern Estuaries

Nutrient and dissolved oxygen conditions should improve during the wet season within the Caloosahatchee River and Estuary given the reduction in high flow events due to implementation of the C-43 Reservoir Project (Corp 2010) and CEPP (Corp 2013). The frequency of dry season algal events within the upper estuary may decrease as a result of increased dry season flows through the S-79 structure during the late spring due to implementation of the C-43 Reservoir Project (Corps 2010).

Nutrient and dissolved oxygen conditions should improve during the wet season within the St. Lucie Estuary, given the reduction in high flow events due to implementation of the Indian River Lagoon South Project (Corps 2004a) and CEPP (Corps 2013). Low-flow event conditions do not change significantly within the St. Lucie for the FWO conditions; therefore, no change to water quality is expected during the dry season. Mercury methylation conditions within the estuaries should improve due to the implementation of the proposed mercury TMDL for Florida; however, the greatest reduction in methylated mercury will only come about through international controls on atmospheric emissions of mercury related to the combustion of coal and other fuels.

C.1.3.13 Flood Control

The negative effects associated with flooding are expected to increase during the period between the present and the year 2083. As agricultural and urban development continues, the volume, duration, and frequency of floodwaters may increase, and the actual levels of service for flood control may decline in some areas. If sea level change continues as predicted, it is foreseeable that the Biscayne aquifer is likely to experience greater intrusion of saltwater, possibly rendering some of the current water supply well fields unusable due to contamination. Higher groundwater stages in the Project Area would reduce the ability of water managers to store rainfall runoff wither within wetlands or the surficial aquifer, resulting in increased intensity of stormwater flows through the primary canals. Reduced water storage reduces the capacity of the flood control system to accommodate runoff and would likely lead to increased frequency of flooding events. Sea level change may also impact flood control effectiveness as rising tail water conditions at the coastal canal structures reduce the effective maximum release rates. As additional information becomes available, these structures may be modified or replaced with pumps to ensure continued effective flood control. This may also require the implementation of forward pumping to maintain the existing level of flood protection in the future. An analysis of sea level change was performed for LOWRP, as discussed in **Section 6** and **Annex H**. Sea level change is not included in the FWO modeling for LOCAR; however, the effects would be expected to be similar to LOWRP.

Future non-CERP projects, implemented through the Corps and/or SFWMD may potentially alter the levels of service for flood control within the Study Area, including, but not limited to: potential LORS changes, SFWMD Restoration Strategies, C&SF C-51 West End Flood Control Project, the C-111 South Dade Project, Modified Water Deliveries, and other potential future C&SF operational plan studies. Potential flood control affects, including improved or reduced levels of service, would be thoroughly assessed through the public NEPA process. To the extent that these projects have been identified and defined, these non-CERP projects have been included in the FWO modeling assumptions.

The Water Resources Development Act of 2000 (WRDA) approved the CERP Plan contained in the *Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* dated April 1, 1999. As stated in Section 601(h) of WRDA 2000, “the overarching objective of the Plan is the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection.” Section 601 of WRDA 2000 required the Secretary of the Army, with the concurrence of the Secretary of the Interior and the Governor of Florida, and after notice and opportunity for public comment, to promulgate Programmatic Regulations to ensure that the goals and purposes of the plan are achieved and to establish the processes necessary for implementing the plan. The final Programmatic Regulations became effective on November 12, 2003, as 33 CFR Part 385.

Identifying if an elimination or transfer of existing legal sources of water will occur as a result of implementation of CERP and whether levels of service for flood protection will be reduced by implementation of CERP is required by Section 601(h)(5) of WRDA 2000. The WRDA 2000 Savings Clause requires that “Implementation of the Plan shall not reduce levels of service for flood protection that are: (i) in existence on the date of enactment of this Act [11 December 2000]; and (ii) in accordance with applicable law.” Consistent with the Savings Clause requirements, each CERP project included in the LOCAR FWO (i.e., Indian River Lagoon-South, Picayune Strand Restoration, Site 1 Impoundment, Biscayne Bay Coastal Wetlands, Broward County Water Preserve Areas, Caloosahatchee River [C-43] West Basin Storage Reservoir, C-111 Spreader Canal Western) must independently demonstrate in the respective project implementation reports that implementation of these CERP projects would not adversely impact the levels of service for flood protection. Operations protocols for the first- and second-generation CERP projects were modeled in the LOCAR FWO consistent with the draft Project operating manuals, as documented in the respective project implementation reports.

C.1.3.14 Water Supply

The frequency, severity, and duration of water shortages and the volume of water unavailable to meet existing demands are expected to decrease in the FWO condition as a result of other CERP projects that contribute to increased storage in LOSA.

C.1.3.15 Air Quality

During the period between the present and the year 2083, air quality is expected to be degraded due to increased populations and urbanization. Air quality is expected to comply with air quality standards. However, it is possible that regions of the Study Area may not meet NAAQS and be in non-attainment of standards.

C.1.3.16 Hazardous, Toxic, and Radioactive Wastes

The HTRW conditions under the FWO condition are expected to be very similar to the present condition. Farming and grazing operations and the accompanying HTRW contamination would continue for the foreseeable future until the overlying peat soils are exhausted due to oxidation. HTRW contamination and cleanup will continue at present rates given continued agricultural, residential, and commercial use of other lands within the Study Area.

C.1.3.17 Noise

Sources of noise associated with surrounding land use are expected to be similar to those described in existing conditions. During the period between the present and the year 2083, noise within the major natural areas of South Florida would continue to be limited and of low occurrence. Noise levels would be expected to change where land use is projected to change. Within rural municipalities and urban areas, sound levels would be expected to be of greater intensity, frequency, and duration as areas are further developed from agricultural to residential/commercial due to increased noise from traffic, construction associated with development, and increased operations at commercial and industrial facilities.

C.1.3.18 Aesthetics

Sources of visual aesthetics are expected to be similar to those described in existing conditions. Visual characteristics would be expected to change where land use is projected to change. During the period between the present and the year 2084, the visual environment within the major natural areas of South Florida is expected to decline as changes in the availability and distribution of freshwater would further exacerbate changes occurring in fish and wildlife resources and vegetative communities as described in **Subsections C.1.1.3** and **C.1.1.4**. Within rural municipalities and urban areas, the occurrence of visible topographic features would be expected to be of greater occurrence as areas are further developed from agricultural to residential/commercial. Increased occurrence of visible topographic features (i.e., heavily used roads, highways, single-family homes, high rises, commercial and industrial facilities) may detract from the regional aesthetic. Conversely, if the 2014 Florida Land and Water Conservation Initiative, Amendment 1, receives more funding in the future, regional aesthetic features may increase.

C.1.3.19 Land Use

The region, including cities within the Study Area, is expected to grow slightly in both population and development to meet population demands. Florida is expected to grow exponentially, exceeding the national expected growth rate; however, the growth rate is not as inflated for Glades, Highlands, and

Okeechobee Counties in comparison to other counties in Florida (USCB 2012). Much of the land in the Study Area is currently zoned for agricultural use. As growth continues, rezoning of lands for commercial and industrial use is likely to occur. Development pertaining to increased population includes the demand for additional infrastructure of roads, fire districts, schools, recreation facilities, stormwater management, water and sewer systems, and other facilities the developer may require. Agriculture is expected to remain a strong economic driver within the Study Area. It is not anticipated that land use acreages will increase or decrease substantially based on future population projections.

C.1.3.20 Recreation

In general, the variety of recreational interests in the U.S. appears to be increasing along with recreational participation rates. As future recreation needs and interests develop, it is important to recognize that participation in specific types of recreational activities is often linked to demographic factors, such as age and income. For example, participation in activities requiring vigorous exercise is considerably higher for young people than for senior citizens. However, the elderly population is increasing recreation participation because of growing awareness regarding the importance of physical fitness. Participation in most activities is low for those with family incomes below $25,000 per year. Interestingly, participation is low for those with family incomes greater than $100,000 per year. Most outdoor recreational activities appear to be enjoyed largely by the middle class, those with family incomes between $25,000 and $75,000 per year.

Figure C.1-36 Figure C.1-36 below, from SCORP 2019, predicts population growth in all recreational planning regions. All regions are expected to have significant increases in demands for the selected recreation activities with a commensurate need to increase development of the regions' recreation resources and facilities. The greatest growth is expected in the Project Area.

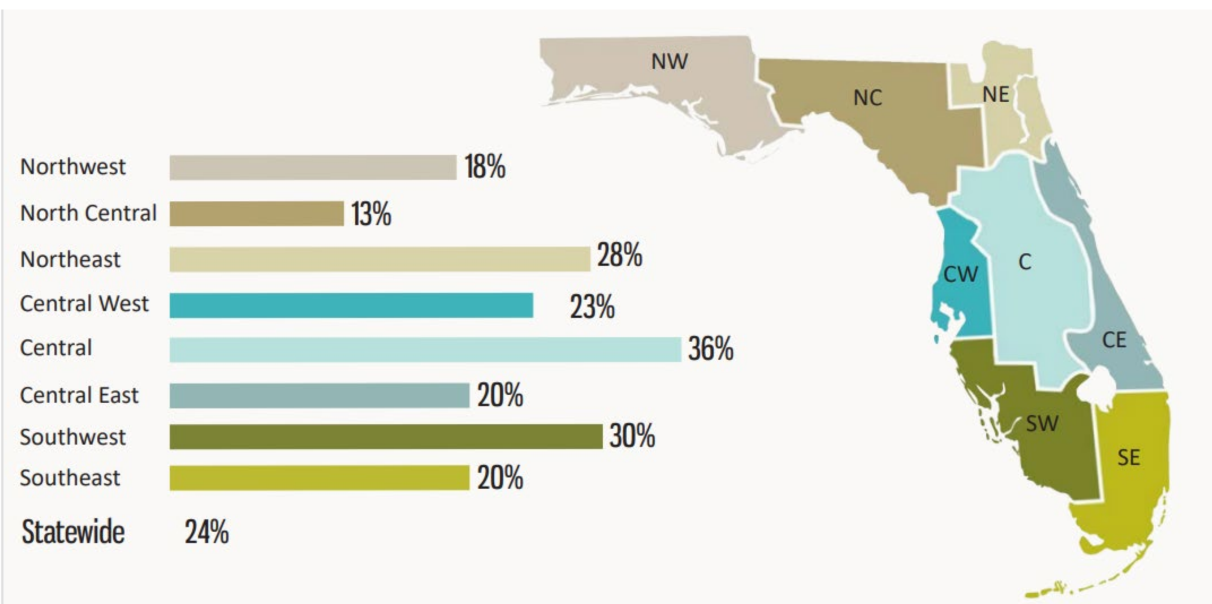


Figure C.1-36. Predicted population increase by 2035 for each SCORP Planning Region (SCORP 2019).

C.1.3.21 Socioeconomics

The 2020 Census count of total population, as reported by the U.S. Census Bureau, is the basis for the 2025 to 2050 population projections, as reported by the University of Florida's Bureau of Economic and Business Research (BEBR). The BEBR publishes low, medium, and high projections to account for uncertainty regarding future population growth. The BEBR believes the medium projections are the most likely to provide accurate forecasts in most circumstances, but the low and high projections provide an indication of the uncertainty surrounding the medium. The projections refer only to permanent residents of Florida; they do not include tourists or seasonal residents (BEBR 2022). **Table C.1-21** provides BEBR population projections for the low, medium, and high ranges for 2025 to 2050 for the counties in the LOCAR Study Area. Using the medium projections, the coastal counties of Martin and Palm Beach are projected to have higher population growth (12.2 percent and 16.4 percent, respectively) than the inland counties of Glades, Highlands, and Okeechobee (5.6 percent, 7.8 percent, and 4.3 percent, respectively) (BEBR 2022).

C.1.3.22 Environmental Justice

The conditions under the FWO conditions are expected to be very similar to the existing conditions. Looking at the Study Area as a whole, the largest racial group in the Study Area is White, but there are communities throughout the Study Area with people of color populations. The major people of color populations in the Study Area are Native Americans (the STOF Brighton Reservation), and people of Hispanic or Latino origin. The Study Area, as a whole, has a lower percentage of persons below poverty than compared to the state, but there are low-income communities throughout the Study Area. Several of the counties in the Study Area, including several of the census tracts adjacent to the Project Area, had higher percentages of persons below poverty than compared to the state. The coastal counties of Martin and Palm Beach had higher per capita and mean household income levels, and lower percentages of persons in poverty, compared to the inland counties of Glades, Highlands, and Okeechobee.

C.1.3.23 Cultural Resources

There are hundreds of previously identified archeological sites within the region. Future economic growth within the Study Area may lead to population increase and development of agricultural lands. Future development and expansion of infrastructure has the potential to adversely impact cultural resources during construction of roads, sewer systems, and other facilities; however, all applicable state and federal regulations that consider cultural resources would still apply.

C.1.3.24 Invasive and Exotic Species

Since the climate of South Florida is subtropical, it presents a hospitable environment for non-native species to invade and become established. It is expected that anthropogenic effects would continue to negatively impact the Study Area and new invasions and expansion of current invasive species would continue in the future.

Table C.1-21. BEBR Population Projections for the LOCAR Study Area for 2025 to 2050.

County	Projection	2025	2030	2035	2040	2045	2050	Percent Change 2025–2050
Glades	Low	11,700	11,400	11,100	10,700	10,400	10,100	-13.7%
Glades	Medium	12,500	12,700	12,900	13,000	13,100	13,200	5.6%
Glades	High	13,200	14,000	14,600	15,200	15,800	16,200	22.7%
Highlands	Low	99,000	97,400	95,600	93,600	91,700	89,900	-9.2%
Highlands	Medium	104,200	106,500	108,300	109,800	111,100	112,300	7.8%
Highlands	High	109,500	115,500	121,000	126,000	130,600	134,800	23.1%
Martin	Low	154,400	152,800	150,300	147,300	144,200	141,000	-8.7%
Martin	Medium	164,300	169,700	174,200	178,000	181,300	184,400	12.2%
Martin	High	174,100	186,700	198,200	208,700	218,500	227,700	30.8%
Okeechobee	Low	37,900	37,100	36,100	35,100	34,100	33,300	-12.1%
Okeechobee	Medium	39,900	40,500	40,900	41,200	41,400	41,600	4.3%
Okeechobee	High	41,900	44,000	45,700	47,200	48,600	49,900	19.1%
Palm Beach	Low	1,492,900	1,504,200	1,502,700	1,492,900	1,478,700	1,462,900	-2.0%
Palm Beach	Medium	1,571,500	1,643,900	1,702,700	1,751,200	1,792,300	1,828,700	16.4%
Palm Beach	High	1,650,100	1,783,600	1,902,800	2,009,500	2,106,000	2,194,400	33.0%
Total, LOCAR Study Area	Low	1,795,900	1,802,900	1,795,800	1,779,600	1,759,100	1,737,200	-3.3%
Total, LOCAR Study Area	Medium	1,892,400	1,973,300	2,039,000	2,093,200	2,139,200	2,180,200	15.2%
Total, LOCAR Study Area	High	1,988,800	2,143,800	2,282,300	2,406,600	2,519,500	2,623,000	31.9%

Source: BEBR 2022.

BEBR–Bureau of Economic and Business Research; LOCAR–Lake Okeechobee Storage Reservoir Section 2023 Study; Study Area–the Project Area plus Lake Okeechobee and the Caloosahatchee and St. Lucie Estuaries

Many factors affect the future expansion and reduction of invasive species. New introductions of invasive species constrain the ability to predict the populations, expansion, and reduction of invasive species. Each species has a diverse and intricate biological heritage that influences its ability to inhabit and thrive in areas outside of its native range.

Canals within the Study Area provide deep-water refugia for species of tropical fish and serve as pathways for invasive species to travel and expand into previously uninhabited areas. Historically wetter areas are now experiencing drier conditions and would be expected to continue to shift in vegetation composition. Woody shrubs, such as willow, and invasive species, such as melaleuca, will continue to expand in these areas. Continued deliveries of nutrient-rich water to the Project Area will further promote the expansion of cattail. Sea level rise is expected in the future, which will allow saltwater species to invade farther inland.

Environmental manipulation and construction activities, urban development, and agriculture will continue to provide disturbance within South Florida. Natural weather events, such as floods, droughts, and hurricanes, will also provide disturbance and avenues for invasive species introduction and expansion. Disturbance of any type promotes the establishment and expansion of invasive species.

Management of invasive species within the Study Area is conducted by several agencies. The magnitude of the control programs is dependent upon the level of funding available. Portions of allocated funding for these programs have been and potentially will be redirected to other programs in the future. Management activities vary in effectiveness, which also influences species control and spread. Management components will be incorporated into CERP projects, which will reduce some species within those projects. This will reduce sources for invasions into other areas. Little is known about control and management measures for most species already present; therefore, these species will perpetuate and spread to other areas.

The large aquarium, pet, and ornamental plant industries import new non-native species into Florida on a regular basis. Therefore, new invasive species introductions will continue to occur. On average, each year, 10 new non-native organisms are introduced into Florida that are capable of establishing, becoming invasive, and causing environmental harm. New imported non-native species introductions will occur through intentional and unintentional freshwater flows. Educational efforts may slightly reduce the number of intentional freshwater flows.

The deeper navigation channels and expansion of ports in Florida, such as Miami and Port Everglades, will provide new trade opportunities for the state. Deeper channels will allow larger container cargo vessels to enter the ports. The number of non-native species introductions into Florida is expected to increase because of the Miami Harbor deepening project. The ships, barges, and goods coming into these ports are from all over the world. Ports are known points for species to be introduced from native to non-native locations.

C.1.4 Future Without Project Conditions of Native Americans

The Brighton Reservation on the northwest side of Lake Okeechobee would still exist under the FWO. It is expected that the STOF would continue to use the areas around the Brighton Reservation for hunting and fishing. The MTI owns one property located within the Study Area approximately 8 mi west of the Brighton Reservation. It is expected that, in the FWO, Tribal properties would remain unaffected. Members of both Tribes continue to rely upon the areas off the reservations to support their cultural, medicinal, subsistence, and commercial activities. Future economic growth within the Study Area may lead to population increase and development of agricultural lands.

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PART 2: EFFECTS OF THE ALTERNATIVES

Part 2 Table of Contents

Part 2 List of Tables

Part 2 List of Figures

C.2 Effects of the Final Array of Alternatives and the Recommended Plan

This section provides a detailed discussion of the potential environmental effects, which can be either positive or negative, that could result from implementation of the alternatives. The evaluation of the effects was based on results of modeling simulations, current information, including scientific literature, direct observation, project design reports, reasonable scientific judgment, the National Environmental Policy Act (NEPA) scoping processes, and information contained within other Environmental Impact Statement (EIS) documents for similar projects. The No Action Alternative is always considered and carried forward as a requirement of NEPA; it forms the basis of comparison and evaluation of alternatives. The NEPA No Action Alternative (referred to as the Future Without Project [FWO]) considers the environmental conditions in the affected regions without the Proposed Action, also referred to as the Recommended Plan.

Environmental impacts include both direct and indirect effects. Under the Council on Environmental Quality (CEQ) regulations, direct effects are “caused by the action and occur at the same time and place,” while indirect effects are,

> *caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems* (40 Code of Federal Regulations [CFR] Section 1508.8).

Under NEPA, one purpose is to identify at an early stage the significant environmental issues deserving of study and deemphasize insignificant issues, narrowing the scope of the EIS accordingly (40 CFR Section 1501.1).

The resource conditions that were evaluated include climate; geology; soils; vegetation; wildlife; hydrology; water quality; flood control; air quality; hazardous, toxic, and radioactive waste (HTRW); noise; aesthetics, land use; agriculture; socioeconomics; environmental justice (EJ); recreation; cultural resources; and invasive species.

The features of the Recommended Plan, Alternative 1, are described in **Section 6**, with specific features located in **Figure 6-1**. The Recommended Plan will improve the amount, timing, and distribution of water entering Lake Okeechobee, provide for better management of lake water levels, reduce high-volume flows to the Caloosahatchee and St. Lucie Estuaries (collectively referred to as the “Northern Estuaries”) from Lake Okeechobee, and improve systemwide operational flexibility. Better managing Lake Okeechobee stage levels within an ecologically preferred stage envelope benefits plant and animal communities of Lake Okeechobee by concentrating prey resources in the littoral zone where wading birds forage; providing optimal light levels for photosynthesis in the summer months to benefit submerged plants and bulrush; favoring development of a diverse emergent plant community; and providing water supply benefits to Lake Okeechobee Service Area (LOSA) existing legal users. Reducing the return frequency, volume, and duration of Lake Okeechobee flows to the Northern Estuaries will improve salinity and turbidity conditions, as well as benefit seagrass beds and the animals that inhabit them.

C.2.1 Climate

Climate change is expected to be similar in the FWO (No Action Alternative) and the alternatives. Implementation of any of the alternatives would have a short-term, regionally negligible, and less-than-significant effect on climate within the Study Area. Minor, localized effects to microclimate may occur under all the alternatives because of redistribution of water and shifts in vegetation. Potential effects may include increases in evapotranspiration and localized rainfall, and temperature changes. Refer to **Annex H** for a detailed overview of the projected impact of climate change within the Study Area.

C.2.2 Physical Landscape

Implementation of any of the alternatives would result in conversion of agricultural land and depressional wetlands to an aboveground reservoir. This change in the physical landscape of the Project footprint differs from the FWO condition wherein the area would remain as agricultural lands. The physical landscape in upland portions of the Project Area would be expected to change with development patterns; changes in land use are discussed more in **Section C.2.18**.

Minor and less than significant impacts would be expected from the excavation of surface cover (e.g., vegetation and soil) within the Project footprint to obtain material for construction of levees, canals, and roads.

C.2.3 Vegetative Communities

The effects of the final array of alternatives on the vegetative communities is documented below and compared to the FWO.

C.2.3.1 Lake Okeechobee Watershed

Under all alternatives, a 200,000 acre-foot (ac-ft) aboveground storage reservoir and pump stations would be constructed. For all three alternatives, most existing plant cover within the reservoir footprint would be removed. **Table C.2-1** shows the vegetative cover that would be impacted by construction of the aboveground storage feature for each alternative.

Table C.2-1. Planning-level Land Use Acres in the Storage Footprint for Each Alternative.

FLUCCS Code Description	Alternative 1	Alternative 2	Alternative 3
Cropland and Pastureland	10,132.8	10,220.5	4,394.6
Disturbed Lands	36.7	49.2	28.5
Herbaceous	189.8	352.3	955.6
Reservoirs	286.0	286.0	377.0
Shrub and Brushland	37.1	96.2	93.6
Streams and Waterways	10.0	13.7	14.7
Transportation	0	1.4	1.4
Tree Crops	0	6,204.2	7,145.5
Upland Hardwood Forests	0	21.2	16.2
Upland Mixed Forests	0	0.9	0
Vegetated Non-Forested Wetlands	2,214.5	2,804.4	1,783.7
Wetland Hardwood Forests	137.0	467.2	236.1
Grand Total	13,043.9	20,517.1	15,046.8

FLUCCS–Florida Land Use, Cover, and Forms Classification System

In general, construction would largely replace existing improved and unimproved pasture. Aquatic plant species that may colonize in a reservoir in the area include sawgrass (*Cladium jamaicense*) and scattered clumps of Carolina willow *(Salix caroliniana*), sweetbay *(Magnolia virginiana*), cypress (*Taxodium* spp.), pond cypress (*Taxodium ascendens*), red maple *(Acer rubrum*), dahoon holly *(Ilex cassine*), swamp bay *(Persea palustris*), sweet bay (*Magnolia virginiana*), wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), St. John's wort (*Hypericum* spp.), chain fern (spp.), and fireflag (*Thalia geniculata*). The construction of a reservoir may provide some deepwater refugia and/or littoral habitat. Alternatives would likely experience wide-ranging depth and duration fluctuations throughout the year ranging from complete dry down to full capacity (e.g., 5 to 15 feet [ft] above soil surface) on an annual basis. This would potentially impact the survival of any wetland species and provide limited benefits to opportunistic plants that could adapt to such environmental dynamics.

The interior of the reservoir would have minimal productive littoral zone because of the necessity to construct relatively steep sides to maximize water storage capacity. The design for the perimeter canals, however, includes littoral areas in the corners and along some of the banks. Exotic plant species are not expected to be a problem under any of the alternatives, as appropriate construction and maintenance procedures would be established to deter and control exotic plant establishment at the Project site.

C.2.3.2 Wetlands

Minor impacts would be expected to wetlands from the construction and operation of the Lake Okeechobee Storage Reservoir Section 203 Study (LOCAR or Project). The dominant land use in the footprint of each alternative is improved or unimproved pasture. There are some wetlands in each footprint as quantified in **Table C.2-2.** The table shows the acres of wetland in each storage feature footprint by National Wetland Inventory code description. A portion of the wetland area in each alternative footprint are above ground impoundment (AGI) ponds: 867 acres (ac) in Alternative 1, 1,712 ac in Alternative 2, and 1,491 ac in Alternative 3.

Table C.2-2. Estimated Acres of Wetlands in Each Storage Feature Footprint by NWI Code.

NWI Code Description	Alternative 1	Alternative 2	Alternative 3
Freshwater Emergent Wetland	2,090.8	2,705.0	2,217.0
Freshwater Forested/Shrub Wetland	260.9	569.9	225.5
Freshwater Pond	0	1.5	1.5
Lake	463.7	463.7	0
Riverine	104.6	164.3	148.2
Grand Total	2,920	3,904	2,592

NWI–National Wetlands Inventory

C.2.3.3 Lake Okeechobee

Moderate, long-term beneficial effects to Lake Okeechobee's littoral vegetation are anticipated from any of the alternatives, relative to the FWO. The overall effect of the alternatives is to stabilize water levels and reduce high lake stages, maintaining lake stage within the ecologically preferred seasonal stage envelope (11.5 to 15.5 ft. NGVD or 10.3 to 14.3 ft NAVD) more frequently than the FWO (**Table C.2-3** and **Figure C.2-1)**. Stages were within the envelope 6 percent more time than FWO for all three alternatives, with 7 percent less time spent above the envelope– a critically important metric due to the severity and longevity of high-stage impacts to the littoral ecosystem (Havens 2002, Havens and Gawlik 2005). Although all alternatives primarily reduced durations at moderate to high stages, there was also a slight increase in duration of low stages, with all three alternatives spending 1 percent more time below the envelope than the FWO. However, compared to the 7 percent reduction in time above, and 6 percent increase in time within the envelope, this effect is minimal and would likely help to offset impacts from remaining high-stage events (Havens et al. 2004, Jin and Ji 2013).

There were similar effects to extreme high and low stages for all alternatives relative to FWO, with substantial reductions in time above 17 ft NGVD29, or 15.8 ft NAVD88, but slight increases in time spent below 10 ft NGVD29, or 8.8 ft NAVD88, (**Figure C.2-2**). All three alternatives had similar reductions in time above 17 ft NGVD29, or 15.8 ft NAVD88, relative to FWO, at approximately 1.5 percent reductions. Increases in time below 10 ft NGVD29, or 8.8 ft NAVD88, relative to FWO were smaller, with Alternative 2 having a 0.93 percent increase, while Alternative 1 and Alternative 3 had increases of 1.06 and 1.07 percent, respectively.

Exceedance rates of moderately high and low stages are also an important metric for lake ecology, so time above 16 ft NGVD29 and below 11 ft NGVD29, or above 14.8 ft NAVD88 and below 9.8 ft NAVD88 were tabulated as well. There were again substantial improvements in time above 16ft NGVD29, or above 14.8 ft NAVD88, with nearly 4.5 percent reductions for each alternative relative to FWO. Importantly, these major improvements to high-stage durations only resulted in slight increases of time below 11 ft NGVD29, or below 9.8 ft NAVD88, at just 0.4 percent or less increases relative to FWO (**Figure C.2-3**). Further, there were slight reductions in the number of minimum flow and level (MFL) exceedances for all three alternatives, with Alternative 2 having six exceedances compared to eight under the FWO, and Alternatives 1 and 3 each having seven.

Table C.2-3. Amount of Time Each Alternative is within the Lake Okeechobee Stage Envelope.

Category	Lake Okeechobee Stage Levels	Future Without Project	Alternative 1	Alternative 2	Alternative 3
% Time Inside Ecologically Preferred Stage Envelope	Varies between11.5 ft and 15.5 ft seasonally	22%	28%	28%	28%
%Time Above Stage Envelope	Varies between12.5 ft and 15.5 ft seasonally	48%	41%	41%	41%
%Time Below Stage Envelope	Varies between11.5 ft and 14.5 ft seasonally	30%	31%	31%	31%
% Time Below Navigational Min. Stage	% TIME <12.5 ft	27.2%	30.1%	29.6%	30.2%
Extreme High Stage	% TIME >17 ft	2.05%	0.59%	0.58%	0.58%
Extreme Low Stage	% TIME <10 ft	3.05%	4.11%	3.98%	4.12%

Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

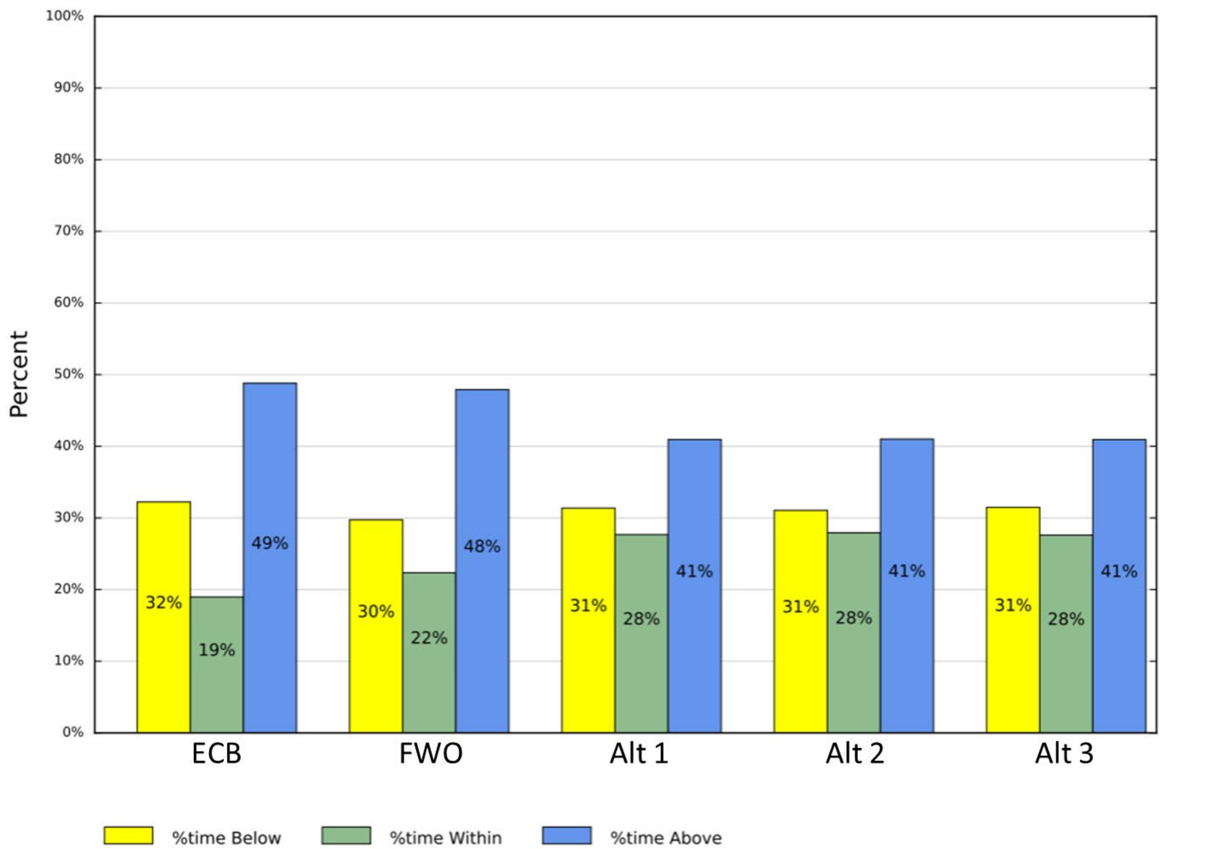
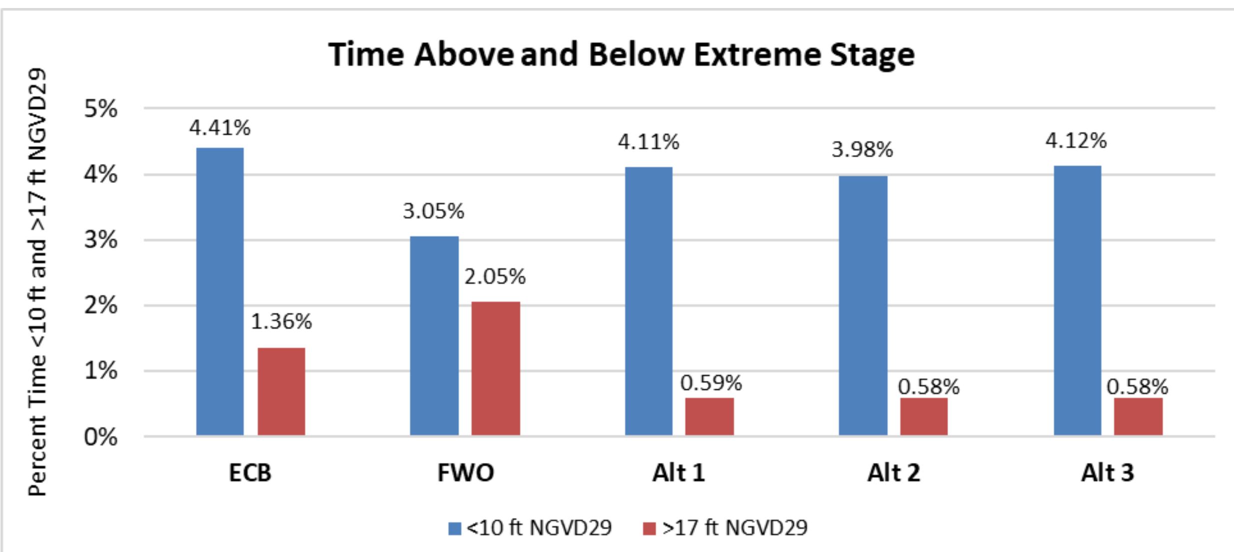
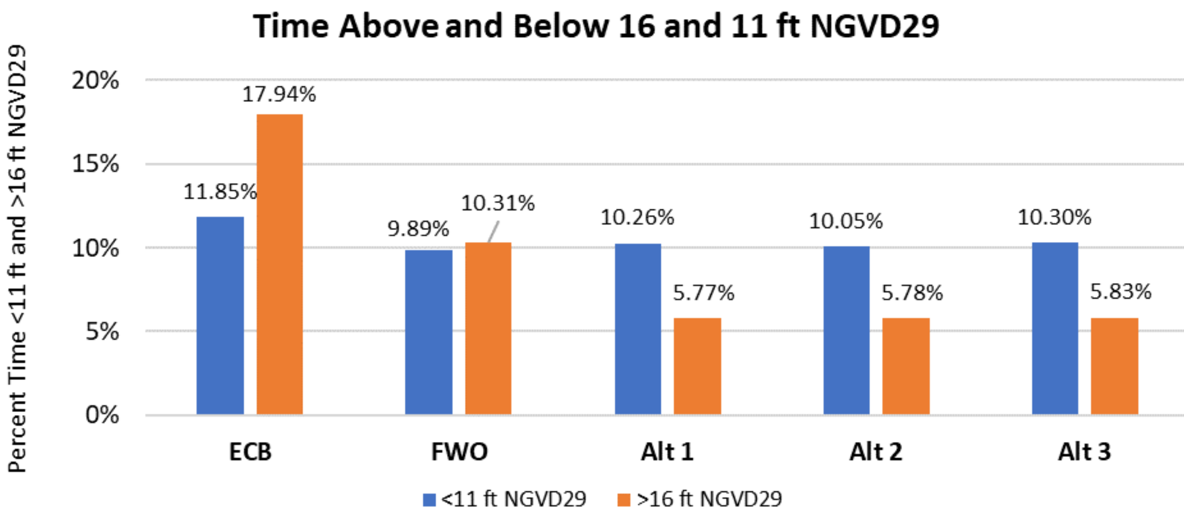


Figure C.2-1. Percent of time modeled stages were below, within, and above the Lake Okeechobee Stage Envelope.



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

Figure C.2-2. Percent of time modeled stages were >17 ft NGVD29 or <10 ft NGVD29 on Lake Okeechobee for all alternatives.



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

Figure C.2-3. Percent of time modeled stages were >16 ft NGVD29 or <11 ft NGVD29 on Lake Okeechobee for all alternatives.

The overall effect of substantially lowering the duration and frequency of moderate and high lake stages with only minimal increases in low stage durations should significantly improve vegetation throughout the littoral marshes relative to FWO, primarily by reducing hydroperiods at the upper elevations and providing larger areas for submerged aquatic vegetation (SAV) at low elevations. When lake stages are maintained nearer the ecological envelope, the maximum practicable extent and diversity of littoral marsh is realized; the base of the surrounding levee sits at approximately 15 ft NGVD29, or 13.8 ft NAVD88, and relatively steeper bathymetric slopes occur at roughly 9 ft NGVD29, or 7.8 ft NAVD88, and below. When lake stages are above the envelope, large portions of diverse, medium-short hydroperiod marshes can be replaced by invasive cattail, while SAV and fringing bulrush communities are reduced or lost at the limnetic interface (approximately 9 to 10 ft NGVD29 or 8 to 9 ft NAVD88). Increased transport of turbid limnetic water to clearer, nearshore littoral areas during high lake stages decreases light levels and reduces coverage of SAV and emergent marshes; all ultimately reducing the quantity and quality of littoral habitat (Havens 2002, Havens et al. 2005).

Conversely, when lakes stages are kept below the envelope for extended durations, higher elevation marshes can be invaded by woody species like wax myrtle (*Myrica cerifera*) and willow (*Salix caroliniana*), and exotic species like torpedograss (*Panicum repens*). Simultaneously, emergent marsh species can move downslope and displace SAV communities where steep shorelines at the limnetic interface limit the extent to which SAV can migrate lakeward.

The ecological envelope represents a suite of seasonally variable stages that promote the largest extent of littoral marsh with the greatest diversity of vegetation communities (Richardson et al. 1995) comprised of short-hydroperiod marshes at high elevations and large expanses of SAV habitat at low elevations. Because all action alternatives increase the frequency of time inside the envelope, primarily by reducing the time spent above it, littoral marshes of the lake should increase in diversity, have increased coverage of short-hydroperiod communities, see improvements to woody habitats that support wading bird nesting, and produce greater recovery of SAV beds relative to FWO. These benefits are evident in the potential habitat unit (HU) lift for the alternatives relative to FWO; 54,568 HU lift for Alternative 1, 56,034 HU lift for Alternative 2 and 54,387 HU lift for Alternative 3.

C.2.3.4 Northern Estuaries

Overall, there is marked improvement in all high and damaging flow metrics triggered by Lake Okeechobee regulatory releases when compared to the ECB and the FWO (**Table C.2-4** and **Table C.2-5**). Across all alternatives, low flows (SLE biweekly flows less than 150 cfs and CRE biweekly flows less than 750 cfs) perform worse than the ECB and the FWO, due to Lake Operations decisions. High and stressful flow events, triggered by basin runoff rather than Lake Okeechobee regulatory releases, improve across all alternatives compared to the ECB but are worse than the FWO. Finally, across alternatives, extreme high flows in the estuaries (SLE biweekly flows between 1,700 and 4,000 cfs and greater than 4,000 cfs; and CRE biweekly flows between 2,600 and 4,500 cfs, 4,500 to 6,500 cfs, and greater than 6,500 cfs) show overall improvements, but the degree of improvement depends on the estuary and flow category in question.

Because the difference in performance between alternatives are marginal across all Northern Estuaries performance metrics, the below sections provide further analysis mainly of Alternative 1 (the best performing) compared to the existing conditions baseline (ECB) and Future Without Project performance.

Table C.2-4. Caloosahatchee Estuary Modeled Results for the Alternatives, Existing Conditions Baseline, and Future Without Project Condition.

Scenario	ECB	FWO	Alternative 1	Alternative 2	Alternative 3
Low Flow - # of 14-day periods <750 cfs	549	752	586	584	586
Optimal Flow - # of 14-day periods ≥750 cfs and <2,100 cfs	638	549	688	686	689
High Flow (Basin Runoff) - # of 14-day periods ≥2,100 cfs and <2,600 cfs	166	124	153	154	154
High Flow (LOK Regulatory) - # of 14-day periods ≥2,100 cfs and <2,600 cfs	77	66	42	42	41
Damaging Flow (Basin Runoff) - # of 14-day periods ≥2,600 cfs	230	160	179	178	179
Damaging Flow (LOK Regulatory) - # of 14-day periods ≥2,600 cfs	86	66	55	56	55
Damaging Flow (Total Flows) - # of 14-day periods ≥2,600 and ≤4,500 cfs	241	181	179	178	178
Damaging Flow (Total Flows) - # of 14-day periods ≥4,500 and ≤6,500 cfs	105	80	75	77	76
Damaging Flow (Total Flows) - # of 14-day periods ≥6,500 cfs	84	56	64	64	64

cfs–cubic foot per second; FWO–Future Without Project; LOK–Lake Okeechobee

Table C.2-5. St. Lucie Estuary Modeled Results for the Alternatives, Existing Conditions Baseline, and Future Without Project Condition.

Scenario	ECB	FWO	Alternative 1	Alternative 2	Alternative 3
Low Flow - # of 14-day periods <150 cfs	183	163	209	208	210
Optimal Flow - # of 14-day periods >= 150 cfs and <1,400 cfs	910	997	1013	1011	1012
High Flow (Basin Runoff) - # of 14-day periods ≥1,400 cfs and <1,700 cfs	279	238	262	261	263
High Flow (LOK Regulatory) - # of 14-day periods ≥1,400 cfs and <1,700 cfs	30	49	20	20	20
Damaging Flow (Basin Runoff) - # of 14-day periods ≥1,700 cfs	452	344	350	350	351
Damaging Flow (LOK Regulatory) - # of 14-day periods ≥1,700 cfs	41	58	29	30	27
Damaging Flow (Total Flows) - # of 14-day periods ≥1,700 and ≤4,000 cfs	427	352	337	339	339
Damaging Flow (Total Flows) - # of 14-day periods ≥4,000 cfs	166	129	118	118	118

cfs–cubic foot per second; FWO–Future Without Project; LOK–Lake Okeechobee

Low Flows

In the CRE, low flows (biweekly flows under 750 cfs) are improved across alternatives compared to the FWO but worsen compared to the ECB. Meanwhile in the SLE, low flows (biweekly flows under 150 cfs) worsen across all alternatives compared to the ECB and the FWO. Consider that the modeling assumptions for the FWO simulation includes a version of the LORS 2008 (LORS08+) schedule rather than LOSOM, and the ECB and all alternative simulations use LOSOM. LOSOM ensured improvements in low flows compared to LORS08+, especially in the CRE where decreases in the frequency and duration of base flow will result in salinity optima needed for freshwater and oligohaline species of submerged aquatic vegetation, namely tape grass. While the combined measured low flows into the SLE don't impact the estuary proper, flows under 150 cfs can result in salinity increases and potential detriment to juvenile fish and fish nursery habitat in the St. Lucie River upstream of the SLE north fork.

Alternative 1 is ranked the best performing overall for the estuaries. In the CRE, there are 37 more low flow events in the period of simulation than the ECB. In the SLE, there are 26 more low flow events in the period of simulation than the ECB. This can be explained due to Lake Operations in which, under certain conditions, water is held in Lake Okeechobee to prevent time below the stage envelope (12 ft).

A sensitivity analysis was conducted to demonstrate Alternative 1 performance compared to a FWO scenario that is more representative of LOSOM operations (FWOLL) (**Table C.2-6**). This shows improvement for the CRE low flows in Alternative compared to FWOLL, with 15 fewer low flow events of the period of simulation. For the SLE, we still see 23 more low flow events in the FWOLL and Alternative compared to the ECB (**cfs–cubic foot** per second; FWO–Future Without Project; LOK–Lake Okeechobee; LOSOM–Lake Okeechobee System Operating Manual

Table **C.2-7**) due to LOSOM operations that send supplemental baseflows to the CRE and restricting flows to the SLE.

Table C.2-6. Caloosahatchee Estuary Modeled Results for the Sensitivity Run of LOSOM-like Operations of the FWO and Alternative 1.

Scenario	ECB	FWOLL	Alternative 1
Low Flow - # of 14-day periods <750 cfs	549	487	472
Optimal Flow - # of 14-day periods ≥750 cfs and <2,100 cfs	638	769	783
High Flow (Basin Runoff) - # of 14-day periods ≥2,100 cfs and <2,600 cfs	166	153	154
High Flow (LOK Regulatory) - # of 14-day periods ≥2,100 cfs and <2,600 cfs	77	55	52
Damaging Flow (Basin Runoff) - # of 14-day periods ≥2,600 cfs	230	179	184
Damaging Flow (LOK Regulatory) - # of 14-day periods ≥2,600 cfs	86	59	57

cfs–cubic foot per second; FWO–Future Without Project; LOK–Lake Okeechobee; LOSOM–Lake Okeechobee System Operating Manual

Table C.2-7. St. Lucie Estuary Modeled Results for the Sensitivity Run of LOSOM-like Operations of the FWO and Alternative 1.

Scenario	ECB	FWOLL	Alternative 1
Low Flow - # of 14-day periods <150 cfs	183	206	206
Optimal Flow - # of 14-day periods ≥150 cfs and <1,400 cfs	910	1018	1018
High Flow (Basin Runoff) - # of 14-day periods ≥1,400 cfs and <1,700 cfs	279	269	265
High Flow (LOK Regulatory) - # of 14-day periods ≥1,400 cfs and <1,700 cfs	30	16	17
Damaging Flow (Basin Runoff) - # of 14-day periods ≥1,700 cfs	452	354	350
Damaging Flow (LOK Regulatory) - # of 14-day periods ≥1,700 cfs	41	21	19

cfs–cubic foot per second; FWO–Future Without Project; LOK–Lake Okeechobee; LOSOM–Lake Okeechobee System Operating Manual

Optimal Flows

Overall, the number of times in the period of simulation in which we meet Optimal Flows in both estuaries (CRE biweekly 750 to 2,100 cfs; and SLE biweekly 150 to 1,400 cfs) increases. Benefit is more evident in the SLE, where there are 110 more Optimal events in the period of simulation for Alternative 1 than the ECB (**Table C.2-7**). There are 50 more Optimal events in the period of simulation in the CRE in compared to the ECB (**Table C.2-6**).

Optimal Flows as defined by RECOVER (2020) would result in a suitable salinity gradient throughout the estuary to support the range of indicator species in the estuaries. In the SLE, salinities are optimal for oysters in the north fork, south fork, and middle estuary, and suitable for marine SAV in the lower estuary. In the CRE, salinities remain below 10 in the upper estuary to support tape grass, with a salinity gradient moving downstream that is optimal for both oysters in mid and lower estuary and marine SAV in the lower estuary and San Carlos Bay.

Stress (High) Flows

In the CRE, there are 35 fewer events of biweekly Stress (High) Flows (2,100 to 2,600 cfs) that are triggered by Lake Okeechobee regulatory releases, and 13 fewer triggered by Basin Runoff, over the period of simulation than the ECB (**Table C.2-6**). In the SLE, there are 10 fewer events of biweekly Stress (High) Flows (1,400 to 1,700 cfs) that are triggered by Lake Okeechobee regulatory releases, and 17 fewer triggered by Basin Runoff, over the period of simulation than the ECB (**Table C.2-7**).

Stress (High) Flows in the CRE (biweekly flows of 2,100 to 2,600 cfs) are characterized by salinities falling below the optima for oysters at their most upstream extent of the estuary while tape grass in the upper estuary, and oysters and marine SAV in the lower estuary and San Carlos Bay remain unaffected. This Stress Flow range was defined by RECOVER (2020) as a conservative measure of impact to the estuary outside the Optimal Flows. In the SLE, Stress (High) Flows (biweekly flows 1,400 to 1,700 cfs) result in lower salinities in the north fork and south fork, falling outside of the salinity optima for oysters and marine SAV. Typically, oyster reefs in the forks are less dense (oysters per m^2), with a lower proportion of live-to-dead individual oysters compared to the middle estuary where salinities are higher. Similarly, these Stress Flows were defined by RECOVER (2020) as a conservative measure of impact in the estuary outside of Optimal Flows.

Damaging Flows

In the CRE, there are 31 fewer events of biweekly Stress (High) Flows (over 2,800 cfs) that are triggered by Lake Okeechobee regulatory releases, and 51 fewer triggered by Basin Runoff, over the period of simulation than the ECB (**Table C.2-6**). In the SLE, there are 11 fewer events of biweekly Stress (High) Flows (over 1,700 cfs) that are triggered by Lake Okeechobee regulatory releases, and 102 fewer triggered by Basin Runoff, over the period of simulation than the ECB (**Table C.2-7**).

To understand the improvements in extreme damaging flows between the ECB, FWO, and alternatives, additional flow bins above the Damaging Flow ranges for the CRE (over 2,800 cfs) and SLE (over 1,700 cfs) were modeled (**Table C.2-6** and **Table C.2-7**). In the CRE, these include biweekly flows of 2,800 to 4,500 cfs, 4,500 to 6,500 cfs, and over 6,500 cfs, which would result in progressive decreases in salinity throughout the entire estuary, and therefore adverse impacts to mesohaline and euryhaline species. The number of biweekly events between 2,800 and 4,500 cfs over the period of simulation in the CRE decrease by 62, while biweekly flows of 4,500 to 6,500 cfs decrease by 30 events, biweekly flows over 6,500 cfs decrease by 20 events with Alternative 1 compared to the ECB, respectively (**Table C.2-6**).

In the SLE, extreme high biweekly flows between 1,700 and 4,000 cfs, and above 4,000 cfs were modeled (**Table C.2-7**), the latter of which could result in salinities decreasing below five in the whole SLE. Compared to the ECB, Alternative 1 results in 90 fewer biweekly flow events of 1,700 to 4,000 cfs, and 48 fewer biweekly flow events over 4,000 cfs for the period of simulation.

There is less improvement in the highest of the flow bins modeled, likely due to flood protection and flood control measures made prior to or following extreme precipitation with lower capacity to move water south, and the need to lower Lake Okeechobee levels below the high stage line (17 ft).

C.2.4 Threatened and Endangered Species

The overall objective of LOCAR is to increase water storage capacity in the watershed, improve the quantity and timing of flows to the Northern Estuaries, and restore wetlands. Federally and state-listed threatened, endangered, and candidate species may occur within the Project Area (**Table C.2-8**). Species described in the following section were determined by the Corps to potentially be affected by the Project. Species determinations are described in a BA that was prepared for the Project and submitted to USFWS for review on August 16, 2023, located in **Annex A**. The USFWS reviewed the BA, and prepared a BO for the Project that was received on November 30, 2023, and is located in **Annex A**..

Table C.2-8. List of Threatened, Endangered, and Candidate Species Known to Occur in Highlands County. State Listed Species of Special Concern are also Listed.

Scientific Name	Common Name	Federal Status	State Status	Alternatives 1, 2, 3 Determinations
Reptiles	-	-	-	
Alligator mississippiensis	American alligator	Similarity of Appearance, Threatened (SAT)	Not Listed	No Effect
Drymarchon couperi	Eastern indigo snake	Threatened	Not Listed	May Affect
Gopherus polyphemus	Gopher tortoise	Not listed	Threatened	May Affect
Pituophis melanoleucus mugitus	Florida pine snake	Not listed	Threatened	May Affect
Birds	-	-	-	
Ammodramus savannarum floridanus	Florida grasshopper sparrow	Endangered	Not Listed	May Affect Not Likely to Adversely Affect
Aphelocoma coerulescens	Florida scrub jay	Threatened	Not Listed	No Effect
Athene cunicularia	Burrowing owl	Not listed	Threatened	May Affect
Egretta caerulea	Little blue heron	Not listed	Threatened	May Affect
Egretta tricolor	Tricolored heron	Not listed	Threatened	May Affect
Falco sparverius paulus	Southeastern American kestrel	Not listed	Threatened	May Affect
Grus canadensis pratensis	Florida sandhill crane	Not listed	Threatened	May Affect
Laterallus jamaicensis ssp. jamaicensis	Eastern black rail	Threatened	Not Listed	May Affect Not Likely to Adversely Affect
Mycteria americana	Wood stork	Endangered	Not Listed	May Affect Not Likely to Adversely Affect
Polyborus plancus audubonii	Audubon’s crested caracara	Threatened	Not listed	May Affect
Rostrhamus sociabilis plumbeus	Everglade snail kite	Endangered	Not Listed	May Affect Not Likely to Adversely Affect
Mammals	-	-	-	-
Perimyotis subflavus	Tricolored bat	Proposed Endangered	Not Listed	May Affect
Eumops floridanus	Florida bonneted bat	Endangered	Not Listed	May Affect
Puma concolor coryi	Florida panther	Endangered	Not Listed	May Affect
Trichechus manatus	West Indian (Florida) manatee	Endangered	Not Listed	May Affect Not Likely to Adversely Affect
Plants and Lichens	-	-	-	
Chionanthus pygmaeus	Pygmy fringe-tree	Endangered	Endangered	No Effect

Scientific Name	Common Name	Federal Status	State Status	Alternatives 1, 2, 3 Determinations
Cladonia perforata	Florida perforate cladonia	Endangered	Endangered	No Effect
Clitoria fragrans	Pigeon wings	Threatened	Endangered	No Effect
Conradina brevifolia	Short-leaved rosemary	Endangered	Endangered	No Effect
Cucurbita okeechobeensis	Okeechobee gourd	Endangered	Endangered	May Affect Not Likely to Adversely Affect
Crotalaria avonensis	Avon Park harebells	Endangered	Endangered	No Effect
Dicerandra christmanii	Garret's mint	Endangered	Endangered	No Effect
Dicerandra frutescens	Scrub mint	Endangered	Endangered	No Effect
Eryngium cuneifolium	Snakeroot	Endangered	Endangered	No Effect
Hypericum cumulicola	Highlands scrub hypericum	Endangered	Endangered	No Effect
Liatrus ohlingerae	Scrub blazing star	Endangered	Endangered	No Effect
Paronchia chartacea	Papery whitlow-wort	Threatened	Endangered	No Effect
Polygala lewtonii	Lewton’s polygala	Endangered	Endangered	No Effect
Polygonella basiramia	Wireweed	Endangered	Endangered	No Effect
Polygonella myriophylla	Sandlace	Endangered	Endangered	No Effect
Warea carteri	Carter’s mustard	Endangered	Endangered	No Effect
Ziziphus celata	Florida ziziphus	Endangered	Endangered	No Effect
Critical Habitat	-	-	-	-
Rostrahamus sociabilis plumbeus	Everglade snail kite	Endangered	Endangered	May Affect Not Likely to Adversely Affect
Trichechus manatus	West Indian Manatee	Endangered	Endangered	No Effect

C.2.4.1 Florida Grasshopper Sparrow

The Project Area and alternative are within the USFWS Consultation Area for Florida grasshopper sparrow, and there is potential habitat in the Project Area and the other two alternatives. Within the Project Area (Alternative 1) there are 7,838 ac of improved pasture. Nearly all this improved pasture has some potential to support nesting Florida grasshopper sparrows. During a site visit on May 3, 2023, it was observed that there are large expanses of open pasture, areas typically suitable for nesting. Grazing was observed during the site visit and is the only form of vegetation management in the Project Area; no fire is used. Improved pasture is prevalent in the Project Area, and it is also prevalent in the region.

Alternatives 2 and 3 also have potential habitat to support Florida grasshopper sparrow. Within Alternative 2 there are 7,906 ac of improved pasture, and within Alternative 3 there are 2,665 ac of improved pastures.

The Recommended Plan will result in removal of habitat and placement of LOCAR will permanently reduce the amount of nesting habitat available for Florida grasshopper sparrow. However, based on the limited suitability of the habitat for Florida grasshopper sparrow due to the lack of prescribed fire and cattle grazing, the Recommended Plan “May Affect, but is Not Likely to Adversely Affect” Florida grasshopper sparrow. Preconstruction surveys shall be conducted prior to building all features to confirm there are no grasshopper sparrows present. If Florida grasshopper sparrows are encountered during the pre-construction surveys, the Corps would work closely with USFWS to identify options to eliminate or minimize any potential effects.

C.2.4.2 Eastern Black Rail

Eastern black rail has a moderate probability of occurrence within the Project Area (Alternative 1) and the other two alternatives based on potentially suitable habitat that is present. Alternative 1 will permanently remove 2,846 ac of wetland habitats (emergent and shrub wetlands, marshes, and wet prairie) that could support Eastern black rail and is therefore likely to have unavoidable adverse effects on the species. The other two alternatives would also impact wetland habitat that could support eastern black rail: Alternative 2 includes 3,318 ac, and Alternative 3 includes 2,421 ac.

Efforts will be made to avoid mortality of the species during construction by avoiding vegetation clearing/grubbing during the active nesting season. Direct mortality, while unlikely, could result from collision with construction-related equipment and motorized vehicles. It is not possible to estimate how many Eastern black rails may be killed so habitat, as described below, will be used as a surrogate for estimating take.

The Corps will use Standard Protection Measures for Eastern black rails throughout the Project design and construction to minimize any potential adverse effects to the extent practicable. It has been determined that the Recommended Plan "May Affect, but is Not Likely to Adversely Affect" Eastern black rail.

C.2.4.3 Audubon's Crested Caracara

The Project Area (Alternative 1) and the alternatives are within the USFWS Consultation Area for Audubon's crested caracara. There are known caracara observations, nest sites, communal roosts and gathering areas, and foraging habitat within the footprint of all three alternatives. During a site visit on May 3, 2023, many caracaras were observed in and around Alternative 1. Nesting occurs exclusively in cabbage palms, which are prevalent in the Alternative 1. Cabbage palms will be removed from the Project footprint at a time when caracara nests are not active, removing the potential for mortality to occur.

Construction of Alternative 1 would remove 7,875 ac of mapped caracara habitat. This habitat will be permanently removed and replaced with infrastructure that is not suitable for caracara nesting or foraging. Alternative 2 would likely have the greatest impact, as it would remove 7,943 ac of habitat. Alternative 3 would have the least impact, affecting 2,672 ac. Caracaras may forage along future storage features. As a result, all with-action Project features would likely need surveys to identify caracara nests and better define the magnitude of adverse or potentially beneficial effects. A biological opinion exempting incidental take of caracaras will likely be needed for any with-action alternative. The Recommended Plan for removal of upland habitat when caracara nests are not active, "May Affect" crested caracaras.

C.2.4.4 Florida Bonneted Bat

The Project Area (Alternative 1) and the alternatives are located is the USFWS Florida bonneted bat consultation area. Florida bonneted bat may use all three alternatives for roosting, foraging, and drinking habitat. There are locations in the Alternative 1 where potential roost trees occur, although most of Alternative 1 only provides foraging habitat. Preconstruction acoustic surveys would be completed to identify whether roost trees are occupied by bats. This is consistent with the Consultation Key for the Florida bonneted bat (USFWS 2019). If bats are encountered, the Corps will coordinate measures with the USFWS to minimize or avoid potentially adverse effects. No mortality of individuals is anticipated during construction or operation of the facility.

Construction of any of the alternatives would retain some benefits to Florida bonneted bat with the creation of aboveground water storage available for foraging and drinking, though it would replace more natural wetland complexes, which also provide this type of habitat and likely support higher concentrations of prey. However, the alternatives contain uplands that may contain roosting trees, thus all alternatives may remove roosting habitat. Alternative 2 has the most potential habitat for trees that are suitable for roosting, followed by Alternative 1 and then Alternative 3 (**Table C.2-9**). Construction of Alternative 1 will remove 13,066 ac of more natural wetland/upland habitat matrix, including grassland and shrubland with intermixed wetlands, and replace it with 13,066 ac of aboveground reservoir. The other alternatives would result in removal of a similar amount of natural wetland/upland habitat: Alternative 2 would remove 19,957 ac, and Alternative 3 would remove 14,574 ac.

Acoustic surveys to detect bats would be completed prior to construction so that if bats are encountered, the Corps can coordinate measures with USFWS to minimize or avoid potentially adverse effects. Because Alternative 1 is within the Florida bonneted bat consultation area and contains trees in which bats could potentially roost, the Corps has determined that the Recommended Plan “May Affect” the Florida bonneted bat.

Table C.2-9. Acres Where Potential Bonneted Bat Tree Roosts May be Present in Each Alternative Footprint.

Category	Alternative 1	Alternative 2	Alternative 3
Acres of uplands	10,128	16,445	12,060
Acres of woodlands	2,158	2,423	1,240
Total acres of wetlands/uplands lost	13,066	19,957	14,574

C.2.4.5 Tricolored Bat

Tricolored bat may use the Project Area (Alternative 1) for roosting, foraging, and drinking habitat. There are locations in the proposed reservoir boundary where potential roost trees occur, though most of the Project Area only provides foraging habitat. Preconstruction acoustic surveys would be completed to identify whether roost trees are occupied by bats. If bats are encountered, the Corps will coordinate measures with the USFWS to minimize or avoid potentially adverse effects. No mortality of individuals is anticipated during construction or operation of the facility.

The Project would retain some benefits to tricolored bat with the creation of aboveground water storage available for foraging and drinking, though it would replace more natural wetland complexes, which also provide this type of habitat and likely support higher concentrations of prey. The Project will remove 12,392 acres of more natural wetland/upland habitat matrix, including grassland and shrubland with intermixed wetlands and replace it with 12,392 acres of aboveground reservoir. Due to the presence of potential roost trees and the amount of foraging habitat being removed, the Corps has determined that the Project “May Affect” tricolored bat.

C.2.4.6 Everglades Snail Kite

Snail kites are known to nest and forage in and around Lake Okeechobee during most non-drought years. They may also occupy Lake Istokpoga and the Kissimmee River floodplain as hydrologic conditions and availability of apple snails (the kite’s main prey item) allow. In recent years, the introduction and expansion of the exotic apple snail (*Pomacea maculata*) population has expanded both the areas in which snail kites may forage and nest as well as prolonged the nesting season in some years from the spring into the summer and sometimes fall.

The Project Area (Alternative 1) and the two additional alternatives are within the USFWS Everglade snail kite consultation area. Numerous freshwater wetlands and open water systems suitable for nesting and foraging habitat for Everglade snail kite will be permanently removed by the construction of the alternatives.

Alternative 1 will result in the loss of 2,847 ac of freshwater marshes, wet prairies, and mixed-scrub-shrubland, all of which have the potential to support roosting and foraging habitat for Everglade snail kite. The habitats being lost are not unique to the region but the amount of habitat being lost at one time is notable. The other alternatives would also result in loss of habitat for Everglades snail kites: Alternative 2 would result in 3,332 ac of habitat loss, and Alternative 3 would result in 2,428 ac of habitat loss.

Conversely, the construction of any of the alternatives has the potential to indirectly benefit snail kites if the hydrology allows for creation and maintenance of apple snail populations and if nesting substrate is available in Lake Okeechobee. Water storage would likely improve the overall lake levels and moderate stage fluctuations. This may increase suitable habitat for apple snails, thereby increasing spatial extent of suitable foraging opportunities for snail kites. Minor beneficial effects to vegetation (including vegetation used for snail kite nesting) within Lake Okeechobee's extensive littoral zone are also anticipated. These ecological benefits are a result of the small increase in amount of time within the beneficial stage envelope and less time in the extremely high stages (greater than 17 ft NGVD or 15 ft NAVD88; **Table C.2-3.**).

Converse to providing beneficial effects due to a change in lake stages, the high-water levels could cause short-term, minor adverse effects to the littoral zone and nearshore aquatic vegetation that need lower lake stages to persist. This may not result in a difference in vegetation from what is currently occurring through natural conditions and current operations. However, if the high lake stages do occur more often and the vegetation shifts to a different type of community, this could impact the ability for apple snails to persist.

Efforts will be made to avoid mortality of the species during construction by avoiding vegetation clearing/grubbing during the active nesting season. It is therefore not anticipated that mortality would occur as a result of the Project.

The change in lake stages does not appear to result in many occurrences above or below the optimal stage envelope for vegetation as compared to the current conditions. Rapid recession rates during the dry (breeding) season and associated low-water levels can allow nests to become accessible to land-based predators, resulting in decreased nest success (Beissinger 1986; Sykes 1987b). While recession rates were not analyzed specific to Alternative 1 effects on Lake Okeechobee's stages, Alternative 1 provides additional capability to moderate Lake Okeechobee stages, particularly in the dry season, which may or may not reduce high recession rates (over 0.16 ft per week; Fletcher et al. 2017). The Corps has determined that the Recommended Plan " May Affect, but is Not Likely to Adversely Affect", Everglade snail kites.

C.2.4.7 Everglades Snail Kite Critical Habitat

Designated critical habitat within the Project Area includes western portions of Lake Okeechobee. Snail kite critical habitat in Lake Okeechobee is located in the western parts of Glades and Hendry Counties, extending along the western shore to the east of the dike system and the un-diked high ground at Fisheating Creek, and from the Hurricane Gate at Clewiston northward to the mouth of the Kissimmee River, including all the spike rush flats of Moonshine Bay, Monkey Box, and Observation Shoal, but excluding the open water north and west of the northern tip of Observation Shoal north of Monkey Box and east of Fisheating Bay (USFWS 2023a).

The Project indirect benefits described above for vegetation within the Lake Okeechobee littoral zone are mostly within the designated snail kite critical habitat. Therefore, snail kite critical habitat in Lake Okeechobee should indirectly benefit by implementation of the Project, particularly by reducing the frequency of extreme low lake stages. Due to these anticipated indirect beneficial effects on Lake Okeechobee's littoral vegetation, the Corps has determined that implementation of the Recommended Plan "May Affect, but is Not Likely to Adversely Affect", Everglade snail kite critical habitat.

C.2.4.8 Wood Stork

There are no known wood stork nesting colonies in the Project Area (Alternative 1) or the other two alternatives; therefore, it is unlikely that species mortality would occur from construction of the Project. Nonetheless, efforts will be made to avoid mortality of the species during construction by avoiding removal of any active nests documented during preconstruction surveys. The entire Alternative 1 is located in Core Foraging Habitat for the Gator Farm and Lemkin Creek nesting colonies (USFWS 2021b). Once the Project is constructed, approximately 2,900 ac of wetland habitat will be permanently removed. The other two alternatives would also result in permanent removal of wetland habitat: Alternative 2 would result in 3,332 ac of habitat loss, and Alternative 3 would result in 2,428 ac of habitat loss.

Implementation of all action alternatives would be expected to improve conditions for wood storks throughout much of the Study Area. Rehydration and vegetation shifts within the Lake Okeechobee Watershed (i.e., restored Project wetlands) and lake levels (via additional Project storage) are likely to increase the spatial extent of suitable foraging opportunities and nesting habitat for wood storks, providing a moderate beneficial effect. Minor beneficial effects to vegetation within Lake Okeechobee's extensive littoral zone are anticipated as a result of any of the alternatives. These ecological benefits are a result of the small increase in amount of time within the beneficial stage envelope and a reduction of time in the extremely high (above the stage envelope and extreme high stage envelope [e.g., over 17 ft NGVD or 15 ft NAVD]) stages for any of the alternatives compared to the FWO (**Table C.-2-3.**). This increase in time in the beneficial stage envelope improves the foraging habitat in the littoral zone of Lake Okeechobee for wood storks. Conversely, also as compared with FWO, all alternatives may cause short-term, minor adverse effects to the ecological indicators and littoral and nearshore aquatic vegetation due to increased time that lake stages are in the extremely low stages (under 10 ft NGVD or 9 ft NAVD), which may affect foraging habitat for wood storks.

The Recommended Plan would be expected to improve conditions for wood storks throughout much of the Project Area, including the littoral community within Lake Okeechobee, due to the increased time the water levels would be within the beneficial stage envelope. This would allow greater opportunity for wood stork foraging. Rehydration and vegetation shifts within lake levels (via additional Project storage) are likely to increase suitable foraging opportunities and nesting habitat for wood storks providing a moderate beneficial effect. The Recommended Plan will result in the removal of suitable foraging habitat within the core foraging area of two wood stork colonies. Consistent with the 2010 Wood Stork Effects Determination Key (USFWS 2010), compensation will be provided in accordance with the Clean Water Act section 404(b)(1) guidelines and shall not be contrary to the Habitat Management Guidelines (USFWS 1990); habitat compensation shall be within the appropriate Core Foraging Area or within the service area of a USFWS-approved mitigation bank; and habitat compensation shall replace foraging value, consisting of wetland enhancement or restoration matching the hydroperiod of the wetlands affected, and provides foraging value similar to or higher than those impacted. As a result, the Corps has determined that the Recommended Plan "May Affect, but is Not Likely to Adversely Affect", wood storks.

C.2.4.9 Eastern Indigo Snake

For all action alternatives, most of the current land uses in the storage feature footprints are improved and unimproved pastures. **Table C.2-10** shows the amount of uplands and pasturelands that will be converted to deep-water habitat for each alternative. Eastern indigo snakes have a high probability of occurrence within all proposed storage footprints based on the acreage of the potential Project components and the available potential snake habitat. As a result of construction, the species is likely to be displaced or possibly killed.

Alternative 1 will permanently remove 10,128 ac of uplands vegetative communities. This is primarily improved pasture, but also includes a large portion of woodland pasture (**Table C.2-3**), which could support eastern indigo snakes. Alternative 2 would remove approximately 16,445 ac of potential habitat, and Alternative 3 would remove approximately 12,060 ac of potential habitat. All alternatives are likely to have unavoidable adverse effects on Eastern indigo snakes.

Eastern indigo snakes have a high probability of occurrence within all proposed wetland restoration footprints based on the acreage of the potential Project components and the available potential snake habitat. The Recommended Plan is likely to have unavoidable adverse effects on Eastern indigo snakes due to removal of pasturelands and uplands. The Corps will require standard protection measures for eastern indigo snakes throughout Project design and construction to minimize any potential adverse effects to the extent practicable. The Corps has determined that the LOCAR "May Affect" eastern indigo snake since the Project will result in removal of more than 25 acres of habitat. This determination is consistent with the Consultation Key for the Eastern Indigo Snake (USFWS 2017).

Table C.2-10. Acres of Potential Upland Habitat in Each Alternative Footprint.

Categories	Alternative 1	Alternative 2	Alternative 3
Acres of uplands	10,128	16,445	12,060
Acres of pasture	7,838	7,906	2,665
Acres of woodlands	2,158	2,423	1,240
Total acres of uplands removed	10,128	16,445	12,060

C.2.4.10 Florida Manatee

West Indian (Florida) manatee occurs in Lake Okeechobee and the Project Area (Alternative 1) and the other two alternatives are within the USFWS West Indian Manatee Consultation Area. Manatee does not occur within the footprints of any of the alternatives. There will be no mortality of the species anticipated as the result of the Project.

The Florida manatee is a large, plant-eating aquatic mammal that can be found in Lake Okeechobee and its rim canal, the Kissimmee River below S65-E, and the shallow coastal waters, rivers, and springs of Florida. Florida manatees live in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. They move from the inland locations to warmer coastal waters in winter.

All the alternatives would indirectly improve the overall manatee foraging habitat within Lake Okeechobee, local canals, and the Northern Estuaries. With all the alternatives, Lake Okeechobee's extensive littoral zone is expected to be within the optimal lake level condition more often than without the Project and therefore improve the foraging habitat in Lake Okeechobee for manatees. There are also expected to be fewer high-volume flow months within the Northern Estuaries, providing a beneficial effect to SAV. Reduction in high flows and accompanying flow velocities would result in lower suspended solid loading and decreased concentration of colored dissolved organic matter, thereby allowing greater light penetration to promote growth of SAV. In addition, reduction in high-volume discharge events from Lake Okeechobee would reduce extreme salinity fluctuations associated with such events. Although some SAV are tolerant of a wide range of salinity levels, a reduction in high-volume discharge events would reduce stress to SAV, promote increases in seagrass shoots, and have the potential to increase foraging opportunities for manatees in this region, which would provide a minor beneficial effect.

Within Lake Okeechobee's extensive littoral zone, minor beneficial effects to vegetation are anticipated as a result of any of the alternatives. These ecological benefits are a result of the small increase in amount of time within the beneficial stage envelope and less time in the extremely high stages (over 17 ft NGVD or 15 ft NAVD) and above the stage envelope for any of the alternatives compared to the FWO (**Table C.2-3.**). This increase in time in the beneficial stage envelope improves the foraging habitat in Lake Okeechobee for manatees.

Standard manatee protection guidelines will be used during construction along canals and rivers accessible to manatees to avoid negative effects. The Corps has determined that the Recommended Plan "May Affect, but is Not Likely to Adversely Affect" West Indian (Florida) manatee. In fact, there is likely to be a net benefit to the species in Lake Okeechobee because water levels will be more stable in Lake Okeechobee and the Northern Estuaries with the Project in place.

C.2.4.11 Florida Panther

The Project Area (Alternative 1) and the other alternatives are within a Florida panther Focus Area. The Florida panther has been found in almost all Lake Okeechobee watershed ecological communities. The Florida panther uses mesic pine flatwoods in combination with other forested communities. Mesic flatwoods are associated with natural drainage patterns defining travel corridors. No mortality of Florida panther is expected from construction of the Project; however, conversion of approximately 13,066 ac of upland and wetland habitat to aboveground storage may affect the panther's dispersal pathways in the region. The other two alternatives may also affect Florida panther dispersal pathways in the region and result in conversion of habitat to aboveground storage. Alternative 2 would result in removal of 19,957 ac of habitat, and Alternative would result in removal of 14,574 ac of habitat.

In addition, as lands within the Study Area become restored to their more natural conditions, the concomitant improved prey base would result in greater use of these areas by the Florida panther.

Because Florida panther is a wide-ranging species with most sightings west of the Recommended Plan, the Recommended Plan "May Affect" the species. This determination is consistent with the Florida Panther Effect Determination Key (USFWS 2007).

C.2.4.12 Okeechobee Gourd

The Okeechobee gourd is found along Lake Okeechobee and along St. Johns River (USFWS 2021a). At Lake Okeechobee, the species is limited to the shoreline and island around the southern and northwestern parts of the lake (USFWS 2021a). There are unlikely to be Okeechobee gourds present in the Project Area or the other two alternatives, therefore no direct mortality is expected within the Project Area (Alternative 1) or the other alternatives.

The decline of Okeechobee gourd is largely attributable to conversion of swamp forests to agriculture, and water level management in Lake Okeechobee. For the gourd to maintain viable healthy populations, fluctuations in lake level are necessary. High lake levels facilitate dispersal and inundate and destroy aggressive weeds in local habitats. As lake levels decrease, the cleared open habitats allow the quickly germinating Okeechobee gourd seeds to sprout and begin climbing before they have to compete with other pioneer species. Water regulation practices can greatly influence the timing and duration of flooding and drying cycles across remnant areas of suitable elevation and soils around Lake Okeechobee. Permanent inundation of suitable soils is detrimental to the plant. Another potential threat to this plant is the proliferation of exotic plant species around the edges of Lake Okeechobee (USFWS 1999). The Corps has determined the Recommended Plan "May Affect, but is Not Likely to Adversely Affect" the species.

C.2.5 State-Listed Species

The Study Area contains habitat suitable for the presence, nesting, and/or foraging of eight state-listed threatened species, including Florida burrowing owl (*Athene cunicularia*), Florida sandhill crane (*Grus canadensis pratensis*), little blue heron (*Egretta caerulea*), Southeastern American kestrel (*Falco sparverius paulus*), tricolored heron (*Egretta tricolor*), gopher tortoise (*Gopherus polyphemus*), Florida pine snake (*Pituophis melanoleucus mugitus*), and short-tailed snake (*Lampropeltis extenuata*).

C.2.5.1 Burrowing Owl

Burrowing owls inhabit open, native prairies and cleared areas that offer short groundcover including pastures, agricultural fields, golf courses, airports, and vacant lots in residential areas. All alternatives include storage features that will convert uplands to deep-water habitat. For all alternatives, most of the current land use in the alternatives are pastures. Florida burrowing owls have a high probability of occurrence within all proposed alternatives and are likely to be displaced as a result of construction. The Corps shall coordinate with the Florida Fish and Wildlife Conservation Commission (FWC) on mitigation measures as well as a secure a permit for relocation. Prior to construction, burrowing owl surveys will be conducted and if burrows are found, they will be relocated to minimize the impact of the Project. All action alternatives may have an unavoidable adverse effect. As needed, the Corps will coordinate with the FWC on appropriate burrowing owl impact avoidance, minimization, and/or mitigation measures.

C.2.5.2 Florida Sandhill Crane

Florida sandhill cranes are non-migratory and inhabit prairies, improved pastures, and freshwater marshes. All alternatives include storage features that will convert uplands to deep-water habitat. For all alternatives, most of the current land use in the storage feature footprints are pastures or citrus groves. Florida sandhill cranes may occur within all three alternatives and may be displaced from storage features by construction. All alternatives provide a benefit to the Florida sandhill crane. Prior to construction, Florida sandhill crane surveys would be conducted. As needed, the Corps will coordinate with the FWC on appropriate Florida sandhill crane impact avoidance, minimization, and/or mitigation measures.

C.2.5.3 State-Listed Wading Birds (little blue heron, roseate spoonbill, tricolored heron)

State-listed wading bird species in the Project Area include the little blue heron and the tricolored heron. Implementation of all action alternatives would be expected to significantly improve conditions for wading birds throughout much of the Project Area. Rehydration and vegetation shifts within the Lake Okeechobee Watershed and lake levels are likely to increase the extent of suitable foraging opportunities and nesting habitat for wading birds, providing a moderate beneficial effect. Minor beneficial effects to vegetation within Lake Okeechobee's extensive littoral zone are anticipated with any of the alternatives. These ecological benefits are a result of the small increase in amount of time within the beneficial stage envelope and less time in the extremely high stages (over 17 ft NGVD or 15 ft NAVD) and above the stage envelope for any of the alternatives compared to the FWO (**Figure C.2-3.**). This increase in time in the beneficial stage envelope improves the foraging habitat in Lake Okeechobee for wading birds. All alternatives significantly increase the spatial extent of suitable foraging opportunities and nesting habitat for wading birds.

C.2.5.4 Southeastern American Kestrel

Southeastern American kestrels have a high likelihood of occurrence within all proposed storage feature footprints and are likely to be displaced or lose nesting sites because of construction. Alternative 1 would remove approximately 13,066 acres of potential habitat, Alternative 2 would remove approximately 19,957 acres of potential habitat and Alternative 3 would remove approximately 14,574 acres of potential habitat. All alternatives may have an unavoidable adverse effect. Prior to construction, southeastern American kestrel surveys will be conducted. As needed, the Corps will coordinate with the FWC regarding appropriate southeastern American kestrel impact avoidance, minimization, and/or mitigation measures.

C.2.5.5 Gopher Tortoise

The gopher tortoise, an upland dwelling reptile, is currently listed as a candidate species in the Eastern U.S. by the USFWS (USFWS 2013). The gopher tortoise commonly occupies habitats with a well-drained sandy substrate, ample herbaceous vegetation for food, and sunlit areas for nesting. Many vertebrate and invertebrate species are known to seek refuge in gopher tortoise burrows, including protected species like the Eastern indigo snake and the Florida pine snake. All alternatives include storage features. For all alternatives, most of the current land use in the storage feature footprints is improved and unimproved pastures. Gopher tortoises have a high probability of occurrence within all proposed storage feature and wetland restoration footprints and are likely to be displaced by construction. Alternative 1 would remove approximately 13,066 acres of potential habitat, Alternative 2 would remove approximately 19,957 acres of potential habitat and Alternative 3 would remove approximately 14,574 acres of potential habitat. Prior to construction, gopher tortoise surveys would be conducted, and any tortoises relocated to minimize the impact of the project. As needed, the Corps will coordinate with the FWC on appropriate gopher tortoise impact avoidance, minimization, and/or mitigation measures. All with action alternatives may have unavoidable adverse effects.

C.2.5.6 Florida Pine Snake

The Florida pine snake is found in the Project Area and prefers habitats with well-drained, sandy soils, and moderate to open canopy cover (Franz 1992, Ernst and Ernst 2003). The most common natural habitat of pine snakes in Florida is sandhill, but they also are found in scrub, xeric hammock, scrubby flatwoods, mesic pine flatwoods, and dry prairie with dry soils (Allen and Neill 1952, Enge 1997, Franz 2005). Florida pine snakes are fossorial, spending about 80 percent of their time in underground retreats (primarily burrows of the southeastern pocket gopher [*Geomys pinetis*]) (Franz 2005, Miller 2008) as well as other retreats such as stumpholes, mole runs, and burrows of gopher tortoises (Gopherus polyphemus), nine banded armadillos (Dasypus novemcinctus), and mice (Franz 2005, Miller 2008). All alternatives include storage features that will convert uplands to deep-water habitat. For all alternatives, most of the current land use in the storage feature footprints are improved and unimproved pastures. Alternative 1 would remove approximately 13,066 acres of potential habitat, Alternative 2 would remove approximately 19,957 acres of potential habitat and Alternative 3 would remove approximately 14,574 acres of potential habitat. Prior to construction, Florida pine snake surveys will be conducted and the Corps will coordinate with the FWC as needed regarding appropriate Florida pine snake impact avoidance, minimization, and/or mitigation measures.

Short-tailed Snake

Short-tailed snakes are endemic to Florida and found primarily within the north-central peninsular region, west of St. John’s River. Habitat includes dry, sandy uplands including sandhills (long-leaf pine-turkey oak sandhills), xeric oak hammocks, and rosemary-sand pine scrub. The species is a secretive burrower and is rarely seen above ground, therefore little is known about the ecology and behavior of the species.

All alternatives include storage features that will convert uplands to deep-water habitat. For all alternatives, most of the current land use in the storage feature footprints are improved and unimproved pastures. Alternative 1 would remove approximately 13,066 acres of potential habitat, Alternative 2 would remove approximately 19,957 acres of potential habitat and Alternative 3 would remove approximately 14,574 acres of potential habitat. As needed, the Corps will coordinate with the FWC on appropriate short-tailed snake impact avoidance, minimization, and/or mitigation measures.

C.2.6 Fish and Wildlife

Negligible benefits would be expected to fish and wildlife from any of the alternatives; beneficial effects would be offset by negative effects from the conversion of pastureland to an aboveground reservoir. A comparison of the FWO and alternative’s potential effects on fish and wildlife within the Study Area are summarized below. Impacts on state and federally listed species are described in further detail in **Subsection C.2.4** and in **Annex A**. Implementation of alternatives would benefit most fish and wildlife resources within the Project Area. These benefits are described in greater detail in the sections below.

C.2.6.1 Invertebrates

Within the storage feature footprints of the watershed reservoir, a diverse population of invertebrates is not expected due to a probable lack of emergent vegetation and frequent water level fluctuations. A loss of diversity would be expected where natural habitats are converted to a deep-water reservoir directly within the Project footprint.

The intakes for the storage features may cause the entrainment and impingement of aquatic invertebrates during operation. See **Subsection C.2.6.2** for the analysis of "with-project" effects on aquatic invertebrates and fish.

Minor beneficial effects to the aquatic invertebrate community within Lake Okeechobee are anticipated under any alternative. All alternatives increase emergent and submerged aquatic vegetation which provides a beneficial effect to invertebrate habitat. Due to the increased potential habitat, the invertebrate diversity and abundance is expected to increase in the limnetic, nearshore, and littoral zones.

As compared with the FWO, all alternatives show a minor beneficial effect with performance improvement within the Northern Estuaries as indicated by fewer high volume flow months. Reductions in high volume flows and salinity fluctuations would likely benefit oysters and other associated invertebrates (e.g., crabs, shrimp, snails, sea stars) within the Northern Estuaries. Reduction in high flows and accompanying flow velocities would help lessen the current problem of flushing of oyster spat into outer areas of the Northern Estuaries that experience high salinities levels during the dry season resulting in increased predation and disease in the oyster population.

C.2.6.2 Fish

Fish are found within the Lake Okeechobee watershed, Lake Okeechobee itself, and in the Northern Estuaries.

Lake Okeechobee Watershed

The construction of storage features, seepage canals, and perimeter canals may provide some deep-water refugia and/or littoral habitat for use by fish and amphibian species when the storage feature is drawn down. Some areas of existing wetland/aquatic habitat would be lost under the storage feature construction footprint. Once the storage feature is filled, aquatic (open water) habitat will substantially increase. The reservoir for Alt 1 will be approximately 12,800 acres, for Alt 2 approximately 20,400 acres, and the reservoir in Alt 3 will be approximately 14,900 acres. The open water storage features will likely harbor fish typical of nearby canals. Water would be conveyed to the storage features by these canals which also act as conduits for the introduction of many aquatic organisms, including fish. Due to the operation of the pumps, there will likely be some entrainment and impingement of fish and other aquatic organisms. Some of these organisms may survive the pumping process, others may be killed or disoriented enough that they become easy prey for other animals inside the storage features (wading birds, alligators, turtles, or other fish). Species that will likely inhabit the storage features include: largemouth bass, black crappie, gar, red ear sunfish, bluegill, and mosquitofish, among others, including exotic species such as armored catfish and cichlids. Shallow water fish bedding and rearing habitat will be limited to the margins of the reservoirs. The design of the seepage canal, however, includes littoral areas for fish and wildlife use.

Pump stations located on or near the Kissimmee River have the potential to impact fish and aquatic invertebrates through entrainment and impingement. The larval and post-larval stages of black crappie (*Pomoxis nigromaculatus*) are especially at risk because after the channelization of the Kissimmee River, C-38 South of S-65E became a favorite spawning location for this species. The typical spawning period for black crappie at this location occurs from January through May. Adults prefer to nest in colonies in shallow water near aquatic vegetation. A few days after hatching, post-larvae disperse from the nest area and eventually move to deeper water near the middle of the channel. Fry move vertically throughout the water column primarily to forage on other planktonic species and secondarily to avoid predation. They follow the currents downstream into Lake Okeechobee. The black crappie spawning requirements increase the likelihood that in the lower Kissimmee River, which is contiguous with Lake Okeechobee, nest sites will be near intakes (assuming that these structures will also be near or on the stream bank). The larval and post-larval stages are poor swimmers and would be unable to escape intake velocities (0.25 ft./sec) once drawn into the water intake flow-field. This is important to note not only for those fish hatching near the shoreline, but also for those that may be drifting down from upstream spawning locations (including open-water spawners like threadfin or gizzard shad). Shad entrainment and impingement has been a major concern with many water withdrawal systems because shad are the primary forage food for many predators, and locally are nearly the sole food source of adult black crappie (FWC 2017). Many other species of fish spawn during the same period as black crappie (**Table C.2-11**) and they could experience similar effects and have similar risks. For those species that spawn in the summer (shiners) or fall (some sunfishes, *Lepomis* species) the predicted effect may be similar to speckled perch.

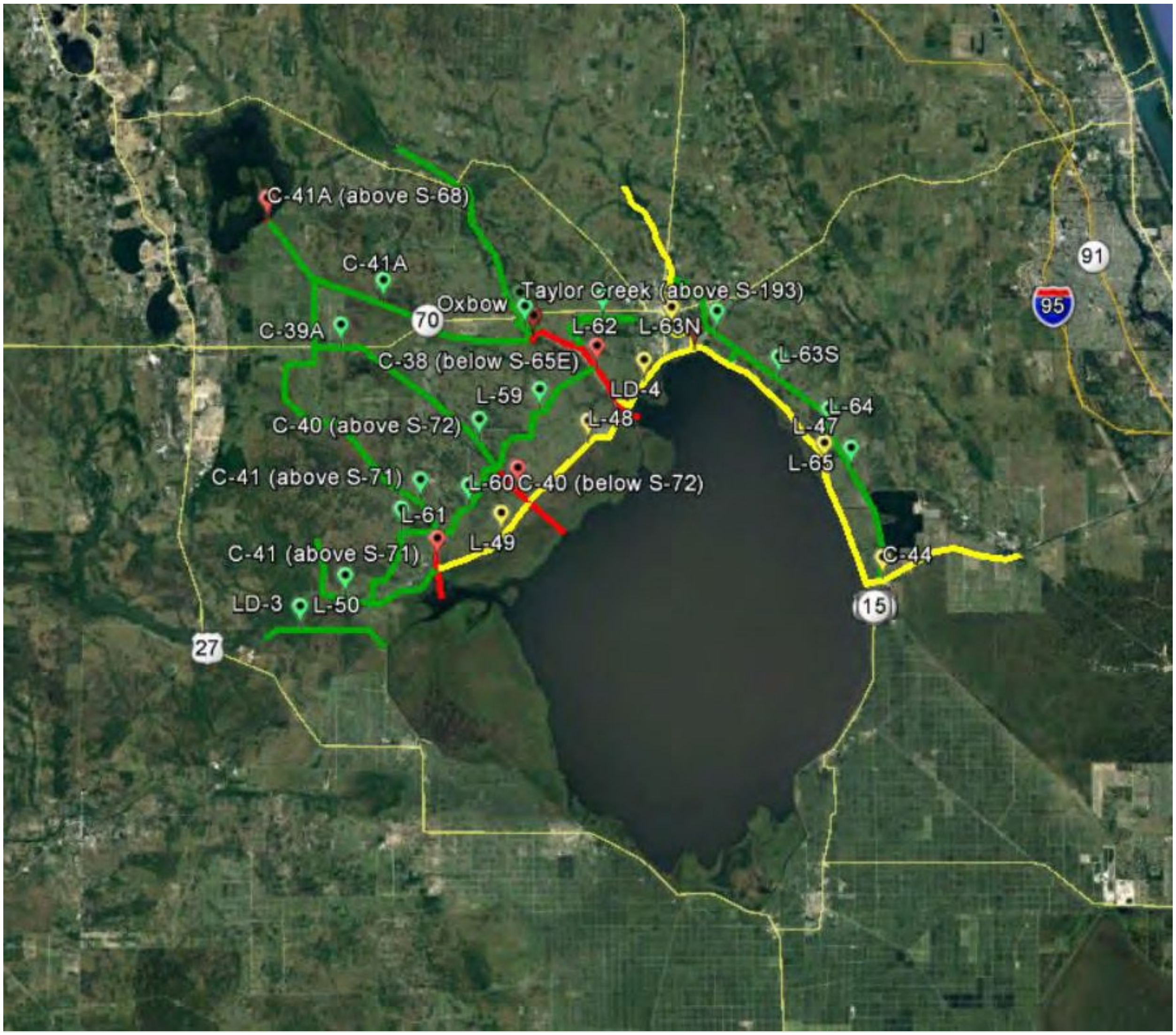
Table C.2-11. Spawning Months for Critical Species in the lower Kissimmee River.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black crappie	X	X	X	X	X	-	-	-	-	-	-	-
Sunfish species	-		X	X	X	X	X	X	X	-	-	-
Threadfin and gizzard shad	X	X	X	X	X	X	X	X	X	-	-	-
Shiners	-	-	X	X	X	X	X	X	-	-	-	-

Source: FWC 2017.

Figure C.2-4 shows the potential risks to fisheries in the Lake Okeechobee watershed. The highest risk areas (red) are in the lower Kissimmee River, south of S-65E, is contiguous with Lake Okeechobee and is a critical spawning area for black crappie and several sunfishes (**Figure C.2-4**). Moderate risk areas (yellow) are further from the critical fish spawning areas and are located along the rim canal (**Figure C.2-4**). The lowest risk areas are furthest from the critical fish spawning areas and do not have a direct connection to Lake Okeechobee and are located above S-65E.

All alternatives would involve a pump station moving water from downstream of the S-84 structure in the C-38 canal back upstream of the S-84 structure to the C-41A canal. This would be the area of highest risk for fish entrainment in the project area (upstream portion of the C-38 near the S-65E structure). All other pump locations would be in low-risk areas.



Note: Red canal segments are the highest risk category, yellow moderate, and green have the lowest risk.

Figure C.2-4. Risk level associated with entrainment and entrapment for different canal segments in the Lake Okeechobee Watershed (FWC 2017).

All alternatives may have a major impact on the entrainment and impingement of fish and aquatic invertebrates if they operate at times of the year when these organisms are present in the surface water, due to intake locations on the C-38 canal south of S-65E. However, the impact may be limited due to the fact that the stretch between S-84 and S-65E is a lesser "high risk" because the two drops produce turbulence that fish do not like. The intakes could also be designed to limit impingement and entrainment by installing screens with a pore size of 1 mm and an anticipated intake velocity at the screen face of 0.25 ft/sec. with screen setting depth below the zones that fish larvae inhabit and/or installing a wildlife exclusion barrier curtain.

Lake Okeechobee

All alternatives will improve conditions for fish in Lake Okeechobee by increasing the amount of time water levels are in the beneficial stage envelope and reducing the frequency and duration of high lake stages (**Figure C.2-1** to **Figure C.2-3**). Reductions in extreme and moderate high lake stage durations will increase emergent and submerged aquatic vegetation habitat for fish use in the nearshore and littoral zones, while only slight increases in moderate and extreme low stage durations will help balance the negative impacts of reduced aquatic habitat during low stages with positive effects like improvements to habitat health (e.g., germination and recovery of SAV) during the same events. Alternative 2 had slightly better performance than the other alternatives in stage exceedance categories but all alternatives were within 0.25 percent of each other in either extreme or moderate stage exceedance rates. Overall, an improvement in habitat and more stabilized water levels will provide moderate beneficial effects for fish communities on Lake Okeechobee under any of the alternatives.

Amphibians and Reptiles

The construction of a storage feature and seepage canal may provide some deepwater refugia and/or littoral habitat for use by fish and amphibian species when the storage feature is drawn down. The operational plan for the storage feature, to meet the project objectives, constrains the ability of the project site (either storage feature or seepage canal) to be optimized for management as habitat for fish and wildlife.

Amphibians and aquatic reptiles including frogs, turtles, snakes, and alligators will likely inhabit the reservoirs in all alternatives with minor beneficial effects to amphibian and reptile communities anticipated. There would also be a loss of habitat within reservoir footprints for upland herps (e.g., toads, certain snakes, and box turtle) or where wetlands are converted to reservoir. Excluding agricultural areas, Alt 1 would remove approximately 2,600 acres of potential upland and/or wetland habitat, Alt 2 would remove approximately 3,800 acres of potential habitat, and Alt 3 would remove approximately 3,100 acres of potential habitat.

Birds

The deep reservoirs in all Alternatives may create foraging habitat for osprey, bald eagle, terns, cormorant, and other aquatic birds that feed on fish. Forested or upland bird species (turkey, bobwhite quail, and songbirds) would lose habitat within the storage footprints. As predicted by the Trophic Hypothesis (RECOVER 2004) an increase in density of small fishes would directly benefit higher trophic level predators such as wading birds. All Alternatives are anticipated to show a moderate beneficial effect on nesting and foraging activities of wading bird species within Lake Okeechobee by reducing duration of high lake stages. Impacts to the grasshopper sparrow, snail kite, and wood stork are further discussed in **Subsection C.2.4** and in **Annex A**. Ducks may also use the reservoirs, but the presumed lack of emergent or submersed vegetation would limit the habitat value for these species.

All action alternatives have the potential to have an adverse impact on overwintering, nesting, or foraging songbirds that use uplands or other natural habitats in the storage feature footprints.

C.2.6.3 Mammals

As compared with FWO, potential minor beneficial effects to mammals within the Study Area are anticipated with implementation of any alternative. Small mammals including raccoons and river otters would benefit from increased small prey fish biomass in rehydrated areas within the watershed along the Kissimmee River. Effects to state and federally listed species are described in further detail in **Subsection C.2.4** and in **Annex A**. Mammals in the storage features will likely be limited to river otter.

LOCAR implementation could have a major and adverse effect on mammals dependent upon upland habitat (e.g., deer, armadillos, opossum, skunks, woodrats, and raccoons) within the reservoir footprint. Although mammals occurring within the Project Area are adapted to the naturally fluctuating water levels of this poorly drained landscape, there is an increased potential for this vegetation transition to negatively affect mammals dependent on upland habitat.

C.2.6.4 Airport Wildlife Strike Hazard Assessment

Negligible effects to airspace and the potential for aircraft wildlife strikes because of the distance from proposed LOCAR alternatives and nearby airports. Aircraft-wildlife strikes pose risks to safe aviation and wildlife conservation. The 2013 Memorandum of Agreement (MOA) between the Federal Aviation Administration (FAA), the U.S. Air Force, Corps, EPA, USFWS, and the U.S. Department of Agriculture – Wildlife Services established procedures necessary to coordinate their agency missions to more effectively address existing and future environmental conditions contributing to aircraft-wildlife strikes throughout the United States. These efforts are intended to minimize wildlife risks to aviation and human safety, while protecting the Nation's valuable environmental resources (FAA 2013). The National Plan of Integrated Airport Systems (NPIAS) encompasses approximately 3,400 airports in the national network of airports and the national airport plan, which identifies existing and proposed new airports to serve commercial and general aviation needs. The NPIAS contains all commercial service airports, all reliever airports, and selected general aviation airports. Specific criteria were established to meet national aviation needs at a reasonable cost. These criteria considered the number of based aircraft and annual operations, scheduled air carrier service, and proximity to other airports in the national plan. Airports that met special needs, such as access to remote populations, could also be included.

There are three airports within the Project Area (**Figure C.2-5**). Of these, the Okeechobee County Airport (Okeechobee Jet Center; KOBE) is a NPIAS airport. The other two airports, River Acres Airport (FAA ID FD70) and River Oak Airport (FAA ID OOFL) are not in the NPIAS system and, therefore, do not require analysis pursuant to the MOA.

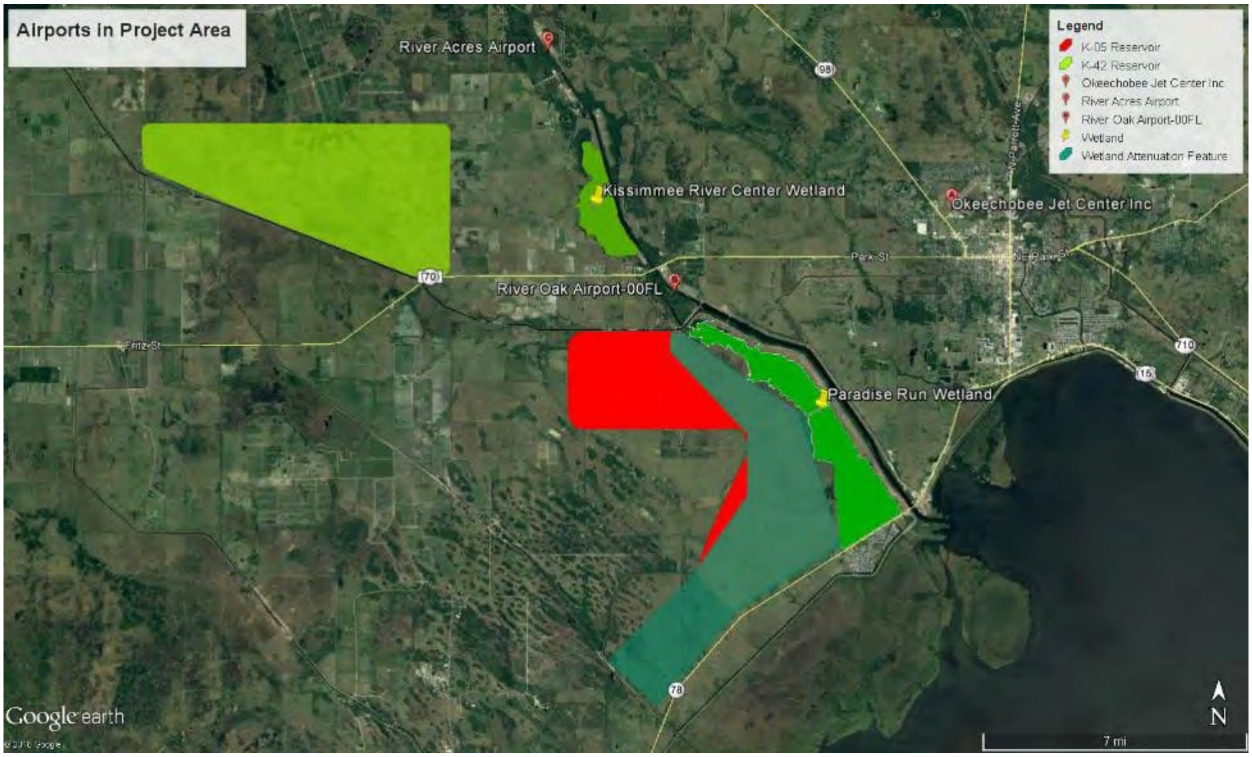


Figure C.2-5. Airport locations within the LOCAR Project Area.

River Acres Airport and River Oak Airport are both private short grass landing strips within airpark neighborhoods; both are general aviation airports or civilian airports that do not serve scheduled passenger service and usually serve private aircraft and small aircraft charter operations.

The FAA MOA requires an analysis of project effects within the separation distances of 5,000 ft (airports serving piston-powered, e.g., propeller aircraft), 10,000 ft (airports selling Jet-A fuel, e.g., serving turbine-powered aircraft) and 5 miles (airspace). For all airports, the FAA recommends a distance of 5 statute miles between the farthest edge of the airport's airport operations area (AOA) and a hazardous wildlife attractant if the attractant could cause hazardous wildlife movement into or across the approach or departure airspace. The basis for the separation criteria is found in existing FAA regulations. The separation distances are based on (1) flight patterns of piston-powered aircraft and turbine-powered aircraft, (2) the altitude at which most strikes happen (78 percent occur under 1,000 ft. and 90 percent occur under 3,000 ft. above ground level), and (3) National Transportation Safety Board (NTSB) recommendations (FAA 2007, AC150/5200-33B).

In all alternatives, the storage sites are located greater than the 5-mile separation distance from the Okeechobee Jet Center and, thus, no discussion of mitigation recommendations is required. Although analysis of the two non-NPIAS airports is not required per the MOA, the 5,000-foot (ft) separation distance from project features was evaluated for both.

C.2.7 Essential Fish Habitat

The Study Area includes two distinct regional estuarine and nearshore coastal systems: the Northern Estuaries including the Caloosahatchee River and the St. Lucie Estuary. Lake Okeechobee flows into the two Northern Estuaries. The St. Lucie Canal feeds into the St. Lucie Estuary, and the Caloosahatchee Canal/River feeds into the Caloosahatchee Estuary to the west. Effects to species in these systems would be negligible. The exception would be in instances of low flows. Increases in the number of low flow events in the St. Lucie estuary could increase the frequency of periods when the lower St. Lucie River experiences salinities >10 ppt, which would impact hot spots of larval fish (such as Common Snook or Red Drum). These indirect effects would be expected to be similar to the effects of recent Lake Okeechobee operations evaluations.

The flows to the Caloosahatchee and St. Lucie estuaries from Lake Okeechobee are largely due to operational decisions made the by Corps. Modeling results of authorized lake operations versus sensitivity runs made for proposed lake operations illustrate the influence operational influences on estuarine water levels.

C.2.8 Hydrology

Hydrologic modeling simulations of the ECB and the FWO condition were developed with the RSM-BN sub-regional modeling tool, to provide baseline conditions for plan formulation, the assessment of project benefits (comparisons against FWO), and the assessment of alternative performance for the level-of-service for flood protection and water supply (comparisons against ECB). The ECB was developed to represent the system-wide infrastructure and operations that were in place at the time plan formulation was initiated. The FWO for LOCAR assumes the construction and implementation of currently authorized CERP and non-CERP projects, and other Federal, state or local projects constructed or approved under existing governmental authorities that occur in the Study Area. Selection of the Recommended Plan is conducted based on comparisons between the alternatives and the LOCAR FWO. The reader should refer to **Section 2.5** of the LOCAR FS main report.

C.2.8.1 Lake Okeechobee Watershed

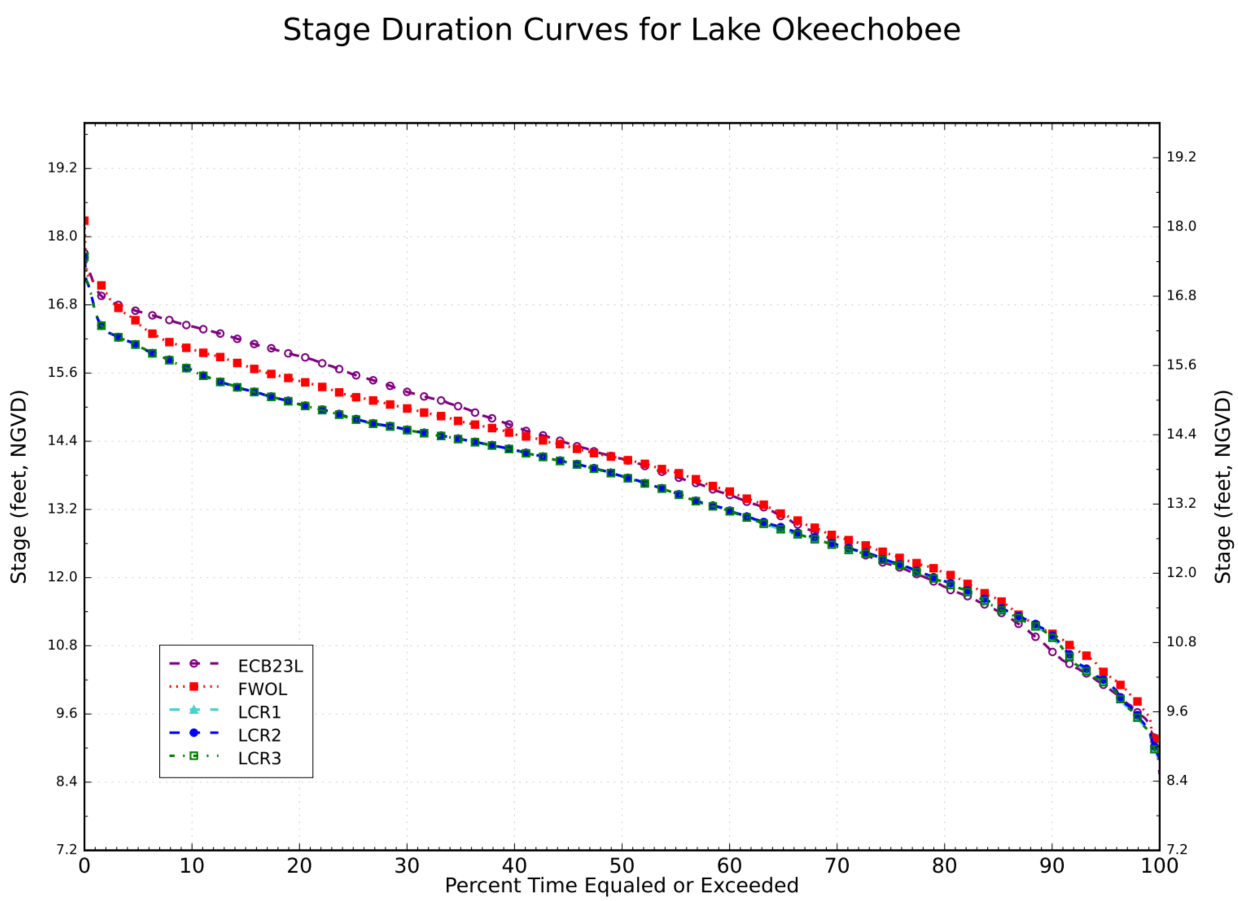
The alternatives proposed in LOCAR will improve the system performance, primarily measured in the Lake Okeechobee and Northern Estuaries. At regional level, the system would experience a moderate improvement to hydrology as reservoirs will capture high peak flows adding more flexibility into the system.

C.2.8.2 Lake Okeechobee and the Northern Estuaries

Operational changes to Lake Okeechobee were limited to changes within the flexibility of the 2008 LORS with CEPP EAA Phase operational assumptions. Lake Okeechobee operational assumptions were adjusted per alternative for the final array modeling. These adjustments included changes to the decision tree outcome maximum allowable flows dependent on Lake Okeechobee inflow forecasts, time of year (wet season or dry season), stage level (regulation zone), and/or stage trends (receding or ascending). The changes are all assumed to occur within the flexibility of LORS 2008 (Regulation Schedule zones unchanged), for the purpose of increasing LOCAR potential benefits. Details pertaining to the proposed operations for Lake Okeechobee are separately addressed in the draft Project Operating Manual (refer to **Annex C**). Details of changes to hydrology in Lake Okeechobee and the Northern Estuaries are described in **Subsections C.2.3.3.** and **C.2.3.4.** respectively.

The hydrologic effects to Lake Okeechobee would be beneficial during high stages but roughly the same as the FWO during low flow conditions for all the future with project alternatives as illustrated in **Figure C.2-6** and **Figure C.2-7**. The effects of LOCAR on hydrology in the Northern Estuaries are illustrated in **Figure C.2-7** through **Figure C.2-9. Note: ECB–**existing conditions baseline; FWOL–Future Without Project; LCR1–Alternative 1; LCR2–Alternative 2; LCR3–Alternative 3

Figure C.2-9 shows that high flows at S-79 on the Caloosahatchee River are similar between all the alternatives. The alternatives are slightly higher than, or equal to, FWO conditions. When Lake Okeechobee Releases (LOK) are combined with basin runoff flows the alternatives perform nearly the same as the FWO condition in the Caloosahatchee. Conditions in the St. Lucie Estuary illustrate reduced damaging and high flows in the alternatives compared to the FWO when combining LOK and basin runoff results.



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

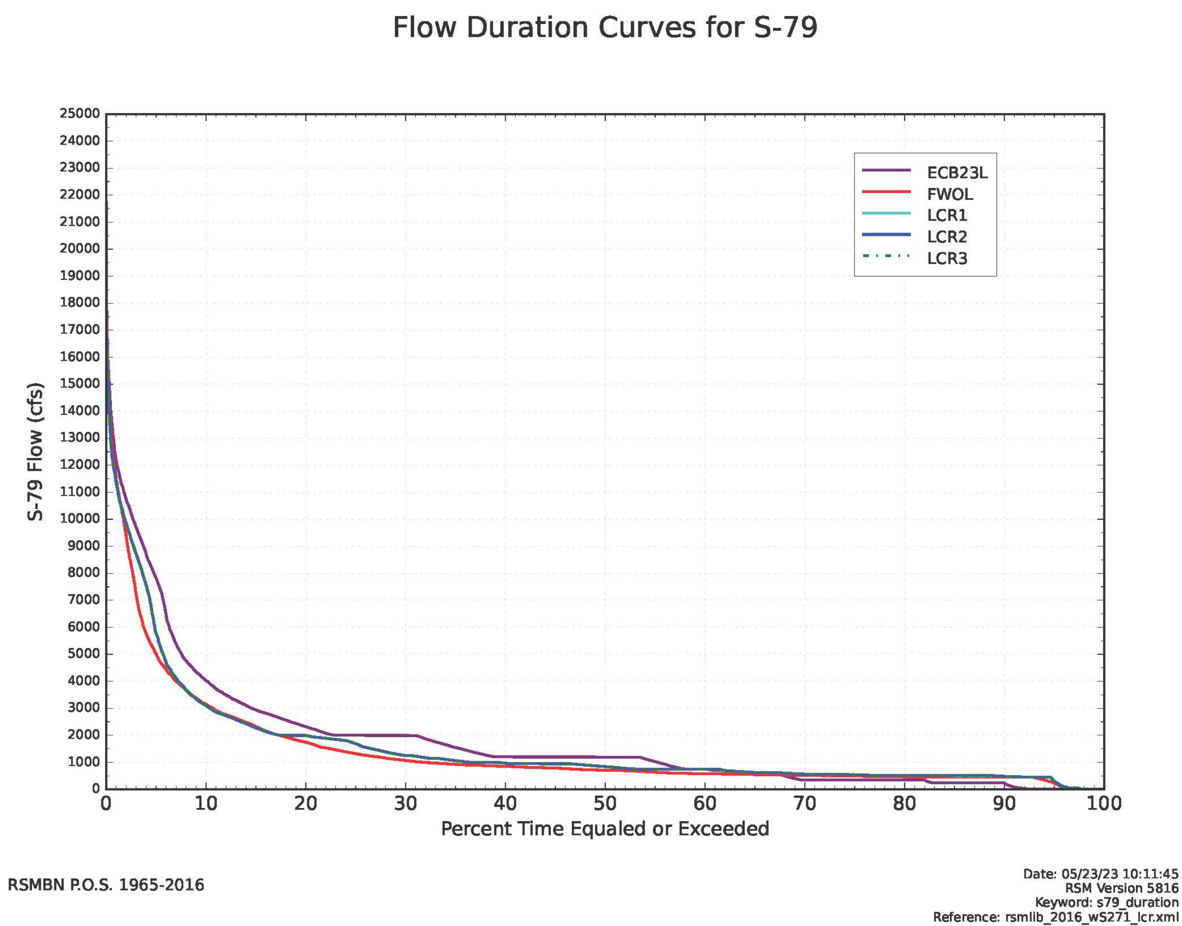
Figure C.2-6. Lake Okeechobee stage duration curves.

Table C.2-12. Peak Stage in Lake Okeechobee Comparisons between Alternatives and Baselines.

Area	Criteria	ECB	FWO	Diff. FWO vs ECB	Alt 1	Diff. Alt 1 vs FWO	Alt 2	Diff. Alt 2 vs FWO	Alt 3	Diff. Alt 3 vs FWO
Lake Okeechobee	Peak Stage (ft NGVD29)	17.71	18.28	0.57	17.64	-0.64	17.63	-0.65	17.65	-0.63

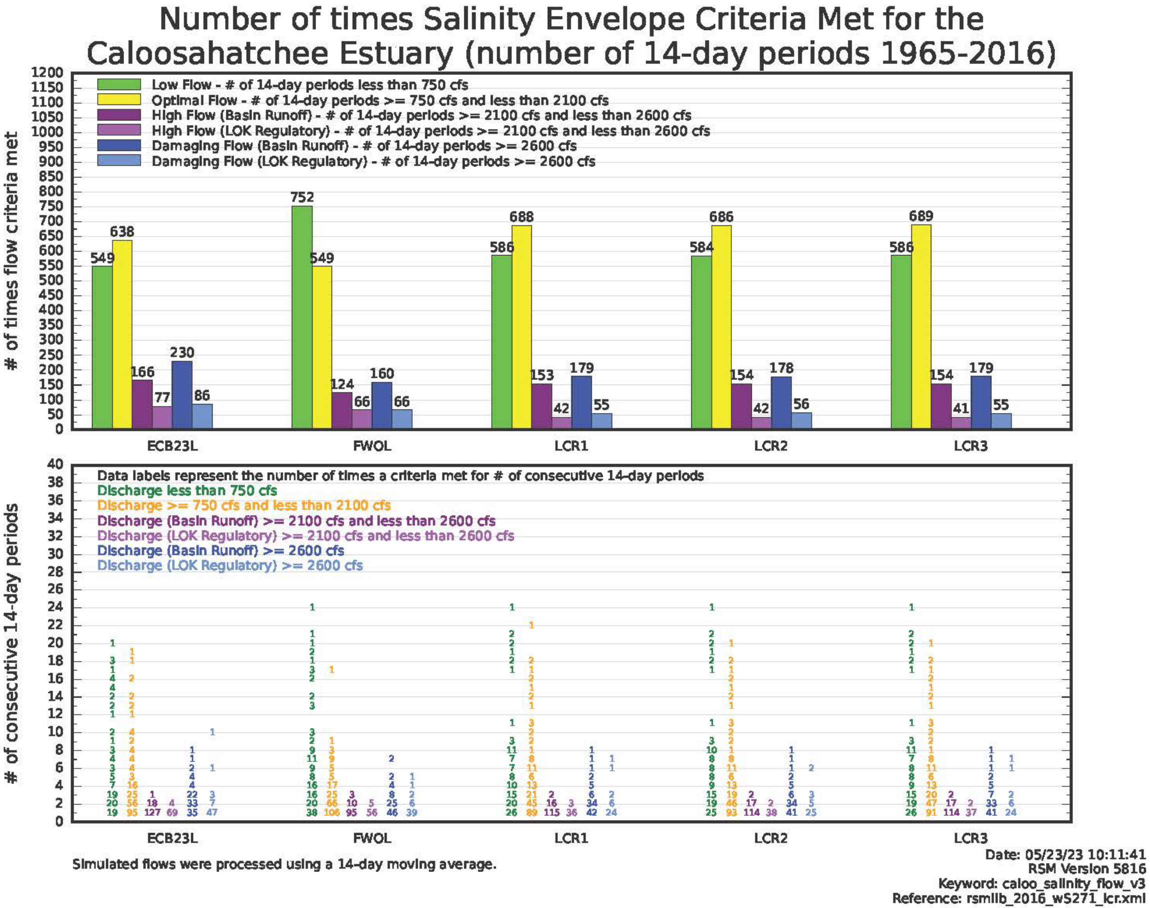
Alt–Alternative; ECB–existing conditions baseline; ft–foot; FWO–Future Without Project; NGVD29–National Geodetic Vertical Datum of 1929

Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet



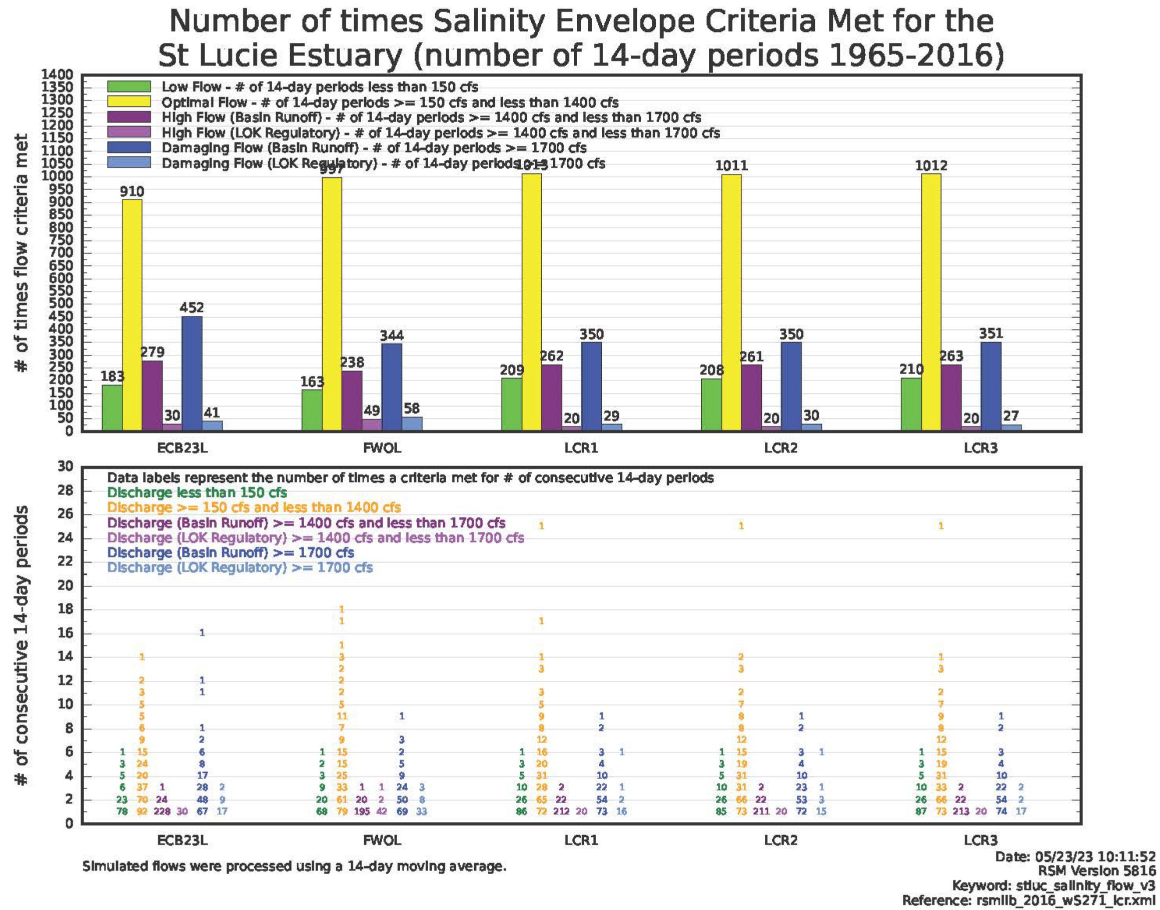
Note: ECB–existing conditions baseline; FWOL–Future Without Project; LCR1–Alternative 1; LCR2–Alternative 2; LCR3–Alternative 3

Figure C.2-7. Caloosahatchee river flow duration at S79.



Note: ECB–existing conditions baseline; FWOL–Future Without; Project LCR1–Alternative 1; LCR2–Alternative 2; LCR3–Alternative 3

Figure C.2-8. Caloosahatchee salinity envelope criteria not met.



Note: ECB–existing conditions baseline; FWOL–Future Without Project; LCR1–Alternative 1; LCR2–Alternative 2; LCR3–Alternative 3

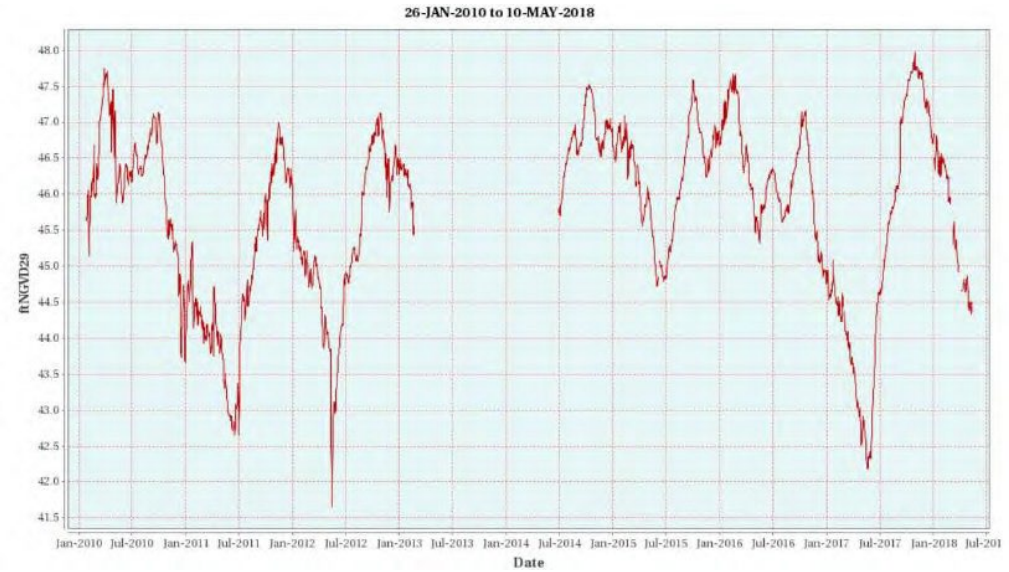
Figure C.2-9. St. Lucie salinity envelope criteria not met.

Aquifers

Three aquifers are affected in the FWO condition and implementation of alternatives: the unconfined surficial aquifer system (SAS), the confined Upper Floridan Aquifer (UFA), and the confined Avon Park Permeable Zone (APPZ). In the Project Area, the UFA occurs at depths of 372 to 525 ft below land surface (Sunderland et al. 2011). The APPZ occurs at depths of 1150 to 1468 ft below land surface (Sunderland et al. 2011).

Under the FWO condition, SAS groundwater levels are affected primarily by rainfall in the Kissimmee River basin. Regional recharge occurs in the upland areas, and groundwater flows downgradient to release into the Kissimmee River and Lake Okeechobee. The primary use of SAS groundwater is to satisfy agricultural demands, which are expected to increase by 15 percent by 2035. Under alternatives, SAS groundwater levels are expected to increase due to seepage from the shallow or deep storage features.

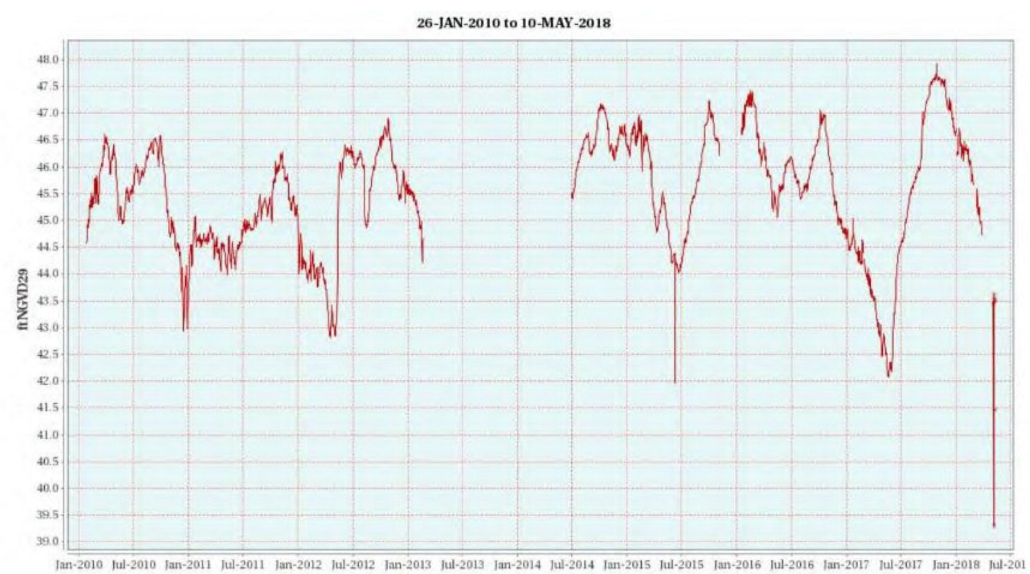
Under the FWO condition, UFA groundwater levels are affected locally by agricultural pumping stresses. There are few UFA wells in the Project Area that monitor groundwater levels continuously. One such well, OKF-105 (Sunderland et al. 2011), is located near the S-65C structure (now removed), on the Kissimmee River near the border between Highland and Glades Counties (**Figure C.2-10**). Groundwater level variations of up to 6 ft reflect pumping stresses during the dry season for agricultural demands. The UFA in this location is fresh. Chloride concentrations are below the drinking water maximum contaminant level (250 mg/L), ranging from 79 to153 mg/L (n=3, SFWMD DBHYDRO 2018).



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

Figure C.2-10. Average daily groundwater level measurements at UFA Well OKF-105U (POR January 2010 through May 2018).

Under the FWO condition, APPZ groundwater levels also respond to pumping stresses, most likely from pumping in the UFA. The maximum range in the APPZ groundwater levels is approximately 5 ft, and variations are synchronous with those in the UFA (**Figure C.2-11**). The APPZ in this location is slightly brackish. Chloride concentrations exceed the drinking water maximum contaminant level (250 mg/L), ranging from 495 to 536 mg/L (n=4, SFWMD DBHYDRO, 2018). Higher chloride concentrations suggest that APPZ groundwater is not suitable for agricultural water supply.



Note: At the reservoir site, the datum conversion from NGVD29 to NAVD88 is: Feet NAVD88 = Feet NGVD29 – 1.2 Feet

Figure C.2-11. Average daily groundwater level measurements at APPZ Well OKF-105M (POR January 2010 through May 2018).

Because chloride concentrations in the UFA and APPZ generally are low, it is anticipated that recovery efficiencies will exceed 40 percent by volume. Also, storing surface water in the APPZ will freshen the aquifer, leading to improved recovery efficiencies over time.

C.2.9 Regional Water Management (Operations)

Major beneficial effects to operations would be expected from implementation of LOCAR. As illustrated by the modeled results and sensitivity runs, differences between proposed (LOSOM) and authorized Lake Okeechobee operations influence Project benefits to the Northern Estuaries and water supply users. In general, water management operations on Lake Okeechobee may be optimized to account for available storage. Changes to the Lake Okeechobee Regulation Schedule (LORS) can only occur after great consideration and required NEPA analysis. The operation of the Project features in any of the alternatives would not directly trigger any changes in the LORS.

C.2.10 Groundwater Resources

Negligible effects on groundwater resources would be expected from each of the Alternatives. **Table C.2-13** describes the groundwater resources for each alternative.

Table C.2-13. Effects of the Alternatives on Groundwater Resources.

Alternative	Surficial Aquifer System (SAS)	Upper Floridan Aquifer (UFA)	Avon Park Permeable Zone (APPZ)
FWO	Total water demand is expected to increase by 15 percent by 2035, mostly due to agricultural demands. Surficial aquifer would meet part of those demands. Extensive pumping of the SAS could potentially affect regional water levels in this unconfined aquifer.	Estimated future demands on UFA groundwater may be limited near the Lake Wales Ridge in order to maintain minimum flows and levels in adjacent lakes. However, sufficient confinement separates Lake Istokpoga and Lake Okeechobee from the UFA, so increased demands are unlikely to affect water levels in these lakes.	The APPZ is not a water supply source due to greater salinity compared to the UFA, as well as greater depth. It is unlikely that the APPZ will provide drinking water or agricultural irrigation supplies in the future.
Alternative 1	Seepage from LOCAR would be managed by a seepage canal and discharge to C-41A. The project would benefit the unconfined SAS by providing recharge to the aquifer.	No effect on the UFA would be expected from LOCAR.	No effect on the APPZ would be expected from LOCAR.
Alternative 2	Seepage from LOCAR would be managed by a seepage canal and discharge to C-41A. The	No effect on the UFA would be expected from LOCAR.	No effect on the APPZ would be expected from LOCAR.

Alternative	Surficial Aquifer System (SAS)	Upper Floridan Aquifer (UFA)	Avon Park Permeable Zone (APPZ)
	project would benefit the unconfined SAS by providing recharge to the aquifer.		
Alternative 3	Seepage from LOCAR would be managed by a seepage canal and discharge to C-41A. The project would benefit the unconfined SAS by providing recharge.	No effect on the UFA would be expected from LOCAR.	No effect on the APPZ would be expected from LOCAR.

FWO–Future Without Project; LOCAR–Lake Okeechobee Storage Reservoir Section 203 Study

C.2.11 Water Quality

The alternatives selected for the final array may provide minor improvements to water quality. The section below outlines the effects of the final array on water quality.

C.2.11.1 Lake Okeechobee Watershed

In comparison to the FWO, implementation of any of the action alternatives may result in some minor improvements in the water quality of the Lake Okeechobee watershed. The reservoir components will provide increased watershed runoff retention times and will result in direct conversion of pasture and upland to a reservoir. Inflows to Lake Okeechobee may contain nutrients such as nitrogen and phosphorus from surrounding uplands. If this upland flow is diverted to a reservoir prior to entering Lake Okeechobee, there would be greater opportunity for retention and storage of nutrients within these systems. While the reservoir compartments may be too deep to support plant growth, water may remain there long enough so that particulates and associated nutrients settle within the reservoir, providing minor improvement to water quality before it is returned to the watershed canals.

C.2.11.2 Lake Okeechobee

Relative to the FWO option, implementation of any of the action alternatives are unlikely to have any noticeable effects on Lake Okeechobee water quality. To evaluate the alternatives compared to the FWO option, loads for the sub-watersheds directly affected by the Project were estimated using a phosphorus loading spreadsheet model (PLSM; James 2018) (Kissimmee River, and Indian Prairie/Istokpoga). The PLSM used daily flow estimates from the Regional Simulation Model (RSM) and a constant baseline phosphorus concentration of 40 micrograms phosphorus per liter (µg P/L), applied to all inflows prior to entering Project features. The PLSM demonstrated a slight decrease in flows to the Lake compared to the FWO, and therefore P loads also decreased slightly (**Table C.2-14** and **Table C.2-15**).

Table C.2-14. Average Annual Flow Volume (1965–2016) for the Future Without Project, Alternatives 1, 2, and 3.

Alternative	Flow from Watershed Independent of Project[1] (1,000 ac-ft)	Recycled Reservoir Input (1,000 ac-ft)[2]		Percent Difference from FWO

FWO	1,600			
Alternative 1	1,591	46.90		-0.5%
Alternative 2	1,587	55.94		-0.8%
Alternative 3	1,590	56.79		-0.6%

1/ Includes Indian Prairie/Istokpoga and Kissimmee River sub-watersheds.
2/ Recycled water is already included in Lake flow calculations and is therefore not an additional flow to Lake.
ac-ft–acre-foot; FWO–Future Without Project

Table C.2-15. Average Annual (1965–2016) Phosphorus Load Estimates for Future Without Project, Alternatives 1, 2, and 3.

Alternative	Load from Watershed Independent of Project[1] (metric tons P)	Recycled Reservoir Input (metric tons P)[2]		Percent Difference from FWO
FWO	78.9	-		-
Alternative 1	78.5	2.2		-0.5%
Alternative 2	78.3	2.8		-0.8%
Alternative 3	78.5	2.5		-0.6%

Note: Assumes a baseline concentration of 40 micrograms phosphorus per liter
1/ Includes Indian Prairie/Istokpoga and Kissimmee River sub-watersheds.
2/ Recycled water is already included in Lake P load calculations and is therefore not an additional load to Lake.

ac-ft–acre-foot; FWO–Future Without Project; P–phosphorous

As discussed in the FWO conditions section, there is an existing Total Maximum Daily Load (TMDL) for phosphorus for Lake Okeechobee (FDEP 2001). This TMDL requires a reduction in annual phosphorus loading to 140 metric tons per year. Concentration estimates to reach these loadings range from 25 to 114 $\mu g\ P\ l^{-1}$ for the Kissimmee and the Indian Prairie/Istokpoga sub-watersheds. To reflect this variation in ranges and account for the sum of load and flow contributions from the sub-watersheds, results were estimated from the PSLM using a range of concentrations from 40 to 100 $\mu g\ P\ l^{-1}$ (James 2018). This analysis compared the effect of variation of phosphorus concentration on the overall loads for each alternative. This sensitivity analysis indicated that the with-project action alternatives may result in decreased phosphorus loads between 0.5 and 0.8 percent (**Figure C.2-12**).

The PLSM indicates phosphorus loads will decrease slightly with the alternatives. The water source for the alternatives is being withdrawn from Lake Okeechobee downstream of S65E to be stored in the reservoir, where settling may occur. It is important to note that the phosphorus decrease is predominantly attributed to this settling of P-rich particulate matter exported from the lake, and the benefit is therefore dependent on the residence time of the lake water within the reservoir. Water will be returned to the Lake during dry times or when water is needed in the system. Consequently, the PLSM indicated all the alternatives also provide water supply benefits.

The existing condition average annual load from the Kissimmee River and Indian Prairie/Istokpoga sub-watersheds using water years 2018 to 2022 was 311 metric tons per year (Jones et al. 2023). The FWO condition is estimated as 78.9 metric tons/yr at 40 $\mu g\ P\ l^{-1}$ to 197.3 metric tons/yr at the highest baseline, 100 $\mu g\ P\ l^{-1}$ (**Figure C.2-13**; **Annex I**).

Alternative 1 vs. FWO

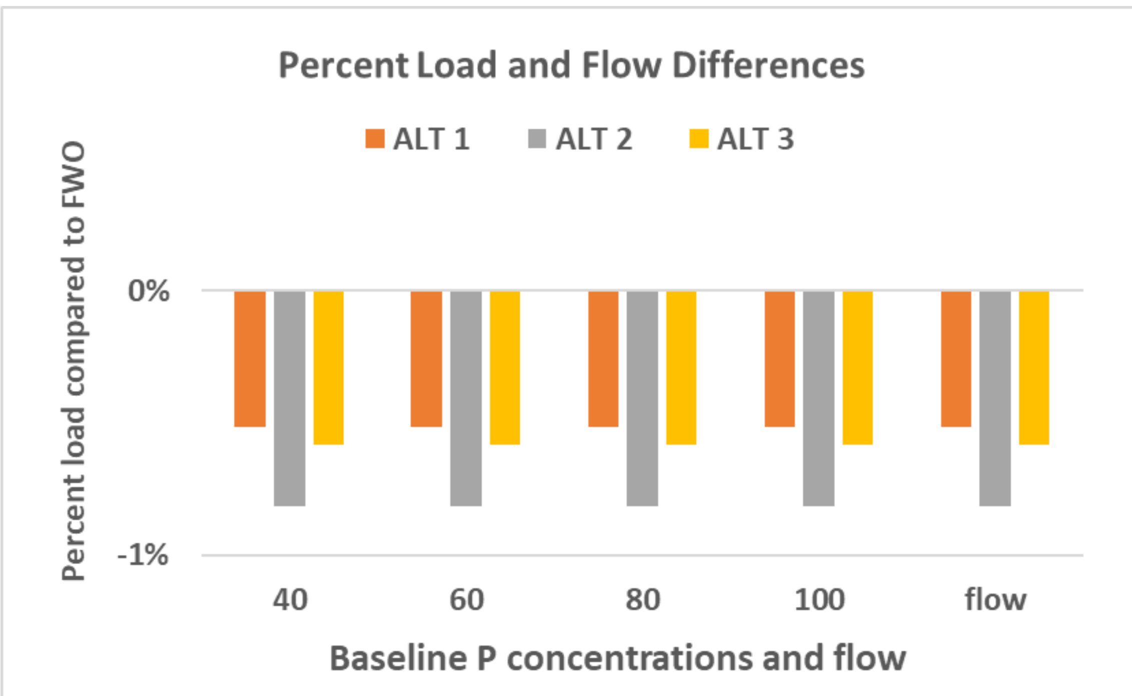
Alternative 1 showed a slight decrease in phosphorus loadings to the lake of 0.5 percent compared to the FWO condition (**Figure C.2-12**). This would equate to predicted flow releases of 79 to 196 metric tons/yr for baseline concentrations of 40 to 100 μg P/L^{-}(**Figure C.2-13**).

Alternative 2 vs. FWO

Alternative 2 showed a slight decrease in phosphorus loadings to the lake of 0.8 percent compared to the FWO condition(**Figure C.2-12**). This would equate to predicted flow releases of 78 to 196 metric tons/yr for baseline concentrations of 40 to 100 μg P/L (**Figure C.2-13**).

Alternative 3 vs. FWO

Alternative 3 showed a slight decrease in phosphorus loadings to the lake of 0.6 percent compared to the FWO condition(**Figure C.2-12**). This would equate to predicted flow releases of 78 to 196 metric tons/yr for baseline concentrations of 40 to 100 μg P/L^{-} (**Figure C.2-13**).



Note: Includes Indian Prairie/Istokpoga and Kissimmee River sub-watersheds.

Figure C.2-12. Estimated percent P load change resulting from Alternative (ALT) 1, 2, and 3 compared to the FWO condition.

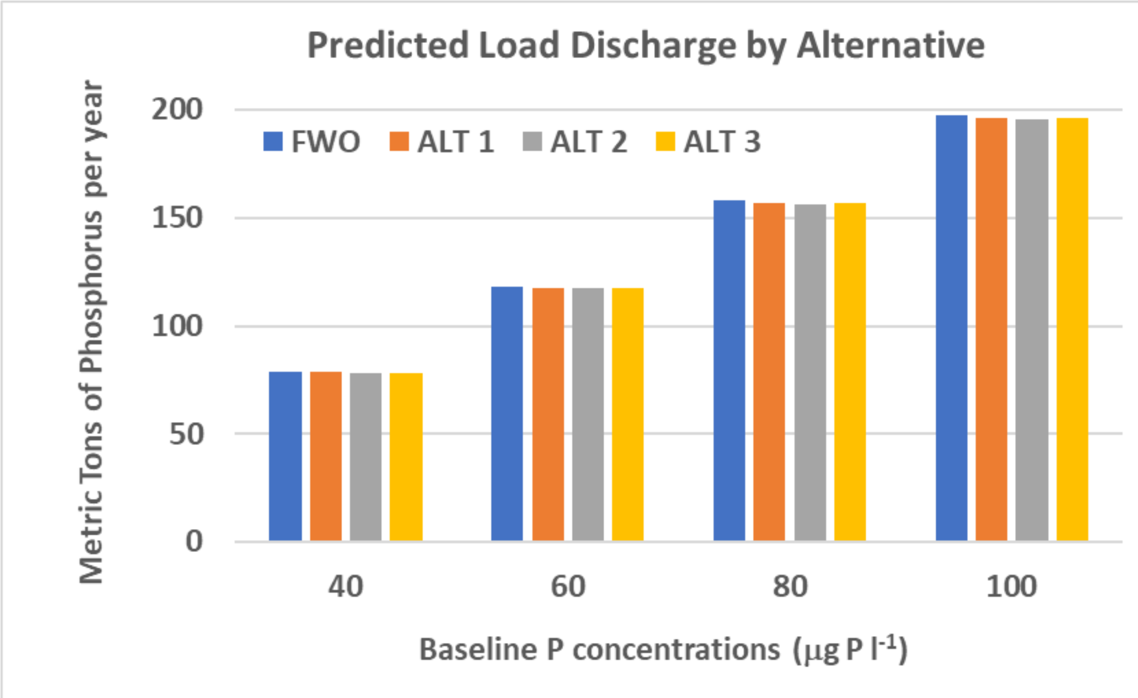


Figure C.2-13. Predicted possible average annual P loads to Lake Okeechobee from Indian Prairie/Istokpoga and Kissimmee River sub-watersheds at different baseline P concentrations.

C.2.11.3 Northern Estuaries

Changes in flows to the Caloosahatchee and St. Lucie Estuaries would be expected to have negligible effects on water quality.

C.2.12 Flood Control

To address the Savings Clause requirements for CERP, the FS includes an analysis of potential effects of the alternatives, where applicable, to existing legal sources for water supply and/or the levels of service for flood protection. Refer to **Section 6** of the main report for summary information and **Annex B** for the complete analysis. However, it was determined that the implementation of the alternatives will not degrade the existing level of flood protection offered by various components of the C&SF Project for this area. Further, LOCAR will ensure flood protection of the area through engineering design and construction following state of the practice methods for design and construction of pertinent features of the plan. U.S. Army Corps of Engineers (Corps) ER 1110-2-1150, *Engineering and Design for Civil Works Projects*, and ER 1110-2-1156, *Engineering and Design Safety of Dams – Policy and Procedures*, along with various other site/structure-specific regulations, will be adhered to before and during the PED phase.

C.2.13 Water Supply

The water supply performance of the alternatives was modeled to quantify conditions for LOSA, the Seminole Tribe of Florida Brighton, and Big Cypress Reservations. Water supply in the ECB and FWO project condition are quantified and displayed for comparison to the final array of alternatives. Overall, storage is expected to be a long-term benefit to water supply stability.

C.2.13.1 Lake Okeechobee

Each of the alternatives reduces water supply for existing permitted users in LOSA compared to the FWO. For the 8 years with the largest water supply cutbacks within the LOSA, the water supply cutback percentage is reduced, compared to the FWO (**Figure C.2-14**). Based on the LOCAR alternative modeling assumptions and the resulting moderate stage increase within Lake Okeechobee, the average annual percentage of water supply demand not met is projected to increase in LOSA including the EAA (**Figure C.2-15**). In the EAA, each of the alternatives increases the percentage of unmet demands from 6 percent in the future without project condition to 8 percent (**Figure C.2-15**).

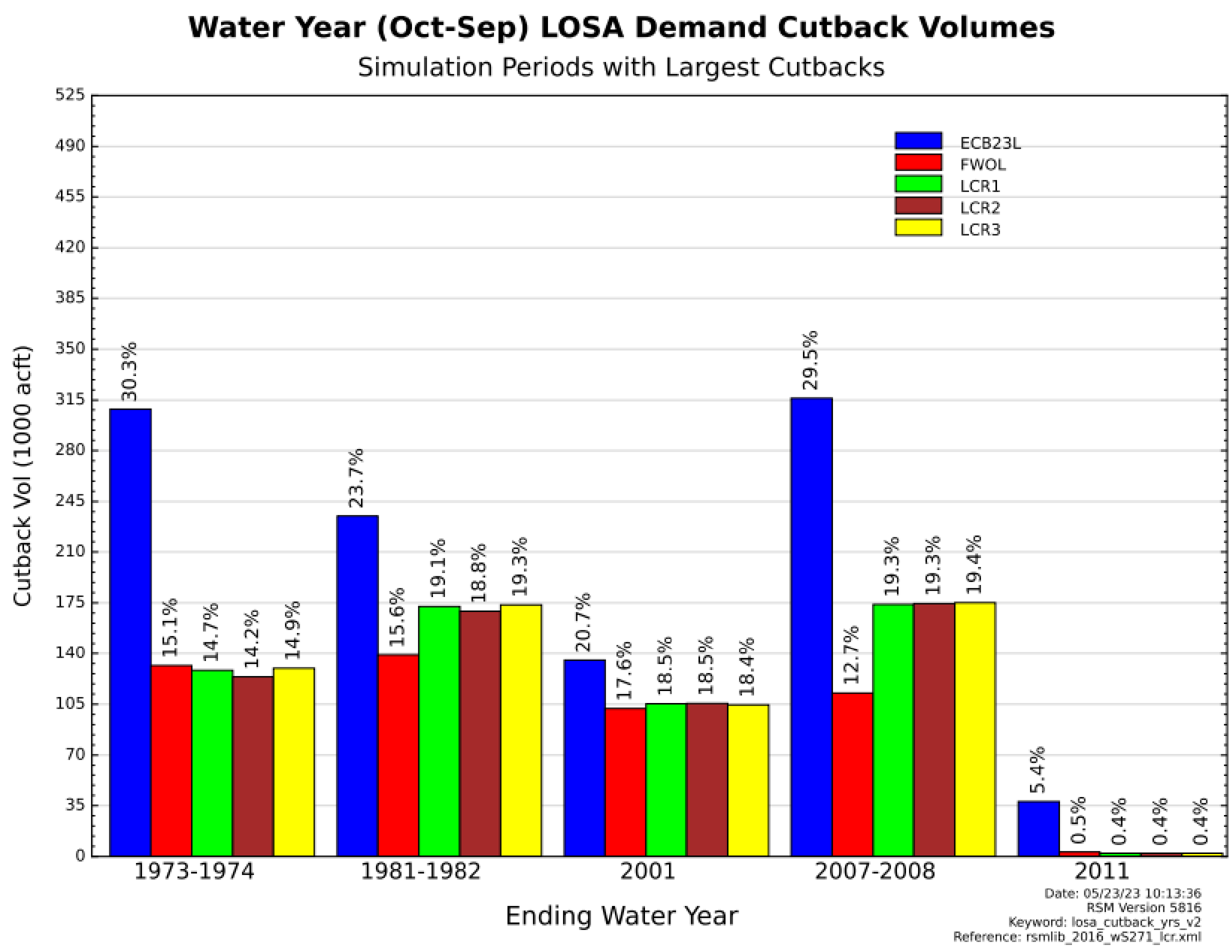


Figure C.2-14. LOSA demand cutback volumes for the 8 years with the largest cutbacks.

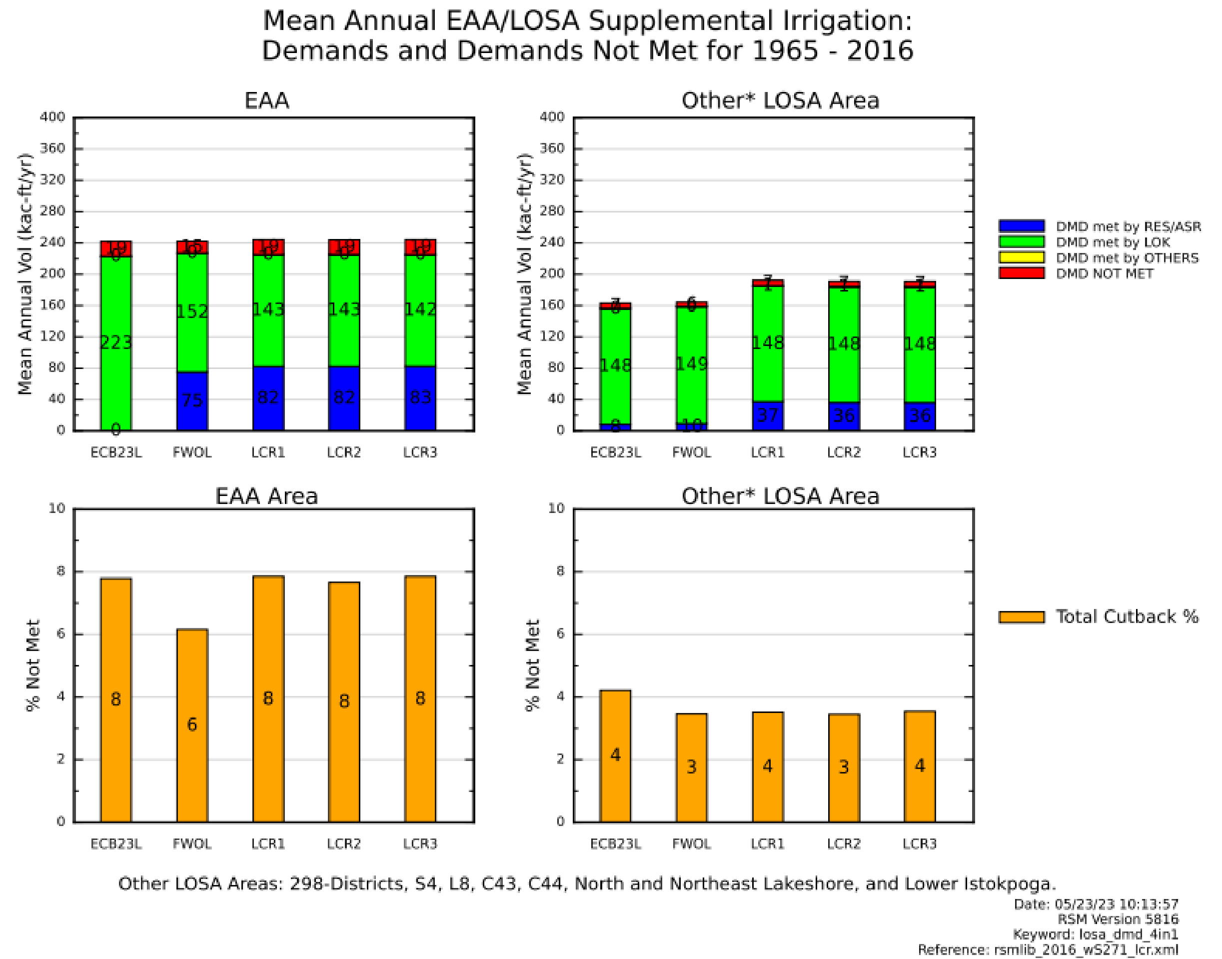


Figure C.2-15. Mean annual EAA/LOSA supplemental irrigation: demands and demands not met for 1965 to 2005.

As measured by RECOVER Performance Measure WS-1 (**Table C.2-16**), the frequency and severity of water restrictions in LOSA is increased by all alternatives in the final array compared to the FWO project condition. However, water supply cutbacks are reduced when using the proposed LOSOM schedule (FWOLL model simulation).

Table C.2-16. RECOVER Performance Measure WS-1: Frequency and Severity of Water Restrictions for Lake Okeechobee Service Area.

Simulation	POR	Cutback Total (kaf)	Frequency	Severity Score	Number of Water Years with at Least 1 Cutback
ECB	1965–2016	1,335	13	31	13
FWO	1965–2016	600	9	16	9
Alternative 1	1965–2016	753	10	18	10
Alternative 2	1965–2016	734	9	17	9
Alternative 3	1965–2016	755	10	18	10

FWO–Future Without Project; POR–period of reference; RECOVER–Restoration Coordination and Verification

C.2.13.2 Seminole Tribe of Florida

Both the Brighton and Big Cypress Reservations depend partially on Lake Okeechobee for supplemental irrigation water supplies for agricultural and other needs. The volume and percentage of water demand not met can be compared to assess the ability of existing legal sources to continue to meet demands. For the Brighton Reservation, water supply performance for Alternatives 1, 2, and 3 is similar to the ECB condition, while the majority of the demand met shifts from Lake Okeechobee to the reservoir. The volume and percentage of demand not able to be met are 2,000 ac-ft and approximately 4 percent, respectively, for the ECB and three proposed alternatives (**Figure C.2-16**).

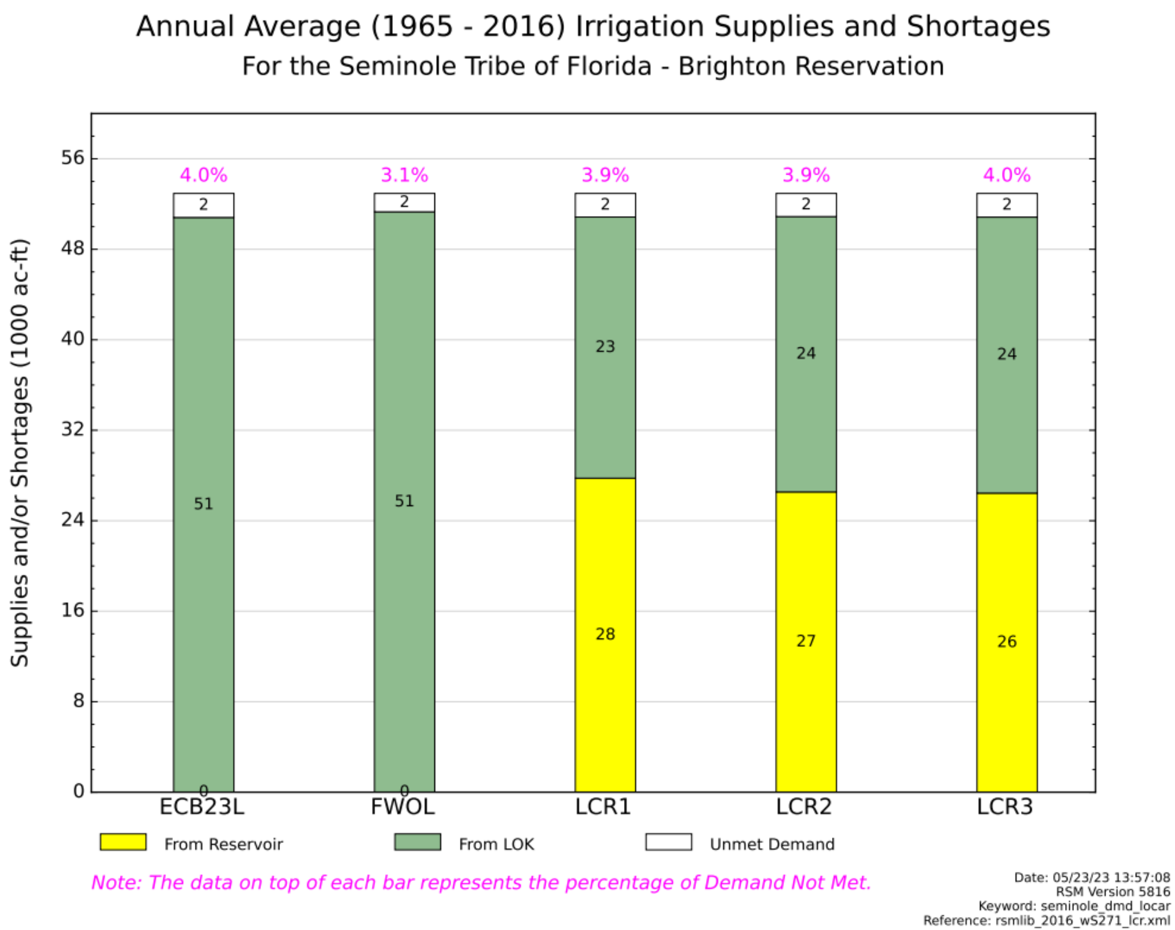


Figure C.2-16. Annual Average (1965–2016) Irrigation Supplies and Shortages for the STOF Brighton Reservation.

For the Big Cypress Reservation, the volume of demand not able to be met is essentially the same for the ECB, FWO, and Alternatives 1, 2, and 3. The percentage of demand not met is slightly reduced from the ECB for the FWO and Alternatives 1, 2, and 3. The volume and percentage of demand not met are 1,000 ac-ft and 1.8 percent, respectively, for Alternatives 1, 2, and 3. For the FWO condition, the volume and percentage of demand not met are 1,000 ac-ft and 1.7 percent. The volume of water supplied by the three sources (Lake Okeechobee, stormwater treatment areas (STAs), and S-190) remains unchanged; therefore, no transfer occurs. Based on this comparison, water supply performance for the STOF Brighton and Big Cypress Reservations is unchanged with implementation (**Figure C.2-17**). The volume of water supplied by Lake Okeechobee is reduced and replaced with increased supplies from basins and stormwater treatment areas, while local supplies from the S-190 structure remain unchanged. Based on this comparison, water supply performance for the STOF Brighton and Big Cypress Reservations is mostly unchanged with the LOCAR implementation.

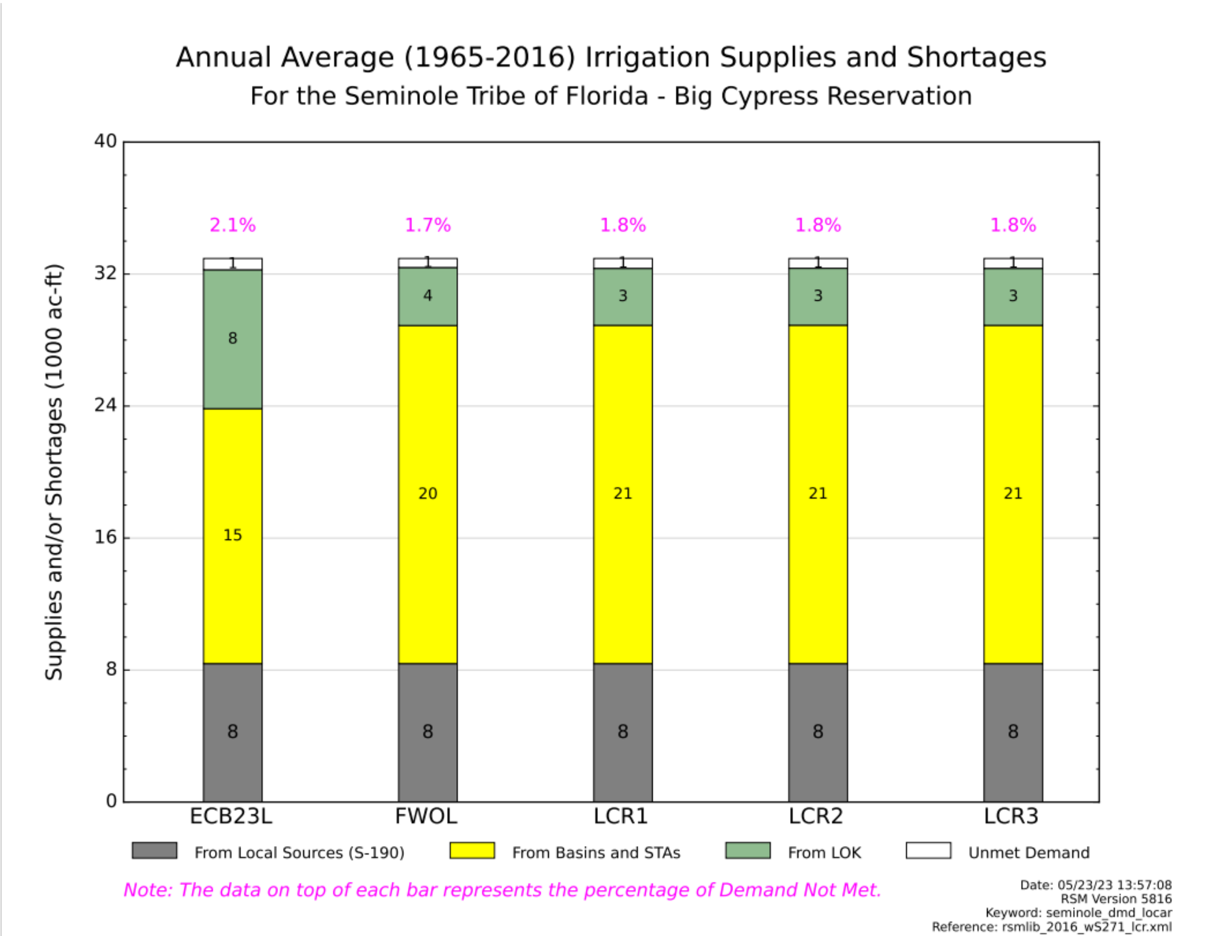


Figure C.2-17. Annual average (1965–2016) irrigation supplies and shortages for the STOF Big Cypress Reservation.

C.2.14 Air Quality

Direct emissions from the proposed construction of the project features would be confined to exhaust emissions of labor transport equipment and construction equipment (dump trucks, excavators, graders, bulldozers, a concrete batch plant, etc.). Clean Air Act pollutants considered in this air quality assessment are SOx; volatile organic compounds (VOC); nitrogen oxides (NOx), CO, PM10, and PM2.5. Greenhouse gas emissions are also considered. Volatile organic compounds, sulfur oxides, and nitrogen oxides are important since they are precursors to ozone generation. **Table C.2-17** provides modeled emissions expected to be generated by the construction and operational activities associated with the proposed action alternatives. Assumptions during construction would expect to exceed allowable emissions for PM10. Exceedances of PM10 would not be expected if less than 2 million square feet of soil was left bare for less than 3 consecutive months. Reasonable precautions should be taken to prevent dust from becoming airborne. Reasonable precautions might include using water to control dust from building construction and demolition, road grading, or land clearing. Cleared or graded land would be stabilized by mechanical controls, seeded and/or vegetated in a timely manner to reduce fugitive dust.

Using CO2e as a surrogate for CO2 emissions, the highest annual emissions would be expected during construction at more than 38,000 tons (roughly 35,000 metric tons). Table C.2-17 presents that more than 60 percent of these emissions are from hauling material to the Project. For perspective, this would be 0.02 percent of the annual CO2 emissions in Florida in 2021 (USEIA 2023). The annual operational emissions would be 8 tons; 2 times the global annual average use of an individual (4.7 tons per year) and a fraction (15 percent) of the annual use by the wealthiest (top 10 percent) people living in the United States (55 tons per year).

Over the 50-year project life-cycle, the social cost of carbon (SCC) of operations (beginning 2034) of Alternative 1 was estimated to be roughly $38,552 (Friedlinstein et al 2022, IWG 2021). The SCC of Alternatives 2 and 3 would be slightly higher from the use of additional emergency generators at pump stations. Mitigation measures for controlling dust during construction would be implemented.

Table C.2-17. Modeled Emissions for Alternative 1 Compared to Significance Indicators.

Pollutant	Hauling quarry material onsite (ton/year)	Embankment Construction Emissions (ton/year)	Operational Emissions (ton/year)	Significance Indicator (ton/year)	Significance Indicator Exceedance (Yes or No)
Volatile organic compound (VOC)	7	5	0.0	250	No
Nitric oxide (NOx)	64	39	0.1	250	No
Carbon monoxide (CO)	29	23	0.2	250	No
Sulfur oxide (SOx)	0.2	0.1	0.0	250	No
Particulate Matter 10 (PM 10)	2.7	>250	0.0	250	Yes, during construction
Particulate Matter 2.5 (PM 2.5)	2.5	1.5	0.0	250	No
Lead (Pb)	0	0.0	0.0	25	No
Ammonia (NH_3)	0.4	0.2	0.0	250	No
Carbon dioxide equivalent (CO2e)	24,347	13,975	8	-	-

Source: USAF 2023.
Note: Construction emissions are based on the highest use expected.

In Lake Okeechobee and the Northern Estuaries, population growth in the area is expected in the FWO condition relative to existing baseline conditions, representing the potential for an increase in air pollution. However, air quality compliance is expected. All action alternatives are expected to have no change relative to FWO conditions in Lake Okeechobee and the Northern Estuaries. Reduction in ranching equipment used on the reservoir lands in the FWO condition will be offset by an increase in air pollutants. New pump stations would be electric.

C.2.15 Hazardous, Toxic, and Radioactive Waste

Negligible effects from HTRW contamination would be expected because the non-federal sponsor will be required to remediate these sites at their sole expense. During the construction of any of the alternatives, it is possible that undiscovered HTRW contamination will be found. There is also the potential for HTRW release associated with the operation of Project pump stations; however, with modern facilities and best management practices, this presents a minor risk to the environment.

The Corps HTRW policy (ER 1165-2-132) directs that Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. In September 2011, the ASA (CW) provided a clarification of this HTRW policy for CERP Projects (Memorandum for Deputy Commanding General for Civil and Emergency Operations, Subject: Comprehensive Everglades Restoration Plan (CERP)–Residual Agricultural Chemicals, Dated September 14, 2011). If specific criteria are met, this policy memorandum allows the Corps, at SFWMD's explicit request and expense, to (a) conduct the response action to address residual agricultural chemicals during the construction phase; and/or (b) allow soils containing residual agricultural chemicals to remain on project lands as part of an approved response action.

Each alternative requires land conversion from agricultural production to aquatic restoration which inundates the land with water. The avoidance of lands that may contain residual agricultural chemicals is not practicable.

Environmental Conditions that indicate likely HTRW issues including ag-chemicals have been identified via prior Pre-Acquisition Environmental Due Diligence completed by the non-federal sponsor at relatively localized areas situated within the limited subset of previously acquired properties within the Project footprint. These HTRW issues remain currently unabated. Prior to construction, these HTRW issues will be satisfactorily addressed by the non-federal sponsor. In addition, all additional properties to be acquired will be evaluated via current Pre-Acquisition Environmental Due Diligence requirements to identify any additional Recognized Environmental Conditions and/or HTRW issues. Finally, due to the time that has elapsed since the acquisition of selected properties within the project footprint, these properties will be evaluated consistent with current requirements to ensure that no HTRW issues remain outstanding. Prior to construction and during operation, the Corps and the non-federal sponsor will comply with applicable requirements.

The non-federal sponsor will be 100 percent responsible for the cost of actions taken due to the presence of residual agricultural chemicals, at no expense to the Federal Government. Any future costs associated with the presence of residual agricultural chemicals at the Federal project site will be the sole responsibility of the non-federal sponsor. The costs for characterization of the Project lands in preparation for conducting a response action for the residual agricultural chemicals and removal of soils that are hazardous waste will be included as 100 percent non-federal sponsor's responsibility. The Corps will not conduct actions to address residual agricultural chemicals for the SFWMD during the OMRR&R phase of the project.

C.2.16 Noise

For the action alternatives, there would be minor, short-term, and less than significant increases in noise during construction activities. Construction noise would be expected to include an on-site concrete batch plant. Construction noise would be expected to be attenuated over distances where noise would be negligible to local residents or off-site workers in the area. Noise 400 to 800 ft away from a load noise—noise in the range of 120 decibels—would be reduced to the level of normal speech. However, with multiple items of equipment operating concurrently, noise levels can be relatively high within 400 to 800 ft from the site of construction. Although construction activities would cause temporary noise impacts, most activities would be confined to the Project footprint and roughly a mile (5,200 ft) or further from residential areas or businesses.

All alternatives include additional pump stations which would result in long-term, localized increases in noise. Since Alternative 1 adds the fewest number of pump stations (two), it would have the least effect while Alternatives 2 and 3 which both have additional pump stations would have the greatest effect.

C.2.17 Aesthetics

Aesthetic effects refer generally to impacts on the visual qualities of the environment. Restoration of the South Florida ecosystem is expected to result in a healthier environment that would support vigorous plant communities, larger fish and aquatic animal populations, large numbers of wading birds, alligators, and sustainable populations of wide-ranging mammals in a natural setting, in perpetuity. People value viewing wildlife, wetlands, and open, relatively pristine spaces, as supported by tourism statistics for South Florida. During construction there would be a temporary, short-term, major impact to aesthetic values in the construction area. However, all action alternatives show a major increase in aesthetic value over the FWO due to the creation of a reservoir in the Lake Okeechobee watershed. Construction of the reservoir provides additional habitat for native aquatic plants, fish, wading birds, and mammals, and opportunities for wildlife viewing. The proposed reservoirs in all the alternatives would provide some potential habitat for fish and wildlife that would enhance the aesthetics of the area. There will be a long-term, major adverse impact in reservoir areas due to levees in line of sight. An earthen dam will be visible on the rise but covered in grass to minimize the aesthetics impact. There will be a moderate adverse impact with the addition of a pump stations and reservoirs by adding human-made features to the natural landscape. All alternatives will have a minor effect to the night sky resource (nightscape) within the vicinity of this project due to increased light pollution. The light pollution concern includes light pollution at pump stations at night in an otherwise dark landscape. Pump stations will be designed to have a minimum number of fully shielded LEDs for exterior lighting. Floodlights used for security during construction will be minimized. All alternatives will have minor effects after minimizing light type, number, direction of orientation, and location compared to residential areas. There are no affects to public parks, conservation areas, or refuges in the Project Area.

There would be negligible and less than significant effects due to LOCAR in Lake Okeechobee. In the Northern Estuaries, the action alternatives would increase the aesthetic value due to decreased high-flow events and provide minor beneficial effects. Reductions in high-volume flows to the estuaries would result in lower suspended solids, increased water clarity, and the correct salinity envelope to maintain healthy SAV beds. These benefits could also and lead to an increase in wildlife viewing opportunities (Orth et al. 2006).

C.2.18 Land Use

Converting privately owned pasture or citrus crop land to aboveground storage accessible to the public would be expected to provide negligible benefits to local land use when compared to the FWO. Privately held lands could remain in agricultural use or be converted to residential or other uses in the future.

Construction of LOCAR would maintain the natural landscape and create recreational opportunities. Coordination with the USDA and NRCS to meet the requirements of the Farmland Protection Policy Act is ongoing. When a detailed design is completed, the impact to unique farmland would be defined and mitigated if needed.

C.2.19 Recreation

Converting private lands to publicly accessible lands would provide a negligible effect to recreational opportunities. In the Lake Okeechobee Watershed, LOCAR would offer small boats opportunities for fishing, hunting, and frogging, with hiking and biking opportunities on the dam. The features would provide an alternate location for fishing and hunting. LOCAR would likely be incorporated into the statewide FWC alligator and waterfowl quota hunting programs. Reductions in high and low water stages in Lake Okeechobee would provide minor beneficial effects to recreation by improving lake ecology, and thus recreational opportunities such as fishing, boating, and kayaking. A slight increase in the time Lake Okeechobee would be below navigational minimum stage would be expected. Reductions in high flows to the Northern Estuaries would provide minor beneficial effects by increasing water clarity and SAV coverage, enhancing fish utilization of estuaries and subsequently improving related recreational opportunities such as fishing, boating, and kayaking. A Recreation Plan is included in **Appendix F**.

C.2.20 Socioeconomics

The counties containing the LOCAR Study Area are expected to increase in population by 15.2 percent from 2025 to 2050, using the BEBR medium projections (**Table C-16**). This rate of growth is consistent with that projected previously in CERP planning efforts. Martin and Palm Beach counties are projected to attract the greatest number of new residents. Martin County is projected to grow by about 12.2 percent, gaining about 20,100 people. Palm Beach County is projected to grow about 16.4 percent, gaining about 257,200 people. Glades, Highlands, and Okeechobee counties are expected to increase by 700 people (5.6 percent); 8,100 people (7.8 percent); and 1,700 people (4.3 precent), respectively. When aggregated, the total population of the five counties is projected to increase by 287,800 people, and the majority of those would be expected in Palm Beach County (BEBR 2022). Population projections are not anticipated to differ between the FWO and alternative conditions.

Beneficial economic effects would be expected from the construction and operation of the reservoir. The infusion of construction funds into the regional economy would generate increased sales, additional jobs, increased labor income, and increased gross regional product during the construction period. OMRR&R funds will have the same beneficial effects throughout the life of the Project. Primary industries affected would be construction, food and drink services, and engineering services. Operation of the reservoir would see beneficial economic effects from new recreational features added to the LOCAR and improved recreational opportunities at Lake Okeechobee (see **Section 6.2.2** and **Appendix F** for LOCAR recreational analysis). LOCAR recreational features would help meet the anticipated increase in demand for recreation from the projected Study Area population increase, as well as attract visitors because of the LOCARs proximity to Lake Okeechobee, the Kissimmee River, and several other water management areas. This would be expected to result in increased spending from residents and tourists in accommodations and food services, real estate rentals, recreation, and retail trade industries, and an increase in state and local sales tax revenue. Recreation at Lake Okeechobee would see minor beneficial effects because reductions in high and low water stages in the lake would improve lake ecology, and thus recreational opportunities such as fishing, boating, and kayaking.

For all private-sector relocations, a private landowner would be monetarily compensated for the economic value of their property based on a fair market value appraisal, and the non-Federal sponsor would provide relocation assistance for affected businesses per the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended. Therefore, it is expected that business owners would be monetarily compensated and may have the opportunity to relocate to a suitable location in the region and socioeconomic impacts would therefore be less than significant. Agricultural jobs displaced by property acquisition may be transferred elsewhere in the regional economy. All private land acquisition will result in a decrease in ad valorem property tax revenue for the counties in which the property is located.

C.2.21 Environmental Justice

The effects of the final array of alternatives on the EJ communities are described below.

C.2.21.1 EJ Aesthetics

The aesthetics concern from the STOF and local communities is that the proposed levees will block the current unobstructed view of the landscape. In the short-term, all alternatives would have temporary, major adverse impacts to aesthetic values in the Project Area during construction. In the long term, all alternatives would have major adverse impacts in reservoir areas due to levees in line of sight. The proposed reservoir in all alternatives would have a perimeter dam with an average levee height of about 33 ft above the ground. The levee would be visible on the rise but covered in grass to minimize the aesthetics impact. The proposed reservoir site for all of the alternatives would be about 5 miles north of the STOF Brighton Reservation, about 9 miles northeast of the MTI North Ranch (formerly known as Cherry Ranch) Tribal-owned lands, and less than 5 miles from local communities.

The proposed reservoir also would have long term beneficial aesthetic effects. Restoration of the South Florida ecosystem is expected to result in a healthier environment, and the reservoir itself would provide habitat for fish and wildlife, thereby benefiting the aesthetics of the Study Area. In the long-term, all alternatives show an increase in aesthetic value over the FWO due to the creation of a reservoir in the Lake Okeechobee watershed. People value viewing wildlife, open water, and open, relatively pristine spaces, as supported by tourism statistics for South Florida (see **Section C.2.17**).

C.2.21.2 EJ Noise

The noise concern includes noise during construction and from pump operations in an otherwise quiet landscape with only periodic noise from roads and agricultural/land management activities. All alternatives would have a minor, short-term, and less than significant increase in noise during construction activities. All alternatives include pump stations which would result in long-term, localized increases in noise. Since Alternative 1 would add the fewest number of pump stations (two), it would have the least effect, while Alternatives 2 and 3 with 3 pump stations would have the greatest effect (**Section C.2.16**).

C.2.21.3 EJ Light Pollution

The light pollution concern includes light pollution at pump stations at night in an otherwise dark landscape. Pump stations will be designed to have a minimum number of fully shielded LEDs for exterior lighting.

Floodlights used for security during construction will be minimized. All alternatives will have minor effects after minimizing light type, number, direction of orientation, and location compared to residential areas (**Section C.2.17**).

C.2.21.4 EJ Air Quality

The air quality concern includes pollutants in the air near the local community and the STOF's Brighton Reservation in the short-term from construction activity and in the long-term from pump station operation. All alternatives would have short-term adverse effect in direct emissions from the construction of Project features (exhaust emissions of labor transport equipment and construction equipment [dump trucks, excavators, graders, bulldozers, etc.]). All action alternatives would be expected to have negligible effects in the long-term from operation of electric pump stations. Reduction in farming or ranching equipment currently used on the proposed reservoir site would be offset by air pollutants from new pump stations. The alternatives would not substantially increase climate change risks, GHG emissions, or result in a substantial social cost of carbon (see **Section C.2.14**).

C.2.21.5 EJ Wetlands

The wetland concern includes the loss of wetlands in the aboveground storage footprints. While the majority of the aboveground storage sites in each alternative are improved and unimproved agricultural land, there are some wetlands in each Project alternative that would be removed in the construction of the reservoir. Much of the wetland area in the Project footprint is human-made for agricultural stormwater ponds. Potential minor adverse impacts on wetlands would be assessed during detailed design (**Section C.2.3.2**).

C.2.21.6 EJ Cultural and Historic Resources – Burial Resources

Most lands within the Project Area had not been previously surveyed for the presence of historic properties or cultural resources. Several known prehistoric mounds and earthworks complexes are also located within or near the Study Area. Therefore, prehistoric burial resources might be present within the final array of alternatives. The STOF have expressed concerns that burial resources could be inundated by the construction of aboveground storage features or impacted by wetland restoration. Burial resources are highly likely in mounds and earthwork sites throughout the region. If burials are identified during the Project, the procedures stipulated within the Burial Resource Agreement (BRA) between the STOF and the Corps-SAJ will ensure meaningful consultation with respect to burial resources. Although not signatories of the BRA, the presence of burial resources will also require consultation with the MTI and other appropriate federally recognized Tribes pursuant to Section 106 of the National Historic Preservation Act (NHPA), the Corps Trust Responsibility, and other federal regulations, executive orders, and departmental policies.

The SFWMD is conducted a cultural resource assessment survey (CRAS) to evaluate cultural resources and determine effects of the undertaking on historic properties prior to completion of the SFWMD Section 203 Study. For this project, the area of potential effect (APE) for cultural resources covers the Project Area but also the surrounding landscape and viewshed. Preliminary results from ongoing CRAS have determined that Alternatives 1, 2, and 3 would adversely affect historic properties but the Recommended Plan would avoid historic properties. Consultation is ongoing and would be complete prior to signing of the ROD (see **Section C.2.22**).

C.2.21.7 EJ Cultural and Historic Resources – NRHP Eligible Sites

The majority of lands within the Project Area had not been previously surveyed for the presence of cultural resources. Preliminary results from ongoing CRAS have determined that Alternatives 1, 2, and 3 would adversely affect historic properties but the Recommended Plan would avoid historic properties. The Jacksonville District concluded no adverse effect to cultural and historic resources for the Recommended Plan. Completion of consultation will be documented in the ROD (see **Section C.2.22**).

C.2.21.8 EJ Cultural and Historic Resources – Impacts to Traditional Cultural Properties

The concern is that there are traditional cultural properties (TCP) which may be eligible for inclusion in the NRHP based on associations with cultural practices, traditions, beliefs, ways of life, arts, crafts, or social institutions of a living community including the STOF and MTI in the Study Area. The proposed Project Area for the three alternatives is about 5 miles north of the STOF Brighton Reservation and about 9 miles northeast of the MTI North Ranch (formerly known as Cherry Ranch). National Register Bulletin 38 describes TCPs as properties that are eligible for inclusion in the NRHP because of their association with cultural practices or beliefs of a living community that is rooted in that community's history and is important in maintaining the continuing cultural identity of the community (Parker and King 1998). A TCP must meet specifically defined criteria and any potential TCPs identified will require evaluation and consultation. At this time, there are no known TCPs located within the final array of alternatives sites. Preliminary results from ongoing CRAS have determined that Alternatives 1, 2, and 3 would adversely affect historic properties but the Recommended Plan would avoid historic properties. Consultation is ongoing and would be complete prior to signing of the ROD (see **Section C.2.22**).

C.2.21.9 EJ Economics – Displacement of Endangered Species

The concern is displacement of species from Project footprints to adjacent lands could increase ESA compliance costs and limit the range of economic activities on lands. For all alternatives, species assessments on the Project footprint would be required to determine the abundance of threatened and endangered species (see **Section C.2.4**). These surveys and a final determination of effects for endangered species was coordinated with USFWS via consultation under the ESA. Upland flora species could be planted next to the aboveground storage features to replace upland habitat that is affected by the Project.

C.2.21.10 EJ Economics – Water Supply Entitlement – STOF

The concern is losing access and volume of water that the STOF has reserved as part of three-party water compact. The STOF has surface-water entitlement rights pursuant to the 1987 Water Rights Compact and subsequent entitlement provisions executed between the STOF, the State of Florida, and the SFWMD. Based on LOCAR alternative modeling, volume of water available for water supply would be greater in Alternative 1 than the FWO, and negligible effects would be expected. Water rights would be maintained for the STOF Brighton and Big Cypress Reservations. Water supply performance for the STOF Brighton and Big Cypress Reservations is mostly unchanged with the LOCAR implementation (**Section C.2.13.2**).

C.2.21.11 EJ Economics – Water Supply Entitlement – Lake Okeechobee

The concern is for existing users of Lake Okeechobee and other surface and ground water sources to maintain existing permitted withdrawals. Based on the LOCAR alternative modeling assumptions, the volume of water available for water supply would be greater in Alternative 1 than the FWO, and negligible effects would be expected. Permitted consumptive use would be maintained for legal users (**Section 5.13**).

C.2.21.12 EJ Economics – Ranching Impacts

The concern is impacts to ranching due to seepage and potential dam break due to aboveground storage. For all alternatives, a seepage canal will be designed to limit seepage outside the reservoir and there will be no discernible impact to ranching from seepage. Groundwater effects will be modeled during PED. A formal dam safety risk assessment was completed, and results are included in this Section 203 Study. A desktop evaluation of all alternatives in the final array indicates that the alternatives are well within tolerable risk limit guidelines. Planning-level breach assessments confirm that the probability of a breach is extremely low for each surface storage configuration in the final array of alternatives due to robust design criteria of modern design standards for high-hazard dams. Therefore, the risk of impacts to environmental justice communities is extremely low. A dam breach analysis was completed by the SFWMD for the selected alternative to provide additional details about potential impacts. Corps ER 1110-2-1150, *Engineering and Design for Civil Works Projects*, and ER 1110-2-1156, *Engineering and Design Safety of Dams – Policy and Procedures*, along with various other site/structure-specific regulations, will be adhered to prior to and during the PED phase (**Sections 6.7 and 6.8**).

C.2.21.13 EJ Economics – Restricted Drainage of STOF Brighton Reservation

The concern is that the aboveground storage features will restrict drainage patterns on the Brighton Reservation. Reservoirs could block drainage canals near the perimeter of the Project, and plugged drainage could cause flooding on STOF lands if not avoided and minimized. For all alternatives, the reservoir would be about 5 miles north of STOF Brighton Reservation, and design of the reservoir would maintain existing drainage patterns outside the reservoir (**Section C.2.10**). Existing drainage patterns outside of reservoir footprints would be maintained as part of savings clause analysis.

C.2.21.14 EJ Health – Fish and Wildlife (Food) Contamination

All alternatives will not affect fish and wildlife (food) contamination.

C.2.21.15 EJ Health – Dam Breach Impacting Property and Life

The concern is the impact to life and property in the event of a dam breach in the aboveground storage features. Formal dam safety risk assessments were completed and included in this Section 203 Study. A desktop evaluation of all alternatives in the final array indicates that the alternatives are well within tolerable risk-limit guidelines. Planning-level breach assessments confirm that the probability of a breach is extremely low for each surface storage configuration in the final array of alternatives due to robust design criteria of modern design standards for high hazard dams; therefore, the risk of impacts to environmental justice communities is extremely low. A dam breach analysis was completed for the selected alternative to provide additional details about potential impacts. Corps ER 1110-2-1150, *Engineering and Design for Civil Works Projects*, and ER 1110-2-1156, *Engineering and Design Safety of Dams – Policy and Procedures*, along with various other site/structure-specific regulations will be adhered to prior to and during the PED phase (**Sections 6.7 and 6.8**). The MTI and STOF support a northern reservoir to benefit Lake Okeechobee; however, they do not accept the worst-case potential for a dam breach and request mitigation of any potential flooding that would occur on their lands.

C.2.21.16 EJ Cultural Practices – Access to Sacred/Ceremonial Sites

The concern is that access to sacred/ceremonial sites will be impacted by the alternatives. At this time, the majority of Project lands are under private ownership and access may currently be restricted. Cultural resource surveys and evaluations were conducted in previously un-surveyed areas that have a high potential for containing historic properties. A determination of no adverse effect to historic resources was made and completion of consultation will be documented in the ROD (see **Section C.2.22**).

C.2.21.17 EJ Cultural Practices – Hunting and Fishing Impacts

The concern is that traditional hunting and fishing grounds will be impacted by the alternatives. Aboveground storage features will reduce habitat for upland species. All alternatives will reduce upland game species on the proposed reservoir land, representing a potential loss to hunting if there is current access to the property; however, the land is private, used for agriculture, and probably not open to the public for hunting. There is a potential increase to hunting on surrounding properties (if open to the public for hunting) if upland species are relocating to different areas due to habitat loss in the array of alternative site footprints. All alternatives have the potential to increase fishing due to increased access to aboveground storage sites. All alternatives have the potential to negatively impact fishing due to impingement of larval fish; however, this impact can be mitigated by location of pump stations, distance from Lake Okeechobee and the Kissimmee River, operations, and installment of screens.

C.2.21.18 EJ Climate

The climate change analysis determined that climate change is expected to be similar in the FWO (No Action Alternative) and the alternatives. The implementation of any of the alternatives would have a short-term, regionally negligible, and less-than-significant effect on climate within the Study Area (**Section C.2.1**); therefore, no disproportionate and adverse climate-related impacts would be expected on disadvantaged, lower-income communities in the Study Area identified by the CEJST.

C.2.21.19 Summary of EJ Effects and Determination

The alternatives would provide benefits to quality of life by improving Lake Okeechobee ecology, improving the estuarine environment, and contributing to hydrological improvements and recreational and subsistence improvements in the historic Everglades. The estuarine habitat improvements would benefit fish and wildlife species abundance, recreational and subsistence fishing/hunting, as well as aesthetic value. The alternatives would provide new recreational opportunities such as hiking, fishing, boating, and kayaking at the LOCAR, and improve recreation at Lake Okeechobee because of reductions in high and low water stages in the lake. The alternatives would provide socioeconomic benefits by creating job opportunities, with the potential to target and train local residents for these positions through coordination with local employment agencies and schools.

Several EJ communities were identified in the Study Area as having a potential to be affected. Low-income communities located in Glades, Highlands, and Okeechobee counties in the Study Area, including census tracts adjacent to the Project Area, have income levels notably lower than state and national averages and poverty rates that are higher than the state and national averages. People-of-color communities in the Study Area that could be affected by the project are the STOF Brighton Reservation in Glades County which represents Tribal National lands, and a community southwest of the proposed reservoir site in census tract 9617.02 in Highlands County where almost half the population is of Hispanic or Latino origin.

Based on the above analysis, no disproportionate and adverse impacts or benefits are imparted upon the STOF, people-of-color communities, and/or lower-income communities. Alternative 1 would not substantially increase climate change risks, GHG emissions, or result in a substantial social cost of carbon (see **Section C.2.14**). Any remaining minimal impacts will be further avoided, minimized, and/or mitigated, as described in the resource sections.

C.2.22 Cultural Resources

Alternatives 1, 2, and 3 would adversely affect historic properties. However, the Recommended Plan would have no adverse effect to historic properties and cultural resources. The Study Area has been impacted by human agricultural activities for over 100 years, and a review of the Florida Master Site Files (FMSF) indicates that there are previously recorded cultural resource sites and resource groups within the vicinity of the Project Area. However, the Project Area, commonly known Basinger Tract (approximately 43,700 ac) all in Highlands County, has not been subjected to a systematic archaeological assessment. Therefore, SFWMD conducted a cultural resource assessment survey (CRAS) to evaluate cultural resources and determine effects of the undertaking on historic properties prior to completion of the SFWMD Section 203 Study. For this project, the area of potential effect (APE) for cultural resources covers the Project Area but also the surrounding landscape and viewshed. Results from the CRAS have determined that the Recommended Plan would avoid historic properties.

The Corps made a determination of no adverse effect for cultural and historic resources for the Recommended Plan; completion of consultation will be documented in the ROD.

The evaluation of effects to cultural resources was based on a review of the following significance thresholds. These thresholds were used in determining whether the alternatives would result in a significant impact to historic properties or cultural resources. An impact is considered significant if implementation of a component of an Alternative would result in any of the following when compared to FWO:

- Result in a change in the significance or NRHP-eligibility of a historical property, including but not limited to any contributing elements.
- Disturb any human remains, including but not limited to those outside of formal cemeteries.
- Disturb memorials determined to hold public significance regardless of age.
- Result in adverse changes to sites identified through consultation with Native American Tribes as having cultural significance.

For this document, the use of the term "cultural resources" includes significant historic properties that are determined eligible or potentially eligible for NRHP listing and culturally significant sites.

Further, the Jacksonville District has implemented a Burial Resources Agreement (BRA) with the Seminole Tribe of Florida which serves as the basis for consultation regarding the presence of burial resources and sets forth procedures that will ensure the culturally sensitive treatment of burial resources pursuant to the Corps Trust Responsibility. The 2008 CERP Policy on Human Remains also applies to the current study and is only superseded by the BRA for consultation regarding burial resources with the STOF.

C.2.22.1 Comparison of Proposed Action Alternatives and Future Without Project Conditions

C.2.23 The Corps determined the Recommended Plan will have no adverse effect to historic properties. The Corps provided the final cultural resources assessment survey report to the State Historic Preservation Officer and federally recognized Tribes on January 10, 2024 with a letter documenting the determination of no adverse effect to historic properties requesting comment on the determination. Completion of consultation will be documented in the ROD. Invasive and Exotic Species

All of the alternatives have the potential and likelihood for establishment and spread of non-native invasive and native nuisance species. Proposed restoration activities may affect ecosystem drivers that directly or indirectly influence the invasiveness of non-native species. These factors may affect invasive species positively or negatively, depending on the unique characteristics of individual species and the environmental conditions for a given biological invasion (Doren et al. 2009). For example, shortened surface water drawdowns may reduce the recolonization rates of melaleuca in marshes while increasing habitat suitability for Old World climbing fern in other areas. Many of the areas where alternatives are proposed are likely inhabited by non-native invasive and native nuisance species. Construction of LOCAR has the potential to spread the existing non-native invasive and native nuisance species onsite as well as introduce new invasive species via contaminated equipment. Disturbed areas resulting from construction are likely to become established with non-native invasive and native nuisance species. New flows created by operations may serve as vectors to spread invasive and native nuisance species into new areas. The large number of existing and potential invasive plant and animal species and the often-incomplete knowledge of invasive mechanisms for each species create moderate to high uncertainty in this evaluation. Long-term monitoring in an adaptive management framework is critical to ensure efficient management of the most threatening non-native invasive species in the restoration footprint.

C.2.23.1 Lake Okeechobee Watershed

All the alternatives have the potential and likelihood for increasing or decreasing the establishment and spread of non-native and native nuisance species. The establishment of deep-water reservoirs could potentially decrease terrestrial invasive species present; however, the addition of the reservoirs will likely increase emergent and/or submersed non-native and potentially native nuisance species such as cattail. In addition, new flows created by the connecting the features could serve as pathways for new plant and animal non-native invasive species introductions.

C.2.23.2 Lake Okeechobee

All the alternatives have the potential and likelihood for increasing or decreasing the establishment and the spread of non-native and native nuisance species. Slight increases in the duration of very low lake stages could increase the spread of non-native invasive plants species such as torpedograss and melaleuca, and native nuisance species such as saltbush, willow, and wax myrtle at high elevations. Reduced duration of higher lake stages may decrease the spread of some littoral zone non-native invasive species such as water lettuce and water hyacinth, and native nuisance species such as cattail. Long-term monitoring and employing an adaptive management plan will help enable management of the non-native invasive and native nuisance species in the littoral zone.

C.2.23.3 Northern Estuaries

All of the alternatives would reduce freshwater flows from Lake Okeechobee to the Northern Estuaries, allowing slightly higher salinity levels to persist in the estuaries. The reduced freshwater outflows are not expected to have an impact on non-native invasive or native nuisance species. Existing invasive species under active management are expected to persist at baseline levels if current funding levels are sustained (e.g., melaleuca, lionfish). Existing species not under active management or which are ineffectively controlled are expected to increase in abundance and spatial extent (tropical American water grass). New invasions of non-native plant and animal species are expected, but estimates of species number and severity of impacts are conjectural.

C.2.24 Effects of the Final Array on Native Americans

The MTI and the STOF rely upon the Everglades in its natural state to support their cultural, subsistence, and commercial activities. Subsistence activities for members of the both the MTI and the STOF include gathering of materials, hunting, trapping, frogging, and fishing.

C.2.24.0 Miccosukee Tribe of Indians of Florida

None of the alternatives are located within or adjacent to known MTI-owned lands, reservation lands, or Traditional Cultural Properties. Pursuant to Section 106 of the NHPA (54 U.S.C. §306101 et. seq.) and obligations regarding Corps Trust Responsibilities to federally recognized Native American Tribes, consultation with the MTI is detailed in Appendix A of the Final EIS. The MTI are concerned about the disproportionate impacts to both the Indian prairie and the MTI. The MTI prefer shallow-storage alternatives that will do more to improve water quality.

C.2.24.1 Seminole Tribe of Florida

The STOF's Brighton Reservation lands are situated 5 miles south of the LOCAR Project alternatives. Pursuant to Section 106 of the NHPA (54 U.S.C. §306101 et. seq.), obligations regarding Corps Trust Responsibilities to federally recognized Native American Tribes, and in consideration of the Burial Resources Agreement between Corps and the STOF, consultation with the STOF is documented in Appendix A of the Final EIS.

C.2.25 Cumulative Effects

Cumulative effects are defined in 40 CFR § 1508.1(g)(3) as those effects that result from:

"Cumulative effects, which are effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non–Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.".

Cumulative effects for LOCAR were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ). The primary goal of cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions. The following summarizes past, present, and projected Corps efforts that cumulatively affect the regional environment of South Florida (**Table C.2-18**). In addition, there are efforts underway by other federal, state, and local agencies, as well as non-governmental organizations, which are too numerous to mention, that are all working towards similar restoration goals.

Table C.2-19 shows the net cumulative effects of the various resources which are directly or indirectly impacted. LOCAR is expected to contribute to a net beneficial cumulative impact on the regional ecosystem.

Table C.2-18. Past, Present, and Reasonably Foreseeable Actions and Plans Affecting the Project Area.

Component	Past Actions/Authorized Plans	Current Actions and Operating Plans	Reasonably Foreseeable Future Actions and Plans
Status of Non-CERP Projects	• C&SF Project (1948) • Everglades National Park (ENP) Protection and Expansion Act (1989) • Modified Waters Delivery (MWD) GDM and Final EIS (1992) • C-111 South Dade General Reevaluation Report (GRR) (1994)	• MWD 8.5 Square Mile Area GRR (2000) • MWD Tamiami Trail Modifications Limited Reevaluation Report (2008) • C&SF C-51 West End Flood Control Project • Kissimmee River Restoration Project • Seepage Barrier near the L-31 N Levee (Miami-Dade Limestone Products Association) • Tamiami Trail Modifications Next Steps Project • SFWMD Florida Bay Initiatives • C-111 South Dade Project (Contracts 8, 8A, and 9)	• The state of Florida has water quality programs like BMAPs that are intended to improve water quality • MWD Closeout • Natural Resources Conservation Service (NRCS) Wetland Reserve Projects • State Dispersed Water Projects
Operations Plan for Lake Okeechobee, Water Conservation Area 3A, ENP and the SDCS	• Water Supply and Environment (WSE) Lake Okeechobee Regulation Schedule (2000) • Interim Operational Plan 2002 to Present	• Lake Okeechobee Regulation Schedule (2008 LORS) • SFWMD Lower East Coast (LEC) Regional Water Supply Plan • Everglades Restoration Transition Plan (ERTP) October 2012 to present; deviation includes Increment 1 and Increment 1.1 and 1.2 and 2.0 Operational Strategies • Herbert Hoover Dike Dam Safety Modification Study (HHD DSMS) risk reduction measures (2011 through 2025)	• 2008 LORS to be replaced by Lake Okeechobee System Operating Manual (LOSOM) of HHD rehabilitation • SFWMD periodically revises the LEC Regional Water Supply Interim Plan • Combined Operating Plan which includes MWD and C-111 components

Component	Past Actions/Authorized Plans	Current Actions and Operating Plans	Reasonably Foreseeable Future Actions and Plans
CERP Projects	•	• Congressional Authorization Received: • Broward County Water Preserve Areas Project C-9 Impoundment and Seepage Management Area • Caloosahatchee River (C-43) West Basin Storage Reservoir • Central Everglades Planning Project (North Phase) and (New Water Phase) • Congressional Authorization Received and Construction in Progress: • Indian River Lagoon-South Project • Picayune Strand Restoration Project • Site 1 Impoundment Project • Biscayne Bay Coastal Wetlands Project • C-111 Spreader Canal Western Project (operated by SFWMD) • Broward County Water Preserve Areas Project C-11 Impoundment • CEPP (South Phase), including USDOI removal of portions of the old Tamiami Trail roadway and SFWMD construction of the increased S-333 structure	• Future CERP Projects (Lake Okeechobee Watershed Restoration Project, Western Everglades Restoration Project) • CERP LORS (Component F) upon completion of north and south of lake storage features • Everglades Agricultural Area Storage Reservoir and Stormwater Treatment Area •

1 **Table C.2-19. Summary of Cumulative Effects.**

Condition	Cumulative Effects
Hydrology	
Past Actions	Flood and water control projects have greatly altered the natural hydrology.
Present Actions	Federal and state agencies are coordinating on and implementing projects to improve hydrology.
Proposed Action	Implement Recommended Plan in to realize additional reductions in high flow events from Lake Okeechobee to the Northern Estuaries. Improvement in the timing and distributions of flows into Lake Okeechobee. Reductions in high flow events from Lake Okeechobee to the Northern Estuaries. Rehydrate previously drained areas. Major beneficial hydrologic effects are anticipated within the Lake Okeechobee watershed through storing water north of Lake Okeechobee.
Future Actions	Additional CERP projects propose to restore hydrology to more natural conditions (e.g., Western Everglades Restoration Project and Loxahatchee River Watershed Restoration Project). Future refinements to water control manuals such as the Combined Operational Plan, Kissimmee River Headwaters, and future updates to the LORS would further improve hydrology within the Northern Estuaries and Greater Everglades.
Cumulative Effect	Although it is unlikely that natural hydrologic conditions would be fully restored to pre-drainage conditions, hydrology would improve. CERP is expected to improve the quantity, quality, timing, and distribution of freshwater flow.
Threatened and Endangered Species	
Past Actions	Water management practices and urbanization resulted in the degradation of existing habitat function and direct habitat loss, leading to negative population trends of threatened and endangered species.
Present Actions	Ongoing efforts have been made by federal and state agencies to implement projects to improve hydrology within the Study Area, thus improving habitat for some threatened and endangered species.
Proposed Action	Implement Recommended Plan to provide more habitat and foraging opportunities for the Everglades snail kite, Florida manatee, Florida panther, and the wood stork.
Future Actions	Construction of Aquifer Storage and Recovery (ASR) wells and/or restoration of wetlands along the Kissimmee River that were proposed as part of the Lake Okeechobee Watershed Restoration Project (LOWRP) would help to maintain T&E species (e.g. snail kite) within the Study Area, if implemented.
Cumulative Effect	Habitat improvement, monitoring, and management of threatened and endangered species are anticipated to allow populations to be maintained. Improvement of degraded populations is expected to be facilitated by the restoration and enhancement of suitable habitat through efforts to restore more natural hydrologic conditions within the Study Area.
Fish and Wildlife Resources	
Past Actions	Water management practices resulted in aquatic vegetation community changes and a resultant disruption of aquatic productivity and function that has had repercussions throughout the food web, including effects on wading birds, large predatory fishes, reptiles, and mammals.
Present Actions	Ongoing efforts are being made by federal and state agencies to implement projects to improve hydrology within the Study Area to restore habitat conditions for fish and wildlife resources.
Proposed Action	The effects of converting pasture to an aboveground reservoir would be negligible to fish and wildlife resources. A reservoir would increase the spatial extent of suitable habitat for

Condition	Cumulative Effects
	several fish and wildlife resources at the expense of upland species. Increases in forage prey availability (crayfish, other invertebrates, and fish) would directly benefit aquatic amphibian, reptile, small mammal, and wading bird species. Nesting and foraging activities of resident wading bird species are anticipated to improve. Although upland species occurring within the Project Area are adapted to the naturally fluctuating water levels, there is an increased potential that species currently using upland habitat may be negatively affected. There are expected beneficial effects to fish and wildlife resources within Lake Okeechobee due to increased time within the preferred stage envelope. Reductions in the number of freshwater flows to the Northern Estuaries are anticipated to improve suitable habitat for key indicator species, such as oysters.
Future Actions	Construction of Aquifer Storage and Recovery (ASR) wells and/or restoration of wetlands along the Kissimmee River that were proposed as part of the Lake Okeechobee Watershed Restoration Project (LOWRP) would benefit or help to maintain T&E species (e.g. snail kite) within the Study Area, if implemented. It would also help to improve water levels within Lake Okeechobee, and restore hydroperiods and some flow to riparian wetlands along the Kissimmee River, if implemented. Some level of improvement to fish and wildlife resources would be expected to occur as a result of implementation of projects with the capability of improving the timing, quantity, quality, and distribution of freshwater flow to the Study Area. Hydrologic restoration planned as part of CERP will further improve fish and wildlife habitat.
Cumulative Effect	Habitat improvement efforts are anticipated to benefit fish and wildlife resources.
Vegetation and Wildlife	
Past Actions	Drainage of Florida's interior wetlands, conversion of wetlands to agriculture, and urban development reduced the spatial extent and quality of wetland resources.
Present Actions	State and federal regulatory agencies are taking steps to reduce wetland losses.
Proposed Action	Moderate beneficial effects to vegetation within Lake Okeechobee are anticipated by reductions in frequency and duration of high lake stages. Reductions in the number of high flow events to the Northern Estuaries are anticipated to improve conditions for estuarine SAV.
Future Actions	While the spatial extent of natural plant communities in the Project footprint will be devoid of vegetation, other projects to restore the Kissimmee River and create wetland habitat in areas surrounding the river will provide quality vegetative communities where they currently do not exist.
Cumulative Effect	While the spatial extent of natural plant communities will not be restored to historic proportions, the quality of vegetative communities will be improved.
Cultural Resources	
Past Actions	Flood and water control projects, conversion of wetlands into agriculture and urban development had adverse unmitigated effects to cultural resources, either directly or indirectly.
Present Actions	State and federal agencies are making efforts to conduct cultural resource investigations near the project area, thereby avoiding or minimizing adverse effects to cultural resources.
Proposed Action	No adverse effects to cultural resources, or historic properties, would be expected from the Preferred Alternative based on the results of a cultural resources survey. Preferred Alternative
Future Actions	Continued improvement to hydroperiods and extreme water level events in Lake Okeechobee could stabilize the environment and prevent impacts to cultural resources surrounding Lake Okeechobee. Transferring significant cultural sites within the Project

Condition	Cumulative Effects
	Area from private ownership into public ownership may assist in protecting sites from impacts from agriculture and other anthropogenic activities.
Cumulative Effect	As the Project is not adversely affecting cultural resources, cumulative effects to cultural resources are not anticipated.
Water Quality	
Past Actions	Water quality has been degraded by urban, suburban, commercial, industrial, recreational, and agricultural development in addition to channelization (such as Kissimmee River) and drainage within the Study Area and upstream.
Present Actions	Efforts to improve water quality are ongoing. The state of Florida has adopted a TMDL for Lake Okeechobee and the Lake Okeechobee Watershed. To achieve the water quality improvements necessary to meet the TMDL in the lake and watershed, the Florida legislature established the Northern Everglades and Estuaries Protection Program, which directed the FDEP to develop and implement water quality improvement plans called Basin Management Action Plans (BMAPs) that provided milestones and management measures necessary to meet the TMDL within a measured period.
Proposed Action	The Recommended Plan would not be expected to adversely affect water quality. Results from a simple phosphorus load analysis showed slightly reduced phosphorus loading of less than 1 percent compared to the FWO project condition, predominantly due settling of particulate matter from the Lake in the reservoir. Additionally, the current and proposed state actions, including the adoption of TMDLs and the Lake Okeechobee BMAP, are anticipated to improve water quality to further meet hydrologic restoration objectives.
Future Actions	Actions by the State of Florida would decrease nutrient concentration and loadings to the project area.
Cumulative Effect	While anthropogenic effects on water quality are unlikely to be eliminated, water quality would be expected to slowly improve over existing and recent past conditions. During detailed planning and design, the Corps and SFWMD are committed to ensuring that the Project implementation would not result in water quality degradation.
Water Supply / Flood Control	
Past Actions	Water supply and flood control for agricultural and urban users have benefited from construction and operation of the C&SF Project.
Present Actions	Availability of water from Lake Okeechobee for agricultural users was diminished through implementation of 2008 LORS. The SFWMD has implemented Restricted Allocation Area Rules to cap allocations to existing legal users within the LOSA and Indian Prairie Basin.
Proposed Action	Implementation of the Project would be expected to benefit existing legal users of water supplies within the LOSA.
Future Actions	Future supplies would not change unless additional CERP storage features were implemented to increase water availability.
Cumulative Effect	While effects on water supplies are unlikely to fully restore the level of service experienced prior to implementation of 2008 LORS, water supply availability would improve as additional storage is constructed.

APE–area of potential effect; C&SF Project–Central and Southern Florida Project; CERP–Comprehensive Everglades Restoration Plan; CFR; Code of Federal Regulations; Corps–U.S. Army Corps of Engineers; FDEP–Florida Department of Environmental Protection; FWO–Future Without Project; LORS–Lake Okeechobee Regulation Schedule; LOSA–Lake Okeechobee Service Area; Northern Estuaries–Caloosahatchee and St. Lucie Estuaries; PED–preconstruction engineering and design; Project–Lake Okeechobee Storage Reservoir Section 203 Study; SAV–submerged aquatic vegetation; SFWMD–South Florida Water Management District; Study Area–Project Area plus Lake Okeechobee and the Northern Estuaries; TMDL–Total Maximum Daily Load

Prior to drainage and compartmentalization, the Everglades were a shallow wetland conveying water from Lake Okeechobee to the southern coast of Florida. The Everglades Drainage District, encompassing 7,150 square miles, was created in 1907 by Florida Governor Napoleon Bonaparte Broward for the purpose of drainage and reclamation of the Everglades (Light and Dineen 1994). In the early 1900s, the Everglades Drainage District constructed several canals that impacted Lake Okeechobee and the Greater Everglades. By 1917, the West Palm Beach, Hillsboro, North New River, and Miami canals had been constructed (Allison et al. 1948). By 1931, the outlet from Lake Okeechobee to the Caloosahatchee River was improved, and the completion of the St. Lucie Canal east to the Atlantic Ocean provided another way of controlling lake levels. The Bolles and Cross Canals became connectors to the four major canals south of Lake Okeechobee bringing the total miles of canal excavated to 440 (Light and Dineen 1994). The Everglades Drainage District also constructed 47 miles of levees around the southern rim of Lake Okeechobee during this time (Allison et al. 1948). Within a similar timeframe (1915 to 1928), the construction of Tamiami Trail was completed, which linked Miami with Naples on the west coast. Hurricanes in 1926 and 1928 shifted attention from Everglades drainage to controlling flooding around Lake Okeechobee. In 1930, the Corps became a major participant with the state (Okeechobee Flood Control District) in controlling flooding around Lake Okeechobee. Florida agreed to share a portion of the costs to increase flows from the lake, improve canal works, and reconstruct and enlarge the levees around it (Light and Dineen 1994). The effect of levees on the agricultural area south of Lake Okeechobee was dramatic and sugarcane production was doubled in 10 years between 1931 and 1941. Drainage of the Everglades and the linkage of the east and west coast promoted urban growth in South Florida and the population escalated from 22,961 in 1900 to 228,454 by 1930 (Dietrich 1978). During the 1930s and into the 1940s, construction was abandoned, and maintenance ceased on Everglades Drainage District works (Light and Dineen 1994).

Although modifications to Lake Okeechobee and the Everglades began in the early 1900s, the greatest influence on the alteration of flow was the Central and Southern (C&SF) Flood Control project, which was originally authorized by Congress in 1948. The C&SF Flood Control project was designed to lower water levels east of the eastern protective levee by 4 to 5 ft (Light and Dineen 1994). Increased flood protection coupled with lowering the water table east of the levee had a dramatic effect on urbanization and development and acted as a catalyst for a population explosion in South Florida. Between 1952 and 1954 the eastern perimeter levee along the WCAs was constructed from Palm Beach to Dade County to stop sheet flow from the Everglades toward the urbanizing eastern coastal areas (Light and Dineen 1994). Between 1954 and 1959 additional levees (L-1–L-7) were constructed to partition the EAA from the remainder of the Everglades, and the old Everglades Drainage District canals (West Palm Beach, Hillsboro, North New River, and Miami) were deepened within the EAA to provide better flood conveyance from the agricultural area into the WCAs (Light and Dineen 1994).

Between 1960 to 1963, substantial portions of the C&SF Flood Control project were completed. Construction of the levees surrounding WCA 3 was completed by 1963 with the L-67A levee dividing WCA 3 into two compartments, WCA 3A and WCA 3B (Light and Dineen 1994). The L-67A levee (completed 1962) and the parallel L-67C levee (completed 1966) were originally constructed for several reasons, including as a step-down system to reduce seepage to the east to allow for urban and agricultural developments in Miami-Dade County, and to increase storage of water in WCA 3A to provide water supply to an expanding urban population to the east. S-151 and S-31 structures were also constructed during this time. These two structures improved the release capacity of the Miami Canal to coastal communities, further exacerbating the unnatural drainage of northern WCA 3A. In an attempt to remedy excessive drainage caused by the Miami Canal, two structures, S-339 and S-340, were built across the Miami Canal in 1980 to block water from flowing directly down the canal, except at times of extreme high water or when increased conveyance capacity is needed to deliver water for the ENP and/or the LEC. Upstream from each structure, water was expected to flow laterally from the canal into the marsh through 100-ft gaps that had been left at 500-ft intervals along the Miami Canal side cast spoil material. In combination with the northern levees of WCA 3A (L-4 and L-5), the Miami Canal has substantially impacted historical sheetflow and natural wetland hydroperiods. As a result, during wet periods, the natural capability of WCA 3A to store water is lost and the Miami Canal effectively over-drains the area. These hydrologic changes have increased the frequency of severe peat fires and have also resulted in the loss of the ridge and slough topography that was once characteristic of the area. Northern WCA 3A has become largely dominated by sawgrass, cattail and scattered shrubs and lacks the structural diversity of plant communities seen in central and western WCA 3A.

Completion of the L-29 levee in 1962 led to ponding in the southern portions of WCA 3A. Exacerbating this problem were the major canal systems (i.e., Miami Canal, L-67A) which accelerate the flow of water from north to south within WCA 3A, drying the north while further ponding the south (Zaffke 1983), especially along the L-67A and L-29. As a result of this ponding, extended hydroperiods and increased water depths led to changes in vegetation communities in which wet prairies were displaced by aquatic slough communities (Zaffke 1983; Tanner et al. 1987). In addition, many tree islands within southern WCA 3A were lost due to increased water depths (Craighead 1971), with many of the remaining islands showing signs of stress. Wood and Tanner (1990) documented the trend in southern WCA 3A toward deep water lily dominated sloughs due to impoundment within the southern end of WCA 3A.

Four control structures located along the L-29 were constructed between 1960 and 1963 (S-12A, S-12B, S-12C, and S-12 D). These structures were used to regulate release from WCA 3A to the western part of Shark River Slough (Light and Dineen 1994). Construction of the L-67 Extension levee, extending 8 miles south of Tamiami Trail, was completed in 1967 to facilitate water delivery from WCA 3A to ENP. Completion of the L-67A and L-67C canal and levee system intercepted water that would otherwise flow to WCA 3B. With its impoundment, WCA 3B became isolated from the rest of the Everglades with inflows and outflows limited to rainfall and levee seepage. Within WCA 3B, the ridge and slough landscape has become severely compromised by the virtual elimination of overland sheetflow and has largely turned into a sawgrass monoculture where relatively few sloughs or tree islands remain. Loss of sheetflow to WCA 3B has also accelerated soil loss reducing elevations of the remaining tree islands in WCA 3B and making them vulnerable to high water stages. With the construction of WCA 3A, WCA 3B, and the L-67 Extension Levee, flows to ENP became subject to water supply deficits during the dry season and excesses during the wet season, resulting in a decline in ecological quality.

Among the first congressional actions to offset adverse impacts to ENP by improving the supply and distribution of water, the Flood Control Act of 1968 provided for modifications to the C&SF Project through the implementation of the ENP South Dade Conveyance System (SDCS). Additional congressional actions ensued, including the ENP Protection and Expansion Act of 1989, which expanded ENP to incorporate NESRS and the East Everglades into the Park’s boundary for protection and restoration of the natural hydrologic conditions within ENP. This Act also provided authorization for development of the Modified Water Deliveries (MWD) to ENP project. The goal of the MWD Project was to improve water deliveries into ENP and, to the extent practicable, take steps to restore the natural hydrologic conditions within ENP. The Water Resources Development Act (WRDA) of 2000 established CERP to provide for the restoration, protection, and preservation of the water resources of central and southern Florida, including the Everglades and Florida Bay (Corps 1999).

The CERP contains 68 components that include approximately 217,000 ac of new reservoirs and wetlands-based water treatment areas. A number of operational components have also been identified in CERP and will, in most cases, occur in conjunction with related construction features. The operational features in CERP include: a modified Lake Okeechobee regulation schedule; environmental water supply deliveries to the Caloosahatchee and St. Lucie estuaries; modifications to the regulation schedules for WCAs 2A, 2B, 3A, 3B, and the current rainfall delivery formula for ENP to implement rain-driven operations; modified Holey Land Wildlife Management Area Operation Plan; Modified Rotenberger Wildlife Management Area Operations Plan; a modification for coastal well field operations in the Lower East Coast (LEC); LEC utility water conservation; and operational modifications to the southern portion of L-31 and C-111.

The CERP projects would increase the supply of freshwater for the Everglades and South Florida ecosystem. Large areas within the Study Area would be used to increase water storage resulting from CERP projects for the overall gain and long-term benefit of the regional system. These project features would provide important storage functions and are essential to the overall restoration of the freshwater marshes and the estuaries of the Greater Everglades ecosystem. Project components in the area, especially storage, seepage control, and redirection of point source canal flows to overland flow will restore more natural freshwater flows to the northern and southern estuaries, reduce seepage losses from the Everglades, improve recharge of the Biscayne aquifer, and should result in other beneficial environmental effects.

Construction has begun on first, second, and third generation CERP projects authorized by Congress. All these projects will result in major environmental benefits to the CERP project area, improving the quantity, quality, timing, and delivery of water to the natural system. Further information on the above-mentioned CERP projects assumed to be in the future without Project conditions are provided in **Section 2.5**.

Several other non-CERP projects have also been constructed or are in design. These projects include several that address water quality concerns associated with existing flows to the Everglades Protection Area to achieve water quality standards established for the Everglades. The SFWMD is implementing a technical plan to complete six projects that will create more than 6,500 ac of new STAs and 110,000 ac-ft of additional water storage through construction of FEBs.

The C&SF Project has numerous water management structures consisting of culverts, spillways, and pump stations that have specified operating criteria for managing or regulating water levels for congressionally authorized project purposes. Regulation schedules have been, and will continue to be, designed to balance multiple, and often competing, project purposes and objectives. Managing for better performance of one objective often lessens the effectiveness of performance of competing objectives. For example, for Lake Okeechobee, higher regulation schedules tend to benefit water supply, but may increase the risk to public health and safety and can harm the ecology of the lake. By contrast, lower lake schedules may produce lake levels more desirable for the lake ecology and improved flood protection but reduce water supply potential.

Since April 2008, Lake Okeechobee has been operated in accordance with the 2008 Lake Okeechobee Regulation Schedule (2008 LORS). Prior to the 2008 LORS, Lake Okeechobee operations were managed under the “Water Supply and Environment (WSE) Regulation Schedule” since July 2000. The 2008 LORS operational study was initiated to address high lake levels, high estuarine flows, estuary ecosystem conditions, and lake ecology conditions that occurred during the 2003 to 2005 time period. The study considered the back-to-back, historically significant 2004 and 2005 hurricane seasons’ effects on the recognized structural integrity issues of HHD along with effects to other project purposes. The 2008 LORS was identified to be effective at decreasing the risk to public health and safety, reducing the number of high-volume flows to the estuaries, and providing critical flexibility to perform water-management operations.

The CERP identifies storage north, south, east, and west of Lake Okeechobee that work together to achieve beneficial ecological effects. These storage components are critical to the overall success of the CERP and other CERP components. The combination of these storage features with other CERP components provide synergy in achieving Everglades restoration. The previously authorized projects are components that were identified in the CERP and are being implemented incrementally over time consistent with the Integrated Delivery Schedule, reducing the risks and uncertainties associated with project planning and implementation.

For the LOCAR FWO condition, other CERP and non-CERP projects that improve the condition of Lake Okeechobee that have been authorized, are under construction, or are completed, are assumed to be in place. Perhaps the largest and most important reasonably foreseeable future actions accounted for in the FWO condition is the EAA Storage Reservoir and STA. The EAA Storage Reservoir and STA received authorization in October 2018.

The EAA Storage Reservoir and STA proposes to increase the amount of water storage and treatment in the currently authorized CEPP plan. The CEPP provided the first increment of restoration of the central Everglades by reducing some of the high flows to the Northern Estuaries and providing an average of approximately 210,000 ac-ft per year of additional flow into the central portion of the Everglades. The EAA Storage Reservoir and STA is a 240,000-ac-ft reservoir with multi-purpose operational flexibility, 6,500-acre STA, and conveys improvements that would beneficially affect more than 1.5 million acres in the St. Lucie and Caloosahatchee estuaries, WCA 31, WCA 3B, ENP, and Florida Bay.

The EAA Storage Reservoir and STA would increase CEPP flows to the central portion of the Everglades from an average annual flow of approximately 210,000 ac-ft to 370,000 ac-ft. Like the LOCAR objectives, one of the primary purposes of the EAA Storage Reservoir and STA is to further reduce the number, return frequency, and severity of high-volume flows from Lake Okeechobee, improving salinity and water quality conditions in the Northern Estuaries. High flows lasting more than 60 days in the Caloosahatchee Estuary or more than 42 days in the St. Lucie Estuary have been found to be particularly degrading to the oyster populations. The EAA Storage Reservoir and STA would reduce high flows to the Northern Estuaries lasting more than 60 days to the Caloosahatchee Estuary by 40 percent and would provide a 55 percent reduction in high flows lasting more than 42 days in the St. Lucie Estuary, in addition to the benefits provided by the previously authorized projects. Salinity conditions in the estuaries would also be improved by reducing the number of Lake Okeechobee events that exceed the preferred salinity envelope by 45 percent in the Caloosahatchee Estuary and 39 percent in the St. Lucie Estuary.

The LOCAR Recommended Plan, EAA Storage Reservoir and STA and other authorized projects complement each other to improve conditions in Lake Okeechobee and Northern Estuaries. Proposed operational changes to Lake Okeechobee in the Lake Okeechobee System Operating Manual (LOSOM) would also be expected to improve conditions in the Study Area. LOSOM is not approved and therefore not included in the FWO. A sensitivity analysis was conducted to demonstrate the effect of LOSOM with LOCAR and other authorized projects including the EAA Storage Reservoir and STA. The CERP goal is relative to the Pre-CERP Baseline (PCB) conditions. From an effectiveness standpoint, the Recommended Plan with the EAA Storage Reservoir and STA, as defined above, is very close to achieving the total CERP goal in reducing the volumes of high flows to the Northern Estuaries (**Figure C.2-18**). The CERP goal is met for reduction in number of high flows from Lake Okeechobee to the Northern Estuaries flows when the LOCAR Recommended Plan and EAA Storage Reservoir and STA are combined. Additionally, the two projects meet the CERP goal for lake-weighted improvements of Lake Okeechobee. Effectiveness of the LOCAR Recommended Plan with the EAA Storage Reservoir and STA towards the CERP goal is summarized in **Table C.2-20**.

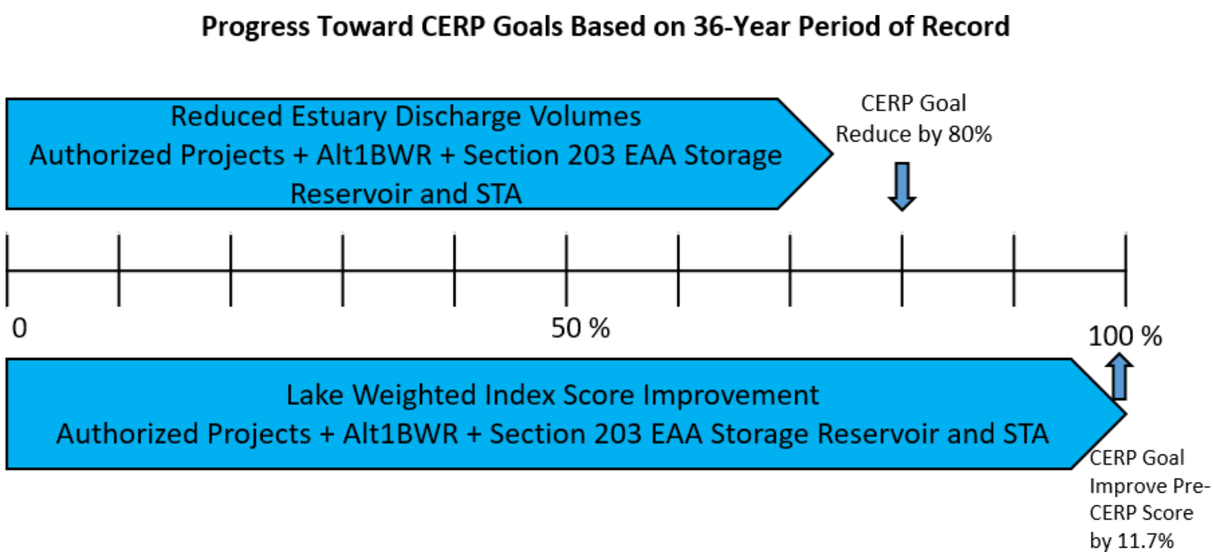


Figure C.2-18. Progress toward meeting CERP goal—Authorized CERP projects, LOCAR Recommended Plan, and EAA Storage Reservoir and STA.

Table C.2-20. Effectiveness of LOCAR Recommended Plan with the EAA Storage Reservoir and STA.

Metric (36-year POR)*	CERP Goal	LOCAR Recommended Plan (Alternative 1)	LOCAR Recommended Plan + EAA Storage Reservoir And STA
Reduction in number of high-flow estuary events	81%	67% (83% of CERP goal)	81% (100% of CERP goal)
Reduction in volumes from Lake	80%	57%	73%

Okeechobee to the Northern Estuary Flows		(71% of CERP goal)	(91% of CERP goal)
Lake Okeechobee Index Score (percent improvement)	11.7%	9.2 (79% of CERP goal)	12.6% (100% of CERP goal)

* Based on the 36-year modeled simulation period (1965–2000) available from RECOVER
CERP–Comprehensive Everglades Restoration Plan; EAA–Everglades Agricultural Area; LOWRP–Lake Okeechobee Watershed Restoration Plan; Northern Estuaries–Caloosahatchee and St. Lucie Estuaries; POR–period of reference; STA–stormwater treatment area

This combination of the authorized projects, the EAA Storage Reservoir and STA, and the LOCAR Recommended Plan would be a significant accomplishment in reducing the volume of flows to the Northern Estuaries. In addition to these improvements, three general conclusions can be drawn from this analysis:

1. The LOCAR Recommended Plan and the EAA Storage Reservoir and STA benefits are complementary. Although parallel planning efforts may illustrate similar trends between the two efforts, the combined effect of the projects is additive, not coincident.
2. The combination of the LOCAR Recommended Plan and the EAA Storage Reservoir and STA project can come close to or fully achieve the CERP goal in the Northern Estuaries.
3. The CERP goal is met for ecological Lake Okeechobee improvements and in the reduction of number of high-flow estuary events.

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