DRAFT
LAKE APOPKA NORTH SHORE
LAND MANAGEMENT PLAN

LAKE AND ORANGE COUNTIES, FLORIDA

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT

JANUARY 14, 2025


Northwest Florida
Water Management District
Suwannee River
Water Management
District
St. Johns
River Water
Management
District
Southwest
Florida Water
Management
District
South Florida
Water Management
District

EXECUTIVE SUMMARY

MANAGEMENT AREA SIZE: 19,726 acres

DATE OF ACQUISITION: Acquisition of parcels within the Lake Apopka North Shore (North Shore or Property) began in October 1988.

DATE OF PLAN: January 14, 2025
MAJOR BASINS: Ocklawaha River
PLANNING BASINS: Lake Apopka

LOCATION: The North Shore is located in Orange and Lake counties approximately 15 miles northwest of Orlando.

FUNDING SOURCE: The acquisition funding sources for the North Shore include Lake Apopka West-Specific Appropriations, Ad Valorem, Florida Forever, Preservation 2000, USDA Wetland Reserve Program, Lake Apopka North-Specific Appropriations, and Save Our Rivers.

MANAGEMENT PARTNERS: The St. Johns River Water Management District (District) is sole fee owner and lead manager of the Property. Several management partnerships are in place on the Property. The District will pursue additional partnerships over the term of this plan.

VISION STATEMENT: The North Shore will be actively managed as marsh systems for the continued restoration of the water resources of Lake Apopka. The focus of the District's ongoing efforts on the North Shore are to manage phosphorus (P), water availability, flood protection, and residual organochlorine pesticide (OCP) exposure. North Shore marshes will be managed to provide important habitat for wildlife including numerous species of migratory and resident birds. The uplands will be managed to support a suite of Florida endemics and numerous listed species, including several rare plants. Recreational opportunities will continue to be developed with the goal of providing public access that is compatible with resource management and restoration objectives.

RESOURCE PROTECTION AND MANAGEMENT:

- **WATER RESOURCES** – Water resource management is central to meeting performance measures for all other categories of ecological management on the North Shore. Water resources will be managed to balance minimizing phosphorus loads to Lake Apopka, while providing hydrologic conditions on the Property that are conducive to establishing healthy and diverse functioning marsh systems.
- **FOREST AND ECOLOGICAL MANAGEMENT AND RESTORATION** – Ecological management at the North Shore is primarily focused on improving marsh system health and diversity. Uplands will be managed to control invasive species and provide habitat for rare and endemic species.

- **FIRE MANAGEMENT** – The application of prescribed fire will occur in accordance with the annual burn plan and the North Shore Fire Management Plan.
- **FLORA AND FAUNA** – The North Shore provides habitat for numerous wildlife species, including a long list of avian taxa and listed species such as the gopher tortoise (*Gopherus polyphemus*) and wood stork (*Mycteria americana*). Invasive and nuisance plant management is a significant component of ecological management on the Property. The District regularly monitors for the presence of invasive and nuisance plants and animals and implements appropriate management actions as needed.
- **CULTURAL AND HISTORICAL RESOURCES** – A review of the Department of State Division of Historical Resources Master Site File indicates 14 documented sites within the Property.

LAND USE MANAGEMENT:

- **ACCESS** – Currently the Property is host to 100 miles of road, 80 gates, six public entrances/trailheads, five parking areas, five picnic areas, 20 kiosks, four observation towers, six portable restrooms, and two boat ramps.
- **RECREATION** – The Property is open to the public for hiking, bicycling, horseback riding, and wildlife viewing. The District operates the Lake Apopka Wildlife Drive, which allows visitors to drive an 11-mile one-way route through the Property on Fridays, weekends, and federal holidays. The District intends to develop a non-motorized vessel launch to provide public access to the West Marsh area of the Property. The Florida Fish and Wildlife Conservation Commission (FWC) is currently evaluating potential waterfowl hunting and/or fishing opportunities within West Marsh cells D–H.
- **SECURITY** – Maintenance of fence lines, signage, gates, and locks is conducted by the District. District staff coordinate with FWC and local law enforcement for security needs.

ADMINISTRATION:

- **REAL ESTATE ADMINISTRATION** – Approximately 501 acres have been identified as potential acquisitions adjacent to the North Shore. In addition, the District may consider purchasing parcels near the Property that become available and will aid in the conservation of water resources within the Lake Apopka basin.
- **COOPERATIVE AND SPECIAL USE AGREEMENTS, LEASES, AND EASEMENTS** – Portions of the North Shore are subject to numerous cooperative agreements, leases, easements, and Special Use Authorizations (SUAs). The District administers a revenue-generating agricultural lease.
- **MANAGEMENT COSTS AND REVENUES** – Management costs at the North Shore were $20,835,985 from 2013–2024 and are projected at $10,957,335 from 2025–2034. Revenues from the agricultural lease, donations, and timber sales were $232,415 from 2013–2024 and are projected at $311,250 from 2025–2034.

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VISION STATEMENT

The Lake Apopka North Shore (North Shore or Property) will be actively managed as marsh systems for the continued restoration of the water resources of Lake Apopka. The focus of the St. Johns River Water Management District's (District) ongoing efforts on the North Shore are to manage phosphorus (P), water availability, flood protection, and residual organochlorine pesticide (OCP) exposure. North Shore marshes will be managed to provide important habitat for fish and wildlife including numerous species of migratory and resident birds. The uplands will be managed to improve important habitat that supports a suite of Florida endemics and numerous listed species, including several rare plants. Recreational opportunities will continue to be developed with the goal of providing public access that is compatible with resource management and restoration objectives.

OVERVIEW

This document provides the goals and strategies for implementation of land management activities at Lake Apopka North Shore through 2034. The District is lead manager of the North Shore. This is an update to the January 2013 District Governing Board-approved land management plan. This land management plan was developed in accordance with Section 373.1391 and Section 373.591, Florida Statutes. Prior to and throughout the development of this plan, District staff consulted with a variety of stakeholders through both formal and informal engagements, including convening a Management Advisory Group (MAG) (Appendix A). Following completion of the draft management plan, the District also held a public meeting to receive input from the public regarding plan content (Appendix B).

The area that is now the North Shore has a long agricultural history. During the 1890s, the Apopka-Beauclair Canal (A-B Canal) was dredged, connecting lakes Apopka and Beauclair, in part to move commerce, including citrus. The construction of the A-B Canal lowered Lake Apopka's water levels by approximately 3 feet. This increased the exposure of the lake's northern floodplain marshes. In the 1940s, the North Shore floodplain was isolated from the lake by the construction of a levee. With the addition of pumps to drain the North Shore, farms began to cultivate the rich organic soils of the drained wetlands. Decades of nutrient-rich discharge from agricultural and other industrial and residential sources created conditions that contributed to intense chronic algal blooms within the lake. These blooms shaded the water column and resulted in a subsequent die-off of extensive submerged aquatic vegetation (SAV) throughout the lake. This SAV was the critical habitat responsible for the lake's world-class bass fishery. Once the SAV disappeared, the fishery collapsed along with the dozens of fish camps and lodges that ringed the lake. The lake became known as the most polluted of Florida lakes (EPA 1979, Hoge et al. 2003, and Friends of Lake Apopka 2024).

Efforts to restore water quality within Lake Apopka have been extensive, including legislative action. The Lake Apopka Restoration Act, passed in 1985, and the Surface Water Improvement and Management (SWIM) Act, passed in 1987, directed that the District develop and implement plans to restore Lake Apopka to Class III water body; suitable for recreation, propagation and maintenance of healthy well-balanced populations of fish and wildlife.

In 1988, the District began acquiring land on the northern shore of Lake Apopka, west of the A-B Canal, to implement the Marsh Flow-Way (MFW) Project, which was a major component of the SWIM restoration plan. In 1996, additional Lake Apopka legislation was adopted, which provided funding and directed the District to purchase the muck farms and their related facilities along the north shore on the east side of the A-B Canal to reduce phosphorus (P) loading to the lake. Acquiring these agricultural properties and beginning to convert these areas to wetlands dramatically reduced the volume of water and associated phosphorus pumped from the farms to Lake Apopka. In 1999, the District completed the purchase of the large muck farms and through 2017 continued acquisitions of small parcels beneath the 70-foot contour line that historically marked the lake's approximate high-water line.

The North Shore project has resulted in the establishment of more than 15,000 acres of managed marsh wetlands on the Property. Along with improving Lake Apopka's water quality, improving the ecological conditions within the Property's marshes is a major focus of management actions on the Property. Since acquisition, the District has conducted numerous activities to improve hydrologic management capacity, reduce invasive/nuisance vegetation coverage, and increase coverage of desirable native vegetation communities. These management actions have been beneficial to the water quality of Lake Apopka and wildlife communities of the North Shore.

The North Shore is also a significant recreational resource—not only for local communities, but also regionally and globally. The Lake Apopka Loop Trail (LALT) and Lake Apopka Wildlife Drive (LAWD) both draw people from around the world to the Property.

LOCATION

The North Shore includes 19,726 acres in Orange and Lake counties within the Lake Apopka Planning Unit of the Ocklawaha River Basin. The Property consists of 80 individual parcels and is located in numerous sections of Township 20 and 21 South, Ranges 26, 27, and 28 East.

The North Shore is located on the northern shore of Lake Apopka, approximately 15 miles northwest of Orlando and 2.5 miles west of the city of Apopka. Winter Garden and the town of Oakland are located on the south shore of the lake. The town of Monteverde is on the west shore and the towns of Ocoee and Groveland are located to the east and west of the lake, respectively. Figure 1 illustrates the location of the North Shore. Figure 2 is a 2017 aerial image of the Property.

REGIONAL SIGNIFICANCE

The North Shore is a significant landscape feature—within a rapidly urbanizing part of central Florida—encompassing much of the historic floodplain marsh and other littoral wetlands along the northern shore of Lake Apopka. The marshes of the North Shore have historically been important habitat to a variety of wetland wildlife species, especially waterbirds. The productivity and expansiveness of these wetlands combined with the Property's network of levee roads provide a unique experience for public recreational users. These unique characteristics coupled with the proximity to a major metropolitan area result in the North Shore being not only a regional but also an internationally renowned recreational resource. Birdwatchers from around the world travel to the Property. With 346 species, the Orange County section of the North Shore

is the second top eBird hotspot in the state of Florida. The Property is also host to significant cycling group rides, training, and events.

Other publicly owned lands within close proximity to the North Shore include the Wekiwa Springs State Park, Lower Wekiva River State Preserve, Rock Springs Run State Reserve, Seminole State Forest, Withlacoochee State Forest, Ferndale Preserve, Oakland Nature Preserve, and Double Run Preserve. Nearby District-managed properties include Sunnyhill Restoration Area as well as Lake Harris, Lake Norris, and Emeralda Marsh Conservation Areas. Figure 3 illustrates the regional significance of the North Shore. These lands provide for the protection of water quality and storage, native plant and wildlife species, and cultural resources, as well as offering numerous natural resource-based recreational opportunities.

Lake Apopka is within the District's Ocklawaha River Basin. It is one of two major sources of water for the Ocklawaha River and the first lake in the Upper Ocklawaha River Basin Chain of Lakes, which includes lakes Beauclair, Dora, Eustis, Harris, Yale, and Griffin. At approximately 48.4 square miles in size, Lake Apopka is the fourth-largest lake in Florida and receives water via spring flow, rainfall, and stormwater runoff.

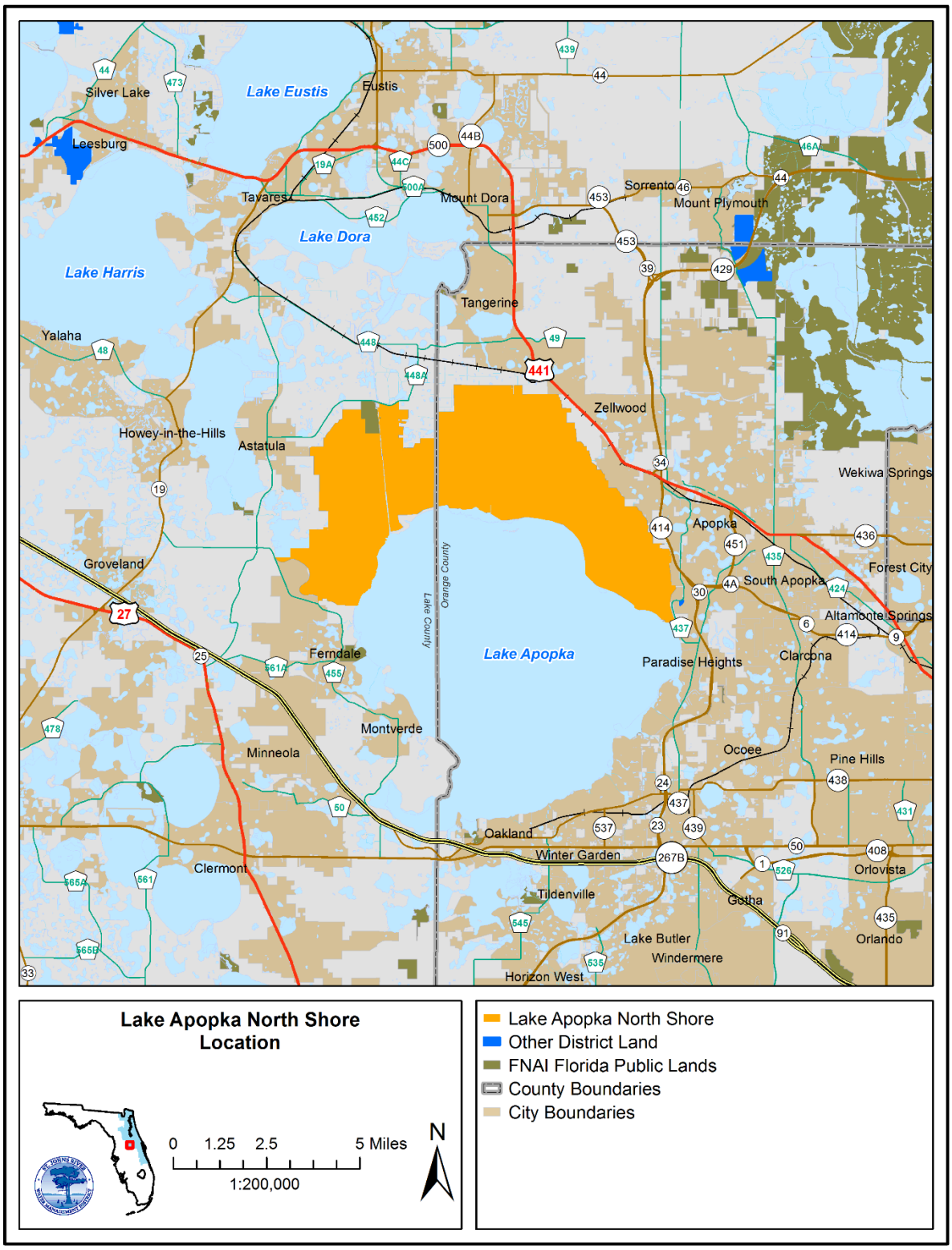


Figure 1: General Location Map

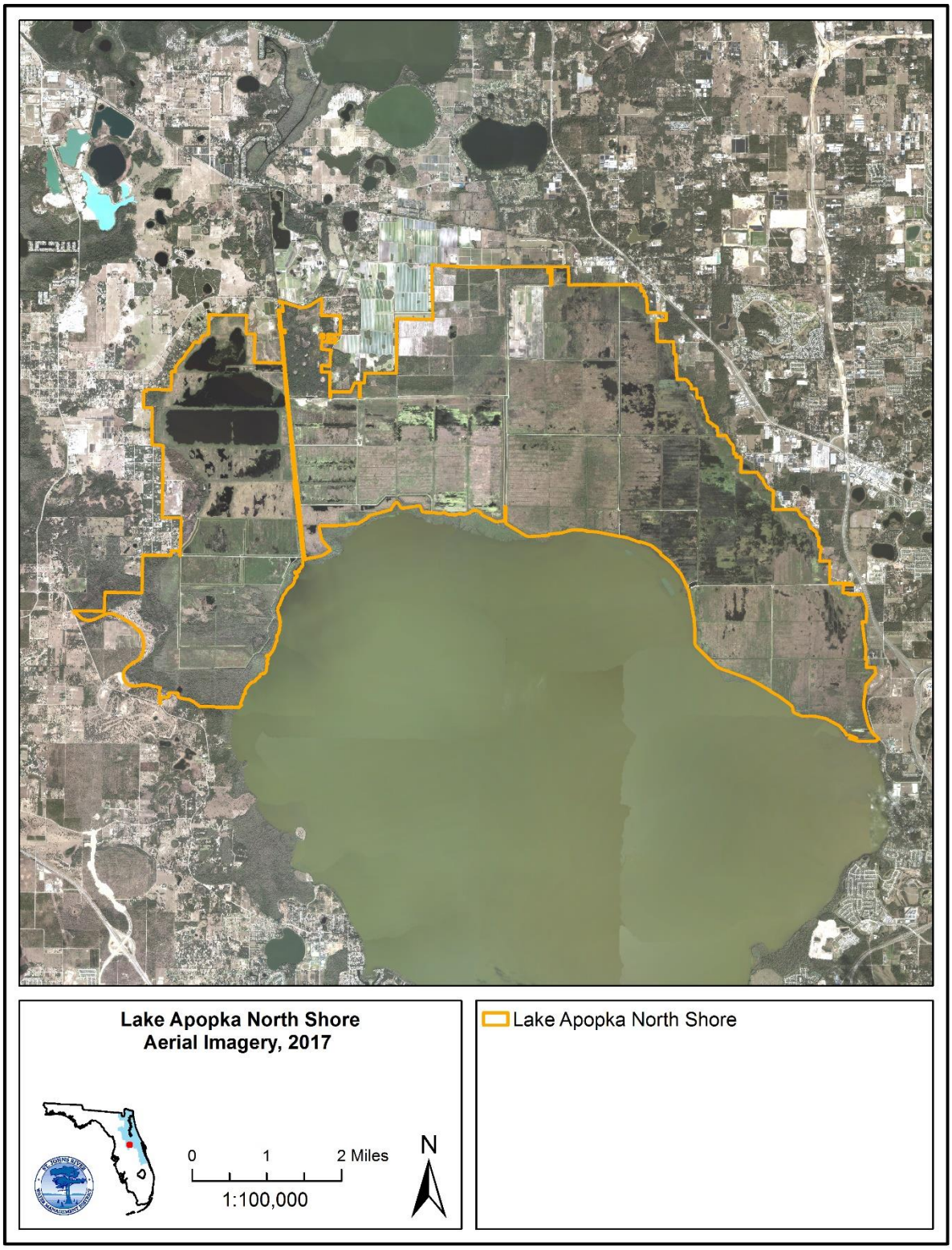


Figure 2: Aerial Imagery Map

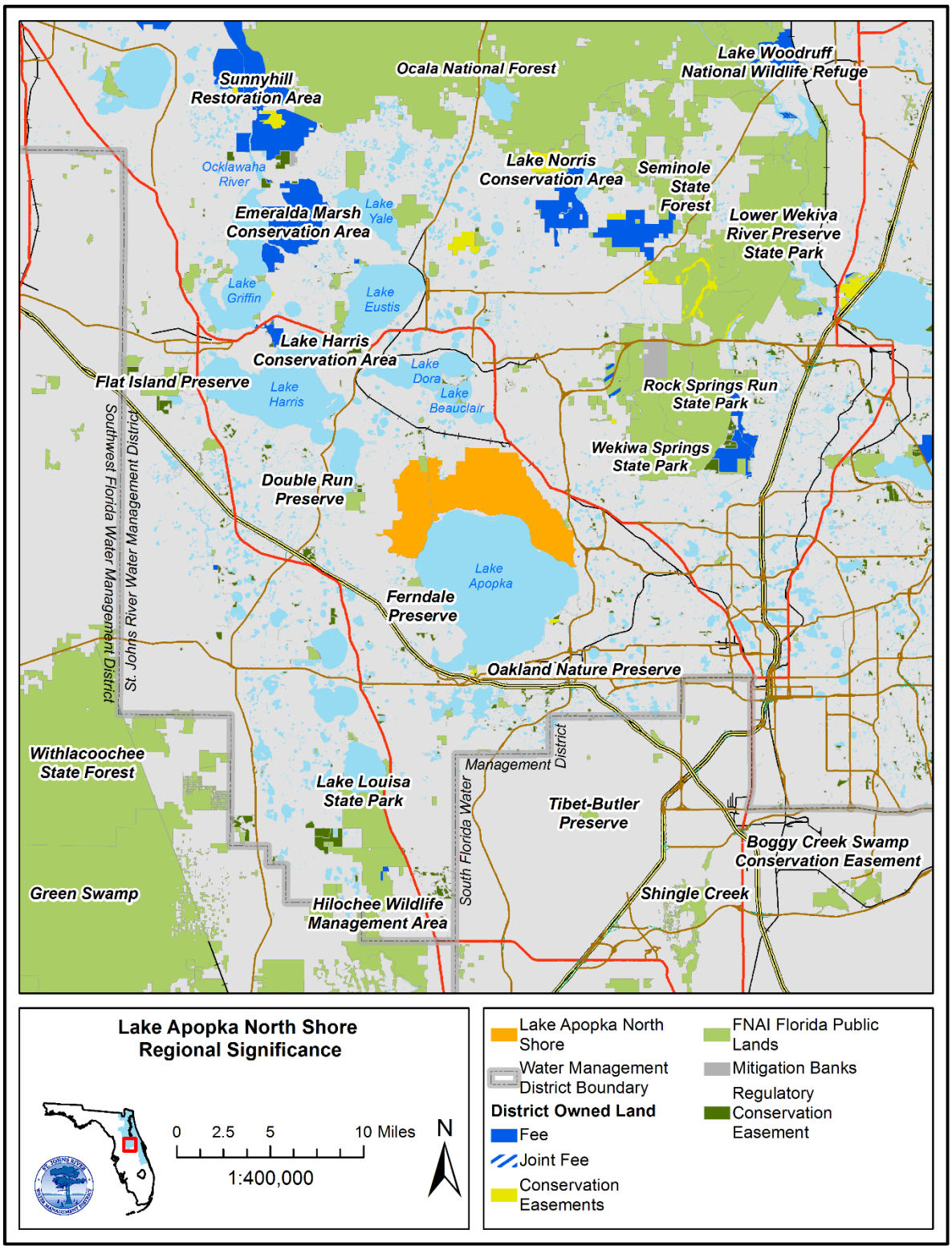


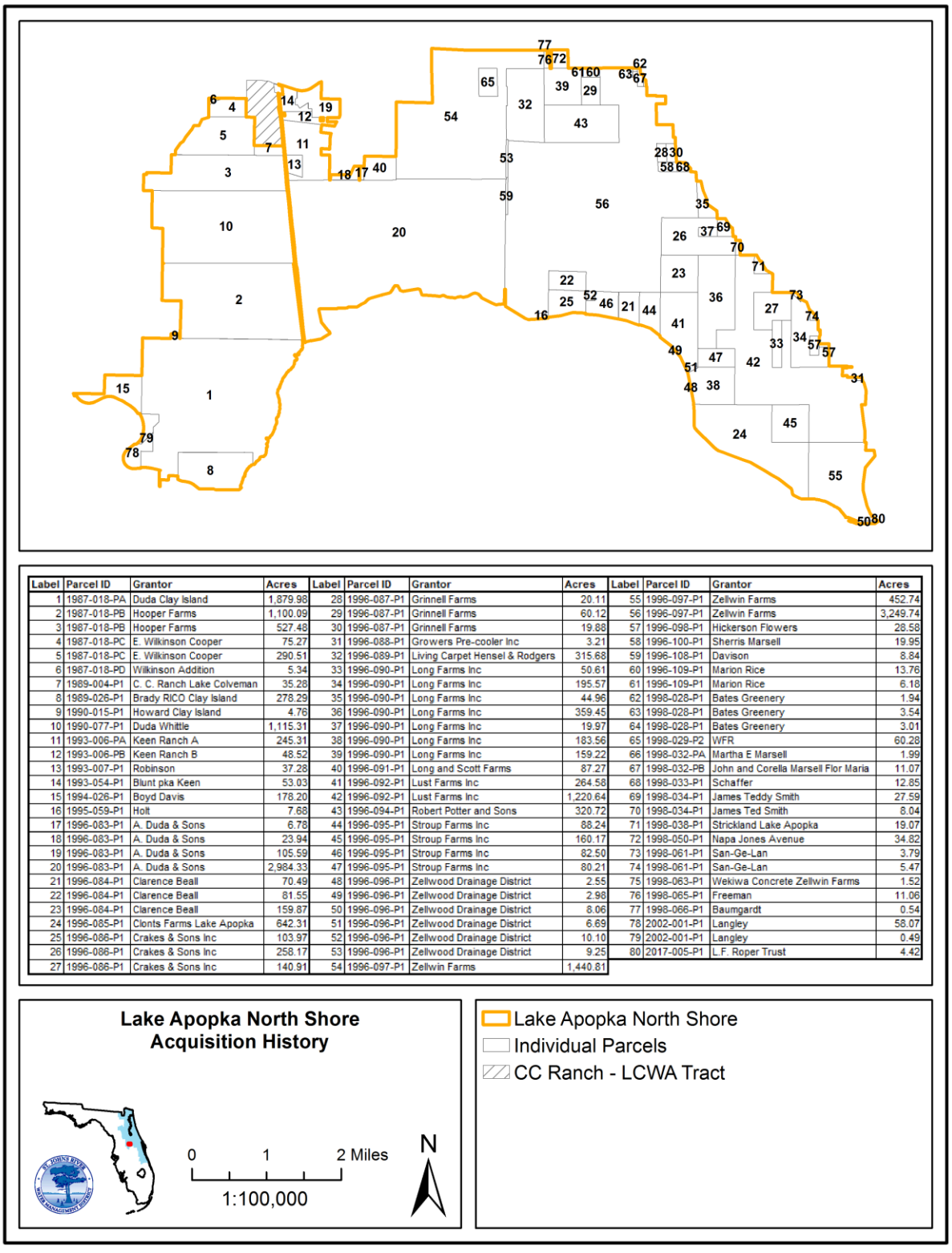
Figure 3: Regional Significance Map

ACQUISITION HISTORY

Acquisition of parcels that comprise the North Shore provide for the protection of important water resources and ecological functions. In 1988, the District began acquiring land on the northern shore of Lake Apopka, west of the A-B Canal, to implement the MFW Project, which was a major component of the Lake Apopka SWIM restoration plan. In 1996, additional Lake Apopka legislation was adopted, which provided funding and directed the District to purchase the farms and their related facilities along the north shore on the east side of the A-B Canal. The District accomplished the acquisition of these farms on the east side of the A-B Canal between 1996–1999. Through 2017, the District continued to purchase parcels beneath the 70-foot contour line that historically marked the lake's historic high-water elevation. In 2021, the District transferred 220 acres of the CC Ranch tract to Lake County Water Authority (LCWA) to further its nutrient reduction goals in the Harris Chain of Lakes. Between 2007–2021, LCWA had leased the 220-acre area and constructed and continuously operated the Nutrient Reduction Facility (NuRF). The District retained a flowage easement over the transferred property and a right of reversion to be exercised if the LCWA's use of the property becomes inconsistent with the Lake Apopka Restoration Act.

Currently, the Lake Apopka North Shore is comprised of 80 parcels totaling approximately 19,727 acres (Figure 4), derived from Geographic Information System (GIS) calculations. A table detailing the properties acquired and funding sources is located in Appendix C.

Many parcels within the North Shore were acquired with funding from the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) under the Wetland Reserve Program (WRP) and, at the time of acquisition, were encumbered by a conservation easement in favor of the NRCS. The NRCS easements within the North Shore were terminated in 2009 in exchange for perpetual easements over other District lands at Orange Creek Restoration Area and Ocklawaha Prairie Restoration Area.



Label	Parcel ID	Grantor	Acres	Label	Parcel ID	Grantor	Acres	Label	Parcel ID	Grantor	Acres
1	1987-018-PA	Duda Clay Island	1,879.98	28	1996-087-P1	Grinnell Farms	20.11	55	1996-097-P1	Zellwin Farms	452.74
2	1987-018-PB	Hooper Farms	1,100.09	29	1996-087-P1	Grinnell Farms	60.12	56	1996-097-P1	Zellwin Farms	3,249.74
3	1987-018-PB	Hooper Farms	527.48	30	1996-087-P1	Grinnell Farms	19.88	57	1996-098-P1	Hickerson Flowers	28.58
4	1987-018-PC	E. Wilkinson Cooper	75.27	31	1996-088-P1	Growers Pre-cooler Inc	3.21	58	1996-100-P1	Sherris Marsell	19.95
5	1987-018-PC	E. Wilkinson Cooper	290.51	32	1996-089-P1	Living Carpet Hensel & Rodgers	315.68	59	1996-108-P1	Davison	8.84
6	1987-018-PD	Wilkinson Addition	5.34	33	1996-090-P1	Long Farms Inc	50.61	60	1996-109-P1	Marion Rice	13.76
7	1989-004-P1	C. C. Ranch Lake Colveman	35.28	34	1996-090-P1	Long Farms Inc	195.57	61	1996-109-P1	Marion Rice	6.18
8	1989-026-P1	Brady RICO Clay Island	278.29	35	1996-090-P1	Long Farms Inc	44.96	62	1998-028-P1	Bates Greenery	1.94
9	1990-015-P1	Howard Clay Island	4.76	36	1996-090-P1	Long Farms Inc	359.45	63	1998-028-P1	Bates Greenery	3.54
10	1990-077-P1	Duda Whittle	1,115.31	37	1996-090-P1	Long Farms Inc	19.97	64	1998-028-P1	Bates Greenery	3.01
11	1993-006-PA	Keen Ranch A	245.31	38	1996-090-P1	Long Farms Inc	183.56	65	1998-029-P2	WFR	60.28
12	1993-006-PB	Keen Ranch B	48.52	39	1996-090-P1	Long Farms Inc	159.22	66	1998-032-PA	Martha E Marsell	1.99
13	1993-007-P1	Robinson	37.28	40	1996-091-P1	Long and Scott Farms	87.27	67	1998-032-PB	John and Corella Marsell Flor Maria	11.07
14	1993-054-P1	Blunt pka Keen	53.03	41	1996-092-P1	Lust Farms Inc	264.58	68	1998-033-P1	Schaffer	12.85
15	1994-026-P1	Boyd Davis	178.20	42	1996-092-P1	Lust Farms Inc	1,220.64	69	1998-034-P1	James Teddy Smith	27.59
16	1995-059-P1	Holt	7.68	43	1996-094-P1	Robert Potter and Sons	320.72	70	1998-034-P1	James Ted Smith	8.04
17	1996-083-P1	A. Duda & Sons	6.78	44	1996-095-P1	Stroup Farms Inc	88.24	71	1998-038-P1	Strickland Lake Apopka	19.07
18	1996-083-P1	A. Duda & Sons	23.94	45	1996-095-P1	Stroup Farms Inc	160.17	72	1998-050-P1	Napa Jones Avenue	34.82
19	1996-083-P1	A. Duda & Sons	105.59	46	1996-095-P1	Stroup Farms Inc	82.50	73	1998-061-P1	San-Ge-Lan	3.79
20	1996-083-P1	A. Duda & Sons	2,984.33	47	1996-095-P1	Stroup Farms Inc	80.21	74	1998-061-P1	San-Ge-Lan	5.47
21	1996-084-P1	Clarence Beall	70.49	48	1996-096-P1	Zellwood Drainage District	2.55	75	1998-063-P1	Wekiwa Concrete Zellwin Farms	1.52
22	1996-084-P1	Clarence Beall	81.55	49	1996-096-P1	Zellwood Drainage District	2.98	76	1998-065-P1	Freeman	11.06
23	1996-084-P1	Clarence Beall	159.87	50	1996-096-P1	Zellwood Drainage District	8.06	77	1998-066-P1	Baumgardt	0.54
24	1996-085-P1	Clonts Farms Lake Apopka	642.31	51	1996-096-P1	Zellwood Drainage District	6.69	78	2002-001-P1	Langley	58.07
25	1996-086-P1	Crakes & Sons Inc	103.97	52	1996-096-P1	Zellwood Drainage District	10.10	79	2002-001-P1	Langley	0.49
26	1996-086-P1	Crakes & Sons Inc	258.17	53	1996-096-P1	Zellwood Drainage District	9.25	80	2017-005-P1	L.F. Roper Trust	4.42
27	1996-086-P1	Crakes & Sons Inc	140.91	54	1996-097-P1	Zellwin Farms	1,440.81				

Figure 4: Acquisition Map

LOCAL GOVERNMENT LAND USE DESIGNATION

Orange County

According to the 2023 update to the 2010–2030 Orange County Comprehensive Plan, the Future Land Use designation for the North Shore is Rural (Orange County Planning, Environmental and Development Services Department 2023).

Other land use designations for property that surrounds the North Shore include:

- Industrial – Industrial uses include the processing of both hazardous and non-hazardous materials ranging from light assembly and manufacturing to chemical processing. The maximum Density and Floor Area Ratio (FAR) is 0.75 FAR. The FAR is calculated by dividing the total number of units/square footage by the net developable land area.
- Agricultural Resource – This designation consists of lands suited for intensive cultivation, ranching, aquaculture, and timber farming. The maximum residential density shall not exceed one (1) dwelling unit per ten (10) acres.
- Forestry Resource – Areas of land that are primarily suited for silviculture. The maximum residential density shall not exceed one (1) dwelling unit per twenty (20) acres.
- Environmental Systems Corridor – These areas of land are important ecological corridors consisting of environmentally sensitive and ecologically significant lands. The maximum residential density shall not exceed one (1) dwelling unit per twenty-five (25) acres.
- Rural – This designation consists of areas that are a mixture of agriculture and low-density residential development of one (1) dwelling unit per five (5) acres.

Lake County

According to the September 14, 2023, update to the 2030 Lake County Comprehensive Plan, the Future Land Use designation for the North Shore is Conservation. This land provides the framework for the preservation, protection, and enhancement of the county's natural resources. This designation divides the goals, objectives, and policies of Lake County, relating to natural resources, into four broad categories: air, water, land, and human systems (Lake County Department of Growth Management Division of Planning and Community Design 2023).

Other land use designations for property that surrounds the North Shore include:

- Rural – This Future Land Use Category provides for residential development at densities equal to or less than one dwelling unit per 5 net buildable acres, agricultural operations, civic uses compatible with a rural community, and Rural Support functions where appropriate.

NATURAL RESOURCES

WATER RESOURCES

This section describes the surface and groundwater resources of Lake Apopka North Shore.

Surface Water

The North Shore sits within the 183-square-mile Lake Apopka watershed (Figure 5). Water enters the Property through rainfall and stormwater flows from Jones Avenue down Lake Level Canal and then to Phases 1 and 7 (Figure 10). Additionally, dispersed stormwater flows enter the Property from adjacent properties, and several small seeps contribute to surface water in the western portion of the North Shore. While it is possible to discharge Lake Apopka water onto the Property, this practice has not been utilized often. Discharges from the North Shore—which send water to Lake Apopka and/or the A-B Canal—are controlled to minimize nutrient releases to adjoining and downstream waterbodies. The conversion of the North Shore from agriculture to wetland has greatly reduced the volume of water pumped to Lake Apopka and thus resulted in a large reduction in phosphorus loading to the lake.

Lake Apopka receives water from Apopka Spring (Gourd Neck Spring), rainfall, and runoff. Lake Apopka is the first lake in the Upper Ocklawaha River Basin Chain of lakes, which serves as the headwaters to the Ocklawaha River (an Outstanding Florida Waterbody). Lake Apopka has an established Total Maximum Daily Load (TMDL) for phosphorus (P). In recent years, the lake has met this water quality goal. Water leaving Lake Apopka flows through the A-B Canal to Lake Beauclair and then on to lakes Dora, Eustis, and Griffin. These downstream lakes have not yet met their water quality goals for phosphorus, which were established in 2003.

Historically, the floodplain marsh, or areas below the 69-foot contour (all elevations reported are North American Vertical Datum of 1988, i.e., NAVD88), encompassed much of the littoral wetlands along the north shore of Lake Apopka. Prior to District acquisition, hydrology within the Lake Apopka North Shore was extensively altered. At the time of acquisition, the Property was a combination of drainage-controlled muck farms, woodlands, and improved and feral pasture, with few areas of intact natural systems. Hydrologic disturbances are largely attributed to the prior agricultural land use and include roads, levees, ditches, canals, culverts, and bridges. An extensive levee system with numerous pumps allows water levels to be managed across the Property, to protect levees and promote restoration when possible.

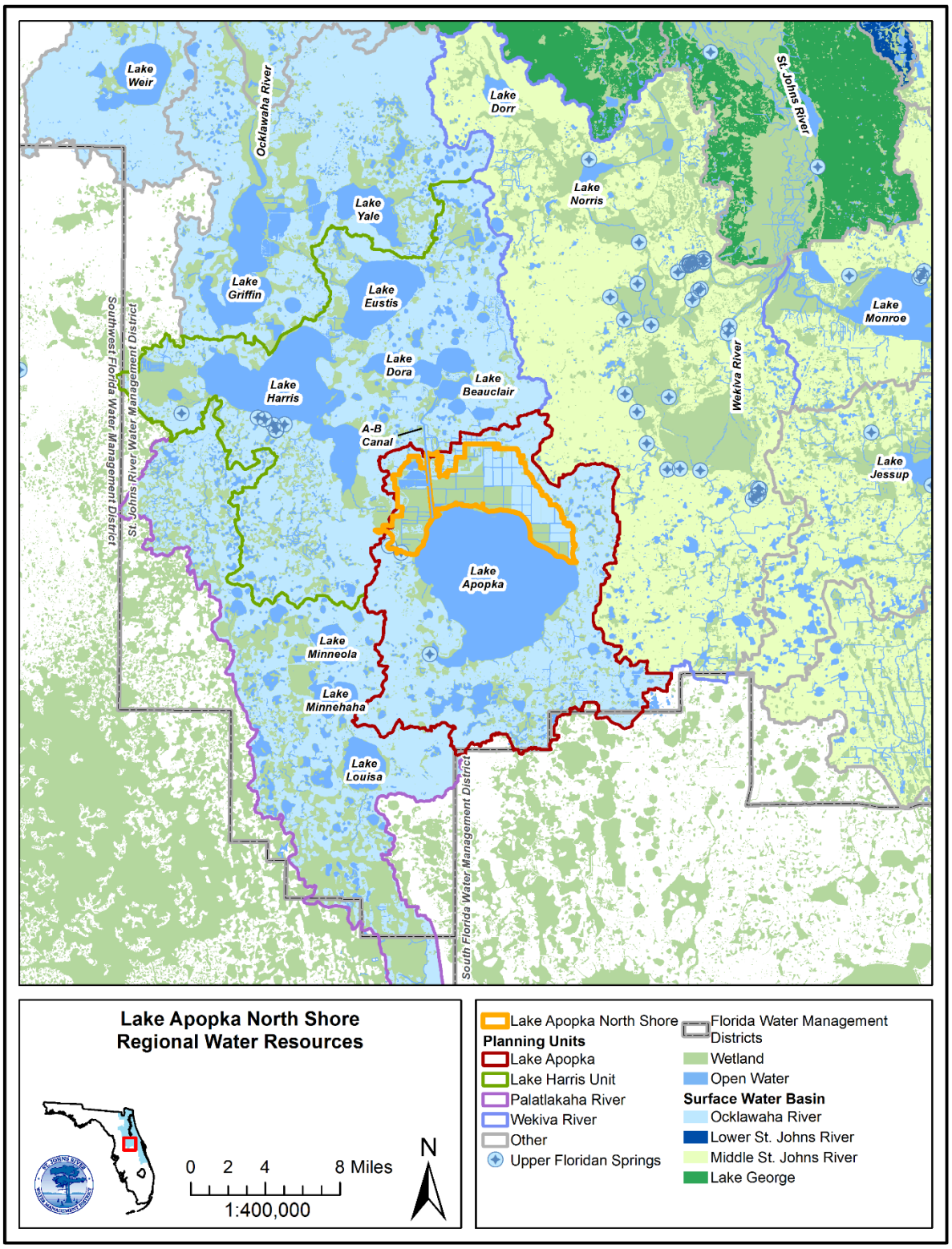


Figure 5: Regional Water Resources

Topography
The previously farmed peat-based muck soil areas of the North Shore experienced soil oxidation and subsidence as result of agricultural drainage and tilling. The farmed areas are estimated to have lost approximately 1 foot of elevation per decade of agricultural operations, with some of the North Shore now roughly 5 feet lower than its unaltered elevation. As a result, most of the North Shore is currently below lake elevation and thus vulnerable to flooding over the perimeter levee (Figure 6). This requires that all water to be moved from the North Shore to the lake be pumped. The North Shore wetlands will only persist as long as the perimeter levee isolates the higher lake water elevation from the North Shore.

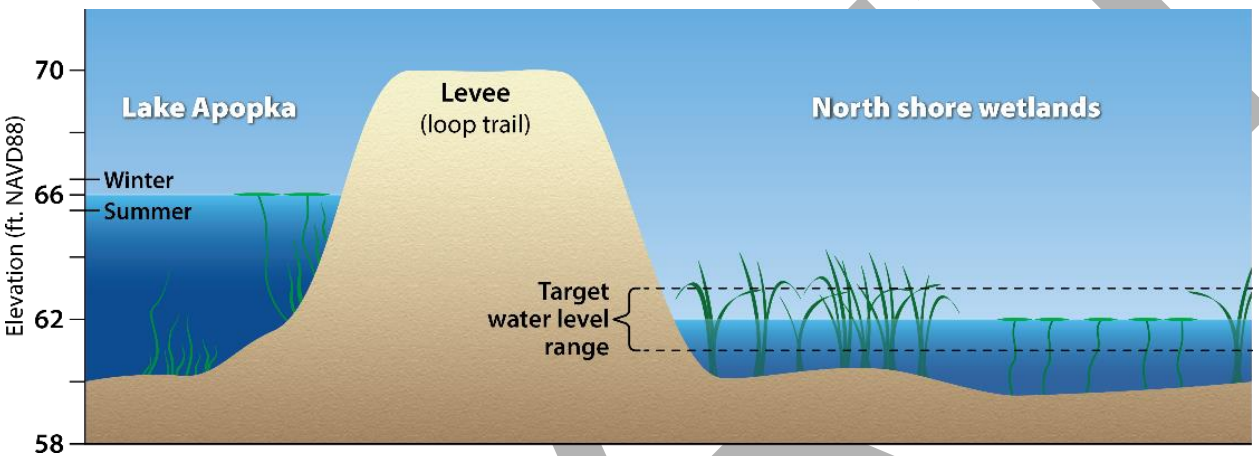


Figure 6: Lake Regulation and Soil Elevation in the North Shore

A Light Detection and Ranging derived Digital Elevation Model (LiDAR DEM) is available from 2018 (Lake and Orange counties, Figure 7) for the Property. Land surface elevations for Lake Apopka North Shore range from approximately 55–116 feet. Elevations below 54.42 feet—the water level at time of LiDAR data collection—are not identified, as LiDAR does not penetrate below the water surface. In general, the highest elevations are present on the southwest portions of the Property. The median elevation from previous surveys of the eastern wetland portions of this property is 58.19 feet.

Physiography
The North Shore primarily lies within the Tavares Lakes Province, with small portions falling within the Mount Dora Ridge and Lake Wales Ridge (LWR) Complex Provinces of the Lakes District (Williams 2022). The Tavares Lakes Province is distinguished from adjacent provinces because of its overall lower elevation and abundance of large, karst lakes. The Lake Apopka Basin includes approximately 120,000 acres and is bordered to the east by the Mount Dora Ridge and to the west by the northern portions of the LWR. Ridge elevations range between 75–308 feet above sea level (Hoge et al. 2003).

Site Geology
According to the Geologic Map of the USGS Orlando (FGS 2015), Lake Apopka North Shore surface geology is predominately comprised of quartz and carbonate sand with muds and organics;more broadly classified as Holocene, or recent, sediments.

Underlying the Holocene sediments is the Cypresshead Formation (Pliocene) comprised of siliciclastics, shallow marine near-shore deposits that consist of reddish brown to reddish orange, unconsolidated to poorly consolidated, fine to very coarse grained, clean to clayey sands (FGS 2015). The Cypresshead Formation has permeable sands and clays to form part of the surficial aquifer system (FGS 2015).

The Hawthorn Group underlies the Cypresshead Formation (Miocene) and is composed of poorly to moderately consolidated clayey sands to silty clay with occasional pure clays, quartz sandy dolostones, and dolomite cemented sands.

Below the Hawthorn Group is Ocala Limestone (Eocene), which consists of marine limestones and occasional dolostones (FGS 2015). The Ocala Limestone is the uppermost unit in the Upper Floridan aquifer.

Hydrogeology

Lake Apopka North Shore is within the Wekiwa Springshed. Local geologic formations and soils data show that within the Lake Apopka North Shore, the Upper Floridan aquifer (UFA) is mostly confined by the intermediate confining unit of the Hawthorn Group (FGS 2015). The surficial soils have relatively low infiltration rates (Figure 8). A piezometer study (Bryant and Shih 1990) showed that direction of surficial aquifer flow was northward from the lake through the North Shore. Most of the Property is an area of low groundwater recharge, however the southwestern portion is known to be an area of groundwater discharge with numerous areas of seepage (Figure 9).

The area of discharge in the southwestern section of the North Shore coincides with the Clay Island and MFW sites where there are multiple springs and seeps, including within the MFW's treatment cells (B1 and C1).

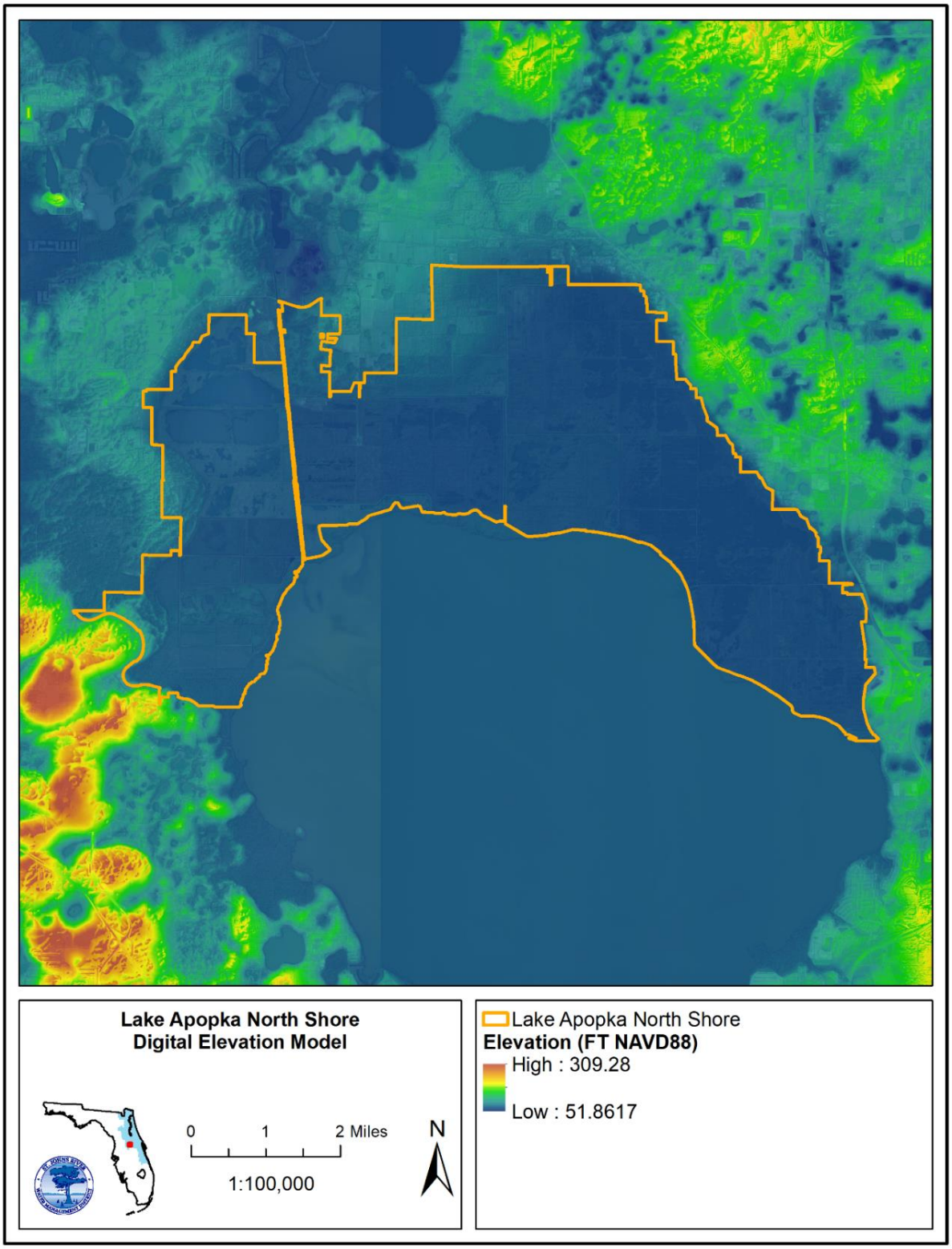


Figure 7. Digital Elevation Model

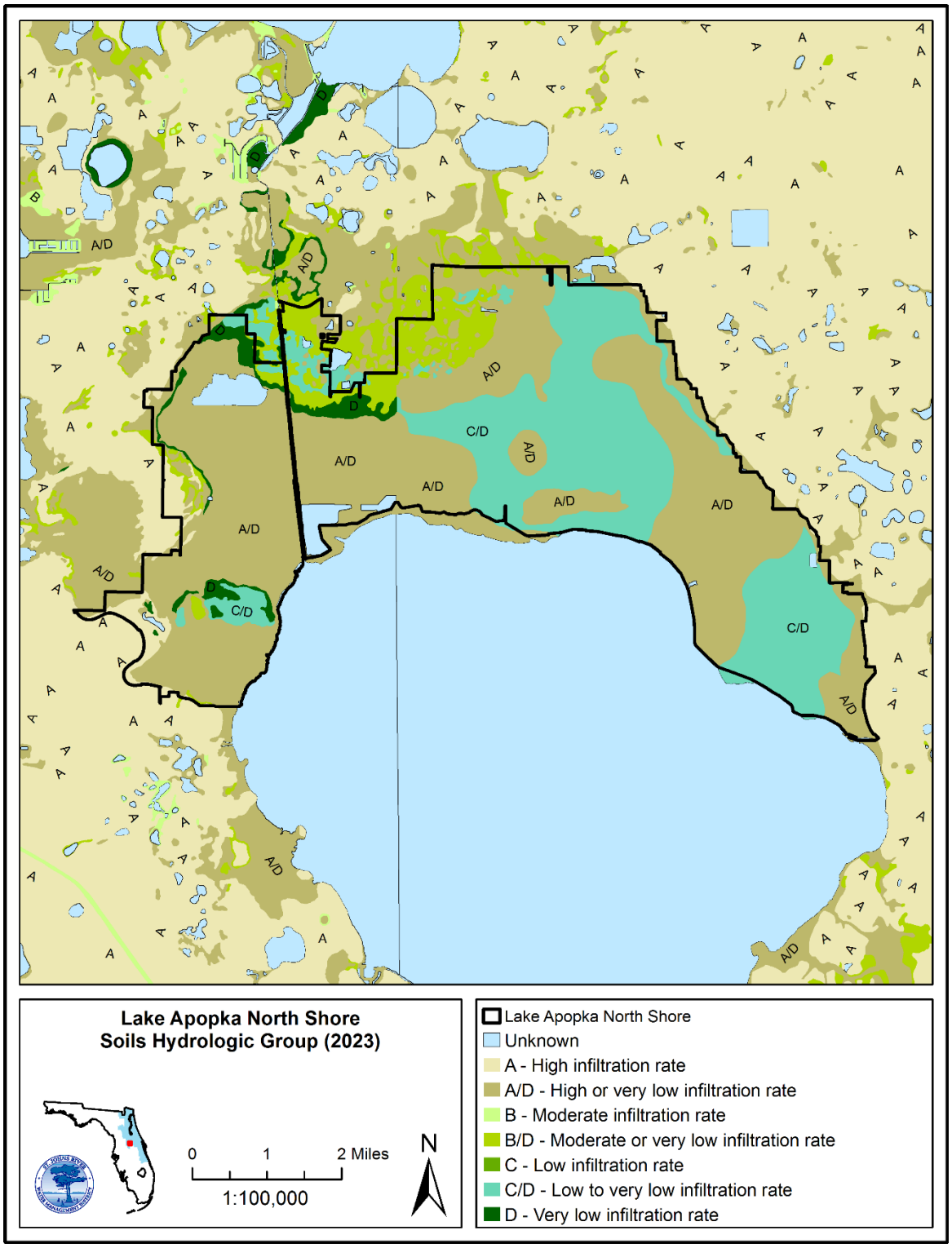


Figure 8: Soils Hydrologic Group

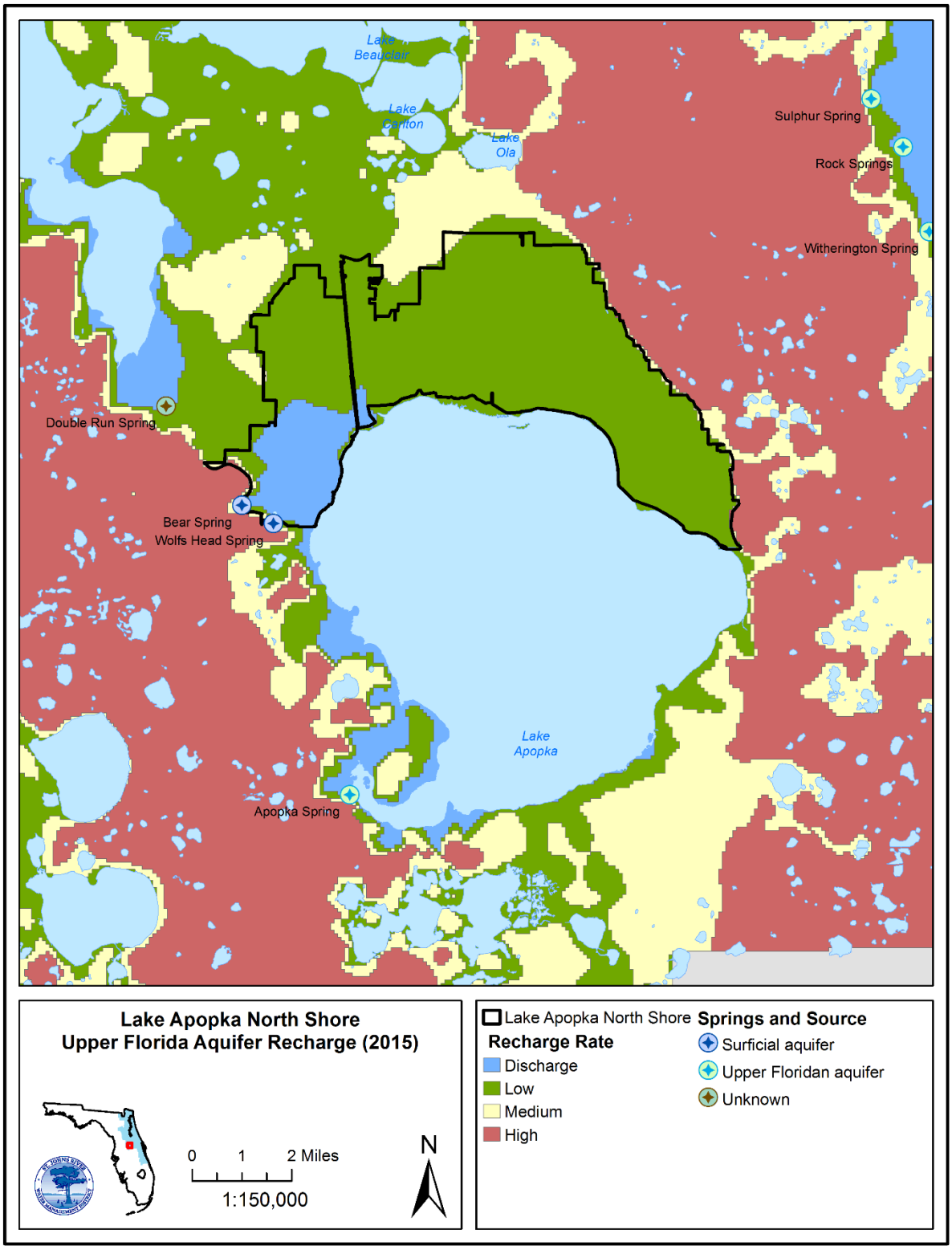


Figure 9: Predicted Upper Floridan Aquifer (UFA) Groundwater Recharge

Hydrologic Modifications

Prior to District acquisition, an extensive network of levees, canals, and pumps were constructed to drain and irrigate the floodplain for agriculture. A subset of these levees or roads and associated ditches continues to be maintained within the North Shore to manage water and provide access for management and recreation (Figure 10). The canals formerly used to bring lake water onto the North Shore for irrigation, such as Lake Level Canal, have been disconnected from the lake and merged with the drainage canals that are now used to manage water levels throughout the North Shore. Lake Level Canal now conveys stormwater from Jones Avenue into Phases 1 and 7. The current network of pumps and canals allows for water management in three hydrologically separate areas (Figure 10). These separate areas are (1) the areas west of the A-B Canal including the West Marsh, MFW, and Clay Island, (2) Duda, and (3) Phases 1–8. Specific water level targets for the North Shore are further divided into seven zones for management and monitoring (Figure 11). The District has recently completed a project that allows water from the Duda area to be pumped east into Lake Level Canal.

The 2018 Biological Assessment (Appendix D) submitted to the U.S. Fish and Wildlife Service (USFWS) and the agency's concurrence allowed greater flexibility in water management so that maximum water levels can now be constrained by the elevation of internal levees and the needs of the recovering wetlands. Water level management has focused on reducing pumping from the North Shore into the lake. The combination of high rainfall and reduced pumping has resulted in deeper water depths across the North Shore. Water level elevations for the North Shore follow a 2020 technical memorandum (Appendix E) that began identifying the hydrologic regimes of various types of wetlands to be restored across the North Shore.

To achieve water and phosphorus management goals on the North Shore, the District has undertaken numerous projects to expand water management capabilities, including culvert improvements, removal of dilapidated water control structures, construction of two new pump stations, replacing diesel pump motors with electric motors, pump and infrastructure operation and maintenance, installation of alum treatment systems, and raising levee elevations to increase water storage capacity. To effectively manage the North Shore, water quality and water level monitoring sites have been established across the Property (Figures 11 and 12). In addition, the MFW's treatment cells were releveled and recontoured as part of maintaining the system's water treatment performance in 2021.

Additional internal pumps have been installed and levees raised to accommodate internal management of water to provide desired water depths without pumping water to the lake. However, pumping into the lake is occasionally necessary to protect levee integrity or wetland health. Prior to discharge, water can be treated with aluminum sulfate (alum), as necessary, to reduce the loading of biologically available P to the lake. Treatment decisions are based upon a combination of P concentration of water to be pumped, previously discharged P loads during the year, and availability of resources to run alum systems.

Water Quality Background

The established Total Maximum Daily Load (TMDL) target concentration for Lake Apopka is 0.055 milligrams per liter (mg/L), with an allowable annual loading of 14.16 metric tons per year (MT/yr) P (Magley 2003). As a subset of that annual load, the District's target annual load from

the North Shore is 5.53 MT/yr. The purpose of purchasing the North Shore farms was to improve water quality in Lake Apopka by reducing P loading to the lake from the North Shore. Restoring wetlands on the Property allowed for water to be stored there, greatly reducing the volume of water pumped. Discharges have occurred when North Shore water elevations threaten the integrity of infrastructure or the health of wetlands. The North Shore's annual P target has been met each year since 2011 (Figure 13). Periods of high precipitation, especially related to large low-pressure system storms, have been the only times that the North Shore loading target has not been achieved for that year.

The District's P management approach for Lake Apopka can be described as a "diet, exercise, and physical therapy" approach. The "diet" is the reduction in P loading to the lake. The purchase of the farms and related facilities was the key component of the diet. In 2002, to further reduce P loading, the District Governing Board adopted the Lake Apopka Stormwater Rule, which increased the stormwater treatment requirements associated with new construction within the watershed.

"Exercise" involves the removal of legacy phosphorus from the lake to hasten the reduction of the phosphorus concentration in the water column. This focused on two projects, the gizzard shad harvest and Phase I of the MFW. The District has managed an annual harvest of gizzard shad from the lake since 1993. Removing these fish and the P in their tissues has removed significant amounts of P as well as reduced the recycling of phosphorus generated by their feeding. Next, in 2003, the MFW was completed and began operation, as a recirculating wetland filter that removes particulate matter (e.g., algae, sediment, and associated nutrients) from the lake's surface water via four independent wetland cells. The MFW was built on subsided fields so lake water flows through the cells via gravity, with the treated water collecting in the pump basin where it is pumped back up to lake level and discharged to Lake Apopka and the A-B Canal.

Over the years the District has implemented major changes to the North Shore's drainage and water management systems to facilitate the continued reductions in water discharges to the lake. As the water quality has improved, native SAV began recolonizing the lake in 1995. In light of the improving conditions, the District and other agencies began planting several species of native wetland plants in the lake's littoral zone to aid in the restoration of fish and wildlife habitat. These efforts to accelerate the recovery of key biological communities is the "physical therapy" part of the lake's treatment plan.

Since 1987, water quality within the lake has shown an overall improving trend with exceptions in years of significant multi-year droughts (2000–2002, 2006–2008, 2010–2012). In 2022 the lake's annual average P concentration was below the target concentration of 0.055 mg/L. In the years the lake was approaching the target, the clearer water and more light have stimulated the rapid growth of submerged aquatic vegetation in the lake, as was predicted when the target was established (Florida Statutes 1996, Lowe et al. 1999, and Magley 2003). Management of the North Shore's wetlands will be perpetual and increasingly focus on improving the mosaic of wetland types.

During the farm operations period from the 1940s to late 1990s, agrichemicals were applied to the Property, including multiple OCPs (i.e., DDT, dieldrin, toxaphene). OCPs and their breakdown byproducts were found by the District as part of the Environmental Site Assessments (ESAs) conducted for the acquisition of each of the farms. Many contaminated sites were identified and remediated as part of the ESA process. These included both fuel and OCP contaminated sites (Bartol and Brown 2016).

The OCPs were the cause of a significant bird mortality event in the fall and winter of 1998 and 1999. The District implemented a multi-year investigation into the mortality event (Coveney and Conrow 2016). Subsequent management actions included an innovative soil inversion project to reduce residual soil OCP exposure to meet safe parameters for inundating the fields.

Management and restoration activities will continue to be influenced by the level of risk posed to wildlife as indicated by the presence of OCPs within the North Shore. Monitoring of soil, fish, and birds has occurred throughout restoration and management in compliance with consultation with the USFWS. Sampling of OCP and analytes within waterfowl tissues specifically harvest from the West Marsh was conducted in 2012 and 2021. A summary of OCP and analyte results for fish and waterfowl tissue samples are provided in Appendices D and F, respectively. As described in the most recent Biological Assessment (Bowen and Slater 2018) and the USFWS letter of concurrence on February 28, 2018, all active management can be implemented on the North Shore including selective planting, drawdown, deep inundation, prescribed fire, habitat restoration, beneficial soil/sediment placement, and control of invasive vegetation, and these activities are not likely to adversely affect wildlife, especially wading birds. Active management will be used to develop a mosaic of wetland habitats that prevent oxidation of muck soils, phosphorus release, and create wetlands beneficial to wildlife. In November 2021, the District submitted its North Shore OCP monitoring data to the USFWS and requested that the District monitoring associated with the 2018 BA Biological Assessment be ceased due to the low OCP concentrations found. The USFWS concurred with this request on December 10, 2021.

Water from Lake Apopka flows through the A-B Canal and controlled by the District's Apopka lock and dam, or through the NuRF, before flowing downstream into Lake Beauclair. Co-located next to the lock and dam, the LCWA NuRF uses alum to remove P from the water as it flows downstream.. Water flows through the NuRF via gravity, taking advantage of the elevation drop at the dam. Phosphorus and suspended solids are captured in the floc generated when alum is dosed into the water. The floc is trapped and removed from the water and the resulting solids are stored on the NuRF facility. The NuRF facility is located on land that the District initially leased and then transferred to Lake County. The NuRF was constructed to help reduce the P loading to lakes downstream of Apopka, which are more sensitive to P loading and have lower P concentration targets.

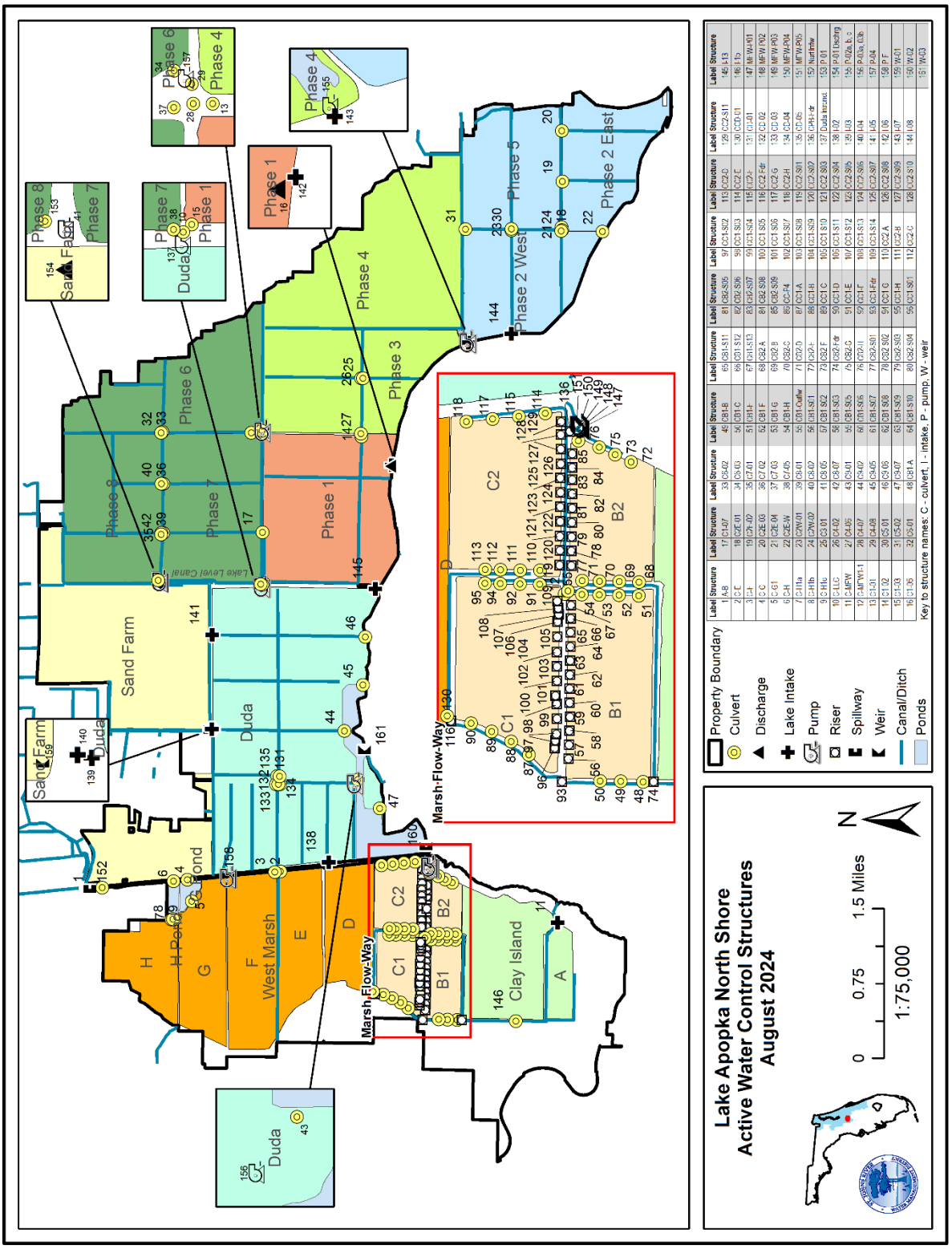


Figure 10. Hydrologic Modifications Map

Monitoring

Detailed hydrologic and water quality monitoring of Lake Apopka and the North Shore is necessary to manage discharges from the lake as per its regulation schedule, estimate the water and P budgets for Lake Apopka and downstream lakes, adaptively manage the MFW's performance, and manage the hydrology of the various phases and their associated wetlands. An extensive network of water quality and water level monitoring stations has been established across the North Shore to provide data to calculate total phosphorus (TP) loading to the lake and treatment efficiency of the MFW, to determine nutrient loading to the North Shore from offsite, and to monitor water levels (Figures 11 and 12). For each water quality monitoring site, the status (mean concentration) was calculated for the period of record from 1989 to 2023 (Table 1). Water quality sites and data from the MFW are not included because they are influenced by changes in Lake Apopka's water quality as well as treatment efficiency. Management of water levels within each phase can be manipulated through board placement in culverts adjacent to canals and pumping. For further information see Appendix E.

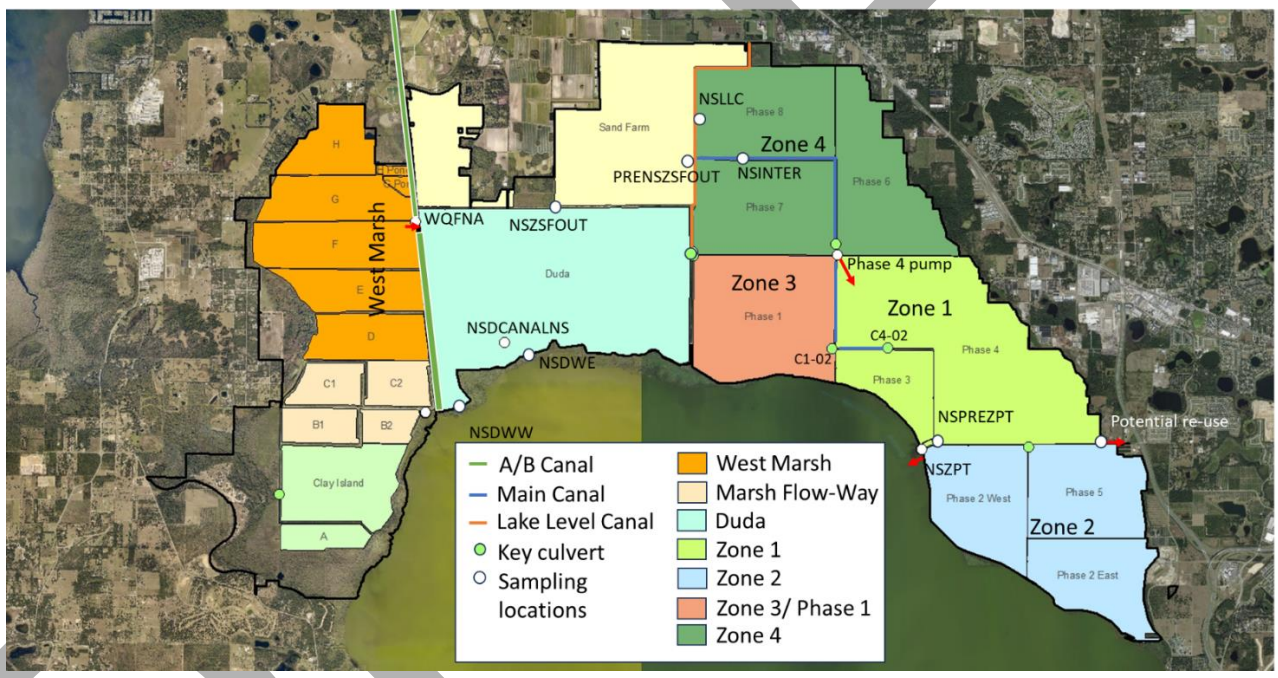


Figure 11: Water Quality Sampling Locations as of 2024 for Determining North Shore Contributions to the TMDL for Lake Apopka

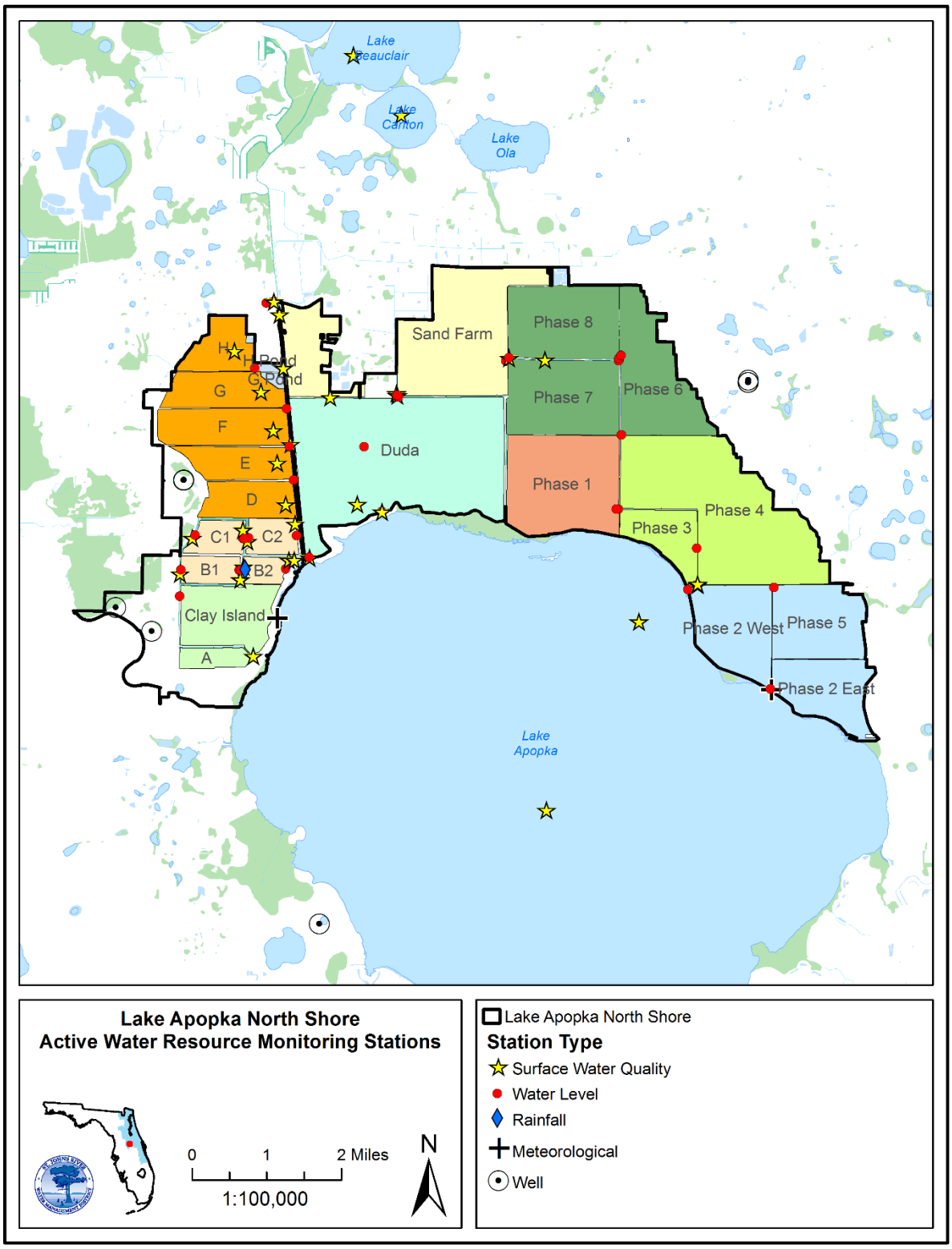


Figure 12: Water Resources Monitoring Stations Map

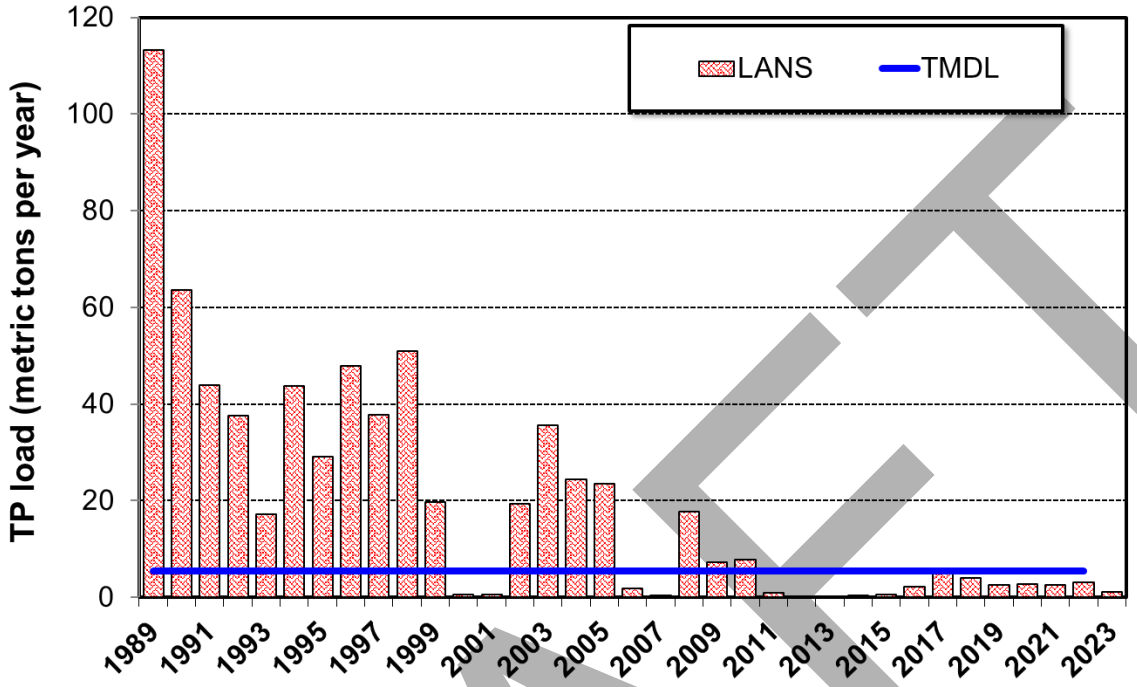


Figure 13: Total Annual P Load from the North Shore to Lake Apopka from 1989 to 2023

Table 1: Water quality data from sampling for P loading calculations used to determine North Shore contribution to the TMDL for Lake Apopka.

Site	Mean TP (mg/L)	Period of record	Sampling frequency	Purpose of monitoring
NSDCANALS	0.32	8/8/2012-3/8/2023	When pumping	Discharge pre-alum treatment
NSDWW	0.04	8/27/2015-2/20/23	When pumping	Discharge post- alum treatment
NSINTER	0.32	04/6/2016-2/14/2024	Monthly	Interceptor canal prior to Unit 1 pump
NSPREZSFOUT	0.25	01/19/2016-3/30/2023	When discharging	Discharge from Unit 1 pump prior to Sand Farm
NSZSFOUT	0.15	11/3/2014-3/30/2023	When discharging	Discharge from Unit 1 pump prior to Sand Farm
NSPREZPT	0.09	5/21/2015-8/2/2023	When pumping	Discharge pre- alum treatment Unit 2 pump
NSZPT	0.09	5/21/2015-9/21/2023	When pumping	Discharge post- alum treatment Unit 2 pump
NSLLC	0.89	04/16/2016-9/18/2024	Monthly	Inflow from Jones Ave runoff
WQNFA	0.10	5/29/2018-2/6/2024	When pumping	West Marsh Discharge

NATURAL COMMUNITIES

The North Shore is host to a variety of natural and altered land cover. Plant communities of the Property have been mapped under contract by the District in 2013, 2017, and 2021. These mapping efforts are highly valuable for tracking vegetation community changes over time and provide detailed delineation of relatively narrow categories of land cover. Relevant data from these mapping efforts are shown in the Forest and Ecological Management and Restoration portion of the Implementation section in this document.

The North Shore natural community descriptions provided below utilize broad natural community definitions (Figure 14), as generally detailed in the Florida Natural Areas Inventory (FNAI) Guide to the Natural Communities of Florida (FNAI 2010). The majority of the Property is comprised of novel wetland communities, primarily in the form of managed marshes. Uplands, primarily in the form of restoration flatwoods and other altered land covers, account for approximately 13% of the total area.

Decades of agricultural production, altered hydrology, soil composition, land elevation, altered fire regimes, non-native species introductions, vegetation management techniques, and impacts to water quality at the North Shore have shaped the wetland communities on site. The expansion and persistence of nuisance plants such as Carolina willow (*Salix caroliniana*) and cattail (*Typha* sp.), along with numerous invasive plant species in the marshes of North Shore, have led to the District investing substantial resources to understand the impacts and management dynamics of these novel habitats. Prior to the OCP soil remediation work in 2009, one of the techniques employed to reduce OCP exposure to fish-eating birds was to allow woody, shrubby, or emergent vegetation to grow densely enough to limit the birds' foraging ability and thus reduce exposure to fish containing OCPs. Over time as OCPs degraded and as soil remediation was implemented, the soil and thus fish OCP content has declined to below the site-specific thresholds developed by the District. This has allowed the process of removing dense vegetation to begin and the creation of more diverse and open wetland communities that are safe and more attractive to wildlife.

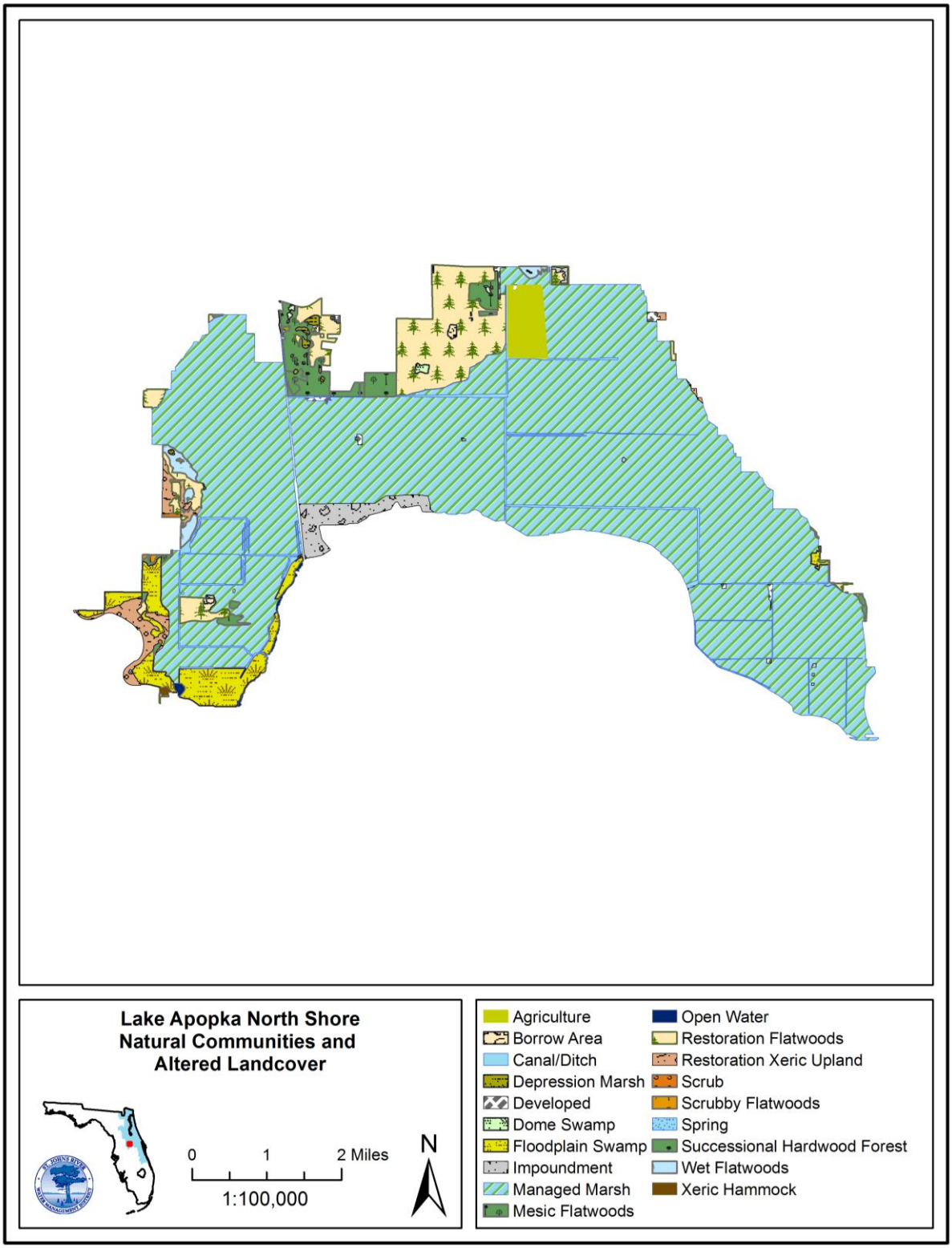


Figure14: Current Natural Communities and Altered Landcover Map

Managed Marsh (15,357 acres, 78%)
The term "managed marsh" implies the manipulation of hydrology via the movement of water across various phases of the marsh or into various canals. This manipulation is conducted via an engineered drainage system operating through a combination of gravity and pumps that allow water to be moved between phases of the North Shore. Hydrologic manipulation also includes the ability to discharge water from the North Shore to Lake Apopka.

Prior to disturbance, the vast areas identified as managed marsh within the Lake Apopka North Shore were historically floodplain marsh and, as such, were likely dominated by sawgrass (*Cladium jamaicense*). Given this fact combined with District management goals and activities, within the context of FNAI definitions, these managed marshes can also be considered floodplain marsh restoration communities. Floodplain marshes, according to FNAI, may include organic soils over sand and may be saturated for most of the year. This marsh type is typically located along rivers, streams, or lakes with inflow and outflow. Hydroperiods of approximately 120–350 days per year are essential to the maintenance of this community and critical in the minimization of soil oxidation and subsidence. Many floodplain marshes exhibit vegetative zonation. Broadleaf emergent and floating plants occupy the deepest, most frequently flooded areas while mixed herbaceous stands are found in the higher areas. In addition to inundation, frequent fire can be an important factor in maintaining the open herbaceous characteristics of the floodplain marsh system and is crucial in limiting the encroachment of woody species. Many of these managed marsh cells will not routinely carry fire unless they are dried out, damaged by frost, or treated with herbicide.

Significant alterations to the floodplain marsh began in the 1890s with the construction of the A-B Canal. The construction of the canal, which was designed to facilitate the transportation of citrus, lowered lake elevations 3 feet and altered marsh hydrology. Subsequent levee construction and wetland drainage through the 1940s further exposed organic soils, resulting in decades of intense muck farm agriculture. At the time of acquisition, these former marshes were in active, intense row-crop agriculture, void of native vegetation and natural perturbations, and had suffered considerable soil oxidation and subsidence.

Post-acquisition activities targeting the improvement of water quality within the lake have included the simulation of natural marsh functions within the managed marsh area. The primary goals of these activities have been to minimize the discharge of nutrient laden water into the lake and filter lake water through the MFW's marsh filtration system. Additional activities have included the reengineering of existing drainage infrastructure, and the initial application of soil amendments to bind and trap excess residual phosphorus.

The MFW, a recirculating constructed wetland, is located within the western portion of the managed marsh, west of the A-B Canal. The MFW is approximately 760 acres in size and includes four treatment cells and several levees, canals, and ditches. The MFW is gravity-fed, with P, algae, and sediment-laden lake water entering to the south of the system. Water is then directed through the various treatment cells, which are maintained as emergent marshes. The treatment cells filter lake water by slowing flow, providing time for sediments and associated particulate phosphorus and nitrogen to settle out of the water. Once the water has filtered through

the treatment cells, it collects at the pump basin and is pumped back up to the lake or flows downstream via the A-B Canal.

Currently, the majority of the managed marsh area can be described as some variant of treeless wetland on former agricultural fields. Current conditions in the managed marsh include a mosaic that range from shallow open water to areas of heavy shrub and woody vegetation encroachment. The managed marsh area is divided into phases for restoration and management purposes; these phases are delineated, and a more detailed description of condition is provided in both the Water Resources Overview and Resource Protection and Management sections.

Floodplain Swamp (675 acres, 3%)
Floodplain swamp communities typically occur on flooded soils along stream channels and within river floodplains. The majority of the floodplain swamp communities within the North Shore occur on the southwestern portions of the Property. These communities are largely intact and outside the North Shore perimeter levee.

Soils that support floodplain swamp communities are variable but may include a mixture of sand, organic, and alluvial material. The most important physical factor associated with the shaping and maintenance of the floodplain swamp is the hydroperiod. Extended periods of inundation, which may last for most of the year, are common in the floodplain swamp environment. Since this community type is maintained by hydrologic regimes, it is not fire-dependent; however, wildfires may occur during times of drought.

Wet Flatwoods (127 acres, 1%)
Soils that support wet flatwoods communities are generally very poorly drained sandy soils that may have a mucky texture in upper horizons. Wet flatwoods occur as ecotonal areas between the drier mesic flatwoods and wetter areas, such as bogs or swamps. They may also occur in broad, low flatlands embedded within these communities.

Well-maintained wet flatwoods exhibit a relatively open-canopy forest of scattered pine trees (longleaf, loblolly, slash, or pond) or cabbage palms (*Sabal palmetto*) with either a thick shrubby understory and sparse groundcover or sparse understory with dense groundcover. Understory species of the subcanopy and shrub layers may include sweetbay (*Magnolia virginiana*), loblolly bay (*Gordonia lasianthus*), and saw palmetto, as well as a suite of ericaceous plants. The groundcover layer may include species such as wiregrass, blue maidencane (*Amphicarpum muhlenbergianum*), and numerous hydrophytic species. The variations in structure and composition may be attributed to subtle edaphic differences as well as differences in hydrologic and fire regimes.

The wet flatwoods plant community is fire-dependent and the District targets return intervals ranging from 1–3 years, which is consistent with FNAI 2010 descriptions. These communities occur outside the North Shore perimeter levee and are thus not directly impacted by water level management within managed marshes. That said, the historic wet flatwoods within the North Shore exhibit signs of successional changes, due primarily to altered hydrology and the prolonged absence of fire. These areas exhibit heavily overgrown midstories.

Mesic Flatwoods (50 acres, <1%)

Soils that support mesic flatwoods communities are generally poorly drained, acidic, and sandy soils deposited on ancient, shallow seabeds. Many flatwoods communities have a clay or organic hardpan. Hardpan soils become saturated during the rainy season causing the accumulation of surface water; and can be droughty during dry periods. The presence of the hardpan translates to extreme seasonal fluctuations in the amount of water available to support plant life. These seasonal hydroperiods are essential in the maintenance of the flatwoods system.

Intact mesic flatwoods typically have a layered appearance, with a distinct, high, discontinuous canopy, low shrub layer, and diverse herbaceous layer. The canopy densities are variable and may include (depending on location) longleaf pine (*Pinus palustris*), slash pine (*P. elliottii*), loblolly pine (*P. taeda*), or pond pine (*P. serotina*). The shrub layer may include a mixture of species or be dominated by species such as saw palmetto (*Serenoa repens*), wax myrtle (*Myrica cerifera*), and numerous members of the Ericaceae family. The herbaceous coverage may be dominated by wiregrass; however, species abundance and diversity are often dictated by the openness of both shrub and canopy layers.

These communities occur outside the North Shore perimeter levee and are thus not directly impacted by water level management within managed marshes. What remains of mesic flatwoods communities within the North Shore are highly disturbed, with the most significant alterations resulting from agricultural activities such as cattle grazing and the effects of prolonged fire exclusion. Groundcover assemblages are largely suppressed and in some areas are void of these components. Pine species present within the flatwoods communities on the North Shore include longleaf and slash pine.

Fire is an important physical factor associated with the shaping and maintenance of this community type. The District targets natural fire frequency intervals of approximately every 2–4 years within the mesic flatwoods, which is consistent with the FNAI 2010 description. Fires in well-maintained mesic flatwoods tend to burn quickly and at relatively low temperatures. In areas of prolonged fire exclusion, altered hydrology, or hardwood encroachment, higher soil and fuel moistures may require more extreme conditions to facilitate a fire, causing fires to be more catastrophic in nature.

Depression Marsh (46 acres, <1%)
Depression marsh communities often occur embedded within a matrix of well-maintained pyric plant communities (FNAI 2010). Depression marshes are typically found on flat landscapes throughout Florida. They develop when the overlying sand has slumped into a depression in the limestone underlayment. Soils are typically depressional phases of fine sands. Depression marshes are maintained in part against woody shrub invasion by fluctuations in water levels associated with rainfall, fire, and, in many cases, a combination of both. These seasonal ponds are important habitat for numerous species of wildlife but are particularly important for many amphibians that require breeding sites that are free of predatory fish (Moler 1987).

Open Water (38 acres, <1%)
Most of the open water mapped at the North Shore is associated with the shoreline of Lake Apopka.

Dome Swamp (23 acres, <1%)
Dome swamp communities typically occur embedded within well-maintained pyric plant communities such as flatwoods (FNAI 2010). The dome swamp communities within the North Shore occur primarily within the mesic flatwoods and pine plantations, and most are altered.

Dome swamps are typically found on flat terraces, where they develop when the overlying sand has slumped into a depression in the limestone underlayment. Soils that support dome swamp communities are variable but may include a layer of peat that thickens towards the center. The peat layer is typically underlain with acidic sands or marl and then limestone or a clay lens. An important physical factor associated with the shaping and maintenance of the dome swamp is the hydroperiod. Water levels in dome swamps fluctuate seasonally with rainfall changes. Normal dome swamp hydroperiods are from 180–270 days per year (FNAI 2010).

Typical of the dome swamp system, many of the examples of this community type within the North Shore include a dome-shaped profile created by the presence of smaller trees growing in the shallow waters of the outer edge, with the large trees growing in the deeper center. The canopy of hydrophytic trees includes cypress and water tupelo.

Without frequent fire, cypress may become less dominant, being replaced by hardwood or bay species, and may exhibit an increase in peat accumulation. Fire frequency within these communities is greatest around the edges. The longer hydroperiods within the center of most dome swamps will restrict the advance of most fires under normal conditions. Thus, the fire return interval for dome swamps may range from 3–5 years along the edges and may be as great as 100–150 years in the center (FNAI 2010).

Scrub (12 acres, <1%)
Scrub is characterized as a community composed of evergreen shrubs, with or without a canopy of sand pine. Scrub systems are found on dry, infertile sandy ridges. Soils that support these systems are low-nutrient acid sands with little organic matter. There are three recognized variants of scrub: oak scrub, rosemary scrub, and sand pine scrub. All three variants include areas of exposed bare sand and exhibit sparse groundcover assemblages.

The most common form of scrub across Florida is oak scrub, which is dominated by myrtle oak, sand live oak, and Chapman's oak. Oak scrub may also include some scattered saw palmetto and rusty staggerbush and may include some sand pine and rosemary.

A remnant example of oak scrub occurs within the North Shore. While disturbed from past land use activities, the area retains many of the signature species of the oak scrub system. Shrub heights in these areas range from approximately 6–9 feet. This area includes patches of barren sand and numerous active gopher tortoise burrows and sand skinks. This area also includes numerous rare and listed plant species.

Scrub communities are fire-maintained and generally burn catastrophically every 5–40 years. The high variability of fire intervals within scrub systems is relative to the productivity of the site (Myers 1990). Highly productive sites will have a lower return interval. Scrub is globally

imperiled, according to FNAI, due to the relative rarity of occurrence and vulnerability to extinction.

Xeric Hammock (9 acres, <1%)
Xeric hammock is characterized as an evergreen forest with a low canopy and little understory plants other than palmetto, or a multi-storied forest of tall trees with an open or closed canopy. Several gradations between these extremes may occur.

The xeric hammock natural community is typically an advanced successional stage of scrub or sandhill. It is a climax community, having been protected from fire for 30 or more years. When fire does occur in the xeric hammock, it is under extreme conditions, burns catastrophically, and may revert the community back to an earlier successional stage. An example of xeric hammock within the North Shore occurs on the southwestern portion of the Property and is typical as described by FNAI in that it appears succeeded from sandhill and scrub.

Scrubby Flatwoods (8 acres, <1%)
Scrubby flatwoods communities generally occur on moderately well-drained, sandy soils. This community type occurs on slight rises within mesic flatwoods and in broad transitional areas. Standing water is uncommon in scrubby flatwoods as the depth to the water table is generally greater than adjacent mesic flatwoods.

Scrubby flatwoods have a stratified appearance and are characterized as an open canopy forest of widely scattered pine trees with a sparse shrubby understory and numerous areas of barren white sand. The vegetation in these ecotonal areas is a combination of mesic flatwoods and scrub and/or sandhill species. Canopies of the scrubby flatwoods in central Florida may include longleaf or slash pine. Shrub layers will often include xeric oaks, saw palmetto, and various Ericaceous plants. Groundcover, while generally sparse, may include wiregrass. Scrubby flatwoods communities within the North Shore occur along the western fringe of the Property and, while limited in extent, are generally intact.

Restoration Flatwoods (1,468 acres, 7%)
Historically, based on soils, much of the area delineated as restoration flatwoods were likely mesic flatwoods. Impacts in these areas are significant with most areas having been cleared prior to public acquisition for agricultural purposes. The majority of these areas within the North Shore include a heavy coverage of exotic pasture grasses including bahia grass (*Paspalum notatum*), Bermuda grass (*Cynodon dactylon*), and Pangola grass (*Digitaria eriantha*). Portions of the area delineated as Restoration Flatwoods have been planted in longleaf pine and wiregrass (*Aristida stricta*) with marginal success observed.

This land cover also includes areas formerly identified as pine plantations. These areas were established in improved pastures that were subject to cattle grazing, while others were planted on former row-crop sites. Since the time of acquisition, the District has planted these areas in longleaf and slash pine. Groundcover, where present, consists primarily of exotic pasture grasses. Notably, approximately 25–50% of the Zellwin Farms (Sand Farm) parcel restoration flatwoods are infested with cogongrass (*Imperata cylindrica*). Treating cogongrass at this scale within a forested area is extremely challenging.

Successional Hardwood Forest (521 acres, 3%)
Successional hardwood forests are closed-canopied forests dominated by fast-growing hardwoods and may include remnant pines. These areas are either invaded/fire-suppressed natural areas or old fields that have succeeded to forest. The successional hardwood forests within the North Shore include areas of both fire-suppressed natural areas and succeeded pastures.

Canal/Ditch (354 acres, 2%)
Numerous canals and ditches occur on the North Shore, many of which are remnants of irrigation and drainage infrastructure from former farming activities. Since the time of acquisition, several of the remnant canals and ditches have been reengineered to facilitate the movement of water across the managed marsh area while restricting the release of nutrient-rich water into Lake Apopka. In addition, new ditches and canals have been constructed in the MFW to facilitate nutrient removal from Lake Apopka's water column.

Impoundment/Artificial Pond (340 acres, 2%)
Several impoundments or artificial ponds were constructed in the managed marsh and utilized in mesocosm studies to assess the accumulation of pesticides in fish and the breakdown of residual pesticides in the soils within the North Shore. Other impoundments or artificial ponds were constructed on the southern end of the Duda parcel so that farm discharges could be made to the ponds and avoid P loading to Lake Apopka. These ponds were also used to help meet irrigation needs and allowed the Duda operation to avoid any P loading for several years. Once the District acquired the farms, the west pond was repurposed to capture alum floc.

Agriculture (310 acres, 2%)
A portion of the former agricultural land at the North Shore is currently leased for agricultural operations. Conditions of the lease agreement place certain responsibilities on the lessee. Prior to conducting any agricultural operations on the Property, the lessee prepared a water management plan. The lessee must utilize applicable Best Management Practices for its agricultural activities to minimize nutrient pollution (nitrogen and phosphorus) to surface and groundwaters. Phosphorus shall not be added unless required based upon soil analysis conducted by an entity approved by the District. Fertilizer and pesticide application reports are submitted to the District annually. No bedding or furrowing is allowed. Crops are subject to District's prior approval.

Restoration Xeric Upland (291 acres, 1%)
Historically, based on soils, much of the area delineated as Restoration Xeric Uplands-were likely scrub, scrubby flatwoods, or sandhill. Impacts in these areas are significant with most areas having been cleared for agricultural purposes prior to public acquisition. The majority of these areas within the North Shore include a moderate heavy coverage of non-native pasture grasses including bahia grass, Bermuda grass, and Pangola grass. In addition, rose natalgrass (*Melinis repens*), an invasive species, is also present in many areas. Portions of the Xeric Uplands-Disturbed areas have been planted in longleaf pine and wiregrass (*Aristida stricta*) with marginal success observed. Areas along the northern reaches of Ranch Road have also been planted in a variety of site-appropriate xeric oaks. Despite severe and long-standing alterations, many of these areas retain a remarkable diversity of rare and listed plant species including

Florida bonamia (*Bonamia grandiflora*), scrub plum (*Prunus geniculata*), Britton's beargrass (*Nolina brittoniana*), nodding pinweed (*Lechea cernua*), pygmy fringetree (*Chionanthus pygmaeus*), and clasping warea (*Warea amplexifolia*).

Developed and Remnant Infrastructure (63 acres, <1%)
Several areas of existing development and remnant infrastructure exist within the North Shore. These areas range from currently utilized offices, sheds, parking areas, pump structures, dilapidated barns, and concrete or asphalt slabs from removed structures and former airstrips.

Borrow Area (34 acres, <1%)
Numerous borrow pits are scattered across the North Shore. Many of these areas were mined for sand or clay, which was utilized elsewhere on the Property. A few of the borrow pits remain active and are located along the northern portion of the Property.

SOILS

The Lake and Orange County Soil Survey (General Soil Map, Lake and Orange Counties Area, Florida) shows the Property as being predominantly Everglades muck, Terra Ceia muck, and Gator muck, indicating that the area is nearly level with poorly drained soils (USDA SCS 2023). Although the soils for most of the Property are hydric, they are listed as having a high to very low infiltration rate dependent on the confining clay in the area. For several decades, the agricultural drainage and tillage of the North Shore's soils to facilitate farming activities resulted in significant soil oxidation and subsidence. Today, the former farm fields within the North Shore are approximately 5 feet below lake level, a significant change from their higher floodplain elevation prior to drainage.

In addition to farming activities and subsidence, District soil remediation projects have further affected soils within the North Shore. These projects were implemented across approximately 4,000 acres to reduce the concentrations of OCPs in the upper horizons of the soil through inversion of the upper 3 feet of soil, bringing cleaner, less-contaminated soil to the surface. The remediation technique, which buries the pesticides below the most biologically active portions of the soil profile, was implemented to reduce the exposure to fish-eating birds upon flooding and leave the most contaminated soils under anoxic conditions where OCP breakdown is facilitated.

According to data produced by the U.S. Department of Agriculture NRCS, there are 34 different soil types present within the North Shore. Full soil descriptions and a detailed map are provided in Appendix G.

CULTURAL AND HISTORICAL RESOURCES

Due to the proximity to a large waterbody and abundance of available resources, the North Shore has been a significant site for humans since before European colonization. The earliest human utilization of Lake Apopka is documented from around 10,000 B.C. However, the relative lack of significant upland areas at the Property would have limited habitation of the North Shore prior to hydrologic modifications. The Department of State Division of Historical Resources (DHR) maintains records of 14 separate archaeological resource sites on the Property. These sites include one prehistoric burial midden, one other midden, and six separate locations containing

dugout canoes. Several of the remaining resources are not well documented. If any previously undocumented sites are located, District staff will document and report the sites to the DHR.

IMPLEMENTATION

The following sections outline land management strategies for resource protection, land use, and administration on the North Shore for the next 10 years. Management Review Teams, as outlined in Section 373.591, Florida Statutes, are convened every 5 years to ensure the goals and strategies listed below are achieved.

RESOURCE PROTECTION AND MANAGEMENT

Water Resources

Goal: Protect water quality and quantity; manage hydrology to support diverse wetlands, as feasible

Strategies:

- Manage water resources to meet established Lake Apopka phosphorus criterion
- Maintain water resource structures database, incorporate maintenance and repair; add or remove structures as necessary
- Continue water quality monitoring on-site
- Continue hydrologic monitoring on-site
- Evaluate each hydrologic area's water level management based upon wetland health
- Assess areas of high nutrient inputs and identify methods to improve water quality prior to discharge to the lake
- Continue to coordinate with LCWA on discharges from the North Shore to ensure a majority of discharged water is treated by the NuRF
- Evaluate the feasibility of using North Shore water for beneficial water supply uses rather than pumping to the lake
- Continue to operate the MFW to reduce TP and Total Suspended Solids (TSS) from the lake's water column
- Assess success of beneficial use of dredged material (BUD MAT) projects and, if appropriate, pursue additional projects
- Assess need for additional water control structures or pumps

The primary goal of water resource management throughout the North Shore is to continue to improve water quality in Lake Apopka. In recent years, decreased loads from the North Shore and other projects have resulted in TP concentrations in the lake approaching the target TMDL concentration of 0.055 mg P/L. The decreased loading was possible as the entire North Shore was able to be safely inundated from an OCP exposure perspective. Prior to the USFWS 2018 concurrence that the District could safely implement the full range of management actions, portions of the North Shore were intentionally allowed to develop dense stands of cattail, willow, and other vegetation that restricted the foraging of fish-eating birds as means to reduce OCP exposure. After 2018's concurrence, the District began managing the Property to reduce dense vegetation and create more attractive wetlands for fish-eating birds. A multi-pronged approach is required to accomplish the water resource goals of managing water quality, restoring wetland

hydrology to the extent feasible, and maintaining the restored condition of the North Shore while maintaining a focus on water quality in Lake Apopka. Continued collaboration between staff in the District's bureaus of Basin Management and Project Development, Environmental Sciences, Land Resources, Operations and Maintenance, Projects and Construction, and Water Resource Information will ensure that the water resources within the North Shore are managed to protect water quality in Lake Apopka as well as improve the mosaic of wetland systems on the North Shore.

A District-funded study of water resource infrastructure at the North Shore identified possible improvements that would maximize water level management within the North Shore to promote SAV growth (District 2018). Certain recommendations from this study have been implemented. As the North Shore's infrastructure continues to be utilized, further assessment should be conducted to identify additional water resource infrastructure that could contribute to optimizing water levels throughout the Property to support a diversity of desirable wetland habitats.

The collection of relevant water quality and hydrologic information is necessary to effectively manage water resources. The District will continue to monitor both water quality and hydrologic conditions at the North Shore. Relevant data for all North Shore roads, levees, and water control structures is stored in a Geographic Information System (GIS) database. This database requires ongoing maintenance as infrastructure is added, removed, repaired, maintained, or modified.

The telemetry network of water elevation monitoring stations across the North Shore allows staff to monitor water levels continuously and make necessary changes in operation of pumps and water control structures. Two pumps installed in 2021 allow more flexibility in internal water management across Duda and Phases 6, 7, and 8. This increased flexibility in turn improves habitat restoration potential and reduces discharge to the lake (Table 2, Figure 15). The first pump is an interconnect pump that allows the movement of water from the Duda phase into Lake Level Canal. The second pump moves water into Phase 4, which is planned to have greater water storage and host a deeper water wetland community. Pump operational criteria are described more fully in Canion and McCloud (2020) (Appendix E).

Table 2: Summary of current pump-on elevations (ft NAVD88) for Water Management of North Shore *(Canion and McCloud, 2020). Cells with two values indicate a seasonal schedule (May 1–Sept. 30 / Oct. 1–April 30). Culvert discharge elevations have been omitted for simplicity.*

Water elevation (NAVD88)	Unit 1 Pump	Unit 2 Pumps	Duda Pumps	Duda Interconnect Pumps	Phase 4 Pump	F-pump
Pumps on	61.5/62.5	62.5/63	62.5/63	61	61	65.5
Pumps off	61/62	62/62.5	62/62.5	60.5	60.5	65

Table 3. Water level criteria for high water levels which protect levees and low water elevations set to protect conditions for emergent wetland vegetation. All elevations are in ft. NAVD88.

	Zone 1	Zone 2	Zone 3	Zone 4	Duda	F-pump

Target water level	61	60.5	61.5	61	60.5	64.5
Undesirable 7-day max	63.5	63.5	63.5	63.5	63.5	66
Minimum desirable	58.9	58.6	59.6	59	59.5	Average bottom elevation unknown
60-day low	58.5	58	59	58.5	59	Average bottom elevation unknown

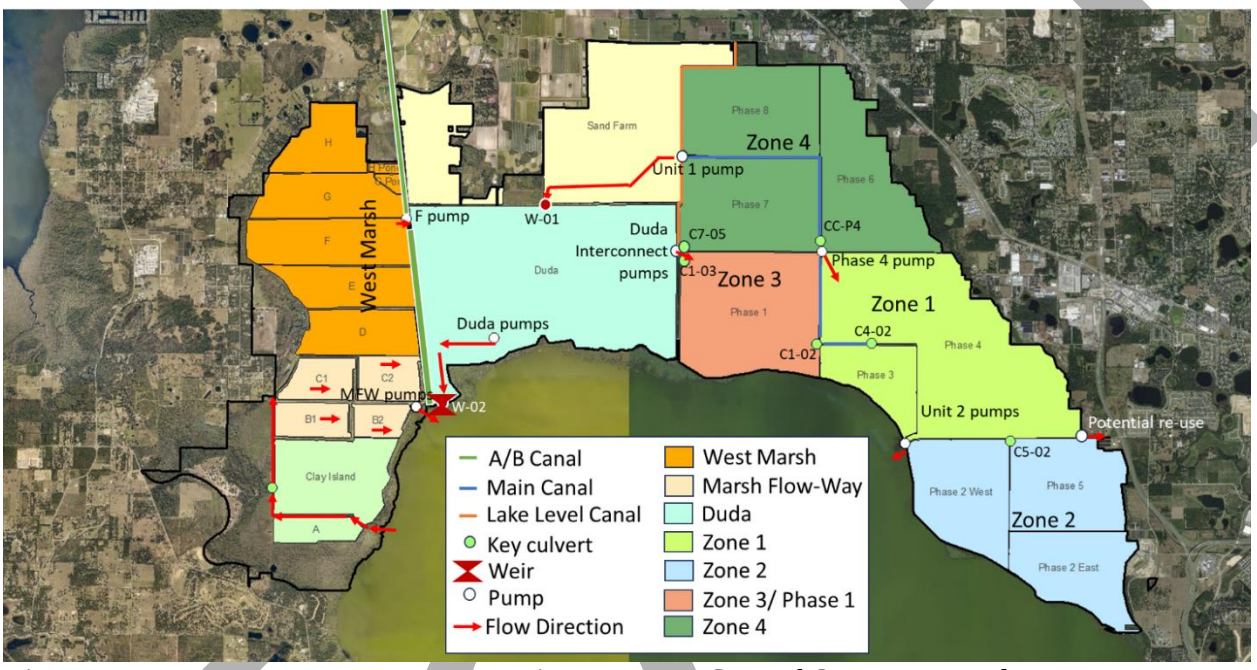


Figure 15: Water Management Zones, Primary Water Control Structures, and Pumps

Water quality within the North Shore can be influenced by zone, retention time, water depth, and source of water. To help meet the lake's TMDL, minimizing TP loading to Lake Apopka is accomplished primarily by an overall reduction in volume of water discharged to the lake and treating water with alum when needed prior to discharge. Stormwater runoff entering the North Shore consistently has elevated TP concentrations (Table 1). This runoff flows into phases 1 and 7 and then out through Phase 4. There is evidence of nutrient attenuation through wetland processes occurring within the North Shore, when comparing concentrations entering the Property to those prior to discharge. Opportunities remain to evaluate and continue treating offsite nutrient load to the North Shore.

Additionally, Lake Apopka water quality is improved on the North Shore by the operation of the MFW. The MFW, on the western side of the Property, improves the water quality of Lake Apopka by trapping and removing algae and suspended sediment and associated nutrients from the lake's water column as it moves through the MFW. Initial target operational efficiencies are 90% for TSS and 25–30% for TP. However, as TP concentrations in the lake have decreased over time, TP removal efficiency has also decreased for the MFW with an annual total removal efficiency of 12% for 2023. Operation of the MFW not only removes nutrients from the water

column but also improves water clarity by removing TSS. Annual removal efficiency of TSS for 2023 was 89%.

Downstream of the North Shore, on the A-B Canal, the LCWA owns and manages the NuRF. The NuRF takes water from the A-B Canal, above the dam, and removes nutrients—primarily phosphorus—before returning the cleaned water back into the A-B Canal below the dam. The NuRF is located at the dam to take advantage of the water elevation drop at the dam and thereby use gravity to move water through the treatment process.

It is the goal of the District and LCWA to maximize the fraction of water discharged from Lake Apopka that passes through the NuRF. The District determines on a daily basis the flow out of the lake and coordinates with the LCWA on whether the NuRF can treat this flow. If the LCWA determines that it cannot treat the flow out of the lake, the District will open the dam's gate. In this scenario, the NuRF's flow and treatment capacity is maximized while the dam will discharge the balance. When the dam is open, the District should make every effort to stop discharges from the North Shore. This does not include the MFW because its operation does not add water to the lake. Once the required discharge from the lake can be treated by the NuRF and the dam closed, the District can reinitiate pumped discharges from the North Shore.

Alternative water supply projects on the North Shore may be implemented to further reduce pumping to Lake Apopka and improve local water supply resilience. Use of surface water from the North Shore should not cause water levels to fall below the lowest desired water level identified in Canion and McCloud (2020) or updated evaluations of the North Shore wetlands' hydrologic needs to prevent further oxidation and subsidence of wetland soils.

A conceptual permit from the Florida Department of Environmental Protection (FDEP) for projects utilizing BUD MAT on the North Shore has been obtained by the District and is in effect until 2039. The lake-wide dredging and placement permit from the U.S. Army Corps of Engineers is in effect until 2030. Each phase across the North Shore was identified as a potential recipient of dredged sediment material from a specific area of the lake. These projects would help to cover soils with historically elevated residual OCPs and help raise the soil elevation to offset historic subsidence.

Forest and Ecological Management and Restoration

Goal: Maintain, improve, and restore forest and non-forested land cover

Strategies:

- Maintain fire-adapted natural communities with appropriate burn return interval
- Manage vegetation within managed marshes to provide a mosaic of habitats
- As feasible, manage hydrology within managed marshes to provide a mosaic of habitats
- Continue to evaluate, implement as possible, hydrologic drawdowns within portions of managed marsh
- Pursue partnerships to expand wetland habitat enhancement and management
- Develop and implement phased plan to reduce nuisance plant abundance and promote desirable species coverage to achieve desired habitat mosaic
- Conduct forest management activities within the Sand Farm (Zellwin Farms) parcel that facilitate invasive species management and promote forest health

Natural system and habitat management on the North Shore is primarily focused on non-forested wetlands. Prior to District acquisition, these marshes experienced a long history of hydrologic modifications and agricultural production. Over the course of the District's management of the Property, habitat management objectives have shifted as part of efforts to manage and reduce OCP exposure to wildlife and in response to changes in guidance from regulatory agencies, especially the USFWS. Since 2018, District resource managers have been engaged in the full range of active management of wetland habitats. The goals of this active management are to improve water quality as well as a range of conditions for a variety of fish, wildlife, and plants. Management actions have included installation of new water control structures, herbicide treatments for nuisance and invasive plants, and prescribed fire. Nuisance species are defined as native species that cause economic or environmental harm (Iannone 2021). The primary nuisance vegetation targets for management on the Property historically have been cattail (*Typha* sp.) and Carolina willow (*Salix caroliniana*). Numerous species of invasive plants have also been treated on the North Shore and are discussed in the Flora and Fauna – Invasive Species Management section of this document.

In general, when considered across the entire North Shore, land cover changes between 2013–2021 within managed marshes on the Property have been positive. Based on District data, shrub-dominated wetland acreage has decreased by more than 4,200 acres (Figure 16 and Table 4). This is considered a benefit due to the high evapotranspiration rate and low biodiversity typically found in large stands of woody shrub-dominated wetlands (Hall, 2017). Over this same period, mixed herbaceous emergent marsh, open water, and SAV have all increased in acreage, by 1,637 acres, 2,192 acres, and 178 acres, respectively. All these increases can generally be seen as positive and illustrate progress toward creating a mosaic of native wetland communities.

When the distribution of these land covers is examined in more detail, certain spatial patterns become obvious. In general, desirable habitat increases have been concentrated in a few specific areas. Most of the open water increases are concentrated in the eastern portions of the North Shore, especially Phase 4. Similarly, much of the herbaceous emergent gains have been in Duda, and SAV increases have been concentrated in the West Marsh. Ideally, these various

cover classes would be more heterogeneously distributed, with a mosaic of emergent vegetation, SAV, and open water occurring across the Property.

Numerous strategies and actions address improving overall health and distribution of marsh vegetation communities. The most fundamental strategies to increase the heterogeneity of marsh communities relate to the management of hydrology. These strategies include the management of water depth, timing, and duration of flooding—often in concert with other vegetation management techniques such as herbicide application and/or prescribed burning—to limit the expanse of monotypic vegetation. Drawdowns are a specific management strategy that is used in wetland and aquatic habitat management to reduce water levels, often to the point of exposing sediments for limited periods. Across wide expanses of open water marsh, drawdowns are the most effective means to reestablish emergent vegetation by allowing germination of new emergent plants. Conducting drawdowns on the North Shore has been limited in the past by legacy soil OCP concentrations, soil oxidation avoidance/mitigation, and the limited ability to move sufficient water between the various phases of the Property. The opportunity to pursue drawdowns within portions of managed marsh should continue to be considered; drawdowns should be implemented as appropriate and part of ecohydrological plans.

Management of hydrology to affect marsh vegetation condition and improve overall marsh structure and composition should be conducted as part of an integrated strategy that includes other management techniques such as mechanical treatments, herbicide application, and prescribed fire. The District will develop and implement a phased plan to improve the marsh vegetation mosaic across the North Shore, utilizing the integrated techniques listed above. This plan will identify targets for specific vegetation communities within specific phases of the Property. Across the North Shore, meeting these targets will require reducing nuisance and invasive vegetation coverage and improving coverage of desirable vegetative components. Vegetation community targets should be compatible with hydrologic conditions that are reasonable to expect within each phase, given constraints of water management infrastructure and existing land elevation. The plan will prescribe a series of management actions to conduct, given both existing and desired future marsh vegetative conditions, establishing a framework or model for decision making.

It is vital that North Shore habitat management planning provides the opportunity for adaptability in the decision-making process to accommodate potential future needs for alternative water supply projects. The development of any potential future alternative water supply projects should be done in collaboration with the establishment of vegetation community targets for the North Shore. Establishing hydrologic regimes that support a wide range of wetland communities — from wet prairie to low-stature emergent marsh to open water SAV-dominated marsh — should be a priority for future hydrologic management decisions. .

The District intends to pursue collaborative partnerships with local, state, and federal agencies, as well as non-governmental organizations, to receive funding, technical, and/or logistical support for implementation of marsh management strategies on the North Shore. Possible partners with an established record of wetland restoration, enhancement, and management achievements include but are not limited to USFWS, FWC, Ducks Unlimited, and FDEP.

A forest resource analysis was conducted taking into consideration the timber management requirements in section 253.036, Florida Statutes, wherein the feasibility of managing timber resources on the North Shore for resource conservation and revenue generation purposes

through a stewardship ethic that embraces sustainable forest management practices was assessed.

Primary objectives of upland management on the North Shore are restorative in nature and are to improve species diversity and the overall natural community health and vigor. Harvesting of timber resources may occur in response to disease, insect infestation, or mortality from wildfire or wind events. All revenue generated through forest management is applied toward the District Bureau of Land Resources' budget to offset management costs for the Property.

The management objectives of the North Shore will require pine harvesting. In addition to planned forest management activities, the District will remove trees as needed in the case of insect infestations, disease, and damage from severe weather, wildfire, or other occurrences that could jeopardize the health of natural communities. Harvesting may also provide some protection against wildfires and pine beetle outbreaks. The District will abide by Florida Silviculture Best Management Practices, Florida Forestry Wildlife Best Management Practices for State Imperiled Species, and will target the achievement of appropriate overstory species in proper stand densities as described in the District Forest Management Plan (Appendix H).

Most of the upland portions of the North Shore, at the time of acquisition, were highly disturbed and in many cases void of site appropriate vegetation. Many of these areas were abandoned agricultural fields. District staff implemented site preparation activities that included the application of herbicide and the implementation of prescribed fire. The areas were planted in either slash or longleaf pine. Groundcover in these areas is highly disturbed with only the most resilient and disturbance-adapted native species remaining. Extensive areas of cogongrass (*Imperata cylindrica*), approaching 25–50% coverage of the entire area, are established throughout the planted pine of the Zellwin Farms (Sand Farm) parcel. Treatment of this cogongrass population will likely require removal of trees from a majority of this stand.

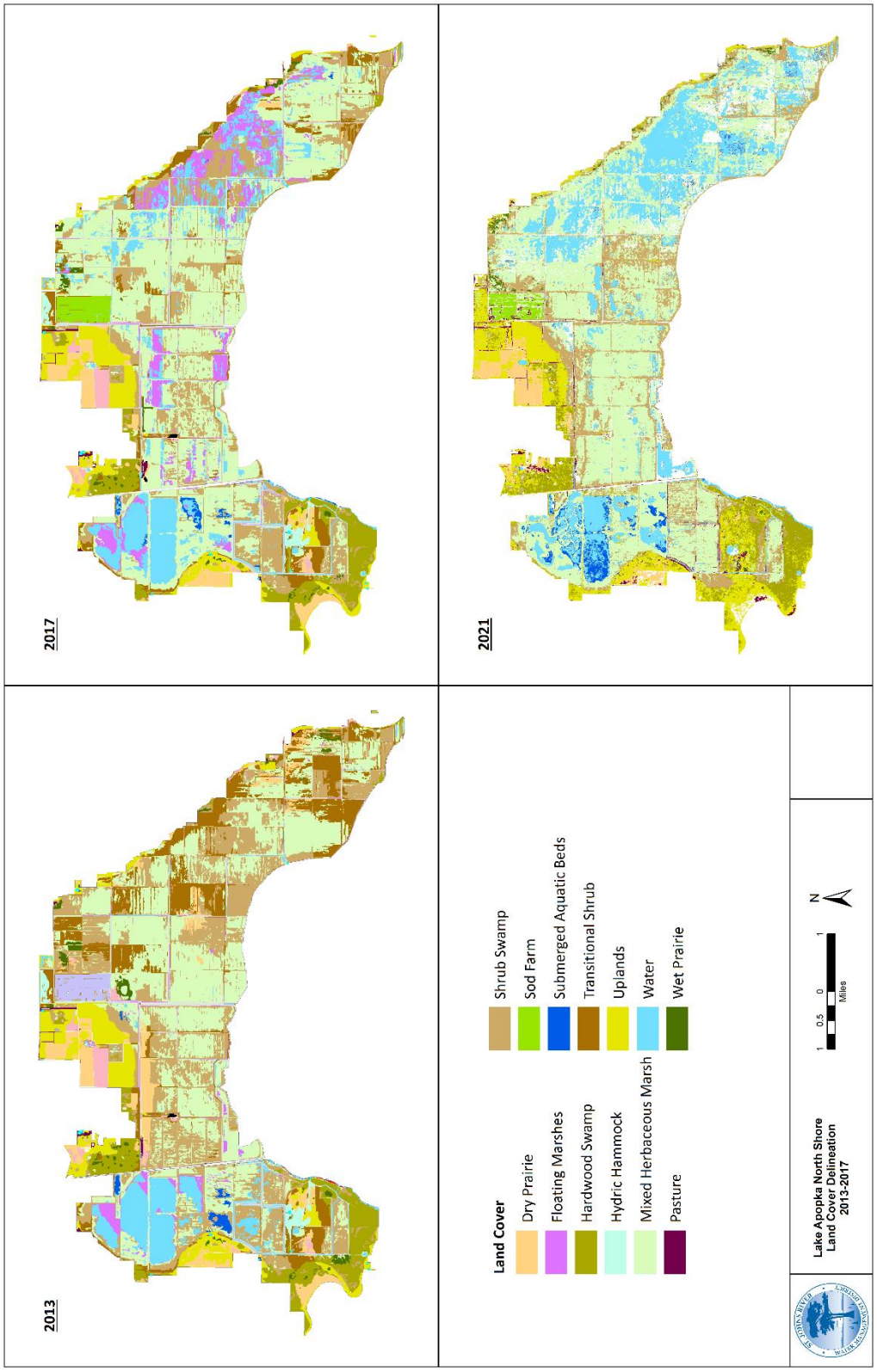


Figure 16: Land Cover Change from 2013-2021

Table 4: Acreages for select land cover classes from 2013 to 2021

Land Cover	2013	2017	2021	2013–2021
Dry Prairie	1,082	713	562	-520
Floating Marshes	299	1,265	NA	-299
Mixed Herbaceous Marsh	6,068	7,268	7,705	1,637
Shrub Swamp	4,767	3,489	2,929	-1,838
Submerged Aquatic Beds	93	83	271	178
Transitional Shrub	2,400	1,053	NA	-2,400
Uplands	1,262	1,173	1,879	617
Water	1,204	2,214	3,396	2,192

Fire Management

Goal: Implement a prescribed burning program in accordance with District's Fire Management Plan

Strategies:

- Implement prescribed burning as described in the District's Fire Management Guidelines and Procedures (FMGP) and the Lake Apopka North Shore Fire Management Plan
- Develop annual burn plans and populate the fire management database (FMD) after prescribed fire or wildfire event
- Conduct firebreak maintenance
- Create and maintain new firebreaks, as needed, and approved by the program manager

Ecological and fire management activities within the Property are critically important and integrally linked. The planning and implementation of habitat and fire management activities must be coordinated to achieve restoration and management goals.

Fire is a vital factor in managing the character and composition of vegetation in many of Florida's natural communities. The District's primary use of fire is to mimic natural fire regimes to encourage the amelioration of native pyric plant communities and dependent wildlife. Additionally, the application of fire aids in the reduction of fuels and minimizes the potential for catastrophic and damaging wildfires. A vast majority of the land cover at the North Shore has the potential to contain fire-adapted vegetation. The lack of pyric graminoid species within the North Shore's managed marshes currently limits the use of prescribed fire across much of the Property. Where it can be applied, prescribed fire is an important tool for use in the restoration and maintenance of plant communities within the Property. Since the writing of the last plan, more than 13,764 acres of the Property have received prescribed fire at least once at the North Shore (Figure 17). Accounting for multiple burns in many units, prescribed fire has been applied to 22,073 acres since 2013.

Historically, most fires occurring on what is now the North Shore would have been ignited by lightning during the growing season. The District intends to reintroduce growing-season fires

where possible, understanding that constraints in some areas such as young pine plantations, high fuel loading, potential for organic soil fires including within the levees, and proximity to smoke-sensitive areas may predicate the use of dormant season burning.

The Property has 18.9 miles of pre-suppression firebreaks to allow for access and control of prescribed fire and wildfires. These breaks are disked one to two times a year to maintain the footprint of the break and provide a mineral soil fuel break. Interior roads are also used as firebreaks. In addition to these existing breaks, additional firebreaks may be considered during the term of this plan. As these breaks are constructed, this will allow additional Fire Management Units (FMUs) to be incorporated into the Property's prescribed fire goals.

While prescribed fire is the preferred tool for restoration and maintenance within the Property, it may be necessary, under certain circumstances, to implement alternative methods. During periods of extended drought conditions or in upland areas where implementing prescribed fire safely is not feasible, the District may employ management methods such as selective herbicide treatments, mowing, mulching, roller chopping, and overstory manipulation through timber harvest. In wetlands, prescribed fire surrogates may include mechanical harvesting, mechanical shredding, herbicide applications, and hydrologic manipulations.

In addition to a general lack of pyric fuels, particularly within the managed marshes, limiting factors narrowing the window of opportunity for the application of prescribed fire on the portions of the North Shore is the close proximity to critical smoke-sensitive areas including U.S. Highway 441, State Road 44B, airports, numerous surface streets, and suburban and residential areas, and the down drainage effects of Lake Apopka and other water bodies. Smoke management is paramount, and any potential burns will be conducted to minimize off-site impacts by maneuvering smoke plumes away from smoke-sensitive areas and by ensuring adequate smoke dispersal. Smoke management concerns and smoke radii for the North Shore are depicted in Figure 18.

A significant consideration when implementing prescribed fire within the Property is the necessity of keeping fire from igniting organic wetland soils. Under dry conditions these soils will smolder for extended periods of time, creating a problematic smoke management situation and further exacerbating soil loss that has impacted the area from prior land uses. Appropriate soil and fuel moisture conditions will be selected to mitigate this potential.

All implementation of prescribed fire within the Property will be conducted in accordance with the District's FMGP, the Lake Apopka North Shore Fire Management Plan (Appendix I), and annual burn plans for the Property. Prescribed fires and wildfires will be reported in the Prescribed and Wildfire Report in Survey123, which updates the FMD.

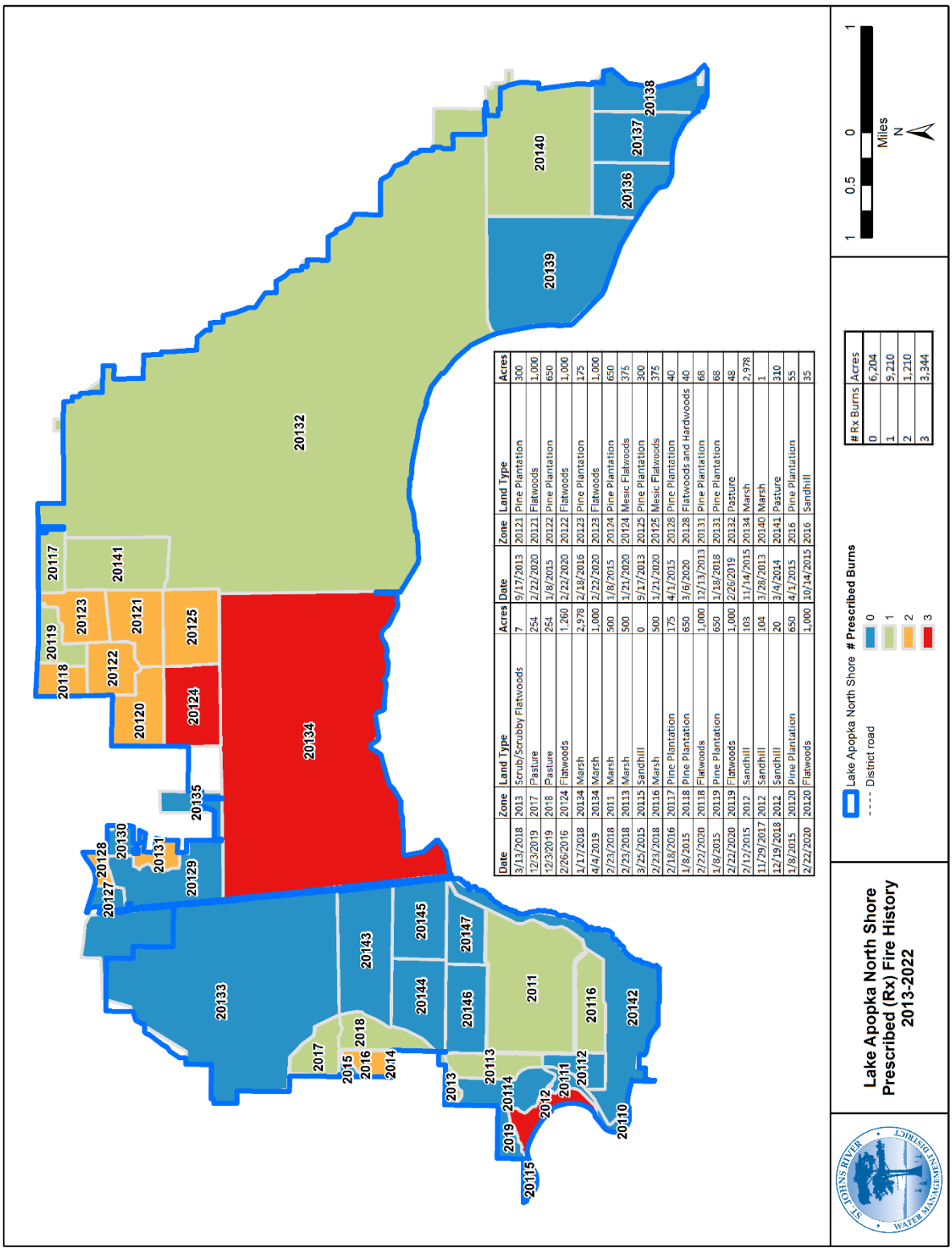


Figure 17: Fire History Map

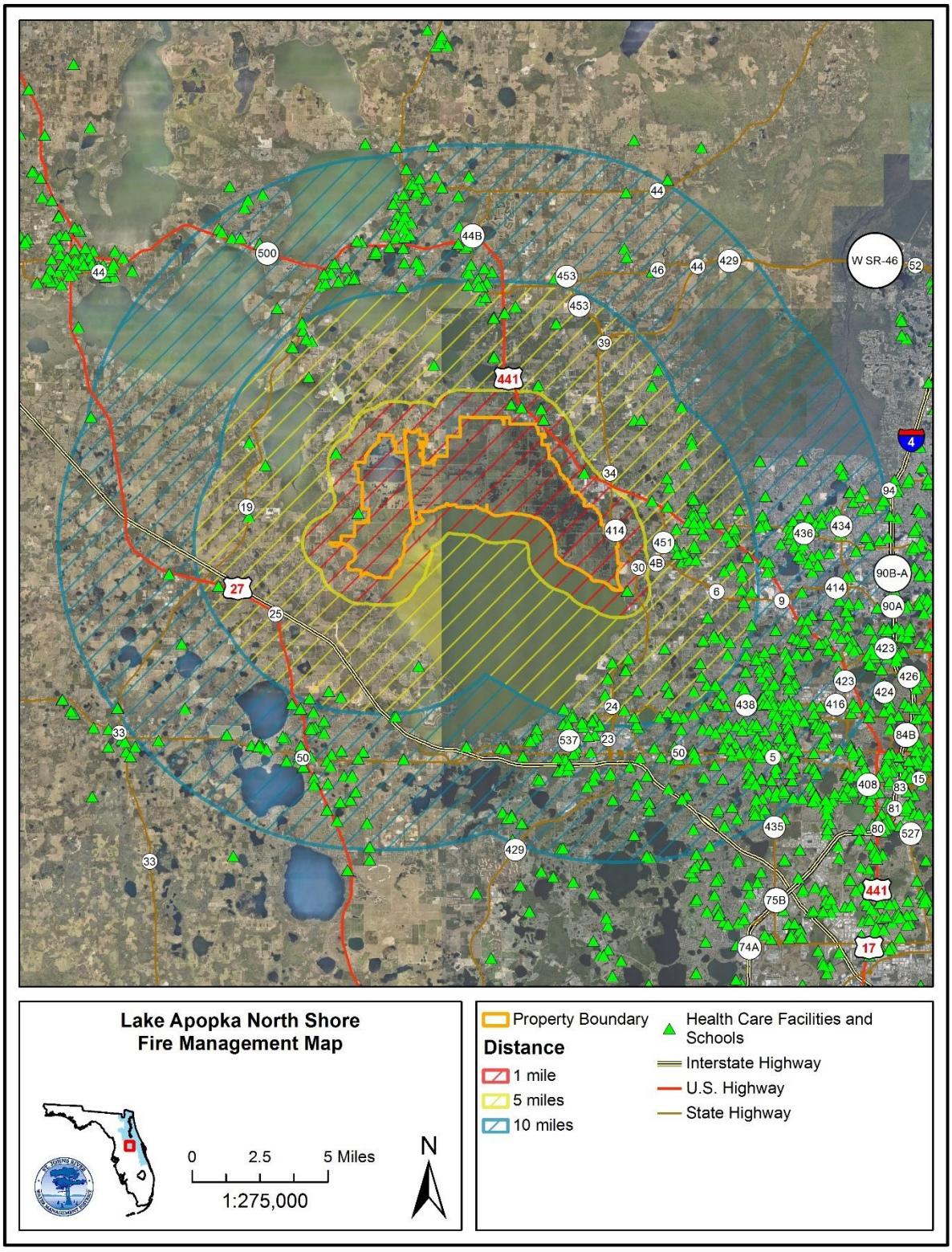


Figure 18: Fire Management Map

A system of Fire Regime Condition Class measures was originally developed in 2003 by the Nature Conservancy and the USDA Forest Service to assess ecosystem health. The system is based on a relative measure and describes the degree of departure from the historical natural fire regime of a given ecosystem (Hann et al. 2003). This departure results in changes to one or more of the following ecological components: species composition, structural stages, stand age, canopy closure, or mosaic pattern. The District adopted the system in 2008 to establish a reference for ecosystem health and land management effectiveness. While fire is the preferred disturbance that maintains most natural communities in Florida, other disturbances, such as timber harvest or mechanical fuels treatments, may serve to accomplish or aid in the accomplishment of management objectives. Annually, each burn zone is assigned a Condition Class score based upon the most recent disturbance and the fire frequency recommended for that plant community by FNAI. If FNAI recommends a fire return interval of 3–5 years, a plant community that has benefited from disturbance in the past 5 years is in Condition Class 1. If it has been more than 5 years but less than 15 years, or three cycles, the zone is in Condition Class 2. If it has been more than three times the fire return interval, but can still be recovered by fire, it would fall into Condition Class 3. If the plant community has gone without disturbance so long that fire alone can no longer restore the area, it is in Condition Class 4. The North Shore has approximately 1,329 acres that are not maintained by fire or disturbance; these areas are referred to as Condition Class 5.

District staff will make annual condition class assessments and incorporate them into annual burn and work plans. The overall condition class distribution of the Property zones in 2023 was 91 percent Condition Class 1, less than 1 percent Condition Class 2, and 1.5 percent in Condition Class 4. In 2023, no zones fell within Condition Class 3. Since 2013, there has been a large increase in the percentage of zones in Condition Classes 1 and a decrease in Condition Class 4 (Figure 19). A vast majority of the condition class improvement occurred following the 2018 increase in active management activities within North Shore managed marsh habitat.

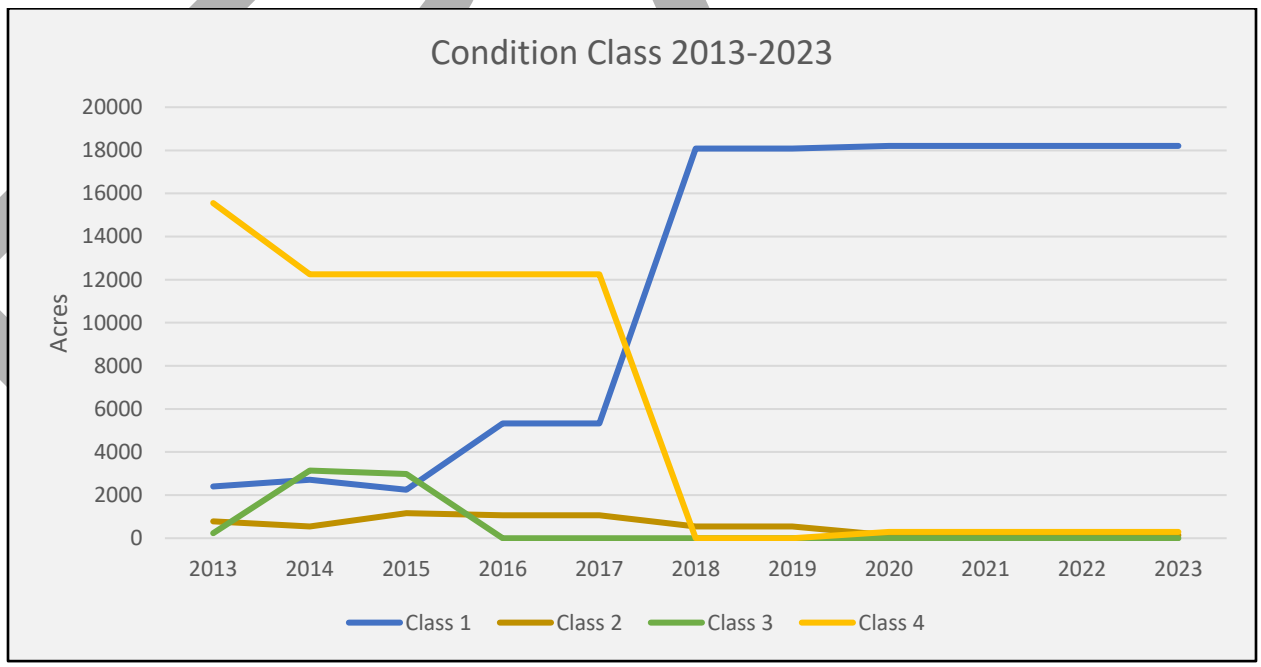


Figure 19: Condition Classes

Flora and Fauna – Native and Listed Species

Goal: Maintain, improve, or restore native and listed species populations

Strategies:

- Conduct plant and wildlife surveys and develop species lists
- Monitor for the presence of listed species and adjust management actions appropriately
- Continue partnership with the Florida Native Plant Society (FNPS) and other organizations to manage Lake Wales Ridge (LWR) endemic plant populations
- Coordinate with USFWS, FWC, and other organizations on listed species monitoring and management
- Coordinate with USFWS prior to conducting management activities not described within relevant biological assessments

Despite the extensive disturbance, the North Shore supports a wide range of conditions that provide important habitat for a variety of floral and faunal species. Of notable occurrence is the suite of avian species known to utilize the managed marsh portions of the North Shore. District staff, contractors, and volunteers have documented numerous floral and faunal species from across the North Shore and these observations are compiled into the North Shore species list (Appendix J). The Property species list also includes quality-checked species occurrence records gathered from the crowdsourced community science databases iNaturalist and eBird. The District will continue to conduct periodic plant and wildlife surveys and collect opportunistic records of species occurrences.

Below are descriptions of taxa documented on the North Shore that are significant for various management reasons. When conducting activities that may impact listed species, the District will utilize all relevant management guidelines including but not limited to the FDAC's Forestry Wildlife Best Management Practices for State Imperiled Species and FWC's Species Action Plans (https://myfwc.com/wildlifehabitats/wildlife/species-action-plans/). District staff will continue to coordinate with USFWS, FWC, and other organizations to conduct listed species monitoring as needed. Relevant agencies will be consulted during planning of projects that fall within known listed species habitat. Additionally, District staff will coordinate with the USFWS prior to conducting any resource management activities that are not described within relevant biological assessments and/or biological opinions. The primary biological assessment covering the North Shore (Bowen 2018) allows for most customary marsh management activities, with the exception of disking, tilling, or any other sediment disturbance.

Rare and Listed Plants

Some of the more remarkable plant species documented within the upland portions of the North Shore include Florida bonamia, pygmy fringe tree, scrub buckwheat, Britton's beargrass, scrub plum, and clasping warea, all federally listed plants.

The District has worked with volunteers, including groups from local FNPS chapters, to develop a better understanding of the occurrence and distribution of rare and listed plants across the Property. Additionally, portions of the North Shore's disturbed xeric uplands have been actively managed as a recipient site for native scrub and sandhill plant species. In most cases these plants

— largely representing rare and endemic LWR species — have been rescued by volunteers from nearby sites prior to those sites being developed. In the rapidly developing northern LWR, the North Shore acts as an important refuge site for these species. The District will continue to work with FNPS and other partners to continue supporting native plant conservation actions at the North Shore.

Restoration and land management techniques across much of the North Shore will include mechanical treatments, herbicide applications, prescribed fire, or a combination of techniques. Management activities that occur in areas where rare or listed plants are known to occur will be conducted, to the extent possible, in such a way as to identify and provide the most protection for these plants. The District will continue to work to expand populations of listed and rare plants through appropriate management actions that may include prescribed fire, planting, and seeding.

Sand Skink

The sand skink (*Neoseps reynoldsi*), a federally threatened species, is documented within the North Shore. This species is a small, seldom-seen lizard, about 5 inches long. Sand skinks are fossorial, spending the majority of their life below the sand surface, and feed on a variety of arthropods including beetle larvae and termites. Sand skinks have reduced/vestigial limbs that press into the body allowing for the "characteristic 'sand swimming' locomotion" (Christman 1992). The characteristic sine-wave trails in the sand created by this form of locomotion is the primary method of detection for this species.

Sand skinks are endemic to central Florida and are only known to occur along the Central Ridge, from Marion to Highlands counties and are most abundant on the LWR. Populations occurring on the Mount Dora Ridge are rare and highly localized (Christman 1992). Sand skinks occur in areas of rosemary scrub, sand pine scrub, oak scrub, scrubby flatwoods, "turkey oak barrens" (Christman 1992), and sandhills, as well as disturbed areas such as citrus groves and pine plantations. Ideal habitat is not fully described although ideal sand skink habitat is generally thought to include sandy areas that have a "low coverage of grasses, contain ample areas of bare sandy ground, have low canopy coverage" (Christman 1992). Sand skink distribution is also strongly associated with certain elevations and soils. Sand skinks typically occur in areas of higher elevation and on well-drained sandy soils that include Apopka, Arredondo, Archbold, Astatula, Candler, Daytona, Duette, Florahome, Gainesville, Hague, Kendrick, Lake, Millhopper, Orsino, Paola, Pomello, Satellite, St. Lucie, Tavares, and Zuberin. Anecdotal observations of sand skink occurrence within the North Shore suggest they occur across much of the uplands in the western portions of the Property.

Population decline of sand skink is due primarily to loss of habitat resulting from agricultural, commercial, and residential development in Florida. Sand skinks are sensitive to disturbance, particularly when activities disturb the soils. According to the Biological Opinion (BO) (Log# 41901-2011-F-0297) received by the District from the USFWS for the Astatula Scrub Restoration (ASR) project, mechanical and pyric disturbances may have an adverse effect on sand skink either through direct mortality or from soil compaction. However, since restoration activities are deemed beneficial to this species, an incidental take of no more than 10-percent harm, 10-percent harassment, or 10-percent mortality is authorized in the BO. Activities that occur within the ASR project area are subject to the terms of the BO and should be screened by

appropriate land management staff. The USFWS Species Conservation and Consultation Guide does not supersede the BO but may provide additional guidance. In other portions of the Property, management activities that will result in disturbance of soils indicated above, outside of existing roads and fire lines, including disking, grading, roller chopping, tilling, hardening of roads, excavating, deposition of fill or other material, or the use of heavy equipment should consider the presence of sand skink and coordinate with land management staff.

Gopher Tortoise

The gopher tortoise (*Gopherus polyphemus*), a State Threatened species, occurs within the North Shore, primarily in the areas of pine plantation, in the scrub, and disturbed upland fringes of the Property. Gopher tortoises excavate deep burrows and are considered a keystone species because their burrows provide refuge for more than 300 animal species. Management activities within the upland communities of the Property will focus on restoring species composition that will benefit gopher tortoises. When conducting activities that may impact gopher tortoise, the District will utilize FWC's Gopher Tortoise Management Plan (https://myfwc.com/media/1819/gt-management-plan.pdf).

The North Shore is not suitable as a gopher tortoise recipient site. While not in conflict with the conservation management purpose of the Property, the Property's poorly drained soils and restoration natural community site conditions do not provide adequate habitat following FWC's Gopher Tortoise Permitting Guidelines (FWC 2023).

In January 2011, District staff conducted a 10% baseline gopher tortoise burrow survey in advance of the development of the ASR plan. All active and potentially active burrows were documented and flagged, and GPS locations were recorded. The survey was conducted utilizing established protocol and the results were split providing population estimates for northern and southern portions of the ASR area. A total of 38 burrows were identified, of which six were abandoned, and no juvenile burrows were observed. Using the most recent method of measuring gopher tortoise population densities, District staff determined a population estimate of ~0.77 tortoises per acre on the northern sites and ~1.78 per acre on the southern sites. This population estimate indicates low occupancy and is what might be expected on such a degraded and marginal site. The carrying capacity for intact sandhills can exceed four tortoises per acre (Ashton 2008).

Eastern Indigo Snake

The eastern indigo snake (*Drymarchon couperi*), a federally threatened species, is documented within the Lake Apopka North Shore. The eastern indigo snake is the longest of the North American snakes, is relatively docile, and non-venomous. Animals of this species are iridescent bluish-black bodied with reddish, orange, or cream-colored pigment on the chin and sides of the head. This species is a habitat generalist, utilizing a wide variety of habitat types both natural and human-altered, including flatwoods, sandhills wet prairies, hammocks, and citrus groves (Behler 1979, Moler 1992). As of the writing of this plan, the most recent observation of this species occurred off Ranch Road in June 2012 and off Lust Road in September 2012. While there are no special management considerations with regards to the management of habitat for this species, District staff will observe the Eastern Indigo Standard Protection Measures and Education Management Plan. All workers within the North Shore, including contractors and volunteers,

should be made aware of this plan and the legal penalties for anyone who injures, harms, harasses, or kills an eastern indigo snake.

Florida Black Bear

The Florida black bear (*Ursus americanus floridanus*) is documented within the North Shore, and numerous road-killed and nuisance animals have been documented in close proximity of the North Shore. In addition to habitat loss and fragmentation and a host of diseases and parasites, threats to the bear include human caused mortality and incompatible habitat management. Human caused mortality typically includes illegal killing, euthanasia performed on nuisance bears, and roadkill (FWC 2019). The northern portion of the North Shore lies within the secondary range for the Ocala population of the black bear, and the Property is just west of the primary range. To the extent that issues relate to District-managed lands, District staff will coordinate as necessary with the FWC and other relevant parties regarding the management of bear habitat and the facilitation of movement across the landscape.

Barn Owl

In 2005 and in response to periodic outbreaks of rodent populations 1998–1999, the District began the Barn Owl (*Tyto alba*) nest box project on the North Shore and in nearby areas. The District since 2006 has installed 21 nest boxes, many of which were donated by the Space Coast Audubon Chapter. The nest boxes have proven successful, with monitoring data revealing generally positive trends with high occupancy and nesting, with many boxes having multiple nests documented each year. The owl boxes have proven to be an effective tool in providing opportunities for the expansion of owl populations in response to increasing rodent populations. The predator-prey relationship is highlighted when rodent population data, collected by the University of Central Florida in cooperation with the District, is compared to owl box activity data. Increases in rodent populations are met with increases in Barn Owl populations.

It is anticipated that monitoring and maintenance of nest boxes will continue through the scope of this plan; however, these activities are subject to staff and budget availability.

Bald Eagle

The North Shore is in an area of significant Bald Eagle (*Haliaeetus leucocephalus*) nesting site activity. Twelve Bald Eagle nest sites are currently documented within, or on, the North Shore property boundary. Numerous other nest sites are within close proximity of the North Shore. The District will adhere to the guidelines established in the February 2006 USFWS Draft National Bald Eagle Guidelines. This document is effective following the delisting of the species from the Endangered Species list. The Bald Eagle continues to receive protection through the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The District will consult with the FWC and/or the USFWS, as applicable, prior to conducting management activities within the established management zones that may impact bald eagle nesting between the dates of October 1–May 15. Additionally, the District will confirm activity status at known nesting sites as needed. Should new nest sites be identified, GPS locations will be recorded and incorporated into the District database. The District currently maintains a Special Use Authorization granting National Audubon Society's Eagle Watch Program vehicular access to specific North Shore roads for the purpose of conducting eagle nest monitoring on a regular basis.

Wood Stork

The North Shore lies within portions of a core foraging area for a nesting colony of the federally endangered Wood Stork (*Mycteria americana*). This rookery is documented approximately 13 miles to the north of the North Shore (Wood Storks 2010) and the Property is within the foraging area radii limits established for north Florida wood stork rookeries. The District will adhere to the guidelines established in the January 1990 U.S. Fish and Wildlife Service (FWS) *Habitat Management Guidelines for the Wood Stork in the Southeast Region.*

Everglade Snail Kite
Federally endangered Everglade Snail Kites (*Rostrhamus sociabilis plumbeus*) have been documented foraging in portions of the North Shore in recent years. No known kite nesting has been documented on the Property. The District will continue to document occurrences of Kites utilizing the Property and coordinate with USFWS as appropriate for management of this species.

Black Rail
In October 2020, the USFWS added the Black Rail (*Laterallus jamaicensis jamaicensis*) as a threatened species to the List of Endangered and Threatened Wildlife. The North Shore falls outside of the current focal areas that have been identified for Black Rail in Florida, but rails may take advantage of appropriate conditions as they episodically occur on the site. Improvements to hydrology and vegetation may provide more opportunity for black rail utilization of the site. Currently, Black Rail habitat, including dense vegetation, open ground sub-canopy "runways," limited shrub cover, dry-to-saturated ground adjacent to very shallow water, is very limited at the North Shore. Opportunities may exist at the North Shore, through hydrologic and vegetation management, to support increased Black Rail habitat. The USFWS Black Rail management guidance will be consulted when conducting activities within potential Black Rail habitat (Watts 2022).

Shorebirds and Wading Birds
The North Shore has provided significant habitat for a wide range of both wading and shorebirds in the past. During the period of agricultural land use on the Property, wintering shorebirds used flooded farm fields intensively. Wading birds are common throughout the managed marshes of the North Shore, where appropriate water levels allow foraging. Under current vegetation conditions, shorebird habitat on the North Shore is very limited in extent. Wading bird habitat, although widespread, is often limited by excessive water depths within phases of the Property. Opportunities may exist at the North Shore, through hydrologic and vegetation management, to support increased wading and shorebird habitat.

General Birds
The North Shore has one of the highest rates of avian species richness for any conservation area in the state of Florida. Currently, the list of bird species documented on the Property contains 482 taxa. The District has supported numerous avian surveys on the Property in the past. The District will continue to seek a better understanding of the avian communities on the Property and how to manage for their benefit.

Flora and Fauna – Invasive Species

Goal: Manage invasive plants and animals

Strategies:

- Maintain a database on locations of invasive species
- Locate, map, and manage invasive species populations
- Consider and implement, as appropriate, novel approaches to manage invasive species populations
- Continue to monitor feral hogs and conduct removal activities as needed
- Develop and implement phased plan to reduce invasive plant abundance and promote desirable species coverage to achieve desired habitat mosaic

In addition to the common nuisance plant species, identified in the Forest and Ecological Management and Restoration section, invasive plants known to occur within the Property include cogongrass (*Imperata cylindrica*), hydrilla (*Hydrilla verticillata*), Cuban bulrush (*Cyperus blepharoleptos*), floating plants (*Pistia stratiotes* and *Eichhornia crassipes*), and camphor tree (*Cinnamomum camphora*). By definition, invasive species are non-native to the area; are introduced, either intentionally or unintentionally; cause or are likely to cause environmental harm, economic harm, and/or harm to humans (Iannone 2021). Invasive species management is necessary to inhibit the continued proliferation of invasive plants and is integral in the maintenance and restoration of plant communities on the North Shore. The District utilizes an integrated pest management approach for invasive and nuisance plant management. Integrated pest management involves harnessing the benefits of a variety of management techniques including hydrologic manipulations, fire, mechanical, biological, and chemical treatments. All herbicides used on the North Shore are approved by the U.S. Environmental Protection Agency and authorized by the Florida Department of Agriculture and Consumer Services for use in Florida. Herbicide treatments are conducted in accordance with label information and employ the most appropriate method of application for the target species.

While it is unlikely that the District will eradicate invasive plants within the North Shore, achieving maintenance control of such species is targeted within the scope of this plan. Invasive plant infestations are moderate to heavy across the North Shore; the Property is regularly monitored and treated as necessary. Between 2013–2024, over 22,000 acres of vegetation management was conducted on the North Shore (Table 5). As described in the Forest and Ecological Management and Restoration section, the District will develop and implement a phased plan to improve the marsh vegetation mosaic across the North Shore, utilizing the integrated techniques. This plan will identify targets for specific vegetation communities within specific phases of the Property. Across the North Shore, meeting these targets will require reducing nuisance and invasive vegetation coverage and improving coverage of desirable vegetative components. Vegetation community targets should be compatible with hydrologic conditions that are reasonable to expect within each phase, given constraints of water management infrastructure and existing land elevation. The plan will prescribe a series of

management actions to conduct, given both existing and desired future marsh vegetative conditions, establishing a framework or model for decision making.

Non-native wildlife species known to occur within the Property include various fish species, Cuban treefrog (*Osteopilus septentrionalis*), feral hogs (*Sus scrofa*), and brown anole (*Anolis sagrei*). The District has maintained and plans to continue a Special Use Authorization (SUA) for control of feral hogs on the Property. In the past, the District coordinated via contract with the U.S. Department of Agriculture (USDA) to assist in the removal of feral hogs from the North Shore. The District retains the flexibility to enter into short-term agreements with the USDA to address specific population reduction initiatives.

Table 5: Active Vegetation Management from 2013-2024

Species	**Acre**
Alternanthera philoxeroides	173.49
Cinnamomum camphora	849.31
Colocasia esculenta	0.50
Cyperus blepharoleptos	2,200.77
Eichhornia crassipes	303.82
Eichhornia crassipes/Pistia stratiotes	407.23
Enterolobium contortisiliquum	0.73
Floating plants	1,337.54
Hydrilla verticillata	2,810.11
Hymenachne amplexicaulis	118.08
Imperta cylindrica	2,964.51
Ipomoea sp.	38.00
Leucaena leucocephala	0.03
Lygodium japonicum	1.57
Melia azedarach	3.02
Melinis repens	511.90
Mixed vegetation	3,400.21
Panicum repens	2.00
Paspalum notatum	7.00
Phragmites australis	9.08
Pistia stratiotes	701.08
Praxelis clematidea	3.66
Ricinus communis	766.35
Salix caroliniana	2,550.08
Schinus terebinthifolius	207.01
Sorghum halepense	41.64
Sphagneticola trilobata	0.10
Triadica sebifera	0.44
Typha sp.	3,246.40
Urena lobata	10.15
Total	**22,665.79**

Cultural Resource Protection

Goal: Identify, protect, and maintain any cultural resources found on the Property

Strategies:

- Continue to monitor, protect, and preserve the documented Master Sites in accordance with DHR procedures
- Identify and report any detrimental activities to the sites to the DHR and law enforcement
- Identify and report undocumented sites to the DHR

A review of the DHR data indicates 14 documented Florida Master Site File cultural sites within the Property. If additional sites are located, District staff will document and report sites to the DHR. District land management activities that may affect or impact these resources will be evaluated and modified to reduce the potential for disturbance of the identified sites. Additionally, detrimental activities discovered on these sites will also be reported to the DHR and appropriate law enforcement agencies. Due to District and State policy, the locations of such cultural sites are not identified on public maps.

LAND USE MANAGEMENT

Access and Infrastructure

Goal: Maintain and pursue additional infrastructure to facilitate access to and around the Property for land management, resource protection, and recreation

Strategies:

- Inspect, maintain, improve, and repair levees, pumps, access walkways, alum systems, and water control structures
- Consider opportunities to improve and/or expand amenities to support increasing recreational use; implement as appropriate
- Inspect, maintain, improve, and repair kiosks, parking areas, signs, gates, roads, bridges, and trails
- Update District database on maintenance of existing and creation of new kiosks, parking areas, signs, gates, roads, and trails
- Pursue additional Lake Apopka Wildlife Drive (LAWD), Lake Apopka Loop Trail (LALT), and West Marsh resource-sharing partnerships for public recreational access and related infrastructure maintenance/repair
- Based on assessment of water resource needs, install additional water control structures and/or pumps, as appropriate
- Maintain rough fish harvesting landing site adjacent to McDonald Canal boat ramp
- Consider and, as appropriate, install airboat launches at strategic locations for use by District staff, cooperators, partners, and contractors
- Install publicly accessible non-motorized vessel launch(es) at West Marsh

- Map locations of submerged hazards within cells and phases
- Increase automation of water control structures

The North Shore contains extensive infrastructure to support access for both resource management and recreation. Currently the Property is host to 100 miles of road, 80 gates, six public entrances/trailheads, five parking areas, five picnic areas, 20 kiosks, four observation towers, six portable restrooms, and two boat ramps (Figure 20 and 21). The Property also contains 39 miles of marked trail, including the regionally significant LAWD and approximately 17.3 miles of the LALT. With the exception of the 2.6-mile Red Trail, all trails on the North Shore follow District roads.

The Green Mountain Trailhead and McDonald Canal Boat Ramp access points, both on District-owned land, are managed through cooperative agreements by Lake County. Access to the Property from the southeast, via the LALT, is facilitated through a connector trail to Orange County's Magnolia Park. This connector trail, as well as the associated entrance to the Property, are managed by Orange County through a cooperative agreement. Apart from these management designations, all other infrastructure at the Property is managed by the District.

The District is currently in the process of developing another access point to the North Shore, at the western terminus of the F/G West Marsh levee (Figure 15). This access point will include a parking area and a non-motorized vessel launch. It is anticipated that this access point will facilitate District and public use of the interior of West Marsh cells D–H. The District will also consider, and implement as appropriate, the installation of airboat launch sites at strategic locations on the North Shore. These launches would improve access for management purposes by District staff, cooperators, partners, and contractors.

The District will continue to maintain, improve, and repair infrastructure on the Property. The District will consider the removal of infrastructure that is no longer serviceable or inhibits resource management. The District will also consider additional infrastructure to improve and/or expand resource management and/or recreational uses. Additional infrastructure must be compatible with overall resource management objectives. The District's resources available to maintain infrastructure on the Property is a significant factor limiting expansion of additional recreational amenities. To aid in the management of recreational infrastructure, especially related to the LAWD, LALT, and West Marsh, the District will pursue resource-sharing partnerships. The District maintains GIS databases of infrastructure and recreational amenities. These databases require regular updating to record maintenance of existing, creation of new, and removal of obsolete infrastructure.

Existing water resource infrastructure is described in the Water Resources section. Continued maintenance of the extensive network of levees, ditches, control structures, and pumps within the North Shore will allow wetland water levels to be managed to desired elevations. Recent work has elevated levees to 64 ft. NAVD88. However, over time the muck levees, including driving surfaces and side slopes, will subside and require maintenance. Maintenance and operation of control structures and pumps is crucial to achieving desired results across the North Shore. Based on assessment of water resource needs, installation of additional water control structures and/or pumps, to facilitate improved water level management, will be pursued, as appropriate. Pump

automation would ensure operation of pumps at desired water levels, as well as capture necessary data for pump run times used in calculations of P loading to Lake Apopka and reduce need for staff to physically operate structures.

Relics of the North Shore's agricultural past are still present throughout the Property. Many of the farming implements and structures that were left behind in fields prior to flooding are still present and often submerged. As marsh vegetation management and restoration projects continue and expand, access to the interior portions of North Shore phases and cells is necessary. For the safety of District staff, contractors, and management partners, the submerged hazards present throughout the North Shore will be mapped within the first 5 years of this planning period.

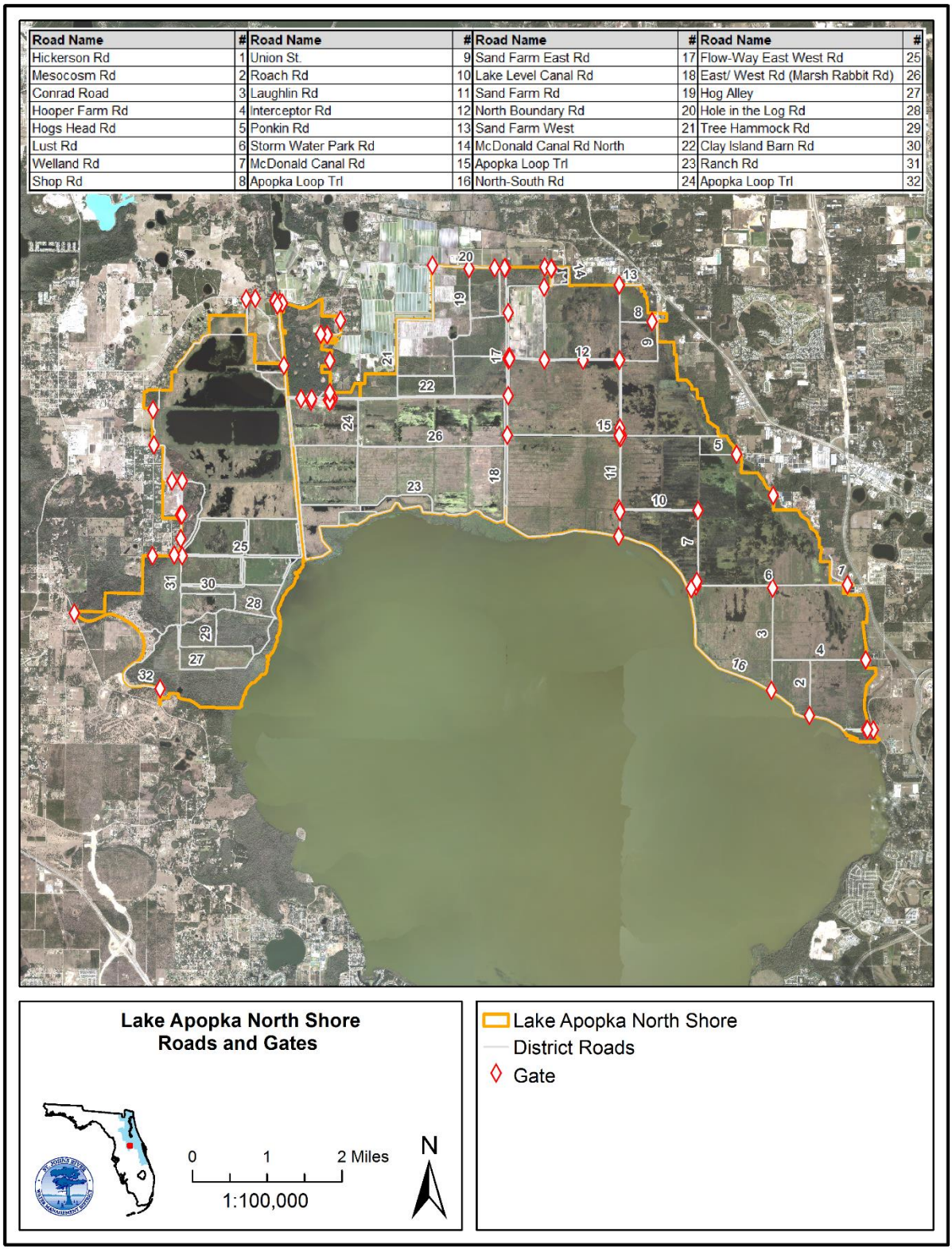


Figure 20: Road Infrastructure

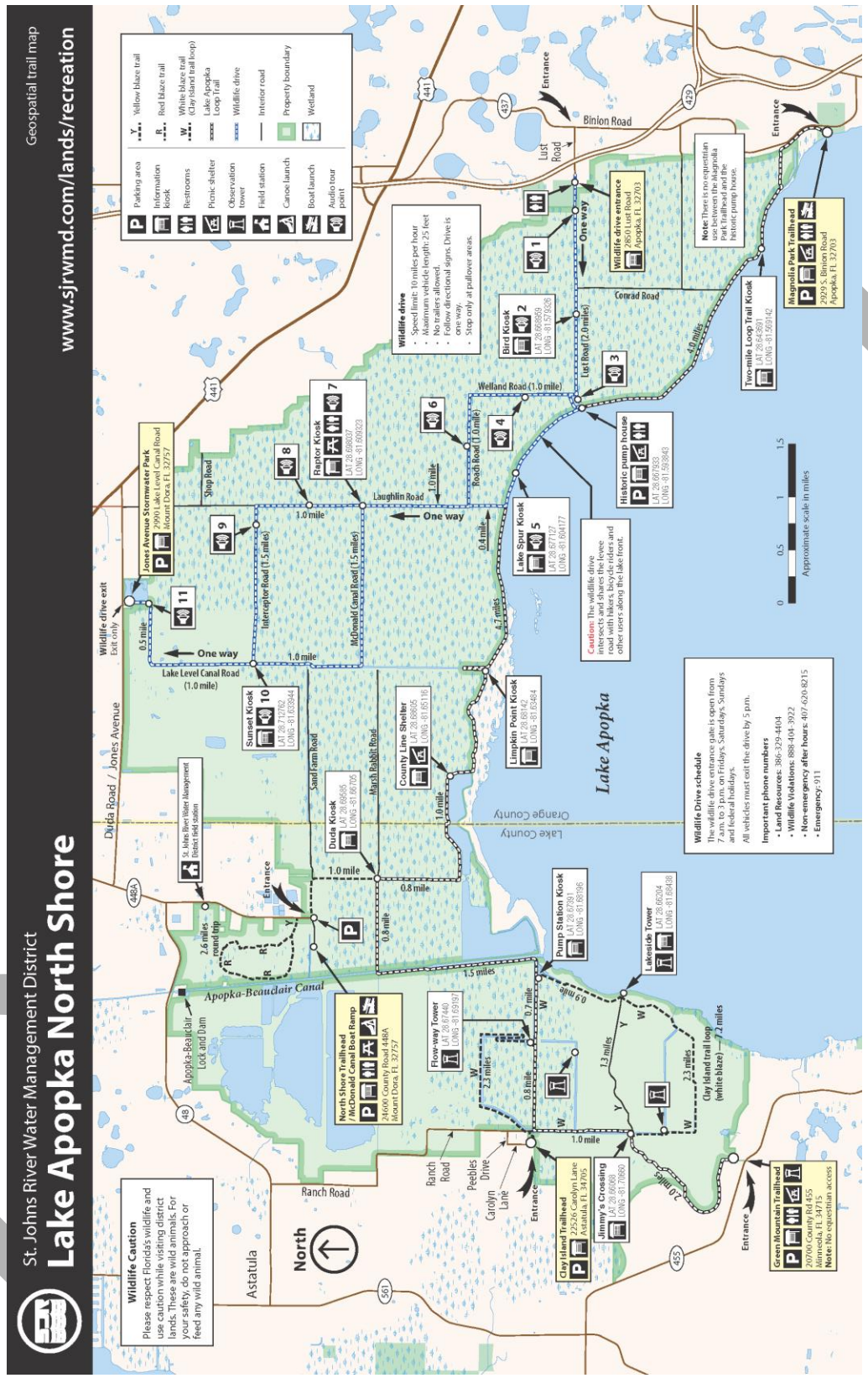


Figure 21: Recreation Map

Recreation

Goal: Maintain current and provide additional public recreation opportunities on the Property

Strategies:

- Continue coordination with Orange Audubon Society for LAWD visitor management
- Continue coordination with Friends of Lake Apopka (FOLA), Orange County, Lake County, and the Green Mountain Scenic Byway for management of LALT
- Continue coordination with Lake County for management of Green Mountain Trailhead and McDonald Canal Boat Ramp facility
- Maintain current recreational access information on District website
- Continue to conduct Recreational Public Meetings annually to gather input regarding the North Shore from the public
- Improve public recreational access to interior of West Marsh cells D–H
- Coordinate with FWC to evaluate potential waterfowl hunting and/or fishing opportunities within West Marsh cells D–H, implement as appropriate

The primary objective of the District's recreation management is to facilitate resource-based recreational activities on District lands. An aspect in developing the District recreation program is not to compete with other local recreational opportunities, but rather complement what they may already have in place by filling an outdoor recreation niche through dispersed recreation opportunities. Dispersed recreation activities generally require large tracts of land with some level of isolation. This type of recreation blends well with District conservation and restoration areas, providing numerous opportunities for resource-based recreation, which also provides solitude and challenge. Public access to District lands, including the North Shore, can change periodically, based on road and/or trail conditions, resource management projects, and other variables. The District maintains up-to-date recreational access information on its website (www.sjrwmd.com).

Partnerships have been critical to the success of implementing the North Shore's recreational opportunities. The District will continue to cooperate with our existing partners and pursue additional partnerships to allow public recreational access that is compatible with the resource management objectives for the Property.

Currently, recreational opportunities within the North Shore are dispersed resource-based activities including hiking, bicycling, horseback riding, and wildlife viewing and photography. Recreation amenities (Figure 21) are described in the previous section, Access and Infrastructure. Trails routed through the Property primarily use interior levees that also serve and are maintained as access for land and water management purposes. The trail system is predominantly for hiking, off-road bicycling, and/or horseback riding, and may access areas for wildlife viewing. Horses are not permitted at the Green Mountain and Magnolia Park trailheads. Motorized vehicle access is currently available only on the LAWD and only on Fridays, Saturdays, Sundays, and federal holidays. The McDonald Canal Boat Ramp facility, although on the North Shore, is managed by Lake County through a cooperative agreement. This boat ramp allows access to the A-B Canal and connected waters, including Lake Apopka. Currently boating and canoeing opportunities are not available on the North Shore. However, the District is pursuing development of an access point to the West Marsh, which will include a non-motorized vessel launch. Following

completion of this access point, non-motorized vessels will be allowed to access the interior of these marshes. Pursuant to section 379.3001, Florida Statutes, the FWC is evaluating potential waterfowl hunting and/or fishing opportunities within West Marsh cells D–H (Figure 15). Based on the findings of this evaluation, the FWC, in coordination with the District, will determine the suitability of the West Marsh for these recreational opportunities. No further expansion of hunting beyond West Marsh cells D-H is planned. Any expansion beyond this footprint would require a Governing Board-approved amendment to this management plan. The District values an equitable balance of access to North Shore resources among the wide and varied resource-based recreational users with an interest in the Property.

A multi-partner initiative including the District, Orange and Lake counties, FOLA, the Green Mountain Scenic Byway group, and other entities have developed recreational and ecotourism opportunities in and around the North Shore. The LAWD grew out of this initiative and has become a very popular regional nature-based attraction. This one-way, 11-mile, self-guided driving tour utilizes an entrance on the eastern property boundary at Lust Road and is free to the public. The LAWD exits the Property at the Jones Avenue Stormwater Park. Opened to the public in 2015, average annual attendance has been over 110,000 visitors per year, based on vehicle counter data collected by the District. It is important to note that attendance has generally grown every year. Since 2020, the LAWD has experienced an average of over 150,000 visitors per year. This level of use leads to many management challenges.

The LAWD operates on levee roads that are necessary for general resource management activities, such as water resource infrastructure maintenance and vegetation management. Given the design of these levee roads, two-way traffic patterns or vehicular passing is very restricted. This fact limits the District's ability to operate both the LAWD and conduct resource management simultaneously. Therefore, motorized public access to the LAWD is restricted to Fridays, weekends, and federal holidays. The high rate of use has also caused the District to administer other activities on the Property that are not typical to properties under its management. These LAWD considerations include maintaining a portable toilet contract at multiple locations, weekly trash pick-up operations, and a non-emergency after-hours phone line for visitor issues. Roads used for the LAWD also receive more maintenance than typical District roads.

Since 2020 the District has partnered with the Orange Audubon Society for visitor management support. Orange Audubon volunteers provide valuable information to visitors entering the LAWD. Additionally, Orange Audubon volunteers drive the LAWD at the end of each day to ensure that all visitors have left the Property. The District values these services and will continue to partner with this organization for visitor management support at the LAWD.

The North Shore is home to the initial phases of the LALT, which traverses approximately 18 miles of District levee roads, covering the length of the Property from east to west. Eventually, the LALT is envisioned to provide a connected network of non-motorized pathways circumnavigating the lake. On the North Shore, the LALT is a popular amenity, particularly with cycling enthusiasts and runners. It is anticipated that use of the LALT will continue to grow throughout the term of this plan due to several variables: expansion of Central Florida's population; concurrent reduction in suitable roads/locations for athletic training; increase in

popularity of gravel bicycle riding; completion of additional phases of the LALT; and connection of the LALT to other regional trail networks, including the Florida Coast-to-Coast Trail. Given the current and projected future use of the LALT, partnership management of this resource is imperative. Our cooperators, including FOLA, Orange County, Lake County, and the Green Mountain Scenic Byway, have played various roles in management of the North Shore's LALT segment. The District will continue coordination with these partners and seek additional partnerships, particularly with FDEP's Office of Greenways and Trails, for management of LALT.

Through administration of SUAs and/or cooperation with other organizations, the North Shore is host to a large number and wide range of events on an annual basis including numerous cycling and running events, birding festivals, Audubon's Christmas Bird Count, and group tours. The District will continue to support events on the Property that are compatible with overall management objectives.

The District is actively engaged with the public through various means to receive input regarding management of the North Shore. Recreational Public Meetings are among the outlets the District uses to collect information from the public. The purpose of these public meetings is to receive input regarding recreational policies and practices applicable to public recreational utilization of District lands. The District will continue to conduct Recreational Public Meetings on an annual basis.

Security

Goal: Provide and maintain the Property's security

Strategies:

- Maintain boundary signage, fences, gates, and locks
- Continue coordination with FWC, local, state, and federal law enforcement
- Consider opportunities to provide security resident housing, pursue as appropriate

Security concerns within the North Shore include those typical to any conservation land in Florida: illegal motorized vehicle access, poaching, wildlife harassment, vandalism, and dumping. The District coordinates with FWC and local law enforcement to administer security within the Property.

The District will consider the opportunity to provide security resident housing at the North Shore. The District has several similar residences established on other conservation lands, occupied by either county or FWC law enforcement officers. The presence alone of these residences can contribute to increased site security. In the event of needed law enforcement action, these residences significantly improve response time and efficacy.

In addition to typical security issues, somewhat unique security challenges are also present on the Property. Low-flying aircraft are a frequent issue at the North Shore. In addition to safety concerns low-flying aircraft present, their operation can also harass wildlife on the Property. The Federal Aviation Administration (FAA) is the government agency responsible for aviation safety and provides guidelines for addressing low-flying aircraft.

ADMINISTRATION

Real Estate Administration

Goal: Pursue potential opportunities for acquisitions, transfers, exchanges, and surplus in support of the District's four core missions

Strategy:

- Evaluate adjacent properties and inholdings for potential acquisition
- Evaluate parcels identified for potential surplus, if necessary

The District has identified 14 parcels totaling 501 acres adjacent to the Property as potential acquisitions (Figure 22). These acquisitions are a combination of what remains of the properties below the 70-foot contour line that historically marked the lake's approximate high-water line and areas identified as critical wetlands. If adjacent or nearby parcels become available that provide additional protection to Lake Apopka or the North Shore, support water resource projects, increase conservation value, improve manageability of Property boundary, and/or allow for restoration of impacted land, they will be evaluated for acquisition by District staff.

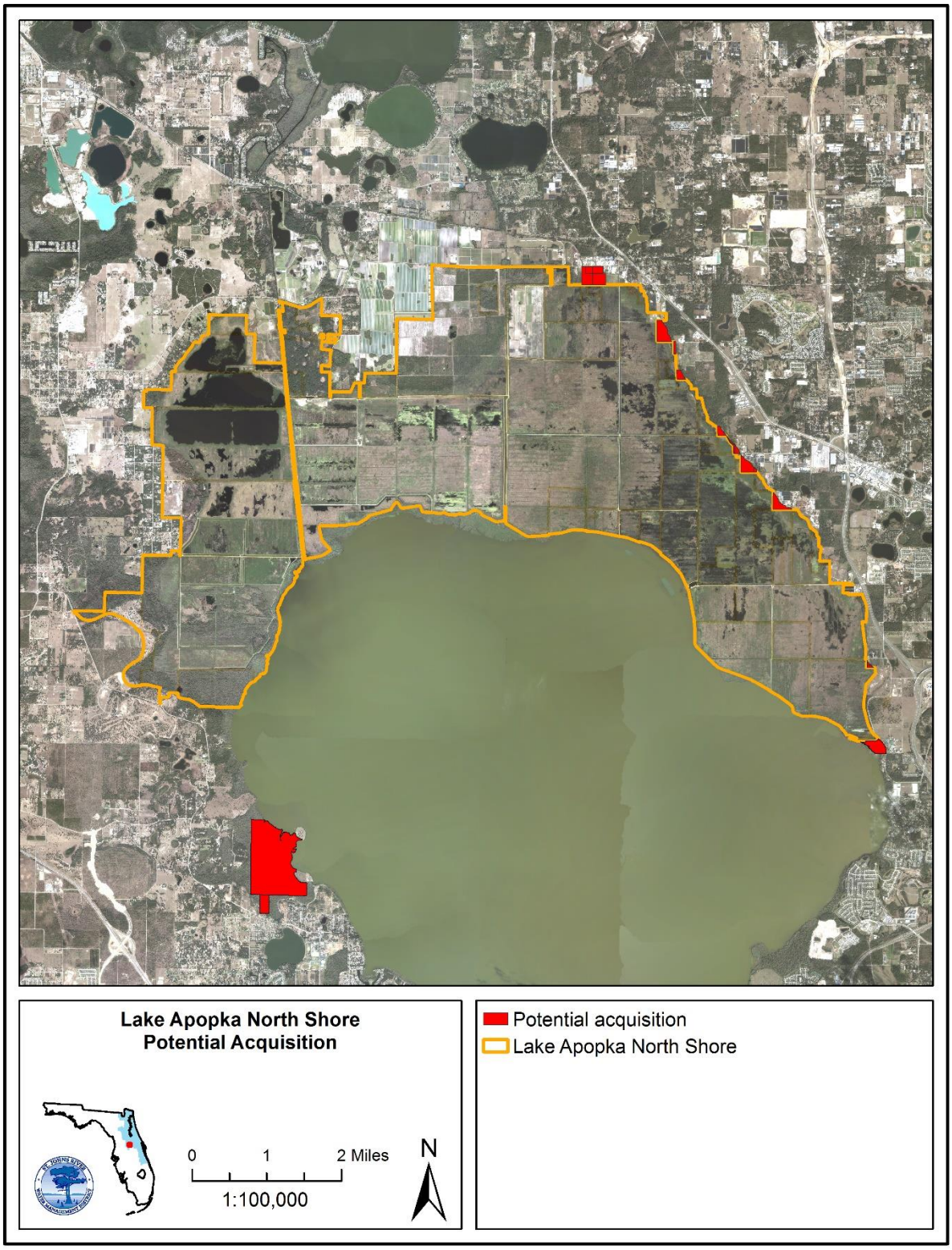


Figure 22: Potential Acquisition Map

Pursuant to Section 373.089, Florida Statutes, the District may explore and pursue surplusing portions of its land. In 2012, the District's Governing Board approved the Lands Assessment and Implementation Plan. Of the 630 acres identified for potential surplus, 86 were transferred to Orange County for a park, with a conservation easement/reverter. The District's interest in surplusing land may arise from a variety of considerations, including but not limited to:

- A property purchased as part of a larger acquisition and the surplus portion is not needed for District purposes but was included to complete a larger acquisition
- Original project for which a property was purchased was not built
- A property is part of a patchwork of conservation ownership, managed by another agency or local government and the surplus is to transfer the ownership to the entity managing the property for conservation purposes
- Actions by adjacent owners that lower a property's conservation values or increase management costs

Any surplus of District-owned property requires the approval of the District's Governing Board.

If it is found to be in the public interest and for the public convenience and welfare, and for the public benefit, the District may also convey land or rights of land owned to any governmental entity. When transferring lands, the District may retain a conservation easement over the property and/or include a reverter provision in the deed. This provides for the future conservation of the property and to insure the property remains in public ownership.

Cooperative Agreements, Leases, Easements, and SUA

Goal: Evaluate, pursue, and manage cooperative opportunities

Strategies:

- Maintain intergovernmental agreements
- Evaluate lease and agreement opportunities for compatibility with management goals, minimize incompatible alternative uses
- Adhere to conditions of the restrictive covenants on the contamination and cleanup sites
- Continue to cooperate with researchers and universities as appropriate
- Consider cooperative agreements that share responsibility for public access management, implement as appropriate
- Pursue additional revenue sources and partnerships to increase funding for North Shore management and recreational amenities, as appropriate
- Pursue opportunity to expand environmental education opportunities through partnerships with local school boards and other organizations

Section 373.1391, Florida Statutes, authorizes and encourages the District to enter into cooperative land management agreements with state agencies or local governments to provide for the coordinated and cost-effective management of lands to which the water management districts, the Florida Board of Trustees of the Internal Improvement Trust Fund (Trustees or TIITF), or local governments hold title. District Policy No. 820 promotes the District entering

into agreements with other agencies and private parties for cooperation and coordination of management of the District's lands. Section 373.093, F.S. states "The governing board of the district may lease any lands or interest in land… as long as the lease is consistent with the purposes for which the lands or any interest in land was acquired". Rule 40C-9.370, FAC interprets the statute as a "lease may be granted only when the purpose of the lease is consistent with the land management plan for such District Land".

In addition, the District is authorized to enter into cooperative agreements, cooperative management leases, leases, easements, and SUAs to protect the District's water management interests and to enhance the management and public value of the land. Leases can be a useful tool to accomplish land management objectives and will be evaluated and implemented where appropriate. Common examples include cattle grazing and apiaries, and the District remains open to considering other types of leases that help achieve management goals. Figure 23 and Table 6 detail the easements and leases in effect at the North Shore during the writing of this plan.

Due to the amount of infrastructure in place, the intensity of ecological restoration activities implemented, and the high rate of public use, managing both the natural systems and public access on the North Shore requires extensive resources. The District will take a two-pronged approach to address North Shore resource management needs. First, the District will actively consider and pursue opportunities to increase revenue generated on the Property, as appropriate and compatible with management goals. Examples could include: expanding and/or enhancing the donation program, collecting fees for authorized uses of the Property, cooperating with concessionaires to provide nature-based educational tours, and/or collecting individual user fees. Revenue generating activities ideally will help meet overarching resource management objectives. Revenue generated from the Property will be used for land management activities. The second approach to meeting the Property's needed resources involves partnerships. The District currently partners successfully with various agencies and organizations. During the term of this plan the District will seek to expand partnerships, especially through cooperative agreements and other formal arrangements.

The North Shore is a productive and valuable educational resource, host to various research projects and education programs. The District will continue to cooperate with universities and other research organizations to make the Property available for scientific purposes. The District will also continue supporting environmental education and outreach opportunities on the Property. Given the expanding population in this part of Florida, it is anticipated that the demand for educational opportunities on the Property will also expand in the term of this plan. The District hopes to meet this demand through partnerships with local school boards and other organizations.

The number of lease and agreement opportunities proposed to the District at the North Shore every year creates a challenge for administrative functions. The most important consideration for administering this program is to ensure that uses of the Property are compatible with the water and land resource management goals for the Property. Uses of the North Shore that have the potential to negatively impact water quality, water supply or availability should be prohibited. To meet this standard, lease and agreement opportunities will be evaluated for compatibility with

conservation and management goals. The District will aim to minimize alternative uses that are inconsistent with water and natural resource management objectives.

There are four remediation sites that have restrictive covenants in the form of deed restrictions. Special management considerations for these areas are included with the site descriptions below. Additionally, there is one Petroleum Cleanup Program Site and associated monitoring wells within the North Shore.

- **CC Ranch RCS:** This site is approximately 0.43 acres and is associated with the tract of CC Ranch-Lake Coleman parcel (LA # 1989-004) that was transferred to LCWA. A petroleum discharge was documented in 1991 during the acquisition process, with petroleum contamination of the shallow groundwater being the primary concern. There is no contamination residual in the soil and the contaminated groundwater plume has shown to be stable within the shallow aquifer. The restrictive covenant (RC) precludes the potable use of groundwater. FDEP has the right of inspection to this area.
- **Hooper North RCS**: This site is approximately 2.53 acres and is associated with the Hooper Farms parcel (LA# 1987-018). Prior to public acquisition, this area was utilized as a storage area and workshop for agricultural operations. OCP-contaminated soils that exceeded Residential Soil Cleanup Target Levels occur in this area. An RC in the form of a deed restriction was placed on the Property in 2007 to restrict access to the remaining OCP-contaminated soils. The site will not be utilized for residential purposes and any movement of the soil or change in land use in this area will require laboratory analysis for OCPs. FDEP has the right of inspection to this area.
- **Hensel and Rodgers RCS:** This site is approximately 2.02 acres and is associated with the Living Carpet-Hensel and Rogers parcel (LA# 1996-089). Approximately 180 tons of arsenic-contaminated soil was removed from this site. No contamination remains in the soil; however, arsenic remains in the shallow groundwater. The arsenic plume has shown to be stable within the shallow aquifer. An RC in the form of a deed restriction was placed on the Property to restrict potable use of the groundwater. Any movement of the soil in this area will require laboratory analysis, and FDEP has rights to inspection of this area.
- **Hickerson Flowers RCS:** This site is approximately 0.63 acres and is associated with Hickerson Flowers parcel (LA# 1996-098). Over 1,300 truckloads of arsenic- contaminated soil was removed from the site. While no arsenic contamination remains in the soil, arsenic is present in the shallow groundwater. The arsenic groundwater plume has shown to be stable within the shallow aquifer. An RC in the form of a deed restriction has been placed on the Property to restrict potable use of the groundwater. Any movement of soil in this area will require laboratory analysis, and FDEP has rights to inspect this area.
- **Zellwin Maintenance Area (ZMA) Petroleum Cleanup Program Site**: This site is approximately 0.45 acres and is associated with the Zellwin Farms parcel (LA# 1996- 097). This site is the former maintenance area for the old Zellwin Farms. This site included underground tanks that likely contained petroleum products. The areas had some cleanup funded by FDEP; however, funding is not currently available for continuation of the project. The area includes monitoring wells that should not be disturbed. Wells will be abandoned once the District has received an unconditional Site Rehabilitation Completion Order from FDEP.

Table 6: Leases and Easements

Agreement Number	Lease Type	Lease Name	Term
804	Intergovernmental	Cooperative Agreement and Lease - Lake County - CR 455 (Green Mountain) Trailhead	1/13/2033, initial 20-year, two additional 10-year auto-renewals
1789	Lease - Non-Revenue	NuQuatic LLC FKA Phosphorus Free Water Solutions, LLC	1/30/2025
977	Other Agricultural	Apopka Lake Jem Farms Inc.- Revenue	1/20/2029
252	Easement – Access/ Construction/ Maintenance	Orange County Jones Ave Stormwater Park	8/6/2048
LA Number	**Easement Type**	**Easement Name/Grantee/Grantor**	**Term**
1990-077-P1	Flowage and Maintenance	NuRF	Perpetual
1998-067-PB	Flowage	Bedsole-Pelton Hold Harmless and Flowage Easement	Perpetual
1998-029-P1	Flowage	Lake Apopka Restoration Area - Flowage Easement	Perpetual
1998-049-P1	Flowage	Shortz-Lutchman Hold Harmless and Flowage Easement	Perpetual
1995-059-P1	Access - From District	Joseph P. Holt Jr. and William W. Holt	Perpetual
1996-098-P1	Access - From District	Lisa L. Hill	Perpetual
1996-098-P1	Access - From District	Orlando-Orange County Expressway Authority	Perpetual

1993-006-PA	Access - From District	Joseph Paynter Holt Jr. and William Walter Holt	Perpetual
1996-098-P1	Access - From District	City of Apopka	Perpetual
1989-004-P1	Access - From District	LCWA	Perpetual
1996-083-P1	Drainage and Maintenance	Long and Scott Farms	Perpetual
1990-015-P1	Utility and Maintenance	Lake County	Perpetual
1989-004-P1	Access, Operations, Maintenance	LCWA	Perpetual
1989-004-P3	Flowage	LCWA	Perpetual
1989-004-P4	Access - To District	LCWA	Perpetual
1996-091-P2	Access - To District	Long and Scott Farms Family Limited LLP	Perpetual
1998-034-P3	Access - To District	James Ted Smith	Perpetual
1998-050-P1	Facility	Cooperative Agreement – Jones Avenue Regional Stormwater Management Project	8/6/2048
1996-083-P1	Utility and Maintenance	Duke Energy	Perpetual
1996-108-P1	Utility and Maintenance	Duke Energy	Perpetual

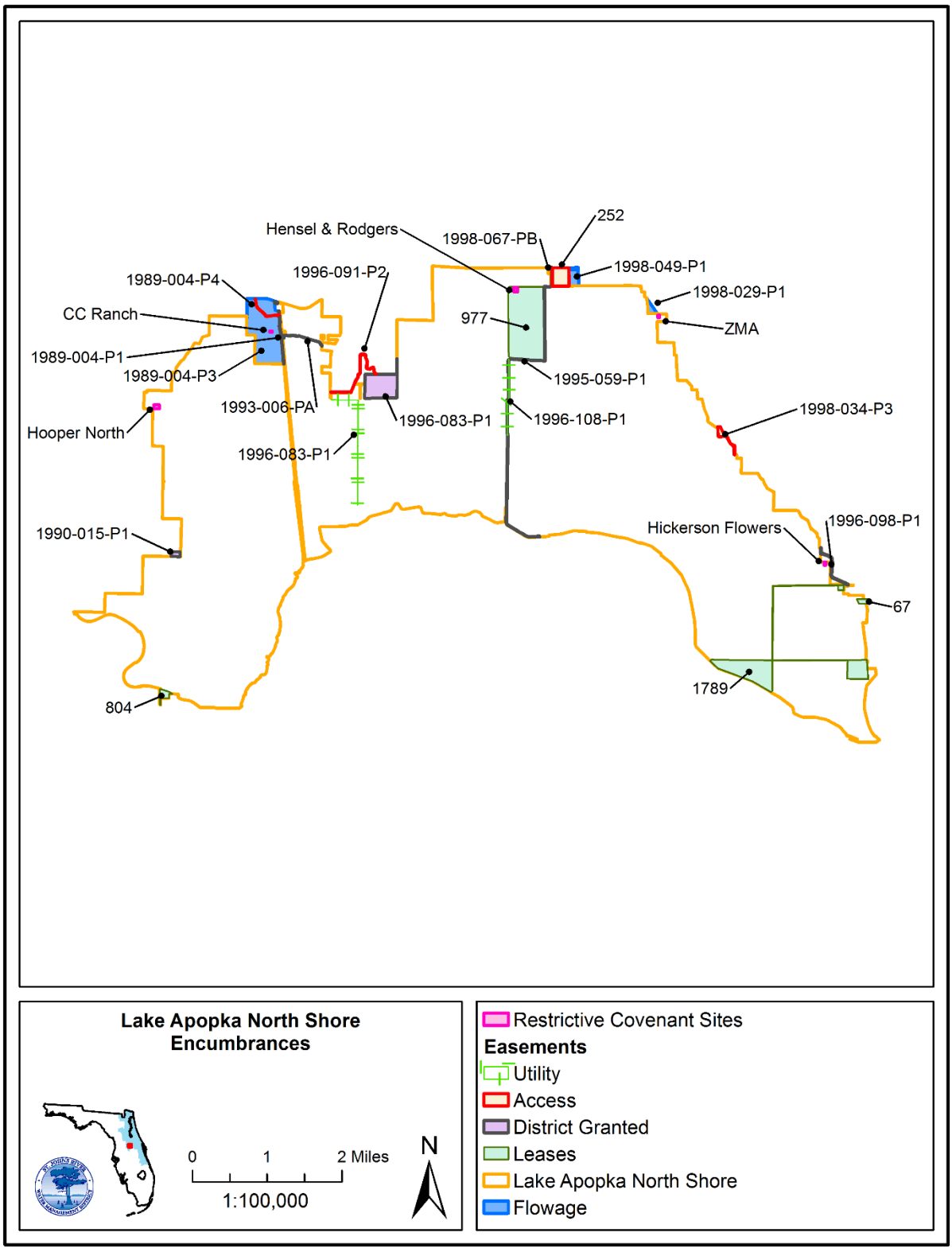


Figure 23: Encumbrances

Management Revenues and Costs

Goal: Analyze and report projected and actual costs and revenues

Strategies:

- Analyze and report revenues
- Analyze and report land management costs
- Maintain and expand or improve donation system for North Shore recreation

This section reviews costs and revenues since the last land management plan update (2013–2024) as well as projects costs and revenues for the upcoming planning period (2025–2034). All generated revenue will be applied toward the District's land management budget to offset management costs for the Property.

Tables 7 and 8 provide the received revenue and land management costs for the Lake Apopka North Shore since the last land management plan update in 2013. Most of the revenue was produced by the agricultural lease while the greatest cost was associated with road and levee maintenance. Revenue was also generated through timber sales and the donation system that has been established for the North Shore. The District will continue to maintain the North Shore public donation system during the term of this plan. The District will also seek additional revenue sources to offset North Shore management costs.

Revenues and Costs Since Last Land Management Plan Update (2013–2024)
Revenues since the last land management plan update, 2013–2024, total $233,415 (Table 7). Costs between 2013–2024 have totaled $16,026,598 (Table 8).

Table 7: Revenues from 2013–2024

Activity	Revenue Year	Revenue
2015 Timber Sale	2015–2016	$7,567
2018 Timber Sale	2018–2019	$42,489
Donations	2020–2021	$4,216
Donations	2021–2022	$5,429
Donations	2022–2023	$4,453
Donations	2023–2024	$3,621
Agricultural Lease	2013–2014	$11,250
Agricultural Lease	2014–2015	$15,000
Agricultural Lease	2015–2016	$15,000
Agricultural Lease	2016–2017	$15,000
Agricultural Lease	2017–2018	$15,000
Agricultural Lease	2018–2019	$15,000
Agricultural Lease	2019–2020	$15,000
Agricultural Lease	2020–2021	$15,000
Agricultural Lease	2021–2022	$15,000
Agricultural Lease	2022–2023	$15,000

Agricultural Lease	2023–2024	$15,000
Agricultural Lease	2024–2025	$3,750
Total		**$232,775**

Table 8: Management Costs from 2013–2024

Recurring Annual Costs				
Activity	**Number of Units (annual)**	**Units**	**Annual Cost**	**11 Year Total Cost**
Invasive plant control	2,061	Acres	$328,139	$3,609,526
Road maintenance (mowing, minor repairs)	90	Miles	$225,000	$2,250,000
Staff time	6,240	Hours	$179,400	$1,973,400
Water control structure repair	1	Total	$50,000	$500,000
Portable toilet maintenance (since 2015)	6	Toilets	$39,000	$351,000
Road repair (LAWD, LALT)	29	Miles	$30,000	$300,000
Water control structures maintenance	1	Total	$25,000	$250,000
Prescribed fire	2,007	Acres	$20,002	$200,022
Levee maintenance (LAWD)	11	Miles	$10,000	$100,000
Firebreak disking	19	Miles	$6,650	$73,150
Trails and parking lot mowing	4 miles trail; 3 access points		$2,050	$20,500
One Time Activity Costs				
Activity	**Number of Units**	**Units**	**Cost**	**Total**
MFW regrading	760	Acres	$2,000,000	$2,000,000
LALT raised and stabilization (Magnolia to Laughlin)	5	Miles	$1,000,000	$1,000,000
LAWD slope stabilization	11	Miles	$1,000,000	$1,000,000
Pump station upgrading/refurbishment (Unit 1, Unit 2, MFW, Duda)	4	Pump Stations	$1,000,000	$1,000,000
A-B Canal levee repair/regrading	3	Miles	$750,000	$750,000
LAWD and LALT regrading	29	Miles	$500,000	$500,000
Minor infrastructure repair	10	Years	$500,000	$500,000
Water control structure installation	3	Projects	$4,4458,387	$4,4458,387
Total cost over 10 years				**$20,837,985**

Projected Management Revenues and Costs (2025–2034)

The projected revenues from the agricultural lease, donations, and forest management at the North Shore between 2025–2034 are $311,250 (Table 9). Projected management costs for the

Property from 2025–2034 are $10,737,335 (Table 10). Years in which activities take place are estimated. It is anticipated that future management costs could exceed those projected, given the higher level of management costs on the Property historically.

Table 9: Projected revenues between 2025-2034

Activity	Year	Revenue
Timber sale	2025–2026	$200,000
Agricultural Lease	2024–2025	$11,250
Agricultural Lease	2025–2026	$15,000
Agricultural Lease	2026–2027	$15,000
Agricultural Lease	2027–2028	$15,000
Agricultural Lease	2028–2029	$5,000
Donations	2024–2025	$5,000
Donations	2025–2026	$5,000
Donations	2026–2027	$5,000
Donations	2027–2028	$5,000
Donations	2028–2029	$5,000
Donations	2029–2030	$5,000
Donations	2030–2031	$5,000
Donations	2031–2032	$5,000
Donations	2032–2033	$5,000
Donations	2033–2034	$5,000
Donations	2034–2035	$5,000
Total		**$311,250**

Table 10: Projected Management costs between 2025–2034

Recurring Annual Costs

Activity	Number of Units (annual)	Units	Annual Cost	10 Year Total Cost
Invasive plant control	2,061	Acres	$328,132	$3,281,315
Road maintenance (mowing, minor repairs)	90	Miles	$225,000	$2,250,000
Staff time	6,240	Hours	$179,400	$1,794,000
Water control structure repair	1	Total	$50,000	$500,000
Road repair (WLD, Loop Trail)	29	Miles	$30,000	$300,000
Water control structure maintenance	1	Total	$25,000	$250,000
Portable toilet maintenance	6	Toilets	$22,000	$220,000
Prescribed fire	2,007	Acres	$20,002	$200,020
Levee maintenance (WLD)	11	Miles	$10,000	$100,000
Fire line disking	19	Miles	$6,650	$66,500

Trails and parking lot mowing	4 miles trail; 3 access points	$2,050	$20,500

One Time Activity Costs

Activity	Total Number of Units	Units	Cost	Total
MFW Cell Maintenance 2027			$225,000	$225,000
MFW Pump Rehab. 2027			$200,000	$200,000
Cap Wildlife Drive/Loop Trail 2028			$200,000	$200,000
Cap Wildlife Drive/Loop Trail 2029			$200,000	$200,000
Levee Stabilization 2025			$200,000	$200,000
Unit 2 PS Upgrade 2032			$120,000	$120,000
Pump Station Automation 2025			$120,000	$120,000
Replace Alum Tanks 2025			$100,000	$100,000
Minor Water Control Structure Repair 2026			$100,000	$100,000
Unit 2 Pump Basin Cleaning 2027			$100,000	$100,000
MFW Pump Basin Cleaning 2027			$100,000	$100,000
Duda PS Upgrade 2033			$100,000	$100,000
Interconnect PS Upgrade 2030			$80,000	$80,000
Unit 1 PS Upgrade 2031			$80,000	$80,000
West Marsh Access Improvements 2024			$50,000	$50,000
Total cost over 10 years				**$10,957,335**

Table 11 provides goals and strategies to implement the Lake Apopka North Shore Land Management Plan for the next 10 years. Each strategy has a specific measurement and timeframe for completion. Each strategy also has an identified lead District work group and relevant cooperators. This schedule will be used by the Management Review Team during Land Management Reviews.

Table 11: Land Management Plan Implementation Schedule

RESOURCE PROTECTION AND MANAGEMENT				
Water Resources				
Goal	Protect water quality and quantity; manage hydrology to support diverse wetlands, as feasible	Measure	Planning Period	Lead (Cooperator)
Strategy A	Manage water resources to meet established Lake Apopka phosphorus criterion	Phosphorus loads to Lake Apopka meet or exceed P loading goal	Ongoing	BES (BBMP, BOM, BOP, WRI)
Strategy B	Maintain water resource structures database, incorporate maintenance and repair; add or remove structures as necessary	Database maintained	Ongoing	BOM
Strategy C	Continue water quality monitoring on-site	Water quality monitored	Ongoing	WRI (BES, BOM)
Strategy D	Continue hydrologic monitoring on-site	Hydrology monitored	Ongoing	WRI (BES, BOM)
Strategy E	Evaluate each hydrologic area's water level management based upon wetland health	Hydrology evaluated	Ongoing	BES (WRI, BOM, BOP, BLR)

Table 11: Land Management Plan Implementation Schedule

Strategy F	Assess areas of high nutrient inputs and identify methods to improve water quality prior to discharge to the lake	Water quality improved before discharge	Ongoing	BES (BBMP, BOP, WRI)
Strategy G	Continue to coordinate with LCWA on discharges from the North Shore to ensure a majority of discharged water is treated by the NuRF	Percent of discharged water flows through NuRF	Ongoing	BOM
Strategy H	Evaluate the feasibility of using North Shore water for beneficial water supply uses rather than pumping to the lake	Beneficial water supply uses evaluated	Ongoing	DWSP (BBMP, BES, BOM, BOP, WRI)
Strategy I	Continue to operate the MFW to reduce TP and TSS from the lake's water column	Mass of TP and TSS removed annually	Ongoing	BES (BLR, BOM, BOP, WRI)
Strategy J	Assess success of BUD MAT projects and, if appropriate, pursue additional projects	Additional BUD MAT projects pursued	1–5 Years	BES (BBMP, BLR, BOM, BOP, WRI)
Strategy K	Assess need for additional water control structures or pumps	Need for additional infrastructure assessed	1–5 Years	BES (BOP, WRI)
Forest and Ecological Management and Restoration				
Goal	**Maintain, improve, and restore forest and non-forested land cover**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Maintain fire-adapted natural communities with appropriate burn return interval	Acres burned	Ongoing	BLR
Strategy B	Manage vegetation within managed marshes to provide a mosaic of habitats	Heterogeneity of vegetation communities	Ongoing	BLR (BES)

Table 11: Land Management Plan Implementation Schedule

Strategy C	As feasible, manage hydrology within managed marshes to provide a mosaic of habitats	Heterogeneity of vegetation communities	5–10 Years	BES (BLR, BOM, BOP, WRI)
Strategy D	Continue to evaluate, implement as possible, hydrologic drawdowns within portions of managed marsh	Drawdowns evaluated and implemented	5–10 Years	BES (BBMP, BLR, BOM, BOP, WRI)
Strategy E	Pursue partnerships to expand wetland habitat enhancement and management	Partnerships pursued	1–5 Years	BLR (BES)
Strategy F	Develop and implement phased plan to reduce nuisance plant abundance and promote desirable species coverage to achieve desired habitat mosaic	Plan to establish desired wetland habitat mosaic implemented	1–5 Years	BLR
Strategy G	Conduct forest management activities within the Sand Farm (Zellwin Farms) parcel that facilitate invasive species management and promote forest health	Forest management activities conducted	1–5 Years	BLR
Fire Management				
Goal	**Implement a prescribed burning program in accordance with District's Fire Management Plan**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Implement prescribed burning as described in the District's FMGP and the Lake Apopka North Shore Fire Management Plan	Burning implemented as described in fire management plans	Ongoing	BLR
Strategy B	Develop annual burn plans and populate the FMD after prescribed fire or wildfire event	Burn plan and reports	Ongoing	BLR
Strategy C	Conduct firebreak maintenance	Firebreak maintained	Annually by October	BLR (BOM)

Strategy D	Create and maintain new firebreaks, as needed, and approved by the program manager	Miles maintained or constructed	Annually by October	BLR (BOM)
Flora and Fauna				
Goal	**Maintain, improve, or restore native and listed species populations**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Conduct plant and wildlife surveys and develop species lists	Updates to species list	Ongoing	BLR (BES, FWC, USFWS)
Strategy B	Monitor the presence of listed species and adjust management actions appropriately	Updates to species list and adjusted management actions	Ongoing	BLR (BES, FWC, USFWS)
Strategy C	Continue partnership with FNPS and other organizations to manage LWR endemic plant populations	LWR endemic plant populations managed	Ongoing	BLR
Strategy D	Coordinate with USFWS, FWC, and other organizations on listed species monitoring and management	Coordination with relevant organizations	Ongoing	BLR (BES)
Strategy E	Coordinate with USFWS prior to conducting management activities not described within relevant biological assessments	Necessary coordination with USFWS conducted	Ongoing	BLR (BES)
Goal	**Manage invasive plants and animals**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Maintain a database on locations of invasive species	Database maintained	Ongoing	BLR
Strategy B	Locate, map, and manage invasive species populations	Invasive plants managed	Ongoing	BLR

Table 11: Land Management Plan Implementation Schedule

Strategy C	Consider and implement, as appropriate, novel approaches to manage invasive species populations	Novel approaches considered and implemented	Ongoing	BLR
Strategy D	Continue to monitor feral hogs and conduct removal activities as needed	Number of hogs removed	Annually by September	BLR
Strategy E	Develop and implement phased plan to reduce invasive plant abundance and promote desirable species coverage to achieve desired habitat mosaic	Plan developed and implemented	1–5 years	BLR
Cultural Resource Protection				
Goal	**Identify, protect, and maintain any cultural resources found on the Property**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Continue to monitor, protect, and preserve the documented Master Sites in accordance with DHR procedures	Sites protected	Ongoing	BLR
Strategy B	Identify and report any detrimental activities to the sites to the DHR and law enforcement	Sites identified and reported	Ongoing	BLR
Strategy C	Identify and report undocumented sites to the DHR	All sites documented	Ongoing	BLR
LAND USE MANAGEMENT				
Access and Infrastructure				
Goal	**Maintain infrastructure to facilitate access to and around the Property for land management, resource protection, and recreation**	**Measure**	**Planning Period**	**Lead (Cooperator)**

Table 11: Land Management Plan Implementation Schedule

Strategy A	Inspect, maintain, improve, and repair levees, pumps, access walkways, alum systems, and water control structures	Water resource infrastructure inspected, maintained, and repaired	Ongoing	BOM (BES, BLR)
Strategy B	Consider opportunities to improve and/or expand amenities to support increasing recreational use; implement as appropriate	Recreational amenity improvements/expansion	Ongoing	BLR (BOP)
Strategy C	Inspect, maintain, improve, and repair kiosks, parking areas, signs, gates, roads, bridges, and trails	Recreation and access infrastructure inspected, maintained, and repaired	Ongoing	BLR (BOP)
Strategy D	Update District database on maintenance of existing and creation of new kiosks, parking areas, signs, gates, roads, and trails	Database updated	Ongoing	BLR (BOP)
Strategy E	Pursue additional LAWD, LALT, and West Marsh resource-sharing partnerships for public recreational access and related infrastructure maintenance/repair	District maintenance cost/effort reduced	Ongoing	BLR (BBMP, BOP, RES)
Strategy F	Based on assessment of water resource needs, install additional water control structures and/or pumps, as appropriate	Water resource infrastructure installed	Ongoing	BOP (BES, BOM, BLR)
Strategy G	Maintain rough fish harvesting landing site adjacent to McDonald Canal boat ramp	Landing facility maintained as operational	Ongoing	BOM (BES)
Strategy H	Consider and, as appropriate, install airboat launches at strategic locations for use by District staff, cooperators, partners, and contractors	Airboat launches installed	1–5 Years	BOM (BLR, BES)
Strategy I	Install publicly accessible non-motorized vessel launch(es) at West Marsh	Vessel launch(es) installed	1–5 Years	BOP (BLR)

Strategy J	Map locations of submerged hazards within cells and phases	Submerged obstacles mapped	1–5 Years	BES (BLR, BOP)
Strategy K	Increase automation of water control structures	Water control structures automated	1–5 Years	BES (BOM)
Recreation				
Goal	**Provide public recreation opportunities on the Property**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Continue coordination with Orange Audubon Society for LAWD visitor management	LAWD visitor management assistance from Orange Audubon	Ongoing	BLR
Strategy B	Continue coordination with FOLA, Orange County, Lake County, and Green Mountain Scenic Byway for management of LALT	Management of LALT shared with relevant organizations	Ongoing	BLR (BOP)
Strategy C	Continue coordination with Lake County for management of Green Mountain Trailhead and McDonald Canal Boat Ramp facility	Coordination continued	Ongoing	BLR
Strategy D	Maintain current recreational access information on District website	Website updated as needed	Ongoing	BLR (OSCE)
Strategy E	Continue to conduct Recreational Public Meetings annually to gather input regarding the North Shore from the public	Recreational Public Meetings conducted	Ongoing	BLR
Strategy E	Improve public recreational access to interior of West Marsh cells D–H	Public access to interior of West Marsh cells D-H	1–5 Years	BLR

Strategy F	Coordinate with FWC to evaluate potential waterfowl hunting and/or fishing opportunities within West Marsh cells D–H, implement as appropriate	Coordination with FWC	1–5 Years	BLR
Security				
Goal	**Provide and maintain the Property's security**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Maintain boundary signage, fences, gates, and locks	Signs, fences, gates, and locks maintained	Ongoing	BLR (BOP)
Strategy B	Continue coordination with FWC, local, state, and federal law enforcement	Secure property	Ongoing	BLR
Strategy C	Consider opportunities to provide security resident housing, pursue as appropriate	Security resident(s) established	1–5 Years	RES (BLR)
ADMINISTRATION				
Real Estate Administration				
Goal	**Pursue potential opportunities for acquisitions, transfers, exchanges, and surplus in support of the District's four core missions**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Evaluate adjacent properties and inholdings for potential acquisition	Properties evaluated	Ongoing	RES (BBMP, BLR, BES)
Strategy B	Evaluate parcels identified for potential surplus, if necessary	Parcels evaluated	Ongoing	RES (BBMP, BLR, BES)
Cooperative Agreements, Leases, Easements, and SUA				
Goal	**Evaluate, pursue, and manage cooperative opportunities**	**Measure**	**Planning Period**	**Lead (Cooperator)**

Table 11: Land Management Plan Implementation Schedule

Strategy A	Maintain intergovernmental agreements	Agreements administered	Ongoing	RES (BLR)
Strategy B	Evaluate lease and agreement opportunities for compatibility with management goals, minimize incompatible alternative uses	Leases and agreements evaluated; appropriate actions taken	Ongoing	RES (BBMP, BLR, BES)
Strategy C	Adhere to conditions of the restrictive covenants on the contamination and cleanup sites	Adherence to restrictive covenants	Ongoing	BLR (BOP, BBMP, BES)
Strategy D	Continue to cooperate with researchers and universities as appropriate	Research SUAs evaluated	Ongoing	BES (BLR)
Strategy E	Consider cooperative agreements that share responsibility for public access management, implement as appropriate	Cooperative agreements implemented	Ongoing	RES (BBMP, BLR)
Strategy F	Pursue additional revenue sources and partnerships to increase funding for North Shore management and recreational amenities, as appropriate	Additional funding sources and partnerships pursued	1–5 Years	BLR (BBMP)
Strategy G	Pursue opportunity to expand environmental education opportunities through partnerships with local school boards and other organizations	Environmental education partnerships pursued	1–5 Years	BLR (BES, OSCE)
Management Revenues and Costs				
Goal	**Analyze and report projected and actual costs and revenues**	**Measure**	**Planning Period**	**Lead (Cooperator)**
Strategy A	Analyze and report revenues	Annual report	Annually by November	BLR (RES)

Table 11: Land Management Plan Implementation Schedule

Strategy B	Analyze and report land management costs	Annual report	Annually by November	BLR
Strategy C	Maintain and expand or improve donation system for North Shore recreation	Donated funds used for infrastructure and maintenance.	Ongoing	BLR

Table 12: Key to District Work Group Acronyms Used in Implementation Schedule

Acronym	**District Work Group**
BES	Bureau of Environmental Science
BBMP	Bureau of Basin Management and Project Development
BLR	Bureau of Land Resources
BOM	Bureau of Operations and Maintenance
BOP	Bureau of District Projects and Construction
OSCE	Office of Strategic Communications and Engagement
RES	Real Estate Services Program
DWSP	Division of Water Supply Planning and Assessment
WRI	Bureau of Water Resource Information

WORKS CITED

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SUMMARY

KICK-OFF MEETING
LAKE APOPKA NORTH SHORE
MANAGEMENT ADVISORY GROUP
2024 LAND MANAGEMENT PLAN UPDATE

On February 27, 2024, the Management Advisory Group (MAG) for the Lake Apopka North Shore (LANS) Land Management Plan (LMP) held a meeting to initiate the 2024, plan update process. The meeting was held at the St. Johns River Water Management District's (SJRWMD) Apopka Service Center, 2501 S Binion Rd, Apopka, FL 32703. The objective of the MAG Meeting was for SJRWMD staff to collect suggestions from advisory group members regarding management goals, strategies, opportunities, and constraints to include in the 2024 LANS LMP. Sixteen members of the MAG and ten SJRWMD staff participated in the meeting. This summary includes an outline of the meeting agenda and a record of substantive input received by the SJRWMD through the meeting. This summary also includes information submitted by MAG members during a four-week period following the meeting. Information received following the meeting is either identified as such within the body of this document or included within Appendix A.

MEETING AGENDA

1. Opening Remarks
2. Introductions
3. LANS Background Presentation
4. Timeline Exercise
5. Break
6. Key LMP Components Presentation
7. Opportunities/Constraints Round Robin Discussion
8. Lunch
9. Goals/Strategies Exercise
10. Closing Remarks
11. Workshop Announcement

MEETING PARTICIPANTS

MANAGEMENT ADVISORY GROUP

Present: *Scott Bisping* (Florida Fish and Wildlife Conservation Commission [FWC], Freshwater Fisheries Management), *Joe Dunn* (Friends of Lake Apopka), *Greg Gensheimer* (Green Mountain Scenic Byway), *Deborah Green* (Orange Audubon), *Artena Greene* (West Orange Chamber of Commerce), *Gary Jennings* (American Sportfishing Association), *Dan Kolterman* (FWC, Aquatic Habitat Restoration and Enhancement), *Andrew Marbury* (FWC, Freshwater Fisheries Management), *Aline Morrow* (United States Fish and Wildlife Service [USFWS], Partners for Fish and Wildlife), *Rosi Mulholland* (Florida Native Plant Society), *Wendy Poag* (Lake County, Parks and Water Resources), *Alyssa Pruett* (FWC, Hunting and Game Management), *Regina Ramos* (Orange County, Parks and Recreation), *Travis Thompson* (All Florida), *Stacy Whittum* (Delta Waterfowl), Radley Williams (City of Apopka, Parks and Recreation)
Invited, Not Present: *Andrew Fanning* (FWC, Hunting and Game Management), *Elizabeth Guthrie* (Ducks Unlimited), *Anna Hopkins* (Florida Department of Environmental Protection [FDEP], Office of Greenways and Trails), *Keith Mousel* (Florida Forest Service), *Mark Romagosa* (FDEP, Florida Park Service), *Nathalie Visscher* (FWC, Invasive Plant Management)

SJRWMD STAFF

Brent Bachelder (Planner, Bureau of Land Resources), *Susan Davis* (Governmental Affairs Manager, Governmental Affairs Program), *Brian Emanuel* (Chief, Bureau of Land Resources), *Ben Gugliotti* (Land Manager, Bureau of Land Resources), *Dale Jenkins* (Director, Division of Infrastructure and Land Resources), *Patrick McCord* (Specialist, Bureau of Land Resources), *Jennifer Mitchell* (Environmental Scientist, Bureau of Environmental Sciences), *Teresa Monson* (Coordinator, Bureau of Land Resources), *Jim Peterson* (Strategic Planning Basin Coordinator, Bureau of Basin Management and Project Development), *Mary Ellen Winkler* (Assistant Executive Director)

MEETING MINUTES/NOTES

OPENING REMARKS – 9:15 AM

Brent Bachelder provided a presentation outlining group objective, expectations, ground rules, overall LMP process. Emphasis was place on the role of the MAG – providing input to improve the forthcoming LMP.

INTRODUCTIONS – 9:25 AM

Group members introduced themselves – including their name, what organization they represent and what Apopka means to them.

LANS BACKGROUND PRESENTATION – 9:45 AM

Brent Bachelder provided a presentation introducing LANS, land management accomplishments, old LMP, and changes since 2013.

TIMELINE ACTIVITY – 10:00 AM

Facilitated by Jennifer Mitchell – MAG members self-organized into a participatory timeline based on their first time becoming involved with the LANS. Designated small groups created a timeline of the LANS focusing on the last five years and ending today. Small groups shared their timelines with the whole MAG. Individuals marked timelines with color coded stickers to indicate: their most impactful experience, a time they were frustrated with SJRWMD action, a time when coordination between the SJRWMD and stakeholders was good (Figures 1-4). Collectively, the group made observations regarding patterns across timelines.

BREAK – 10:45 AM

Mingle, biological needs and optional map exercise (Figure 5)

KEY LMP COMPONENTS PRESENTATION – 11:00 AM

Brent Bachelder provided a presentation introducing the group to the function of goals, strategies, opportunities and constraints within a LMP.

OPPORTUNITIES/CONSTRAINTS ROUND ROBIN DISCUSSION – 11:10 AM

Facilitated by Brent Bachelder – MAG members provided recommendations for opportunities and constraints to consider for inclusion within the 2024 LANS LMP. Summarized input provided by MAG members is listed below.

- Poag: Is this site considered for future regional water supply? Both constraint and opportunity. Being asked at local level.
- Gensheimer: Managing for diversity of habitats – by more actively managing for a variety of wetland inundation levels – across LANS. Instead of discharging water to lake, rotate water from cell to cell, mimicking natural wetland cycle. Deep water kills off vegetation. Shallow water encourages ducks, shorebirds and storks. Opportunity to introduce the public to new types of birds.

- Pruett: Constraint is funding. Opportunity is involving more user groups, including hunting and fishing at LANS. Increasing recreational opportunities will increase funds for habitat management. Hunters consider LANS off-limits, so involving them more would be beneficial.
- D. Green: Improve habitat on Lake Apopka Wildlife Drive (LAWD) exit, increasing opportunity for wildlife photography. More work on that area, which is a walkable entrance.
- Bisping: North Shore doesn't have as much access for hunting and fishing as other recreational uses. Finding ways to provide access could open up FWC funding opportunities for habitat management.
- A. Greene: No opportunities or constraints to provide at this time.
- Thompson: A lot of opportunity for increased access, particularly hunting. Constraint is District not charging for use of property. Quota fee for hunting could generate revenue.
    - Winkler: Charging for use of property will cause the SJRWMD to lose recreational immunity.
    - Gensheimer: So many drivers on LAWD, consider charging only for that portion. Could balance with cost of insurance.
- Dunn: Imminent Lake Apopka Loop Trail (LALT) expansion and completion of connecting loop will increase thru-put on LANS. The LANS portion of the LALT is already popular. Completion of LALT will increase notoriety and bring national attention. Enhancements along LALT might include drinking water. Enhance cycling and hiking opportunity by having spurs off the main trail. Make sure the LANS portion of LALT is ready in a couple of years when expansion occurs. Gravel riding (cycling) is in demand and LANS is one of the most popular destinations in the state for this activity.
- Mulholland: Native Plant Society priority is uplands. Small area but opportunity because losing privately owned Lake Wales Ridge endemic plants populations due to development. Establish self-producing native plant populations. Constraint is water/sources. Supplemental water source in restoration areas is needed – both for watering transplanted natives and for fire management activities.
- Morrow: Likes Greg's concept of rotating cells of varying water depths and would like to explore it. Also, support endemic plants on Lake Wales Ridge and would like further exploration. Opportunity and challenge is subsidence and difference in water levels between lake and wetlands. Beneficial use of dredge materials within wetlands could be a path to increase marsh bottom elevation – counteracting subsidence. Regulatory hurdles, expensive.
- Kolterman: Dredge sediments to repair subsidence areas and get more emergent plants in those areas. Invasives (primrose willow, Carolina willow, cattails) present potential for aquatic enhancement activities. Improve recreation-based activities.
- Williams: Opportunity for more educational components. Potential school board interest in education programs at LANS. Constraint is funding these programs. (Youth stewardship programs)

- Whittum: Educational component and access for more user groups such as youth hunts. Connection between hunting, education, access and opportunity. Constraint is funding; partnerships could benefit access, funding, etc. Opportunity to enact time limits for different uses, managing different areas for different uses at different times.
  - Pruett: South Florida Water Management District provides an example of rotating hunter access and opportunity in Stormwater Treatment Areas.
- Jennings: Greg's idea is great for bird diversity. Regarding hunter access, sportsmen/women are used to paying for their activities. Could potentially pay for participation (hunting, fishing). Could still have limits such as catch-and-release but anglers are used to it. Boating and waterways funding source for boat ramps.
- Ramos: Expanding on Joe's idea, construction to start within next year to connect to Coast-to-Coast Trail, finish in about three years. Ecotourism opportunities. Points of interest to be more inclusive for ADA access.
- Marbury: Fisheries perspective, access is important but also potential for big fish in west marsh. Constraint could be dissolved oxygen, habitat limitations – too much vegetation for fisheries. Area is developing quickly around Lake Apopka and will result in additional constraints in the future.
- Jennings: Home fertilizer impacts on water quality.
- Gensheimer: Consider holistic economic survey of users, impacts of hunting, fishing and bicycling, etc., from a basin-wide perspective. Data could influence decisionmakers. Identify economic impact, leverage for future funding.
- D. Green: Opportunity to use information from the 2018 Lake Apopka North Shore Recrational Use Study within LMP update.
- Gensheimer – *submitted via email on March 22*: Significant constraint! Hunting "use" appears to be the only use type that is a constraint on every other type of use across the LANS. When an area is opened to hunting, no other use can be allowed in that area. Given the current problems SJRWMD faces in managing people (across user types) without the constraint of hunting, significant conflicts during hunting days will likely escalate if not result in injury or death. Considering the hunting season lasts five months (most of the year's best weather), the use of any part of LANS for hunting will be an extreme detriment to all other users during nearly ½ of every year.
- Gensheimer – *submitted via email on March 22*: Athletes, whether on foot or 2-wheels are a significant user group / stakeholder not represented in this process. Anecdotal evidence of these users indicates a lower level of compliance in adhering to closed areas, closed gates, etc which would increase safety concerns if hunting were allowed.
- Mulholland – *submitted via email on March 24*: The mission of the Florida Native Plant Society (FNPS) is to promote the preservation, conservation, and restoration of the native plants and native plant communities of Florida. Specifically, for LANS this translates into the many opportunities to expand all restoration plans for all the LANS habitats – wetlands and uplands. These restoration efforts whether lacustrine, marsh, or upland need to focus on reducing invasive species, increasing listed species populations, and increasing native plant diversity. The constraints on native plant community restoration include the minimal

capacity to regulate water between individual marsh cells; the inability to discharge water to either the lake or to some other designated holding area; the high concentration of invasive wetland species; a lack of water resources in upland areas to support initial upland restoration plantings; and the potential risk for the current restoration focus and budget to be diverted from land management and restoration into new user groups facilities without additional staffing and additional budget to adequately manage the current recreational users of LANS. Presently, the FNPS is focused on its high priority mission of establishing new self-maintaining populations of rare and endemic Lake Wales Ridge at LANS. These species are being incorporated into the western upland areas. The FNPS goal is to have LANS (along with several other protected areas) act as a refuge for these LWR species that are rapidly being extirpated in Lake, Polk, and Osceola Counties due to extreme development pressures.

- D. Green — *submitted via email on March 22*: Gravel bikers (cyclists) ride all through the Lake County part of the North Shore, any day of the week. Birders walk in as well, especially when rare birds are seen, and many people walk on the trails for quiet and exercise.
  The Lake Apopka North Shore is different from other SJRWMD properties that are managed for hunting.
  It is adjacent to an urban area and very important for the local population as a quiet refuge. Plus it is more of an ecotourism draw already with tremendous input to the local economy, not needing any boost from hunting. Visitation to the Wildlife Drive in 2023 was over 150,000, according to District gate counters, and based on participation in Orange Audubon Society's Lake Apopka Wildlife Drive Ambassador Program, I can verify that visitors come from all over the country and world, as well as Central Florida. Extrapolating from the District's 2018 University of Florida ecotourism study, that is a $6 million dollar input to the local economy.
  Fulvous Whistling-Duck was mentioned as a target bird. That species is present also at T.M. Goodwin. That property is successfully managed for hunting, is distant from urban areas and has limited visitation by the user groups that currently appreciate the North Shore.
  By the way, the same West Marsh area that is proposed for duck hunting had earlier been proposed to enhance threatened Black Rail habitat and shorebird habitat, which are habitats that are very limited elsewhere.

LUNCH – 12:00 PM

Food provided by the SJRWMD. MAG members encouraged to socialize, share ideas and continue to work on optional map exercise.

GOALS/STRATEGIES ACTIVITY – 12:40 PM

Facilitated by Brent Bachelder – MAG members were given 15 minutes to reflect on substance of meeting and asked to record recommended strategies to be considered for inclusion in 2024 LANS LMP. Strategies were recorded on large (11"x11") sticky notes; one strategy per sticky note. MAG members then adhered sticky notes to wall and were asked to read strategies and consider commonalities. Next, SJRWMD staff adhered banners to wall identifying universal goals used within SJRWMD LMP documents. MAG members were asked to reorganize placement of strategies on wall to categorize each strategy within the appropriate goal. MAG members were then asked to work together to consolidate strategies that address the same topic into a smaller group of strategies. A list of the standard SJRWMD goals, with recommended strategies—as recorded and consolidated by MAG members—is provided below.

KEY TO STRATEGIES OUTLINE:

1. Goal: Standard SJRWMD LMP goal that strategies address
    a. Consolidated strategy: strategy, as recorded by MAG members, that captures content of sub-strategies
        i. Sub-strategy: strategy, as recorded by MAG members, that includes content captured by above listed consolidated strategy

1. Recreation – provide public recreation opportunities on the property
    a. Additional amenities to support growing recreational uses (water fountains, restrooms, pavilions, etc.); especially signage and trail infrastructure
        i. Expand access to potable water on LANS, especially along LALT
        ii. Improve signage and road surfaces of LALT in anticipation of LALT connections in 2026 (bike repair station?)
        iii. Coordinate with local jurisdictions on wayfinding and signage to the site
        iv. Continue to improve all trail markers, directional signage, interpretive kiosks, mileage, viewpoints
        v. Maintain and improve trail systems for future increased uses and loads
        vi. Expand LALT with spurs and alternate routes (signage and road surface improvements)
    b. To look into funding sources from multiple areas outside of SJRWMD: quotas, Sportfishing Restoration funds, special opportunity hunts/tournaments, other organizations
        i. Utilize Sportfish Restoration funding for hunting and fishing access
        ii. Bring in sponsorships with companies to help fund projects; i.e. Nikon, Shimano bikes, etc.
        iii. Explore funding opportunities for all user groups: daily use fee, yearly pass (like parking pass for garage
    c. Continue to grow recreational opportunities utilizing partnerships with Local, State and Federal agencies
        i. Access for wider range of user groups (currently only limited to a few user groups)
        ii. Increase public access opportunities for various user groups

   iii. Increase/create opportunities for sportsmen (hunters and anglers)
d. Expand access and staged plan to increase opportunities in the LANS to include waterfowl hunting and fishing; special opportunity hunts for youth /veterans
   i. Open access to waterfowl hunters
   ii. Provide a minimum of two recreational access points for fishing and hunting opportunities
e. Leverage volunteer labor (Nature Conservancy, Scouts, IDEAS, etc.) for enhancement projects (maybe designate a volunteer coordinator)
   i. Reach out to other user groups to help with volunteering opportunities on the property
f. Hunting and fishing with quotas/species specifications/law enforcement
   i. Staged plan to increase access for hunters
g. Measure angler/hunter satisfaction: bag surveys, creel surveys, trophy fish measure, fulvous success
h. Take advantage of local and state agencies to avoid/minimize recreational liabilities through partnerships
i. Annual survey of types of user groups to better understand who and how many users are utilizing property and their recreational interest
j. *Submitted via email on March 22*: Considering that hunting as a "use" will restrict the use of every other activity both directly and indirectly; planners need to evaluate Emeralda Marsh/Restoration Area for negative impacts that hunting has had on bicycling, wildlife viewing, fishing, kayaking and hiking/ walking in that area. Those impacts will be enhanced at LANS due to this area existing in a much higher populated area as well as being open to and a very popular area over the last 10 years to all types of passive recreation. The LANS is akin to a state park; not a relatively inaccessible "district property." The benefits of "opening" the area to hunting will be drastically overwhelmed by the harms of "taking" the area away from all other users. The 5-month open hunting season coincides with the best weather for other users.

   A possible strategy to both allow hunting as well as attempting to maintain safety for all users would be to allow hunting by permit only. The District, in cooperation with the FWC would create some number of blinds or specified shooting positions within the open areas and then use a lottery to distribute hunting permits for those specific areas. Also, the blinds or shooting positions would only be open for a limited and discreet calendar of open hunting days; say 3-1 week periods. One first week of October, first week of December and first week of January. This type of hunting schedule would provide the "rest" that the duck hunting stakeholders said would be required for the ducks. This permit system should encourage hunter safety while discouraging overhunting as well as decreasing conflicts with non-hunting users.

2. Administration – explore opportunities for adjacent property acquisition; evaluate, pursue and manage cooperative opportunities; analyze and report projected and actual costs and revenues.
   a. Gather inclusive stakeholder use and opinions and educate the public as local populations change
      i. Continue and identify new ways to inform and gather input from stakeholders regarding management on the LANS
      ii. Provide myriad natural resource education opportunities to inspire others to 'act' and care
      iii. Increase/encourage cross-stakeholder appreciation

   iv. Cultural resource education
   v. Increase awareness of restoration progress through educational events like EcoBuggy tours
   vi. Improve youth educational opportunities by engaging with the local school districts and state universities
b. Work with State or Counties on how to increase funding to better manage property
   i. Evaluate imposing user fees to pay for management tasks
   ii. Identify funding sources to aid in future management of LANS
c. Explore revenue generating programs to fund wetland restoration activities – collaborate/partner with State/County agencies to fund wetland restoration activities
   i. Explore cooperative funding sources/grants; eaxmples – America the Beautiful, NOAA Resilience, wetland grants, etc.
d. Continue to increase collaboration with other agency partners
e. Connect with media outlets for public education on Lake Apopka and LANS access
f. Periodically survey different user groups regarding expenses surrounding visits and compile data to measure economic impact trends
g. Incorporate effects of management plans on potential impacts on various user groups
h. Seek additional funding sources (example – FWC Boating and Waterways) to create diverse access opportunities
i. Encourage creation of different "Friends of" groups representing different users to leverage improvements

3. Forest and Marsh Management and Restoration – Maintain, improve, and restore forest and marsh resources
   a. Increase abilities to manipulate water levels throughout marshes to improve water storage, plant and animal diversity and a diversity of recreational opportunities, and restoration of Lake Apopka
      i. Maximize water levels to encourage different ecosystems for wildlife use
      ii. Create multiple impoundments (cells) designed to manage water levels to varying degrees of wetland succession
      iii. Restore/enhance 1,000 acres of wetland habitats to provide benefits to fish/wildlife
      iv. Develop "moist soil management" plan. Use of impoundments to create varying water heights to meet management goals (ability to burn, herbicide, species use, invasive species control
      v. Further increase marsh platform via introduction of material; example Beneficial Use of Dredge Material
   b. Manage cells for diverse native plant communities and water levels
      i. Managing cells/areas across entire property to support wider range of species and diversity in habitat types
      ii. Maximize ecosystem service via management for biodiversity, water levels and native plant communities
      iii. Increase habitat diversity to benefit fish and wildlife species
      iv. Habitat restoration to maximize access points
   c. Continue treatment of Hydrilla and invasive plants on property
   d. Explore use of cattle to manage vegetation – silvopasture?

e. Increase funding and infrastructure to expedite xeric habitat restoration especially as a living repository for endemic and rare Lake Wales Ridge (LWR) plants
f. Contractors instructed to avoid good bird habitat (like broomsedge uplands)
g. Terminate sod farm lease and convert area to wintering shorebird usage via plant diversity, water level diversity. Tie into visitor use of Jones Avenue Stormwater Area.

4. Flora and Fauna – Maintain, improve, or restore native species populations; manage invasive and/or exotic plants and animals
   a. Coordinate with USFWS and FWC on threatened and endangered species monitoring surveys; examples – Black Rail, Snail Kite, Wood Stork, LWR plants
      i. LANS monthly bird survey to compare with earlier by same methods (Jay Marburger/Pam Bowen
      ii. Targeted management strategies for Black Rail and Snail Kite???
      iii. Sod field to Black Rail habitat
   b. Increase management of invasive plants to allow for beneficial species to colonize/expand
      i. Use available resources to minimize/reduce invasive plants
5. Water Resources – Protect water quality and quantity, restore hydrology to the extent feasible, and maintain the restored condition
   a. Maximize natural system and continue management practices aimed at improving water quality of Lake Apopka
      i. Maximize natural systems use for water quality improvement
   b. Re-evaluate flood storage compared to extreme events, periodicity, risks, etc.
   c. Minimize 'external' nutrient loads to the 'system'
   d. Finalize establishment of MFLs and monitor
6. Access – Maintain access to and around the property to facilitate both land management and resource protection
   a. Adding infrastructure for persons with disabilities on potential hunt/fish area. Off season could double and be used for wildlife viewing/fishing pier/platform (stakeholder input)
      i. Meet with community on desired improvements for accessibility (ADA)
7. Fire Management – Implement a prescribed burning program in accordance with District's Fire Management Plan
   a. Utilize more fire to manage vegetation in Marsh Flow-Way (MFW) and Duda Tract
8. *PROPOSED GOAL*: Climate Resilience – *submitted via email by Rosi Mulholland on February 27*
   a. If hurricanes become more common, levees need raising by so many inches
   b. If water levels have risen to some critical levels, where are the best places to send water to for more storage or where are best places to discharge to
   c. If there are more 100 degree days, the loop trail needs more shade shelters
   d. If a south Florida plant species in is danger of extinction due to sea level rise, the district will consider "introducing" it to the property as a refuge site (I'm talking about native species)
   e. With the number of cars driving the property increasing, the district will consider carbon offsets
   f. As all of the surrounding lands become developed, will there continue to be enough water inputs to sustain the lake

CLOSING REMARKS – 1:55 PM

Brent Bachelder provided a brief presentation, thanking MAG members for their dedication and perseverance in completing all of the meeting activities. MAG was notified of the milestones and general timeline for the LANS LMP process (Table 1). MAG was notified that all information gathered today—suggested opportunities, constraints, goals, and strategies—will be considered for inclusion in the plan. All input from MAG will be assessed based on feasibility and compatibility with balancing multiple needs of the property. District staff all have open door policies and welcome input from MAG members at any point in the planning process. Review and input from MAG will specifically be sought, likely including a second MAG meeting, following completion of the draft LMP in June.

Milestone	Completion date (2024)
MAG Kick-off Meeting	February
Draft LMP Complete - Distribute to MAG	June
Draft LMP MAG Review	July
Complete edits to LMP, based on MAG Review	August
Public Meeting, start of public review period	August
Public review period	2-weeks after start
Final LMP review by SJRWMD leadership	October
District Governing Board Consideration	November

Table 1: LANS LMP Process Milestones and Completion Dates

WORKSHOP ANNOUNCEMENT – 2:10 PM

Mary Ellen Winkler announced the March 5, 2024 public meeting, hosted by the SJRWMD, regarding Lake Apoka Restoration Efforts and Vegetation Management Activities.

MEETING ADJOURNED – 2:20 PM

Figure 1: Timeline exercise – Kolterman, Mulholland, Pruett, and Williams

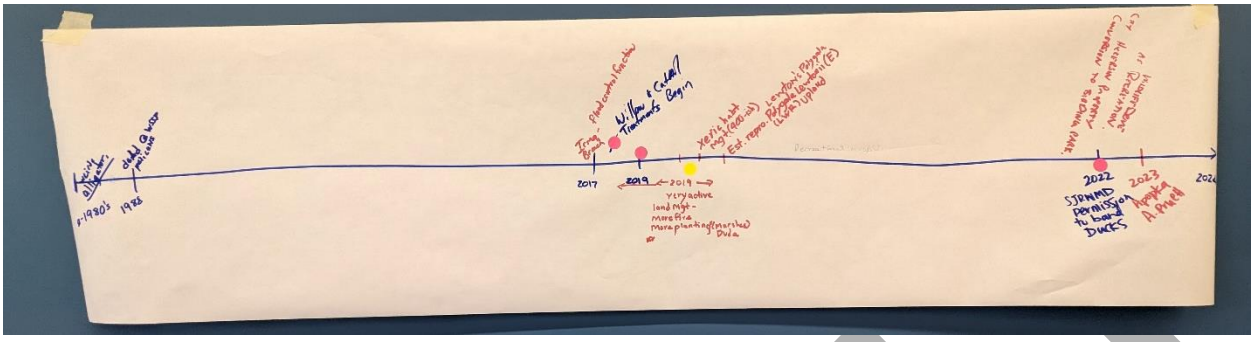

Figure 2: Timeline exercise – Gensheimer, A. Greene, Jennings, and Ramos

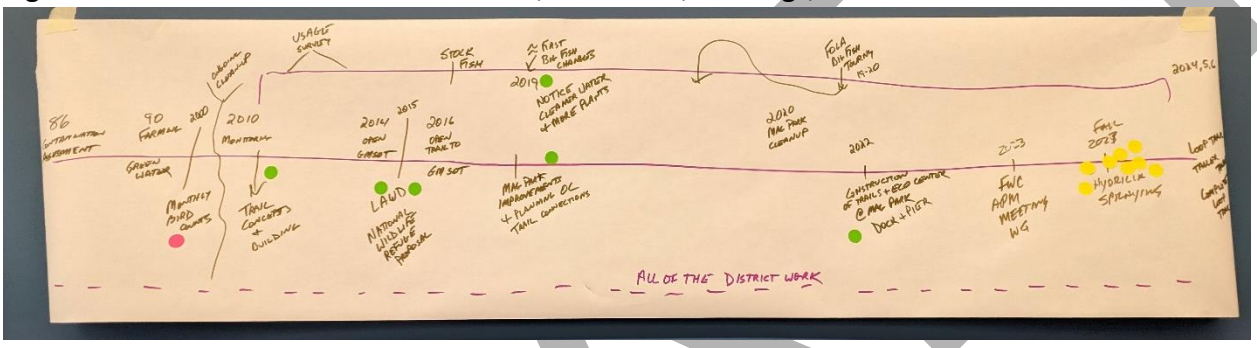

Figure 3: Timeline exercise – D. Green, Marbury, Poag, and Thompson

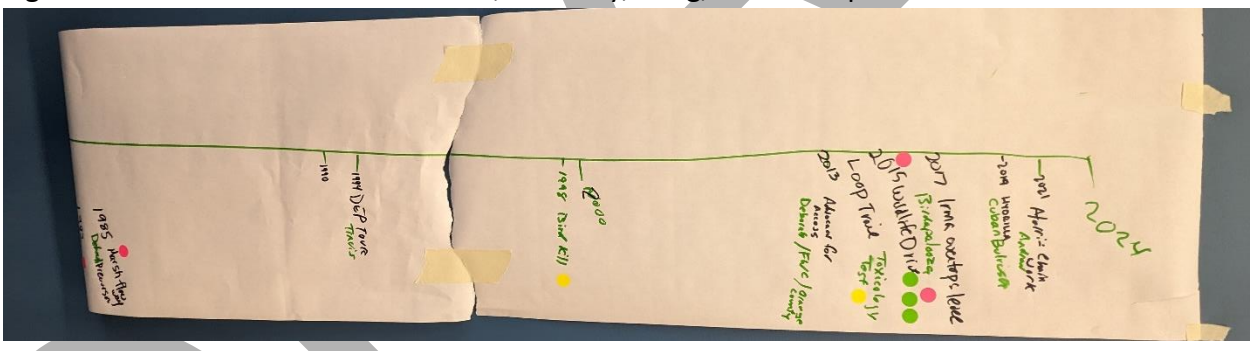

Figure 4: Timeline exercise – Bisping, Dunn, Morrow, and Whittum

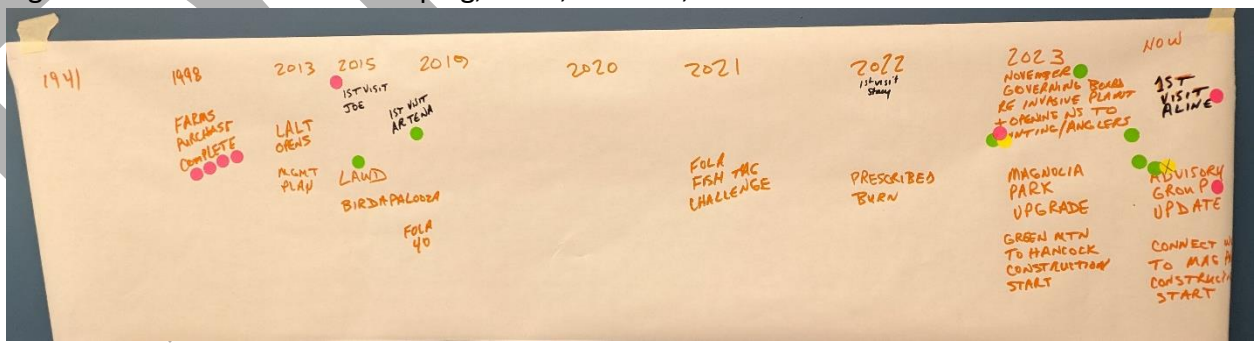

Figure 5: Map exercise and table

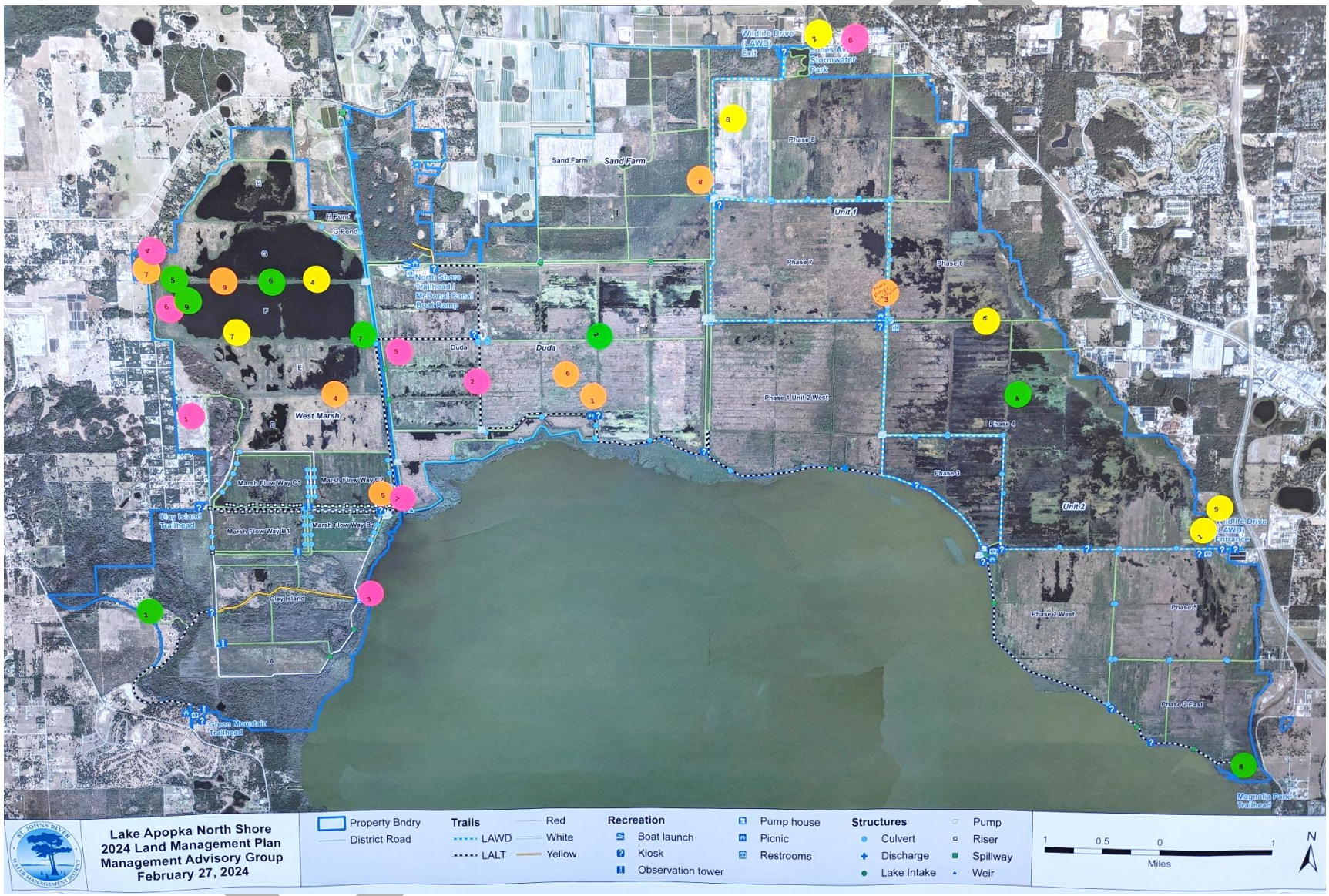

Figure 5, cont.: Map exercise table				
				
1	water fountain	well for restoration	visitor center	well for restoration
2			visitor access trails (maybe ADA & wildlife viewing around Jones Stormwater	
3	more internal pumps			kayak pull up for Blue Way, half way between McDonald launch & Ferndale kayak facility
4	habitat management – currently seems thick & unusable in cells D, E, F specifically	future area for potential recreational use (paddlers, hunting, fishing)	infrastructure for ADA use/wildlife viewing, fishing pier	access for active recreational users (hunting/fishing)
5	kid's fishing area/ADA fishing opportunity at pump pond (catch & release)	paddle (kayak, canoe) access for hunting/fishing parking/restroom	swing arm gate – pay to play wildlife driving tour	no hunting/fishing signage east of Beauclair Canal
6	Spray! Burn!	hunting opportunity	expansion of hunting opportunity	ADA accessible duck blind
7	access for the new area in West Marsh – parking, shelter, canoe/kayak launch, restrooms, information kiosk	signage for "hunt" areas	habitat clean up trails for marsh on levees	pond by pump station for youth and ADA fishing opportunities
8	owl boxes	quicker access by bicycle or pedestrian from Magnolia Park	Black Rail and/or shorebird habitat	enhance habitat at LAWD exit
9	possible bank fishing opportunities depending on management priorities in West Marsh cells	kayak launch/access point		

SUMMARY

LAKE APOPKA NORTH SHORE
PUBLIC COMMENT MEETING
2025 LAND MANAGEMENT PLAN UPDATE

On October 24, 2024, a public comment meeting was held from 6:00 PM to 8:00 PM at the St. Johns River Water Management District (District) Apopka Service Center, 2501 S. Binion Road, Apopka, FL 32703. The purpose was to solicit input regarding the Lake Apopka North Shore 2025 Draft Land Management Plan (LMP). Twelve District staff, six members of the Management Advisory Group (MAG) and 21 members of the public participated in the meeting.

The meeting was noticed through various sources. In addition to the Florida Administrative Register (FAR) (Exhibit A), notification of the meeting was distributed via email to more than 150 interested parties and published on the District's website. Both written and spoken public comment was collected during the public comment period associated with this meeting. A summary of the meeting and comments received are provided below.

PUBLIC HEARING AGENDA

1. Opening Remarks
2. Recreation Update
3. LMP Overview
4. Break
5. Public Comment

HEARING PARTICIPANTS

MANAGEMENT ADVISORY GROUP

Present: Scott Bisping (FWC), Greg Gensheimer (Green Mountain Scenic Byway), Deborah Green (Orange Audubon), Adrew Marbury (FWC), Rosi Mulholland (Florida Native Plant Society), Stacy Whittum (Delta Waterfowl)
Not Present: Joe Dunn (Friends of Lake Apopka), Artena Greene (West Orange Chamber of Commerce), Gary Jennings (American Sportfishing Association), Dan Kolterman (FWC), Aline Morrow (USFWS), Wendy Poag (Lake County), Alyssa Pruett (FWC), Regina Ramos (Orange County, Parks and Recreation), Travis Thompson (All Florida), Andrew Fanning (FWC), Elizabeth Guthrie (Ducks Unlimited), Anna Hopkins (FDEP, Office of Greenways and Trails), Keith Mousel (Florida Forest Service), Mark Romagosa (FDEP, Florida Park Service), Nathalie Visscher (FWC)

PUBLIC

Andy Braddock, Steve Whittum, Blake Labreche, Scott Stone, Matthew Cochrane, Bill Wilson, Jeff Carter, Jennifer Coleman, Ryan Briggs, Ava Berges, Marian Lichter, Lance Hart, Rachel

Comstock, Rick Baird, Gallus Quigley, Jack Conenna, Mike Hamlin, Sidney Curtis, Fred Milch, Zachary Tuckfield, Mary Soule

DISTRICT STAFF
Brent Bachelder (Planner, Bureau of Land Resources), Suzanne Archer (Technical Program Manager, Division of Water Supply Planning and Assessment), Brian Emanuel (Chief, Bureau of Land Resources), Danielle FitzPatrick (Public Communications Coordinator, Strategic Communications and Engagement), Ben Gugliotti (Land Manager, Bureau of Land Resources), Pete Henn (Program Manager, Bureau of Land Resources), Dale Jenkins (Director, Division of Infrastructure and Land Resources), Patrick McCord (Specialist, Bureau of Land Resources), Jennifer Mitchell (Environmental Scientist, Bureau of Environmental Sciences), Teresa Monson (Coordinator, Bureau of Land Resources), Jim Peterson (Strategic Planning Basin Coordinator, Bureau of Basin Management and Project Development), Mary Ellen Winkler (Assistant Executive Director)

MEETING MINUTES/NOTES

OPENING REMARKS – 6:00 PM
Brent Bachelder provided a presentation outlining the purpose of the meeting.

RECREATION UPDATE – 6:10 PM
Patrick McCord and Ben Gugliotti provided a presentation describing the land management accomplishments and challenges at LANS over the past year and forthcoming projects.

LMP OVERVIEW – 6:40 PM
Brent Bachelder provided a presentation describing the draft LMP and approval process.

BREAK – 6:50 PM
Meeting participants were encouraged to informally discuss meeting content and complete public comment cards.

PUBLIC COMMENT – 7:00 PM
Meeting participants were given the opportunity to provide spoken public comment. Written comments were also collected, through cards collected at the meeting and email. Below is a synopsis of the substantive spoken comments received. Exhibit B includes all written comment received during the public comment period associated with this meeting.

- Deborah Green: Waterfowl hunting needs monitored check stations to avoid incidents and to ensure the wintering ground is maintained. FWC should have the money for the check stations.
- Stacy Whittum: Thanks for working with stakeholders. Exciting process. Looking forward to growing the partnership and volunteer opportunities.
- Jeffrey Carter: Request for electric trolling motors for older hunters.
- Marian Lichter: Supportive of Deborah Green's comments

- Steve Whittum: Totally open to fee associated with quota. Hoping for additional opportunities.
- Jennifer Coleman: Questions ecological impact from hunting. Breeding, feeding and migration can be affected, including from lead pellets. Hunting is opposed to conservation of migratory birds. Water quality and pollution from hunting, particularly in wetland areas. Gauge public sentiment – many people are unaware of the hunting proposal.
- Ryan Briggs: Thank you for the opportunity to hunt LANS. Lead shot is not allowed when hunting waterfowl. Hunting is conservation, see United Waterfowl and Ducks Unlimited. Check stations can be found on Merritt Island and it works.
- Sidney Curtis: Supportive of Ryan Brigg's comments. Try hard to abide by rules. Thank you for the opportunity to hunt on the lake. All waterfowl hunting will be federally regulated. Honest hunters will be accepting of check stations.

MEETING ADJOURNED AT 8:00 PM

Brent Bachelder adjourned the meeting.

EXHIBIT A – FAR (VOL. 50/NO. 188, SEPTEMBER 25, 2024) NOTIFICATION

Notice of Meeting/Workshop Hearing

WATER MANAGEMENT DISTRICTS

St. Johns River Water Management District

The St. Johns River Water Management District announces a public meeting to which all persons are invited.

DATE AND TIME: Thursday, October 24, 2024, 6:00 p.m. – 8:00 p.m.

PLACE: St. Johns River Water Management District, Apopka Service Center, 2501 S. Binion Road, Apopka, FL 32703

GENERAL SUBJECT MATTER TO BE CONSIDERED: Combined Lake Apopka North Shore draft ten-year Land Management Plan public comment and Recreational Public Meeting. Public meeting to discuss and receive public comment regarding the draft ten-year Land Management Plan for the St. Johns River Water Management District's (District) Lake Apopka North Shore and recreational use of this management area. Use contact information provided below to request a copy of the proposed Land Management Plan and/or meeting agenda. Comments may be presented orally or in writing at the meeting. Written comments may also be submitted via mail or electronic mail using the contact information provided below. Comments should be mailed to arrive at the District prior to the date of the public meeting.

Note: One or more members of the District's Governing Board may attend the scheduled Public Meeting.

A copy of the agenda may be obtained by contacting: Brent Bachelder, Land Resource Specialist, P.O. Box 1429, Palatka, FL, 32178-1429, email: bbachelder@sjrwmd.com, phone: (386)643-1973

Pursuant to the provisions of the Americans with Disabilities Act, any person requiring special accommodations to participate in this workshop/meeting is asked to advise the agency at least 7 days before the workshop/meeting by contacting: bbachelder@sjrwmd.com. If you are hearing or speech impaired, please contact the agency using the Florida Relay Service, 1(800)955-8771 (TDD) or 1(800)955-8770 (Voice).

If any person decides to appeal any decision made by the Board with respect to any matter considered at this meeting or hearing, he/she will need to ensure that a verbatim record of the proceeding is made, which record includes the testimony and evidence from which the appeal is to be issued.

For more information, you may contact: Brent Bachelder, bbachelder@sjrwmd.com or (386)643-1973.

EXHIBIT B – WRITTEN COMMENTS

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Stacy Whittum Affiliation: Delta Waterfowl Date: 10/24/24

E-mail: swhittum@deltawaterfowl.org Subject: Management Plan ☒ Recreation ☐

Comments: Want to thank the District & staff for working w/ stakeholders on the updated Land management Plan. We look forward to continuing & growing our partnership w/ the district. Duck hunters are excited for this new PSGA!

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Mike Hamlin Affiliation: N/A Date: 10-24-24

E-mail: MPKDarters@gmail.com Subject: Management Plan ☒ Recreation ☐

Comments: There was nothing that improves the lake at this meeting I would like to see another lake Filtration System that would Filter the lake. Very easy Intake at Hoopers Farm an Discharge at Pump House This would Clean the lake. The other Just Cleans the water an Sends it Down the chain.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Sidney Curtis Affiliation: Hunter/Fisher Date: 10/24/24

E-mail: Twomooreoh@aol.com Subject: Management Plan ☑ Recreation ☐

Comments: I would like a better Filtration System for the Water coming out of the North Shore into Apopka. Have Airators been looked into?

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Blake Labreche Affiliation: Public Citizen/Duck Hunter Date: 10-24-24

E-mail: Blabreche@RES.US Subject: Management Plan ☒ Recreation ☒

Comments: Would like to see more burning proposed in land management Would like to see more access to marsh system for hunting.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Rick Baird Affiliation: Orange Audubon Date: 10/24/24

E-mail: rbaird4@att.net Subject: Management Plan ☑ Recreation ☑

Comments: If/when duck hunting is allowed in the West Marsh, it should be a top priority for SJRWMD partner with FWC to ensure that "bag" limits for waterfowl are followed. Orange Audubon as LAWD Ambassadors are very passionate about safe habitat for bird viewing. SJRWMD has done an excellent job of improving water quality and recreational opportunities for Lake Apopka.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Fred Milch Affiliation: Audubon/Sierra Date: 10/24/2024

E-mail: fmilch5555@gmail.com Subject: Management Plan ☐ Recreation ☐

Comments: 1.) Perhaps the state should fund more for both management and recreation because visitors to the North Shore come specifically to the area for this amenity and they add to the economic vitality by paying taxes directly to the state and help the local businesses be successful. An economic study could quantify this benefit to determine portion that could go toward these management + recreation improvements.

2.) Duck hunting is fine so long as it does not interfere with other recreational pursuits that many more people enjoy.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Gallus Quigley Affiliation: Archaeopteryx Birding & Nature Tours Date: 10/24/2024

E-mail: archaeopteryxtours@gmail.com Subject: Management Plan ☐ Recreation ☑

Comments:

Protect all current access to current facilities to ensure my company to continue to bring birders from all over the world to Lake Apopka to view the many species that occur there. Avoid any closures due to hunting at any point now or in the future.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Gallus Quigley Affiliation: Lake County Date: 10/24/2024

E-mail: gallusquigley@lakecountyfl.gov Subject: Management Plan ☑ Recreation ☐

Comments:

No recreation change should in any way impact usage of the Lake Apopka Loop Trail which once completed will be added as scenic alternate route for the Coast to Coast trail

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Gallus Quigley Affiliation: National Audubon Date: 10/24/2024

E-mail: gallusq@gmail.com Subject: Management Plan ☑ Recreation ☑

Comments:

The Lake Apopka Christmas Bird Count which occurs the first Thursday from December 14 to January 5 each year. Data goes back to 1960's for this count. example this year 2024 is 12/19/2024 Thursday plus the 3 days before & after. Go full access to the North Shore & not have any hunt days during that time.

I would like to get up and speak.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Jennifer Coleman Affiliation: Orange Audubon & Haven for Injured + Orphaned Wildlife Date: Oct 26

E-mail: Jennylouise2@gmail.com Subject: Management Plan ☒ Recreation ☒

Comments: I want to question the idea of opening LANS to hunting. I need to know ~~study~~ studies have been made ~~and~~ concerning environmental and economic impact. Points like: Ecological Impact, Conservation Goals, Public Safety, Economic impact, water quality, and Public Sentiment should all be considered.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Marian Lichter Affiliation: Audubon Date: 10-24-24

E-mail: _____ Subject: Management Plan ☐ Recreation ☒

Comments: Keep hunting + other recreation separate
have check stations for all hunting

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Steve Whitten Affiliation: Duck hunter Date: 10-24-24

E-mail: Steven_Whitten@yahoo.com Subject: Management Plan ☐ Recreation ☑

Comments: We as hunters appreciate the access opportunity that will be provided. I speak for a lot of us when saying we would be happy to pay if drawn, much like merritt island. I would very much be happy to be a financial contributor. Hopefully future considerations will include more huntable acreage and motor usage.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Deborah Green Affiliation: Orange Audubon Society Date: 10/25/24

E-mail: info@orangeaudubonfl.org Subject: Management Plan ☐ Recreation ☒

Comments: For proposed waterfowl hunting, check stations are essential. This is too widely used a property to let it be on the honor system. In addition to the people (other stakeholders) that would be impacted, waterfowl needs this overwintering site. Needs to be regulated with check stations. If hunting is such an economic boon, FWC can use that for this

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Jeffrey Carter Affiliation: Date: 10/23/24

E-mail: fishingcarter@gmail.com Subject: Management Plan ☐ Recreation ☑

Comments: I am requesting that the hunting area be allowed electric motors for older hunters.

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Rosi Mulholland Affiliation: Fla. Native Plant Soc / Rec. User / Volunteer Date: 10/24/2024

E-mail: rmulholl@gmail.com Subject: Management Plan ☐ Recreation ☒

Comments:

The LANS has no history of hunting behind the lake levee. The property has evolved differently than most of the District's other properties in that is has been historically known as a renowned birding location. This has been the case from when the Farms were operating. All of us local birders have been birding on the property since the 1980's and that continues to this day. There is no way that waterfowl hunting will not impact the quality of experience for every other user group. Opening the area to fishing is very compatible with all other users but hunting is not - it is the one use that negatively all users.

The district does not to treat all properties the same as far as recreational ^need opportunities. # The district needs a system-wide approach to recreational opportunities, and is providing waterfowl hunting at Emeralda Marsh and at T.M. Godwin, as well as others.

If a quota hunt is established, it's schedule needs to coordinate with the LANS Birding Festival, and there should be absolutely NO overlap in those dates.

I believe the District is being short-sited to get the waterfowl hunting route when there are already well-established user groups who will be negatively impacted in their experience on the property.

R. Mul

St. Johns River Water Management District
Lake Apopka North Shore Public Meeting
Comment Card

PLEASE PRINT NEATLY
Submit in-person or email to:
bbachelder@sjrwmd.com

Name: Ryan Briggs Affiliation: Rec user of the area Date: 10/24/24

E-mail: Troutman561@gmail.com Subject: Management Plan ☐ Recreation ☒

Comments: I appreciate the hunting access opportunities. A suggestion for another revenue stream would be a fee ~~for~~ an awarded quota permit in the future. If the free quota area proves successful, perhaps opening "better" areas with a fee like MINWR has per hunt is a viable option?

From: Kathy Rigling
To: Brent Bachelder
Subject: Comments on Duck Hunting on the North Shore of Lake Apopka
Date: Friday, October 25, 2024 10:17:16 AM

Good morning,

I am strongly opposed to any form of hunting being permitted on the North Shore of Lake Apopka.
I am a birder,naturalist , photographer and bicyclist. I frequently visit the North Shore of Lake Apopka with friends to look for birds, enjoy the quiet and solitude of nature. I enjoy taking photographs of what I see. In the cooler months I travel on my bicycle.
I have lived in Tangerine since the late 80's I have seen so much development and destruction of habitats and the rate of destruction in the Apopka area is escalating rapidly.
Wildlife needs space and no additional pressure in the form of human predators.
Hunting is permitted on the lake and that is okay but please leave the North Shore alone. In the past 50 years over 3 billion bird species have been lost. The ducks that winter at the North Shore of Lake Apopka need a place of safety where they can survive to continue their species.
People need places where they can peacefully enjoy the solitude of nature without continual gunshots and the fear of stray bullets.
We have lost so much habitat in Central Florida please protect this special place.

The Lake Apopka North Shore brings in positive economic impact through all the people who travel to enjoy the wildlife particularly great variety of species found there.
Hunting can threaten that growing industry.

Are there even enough staff to ensure that hunters are staying at their limits and within their boundaries? If not over hunting can happen and bicyclists and hikers can be at risk.

I hope that the needs of the wildlife and the majority of the people who visit the North Shore will win out over a very vocal group of hunters who had very little to do with the restoration of this special place.

Respectfully,

Kathy Rigling
Orange County resident

From: Samuel Kendall
To: Brent Bachelder
Subject: Duck hunting is bad for ducks
Date: Friday, October 25, 2024 11:41:06 AM

Mr. Bachelder,

I don't know if you were around when we learned that birds were dying at Lake Apopka but I saw it happening. I was on one of my first Audubon field trips and was taken aback by the thousands of migrating birds swarming over and resting and feeding in the wetlands. Then several of us noticed some of the herons on the ground that seemed to be wobbling side to side as they walked. Within a few weeks after that we learned that birds were being sickened and dying by all the toxins in the soil and water. We were horrified. These images remain in my memory today.

Now, just as the Lake appears to be once again a welcoming stopover for hundreds of thousands of migrants, you are proposing to scare them away and even kill them. Other species rely on that habitat besides ducks. That was the whole point of restoration. Their rest and feeding will be disrupted. Humans have and continue to develop and reduce suitable stopover points for migrating birds. Lake Apopka was once so valuable for them. The District and others have spent years of work restoring water quality and habitat. Opening this area to hunting is simply not compatible with the objectives of this extensive and expensive operation.

I think about the California condors that have been harmed by lead shot. This isn't compatible with water quality and cleaning up wetland habitat either. Bird watching is already bringing in millions of dollars and there will be more to come. Why make these people anxious knowing there may be firearms in the area. Hunting conflicts with the peaceful flow of the natural world.

Biodiversity loss is happening worldwide at an alarming pace. We are proud of the work the District has done after we all recognized the mistakes at the Lake. I urge you not to permit interference with our attempt to repair this wonderful bird sanctuary.

Sincerely,
Samuel Kendall
Altamonte Springs

From: Gail Spratley
To: Brent Bachelder
Cc: sabalpress@mac.com; robert20sanders@gmail.com
Subject: Duck hunting on Lake Apopka North Shore
Date: Friday, October 25, 2024 10:42:16 AM

Mr Bachelder,

It has come to me attention only this morning, Friday 10/25/2024, that the St Johns River Water Management District has held meetings to consider allowing duck hunting on the Lake Apopka North Shore.

My public comment is NOT TO ALLOW HUNTING OF ANY KIND on the District property known as the Lake Apopka North Shore.

Truly,
Gail Spratley
200 Saint Andrews Blvd #2503
Winter Park FL 32792
407.312.9722

Yahoo Mail: Search, Organize, Conquer

From: Robert Sanders
To: Brent Bachelder
Subject: Duck hunting on Lk Apopka North Shore
Date: Friday, October 25, 2024 10:08:28 AM

I just heard that there's a proposal to allow duck hunting on the north shore of Lk. Apopka.

ABSOLUTELY NOT! ARE YOU INSANE?

Wildlife and humans need a refuge from exploitive, extractive activities. The North Shore is a quiet, peaceful place for people & wildlife and must be retained as such.

Hunters already have access to many areas for hunting. Keep them out of the North Shore. They don't need it. Non-hunters need it more.

Bob Sanders, Orlando, FL

From: carol niemi
To: Brent Bachelder
Subject: Lake Apopka Hunting
Date: Friday, October 25, 2024 12:18:42 AM

Dear Mr. Brent Bachelder,
I am very concerned of the strong possibility of opening a portion of the Lake Apopka North Shore to duck hunting. This is as bad as putting in golf courses and pickleball courts.

My concerns:
-Ecological Impact: Hunting could disrupt local wildlife ecosystems, especially for non-target species. Duck hunting negatively affects other species relying on the habitat for breeding, feeding, or migration.

--Conservation Goals: If the area is designated for conservation, hunting conflicts with its primary objective—protecting biodiversity and habitat restoration.

--Public Safety: Introducing firearms into public land used by hikers, birdwatchers, or other visitors may pose risks, reducing its appeal as a safe recreational space.

--Non-consumptive Use: Activities like birdwatching and ecotourism has generated locally 6 million dollars according to a study made in 2018.

-Water Quality and Pollution: Duck hunting can introduce lead shot and other pollutants into waterways, threatening water quality and aquatic life, particularly in wetland area.

Please do not open this area to hunting.
It is a wonderful area for use by the public in the Central Florida Area.

Regards,

Carol Niemi
Seminole County

From: Chris Rocheleau
To: Brent Bachelder
Cc: Gigany Rocheleau
Subject: Lake Apopka North Shore
Date: Friday, October 25, 2024 7:22:40 AM

Good morning-
Thank you for considering this proposal. My two young daughters and I regularly drive the 11mile access through the north shore on weekends to enjoy the wildlife. I fish with my girls regularly and they currently only accompany me on duck hunts but I look forward to them joining the sport. The diverse abundance of waterfowl north of lake Apopka is astounding for the area and the opportunity to hunt within this location soon and eventually with my girls is a dream come true.

Sent from my iPhone

Brent Bachelder

From: Melissa Steinberg <emkaeess@gmail.com>
Sent: Friday, October 25, 2024 5:33 AM
To: Brent Bachelder
Subject: Lake Apopka Wildlife Drive

Please don't allow duck hunting in the Lake Apopka North Shore. I volunteer at the wildlife drive and before becoming a volunteer visited regularly to bird. It is a special place. I will never forget the first time I visited the drive, it is a memory so warm and special. It opened mine and my husband's eyes to the birding that existed in central Florida. We moved here from New York and the drive was one of the things we looked forward to as part of our move.

We made friends at the drive when we moved here. We participate in the birding festival every year. As a volunteer, I see first hand the excitement and specialness of the place when interacting with the folks that come from all over the world to see the place.

How does duck hunting possibly fit into all of that. The area was created to reclaim farm land and make Lake Apopka healthy again. How would duck hunting possibly contribute to making Lake Apopka healthy? It would be disruptive and have a negative impact on the wildlife, wildlife that shows up in Apopka that does not show up anywhere else in the state. It would have a negative impact on visitors there to see the wildlife and the habitats of Florida.

There are so many other places already designated for duck hunting outnumbering the places designated just for conservation, how many more places are needed for hunting? Please don't allow it.

We love Florida in part because of the conservation efforts being done to restore land and make waterways healthy again. Lake Apopka is a shining example of that. Please don't ruin it by allowing hunting.

Melissa (and Gary and Noah)

From: Brandon Corry
To: Brent Bechelder
Subject: Opposition to duck hunting at Lake Apopka
Date: Friday, October 25, 2024 10:43:17 AM

This email is directed to those involved with deciding the status of duck hunting along the north shore of Lake Apopka.

As a Floridian and avid environmentalist PLEASE DO NOT allow duck hunting. These locations are necessary safe havens for waterfowl during their migration periods. Not only that, but by allowing hunting in an area that is frequented in large numbers by birders and outdoorsman, you are encouraging conflict among the community. There are plenty of spots to hunt waterfowl in Florida already. This is not worth the stress it will bring.

For peace among the community and the preservation of our waterfowl species, please prevent hunting at this location.

Thank you,
Brandon Corry

From: DAVID SLONGWHITE
To: Brent Bechelder
Subject: Protect Lake Apopka"s wildlife and environment from hunting.
Date: Friday, October 25, 2024 3:39:56 AM

I am against duck hunting in Lake Apopka wildlife conservation area. I have introduced my friends and family to Lake Apopka wildlife drive. They in turn have shared with their friends. Any visitors to Florida that I meet, I have recommended they visit Lake Apopka Wildlife Drive. I have met people that were on vacation to Florida that they went to Lake Apopka Wildlife Drive. Thay came United Kingdom, Hungary, Canada, as well as United States (Washinton, Michigan, Indiana Florida etc...). Below are key points that need to be considered. Thank you for your time and support in protecting Lake Apopka Wildlife area from duck hunting.

--Ecological Impact: Hunting could disrupt local wildlife ecosystems, especially for non-target species. Duck hunting negatively affects other species relying on the habitat for breeding, feeding, or migration.

--Conservation Goals: If the area is designated for conservation, hunting conflicts with its primary objective —protecting biodiversity and habitat restoration.

--Public Safety: Introducing firearms into public land used by hikers, birdwatchers, or other visitors may pose risks, reducing its appeal as a safe recreational space.

--Non-consumptive Use: Activities like birdwatching and ecotourism has generated locally 6 million dollars last year according to a study made in 2018. While preserving the area's natural integrity, potentially providing more long-term benefits than hunting.

--Water Quality and Pollution: Duck hunting can introduce lead shot and other pollutants into waterways, threatening water quality and aquatic life, particularly in wetland areas.

David Slongwhite
Altamonte Springs

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: [redacted]
Date: [redacted]
Attachments: [redacted]

Hi Brent,
Here are my written comments. I have copied the Final FMP. Chapters as I see FMP is mentioned in the plan. I have attached a copy of the draft plan in the hope you have a copy (my notes are in the plan, fyi)

Page iv – Flora and Fauna: I suggest this revision – "Invasive and nuisance plant species management" as that invasive could be species and clearly addressed

Page 24, 3rd paragraph: Cattails are referred to as nuisance. Aren't they beneficial in uptake of nutrients? I think statement based on density? Cattails, a native species, especially one that may compete against exotic invaders, could provide beneficial habitat.

Page 52, 2nd paragraph: Some invasive wildlife species are mentioned. The gray-headed swamphen is of serious concern and should be mentioned here. The District should assess the impacts of their increasing population, especially as a direct competitor of the native purple gallinule. The District should evaluate measures to control this species.

Page 54, second to last paragraph: What types of recreation are being considered? I would oppose non-compatible, active recreation such as: fishing/golf, mountain bike trails in forested areas and any recreation that results in habitat loss.

Regards,
Danny Young
Young Gator Environmental Consulting
[redacted]
386-333-1953

From: Grant Gschwider <[redacted]@sjrwmd.com>
Sent: Tuesday, October 1, 2024 3:02 PM
Subject: Upcoming Lake Apopka north Shore draft Land management plan and recreation public meeting - Oct. 24

Good afternoon,
On behalf of the St. Johns River Water Management District, I invite you to the upcoming Lake Apopka North Shore Draft Land Management Plan and Recreation Public Meeting in Apopka, from 6:00 – 8:00pm on Thursday, October 24, 2024.

Additional information is below and the same information is attached. Please contact me if you have any questions. I look forward to your participation during the meeting.

Thank you,
Brent Batchelder

Brent Batchelder
Land Resource Specialist
Bureau of Land Resources
St. Johns River Water Management District
P.O. Box 1429 ● Palatka, FL 32178-1429
Office: 386-431-1915
Email: [redacted]@sjrwmd.com
Website: www.sjrwmd.com
Connect with us: Newsletter, Facebook, Twitter, Instagram, Youtube, Pinterest

www.sjrwmd.com/ePermit

SUBJECT: Lake Apopka North Shore Draft Land Management Plan and Recreation Public Meeting

The St. Johns River Water Management District's (District) Lake Apopka North Shore (North Shore) Draft Land Management Plan and Recreation Public Meeting is scheduled for **6- 8 p.m.** on **Thursday, Oct. 24, 2024**. The meeting will be held in person at the District's Apopka Service Center, St. Johns Conference Room, located at 1312 E. Semoran Road Apopka FL 32703.

The purpose of this meeting is to discuss and receive public comment regarding the draft 10-year Land Management Plan for the District's North Shore and recreational use of this management area. All members of the public are encouraged to participate in this meeting.

A draft of the proposed Land Management Plan is available at: http://www.sjrwmd.com/media/lakeapopkaplan/2025_Lake_Apopka_North_Shore_Draft.pdf. Please use the contact information provided below to request a copy of the meeting agenda. Comments may be provided orally at or during the meeting. Written comments may be submitted via mail or electronic mail using the contact information provided below. It is requested that comments be mailed so that they arrive at the District prior to the date of the public meeting.

Topics will include:
1. North Shore Restoration and Land Management Update
2. Overview of Draft Land Management Plan
3. Opportunity for Public Comment

District contact information:
Brent Batchelder, Land Resource Specialist
P.O. Box 1429,
Palatka FL, 32178-1429
email: bbatchelder@sjrwmd.com
phone: (386)443-1915
We value your opinion. Please take a few minutes to share your comments on the service you received from the District by clicking the link.

Notices:
• Email to and from the St. Johns River Water Management District are archived and, unless exempt or confidential by law, are subject to being made available to the public upon request. Users should not have an expectation of confidentiality or privacy.
• Individuals lobbying the District must be registered as lobbyists (112.3261, Florida Statutes). Details, applicability and the registration form are available at http://www.sjrwmd.com/lobbyist/

Appendix C - Parcel Summary

Parcel	LA Number	Acres*	Total Purchase Price	District Amount	Funding Source	Closing Date
Duda-Clay Island	1987-018-PA	1,880	$4,500,000.00		Lake Apopka West – Specific Appropriations	11/30/1988
Hooper Farms	1987-018-PB	200	$200,000.00		Lake Apopka West – Specific Appropriations	10/27/1988
Hooper Farms	1987-018-PB	1,428	$4,800,000.00		Lake Apopka West – Specific Appropriations	3/28/1990
E. Wilkinson- Cooper	1987-018-PC	366	$1,279,145.00		Lake Apopka West – Specific Appropriations	5/15/1992
Wilkinson Addition	1987-018-PD	5	$18,725.00		Lake Apopka West – Specific Appropriations	1/26/2001
CC Ranch – Lake Coleman	1989-004-P1	278	$669,296.25		Lake Apopka West – Specific Appropriations	5/15/1992
	Transfer Out	-219	$0.00			4/13/2021
Brady/RICO- Clay Island	1989-026-P1	278	$83,196.85	$83,196.82	Ad Valorem	1/2/1990
Howard – Clay Island	1990-015-P1	5	$70,000.00		Lake Apopka West – Specific Appropriations	8/6/1990
Duda/Whittle	1990-077-P1	1,115	$2,950,000.00		Lake Apopka West – Specific Appropriations	8/30/1990
Keen Ranch A	1993-006-PA	256	$434,348.20		Lake Apopka West – Specific Appropriations	12/9/1993
Keen Ranch A (Holt Exchange)	1996-006-PA	(11)	($18,360.00)		Lake Apopka West – Specific Appropriations	9/28/2004
Keen Ranch A Totals		**245**	**$415,988.20**			
Holt (Keen Ranch A Exchange)	1995-059-P1	8	$18,360.00	$18,360.00	-----	9/28/2004
			($17,000.00)	($17,000.00)	-----	9/28/2004
Holt Totals		**8**	**$1,360.00**	**$1,360.00**	**-----**	
Keen Ranch B	1993-006-PB	50	$171,311.61	$171,311.61	Florida Forever	12/19/2002
Robinson	1993-007-P1	37	$84,870.00	$84,870.00	P2000	4/19/1995

Blunt	1993-054-P1	53	$106,000.00	$106,000.00	P2000	5/29/1995
Boyd-Davis	1994-026-P1	178	$474,128.12	$474,128.12	P2000	8/30/1995
A.Duda & Sons	1996-083-P1	3,175	$4,979,162.00		Federal – USDA Wetland Reserve Program	4/18/1997
			$9,183,408.00		Lake Apopka North – Specific Appropriations – DEP CARL	4/18/1997
			$1,533,000.00		Federal – USDA Wetland Reserve Program	4/18/1997
			$4,051.58	$4,051.58	Lake Apopka North – Other Funding SJRWMD	4/18/1997
			$6,235,473.42	$6,235,473.42	Lake Apopka North – Specific Bond Appropriation – SJRWMD SOR Bonds	4/18/1997
			($1,528,948.42)	($1,528,948.42)	Lake Apopka North – Specific Bond Appropriation – SJRWMD SOR Bonds	9/14/1998
			($4,051.58)	($4,051.58)	Lake Apopka North – Other Funding	9/14/1998
	Exchange	-54.5	$0.00	$0.00	SJRWMD	3/2/2015
A. Duda & Sons Totals		**3,175**	**$20,402,095.00**	**($4,706,525.00)**		
Beall, Clarence	1996-084-P1	312	$620,980.00		Federal – USDA Wetland Reserve Program	9/14/1998
			$754,141.00		Lake Apopka North – Specific Appropriation DEP P200	9/14/1998
			($2,869.00)	($2,869.00)	Lake Apopka North – Other Funding – SJRWMD	9/14/1998
Beal, Clarence Totals		**312**	**($1,372,252.00)**	**($2,869.00)**		

Clonts Farms	1996-085-P1	642	$1,285,480.00		Federal – USDA Wetland Reserve Program	9/14/1998
			$2,975,100.00		Lake Apopka North – Specific Appropriation – DEP P2000	9/14/1998
			($5,480.00)	($5,480.00)	Lake Apopka North – Other Funding SJRWMD	9/14/1998
Clonts Farms Totals		**642**	**$4,260,580.00**	**($5,480.00)**		
Crakes & Son, Inc.	1996-086-P1	503	$1,017,680.00		Federal – USDA Wetland Reserve Program	10/6/1998
			$1,691,975.00		Lake Apopka North – Specific	10/6/1998
					Appropriation – DEP P2000	
			$20,133.53	$20,133.53	Lake Apopka North – Other Funding SJRWMD	10/6/1998
Crakes & Son, Inc. Totals		**503**	**$2,729,788.53**	**$20,133.53**		
Grinnell Farms	1996-087-P1	113	$1.00	$1.00	Lake Apopka North – Specific Appropriation - SOR	8/20/1999
	Exchange	(6)	$0.00	$0.00		11/26/2001
WFR Flowage Easement	1998-029-P1	8	$189,000.00	$189,000.00	Exchange	11/26/2001
Living Carpet – Hensel & Rodgers	1996-089-P1	369	$1.00	$1.00	Lake Apopka North – Specific Appropriation – SOR Bonds	8/20/1999
	Surplus	(53)	$0.00	$0.00		2/19/2003
Robert Potter and Sons	1996-094-P1	321	($17,000.80)	($17,000.80)	Exchange	8/20/1999
			($63,274.49)	($63,274.49)	Exchange	8/20/1999
			($237,240.00)	($237,240.00)	Lake Apopka North – Specific Appropriation	8/20/1999
Progressive Growers	1996-099-P1	2	$0.00	$0.00	Lake Apopka North – Specific Appropriation	8/20/1999

	Exchange	(2)	$0.00	$0.00	Lake Apopka North – Specific Appropriation	8/20/1999
Rice	1996-109-P1	20	$1.00	$1.00	Lake Apopka North – Specific Appropriation –	
					SOR Bonds	
	Exchange	(2)	$0.00	$0.00		
Growers Pre- cooler, Inc	1996-088-P1	21	$3,459,003.00		Lake Apopka North – Specific Appropriation – DEP P2000	10/14/1998
			($19,465.00)	($19,465.00)	Lake Apopka North – Other Funding SJRWMD	10/14/1998
	Surplus	(9)	($227,208.00)		OOCEA (Orlando Orange County Expressway Authority)	4/21/2010
		12	**$3,212,330.00**	**($19,465.00)**		
Long Farms, Inc.	1996-090-P1	1,013	$1,624,506.00		Federal – USDA Wetland Reserve Program	10/6/1998
			$5,915,548.67		Lake Apopka North – Specific Appropriation – DEP P2000	10/6/1998
			$394,813.00	$394,813.00	Lake Apopka North – WMLTF-SJRWMD	10/6/1998
			$1,150,917.33	$1,150,917.33	Lake Apopka North – Other Funding SJRWMD	10/6/1998
			$9,085,785.00	**$1,545,730.33**		
Lust Farms, Inc.	1996-092-P1	1,500	$2,427,823.84		Lake Apopka North – Specific Appropriation – DEP P2000	9/14/1998
			$3,015,028.00		Federal – USDA Wetland Reserve Program	9/14/1998
	Exchange	-1.53	$0.00	$0.00		
Long & Scott Farms	1996-091-P1	87.34	$0.00	$0.00		3/2/2015

			$3,950.076.16		Lake Apopka North – Specific Appropriation – DEP General Revenue	9/14/1998
			($28,232.00)	($28,232.00)	Lake Apopka North – Other Funding SJRWMD	9/14/1998
	Surplus	(3)	($72,072.00)	($72,072.00)	Lake Apopka North – Other Funding SJRWMD	4/21/2010
		1,497	**$9,392,928.00**	**($100,304.00)**		
Lust & Long Pre-Cooler	1996-093-P1	13	$1,354,025.00		Lake Apopka North – Specific Appropriation – DEP P2000	9/25/1998
			($54,160.00)	($54,160.00)	Lake Apopka North – Other Funding SJRWMD	
	Surplus	(1)	($23,320.00)	($23,320.00)	Land Acquisition Fund Balance	6/24/2003
	Surplus	(6)	($425,300.00)	($425,300.00)	Land Acquisition Fund Balance	9/10/2003
	Surplus	(6)	($825,845.00)	($825,845.00)	Land Acquisition Fund Balance	1/14/2005
		0	**$25,400.00**	**($1,328,625.00)**		
San-Ge-Lan	1998-061-P1	9	$825,845.00	$825,845.00	Exchange	1/14/2005
Stroup Farms, Inc.	1996-095-P1	411	$1,422,383.49		Lake Apopka North – Specific Appropriation – DEP P2000	9/14/1998
			$828,860.00		Federal – USDA Wetland Reserve Program	9/14/1998
			($20,193.00)	($20,193.00)	Lake Apopka North – Other Funding SJRWMD	9/14/1998
			$2,231,050.49	**($20,193.00)**		
Zellwood Drainage District Property	1996-096-P1	41	$0.00		Donation	4/6/2000
	Exchange	(1)		($14,700.00)	Exchange	10/18/2011
		40	**$0.00**	**($14,700.00)**		

Wekiva Concrete- Zellwin Farms	1998-063-P1	2	$0.00	$0.00	Exchange	10/18/2011
Zellwin Farms	1996-097-P1	5,149	$2,816,592.00		Lake Apopka North – Specific Appropriation DEP CARL	9/14/1998
			$21,049,923.84		Lake Apopka North – Specific Appropriation – WMLTF SJRWMD	9/14/1998
			$3,553,780.00		Lake Apopka North – Other Funding SJRWMD	9/14/1998
			$1,764,526.58	$1,764,526.58	Lake Apopka North – Specific Appropriation – SJRWMD SOR Bonds	9/14/1998
			$4,450,078.77	$4,450,078.77	Lake Apopka North WMLTF SJRWMD	9/14/1998
			($231,228.85)	($231,228.85)	Lake Apopka North – Other Funding SJRWMD	9/14/1998
	Surplus	(6)	($425,000.00)	($425,000.00)	Land Acquisition Fund Balance	3/2/2004
		5,143	**$32,978,672.34**	**$5,558,376.50**		
Hickerson Flowers	1996-098-P1	121	$1,635,991.00		Lake Apopka North – Specific Appropriation WMLTF	8/20/1999
			$1,644,000.00	$1,644,000.00	Lake Apopka North – WMLTF SJRWMD	8/20/1999
			$37,337.50	$37,337.50	Lake Apopka North – Other Funding SJRWMD	8/20/1999
	Surplus	(23)	($652,434.00)	($652,434.00)	Land Sales	4/21/2010
	Exchange	(70)				10/23/2018
		98	**$2,664,894.50**	**$1,028,903.50**		
Marsell, Sherris	1996-100-P1	2	$52,947.00	$52,947.00	Lake Apopka North – Other Funding SJRWMD	6/29/2000
Davison	1996-108-P1	9	$36,148.22	$36,148.22	Lake Apopka North – Other Funding SJRWMD	3/30/2001
Bates	1998-028-P1	8	$213,000.00	$213,000.00	Lake Apopka North – Other Funding SJRWMD	7/20/2000

WFR	1998-029-P2	60	$328,000.00	$328,000.00	OOCEA-Western Beltway Part-C	9/19/2002
Marsell, Martha E.	1998-032-PA	2	$7,960.00	$7,960.00	Lake Apopka North – Other Funding SJRWMD	6/29/2000
Marsell, John and Corella, Flor Maria	1998-032-PB	11	$44,280.00	$44,280.00	Lake Apopka North – Other Funding SJRWMD	6/29/2000
Schaffer	1998-033-P1	13	$38,580.00	$38,580.00	Lake Apopka North – Other Funding SJRWMD	5/17/2001
Smith, James- Teddy	1998-034-P1	36	$108,550.00	$108,550.00	Lake Apopka North – Other Funding SJRWMD	3/22/2000
Strickland	1998-038-P1	19	$55,173.40	$55,173.40	Ad Valorem	2/1/2002
Wallace Carrots, Inc. – Equipment Lake Apopka	198-042- P1	0	$155,000.00	$155,000.00	Lake Apopka North – Other Funding SJRWMD	4/21/1999
Napa Property – Jones Avenue Stormwater Project	1998-050-P1	35	$259,873.21	$259,873.21	OOCEA – Western Beltway Part-C	8/31/2000
Freeman	1998-065-P1	11	$30,000.00	$30,000.00	Lake Apopka North – Other Funding SJRWMD	9/9/1999
Baumgardt	1998-066-P1	<1	$20,000.00	$20,000.00	Lake Apopka North – Other Funding SJRWMD	9/9/1999
Bedsole	1998-067-PA	<1	$12,700.00	$12,700.00	Ad Valorem	7/9/2002
	Exchange	(<1)	($12,700.00)	($12,700.00)	Exchange	9/22/2006
Bedsole- Pelton Flowage Easement	1998-067-PB	1	$12,700.00	$12,700.00	Exchange	9/22/2006
Langley	2002-001-P1	59	$141,370.03	$141,370.03	OOCEA-Western Beltway Part-C	12/20/2002
		Totals	**$189,882,419.78**	**$16,446,156.84**		

Lake Apopka North Shore
Biological Assessment for Active Management
for Phases 1 through 8 and Duda

Prepared by

Pamela Bowen
Jodi Slater
Bureau of Water Resources
Division of Land and Water Resources
St. Johns River Water Management District

January 31, 2018

Executive Summary

Duda and the phases in Units 1 and 2 on the Lake Apopka North Shore (LANS), have been inundated for various periods of time. Duda was first inundated in 2002 and 2003 and the Marsh Flow-Way began operation in 2003. Subsequently, additional phases were inundated in the following years. The last area flooded was Phase 8 in 2015. When these areas were initially flooded, the goal was to promote the growth of dense emergent vegetation to discourage fish-eating birds from using the area. Once Duda, Phase 1, Phase 2 West, and Phases 6 and 7 had been inundated for five years, fish were collected in these areas and organochlorine pesticide (OCP) fish tissue data were analyzed to determine if the development of mixed marsh habitat, entering into active management could be safely used without posing a risk to listed species. The United States Fish and Wildlife Service (USFWS) concurred with the District that active management was not likely to adversely affect listed species in Duda, Phase 1, Phase 2, and Phases 6 and 7. The remaining phases, Phase 2 East, 3, 4, 5, and 8 continued to be managed for shallow water depths and dense wetland vegetation. However, high annual rainfall between 2014 and 2017, in addition to flooding from a lake levee breach associated with Hurricane Irma, have resulted in higher water depths and large sections of open water in Phases 3 and 4. The large open water conditions, which have been predicted to result in higher OCP concentrations in fish, were concerning. As a result, the District conducted an analysis of Predicted Open Water OCP fish tissue concentrations in the phases that were not currently under active management, Phases 2 East, 3, 4, 5, and 8, to determine if foraging in these areas would adversely impact listed species. The analysis demonstrated the predicted open water concentrations were not likely to adversely impact listed species.

The purpose of this Biological Assessment (BA) is to expand the use of active management activities to all phases of the LANS east of the Apopka Beauclair Canal (ABC) and to further define what activities are included in active management. Active management includes selective planting, drawdown, deep inundation, prescribed fire, habitat restoration, beneficial soil/sediment placement, and control of invasive vegetation. Active management will be used to develop a mosaic of wetland habitats that prevent oxidation of muck soils to prevent phosphorus release and to create wetlands which are beneficial to wildlife. This BA is also being used to address the use of the LANS for flood storage under specified conditions in the Apopka and Upper Ocklawaha River basins.

After the 1998-1999 bird mortality event, research efforts furthered the District's understanding of legacy pesticides in highly organic soils on the LANS. OCP risk is now evaluated in a variety of ways. The risk of individual OCPs is evaluated via comparison with toxicity reference values (TRVs) and hazard quotients (HQ). The cumulative lethality of all toxic OCPs is evaluated via comparison with hazard indices (HI). Sublethal effects are evaluated by either comparison of DDE concentrations against the DDE TRV or the DDE HQ. Research that demonstrated higher biota sediment accumulation factors (BSAFs) in deeper wetland conditions relative to shallow conditions allows us to estimate the deeper water risk

from available shallow water OCP data. This is done as a conservative factor. That research indicated fish accumulate more OCPs in open water habitats than in vegetated ones, and enabled a calculation for a body burden ratio of "fish in open water to fish in vegetation" for each analyte of concern. These ratios allow the District to estimate the OCP concentrations expected in fish maintained in open water based on the OCP concentrations found in fish living in vegetated marsh systems. A secondary finding from the research was that OCP accumulation in fish was similar across a variety of fish species. Thus, even if a different assemblage of fishes occupies the wetland systems in Phases 2 East, 3, 4, 5, and 8 after the proposed management changes, the current data based on forage fish collected in mostly vegetated areas will be relevant for projected OCP concentrations in open water areas.

The recent 2015 and 2016 analysis of OCP concentrations in composite fish samples of mosquitofish (*Gambusia sp.)* collected from vegetated areas in Phases 2 East, 3, 4, 5, and 8 confirms that all concentrations are below the toxicity reference value (TRV) for each analyte. Additionally, for eight of the ten analytes, results were reported at or below the laboratory MDL. The resulting value for these samples were "U" coded, indicating they fell below the method detection limit (MDL). The analytes which had at least one sample at or below the MDL were DDT, alpha-Chlordane, cis-Nonachlor, Dieldrin, gamma-Chlordane, Heptachlor, Heptachlor epoxide, and Oxychlordane. The data were statistically summarized by phase to determine the mean, median, minimum, and maximum values of the fish tissue OCPs in vegetated areas and these data are reported in Table ES-1. The mean DDE values represented the largest percentage of the TRV for all analytes for Phases 2 East, 3, 4, 5, and 8. In Phase 5, which had the lowest levels of DDE, mean DDE was 13.2% of the TRV and in Phase 4, which had the highest levels of DDE, mean DDE was 43.2% of the TRV. The mean DDE values for Phases 2 East, 3, and 8 represented 19.5%, 14.4%, and 20.9% of the TRV. Heptachlor and Gamma-chlordane had the lowest values in relationship to the TRV. This analysis indicates the OCP concentrations from Phases 2 East, 3, 4, 5, and 8 are well below the established TRVs.

A hazard quotient (HQ) of less of than one results when the fish OCP concentration is less than the TRV and suggests the associated mortality risk is low and acceptable. The conservative open water estimated HQs for each analyte, except DDE, for Phases 2 East, 3, 4, 5, and 8 were low. The HQs ranged from 0.00 for Heptachlor to 0.46 in Dieldrin (Table ES-2).

Hazard Indices (HI) are summations of all the lethal OCPs' HQs, excluding DDE because it's effects are sublethal. The average estimated open water HI ranged from 0.52 in Phase 5 to 0.95 in Phase 8 (Table ES-2). The average estimated open water HI for Phases 2 East, 3, and 4 were 0.67, 0.65, and 0.62 respectively. All predicted open water HIs reported in Table ES-2 were below one.

The mean DDE HQ in Phase 4 is the only HQ that exceeded 1.00. It was 1.03 (Table ES-2) and was impacted by the OCP value of a single sample. DDE is sublethal and is not considered to

Table ES-1. Summary of fish tissue organochlorine pesticide data for Phase 2 East, 3, 4, 5, and 8 by analyte and toxicity reference values (TRV) from samples collected in 2015 and 2016.

Phase	Statistics	Organochlorine Pesticide Analyte (µg/kg wet weight)					
		4,4'-DDE	4,4'-DDTr	alpha-Chlordane	cis-Nonachlor	Dieldrin	gamma-Chlordane
Phase 2 East	Mean	292.17	20.39	3.88	9.23	1.63	1.44
n=6	Median	290.00	20.20	3.75	9.55	1.42	1.45
	Minimum	161.00	11.19	3.10	7.70	0.56	0.85
	Maximum	431.00	30.18	5.20	10.30	2.90	2.10
	Range	270.00	18.99	2.10	2.60	2.34	1.25
	Standard Deviation	138.78	9.67	0.72	0.96	1.08	0.48
	Standard Error	56.66	3.95	0.29	0.39	0.44	0.20
Phase 3	Mean	216.00	15.78	6.80	7.60	7.20	1.40
n=3	Median	223.00	16.38	7.50	7.70	7.40	1.40
	Minimum	199.00	14.46	5.40	7.20	5.80	1.00
	Maximum	226.00	16.50	7.50	7.90	8.40	1.80
	Range	27.00	2.04	2.10	0.70	2.60	0.80
	Standard Deviation	14.80	1.14	1.21	0.36	1.31	0.40
	Standard Error	8.54	0.66	0.70	0.21	0.76	0.23
Phase 4	Mean	648.13	48.23	2.14	3.89	4.67	0.54
n=15	Median	628.00	44.95	1.80	4.00	4.40	0.00
	Minimum	469.00	32.39	0.52	1.50	2.80	0.00
	Maximum	1080.00	89.02	4.10	8.80	7.80	1.70
	Range	611.00	56.63	3.58	7.30	5.00	1.70
	Standard Deviation	144.49	13.91	1.14	2.16	1.34	0.64
	Standard Error	37.31	3.59	0.29	0.56	0.35	0.16
Phase 5	Mean	198.33	14.56	2.15	5.22	4.23	0.63
n=6	Median	201.00	14.70	2.00	4.90	3.90	0.61
	Minimum	132.00	10.54	1.20	3.80	2.40	0.20
	Maximum	268.00	19.76	3.40	6.80	7.10	0.92
	Range	136.00	9.22	2.20	3.00	4.70	0.72
	Standard Deviation	55.38	3.94	0.91	1.32	1.62	0.27
	Standard Error	22.61	1.61	0.37	0.54	0.66	0.11
Phase 8	Mean	312.85	23.77	4.15	3.15	20.64	0.97
n=12	Median	136.00	9.54	2.50	2.45	1.98	0.70
	Minimum	45.60	3.44	0.42	0.55	0.41	0.00
	Maximum	1040.00	84.81	15.70	8.10	98.00	3.70
	Range	994.40	81.37	15.28	7.55	97.59	3.70
	Standard Deviation	374.61	29.57	4.72	2.68	35.34	1.12
	Standard Error	108.14	8.54	1.36	0.77	10.20	0.32
Toxicity Reference Value (TRV)		**1500**	**1500**	**1000**	**550**	**140**	**1000**
Exceed TRV?		**No**	**No**	**No**	**No**	**No**	**No**

Table ES-1 (continued). Summary of fish tissue organochlorine pesticide data for Phases 2 East, 3, 4, 5, and 8 by analyte and toxicity reference values (TRV) from samples collected in 2015 and 2016.

Phase	Statistics	Organochlorine Pesticide Analyte (µg/kg wet weight)				
		Heptachlor	Heptachlor epoxide	Oxychlordane	Toxaphene	trans-Nonachlor
Phase 2 East	Mean	0.04	0.13	4.40	78.22	27.00
n=6	Median	0.00	0.05	4.45	77.40	26.95
	Minimum	0.00	0.00	3.40	64.40	21.00
	Maximum	0.12	0.54	5.10	91.90	33.20
	Range	0.12	0.54	1.70	27.50	12.20
	Standard Deviation	0.06	0.21	0.65	9.44	5.43
	Standard Error	0.02	0.09	0.27	3.85	2.22
Phase 3	Mean	0.00	0.00	2.03	73.57	24.50
n=3	Median	0.00	0.00	2.00	69.70	25.50
	Minimum	0.00	0.00	2.00	69.50	21.90
	Maximum	0.00	0.00	2.10	81.50	26.10
	Range	0.00	0.00	0.10	12.00	4.20
	Standard Deviation	0.00	0.00	0.06	6.87	2.27
	Standard Error	0.00	0.00	0.03	3.97	1.31
Phase 4	Mean	0.05	0.68	3.25	147.97	9.25
n=15	Median	0.00	0.61	3.10	107.00	8.80
	Minimum	0.00	0.00	0.93	59.80	3.70
	Maximum	0.25	1.40	7.10	309.00	20.40
	Range	0.25	1.40	6.17	249.20	16.70
	Standard Deviation	0.08	0.36	1.79	92.19	5.01
	Standard Error	0.02	0.09	0.46	23.80	1.29
Phase 5	Mean	0.02	0.28	3.22	75.10	14.23
n=6	Median	0.00	0.27	3.20	68.30	13.05
	Minimum	0.00	0.00	2.20	59.90	9.90
	Maximum	0.10	0.60	4.30	110.00	19.90
	Range	0.10	0.60	2.10	50.10	10.00
	Standard Deviation	0.04	0.20	0.93	19.24	4.24
	Standard Error	0.02	0.08	0.38	7.85	1.73
Phase 8	Mean	0.07	0.00	1.98	224.48	9.42
n=12	Median	0.00	0.00	2.25	96.15	6.35
	Minimum	0.00	0.00	0.26	28.90	0.87
	Maximum	0.53	0.00	3.80	828.00	29.10
	Range	0.53	0.00	3.54	799.10	28.23
	Standard Deviation	0.18	0.00	1.27	270.97	9.84
	Standard Error	0.05	0.00	0.37	78.22	2.84
Toxicity Reference Value (TRV)		**400**	**100**	**50**	**5000**	**450**
Exceed TRV?		**No**	**No**	**No**	**No**	**No**

Table ES-2. Projected hazard quotients (HQ) and hazard indices (HI) for predicted open water fish organochlorine pesticide values for Phases 2 East, 3, 4, 5, and 8 based on data collected in 2015 and 2016.

Phase	Year	n (Stations)	Fish Organochlorine Pesticide Tissue Sample Averaged Hazard Quotients (HQ) - Predicted Open Water											Hazard Index (Sum HQ, without DDE)*
			4,4'-DDE	4,4'-DDTr	alpha-Chlordane	cis-Nonachlor	Dieldrin	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Oxychlordane	Toxaphene	trans-Nonachlor	
PHASE 2 East	2015	6	0.47	0.03	0.02	0.05	0.04	0.01	0.00	0.00	0.19	0.08	0.25	0.67
PHASE 3	2015	3	0.34	0.03	0.03	0.04	0.16	0.00	0.00	0.00	0.09	0.08	0.22	0.65
PHASE 4	2016	15	1.03	0.08	0.01	0.02	0.10	0.00	0.00	0.02	0.14	0.16	0.08	0.62
PHASE 5	2015	6	0.32	0.02	0.01	0.03	0.09	0.00	0.00	0.01	0.14	0.08	0.13	0.52
PHASE 8	2016	12	0.50	0.04	0.02	0.02	0.46	0.00	0.00	0.00	0.09	0.24	0.09	0.95

* Hazard Index (HI) is a summation of all lethal organochlorine pesticide sample Hazard Quotients (HQ). DDE is sublethal and is not included in the HI calculation

impact mortality, but high levels of DDE could impact the reproductive success of a species. However, birds are not expected to feed exclusively in Phase 4. The mean HQ for Phases 2 East, 3, 4, 5, and 8 is below 1.00 (HQ=0.53) and is expected to be the most representative of the actual risks associated with moving this phase into active management.

The fish tissue OCP concentrations in these phases were below the established TRVs and the HQs and HIs were considered low or acceptable (average HI or HQ values were below 1) indicating that all species of interest should be safe from any potential effects from localized consumption of fish. The District expects no adverse effects to listed species from this plan which will provide expanded flexibility to develop mixed marsh conditions using active management techniques. Additionally, the District does not expect any adverse effects to listed species from occasional use of the property for flood storage.

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List of Acronyms

ABC	Apopka Beauclair Canal
ASTM	American Society for Testing and Materials
BA	Biological Assessment
BETL	Best estimate target level
BSAF	Biota sediment accumulation factor
CFA	Core Foraging Area
DDTx	Sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT
dw	Dry weight
ESA	Environmental site assessment
ESCA	Endangered Species Conservation Act
FDEP	Florida Department of Environmental Protection
gpm	gallons per minute
HI	Hazard index
HQ	Hazard quotient
LANS	Lake Apopka North Shore
NRCS	Natural Resources Conservation Service
NSRA	North Shore Restoration Area
OCP	Organochlorine pesticide
SJRWMD	St. Johns River Water Management District
TOC	Total organic carbon
TRV	Toxicity reference value
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

ww	Wet weight
ZDWCD	Zellwood Drainage and Water Control District

1.0 Introduction

Lake Apopka is a 31,000-acre lake in central Florida about 15 miles northwest of the Orlando metropolitan area. The fourth largest lake in Florida, Lake Apopka is the headwater for the Ocklawaha Chain of Lakes (Figure 1). The St. Johns River Water Management District (SJRWMD; District) is currently proposing to actively manage Phases 2 East, 3, 4,5, and 8, 4,360 acres on the north shore of Lake Apopka (Figure 2) and to transition the area into mixed marsh habitat. The District also proposes to use areas on the LANS for flood storage.

Lake Apopka was once bordered on the north by an extensive floodplain marsh. Until 1946, the lake was clear and had extensive submersed aquatic plant beds in which game fish flourished (Clugston 1963). The polluted condition of Lake Apopka resulted from excessive phosphorus loading, primarily from a large farming area created on the floodplain marsh (Battoe *et al*. 1999; Lowe *et al*. 1999; Schelske *et al*. 2000). Degradation of the 50,000-acre Lake Apopka ecosystem persisted for more than 50 years.

Restoration efforts for Lake Apopka began in 1985 with passage of the Lake Apopka Restoration Act (Chapter 85, Laws of Florida) and were continued by listing Lake Apopka as a priority water body in the 1987 Surface Water Improvement and Management Act (SWIM Act) (Chapter 373.461, Laws of Florida). Both acts directed SJRWMD to develop and implement a plan to restore and preserve the lake and its environment.

Cessation of farming and restoration of wetland and aquatic habitat was recognized by the Florida legislature as the most effective and equitable means of achieving the first and most essential step in the lake's restoration: reduction of phosphorus loading. Acquisition of 5,300 acres (2,144 ha) of farms on the west side of the Apopka Beauclair Canal (ABC) began through legislative appropriation ($15 million) in 1988 and was completed in 1992. A portion of that property was used for the Lake Apopka Marsh Flow-Way Project, and the majority of the remainder are wetlands with water levels that are dependent upon the level of water in the lake.

Acquisition of the farms on the east side of the ABC was initiated by the 1996 Lake Apopka Restoration Act which provided $20 million to acquire farmland. An additional $26 million was authorized in 1997 from the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) as matching funds for farm purchase. An additional $56 million from the state allowed completion of the farm purchases.

1.1 Location and Initial Restoration

The portion of the Lake Apopka North Shore (LANS) that is located east of the Apopka-Beauclair Canal encompasses several former farming entities. Restoration of the LANS began in 2002-2003 with the flooding of the Duda property. In March 2008, flooding of Phase 1 (Unit 2 West) began the restoration of the former Zellwood Drainage and Water Control District (ZDWCD) farms to a productive wetland and aquatic system. In April 2009, Phase 2 (East and West) was flooded. In January 2011, flooding of Phase 6 began, followed by

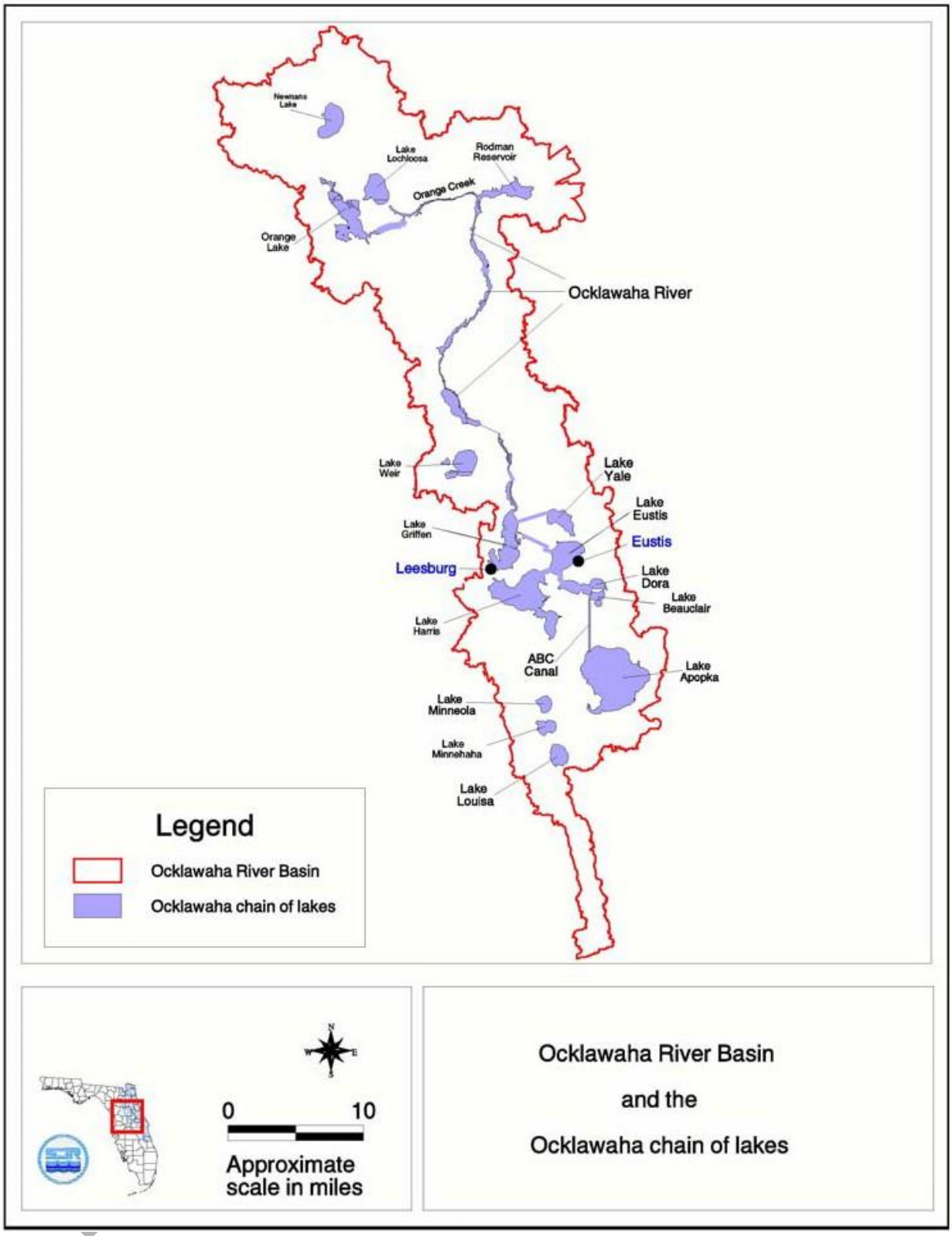

Figure 1. Overview of Lake Apopka and the Ocklawaha Basin

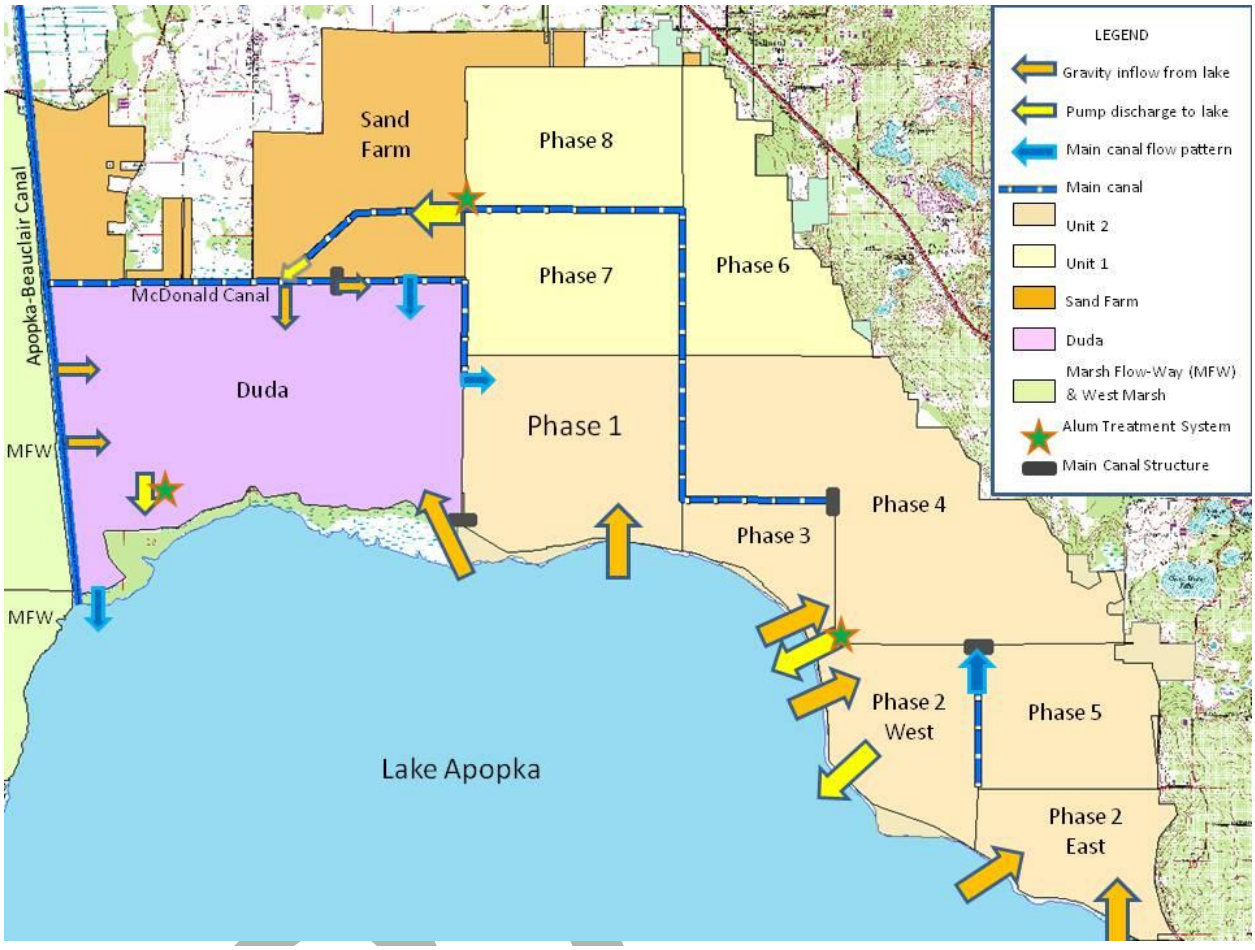

Figure 2. Lake Apopka North Shore: Unit 1 is comprised of Phases 6, 7, and 8, while Unit 2 is comprised of the remaining Phases 1-5

flooding of Phase 7 in April 2011. In April 2012, an informal consultation with the Service resulted in plans to re-hydrate the remaining phases. Phases 3, 4, 5, and 8 were re-hydrated between 2013 and 2014.

1.2 Purpose

The District proposes to include Phases 1 through 8 and the former Duda property in this Biological Assessment (BA) and to move all these areas into an active management phase that will result in the development of mixed marsh habitat throughout the LANS. One section of this document will provide an overview of the areas that already have active management BAs that the United States Fish and Wildlife Service (USFWS) with which has concurred, including the former Duda property and Phases 1, 2 West, 6 and 7. No additional OCP analysis will be done on these properties. This section will provide references to the BAs, information on when concurrences were received, the predicted open water hazard

indices (HIs), and the current monitoring status of each area. These areas are being included in this BA so that they will be covered under a more inclusive definition of active management and occasional use of the various areas for flood storage.

A separate section in this BA proposes to expand active management to Phases 2 East, 3, 4, 5, and 8 to provide additional ecological benefits to a wider range of plant and wildlife species in these phases. This will be accomplished by moving these areas which have been managed for dense emergent vegetation, into the active management phase which will allow a wider range of water levels, along with mechanical, chemical, and ecological land management techniques.

Finally, this document will identify the various mechanical, chemical and ecological techniques that may be used to develop mixed marsh habitat under the active management phase and it will identify the criteria under which these areas may be used for flood storage. These activities will be included in section 1.4.2 on Active Management and Flood Storage. The goal is to improve the existing wetlands to include a mixed marsh of emergent non-woody hydrophytic plants and open water with an embedded matrix of floating vegetation over most of the area. Other components of a mixed marsh will occur seasonally with variations in water depths and may include areas of wet prairie and mudflats, and a modest coverage of shrub and other woody vegetation. A mixed marsh will provide habitat to a wide array of animal species and recreational wildlife viewing opportunities to the public along the existing wildlife drive. These benefits will be gained without significant identifiable risk to the health of wildlife using the site.

1.3 History

In 1998, as the farm properties were purchased by SJRWMD, the farmers were asked to leave their fields shallowly flooded following their final crop harvest in the summer of 1998. Shallow flooding for four to six weeks at the end of each year's growing season was standard farming practice to minimize soil subsidence and erosion and to control nematodes. Over the past fifty years, migratory birds have used Florida's flooded farm fields during July, August, and September (Stevenson 1972; Sykes and Hunter 1978; Kale *et al.* 1990). After SJRWMD gained ownership of the farmlands in August and September 1998, the fields remained flooded to minimize discharge of phosphorus-rich water to the lake and to inhibit growth of terrestrial vegetation. The fields were to be drained during the winter and treated with a soil amendment (alum residual) to reduce phosphorus release when restoration flooding commenced. Following the initial shallow flooding by the farmers, water levels increased due to significant rainfall during the summer of 1998.

As water levels in the Unit 2 farm fields began to rise with seepage and rainfall, more migratory birds arrived and the situation became unique and unprecedented. In December 1998, the population of American white pelicans on the LANS rose to over 3,500 in one day's count and, also that month, the first of many mortalities was recorded. Over the next four

months more than 400 white pelicans, 28 wood storks, 24 great egrets, 20 great blue herons and smaller numbers of 10 other bird species died on the Unit 2 portion of the LANS.

In February 1999, the U. S. Fish and Wildlife Service (USFWS; Service) released preliminary findings attributing the deaths to organochlorine pesticide (OCP) poisoning. By the first week of March 1999, the entire LANS farm field area had been drained and the mortality ceased. The LANS Unit 1 and 2 fields were kept dry through pumping and became vegetated with upland prairie and shrub communities.

In March 1999, SJRWMD and NRCS, with support from a 13-agency Technical Advisory Group, launched a $1.5 million project to investigate the cause of the bird mortality and to determine how to proceed with restoration.

In May 2001, SJRWMD and NRCS submitted to USFWS a biological assessment (BA) and interim restoration plan for three fields (~680 acres) in the eastern portion of the Duda property, where OCP soil concentrations were low. A Biological Opinion was issued by the Service in April 2002 and flooding was initiated two months later. After over a year of vigorous monitoring of bird use and fish OCP concentrations, the three agencies agreed to inundate the remaining fields of Duda, except for a small 38-acre field in the north near the boat ramp. Monitoring continued and quarterly fish samples from each of the field units were collected and analyzed.

In October 2003, SJRWMD entered into a Memorandum of Understanding with the United States Government. The agreement was the result of a collaborative effort among SJRWMD, the Department of Justice and the USFWS and resolved the legal issues relating to the bird deaths as they pertained to the District.

In November 2004, a biological analysis and restoration plan for the Sand Farm South property was completed and accepted by the Service. Two consecutive years of fish monitoring demonstrated fish OCP concentrations that were less than or equal to one-half the trigger values provided in the biological opinion (USFWS 2002) for the Duda property. Annual sampling requirements were satisfied, and additional monitoring was halted in 2006 in accordance with the *Biological analysis and restoration plan for the Sand Farm South,* submitted to the Service in November 2004.

In July 2006, the Service reviewed the BA and monitoring plan for Unit 2 West (now called Phase 1) and concurred with the NRCS that the project may affect, but was not likely to adversely affect federally listed species. Despite approval to commence inundation, drought conditions prevented restoration efforts until March 2008. Initial fish OCP data collected in April 2008 were well below established toxicity reference value (TRV) thresholds. The first quarterly fish sampling occurred in July 2008 and, after one year of sampling, monitoring was curtailed in all fields except ZSW-C and Beall. The District continued monitoring OCPs in fish from these fields until DDE values fell below the TRV. Field values of all other constituents in these fields were below the TRV thresholds.

In December 2008, the Service reviewed the BA and monitoring plan for Phase 2 and concurred with the NRCS that the project may affect, but was not likely to adversely affect federally listed species. After one year of quarterly fish samples, the hazard index (HI) for Phase 2 was less than the projected HI. Due to the low HI in the first year, sampling was halted on all but one field which was sampled for an additional quarter to verify that values were below the TRVs.

In January 2011, the Service reviewed the BA for Phases 6 and 7 and concurred that the project may affect, but was not likely to adversely affect federally listed species. Due to generally low rainfall in Central Florida, only two of four fields in Phase 6 and two of three fields in Phase 7 were maintained under inundated conditions. After a year of quarterly fish analyses, all fish OCP data from the inundated field units were well below the TRVs.

In April 2012, the Service reviewed the BA and monitoring plans for Phases 3, 4, 5, and 8 and concurred that the project may affect, but was not likely to adversely affect federally listed species. However, a regional drought prevented restoration inundation until fall 2013. Quarterly fish sampling in Phases 3, 4, and 5 began in December 2013. After collecting one year of fish data with OCP values below the TRVs, sampling was halted in Phases 3 and 5. Sampling continued in Phase 4 until December 2015 when four consecutive quarters of fish data had DDE values below the TRVs. Phase 8 was inundated later. Quarterly fish sampling began in this phase in December 2014 and was concluded in September 2015; none of the TRVs were exceeded in these samples.

In June of 2014, the Service reviewed the Duda BA that was revised to allow for active management of the property into a mixed marsh wetland. The Service concurred that adverse affects were not expected from the proposed expanded flexibility for active management and restoration techniques. Active management of Duda began and has so far included roller-chopping, hydrologic management, herbicide treatments, and prescribed burning. The first annual fish samples were collected in May 2015 and were analyzed for OCPs. All fish OCP data from the flooded field units were well below the TRVs. The second annual fish samples were collected in May 2016 and the associated OCP data were also well below the established TRVs. After having collected two years of OCP fish data that resulted in HIs of less than 1.0 and an HQ of less than 1.0 for DDE, monitoring on this property was concluded.

In September of 2015, a letter modification was submitted to the Service for Duda and Units 1 and 2, to request termination of the aerial and ground-based avian surveys and vegetation monitoring in areas that have had a minimum of quarterly fish sampling for one year post-project completion and no avian mortality events associated with these properties attributed to contaminants since project completion. The Service concurred that the proposed modifications were not likely to adversely affect federally listed species.

Fish in Phase 1, also known as Unit 2 West, were sampled again in April 2015 and all OCP values were reported as well below the TRVs. These results indicated the District could

proceed with submission of a revised BA for this phase. A revised BA was submitted to the Service to allow for active management of the property for the creation of a mixed marsh wetland. In May 2016, the Service reviewed the revised BA for Phase 1 and concurred that the project was not likely to adversely affect federally listed species.

Fish in Phase 2 West were sampled in July 2015 and all OCP values were well below the TRVs. These results indicated the District could proceed with submission of a revised BA for this phase. A revised BA was submitted to the Service to allow active management of the property for the creation of a mixed marsh wetland. In November 2016, the Service reviewed the revised BA for Phase 2 West and concurred that the project was not likely to adversely affect federally listed species. The Service also concurred that OCP monitoring in this phase could be concluded after a minimum of two years provided the Open Water Predicted HI was less than or equal to 1.0 and the HQ for DDE was less than 1.0.

Fish in Phases 6 and 7 were sampled in July 2016 and the resulting OCP values were below the TRVs. Analysis of the OCP data revealed that OCP concentrations were low enough to safely proceed with active management in these phases. A revised BA was submitted to the Service to allow active management in these phases to create mixed marsh habitat. The Service reviewed the revised BA and concurred that the project was not likely to adversely affect federally listed species. The Service also concurred that OCP monitoring in these phases could be concluded after a minimum of two years as long as the Open Water Predicted HI for the area was less than or equal to 1.0 and the HQ for DDE was less than 1.0.

1.4 Project Description

1.4.1 Project Area

The project area for this BA includes 11,104 acres owned by the District on the north shore of Lake Apopka in Orange and Lake County Florida. The properties included appear in Figure 3. The areas that are shown in green have already received concurrence from USFWS for active management for mixed marsh habitat. These areas cover 6,844 acres or nearly 62 percent of the area. The former Duda property, with 3,000 acres, was the first area to be moved into active management. This occurred in 2014 and, since that time, activities on this property have included applying herbicide, burning, and planting. Phase 1 and Phase 2 West were moved into active management in 2016 and Phases 6 and 7 were moved into active management in 2017.

The areas shown in orange in Figure 3 are being proposed for active management in this BA. They cover 4,260 acres or approximately 38 percent of the area. These areas include Phase 2 East and Phases 3, 4, 5, and 8. Phase 2 East was originally inundated in 2009 after receiving concurrence from USFWS that inundation was not likely to adversely impact listed species. Phase 2 East was being considered as a location to receive beneficial reuse of sediments from Lake Apopka from the Newton Park dredging project; that consideration

Figure 3. The project area for the Lake Apopka North Shore BA for active management. Areas that have already received concurrence from USFWS for active management are shown in green; areas currently being proposed for active management are shown in orange.

delayed its movement into active management for mixed marsh habitat. It is no longer being considered for that purpose and it is ready for the development of mixed marsh habitat. Phases 3, 4, 5, and 8 received concurrence for inundation in 2014.

Since that time, they have been managed to promote dense emergent vegetation with water depths targeted to range from 12 to 24 inches. However, unplanned flooding associated with a lake levee breach during Hurricane Irma has resulted in significantly higher water levels in these phases.

1.4.2 Active Management and Flood Storage

Portions of the former Duda property were inundated in 2002 and 2003. Initial management on the Duda property involved maintaining water depths in the 18 to 24-inch range in order to promote the growth of dense emergent wetland species, especially cattail, that would preclude fish-eating birds from using the area. This management strategy was also used in Phases 1 through 8 when they were subsequently inundated over the following years.

During periods with extreme high water levels, such as in 2004 and 2017, which were impacted by hurricanes Charley, Frances, Jeanne, and Irma, water levels throughout the LANS property remained high for several months, resulting in areas of open water as pumps worked to move the water off the property to the lake. A severe drought in 2012 and 2013 resulted in low lake levels, which limited the District's ability to maintain water depths between 12 to 24 inches on the LANS. Consequently, this resulted in the encroachment of undesirable woody vegetation, particularly Carolina willow (*Salix caroliniana*), in various areas across Duda and throughout Phases 1 through 8.

The District's goal is to use an integrated management approach to develop or preserve mixed marsh habitat. The presence of large monotypic stands of cattail and the encroachment of Carolina willow and other shrubby vegetation interferes with this goal. This integrated management approach will include using one or a combination of plant management techniques, depending on the situation and consideration of available resources needed to achieve the establishment or maintenance of mixed marsh habitat. These techniques may include mechanical treatments such as mowing, roller chopping, and mulching; the use of chemical controls such as aerial, broadcast, or basal application of herbicides; and the use of ecological controls such as prescribed fire and/or altering an area's hydrology and manipulation of water levels, including flooding. The District may also plant desirable species to further enhance the development of mixed marsh habitat and to restrict further encroachment of Carolina willow or other shrubby species into the mixed marsh areas.

The District is investigating two new management activities. One is the use of the LANS for reusing sediments from the lake. Lake sediments are being removed to improve boater access and navigation adjacent to boat ramps and to remove surficial sediments to improve habitat for submersed aquatic vegetation establishment and growth. These sediments are expected to have lower OCP concentrations than LANS soils and, once deposited on the LANS, provide a means to reduce OCP exposure. In addition, the increased soil elevation will help counter the significant soil subsidence (~ one foot per decade) which occurred during farming activities and will provide additional variation in topography which may support creation of a mosaic of wetland types within each area.

In the event suitable material becomes available for beneficial placement on the LANS, marsh nourishment may also be considered for Duda and/or Phases 1 through 8. Restoring subsided land elevations would benefit the phase by burying remaining OCPs in sediment, and reduce the extent of open water areas during periods of high water, allowing a greater percentage of shallow mixed marsh. In addition, it would expedite the timeline required to move these phases into active recreational use. Should appropriate material become available for marsh nourishment, the District anticipates re-initiating consultation to coordinate specific information on the project.

The second activity is to use the LANS for temporary floodwater storage during extreme events, when actual or anticipated rainfall is expected to require flood releases from the District's water control structures in the Ocklawaha basin. By temporarily storing some

floodwater on the LANS, the District may be able to maintain discharges out of Lake Apopka to flows below which will not create downstream flooding risk.

Flooding is a natural disturbance that would have occurred in this area prior to construction of the lake levee. Its return would be beneficial in managing woody species.

During extreme weather events, areas in Duda and/or Phases 1 through 8 may be used for flood storage when the following conditions are met:

- The elevation of Lake Apopka is at or above the maximum desirable elevation (66.39 ft NAVD88) set for the lake or if forecasted rainfall is expected to bring the elevation of Lake Apopka up to or above the maximum desirable elevation for the lake.
- A discharge rate from Lake Apopka exceeding 300 cfs would contribute to flooding in downstream water bodies.
- The duration of flood storage in this area will not exceed 90 days.

If the District intends to use the LANS for flood storage and any of the above conditions are not met, the District will contact the Service and coordinate an appropriate course of action.

The maximum desirable elevation for the lake is currently set at 66.39 ft NAVD88 and is based on recommendations that were made in the 1950s to address flooding. The discharge capacity of the Nutrient Removal Facility is 300 cfs and any discharge exceeding this would contribute adversely to downstream water levels and flood risk. High water conditions for up to 90 days are not expected to adversely impact wetland plant communities and would also assist in the control of the germination of undesirable woody species such as Carolina willow. Occasional flooding which may occur once every few years can provide an excellent tool for plant management.

1.4.3 Public Access and Use

For many years, public access to the LANS was highly restricted and public use was limited. The LANS is currently open to the public and allows for multiple recreational opportunities (Figure 4). Hiking, bicycling, and wildlife viewing are allowed on almost all of the LANS, though it is recommended that visitors stay on the established trails. Horseback riding is also allowed on restricted portions of the property. Fishing and hunting are not allowed.

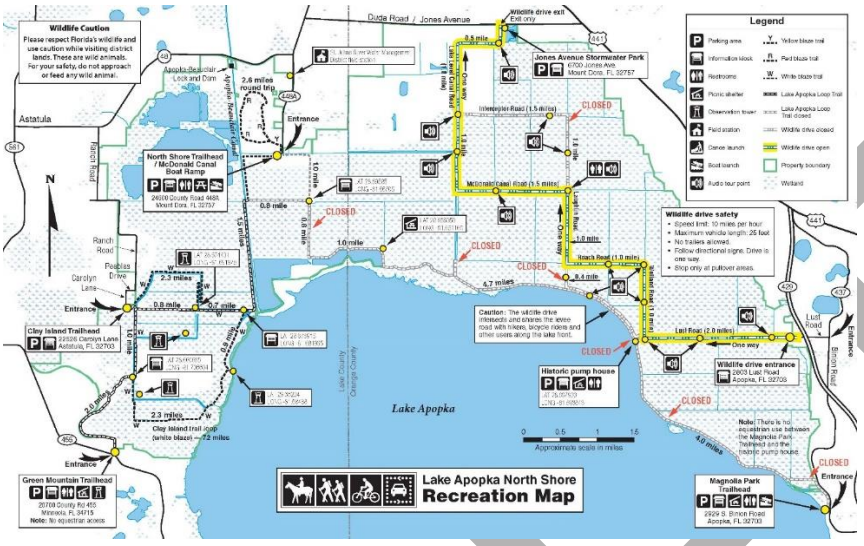

Figure 4. Recreational map available online at https://www.sjrwmd.com/static/lands/trailguides/Lake%20Apopka-trail%20guide%20map-Rev2017-12-21.pdf

The only area open to motorized vehicles is the Lake Apopka Wildlife Drive, which opened May 1, 2015. The Drive is a one-way drive, approximately 11 miles in length, that begins at Lust Road in the southeast portion of the property, and provides viewing opportunities into Phases 4, 5, 2 West, 3, 6, 7 and 8 as it traverses the property and exits on Jones Avenue on the north side of the property (Figure 4). The Lake Apopka Wildlife Drive is open Fridays, Saturdays, Sundays and federal holidays between sunrise and sunset. The entrance gate is open during daylight hours and closes approximately one hour prior to sunset to allow visitors to complete the drive and exit the property by sunset. During its first two years of operation, between May 2015 and April 2017, more than 130,000 visitors had traversed the wildlife drive.

1.5 Summary of Scientific Investigations on the LANS

As part of the LANS acquisition process, all properties, received an Environmental Site Assessment (ESA) in accordance with the American Society for Testing and Materials (ASTM) Standard E1527. The ESAs were reviewed by SJRWMD and Florida Department of Environmental Protection (FDEP) staff throughout the process. An ESA consists of up to four phases, and all four phases were implemented for the LANS. The first phase is an in-depth review of the documents available concerning historical land use and what potential contamination issues might be present, as well as a site reconnaissance and interviews with property owners. The second phase implements sampling based upon the recommendations made in the Phase I. All recognized environmental conditions verified in Phase II were addressed further in Phase III and IV investigations and were approved by the FDEP.

As a consequence of the 1998-1999 bird mortality on the flooded LANS Unit 2 property, an

extensive investigation was undertaken by SJRWMD and NRCS in an effort to determine whether OCPs had killed the birds and to reassess the risks to wildlife posed by OCPs. The Technical Advisory Group reviewed sampling design, analytical methods, and a work plan for data analysis. A total of 920 soil samples were collected in 1999 from 709 locations and analyzed at EnChem Laboratory (currently known as PACE). This lab was chosen due to its extensive experience with OCPs, especially toxaphene.

In addition to the soil samples, 158 tissue samples from 34 birds and 36 whole fish (6 species) were analyzed for pesticide levels by the same laboratory. All data on soils and sediments, birds, and fish were provided to Exponent Inc., a consulting firm based in Bellevue, WA. Their analysis of the data and report on the mortality event and on restoration issues was completed August 2003 (Exponent 2003). The report provides soil concentration thresholds for sublethal effects for the OCPs toxaphene, dieldrin, and the sum of DDT and its metabolites (DDD, DDE) expressed as DDT equivalents (DDTr) *sensu* Stickel *et al.* (1970). These thresholds were used to segregate the LANS into areas of higher and lower risks to wildlife from residual OCPs.

In 2003, BEM Systems, Inc. completed a report for NRCS that provided a screening level ecological risk evaluation for the remainder of the Duda property based on soil data collected and analyzed in 1999. MACTEC Engineering and Consulting Inc. further summarized the nature and extent of contamination and risks posed by OCPs in soil within Units 1 and 2 of the LANS (MACTEC 2005). For each of the field units a best estimate and a conservative estimate of the carbon-normalized concentrations of each of the contaminants of potential concern were calculated. The best estimate target levels (BETLs) were calculated from the trigger values in fish tissue provided in the USFWS Biological Opinion for the Duda property (USFWS 2002). The conservative target levels were one-half of the BETLs and incorporated potential uncertainties that was hoped to be resolved by ongoing research.

Beginning in May 2001, the District entered into a multi-year contract with the University of Florida for a Bioaccumulation Study. The study measured uptake of OCPs from LANS soils into fish and crayfish using lab-based microcosms and mesocosms constructed on-site at the LANS. Data collected from open-water and vegetated fish ponds were used to calculate biota sediment accumulation factors (BSAFs) for fish and crayfish. Finally, fish grown in on-site fish ponds with high background concentrations of soil OCPs were fed to great egrets (*Ardea alba*) in a controlled experiment. Accumulations of OCPs in tissues of the birds were measured and fasting factors were determined to adjust the trigger values.

In 2006, the District conducted a pilot project to determine the effectiveness of two different types of equipment to reduce soil OCP concentrations in selected fields of the LANS. Both methods–vertically blending soil to a depth of 3 or 4 ft (0.9 to 1.2 m) and soil inversion via deep plowing by covering the top foot (30 cm) of contaminated soil with deeper, cleaner soil–resulted in double-digit percent reduction of OCPs. However, soil inversion was a much faster process, and thus, a more cost-effective remedial alternative.

In 2007, the original soil sites sampled in 1999, plus additional sites, were again sampled and

they were analyzed by Pace for OCPs and by D.B. Labs for total organic carbon content. These data were used to identify areas for remediation by soil inversion. However, because the fields had remained dry and fallow since 1999, the property had to be prepared for plowing. Preparation included mowing, roller chopping and, in areas where woody vegetation dominated, cutting with a Brontosaurus, a specialized piece of equipment. Once the preparation work and plowing were completed, a soil amendment was applied. The amendment, consisting of alum residual from the City of Melbourne Water Treatment Plant, is a byproduct of the process used to clarify drinking water. The soil amendment was applied to the fields to reduce the amount of phosphorus released into the water column when the soils were inundated (Hoge *et al*. 2003). Fields treated by inversion were resampled to quantify the change in OCP concentrations.

The cumulative research has shown that soil OCP concentrations vary greatly in units of the LANS. The lowest areas of contamination – the Duda property and the Sand Farm – have been inundated for more than ten years. Monitoring programs have shown that mean concentrations of OCPs in fish tissue in these areas are well below the trigger values provided in the biological opinion for Duda sub-East (USFWS 2002) or for the updated trigger levels used in the Phases 1-8 BAs.

1.5.1 Consultation History with USFWS

- On September 10, 2003, the United States Environmental Protection Agency (USEPA) received a BO for the initial operation of the Marsh Flow-Way from the Service. The BA was routed through the USEPA, via an informal section 7 consultation as they had provided $1M for Marsh Flow-Way construction.
- On February 9, 2004, USFWS and SJRWMD met to discuss guidelines for sediment/soil sampling. A follow-up letter summarizing the discussion was sent (by SJRWMD to Ms. Karen Benjamin) on March 9, 2004.
- On August 30, 2005, USFWS, NRCS and SJRWMD convened their annual meeting to discuss collected data from the Duda wetlands, as well as results from egg monitoring. In addition, the group discussed plans to flood Phase 1 (Unit 2 West).
- On November 29, 2005, SJRWMD presented a briefing to USFWS and NRCS on the North Shore Restoration Area (NSRA) Safe Levels Project. At this meeting an overview was presented regarding how the District intended to calculate Biota Sediment Accumulation Factors (BSAFs) using data from the Bioaccumulation study; how the scientific literature was being explored to determine the best Toxicity Reference Values (TRVs); how the NSRA soil dataset was being organized to provide flexibility to easily incorporate BSAFs, TRVs, and other components to calculate Hazard Quotients (HQ) and Hazard Indices (HI) for individual field units or groups of units.
- On January 31, 2006, USFWS and SJRWMD met for an update of the Safe Levels Project. Because of the importance of the project to future restoration decisions, the

group decided to delay for further consideration the TRVs for the OCPs of concern and, in particular, the various chlordane constituents. In the interim, SJRWMD and NRCS would use OCP trigger levels provided in the biological opinion for the Duda property in evaluating the Phase 1 (Unit 2 West) project.

- In April 11-13 2006, USFWS and SJRWMD met with a team of three professional ecotoxicologists to discuss the draft report "Analysis of risks to piscivorous birds from pesticide residues in soils and fish on the North Shore Restoration Area at Lake Apopka".
- In June 2006, SJRWMD submitted a BA for Phase 1 (Unit 2 West) to the USFWS as a precursor to flooding the area. In July 2006, the USFWS concurred with the determination that the proposed action would not likely affect federally listed species. Phase 1 was not able to be inundated until 2008 due to an extended drought. In June 2009, USFWS and SJRWMD agreed to reduce biological monitoring in Phase 1.
- On May 30, 2007, USFWS and SJRWMD met for an update on progress with the pilot study for soil inversion as a remediation method, preliminary results of the LANS soil resampling, an engineering update and hydrologic questions, and to discuss the Conceptual Remediation Plan. Jay Herrington requested that the District compare calculations of risk using the "old" (Duda Biological Opinion) trigger values with the new safe-level TRVs for the newly collected soil data. This requested information was transmitted by email on 6/11/07. The HQs calculated using the newer TRVs were typically higher than HQs calculated with the old trigger values. However, in the Duda BO the Service provided a chlordane trigger value for all congeners combined (285 µg/kg ww). The updated TRVs accounted for some chlordane congeners presenting a greater risk than others, and each congener was assigned its own TRV value. As a result, the HQ for Total Chlordane was less using the new reference values.
- In December 2008, the USFWS reviewed the Phase 2 BA and concurred the project was not likely to adversely affect federally listed species. Following that, the area was inundated using natural rainfall. In September 2010, after one year of sampling in Phase 2, USFWS and SJRWMD agreed to reduce monitoring to twice a year fish sampling in field ZSE-J. Subsequently, two more quarterly fish sampling events resulted in all OCPs of concern reported at less than the TRVs, and sampling was halted.
- In January 2011, USFWS, USACOE and SJRWMD staff toured the project area to discuss progress and future flooding plans. The BA for Phases 6 and 7 was approved by USFWS shortly thereafter.
- In February 2012, USFWS, USACOE and SJRWMD staff met on site to view construction changes to infrastructure and to discuss hydrologic plans and future phases.
- In April 2012, the Service concurred that inundating Phases 3, 4, 5, and 8 was not

likely to adversely affect federally listed species. After collecting OCP fish tissue with concentrations below the TRVs, USFWS agreed the District could stop sampling Phases 3 and 5 in January 2015. Sampling in Phases 8 and 4 ended in December 2015 and January 2016 respectively after a full year of zero TRV exceedances.

- In June 2014, the revised BA for the Duda property was submitted and approved by USFWS to allow for more flexible active management to create a mixed marsh wetland. The USFWS concurred with the determination that the proposed plan would not likely affect federally listed species.
- In September 2015, a letter modification was submitted by SJRWMD to the USFWS to allow the termination of aerial and ground-based avian surveys and vegetation monitoring for all BAs on the LANS. The USFWS concurred with this modification in November 2015.
- In February 2016, SJRWMD submitted a revised BA for Phase 1 (Unit 2 West) to allow for more flexible management to create mixed marsh habitat. In May 2016, USFWS concurred with the determination that the proposed revised plan would not likely affect federally listed species.
- In September 2016, SJRWMD submitted a revised BA for Phase 2 West, encompassing the western half of Phase 2, to allow for more flexible management to create mixed marsh habitat. In November 2016, USFWS concurred with the determination that the proposed revised plan would not likely affect federally listed species. The Service also agreed that the District could stop monitoring OCPS in fish after collecting a minimum of two years of annual data if results from Predicted Open Water HIs were less than or equal to 1.0 and where the Predicted Open Water HQ for DDE was less than 1.0.
- In June 2017, SJRWMD submitted a revised BA for Phases 6 and 7 to allow for more flexible management to create mixed marsh habitat. In July 2017, USFWS concurred with the determination that the proposed revised plan would not likely affect federally listed species. The revised BA also stipulated that monitoring OCPs in fish could stop after collecting a minimum of two years of annual data, where results for Predicted Open Water HIs were less than or equal to 1.0 and the Predicted Open Water HQ for DDE was less than 1.0.

2.0 Areas Currently Under Active Management – Duda and Phases 1, 2 West, 6, and 7

2.1 Previous Concurrence and Properties Included

Duda and Phases 1, 2 West, 6, and 7 have already received concurrence from USFWS for active management for mixed marsh habitat. These areas cover 6,844 acres or nearly 62 percent of the area (Figure 5). The former Duda property was the first area to be moved into active management. This occurred in 2014 and, since that time, activities on this property have included applying herbicide, burning, and planting. Phase 1 and Phase 2 West were moved into active management in 2016 and have had herbicide applies in specific areas to promote more of a mixed marsh habitat. Phases 6 and 7 were moved into active management in 2017. Since the OCP data from these areas have already been analyzed in earlier BAs, those data will not be reported again here. Instead, a high-level overview of the HIs for these areas and their current monitoring status are provided, along with references for the BAs, in Table 1. These areas are being included in this BA so that they will be covered under a more detailed description of the activities that will be used under active management and for flood storage.

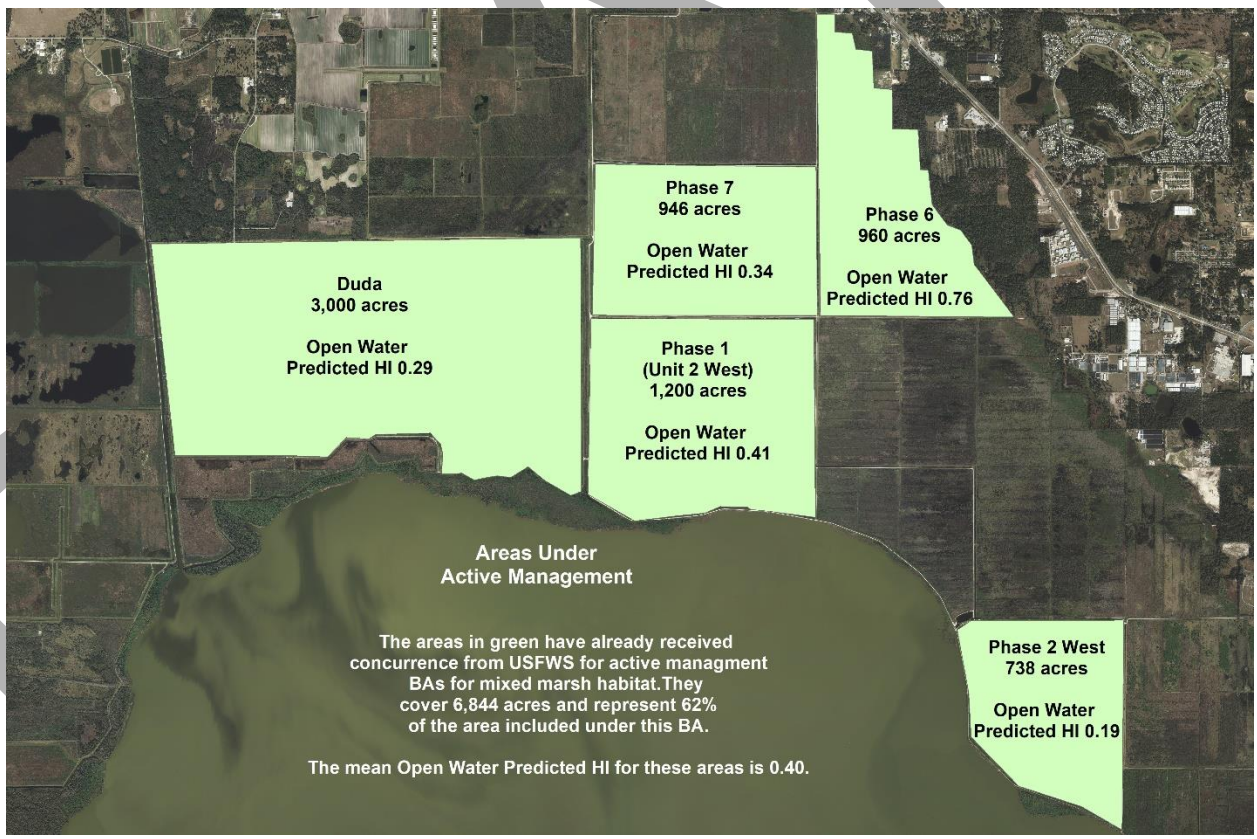

Figure 5. Areas already under active management, including Duda and Phases 1, 2 West, 6, and 7.

Table 1. An overview of the mean Predicted Open Water HIs for those areas currently under active management, including Duda and Phases 1, 2 West, 6, and 7, and their current monitoring status

Area	Date of Concurrence	Mean Predicted Open Water HI	Monitoring Status
Duda(a)	30-Jun-14	0.29	Sampled in 2015 (HI=0.22) and 2016 (HI= 0.25). Received approval to stop monitoring in December 2016.
Phase 1(b)	20-May-16	0.41	Sampled in May 2017 (HI=0.17). Will sample again in 2018.
Phase 2 West(c)	30-Nov-16	0.19	Sampled in December 2017. Currently waiting for lab results.
Phase 6(d)	7-Jul-17	0.76	Will be sampled for the first time in July 2018.
Phase 7(d)	7-Jul-17	0.34	Will be sampled for the first time in July 2018.

(a) Conrow, R. 2014. Lake Apopka North Shore Restoration Area Biological Assessment for the Duda Property Active Management Phase. St Johns River Water Management District, Palatka, FL 56 pp.

(b) Slater, J. B. 2016. Lake Apopka North Shore Restoration Area Biological Assessment for Phase 1 (formerly Unit 2 West) Active Management Phase. St Johns River Water Management District, Palatka, FL 49 pp.

(c) Bowen, P. J. and J. B. Slater 2016. Lake Apopka North Shore Biological Assessment for Phase 2 West Active Management Phase. St. Johns River Water Management District, Palatka, FL 54 pp.

(d) Bowen, P. J. and J. B. Slater 2017. Lake Apopka North Shore Biological Assessment for Phases 6 and 7 Active Management Phase. St. Johns River Water Management District, Palatka, FL 55 pp.

The mean Predicted Open Water HIs in these areas ranges from 0.19 in Phase 2 West to 0.76 in Phase 6. The mean Predicted Open Water HI for all areas combined is 0.40, well below 1.0, indicating that the risk of acute toxicity is low and acceptable and that active management in these areas is not likely to adversely impact listed species. The mean Predicted Open Water HQ for DDE were also evaluated for each of these areas and they were below 1.0, indicating that foraging in these areas is not likely to effect reproductive success.

3.0 Areas Proposed for Active Management – Phase 2 East, 3, 4, 5, and 8

3.1 Field Sampling and Lab Analysis

The fish OCP samples for this assessment were collected between July 2015 and August 2016. One sampling event was conducted in each area, including Phases 2 East, 3, 4, 5, and 8, during this period (Figure 6). Fish were sampled from inundated fields in each phase. For this analysis, the same sampling sites were used to collect fish samples as the sites that were originally used to monitor OCP concentrations when these areas were first inundated. The number of sites sampled in each phase was based on the total area of the phase. Three composite fish samples were obtained from each site. The only area where fish could not be sampled was in Phase 2 East, in field ZSE-J (Figure 7). In compliance with the original BA for Phase 2, the District has kept the northern 20 acres of field ZSE-J dry; the high mineral content in the soils in this area resulted in an HI indicating that foraging in this field could pose a threat to wildlife. Although the original Phase 2 BA did include inundating all areas south of field ZSE-J, staff were unable to collect fish samples at the south end of this field. This area is heavily vegetated with willow and other tree species. Staff were unable to access the interior of the field or to find fish along the edge of the field. All samples were analyzed at Pace Analytical Services, Inc. for the OCP analytes of interest. Appendix A provides a table with the resulting OCP data from these sampling events.

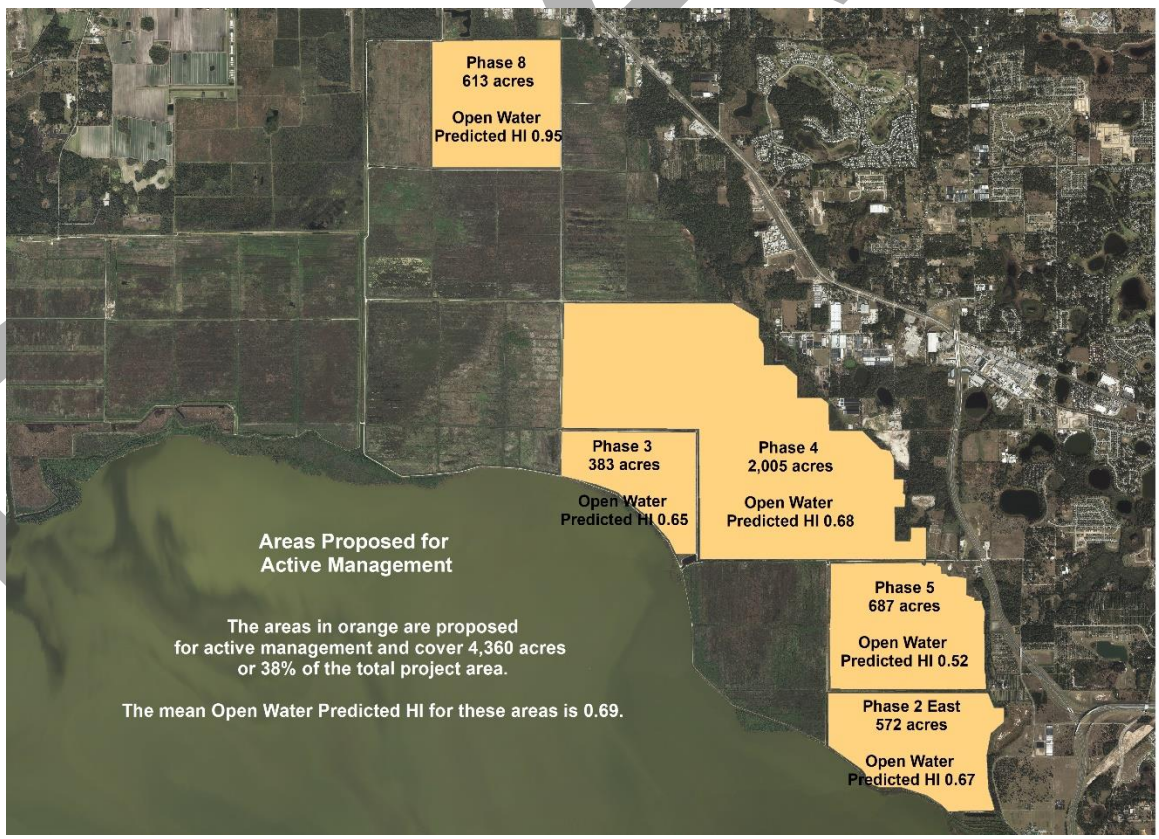

Figure 6. Areas proposed for active management, including Phases 2 East, 3, 4, 5, and 8.

Figure 7. Phase 2 East and field ZSE-J where no fish tissue samples were collected. The 20-acre area at the north end of field ZSE-J has a relatively high elevation and has been kept dry due to its high mineral content and resulting HI over 1.

3.2 OCP Concentrations in Fish and Comparison to Toxicity Reference Values

An important component of a risk assessment is a quantitative measure of the toxicity of a chemical to the animal of concern, in this case the concern is for fish-eating birds. This measure is referred to as a toxicity reference value (TRV; USACHPPM 2000). In the original assessment of risk for these phases, predicted fish OCP concentrations were calculated based on soil concentrations for when the project was inundated, during which time fish tissue data were unavailable. Those predicted values were then evaluated against the TRVs. However, in this case, Phase 2 East has been inundated for nine years, Phases 3, 4, and 5 have been flooded for four years, and Phase 8 has been inundated for more than three years. The District has fish tissue OCP concentrations from samples collected from forage fish for this BA.

Based on a comprehensive search of the primary scientific literature, the District identified the lowest dietary concentrations associated with toxic effects in birds. The District considered two types of effects. The first, mortality, was used to derive TRVs where the

Table 2. Toxicity Reference Values (TRVs) and fasting factors.

Analyte	Toxicity Reference Values (TRV) for fish prey (µg/kg ww)	Fasting Factor	Adjusted TRV (µg/kg ww)
4,4'-DDE	1,500	1	1,500
4,4'-DDTr*	3,000	2	1,500
Dieldrin	280	2	140
Toxaphene	10,000	2	5,000
cis-Nonachlor	1,100	2	550
gamma-Chlordane	2,000	2	1,000
Heptachlor	800	2	400
Heptachlor epoxide	200	2	100
Oxychlordane	100	2	50
trans-Nonachlor	900	2	450
alpha-Chlordane	2,000	2	1,000

*After Stickel et al. (1970): DDT equivalents=DDTr= (DDD/5)+(DDE/15)+DDT

endpoint was death of an individual or physiological harm that could lead to increased mortality. The second endpoint, for DDE only, was a reduction in reproductive success due to thinning and breakage of eggshells and loss of embryos. To provide an additional margin of safety, a "fasting factor" was applied to those TRVs that were evaluated against a mortality threshold (i.e. everything but DDE). In a bird-feeding study (Gross *et al.* 2006), great egret brain concentrations of several OCPs increased when food was withheld. Therefore, a fasting factor of two was included in the risk analyses (Table 2).

The open water predicted fish OCP concentration is estimated using the biota-sediment accumulation factor (BSAF) model (Sepúlveda *et al.* 2005). The BSAF describes the ability of an OCP to accumulate in the biota's lipids relative to the abundance of the OCP in the total organic carbon (TOC) fraction of the soil.

The BSAF is calculated as:

$$BSAF = \frac{([Fish\ (ww)]_{OCP} / [Fish]_{Lipid})}{([Soil(dw)]_{OCP}/Soil_{TOC})}$$

A BSAF equal to one means the lipid-normalized OCP concentration in the fish is equal to the carbon-normalized concentration in the soil. Though a robust predictor across a broad range of soil types and fish species, the most accurate BSAF values are those that are derived from fish collected under conditions that mimic as closely as possible those of the anticipated project. In this case, ponds were constructed on undisturbed soil in fields of the LANS that possessed soil TOC and OCP conditions that included what were expected on the project site.

Table 3. Median biota-sediment accumulation factor (BSAF; µg/kg wet weight) for fish from experimental ponds located on the Lake Apopka North Shore, representing flooded conditions with wetland vegetation and open water.

Analyte	BSAFvegetation	BSAFopen water	Ratio open: veg
DDD	2.71 (229)*	9.10 (114)	3.36
DDE	8.06 (314)	19.24 (114)	2.39
DDT	0.32 (229)	0.66 (114)	2.08
Dieldrin	1.47 (314)	4.56 (114)	3.11
Toxaphene	0.77 (314)	4.04 (114)	5.26
cis-Nonachlor	0.32 (314)	0.95 (114)	2.97
gamma-	-	-	3.57**
Heptachlor**	-	-	3.57**
H. epoxide**	-	-	3.57**
Oxychlordane	0.14 (314)	0.31 (114)	2.16
trans-Nonachlor	0.69 (314)	2.81 (114)	4.09
alpha-Chlordane	0.31 (314)	1.56 (114)	5.05

*Number of fish samples used in the calculation is shown in parenthesis

** The BSAFs for the chlordanes are ratios of each chlordane congener in fish to the total of the chlordane congeners in the soil. Ratio estimated as the mean of the ratios of the other four chlordane family components: *alpha*-Chlordane, *cis*-Nonachlor, Oxychlordane, and *trans*-Nonachlor

Vegetation and fish in the ponds also reflected the species that the District expected to find in all restoration phases. Thus, BSAFs (Table 3) were based on a large number of vegetated and open water fish and soil data from the pond experiment, increasing reliability and stability of the ratios.

For this BA, the District has OCP values from fish collected from flooded vegetated sites that were collected in either 2015 or 2016. Except for the Phase 2 East samples, which were specifically collected for the development of a new BA, all of the samples were collected one year after completing all OCP monitoring after initial inundation of the area. Due to the likelihood of the proposed management options including large areas of open water for extended periods of time, the most conservative approach was to use the ratio of open water to vegetated BSAFs derived from the pond experiments to calculate the expected OCP burden of fish living for an extended period in open water (Table 3).

For example:

The OCP tissue concentration of a fish living in open water is predicted using the OCP tissue concentration of a fish living in vegetated waters (Appendix A.1) and multiplying by the ratio of a BSAF value from open water to a BSAF value from vegetation (Table 3), as shown below using 2015 DDE results from field ZSE-G in Phase 2 East. For example, the calculation for the first sample collected in field unit ZSE-G appears below:

(415.00 µg/kg ww DDE in fish from vegetated wetland) (2.39 $BSAF_{ratio}$) = 991.85 µg/kg ww predicted DDE for open water fish

Similar calculations to predict fish OCP concentrations in open water conditions were made for each of the composite samples and analytes of interest. The predicted open water value of each composite sample in each phase was averaged together to determine the average predicted open water value for each individual phase (Table 4).

Table 4. Phase 2 East, 3, 4, 5, and 8 average vegetated and predicted open water fish OCP concentrations (µg/kg ww) based on tissue samples from fish captured in vegetated wetlands in 2015 and 2016.

Phase	n (Stations)	Average Fish Tissue Organochlorine Pesticide Concentrations by Phase from Field Sampled Vegetated and Predicted Open Water Wetlands (µg/kg wet weight)							
		4,4'-DDE		4,4'-DDTr		alpha-Chlordane		cis-Nonachlor	
		Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)
PHASE 2 East	6	292.17	698.28	20.39	49.54	3.88	19.61	9.23	27.43
PHASE 3	3	216.00	516.24	15.78	38.67	6.80	34.34	7.60	22.57
PHASE 4	15	648.13	1549.04	48.23	119.80	2.14	10.83	3.89	11.56
PHASE 5	6	198.33	474.02	14.56	35.43	2.15	10.86	5.22	15.50
PHASE 8	12	312.85	747.71	23.77	59.20	4.15	20.94	3.15	9.36

Table 4 (continued). Phase 2 East, 3, 4, 5, and 8 average vegetated and predicted open water fish OCP concentrations (µg/kg ww) based on tissue samples from fish captured in vegetated wetlands in 2015 and 2016.

Phase	n (Stations)	Average Fish Tissue Organochlorine Pesticide Concentrations by Phase from Field Sampled Vegetated and Predicted Open Water Wetlands (µg/kg wet weight)							
		Dieldrin		gamma-Chlordane		Heptachlor		Heptachlor epoxide	
		Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)
PHASE 2 East	6	1.63	5.06	1.44	5.14	0.04	0.13	0.13	0.47
PHASE 3	3	7.20	22.39	1.40	5.00	0.00	0.00	0.00	0.00
PHASE 4	15	4.67	14.53	0.54	1.91	0.05	0.19	0.68	2.43
PHASE 5	6	4.23	13.17	0.63	2.25	0.03	0.09	0.28	1.01
PHASE 8	12	20.64	64.18	0.97	3.47	0.07	0.26	0.00	0.00

Table 4 (continued). Phase 2 East, 3, 4, 5, and 8 average vegetated and predicted open water fish OCP concentrations (µg/kg ww) based on tissue samples from fish captured in vegetated wetlands in 2015 and 2016.

Phase	n (Stations)	Average Fish Tissue Organochlorine Pesticide Concentrations by Phase from Field Sampled Vegetated and Predicted Open Water Wetlands (µg/kg wet weight)					
		Oxychlordane		Toxaphene		trans-Nonachlor	
		Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)	Avg Sample (vegetated)	Avg Predicted (open water)
PHASE 2 East	6	4.40	9.50	78.22	411.42	27.00	110.43
PHASE 3	3	2.03	4.39	73.57	386.96	24.50	100.21
PHASE 4	15	3.25	7.02	147.97	778.34	9.25	37.82
PHASE 5	6	3.22	6.95	75.10	395.03	14.23	58.21
PHASE 8	12	1.98	4.28	224.48	1180.74	9.42	38.51

The ratio of an estimated fish OCP concentration to the TRV is defined as a hazard quotient (HQ):

$$HQ_{OCP} = \frac{\text{Predicted Prey}_{OCP}}{\text{Toxicity Reference Value}_{OCP}}$$

For example:

The predicted open water fish OCP concentration for DDE in the first sample in field ZSE-G in Phase 2 East is 991.85 µg/kg ww (previous example). The adjusted TRV for DDE is 1,500 µg/kg ww (Table 2). The calculated HQ for this sample is:

$$HQ_{DDE} = \frac{991.85 \text{ µg/kg ww}}{1500 \text{ µg/kg ww}} = 0.66$$

The individual HQs for each sample were averaged for an overall HQ for each analyte for each phase (Table 5). A HQ of less of than one results when the fish concentration is less than the TRV and suggests the risk associated with the OCP is low and acceptable. In this case, with DDE, its sublethal, reproductive effect is acceptable in all of the phases except Phase 4. To assess the additive impact for lethality, the HQs for each OCP (except DDE, which is sublethal) are summed together to create a hazard index (HI; Table 5).

$$HI = \sum HQ_{OCP(\text{except DDE})}$$

A HI of less than one suggests the cumulative risk for acute mortality associated with OCPs is low and acceptable for the area.

Table 5. Average hazard quotients (HQ) and hazard indices (HI) for predicted open water fish organochlorine pesticide values for Phases 2 East, 3, 4, 5, and 8 based on data from fish tissue samples collected in 2015 and 2016.

Phase	Year	n (Stations)	Fish Organochlorine Pesticide Tissue Sample Averaged Hazard Quotients (HQ) - Predicted Open Water											Hazard Index (Sum HQ, without DDE)*
			4,4'-DDE	4,4'-DDTr	alpha-Chlordane	cis-Nonachlor	Dieldrin	gamma-Chlordane	Heptachlor	Heptachlor epoxide	Oxychlordane	Toxaphene	trans-Nonachlor	
PHASE 2 East	2015	6	0.47	0.03	0.02	0.05	0.04	0.01	0.00	0.00	0.19	0.08	0.25	0.67
PHASE 3	2015	3	0.34	0.03	0.03	0.04	0.16	0.00	0.00	0.00	0.09	0.08	0.22	0.65
PHASE 4	2016	15	1.03	0.08	0.01	0.02	0.10	0.00	0.00	0.02	0.14	0.16	0.08	0.62
PHASE 5	2015	6	0.32	0.02	0.01	0.03	0.09	0.00	0.00	0.01	0.14	0.08	0.13	0.52
PHASE 8	2016	12	0.50	0.04	0.02	0.02	0.46	0.00	0.00	0.00	0.09	0.24	0.09	0.95

* Hazard Index (HI) is a summation of all lethal organochlorine pesticide sample Hazard Quotients (HQ). DDE is sublethal and is not included in the HI calculation

3.3 Inspection of Data

The data were reviewed by SJRWMD staff for quality assurance/quality control. All data that indicated the laboratory reported value was below the method detection limit (MDL) of the instrument had the working values adjusted to the instrument output, as a conservative measure of the potential field value. These working values were used in the subsequent analyses.

The 2015 and 2016 laboratory results of OCP concentrations in composite whole fish samples of mosquitofish (*Gambusia sp.)* collected from vegetated areas in Phases 2 East, 3, 4, 5, and 8 confirm that all levels are below the TRVs listed in Table 2 and that eight of the ten analytes had samples at or below the laboratory MDL. The resulting value for these samples were "U" coded, indicating they fell below the detection limit. The analytes which had at least one sample at or below the MDL were DDT, alpha-Chlordane, cis-Nonachlor, Dieldrin, gamma-Chlordane, Heptachlor, Heptachlor epoxide, and Oxychlordane. All 42 of the heptachlor samples had values that were below the MDL, 41 of the DDT values were below the MDL, and 39 of the heptachlor epoxide values were below the MDL. All 42 of the samples for DDE, toxaphene, and trans-Nonachlor had values above the MDL, but below the TRV.

Individual concentrations of fish tissue OCPs for each site sampled in 2015 and 2016 are reported in Appendix A. No TRVs were exceeded. To quantify the data, the data were statistically summarized by phase to determine the mean, median, minimum, and maximum values for fish tissue OCPs in vegetated areas and are reported in Table 6. The mean DDE values represented the largest percentage of the TRV for all analytes for Phases 2 West, 3, 4, 5, and 8. In Phase 5, which had the lowest levels of DDE, mean DDE was 13.2% of the TRV. In Phase 4, which had the highest levels of DDE, mean DDE was 43.2% of the TRV. The mean DDE values for Phases 2 East, 3, and 8 represented 19.5%, 14.4%, and 20.9% of the TRV. Heptachlor had the lowest mean values in relationship to the TRV with the means from all phases being 0.0%. Gamma-chlordane had the second lowest values in relationship to the TRV with the means from all phases being 0.1% of the TRV. Alpha-chlordane and heptachlor epoxide also had mean values for all phases that were less than 1.0% of the TRV. Trans-nonachlor had the second highest mean OCP percent of the TR, with the means ranging from 2.1% of the TRV in Phases 4 and 8 to 6.0% in Phase 2 East. This analysis indicates that the OCP concentrations in these phases are well below the established TRVs for these analytes.

Because a broader suite of management options is proposed for Phases 2 East, 3, 4, 5, and 8, it is necessary to consider the "worst case scenario" in terms of OCP accumulation in fish. Thus, for this assessment, as a conservative measure, the entire area was assumed to be open water. Based on bioaccumulation studies conducted by the District, fish in open water conditions accumulate approximately two to five times the amount of contaminant than those in vegetated areas, depending on the OCP. Predicted open water values for each phase are reported in Table 4. Even if District staff conservatively assume an extended open water scenario for all field units simultaneously, all of the predicted open water HQs reported in Table 5 are less than one, except for DDE in Phase 4.

Table 6. A statistical summary of fish tissue organochlorine pesticide concentrations from samples collected in Phases 2 East, 3, 4, 5, and 8 in 2015 and 2016.

Phase	Statistics	Organochlorine Pesticide Analyte (µg/kg wet weight)					
		4,4'-DDE	4,4'-DDTr	alpha-Chlordane	cis-Nonachlor	Dieldrin	gamma-Chlordane
Phase 2 East	Mean	292.17	20.39	3.88	9.23	1.63	1.44
n=6	Median	290.00	20.20	3.75	9.55	1.42	1.45
	Minimum	161.00	11.19	3.10	7.70	0.56	0.85
	Maximum	431.00	30.18	5.20	10.30	2.90	2.10
	Range	270.00	18.99	2.10	2.60	2.34	1.25
	Standard Deviation	138.78	9.67	0.72	0.96	1.08	0.48
	Standard Error	56.66	3.95	0.29	0.39	0.44	0.20
Phase 3	Mean	216.00	15.78	6.80	7.60	7.20	1.40
n=3	Median	223.00	16.38	7.50	7.70	7.40	1.40
	Minimum	199.00	14.46	5.40	7.20	5.80	1.00
	Maximum	226.00	16.50	7.50	7.90	8.40	1.80
	Range	27.00	2.04	2.10	0.70	2.60	0.80
	Standard Deviation	14.80	1.14	1.21	0.36	1.31	0.40
	Standard Error	8.54	0.66	0.70	0.21	0.76	0.23
Phase 4	Mean	648.13	48.23	2.14	3.89	4.67	0.54
n=15	Median	628.00	44.95	1.80	4.00	4.40	0.00
	Minimum	469.00	32.39	0.52	1.50	2.80	0.00
	Maximum	1080.00	89.02	4.10	8.80	7.80	1.70
	Range	611.00	56.63	3.58	7.30	5.00	1.70
	Standard Deviation	144.49	13.91	1.14	2.16	1.34	0.64
	Standard Error	37.31	3.59	0.29	0.56	0.35	0.16
Phase 5	Mean	198.33	14.56	2.15	5.22	4.23	0.63
n=6	Median	201.00	14.70	2.00	4.90	3.90	0.61
	Minimum	132.00	10.54	1.20	3.80	2.40	0.20
	Maximum	268.00	19.76	3.40	6.80	7.10	0.92
	Range	136.00	9.22	2.20	3.00	4.70	0.72
	Standard Deviation	55.38	3.94	0.91	1.32	1.62	0.27
	Standard Error	22.61	1.61	0.37	0.54	0.66	0.11
Phase 8	Mean	312.85	23.77	4.15	3.15	20.64	0.97
n=12	Median	136.00	9.54	2.50	2.45	1.98	0.70
	Minimum	45.60	3.44	0.42	0.55	0.41	0.00
	Maximum	1040.00	84.81	15.70	8.10	98.00	3.70
	Range	994.40	81.37	15.28	7.55	97.59	3.70
	Standard Deviation	374.61	29.57	4.72	2.68	35.34	1.12
	Standard Error	108.14	8.54	1.36	0.77	10.20	0.32
Toxicity Reference Value (TRV)		**1500**	**1500**	**1000**	**550**	**140**	**1000**
Exceed TRV?		**No**	**No**	**No**	**No**	**No**	**No**

Table 6 (continued). A statistical summary of fish tissue organochlorine pesticide concentrations from samples collected in Phases 2 East, 3, 4, 5, and 8 in 2015 and 2016.

Phase	Statistics	Organochlorine Pesticide Analyte (µg/kg wet weight)				
		Heptachlor	Heptachlor epoxide	Oxychlordane	Toxaphene	trans-Nonachlor
Phase 2 East	Mean	0.04	0.13	4.40	78.22	27.00
n=6	Median	0.00	0.05	4.45	77.40	26.95
	Minimum	0.00	0.00	3.40	64.40	21.00
	Maximum	0.12	0.54	5.10	91.90	33.20
	Range	0.12	0.54	1.70	27.50	12.20
	Standard Deviation	0.06	0.21	0.65	9.44	5.43
	Standard Error	0.02	0.09	0.27	3.85	2.22
Phase 3	Mean	0.00	0.00	2.03	73.57	24.50
n=3	Median	0.00	0.00	2.00	69.70	25.50
	Minimum	0.00	0.00	2.00	69.50	21.90
	Maximum	0.00	0.00	2.10	81.50	26.10
	Range	0.00	0.00	0.10	12.00	4.20
	Standard Deviation	0.00	0.00	0.06	6.87	2.27
	Standard Error	0.00	0.00	0.03	3.97	1.31
Phase 4	Mean	0.05	0.68	3.25	147.97	9.25
n=15	Median	0.00	0.61	3.10	107.00	8.80
	Minimum	0.00	0.00	0.93	59.80	3.70
	Maximum	0.25	1.40	7.10	309.00	20.40
	Range	0.25	1.40	6.17	249.20	16.70
	Standard Deviation	0.08	0.36	1.79	92.19	5.01
	Standard Error	0.02	0.09	0.46	23.80	1.29
Phase 5	Mean	0.02	0.28	3.22	75.10	14.23
n=6	Median	0.00	0.27	3.20	68.30	13.05
	Minimum	0.00	0.00	2.20	59.90	9.90
	Maximum	0.10	0.60	4.30	110.00	19.90
	Range	0.10	0.60	2.10	50.10	10.00
	Standard Deviation	0.04	0.20	0.93	19.24	4.24
	Standard Error	0.02	0.08	0.38	7.85	1.73
Phase 8	Mean	0.07	0.00	1.98	224.48	9.42
n=12	Median	0.00	0.00	2.25	96.15	6.35
	Minimum	0.00	0.00	0.26	28.90	0.87
	Maximum	0.53	0.00	3.80	828.00	29.10
	Range	0.53	0.00	3.54	799.10	28.23
	Standard Deviation	0.18	0.00	1.27	270.97	9.84
	Standard Error	0.05	0.00	0.37	78.22	2.84
Toxicity Reference Value (TRV)		**400**	**100**	**50**	**5000**	**450**
Exceed TRV?		**No**	**No**	**No**	**No**	**No**

The DDE HQ in Phase 4 is the only HQ that exceeded one. It was 1.03 (Table 5) and was impacted by the OCP value of a single sample. DDE is sublethal and is not considered to cause mortality, but high levels of DDE could impact reproductive success in a species. However, birds are not expected to feed exclusively in Phase 4. The average DDE HQ for Phases 2 East, 3, 4, 5, and 8 is below 1.00 (HQ=0.53) and is expected to be more representative of the actual risks associated with moving these phases into active management.

Inundated LANS phases have been managed for dense emergent vegetation to limit fish populations and species and foraging by fish-eating birds. The success of this strategy has been evident, as it requires substantial effort to collect enough fish for analyses and the available species are almost exclusively limited to forage fish, primarily mosquitofish (*Gambusia affinis*). It is prudent to consider what additional fishes might thrive in a more diverse habitat that includes deeper open water areas and whether accumulation of OCPs by these fishes would be substantially different.

Fish OCP data from Lake Apopka reflective of open water conditions have indicated that the accumulation of OCPs by gamefish species would not be substantially different than that of forage fish. As part of a Memorandum of Understanding between SJRWMD and the federal government, fish were collected from three stations in the lake for five concurrent years, ending in 2008. Whole-fish levels of DDE were similar for forage fish and the other species expected to colonize the project, such as sunfish *(Lepomis spp.*)— primarily bluegill (*L. macrochirus)* and redear (*L. microlophus*)—brown bullhead catfish (*Ictalurus nebulosus)*, and tilapia (*Oreochromis aureus)* (Figure 8).

Based on fish populations observed in other established wetland projects in the Upper Ocklawaha Chain of Lakes, District staff do not expect bowfin (*Amia calva)* or gar (*Lepisosteus* spp.) in Phases 2 East, 3, 4, 5, and 8. But for comparison, data for those lake species also are included in Figure 8.

3.4 Summary of Risk

Only portions of the property will have open water and the District's goal is to improve the existing wetlands to include a mixed marsh of emergent non-woody hydrophytic plants and open water with an embedded matrix of floating vegetation. Other components of a mixed marsh will occur seasonally with variations in water depths and may include areas of wet prairie and mudflats, and finally, a modest coverage of shrub and other woody vegetation.

All OCP concentrations are low and acceptable (Tables 4-6). Phases 2 East, 3, 4, 5, and 8 have average HIs of less than 1, even when calculations include the additional safety factor for increased OCP accumulation by fish in open water (Table 5). Based on pond studies conducted on-site and sampling efforts in the lake, OCP accumulation among a variety of fish species expected in the managed wetland will likely be similar. These analyses indicate that the risk to fish-eating predators from OCPs in Phases 2 East, 3, 4, 5, and 8 is low and acceptable.

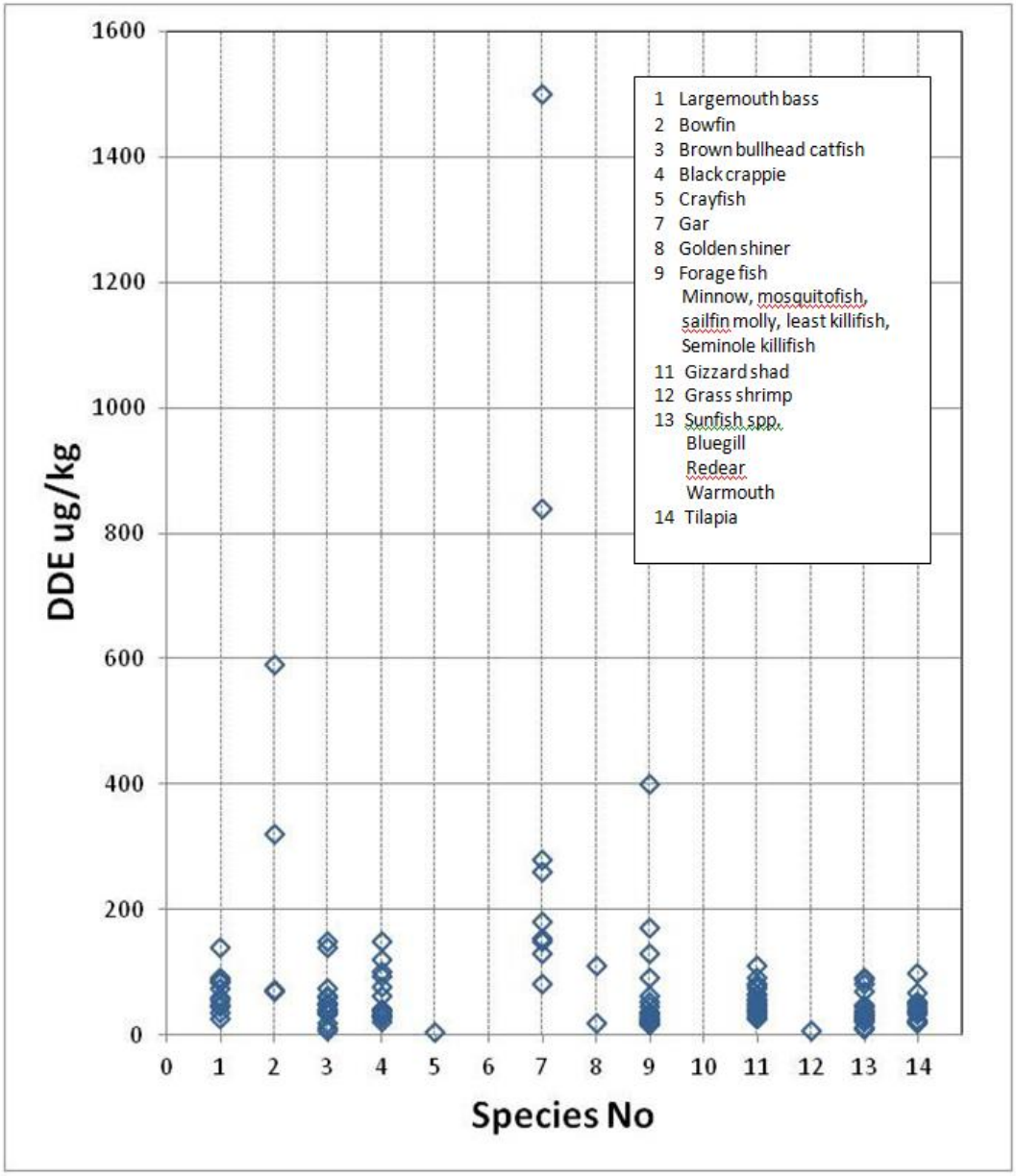

Figure 8. Measured values of DDE in fish composite samples collected over a five-year period from Lake Apopka.

4.0 Species Accounts

4.1 Orange County Federally Listed Species

Five birds, three reptiles, one amphibian, and seven plants are federally-listed threatened or endangered species in Orange County, Florida (Table 7). The gopher tortoise and the striped newt have been added to the species list as candidates for listing.

At a meeting on January 31, 2001 in Jacksonville regarding the BA for the Duda sub-East Project, it was agreed that, for the Orange County list, seven plant species, the Florida scrub-jay, red-cockaded woodpecker and sand skink are upland species and would not be found on the project area due to lack of suitable habitat. Similarly, the gopher tortoise is an upland species, and is not expected to be found on the project site. Striped newts are normally found in longleaf pine-dominated savanna, scrub, or sandhill habitats, and they breed in shallow, isolated temporary ponds and are not expected on the project site (USFWS 2011). Audubon's crested caracara and eastern indigo snake were not included in the Biological Opinion for Duda sub-East and the letter of concurrence for Phase 1 (Unit 2 West; USFWS 2002, 2006). However, because of the proposed greater flexibility in management options,

Table 7. Orange County, Florida, Federally Listed Species.

The following table lists those federally-listed species known to be present in the county.
Code Key: E = Endangered, T = Threatened, CH = Critical Habitat Designated, C = Candidate [Note 1]

Category	Species Common Name	Species Scientific Name	Code
Mammals	None		
Birds	Audubon's Crested Caracara	*Polyborus plancus audubinii*	T
	Everglade Snail Kite	*Rostrhamus sociabilis plumbeus*	E
	Florida Scrub-jay	*Aphelocoma coeruluscens*	T
	Wood Stork	*Mycteria americana*	E
	Red-cockaded Woodpecker	*Picoides borealis*	E
Fish	None		
Reptiles	Gopher Tortoise	*Gopherus polyphemus*	C
	Sand Skink	*Neoseps reynoldsi*	T
	Eastern Indigo Snake	*Dymarchon corais couperi*	T
Amphibians	Striped Newt	*Notophthalmus perstriatus*	C
Mollusks	None		
Crustaceans	None		
Plants	Britton's Beargrass	*Nolina brittoniana*	E
	Florida Bonamia	*Bonamia grandiflora*	T
	Scrub Lupine	*Lupinus aridorum*	E
	Beautiful Pawpaw	*Deeringothamnus pulchellus*	E
	Sandlace	*Polygonella myriophylla*	E
	Papery Whitlow-wort	*Paronychia chartacea = Nyachia pulvinata*	T
	Scrub Wild Buckwheat	*Eriogonum longifolium* var. *gnaphalifolium*	T

Note 1. Candidate species receive no statutory protection under the ESA. The FWS encourages cooperative conservation efforts for these species because they are, by definition, species that may warrant future protection under the ESA. (Table available at http://www.fws.gov/northflorida/CountyList/Orange.htm; accessed 1-12-2018)

it is possible that the eastern indigo snake could be found on site and its account is included here. The status of the wood stork was downlisted to threatened in 2014.

4.2 Site-Specific Listed Species

Two threatened and one endangered species potentially have suitable habitat present on the LANS and are assumed to possibly be present on the project site. These species are the endangered snail kite, and the threatened wood stork and eastern indigo snake. Each of these species are discussed below.

4.2.1 Everglade Snail Kite

The species was federally-listed as endangered in 1967 and critical habitat was determined in 1977 (FR 42(155): 40685-40688). That protection was continued under the Endangered Species Conservation Act (ESCA) of 1969 and the ESCA, as amended. The snail kite (*Rostrhamus sociabilis*) was listed because of its limited distribution and threats to its habitat posed by large-scale conversion of habitat in southern Florida to agricultural uses.

Distribution

Six large freshwater systems (Upper St. Johns River, Kissimmee Chain of Lakes, Lake Okeechobee, Loxahatchee Slough, Everglades and Big Cypress basin) generally encompass the current species range, although radio tracking of snail kites has revealed that frequented habitats include many other smaller widely dispersed wetlands (Bennetts and Kitchens 1997).

Habitat

Snail kite habitat consists of subtropical fresh-water marshes and the shallow vegetated edges of subtropical lakes (natural and man-made) where apple snails (*Pomacea paludosa*) are present. Suitable foraging habitat for the snail kite is typically a combination of low profile (<10 feet) marsh with a matrix of shallow (0.65 - 4.25 ft) open water, which is relatively clear and calm.

Nesting and roosting sites almost always occur over water. Nesting habitat includes small trees (usually < 32.8 ft in height), herbaceous vegetation, such as sawgrass (*Cladium* sp), cattail (*Typha* sp.), bulrush (*Scirpus* sp.), and reed (*Phragmites* sp.) (FWS 1986). Suitable nesting habitat must be close to suitable foraging habitat, so extensive areas of contiguous woody vegetation are generally unsuitable for nesting.

Foraging

The snail kite feeds almost exclusively on apple snails, primarily the Florida endemic species *Pomacea paludosa*, but may also feed on the various invasive apple snail species present in Florida (e.g., *P. insularum, P. diffusa*, and potentially *P. canaliculata*). Apple snails are primarily herbivores. Snail kites spend between 25 to 50% of their time foraging and between 31 and 68% of the time foraging during pre- and post-nest desertion periods. Feeding perches include living and dead woody-stemmed plants, blades of sawgrass and

cattails, and fence posts.

Project Effect

District staff do not anticipate any project related effects to snail kites as the project area is outside of the typical distribution range for the species and there has been limited evidence of mature snail kites actively using the LANS in the past to forage or nest. Since August 1998, there have been single sightings of snail kites on the LANS by expert birder Harry Robinson on July 16, 1999, August 20, 2000, August 14, 2002, September 14, 2008, September 4, 2011, May 29, 2013, June 5, 2013, August 31, 2015, and February 27, 2017. According to Mr. Robinson, who has been documenting LANS bird species since 1998, these were all immatures and there were no adult males observed at the time. However, in March 2017, a visitor on the Lake Apopka Wildlife Drive photographed an adult male snail kite using the LANS. Harry Robinson continued to watch closely for any additional sightings. As of August 2017, Harry's last month conducting surveys at Apopka, he had not observed any additional snail kites and there was no evidence of snail kites nesting in the area.

It is possible that snail kites, a highly mobile species, may move into the Lake Apopka area in response to future regional hydrologic conditions. Within a short radius of the site are numerous natural water bodies as well as other state-owned former farm properties in the Upper Ocklawaha River Basin that are presently under various stages of wetland restoration. In addition, as more acreage is restored to wetlands on the LANS, suitable conditions may develop. With the plan to convert Phases 2 East, 3, 4, 5, and 8 to a mixed marsh, the suitability of the habitat would increase with increased available foraging area.

The snail kite's native prey organism, the apple snail (*Pomacea paludosa*), has been observed in small numbers on the LANS. However, at this time, it is not expected to populate the project area in numbers sufficient for foraging birds (Darby *et al.* 1997). It is possible that an invasive non-native species of apple snail could colonize the area, providing more prey for snail kites. It is unlikely that snail kites would exhibit effects from foraging on the project site because projected OCP concentrations in fish are far below the TRVs for the contaminants of concern and less than one for all calculated HIs for Phases 2 East, 3, 4, 5, and 8. District staff suspect that apple snails may have lower OCP concentrations than fish due to their vegetarian diet, potentially transferring smaller amounts to the snail kites if they were to forage in these phases.

The District believes that this project would have no effect on snail kite populations.

3.2.2. Wood Stork

The United States population of wood stork (*Mycteria americana*) was listed as endangered in 1984 because it had declined by more than 75 percent since the 1930s (49 FR 7335). In 2014, the wood stork was down-listed from endangered to threatened.

Distribution

No critical habitat has been designated for this species. Wood storks are found in Orange

County and all the surrounding counties. Numerous wood stork colonies have been documented in central Florida during the past decade (Figure 9). Wood storks may forage many miles from their colonies (Figure 9). Wood storks in south Florida typically feed within 31 miles of the colony, but could travel up to 81 miles (Coulter *et al*. 1999). In north Florida, the average foraging distance was 7.5 miles; however, more than 90% of the foraging trips were within 15.5 miles of the colony or roost. Bryan and Coulter (1987) found that 86% of wood stork foraging sites were within 12.4 miles of the colony and only one site was more than 31 miles from the colony.

Habitat

The wood stork is primarily associated with freshwater for nesting, roosting, foraging, and rearing. Wood storks typically construct their nests in medium to tall trees that occur in stands located either in swamps or on islands surrounded by relatively broad expanses of open water (Ogden 1991). During the non-breeding season or while foraging, wood storks occur in a wide variety of wetland and other aquatic habitats that include freshwater marshes, ponds, seasonally flooded roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, swamps and sloughs.

Foraging

The natural hydrologic regime in Florida involves seasonal flooding of extensive areas of the flat, low-lying peninsula, followed by drying events, which confine water to ponds and sloughs. Fish populations increase during the wet season and become concentrated into smaller areas as drying events occur. Wood storks are able to exploit these high concentrations of fish in drying pools and sloughs.

Storks forage in a wide variety of shallow wetlands, wherever prey reach high densities in water that is shallow and open (Ogden *et al.* 1978; Browder 1984; Coulter 1987). Good feeding conditions usually occur in relatively calm open water, where depths are between 4 to 10 inches, (Coulter and Bryan 1993). Typical foraging sites throughout the wood stork's range include freshwater marshes and stock ponds; shallow, seasonally flooded roadside or agricultural ditches; narrow tidal creeks or shallow tidal pools; managed impoundments; and depressions in cypress heads and swamp sloughs. Almost any shallow wetland depression that concentrates fish, either through local reproduction or the consequences of area drying, may be used as feeding habitat.

Project Effect

In general, wood storks move into and out of the Lake Apopka Basin in response to suitable regional hydrologic conditions. If feeding conditions become optimal, wood storks may quickly congregate in large numbers. The LANS is currently within a Core Foraging Area (CFA), which is defined by the USFWS as an area within 15 miles of an active nesting colony (Figure 10).

Wood stork observations typically occur during dry periods, when fish are often

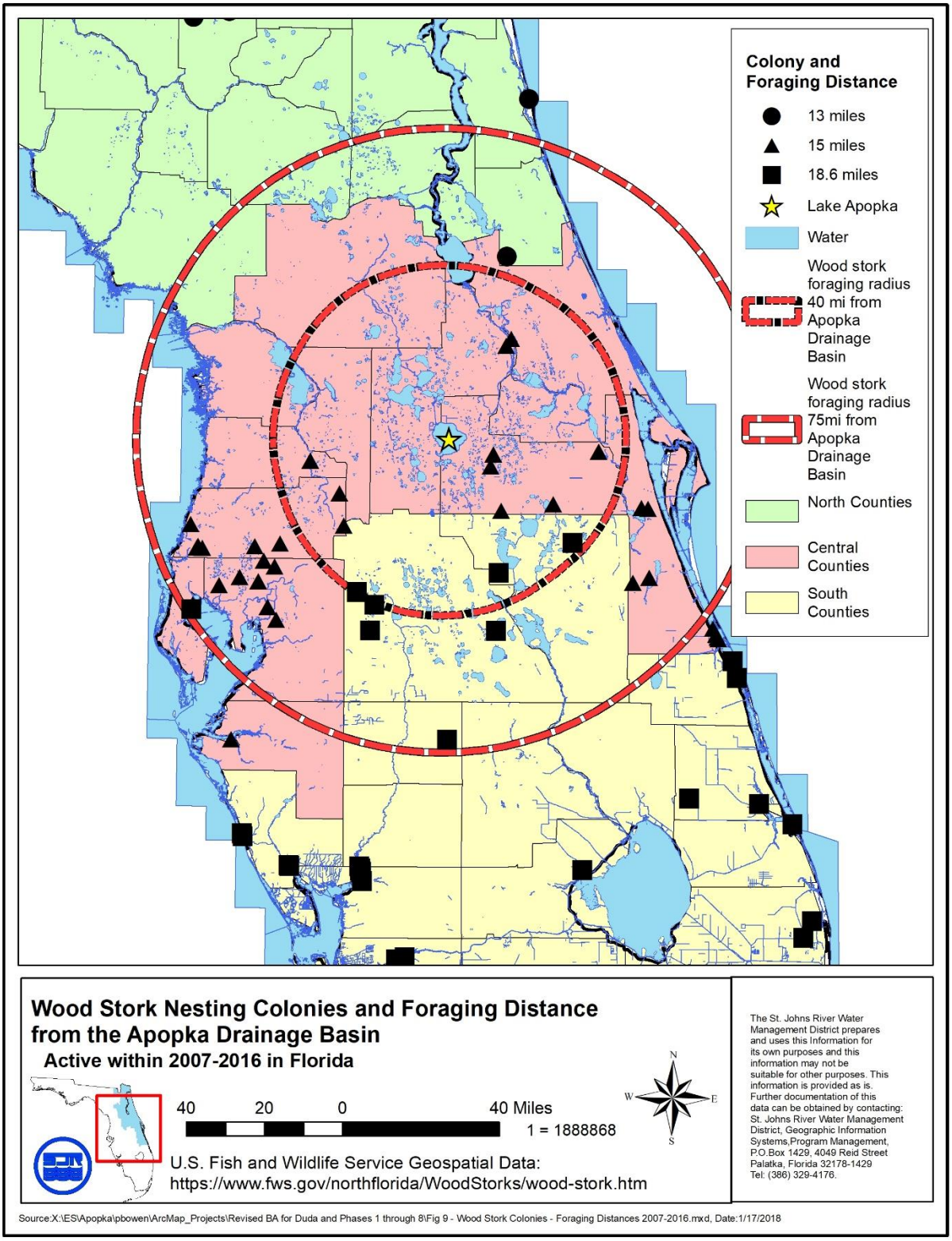

Figure 9. The location of active wood stork colonies in 2007-2016 in relation to their distance from the Lake Apopka drainage basin (data source: USFWS 2017).

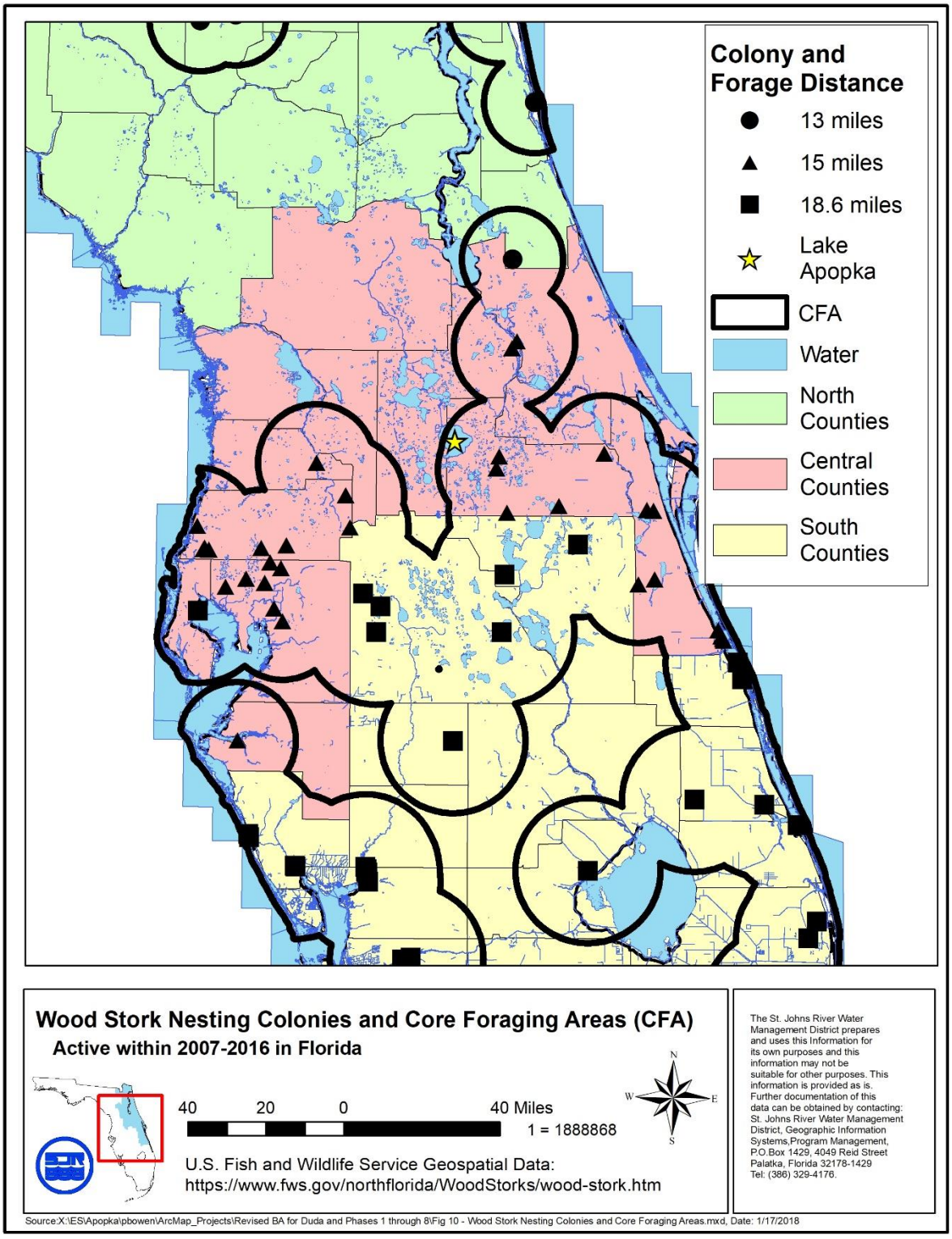

Figure 10. All active wood stork nesting colony locations from 2007-2016. Each colony was populated at least once in the 10-year time period, but may not have been present in 2016 (data source: USFWS 2017)

concentrated in smaller bodies of water and when forage depths are optimally shallow, relative to wetter periods. The earlier BA, adopted in 2012, for Phases 3, 4, 5, and 8 anticipated that these phases would become filled with dense plant growth which would limit the use of these areas by fish-eating birds and species such as the snail kite and wood stork. The BA also indicated that the ideal water levels for these phases, considering the elevation in these phases, would fluctuate between 12 and 30 inches, which is deeper than the 4 to 10-inch levels considered to be good foraging conditions for wood storks. High annual rainfall between 2014 and 2017, as well as flooding from Hurricane Irma, have resulted in several large areas of deep open water in both Phases 3 and 4. These areas are not heavily vegetated and the deep water in these areas is not conducive to foraging by wood storks. If any of these phases are used for flood storage in the future, it is anticipated that even deeper water levels would further discourage wood stork use of the area.

Fish tissue OCP data for Phases 2 East, 3, 4, 5, and 8 show projected OCP concentrations in fish are well below the TRVs for the contaminants of concern and less than one for all predicted open water HIs. The predicted open water HI for each of these phases is less than 1.0. There is a low and acceptable risk to wood storks consuming fish from Phases 2 East, 3, 4,5, and 8 (HI<1). Therefore, the District does not anticipate any project related effects to wood storks.

Overall, this project is not likely to adversely affect wood stork populations.

4.2.3 Eastern Indigo Snake

The eastern indigo snake (*Drymarchon corais*) is one of eight subspecies of a primarily tropical species, of which only the eastern indigo and the Texas indigo (*Drymarchon corais erebennus*) occur within the United States (USFWS 1982). The eastern indigo snake is the longest snake in North America, obtaining lengths of up to 104 inches (Ashton and Ashton 1981). The eastern indigo snake was federally listed as threatened on January 31, 1978, due to population declines caused by habitat loss (Speake and Mount 1973; Speake and McGlincy 1981). No critical habitat has been designated for the eastern indigo snake.

Habitat

Eastern indigo snakes use a variety of habitats that includes longleaf pine forest ecosystems that are habituated by gopher tortoises (*Gopherus polyphemus*) and red-cockaded woodpeckers (*Picoides borealis*). On the sandy central and coastal ridges of south Florida, indigo snakes use gopher tortoise burrows more than other underground refugia (Layne and Steiner 1996). Other underground refugia include burrows of armadillos (*Dasypus novemcinctus*) and cotton rats (*Sigmodon hispidus*), hollows at the base of trees or shrubs, ground litter, trash piles and in the crevices of rock-lined ditch walls (Layne and Steiner, 1996). These refugia sites are used most frequently where tortoise burrows are not available, principally in low-lying areas of central and coastal ridges.

Monitoring of radio-fitted indigo snakes on the central ridge of south Florida indicated that

snakes used a wide variety of natural, disturbed, and non-natural habitat types throughout the year (Smith 1987). On the ridge itself, eastern indigo snakes favored mature oak phase scrub, turkey oak sandhill, and abandoned citrus grove habitats, while snakes found off the sandy ridges used flatwoods, seasonal ponds, improved pasture, active and inactive agricultural lands. There was no apparent selection for one habitat type over another as the use of habitats closely reflected the relative availability and distribution of vegetation types in these areas (Layne and Steiner 1996).

Foraging

The eastern indigo snake is an active terrestrial and fossorial predator that will eat any vertebrate small enough to be overpowered. Layne and Steiner (1996) documented several instances of indigos flushing prey from cover and then chasing it. Though unusual, indigo snakes may also climb shrubs or trees in search of prey. An adult eastern indigo snake's diet may include fish, frogs, toads, other snakes, lizards, turtles, turtle eggs, juvenile gopher tortoises, small alligators, birds and small mammals (Keegan 1944; Babis 1949; Kochman 1978; Steiner *et al.* 1983).

Project Effect

District staff anticipate that this project is not likely to adversely affect the eastern indigo snake, as the project occurs outside suitable habitat and is accessible only via levees. Phases 2 East, 3, 4, 5, and 8 are mostly wet marsh systems with high water tables that lack underground refugia; however, these phases are linked by levees to some sandhill habitat to the north and east that is potentially suitable to maintain a population of indigo snakes.

There was one possible observation of an eastern indigo snake on the south side of field unit B2 of the Marsh Flow-Way, which is west of the project area. This sighting was previously reported several years ago in the Marsh Flow-Way OCP one-year monitoring report submitted to the US Fish and Wildlife Service (Reference Number FWS/R4/ES/-JAFL). A second, documented sighting occurred on Airport Rd, also known as Conrad Rd, which is just west of Phase 2 East and Phase 5, in 2011 (Figure 11).

It is unlikely that eastern indigo snakes would exhibit effects from foraging on the project, since projected OCP concentrations in fish are far below the TRVs for the contaminants of concern and all of the phases have predicted open water HIs of less than one. Based on laboratory analyses of various prey items such as frogs and rodents, District staff expect other food items would have lower OCP concentrations than fish. Use of some of these phases for flood storage is expected to have little or no impact on the eastern indigo snake. Although water levels would be higher than normal, the levees will continue to be maintained and would still provide a connection for the snake to its upland habitat. The District anticipates that this project is not likely to adversely affect the eastern indigo snake, as the project occurs outside its suitable habitat and is only accessible by levee, with infrequent visitation expected within the marsh habitat of Phases 2 East, 3, 4, 5, and 8.

Figure 11. Eastern indigo snake, approximately 5 to 6 ft long, crossing Airport/Conrad Rd in the LANS, 2 April 2011.

When using the *Eastern Indigo Snake Programmatic Effect Determination Key* (USFWS 2013a), this project meets the following criteria:

- Project is not solely located in open water or salt marsh
- Permit will be conditioned for use of the Service's *Standard Protection Measures For The Eastern Indigo Snake* during site preparation and project construction
- There are no gopher tortoise burrows, holes, cavities, or other refugia where a snake could be buried or trapped and injured during project activities

The above inputs into the *Eastern Indigo Snake Effect Determination Key* results in 'NLAA', meaning that the project is 'not likely to adversely affect' the eastern indigo snake, meeting the requirements of section 7 of the Endangered Species Act and no further action is required. Any project changes not included in this document would require consultation with USFWS.

4.3 Management Plan and Minimization of Impacts to Listed Species of Concern

4.3.1 Actions Taken to Minimize Impacts

The District's goal is to manage Phases 2 East, 3, 4, 5, and 8 to produce a variety of habitats

with some open water areas, resulting in a mixed marsh condition. District staff expect that dense plant growth in portions of the LANS will continue to act as a physical barrier to many fish-eating birds and limit widespread use of the site by species, such as snail kites, that prefer more open water conditions. Deeper water which is expected to occur in some areas of the property is not expected to provide suitable foraging depths for wood storks and wood storks would not be expected to use this area. However, other areas will likely attract a diversity of avian species as it is transitioned into a mixed marsh habitat. Fish tissue OCP data indicate all species of interest should be safe from any potential effects from localized consumption of prey fish.

With the opening of the Lake Apopka Wildlife Drive in May 2015, there has been an increased chance of public interactions with snakes along the road. SJRWMD – in an abundance of caution- set a speed limit of 10 mph for human safety. Although SJRWMD does not expect the eastern indigo snake to use the area, this speed limit has the added advantage of providing protection for the indigo snake as well.

The District plans on complying with the USFWS *Standard Protection Measures for the Eastern Indigo Snake* USFWS 2013b) for any future construction activity that may impact any of these phases.

Monitoring

Composite fish samples will be collected to determine OCP concentrations on an annual basis for a minimum of two years. Since this revised BA will cover the entire area and will involve numerous sampling events, collection of samples will be spread out over in order to balance the sampling workload. The schedule for the collection of these fish samples appears in Appendix B. For each sampling event the Open Water Predicted HI will be calculated using the Open Water Predicted HQs for each analyte mean, except DDE. If the Open Water Predicted HI for each monitoring event over the two years is equal to or less than 1, then monitoring will no longer be required. The HQ for DDE will be evaluated separately since it is sublethal and its HQ must also be less than 1 to stop monitoring.

In addition to the monitoring specified in the paragraph above, the District also conducts the following monitoring to support its mission. These activities are expected to continue for the for seeable future, but may change as new projects, directives, and budgets are adopted.

- Hydrologic monitoring of water levels and the current sampling scheme to test water chemistry will continue to be collected at historic locations.
- The District monitors its properties with aerial survey flights over several SJRWMD areas to provide a broad overview and visual check of the properties, hydrologic conditions, vegetative changes, and noticeable avian activity.
- Vegetation communities are monitored using aerial photography and photo-interpretation every three years. Onsite ground-truthing is also conducted.

In addition to these District monitoring activities, increased public access along the Lake Apopka Wildlife Drive allows the public to monitor wildlife activity along that route, with the

ability to report any issues encountered or events of interest to District staff.

Contingency Plan

If fish TRVs are exceeded or if unusual bird illness or mortality occurs, SJRWMD will coordinate with USFWS to determine an appropriate course of action. Options may include, but are not limited to, dewatering, hazing, and/or additional monitoring or testing.

The District intends to keep field ZSE-J in Phase 2 East dry due to its high mineral content and the potential risk it may pose to wildlife. However, if this field becomes flooded or is used for flood storage, District staff will monitor the field for bird activity on a weekly basis until standing water no longer appears in the field. Fish samples will be collected in this field within 30 to 60 days of initial inundation, provided the field is expected to be flooded for a minimum of 60 days. The samples will be analyzed so that the potential risk to foraging birds can be more accurately assessed. When the resulting Predicted Open Water HIs for this field are at or less then 1.0 for three sampling events, monitoring in this field will no longer be required.

If dewatering of the system is prudent, a network of field ditches, canals and pumps are in place to facilitate dewatering of the fields on the LANS. Raising or lowering water levels may be sufficient action to cause species of concern to leave the site. If it is necessary to actively discourage bird use of the site, SJRWMD will contract with personnel from the USDA who possess the necessary federal permits to haze migratory and endangered birds.

If snail kites are present and actively foraging and/or nesting on Phases 2 East, 3, 4, 5, and 8 or on any of the areas currently under active management, the District will coordinate with USFWS to develop an appropriate monitoring plan. Options may include, but are not limited to, snail kite foraging and/or nesting surveys, apple snail surveys, and/or apple snail tissue analyses for OCPs or other tissue concentrations of interest.

5.0 Conclusions

Duda, Phases 1, 2 West, 6, and 7 extend over 6,844 acres, or 62 percent of the project area. The Predicted Open Water HIs for these phases range from 0.19 to 0.76 and the mean Predicted Open Water HI for these areas combined is 0.40. (Table 8). The OCP fish tissue data indicate foraging within these areas does not pose a significant risk to fish-eating birds or to listed species. Duda, the first area to go into active management, has already completed two years of annual sampling with annual HIs based on means of less than 1.0 (2015 HI = 0.22 and 2016 HI = 0.25). The first annual samples from Phase 1, collected in 2017, had an HI of 0.17. Based on this, it is anticipated that the second annual sampling event for Phase 1 will result in a similarly low HI.

Phases 2 East, 3, 4, 5, and 8 extend over approximately 4,360 acres on the LANS and represent 38 percent of the project area. All current OCP concentrations for fish in these areas are low and acceptable (below TRVs). Fish collected from these phases have Predicted Open Water HIs ranging from 0.52 in Phase 5 to 0.96 in Phase 8 and a combined mean HI for all phases of 0.68 (Table 8.) All of the HIs for these areas are less than 1 and indicate that foraging within these areas should not pose a significant risk to listed species.

Additionally, the mean Predicted Open Water HI for all of the areas in the project, including the areas that are currently under active management and the areas that are proposed for active management, is 0.64, well below 1.0 (Table 8). The fish tissue OCP data, analyzed by phase and across the entire area, indicate all species of interest should be safe from any potential effects from localized consumption of prey fish. The District expects no adverse effects to listed species from the proposed plan to provide expanded flexibility for active management and restoration techniques that may include, but are not limited to, selective planting, drawdown, deep flooding, fire, habitat restoration, beneficial sediment placement, control of invasive vegetation, and from use for flood storage.

Table 8. Predicted Open Water HIs for the areas currently under active management, the areas proposed for active management, and the combined total area. The table also includes the total mean Predicted Open Water value for each group.

Areas Currently Under Active Management	
Area	**Predicted Open Water HI**
Duda	0.29
Phase 1	0.41
Phase 2 West	0.19
Phase 6	0.76
Phase 7	0.34
Mean Predicted HI	
Open Water HI	0.40
Areas Proposed for Active Management	
Area	**Predicted Open Water HI**
Phase 2 East	0.67
Phase 3	0.65
Phase 4	0.62
Phase 5	0.52
Phase 8	0.96
Mean Predicted HI	
Open Water HI	0.68
All Areas Combined (Duda and Phases 1 through 8)	
Area	**Predicted Open Water HI**
Duda	0.29
Phase 1	0.41
Phase 2 East	0.67
Phase 2 West	0.19
Phase 3	0.65
Phase 4	0.62
Phase 5	0.52
Phase 6	0.76
Phase 7	0.34
Phase 8	0.96
Mean Predicted	
Open Water HI	0.64

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7.0 Appendix A. Phase 2 East, 3, 4, 5, and 8 OCP Fish Tissue Data

Table A.1. Field data of Phases 2 East, 3, 4, 5, and 8 fish tissue OCP concentrations from vegetated wetlands analyzed at Pace Analytical Services, Inc. [Detailed data available upon request.]

Fish Tissue Organochlorine Pesticide Concentrations Sampled from Vegetated Wetlands (µg/kg wet weight)

Phase	Sample Date	Area	Station	4,4'-DDD	4,4'-DDE	4,4'-DDT	4,4'-DDTr	4,4'-DDTx
PHASE 2 East	7/7/2015	ZSE-G	4739	6.20	415.00	0.00	28.91	421.20
			4740	5.80	431.00	0.29	30.18	437.09
			4741	5.90	410.00	0.00	28.51	415.90
		ZSE-I	4742	2.80	166.00	0.00	11.63	168.80
			4743	2.30	161.00	0.00	11.19	163.30
			4744	2.80	170.00	0.00	11.89	172.80
PHASE 3	10/19/2015	ZSC-C	4808	4.60	199.00	0.27	14.46	203.87
			4809	6.10	223.00	0.29	16.38	229.39
			4810	5.60	226.00	0.31	16.50	231.91
PHASE 4	12/7/2016	ZNC-B	4974	5.50	750.00	0.39	51.49	755.89
			4975	5.10	575.00	0.20	39.55	580.30
			4976	4.70	633.00	0.13	43.27	637.83
		ZNE-A1	4977	5.80	485.00	0.00	33.49	490.80
			4978	6.10	527.00	0.00	36.35	533.10
			4979	6.30	594.00	0.00	40.86	600.30
		ZNE-A2	4980	38.70	729.00	0.57	56.91	768.27
			4981	42.60	628.00	0.44	50.83	671.04
			4982	35.10	656.00	0.32	51.07	691.42
		ZNE-A3	4983	7.10	653.00	0.00	44.95	660.10
			4984	7.90	609.00	0.30	42.48	617.20
			4985	5.60	469.00	0.00	32.39	474.60
		ZNE-D	4986	46.70	621.00	0.53	51.27	668.23
			4987	81.70	1080.00	0.68	89.02	1162.38
			4988	57.50	713.00	0.52	59.55	771.02
PHASE 5	10/19/2015	ZSE-E	4811	1.50	148.00	0.37	10.54	149.87
			4812	1.70	171.00	0.53	12.27	173.23
			4813	2.80	240.00	0.56	17.12	243.36
	10/20/2015	ZSE-F	4814	7.10	268.00	0.47	19.76	275.57
			4815	7.00	231.00	0.33	17.13	238.33
			4816	4.40	132.00	0.88	10.56	137.28
PHASE 8	8/29/2016	Z1N-D	4965	1.20	84.30	0.12	5.98	85.62
			4966	0.72	52.80	0.06	3.72	53.58
			4967	1.40	108.00	0.12	7.60	109.52
		Z1N-F1	4968	1.80	251.00	0.11	17.20	252.91
			4969	2.20	192.00	0.11	13.35	194.31
			4970	1.90	164.00	0.16	11.47	166.06
	8/31/2016	Z1N-C	4962	3.30	49.20	0.00	3.94	52.50
			4963	2.00	45.60	0.00	3.44	47.60
			4964	3.50	54.30	0.00	4.32	57.80
		Z1N-F2	4971	60.40	1040.00	3.40	84.81	1103.80
			4972	40.90	939.00	0.00	70.78	979.90
			4973	35.00	774.00	0.00	58.60	809.00

Table A.1 (continued). Field data of Phases 2 East, 3, 4, 5, and 8 fish tissue OCP concentrations from vegetated wetlands analyzed at Pace Analytical Services, Inc. [Detailed data available upon request.]

Fish Tissue Organochlorine Pesticide Concentrations Sampled from Vegetated Wetlands (µg/kg wet weight)

Phase	Sample Date	Area	Station	alpha-Chlordane	cis-Nonachlor	Dieldrin	gamma-Chlordane	Heptachlor
PHASE 2 East	7/7/2015	ZSE-G	4739	3.50	10.30	2.00	0.98	0.00
			4740	3.90	9.70	2.80	1.60	0.10
			4741	3.10	9.80	2.90	0.85	0.00
		ZSE-I	4742	5.20	9.40	0.56	2.10	0.12
			4743	3.60	8.50	0.68	1.30	0.00
			4744	4.00	7.70	0.83	1.80	0.00
PHASE 3	10/19/2015	ZSC-C	4808	5.40	7.20	5.80	1.00	0.00
			4809	7.50	7.90	8.40	1.40	0.00
			4810	7.50	7.70	7.40	1.80	0.00
PHASE 4	12/7/2016	ZNC-B	4974	0.52	1.80	4.40	0.00	0.05
			4975	0.63	1.60	2.90	0.00	0.00
			4976	0.72	1.50	2.80	0.00	0.00
		ZNE-A1	4977	1.80	3.50	4.80	0.00	0.00
			4978	1.80	4.00	5.20	1.40	0.00
			4979	2.20	4.30	5.90	0.69	0.00
		ZNE-A2	4980	1.80	2.20	6.10	0.00	0.09
			4981	1.30	1.90	5.00	0.88	0.00
			4982	1.50	1.70	7.80	0.00	0.13
		ZNE-A3	4983	3.40	5.80	4.30	1.70	0.25
			4984	3.20	5.50	4.40	1.10	0.20
			4985	2.60	4.30	3.40	0.86	0.08
		ZNE-D	4986	2.90	5.20	3.30	0.00	0.00
			4987	4.10	8.80	5.60	1.40	0.00
			4988	3.70	6.30	4.20	0.00	0.00
PHASE 5	10/19/2015	ZSE-E	4811	1.30	3.80	4.20	0.64	0.05
			4812	1.20	4.10	4.80	0.20	0.00
			4813	1.70	5.20	7.10	0.57	0.00
	10/20/2015	ZSE-F	4814	3.40	6.80	3.60	0.91	0.10
			4815	3.00	6.80	3.30	0.92	0.00
			4816	2.30	4.60	2.40	0.55	0.00
PHASE 8	8/29/2016	Z1N-D	4965	2.30	2.10	0.64	0.52	0.00
			4966	1.30	1.50	0.41	0.29	0.53
			4967	2.40	2.80	0.73	0.76	0.00
		Z1N-F1	4968	2.60	2.40	3.80	0.63	0.00
			4969	2.90	2.60	3.20	0.79	0.00
			4970	2.90	2.50	3.10	0.77	0.00
	8/31/2016	Z1N-C	4962	0.44	0.59	0.82	0.00	0.00
			4963	0.42	0.55	0.58	0.00	0.00
			4964	0.51	0.67	0.85	0.00	0.00
		Z1N-F2	4971	15.70	6.60	98.00	3.70	0.35
			4972	9.60	8.10	71.50	2.20	0.00
			4973	8.70	7.40	64.00	2.00	0.00

Table A.1 (continued). Field data of Phases 2 East, 3, 4, 5, and 8 fish tissue OCP concentrations from vegetated wetlands analyzed at Pace Analytical Services, Inc. [Detailed data available upon request.]

Fish Tissue Organochlorine Pesticide Concentrations Sampled from Vegetated Wetlands (µg/kg wet weight)

Phase	Sample Date	Area	Station	Heptachlor epoxide	Oxychlordane	Toxaphene	trans-Nonachlor
PHASE 2 East	7/7/2015	ZSE-G	4739	0.14	5.10	73.70	33.20
			4740	0.54	4.70	75.70	31.60
			4741	0.10	5.00	79.10	30.80
		ZSE-I	4742	0.00	3.40	91.90	23.10
			4743	0.00	4.20	64.40	22.30
			4744	0.00	4.00	84.50	21.00
PHASE 3	10/19/2015	ZSC-C	4808	0.00	2.00	81.50	21.90
			4809	0.00	2.00	69.50	26.10
			4810	0.00	2.10	69.70	25.50
PHASE 4	12/7/2016	ZNC-B	4974	0.26	1.10	75.90	3.80
			4975	0.53	0.93	59.80	3.70
			4976	0.34	1.00	65.20	3.70
		ZNE-A1	4977	0.61	3.00	89.40	8.20
			4978	0.98	3.10	104.00	8.80
			4979	0.53	4.00	95.70	9.80
		ZNE-A2	4980	0.00	1.80	114.00	5.70
			4981	0.47	2.60	90.60	4.70
			4982	0.52	1.60	143.00	4.90
		ZNE-A3	4983	1.00	4.90	107.00	13.90
			4984	0.91	4.50	108.00	13.70
			4985	0.69	3.60	298.00	10.60
		ZNE-D	4986	0.96	4.30	284.00	11.90
			4987	1.40	7.10	309.00	20.40
			4988	1.00	5.20	276.00	14.90
PHASE 5	10/19/2015	ZSE-E	4811	0.19	2.20	59.90	9.90
			4812	0.00	2.70	60.80	11.30
			4813	0.22	3.70	72.60	14.80
	10/20/2015	ZSE-F	4814	0.60	4.30	110.00	19.90
			4815	0.38	4.10	83.30	18.60
			4816	0.31	2.30	64.00	10.90
PHASE 8	8/29/2016	Z1N-D	4965	0.00	1.60	83.80	5.10
			4966	0.00	1.10	143.00	3.10
			4967	0.00	2.10	70.70	5.90
		Z1N-F1	4968	0.00	2.40	121.00	6.80
			4969	0.00	2.60	87.30	7.00
			4970	0.00	2.60	105.00	7.00
	8/31/2016	Z1N-C	4962	0.00	0.33	28.90	0.93
			4963	0.00	0.26	34.70	0.87
			4964	0.00	0.28	45.30	1.10
		Z1N-F2	4971	0.00	3.80	828.00	29.10
			4972	0.00	3.60	584.00	24.30
			4973	0.00	3.10	562.00	21.80

8.0 Appendix B. OCP Fish Sampling Schedule for Phases 1 through 8 for 2018 through 2020

Table B.1. OCP fish sampling schedule for Phases 1 through 8 for 2018 through 2020. All samples for the Duda property have already been collected and no further sampling is required in that area. This schedule was created with the assumption that only two annual samples would be necessary in each phase. However, if this assumption is not met, the schedule will be adjusted accordingly and the phases that require more than two years of annual sampling will be sampled until two consecutive years of data are collected that result in Open Water Predicted HIs for each year that are equal to or less than 1 and have DDE HQs that are less than or equal to 1.

FY18				
		Number of	**Number of**	**Scheduled for**
Phase	**Event**	**Sites**	**Samples**	**Sampling in**
P1	2nd annual	7	21	May/June 2018
P2W	2nd annual	3	9	December 2018
P6	1st annual	4	12	July 2018
P7	1st annual	3	9	July 2018
Total Samples			**51**	
FY19				
		Number of	**Number of**	**Scheduled for**
Phase	**Event**	**Sites**	**Samples**	**Sampling in**
P2E	1st annual	2	6	February 2019
P3	1st annual	3	9	February 2019
P4	1st annual	7	21	March 2019
P5	1st annual	3	9	April 2019
P6	2nd annual	4	12	July 2019
P7	2nd annual	3	9	July 2019
P8	1st annual	4	12	April 2019
Total Samples			**78**	
FY20				
		Number of	**Number of**	**Scheduled for**
Phase	**Event**	**Sites**	**Samples**	**Sampling in**
P2E	2nd annual	2	6	February 2020
P3	2nd annual	3	9	February 2020
P4	2nd annual	7	21	March 2020
P5	2nd annual	3	9	April 2020
P8	2nd annual	4	12	April 2020
Total Samples			**57**	

From: Erin Gawera <erin_gawera@fws.gov>
Sent: Tuesday, February 20, 2018 5:12 PM
To: Pam Bowen
Cc: Rebecca Trudeau; Erich Marzolf; Dean Dobberfuhl; Andy Canion; Jodi Slater; Lori McCloud
Subject: RE: Biological Assessment for the Lake Apopka North Shore for Active Management Flood Storage

Hi Pam,

I have reviewed the revised BA and concur with the findings. Did I send you a letter for the 2017 concurrence? I plan to do so for this one.

Erin

****

Erin M. Gawera, Fish and Wildlife Biologist
US Fish and Wildlife Service
Email: erin_gawera@fws.gov
http://www.fws.gov/northflorida
7915 Baymeadows Way, Suite 200
Jacksonville, FL 32256-7517
904/731-3121 (direct)
904/731-3336 (main)
Fax: 904/731-3045 or 3048

From: Pam Bowen [mailto:pbowen@sjrwmd.com]
Sent: Wednesday, January 31, 2018 3:01 PM
To: Erin Gawera (erin_gawera@fws.gov) <erin_gawera@fws.gov>
Cc: Rebecca Trudeau <RTrudeau@sjrwmd.com>; Erich Marzolf <EMarzolf@sjrwmd.com>; Dean Dobberfuhl <ddobberfuhl@sjrwmd.com>; Andy Canion <ACanion@sjrwmd.com>; Jodi Slater <JSlater@sjrwmd.com>; Lori McCloud <lmccloud@sjrwmd.com>
Subject: Biological Assessment for the Lake Apopka North Shore for Active Management Flood Storage

Erin,

Hey!!! I hope you're doing terrific and that all is well.

Attached is the new biological assessment (BA) for the Lake Apopka North Shore which will allow us to expand active management to Phases 2 East, 3, 4, 5, and 8. It will also allow us to use these areas, along with the areas that were previously moved into active management, Duda and Phases 1, 2 West, 6, and 7, for flood storage. It ultimately encompasses Duda and Phases 1 through 8 which extend over 11,000 acres on the north shore of Lake Apopka, east of the Apopka Beauclair Canal. The BA follows basically the same format we used to prepare active management BAs for Duda, Phase 1, 2 West, 6, and 7. Like the previous two BAs, it includes the same criteria defining when we would be able

United States Department of the Interior

U. S. FISH AND WILDLIFE SERVICE

7915 BAYMEADOWS WAY, SUITE 200
JACKSONVILLE, FLORIDA 32256-7517

IN REPLY REFER TO:

FWS Log No. 04EF1000-2018-I-0373

February 28, 2018

Pamela J. Bowen
St. Johns River Water Management District
P.O. Box 1429
Palatka, FL 32178-1429

Re: Lake Apopka North Shore Restoration Area Biological Assessment for Active Management for Phases 1 through 8 and Duda

Dear Ms. Bowen:

Reference is given to email correspondence and attachments that we received January 31, 2018 from the St. Johns River Water Management District (SJRWMD) requesting informal consultation regarding modifications to the Biological Assessment for Phases 1 through 8 and Duda within the Lake Apopka North Shore (LANS) project.

The District is requesting concurrence from the Service for a modification to this BA that will expand the use of active management activities to all phases of the LANS east of the Apopka Beauclair Canal (ABC). Phase 1 and Phase 2 West were moved into active management in 2016, and Phases 6 and 7 were moved into active management in 2017. This modification will add Phase 2 East and Phases 3, 4, 5, and 8 into active management. The BA modification also further defines what activities are included in active management: included are selective planting, drawdown, deep inundation, prescribed fire, habitat restoration, beneficial soil/sediment placement, and control of invasive vegetation with a goal of developing a mosaic of wetland habitats that prevent oxidation of muck soils to prevent phosphorus release and to create wetlands which are beneficial to wildlife. Additionally, use of LANS for temporary flood storage under specified conditions in the Apopka and Upper Ocklawaha River basins is outlined.

In accordance with the Endangered Species Act of 1973, (ESA) as amended (16 U.S.C. 1531 *et seq.),* the U.S. Fish and Wildlife Service (Service) has reviewed the modifications to the Biological Assessment (BA) entitled *"Lake Apopka North Shore Biological Assessment for Active Management for Phases 1 through 8 and Duda "* (dated January 31, 2018). The Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect federally listed species; provided implementation, management, and monitoring are conducted as described in the BA and per the agreed on modifications. Thank you for your continued dedication to the restoration and management of the Lake Apopka North Shore. If you have any questions or concerns about this consultation, please feel free to contact Erin M. Gawera of my staff at 904-731-3121.

Sincerely,

Jay B. Herrington,
Field Supervisor

HYDROLOGIC AND VEGETATION COMMUNITY ANALYSIS FOR WATER LEVEL MANAGEMENT SCENARIOS ON THE LAKE APOPKA NORTH SHORE

by

Andy Canion, Ph.D.
Lori McCloud

Technical Memorandum

St. Johns River Water Management District

Palatka, Florida

2020

CONTENTS

SUMMARY

The Lake Apopka North Shore (LANS) is a 20,000-acre management area owned by the St. Johns River Water Management District (District), comprised primarily of wetlands that were reclaimed from agriculture. A major bird mortality event linked to organochlorine pesticide (OCP) toxicosis occurred in 1998 after the wetlands were first allowed to be re-inundated after being purchased by the District. In order to reduce the risk of OCP transfer from organic soils to fish and wading birds, the District intentionally managed for shallow water conditions across much of the eastern LANS from 2006 – 2018 to encourage the growth of dense, emergent vegetation that would limit foraging by wading birds and accelerate OCP degradation. The maintenance of shallow water conditions limited the capacity of the LANS to achieve its original goal of storing water to reduce phosphorus (P) loading to Lake Apopka.

In February 2018, the USFWS gave concurrence on a biological assessment that allowed for active management of water levels for all portions of the eastern LANS, reflecting soil OCP concentrations not likely to adversely affect wading birds. This allowed the District to begin to manage water levels to better achieve the goal of storing water to reduce phosphorus (P) loading to Lake Apopka. The District has begun to construct a set of projects to improve infrastructure for water storage on the LANS and has also begun to evaluate the potential to use water on the LANS for aquifer recharge.

In the present study, 7 modeled water management strategies for the LANS were evaluated to determine how much discharge to Lake Apopka could be reduced, whether high and low water wetland hydrologic criteria were met, and what effects water management would have on wetland communities. These scenarios included water management with current infrastructure, with newly planned infrastructure, and with water withdrawals for aquifer recharge.

Analysis of hydrologic model results indicated that increasing water storage could reduce P loading from the LANS to Lake Apopka by 1,910 lbs P yr^{-1}. An additional 1,480 and 2,290 lbs P yr^{-1} of load reduction were predicted with 5 and 10 million gallon per day (MGD) withdrawals for recharge, respectively. Based on hydrologic criteria analysis, recommendations for operational criteria under both current conditions and after completion of infrastructure improvements were developed. Hydrologic analysis of recharge withdrawal scenarios indicated that 5 MGD could be withdrawn without affecting wetlands if the water elevation to initiate withdrawals was at or above 60.5 ft (NAVD88).

Prediction of wetland community types under all water management scenarios resulted in more open water and less emergent marsh than the goals established in the LANS Land Management Plan. However, the amount of pumping necessary to maintain emergent marsh in areas that have experienced soil subsidence may be acceptable in the future as restoration of Lake Apopka proceeds. Water management scenarios with recharge withdrawals resulted in an increase in emergent marsh, and thus, recharge withdrawals, if properly managed, may be beneficial for wetland restoration on the LANS.

INTRODUCTION

The Lake Apopka North Shore (LANS) is a 20,000-acre property owned by the St. Johns River Water Management District that includes 13,000 acres of wetlands adjacent to Lake Apopka. The wetlands are isolated from the lake by levees and are divided internally by levees. Historically, the LANS was a shallow floodplain marsh dominated by sawgrass and was converted into muck farms between the 1900s – 1940s. Agricultural nutrient loading from these farms was the primary cause of eutrophication and ecosystem degradation of Lake Apopka (Hoge et al. 2003). Between 1988 – 1999, the District acquired the LANS property with state funding and federal funding from the USDA National Resources Conservation Service (NRCS), with the intent to reduce phosphorus (P) loading to Lake Apopka.

In December 1998, following the natural re-inundation of the LANS, a major bird mortality event occurred. The District and US Fish and Wildlife Service (USFWS) linked the mortality to organochlorine pesticides (OCP). The District and NRCS initiated a study of OCPs on the LANS, one component of which was to determine soil OCP concentrations that would minimize risk to piscivorous birds (Coveney and Conrow 2016). Until OCP concentrations and risk declined, the District committed to keep water levels shallow enough on the LANS to facilitate dense, emergent vegetation to inhibit foraging by wading birds. In 2018, analysis of OCP concentrations indicated that OCP levels on the LANS had reached target concentrations that were not likely to adversely affect foraging birds, and the District received concurrence from USFWS on a biological assessment that allowed increased flexibility in water management over the entire LANS (Bowen and Slater 2018).

At present, the ability to fully manage LANS water levels allows for the full utilization of the LANS to store water and limit P loading to Lake Apopka. Although reducing P loading to Lake Apopka through water storage is the primary goal of LANS operations, maintaining floating-leaved and emergent wetlands is consistent with wetland restoration goals. Thus, a desirable water management strategy will provide maximum water storage, maintain desirable wetland communities where possible, and maintain internal levee access. The District is implementing a set of projects to improve the LANS infrastructure to allow for improved water management, including raising internal levees and adding two internal pumps to better manage stored water. The possibility of other beneficial uses for LANS water are also under consideration, including the withdrawal of excess stored water for aquifer recharge and reuse augmentation.

The purpose of the present study was to evaluate hydrologic model scenarios of long-term water levels on the LANS under different water management scenarios and determine: 1) the effect on pump discharges and P loading to Lake Apopka, 2) whether water levels on the LANS meet high and low water hydrologic criteria, and 3) the effect on wetland vegetation. Seven scenarios were analyzed that included current conditions, operation with planned infrastructure improvements, and operation with withdrawals for aquifer recharge.

OVERVIEW OF LANS INFRASTRUCTURE AND PROPOSED WATER MANAGEMENT ZONES

The LANS can be divided into 3 hydrologically separated areas: 1) the areas west of the Apopka-Beauclair (A-B) Canal (West Marsh, Marsh Flow-way, Clay Island), 2) Duda, and 3) Phases 1-8, the former Zellwood Drainage and Water Control District (Figure 1). For the present report, analyses were only performed for Duda and Phases 1-8. On the eastern LANS, water levels are controlled by 3 pump stations that pump water into Lake Apopka (see Figure 2). In Phases 1-8, water levels in each phase can be individually manipulated using riser structures on their respective outlet culverts. These culverts are connected into a main canal system from which the Unit 1 and Unit 2 pump stations draw water. Duda has a separate pump station that pumps into a holding pond which overflows to the lake via a weir.

The individual management of Phases was critical to maintain water levels required during OCP remediation, when water levels had to be kept shallow (see Appendix for previous water level criteria). With the current transition to active water management, there is more flexibility in how water levels can be managed on the LANS. Although it is possible to bring water into the LANS from Lake Apopka, it is not currently under consideration as a means to regulate water levels on the LANS. Therefore, LANS water levels are currently only regulated by pumping from the LANS into Lake Apopka.

District staff determined that it is more desirable to manage water levels in multiple phases at once. This will minimize operational effort, allow for optimization of water storage in some Phases, and facilitate wetland restoration in other designated Phases. In order to plan for future LANS operations, Phases 1 - 8 were divided into 4 water management zones. The zones are shown in Figure 2, and are described below:

Zone 1: Includes the 3 phases south of Lust Rd. (Phases 2E, 2W, and 5). These phases cannot be pumped independently of Phase 4 because the canal they drain into (along Lust Rd.) is no longer isolated from Phase 4. Water levels in these areas can all be controlled by a set of culverts (C5-02) at the north end of Conrad (Airport) Rd.

Zone 2: Includes Phases 3 and 4. This zone will be utilized for water storage and can receive water from all other zones. The Unit 2 pump station (P2) draws water directly from this zone.

Zone 3: Includes only Phase 1. Phase 1 receives the majority of watershed runoff to the LANS via Lake Level canal (through culvert C1-03) and is often maintained at a higher stage than other phases. The primary outlet for this zone is the set of culverts (C1-02) in the southeast that connect into the main canal.

Zone 4: Includes Phases 6, 7, and 8. The Unit 1 pump (P1) can be configured to pump from only the northern phases (6,7, and 8) by closing the structure at Laughlin Rd. and McDonald Canal Rd. (C1-01). Additionally, a new pump station at the intersection of Laughlin

Rd. and McDonald Canal Rd. (Figure 2) will add the ability to pump water from this zone into Zone 2.

A series of projects are under construction or planned that will enhance current water management capabilities on the LANS. Internal levees in Phases 1-8 and Duda will be raised to 64 ft (NAVD88). Higher internal levees will permit higher water levels without risking roadbed damage and will limit the possibility of road flooding preventing access to pumps. Two new pump stations, one from Duda into Lake Level Canal (directly east of Duda) and one from the main canal/Zone 4 into Zone 2, are under construction (Figure 2). These pumps will allow water to be moved into Zone 2 when storage is available. Lastly, the feasibility of an aquifer recharge well at the east end of the Lust Rd. is being evaluated. This well would withdraw available water from Zone 2, treat the water at an existing facility, and recharge onsite using injection wells. The existing facility was constructed by the City of Apopka to withdraw water to augment their reclaimed water system but has not been utilized. Implementation of these projects will reduce the amount of water that needs to be pumped from the LANS, which will result in reduced phosphorus loading to Lake Apopka.

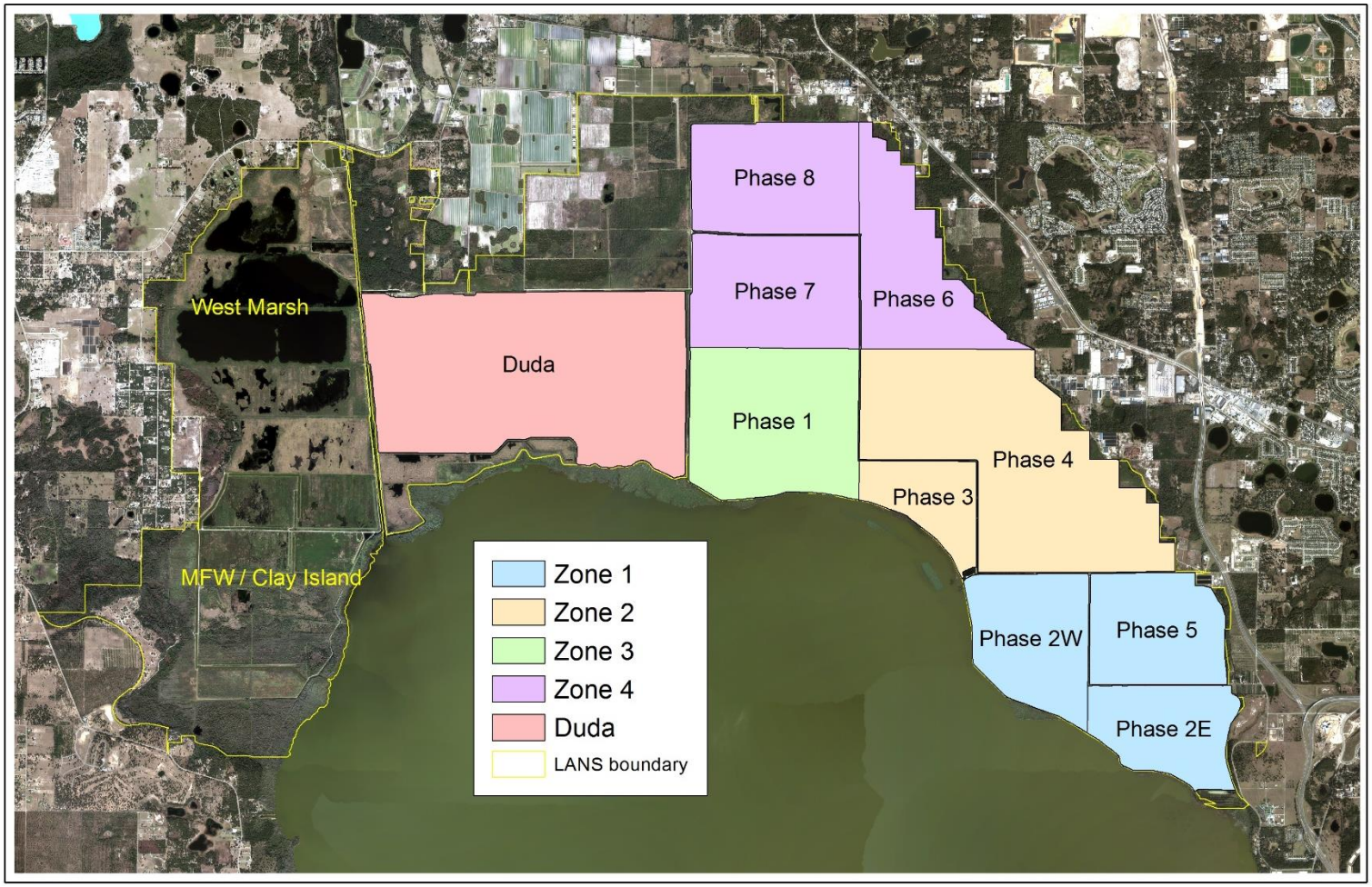

Figure 1. Water management zones and their relationship to current phases.

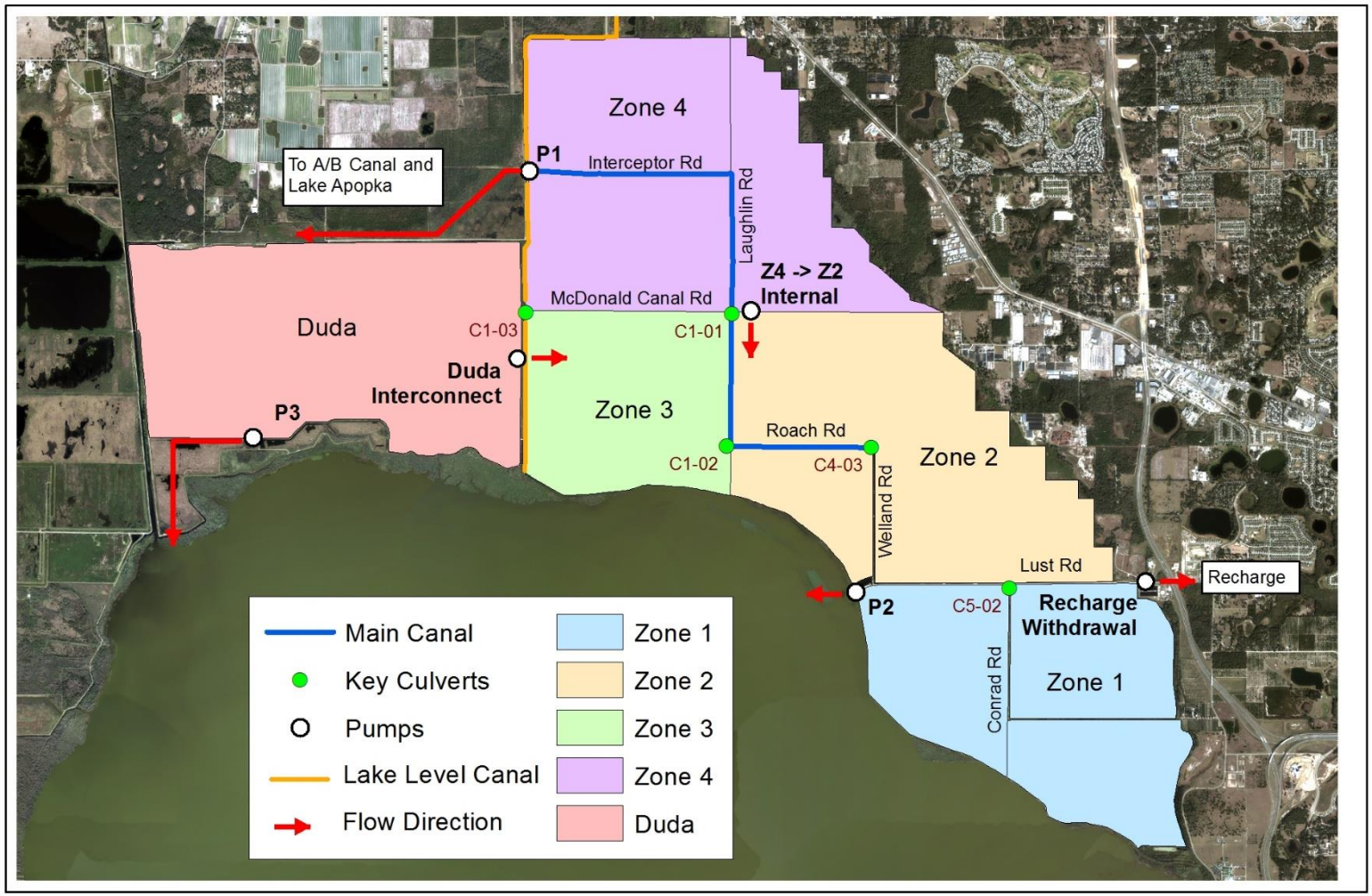

Figure 2. Water management zones, primary water control structures, and pumps on the eastern LANS.

HYDROLOGIC ANALYSIS

Model scenarios

Water level management scenarios were modeled by the Bureau of Watershed Management and Modeling using the Hydrologic Simulation Program – Fortran (HSPF) model, over the period of record 1978 – 2016. The HSPF model setup and full results are detailed in a separate report (Seong 2019). An existing calibrated HSPF model for the Upper Ocklawaha River Basin was modified by splitting a single modeled storage for Phases 1 – 8 into 4 storage areas corresponding to each water management zone, based on previously determined stage-area-volume relationships (Appendix).

Seven out of the original 9 model scenarios were evaluated in the present study (Table 1). The baseline scenario did not include any of the planned infrastructure improvements but did incorporate current (i.e., post – 2018) water level management conditions. Scenario 2 (maximum storage) incorporated the ability to allow higher water levels with planned levee improvements but did not include new internal pumps. Scenario 4 included levee improvements and new internal pumps (Figure 2). Scenarios 5 and 6 included the addition of 5 million gallons per day (MGD) and 10 MGD of withdrawals for aquifer recharge, respectively. The water elevation threshold for recharge withdrawals in Scenarios 5 and 6 was >60.5 feet (NAVD88). Lastly, two more scenarios (8 and 9) with recharge withdrawals were simulated with a recharge withdrawal water elevation threshold of >59ft.

Table 1. Summary of pump-on elevations (ft NAVD88) for each model scenario. Cells with two values indicate a seasonal schedule (May 1 – Sep 30 / Oct 1 – April 30). Control point culvert elevations for each scenario have been omitted for simplicity.

Original Model Scenario	Scenario Description	New Infrastructure	Unit 1 (P1)	Unit 2 (P2)	Duda (P3)	Duda Inter-connect	Z4 → Z2 Internal Pump	Recharge Well
1	Baseline	None	61	61.5	62.5	-	-	-
2	Max water storage	Levee Improvements	62.5	63	63	-	-	-
4	New infrastructure improvements	Levee Improvements + New Internal Pumps	61.5/62.5	62.5/63	62.5/63	61	61	-
5	5 MGD recharge/ 60.5 ft withdrawal threshold	Levee Improvements + New Internal Pumps + 5 MGD recharge	61.5/62.5	62.5/63	62.5/63	61	61	60.5
6	10 MGD recharge/ 60.5 ft withdrawal threshold	Levee Improvements + New Internal Pumps + 10 MGD Recharge	61.5/62.5	62.5/63	62.5/63	61	61	60.5
8	5 MGD recharge/ 59 ft withdrawal threshold	Levee Improvements + New Internal Pumps + 5 MGD recharge	62	62/62.5	62.5	61	61	59
9	10 MGD recharge/ 59 ft withdrawal threshold	Levee Improvements + New Internal Pumps + 10 MGD Recharge	62	62/62.5	62.5	61	61	59

Discharge and phosphorus loading to Lake Apopka

In order to evaluate the effect of water level management on phosphorus loading from the LANS to Lake Apopka, the total volume pumped to Lake Apopka was calculated for each scenario. Total volume pumped to Lake Apopka was calculated as the sum of annual pump volume totals from Pump 1 (Unit 1 pump), Pump 2 (Unit 2 pumps), and Pump 3 (Duda pumps). A comparison of cumulative pumping over the model simulation period showed that all scenarios without aquifer recharge withdrawals had similar cumulative pumping totals (Figure 3). Scenarios with recharge withdrawals had significantly less cumulative pumping to Lake Apopka.

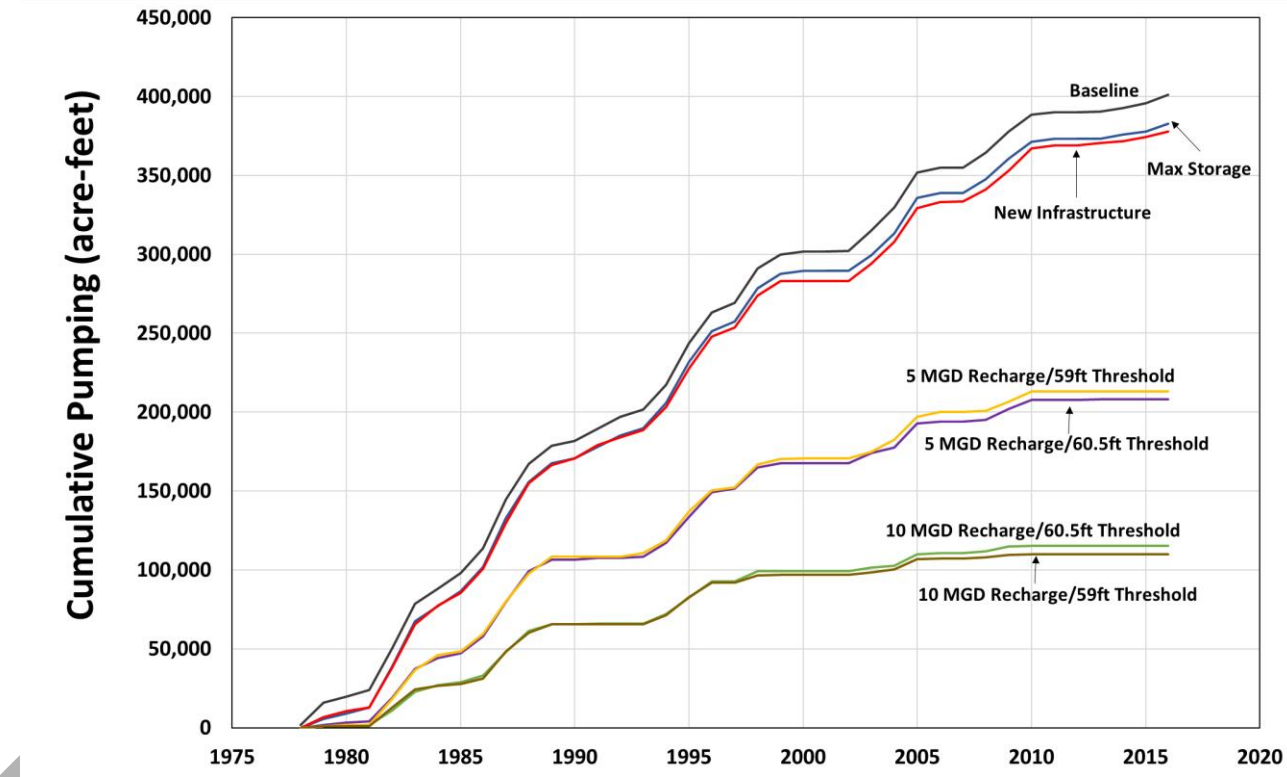

Figure 3. Cumulative pumping from the LANS to Lake Apopka for the 7 model scenarios.

Observed and modeled average annual P loading are presented in Table 2. Based on recently (2015 - 2019) observed total phosphorus loads from the LANS, the 3 scenarios without recharge withdrawals resulted in an average load reduction to Lake Apopka of approximately 1,910 lbs P yr^{-1} (Table 2). The model P load estimates are based on an observed P loading rate of 0.317 lbs of P per acre-foot of water pumped from the LANS after alum treatment. The scenarios with 5 MGD and 10 MGD withdrawals for aquifer recharge provided an additional reduction of 1,480 and 2,290 lbs P yr^{-1}, respectively.

Table 2. Observed and modeled mean annual discharge and P load to Lake Apopka from the LANS.

Observation/Modeled Scenario	Mean Annual Discharge to Lake Apopka (acre-feet)	Mean Annual P load to Lake Apopka (lbs. yr^{-1})	Mean Annual TP load to Lake Apopka as Percent of LANS TMDL Allocation
Observed 2000 -2019	11,133	16,052	132%
Observed 2015 - 2019	15,485	5,142	42%
Baseline	10,556	3,346	27%
Max Storage	10,074	3,193	26%
New Infrastructure	9,944	3,152	26%
5MGD Recharge / 60.5ft threshold	5,475	1,735	14%
10MGD Recharge / 60.5ft threshold	3,033	961	8%
5MGD Recharge / 59ft threshold	5,604	1,777	15%
10MGD Recharge / 59ft threshold	2,889	916	8%

Influence of LANS water management on Lake Apopka stage

The extent to which pumping from the LANS influences water levels in Lake Apopka is an important consideration for water management on the LANS. The impact of water level management scenarios on Lake Apopka stage was determined by comparison of the two scenarios with the largest difference in cumulative pumping volumes: the baseline scenario and the scenario with 10 MGD of recharge / 59 ft. withdrawal threshold (Figure 4). Lake Apopka stage showed minimal difference over the modeled period of record for these two scenarios. The maximum difference in stage was 0.23 ft. A separate modeling effort by the District that included a scenario with no pumping from the LANS showed a similar lack of influence of LANS pumping on Lake Apopka stage, with a maximum difference in stage of 0.18 ft between scenarios with and without pumping from the LANS (Wester, pers. comm.). These results suggest that pumping from the LANS into Lake Apopka, in general, has minimal effect on Lake Apopka stage, most likely due to the limited pumping capacity on the LANS and the lake's large volume.

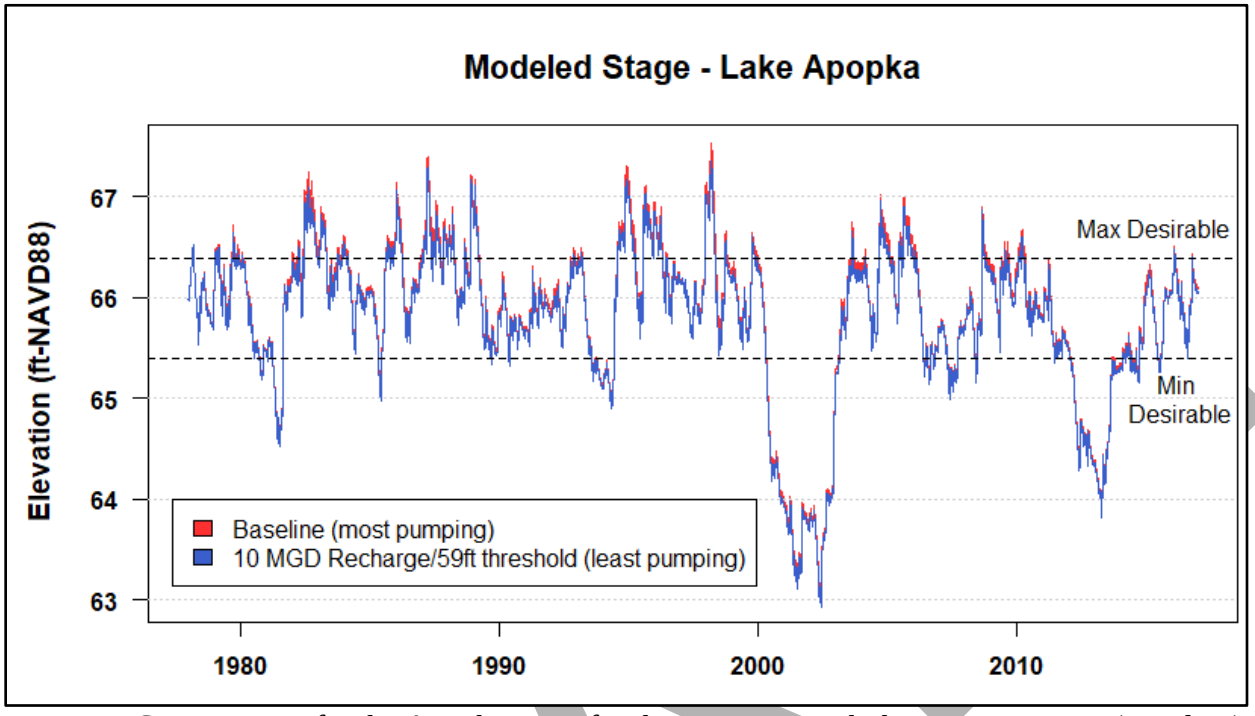

Figure 4. Comparison of Lake Apopka stage for the scenarios with the most pumping (Baseline) and least pumping (10 MGD Recharge/ 59ft threshold) from the LANS into the lake.

Assessment of water level criteria

The first set of hydrologic criteria for wetlands on the LANS were developed in 2006 (Conrow and Coveney, unpublished). The criteria were developed with the goal of promoting dense, emergent wetland vegetation across properties east of the Apopka-Beauclair. Establishment of emergent wetlands would limit foraging by wading birds, an operational goal established by Biological Assessments approved by the U.S. Fish and Wildlife Service. The general target to promote emergent wetlands was to have 1 – 2 feet of water over most of the wetland cells. Low and high-water criteria were also specified. These criteria were to meet goals of drying down for germination, avoiding organic soil oxidation, and avoiding extended high water levels that would convert emergent marsh to open water (Appendix Table A1). Criteria were specified as depths referenced to the typical low soil elevation for each phase and were the same for all phases and Duda.

The approval of active management of water levels in the most recent Biological Assessment submitted to USFWS (Bowen and Slater 2018) now allows the District more flexibility in managing the LANS to store water and reduce phosphorus loading to Lake Apopka. Maximum water levels on the LANS are ultimately constrained by internal levee heights, and minimum water levels should be protective of the wetlands created by the rehydration of the LANS. Wetland plants provide both short and long-term sequestration of phosphorus and provide habitat and great recreational and aesthetic value. Maintaining vegetated wetlands on the LANS will promote soil accretion and allow elevation to build naturally across the LANS, which will further reduce the potential for OCP bioaccumulation.

Two hydrologic criteria were developed to test against model scenarios:

1. Frequency of Inundation

The frequency of inundation criterion is intended to prevent oxidation of organic soils and subsidence. The LANS is almost entirely underlain by deep organic soils. For each zone, the elevation where a steep increase in the stage-area relationship occurred was chosen as the critical value for this criterion (Figure 7). The critical elevations covered greater than 90 % of the wetland area of each zone. The statistic calculated is the percent of days that water elevation is above the critical value. Daily water elevations should exceed the critical value for at least 60% of days over the period of record (30 year minimum).

2. Undesirable 7-day Maximum

The undesirable 7-day maximum is set to protect levees from roadbed damage. All internal levees will be raised to at least 64 ft. NAVD88 elevation and water should remain 1 foot below the lowest levee elevation surrounding each zone. The critical value for the 7-day maximum was set at 63.5 ft, or 0.5 feet below the lowest levee elevation, to allow for transient peaks in water elevation (Figure 7). The statistic calculated is the return interval (in years) for which the 7-day rolling mean exceeds the critical elevation. The 7-day rolling mean should not exceed the critical value more than 1 in 10 years.

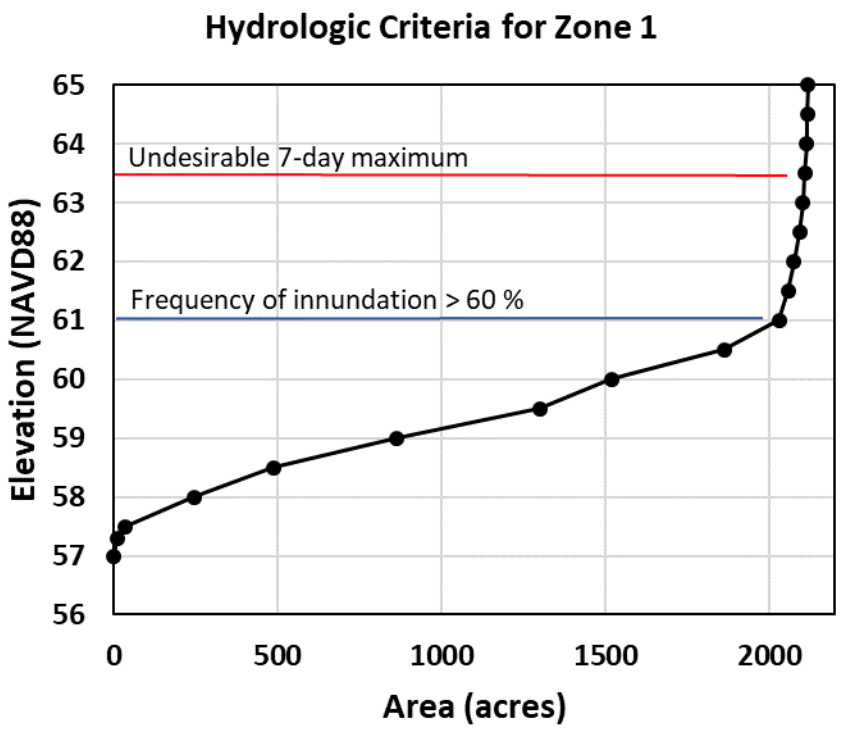

Figure 7. Example of hydrologic criteria displayed on the stage-area curve for Zone 1.

The results of the assessment of hydrologic criteria for the 7 evaluated scenarios are summarized in Table 3. The baseline scenario did not meet the frequency of inundation criterion for Zones 1 and 4, however, inundation frequencies were above 50%. For both the maximum storage and new infrastructure scenarios, the undesirable 7-day maximum was not met for Zones 1 – 4. However, time series plots of stage in Zones 1-4 (Appendix Figure A1) show that levees (64 ft) were only overtopped once in the 38-year model period. These results indicate that the new infrastructure scenario can be used for water management but with adjustments to pump-on elevations (see section "Recommended Operational Criteria for Phases 1-8 and Duda").

For the 4 scenarios with withdrawals for aquifer recharge, the frequency of inundation criterion was not met in 4 cases: in Zone 2 under the 10 MGD recharge/ 59 ft threshold scenario and in Zone 4 for the 5 MGD recharge/59 ft threshold and both 10MGD recharge withdrawal scenarios (Table 3). Additionally, the Undesirable 7-day Maximum was exceeded in Zones 1-3 for the 5 MGD recharge/ 59 ft threshold scenario. Both recharge scenarios with a 59 ft. threshold utilized a different baseline scenario than the scenarios with a 60.5 ft withdrawal threshold. As a result, the 59 ft. withdrawal scenarios resulted in more pumping from Duda into Zones 1 and 2, which likely explains the exceedance of the Undesirable 7-day Maximum. For recharge withdrawal scenarios, the results suggest that 5 MGD of recharge withdrawal is feasible with a pumping elevation threshold of 60.5, and changes to the internal pump operations may allow 5 MGD of recharge withdrawal with the 59 ft threshold. Verification that water level criteria could be met under a 10 MGD withdrawal will require further modeling of operational changes.

Table 3. Hydrologic Criteria Statistics for the 7 evaluated scenarios. Refer to text for explanation of statistics. Criteria that were not met are highlighted in yellow.

Zone	Criteria	Critical Value (NAVD88)	Baseline	Max Storage	New Infrastructure	5 MGD Recharge / 60.5 ft threshold	10 MGD Recharge / 60.5 ft threshold	5 MGD Recharge / 59 ft threshold	10 MGD Recharge / 59 ft threshold
Zone 1	**Mean Water Level**	-	60.96	62.24	62.4	62	61.8	61.6	61.2
	Freq. of Inundation	61	52%	90%	90%	84%	82%	73%	66%
	Undesirable 7-day max	63.5	-	4.2	3.1	10	40	6.7	-
Zone 2	**Mean Water Level**	-	61.03	62.44	62.6	61.9	61.2	61.2	60.3
	Freq. of Inundation	60.5	83%	98%	100%	85%	66%	65%	43%
	Undesirable 7 day max	63.5	-	3.3	3.6	13.3	40	6.7	-
Zone 3	**Mean Water Level**	-	61.71	62.39	62.5	62.2	62.2	62.0	61.8
	Freq. of Inundation	61.5	70%	87%	88%	85%	84%	77%	74%
	Undesirable 7 day max	63.5	-	3.6	3.3	8	40	6.7	-
Zone 4	**Mean Water Level**	-	61.07	62.49	61.8	61.4	61.2	61.1	61.1
	Freq. of Inundation	61	53%	97%	84%	65%	56%	52%	52%
	Undesirable 7 day max	63.5	-	3.3	10	-	-	-	-
Duda	**Mean Water Level**	-	61.89	61.89	61.6	61.2	61	60.7	60.7
	Freq. of Inundation	60.5	95%	95%	86%	78%	74%	70%	70%
	Undesirable 7 day max	63.5	-	-	40	-	-	-	-

WATER MANAGEMENT EFFECTS ON WETLAND VEGETATION

In 2013, the District Governing Board approved a land management plan for the LANS (SJRWMD 2013) that set goals for the maintenance of a "mixed marsh" condition after restoration activities were completed. The mixed marsh condition was defined as 10 – 30 % open water, 30 – 70 % emergent marsh, and 10 – 30 % other components. The open water category included floating, floating rooted, and submersed vegetation, and the other components category included dryer components like shrub and wet prairie. Because of soil oxidation and subsidence of some areas of the LANS during years of muck farming, a mixed marsh condition is difficult to meet for some water management zones within the LANS without significant pumping to Lake Apopka.

For the present model scenarios, the expected distribution of vegetation community types was predicted using an index model for wetland vegetation class. The model was originally developed to predict community types in the Upper St. Johns River Basin (Jimenez et al. 2003). The model assigns index scores using ranges of four hydrologic statistics: frequency of inundation, average annual depth, maximum depth, and minimum depth. A single combined weighted index is then used to predict the community type as water, slough, emergent wetland, transitional wetland, or upland. For each scenario, hydrologic statistics were calculated relative to a series of elevations at 0.5-foot intervals. The stage-area curves were then used to calculate the percentage of each community type expected for each water management zone.

The community types for each water management zone under each scenario are shown in Table 4. With the exception of Duda and Zone 3, all water management scenarios resulted in less than 30 % emergent wetlands, which is below the lower value of the target range from the land management plan. Open water and slough (floating leaved) community types were always 50 % or greater. The percentage of plant community types across the entire eastern LANS is presented in the last section of Table 4, but for this total, Zone 2 was excluded because it will be managed primarily for water storage. Across the remaining eastern LANS, the modeled scenarios resulted in 15 – 41 % open water, 28 – 40 % slough, 14 – 27 % emergent wetland, 6 – 14 % transitional wetland, and 5 – 11 % upland. Scenarios with withdrawals for recharge increased the percentage of emergent wetland to approximately 27 %. These results indicate that recharge withdrawals, if properly managed to prevent over-drying, may be an important tool in water management on the LANS to promote emergent wetlands.

The distribution of vegetation is mapped in Figure 8 for the two scenarios with the largest difference in open water community types (Baseline and New Infrastructure). Most of Zone 1 and 2 (Phases 2E, 2W, 3, 4, and 5) and the eastern side of Zone 4 (Phase 6) are predicted to be open water under the new infrastructure water management scenario. However, these maps do not account for small scale topographic variation and do not show areas of emergent wetland and shrubs that are known to occur along relict levees in the mostly open water areas. Figure 9 illustrates plant communities under the recharge withdrawal scenarios of 5 and 10 MGD withdrawals for recharge (with the 60.5 ft pumping elevation threshold). Under these scenarios,

it can be seen that less open water and more emergent marsh and slough could be established versus the new infrastructure scenario. Thus, withdrawing water for recharge may be a management tool to maintain desirable marsh habitat while reducing discharges and P loading from the LANS to Lake Apopka.

Although present water management scenarios did not meet the land management goals for mixed marsh habitat, more mixed marsh will be established either when Lake Apopka water quality reaches a point where more water can be pumped from the LANS or if water is withdrawn for aquifer recharge. At that point, environmental hydrologic criteria may be established so that water management better mirrors the natural hydrologic regime of emergent marsh. This approach would be consistent with the approach established in the Upper St. Johns River Basin (Miller et al. 2020).

Table 4. Vegetation community types predicted using the index model under different water management scenarios. Cells are color-coded by the original land management plan category. Blue: Open Water, Green: Emergent Marsh, Brown: Other components.

Zone	Community Type	Baseline	Max Storage	New Infrastructure	5 MGD Recharge / 60.5 ft threshold	10 MGD Recharge / 60.5 ft threshold	5 MGD Recharge / 59 ft threshold	10 MGD Recharge / 59 ft threshold
Zone 1	Open Water	23%	61%	72%	61%	61%	41%	23%
	Slough	38%	27%	24%	27%	27%	31%	49%
	Emergent Wetland	27%	10%	3%	10%	9%	25%	24%
	Transitional Wetland	10%	2%	1%	1%	2%	2%	3%
	Upland	2%	0%	0%	1%	1%	1%	1%
Zone 2	Open Water	58%	77%	92%	77%	58%	58%	39%
	Slough	29%	19%	5%	15%	34%	29%	38%
	Emergent Wetland	9%	2%	1%	6%	4%	10%	15%
	Transitional Wetland	1%	2%	1%	1%	2%	2%	7%
	Upland	2%	0%	0%	1%	1%	1%	1%
Zone 3	Open Water	0%	18%	33%	18%	18%	18%	1%
	Slough	33%	54%	39%	54%	29%	29%	46%
	Emergent Wetland	39%	26%	27%	26%	50%	50%	48%
	Transitional Wetland	27%	3%	1%	2%	2%	2%	4%
	Upland	1%	0%	0%	1%	1%	1%	1%
Zone 4	Open Water	30%	69%	59%	46%	30%	30%	30%
	Slough	29%	11%	15%	23%	39%	39%	39%
	Emergent Wetland	21%	9%	15%	17%	11%	11%	11%
	Transitional Wetland	11%	7%	4%	7%	11%	11%	11%
	Upland	9%	4%	7%	7%	9%	9%	9%

Table 4. (continued)

Zone	Community Type	Baseline	Max Storage	New Infrastructure	5 MGD Recharge / 60.5 ft threshold	10 MGD Recharge / 60.5 ft threshold	5 MGD Recharge / 59 ft threshold	10 MGD Recharge / 59 ft threshold
Duda	Open Water	2%	2%	2%	2%	2%	0%	0%
	Slough	55%	55%	43%	21%	21%	23%	23%
	Emergent Wetland	18%	18%	31%	52%	46%	34%	34%
	Transitional Wetland	14%	14%	14%	10%	16%	18%	18%
	Upland	11%	11%	11%	15%	15%	25%	25%
Total (Excluding Zone 2)	Open Water	15%	40%	41%	33%	27%	22%	15%
	Slough	40%	34%	29%	28%	29%	31%	38%
	Emergent Wetland	24%	14%	18%	27%	27%	27%	26%
	Transitional Wetland	14%	7%	6%	6%	9%	10%	10%
	Upland	7%	5%	6%	7%	8%	11%	11%

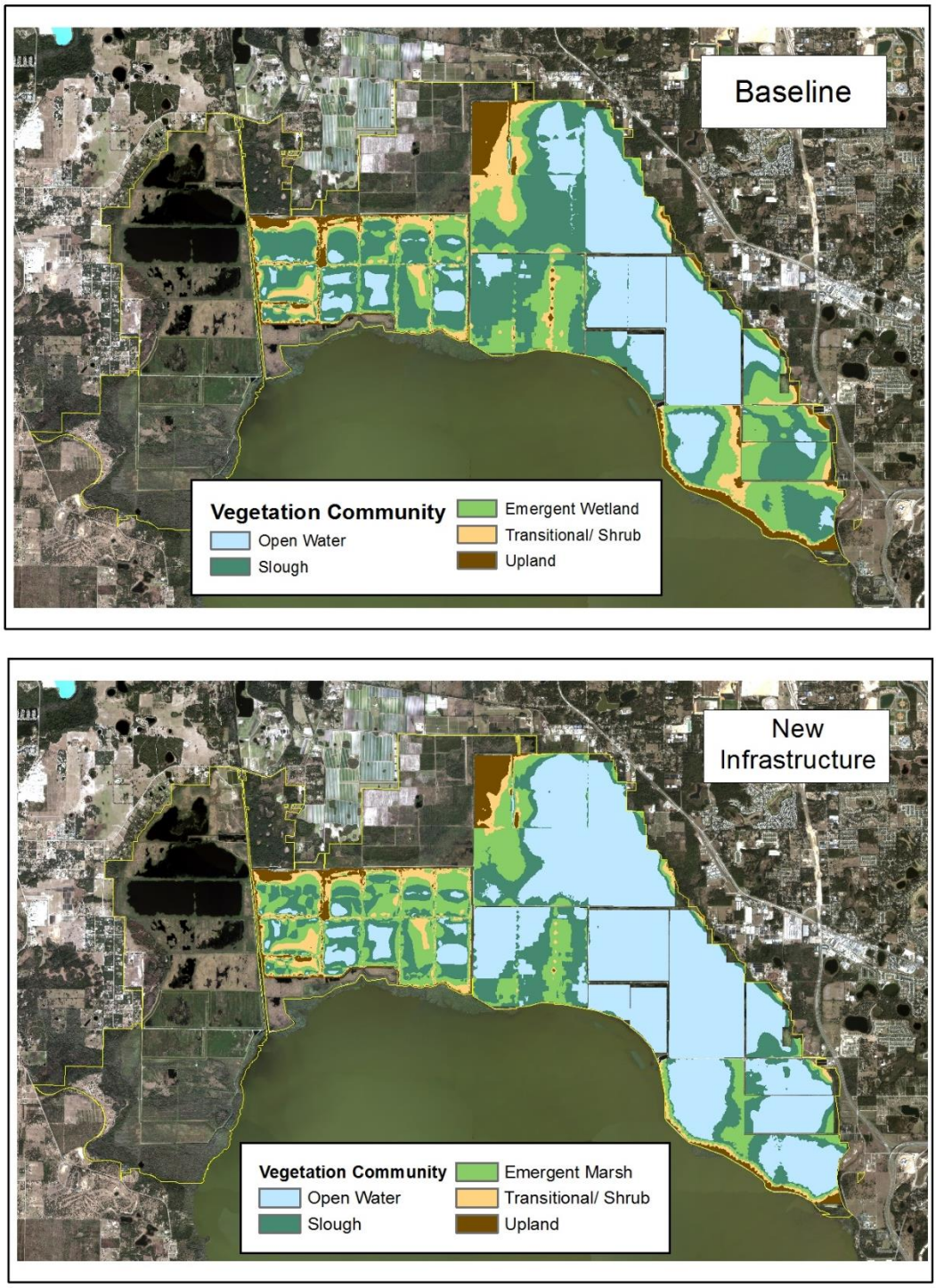

Figure 8. Predicted vegetation community types for the baseline and new infrastructure scenarios.

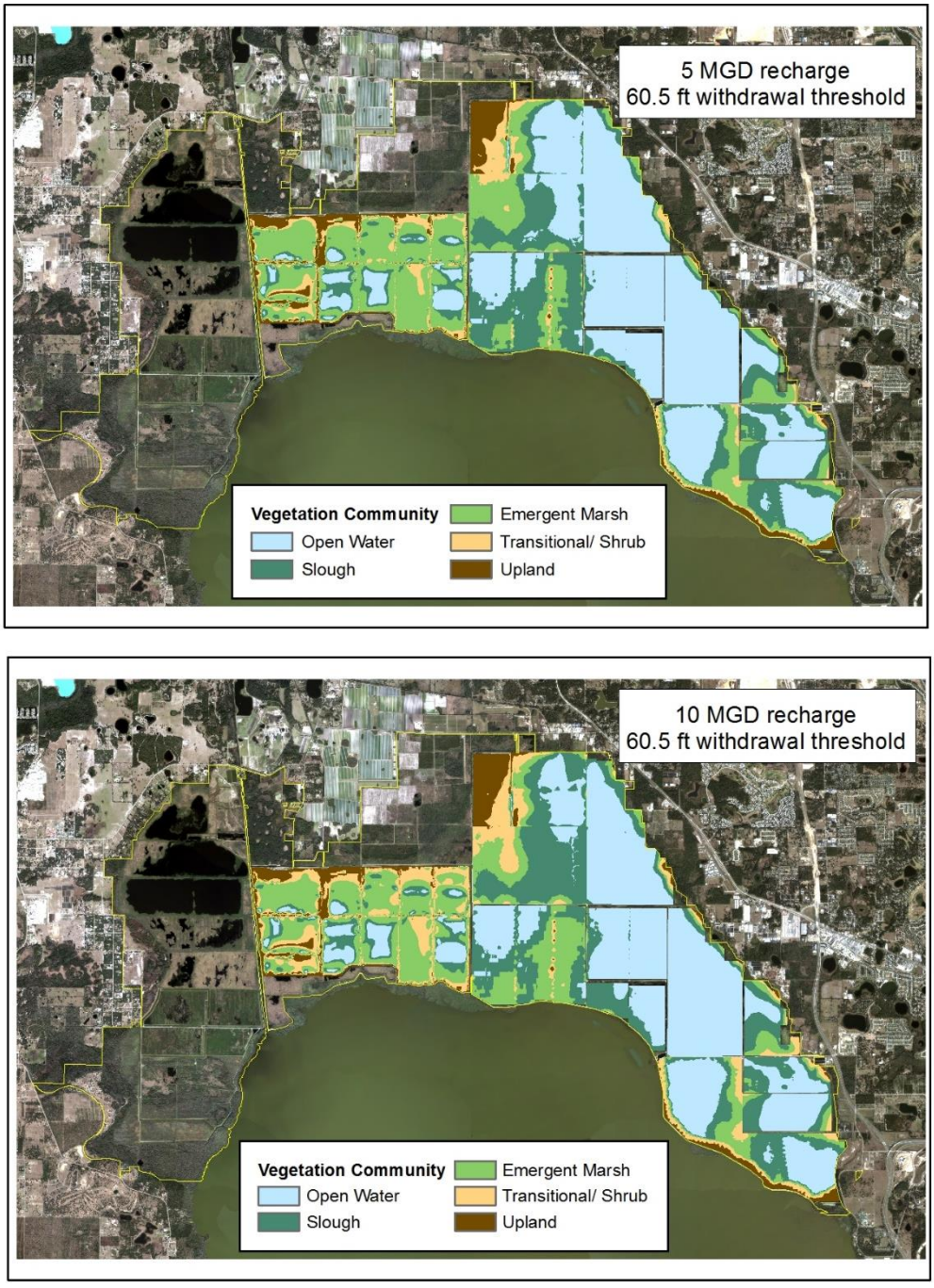

Figure 9. Predicted vegetation community types for the scenarios with 5 and 10 MGD withdrawals for recharge. Both scenarios had a pumping elevation threshold of 60.5 feet, below which recharge withdrawals stopped.

RECOMMENDED OPERATIONAL CRITERIA FOR PHASES 1-8 AND DUDA

Based on model results, the new infrastructure scenario (originally scenario 4) was chosen as the best scenario for future operations. The Unit 2 Pump (pump 2) pump-on elevations for both seasons were lowered by 0.5 feet from the original model scenario to avoid the frequent exceedance of the undesirable 7-day maximum. Additionally, the 3 pumps at the Unit 2 Pump station will begin operation in stages prior to the target elevation.

Full operational criteria are provided for current conditions in Table 5, and operational criteria after infrastructure improvements are completed are provided in Table 6. The criteria include individual elevations for operation of each of the 3 pumps at Unit 2, as well as the 2 pumps at Duda. Elevations for main control point culverts are also provided from the original HSPF model. Operating criteria may need further adjustment based on observed water levels or operational constraints. No guidelines for operation under scenarios with withdrawals for recharge are presently provided. However, the scenario with 5MGD recharge/ 60.5 ft. threshold provides the best option for operating with withdrawals for recharge. Further modeling of the recharge well project during full project design should be performed to confirm that hydrologic criteria will be met.

Table 5. Recommended operating criteria under current conditions (without infrastructure improvements).

Structure	Location	Operation
Unit 1 Pump (P1)	Zone 4	If Zone 2 > 61.0 ft, Turn pump on When Zone 2 = 60.8 ft while pumping, turn pumps off
Unit 2 Pump (P2)	Zone 2	If Zone 2 > 61.2 ft, Use 1 pump If Zone 2 > 61.7 ft, Use 2 pumps If Zone 2 > 62 ft, Use 3 pumps When Zone 2 = 61.7 ft while pumping, Use 2 pumps When Zone 2 = 61.2 ft while pumping, Use 1 pump When Zone 2 = 61.0 ft while pumping, turn pumps off
Duda Pump (P3)	Duda	If Duda > 62.4 ft, Use 1 pump If Duda > 62.9 ft Use 2 pumps When Duda = 61.9 ft while pumping, turn pumps off
C5-2	Zone 1	Riser elevation at 60.5 ft
C1-01	Main Canal	Open
C1-2	Zone 3	Riser elevation 62 ft
All Phase 6,7,8 culverts	Zone 4	Riser elevation at 60.5 ft

Table 6. Recommended operating criteria after infrastructure improvements.

Structure	Location	Season	Operation
Unit 1 Pump (P1)	Zone 4	May 1 - Sep 30	If Zone 4 > 61.5 ft, turn pump on When Zone 4 = 61.2 ft while pumping, turn pumps off
		Oct 1 - Apr 30	If Zone 4 > 62.5 ft, turn pump on When Zone 4 = 62 ft while pumping, turn pumps off
Unit 2 Pump (P2)	Zone 2	May 1 - Sep 30	If Zone 2 > 61.5 ft, Use 1 pump If Zone 2 > 61.7 ft, Use 2 pumps If Zone 2 > 62 ft, Use 3 pumps When Zone 2 = 61.7 ft while pumping, Use 2 pumps When Zone 2 = 61.5 ft while pumping, Use 1 pump When Zone 2 = 61.3 ft while pumping, turn pumps off
		Oct 1 - Apr 30	If Zone 2 > 61.8 ft, Use 1 pump If Zone 2 > 62.2 ft, Use 2 pumps If Zone 2 > 62.5 ft, Use 3 pumps When Zone 2 = 62.2 ft while pumping, Use 2 pumps When Zone 2 = 62 ft while pumping, Use 1 pump When Zone 2 = 61.5 ft while pumping, turn pumps off
Duda Pump (P3)	Duda	May 1 - Sep 30	If Duda > 62.2 ft, Turn 1 pump on If Duda > 62.5 ft Turn 2 pumps on When Duda = 62 ft while pumping, turn pumps off
		Oct 1 - Apr 30	If Duda > 62.5 ft, Turn 1 pump on If Duda > 63 ft Turn 2 pumps on When Duda = 62 ft while pumping, turn pumps off
Zone4 -> Zone 2 Internal Pump	Zone 4	All Year	If Zone 4 > 61 ft., turn pump on If Zone 4 > 62.5 ft, turn pump off
Duda Interconnect Pump	Duda	All Year	If Duda > 61 ft, turn pump on If Duda > 62.5 ft, turn pump off
C5-2	Zone 1	All Year	Riser elevation at 61.5 ft
C1-01	Main Canal	All Year	Riser elevation at 63 ft
C1-2	Zone 3	All Year	Riser elevation 62.5 ft
All Phase 6,7,8 culverts	Zone 4	All Year	Riser elevation at 60.5 ft

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APPENDIX

Table A1. Legacy LANS wetland criteria used between 2006 – 2018. All elevations are reported in feet (NAVD88).

		Phase									
		1	**2E**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Duda**
Phase Data	Typical low soil elevation	59	58.5	57.5	58	55.5	57.5	57.5	58.5	58	60
	Median soil elevation	60.5	59.5	59	58.5	57.5	59	58.5	59.5	59.5	61.5
	NWL Weir Elevation	62	61.5	60.5	61	58.5	60.5	60.5	61.5	61	63
High water Criteria	Max High Water Level	63.25	62.75	61.75	62.25	59.75	61.75	61.75	62.75	62.25	64.25
	4 ft depth <30 days	63	62.5	61.5	62	59.5	61.5	61.5	62.5	62	64
	3.5 ft depth < 30 days 2 yr freq	62.5	62	61	61.5	59	61	61	62	61.5	63.5
	3 ft depth < 90 days annual freq	62	61.5	60.5	61	58.5	60.5	60.5	61.5	61	63
	2.5 ft depth < 120 days annual freq	61.5	61	60	60.5	58	60	60	61	60.5	62.5
Low water Criteria	Water level less than 1.5 ft deep 50% 2 yr freq	62	61	60.5	60	59	60.5	60	61	61	63
	Median soil surface exposed 30 days but no more than 60 days 5yr freq	60.5	59.5	59	58.5	57.5	59	58.5	59.5	59.5	61.5

Table A2. Stage-area relationships for LANS phases and water management zones. Areas are reported in acres.

Elevation ft NAVD88	Phase 1	Phase 2W	Phase 2E	Phase 3	Phase 4	Phase 5	Phase 6	Phase 7	Phase 8	Duda	Z1	Z2	Z3	Z4
66.5	1231.5	760.3	643.3	418.3	2043.4	714.9	857.2	946.0	898.0	-	2118.4	2461.8	1231.5	2701.3
66	1231.5	760.3	643.3	418.3	2043.4	714.9	857.2	946.0	880.1	2558.0	2118.4	2461.8	1231.5	2683.3
65.5	1231.5	760.3	643.3	418.3	2043.4	714.9	857.2	946.0	872.4	-	2118.4	2461.8	1231.5	2675.7
65	1231.5	760.3	643.3	418.3	2043.4	714.9	857.2	946.0	860.7	2523.0	2118.4	2461.8	1231.5	2663.9
64.5	1231.5	758.5	643.3	416.8	2043.4	714.9	854.6	944.0	847.2	-	2116.7	2460.3	1231.5	2645.8
64	1231.5	756.8	643.3	415.4	2043.4	714.9	851.9	942.0	829.6	2448.0	2114.9	2458.8	1231.5	2623.6
63.5	1229.3	755.0	639.9	413.9	2039.6	713.2	845.8	940.1	801.4	-	2108.1	2453.5	1229.3	2587.2
63	1220.1	753.2	636.6	412.4	2026.7	711.6	841.7	938.1	728.0	2304.0	2101.4	2439.1	1220.1	2507.9
62.5	1213.7	751.4	631.6	410.9	2019.0	708.6	836.6	936.1	694.5	-	2091.7	2429.9	1213.7	2467.2
62	1200.4	745.9	626.7	409.5	2002.1	702.0	832.1	924.4	656.0	2102.0	2074.5	2411.6	1200.4	2412.6
61.5	1169.5	741.4	621.7	408.0	1988.9	693.6	824.2	922.0	580.0	-	2056.7	2396.9	1169.5	2326.2
61	881.0	730.1	616.8	406.5	1965.5	682.2	815.4	839.0	520.1	1790.0	2029.1	2372.0	881.0	2174.5
60.5	583.7	669.3	558.0	405.0	1925.9	633.8	785.0	734.9	482.5	-	1861.2	2330.9	583.7	2002.4
60	402.4	519.0	422.9	403.6	1860.9	575.5	767.9	651.5	447.6	1155.0	1517.4	2264.5	402.4	1866.9
59.5	220.4	426.5	356.7	399.3	1755.7	515.6	725.9	460.0	411.0	-	1298.8	2155.0	220.4	1596.9
59	17.1	378.9	196.9	308.8	1588.3	287.2	677.8	212.0	353.1	50.0	863.0	1897.2	17.1	1242.9
58.5	0.0	296.0	31.8	84.6	1353.9	158.8	528.8	19.3	253.9	-	486.6	1438.5	0.0	802.1
58		182.3	0.0	46.7	1222.4	61.9	245.5	0.0	65.3	2.0	244.2	1269.1	0.0	310.7
57.5		18.0		13.3	951.6	18.6	19.4		20.6	-	36.5	965.0	0.0	40.0
57		0.0		0.0	808.2	0.0	0.0		0.0	0.0	0.0	808.2	0.0	0.0
56.5					562.5						0.0	562.5	0.0	0.0
56					203.6						0.0	203.6	0.0	0.0
55.5					4.5						0.0	4.5	0.0	0.0
55					0.0						0.0	0.0	0.0	0.0

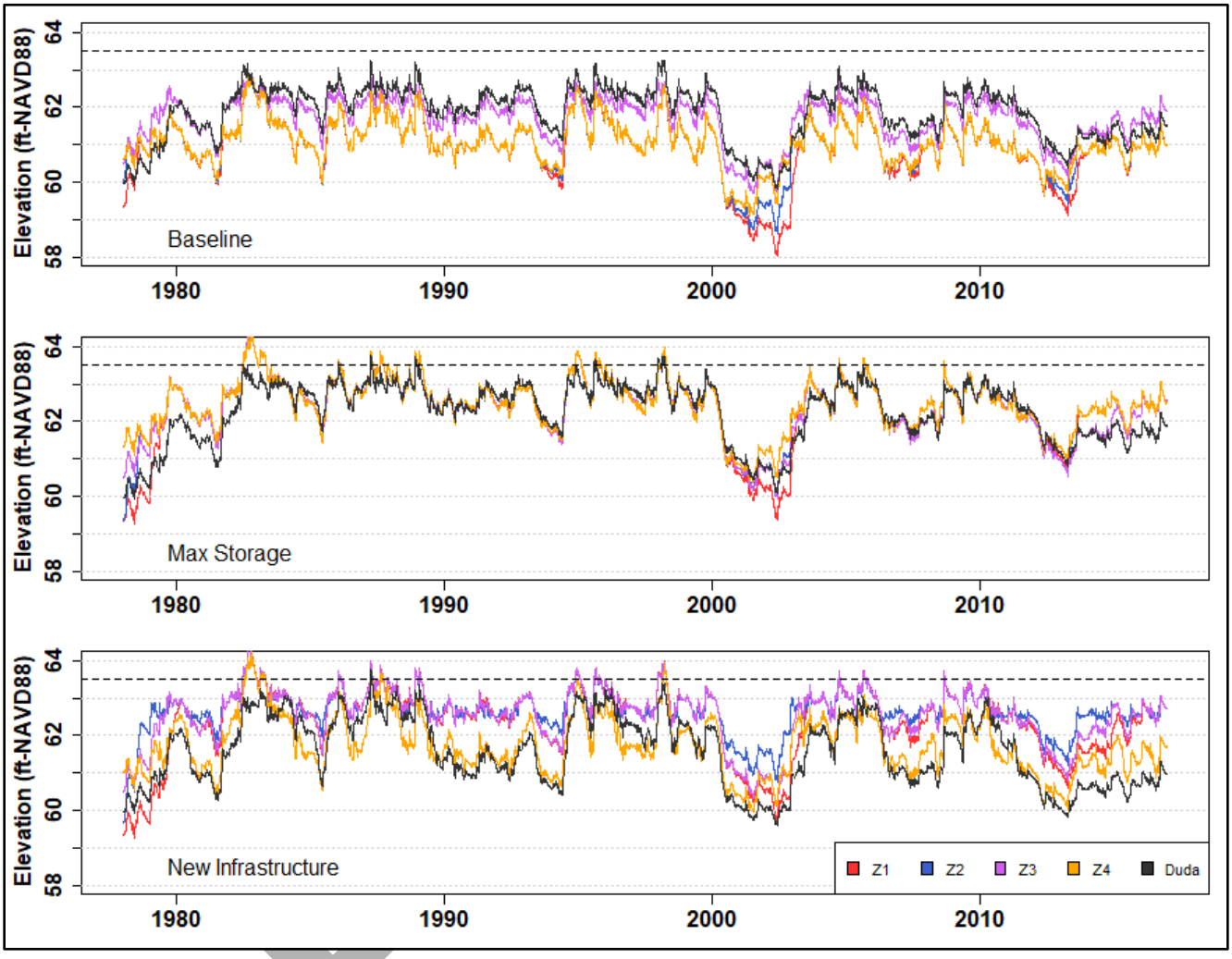


Figure A1. Water level time series for model scenarios: Baseline, Maximum Storage, and New Infrastructure.

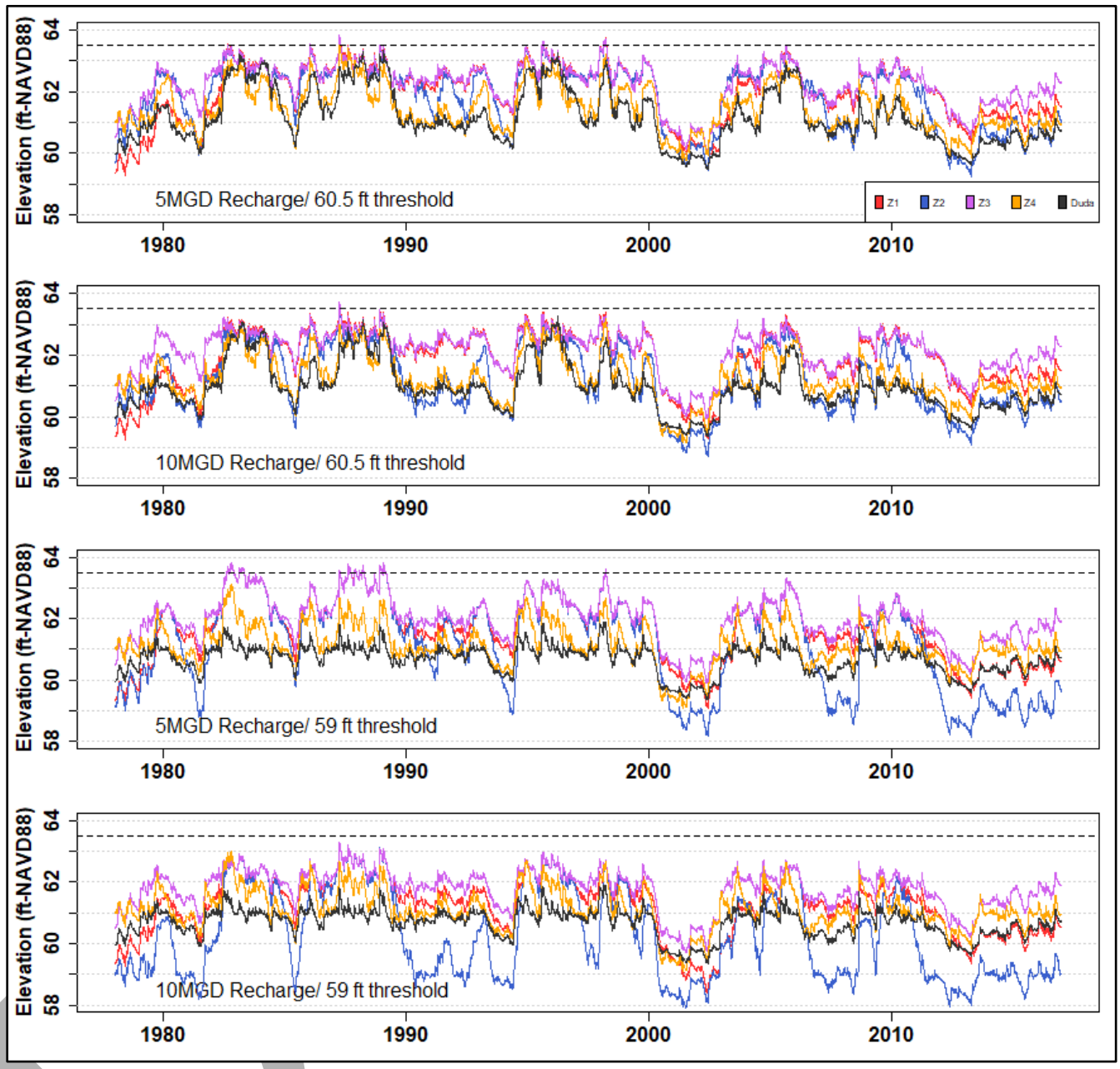


Figure A1 (continued). Water level time series for model scenarios with withdrawals for aquifer recharge.

Table 1. *Summary of all analytes for each species for all 31 individuals of waterfowl sampled in 2021. Pace values of micrograms/kg were converted to milligrams/kg to facilitate comparison with the AMEC 2012 values.*

	Mean Values (mg/kg)						
ANALYTES	Black Bellied Whistling (1)	Blue Winged Teal (8)	Coot (8)	Fulvous Whistling (3)	Mottled (1)	Ringneck (8)	Widgeon (2)
4,4'-DDE	**0.0007**	**0.0418**	**0.0571**	**0.0277**	**0.0063**	**0.0132**	**0.0088**
Aldrin	**0.0003**	**0.0003**	**0.0003**	**0.0003**	**0.0003**	**0.0003**	**0.0003**
alpha-BHC	**0.0010**	**0.0010**	**0.0010**	**0.0010**	**0.0010**	**0.0010**	**0.0010**
alpha-Chlordane*	0.0003	0.0003	0.0005	0.0003	0.0003	0.0003	0.0003
cis-Nonachlor*	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004
Dieldrin	**0.0005**	**0.0005**	**0.0011**	**0.0006**	**0.0005**	**0.0005**	**0.0005**
gamma-Chlordane*	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004	0.0004
Heptachlor*	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Heptachlor epoxide*	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005
Mercury	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Methoxychlor*	0.0034	0.0034	0.0034	0.0034	0.0034	0.0034	0.0034
Oxychlordane*	0.0004	0.0007	0.0013	0.0003	0.0003	0.0003	0.0003
Toxaphene	**0.0111**	**0.0116**	**0.0157**	**0.0102**	**0.0102**	**0.0105**	**0.0102**
trans-Nonachlor*	0.0012	0.0013	0.0007	0.0008	0.0004	0.0008	0.0005
CHLORDANE (calculated from components *)	**0.0070**	**0.0073**	**0.0077**	**0.0065**	**0.0060**	**0.0064**	**0.0061**

*(NOTE: **Bolded** analytes and values are directly comparable to values reported in AMEC 2012 analyses. Non-bolded analytes and values were not directly included in AMEC 2012 but were reported as a composite in Chlordane. Green values are calculated from asterix components of Chlordane.)*

Table 2. *Summary of all analytes for all species for all 31 individuals of waterfowl sampled. Pace values of micrograms/kg were converted to milligrams/kg to facilitate comparison with the AMEC 2012 values.*

	mg/kg			
ANALYTES	Mean	Maximum	Minimum	N
4,4'-DDE	**0.0324**	0.1010	0.0007	31
Aldrin	**0.0003**	0.0003	0.0003	31
alpha-BHC	**0.0010**	0.0010	0.0010	31
alpha-Chlordane*	0.0003	0.0022	0.0003	31
cis-Nonachlor*	0.0004	0.0007	0.0004	31
Dieldrin	**0.0007**	0.0020	0.0005	31
gamma-Chlordane*	0.0004	0.0012	0.0004	31
Heptachlor*	0.0003	0.0003	0.0003	31
Heptachlor epoxide*	0.0005	0.0005	0.0005	31
Mercury	**0.0000**	0.0001	0.0000	31
Methoxychlor*	0.0034	0.0034	0.0034	31
Oxychlordane*	0.0007	0.0025	0.0003	31
Toxaphene	**0.0121**	0.0352	0.0102	31
trans-Nonachlor*	0.0009	0.0031	0.0004	31
CHLORDANE (calculated from components *)	**0.0070**	0.0140	0.0060	8

*(NOTE: **Bolded** analytes and values are directly comparable to values reported in AMEC 2012 analyses. Non-bolded analytes and values were not directly included in AMEC 2012 but were reported as a composite in Chlordane. Green values are calculated from asterix components of Chlordane.)*

The following soil series descriptions are taken directly from the USDA-NRCS using the online query tool. As of the writing of this plan, the query tool may be located at https://soilseries.sc.egov.usda.gov/osdnamequery.asp.

The Anclote series consists of very deep, very poorly drained, rapidly permeable soils in depressions, poorly defined drainage ways, and flood plains. They formed in thick beds of sandy marine sediments. Anclote soils are in depressions, flats, or poorly defined drainage ways in the Lower Coastal Plain. Native vegetation consists of cypress, bay, pond pine, cabbage palm, red maple, and juncus species.

The Apopka series consists of very deep, well drained, moderately permeable soils on ridges and side slopes in the Lower Coastal Plain. They formed in thick beds of sandy and loamy marine or eolian deposits. The understory vegetation supported by this series may consist of bluestem, dog fennel, paspalum, pineland threeawn, and other native grasses and weeds.

The Arrents are disturbed soils.

The Basinger series consists of very deep, poorly drained and very poorly drained, rapidly permeable soils in sloughs, depressions, low flats, and poorly defined drainage ways. They formed in sandy marine sediments. The natural vegetation may consist of wax myrtle, St. Johns wort, maidencane, pineland threeawn, cypress, slash pine, longleaf pine, pond pine, and other water tolerant plants.

The Brighton series consists of very deep, poorly drained, moderately rapid to rapidly permeable organic soils in depressions, freshwater marshes, and swamps. Natural vegetation consists mostly of Jamaica sawgrass, prairie iris, ferns, bull-tongue, buttonbush, maidencane, sedges, and arrow arums in some areas, with other areas being dominated by bald cypress, red bay, white bay, and red maple.

The Candler series consists of very deep, excessively drained, rapidly permeable soils on uplands. They formed in thick beds of eolian or marine deposits of coarse textured materials. They are typically located in Marion County, Florida; approximately 200 feet west of the Base Line Road; about 0.75 mile north of Silver Springs. Native vegetation consists of blue jack oak, turkey oak, post oak, live oak, and longleaf pine with a sparse understory of indiangrass, chalky bluestem, pineland threeawn, hairy panicum, and other annual forbs.

The Canova series consists of very deep, very poorly drained moderately slowly permeable soils in depressions, freshwater swamps, and marshes. Formed in loamy marine sediments. Most areas are in their natural state and are used for wildlife habitat. Vegetation dominated by reeds, sedges, saw grass, lilies, scattered cypress, maple, gum, bay, and myrtle.

The Cassia series consists of very deep, somewhat poorly drained, moderately rapid permeable soils on low ridges and knolls that are slightly higher than the adjacent flatwoods. The native vegetation supported by this series generally consists of scattered slash pine, longleaf pine, and saw palmetto.

Emeralda Fine Sand – The Emeralda series consists of very deep, poorly drained, slowly or very slowly permeable soils in broad, low areas generally near lakes and streams in the lower Coastal Plain. They formed in clayey marine sediments. Emeralda soils are on broad areas in the lower Coastal Plain. Native vegetation consists of live oak, laurel oak, water oak, scattered slash pine, sweetgum, and red maple with an understory of wax myrtle, cabbage palm, saw palmetto, gallberry, cutgrass, beaked panicum, and sand cordgrass.

The Everglades series consists of very deep, very poorly drained, rapid to very rapidly permeable organic soils in freshwater swamps and marshes that flood for very long periods. They formed in thick deposits of hydrophytic plant remains. The natural vegetation includes Florida willow, sawgrass, reeds, lilies, and other aquatic, fibrous, nonwoody plants and hardwood trees.

The Felda series consists of very deep, poorly drained and very poorly drained, moderately permeable soils in drainage ways, sloughs and depressions, and on flood plains and low flats. They formed in stratified, unconsolidated marine sands and clays. Felda soils are in depressions, poorly defined drainage ways, sloughs, flood plains, or low flat. Natural vegetation consists of cypress, wax myrtle, pond pine, slash pine, cabbage palm, pineland threeawn, and various grasses, vines, and shrubs.

The Fellowship series consists of poorly drained and very poorly drained soils that are more than 80 inches thick. Fellowship soils formed in clayey marine sediments. They are on uplands of Peninsular Florida. Native vegetation includes sweetgum, slash pine, hickory, magnolia, water oak, red maple, and Carolina ash. Depressional areas also have cypress.

The Floridana series are very deep, very poorly drained, slowly to very slowly permeable soils on low, broad flats, flood plains, and in depressional areas. They formed in thick beds of sandy and loamy marine sediments. Slopes in areas where this soil is found ranges from 0-1%. Natural vegetation consists of sand cordgrass, cabbage palmetto, myrtle, and pineland threeawn. In depressional areas, most of the soil has a sparse to dense cover of cypress. In floodplains, the vegetation is mostly sweetgum, black gum, red maple, and cypress.

The Gator series consists of very poorly drained organic soils that formed in moderately thick beds of hydrophytic plant remains overlying beds of loamy and sandy marine sediments. They are in depressions and on floodplains with slopes less than 1%. Almost all areas are in marsh or swamp wetlands used for wildlife and water storage. Native vegetation is mostly cordgrass or Jamaica sawgrass, maidencane, coastal palmetto, dogwood, or swamp vegetation including bald cypress, sweetgum, red maple, and American hornbeam.

The Immokalee series are deep to very deep and poorly drained to very poorly drained soils that formed in sandy marine sediments. They occur on flatwoods and in depressions of Peninsular Florida. Slopes tend to be 0 – 2%, but may range to 5%. Principle vegetation is longleaf and slash pine with undergrowth of saw palmetto, gallberry, wax myrtle, and pineland threeawn. In depressions, water tolerant plants such as cypress, loblolly bay, gorodonia, red maple, sweetbay, maidencane, bluestem, sand cordgrass, and blue joint panicum are more common. Most areas with Immokalee soils are in rangeland and forests.

Lake Sand - The Lake series consists of excessively drained, rapidly to very rapidly permeable soils formed in thick beds of sand. They are on nearly level to steep slopes in central Florida. They are located in Lake County, Florida about 3 miles south of Astatula; 1/2 mile west of intersection of State Roads 561 and 455; 150 feet south of Highway 455.

Malabar – Very deep, poorly to very poorly drained soils in sloughs, shallow depressions, and along flood plains. Formed in sandy and loamy marine sediments. Slopes in areas where these soils are found range from 0-2%. Native vegetation consists of scattered slash pine, cypress, wax myrtle, cabbage palm, pineland threeawn, and maidencane. In depressions, the vegetation is dominantly St. Johns Wort or maidencane.

Manatee soils are very deep, very poorly drained, and moderately permeable soils in depressions, broad drainage ways, and on floodplains. They formed in sandy and loamy marine sediments. Slope is dominantly less than 1%, but may range to 2%. Natural vegetation in these soils includes red maple, gum, cabbage palm, and widely spaced cypress. Treeless areas are covered by pickerelweed, sedge, maidencane, sawgrass, cutgrass bluestem, panicum, cinnamon fern, sand cordgrass, St. Johns Wort, and other perennial grasses.

The Martel series consists of very deep, very poorly drained, very slowly permeable soils in depressions and sloughs of central Florida. They formed in clayey marine sediments. The native vegetation is dominated by cypress, sweetgum, pond pine, and water tupelo.

The Myakka series consists of deep and very deep, poorly to very poorly drained soils formed in sandy marine deposits. These soils are on flatwoods, high tidal areas, flood plains, depressions, and gently sloping to barrier islands. Slopes in areas where these soils are found range from 0-8%. Native vegetation includes longleaf and slash pines with an undergrowth of saw palmetto, running oak, inkberry, wax myrtle, huckleberry, chalky bluestem, pineland threeawn, and scattered fetterbush.

The Okeelanta series consists of very deep, very poorly drained, rapidly permeable soils in large fresh water marshes and small depressional areas. They formed in decomposed hydrophytic non-woody organic material overlying sand. Native vegetation consists of sawgrass, lilies, sedges, and other water tolerant plants.

The Ona series consists of poorly drained, moderately permeable soils that formed in thick sandy marine sediments. They are in the flatwoods areas of central and southern Florida. Natural vegetation is slash pine and longleaf pine, gallberry, widely spaced saw palmetto, huckleberry, and pineland threeawn.

The Paola series consists of very deep, excessively drained, very rapidly permeable soils on uplands. They formed in thick sandy marine deposits. These soils are on uplands of the Coastal Plain. Native vegetation consists of sand pine, slash pine, longleaf pine, scrub live oak, scattered turkey oak, and blue jack oak. The undergrowth consists of cacti, mosses, lichens, creeping dodder, rosemary, and scattered saw palmetto.

Pineda – Deep and very deep, poorly and very poorly drained, very slowly permeable soils in depressions, low hammocks, poorly defined drainage ways, broad low flats, and floodplains. Formed in thick beds of sandy and loamy marine sediments on the lower coastal plain. Slopes in areas where these soils are found range from 0-2%. Native vegetation consists of slash pine, cypress, myrtle, cabbage palm, blue maidencane, chalky bluestem, blue point panicum, sedges, pineland threeawn, and sand cordgrass.

The Pit series consists of very deep, poorly drained soils that formed in fine-textured alluvium weathered from extrusive and basic igneous rocks. Pit soils are on flood plains and in basins. Vegetation is hair grass, alpine timothy, Baltic rush, sedges, bluegrass, and scattered silver sagebrush in the drier locations.

The Placid series consists of very deep, very poorly drained, rapidly permeable soils on low flats, depressions, poorly defined drainage ways on uplands, and flood plains on the Lower Coastal Plain. They formed in sandy marine sediments. Natural vegetation consists of pond pine, bay, cypress, gum, pickerel weed, and coarse grasses.

The Pomello series consists of very deep, moderately well to somewhat poorly drained soils that are sandy to depths of more than 80 inches. Pomello soils formed in sandy marine sediments in the flatwoods areas of Peninsular Florida. Native vegetation is dominated by scrub oak, dwarf live oak, saw palmetto, longleaf pine, slash pine, and wiregrass.

Pompano – Pompano consists of very deep, very poorly drained, rapidly permeable soils in depressions, drainage ways, and broad flats. They formed in thick beds of marine sands. Mean annual precipitation is about 50 inches and slopes range from 0-2%. Natural vegetation consists of palmetto, widely spaced cypress, gum, slash pine, and native grasses.

Samsula – Very deep, very poorly drained, rapidly permeable soils that formed in moderately thick beds of hydrophytic plant remains and are underlain by sandy marine sediments. These soils are in swamps, poorly defined drainage ways, and flood plains. Slopes are less than 2%. Natural vegetation is loblolly bay, with scattered cypress, maple, gum, and trees with a ground cover of greenbriers, ferns, and other aquatic plants.

The Sanibel series consists of very poorly drained sandy soils with organic surfaces. They formed in rapidly permeable marine sediments. The soils occur on nearly level to depressional areas with slopes less than 2 percent. Natural vegetation includes sawgrass and some wax myrtle.

The Smyrna series consists of very deep, poorly to very poorly drained soils formed in thick deposits of sandy marine materials. Natural vegetation consists of longleaf and slash pines with an undergrowth of saw palmetto, running oak, gallberry, wax myrtle, and pineland three awn.

The St. Johns series consists of very deep, very poorly or poorly drained, moderately permeable soils on broad flats and depressional areas of the lower Coastal Plain. They formed in sandy marine sediments. Principal vegetation of the forested areas is longleaf pine, slash pine, and

pond pine with an undergrowth of saw palmetto, gallberry, wax myrtle, huckleberry, and pineland threeawn.

St. Lucie Sand – The St. Lucie series consists of very deep, excessively drained, very rapidly permeable soils on dune-like ridges and on isolated knolls. They formed in marine or eolian sand. St. Lucie soils are on dune-like ridges and on isolated knolls. Vegetation is dominated by sand live oak, sand pine, dwarf willow, saw palmetto, rosemary, prickly pear cactus, and lichens.

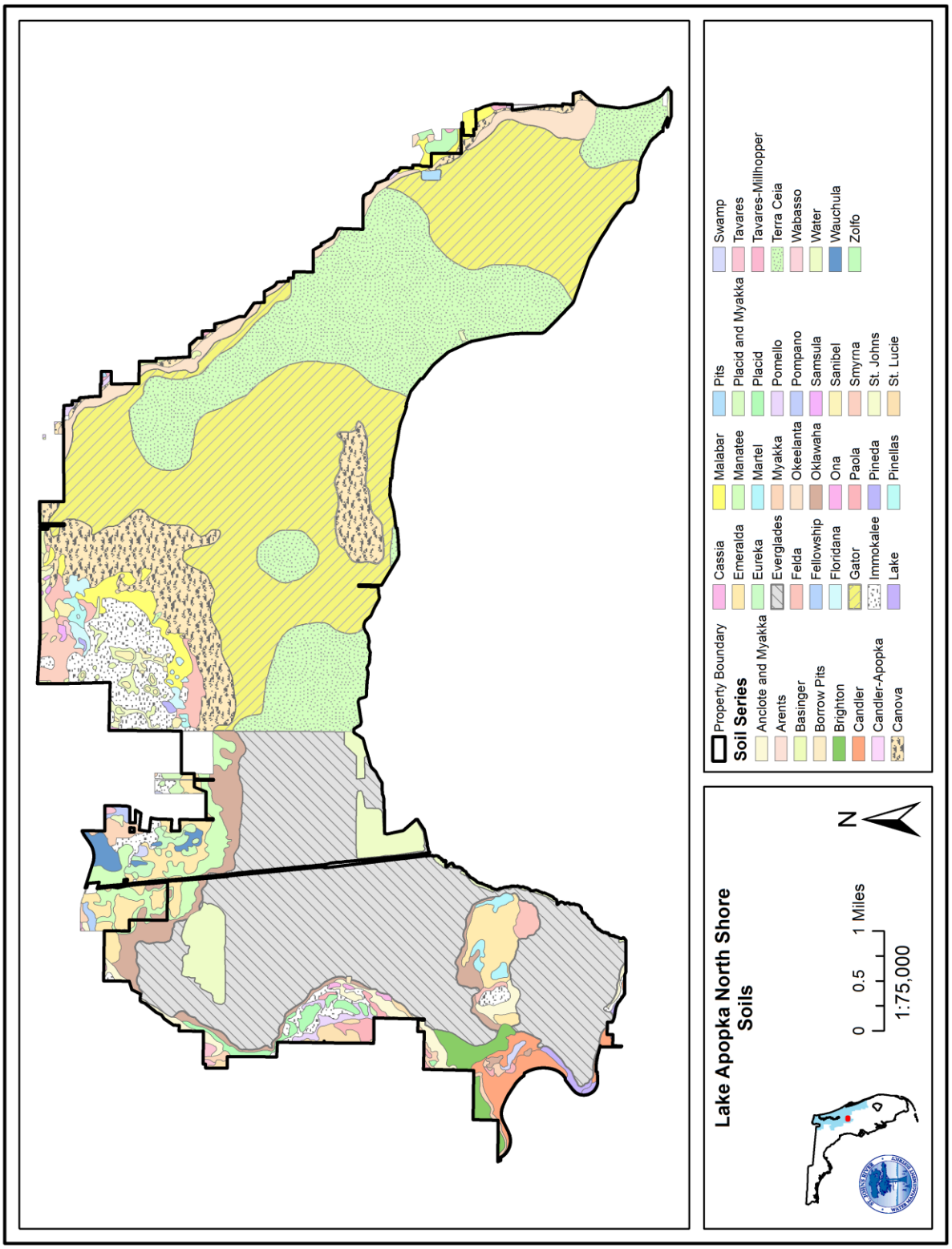
The Tavares series consists of very deep, moderately well drained, rapidly or very rapidly permeable soils on lower slopes of hills and knolls of the lower Coastal Plain. They formed in sandy marine or eolian deposits. In most places the natural vegetation consists of slash pine, longleaf pine, a few scattered blackjack oak, turkey oak, and post oak with an undercover of pineland threeawn. In some places natural vegetation consists of turkey oak, blackjack oak, and post oak with scattered slash pine and longleaf pine.

The Terra Ceia series consists of very deep, very poorly drained organic soils that formed from nonwoody fibrous hydrophytic plant remains. They occur mostly in nearly level freshwater marshes and occasionally on river floodplains and in tidal swamps or flats. Natural vegetation includes sawgrass, lilies, sedges, reeds, maidencane, and other aquatic plants. Wooded areas include cypress, black gum, cabbage palm, Carolina ash, loblolly bay, red maple, sweet bay, and pond pine. Large undeveloped areas are used for wildlife habitat and water storage.

The Wabasso series consists of deep or very deep, very poorly drained, very slowly and slowly permeable soils on flatwoods, floodplains, and depressions in Peninsular Florida. They formed in sandy and loamy marine sediments. Slopes range from 0-2% in areas where these soils are found. Natural vegetation consists of longleaf pine, slash pine, cabbage palm, and live oak with an understory of saw palmetto, laurel oak, wax myrtle, chalky bluestem, and pineland threeawn.

The Zolfo series consists of very deep, somewhat poorly drained soils that formed in thick beds of sandy marine deposits. These soils are on low broad landscapes that are slightly higher than adjacent flatwoods on the lower Coastal Plain of Central Florida. Native vegetation consists of scattered turkey, laurel, or water oaks; long leaf or slash pine with an undercover of pineland threeawn, bluestem, lopsided indiangrass, gallberry, native weeds and saw palmetto.

Appendix G - Lake Apopka North Shore Soils



In 1998 the Florida Legislature charged all state land management agencies with managing the forest resources on the lands they have acquired (253.036, Florida Statutes). To date, the St. Johns River Water Management District (District) has acquired nearly 621,000 acres of land. Approximately 46% of these acres are forested.

Even prior to the legislative directive, the District has been managing its forest resources. Timber sales began in 1991 with a salvage sale at Lake George Conservation Area following a wildfire. Since then, timber sales are conducted based upon the immediate needs of the natural communities and recommendations from individual area management plans. This plan provides guidance and coordination for the management of the District's forest resources.

PURPOSE OF FOREST MANAGEMENT

The District manages forest resources for the:

1) Restoration of natural communities.
2) Maintenance of the health and vigor of natural communities.
3) Generation of revenues to counterbalance the cost of land management activities
4) Reduce wildfire risks
5) Sustainable progress towards core missions

Restoring Natural Communities

The District acquires its land from a variety of private owners, and each owner had their own vision for the land. Many times in fulfilling their vision, private owners altered the natural communities by clearing for agricultural purposes or for planting trees. Whenever practicable, the District is charged with maintaining and/or restoring the land to its natural state and condition.

Thinning, clearcutting, invasive plant management and planting are all tools used to restore natural communities, but in almost all cases they are used in conjunction with fire. The combinations of overstory control and fire management are the primary restoration tools in forested communities.

In forested communities, controlling or manipulating the overstory serves as the primary tool to maintain or restore the natural community. The density of the

overstory dictates the health and diversity of understory species. If the overstory becomes too dense, both the overstory and understory species begin to suffer. In cases where the overstory remains crowded too long, individual understory plants begin to disappear. Often seeds of these plants will remain dormant in the soil. Thinning individual trees from an overcrowded stand allows more light, moisture, and nutrients to be available for groundcover plants. This allows dormant plants to reoccupy their former sites, thereby restoring the natural state and condition.

In some cases, private owners planted a species of tree that did not naturally occupy the site. In these cases, the District will clearcut the undesired tree species and replant with the more appropriate species.

In cases where the previous owner cleared the site, the District will prepare the site and plant the appropriate tree species. Since longleaf pine (*Pinus palustris*) occupies approximately 5% of the area it did in 1900, and since longleaf offers a suite of wildlife benefits greater than most other pines, the District will emphasize planting of longleaf on all sites where longleaf is suited for the site.

Maintenance of the Health and Vigor of the Natural Communities

The health or quality of a forested natural community is maintained by three primary factors: 1) the availability of water, 2) the frequency of fire, and 3) the density and species composition of the overstory.

In few cases do the activities of the District affect the availability of water on District forestlands. Exceptions are where sites are restored through rehydration of historically wetland systems or managing vegetation for water yield benefits. Weather is the primary factor influencing the availability of water.

Fire influences the health of forested communities by altering the process of succession. Fire holds natural communities in an intermediate stage of succession that is referred to as a fire climax community. If fire is removed, these natural communities follow the path of succession to become some other community. In Florida, most natural communities historically experienced fire on a frequent basis. In fact, most communities are dependent upon frequent fire for their continued existence. Because of its importance as a management tool, fire is specifically addressed in detail in the District's Fire Management Plan.

The third factor influencing the health and/or quality of forested natural communities is the overstory density and species composition. In a truly natural

system, wildfire, climatic disturbances, along with insects and diseases combined to control the composition of the overstory, which in turn controls the composition of the understory. Wildfire, insects and disease kill trees as individuals or groups, which reduces the density of the overstory and alters the species composition. These events or outbreaks would often impact large areas, especially areas where the stand density was high, weakening the overstory trees and increasing their susceptibility to pathogens. Prior to human intervention, there were huge expanses of natural land that could easily absorb large-scale alterations of the overstory so that no plant or animal species could be extirpated. Today, Florida is fast approaching a condition where natural areas are becoming islands. Plants and animals have fewer areas to populate and it is more difficult to transfer their genetic material between isolated areas of ideal habitat. Therefore, conservation land managers no longer rely entirely on large-scale disturbances to control overstory density and species composition. By managing the overstory with selective harvesting, the density and species composition can be controlled to maintain a healthy natural community while minimizing the potential for large-scale impacts.

As land managers, the District also has an obligation to protect neighboring landowners from any large-scale wildfire, insect, non-native invasive plant or disease outbreaks that may originate on District land and spread to adjacent lands. This obligation prohibits the District from employing a truly natural management system to control overstory species, density, and composition and requires the District to utilize a more interactive management program.

Generation of Revenues

The Florida legislature has directed public land managers to manage forest resources for an economic return (253.036, Florida Statutes). The District generates revenue when implementing sound overstory management practices to maintain the health of the natural community. These practices include but are not limited to thinning operations, removal of undesired species (clearcuts), and salvage cuts to remove trees damaged from wildfires, insect infestations, non-native invasive plant species and/or disease outbreaks. The revenue generated from these operations can be used to fund land acquisition, restoration and other land management activities.

FOREST RESOURCES INVENTORY

Following legislative directive, and seeking to keep its land management efficient, the District has sought management partners. The following chart illustrates the lead manager status of District owned lands (Figure 1).

The District's Land Management Rule, agreements and philosophy call for the lead manager's rules and policies to direct the management of the affected lands, therefore this plan will be focused on the lands where the District is identified as the lead manager. The District serves as the lead manager on 374,796 acres. These acres managed by the District are broken down as follows (Figure 2).

Thirty-seven percent of the District Managed Lands are forested, with 16% being forested uplands and 21% forested wetlands.

OBJECTIVES OF FOREST MANAGEMENT

The District's forest management objectives are to:

- Maintain the health and diversity of forested communities on District lands.
- Provide for older aged forest conditions. As public landowners we have the opportunity to provide habitat for species requiring older age classed trees.
- Provide for an array of forest stand structures and age classes. Each species of plant and animal has an age-class of forest stand that is most desirable. By providing the array of structures and age-classes, the District can provide habitat for a wide variety of species.
- Implement activities that sustainably advance the District's core missions.

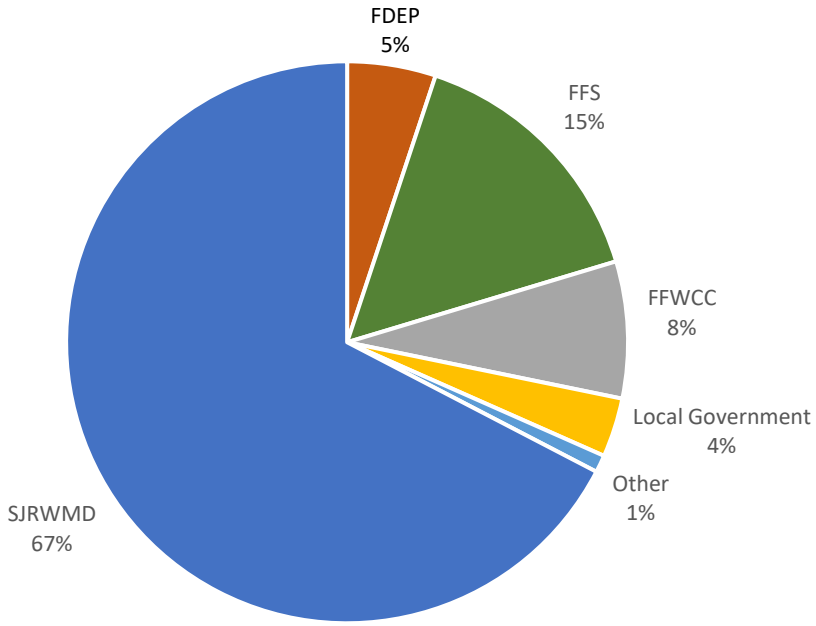


Figure 1: District Owned Land by Lead Manager.

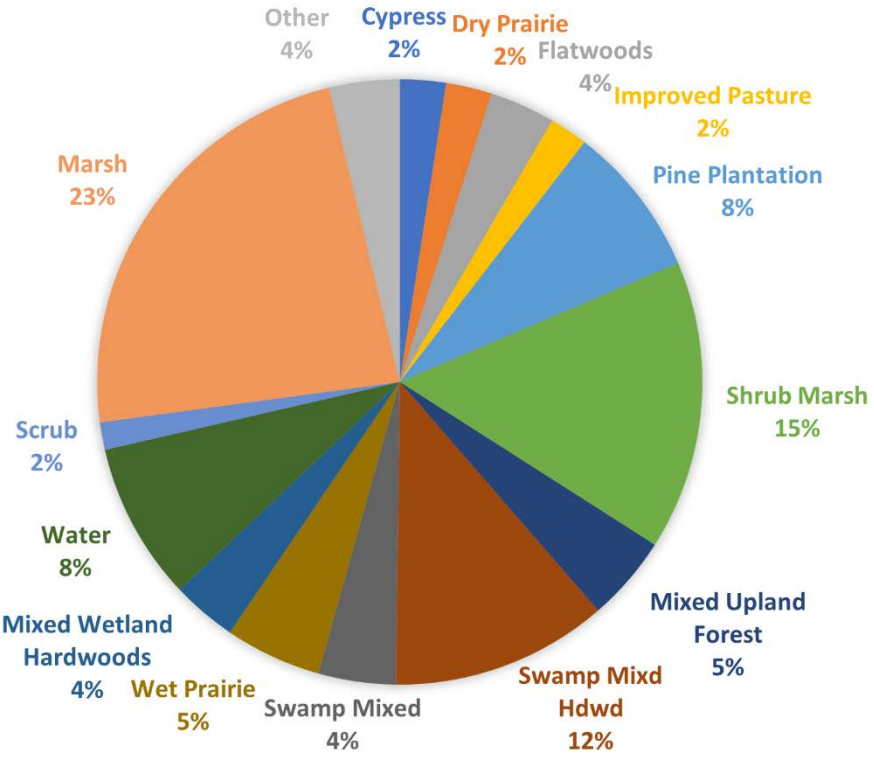


Figure 2: Percentage acres SJRWMD Managed Lands by Land Type.

Techniques of Forest Management

Inventory

The District developed a GIS Forestry database that links timber attribute information, inventory plots, and timber volume information with its spatial location. The database incorporated with annually collected inventory data will track forest changes over time. Changes resulting from harvests, wildfires, insect infestations, disease outbreaks and reforestation efforts can be updated quickly and easily. Periodic updates of volume and growth information is incorporated into the database. The database aids in determining natural community needs along with geographic distribution and appropriate management techniques to implement. The database is an intricate part in managing for community health and in developing future land management workplans.

Harvesting

To accomplish its goals the District employs a suite of harvesting systems. Clearcutting is a silvicultural operation used to remove the entire overstory at one time. This tool will be used with limited application dependent upon the specific management needs. Those needs may include:

1. Insect or disease control. Forest pests occur naturally at low population densities and are a vital part of the forested community. When population densities reach epidemic levels control measures to remove the host and adjacent trees must be implemented to protect the remainder of the stand.
2. Salvage. If the overstory has been killed or severely damaged, removing (salvaging) the overstory will recover some financial value of the timber and will allow the District access necessary to replant the site.
3. Species conversion. If offsite species exist, clearcutting enables the District to replace the offsite species with one that is appropriate.

Thinning is a silvicultural operation where selected individual trees are removed from the stand to reduce the density of overstory trees to improve growing conditions for the remaining overstory trees and the understory plants. This method is not applied with a goal of establishing regeneration.

The seed tree system is a silvicultural operation where the entire overstory except 10-15 prime trees per acre are harvested at one time. These 10-15 trees serve as the seed source for the next generation. This technique is seldom used by the District. While the seed tree system is effective, it creates major change in the stand condition both visually to the public and biologically to the plants and animals in the stand.

Shelterwood is a silvicultural operation in which the overstory is removed in phases. When it is time to regenerate the stand, approximately 60-70 percent of the stand is removed either in one or two harvests. Again, the older trees serve as the seed source for the next generation. Once the younger trees are established the original overstory trees can be removed or they can remain on site and be subject to thinning at the same time as the younger generation. The major benefit of this system is it results in a more gradual change from the mature trees to the next generation both visually to the public and biologically to the plants and animals.
A new modification of the shelterwood called an irregular shelterwood has been developed. An irregular shelterwood begins the same as shelterwood but portions of the original overstory remain on site. When the second-generation trees are thinned, a few of the first-generation trees are also thinned. To be established, both the first- and second-generation trees are reduced to 30-40 square feet of basal area to make room for the third-generation trees. Once the third-generation trees are established the site has few first-generation trees, some second-generation trees and many third-generation trees. This provides for a variety of age classes in a single stand but is much easier to apply and requires much less staff time than uneven-aged selection management.
Uneven-aged selection is a silvicultural operation in which trees, either as individuals or in small ½ acre groups are harvested from throughout the stand every five - ten years. The holes left by the removal of these trees are filled with seedlings from adjacent trees thereby creating a patchwork stand composed of trees of all ages. While this system offers the greatest distribution of age within a stand, truly an uneven aged condition which some scientists think is best for wildlife, it also requires significant staff inputs and to date appears too labor intensive to employ on a large scale.

Site Preparation

When it is necessary to establish regeneration, either naturally or artificially the District may employ one or more of the site preparation techniques described below.
Herbicide will be used when staff have determined that it is the most effective means to control the competing vegetation. Herbicides will not be used if it adversely affects the desirable understory species within the planting site. The use of herbicide is necessary when attempting to restore native trees and groundcover to improved pasture areas. Herbicide can be applied with hand sprayers, tank sprayers, or aerially from a helicopter, depending upon the species to be treated and site conditions.

Disking/Scalping these techniques are most useful when trees are being planted in improved pasture areas. Both techniques protect the seedlings from grass competition but offer no benefit to groundcover restoration.
Drum Chopping is effective at reducing competition from shrub species, especially saw palmetto. If properly applied grasses within the treatment area will survive chopping and will often benefit from the choppers' effect on the shrubs.
Bedding is a technique where a small ridge of surface soil is formed to provide an elevated planting or seedbed. It is used primarily in wet areas to improve soil drainage and aeration for seedlings. This type of site preparation technique is not utilized by the District because of the adverse effects it has on groundcover, sheetflow and thus water quality and availability. Therefore, the District's planting costs are often higher than private industry's because without bedding several plantings are often necessary to establish seedlings on wet sites.

Regeneration

Emphasis will be placed on natural regeneration to the extent practicable. In cases where species conversion is required or where no overstory exists to provide natural seed fall, planting will be necessary.
Hand planting is primarily method used by the District because it offers the following benefits:

1. Trees can be placed on the best microsites (i.e., highest ground in wet areas, areas with the least competition.)
2. Groundcover disturbance is minimized.
3. Seedlings can be randomly spaced or planted in clusters to provide a more natural appearance.

Machine planting is used primarily in old field conditions where scalping is employed and rows are suitable.

OVERALL METHODOLOGY

Forested natural communities can be lumped into three different groups with regards to forest management. These include Pine Forests, Upland Hardwoods, and Wetland Hardwood/Cypress. The management of each will differ and be described separately.

Pine Forests

Pine forests include flatwoods, plantations, sandhills and sand pine scrub. With the exception of sand pine scrub pine forests will be managed through thinning. Once the stand is established and trees have reached merchantable size (5 inches at

diameter breast height) at approximately 15-20 years of age depending on tree species and sites, thinning will begin. Stands will be thinned as necessary to maintain an overstory basal area range of 60 to 90 square feet per acre. This range promotes good growth of understory plants and provides good habitat for most wildlife using forested natural communities. In order to maintain this basal area range harvests will occur in each stand approximately every ten years, depending on growth rates of the trees. Great care will be exercised during harvesting operations to minimize disturbance of the soil and groundcover. When properly performed, harvesting actually benefits groundcover regeneration by reducing shrub species and improving growing conditions, such as an increase in light availability.

The need for regeneration will be determined by an inventory of the health, vigor and species composition for the trees in each stand. Once the conditions of the overstory trees indicate the need, a regeneration harvest will be scheduled employing the appropriate silvicultural system described previously. Emphasis will be placed on making the most seamless transition from one generation to the next. Irregular shelterwood harvests will be employed frequently in loblolly, slash and longleaf pine stands.

Emphasis will be placed on having a wide array of age classes between stands and an array of different aged trees within stands. Included in the desired array of ages will be trees and stands significantly older than those typically found on private lands.

To ensure the wide array of age classes is met, the District will separate pine stands into four different types based upon general age and condition. These four types include:

1. Regeneration (age 0 - 10) The site is occupied primarily by tree seedlings and saplings, herbs and shrubs. Competition from the trees has not yet resulted in any reduction in herb or shrub layer. This type begins at planting and continues until crown closure. Herbs, shrubs and grasses occupy 20%-80% of the ground. This type offers benefits to early successional wildlife species such as quail, rabbits, gopher tortoises, deer, turkeys and their predators.
2. Closed Canopy (age 11 - 20) Trees fully occupy the site and form a single, main canopy layer. There is little understory development due to the lack of light passing through the canopy. Where understory exists it is dominated frequently by palmetto and/or gallberry. This type benefits fewer wildlife species but does offer bear and deer good escape cover.
3. Understory (age 21 - 60) The overstory density has been reduced through thinning and the understory is beginning to reinitiate. Adequate light is again available to the forest floor. Groundcover plant species and wildlife both begin

to flourish again. Wildlife benefiting from this stand type include: deer, turkey, quail, gopher tortoises.

4. Older Forest Structure (age 60+) This stand type begins to develop a layered overstory. Trees are large, with diameters >12 inches. Snags will begin to appear and should be protected. The understory is diverse and healthy. Wildlife benefiting from this stand are fox squirrels, great horned owl, southeastern kestrel, turkeys, quail, gopher tortoises, red cockaded woodpeckers, eagles and ospreys (nesting trees).

The District will strive to keep 10-15% of its pine forests in type 1, 10-15% in type 2, 30-40% in type 3 and 40% in type 4. The present condition is shown below (Figure 3):

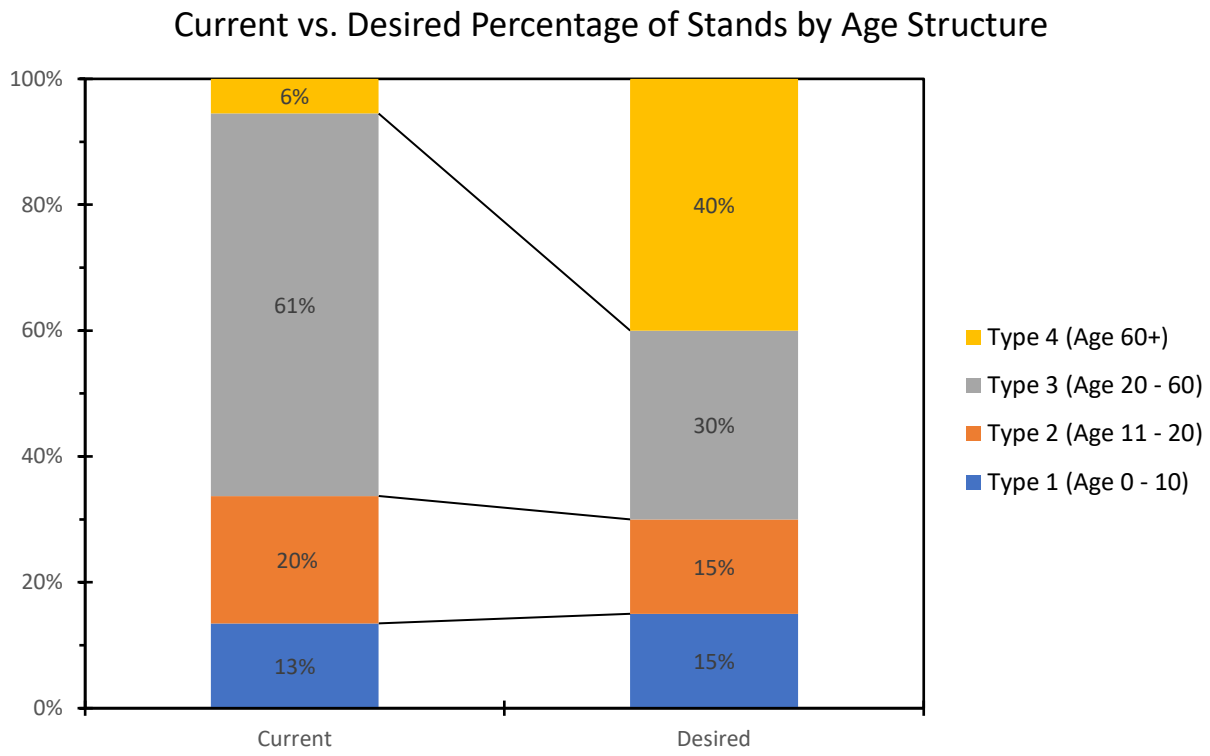


Figure 3: Current vs. Desired Percentage of Stands by Type.

Sand pine management will differ from other pine types because it is adapted to an even aged distribution. Sand pine characteristically grows in dense, even-aged, pure stands, which originated as a direct result of catastrophic fires or similar events. When a killing fire sweeps through a stand of cone-bearing trees, the serotinous cones (which remain tightly closed for many years unless opened by

heat) open and release large quantities of seeds to naturally regenerate the area. These catastrophic fires are difficult to mimic with prescribed fire since they are difficult to control. Complete stand removal (clearcutting) is the preferred method available to mimic the natures stand replacing events. The natural cycle for stand replacing events are from 20 – 60 years. Sand pine stand will therefore be clearcut and regenerated on a similar cycle.

The primary forest management activities of the District will be within these pine stands.

UPLAND HARDWOODS

Currently Upland hardwoods constitute 2% of District managed lands. Typically, they are mesic and xeric hammocks with the dominant species being live oak. There is no ecological need for harvesting within these communities and no commercial value to be derived from harvesting live oak.

Limited areas of upland hardwoods have developed on former sand hills and flatwoods due to a lack of fire or other ownership priorities prior to acquisition. These areas can be returned to their original natural community by harvesting the overstory and planting the original species appropriate to the site. Hardwood species encountered on such site include turkey oak, laurel oak, bays and sweetgum.

WETLAND HARDWOODS AND CYPRESS

As with State Forests, in an effort to protect water quality, the District has no plans to harvest timber from the swamps. However, the following may be situations where limited harvesting would offer the District benefits.

Following a catastrophic outbreak of insects, disease or wildfire harvesting the dead timber can create the growing space for the next generation. Most swamp species reproduce from both seed and sprouting. Removing the dead overstory will reduce the hazard from trees falling on people and young trees.

Twenty to 30 years following some catastrophic event the District may choose to selectively thin the hardwoods and cypress to accelerate the process of developing old-growth conditions. In a truly natural setting, the development of old-growth conditions will take 75 - 100 years since the trees compete with one another until the weaker individuals die. Through thinning, the number of trees can be reduced,

and the growth concentrated on the remaining trees so that they become larger faster and old-growth habitat can be created earlier.

The sensitivity required to log wetland systems cannot be overly stressed. Any harvesting performed in wetlands must be carried out under the most stringent conditions to avoid damage to the site. Harvesting can only be done when rutting and damage to residual trees can be minimized. Harvesting must be closely monitored and shut down if conditions deteriorate.

This plan was approved by the Governing Board in February, 2000 with charts updated January 2020

Lake Apopka North Shore

FIRE MANAGEMENT PLAN

PREPARED BY

ST. JOHNS RIVER WATER MANAGEMENT DISTRICT
BUREAU OF LAND RESOURCES

Lake Apopka North Shore
Fire Management Plan
Lake and Orange Counties, Florida

The District Fire Management Guidelines and Procedures (FMGP) provide general fire management information relative to policy, procedure, and reporting. This document provides the guidelines for the implementation of prescribed fire activities on the Lake Apopka North Shore (North Shore.)

Introduction and Objectives

The North Shore covers approximately 19,726 acres in Lake and Orange Counties and provides protection for Lake Apopka as well as the associated swamp and marsh systems. The North Shore includes several parcels located in numerous Sections of Township 20 and 21 South, Ranges 26, 27 and 28 East.

The North Shore is located in northwest Orange and southeastern Lake Counties. The property is situated north of the Florida Turnpike, southwest of US Highway 441, just west of the City of Apopka, and approximately 15 miles northwest of Orlando. Figure 1 depicts the general location of the North Shore.

Historically, fires have played a vital role in the shaping and maintenance of many of the natural communities in Florida. As such, most vegetative communities and associated wildlife are fire adapted and in many instances fire dependant. Conversely, the exclusion of fire from an area allows for successional changes within the plant community. Fire exclusion leads to the excessive accumulation of fuel loads, which increases the risk for catastrophic wildfires. The goals for the implementation of fire management activities within the North Shore include:

- Reduction of fuel loads through the application of dormant season burns to decrease potential risk of damaging wildfires
- Reintroduction of growing season burns to encourage the perpetuation of native fire adapted ground cover species
- Mitigation of smoke management issues
- Restoration and maintenance of a mosaic of plant communities and ecological diversity
- Maintenance and restoration of ecotonal areas

The achievement of these goals requires that the North Shore be partitioned into manageable burn units prior to the application of prescribed fire within those units. The following sections summarize the considerations necessary for the safe and effective use of prescribed fire as a land management tool within the North Shore.

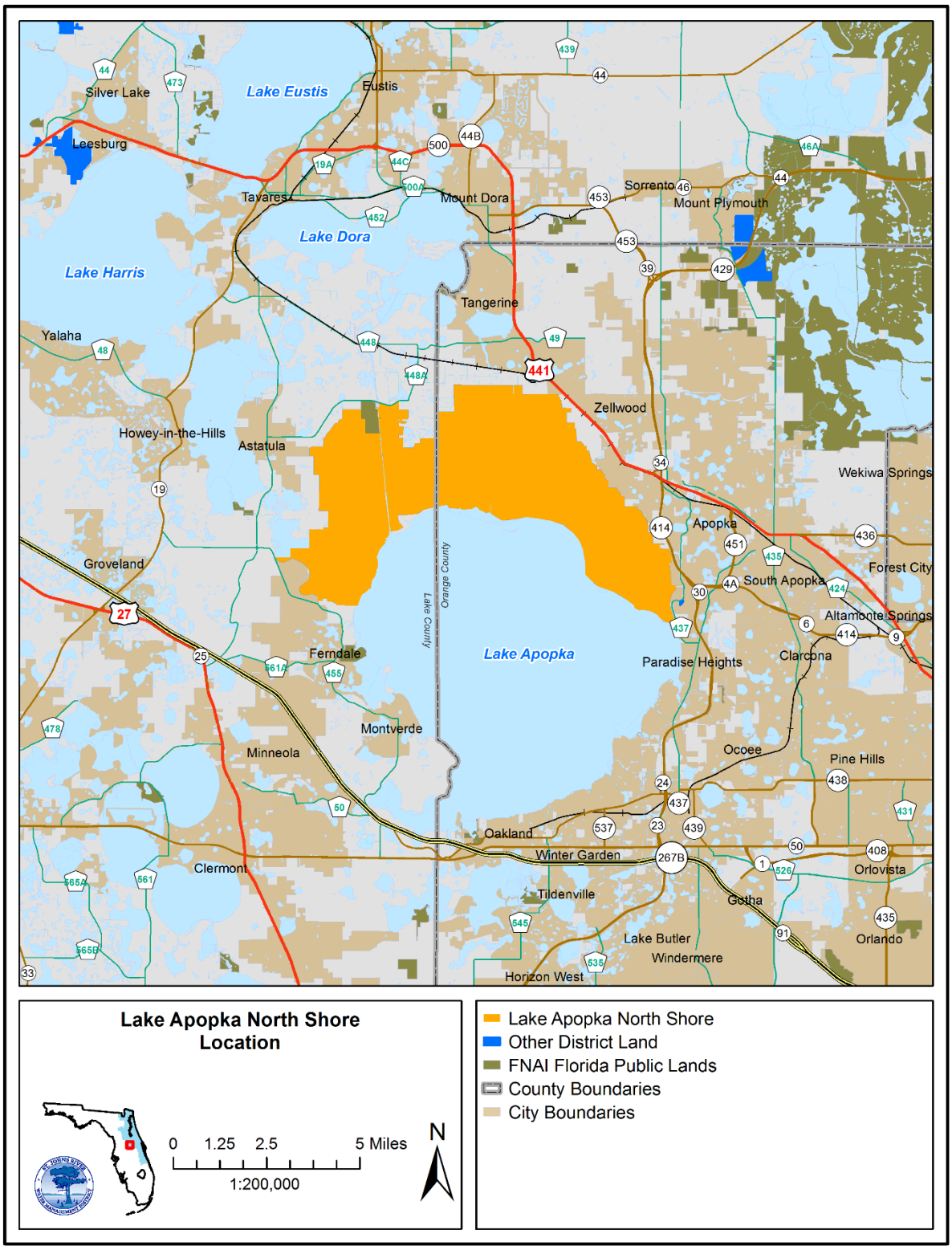


Figure 1: Location Map

Fire Return Interval

The general frequency to which fire returns to a community type under natural conditions is termed its fire return interval. Some communities require frequent pyric disturbances to perpetuate themselves while others are not fire adapted and subsequently do not require fire to maintain their characteristics. Table 1 and the following discussion of native plant communities occurring within the North Shore and optimal fire return intervals was characterized in part using information from the Florida Natural Areas Inventory's *Guide to the Natural Communities of Florida*.

Table 1.

Vegetative Community Type	Fire Return Interval
Managed marsh	Unknown; targeting 2-3 years
Wet Flatwoods	1 to 3 years
Mesic Flatwoods	2 to 4 years
Scrubby Flatwoods	5-15 years
Scrub	5-40 years
Xeric Hammock	Will burn in conjunction with surrounding areas, may require mechanical treatments prior to burning.
Pine Plantation*	2 to 4 years
Abandoned Field	2 to 4 years
Depression Marsh	Will burn in conjunction with surrounding community type.
Dome Swamp	Will burn in conjunction with surrounding community type; 3 to 5 years.
Mesic Upland - Disturbed	Will burn as often as fuels will facilitate use of fire – frequency may change as management and restoration actions are applied.
Xeric Uplands - Disturbed	Will burn as often as fuels will facilitate use of fire – frequency may change as management and restoration actions are applied.
Floodplain Swamp	This community is not fire adapted.
Successional Hardwood Forest**	This community is in an advanced successional state and will require restorative management techniques including mechanical and herbicide treatments prior to the application of prescribed fire.

*Fire return intervals in planted pine stands vary depending on species and age.
**Fire return intervals in areas of active restoration and enhancement activities may vary depending on fuel availability and duration between plantings.

The above referenced fire return intervals relate to high quality natural communities. The fire return interval within degraded systems is variable. Prescribed fire will be applied as necessary to achieve restoration and management goals.

Managed marsh is the most prevalent vegetated community coverage found within the North Shore. The historical land use for these areas was row-crop agriculture resulting in a highly disturbed system. Since the time of acquisition, restoration efforts have improved the functioning of the marsh system, however, much of this area will require a combination of mechanical and herbicide treatments prior to any application of prescribed fire. The target community for restoration activities in much of the managed marsh system is a mosaic of mixed marsh conditions. The managed marshes within the North Shore have a high incidence of encroaching shrub species such as Carolina willow, primrose willow, and other woody shrubs and trees. Additionally, many areas include a dense cover of cattail.

Wet flatwoods and scrubby (flatwoods) are prevalent fire adapted natural community types found within the North Shore. The majority of the flatwoods within the North Shore were utilized in agricultural and cattle grazing operations. As a result, much of this natural community type is highly degraded. Additionally, the midstory and groundcover species within these areas are altered. In some areas, the midstory and groundcover components are highly suppressed and exotic grasses are the primary carrier of fire. In other areas the, midstory species are heavily overgrown and combine with leaf litter, will contribute to the spread of fire. Shrub and groundcover components of the flatwoods on the western boundary of North Shore include a more diverse and abundant coverage of herbaceous and shrub components including wiregrass and saw palmetto and will contribute to the spread of fire.

Pine plantations, abandoned fields, and disturbed mesic and xeric uplands are found on the property. Historically, these areas were likely wet, mesic, scrubby flatwoods, sandhill, or scrub. These areas were cleared and pasture grasses such as Bermuda grass have long been established. Since the time of acquisition, some of these areas have been planted in longleaf and slash pine; however, a few areas remain in abandoned field condition. The Bermuda grass coverage will carry fire. It is anticipated that fire will be applied to these areas every 1 to 4 years or as frequently as can be facilitated by accumulated fuels.

Fire management within the remaining pyric plant communities will be in conjunction with the associated natural communities. These plant communities will burn as site conditions permit during the implementation of controlled burns in the adjacent plant communities. Additionally, these areas will not be excluded from fire activities unless warranted by safety or smoke management issues.

Seasonality and Type of Fire

Historically, most fires in Florida occurred in what is commonly referred to as the “growing season.” The growing season usually spans from mid March through July. Fires during the spring and early summer months generally have significant ecological benefits by perpetuating fire-adapted flora. Mimicking lightning ignited natural fires by implementing prescribed fire

during the growing season provides benefits to natural systems by controlling shrub layers and encouraging diversity in groundcover species.

Dormant season burns, conducted from mid November through the end of February, are less intense than growing season burns and are a desirable alternative when igniting fire in young pine plantations. Additionally, dormant season burns help to reduce fuel loads resulting in fewer safety and smoke management issues. Fuel loads are moderate across most of the North Shore and includes duff accumulation and muck. These fuel conditions may require that some of the initial applications of fire be in the form of dormant season burning. This will allow for the reduction of fuel loads while providing for the protection of desirable vegetation. The ultimate goal of this strategy will be to move the prescribed fire application into a growing season rotation. District staff anticipates the transition to growing season burns to occur only after a sufficient reduction of fuel levels and tree growth (in the planted areas) is achieved.

Some of the fire management units (FMUs) within the North Shore have row-based silviculture present in various stages of development. It is not the purpose of this prescribed fire program to harm existing mature pine within the North Shore and furthermore, extra caution will be taken when applying fire to a pine plantation, especially a young plantation where the height to the crown is short. Severe scorch can harm or even cause mortality in young pine trees. This type of damage will be mitigated by burning during the dormant season when the trees are not actively growing and the meristem areas are protected by a needle layer.

Prescribed fire should not be applied to a recently thinned area of pines. A period of at least one (1) growing season, post harvest will allow the residual trees adequate recovery time. The implementation of prescribed fire inside the recovery window may further stress, weaken, and potentially cause mortality on the remaining trees.

In many cases, fire management units with similar fire management needs may be burned simultaneously, either with crews igniting the areas by hand from the ground, or with the aid of aircraft. Aerial ignition allows District staff to ignite fire management units more quickly, resulting in a faster burnout. In an area with a large mosaic of unavailable fuels, fire can be applied easily to all portions of the unit. With ground based crews this sometimes is infeasible or impossible and may pose a safety issue. An aerial burn safety plan (Exhibit 1) will accompany the individual burn prescriptions and be onsite and on the ground the day of any aerial burn.

Wildfire Policy

In the event of a wildfire, if conditions permit, suppression strategies will utilize existing fuel breaks to contain the wildfire. These fuel breaks may include previously burned areas, existing roads, trails, and firelines, and wetlands and other water bodies. This is only possible, with the agreement of local fire rescue, DOF, District staff, and when all of the following conditions are met:

1) Fuels within the area have been managed
2) No extreme weather conditions are present or expected

3) There are no other wildfires that may require action
4) There are sufficient resources available to manage the fire to containment
5) The fire and the resulting smoke will not impact neighbors or smoke sensitive areas

If any of these conditions are not met, direct suppression action will be taken.

As soon as possible following a fire in which firelines are plowed, a plan for fireline rehabilitation shall be developed and implemented.

Persons discovering arson or wildfires on the North Shore should report them to the Florida Department of Agriculture and Consumer Services, Florida Forest Service (FFS), the St. Johns River Water Management District, or by dialing 911.

Post Burn Reports

Burn reports must be completed after each controlled burn or wildfire. These reports include detailed information regarding the acreage, natural communities, staff and equipment hours, and contractor hours. The timely completion of these reports is necessary for the compilation of information relative to the entire District burn program. Additionally, these reports provide a documented account of site-specific conditions, which are helpful in the planning of future burns.

Smoke Management

A significant challenge to the implementation of any prescribed burn program is smoke management. Since 2006, approximately 2,543 acres have been prescribed burned (Figure 2). Fuel accumulation (dead and live) across the property is moderate. This accumulation of fuels has the potential to produce a tremendous amount of smoke as areas are burned. As surrounding areas become increasingly urbanized, this problem will increase in magnitude, as there become fewer acceptable places to maneuver a smoke column from a prescribed fire.

While the North Shore has an acceptable smoke shed in which to place a smoke column from a prescribed fire, there are smoke sensitive areas that surround the North Shore and may affect the smoke management of each burn unit. Smoke management is a limiting factor in the application of prescribed fire with in the restoration area. Figure 3 illustrates smoke sensitive areas in relation to the restoration area. As development increases in the area, fire management will become more difficult. Increasing daily traffic on US 441, SR 44B, various surface streets and local roads will further impair the District's ability to implement prescribed burns at the appropriate fire return intervals within the restoration area.

The majority of fire dependent areas at the North Shore fall within fuel models 1,2, 3, 4, 7, 9, and 10 or a combination thereof (Figure 4). Depending on the arrangement and composition of fuels, fire spread will be through grasses, needle/leaf litter, and/or, the

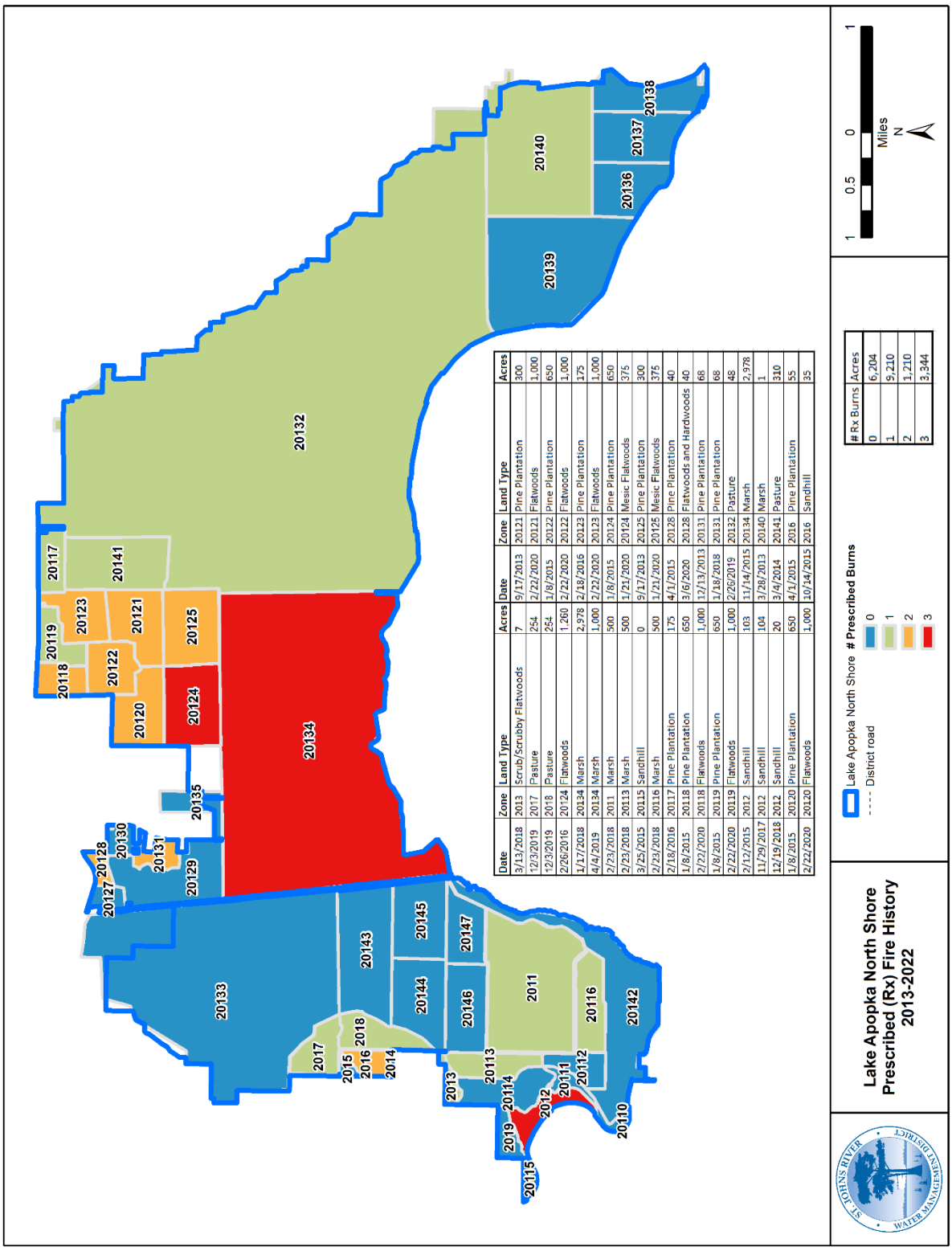


Figure 2: Fire History Map

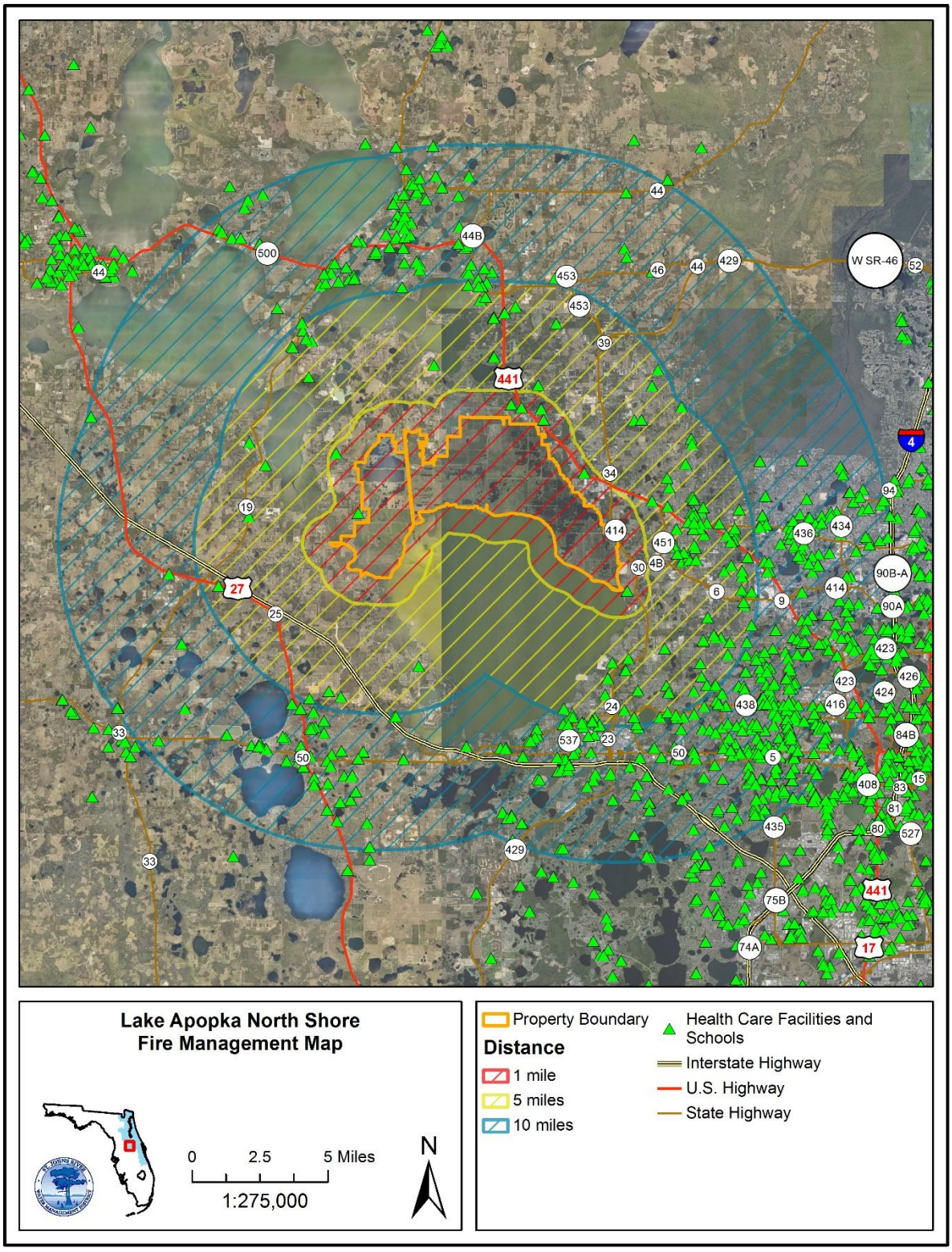


Figure 3: Fire Management Map

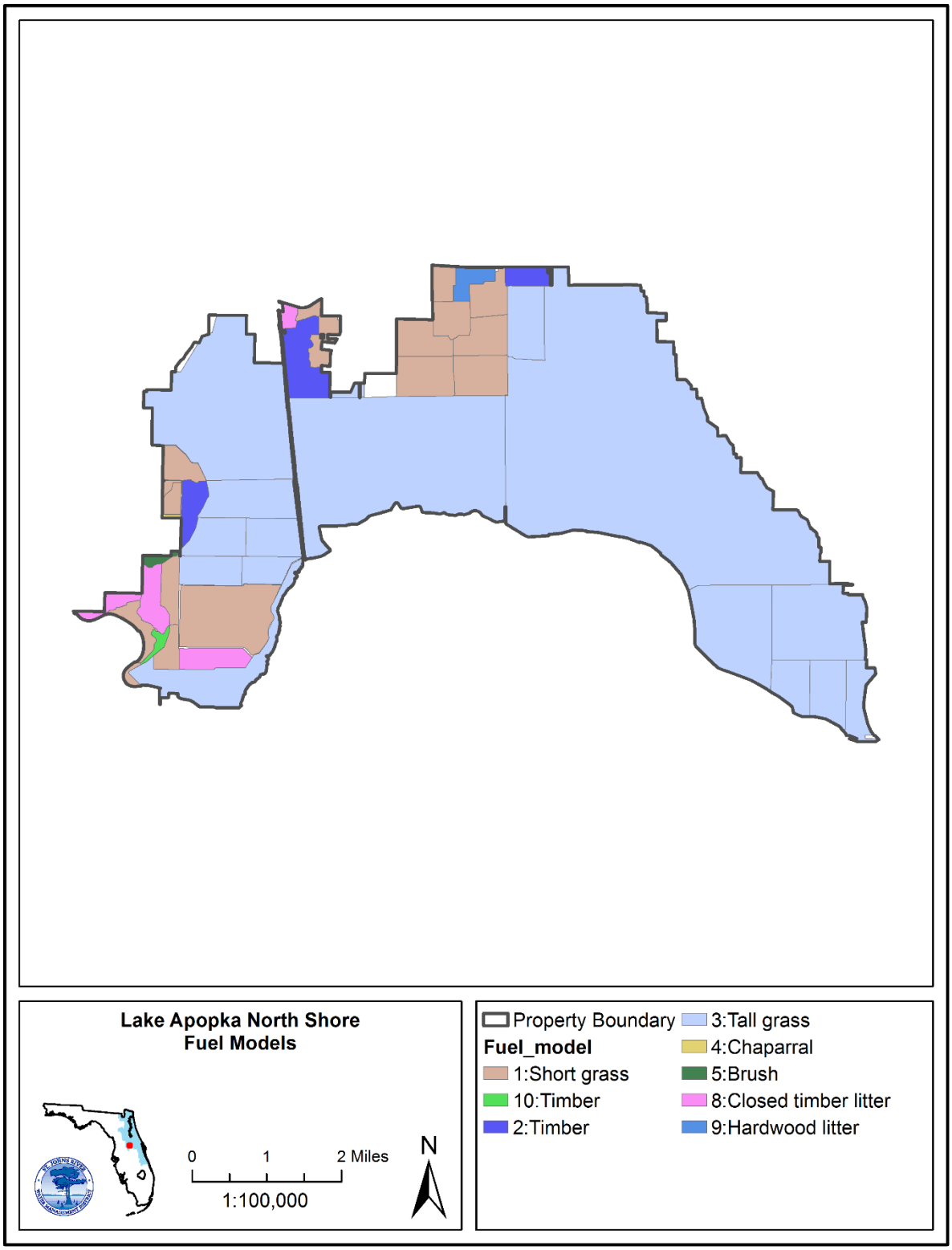


Figure 4: Fuel Models Map

shrub layer. Areas within the North Shore having heavier fuel accumulations can burn for long periods causing additional smoke management issues.

A smoke screening process will be completed with each prescription, before an authorization is obtained from the FFS. A fire weather forecast is obtained and evaluated for suitable burning conditions and smoke management objectives. A wind direction is chosen that will transport smoke away from urbanized areas and/or impact these smoke sensitive areas in the least possible way. When possible, the smoke plume from burns should be directed back through the North Shore. Smoke can then mix and loft into the atmosphere over uninhabited or rural land adequately enough to minimize off-site impacts.

On burn day, the ability of smoke to mix and disperse into the atmosphere should be good. Dispersion indices should be above 35. Dispersions of greater than 69 will only be selected if other weather and/or site conditions allow for the mitigation of potential extreme fire behavior. Forecast mixing heights should be above 1700ft. Transport winds should be at least 9 mph to effectively minimize residual smoke. Lower transport wind speeds can be utilized if dispersion index and mixing heights are above average. Burns will be conducted with a carefully plotted wind direction to limit and/or eliminate negative impacts from smoke to neighbors and urbanized areas.

Mechanical Treatments

Short and long-term weather conditions and urban interface issues are important considerations when implementing a prescribed fire program. Weather conditions such as extended droughts or insurmountable smoke management issues due to increased urbanization may require the District to manage natural systems mechanically. While not exact ecological surrogates for fire, a variety of methods including mowing, roller chopping, and herbicide applications may be incorporated as alternatives to prescribed fire.

Legal Considerations

Only burn managers certified by FFS will approve the unit prescriptions and must be on site while the burn is being conducted. Certified burn managers adhering to the requirements of F.S. 590.026 are protected from liability for damage or injury caused by fire or resulting smoke, unless negligence is proven.

Fire Management Units

Fire management units have been delineated on the North Shore. Where logical, the District used (or will use) existing timber stand boundaries to delineate fire management units. In many cases, individual timber stands represent the smallest areas of land that are free of roads, trails, or other barriers to fire. Occasionally, several fire management units with similar fire needs will be burned simultaneously and stand lines provide a break in fuels so that staff may burn smaller areas than initially planned if needed. Additionally, in an effort to mitigate smoke management

and potential urban interface issues, fire management units may be smaller in size than on other parcels or conservation areas.

Ideally, District staff would thoroughly address and describe each fire management unit in terms of its fire management needs. Though all units within the bounds of the North Shore are somewhat different, all can be categorized into one of several fuel model (FM) descriptions. The thirteen standard fuel models (as described in Hal E. Anderson's *Aids to Determining Fuel Models For Estimating Fire Behavior*) were used as a basis for this categorization. The factors considered in determining each FM are: amount, composition and arrangement of available fuels within units, predicted fire behavior within each unit (under conditions acceptable to implement a prescribed burn), and resources necessary to regain management of a fire in extenuating circumstances. District staff anticipates the change of vegetative assemblages over time due to growth and/or restoration and understand that fuel characteristics, models, and resulting fire behavior will also change.

Below is a brief description of each fuel model occurring within the North Shore and associated natural communities. A detailed description of each individual fire management unit and its associated objectives will be included in the individual prescriptions. Some fire management units within the North Shore contain multiple FMs. In these instances, the designated FM is dominant in coverage. Figure 4(above) illustrates the FM associated with individual fire management units.

Fuel Models

Fuel Model 1
This category includes fire management units within the North Shore that can best be described disturbed, former agricultural sites, some of which have been planted in pine. These areas have a broad coverage of herbaceous fuels, which is the primary carrier of tire. These fires are surface fires that move rapidly, particularly when fuels are cured.

Fuel Model 2
This category includes fire management units within the North Shore that can best be described as planted pine/pastures on former mesic flatwoods sites. Fires in these fuels are typically spread through the herbaceous layer and may include an overstory of pine and scattered oak. Given appropriate wind speeds and fuel moisture conditions, fire spread can be very rapid. The optimal fire return interval in this fuel model is approximately every 2-8 years with growing season burns being preferred.

Fuel Model 3
This category includes fire management units within the North Shore that are best described as marsh. This fuel model may display intense fires with high rates of spread under the influence of wind. The wind may drive fire into the upper heights of the grass and across standing water. Fire management units included in this fuel model may include large areas of non-pyric plant species and open water.

Fuel Model 4
This category includes fire management units within the North Shore that are best described as oak scrub. Fires in this fuel model are intense and will spread rapidly. Fire is carried through the canopy of the shrub layer and dead woody material and leaf litter may contribute to fire intensity. The optimal fire return interval in this fuel model is approximately every 5 -40years. These areas are known to include Florida Scrub-jay and sand skink populations and as such, are subject to considerations for those species.

Fuel Model 7
This category includes fire management units within the North Shore that are best described as mesic and scrubby flatwoods. This fuel model may display fires that are generally intense with fire spreading easily through both the surface and shrub layers.

Fuel Model 8
This category includes fire management units within the North Shore that are best described as Floodplain Swamp or hammocks that are hydric in nature. Fires are likely to be infrequent. When fires do occur in these areas, they will likely be slow burning with low intensity.

Fuel Model 9
This category includes fire management units that are best described as successional hardwood forests. Fires in these fuels will typically run through the surface fuels, which will mostly include leaf litter. High winds may cause high rate of spread and potential spotting problems due to blowing leaves.

Fuel Model 10
This category includes fire management units that are best described as disturbed xeric uplands. Fires in this fuel model will typically burn through the surface fuels with high intensity due to the volume of dead woody material on the forest floor.

Exhibit 1
Aerial Burn Safety Plan
Lake Apopka North Shore

The hazards associated with this type of burning are related to working with the helicopter, the sphere dispenser, and dealing with active fire. All helicopter safety procedures and all district fireline policies and procedures will be followed.

1. **BRIEFING -** During the operational briefing, the safety plan will be reviewed with all personnel on the burn.
2. **HELICOPTER SAFETY -** The pilot will give a helicopter safety briefing at the morning operational briefing.
3. **IGNITION MACHINE SAFETY –** The operator will review the operation and cleaning procedures for the dispenser at the morning briefing.
4. **PERSONAL PROTECTIVE EQUIPMENT –** The incident commander will ensure that all personnel have the required PPE.
5. **HIGH HAZARD AREAS –** All high hazard areas such as power lines shall be designated on the map and attached to the burn plan.
6. **EMERGENCY LANDING ZONES –** These should be confirmed with the pilot and indicated on the burn map. **Helispot** **Latitude** _____**"N**
   Longitude _____**"W**

Crash Rescue Plan

In the event of an accident involving the helicopter, the following procedures will be followed.

INCIDENT COMMANDER or BURN BOSS

1. **Notify 911**
2. Notify Lake County Sheriff's Office (352) 343-2101
3. Notify Orange County Sheriff's Office (407) 254-7000
4. Notify Lake County Fire Rescue (352) 343-9548
5. Notify Orange County Fire Rescue (407) 836-9000
6. Assume responsibility of the Rescue Operation.
7. Notify NTSB (305)957-4610 OR 404-462-1666)
8. Delegate responsibility of fire control to the second in command or the most qualified.

SECOND IN COMMAND

1. Assume responsibility of the burn.
2. Assist the IC or Burn Boss with resource and personnel needs for the rescue operation.
3. If the IC is in the helicopter, second in command will assume rescue operation responsibilities and assign the most qualified to fire control.

Level I Trauma Center

1. Shands Gainesville – 352-265-0111
2. ORMC 321-841-6582

DIVISION OF FORESTRY

1. Withlacoochee Dispatch 352-754-6777
2. Orlando Dispatch 407-856-6514

NTSB

1. Southeast Regional Office **305-957-4610**
2. Southeast Field Office **404-462-1666**

PLANTS

Scientific Name	Common Name	USFWS	FWC	FNAI	Source
Abutilon theophrasti	Velvetleaf				SJR
Acalypha gracilens	Slender Threeseed Mercury				iNat
Acalypha rhomboidea	Diamond Threeseed Mercury				SJR
Acer rubrum	Red Maple				SJR, iNat
Acrostichum danaeifolium	Giant leather fern				iNat
Alocasia odora	Taro				SJR
Alternanthera philoxeroides	Alligatorweed				SJR, iNat
Amaranthus australis	Southern Amaranth				iNat
Amaranthus hybridus	Slim Amaranth				SJR
Ambrosia artemisiifolia	Common Ragweed				SJR, iNat
Ammannia coccinea	Valley Redstem				SJR
Amorpha fruticosa	False Indigobush				SJR
Ampelaster carolinianus	Climbing Aster				iNat
Ampelopsis arborea	Peppervine				SJR
Andropogon glomeratus	Bushy Bluestem				SJR
Andropogon tenuispatheus	Maritime Bluestem				iNat
Annona glabra	Pond Apple				SJR
Araujia odorata	Latexplant				iNat
Ardisia crenata	Scratchthroat				SJR
Argemone albiflora	Bluestem Prickly Poppy				SJR
Argemone mexicana	Mexican Prickly Poppy				SJR, iNat
Arisaema dracontium	Greendragon				SJR
Arisaema triphyllum	Jack-In-The-Pulpit				SJR
Aristida stricta	Wiregrass				SJR
Asclepias curassavica	Tropical Milkweed				iNat
Asclepias tuberosa	Butterflyweed				SJR
Azolla caroliniana	Carolina Mosquito Fern				SJR
Azolla filiculoides	Water Fern				iNat
Baccharis halimifolia	Groundsel Tree				SJR, iNat
Bacopa monnieri	Herb-Of-Grace				SJR, iNat
Berlandiera subacaulis	Florida Greeneyes				SJR
Bidens alba	White Beggarticks				iNat
Bidens alba radiata	Romerillo				SJR
Bidens bipinnata	Spanish Needles				SJR, iNat
Bidens laevis	Smooth Beggartick				SJR, iNat
Bidens mitis	Smallfruit Beggarticks				iNat
Bidens trichosperma	Marsh Tickseed				iNat
Boehmeria nivea	Ramie				SJR
Boltonia diffusa	Smallhead Doll's Daisy				iNat
Bonamia grandiflora	Florida Bonamia	T		S3/G3	SJR
Brassica juncea	Brown Mustard				SJR
Brassica rapa	Field Mustard				iNat
Callicarpa americana	American Beautyberry				SJR, iNat
Calyptocarpus vialis	Straggler Daisy				iNat
Calystegia sepium	Hedge Bindweed				iNat
Canna flaccida	Golden Canna				SJR, iNat
Capsella bursa-pastoris	Shepherd's-Purse				iNat

Carex longii	Green-and-White Sedge				iNat
Carex stipata maxima	Great Fox Sedge				iNat
Carphephorus corymbosus	Florida Paintbrush				SJR
Carya glabra	Pignut Hickory				SJR
Celtis laevigata	Sugar Hackberry				iNat
Celtis occidentalis	Hackberry				SJR
Cenchrus purpureus	Napier Grass				iNat
Cephalanthus occidentalis	Common Buttonbush				SJR, iNat
Ceratophyllum demersum	Coontail				iNat
Chenopodium album	Lamb's-Quarters				SJR
Chionanthus pygmaeus	Pigmy Fringetree	E		S2S3/G2G3	SJR
Chloris gayana	Rhodes Grass				iNat
Christella dentata	Soft Fern				iNat
Cicuta maculata	Spotted Water Hemlock				SJR, iNat
Cinnamomum camphora	Camphortree				SJR
Cirsium horridulum	Bristle Thistle				iNat
Cirsium nuttallii	Nuttall's Thistle				SJR, iNat
Cladium jamaicense	Jamaica Swamp Sawgrass				SJR
Clematis reticulata	Netleaf Leather-Flower				SJR
Clerodendrum indicum	Turk's Turban				iNat
Colocasia esculenta	Taro				iNat
Commelina communis	Asiatic Dayflower				SJR
Commelina diffusa	Common Dayflower				SJR, iNat
Conyza canadensis	Canadian Horsweed				SJR
Cornus foemina	Stiff Dogwood				SJR, iNat
Crinum americanum	Florida Swamp-lily				SJR, iNat
Crotalaria pallida	Smooth Rattlebox				SJR
Crotalaria spectabilis	Showy Rattlebox				iNat
Croton glandulosus	Tropic Croton				iNat
Cyclosorus interruptus	Swamp Shield-fern				iNat
Cyclospermum leptophyllum	Marsh Parsley				iNat
Cyperus blepharoleptos	Cuban Bulrush				iNat
Cyperus distinctus	Swamp Flatsedge				iNat
Cyperus odoratus	Fragrant Flatsedge				SJR, iNat
Cyperus rotundus	Purple Nutsedge				iNat
Cyperus surinamensis	Tropical Flatsedge				iNat
Dactyloctenium aegyptium	Durban Crowfoot				iNat
Dalea pinnata	Summer Farewell				SJR
Descurainia pinnata	Western Tansymustard				iNat
Desmodium incanum	Creeping Beggarweed				iNat
Dioscorea bulbifera	Air Potato				iNat
Diospyros virginiana	Common Persimmon				SJR, iNat
Echinochloa crusgalli	Barnyardgrass				SJR
Echinochloa walteri	Walter's barnyard grass				iNat
Eclipta prostrata	False Daisy				iNat
Emilia fosbergii	Red Tasselflower				iNat
Emilia praetermissa	Pale Tasselflower				iNat
Emilia sonchifolia	lilac tasselflower				iNat
Epipremnum aureum	Golden Pothos				iNat

Erechtites hieraciifolius	American burnweed				iNat
Eulophia graminea	Chinese Crown Orchid				iNat
Eulophia maculata	Monk Orchid				iNat
Eupatorium capillifolium	Dogfennel				SJR, iNat
Eupatorium serotinum	Late Boneset				iNat
Euphorbia cyathophora	Painted Leaf				iNat
Euphorbia heterophylla	Painted Spurge				iNat
Euphorbia hirta	Asthma plant				iNat
Euphorbia hypericifolia	Graceful Spurge				iNat
Euphorbia maculata	Spotted Spurge				iNat
Euphorbia prostrata	Prostrate Sandmat				iNat
Euthamia graminifolia	Flattop Goldenrod				SJR
Flaveria linearis	Narrowleaf Yellowtops				SJR
Fraxinus caroliniana	Pop Ash				SJR
Fumaria officinalis	Drug Fumitory				SJR
Galactia volubilis	Downy Milkpea				SJR
Galium aparine	Catchweed Bedstraw				iNat
Galium tinctorium	Stiff Marsh Bedstraw				SJR, iNat
Gamochaeta purpurea	Purple Cudweed				iNat
Garberia heterophylla	Garberia				SJR
Geranium carolinianum	Carolina Crane's-Bill				iNat
Gordonia lasianthus	Loblolly Bay				iNat
Habenaria repens	Waterspider Bog Orchid				SJR, iNat
Hamelia patens	Firebush				iNat
Hibiscus coccineus	Scarlet Rosemallow				SJR, iNat
Hydrilla verticillata	Hydrilla				iNat
Hydrocotyle bonariensis	Largeleaf Pennywort				iNat
Hydrocotyle ranunculoides	Floating Marshpennywort				SJR, iNat
Hydrocotyle umbellata	Manyflower Marshpennywort				SJR, iNat
Hydrolea corymbosa	Skyflower				iNat
Hypericum hypericoides	St. Andrew's cross				iNat
Hypericum reductum	Atlantic St.John's-Wort				SJR
Hyptis mutabilis	Tropical Bushmint				iNat
Ilex ambigua	Carolina Holly				SJR
Ilex cassine	Dahoon				SJR
Imperata cylindrica	Cogongrass				SJR, iNat
Indigofera hirsuta	Hairy Indigo				SJR, iNat
Indigofera spicata	Creeping Indigo				iNat
Ipomoea alba	Moonflower				iNat
Ipomoea cordatotriloba	Tievine				iNat
Ipomoea triloba	Littlebell				iNat
Juncus effusus solutus	Soft Rush				SJR
Kallstroemia maxima	Big caltrop				iNat
Kosteletzkya pentacarpos	Saltmarsh mallow				iNat
Lactuca graminifolia	Grass-Leaf Lettuce				iNat
Lamium amplexicaule	Henbit Deadnettle				iNat
Lantana strigocamara	Lantana				iNat
Lantana camara	West Indian Lantana				SJR, iNat
Lechea cernua	Nodding Pinweed	N		S3/G3	SJR

Lechea deckertii	Deckert's Pinweed				SJR
Lepidium virginicum	Virginia Pepperweed				iNat
Limnobium spongia	American Frogbit				SJR, iNat
Linaria floridana	Apalachicola Toadflax				SJR
Lindernia dubia	Moistbank Pimpernel				iNat
Liquidambar styraciflua	Sweetgum				SJR, iNat
Lobelia cardinalis	Cardinal Flower				iNat
Lonicera sempervirens	Coral Honeysuckle				iNat
Ludwigia leptocarpa	Anglestem Primrosewillow				SJR, iNat
Ludwigia octovalvis	Mexican Primrosewillow				SJR, iNat
Ludwigia peruviana	Peruvian Primrosewillow				SJR, iNat
Lupinus diffusus	Skyblue Lupine				SJR
Lygodium microphyllum	Climbing Maidenhair				iNat
Macroptilium lathyroides	Phasey Bean				iNat
Macrothelypteris torresiana	Mariana Maiden Fern				iNat
Magnolia virginiana	Sweetbay				SJR
Mecardonia procumbens	Baby Jumpup				iNat
Medicago lupulina	Black Medick				iNat
Megathyrsus maximus	Guinea Grass				iNat
Melanthera nivea	Snow Squarestem				iNat
Melilotus albus	White Sweetclover				iNat
Melilotus indicus	Small Melilot				iNat
Melinis repens	Natal Grass				iNat
Melothria pendula	Creeping Cucumber				iNat
Mikania scandens	Climbing Hempvine				iNat
Mitreola petiolata	Lax Hornpod				iNat
Modiola caroliniana	Carolina Bristlemallow				iNat
Momordica charantia	Bitter Melon				iNat
Monarda punctata	Spotted Beebalm				SJR
Morella cerifera	Wax Myrtle				iNat
Morus rubra	Red Mulberry				SJR
Myrica cerifera	Southern Wax Myrtle				SJR
Najas filifolia	Narrowlead Naiad	UR		S2/G3	SJR
Najas guadalupensis	Southern Naiad				SJR
Nekemias arborea	Peppervine				iNat
Nelumbo lutea	American lotus				iNat
Nephrolepis cordifolia	Fishbone Fern				iNat
Nolina brittoniana	Britton's Beargrass	E		S3/G3	SJR
Nuphar advena	Spatterdock				iNat
Nuttallanthus canadensis	Blue Toadflax				iNat
Nymphaea mexicana	Yellow Waterlily				iNat
Nymphaea odorata	American white waterlily				iNat
Oenothera laciniata	Cutleaf Evening Primrose				iNat
Oplismenus hirtellus	Basket Grass				iNat
Opuntia humifusa	Pricklypear				SJR
Osmunda spectabilis	American Royal Fern				iNat
Oxalis corniculata	Creeping Woodsorrel				iNat
Oxalis debilis	Largeflower pink-sorrel				iNat
Packera glabella	Butterweed				SJR, iNat

Paederia foetida	Skunk Vine				iNat
Palafoxia feayi	Feay's Palafox				SJR
Parthenocissus quinquefolia	Virginia creeper				iNat
Paspalum notatum	Bahiagrass				SJR
Paspalum urvillei	Vasey Grass				iNat
Passiflora incarnata	Purple Passionflower				iNat
Pectis prostrata	Spreading Chinchweed				iNat
Persicaria hydropiperoides	Swamp Smartweed				iNat
Phlebodium aureum	Golden Polypody				iNat
Phoebanthus grandiflorus	Florida False Sunflower				SJR
Phragmites australis	Common Reed				iNat
Phyla nodiflora	Turkey Tangle Frogfruit				iNat
Phytolacca americana	Maritime Pokeweed				iNat
Pinus clausa	Sand Pine				SJR
Pinus elliottii	Slash Pine				SJR, iNat
Pinus palustris	Longleaf Pine				SJR
Pistia stratiotes	Water Lettuce				iNat
Pityopsis oligantha	Grassleaf Goldenaster				SJR
Pleopeltis michauxiana	Resurrection Fern				iNat
Pluchea foetida	Stinking Camphorweed				iNat
Pluchea odorata	Marsh Fleabane				iNat
Plumbago zeylanica	Wild Leadwort				iNat
Polanisia tenuifolia	Slenderleaf Clammyweed				SJR
Polypremum procumbens	Rust Weed				iNat
Pontederia cordata	Pickerelweed				SJR, iNat
Pontederia crassipes	Common Water Hyacinth				iNat
Portulaca oleracea	Common Purslane				iNat
Portulaca pilosa	Shaggy Portulaca				iNat
Prunus caroliniana	Carolina Laurelcherry				iNat
Prunus geniculata	Scrub Plum	E		S3/G3	SJR
Prunus umbellata	Flatwoods Plum				SJR
Psychotria tenuifolia	Velvet-leafed Wild Coffee				iNat
Pteridium aquilinum latiusculum	Eastern Bracken				SJR
Pteris vittata	Ladder Fern				iNat
Ptilimnium capillaceum	Herbwilliam				iNat
Quercus chapmanii	Chapman's Oak				SJR
Quercus geminata	Sand Live Oak				SJR
Quercus laurifolia	Laurel Oak				SJR
Quercus myrtifolia	Myrtle Oak				SJR
Quercus nigra	Water Oak				SJR
Quercus virginiana	Southern Live Oak				SJR, iNat
Rhamphospermum arvense	Charlock				iNat
Rhus copallinum	Shining Sumac				SJR, iNat
Richardia grandiflora	Largeflower Mexican Clover				iNat
Ricinus communis	Castorbean				SJR, iNat
Rivina humilis	Pigeonberry				iNat
Ruellia blechum	Browne's Blechum				iNat
Rumex hastatulus	Heartwing Dock Sorrel				SJR

Rumex pulcher	Fiddle Dock				SJR
Sabal palmetto	Cabbage Palm				SJR, iNat
Sagittaria lancifolia	Lanceleaf Arrowhead				iNat
Sagittaria latifolia	Broadleaf Arrowhead				SJR, iNat
Salix caroliniana	Coastalplain Willow				SJR, iNat
Salvia coccinea	Tropical sage				iNat
Salvia lyrata	Lyreleaf Sage				iNat
Salvia misella	River Sage				iNat
Salvinia minima	Water Spangles				iNat
Sambucus nigra canadensis	Elderberry				SJR, iNat
Sapium sebiferum	Popcorntree				SJR
Saururus cernuus	Lizard's Tail				iNat
Schinus terebinthifolia	Brazilian Pepper				iNat
Schoenoplectus californicus	Giant Bulrush				iNat
Scoparia dulcis	Licorice Weed				iNat
Scoparia montevidensis	Broomwort				iNat
Selaginella arenicola	Sand Spike-Moss				SJR
Senna obtusifolia	American Sicklepod				iNat
Serenoa repens	Saw Palmetto				SJR
Sesbania herbacea	Bigpod Sesbania				iNat
Sesbania vesicaria	Bladder Pod				iNat
Setaria magna	Giant Bristlegrass				iNat
Setaria parviflora	Knotroot Bristlegrass				iNat
Sida rhombifolia	Cuban Jute				iNat
Sida ulmifolia	Common Fanpetals				iNat
Sideroxylon alachuense	Silver Buckthorn	N		S1/G1	SJR
Smilax bona-nox	Saw Greenbrier				SJR, iNat
Solanum americanum	American Black Nightshade				SJR
Solanum capsicoides	Cockroach Berry				iNat
Solanum viarum	Tropical Soda Apple				SJR, iNat
Sonchus asper	Prickly Sowthistle				iNat
Sorghum halepense	Johnsongrass				SJR
Spartina bakeri	Sand Cordgrass				SJR
Spermacoce remota	Woodland False Buttonweed				iNat
Spermacoce verticillata	Shrubby False Buttonweed				iNat
Sphagneticola trilobata	Trailing Daisy				iNat
Stachys floridana	Florida Hedgenettle				iNat
Symphyotrichum elliottii	Elliott's Aster				iNat
Symphyotrichum simmondsii	Simmonds' Aster				iNat
Taxodium ascendens	Pond Cypress				iNat
Taxodium distichum	Bald-Cypress				SJR, iNat
Thalia geniculata	Alligator Flag				iNat
Thlaspi arvense	Field Penny-cress				iNat
Tillandsia bartramii	Bartram's airplant				iNat
Tillandsia recurvata	Ballmoss				iNat
Tillandsia usneoides	Spanish Moss				iNat
Torenia crustacea	Brittle False Pimpernel				iNat
Toxicodendron pubescens	Atlantic Poison Oak				SJR
Tradescantia ohiensis	Bluejacket				iNat

Triadica sebifera	Chinese Tallow				iNat
Trichostema dichotomum	Forked Bluecurls				SJR, iNat
Tridax procumbens	Tridax daisy				iNat
Trifolium repens	White Clover				iNat
Typha domingensis	Southern Cattail				SJR
Typha latifolia	Broadleaf Cattail				SJR, iNat
Ulmus americana	American Elm				SJR, iNat
Ulmus parvifolia	Chinese elm				iNat
Urena lobata	Caesarweed				SJR, iNat
Utricularia foliosa	Leafy Bladderwort				iNat
Utricularia gibba	Humped Bladderwort				iNat
Vaccinium myrsinites	Shiny Blueberry				SJR
Vaccinium stamineum	Deerberry				SJR
Verbena brasiliensis	Brazilian Vervain				iNat
Verbesina virginica	Frostweed				iNat
Vernonia gigantea	Tall Ironweed				iNat
Vicia acutifolia	Fourleaf Vetch				iNat
Vigna luteola	Wild Cowpea				iNat
Vitis cinerea floridana	Florida grape				iNat
Vitis rotundifolia	Muscadine				SJR
Vittaria lineata	Shoestring Fern				iNat
Warea amplexifolia	Clasping Warea	E		S1/G1	SJR
Wolffiella gladiata	Florida Mudmidget				iNat
Youngia japonica	Oriental False Hawksbeard				iNat
AMPHIBIANS					
Scientific Name	**Common Name**	**USFWS**	**FWC**	**FNAI**	**Source**
Acris gryllus dorsalis	Florida Cricket Frog				SJR
Amphiuma means	two-toed amphiuma				SJR
Anaxyrus quercicus	Oak Toad				SJR
Anaxyrus terrestris	Southern Toad				SJR, iNat
Eleutherodactylus planirostris	Greenhouse Frog				SJR
Gastrophryne carolinensis	Eastern Narrowmouth Toad				SJR
Hyla cinerea	Green Treefrog				SJR, iNat
Hyla femoralis	Pinewoods Treefrog				SJR
Hyla gratiosa	Barking Treefrog				SJR
Hyla squirella	Squirrel Treefrog				SJR, iNat
Lithobates capito	Gopher Frog	UR	N	S3/G2G3	SJR
Lithobates catesbeianus	Bullfrog				SJR
Lithobates clamitans clamitans	Bronze Frog				SJR
Lithobates grylio	Pig Frog				SJR, iNat
Lithobates sphenocephalus	Southern Leopard Frog				iNat
Notophthalmus viridescens	Eastern Newt				SJR
Osteopilus septentrionalis	Cuban Treefrog				SJR
Pseudacris crucifer	Spring Peeper				SJR
Pseudacris nigrita	Southern Chorus Frog				SJR
Pseudacris ocularis	Little Grass Frog				SJR
Siren	Sirens				iNat
Siren lacertina	Greater Siren				SJR, iNat

BIRDS

Scientific Name	Common Name	USFWS	FWC	FNAI	Source
Accipiter cooperii	Cooper's Hawk				SJR, iNat, eBird
Accipiter striatus	Sharp-shinned Hawk				SJR, iNat, eBird
Acridotheres tristis	Common Myna				SJR, eBird
Actitis macularius	Spotted Sandpiper				SJR, iNat
Aegolius acadicus	Northern Saw-whet Owl				SJR
Agelaius phoeniceus	Red-winged Blackbird				SJR, iNat
Aix sponsa	Wood Duck				SJR, iNat
Alopochen aegyptiaca	Egyptian Goose				SJR, eBird
Ammodramus leconteii	Leconte's Sparrow				SJR, eBird
Ammodramus savannarum	Grasshopper Sparrow				SJR, iNat
Ammospiza nelsoni	Nelson's Sparrow				SJR, eBird
Anas acuta	Northern Pintail				SJR
Anas bahamensis	White-cheeked Pintail				SJR, eBird
Anas crecca	Green-winged Teal				SJR, iNat
Anas fulvigula	Mottled Duck				SJR, iNat, eBird
Anas platyrhynchos	Mallard				SJR, iNat, eBird
Anas rubripes	American Black Duck				SJR, eBird
Anhinga anhinga	Anhinga				SJR, iNat, eBird
Anous stolidus	Brown Noddy	N	N	S1/G5	SJR, eBird
Anser albifrons	Greater White-fronted Goose				SJR, eBird
Anser anser	Graylag Goose				eBird
Anser caerulescens	Snow Goose				SJR, iNat, eBird
Anser cygnoides	Swan Goose				eBird
Anser rossii	Ross's Goose				SJR, eBird
Anthus rubescens	American Pipit				SJR, eBird
Antigone canadensis	Sandhill Crane				SJR, iNat, eBird
Antigone canadensis pratensis	Florida Sandhill Crane	N	ST	S2/G5T2	iNat, eBird
Antrostomus carolinensis	Chuck-will's-widow				SJR, iNat, eBird
Antrostomus vociferus	Eastern Whip-poor-will				SJR, eBird
Aphelocoma coerulescens	Florida Scrub Jay	T	FT	S1S2/G1G2	SJR, eBird
Aquila chrysaetos	Golden Eagle				SJR, eBird
Aramus guarauna	Limpkin	N	N	S3/G5	SJR, iNat, eBird
Archilochus alexandri	Black-chinned Hummingbird				SJR, eBird
Archilochus colubris	Ruby-throated Hummingbird				SJR, iNat, eBird
Ardea alba	Great Egret				SJR, iNat, eBird
Ardea herodias	Great Blue Heron				SJR, iNat, eBird
Ardenna grisea	Sooty Shearwater				SJR, eBird
Arenaria interpres	Ruddy Turnstone				SJR, eBird
Asio flammeus	Short-eared Owl				SJR, eBird
Asio otus	Long-eared Owl				SJR
Athene cunicularia	Burrowing Owl		SSC	S3	SJR, eBird
Aythya affinis	Lesser Scaup				SJR, iNat, eBird
Aythya americana	Redhead				SJR, eBird
Aythya collaris	Ring-necked Duck				SJR, iNat, eBird
Aythya marila	Greater Scaup				SJR, iNat, eBird
Aythya valisineria	Canvasback				SJR, iNat, eBird
Baeolophus bicolor	Tufted Titmouse				SJR, eBird

Bartramia longicauda	Upland Sandpiper				SJR, eBird
Bombycilla cedrorum	Cedar Waxwing				SJR, iNat, eBird
Botaurus lentiginosus	American Bittern				SJR, eBird
Branta bernicla	Brant				SJR, eBird
Branta canadensis	Canada Goose				SJR, eBird
Bubo virginianus	Great Horned Owl				SJR, iNat, eBird
Bubulcus ibis	Western Cattle Egret				SJR, iNat, eBird
Bucephala albeola	Bufflehead				SJR, iNat, eBird
Bucephala clangula	Common Goldeneye				SJR, eBird
Buteo brachyurus	Short-tailed Hawk	N	N	S1/G4G5	SJR, eBird
Buteo jamaicensis	Red-tailed Hawk				SJR, eBird
Buteo lagopus	Rough-legged Hawk				SJR, eBird
Buteo lineatus	Red-shouldered Hawk				SJR, iNat, eBird
Buteo platypterus	Broad-winged Hawk				SJR, eBird
Buteo regalis	Ferruginous Hawk				SJR, eBird
Buteo swainsoni	Swainson's Hawk				SJR, eBird
Butorides virescens	Green Heron				SJR, iNat, eBird
Cairina moschata	Muscovy Duck				SJR, eBird
Calamospiza melanocorys	Lark Bunting				SJR
Calcarius lapponicus	Lapland Longspur				SJR, eBird
Calidris acuminata	Sharp-tailed Sandpiper				SJR, eBird
Calidris alba	Sanderling				SJR, eBird
Calidris alpina	Dunlin				SJR, eBird
Calidris bairdii	Baird's Sandpiper				SJR, eBird
Calidris canutus	Red Knot				SJR, eBird
Calidris ferruginea	Curlew Sandpiper				SJR, eBird
Calidris fuscicollis	White-rumped Sandpiper				SJR, eBird
Calidris himantopus	Stilt Sandpiper				SJR, eBird
Calidris mauri	Western Sandpiper				SJR, eBird
Calidris melanotos	Pectoral Sandpiper				SJR, iNat, eBird
Calidris minutilla	Least Sandpiper				SJR, iNat, eBird
Calidris pugnax	Ruff				SJR, eBird
Calidris pusilla	Semipalmated Sandpiper				SJR, iNat, eBird
Calidris subruficollis	Buff-breasted Sandpiper				SJR, eBird
Caracara plancus	Crested Caracara	T	FT	S2/G5	SJR, eBird
Cardellina canadensis	Canada Warbler				SJR, eBird
Cardellina pusilla	Wilson's Warbler				SJR, iNat, eBird
Cardinalis cardinalis	Northern Cardinal				SJR, eBird
Cathartes aura	Turkey Vulture				SJR, iNat, eBird
Catharus bicknelli	Bicknell's Thrush				SJR
Catharus fuscescens	Veery				SJR, eBird
Catharus guttatus	Hermit Thrush				SJR, iNat, eBird
Catharus minimus	Gray-cheeked Thrush				SJR, eBird
Catharus ustulatus	Swainson's Thrush				SJR, eBird
Centronyx henslowii	Henslow's Sparrow				SJR, eBird
Chaetura pelagica	Chimney Swift				SJR, eBird
Charadrius melodus	Piping Plover	T	FT	S2/G3	SJR, eBird
Charadrius semipalmatus	Semipalmated Plover				SJR, eBird
Charadrius vociferus	Killdeer				SJR, iNat, eBird

Charadrius wilsonia	Wilson's Plover	N	N	S2/G5	SJR, eBird
Chlidonias niger	Black Tern				SJR, iNat, eBird
Chondestes grammacus	Lark Sparrow				SJR, eBird
Chordeiles acutipennis	Lesser Nighthawk				SJR, eBird
Chordeiles minor	Common Nighthawk				SJR, eBird
Chroicocephalus philadelphia	Bonaparte's Gull				SJR, eBird
Circus hudsonius	Northern Harrier				SJR, iNat
Cistothorus palustris	Marsh Wren				SJR, iNat, eBird
Cistothorus stellaris	Sedge Wren				SJR, iNat, eBird
Clangula hyemalis	Long-tailed Duck				SJR, eBird
Coccyzus americanus	Yellow-billed Cuckoo				SJR, iNat, eBird
Coccyzus erythropthalmus	Black-billed Cuckoo				SJR, eBird
Colaptes auratus	Northern Flicker				SJR, iNat, eBird
Colinus virginianus	Northern Bobwhite				SJR, eBird
Columba livia	Rock Pigeon				SJR, eBird
Columbina passerina	Common Ground-Dove				SJR, iNat, eBird
Contopus cooperi	Olive-sided Flycatcher				SJR, eBird
Contopus virens	Eastern Wood-Pewee				SJR, eBird
Coragyps atratus	Black Vulture				SJR, iNat, eBird
Corthylio calendula	Ruby-crowned Kinglet				SJR, eBird
Corvus brachyrhynchos	American Crow				SJR, eBird
Corvus ossifragus	Fish Crow				SJR, iNat, eBird
Coturnicops noveboracensis	Yellow Rail				SJR, eBird
Crotophaga ani	Smooth-billed Ani				SJR, iNat, eBird
Crotophaga sulcirostris	Groove-billed Ani				SJR, iNat, eBird
Cyanocitta cristata	Blue Jay				SJR, iNat, eBird
Cygnus atratus	Black Swan				SJR, eBird
Dendrocygna autumnalis	Black-bellied Whistling-Duck				SJR, iNat, eBird
Dendrocygna bicolor	Fulvous Whistling-Duck				SJR, iNat, eBird
Dendrocygna viduata	White-faced Whistling-Duck				SJR, eBird
Dolichonyx oryzivorus	Bobolink				SJR, iNat
Dryobates pubescens	Downy Woodpecker				SJR, iNat
Dryobates villosus	Hairy Woodpecker	N	N	S3/G5	SJR, eBird
Dryocopus pileatus	Pileated Woodpecker				SJR, iNat
Dumetella carolinensis	Gray Catbird				SJR, iNat, eBird
Egretta caerulea	Little Blue Heron	N	ST	S4/G5	SJR, iNat, eBird
Egretta rufescens	Reddish Egret	N	ST	S2/G4	SJR, eBird
Egretta thula	Snowy Egret	N	N	S3/G5	SJR, iNat, eBird
Egretta tricolor	Tricolored Heron	N	ST	S4/G5	SJR, iNat, eBird
Elanoides forficatus	Swallow-tailed Kite	N	N	S2/G5	SJR, iNat, eBird
Elanus leucurus	White-tailed Kite	N	N	S1/G5	SJR, eBird
Empidonax alnorum	Alder Flycatcher				SJR, eBird
Empidonax flaviventris	Yellow-bellied Flycatcher				SJR, eBird
Empidonax minimus	Least Flycatcher				SJR, iNat, eBird
Empidonax traillii	Willow Flycatcher				SJR, eBird
Empidonax virescens	Acadian Flycatcher				SJR, eBird
Eudocimus albus	White Ibis	N	N	S4/G5	SJR, iNat, eBird
Eudocimus ruber	Scarlet Ibis				SJR
Euphagus carolinus	Rusty Blackbird				SJR, eBird

Euphagus cyanocephalus	Brewer's Blackbird				SJR, eBird
Euplectes franciscanus	Northern Red Bishop				eBird
Falco columbarius	Merlin	N	N	S2/G5	SJR, iNat, eBird
Falco peregrinus	Peregrine Falcon	N	N	S2/G4	SJR, iNat, eBird
Falco sparverius	American Kestrel				SJR, iNat, eBird
Falco tinnunculus	Eurasian Kestrel				SJR, iNat, eBird
Fregata magnificens	Magnificent Frigatebird	N	N	S1/G5	SJR, eBird
Fulica americana	American Coot				SJR, iNat, eBird
Gallinago delicata	Wilson's Snipe				SJR, iNat, eBird
Gallinula galeata	Common Gallinule				SJR, iNat, eBird
Gallus gallus	Red Junglefowl				SJR, eBird
Gavia immer	Common Loon				SJR, eBird
Gavia pacifica	Pacific Loon				SJR, eBird
Gavia stellata	Red-throated Loon				SJR, eBird
Gelochelidon nilotica	Gull-billed Tern	N	N	S2/G5	SJR, eBird
Geopelia cuneata	Diamond Dove				SJR, eBird
Geothlypis formosa	Kentucky Warbler				SJR, eBird
Geothlypis trichas	Common Yellowthroat				SJR, iNat, eBird
Grus americana	Whooping Crane	XN	E	SNR/G1	SJR, eBird
Haemorhous mexicanus	House Finch				SJR, eBird
Haemorhous purpureus	Purple Finch				SJR, eBird
Haliaeetus leucocephalus	Bald Eagle	N	N	S3/G5	SJR, iNat
Helmitheros vermivorus	Worm-eating Warbler	N	N	S1/G5	SJR, eBird
Himantopus mexicanus	Black-necked Stilt				SJR, iNat, eBird
Hirundo rustica	Barn Swallow				SJR, iNat, eBird
Hydrocoloeus minutus	Little Gull				SJR
Hydroprogne caspia	Caspian Tern	N	N	S2/G5	SJR, iNat, eBird
Hylocichla mustelina	Wood Thrush				SJR, eBird
Icteria virens	Yellow-breasted Chat				SJR, eBird
Icterus bullockii	Bullock's Oriole				SJR, eBird
Icterus galbula	Baltimore Oriole				SJR, iNat, eBird
Icterus spurius	Orchard Oriole				SJR, iNat, eBird
Ictinia mississippiensis	Mississippi Kite				SJR, iNat, eBird
Ixobrychus exilis	Least Bittern				SJR, iNat, eBird
Junco hyemalis	Dark-eyed Junco				SJR, eBird
Lanius ludovicianus	Loggerhead Shrike				SJR, eBird
Larus argentatus	Herring Gull				SJR, eBird
Larus delawarensis	Ring-billed Gull				SJR, eBird
Larus fuscus	Lesser Black-backed Gull				SJR, eBird
Larus glaucoides	Iceland Gull				SJR, eBird
Larus hyperboreus	Glaucous Gull				SJR, eBird
Larus marinus	Great Black-backed Gull				SJR, eBird
Larus thayeri	Thayer's Gull				SJR
Laterallus jamaicensis	Black Rail	T	N	S2/G3	SJR
Leiothlypis celata	Orange-crowned Warbler				SJR, iNat
Leiothlypis peregrina	Tennessee Warbler				SJR, eBird
Leiothlypis ruficapilla	Nashville Warbler				SJR, eBird
Leucophaeus atricilla	Laughing Gull				SJR, iNat, eBird
Leucophaeus pipixcan	Franklin's Gull				SJR, eBird

Limnodromus griseus	Short-billed Dowitcher				SJR, eBird
Limnodromus scolopaceus	Long-billed Dowitcher				SJR, iNat, eBird
Limnothlypis swainsonii	Swainson's Warbler				SJR, eBird
Limosa fedoa	Marbled Godwit				SJR, eBird
Limosa haemastica	Hudsonian Godwit				SJR, eBird
Lonchura punctulata	Scaly-breasted Munia				eBird
Lophodytes cucullatus	Hooded Merganser				SJR, eBird
Mareca americana	American Wigeon				SJR, iNat, eBird
Mareca penelope	Eurasian Wigeon				SJR, eBird
Mareca strepera	Gadwall				SJR, iNat, eBird
Megaceryle alcyon	Belted Kingfisher				SJR, iNat, eBird
Megascops asio	Eastern Screech-Owl				SJR, eBird
Melanerpes carolinus	Red-bellied Woodpecker				SJR, iNat, eBird
Melanerpes erythrocephalus	Red-headed Woodpecker				SJR, eBird
Melanitta americana	Black Scoter				SJR, eBird
Melanitta perspicillata	Surf Scoter				SJR, eBird
Meleagris gallopavo	Wild Turkey				SJR, eBird
Melopsittacus undulatus	Budgerigar				SJR, eBird
Melospiza georgiana	Swamp Sparrow				SJR, iNat, eBird
Melospiza lincolnii	Lincoln's Sparrow				SJR, eBird
Melospiza melodia	Song Sparrow				SJR, iNat, eBird
Mergus merganser	Common Merganser				SJR, eBird
Mergus serrator	Red-breasted Merganser				SJR, eBird
Mimus polyglottos	Northern Mockingbird				SJR, iNat, eBird
Mniotilta varia	Black-and-white Warbler				SJR, eBird
Molothrus aeneus	Bronzed Cowbird				SJR, eBird
Molothrus ater	Brown-headed Cowbird				SJR, iNat, eBird
Molothrus bonariensis	Shiny Cowbird				SJR, eBird
Mycteria americana	Wood Stork	DL	FT	S2/G4	SJR, iNat, eBird
Myiarchus cinerascens	Ash-throated Flycatcher				SJR, iNat, eBird
Myiarchus crinitus	Great Crested Flycatcher				SJR, iNat, eBird
Myiarchus tyrannulus	Brown-crested Flycatcher				SJR, eBird
Nannopterum auritum	Double-crested Cormorant				SJR, iNat, eBird
Nannopterum brasilianum	Neotropic Cormorant				SJR, iNat, eBird
Numenius americanus	Long-billed Curlew				SJR, eBird
Numenius phaeopus	Whimbrel				SJR, eBird
Numida meleagris	Helmeted Guineafowl				eBird
Nyctanassa violacea	Yellow-crowned Night-Heron	N	N	S3/G5	SJR, iNat, eBird
Nycticorax nycticorax	Black-crowned Night-Heron	N	N	S3/G5	SJR, iNat, eBird
Nymphicus hollandicus	Cockatiel				SJR, eBird
Onychoprion anaethetus	Bridled Tern				SJR, eBird
Onychoprion fuscatus	Sooty Tern	N	N	S1/G5	SJR, eBird
Oxyura jamaicensis	Ruddy Duck				SJR, iNat, eBird
Pandion haliaetus	Osprey	N	N	S3S4/G5	SJR, iNat, eBird
Parkesia motacilla	Louisiana Waterthrush	N	N	S2/G5	SJR, eBird
Parkesia noveboracensis	Northern Waterthrush				SJR, eBird
Passer domesticus	House Sparrow				SJR, eBird
Passerculus sandwichensis	Savannah Sparrow				SJR, iNat, eBird
Passerella iliaca	Fox Sparrow				SJR, eBird

Passerina amoena	Lazuli Bunting				SJR, eBird
Passerina caerulea	Blue Grosbeak				SJR, iNat, eBird
Passerina ciris	Painted Bunting	N	N	S1S2/G5T3Q	SJR, eBird
Passerina cyanea	Indigo Bunting				SJR, iNat, eBird
Pavo cristatus	Indian Peafowl				eBird
Pelecanus erythrorhynchos	American White Pelican				SJR, iNat, eBird
Pelecanus occidentalis	Brown Pelican				SJR, eBird
Perdix perdix	Gray Partridge				SJR, eBird
Petrochelidon fulva	Cave Swallow				SJR, eBird
Petrochelidon pyrrhonota	Cliff Swallow				SJR, eBird
Peucaea aestivalis	Bachman's Sparrow	N	N	S3/G3	SJR, eBird
Phalaropus fulicarius	Red Phalarope				SJR, eBird
Phalaropus lobatus	Red-necked Phalarope				SJR, iNat, eBird
Phalaropus tricolor	Wilson's Phalarope				SJR, eBird
Phasianus colchicus	Ring-necked Pheasant				SJR, eBird
Pheucticus ludovicianus	Rose-breasted Grosbeak				SJR, eBird
Phoenicopterus ruber	American Flamingo				SJR, eBird
Picoides borealis	Red-cockaded Woodpecker	E	SSC	S2/G3	SJR
Pipilo erythrophthalmus	Eastern Towhee				SJR, eBird
Piranga ludoviciana	Western Tanager				SJR, eBird
Piranga olivacea	Scarlet Tanager				SJR, eBird
Piranga rubra	Summer Tanager				SJR, eBird
Platalea ajaja	Roseate Spoonbill	N	ST	S2/G5	SJR, iNat, eBird
Plegadis chihi	White-faced Ibis				SJR, iNat, eBird
Plegadis falcinellus	Glossy Ibis	N	N	S3/G5	SJR, iNat, eBird
Pluvialis dominica	American Golden-Plover				SJR, iNat, eBird
Pluvialis squatarola	Black-bellied Plover				SJR, iNat, eBird
Podiceps auritus	Horned Grebe				SJR, eBird
Podiceps grisegena	Red-necked Grebe				SJR
Podiceps nigricollis	Eared Grebe				SJR, eBird
Podilymbus podiceps	Pied-billed Grebe				SJR, iNat, eBird
Poecile carolinensis	Carolina Chickadee				SJR, eBird
Polioptila caerulea	Blue-gray Gnatcatcher				SJR, iNat, eBird
Pooecetes gramineus	Vesper Sparrow				SJR, iNat, eBird
Porphyrio martinica	Fox Sparrow				SJR, iNat, eBird
Porphyrio poliocephalus	Gray-headed Swamphen				SJR, iNat, eBird
Porzana carolina	Sora				SJR, iNat, eBird
Progne subis	Purple Martin				SJR, iNat, eBird
Protonotaria citrea	Prothonotary Warbler				SJR, eBird
Pyrocephalus rubinus	Vermilion Flycatcher				SJR, iNat, eBird
Quiscalus major	Boat-tailed Grackle				SJR, iNat, eBird
Quiscalus quiscula	Common Grackle				SJR, iNat, eBird
Rallus elegans	King Rail				SJR, iNat, eBird
Rallus limicola	Virginia Rail				SJR, eBird
Rallus longirostris	Clapper Rail				SJR
Recurvirostra americana	American Avocet	N	N	S2/G5	SJR, eBird
Regulus satrapa	Golden-crowned Kinglet				SJR, eBird
Riparia riparia	Bank Swallow				SJR, iNat, eBird
Rostrhamus sociabilis	Snail Kite	E	FE	S2/G4G5	SJR, iNat, eBird

Rynchops niger	Black Skimmer	N	ST	S3/G5	SJR, iNat, eBird
Sayornis phoebe	Eastern Phoebe				SJR, iNat, eBird
Scolopax minor	American Woodcock				SJR, eBird
Seiurus aurocapilla	Ovenbird				SJR, eBird
Setophaga americana	Northern Parula				SJR, eBird
Setophaga caerulescens	Black-throated Blue Warbler				SJR, eBird
Setophaga castanea	Bay-breasted Warbler				SJR, eBird
Setophaga cerulea	Cerulean Warbler				SJR, eBird
Setophaga citrina	Hooded Warbler				SJR, eBird
Setophaga coronata	Yellow-rumped Warbler				SJR, iNat, eBird
Setophaga discolor	Prairie Warbler				SJR, iNat, eBird
Setophaga dominica	Yellow-throated Warbler				SJR, iNat, eBird
Setophaga fusca	Blackburnian Warbler				SJR, eBird
Setophaga magnolia	Magnolia Warbler				SJR, eBird
Setophaga nigrescens	Black-throated Gray Warbler				SJR, eBird
Setophaga palmarum	Palm Warbler				SJR, iNat, eBird
Setophaga pensylvanica	Chestnut-sided Warbler				SJR, eBird
Setophaga petechia	Yellow Warbler				SJR, iNat, eBird
Setophaga pinus	Pine Warbler				SJR, iNat, eBird
Setophaga ruticilla	American Redstart	N	N	S2/G5	SJR, iNat, eBird
Setophaga striata	Blackpoll Warbler				SJR, eBird
Setophaga tigrina	Cape May Warbler				SJR, iNat, eBird
Setophaga virens	Black-throated Green Warbler				SJR, eBird
Sialia sialis	Eastern Bluebird				SJR, iNat, eBird
Sitta canadensis	Red-breasted Nuthatch				eBird
Sitta pusilla	Brown-headed Nuthatch				SJR, eBird
Spatula clypeata	Northern Shoveler				SJR, iNat, eBird
Spatula cyanoptera	Cinnamon Teal				SJR, eBird
Spatula discors	Blue-winged Teal				SJR, iNat, eBird
Spermestes cucullata	Bronze Mannikin				SJR, eBird
Sphyrapicus varius	Yellow-bellied Sapsucker				SJR, iNat, eBird
Spinus pinus	Pine Siskin				SJR, eBird
Spinus tristis	American Goldfinch				SJR, eBird
Spiza americana	Dickcissel				SJR, iNat, eBird
Spizella pallida	Clay-colored Sparrow				SJR, iNat, eBird
Spizella passerina	Chipping Sparrow				SJR, eBird
Spizella pusilla	Field Sparrow				SJR, iNat, eBird
Stelgidopteryx serripennis	Northern Rough-winged Swallow				SJR, eBird
Stercorarius parasiticus	Parasitic Jaeger				SJR, eBird
Stercorarius pomarinus	Pomarine Jaeger				SJR, eBird
Sterna dougallii	Roseate Tern	T	FT	S1/G4	SJR, eBird
Sterna forsteri	Forster's Tern				SJR, iNat, eBird
Sterna hirundo	Common Tern				SJR, iNat, eBird
Sterna paradisaea	Arctic Tern				SJR, eBird
Sternula antillarum	Least Tern	ST	T	S3/G4	SJR, eBird
Streptopelia decaocto	Eurasian Collared Dove				SJR, iNat, eBird
Strix varia	Barred Owl				SJR, iNat, eBird
Sturnella magna	Eastern Meadowlark				SJR, eBird
Sturnus vulgaris	European Starling				SJR, eBird

Sula leucogaster	Brown Booby				SJR, eBird
Tachycineta bicolor	Tree Swallow				SJR, iNat, eBird
Taeniopygia guttata	Zebra Finch				SJR, eBird
Thalasseus maximus	Royal Tern	N	N	S3/G5	SJR, eBird
Thalasseus sandvicensis	Sandwich Tern	N	N	S2/G5	SJR, eBird
Thryomanes bewickii	Bewick's Wren				SJR, eBird
Thryothorus ludovicianus	Carolina Wren				SJR, iNat, eBird
Toxostoma rufum	Brown Thrasher				SJR, iNat, eBird
Tringa flavipes	Lesser Yellowlegs				SJR, iNat, eBird
Tringa melanoleuca	Greater Yellowlegs				SJR, iNat, eBird
Tringa semipalmata	Willet				SJR, eBird
Tringa solitaria	Solitary Sandpiper				SJR, iNat, eBird
Troglodytes aedon	House Wren				SJR, iNat, eBird
Troglodytes hiemalis	Winter Wren				SJR, eBird
Turdus migratorius	American Robin				SJR, iNat, eBird
Tyrannus dominicensis	Gray Kingbird				SJR, eBird
Tyrannus forficatus	Scissor-tailed Flycatcher				SJR, iNat, eBird
Tyrannus melancholicus	Tropical kingbird				SJR, eBird
Tyrannus savana	Fork-tailed Flycatcher				SJR, iNat, eBird
Tyrannus tyrannus	Eastern Kingbird				SJR, iNat, eBird
Tyrannus verticalis	Western Kingbird				SJR, iNat, eBird
Tyrannus vociferans	Cassin's Kingbird				SJR, iNat
Tyto alba	Barn Owl				SJR, iNat, eBird
Vermivora chrysoptera	Golden-winged Warbler				SJR
Vermivora cyanoptera	Blue-winged Warbler				SJR, eBird
Vidua macroura	Pin-tailed Whydah				SJR, eBird
Vireo altiloquus	Black-whiskered Vireo	N	N	S3/G5	SJR
Vireo bellii	Bell's Vireo				SJR, eBird
Vireo flavifrons	Yellow-throated Vireo				SJR, eBird
Vireo griseus	White-eyed Vireo				SJR, eBird
Vireo olivaceus	Red-eyed Vireo				SJR, eBird
Vireo philadelphicus	Philadelphia Vireo				SJR, eBird
Vireo solitarius	Blue-headed Vireo				SJR, iNat, eBird
Xanthocephalus xanthocephalus	Yellow-headed Blackbird				SJR, eBird
Zenaida asiatica	White-winged dove				SJR, iNat, eBird
Zenaida macroura	Mourning Dove				SJR, iNat, eBird
Zonotrichia albicollis	White-throated Sparrow				SJR
Zonotrichia leucophrys	White-crowned Sparrow				SJR, iNat, eBird

FISH

Scientific Name	**Common Name**	**USFWS**	**FWC**	**FNAI**	**Source**
Amia calva	Bowfin				SJR
Gambusia holbrooki	eastern mosquitofish				SJR
Ameiurus catus	White catfish				SJR
Ameiurus nebulosus	Brown bullhead				SJR
Ctenopharyngodon idella	Grass Carp				iNat
Dorosoma cepedianum	Gizzard Shad				SJR
Fundulaus seminolis	Seminole Killifish				SJR
Hoplosternum littorale	Brown Hoplo				iNat
Lepisosteus osseus	Longnose Gar				iNat

Lepisosteus platyrhincus	Florida gar				SJR, iNat
Lepomis gulosus	Warmouth				SJR
Lepomis macrochirus	Bluegill				SJR
Lepomis microlophus	Redear sunfish				SJR
Micropterus salmoides	Largemouth Bass				SJR
Notemigonus crysoleucas	Golden shiner				SJR
Oreochromis aureus	Blue Tilapia				iNat
Poecilia latipinna	Sailfin Molly				iNat
Pomoxis nigromaculatus	Black Crappie				SJR
INVERTEBRATES					
Scientific Name	**Common Name**	**USFWS**	**FWC**	**FNAI**	**Source**
Abaeis nicippe	Sleepy Orange				SJR, iNat
Acanthocephala femorata	Florida Leaf-footed Bug				iNat
Acronicta insularis	Marsh Dagger				iNat
Acronicta oblinita	Smeared Dagger				iNat
Agraulis vanillae	Gulf Fritillary				SJR
Alcaeorrhynchus grandis	Giant Strong-nosed Stink Bug				iNat
Anartia jatrophae	White Peacock				SJR, iNat
Anatrytone logan	Delaware Skipper				iNat
Anax junius	Common Green Darner				SJR
Anax longipes	Comet Darner				SJR
Aphylla williamsoni	Two-striped Forceptail				SJR, iNat
Apis mellifera	Western Honey Bee				iNat
Argia fumipennis	Variable Dancer				SJR
Argia moesta	Powdered Dancer				SJR
Argiope aurantia	Yellow Garden Spider				iNat
Arigomphus pallidus	Gray-Green Clubtail				SJR
Armadillidium vulgare	Common Pill Woodlouse				SJR, iNat
Ascia monuste	Great Southern White				SJR, iNat
Asterocampa celtis	Hackberry Emperor				SJR, iNat
Asterocampa clyton	Tawny Emperor				SJR, iNat
Atlides halesus	Great Purple Hairstreak				SJR, iNat
Atrytonopsis hianna	Dusted Skipper				SJR
Battus philenor	Pipevine Swallowtail				SJR
Bombus pensylvanicus	American Bumble Bee				iNat
Brachymesia gravida	Four-Spotted Pennant				SJR, iNat
Brachymyrmex obscurior	Seaside Rover Ant				iNat
Burnsius albezens	White Checkered-Skipper				iNat
Burnsius oileus	Tropical Checkered-Skipper				iNat
Calopteryx maculata	Ebony Jewelwing				SJR
Calpodes ethlius	Brazilian Skipper				SJR
Calycopis cecrops	Red-banded Hairstreak				SJR, iNat
Camponotus castaneus	Chestnut Carpenter Ant				iNat
Camponotus floridanus	Florida Carpenter Ant				iNat
Celastrina ladon	Spring Azure	N	N	S2/G4G5	SJR
Celithemis amanda	Amanda's Pennant				SJR
Celithemis bertha	Red-veined Pennant				SJR
Celithemis eponina	Halloween Pennant				SJR, iNat
Celithemis fasciata	Banded Pennant				SJR

Celithemis ornata	Faded Pennant				SJR
Chauliognathus marginatus	Margined Leatherwing Beetle				iNat
Chortophaga australior	Southern Green-striped Grasshopper				iNat
Chrysis angolensis	Metallic Bluish-green Cuckoo Wasp				iNat
Chrysomela scripta	Cottonwood Leaf Beetle				iNat
Chrysops brunneus	Brownish Deer Fly				iNat
Cicindela punctulata	Punctured Tiger Beetle				iNat
Cisseps fulvicollis	Yellow-collared Scape Moth				iNat
Clogmia albipunctata	Bathroom Moth Fly				iNat
Coccinella septempunctata	Seven-spotted Lady Beetle				iNat
Coelotanypus concinnus					iNat
Colias eurytheme	Orange Sulphur				SJR
Copaeodes minima	Southern Skipperling				iNat
Copestylum mexicanum	Mexican Cactus Fly				iNat
Coryphaeschna adnexa	Blue-faced Darner				SJR, iNat
Coryphaeschna ingens	Regal Darner				SJR, iNat
Cosmosoma myrodora	Scarlet-bodied Wasp Moth				iNat
Crocothemis servilia	Scarlet Skimmer				SJR, iNat
Cymaenes tripunctus	Three-spotted Skipper				iNat
Danaus eresimus	Soldier				SJR, iNat
Danaus gilippus	Queen				SJR, iNat
Danaus gilippus berenice	Florida Queen				iNat
Danaus plexippus	Monarch				SJR, iNat
Dasymutilla occidentalis	Common Eastern Velvet Ant				iNat
Diabrotica balteata	Banded Cucumber Beetle				iNat
Diachlorus ferrugatus	Yellow Fly of the Dismal Swamp				iNat
Dichromorpha viridis	Short-winged Green Grasshopper				iNat
Dione vanillae	Gulf Fritillary				iNat
Dolomedes triton	Six-spotted Fishing Spider				iNat
Dorymyrmex bureni	Buren's Pyramid Ant				iNat
Draeculacephala producta					iNat
Dromogomphus armatus	Southeastern Spinyleg	N	N	S3/G4	SJR
Dryas iulia	Julia Heliconian				iNat
Dysdercus suturellus	Common Cotton Stainer Bug				iNat
Enallagma civile	Familiar Bluet				SJR
Enallagma coecum	Purple Bluet				SJR
Enallagma concisum	Cherry Bluet				SJR
Enallagma doubledayi	Atlantic Bluet				SJR
Enallagma pollutum	Florida Bluet				SJR, iNat
Enallagma signatum	Orange Bluet				SJR
Enallagma vesperum	Vesper Bluet				SJR
Epiaeschna heros	Swamp Darner				SJR
Epitheca cynosura	Common Baskettail				SJR
Epitheca princeps	Prince Baskettail				SJR, iNat
Epitheca sepia	Sepia Baskettail				SJR
Epitheca stella	Florida Baskettail				SJR
Erynnis juvenalis	Juvenal's Duskywing				SJR
Erythemis plebeja	Pin-tailed Pondhawk				SJR, iNat
Erythemis simplicicollis	Eastern Pondhawk				SJR, iNat

Erythemis vesiculosa	Great Pondhawk				SJR, iNat
Erythrodiplax minuscula	Little Blue Dragonlet				SJR
Erythrodiplax umbrata	Band-winged Dragonlet				SJR, iNat
Estigmene acrea	Salt Marsh Moth				iNat
Euchaetes egle	Milkweed Tussock Moth				iNat
Eudryas unio	Pearly Wood-nymph				iNat
Euphyes vestris	Dun Skipper				SJR, iNat
Euptoieta claudia	Variegated Fritillary				SJR, iNat
Eurema daira	Barred Yellow				SJR
Eurytides marcellus	Zebra Swallowtail				SJR
Gomphaeschna furcillata	Harlequin Darner				SJR
Gomphus minutus	Cypress Clubtail				SJR
Gonatista grisea	Grizzled Mantis				iNat
Gynacantha nervosa	Twilight Darner				SJR
Habronattus brunneus					iNat
Halictus poeyi	Poey's Furrow Bee				iNat
Harmonia axyridis	Asian Lady Beetle				iNat
Heliconius charithonia	Zebra Longwing				iNat
Hemiargus ceraunus	Ceraunus Blue				SJR, iNat
Hemiargus ceraunus antibubastus					iNat
Heraclides cresphontes	Eastern Giant Swallowtail				iNat
Hermetia sexmaculata					iNat
Hermeuptychia sosybius	Carolina Satyr				SJR
Hesperia attalus	Dotted Skipper				SJR
Hylephila phyleus	Fiery Skipper				iNat
Hypolimnas misippus	Mimic				SJR
Ischnura hastata	Citrine Forktail				SJR, iNat
Ischnura posita	Fragile Forktail				SJR, iNat
Ischnura ramburii	Rambur's Forktail				SJR, iNat
Junonia coenia	Common Buckeye				SJR, iNat
Larinia directa					iNat
Larra bicolor					iNat
Leptoglossus oppositus					iNat
Leptotes cassius	Cassius Blue				SJR, iNat
Lerema accius	Clouded Skipper				iNat
Lerodea eufala	Eufala Skipper				SJR
Lestes disjunctus	Common Spreadwing				SJR
Leucauge argyra					iNat
Libellula auripennis	Golden-winged Skimmer				SJR
Libellula axilena	Bar-winged Skimmer				SJR
Libellula deplanata	Blue Corporal				SJR
Libellula incesta	Slaty Skimmer				SJR, iNat
Libellula needhami	Needham's Skimmer				SJR, iNat
Libellula semifasciata	Painted Skimmer				SJR
Libellula vibrans	Great Blue Skimmer				SJR
Libytheana carinenta	American Snout				SJR, iNat
Limenitis archippus	Viceroy				SJR, iNat
Limenitis archippus floridensis	Florida Viceroy				iNat

Limenitis arthemis	Red-spotted Purple or White Admiral				SJR
Limenitis arthemis astyanax	Red-spotted Purple				iNat
Macrodiplax balteata	Marl Pennant				SJR, iNat
Macromia illinoiensis	Illinois River Cruiser				SJR
Malacosoma americana	Eastern Tent Caterpillar Moth				iNat
Mallodon dasystomus	Hardwood Stump Borer				iNat
Megisto cymela	Little Wood Satyr				SJR
Melissodes bimaculatus	Two-spotted Longhorn Bee				iNat
Menemerus bivittatus	Gray Wall Jumping Spider				iNat
Miathyria marcella	Hyacinth Glider				SJR, iNat
Monobia quadridens	Four-toothed Mason Wasp				iNat
Nasiaeschna pentacantha	Cyrano Darner				SJR
Nathalis iole	Dainty Sulphur				SJR, iNat
Nehalennia integricollis	Southern Sprite				SJR
Neotibicen lyricen virescens	Coastal Lyric Cicada				iNat
Neotridactylus apicialis	Larger Pygmy Mole Grasshopper				iNat
Nymphalis antiopa	Mourning Cloak	N	N	S2/G5	SJR
Oebalus pugnax	Rice Stink Bug				iNat
Oiketicus abbotii	Abbot's Bagworm Moth				iNat
Oligoria maculata	Twin-spot Skipper				SJR
Orchelimum pulchellum	Handsome Meadow Katydid				iNat
Orgyia detrita	Fir Tussock Moth				iNat
Ormenaria rufifascia	Palm Flatid Planthopper				iNat
Ornidia obesa	Green Jewel Fly				iNat
Orthemis ferruginea	Roseate Skimmer				SJR
Pachydiplax longipennis	Blue Dasher				SJR, iNat
Palpada agrorum	Double-banded Plushback				iNat
Palpada pusilla	Bicolored Plushback				iNat
Palpada vinetorum	Northern Plushback				iNat
Panoquina ocola	Ocola Skipper				iNat
Pantala flavescens	Wandering Glider				SJR, iNat
Pantala hymenaea	Spot-winged Glider				SJR
Papilio cresphontes	Giant Swallowtail				SJR
Papilio glaucus	Eastern Tiger Swallowtail				SJR, iNat
Papilio palamedes	Palamedes Swallowtail				SJR
Papilio polyxenes	Black Swallowtail				SJR, iNat
Papilio troilus	Spicebush Swallowtail				SJR, iNat
Paroxya atlantica	Atlantic Grasshopper				iNat
Paroxya clavuligera	Olive-green Swamp Grasshopper				iNat
Parrhasius m-album	White M Hairstreak				SJR, iNat
Periplaneta australasiae	Australian Cockroach				iNat
Perithemis tenera	Eastern Amberwing				SJR, iNat
Peucetia viridans	Green Lynx Spider				iNat
Pheidole obscurithorax	Large Imported Big-headed Ant				iNat
Phidippus regius	Regal Jumping Spider				iNat
Phoebis agarithe	Large Orange Sulphur				SJR
Phoebis philea	Orange-Barred Sulphur				SJR
Phoebis sennae	Cloudless Sulphur				SJR, iNat
Phyciodes phaon	Phaon Crescent				SJR, iNat

Phyciodes tharos	Pearl Crescent				SJR, iNat
Phyllomydas parvulus					iNat
Pieris rapae	Cabbage White				SJR
Plecia nearctica	Common Lovebug				iNat
Polistes exclamans	Guinea Paper Wasp				iNat
Polistes major	Horse's Paper Wasp				iNat
Polistes major major					iNat
Polistes metricus	Metric Paper Wasp				iNat
Polygonia interrogationis	Question Mark				SJR, iNat
Poneracantha triangularis					iNat
Pontia protodice	Checkered White				SJR, iNat
Problema byssus	Byssus Skipper				SJR
Pseudomyrmex gracilis	Graceful Twig Ant				iNat
Pseudomyrmex pallidus	Pallid Twig Ant				iNat
Ptichodis vinculum	Black-tipped Ptichodis Moth				iNat
Pyrausta tyralis	Coffee-loving Pyrausta Moth				iNat
Pyrisitia lisa	Little Yellow				SJR
Pyrrharctia isabella	Isabella Tiger Moth				iNat
Romalea microptera	Eastern Lubber Grasshopper				iNat
Satyrium calanus	Banded Hairstreak				SJR
Sceliphron caementarium	Yellow-legged Mud-dauber Wasp				iNat
Schistocerca americana	American Bird Grasshopper				iNat
Schistocerca obscura	Obscure Bird Grasshopper				iNat
Solenopsis invicta	Red Imported Fire Ant				iNat
Sphex ichneumoneus	Great Golden Digger Wasp				iNat
Spoladea recurvalis	Hawaiian Beet Webworm Moth				iNat
Spragueia onagrus	Black-dotted Spragueia Moth				iNat
Strymon melinus	Gray Hairstreak				SJR
Stylurus plagiatus	Russet-tipped Clubtail				SJR
Syngamia florella	Orange-spotted Flower Moth				iNat
Systoechus	Woolly Bee Flies				iNat
Taxodiomyia cupressiananassa	Cypress Twig Gall Midge				iNat
Telebasis byersi	Duckweek Firetail				SJR, iNat
Thorybes confusis	Confused Cloudywing				SJR
Thorybes dorantes	Dorantes Longtail				iNat
Tramea carolina	Carolina saddlebags				SJR, iNat
Tramea lacerata	Black Saddlebags				SJR, iNat
Tramea onusta	Red Saddlebags				iNat
Trepobates					iNat
Triacanthagyna trifida	Phantom Darner				SJR, iNat
Trichiotinus lunulatus	Emerald Flower Scarab				iNat
Trichonephila clavipes	Golden Silk Spider				iNat
Trigonopeltastes delta	Delta Flower Scarab				iNat
Trimerotropis maritima	Seaside Grasshopper				iNat
Urbanus proteus	Long-tailed Skipper				iNat
Vanessa atalanta	Red Admiral				SJR, iNat
Vanessa cardui	Painted Lady				SJR
Vanessa virginiensis	American Lady				SJR
Wallengrenia egeremet	Northern Broken-Dash				SJR

Wallengrenia otho	Southern Broken-Dash				SJR
Xylophanes tersa	Tersa Sphinx				iNat
Zelus longipes	Milkweed Assassin Bug				iNat
Zerene cesonia	Southern Dogface				SJR
Zethus slossonae	Slosson's Mason Wasp				iNat
MAMMALS					
Scientific Name	**Common Name**	**USFWS**	**FWC**	**FNAI**	**Source**
Blarina carolinensis	Southern Short-tailed Shrew				SJR
Canis latrans	Coyote				SJR, iNat
Cryptotis parva	Least Shrew				SJR
Dasypus novemcinctus	Nine-Banded Armadillo				SJR, iNat
Didelphis virginiana	Virginia Opossum				SJR, iNat
Geomys pinetis	Southeastern Pocket Gopher				SJR
Glaucomys volans	Southern Flying Squirrel				SJR
Lontra canadensis	North American River Otter				SJR, iNat
Lynx rufus rufus	Eastern Bobcat				iNat
Macaca mulatta	Rhesus Macaque				SJR
Mephitis mephitis	Striped skunk				SJR
Mus musculus	House Mouse				SJR
Mustela frenata	Long-tailed weasel				SJR
Neofiber alleni	Round-tailed Muskrat	N	N	S2/G2	SJR, iNat
Neotoma floridana	Eastern woodrat				SJR
Odocoileus virginianus	White-Tailed Deer				SJR
Oryzomys palustris	Marsh rice rat				SJR
Peromyscus gossypinus	Cotton Mouse				SJR
Procyon lotor elucus	Florida Raccoon				iNat
Rattus norvegicus	Norway Rat				SJR
Rattus rattus	Black Rat				SJR
Reithrodontomys humulis	Eastern harvest mouse				SJR
Sciurus carolinensis	Eastern gray squirrel				SJR, iNat
Sigmodon hispidus	Hispid cotton rat				SJR, iNat
Spilogale putorius	Eastern Spotted Skunk				SJR
Sus scrofa	Feral Hog				SJR
Sylvilagus floridanus	Eastern Cottontail				SJR
Sylvilagus palustris	Marsh Rabbit				SJR, iNat
Urocyon cinereoargenteus	Gray Fox				SJR
Ursus americanus floridanus	Florida Black Bear	N	N	S4/G5T4	SJR
Vulpes vulpes	Red Fox				SJR
REPTILES					
Scientific Name	**Common Name**	**USFWS**	**FWC**	**FNAI**	**Source**
Agkistrodon conanti	Florida Cottonmouth				SJR
Alligator mississippiensis	American Alligator	SAT	FT(S/A)	S4/G5	SJR, iNat
Anolis carolinensis	Green Anole				SJR, iNat
Anolis sagrei	Brown Anole				SJR, iNat
Apalone ferox	Florida Softshell Turtle				SJR, iNat
Aspidoscelis sexlineata	Six-Lined Racerunner				SJR
Chelydra serpentina	Common Snapping Turtle				SJR, iNat
Coluber constrictor priapus	Southern Black Racer				SJR, iNat

Crotalus adamanteus	Eastern Diamondback Rattlesnake	UR	N	S3/G3	SJR
Deirochelys reticularia chrysea	Florida Chicken Turtle				iNat
Diadophis punctatus punctatus	Southern Ringneck Snake				SJR
Drymarchon couperi	Eastern Indigo Snake	T	FT	S2/G3	SJR
Farancia abacura	Mudsnake				SJR, iNat
Gopherus polyphemus	Gopher Tortoise	N	ST	S3/G3	SJR
Heterodon platirhinos	Eastern hognose snake				SJR
Kinosternon baurii	Striped Mud Turtle				SJR, iNat
Kinosternon subrubrum	Eastern mud turtle				SJR
Liodytes alleni	Striped Swampsnake				iNat
Liodytes pygaea pygaea	Northern Florida Swampsnake				iNat
Masticophis flagellum flagellum	Eastern Coachwhip				SJR
Nerodia fasciata pictiventris	Florida Watersnake				SJR, iNat
Nerodia floridana	Florida Green Watersnake				SJR, iNat
Nerodia taxispilota	Brown Watersnake				SJR, iNat
Opheodrys aestivus carinatus	Florida Rough Greensnake				iNat
Ophisaurus ventralis	Eastern Glass Lizard				SJR
Pantherophis alleghaniensis	Eastern Ratsnake				iNat
Pantherophis guttatus	Corn Snake				SJR, iNat
Pituophis melanoleucus mugitus	Florida Pine Snake				SJR
Plestiodon inexpectatus	Southeastern Five-Lined Skink				SJR
Plestiodon laticeps	Broadhead Skink				SJR
Plestiodon reynoldsi	Sand skink	T	FT	S3/G3	SJR
Pseudemys concinna floridana	Florida Cooter				SJR
Pseudemys nelsoni	Florida Redbelly Turtle				SJR, iNat
Pseudemys peninsularis	Peninsular Cooter				iNat
Scincella lateralis	Little Brown Skink				SJR, iNat
Sistrurus miliarius	Pigmy Rattlesnake				SJR
Sternotherus minor minor	Loggerhead musk turtle				SJR
Sternotherus odoratus	Common Musk Turtle				SJR, iNat
Storeria victa	Florida Brownsnake				iNat
Terrapene carolina bauri	Florida Box Turtle				iNat
Thamnophis saurita sackenii	Peninsula Ribbon Snake				iNat
Thamnophis sirtalis sirtalis	Eastern Garter Snake				SJR
Trachemys scripta	Pond Slider				iNat
Trachemys scripta elegans	Red-Eared Slider				SJR

STATUS

FNAI Global Element Rank
G1 = Critically imperiled globally because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme vulnerability to extinction due to some natural or man-made factor.
G2 = Imperiled globally because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due to some natural or man-made factor.
G3 = Either very rare and local throughout its range (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted
range or vulnerable to extinction from other factors.
G4 = Apparently secure globally (may be rare in parts of range).
G5 = Demonstrably secure globally.
G#G# = Range of rank; insufficient data to assign specific global rank (e.g., G2G3).
G#T# = Rank of a taxonomic subgroup such as a subspecies or variety; the G portion of the rank refers to the entire species and the T
portion refers to the specific subgroup; numbers have same definition as above (e.g., G3T1).

FNAI State Element Rank
S1 = Critically imperiled in Florida because of extreme rarity (5 or fewer occurrences or less than 1000 individuals) or because of extreme
vulnerability to extinction due to some natural or man-made factor.
S2 = Imperiled in Florida because of rarity (6 to 20 occurrences or less than 3000 individuals) or because of vulnerability to extinction due
to some natural or man-made factor.
S3 = Either very rare and local in Florida (21-100 occurrences or less than 10,000 individuals) or found locally in a restricted range or
vulnerable to extinction from other factors.
S4 = Apparently secure in Florida (may be rare in parts of range).
S5 = Demonstrably secure in Florida.
SNR = Element not yet ranked (temporary).

Federal (FWS) Legal Status
DL = Species has been delisted.
E = Endangered: species in danger of extinction throughout all or a significant portion of its range.
E, T = Species currently listed endangered in a portion of its range but only listed as threatened in other areas
XN = Species currently listed endangered but tracked population is a non-essential experimental population.
T = Threatened: species likely to become Endangered within the foreseeable future throughout all or a significant portion of its range.

Legal status information provided for information only. For official definitions and lists of protected species, consult the relevant federal agency. Definitions derived from U.S. Endangered Species Act of 1973, Sec. 3. Note that the federal status refers only to Florida

State (FWC) Legal Status
FE = Listed as Endangered Species at the Federal level by the U. S. Fish and Wildlife Service
FT = Listed as Threatened Species at the Federal level by the U. S. Fish and Wildlife Service
FXN = Federal listed as an experimental population in Florida
FWC-T = State population listed as Threatened by the FFWCC. Defined as a species, subspecies, or isolated population which is acutely vulnerable to environmental alteration, declining in number at a rapid rate, or whose range or habitat is decreasing in area at a rapid rate and as a consequence is destined or very likely to become an endangered species within the foreseeable future.
FDACS-CE = Listed as Commercially Exploited by the Florida Department of Agriculture and Consumer Services.

Appendix J - Lake Apopka North Shore Species List

FDACS-E = Listed as Endangered by the Florida Department of Agriculture and Consumer Services.
FDACS-T = Listed as Threatened by the Florida Department of Agriculture and Consumer Services.

Provided for information only. For official definitions and lists of protected species, consult the relevant state agency.