APPENDIX C — ENVIRONMENTAL METHODS, DATA, AND METRICS

Environmental Analyses

MFLs determinations incorporate biological and topographical information collected in the field with hydrologic data collected from monitoring sites, hydrologic models, wetlands, and soils as well as land use/land cover and land ownership from GIS layers, aerial photography, and eco-hydrological information from scientific literature. This appendix describes the environmental methods, analyses, and assumptions used in the MFLs determination process for Lake Prevatt including field procedures such as site selection, field data collection, and data analyses, in addition to details and support for recommended MFLs metrics. Vegetation, soils, and elevation data were analyzed in conjunction with output from hydrologic and hydraulic models (see Appendix B for details of hydrologic analyses and model report) and scientific literature to develop a minimum hydrologic regime that protects the ecological structure and function of the Lake Prevatt system.

Field Methods

Preliminary Site Review

Familiarization with the field site began with a site history survey and a literature and data search. All pertinent information was compiled from St. Johns River Water Management District (SJRWMD) library documents, project record files, the hydrologic database, and SJRWMD Division of Surveying Services files. The Florida Natural Areas Inventory (FNAI) biodiversity matrix tool (http://www.fnai.org/) was queried for the presence of threatened or endangered species at potential sites. The goal of the search was to familiarize staff with site characteristics, locate important basin features, and assess prospective sampling locations. The types of information included:

- On-site and regional vegetation surveys and maps;
- Aerial photography (current and historical);
- Remote sensing (vegetation, land use, etc.) and topographic maps;
- Soil surveys, maps, and descriptions;
- Hydrologic data (hydrographs and stage duration curves);
- Environmental, engineering, or hydrologic reports;
- Topographic survey profiles; and
- Occurrence records of rare and endangered flora and fauna.

Transect Site Selection

Ecological and environmental data were initially collected along linear transects, with many factors considered in the selection of transect locations. Transects are fixed sample lines across a water body or wetland and typically extend from uplands to open water. Elevation, soils, and vegetation were sampled along transects to characterize the distribution of soils and plant communities. These data were then compared to system hydrological data to determine the influence of flooding and drying events on soils and plant species or communities.

Data compiled during the site selection process were reviewed to familiarize staff with site characteristics, locate important basin features that needed to be evaluated, and assess prospective field transect locations. Potential transect locations at Lake Prevatt were initially identified from maps of wetlands, soils, topography, and land ownership. Specific transect site selection goals included:

- Establishing transects at sites where multiple wetland communities of the most commonly occurring types were traversed;
- Establishing transects that traverse unique wetland communities;
- Establishing transects that traverse shallow reaches (i.e., potentially sensitive to reduced water levels); and
- Establishing transects at locations where earlier MFLs field data were collected (if possible).

These goals help to ensure ecosystem protection of both commonly occurring and unique wetland ecosystems at Lake Prevatt. Transect characteristics were subsequently field-verified to ensure that prospective locations contained representative wetland communities, hydric soils, and reasonable upland access. Specific transect locations were chosen because they met the transect selection criteria and were deemed to be the best candidate locations (i.e., these transects are good representations of wetland communities found at Lake Prevatt). Individual transects are described below.

Field Data Collection

Field data collection procedures involved collecting vegetation, soils, and elevation data along multiple fixed transects across a hydrologic gradient (i.e., from uplands to open water). Transects were established in areas exhibiting transitions in vegetation communities and hydric soils with a marked hydrologic gradient. The main purpose in using transects, where the change in vegetation and soils was clearly directional, was to describe the maximum variations in vegetation elevation and composition that may occur at Lake Prevatt with hydrologic fluctuations.

<u>Vegetation Sampling Procedures</u>

Vegetation data were collected on each transect using the line-intercept method (Canfield 1941) at 1-foot (ft) intervals. This semi-quantitative method involves measuring the length (i.e., longitudinal location along the transect) of each individual plant that overlaps the transect line. All individual plants that intercepted the transect line were identified to species or lowest possible taxon. This technique provides precise data on the distribution (and elevation range, mean, etc.) of individual species.

SJRWMD’s Wetland Vegetation Classification System (Kinser 2012) was used to standardize the names of wetland plant communities. Community boundaries are spatial localities where the degree of change in species composition is greatest (Fagan et al. 2003). In some instances, intermediate habitats termed “transition zones” were assigned when community boundaries exhibited characteristics of more than one adjoining community.

The spatial extent of plant communities, and transition zones among plant communities, was determined using reasonable scientific judgement aided by data collected from the line-intercept vegetation. Reasonable scientific judgement involves the ability to collect and analyze information using technical knowledge, personal skills, and experience to serve as a basis for decision making (Gilbert et al. 1995). In this case, such judgement was based upon field observations of relative abundance of dominant plant species, occurrence and distribution of soils and hydric soil indicators, and changes in land slope or elevation along the hydrologic gradient.

Once the spatial extent of plant communities and transition zones were delineated, belt transect data were collected. The belt transect is a transect line of varying width (belt width) that forms a long, thin, rectangular plot divided into smaller sampling areas called quadrats (Bonham 2013). Quadrats within the belt transect correspond to the spatial extent of plant communities or transitions between plant communities. The belt transect width varies depending on the type of plant community to be sampled. For example, a belt width of 10 ft (5 ft on each side of the transect line) is used for sampling herbaceous plant communities of a floodplain marsh (Figure C-1). A belt width of 50 ft (25 ft on each side of the line) is used to adequately characterize a forested community (e.g., hydric hammock, hardwood swamp). Plants were identified down to lowest possible taxon, and the percent cover of plant species were estimated if they occurred within the established belt width (i.e., quadrat) for the plant community under evaluation.

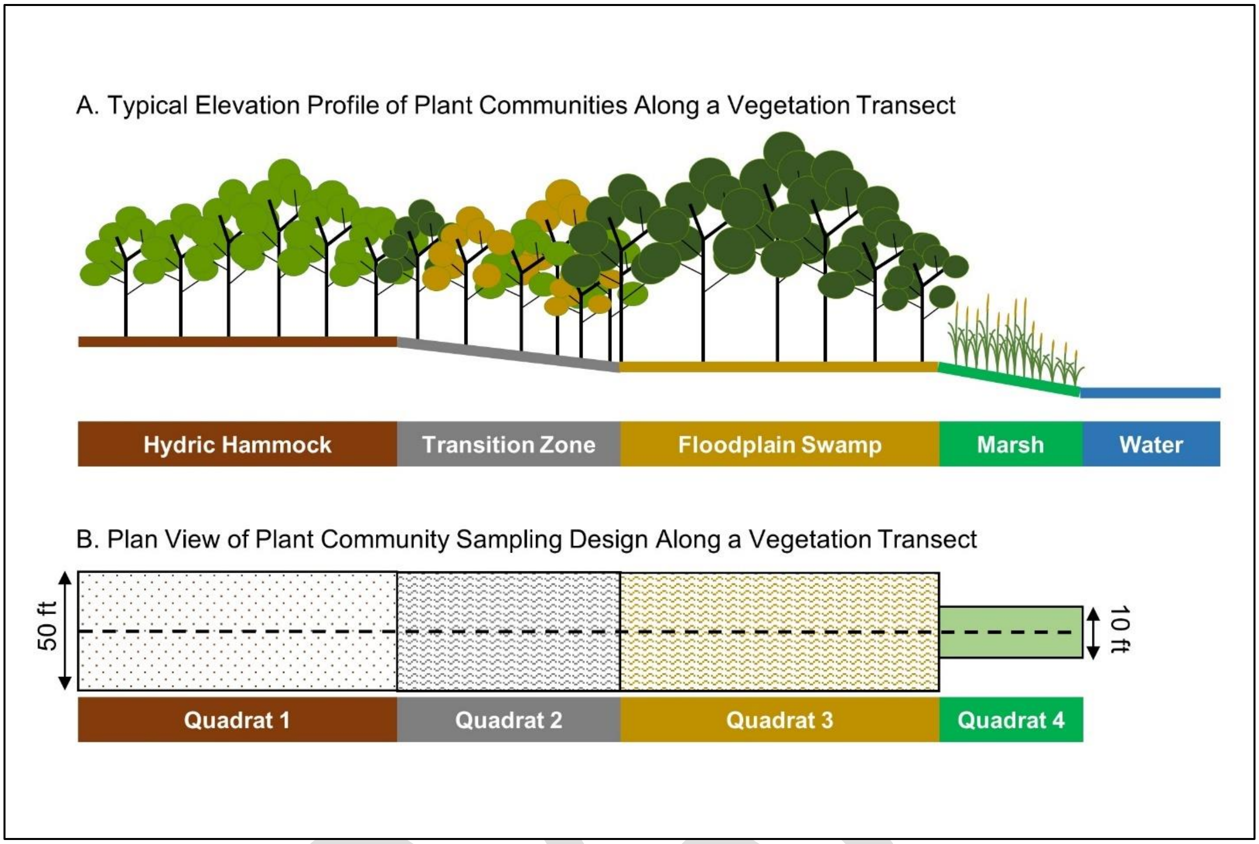

Figure C-1. Example of belt transect within forested and herbaceous plant communities.

Percent cover is defined as the vertical projection of the crown or shoot area of a plant to the ground surface, expressed as a percentage of the quadrat area (Barbour et al. 1999). Percent cover, as a measure of plant distribution, is often considered of greater ecological significance than density largely because percent cover gives a better measure of plant biomass than the number of individuals (Bonham 2013). The canopies of the plants inside the quadrat often overlap, so the total percent cover of plants in a single quadrat will frequently sum to more than 100%. Percent cover was estimated visually using cover classes, or ranges of percent cover, that standardize vegetation collection among observers (Mueller-Dombois and Ellenberg 1974; Bonham 2013). The cover classes and percent cover ranges were estimated using a modified Daubenmire scale (Daubenmire 1959; Baily and Poulton 1968), where the lowest cover class is split between presence only and rare coverage (Table C-1).

Table C-1. Vegetation cover classes with class midpoint and descriptor.

Cover Class	Percent Cover Range	Midpoint	Description
X	0 – 1	0.5	Present
1	1 – 5	3	Rare
2	5 – 25	15	Scattered
3	25 – 50	37.5	Numerous
4	50 – 75	62.5	Abundant
5	75 – 95	85	Codominant
6	95 – 100	97.5	Dominant

Site Survey

Once a given transect was established and vegetation data collected, the minimum vegetation necessary was trimmed to allow a line-of-sight along the length of the transect. Elevation measurements were surveyed at 5-ft intervals on the ground along the length of the transect using a rod and transit level, recorded to the nearest hundredth of a foot. Additional elevations were measured at obvious elevation changes, vegetation community changes, and soil changes. Elevations were calculated relative to a datum associated with established benchmarks near each transect. SJRWMD uses the North American Vertical Datum of 1988 (NAVD88) as its standard datum. All elevations referenced within this document were calculated relative to this datum.

Latitude and longitude data were also collected using a global positioning system (GPS) receiver at selected points along the length of each transect. These data were used to create accurate maps of transect locations, locate specific features along the transects, and facilitate recovering transect locations in the future.

Soil Sampling Procedures

The presence and depth of organic soils (histosols and histic epipedons) were the primary soil criteria used for MFLs determinations (whether event-based or exceedance-based). In addition to these organic soil indicators (i.e., A1 and A2), the extent of other hydric soil indicators (HI) observed along field transects were also documented. Soil profiles were described following standard Natural Resources Conservation Service (NRCS) procedures (USDA, NRCS 2018; Schoeneberger et al. 2012). Each soil horizon (layer with homogenous, distinctive properties) was generally described with respect to thickness, texture, Munsell color (Kollmorgen Corp. 1992), percent organic coating, and features (depletions, mottles, redox concentrations, inclusions, organic bodies, or any other notable feature).

Soil borings were taken every 5 ft along transects to sample all significant geomorphic features, landscape positions, and plant communities. Permanently flooded areas such as deep marshes are generally not sampled due to difficulty in obtaining samples. Soil series designations were compared to mapped NRCS soils, useful in MFLs determinations when applying NRCS soil hydrologic data.

The procedure to document hydric soils included:

- Digging a hole and describing the soil profile to a depth of at least 10-16 inches (in.), and using a completed soil description, specifying which hydric soil indicators have been matched;
- Performing deeper examination of the soil where field indicators are not easily seen within 16 in. of the soil surface. It is always recommended that soils be excavated and described as deep as necessary to make reliable interpretations and classification; and
- Paying particular attention to changes in microtopography over short distances since small elevation changes may result in repetitive sequences of hydric/nonhydric soils and the delineation of individual areas of hydric and nonhydric soils may be difficult (Hurt et al. 1998).

Environmental Transect Results and Discussion

Lake Prevatt Mapped Wetland Community Data

A detailed, vegetation map (Figure C-2) was created for Lake Prevatt from January 2021 aerial imagery (FDOT 2021) when water levels were approximately 55.5 ft NAVD88. This elevation is exceeded only 38.3% of the time in the historical record and is just under the lake outflow elevation of 55.6 ft NAVD88. At a water level of 55.5 ft NAVD88, Lake Prevatt has a surface area of approximately 100.6 acres.

All communities visible in aerial imagery within a 67.3 ft NAVD88 elevation bound (128.5 acres) were mapped to encompass the range of water level fluctuation at the site. As of 2021, the majority of Lake Prevatt was composed of Deep Marsh – Floating habitat (36.0 acres) followed by Open Water (26 acres) and Deep Marsh – Emergent habitat (18.5 acres; Table C-2). The littoral zone of the lake was comprised of Shrub Swamp dominated by buttonbush (11.1 acres) and Willow Scrub-shrub (1.2 acres) with scattered Shallow Marsh communities (2.1 acres). The area directly surrounding the lake consisted mainly of Oak Hammock (30.0 acres) with small amounts of mixed Hardwood communities (3.5 acres) and anthropogenic disturbance from the camp structures on the west side of the South Lobe (0.1 acres). The broad-scale description of vegetation communities present around the lake aided the process of transect establishment to maximize the number of possible vegetation communities to be captured by environmental transects. While present during vegetation mapping in 2021, the historic aerial imagery in Figure C-3 displays the variation in littoral communities that occurs with regular, large water level fluctuations.

Table C-2. Lake Prevatt vegetation communities within 67.3 ft NAVD88 and their respective areas from 2021 aerial imagery.

Vegetation Community	Area (acres)
Deep Marsh – Floating	36.0
Oak Hammock	30.0
Open Water	26.0
Deep Marsh – Emergent	18.5
Buttonbush Shrub	11.1
Mixed Hardwood – Oak Hammock	3.5
Shallow Marsh	2.1
Willow Scrub-shrub	1.2
Disturbed (anthropogenic)	0.1

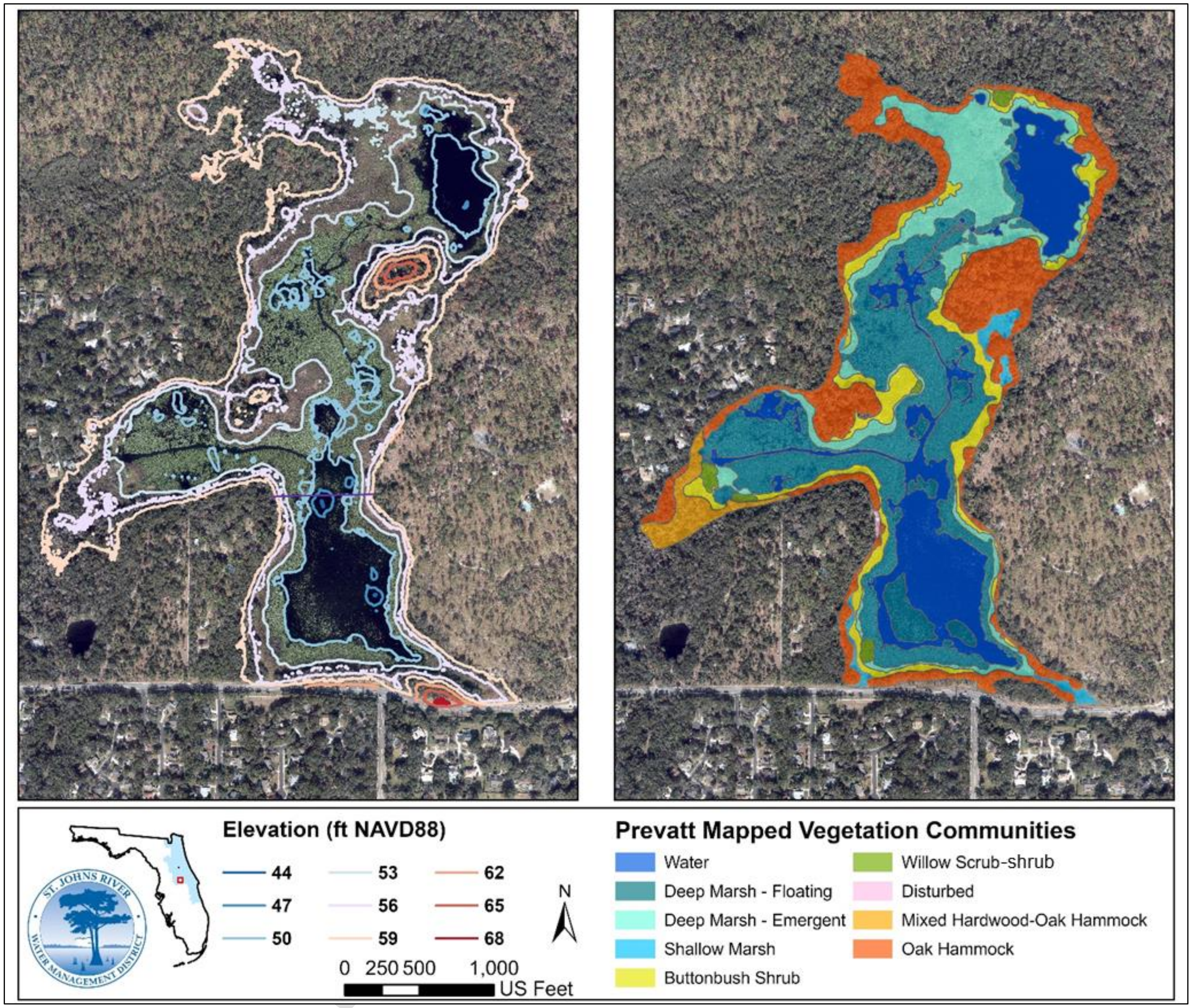

Figure C-2. Lake Prevatt 3-ft elevation contours (left) and vegetation communities within 67.3 ft NAVD88 (right).

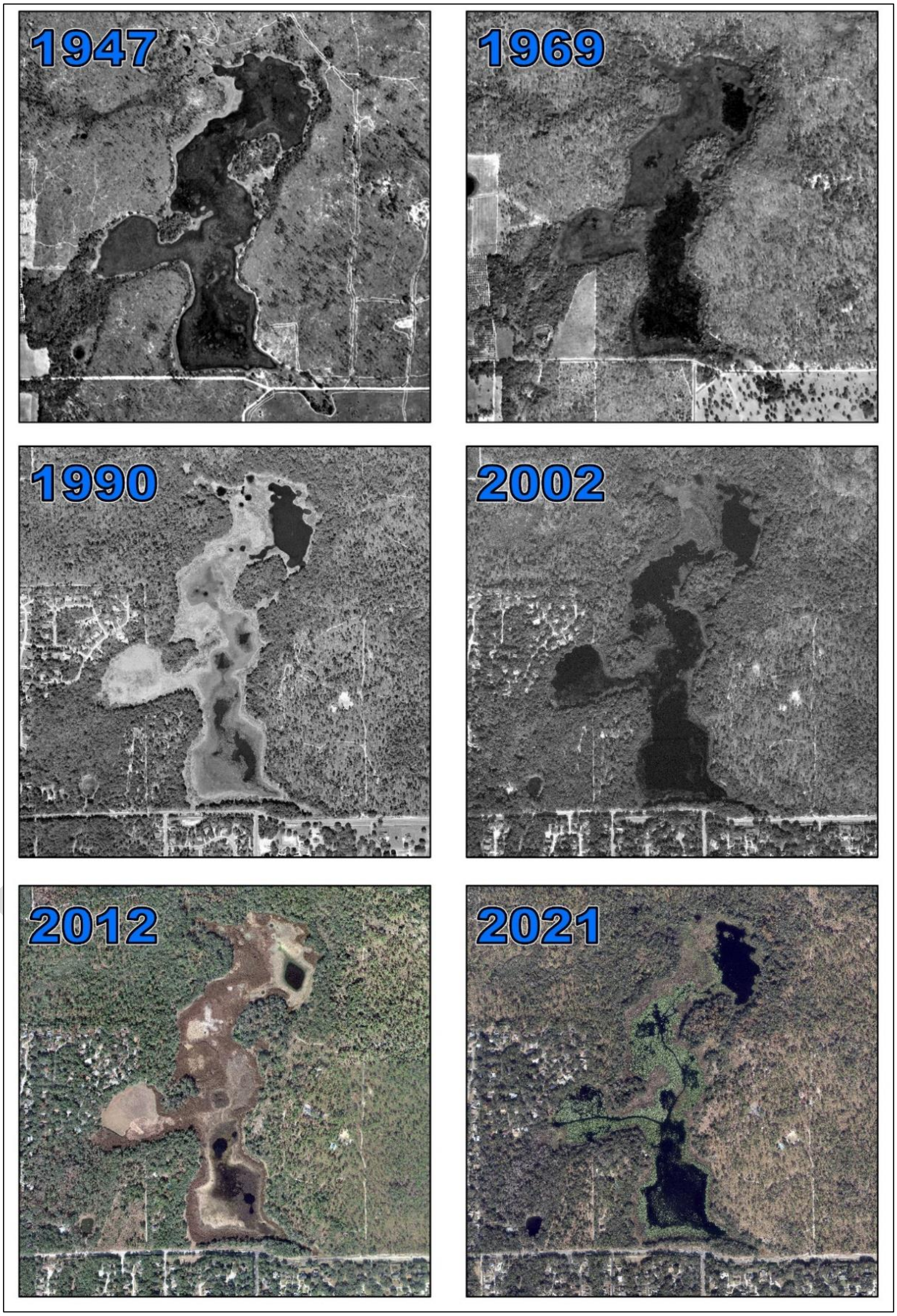

Figure C-32. Aerial imagery of Lake Prevatt from 1947 – 2021 showing fluctuations of high and low water levels.

Field Data

Elevation, soil, and vegetation data were collected at three environmental transects at Lake Prevatt (Table C-3, Figure C-4). Vegetation and elevation field data for all transects were collected from June – September 2022 when water levels were 52.1 ft NAVD88 on average. Soils data were collected in September 2022 for Transect 1 and October of 2023 for Transects 2 and 3 due to the arrival of Hurricane Ian in late September 2022, increasing water levels temporarily to 57 ft NAVD88. All three transects were established in the South Lobe of Lake Prevatt as sinkhole features in the South Lobe produce an overall deeper bathymetric profile, allowing for a wider range of water level fluctuation as compared to the North Lobe.

Throughout the period of data collection, from 2022 – 2023, a water fluctuation of over 5 ft was witnessed along with the resulting changes in vegetation. While all vegetation data were collected in 2022 before a marked rise in water levels, the extent of shallow and deep marsh communities were observed to be quite ephemeral. This pattern was not unexpected as large lake level fluctuations are inherent in sandhill and sinkhole lakes; however, the shallow bathymetric profile of Lake Prevatt combined with this fluctuation was noted for vegetation analysis as transient marsh communities were observed to be a constant feature of the system.

Table C-3. Location of field transects used for Lake Prevatt MFLs.

Transect	Latitude – Longitude (Begin)	Latitude – Longitude (End)	Transect Length (ft)
1	28° 42' 46.83" N 81° 29 ' 20.0 " W	28° 42' 41.88" N 81° 29 ' 23.39" W	592
2	28° 42' 22.33" N 81° 29' 21.10" W	28° 42' 25.30" N 81° 29' 21.0" W	300
3	28° 42' 35.56" N 81° 29' 26.96" W	28° 42' 33.22" N 81° 29' 22.35" W	580

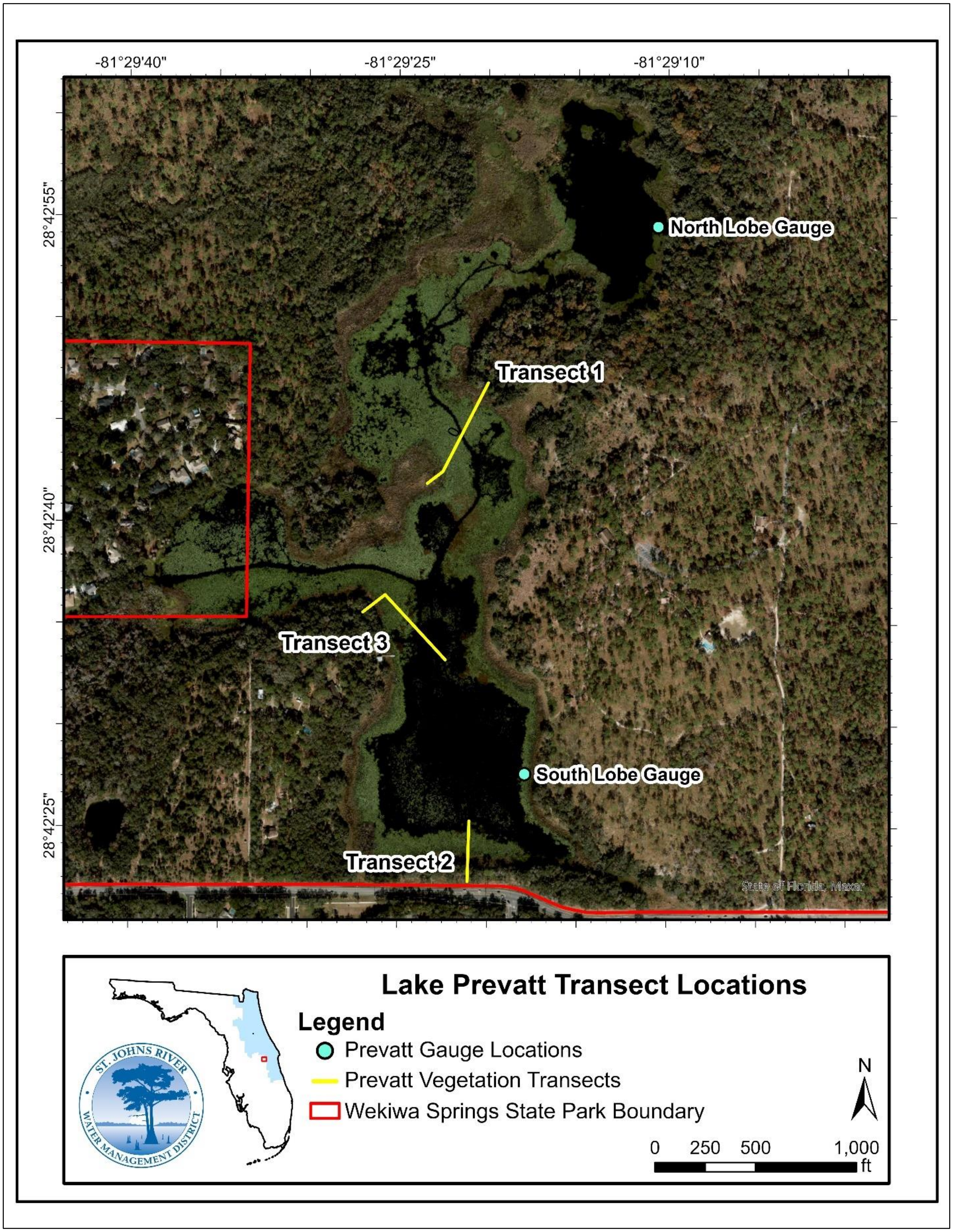

Figure C-4. Lake Prevatt environmental transect and gauge locations.

Transect 1

Transect 1 was established in June 2022 beginning on the east side of Lake Prevatt within Wekiwa Springs State Park. The transect extended southwest (211°) from a peninsula in an area mapped as Oak Hammock, across the body of the lake (Figure C-2, Figure C-4). A small turn was placed at station 498 ft to turn the transect toward the Willow Scrub-shrub community (237°) to the west. Transect 1 terminated at 592 ft in a vegetation community mapped as Willow Scrub-shrub on the west side of Lake Prevatt.

<u>Vegetation</u>

Lake Prevatt Transect 1 captured the frequent shallow marsh and deep marsh transitions that occurred through much of the northern half of Prevatt's south lobe. No open water was reached along this transect, but rather the transect traversed the wide and shallow marsh transitions of the lake (Figure C-2, Table C-4, Figure C-5).

Transect 1 (Figure C-6) began in a Mesic Hammock community (stations 0 – 25 ft) on the southern side of the Mesic Hammock peninsula on Prevatt's east side (Figure C-2, Figure C-4). Canopy cover in the Mesic Hammock community had abundant slash pine (*Pinus elliottii*) and live oak (*Quercus virginiana*). The shrub and groundcover layers had codominant saw palmetto (*Serenoa repens*) with scattered common persimmon (*Diospyros virginiana*).

The transect traversed from the Mesic Hammock in a southwesterly direction through a Transition Zone (stations 25 – 60 ft) where canopy vegetation was absent. The shrub layer transitioned to include only scattered buttonbush (*Cephalanthus occidentalis*), and the groundcover comprised of codominant maidencane (*Panicum hemitomon*) with numerous Elliot's milkpea (*Galactia elliottii*).

The Transition Zone gave way to a Transitional Shrub Swamp community (stations 60 – 81 ft). The Transitional Shrub community was composed of numerous buttonbush with a groundcover composed of numerous maidencane and scattered dog fennel (*Eupatorium capillifolium*), dotted smartweed (*Persicaria punctata*), and harsh vervain (*Verbena scabra*).

Continuing downslope, the Transitional Shrub Zone of Transect 1 shifted to Shrub Swamp 1 (stations 81 – 118 ft). This community was covered with codominant buttonbush in the shrub layer. The groundcover of this community was covered with abundant dog fennel and scattered dotted smartweed.

Shallow Marsh 1 (stations 118 – 140 ft) began at the downslope edge of Shrub Swamp 1. This community had only groundcover of abundant dotted smartweed intermixed with scattered fragrant flatsedge (*Cyperus odoratus*) and coast cockspur (*Echinochloa walteri*).

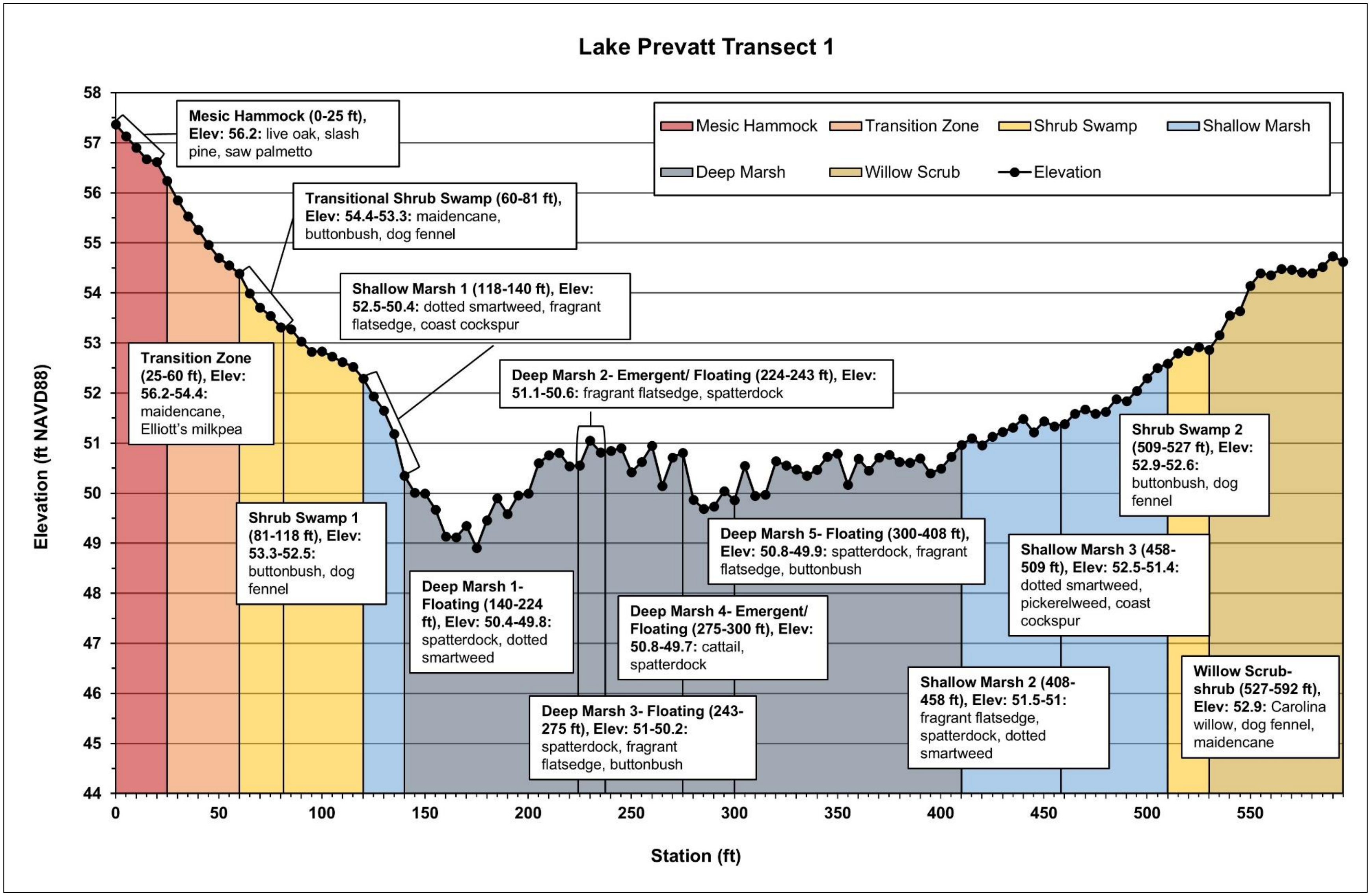

Figure C-5. Lake Prevatt Transect 1 topography and vegetation communities.

The following Deep Marsh communities crossing the central portion of Lake Prevatt oscillated from Floating to Emergent/Floating. Deep Marsh 1 (stations 140 – 224 ft) was characterized by numerous spatterdock (*Nuphar advena*) with scattered dotted smartweed. Deep Marsh 2 – Emergent/Floating (stations 224 – 243 ft) was covered with abundant fragrant flatsedge, numerous spatterdock, and scattered dotted smartweed. The transition to Deep Marsh 3 – Floating (stations 243 – 275 ft) resembled the community composition of Deep Marsh 1. From stations 275 – 300 ft, the Deep Marsh 4 – Emergent/Floating community was dominated by cattail (*Typha domingensis*) with scattered spatterdock. The final deep marsh community, Deep Marsh 5 – Floating (stations 300 – 408 ft), was composed of numerous spatterdock and scattered dotted smartweed.

On the western shore of Lake Prevatt, the deep marsh communities transitioned to Shallow Marsh 2 (stations 408 – 458 ft). This community was dominated by fragrant flatsedge with numerous spatterdock and dotted smartweed. Additionally in this community was scattered buttonbush and fall panicgrass (*Panicum dichotomiflorum*).

Shallow Marsh 2 transitioned to Shallow Marsh 3 from stations 458 – 509 ft. The dominant vegetation shifted to dotted smartweed. Scattered in the smartweed was buttonbush, coast cockspur, spatterdock, and pickerelweed (*Pontederia cordata*).

The transect traversed further upslope into Shrub Swamp 2 (stations 509 – 527) from the shallow marshes. Here, buttonbush was codominant with numerous dog fennel throughout. Scattered within this community was corkystem passionflower (*Passiflora suberosa*) and dotted smartweed.

Transect 1 of Lake Prevatt ended in a Willow Scrub-shrub community (stations 527 – 592 ft) with a canopy of abundant Carolina willow (*Salix caroliniana*) and scattered Chinese tallow (*Triadica sebifera*). The understory of this community was covered by codominant dog fennel and had abundant maidencane. Scattered throughout the understory was dotted smartweed. Additional plant species observed along Lake Prevatt Transect 1 may be found in Table C-5.

Table C-4. Lake Prevatt Transect 1 vegetation community statistics.

Vegetation Community	Station Distance (ft)	Mean (ft NAVD 88)	Median (ft NAVD 88)	Min (ft NAVD 88)	Max (ft NAVD 88)
Mesic Hammock	0 – 25			56.2	
Transition Zone	25 – 60	55.2	55.1	54.4	56.2
Transitional Shrub Swamp	60 – 81	53.8	53.7	53.3	54.4
Shrub Swamp 1	81 – 118	52.8	52.8	52.3	53.3
Shallow Marsh 1	118 – 140	51.5	51.7	50.4	52.3
Deep Marsh 1 – Floating	140 – 224	49.9	50.0	48.9	50.8
Deep Marsh 2 – Emergent/Floating	224 – 243	50.8	50.9	50.6	51.1
Deep Marsh 3 – Floating	243 – 275	50.7	50.7	50.2	51.0
Deep Marsh 4 – Emergent/Floating	275 – 300	50.0	49.9	49.7	50.8
Deep Marsh 5 – Floating	300 – 408	50.5	50.6	49.9	51.0
Shallow Marsh 2	408 – 458	51.2	51.2	51.0	51.5
Shallow Marsh 3	458 – 509	51.9	51.8	51.4	52.6
Shrub Swamp 2	509 – 527	52.8	52.8	52.6	52.9
Willow Scrub	527 – 592			52.9	
Deep organic soils (≥ 8" thick)	140 – 210 255 270 – 305 330 – 335	50.0	50.0	48.9	50.8

Prevatt T1 station 20 looking northeast into Mesic Hammock

Prevatt T1 station 60 looking southwest into Transitional Shrub Swamp and Shrub Swamp 1

Figure C-6. Lake Prevatt Transect 1 photos.

Prevatt T1 station 125 looking northeast into Shallow Marsh 1 and Shrub Swamp 1

Prevatt T1 10 ft west of station 150 looking east into Shallow Marsh 1/Deep Marsh 1 Transition

Figure C-6. Continued. Lake Prevatt Transect 1.

Prevatt T1 station 140 looking southwest into Deep Marsh 1

Prevatt T1 station 408 looking northeast into Deep Marsh 5

Figure C-6. Continued. Lake Prevatt Transect 1.

Prevatt T1 station 458 looking northeast into Shallow Marsh 2

Prevatt T1 station 458 looking southwest into Shallow Marsh 3

Figure C-6. Continued. Lake Prevatt Transect 1.

Prevatt T1 station 509 looking southwest into Shrub Swamp 2

Figure C-6. Continued. Lake Prevatt Transect 1.

Prevatt T1 station 570 looking northeast into Willow Scrub-shrub

Figure C-6. Continued. Lake Prevatt Transect 1.

Table C-5. Vegetation cover estimates for Lake Prevatt Transect 1, Orange County, FL.

Scientific name	**Common name**	Community[1]	MH	TZ	TSS	SS1	SM1	DM1	DM2	DM3	DM4	DM5	SM2	SM3	SS2	WS
		From	0	25	60	81	118	140	224	243	275	300	408	458	509	527
		To	25	60	81	118	140	224	243	275	300	408	458	509	527	592
		NWPL Code[2]	**Plant Species Cover Estimates[3]**													
Andropogon glomeratus	bushy bluestem	FACW													X	
Callicarpa americana	American beautyberry	FACU	X													
Cephalanthus occidentalis	buttonbush	OBL		2	3	5		1		1		1	2	2	5	1
Cyperus distinctus	swamp flatsedge	FACW												X		X
Cyperus odoratus	fragrant flatsedge	FACW					2	1	4	1		1	6	1		
Cyperus polystachyos	manyspike flatsedge	FACW		X												
Cyperus virens	green flatsedge	FACW		X												
Digitaria ciliaris	southern crabgrass	FACU		X												
Drymaria cordata	drymary	FAC													X	
Diospyros virginiana	common persimmon	FAC	2													
Echinochloa walteri	coast cockspur	OBL					2							2		
Eleocharis vivipara	viviparous spikerush	OBL						1	X	1		1	1	X		

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SM1	DM1	DM2	DM3	DM4	DM5	SM2	SM3	SS2	WS
		From	0	25	60	81	118	140	224	243	275	300	408	458	509	527
		To	25	60	81	118	140	224	243	275	300	408	458	509	527	592
		NWPL Code[2]	**Plant Species Cover Estimates[3]**													
Eupatorium capillifolium	dog fennel	FACU			2	4	X						X	X	3	5
Eupatorium leptophyllum	false fennel	FACW							X							
Fimbristylis autumnalis	slender fimbry	OBL							1				1	X		
Galactia elliottii	Elliott’s milkpea	FACU		3												
Hypericum hypericoides	St. Andrew’s cross	FAC		X												
Mikania scandens	climbing hempvine	FACW		2	2	2							1	1	X	
Morella cerifera	wax myrtle	FAC		X												
Nephrolepis exaltata	sword fern	FAC	X													X
Nuphar advena	spatterdock	OBL						3	3	3	2	3	3	2	1	
Panicum dichotomiflorum	fall panicgrass	FACW					1						2	1		
Panicum hemitomon	maidencane	OBL		5	3	1										4
Passiflora suberosa	corkystem passionflower	UPL													2	1
Persicaria punctata	dotted smartweed	OBL		1	2	2	4	2	2	2	1	2	3	6	2	2

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SM1	DM1	DM2	DM3	DM4	DM5	SM2	SM3	SS2	WS
		From	0	25	60	81	118	140	224	243	275	300	408	458	509	527
		To	25	60	81	118	140	224	243	275	300	408	458	509	527	592
		NWPL Code[2]	**Plant Species Cover Estimates[3]**													
Pinus elliottii	slash pine	FACW	4													
Pontederia cordata	pickerelweed	OBL				X	1		X		1		1	2	X	
Quercus virginiana	live oak	FACU	4													
Rhynchospora nitens	shortbeak beaksedge	OBL												X		
Sabal palmetto	cabbage palm	FAC	3	1												
Salix caroliniana	Carolina willow	OBL														4
Serenoa repens	saw palmetto	FACU	5													
Sesbania herbacea	danglepod	FACW						X	1	X		X	1	X		
Setaria magna	giant bristlegrass	FACW			1	1									1	1
Setaria parviflora	yellow bristlegrass	FACW		X												
Thelypteris hispidula	hairy maiden fern	FACW														X
Thelypteris palustris	marsh fern	OBL													X	
Triadica sebifera	Chinese tallow	FAC														2

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SM1	DM1	DM2	DM3	DM4	DM5	SM2	SM3	SS2	WS
		From	0	25	60	81	118	140	224	243	275	300	408	458	509	527
		To	25	60	81	118	140	224	243	275	300	408	458	509	527	592
		NWPL Code[2]	**Plant Species Cover Estimates[3]**													
Typha domingensis	cattail	OBL		X							6			X		
Verbena scabra	harsh vervain	FACW			2											
Vitis rotundifolia	muscadine	FAC	1													
Woodwardia virginica	Virginia chain fern	OBL														X

[1]**Community:** MH = Mesic Hammock, TZ = Transition Zone, TSS = Transitional Shrub Swamp, SS = Shrub Swamp, SM = Shallow Marsh, DM = Deep Marsh, WS = Willow Scrub

[2]**NWPL** codes are taken from the National Wetland Plant List (NWPL; USDA NRCS 2016). Species not listed or almost always occur in non-wetlands under natural conditions are considered **Upland (UPL)**. **Facultative Upland (FACU) –** Plants usually occurring in non-wetlands but occasionally found in wetlands. **Facultative (FAC)** – Plants with similar likelihood of occurring in both wetlands and uplands. **Facultative Wet (FACW)** – Plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or saturation but may also occur in uplands. **Obligate (OBL)** – Plants that are found or achieve their greatest abundance in an area that is subject to surface water flooding and/or saturation; rarely occur in uplands.

3**Plant Species Cover Estimates:** Areal extent of vegetation species along the transect within a given vegetation community where X=<1%, 1=1 to 5%, 2=5 to 25%, 3=25 to 50%, 4=50 to 75%, 5=75 to 95% and 6=95-100%.

Soils

Soils at Lake Prevatt Transect 1 were mapped as Candler fine sand in the very beginning of the transect and Basinger fine sand, frequently ponded for the remainder of the transect (Figure C-7). Field soil samples may have varied from the SSURGO map delineation due to the mapping scale; most soils samples resembled the Basinger series over the Candler fine sand series, likely to be hydric and frequently ponded (USDA, NRCS 2014). Soils were sampled every 5 ft along Lake Prevatt Transect 1 where water or root refusal did not occur (Figure C-8); five locations were described in depth where major changes in hydric soil indicators occurred (Table C-6).

Hydric soils were documented in all soils sampled in Transect 1. Beginning in the Mesic Hammock community (stations 0 – 25 ft), soil sampled at 5-ft intervals throughout this vegetation zone were sandy with a stripped matrix hyrdric soil indicator (S6; stripping within 6 in. of the soil surface). A detailed description collected at station 5 ft noted the stripped matrix indicator beginning at 3.5 in. below the soil surface.

Continuing downslope, stripped matrix continued through the Mesic Hammock community, into the vegetation Transition Zone (stations 25 – 60 ft). At station 55 ft, sandy soils with stripped matrix starting 1.5 in. below the surface also picked up the indicator polyvalue below surface (S8) starting at the soil surface; the S8 indicator remained present through the end of the Mesic Hammock community. The spodic horizon was met at 20 in. below soil surface in this profile.

In the Shrub Swamp 1 vegetation community (stations 81 – 118 ft), additional hydric soil indicators were recorded in a soil profile from station 85 ft. This location was the first where muck at the soil surface (A8) and 5-centimeter (cm) mucky mineral (A7) indicators were documented. These indicators were accompanied by the presence of stripped matrix (S6), dark surface (S7), and polyvalue below surface (S8). The presence of these indicators and muck at the surface are hydric soil indicators, but muck depth must equal at least 8 in. to classify the soils as organic for use in the minimum average deep organics MFL metric.

The first indication of deep organics on Transect 1 occurred at station 140 ft at the Shallow Marsh 1 – Deep Marsh 1 community boundary. Here, a histosol (A1) was met with muck texture recorded within the top 17 in. below the soil surface. A layer of dark sand under the 17 in. of muck allowed for the additional hydric indicators of muck presence (A8) and dark surface (S7) to be present. After station 140 ft, water refusal inhibited the collection of soil data until station 200 ft. As the elevations between 140 and 195 ft were lower than that of station 140 ft where 17 in. of muck were recorded, histosol extent was assumed for the stations of water refusal until confirmed again at station 200 ft.

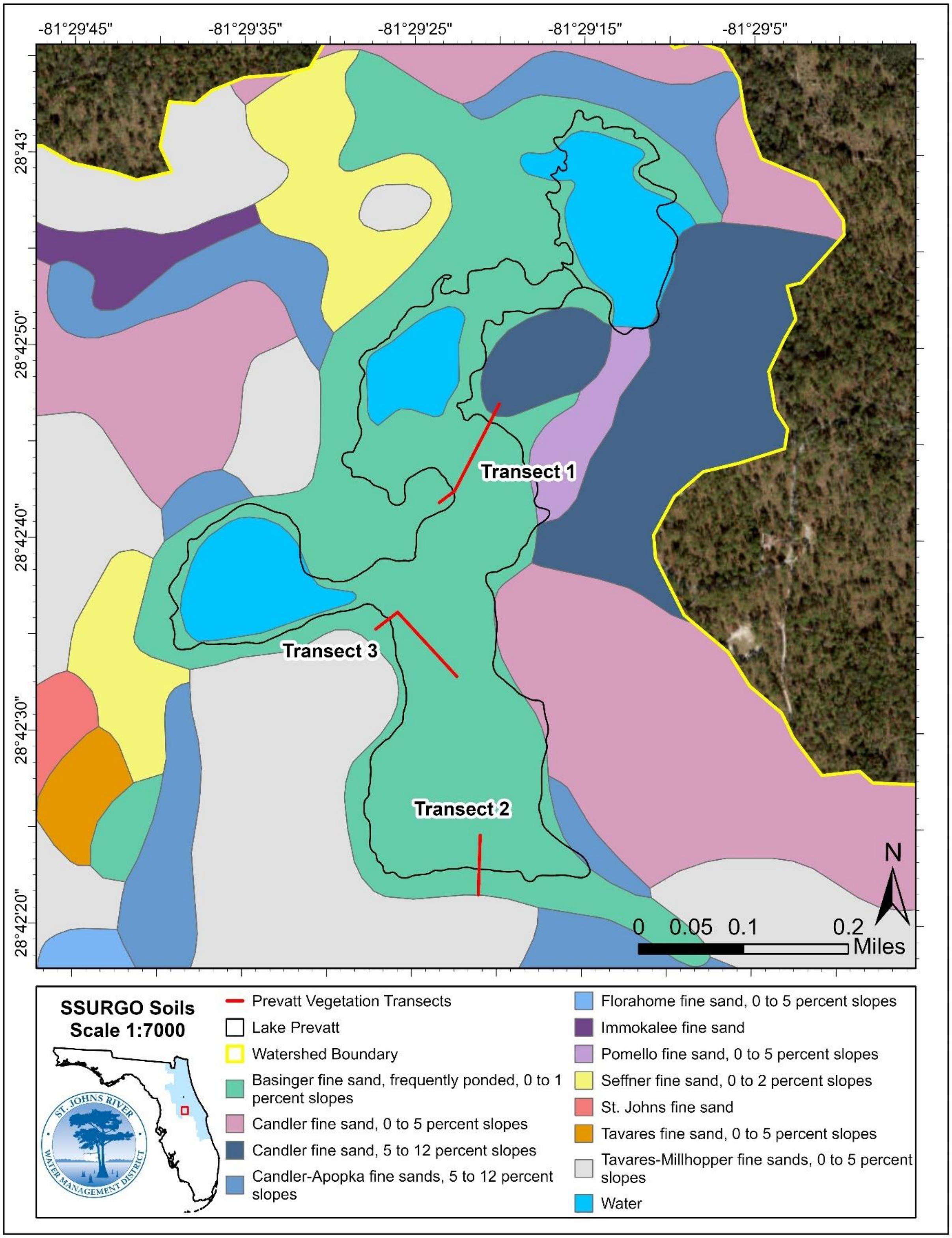

Figure C-7. SSURGO soil map at Lake Prevatt.

Histosols (A1) reduced in depth to a histic epipedon at station 210 ft in the Deep Marsh 1 community. Ten in. of muck at the surface was recorded here, underlain by an accumulation horizon of sand with 99% organic coating. After station 210 ft, muck presence (A8) was recorded for additional 15 ft when sandy indicators: stripped matrix (S6), dark surface (S7), and polyvalue below surface (S8), resumed with increased elevations of Deep Marsh 2 and Deep Marsh 3.

The return of histosols (A1) or histic epipedons (A2) occurred within Deep Marsh 4 (stations 275 – 300 ft) and parts of Deep Marsh 5 (stations 300 – 408 ft). Deep organics occurred less often in Deep Marsh 5 than Deep Marsh 4 and were not recorded at all past station 335 ft. The maximum and mean elevations of deep organics at Transect 1 were 50.8 ft NAVD88 and 50.0 ft NAVD88 respectively. Soil data collection on Transect 1 was halted for collection for a later date past station 405 ft, but was ultimately unable to be collected as water levels rose too high for data collection after the arrival of Hurricane Ian in September of 2022. In summary, all soils analyzed along Transect 1 were hydric, but deep organic soils only occurred in elevations below 50.8 ft NAVD88, supporting longer durations of inundation at these elevations.

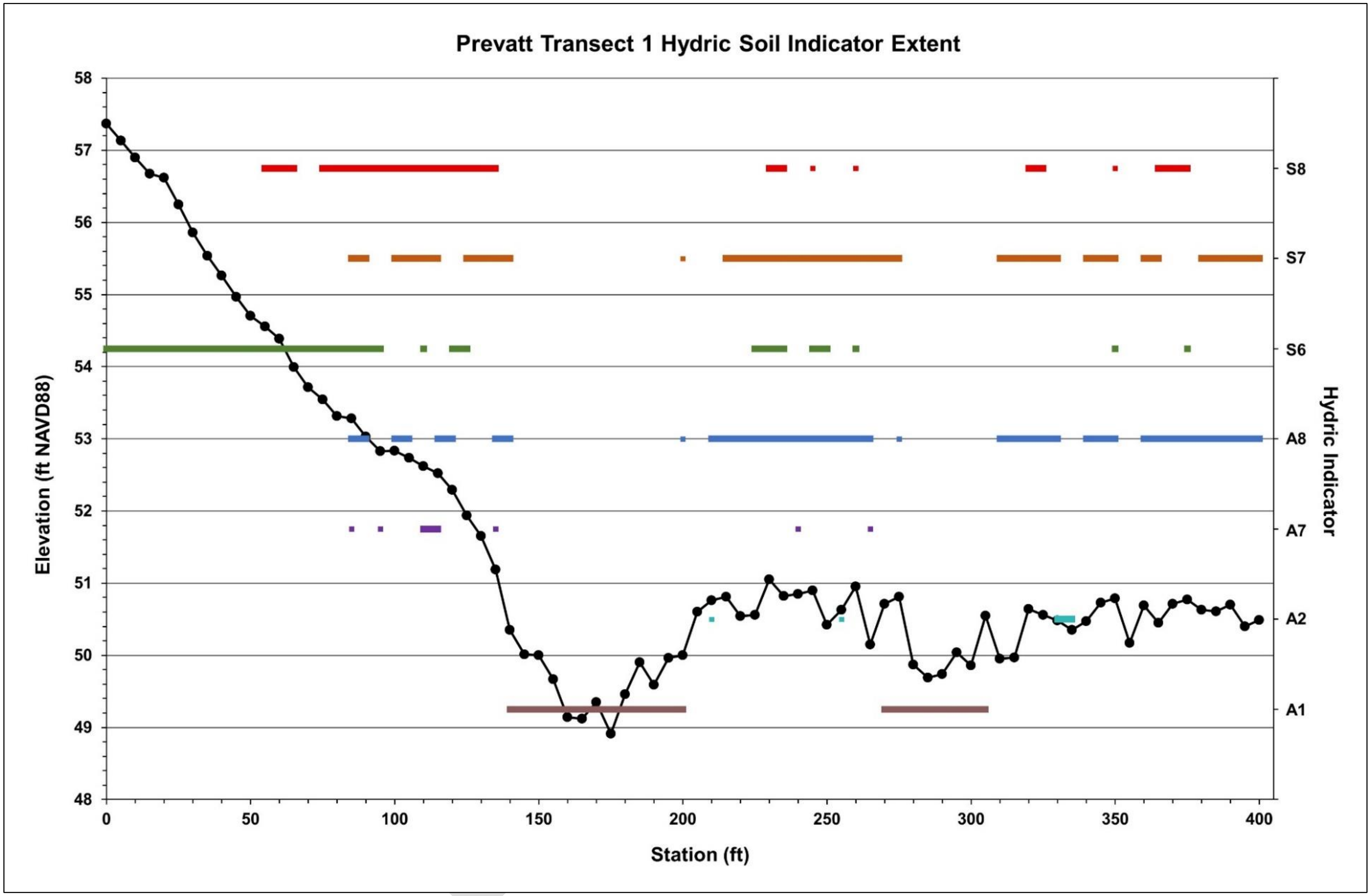

Figure C-8. Extent of hydric soil indicators with ground elevation along Lake Prevatt Transect 1. Stations after 400 ft were met with water refusal when data collection resumed post Hurricane Ian.

Table C-6. Lake Prevatt Transect 1 detailed soils descriptions.

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
5	Mesic Hammock	Stripped Matrix	A1	0 – 0.25”	10YR 2/1	Sand	OC:95%; aggregated balls of organic
			A2	0.25 – 3.5”	10YR 4/1	Sand	Mottle: 10YR 2/1, 30%, clear, round Mottle: 10YR 6/1, 15% clear, round
			E1	3.5 – 6.5”	10YR 4/1	Sand	Mottle: 10YR 3/1, 20%, clear, round Depletion: 10YR 6/1, 25%, diffuse, round
			E2	6.5 – 14”	10YR 6/1	Sand	Mottle: 10YR 4/1, 10%, diffuse, round Depletion: 10YR 7/1, 25%, diffuse, round
55	Transition Zone	Stripped Matrix Polyvalue Below Surface	A	0 – 1.5”	10YR 2/1	Sand	OC: 80%
			AE	1.5 – 5.75”	10YR 3/1	Sand	OC: <50% Mottle: 10YR 2/1, 15%, sharp, round Mottle: 10YR 6/1, 30%, clear, round Depletion: 10YR 5/1, 10%, diffuse, round
			E1	5.75 – 8”	10YR 4/1	Sand	Mottle: 10YR 3/1, 25%, diffuse, round Depletion: 10YR 5/1, 10%, diffuse, round Depletion: 10YR 6/1, 20%, clear, round
			E2	8 – 9.5”	10YR 5/1	Sand	Depletion: 10YR 6/1, 15%, diffuse, round Mottle: 10YR 3/1, 20%, diffuse, round Mottle: 10YR 4/1, 10%, diffuse, round
			E/B	9.5 – 11.5”	E: 10YR 5/1 B: 10YR 3/2	Sand	(E) Depletion: 10YR 6/1, 15%, diffuse, round (E) Mottle: 10YR 3/1, 10%, diffuse, round (B) Depletion: 10YR 5/2, 20%, diffuse, round
			B	11.5 – 15”	10YR 3/2	Sand	Depletion: 10YR 5/2, 20%, diffuse, round
			Bh met at 20 inches				

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
85	Shrub Swamp 1	5-cm Mucky Mineral Muck Presence Stripped Matrix Dark Surface Polyvalue Below Surface	Oa	0 – 0.5"	10YR 2/1	Muck	OC: 99%
			A	0.5 – 4"	10YR 2/1	Mucky Mineral	OC: 99%
			E1	4 – 8.5"	10YR 4/1	Sand	Mottle: 10YR 2/1, 15%, clear, round Mottle: 10YR 3/1, 15%, clear, round Mottle: 10YR 7/1, 10%, clear, round Depletion: 10YR 5/1, 10%, diffuse, round
			E2	8.5 – 14"	10YR 4/1	Sand	Depletion: 10YR 5/1, 10%, diffuse, round Mottle: 10YR 3/1, 10%, diffuse, round
140	Shallow Marsh 1 Deep Marsh 1 Boundary	Histosol Muck Presence Dark Surface	Oa	0 – 17"	10YR 2/1	Muck	OC: 100%
			A	17 – 19"	10YR 2/1	Sand	OC: 75% Depletion: 10YR 3/1, 10%, diffuse, round
210	Deep Marsh 1	Histic Epipedon Muck Presence Dark Surface	Oa	0 – 10"	10YR 2/1	Muck	OC: 100%
			A	10 – 13.5"	10YR 2/1	Sand	OC: 99%

Transect 2

Transect 2 was established in August 2022 beginning on the south side of Lake Prevatt within Wekiwa Springs State Park. The transect extended north/northeast (12°) from the edge of the park access road along Welch Road through an area mapped as Oak Hammock (Figure C-2). Transect 2 traced a portion of the original Lake Prevatt MFL transect from 1997 (Hupalo 1997) that continued north before making a 90° turn to the east shore. Transect 2 established in 2022 terminated at 300 ft in a vegetation community mapped as Deep Marsh - Floating on the south side of Lake Prevatt. Elevation, vegetation, and preliminary soil (soils: up to station 170 ft) data were collected in 2022; however, the arrival of Hurricane Ian in September pushed off formal soil description data collection until October of 2023. Increased water levels limited the collection of formal soil descriptions in 2023 to the first 130 ft of transect.

<u>Vegetation</u>

Lake Prevatt Transect 2 captured the sharper elevation and vegetation transitions occurring on much of the south and east shores of the South Lobe. No open water was reached along this transect as at the time of establishment; open water only existed in the sinkhole features of the lake (Figure C-9, Table C-7, Figure C-10).

Transect 2 began in a Mesic Hammock community (stations 0 – 31 ft) on the northern side of the access road off of Prevatt's south side. Canopy cover in the Mesic Hammock community was comprised of codominant live oak with numerous slash pine. The shrub layer was mostly open with only scattered laurel oak (*Quercus laurifolia*). The groundcover of the Mesic Hammock community was covered with numerous saw palmetto with scattered American beautyberry (*Callicarpa americana*) and shiny blueberry (*Vaccinium myrsinites*).

Moving north, the Mesic Hammock community turned into a Transition Zone at station 31 ft (stations 31 – 78 ft). The canopy here was codominated by live oak with numerous laurel oak and slash pine. The shrub layer was covered with abundant cabbage palm, and the groundcover was composed of numerous maidencane and scattered false fennel (*Eupatorium leptophyllum*).

The Transition Zone gave way to a Transitional Shrub Swamp community (stations 78 – 98 ft) without canopy cover. The Transitional Shrub community was composed of numerous buttonbush with a groundcover codominated by maidencane and scattered paragrass (*Urochloa mutica*).

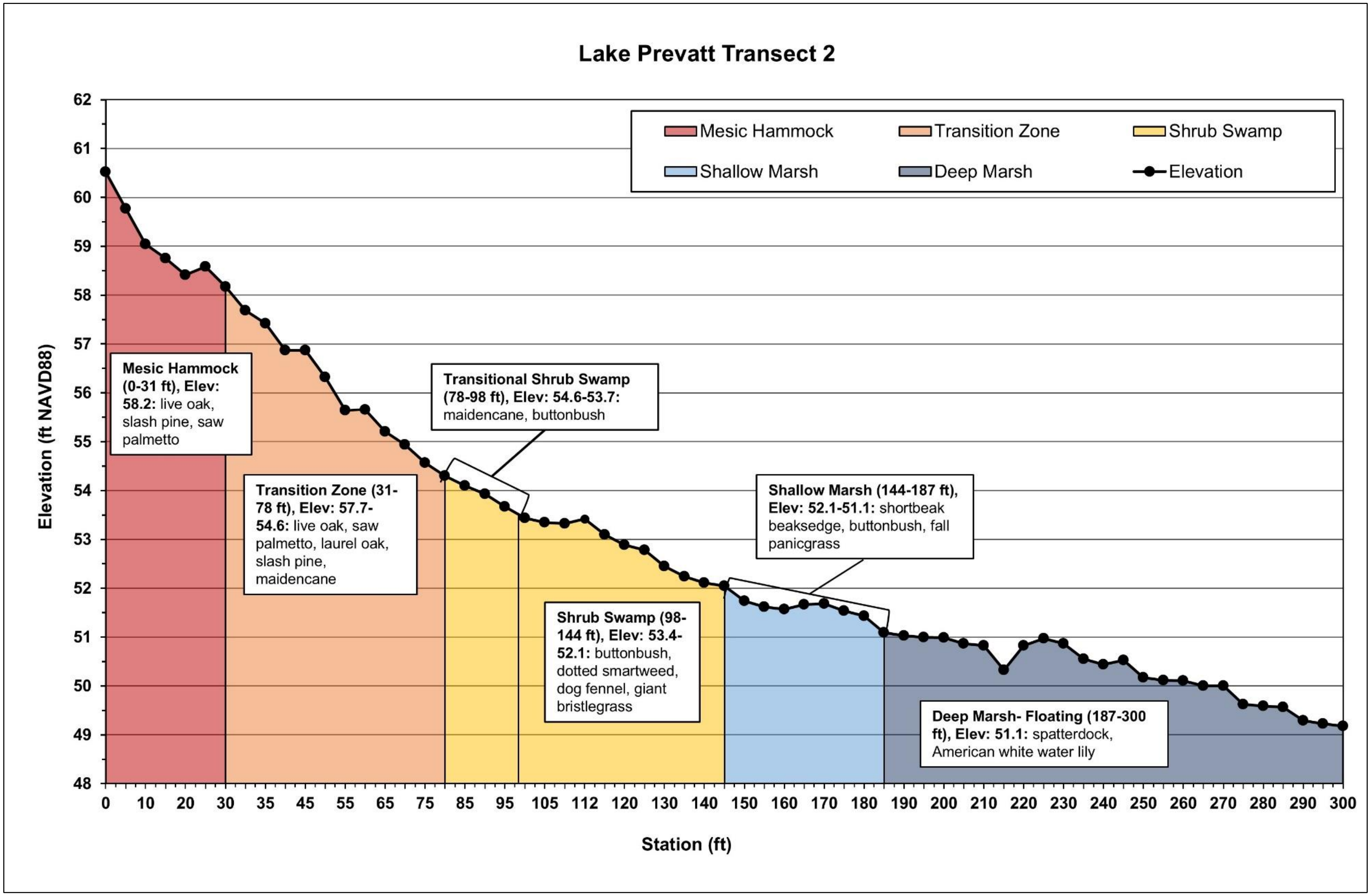

Figure C-9. Lake Prevatt Transect 2 with topography and vegetation communities.

Continuing downslope, the Transitional Shrub Zone of Transect 2 shifted to a Shrub Swamp community (stations 98 – 144 ft). This community was covered by abundant buttonbush in the shrub layer. The groundcover of this community was covered with abundant dotted smartweed, numerous dog fennel and giant bristlegrass (*Setaria magna*), and scattered paragrass, fall panicgrass, and pickerelweed.

A Shallow Marsh community began at station 144 ft (stations 144 – 187 ft). This community was covered with abundant shortbeak beaksedge (*Rhynchospora nitens*), numerous fall panicgrass, and scattered fragrant flatsedge, maidencane, and dotted smartweed. The transect ended in a Deep Marsh – Floating community (stations 187 – 300 ft) with a mix of numerous spatterdock and scattered American white water lily (*Nymphaea odorata*). Additional plant species observed along Lake Prevatt Transect 2 may be found in table C-8.

Table C-7. Lake Prevatt Transect 2 vegetation community statistics.

Vegetation Community	Station Distance (ft)	Mean (ft NAVD 88)	Median (ft NAVD 88)	Min (ft NAVD 88)	Max (ft NAVD 88)
Mesic Hammock	0 – 31			58.2	
Transition Zone	31 – 78	56.1	56.0	54.3	58.2
Transitional Shrub Swamp	78 – 98	53.9	53.9	53.4	54.3
Shrub Swamp	98 – 144	52.8	52.9	52.1	53.4
Shallow Marsh	144 – 187	51.5	51.6	51.0	52.1
Deep Marsh - Floating	187 – 300				51.0
Deep organic soils (≥ 8” thick)	165 – 170				51.7

Lake Prevatt Transect 2 Station 0 facing north through Mesic Hammock

Lake Prevatt Transect 2 Station 90 facing south in Transitional Shrub Swamp toward Transition Zone and Mesic Hammock

Figure C-10. Lake Prevatt Transect 2.

Lake Prevatt Transect 2 Station 90 facing north toward Shrub Swamp

Lake Prevatt Transect 2 Station 120 facing west in Shrub Swamp

Figure C-10. Continued. Lake Prevatt Transect 2.

Lake Prevatt Transect 2 Station 144 facing east along Shrub Swamp and Shallow Marsh boundary.

Lake Prevatt Transect 2 Station 144 facing northeast across the Shallow Marsh toward the Deep Marsh.

Figure C-10. Continued. Lake Prevatt Transect 2.

Table C-8. Vegetation cover estimates for Lake Prevatt Transect 2, Orange County, FL.

Scientific name	**Common name**	Community[1]	MH	TZ	TSS	SS	SM	DM
		From	0	31	78	98	144	187
		To	31	78	98	144	187	300
		NWPL Code[2]	**Plant Species Cover Estimates[3]**					
Amphicarpum muehlenbergianum	blue maidencane	FACW		1				
Callicarpa americana	American beautyberry	FACU	2					
Centella asiatica	spadeleaf	FACW		X				
Cephalanthus occidentalis	buttonbush	OBL		X	3	4	3	
Cyperus haspan	haspan flatsedge	OBL			X	X	X	
Cyperus odoratus	fragrant flatsedge	FACW					2	X
Dichanthelium commutatum	variable witchgrass	FAC	X					
Dichanthelium portoricense	hemlock witchgrass	FACU	1					
Diodia virginiana	Virginia buttonweed	FACW			1			
Echinochloa walteri	coast cockspur	OBL					1	
Edrastima uniflora	clustered mille graines	FACW		X				
Erechtites hieraciifolius	fireweed	UPL		X				

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS	SM	DM
		From	0	31	78	98	144	187
		To	31	78	98	144	187	300
		NWPL Code[2]	**Plant Species Cover Estimates[3]**					
Eupatorium capillifolium	dog fennel	FACU			X	3		
Eupatorium leptophyllum	false fennel	FACW		2				
Fuirena breviseta	saltmarsh umbrellasedge	OBL					X	
Gelsemium sempervirens	yellow jessamine	FAC	1					
Hypericum hypericoides	St. Andrew's cross	FAC		X				
Leersia hexandra	southern cutgrass	OBL			X			
Ludwigia octovalvis	Mexican primrose willow	OBL				X		
Ludwigia suffruticosa	shrubby primrose willow	OBL				X		
Mikania scandens	climbing hempvine	FACW		X	1	4	X	
Nuphar advena	spatterdock	OBL					1	3
Nymphaea odorata	American white water lily	OBL					1	2
Nymphoides aquatica	big floating heart	OBL						1
Panicum dichotomiflorum	fall panicgrass	FACW				2	3	

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS	SM	DM
		From	0	31	78	98	144	187
		To	31	78	98	144	187	300
		NWPL Code[2]	**Plant Species Cover Estimates[3]**					
Panicum hemitomon	maidencane	OBL		3	5		2	1
Paspalum setaceum	thin paspalum	FAC	X					
Persicaria punctata	dotted smartweed	OBL				4	2	1
Pinus elliottii	slash pine	FACW	3	3				
Polypremum procumbens	rustweed	FACU		1				
Pontederia cordata	pickerelweed	OBL			X	2		
Quercus laurifolia	laurel oak	FACW	2	3				
Quercus virginiana	live oak	FACU	5	5				
Rhus copallinum	winged sumac	UPL	1					
Rhynchospora nitens	shortbeak beaksedge	OBL				X	4	1
Sabal palmetto	cabbage palm	FAC		4				
Scleria triglomerata	tall nutgrass	FACW	X					
Serenoa repens	saw palmetto	FACU	3					

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS	SM	DM
		From	0	31	78	98	144	187
		To	31	78	98	144	187	300
		NWPL Code[2]	**Plant Species Cover Estimates[3]**					
Sesbania herbacea	danglepod	FACW					1	
Setaria magna	giant bristlegrass	FACW			X	3		
Thelypteris kunthii	widespread maiden fern	FACW			X			
Urena lobata	caesarweed	FAC	1	1				
Urochloa mutica	paragrass	FACW			2	2		
Vaccinium myrsinites	shiny blueberry	FACU	2					
Vitis rotundifolia	muscadine	FAC	2					

[1]**Community:** MH = Mesic Hammock, TZ = Transition Zone, TSS = Transitional Shrub Swamp, SS = Shrub Swamp, SM = Shallow Marsh, DM = Deep Marsh

[2]**NWPL** codes are taken from the National Wetland Plant List (NWPL; USDA NRCS 2016). Species not listed or almost always occur in non-wetlands under natural conditions are considered **Upland (UPL)**. **Facultative Upland (FACU) –** Plants usually occurring in non-wetlands but occasionally found in wetlands. **Facultative (FAC)** – Plants with similar likelihood of occurring in both wetlands and uplands. **Facultative Wet (FACW)** – Plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or saturation but may also occur in uplands. **Obligate (OBL)** – Plants that are found or achieve their greatest abundance in an area that is subject to surface water flooding and/or saturation; rarely occur in uplands.

[3]**Plant Species Cover Estimates:** Areal extent of vegetation species along the transect within a given vegetation community where X=<1%, 1=1 to 5%, 2=5 to 25%, 3=25 to 50%, 4=50 to 75%, 5=75 to 95% and 6=95-100%.

Soils

Soils at Lake Prevatt Transect 2 were mapped as Basinger fine sand, frequently ponded for the entirety of the transect (Figure C-7). Field soil samples may have varied from the SSURGO map delineation due to the mapping scale; however, most soils samples resembled the Basinger series (USDA, NRCS 2014). Soils were sampled every 5 ft along Transect 2 where water or root refusal did not occur (Figure C-11); four locations were described in depth where major changes in hydric soil indicators occurred (Table C-9).

Hydric soils were documented in most soils sampled in Transect 2. Beginning in the Mesic Hammock community (stations 0 – 31 ft), soils at station 0 ft were non-hydric, but transitioned to sandy with a stripped matrix hydric soil indicator (S6; stripping within 6 in. of the soil surface) by station 5 ft. At station 20 ft, the presence of organic bodies (A6) from 0 – 4 in. below soil surface was noted in addition to stripped matrix.

The presence of stripped matrix (S6) and organic bodies (A6) continued downslope into the vegetation Transition Zone (station 31 – 78 ft). A soil profile described at station 55 ft had sand texture throughout but noted the change in the depth of organic bodies (A6) to a depth of 0 – 3 in. below soil surface. Stripped matrix (S6) was still present in this profile, and the start of the spodic horizon was noted at 14.5 in. below soil surface. The substratum layer (C horizon) was recorded beginning at 29 in. below the soil surface.

Stripped matrix (S6) and organic bodies (A6) remained present in soil profiles until station 95 ft, within the Transitional Shrub Swamp vegetation community (stations 78 – 98 ft). A soil profile described at this location had a layer of muck textured material within the first 0.5 in. from soil surface and a layer of mucky mineral textured material from 0.5 – 2.75 in. below soil surface. The presence of these two layers indicate the presence of the muck presence (A8) and 5-cm mucky mineral (A7) hydric soil indicators. Stripped matrix (S6) and polyvalue below surface (S8) were also present in this profile.

Continuing downslope, muck indicators increase in number in the Shrub Swamp community (stations 98 – 144 ft). A soil profile described at station 130 ft included the hydric indicators 5-cm mucky mineral (A7), muck presence (A8), and 1-cm muck (A9). These were accompanied by sandy indicators dark surface (S7), polyvalue below surface (S8), and thin dark surface (S9). A histic epipedon (A2) was reached further downslope at station 165 ft within the shallow marsh vegetation community (stations 144 – 187 ft). Soils were not documented past station 170 ft due to water refusal. Formal descriptions of profiles containing deep organics along this transect were unable to be collected as hurricane Ian arrived shortly after initial data collection; quick and prolonged water level rise delayed formal descriptions until 2023 when water levels remained too high to describe profiles containing deep organics; formal descriptions ended at station 130 ft.

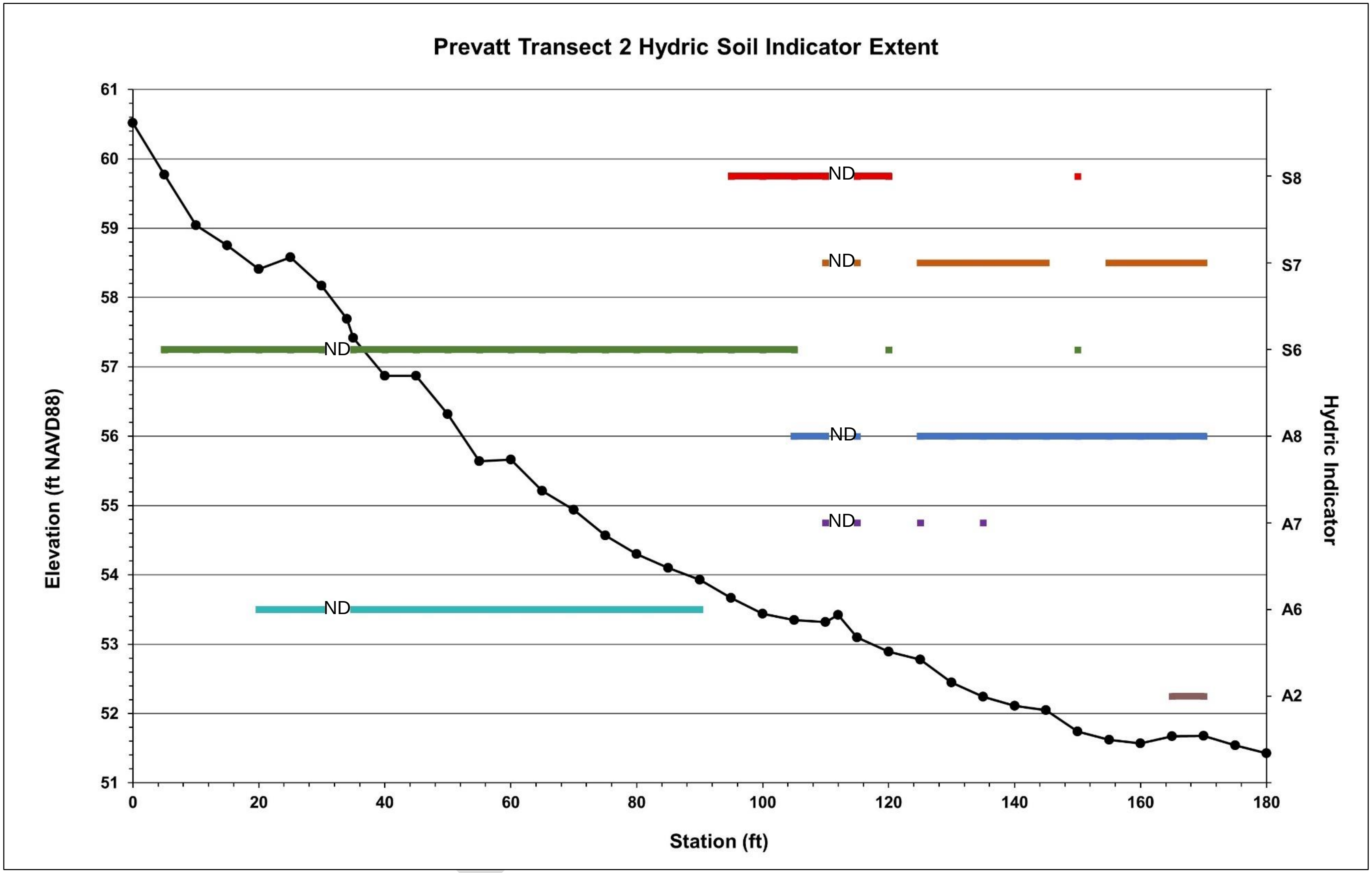

Figure C-11. Extent of hydric soil indicators with ground elevation along Lake Prevatt Transect 2. Stations after 175 were met with water refusal when data collection resumed post Hurricane Ian. ND indicates no data.

Table C-9. Lake Prevatt Transect 2 detailed soils descriptions.

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
20	Mesic Hammock	Organic Bodies Stripped Matrix	Oi	1.5 – 0”	7.5YR 2.5/2	Peat	Palmetto Husk Inclusion: 10YR 2/1, 25%, muck aggregates Inclusion: 10YR 7/1, 10%, sand btw aggregates
			A	0 – 4”	10YR 6/1	Sand	Depletion: 10YR 7/1, 10%, clear, round Organic Bodies: muck, 7%
			E	4 – 14”	10YR 7/1	Sand	Depletion: 10YR 8/1, 20%, diffuse, round
			BE at 16 inches and Bh at 21 inches below ground surface				
55	Transition Zone	Organic Bodies Stripped Matrix	A	0 – 1.5”	10YR 2/1	Sand	OC: 90% Inclusion: 10YR 2/1, muck aggregates Mottle: 10YR 6/1, 7%, sharp, round Organic Bodies: muck, 20%
			E1	1.5 – 3”	10YR 4/1	Sand	Depletion: 10YR 6/1, 15%, clear, round Mottle: 10YR 2/1, 25%, clear, round Organic Bodies: muck, 10%
			E2	3 – 7.5”	10YR 4/1	Sand	Depletion: 10YR 6/1, 10%, diffuse, round Mottle: 10YR 2/1m 20%, sharp, round
			E3	7.5 – 11”	10YR 5/1	Sand	Depletion: 10YR 6/1, 15%, diffuse, round Mottle: 20YR 2/1, 10%, clear, round Depletion: 2.5Y 8.5/1, 5%, sharp, round
			E4	11 – 14.5”	10YR 5/2	Sand	Depletion: 10YR 6/2, 25%, diffuse, round Depletion: 10YR 6/1, 10%, diffuse, round Mottle: 10YR 2/1, 5%, sharp, round Depletion: 2.5Y 8.5/1, 5%, sharp, round
			BE	14.5 – 17”	10YR 4/1	Sand	Depletion 10YR 5/2, 25%, diffuse, round

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
							Mottle: 10YR 2/1, 15%, clear, round
			Bhs1	17 – 23”	10YR 3/3	Sand	Mottle: 10YR 2/1, 15%, diffuse, round
			Bhs2	23 – 29”	10YR 3/2	Sand	Mottle: 10YR 2/1, 30%, diffuse, round Depletion: 10YR 4/2, 10%, diffuse, round
			C1	29 – 33”	10YR 4/2	Sand	Depletion: 10YR 5/2, 20%, diffuse, round Mottle: 10YR 4/3, 5%, diffuse, round Mottle: 10YR 2/2, 7%, diffuse, round
			C2	33 – 43”	10YR 5/2	Sand	Depletion: 10YR 6/2, 25%, diffuse, round Mottle: 10YR 4/3, 5%, diffuse, round Mottle: 10YR 2/1, 5%, diffuse, round
			Depth to water table is 18 inches below ground surface				
95	Transitional Shrub Swamp	5-cm Mucky Mineral Muck Presence Stripped Matrix Polyvalue Below Surface	Oa	0 – 0.5”	10YR 2/1	Muck	None
			A1	0.5 – 2.75”	10YR 2/1	Mucky Mineral	None
			A2	2.75 – 3.25”	10YR 2/1	Sand	OC: 99%
			E1	3.25 – 5”	10YR 4/1	Sand	Mottle: 10YR 2/1, 25%, clear, round Mottle: 10YR 3/1, 20%, diffuse, round Depletion: 10YR 6/1, 10%, diffuse, round
			E2	5 – 14.5”	10YR 6/1	Sand	Depletion: 10YR 7/1, 25% diffuse, round Mottle: 10YR 4/1, 15%, diffuse, round Mottle: 10YR 2/1, 7% diffuse, round
			BE at 16 inches and Bh at 21 inches below ground surface				
130	Shrub Swamp	5-cm Mucky Mineral Muck Presence	Oa	0 – 1.5”	10YR 2/1	Muck	None

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
		1-cm Muck Dark Surface Polyvalue Below Surface Thin Dark Surface	A1	1.5 – 3.5”	10YR 2/1	Mucky Mineral	None
			A2	3.5 – 7.5”	10YR 2/1	Sand	OC: 99%
			E1	7.5 – 12”	10YR 2/1	Sand	OC: 95% Depletion: 10YR 4/1, 15%, diffuse, round
			E2	12 – 16”	10YR 5/1	Sand	Depletion: 10YR 6/1, 25%, diffuse, round Mottle: 10YR 2/1, 15%, clear round

Transect 3

Transect 3 was established in September 2022 on the west side of Lake Prevatt on the Camp Thunderbird property. The transect extended northeast (52°) from the camp area through an area mapped as Oak Hammock (Figure C-2). The transect turned at station 140 ft to the southeast (137°) to extend toward one of the sinkholes present in Lake Prevatt. Transect 3 extended to 580 ft ending in an area mapped as a Deep Marsh after crossing the open water created by the sinkhole feature. Elevation, vegetation, and preliminary soil data were collected in 2022; however, the arrival of Hurricane Ian in September pushed off formal soil description data collection until October of 2023. Additionally, increased water levels limited the collection of soil descriptions in 2023 to the first 75 ft of transect.

<u>Vegetation</u>

Lake Prevatt Transect 3 captured the transition into and out of open water within the lake (Figure C-12, Table C-10, Figure C-13). Transect 3 began in a Mesic Hammock community (stations 0 – 10 ft) on the western side of the Prevatt’s South Lobe. Canopy cover in the Mesic Hammock community had codominant cover of live oak with numerous water oak (*Quercus nigra*); water oak was also scattered in the shrub layer. Groundcover in the Mesic Hammock community had codominant cover of saw palmetto with scattered winged sumac (*Rhus copallinum*).

Downslope of the Mesic Hammock community was a Transition Zone (stations 10 – 40 ft) with dominant canopy coverage of live oak; the live oak canopy of this zone was rooted upslope of the transition zone. This was a mainly grassy-structured transition zone with a shrub layer composed of scattered Chinese tallow. Groundcover within this community was composed of abundant maidencane, numerous caesarweed (*Urena lobata*), and scattered spadeleaf (*Centella asiatica*).

A Transitional Shrub Swamp community followed the transition zone from stations 40 – 61 ft. The canopy coverage of this community was shaded by dominant live oak rooted upslope of the community. The shrub layer of this community was composed of scattered buttonbush. Groundcover included numerous maidencane, scattered spadeleaf, and rare southern cutgrass (*Leersia hexandra*).

After station 61 ft, Shrub Swamp 1 (stations 61 – 81 ft) began. This community had abundant Carolina willow in the canopy and no species present in the shrub layer. Scattered throughout the groundcover of this community was dog fennel, maidencane, dotted smartweed, and American cupscale (*Sacciolepis striata*).

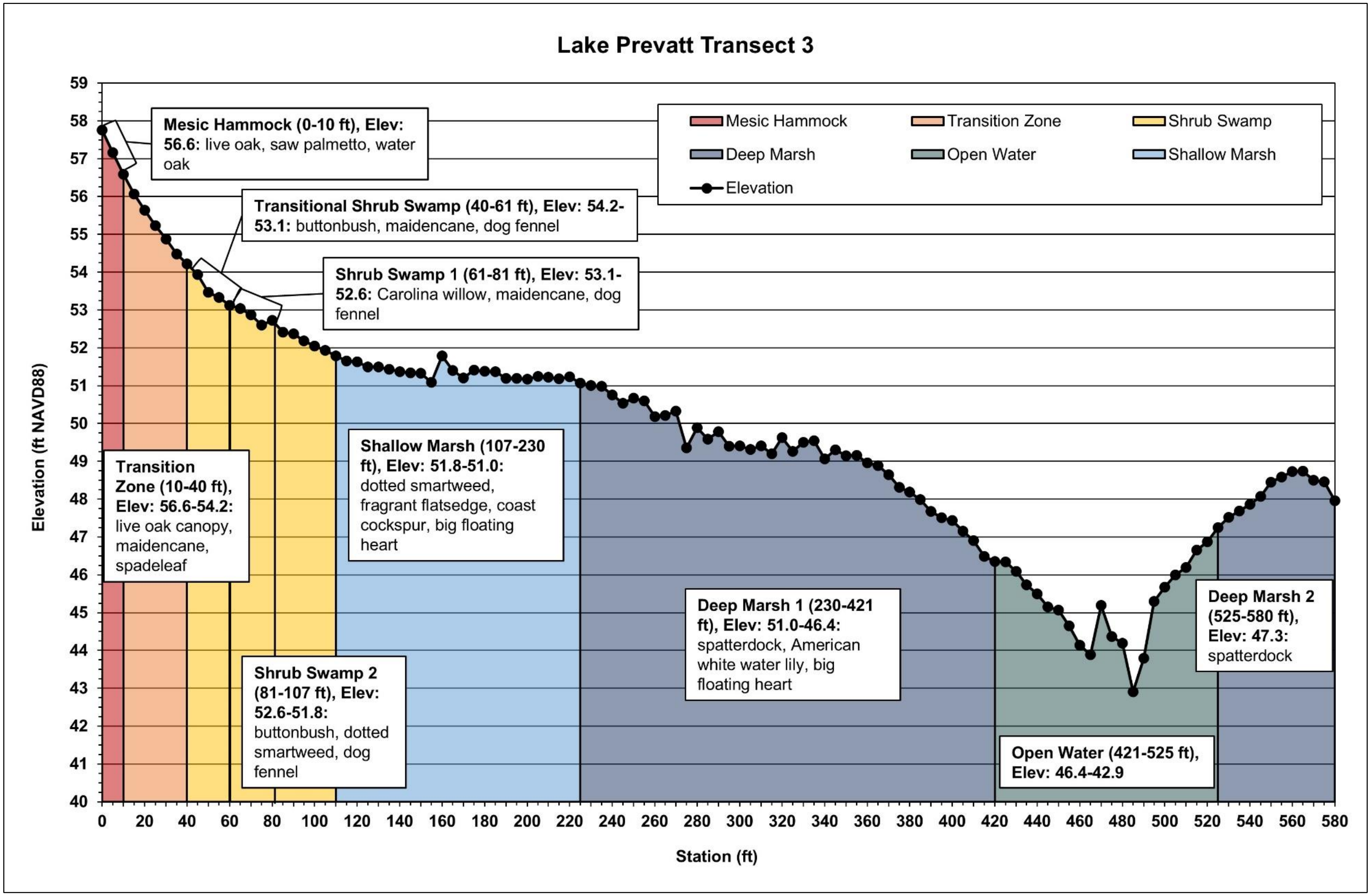

Figure C-12. Lake Prevatt Transect 3 with topography and vegetation communities.

Shrub Swamp 1 turned into Shrub Swamp 2 at station 81 ft (stations 81 – 107 ft) when all canopy coverage dropped out and the shrub layer was covered in abundant buttonbush. The groundcover in this community had abundant dotted smartweed coverage and scattered dog fennel, spatterdock, and American cupscale.

Downslope of the Shrub Swamps was a Shallow Marsh community (stations 107 – 230 ft). This community was covered with numerous dotted smartweed and scattered fragrant flatsedge, coast cockspur, big floating heart (*Nymphoides aquatica*), and danglepod (*Sesbania herbacea*).

Two deep marsh communities occurred at the end of Transect 3 separated by a stretch of open water. Deep Marsh 1 (stations 230 – 421 ft) began directly downslope of the Shallow Marsh community. This community was comprised of codominant spatterdock with scattered big floating heart. The stretch of Open Water occurred from stations 421 – 525 ft. Deep Marsh 2 began at station 525 ft (stations 525 – 580 ft) and was dominated by spatterdock. Additional plant species observed along Lake Prevatt Transect 3 may be found in table C-11.

Table C-10. Prevatt Transect 3 vegetation community statistics.

Vegetation Community	Station Distance (ft)	Mean (ft NAVD 88)	Median (ft NAVD 88)	Min (ft NAVD 88)	Max (ft NAVD 88)
Mesic Hammock	0 – 10			56.6	
Transition Zone	10 – 40	55.3	55.2	54.2	56.6
Transitional Shrub Swamp	40 - 61	53.6	53.5	53.1	54.2
Shrub Swamp 1	61 – 81	52.9	52.9	52.6	53.1
Shrub Swamp 2	81 – 107	52.2	52.2	51.8	52.7
Shallow Marsh	107 – 230	51.3	51.3	51.0	51.8
Deep Marsh 1	230 – 421	49.1	49.3	46.4	51.0
Open Water	421 – 525	45.3	45.4	42.9	47.3
Deep Marsh 2	525 – 580			47.3	

Lake Prevatt Transect 3 looking southwest toward Mesic Hammock at station 0 in the Transition Zone at station 30

Lake Prevatt Transect 3 looking northeast toward Transition Zone at station 25

Figure C-13. Lake Prevatt Transect 3 photos.

Lake Prevatt Transect 3 looking south in Transition Zone at station 30

Lake Prevatt Transect 3 looking northeast at Shrub Swamp 1 (station 61). Photo taken at station 60.

Figure C-13. Continued. Lake Prevatt Transect 3 photos.

Lake Prevatt Transect 3 looking southwest in Shrub Swamp 2 at station 90

Lake Prevatt Transect 3 looking southeast toward Deep Marsh 1 at Shallow Marsh station 140.

Figure C-13. Continued. Lake Prevatt Transect 3 photos.

Table C-11. Vegetation cover estimates for Lake Prevatt Transect 3, Orange County, FL.

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SS2	SM	DM1	OW	DM2
		From	0	10	40	61	81	107	230	421	525
		To	10	40	61	81	107	230	421	525	580
		NWPL Code[2]	**Plant Species Cover Estimates[3]**								
Centella asiatica	spadeleaf	FACW		2	2						
Cephalanthus occidentalis	buttonbush	OBL		1	2		4	1			
Cirsium horridulum	horrid thistle	FAC		X							
Cyperus odoratus	fragrant flatsedge	FACW						2			
Dichanthelium portoricense	hemlock witchgrass	FACU	X	X							
Echinochloa walteri	coast cockspur	OBL						2			
Eupatorium capillifolium	dog fennel	FACU			2	2	2				
Galactia elliottii	Elliott's milkpea	FACU	1	X							
Galium tinctorium	stiff marsh bedstraw	FACW		X							
Gelsemium sempervirens	yellow jessamine	FAC	3	X							
Hypericum hypericoides	St. Andrew's cross	FAC			X						
Leersia hexandra	southern cutgrass	OBL			1	1					
Mikania scandens	climbing hempvine	FACW		X	2	1	1				

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SS2	SM	DM1	OW	DM2
		From	0	10	40	61	81	107	230	421	525
		To	10	40	61	81	107	230	421	525	580
		NWPL Code[2]	**Plant Species Cover Estimates[3]**								
Nuphar advena	spatterdock	OBL				X	2		5		6
Nymphaea odorata	American white water lily	OBL					1	1	1		
Nymphoides aquatica	big floating heart	OBL						2	2		
Oplismenus hirtellus	basketgrass	FAC		X							
Panicum dichotomiflorum	fall panicgrass	FACW					1				
Panicum hemitomon	maidencane	OBL		4	3	2					
Paspalum laeve	field paspalum	FACW						X			
Persicaria punctata	dotted smartweed	OBL		X		2	4	3			
Pluchea odorata	sweetscent	FACW						X			
Pontederia cordata	pickerelweed	OBL				X		X			
Quercus nigra	water oak	FAC	3								
Quercus virginiana	live oak	FACU	5	6	6						
Rhus copallinum	winged sumac	UPL	2								
Rhynchospora nitens	shortbeak beaksedge	OBL						1			

Scientific name	Common name	Community[1]	MH	TZ	TSS	SS1	SS2	SM	DM1	OW	DM2
		From	0	10	40	61	81	107	230	421	525
		To	10	40	61	81	107	230	421	525	580
		NWPL Code[2]	**Plant Species Cover Estimates[3]**								
Sabal palmetto	cabbage palm	FAC	1	1							
Sacciolepis striata	American cupscale	OBL				2	2				
Salix caroliniana	Carolina willow	OBL				4					
Serenoa repens	saw palmetto	FACU	5								
Sesbania herbacea	danglepod	FACW					X	2			
Setaria magna	giant bristlegrass	FACW				1	1				
Smilax auriculata	earleaf greenbrier	FACU	X								
Smilax rotundifolia	bullbriar	FAC	X								
Thelypteris palustris	marsh fern	OBL			X						
Triadica sebifera	Chinese tallow	FAC		2	X						
Urena lobata	caesarweed	FAC	1	3	2						

[1]**Community:** MH = Mesic Hammock, TZ = Transition Zone, TSS = Transitional Shrub Swamp, SS = Shrub Swamp, SM = Shallow Marsh, OW = Open Water, DM = Deep Marsh

[2]**NWPL** codes are taken from the National Wetland Plant List (NWPL; USDA NRCS 2016). Species not listed or almost always occur in non-wetlands under natural conditions are considered **Upland (UPL)**. **Facultative Upland (FACU) –** Plants usually occurring in non-wetlands but occasionally found in wetlands. **Facultative (FAC)** – Plants with similar likelihood of occurring in both wetlands and uplands. **Facultative Wet (FACW)** – Plants that typically exhibit their maximum cover in areas subject to surface water flooding and/or saturation but may also occur in uplands. **Obligate (OBL)** – Plants that are found or achieve their greatest abundance in an area that is subject to surface water flooding and/or saturation; rarely occur in uplands.

[3]**Plant Species Cover Estimates:** Areal extent of vegetation species along the transect within a given vegetation community where X=<1%, 1=1 to 5%, 2=5 to 25%, 3=25 to 50%, 4=50 to 75%, 5=75 to 95% and 6=95-100%.

<u>Soils</u>

Soils at Lake Prevatt Transect 3 were mapped as Basinger fine sand, frequently ponded for the entirety of the transect (Figure C-7). Field soil samples may have varied from the SSURGO map delineation due to the mapping scale; however, most soils samples resembled the Basinger series (USDA, NRCS 2014). Soils were sampled every 5 ft along Transect 3 where water or root refusal did not occur (Figure C-14); four locations were described in depth where major changes in hydric soil indicators occurred (Table C-12).

Soils along Transect 3 were non-hydric throughout the Mesic Hammock vegetation community (stations 0 – 10 ft). At station 15 ft, within the vegetation Transition Zone (stations 10 – 40 ft), hydric soils were documented with the indicators organic bodies (A6) and stripped matrix (S6). The organic bodies at this location had a muck texture, and a spodic horizon was reached at 8.5 in. below soil surface.

Continuing downslope, but still within the vegetation Transition Zone, soil profiles exhibited muck at the soil surface (muck presence; A8) starting at station 30 ft. Also present were the hydric indicators dark surface (S7), polyvalue below surface (S8), and thin dark surface (S9). A spodic horizon was reached 11 in. below the soil surface in this profile. Within the Transitional Shrub Swamp community at station 50 ft, muck at the surface was lost in soil profiles.

The final profile described on Transect 3 was from the Shrub Swamp 1 vegetation community (stations 61 – 81 ft) at station 75 ft. Three hydric indicators recorded there were 5-cm mucky mineral (A7), polyvalue below surface (S8), and thin dark surface (S9). Hydric soil indicators continued through station 145 ft until water refusal occurred; however, formal descriptions could not be collected as water levels rose too high for data collection post hurricane Ian. No deep organics were recorded in any soil profile along Transect 3.

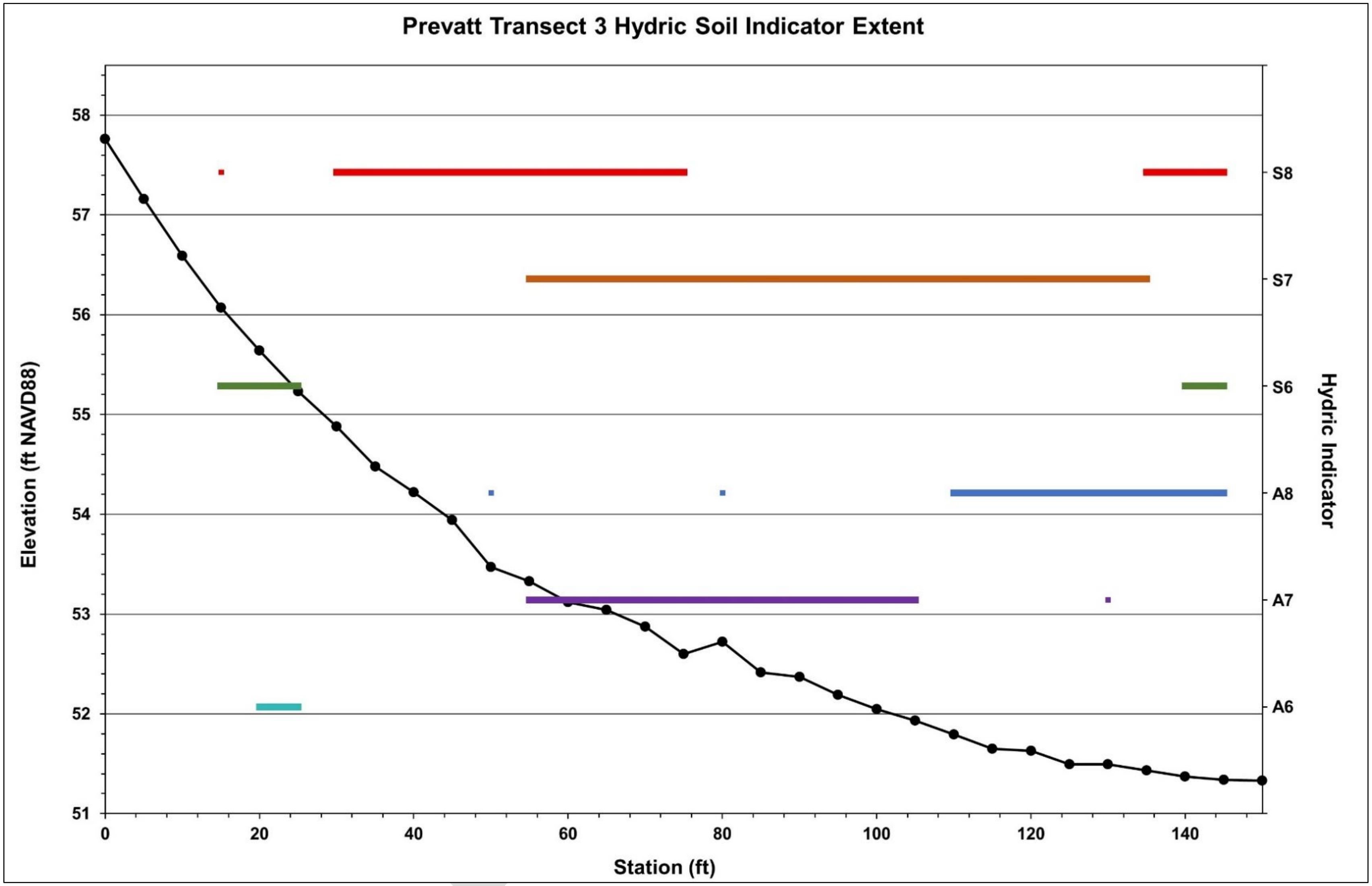

Figure C-14. Extent of hydric soil indicators with ground elevation along Lake Prevatt Transect 3. Stations after 145 ft were met with water refusal; stations after 75 ft were met with water refusal when data collection resumed post Hurricane Ian for profile descriptions.

Table C-12. Lake Prevatt Transect 3 soil descriptions.

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
15	Transition Zone	Organic Bodies Stripped Matrix	A	0 – 1.5”	10YR 2/1	Sand	Organic bodies: Muck, 5% OC: 90% Mottle: 10YR 6/1, 10%, clear, round
			E1	1.5 – 6”	10YR 4/1	Sand	Mottle: 10YR 2/1, 25%, clear, round Depletion: 10YR 5/1, 5%, diffuse, round
			E2	6 – 8.5”	10YR 4/1	Sand	Mottle: 10YR 2/1, 15%, clear, round Depletion: 10YR 5/1, 20%, diffuse, round Depletion: 10YR 6/1, 10%, diffuse, round
			BhE	8.5 – 14”	10YR 3/1	Sand	OC: < 50% Mottle: 10YR 2/1, 15%, diffuse, round Depletion: 10YR 4/1, 25%, diffuse, round
30	Transition Zone	Muck Presence Dark Surface Polyvalue Below Surface Thin Dark Surface	Oa	0 – 0.75”	10YR 2/1	Muck	None
			A	0.75 – 4”	10YR 2/1	Sand	OC: 99% Inclusion: Mucky mineral 25%
			AE	4 – 11”	10YR 2/1	Sand	OC: 90% Depletion: 10YR 4/1, 20%, diffuse, round
			BhE	11 – 15”	10YR 2/2	Sand	Depletion: 10YR 4/2, 10%, diffuse, round Mottle: 10YR 2/1, 5%, diffuse, round
50	Transitional Shrub Swamp	Stripped Matrix Polyvalue Below Surface Thin Dark Surface	A	0 – 3.5”	10 YR 2/1	Sand	OC: 95%
			AE1	3.5 – 7”	10YR 2/1	Sand	OC: 90% Depletion: 10YR 4/1, 25%, diffuse, round
			AE2	7 – 12.5”	10YR 2/1	Sand	OC: 95% Depletion: 10YR 3/1, 15%, diffuse, round

Station	Vegetation Community	Hydric Soil Indicator	Horizon	Depth	Matrix (Hue Value/Chroma)	Texture	Notes
75	Shrub Swamp 1	5-cm Mucky Mineral Polyvalue Below Surface Thin Dark Surface	A1	0 – 1.5”	10YR 2/2	Mucky Mineral	None
			A2	1.5 – 3.5”	10YR 2/1	Mucky Mineral	None
			AE	3.5 – 13”	10YR 2/1	Sand	OC: 90% Depletion: 10YR 4/1, 10%, diffuse, round

Transect Summary

The three environmental transects established at Lake Prevatt traversed from Mesic Hammock communities at their highest extent to either deep marshes or open water at their deepest extents. The Mesic Hammock communities had a mean minimum elevation of 57.0 ft NAVD88 (Table C-13), followed immediately by vegetation transition zones. Transitional Shrub and Shrub Swamp communities were present on all transects with overall mean elevations of 53.8 and 52.7 ft NAVD88, respectively. Shallow and Deep marsh communities were also present on every transect with mean elevations of 51.5 and 49.6 ft NAVD88 respectively.

Table C-13. Summary statistics of all community types documented at Lake Prevatt environmental transects.

Community	Mean Minimum Elevation	Mean Elevation	Median Elevation	Mean Maximum Elevation
Mesic Hammock	57.0			
Transitional Shrub	53.3	53.8	53.7	54.3
Shrub Swamp	52. 2	52.7	53.0	53.6
Shallow Marsh	50.6	51.5	51.5	52.8
Deep Marsh	47.7	49.6	49.8	51.1
Deep Organics (A1, A2)	48.9*	50.0*	50.0*	51.3
*Based on data from Transect 1 only				

In the period of data collection from 2022 – 2023, SJRWMD staff noted that the quick 5 ft fluctuation in water levels followed by a sustained 2.5 ft increase after flood water recession shifted communities either partially or permanently inundated (i.e., shallow and deep marsh communities). This observation coincided with the collection of highly opportunistic species present in the shallow marsh communities during vegetation data collection. Smartweeds (*Persicaria* spp.), grasses (*Panicum* spp.), and flatsedges (*Cyperus* spp.) dominated these communities in an elevation zone where quick and often water fluctuations occur.

Upon soils collection data in 2023, the initial elevations of shallow marsh communities were replaced with deep marsh species (spatterdock, water lily). Transitional Shrub Swamp and Shrub Swamp communities were maintained throughout this time period as they were dominated mainly by longer-lived buttonbush, tolerant of both relatively prolonged inundation and drought. The transience or permanence of these communities was noted for the creation of vegetation metrics at Lake Prevatt. More permanent communities representative of longer-term hydrologic trends are of greater use in MFLs metric creation than highly ephemeral communities produced by highly fluctuating lake level regimes.

Due to the quick water level rise in September of 2022 from Hurricane Ian, soils data collection was also limited. Although muck was present at multiple transects, deep organics were only documented fully on Transect 1 and in the last two samples of Transect 2. No deep organics were documented on Transect 3. Therefore, the mean elevation of histosol and histic epipedon was derived here from only Transect 1.

MFL METRICS

Event-Based Approach

Wetland and aquatic species and hydric soils require a minimum frequency of critical hydrologic events for long-term persistence. The hydrologic range of flooding and drying events are required to fulfill many different life-history requirements of wetland communities (Euliss et al. 2004; Murray-Hudson et al. 2014). This hydrologic range, known as hydroperiod, is often described as the inter-annual and seasonal pattern of water level resulting from the combination of water budget and storage capacity (Welsch et al. 1995). Hydroperiod is also a primary driver of wetland plant distribution and composition, hydric soils type and location, and to a lesser degree, freshwater fauna (Foti et al. 2012; Murray-Hudson et al. 2014).

Wetland hydroperiods vary spatially and temporally and consist of multiple components, including: magnitude, duration, return interval, rate of change, and timing (Poff et al. 1997). However, because the latter two are thought to be a function of climate, only the first three are typically the focus of the SJRWMD event-based approach. Magnitude and duration components define the critical ecological events that affect species at an individual level (i.e., individual organisms). The return interval of an event is a function of variations in climate and/or water withdrawal. By comparing the current frequency of ecologically critical events to the recommended minimum frequency of these same events, the SJRWMD event-based method determines the amount of water that is available, or needed for recovery, within a given ecosystem under different water withdrawal conditions.

Varying flooding and drying events are necessary to maintain the extent, composition, and function of wetland and aquatic communities. Native wetland and aquatic communities have adapted to and are structured by this natural variability (Poff et al. 1997; Richter et al. 1997; Murray-Hudson et al. 2014). Because of the role of hydroperiod in structuring and maintaining wetland and aquatic communities, the SJRWMD MFLs approach is centered on the concept of protecting a minimum number of flooding events or preventing more than a maximum number of drying events for a given ecological system.

For example, the long-term maintenance of the maximum extent of a wetland may require an infrequent flooding event of sufficient duration and return interval to ensure that upland species do not permanently shift downslope into that wetland. In addition to flooding events, some aspects of wetland ecology (e.g., plant recruitment, soil compaction, nutrient mineralization) are also dependent upon drying events, as long as they do not occur too often. Because hydroperiods vary spatially and temporally (Mitsch and Gosselink 2015), multiple MFLs are typically used to protect different portions of a system’s natural hydrologic regime (Figure C-15; Neubauer et al. 2008). For many systems, SJRWMD sets three MFLs: a minimum frequent high (FH), a minimum average (MA), and a minimum frequent low (FL) flow and/or water level. In some cases (e.g., for sandhill-type lakes) a minimum infrequent high (IH) and/or minimum infrequent low (IL) may also be set.

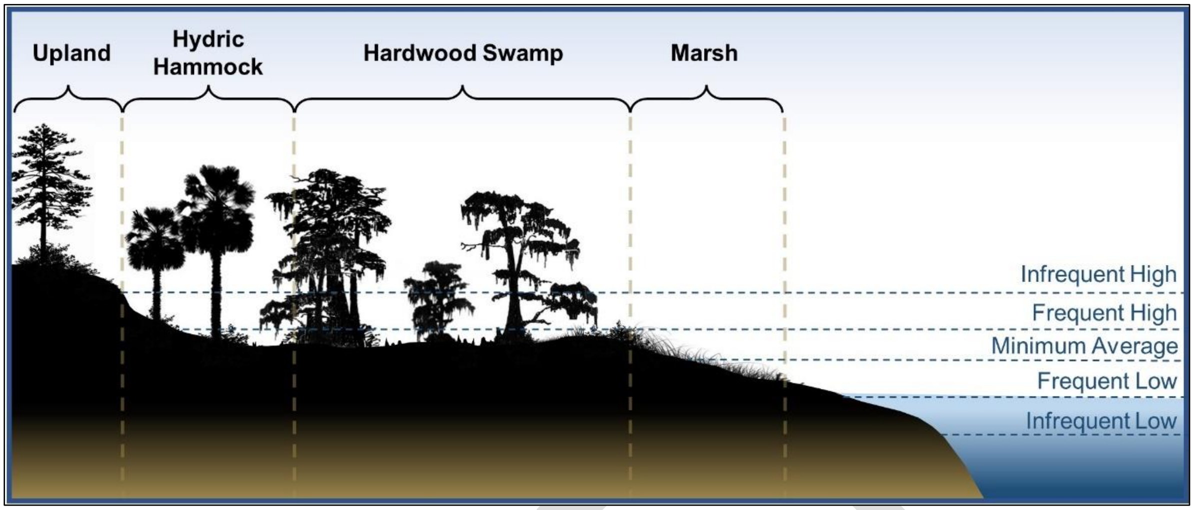

Figure C-15. Conceptual drawing showing the five most common minimum flows and/or levels developed using SJRWMD's event-based approach.

Surface Water Inundation/Dewatering Signatures (SWIDS)

MFLs minimum hydrological events have three primary components: magnitude, duration, and return interval. Magnitude and duration define biologically relevant events, while the return interval of an event is considered the manageable component (Neubauer et al. 2008). For example, if a 30-day flooding event of the maximum elevation of a shallow marsh has an annual probability of exceedance of 33%, then the event is interpreted as occurring 33 times in 100 years or on a 3-year return interval. These statistics are long-term averages that may be decreased in the case of flooding events or increased in the case of dewatering events until some threshold is reached where an important ecological process or function is significantly harmed.

One of the techniques used to identify these thresholds is known as “Surface Water Inundation/Dewatering Signatures” (SWIDS). The SWIDS approach provides a guide for determining the maximum change in the return interval of a given event (with duration held constant) that could occur while still maintaining a given ecological process or function. However, they must be used with caution since there can be other variables that maintain the feature of interest besides stage of the water body (e.g. seepage from uplands, fire, disturbance history). The collection of SWIDS from a set of similar water bodies provides a range of hydrologic conditions that support an ecological feature of interest.

Once data from similar water bodies within SJRWMD are compiled, SWIDS are derived from frequency analysis of long-term simulated or observed stage data. Using these data, hydroperiod tables are developed for MFLs water bodies. Hydroperiod tables include exceedance (flooding) and non-exceedance (drying) probabilities for specific key elevations over a range of durations. The former are typically used to evaluate return intervals for the FH while the latter are typically used to evaluate return intervals for the FL. Average non-exceedance probabilities are typically used to evaluate return intervals for the MA. Key elevations may be maximum, average, or minimum elevations for particular wetland plant communities, common wetland species, and hydric soil indicators.

While conceptually strong, to date providing the best estimate of return intervals for MFLs events, the SWIDS approach often results in a very large range of frequencies for a given event. This large range can introduce uncertainty in the recommended minimum frequency for specific MFL events. To address this concern, SJRWMD updated the SWIDS approach in 2023 (Deschler et al. 2023) and 2024 (this report) to tailor frequency calculations more specifically to individual metrics (e.g., hydrological, soil-related, hydroecological). In this process, SWIDS return intervals are still calculated based on observed hydroperiods of organic soils, vegetation species, or community type, but the determination of suitable sites for comparison is refined. Suitable sites for comparison are considered those that share hydrologic and landscape characteristics which may influence local ecological patterns.

Cluster Approach – A Top-down Method for Deep Organic (MA) Frequencies

A cluster method used to create subsets of MFL lakes for SWIDS analysis was completed in response to peer review comments for the Sylvan Lake MFLs determination (Deschler et al. 2023). Built on the concepts presented in Epting et al. (2008), a top-down approach was developed where landscape and water level characteristics were used to assemble groups of similar sites. This assumed that grouping lakes based on hydrological variables, connection to the Upper Floridan aquifer (UFA), soil characteristics, etc., would result in smaller event frequency ranges, making the determination of appropriate minimum event frequencies more apparent and defensible. This cluster analysis reduced the range of event frequencies (with the intent of reducing uncertainty) that were then used as the basis for recommended minimum events for Sylvan Lake; this method is further refined herein for Lake Prevatt. Twenty-eight sites had required deep organics information available for this analysis

The process to reduce potential uncertainty first involved selecting hydrologic variables used in previous analyses to explain variance among groups of lakes in the District. The first set of hydrologic variables, including stage ranges and distribution shape, were modeled after those used by Epting et al. (2008). Stage ranges were described in three parts to represent the upper half, lower half, and total stage range, included as the 20^{th} to 50^{th}, 50^{th} to 80^{th}, and 10^{th} to 90^{th} percentile ranges, respectively. The shape of lake stage distributions (i.e., measures of stage rise and fall) can account for short-term climate variations in lake stage due to evaporation and rainfall and integrate basin characteristics of inflow, outflow, and leakage. Therefore, measures of monthly lake stage change distribution skewness and kurtosis were included in this analysis.

In an effort to be consistent across sites, hydrologic parameters used in this cluster analysis were calculated based on twenty years of water level data directly prior to ecological data collection for each site. Twenty years of antecedent data was used in Deschler et al. (2023) to correspond to the transitional shrub and shallow marsh locations estimated at the time of MFLs development for the water body; however, in the current analysis, this data set is used only in the calculation of frequencies for deep organics (MA), as vegetation metrics used an alternative bottom-up approach described in the next section.

To further reduce event frequency range, additional hydrologic variables were added to this analysis. A lake-UFA correlation coefficient was added to provide a measure of UFA connection to each individual lake (Table C-14). The UFA well with the required period of record (POR) closest to each lake was used in the creation of this variable. Another variable, maximum cumulative fluctuation (MCF), was also included as a measure of the highest observed lake level fluctuation among years in the required POR. As high lake level fluctuations are often associated with high UFA connectivity, MCF provides another dimension to the linkage between lake level variability and lake-UFA connection strength.

In addition to hydrologic variables, a suite of landscape parameters were added to aid in the grouping of sites (Table C-14). Within a 500-meter (m) buffer surrounding each lake, the area of landscape soil drainage class and soil permeability were calculated from SSURGO data (USDA NRCS 2021). As the goal of this cluster analysis is to cluster similar sites related to the formation of deep organic soils sampled within close proximity to the lake, areas outside 500 m from the lake edge were not considered. Both parameters were classified into high, moderate, or low values. The percent coverage of these soil types were used rather than raw acreage to standardize for varying areas analyzed among lakes due to differences in lake size. Also calculated within the 500 m lake buffer area was the median depth to water table value calculated from the SJRWMD water table depth raster (SJRWMD 2015). All data were standardized to z-scores before analysis.

Ward's method of hierarchical clustering, which minimizes variance among sites within a group while maximizing variance between groups (Ward 1963; Murtagh and Legendre 2014), was used to identify lake groups with similar hydrologic and landscape characteristics. The number of significant clusters in the dataset were defined using the "NbClust" package in R (Charrad et al. 2014). Thirty different cluster significance tests are available in this package; the number of clusters used in analysis is the number of clusters over two supported by the greatest number of significance tests. All analyses were completed for Lake Prevatt using R version 4.1.1 (R Core Team 2021). SWIDS analyses were updated using only the lakes in the group that included Lake Prevatt, for which there also existed corresponding deep organic soils data. For example, if not all lakes in the Lake Prevatt group had deep organics data, only those lakes in the appropriate group that have the appropriate ecological data were used.

The final non-exceedance metric frequency was then derived from the mean return interval of all sites minus the standard error of return intervals across sites. A mean minus standard error value was used to account for the variation that occurs among all sites considered. This value incorporates an allowance for natural community/species fluctuation that occurs with climatic variability through time or that may be occurring due to factors not considered.

Transect Quadrat-level Cluster Approach – A Bottom-up Method for Vegetation and Community Frequencies

While proving useful in reducing event frequency range for the MA (i.e., to maintain deep organic soils), the site cluster approach based on larger-scale variables still resulted in relatively large frequency ranges for metrics derived from vegetation data. Therefore, a bottom-up approach was developed to group individual transect quadrats based on local landscape and vegetation similarities. This approach has the same goal as the MA method of reducing frequency ranges (uncertainty) in SWIDS analyses. The purpose of the MFLs SWIDS process is to inform recommended and protective event frequencies and durations for species and communities based on hydrological trends across MFL sites. Therefore, additional data describing local-scale (transect quadrat-level) influences on hydrology was necessary.

First a dataset of all lakes with adopted and in-progress MFLs was compiled for which belt transect, community-level species coverages were available. Twenty-nine MFL lakes, including Lake Prevatt, had the required species coverage data available. This dataset includes site and community identification information, the MFL report-labelled community designation, and the full community composition along with minimum, mean, and maximum community elevations converted to NAVD88 elevations. For each transect quadrat defined in this dataset, a series of variables were calculated including the quadrat slope, percent exceedance of the mean elevation of the quadrat, water level range (P10 – P90), and the prevalence index (PI) of quadrat vegetation.

Quadrat slope was included as a variable to characterize water movement, or permanence within an area. Areas at a given elevation that have a relatively low slope may result in wetter vegetation communities as compared to areas at the same elevation but with a higher slope (i.e., low slopes may increase water ponding while higher slopes may increase runoff potential). Consideration of communities without slope could result in higher, wetter communities being compared with other similar communities generally found at lower elevations across sites, increasing uncertainty in frequency determination. Other variables may be included in future analyses to help further characterize water movement or permanence at a site.

Table C-14. Ward's D clustering parameters and values for 28 SJRWMD lakes, including Lake Prevatt, used in minimum average return interval calculations. Spatial parameters were calculated within 500 m of each lake; tabular parameters were calculated on monthly values. Skewness and kurtosis were calculated on a 1-month lake stage change distribution. MCF (maximum cumulative fluctuation) index is a measure of lake fluctuation with a connection to the UFA.

Site	Water Level Range (ft)			Monthly Water Level Change Symmetry		Landscape Soil Drainage Class (% area)			UFA Connection		Median Depth to Water Table (ft)	Soil Permeability (% acres)		
	Lower (P80-P50)	Upper (P50-P20)	Total (P90-P10)	Skewness	Kurtosis	High	Moderate	Low	Lake-UFA Correlation Strength	MCF (ft)		High	Moderate	Low
Apshawa South	1.99	3.10	6.42	0.22	1.98	81.25	4.56	14.18	0.67	4.76	5.37	100.00	0.00	0.00
Ashby	0.57	1.01	2.70	1.22	5.84	0.00	3.52	96.48	0.91	1.26	3.20	82.70	8.05	9.25
Banana	1.58	1.32	3.81	0.72	0.69	43.45	35.92	20.63	0.84	4.77	9.88	92.02	7.98	0.00
Bowers	2.17	0.84	4.47	0.50	0.34	68.06	15.00	16.93	0.87	5.70	6.98	97.75	2.25	0.00
Cherry	1.28	0.73	3.21	0.48	0.59	62.47	5.75	31.78	0.74	3.13	11.89	95.66	1.66	2.68
Como	1.78	1.41	4.47	0.63	0.62	60.95	22.05	17.01	0.92	4.65	10.48	95.17	4.83	0.00
Cowpen	1.31	2.05	6.48	1.27	5.25	39.71	47.23	13.06	0.91	7.02	10.54	99.63	0.00	0.37
East Crystal	1.67	0.97	3.80	1.08	1.46	27.85	46.50	25.65	0.88	3.73	6.14	100.00	0.00	0.00
West Crystal	1.75	2.04	5.07	2.56	13.69	18.49	38.45	43.06	0.71	5.09	6.02	100.00	0.00	0.00
Daugharty	1.80	1.02	5.11	1.62	4.64	45.41	32.87	21.73	0.94	3.69	5.47	94.08	5.92	0.00
Dias	0.36	0.28	1.09	0.93	2.71	33.97	36.13	29.90	0.91	0.80	5.28	93.51	6.49	0.00
Gore	0.60	0.33	1.59	1.39	3.46	0.00	6.29	93.71	0.66	1.12	2.27	70.83	27.01	2.16
Halfmoon	2.41	1.36	6.46	0.96	1.74	40.90	6.07	53.03	0.80	6.46	2.01	98.01	1.99	0.00
Hopkins	1.25	1.00	3.54	1.22	3.38	49.91	16.43	33.66	0.74	2.69	2.16	96.55	3.45	0.00
Johns	1.96	1.36	4.64	1.50	3.22	57.80	14.49	27.71	0.81	2.61	4.21	96.60	3.40	0.00
Kerr	1.77	1.04	3.93	0.82	1.56	68.60	12.93	18.47	0.78	4.06	6.91	99.77	0.23	0.00
Little Como	1.97	1.83	5.14	1.43	13.90	79.37	14.03	6.60	0.91	3.23	11.36	100.00	0.00	0.00
Louisa	0.98	0.89	2.61	1.02	1.67	44.68	5.49	49.84	0.48	2.62	5.30	91.16	8.84	0.00

Site	Water Level Range (ft)			Monthly Water Level Change Symmetry		Landscape Soil Drainage Class (% area)			UFA Connection		Median Depth to Water Table (ft)	Soil Permeability (% acres)		
	Lower (P80-P50)	Upper (P50-P20)	Total (P90-P10)	Skewness	Kurtosis	High	Moderate	Low	Lake-UFA Correlation Strength	MCF (ft)		High	Moderate	Low
Lochloosa	1.40	1.76	3.86	1.16	3.70	0.00	10.54	89.46	0.95	3.50	3.64	89.52	0.00	10.48
Prevatt	2.47	2.47	8.55	0.92	4.22	49.80	33.70	16.50	0.84	5.23	7.02	97.82	2.18	0.00
Purdom	1.57	0.48	2.97	0.65	2.30	59.25	5.73	35.02	0.89	2.93	3.65	89.73	10.27	0.00
Savannah	1.24	0.68	2.53	1.50	2.21	14.72	32.84	52.44	0.59	2.94	3.28	70.14	29.86	0.00
Smith	2.98	1.63	8.07	0.65	0.55	88.41	8.08	3.51	0.86	11.08	8.87	100.00	0.00	0.00
Swan	2.93	1.46	6.21	0.59	0.74	61.78	23.91	14.30	0.87	6.21	13.74	100.00	0.00	0.00
Sylvan	1.38	2.39	4.47	2.17	7.64	17.85	43.83	38.32	0.73	3.92	4.98	100.00	0.00	0.00
Trone	1.70	1.45	4.49	0.53	1.69	47.62	39.05	13.33	0.88	3.58	8.72	98.16	1.84	0.00
Weir	1.12	1.25	3.32	0.60	0.12	65.47	16.69	17.84	0.84	3.40	5.42	96.25	3.64	0.11
Winona	0.82	1.96	3.75	0.45	0.87	40.54	53.59	5.87	0.25	4.52	7.77	99.75	0.25	0.00

The influence of water level fluctuation on an individual quadrat community was characterized using two variables: the percent exceedance of the mean quadrat elevation and the site's water level range (P10 – P90). The percent exceedance is the amount of time an elevation is equaled or exceeded by the surface waterbody calculated from the full POR available before the MFL was set. The P10 – P90 range represents the total range of water level fluctuation previously described for the MA but can only be determined at a site level (i.e., not for each quadrat).

The PI is an average weighted index used to characterize the hydrologic preference of vegetation. This method was originally developed by Wentworth et al. (1988) and has been used for vegetation analysis by federal agencies for the delineation of wetlands (Reed 1988; Gage & Cooper 2010). The system assigns ecological index values (1 – 5) for five plant indicator status categories (obligate, facultative wetland, facultative, facultative upland, non-wetland respectively) based on their probability to occur in a wetland (Figure C-16). Although many variables may influence the composition of vegetation communities, PI provides a way to condense the composition down to the variability caused by moisture availability.

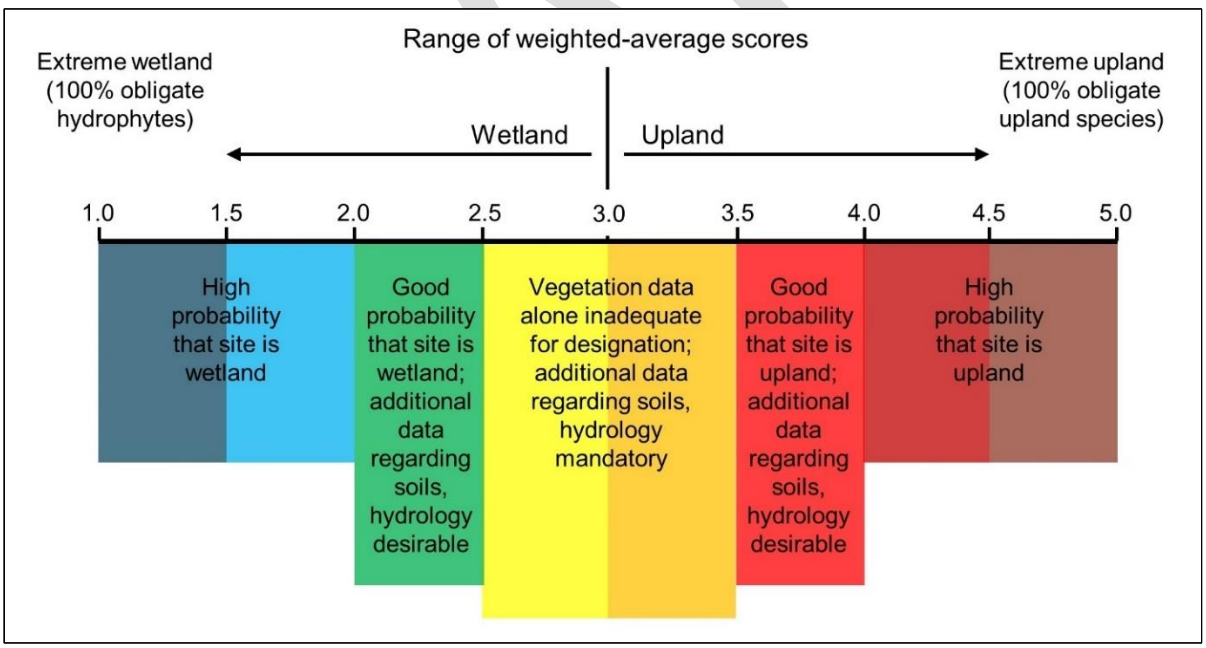

Figure C-16. Range of hydrologic preference (Prevalence Index) for vegetation communities based on species coverage. Adapted from Wentworth et al. (1986).

The quadrat-level dataset of PI, slope, percent exceedance of mean elevation, and water level range (P10-P90) was standardized to z-scores, then analyzed with Principle Components

Analysis (PCA). PCA axes were then clustered into significant groups using Ward's method of hierarchical clustering with significance tests as previously described in the MA method. PCA groups were then used as constraints in the calculation of species-based or community-based return interval calculations. For example, if calculating an RI for buttonbush at Lake Prevatt, only quadrats with a species cover class of 3 or above would be considered. A cover class of 3 or above was used in species-specific calculations because it represents a species coverage of at least 25% within a quadrat. Smaller cover classes were avoided to reduce the possibility of species occurrence due to microtopographical variations or spatial heterogeneity within a vegetation community.

Multiple quadrats may be present with buttonbush at a cover class of at least a 3, and it is possible that variations in local landscape variables separated the quadrats into more than one group in the PCA. If this occurred, the group including the majority of MFL site buttonbush quadrats was used for SWIDS calculation. For example, if the majority of quadrats at Lake Prevatt with buttonbush over a cover class of 3 were in Group 2, only Group 2 quadrats across sites were considered for comparison.

When calculating a community-based metric, species cover classes played no role, and the comparison group was designated by the majority group of the target community at the MFL site. For example, if calculating an RI for Shrub Swamp at Lake Prevatt, if the majority of Shrub Swamp quadrats at Lake Prevatt were in Group 3, the RI was calculated off of all quadrats included in Group 3. This ensured that the group for comparison was based on local landscape and vegetation characteristics and not biased by a designated community name. Averaged elevations from individual quadrats within a constraining group were used in the calculation of site return intervals using data from hydroperiod tables.

After RIs were calculated for each site included in the PCA cluster, the final site RI was calculated by taking the mean ± standard error of all observed RIs. A mean + standard error was used for exceedance metrics and the mean - standard error for nonexceedance. These values were used to incorporate an allowance for natural community/species fluctuation that occurs with climatic variability through time, or that may be occurring due to factors not considered.

Fish and Wildlife Habitat Metrics Using the Hydroperiod Tool

Per Rule 62-40.473, *Florida Administrative Code (F.A.C.)*, water management districts are directed to consider a suite of environmental values, also called water resource values (WRVs), when setting MFLs. One of these WRVs is "*fish and wildlife habitats and the passage of fish*". Typically, SJRWMD addresses this WRV through event-based metrics that are developed to maintain the long-term persistence and integrity of wetland communities.

In the absence of stable wetlands, as seen in sandhill lakes, where rapid water level fluctuations produce highly ephemeral communities, an alternative approach to event-based metrics is considered. Despite the unstable nature of these wetland communities, they both harbor diverse wetland plant and animal communities that, while unstable (i.e., their locations move over the decades due to climate-driven lake fluctuation), are worth protecting from significant harm due to withdrawals.

In recent MFLs (Sutherland et al. 2021), a new approach was developed to evaluate the effects of water level decline on fish and wildlife habitat, using a Geographic Information System (GIS)-based “hydroperiod tool”. This customized tool was developed, with the South Florida Water Management District (SFWMD) and the University of Texas (Austin), to work with ESRI’s ArcMap© (Appendix G). The hydroperiod tool functions primarily with raster (grid-based) representations of the environment in which elevation values from a Digital Elevation Model (DEM) are subtracted from an interpolated water surface elevation on a grid cell by grid cell basis, producing a new raster surface containing elevation or depth of water for each grid cell (Figure C-17). The DEM for Lake Prevatt was developed using 2018 LIDAR data, acoustic doppler profiler (ADP) data, surveyed spot elevation data, and elevation data surveyed along numerous transects.

Over recent years, since the start of data collection for Lake Prevatt in 2021, SJRWMD staff observed major fluctuations in shallow and deep marsh communities in response to large water level fluctuations. As communities move downslope during periods of drought, their areal coverage (e.g. total acreage) and habitat volume also change. Changes in the extent of nearshore habitat are related to the combined effect of changing water level and specific lake bathymetry. For example, if “habitat” is defined as portions of the lake with depths ranging from 1 to 2 feet, the areal extent of this habitat will vary with water level and be a function of lake shape and slope. The extent of some habitats may be minimal at high elevations, if banks are steep, and may be extensive at lower elevations that are characterized by low slope (e.g., if there is a large flat shelf or lake bottom). The hydroperiod tool was used to estimate the area of different fish and wildlife habitats and estimate how they change with lake level change (Figure C-18).

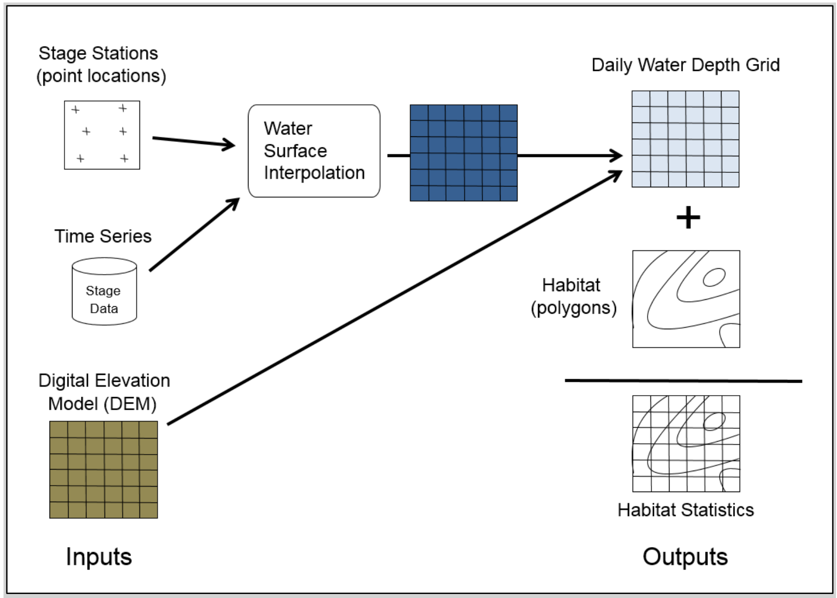

Figure C-17. Conceptual diagram of the hydroperiod tool used to estimate the relationship between lake stage and habitat area.

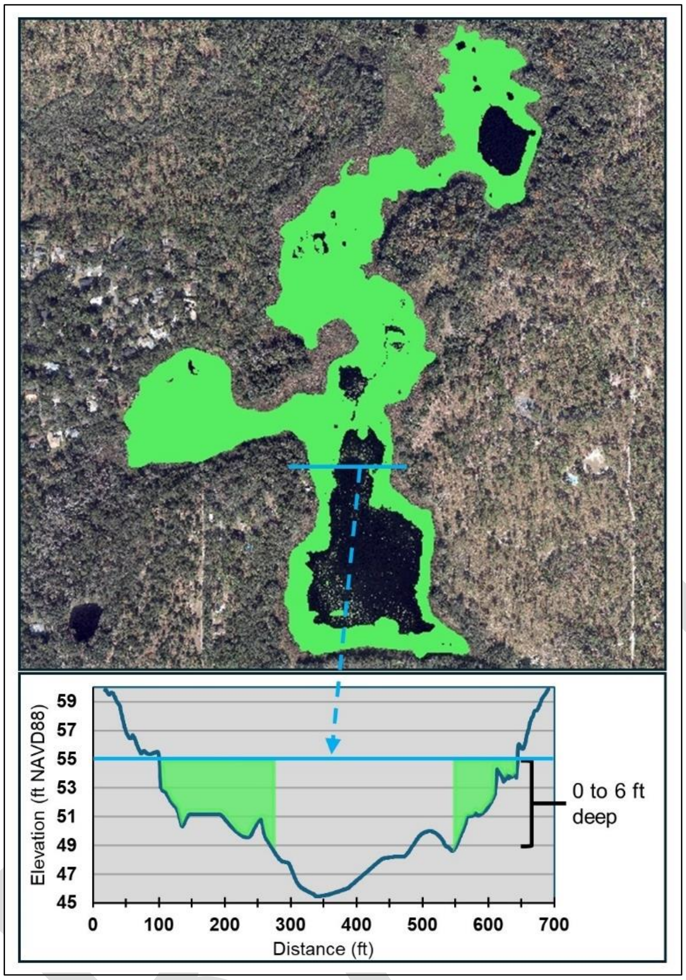

Figure C-18. Example hydroperiod tool output showing relationship between water level and habitat (0–6 ft) area at a stage elevation of 55 ft NAVD88.

<u>Impact Threshold</u>

Nearshore wetland communities at Lake Prevatt change location and change in areal extent as lake levels fluctuate naturally (i.e., due to changes in climate). However, these communities can also change in extent due to withdrawal. Therefore, it was deemed important to understand the relationship between lake level decline and change in habitat extent to understand whether withdrawal has caused (or will cause) the amount of nearshore habitat to decline beyond an acceptable threshold.

The significant harm threshold used for this metric is a 15% change in areal extent (acreage) of different habitats (*see following sections for habitat descriptions*). A 15% reduction of habitat availability has been used by other water management districts as a significant harm threshold for MFLs (Munson and Delfino 2007). This threshold has been peer reviewed and has been the basis for numerous adopted MFLs (see SJRWMD MFLs Brooklyn and Geneva or SWFWMD MFLs for Crystal River, Gum Slough, Chassahowitzka River, and Homosassa

River, among others). While many MFLs using this threshold are for flowing systems, a 15% reduction in habitat has also been used as a critical threshold for lakes and is based on bird species richness studies (Hoyer and Canfield 1994; Leeper et al. 2001; Emery et al. 2009). This threshold is also within the range (10 to 33%) of percent allowable change documented in other studies (Munson and Delfino 2007).

As noted in previous peer review of hydroperiod tool-based MFLs, this threshold has been supported by others, including Shaw et al. (2005) who states that *"... changes in available habitat ...occur along a continuum with few inflections or breakpoints where the response dramatically shifts.",* and therefore *"…loss or reduction in a given metric occurs incrementally …and in the absence of any clear statutory guidance* [they] *believe that the use of a 15 percent for loss of habitat is reasonable and prudent."*

Average Habitat Area

Average area was calculated for each fish and wildlife habitat, for each day in the POR, using the stage/habitat area relationship derived from the hydroperiod tool and the simulated water surface elevations for the no-pumping condition. The MFLs condition for fish and wildlife habitat metrics equals a 15% reduction in average habitat area under the no-pumping condition (i.e., habitat area averaged across the entire no-pumping condition lake level timeseries). Assessment of habitat metrics is then simply the comparison of the average habitat area under no-pumping condition to the average habitat area under the current-pumping condition (see Appendix D for more details).

Nearshore habitats

The nearshore environment (littoral zone) within Lake Prevatt provides habitat for numerous wildlife species, including wading birds (SJRWMD staff observations). The shallow littoral zone fringing the lake provides valuable habitat for various life stages, including refugia and forage habitat for aquatic invertebrates and small-bodied fishes. These areas also provide important reproductive habitat for fish, amphibians, and reptiles and forage habitat for wading birds.

Four nearshore habitats were defined for this analysis. Habitats are areas within the nearshore environment with specific depth ranges and are based on water level requirements of plant and animal species known to inhabit the area (Figure C-19; Neubauer 1994; SJRWMD staff observations). These habitats were chosen to ensure that multiple portions of the nearshore environment were evaluated, in case one or more was particularly sensitive to water level change. Each habitat described below was evaluated using the hydroperiod tool to determine the amount of water level decline that is associated with a 15% reduction in habitat extent (acres), relative to the long-term average no-pumping condition.

Emergent Marsh Habitat

The littoral zone at Lake Prevatt includes both shallow and deep marsh habitats, with woody wetland shrubs (e.g., buttonbush). Shallow marsh vegetation is dominated by dotted smartweed, various nutsedges, spatterdock, maidencane, pickerelweed, coast cockspur, and fall panicgrass. Deep marsh habitats are dominated by cattail, spatterdock, American white water lily, big floating heart, and fragrant flatsedge. Emergent marsh generally extends from the edge of the shore to approximately 6 ft deep. A maximum depth of 6 ft was used based on the known depth ranges for species inhabiting these communities (e.g., maidencane, and spatterdock). Based on this, the emergent marsh habitat depth range used for this analysis is 0 to 6 ft.

Game Fish Spawning Habitat

This habitat metric prevents significant harm to small forage fish spawning habitat due to withdrawal. The depth range for this metric is based on game fish preferences of 1 – 4 ft (Stuber et al. 1982; Bruno et al. 1990; Hill and Cichra 2005; Strong et al. 2010); however, in the absence of game fish at Lake Prevatt, this depth range will also provide important refuge habitat for small forage fish that form the base of production for birds and other wildlife. These small-bodied fish seek refuge from larger fish, birds, and other predators among the shallow marsh vegetation. Habitat depths of 1 to 4 ft will provide protection for this important component of the aquatic community at this lake.

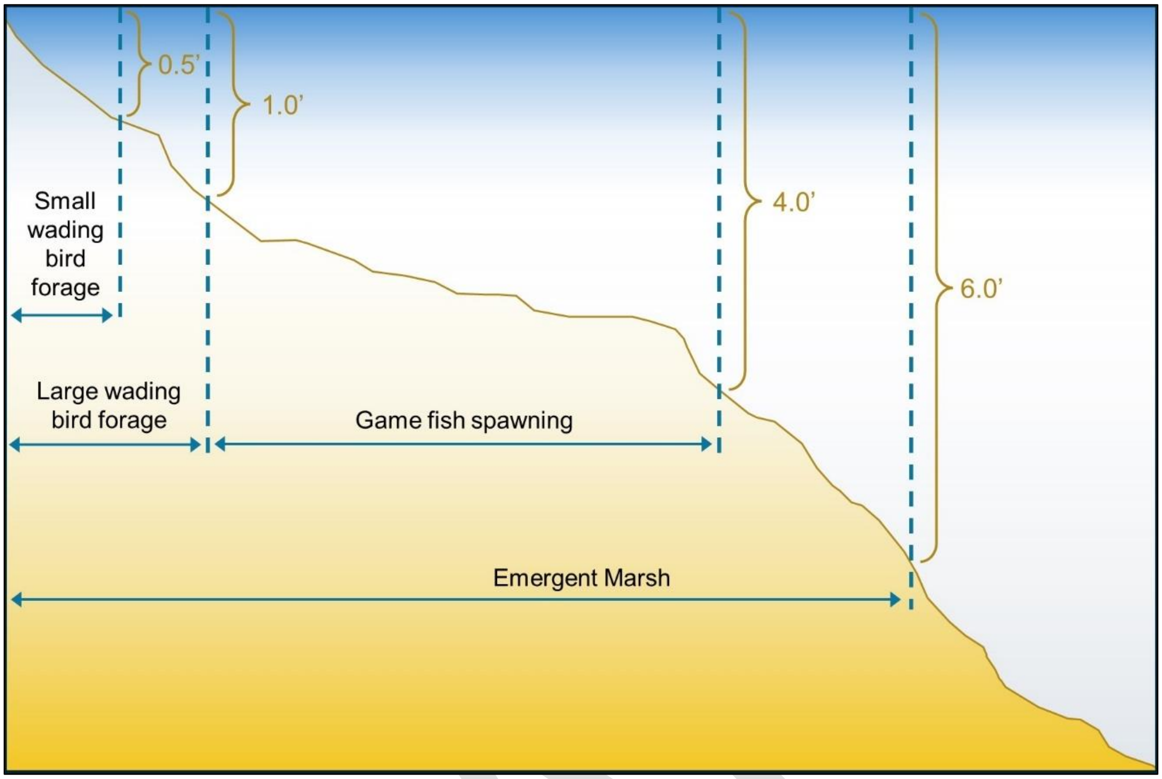

Figure C-19. Nearshore habitats and water depth ranges used in fish and wildlife habitat analyses.

Large Wading Bird Habitat

Water depth is a critical component of wading bird habitat (Bancroft et al. 2002; Pierce and Gawlik 2010; Lantz et al. 2011). Forage success of long-legged wading bird species (e.g., great egret, great blue heron) can be constrained by their leg length (Powell 1987) and typically forage in vegetation in water less than or equal to ~10–12" (Kushlan 1979; Kushlan et al. 1985; Bancroft et al. 1990). Therefore, the depth range used to prevent a significant shift in forage habitat for large wading birds, is 0 to 1 ft.

Small Wading Bird Habitat

Short-legged wading birds (little blue heron, snowy egret, ibis, etc.) require shallower habitat (~0.5 feet) for suitable foraging (Kushlan 1979; Kushlan et al. 1985). The depth range used, to prevent significant change to forage habitat for small wading birds, is 0 to 0.5 ft.

Recreation Habitats

In addition to the fish and wildlife habitat WRV, Rule 62-40.473, *F.A.C.*, also mandates consideration of other environmental values and beneficial uses. One of these WRVs is "recreation, in and on the water," the purpose of which is to protect water depths necessary for various recreational activities (e.g., fishing, swimming, etc.). Recreation in and on Lake Prevatt is an important beneficial use, both historically and currently. The lake is within Wekiwa Springs State Park, and there are youth camps on the west and east shores of the south lobe of the lake. Park visitors, members of the summer camp, and others, use the lake for kayaking, canoeing, and other recreational activities.

Canoe Depth

The purpose of this criterion is to prevent a significant change, due to water withdrawal and relative to no-pumping conditions, to minimum depths that allow for canoe/kayak passage around Lake Prevatt. Recreational value at Lake Prevatt is linked to the ability to canoe and kayak and therefore is dramatically reduced when the area suitable for paddling is reduced.

The paddling area for this metric is based on a depth offset. The offset (20”) was chosen based in part on a 2004 environmental value assessment conducted on the St. Johns River that reported the draft of small flat bottomed jon boats of 16 ft or less to be usually 1.5 ft or less (HSW 2004). The majority of watercraft used at Lake Prevatt are small and have small draft/depth requirements. The boat depth suggested by the HSW study is also consistent with an FDEP study that suggests that a minimum of 20” water depth is required for protecting bottom vegetation damage from paddling and boat prop actions. This study was conducted to determine the likelihood of “paddle gouging” of submerged vegetation within the Wekiva River basin by canoeists and boat propellers (FDEP 1990). The chosen minimum paddling depth (20”) for the Lake Prevatt MFL is also consistent with canoe paddling depths used by Suwannee River Water Management District in MFL determinations. Further, the most common recreational activities at Lake Prevatt (e.g. canoeing, kayaking, etc.) typically require at least 20” of water for safe operation. For these reasons, an offset of 20” was chosen.

Open Water

An open-water metric has been developed to protect deep water habitats that provide important refuge habitat for fish and other organisms, especially during periods of low water. Generally, this metric is largely recreation-based to allow for enough water clearance for motorized watercraft activities; however, as Lake Prevatt is not accessible to motorized watercraft, the main benefits of this metric are related to fish refugia and water quality. With Lake Prevatt located within a state park, ecological values of this metric are indirectly recreational. Open water is defined, for this metric, as those areas of the lake greater than or equal to 5 ft deep. The majority of emergent and floating-leaved plants at Lake Prevatt grow in water ranging in depths from 0 to 5 ft, sometimes reaching to 6 ft in depth (see emergent marsh vegetation metric).

In many water bodies, aquatic organisms require refuge from drought. Although droughts are natural phenomena, water withdrawal can mimic and exacerbate drought and drying of aquatic ecosystems (Magoulick and Kobza 2003). Drought refugia are especially important for fish. During periods of low water (whether from drought and/or pumping) decreasing volumes of water can result in increases in extremes of abiotic conditions (e.g., high temperature and low dissolved oxygen), concentrating organisms into smaller areas (Magoulick and Kobza 2003). The concentration of fish in drought refugia results in competition for space and resources, increasing exposure to predation (e.g., from birds and other fish) and disease (Lowe-McConnell 1975; Magoulick and Kobza 2003; Mathews and Marsh-Mathews 2003; Lennox et al. 2019).

As lakes recede, fish and other organisms move from shallow nearshore habitats to deeper areas (Gaeta et al. 2014). These open-water deep areas within lakes are more resistant than shallow areas to water level decline, and thus provide critical refugia for fish and other species (White et al. 2016). Deep areas in lakes provide protection for fish from both predation (e.g., avian predators) and protection from high temperatures. Deeper, cool water refugia are important habitats for game fish species throughout Florida (Florida Fish and Wildlife Conservation Commission, personal communication). The open-water area metric will help prevent significant harm from occurring by the reduction of important thermal-refuge, especially during summer months and prolonged drought periods (Lennox et al. 2019).

Water level decline due to drought and/or withdrawal can also negatively affect lake water quality, indirectly affecting fish and other organisms. As lake levels decline, remaining refuge areas become warmer, have higher solar irradiation, and increased concentrations of nutrients (Lennox et al. 2019). These factors can lead to the increased potential for excessive algal growth and decreased water quality. The open-water metric will benefit Lake Prevatt water quality by reducing the potential for an increase in these negative effects.

The open-water metric generally also serves to protect a lake from increased eutrophication due to wind-driven mixing. However, due to the small size and shallow nature of Lake Prevatt, wind-driven mixing would be a normal phenomenon. Therefore, reduction of wind-driven mixing is not appropriate for consideration at Lake Prevatt.

Drought-related reductions in habitat area/volume, increased physical and chemical extremes, and increased negative biotic interactions (i.e., predation and competition) naturally occur in aquatic ecosystems (Magoulick and Kozba 2003; Humphries and Baldwin 2003). However, these stressors can be exacerbated by human-induced alterations (Lennox et al. 2019), including water level declines due to withdrawal (Magoulick and Kozba 2003). In addition to protecting ecological functions and values, the open-water metric will also help minimize these negative effects of water level decline on recreational uses and water quality at Lake Prevatt.

The MFLs condition for the open-water metric equals a 15% reduction in the average open-water area (lake area ≥ 5 ft deep) under the no-pumping condition (i.e., open-water area averaged across the entire no-pumping condition lake level timeseries). As discussed above, the use of a 15% loss of area is reasonable and prudent (Shaw et al. 2005; Cardno 2018). As with the fish and wildlife habitat metrics, assessment of the open-water metric is simply the comparison of the allowable average open-water area (15% reduction of area under no-pumping condition) to the average open-water area under the current-pumping condition (see Appendix D for more details).

MFL Determinations for Lake Prevatt

Lake Prevatt is located within a sandhill area modified by karst processes (Brooks 1982) but, despite having considerable lake level fluctuation, is not typical of other sandhill-type lakes. The wide, shallow basin of the lake allows Prevatt to function as an extensive, contiguous, regularly flooded wetland system with deep organic soils. For this reason, three event-based metrics and a suite of hydroperiod tool metrics were assessed for Lake Prevatt. The following sections describe the criteria and rationale for the development of minimum levels for Lake Prevatt.

SWIDS – Recommended Event Frequencies

As detailed above, cluster analyses were performed to identify lake groups with similar hydrological and landscape characteristics in an effort to reduce uncertainty in event frequency range (see Surface Water Inundation/Dewatering Signatures (SWIDS) subsection in the MFLs Metrics section for more details). For MA event frequency calculations, the clustering method was based on larger-scale site characteristics to identify relevant groupings for comparing the non-exceedances of deep organics among 28 MFL sites. For FH and FL metrics, characteristics accounting for vegetation, hydrology, and slope were used to group individual belt transect quadrats for comparison from 29 MFL systems with applicable data.

<u>Minimum Average (MA) Non-exceedance for Deep Organic Soils</u>

Similar sites, used for the MA frequency calculation, were defined as those sharing similar water fluctuation, soil, and aquifer connection characteristics based on a hierarchical cluster analysis. As a result of this analysis, the 28 lakes analyzed were grouped into five distinct clusters (Figure C-20). Lake Prevatt was in a group with 6 other MFL lakes that were generally characterized by 1) a relatively high P10-P90 range; 2) greater areas within 500 m of the lake of high drainage soil types; and 3) relatively higher MCF. All lakes within the Lake Prevatt cluster had deep organic soil (histosol/histic epipedon) data for use in the SWIDS calculation.

The lake classification process resulted in a modest reduction in frequency range (relative to using all sites). The overall average non-exceedance range for a 180-day duration was reduced from 44.9% over all sites to 31.7% within the Lake Prevatt group. While the difference in mean exceedance between all sites and cluster sites was small, the resulting central tendency (mean minus standard error) provides a more appropriate recommendation for a minimum frequency (relative to using all sites) because it is based on sites with similar hydrological and landscape characteristics.

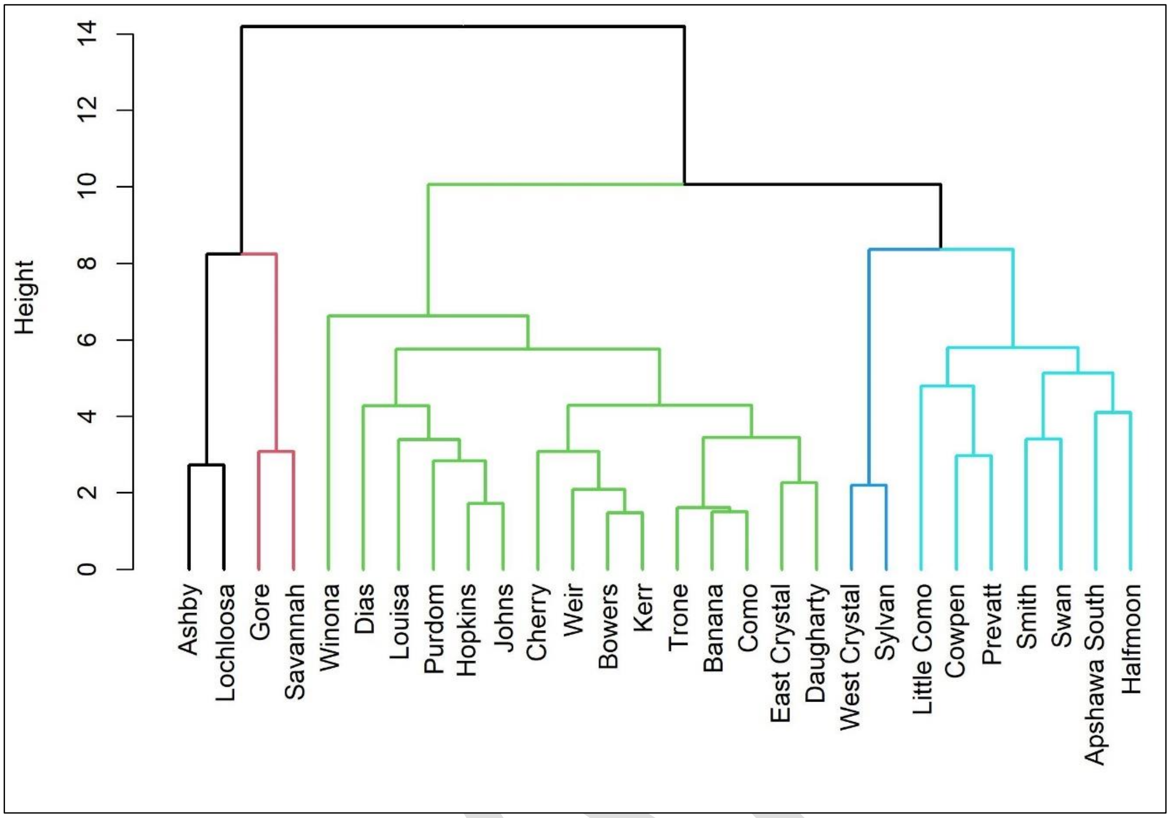

Figure C-20. Five significant groups defined from the Ward's D clustering of site characteristics for use in the calculation of MA event frequencies (return intervals).

Frequent High (FH) Exceedance and Frequent Low (FL) Non-exceedance for Vegetation

To reduce uncertainty in the range of return intervals for vegetation-based metrics, an alternate clustering procedure than that used for the MA was performed (see Surface Water Inundation/Dewatering Signatures (SWIDS) subsection in the MFLs Metrics section for more details). Four-hundred sixteen individual quadrats from belt transects of 29 different MFL sites were grouped based on the quadrat vegetation PI, slope, percent exceedance of the mean elevation, and site P10-P90 range (Table C-15).

This variation in method was introduced for Lake Prevatt because the site-wide cluster (MA method) was not ideal for analyzing vegetation-based metrics. As communities and/or species were not always shared by sites within a group, movement up the dendrogram (group tree) was often necessary and did not often result in reductions in event frequency uncertainty (ie., reductions in the range of exceedance percentages for a given duration). Larger site characteristics, such as generalized soil types or proxies of aquifer connection, cannot always account for local hydrologic variability that may be driving trends in long-term vegetation communities. Therefore, the local-scale approach was used to determine the most applicable communities for comparison in calculating event frequencies of vegetation metrics. Sites differed slightly from those used in the MA analysis due to differences in data type availability among sites.

Table C-15: Quadrat variables P10-P90 range, PI, slope, and percent exceedance of mean elevation used in FH and FL SWIDS PCA.

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Butler_T1b_2004	Wet Prairie	9.48	2.61	7.62	4.60
Butler_T1c_2004	Shallow Marsh	9.48	2.21	3.94	43.10
Butler_T1d_2004	Deep Marsh	9.48	1.00	5.58	69.60
Butler_T2b_2004	Wet Prairie	9.48	2.39	5.06	8.60
Butler_T2c_2004	Shallow Marsh	9.48	1.43	4.08	41.80
Butler_T2d_2004	Deep Marsh	9.48	1.00	1.95	64.60
Butler_T3b_2004	Wet Prairie	9.48	2.08	4.62	7.20
Butler_T3c_2004	Shallow Marsh	9.48	2.23	11.52	41.60
Butler_T3d_2004	Deep Marsh	9.48	1.00	1.73	66.00
Butler_T4b_2004	Wet Prairie	9.48	2.10	5.28	7.20
Butler_T4c_2004	Shallow Marsh	9.48	1.42	5.00	24.70
Butler_T4d_2004	Deep Marsh	9.48	1.27	4.15	59.90
Butler_T5b_2004	Wet Prairie	9.48	2.25	5.78	2.50
Butler_T5c_2004	Shallow Marsh	9.48	1.63	4.68	26.50
Butler_T5d_2004	Deep Marsh	9.48	1.17	1.59	62.10
Butler_T6b_2004	Wet Prairie	9.48	2.68	4.86	7.40
Butler_T6c_2004	Shallow Marsh	9.48	1.26	3.62	38.30
Butler_T6d_2004	Deep Marsh	9.48	1.00	2.89	62.90
Butler_T7b_2004	Wet Prairie	9.48	2.41	2.80	7.10
Butler_T7c_2004	Shallow Marsh	9.48	1.48	2.99	30.80
Butler_T7d_2004	Deep Marsh	9.48	1.00	4.37	55.90
Doyle_T8b_2004	Wet Prairie	9.48	2.76	2.91	7.30
Doyle_T8c_2004	Shallow Marsh	9.48	1.59	2.90	35.10
Doyle_T8d_2004	Deep Marsh	9.48	1.10	2.22	66.30
Doyle_T9b_2004	Wet Prairie	9.48	2.31	6.75	6.70
Doyle_T9c_2004	Shallow Marsh	9.48	1.79	6.26	31.70
Doyle_T9d_2004	Deep Marsh	9.48	1.00	4.81	66.70

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Butler_T1b_2009	Wet Prairie	9.48	3.05	0.00	0.20
Butler_T1c_2009	Shallow Marsh	9.48	2.19	1.37	19.60
Butler_T1d_2009	Shallow Marsh	9.48	1.50	5.02	39.70
Butler_T1e_2009	Transition	9.48	1.00	4.09	52.80
Butler_T1f_2009	Deep Marsh	9.48	1.00	4.06	55.40
Butler_T1g_2009	Deep Marsh	9.48	1.00	4.23	61.40
Butler_T2b_2009	Transition	9.48	2.39	3.67	0.20
Butler_T2c_2009	Shallow Marsh	9.48	2.69	3.84	9.70
Butler_T2d_2009	Shallow Marsh	9.48	2.00	4.35	28.60
Butler_T2e_2009	Deep Marsh	9.48	1.24	2.84	54.30
Butler_T2f_2009	Deep Marsh	9.48	1.00	1.38	64.50
Butler_T4b_2009	Transition	9.48	2.19	6.84	0.00
Butler_T4c_2009	Wet Prairie	9.48	2.06	4.18	1.90
Butler_T4d_2009	Transition	9.48	2.10	4.09	11.30
Butler_T4e_2009	Shallow Marsh	9.48	2.00	9.76	23.00
Butler_T4f_2009	Transition	9.48	1.77	3.55	32.50
Butler_T4g_2009	Deep Marsh	9.48	2.50	7.63	43.40
Butler_T4h_2009	Deep Marsh	9.48	1.00	3.60	54.00
Butler_T5b_2009	Transition	9.48	2.00	5.36	1.60
Butler_T5c_2009	Shallow Marsh	9.48	2.29	4.59	21.00
Butler_T5d_2009	Shallow Marsh	9.48	1.50	1.75	56.30
Butler_T6b_2009	Wet Prairie	9.48	3.00	4.57	4.00
Butler_T6c_2009	Shallow Marsh	9.48	2.28	3.01	22.50
Butler_T6d_2009	Transition	9.48	2.38	5.51	47.50
Butler_T7b_2009	Transition	9.48	2.11	2.45	2.50
Butler_T7c_2009	Transition	9.48	3.00	2.78	5.30
Butler_T7d_2009	Shallow Marsh	9.48	3.69	3.75	13.20
Butler_T7e_2009	Shallow Marsh	9.48	2.32	1.95	23.90
Butler_T7f_2009	Shallow Marsh	9.48	2.08	3.43	40.30
Doyle_T8b_2009	Transition	9.48	2.17	2.91	3.60
Doyle_T8c_2009	Shallow Marsh	9.48	2.00	3.27	22.30

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Doyle_T8d_2009	Shallow Marsh	9.48	2.09	2.18	40.50
Doyle_T8e_2009	Transition	9.48	2.04	2.51	47.40
Doyle_T8f_2009	Deep Marsh	9.48	2.00	2.90	59.70
Doyle_T8g_2009	Deep Marsh	9.48	1.55	2.18	66.60
Doyle_T8h_2009	Deep Marsh	9.48	1.00	1.28	69.80
Doyle_T9_c_2009	Wet Prairie	9.48	3.52	6.26	24.50
Doyle_T9_d_2009	Shallow Marsh	9.48	2.59	6.28	49.20
Doyle_T9_e_2009	Deep Marsh	9.48	1.62	4.55	62.80
Doyle_T9_f_2009	Deep Marsh	9.48	1.00	3.86	66.80
Lochloosa_T1b_2017	Hydric Hammock	4.23	2.08	0.64	6.80
Lochloosa_T1c_2017	Transition	4.23	2.17	0.29	12.70
Lochloosa_T1d_2017	Hardwood Swamp	4.23	1.38	0.17	33.80
Lochloosa_T1e_2017	Transition	4.23	1.00	2.64	75.50
Lochloosa_T1f_2017	Deep Marsh	4.23	1.06	0.44	100.00
Lochloosa_T2b_2017	Hydric Hammock	4.23	1.71	0.69	17.50
Lochloosa_T2c_2017	Hardwood Swamp	4.23	1.56	0.24	41.20
Lochloosa_T2d_2017	Transition	4.23	1.08	4.41	68.40
Lochloosa_T2e_2017	Deep Marsh	4.23	1.00	0.35	100.00
Lochloosa_T3b_2017	Hydric Hammock	4.23	1.81	0.40	15.70
Lochloosa_T3c_2017	Cypress Swamp	4.23	1.11	0.44	53.30
Lochloosa_T3d_2017	Transition	4.23	1.00	2.41	83.70
Lochloosa_T3e_2017	Deep Marsh	4.23	1.00	0.47	100.00
Cowpen_T1b_2016	Wet Prairie	8.73	1.50	7.83	56.00
Cowpen_T1c_2016	Shallow Marsh	8.73	1.00	9.37	71.90
Cowpen_T1d_2016	Deep Marsh	8.73	1.04	5.57	96.40
Cowpen_T1e_2016	Aquatic Bed	8.73	1.00	6.11	100.00
Cowpen_T2a_2016	Transitional Shrub	8.73	3.00	0.44	50.60
Cowpen_T2b_2016	Transition	8.73	2.87	2.48	60.30
Cowpen_T2c_2016	Shallow Marsh	8.73	1.54	3.24	66.00
Cowpen_T2d_2016	Deep Marsh	8.73	1.08	0.92	96.20
Cowpen_T6a_2016	Shallow Marsh	8.73	1.00	2.19	82.30

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Cowpen_T6b_2016	Deep Marsh	8.73	1.00	1.40	96.40
Melrose_T1a_2011	Floating Marsh	1.30	1.04	2.18	100.00
Melrose_T1b_2011	Shrub Swamp	1.30	1.42	3.62	100.00
Melrose_T1c_2011	Hardwood Swamp	1.30	2.00	0.09	11.60
Melrose_T1d_2011	Hardwood Swamp	1.30	2.18	0.28	1.90
Melrose_T1e_2011	Transition	1.30	2.51	0.38	0.20
Melrose_T2b_2011	Transition	1.30	2.37	2.18	0.50
Melrose_T2c_2011	Hardwood Swamp	1.30	2.04	0.34	13.70
Melrose_T2d_2011	Shrub Swamp	1.30	1.96	3.43	100.00
Melrose_T2e_2011	Floating Marsh	1.30	1.51	2.16	100.00
Melrose_T3b_2011	Transition	1.30	2.32	4.00	0.00
Melrose_T3c_2011	Baygall	1.30	2.10	0.47	0.05
Melrose_T3d_2011	Transition	1.30	2.24		0.04
Melrose_T3e_2011	Hardwood Swamp	1.30	2.08	0.65	3.10
Melrose_T3f_2011	Floating Marsh	1.30	1.11	1.78	100.00
Indian_T1a_2007	Low Flatwoods	8.27	2.23	1.06	4.20
Indian_T1b_2007	Transition	8.27	1.77	0.29	18.70
Indian_T1c_2007	Bayhead	8.27	1.86	0.26	16.30
Indian_T1d_2007	Hardwood Swamp	8.27	2.00	0.92	26.40
Indian_T1e_2007	Shallow Marsh	8.27	1.96	1.93	49.20
Indian_T2b_2007	Hardwood Swamp	8.27	1.88	1.23	29.20
Indian_T2c_2007	Bay Head	8.27	2.00	1.31	12.10
Indian_T2d_2007	Transition	8.27	2.46	2.67	0.30
Indian_T2e_2007	Low Flatwoods	8.27	2.58	6.28	0.00
Apshawa_South_T1b_2011	Transition	5.78	2.88	10.08	5.80
Apshawa_South_T1c_2011	Wet Prairie	5.78	2.71	2.08	18.60
Apshawa_South_T1d_2011	Shallow Marsh	5.78	2.05	0.41	36.40
Apshawa_South_T1e_2011	Wet Prairie	5.78	2.93	0.46	23.00

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Apshawa_South_T1f_2011	Shallow Marsh	5.78	2.00	1.10	55.30
Apshawa_South_T1g_2011	Deep Marsh	5.78	1.50	1.20	89.30
Apshawa_South_T2b_2011	Transitional Shrub	5.78	2.75	4.80	22.70
Apshawa_South_T2c_2011	Shallow Marsh	5.78	2.50	5.32	68.90
Apshawa_South_T2d_2011	Deep Marsh	5.78	1.15	2.06	90.20
Apshawa_South_T2e_2011	Deep Marsh	5.78	1.00	1.07	89.60
Apshawa_South_T2f_2011	Shallow Marsh	5.78	1.15	3.00	80.80
Apshawa_South_T2g_2011	Shallow Marsh	5.78	1.00	6.60	52.50
Apshawa_South_T2h_2011	Shallow Marsh	5.78	1.55	2.58	71.70
Apshawa_South_T2i_2011	Deep Marsh	5.78	1.00	2.85	87.60
Apshawa_North_T1c_2011	Transitional Shrub	3.06	3.00	5.57	2.80
Apshawa_North_T1d_2011	Wet Prairie	3.06	3.05	3.85	7.30
Apshawa_North_T1e_2011	Transition	3.06	2.00	4.24	46.70
Apshawa_North_T1f_2011	Deep Marsh	3.06	1.11	1.19	73.00
Apshawa_North_T1g_2011	Deep Marsh	3.06	1.00	6.79	94.00
Apshawa_North_T2b_2011	Transitional Shrub	3.06	3.48	6.75	2.90
Apshawa_North_T2d_2011	Deep Marsh	3.06	1.00	0.51	81.70
Apshawa_North_T2e_2011	Deep Marsh	3.06	1.00	0.44	78.00
Apshawa_North_T2f_2011	Deep Marsh	3.06	1.00	0.31	74.00
Swan_T1Bb_2001	Transitional Shrub	7.03	2.20	1.92	7.40
Swan_T1Bc_2001	Wet Prairie	7.03	2.33	4.05	32.10
Swan_T1Bd_2001	Shallow Marsh	7.03	1.46	0.81	84.20
Swan_T1Cb_2001	Transitional Shrub	7.03	2.44	2.14	17.60
Swan_T1Cc_2001	Wet Prairie	7.03	2.81	2.03	66.30
Swan_T1Cd_2001	Shallow Marsh	7.03	1.61	0.89	82.80
ThreeIsland_TAb	Pine Fringe	6.76	2.19	2.24	0.30

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
ThreeIsland_TAc	Transitional Shrub	6.76	1.47	3.53	12.50
ThreeIsland_TAd	Shallow Marsh	6.76	1.11	0.73	50.40
ThreeIsland_TAe	Deep Marsh	6.76	1.00	1.18	74.00
ThreeIsland_TBa	Upland	6.76	3.47	2.75	0.00
ThreeIsland_TBb	Pine Fringe	6.76	2.69	2.67	0.90
ThreeIsland_TBc	Transitional Shrub	6.76	2.31	5.27	6.40
ThreeIsland_TBd	Shallow Marsh	6.76	1.12	4.87	44.60
ThreeIsland_TBe	Deep Marsh	6.76	1.08	2.36	76.70
Daugharty_T1a	Mesic Hammock	3.76	4.58	4.57	0.00
Daugharty_T1b	Disturbed Floodplain Swamp	3.76	2.46	4.15	0.00
Daugharty_T1c	Disturbed Floodplain Marsh	3.76	2.02	7.41	29.30
Daugharty_T1d	Littoral Zone: Disturbed Emergent Marsh	3.76	1.64	16.17	75.90
Daugharty_T1e	Littoral Zone: Deep Marsh	3.76	1.00	10.20	87.10
Daugharty_T2a	Disturbed Mesic Hammock	3.76	3.78	3.03	0.00
Daugharty_T2b	Disturbed Floodplain Swamp	3.76	1.97	3.75	0.00
Daugharty_T2c	Disturbed Floodplain Marsh	3.76	1.97	1.38	29.30
Daugharty_T2d	Littoral Zone: Mud Flat	3.76	2.00	8.22	76.00
Kerr_T1b_2012	Wet Prairie	4.83	1.79	4.78	34.00
Kerr_T1c_2012	Shallow Marsh	4.83	1.17	1.36	76.60
Kerr_T1d_2012	Shallow Marsh	4.83	1.14	1.46	89.70
Kerr_T1e_2012	Deep Marsh	4.83	1.00	1.46	100.00
Kerr_T1f_2012	Aquatic Bed	4.83	1.00	0.88	100.00

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Kerr_T1g_2012	Deep Marsh	4.83	1.00	1.15	100.00
Kerr_T2a_2014	Shallow Marsh	4.83	1.66	1.31	99.80
Kerr_T2b_2014	Wet Prairie	4.83	2.00	2.11	79.10
Kerr_T2c_2014	Transition	4.83	2.63	2.15	43.50
Kerr_T2d_2014	Shrub Swamp	4.83	3.07	0.65	60.70
Kerr_T2e_2014	Wet Prairie	4.83	3.89	3.81	58.50
Kerr_T2f_2014	Shallow Marsh	4.83	1.81	3.73	90.60
Kerr_T3a_2014	Shallow Marsh	4.83	1.07	1.58	99.80
Kerr_T3b_2014	Wet Prairie	4.83	2.21	2.44	78.10
Kerr_T3c_2014	Transition	4.83	2.75	2.50	39.50
Kerr_T3d_2014	Shrub Swamp	4.83	2.71	0.46	78.20
Kerr_T3e_2014	Shrub Swamp	4.83	2.19	0.43	76.50
Kerr_T3f_2014	Shrub Swamp	4.83	1.71	0.22	79.70
Kerr_T4b_2012	Transition	4.83	2.57	3.05	30.60
Kerr_T4c_2012	Shrub Swamp	4.83	1.49	1.03	79.10
Kerr_T4d_2012	Shrub Swamp	4.83	1.81	2.54	87.40
Kerr_T4e_2012	Shallow Marsh	4.83	1.00	3.89	100.00
Kerr_T4f_2012	Deep Marsh	4.83	1.00	2.29	100.00
Kerr_T6d_2012	Transition	4.83	2.76	4.50	27.40
Kerr_T6e_2012	Wet Prairie	4.83	1.97	2.81	71.60
Kerr_T6f_2012	Shrub Swamp	4.83	1.49	0.60	81.30
Kerr_T6g_2012	Transition	4.83	1.22	1.41	91.20
Kerr_T6h_2012	Deep Marsh	4.83	1.28	2.43	100.00
Kerr_T7b_2012	Transition	4.83	1.12	3.05	17.60
Kerr_T7c_2012	Shrub Swamp	4.83	1.00	2.41	39.70
Kerr_T7d_2012	Shrub Swamp	4.83	1.40	0.74	72.90
Kerr_T7e_2012	Shrub Swamp	4.83	1.86	0.71	80.50
Kerr_T7f_2012	Shallow Marsh	4.83	1.00	3.93	97.00
Kerr_T7g_2012	Deep Marsh	4.83	1.00	4.00	100.00

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Upper_Louise_T1b_1999	Seepage Slope	3.17	2.75	0.85	0.03
Upper_Louise_T1c_1999	Upper Wet Prairie	3.17	3.11	0.42	20.80
Upper_Louise_T1d_1999	Lower Wet Prairie	3.17	2.00	0.21	31.60
Upper_Louise_T1e_1999	Emergent Marsh	3.17	1.37	3.45	74.80
Upper_Louise_T2b_1999	Seepage Slope	3.17	2.08	2.74	0.17
Upper_Louise_T2c_1999	Wet Prairie	3.17	1.90	0.78	22.90
Upper_Louise_T2d_1999	Bay Head	3.17	2.21	0.16	36.80
Upper_Louise_T2e_1999	Cypress Swamp	3.17	1.53	0.51	61.40
Upper_Louise_T2f_1999	Emergent Marsh	3.17	1.00	0.43	80.40
Bowers_T1b_2003	Transitional Shrub	3.75	2.56	1.71	7.10
Bowers_T1c_2003	Shallow Marsh	3.75	1.39	1.41	74.40
Bowers_T1d_2003	Deep Marsh	3.75	1.15	0.02	85.20
Bowers_T1e_2003	Deep Marsh Littoral Zone	3.75	1.44	0.52	79.60
Bowers_T2b_2003	Transitional Shrub	3.75	1.92	1.51	29.70
Bowers_T2c_2003	Shallow Marsh	3.75	1.62	1.41	74.40
Bowers_T2d_2003	Deep Marsh	3.75	1.13	0.09	84.70
Bowers_T3b_2003	Bay Head	3.75	2.00	2.50	5.00
Bowers_T3c_2003	Shallow Marsh	3.75	1.24	0.80	79.90
Smith_T1b_2003	Transitional Shrub	5.47	3.00	1.66	7.10
Smith_T1c_2003	Shallow Marsh	5.47	1.00	1.16	60.90
Smith_T1d_2003	Deep Marsh	5.47	2.50	2.83	89.10
Smith_T2b_2003	Transitional Shrub	5.47	2.76	3.56	46.90
Smith_T2c_2003	Shallow Marsh	5.47	2.10	0.99	79.80
Smith_T2d_2003	Deep Marsh	5.47	3.65	0.11	79.80
Smith_T3b_2003	Transitional Shrub	5.47	2.44	0.29	7.60
Smith_T3c_2003	Wet Prairie	5.47	3.00	0.21	9.40
Smith_T3d_2003	Shallow Marsh	5.47	2.00	1.37	54.90

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Johns_T1b_2023	Ecotone - Salix	7.25	2.68	2.11	4.50
Johns_T1c_2023	Shrub Swamp - Salix	7.25	1.51	3.56	10.30
Johns_T1d_2023	Shrub Swamp - Cephalanthus w/floating veg	7.25	1.40	4.87	35.00
Johns_T1e_2023	Deep Marsh	7.25	1.61	5.00	82.90
Johns_T2b_2023	Upland Transition	7.25	3.55	4.63	0.92
Johns_T2c_2023	Transition - Salix	7.25	1.94	3.06	76.85
Johns_T2d_2023	Transition - Cephalanthus	7.25	1.62	4.30	18.00
Johns_T2e_2023	Shrub Swamp - Cephalanthus w/floating veg	7.25	1.36	3.81	36.00
Johns_T2f_2023	Deep Marsh - Typha	7.25	1.24	3.88	49.60
Johns_T2g_2023	Deep Marsh	7.25	1.67	2.21	87.80
Johns_T3b_2023	Ecotone	7.25	3.52	4.55	0.50
Johns_T3c_2023	Ecotone	7.25	2.63	5.45	5.40
Johns_T3d_2023	Shallow Marsh	7.25	1.35	6.61	12.00
Johns_T3e_2023	Cattail Marsh	7.25	1.00	1.68	33.30
Johns_T3f_2023	Cephalanthus w/floating veg	7.25	1.00	3.19	37.40
Johns_T3g_2023	Deep Marsh	7.25	1.00	1.71	41.20
Johns_T4b_2023	Ecotone	7.25	2.34	2.48	1.20
Johns_T4c_2023	Ecotone	7.25	1.93	2.16	7.00
Johns_T4d_2023	Shallow Marsh	7.25	1.74	2.49	13.90
Johns_T4e_2023	Cephalanthus w/spartina	7.25	1.14	1.82	21.80
Johns_T4f_2023	Cephalanthus w/floating veg	7.25	1.00	1.75	36.10
Johns_T5b_2023	Ecotone	7.25	3.73	4.68	1.01

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Johns_T5c_2023	Ecotone	7.25	2.21	2.52	6.10
Johns_T5d_2023	Cephalanthus w/mixed species	7.25	1.21	1.06	11.30
Johns_T5e_2023	Shallow Marsh	7.25	1.42	0.43	17.60
Johns_T5f_2023	Cephalanthus w/spartina	7.25	1.36	0.29	21.10
Johns_T5g_2023	Shallow Marsh	7.25	1.51	0.72	23.40
Johns_T5h_2023	Ecotone	7.25	1.40	1.17	26.90
Johns_T5i_2023	Cattail Marsh	7.25	1.00	2.38	40.90
Johns_T5j_2023	Deep Marsh	7.25	1.00	4.13	76.20
Dias_T1a_2005	Hydric Hammock	1.56	1.84	0.81	0.50
Dias_T1b_2005	Hardwood Swamp	1.56	1.91	0.35	16.00
Gore_T1a	Shrub Swamp	1.61	1.49	0.76	96.90
Gore_T1b	Hardwood Swamp	1.61	1.69	1.00	89.40
Gore_T1c	Upper Hardwood Swamp	1.61	1.94	1.03	52.30
Gore_T1d	Seepage Slope	1.61	3.81	3.81	0.80
Gore_T1e	Low Flatwoods	1.61	2.39	1.53	0.00
Gore_T2a	Shrub Swamp	1.61	1.86	1.00	91.90
Gore_T2b	Hardwood Swamp	1.61	1.80	0.98	79.70
Gore_T2c	Seepage Slope	1.61	3.30	14.04	0.00
Gore_T2d	Low Flatwoods	1.61	4.57	3.21	0.00
Pierson_T1b_2000	Bay Swamp	1.76	1.57	1.99	63.90
Pierson_T1c_2000	Mixed Hardwood Swamp	1.76	1.74	0.53	58.80
Pierson_T1d_2000	Lakeshore Berm	1.76	1.85	3.91	41.90
Pierson_T1e_2000	Emergent Aquatic Bed	1.76	1.00	3.15	98.80
Pierson_T2b_2000	Seepage Slope	1.76	2.53	2.06	0.00

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Pierson_T2c_2000	Bay Head	1.76	2.00	3.18	1.10
Pierson_T2d_2000	Bay Swamp	1.76	1.55	1.10	37.50
Pierson_T2e_2000	Mixed Hardwood Swamp	1.76	1.66	0.90	73.60
Pierson_T3b_2000	Bay Swamp	1.76	1.93	2.67	7.00
Pierson_T3c_2000	Mixed Hardwood Swamp	1.76	1.84	0.31	47.20
Prevatt_T1b_2022	Transition	7.81	2.72	2.94	43.70
Prevatt_T1c_2022	Transitional Shrub Swamp	7.81	1.57	3.00	62.40
Prevatt_T1d_2022	Shrub Swamp	7.81	2.15	1.24	74.20
Prevatt_T1e_2022	Shallow Marsh	7.81	1.18	4.94	85.20
Prevatt_T1f_2022	Deep Marsh	7.81	1.05	1.30	88.40
Prevatt_T1g_2022	Deep Marsh	7.81	1.54	1.51	87.30
Prevatt_T1h_2022	Deep Marsh	7.81	1.05	1.43	87.40
Prevatt_T1i_2022	Deep Marsh	7.81	1.00	2.52	88.20
Prevatt_T1j_2022	Deep Marsh	7.81	1.05	0.48	87.60
Prevatt_T1k_2022	Shallow Marsh	7.81	1.54	0.57	86.50
Prevatt_T1l_2022	Shallow Marsh	7.81	1.05	1.24	83.20
Prevatt_T1m_2022	Shrub Swamp	7.81	2.11	0.95	74.20
Prevatt_T2b_2022	Transition	7.81	2.72	3.77	26.80
Prevatt_T2c_2022	Transitional Shrub Swamp	7.81	1.15	2.58	58.90
Prevatt_T2d_2022	Shrub Swamp	7.81	1.79	1.62	73.30
Prevatt_T2e_2022	Shallow Marsh	7.81	1.29	2.87	85.10
Prevatt_T3b_2022	Transition	7.81	2.86	4.57	42.00
Prevatt_T3c_2022	Transitional Shrub Swamp	7.81	2.94	3.00	65.20
Prevatt_T3d_2022	Salix Shrub	7.81	1.39	1.15	74.20
Prevatt_T3e_2022	Cephalanthus Shrub	7.81	1.29	1.10	79.70
Prevatt_T3f_2022	Shallow Marsh	7.81	1.28	0.42	85.70
Prevatt_T3g_2022	Deep Marsh	7.81	1.00	1.38	89.90

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Prevatt_T3h_2022	Deep Marsh Floating	7.81	1.00	4.57	99.60
Ashby_T1b_2005	Forested Depression	2.54	2.55	5.60	0.10
Ashby_T1c_2005	Hydric Hammock	2.54	2.35	0.67	5.90
Ashby_T1d_2005	Hardwood Swamp	2.54	1.97	0.00	19.50
Ashby_T2b_2005	Hydric Hammock/Hardwood Swamp	2.54	2.14	1.07	6.90
Colby_TAb_2005	Transitional Shrub	7.41	3.28	2.43	0.40
Colby_TAc_2005	Wet Prairie	7.41	1.38	2.10	25.60
Colby_TAd_2005	Shallow Marsh	7.41	1.21	1.23	52.70
Colby_TBb_2005	Transitional Shrub	7.41	3.68	4.09	2.70
Colby_TBc_2005	Wet Prairie	7.41	1.36	1.91	32.70
Colby_TBd_2005	Shallow Marsh	7.41	1.24	1.09	54.10
Colby_TCb_2005	Forested Depression	7.41	2.53	1.43	0.10
Colby_TCc_2005	Wet Prairie	7.41	1.71	0.82	18.40
Colby_TCd_2005	Shallow Marsh	7.41	1.03	0.97	48.90
Colby_TDb_2005	Wet Prairie	7.41	1.14	2.78	21.50
Colby_TDc_2005	Shallow Marsh	7.41	1.18	1.00	44.30
Colby_TDd_2005	Wet Prairie	7.41	1.20	1.05	30.40
Colby_TDe_2005	Shallow Marsh	7.41	1.29	1.37	53.80
Como_T4b_1991	Transition	4.50	2.00	1.62	7.70
Como_T4c_1991	Bayhead	4.50	2.06	1.75	24.70
Como_T4d_1991	Wet Prairie	4.50	2.64	1.21	53.10
Como_T4e_1991	Shallow Marsh	4.50	2.38	2.72	68.60
Como_T4f_1991	Transition	4.50	1.93	3.21	79.40
Como_T4g_1991	Deep Marsh	4.50	1.04	0.43	99.60
Como_T5b_1991	Transition	4.50	2.09	2.56	4.30
Como_T5c_1991	Hardwood Swamp	4.50	1.84	0.72	17.00
Como_T5d_1991	Shallow Marsh	4.50	2.20	5.33	66.20
Como_T5e_1991	Deep Marsh	4.50	1.42	3.71	100.00

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
Banana_T4b_1991	Transition	3.85	2.30	2.18	0.60
Banana_T4c_1991	Forested Flatwoods	3.85	1.89	0.35	6.20
Banana_T4d_1991	Transitional Shrub	3.85	1.55	4.08	20.40
Banana_T4e_1991	Wet Prairie	3.85	2.14	2.32	39.20
Banana_T4f_1991	Shallow Marsh	3.85	1.08	1.87	69.60
Banana_T4g_1991	Transition	3.85	1.06	2.03	87.00
Banana_T4h_1991	Deep Marsh	3.85	1.00	2.15	100.00
LittleComo_T3b_1995	Transition	4.99	1.31	8.43	38.10
LittleComo_T3c_1995	Shallow Marsh	4.99	1.81	0.98	78.90
LittleComo_T3d_1995	Shallow Marsh	4.99	1.96	1.26	85.50
LittleComo_T3e_1995	Transition	4.99	2.00	2.39	94.50
LittleComo_T3f_1995	Deep Marsh	4.99	1.00	2.55	98.90
LittleComo_T4a_1995	Bayhead	4.99	2.10	5.12	5.60
LittleComo_T4b_1995	Shallow Marsh	4.99	1.88	1.05	70.50
LittleComo_T4c_1995	Shallow Marsh	4.99	2.28	2.62	84.60
LittleComo_T4d_1995	Deep Marsh	4.99	1.13	2.62	98.80
Trone_T3b_1996	Transition	3.84	2.00	3.31	20.30
Trone_T3c_1996	Wet Prairie	3.84	2.30	1.01	58.20
Trone_T3d_1996	Transition	3.84	1.74	7.31	85.90
Trone_T3e_1996	Deep Marsh	3.84	1.00	2.18	100.00
Trone_T5b_1996	Deep Marsh	3.84	1.00	2.38	100.00
Trone_T5c_1996	Shallow Marsh	3.84	1.15	2.39	99.60
Trone_T5d_1996	Transition	3.84	1.35	2.43	98.50
Trone_T5e_1996	Wet Prairie	3.84	1.61	2.14	66.00
WestCrystalLake_T1b_2023	Transition Zone	6.19	2.24	5.27	2.80
WestCrystalLake_T1c_2023	Transition Zone	6.19	2.16	1.91	18.40
WestCrystalLake_T1d_2023	Wet Prairie	6.19	1.61	1.61	30.00
WestCrystalLake_T1e_2023	Wet Prairie	6.19	1.00	1.23	41.00
WestCrystalLake_T1f_2023	Deep Marsh	6.19	1.00	1.00	63.30
WestCrystalLake_T1g_2023	Shallow Marsh	6.19	1.00	1.58	69.80

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
WestCrystalLake_T1h_2023	Shallow Marsh	6.19	1.00	1.49	56.10
WestCrystalLake_T1i_2023	Shallow Marsh	6.19	1.37	1.35	39.50
WestCrystalLake_T1j_2023	Shrub Swamp	6.19	1.87	0.38	31.40
WestCrystalLake_T1k_2023	Shallow Marsh	6.19	1.00	0.61	38.00
WestCrystalLake_T1l_2023	Shrub Swamp	6.19	1.00	1.44	42.60
WestCrystalLake_T1m_2023	Shallow Marsh	6.19	1.00	0.51	49.50
WestCrystalLake_T1n_2023	Deep Marsh	6.19	1.00	0.83	58.00
WestCrystalLake_T2b_2023	Transition Zone	6.19	2.44	1.82	14.30
WestCrystalLake_T2c_2023	Successional Hardwood Swamp	6.19	2.57	0.73	26.90
WestCrystalLake_T2d_2023	Transition Zone	6.19	2.41	0.72	33.80
WestCrystalLake_T2e_2023	Shrub Swamp	6.19	1.82	0.18	36.50
WestCrystalLake_T2f_2023	Shallow Marsh	6.19	1.19	0.29	36.50
WestCrystalLake_T2g_2023	Sawgrass	6.19	1.00	1.02	38.00
WestCrystalLake_T2h_2023	Shallow Marsh	6.19	1.00	0.50	42.60
WestCrystalLake_T2i_2023	Shallow Marsh	6.19	1.00	1.26	45.70
WestCrystalLake_T2k_2023	Shallow Marsh	6.19	1.00	1.31	49.50
WestCrystalLake_T3b_2023	Transition Zone	6.19	2.97	3.63	3.10
WestCrystalLake_T3c_2023	Transitional Shrub	6.19	1.86	1.02	19.40
WestCrystalLake_T3d_2023	Transitional Shrub	6.19	1.74	0.09	25.20
WestCrystalLake_T3e_2023	Transitional Shrub	6.19	1.09	2.37	35.20
WestCrystalLake_T3f_2023	Shallow Marsh	6.19	1.00	1.47	45.70
WestCrystalLake_T3g_2023	Wet Prairie	6.19	1.40	1.77	35.20
WestCrystalLake_T3h_2023	Wet Prairie	6.19	1.85	0.97	25.20
WestCrystalLake_T3i_2023	Cypress	6.19	1.71	0.36	20.40

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
WestCrystalLake_T3j_2023	Wet Prairie	6.19	1.44	0.90	22.70
WestCrystalLake_T3k_2023	Shrub Swamp	6.19	1.94	0.94	31.40
WestCrystalLake_T3l_2023	Shrub Swamp	6.19	1.47	2.74	41.00
WestCrystalLake_T3m_2023	Shallow Marsh	6.19	1.00	1.31	56.10
WestCrystalLake_T3n_2023	Deep Marsh	6.19	1.00	2.32	89.80
WestCrystalLake_T4b_2024	Hardwood Swamp	6.19	2.07	0.56	12.00
WestCrystalLake_T4c_2024	Maple Swamp	6.19	2.89	1.91	20.40
WestCrystalLake_T4d_2024	Hardwood Swamp	6.19	1.27	2.06	32.70
WestCrystalLake_T4e_2024	Shrub Swamp	6.19	1.06	3.18	47.50
WestCrystalLake_T4f_2024	Shallow Marsh	6.19	1.00	3.87	63.30
WestCrystalLake_T4g_2024	Deep Marsh	6.19	1.00	2.28	93.50
EastCrystalLake_T1b_2024	Transition Zone	4.29	1.95	1.43	15.70
EastCrystalLake_T1c_2024	Shrub Swamp	4.29	1.19	1.36	55.70
EastCrystalLake_T1d_2024	Shallow Marsh	4.29	1.00	1.74	77.20
EastCrystalLake_T1e_2024	Deep Marsh	4.29	1.00	1.22	84.00
EastCrystalLake_T2b_2024	Transition Zone	4.29	2.69	1.71	0.10
EastCrystalLake_T2c_2024	Transition Zone	4.29	2.39	2.55	6.60
EastCrystalLake_T2d_2024	Transitional Shrub	4.29	1.25	6.05	32.60
EastCrystalLake_T2e_2024	Shrub Swamp	4.29	1.24	1.67	55.70
EastCrystalLake_T2f_2024	Shallow Marsh	4.29	1.00	1.48	68.60
EastCrystalLake_T2g_2024	Deep Marsh	4.29	1.00	0.72	74.80
EastCrystalLake_T2h_2024	Shallow Marsh	4.29	1.00	2.53	79.70
EastCrystalLake_T2i_2024	Deep Marsh	4.29	1.00	1.39	84.00
EastCrystalLake_T2j_2024	Shallow Marsh	4.29	1.00	1.17	82.10
EastCrystalLake_T2k_2024	Deep Marsh	4.29	1.00	1.26	78.10

Quadrat Name	Report-Labeled Community	P10-P90 Range (ft)	Prevalence Index (PI)	Slope (degrees)	% Exceedance of Mean Quadrat Elevation
EastCrystalLake_T2l_2024	Shallow Marsh	4.29	1.00	1.07	61.50
EastCrystalLake_T2m_2024	Shallow Marsh	4.29	1.39	1.04	58.90
EastCrystalLake_T2n_2024	Deep Marsh	4.29	1.00	0.90	78.10
EastCrystalLake_T2o_2024	Deep Marsh	4.29	1.00	0.59	96.20
Sylvan_T1b_2005	Transitional Shrub	4.00	1.56	1.43	3.50
Sylvan_T1c_2005	Shallow marsh/shrub swamp	4.00	1.21	0.57	49.40
Sylvan_T1d_2005	Aquatic Bed	4.00	1.00	1.70	100.00
Sylvan_T2b_2005	Wet Flatwoods	4.00	2.26	1.83	0.00
Sylvan_T2c_2005	Transitional Shrub	4.00	1.92	1.07	3.50
Sylvan_T2d_2005	Shallow Marsh	4.00	1.05	0.94	42.50
Sylvan_T2e_2005	Deep Marsh	4.00	1.04	0.48	74.90
Sylvan_T2f_2005	Shallow Marsh	4.00	1.13	1.04	74.90
Sylvan_T2g_2005	Aquatic Bed	4.00	1.00	3.01	99.90
Sylvan_T3b_2005	Wet Flatwoods	4.00	3.19	5.24	0.00
Sylvan_T3c_2005	Transitional Shrub	4.00	1.51	3.78	38.40
Sylvan_T3d_2005	Shallow Marsh	4.00	1.10	5.24	78.00

The Ward’s D cluster of PCA axes resulted in 9 groups. The Transitional Shrub Swamp communities, used as the FH of Lake Prevatt, were grouped with quadrats of similar characteristics from lakes Butler, Doyle, Cowpen, Swan, and Johns. This group (Group 4) was characterized by the highest (relative to included sites) P10-P90 range and quadrats with a low PI (obligate and FACW vegetation), a moderate slope (relative to other quadrats), and water levels that are exceeded on average 66.1% of the time (Table C-16).

Table C-16: Mean quadrat group values of PCA input variables for vegetation-based metrics.

	P10-P90 Range (ft)	PI	Slope (degrees)	Percent Exceedance
Group 1	7.83	1.86	5.21	19.14
Group 2	7.97	2.26	2.27	20.65
Group 3	6.22	1.22	1.33	41.46
Group 4	8.73	1.32	2.56	66.10
Group 5	5.40	1.73	9.30	58.74
Group 6	4.13	1.27	2.66	89.71
Group 7	3.54	1.66	1.51	43.40
Group 8	5.28	3.14	3.12	17.10
Group 9	5.44	2.31	1.93	74.59

Using quadrats most similar to Lake Prevatt Transitional Shrub Swamp quadrats (Group 4), the resulting event frequency (mean + se) for the mean Transitional Shrub Swamp FH at Lake Prevatt is an event with a minimum return interval of 1.3 years (~77 times in a century on average). The average site-wide 30-day exceedance for similar communities within this group is 85.1% with a range in site-wide 30-day exceedances of only 34.2% (Table C-17). A 30-day FH event calculated from all transitional shrub data from any MFL site without the clustering method results in an event frequency of 3.0 years (~33 times in a century on average). The average site-wide 30-day exceedance across all sites is 56.1% with an overall range in 30-day events of 83.5%. The result of the cluster analysis is a reduction in overall event range of 49.3%.

In determining the event frequency for Lake Prevatt's FL, Deep Marsh communities were grouped with quadrats of similar characteristics from lakes Butler, Doyle, Cowpen, and Johns. The Deep Marsh group was still in Group 4, as previously described, but only included the most landward Deep Marsh quadrat from any site transect. When transects traversed multiple Deep Marsh communities over a flatter area (as in Lake Prevatt T1), all quadrats were used.

Using quadrats most similar to Lake Prevatt Deep Marsh quadrats, the resulting event frequency (mean - se) for the maximum Deep Marsh (shallow marsh – deep marsh boundary) FL at Lake Prevatt is an event with a minimum return interval of 3.6 years (~28 times in a century on average). The average site-wide 120-day non-exceedance for similar communities within this group is 28.2% with a range in site-wide 120-day exceedances of only 42% (Table C-17). A 120-day FL event calculated from all Deep Marsh data from any MFL site without the clustering method results in an event frequency of 6.7 years (~15 times in a century on average). The average site-wide 120-day non-exceedance across all sites is 27.2% with an overall range in 120-day events of 89.9%. The result of the cluster analysis is no major change in average event non-exceedance but a reduction in overall event range of 47.9%.

Therefore, the clustering method not only reduced the uncertainty in FH and FL event frequency calculations but also provided a more appropriate recommendation for a minimum frequency (relative to using all sites) because it was based on sites with similar local hydrologic and landscape characteristics.

Table C-17. For MA, pre-cluster is calculated from all 28 sites in the cluster analysis (all sites with deep organics). For the FH, pre-cluster is calculated from the previous SWIDS method (mean of all transitional shrub swamps across all MFL sites with transitional shrub swamps). For the FL, pre-cluster is calculated from the previous SWIDS method (mean max of all DM across all MFLs with DM communities). FH and FL cluster sites derived from clustering of PCA axes of 29 MFL lake quadrats with local landscape variables.

	Minimum Average		Frequent High		Frequent Low	
	Mean Non-Exceedance (%)	Non-Exceedance Range (%)	Mean Exceedance (%)	Exceedance Range (%)	Mean Non-Exceedance (%)	Non-Exceedance Range (%)
Pre-Cluster	31.9	44.9	56.1	83.5	27.2	89.9
Sites in Prevatt Cluster	28.5	31.7	85.1	34.2	28.2	42.0
Difference	3.4	13.2	-29	49.3	-1.0	47.9

Minimum Average (MA) Level (49.7 ft NAVD88)

The recommended minimum average (MA) level for Lake Prevatt is 49.7 ft NAVD88, with an associated mean non-exceedance duration of 180 days and a return interval of 3.5 years. The MA approximates a typical stage that protects wetland soils (Rule 40C-8.021(15), *F.A.C.*) and prevents the encroachment of upland plant species into the wetland (Hupalo et al. 1994). At the MA level, substrates may be exposed during non-flooding periods of typical years, but the substrate remains saturated. The MA level at Lake Prevatt corresponds to a water level that is expected to occur, on average, every three to four years for about 6 months during the dry season.

<u>Magnitude</u>

The recommended MA magnitude (i.e., elevation) component equals the average elevation of deep organic soils minus 0.3 ft. The MA level of 49.7 ft NAVD88 equals a 0.3 ft soil water table drawdown from the average ground surface elevation of the histic epipedon and histosols in the shallow marshes and/or deep marshes observed in 2021 at Transect 1 (50.0 ft NAVD88). Periodic flooding to this elevation will maintain saturated soil conditions across the majority of the deep organic soils within Lake Prevatt. Of concern is the decomposition of soil organic matter (loss of soil carbon) that occurs when wetlands soils are drained or hydrologically altered, resulting in lowered land surface elevations (i.e., subsidence). Soil subsidence is a function of two processes termed primary and secondary subsidence (Stephens 1984; Vepraskas and Ewing 2006). Primary subsidence results from loss of soil buoyancy provided by soil pore water. Once pore water leaves the soil, the support it provided to the overlying soil particles is lost. When air fills these pore spaces, the soil compacts under its own weight. Secondary subsidence occurs by direct oxidation of the soil organic carbon to inorganic carbon, which may be lost to the atmosphere as carbon dioxide (CO_2) and methane emissions (Vepraskas and Ewing 2006; Parent et al. 1977). In addition, aerobic soil decomposition can also lead to the release of inorganic nutrients (e.g., nitrogen and phosphorus), metals, and toxic materials that might otherwise remain sequestered in the soil under flooded (anaerobic) conditions (Reddy and DeLaune 2008; Osborne et al. 2014).

The MA level should conserve the hydric nature and ecological functions of the lake organic soils. The presence of deep organic soils ($\geq$8 in. thick organic layer(s) within the top 32 in. of the soil surface) are indicative of long-term soil saturation and/or inundation (USDA NRCS 2010). Stephens (1974) reported that the oxidation and subsidence of Everglades peat soils occurred when the long-term average elevation of the water table was greater than 0.3 ft below the soil surface. The 0.3 ft organic soil drawdown criterion is also supported by studies of organic soils in Blue Cypress Water Management area in the Upper St. Johns River Basin (Reddy et al. 2006). Field and laboratory experiments suggested that the top 10 cm (4 in. [0.33 ft]) is the most reactive (i.e., labile) soil area with respect to microbial oxidation. Therefore, this layer of reactive soil is most susceptible to oxidation and requires protection (Reddy et al. 2006).

A recent study by researchers in UF's Soil and Water Science Department also supports this conclusion. They investigated the effect of water table drawdown on gaseous carbon emissions, which can lead to soil loss through oxidation and subsidence. In general, higher water-tables reduce CO2 emission (Komulainen et al. 1999) and subsidence (Wosten et al. 1997) in organic soils. Soil CO2 flux is an indicator of soil oxidative processes and potentially soil subsidence (Reddy et al. 2006). Through in-situ (field-based) measurements and laboratory experiments Osborne et al. (2014), similar to Reddy et al. (2006), determined that water level drawdown below the soil surface leads to dramatic increases in carbon emissions. Carbon dioxide flux observations, related to varying hydrology, indicates that in order to maintain quality, depth, and elevation of organic soils (i.e., prevent oxidation and/or subsidence), long-term minimum water table levels should be no more than 0.28 ft (rounded to 0.3 ft for this analysis) below the mean soil surface over the long-term (Osborne et al. 2014; Reddy et al. 2006). Where deep organic soils are observed, a 0.3 ft organic soil water table drawdown criterion is typically applied when developing the MA level (Mace 2007, 2014, 2015).

An important factor considered in the protection of organic soils from oxidation and mineral soils from desiccation is the action of the capillary fringe. The capillary fringe is the subsurface soil layer in which groundwater wicks up from the water table by capillary action to fill pores in the soil, contributing to saturation of soils and anaerobic conditions above the water table elevation (Ponnamperuma 1972; Reddy et al. 2006). Reddy et al. (2006) measured redox potentials in situ in organic soils of the Upper St. Johns River marsh, as well as in soil cores subjected to lowered water tables in the laboratory. The capillary fringe extended +5 to +10 cm (0.2 to 0.3 ft) above the static water level. Deeper water table depths (e.g., -30 cm [1 ft]) had the greatest rise (+10 cm [0.3 ft]) in the capillary fringe (Reddy et al. 2006). Thus, the action of the capillary fringe could significantly affect the rates of organic soil oxidation and mineral soil desiccation, ultimately reducing the net organic soil oxidation during seasonal drawdowns (Reddy et al. 2006) by maintaining soil saturation above the soil water table.

Protecting wetlands soils is also important for maintaining biogeochemical cycles, particularly as reservoirs of carbon (Mitsch and Gosselink 2015). Soil organic matter in wetlands provides long-term nutrient storage for plant growth. Accumulation of soil organic carbon is a function of the balance between primary productivity and decomposition. When wetland primary productivity exceeds decomposition and erosion rates, soil organic matter accumulates by the stratified build-up of partially decomposed plant remains (Reddy and DeLaune 2008). Soil organic matter is also a source of exchange capacity for cations in soils, and the large surface area of organic colloids present in organic soils plays an important role in the bioavailability of various metals and toxins in wetlands (Reddy and DeLaune 2008). Thus, maintaining biogeochemical cycles that prevent soil subsidence is an important benefit of protecting deep organic soils.

Additionally, periodic low water levels, provided by the MA non-exceedance event, allow for the decomposition and/or the compaction of surficial flocculent organic sediments. Aerobic microbial breakdown of the sediment begins with receding water levels, releasing nutrients, thereby stimulating primary production within the floodplain. Sunlight also heats, dries, and ultimately consolidates exposed sediment into firmer substrates. Normally, upon reflooding, habitat conditions for fish nesting and foraging improve since the swamp and marsh surfaces have consolidated, structural cover has increased, and forage resources (terrestrial and aquatic invertebrates) are abundant (Kushlan and Kushlan 1979; Merritt and Cummins 1984). This seasonal drying is essential to maintain energy and nutrient flows within the system (Kushlan 1990), as long as these events are not too long or too frequent.

Despite the presence of extensive and continuous wetlands in Lake Prevatt, the high fluctuation in lake levels results in organic accumulation more similar to that observed in sandhill lakes. The fluctuating water table creates an occasionally flooded transitional zone that cannot build up organic matter due to its relatively frequent drying (JEA 2006). Therefore, the deeper areas of Lake Prevatt contain all of the deep organic material present in the lake from the settlement of detrital material in areas of lower elevation and the ability to maintain those soils at lower elevations as a result of less frequent exposure to aerobic conditions. Despite accumulating lower in the lake's elevation profile, the organics that accumulate in deeper portions of the lake still support important ecological functions that rely on the maintenance of sufficiently high soil water table levels to prevent accelerated oxidation of organic matter (Maushbach 1992; Pant and Reddy 2001; Price et al. 2002; Schipper and McLeod 2002; Morris et al. 2004; Blodau et al. 2004).

Duration

The recommended duration for the average non-exceedance water level for the MA is 180 days. The 180-day MA duration will typically allow for numerous, short duration, alternating aerobic and anaerobic conditions of the organic soil surface elevation. Field and laboratory experiments by Reddy et al. (2006) with organic soils in the Upper St Johns River Basin found that shorter duration dewatering events, alternating aerobic and anaerobic conditions, are less likely to result in oxidation of organic matter. The wicking action of the capillary fringe in these soils likely inhibits soil oxidation. Additionally, wetland soils are a medium for denitrification, a process important in maintaining aquatic/wetland water quality. The denitrification process is most effective in wetlands that are subject to alternating aerobic and anaerobic conditions because the aerobic conditions allow for conversion of ammonium to nitrate (nitrification), which is then subject to denitrification (Payne 1981; Reddy and DeLaune 2008).

The recommended MA 180-day duration is also supported by the flooding and dewatering characteristics described by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Official Soil Series Descriptions website (USDA NRCS 2018) for the soils identified in the Lake Prevatt basin. The majority of soils within Lake Prevatt are characterized as Basinger fine sand. Most soils within the Lake Prevatt basin are sandy except for those in the deepest portion of the lake where organic matter accumulates. The Basinger series is described as ponded under natural conditions very frequently for very long durations (6 to 9 months). The 180-day duration is within this corresponding non-exceedance duration.

Further, in a baseline study from Water Conservation Area 3A of the Everglades, Zafke (1983) reported that sawgrass, a species that generally occurs on organic soils, tolerated annual durations of inundation ranging from 15 to 94 percent (~55 – 343 days, respectively). Conversely, these same soils would be dewatered ranging from 22 – 310 days. Similarly, Sincock (1958) noted that sawgrass in the Upper Basin of the St. Johns River usually occurred where there was annual duration of saturation of 45 percent (~164 days). These data suggest that organic soils may form under widely ranging durations of saturation. The average of the annual range provided by Zafke (1983) is 54 percent, very similar to the 180-day MA duration herein recommended for Lake Prevatt.

<u>Return Interval</u>

The MA event defines a surface water level and/or flow that usually occurs during normal dry seasons. The MA is usually associated with the "typically saturated" hydroperiod category:

> "…where for extended periods of the year the water level should saturate or inundate. This results in saturated substrates for periods of one-half year or more during non-flooding periods of typical years. Water levels causing inundation are expected to occur fifty to sixty per cent of the time over a long-term period of record. This water level is expected to have a recurrence interval, on the average, of one or two years over a long -term period of record…" (Rule 40C-8.021, *F.A.C.*).

This dewatering event typically occurs with short return intervals between dewatering events. Such events are important to protect deep muck soils from losses caused by oxidation and subsidence. For many MFLs systems, an MA return interval of 1.7 to 1.8 years is typical. For Lake Prevatt, the MA return interval was based on hydroperiod data collected for other organic soils data from similar MFL sites (as previously described). The data used for this analysis were mean dewatering probabilities for mean elevations of deep organic soils minus 0.3 ft at 7 MFL sites (Table C-18). Based on these data, an MA return interval of 3.5 years (~29% probability) was calculated for Lake Prevatt and equals the mean (minus standard error) return interval for these other Florida lakes.

Table C-18: Non-exceedance of mean deep organic elevation minus 0.3 ft from all lakes within the Lake Prevatt cluster used in the calculation of the Lake Prevatt MA event frequency.

Site	% Non-exceedance	Return Interval (yr)
Cowpen	34.5	2.9
Prevatt	21.2	4.7
Smith	21.0	4.8
Apshawa South	26.1	3.8
Halfmoon	23.5	4.3
Swan	52.4	1.9
Little Como	20.8	4.8
Mean	28.5	3.9
Mean - SE		3.5

The calculated return interval for the Lake Prevatt MA is approximately twice that of what is typically recommended for this metric. In the MA cluster analysis, Lake Prevatt was grouped with other sites that were characterized by high water level fluctuation and high drainage soils. The reduction in uncertainty range within and outside of the Lake Prevatt cluster for MA frequency can be seen in Figures C-21 and C-22. On average, the return intervals of these lakes were larger than considered "typical" of systems with less fluctuation. As a result of a more appropriate cluster group of sites used in calculation and organic soil depths lower in elevation than the major ranges of normal fluctuation, the event frequency for Prevatt was calculated as occurring once every 3.5 years (~29 times per century, on average). A drawdown to 49.7 ft would represent a substantial water drawdown unlikely to occur at Lake Prevatt at a higher frequency.

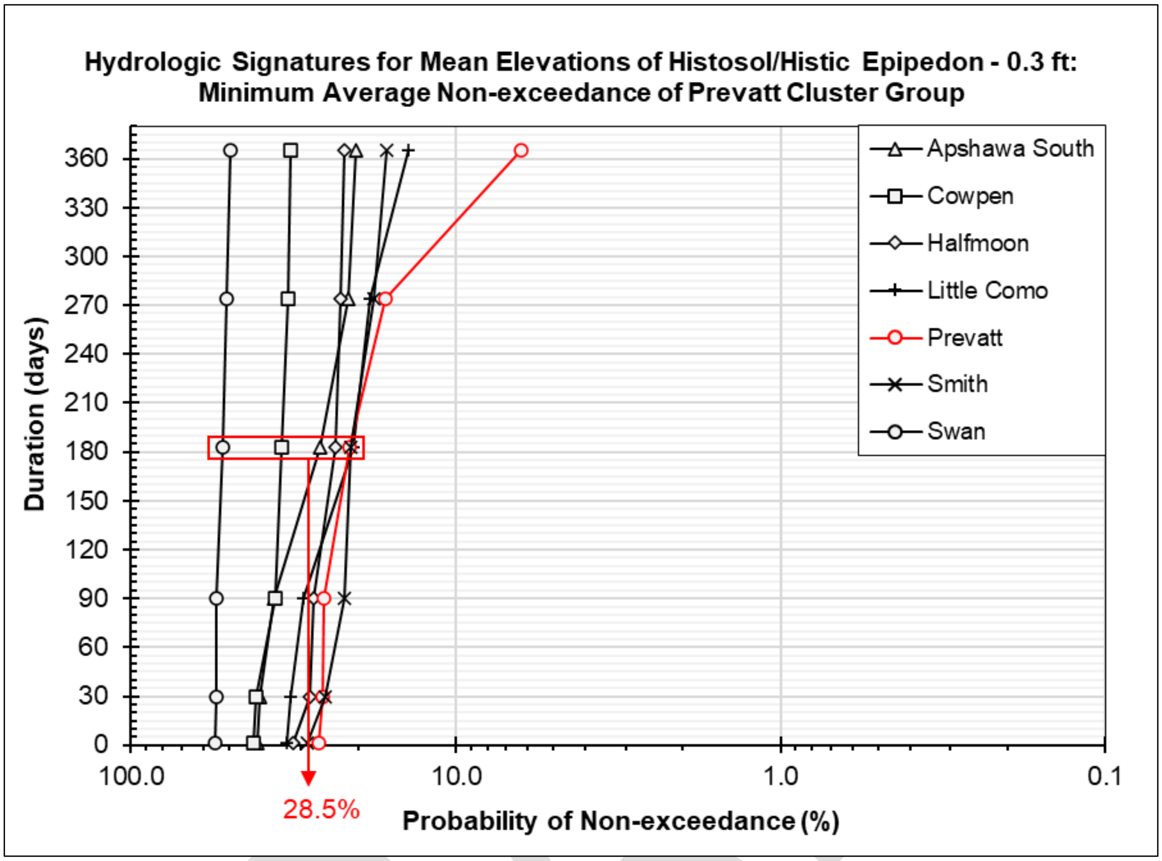

Figure C-21: SWIDS plot showing the distribution of hydrologic signatures for minimum average non-exceedance of elevations (of various durations) for mean elevations of deep organic soil elevations for sites within the Lake Prevatt cluster group. Arrow depicts the mean-se average non-exceedance for the Prevatt Cluster group.

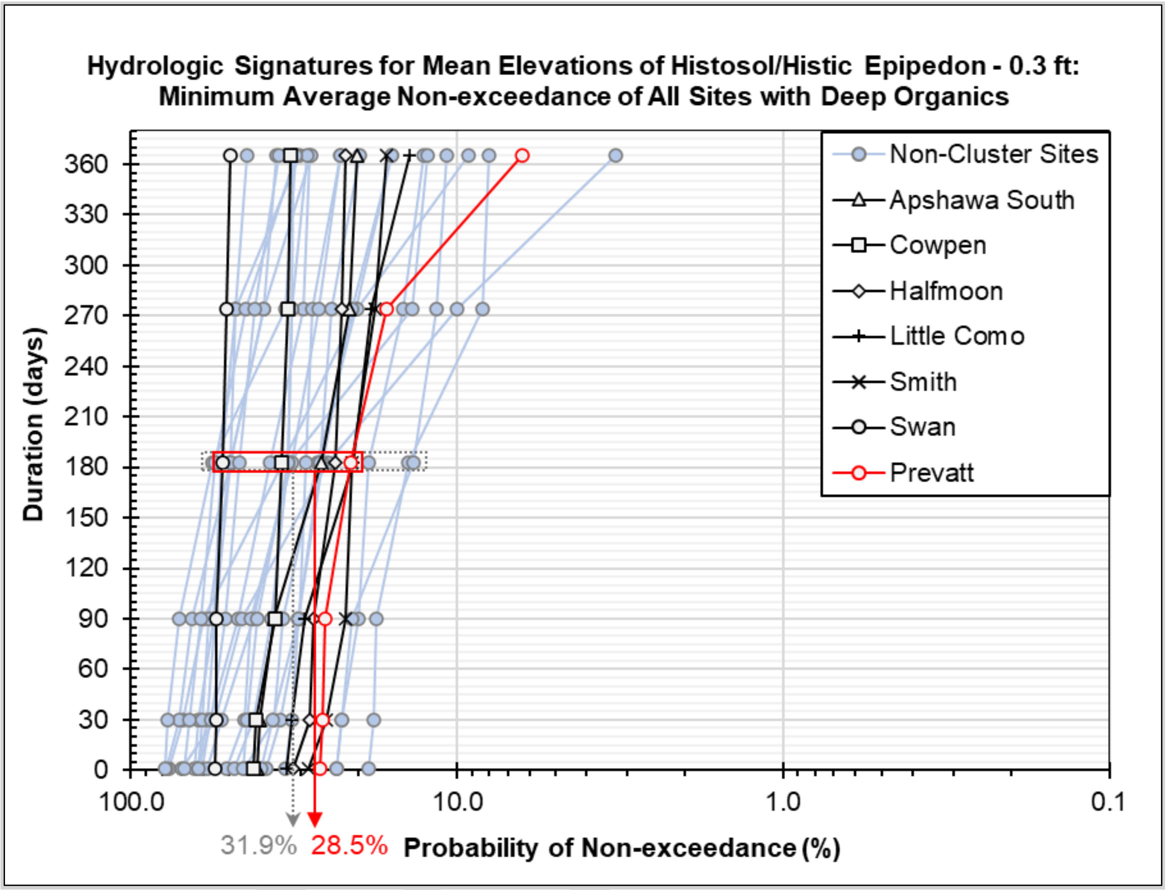

Figure C-22: SWIDS plot showing the distribution of hydrologic signatures for minimum average non-exceedance of elevations (of various durations) for mean elevations of deep organic soil elevations for sites within and outside of the Lake Prevatt cluster group. Arrows depict the difference in mean-se average non-exceedances for the Prevatt Cluster group (red) and all sites (gray).

Frequent High (FH) Level (53.8 ft NAVD88)

The recommended frequent high (FH) level for Lake Prevatt is 53.8 ft NAVD88, with an associated exceedance duration of 30 continuous days and a return interval of 1.3 years (approximately 77 events per 100 years on average). The MFH level is defined as "…a chronically high surface water level or flow with an associated frequency and duration that allows for inundation of the floodplain at a depth and duration sufficient to maintain wetland functions" (Rule 40C-8.021, *F.A.C.*).

<u>Magnitude</u>

The FH level of 53.8 ft NAVD88 equals the average elevation of the transitional shrub swamp communities from all Lake Prevatt transects. The goal of the recommended FH level is to maintain the spatial extent and functions of the transitional shrub swamp and the contiguous wetlands at Lake Prevatt. Maintaining water levels at this average elevation will promote inundation and/or saturation conditions sufficient to support hydrophytic (i.e., obligate, facultative wet, and facultative) plant species (Ahlgren and Hansen 1957; Menges and Marks 2008; Mace 2015), thus preventing a permanent downward shift of the shrub swamp and other wetland communities.

The FH level represents a high lake stage that generally occurs during moderate high water events and typically results in inundated wetlands with ecological benefits. At Lake Prevatt, the FH level of 53.8 ft NAVD88, corresponding to a level exceeded 62.2% in the historical record, is lower than a P50 elevation of 54.9 ft in the historical record. Due to the flashy nature of water levels at Lake Prevatt, water often stages higher than the FH level but is not maintained for the duration defined as part of the FH (see below).

The recommended FH level provides inundation or saturation within the transitional shrub swamp communities at Lake Prevatt for a frequency and duration that is sufficient to maintain the spatial extent of this community. The recommended FH elevation component, 53.8 ft NAVD, provides about 2.4 ft of water over the mean elevation of the shallow marsh (littoral emergent) communities. The longer duration with more frequent inundation in the shallow marsh communities is sufficient to support the obligate and facultative wetland plant species within the spatial extent and functions of the shallow marsh communities. Schneider and Sharitz (1986) reported that short-term flooding events are important to the redistribution of plant seeds within aquatic habitats. The species composition and structural development of floodplain plant communities are influenced by the timing and duration of floods occurring during the growing season (Huffman 1980). Floods affect reproductive success as well as plant growth. The resulting anaerobic soil conditions within the wetland communities favor hydrophytic vegetation, tolerant of longer periods of soil saturation, and eliminate upland plant species that have invaded during low water events.

This level also allows sufficient water depths for fish and other aquatic organisms to feed and spawn on the lake floodplain. Bain (1990) and Poff et al. (1997) have reported that connecting the lake and floodplain are extremely important to animal productivity. Similar benefits likely result from flooding the shallow marsh communities at Lake Prevatt. As water levels rise, the amount of habitat available to aquatic organisms increases greatly as large areas of the floodplain are inundated (Light et al. 1998). Inundation of the floodplain is also necessary for the exchange of particulate organic matter and nutrients (McArthur 1989). Flooding events redistribute and concentrate organic particulates (i.e., decomposing plant and animal parts, seeds, etc.) across the floodplain (Junk et al. 1989). This organic matter is assimilated by bacteria and invertebrate populations (Cuffney 1988), which, in turn, serves as food for larger fauna.

Surface water connections of the lake to the floodplain are extremely important to animal productivity (Bain 1990; Poff et al. 1997). The floodplain provides feeding and spawning habitat (Guillory 1979; Ross and Baker 1983) and refugia for juvenile fishes (Finger and Stewart 1987). Additionally, lake water quality may be improved significantly as water flows through the floodplain wetlands. Lake floodplains, especially those with extensive shallow marshes, function as an important filter/sink for dissolved and suspended constituents (Wharton et al. 1982).

Duration

The duration component of the FH is a minimum of 30 days continuously flooded at or above 53.8 ft NAVD88. A 30-day continuous flooding event represents a sufficient period of soil saturation or inundation needed to protect the structure and functions of seasonally flooded wetland plant communities (Hill et al. 1991). The life cycles of many fishes are related to seasonal water level fluctuations, particularly annual flood patterns (Guillory 1979). Several months of flooding should be provided to ensure fish access to the floodplain and ensure nesting success (Knight et al. 1991).

The 30-day flooding duration roughly corresponds to the durations of saturation that defines the upper boundaries of many wetlands. From a regulatory standpoint, the U.S. Army Corps of Engineers (USACE) uses durations of saturation between 5% and 12.5% of the growing season in most years as the standard in their wetland delineation manual (USACE 1987). Given the year-round growing season in Florida, this corresponds to durations of 18 to 46 days. However, the National Research Council (NRC 1995) has recommended a shorter duration hydroperiod to define wetland hydrology: saturation within 1 ft of the soil surface for a duration of 2 weeks (14 days) or more during the growing season in most years.

In addition, the 30-day flooding duration is sufficient to cause the mortality of young upland plant species that have become established in the transitional shrub swamps during low water events, maintaining the hydrophytic structure and diversity (Ahlgren and Hansen 1957; Menges and Marks 2008). The species composition and structural development of floodplain plant communities are influenced by the timing and duration of floods occurring during the growing season (Huffman 1980). Floods affect reproductive success, as well as plant growth. The resulting anaerobic soil condition within the wetland communities favors hydrophytic vegetation, tolerant of longer periods of soil saturation, and eliminates upland plant species that have invaded during low water events. The FH provides for inundation or saturation sufficient to support the obligate, facultative wet, and facultative wetland plant species within the Lake Prevatt wetland communities.

Return Interval

The return interval for the Lake Prevatt FH was based on a SWIDS analysis of wetland vegetation communities (see above for description of SWIDS). The SWIDS analysis for Lake Prevatt was conducted using hydrologic signatures for communities most similar to the Lake Prevatt transitional shrub communities. Quadrats from 6 sites were included in the calculation of the FH return interval with a mean + SE of 1.3 years (Table C-19). The cluster analysis, described above, was conducted to minimize the SWIDS event frequency range and thereby reduce uncertainty when determining a recommended minimum return interval for the FH (as well as MA and FL). This analysis resulted in a change in event frequency range from 83.5%, based on previous SWIDS calculation methods, to 34.2% when using only lakes in the Lake Prevatt group (Table C-17; range in highest to lowest exceedance percents in Figure C-23 and C-24). The frequency of this event occurring every 1.3 years is more often than most frequent high events at other MFL sites; however, this is related to the elevations previously described where the frequent high metric has a lower elevation than patterns seen in most lakes due to its highly fluctuating nature.

Table C-19: Exceedance of mean transitional shrub elevation from all lakes within the Lake Prevatt cluster used in the calculation of the Lake Prevatt FH event frequency.

Site	% Exceedance	Return Interval (yr)
Butler	62.9	1.6
Doyle	69.3	1.4
Cowpen	95.2	1.1
Swan	89.9	1.1
Johns	97.1	1.0
Prevatt	96.4	1.0
Mean	85.1	1.2
Mean + SE		1.3

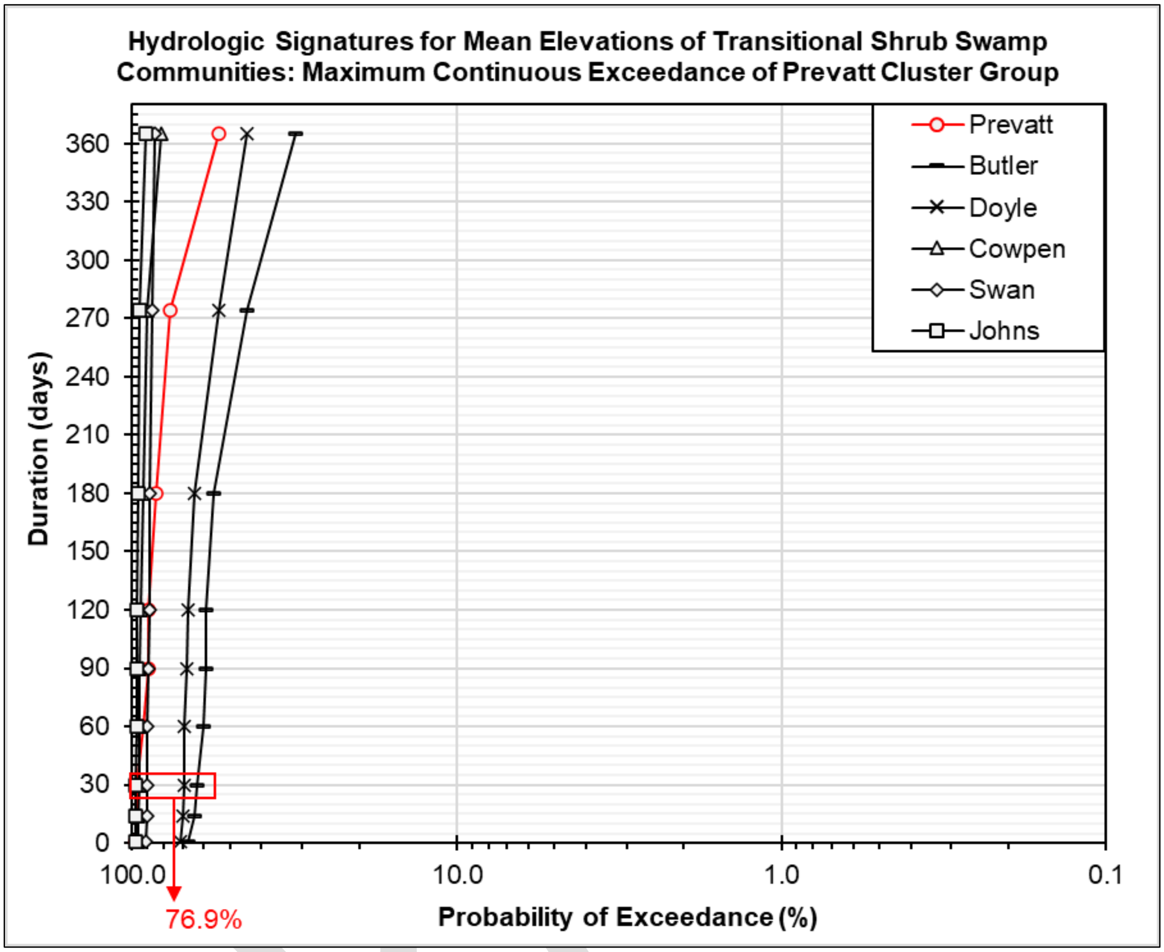

Figure C-23: SWIDS plot showing the distribution of hydrologic signatures for maximum continuous exceedance of elevations (of various durations) for mean elevations of transitional shrub swamp elevations for sites within the Lake Prevatt cluster group. Arrow depicts the mean+se exceedance for the Prevatt Cluster group.

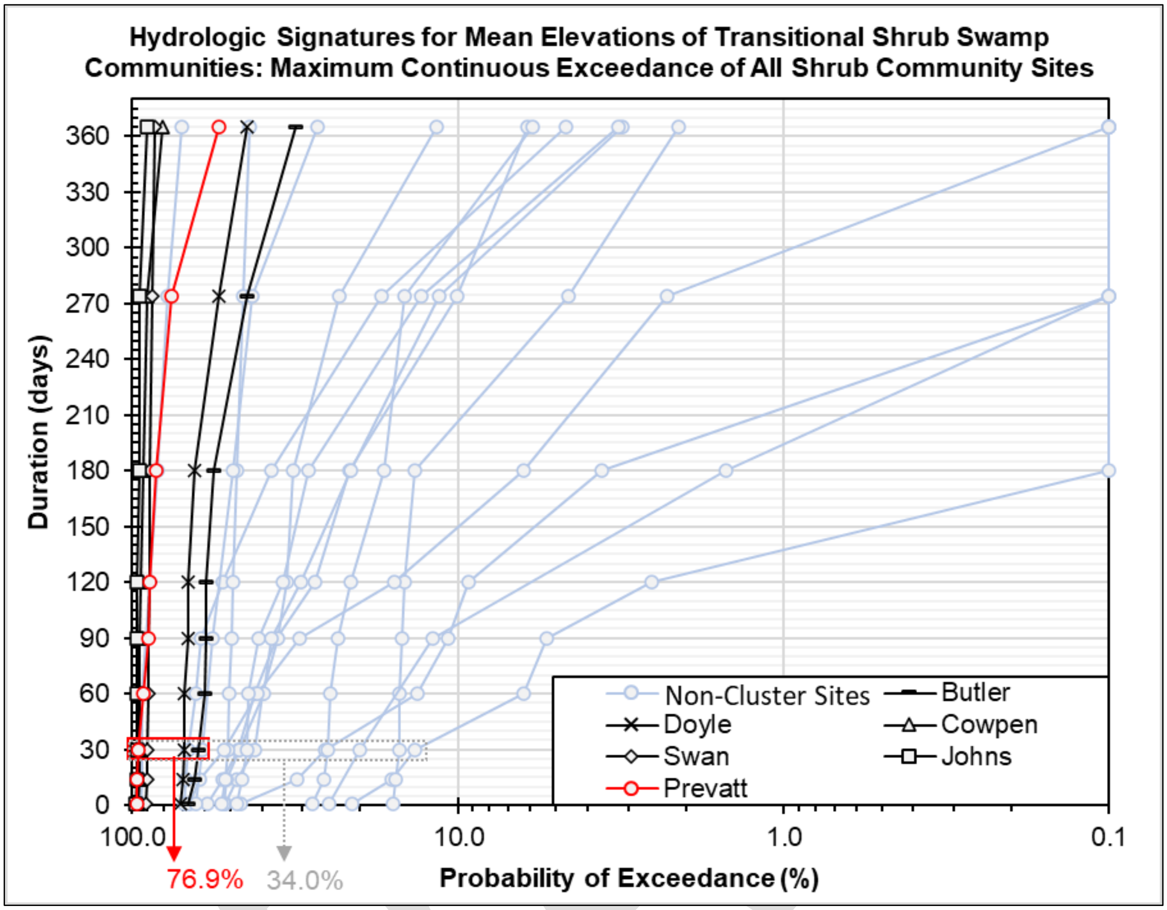

Figure C-24: SWIDS plot showing the distribution of hydrologic signatures for maximum continuous exceedance of elevations (of various durations) for mean elevations of transitional shrub swamp elevations for sites within the Lake Prevatt cluster group and all other MFL sites with transitional shrub swamp communities. Arrows depict the difference in mean+se exceedances for the Prevatt Cluster group (red) and all sites (gray).

Frequent Low (FL) Level (51.1 ft NAVD88)

The recommended minimum frequent low (FL) level elevation component for Lake Prevatt is 51.1 ft NAVD88, with an associated duration of 120 days and a return interval of once every 3.6 years (~ 28 dewatering events in 100 years), on average. The MFL level is defined as "… a chronically low surface water level or flow that generally occurs only during periods of reduced rainfall. This level is intended to prevent deleterious effects to the composition and structure of the floodplain soils, the species composition and structure of floodplain and instream biotic communities, and the linkage of aquatic and floodplain food webs" (Rule 40C-8.021, *F.A.C.*). While discussed here, the FL was ultimately not considered as a final MFL metric (see *Event-Based Metrics for Consideration* below).

Magnitude

The magnitude component of the FL for Lake Prevatt is an elevation of 51.1 ft NAVD88. The recommended MFL elevation component is equivalent to the mean maximum deep marsh elevation from all Prevatt Transects. Deep marsh max elevations are similar to the shallow marsh mean elevation (51.5 ft) at Lake Prevatt making the elevation of the FL protective of the shallow marsh – deep marsh boundary.

The goal of the recommended FL level is to allow ecologically beneficial dewatering (but not cause excessive dewatering) of the shallow marsh while at the same time providing refugia for wetland and aquatic species in the deep marsh. The FL level represents a low lake stage that generally occurs during moderate droughts and results in dewatered wetlands with ecological benefits. Drawdown conditions enable seeds of emergent wetland plants to germinate from the floodplain seed banks. Seeds of many wetland plant species require exposed soils to germinate (Van der Valk 1981). Exposing the floodplain of Lake Prevatt for suitable durations should maintain healthy and diverse floodplain communities. Upland plant species are able to invade the floodplain and become established during low water events. When these species die in response to rising water, their biomass becomes a significant substrate for bacterial and fungal growth, which becomes a critical food source for invertebrate collector-gathering and collector-filtering guilds (Cuffney 1988). The recommended FL level of 51.1 ft NAVD allows complete dewatering of the shallow marsh at Lake Prevatt but maintains flooded conditions across the deep marsh communities — important refugia for small fish, amphibians, and small reptiles.

Low water levels also allow for the decomposition and/or the compaction of flocculent organic sediments. Aerobic microbial breakdown of the sediment begins with a receding water level, which releases nutrients, thereby stimulating primary production. Sunlight also heats, dries, and compacts sediment into firm substrates. Normally on reflooding, conditions are improved for fish nesting and foraging since the marsh surface has consolidated, structural cover has increased, and forage resources (terrestrial and aquatic invertebrates) are abundant (Kushlan and Kushlan 1979; Merritt and Cummins 1984). The FL level supports protection of the accumulated organic matter in low lying soils by preventing its loss and the associated negative effects. Sandhill lakes typically do not have large quantities of organic matter, so even minor losses could significantly impact heterotrophic production, water quality, and ecosystem health (JEA Inc. 2006). The FL level supports: (1) turnover and storage of nutrients in the ecosystem, which provides the energy source to drive the detrital food chain; and (2) prevention of carbon loss, keeping organic soil features at near historical elevations.

Oxygen is readily depleted by the action of microorganisms in saturated soil (JEA Inc. 2006). As a result, organic matter accumulates as the breakdown by microorganisms is slowed due to lack of oxygen. With substantially lower water levels, the soil carbon supply in the low-lying soils could oxidize and be removed from the lake system. Organic matter is a well-documented source and sink for many important nutrients, such as carbon, nitrogen, and phosphorus (JEA Inc. 2006). Organic matter also has a high affinity for environmentally harmful substances, such as metals (e.g., copper, mercury, arsenic), and can serve as a sink for these pollutants. Rapid oxidation of organic matter could release these nutrients and pollutants to the surrounding environment with adverse ecological effects.

Duration

The FL duration is a minimum of 120 days for this continuously non-exceeded (drying) event. This corresponds to the length of a normal dry season in central Florida between the end of winter rains and the start of the summer rainy season. This duration will allow for seed germination and providing adequate time for regeneration and growth of shallow marsh wetland plants to a height able to survive a next flood event (Ware, 2000), while also providing sufficient depths to maintain the ecological integrity of deep marsh habitats

Return Interval

Limited dry periods are associated with ecological benefits but can be harmful if they occur too often. The FL for Lake Prevatt was developed to prevent an excessive number of drying events with the primary goal of protecting shallow and deep marsh habitats along with their associated ecological functions and values. The return interval for the Lake Prevatt FL was based on a SWIDS analysis of wetland vegetation communities (see above for description of SWIDS). The SWIDS analysis for Lake Prevatt was conducted using hydrologic signatures for communities most similar to the Lake Prevatt deep marsh communities. Quadrats from 5 sites were included in the calculation of the FL return interval with a mean - SE of 3.6 years (Table C-20).

The cluster analysis, described above, was conducted to minimize the SWIDS event frequency range and thereby reduce uncertainty when determining a recommended minimum return interval for the FL. This analysis resulted in a change in event frequency range from 89.9%, based on previous SWIDS calculation methods, to 42.0% when using only lakes in the Lake Prevatt group (Table C-17; range in highest to lowest non-exceedance percents in Figure C-25, C-26).

Table C-20: Non-exceedance of maximum deep marsh elevation from all lakes within the Lake Prevatt cluster used in the calculation of the Lake Prevatt FL event frequency.

Site	% Non-exceedance	Return Interval (yr)
Butler	50.0	2.0
Doyle	41.9	2.4
Cowpen	19.8	5.0
Johns	8.0	12.5
Prevatt	21.0	4.8
Mean	28.2	5.3
Mean - SE		3.6

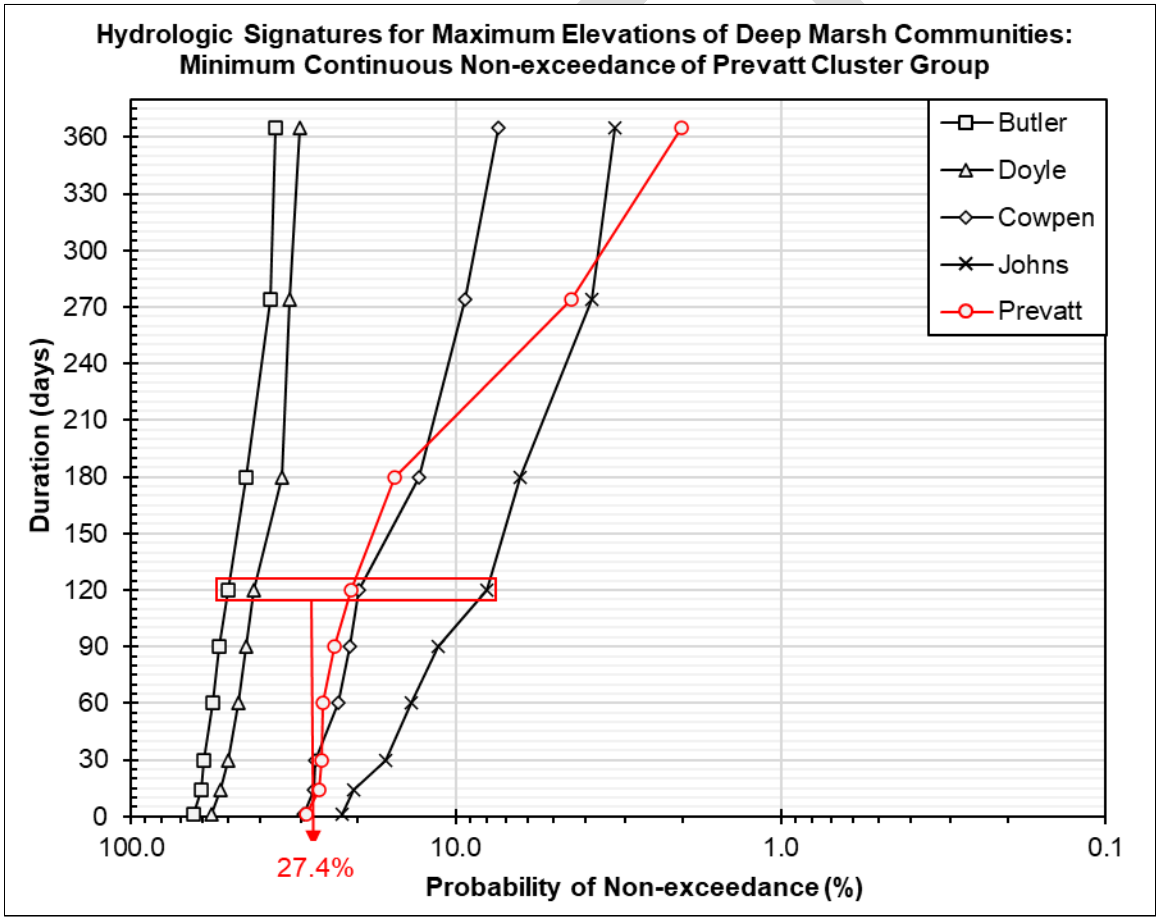

Figure C-25: SWIDS plot showing the distribution of hydrologic signatures for minimum continuous non-exceedance of elevations (of various durations) for maximum elevations of deep marsh elevations for sites within the Lake Prevatt cluster group. Arrow depicts the mean-se non-exceedance for the Prevatt Cluster group.

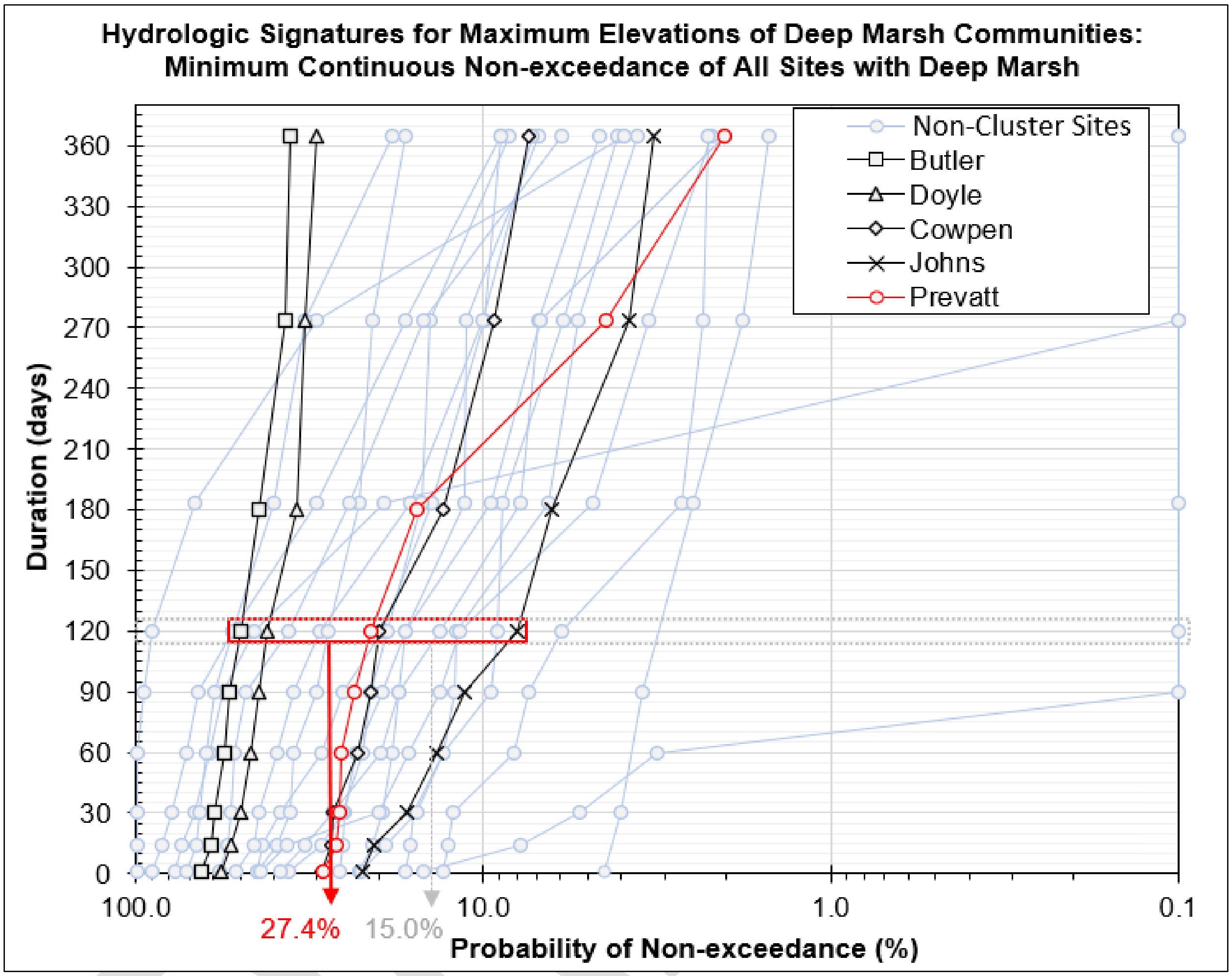

Figure C-26: SWIDS plot showing the distribution of hydrologic signatures for minimum continuous non-exceedance of elevations (of various durations) for maximum elevations of deep marsh elevations for sites within and outside of the Lake Prevatt cluster group. Arrows depict the difference in mean-se non-exceedances for the Prevatt Cluster group (red) and all sites (gray).

Event-based Metrics for Consideration

As previously described, the highly fluctuating nature of Lake Prevatt water levels results in ephemeral shallow and deep marsh vegetation communities. The FL elevation described above is based on the elevation of the shallow marsh – deep marsh boundary at the time of vegetation data collection in 2022. In more stable systems, the shallow marsh – deep marsh boundary is an accurate reflection of vegetation communities in the lower elevation profile of a lake's transitional slope; however, at Lake Prevatt, this boundary is more representative of short-term rainfall trends than a long-term interaction between climate and lake hydrology.

Therefore, while still assessed and discussed in appendices, the FL at Lake Prevatt was not considered as a final event-based metric for consideration. Compared to the FH and MA, based on a longer-lived vegetation community (transitional shrub swamp composed of mainly buttonbush) and organic soils respectively, the FL may be considered a less reliable metric at Lake Prevatt. Such transient communities are not ideal for the creation of MFL metrics relying on long-term trends. This conclusion has also been documented in other MFLs reports (see Sutherland et al. 2021).

Hydroperiod Tool Metrics Results

<u>Nearshore Fish and Wildlife Habitat</u>

At Lake Prevatt, the four fish and wildlife habitats have varying trends with increases in water levels (Figure C-27). Shallow water metrics including Small Waders (0.1 – 0.5 ft) and Large Waders (0.1 – 1.0 ft) peak in maximum area at around 52 ft (equivalent to a P81). Above 52 ft in water elevation, as depths increase, these metrics generally decrease in area. The wide, flat shape of the Lake Prevatt basin plays a large role in these trends, with shallow water habitat area increasing as low water exposes normally flooded areas and thus becomes available to wading birds and other wildlife.

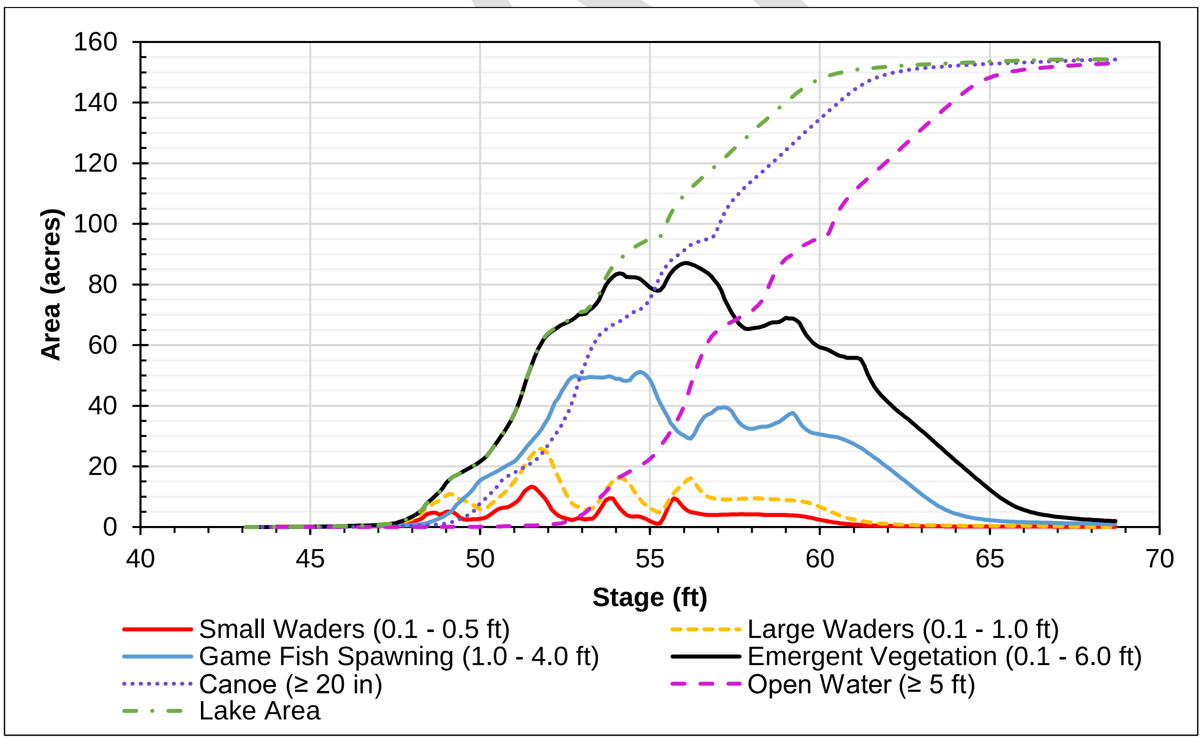

Figure C-27: Stage-area trends for Lake Prevatt hydroperiod tool metrics.

The occasional exposure of these lower elevations is especially important in this system as Lake Prevatt is within Wood Stork (*Mycteria americana*) Core Foraging Area (CFA) and used by numerous other wading bird species as foraging habitat. Low water habitats concentrate forage fish into shallow pools, facilitating foraging for wading bird species. While the FNAI biodiversity index states this area as only likely for Wood Stork and White Ibis (*Eudocimus albus*), these and various other species were observed foraging in Lake Prevatt by SJRWMD staff in August of 2022 (Figure C-28). Some other wading birds observed in the west lobe of Lake Prevatt include Roseate Spoonbill (*Platalea ajaja*, state-designated threatened), Great Blue Heron (*Ardea herodias*), Little Blue Heron (*Egretta caerulea*, state-designated threatened), Tricolored Heron (*Egretta tricolor*, state-designated threatened), Great Egret (*Ardea alba*), Gallinule (*Gallinula galeata*), and Snowy Egret (*Egretta thula*).

Figure C-28: Various wading bird species observed foraging in low-water conditions in Prevatt's west lobe. Species shown are a subset of those recorded in August of 2022.

The habitat for Emergent Vegetation (0.1 – 6.0 ft) and Game Fish Spawning (1.0 – 4.0 ft) have similar trends with increasing lake stage. Emergent vegetation (0.1 – 6.0 ft) peaks at about 56 ft (equivalent to a P28; Figure C-27). Game Fish Spawning (1.0 – 4.0 ft) peaks between 52 and 55 ft (equivalent to a P46). As game fish are not present in Lake Prevatt, both of these metrics provide spawning area and additional forage/habitat area for small fish and wildlife present in Lake Prevatt.

Recreation and Lake Area Metrics

Recreation and lake area metrics have similar trends as they all continue to increase with increasing lake stage. Lake area (> 0 ft) begins to increase around 48 ft as the majority of lake bottom at Prevatt has an elevation at or above 48 ft (Figure C-27). The Canoe metric (≥ 20 in begins to increase dramatically around 49.5 ft as 20 inches of water becomes available for canoeable area. Canoeing is a common use of the lake by surrounding youth camps; the water is accessed either by floating dock on the west side of the lake or lake edge. Open water area ≥ 5 ft in depth is essential for the maintenance of deep marsh habitats, deep water habitat, and water quality. Open water habitats begin to increase in acreage around 53 ft stage elevation when the lake transitions from an open wetland system to a larger, contiguous water body. Table C-21 displays the minimum, average, and maximum habitat area for all hydroperiod tool metrics as compared to the acres available under the MFLs condition based on a 15% reduction in open water habitat.

Table C-21. Hydroperiod tool area calculations under a no-pumping condition and an MFL condition of a 15% reduction in open water area.

	No-pumping Condition Habitat Area (acres)			MFLs Condition (15% reduction from NP, average acres)
Habitat	**Minimum**	**Average**	**Maximum**	
Small Waders	0.0	4.6	13.3	4.6
Large Waders	0.0	10.7	25.9	10.5
Game Fish Spawning	0.0	36.0	51.2	35.1
Emergent Vegetation	0.0	70.0	87.1	66.6
Canoe	0.0	66.9	127.4	61.5
Open Water	0.0	27.2	90.89	23.3
Lake Area	0.0	85.7	143.0	80.0

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