January 22, 2004

MEMORANDUM

TO: **File**

FROM: **Doug Leeper, Senior Environmental Scientist,**
Adam Munson, Environmental Scientist 3,
Lisa Henningsen, Environmental Scientist 3, and
Richard Gant, Field Technician Supervisor
Resource Conservation and Development Department
Southwest Florida Water Management District

SUBJECT: **Proposed minimum and guidance levels for Weekiwachee Prairie Lake in Hernando County, Florida**

Weekiwachee Prairie Lake (Lake Theresa)

General Description

Weekiwachee Prairie Lake (Figure 1), also known as Lake Theresa, is located in Hernando County, Florida, in the Coastal Rivers Basin of the Southwest Florida Water Management District (Sections 13, 14, 23 and 24, Township 23S, Range 17E). White (1970) classified the area of west-central Florida containing Weekiwachee Prairie Lake as the Northern Gulf Coastal Lowlands physiographic region. Brooks (1981) characterized the area surrounding the lake as the Weeki Wachee Dune Field subdivision of the Ocala Uplift Physiographic District, and described the subdivision as "an area of paleo sand dunes and solution basins" with sand pine and longleaf pine-turkey oak assemblages as the dominant vegetative communities. As part of the Florida Department of Environmental Protection's Lake Bioassessment/Regionalization Initiative, the area has been identified as the Weeki Wachee Hills lake region and described as an area of Pleistocene sand dunes with mostly clearwater, circumneutral-pH lakes that have moderately low alkalinity and nutrient levels (Griffith *et al.* 1997).

Most of the lake shoreline and near shore area has been cleared, dredged and filled for residential development (Figure 2). Although extensive canalization has occurred throughout the basin, a portion of the northeastern shoreline remains in a relatively natural state with distinct vegetative zonation evident. There are no public boat ramps located on the Weekiwachee Prairie Lake. Access to the lake is, however, available along the western lakeshore at Delta Woods Park, a public park maintained by the Hernando County Government.

Weekiwachee Prairie Lake is located in the Hammock Creek drainage basin and was historically an isolated system. Currently, a series of canals and culverts connect Weekiwachee Prairie Lake to systems to the north and south of the basin. An inlet/outlet at the end of a canal at the northern lakeshore connects Weekiwachee Prairie Lake to Lakes Liberty, Century and Crescent when water surface elevation in the basins exceeds about 21.5 ft above NGVD (Figure 3). An outlet conveyance system originates along the southeast shore of Weekiwachee Prairie Lake. The outlet conveyance system includes extensive canals that run through several small basins, ultimately draining to Hunters Lake, a large, natural lake at the southern border of Hernando County. An outlet along the western shore of Hunters Lake drains the entire system through the Baffin Waterway to the Gulf of Mexico.

There are no surface water withdrawals from the lake currently permitted by the District. Non-permitted (and presumably small magnitude) surface water withdrawals are common within the basin, based on the numerous withdrawals pipes along the lake shoreline. There are a few permitted groundwater withdrawals in the vicinity of the lake.

The "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969), lists the lake area as 269 acres at an elevation of 23 ft above the National Geodetic Vertical Datum of 1929 (NGVD). The 1954 (photorevised 1988) United States Geological Survey 1:24,000 Port Richey NE, Fla. quadrangle map does not include a surface water elevation for the lake. The 23-ft elevation listed in the "Gazetteer of Florida Lakes" corresponds to a lake surface area of 336 acres, based on a topographic map of the basin generated in support of minimum levels development (Figure 4). Data used for production of the topographic map were obtained from field surveys conducted in June 2003 and 1:200 aerial photography maps containing one-foot contour lines prepared using photogrammetric methods.

Figure 1. Location of Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida.

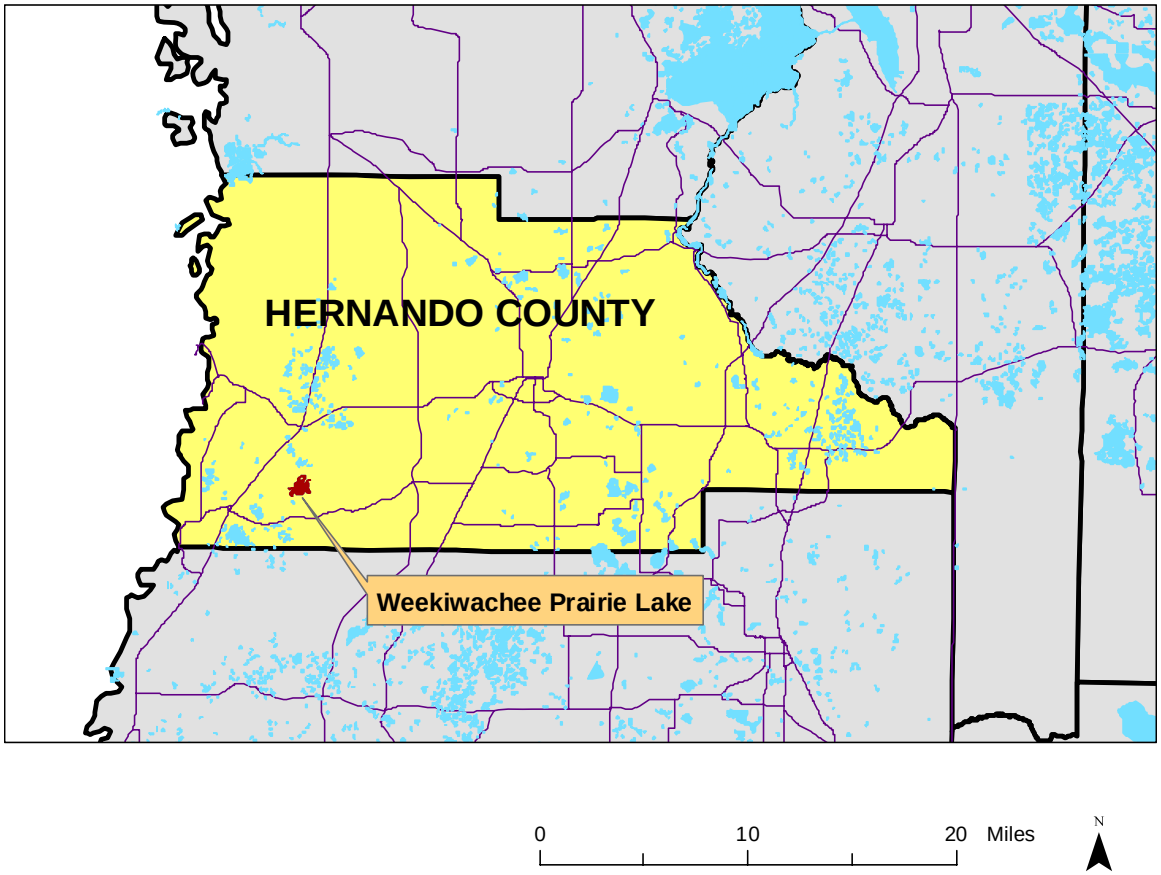
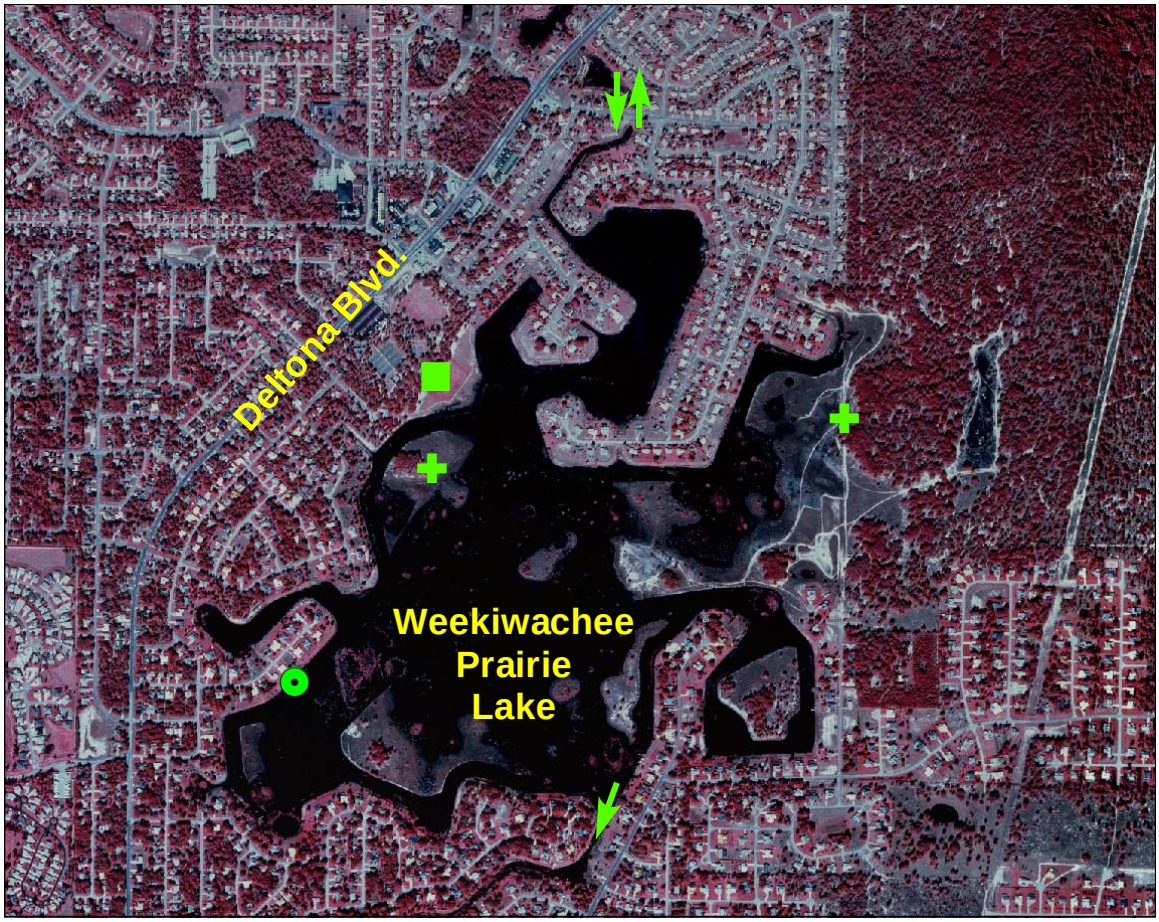


Figure 2. Location of District lake-level gauge, inlet, outlets, lakeshore public park and sites where hydrologic indicators were measured at Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida.



Lake gauge

Inlet/Outlet

Hydrologic Indicators

Public Park

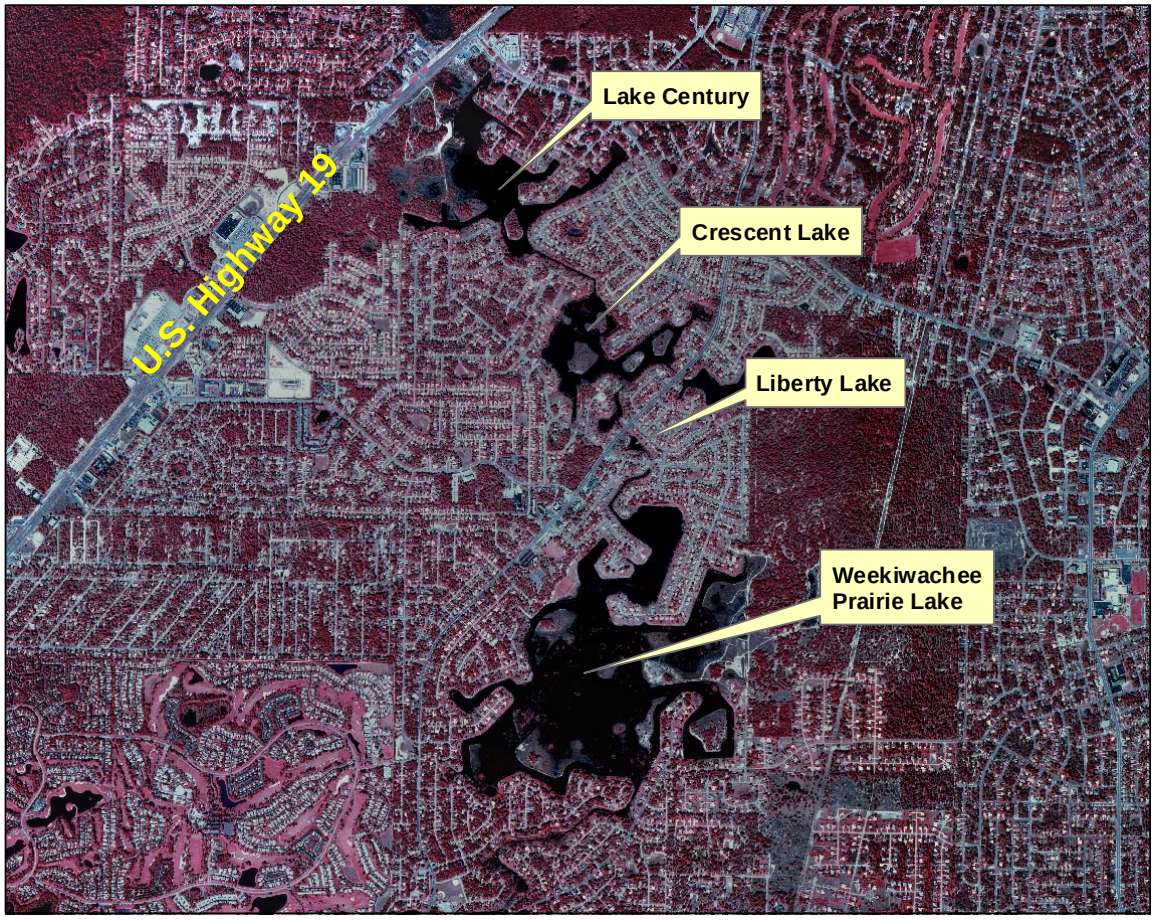
0 1,000 2,000 3,000 Feet

N

Aerial photography from 1999 USGS Digital Orhtophotograph.

Map prepared September 23, 2003

Figure 3. Location of Weekiwachee Prairie Lake (Lake Theresa), Liberty Lake, Crescent Lake and Lake Century in Hernando County, Florida.



Aerial photography from 1999 USGS Digital Orhtophotograph.

Map prepared January 16, 2004

0 0.5 1 Miles

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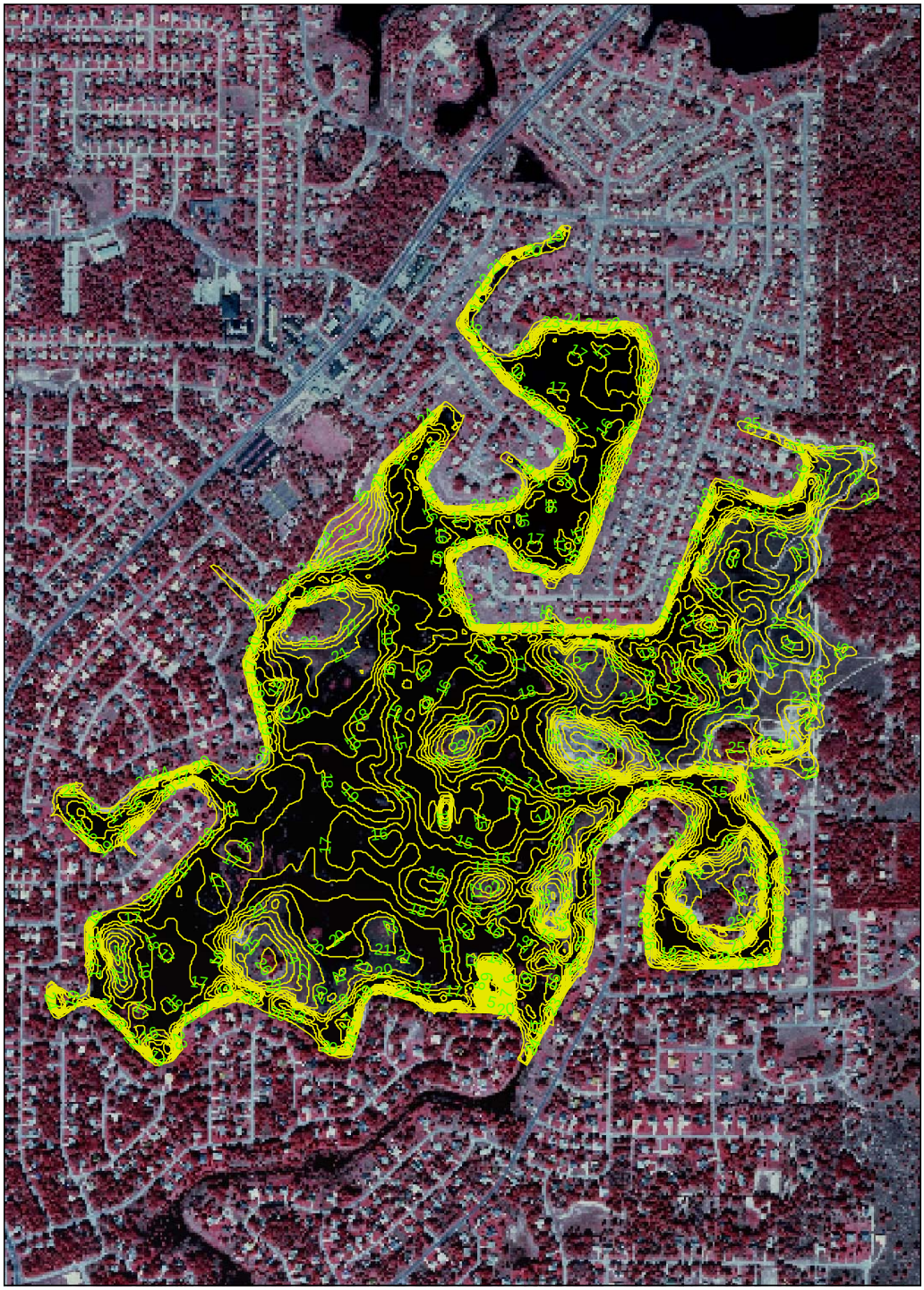
Figure 4. One-foot contours within the Weekiwachee Prairie Lake (Lake Theresa) basin in Hernando County, Florida. Values shown are elevations, in feet above the National Geodetic Vertical Datum of 1929.



Map prepared September 26, 2003 using 1999 USGS digital orthophotography, elevation data from 1979 SWFWMD aerial photography with contours maps (Sheet Nos. 13-23-27, 14-23-27, 23-23-27 and 23-24-27), and elevation data collected in June 2001 and September 2002 by SWFWMD staff.

0 500 1,000 Feet

N

Previously Adopted Lake Management Levels

Management levels have not previously been developed or adopted for Weekiwachee Prairie Lake.

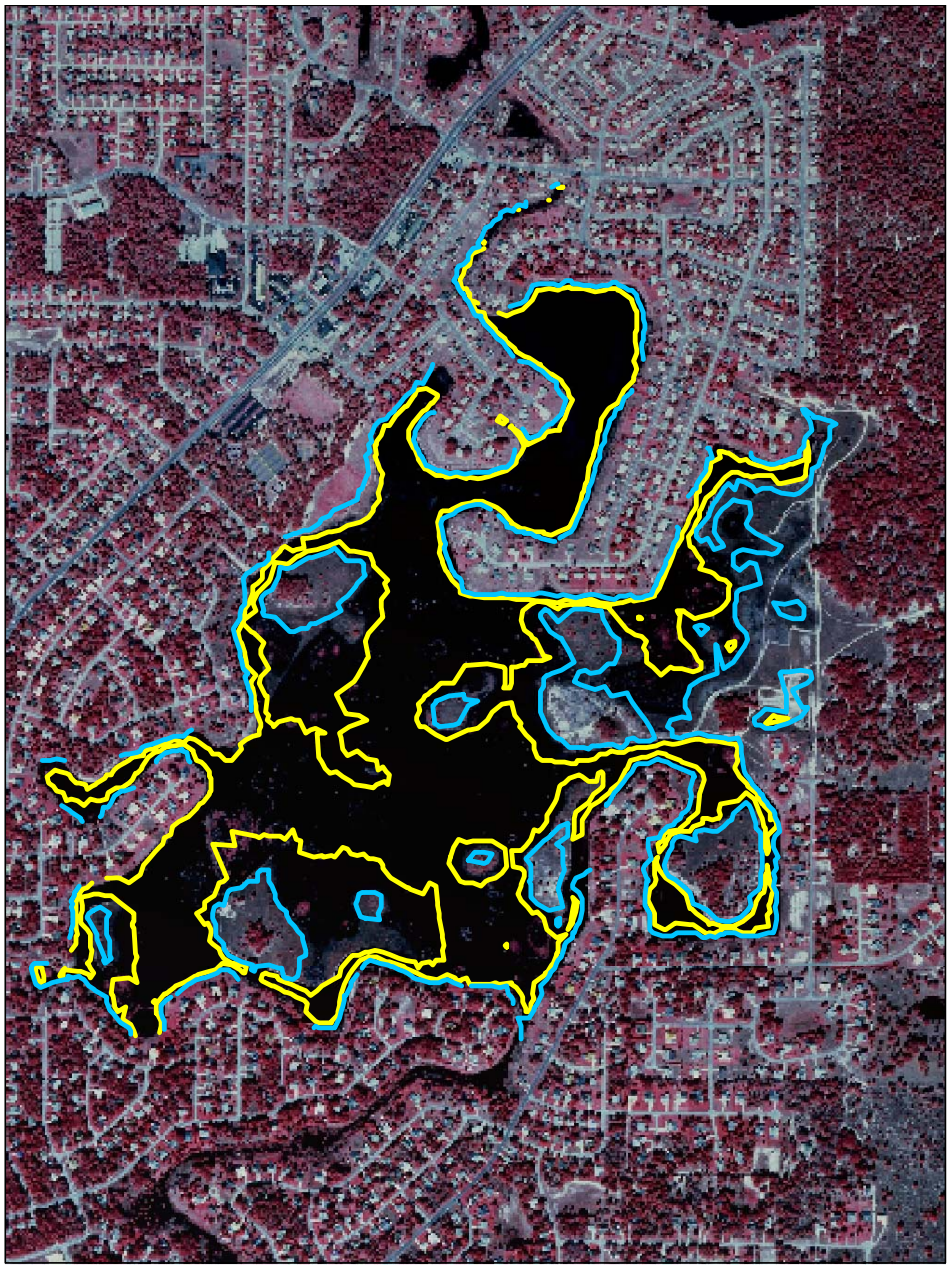
Proposed Minimum and Guidance Levels

Proposed Minimum and Guidance Levels were developed for Weekiwachee Prairie Lake using the methodology for Category 3 Lakes described in District rules (Chapter 40D-8, Florida Administrative Code). Proposed levels, along with lake surface area values for each level are listed in Table 1. Locations of the proposed minimum levels within the lake basin are shown in Figure 5.

Table 1. Proposed minimum levels, guidance levels and associated surface areas for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida.

Level	Elevation (feet above NGVD)	Lake Area (acres)
Ten Year Flood Guidance Level	24.0	355
High Guidance Level	22.6	327
High Minimum Lake Level	21.4	294
Minimum Lake Level	18.3	172
Low Guidance Level	17.5	128

Figure 5. Approximate location of the proposed Minimum Lake Level (yellow) and proposed High Minimum Lake Level (blue) for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Elevations of contours are in feet above the National Geodetic Vertical Datum of 1929.



Map prepared September 26, 2003 using 1999 USGS digital orthophotography, elevation data from 1979 SWFWMD aerial photography with contours maps (Sheet Nos. 13-23-27, 14-23-27, 23-23-27 and 23-24-27), and elevation data collected in June 2001 and September 2002 by SWFWMD staff.

0 500 1,000 Feet

N

Minimum Lake Levels

18.3 ft above NGVD

21.4 ft above NGVD

Summary of Data and Analyses Supporting Recommended Minimum and Guidance Levels

Hydrologic data are available for Weekiwachee Prairie Lake (District Universal ID Numbers STA 735 598 and STA 735 4148) from a single date in 1942, from May 1968 through June 1981, from a single date in 1996, and from March 2003 to the present date (Figure 6, see Figure 2 for current location of the SWFWMD lake-level gauge). Monthly mean water surface elevations, along with proposed guidance and minimum levels are shown in Figure 7. For the entire period of record, the hydrologic data are classified as Historic data. Historic data collected through September 2003 were used to calculate the Historic P10, P50, and P90 (Table 2).

The Normal Pool elevation was established at 24.6 ft above NGVD based on elevations of saw palmetto (*Serenoa repens*) shrubs along the northeast and west shores of the lake (Table 3). The control point elevation was established at 23.9 ft above NGVD, based on information collected by the SWFWMD Engineering Section in September 2003 (Figure 8). Elevations of residential buildings and other structures were determined using available one-foot contour interval aerial maps and field survey data collected in September and December 2003 (Table 2). Based on the existence of an outlet conveyance system that connects Weekiwachee Prairie Lake to Hunters Lake, Weekiwachee Prairie Lake is classified as an open basin lake.

Based on the availability of Historic hydrologic data, the High Guidance Level was established at the Historic P10 elevation of 22.6 ft above NGVD (Table 3). The Historic P50 (19.5 ft above NGVD) and Low Guidance Level (17.5 ft above NGVD) were also determined using Historic hydrologic data.

The Ten Year Flood Guidance Level for Weekiwachee Prairie Lake was established at 24.0 ft above NGVD, using the methodology for closed basin lakes described in current District rules. Although the lake has an outlet, this approach was considered appropriate because the lake surface has typically been below the outlet control elevation of 23.3 feet above NGVD for extended periods. Peak flood elevations are therefore influenced more by long-term rainfall and evaporation patterns than single storm events, and the "closed-basin lake" methodology is applicable. In accordance with the closed-basin methodology, the 10-year flood level was based on a frequency analysis of the lake stage values (using a Log Pearson Type III distribution) derived from a HSPF (Hydrologic Simulation Program Fortran) continuous simulation model. Inputs to the model included standard watershed parameters (basin size, slope, infiltration rate, ground water recession rate*, etc*.) and rainfall records from the Brooksville National Weather Service site for the period from 1950 through 2003.

Stage records from the District Water Management Database indicate the Ten Year Flood Guidance Levels was exceeded during the summer and fall of 2003 (Figure 6). Anecdotal information (discussion with resident at the location of the District lake-level gauge) indicates that the guidance level was also exceeded in 1998. The highest surface elevation for Weekiwachee Prairie Lake included in the District Water

Management Database, 24.55 ft above NGVD, was recorded on September 26, 2003. The low of record, 15.00 ft above NGVD, occurred on June 15, 1981.

Weekiwachee Prairie Lake is not contiguous with cypress-dominated wetlands of 0.5 or more acres in size and is therefore classified as a Category 3 Lake for the purpose of minimum levels development. Aquatic macrophytes and hydrophytes, *including cattail (Typha sp.),* fragrant water lily (*Nymphaea odorata*), banana lily (*Nymphoides aquatica*), bacopa (*Bacopa* sp.), pickerelweed (*Pontederia cordata*), maidencane (*Panicum hemitomum*), torpedograss (*Panicum repens*), rush fuirena (*Fuirena scirpoidea*), cordgrass (*Spartina bakeri*), Tracy's beak-rush (*Rhynchospora tracyi*), buttonbush (*Cephalanthus occidentalis*), wax myrtle (*Myrica cerifera*), and willow (*Salix* sp.) occur throughout the basin.

Recreation/Ski, Dock-Use, Basin Connectivity, Species Richness, Aesthetics and Mixing Standards were evaluated for minimum levels development (Table 3). The Recreation/ Ski Standard was established at 25.0 ft above NGVD, based on the elevation at which the lake could contain a safe skiing area (23 ft above NGVD) and the difference between the Historic P50 and Historic P90 elevations (2.0 ft). The Dock-Use Standard was established at 23.8 ft above NGVD, based on the elevation of sediments at the end of ninety percent of the 22 non-floating docks at the lake (19.8 ft above NGVD, Table 5), a clearance factor of 2-ft for use of powerboats in the lake, and the Historic P50-Historic P90 difference. A few (6) floating docks were observed within the basin, but were not used for development of the Dock-Use Standard. The Basin Connectivity Standard was established at 22.0 ft above NGVD, based on the elevation that ensures connectivity among the major lake sub-basins (18 ft above NGVD), a clearance value of 2-ft for use of powerboats on the lake and the difference between the Historic P50 and Historic P90 elevations. The Species Richness Standard was established at 18.8 ft above NGVD, based on limiting change in lake surface area to less than a 15% reduction from the area at the Historic P50 elevation. The Aesthetic-Standard for the lake was established at the Low Guidance Level elevation of 17.5 ft above NGVD. Based on review of dynamic ratio values (Figure 8; see Bachman *et al.,* 2000) a Mixing Standard for preventing significant change in natural sediment resuspenion patterns was established at 16.3 ft above NGVD.

Review of the relationships between lake stage and area indicated that use of the Mixing Standard would not be appropriate for minimum levels development (Figure 9). At the Mixing Standard elevation, the lake surface area would be less than 17% of the surface area at the Historic P50 elevation (Figure 9). The Recreation/Ski Standard was also considered to be inappropriate for minimum levels development because it exceeds the Historic P50 elevation.

The Basin Connectivity and Dock-Use Standards, two of the four standards considered appropriate for minimum levels development, are greater than the Historic P50 elevation. A provisional Minimum Lake Level was, therefore, established at the Historic P50 elevation (19.5 ft above NGVD). A provisional High Minimum Lake Level was established at 22.6 ft above NGVD, an elevation corresponding to the Minimum Lake

Level plus the difference between the Historic P50 and the Historic P10 (3.1 ft).

The provisional High Minimum Lake Level is approximately 8.9 ft below the lowest residential home floor slab within the immediate lake basin. Staging of the lake at the proposed High Minimum Lake Level would, however, inundate a portion of a soccer field and several associated utility (lighting) poles located in Delta Woods Park. The level is also only 0.3 ft below the lowest residential floor slab in the Lake Century basin, and 0.2 ft above the concrete slab of a swimming pool located adjacent to Lake Century. Based on elevations of these features and the potential for discharge from Weekiwachee Prairie Lake into Liberty Lake, Crescent Lake and Lake Century when water level in Weekiwachee Prairie Lake exceeds 21.5 ft above NGVD, staging of the lake at the provisional High Minimum Lake Level may be expected to result in flooding in the Lake Century basin.

Because staging of Weekiwachee Prairie Lake at the provisional High Minimum Lake Level could lead to flooding, the provisional minimum levels developed for the lake were not considered appropriate. Proposed levels were, instead, developed based on minimizing flooding potential. The proposed High Minimum Lake Level was established at 21.4 ft above NGVD, an elevation one-foot below the low pool slab adjacent to Lake Century. The proposed Minimum Lake Level was established at 18.3 ft above NGVD, an elevation corresponding to the High Minimum Lake Level minus the difference between the Historic P10 and Historic P50 (3.1 ft).

Figure 6. Surface water elevation at Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Data through September 2003 are shown.

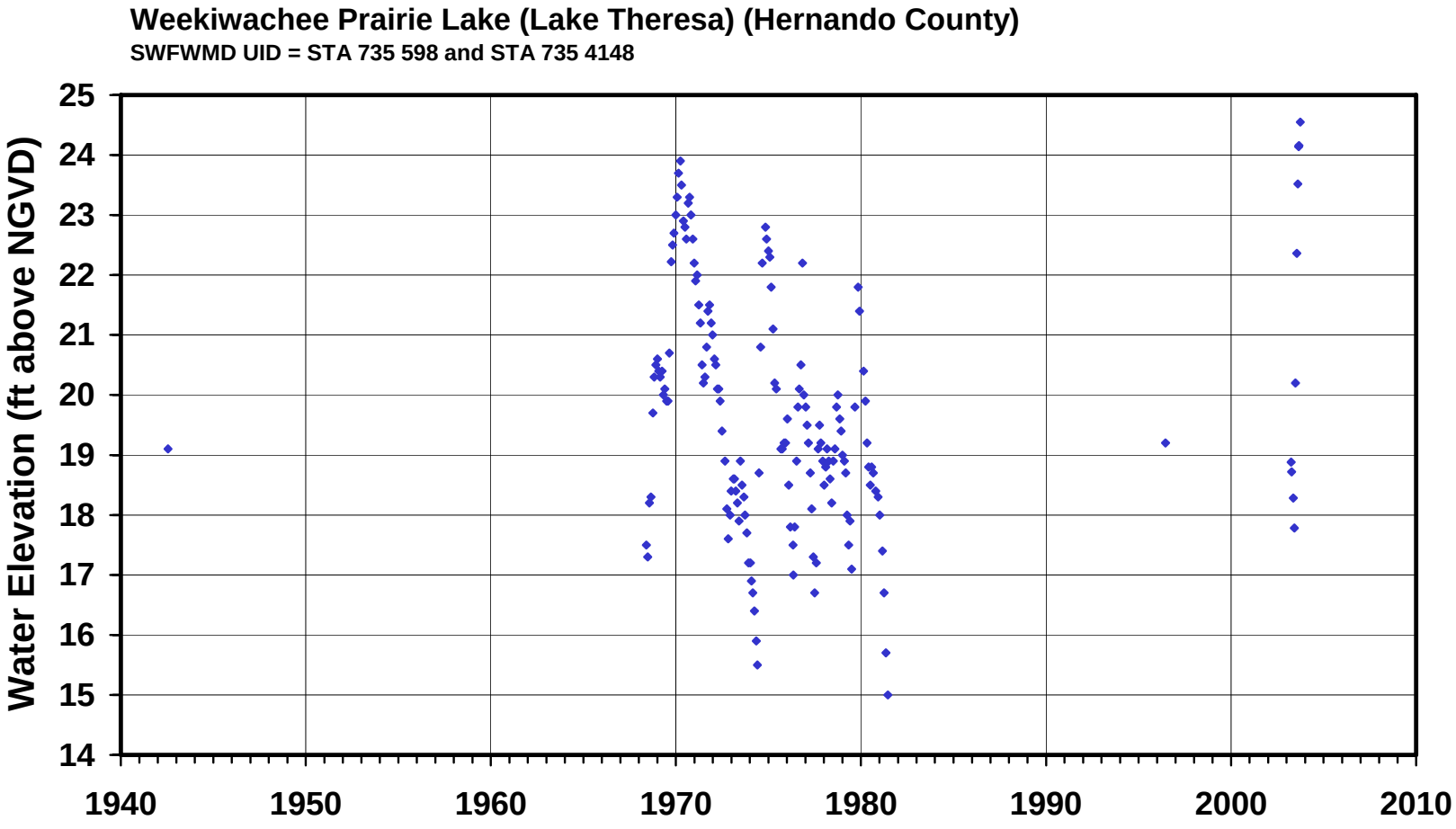


Figure 7. Mean monthly surface water elevation through September 2003, and proposed guidance and minimum levels for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Proposed levels include the Ten Year Flood Guidance Level (10-YR), High Guidance Level (HGL), Low Guidance Level (LGL), High Minimum Lake Level (HMLL), and Minimum Lake Level (MLL).

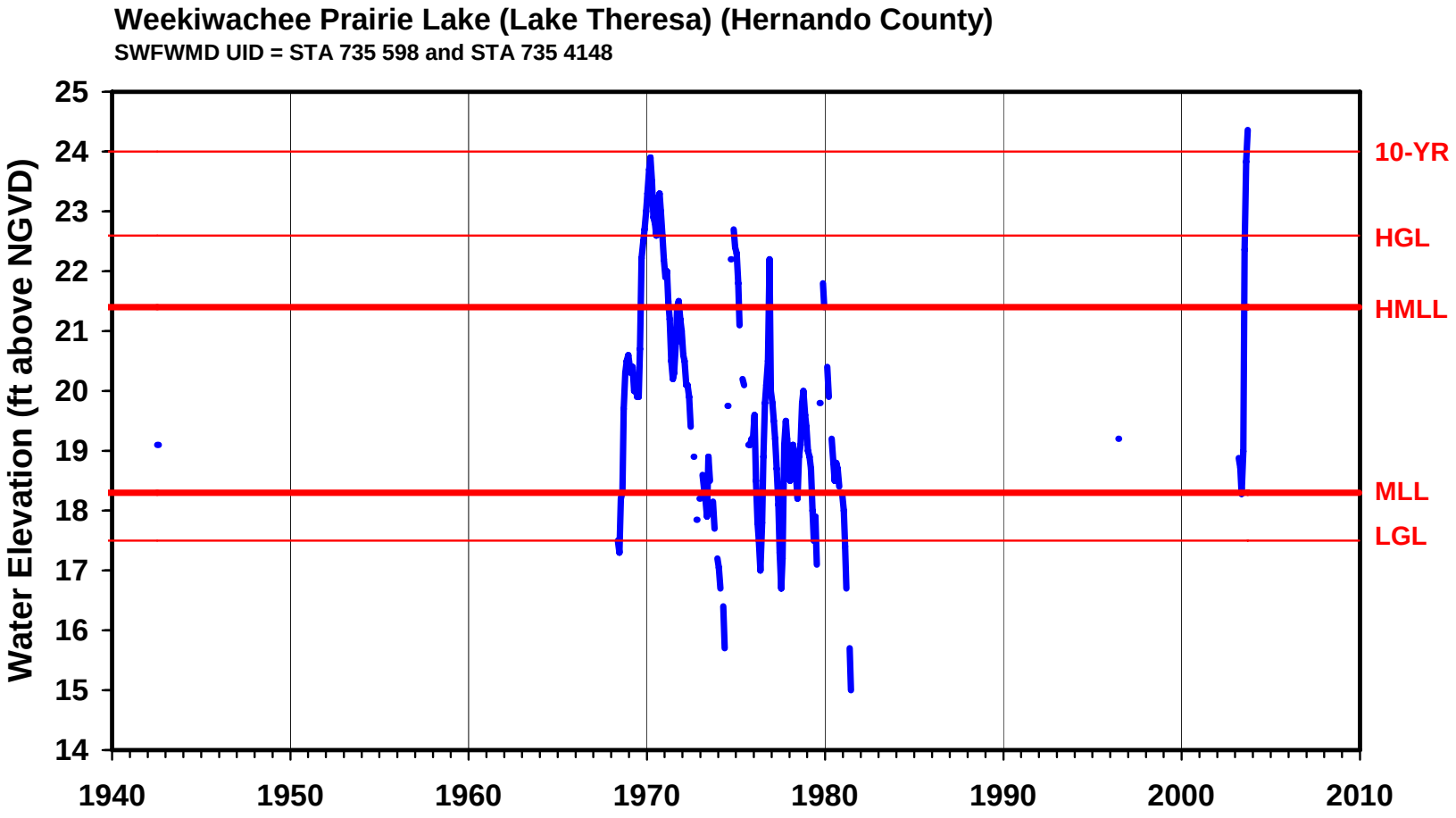


Table 2. Elevation data and associated area values used for establishing minimum and guidance levels for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida.

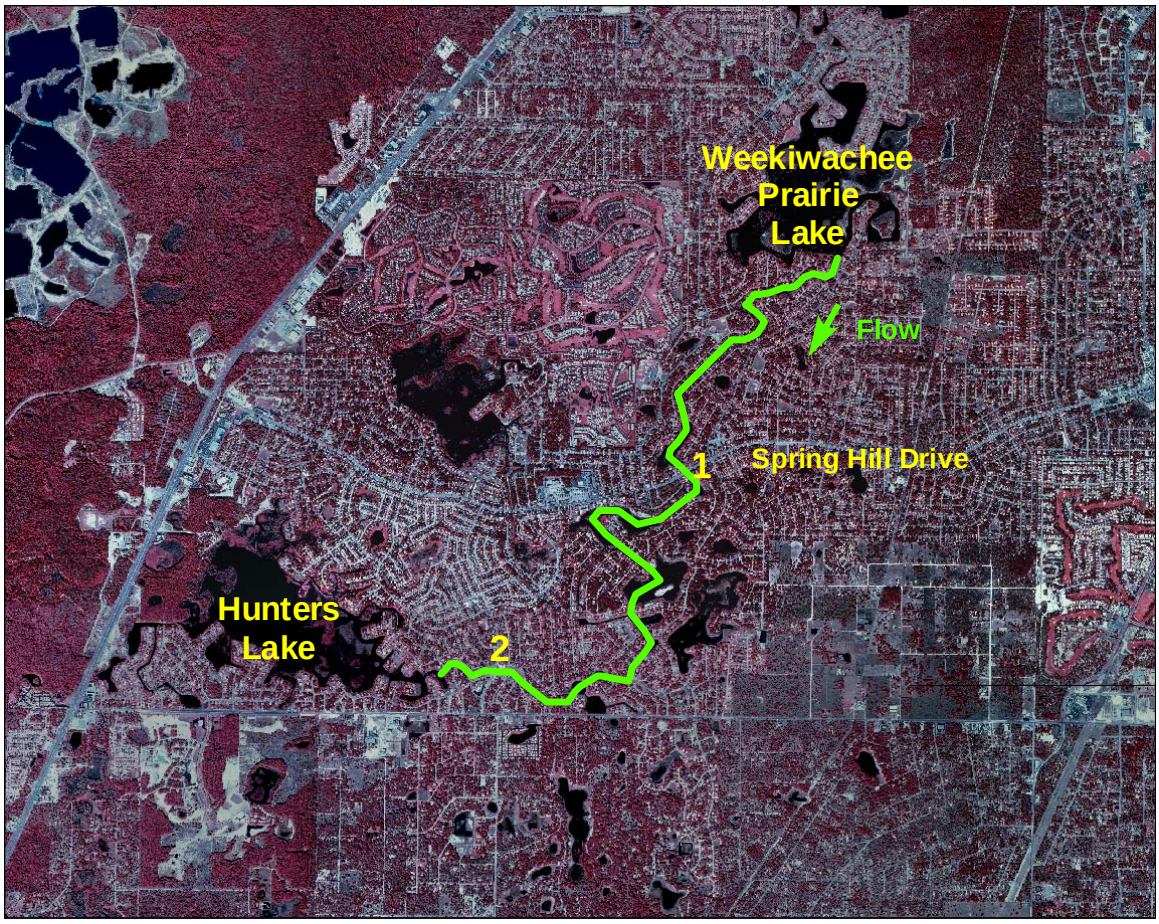
Level or Feature	Elevation (feet above NGVD)	Lake Area (acres)
Historic P10	22.60	327
Historic P50	19.45	226
Historic P90	17.47	128
Normal Pool	24.6	365
Low Floor Slab (Weekiwachee Prairie Lake shoreline)	31.5	NA
Low Floor Slab (Lake Century shoreline)	22.9	334
Low Other (pool slab at residence along Lake Century shoreline)	22.4	322
Low Other (wood and concrete floors of sheds behind residences at Lake Century shoreline)	21.5	297
Low Road (Lake Century basin)	23.5	347
Low Road (Weekiwachee Prairie Lake basin)	28.7	NA
Control Point	23.3	343
Recreation/Ski Standard	25.0	375
Dock-Use Standard	23.8	352
Basin Connectivity Standard	22.0	310
Species Richness Standard	18.8	195
Aesthetic Standard	17.5	128
Mixing Standard	16.3	38

NA = not available/applicable

Table 3. Elevation data used for establishing the Normal Pool Elevation for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Data were collected in June 2001 and September 2002 by District staff.

Hydrologic Indicator	Elevation (feet above NGVD)
Base of saw palmetto	23.4
Base of saw palmetto	24.0
Base of saw palmetto	24.2
Base of saw palmetto	24.3
Base of saw palmetto	25.0
Base of saw palmetto	25.4
Base of live oak	25.0
Base of live oak	25.3
N	**8**
Median	**24.6**
Mean	**24.6**
SD	**0.7**

Figure 8. Outlet conveyance system for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Ditched flow path is indicated by the green line.



Aerial photography from 1999 USGS
Digital Orhtophotograph.

0 0.5 1 Miles

N

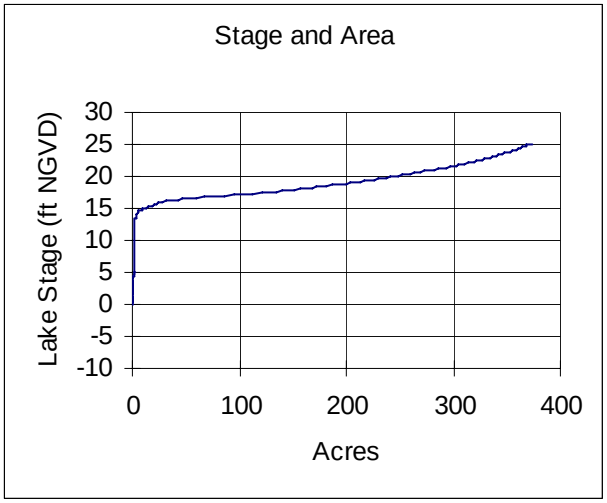
Map prepared October 9, 2003

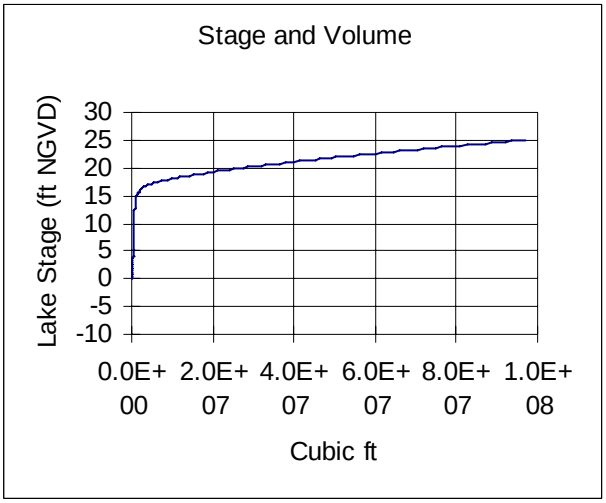
Site	Description	Elevation (ft above NGVD)
1	Ground elevation at base of a corrugated metal-pipe riser at the north end of a 48-inch reinforced concrete pipe that runs under Spring Hill Drive. Invert of the north end of the pipe is 19.2 ft above NGVD.	20.9
2	Control point; east invert of northernmost of two 36-inch X 52-inch culverts running under Cobblestone Drive. Invert at west end of southernmost pipe is at the same elevation.	23.3

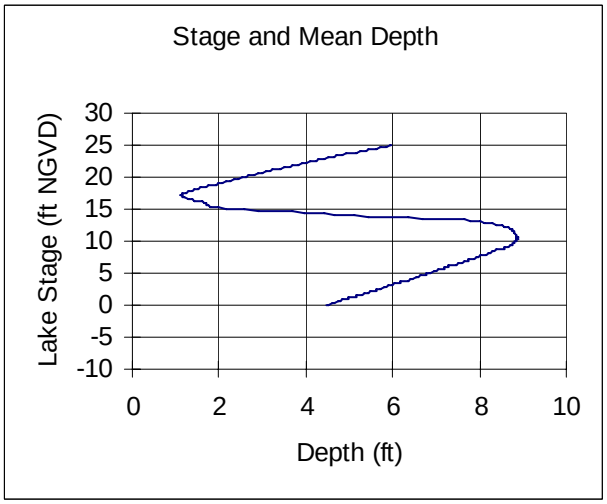
Table 4. Summary statistics for elevation data for 22 docks at Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida. Data were collected in June 2003 by District staff. Percentiles (P10, P50 and P90) represent elevations exceeded by 10, 50 and 90 percent of the docks. Elevations for floating-type docks were not used for development of summary statistic.

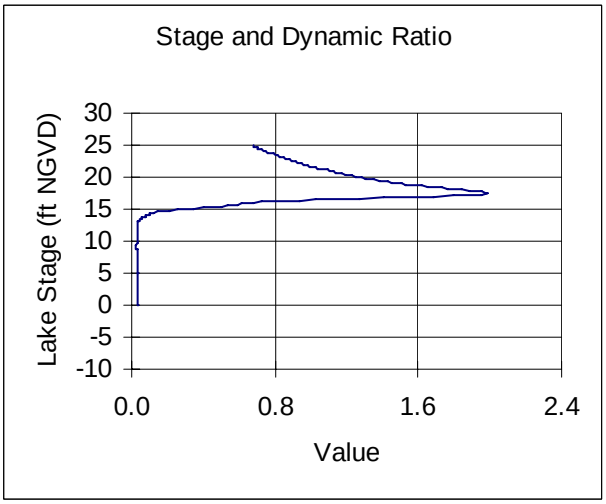
Statistic	Elevation of Sediments at Dock Ends (feet above NGVD)	Elevation of Dock Platform (feet above NGVD)
Mean	18.8 (0.9)	23.0 (0.9)
P10	19.8	23.8
P50	19.0	22.9
P90	17.7	22.0
Maximum	20.5	25.1
Minimum	16.8	21.6

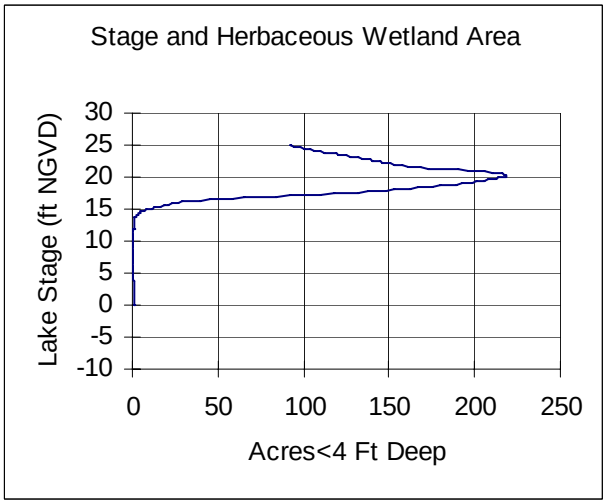
Figure 9. Surface area, volume, mean depth, dynamic ratio (basin slope), and potential herbaceous wetland area versus lake stage for Weekiwachee Prairie Lake (Lake Theresa) in Hernando County, Florida.











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