

February 4, 2003

MEMORANDUM

TO: File

**FROM: Doug Leeper, Senior Environmental Scientist
Resource Conservation and Development Department
Southwest Florida Water Management District**

**SUBJECT: Proposed minimum and guidance levels for Lake Raleigh in
Hillsborough County, Florida**

Lake Raleigh

General Lake Description

Lake Raleigh is located in the Northwest Hillsborough Basin in Hillsborough County, Florida in Sections 26 and 27, Township 27S, Range 17E (Figure Raleigh-1). The area surrounding the lake is categorized as the Land-O-Lakes subdivision of the Tampa Plain in the Ocala Uplift Physiographic District (Brooks 1981); a region of many lakes on a moderately thick plain of silty sand overlying Tampa Limestone. As part of the Florida Department of Environmental Protection's Lake Bioassessment/Regionalization Initiative, the area has been identified as the Keystone Lakes region, and described as an area of numerous slightly acidic, low nutrient, and mostly clear-water lakes (Griffith *et al.* 1997). A portion of the Lake Raleigh basin lies within the Cosme-Odessa Wellfield, which is one of the major water supply wellfields operated by Tampa Bay Water. The Hillsborough County Parks and Recreation Department maintains a segment of the lake basin as a county park (Lake Rogers Park).

Lake Raleigh is an isolated lake, although surface inflow and outflow may occur through a culvert under Gunn Highway (Figure Raleigh-2). There are currently no surface water withdrawals from the lake permitted by the District. There are, however, several groundwater withdrawals in the vicinity of the lake, including those associated with the Cosme-Odessa Wellfield. In 1998 and 2002, the lake was augmented with water pumped from Lake Pretty through Horse Lake (Wylupek 2001, personal observation).

The Florida Lake Gazetteer (Florida Board of Conservation 1969, Shafer *et al.* 1986) lists a lake area of 24 acres. The United States Geological Survey 1956 (photorevised 1987) 1:24,000 Citrus Park, Fla. quadrangle map indicates a water level elevation of 38 ft, NGVD. This elevation corresponds to a lake surface area of 23 acres, based on a topographic map of the basin generated in support of minimum levels development (Figure Raleigh-3). Data used for production of the topographic map were obtained from field surveys and 1:200 aerial photograph maps containing one-foot contour lines prepared using photogrammetric methods.

Figure Raleigh-1. Location of Lake Raleigh in Hillsborough County, Florida.

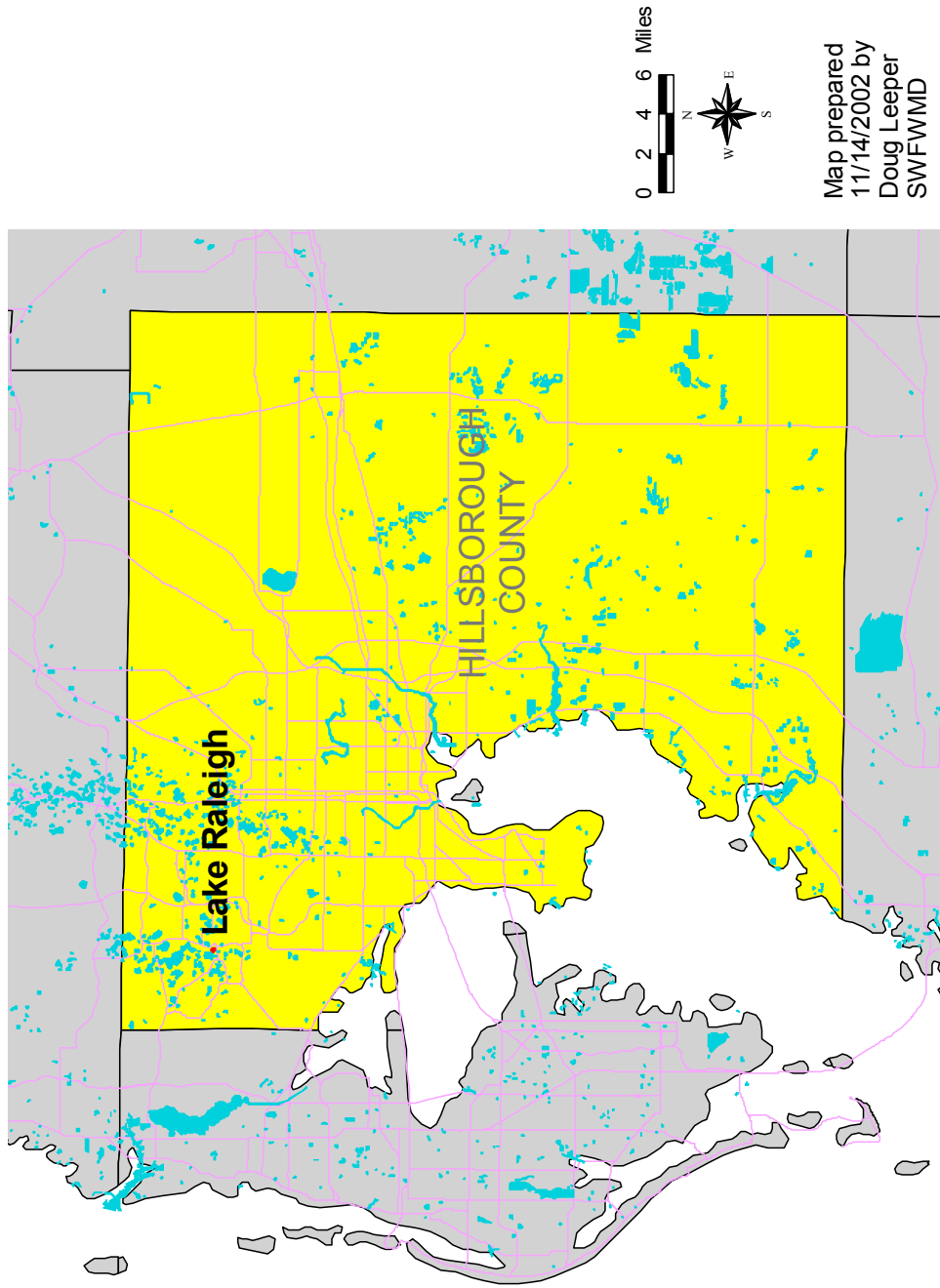


Figure Raleigh-2. Location of District lake gauge, inlet/outlet and site where hydrologic indicators were measured for Lake Raleigh, Hillsborough County, Florida.

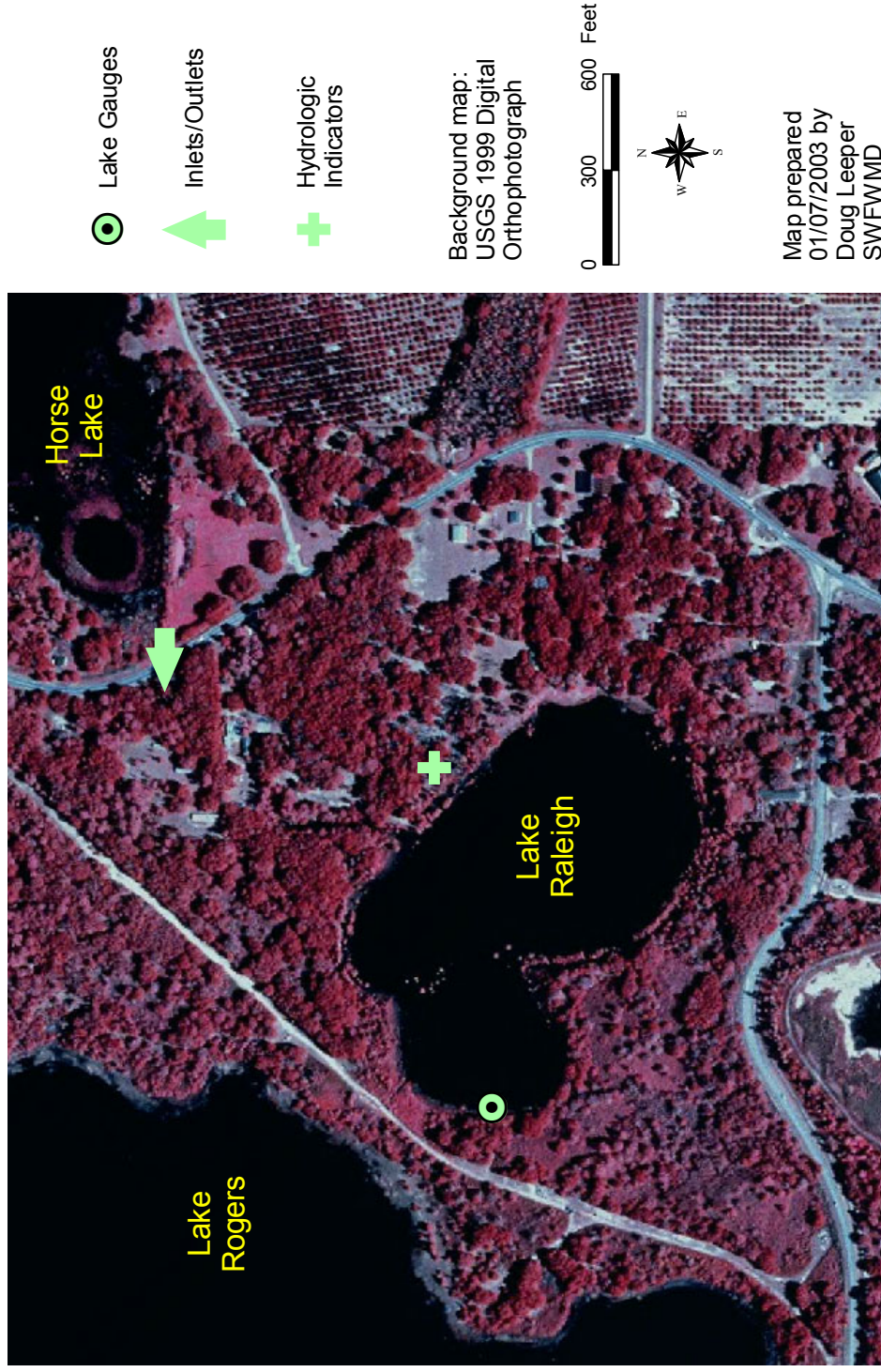
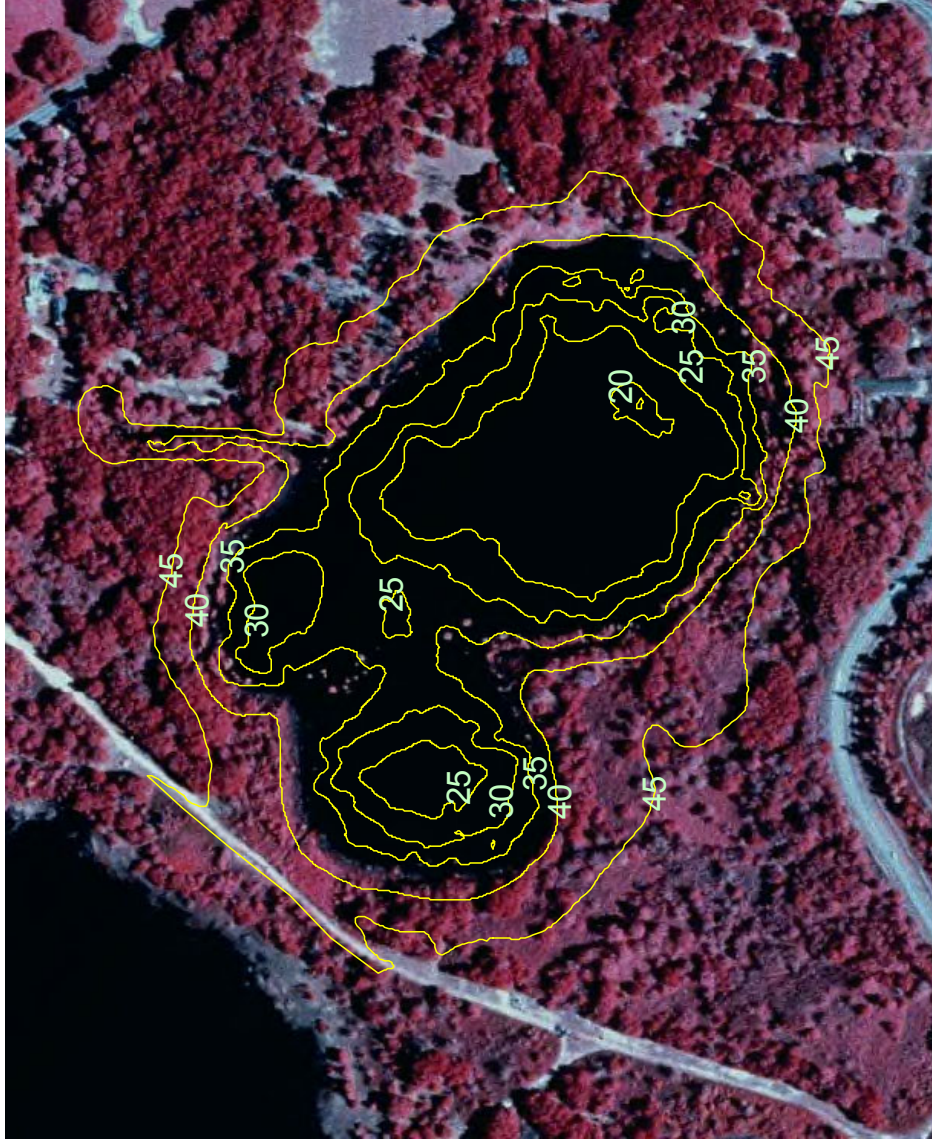


Figure Raleigh-3. Five-foot contours within the Lake Raleigh basin, Hillsborough County, Florida. Values shown are elevations, in feet, relative to the National Geodetic Vertical Datum.



Background map:
USGS 1999 Digital
Orthophotograph

0 200 400 Feet



Map prepared
01/07/2003 by
Doug Leeper
SWFWMD

Previously Adopted Lake Management Levels

Based on work conducted in 1977 (SWFWMD 1996), the District Governing Board adopted lake management levels (currently referred to as Guidance Levels) for Lake Raleigh in September 1980 (Table Raleigh-1). A Maximum Desirable Level of 40.00 ft above NGVD was also developed, but was not adopted by the Governing Board.

Table Raleigh-1. Adopted Guidance Levels and associated surface areas for Lake Raleigh, Hillsborough County, Florida.

Level	Elevation (feet above NGVD)	Total Lake Area (acres)
Ten-Year Flood Guidance Level	43.30	33
High Level	42.50	31
Low Level	38.00	23
Extreme Low Level	35.00	18

Proposed Minimum and Guidance Levels

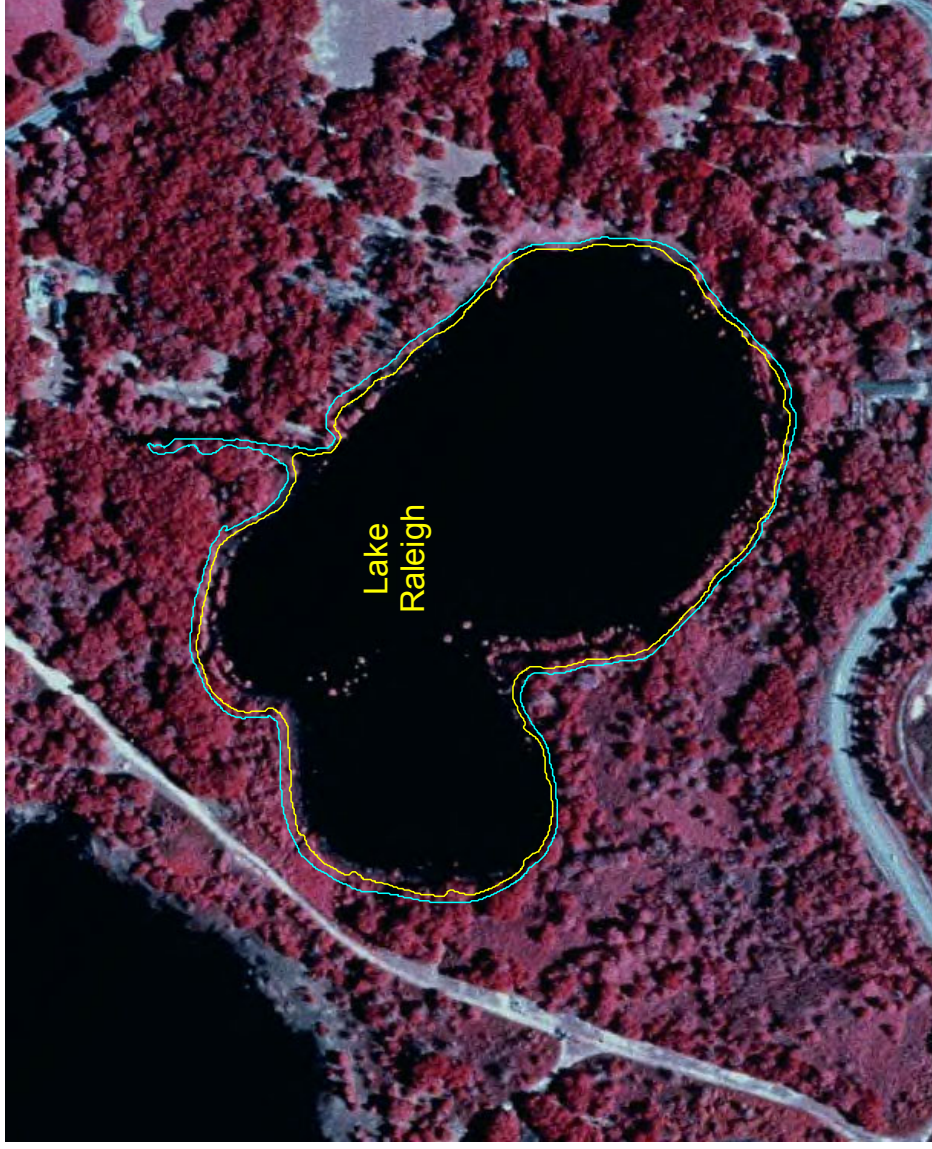
Proposed Minimum and Guidance Levels were developed for Lake Raleigh based on the methodology for Category 3 Lakes described in Leeper *et al.* (2001), in accordance with modifications outlined by Dierberg and Wagner (2001), and based on review of spot elevation information for various features within the Lake Rogers and Lake Raleigh basins. Proposed levels, along with lake surface area values for each level are listed in Table Raleigh-2. The locations of the proposed minimum levels within the lake basins are shown in Figure Raleigh-4.

Table Raleigh-2. Proposed Minimum Levels and Guidance Levels with associated lake surface areas for Lake Raleigh, Hillsborough County, Florida.

Level	Elevation (feet above NGVD)	Total Lake Area (acres)
Ten-Year Flood Guidance Level	45.80	NA
High Guidance Level	44.88	38
High Minimum Lake Level	40.00	26
Minimum Lake Level	39.00	24
Low Guidance Level	42.78	32

NA = not available

Figure Raleigh-4. Approximate location of the proposed Minimum Lake Level (yellow) and the proposed High Minimum Lake Level (blue) for Lake Raleigh, Hillsborough County, Florida. Elevations listed are in feet, relative to the National Geodetic Vertical Datum.



**Proposed
Minimum Levels**
**High Minimum
Lake Level = 40.0 ft**
**Minimum
Lake Level = 39.0 ft**

**Background map:
USGS 1999 Digital
Orthophotograph**

0 200 400 Feet



**Map prepared
01/07/2003 by
Doug Leeper
SWFWMD**

Summary of Data and Analyses Supporting Development of the Proposed Minimum and Guidance Levels

Hydrologic data are available for Lake Raleigh (Southwest Florida Water Management District Universal Identification Number = STA 281 281) from September 1930 through August 1949, from March 1958 through May 1978, and from October 1984 to the current date (Figure Raleigh-5). For the period from January 1964 to the present date, hydrologic data for the lake are classified as Current data. Current data collected through January 2002 were used to calculate the Current P10, P50 and P90 (Table Raleigh-3).

The Category 3 Lake Normal Pool elevation was established using cypress (*Taxodium* sp.) trees along the east shore of the lake (Tables Raleigh-3 and Raleigh-4, Figure Raleigh-2). The low floor slab elevation and extent of structural alteration were determined using available one-foot contour interval aerial maps and field survey data (Tables Raleigh-3 and Raleigh-5, Figure Raleigh-6). The low spot on one of the dirt roads used for accessing Lake Rogers Park was identified at 42.8 ft above NGVD. Culverts that could allow water to flow into or out of the Lake Raleigh or Lake Rogers were identified under Race Track Road and Gunn Highway. Based on the elevation of the culvert inverts, Lake Raleigh was determined to be a closed basin lake. A control point elevation was, therefore, not established, and the lake is considered not to be Structurally Altered for the purpose of minimum levels development.

Based on the relationship between the Category 3 Lake Normal Pool elevation and the Current P10, the High Guidance Level was established at the Category 3 Lake Normal Pool (Table Raleigh-3). The Historic P50 and Low Guidance Level were determined using the High Guidance Level and the Northern Tampa Bay Region RLWR50 (1.0 ft) and RLWR90 (2.1 ft) (Table Raleigh-3, see SWFWMD 1999 for a discussion of the reference lake water regime statistics).

The Ten Year Flood Guidance Level of 45.8 ft above NGVD was established for Lake Raleigh using the methodology for closed basin lakes described in current District Rules (Chapter 40D-8, Florida Administrative Code). The closed basin criteria were selected because Lake Raleigh has no positive outfall. Lake stage in the basin appears to be impacted after 1961 by groundwater withdraws from the Cosme-Odessa Wellfield. In accordance with the closed-basin methodology, the 10-year flood level was based on a frequency analysis of the lake stage record from 1930 to 1961. A frequency analysis using data collected since 1961 would have lowered the 10-year flood level as a result of using lake stage data from a period impacted by groundwater withdrawals. Based on available data, the Ten Year Flood Guidance Level has been equaled or exceeded on nine dates during the past 72 years. The peak stage recorded for Lake Raleigh, 46.1 ft above NGVD, occurred on September 1, 1937. In recent years, a peak stage of 40.54 ft above NGVD occurred on February 17, 1998 as a result of the augmentation of the lake with water pumped from Lake Pretty through Lake Horse (Wylupek 2001).

Lake Raleigh is not contiguous with any 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. The basin contains extensive stands of maidencane (*Panicum hemitomum*), rush fuirena (*Fuirena scirpoidea*) and other wetland vegetation. The basin also contains a large number of melaleuca (*Melaleuca quinquenervia*) trees. Terrestrial vegetation has encroached onto much of the former lakebed.

Aesthetics, Species Richness and Basin Connectivity Standards were evaluated for minimum levels development. The Aesthetics Standard for Lake Raleigh was established at the Low Guidance Level elevation of 42.78 ft above NGVD. The Species Richness Standard was established at 41.95 ft above NGVD, based on a 15% reduction in lake surface area from that at the Historic P50 elevation. The Basin Connectivity Standard was established at 36.6 ft, based on use of non-gasoline powered boats in the lake, a critical high-spot elevation of 34.5 ft and the RLWR5090 for the northern Tampa Bay area (1.1 ft). No docks are located at the lake, so a Dock-Use Standard was not developed. Similarly, a Recreation/Ski Standard was not developed, based on restrictions imposed upon skiing activity within the basin. Review of the dynamic ratio for lake stages bounded by the Current P10 and Current P90 elevations and the High and Low Guidance Levels did not indicate that potential changes in basin susceptibility to wind-induced sediment resuspension would be of concern for minimum levels development (Figure Raleigh-7). Review of changes in potential herbaceous wetland area associated with change in lake stage, and potential change in area available for aquatic macrophyte colonization did not indicate that use of any of the identified standards would be inappropriate for minimum levels development (Figure Raleigh-7).

The Aesthetics Standard, the most conservative (*i.e.*, highest) of the identified standards was used to establish a proposed Minimum Lake Level at 42.78 ft above NGVD. A proposed High Minimum Lake Level was established at 43.78 ft above NGVD, an elevation corresponding to the provisional Minimum Lake Level plus the RLWR50 (1.0 ft) for the northern Tampa Bay area.

Comparison of the proposed Minimum Levels with spot elevation information for the basin suggested that use of the Aesthetics Standard is not appropriate for minimum levels development for Lake Raleigh. The proposed minimum levels would result in flooding of an access road that runs through Lake Rogers Park, between Lake Rogers and Lake Raleigh. In addition, compliance with the proposed minimum levels would result in destruction of mature, upland vegetation that has encroached into the basins of Lakes Raleigh and Rogers. For example, a large oak tree located near the lake gauge on Lake Rogers at an elevation of 43.13 ft above NGVD (Czerwinski 2000) could be injured or killed as a result of sustained water levels near or above the proposed High Minimum Lake Level. Based on a field inspection of the Lake Rogers basin conducted in October 2000, similar impacts could be expected throughout the basins. At several sites within the Lake Rogers basin, technical representatives for the District and other interested parties identified transitional vegetation zones at about 40 to 41 ft above NGVD (Czerwinski 2000, Shea 2000). The transitions from herbaceous upland or wetland species to mature woody species occurring in this elevation range were found to be coincident with scarp features.

Proposed minimum levels for Lake Raleigh were, therefore, developed based on consideration of potential flooding and preservation of identified lake attributes. To mitigate potential flooding of the park access road and mature upland plant assemblages, the proposed High Minimum Lake Level was established at 40.0 ft above NGVD. Staging of the lake at or above this level for ten percent of the time would not be expected to cause significant mortality of the mature upland vegetation within the basins, but would be expected to kill some encroaching shrubby and small, woody upland plants. The proposed Minimum Lake Level was established at 39.0 ft above NGVD, an elevation corresponding to the High Minimum Lake Level minus the RLWR50 (1.0 ft) for the Northern Tampa Bay area. The proposed minimum levels would provide for basin connectivity and the associated movement of aquatic fauna and recreational boaters among the sub-basins of Lake Raleigh.

The proposed High Minimum Lake Level is 4.9 ft below the High Guidance Level and 2.8 ft below the low spot in the park access road located between Lake Rogers and Lake Raleigh. Lake surface area at the proposed Minimum Lake Level is about 70% of that associated with the Historic P50 elevation.

Figure Raleigh-5. Mean monthly surface water elevation, and proposed guidance and minimum levels for the Lake Raleigh, Hillsborough 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).

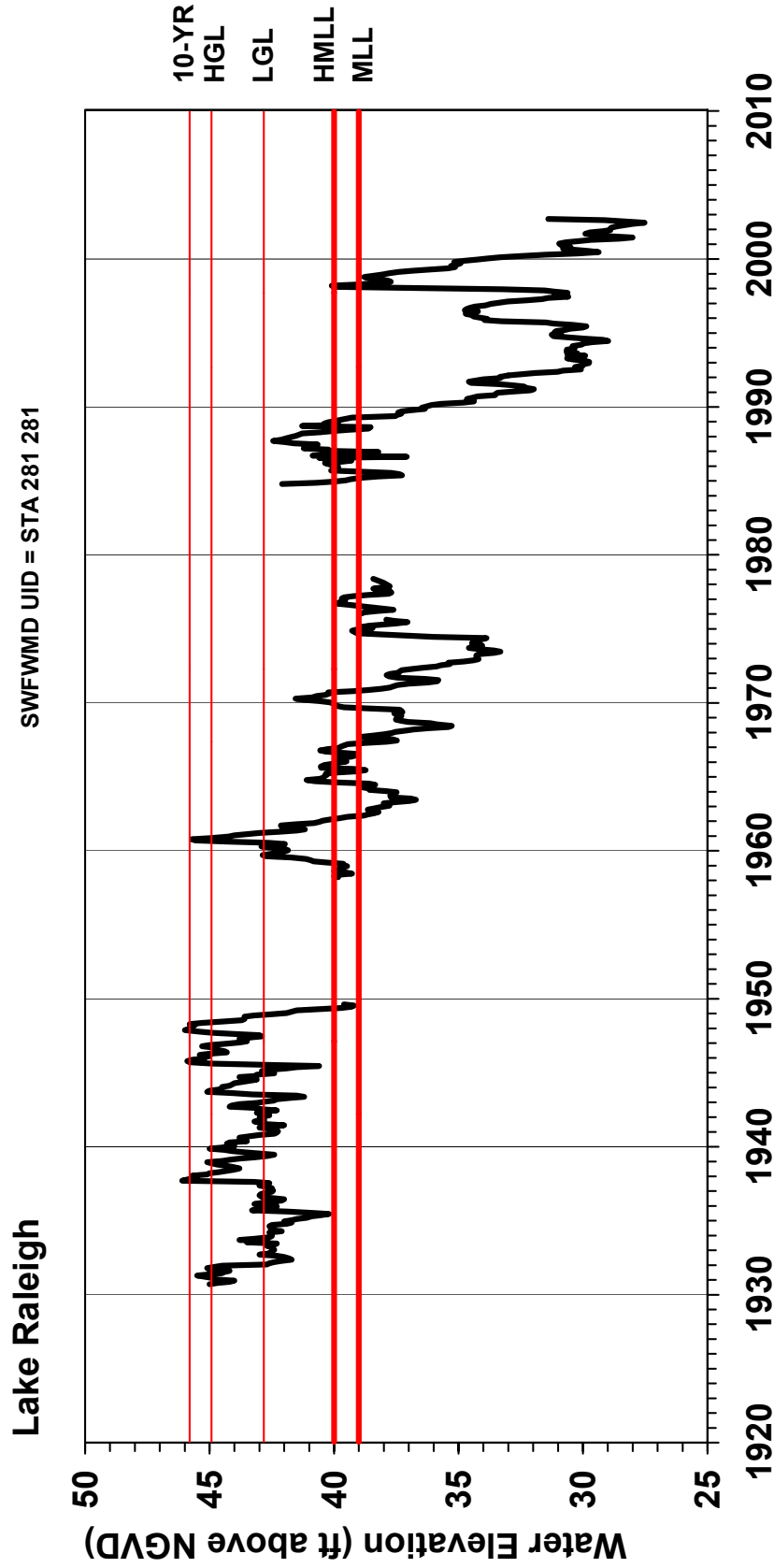


Table Raleigh-3. Summary of elevation data and associated lake surface areas used for establishing minimum levels for Lake Raleigh in Hillsborough County, Florida.

Level or Feature	Elevation (feet above NGVD)	Total Lake Area (acres)
Current P10	40.35	27
Current P50	37.31	22
Current P90	30.41	12
Category 3 Lake Normal Pool	44.88	38
Low Floor Slab	47.07	NA
Low Other (pool deck in Lake Raleigh basin)	45.58	NA
Low Road (low spot in dirt road used for Lake Roger park access)	42.8	NA
High Guidance Level	44.88	38
Historic P50	43.88	35
Low Guidance Level	42.78	32
Aesthetics Standard	42.78	32
Species Richness Standard	41.95	30
Basin Connectivity Standard	36.6	21

NA = not applicable

Table Raleigh-5. Elevation data used for establishing the Category 3 Lake Normal Pool elevation for the Lake Raleigh, Hillsborough County, Florida. Data were collected on June 1, 1998; the lake water level was 38.10 ft above NGVD.

Hydrologic Indicator	Elevation (feet above NGVD)
Cypress (<i>Taxodium</i> sp.) normal pool	44.86
Cypress (<i>Taxodium</i> sp.) normal pool	45.00
Cypress (<i>Taxodium</i> sp.) normal pool	44.90
Cypress (<i>Taxodium</i> sp.) normal pool	44.77
Cypress (<i>Taxodium</i> sp.) normal pool	45.14
Cypress (<i>Taxodium</i> sp.) normal pool	44.84
N	6
Mean	44.92
Standard Deviation	0.13
Median	44.88

Table Raleigh-6. Summary of structural alteration / control point elevation information for the Lake Raleigh. Numbers correspond to those shown in Figure Raleigh-6.

No.	Description	Elevation (feet above NGVD)
1	Invert at east end of 24 inch reinforced concrete pipe under Gunn Highway	46.3
2	Invert at east end of 24 inch reinforced concrete pipe under Gunn Highway; low spot in road north of pipe location is 49.95 ft above NGVD	46.78
3	Ground elevation at spot in dirt park-access road	43.1
4	Ground elevation at low spot in dirt park-access road	42.8
5	Invert at south end of culvert under walking trail bridge; centerline of bridge platform is at 44.77 ft above NGVD	41.46
6	Invert at north end of buried 24 inch reinforced concrete pipe under Race Track Road; centerline of road at pipe location is 48.0 ft above NGVD	43.49
7	Invert at south end of 12 inch metal pipe; invert of north end is ~42.6 ft above NGVD (north end of pipe is buried)	43.2
8	Centerline of berm	47.4
9	Low spot in Crawley Road	46.53

Figure Raleigh-6. Outlet conveyance system and spot elevation sites for Lake Raleigh, Hillsborough County, Florida. Numbered sites are described in Table Raleigh-6.

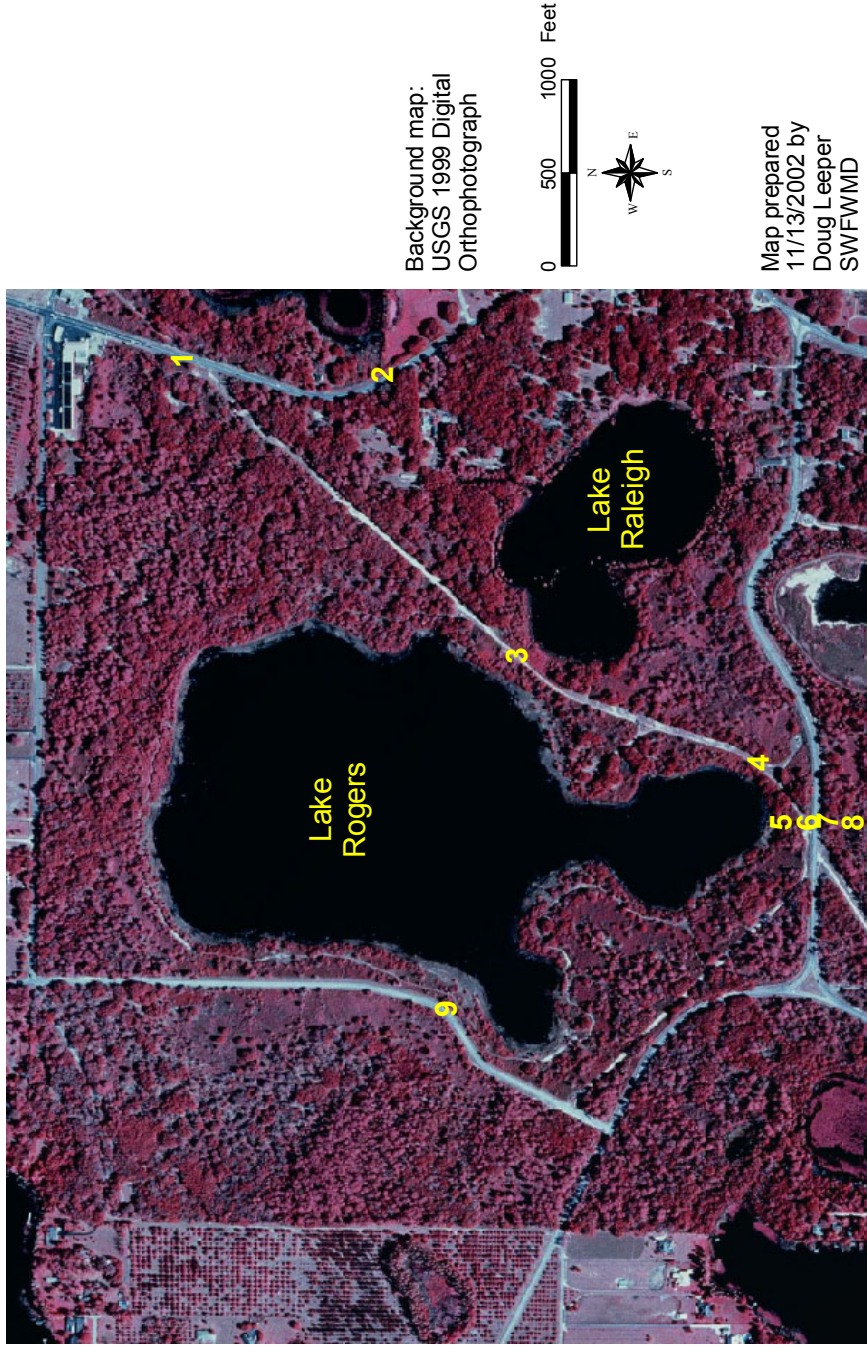
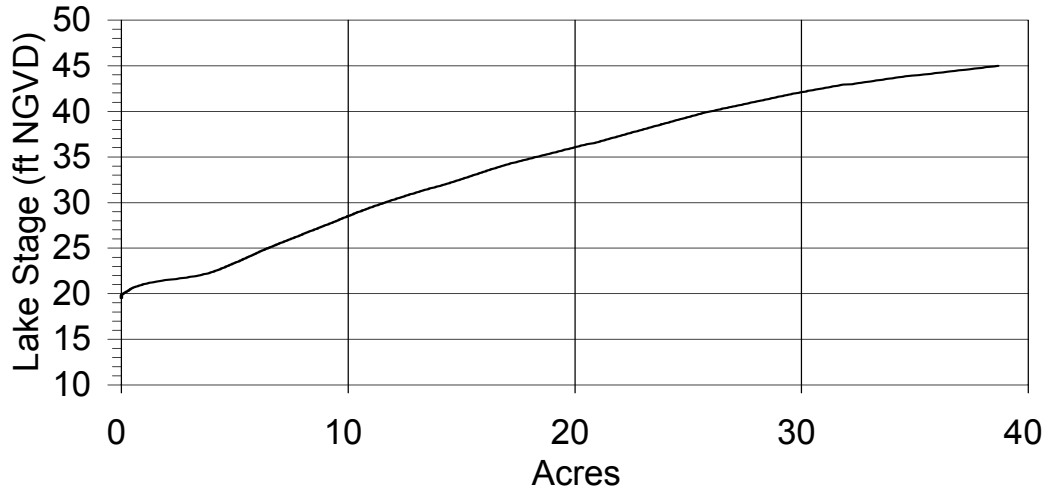


Figure Raleigh-7. Surface area, volume, potential herbaceous wetland area, area potentially colonized by aquatic macrophytes, and dynamic ratio versus lake stage for Lake Raleigh, Hillsborough County, Florida.

Stage and Area



Stage and Volume

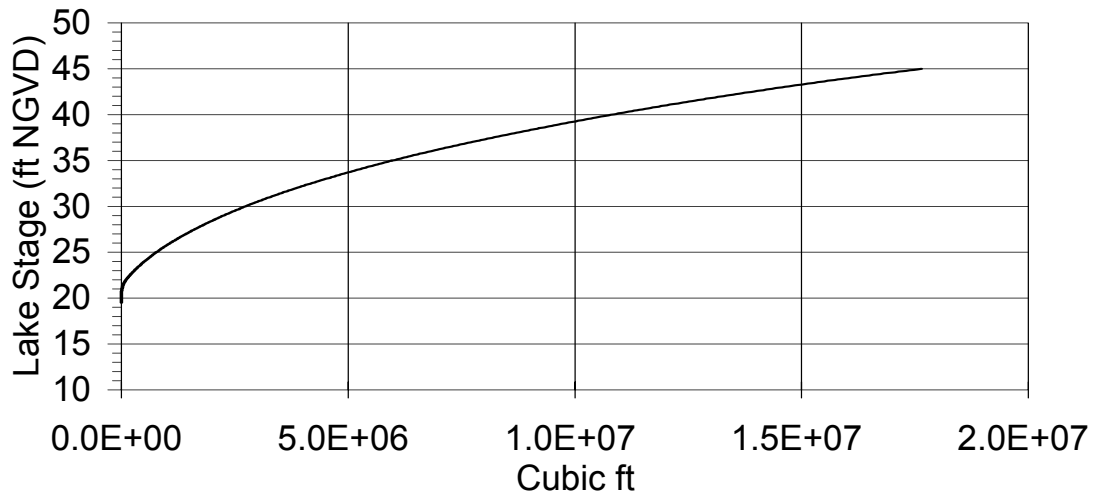
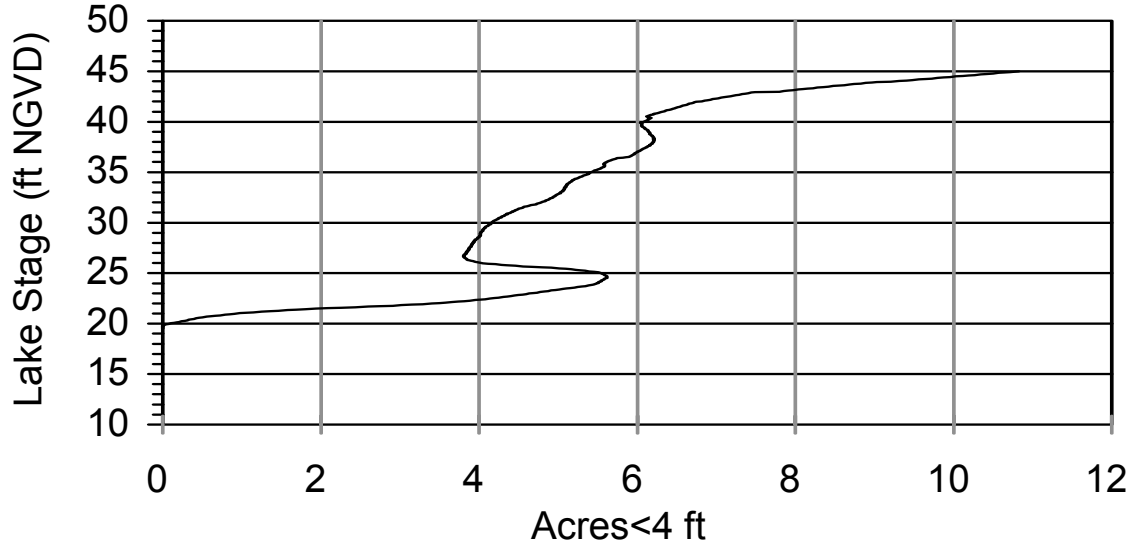


Figure Raleigh-7. (continued)

Stage and Herbaceous Wetland Area



Stage and Area Available for Aquatic Plant Colonization

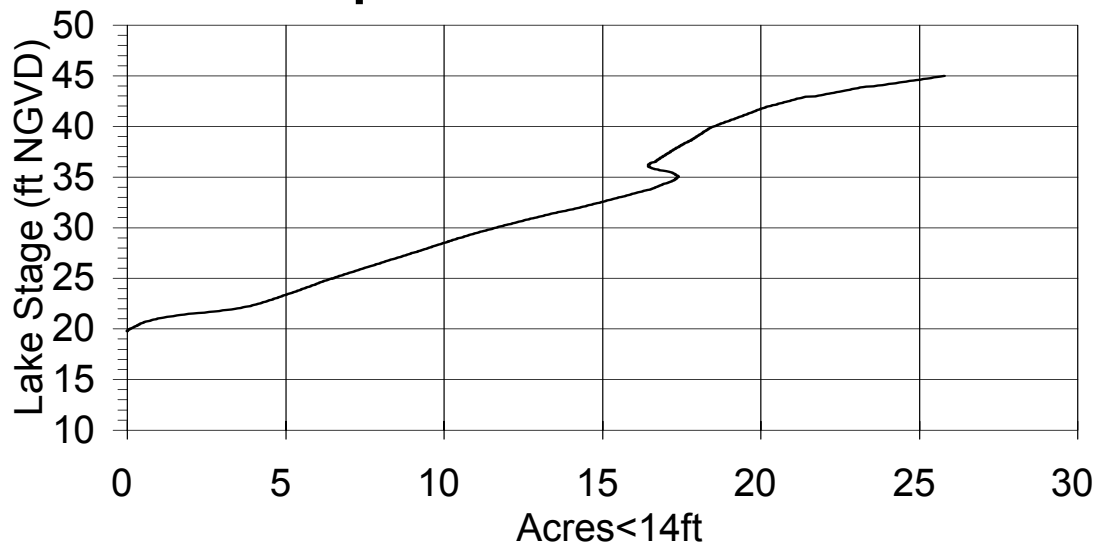
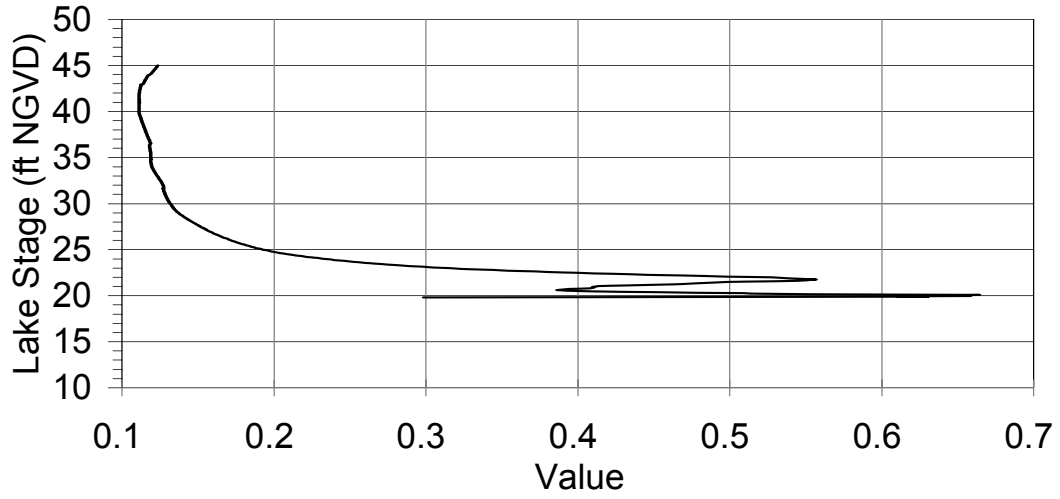


Figure Raleigh-7. (continued)

Stage and Dynamic Ratio



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