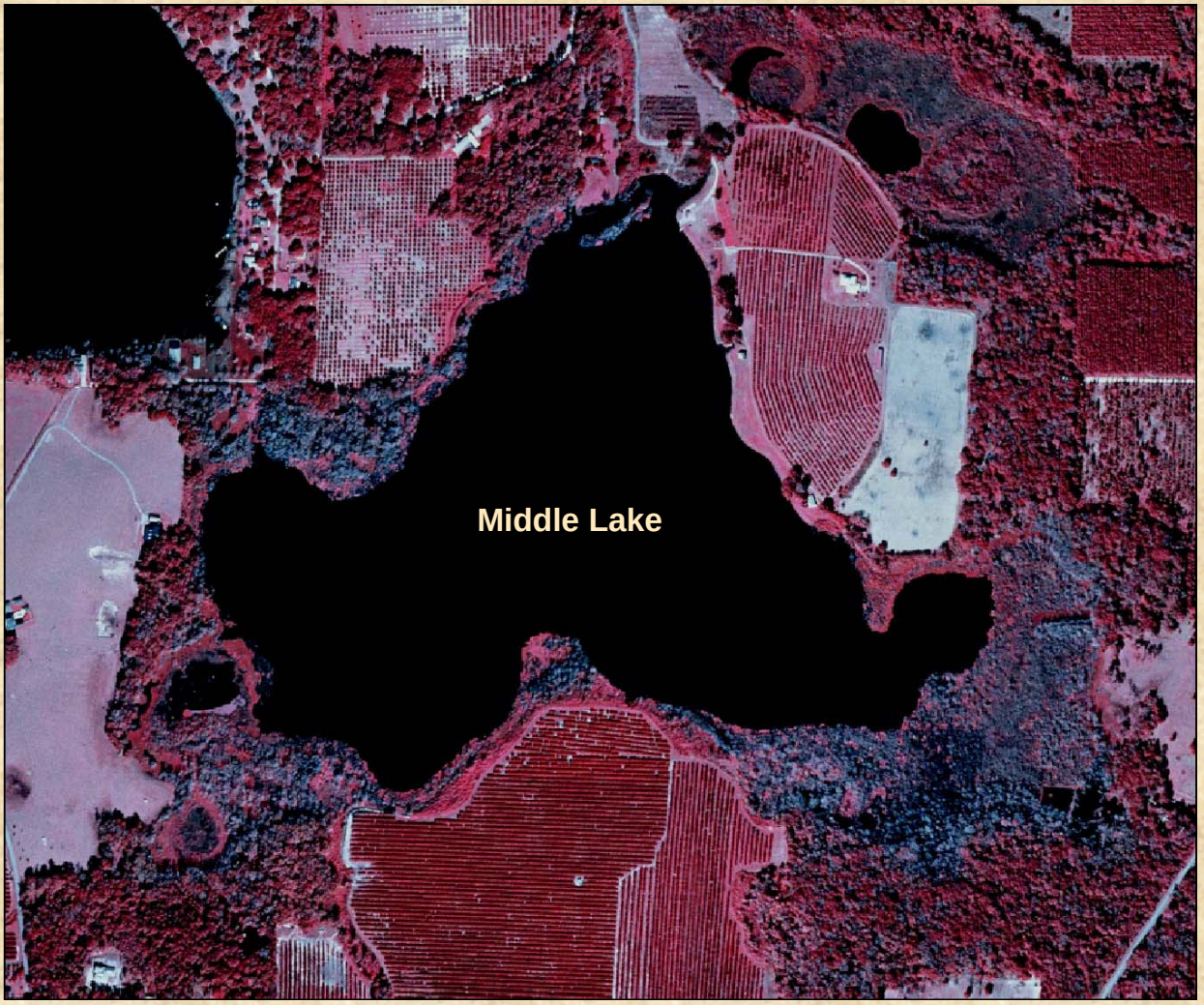
Minimum and Guidance Levels for

Middle Lake

in Pasco County, Florida



Draft – October 2004

Ecologic Evaluation Section

Resource Conservation and Development Department

Southwest Florida
Water Management District

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Proposed Minimum and Guidance Levels for Middle Lake

State law (Section 373.042, Florida Statutes; hereafter F. S.) directs the Department of Environmental Protection or the water management districts to establish minimum flows and levels (MFLs) for lakes, wetlands, rivers and aquifers. As currently defined by statute, the minimum level of an aquifer or surface water body is "the level of groundwater in the aquifer and the level of surface water at which further withdrawals would be significantly harmful to the water resources of the area". Adoption of a minimum water level does not necessarily protect a water body from significant harm, however, protection, recovery or regulatory compliance can be gauged once a standard has been established.

Minimum flows and levels are to be established based upon the best available information and shall be developed with consideration of "…changes and structural alterations to watersheds, surface waters and aquifers, and the effects such changes or alterations have had, and the constraints such changes or alterations have placed on the hydrology of the affected watershed, surface water, or aquifer…", with the caveat that these considerations shall not allow significant harm caused by withdrawals (Section 373.0421, F. S.). Additional guidance for the establishment of minimum flows and levels is provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, Florida Administrative Code; hereafter F.A.C.), which requires that "consideration shall be given to the protection of water resources, natural seasonal fluctuations in water flows, and environmental values associated with coastal, estuarine, aquatic and wetland ecology, including: a) recreation in and on the water; b) fish and wildlife habitats and the passage of fish; c) estuarine resources; d) transfer of detrital material; e) maintenance of freshwater storage and supply; f) aesthetic and scenic attributes; g) filtration and absorption of nutrients and other pollutants; h) sediment loads; i) water quality; j) and navigation."

To address this legislative mandate within its jurisdictional boundaries, the Southwest Florida Water Management District (District or SWFWMD) has developed specific methodologies for establishing minimum flows and levels for lakes, wetlands, rivers and aquifers, and adopted them into it Water Levels and Rates of Flow Rule (Chapter 40D-8, F.A.C.) For lakes, methodologies have been developed for establishing Minimum Levels for systems with fringing cypress-dominated wetlands 0.5 acres or greater in size (Category 1 or 2 lakes), and for those without fringing cypress wetlands 0.5 acres or greater in size (Category 3 lakes). Lakes with fringing cypress wetlands where water levels currently rise to an elevation expected to fully maintain the integrity of the wetlands are classified as Category 1 lakes. Lakes with fringing cypress wetlands that have been structurally altered such that lake water levels do not rise to former levels are classified as Category 2 lakes. Lakes without fringing cypress wetlands 0.5 acres or greater in size are classified as Category 3 lakes. Chapter 40D-8, F.A.C. also provides for the establishment of Guidance Levels, which serve as advisory information for the District, lake shore residents and local governments, or to aid in the management or

control of adjustable water level structures. Typically two Minimum Levels and three Guidance Levels are established for lakes, and upon adoption by the District Governing Board, are incorporated into Chapter 40D-8, F.A.C. The levels, which are expressed as elevations in feet above the National Geodetic Vertical Datum of 1929 (NGVD), are described below.

The **Ten Year Flood Guidance Level** is provided as an advisory guideline for lake shore development. It is the level of flooding expected on a frequency of not less than the ten year recurring interval, or on a frequency of not greater than a ten percent probability of occurrence in any given year.

The **High Guidance Level** is provided as an advisory guideline for construction of lake shore development, water dependent structures, and operation of water management structures. The High Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ten percent of the time (P90) on a long-term basis.

The **High Minimum Lake Level** is the elevation that a lake's water levels are required to equal or exceed ten percent of the time (P10) on a long-term basis.

The **Minimum Lake Level** is the elevation that a lake's water levels are required to equal or exceed fifty percent of the time (P50) on a long-term basis.

The **Low Guidance Level** is provided as an advisory guideline for water dependent structures, information for lake shore residents and operation of water management structures. The Low Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ninety percent of the time (P90) on a long-term basis.

In accordance with Chapter 40D-8, F.A.C., proposed Minimum and Guidance Levels were developed for Middle Lake (Table 1), a Category 3 lake located in Pasco County, Florida. The levels were established using best available information, including field data that were obtained specifically for the purpose of Minimum Levels development. Data and analyses used for development of the proposed Minimum and Guidance Levels are described in the remainder of this report.

Table 1. Proposed Minimum and Guidance Levels for Middle Lake.

Minimum and Guidance Levels	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	106.9
High Guidance Level	103.1
High Minimum Lake Level	102.5
Minimum Lake Level	100.2
Low Guidance Level	99.2

Data and Analyses Supporting Proposed Minimum and Guidance Levels for Middle Lake

Lake Setting and Description

Middle Lake is located in Pasco County, Florida (Sections 4, 5, 8 and 9, Township 24S, Range 20E), in the Hillsborough River Basin of the Southwest Florida Water Management District (Figure 1). White (1970) classified the area of west-central Florida containing Middle Lake as the Brooksville Ridge physiographic region. Brooks (1981) identified the area surrounding the lake as the Dade City Hills subdivision of the Ocala Uplift Physiographic District. The subdivision is characterized as a spectacular ridge of high hills dissected from Upper Miocene sand and silty sand. As part of the Florida Department of Environmental Protection's Lake Bioassessment/Regionalization Initiative, the area has been identified as the Southern Brooksville Ridge lake region, and described as an area of thick sand hills overlying limestone, with slightly colored, mostly neutral to alkaline (some are acidic), mesotrophic or meso-eutrophic lakes (Griffith *et al.* 1997).

Middle Lake is located in the Crews Lake Outlet drainage basin in the Pithlachascottee River watershed and has a drainage area of 3.3 square miles (SWFWMD 1996a). Surface water flows into Middle Lake from a wetland system located to the northeast, and Moody Lake located to the southeast when it stages above 104.2 ft above NGVD. Middle Lake discharges to Hancock Lake when it stages above 99.5 ft above NGVD (Figure 2). There are a number of permitted ground water withdrawals within the surrounding area, but there are no surface water withdrawals from the lake currently permitted by the District.

The 1954 (photorevised 1988) United States Geological Survey 1:24,000 Spring Lake, Fla. quadrangle map indicates an elevation of 107 ft above NGVD for Middle Lake. The "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986) lists the lake area as 215 acres at this elevation. A topographic map of the lake basin generated in support of minimum levels development (Figure 3) indicates that the lake extends over 248 acres at an elevation of 107 ft above NGVD.

Most of the uplands surrounding Middle Lake as well as the eastern shoreline area have been cleared for agriculture, primarily citrus and pasture. The remainder of the shoreline is dominated by shrubby wetland vegetation that extends into more expansive wetlands along the northwestern, southwestern and southeastern lake shore areas. Wetland and aquatic vegetation observed along the shoreline and within the lake basin include hydrilla (*Hydrilla verticillata*), willow (*Salix caroliniana*), primrose willow (*Ludwigia sp.*), torpedo grass (*Panicum repens*), cattail (*Typha sp.*), pennywort (*Hydrocotyle umbellata*), pickerelweed (*Pontederia cordata*), alligator weed (*Alternanthera philoxeroides*), bladderwort (*Utricularia sp.*), floating hearts (*Nymphoides aquatica*), spatterdock (*Nuphar luteum*), duckweed (*Lemna minor*) and azolla (*Azolla caroliniana*). The District uses herbicides to control noxious aquatic plants such as

hydrilla within Middle Lake. The lake is also stocked with grass carp to control aquatic plants. The Albert H. Pless public boat ramp located on the north shore provides access to Middle Lake.

Figure 1. Location of Middle Lake in Pasco County, Florida.

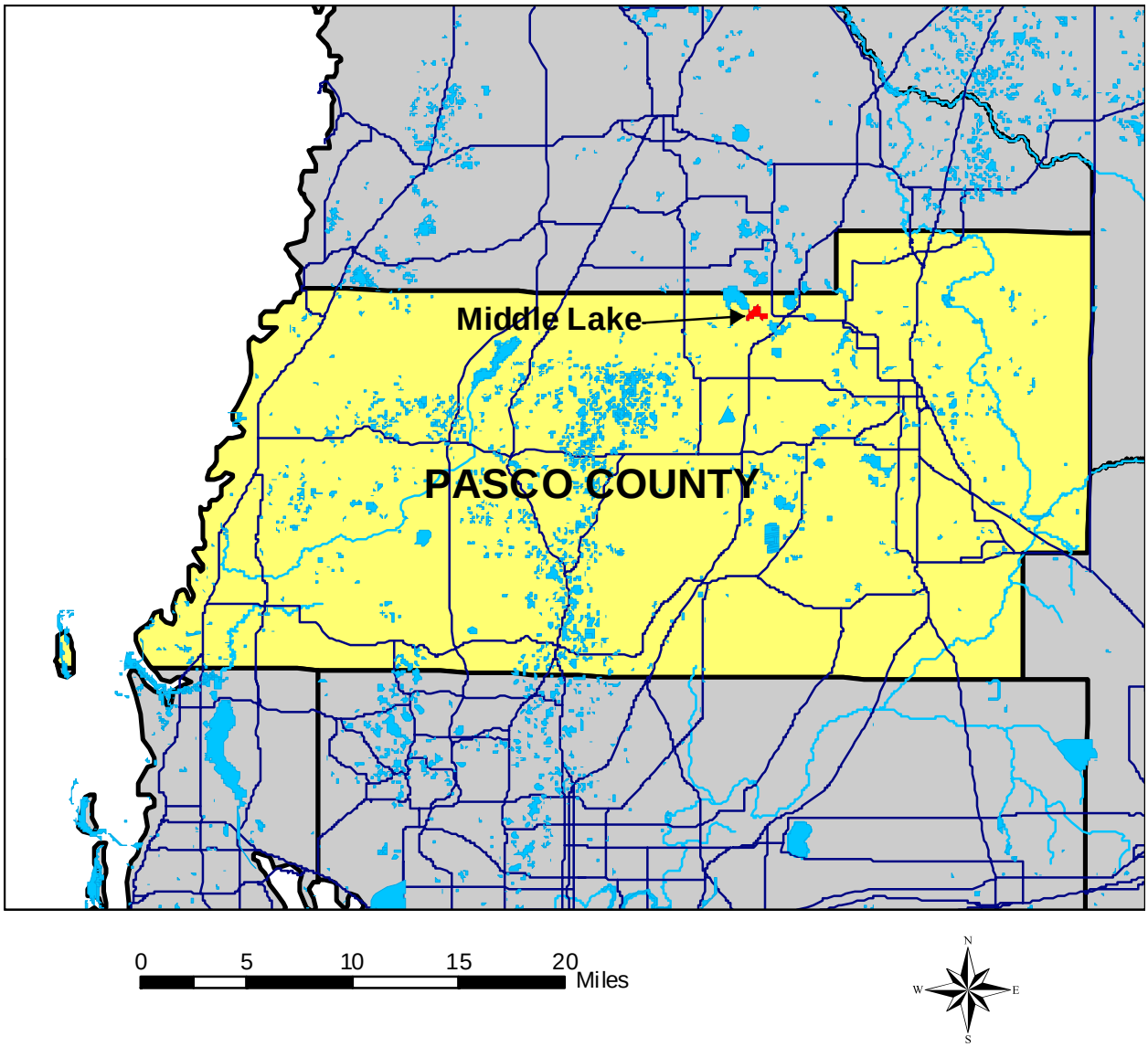
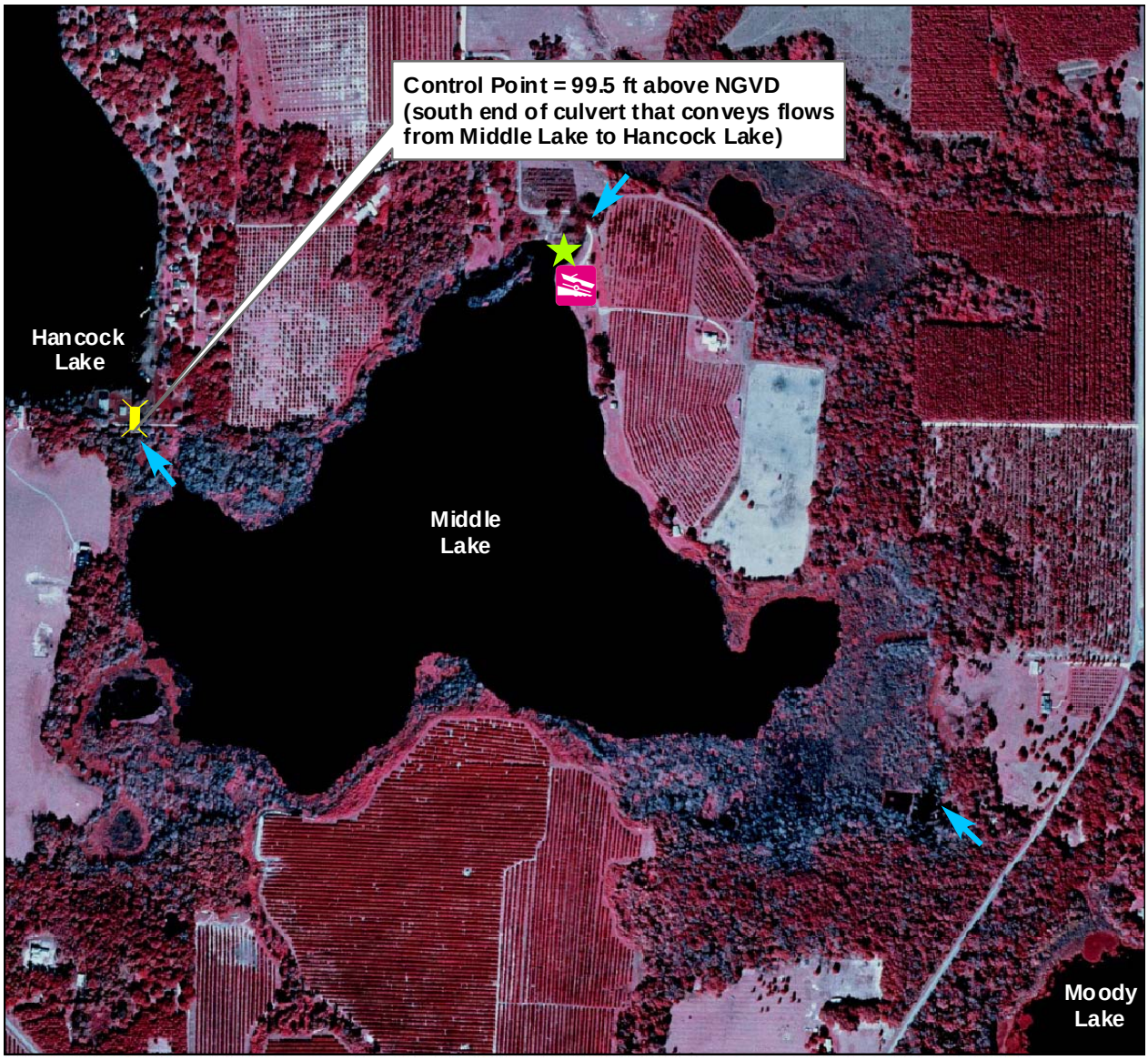


Figure 2. Location of lake water level gauge, boat ramp, inflows, outflow, and control point for Middle Lake.



Legend

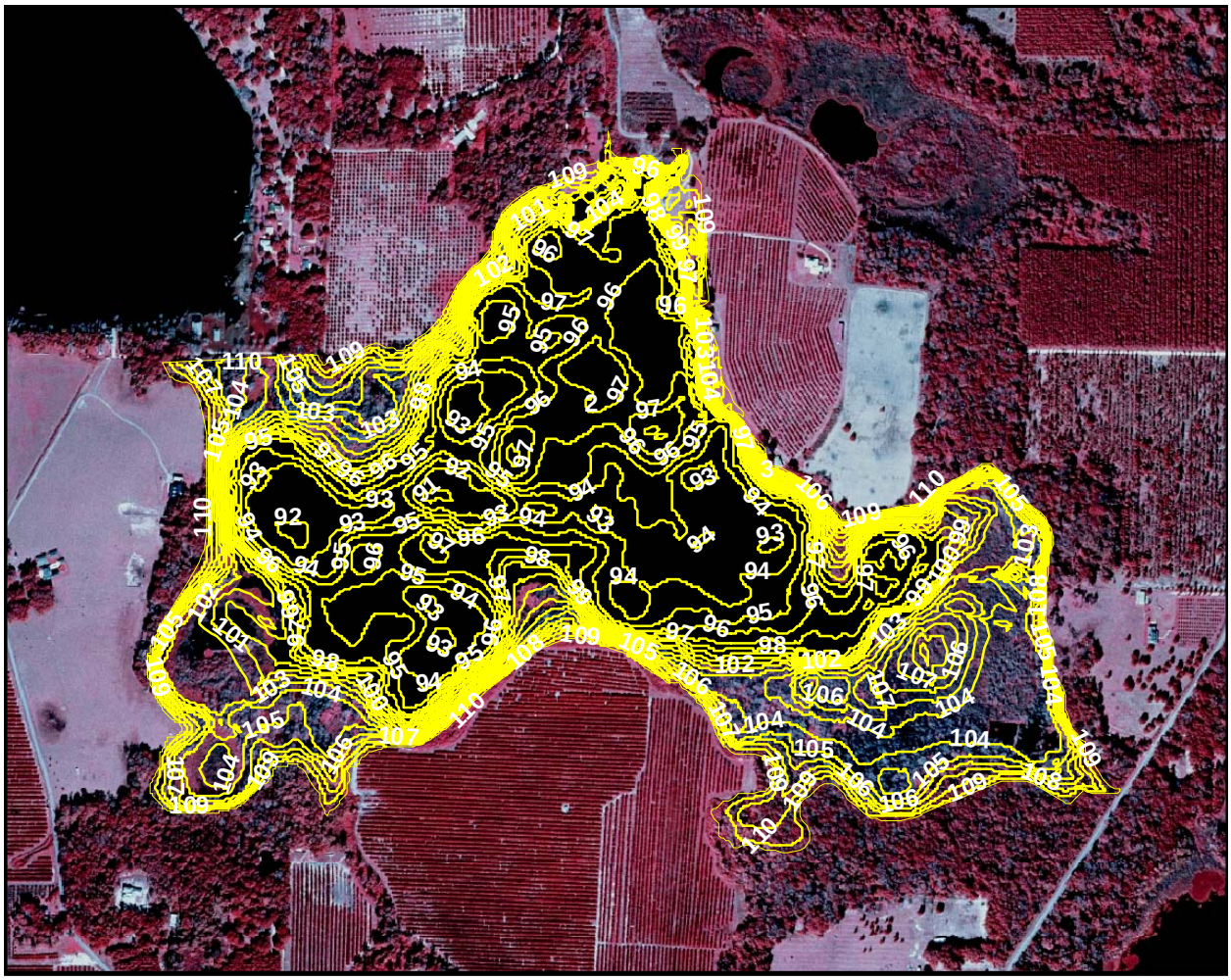
- Inflows, outflow
- Lake gauge
- Boat ramp
- Culvert

N
W E
S

0 500 1,000 2,000
Feet

Aerial photography from 1999 USGS Digital Orthophotograph.

Figure 3. One foot contours within the Middle Lake basin. Values shown are elevations in feet above the National Geodetic Vertical Datum of 1929.



Map prepared using 1999 USGS digital orthophotography, elevation data from 1987 SWFWMD aerial photography with contours map (Sheet Nos. 04-24-20, 05-24-20, 08-24-20 and 09-24-20), and elevation data collected on July 1, 2004 by D.C. Johnson & Associates, Inc.

0 500 1,000 2,000
Feet

N
W E
S

Currently Adopted Lake Guidance Levels

The District has a long history of water resource protection through the establishment of lake management levels. With the development of the Lake Levels Program in the mid-1970s, the District began an initiative for establishing lake management levels based on hydrologic, biological, physical and cultural aspects of lake ecosystems. By 1996, management levels for nearly 400 lakes had been established.

Based on work conducted in the 1980s (see SWFWMD 1996a), the District Governing Board adopted Guidance Levels for Middle Lake in May 1986 (Table 2). A Maximum Desirable Level of 106.50 ft above NGVD was also developed, but was not adopted. The adopted Guidance Levels and Maximum Desirable Level were developed using a methodology that differs from the current District approach for establishing Minimum and Guidance Levels. The levels do not, therefore, necessarily correspond with levels developed using current methodologies. Minimum and Guidance Levels established during minimum levels development shall replace current Guidance Levels shown in Table 2 upon adoption by the District's Governing Board into Chapter 40D-8, F.A.C.

Annually since 1991, a list of stressed lakes has been developed to support the District's consumptive water use permitting program. As described in Chapter 40D-2, F.A.C., Consumptive Use of Water, "a stressed condition for a lake is defined to be chronic fluctuation below the normal range of lake level fluctuations". For lakes with adopted Guidance Levels, chronic fluctuation below the Low Level is considered a stressed condition. For lakes without adopted levels, determination of stressed condition is determined on a case-by-case basis. Middle Lake is included on the current Stressed Lakes List (Gant *et al.* 2004), and has been classified as a stressed lake since 1991.

Table 2. Adopted Guidance Levels and associated surface areas for Middle Lake.

Management Levels	Elevation (feet above NGVD)	Lake Area (acres)
Ten Year Flood Guidance Level	107.48	252
High Level	107.00	248
Low Level	105.00	226
Extreme Low Level	103.00	174

Development of Minimum and Guidance Levels

Proposed Minimum and Guidance Levels for Middle Lake were developed using the methodology for Category 3 lakes described in Chapter 40D-8, F.A.C. and best available information in accordance with Section 373.042, F.S. Additional information gathered through field evaluations were also used. The levels and additional

information are listed in Table 3, along with surface areas for each elevation. Detailed descriptions of the development and use of these data are provided in the remainder of this report.

Table 3. Proposed Minimum and Guidance Levels, Historic P50, lake stage percentiles, normal pool and control point elevations, and significant change standards for Middle Lake.

Levels	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Percentiles		
Historic P10	103.14	177
Historic P50	101.35	156
Historic P90	99.20	139
Other Levels		
Normal Pool	NA	NA
Control Point	99.5	142
Guidance Levels and Historic P50		
Ten Year Flood Guidance Level	106.9	247
High Guidance Level	103.1	177
Historic P50	101.4	156
Low Guidance Level	99.2	139
Significant Change Standards		
Recreation/Ski Standard	102.2	162
Basin Connectivity Standard	99.4	141
Aesthetics Standard	99.2	139
Species Richness Standard	98.3	133
Lake Mixing Standard	98.1	131
Dock-Use Standard	NA	NA
Minimum Levels		
High Minimum Lake Level	102.5	164
Minimum Lake Level	100.2	147

NA = not available/not appropriate

Lake Stage Data and Percentiles

Lake stage data, *i.e.,* surface water elevations for Middle Lake (District Universal ID Number STA 198 198) were obtained from the District's Water Management Data Base. The period of record for the data extends from April 1980 through the present date (Figure 4, see Figure 2 for current location of the SWFWMD lake water level gauge). The highest surface water elevation for Middle Lake recorded in the Water Management Data Base, 108.30 ft above NGVD, occurred in April 1998. The low of record, 96.18 ft above NGVD, occurred on June 11, 2001. Based on available lake stage data, monthly mean lake surface elevations were calculated and graphed (Figure 5). The data record for Middle Lake is not continuous, *i.e.*, there are some months during the period of record when lake surface elevations were not recorded.

For the purpose of minimum levels determination, lake stage data are categorized as "Historic" for periods when there were no measurable impacts due to water withdrawals, and impacts due to structural alterations were similar to existing conditions. Lake stage data are categorized as "Current" for periods when there were measurable, stable impacts due to water withdrawals, and impacts due to structural alterations were stable. Lake stage data for Middle Lake from April 1980 to the present date are classified as Historic data.

Historic data collected through December 2003 were used to calculate the **Historic P10, P50, and P90** lake stage percentile elevations. The Historic P10 elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the current period, was **103.14 ft above NGVD**. The Historic P50 elevation, the elevation the lake water surface equaled or exceeded fifty percent of the time during the current period, was **101.35 ft above NGVD**. The Historic P90 elevation, the elevation the lake water surface equaled or exceeded 90 percent of the time during the current period, was **99.20 ft above NGVD**.

Normal Pool and Control Point Elevations

The **Normal Pool** elevation, a reference elevation used for development of minimum lake and wetland levels, is established based on the elevation of Hydrologic Indicators of sustained inundation, including biological and physical features. Because there are no appropriate biological or physical features within the lake shore area that could be used to determine an elevation of sustained inundation, development of the Normal Pool elevation is **not appropriate**.

The **Control Point** elevation is defined as the highest stable point along the outlet profile of a surface water conveyance system (*e.g.*, structure, ditch, culvert, or pipe) that principally controls lake water level fluctuations. For Middle Lake, the Control Point was established at **99.5 ft above NGVD**, the elevation of the south end of a culvert that conveys flow from Middle Lake to Lake Hancock (Figure 2).

Proposed Guidance Levels and the Historic P50

The **Ten Year Flood Guidance Level** is provided as an advisory guideline for lake shore development. It is the level of flooding expected on a frequency of not less than the ten year recurring interval, or on a frequency of not greater than a ten percent probability of occurrence in any given year. The Ten Year Flood Guidance Level for Middle Lake was established at **106.9 ft above NGVD** using the methodology for closed basin lakes described in current District Rules (Chapter 40D-8, Florida Administrative Code). For the analysis, the long-term gauging record for Middle Lake was used to assess flooding potential. Flood frequency elevation estimates were based on probability analysis of annual peak stages recorded between 1950 and 2003. Various frequency distributions and probability plots were compared to establish the best estimate of flood frequency elevations. Based on available lake stage data, the Ten Year Flood Guidance Level has not been exceeded since November 1998.

The **High Guidance Level** is provided as an advisory guideline for construction of lake-shore development, water dependent structures, and operation of water management structures. The High Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ten percent of the time (P10) on a long-term basis. Because Historic data are available, the High Guidance Level was established at **103.1 ft above NGVD**, the Historic P10 elevation.

The **Historic P50** elevation is the elevation that a lake's water levels are expected to equal or exceed fifty percent of the time on a long-term basis. It is derived to support development of minimum lake levels, and is established using Historic or Current data and, in some cases, reference lake water regime statistics. Reference lake water regime (RLWR) statistics are used to describe expected water level fluctuations for lakes that lack adequate Historic or Current data. The statistics include the RLWR50, RLWR5090, and RLWR90 and are derived using lake stage data for typical, regional lakes that exhibit little or no impacts from water withdrawals. Because Historic data are available for Middle Lake, the Historic P50 was established at **101.4 ft above NGVD**.

The **Low Guidance Level** is provided as an advisory guideline for water dependent structures, information for lake shore residents and operation of water management structures. The Low Guidance Level is the elevation that a lake's water levels are expected to equal or exceed ninety percent of the time (P90) on a long-term basis. Because Historic data are available, the Low Guidance Level was established at **99.2 ft above NGVD**, the Historic P90 elevation.

Lake Categorization

Lakes are classified as Category 1, 2, or 3 for the purpose of Minimum Levels development. Those with fringing cypress wetlands greater that 0.5 acres in size where water levels currently rise to an elevation expected to fully maintain the integrity of the wetlands (*i.e*., the Historic P50 is equal to or higher than an elevation 1.8 ft below the Normal Pool elevation) are classified as Category 1 Lakes. Lakes with fringing cypress

wetlands greater than 0.5 acres in size that have been structurally altered, such that the Historic P50 elevation is more than 1.8 ft below the Normal Pool elevation, are classified as Category 2 Lakes. Lakes without fringing cypress wetlands or with cypress wetlands less than 0.5 acres in size, are classified as Category 3 Lakes. Because Middle Lake does not have fringing cypress wetlands, it is classified as a **Category 3** lake.

Significant Change Standards and Other Information for Consideration

Lake-specific significant change standards and other available information are developed for establishing Minimum Levels. The standards are used to identifiy thresholds for preventing significant harm to cultural and natural system values associated with lakes in accordance with guidance provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, F.A.C.). Other information taken into consideration includes potential changes in the coverage of herbaceous wetland vegetation and aquatic plants.

For Category 3 lakes, six significant change standards are developed, including a Species Richness Standard, an Aesthetics Standard, a Lake Mixing Standard, a Recreation/Ski Standard, a Dock-Use Standard, and a Basin Connectivity Standard. Potential changes in the coverage of herbaceous wetland vegetation and aquatic plants associated with use of standards for development of Minimum Levels for Category 3 lakes is also taken into consideration. Since Middle Lake is a Category 3 lake, the applicable significant change standards were developed (Table 3) and evaluated with respect to potential changes in plant cover.

The **Recreation/Ski Standard** is developed to identify the lowest elevation within the lake basin that will contain an area suitable for safe water skiing. The standard is based on the lowest elevation (the Ski elevation) within the basin that can contain a five-foot deep ski corridor delineated as a circular area with a radius of 418 ft, or a rectangular area 200 ft in width and 2,000 ft in length, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because Historic data are available for Middle Lake, the Recreation/Ski Standard was established at **102.2 ft above NGVD**, based on the sum of the Ski elevation (100 ft above NGVD), and the difference between the Historic P50 and Historic P90 (2.2 ft).

The **Basin Connectivity Standard** is developed to protect surface water connections between lake basins or among sub-basins within lake basins to allow for movement of aquatic biota, such as fish, and support recreational uses. The standard is based on the elevation of lake sediments at a critical high spot between lake basins or lake sub-basins, clearance values for movement of aquatic biota or powerboats and other watercraft, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because Historic data are available, the Basin Connectivity Standard was established at **99.4 ft above NGVD**, based on the sum of the critical high spot elevation (95.2 ft NGVD), the clearance value for powerboats and movement of biota (2 ft), and the difference between the Historic P50 and the Historic P90 (2.2 ft).

The **Aesthetics Standard** is developed to protect aesthetic values associated with the inundation of lake basins. The standard is intended to limit potential change in aesthetic values associated with the median lake stage from diminishing below the values associated with the lake when it is staged at the Low Guidance Level. The Aesthetic Standard was established at the Low Guidance Level, which is **99.2 ft above NGVD**.

The **Species Richness Standard** is developed to prevent a decline in the number of bird species that may be expected to occur at or utilize a lake. Based on an empirical relationship between lake surface area and the number of birds expected to occur at Florida lakes, the standard is established at the lowest elevation associated with less than a 15 percent reduction in lake surface area relative to the lake area at the Historic P50 elevation. For Middle Lake, the Species Richness Standard was established at **98.3 ft above NGVD**.

The **Lake Mixing Standard** is developed to prevent significant changes in patterns of wind-driven mixing of the lake water column and sediment resuspension. The standard is established at the highest elevation at or below the Historic P50 elevation where the dynamic ratio (see Bachmann *et al*. 2000) shifts from a value of <0.8 to a value >0.8, or from a value >0.8 to a value <0.8. The Lake Mixing Standard was established at **98.1 ft above NGVD**, the highest elevation at which the dynamic ratio shifts across the 0.8 threshold (Figure 6).

The **Dock-Use Standard** is developed to provide for sufficient water depth at the end of existing docks to permit mooring of boats and prevent adverse impacts to bottom-dwelling plants and animals caused by boat operation. The standard is based on the elevation of lake sediments at the end of existing docks, a clearance value for boat mooring, and use of Historic lake stage data or region-specific reference lake water regime statistics. Because only one non-floating dock platform is located on Middle Lake, use of this standard for Minimum Levels development is **not appropriate**.

Herbaceous Wetland Information is taken into consideration to determine the elevation at which change in lake stage would result in substantial change in potential wetland area within the lake basin (*i.e*., basin area with a water depth less than or equal to four feet). Review of changes in potential herbaceous wetland area in relation to change in lake stage did not indicate that there would be a significant increase or decrease in the area of herbaceous wetland vegetation associated with use of the applicable significant change standards (Figure 6).

Submersed Aquatic Macrophyte Information is taken into consideration to determine the elevation at which change in lake stage would result in substantial change in the area available for colonization by submersed aquatic plants. Because of limited Secchi depth data, it was not possible to determine the depth of macrophyte colonization for Middle Lake.

Proposed Minimum Levels

The High Minimum Lake Level and the Minimum Lake Level are developed using lake-specific significant change standards, lake categorization, and other available information including substantial changes in the coverage of herbaceous wetland vegetation and aquatic macrophytes; elevations associated with residential dwellings, roads or other structures; frequent submergence of dock platforms; faunal surveys; aerial photographs; typical uses of lakes (*e.g.,* recreation, aesthetics, navigation, and irrigation); surrounding land-uses; socio-economic effects; and public health, safety and welfare matters.

The **Minimum Lake Level** is the elevation that a lake's water levels are required to equal or exceed fifty percent of the time on a long-term basis. The Minimum Lake Level for Category 3 Lakes is established at the elevation corresponding to the most conservative, *i.e*., the standard with the highest elevation, except where that elevation is above the Historic P50 elevation, in which case, the Minimum Lake Level is established at the Historic P50 elevation. By rule, the Minimum Lake Level for Middle Lake would be established at the Basin Connectivity Standard (99.4 ft above NGVD), the most conservative of the appropriate standards (the Recreation/Ski Standard was not considered appropriate because it is above the Historic P50). However, because the Minimum Lake Level for downstream Hancock Lake (100.2 ft above NGVD) is above 99.4 ft above NGVD, it is not appropriate to establish the Minimum Lake Level for Middle Lake at the Basin Connectivity Standard. To maintain the Minimum Lake Level for Hancock Lake, the Minimum Lake Level for Middle Lake was revised to **100.2 ft above NGVD** (Table 3, Figures 5 and 7). The water level equaled or exceeded fifty percent of the time (P50) has been above the Minimum Lake Level for Middle Lake over the last five long-term (10-year) periods (Table 5).

Table 5. Comparisons between the Minimum Lake Level for Middle Lake and water surface elevations equaled or exceeded fifty percent of the time (P50) over the last five 10-year periods.

10-year Period			MLL Equaled or Exceeded ?	Feet P50 is above(+) or below (-) MLL
January 1994	through	December 2003	Yes	+1.3
January 1993	through	December 2002	Yes	+1.1
January 1992	through	December 2001	Yes	+0.9
January 1991	through	December 2000	Yes	+0.9
February 1990	through	December 1999	Yes	+1.2

The **High Minimum Lake Level** is the elevation that a lake's water levels are required to equal or exceed ten percent of the time on a long-term basis. Because Middle Lake is a Category 3 lake and Historic data are available, by rule, the High Minimum Lake

Level would be established at 101.2 ft above NGVD by adding the difference between the Historic P10 and the Historic P50 (1.8 ft) to the Minimum Lake Level (99.4 ft above NGVD). However, because the High Minimum Lake Level for downstream Lake Hancock (102.5 ft above NGVD) is above 101.2 ft above NGVD, it is not appropriate to establish the High Minimum Lake Level for Middle Lake at 101.2 ft above NGVD. To maintain the Minimum Lake Levels for downstream Hancock Lake, the High Minimum Lake Level for Middle Lake was revised to **102.5 ft above NGVD** (Table 3, Figures 5 and 7). The water level equaled or exceeded ten percent of the time (P10) has been above the High Minimum Lake Level for Middle Lake over the last five long-term (10-year) periods (Table 6).

Table 6. Comparisons between the High Minimum Lake Level for Middle Lake and water surface elevations equaled or exceeded ten percent of the time (P10) over the last five 10-year periods.

10-year Period			HMLL Equaled or Exceeded ?	Feet P10 is above (+) or below (-) HMLL
January 1994	through	December 2003	Yes	+3.0
January 1993	through	December 2002	Yes	+3.3
January 1992	through	December 2001	Yes	+3.5
January 1991	through	December 2000	Yes	+3.3
February 1990	through	December 1999	Yes	+3.4

Comparison of the Minimum Lake Levels with Lake Basin Features

The elevations of various man-made features within the immediate Middle Lake basin were determined to evaluate the potential for flooding when the lake surface is at the proposed High Minimum Lake Level. Based on review of available one-foot contour interval aerial maps for the region and field survey data collected in July 2003 and October 2004, the proposed High Minimum Lake Level is 12.6 ft below the threshold of the lowest residential dwelling (mobile home) within the lakeshore area, 11.3 ft below the slab of the mobile home car port, 2.0 ft below the lowest residential dwelling along the lakeshore of Hancock Lake, and 2.8 ft below the lowest road located between Hancock Lake and Middle Lake. The bottom edge of the Albert H. Pless public boat ramp on Middle Lake is 5.5 ft below the Minimum Lake Level (Table 7).

Table 7. Elevations of lake basin features surrounding Middle Lake.

Lake Basin Features	Elevation (feet above NGVD)
Low Floor (mobile home threshold)	115.8
Low Other (car port slab)	114.5
Low Floor stab (house on Hancock Lake)	105.2
Low Road (between Hancock and Middle Lakes)	106.0
Bottom edge of public boat ramp	94.7

Figure 4. Surface water elevations through December 2003 for Middle Lake.

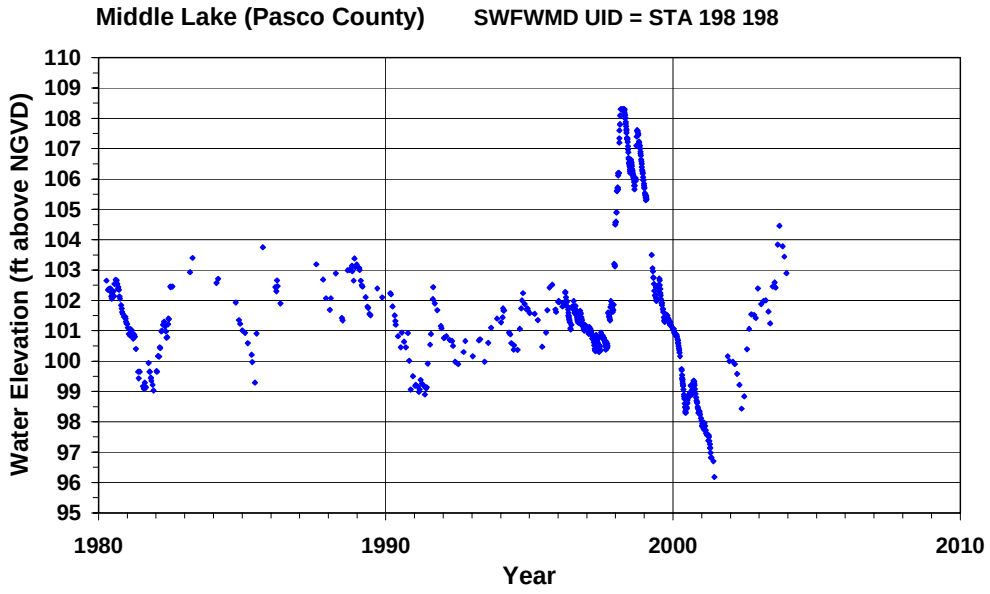


Figure 5. Mean monthly surface water elevations through December 2003, and proposed Guidance and Minimum Levels for Middle Lake. Proposed levels include the Ten-Year Flood Guidance Level (10-YR), High Guidance Level (HGL), Low Guidance Level (LGL), High Minimum Lake Level (HMLL), and Minimum Lake Level (MLL).

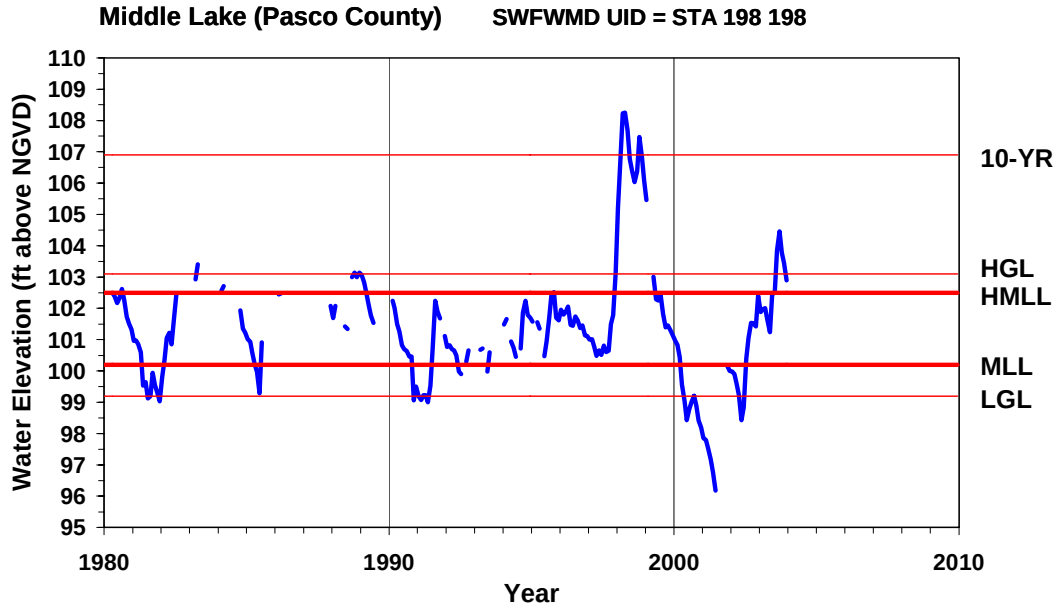
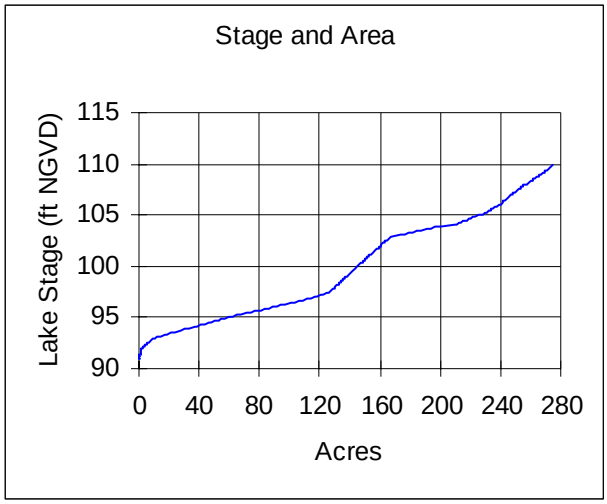
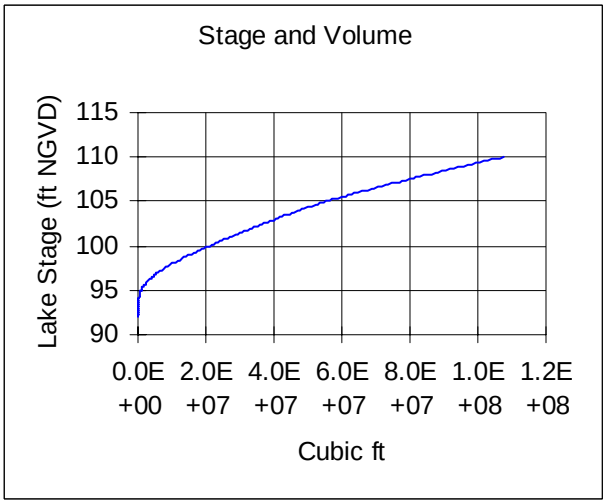
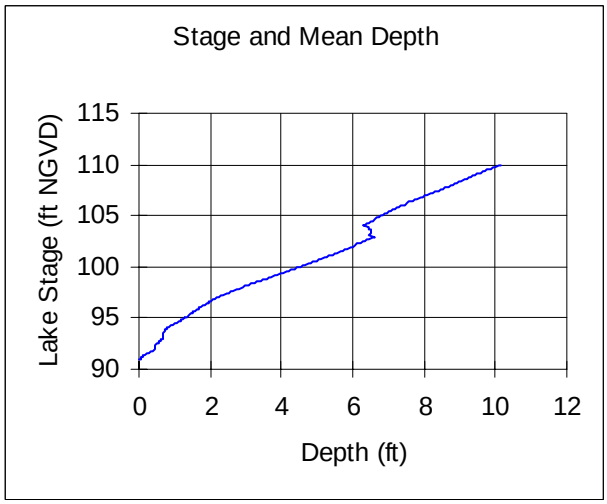
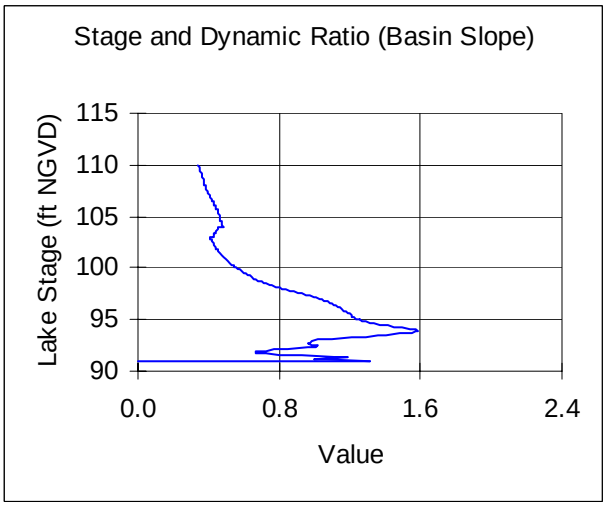


Figure 6. Surface area, volume, mean depth, dynamic ratio (basin slope), and potential herbaceous wetland area versus lake stage for Middle Lake.









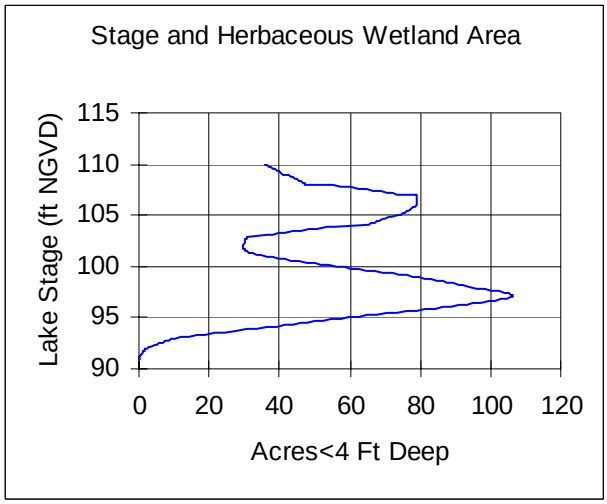
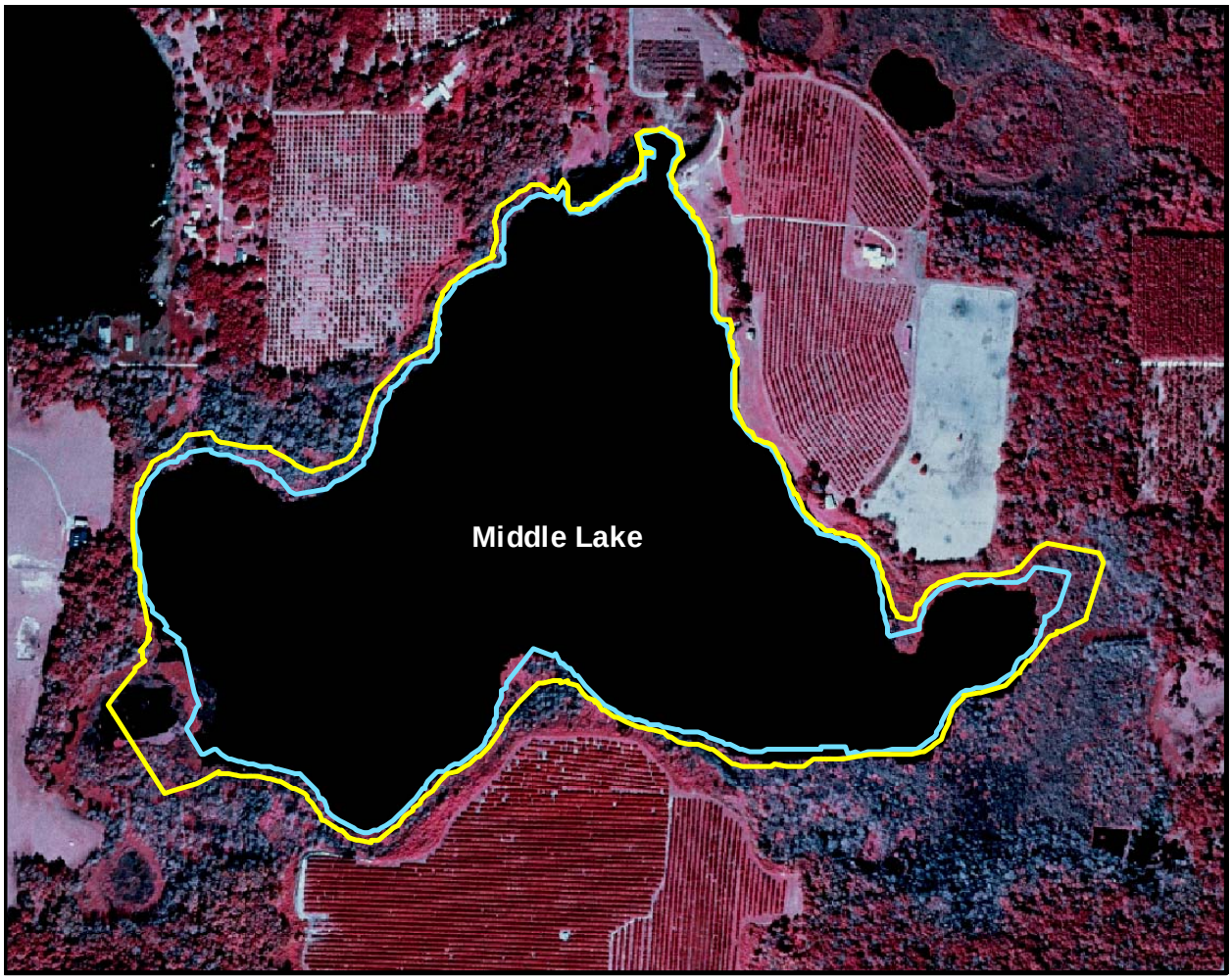


Figure 7. Approximate location of the proposed Minimum Lake Level (MLL) and High Minimum Lake Level (HMLL) for Middle Lake.



Legend

Middle Minimum Levels

100.2 ft above NGVD = MLL

102.5 ft above NGVD = HMLL

N
W E
S

Map prepared using 1999 USGS digital orthophotography, elevation data from 1987 SWFWMD aerial photography with contours map (Sheet Nos. 04-24-20, 05-24-20, 08-24-20 and 09-24-20), and elevation data collected on July 1, 2004 by D.C. Johnson & Associates, Inc.

0 500 1,000 2,000
Feet

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