

Minimum and Guidance Levels for Lake Virginia in Hillsborough County, Florida



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Draft

Ecologic Evaluation Section
Resource Conservation and Development Department



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Southwest Florida Water Management District
Brooksville, Florida 34604-6899

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On the cover: Aerial photograph of Lake Virginia in 2004. Image is from United States Geological Survey digital orthophotography (USGS 2004).

Proposed Minimum and Guidance Levels for Lake Virginia

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 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; and j) 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 or levels for lakes, wetlands, rivers and aquifers, and adopted them into its Water Level 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 greater than 0.5 acre in size, and for those without fringing cypress wetlands. 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 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, lakeshore 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 lakeshore 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 lakeshore 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 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 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 on a long-term basis.
- The Low Guidance Level is provided as an advisory guideline for water dependent structures, information for lakeshore 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 on a long-term basis.

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

Table 1. Proposed minimum and guidance levels for Lake Virginia in Hillsborough County, Florida.

Level	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	63.1
High Guidance Level	61.8
High Minimum Lake Level	61.8
Minimum Lake Level	60.7
Low Guidance Level	59.7

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

Lake Setting and Description

Lake Virginia (Figure 1) is located in the Rocky/Brushy Creek watershed in the Northwest Hillsborough River Basin of the Southwest Florida Water Management District in Hillsborough County, Florida (Section 3, Township 27 South, Range 18 East). White (1970) classified the area of west-central Florida containing Lake Virginia as the Northern Gulf Coastal Lowlands physiographic region. Brooks (1981) characterized the area surrounding the lake as the Land-O-Lakes subdivision of the Tampa Plain in the Ocala Uplift Physiographic District, and described the subdivision as 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 Land-O-Lakes lake region, and described as an area of numerous neutral to slightly alkaline, low to moderate nutrient, clear-water lakes (Griffith *et al.* 1997).

Most of the immediate Lake Virginia basin has been cleared for residential development or livestock grazing (Figure 2; also refer to the cover of this report). The lake is contiguous with a cypress-dominated wetland along the southern lakeshore, and contains diverse stands of aquatic macrophytes and other hydrophytes, including torpedograss (*Panicum repens*), cattail (*Typha* sp.), maidencaine (*Panicum hemitomon*), pennywort (*Hydrocotyle umbellata*), primrose willow (*Ludwigia* sp.), willow (*Salix* sp.), red maple (*Acer rubrum*), and wax myrtle (*Myrica cerifera*). Public access to the shoreline is not available.

Lake Virginia receives inflow from Lake Harvey to the north and at times, from Lake Allen to the south (Figure 2). The lake discharges to the west through a ditch to a dredged wetland system known locally as Sun Lake when water levels in the lake exceed about 60.5 ft above NGVD (Figures 2 and 3). Water from Lake Virginia may also flow to Lake Allen, through a dredged canal, and ultimately to the Sun Lake wetland system through a ditch/culvert system along the northwest shore of Lake Allen. At higher lake stages, the canals connecting Lakes Harvey, Virginia and Allen allow the lake surfaces to equalize. There are currently no District-permitted surface water withdrawals from Lake Virginia, Harvey, Lake Harvey or Lake Allen.

The "Gazetteer of Florida Lakes" (Shafer *et al.* 1986) lists a water surface elevation of 60 feet above NGVD for Lake Virginia. The 1943, 1974 and 1987 (photorevised) United States Geological Survey 1:24,000 Lutz quadrangle maps do not include an elevation for the lake surface. A topographic map of the Lake Virginia basin that was generated to support of minimum levels development (Figure 4) indicates that the lake extends over 22 acres when the water surface is at 60 feet above NGVD.

Figure 1. Location of Lake Virginia in Hillsborough County, Florida.

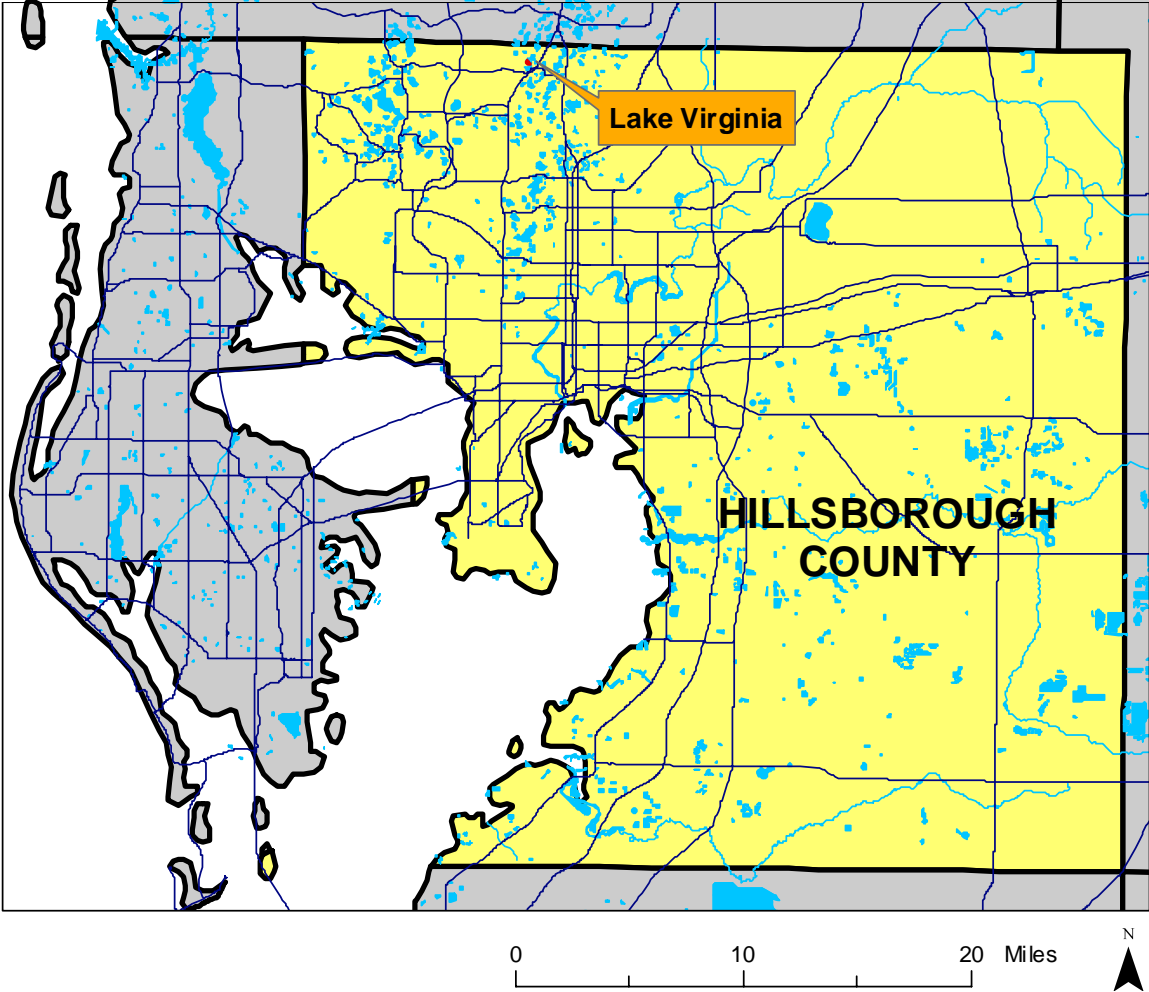
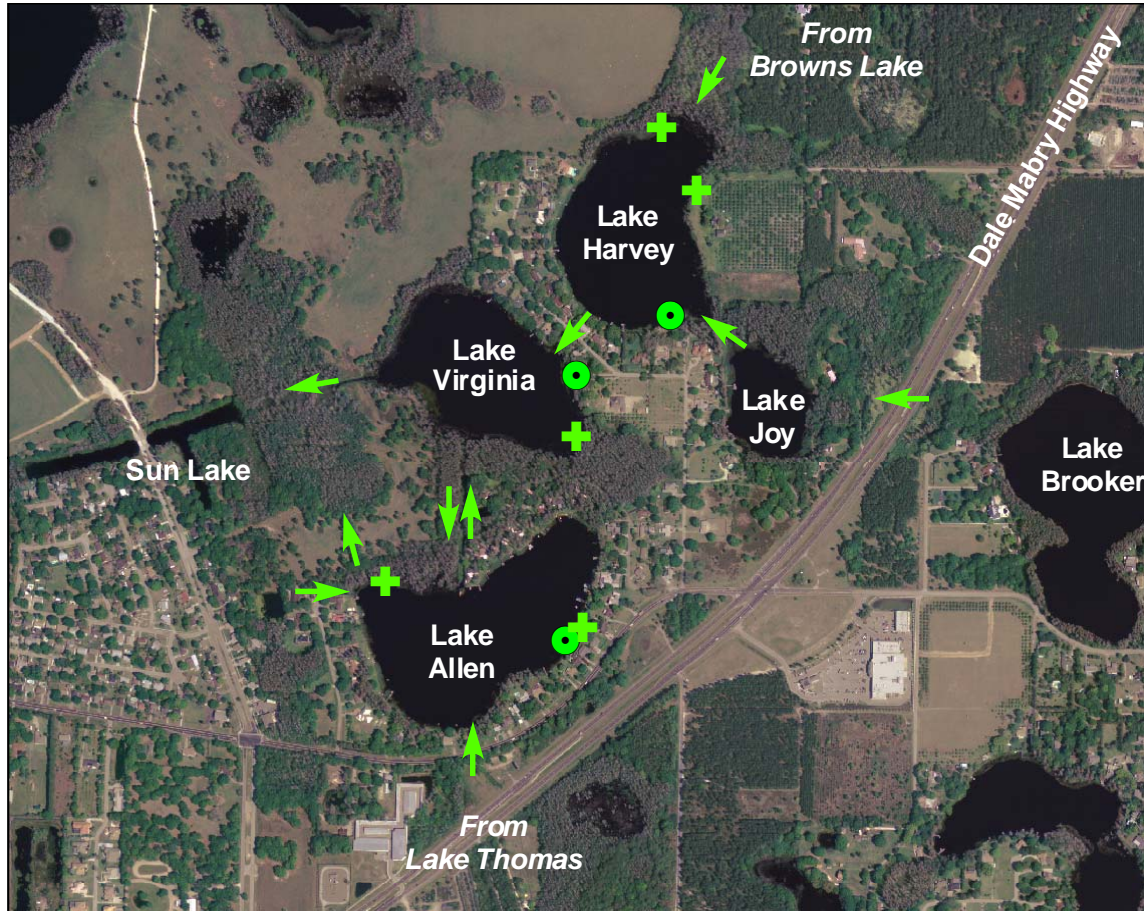





Figure 2. Location of District lake-level gauges, inlets, outlets and sites where hydrologic indicators were measured at Lakes Virginia, Harvey and Allen.



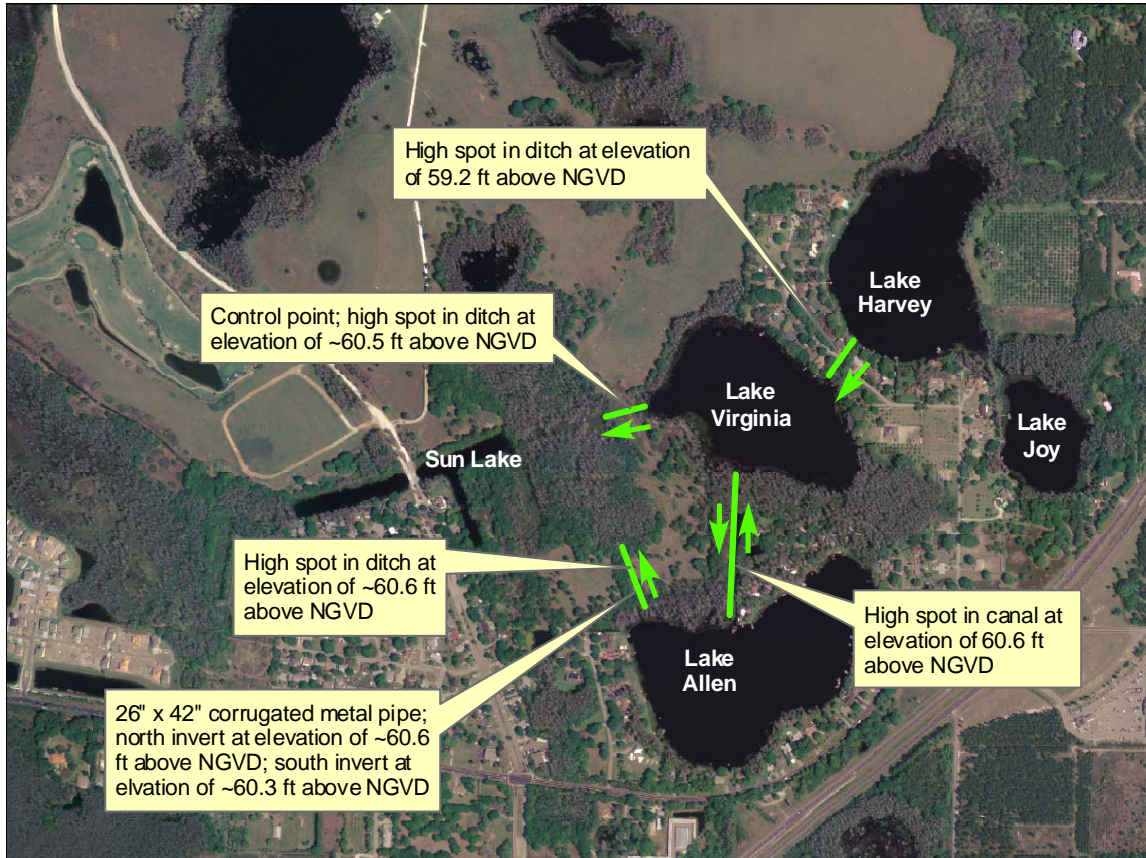
-  Lake gauges
-  Inlets/Outlets
-  Hydrologic Indicators

0 500 1,000 Feet



Map created October 11, 2005 using 2004 USGS Digital Orthophoto graphy.

Figure 3. Inlet and outlet conveyance system for Lake Virginia. Ditched flow paths are shown as green lines; arrows indicate flow direction.

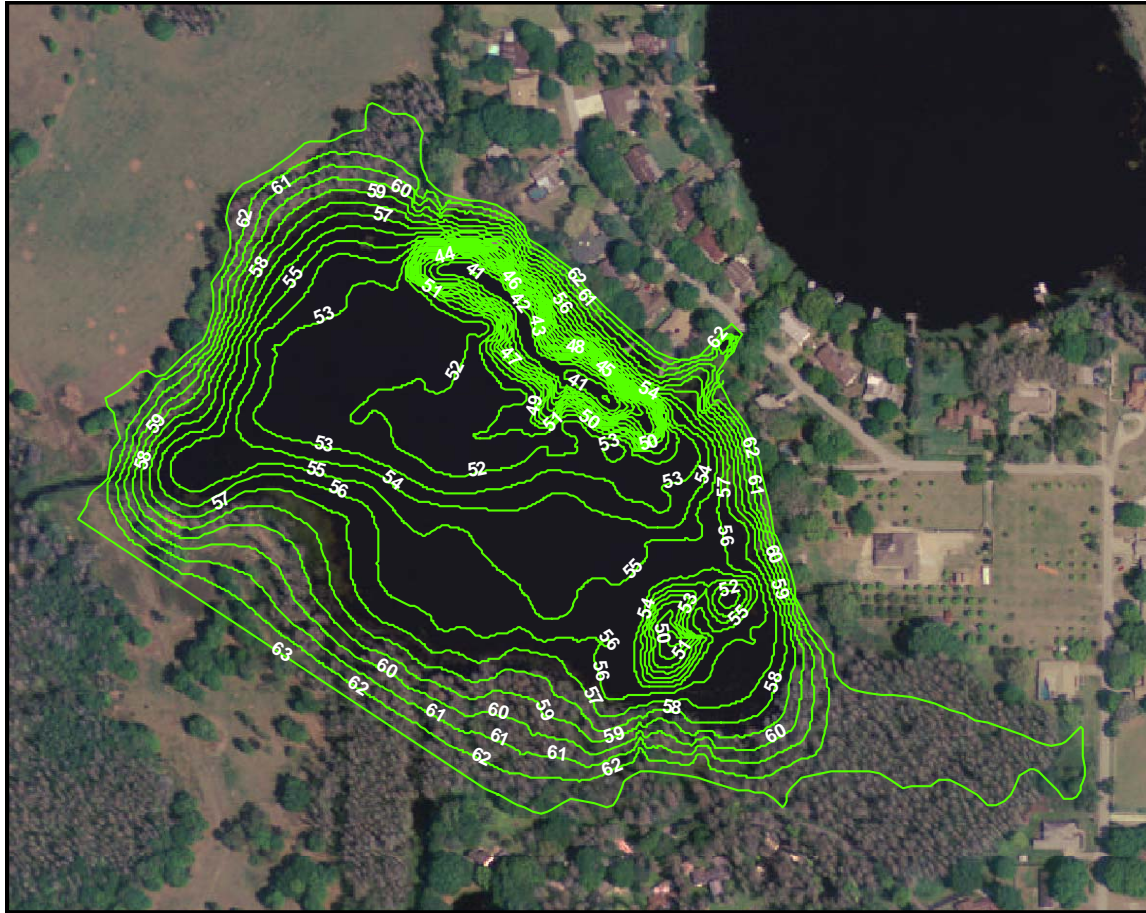


Map prepared October 11, 2005 using 2004 USGS Digital Orthophotography, elevation data collected in June 2003 by SWFWMD staff, and elevation data prepared in March 2004 by PBS&J for the Hillsborough County Public Works Department.

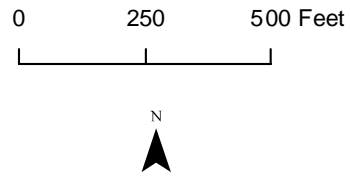
0 500 1,000 Feet



Figure 4. One-foot contours within the Lake Virginia basin. Values shown are elevations, expressed as feet above the National Geodetic Vertical Datum of 1929.



Map prepared October 11, 2005 using 2004 USGS digital orthophotography, elevation data from 1989 SWFWMD aerial photography with contours maps (Sheet No. 3-27-18), and elevation data collected by SWFWMD staff on June 26 and August 7, 2003.



Currently Adopted Guidance Levels

The Southwest Florida Water Management 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 establishing 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 1970s (see SWFWMD 1996), the District Governing Board adopted management levels (currently referred to as Guidance Levels) for Lake Virginia in September 1980 (Table 2) and incorporated the levels into Chapter 40D-8, F.A.C. A Maximum Desirable Level of 62.25 feet above NGVD was also developed, but was not adopted by the Governing Board. The adopted Guidance Levels and the 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. Upon adoption by the District Governing Board, Minimum and Guidance Levels developed using current methods will replace the existing Guidance Levels.

Annually since 1991, a list of stressed lakes has been developed to support the District's consumptive water use permitting program. As described in the District's Consumptive Use of Water Rule (Chapter 40D-2, F.A.C.), "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, the evaluation of stressed condition is conducted on a case-by-case basis. Lake Virginia is not included on the current Stressed Lakes List (Gant *et al.* 2005), although the lake has previously been classified as a stressed lake.

Table 2. Currently adopted guidance levels and associated water-surface areas for Lake Virginia.

Level	Elevation (feet above NGVD)	Lake Area (acres)
Ten Year Flood Guidance Level	63.00	29
High Level	62.50	27
Low Level	60.25	26
Extreme Low Level	58.00	18

Development of Proposed Minimum and Guidance Levels

Proposed Minimum and Guidance Levels were developed for Lake Virginia using the methodology for Category 1 Lakes described in current District Rules (Chapter 40D-8, F.A.C.). Proposed levels and additional information are listed in Table 3, along with lake surface area values. Detailed descriptions of the development and use of these data are summarized in subsequent sections of this report.

Table 3. Proposed Minimum and Guidance Levels, lake stage percentiles, normal pool, control point elevation, Historic P50, significant change standards and associated surface areas for Lake Virginia.

Level or Feature	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Percentiles		
Current P10	61.6	25
Current P50	59.5	21
Current P90	56.7	15
Surrogate Current P10	61.8	25
Surrogate Current P50	60.4	22
Surrogate Current P90	57.8	17
Other Levels		
Normal Pool	62.5	26
Control Point	60.5	22
Guidance Levels and Historic P50		
Ten Year Flood Guidance Level	63.1	NA
High Guidance Level	61.8	25
Historic P50	60.8	23
Low Guidance Level	59.7	21
Significant Change Standards		
Cypress Standard	60.7	23
*Connectivity Standard	62.3	26
*Aesthetic Standard	59.7	21
*Species Richness Standard	59.0	20
*Dock-Use Standard	NA	NA
*Recreation/Ski Standard	NA	NA
*Mixing Standard	NA	NA
Minimum Levels		
High Minimum Lake Level	61.8	25
Minimum Lake Level	60.7	23

NA = not available or not applicable

* = Developed for comparative purposes only; not used for minimum levels establishment

Lake Stage Data and Percentiles

Lake stage data, *i.e.*, surface water elevations for Lake Virginia (District Universal Identification Number STA 50 50) are available from the District's Water Management Database from September 1977 and January 1988 through the present date (Figure 6, see Figure 2 for current location of the District lake water level gauge in Lake Virginia). The highest surface elevation for the lake included in the database, 63.88 feet above NGVD, occurred on December 15, 1997. The low of record, 53.3 feet above NGVD, occurred on May 28, 2002.

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. In the context of minimum levels development, "structural alterations" means man's physical alteration of the control point (*i.e.*, the highest stable point along the outlet conveyance system of a lake), to the degree that water level fluctuations are affected. 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.

Based on water-use estimates and analysis of lake stage and regional ground water fluctuations, hydrologic data collected prior to 1963 for many lakes in the vicinity of Lake Virginia may be classified as Historic data, and data collected after 1973 may be classified as Current Data. Using these criteria, hydrologic data for Lake Virginia that were collected from January 1974 through the present date were classified as Current data.

Monthly mean water surface elevations, based on Current data collected through May 2005, were used to calculate the Current P10, P50, and P90 elevations. The Current P10 elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the current period, was 61.6 feet above NGVD. The Current P50 elevation, the elevation the lake water surface equaled or exceeded fifty percent of the time during the current period, was 59.5 feet above NGVD. The Current P90 elevation, the elevation the lake water surface equaled or exceeded ninety percent of the time during the current period, was 56.7 feet above NGVD.

Because minimum levels are to be developed using the best available information, surrogate Current P10, P50 and P90 elevations were calculated for Lake Virginia to better characterize water level fluctuations in the basin. The surrogate statistics were developed using the period of record stage data for Lakes Allen and Harvey. These data were utilized since the period of record for the Lakes Allen and Harvey stage data exceeds that of Lake Virginia by fourteen years (see Figures 6 through 8), and because water levels in the three basins are equalized by interconnecting canals. The surrogate statistics for Lake Virginia were developed by averaging the Current P10, Current P50, or Current P90 values for Lakes Harvey and Allen. The resulting surrogate Current P10, P50 and P90 were 61.8, 60.4 and 57.8 feet above NGVD.

Figure 6. Surface water elevations of Lake Virginia through May 2005.

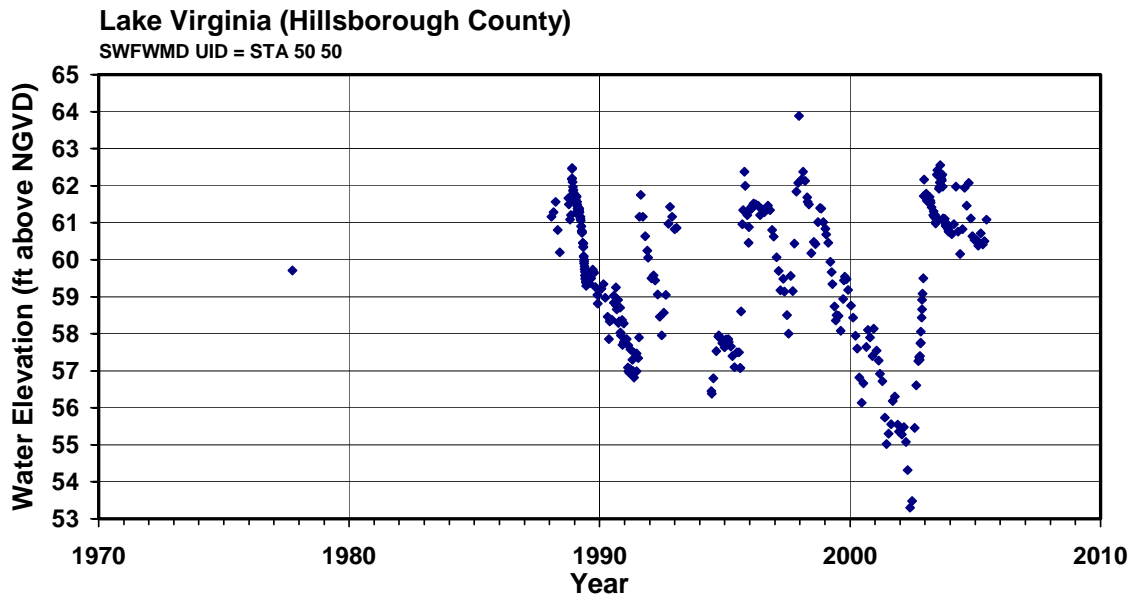


Figure 7. Surface water elevations of Lake Harvey through June 2005.

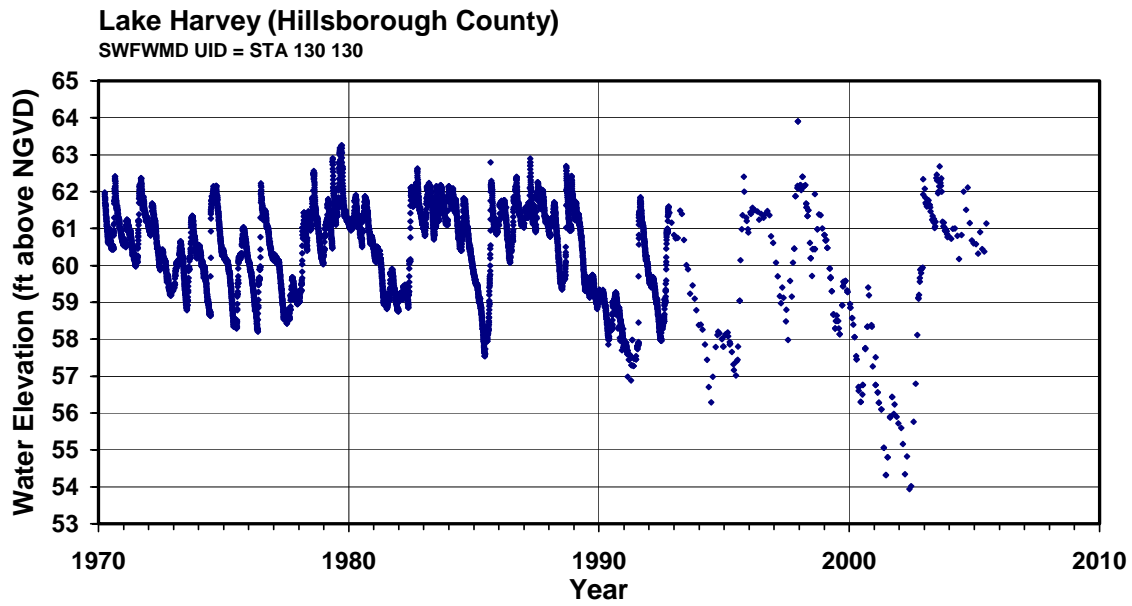
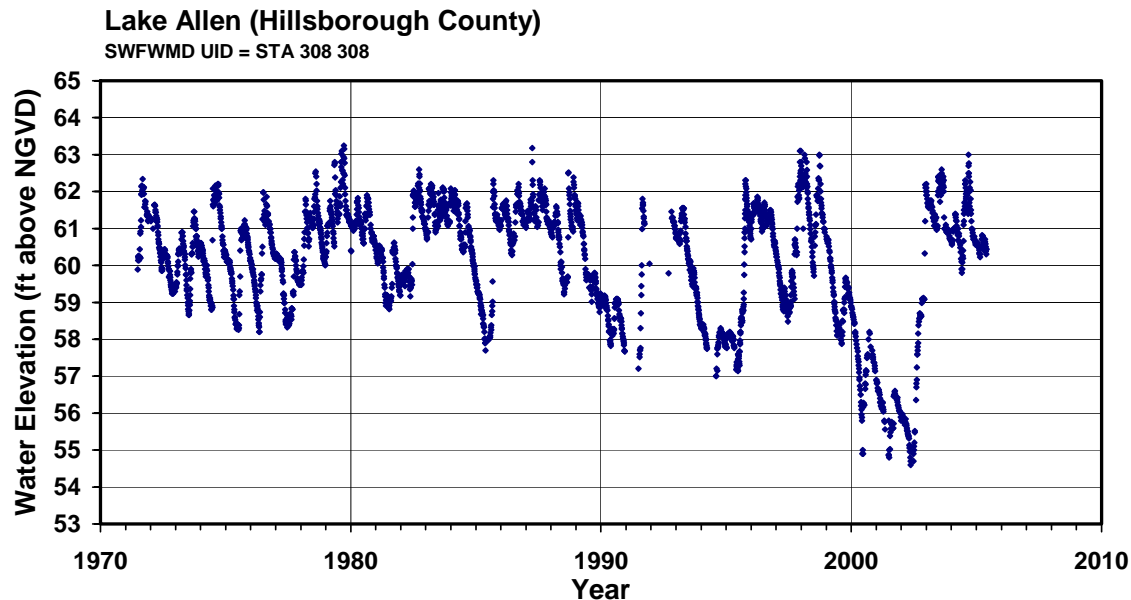


Figure 8. Surface water elevations of Lake Allen through May 2005.



Normal Pool, Control Point Elevation and Determination of Structural Alteration Status

The Normal Pool elevation, a reference elevation used for development of minimum lake and wetland levels, is established using elevation of Hydrologic Indicators of sustained inundation, including biological and physical features. Based on elevations associated with the buttressing of cypress trees (*Taxodium* sp.) along the shores of Lake Virginia, Lake Harvey and Lake Allen (Table 4, Figure 2), the Normal Pool elevation was established at 62.5 feet above NGVD. Measurements for trees from the three lake basins were used to determine the Normal Pool elevation, because water levels in the basins are equalized by flow through the canals that interconnect the lakes.

The Control Point elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system (e.g., weir, ditch, culvert) that is the principal control of lake water level fluctuations. The control point elevation was established at 60.5 ft above NGVD, based on the ground elevation at a high spot in the ditch that conveys flow from the west shore of Lake Virginia to a wetland area between the lake and a dredged stormwater system known as Sun Lake (Figure 3). Based on the existence of this outlet, Lake Virginia was classified as an open basin lake, *i.e.*, a system that is part of an ordered surface water conveyance system.

Structural alteration status is determined to support development of the High Guidance Level. Based on the existence of the outlet to the Sun Lake wetland system and a

Control Point elevation that is lower than the Normal Pool elevation, Lake Virginia is considered to be structurally altered.

Table 4. Summary statistics for hydrologic indicator data (cypress buttress inflection points) used to establish the normal pool elevation for Lake Virginia. Buttresses of trees along the shores of Lakes Virginia, Harvey and Allen were measured by SWFWMD staff in September 2002, July 2003 and August 2003.

Statistic	Statistic Value (N) or Elevation (feet above NGVD)
N	30
Mean (Standard Deviation)	62.5 (0.6)
Median	62.5
Minimum	60.2
Maximum	64.2

Proposed Guidance Levels, the Historic P50 and Reference Lake Water Regime Statistics

The Ten Year Flood Guidance Level is provided as an advisory guideline for lakeshore development and 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 proposed Ten Year Flood Guidance Level for Lake Virginia was established at 63.1 feet above NGVD using the methodology for closed basin lakes described in current District Rules (Chapter 40D-8, F.A.C). Although Lake Virginia has an outlet and was classified as an open basin lake, the closed-basin approach was considered appropriate because peak flood elevations within the basin are influenced more by long-term rainfall and evaporation patterns than single storm events. For the analysis, the long-term gauging record of Lake Allen was used to assess flooding potential. Flood frequency elevation estimates were based on probability analysis of annual peak stages recorded for a thirty-four year period between 1971 and 2004.

The High Guidance Level is provided as an advisory guideline for construction of lakeshore development, water dependent structures, and operation of water management structures. The High Guidance Level is the expected Historic P10 of the lake, and is established at the Historic P10, the Current P10, the control point, or the normal pool elevation. Because only Current data are available for Lake Virginia, Harvey and Allen system, and because Lake Virginia is structurally altered, the proposed High Guidance Level was established at 61.8 feet above NGVD, the higher of the Current P10 (surrogate Current P10) or Control Point elevations.

The Historic P50 elevation is the elevation that the lake surface is expected to equal or exceed fifty percent of the time on a long-term basis. The level 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 statistics are necessary when adequate Historic or Current data are not available. Reference lake water regime statistics represent differences between P10, P50 and P90 elevations for typical, regional lakes that exhibit little or no impacts associated with water withdrawals (*i.e.*, reference lakes). The statistics include the RLWR50, RLWR90 and RLWR5090, which are, respectively, median differences between P10 and P50, P50 and P90, and P10 and P90 percentiles for the set of reference lakes. For the northern Tampa Bay area, RLWR50, RLWR90 and RLWR5090 statistics have been established at 1.0, 2.1 and 1.1 feet, respectively (SWFWMD 1999, Leeper *et. al* 2001).

Because Historic data are not available for Lake Virginia, and the difference between the surrogate Current P10 and surrogate Current P50 (1.4 feet) is greater than the northern Tampa Bay area RLWR50 (1.0 feet), the Historic P50 was established at 60.8 feet above NGVD by subtracting the RLWR50 from the High Guidance Level.

The Low Guidance Level is provided as an advisory guideline for water dependent structures, information for lakeshore 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 on a long-term basis, and is established using Historic or Current data and, in some cases, reference lake water regime statistics. Because Historic data are not available for Lake Virginia and the difference between the surrogate Current P10 and surrogate Current P90 (3.9 feet) exceeds the northern Tampa Bay RLWR90 (2.1 feet), the proposed Low Guidance Level was established at 59.7 feet above NGVD by subtracting the RLWR90 from the High Guidance Level.

Lake Classification

Lakes are classified as Category 1, 2 or 3 for the purpose of Minimum Levels development. Those with fringing cypress wetlands greater than 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 the elevation 1.8 feet 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 feet below the Normal Pool elevation are classified as Category 2 lakes. Lakes without fringing cypress wetlands or with cypress-dominated wetlands less than 0.5 acres in size are classified as Category 3 lakes.

Based on the occurrence of lake-fringing cypress wetlands within the basin, and a 1.7 foot difference between the Normal Pool elevation (62.5 feet above NGVD) and the Historic P50 (60.8 feet above NGVD), Lake Virginia was classified as a Category 1 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 identify thresholds for preventing significant harm to cultural and natural system values associated with lake ecosystems, in accordance with guidance provided in the Florida Water Resources Implementation Rule (Chapter 62-40.473, F.A.C.). Other information taken into consideration for Minimum Levels development includes potential changes in the coverage of herbaceous wetland and submersed aquatic plants.

For Category 1 or 2 lakes, a significant change standard is established at the elevation 1.8 feet below the Normal Pool elevation. This standard, referred to in this report as the Cypress Standard, is used to identify a desired median lake stage that may be expected to preserve the ecological integrity of lake-fringing cypress wetlands. For Lake Virginia, the Cypress Standard was established at 60.7 feet above NGVD.

For Category 3 lakes, six significant change standards are developed, including a Basin Connectivity Standard, a Dock-Use Standard, an Aesthetics Standard, a Species Richness Standard, a Recreation/Ski Standard, and a Lake Mixing 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 are also taken into consideration. Although Lake Virginia is a Category 1 Lake, Category 3 standards were developed for comparative purposes, but were not used to establish proposed Minimum Levels.

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 lake-use. The standard is based on the elevation of lake sediments at a critical high spot between lake basins or lake sub-basins, sufficient water depths 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. The Basin Connectivity Standard was established at 62.3 feet above NGVD, based on the elevation that ensures connectivity between Lake Harvey and Lake Virginia (59.2 feet above NGVD), a two-foot water depth for movement of biota and watercraft, and the Northern Tampa Bay area RLWR5090 (1.1 feet).

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 two-foot water depth for boat

mooring, and use of Historic lake stage data or region-specific reference lake water regime statistics. Elevations associated with existing docks were not obtained as part of the data collection effort for Lake Virginia, so a Dock-Use Standard was not developed.

The Aesthetics Standard is developed to protect aesthetic values associated with the inundation of lake basins. The standard is intended to protect aesthetic values associated with the median lake stage from degrading below the values associated with the lake when it is staged at the Low Guidance Level. For Lake Virginia, the Aesthetic Standard was established at the Low Guidance Level, 59.7 feet 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 a lake, the standard is established at the lowest elevation associated with less than a fifteen percent reduction in lake surface area relative to the lake area at the Historic P50 elevation. For Lake Virginia, the Species Richness Standard was established at 59.0 feet above NGVD.

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 feet, or a rectangular ski area with a width of 200 feet and a length of 2,000 feet, and use of Historic lake stage data or region-specific reference lake water regime statistics. Based on the morphology of the Lake Virginia basin, development of Recreation/Ski Standard would not be appropriate.

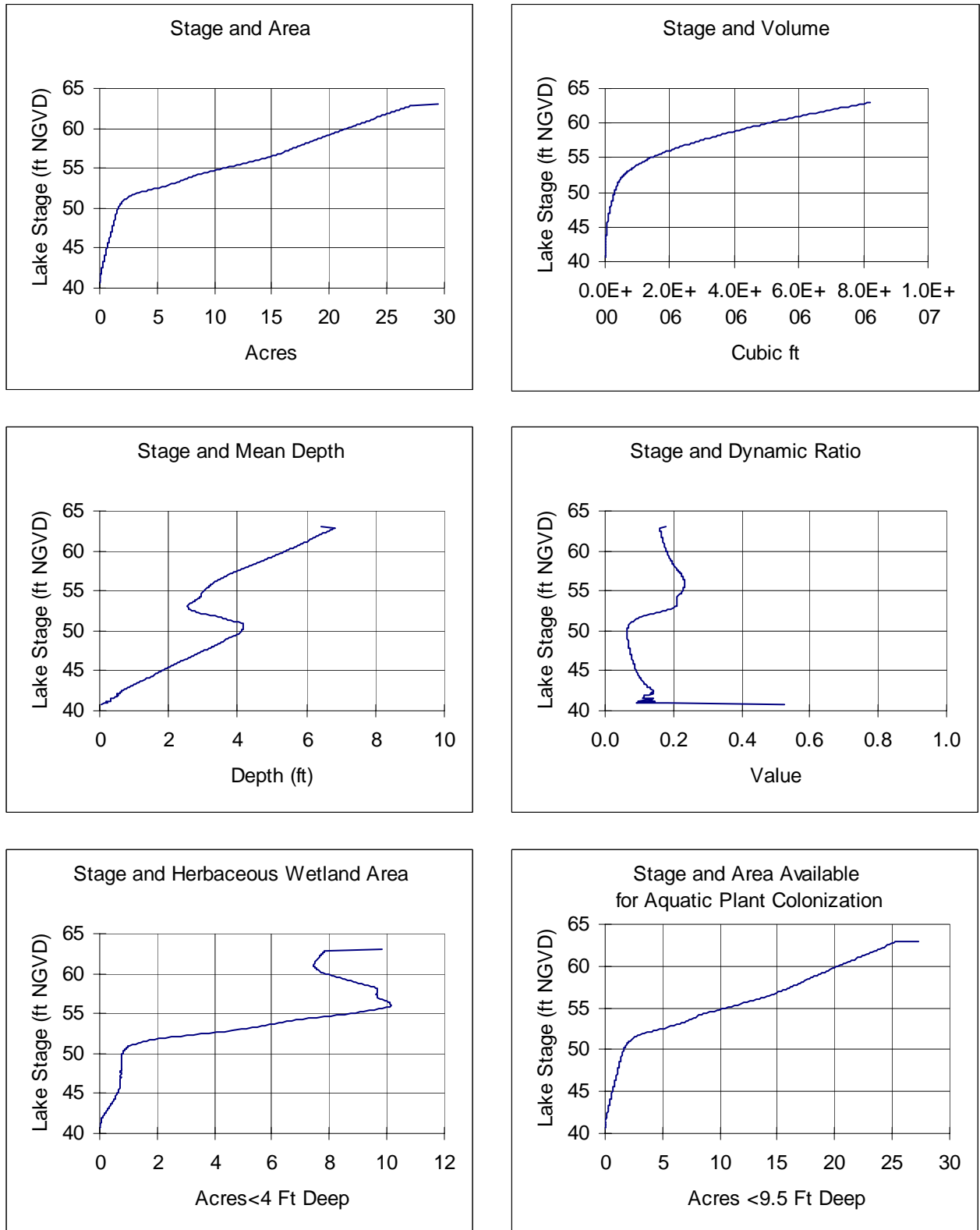
The Lake Mixing Standard is developed to prevent significant changes in patterns of wind-driven mixing of the lake water column and sediment resuspension. The standard is established at the highest elevation at or below the Historic P50 elevation where the dynamic ratio (see Bachmann *et al.* 2000) shifts from a value of <0.8 to a value >0.8 , or from a value >0.8 to a value of <0.8 . Because the dynamic ratio does not shift across the 0.8 threshold as the stage of Lake Virginia changes from approximately 41 to 63 feet above NGVD (Figure 9), a Mixing Standard was not developed for the lake.

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 of four or less feet). Review of changes in potential herbaceous wetland area in relation to change in lake stage did not indicate that use of the applicable significant change standards would be inappropriate for establishment of the Minimum Lake Level (Figure 9).

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. Review of changes in potential submersed macrophyte coverage in relation to change in lake stage did not

indicate that of use of the applicable significant change standards would be inappropriate for establishment of the Minimum Lake Level (Figure 9).

Figure 9. Surface area, volume, mean depth, dynamic ratio (basin slope), potential herbaceous wetland area, and area available for colonization by aquatic macrophytes versus lake stage for Lake Virginia



Proposed Minimum Levels

The High Minimum Lake Level and the Minimum Lake Level are developed using lake-specific significant change standards 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, irrigation); surrounding land-uses; socio-economic effects; and public health, safety and welfare matters. Minimum Level development is also contingent upon lake classification, *i.e.*, whether a lake is classified as a Category 1, 2 or 3 Lake.

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. For Category 1 Lakes, the Minimum Level is established at an elevation 1.8 feet below the Normal Pool elevation, *i.e.*, at the Cypress Standard elevation. For Lake Virginia, the proposed Minimum Lake Level was established at 60.7 feet above NGVD.

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. For Category 1 lakes, the High Minimum Lake Level is established at an elevation 0.4 feet below the Normal Pool elevation. For Lake Allen, the High Minimum Lake level would, therefore, be established at 62.1 feet above NGVD.

Elevations of various man-made features within the Lake Virginia, Lake Allen and Lake Harvey basins were evaluated to determine the potential for flooding when water levels in the lakes equal or exceed 62.1 feet above NGVD. Based on review of 1983 one-foot contour interval aerial maps for the region and field survey data collected in 2003 and 2004, it was determined that the lowest floor slab in the Lake Allen basin occurs at 63.1 feet above NGVD (Table 5). It was also determined that a portion of the road located between Lake Virginia and Lake Allen is at an elevation of 62.3 feet above NGVD, only 0.2 feet above the potential High Minimum Lake Level. Hillsborough County Department of Public Works staff note that flooding complaints have been received from residents living along the shore of Lake Allen when the lake is staged above 62.0 feet above NGVD.

Based on potential flooding associated with the staging of Lakes Virginia, Harvey and Allen at a High Minimum Lake Level of 62.1 feet above NGVD and consideration of structural alterations to the lake system outlets, an alternate High Minimum Lake Level was developed for the lake system. The alternate, proposed High Minimum Lake Level was established at 61.8 feet above NGVD, an elevation corresponding to the proposed High Guidance Level. This alternative level would be expected to mitigate flooding potential expected when the lakes stage above 62 feet above NGVD and maintain the health of cypress-dominated wetlands within the system. Mean monthly water surface elevations and the proposed Minimum and Guidance Levels for Lake Virginia are shown

in Figure 10. The approximate locations of the proposed Minimum Lake Level and High Minimum Lake Level in the Lake Virginia basin are shown in Figure 11.

Table 5. Elevations of selected features in the basins of Lakes Virginia, Harvey, and Allen.

Features (Lake Basin)	Elevation (feet above NGVD)
Low Floor Slab (Lake Harvey basin)	64.1
Low Floor Slab (Lake Allen basin)	63.1
Low Swimming Pool slab (Lake Harvey basin)	64.4
Low Road (Lake Harvey basin)	65.5
Low Road (Lake Allen basin)	62.3

Figure 10. Mean monthly surface water elevations through May 2005 and proposed guidance and minimum levels for Lake Virginia. 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.

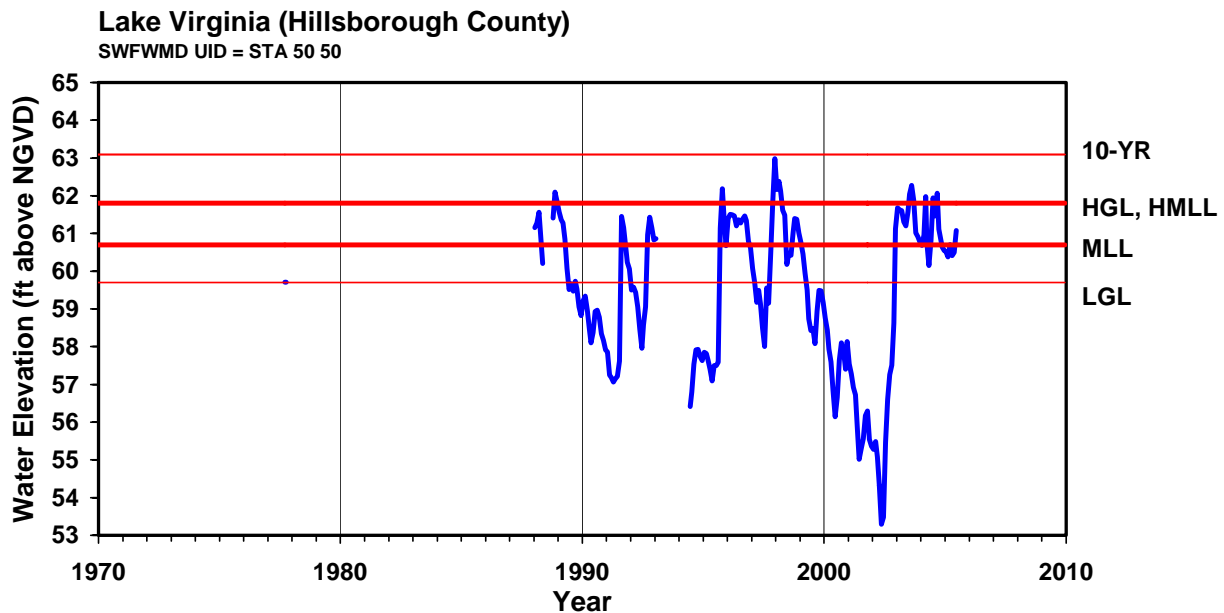
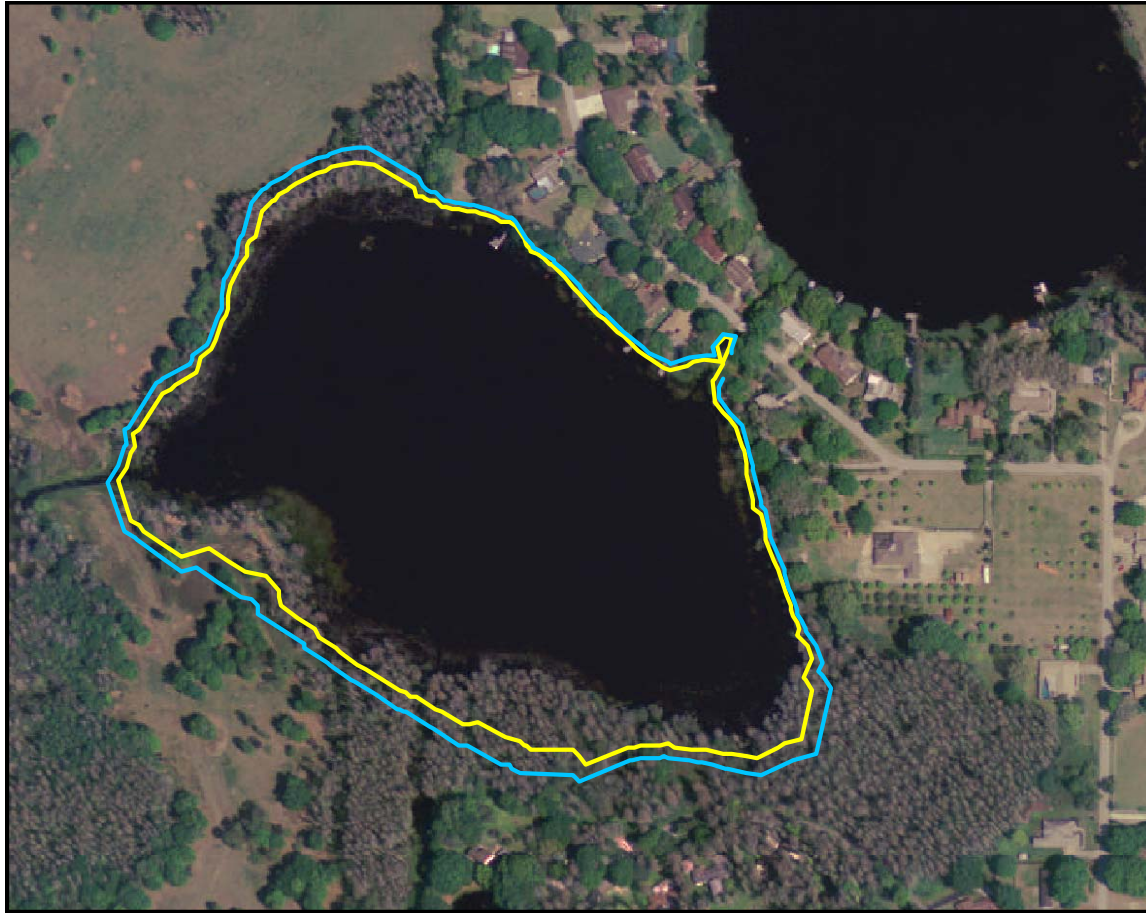


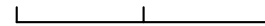
Figure 11. Approximate location of the proposed Minimum Lake Level (MLL) and proposed High Minimum Lake Level (HMLL) for Lake Virginia.



Minimum Level Contours

- MLL = 60.7 ft above NGVD
- HMLL = 61.8 ft above NGVD

0 250 500 Feet



Map prepared October 11, 2005 using 2004 USGS digital orthophotography, elevation data from 1989 SWFWMD aerial photography with contours maps (Sheet No. 3-27-18), and elevation data collected by SWFWMD staff on June 26 and August 7, 2003.

Comparison of Proposed Minimum Levels to Long-Term Percent Exceedance Statistics

The Minimum Lake Level is the elevation that the lake's water levels are required to equal or exceed fifty percent of the time on a long-term basis. For the last six long-term (ten-year) periods, water surface elevations equaled or exceeded fifty percent of the time (P50) in the Lake Virginia basin have been below the proposed Minimum Lake Level (Table 6).

Table 6. Comparisons between the water surface elevations equaled or exceeded fifty percent of the time (P50) over the last six 10-year periods and the proposed Minimum Lake Level (MLL) for Lake Virginia.

Ten-year Period	MLL Equaled or Exceeded by Ten-Year P50?	Feet P50 is above (+) or below (-) MLL
January 1995 through December 2004	No	-0.9
January 1994 through December 2003	No	-1.6
January 1993 through December 2002	No	-2.2
January 1992 through December 2001	No	-1.6
January 1991 through December 2000	No	-1.2
January 1990 through December 1999	No	-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. For the last six long-term (ten-year) periods, water surface elevations equaled or exceeded ten percent of the time (P10) in the Lake Virginia basin have been below the proposed, alternative High Minimum Lake Level (Table 7).

Table 7. Comparisons between the water surface elevations equaled or exceeded ten percent of the time (P10) over the last six 10-year periods and the proposed alternative High Minimum Lake Level (HMLL) for Lake Virginia.

Ten-year Period	HMLL Equaled or Exceeded by Ten Year P10?	Feet P10 is above (+) or below (-) HMLL
January 1995 through December 2004	No	-0.1
January 1994 through December 2003	No	-0.2
January 1993 through December 2002	No	-0.3
January 1992 through December 2001	No	-0.3
January 1991 through December 2000	No	-0.3
January 1990 through December 1999	No	-0.3

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