Adopted Minimum and Guidance Levels for Lake Hooker in Hillsborough County, Florida

August 28, 2012

Ecologic Evaluation and Hydrologic Evaluation Sections
Resource Projects Department

Southwest Florida
Water Management District

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Cover: View of Lake Hooker, March 2011.

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Minimum and Guidance Levels for Lake Hooker

Section 373.042, Florida Statutes (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. Section 373.042(1)(a), F.S., states that the minimum flow for a given watercourse "shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area." Section 373.042(1)(b) defines the minimum level of an aquifer or surface water body as "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." Minimum flows and levels are established and used by the Southwest Florida Water Management District (SWFWMD) for water resource planning, as one of the criteria used for evaluating water use permit applications, and for the design, construction and use of surface water management systems. Development of minimum flows and levels are key components in supporting resource protection, recovery and regulatory compliance by establishing standards below which significant harm will occur in specific water bodies; however, resource protection, recovery and regulatory compliance can be supported once the flow or level standards are established. Section 373.0421, F.S., requires development of a recovery or prevention strategy for water bodies if the " existing flow or level in a water body is below, or is projected to fall within 20 years below, the applicable minimum flow or level." Section 373.0421 (2), F.S., requires that recovery or prevention strategies be developed to: "(a) achieve recovery to the established minimum flow or level as soon as practicable; or (b) prevent the existing flow or level from falling below the established minimum flow or level." Periodic re-evaluation and as necessary, revision of established minimum flows and levels are required by Section 373.0421(3), F.S..

Minimum flows and levels are to be established based upon the best available information with consideration given to "…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.). The Florida Water Resources Implementation Rule (Chapter 62-40.473, Florida Administrative Code (F.A.C.)), provides additional guidance for the establishment of minimum flows and levels, requiring 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." The Water Resource Implementation Rule also indicates that "minimum flows and levels should be expressed as multiple flows or levels defining a minimum hydrologic regime, to the extent practical and necessary to establish the limit beyond which further withdrawals would be significantly harmful to the water resources or the ecology of the area."

The Southwest Florida Water Management District has developed specific methodologies for establishing minimum flows or levels for lakes, wetlands, rivers and aquifers, subjected the methodologies to independent, scientific peer-review, and incorporated the methods into 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 levels expected to fully maintain the integrity of the wetlands are classified as Category 2 Lakes. Lakes without at least 0.5 acre of 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. Information regarding the development of adopted methods for establishing Minimum and Guidance lake levels is provided in Southwest Florida Water Management District (1999), Leeper *et al.* (2001) and Leeper (2006). Peer-review findings regarding the lake level methods are available in Bedient *et al.* (1999), Dierberg and Wagner (2001) and Wagner and Dierberg (2006).

Two Minimum Levels and two Guidance Levels have typically been established for lakes, and upon adoption by the District Governing Board, 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 **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., the adopted Minimum and Guidance Levels were developed for Lake Hooker (Table 1), a Category 3 Lake located in Hillsborough County, Florida. The levels were established using best available information, including field data that were obtained specifically for the purpose of minimum levels development.

The data and analyses used for development of the adopted levels are described in the remainder of this report. Following a public input process, District staff recommended and the Governing Board approved incorporation of the proposed levels into Chapter 40D-8, F.A.C.

All elevation data values shown within this report on graphs, bathymetric maps, and within tables are expressed as elevations in feet above the National Geodetic Vertical Datum of 1929 (NGVD 29). In some circumstances notations are made for data that was collected as North American Vertical Datum of 1988 (NAVD 88) and converted to NGVD 29. All conversions were derived using Corpscon 6.0, a computer software program that performs vertical conversions to and from NGVD 29 and NAVD 88.

Table 1. Adopted Minimum and Guidance Levels for Lake Hooker.

Minimum and Guidance Levels	Elevation in Feet
	NGVD 29
High Guidance Level	43.9
High Minimum Lake Level	43.0
Minimum Lake Level	41.5
Low Guidance Level	40.8

Data and Analyses Supporting Development of the Adopted Minimum and Guidance Levels for Lake Hooker

Lake Setting and Description

Lake Hooker is located in the Hillsborough River Basin in Hillsborough County, Florida in Section 12, Township 29S, Range 20E, near Seffner(Figure 1). The area surrounding the lake is in the Lake Shore Ranch sub-division of Seffner. The Physiographic Region surrounding the lake (Figure 2) is categorized as the Polk Upland Province (Brooks 1981); a region of gentle rolling hills underlain by the presence of clayey sand material of quartz and clastic phosphate characteristic of the Bone Valley Formation that occurs on the southern border of the Ocala uplift (Altschuler et al. 1964; Campbell 1984).

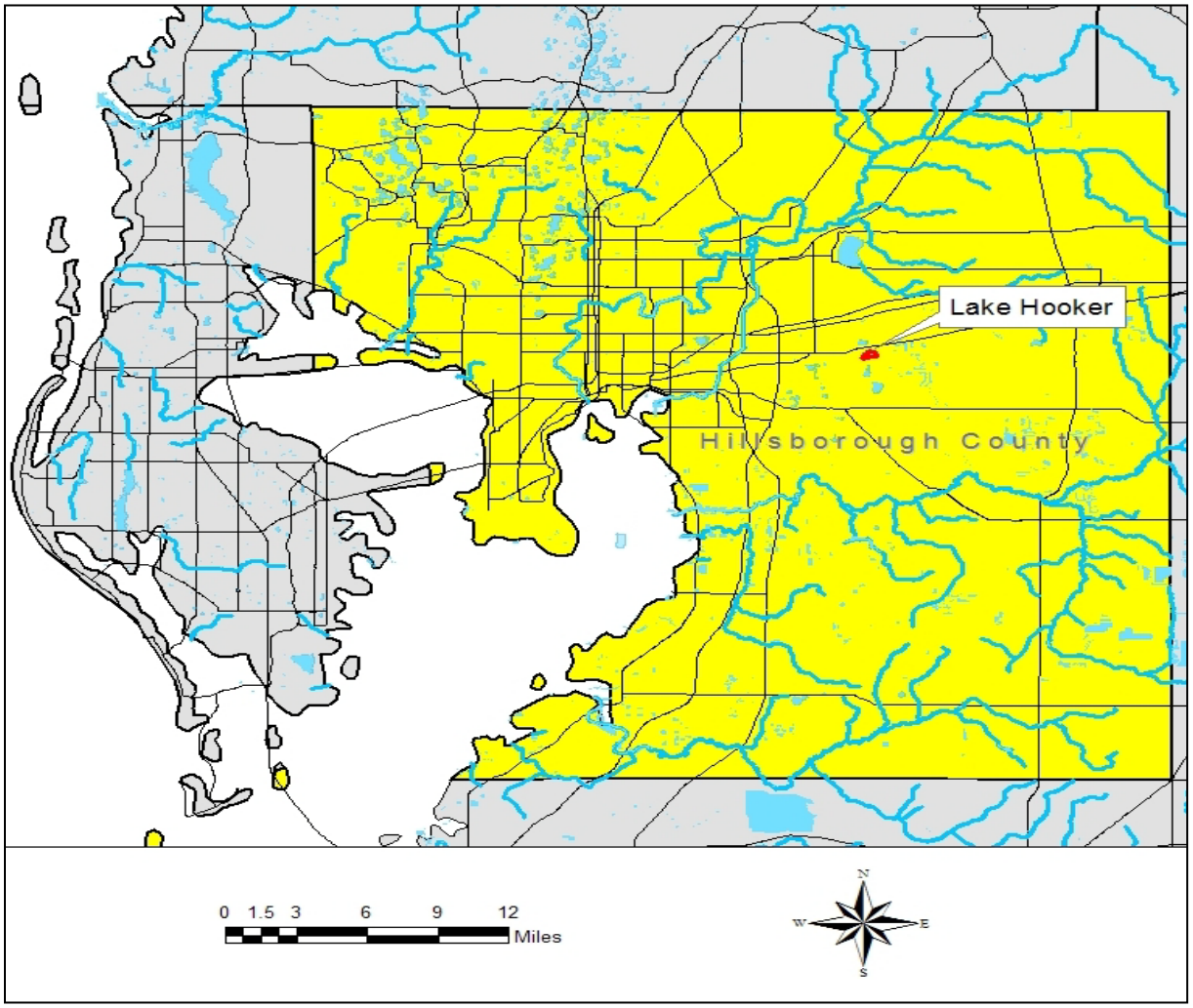


Figure 1. Lake Hooker Location Map in Hillsborough County, Florida

Lake Hooker is located in the Baker Canal watershed. The overall watershed area is approximately 30 square miles and the lake area ranges between 37 to 53 acres and its drainage area is about 890 acres. Lake Hooker is contiguous with lakes and other water bodies by a series of natural outfalls and manmade ditches and underground conveyances (Figure 3). An agricultural tributary originating south of the CSX Railroad line and east of Dover Road named Tributary L, is shown in Figure 3 entering Lake Hooker (Vanasse, Hangen & Brustlin 2009). The chain of lakes, referred to as the Baker Canal System, begins with Lake Valrico which discharges through undefined channels to Long Pond Lake and enters Lake Hooker downstream from Lake Hooker enters the ditch system through Pemberton Creek to Lake Weeks. Medium and high density residential development, agricultural and open lands dominate the area surrounding Lake Hooker (Figure 3).

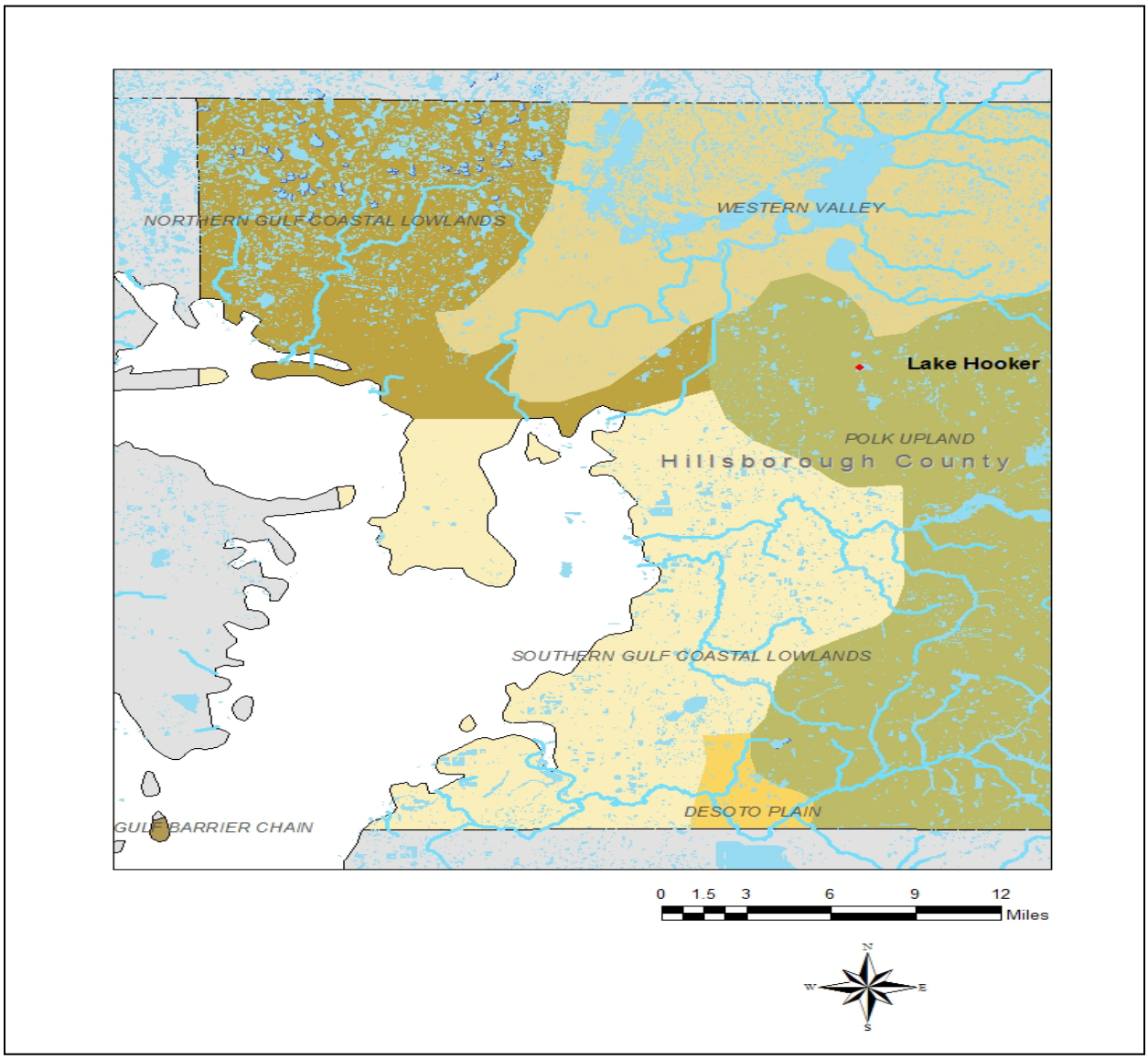


Figure 2. Physiographic regions in the vicinity of Lake Hooker.

Figure 4 shows the path of the underground pipe conveyance system from the undefined channel that connects Long Pond Lake to Lake Hooker.

Basin features for Lake Hooker are provided in Figure 5, showing gage locations, spot elevations and a series of berms, outfall ditches and controlled conveyance structures surrounding the lake and connecting the flow to Lake Weeks to the north and Long Pond to the south. Historical aerial photographs from 1938 and 1957 of the lake system (Figure 6 and 7), shows man-made and natural channels connecting the lakes similar to what currently exists.

Figure 3. The Chain of Lakes known as the Baker Canal System.

Figure 4. Long Pond outfall to Lake Hooker by way of underground pipe.

A topographic map of the lake basin generated in support of Minimum Levels development (Figure 8) indicates that the lake size is approximately 318 acres at an elevation of 46 NGVD 29. Data used for production of the topographic map and bathymetric maps were obtained from field surveys collected in January 2010 and from Light Detection and Ranging (LiDAR) data collected in 2010 and 2011. The topographic map (Figure 8) and corresponding depth contour map (Figure 9) show that the lake basin is relatively flat, with smooth contours and one small deeper hole on the north-west shoreline. The depth contour map shows that the lake is relatively shallow with a deep area to the west. There is public foot access to a boardwalk located on the south west side of the lake.

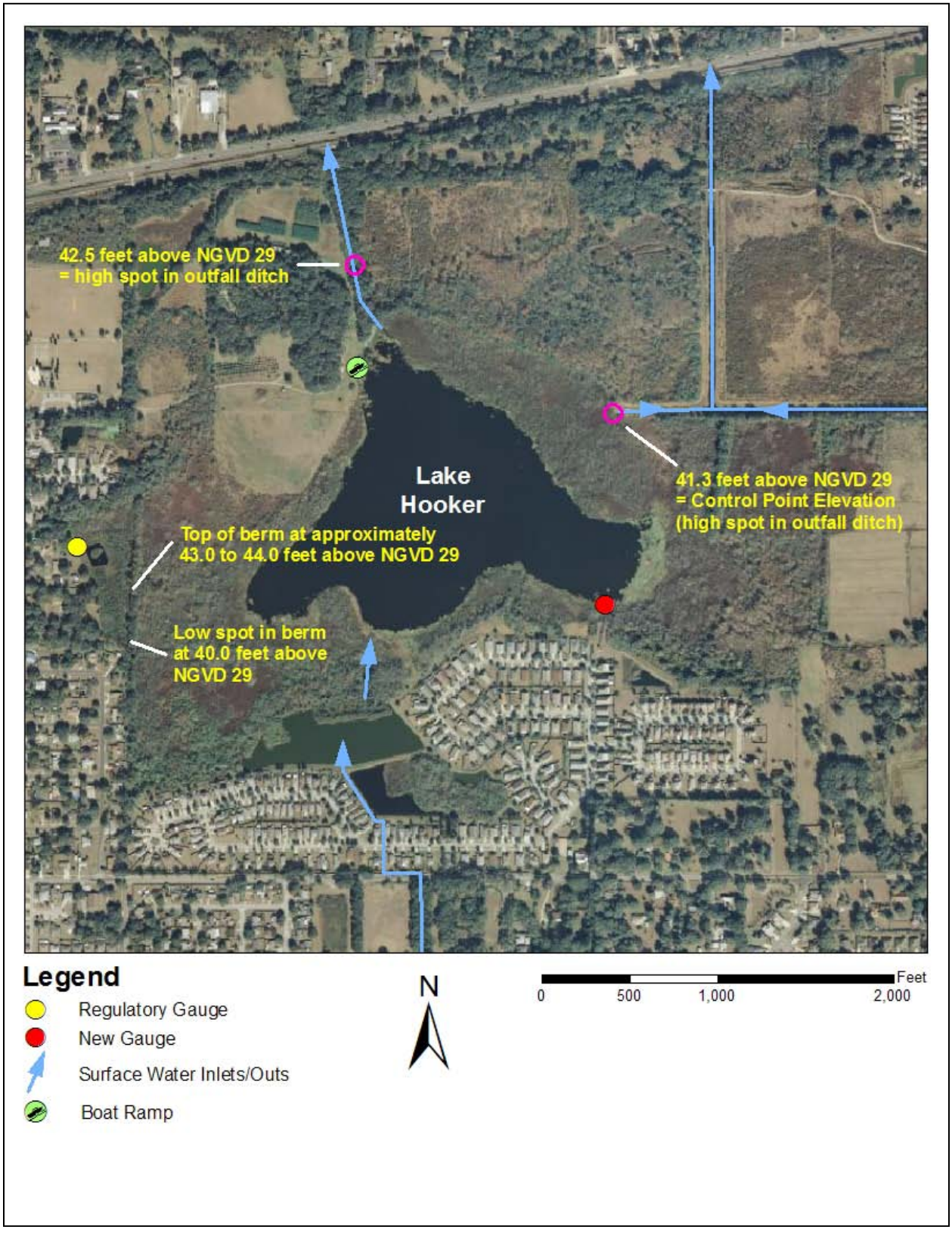


Figure 5. Basin features of Lake Hooker.

There are permitted ground water withdrawals within the surrounding lake area, but there are no surface water withdrawals from the lake currently permitted by the District. From 1992 through 2002, groundwater withdrawal within 1 or 2 miles of the lake was insignificant, less than 1 mgd (Figure 10). The maximum, average, and minimum pumping from 1992 through 2006 within 3 miles of the lake was 9.99, 4.4, and 0.65 mgd, respectively. Water use within the first three miles peaked in 2002 and decreased after 2006 (Figure 10).

The majority of the surficial aquifer around Lake Hooker is composed of various grades of medium to fine-grained sand. This aquifer averages approximately 30 feet in depth but the depth is variable as a result of the Karst nature of the region (Ranalli, 2004). The surficial aquifer is isolated from the Upper Floridan aquifer by a layer of mixed clays and silts. However, there are areas where the clay layer is absent and the water from the surficial aquifer is connected to the Upper Floridan aquifer (Hillsborough, 2002). The water table for Lake Hooker is usually close to the surface or within several feet deep. The majority of the soils groups within the watershed are Groups D and A/D indicating that runoff rates are high to moderate and infiltration capacity is potentially low. This condition results in increasingly high saturated overland flow (also called saturation-excess overland flow) during rainfall events. Upper Floridan water levels in the area are measured at the Turner well (Site ID 18029) near Brandon, located approximately 2.67 miles southeast of Lake Hooker, on the east side of N. Valrico Road and Highway 60. The period of record for the Turner well begins in October 1977 through current. The date of the highest water level was recorded on 9/30/04 at 29.33 feet below land surface (NGVD 29) and the lowest water level was recorded on 5/19/81 at 11.33 feet below land surface (NGVD 29). With maximum depth of approximately 5 feet and a bottom elevation of 37 feet (NGCD 29) a difference between lake bottom and the Upper Floridan aquifer corresponds to about 7 feet at the peak UFA water level date. (Figure 11)

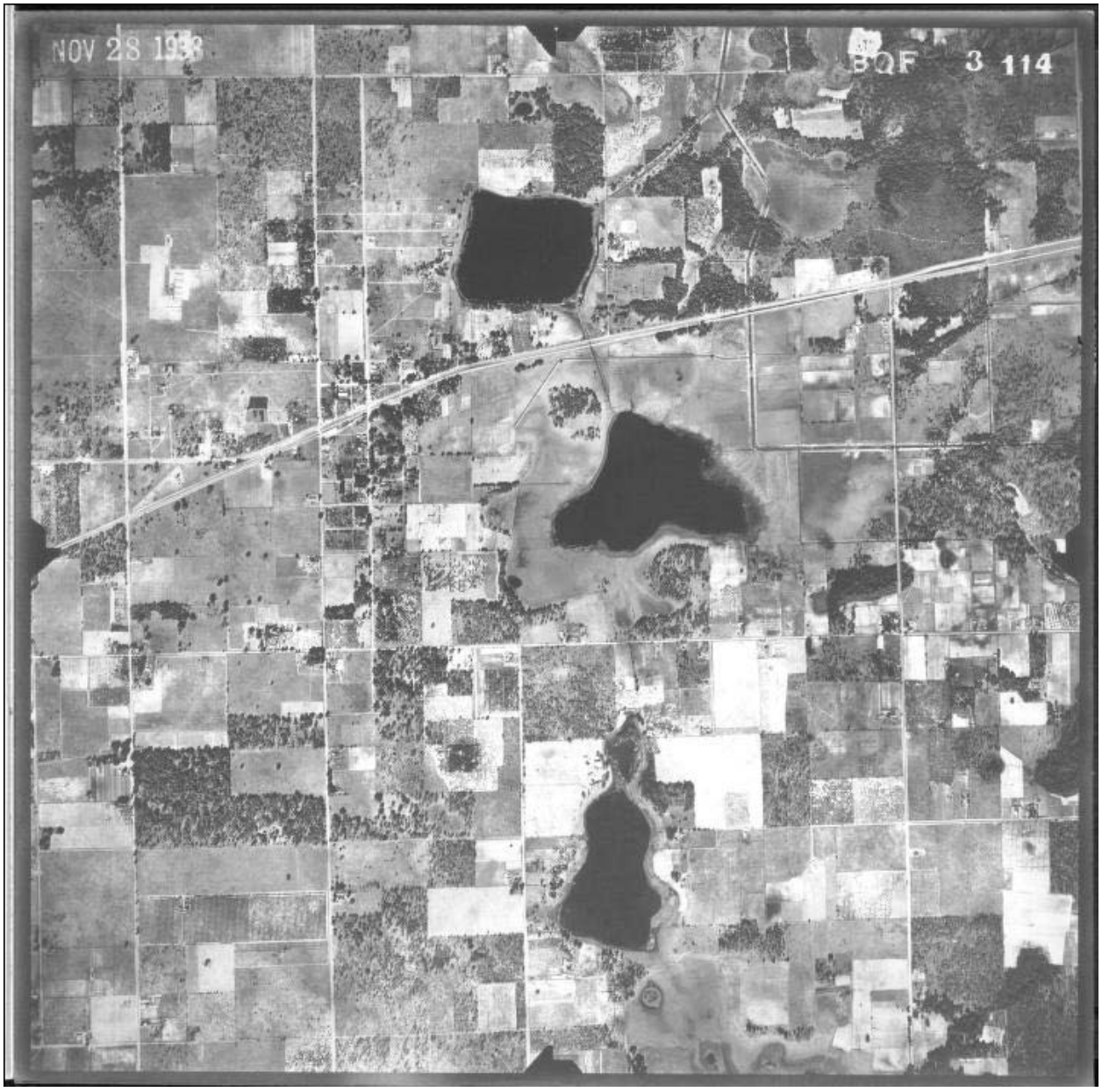


Figure 6. Historical aerial from November 28, 1938, showing connectivity between Lake Weeks, Lake Hooker and Long Pond Lake.

Figure 7. Historical aerial from March 30,1957 showing connectivity between Valrico Lake, Long Pond Lake, Lake Hooker and Lake Weeks, respectively.

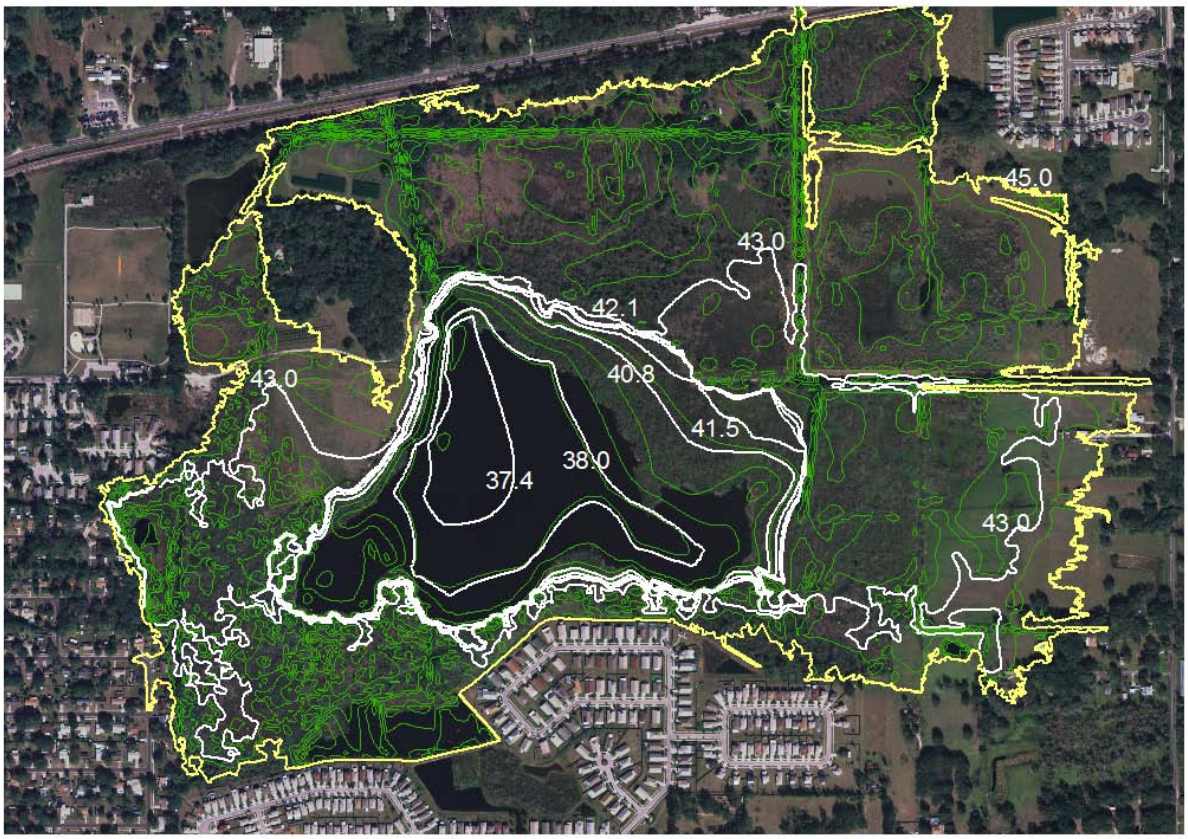
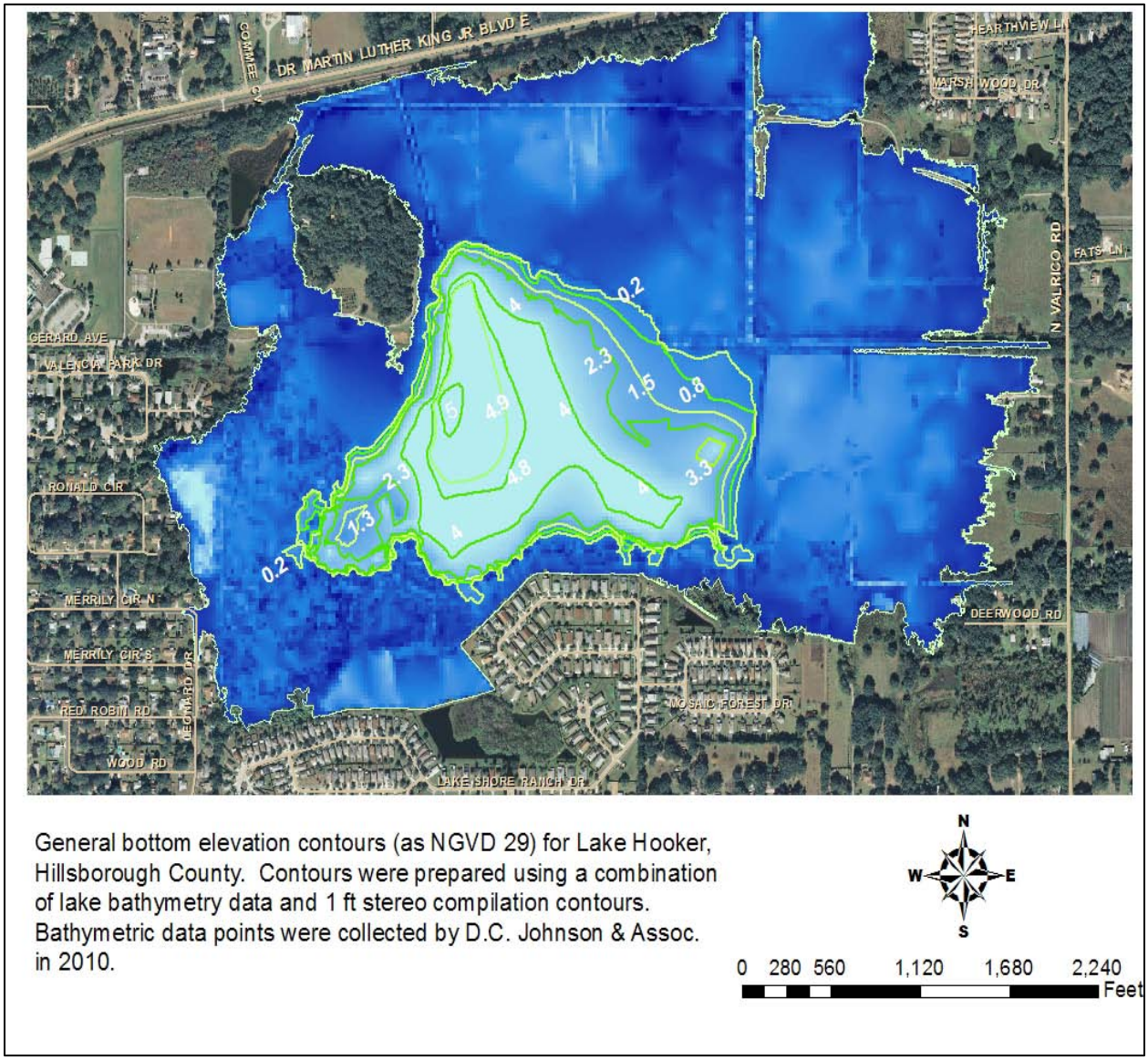


Figure 8. Contours were prepared using a combination of LiDAR and spot elevation data in feet NGVD 29. LiDAR was collected in 2010 by D.C. Johnson and Associates. Background imagery is true color digital orthophotography collected in 2011.



General bottom elevation contours (as NGVD 29) for Lake Hooker, Hillsborough County. Contours were prepared using a combination of lake bathymetry data and 1 ft stereo compilation contours. Bathymetric data points were collected by D.C. Johnson & Assoc. in 2010.

Figure 9. Approximate bottom elevations in NGVD 29 within the Lake Hooker basin.

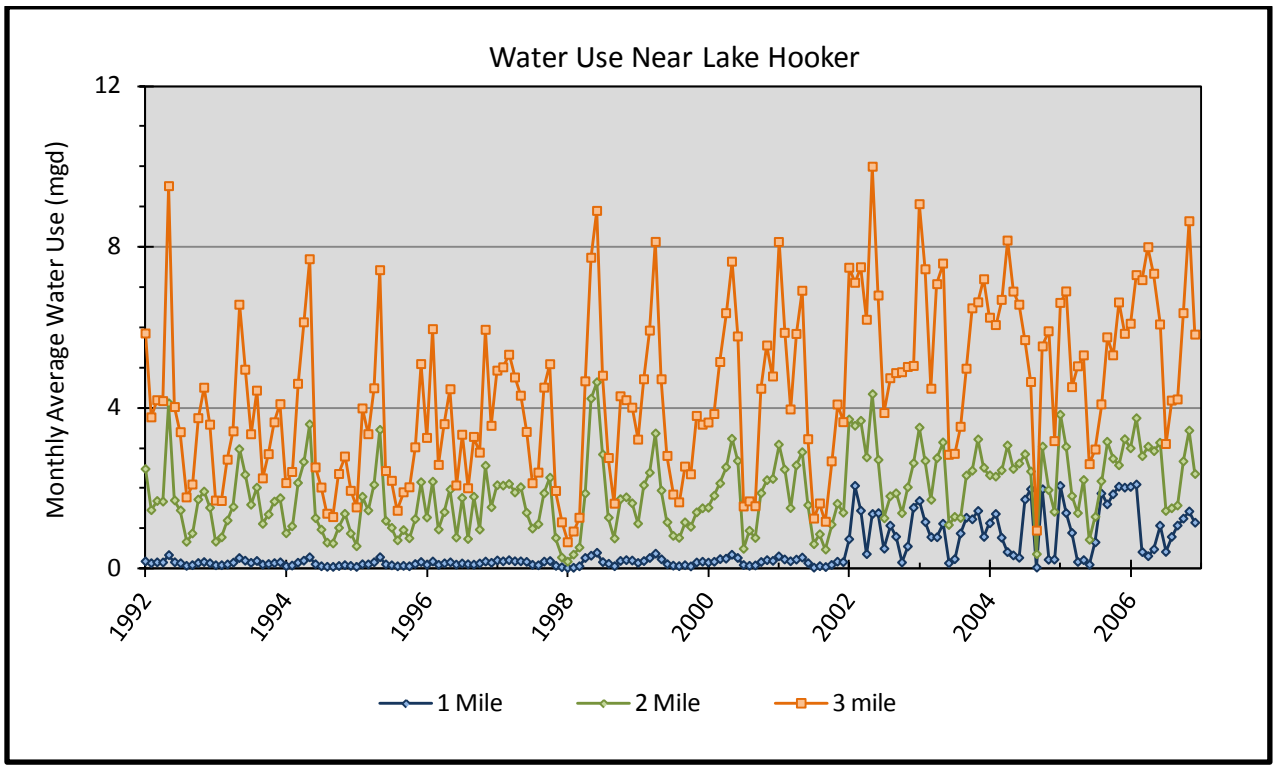


Figure 10. Groundwater use within 3 miles of Lake Hooker.

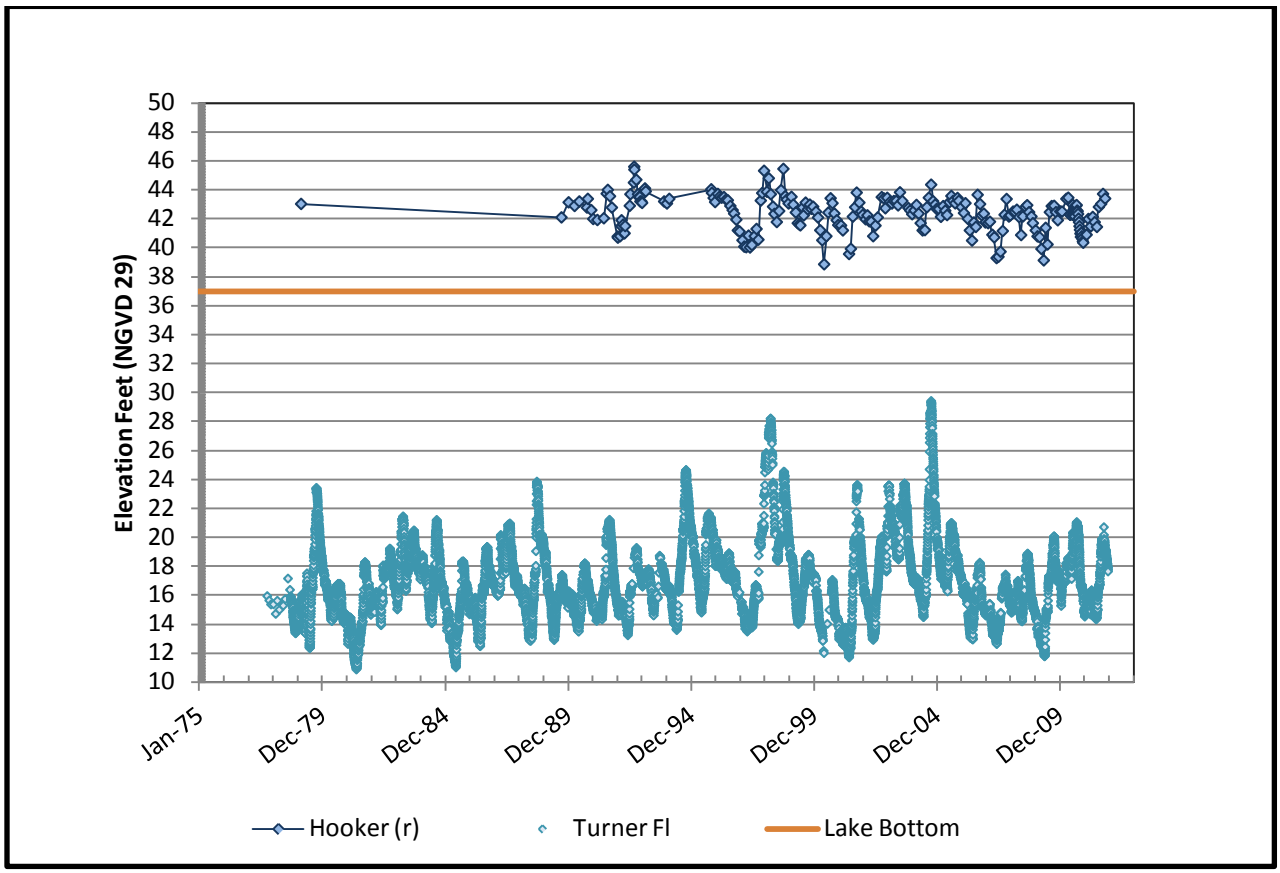


Figure 11. Comparison between Floridan well water level and Lake Hooker water level.

Previously Adopted Lake Management Levels

The Southwest Florida 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 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 1979 (SWFWMD 1996), the District Governing Board adopted management levels (currently referred to as Guidance Levels) for Lake Hooker in September, 9 1980 (Table 2) and incorporated the levels into Chapter 40D-8, F.A.C. The Guidance Levels previously adopted included a High Management Level of 45.00 NGVD 29, a Low Management Level of 43.00 NGVD 29, and an Extreme Low Management Level of 42.00 NGVD 29 (Table 2). A Maximum Desirable Level of 44.00 ft above NGVD was also developed, but was not adopted by the Governing Board. The previously 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 methods. Minimum and Guidance Levels developed using current methods have replaced existing Guidance Levels, adopted on August 28, 2012 by the District Governing Board into Chapter 40D-8, F.A.C. One of the management levels, a Ten Year Flood Guidance Level of 45.50 NGVD, was removed from Chapter 40D-8, F.A.C., in 2007, when the District Governing Board determined that flood-stage elevations should not be included in the District's Water Levels and Rates of Flow rules.

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., "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, evaluation of stressed condition is conducted on a case-by-case basis. Lake Hooker was included on the Stressed Lakes List for 2002, 2003, 2004, 2005, 2009, and 2010 (Gant et *al*. 2008, 2009, 2010).

Table 2. Previously Adopted Guidance Levels for Lake Hooker.

Guidance Levels	Elevation in Feet NGVD 29
Ten Year Flood Guidance Level	45.50
High Level	45.00
Low level	43.00
Extreme Low Level	42.00

Summary Data Used for Development of The Adopted Minimum and Guidance Levels

The adopted Minimum and Guidance Levels were developed for Lake Hooker using the methodology for Category 3 Lakes described in Leeper *et al.* (2001), in accordance with modifications outlined by Dierberg and Wagner (2001). The adopted levels, along with lake surface area values for each level are listed in Table 3. Detailed descriptions of the development and use of these data are provided in the subsequent sections of this report.

Table 3. Adopted Minimum and Guidance Levels, Historic P50, lake stage percentiles, normal pool and control point elevations, and significant change standards for Lake Hooker in Hillsborough County, Florida.

Levels	Elevation in Feet NGVD 29	Lake Area (acres)*
Lake Stage Percentiles		
Period of Record (POR) Current P10	43.8	181.3
Period of Record (POR) Current P50	42.3	87.2
Period of Record (POR) Current P90	40.8	51.8
Long Term Historic P10 (Modeled 1946 to 2010)	43.9	188.8
Long Term Historic P50 (Modeled 1946 to 2010)	42.3	87.2
Long Term Historic P90 (Modeled 1946 to 2010)	40.8	51.8
Normal Pool and Control Point		
Normal Pool	NA	NA
Control Point	41.3	69
Low Floor Slab	46.61	NA
Significant Change Standards		
Aesthetics Standard	40.8	51.8
Species Richness Standard	42.1	74.1
Wetland Offset Elevation	41.5	62.3
Dock-Use Standard	43.0	125.4
Lake Mixing Standard	NA	NA
Basin Connectivity	NA	NA
Recreation/Ski Standard	NA	NA
Minimum and Guidance Levels		
High Guidance Level	43.9	188.8
High Minimum Lake Level	43.7	173.6
Minimum Lake Level	42.1	74.1
Low Guidance Level	40.8	51.8

*****Acreage values are based on extrapolated data

Lake Stage Data and Exceedance Percentiles

Hydrologic data are available for Lake Hooker (Southwest Florida Water Management District Universal Identification Number = STA 156 156; Site Identification Number 19273) for the period from September 1989 through the present date (see Figure 5 for the location of the Regulatory Gage). Note that a second District gage, referenced as the new gage, is located on the western end of the lake (Figure 5) and data from this gage are not included in this hydrologic data set. For the period from September 1989 to the present, the hydrological data are classified as Current data. Current data through March 2011 were used to calculate the Current P10, P50, and P90 (Table 3). The highest surface water elevation for Lake Hooker recorded in the Water Management Information System, 45.6 NGVD 29, occurred in September 4, 1992. The low of record, 38.86 NGVD 29 occurred in May 25, 2000. Based on available lake stage data, monthly mean lake surface elevations were calculated and graphed (Figure 12). The data record for Lake Hooker from 1989 to present is not continuous, i.e., there are some months during the period of record when lake surface elevations were not recorded.

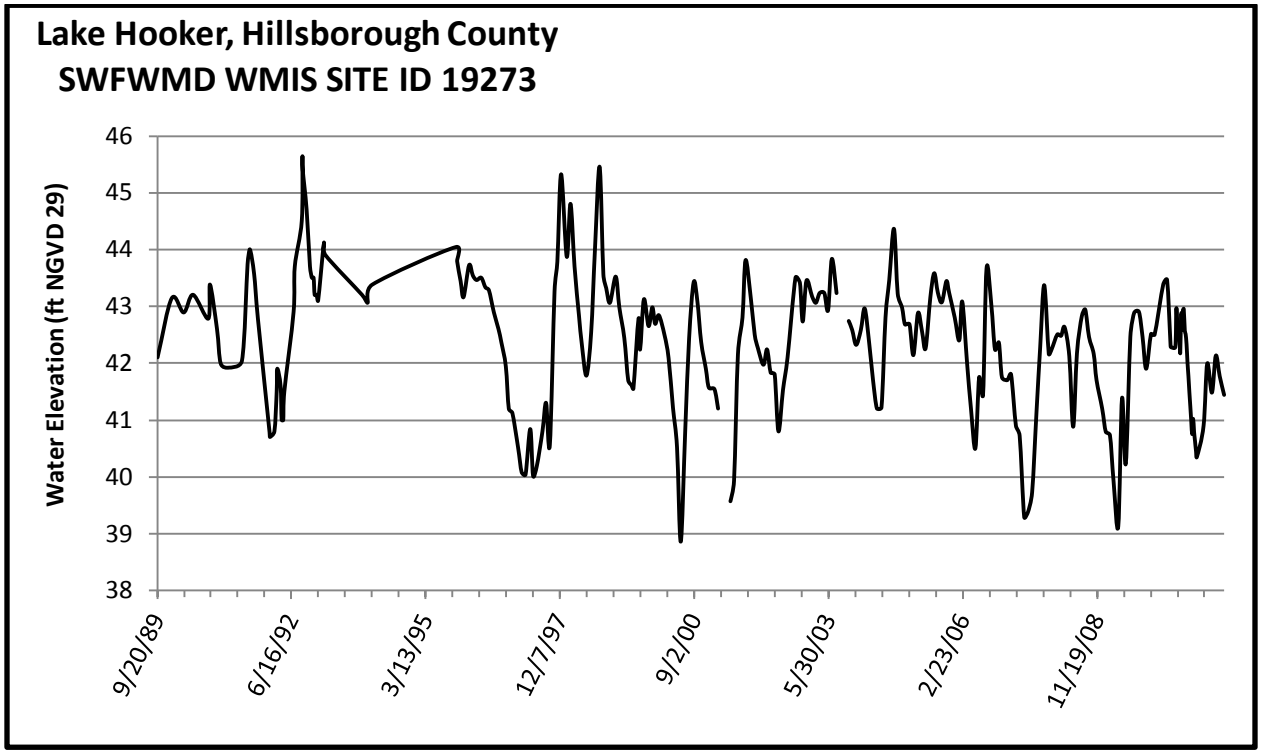


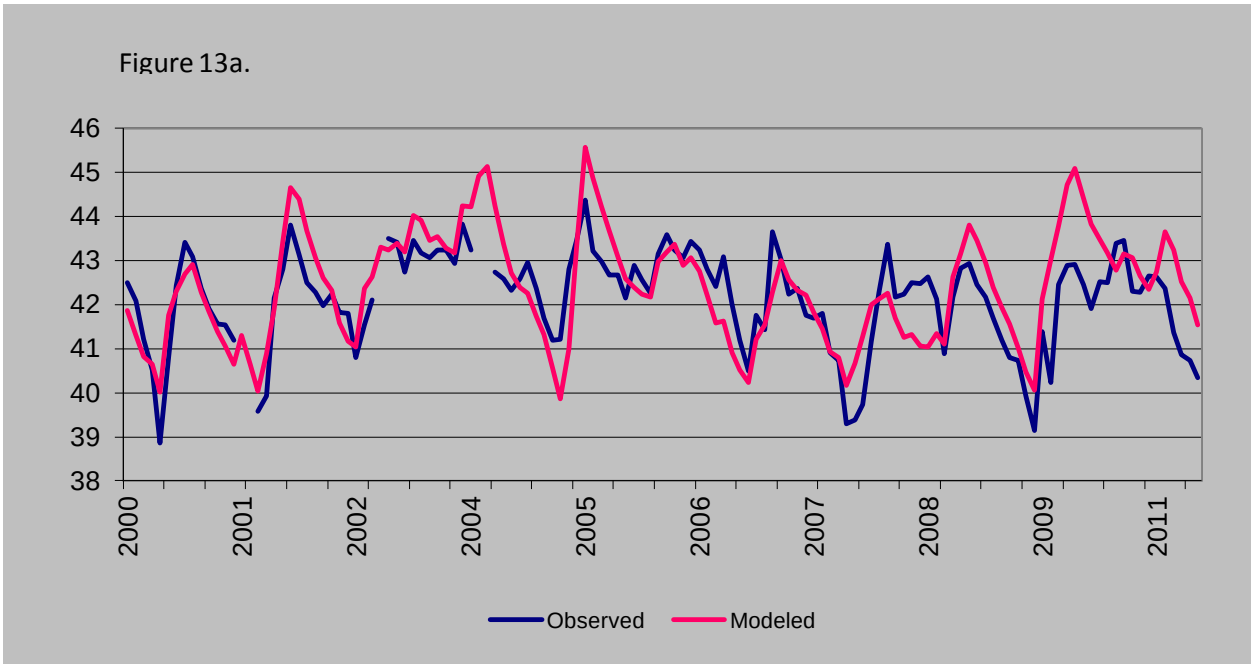
Figure 12. Monthly surface water elevation (NGVD 29) through March 2011 for Lake Hooker.

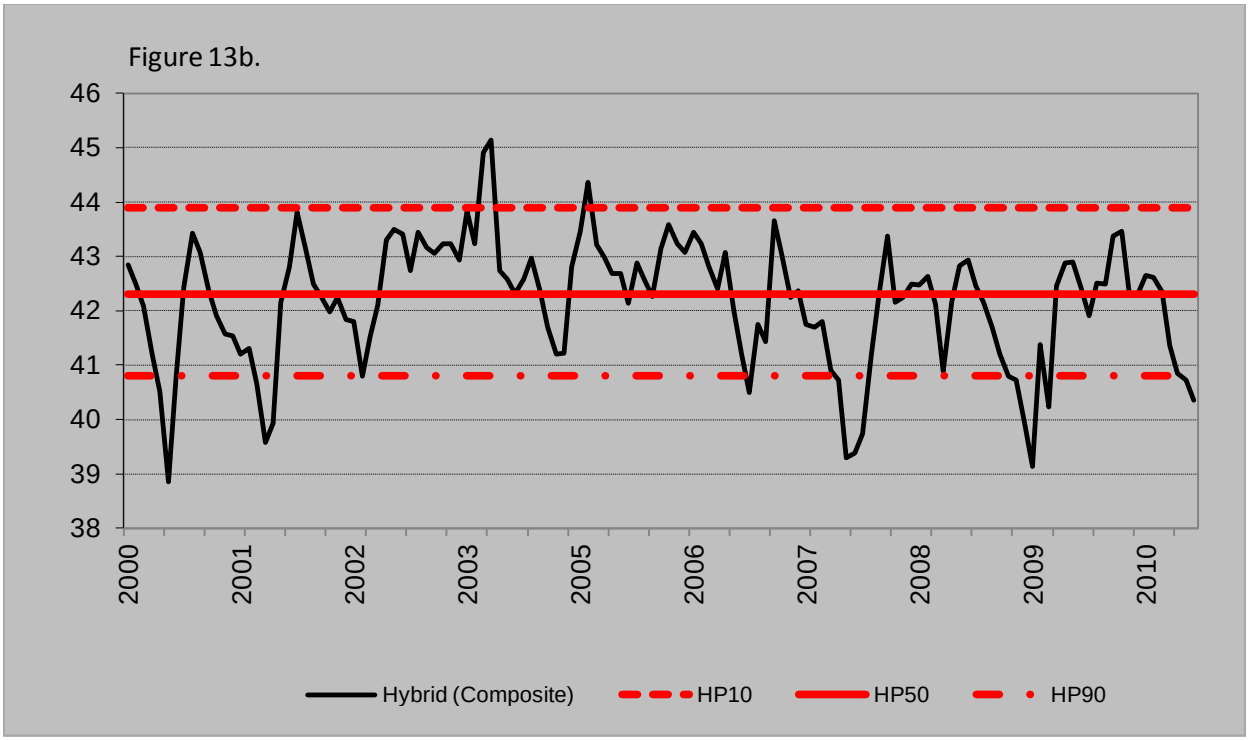
For the purpose of Minimum Levels determination, lake stage data are classified as "Historic" for periods when there were no measurable impacts due to water withdrawals, and impacts due to structural alterations were similar to existing conditions. In the context of Minimum Levels development, "structural alterations" means man's physical alteration of the control

point, or highest stable point along the outlet conveyance system of a lake, to the degree that water level fluctuations are affected. Lake stage data are classified 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 the entire period of record (1989 to Current) for Lake Hooker are classified as Current. The lake was determined to have no measureable impacts from water withdrawals due to its perched geomorphology and the low groundwater pumping rate especially within the 3 mile radius (Figure 10). This determination was made through a water budget and leakage analysis completed by the Hydrologic Evaluation Section (SWFWMD 2010, draft report).

Although the period of record of lake stage data for Lake Hooker are classified as the Historic data set, it is limited by several gaps in the data (Figure 12). There is only one data point from 1989 to 1990 and a data gap from 1990 to 1993 and only one data point in 1994. The relatively short period of continuous record from 1995 to current is limited in its usefulness for long term characterization of water level fluctuation within the basin.

A long term Historic data set of monthly mean lake surface elevations (Figures 13) for Lake Hooker was developed using a sixty-four-year record of modeled Historic and measured lake surface elevations for the period of January 1946 through July 2011. The sixty-four-year period was considered sufficient for incorporating the range of lake stage fluctuations that would be expected based on long-term climatic cycles that have been shown to be associated with changes in regional hydrology. The modeled Historic lake surface water elevation was based on rainfall measured at the Plant City and Romp Dv-1Dover rain gages (WMIS Site ID 25147) from January 1946 to July 2011. The resulting lake level rainfall model had a correlation coefficient or r^2 equal to 0.512 (1 year decay). The most accurate representation of long term Historic water level fluctuations was a composite data set that consisted of the modeled Historic water level and more recent measured water level data. The period of record of the modeled lake level was from 1946 to 2011 and the period of record of the measured lake level data was from 1989 to 2010 (Figure 13).





Figures 13a. and 13b. 13a. Modeled long term Historic lake stage (as monthly means, see red line) and measured lake stage (also as monthly means, see blue line) for Lake Hooker. 13b. Composite of modeled long term Historic lake stage and measured lake stage (both as monthly means) used to calculate the Historic P10, P50 and P90 lake stage percentile elevations for Lake Hooker from January 2000 through December 2010.

The long term composite Historic data set of modeled lake stage and measured lake stage was used to calculate the **Historic P10, P50, and P90** lake stage percentile elevations (Figure 13b).

The **Historic P10** elevation, the elevation the lake water surface equaled or exceeded ten percent of the time during the historic period, was **43.9 NGVD 29**. The **Historic P50** elevation, the elevation the lake water surface equaled or exceeded fifty percent of the time during the historic period, was **42.3 NGVD 29**. The Historic **P90** elevation, the elevation the lake water surface equaled or exceeded 90 percent of the time during the historic period, was **40.8 NGVD 29.**

Normal Pool Elevation, Control Point Elevation and Structural Alteration Status

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. Because Hydrologic Indicators of Normal Pool were not observed at Lake Hooker, a Normal Pool elevation was not established for the lake.
Based on the historic modeled P10 elevation, a historic seasonal high water elevation was estimated at **43.9 NGVD 29.**

The **Control Point** elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system (e.g., structure, ditch, culvert, or pipe) that is the principal control of water level fluctuation in the lake. For Lake Hooker, water discharges from the Lake Hooker to Lake Weeks through an outfall ditch on the north eastern side of the lake at a high spot elevation of **41.3 feet NGVD 29** and through a second outfall ditch to the north at a high spot elevation of **42.5 feet NGVD 29** (Table 4). There are two berm heights at the west end of the lake that reach from **43.0 to 44.0 feet NGVD** in height. Also, a low spot in the berm exists on the west side of the lake. The locations of these control point elevations and structural alterations can be seen in Figure 5. Structural Alteration Status is determined to support development of Minimum and Guidance Levels. Because of known modifications to the outlet of the lake, Lake Hooker is considered to be Structurally Altered.

Table 4. Summary of structural and alteration/control point elevation information for the Lake Hooker.

No.	Description	Elevation (feet above NGVD)
1	Control point – ground elevation; high spot in outfall ditch between Lake Hooker and Lake Weeks	41.3
2	Ground elevation; high spot in outfall ditch	42.5
3	Top of berm at ditch system west of Lake Hooker	43.0 to 44.0
4	Low spot in berm at ditch system west of Lake Hooker	40.0

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 an 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 wetlands less than 0.5 acres in size are classified as Category 3 Lakes. Because Lake Hooker does not have fringing cypress wetlands, it is classified as a **Category 3 Lake**. The common vegetation along the lake edge is comprised of *Salix caroliniana* (Carolina willow), *Typha* spp. (Cattails), *Sapium sebiferum* (Chinese tallow), *Acer rubrum* (Red maple), *Myrica cerifera* (Wax myrtle), *Baccharis* spp. (Salt bush) and *Sambucus canadensis* (elderberry). *Nuphar lutea* (Spatterdock) is present in deeper lake edge areas.

Lake Significant Change Standards and Other Information for Consideration

Lake-specific significant change standards and other available information are developed for establishing minimum levels for Category 3 Lakes. The standards are used to identify 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.

Six significant change standards are developed for Category 3 Lakes, including an Aesthetics Standard, a Species Richness Standard, a Recreation/Ski Standard, a Dock-Use Standard, a Basin Connectivity Standard, and a Lake Mixing Standard. A Wetland Offset Elevation is also developed and used along with the significant change standards to identify desired median lake stage elevations that if achieved, are intended to preserve various natural system and human-use lake values.

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 becoming degraded 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 for Lake Hooker is **40.8 NGVD 29**. Because the Low Guidance Level was established at the Historic P90 elevation, water levels equaled or exceeded the Aesthetics Standard ninety percent of the time during the Historic long term period (1946 to present, Figure 13b).

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 (see Figure 14 for a plot of lake surface area versus lake stage). For Lake Hooker, the Species Richness Standard was established at **42.1 NGVD 29**. The Species Richness Standard was equaled or exceeded fifty seven percent of the time, based on the Historic composite water level record. The standard therefore corresponds to the Historic P57.

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 Historic data are not available, the Dock-use Standard was established at **43.0 ft NGVD 29** by adding a clearance value of 2 ft and the difference between the P90 and the P50 to the elevation of sediments at the end of 90 percent of the 2 docks (39.5 ft) that were observed at the lake in October 2010 (Table 3).

The **Recreation/Ski Standard, the Basin Connectivity Standard, and Lake Mixing Standard** were not applicable to Lake Hooker. 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. As a result of its small surface area and morphology, shallow depth and the high number of stormwater discharges and associated debris observed in the lake, the Lake Hooker basin does not meet the minimum lake size or safety requirements for establishing a Recreation/Ski standard. 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. Because lake-basin depth measurements indicate that Lake Hooker does not contain sub-basins, the Basin Connectivity Standard was not considered applicable for the lake. The Lake Mixing Standard is developed to prevent significant changes in patterns of wind-driven mixing of the lake water column and sediment re-suspension. 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. Because the dynamic ratio does not shift across the 0.8 threshold over the range of water levels that may be expected within the basin, a Lake Mixing Standard was not developed (Figure 14).

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). Similarly, changes in lake stage associated with changes in lake area available for colonization by rooted submersed or floating-leaved macrophytes are also evaluated, based on water transparency values. 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 14).

Because herbaceous wetlands are the dominant vegetation within the Lake Hooker basin, it was determined that an additional measure of wetland change should be considered for minimum levels development. Based on a recent review (Hancock 2006) of the development of minimum level methods for cypress-dominated wetlands, it was determined that up to an 0.8 foot decrease in the Historic P50 elevation would not likely be associated with significant changes in the herbaceous wetlands occurring within lake basins. A Wetland Offset elevation of **41.5 NGVD** was therefore established for Lake Hooker by subtracting 0.8 feet from the Historic P50 elevation. The standard elevation was equaled or exceeded 74 percent of the time, based on the Historic, composite water level record. The standard elevation therefore corresponds to the Historic P74.

Review of changes in potential wetland area in relation to change in lake stage indicated there would not be a substantial increase or decrease in potential wetland area within the lake basin at the Wetland Offset Elevation (16% of the lake basin) relative to the potential wetland area at the Historic P50 elevation (18.6% of the lake basin).

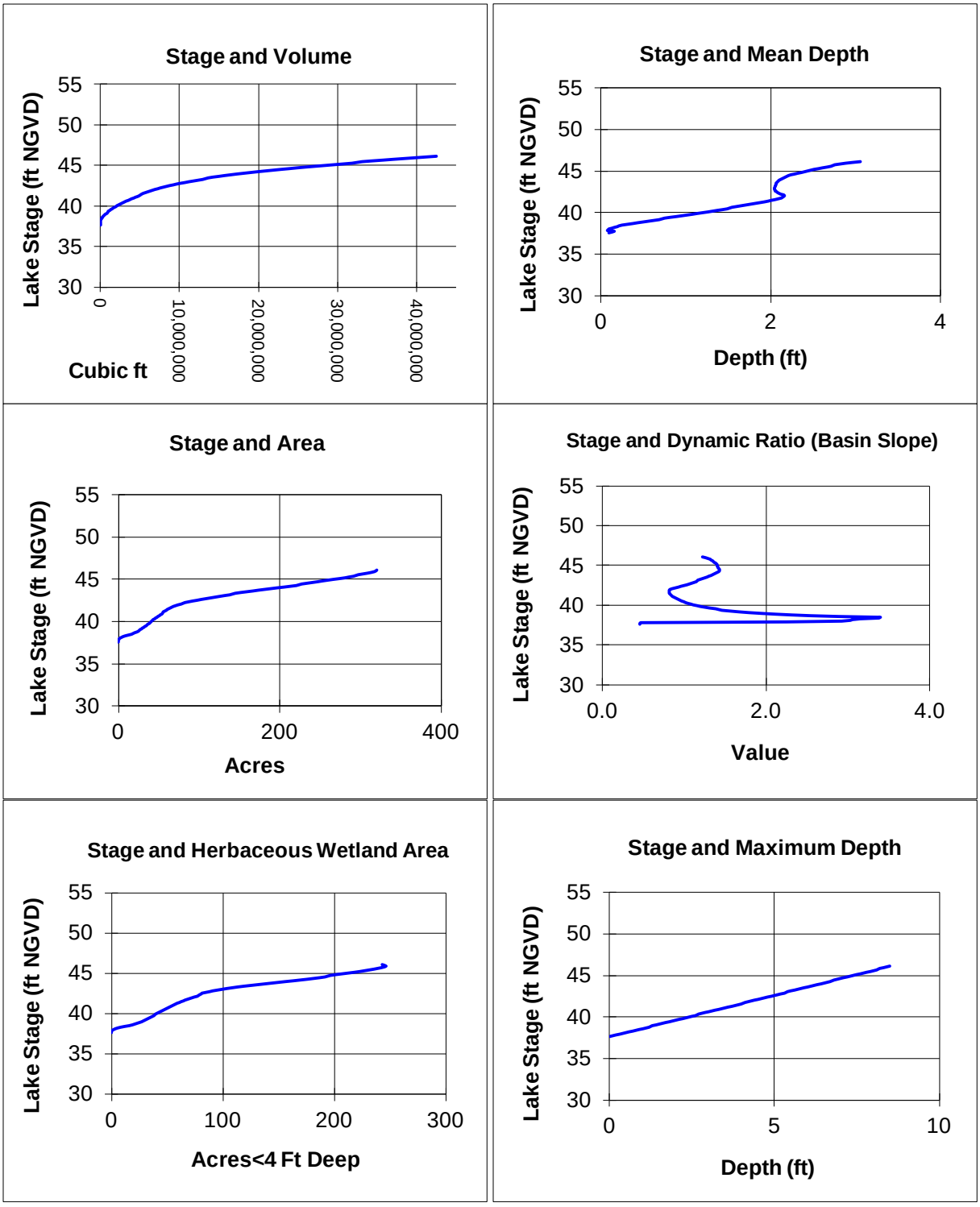


Figure 14. Surface area, maximum depth, mean depth, volume, herbaceous wetland area and dynamic ratio (basin slope) versus lake stage in feet above NGVD 29 for Lake Hooker.

Adopted Guidance Levels

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 expected Historic P10 of the lake and is established using historic lake stage data if it is available, or is estimated using the Current P10, the control point, and the normal pool elevation. Based on this information and the availability of the long term Historic data record for Lake Hooker, the Control Point elevation, and several structural alterations within the lake basin that control water levels, the adopted High Guidance Level was established at the Historic P10 elevation of **43.9 NGVD 29** (Figure 15 Table 3).

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. The level is established using Historic or Current lake stage data, and in some cases, the Reference Lake Water Regime (RLWR) statistics. Based on the availability of the long term Historic data set for Lake Hooker, the adopted Low Guidance Level for Lake Hooker was established at the long term Historic P90 elevation, **40.8 NGVD 29** (Figure 15 and Table 3).

Adopted Minimum Levels

Minimum Lake Levels are developed using specific lake-category significant change standards and other available information or unique factors, 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. Minimum Levels 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 (MLL)** 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 3 Lakes, the Minimum Lake Level is typically established at the elevation corresponding to the most conservative significant change standard, 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. Because all appropriate significant change standards were below the Historic P50 elevation, the Minimum Level for Lake Hooker is established at the Species Richness Elevation, **42.1 NGVD 29**. This level is expected to afford protection to the natural system and human-use values associated with the identified significant change standards and also provide protection for wetlands occurring within the basin (Figure 15).

The **High Minimum Lake Level (HMLL)** 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 3 lakes, the High Minimum Lake Level is developed using the Minimum Lake Level, Historic data or reference lake water regime statistics. If Historic Data are available, the High Minimum Lake Level is established at an elevation corresponding to the Minimum Lake Level plus the difference between the Historic P10 and Historic P50. If Historic data are not available, the High Minimum Lake Level is set at an elevation corresponding to the Minimum Lake Level. Based on the availability of Historic data for Lake Hooker, the adopted High Minimum Lake Level was established at **43.7 NGVD 29**, the adopted Minimum Lake Level plus the difference between the Historic P10 (43.9 NGVD 29) and Historic P50 (42.3 NGVD 29) a difference of 1.6 feet (Figure 15).

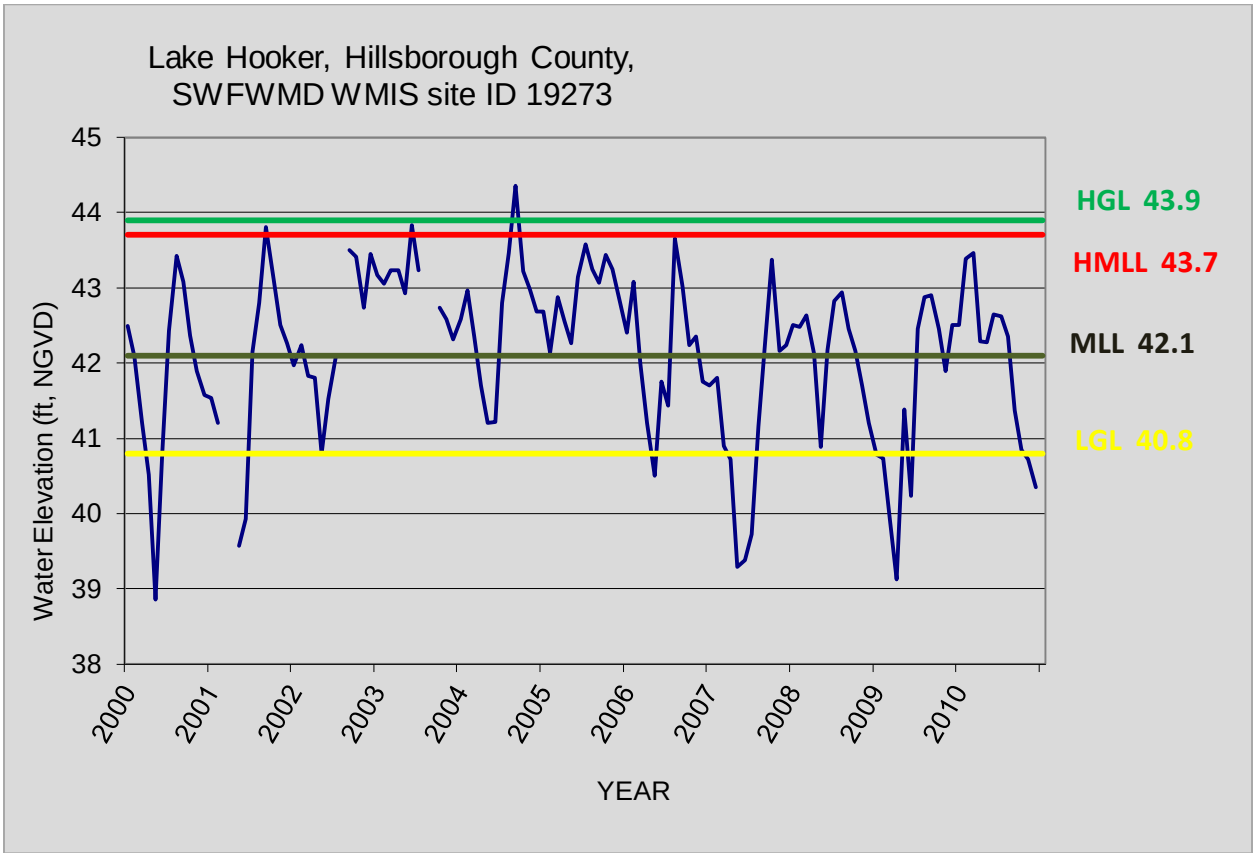


Figure 15. Mean monthly lake stage for the period of record and Minimum and Guidance Levels for Lake Hooker, in feet above NGVD 29. Adopted levels include the High Guidance Level (HGL), High Minimum Lake Level (LMLL), Minimum Lake Level (MLL) and the Low Guidance Level (LGL).

Table 5. Minimum and Guidance Level Summary for Lake Hooker, Hillsborough County

Lake Morphology	NGVD
Maximum Lake Depth	5.0
Structural	
Outfall ditch	41.3
Top of Berm	43 -44
Low Spot in Berm	40
Low Slab	46.61
Bottom at Docks (median)	39.38
Docks 90th Percentile	39.54
Top of Docks (median)	45.03

Historic Percentiles and Proposed Levels (NGVD)	
HP 10	43.9
HP 50	42.3
HP 90	40.8
HGL	43.9
HMLL	43.7
MLL	42.1
LGL	40.8

Standards (NGVD)	
Dock	43.0, > HP50
Wetland Offset	41.5, <HP50
Species Richness	42.1, <HP50
Aesthetics	40.8, <HP50

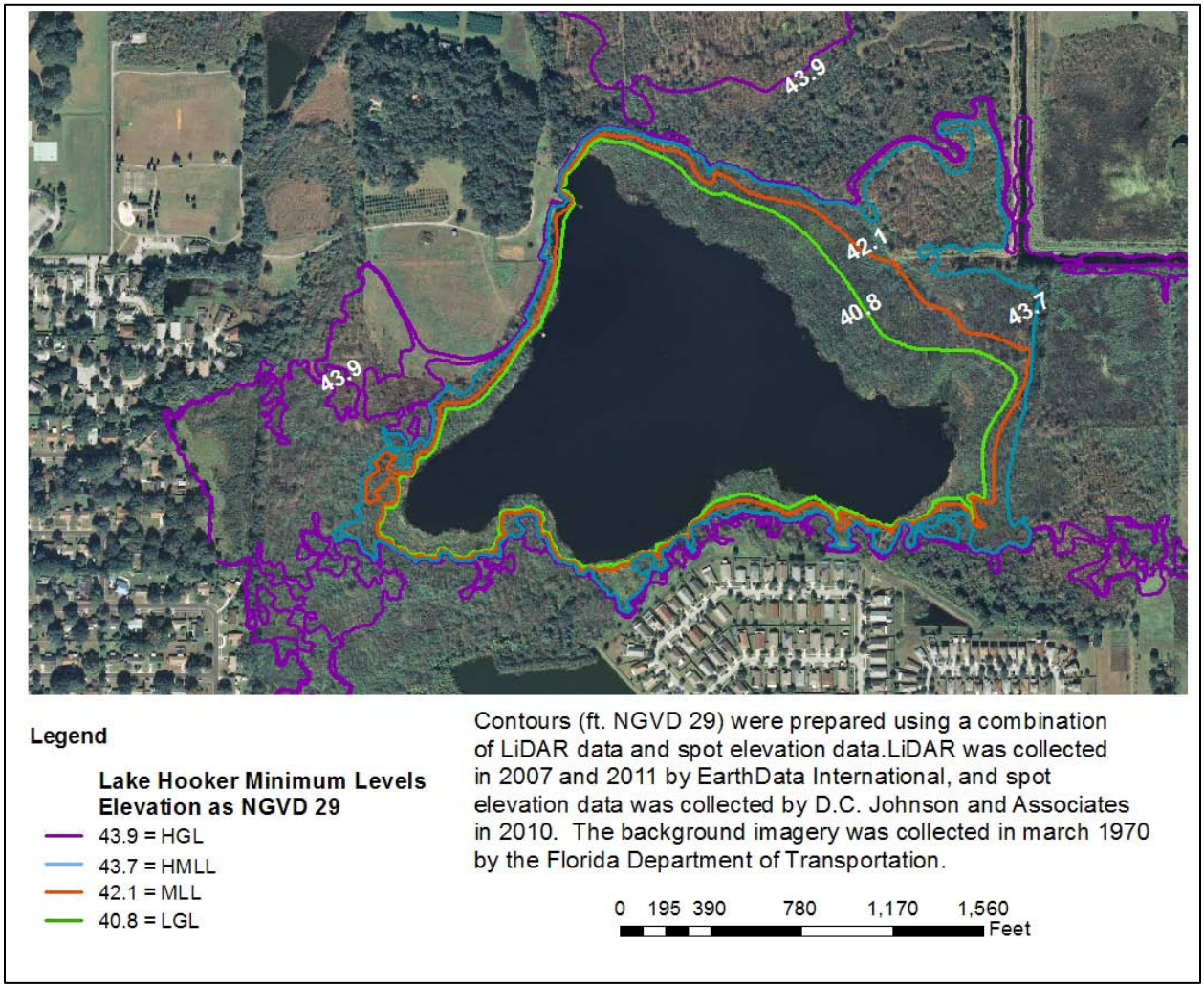


Figure 16. Approximate location of the adopted High Minimum Lake Level, Minimum Lake Level (MLL) and Low Guidance Level (LGL) for Lake Hooker in Hillsborough County, during recent conditions within the 2010 aerial imagery. Based on gage readings the estimated lake stage was 42.28 NGVD 29 on the date of the imagery.

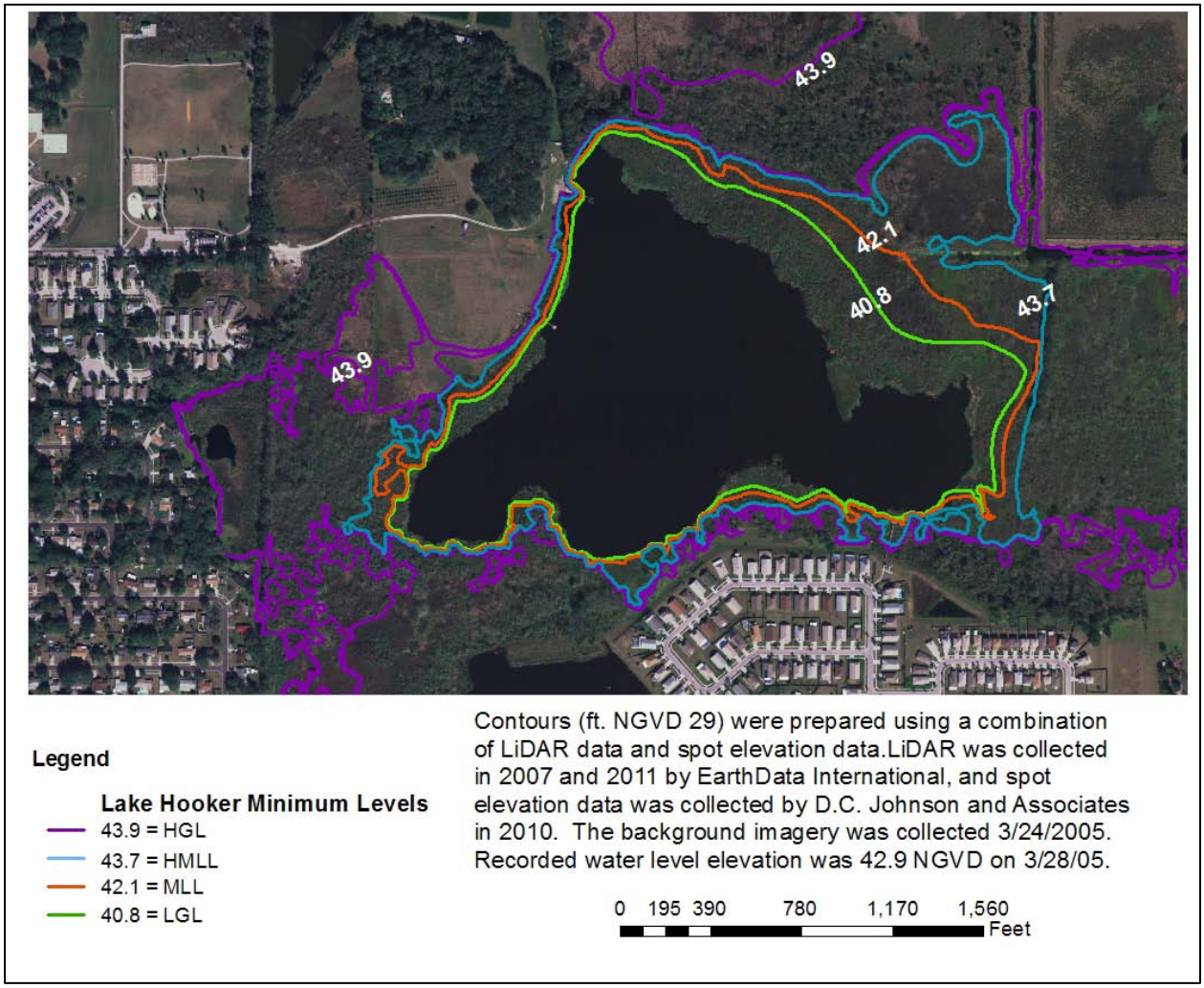


Figure 17. Approximate location of the adopted High Minimum Lake Level, Minimum Lake Level (MLL) and Low Guidance Level (LGL) for Lake Hooker in Hillsborough County, during recent conditions within the 2005 aerial imagery. Based on gage readings the estimated lake stage was 42.9 NGVD 29 on the date of the imagery.

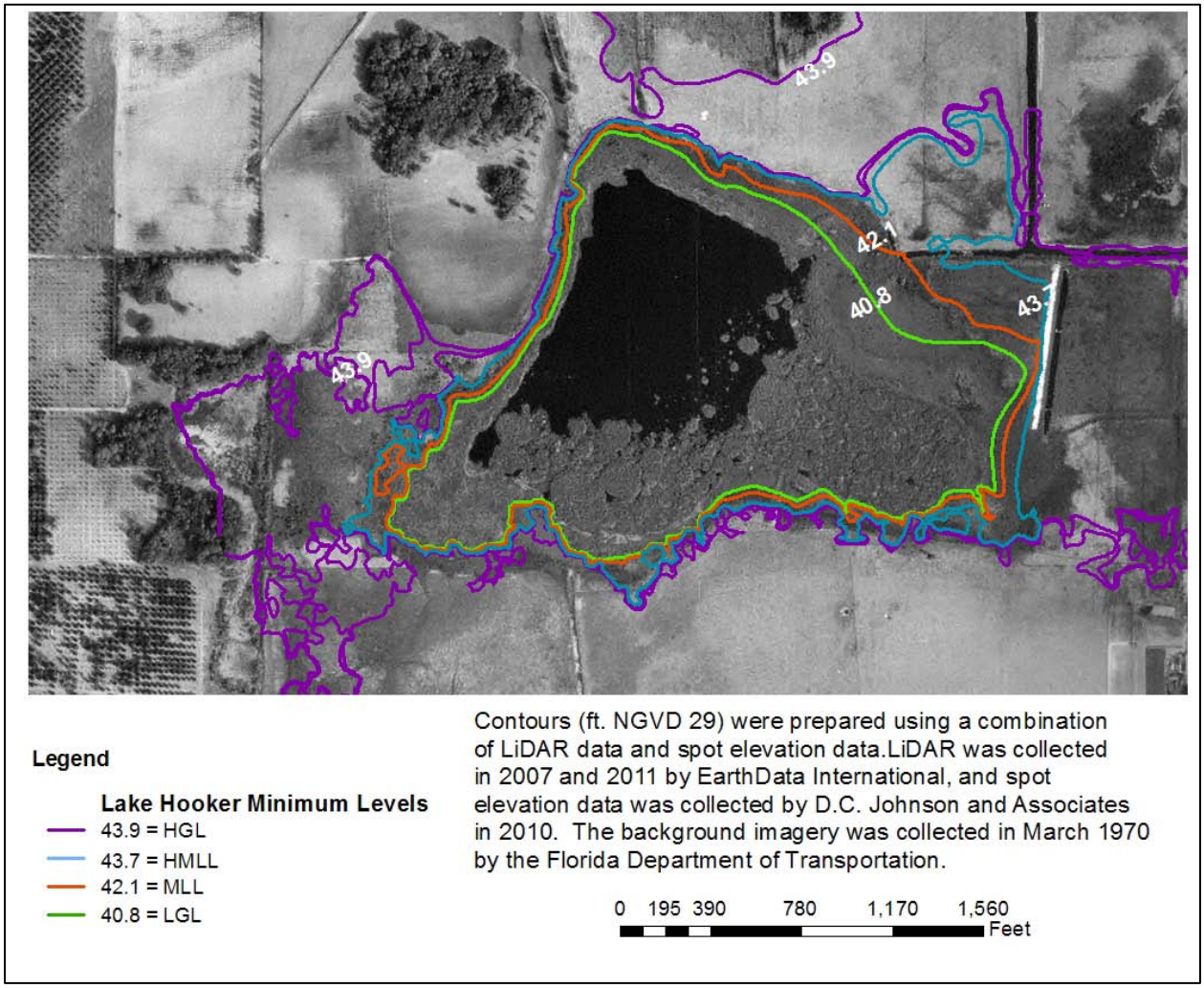


Figure 18. Approximate location of the adopted High Minimum Lake Level (HMLL), Minimum Lake Level (MLL), Low Guidance Level (LGL), and High Guidance Level (HGL) for Lake Hooker as associated with conditions observed in March 1970.

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