

Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake) in Pasco County, Florida



March 31, 2008

Ecologic Evaluation Section
Resource Projects Department

Southwest Florida
Water Management District



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Southwest Florida Water Management District
Brooksville, Florida 34604-6899

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Cover: Ground-level photograph of Unnamed Lake Number 22, which is also known as Loyce Lake (Southwest Florida Water Management District files).

Table of Contents

	<u>Page</u>
Title Page	1
Table of Contents	2
Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake)	3
Data and Analyses Supporting Development of the Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake)	6
Lake Setting and Description	6
Previously Adopted Guidance Levels	22
Summary Data Used for Minimum and Guidance Level Development	23
Lake Stage Data and Exceedance Percentiles	24
Normal Pool, Control Point Elevation and Determination of Structural Alteration Status	27
Guidance Levels	29
Lake Classification	30
Significant Change Standards and Other Information for Consideration	30
Minimum Levels	35
Documents Cited and Reviewed for Development of Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake)	39

Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce 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 for lakes, wetlands, rivers and aquifers. As currently defined by statute, 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", and 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". Minimum flows and levels are used by the Southwest Florida Water Management District (District) 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. Establishing a minimum flow or level does not in itself protect a water body from significant harm; however, resource protection, recovery and regulatory compliance may be ensured once the flow or level standards have been adopted.

Minimum flows and levels are 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; hereafter 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 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 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 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 guidance and minimum lake levels is provided in Southwest Florida Water Management District (1999) and Leeper *et al.* (2001). Bedient *et al.* (1999) and Dierberg and Wagner (2001) provide peer-review findings regarding the lake-level methods.

Two Minimum Levels and three 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 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 October 2007, the District Governing Board approved rule amendments pertaining to the elimination of Ten Year Flood Guidance Levels and references to the levels from Chapter 40D-8, F.A.C. Work related to the development of ten-year flood levels and other flood-recurrence levels is currently conducted through the District Watershed Management Program, and information pertaining to flood levels is included in watershed management plans that result from program activities.

In accordance with Chapter 40D-8, F.A.C., proposed Minimum and Guidance Levels were developed for Unnamed Lake Number 22 (also known as Loyce Lake), a

Category 3 Lake located in Pasco County, Florida (Southwest Florida Water Management District 2006a). The levels were established using best available information, including data that were obtained specifically for the purpose of minimum levels development. Following a public input process, the District Governing Board approved adoption of the proposed levels on November 30, 2006 and the levels (Table 1) were subsequently incorporated into Chapter 40D-8, F.A.C. The data and analyses used for development of the adopted levels are described in the remainder of this report.

Table 1. Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake).

Minimum and Guidance Levels	Elevation (feet above NGVD)
High Guidance Level	60.1
High Minimum Lake Level	59.3
Minimum Lake Level	55.8
Low Guidance Level	53.7

Data and Analyses Supporting Development of Minimum and Guidance Levels for Unnamed Lake Number 22 (Loyce Lake)

Lake Setting and Description

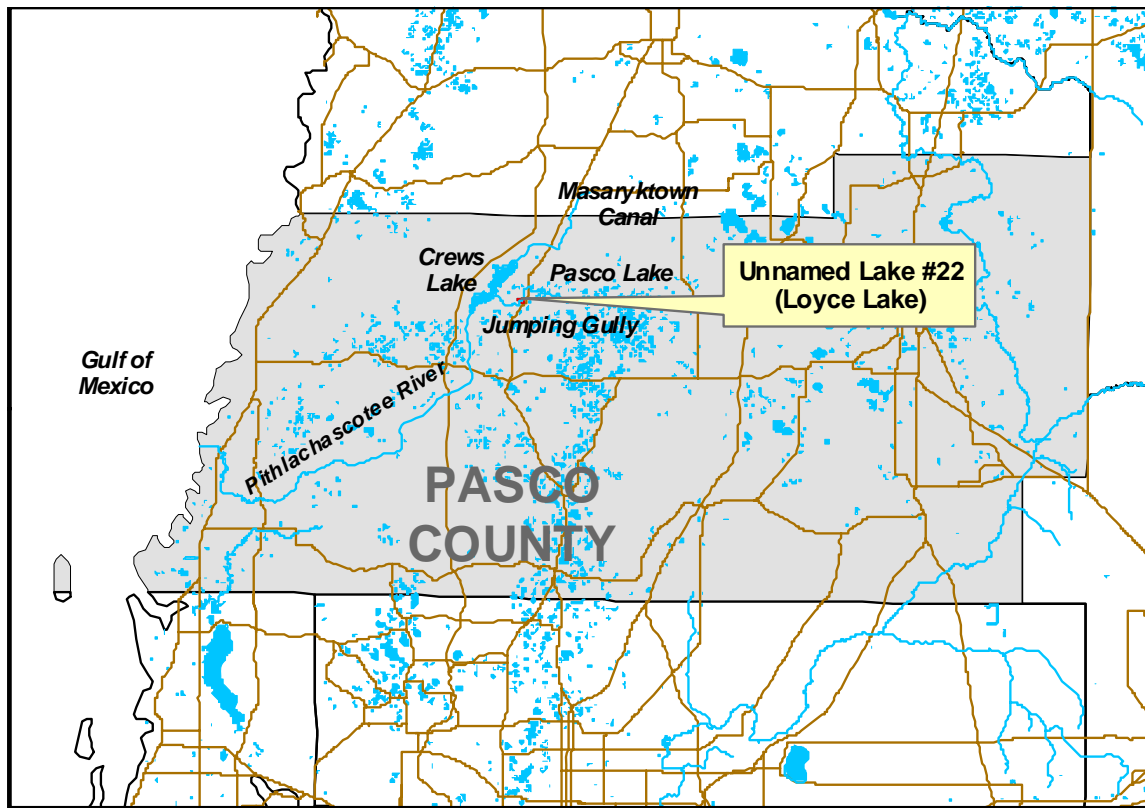
Unnamed Lake Number 22 (a.k.a. Loyce Lake) is located in north-central Pasco County, Florida (Sections 22 and 27, Township 24 South, Range 18 East) in the Coastal Rivers Basin of the Southwest Florida Water Management District (Figures 1 and 2). White (1970) classified the region of central or mid-peninsular Florida containing Unnamed Lake No. 22 as the Northern Gulf Coastal Lowlands. Brooks (1981) categorized the area surrounding the lake as the Land O Lakes subdivision of the Tampa Plain division of the Ocala Uplift District, and described the region as a plain with numerous small lakes imbedded in moderately thick silty sand deposits lying above the Tampa Limestone formation. As part of the Florida Department of Environmental Protection's Lake Bioassessment/ Regionalization Initiative, the area has been identified as the Tampa Plain lake region (Griffith *et al.* 1997). Lakes in the region are mostly mesotrophic, dark-water, slightly acidic systems.

Inundated or wetted portions of the basin include a diverse assemblage of wetland and aquatic plants, including southern naiad (*Najas guadalupensis*), bladderwort (*Utricularia* sp.), water pennywort (*Hydrocotyle umbellata*), spatterdock (*Nuphar luteum*), fragrant water lily (*Nymphaea odorata*), pickerelweed (*Pontederia cordata*), arrowhead (*Sagittaria* sp.), torpedo grass (*Panicum repens*), cattail (*Typha* sp.), sawgrass (*Cladium jamaicense*), primrose willow (*Ludwigia* sp.), wax myrtle (*Myrica cerifera*), and several sedge species. Uplands in the immediate lake basin include naturally forested areas and areas that are currently used for livestock grazing and residential development (Figure 3). Historical photographs from 1941 through 1999 (Figures 4-12) indicate that a portion of the eastern lakeshore was dredged or re-contoured sometime between 1957 and 1973. The District currently maintains a water-level gauging station in the northern portion of the dredged area.

The lake lies within the Jumping Gully drainage basin in the Upper Coastal Areas watershed (United States Geological Survey Hydrologic Unit Classification System). Surface water inputs include direct precipitation on the lake surface, runoff from immediately adjacent upland areas, inflow from Jumping Gully, and groundwater from the Floridan Aquifer System, which is pumped into the basin to augment water levels. The well used for lake augmentation is located along the northwestern lakeshore (Figure 3), and has been maintained and operated by Tampa Bay Water since 1996. Jumping Gully provides conveyance into the lake from several upstream water bodies, including Unnamed Lake Number 10, Pasco Lake, and various systems on the Cross Bar Ranch wellfield. Discharge in Jumping Gully upstream of Unnamed Lake Number 22 (Loyce Lake) has been measured by the United States Geological Survey at a site (United States Geological Survey Site Number 02310240, Southwest Florida Water Management District Universal Identification Number FLO 23 50) near U.S. Highway 41, from the mid-1960s through January 1988, and since January 1998. In recent years,

there has often been no flow in Jumping Gully. Prior to 1988, flows were typically less than 100 cfs, but reached as high as 890 cfs. Jumping Gully also serves as the outlet for Unnamed Lake Number 22, providing conveyance to Crews Lake, the headwaters of the Pithlachascotte River. There are no surface withdrawals from the lake permitted by the District. There are, however, several permitted groundwater withdrawals in the lake vicinity.

Because Unnamed Lake Number 22 is not named on United States Geological Survey topographic maps, it was not possible to determine whether the lake is listed in the "Gazetteer of Florida Lakes" (Florida Board of Conservation 1969, Shafer *et al.* 1986). The 1954 (and 1988 photorevised) United States Geological Survey 1:24,000, Masaryktown, Fla. and Ehren, Fla. quadrangle 7.5 minute topographic maps show the lake surface at an elevation of 61 feet above NGVD (see Figure 13 for a composite of recent United States Geological Survey topographic maps of the Unnamed Lake Number 22 area). A topographic map of the lake basin generated in support of minimum levels development (Figure 14) indicates that the lake extends over 31 acres when it is staged at 56 feet above NGVD.



■ Unnamed Lake Number 22
(a.k.a., Loyce Lake)

■ Other Water Bodies

— Highways and Major Roads

0 10 20 Miles



Figure 1. Location of Unnamed Lake Number 22 (also known as Loyce Lake), other regional water bodies, highways and major roads within or near Pasco County, Florida.

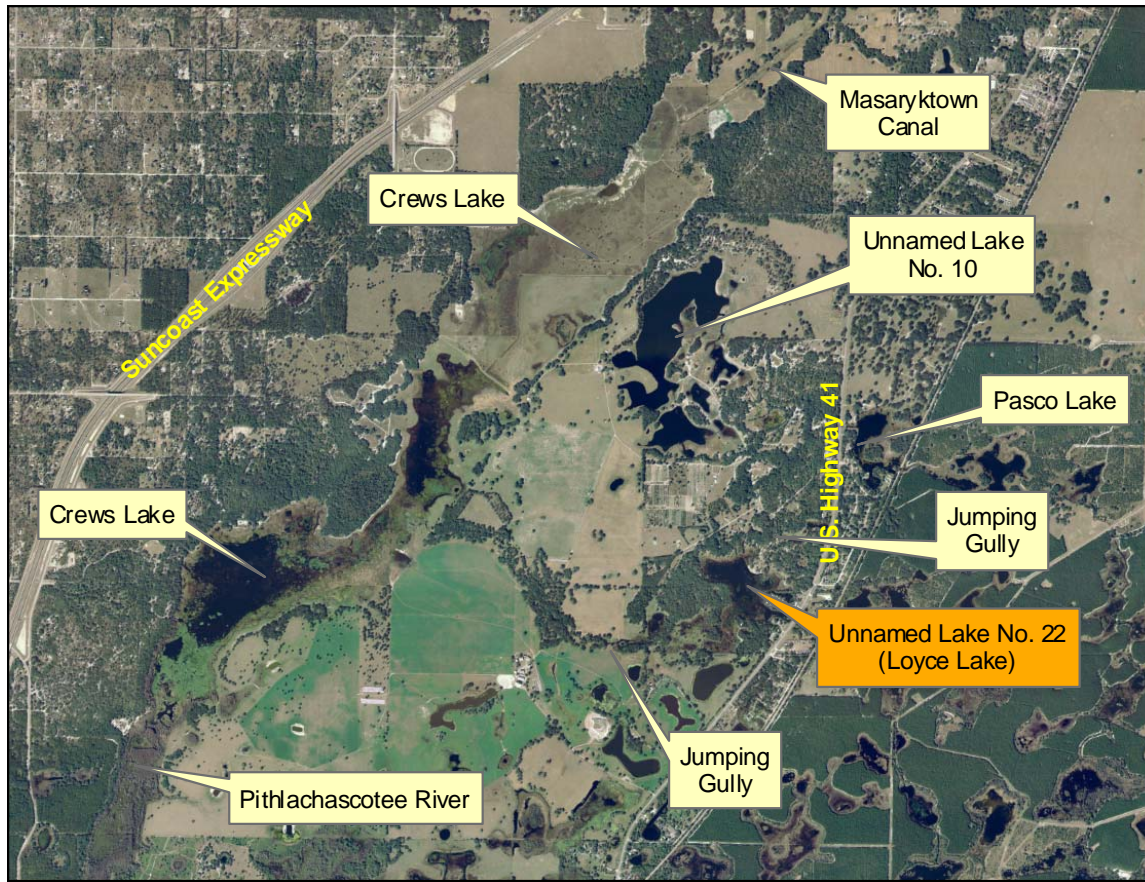







Figure 2. Aerial photograph of the Unnamed Lake Number 22 area in 2005, showing other major water bodies and roads. Photographic image is from United States Geological Survey (2005) digital orthophotography.

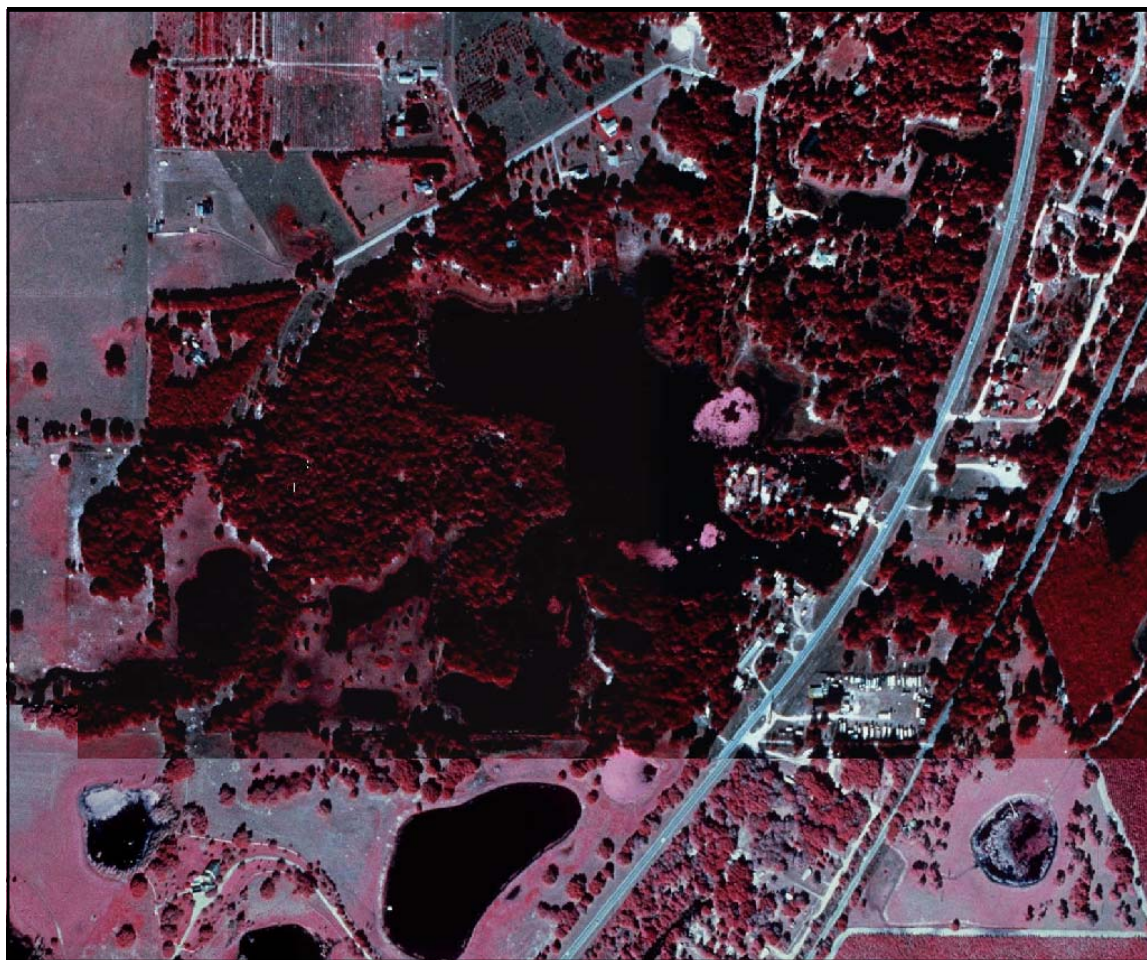


-  Water level gauge
-  Augmentation wells
-  Hydrologic indicators site
-  Control Point = high spot in Jumping Gully at 58.3 feet above NGVD
-  Inlet/outlet flow direction

0 1,000 2,000 Feet



Figure 3. Aerial photograph of Unnamed Lake Number 22 in 2005, showing the location of the District water level gauge, the wells used to augment the lake, and the site where hydrologic indicators were measured. The lake inlet and outlet is also shown and the Control Point elevation for the lake is identified. The photographic image is from United States Geological Survey (2005) digital orthophotography.



0 1,000 2,000 Feet



Figure 4. Aerial photograph of Unnamed Lake Number 22 in 1999. The image is from United States Geological Survey (1999) digital orthophotography.



0 1,000 2,000 Feet



Figure 5. Aerial photograph of Unnamed Lake Number 22 in 1994. The image is from United States Geological Survey (1994) digital orthophotography.



0 1,000 2,000 Feet



Figure 6. Aerial photograph of Unnamed Lake Number 22 in 1984. The image is from United States Geological Survey (1984) National High Altitude Photography.



0 1,000 2,000 Feet



Figure 7. Aerial photograph of Unnamed Lake Number 22 in 1973. The image is from Woolpert (2003).

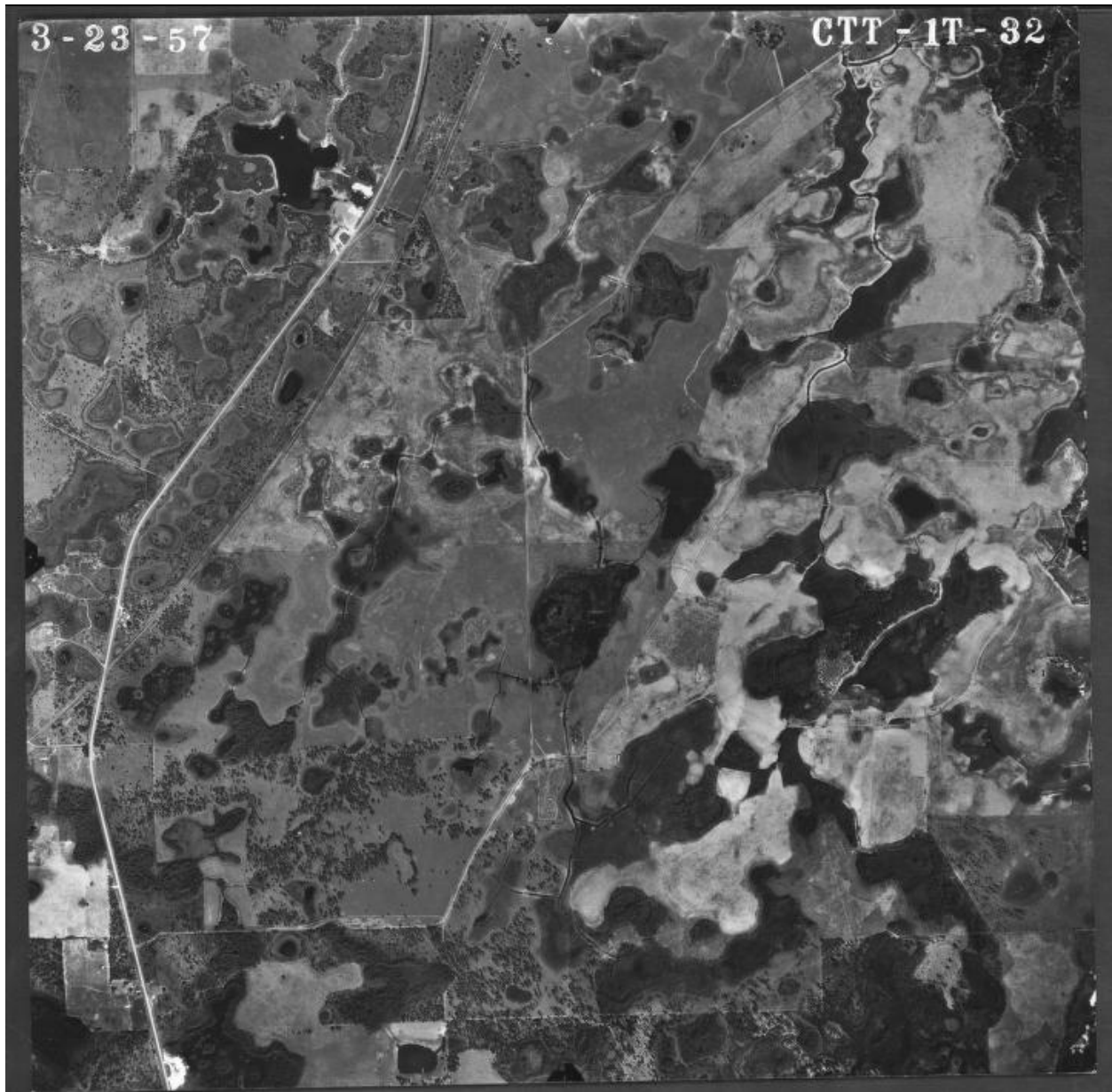


Figure 8. Aerial photograph of the Unnamed Lake Number 22 area in March 1957 (United States Department of Agriculture 1957b).



Figure 9. Aerial photograph of the Unnamed Lake Number 22 area in January 1952 (United States Department of Agriculture 1952b).

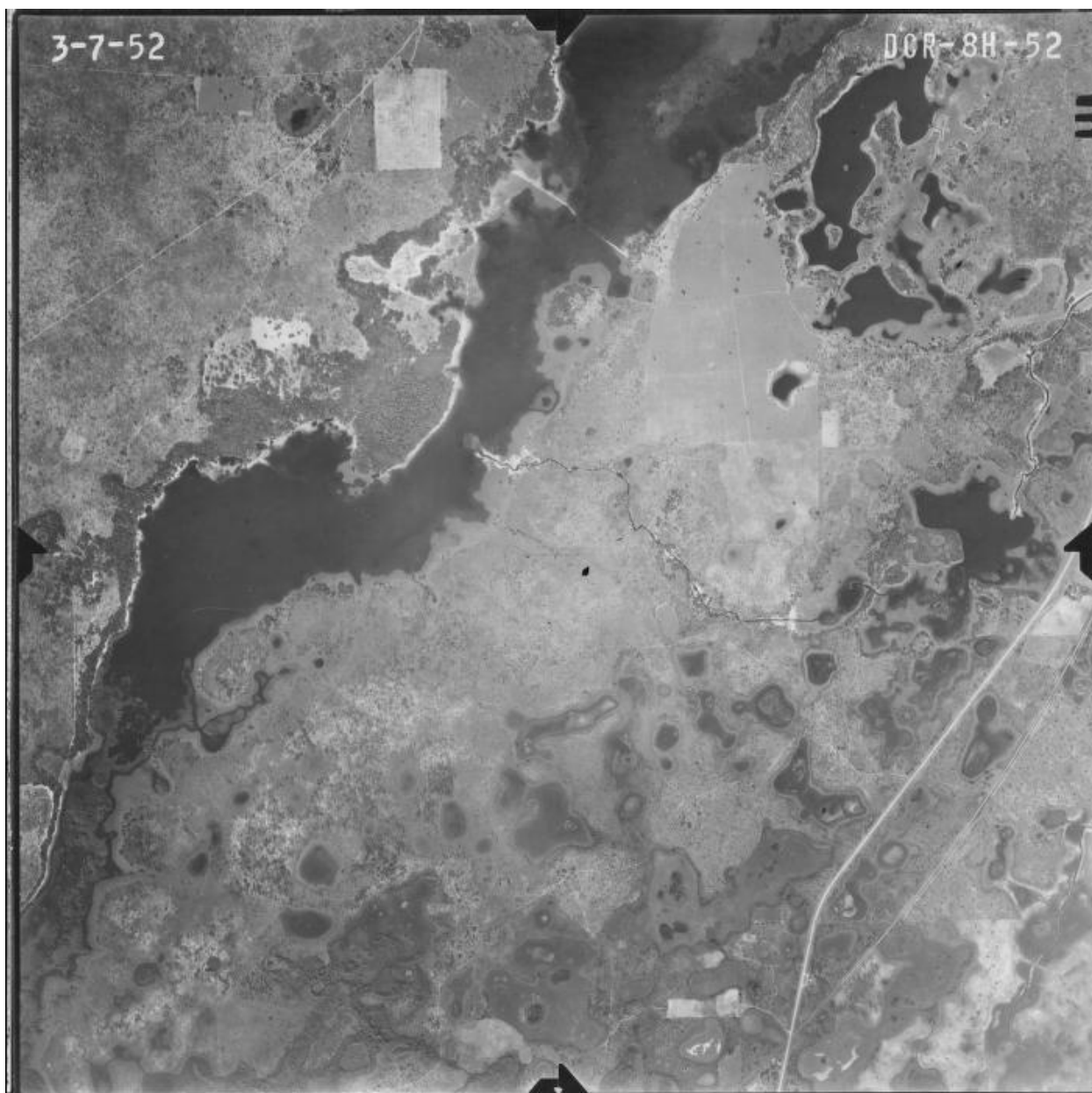


Figure 10. Aerial photograph of the Unnamed Lake Number 22 area in March 1952 (United States Department of Agriculture 1952d).

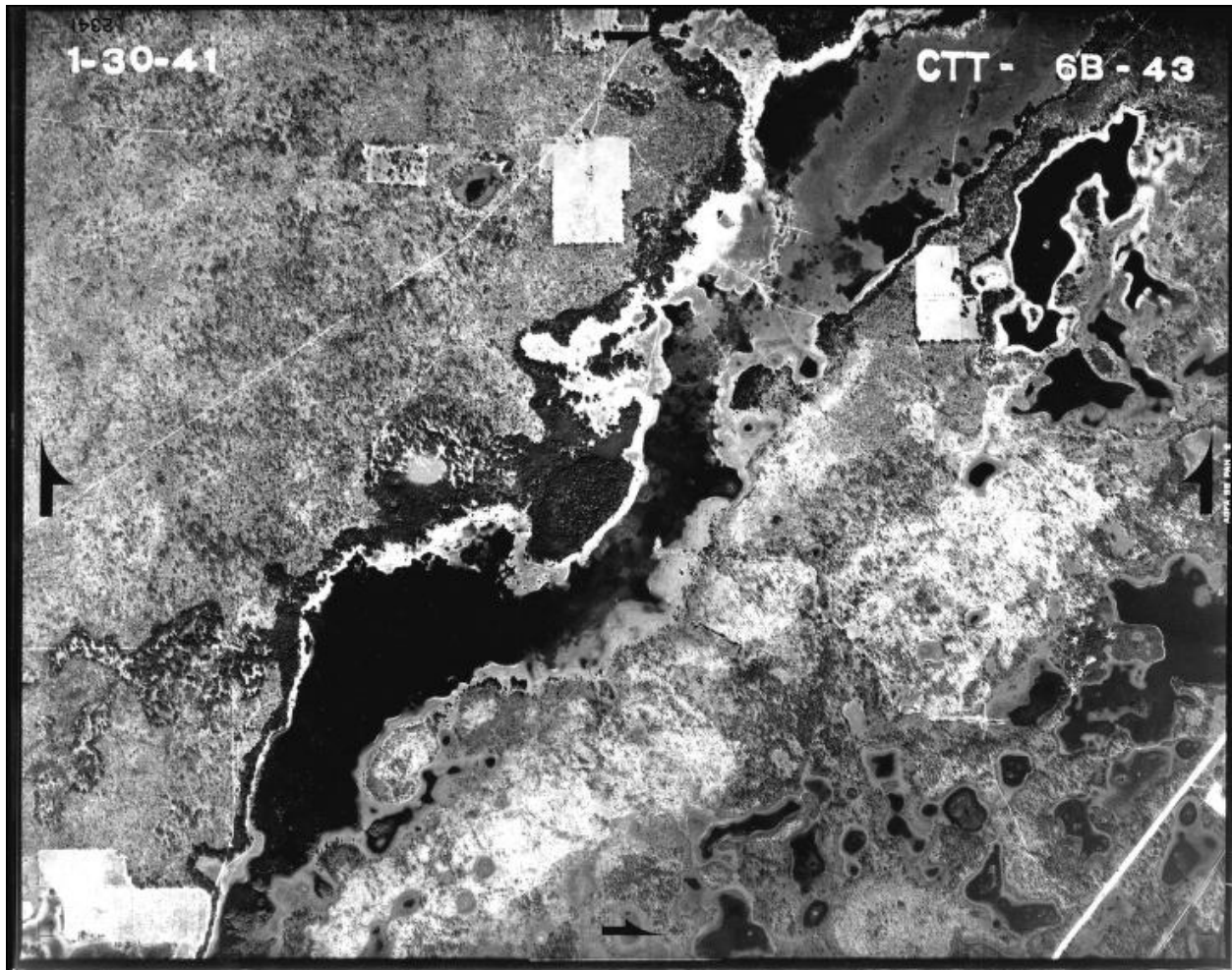


Figure 11. Aerial photograph of the Unnamed Lake Number 22 area in January 1941 (United States Department of Agriculture 1941b).

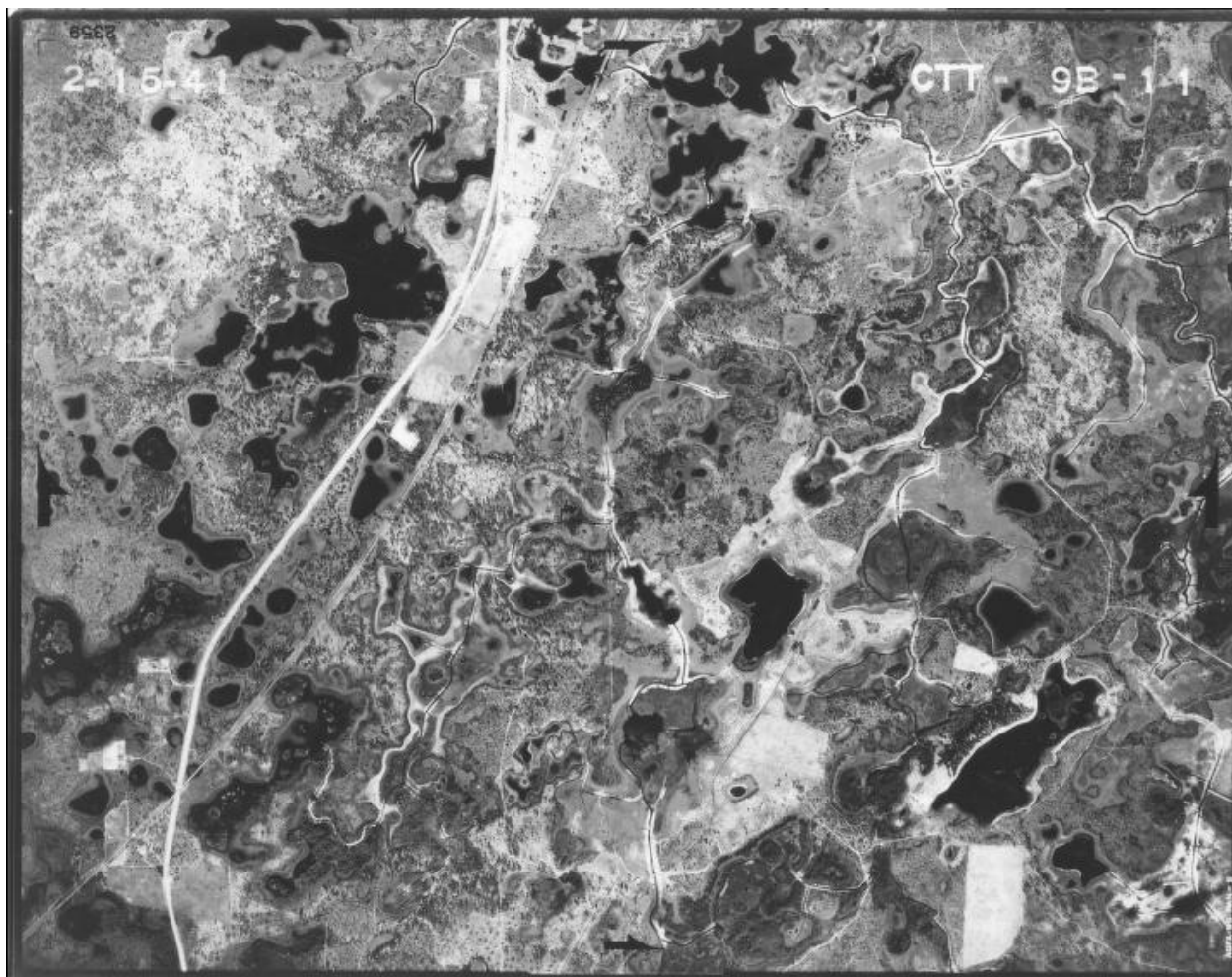


Figure 12. Aerial photograph of the Unnamed Lake Number 22 area in February 1941 (United States Department of Agriculture 1941c).

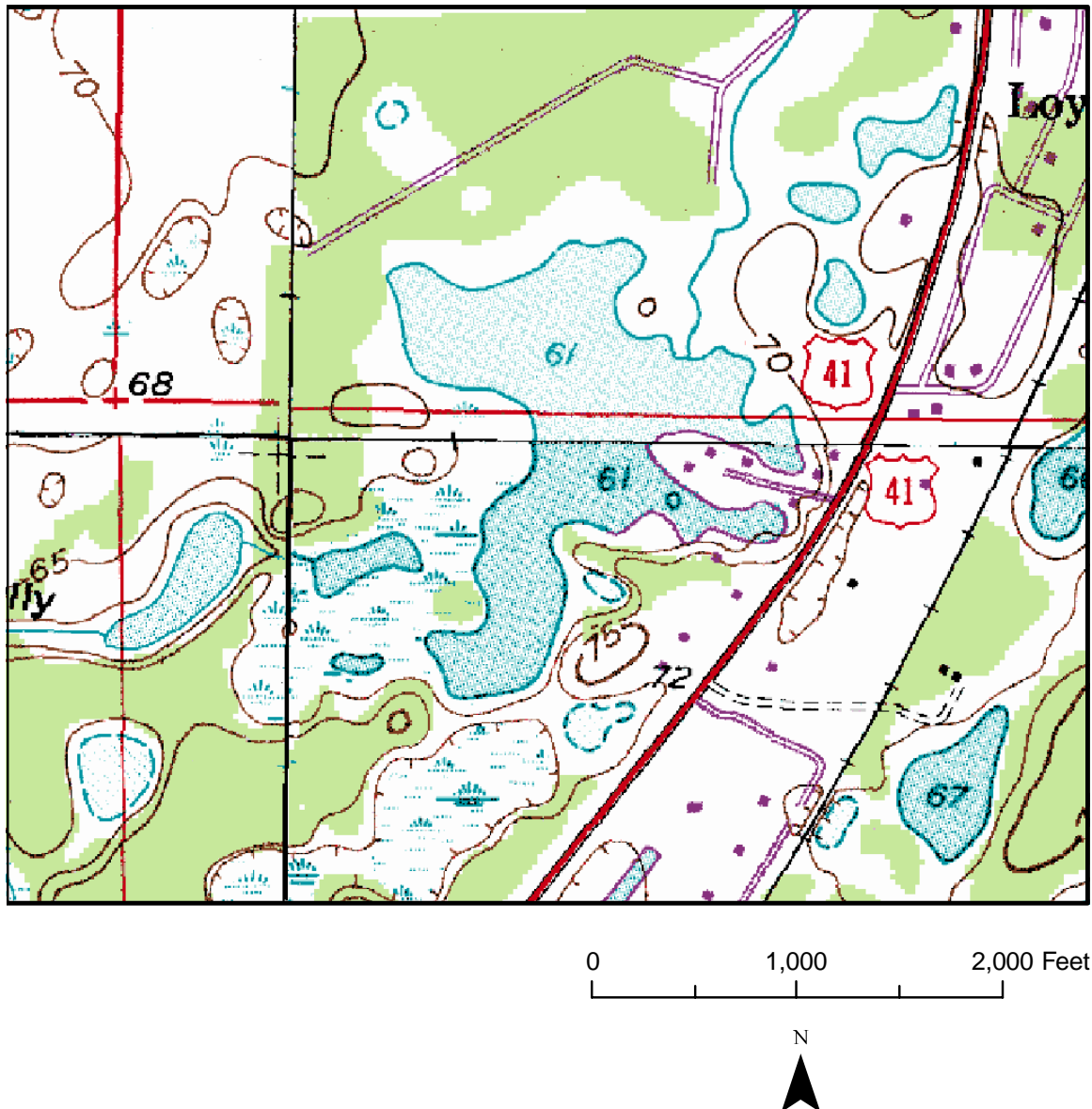
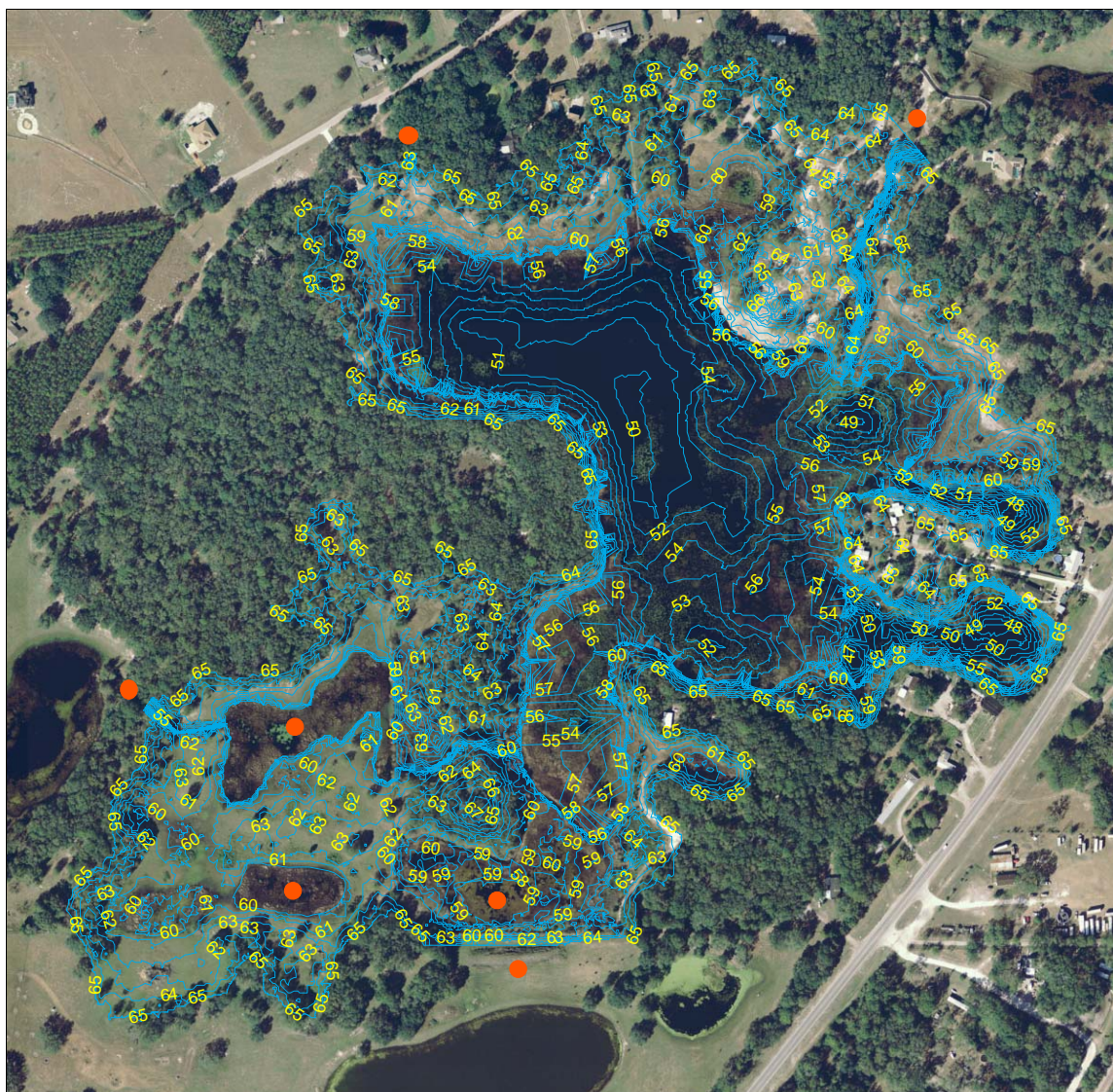


Figure 13. Five-foot elevation (feet above NGVD) contours in the vicinity of Unnamed Lake Number 22 as shown on United States Geological Survey (1954a-d, 1988a-d) 7.5 minute series topographic maps. Note that the lake water surface is listed at 61 feet above NGVD 1929. Image is from the United States Geological Surveys 1:24,000 scale topographic map (DRG) layer available from the Mapping and GIS Section of the Southwest Florida Water Management District.



Map prepared using spot elevation data collected by D.C. Johnson Associates in May 2005, LiDAR data collected by EarthData International, Inc. in 2004, and USGS 2005 digital orthophotography.

0 250 500 Feet



Figure 14. One-foot elevation (feet above NGVD) contours within the Unnamed Lake Number 22 basin. Orange dots indicate areas where spot elevation data were not available (interior of the mapped area) or regions where contours were truncated (margin of mapped area) for mapping purposes.

Previously 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.

Management levels, currently referred to as Guidance Levels (Table 2), were approved for Unnamed Lake Number 22 by the Governing Board in November 1984 and incorporated into Chapter 40D-8, F.A.C. 2). A Maximum Desirable Level of 62.00 feet above NGVD was also developed but was not adopted by rule. The levels were developed using a methodology that differs from the current District approach for establishing Minimum and Guidance Levels, and do not, therefore, necessarily correspond with levels developed using current methods. Following the November 2006 adoption of Minimum and Guidance Levels for Unnamed Lake Number 22 that were developed using the current methods, the previously adopted Guidance Levels were removed from Chapter 40D-8., F.A.C.

Annually since 1991, a list of stressed lakes has been developed to support the District's 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 High, Low and Extreme Low 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.

Unnamed Lake Number 22 has previously been classified as a stressed lake (see Gant 1999a, 1999b, 2000, 2002, 2003, 2004, 2005). Based on the adoption of Minimum Levels for the lake in November 2006, the lake was not included in the most recent stressed lakes list (Gant 2007) nor will it be included in future list evaluations. Evaluation of water level fluctuations within the basin will instead be incorporated in annual determinations of compliance with adopted Minimum Levels.

Table 2. Previously adopted guidance Levels for Unnamed Lake Number 22.

Minimum and Guidance Levels	Elevation (feet above NGVD)
Ten Year Flood Guidance Level	62.60
High Level	62.50
Low Level	59.50
Extreme Low Level	57.50

Summary Data Used for Minimum and Guidance Level Development

Minimum and Guidance Levels were developed for Unnamed Lake Number 22 using the methodology for Category 3 lakes described in Chapter 40D-8, F.A.C. The levels and additional information are listed in Table 3, along with lake surface areas for each elevation. Detailed descriptions of the development and use of these data are summarized in subsequent sections of this report.

Table 3. Minimum and Guidance Levels, lake stage exceedance percentiles, Normal Pool, Control Point elevation, significant change standards and associated surface areas for Unnamed Lake Number 22.

	Elevation (feet above NGVD)	Lake Area (acres)
Lake Stage Exceedance Percentiles		
Historic P10	60.1	46
Historic P50	56.6	33
Historic P90	53.7	15
Current P10	60.0	46
Current P50	NA	NA
Current P90	NA	NA
Period of Record P10	60.1	46
Other Levels		
Normal Pool	65.3	NA
Control Point	58.3	36
Significant Change Standards		
Dock-Use Standard	62.0	63
Basin Connectivity Standard	60.5	49
Wetland Offset	55.8	30
Species Richness Standard	55.5	28
Aesthetic Standard	53.7	15
Recreation/Ski Standard	NA	NA
Lake Mixing Standard	NA	NA
Minimum Levels		
High Guidance Level	60.1	46
High Minimum Lake Level	59.3	40
Minimum Lake Level	55.8	30
Low Guidance Level	53.7	15

NA = not available or not applicable

Lake Stage Data and Exceedance Percentiles

Lake stage data, *i.e.*, surface water elevations, for Unnamed Lake Number 22 (District Universal Identification Number STA 426 427) are available from the District's Water Management Data Base from October 1983 through the present date (see Figure 15 for data collected through October 2006; see Figure 3 for current location of the District water level gauge). The highest surface water elevation for the lake included in the database, 61.64 feet above NGVD, occurred on March 16, 1998. The low of record, 50.01 feet above NGVD, was recorded on May 21, 2001.

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 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 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 for Unnamed Lake Number 22 collected after December 1984 were classified as Current data, and water level records collected prior to January 1985 were considered to be Current data. The Current P10, *i.e.*, the water surface elevation equaled or exceeded ten percent of the time during the Current period, was 60.0 feet above NGVD. Current P50 and P90 elevations, which are water surface elevations equaled or exceeded fifty and ninety percent of the time, respectively, during the current period, were not calculated due to effects of lake augmentation on lake water levels during the Current period. Augmentation of Unnamed Lake Number 22 with pumped groundwater during low-water periods would be expected to skew P50 and P90 exceedance percentiles for the Current period.

Limited availability of Historic data for Unnamed Lake Number 22 did not allow confident estimation of Historic lake stage exceedance percentiles. Water surface elevations were recorded for only five dates during the Historic period. Review of peak lake stage values occurring throughout the entire period of record (see Figure 15) suggested, however, that the Historic P10 elevation could be approximated using the period of record P10 elevation (60.1 feet above NGVD). Effects of regional water withdrawals and lake augmentation during the Current period limited the usefulness of period of record data for estimation of the Historic P50 and P90 elevations.

Historic P50 and P90 elevations for Unnamed Lake Number 22 were, therefore, developed using reference lake water regime statistics that were based on Historic P10, P50 and P90 percentiles calculated for nearby Crews Lake. Reference lake water regime statistics represent differences between P10, P50 and P90 lake stage elevations for typical, regional lakes that exhibit little or no impacts associated with water withdrawals (*i.e.*, reference lakes). Reference lake water regime statistics are

developed for use when adequate Historic or Current data are not available for calculation of Historic lake-stage exceedance percentiles. Reference lake water regime statistics include the RLWR50, RLWR90 and RLWR5090, which are, respectively, median differences between P10 and P50, P50 and P90, and P10 and P90 lake stage percentiles for a reference lake or set of reference lakes.

The lake-stage exceedance percentiles that were used to develop reference lake water regime statistics for Unnamed Lake Number 22 were calculated using a composite 56-year record of monthly mean lake surface elevations based on: 1) available Crews Lake stage records for a period when the lake was not impacted by withdrawals, and 2) modeled lake stage estimates for periods when lake-stage data were not available or when withdrawals affected the lake's levels. A similar composite water level record could not be constructed for Unnamed Lake Number 22, due to the limited availability of historic data that could be used to develop modeled lake-stage values. The 56-year period or record for the Crews Lake composite water level data set 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 (Enfield et al. 2001, Basso and Schultz 2003, Kelly 2004).

Modeled monthly mean lake stage values for the composite Crews Lake water level data set were estimated using a linear fitting procedure known as the line of organic correlation (see Helsel and Hirsch 1992). The procedure was utilized to describe the relationship between available lake stage data for Crews Lake and potentiometric surface elevations for the Upper Floridan Aquifer system, as measured at the Sharpes Ferry West Floridan well site (District Universal Identification Number WEL 2555 1834; United States Geological Survey Number 29111508592501) in Marion County. The line of organic correlation equation developed for the lake and well data collected from March 1964 through September 2002 was used to estimate water surface elevations for Crews Lake for the period from January 1946 through September 2002 (M. Hancock, Southwest Florida Water Management District unpublished data). A Historic, composite data set of monthly mean water surface elevations for Crews Lake was then developed using the modeled water surface elevations and available lake stage records (Figure 16). Historic P10, P50 and P90 elevations of 54.9, 51.4 and 48.5 feet above NGVD, respectively, were calculated for Crews Lake using the historic, composite data set. Differences between these exceedance percentiles were then used to establish RLWR50 (3.5 feet), RLWR5090 (2.9 feet), and RLWR90 (6.4 feet) statistics to be used for determining the Historic P50 and Historic P90 for Unnamed Lake Number 22 (Loyce Lake).

The Historic P50 elevation for Unnamed Lake Number 22, the water surface elevation equaled or exceeded fifty percent of the time during the historic period, was established at 56.6 feet above NGVD by subtracting the RLWR50 from the Historic P10 elevation, *i.e.*, from the High Guidance Level (see the Guidance Levels section of this report). The Historic P90, the elevation the lake water surface equaled or exceeded ninety percent of

the time during the historic period, was established at 53.7 feet above NGVD, by subtracting the RLWR90 from the Historic P10.

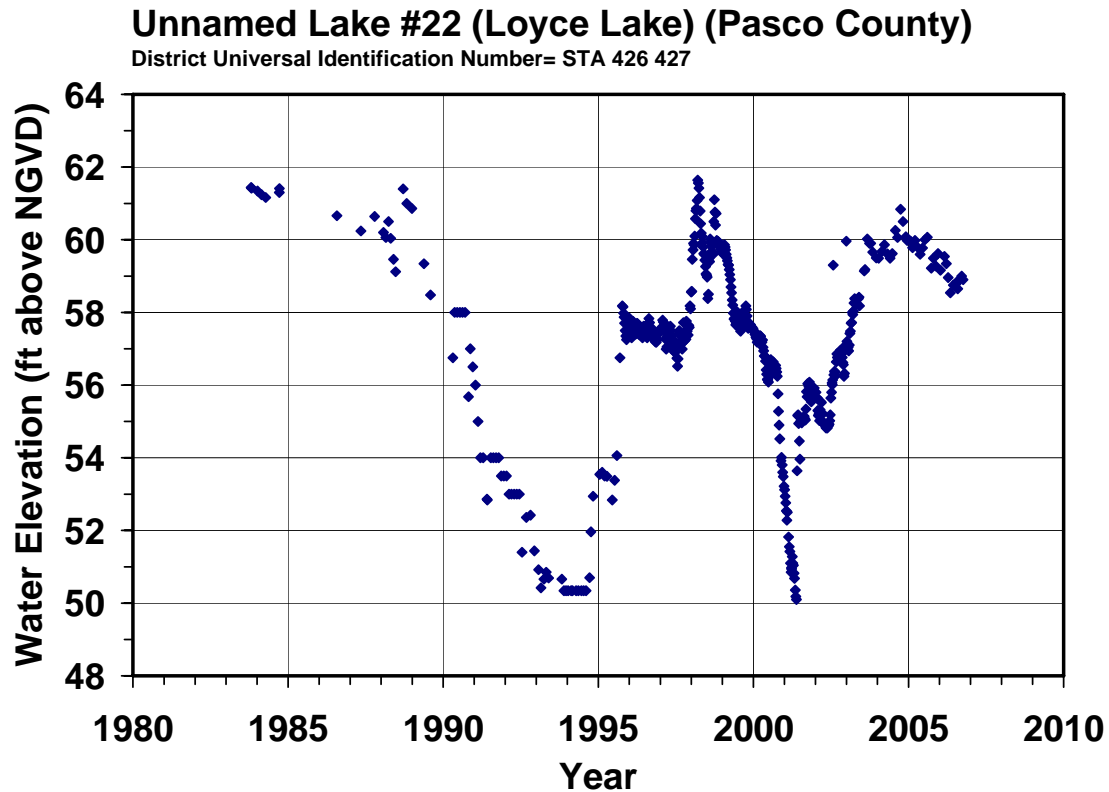


Figure 15. Surface water elevation values for Unnamed Lake Number 22 through October 2006. Data were obtained from the District Water Management Database.

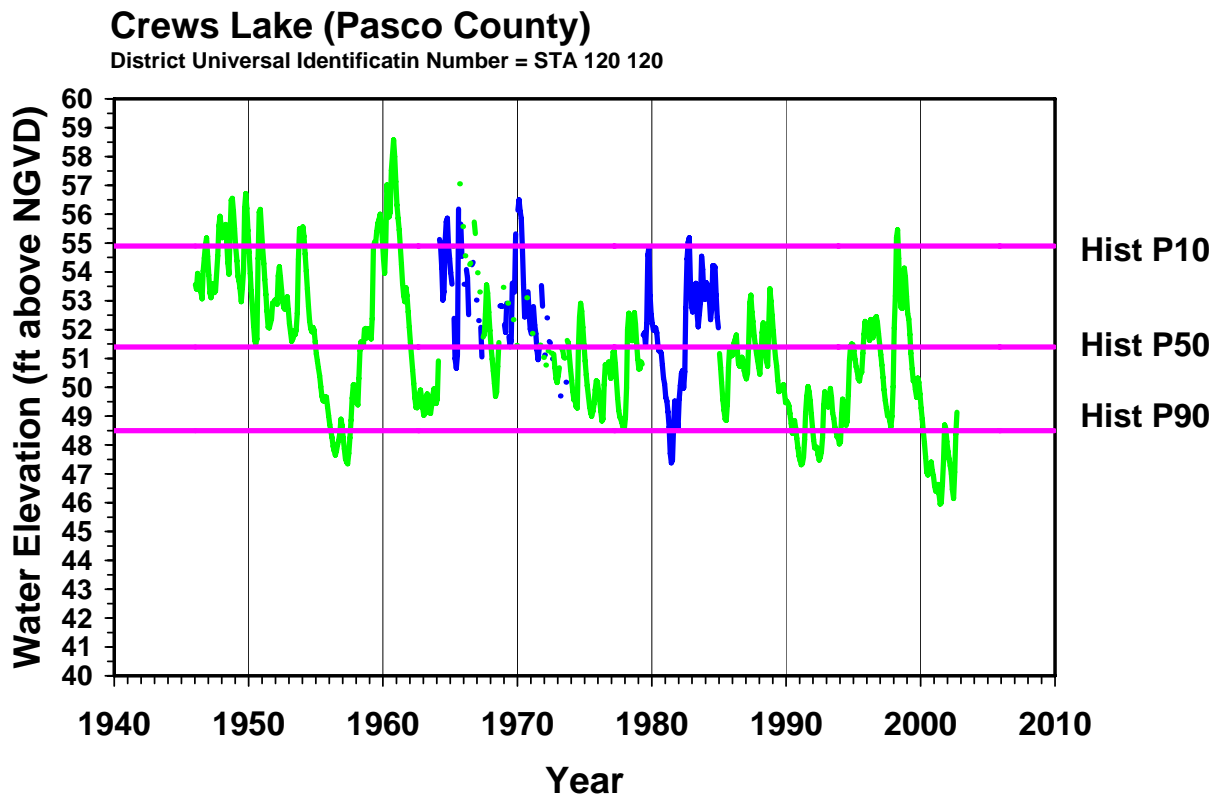


Figure 16. Composite monthly-mean surface water elevations and Historic lake-stage exceedance percentiles for Crews Lake, from January 1946 through September 2002. Composite data include values based on measured water surface elevations (blue) and modeled values (green). Historic exceedance percentiles include the Historic P10 (Hist P10), Historic P50 (Hist P50) and Historic P90 (Hist P90). Differences between the Historic exceedance percentiles were used to establish reference lake water regime statistics for Pasco Lake.

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 based on the distribution of Hydrologic Indicators of sustained inundation. Hydrologic indicators of Normal Pool include biological and physical features that become established as a result or recent of long-term water levels. Based on ground elevations at the base of saw palmetto (*Serenoa repens*) shrubs located along the northwest shore of the lake, the Normal Pool elevation was established at 65.3 feet above NGVD (Table 4, Figures 3 and 17).

For development of minimum and guidance levels, lakes are classified as open or closed basin lakes. Open basin lakes are systems that are connected to, or are part of an ordered surface water conveyance system, *i.e.*, they have outlets or inlets for

conveyance of surface water. Closed basin lakes are those that are not part of an ordered conveyance system. Because Unnamed Lake Number 22 discharges through Jumping Gully to Crews Lake, it was classified as an open basin lake.

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, canal or culvert) that is the principal control of water level fluctuations in the lake. A Control Point may be established at the invert or crest elevation associated with a water control structure at a lake outlet, or at a high, stable point in a lake-outlet canal, ditch or wetland area. The invert elevation is the lowest point on the portion of a water control structure that provides for conveyance of water across or through the structure. A crest elevation typically refers to the top or ridge of fixed-weirs or operable gates, over which water may flow. Based on review of available aerial photography with contours maps of the region (Southwest Florida Water Management District 1974a-e, 1978a-c), LiDAR data (EarthData International, Inc. 2004) and recent survey work (Southwest Florida Water Management District 2006b, c), the Control Point elevation for Unnamed Lake Number 22 was established at a high spot in Jumping Gully, at an elevation of 58.3 feet above NGVD (see Figure 3 for the Control Point location).

Structural alteration status is determined to support development of the High Guidance Level. In addition to identification of outlet conveyance system modifications, comparison of the Control point elevation with the Normal Pool elevation is typically used to determine if a lake has been structurally altered. If the Control Point elevation is below the Normal Pool, the lake is classified as a structurally altered system. If the Control Point elevation is above the Normal Pool or the lake has no outlet, then the lake is not considered to be structurally altered. Because Jumping Gully, the outlet for Unnamed Lake Number 22 has been altered from its natural state, and because the Control Point elevation is lower than the Normal Pool, the lake was classified as structurally altered.

Table 4. Summary statistics for hydrologic indicator measurements (elevation at the base of individual *Serenoa repens* shrubs) used for establishing the Normal Pool elevation for Unnamed Lake Number 22. Data were collected in July 2006 by District staff.

Statistic	Statistic Value (N) or Elevation (feet above NGVD)
N	20
Median	65.3
Mean (SD)	65.1 (0.6)
Minimum	63.5
Maximum	65.9

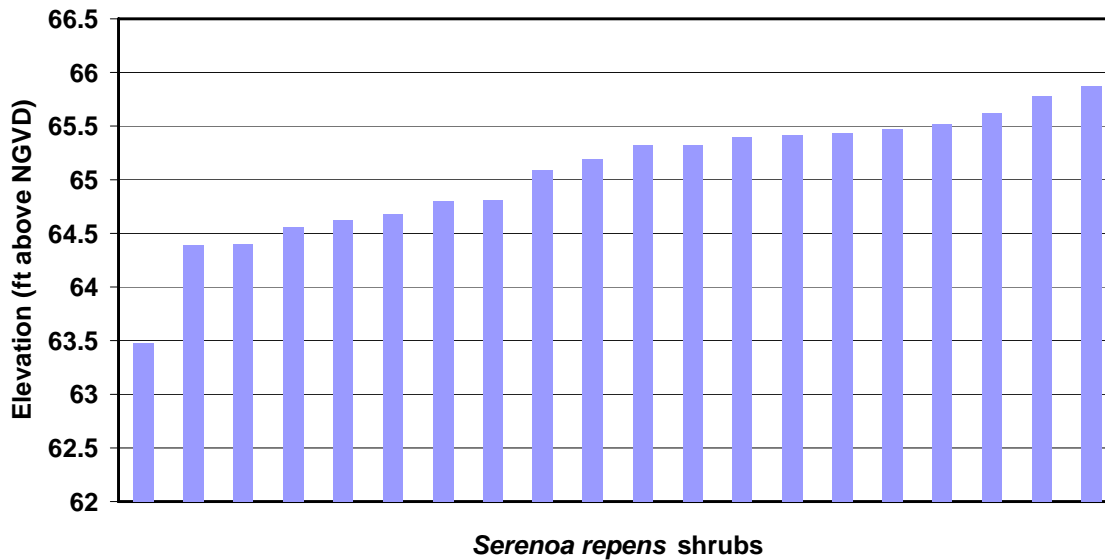


Figure 17. Ground elevations at the base of *Serenoa repens* used to establish the Normal Pool elevation for Unnamed Lake Number 22.

Guidance Levels

The Ten Year Flood Guidance Level has historically been provided as advisory information 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. District rules (Chapter 40D-8, F.A.C.) previously included a Ten Year Flood Guidance Level of 62.6 feet above NGVD for Unnamed Lake Number 22 (see Southwest Florida Water Management District 1991, 1996a). Recent work completed in support of the District's Watershed Management Program has, however, yielded a new, provisional ten-year recurrence flood stage for the lake. Based on a storm-event modeling approach, Ardaman and Associates, Inc. (2007) identified a ten year flood recurrence level for Unnamed Lake Number 22 at 63.6 feet above NGVD. It should be noted that the Watershed Management Plan that includes the provisional flood elevation for the Lake will be subjected to public review prior to finalization of project results.

In October 2007, the District Governing Board approved rule amendments to remove all adopted Ten Year Flood Guidance Levels from Chapter 40D-8, F.A.C. The intent of this action was not to discontinue development of regional and site-specific flood stage information, but rather to promote organizational efficiency by eliminating unnecessary rules. Flood stage levels continue to be developed under the District's Watershed Management Program, but ten year flood recurrence levels are not incorporated into Chapter 40D-8, F.A.C. In accordance with this policy, Chapter 40D-8, F.A.C. does not currently include a Ten Year Flood Guidance Level for Unnamed Lake Number 22.

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 using Historic data if it is available, or is estimated using the Current P10, the Control Point and the Normal Pool elevation. Because competent Historic and Current data are not available for Unnamed Lake Number 22, the High Guidance Level could be established at the Control Point elevation, 58.3 feet above NGVD. However, based on a P10 elevation of 60.0 feet above NGVD for the data collected since January 1985 (which could be classified as Current data, except for the confounding effect of lake augmentation), establishment of the High Guidance Level at 58.3 feet above NGVD was not considered appropriate. A better approximation of the Historic P10, the period of record P10 elevation, was instead, used to establish the High Guidance Level at 60.1 feet above NGVD.

The Low Guidance Level is provided as an advisory guideline for water dependent structures, and as 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 competent Historic or Current data are not available for Unnamed Lake Number 22, the Low Guidance Level was established at 53.7 feet above NGVD, by subtracting the appropriate RLWR90 (6.4 feet) from the High Guidance Level.

Lake Classification

Lakes are classified as Category 1, 2 or 3 for the purpose of Minimum Levels development. Systems with fringing cypress wetlands greater than 0.5 acres in size where water levels regularly rise to an elevation expected to fully maintain the integrity of the wetlands (*i.e.*, the Historic P50 is not more than 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 is more than 1.8 feet below the normal pool elevation are classified as Category 2 Lakes. Lakes without fringing cypress wetlands or with less than 0.5 acres of fringing cypress wetlands are classified as Category 3 Lakes. Based on the lack of lake-fringing cypress wetlands within the basin, Unnamed Lake Number 22 was 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 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 3 lakes, six significant change standards, 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 are developed. These standards identify desired median lake stages that if achieved, are intended to preserve various natural system and human-use lake values.

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 use of the lake. The standard is based on the elevation of lake sediments at a critical high spot between lake basins or lake sub-basins, identification of water depths sufficient for movement of biota and/or watercraft across the critical high spot, and use of Historic lake stage data or region-specific reference lake water regime statistics. The Basin Connectivity Standard was established at 60.5 feet above NGVD, based on the elevation that ensures connectivity between the lake's northern sub-basins and the southern basin (56.6 feet above NGVD), a one-foot water depth in the area of connectivity to allow for movement of biota between the sub-basins, and the difference between the Historic P50 and Historic P90 elevations (2.9 feet). If powerboats were used at the lake, the Basin Connectivity Standard would be established at 61.5 feet above NGVD, based on the requirement for a water depth of two feet at the critical high spot of connectivity.

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 Unnamed Lake Number 22, the Species Richness Standard was established at 55.5 feet above NGVD.

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 beyond the values associated with the lake when it is staged at the Low Guidance Level. The Aesthetic Standard is established at the Low Guidance Level, which for Unnamed Lake Number 22 occurs at an elevation of 53.7 feet above NGVD.

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. The Dock-Use Standard for Unnamed Lake Number 22 was

established at 62.0 feet above NGVD, based on the sum of the elevation of sediments at the end of 90% of the 4 docks within the basin (57.1 feet above NGVD, Table 5), a two-foot water depth for boat mooring, and the appropriate RLWR5090 (2.9 feet)

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 200 feet in width and 2,000 feet in length, and use of Historic lake stage data or region-specific reference lake water regime statistics. Based on field observations indicating that the lake is not used for recreational skiing, and also based on basin morphology, which would not allow for the occurrence of a suitable ski area, a Recreation/Ski Standard was not developed for Unnamed Lake Number 22.

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 of <0.8 . Because the dynamic ratio does not shift across the 0.8 threshold as the stage of Unnamed Lake Number 22 ranges from dry conditions to 65 feet above NGVD (Figure 18), a Mixing Standard was not developed.

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 18). However, because herbaceous wetlands are common within the lake basin, it was determined that an additional measure of potential 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 likely not lead to significant change in the herbaceous wetlands occurring within lake basins. A Wetland Offset elevation of 55.8 feet above NGVD was therefore established for Unnamed Lake Number 22 by subtracting 0.8 feet from the Historic P50 elevation.

Table 5. Summary statistics for elevations associated with docks in Unnamed Lake Number 22. Percentiles (P10, P50, P90) represent elevations exceeded by 10, 50 and 90 percent of the docks, based on measurements collected by District staff in July 2006.

Summary Statistic	Statistic Value (N) or Elevation (feet above NGVD) of Sediments at Waterward End of Docks	Statistic Value (N) or Elevation (feet above NGVD) of Dock Platforms
N	4	4
Mean (Standard Deviation)	55.1 (2.3)	61.6 (0.8)
P10	57.1	62.3
P50 or Median	55.5	61.8
P90	52.9	60.9
Maximum	57.3	62.4
Minimum	52.3	60.5

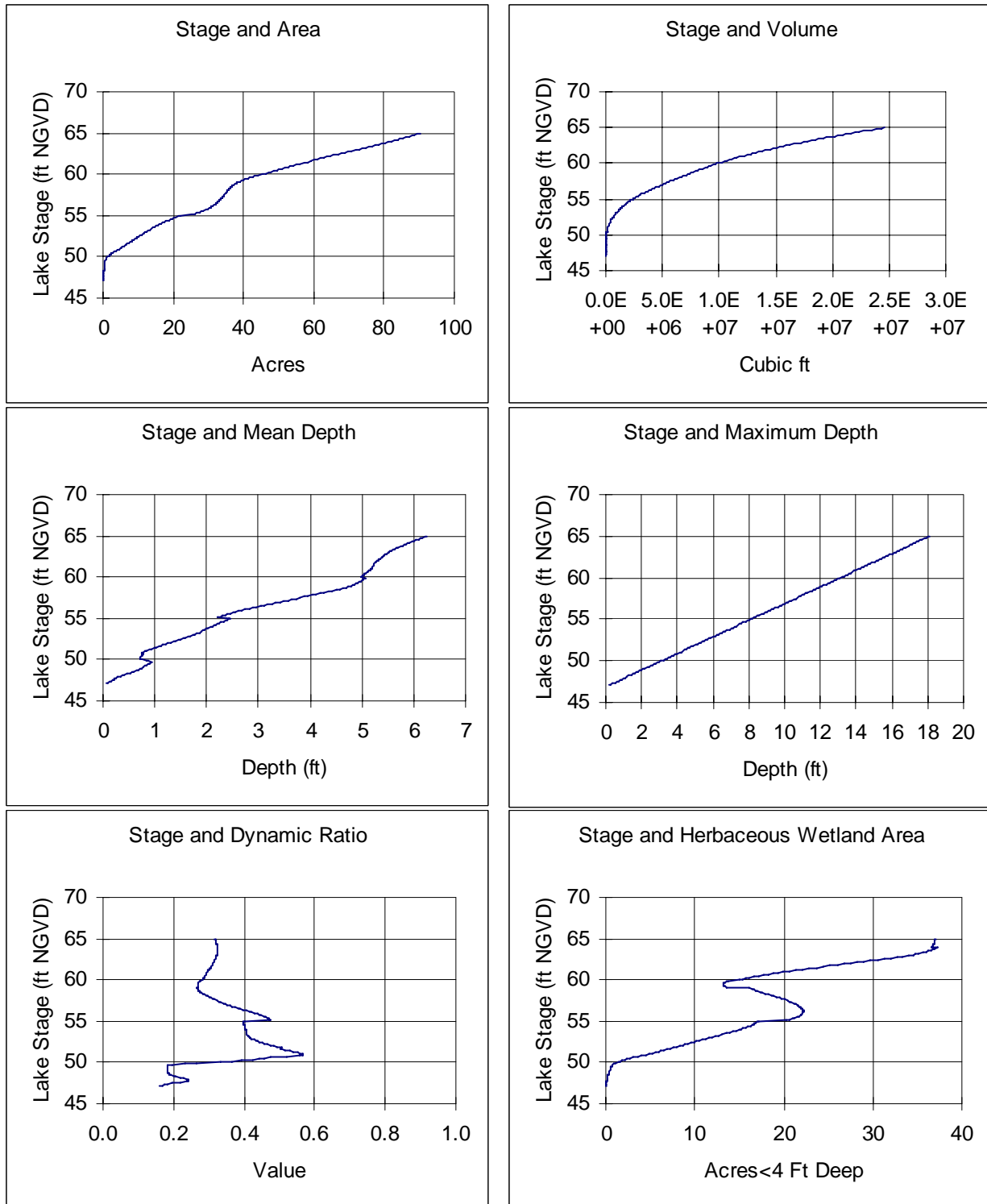


Figure 18. Unnamed Lake Number 22 surface area, volume, mean depth, maximum depth, dynamic ratio (basin slope) and potential herbaceous wetland area versus lake stage.

Minimum Levels

Minimum Lake Levels are developed using specific lake-category significant change standards and other available information or unique factors, including: potential 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 3 lakes, the Minimum 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 Level is established at the Historic P50 elevation. Because the Dock-Use and Basin Connectivity Standards for Unnamed Lake Number 22 are higher than the Historic P50 elevation, the Minimum Level could be established at the Historic P50 elevation, 56.6 feet above NGVD. However, because the Dock-Use and Basin Connectivity Standard are also higher than the Historic P10, and because establishment of the Minimum Lake Level at the Historic P50 elevation would mean that any withdrawal impact, no matter how small, would not be permitted, it was determined that it would not be appropriate to use the Dock-Use or Basin Connectivity Standards for establishing the Minimum Lake Level. The Minimum Lake Level could, instead, be established at 55.5 feet above NGVD, the elevation corresponding to the Species Richness Standard, the highest standard below the Historic P50. However, because the Wetland Offset elevation is higher than the Species Richness Standard, the Minimum Lake Level was established at the Wetland Offset elevation, 55.8 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 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 plus the region-specific RLWR50. Because Historic data are not available for Unnamed Lake Number 22, the High Minimum Lake Level was established at 59.3 feet above NGVD, by adding the appropriate RLWR50 (3.5 feet) to the Minimum Lake Level.

The minimum and guidance levels for Unnamed Lake Number 22 are shown in Figure 19 along with mean water surface elevations. Review of available data indicated that

staging of the lake at the Minimum Levels would not flood any man-made features within the immediate lake basin (see Figure 20 for the approximate lake margins when the water surface is at the minimum levels). Based on recent field survey data (Southwest Florida Water Management District 2006b, c), the High Minimum Lake Level is 6.0 feet below the lowest spot on the public roads in the lake vicinity, and 6.2 feet below the floor elevation of the lowest residential home within the immediate lake basin (Table 6).

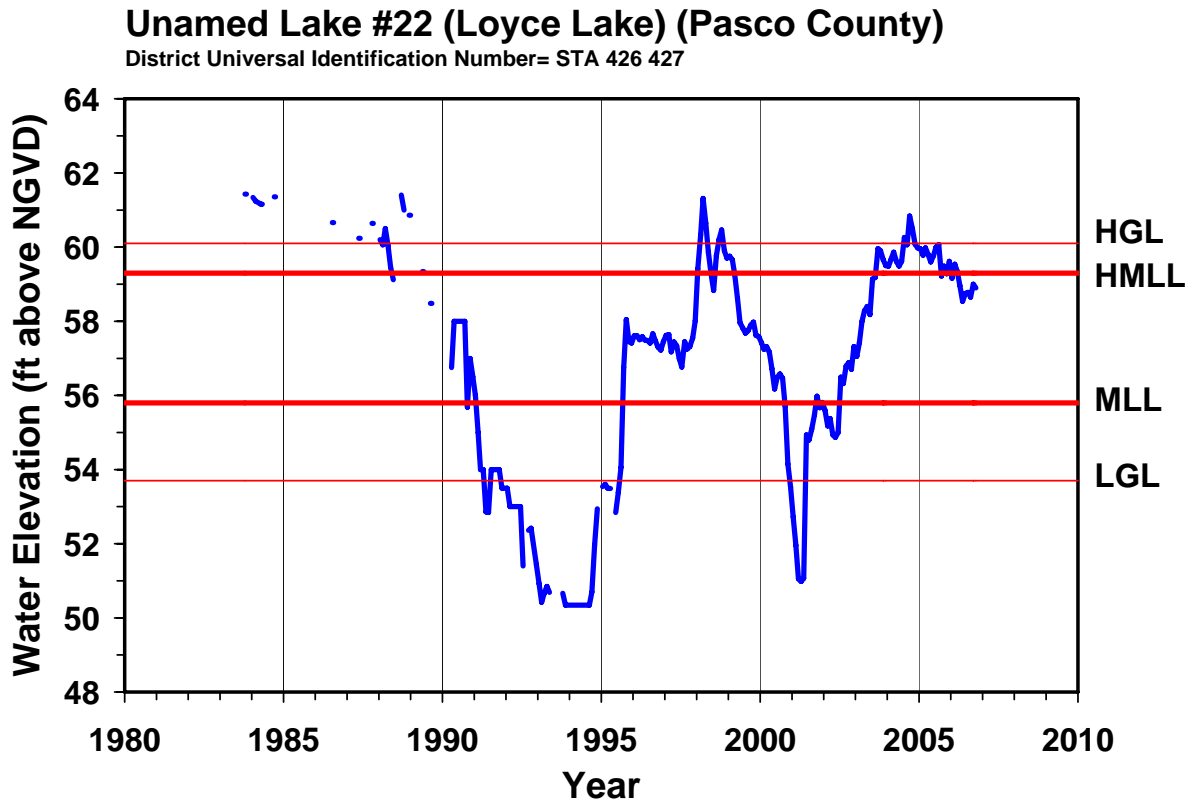
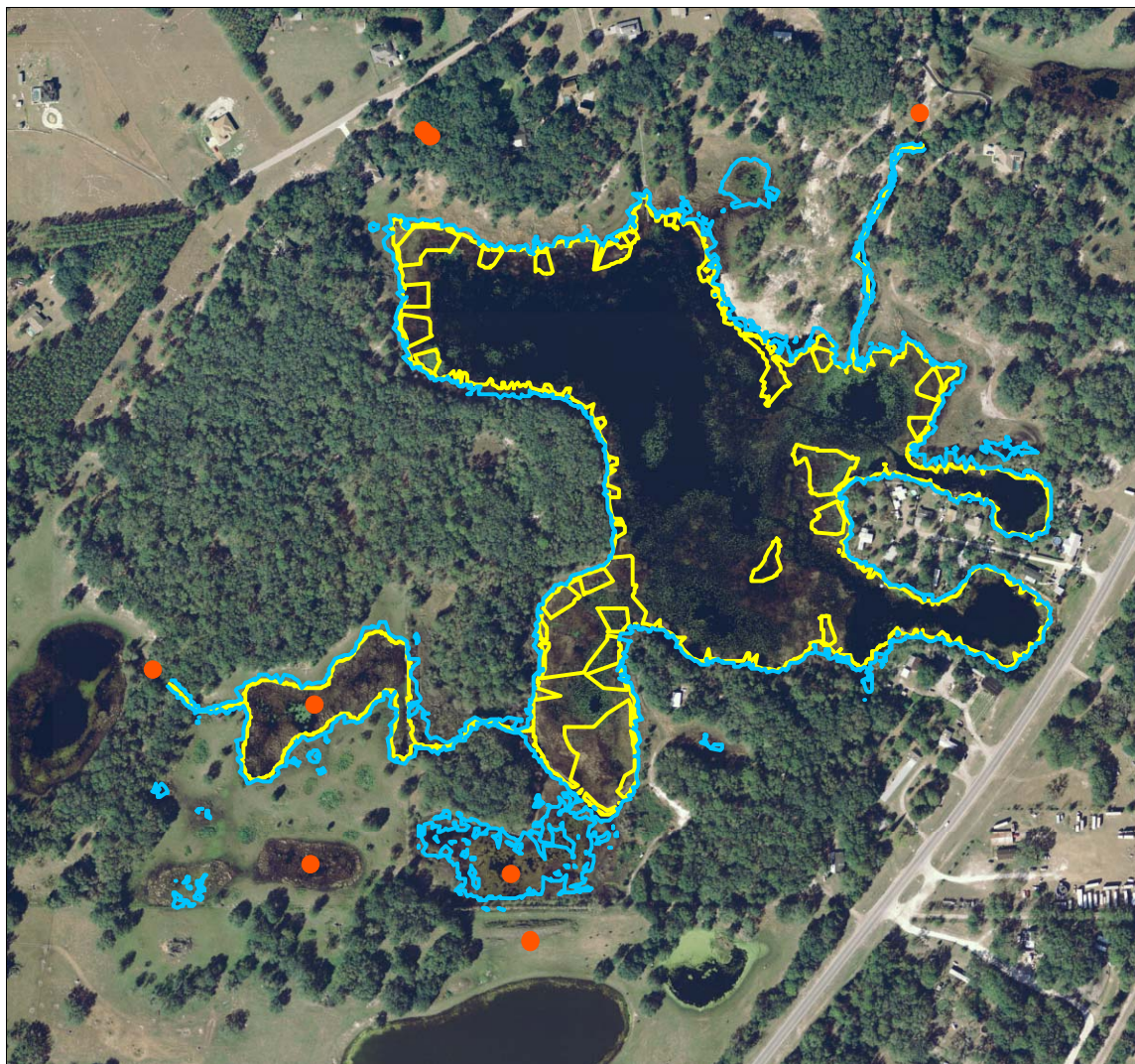


Figure 19. Minimum and Guidance Levels and mean monthly surface water elevations of Unnamed Lake Number 22 through October 2006. Adopted levels include the High Guidance Level (HGL), High Minimum Lake Level (HMLL), Minimum Lake Level (MLL) and Low Guidance Level (LGL).

Table 6. Elevations of lake basin features in the immediate Unnamed Lake Number 22 basin.

Lake Basin Features	Elevation (feet above NGVD)
Lowest floor slab – residential dwelling	65.5
Second lowest floor Slab – residential dwelling	66.0
Garage Floor	65.6
Centerline of dirt road in residential area	65.3



Minimum Levels Contours

- MLL = 55.8 ft above NGVD
- HMLL = 59.3 ft above NGVD

0 250 500 Feet



Map prepared using spot elevation data collected by D. C. Johnson Associates in May 2005, LiDAR data collected by EarthData International, Inc. in 2004, and USGS 2005 digital orthophotography.

Figure 20. Approximate location of the Minimum Lake Level (MLL) and High Minimum Lake Level (HMLL) for Unnamed Lake Number 22. Orange dots indicate areas where spot elevation data were not available (interior of the mapped area) or regions where contours were truncated (margin of mapped area).

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