DRAFT

Reevaluation of Minimum Levels for Lake Wailes in Polk County, Florida Draft

September 15, 2026

Southwest Florida
Water Management District

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Environmental Flows and Levels Section

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EXECUTIVE SUMMARY

The Southwest Florida Water Management District (District) is directed by the Florida Legislature to establish minimum levels for lakes within its boundaries. Minimum levels are defined in Section 373.042(1) of the Florida Statutes as “the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.” Once adopted into District rules, minimum levels can be used for water supply planning, water use permitting, and environmental resource regulation.

This report identifies minimum levels that were developed as part of a reevaluation of minimum levels currently adopted within the District’s Water Level and Rates of Flow rules (Chapter 40D-8, Florida Administrative Code) for Lake Wailes in Polk County. The reevaluation was conducted to support an ongoing assessment of the implementation of the Southern Water Use Caution Area Recovery Strategy in a region of the District where recovery of minimum flows and minimum water levels has been necessary.

For the reevaluation, the physical setting of Lake Wailes and other relevant information, including regional physiography and hydrogeology, water level and bathymetric data for the basin, land-use and area water use information, and currently established minimum levels and their status were reviewed and summarized. The reevaluation also included development and use of a new water budget model for simulating lake water levels, and use of newly developed criteria and screening procedures, including the use of a Xeric Wetland Offset and other best available information, for development of proposed minimum levels that address all relevant environmental values identified in the Florida Water Resource Implementation Rule (specifically, Rule 62-40.473, Florida Administrative Code) for consideration when setting minimum levels.

Two minimum water levels were developed as a result of the reevaluation of currently established levels for the lake. A Minimum Lake Level of 102.1 ft above the National Geodetic Vertical Datum of 1929 (NGVD29) is proposed as a water surface elevation that must be equaled or exceeded 50% of the time, on a long-term basis. A High Minimum Lake Level of 106.3 ft NGVD29 is proposed as a water surface elevation that must be equaled or exceeded 10% of the time, on a long-term basis.

Assessment of long-term water levels in Lake Wailes indicates the proposed Minimum Lake Level and High Minimum Lake Level are both currently met, and adoption or modification of an existing recovery strategy would, therefore, not be required in association with adoption of the proposed minimum levels. Additionally, projected data indicate that the Minimum Lake Level and High Minimum Lake Level will continue to be met during the next two decades, so implementation of a prevention strategy is similarly not required. If the lake’s levels fall below, or are projected to fall below an applicable minimum level, the District will expeditiously adopt or modify and implement a recovery or prevention strategy in accordance with Section 373.042(2), F.S. Additionally, the District will continue to implement a general, three-pronged approach that includes monitoring, annual status assessment of established minimum levels, and regional water

supply planning, to ensure that the adopted minimum levels for the lake continue to be met. The District will also continue to monitor levels in Lake Wailes and other lakes to further understanding of lake hydrology and ecology and to support future refinements to District minimum levels methods.

CHAPTER 1 – INTRODUCTION

The Southwest Florida Water Management District (District or SWFWMD) is directed by the Florida Legislature to establish minimum water levels for priority water bodies within its boundaries. Minimum levels are defined for surface waters in Section 373.042(1) of the Florida Statutes (F.S.) as “the level of surface water at which further withdrawals would be significantly harmful to the water resources or ecology of the area.” Once established, i.e., adopted into the District’s Water Levels and Rates of Flow rules (Chapter 40D-8, Florida Administrative Code or F.A.C.), minimum levels are used for water resource regulation and management.

Minimum lake levels were last established in 2015 and adopted in 2016 for Lake Wailes in Polk County, replacing minimum levels established for the lake in 2007. Reevaluation of the currently established minimum levels is occurring to support the ongoing assessment of recovery needs in the Southern Water Use Caution Area, a region of the District where a recovery strategy is being implemented to help achieve minimum flows and minimum water levels that are currently not being met (see Rule 40D-80.074, F.A.C., and SWFWMD 2006, 2023b).

In support of the reevaluation, information on the physical setting and other relevant characteristics of Lake Wailes are summarized in this document. Regional physiography and hydrogeology are described, as are water level and bathymetric data for the basin, land-use and area water use information, and the currently established minimum levels for the lake. Application of an updated approach for lake-level standards and screening criteria for minimum levels establishment are also described.

Using this best available information, revised minimum water levels for Lake Wailes were developed in accordance with all relevant statutory and rule requirements pertaining to minimum levels establishment. In addition, a status assessment that indicated the recommended, revised minimum levels are currently met and are projected to be met during the next 20 years (through 2045) was completed. Based on these findings, an update of the minimum water levels established for Lake Wailes in Rule 40D-8.624, F.A.C., with the revised minimum levels described in this document is recommended.

1.1 Legal Directives

Section 373.042 of the F.S. requires the Florida Department of Environmental Protection (FDEP) or the state water management districts to establish minimum water levels, which are defined 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 water levels are to be calculated using the “best information available” and when appropriate, “may be calculated to reflect seasonal variations.”

When establishing minimum water levels, the “department and the governing board shall consider, and at their discretion may provide for, the protection of nonconsumptive uses in the establishment of minimum flows and minimum water levels." In addition, "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", must be considered when establishing minimum water levels, with the caveat that these considerations shall not allow significant harm caused by withdrawals (Section 373.0421, F.S.).

Minimum water levels are adopted into the District's Water Levels and Rates of Flow Rules (Chapter 40D-8, F.A.C.) and used for water supply 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.

Emphasizing the importance of minimum water levels (and minimum flows) for water resource protection and management, Section 373.0421(2), 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 below within 20 years (through 2045), the applicable minimum flow or level established pursuant to S. 373.042." Necessary recovery or prevention strategies are developed to: "(a) [A]chieve recovery to the established minimum flow or level as soon as practicable; or (b) [P]revent the existing flow or level from falling below the established minimum flow or level." Further supporting the adaptive management aspect of minimum levels establishment and implementation, Section 373.0421(3), F.S., requires the periodic reevaluation and, as necessary, revision of established minimum levels.

The District's Recovery and Prevention Strategies for Minimum Flows and Levels Rules (Chapter 40D-80, F.A.C.) describe the regulatory portions of the recovery or prevention strategies to achieve or protect, as applicable, minimum flows and levels established within the District.

The Florida Water Resource 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 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 Central Florida Water Initiative Area Uniform Process for Setting Minimum Flows and Minimum Water Levels and Water Reservations Rule 62-41.304, F.A.C., within the Regulation of the Consumptive Use of Water Rules of the DEP (Chapter 62-41, F.A.C.) identifies additional requirements for minimum flow and level prioritization, establishment, and status assessments for certain waterbodies. These water bodies include those within the Central Florida Water Initiative (CFWI) area, which as defined in Section 373.0465, F.S., includes all of Orange, Osceola, Polk and Seminole counties and southern Lake County. The CFWI is a collaborative water supply planning effort among the St. Johns River, South Florida and Southwest Florida water management districts, the FDEP, the Florida Department of Agriculture and Consumer Services, regional utilities, business organizations, environmental groups, agricultural interests, and other stakeholders (CFWI 2025). Rule 62-41.304, F.A.C., requires the FDEP, St. Johns River Water Management District, Southwest Florida Water Management District, and the South Florida Water Management District to meet prior to the annual submission of each District's MFLs priority list to FDEP for approval to discuss CFWI-area waterbodies proposed for inclusion on the priority lists. The annual noticing and facilitation of a joint public workshop within the CFWI Area by the three districts for discussion of each district's proposed priority list applicable to the CFWI is also required. In addition, the sharing of information supporting any proposed MFL between the three water management districts and the FDEP is required prior to a district seeking independent scientific peer review of the proposed MFL or prior to publishing a Notice of Proposed Rule associated with the proposed MFL, whichever comes first.

Lake Wailes is located within the Central Florida Water Initiative area, where groundwater withdrawals are collectively managed across multiple water management districts. As a result, withdrawals within the CFWI, including those from the Southwest Florida Water Management District as well as adjacent districts, have the potential to influence the lake's water levels. Accordingly, these potential effects were considered as part of the prioritized reevaluation of the minimum levels established for Lake Wailes, as included on the District's Priority List and Schedule for the Establishment of Minimum Flows and Levels and Reservations. Coordination with the South Florida Water Management District and the St. Johns River Water Management District was conducted as part of the minimum level reevaluation described in this report.

1.2 Minimum Levels: Background Information

To address relevant legislative mandates and rule requirements within its boundaries, the District has developed, and as appropriate, updated specific methodologies for establishing minimum levels for lakes, wetlands, and aquifers. Methods that have been used by the District for minimum level establishment for lakes and wetlands are described in Campbell et al. (2020), Cameron (2022), Cameron et al. (2022a, b, c), GPI & SWFWMD (2022), Leeper (2006), Leeper et al. (2001), and SWFWMD (1999a, b, 2022). Bedient et al. (1999), Dierberg & Wagner (2001), Emery et al. (2022a, b), and Wagner & Dierberg (2006) include peer-review findings for the methods. Minimum aquifer levels are not further discussed in this reevaluation document for Lake Wailes; information on their development and use can be found in documents available from the District's Minimum Flows and Levels Documents and Reports web page[1].

Once a minimum level is developed and approved by the Governing Board, rulemaking is initiated to adopt the level into District rules. Minimum levels, including Minimum Wetland Levels, High Minimum Lake Levels, Minimum Lake Level and Minimum Aquifer Levels established by the District are defined in Rule 40D-8.021(7), F.A.C., as "the Long-term level of surface water, water table, or potentiometric surface at which further withdrawals would be significantly harmful to the water resources of the area and which may provide for the protection of nonconsumptive uses."

For minimum level purposes, "'Long-term' means an evaluation period used to establish Minimum Flows and Minimum Water Levels, determine compliance with established Minimum Flows and Minimum Water Levels, and assess withdrawal impacts on established Minimum Flows and Minimum Water Levels that represents a period which spans the range of hydrologic conditions which can be expected to occur based upon historical records, ranging from high water levels to low water levels. In the context of an average water level, the average will be based upon the historic expected range and frequency of levels. Relative to Minimum Flow and Level establishment and compliance, the best available information, selected through application of reasonable scientific judgement, that is sufficiently representative of Long-term conditions will be used" (Rule 40D-8.021(5), F.A.C.).

Two minimum levels, a Minimum Lake Level and a High Minimum Lake Level are established for lakes. The Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed fifty percent of the time (P50) on a long-term basis (Rule 40D-8.624(4), F.A.C.). The High Minimum Lake Level is the elevation that a lake's water levels are required to equal or exceed ten percent of the time (P10) on a long-term basis (Rule 40D-8.624(3), F.A.C.).

Several terms relevant to and necessary for understanding the development and implementation of minimum levels by the District are defined in Rule 40D-8.021, F.A.C. These terms include "Current", which "means a recent Long-term period during which Structural Alterations and hydrologic stresses are stable" and "Historic", which "means a Long-term period when there are no measurable impacts due to withdrawals and Structural Alterations are similar to current conditions." For these definitions, "Structural Alteration" "means human alteration of an inlet or outlet of a lake or wetland that affects water levels." Also, for minimum level purposes, ""P50"" means the percentile ranking represented by the elevation of the water surface of a lake or wetland that is equaled or exceeded 50 percent of the time as determined from a Long-term stage frequency analysis", and "P10" and "P90" are similarly defined as percentile rankings associated with water levels equaled or exceeded ten and ninety percent of the time.

[1] Southwest Florida Water Management District Minimum Flows and Levels documents and reports are available on our website.

1.3 Programmatic Description and Major Assumptions

Since the enactment of the Florida Water Resources Act of 1972 (Chapter 373, F.S.), in which the legislative directive to establish minimum flows and minimum water levels originated, and following subsequent modifications to this directive and adoption of relevant requirements in the Water Resource Implementation Rule and District rules, the District has actively pursued the adoption, i.e., establishment of minimum flows and levels for priority water bodies. The District implements established minimum flows and levels primarily through its water supply planning, water use permitting and environmental resource permitting programs, and through the funding of water resource and water supply development projects that are part of a recovery or prevention strategy. The District's Minimum Flows and Levels (MFLs) program addresses all relevant requirements expressed in the Florida Water Resources Act, the Water Resource Implementation Rule and within its own rules.

A substantial portion of the District's organizational resources has been dedicated to its MFLs Program, which logistically addresses six major tasks: 1) development and reassessment of methods for establishing MFLs; 2) adoption of MFLs for priority water bodies (including the prioritization of water bodies and facilitation of public and independent scientific review of proposed MFLs and methods used for their development); 3) monitoring and MFLs status assessments, i.e., compliance evaluations; 4) development and implementation of recovery strategies; 5) MFLs compliance reporting; and 6) ongoing support for minimum flow and level regulatory concerns and prevention strategies. Many of these tasks are discussed or addressed in this Minimum Levels report.

The District's MFLs Program is implemented based on three fundamental assumptions. First, it is assumed that many water resource values and associated attributes are dependent upon and affected by long-term hydrology and/or changes in long-term hydrology. Second, it is assumed that relationships between some of these variables can be quantified and used to develop significant harm thresholds or criteria that are useful for establishing minimum flows and minimum water levels. Third, the approach assumes that alternative hydrologic regimes may exist that differ from non-withdrawal impacted conditions but are sufficient to protect water resources and the ecology of these resources from significant harm.

With regard to the assumption associated with alternative hydrologic regimes, consider a historic condition for an unaltered river or lake system with no local groundwater or surface water withdrawal impacts. A new hydrologic regime for the system would be associated with each increase in water use, from small withdrawals that have no measurable effect on the historic regime to large withdrawals that could substantially alter the regime. A threshold hydrologic regime may exist that is lower or less than the historic regime, but which protects the water resources and ecology of the system from significant harm. This threshold regime could conceptually allow for water withdrawals, while protecting the water resources and ecology of the area. Thus, minimum flows and levels may represent minimum acceptable rather than historic or potentially optimal hydrologic conditions.

Support for the assumptions inherent in the District's establishment of minimum flows and minimum water levels is provided by a large body of published scientific work addressing relationships between hydrology, ecology and human-use values associated with water resources (e.g., see reviews and syntheses by Postel and Richter 2003, Wantzen *et al.* 2008, Poff *et al.* 2010, Poff and Zimmerman 2010). This information has been used by the District and other water management districts within the state to identify significant harm thresholds or criteria supporting development of minimum flows and minimum water levels for hundreds of water bodies, as summarized in the numerous publications associated with these efforts (e.g., SFWMD 2000, 2006, Flannery *et al*. 2002, SRWMD 2004, 2005, Neubauer *et al.* 2008, Mace 2009).

1.4 Consideration of Changes and Structural Alterations and Environmental Values

As noted in Section 1.1, the District considers "…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…" when establishing minimum flows and levels. Also, as required by statute, the District does not establish minimum flows or levels that would allow significant harm caused by withdrawals when considering the changes, alterations and their associated effects and constraints. These considerations are based on review and analysis of best available information, such as water level records, environmental and construction permit information, water control structure and drainage alteration histories, and observation of current site conditions.

When establishing, reviewing, or implementing minimum flows and levels, considerations of changes and structural alterations may be used to:

- adjust measured flow or water level historical records to account for existing changes/alterations;
- model or simulate flow or water level records that reflect long-term conditions that would be expected based on existing changes/alterations and in the absence of measurable withdrawal impacts;
- develop or identify significant harm standards, thresholds and other criteria;
- aid in the characterization or classification of lake types or classes based on the changes/alterations; and
- evaluate the status of water bodies with proposed or established minimum flows or levels (i.e., determine whether the current flow and/or water level are below, or are projected to fall below the applicable minimum flow or level).

As indicated in Section 1.2, the District has developed specific methodologies for establishing minimum flows or levels for lakes, wetlands, rivers, estuaries and aquifers, and subjected the methodologies to independent, scientific peer-review.

In 2022, the District finalized a multiyear effort to review and update criteria and methods used to support development of minimum levels for lakes. Details regarding the updated criteria and methods are summarized in Cameron and Ellison, and SWFWMD (2022a). As a consequence of the review effort, lake categories and methods associated with minimum lake levels were removed from District rules in 2021 (SWFWMD 2021b). Lakes had previously been divided into three categories, with methods identified for each (SWFWMD 1999a, 1999b; Leeper et al., 2001, SWFWMD 2021b). These rule changes supported further methods refinement and are expected to enhance flexibility regarding future methods development and application to better address each lake's unique characteristics during the development of minimum levels.

Currently, the environmental criteria and associated methods used for minimum lake level development are classified as "standards" or "screenings" (SWFWMD 2022). A standard identifies a lake-specific water surface elevation which is considered with other standards for identification of a recommended Minimum Lake Level that is based on the most sensitive, appropriate standard, i.e., standard associated with the highest water surface elevation. A recommended High Minimum Lake Level is subsequently developed using the recommended Minimum Lake Level and lake-specific water level fluctuations. Screening criteria are then used to assess lake-specific sensitivity for a given environmental value associated with the recommended minimum levels. If the screening indicates potential sensitivity, additional analyses are completed, and as necessary, the standard-based, recommended minimum levels are revised.

The approach involves assigning the greatest initial weight to the highest-confidence criteria/methods, while allowing for use of additional criteria/methods on a site-specific basis, as needed, to ensure sufficient protection against significant harm for all relevant environmental values. Collectively, the District's updated criteria and methods for the establishment of minimum lake levels address all the environmental values identified in the Water Resource Implementation Rule for consideration when developing minimum lake levels (Table 1-1).

Table 1-1: Environmental values from the Water Resource Implementation Rule (62-40.473, F.A.C.), associated significant change standards and screening criteria considered when establishing minimum lake levels.

Environmental Value	Associated Significant Change Standards and Screening Criteria
Recreation in and on the water	Basin Connectivity, Aesthetics, Species Richness, Dock Use, Aquatic Habitat Zone, Wetland Offsets
Fish and wildlife habitats and the passage of fish	Wetland Offsets, Basin Connectivity, Species Richness, Aquatic Habitat Zone
Estuarine resources	NA
Transfer of detrital material	Wetland Offsets, Basin Connectivity, Aquatic Habitat Zone
Maintenance of freshwater storage and supply	All
Aesthetic and scenic attributes	Wetland Offsets, Dock Use, Aesthetics, Species Richness, Aquatic Habitat Zone
Filtration and absorption of nutrients and other pollutants	Wetland Offsets, Aquatic Habitat Zone
Sediment loads	NA
Water quality	Wetland Offsets, Aquatic Habitat Zone, Basin Connectivity
Navigation	Basin Connectivity, Aquatic Habitat Zone, Dock Use

NA = Not applicable for consideration for most priority lakes.

Many of the standards and screenings rely on estimates of historic lake water levels, i.e., water levels in the absence of withdrawal impacts but with current structural alterations in place. The modeling procedures used to develop Historic records were evaluated as part of the lake methods review and the resulting updated processes are described in Cameron and Ellison (2019) and Cameron et al. (2022a). Status assessment, a separate but necessary process for minimum levels development and implementation was also updated as part of the District's recent minimum level methods review and is described in Cameron et al. (2023).

Each minimum levels evaluation or reevaluation incorporates the best available information and involves professional scientific judgement. On a lake-specific basis, individual standards, screenings, or methods may be deemed inappropriate or in need of refinement, or additional assessments or adjustments may be found necessary to address factors such as flooding concerns.

1.5 Currently Established Minimum Levels for Lake Wailes

Minimum levels for Lake Wailes (Table 1-2) were established by the District in 2015 and are currently included in Table 8-2 within Rule 40D-8.624(6), F.A.C. The Minimum Lake Level of 104.8 ft above the National Geodetic Vertical Datum of 1929 (NGVD29) and the High Minimum Lake Level of 107.7 ft NGVD29 were developed using best available information at that time, which included historic water levels and percentiles identified for characterizing expected water levels in the absence of withdrawal impacts, given the existing structural conditions at the lake and significant harm standards that were previously used for minimum lake level development, as described in SWFWMD (2007).

The levels established in 2015 replaced levels that had been adopted for Lake Wailes in 2007 (SWFWMD 2007). The Minimum Lake Level and High Minimum Lake Level adopted for Lake Wailes in 2007 were 106.6 ft NGVD29 and 107.7 ft NGVD29, respectively.

Table 1-2. Currently established minimum levels for Lake Wailes.

Minimum Levels	Stage Elevation (ft NGVD29)	Stage Elevation (ft NAVD88)
High Minimum Lake Level	107.7	106.7
Minimum Lake Level	104.8	103.8

To be considered met or achieved, the established minimum levels for Lake Wailes must be equaled or exceeded fifty (Minimum Lake Level) and ten (High Minimum Lake Level) percent of the time, respectively, on a Long-term basis. A status assessment completed in 2015 to support development of the currently established minimum levels indicated they were not met. Subsequent annual status assessments completed through 2025 indicated the minimum levels established for the lake have continued to not be met (Ghile 2024). Based on its location in Polk County, the recovery strategy outlined in Rule 40D-80.074, F.A.C. for the Southern Use Water Caution Area (SWUCA) would be applicable.

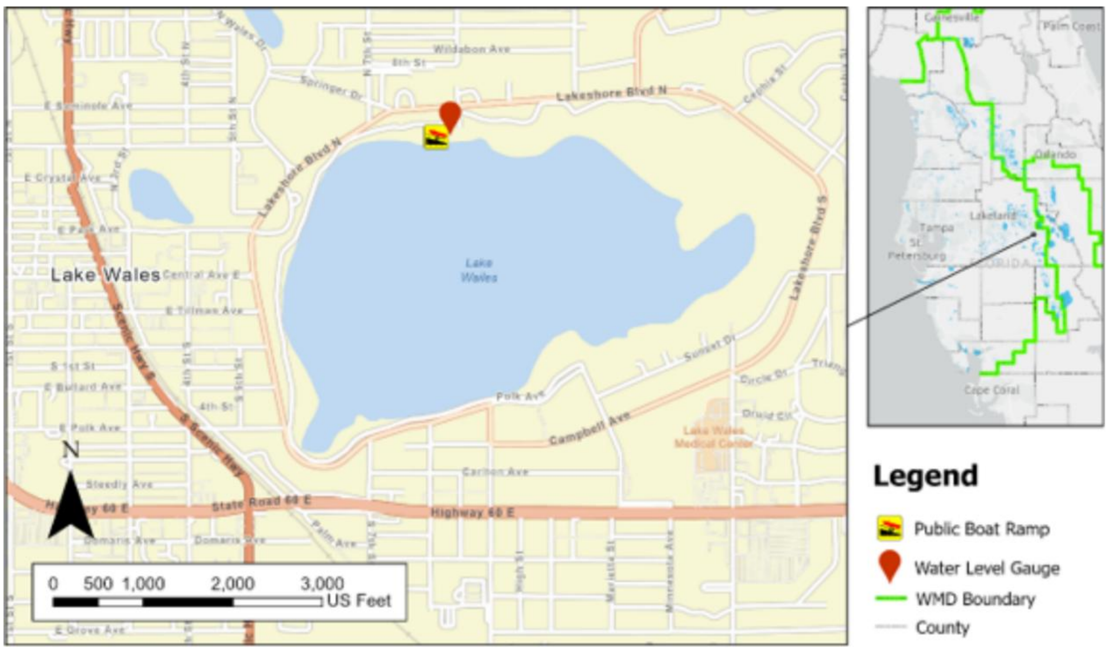
Because the District has recently completed a multi-year process of migrating all vertical elevation data from NGVD 29 to the North American Vertical Datum of 1988 (NAVD 88), tables in this report include elevation data values in both NGVD 29 and NAVD 88. Elevation data values shown on graphs and the topographic contours on the bathymetric map are presented using NGVD 29. In some circumstances within this document, elevation data that were collected or reported relative to mean sea level or relative to NGVD 29 are converted to elevations relative to NAVD 88. All datum conversions were derived using the Corpscon 6.0 software distributed by the United States Army Corps of Engineers or based on elevations provided by professional surveyors.

CHAPTER 2 – PHYSICAL SYSTEM

2.1 Location

Lake Wailes is an approximate 300-acre lake located in east-central Polk County, just northeast of the intersection of Alternate US Highway 27/State Road 17 and State Road 60 in the City of Lake Wales, Florida (Figure 2-1). The lake is predominantly surrounded by residential development with commercial and industrial land use on the eastern portion of the lake. An improved walking path lines most of the shoreline allowing public access to several recreational areas and a boat ramp on the northern shore of the lake.

Figure 2-1. Location of Lake Wailes in Polk County, Florida



2.2 Watershed and Structural Control

With a drainage area of approximately 698 acres, Lake Wailes lies within the Tiger Creek sub-basin of the Kissimmee River watershed, as identified by ADA Engineering (2012) and Atkins (2013) for watershed management program modeling. Rainfall that does not immediately infiltrate into the soils in the contributing watershed could potentially run off into the lake. Overall runoff volumes to the lake are expected to be low due to the relatively small size of the drainage area, well-drained soils prevalent within the watershed (discussed in Section 2.5), and generally deep water-table in the area. However, residential development on the northwest shore and a moderately steep topographic gradient (discussed in Section 2.4) within the watershed serves to increase local runoff to the lake. Based on review of one-foot contour interval maps and field survey data, Lake Wailes does not have an outlet conveyance system. The lake is therefore considered a closed basin system and there is no Control Point elevation.

Figure 2-2. Lake Wailes watershed

2.3 Stage History

Surface water level data collection at Lake Wailes (SID 25351) began in September 1965, when the United States Geological Survey (USGS) started measuring water levels daily with a recorder. Although a few manual data points exist prior to the daily record starting in 1951. Data collection frequency was daily through September 1971 when manual recording started. After September 1971, the frequency ranged from two times per week to monthly until early 1991, when data collection became monthly.

The highest lake surface elevation based on period-of-record data collected through December 2024, was 111.66 ft NGVD29 (110.69 ft NAVD88) and occurred on December 21, 2005. The record low, 97.58 ft NGVD29 (96.61 ft NAVD88), occurred on May 22, 1990. The P10 (10^{th} exceedance percentile), P50 (median), and P90 (90^{th} exceedance percentile) stage elevations for Lake Wailes are 106.54, 101.55, and 98.72 ft NGVD29 (105.57, 100.58, and 97.75 ft NAVD88), respectively. These values yield a P10-P50 difference of 5.0 ft and P10-P90 difference of 7.8 ft.

A drainage well (now capped) was located near the middle part of the lake about 250 feet south of the southern shore. A District Survey dated July 25, 1991 shows the top elevation of the 18-inch drainage well at 122.48 ft. NGVD29. District files indicate the drainage well was 790 feet deep with approximately 155 feet of casing (Dave DeWitt, Personal

Communication, 2015). The well construction date could not be found in District files; therefore, the age of the well and date the well was capped is not known. It is unknown if the lake ever overflowed into the drainage well as the highest measured period of record level for Lake Wailes was 111.66 ft. NGVD29 on December 21,2005. However, an archived historical photo from 1913 (Courtesy of Historic Lake Wales Society and Depot Museum) taken from the water tower of The Hotel Wales shows a short canal that allowed flow from Crystal Lake into Lake Wailes (Figure 2-4). For reference, the minimum lake level for Crystal Lake is 114.2 ft. NGVD29 and the high minimum lake level is 117.5 ft. NGVD29 and were established in 2011. Thus, indicating water levels within the area could have reached the drainage well elevation.

Figure 2-3. Lake Wailes water level (stage) observations (ft NGVD29) from December, 1951 through December 31, 2024

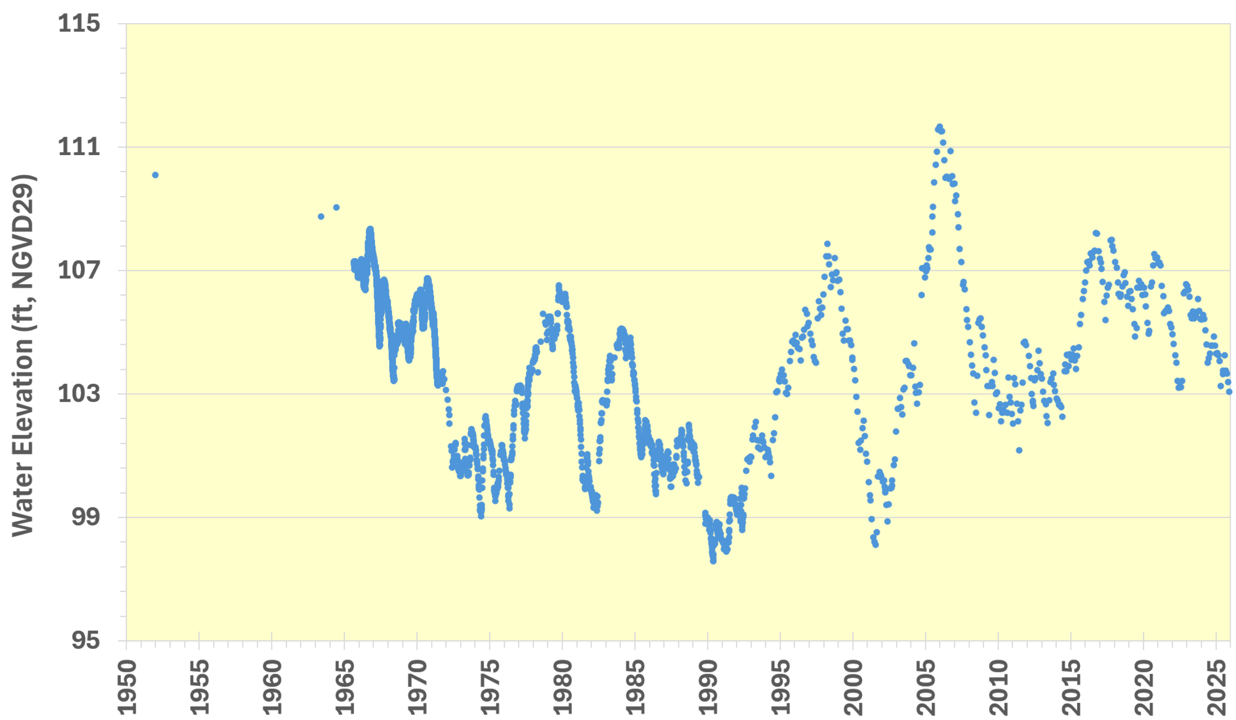
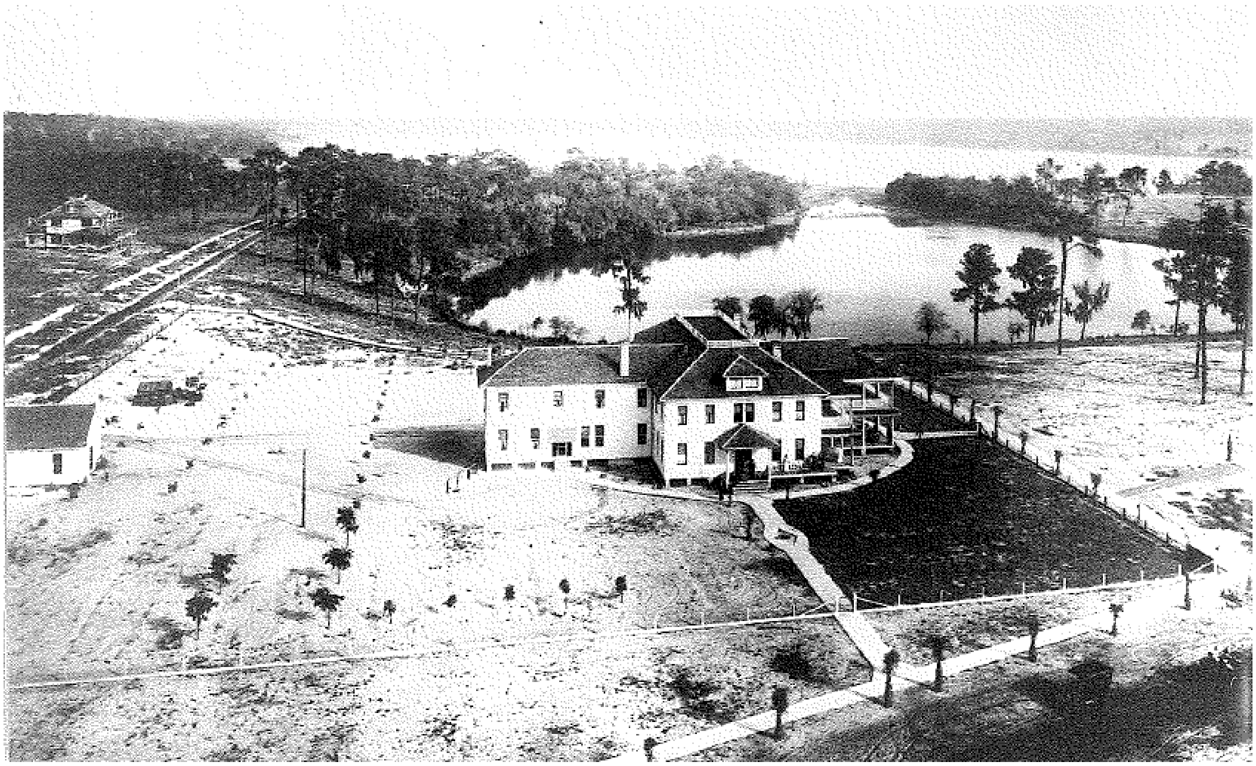


Figure 2-4. The Hotel Wales in early 1913 looking east towards Crystal Lake (foreground) and Lake Wailes (background). Image courtesy of Historic Lake Wales Society and Depot Museum.



2.4 Bathymetry

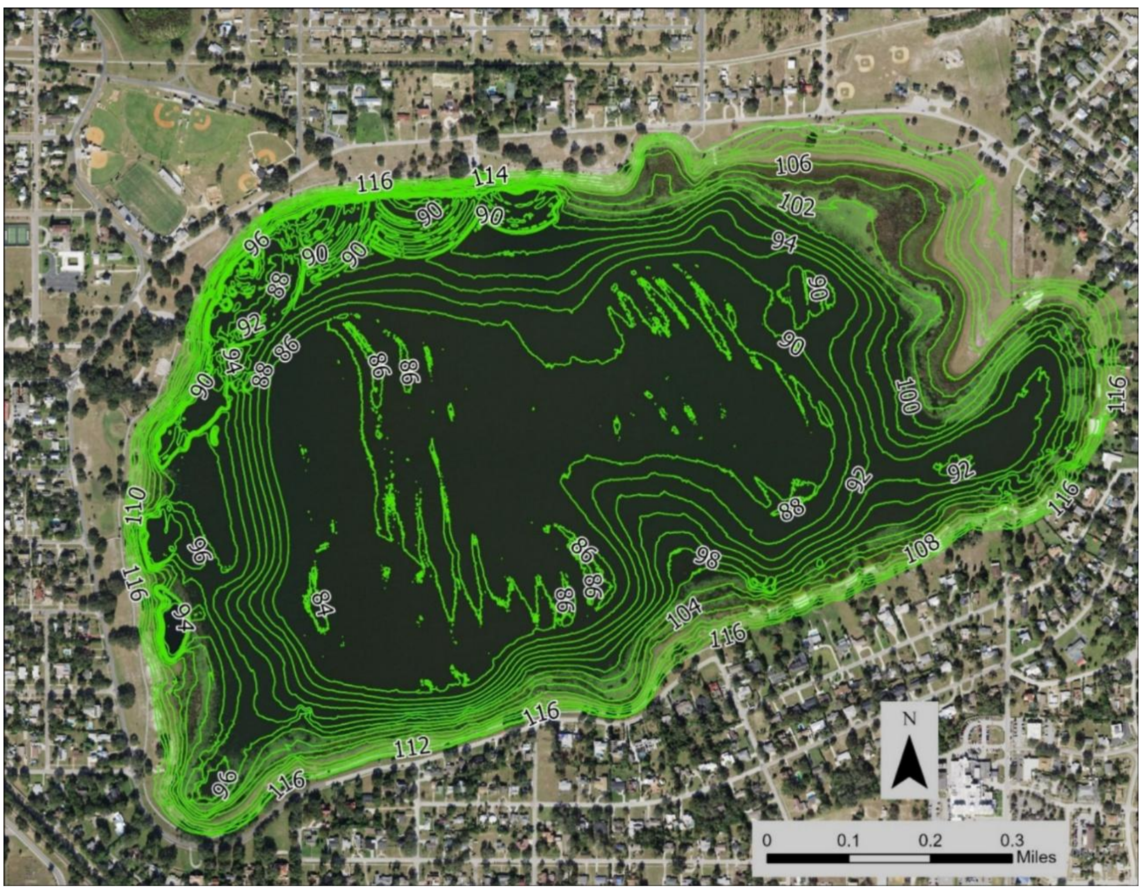
Relationships between water surface elevation (i.e., stage), inundated area, and volume can be used to evaluate expected fluctuations in water body size that may occur in response to climate, other natural factors, and anthropogenic impacts such as structural alterations or water withdrawals. Because long term reductions in stage, inundated area, and total volume can be detrimental to many of the environmental values identified for consideration when establishing minimum water levels, stage-area-volume data are useful for minimum level development and assessment. This information is also needed for development of lake water budget models used for estimating the lake-level response to rainfall, evaporation, runoff, outflow, leakance, and groundwater withdrawals.

Stage-area-volume relationships for Lake Wailes were previously developed by the District (SWFWMD, 2015) to support minimum levels development. For the current reevaluation of the minimum levels, updated bathymetric and topographic data were collected in 2022 and used exclusively to develop new stage-area-volume relationships. Elevations of the lake bottom and surrounding land surface were processed with ESRI® ArcGIS Pro software, the 3D Analyst ArcGIS Pro Extension, and Python to construct an updated model. The process involved merging the terrain morphology of the drainage basin around Lake Wailes with the new basin morphology data to produce a single, continuous three-dimensional digital elevation model (DEM).

Two elevation data sets were merged to develop the DEM. Light Detection and Ranging (LiDAR) data Snoopy A Series Velodyne 32-HDL sensor and bathymetric data collected for the lake using both sonar and mechanical (manual) methods. The data collection process for both is outlined in SurvTech, Inc. 2022.

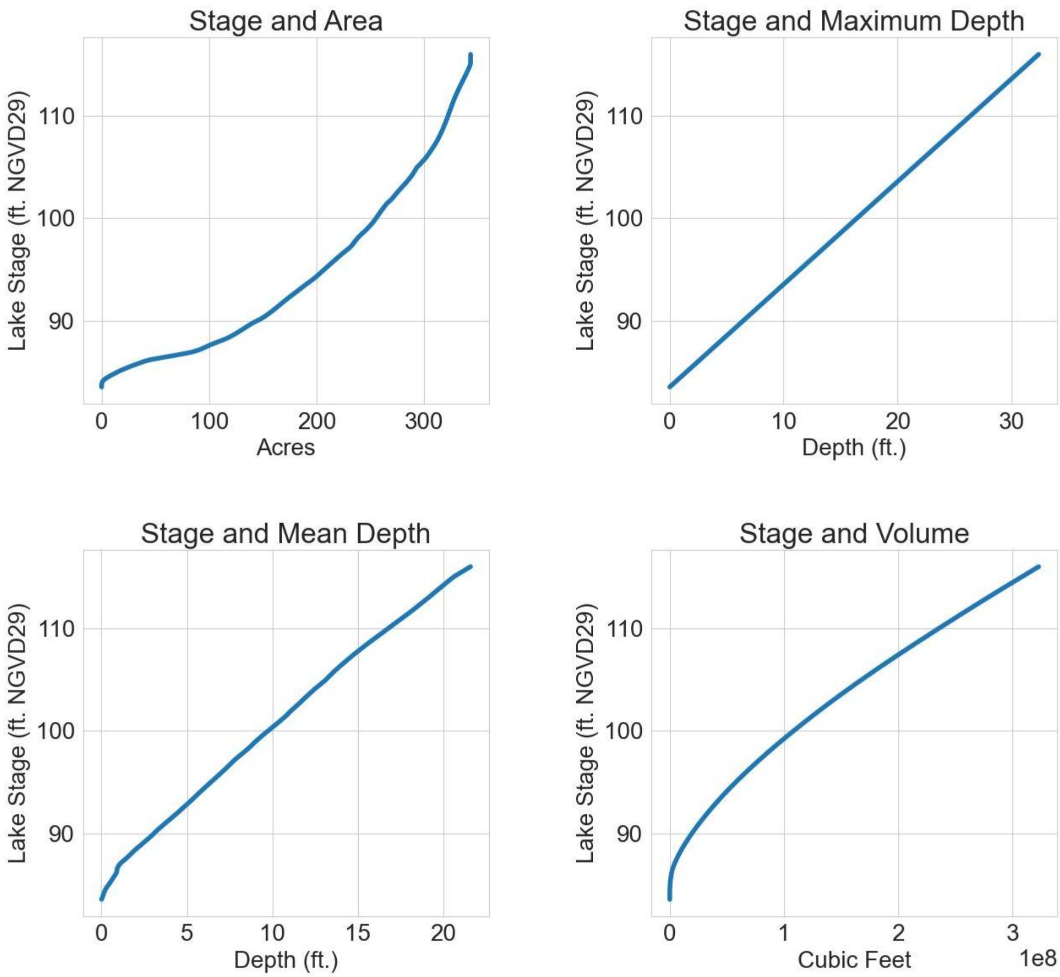
The combined elevation data sets were used to develop a DEM, that was then used to develop stage-area-volume data by using a Python script file to iteratively run the Surface Volume tool in the Functional Surface toolset of the ESRI® 3D Analyst toolbox at one-tenth of a foot elevation change increments from a peak or flood-stage elevation downward to a base elevation associated with the deepest portion of the lake. The DEM was also used to develop topographic contours of the lake (Figure 2-5) with the deepest portion of the lake bottom occurring at an elevation of 82 ft NGVD29 in the central portion of the basin (Figure 2-5).

Figure 2-5. Topographic and lake bottom elevations (ft NVGD 29) of Lake Wailes



At the period-of-record median (P50) stage of 105.0 ft NGVD29, Lake Wailes extends over 290 acres. From the period-of-record P90 (100.56 ft NGVD29) to P10 (107.08 ft NGVD29) stages, the lake area varies from 259 to 309 acres. Surface area, maximum depth, mean depth, and volume relationships with lake stage are shown in Figure 2-6.

Figure 2-6. Surface area, maximum depth, mean depth, and volume versus lake stage for Lake Wailes.



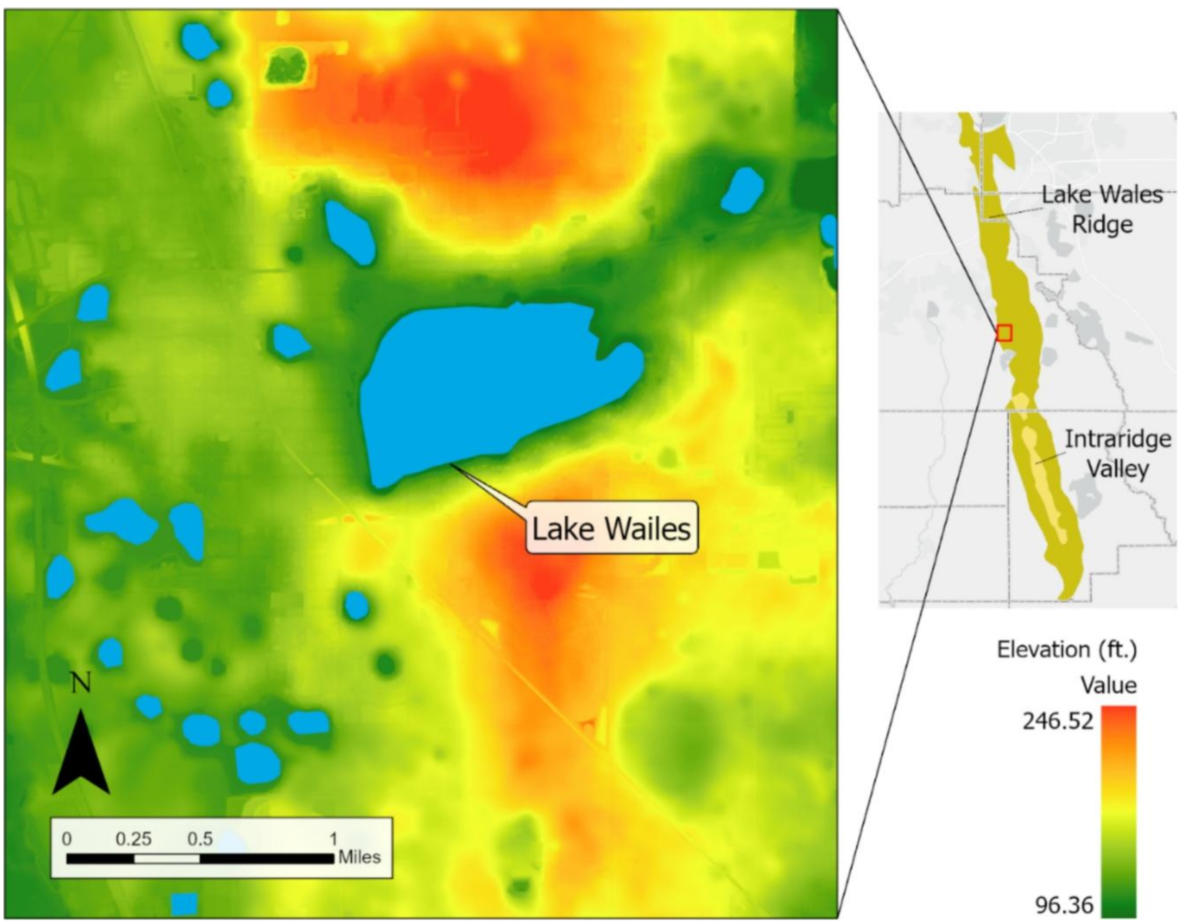
2.5 Physiography and Soils

Lake Wailes is situated between the eastern and western boundaries of a north-south oriented ridge (the Lake Wales Ridge) that is approximately 100 miles long and ranges from four to ten miles wide (Figure 2-7). The area surrounding the lake is categorized as the Iron Mountains on the Central Lake Physiographic District (Brooks, 1983). It is a sub-region of the Lake Wales Ridge and contains very high sand hills underlain by sand, gravel, and clayey sand that are deeply weathered. The Lake Wales Ridge area is predominantly well-drained and has internal drainage caused by numerous karst features, making it an uplands recharge area for the upper Floridan aquifer in Central Polk and Highlands counties. Dissolution of the underlying limestone creates the relief seen in Lake

Wales Ridge. The Lake Wales Ridge Complex is a remnant of a broader upland that has been eroded and lowered by sea level fluctuations, fluvial erosion, and aeolian redistribution of sediments (Green et al., 2012). Elevations within the immediate watershed range from the lake edge at about 95 feet to nearly 250 feet NGVD29 on the south side of the lake.

The lake is oriented perpendicular to the Lake Wales Ridge and land surface elevations east and west of the lake do not increase as steeply as land surface to the north and south of the lake. For example, within a quarter mile of the northern and southern boundaries of the lake, land surface elevations can increase by 100 feet or more. The rate of rise to the east and west is more gradual. The soils in the immediate lake watershed are mostly “A” soils with some smaller areas of “B”, “C”, and “D” soils, typically near the lake edge.

Figure 2-7. Land surface elevation (ft NGVD 29) near Lake Wailes within the Lake Wailes Ridge in Polk County



2.6 Land Use and Cover

Land use/land cover (LULC) information for the area within the Lake Wailes watershed has changed over the past century. Figure 2-8 shows land use around Lake Wailes in 1941 which consisted of citrus groves, undeveloped land, and some residential development to the south and west sides of the lake. Land use/land cover in 2010 and 1990 are provided in Table 2-1 and Figure 2-9. Predominant land use within the watershed is medium density residential. A recreation path with amenities including exercise equipment, public parking, and a boat ramp surround the lake perimeter with the exception along the southern shore where residential land use is adjacent to the lake shore.

Land use/land cover information for the area within the Lake Wailes watershed in 2010 and 1990 are provided in Table 2-1 and Figure 2-9 and show very little difference. Urban and built-up is the primary form of land use and comprises approximately 54 percent of the watershed in 2020 and a similar 53 percent in 1990. Only a few parcels were re-classified from Upland to Urban and wetlands to Urban. Historical imagery around Lake Wailes (Figure 2-10) shows land cover changes between 1958 and 2023.

Figure 2-8. 1941 aerial image of Lake Wailes

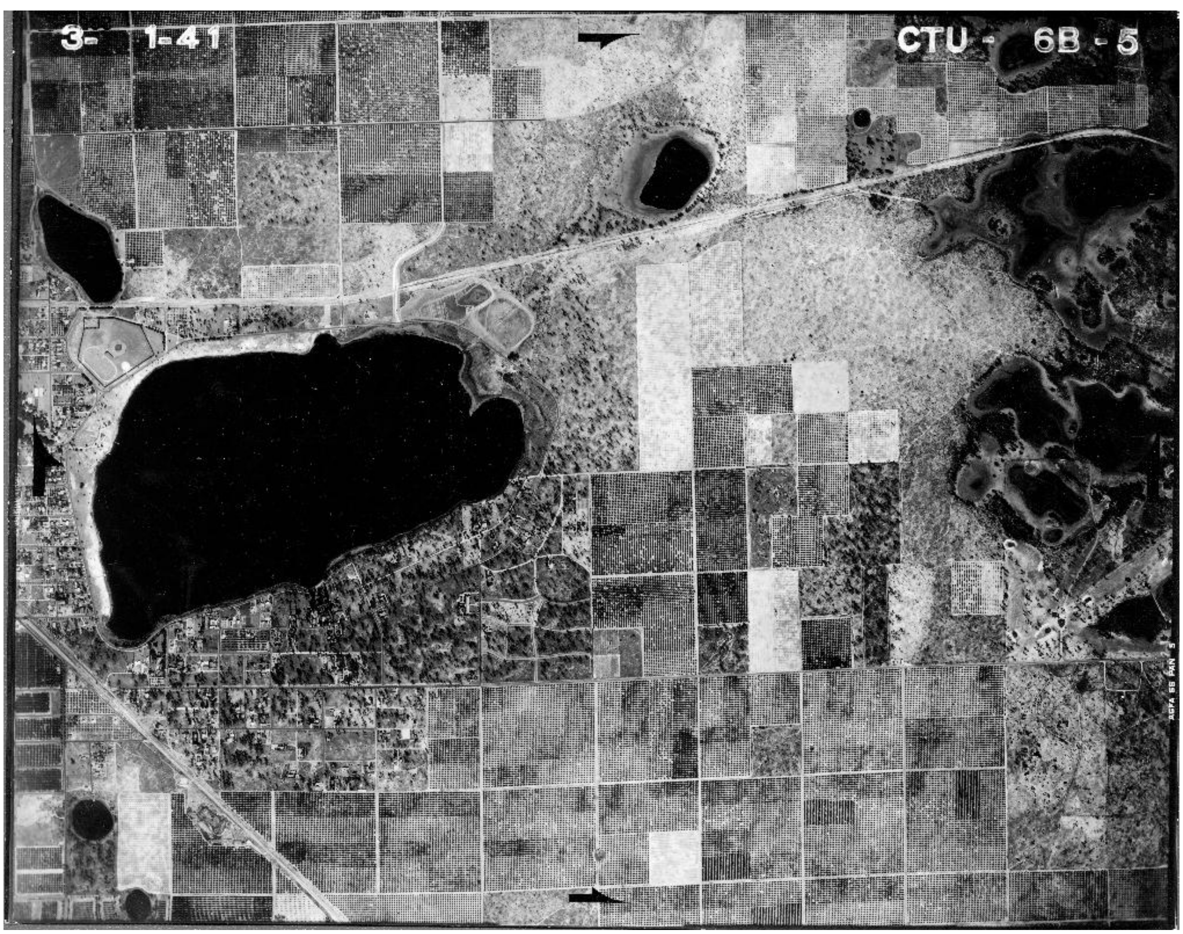
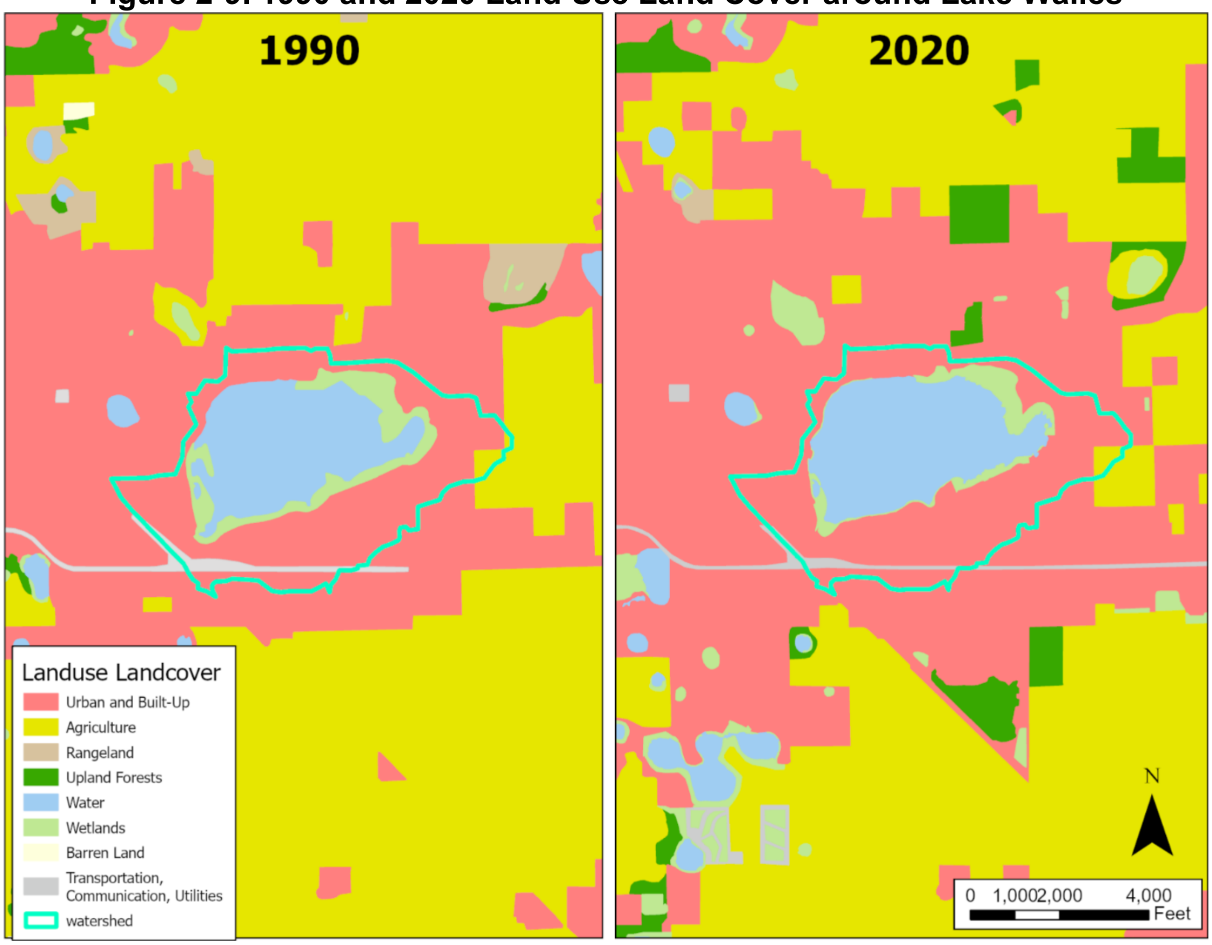


Table 2-1. Land Use Land Cover (LULC) in the Lake Wailes watershed in 1990 and 2020.

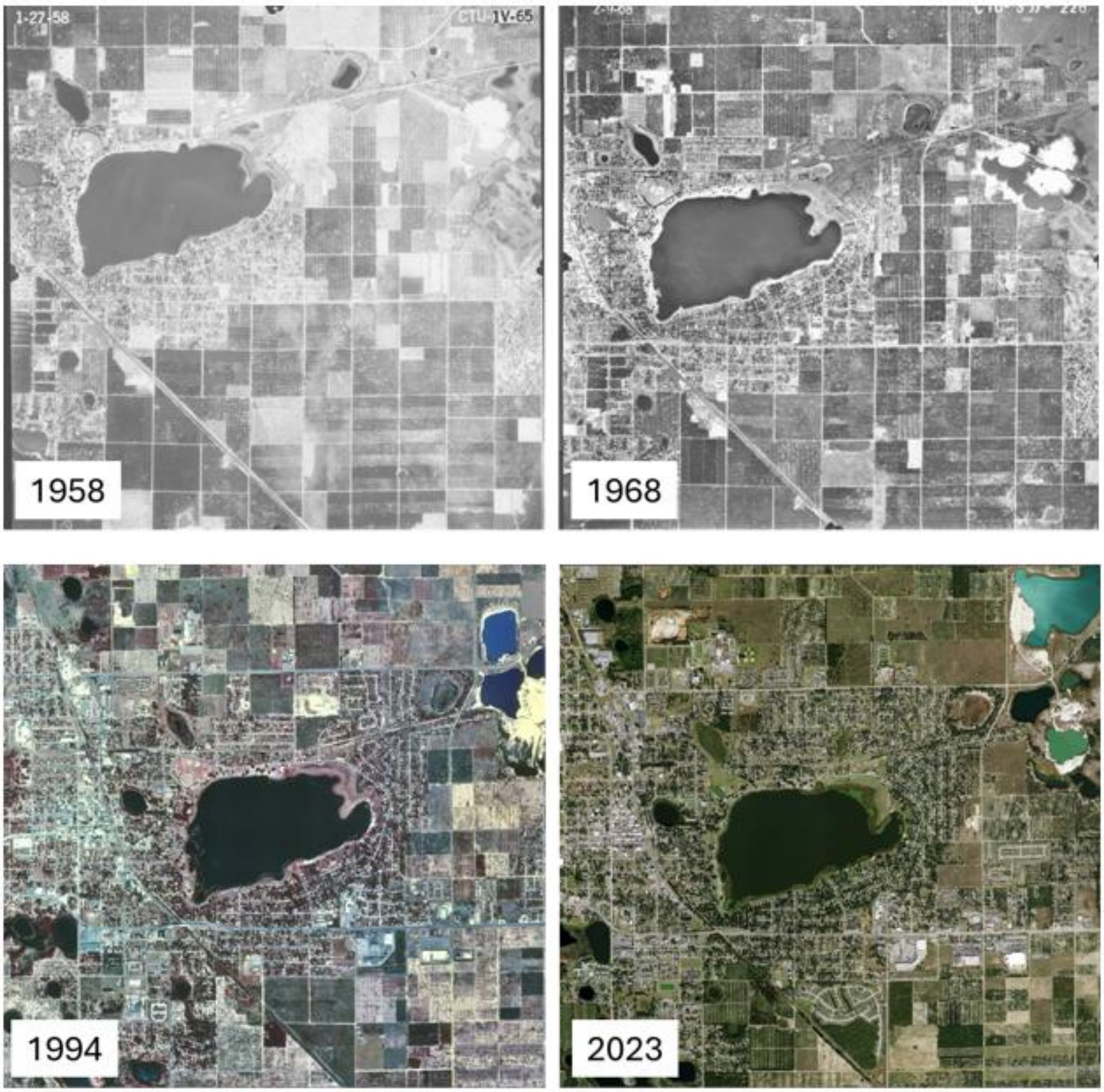
Land Use Land Cover Type	1990 LULC (acres)	% of total acreage	2020 LULC (acres)	% of total acreage
Urban and Built-Up	367	53	377	54
Agriculture	0	0	0	0
Upland Forests	9	1	7	1
Water	263	38	263	38
Wetlands	57	8	48	7

Figure 2-9. 1990 and 2020 Land Use Land Cover around Lake Wailes



Field surveys conducted at Lake Wailes in April 2025 indicate that knotted spikerush (Eleocharis interstincta) is the dominant emergent vegetation species, typically occurring at water depths between 1.7 and 3.4 feet. Additional commonly observed emergent species include pickerelweed (Pontederia cordata), bulltongue arrowhead (Sagittaria lancifolia subsp. Lancifolia), softstem bulrush (Schoenoplectus tabernaemontani) and cattails (Typha spp.). Dominant floating-leaf plants include spatterdock (Nuphar advena subsp. advena) and American white waterlily (Nymphaea odorata) typically occurring at water depths between 3.6 and 13.0 feet.

Figure 2-10. 1958, 1968, 1994 (infrared), and 2020 Aerial photographs of Lake Wailes

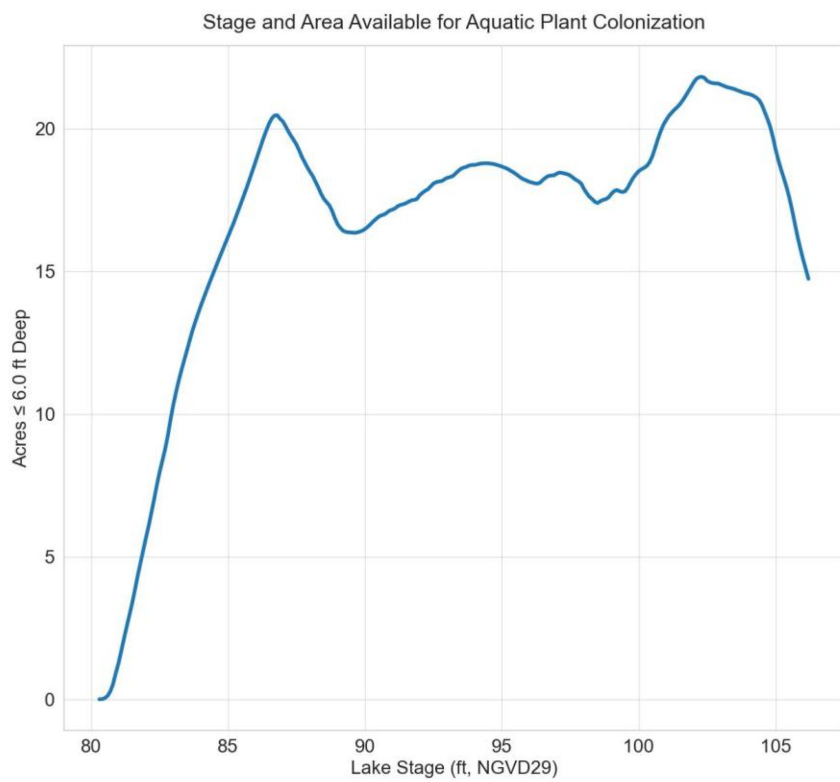


The area available for aquatic plant growth was estimated for Lake Wailes based on a relationship of light attenuation as measured with Secchi depth (*SD*) and maximum depth of plant colonization (*MDC*). Using data from 1985 to 2025 for Lake Wailes obtained through the Polk County Water Atlas, the mean *SD* was 0.87 meters. Use of this Secchi depth with equation 2-1 below (where *MDC* and *SD* are in meters) from Caffrey et al. (2007) yielded an *MDC* value of 6.0 ft.

(Equation 2-1) $\log MDC = 0.66 \log SD + 0.3$

Based on a 6.0 ft *MDC* and stage-area information developed in support of the reevaluation of minimum levels for Lake Wailes (described in Section 2.4.2 of this document), the area available for aquatic plant colonization would range from 0 to 21.8 acres at water surface elevations from 80.3 to 102.3 ft NGVD29 in the Lake Wailes basin (Figure 2-11).

Figure 2-11: Lake stage and area available for aquatic plant colonization in Lake Wailes.



2.7 Climate and Rainfall

2.7.1 Climate

Polk County lies within a humid subtropical zone that is influenced by the Gulf of America and Atlantic Ocean. The area experiences hot, humid summers with mean temperatures in the low 80s (ºF) and mild to cool winters with mean temperatures in the upper 50s (ºF). The annual mean daily temperature is approximately 74ºF (21ºC). Wet season rainfall occurs during the summer from June through October, with remaining months considered "dry season" months. Tropical storms and hurricanes mostly occur between August and the first half of October, which can lead to greater rainfall totals during the late summer and early fall.

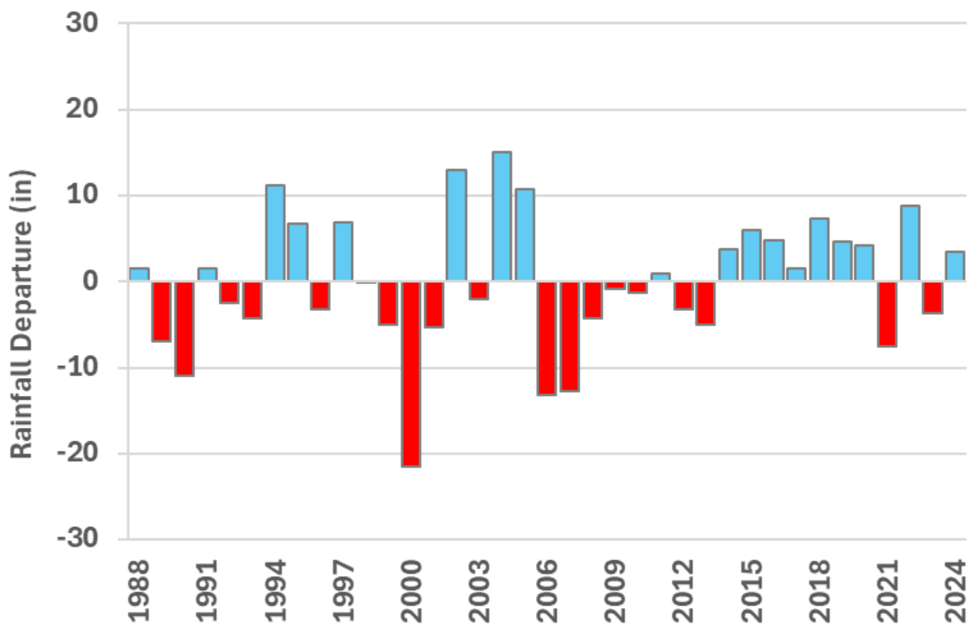
Long-term rainfall in Florida is affected by an oscillation of North Atlantic sea surface temperatures known as Atlantic Multidecadal Oscillation (AMO) (Enfield 2001, Kelly 2004, Kelly and Gore 2008). AMO consists of a cool phase that leads to lower average rainfall and a warm phase that leads to higher average rainfall in Florida. In turn, water bodies within the District experience long-term periods of relatively high flows and levels that switch to periods of relatively low flows and levels. Because a full AMO cycle lasts 60-80 years (Enfield 2001), evaluations of water bodies in the District consider a time period of at least 60 years to best represent all climactic conditions.

2.7.2 Rainfall near Lake Wailes

Local rainfall around Lake Wailes for the period January 1988 through December 2024 was characterized by nearby rain gauges and Next Generation Weather Radar (NEXRAD) rainfall available for a grid (square 2 km cells) that includes and extends beyond the District boundaries. This rainfall dataset was also used as an input to the lake's water budget model (see Chapter 3).

Based on estimates from nearby rain gauges and datasets for the NEXRAD Pixels that encompass Lake Wailes, average annual rainfall for the period from January 1988 through December 2024 equaled 50.3 in/yr. This average is slightly below the long-term average (1915-2024) rainfall recorded in Polk County of 52.1 in/yr derived from the District's annual hydrologic data. Using the nearby rain gauges and NEXRAD data over Lake Wailes, annual rainfall departure from the Polk County long term mean is shown in Figure 2-12. For the 1988 through 2024 period, the localized rainfall estimates resulted in a cumulative departure of -1.8 in from the long term mean of 52.1 in/yr. This estimated departure indicates rainfall conditions for 1988-2024 were nearly equal to long term rainfall conditions.

Figure 2-12. Annual rainfall departure at Lake Wailes from 1988 through 2024



2.8 Hydrogeologic Setting

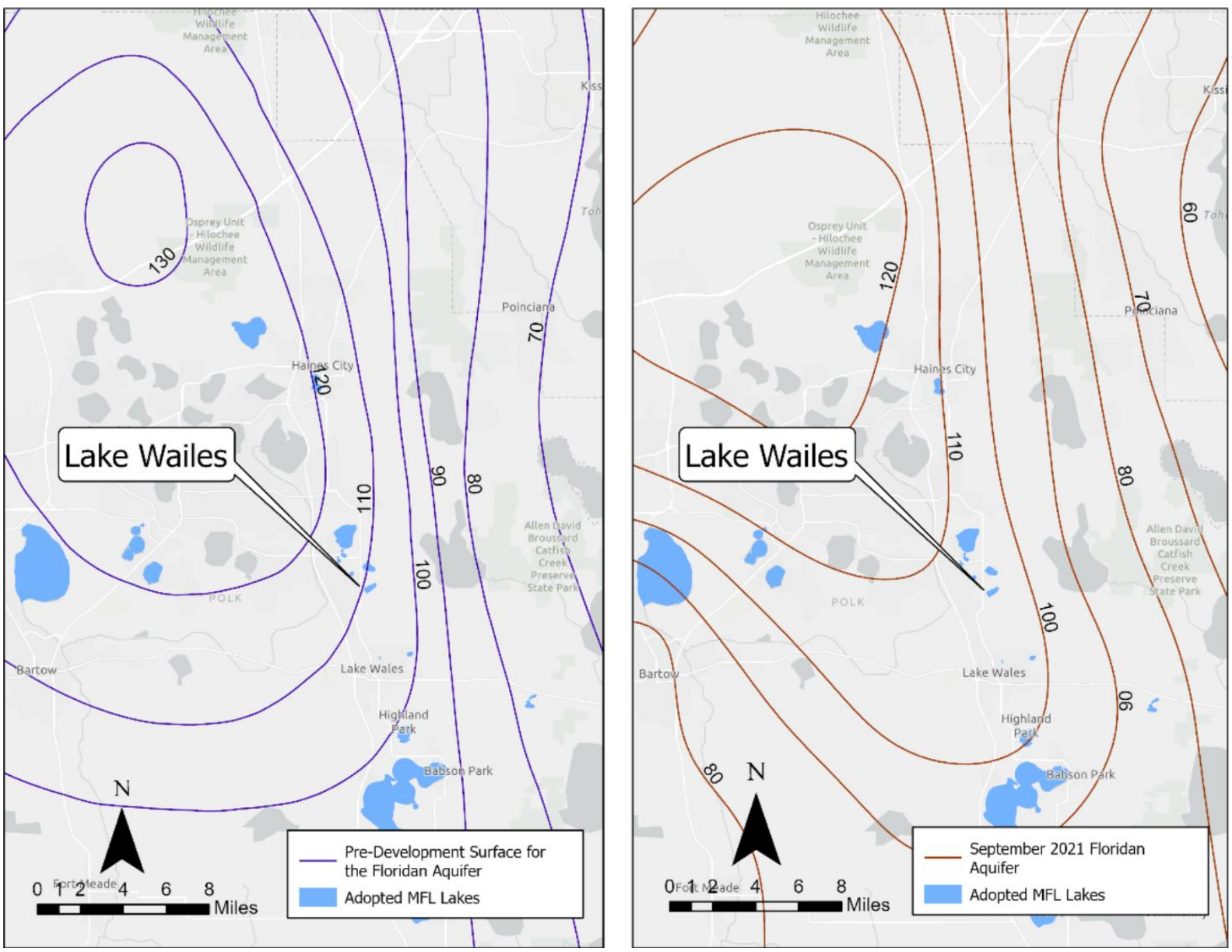
The hydrogeologic framework of the Lake Wales Ridge area includes a relatively thick unconfined surficial aquifer, the Hawthorn confining unit, and a thick carbonate upper Floridan aquifer (SWFWMD, 2023). Lake Wales Ridge can provide high rates of recharge to the upper Floridan aquifer depending primarily on the thickness and hydraulic conductivity of the overlying surficial aquifer and Hawthorn confining unit. Estimates of upper Floridan aquifer recharge in the region range from 1 inch per year up to more than 20 inches per year (Yobbi, 1986), typically with higher rates of recharge in the northern portion of Lake Wales Ridge (Aucott, 1988).

The surficial aquifer thickness along the Lake Wales Ridge varies from 40 to 380 ft, with average thickness of nearly 200 ft. It is generally comprised of fine-to-medium grained quartz sands that grade into clayey sand just above the interface with the underlying Hawthorn confining unit. The surficial aquifer is recharged primarily by the infiltration of rainfall. According to Spechler and Kroening (2007) much of that rainfall drains into lakes or is lost to evapotranspiration (Spechler and Kroening, 2007).

The Hawthorn confining unit is a clay layer of varying thickness, ranging between 0 and 233 ft, indicating discontinuous confinement. Thin, isolated permeable zones of limestone, shell, gravel, or sand that form local aquifers may be imbedded in some portions of the Hawthorn confining unit. Withdrawals from the aquifers embedded in the Hawthorn confining unit are primarily associated with household water use.

All of Polk County is underlain by the upper Floridan aquifer, which is composed of a thick sequence of carbonate rocks that include the upper half of the Avon Park formation, the Ocala Limestone, and (where present) the Suwannee Limestone. The total thickness of the upper Floridan aquifer ranges from several hundred feet to 1,500 ft in Polk County (Clayton, 1998; DeWitt, 1998; Mallams and Lee, 2005; Arthur et al., 2008). Most groundwater withdrawals within Polk County come from the upper Floridan aquifer. Lake Wailes and the other lakes in the Lake Wales Ridge area of Polk County provide recharge to the upper Floridan aquifer through their subsidence features (Sacks et al., 1998). These lakes overlie a potentiometric high that separates two regional groundwater basins. The orientation and shape of the Lake Wales Ridge potentiometric high has changed since predevelopment, i.e., prior to significant groundwater withdrawals, which began around 1930 (Figure 2-11).

Figure 2-13. Pre-development upper Floridan aquifer potentiometric surface (left panel) and September 2021 upper Floridan aquifer (right panel) near lakes in Lake Wales Ridge.



2.9 Water Withdrawals

From 1992 through 2023, there are approximately 1 to 2 million gallons per day (mgd) of permitted groundwater withdrawals occurring within one mile of the Lake Wailes shoreline. Within five miles of the lake shoreline, permitted groundwater withdrawals range from 13 mgd to 29 mgd for the same time period of 1992 through 2023 (Figures 2-12 and 2-13). These estimates come from the District's database containing geospatially distributed monthly groundwater and surface water withdrawal data and estimates for all permits extending back to 1992. The database is updated each year typically two-to-three years after the withdrawals occur (e.g., 2023 geospatial data became available in 2025). Estimated annual pumping for domestic self-supply (household) wells across the District is provided in another database that is updated concurrently with the permitted water use database. Lastly, there are no permitted surface water withdrawals from Lake Wailes.

Nearly all of the permitted groundwater withdrawals within a mile of the lake's shoreline are permitted for public supply. Within five miles of the lake, permitted groundwater withdrawals are predominantly agriculture and public supply (Figure 2-12). In this area, 20 mgd were withdrawn in an average year from 1992 through 2023, and total withdrawals have been relatively stable (varying from 13 to 23 mgd) since 2003 (Figure 2-13). Year-to-year variation is driven by agriculture while the remaining uses have accounted for an approximately constant 6 mgd over the 30-year period. In 2023, agricultural groundwater use comprised 51 percent of the total groundwater withdrawn within 5 miles of Lake Wailes. Public supply accounted for 19 percent of the total, 18 percent for recreation, and 12 percent for industrial was withdrawn for use. Groundwater use for mining and dewatering purposes was less than 1 percent of the total use.

Spechler (2006) provides historical estimates of groundwater use in all of Polk County, noting that groundwater withdrawals were approximately 350 mgd in 1965 and had decreased to approximately 331 mgd by 2000. The decrease was attributed primarily to the reduction in mining operations. which decreased annually from 270 MGD in 1965 to 56 MGD in 2002. Public supply increased from 26 to 75 MGD during the same time period and agriculture water use increased from 52 MGD to 127 MGD.

Annual average groundwater use within one mile of Lake Wailes ranges between 2.2 mgd in 1993 and 0.8 mgd in 2018, showing a decline. Annual average groundwater use within five miles of Lake Wailes has declined from 25 mgd for the period of 1992-2001 to 17 mgd for the period of 2014-2023 (Figure 2-13). The declines in groundwater use have occurred due to water conservation, higher rainfall, land use change, and increased use of reclaimed water. This long-term decreasing trend in water use near Lake Wailes is congruent with the implementation of the SWUCA I rules in the early 2000s (Figure 2-14) that address conservation measures, alternative water supply development, and water use permitting requirements (SWFWMD 2023a, b). As part of the SWUCA Recovery Strategy, the District continues to work with users to develop alternative water supplies to meet water demands while reducing groundwater withdrawals when possible.

Figure 2-14. Permitted groundwater withdrawals in gallons per day (GPD) around Lake Wailes

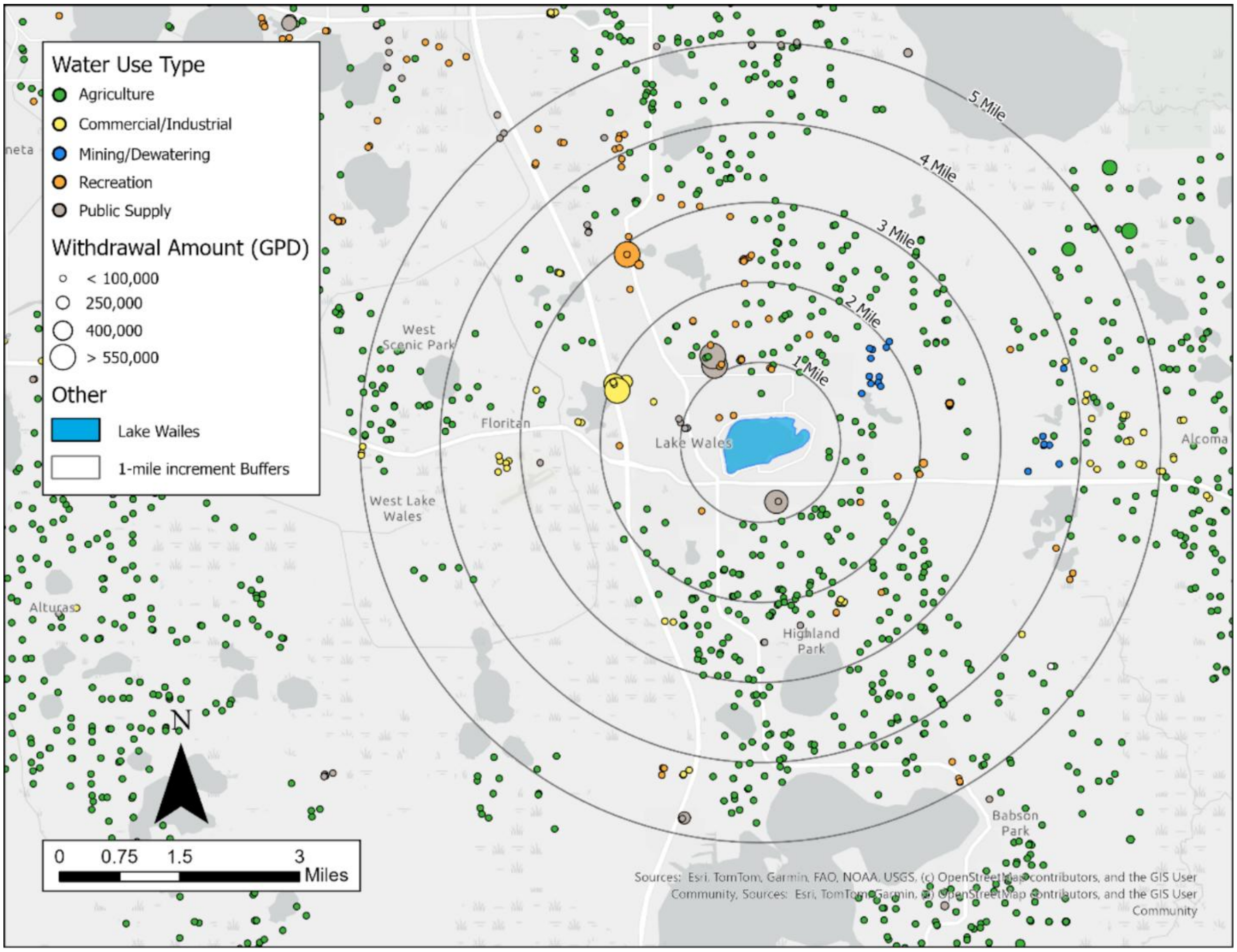


Figure 2-15. Annual average withdrawals within five miles of Lake Wailes

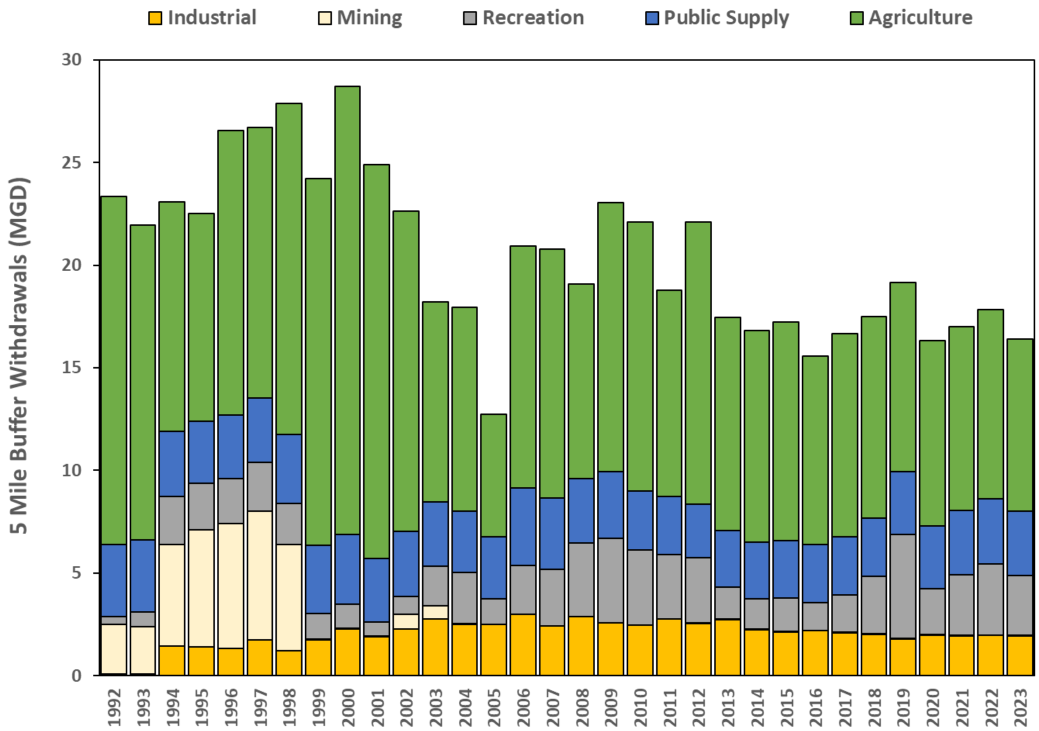
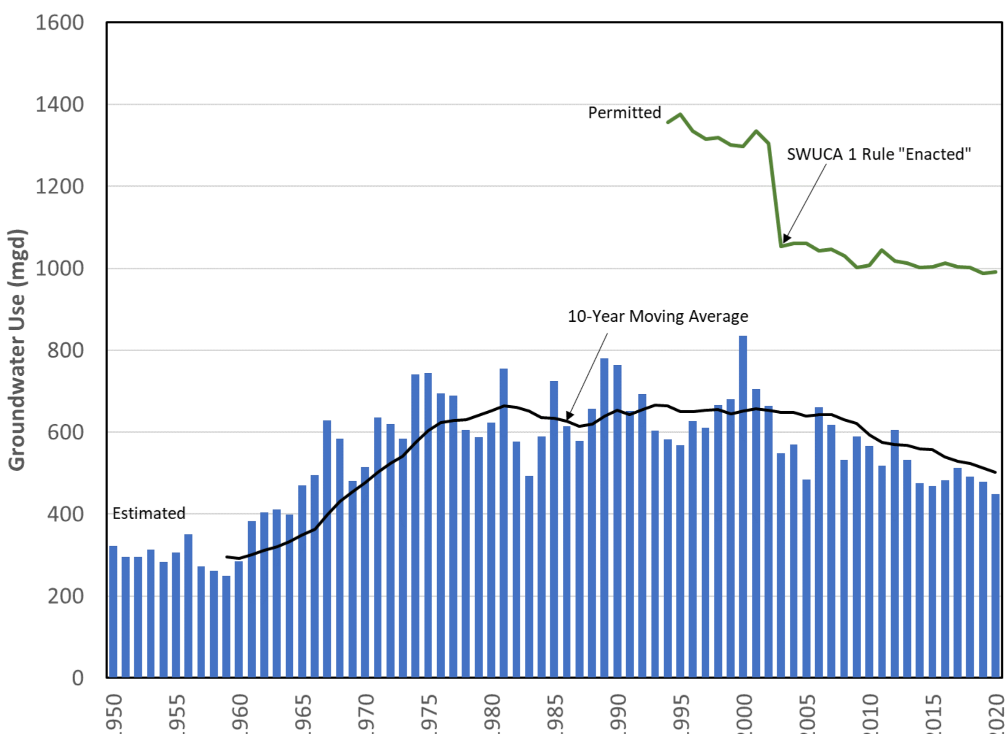


Figure 2-16. Groundwater withdrawals in the Southern Water Use Caution Area from 1950 through 2020 and permitted withdrawals for the area (image reproduced from SWFMWD, 2023)



CHAPTER 3 – WATER BUDGET MODEL

3.1 Water Budget Models

Water budgets (also called water balances) are widely used to represent hydrologic fluxes for lakes and other waterbodies (e.g., Healey et al., 2007). The lake stage change in a water budget is estimated as the difference between summed inflows and summed outflows over a specified time period. Water budget models are developed to estimate Historic water levels and percentiles that can be used to support development of minimum levels for the lake. Historic is defined for minimum lake level purposes in Rule 40D-8.021, F.A.C. as a long-term period with no measurable impacts to withdrawals and structural alterations are similar to current conditions. I

The water budget model implemented by the District for minimum lake level development is a calibrated spreadsheet model that tracks lake water inputs and outputs on a daily timestep to estimate lake water levels. The model developed for Lake Wailes includes precipitation, evaporation, surficial aquifer fluxes, upper Floridan aquifer fluxes, overland flow, and directly connected impervious area (DCIA) runoff. Since Lake Wailes is a closed basin lake, surface outflow was not included in the model.

3.2 General Model Structure

The technical approach for lake water budget models at the District is summarized by Equations 3-1 and 3-2, where *LS* is the lake stage, *△S* is the change in storage, *R* is rainfall directly onto the lake, *E* is evaporation directly from the lake, UFA_{net} is the net exchange between the lake and upper Floridan aquifer, SA_{net} is the net exchange between the lake and surficial aquifer, *O* is overland flow into the lake from its watershed, and *DCIA* is runoff from impervious surfaces directly connected to the lake. Change in storage is added to the prior day's lake stage (LS_{n-1}) to estimate lake stage for the current day (LS_n).

(Equation 3-1) $LS_n = LS_{n-1} + \Delta S_n$

(Equation 3-2) $\Delta S_n = R_n - E_n + UFA_{net,n} + SA_{net,n} + O_n + DCIA_n$

Both *R* and *E* in Equation 3-2 were estimated using only the input data, where rainfall data was collected daily. Monthly evaporation data was available from two studies at Lake Starr (i.e., Swancar et al., 2000, and Swancar, 2015) for the period of August 1996 through July 2011. Swancar (2015) showed that evaporation rates in central Florida lakes can be nearly identical to each other even when the lakes are 60 miles apart, and Lake Wailes is approximately 4 miles south of Lake Starr. Thus, evaporation data from Lake Starr was considered appropriate for the Lake Wailes water budget from August 1996 through July 2011, and monthly normal evaporation rates from this dataset were used for all other months in the water budget model.

Lake Wailes was determined to have flow-through groundwater conditions based on local topography and surficial aquifer water levels ($SA_{in,lev}$ and $SA_{out,lev}$) that were modeled using the ECFTX regional groundwater model (see Chapter 4 for details on this model). Thus, surficial aquifer inflow and outflow were estimated separately as $SA_{in,n}$ and $SA_{out,n}$ using different data sources for each, with $SA_{net,n}$ being the difference between the two variables (Equations 3-3 through 3-5). The leakance coefficient between the lake and the surficial aquifer (L_{SA}) is a calibrated parameter used in this estimation of surficial aquifer flux.

(Equation 3-3) $SA_{net,n} = SA_{in,n} - SA_{out,n}$

(Equation 3-4) $SA_{in,n} = L_{SA}\left(SA_{in,lev} - LS_n\right)$

(Equation 3-5) $SA_{out,n} = L_{SA}\left(SA_{out,lev} - LS_n\right)$

Fluxes between Lake Wailes and the upper Floridan aquifer were estimated similarly to surficial aquifer flux using a calibrated leakance coefficient, L_{UFA}, shown in Equation 3-6 below, where UFA_{lev} is the water level in the upper Floridan aquifer.

(Equation 3-6) $UFA_{net,n} = L_{UFA}\left(UFA_{lev,n} - LS_n\right)$

Both runoff variables, *DCIA* and *O*, were estimated using the SCS curve number methodology (NRCS, 1986). The percentage of the Lake Wailes basin that contributes DCIA runoff (*pDCIA*) and the curve number (*CN*) are calibrated parameters used in the estimation of *DCIA* and *O*. Harper and Baker (2007) outlined a procedure for estimating runoff in Florida based on seasonal rainfall patterns and vegetation conditions. Using this procedure (outlined in Chapter 4 of Harper and Baker, 2007) *DCIA* was estimated assuming an initial abstraction of 0.1 inches, and *O* was estimated using antecedent soil moisture conditions that vary between the growing (Mar-Sept) and dormant seasons (Oct-Feb). Both *DCIA* and *O* were estimated daily in the Lake Wailes water budget model and multiplied by the ratio of the watershed's land surface area (A_{WL}) to the area of Lake Wailes (A_L, which was estimated daily with the stage-area-volume relationship described in Chapter 2).

3.3 Lake Wailes Water Budget Model

3.3.1 Calibration Period

The calibration period for the Lake Wailes water budget model was January 1988 through December 2024. This period was selected based on available lake data. Additionally, there was no structural alteration to the hydrology of the lake during this period. The average annual rainfall, using District rainfall data, from January 1915 to December 2024 was 52.1 in/yr, versus 51.4 in/yr for the water budget model calibration period. Thus, the water budget model calibration period represents slightly drier than normal conditions at the lake.

3.3.2 Input Data

The water budget model input data were obtained from the District's Environmental Data Portal (EDP) as indicated in Table 3-1. Water elevation input locations are shown in Figure 3-1 and rainfall and evaporation input locations are shown in Figure 3-2. All water level data used in the model is shown in Figure 3-3. Water level data collection at Lake Wailes (SID 25351) begin in September 1965, when the United States Geological Survey (USGS) started measuring water levels daily with a recorder, although a few manual data points exist prior to the daily record starting in 1951. Collection frequency continued daily through September 1971 when manual recording started. After September 1971, the frequency ranged from two times per week to monthly until the early 1990's when data collection became monthly.

Several data sources were compiled and used to represent the surficial aquifer within the Lake Wailes area. The ROMP 57X Surf Aq Monitor (SID 25355) well is located approximately one-quarter mile south of Lake Wailes. The data for the surficial well start in November 1987 and are generally daily, with the exception of a few data gaps and a period from November 1994 through October 2003 when data collection was monthly. Missing data were linearly infilled since the gaps were relatively short. In addition to the ROMP 57X Surf Aq Monitor well, surface water level data collected from North Lake Wales (SID 25351), Crystal Lake (SID 25350), and the calculated gradient between Lake Wailes and Bonnie Lake (SID 23687) were used to simulate effects of the surficial aquifer in the water budget model.

North Lake Wales is located approximately one-quarter mile from Lake Wailes. Data begin in 1981 with a few water levels collected with irregular frequency. Data collection with regular frequency began in October 1990, however, water levels were noted to be below land elevation at the staff gage until September 1994. For the time period of January 1988 through September 1994, data were infilled for North Lake Wales using a linear regression of North Lake Wales and ROMP 57X Surf Aq Monitor well, located approximately 1.1 miles south-southeast of North Lake Wales. From October 1994 through December 2023, multi-month data gaps were infilled with estimated data generated using a linear regression of North Lake Wales water level data with Crystal Lake data, which is located about one-third mile southwest of North Lake Wales. Smaller data gaps between months were infilled using linear interpolation between water levels.

Crystal Lake is located approximately 1,000 feet west of Lake Wailes. A water elevation was recorded on May 21, 1963, and then recorded monthly from April 1990 through July 1990. From August 1990 until August 1996, water level data were collected weekly and in September 1996 through current, water level data are recorded monthly. For the time period of January 1988 through April 1990, data were infilled for Crystal Lake using a linear regression of Crystal Lake and ROMP 57X Surf Aq Monitor well, located approximately 1.1 miles southeast of North Lake Wales

Lake Bonnie is located approximately 0.8 miles west of Lake Wailes. Data collection efforts have been attempted at the lake since January, 1998. However, water levels at the lake are below land surface for most of that time. Due to inadequate data and using existing data at the lake, a gradient was estimated between Lake Bonnie and Lake Wailes. The gradient used in the model was -0.0004, and the flow direction is from Lake Wailes toward Lake Bonnie. The calculated gradient is within reason to a previously estimated gradient between Lake Wailes and the South Mine Pond Staff Gage of -0.0007. The South Mine Pond Staff Gage is located just under a mile northeast of Lake Wailes.

Upper Floridan aquifer water levels were obtained from the ROMP 57X U Fldn Aq Monitor well (SID 25354), located roughly one-quarter mile from the southern shoreline of Lake Wailes, near the ROMP 57X Surf Aq Monitor well. There were, for some periods, multi-month gaps in the ROMP 57X upper Floridan aquifer monitor well data. These gaps were infilled using estimated data generated by a linear regression of ROMP 57X upper Floridan aquifer monitor well data with CL-1 upper Floridan aquifer monitor well (SID 23873) data. In some instances, simple linear data infill was not used due to the length of some of the data gaps. The CL-1 upper Floridan aquifer monitor well (well used for the regression) is located approximately 4.5 miles south of Lake Wailes.

A composite dataset consisting of rainfall data from various gages and NEXRAD were used. Distance from the lake, data availability and reasonableness, and model calibration were considered when creating the composite dataset. The data used from January 1, 1988 through December 31, 2000 were an average of Mountain Lake NWS (SID 25147), Blue Lake North Polk (SID 25160), and ROMP 58 JH Wilson Elementary (SID 25146) rain gages. The ROMP 58 JH Wilson Elementary and Mountain Lake NWS gages are approximately 1.4 and 2.6 miles northwest of Lake Wailes, respectively. The Blue Lake North Polk gage is located 2.8 miles south-southwest of Lake Wailes.

Data for Mountain Lake NWS are available for the earliest date necessary to complete the LOC model (January 1935) through present. Data from Blue Lake North Polk are available from August 1967 to December 2003. Data from ROM 58 JH Wilson Elementary are available from June 2000 to present. As is common in hydrologic data records, the gages had some periods of missing values in the time series data. Short gaps where data were not available for any of the three gages were infilled with data from the next closest gage to Lake Wailes. For the period of January 1, 2001 through December 31, 2024, an average of data for four NEXRAD pixels coinciding with the lake were used.

Figure 3-1. Locations of Lake Wailes and the water elevation data collection sites used for input data in the Lake Wailes water budget model

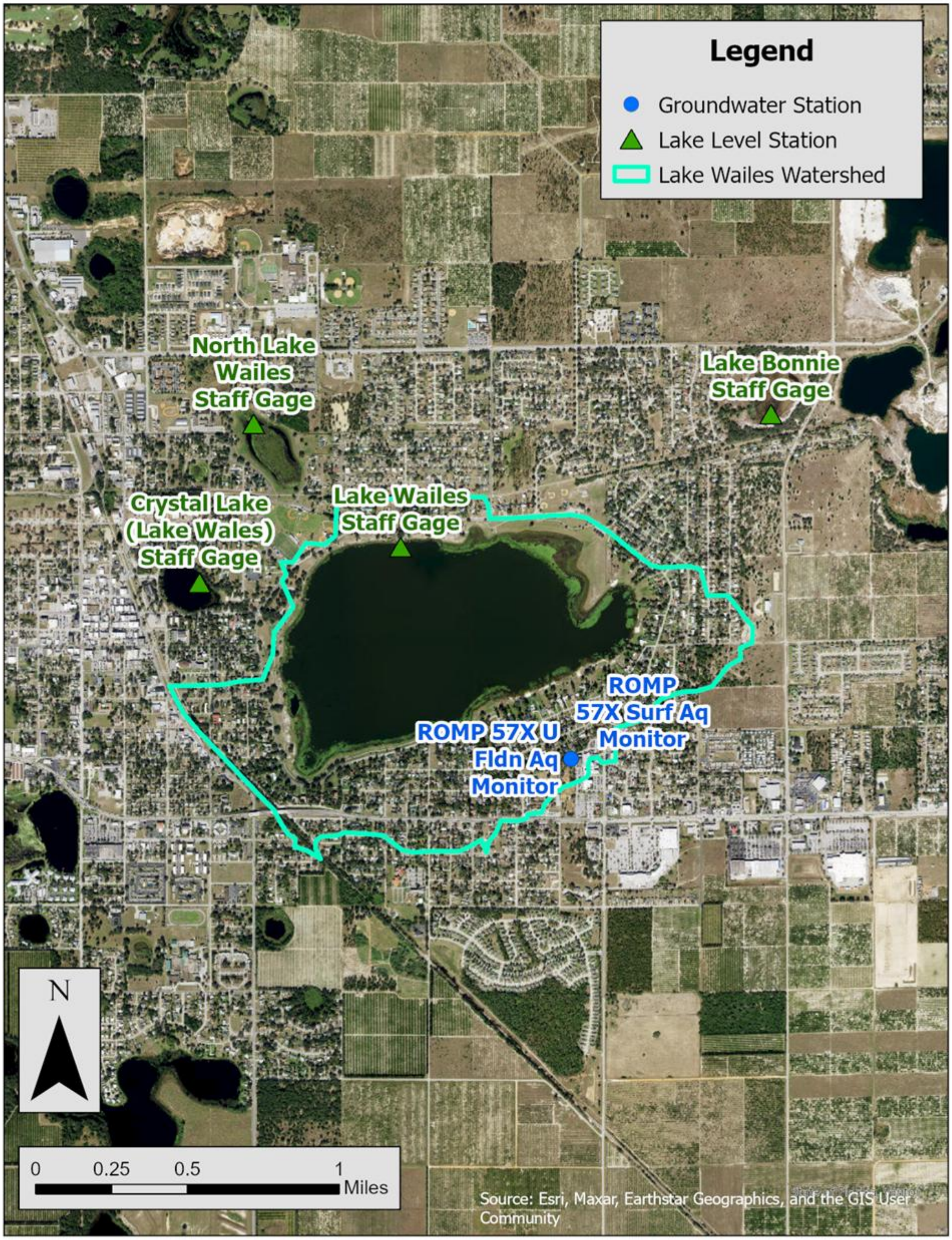


Figure 3-2. Locations of Lake Wailes, rainfall, and evaporation data collection sites used for input data in the Lake Wailes water budget model

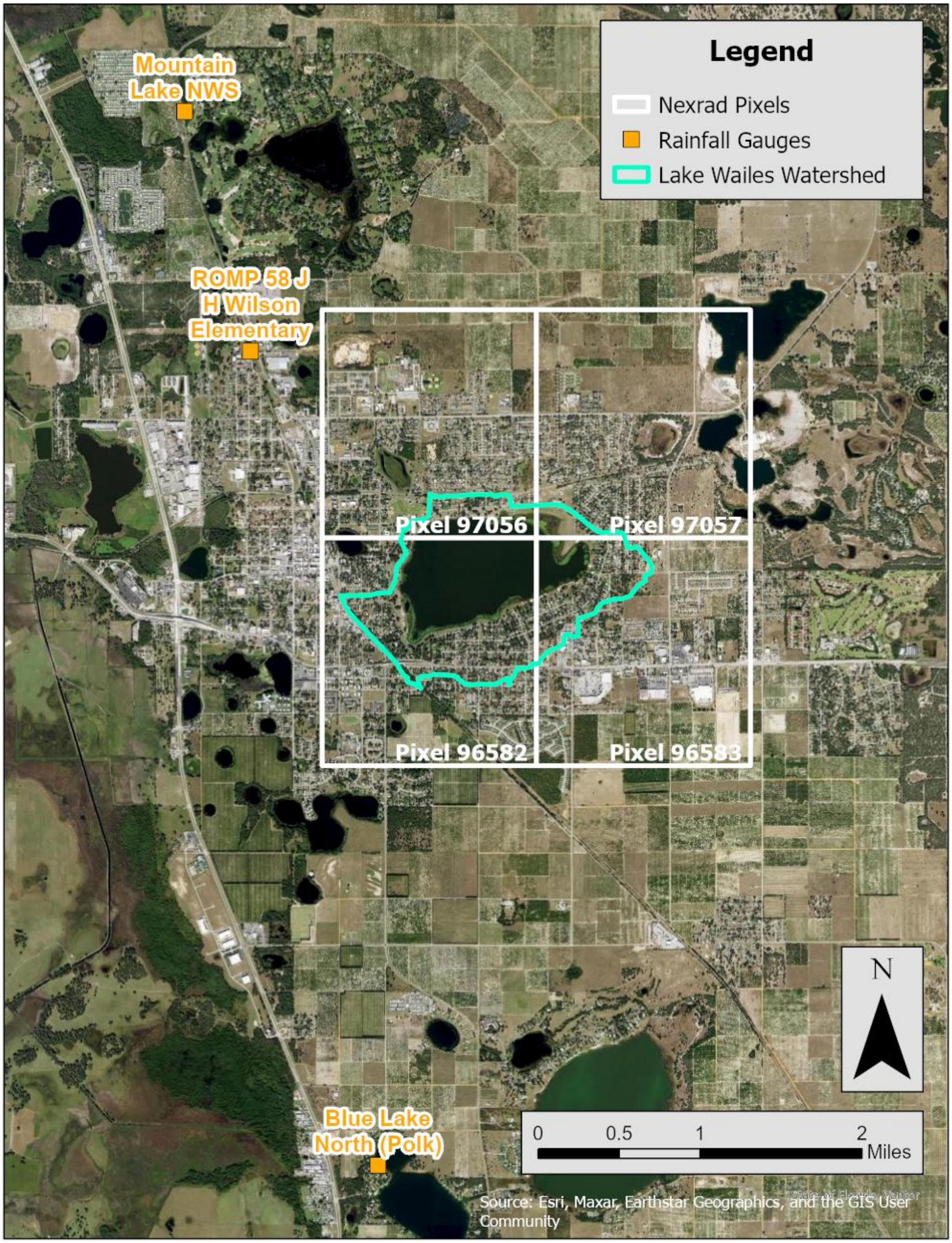


Figure 3-3. Observed water level data from the sites shown in Figure 3-1

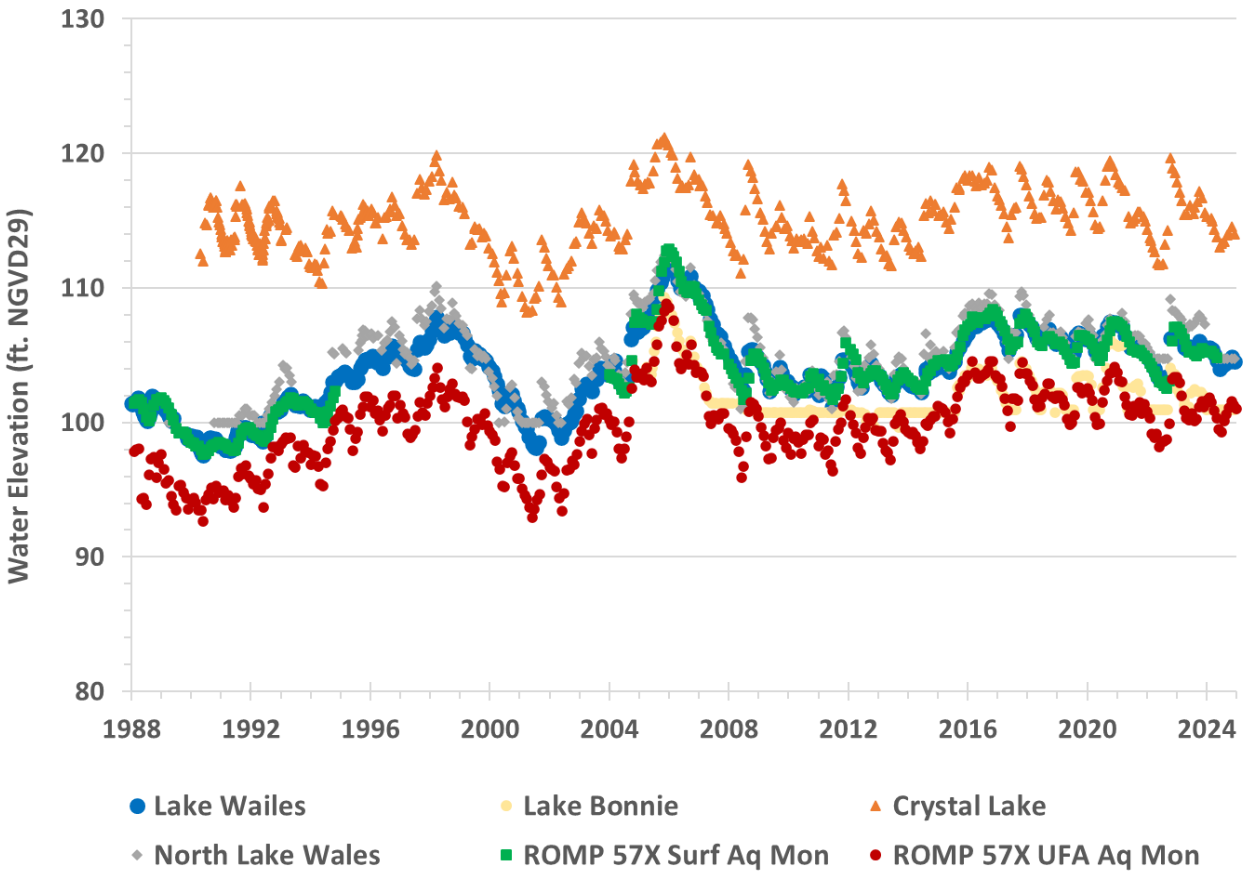


Table 3-1. Time series data input sources for the Lake Wailes water budget model

Station Name(s)	Station/Pixel ID(s)	Input Type
Lake Wailes	25351	Lake Water Level
Crystal Lake	25350	SA Water Level (in)
North Lake Wales	25353	SA Water Level (in)
Lake Bonnie	23687	SA Water Level (out)
ROMP 57X Surf Aq Mon.	25355	SA Water Level (out)
ROMP 57X U Fldn Aq Mon.	25354	UFA Water Level (out)
Mountain Lake NWS	25147	Rainfall (in)
ROMP 58 JH Wilson Elem.	25146	Rainfall (in)
Blue Lake North	25160	Rainfall (in)
NEXRAD (Radar Rainfall)	97056,97057,96582,96583	Rainfall (in)

3.3.3 Model Calibration

3.3.3.1 Calibration Approach

The primary reason for development of the water budget model is to estimate Historic water levels and percentiles that can be used to support the development of minimum levels for the lake. Model calibration was therefore focused on matching long-term percentiles based on measured water levels, rather than short-term high and low levels. Model calibration statistics that are reported are based on comparison of pairs of daily measured and modeled water levels.

Model parameters and outputs are anticipated to remain within an expected or realistic range of values given the physical setting of the lake during the calibration process. Model calibration is non-unique and there may be many combinations of parameter values that produce acceptable calibrations. However, the best match of simulated and observed lake stages may not best represent the physical system. Unrealistic parameterizations and fluxes should not be accepted even if they result in ostensible improvements in model performance relative to a more realistic parameterization.

The realism of modeling efforts is best assessed by verifying calibrated parameters and model output (i.e., the water balance) against independent data. This practice provides more certainty to model predictions as more realistic parameterizations better represent the physical system under a variety of conditions. Ultimately, professional judgement is used to select which model parameterization best balances acceptable calibration with accurate representation of the physical system.

3.3.3.2 Runoff and Channel Fluxes

The lake's watershed area, A_W, was determined to be 698 acres using a subbasin delineation available from a regional floodplain study by ADA Engineering (2012) and Atkins (2013). This delineation is consistent with digital elevation data and stage-area-volume information developed from survey data (see Figures 2-2, 2-5).

The curve number, *CN*, was estimated to be 56 for the water budget model. This value was guided by site visits, review of soils and land use geospatial data (Figure 2-7). This curve number is relatively high for the thick, well-drained, sandy soils in a deep water-table setting that characterize the Lake Wales Ridge (Brooks, 1983), but it is close to an area-weighted estimate of soil and land use geospatial data and reflects the steep topography within the basin (Figure 2-6). Steep topography has been shown to increase *CN* in various watersheds (Ajmal et al., 2020).

The portion of the watershed which is directly connected impervious area, *pDCIA*, was calibrated to a value of 0.05. The previously modeled value of 0.17 was determined to be a much higher value than what is indicated by several site visits, review of culvert as-builts in the immediate area, and the National Land Cover Database (NLCD) data for

2021 (Dewitz, 2021). The NLCD data suggests approximately 6% of the watershed is impervious, but these impervious surfaces are not directly connected to the lake.

Lake Wailes is within the Peace Creek watershed, as identified by ADA Engineering (2012) and Atkins (2013) for watershed management program modeling. The lake has also been identified by the USGS as being part of the Tiger Creek sub-basin of the Kissimmee River watershed. There are no major natural surface water systems draining into the basin. Drainage into the lake is a combination of overland flow, flow through drainage swales and conveyance systems, as well as percolation from the surficial aquifer. It is classified as a closed basin lake (O'Reilly et al., 2014). There are currently no permitted surface water withdrawals from the lake; however, there are many permitted groundwater withdrawals in the vicinity.

3.3.3.3 Groundwater Fluxes

Surficial aquifer inflows were modeled by using water levels from ROMP 57X Surf Aq Monitor, Crystal Lake, North Lake Wales, and a hydraulic gradient between Lake Wailes and Bonnie Lake. Data collected at each location were used to create the expected flow-through conditions at the lake (Lee, 2002; Sacks, 2002), ECFTX-modeled surficial aquifer water levels and water-table depths near the lake, and topographic differences between the well and the area around the lake (Figures 2-6 and 3-2). Calibration of both L_{SA} and surficial aquifer level adjustments considered the surficial aquifer influx for the modeled period, which remained consistent with isotope-derived groundwater flux estimates for Lake Wailes of 15-38 in/yr provided by Sacks (2002).

Both the ROMP 57X U Fldn Aq well and Lake Wailes are around the 100-ft and 110-ft contour of the upper Floridan aquifer potentiometric surface for May and September, respectively (Figures 2-11). Because both the well and the lake have similar proximity to this contour line, no adjustment was necessary for the well to be representative of upper Floridan aquifer water levels under the lake.

The upper Floridan aquifer leakance coefficient, `L_UFA`, was calibrated to a value of 2.0×10^{-4} ft/d/ft. This value is consistent with observed lake- upper Floridan aquifer and surficial aquifer- upper Floridan aquifer head differences, the lake's hydrogeologic province, and stratigraphic information in the vicinity of the lake. Additionally, the long-term upper Floridan aquifer flux was assessed to ensure consistency with the typical values for central Florida lakes (e.g., Fellows & Brezonik, 1980; Deevey, 1988; Belanger & Kirkner, 1994; Grubbs, 1995; Katz et al., 1995; Lee & Swancar, 1997; Motz, 1998, Sacks et al., 1998; Swancar et al., 2000; Motz et al., 2001; Watson, 2001; Lee, 2002; Metz & Sacks, 2002; Sacks, 2002; Swancar, 2015; McBride et al., 2017).

3.3.3.4 Model Performance

Errors occur due to the model's inability to completely represent the physical system and due to uncertainties associated with inputs and parameters used in the models. Winter (1981) provides a summary of uncertainties and errors associated with lake water budgets. Because the MFL rules described in Chapter 1 are stated in terms of percentiles, the water budget model performance is graded on percentile error, while using model fit statistics (e.g., mean error, maximum/minimum error, R^2) as guidance. Ideally, residuals in the P10, P50, and P90 will be less than a tenth of a foot, though water budget errors may prevent this objective. The P50 is regarded as most important as the minimum lake level and is defined by the 50th percentile. Once the simulated P50 is less than ±0.1 from the observed 50th percentile, the P10 l becomes the next objective for calibration, followed by the P90. Both the simulated P10 and P90 may be greater than ±0.1 ft from the observed 10th and 90th percentiles to avoid affecting the P50 residual while maintaining the objective of minimizing these residuals.

The final calibrated Lake Wailes water budget model is acceptable for the purposes of characterizing historic water levels and percentiles in support of minimum levels development for Lake Wailes. The parameterization (Table 3-2) produced fluxes within expected values (Table 3-3) and met the percentile performance objectives described above (Table 3-4). Model-predicted water levels match the pattern and magnitude of observed water levels (Figure 3-3).

Table 3-2. Parameters for the calibrated Lake Wailes water budget model

Parameter	Value
SA `L_SA` (ft/d/ft)* ROMP 57X Surf Aq Mon	0.003
SA `L_SA` (ft/d/ft)* Crystal Lake	0.03
SA `L_SA` (ft/d/ft)* North Lake Wales	0.005
SA `gradient` (dimensionless) Bonnie Lake	-0.0007
UFA `UFA_L` (ft/d/ft)* ROMP 57X UFA Aq Mon	0.0002
Curve Number, CN_{II}*	56
DCIA Proportion of Watershed, `P_DCIA`*	0.05
Watershed Area (including lake), `WS_AREA` (ft^2)	30,488,440
Outflow Efficiency Coefficient†	Not applicable
Control Point (Outflow) Elevation (ft)†	Not Applicable

* Calibrated parameter.
† Lake Wailes is a closed basin lake.

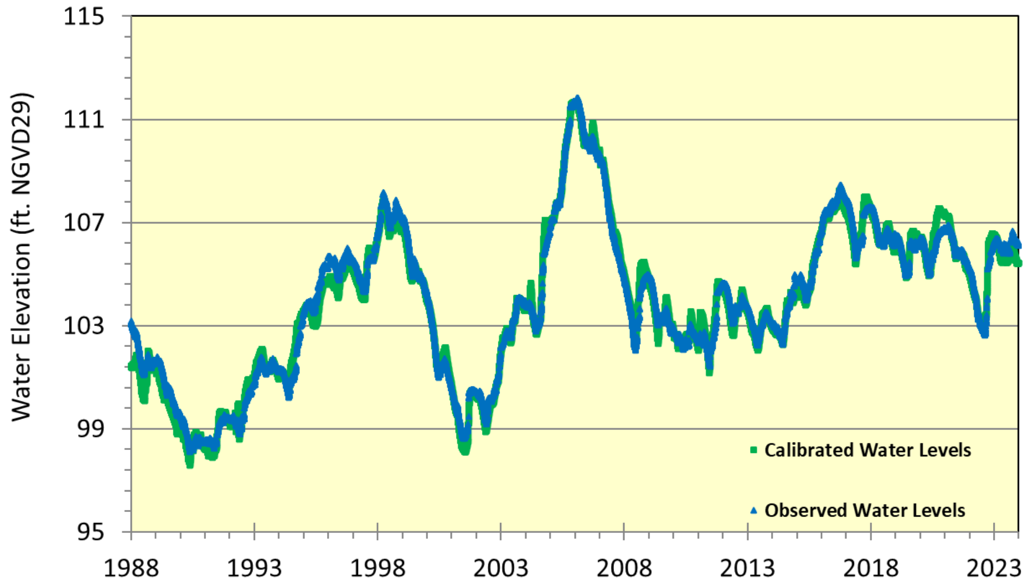
Table 3-3. Average annual water balance for the calibrated Lake Wailes water budget model.

Flux	In (in/yr and pct of total flux)	Out (in/yr and pct of total flux)	Net (in/yr)
Atmosphere			-6.9
Rainfall	52.2 (62%)	-	
Evaporation	-	59.1 (72%)	
Groundwater			3.2
Surficial Aquifer	26.2 (31%)	19.1 (23%)	
Upper Floridan Aquifer	0 (0%)	3.9 (5%)	
Surface Water			5.3
Overland Flow	1.4 (2%)	-	
DCIA	3.9 (5%)	-	
Channel	-	0 (0%)	
Total	83.7 (100%)	82.1 (100%)	1.6

Table 3-4. Comparison of percentiles of measured lake level data to calibration percentiles from the model (NGVD 29).

	Data	Model
P10	107.1	107.1
P50	102.4	102.4
P90	98.6	98.6

Figure 3-5. Observed and modeled lake water levels for the calibrated Lake Wailes water budget model



CHAPTER 4 – DEVELOPMENT OF LONG-TERM HISTORIC PERCENTILES

The development of Long-term Historic percentiles require the lake specific water budget model developed in Chapter 3 to estimate daily Historic water levels. Historic is defined as the period when there are no measurable impacts due to withdrawals and structural alterations are similar to current conditions. The Historic water levels are regressed using a rainfall model to establish the Long-term rainfall conditions. Long-term implies a wide-range of rainfall over the lake area of at least 60-years, or one Atlantic Multidecadal Oscillation cycle (AMO). The Historic water levels and long-term rainfall conditions develop the Long-term Historic percentiles that provide the hydrologic basis for applying the significant change standards and environmental screening methods described in Chapter 5.

The development of Long-term Historic percentiles is a three-step process:

1. First, the drawdown that has occurred in both surficial aquifer and upper Floridan aquifer water levels is estimated. Drawdown is the change in aquifer water levels that has occurred due to pumping. Drawdown can be estimated from regional models by comparison of water levels simulated for “pumps-on” and “pumps-off” scenarios or through evaluation of reduced pumping scenarios, as well as through analysis of actual pumping rates and observed water level data.

2. Historic lake levels are then simulated by removing estimated drawdown from the calibrated water budget model. Estimated drawdown is removed by increasing the surficial and upper Floridan aquifer water level input data.

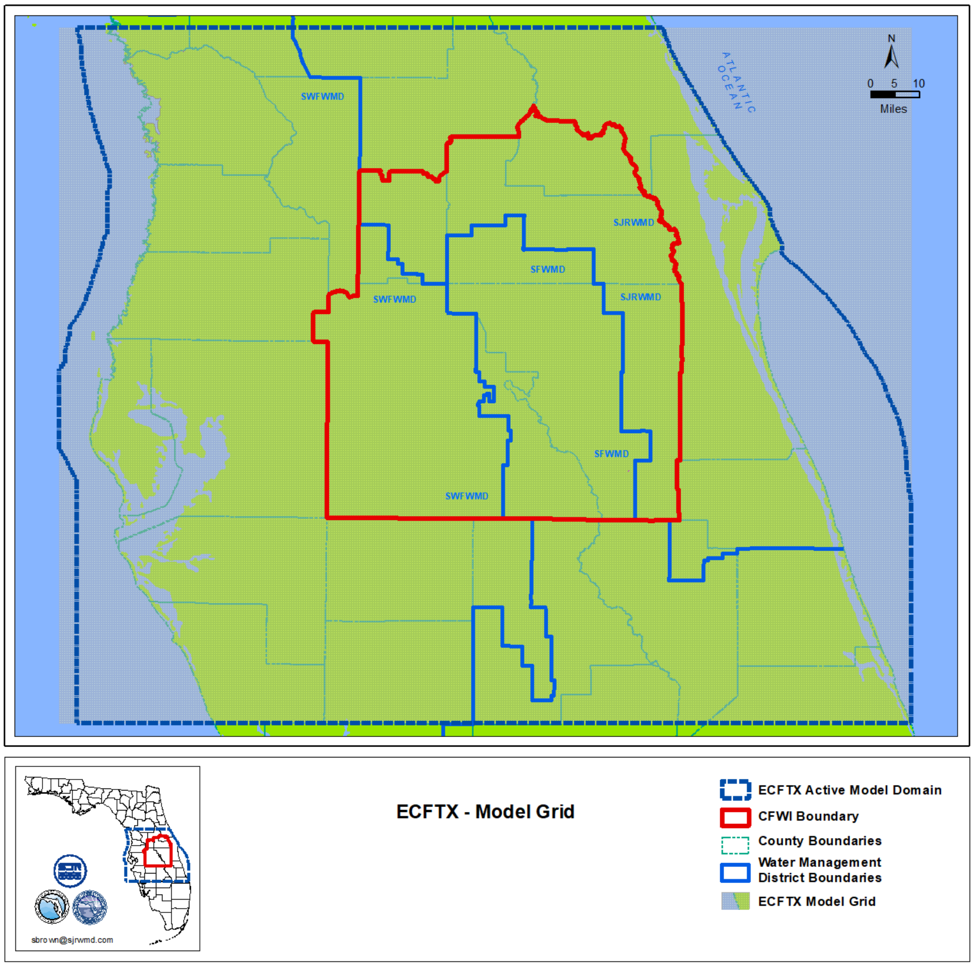
3. The resulting daily Historic lake levels are then extended to a period of at least 60 years (or one AMO cycle) by using a correlation between long-term rainfall and historic water levels. Thus, creating the Long-term Historic percentiles for Lake Wailes.

Implementation of these steps for development of the Long-term Historic percentiles for Lake Wailes are described in this chapter.

4.1 Surficial and Upper Floridan Aquifer Water Level Change Due to Withdrawals

The East Central Florida Transient Expanded (ECFTX) model was used to predict long-term drawdown in the surficial aquifer and upper Floridan aquifer at Lake Wailes. The ECFTX is an 11-layer regional groundwater flow model, which was constructed and calibrated for the years 2003-2014 by the Hydrologic Assessment Team (HAT) for the Central Florida Water Initiative (CFWI) in 2020. The model extends from the Gulf on the west to the Atlantic Ocean on the east and from southern Marion County in the north to the Highlands-Glades County line in the south, covering an approximate 24,000 square mile area (Figure 4-1). Version 1.0 of the model (CFWI-HAT 2020), which was peer-reviewed in 2020 (Andersen et al., 2020) simulates three-dimensional groundwater flow in the surficial aquifer, intermediate aquifer system, upper Floridan aquifer, lower Floridan aquifer, and associated intermediate and middle confining units. The ECFTX version 2.0 model (CFWI-HAT 2022) was developed to improve the original model calibration, support water supply planning decisions, regulatory decisions, and help determine withdrawal impacts in areas where critical water bodies with established MFLs are located.

Figure 4-1. The ECFTX model domain in central Florida.



4.1.1 Drawdown

Groundwater withdrawals are not directly included in the Lake Wailes water budget mode but are indirectly represented by their effects on water levels in the upper Floridan aquifer. When a relationship between withdrawal rates and upper Floridan aquifer potentiometric levels can be established, the effect of changes in groundwater withdrawals can be estimated by adjusting upper Floridan aquifer levels in the model.

For the reevaluation, the ECFTX version 1.0 was used to assist quantifying changes in water levels in response to changes in groundwater withdrawals. This was accomplished using a series of model runs whereby recent withdrawals and irrigation amounts were reduced by 25 percent, 50 percent, and 75 percent. This approach enabled the model to be used within the range of withdrawals that were used during the calibration phase. For the reassessment of minimum levels, the reduced pumping scenarios used a Reference Condition as a basis for comparing model reduction scenarios. The Reference Condition was based on the amount of groundwater withdrawals needed to meet the demands for water that existed as of 2014. Pumping amounts for each year and month of the 12-year transient model run were varied according to rainfall that occurred during each month. Based on the model scenarios it was estimated that modeled groundwater withdrawals have lowered the upper Floridan aquifer water levels by approximately 6.1 feet beneath Lake Wailes.

For the 2015 minimum lake evaluation for Lake Wailes, the East-Central Florida Transient (ECFT) groundwater model (Sepulvida, et al, 2012 and CFWI, 2014) was used to quantify changes in response to changes in groundwater withdrawals. The same approach described above using the ECFTX version 1.0 was used to accomplish withdrawal reduction scenarios (25 percent, 50 percent, and 75 percent) using the Reference Condition based on the amount of groundwater withdrawals needed to meet the demands for water that existed as of 2005. Similarly, the ECFT pumping varies each year and month during the 12-year transient model run according to rainfall that occurred during each month. Based on the model scenarios it was estimated that modeled groundwater withdrawals have lowered the upper Florida aquifer water levels by about 7 feet beneath Lake Wailes.

It was decided when establishing the 2015 minimum levels for Lakes Wailes that an evaluation of long-term changes in water levels were needed to verify model results. For use in the evaluation of Lake Wailes, long-term water levels in the ROMP 57X upper Floridan aquifer well were extended back to the 1940s and 1950s time period using water levels from the Coley Deep well (SID 25339), located near the City of Frostproof, the ROMP 60 upper Floridan aquifer abandoned (SID 17974) and replacement (SID 77757) wells located near the City of Mulberry, and the Claude Hardin upper Floridan aquifer well (SID 17966), located near the City of Mulberry. This was done using water level data averaged over different periods, for example annual and monthly, and single months such as September, May and December. For each regression analysis, the regression parameters were determined using data for the period 1988 to 2014, which is the time period data is available for the ROMP 57X upper Floridan aquifer well. These parameters were then used to estimate water levels for the period available for the respective independent well levels (Coley Deep and ROMP 60 upper Floridan aquifer). For the regression analyses, estimates of long-term changes in groundwater levels ranged from about 3.5 feet to 6.8 feet. It was then determined that modeled drawdown amounts using the ECFT model would be modified and that a recovery level of 4.5 feet in upper Floridan Aquifer levels would be used for the analysis. With respect to the surficial aquifer, the relationship between the leakance coefficient and the ratio of surficial aquifer to upper Floridan aquifer drawdowns established for previous modeling efforts was used. From the water budget model, the leakance coefficient was 0.0008 feet/day/feet which resulted in a ratio of surficial to upper Floridan drawdown of 0.5. The resulting recovery in the surficial aquifer was then estimated as the product of this ratio and the estimated upper Floridan aquifer recovery amount (4.5 feet) or 2.25 feet.

For the current reevaluation, District staff determined to represent long-term changes in the upper Floridan aquifer water levels by using the methodology described and used to establish the initial minimum lake levels in 2015. Groundwater level data for ROMP 57X, Coley Deep well, and ROMP 60 upper Floridan aquifer replacement (SID 77757) were updated through 2023 expanding the regression analysis from 2014 to 2023. For the regression analyses, estimates of long-term changes in groundwater levels ranged from around 4.2 feet to 7.4 feet. It was determined that modeled drawdown amounts using the ECFTX model would be modified and that a recovery level of 5.4 feet in the upper Floridan aquifer levels would be used for the analysis.

Drawdown in the surficial aquifer is difficult to characterize due to high local variability. However, a lake-specific estimate of surficial aquifer drawdown is necessary for characterizing fluxes between the lake and the surficial aquifer in the absence of groundwater withdrawals. Thus, an estimate of surficial aquifer drawdown was developed for Lake Wailes based on work conducted by Hancock and Basso (1999) for the northern Tampa Bay area, which indicates that given the leakance coefficient of the upper Floridan aquifer in ft/d/ft (L_{UFA}), the ratio of surficial aquifer and upper Floridan aquifer drawdown (DD_{SA}/DD_{UFA}, ft/ft) can be calculated using Equation 4-1. This ratio can then be multiplied by the upper Floridan aquifer drawdown to estimate surficial aquifer drawdown. The ratio is an approximation developed using results from a regional groundwater flow model in the northern Tampa Bay area. From the water budget model, the leakance coefficient was 0.0002 ft/d/ft which resulted in a ratio of surficial to upper Floridan drawdown of 0.2 with a range of +/- 0.1. Based on the product, a ratio of 0.25 was used to estimate surficial to upper Floridan aquifer drawdown. The resulting surficial aquifer drawdown using the 0.25 ratio and the estimated upper Floridan aquifer recovery amount (5.4 feet) is 1.4 feet.

(Equation 4-1) $$\frac{DD_{SA}}{DD_{UFA}} = \frac{L_{UFA}}{8.3\times10^{-4}+0.98\times L_{UFA}}$$

4.2 Historic Levels for Lake Wailes

4.2.1 Historic Water Budget Model Development

The calibrated Lake Wailes water budget model, described in Chapter 3, represents current conditions at the lake and simulates lake levels for the period from January 1988 through December 2023. Groundwater level inputs used for model calibration include water level data that were impacted by withdrawals at the time of data collection. These impacts must be removed to represent the historic water levels. Thus, upper Floridan aquifer groundwater level time series inputs were adjusted upwards in the water budget model to offset drawdown in each aquifer. These historic lake levels provide a means to estimate water levels expected in the absence of withdrawals or augmentation, while including existing structural alterations.

To produce Historic water levels for use in the water budget model, upper Floridan aquifer water levels were increased using the drawdown estimate described in Section 4.1.1. Then, the water budget is recalculated using the calibrated parameters (Table 3-2), and water levels are predicted in the absence of groundwater withdrawals.

4.2.2 Historic Water Budget Model Results

The Historic water levels along with those for the calibrated model and observed water levels for the period from January 1988 through December 2023, are provided in Figure 4-2 and Table 4-1. In the absence of withdrawals, the P10, P50, and P90 for Lake Wailes would increase by 1.5 ft for each given percentile, respectively. Relative to comparable percentiles predicted for the calibrated model.

Figure 4-2. Lake Wailes water levels from calibrated and Historic water budget model scenarios

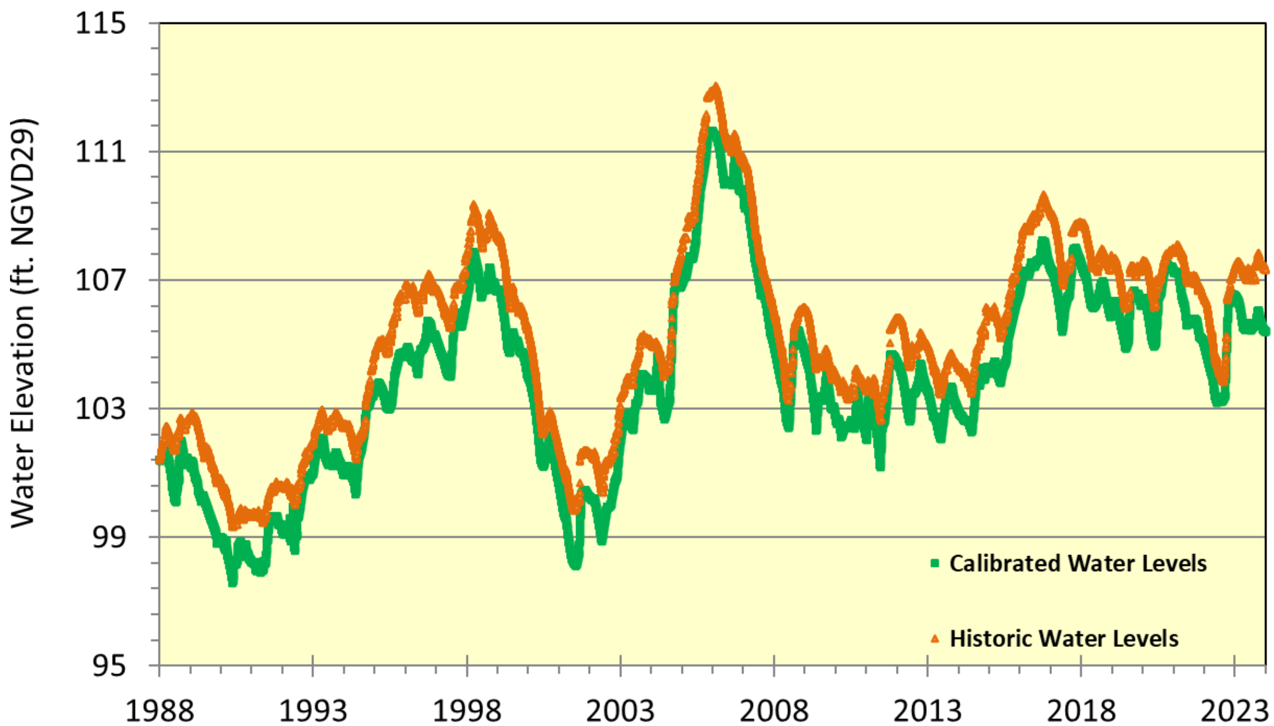


Table 4-1. Comparison of percentiles for observed and Historic water levels

Percentile	Observed (ft NGVD29)	Historic (ft NGVD29)
P10	107.1	108.6
P50	102.4	103.9
P90	98.6	100.1

4.2.3 Historic Water Budget Model Limitations

The difference between calibrated and Historic water level data depends on the magnitude of the leakance coefficients and drawdown estimates, with higher values for either increasing estimated historic water levels. Also, for lakes with structures, structure efficiency dampens inflow/outflow for water levels above structure elevation. Uncertainty in calibrated leakance coefficients and groundwater level adjustments in the water budget model limit the accuracy of the estimated Historic lake water levels because the modeled lake level percentiles are sensitive to changes in these parameters (Qi et al., 2022). Additionally, removing the effects of pumping (i.e., drawdown, which is limited by the accuracy of ECFTX) from the water budget model changes the hydraulic gradients used for the upper Floridan aquifer around the lake, and the availability of predevelopment hydraulic gradients in these units is low, which limits the accuracy of groundwater fluxes in the Historic water budget model. However, the drawdown estimates and calibrated water budget model parameters represent the best information available near Lake Wailes.

4.2.4 Long-term Historic Percentiles

A line of organic correlation (LOC) was performed using the Historic water levels developed from the water budget model and long-term rainfall to extend the data set to produce Long-term Historic percentiles. The LOC is a linear fitting procedure that minimizes errors in both the *x* and *y* directions and defines the best-fit straight line as the line that minimizes the sum of the areas of right triangles formed by horizontal and vertical lines extending from observations to the fitted line (Helsel and Hirsch, 2002). LOC is preferable for this application since it produces a result that best retains the variance (and therefore best retains the “character”) of the original data.

In this application, the simulated lake water levels representing Historic water level data were correlated with long-term rainfall data. For the rainfall regression analysis, additional representative rainfall records were added to the rainfall data used in the water budget model (1988-2023), extending the rainfall record back to 1964. The record consisted of daily rainfall measurements from the closest rain gage and missing daily data values were infilled from the next closest gage with available data until all days were populated with rainfall data. The main gages used to build the Long-term rainfall series (Figure 4-3) were Lake Alfred Experimental Station NWS (SID 17616) and Mountain Lake NWS (SID 25147). Missing days were infilled with gaged rainfall at Blue Lake North Polk (SID

25160), Lake Starr Rain (SID 25149), Babson Park 1 ENE NWS (SID 24809), Winter Haven NWS (SID 24534), and Bartow NWS (SID 25164).

Rainfall data were correlated to Historic lake water level data by applying a linear inverse weighted sum to the rainfall using a concept described by Merritt (2001). The weighted sum gives higher weight to more recent rainfall and less weight to rainfall in the past. In this application, weighted sums varying from 6 months to 10 years were separately used, the results were compared, and one of the weighted rainfall series with the highest coefficient of determination (R^2) was chosen as the best model.

Rainfall was correlated to the water budget model results for the entire period used in the water budget model (1988-2023), and the results from 1964-2023 (60 years) were produced. The final 8-year-weighed model had the highest coefficient determination, with R^2 of 0.71. The results are presented in Figure 4-4.

Figure 4-3. Rainfall Gages used for LOC Model.

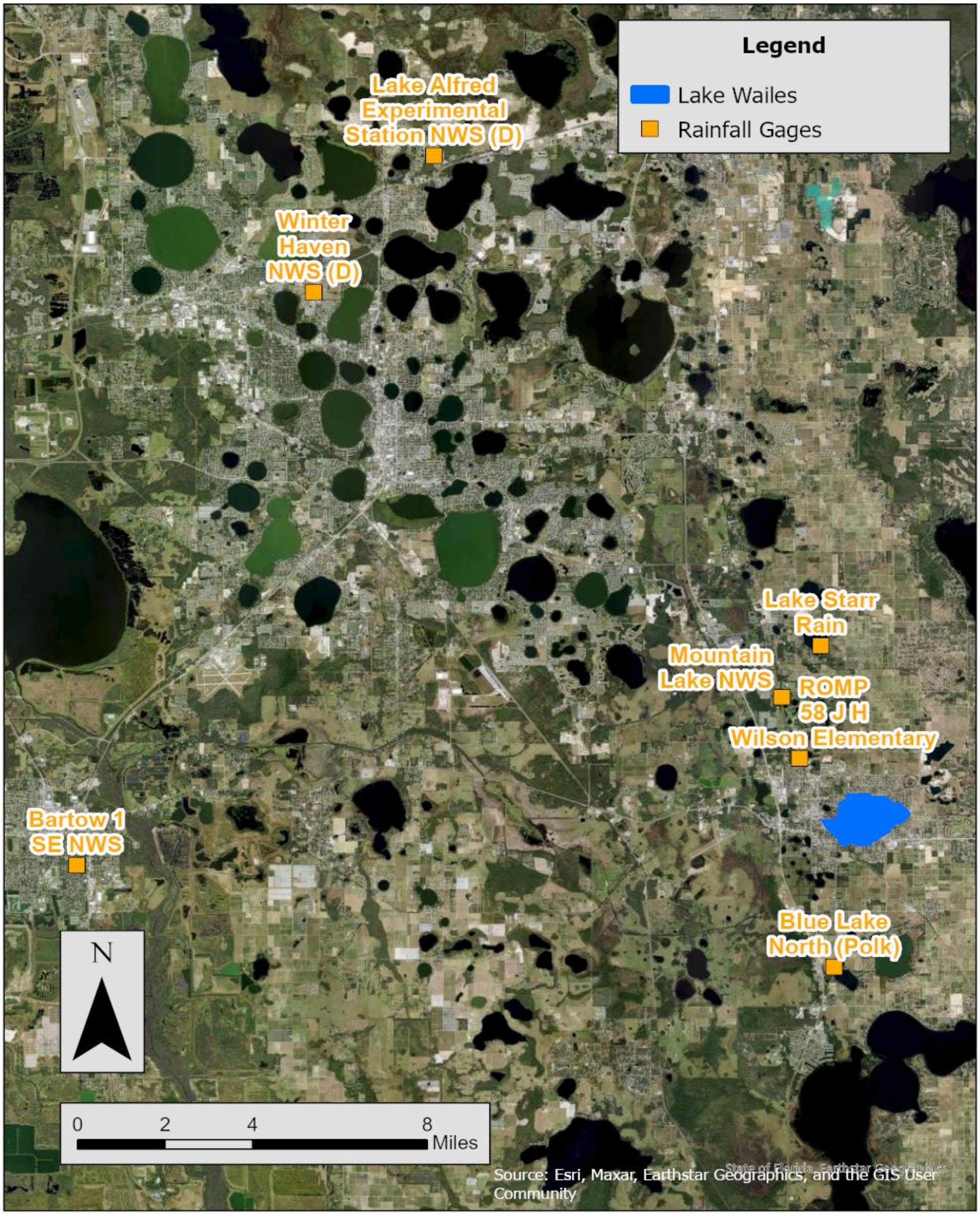


Figure 4-4. LOC model results for Lake Wailes

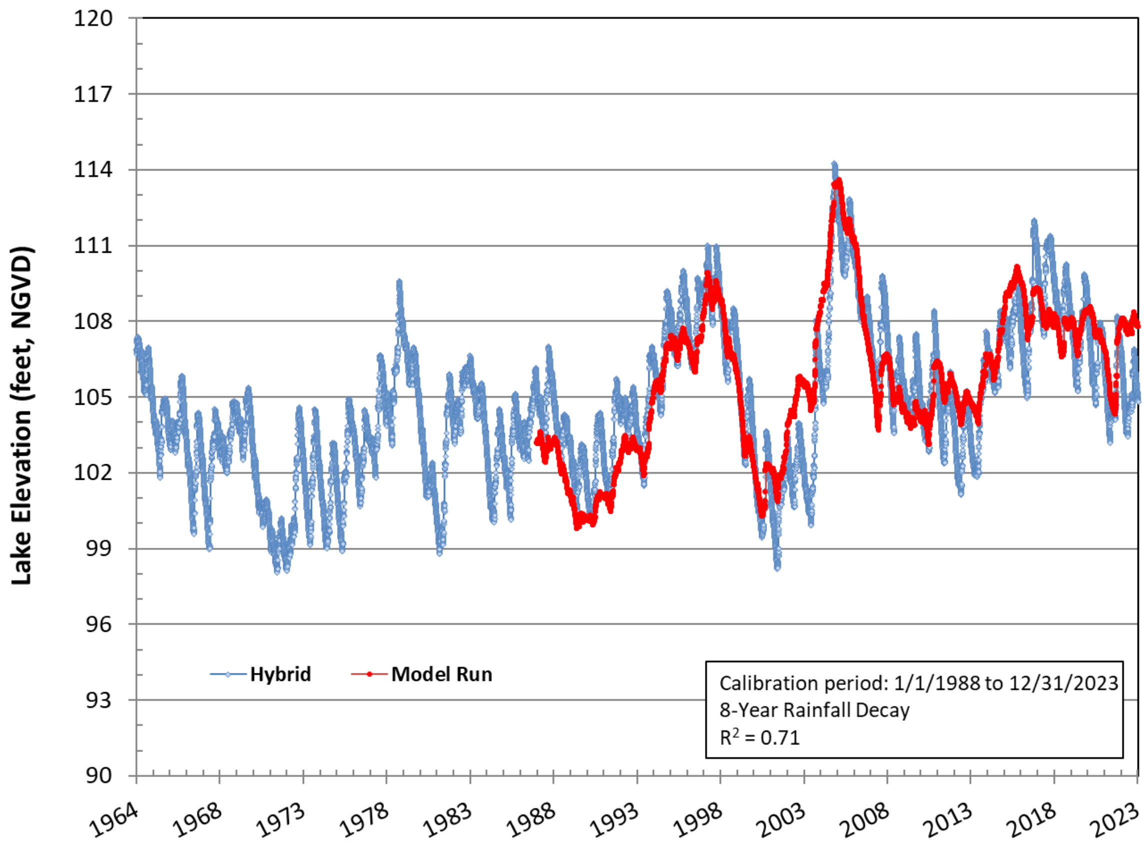


Table 4-2. Historic percentiles as estimated using the hybrid model from 1964 to 2023 (feet NGVD 29).

Percentile	Historic Water Budget Model	Long-term Historic LOC Model
P10	108.6	108.5
P50	103.9	104.3
P90	100.1	100.6

4.4 Summary

Best available information was used to develop Long-term Historic percentiles for Lake Wailes. Lake minimum levels most heavily rely on the estimate of the Long-term Historic 50th percentile (P50), which is the highest confidence percentile derived. The modeled Long-term Historic P50 is associated with some uncertainty but represents the best estimate available. The development of the Long-term Historic water levels and percentiles as described above were considered acceptable for supporting minimum levels development for Lake Wailes.

CHAPTER 5 – ENVIRONMENTAL CRITERIA METHODS, RESULTS AND DISCUSSION

Minimum lake levels were developed for Lake Wailes by first applying two significant change standards to the Long-term Historic water levels and percentiles described in Chapter 4. Next, the standard producing the higher, more protective P50 is selected and carried forward through the environmental screening process. This process is carried out to ensure all environmental screenings are protected from the significant harm threshold (SWFWMD 2022a). For Lake Wailes, the Xeric Wetland Offset Standard produced a higher P50 than the Species Richness Standard and each of the relevant environmental screening tools. Therefore, the Xeric Wetland Offset Standard was used to determine the proposed Minimum Lake Level for Lake Wailes. The difference between the Xeric Wetland Offset Standard P10 and P50 elevations (Table 4-2) was used to identify the High Minimum Lake Level.

5.1 Normal Pool Elevation and Other Hydrologic Indicators of Sustained Inundation

The Normal Pool elevation, a reference elevation used for development of minimum wetland and lake levels, is established based on the elevation of hydrologic indicators of sustained inundation. Inflection points, i.e. buttress swelling, and moss collars on the trunks of cypress trees have been shown to be reliable indicators of Normal Pool (Carr et al. 2006). Because Lake Wailes does not have sufficient cypress trees with adequate hydrologic indicators, a Normal Pool elevation was not determined. As was the case for Normal Pool determination for Lake Wailes, other useful hydrologic indicators of sustained inundation were similarly not identified for the lake.

5.2 Structural Alterations and Other Information for Consideration

No known structural alterations have occurred at Lake Wailes during the water budget model period (1988 – 2023). Existing structural alteration previous to 1988 were not considered. Additional information to consider in establishing minimum levels are the Control Point elevation and elevations associated with the lowest building floor/slab elevation and other relevant features such as low roads, within the lake basin.

As discussed in Sections 1.1, 1.2 and 1.4, the Control Point elevation is the elevation of the highest stable point along the outlet profile of a surface water conveyance system that can principally control the lake water level fluctuations. Because Lake Wailes does not have an outlet conveyance system and is considered a closed basin lake, a control point elevation was not identified for the lake (see Section 2.2). A low floor slab elevation, based on survey reports (Survtech 2021), was established at 117.64 ft NGVD29 for the Lake Wailes basin.

5.3 Significant Change Standards

Two significant change standards, the Xeric Wetland Offset Standard and the Species Richness Standard, were applied to the Long-term Historic water levels and percentiles to establish a stage-area-volume relationship for the lake. The Xeric Wetland Offset Standard was used for Lake Wailes based on its characterization as a xeric lake (GPI 2021a; see also Sections 2.3, 2.5 and 5.3.1).

5.3.1 Xeric Wetland Offset Standard

The Xeric Wetland Offset Standard is developed to protect lake fringing wetlands in xeric settings that are not dominated by cypress. Xeric waterbodies are geographically isolated lakes and wetlands in landscapes dominated by xeric soils and are typically associated with deep water-table conditions and sand pine scrub or longleaf pine–turkey oak hills ecosystems (GPI 2016; GPI 2021b; Nowicki 2019; Nowicki et al. 2021, 2022). Xeric soils contrast with mesic and hydric soils by having low moisture content, typically with a hydric rating below 3.5% (CFWI-EMT 2013; GPI 2016, 2021b). Water levels at xeric waterbodies frequently display high range and low symmetry (Epting et al. 2008; GPI 2016; Schmutz 2019). Additionally, xeric waterbodies are usually internally drained, such that maximum elevations are not typically controlled by surface outflows (GPI 2016).

The Xeric Wetland Offset Standard was developed using hydrologic data and stress-status determinations for xeric wetland sites in the Lake Wales Ridge and northern Tampa Bay areas (GPI & SWFWMD 2022). The standard is applied as an offset from the Long-term Historic P50 elevation and is based on the finding that significant harm is likely to occur at a xeric wetland when the P50 is lowered by more than 2.2 feet relative to Historic conditions.

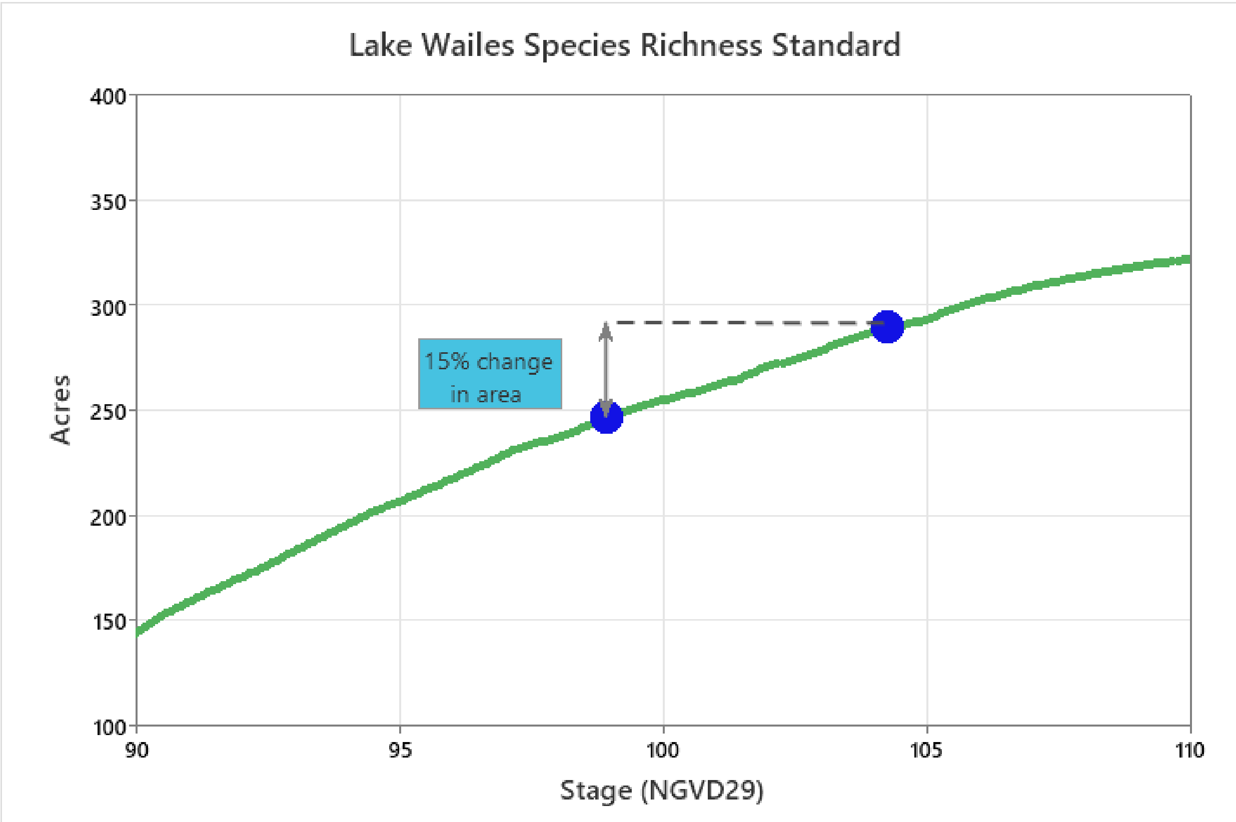
the Xeric Wetland Offset P50 for Lake Wailes is102.1 ft NGVD29, an elevation 2.2 ft. below the Long-term Historic P50 elevation of 104.3 ft NGVD29.

5.3.2 Species Richness Standard

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 Long-term Historic P50 elevation (SWFWMD 2001; Emery et al. 2009).

Application of the Species Richness Standard resulted in an elevation of 99.0 ft NGVD29. This elevation corresponds to a 15% reduction in lake surface area at the Long-term Historic P50 elevation of 104.3 ft (Figure 5-1).

Figure 5-1. Species Richness Standard for Lake Wailes compared to the Long-term Historic P50 (HP50) elevation



5.3.3 Significant Change Standards Determination

For Lake Wailes, applying the Xeric Wetland Offset Standard to the Long-term Historic percentiles produced a P50 of 102.1 ft NGVD29, which is higher, i.e., more sensitive to stage reductions, than the species richness standard of 99.0 ft NGVD29. The Xeric Wetland Offset Standard is therefore considered more protective of significant harm than the species richness standard.

5.5 Environmental Screening Methods

Information associated with four screening processes was evaluated and considered for development of minimum levels for Lake Wailes. The data, associated with aquatic habitat zones, basin connectivity, dock-use, and aesthetics, was evaluated to ensure all relevant environmental values associated with Lake Wailes would be protected with implementation of the Xeric Wetland Offset Standard, and to identify the need for additional analyses prior to identification of proposed minimum levels. A summary of the methods associated with these screenings can be found in SWFWMD 2022a.

5.5.1 Aquatic Habitat Zone Screening

Aquatic habitat zone screening ensures that fish and wildlife habitats, natural system functions, and human-use values are protected from significant harm when assessing minimum lake levels. The screening method requires developing a stage-area-volume relationship using bathymetric data and Long-term Historic water levels. The stage-area-volume relationship is used to calculate aquatic habitat area percent change in several aquatic habitat zones when applying the appropriate standard to the Long-term Historic percentiles. If an average habitat zone changes within 15%, the applied standard is considered protective of the aquatic habitat zone. If an average aquatic habitat zone exceeds 15% change, the water level corresponding to the 15% change determines the environmental screening P50 to ensure the aquatic habitat zone screenings are protected from significant harm.

The District applies a 15% change threshold, a standard commonly used in Florida minimum flows and levels assessments (Sutherland et al. 2021; HSW Engineering, Inc. 2016), to identify whether proposed minimum levels sufficiently protect critical habitat areas. Habitat zones evaluated include littoral and deep-water areas, each defined by specific depth ranges linked to ecological and recreational functions.

The aquatic habitat zone screening for Lake Wailes evaluates potential impacts of proposed minimum lake levels on six key habitat zones: small wading bird forage (0–0.5 ft), sandhill crane nesting (0.5–1.0 ft), large wading bird forage (0–1.0 ft), game fish spawning (1.0–4.0 ft), emergent marsh (0–6.0 ft), and deep-water habitat (>5.0 ft).

All critical habitat zones remained within the District's 15% change threshold when applying the Xeric Wetland Offset Standard to the Long-term Historic percentiles. The percent changes related to this screening are listed in Table 5-1.

Table 5-1. Xeric offset and Average habitat screening area, and percentage change between the xeric offset and habitat area for Lake Wailes.

Habitat	Xeric Offset Habitat Area (acres)	Average Habitat Screening Area (acres)	% of Xeric Offset Under Habitat Screening Area
Small Wading Bird	3.6	4.0	110
Large Wading Bird	7.3	8.0	109
Sandhill Crane	3.7	4.0	108
Game Fish	23.9	26.1	109
Emergent Marsh	48.9	53.9	110
Deep Water Habitat	249	229	92

Average habitat area increased through application of the Xeric Wetland Offset Standard for five of the six habitat zones evaluated. This response reflects the bathymetric characteristics of Lake Wailes, particularly the broad, shallow wetland shelf in the northeastern portion of the lake basin. The application of the Xeric Wetland Offset

Standard place portions of this shelf within the depth ranges used to define the shallow-water habitat zones. Accordingly, these five habitat zones do not indicate a loss of habitat through application of the Xeric Wetland Offset Standard and therefore do not exceed the 15% change threshold used by the screening method. Average habitat area for small wading bird, large wading bird, sandhill crane nesting, game fish spawning, and emergent marsh habitats increased by 10.3%, 9.6%, 8.8%, 9.2%, and 10.1%, respectively, compared to Long-term Historic conditions (Table 5-1).

Deep-water habitat exhibited the opposite response. Average deep-water habitat decreased from 248.7 acres using the Long-term Historic P50 value of 104.3 ft. NGDV29, to 229.0 acres through application of the Xeric Wetland Offset Standard. This represents an approximate 8% reduction. This reduction did not exceed the District’s 15% change threshold.

5.5.2 Basin Connectivity Screening

Basin Connectivity Screening is applied to lakes with sub-basins and in some cases at lakes connected to other lakes or waterbodies for the purpose of protecting surface water connections between lake basins or among sub-basins within lake basins. These surface water connections allow for movement of aquatic biota, such as fish, and support recreational uses. Basin connectivity is evaluated by determining high-spot elevations for all areas of connectivity between relevant lake sub-basins and between the lake and other waterbodies. A high-spot elevation is the lowest elevation at which surface water connection between any two given sub-basins or two waterbodies occurs. A critical fish passage elevation is then determined by adding 0.6 feet to the high-spot elevation and this elevation is evaluated to determine if it is inundated at minimum 80% of the time.

Lake Wailes can be characterized as not having sub-basins and is not connected to other waterbodies. The basin connectivity screening was determined to be not applicable for Lake Wailes.

5.5.3 Dock Use Screening

Dock Use Screening is conducted for lakes with functional, fixed-platform docks. Floating docks which may move up and down in response to water level variation are typically not considered in the screening process, nor are dilapidated docks or those that can be moved up or down the lakeshore in response to changing water levels. The screening process involves determining the mean elevation of sediments at the ends of existing docks, which is referred to as the mean dock sediment elevation (MDSE), and characterizing dock use by relating the MDSE to water-depth percentiles for various scenarios including observed period of record (POR) water levels, historic water levels, and water levels associated with achieving proposed minimum lake levels. Typically, P10, P50 and P90 water-level percentiles are used for comparison with the MDSE.

All docks observed during a field visit on April 18, 2025 were either floating docks or in poor condition, therefore a MDSE was not calculated.

Additionally, there is one public boat ramp on the north side of Lake Wailes. The proposed levels are not expected to impact the boat ramp. The proposed minimum levels are also not anticipated to impact any boating activities and other recreational activities in regard to the boat ramp.

5.5.4 Aesthetics Screening

Aesthetics screening is completed to address and protect aesthetic values associated with lake basin inundation. The screening is used to help prevent unacceptable changes to lake aesthetic attributes that may be associated with the lowering of lake water levels by withdrawals. The screening is based on a lake-user survey that indicates those in Florida prefer water level conditions between the P80 and P10. The screening presumes that aesthetic values are protected if the Minimum Lake Level equals or exceeds the Historic P80.

The Xeric Wetland Offset Standard P50 of 102.1 ft. NGVD29 for Lake Wailes is greater than the Long-term Historic P80 elevation of 101.9 ft NGVD29 (Table 5-5). Therefore, the application of the Xeric Wetland Offset was deemed sufficiently protective of aesthetic and scenic attributes.

Table 5-5. Long-term Historic percentiles and water levels for Lake Wailes.

Long-term Historic percentiles and water levels for Lake Wailes	**Water Level (ft NGVD29)**
HP100	97.9
HP90	100.6
HP80	101.9
HP70	102.9
HP60	103.6
HP50	104.3
HP40	105.0
HP30	105.8
HP20	107.0
HP10	108.5

CHAPTER 6 – PROPOSED MINIMUM LEVELS AND CONSIDERATION OF ENVIRONMENTAL VALUES

6.1 Proposed Minimum Levels

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. The Minimum Lake Level is developed using a process that considers applying professional experience and judgement, and the standards and screenings described in Chapter 5. For Lake Wailes a MLL of 102.1 ft NGVD29 was identified at the elevation corresponding to the xeric wetland offset.

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. The High Minimum Lake Level is established at the elevation corresponding to the Minimum Lake Level plus the difference between the Xeric Wetland Offset Standard P10 and the P50.. Based on the availability of Historic percentiles, the proposed HMLL for Lake Wailes was set at 106.3 ft NGVD29 by adding the P50 to P10 difference to the proposed MLL.

The current vertical datum used by many federal, state, and local agencies for the contiguous United States is NAVD88. The proposed minimum levels for Lake Wailes were therefore converted from elevations relative to NGVD29 to those relative to NAVD88 (Table 6-1). The datum shift was calculated based on third order leveling ties from vertical survey control stations with known elevations above NAVD88. The NGVD29 datum conversion to NAVD88 is -0.97 ft. for the District water-level gaging station no. 25351 at Lake Wailes. Proposed minimum levels for Lake Wailes are plotted in Figure 6-1 along with the observed water level record for the lake. The approximate locations of the lake margin when water levels equal the proposed minimum levels are shown in Figure 6-2.

Table 6-1. Proposed Minimum Levels for Lake Wailes

Minimum Levels	Elevation (ft NGVD29)	Elevation (ft NAVD88)
High Minimum Lake Level	106.3	105.3
Minimum Lake Level	102.1	101.1

DRAFT

Figure 6-1. Proposed Minimum Lake Level and High Minimum Lake Level for Lakes Wailes and water level records for the lake (District Station No. 25351) from 1965 through 2026

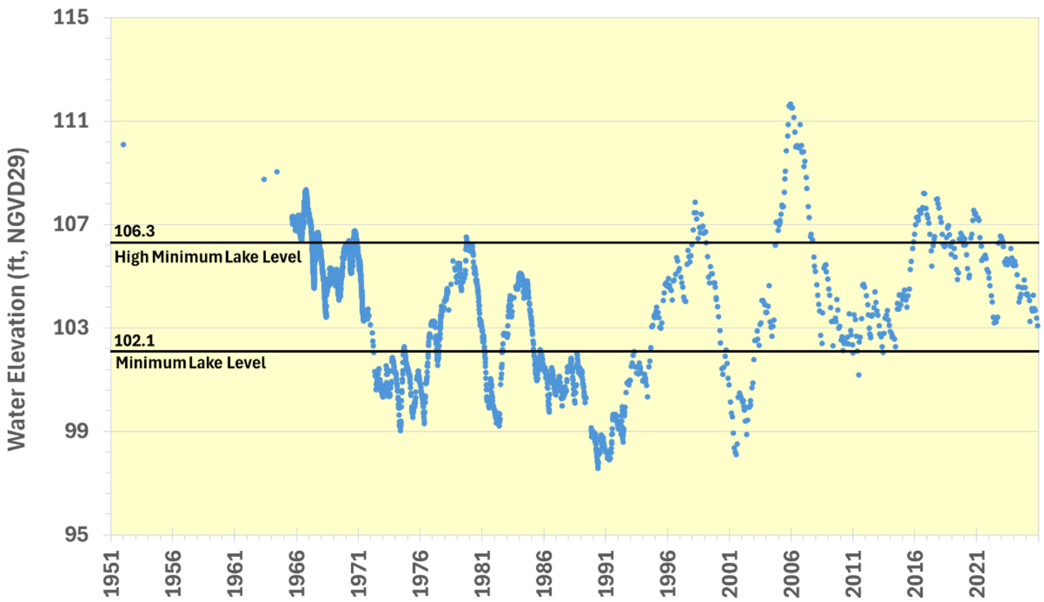


Figure 6-2. Proposed Minimum Lake Level and High Minimum Lake Level for Lake Wailes overlayed on a 2023 aerial photograph.

6.2 Consideration of Environmental Values

The minimum levels for Lake Wailes are protective of all relevant environmental values identified for consideration in the Water Resource Implementation Rule when establishing minimum flows and levels (see Rule 62-40.473, F.A.C.). As described in Chapter 5, the District evaluated and considered significant change standards and other available environmental data for the lake that could potentially exhibit sensitivity to long-term changes in lake water levels.

The Xeric Wetland Offset Standard was applied to develop the proposed minimum levels for Lake Wailes. This standard is associated with protection of several environmental values identified in Rule 6240.473, F.A.C., including: fish and wildlife habitats and the passage of fish, transfer of detrital material, aesthetic and scenic attributes, filtration and absorption of nutrients and other pollutants, and water quality (summarized in Table 1-1).

Screening methods associated with dock-use, basin connectivity, aesthetics and various aquatic habitat zones were also used to support development of the proposed minimum levels. Collectively, these assessments addressed environmental values associated with recreation in and on the water, fish and wildlife habitats and the passage of fish, transfer of detrital material, aesthetic and scenic attributes, filtration and absorption of nutrients and other pollutants, water quality, and navigation (see Table 1-1).

In relatively shallow lakes of central Florida, littoral wetlands form a critical interface between aquatic and terrestrial systems and play a disproportionate role in maintaining ecological function and biodiversity. Within these littoral zones, xeric wetland habitats, characterized by periodically inundated or seasonally saturated soils, support diverse plant communities adapted to fluctuating hydrologic conditions. These habitats provide important structural complexity and serve as key areas for nutrient cycling, wildlife habitat, and shoreline stabilization. Numerous studies have shown that hydrologic variability within littoral wetlands influences plant community composition, productivity, and habitat availability for fish, amphibians, and macroinvertebrates (Wilcox & Nichols, 2008; Keddy, 2010). Because xeric wetland zones occupy the upper portion of the lake littoral gradient, they are particularly sensitive to sustained reductions in water levels, which can alter soil moisture regimes, vegetation composition, and ecological function.

Hydrologic fluctuations are a defining ecological driver for littoral wetlands in Florida lakes. Periodic inundation supports germination and recruitment of wetland plant species, maintains soil moisture necessary for root systems, and facilitates the exchange of nutrients and organic matter between aquatic and terrestrial environments. When water levels decline for extended periods, xeric wetland areas may shift toward upland or transitional vegetation communities, reducing habitat suitability for wetland-dependent species and altering ecosystem processes (Coops et al., 2003; Mitsch & Gosselink, 2015). Changes in hydrologic regimes can also affect wildlife use of littoral wetlands, particularly for amphibians, wading birds, and other species that depend on shallow wetland habitats for breeding and foraging. Maintaining appropriate water levels is therefore critical for preserving the ecological structure and function of these transitional wetland zones.

Xeric wetlands within lake littoral zones also contribute significantly to shoreline stability and water quality. Vegetation within these habitats reduces wave energy, stabilizes sediments, and promotes the retention and transformation of nutrients and organic matter entering the lake. These functions help maintain water clarity and support the broader ecological health of the lake ecosystem. Loss or degradation of xeric wetland habitats can therefore have cascading effects on lake processes, including increased shoreline erosion, altered nutrient cycling, and reduced habitat availability for aquatic and terrestrial species.

Lake-specific analysis indicates that xeric wetland habitats surrounding Lake Wailes are particularly sensitive to reductions in water levels due to their position along the upper littoral gradient. Sustained declines in lake stage can result in prolonged drying of these wetlands, leading to shifts in vegetation composition and a loss of ecological function. Protecting these habitats is therefore important for maintaining the ecological integrity of the lake's shoreline and littoral system. For this reason, preservation of xeric wetland habitat was considered in the development of the minimum level for Lake Wailes.

In addition, the environmental value of maintenance of freshwater storage and supply is also expected to be protected by the proposed minimum levels based on inclusion of conditions in water use permits that stipulate permitted withdrawals will not lead to violation of adopted minimum flows and levels. Additionally, the cumulative impact analysis that occurs for new water use permits or increased allocations for existing permits must demonstrate that existing legal users and established minimum flows or levels are protected, further linking minimum flows and levels with the protection of freshwater storage and supply. Also, reasonable assurance that construction activities addressed in environmental resource permits will not adversely impact the maintenance of surface or groundwater levels or surface water flows associated with established minimum flows and levels is required.

Two environmental values identified in the Water Resource Implementation Rule were not considered relevant to development of the minimum levels proposed for Lake Wailes. Estuarine resources were not considered relevant because Lake Wailes is a closed-basin lake that is not connected to an estuarine resource. Sediment loads were similarly not considered relevant for minimum levels development for the lake, because the transport of sediments as bedload or suspended load is a process typically associated with flowing water systems.

6.3 Comparison of Proposed and Currently Adopted Minimum Levels

The proposed minimum levels identified in this report differ from those currently adopted for Lake Wailes (Table 6-2). The proposed High Minimum Lake Level is 1.2 ft lower than the currently adopted High Minimum Lake Level, and the proposed Minimum Lake Level is 2.6 ft lower than the adopted Minimum Lake Level.

The differences between the currently adopted and proposed minimum levels largely reflect improvements in the data, methods, and model development used for this reevaluation. Similar to the 2015 evaluation, the current analysis relied on lake-specific water-budget and rainfall regression modeling to develop Long-term Historic percentiles used to evaluate the lake’s response to regional groundwater withdrawals and climatic variability. However, the present study incorporates substantially improved datasets, updated hydrologic inputs, and refinements to the model structure and calibration. These improvements include longer and more complete monitoring records, updated representations of rainfall, evaporation, surface runoff, and groundwater interactions, and enhanced characterization of exchanges with both the surficial and upper Floridan aquifers. As a result, the updated model provides a more robust and refined simulation of the lake’s hydrologic regime while maintaining methodological consistency with the previous evaluation.

Additional improvements include incorporation of substantially more field data. Updated bathymetric and topographic surveys were completed in 2022, providing a detailed digital elevation model and refined stage-area-volume relationships that were unavailable during the 2015 analysis. The current evaluation also benefited from an extended period of continuous lake-stage monitoring (1951–2025) and updated regional groundwater modeling (ECFTX model) that more accurately characterizes aquifer drawdowns and hydraulic connectivity between Lake Wailes and surrounding groundwater systems. Together, these advances enable a more robust reconstruction of Historic conditions and more reliable estimation of long-term percentile stages.

Methodological refinements were also applied to the ecological criteria used to define minimum levels. The 2015 adopted Minimum Lake Level was based on a *mesic* wetland offset of 0.8 ft below the Long-term Historic P50, which did not reflect the xeric landscape and limited groundwater connectivity of the Lake Wailes basin. The current reevaluation appropriately applies a *Xeric* Wetland Offset Standard of 2.2 ft below the Long-term Historic P50, consistent with District guidance for lakes with rainfall-driven hydrology and high soil permeability. The use of lake-specific habitat screening further ensures that the proposed levels provide ecological protection under realistic hydrologic conditions.

Field reconnaissance and on-site observations conducted during 2025 corroborate the modeling results. Under existing adopted levels, the lake would exhibit inundation well above observed littoral vegetation limits and surrounding topography, indicating that the previously adopted Minimum Lake Level is high relative to current site conditions. The proposed Minimum Lake Level of 102.1 ft NGVD29 therefore represents a more accurate and defensible estimate of the elevation at which additional drawdown would begin to produce significant ecological harm, while maintaining compliance with the District's 15% habitat change threshold.

Table 6-2. Proposed and existing minimum levels for Lake Wailes.

Minimum Levels	Proposed Elevations (ft NGVD29)	Currently Adopted Elevations (ft NGVD29)
High Minimum Lake Level	106.3	107.7
Minimum Lake Level	102.1	104.8

CHAPTER 7 - MINIMUM LEVELS STATUS ASSESSMENT AND MINIMUM LEVELS RECOMMENDATION

7.1 Status Assessment

To assess the current and projected 20-year status (through 2045) of the proposed minimum levels for Lake Wailes, P10 and P50 water elevations were calculated by extending recent measured stage data to long-term (1964 to 2023) lake stage using a method similar to the method described in Section 4.3.

The current status used stage data measured at the lake (SID 25352) from 1988 through 2025 (SWFWMD, 2022b). The timeframe was selected based on data availability and regional groundwater use trend (Figures 2-13). This recent measured stage data was then extended to long-term lake stage based on long-term rainfall, using the LOC method. The current P10 is 0.7 ft higher than the proposed High Minimum Lake Level and the current P50 is 0.2 ft higher than the proposed Minimum Lake Level (Table 7-1). These results indicate the proposed minimum levels for Lake Wailes are currently being met and development and adoption of a recovery strategy for the lake would not be required in association with adoption of the proposed levels into District rules.

Based on results from ECFTX regional groundwater model (CFWI-HAT, 2022) scenario simulations in support of regional water supply planning for the CFWI (CFWI 2025), upper Floridan aquifer levels beneath Lake Wailes are expected to decrease by 0.6 ft in 2045 relative to recent representative (2016-2020) withdrawal conditions (Figure 7-1). This projected decrease is due to anticipated growth in public water supply in Polk County (SWFWMD 2025). The anticipated impact due to public water supply growth in the upper Floridan aquifer level is approximately 10% of the drawdown used for the Historic condition in the water budget model period (see Figure 4-3), and this information was used for a projected 2045 status assessment for the proposed minimum levels for Lake Wailes.

Projected water levels from the 2045 withdrawals condition scenario of ECFTX were used in the Lake Wailes water budget model to assess the 2045 status. Lake water levels predicted for the 2045 condition with the water budget model were then extended to long-term lake stage values based on long-term rainfall, using the LOC method. The P10 and P50 water surface elevations were then calculated from the resulting long-term lake stages for the projected 2045 condition. The P10 simulated for the 2045 conditions scenario was 0.6 ft higher than the proposed High Minimum Lake Level and the P50 for the scenario results was at the proposed Minimum Lake Level (Table 7-1). These results indicate the proposed minimum levels are projected to be met during the coming approximately 20-year planning horizon and indicate that development and adoption of a specific prevention strategy in addition to the SWUCA for Lake Wailes would not be necessary or required in association with adoption of the proposed levels.

As the lake is meeting its minimum levels, no recovery strategy is required at this time. However, the lake lies within the region of the District covered by an existing recovery strategy for the Southern Water Use Caution Area (Rule 40D-80.074, F.A.C.).

Figure 7-1. Projected drawdown (in feet) between the 2045 withdrawals scenario and the 2016-2020 withdrawals scenario from ECFTX v2.

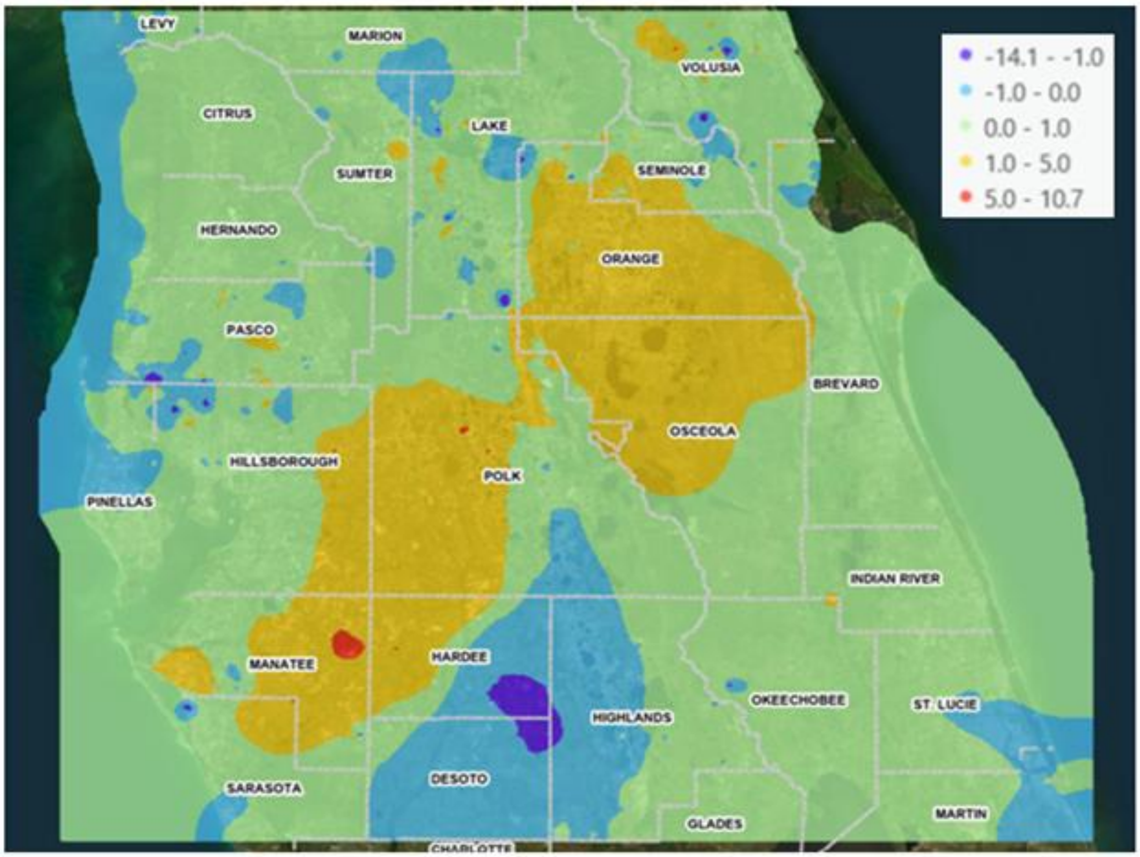


Table 7-1. Proposed minimum levels and current and projected P10 and 50 water levels used to assess the status of the proposed minimum levels for Lake Wailes.

Percentile	Minimum Levels (ft NGVD29)*	Current Water Levels (ft NGVD29)	Projected 2045 Water Levels (ft NGVD29)
P10	106.3	107.1	106.9
P50	102.1	102.3	102.1

* The High Minimum Lake Level is the P10 and Minimum Lake Levels is the P50 that must, respectively, be equaled or exceeded on a long-term basis.

7.2 Minimum Levels Recommendation

Based on results of the reevaluation described in this document, removal of the minimum lake levels established for Lake Wailes from the District's Water Levels and Rates of Flow rules (Chapter 40D-8, F.A.C.) and their replacement with a Minimum Lake Level of 102.1 ft NGVD29 and High Minimum Lake Level of 106.3 ft NGVD29 within the rule is recommended.

A status assessment of the recommended minimum levels indicates the levels are being met and are projected to be met during the next 20 years (through 2045), so there is no need for development and implementation of a water-body specific recovery or prevention strategy. The District will continue to implement its general, three-pronged approach that includes monitoring, annual status assessment of established minimum levels, and regional water supply planning to ensure that the adopted minimum levels for the lake continue to be met. In addition, the District will continue to monitor levels in Lake Wailes, other lakes and surface water bodies, and relevant groundwater systems to further our understanding of lakes and as necessary, to refine our minimum level methods.

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