Focus Assessment Report: Lower Kissimmee Subwatershed

November 19, 2025

Steffany Olson, Santiago Acevedo, Cristina Gauthier, Amanda McDonald, Stephanie Nevadunsky, and Youchao Wang[1]

Contributors: Libo Wu[2]

INTRODUCTION

BACKGROUND

The Northern Everglades and Estuaries Protection Program (NEEPP; Section 373.4595, Florida Statutes) directs the South Florida Water Management District (SFWMD) in cooperation with the Florida Department of Environmental Protection (FDEP) and the Florida Department of Agriculture and Consumer Services (FDACS), collectively referred to as the Coordinating Agencies, and local entities, to complete a watershed protection plan (WPP) for the Lake Okeechobee Watershed (LOW). In 2020, SFWMD began the process of reviewing all the Northern Everglades WPPs annually and committed at the February 11, 2021, SFWMD Governing Board meeting to complete focused basin-specific assessments in areas identified to be the highest priority for action as part of the watershed protection planning process. The purpose of the assessments is to gather information to pinpoint the most significant nutrient loading sources contributing to the water quality problems, determine what remains to be done to improve water quality, and recommend strategic actions for future planning. Information from the assessments will be used to provide information for requests for project proposals, update the WPPs and to inform future FDEP Lake Okeechobee Basin Management Action Plan (BMAP) updates. This report documents the assessment for the Lower Kissimmee Subwatershed. For the period of Water Years (WY) 2020-2024 (May 1, 2019 – April 30, 2024), the Lower Kissimmee had the second highest total phosphorus (TP) unit area load (UAL) in the LOW (Olson et al. 2025) which is why it was selected for an assessment.

LOCATION OF SUBWATERSHED

The Lower Kissimmee Subwatershed is located within the LOW, south of the Upper Kissimmee Subwatershed and east of the Lake Istokpoga Subwatershed (**Figure 1**). The Lower Kissimmee

[1] The authors acknowledge David Anderson, Cassondra Armstrong, Christian Avila, Carmela Bedregal, Mirza Billah, Steve Bousquin, Marcy Frick, Aubrey Frye, Chandler Keenan, Susan Mason, Sara Ouly, Tracey Piccone, Rodolfo Villapando, and Zachariah Welch for providing valuable comments and suggestions to this document. Additionally, the authors acknowledge the staff from the Okeechobee Water Quality office who collect the water quality monitoring samples and the staff in the Analytical Services Section, without their efforts the data used of the assessments would not exist.

[2] Contributed GIS support.

Subwatershed covers 428,886 acres (**Figure 1**) in the LOW. A large portion of the subwatershed is in Okeechobee County, but it also includes portions of Osceola, Polk, and Highlands counties. The Lower Kissimmee Subwatershed discharges to Lake Okeechobee, which is impaired for nutrients.

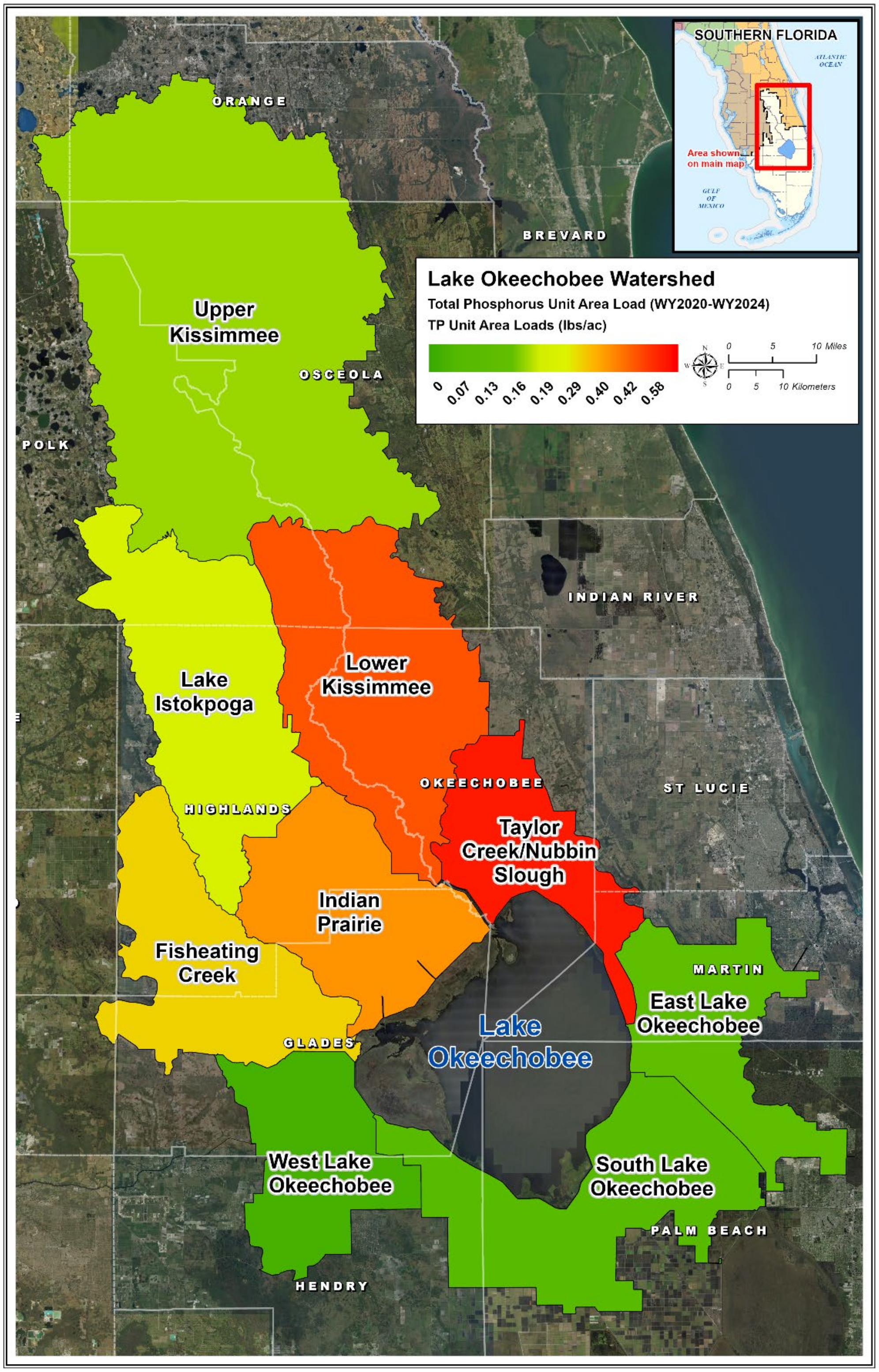


Figure 1. TP Unit Area Loads (UALs) in lbs/acre by subwatershed in the LOW.

NUTRIENT AND STORAGE TARGETS

In the LOW, TP SFWMD planning targets were developed in consultation with FDEP in 2023 (Olson, 2023). The methodology is based on the proportion of the TP load contributed by the subwatershed during the 5-year period from WY2014–WY2018 (May 1, 2013–April 30, 2018), as reported in Table 8B-8 of the 2019 South Florida Environmental Report – Volume I, Chapter 8 (Welch et al., 2019), and the TP TMDL for Lake Okeechobee of 105 metric tons per year (t/yr) based on a five-year moving average (FDEP, 2001). This is the same methodology FDEP used to establish subwatershed targets in the 2020 Lake Okeechobee Basin Management Action Plan (FDEP 2020) and the SFWMD subwatershed planning targets are identical to the subwatershed targets in that document. The TP planning target load for the Lower Kissimmee Subwatershed is 22.1 t/yr based on a 5-year moving average (**Table 1**)**.** The purpose of the planning targets is to allow an assessment of existing and proposed projects and programs to determine where additional load reduction efforts are needed.

Table 1. TP Load (WY2014-WY2018), Percent Contribution, and TP Planning Target for the Lower Kissimmee Subwatershed

Subwatershed	WY2014–WY2018 TP Load (t/yr)	% Contribution of Load	TP Target (t/yr)
Lower Kissimmee	125.9	21	22.1
Total Load to Lake from all 9 Subwatersheds[a]	598.4	100	105.0

[a]Does not include atmospheric deposition.

The TMDL for Lake Okeechobee does not address nitrogen, although it is a concern for Lake Okeechobee (Welch et al. 2025) as well as the downstream Caloosahatchee and St. Lucie Rivers which receive lake water and have TMDLs for nitrogen (Bailey et al. 2009 and Parmer et al. 2008, respectively). While there are no nitrogen planning targets for the Lower Kissimmee Subwatershed, the Lake Okeechobee BMAP (FDEP 2020) identified where nitrogen could be reduced through projects and programs and evaluated the TN concentrations against the benchmark of the numeric nutrient criteria (NNC) of 1.54 mg/L (FDEP 2012) to determine the targeted restoration area (TRA) TN priority for the LOW basins. This benchmark is one of four metrics used in the TRA evaluation. As part of FDEP's TRA process each basin is given a rank of 1 (highest priority), 2 (next highest priority) or 3 (to be addressed as resources allow). In the 2020 BMAP the Lower Kissimmee Subwatershed S65A[3] and S65E basins (**Figure** 2) were given a TRA priority of 3 for TN. The Kissimmee River (S65BCD) had insufficient data to prioritize. In the 2024 Five-Year Review of the Lake Okeechobee BMAP (FDEP 2024a), the S65A basin's TRA TN priority was changed to a 2. The other TN priorities remained the same.

Specific storage targets have not been assigned for the Lower Kissimmee Subwatershed. The Phase II Technical Plan for the Lake Okeechobee Watershed Construction project was required by the NEEPP statute to design projects and identify additional measures needed to improve water quality and quantity, and it identified a static storage target (project capacity) range for the LOW to be 900,000 to 1,300,000 ac-ft/yr (SFWMD et al. 2008) but no specific targets were provided at the subwatershed level. In 2015, an independent technical review completed by the University of Florida Water Institute recommended conducting a strategic planning exercise to provide for additional water storage and treatment north of Lake

[3] Structures are typically labelled with a dash (S-65A) but to avoid confusion with the nomenclature used to retrieve data and to be consistent, the dash was not used throughout this document.

Okeechobee (University of Florida 2015). As part of the 2025 Lake Okeechobee Watershed Protection Plan (LOWPP) update storage targets were reevaluated in the Northern Everglades Watersheds. This effort built on the work completed for the Phase II Technical Plan (SFWMD et al. 2008) and the accompanying Estuary WPPs published in 2009 (SFWMD et al. 2009a and SFWMD 2009b). The results indicated that there is a range of 481,000 to 881,000 ac-ft of unmet storage needs in the LOW (Frye et al. 2025).

SUBWATERSHED/BASIN OVERVIEW

HYDROLOGY

The Lower Kissimmee Subwatershed, at 428,886 acres in size, is the second largest subwatershed in the LOW. Receiving water from the Upper Kissimmee Subwatershed through S65 and releasing water towards Lake Okeechobee through S65E, the Lower Kissimmee Subwatershed consists of three basins, running north to south, named for the control structures located at their downstream end and the former structures within the basin: S65A, S65BCD, and S65E (**Figure 2**). This section of the Kissimmee River was channelized into the C-38 Canal in the 1960's. The flow pattern was towards the canal and then south. The S65BCD basin contains the Kissimmee River Restoration Project (KRRP) which is a project to reestablish the natural path of the Kissimmee River and its associated floodplain. The construction aspect of the project was completed in July 2021 and included nearly 22 miles of backfilling of the C-38 Canal and the removal of two water control structures: S65B in 2001 and S65C in 2017. For further information on KRRP see the Project Evaluation Section below.

The subwatershed can also receive flow from the Lake Istokpoga Subwatershed via the Istokpoga Canal and Istokpoga Creek. However, approximately 89% of the time, there is no flow through the Lake Istokpoga Canal and 96% of the time there is no flow through the creek to Lower Kissimmee based on the analysis in the Water Availability Section below.

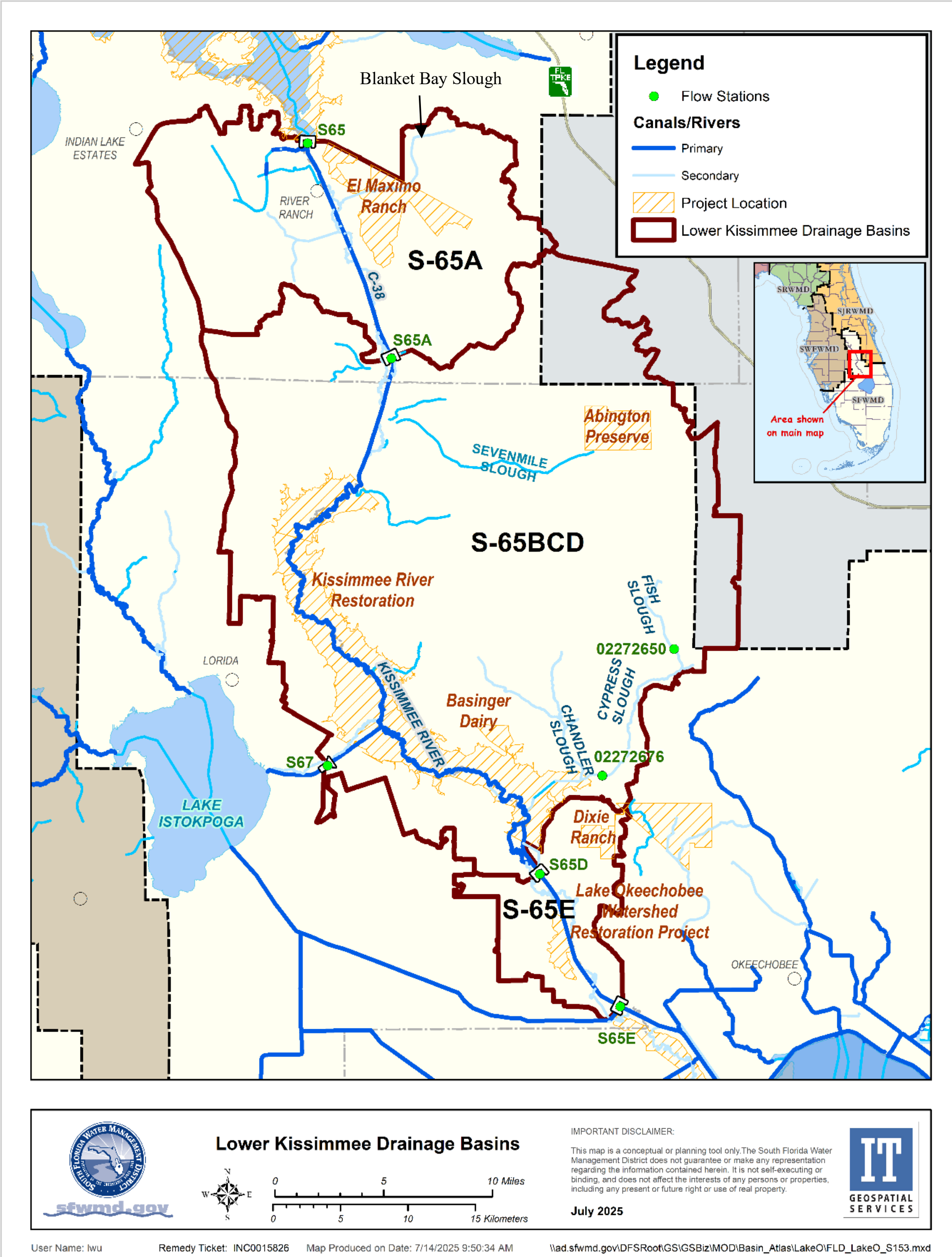


Figure 2. Map of the Lower Kissimmee Subwatershed showing locations of LOWPP projects, the Kissimmee River Restoration footprint, drainage basins, and flow stations.

ELEVATION

The Lower Kissimmee Subwatershed has elevations ranging from approximately 13 feet to 140 feet NAVD88 (**Figure 3**). Higher elevations are primarily found in the northern and western portions along the Lake Wales Ridge, while the Kissimmee River flows southward through the central and southern areas at lower elevations. This river creates a natural low-lying corridor through the subwatershed, accentuating a gradient from high to low as the terrain slopes toward the southeast. The River's path is a prominent feature that shapes the topography, influencing water flow and landforms across the region.

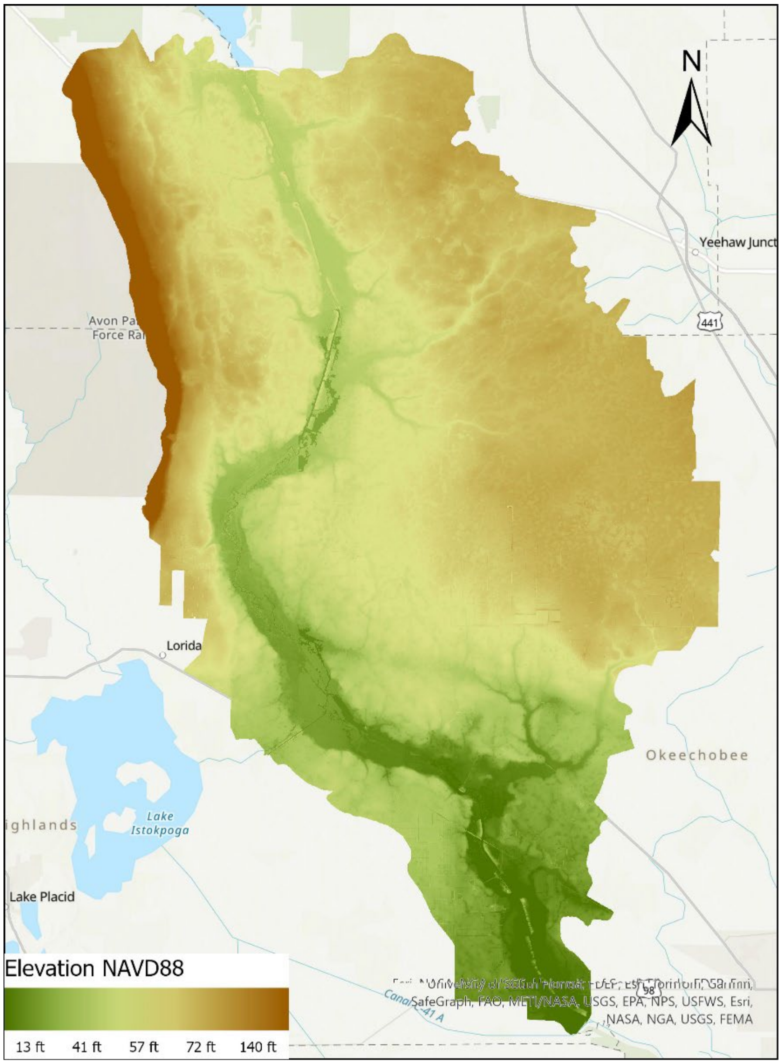


Figure 3. NAVD88 ground surface elevation of the Lower Kissimmee Subwatershed.

WATER AVAILABILITY

Water availability refers to both the quantity and timing of flows potentially accessible for projects, relative to watershed objectives and project operations. A water availability analysis was performed for the Lake Okeechobee Watershed Lower Kissimmee Subwatershed for WY2015 – WY2024 (May 1, 2014 – April 30, 2024). This analysis is reflective of a flow-frequency assessment, characterizing the statistical occurrence and magnitude of hydrologic flows, and is not a quantification of water available for consumptive or other extractive uses. It should not be interpreted as representing water that can be withdrawn without reducing downstream or ecological flows. The monitoring stations considered for the analysis are shown in **Table 2.** Adequate representation of water availability for the Lower Kissimmee Subwatershed by site required combining multiple station flows. Flows presented do not include non-recorded emergency discharges that may have happened as a result of storm events. The stations combined for the sites presented in this analysis are also depicted in **Figures 4, 7, 10, 15,** and **20**.

Table 2. Lower Kissimmee Subwatershed Flow Monitoring Stations in DBHydro.

Site	Station	DBKey
Upper Kissimmee		
S65	S65_S	91658
	S65_LCK	WZ443
Lower Kissimmee / S65A		
S65A	S65A_S	91646
	S65A_LCK	12571
	S65AXC_W	91644
	S65AXB_W	91643
	S65AXA_W	91637
	S65AX_C	91645
	S65AX2_C	91635
	S65AX3_C	91636
Lower Kissimmee / S65BCD		
CYPRESB	2272676	88214
FISH	2272650	88212
S67	S67_C	91660
S65D	S65DX1_C	91652
	S65DX2_S	91653
	S65D_S	91655
	S65D_LCK	X0127
Lower Kissimmee / S65E		
S65E	S65E_S	91656
	S65E_LCK	X0128
	S65EX1_S	AL760

Flow percentiles and availability were used as the main metrics in this analysis. Hydrographs show the daily flow data at each station over the period of record (POR – WY2015-WY2024), and percentile graphs present the frequency that the observed flow exceeds a given rate (e.g.: flow exceeds 500 cfs 2% of the time). These metrics are used as a general assessment on water availability for existing and/or future planned projects.

Available flow is defined for this purpose as flows at and below the 90th percentile observed during the evaluation period. However, the 90th percentile does not capture substantial volumes stemming from the hydrologic variabilities in this subwatershed. The evaluation shows that volumes from extreme events, which encompass the broad seasonal hydrology of this subwatershed, are better captured at the 95th percentile. Any volumes exceeding the available flow might be addressed through stormwater detention, wetland restoration, and other passive methods. For the period of record evaluated, peak flows occurred following Hurricanes Irma (2017) and Ian (2022). These extreme events are observed in all the structure hydrographs.

It is important to note that the recently constructed KRRP and the subsequent Kissimmee River Headwaters Revitalization Schedule (HRS), currently under development, may not be fully represented in this water availability analysis. More information on the HRS can be found in the Project Evaluation Section below.

S65 STRUCTURES

The S65 structure is the primary discharge point for Lake Kissimmee and the inflow for the Lower Kissimmee Subwatershed (**Figure 2**). It is situated on the C-38 Canal (Kissimmee River), immediately downstream of Lake Kissimmee, and marks the upstream border of the Lower Kissimmee Subwatershed (**Figure 4)**. Combined flows from the S65_S and S65_LCK monitoring stations were used to develop the basin inflow hydrograph for S65 (**Figure 5**). Flows documented during the WY2015-2024 POR came from the S65_S structure with no flows reported at S65_LCK.

S65_S station captures flows from a gated spillway with five vertical lift gates. S65_LCK captures flows from a navigation lock structure with two sector gates. Operations are controlled in accordance with river restoration criteria and the Lake Kissimmee Regulation schedule to control stages in Lake Kissimmee and to control upstream and downstream stages and flow. It was designed to pass sufficient discharge during low-flow periods to maintain downstream stages, irrigation demands, and river restoration needs (the KRRP). Discharge at S65 and S65A as specified in the HRS are major factors in operation of these structures.

The flow hydrograph (**Figure 5**) reveals regular seasonal fluctuations that result from the operational management of the structure, with notably higher flow associated with high rainfall, for example, during and following Hurricanes Irma and Ian. For this POR, measurements at S65 had average and median flows of 1,238 and 795 cfs, respectively. The peak recorded flow (13,706 cfs) occurred on 10/11/2022 as a result of Hurricane Ian. For the given period of record (POR), the available flow at S65 was 2,895 cfs at the 90th percentile, meaning 90% of the recorded flow values were at or below 2,895 cfs. The flow was 3,999 cfs at the 95th percentile, indicating that 95% of the recorded flow values were at or below 3,999 cfs. Along with the seasonality observed in the hydrograph, this can indicate water available for future projects -- not taking into account operational restrictions from surrounding projects (i.e. KRRP changes in headwaters), or future operational changes to projects surrounding the structure. Zero-flow conditions occurred approximately 3% of the time during this POR (**Figure 6**).

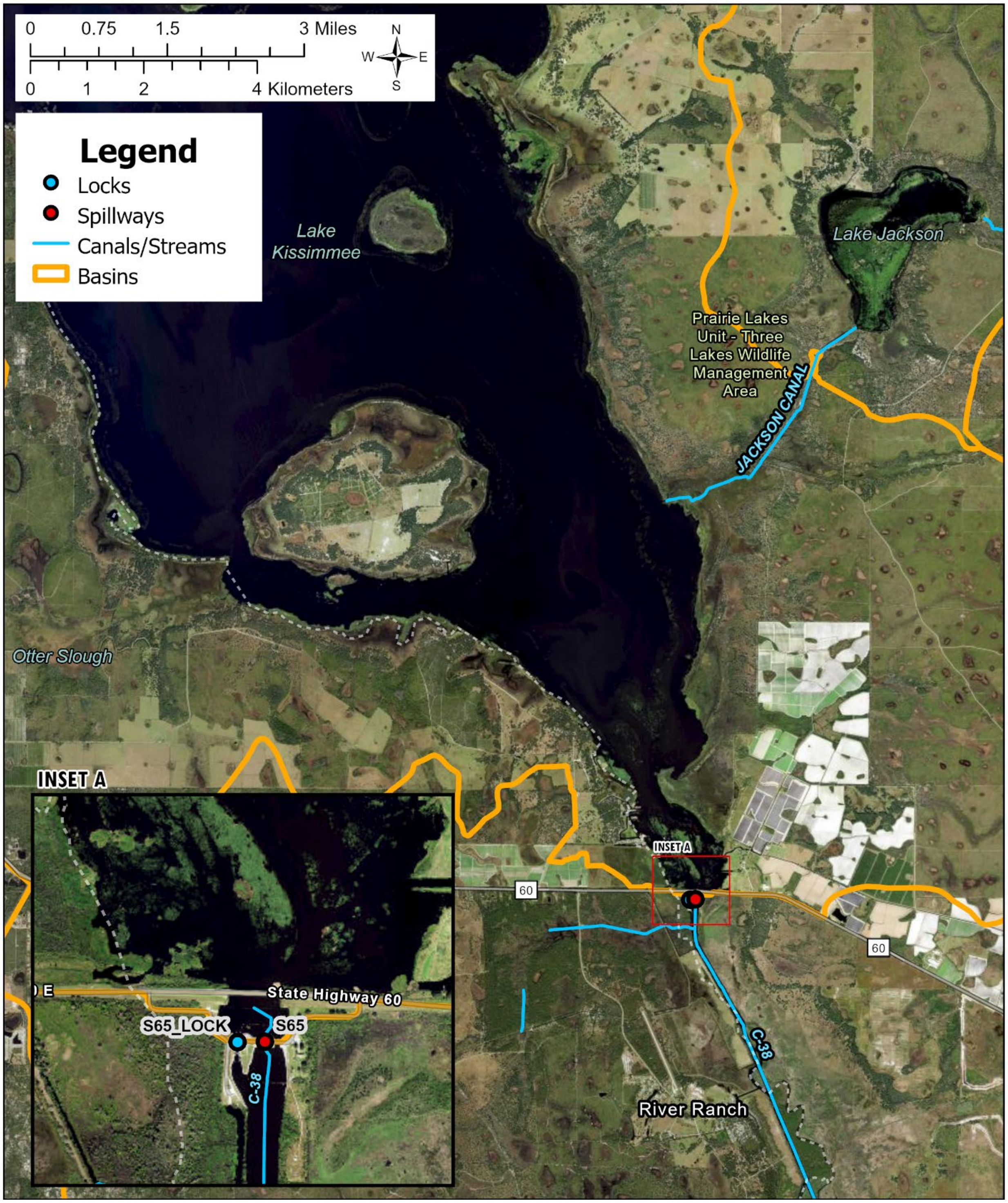


Figure 4. Map of S65 structures.

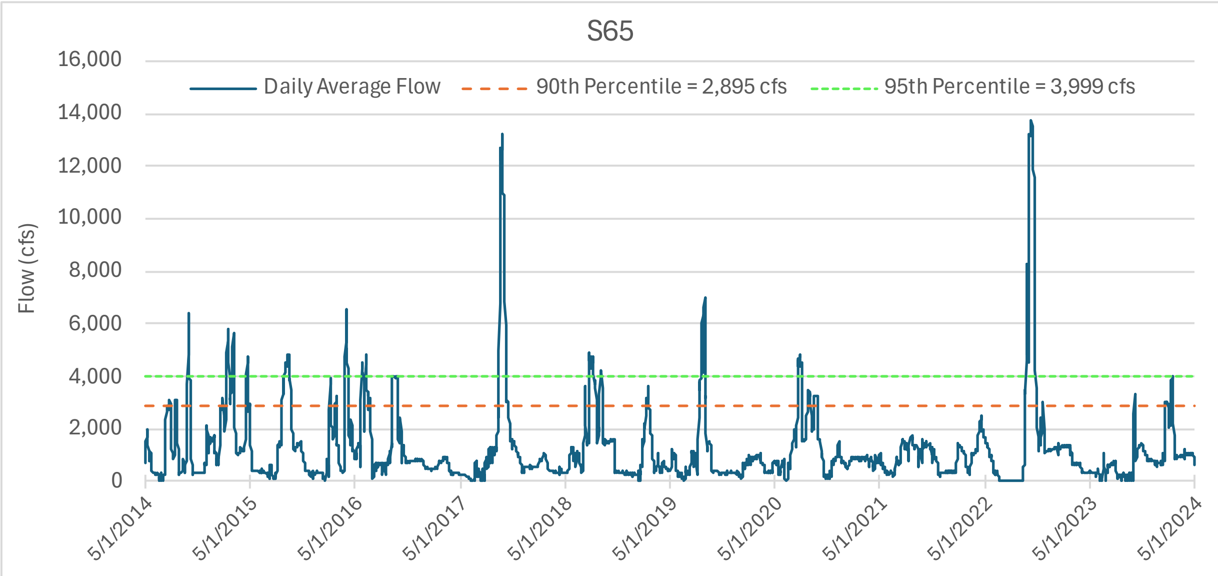


Figure 5. S65 Flow Hydrograph (data source: DBHydro).

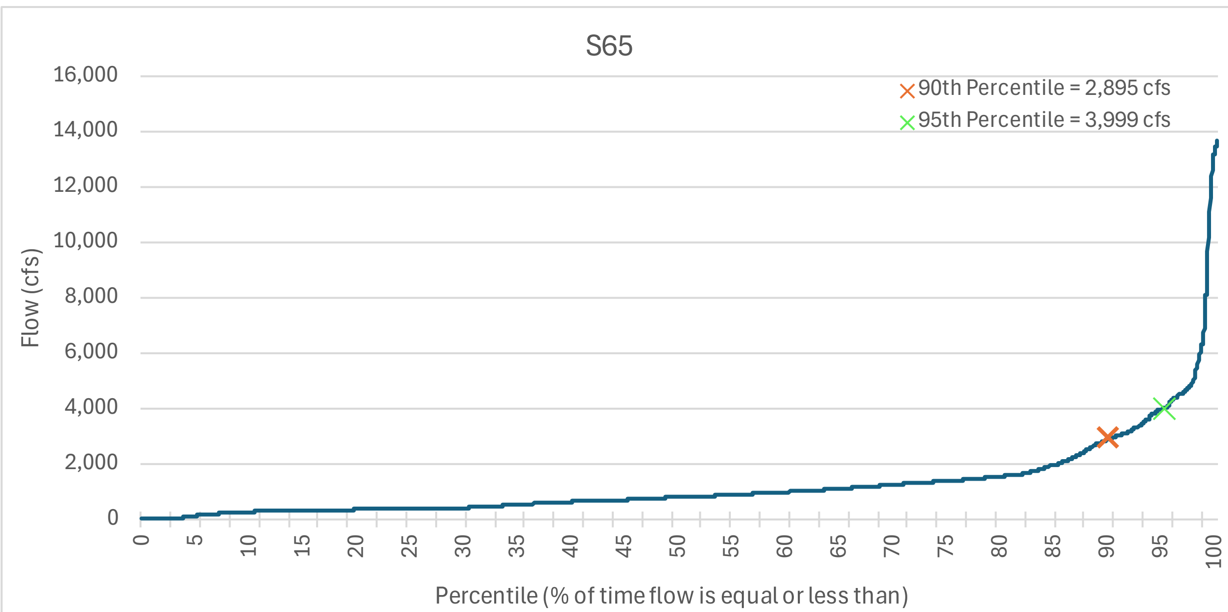


Figure 6. S65 Percentile Graph

S65A STRUCTURES

The S65A structures mark the primary discharge location of the S65A basin and the inflows to the S65BCD Basin (**Figure 2**) and is the primary source of inflow to the KRRP. The basin inflow hydrograph was developed combining flows for the eight S65A structures shown in **Table 2** and **Figure 7**.

The S65A structure is a three-bay gated spillway located about 10.5 miles downstream from Lake Kissimmee on the C-38 Canal. S65A_LCK is the navigation lock structure for S-65A and has four sector gates. These structures maintain optimum upstream stages in C-38 Canal and control flows to the

Kissimmee River, passing sufficient discharge to maintain downstream stages, irrigation demands, and river restoration needs. Tieback weirs S65AX_A, S65AX_B and S65AX_C are located west of the S65A spillway and S65_LCK structures. These passive weirs are used as bypass structures for S65A during flooding. Three bypass culverts (S65AX, S65_AX2, and S65_AX3) are located in the eastern tieback levee of S65A. S65AX consists of a culvert with two sluice gates, while S65_AX2 and S65_AX3 consists of four box culverts each. The original purpose of culverts S65AX, S65_AX2, and S65AX3 was to test the feasibility of creating a flow-through marsh adjacent to S65A in the upstream floodplain, allowing additional discharge capacity adjacent to S65A through the floodplain to reduce upstream impacts. However, that was found unfeasible (SFWMD, 2022). As such, the structures are not currently being used for the KRRP and it was found that the restoration project will benefit most from the discharge of water from the S65A Basin through S65A to provide flow via C-38 Canal to the restoration project.

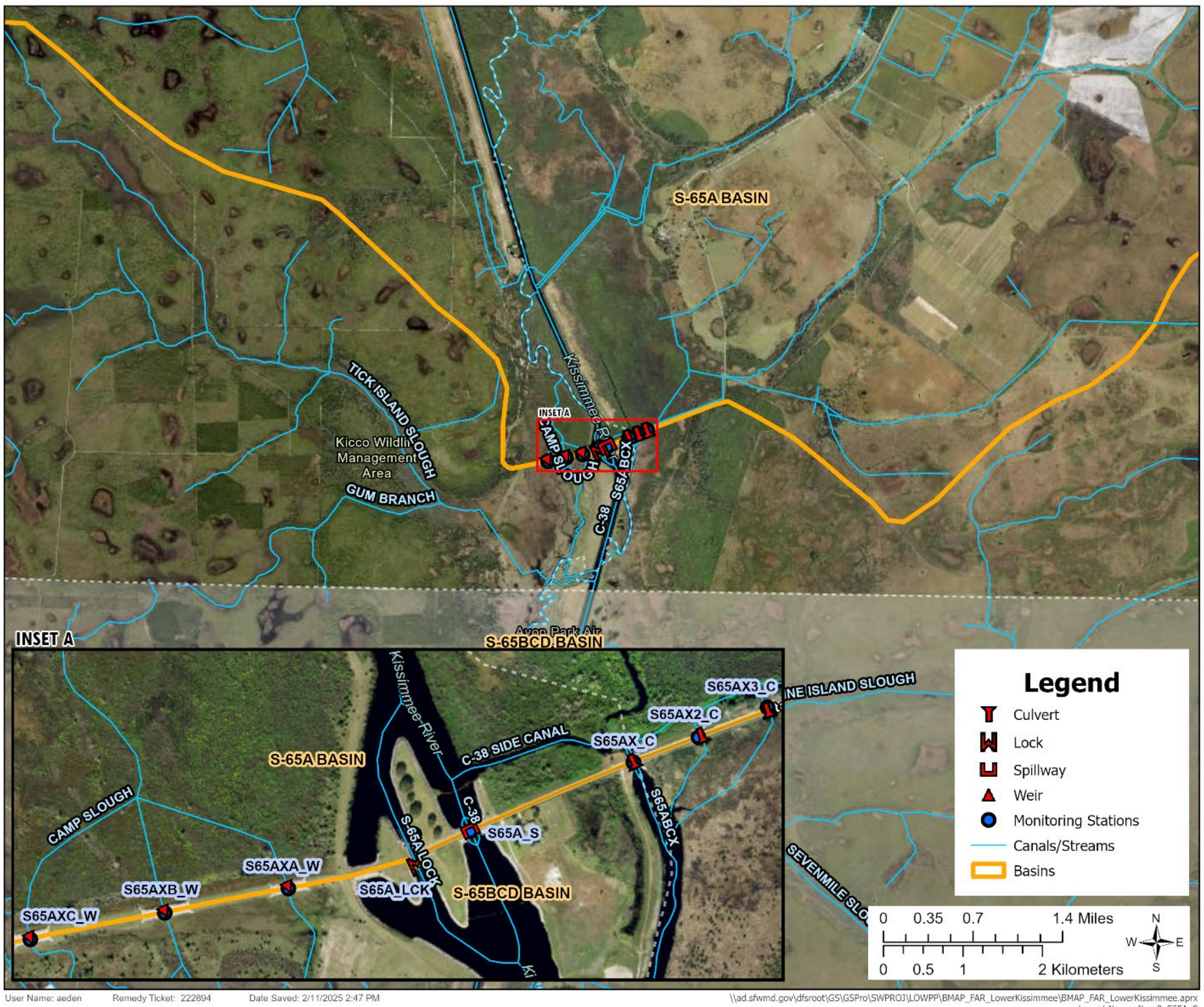


Figure 7. Map of S65A structures.

The flow hydrograph (**Figure 8**) reveals regular fluctuations that result from the operational management of the structure except for the previously mentioned disturbances following Hurricanes Irma and Ian that are observed in all structures analyzed. For this POR, the measurements at S65A had average and median flows of 1,389 cfs and 814 cfs, respectively. The peak discharge (14,676 cfs) occurred on 10/11/2022 as a result of Hurricane Ian. Available flow was 3,391 cfs at the 90th percentile and 4,928 cfs at the 95th percentile. Along with the seasonality observed in the hydrograph, this can indicate water available for future projects, as zero flow conditions occurred 0.1% of the time for this POR (**Figure 9**). Nonetheless, the El Maximo storage project may bring down the water availability estimated at the S65A structures, as the project is not in full operation and its water requirements are not reflected in this analysis. Additionally, any future projects within this basin would need to consider the constraints of the KRRP.

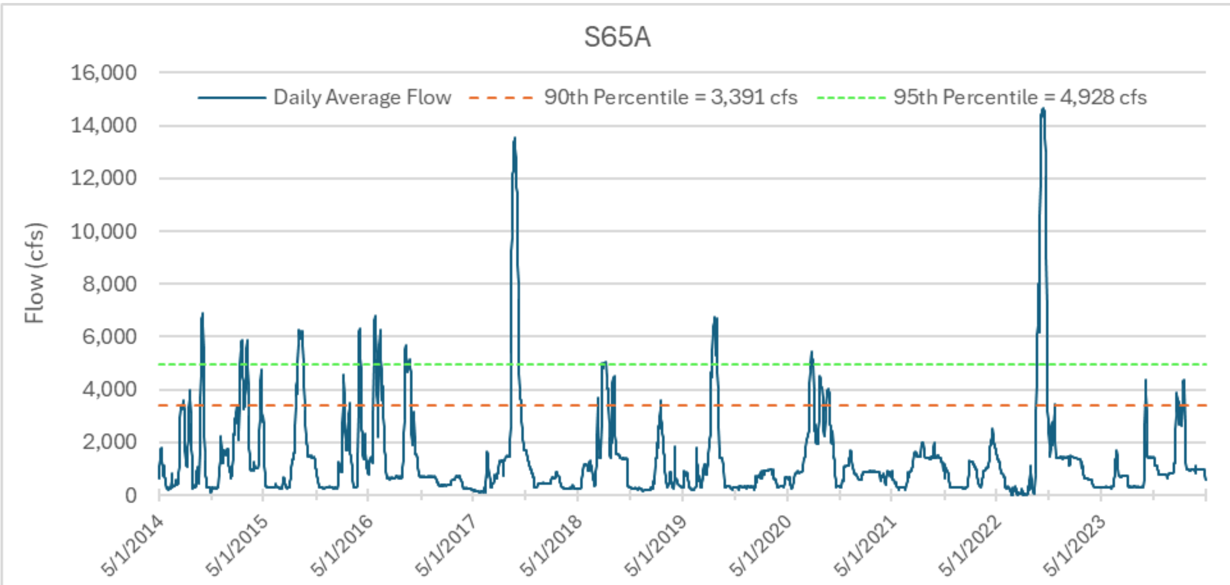


Figure 8. S65A Structures Flow Hydrograph (data source: DBHydro).

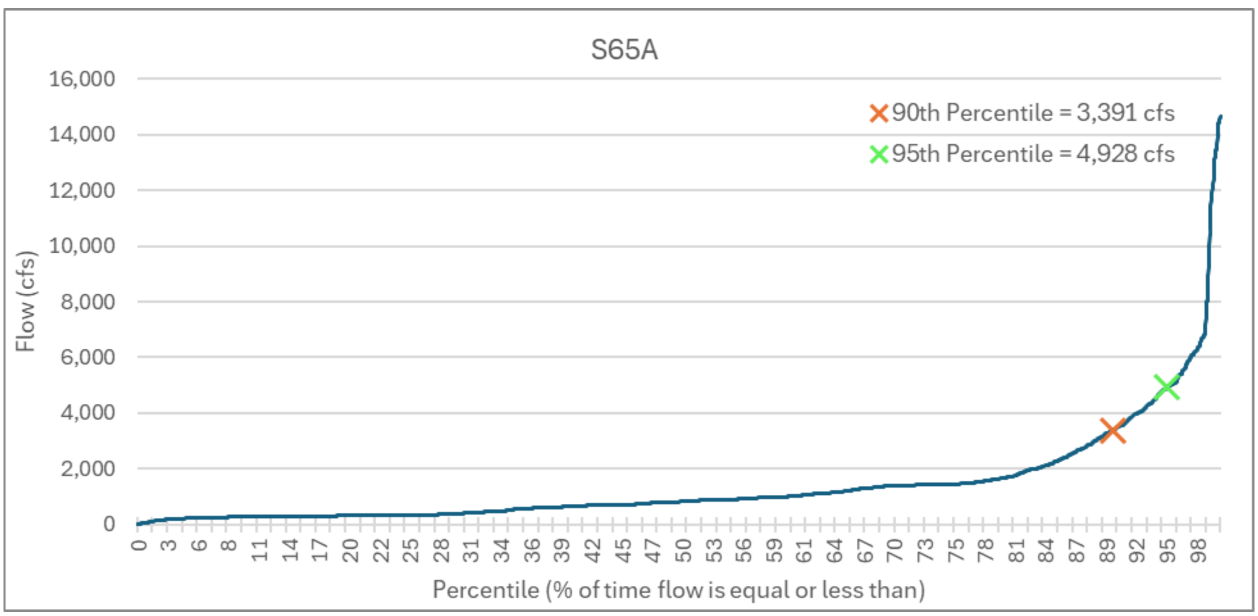


Figure 9. S65A Percentile Graph

S65BCD BASIN: 02272676 SITE

The 02272676 USGS flow monitoring site is located in Cypress Slough, a tributary of Chandler Slough which is a tributary of the Kissimmee River, in the S65BCD Basin near the southeastern boundary (**Figures 2** and **10**). Given its location, this site did not exhibit extreme flows from Hurricane Ian. However, the maximum discharge for this structure was 1,230 cfs and it occurred on 09/11/2017 as a result of Hurricane Irma (**Figure 11**). Average and median flows were 45 cfs and 10 cfs, respectively. Available flow was 128 cfs at the 90th percentile and 206 at the 95th percentile. Along with the seasonality observed in the hydrograph, this can indicate water available for future projects. Zero-flow conditions occurred 14% of the time for this POR (**Figure 12**).

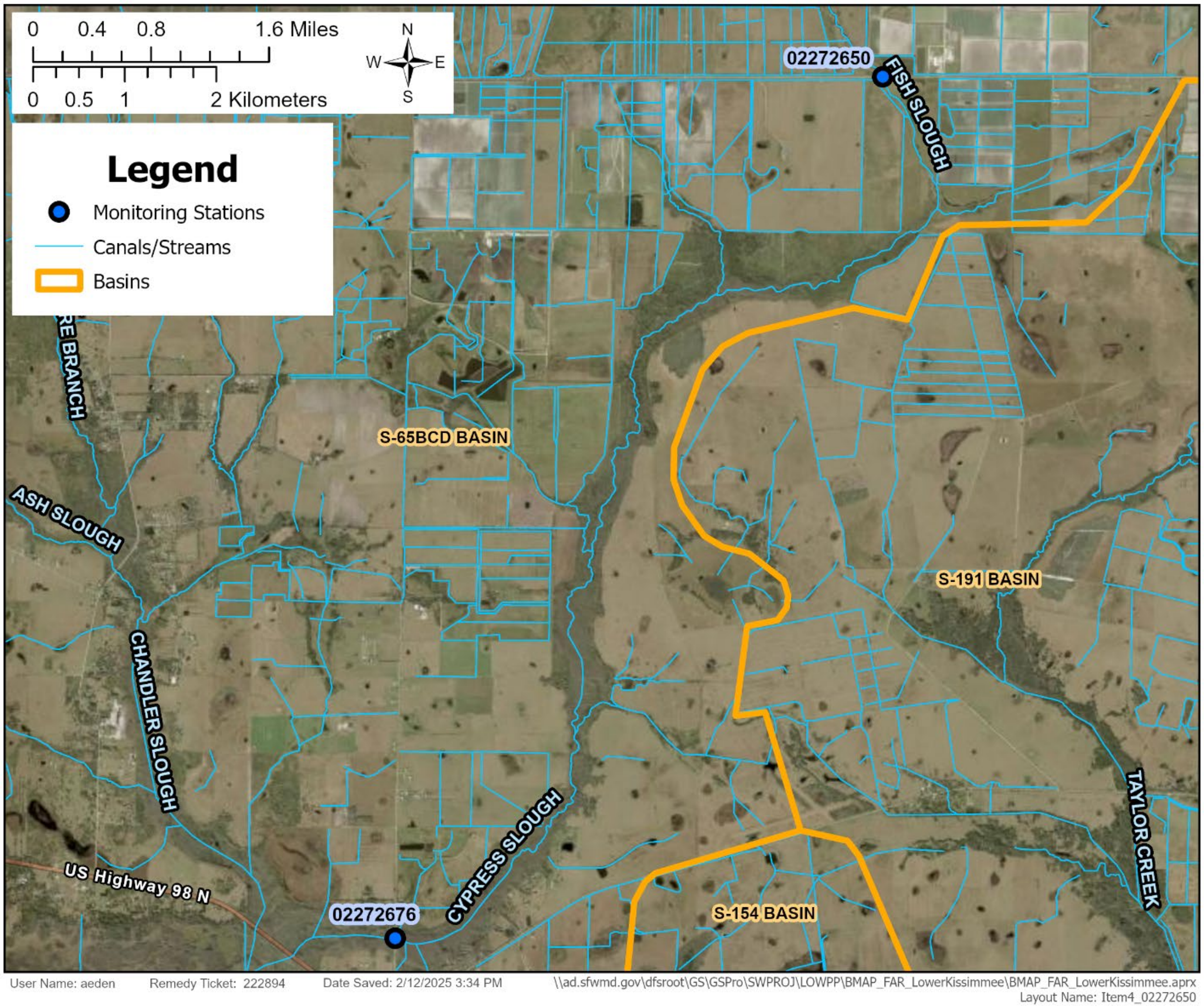


Figure 10. Map of 0272676 and 02272650 monitoring stations.

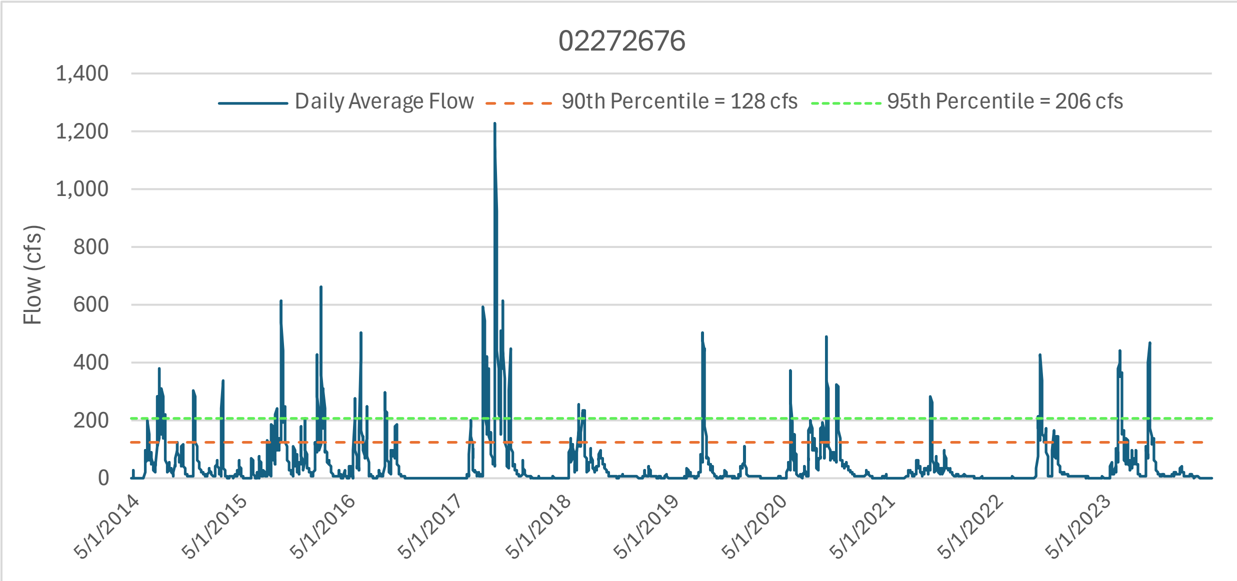


Figure 11. 02272676 Structures Flow Hydrograph (data source: DBHydro).

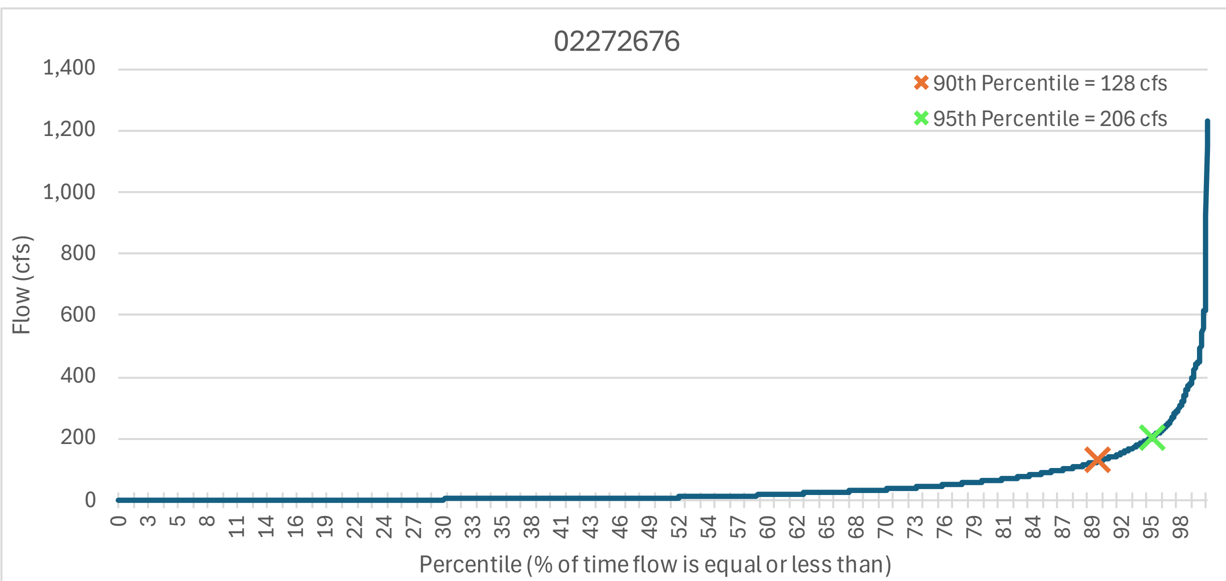


Figure 12. 02272676 Percentile Graph

S65BCD BASIN: 02272650 SITE

The 02272650 USGS flow monitoring site is located in Fish Slough, close to the eastern edge of the basin (**Figures 2** and **10**) and approximately 15 miles east of the Kissimmee River. Fish Slough flows into Cypress Slough which flows into Chandler Slough and then into the Kissimmee River. It did not exhibit extreme flows from Hurricane Ian. The maximum discharge of 1,170 cfs occurred on 09/11/2017 as a result of Hurricane Irma (**Figure 13**). Average and median flows were 34 cfs and 9 cfs, respectively. Available flow was 91 cfs at the 90th percentile and 146 cfs at the 95th percentile. Zero-flow conditions occurred 9% of the time for this POR (**Figure 14**).

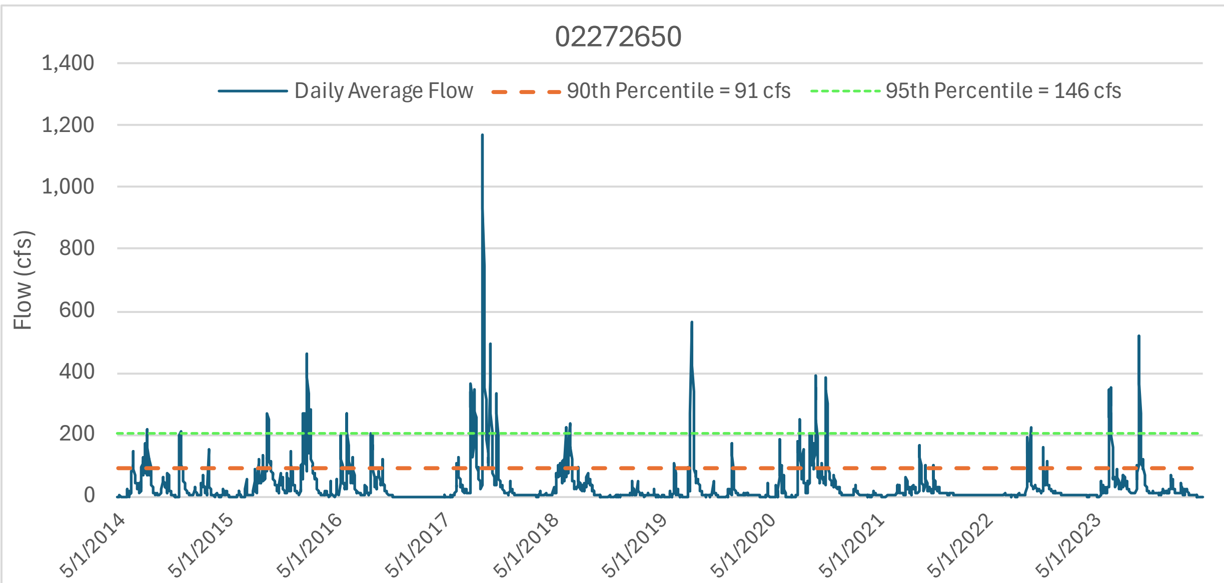


Figure 13. 02272650 Structures Flow Hydrograph (data source: DBHydro).

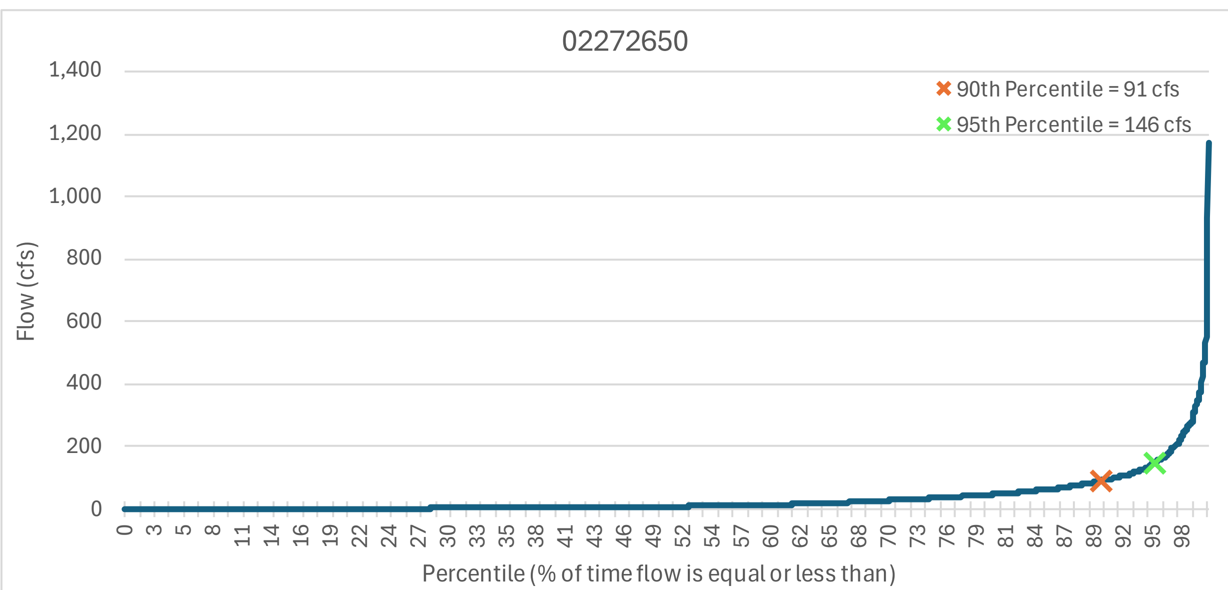


Figure 14. 02272650 Percentile Graph

S65BCD BASIN: S67 STRUCTURE

S67 structure is located on the Istokpoga Canal on the western edge of the S65BCD Basin controlling flows from Lake Istokpoga (**Figures 2** and **15**) into the S65BCD basin. The S67 structure consists of two gates and, along with S67X, prevents impacts to the Lake Istokpoga Basin from the higher flood stages of the restored Kissimmee River during flood events. It also prevents over-drainage of Lake Istokpoga. The maximum discharge for this structure was 423 cfs, which occurred on 02/19/2018 (**Figure 16**). Average flow was 19 cfs with the median being zero flow conditions. Available flow at the 90th percentile was 11 cfs and 175 at the 95th percentile. Zero-flow conditions occurred 89% of the time for this POR (**Figure 17**). Note that the S67X, which is on the Istokpoga Creek, also prevents impacts to Lake Istokpoga Basin from higher flood stages of the restored Kissimmee River during flood events and prevents over-drainage of Lake Istokpoga. S67X was not included in this analysis because it had minimal flow.

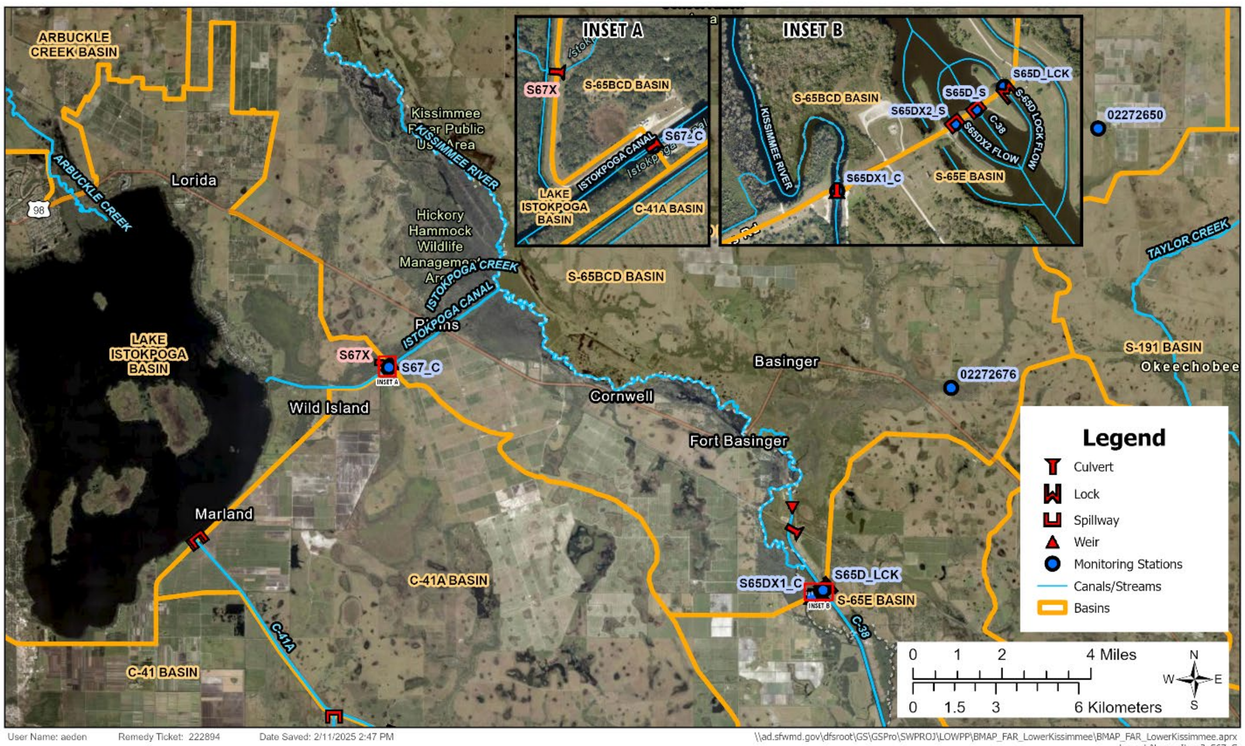


Figure 15. Map of S67 and S65D structures.

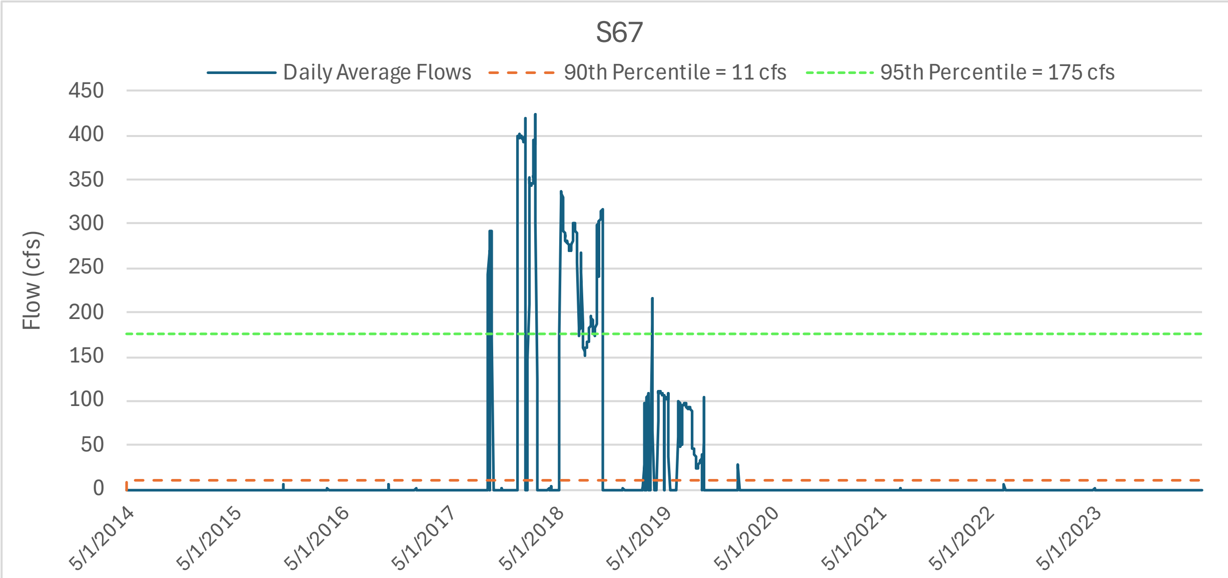


Figure 16. S67 Structures Flow Hydrograph (data source: DBHydro).

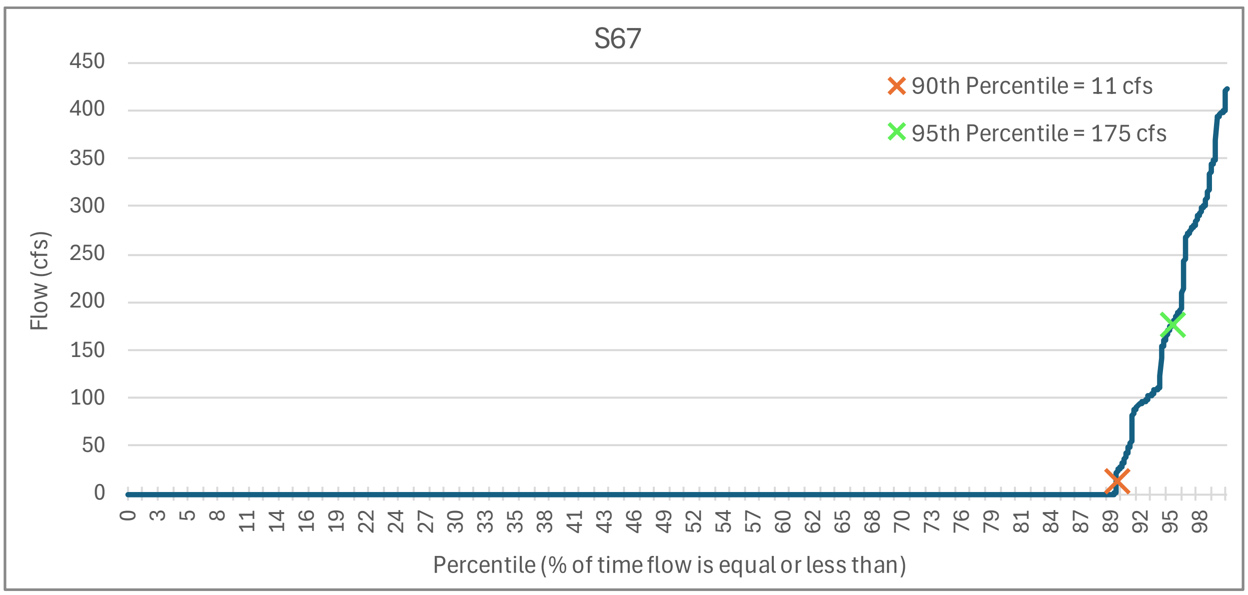


Figure 17. S67 Percentile Graph

S65BCD BASIN: S65D STRUCTURES

S65D structures, located downstream of the KRRP, include combined flows from the S65D_S, S65D_LCK, S65DX1_C, and S65DX2_S (**Figures 2** and **15**). However, no flows were reported for S65D_LCK for the POR. The S65D_S structure is a gated spillway with four vertical lift gates. There is a navigation lock (S65D_LCK) with two pairs of sector gates adjacent to the S65D, as well as a culvert (S65DX1_C) and a spillway (S65DX2_S) that provide additional release during extreme high-water conditions. S65D maintains optimum upstream water control stages in C-38 Canal and passes sufficient discharge during low-flow periods to maintain downstream stages and water supply demands. Note there is also an S65DX3 structure which is not monitored for flow or water quality and is not included in this analysis (**Figure 18**). This is a manually operated gate that was set in 2016 to allow a minimal amount of water to flow in the old river run (B. Chesser, personal communication February 19, 2025).

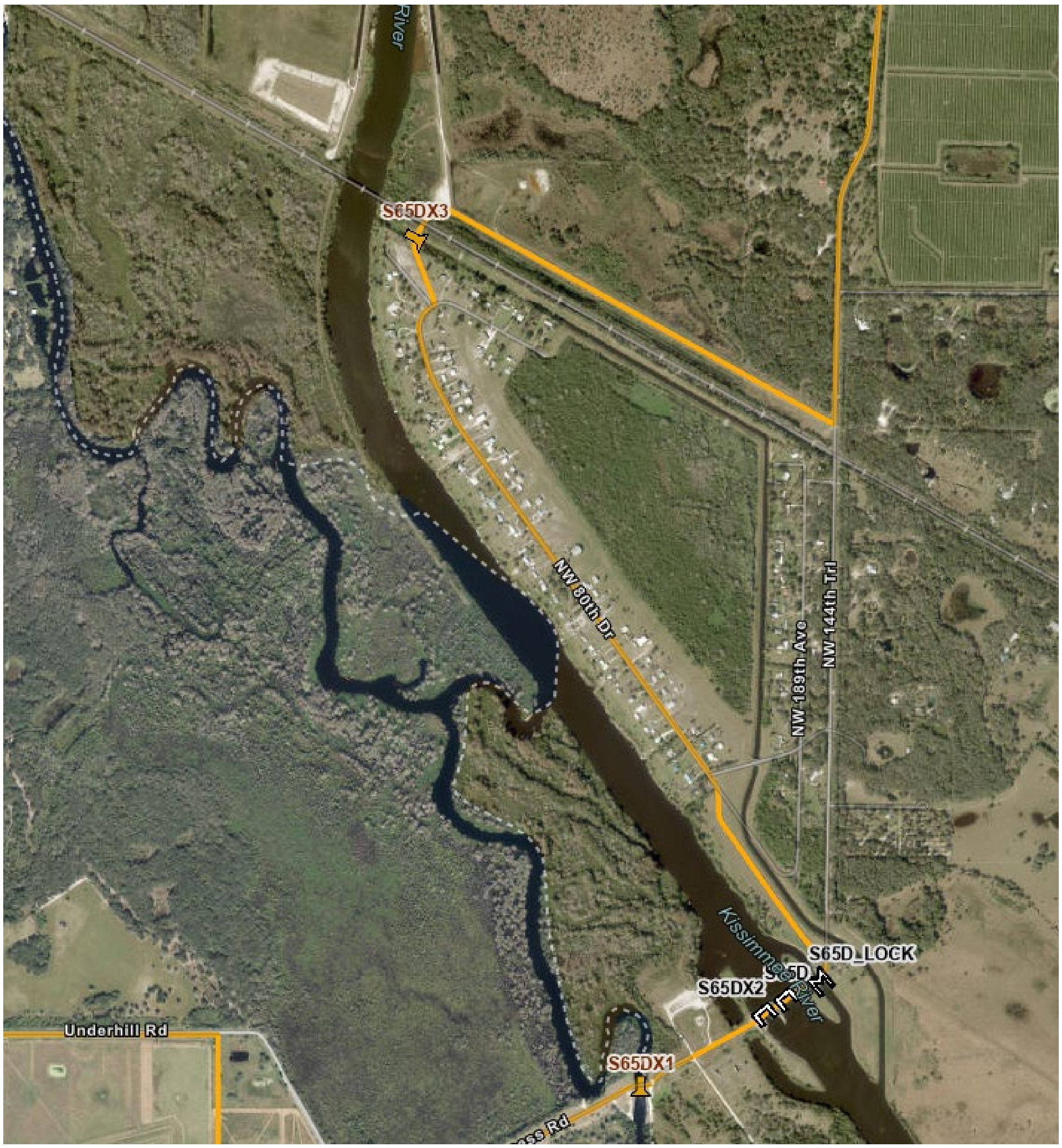


Figure 18. Location of S65DX3

The flow hydrograph (**Figure 19**) reveals regular fluctuations that result from the operational management of the structure except for disturbances following Hurricanes Irma and Ian. For this POR, the measurements at S65D had average and median flows of 1,773 and 1,149 cfs, respectively. The peak recorded flow (14,273 cfs) occurred on 9/16/2017 and was a result of Hurricane Irma. Available flow was 4,046 cfs at the 90th percentile and 5,377 cfs at the 95th percentile. Zero-flow conditions did not occur at any time for this POR (**Figure 20**). Along with the seasonality observed in the hydrograph, this can indicate water available for future projects. In this structure, the water availability can include water that is accounted for in flows from 02272676 (Cypress Slough), 02272650 (Fish Slough), and S67 stations. A portion of these flows could be carried through the watershed via the Kissimmee River (in the case of S67) or Chandler Slough (02272650 and 02272676) to S65D.

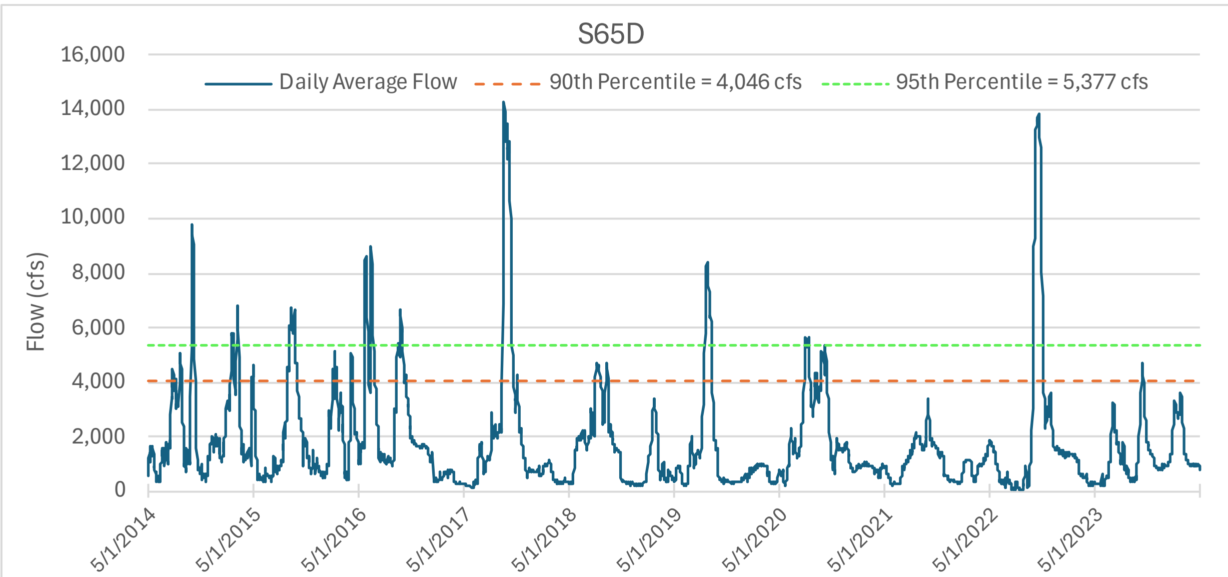


Figure 19. S65D Structures Flow Hydrograph (data source: DBHydro).

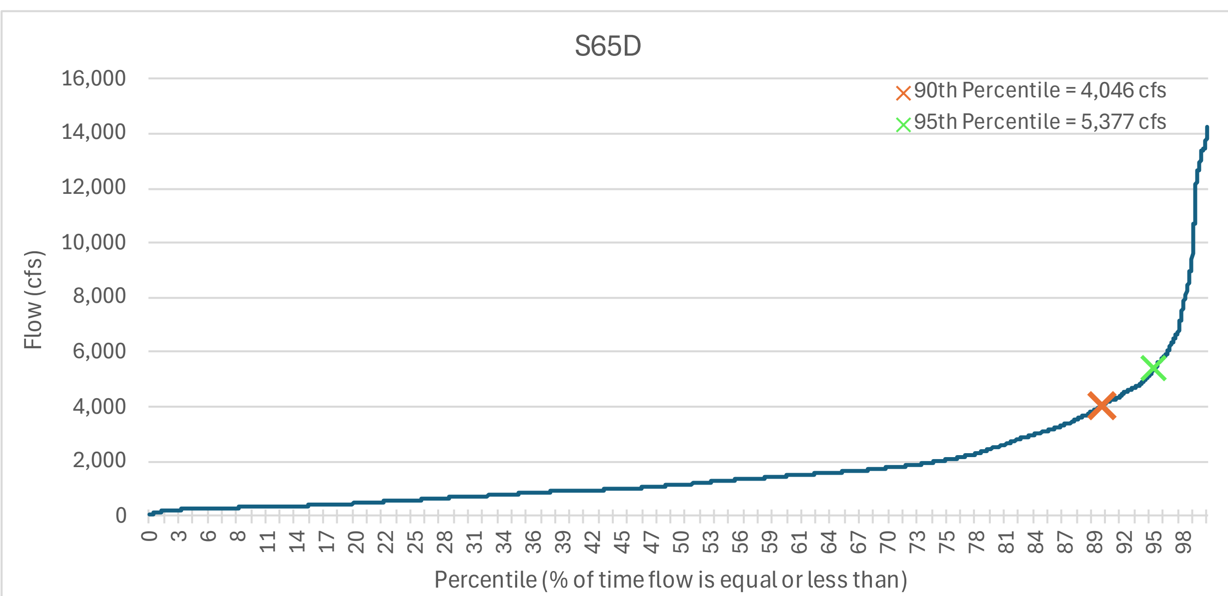


Figure 20. S65D Percentile Graph

S65E STRUCTURES

Located at the southern boundary of the Lower Kissimmee Basin, the S65E structures discharge flows from the subwatershed to Lake Okeechobee. Combined flows from the S65E, S65EX1, and S65E_LCK monitoring stations (**Figures 2** and **21**) were used to develop the basin outflow hydrograph. However, no flows were reported for S65E_LCK during the WY2015-2024 POR.

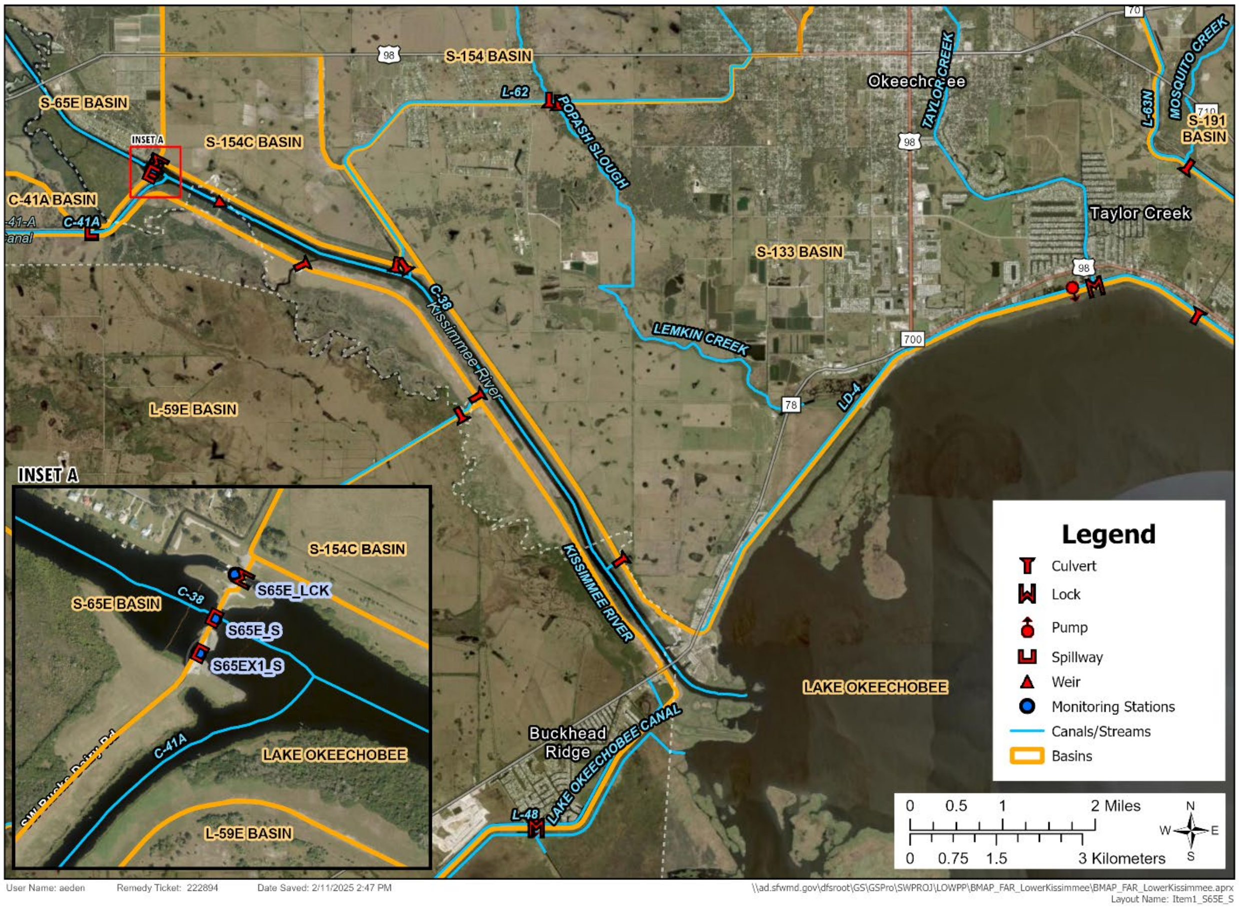


Figure 21. Map of S65E structures.

S65E is the last spillway on the Kissimmee River and consists of six vertical lift gates flowing south into Lake Okeechobee. There is also a navigation lock structure with two pairs of sector gates adjacent to and east of the structure. As a result of the scour produced by the outflow of this structure, a 202-foot steel sheet pile weir was built to increase the tailwater levels during large releases and provide buffer for energy dissipation downstream.

The flow hydrograph (**Figure 22**) reveals regular fluctuations that result from the operational management of the structure except for disturbances following Hurricanes Irma and Ian. For this POR, the measurements at S65E had average and median flows of 1,744 and 1,038 cfs, respectively. The peak recorded flow (15,373 cfs) occurred on 09/15/2017 and was a result of Hurricane Irma. Available flow was 4,039 cfs at the 90th percentile and 5,335 cfs at the 95th percentile. Zero-flow conditions occurred approximately 0.06 % of the time for this POR (**Figure 23**).

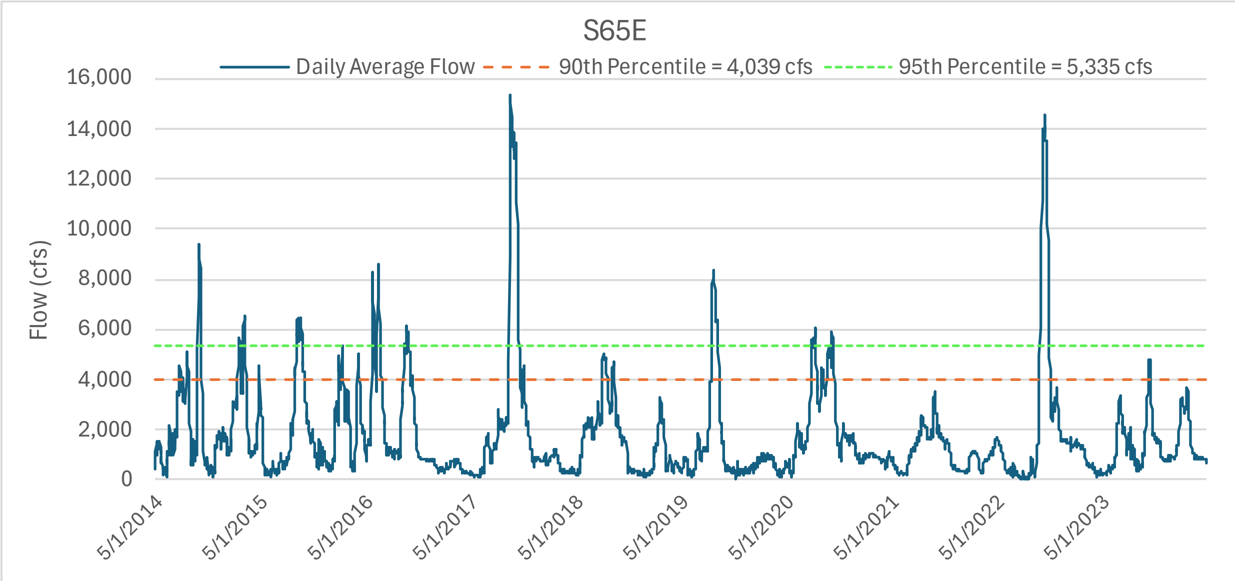


Figure 22. S65E Structures Flow Hydrograph (data source: DBHydro).

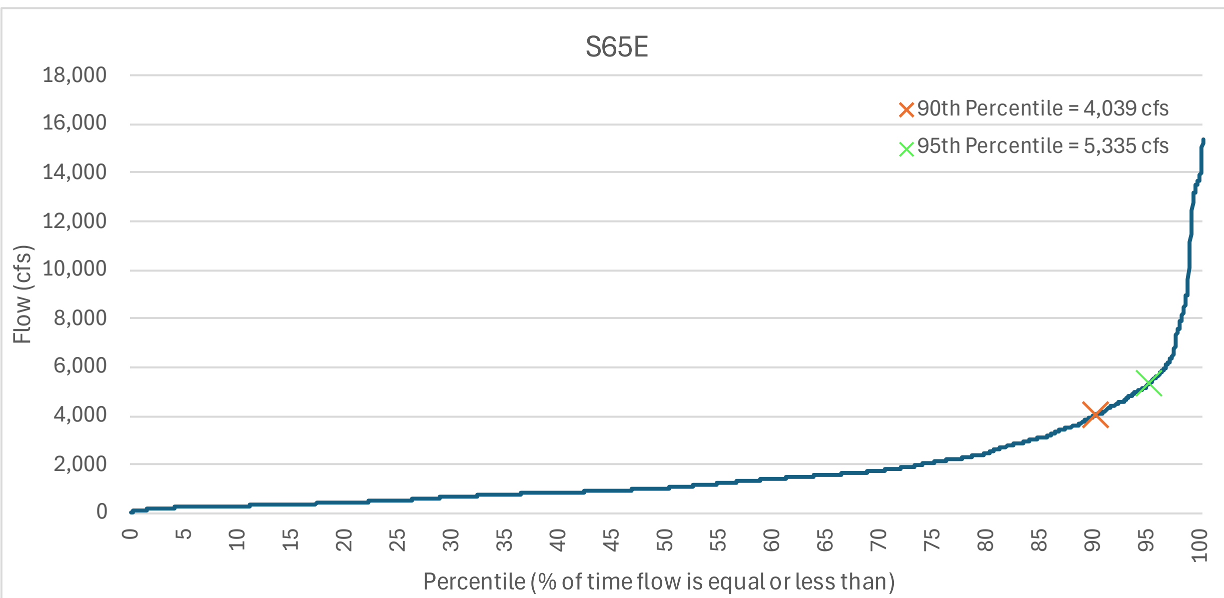


Figure 23. S65E Percentile Graph

WATER AVAILABILITY CONCLUSION

The water availability summary for the Lower Kissimmee Watershed presented in **Table 3** shows that the portion of the C-38 Canal in the S65D and downstream by S65E basins has water availability that could support a typical storage or treatment project. Nonetheless, the Kissimmee River Restoration Project may render the S65D Basin unsuitable for certain projects and careful attention should be given to the impact of river restoration upstream of the S65D structure.

Although S65 and S65A had lower flows than the S65D and S65E stations, percentile values reveal potential for additional projects, under careful design considerations. Overall, the hydrographs for both upstream and downstream stations reveal seasonally driven discharges with intermittent extreme conditions indicated by peaks. This requires consideration in the design of potential future projects, mainly in the consistency of water deliveries needed for their operations and the projects must not adversely impact the restored river areas. Tributaries at the western and eastern ends of the watershed reveal lower flows and considerably less water availability (**Table 3**).

The POR for which this analysis was performed included two hurricanes that impacted average flows at the structures. In order to better represent operations under normal conditions, an estimation of the water availability excluding the hurricane years was done to provide a potential range of values. Both means are shown in **Table 3**. Regardless of storm events, considerable fluctuations in seasonal flows are observed in this subwatershed. Pump design should take into consideration the size and number of pumps that can better accommodate the full range of flow conditions. Subject matter experts should take lessons learned from previous projects (ex. Nubbin Slough Stormwater Treatment Area).

Based on this water availability review the following actions are recommended:

- Re-evaluate NEEPP project operation plans (existing and planned) basin-wide for comprehensive management and to ensure that they are coordinated, synchronized, and operate synergistically for maximum nutrient reduction and storage.
- Consider additional stormwater detention and wetland restoration projects in areas of the subwatershed with adequate flows to increase the storage capacity (**Table 3**).

Table 3: Summary of Monitoring Stations Water Availability

Subwatershed/Basin	Station	Maximum (cfs)	Mean (cfs)	Mean (ac-ft/yr)	Mean (cfs) (excluding hurricanes)	90th Percentile (cfs)	95th Percentile (cfs)
Lower Kissimmee/S65D	S65D	14,273	1,773	1,283,768	1,700	4,046	5,377
Lower Kissimmee/S65E	S65E	15,373	1,744	1,262,566	1,653	4,039	5,335
Lower Kissimmee/S65A	S65A	14,676	1,389	1,005,594	1,303	3,391	4,928
Upper Kissimmee	S65	13,706	1,238	896,081	1,170	2,895	3,999
Lower Kissimmee/S65D	02272676	1,230	45	32,761	42	128	206
Lower Kissimmee/S65D	02272650	1,170	34	24,921	33	91	146
Lower Kissimmee/S65D	S67	423	19	14,064	16	11	175

BASIN LEVEL MONITORING ANALYSIS

SFWMD currently monitors at two hydrologic levels within the LOW: subwatershed and basin level (basin monitoring sites) and subbasin level (upstream monitoring sites) (**Figure 24**). The basin level sites have measurements of flow and nutrient concentrations so loads can be determined. The upstream level sites are used to identify areas of interest further upstream within the basin and most only have measurements of nutrient concentrations. To identify factors contributing to the water quality issues, data from both levels were reviewed. This section covers the basin level analysis and the *Upstream Level Analysis* section discusses the upstream level data.

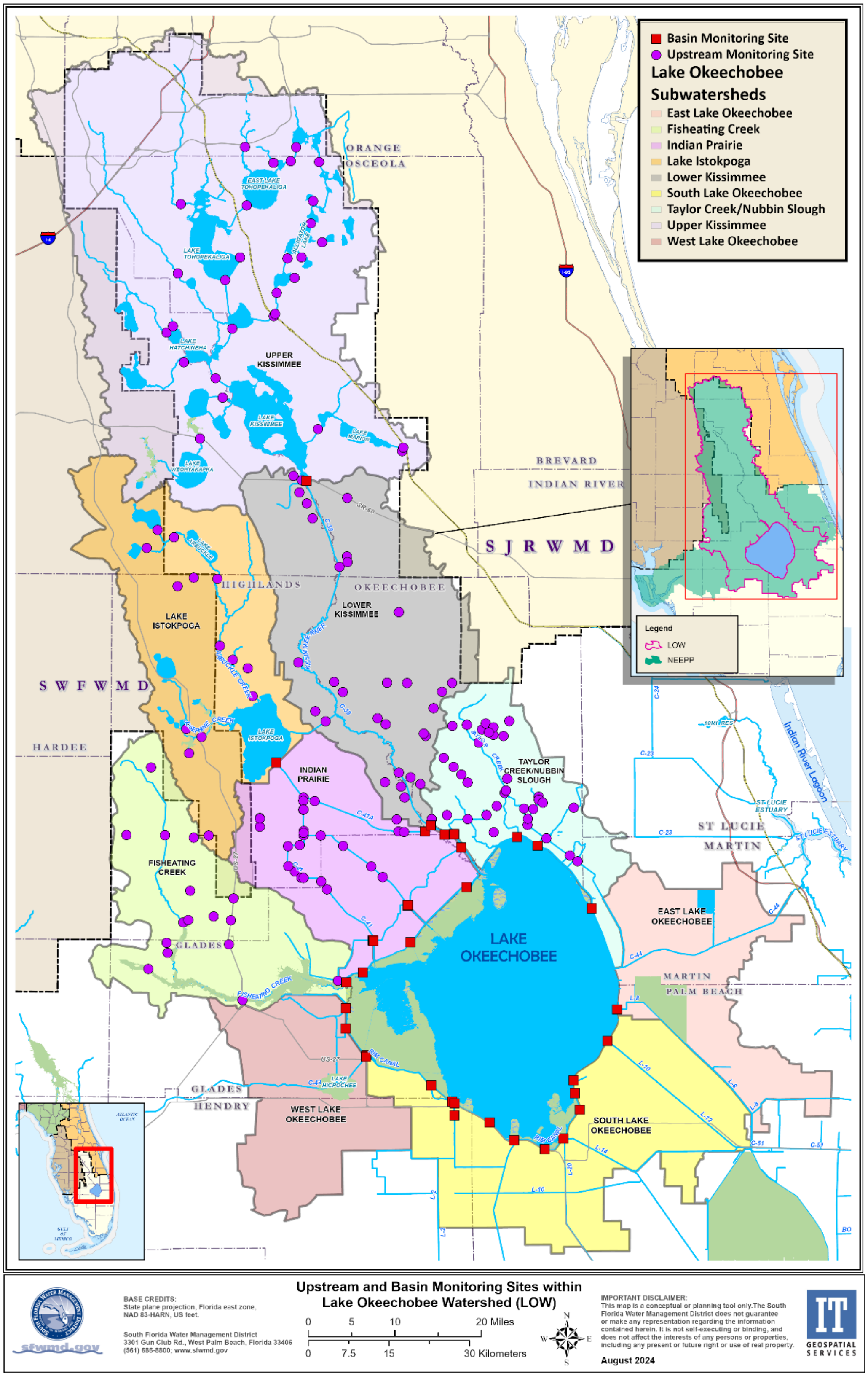


Figure 24. Upstream (purple circles) and basin (red squares) monitoring site locations within the LOW (Olson and Broling 2025).

BASIN LEVEL DATA ANALYSIS

The most recent 5-year TP and TN data for the Lower Kissimmee subwatershed are presented in **Table 4**. The Lower Kissimmee subwatershed had a 5-year (WY2020-WY2024) average TP load of 82 t which is 59.9 t above the long-term average annual planning target for this subwatershed of 22.1 t/yr.

Table 4. Lower Kissimmee Subwatershed monitoring data summarized with the 5-year average (WY2020–WY2024) (Source Tables 8B-8 and 8B-11 of Welch et al. 2025).

Water Year	Flows (ac-ft)	TP			TN		
		Load (t)	UAL (lb/ac)	FWMC (µg/L)	Load (t)	UAL (lb/ac)	FWMC (mg/L)
WY2020	232,000	54	0.28	189	285	1.47	1.00
WY2021	527,000	120	0.62	185	724	3.72	1.11
WY2022	101,000	18	0.09	142	-31	-0.16	N/A
WY2023	224,000	114	0.58	412	314	1.62	1.14
WY2024	379,000	102	0.52	218	768	3.95	1.64
Average	292,000	82	0.42	226	412	2.12	1.14

Figure 25 depicts annual TP loads, annual TP flow-weighted mean concentration (FWMC), and the 5-year rolling average TP load for the period of record (WY1991-WY2024). The annual TP FWMC ranges from 3 µg/L in WY1997 to 617 µg/l in WY2008 with an average over that period of 225 µg/L which is above the FDEP's NNC of 120 µg/L for TP (FDEP 2012). The most recent 5-year average of 226 µg/L TP is over the NNC as well. The annual TP load ranged from 0.3 t in WY1997 to 304.9 t in WY2018 with an average over that period of 80.2 t. The maximum TP load in WY2018 is associated with the maximum annual flow in WY2018 and a high TP FWMC in WY2018. It was hypothesized that very high flows in the Kissimmee River due to Hurricane Irma in WY2018, inundated portions of the floodplain that were former pasture or rarely flooded areas potentially mobilizing legacy phosphorus. Therefore, the large loads in WY2018 appeared to be the results of high flows, construction of the KRRP, and increasing TP concentration trends (Welch et al. 2019). In WY2023, there was a rainfall event (Hurricane Ian) that caused a failure at the S-69 weir (Koebel et al. 2025). This may have impacted the TP loading from Lower Kissimmee Subwatershed.

Figure 26 depicts annual TN loads, annual TN FWMC and the 5-year rolling average TN load for the period of record for the Lower Kissimmee subwatershed. The TN FWMC was below FDEP's NNC of 1.54 mg/L (FDEP 2012) every year except WY1993, WY2007, WY2013, and WY2024. The maximum TN FWMC was 2.40 mg/L in WY2007 for the period of WY1991 to WY2024. The annual TN load ranged from -31 t in WY2022 to 826 t in WY2013 with an average over that period of 441 t. Please note that the negative TN load in WY2022 was calculated using the mass balance method by subtracting the inflow TN load at S65 from the outflow TN load at S65E for the Lower Kissimmee Subwatershed. The mass balance method is discussed further in the *Consideration of Pass-Through Flows* section below.

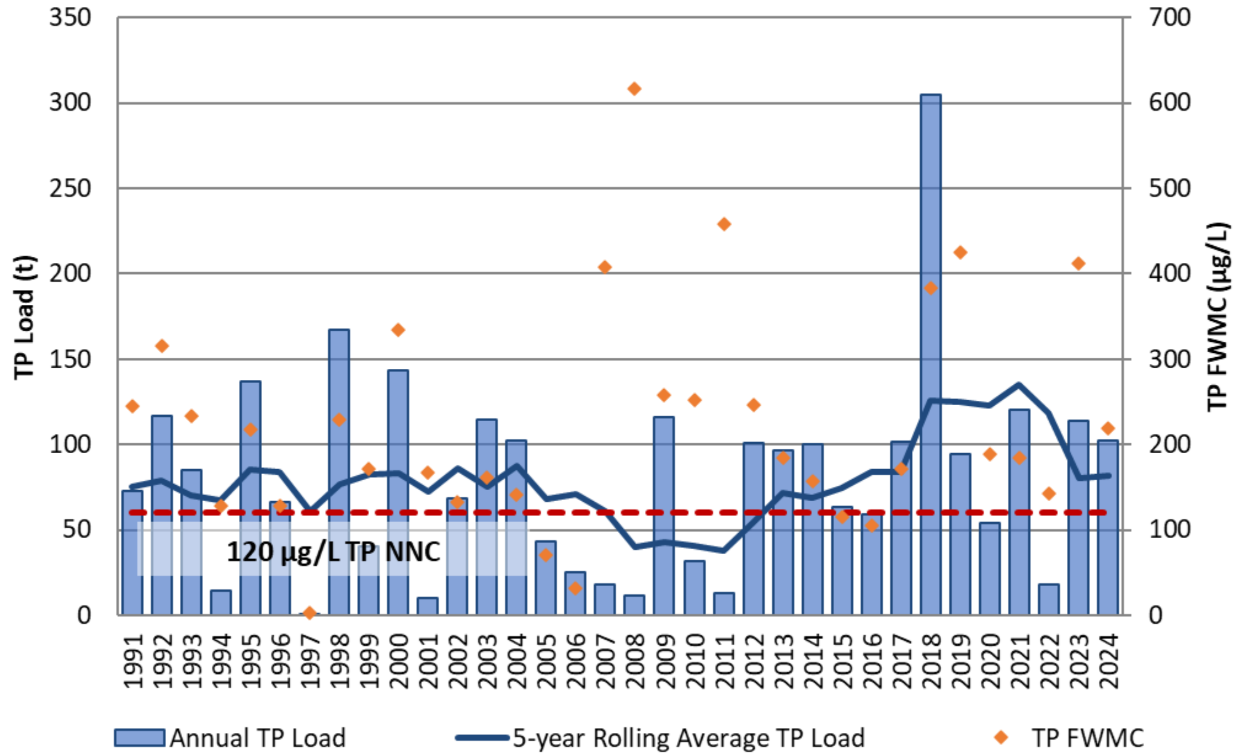


Figure 25. TP load and FWMC data for WY1991-WY2024 with the 5-year rolling average for the Lower Kissimmee Subwatershed (Note: NNC - numeric nutrient criteria).

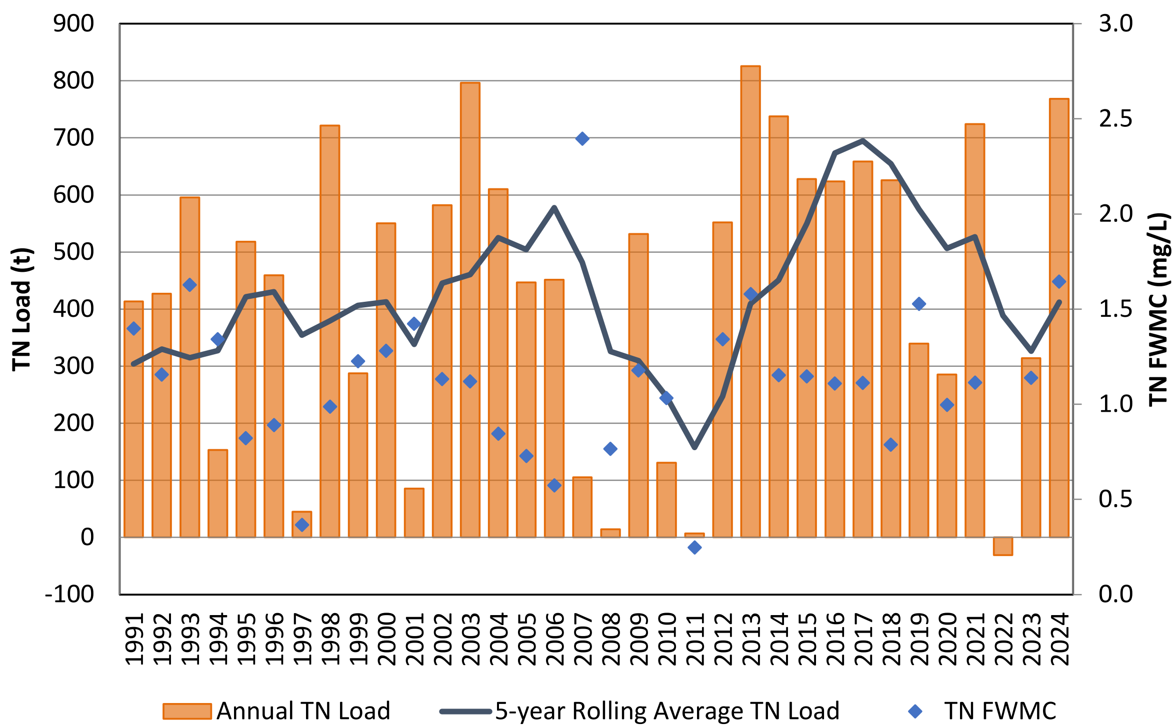


Figure 26. TN load and FWMC data for WY1991-WY2024 with the 5-year rolling average for the Lower Kissimmee Subwatershed.

Figure 27 includes TP loads as well as flow. The annual flow from WY1991-WY2024 for the Lower Kissimmee Subwatershed ranged from 15,090 ac-ft in WY2008 to 644,576 ac-ft in WY2018 with the average annual flow of 333,329 ac-ft. The unit area flow (runoff) was calculated from the annual flow and subwatershed area. The runoff and the annual rainfall for the Lower Kissimmee Subwatershed are presented in **Figure 28**. The annual rainfall ranged from 33 inches in WY2007 to 82 inches in WY1998 with the average annual rainfall of 52 inches. The Lower Kissimmee Subwatershed has the 4th highest runoff in the LOW (**Figure 29).**

Thus, basin level data indicate that the loads in this subwatershed are influenced by both nutrient concentrations and the flows. Based on this information, additional efforts for BMPs and projects should address both nutrients and storage in Lower Kissimmee.

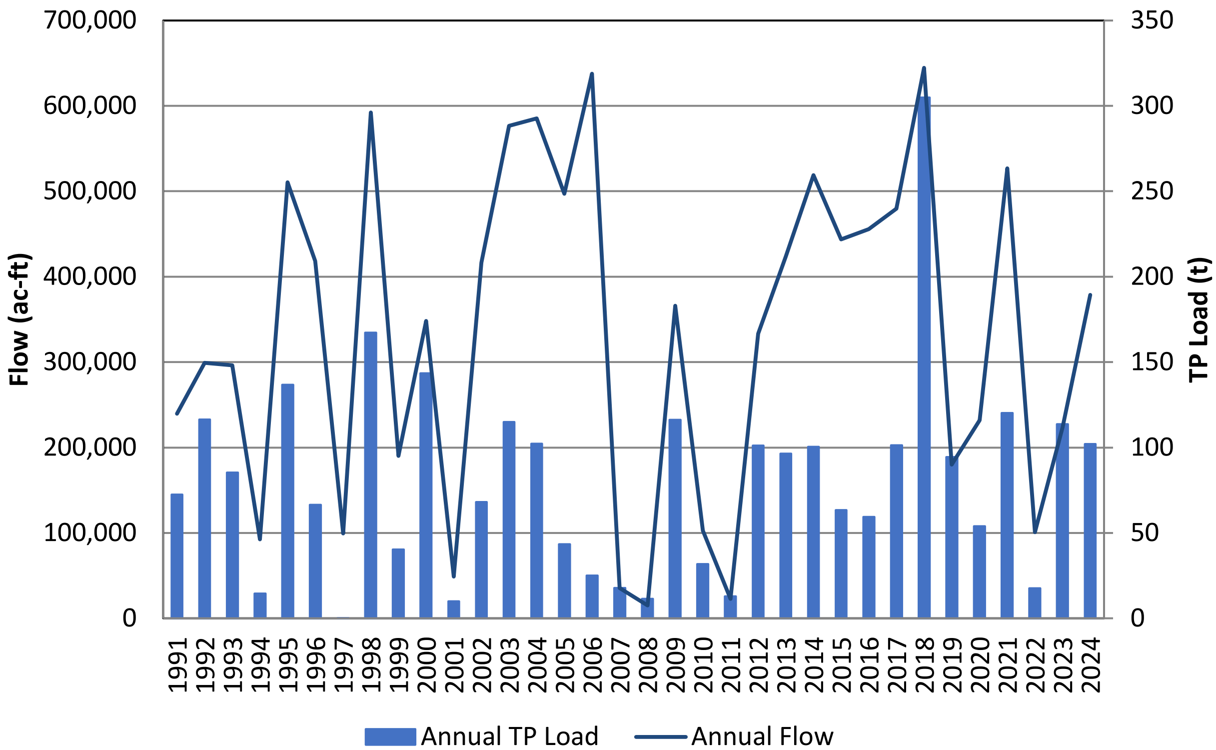


Figure 27. Annual TP load and flow data for WY1991-WY2024 for the Lower Kissimmee Subwatershed.

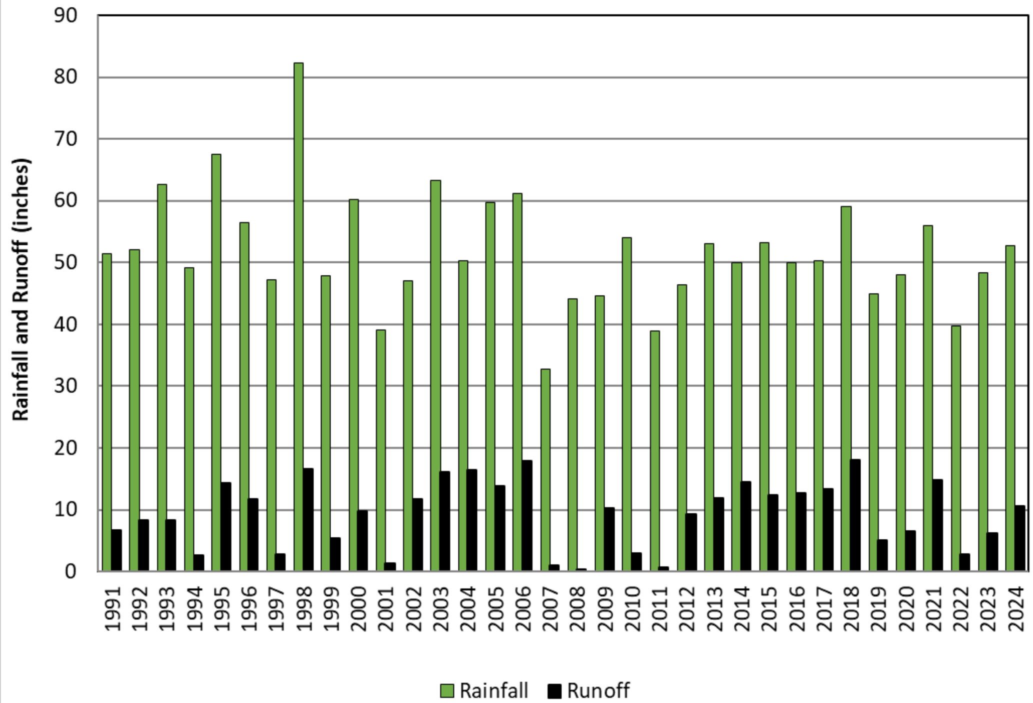


Figure 28. Annual rainfall and runoff data for WY1991-WY2024 for the Lower Kissimmee Subwatershed.

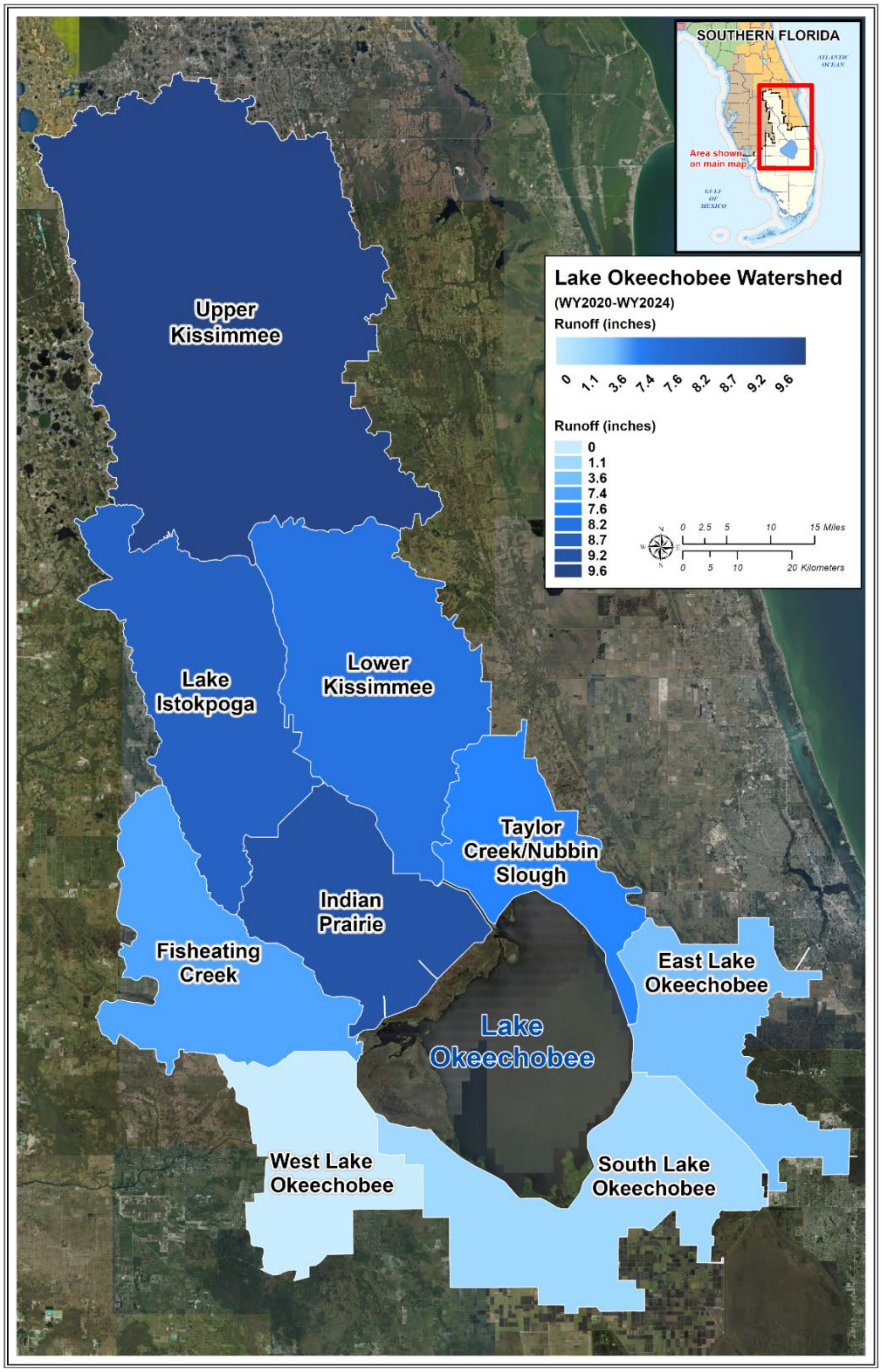


Figure 29. Runoff in inches from the subwatersheds in the LOW.

TREND ANALYSIS ON BASIN LEVEL DATA

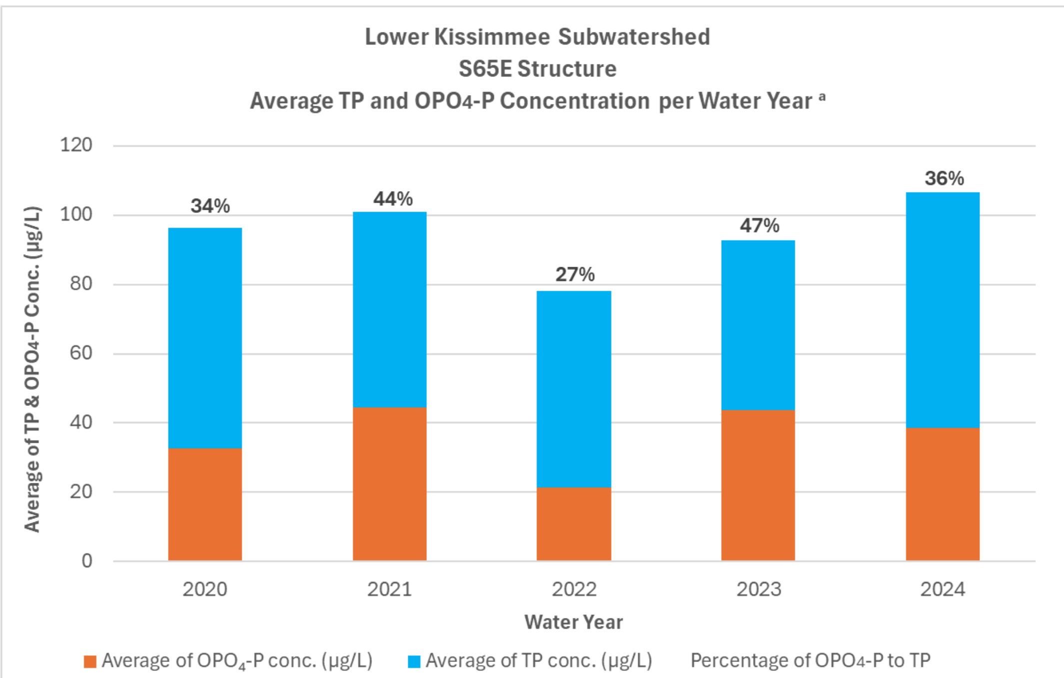
A Seasonal Mann-Kendall test (SKT) trend analysis was completed as part of the 2025 LOWPP update (Jones and Olson 2025). A SKT is a non-parametric test often used to detect trends in water quality time series. It is a rank-order statistic that is not influenced by outliers or skewed data. A SKT was used to analyze flow, nutrient loads, and nutrient FWMCs from the LOW subwatersheds for the period of record

(WY1991–WY2023) and recent 10-year period (WY2014–WY2023). The Lower Kissimmee Subwatershed did not have any statistically significant trends for the recent 10-year dataset and WY1991–WY2023 period.

OPO_4-P AS A PERCENTAGE OF TP AND TOTAL SUSPENDED SOLIDS ANALYSIS

To determine orthophosphate (OPO_4-P) as a percentage of TP at the S65E structure (outlet for the Lower Kissimmee Subwatershed), a comparison was made between the TP and OPO_4-P collected at that location **(Figure 30).** Data used for this analysis were from grab samples, collected when flow was detected and both OPO_4-P and TP were sampled. **Table 5** lists the average annual concentrations, number of samples, and percentage of the data that were OPO_4-P used to create **Figure 30**. Findings show the most recent five years (WY2020–WY2024), OPO_4-P (a dissolved form of phosphorus) contributes 27%–47% of TP. The remaining TP is dominated by forms of phosphorus other than OPO4-P, suggesting the need for a balanced approach to address different forms through BMPs and projects.

Total suspended solids (TSS) are collected as part of the routine sampling at the S65E structure. A review of recent data indicates that TSS concentrations at S65E have averaged 6 mg/L, below the method detection limit of 10 mg/L, for the last 5 water years indicating that suspended solids are not a significant issue at the structure (**Table 6**).



[a]Only used sample collection dates that represented both TP and OPO_4-P.

Figure 30. Annual average TP and OPO_4-P concentrations at the S65E Basin structure and OPO_4-P expressed as a percentage of TP.

Table 5. OPO_4-P as a Percentage of TP per Water Year at the S65E Structure.

S65E OPO_4-P for WY2020-WY2024				
Water Year	Average of TP conc. (µg/L)	Average of OPO_4-P conc. (µg/L)	OPO_4-P as a Percentage of TP	Number of Samples[a]
2020	96.24	32.68	34%	25
2021	101.04	44.62	44%	26
2022	78.12	21.28	27%	25
2023	92.73	43.73	47%	26
2024	106.65	38.69	36%	26
Minimum	**78.12**	**21.28**	**27%**	**25**
Maximum	**106.65**	**44.62**	**47%**	**26**
Average	**95.08**	**36.34**	**38%**	**26**

[a] Only used sample collection dates that represented both TP and OPO_4-P.

Table 6. Annual average TSS at the S65E Structure.

Water Year	Average of TSS conc. (mg/L)	Number of Samples
2020	6	27
2021	6	26
2022	6	26
2023	4	26
2024	6	27
Minimum	**4**	**26**
Maximum	**6**	**27**
Average	**6**	**26**

CONSIDERATION OF PASS-THROUGH FLOWS

SFWMD currently uses a mass balance approach to determine the nutrient loads and flows from the Upper Kissimmee and Lower Kissimmee subwatersheds and this is reported annually in the South Florida Environmental Report (SFER). This approach assumes that the total nutrient loads and flows at S65 (outlet of the Upper Kissimmee Subwatershed) represent Upper Kissimmee Subwatershed runoff contributing to Lake Okeechobee inflows. However, since the Kissimmee River floodplain restoration influences S65 releases and S65 nutrient loads and flows must transit through the Lower Kissimmee subwatershed, the observed S65 flows and loads may not all contribute to Lake Okeechobee inflows, i.e. some may be lost/assimilated in the interim basin. SFWMD currently uses a different approach (pass-through method) for basins in series in the Caloosahatchee River and St. Lucie River watersheds to determine the nutrient loads and flows discharged to the estuaries and which is intended to provide a more balanced accounting of flow and load between these basins.

A comparison was made for the pass-through and mass balance methods to determine the phosphorus loads, flows, and flow weighted mean concentrations for the period of WY2020-WY2024 for the Upper Kissimmee and Lower Kissimmee Subwatersheds (**Figure 31**, **Tables 7-9**). The pass-through method resulted in lower phosphorus loads and flows from Upper Kissimmee, and higher loads and flows from Lower Kissimmee. For planning purposes, results from both methods will be considered to provide a range of phosphorus loads and flow reductions needed. Note that the combined subwatershed total load to Lake

Okeechobee remains the same with both methods (**Table 9**). The annual flow volumes are slightly different for some years due to rounding, however the 5-year average flow volume is the same for both methods.

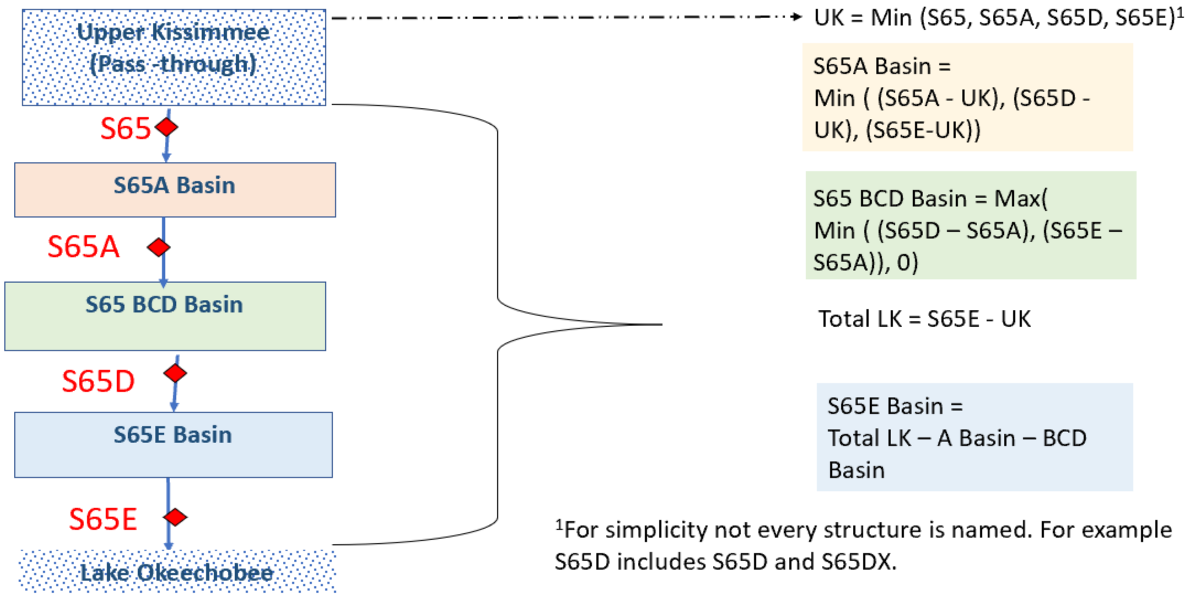


Figure 31. Methodology for Pass-through TP load and flow calculations for Upper Kissimmee and Lower Kissimmee subwatersheds. A daily time step is used for each pass-through calculation.

Table 7. Comparison of Pass-through and Mass Balance Methods for the Upper Kissimmee (UK) Subwatershed.

Pass-Through Method			Mass Balance Method (SFER)		
WY	UK Flow to Lake O (ac-ft)	UK Load to Lake O (t)	WY	UK Flow (ac-ft)	UK Load (t)
2020	592,000	66	2020	643,000	75
2021	835,000	61	2021	883,000	68
2022	591,000	51	2022	690,000	70
2023	1,109,000	89	2023	1,214,000	99
2024	594,000	45	2024	659,000	51
5-year average	**744,000**	**62**	**5-year average**	**818,000**	**73**

Table 8. Comparison of Pass-Through and Mass Balance Methods for the Lower Kissimmee (LK) Subwatershed.

Pass-Through Method			Mass Balance Method (SFER)		
WY	LK Flow to Lake O (ac-ft)	LK Load to Lake O (t)	WY	LK Flow (ac-ft)	LK Load (t)
2020	284,000	62	2020	232,000	54
2021	575,000	127	2021	527,000	120
2022	200,000	37	2022	101,000	18
2023	328,000	124	2023	224,000	114
2024	445,000	108	2024	379,000	102
5-year average	**366,000**	**92**	**5-year average**	**292,000**	**82**

Table 9. Combined Lower Kissimmee (LK) and Upper Kissimmee (UK) total flows and loads using the Pass-Through Method the Mass Balance methods.

Pass-Through Method			Mass Balance Method (SFER)		
WY	LK+UK Flow to Lake O (ac-ft)	LK+UK Load to Lake O (t)	WY	LK + UK Flow (ac-ft)	LK+UK Load (t)
2020	876,000	129	2020	875,000	129
2021	1,410,000	188	2021	1,410,000	188
2022	791,000	88	2022	791,000	88
2023	1,437,000	213	2023	1,438,000	213
2024	1,039,000	153	2024	1,038,000	153
5-year average	**1,110,000**	**154**	**5-year average**	**1,110,000**	**154**

Additionally, the pass-through method allows us to determine the loads from the Lower Kissimmee basins, S65A, S65BCD, and S65E (**Tables 10-12**) and to evaluate which basins contribute the most nutrient loads and flows. Based on this analysis, S65E Basin has the highest 5-year UALs at 1.98 (lb/ac) in the Lower Kissimmee Subwatershed. The S65D and S65E basins are listed as priority basins in the NEEPP statute for projects (373.4595(3)(a)1.a.). Since that initial designation, the S65B and S65C structures were removed as part of the KRPP creating the S65BCD Basin. The S65BCD Basin contributed the highest 5-year average loads (52 t) and had the second highest 5-year average UAL at 0.39 lb/acre which is quite a bit lower than S65E. The S65E Basin contributed the most runoff at 13.66 inches, based on the 5-year average, followed by the S65A Basin at 10.93 inches. The S65BCD Basin contributed 9.68 inches.

Table 10. S65A Basin total flows and loads using the Pass-Through Method.

Pass-Through Method					
WY	Area (acres)	Flow (ac-ft)	Load (t)	Runoff (inches)	UAL (lbs/ac)
2020	104,070	93,000	15	10.72	0.32
2021	104,070	144,000	19	16.60	0.41
2022	104,070	37,000	1	4.27	0.03
2023	104,070	107,000	19	12.34	0.40
2024	104,070	93,000	11	10.72	0.23
5-year average	**104,070**	**95,000**	**13**	**10.93**	**0.28**

Table 11. S65BCD Basin total flows and loads using the Pass-Through Method.

Pass-Through Method					
WY	Area (acres)	Flow (ac-ft)	Load (t)	Runoff (inches)	UAL (lbs/ac)
2020	295,820	181,000	36	7.34	0.27
2021	295,820	380,000	65	15.41	0.49
2022	295,820	127,000	26	5.15	0.20
2023	295,820	195,000	72	7.91	0.53
2024	295,820	310,000	62	12.58	0.47
5-year average	**295,820**	**238,000**	**52**	**9.68**	**0.39**

Table 12. S65E Basin total flows and loads using the Pass-Through Method.

Pass-Through Method					
WY	**Area (acres)**	**Flow (ac-ft)**	**Load (t)**	**Runoff (inches)**	**UAL (lbs/ac)**
2020	28,996	10,000	11	4.14	0.82
2021	28,996	51,000	42	21.11	3.20
2022	28,996	36,000	10	14.90	0.74
2023	28,996	25,000	33	10.35	2.54
2024	28,996	43,000	34	17.80	2.59
5-year average	**28,996**	**33,000**	**26**	**13.66**	**1.98**

PROTECTION PLAN PROJECT EVALUATION

Evaluation of the projects and practices currently implemented in the subwatershed is important to determine if adjustments are needed. Source control activities have been implemented in the Lower Kissimmee Subwatershed since the late 1980s (**Table 13**). Details on past projects and programs can be found in previous LOWPPs and South Florida Environmental Reports (SFERs). Additional information on completed projects by other entities, such as local counties and the Florida Department of Transportation, can be found in the Lake Okeechobee BMAP update (FDEP 2020) and the FDEP Statewide Annual Report (FDEP 2024b). The projects evaluated below include those reported on in the 2025 SFER (Welch et al. 2025).

Table 13. Timeline of major stormwater, source control activities, and treatment projects within the Lower Kissimmee Subwatershed.

Date	Major Source Control Activities
1987	FDER/FDEP Dairy Rule adopted
1989	Okeechobee Works of the District 40E-61 Rule adopted requiring noticed permits in the S-65D and S-65E basins and no notice for remaining areas
1989	Dairy Buyout Program Implemented
1995	Environmental Resource Permit Program adopted; introduced wetland and water quality requirements
1995	Phase I Municipal Separate Storm Sewer System (MS4) Permit issued for Polk County
2001	Phase I of KRRP complete - 7.5 miles backfilled and S-65B removed
2002	FDACS Agricultural Nutrient Management Plans for Priority Basin Dairies (S-65D and S-65E)
2003	FDACS Rule adopted for Lake Okeechobee Priority Basins and Land Application of Animal Waste
2003	Phase II MS4 permit issued for Osceola County
2004	FDER/FDEP Dairy Rule becomes part of Confined Animal Feeding Operation (CAFO) Permitting Program
2004-2007	Butler Oaks Dairy Best Available Technology (BAT) Project is operational
2004-2008	Phosphorus Source Control Grant Projects (2)
2006	FDACS BMAP rule expanded to all Lake Okeechobee basins.
2006	FDACS Tailwater Recover Project
2006	FDACS Dairy Composting Project
2007	Phase IV A of KRPP Complete – 1.8 miles backfilled
2008	Lamb Island Dairy Remediation (S-65D Basin)
2008	FDACS Dairy Stormwater Management Systems (2)
2010	Phase IV B of KRRP Complete – 3.9 miles backfilled
2012	Phase II MS4 permit issued for Okeechobee County
2012	Dixie Ranch passive dispersed water management project began operations
2014	Phase II MS4 permit issued for Highlands County
2015	Abington Preserve passive dispersed water management project began operations
2017	MacArthur Ditch Backfill Complete for KRRP and S65C removed
2020	Phase III KRRP Complete- 2 miles backfilled
2021	Phase II KRRP and S-69 Weir and Backfilling complete for KRRP – 6.5 miles backfilled
2024	El Maximo Public-Private Partnership began operations

FEDERAL/SFWMD PROJECTS

Two large-scale, collaborative restoration efforts led by the U.S. Army Corps of Engineers (USACE) and SFWMD include the KRRP and the Lake Okeechobee Watershed Restoration Project (LOWRP).

Kissimmee River Restoration Project

The KRRP represents a significant regional restoration effort, jointly funded by USACE and the SFWMD. As of 2021, the final construction stages were completed, restoring about one-third of the Kissimmee River and adjacent floodplain, which had been channelized in the 1960s. A key component of this effort is the Kissimmee River HRS, a regulation schedule developed to provide necessary flows for river restoration while preserving existing flood control. Authorized alongside the KRRP in 1992, the HRS includes phased modifications to the operating criteria of structures S65, S65A, and S65D, as well as real estate acquisition around Lakes Kissimmee, Cypress, and Hatchineha (USACE and SFWMD, 2024). Implemented gradually, the HRS allows higher water stages in these lakes to restore historic flow patterns to the river and its floodplain, while also increasing littoral wetland habitat and overall water storage capacity in Upper Kissimmee by approximately 100,000 acre-feet. KRRP is expected to yield significant ecological benefits, such as improved water quality, reestablishment of floodplain wetlands, and enhanced habitat for a range of species. Notably, in August 2024, the first incremental stage increase (Increment 1) was approved and enacted by USACE in partnership with SFWMD, marking a critical milestone. The finalized HRS is expected to be implemented by 2027. The current interim schedule recommends a minimum of 1,400 cfs discharge at S65/S65A when lake stages in the Upper Kissimmee Basin are above 50 ft NGVD 29 (Koebel et al. 2025). The TP load reduction benefits from this project have not been quantified. Further details on KRRP and the revitalization schedule can be found in Chapter 9 of the 2025 SFER (Koebel et al. 2025).

Lake Okeechobee Watershed Restoration Project

LOWRP is a collaborative effort between USACE and SFWMD aimed at expanding water storage within the watershed, stabilizing water levels in Lake Okeechobee, and improving water management to optimize discharge timing to the St. Lucie and Caloosahatchee estuaries while restoring critical wetland habitats. The recommended plan includes two primary components: installing up to 55 Aquifer Storage and Recovery (ASR) wells and restoring approximately 5,900 acres of wetlands along the Kissimmee River, particularly near the Kissimmee River Center and Paradise Run. These wetland areas will provide essential habitats, improve biodiversity, and contribute to flood mitigation by enhancing water retention during high-flow periods.

Funding from the Florida legislature has been secured for the design, engineering, and construction phases of selected LOWRP elements. Since 2019, SFWMD has been advancing ASR exploration, conducting evaluations across several potential well cluster locations. Due to uncertainties related to the ASR Well Program, a phased scientific approach has been adopted to address potential risks systematically. The initial ASR Science Plan, published in June 2021 by SFWMD and USACE, outlined exploratory strategies, and a subsequent plan, refined by feedback from an ASR peer review panel, was made available for public review in Fall 2024. The Plan was updated to include additional studies on water quality treatment, hydrogeological, ecological, and other scientific studies, and the Final ASR Science Plan Version 2 was published in December 2024 (SFWMD and USACE 2024). In addition to its ecological goals, LOWRP is expected to strengthen regional climate resilience by increasing water storage and improving the area's capacity to manage water during extreme weather events (SFWMD and USACE 2022). Further information on LOWRP's progress is accessible through the South Florida Water Management District's LOWRP project page.

SFWMD PROJECTS[4]

Currently, there are three operating projects and one planned SFWMD projects to help reduce nutrient loading and increase storage within the Lower Kissimmee Subwatershed (**Figure 32, Table 14**). These projects may be considered for renewal prior to contract expiration, depending on performance and funding availability.

Dixie Ranch

Dixie Ranch, situated approximately three miles northeast of the Kissimmee River in Okeechobee County, operates as a cow-calf ranch with two water management areas (WMAs) on its western side designed to capture and detain rainwater. The first of these, WMA1, is a 384-acre drainage basin incorporating a network of ditched wetlands that drain into a series of control structures, allowing for passive water storage. The larger WMA2 covers 1,111 acres, with a drainage ditch that originates along Highway 98 North, flows around PW Bishop Dairy, and continues through and out of the Dixie West area. Water control structures were installed as part of the FDACS BMP program to improve on-site wetland hydration. As a Dispersed Water Management Project focused on passive storage, the estimated dynamic storage (i.e. inflow minus outflow) benefit of Dixie Ranch's west side is 315 acre-feet per year. This project has been operating since August 2012. The most recent contract is set to expire in August of 2032.

Abington Preserve

Abington Preserve's water management area is located on the southwest corner of the Abington ranch property and drains into the Kissimmee Prairie Preserve State Park through the Kissimmee River and Seven Mile Slough (**Figure 2**), which flows through the preserve before reaching the river. This area includes both wetland and pasture zones, with flooding patterns ranging from temporary to seasonal, providing diverse habitat conditions and enhancing water retention. Like Dixie Ranch, Abington Preserve functions as a Dispersed Water Management Project with a passive storage approach, yielding an estimated dynamic storage benefit of 397 acre-feet per year. This project has been operating since May 2015 and is scheduled to continue through May 2026 and is under consideration for an extension.

El Maximo Ranch

Covering 7,030 acres of former agricultural lands, El Maximo Ranch is designed to detain rainfall and excess surface water, including water pumped from the Kissimmee River and Blanket Bay Slough (**Figure 2**). This project integrates four pump stations, 19 water control structures, and around 27 miles of berms to manage water effectively across the site. By detaining and treating surface water, it is estimated that El Maximo Ranch will provide an annual phosphorus reduction benefit of 2.4 t, a dynamic water storage benefit of 2,500 acre-feet per year, and a total water treatment volume of 32,675 acre-feet each year. Project operations began in December 2024 and are scheduled to continue through April 2034.

Basinger Dairy Legacy Phosphorus

Launched in summer 2023, the Basinger Dairy Legacy Phosphorus project is a collaborative effort with coordinating agencies to address nutrient remediation on a recently closed dairy farm, located in the S-65D NEEPP Priority Basin about two miles upstream of the Kissimmee River. The project spans 950 acres within a 1,300-acre property, aiming to support the Lake Okeechobee BMAP by removing legacy

[4] Note that the planned Lower Kissimmee Basin Stormwater Treatment Area is not within the Lower Kissimmee Subwatershed. It is located within and will treat water from the Taylor Creek/Nubbin Slough Subwatershed. It is also planned to have the capability to treat water from Lake Okeechobee via the C-38 Canal, downstream of S65E. Since at this time, any potential treatment of water from Lower Kissimmee Subwatershed via Lake Okeechobee and the C-38 Canal by this project is not known, it was not included in this report.

phosphorus from the Lower Kissimmee Subwatershed. Additionally, this project provides an opportunity to conduct innovative nutrient treatment studies. The phytoremediation phase's preliminary design was completed in summer 2024, the alternatives analysis was completed in January 2025, and the final design is expected by July 2025. This project focuses on nutrient remediation and water quality improvement within the subwatershed. As this is a research project, the long-term estimated benefits of the project are not yet quantified.

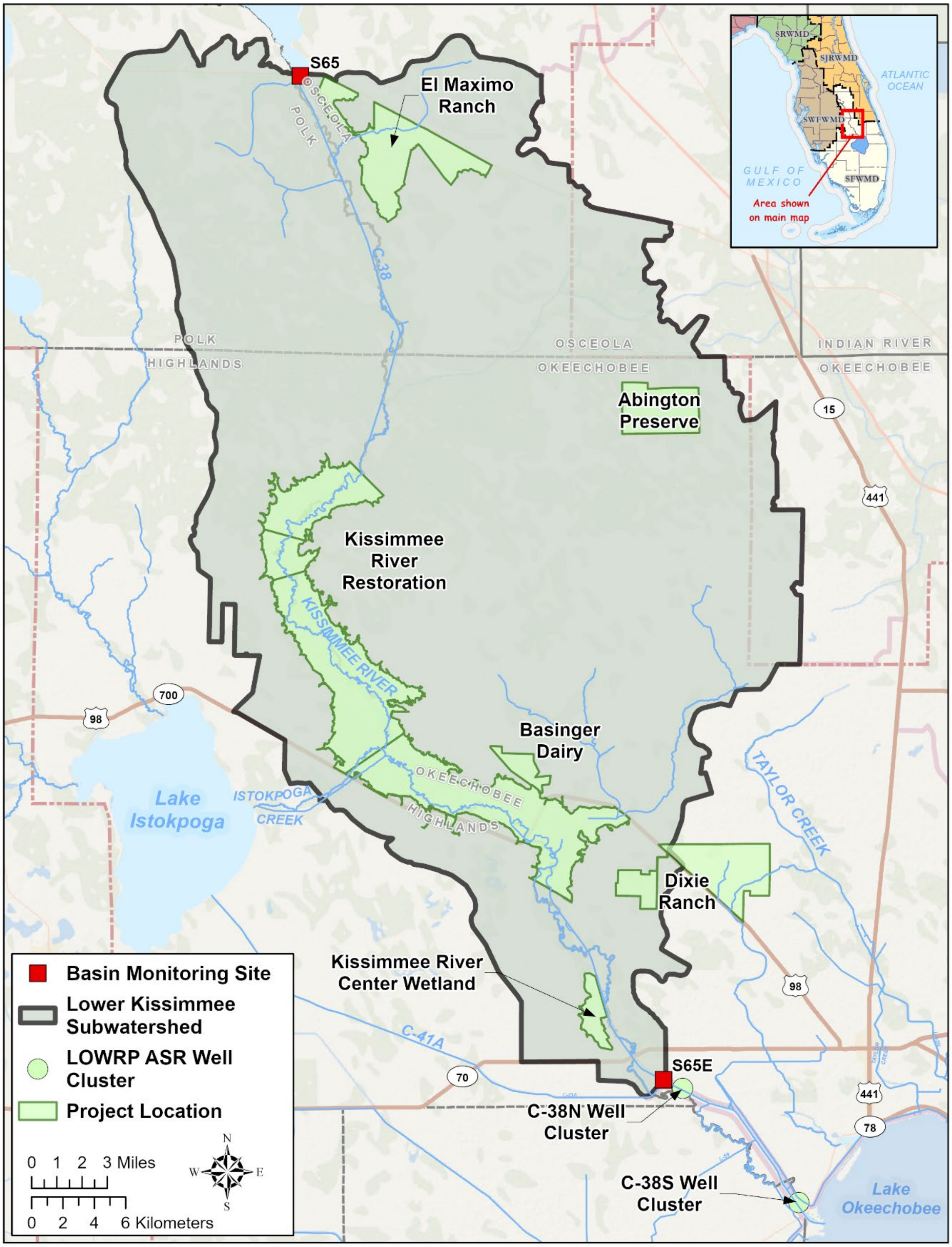


Figure 32. Current LOWPP projects in the Lower Kissimmee Subwatershed.
Note: ASR well clusters are planned components of the regional LOWRP (Welch et al. 2025).

Table 14. Select Coordinating Agencies' projects in the Lower Kissimmee Subwatershed with associated annual estimated and WY2024 storage and TP reductions for each project (Welch et al. 2025).

Project Name	Project Area (ac)	Project Status FY2024	Description	Estimated Storage (ac-ft/yr)	WY2024 Storage (ac-ft)	Estimated TP Removal (t/yr)	WY2024 TP Removed (t)	Estimated TN Removal (t/yr)	WY2024 TN Removed (t)
Dixie Ranch [a]	766	O&M	Public-private partnership. Passive storage project located on a private ranchland that detains direct rainfall and runoff from surrounding areas. Includes former Dixie Ranch and Dixie West projects.	315	315 [b]	0.1	0.1 [b]	0.5	0.6 [b]
Abington Preserve (Triple A Ranch)	106	O&M	Public-private partnership. Passive storage project that consists of a reservoir and a mixed area of wetlands that vary from temporarily to seasonally flooded. The water management area drains downstream into the Kissimmee Prairie Preserve State Park and the Kissimmee River via Seven Mile Slough.	397	280	0.1	0.1 [c]	0.3	0.6 [c]
El Maximo Ranch	7,030	O&M	Public-private partnership. Active treatment and flow attenuation project that will detain water from the Kissimmee River and Blanket Bay Slough before discharging to the Kissimmee River downstream of S-65.	2,500	N/A [d]	2.4	N/A [d]	7.0	N/A [d]
Basinger Dairy Legacy Phosphorus	950	Planning	Public-private partnership. This 5-year research project located on a 950-ac former dairy farm in Okeechobee County is designed to improve systems for legacy phosphorus remediation.	TBD [e]	N/A [d]	TBD [e]	N/A [d]	TBD [e]	N/A [d]
Lower Kissimmee Subwatershed (approximate totals) [f]				**3,212 [g]**	**595**	**2.6**	**0.2**	**7.8**	**1.2**

a. The Dixie Ranch project has components in both the Lower Kissimmee and Taylor Creek/Nubbin Slough Subwatersheds. Only Lower Kissimmee Subwatershed benefits are shown here.
b. WY2024 benefit is estimated due to incomplete monitoring data.
c. No site-specific water quality monitoring. Nutrient benefits calculated using observed project storage and subwatershed/basin FWMC.
d. Project was not in operation during WY2024.
e. TBD – To be determined.
f. Totals do not include projects where information is unavailable.
g. Estimated Storage in this table are dynamic storage (i.e. inflow minus outflow). The LOWCP storage target of 900,000 to 1,300,000 ac-ft is static storage (i.e. project capacity).

ADDITIONAL NUTRIENT REDUCTIONS AND STORAGE NEEDED

A review of the recent 5-year average (WY2020-WY2024) TP loading data calculated via the mass balance and the pass-through method compared to the basin TP planning target **(Table 15)** indicates that an additional 60 to 70 t annual average reduction is needed for the Lower Kissimmee Subwatershed without any future project reductions. That assumes that all existing projects operating for at least five years have achieved their TP reduction benefits and that achievement is reflected in the recent 5-year average water quality data. The long-term average TP load reductions from recently completed and planned projects is 2.4 t from the El Maximo project which reduces the TP load reduction needed to 58 to 68 t annually. This highlights the substantial efforts required to achieve the TP planning target. Achieving that reduction will require additional new projects and the optimization of existing ones where possible. It should be noted that this does not consider benefits from the Basinger Project and from the KRRP as those are not quantified.

Table 15. Planning targets for the Lower Kissimmee Subwatershed and the 5-year average (WY2020-WY2024) 5-year average TP loads (using pass-through and mass balance calculations) and the long-term average annual TP reductions needed to achieve the planning target.

Subwatershed	TP Planning Target (t)	TP loads WY2020-WY2024 avg (t)		TP Reduction Needed without Planned Projects Benefits (t)		Recently Completed and Planned Project Estimated TP Reductions (t)[a]	TP Reduction Needed assuming Planned Project Benefits (t)	
		Pass-Through	Mass Balance	Pass-Through	Mass Balance		Pass-Through	Mass Balance
Lower Kissimmee	22.1	92	82	69.9	59.9	2.4	67.5	57.5

[a] Assumes that all projects operating for 5 years have realized their TP reductions. Includes reductions from recently completed and planned projects where load estimates were available.

The static storage (project capacity) from the Protection Plan projects is 6,415 ac-ft (Frye et al. 2025). Other projects including non-Protection Plan projects, may provide additional storage but those storage capacities were not readily available for inclusion in this report. As mentioned in the introduction there are no set static storage targets for any of the subwatersheds, including the Lower Kissimmee Subwatershed. Reducing flows from a subwatershed that discharges 292,000 to 366,000 ac-ft/yr (5-year average annual flows based on mass balance and pass-through, respectively) would assist in reducing TP loads. However, any efforts in this subwatershed to reduce flows by increasing storage will have to be carefully planned and consider the KRRP, HRS and lakes and river regulation schedules. High rates of change in flow are disruptive to ecology and SFWMD is still working towards the best operation plan for S65 (Koebel et al. 2025). It is recommended that additional storage projects be developed keeping in mind the operational constraints for the downstream structures with regulation schedules. It should be realized that due to water supply and ecological needs, at times those additional projects may not be able to store water. However, they would be a great benefit to capture excess water during periods of inundation in the subwatershed and then be able to discharge the water when needed.

TIMELINE TO ACHIEVE RECENTLY COMPLETED AND PLANNED PROJECT REDUCTIONS

To provide an estimate of the time it will take to achieve the long-term average TP reductions from the recently operating and planned projects, the date when operations began for the El Maximo project was considered (**Table 16**). Note the exact timeline for achieving reductions is not known. The TP load reductions are long-term average annual estimates and individual water years will vary due to variations in rainfall, runoff, and biological removal processes. The Lower Kissimmee Subwatershed could potentially see a 2.4 t/yr reduction around 2029, assuming there are no project delays and the long-term estimate reductions are realized over a 5-year period. Note the Basinger Dairy project and KRRP are not included since the long-term estimated TP load reductions are quantified.

Table 16. Operational dates and expected TP reductions for recently completed and planned projects in the Lower Kissimmee Subwatershed.

Project Name	Long-term Average Annual TP Reduction (t/yr)	Operation Start Date	Long-Term TP Reduction may be Realized
El Maximo	2.4	2024	2029
Total	2.4		

UPSTREAM LEVEL MONITORING ANALYSIS

UPSTREAM DATA

Data from upstream monitoring sites were reviewed to better understand the source of nutrients within the watershed and to better define where additional projects or program adjustments are needed. Currently there are 29 upstream monitoring locations in the Lower Kissimmee Basin where TP, TN, OPO_4-P, NH_3-N, and NOx-N are collected (**Figures 33-34**, **Tables 17-19**). The current frequency of monitoring at most of the upstream monitoring sites is bi-weekly when flowing. At most upstream monitoring locations there is no measurement of flow.

Of the 29 upstream level monitoring sites in the Lower Kissimmee Subwatershed, eighteen had 5-year average annual TP concentrations greater than FDEP's NNC of 120 µg/L (FDEP 2012) and these stations are depicted in red in **Table 17**. Seventeen sites had TN concentrations greater than FDEP's NNC of 1.54 mg/L TN (FDEP 2020) and are depicted in red in **Table 18**.

A trend analysis of the upstream data was conducted similar to the basin level data using the SKT but on monthly average TP and TN concentrations (Jones and Olson 2025). Only 9 of the 29 upstream monitoring stations had data for more than 50% of the months during the recent 10-year period (WY2014-WY2023) and were included in the SKT analysis. None showed a significant trend ($p<0.05$). Thirteen of the 29 upstream stations had data for more than 50% of the months during the entire period of record (WY1991-WY2023) and were included in the SKT analysis of this period. Three stations (CY05353444, CY06363411, and KREA 14) had significant decreasing trends in TP from WY1991 through WY2023. Seven stations (CY17353413, KREA 01, KREA 17A, KREA 22, KREA 23, S65A, and S65D) had significant increasing trends in either TP, TN or both over the same period of record.

Since the Lower Kissimmee Subwatershed has the second highest UALs in the LOW, it is recommended that all of the sites with 5-year average concentrations above the TP and TN NNC (FDEP 2012) be investigated and that the BMPs within the contributing areas for those sites be reevaluated. It might be prudent to begin with the two sites with increasing TP concentration trend that had 5-year averages above the NNC, CY17353413 and KREA 01. CY17353413, located downstream of a dairy farm, had the highest 5-year average concentrations of TP (1,437 µg/L) and TN (3.29 mg/L) in the Lower Kissimmee Subwatershed. KREA 01, which is downstream of a row crop area, had a 5-year average TP concentration of 221 µg/L.

In WY2022, SFWMD worked with the other Coordinating Agencies (FDEP and FDACS) to develop and implement a rapid assessment process to notify each agency and share when unusual events occur, to be proactive in managing water quality issues as outlined in the 2023 Interagency Agreement. Unusual events can include water quality sampler observations of conditions indicative of poor water quality or if laboratory results return extremely high nutrient values. The Coordinating Agencies Technical Team determined in the LOW samples with measurements above the absolute values of TP ≥ 5,000 micrograms per liter (µg/L) and TN values ≥ 10 milligrams per liter (mg/L) would be highlighted. SFWMD completes an initial review as soon as preliminary data are available and, if warranted, an email notification is sent to the Coordinating Agencies. As of January 2025, no rapid assessment notification trigger emails have been sent to the Coordinating Agencies for sites within the Lower Kissimmee Subwatershed as none of those sites have had concentrations greater than the absolute values since the process began.

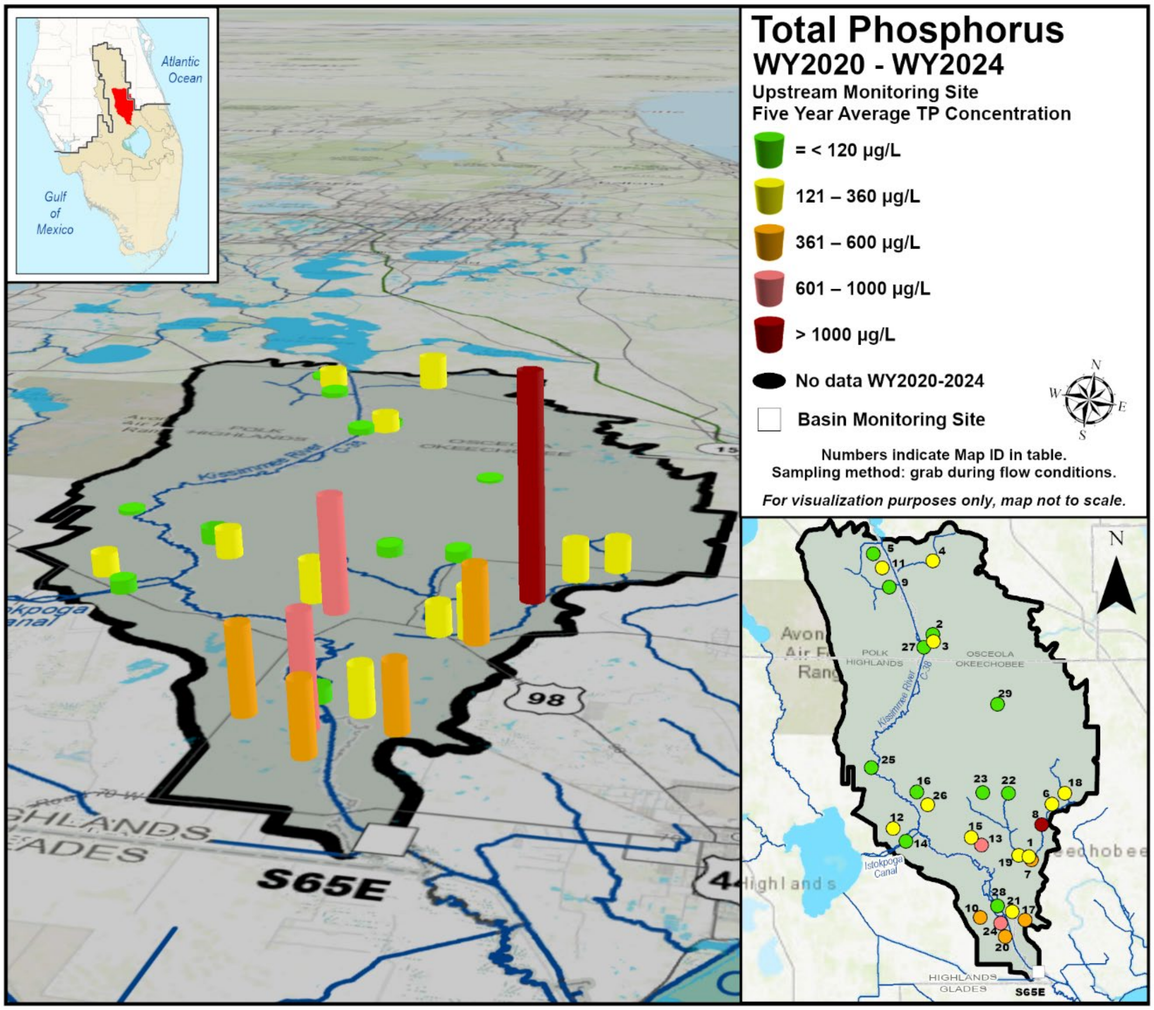


Figure 33. Most recent 5-year average TP concentration (WY2020–WY2024) for upstream monitoring sites within the Lower Kissimmee Subwatershed. Site numbers correspond to Map IDs in **Table 17**. (Olson and Broling 2025).

Table 17. Most recent 5-year TP concentration data (WY2020–WY2024) for the upstream monitoring sites within the Lower Kissimmee Subwatershed. The 5-year average TP concentration is presented in **Figure 33**. (Note: Avg. – Average, Conc. – Concentration, ID – Identifier, Max. – Maximum, and Min. – Minimum, and No. – Number of Samples. Red stations have 5-year averages greater than 120 µg/L) (Olson and Broling 2025).

Lower Kissimmee		WY2020 [a]				WY2021				WY2022				WY2023				WY2024				5-Year Avg. TP Conc. (µg/L)	5-Year TP Median Conc. (µg/L)
		No.	TP Conc. (µg/L)			No.	TP Conc. (µg/L)			No.	TP Conc. (µg/L)			No.	TP Conc. (µg/L)			No.	TP Conc. (µg/L)				
Map ID	Site		Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		
1	02272676[b]	4	326	128	509	18	378	62	912	9	184	48	330	7	401	132	1,053	15	292	62	586	320	288
2	AM22323213[c]	0	-	-	-	11	35	24	113	7	49	24	75	3	40	25	67	10	64	27	147	48	34
3	AM27323211[c]	1	94	94	94	2	136	82	189	0	-	-	-	0	-	-	-	4	178	144	237	154	163
4	BB16313214	4	413	312	549	7	190	101	430	1	541	541	541	2	305	170	439	8	298	164	623	296	268
5	BM15313111[c]	0	-	-	-	9	37	25	64	3	35	29	42	4	40	28	49	6	32	19	46	36	32
6	CY05353444	7	388	183	980	12	203	55	463	3	133	116	168	1	166	166	166	4	374	160	811	267	183
7	CY06363411	2	727	422	1,031	12	544	197	970	5	589	161	920	7	519	93	1,068	12	309	47	770	480	450
8	CY17353413	2	931	590	1,272	10	1,566	480	3,916	4	1,963	477	5,615	6	980	449	1,731	10	1,475	449	3,482	1,437	1,127
9	IC35313112[c]	1	66	66	66	10	50	22	106	11	36	21	65	6	43	29	56	11	62	27	144	49	42
10	KR05373311	1	787	787	787	14	481	80	1,481	4	531	184	912	4	537	316	794	8	500	211	1,068	509	464
11	KR23313113[c]	0	-	-	-	2	198	141	254	1	239	239	239	0	-	-	-	5	131	118	151	161	139
12	KR24353114	0	-	-	-	12	136	55	301	5	129	79	174	1	133	133	133	6	206	65	725	152	123
13	KR29353334	0	-	-	-	1	427	427	427	0	-	-	-	1	1,551	1,551	1,551	1	232	232	232	737	427
14	KR30353214	1	50	50	50	1	33	33	33	1	56	56	56	4	130	59	261	4	67	46	86	84	65
15	KR30353312	2	196	124	268	6	274	121	474	2	407	106	707	0	-	-	-	1	126	126	126	270	256
16	KR32343214[c]	0	-	-	-	11	129	54	520	4	72	26	133	2	239	156	321	9	79	35	197	111	85
17	KR36363312	0	-	-	-	10	448	133	1,016	5	301	140	646	0	-	-	-	0	-	-	-	399	297
18	KREA 01[b]	2	461	152	770	18	230	68	966	14	227	54	878	10	242	51	587	17	167	66	614	221	139
19	KREA 04	4	297	101	533	11	187	108	372	5	161	129	214	3	318	210	441	10	149	56	240	197	159
20	KREA 14	1	794	794	794	18	383	90	1,483	5	363	234	600	7	373	147	626	8	522	224	1,321	418	335
21	KREA 17A	7	209	84	318	21	246	118	471	13	204	130	375	12	338	145	620	18	384	170	774	285	239
22	KREA 22	12	68	32	222	24	80	31	227	16	84	47	137	15	104	36	236	21	75	34	211	82	69
23	KREA 23	6	66	28	116	19	58	26	114	17	116	35	618	10	119	40	294	19	70	33	114	84	65
24	KREA 41A	2	560	545	574	17	902	119	2,408	7	900	367	1,678	12	283	62	841	23	603	37	1,937	656	574
25	KREA 100[c]	5	14	6	22	22	53	19	112	25	28	12	65	23	27	11	49	26	29	9	60	33	27
26	OK09353212	6	128	59	181	17	169	78	384	5	202	131	333	6	407	151	962	15	164	98	247	195	166
27	S65A[d]	24	80	46	291	26	63	32	163	25	63	30	100	24	63	40	137	25	64	39	136	66	59
28	S65D[d]	21	95	54	195	26	86	40	202	21	84	38	163	17	92	40	319	21	91	42	316	89	79
29	SM21333314[c]	0	-	-	-	11	22	12	50	4	24	17	30	9	40	17	97	16	23	14	39	27	23

a. During WY2016, the sampling frequency of most of the upstream ambient/tributary sites was reduced from biweekly to monthly because of SFWMD resource constraints but was restored to biweekly in February 2020 (WY2020).

b. Flow data were collected by the United States Geological Survey and funded by FDACS at associated flow stations. The flow data are available in SFWMD's DBHYDRO database accessible at https://www.sfwmd.gov/science-data/dbhydro.

c. Monitoring reinstated in February 2020 as part of SFWMD expanded monitoring.

d. Flow data were collected by SFWMD at associated flow stations. The flow data are available in SFWMD's DBHYRO database accessible at https://www.sfwmd.gov/science-data/dbhydro. Note there may be other flow monitoring sites in this subwatershed that can be found in the database.

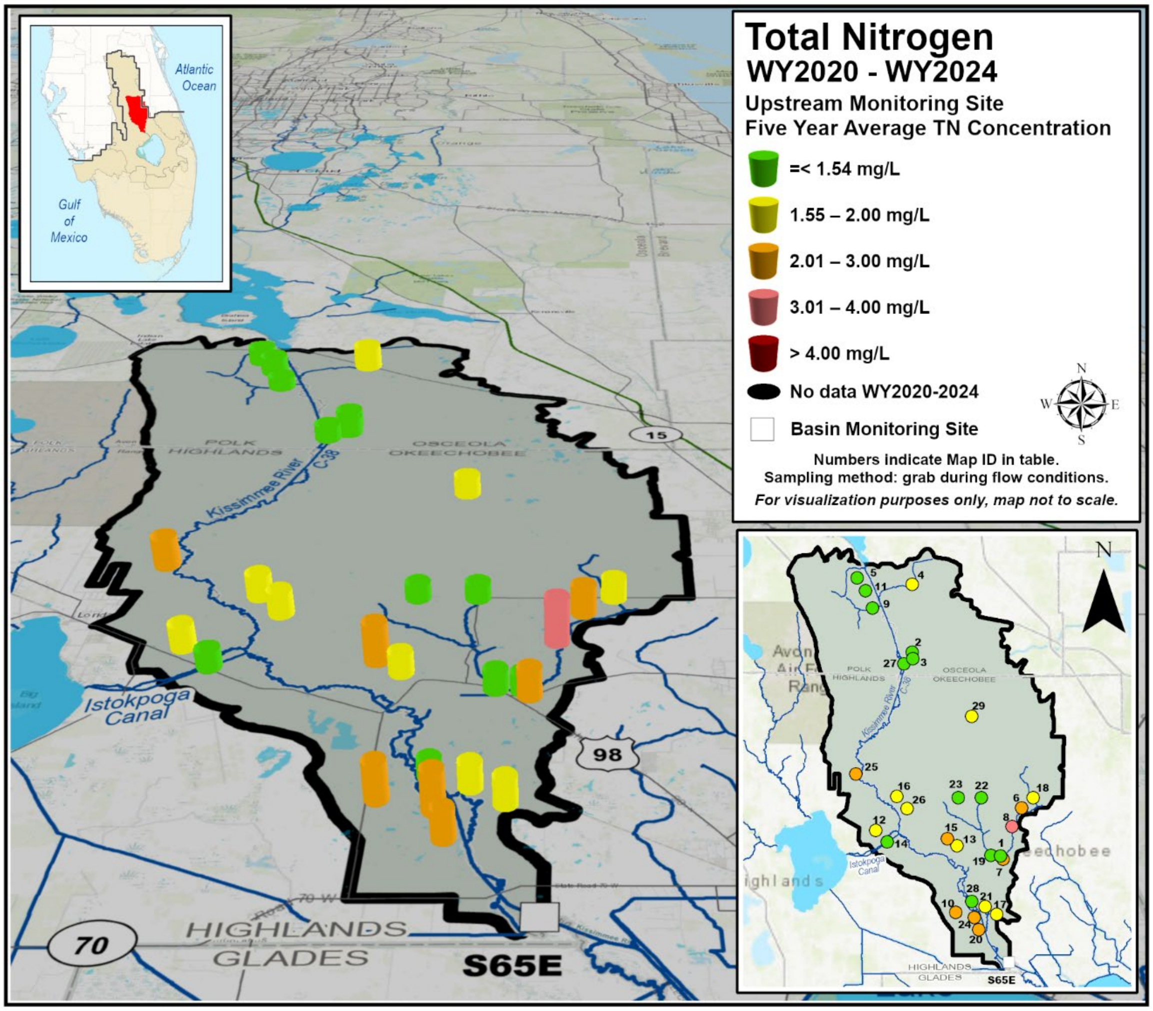


Figure 34. Most recent 5-year average TN concentration (WY2020–WY2024) for upstream monitoring sites within the Lower Kissimmee Subwatershed. Site numbers correspond to Map IDs in **Table 18**. (Olson and Broling 2025).

Table 18. Most recent 5-year TN concentration data (WY2020–WY2024) for the upstream monitoring sites within the Lower Kissimmee Subwatershed. The 5-year average TN concentration is presented in **Figure 34**. (Note: Avg. – Average, Conc. – Concentration, ID – Identifier, Max. – Maximum, and Min. – Minimum, and No. – Number of Samples. Red stations have 5-year averages greater than 1.54 mg/L) (Olson and Broling 2025).

Lower Kissimmee		WY2020[a]				WY2021				WY2022				WY2023				WY2024				5-Year Avg. TN Conc. (mg/L)	5-Year TN Median Conc. (mg/L)
Map ID	Site	No.	TN Conc. (mg/L)			No.	TN Conc. (mg/L)			No.	TN Conc. (mg/L)			No.	TN Conc. (mg/L)			No.	TN Conc. (mg/L)				
			Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		Avg.	Min.	Max.		
1	02272676[b]	4	1.51	1.00	2.08	18	1.39	0.84	2.09	9	1.27	0.69	1.52	7	1.67	1.24	2.39	16	1.36	0.78	2.24	1.40	1.44
2	AM22323213	0	-	-	-	11	1.25	1.09	1.54	7	1.69	1.15	2.29	3	1.26	1.18	1.33	10	1.56	1.20	2.13	1.45	1.33
3	AM27323211	1	0.75	0.75	0.75	2	1.38	1.36	1.40	0	-	-	-	0	-	-	-	4	1.53	1.39	1.62	1.37	1.40
4	BB16313214	0	-	-	-	7	1.67	1.19	2.04	1	3.08	3.08	3.08	2	2.54	2.40	2.68	8	1.91	1.42	3.10	1.95	1.76
5	BM15313111	0	-	-	-	9	1.44	1.22	1.82	3	1.56	1.03	1.98	4	1.48	1.11	2.22	6	1.21	0.92	1.44	1.40	1.36
6	CY05353444	3	1.04	0.91	1.22	12	2.36	1.49	3.21	3	1.54	1.52	1.55	1	2.10	2.10	2.10	4	2.61	2.46	2.94	2.11	2.28
7	CY06363411	0	-	-	-	12	2.45	1.19	4.35	5	2.33	2.06	2.98	7	1.97	0.45	2.81	12	1.58	0.55	3.16	2.05	2.16
8	CY17353413	1	2.75	2.75	2.75	10	4.19	2.48	8.96	4	2.60	1.21	3.78	6	2.17	1.29	3.18	10	3.40	2.06	6.57	3.29	2.75
9	IC35313112	1	0.84	0.84	0.84	10	0.94	0.68	1.47	11	0.97	0.79	1.31	6	1.21	0.97	1.61	11	1.02	0.53	1.49	1.01	1.00
10	KR05373311	0	-	-	-	14	2.71	0.60	6.41	4	2.55	1.73	3.42	4	2.26	1.90	2.53	8	2.59	1.99	3.86	2.60	2.43
11	KR23313113	0	-	-	-	2	1.71	1.64	1.77	1	1.95	1.95	1.95	0	-	-	-	5	1.32	1.03	1.66	1.50	1.62
12	KR24353114	0	-	-	-	12	1.75	1.36	2.38	5	1.86	1.49	2.14	1	1.89	1.89	1.89	6	1.80	1.51	2.17	1.79	1.74
13	KR29353334	0	-	-	-	1	1.17	1.17	1.17	0	-	-	-	1	2.31	2.31	2.31	1	1.22	1.22	1.22	1.57	1.22
14	KR30353214	0	-	-	-	1	1.23	1.23	1.23	1	0.98	0.98	0.98	4	1.66	1.29	1.96	4	1.27	1.04	1.45	1.39	1.33
15	KR30353312	0	-	-	-	6	2.20	1.82	2.67	2	2.71	2.67	2.74	0	-	-	-	1	6.80	6.80	6.80	2.82	2.52
16	KR32343214	0	-	-	-	11	1.93	1.23	2.73	5	1.82	1.44	2.61	2	2.15	2.11	2.19	9	1.57	1.00	2.36	1.81	1.72
17	KR36363312	0	-	-	-	10	1.90	1.38	2.23	5	1.97	1.83	2.14	0	-	-	-	0	-	-	-	1.92	1.96
18	KREA 01[b]	2	2.02	1.86	2.18	18	1.72	0.98	4.90	14	1.55	0.91	2.50	11	1.41	0.61	2.06	18	1.50	1.01	2.17	1.57	1.54
19	KREA 04	4	1.79	1.43	2.23	11	1.44	1.18	1.84	5	1.40	1.25	1.55	3	1.93	1.59	2.33	10	1.33	1.16	1.58	1.49	1.42
20	KREA 14	1	2.86	2.86	2.86	18	2.05	1.57	2.49	5	2.05	1.51	2.36	7	2.09	1.74	2.38	8	2.00	1.39	2.54	2.07	2.12
21	KREA 17A	7	2.21	1.47	3.41	21	1.54	0.86	1.87	13	1.76	1.35	2.24	12	1.83	1.47	2.45	18	1.85	1.27	2.68	1.77	1.75
22	KREA 22	12	1.21	0.84	1.48	24	1.16	0.81	1.57	17	1.26	0.95	1.58	15	1.41	1.06	2.36	21	1.23	0.96	1.63	1.24	1.20
23	KREA 23	6	1.19	0.84	1.59	19	1.18	0.80	1.57	18	1.22	0.71	2.79	10	1.39	0.95	2.35	19	1.16	0.82	1.59	1.21	1.14
24	KREA 41A	2	3.06	2.34	3.78	17	3.33	1.78	7.20	7	2.84	1.74	3.71	12	2.00	1.31	2.90	23	2.74	1.28	6.48	2.78	2.58
25	KREA 100	5	1.08	0.67	1.36	22	2.19	1.40	3.89	26	2.41	1.14	3.63	23	2.36	1.27	3.51	26	2.33	1.15	3.48	2.27	2.39
26	OK09353212	0	-	-	-	17	1.71	1.11	2.21	5	2.14	1.33	3.30	6	2.15	1.67	2.74	15	1.69	1.22	2.21	1.81	1.77
27	S65A[c]	24	1.37	1.15	1.95	26	1.23	1.04	1.60	26	1.31	0.82	1.76	24	1.26	0.84	1.58	25	1.21	0.71	1.40	1.28	1.25
28	S65D[c]	21	1.44	1.23	2.22	26	1.27	0.99	1.78	22	1.28	0.89	1.58	17	1.23	0.85	2.14	21	1.34	0.97	2.03	1.31	1.28
29	SM21333314	0	-	-	-	11	1.46	1.15	2.19	5	1.64	1.34	1.94	9	1.83	1.13	3.60	16	1.46	1.06	1.86	1.56	1.53

a. During WY2016, the sampling frequency of most of the upstream ambient/tributary sites was reduced from biweekly to monthly because of SFWMD resource constraints but was restored to biweekly in February 2020 (WY2020). Note TN monitoring began at many of the upstream monitoring locations in February 2020 as part of SFWMD expanded monitoring.
b. Flow data were collected by the United States Geological Survey and funded by FDACS at associated flow stations. The flow data are available in SFWMD's DBHYDRO database accessible at https://www.sfwmd.gov/science-data/dbhydro.
c. Flow data were collected by SFWMD at associated flow stations. The flow data are available in SFWMD's DBHYRO database accessible at https://www.sfwmd.gov/science-data/dbhydro. Note there may be other flow monitoring sites in this subwatershed that can be found in the database.

Table 19. Five-year average data (WY2020-WY2024) for the Lower Kissimmee Subwatershed. Color bars within each cell represent the relative magnitude of each data value to the range of values for that parameter within the subwatershed for the same period. (Note: Avg. – Average, ID – Identifier, and No. – Number of Samples.) (Olson and Broling 2025).

Lower Kissimmee		WY2020-WY2024									
		TP (µg/L)		OPO_4-P (µg/L)		TN (mg/L)		NH_3-N (mg/L)		NO_X-N (mg/L)	
Map ID	Site	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.	No.	Avg.
1	02272676	53	320	49	272	54	1.40	51	0.04	50	0.03
2	AM22323213	31	48	9	11	31	1.45	9	0.05	9	0.01
3	AM27323211	7	154	7	80	7	1.37	7	0.05	7	0.02
4	BB16313214	22	296	18	171	18	1.95	18	0.15	18	0.04
5	BM15313111	22	36	6	4	22	1.40	7	0.05	7	0.01
6	CY05353444	27	267	0	-	23	2.11	0	-	0	-
7	CY06363411	38	480	18	451	36	2.05	18	0.17	16	0.01
8	CY17353413	32	1437	7	1872	31	3.29	7	1.20	6	0.01
9	IC35313112	39	49	36	5	39	1.01	39	0.04	38	0.02
10	KR05373311	31	509	21	413	30	2.60	21	0.61	19	0.13
11	KR23313113	8	161	8	74	8	1.50	8	0.07	8	0.03
12	KR24353114	24	152	3	28	24	1.79	3	0.07	3	0.01
13	KR29353334	3	737	2	688	3	1.57	3	0.13	3	0.07
14	KR30353214	11	84	8	26	10	1.39	9	0.10	9	0.05
15	KR30353312	11	270	7	185	9	2.82	7	0.70	6	0.13
16	KR32343214	26	111	22	48	27	1.81	27	0.08	25	0.01
17	KR36363312	15	399	12	229	15	1.92	13	0.11	13	0.01
18	KREA 01	61	221	58	137	63	1.57	60	0.14	60	0.12
19	KREA 04	33	197	28	125	33	1.49	29	0.05	29	0.01
20	KREA 14	39	418	35	336	39	2.07	36	0.12	35	0.02
21	KREA 17A	71	285	52	259	71	1.77	54	0.07	53	0.02
22	KREA 22	88	82	72	39	89	1.24	77	0.07	77	0.02
23	KREA 23	71	84	46	11	72	1.21	53	0.03	51	0.01
24	KREA 41A	61	656	18	908	61	2.78	19	0.86	18	0.15
25	KREA 100	101	33	50	12	102	2.27	49	0.06	52	1.72
26	OK09353212	49	195	39	124	43	1.81	41	0.12	40	0.04
27	S65A	124	66	123	8	125	1.28	118	0.02	105	0.02
28	S65D	106	89	106	24	107	1.31	102	0.05	91	0.03
29	SM21333314	40	27	33	5	41	1.56	41	0.05	41	0.01

UPSTREAM OPO_4-P AS A PERCENTAGE OF TP ANALYSIS

To assess how much of the TP consists of OPO_4-P (a soluble form), a comparison was made between total TP and OPO_4-P concentrations collected from grab samples. Data used in this analysis included samples only collected during flow conditions on dates when both TP and OPO_4-P measurements were available. **Table 20** summarizes the average TP and OPO_4-P concentrations, sample counts, and OPO_4-P as a percentage of TP for each station from WY2020 to WY2024. These data were used to create the map shown in **Figure 35**, which illustrates the spatial distribution of OPO_4-P as a percentage of TP across the Lower Kissimmee watershed.

The stations were arbitrarily categorized into three groups based on OPO_4-P as a percentage of TP: low (0–25%), moderate (26–59%), and high (60–90%). If in the low or moderate range, phosphorus is predominantly in forms other than OPO4-P. If in the high range, OPO4-P is the dominant form, reflecting a greater proportion of dissolved phosphorus.

A clear spatial trend emerges, with OPO_4-P dominance increasing in the southern regions closer to Lake Okeechobee. Northern stations generally exhibit low OPO_4-P as a percentage of TP. In contrast, southern stations show significantly higher OPO_4-P as a percentage of TP, suggesting elevated soluble phosphorus, perhaps due to agricultural activities in the southern watershed. To address the observed spatial patterns, management strategies should align with the varying phosphorus dynamics across regions. Areas with higher OPO_4-P concentrations may require interventions that focus on reducing soluble phosphorus.

It's important to note that while two stations may share similar OPO4-P/TP percentages, their actual phosphorus concentrations can differ by orders of magnitude, which may influence management priorities. To see the TP concentration data for each station, please refer to **Table 17** and **Figure 33** above.

Table 20. OPO4-P as a percentage of TP in the Lower Kissimmee Upstream Monitoring Sites for the 5-year period from WY2020-WY2024.

Upstream Monitoring Sites for WY2020-WY2024					
Map ID	**Site**	**Average of TP conc. (µg/L)**	**Average of OPO_4-P conc. (µg/L)**	**OPO_4-P as a Percentage of TP**	**Number of Samples [a]**
1	02272676	320	272	85%	49
2	AM22323213	42	11	25%	9
3	AM27323211	154	80	52%	7
4	BB16313214	270	171	63%	18
5	BM15313111	31	4	13%	6
6	CY05353444	-	-	-	-
7	CY06363411	540	451	83%	18
8	CY17353413	2023	1872	93%	7
9	IC35313112	50	5	9%	36
10	KR05373311	605	413	68%	21
11	KR23313113	161	74	46%	8
12	KR24353114	67	28	42%	3
13	KR29353334	892	688	77%	2
14	KR30353214	85	26	30%	8
15	KR30353312	250	185	74%	7
16	KR32343214	121	49	41%	21
17	KR36363312	330	229	70%	12
18	KREA01	218	139	64%	57
19	KREA04	185	125	67%	28
20	KREA14	400	336	84%	35
21	KREA17A	308	259	84%	52
22	KREA22	85	39	46%	71
23	KREA23	78	11	14%	45
24	KREA41A	1065	908	85%	18
25	KREA100	40	12	30%	50
26	OK09353212	211	124	59%	39
27	S65A	66	8	11%	126
28	S65D	87	24	28%	124
29	SM21333314	26	5	19%	32
	Minimum	**26**	**4**	**9%**	**2**
	Maximum	**2023**	**1872**	**93%**	**126**
	Average	**311**	**234**	**52%**	**32**

[a] Only used sample collection dates that represented both TP and OPO_4-P.

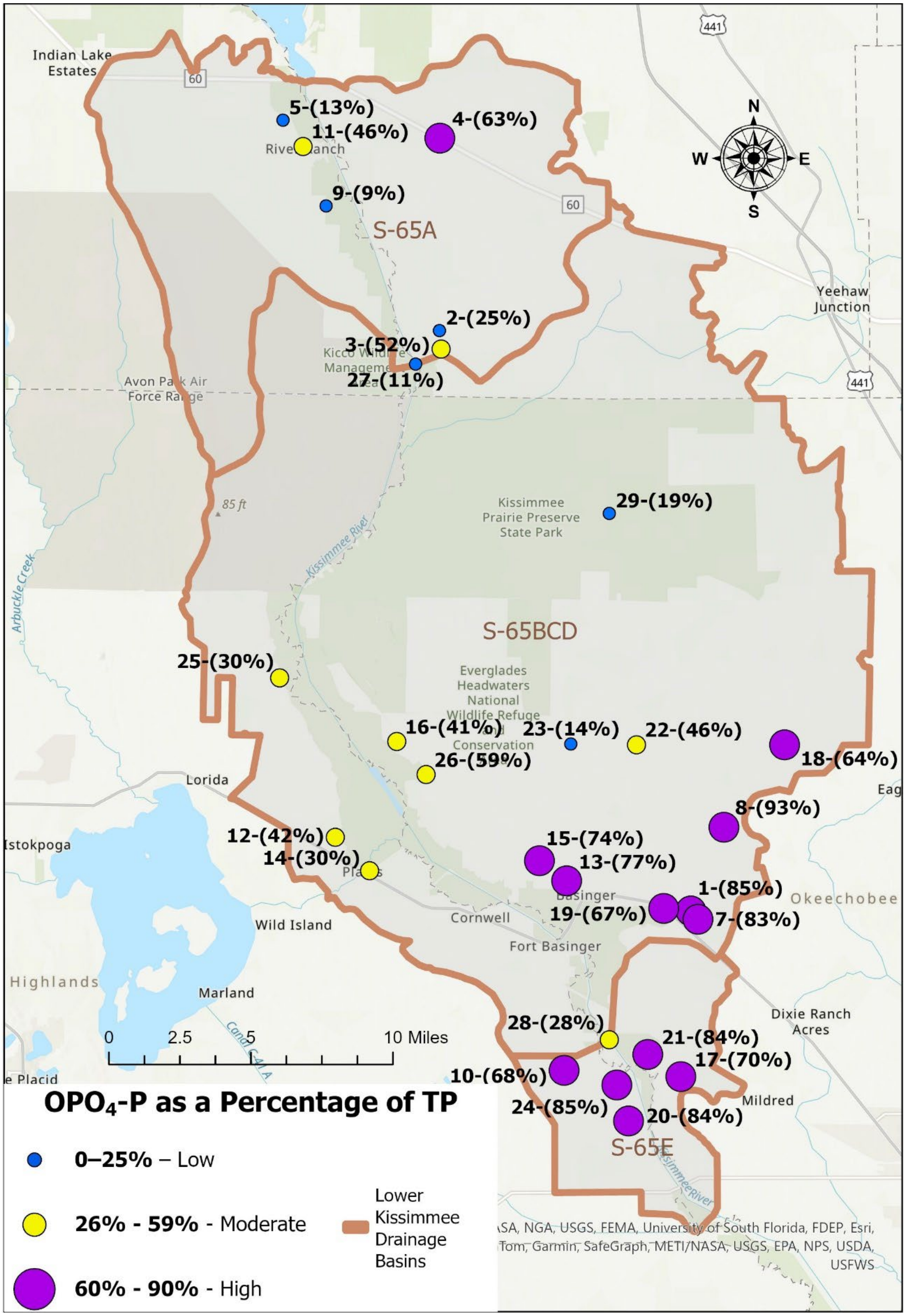


Figure 35. Five-year average OPO_4-P as a percentage of TP (WY2020–WY2024) for upstream monitoring sites within the Lower Kissimmee Subwatershed. Site numbers correspond to Map IDs in **Table 20**.

UPSTREAM PHOSPHORUS LOAD DATA

Phosphorus loading data from the upstream monitoring sites were reviewed to better understand basin contributions to the watershed and to better define where additional projects or program adjustments are needed. TP loading rates vary from year to year because of fluctuating rainfall and weather patterns, changes in land use, and varying operations of water control structures. The most recent five-year average TP load in metric tons for upstream water quality monitoring sites with flow data are presented in **Figure 36** and **Table 21.** Note that flows and loads from upstream basins are not subtracted out from the downstream basin totals in this analysis. Also, note that the areas on the map without color do not have flow monitoring therefore phosphorus loads cannot be calculated from those areas.

The highest five-year average TP load of 13.4 t was observed at site 02272676. This site is located in Cypress Slough near the southeastern watershed boundary. Meanwhile, the KREA 01 site had 8.4 t of TP load. KREA 01 site captures a greater areal extent of flows upstream, which are depicted with red hatching in **Figure 36.** Those flows and loads as well as the orange area south of KREA 01 contribute to the flows and loads at 02272676.

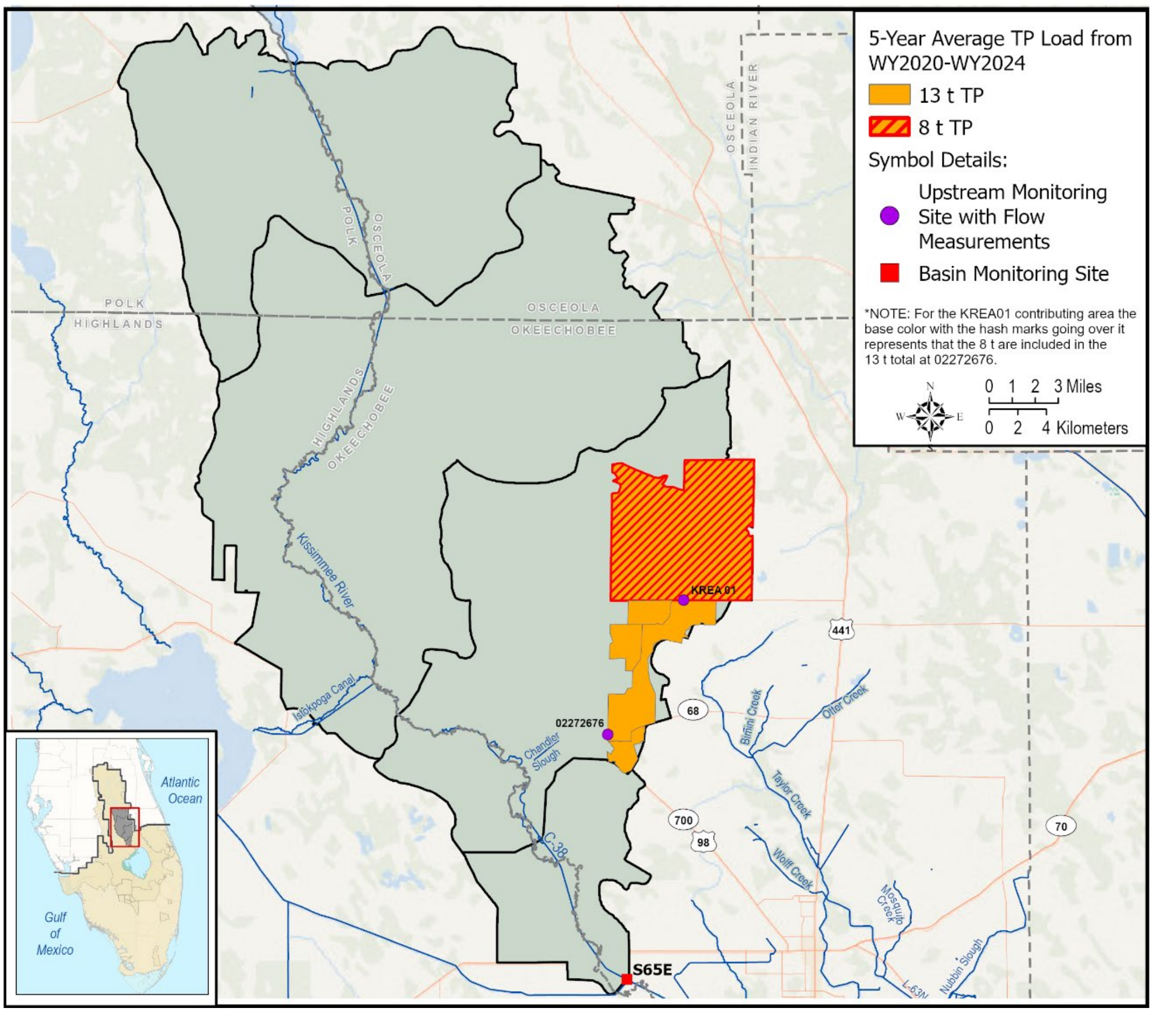


Figure 36. Five-year average TP load (WY2020–WY2024) for upstream monitoring sites with flow measurements within the Lower Kissimmee Subwatershed (Olson and Broling 2025).

Table 21. Most recent 5-year TP load, flow, and FWMC estimates (WY2020–WY2024) for the upstream monitoring sites with associated flow measurements within the Lower Kissimmee Subwatershed. (Note: WQ No. – Number of Water Quality Samples.) [a](Olson and Broling 2025).

Site	WY2020				WY2021				WY2022				WY2023				WY2024				5-Year Average TP Load (t)
	WQ No.	TP Load (t)	Total Flow (ac-ft)	TP FWMC (µg/L)	WQ No.	TP Load (t)	Total Flow (ac-ft)	TP FWMC (µg/L)	WQ No.	TP Load (t)	Total Flow (ac-ft)	TP FWMC (µg/L)	WQ No.	TP Load (t)	Total Flow (ac-ft)	TP FWMC (µg/L)	WQ No.	TP Load (t)	Total Flow (ac-ft)	TP FWMC (µg/L)	
02272676	4	8.8	16,796	422	18	23.9	40,906	473	9	3.2	13,496	190	7	14.3	20,425	564	15	16.6	35,017	383	13.4
KREA 01	2	13.6	17,855	619	18	11.0	34,340	259	14	4.0	12,016	273	10	5.2	12,404	339	17	8.17	29,537	224	8.4

a. Key to units: µg/L – microgram(s) per liter; ac-ft – acre-foot (feet); and t – metric ton(s).

SUMMARY AND DISCUSSION

The Lower Kissimmee Subwatershed has the second highest TP UAL (0.42 lbs/ac) in the LOW and the 4th highest runoff (8.17 inches) based on the 5-year period (WY2020-WY2024). During that period the 5-year average flows ranged from 292,000 to 366,000 ac-ft and the TP loads ranged from 82 to 92 t (from mass balance and pass through methods, respectively). The average annual TP FWMC was 226 µg/L which is greater than FDEP's NNC of 120 µg/L (FDEP 2012). Two basins within the subwatershed (former S65D and S65E) were named as priority for projects per the NEEPP statute due to historic TP loading from those areas. The most recent trend analysis (Jones and Olson 2025) indicates no nutrient or flow trends at the basin level. The upstream level data indicate that 18 of the 29 upstream sites have 5-year average annual TP concentrations (WY2020-WY2024) greater than FDEP's NNC of 120 µg/L, and 17 sites have 5-year average annual TN concentrations greater than the TN NNC of 1.54 mg/L (FDEP 2012). There were 5 upstream sites with increasing TP trends for the POR (WY1991- WY2023) but only two of those have 5-year average annual concentrations greater than the 120 µg/L TP NNC. Based on a review of the data for the most recent period of WY2020 – WY 2024 at S65E, the basin outlet, the OPO_4-P as a percentage of TP indicates that there are low to moderate percentages (27-47%) of OPO_4-P which is a soluble form. This suggests that BMPs and projects need to have a balanced approach to address different phosphorus forms. However, within the subwatershed the southern upstream level sites had higher percentages indicating soluble forms. Management strategies should align with the varying phosphorus dynamics identified by the monitoring data.

Based on the water quality results, projects to improve water quality and source controls would be helpful in this subwatershed. Additional storage where possible would also be helpful to reduce flows and therefore loads. However, storage projects will need to consider the operational constraints of the downstream regulation schedules when developing their operation plans. Projects may have to contend with ecological and consumptive users downstream which are realized in the operational schedules for structures. Those need to be considered during planning when developing operation plans. These projects may only be able to store water at certain times of the year and should be designed with operational discharge structures to release water at appropriate times for water supply and ecological considerations. The S65E Basin, which is downstream of KRRP, had the highest TP UALs and runoff and should be prioritized for projects. The S65A Basin had the second highest runoff and additional storage near the C-38 Canal may assist with KRRP. Projects within that basin that could complement the El Maximo project and be able to release water when needed to the C-38 Canal would be ideal. Water quality projects are recommended for the southeastern regional of S65BCD where very high TP concentrations are present. Note that the potential benefits of KRRP on water quality in the Lower Kissimmee Subwatershed may not be fully realized until years after the HRS is revised as the timing of flows and hydrology are critical to the functioning of that project.

PROJECT OPPORTUNITIES

In this subwatershed there is a need for water quality treatment projects as well as detention, storage, and wetland restoration projects. SFWMD is planning on funding future projects within the Lower Kissimmee Subwatershed through a procurement solicitation. The sections below discuss the public land ownership and propose criteria for future projects evaluations.

PUBLIC LAND OWNERSHIP

In order to determine SFWMD regional project opportunities, the availability of public land to house those potential projects must be determined. The Lower Kissimmee Subwatershed is 58% privately owned (**Figure 37**). The SFWMD owns 42,608 acreas (10%) with most of this land within the Kissimmee River Restoration area. The Board of Trustees of the Internal Improvement Fund of the State of Florida (TIITF) own 61,738 acres or 14% of the subwatershed mostly within the S65D basin, but most of this land is part of the Kissimmee Prairie Preserve State Park. The U.S. Government owns 54,995 acres (13%) which are mostly to the west of the C-38 Canal/Kissimmee River and contain the Avon Park Air Force Range.

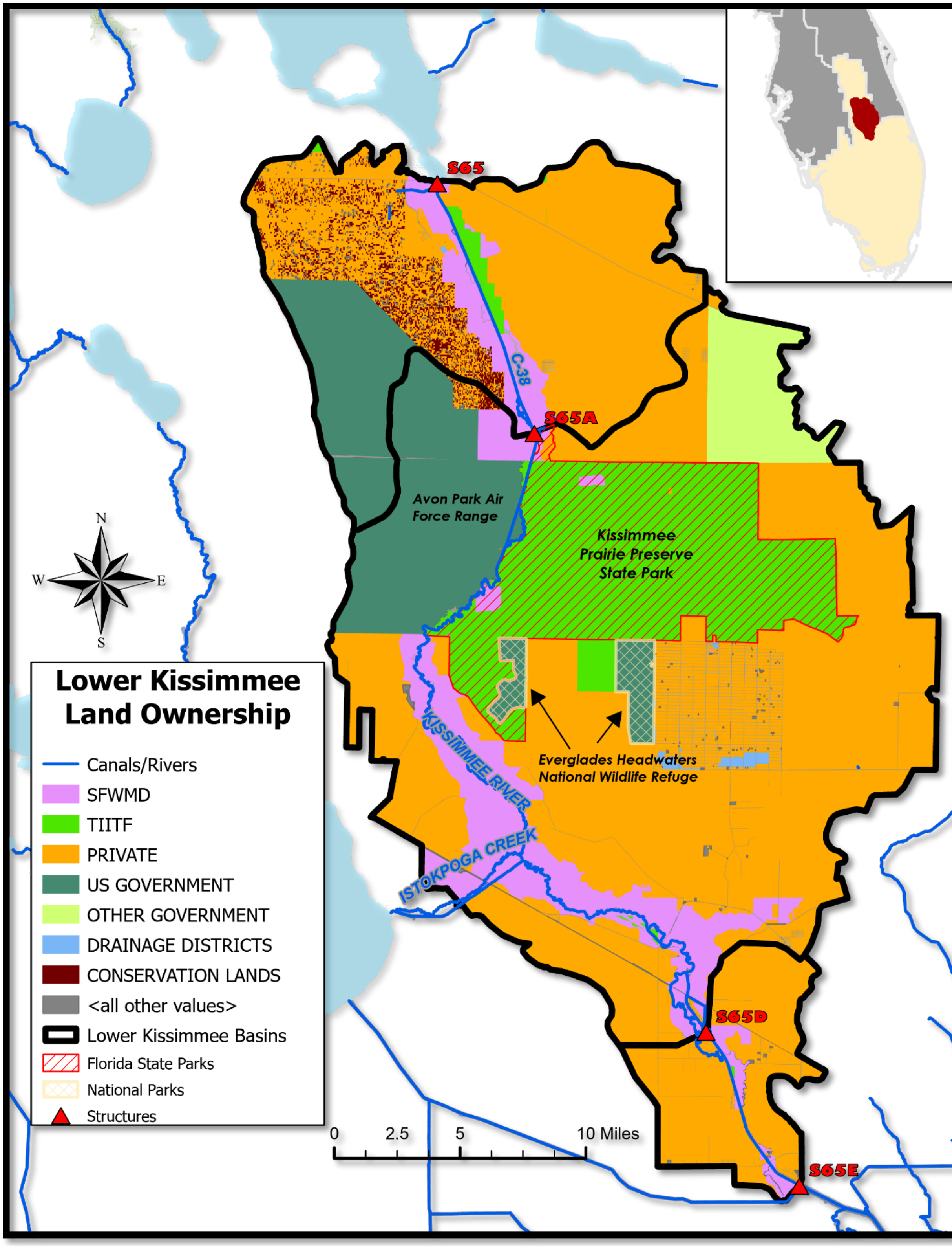


Figure 37. Land ownership within the Lower Kissimmee Subwatershed. Inset shows where the Lower Kissimmee Subwatershed is within the SFWMD and the Florida Peninsula.

PROJECT CRITERIA FOR FUTURE REQUEST FOR PROPOSALS

SFWMD is planning to seek out partnerships for projects in the Lower Kissimmee Subwatershed. Projects can be passive (retains rainfall) or active (inflow from pumps). Based on the summary above, future procurement solicitations should consider the following criteria for project evaluation:

1. Preference will be given to projects with operational discharge structures that allow them to discharge to the regional system.
2. Project operation plans (generally applicable to active projects) must be carefully developed and may be constrained by water availability per the operation plans and regulation schedules at nearby downstream structures and water bodies. Nearby downstream structure operation plans, hydrographs, lake stages, rainfall, and flows must be considered when developing the project operation plan and potential project benefits. Note that the project may not be able to detain water at certain time of the year or under certain hydrologic conditions. A detailed project analysis must be provided to SFWMD that estimates the proposed benefits and identifies the potential operations plan along with a technical justification for both. Hydrographs and regulation schedules for the structures throughout the Kissimmee River Basin can be found on the U.S. Army Corps of Engineers website (https://w3.saj.usace.army.mil/h2o/plots.htm). Other resources to assist in the development of a technical justification include the weekly water conditions report (The Weekly Environmental Conditions Report is available via email and text (SMS). Register online and select the Email or SMS/Text Message option from the drop-down menu. Then click "Submit."), Chapter 9 of the SFER (Chapter 9), and the DBHydro Insights application (https://insights.sfwmd.gov/#/homepage).
3. Projects need to be located where there is available water and must not negatively impact KRRP.
    a. Projects in the following basins should be ranked higher based on the analysis of the basins completed above.
        i. S65 E Basin
        ii. S65 A Basin
        iii. S65 BCD Basin
4. Projects should maximize nutrient removal.
    a. Respondents will need to provide technical justification for the proposed nutrient reductions.
5. Projects should maximize the project storage benefit.
    a. Respondents will need to provide a technical justification for the proposed storage benefit.
    b. Respondents must also demonstrate that the volume of water stored will not harm nearby restoration projects, impact water supply, or impair ecological benefits.
6. Projects in areas that flow to sites with greater TP concentrations shall be ranked higher. Respondents must demonstrate that their project is upstream of a SFWMD monitoring site or provide their own water quality monitoring data for the project area. TP 5-year average TP concentration data should be ranked as follows
    a. ≥1,000 µg/L – 1 (highest priority)
    b. ≥601 but < 1,000 µg/L – 2
    c. ≥361 but <601 µg/L – 3
    d. ≥121 but <361 - 4
    e. <121 µg/L – 5 (lowest priority as these would be achieving the FDEP NNC of 120 µg/L)

7. Projects located at lower elevations and close to downstream receiving water bodies will receive higher rankings.
8. Projects that have effective water retention or return to groundwater limiting return to surface water will be ranked higher.

REPORT ASSUMPTIONS

It should be noted that several assumptions were made when producing this document. The major assumptions are provided below.

1. Reductions were based on the 5-year period of WY2020-WY2024. This assumes that future water years will behave similarly, and they could be very different in terms of rainfall, loads, and flows.
2. It assumes that all projects will achieve the long-term expected nutrient reductions at not only the project outlet but that these reductions will also be realized at the structures flowing into Lake Okeechobee.
3. The timeline assumes that the projects will be completed on time and will achieve their long-term estimated reductions after five years of operations.
4. The recommendations in this report are based on current conditions for SFWMD structures which may be revised as part of resiliency studies or as part of the HRS.

LITERATURE CITED

Bailey, N., W. Magley, J. Mandrup-Poulsen, K. O'Donnell, and R. Peets. 2009. *Final TMDL Report: Nutrient TMDL for the Caloosahatchee Estuary (WQBIDS 3240A, 3240B, and 3240C.* Florida Department of Environmental Protection, Tallahassee, FL. September 2009.

FDEP. 2001. *Total maximum daily load for total phosphorus in Lake Okeechobee*. Tallahassee, FL.

FDEP. 2012. Technical Support Document: Development of Numeric Nutrient Criteria for Florida Lakes, Spring Vents and Streams. Tallahassee, FL.

FDEP. 2020. *Lake Okeechobee Basin Management Action Plan*. Prepared by the Florida Department of Environmental Protection, Tallahasee, FL, with participation from the Lake Okeechobee Stakeholders. January 2020.

FDEP. 2024a. 2024 Five-Year Review of the Lake Okeechobee Basin Management Action Plan Fiscal Year 2024-2025. Florida Department of Environmental Protection, Tallahasee, FL. December, 2024.

FDEP. 2024b. 2023 Statewide Annual Report on Total Maximum Daily Loads, Basin Management Action Plans, Minimum Flows or Minimum Water Levels and Recovery or Prevention Strategies. Florida Department of Environmental Protection, Tallahasee, FL. July 8, 2024.

Frye, A., A. Betts, J. Bobsein, Z. Welch, M. Parker, R. May, C. Brcka, C. Brown, and C. Avila. 2025. Appendix 8A-1: Northern Everglades and Estuaries Protection Plan Regional Simulation Model Update. In: *2025 South Florida Environmental Report – Volume I,* South Florida Water Management District, West Palm Beach, FL.

Jones, P. and S. Olson. 2025. Appendix 8B-3: Long-Term Trend Analyses for Lake Okeechobee (Water Years 1991-2023) in Volume I 2025 South Florida Environmental Report, West Palm Beach, FL.

Koebel, W., S. Bousquin, D. Anderson, C. Carroll, D. Marois, R. Botta, C. Hanlon, M. McKenzie, E. Tate-Boldt, B. Anderson, M. Mann, D. Nelson, and R. Ford. 2025. Chapter 9: Kissimmee River Restoration and Other Kissimmee Basin Initiatives in Volume I 2025 South Florida Environmental Report. West Palm Beach, FL.

Olson, S. 2023. Revised Lake Okeechobee Subwatershed and Basin Total Phosphorus (TP) Planning Targets. Internal Memo. South Florida Water Management District, West Palm Beach, FL.

Olson, S., and M. Broling. 2025. Appendix 8B-1: Water Year 2024 Lake Okeechobee Watershed Upstream Monitoring in Volume I 2025 South Florida Environmental Report. West Palm Beach, FL.

Olson, S., A. McDonald, S. Acevedo, and M. Broling. 2025. Appendix 8B-4: Lake Okeechobee Watershed Basin Assessments in Volume I 2025 South Florida Environmental Report. West Palm Beach, FL.

Parmer, K., K. Laskis, R. McTear, and R. Peets. 2008. *TMDL Report: Nutrients and Dissolved Oxygen TMDL for the St. Lucie Basin*. Florida Department of Environmental Protection, Tallahassee, FL. October 2008.

SFWMD. 2022. S-65AX_Final. Prepared by the South Florida Water Management District, West Palm Beach, FL.

SFWMD, FDEP, FDACS and. 2008. Lake Okeechobee Watershed Construction Project Phase II Technical Plan. South Florida Water Management District. West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL. February 2008.

SFWMD and USACE. 2021. *2021 Aquifer Storage and Recovery Science Plan*. Prepared by the South Florida Water Manamgement District, West Palm Beach, FL, and United States Army Corps of Engineers, Jacksonville, FL. June 2021.

SFWMD and USACE. 2022. *Lake Okeechobee Watershed Restoration Project, Third Revised Draft Integrated Project Implementation Report and Supplemental Environmental Impact Statement.* Prepared by the South Florida Water Management District, West Palm Beach, FL, and United States Army Corps of Engineers, Jacksonville, FL. June 2022.

SFWMD and USACE. 2024. *Aquifer Storage and Recovery Science Plan Version 2*. Prepared by the South Florida Water Manamgement District, West Palm Beach, FL, and United States Army Corps of Engineers, Jacksonville, FL. TBD.

SFWMD, FDEP, and FDACS. 2009a. *Caloosahatchee River Watershed Protection Plan.* South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL. January 2009.

SFWMD, FDEP, and FDACS. 2009b. *St. Lucie River Watershed Protection Plan.* South Florida Water Management District, West Palm Beach, FL; Florida Department of Environmental Protection, Tallahassee, FL; and Florida Department of Agriculture and Consumer Services, Tallahassee, FL. January 2009.

University of Florida, 2015. Options to Reduce High Volume Freshwater Flows to the St. Lucie and Caloosahatchee Estuaries and Move More Water from Lake Okeechobee to the Southern Everglades. An Independent Technical Review by the University of Florida Water Institute. Gainesville, FL.

Welch, Z., J. Zhang, and P. Jones. 2019. Chapter 8B: Lake Okeechobee Watershed Annual Report in Volume I 2019 South Florida Environmental Report. West Palm Beach, FL.

Welch, Z., P. Jones, and A. Betts. 2025. Chapter 8B: Lake Okeechobee Watershed Protection Plan 2025 Update in Volume I 2025 South Florida Environmental Report. West Palm Beach, FL.