Appendix 4-4: Water Year 2012 Supplemental Evaluations for Source Control Programs in the Caloosahatchee and St. Lucie River Watersheds

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INTRODUCTION

The South Florida Water Management District (District or SFWMD) is required under the Northern Everglades and Estuaries Protection Program [NEEPP; Subsection 373.4595(6), Florida Statutes] to provide an annual progress report on water quality and other conditions. Source control programs for the Northern Everglades watersheds are a component of the overall strategy for meeting water quality requirements and reporting on the progress and effectiveness of these programs is the purpose of this appendix.

The River Watershed Phosphorus Source Control Program consists of a combination of distinct and coordinated efforts, including the SFWMD Works of the District (WOD) Phosphorus Control Program, the SFWMD Environmental Resource Permitting (ERP)/Surface Water Management Permitting (SW), the Florida Department of Agriculture and Consumer Services (FDACS) Notice of Intent (NOI) Best Management Practices (BMP) Program, and the Florida Department of Environmental Protection (FDEP) programs. The WOD program is the mandated nonpoint source control program, which focuses on nutrient discharges from new and existing agricultural and nonagricultural land uses. The ERP/SW permits apply to agricultural and nonagricultural projects (new or modifications to existing) that alter surface water flows and have the potential to affect water management and resource protection. The FDACS program is an incentive-based nonpoint source BMP program targeting pollutants from specific agricultural land uses. The FDEP source control programs are primarily for point source nonagricultural areas.

Since source control programs are not yet fully developed and implemented in the Northern Everglades watersheds, it is essential to accurately track their implementation rates. These implementation rates are key to evaluating the effectiveness of the collective source control programs with regard to improving downstream water quality. Once performance measure methodologies are developed and adopted, they will be used in conjunction with implementation rates to evaluate progress toward achieving water quality goals. The implementation of source control programs in the Lake Okeechobee Watershed is provided in Appendix 4-1, while this appendix is specific to the St. Lucie and Caloosahatchee River watersheds for Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012). The following pages provide a brief description of the

existing flow and monitoring networks, water quality data, and geospatial coverage of source control programs in the river watersheds, including lands that have SFWMD WOD and ERP/SW permits, and agricultural lands that are voluntarily enrolled in an FDACS BMP program based on documentation of a landowner's intent to implement BMPs as of April 2012.

Performance measures are currently being developed at the sub-watershed level for evaluating source control effectiveness and monitoring nutrient levels. The existing flow and monitoring networks will be used and, where necessary, modified to track nutrient levels at the sub-watershed level. Total sub-watershed loads represent only nutrient loads discharged from a particular sub-watershed and exclude any pass through flows and loads that may be sourced from an upstream basin (e.g., Lake Okeechobee regulatory releases). Ideally, performance measures will be load based; however, where flow data are not available, concentration-based performance measures may be implemented.

CALOOSAHATCHEE RIVER WATERSHED: BEST MANAGEMENT PRACTICES IMPLEMENTATION

The existing monitoring network provides nutrient and flow data to capture representative discharges from the East Caloosahatchee, West Caloosahatchee, and S-4 sub-watersheds. The S-4 Sub-watershed can discharge to either the Caloosahatchee River or Lake Okeechobee. The coastal and tidal sub-watersheds of the Caloosahatchee River Watershed are characterized by numerous tributary flows into the estuary. While many of these tributaries are actively monitored for water quality, the monitoring network does not currently capture all of the sub-watershed loads for these areas.

Figure 1 provides a flow schematic of the Caloosahatchee River Watershed depicting the sub-watershed divisions, flow transfers between sub-watersheds, and the existing structures associated with the water quality and flow data used for nutrient calculations.

As of June 2012, approximately 456,923 acres of the agricultural and nonagricultural acreage within the Caloosahatchee River Watershed are represented in ERP/SW permits (42 percent), and 260,953 acres of the agricultural lands (49 percent) are represented in NOI documentation. The specific coverage for each of its five sub-watersheds is shown in **Figures 2** through **6**.

Table 1 provides a summary of the WY2012 load and concentration data for the Caloosahatchee sub-watersheds. **Figures 7** and **8** depict the distribution of the observed total nitrogen (TN) and total phosphorus (TP) load, respectively, for the three sub-watersheds where total load can be calculated along with the percent acreage for WY2012. **Figures 9** and **10** provide box-and-whisker plots for the three sub-watersheds where total loads can be calculated. Historical load and concentration data over the current and previous 10 years are provided in **Figures 11** through **20**.

The average TN levels for the three eastern sub-watersheds (S-4, East, and West) between WY2002 and WY2012 ranged from 11 to 2,135 metric tons (mt) for loads and 0.03 to 3.02 parts per million (ppm) for concentrations. Average TP levels between WY2002 and WY2012 ranged from 5 to 102 mt for loads and 21 to 298 parts per billion (ppb) for concentrations. WY2012 nutrient loads and concentrations for the Caloosahatchee River Watershed were lower than the average of the previous 10 years for all three sub-watersheds with the exception of TN concentrations in the S-4 Sub-watershed, which were higher. Load levels are highly sensitive to rainfall and flow (data not shown), which were also below average for all three eastern sub-watersheds. WY2012 loads for both TP and TN were between the 25^{th} and 75^{th} quartile range of historical average (**Figures 9** and **10**).

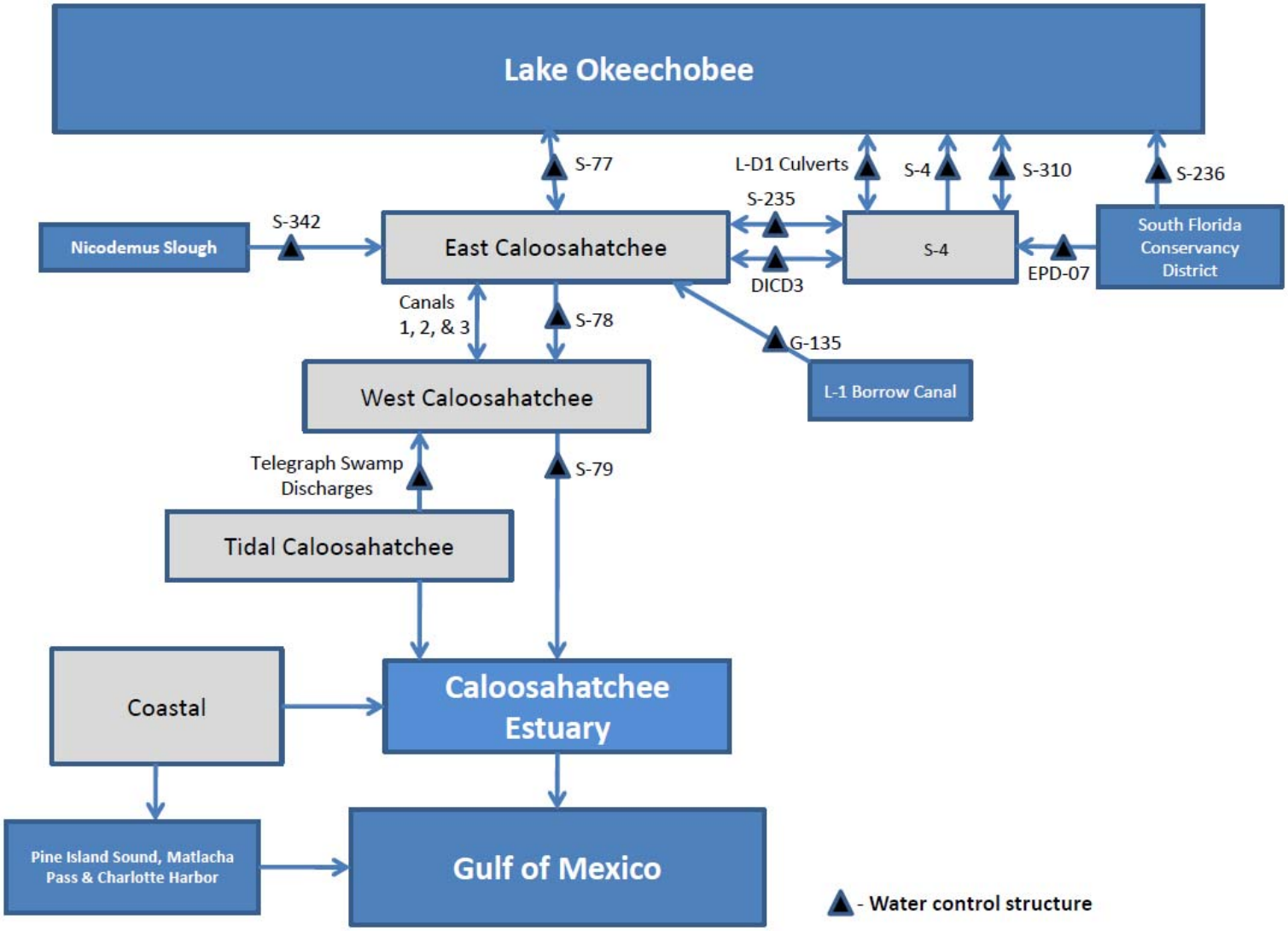


Figure 1. Caloosahatchee River Watershed flow schematic (HDR, 2011a).

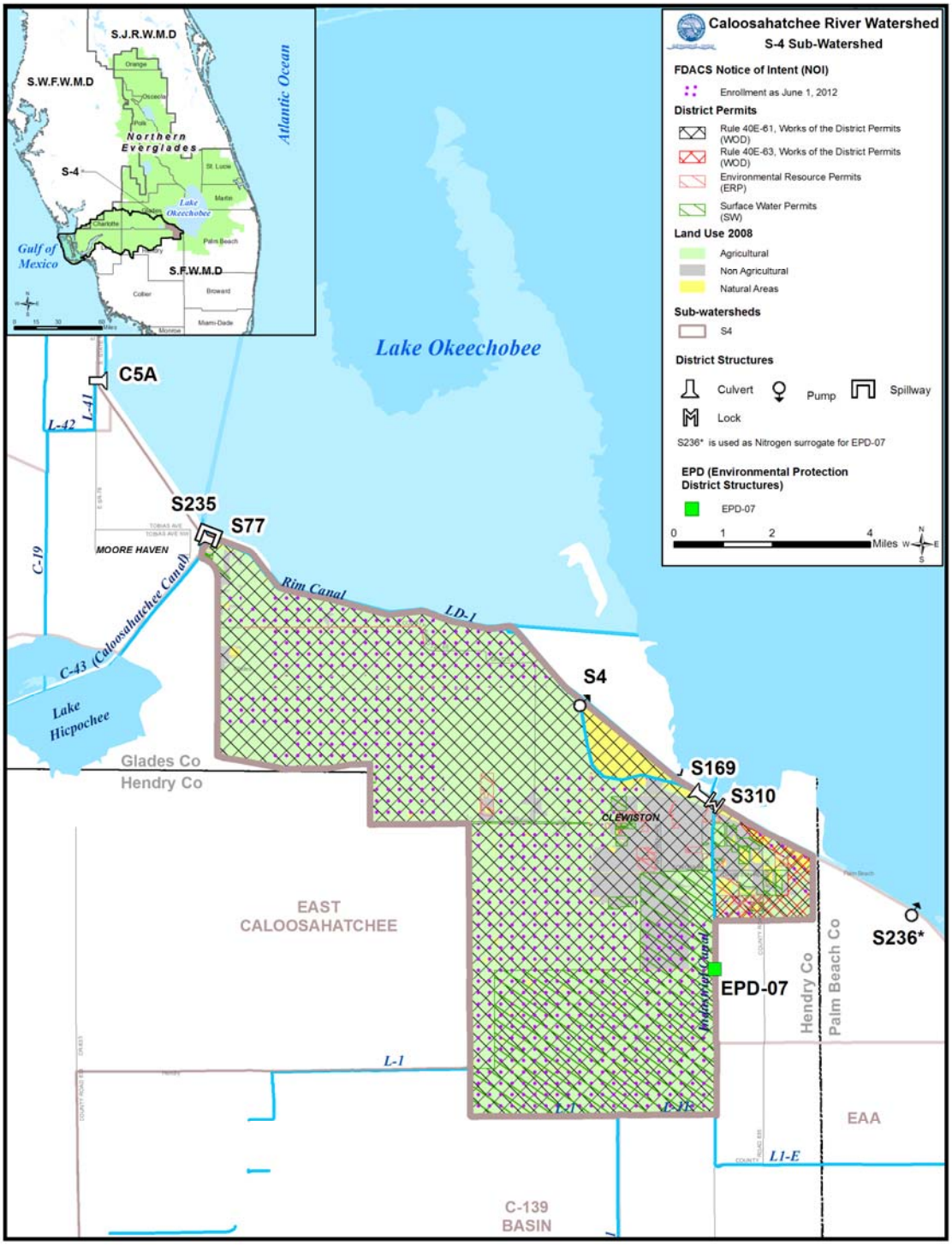
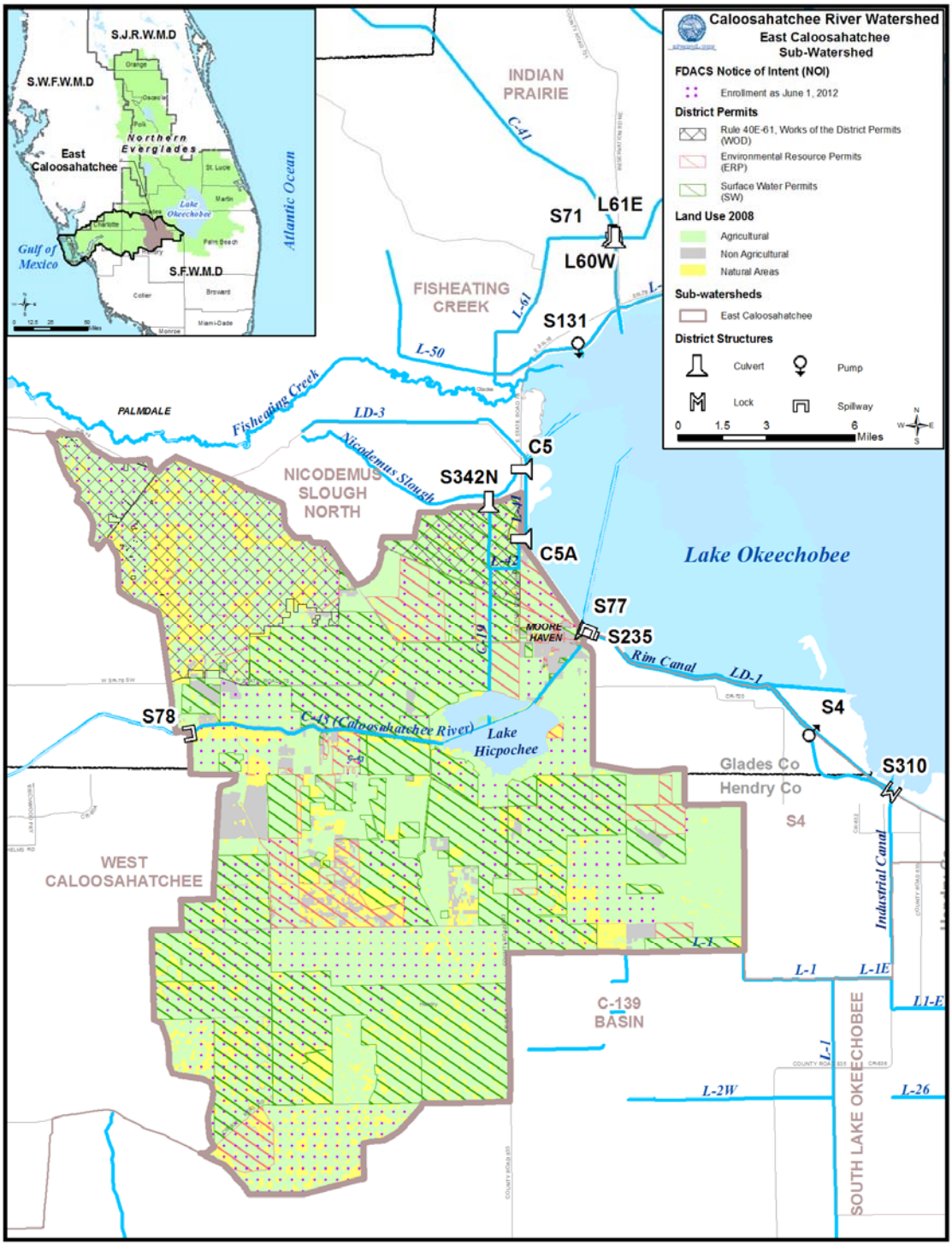
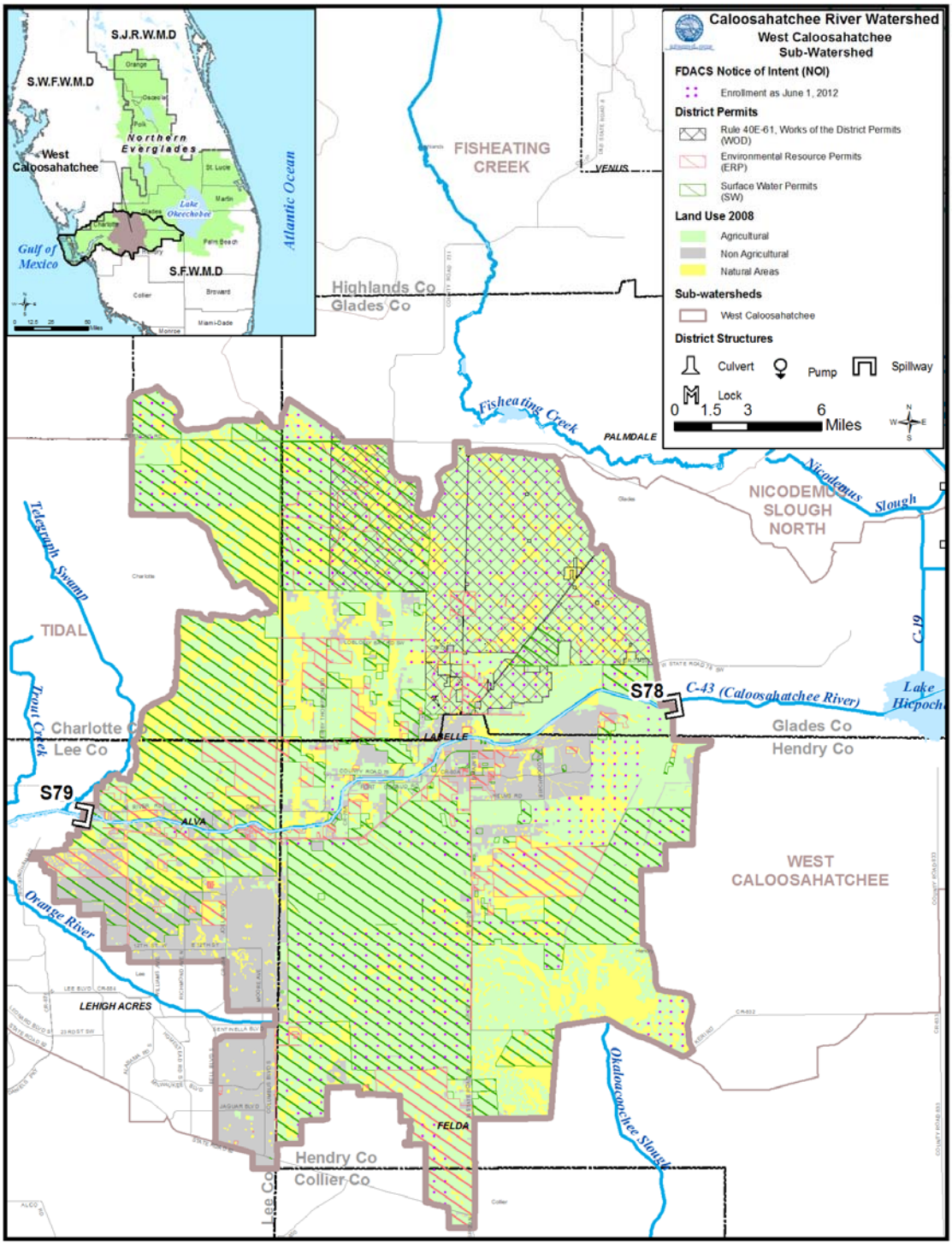


Figure 2. Caloosahatchee River Watershed, S-4 Sub-watershed.



Note: Silviculture is not included on map

Figure 3. Caloosahatchee River Watershed, East Caloosahatchee Sub-watershed.



Note: Silviculture is not included on map

Figure 4. Caloosahatchee River Watershed, West Caloosahatchee Sub-watershed.

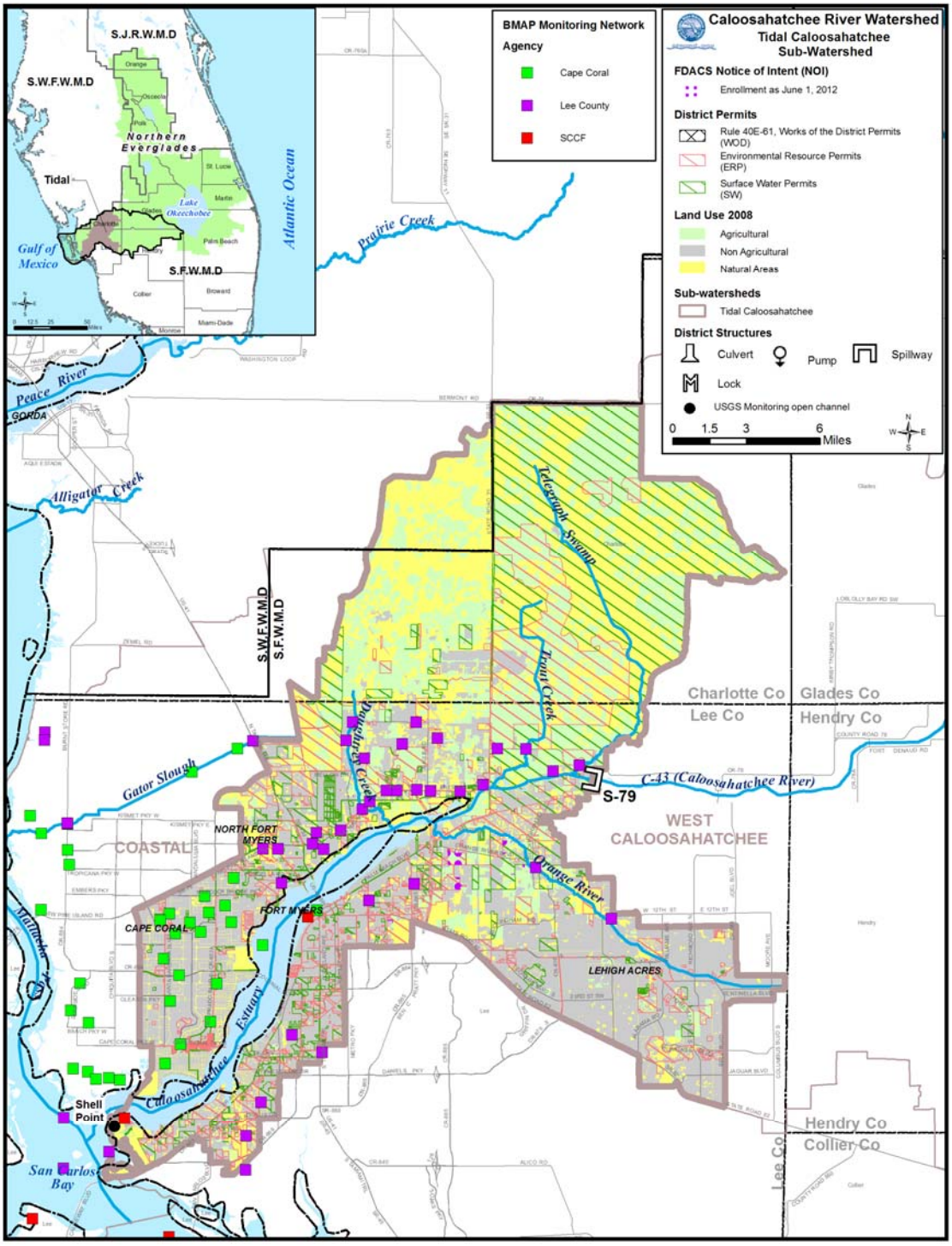


Figure 5. Caloosahatchee River Watershed, Tidal Caloosahatchee Sub-watershed.

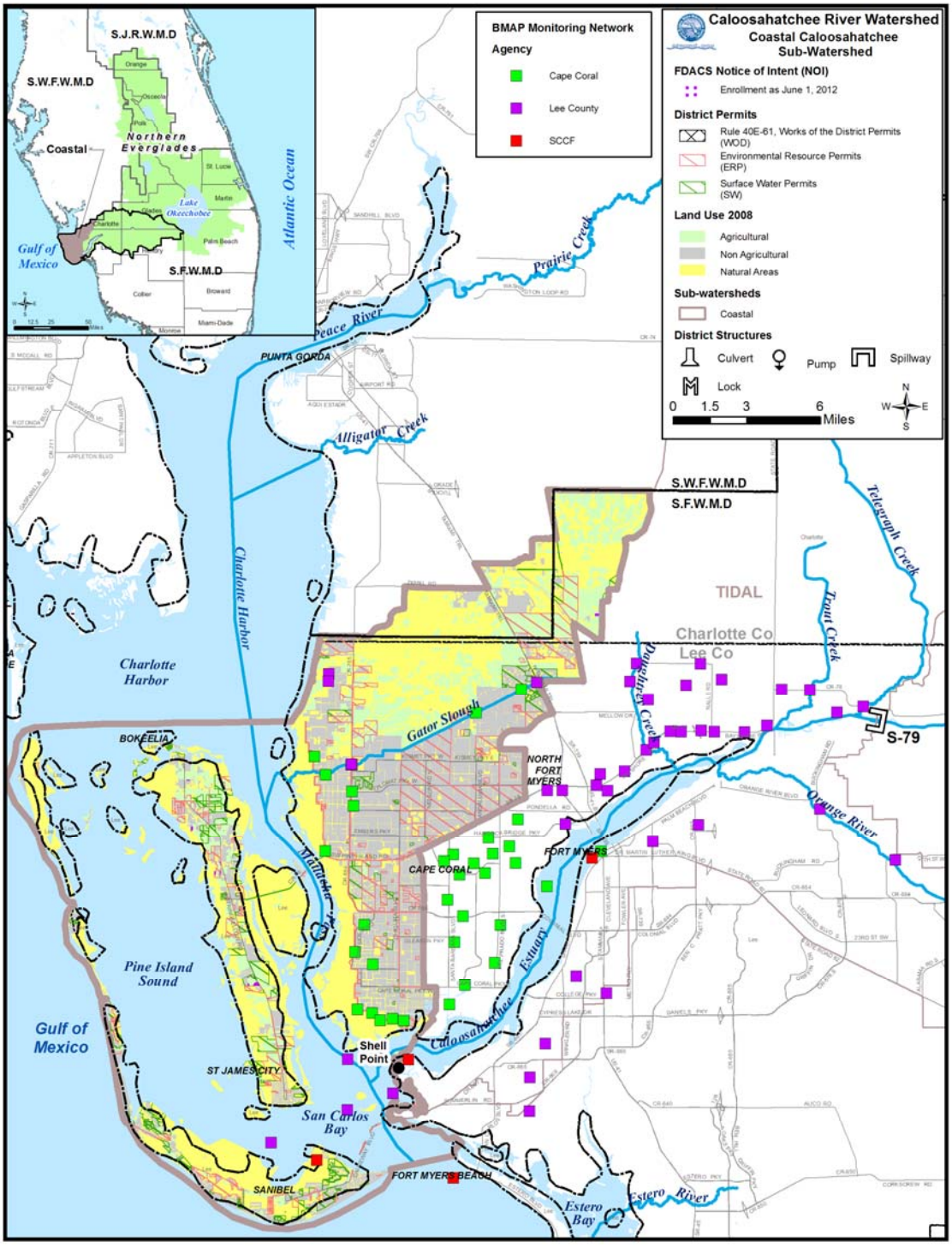


Figure 6. Caloosahatchee River Watershed, Coastal Caloosahatchee Sub-watershed.

Table 1. Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) rainfall in inches (in) and total phosphorus (TP) and total nitrogen (TN) loads in metric tons (mt) and concentrations in parts per billion (ppb)

Sub-Watershed	Annual Rainfall (in)	WY2012 Observed TP Load (mt)	WY2012 Observed TN Load (mt)	WY2012 TP Concentration (ppb)[1]	WY2012 TN Concentration (ppb)[1]
East Caloosahatchee[2]	44.31	34	333	165	1,623
West Caloosahatchee	42.82	97	798	160	1,319
S-4[3]	33.76	11	168	183	2,837
Tidal Caloosahatchee	44.42				
Bayshore Creek		NA	NA	113	1,434
Billy Creek[4]		NA	NA	NA	NA
Chapel Branch		NA	NA	147	1,352
Daughtrey Creek		NA	NA	175	1,166
Deep Lagoon		NA	NA	108	1,166
East Daughtrey Creek		NA	NA	302	1,419
Hancock Creek		NA	NA	148	1,319
Lower Orange River		NA	NA	31	933
Marsh Point		NA	NA	251	1,086
Otter Creek		NA	NA	187	1,437
Owl Creek		NA	NA	52	1,503
Palm Creek		NA	NA	161	1,638
Popash Creek		NA	NA	222	1,535
Powell Creek		NA	NA	155	1,072
Southeast Cape Coral 400		NA	NA	88	876
Southeast Cape Coral 470		NA	NA	88	1,125
Southeast Cape Coral 540		NA	NA	54	837
Stroud Creek		NA	NA	176	1,469
Telegraph Creek		NA	NA	82	1,679
Trout Creek		NA	NA	90	1,231
Whiskey Creek		NA	NA	40	851
Yellow Fever Creek		NA	NA	334	1,019
Coastal Caloosahatchee	58.86				
Durden Creek		NA	NA	9	1,516
Lower Yucca Pen		NA	NA	43	1,096
North-Central Cape Coral 160		NA	NA	11	566
North-Central Cape Coral 190		NA	NA	10	519
Northwest Cape Coral		NA	NA	44	952
Sanibel SANWQ5[5]		NA	NA	NA	NA
Sanibel SANWQ8[5]		NA	NA	NA	NA
Southwest Cape Coral 590		NA	NA	35	805
Southwest Cape Coral 600		NA	NA	60	783
Upper Yucca Pen 129		NA	NA	25	514
Upper Yucca Pen 130		NA	NA	43	924
Upper Yucca Pen GATRGR30		NA	NA	19	898

[1]Concentrations are flow-weighted means for East and West Caloosahatchee sub-watersheds. Concentrations for tributary sites are straight averages based on grab samples collected under the water quality programs of Lee County and the cities of Cape Coral and Sanibel. For data marked NA these tributaries have either not been monitored for flow or flow data is provisional.

[2]Excludes Culv5A at Lake Okeechobee.

[3]Loads from the S-4 Sub-watershed can discharge to both the Caloosahatchee River Watershed and Lake Okeechobee.

[4]Water quality monitoring was not conducted and/or reported at these sites during WY2012.

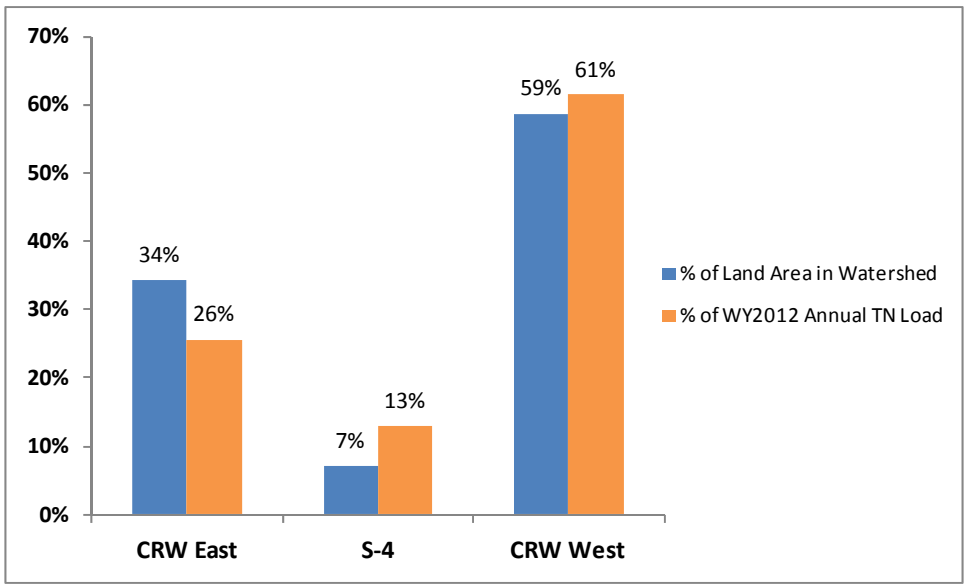


Figure 7. Distribution of total nitrogen (TN) loads in Water Year 2012 (WY2012) (May 1, 2011–April 30, 2012) compared to percent of land area in three sub-watersheds of the Caloosahatchee River.

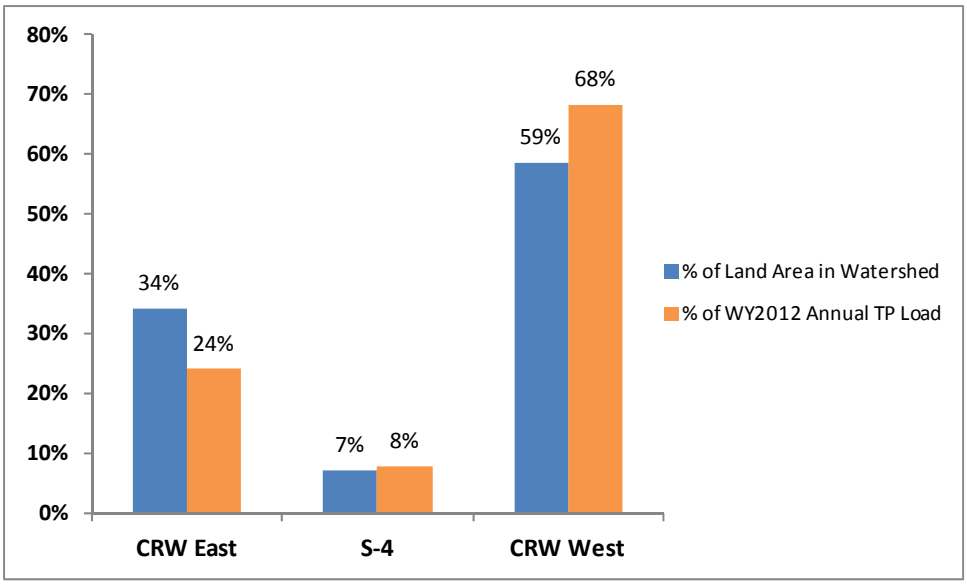


Figure 8. Distribution of total phosphorus (TP) loads in WY2012 compared to percent of land area in three sub-watersheds of the Caloosahatchee River.

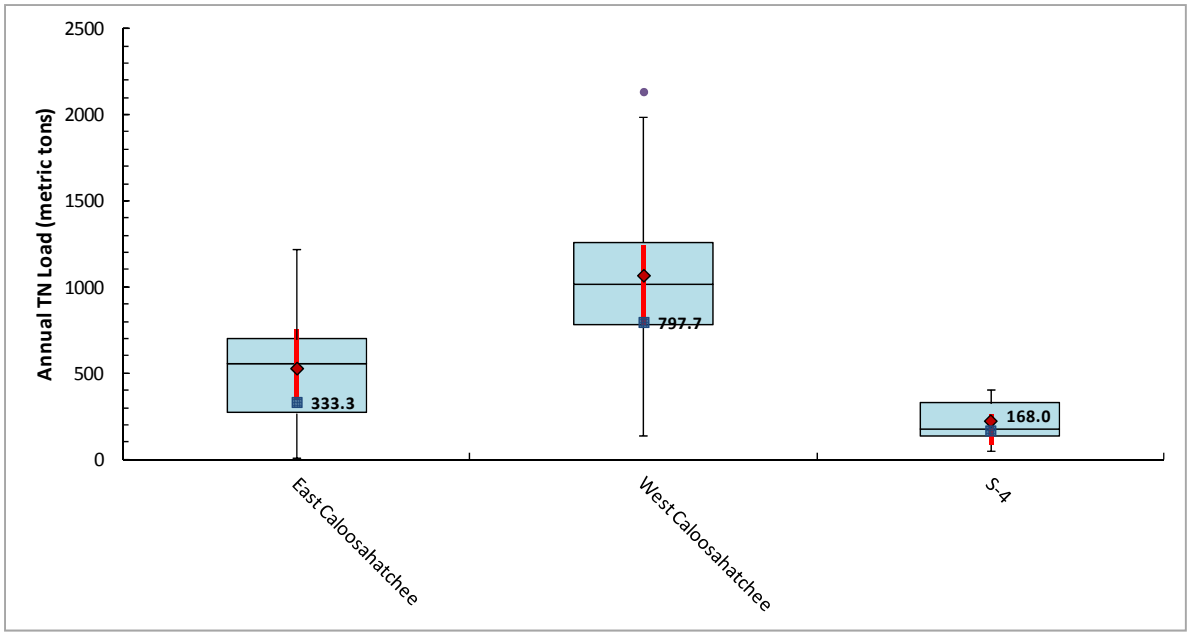


Figure 9. TN load box-and-whisker plot for three sub-watersheds in the Caloosahatchee Watershed.

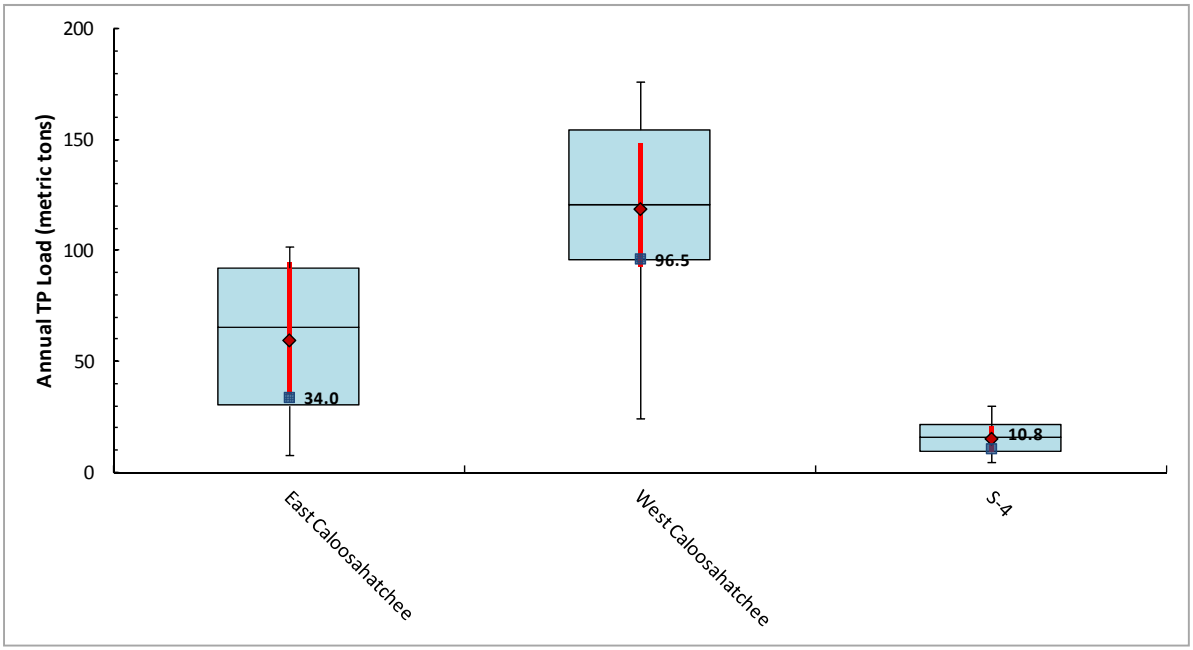


Figure 10. TP load box-and-whisker plot for three sub-watersheds in the Caloosahatchee Watershed.

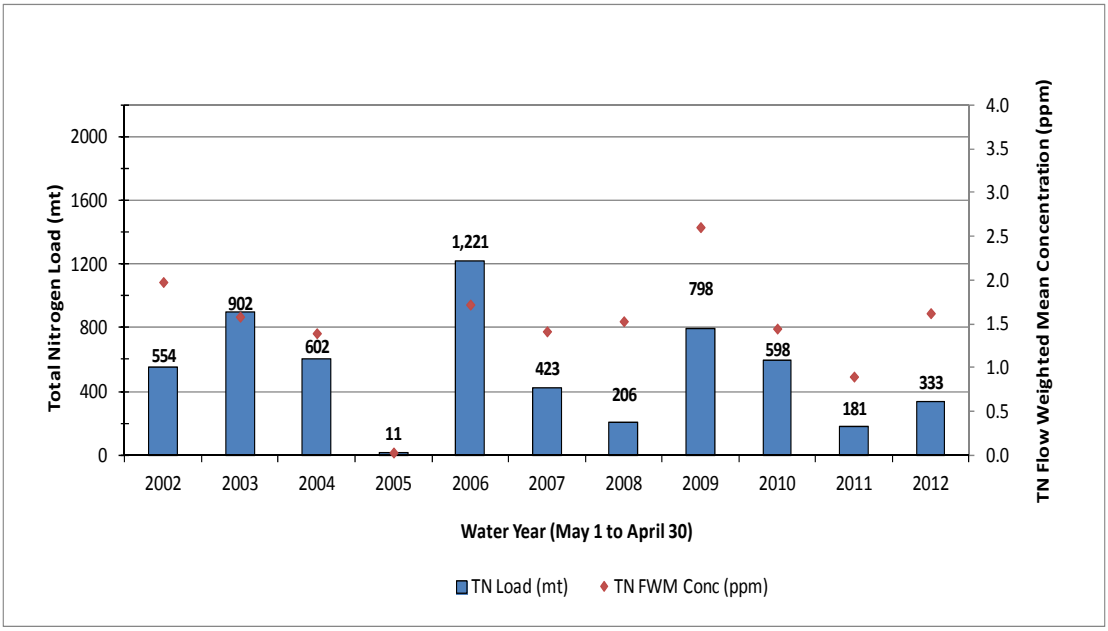


Figure 11. East Caloosahatchee Sub-watershed observed TN loads and flow-weighted mean (FWM) concentrations.

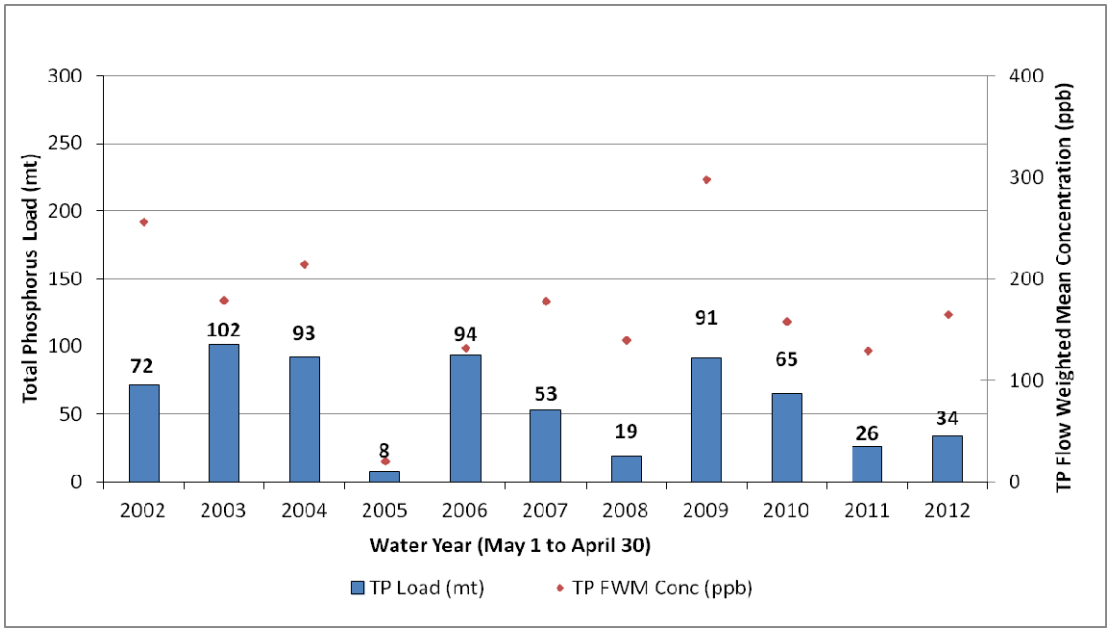


Figure 12. East Caloosahatchee Sub-watershed observed TP loads and FWM concentrations.

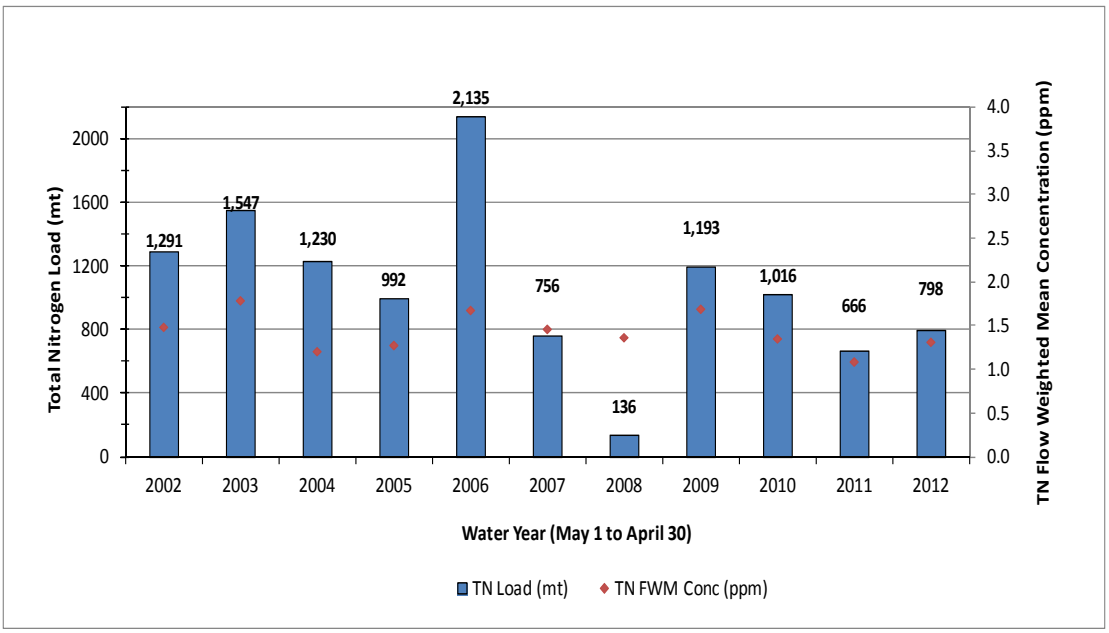


Figure 13. West Caloosahatchee Sub-watershed observed TN loads and FWM concentrations.

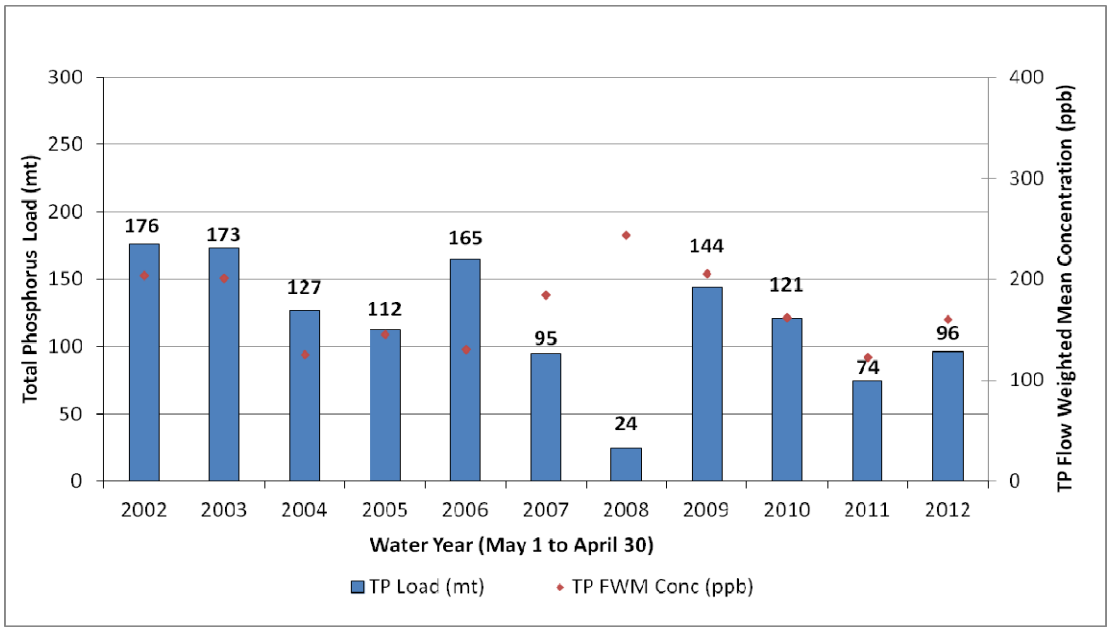


Figure 14. West Caloosahatchee Sub-watershed observed TP loads and FWM concentrations.

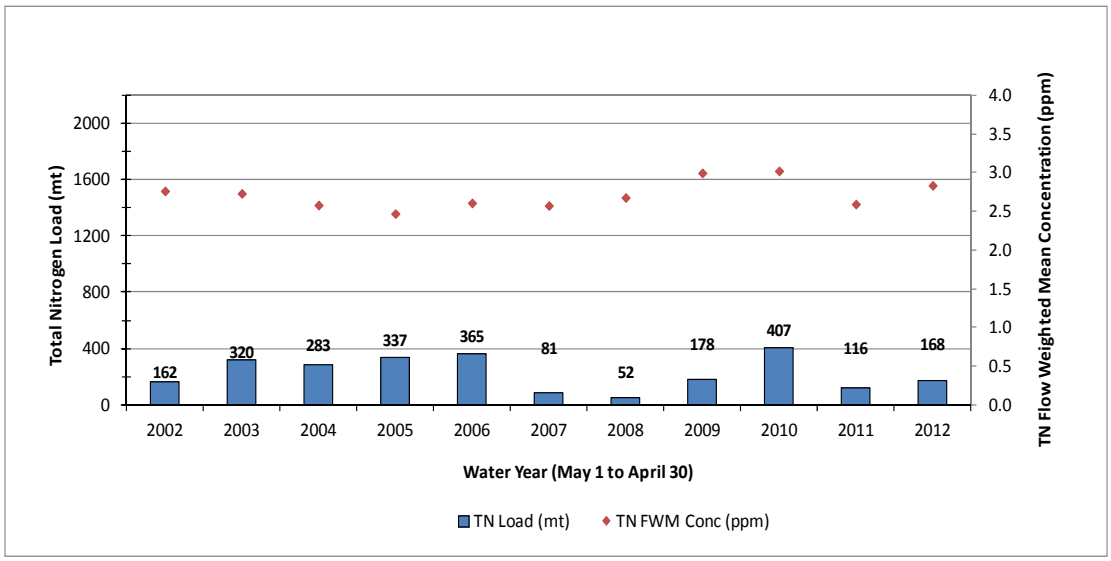


Figure 15. S-4 Sub-watershed observed TN loads and FWM concentrations.

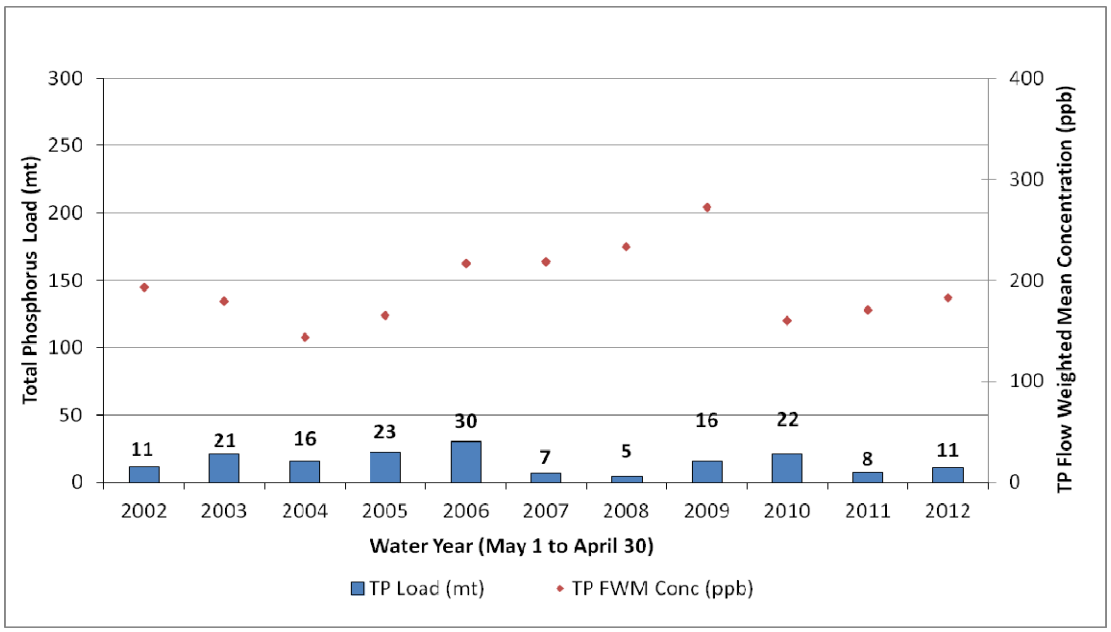


Figure 16. S-4 Sub-watershed observed TP loads and FWM concentrations.

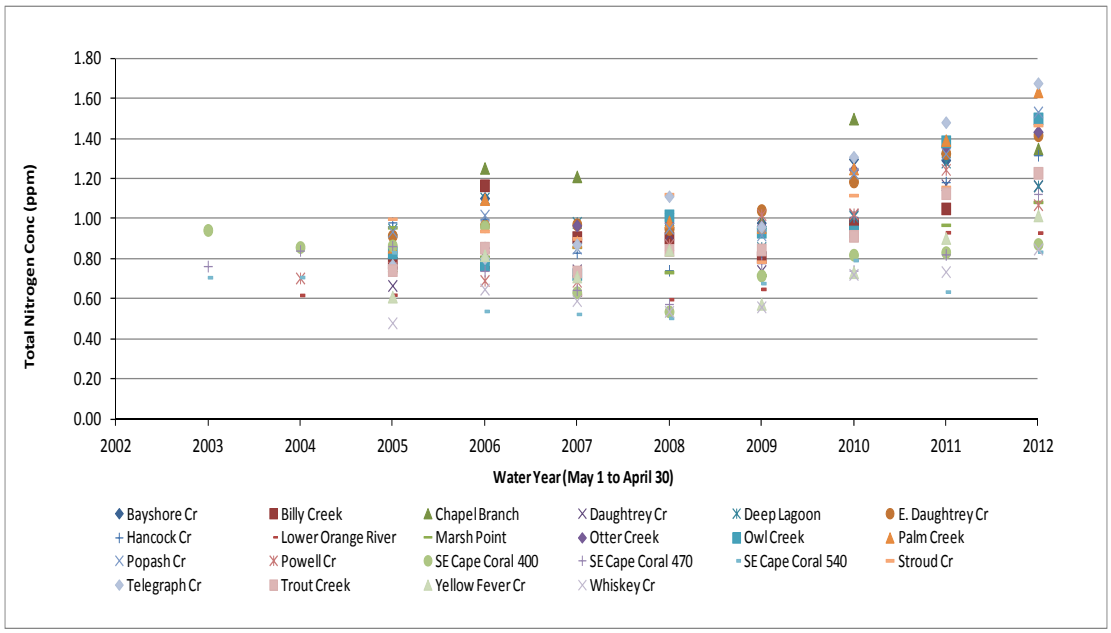


Figure 17. Tidal Caloosahatchee Sub-watershed observed TN concentrations.

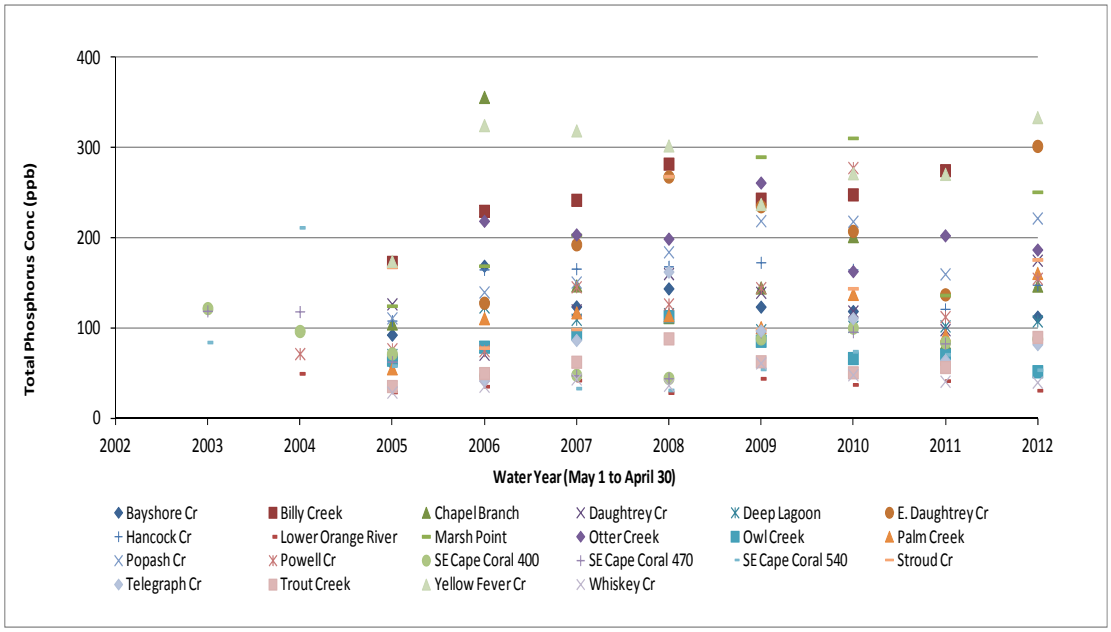


Figure 18. Tidal Caloosahatchee Sub-watershed observed TP concentrations.

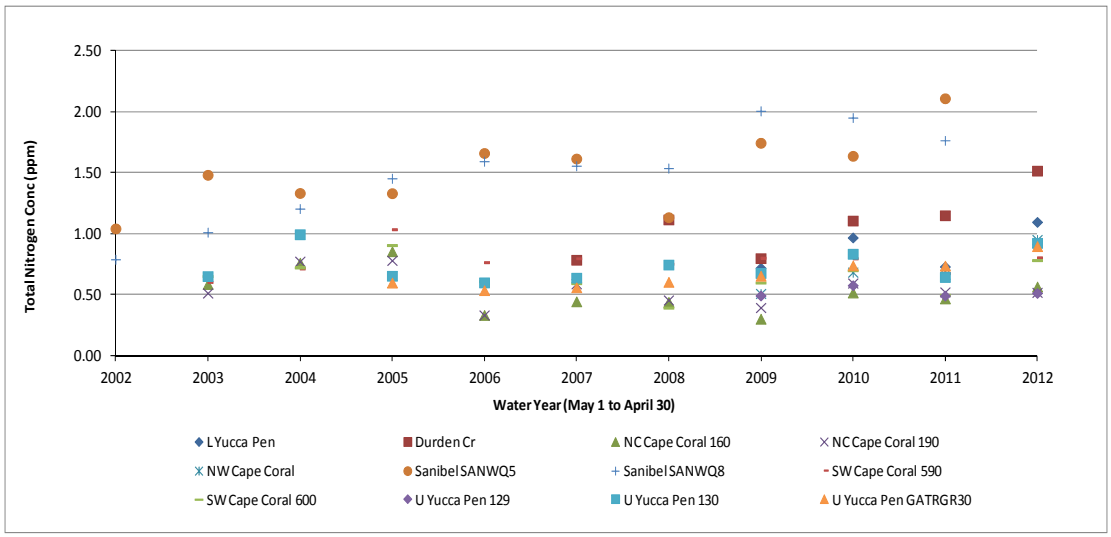


Figure 19. Coastal Caloosahatchee Sub-watershed observed TN concentrations.

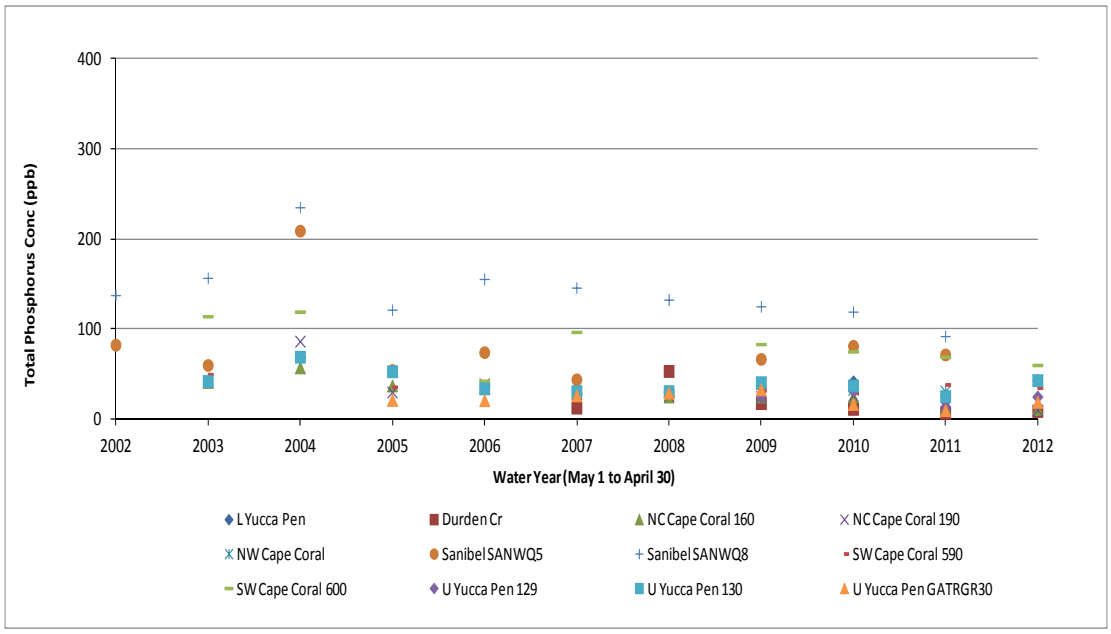


Figure 20. Coastal Caloosahatchee Sub-watershed observed TP concentrations.

ST. LUCIE RIVER WATERSHED: BEST MANAGEMENT PRACTICES IMPLEMENTATION

The existing monitoring network provides nutrient and flow data to capture a majority of the sub-watershed areas for the C-23, C-24, and C-44 sub-watersheds. The coastal sub-watersheds of the St. Lucie River Watershed — North Fork, South Fork, North Mid-Estuary, South Mid-Estuary, Basin 4-5-6, and South Coastal — are characterized by numerous tributary flows into the estuary. While a number of these tributaries are actively monitored for water quality, the monitoring network does not currently capture all of the sub-watershed loads for these areas. Performance measures will be recommended for each of the sub-watersheds depicted in **Figure 21**. For the C-25 and C-25E sub-watersheds only inflows into the St Lucie River Watershed will be considered, as the large majority of discharges from these sub-watersheds are into the Indian River Lagoon.

Figure 21 provides a flow schematic of the St. Lucie River Watershed depicting the sub-watershed divisions, flow transfers between sub-watershed, and the existing structures associated with the water quality and flow data used for nutrient calculations.

As of June 2012, approximately 449,106 acres of the agricultural and non-agricultural acreage within the St Lucie River Watershed are covered by ERP/SW permits (65 percent) and 207,534 acres of the agricultural lands (49 percent) are covered by NOIs. The specific coverage for each of the sub-watersheds is presented in **Figures 22** through **31**.

Table 2 provides a summary of the WY2012 load and concentration data for the St. Lucie sub-watersheds and tributaries. **Figures 32** and **33** summarize the percentages by sub-watershed for WY2012 observed annual TN and TP loads, along with the percentages of total land area represented by each sub-watershed. **Figures 34** and **35** provide box-and-whisker plots for the four sub-watersheds where total loads can be calculated. Historical load and concentration data over the past 10 years are provided in **Figures 36** through **47**.

Average TN levels for the major sub-watersheds between WY2002 and WY2012 ranged from 286 to 323 mt for loads and 1.56 to 2.00 ppm for concentrations. Average TP levels between WY2002 and WY2012 ranged from 52 to 76 mt for loads and 272 to 450 ppb for concentrations. WY2012 nutrient loads and concentrations for the SLRW were lower than the average of the previous 10 years for the C-23, C-24 and C-44 sub-watersheds with the exception of TN concentrations, which were higher for all three sub-watersheds. Flow and rainfall (data not shown) were lower than average in all three major sub-watersheds. Rainfall data presented in **Table 2** depicts the low rainfall values in the southern sub-watersheds at the three southernmost rainfall stations (S80, Pahokee1, and S135). In addition, the C-44 Sub-watershed experienced the lowest TP concentrations recorded for this sub-watershed over the past 10 years. With the exception of the C-44, WY2012 loads for both TP and TN were between the 25^{th} and 75^{th} quartile range of historical average (**Figures 34** and **35**). Concentration data for the tributary sites generally show lower concentration values than the major sub-watersheds.

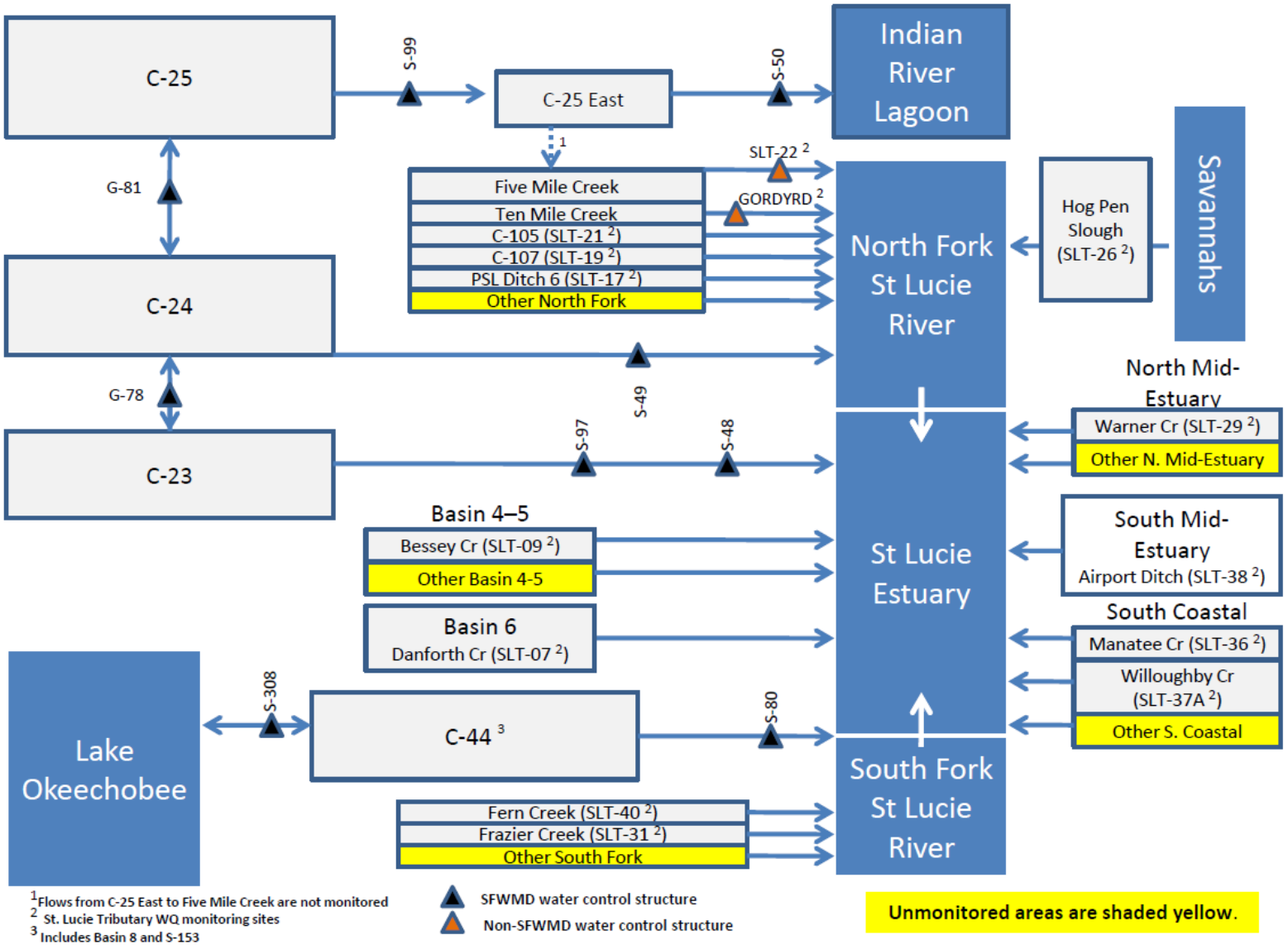


Figure 21. St. Lucie River Watershed flow schematic (HDR, 2011b).

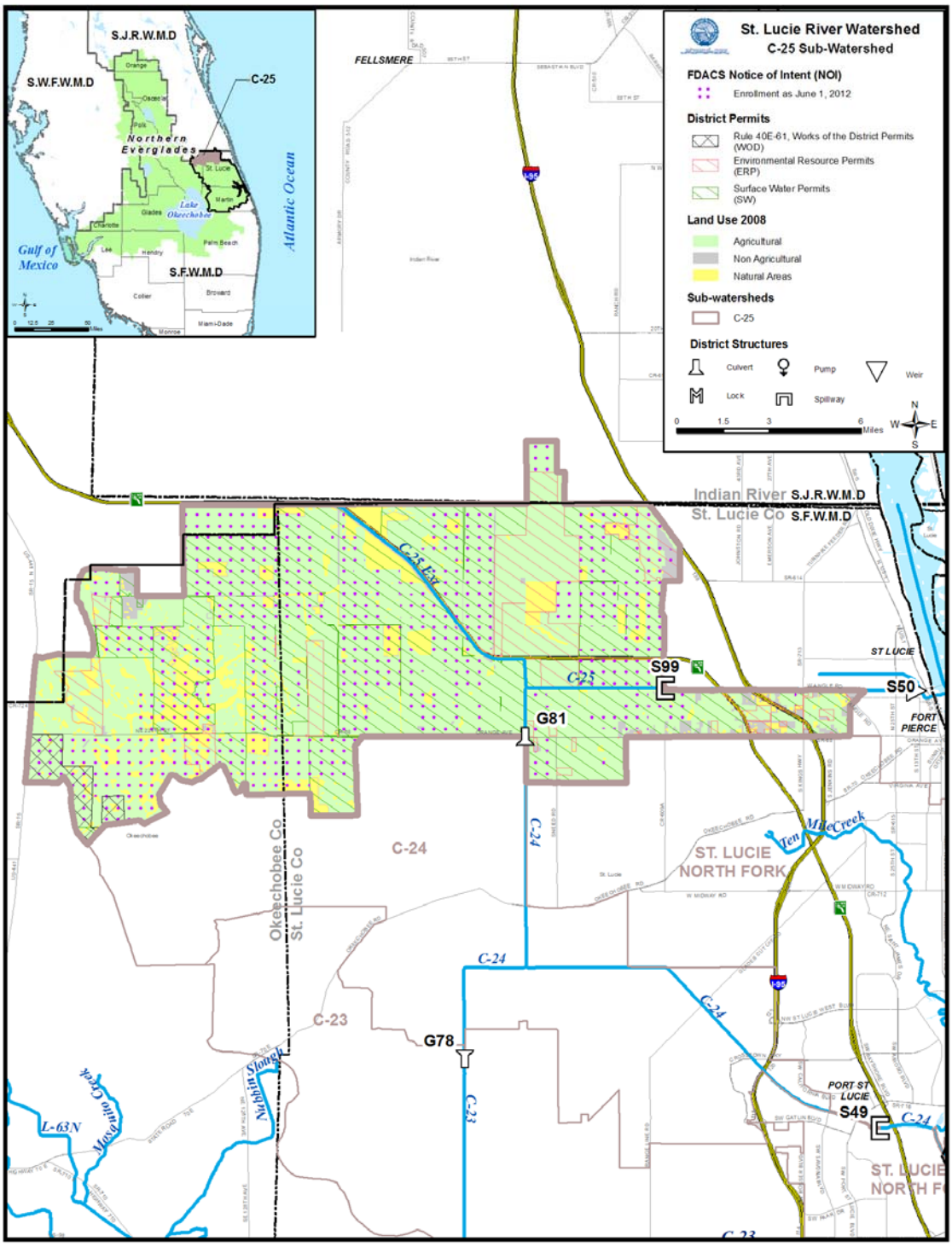


Figure 22. St. Lucie River Watershed, C-25 (including C-25 East) Sub-watershed.

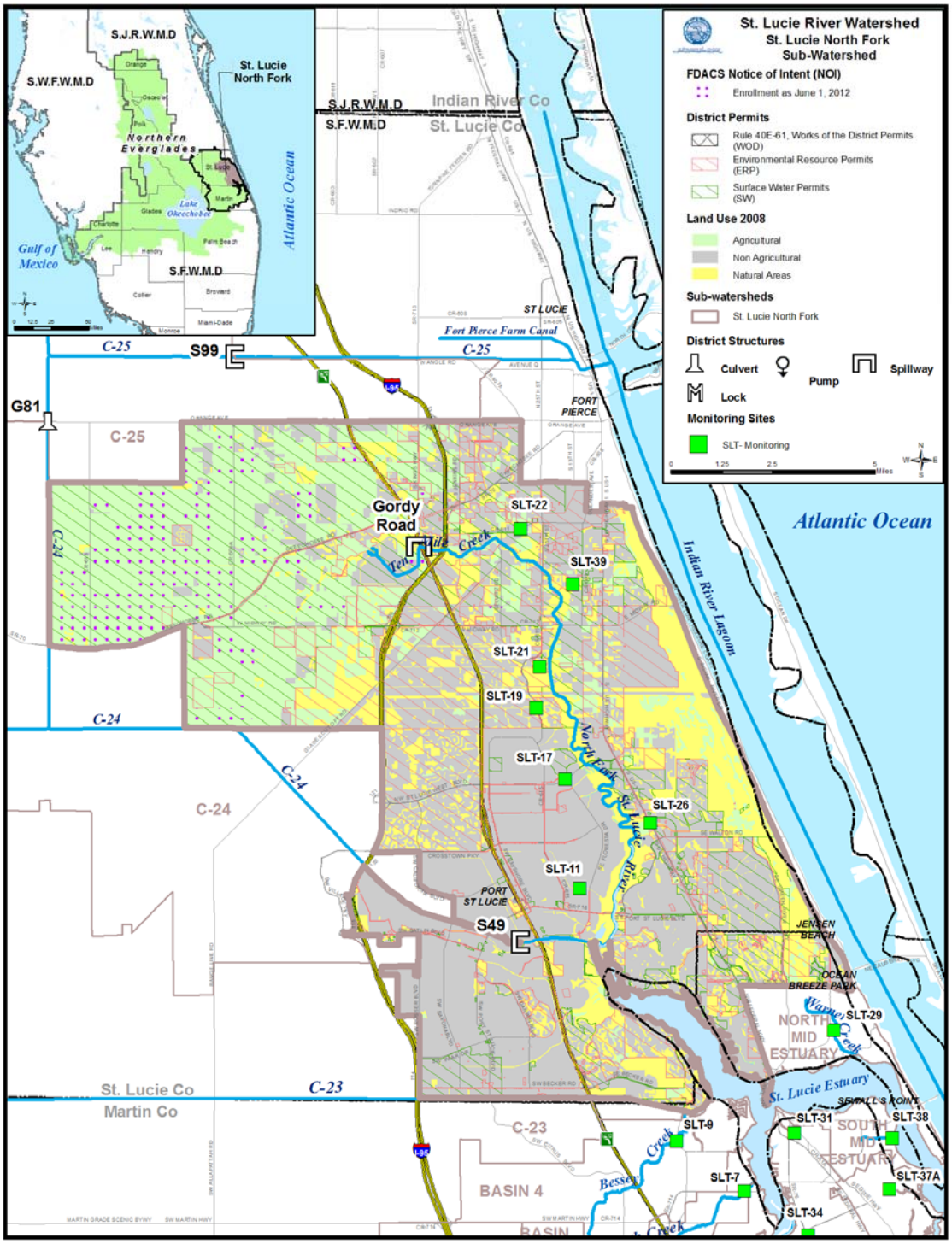


Figure 23. St. Lucie River Watershed, North Fork Sub-watershed.

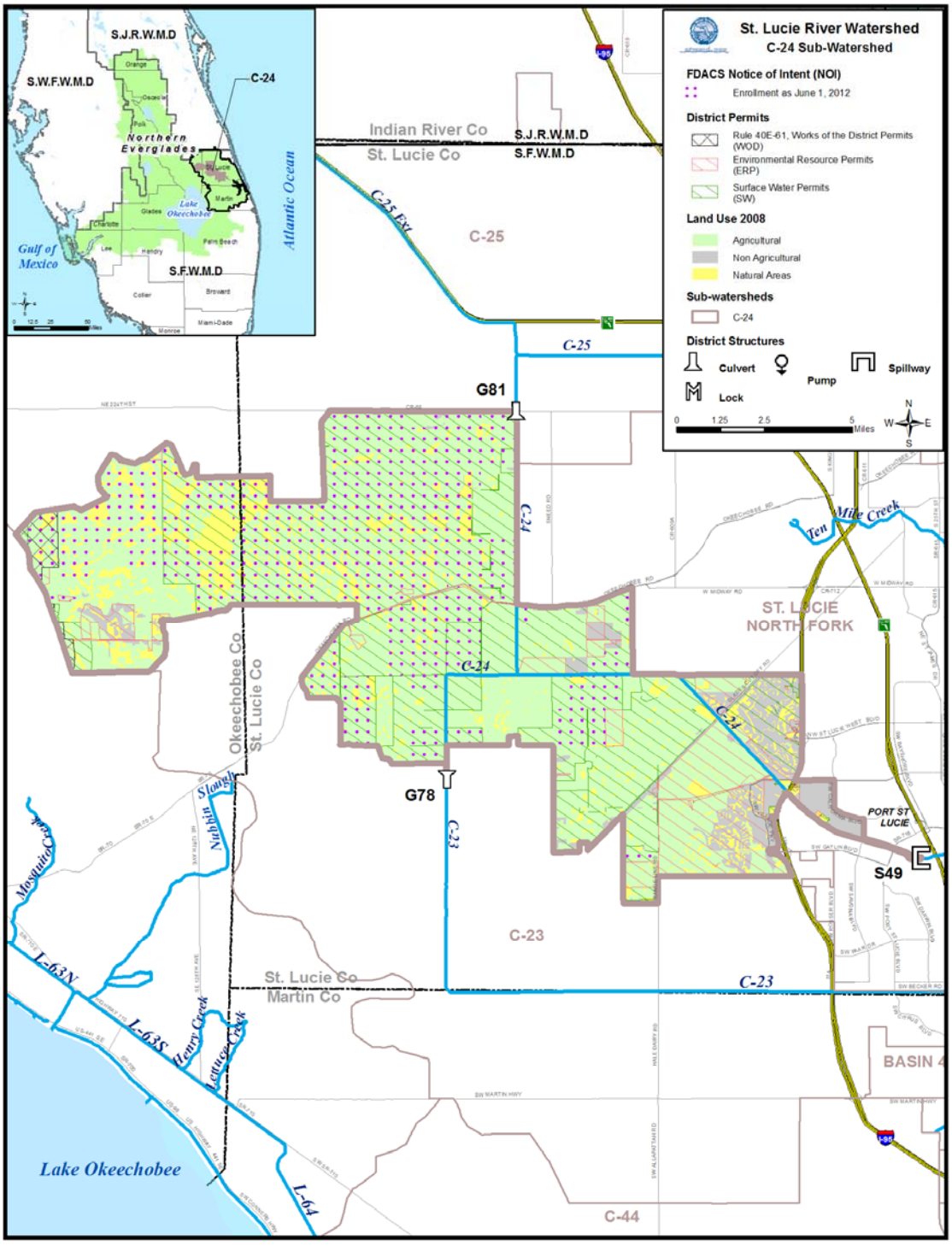


Figure 24. St. Lucie River Watershed, C-24 Sub-watershed.

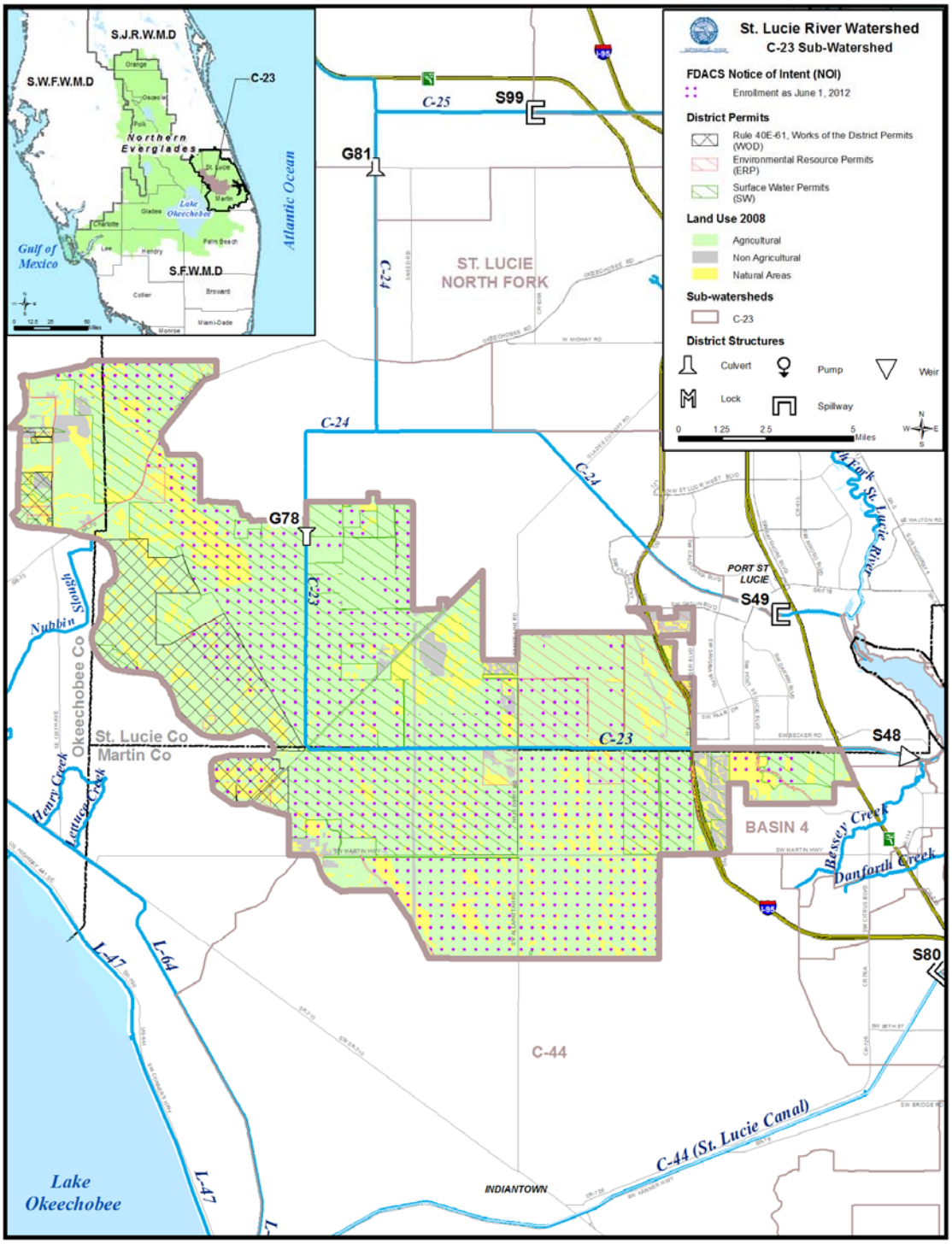


Figure 25. St. Lucie River Watershed, C-23 Sub-watershed.

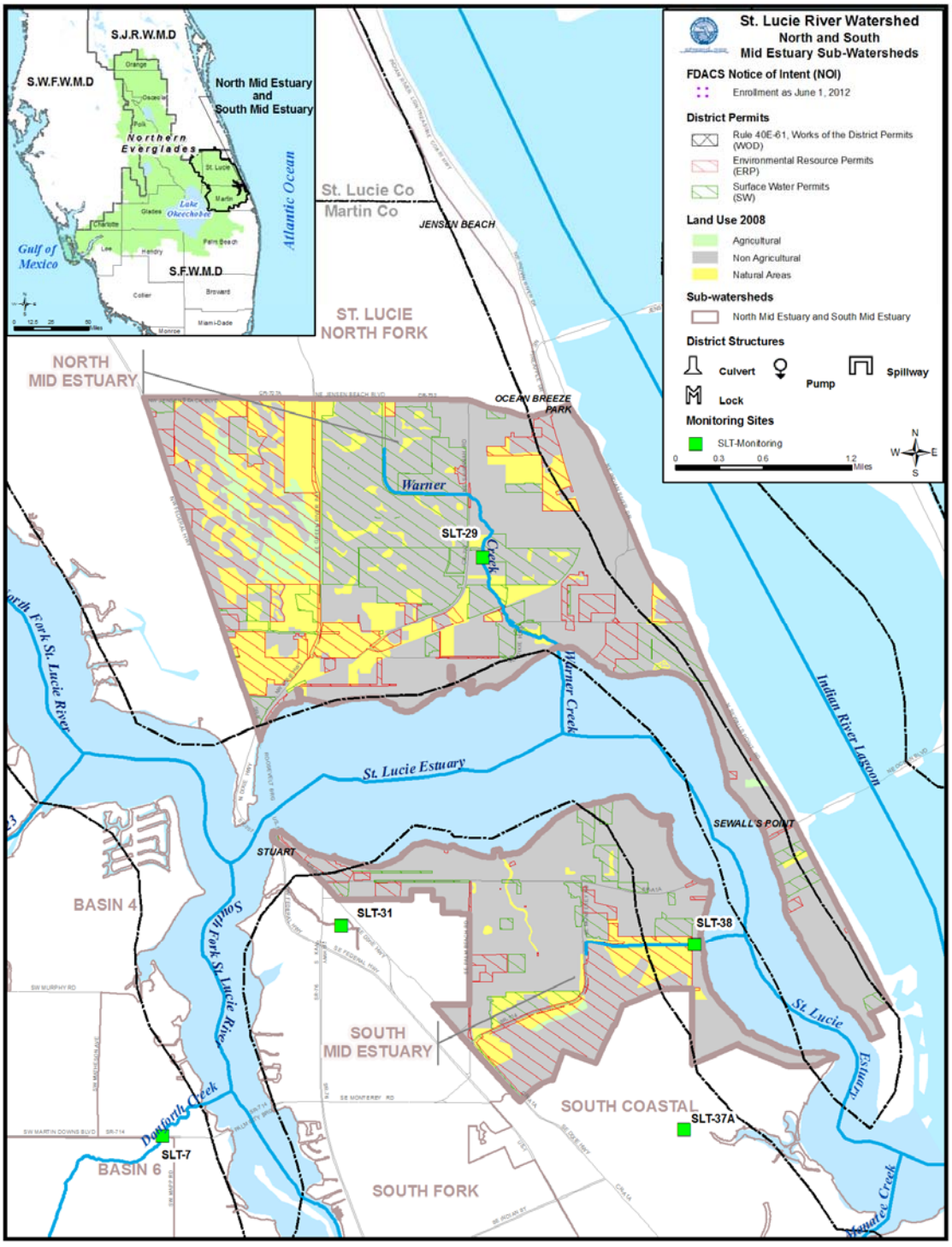


Figure 26. St. Lucie River Watershed, North Mid-Estuary and South Mid-Estuary sub-watersheds.

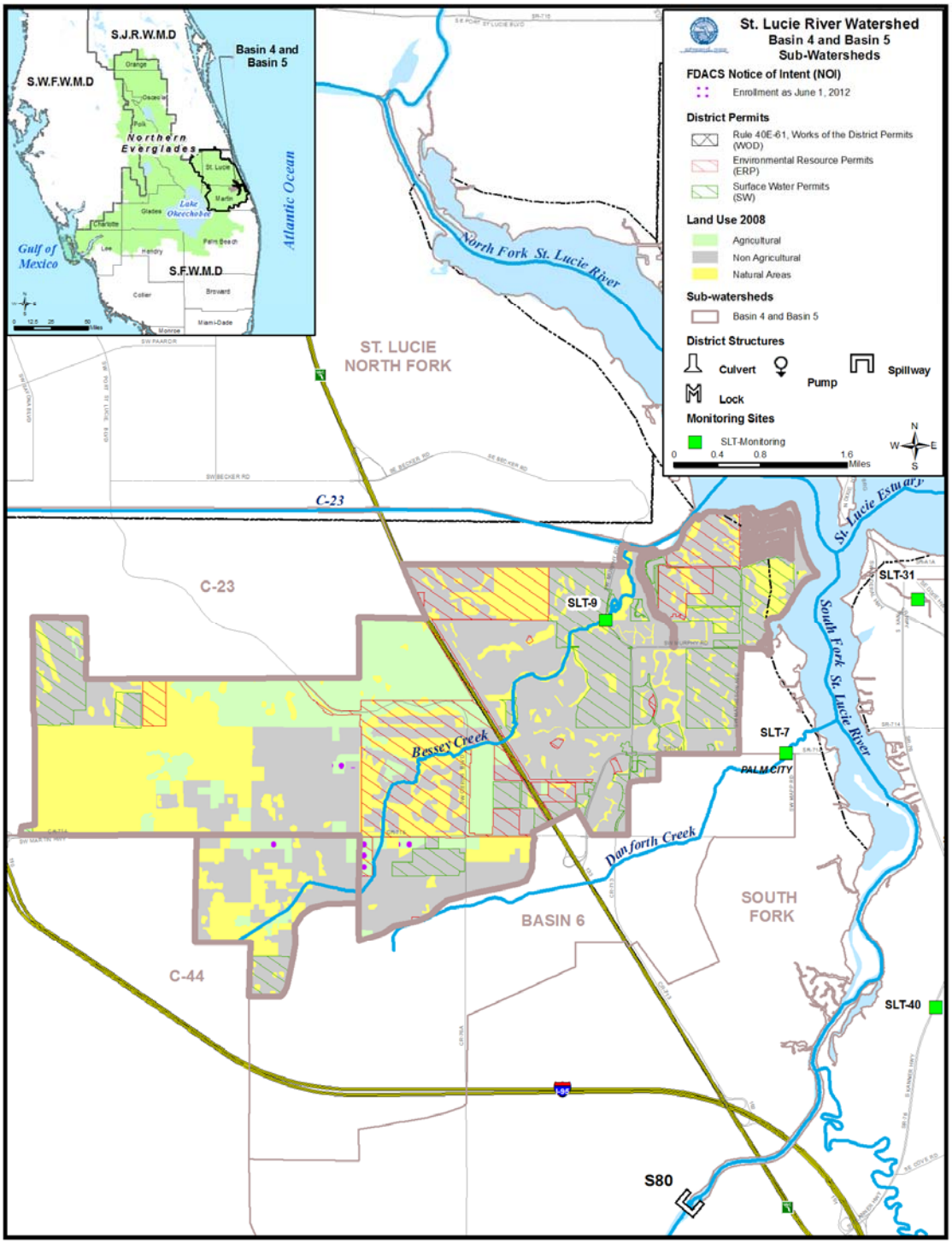


Figure 27. St. Lucie River Watershed, Basins 4 and 5 sub-watersheds.

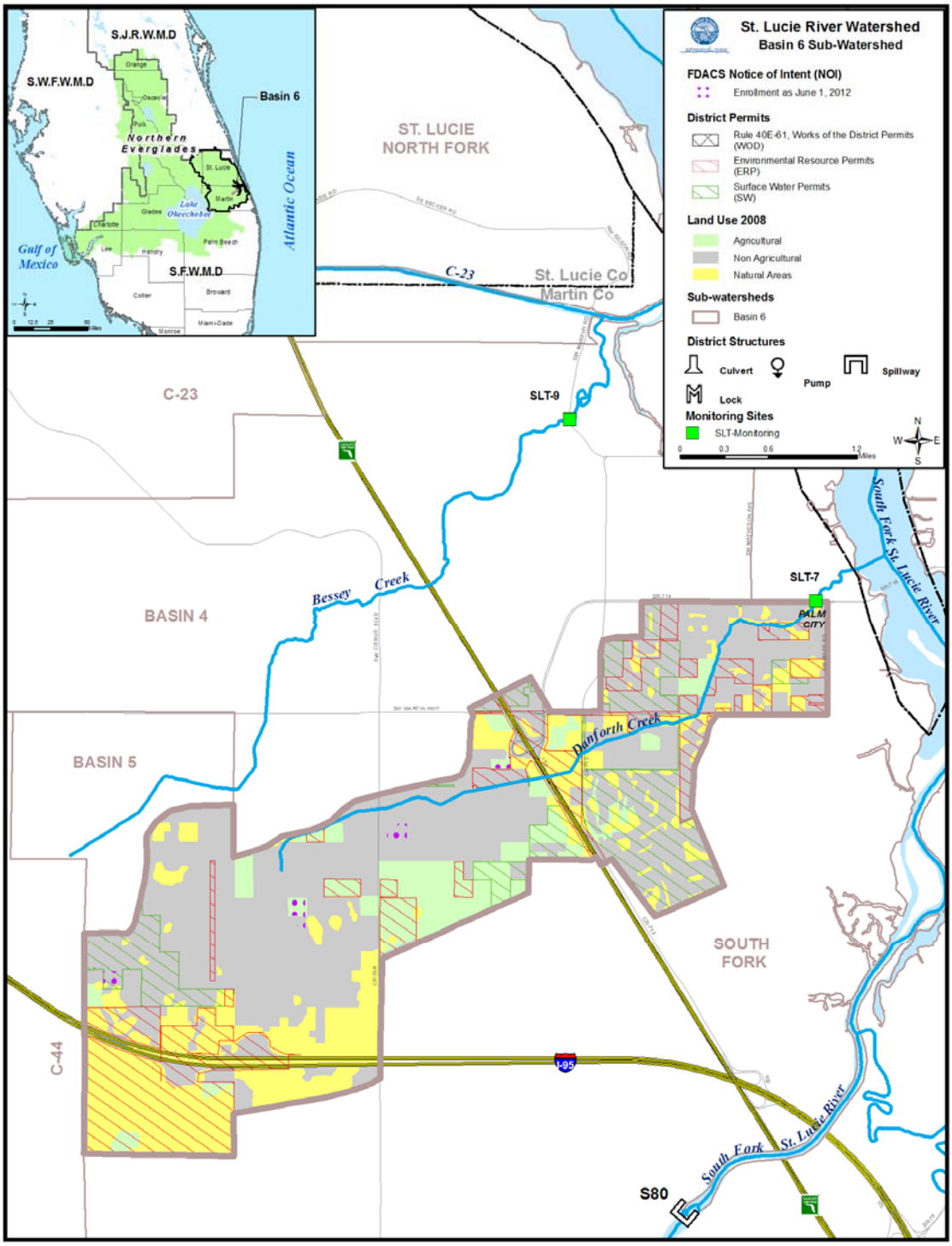


Figure 28. St. Lucie River Watershed, Basin 6 Sub-watershed.

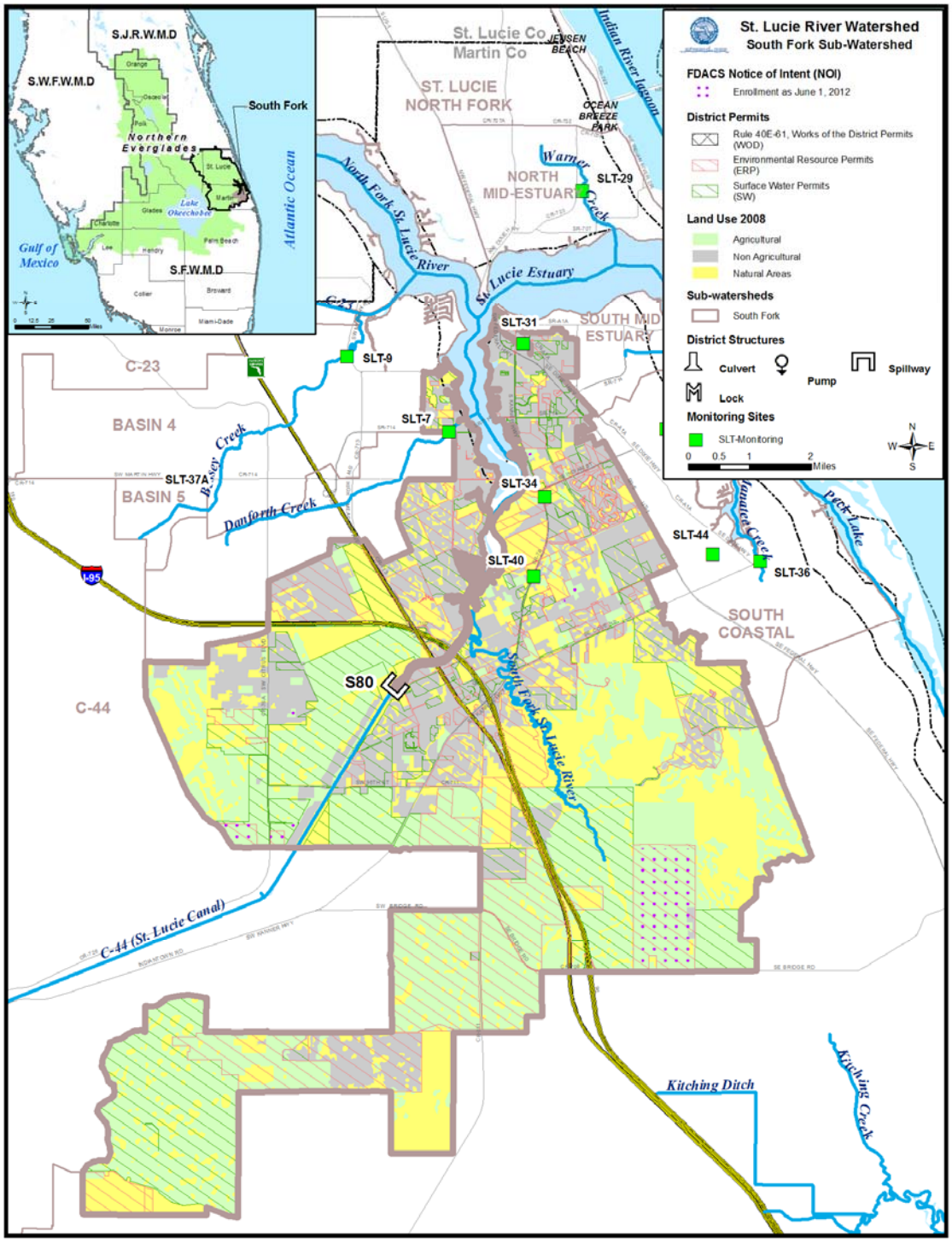


Figure 29. St. Lucie River Watershed, South Fork Sub-watershed.

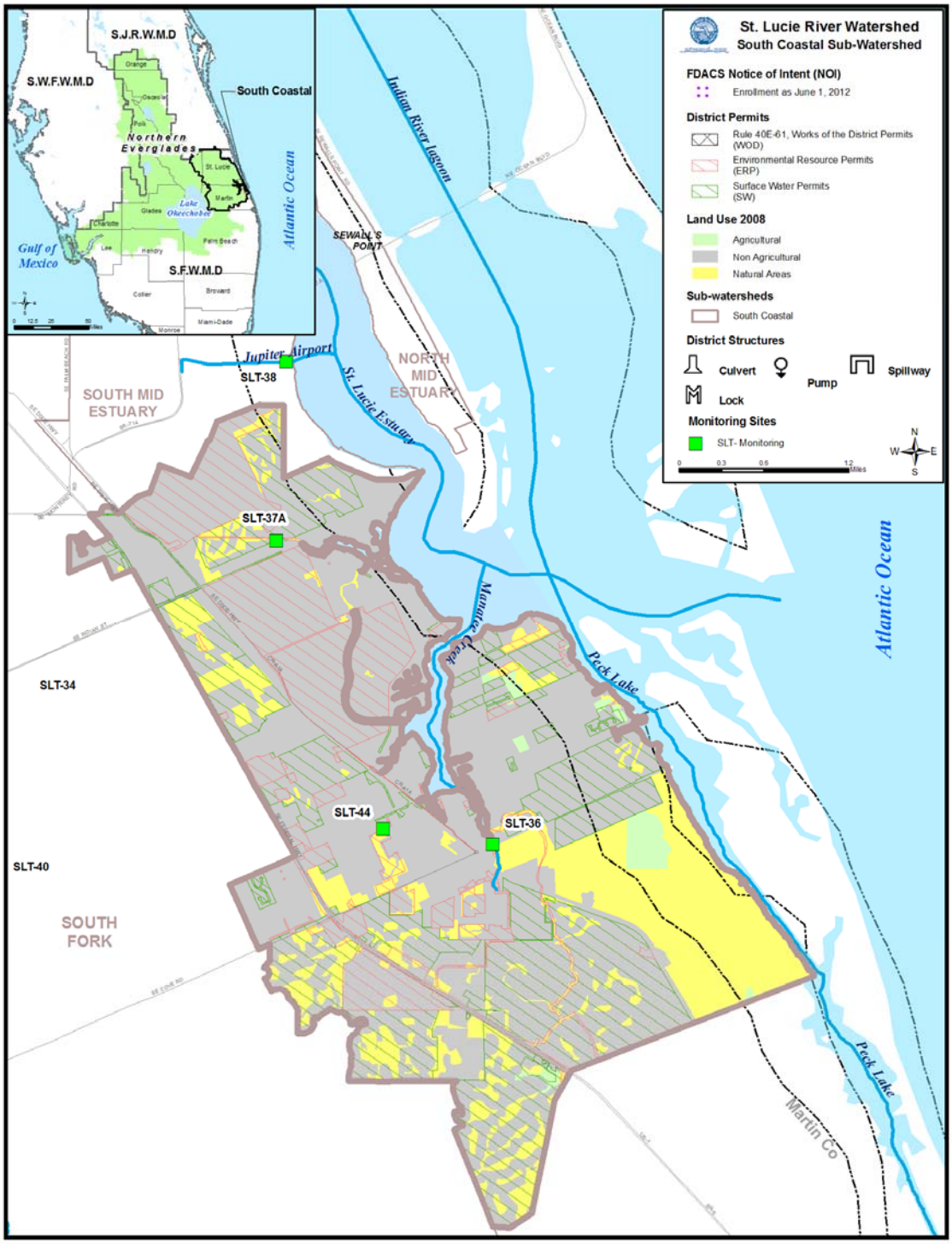


Figure 30. St. Lucie River Watershed, South Coastal Sub-watershed.

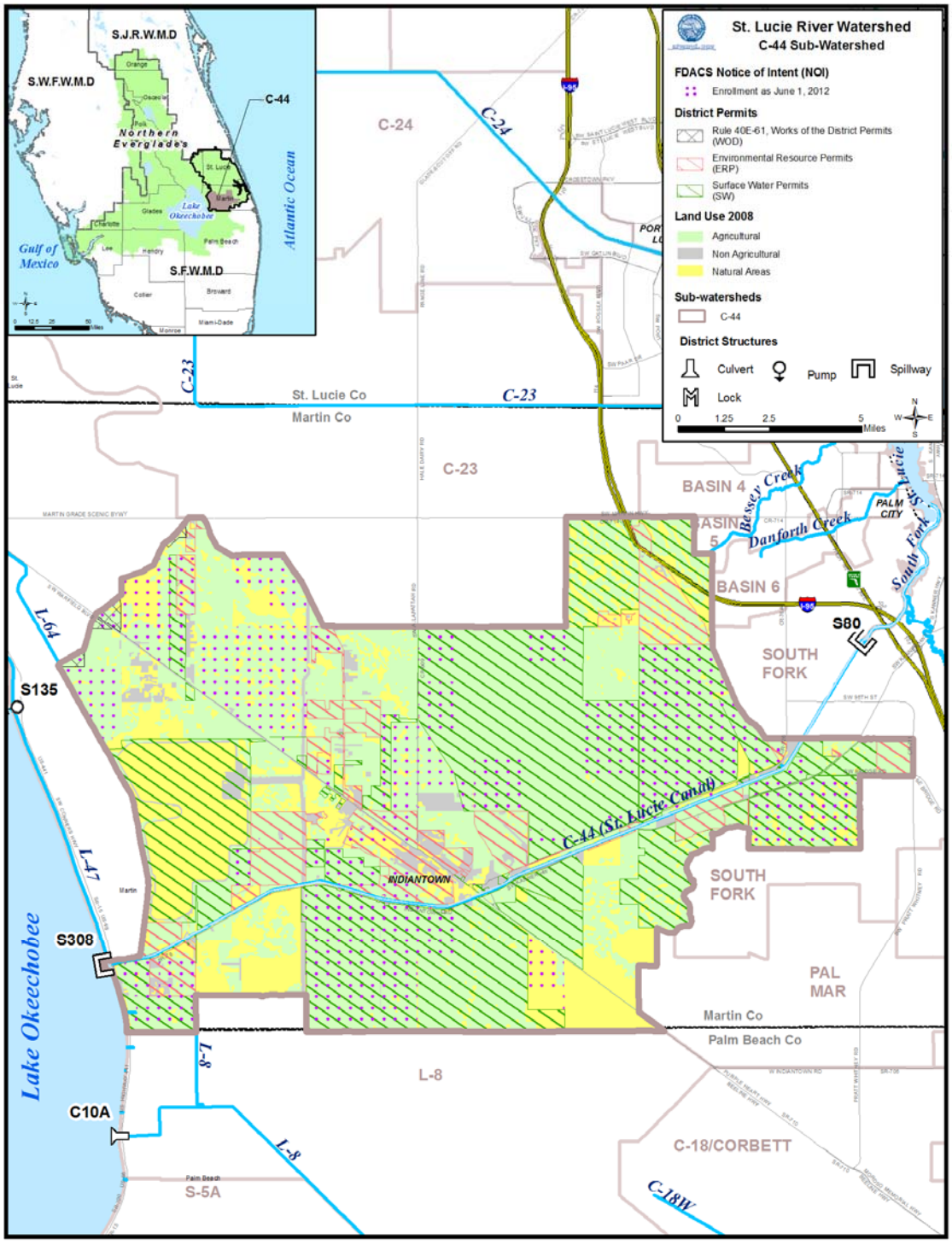


Figure 31. St. Lucie River Watershed, C-44 Sub-watershed.

Table 2. WY2012 rainfall and TP and TN loads and concentrations.

Sub-Watershed	Annual Rainfall (in)	WY2012 Observed TP Load (mt)[1]	WY2012 Observed TN Load (mt)[1]	WY2012 TP Concentration (ppb)[2]	WY2012 TN Concentration (ppb)[2]
C-24	47.79	55	303	315	1,744
C-23	46.32	28	135	368	1,808
C-44[3]	34.33	10	110	170	1,789
North Fork	45.23				
Ten Mile Creek(Gordy)		NA	NA	269	1,074
Five Mile Creek(SLT-22)		NA	NA	95	600
Elkham Waterway(SLT-11)		NA	NA	89	1,031
PSL Ditch 6 (SLT-17)		NA	NA	79	746
C-105 (SLT-21)		NA	NA	23	878
C-107 (SLT-19)		NA	NA	34	789
Hog Pen Slough (SLT-26)		NA	NA	51	747
Platts Creek (SLT-39)		NA	NA	240	748
South Fork	31.90				
Frazier Creek (SLT-31)		NA	NA	48	571
Coral Gardens Ditch (SLT-34A)		NA	NA	184	1,574
Fern Creek (SLT-40)		NA	NA	191	2,506
Basin 4-5	43.14				
Bessey Creek (SLT-09)		NA	NA	271	870
Basin 6	32.33				
Danforth Creek (SLT-07)		NA	NA	181	870
North Mid-Estuary	45.23				
Warner Creek (SLT-29)		NA	NA	64	1,164
South Mid-Estuary	31.72				
Airport Ditch (SLT-38)		NA	NA	103	773
South Coastal	31.72				
Manatee Creek (SLT-36)		NA	NA	298	1,212
Willoughby Creek (SLT-37A)		NA	NA	26	790
Salerno Creek (SLT-44)		NA	NA	35	783

[1]For data marked NA these tributaries have either not been monitored for flow or flow data is provisional

[2]Concentrations are flow-weighted means for C-24, C-23, and C-44. Concentrations for tributary sites are straight averages based on grab samples taken only when flow is observed.

[3]Loads from C-44 can discharge to both the St. Lucie River Watershed and Lake Okeechobee.

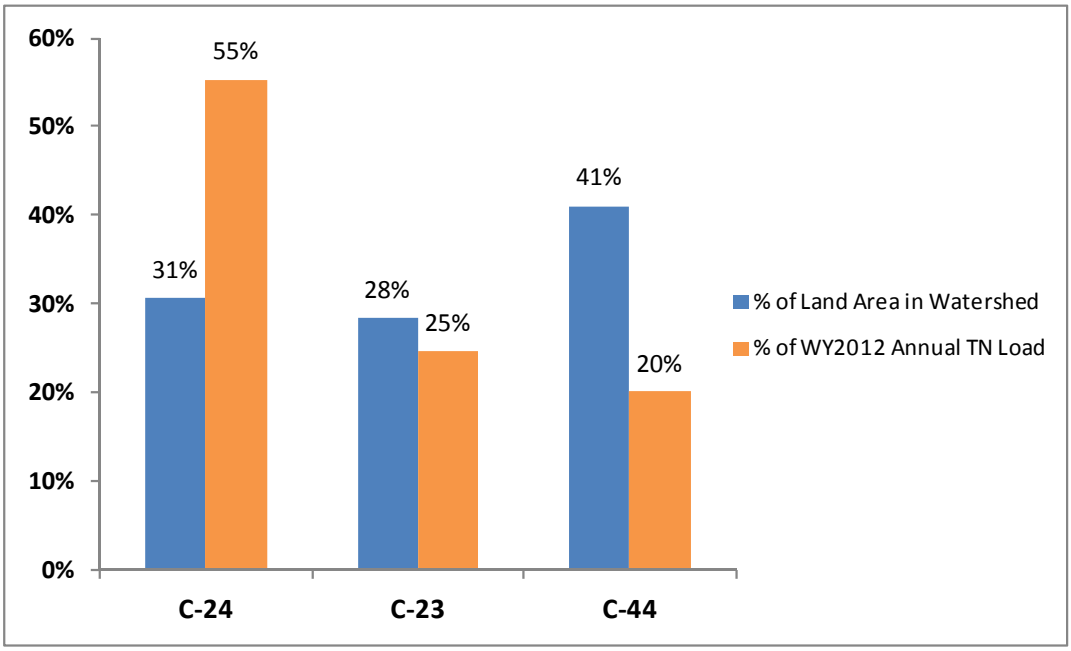


Figure 32. Distribution of TN loads in WY2012 compared to percent of land area in the sub-watersheds of the St. Lucie River.

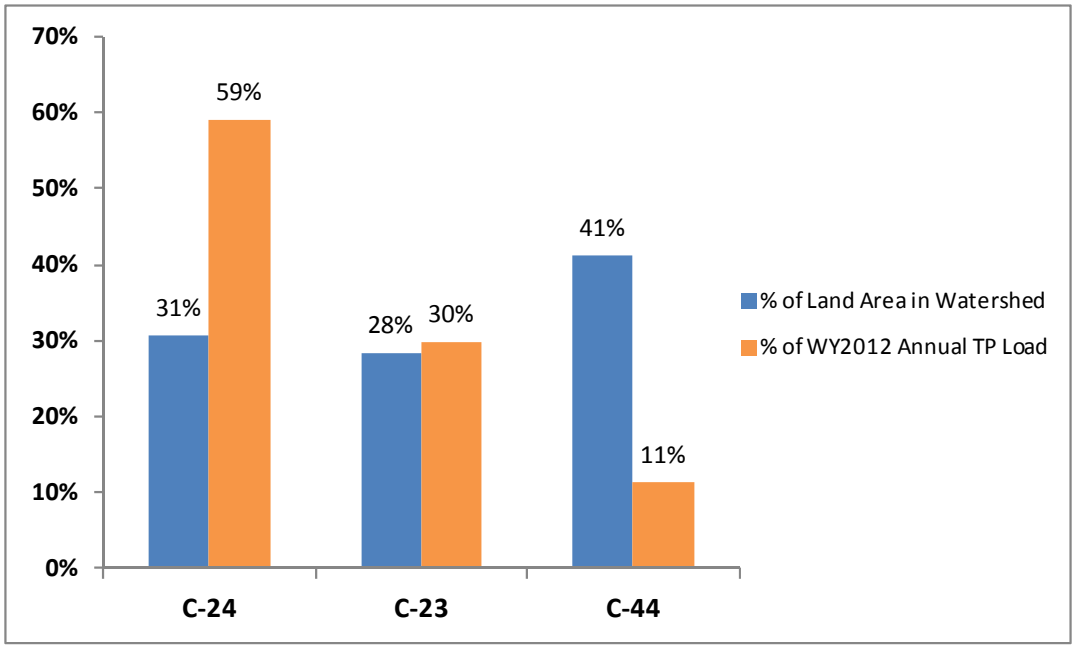


Figure 33. Distribution of TP loads in WY2012 compared to percent of land area in the sub-watersheds of the St. Lucie River.

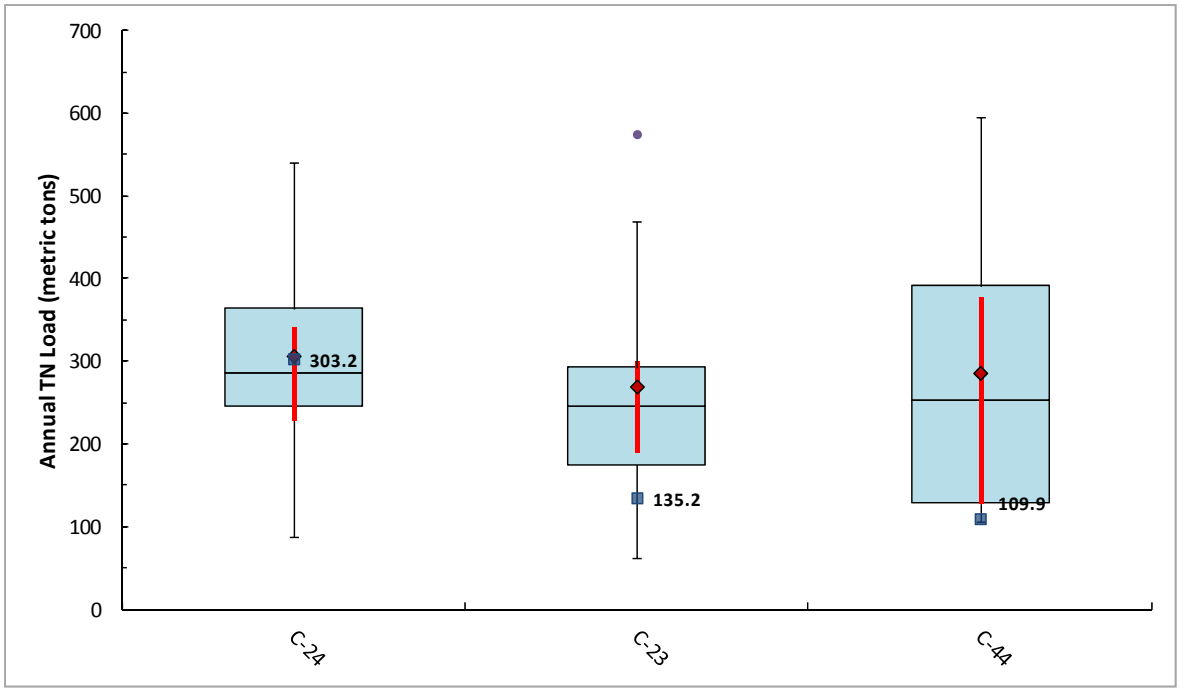


Figure 34. Box-and-whisker plot for St. Lucie Watershed TN load data.

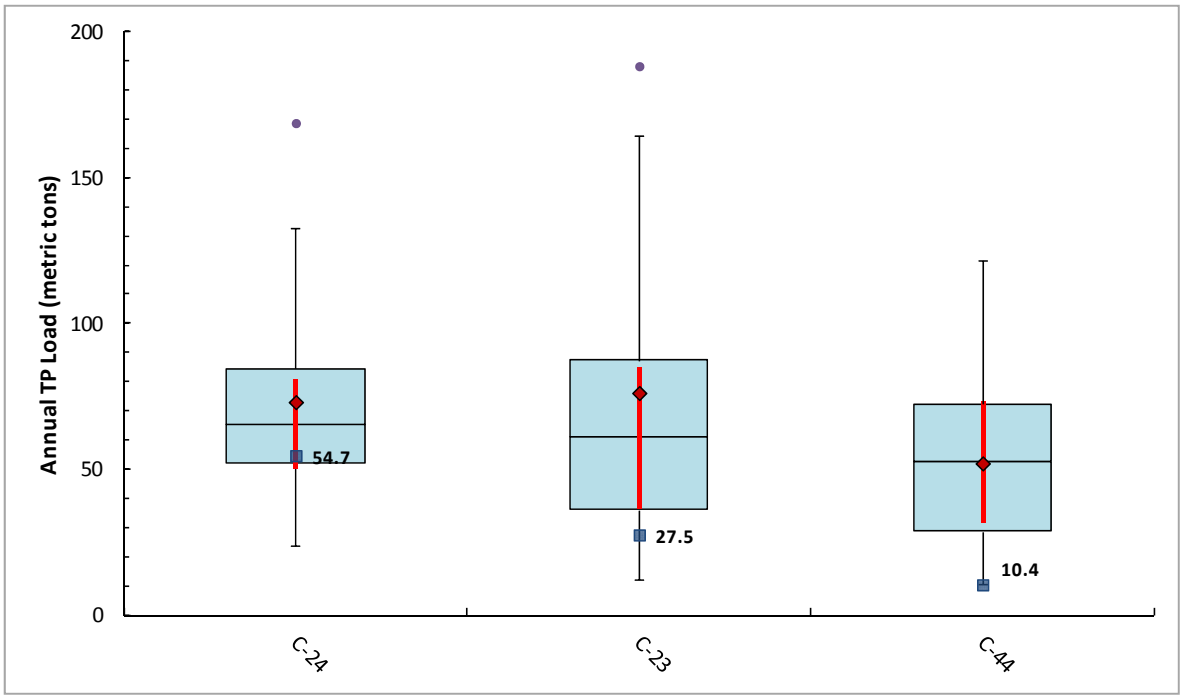


Figure 35. Box-and-whisker plot for St. Lucie Watershed TP load data.

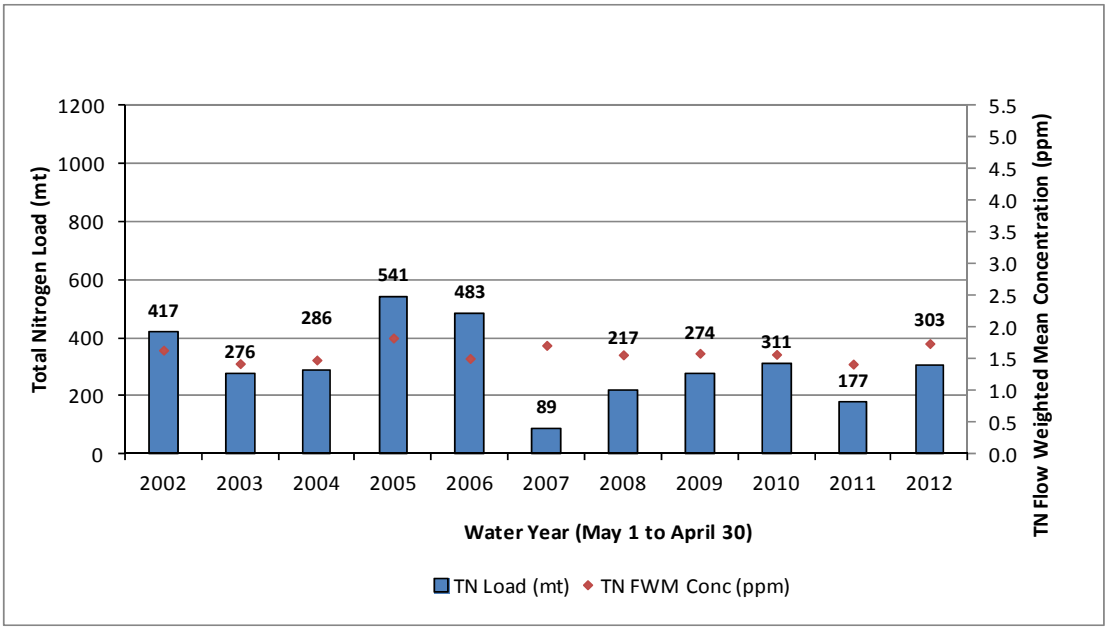


Figure 36. C-24 Sub-watershed observed TN loads and FWM concentrations.

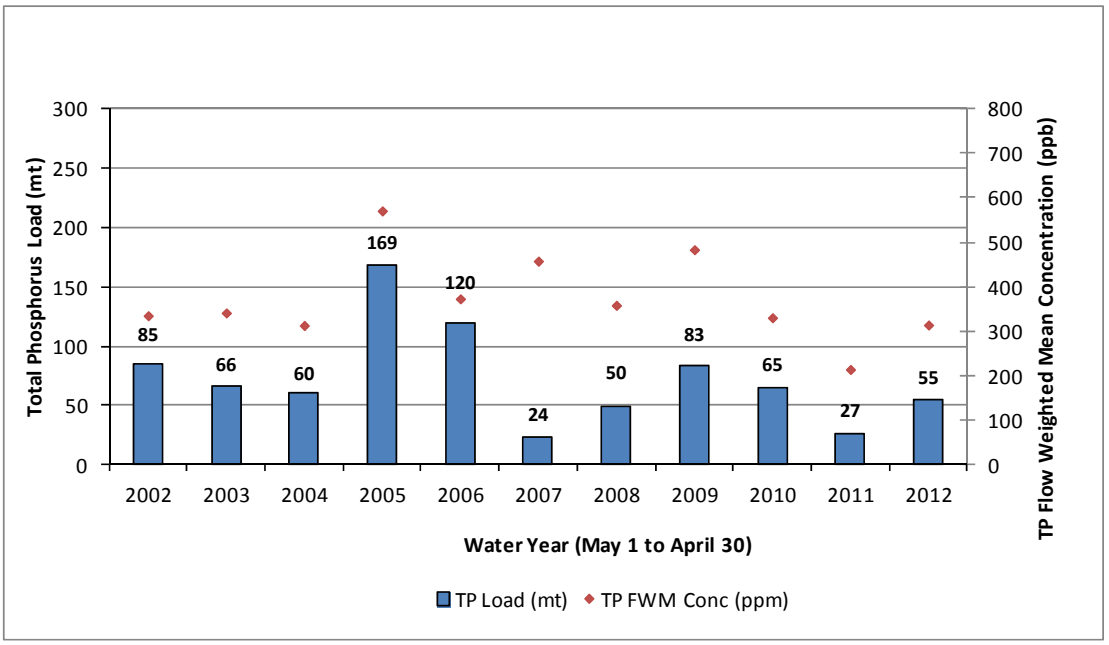


Figure 37. C-24 Sub-watershed observed TP loads and FWM concentrations.

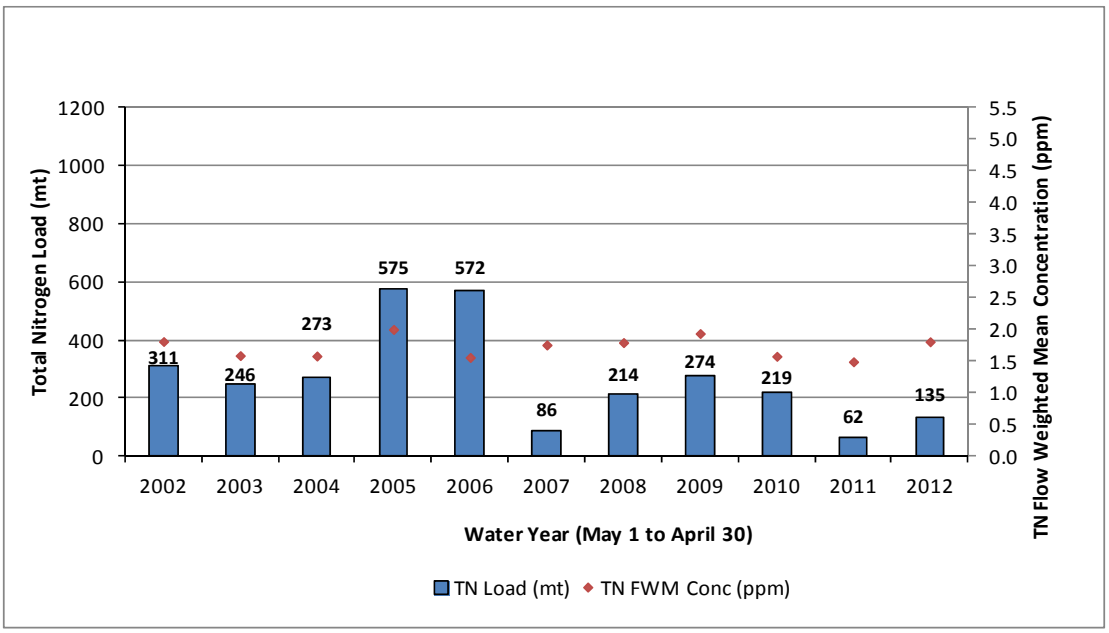


Figure 38. C-23 Sub-watershed observed TN loads and FWM concentrations.

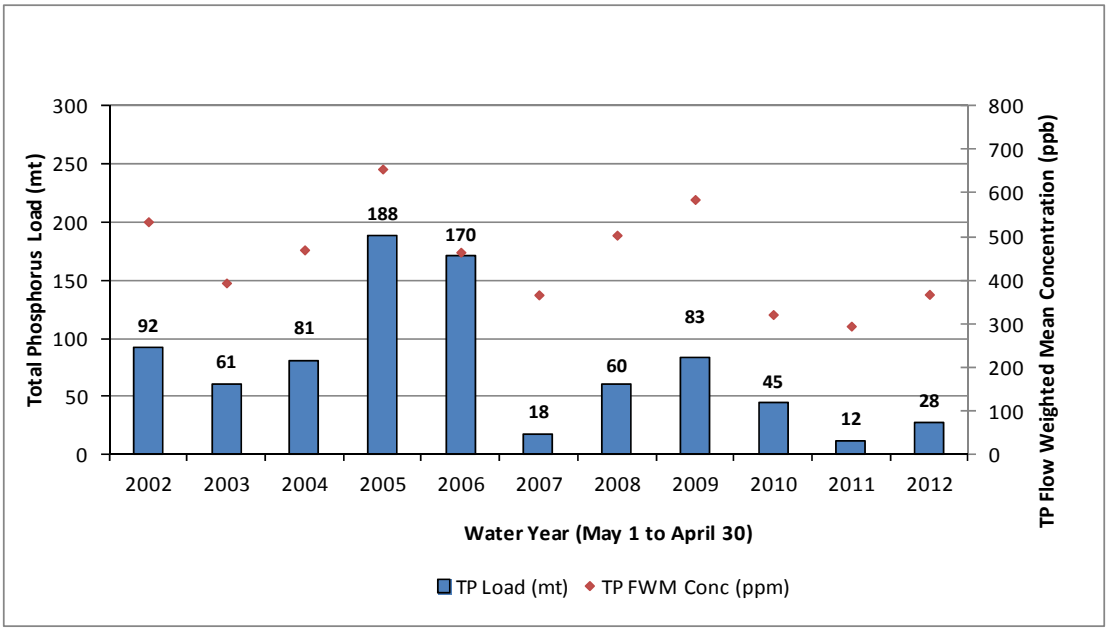


Figure 39. C-23 Sub-watershed observed TP loads and FWM concentration.

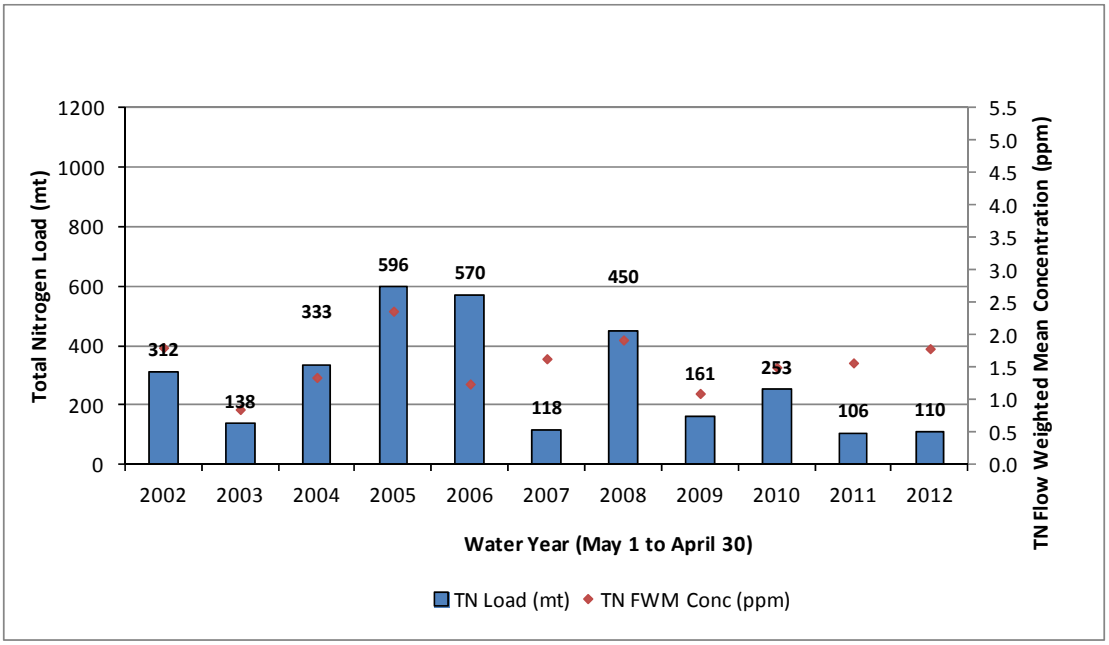


Figure 40. C-44 Sub-watershed observed TN loads and FWM concentrations.

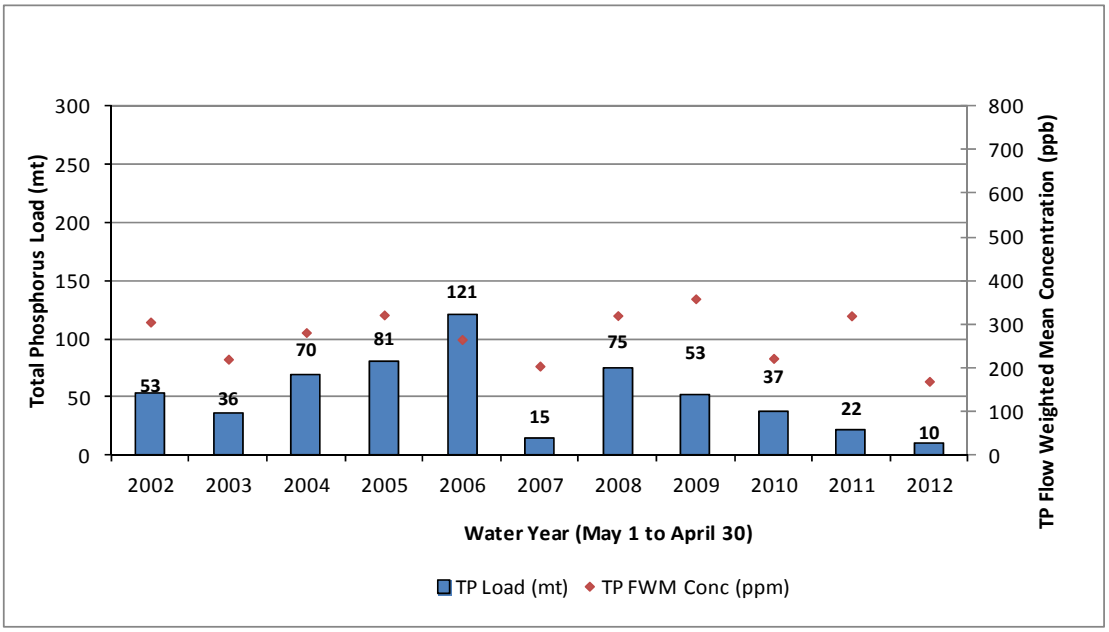


Figure 41. C-44 Sub-watershed observed TP loads and FWM concentrations.

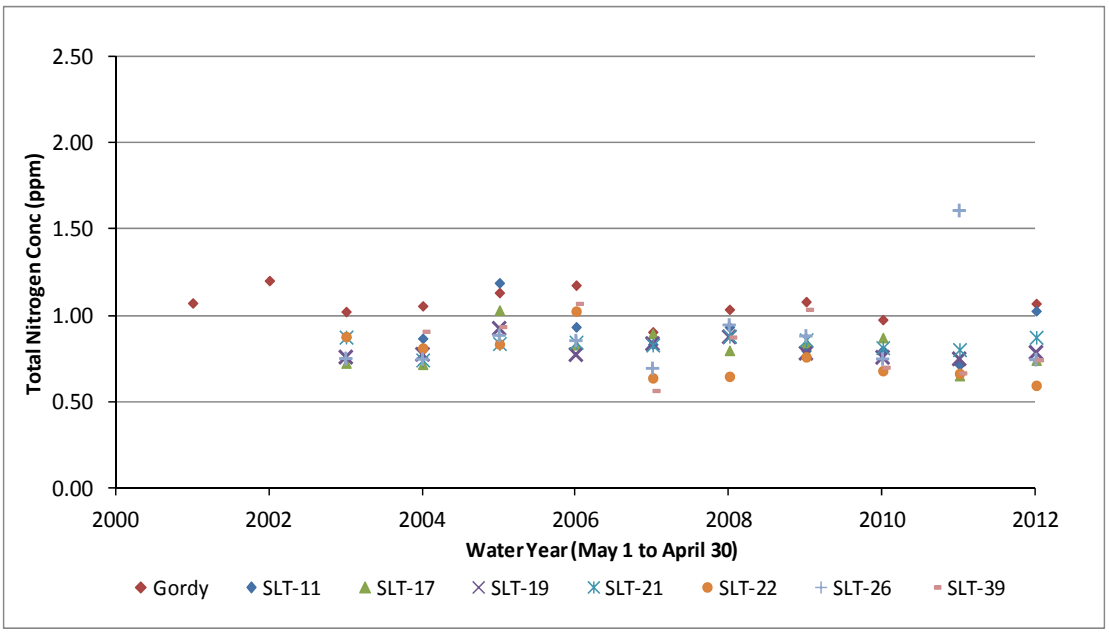


Figure 42. North Fork tributaries observed TN concentrations.

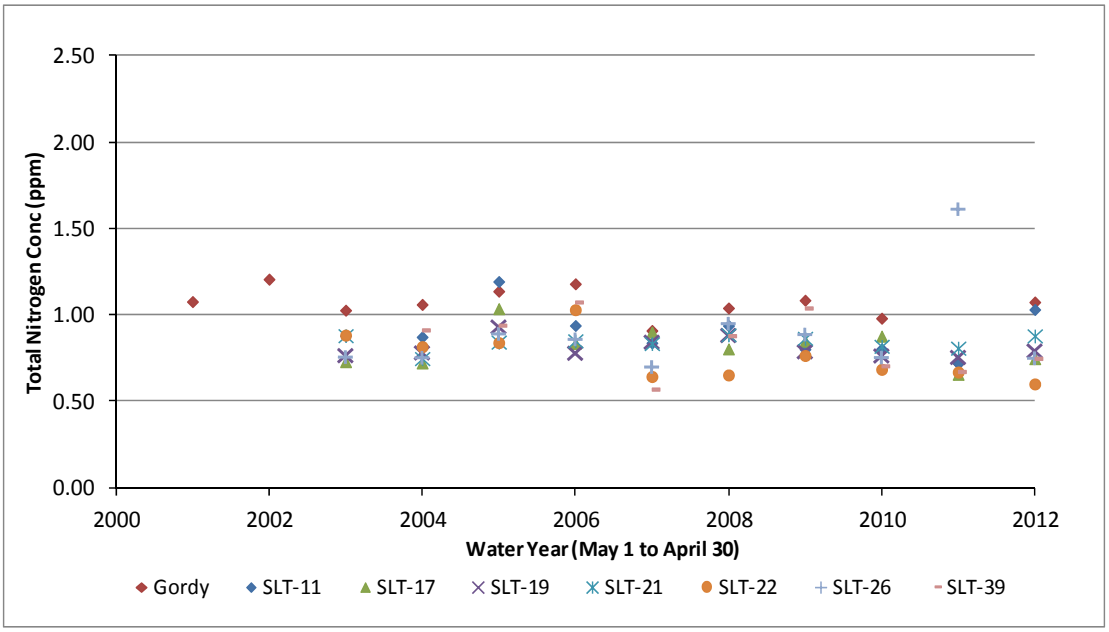


Figure 43. North Fork tributaries observed TP concentrations.

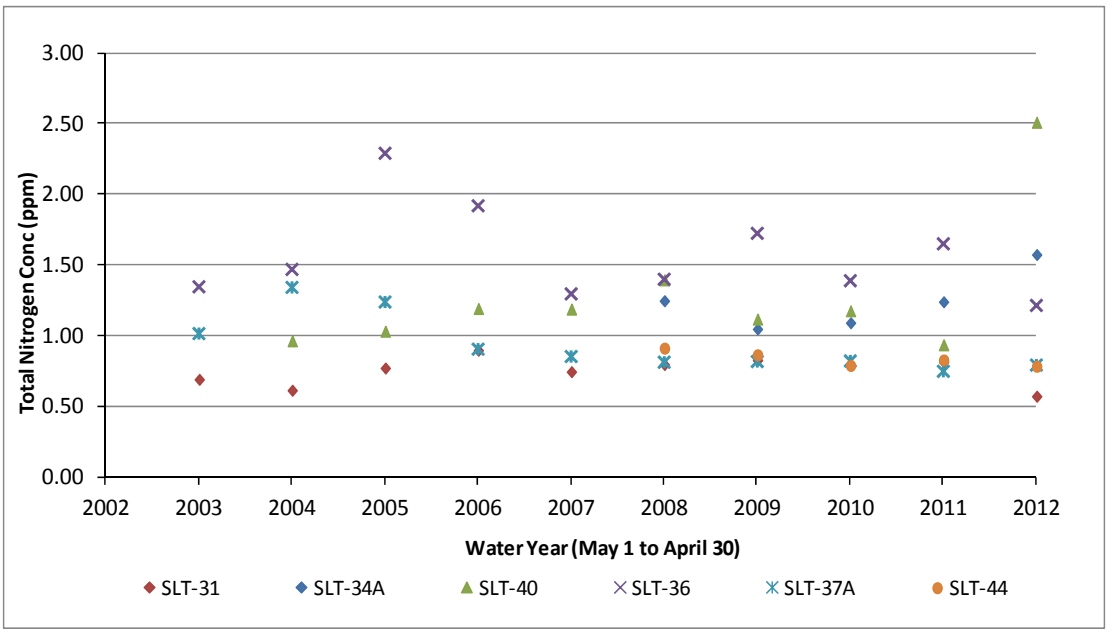


Figure 44. South Fork and South Coastal tributaries observed TN concentrations.

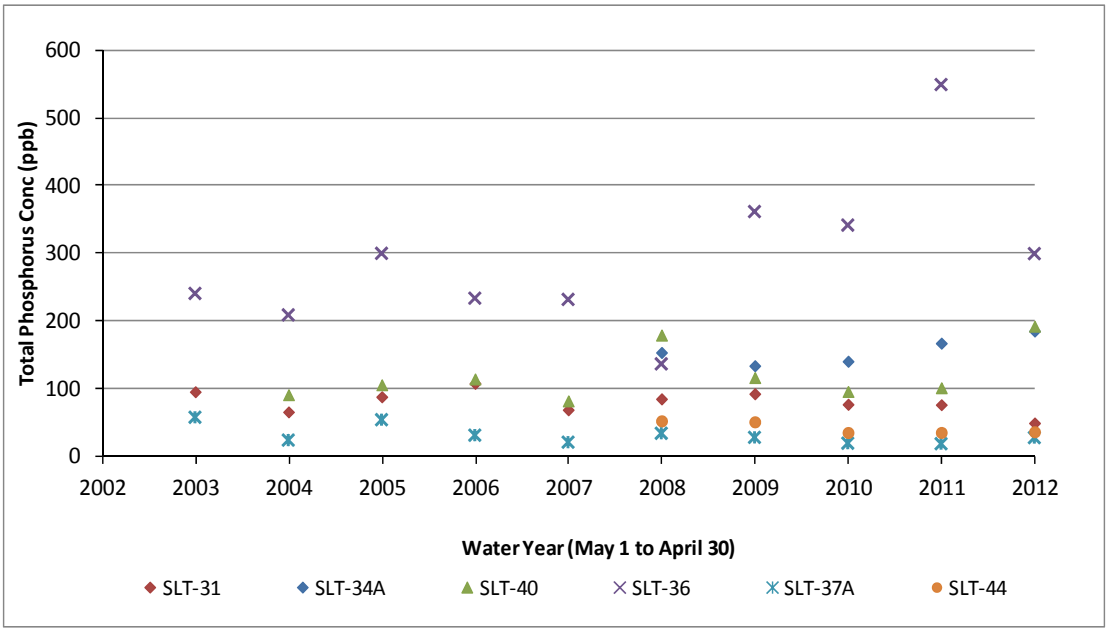


Figure 45. South Fork and South Coastal tributaries observed TP concentrations.

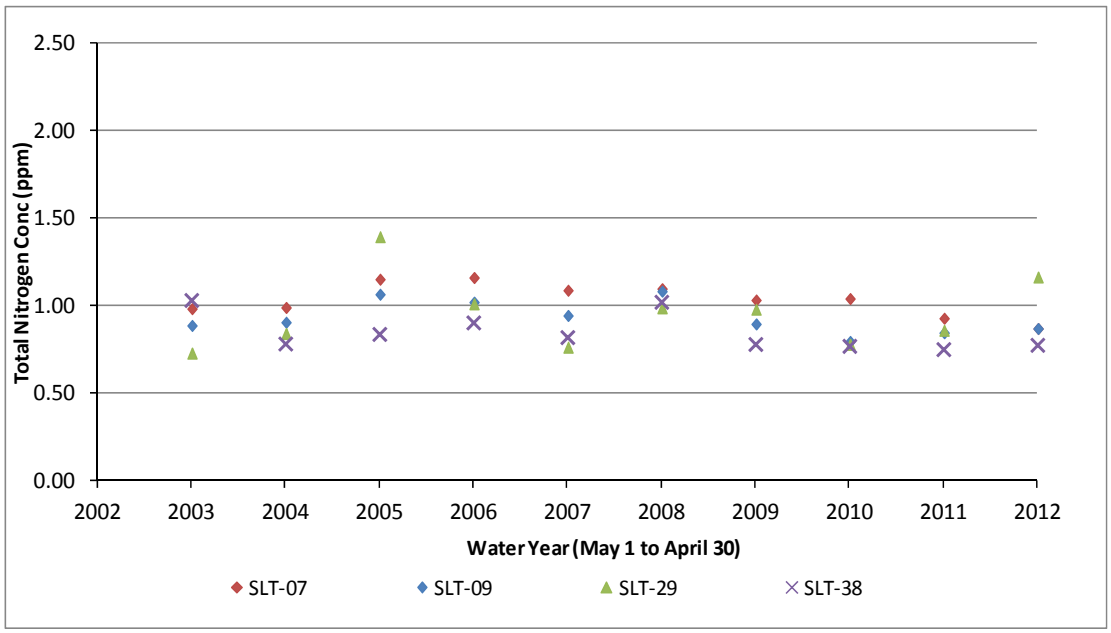


Figure 46. Basin 4-5, Basin 6, North Mid-Estuary, and South Mid-Estuary tributaries observed TN concentrations.

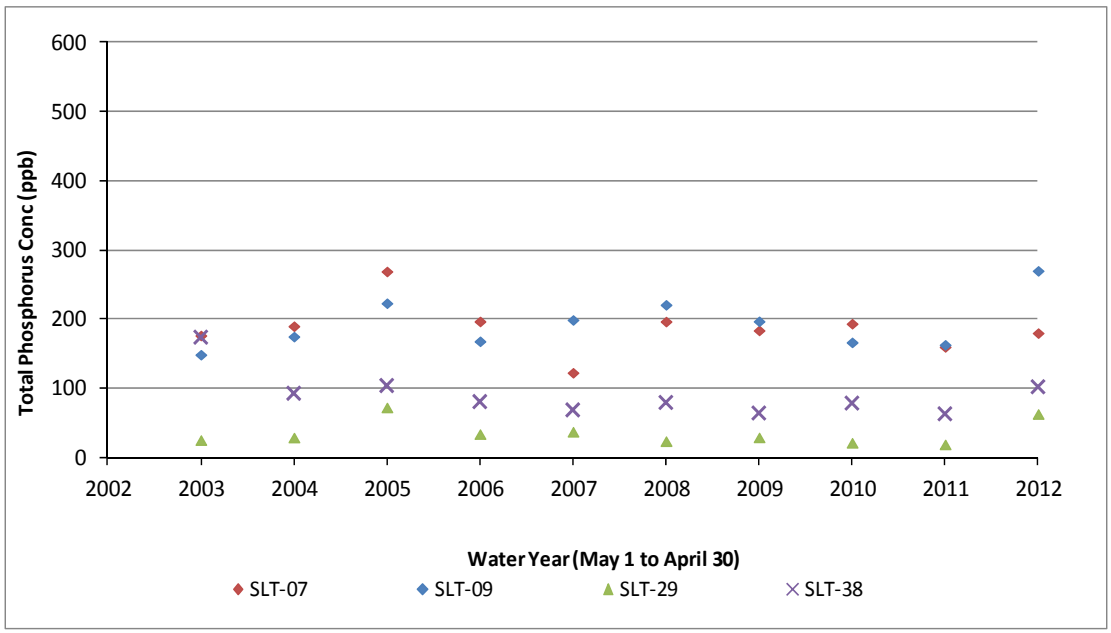


Figure 47. Basin 4-5, Basin 6, North Mid-Estuary, and South Mid-Estuary tributaries observed TP concentrations.

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HDR Engineering, Inc. 2011a. Data Analysis and Performance Measure Development for the Caloosahatchee River Watershed Source Control Programs, Deliverable 5.6, Final Analysis of Historical Data Report. Submitted to South Florida Water Management District, West Palm Beach, FL.

HDR Engineering, Inc. 2011b. Data Analysis and Performance Measure Development for the St. Lucie River Watershed Source Control Programs, Deliverable 5.5, Final Analysis of Historical Data Report. Submitted to South Florida Water Management District, West Palm Beach, FL.