

Preliminary Report (DRAFT)

For Project Entitled

**Nutrient Loading Rates, Reduction Factors and
Implementation Costs Associated with BMPs and
Technologies**

Prepared for

South Florida Water Management District

by

Soil and Water Engineering Technology, Inc.

First Revision

May 8, 2008

INTRODUCTION

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), is developing the Protection Plans for both Caloosahatchee River (C-43) and St. Lucie River (C-44) watersheds as required by the Northern Everglades and Estuaries Protection Program (Senate Bill 392). The plans will be developed partially based on a nutrient reduction spreadsheet approach detailing how water quality standards, including phosphorus and nitrogen, will be met. The spreadsheet provides load reduction estimates resulting from Best Management Practices (BMPs), as well as local and regional projects. The letter report titled "Phosphorus Reduction Performance and Implementation Costs under BMPs and Technologies in the Lake Okeechobee Protection Plan Area" provides only part of the input data needed for the BMP spreadsheet for these additional watersheds. Therefore the overall objectives of this project are to: 1) develop nutrient (nitrogen and phosphorus) loading rates, BMP reduction factors and implementation costs for both C-43 and C-44 watersheds; and 2) conduct a detailed literature review and data analysis to quantify the BMP effectiveness for each commodity and soil type statewide.

This draft report summarizes the efforts to date for completing the first task.

METHODOLOGY AND RESULTS

The approach taken for developing the nutrient reduction spreadsheets for C-43 and C-44 was to update the previously developed spreadsheets for the Okeechobee watershed using the additional literature data, land use data, observed flow and nutrient load data, and information from watershed modeling project for the two watersheds. The SFWMD provided the land use breakdown for the two watersheds for twenty major land use categories, which included the six new land use categories (low density residential, medium density residential, high density residential, horse farms, transportation, and utilities). The following section describes how these data were used to develop the final unit nutrient load and BMP reduction spreadsheets. Though the methodology was very similar for both the Caloosahatchee and the St. Lucie watersheds, they are both included in order to highlight data sources and verification differences.

St. Lucie River Watershed

Figure 1 shows the basins within the St. Lucie River watershed. The 2004 land use distribution for this watershed was provided by SFWMD and is presented in Table 1. As can be seen, the table provides additional land use breakdowns beyond the twenty primary land use categories required for the project. These additional data were used during the development of the unit loads, but were integrated within the twenty categories for the final tables to prevent confusion. Measured data were provided by the SFWMD as presented in Table 2 which compared to data obtained from the CERP System-wide Performance Measure Documentation Sheet (April 5, 2007).

The initial estimates of the unit nutrient loads were developed from the Okeechobee Basin data provided in the BMP Letter Report (Bottcher, 2006), general Florida estimates by Harper and

Baker (2003 and 2007), and data collected within the basin by Graves, et al (2004). The final N and P unit loads for the watershed presented in Table 3 were developed as an iterative process starting with the initial unit loads estimates linked to a basin spreadsheet where the accumulative N and P loads from each basin could be calculated by multiplying the land use acreage by the unit loads. The net N and P loads were then compared to the measured basin and basin loads to verify if the net loads were at least in the ballpark and how the calculated and measured N and P loads for each of the basins compared. It was clear that the dominant land uses in the western basins were improved pasture and citrus while the eastern basins were much more residential and urban. Using this cross information it was possible to estimate the relative importance of the various land uses and adjustments were made accordingly to obtain a reasonable agreement of runoff and nutrient loads and concentrations for each of the basins. However, it was observed that there was a potential problem using the measured flow data for net load estimates because of the high runoff variability between basins as seen in Table 2 for the annual runoff in terms of inches per year. Therefore, the cross basin comparisons focused more on matching the concentrations because they would be less influenced by any flow errors that might be the result of unmeasured inter-basin transfers. Since the unit loads are a function of both concentration and flow, it was first necessary to establish reasonable runoff coefficients for the various land uses (Harper and Baker, 2007). The resulting annual average runoff for the various land uses are provided in Table 3. Tables 3 also provides the resulting N and P unit loads and concentrations from the iterative process of adjusting individual land use unit loads which multiplied by the acreage of each land use within the basins (Table 4) to obtain reasonable basin runoff (Table 5), P loads (Table 6), and N loads (Table 7) comparison to observed data. The P unit load factors were adjusted individually based on best professional judgment. The N unit loads were also initially adjusted individually, but then a global multiplier factor was used to obtain reasonable matches to observed data. The verification for the N and P concentrations are also provided in Tables 6 and 7, respectively at the bottom of the tables. Note that the net calculated loads are slightly higher than observed data because these represent net source loads which do not reflect the additional assimilation that is expected in the stream and canals before reaching the basin outlets.

The next step was to establish BMP N and P reduction estimates for the C-44 basin. This was done by adding BMP reduction estimates for the six additional land use categories to the BMP reduction spreadsheets developed by Bottcher (2006). The resulting BMP reduction estimates and costs for N and P are presented in Appendix A. These tables reflect the updated unit loads provided in Tables 6 and 7. Table 8 provides a summary of the P unit loads and estimated BMP reduction factors for the three categories of owner implemented, typical incentive BMPs and alternative practices. Owner implemented BMPs reflect those that would likely be implemented by land owners without incentives, while the typical incentive BMPs are those that either reasonably funded cost share program or modest regulatory approach would obtain implementation. The alternative practices are those that are more expensive but would be needed if additional nutrient reductions are needed beyond what the first two levels could obtain.

Table 9 provides the estimated existing total P load from the watershed compared to estimated BMP reductions in terms of percentages, loads, and costs for an anticipate BMP program that could be reasonably implemented over the next ten years. Tables 10 and 11 provide the same information as Tables 8 and 9 except for N instead of P. Table 10 provides a summary of the N

unit loads and estimated BMP reduction factors for the three categories of owner implemented and typical incentive BMPs and alternative practices. Table 11 provides the estimated existing total N load from the watershed compared to estimated BMP reductions in terms of percentages and loads for an anticipate BMP program that could be reasonably implemented over the next ten years. The estimated annual average implementation costs are also provided in Tables 9 and 11, which have been adjusted to 2008 costs from the 2006 costs provided in Appendix A.

Caloosahatchee River Watershed

Figure 2 shows the basins within the Caloosahatchee watershed. The 2004 land use distribution for the C-43 basin was provided by SFWMD and is presented in Table 12. As can be seen, the table provides additional land use breakdowns beyond the twenty primary land use categories required for the project. These additional data were used during the development of the unit loads, but were integrated within the twenty categories for the final tables to prevent confusion. Measured data for the major structures on the C-43 canal were provided by the SFWMD and are presented in Table 13. Because of the influence of the Lake Okeechobee releases, only the basin (Freshwater West) between the S-78 and S-79 structures were considered reliable enough for comparisons to actual land source area discharges. Unmonitored flows released from the Lake Okeechobee, Nicodemus Slough, and the S-4 basin into the Freshwater East basin were considered more problematic than potential bypass water around S-78 as documented by the WAM model results (SWET, 2008). Therefore, the loads differences between these two structures shown in Table 13 were used for verification of the land use unit loads. The high measured discharge rates are a concern and are discussed further below.

The initial estimates of the unit nutrient loads were developed from the Okeechobee Basin data provided in the BMP Letter Report (Bottcher, 2006), general Florida estimates by Harper and Baker (2003 and 2007), WMM EMC estimates developed by CDM (2007), and the WAM modeling results for the USACE (SWET, 2008). The final N and P unit loads for the C-43 basin presented in Table 14 were developed as an iterative process starting with the initial unit loads estimates linked to a basin spreadsheet where the accumulative N and P loads from each basin could be calculated by multiplying the land use acreage by the unit loads. The net N and P loads were then compared to the measured basin and basin loads to verify if the net loads were at least in the ballpark and how the calculated and measured N and P loads for each of the basins compared. It was clear that the dominant land uses in the western basins were improved pasture and citrus with limited urban around the Le Belle area. The more highly developed area is located in the western (tidal and north coastal) basins. Using just the Freshwater West basin, however, it was possible to estimate the relative importance of the various land uses and adjustments were made accordingly to obtain a reasonable agreement of runoff and nutrient loads and concentrations for each of the basins. However, it was observed that measured runoff for the Freshwater West basin seems high at 22 inches per year as seen in Table 16, which makes the units loads higher than expected. Therefore, the basin comparisons focused more on matching the concentrations because they would be less influenced by any flow errors that might be the result of unmeasured inter-basin transfers. Since the unit loads are a function of both concentration and flow, it was first necessary to establish reasonable runoff coefficients for the various land uses (Harper and Baker, 2007). The resulting annual average runoff for the various land uses are provided in Table 16. Table 16 also provides the resulting N and P unit loads and

concentrations from the iterative process of adjusting individual land use unit loads which multiplied by the acreage of each land use within the basins (Table 15) to obtain reasonable basin runoff (Table 16), P loads (Table 17), and N loads (Table 18) comparison to observed data. The P unit load factors were adjusted by hand. The N unit loads were also initially adjusted by hand, but then a global multiplier factor was used to obtain reasonable matches to observed data at the basin level. The verification for the N and P loads and concentrations are also provided in Tables 17 and 18, respectively at the bottom of the tables. Note that the net calculated loads and concentrations are slightly higher than observed data because these represent net source loads which do not reflect the additional assimilation that is expected in the streams and canals before reaching the basin outlets.

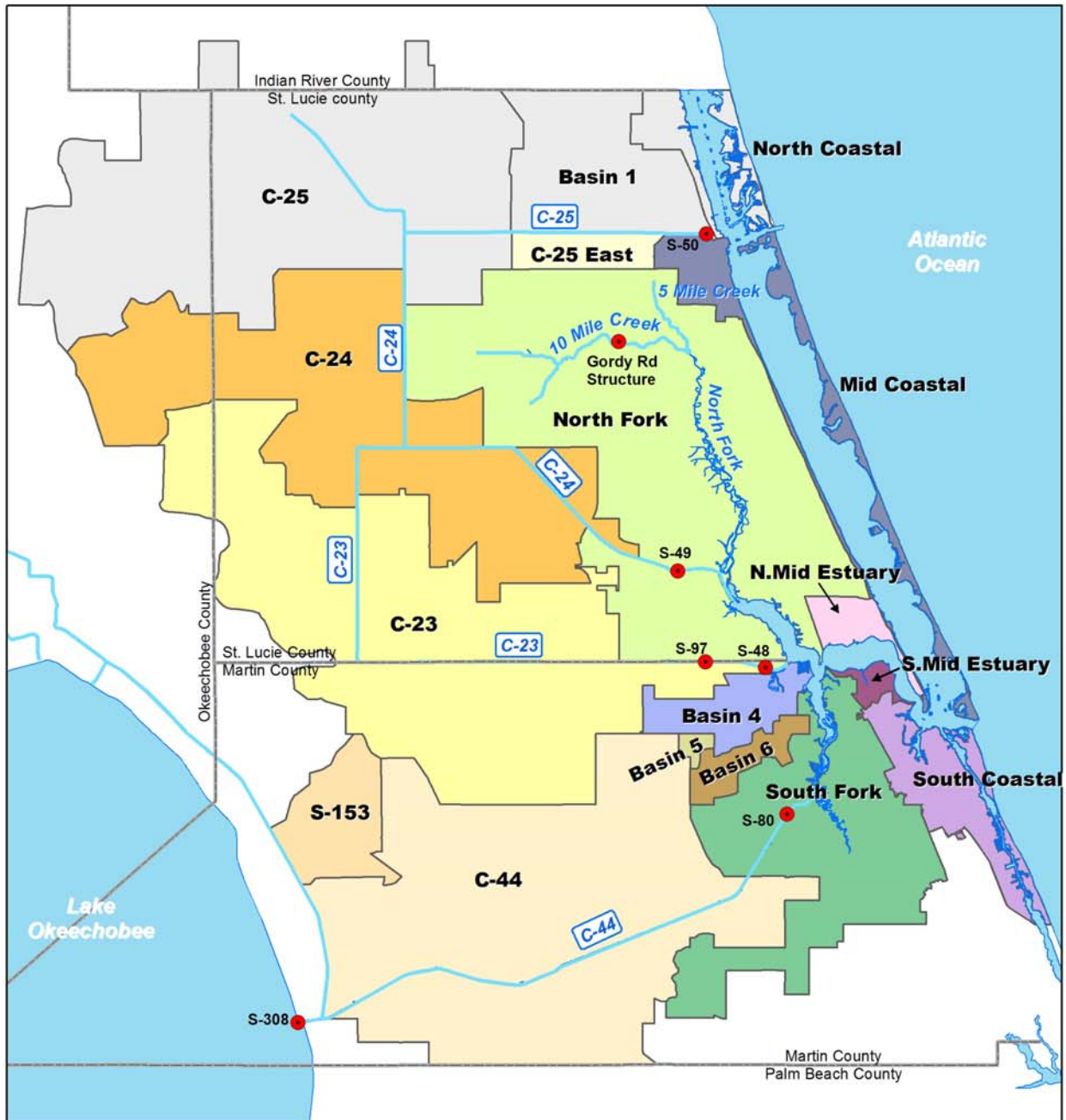
The next step was to establish BMP N and P reduction estimates for the C-43 basin. This was done by adding BMP reduction estimates for the six additional land use categories to the BMP reduction spreadsheets developed by Bottcher (2006). The resulting BMP reduction estimates and costs for N and P are presented in Appendix B. These tables reflect the updated unit loads provided in Table 14. Table 19 provides a summary of the P unit loads and estimated BMP reduction factors for the three categories of owner implemented and typical incentive BMPs and alternative practices. Owner implemented BMPs reflect those that would likely be implemented by land owners without incentives, while the typical incentive BMPs are those that either reasonably funded cost share program or modest regulatory approach would obtain implementation. The alternative practices are those that are more expensive but would be needed if additional nutrient reductions are needed beyond what the first two levels could obtain.

Table 20 provides the estimated existing total P load from the C-44 basin compared to estimated BMP reductions in terms of percentages, loads, and costs for an anticipated BMP program that could be reasonably implemented over the next ten years. Tables 21 and 22 provide the same information as Tables 19 and 20 except for N. Table 21 provides a summary of the N unit loads and estimated BMP reduction factors for the three categories of owner implemented and typical incentive BMPs and alternative practices. Table 22 provides the estimated existing total N load from the C-44 basin compared to estimated BMP reductions in terms of percentages, loads and costs for an anticipate BMP program that could be reasonably implemented over the next ten years. The estimated annual average implementation costs are also provided in Tables 20 and 22 for P and N, respectively. The costs have been adjusted to 2008 costs from the 2006 costs provided in Appendix A.

REFERENCES

- CDM. 2007. Nutrient Load Assessment Estero Bay and Caloosahatchee Watershed. Final Report to South Florida Water Management District. West Palm Beach, FL.
- Graves, G.A., Y. Wan, and D.L. Fike. 2004. Water Quality Characteristics of Storm Water From Major Land Uses in South Florida. J. American Water Resources Association. 1405:1419
- Harper, H.H. and D.M. Baker. 2003. Evaluation of Alternative Stormwater Regulations for Southwest Florida. Final Report prepared by Environmental Research and Design for the Florida Department of Environmental Protection, Tallahassee, FL.
- Harper, H.H. and D.M. Baker. 2007. Evaluation of Current Stormwater Design Criteria within the State of Florida. Final Report prepared by Environmental Research and Design for the Florida Department of Environmental Protection, Tallahassee, FL.
- SWET. 2006. Phosphorus Reduction Performance and Implementation Costs under BMPs and Technologies in the Lake Okeechobee Protection Plan Area. Letter Report to Joyce Zhang, South Florida Water Management District.
- SWET. 2008. Assessment of the Caloosahatchee River (C-43) Basin Using the WAM Model. Final Report to the US Army Corps of Engineers. Jacksonville, FL.

Figure 1. Basin Layout for the St. Lucie River Watershed



Indian River Lagoon and St. Lucie Estuary Watershed With Primary Basins

* C-25, Basin 1, and North Coastal Drainage Basins Flow directly into the Indian River Lagoon

● SFWMD Structures/ WQM Monitoring Sites

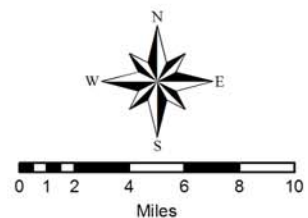


Figure 2. Basin Layout for the Caloosahatchee River Watershed

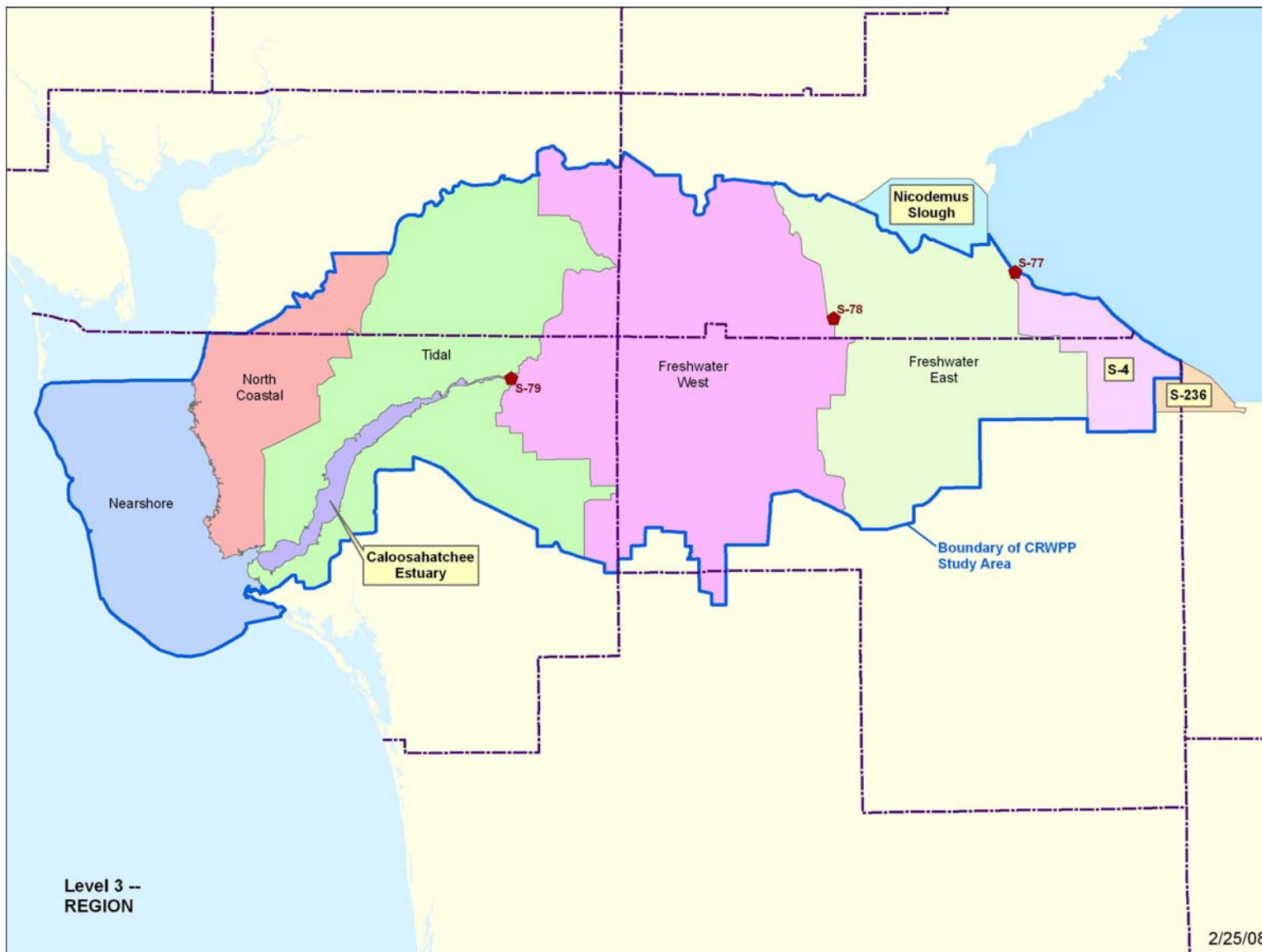


Table 1. Land Use Distribution in the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Area (ac)	Percent	Sum_Area (ac)	Percent
Residential Low Density	Residential Low Density	1100	22,050	4.29%	22,050	4.30%
Residential Medium Density	Residential Medium Density	1200	38,206	7.43%	38,206	7.40%
Residential High Density	Residential High Density	1300	7,698	1.50%	7,698	1.50%
Other Urban	Commercial and Services	1400	5,090	0.99%	15,907	3.10%
	Industrial	1500	2,034	0.40%		
	Extractive	1600	640	0.12%		
	Institutional	1700	2,977	0.58%		
	Recreational	1800	5,167	1.00%		
Improved Pastures	Improved Pastures	2110	106,321	20.67%	106,321	20.70%
Unimproved Pastures	Unimproved Pastures	2120	15,033	2.92%	15,033	2.90%
Woodland Pastures/Rangeland	Woodland Pastures	2130	25,205	4.90%	39,351	7.70%
	Rangeland	3000	14,147	2.75%		
Row Crops	Row Crops	2140	7,881	1.53%	7,881	1.50%
Sugar Cane	Sugar Cane	2156	5,562	1.08%	5,562	1.10%
Citrus	Citrus	2210	116,442	22.64%	116,442	22.60%
Sod Farms	Sod Farms	2420	294	0.06%	294	0.10%
Ornamentals	Ornamentals	2430	1,246	0.24%	1,246	0.20%
Horse Farms	Horse Farms	2510	784	0.15%	784	0.20%
Dairies	Dairies	2520	419	0.08%	419	0.10%
Other Areas	Field Crops	2150	2,800	0.54%	4,108	0.80%
	Other Groves	2230	48	0.01%		
	Cattle Feeding Operations	2310	105	0.02%		
	Poultry Feeding Operations	2320	107	0.02%		
	Tree Nurseries	2410	463	0.09%		
	Specialty Farms	2500	133	0.03%		
	Aquaculture	2540	204	0.04%		
	Fallow Crop Land	2610	248	0.05%		
Tree Plantations	Tree Plantations	4400	0	0.00%	0	0.00%
Water	Water	5000	11,411	2.22%	11,411	2.20%
Natural Areas	Upland Forests	4000	37,608	7.31%	105,380	20.50%
	Wetlands	6000	61,052	11.87%		
	Barren Land	7000	2,613	0.51%		
	Open Land	1900	4,108	0.80%		
Transportation	Transportation	8100	5,665	1.10%	5,665	1.10%
Communication/Utilities	Communication	8200	91	0.02%	10,529	2.00%
	Utilities	8300	10,438	2.03%		
Total			514,287	100.00%	514,287	100.00%

Table 2 Summary of Measured Nitrogen and Phosphorus Load to SLE

Sub-watershed	Area (acres)	Average Annual Discharge ⁽¹⁾ (1995-2005) (Acre-ft)	Calculated Runoff (in)	Average Annual TN Load ⁽²⁾ (1995-2005) (MTons)	Average Annual TN Conc. (Calculated) (1995-2005) (ppb)	Average Annual TP Load ⁽²⁾ (1995-2005) (MTons)	Average Annual TP Conc. (Calculated) (1995-2005) (ppb)
Basins 4 5 6	15055	23620	18.8	34	1182	6	218.96
C-23	112675	152789	16.3	330	1750	91	480.55
C-24	87706	178853	24.5	355	1609	76	343.25
C-44&S-153	129719	158194	14.6	300	1540	40	203.38
North Fork*	119168	126152	12.7	185	1191	43	278
Tidal St. Lucie**	49965	59408	14.3	91	1244	21	285.16
Lake Okeechobee	-	414754		922	1802	96	188.14
Total	514287	1113771		2218	1615	373	271.33

*North Fork basin includes North Fork and N. Mid. Estuary

**Tidal St. Lucie basin includes South Fork and S. Mid. Estuary

(1) Measured data are used for flow from C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for flow from North Fork basin, South Fork basin, and Basin 4 5 6.

(2) Measured data are used for TN concentration for C-23 basin, C-24 basin, C-44&S-153 basin, and Lake Okeechobee. WaSh Model output data are used for TN concentration for North Fork basin, South Fork basin, and Basin 4 5 6.

Table 3. Estimated Runoff, Unit N and P Loads and Concentration for 2004 Land Uses in the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Runoff (in/yr)	Unit N Load ()	N Conc. (mg/l)	Unit P Load (lbs/acre/yr)	P Conc. (mg/l)
Residential Low Density	Residential Low Density ¹	1100	17.57	4.95	1.25	0.49	0.12
Residential Medium Density	Residential Medium Density ²	1200	20.76	7.20	1.53	1.40	0.30
Residential High Density	Residential High Density ²	1300	23.96	10.80	1.99	3.00	0.55
Other Urban	Commercial and Services ²	1400	25.55	9.90	1.71	1.40	0.24
	Industrial ²	1500	27.15	9.00	1.47	2.40	0.39
	Extractive ²	1600	23.96	6.30	1.16	0.66	0.12
	Institutional ²	1700	23.96	6.30	1.16	2.40	0.44
	Recreational ²	1800	17.57	6.30	1.59	0.96	0.24
Improved Pastures	Improved Pastures	2110	19.16	9.99	2.30	1.90	0.44
Unimproved Pastures	Unimproved Pastures	2120	15.97	4.95	1.37	0.92	0.25
Woodland Pastures/Rangeland	Woodland Pastures	2130	15.97	3.69	1.02	0.88	0.24
	Rangeland	3000	15.97	3.69	1.02	0.28	0.08
Row Crops	Row Crops	2140	22.36	13.50	2.67	4.50	0.89
Sugar Cane	Sugar Cane	2156	19.16	7.20	1.66	0.63	0.15
Citrus	Citrus	2210	19.16	7.65	1.76	1.80	0.42
Sod Farms	Sod Farms	2420	19.16	8.10	1.87	2.52	0.58
Ornamentals	Ornamentals	2430	19.16	10.80	2.49	2.90	0.67
Horse Farms	Horse Farms	2510	15.97	14.40	3.99	1.82	0.50
Dairies	Dairies	2520	15.97	18.00	4.98	9.38	2.60
Other Areas	Field Crops	2150	15.97	5.96	1.65	2.96	0.82
	Mixed Crops	2160	19.16	9.90	2.28	3.50	0.81
	Fruit Orchards	2220	19.16	8.10	1.87	2.30	0.53
	Other Groves	2230	19.16	8.10	1.87	2.30	0.53
	Cattle Feeding Operations	2310	19.16	48.65	11.22	8.96	2.07
	Poultry Feeding Operations	2320	19.16	9.00	2.08	1.50	0.35
	Tree Nurseries	2410	15.97	10.80	2.99	2.90	0.80
	Specialty Farms	2500	15.97	7.20	1.99	1.82	0.50
	Aquaculture	2540	7.99	9.00	4.98	0.70	0.39
	Fallow Crop Land	2610	19.16	6.30	1.45	0.70	0.16
Tree Plantations	Tree Plantations	4400	15.97	2.79	0.77	0.18	0.05
Water	Water	5000	3.19	0.81	1.12	0.05	0.07
Natural Areas	Upland Forests (not including 4400's)	4000	14.37	2.25	0.69	0.28	0.09
	Wetlands	6000	1.60	1.35	3.74	0.01	0.03
	Barren Land	7000	23.96	6.30	1.16	0.75	0.14
	Open Land	1900	15.97	3.60	1.00	0.28	0.08
Transportation	Transportation	8100	27.15	8.28	1.35	1.65	0.27
Communication/Utilities	Communications	8200	15.97	5.40	1.49	0.48	0.13
	Utilities	8300	15.97	5.40	1.49	0.48	0.13

1 Assumed on Septic

2 Assumed Discharge from WWT outside basin

Table 4. Acreage of Land Uses within the St. Lucie Watershed

FLUCCS	Basins 4 5 6	C-23	C-24	C-44&S-153	North Fork*	Tidal St. Lucie**	Grand Total
1100	4315.6	1909.4	1236.1	1813.7	9445	3329.8	22049.7
1200	1236.1	303.7	2505.9	314.9	30453.4	3392.3	38206.3
1300	702.6		295	185.7	4784.2	1730.3	7697.8
1400	222.9	9	39.8	204.4	3453.9	1159.8	5089.8
1500	133.2	48.3	55.5	76.7	1552.3	167.8	2033.7
1600	0.8	411.5			92.3	135.2	639.8
1700	110.3	661.7	21.7	97.7	1567.1	518.3	2976.7
1800	683.8	254.8	665.6	209.5	2308.4	1045.2	5167.3
1900	110.8	9.8	74.7	148.7	3291.5	472.2	4107.5
2110	1006.7	33628	33949.7	23185	4998.8	9552.4	106320.6
2120	86.4	5062	6064.3	2167.9	558.4	1094.1	15033.1
2130	374.6	8697.3	6890.3	6457.9	1071.8	1712.9	25204.8
2140	156.1	1696.2	1550.3	852.5	1166.2	2459.9	7881.1
2150		1574.6	834.7	390.9			2800.2
2156				5240.1		321.7	5561.8
2210	30.2	32466.1	17487.8	42754.5	20678.2	3025.4	116442.2
2220							0
2230	5	17.1			26.2		48.3
2310		104.7					104.7
2320			44.3	62.5			106.8
2410	100.2	153.8	55.5	85.3	68.3	0.1	463.1
2420				294.1			294.1
2430	211		25.1	267.6	237.9	504.4	1246
2500				28.7	23.9	79.9	132.6
2510	53.7	54	14.1	591.6		71.1	784.4
2520		419.1					419.1
2540	60.1	70.4	23.3		9.5	40.8	204.2
2610		216.7			31.3		247.9
3000	394.5	1603.5	220.1	6383.5	3494	2051	14146.6
4000	2679	2723.8	1264.5	11535.9	12030.8	7373.6	37607.6
5000	382.5	1810.5	1218.4	1890.7	4317.3	1791.3	11410.7
6000	1262.5	16278.9	12248.2	15114.6	9485.1	6662.2	61051.5
7000		1108.1	297.8	939	235.2	33.2	2613.4
8100	297.6	455.4	521.1	611.2	2623.4	1156.6	5665.3
8200	10.9	10.2		5.6	64.3		91
8300	428.3	916.1	102.4	7808.5	1099.2	83.1	10437.6
Grand Total	15055.4	112674.5	87705.8	129718.9	119167.9	49964.7	514287.2

*North Fork basin includes North Fork and N.Mid.Estuary

**Tidal St. Lucie basin includes South Fork and S.Mid.Estuary

Table 5. Runoff in Acre-ft/yr to Stream by Land Use

FLUCCS	Basins 4 5 6	C-23	C-24	C-44&S-153	North Fork*	Tidal St. Lucie**	Grand Total
1100	6318	2795	1810	2655	13827	4875	32280
1200	2139	525	4336	545	52689	5869	66102
1300	1403	0	589	371	9551	3454	15367
1400	475	19	85	435	7355	2470	10838
1500	301	109	126	174	3512	380	4601
1600	2	821	0	0	184	270	1277
1700	220	1321	43	195	3128	1035	5942
1800	1001	373	974	307	3379	1530	7565
1900	147	13	99	198	4381	628	5467
2110	1608	53706	54219	37028	7983	15256	169799
2120	115	6737	8071	2885	743	1456	20007
2130	499	11575	9170	8595	1426	2280	33544
2140	291	3160	2889	1588	2173	4583	14684
2150	0	2096	1111	520	0	0	3727
2156	0	0	0	8369	0	514	8882
2210	48	51850	27929	68281	33024	4832	185964
2220	0	0	0	0	0	0	0
2230	8	27	0	0	42	0	77
2310	0	167	0	0	0	0	167
2320	0	0	71	100	0	0	171
2410	133	205	74	114	91	0	616
2420	0	0	0	470	0	0	470
2430	337	0	40	427	380	806	1990
2500	0	0	0	38	32	106	176
2510	71	72	19	787	0	95	1044
2520	0	558	0	0	0	0	558
2540	40	47	16	0	6	27	136
2610	0	346	0	0	50	0	396
3000	525	2134	293	8496	4650	2730	18827
4000	3209	3263	1515	13818	14410	8832	45046
5000	102	482	324	503	1149	477	3037
6000	168	2167	1630	2012	1262	887	8125
7000	0	2212	595	1875	470	66	5217
8100	673	1030	1179	1383	5935	2617	12818
8200	15	14	0	7	86	0	121
8300	570	1219	136	10392	1463	111	13891
Grand Total	20417	149043	117341	172566	173382	66183	698,932
(in/yr)	16	16	16	16	17	16	16

*North Fork basin includes North Fork and N.Mid.Estuary

**Tidal St. Lucie basin includes South Fork and S.Mid.Estuary

Table 6. Net P Loads in Pounds/year to Stream within the St. Lucie watershed by Land Use

FLUCCS	Basins 4 5 6	C-23	C-24	C-44&S-153	North Fork*	Tidal St. Lucie**	Grand Total
1100	2115	936	606	889	4628	1632	10804
1200	1731	425	3508	441	42635	4749	53489
1300	2108	0	885	557	14353	5191	23093
1400	312	13	56	286	4835	1624	7126
1500	320	116	133	184	3726	403	4881
1600	1	272	0	0	61	89	422
1700	265	1588	52	234	3761	1244	7144
1800	656	245	639	201	2216	1003	4961
1900	31	3	21	42	922	132	1150
2110	1913	63893	64504	44052	9498	18150	202009
2120	79	4657	5579	1994	514	1007	13830
2130	330	7654	6063	5683	943	1507	22180
2140	702	7633	6976	3836	5248	11070	35465
2150	0	4668	2475	1159	0	0	8301
2156	0	0	0	3301	0	203	3504
2210	54	58439	31478	76958	37221	5446	209596
2220	0	0	0	0	0	0	0
2230	12	39	0	0	60	0	111
2310	0	938	0	0	0	0	938
2320	0	0	66	94	0	0	160
2410	291	446	161	247	198	0	1343
2420	0	0	0	741	0	0	741
2430	612	0	73	776	690	1463	3613
2500	0	0	0	52	43	145	241
2510	98	98	26	1077	0	129	1428
2520	0	3931	0	0	0	0	3931
2540	42	49	16	0	7	29	143
2610	0	152	0	0	22	0	174
3000	110	449	62	1787	978	574	3961
4000	750	763	354	3230	3369	2065	10530
5000	19	91	61	95	216	90	571
6000	13	163	122	151	95	67	611
7000	0	831	223	704	176	25	1960
8100	491	751	860	1008	4329	1908	9348
8200	5	5	0	3	31	0	44
8300	206	440	49	3748	528	40	5010
Grand Total	13264	159686	125049	153531	141301	59983	652814
Conc.(ppbl)	233	384	382	319	292	325	335
Meas.Conc.(ppb)	219	481	343	203	278	285	
Lake Okee (lbs)							211200
Calc. (Mt/yr)	6	73	57	70	64	27	393
Measured (Mt/yr)	6	91	76	40	43	21	373

*North Fork basin includes North Fork and N.Mid.Estuary

**Tidal St. Lucie basin includes South Fork and S.Mid.Estuary

Table 7. Net N Loads in Pounds/year to Stream within the St. Lucie Watershed by Land Use

FLUCCS	Basins 4 5 6	C-23	C-24	C-44&S-153	North Fork*	Tidal St. Lucie**	Grand Total
1100	21362	9452	6119	8978	46753	16483	109146
1200	8900	2187	18042	2267	219264	24425	275085
1300	7588	0	3186	2006	51669	18687	83136
1400	2207	89	394	2024	34194	11482	50389
1500	1199	435	500	690	13971	1510	18303
1600	5	2592	0	0	581	852	4031
1700	695	4169	137	616	9873	3265	18753
1800	4308	1605	4193	1320	14543	6585	32554
1900	399	35	269	535	11849	1700	14787
2110	10057	335944	339158	231618	49938	95428	1062143
2120	428	25057	30018	10731	2764	5416	74414
2130	1382	32093	25425	23830	3955	6321	93006
2140	2107	22899	20929	11509	15744	33209	106395
2150	0	9384	4975	2330	0	0	16689
2156	0	0	0	37729	0	2316	40045
2210	231	248366	133782	327072	158188	23144	890783
2220	0	0	0	0	0	0	0
2230	41	139	0	0	212	0	391
2310	0	5094	0	0	0	0	5094
2320	0	0	399	563	0	0	961
2410	1082	1661	599	921	738	1	5001
2420	0	0	0	2382	0	0	2382
2430	2279	0	271	2890	2569	5448	13457
2500	0	0	0	207	172	575	955
2510	773	778	203	8519	0	1024	11295
2520	0	7544	0	0	0	0	7544
2540	541	634	210	0	86	367	1838
2610	0	1365	0	0	197	0	1562
3000	1456	5917	812	23555	12893	7568	52201
4000	6028	6129	2845	25956	27069	16591	84617
5000	310	1467	987	1531	3497	1451	9243
6000	1704	21977	16535	20405	12805	8994	82420
7000	0	6981	1876	5916	1482	209	16464
8100	2464	3771	4315	5061	21722	9577	46909
8200	59	55	0	30	347	0	491
8300	2313	4947	553	42166	5936	449	56363
Grand Total	79917	762762	616731	803355	723011	303076	3288847
Conc.(ppb)	1404	1836	1885	1670	1496	1643	1688
Meas.Conc.(ppb)	1182	1750	1609	1540	1191	1244	
Lake Okee (lbs)							2028400
Calc. (Mt/yr)	36	347	280	365	329	138	2417
Measured (Mt/yr)	34	330	355	300	185	91	2217

*North Fork basin includes North Fork and N.Mid.Estuary

**Tidal St. Lucie basin includes South Fork and S.Mid.Estuary

Table 8. Land Use Categories, Unit Load Factors, and P Reduction Factors for the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Unit P Load (lbs/acre/yr)	Estimated Phosphorus Reduction		
				Owner Implemented BMPs (1)	Typical Cost Share BMPs	Alternative Practices
Residential Low Density	Residential Low Density ¹	1100	0.49	5%	0%	0%
Residential Medium Density	Residential Medium Density ²	1200	1.40	5%	0%	0%
Residential High Density	Residential High Density ²	1300	3.00	5%	5%	0%
Other Urban	Commercial/Industrial ²	1400-1800	1.54	5%	5%	0%
Improved Pastures	Improved Pastures	2110	1.90	11%	19%	49%
Unimproved Pastures	Unimproved Pastures	2120	0.92	7%	13%	44%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	0.66	4%	6%	35%
Row Crops	Row Crops	2140	4.50	30%	30%	50%
Sugar Cane	Sugar Cane	2156	0.63	10%	23%	52%
Citrus	Citrus	2210	1.80	12%	20%	42%
Sod Farms	Sod Farms	2420	2.52	20%	27%	50%
Ornamentals	Ornamentals	2430	2.90	32%	35%	50%
Horse Farms	Horse Farms	2510	1.82	20%	22%	49%
Dairies	Dairies	2520	9.38	9%	28%	48%
Other Areas	Other Areas	2150-2610	2.78	15%	25%	36%
Tree Plantations	Tree Plantations	4400	0.18	1%	10%	50%
Water	Water	5000	0.05	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	0.14	0%	0%	0%
Transportation	Transportation	8100	1.65	10%	23%	52%
Communication/Utilities	Communication/Utilities	8200/8300	0.48	5%	5%	0%

¹ Assumed on Septic

² Assumed all of Discharge from WWT outside basin

Table 9. Land Use Categories, Unit Load Factors, and Estimated P Reduction Factors Using 2004 Land Use for the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit P Load (lbs/acre/yr)	Total P (MT/yr)	Estimated P Reduction		Annual Cost (\$)
						(percent)	(MT/yr)	
Residential Low Density	Residential Low Density ¹	1100	4.29%	0.49	4.9	5%	0.2	25,288,704
Residential Medium Density	Residential Medium Density ²	1200	7.43%	1.40	24.3	5%	1.2	43,817,697
Residential High Density	Residential High Density ²	1300	1.50%	3.00	10.5	10%	1.0	17,657,364
Other Urban	Commercial/Industrial ²	1400-1800	3.09%	1.54	11.2	10%	1.1	32,580,227
Improved Pastures	Improved Pastures	2110	20.67%	1.90	91.8	30%	27.5	1,886,220
Unimproved Pastures	Unimproved Pastures	2120	2.92%	0.92	6.3	20%	1.3	71,119
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.65%	0.66	11.9	10%	1.2	166,222
Row Crops	Row Crops	2140	1.53%	4.50	16.1	60%	9.7	621,401
Sugar Cane	Sugar Cane	2156	1.08%	0.63	1.6	33%	0.5	219,276
Citrus	Citrus	2210	22.64%	1.80	95.3	32%	30.5	9,781,128
Sod Farms	Sod Farms	2420	0.06%	2.52	0.3	47%	0.2	11,591
Ornamentals	Ornamentals	2430	0.24%	2.90	1.6	67%	1.1	98,245
Horse Farms	Horse Farms	2510	0.15%	1.82	0.6	42%	0.3	12,982
Dairies	Dairies	2520	0.08%	9.38	1.8	37%	0.7	490,398
Other Areas	Other Areas	2150-2610	0.80%	2.78	5.2	40%	2.1	65,079
Tree Plantations	Tree Plantations	4400	0.00%	0.18	0.0	11%	0.0	0
Water	Water	5000	2.22%	0.05	0.3	0%	0.0	0
Natural Areas	Forrests/wetlands/Open	4000/6000	20.49%	0.14	6.5	0%	0.0	0
Transportation	Transportation	8100	1.10%	1.65	4.2	33%	1.4	223,337
Communication/Utilities	Communication/Utilities	8200/8300	2.05%	0.48	2.3	10%	0.2	6,711,109
Total Basin			100.00%	1.22	286	28%	79	122,044,735

1 Assumed on Septic

2 Assumed all of Discharge from WWT outside basin

Table 10. Land Use Categories, Unit Load Factors, and N Reduction Factors for the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Unit N Load (lbs/acre/yr)	Estimated Nitrogen Reduction		
				Owner Implemented BMPs	Typical Incentive BMPs	Alternative Practices
Residential Low Density	Residential Low Density ¹	1100	4.95	15%	15%	15%
Residential Medium Density	Residential Medium Density ²	1200	7.20	25%	25%	15%
Residential High Density	Residential High Density ²	1300	10.80	30%	25%	15%
Other Urban	Commercial/Industrial ²	1400-1800	7.80	25%	25%	15%
Improved Pastures	Improved Pastures	2110	9.99	17%	10%	30%
Unimproved Pastures	Unimproved Pastures	2120	4.95	11%	8%	30%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	3.69	4%	6%	20%
Row Crops	Row Crops	2140	13.50	30%	30%	50%
Sugar Cane	Sugar Cane	2156	7.20	10%	23%	52%
Citrus	Citrus	2210	7.65	10%	20%	42%
Sod Farms	Sod Farms	2420	8.10	20%	27%	50%
Ornamentals	Ornamentals	2430	10.80	25%	25%	25%
Horse Farms	Horse Farms	2510	14.40	30%	22%	30%
Dairies	Dairies	2520	18.00	20%	40%	48%
Other Areas	Other Areas	2150-2610	7.91	15%	25%	36%
Tree Plantations	Tree Plantations	4400	2.79	5%	10%	25%
Water	Water	5000	0.81	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	1.88	0%	0%	0%
Transportation	Transportation	8100	8.28	20%	23%	25%
Communication/Utilities	Communication/Utilities	8200/8300	5.40	30%	25%	15%

¹ Assumed on Septic

² Assumed all of Discharge from WWT outside basin

Table 11. Land Use Categories, Unit Load Factors, and Estimated N Reduction Factors Using 2004 Land Use for the St. Lucie Watershed

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit N Load (lbs/acre/yr)	Total N (MT/yr)	Estimated N Reduction		Annual Cost (\$)
						(percent)	(MT/yr)	
Residential Low Density	Residential Low Density ¹	1100	4.29%	4.95	49.6	30%	14.9	34,543,867
Residential Medium Density	Residential Medium Density ²	1200	7.43%	7.20	125.0	50%	62.5	59,891,448
Residential High Density	Residential High Density ²	1300	1.50%	10.80	37.8	55%	20.8	12,067,329
Other Urban	Commercial/Industrial ²	1400-1800	3.09%	7.80	56.4	55%	31.0	26,857,201
Improved Pastures	Improved Pastures	2110	20.67%	9.99	482.8	27%	130.4	1,286,059
Unimproved Pastures	Unimproved Pastures	2120	2.92%	4.95	33.8	19%	6.4	43,872
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.65%	3.69	66.0	10%	6.6	126,934
Row Crops	Row Crops	2140	1.53%	13.50	48.4	60%	29.0	423,683
Sugar Cane	Sugar Cane	2156	1.08%	7.20	18.2	33%	6.0	150,594
Citrus	Citrus	2210	22.64%	7.65	404.9	30%	121.5	13,942,553
Sod Farms	Sod Farms	2420	0.06%	8.10	1.1	47%	0.5	7,903
Ornamentals	Ornamentals	2430	0.24%	10.80	6.1	50%	3.1	49,989
Horse Farms	Horse Farms	2510	0.15%	14.40	5.1	52%	2.7	9,483
Dairies	Dairies	2520	0.08%	18.00	3.4	60%	2.1	298,538
Other Areas	Other Areas	2150-2610	0.80%	7.91	14.8	40%	5.9	57,682
Tree Plantations	Tree Plantations	4400	0.00%	2.79	0.0	15%	0.0	0
Water	Water	5000	2.22%	0.81	4.2	0%	0.0	0
Natural Areas	Forrests/wetlands/Open	4000/6000	20.49%	1.88	90.1	0%	0.0	0
Transportation	Transportation	8100	1.10%	8.28	21.3	43%	9.2	201,666
Communication/Utilities	Communication/Utilities	8200/8300	2.05%	5.40	25.8	55%	14.2	12,310,996
Total Basin			100%	6.23	1,457	31%	446	150,202,466

1 Assumed on Septic

2 Assumed all of Discharge from WWT outside basin

Table 12. Land Use Distribution for the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Area (ac)	Percent	Area (ac)	Percent
Residential Low Density	Residential Low Density	1100	76,863	7.12%	76,863	7.10%
Residential Medium Density	Residential Medium Density	1200	33,396	3.09%	33,396	3.10%
Residential High Density	Residential High Density	1300	11,453	1.06%	11,453	1.10%
Other Urban	Commercial and Services	1400	8,906	0.82%	23,568	2.20%
	Industrial	1500	2,648	0.25%		
	Extractive	1600	2,278	0.21%		
	Institutional	1700	3,675	0.34%		
	Recreational	1800	6,062	0.56%		
Improved Pastures	Improved Pastures	2110	117,152	10.85%	117,152	10.80%
Unimproved Pastures	Unimproved Pastures	2120	23,827	2.21%	23,827	2.20%
Woodland Pastures/Rangeland	Woodland Pastures	2130	20,280	1.88%	78,130	7.20%
	Rangeland	3000	57,850	5.36%		
Row Crops	Row Crops	2140	9,656	0.89%	9,656	0.90%
Sugar Cane	Sugar Cane	2156	87,741	8.13%	87,741	8.10%
Citrus	Citrus	2210	96,684	8.95%	96,684	9.00%
Sod Farms	Sod Farms	2420	5,070	0.47%	5,070	0.50%
Ornamentals	Ornamentals	2430	861	0.08%	861	0.10%
Horse Farms	Horse Farms	2510	202	0.02%	202	0.00%
Dairies	Dairies	2520	56	0.01%	56	0.00%
Other Areas	Field Crops	2150	5,326	0.49%	10,909	1.00%
	Mixed Crops	2160	17	0.00%		
	Fruit Orchards	2220	12	0.00%		
	Other Groves	2230	1,995	0.18%		
	Tree Nurseries	2410	971	0.09%		
	Specialty Farms	2500	165	0.02%		
	Aquaculture	2540	215	0.02%		
Other Areas	Fallow Crop Land	2610	2,209	0.20%		
Tree Plantations	Tree Plantations	4400	42,498	3.94%	42,498	3.90%
Water	Water	5000	130,368	12.07%	130,368	12.10%
Natural Areas	Upland Forests (not including 4400's)	4000	84,379	7.81%	324,289	30.00%
	Wetlands	6000	184,666	17.10%		
	Barren Land	7000	5,866	0.54%		
	Open Land	1900	49,378	4.57%		
Transportation	Transportation	8100	4,915	0.46%	4,915	0.50%
Communication/Utilities	Communications	8200	96	0.01%	2,159	0.20%
	Utilities	8300	2,063	0.19%		
Total			1,079,796	100.00%	1,079,796	100.00%

Table 13. Summary of Annual Flow and Loads for TP and TN along the main stem of the Caloosahatchee River (C-43 Canal)

Calendar Year	S-77 (02292000)					S-78 (02292480)					S-79 (02292900)					Basin Between S78 and S79				
	Flow	TP Load	TP Conc.	TN Load	TN Conc.	Flow	TP Load	TP Conc.	TN Load	TN Conc.	Flow	TP Load	TP Conc.	TN Load	TN Conc.	Flow	TP Load	TP Conc.	TN Load	TN Conc.
	acre-feet	mtons	ug/L	mtons	mg/L	acre-feet	mtons	ug/L	mtons	mg/L	acre-feet	mtons	ug/L	mtons	mg/L	acre-feet	mtons	ug/L	mtons	mg/L
1990	120,575	14.0	94	237.6	1.60	174,966	33.0	153	322.4	1.49	423,951	101.0	193	936.9	1.79	248,986	68	222	614	2.00
1991	63,594	7.3	93	136.2	1.74	288,783	72.1	202	670.0	1.88	922,265	193.2	170	1,890.5	1.66	633,481	121	155	1,221	1.56
1992	193,275	22.9	96	344.7	1.45	437,933	93.2	172	756.4	1.40	943,491	406.5	349	2,198.8	1.89	505,559	313	502	1,442	2.31
1993	500,243	30.7	50	1,382.3	2.24	645,118	68.2	86	972.4	1.22	1,230,588	182.0	120	2,334.1	1.54	585,470	114	158	1,362	1.89
1994	770,253	50.7	53	1,345.0	1.42	1,044,125	119.2	93	2,201.9	1.71	1,633,414	216.6	108	3,380.2	1.68	589,289	97	134	1,178	1.62
1995	2,110,116	113.5	44	4,311.3	1.66	2,381,744	186.4	63	3,244.1	1.10	3,379,883	314.1	75	5,482.4	1.32	998,139	128	104	2,238	1.82
1996	474,489	47.0	80	797.6	1.36	568,330	58.2	83	853.6	1.22	941,009	129.5	112	1,647.2	1.42	372,680	71	155	794	1.73
1997	158,049	16.2	83	393.5	2.02	290,448	36.2	101	661.3	1.85	756,311	114.8	123	1,413.3	1.51	465,864	79	137	752	1.31
1998	1,618,473	135.5	68	2,988.8	1.50	1,831,790	204.9	91	3,216.9	1.42	2,613,724	296.8	92	4,309.0	1.34	781,933	92	95	1,092	1.13
1999	564,104	52.4	75	945.3	1.36	848,093	123.6	118	1,602.2	1.53	1,578,821	324.1	166	3,041.8	1.56	730,729	201	222	1,440	1.60
2000	477,520	104.7	178	1,683.5	2.86	409,244	47.1	93	687.8	1.36	619,878	118.6	155	1,061.9	1.39	210,634	71	275	374	1.44
2001	72,771	9.0	101	172.2	1.92	176,661	66.0	303	462.5	2.12	835,815	232.8	226	1,694.6	1.64	659,154	167	205	1,232	1.52
2002	466,052	57.4	100	969.6	1.69	888,496	154.4	141	1,774.4	1.62	1,491,120	318.2	173	3,166.7	1.72	602,624	164	220	1,392	1.87
2003	1,396,713	101.5	59	2,454.0	1.42	1,745,887	209.3	97	3,239.4	1.50	2,589,761	335.0	105	4,529.1	1.42	843,874	126	121	1,290	1.24
2004	1,120,739	127.3	92	2,146.6	1.55	1,247,980	128.0	83	1,996.4	1.30	1,853,038	230.2	101	2,815.2	1.23	605,058	102	137	819	1.10
2005	2,266,435	384.6	138	4,597.7	1.64	2,898,397	476.4	133	5,821.6	1.63	3,734,684	577.7	125	6,740.1	1.46	836,287	101	98	918	0.89
2006	353,758	65.1	149	732.9	1.68	463,033	88.2	154	856.5	1.50	920,989	193.0	170	1,689.2	1.49	457,956	105	186	833	1.47
1990-2006	748,656	78.8	85	1,508.2	1.63	961,237	127.3	107	1,725.9	1.46	1,556,985	252.0	131	2,843.0	1.48	595,748	125	170	1,117	1.52
1995-2005	975,042	104.5	87	1,950.9	1.62	1,207,915	153.7	103	2,141.8	1.44	1,854,004	272.0	119	3,263.7	1.43	646,089	118	148	1,122	1.41

Table 14. Estimated Runoff, Unit N and P Loads and Concentration for 2004 Land Uses in the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Runoff (in/yr)	Unit N Load (lbs/acre/yr)	N Conc. (mg/l)	Unit P Load (lbs/acre/yr)	P Conc. (mg/l)
Residential Low Density	Residential Low Density ¹	1100	27.4313	7.26	1.17	0.68	0.11
Residential Medium Density	Residential Medium Density ²	1200	32.4188	10.56	1.44	1.93	0.26
Residential High Density	Residential High Density ²	1300	39.9	15.84	1.75	4.14	0.46
Other Urban	Commercial and Services ²	1400	39.9	14.52	1.61	1.93	0.21
	Industrial ²	1500	42.3938	13.20	1.38	3.31	0.35
	Extractive ²	1600	37.4063	9.24	1.09	0.91	0.11
	Institutional ²	1700	37.4063	9.24	1.09	3.31	0.39
	Recreational ²	1800	27.4313	9.24	1.49	1.32	0.21
Improved Pastures	Improved Pastures	2110	29.925	14.65	2.16	1.93	0.29
Unimproved Pastures	Unimproved Pastures	2120	24.9375	7.26	1.29	0.99	0.18
Woodland Pastures/Rangeland	Woodland Pastures	2130	24.9375	5.41	0.96	0.83	0.15
	Rangeland	3000	19.95	5.41	1.20	0.25	0.06
Row Crops	Row Crops	2140	34.9125	19.80	2.51	3.45	0.44
Sugar Cane	Sugar Cane	2156	29.925	10.56	1.56	0.55	0.08
Citrus	Citrus	2210	29.925	11.22	1.66	0.90	0.13
Sod Farms	Sod Farms	2420	29.925	11.88	1.75	2.79	0.41
Ornamentals	Ornamentals	2430	29.925	15.84	2.34	4.00	0.59
Horse Farms	Horse Farms	2510	24.9375	21.12	3.74	2.51	0.45
Dairies	Dairies	2520	24.9375	26.40	4.68	12.94	2.29
Other Areas	Field Crops	2150	24.9375	8.74	1.55	4.09	0.73
	Mixed Crops	2160	29.925	14.52	2.14	4.83	0.71
	Fruit Orchards	2220	29.925	11.88	1.75	3.17	0.47
	Other Groves	2230	29.925	11.88	1.75	3.17	0.47
	Cattle Feeding Operations	2310	29.925	71.35	10.54	12.37	1.83
	Poultry Feeding Operations	2320	29.925	13.20	1.95	2.07	0.31
	Tree Nurseries	2410	24.9375	15.84	2.81	4.00	0.71
	Specialty Farms	2500	24.9375	10.56	1.87	2.51	0.45
	Aquaculture	2540	12.4688	13.20	4.68	0.97	0.34
	Fallow Crop Land	2610	29.925	9.24	1.36	0.97	0.14
Tree Plantations	Tree Plantations	4400	14.9625	4.09	1.21	0.21	0.06
Water	Water	5000	4.9875	1.19	1.05	0.07	0.06
Natural Areas	Upland Forests (not including 4400's)	4000	14.9625	3.30	0.97	0.10	0.03
	Wetlands	6000	7.48125	1.98	1.17	0.01	0.01
	Barren Land	7000	37.4063	9.24	1.09	1.04	0.12
	Open Land	1900	24.9375	5.28	0.94	0.39	0.07
Transportation	Transportation	8100	49.875	12.14	1.08	2.28	0.20
Communication/Utilities	Communications	8200	27.4313	7.92	1.28	0.66	0.11
	Utilities	8300	24.9375	7.92	1.40	0.66	0.12

1 Assumed on Septic

2 Assumed about 70% of Discharge from WWT outside basin

Table 15. Acreage of Land Uses within the Caloosahatchee Watershed

FLUCCS	Caloosahatchee Estuary	Freshwater East	Freshwater West	Nearshore	North Coastal	S-4	Tidal	Grand Total
1100	19	3,015	14,869	4236	24,084	548	30,092	76,863
1200	65	383	1,758	1741	1,825	1,506	26,118	33,396
1300	15	59	398	983	1,434	77	8,486	11,453
1400	8	191	688	421	384	428	6,787	8,906
1500		236	445	6	23	1,264	673	2,648
1600		553	22	3	340	68	1,292	2,278
1700	0	105	245	91	475	213	2,545	3,675
1800	11	76	472	1193	1,039	257	3,014	6,062
1900	1	2,437	25,047	522	6,947	204	14,220	49,378
2110	1	36,795	55,555	231	2,381	797	21,392	117,152
2120		5,752	12,736	30	436		4,873	23,827
2130	3	5,924	10,033	67	83		4,171	20,280
2140		1,080	6,354	363	228		1,632	9,656
2150		422	1,269	8	56	38	3,533	5,326
2156		52,751	2,058			32,932		87,741
2160			17					17
2210		26,593	69,008	193		66	824	96,684
2220							12	12
2230			53	1793	6		143	1,995
2410		174	111	185		270	230	971
2420		289	2,947				1,833	5,070
2430		16	369	160	15		300	861
2500			79			17	68	165
2510		140	38				24	202
2520		18					38	56
2540		27	91				97	215
2610		133	1,124	80	68		803	2,209
3000	50	4,966	21,510	3087	8,929	278	19,030	57,850
4000	51	7,791	23,793	3396	10,881	359	38,108	84,379
4400		12,923	28,403		69		1,103	42,498
5000	15780	2,061	3,639	94206	6,848	717	7,117	130,368
6000	275	30,329	63,513	24493	21,682	1,193	43,181	184,666
7000		1,910	2,244	67	456	675	514	5,866
8100	6	741	645	36	488	330	2,668	4,915
8200		20	24		10		42	96
8300	1	388	171	62	395	268	777	2,063
Grand Total	16,285	198,299	349,734	137653	89,583	42,504	245,738	1,079,796

Table 16. Runoff in Acre-ft/year to Streams within the Caloosahatchee Watershed

FLUCCS	Caloosahatchee Estuary	Freshwater East	Freshwater West	Nearshore	North Coastal	S-4	Tidal	Grand Total
1100	43	6892	33990	9683	55055	1253	68788	175704
1200	176	1035	4749	4703	4930	4069	70559	90221
1300	50	196	1323	3268	4768	256	28216	38081
1400	27	635	2288	1400	1277	1423	22567	29612
1500	0	834	1572	21	81	4465	2378	9355
1600	0	1724	69	9	1060	212	4027	7101
1700	0	327	764	284	1481	664	7933	11456
1800	25	174	1079	2727	2375	587	6890	13857
1900	2	5064	52051	1085	14437	424	29551	102614
2110	2	91758	138540	576	5938	1988	53346	292148
2120	0	11953	26467	62	906	0	10127	49515
2130	6	12311	20850	139	172	0	8668	42144
2140	0	3142	18486	1056	663	0	4748	28093
2150	0	877	2637	17	116	79	7342	11068
2156	0	131548	5132	0	0	82124	0	218804
2160	0	0	42	0	0	0	0	42
2210	0	66316	172089	481	0	165	2055	241106
2220	0	0	0	0	0	0	30	30
2230	0	0	132	4471	15	0	357	4975
2410	0	362	231	384	0	561	478	2018
2420	0	721	7349	0	0	0	4571	12643
2430	0	40	920	399	37	0	748	2147
2500	0	0	164	0	0	35	141	343
2510	0	291	79	0	0	0	50	420
2520	0	37	0	0	0	0	79	116
2540	0	28	95	0	0	0	101	223
2610	0	332	2803	200	170	0	2002	5509
3000	83	8256	35760	5132	14844	462	31637	96176
4000	64	9714	29667	4234	13567	448	47516	105210
4400	0	16113	35415	0	86	0	1375	52990
5000	6559	857	1512	39154	2846	298	2958	54184
6000	171	18908	39596	15270	13517	744	26921	115128
7000	0	5954	6995	209	1421	2104	1602	18285
8100	25	3080	2681	150	2028	1372	11089	20428
8200	0	46	55	0	23	0	96	219
8300	2	806	355	129	821	557	1615	4287
Total (ac-ft)	7,235	400,330	645,938	95,245	142,636	104,289	460,562	1,856,254

Verification

Calculated Runoff 645,938
 Measured Runoff 646,089
 (inches) 22.17

Table 17. Net P Loads in Pounds/year to Stream within the Caloosahatchee watershed

FLUCCS	Caloosahatchee Estuary	Freshwater East	Freshwater West	Nearshore	North Coastal	S-4	Tidal	Grand Total
1100	12.8	2038.7	10054.4	2864.4	16285.6	370.6	20348.2	51974.8
1200	125.6	740.0	3396.5	3363.6	3525.9	2909.6	50460.0	64521.1
1300	62.1	244.3	1647.7	4069.6	5936.8	318.8	35132.0	47415.4
1400	15.5	369.0	1329.2	813.4	741.9	826.9	13112.5	17206.4
1500	0.0	781.6	1473.8	19.9	76.2	4186.4	2229.0	8770.2
1600	0.0	503.7	20.0	2.7	309.7	61.9	1176.8	2074.8
1700	0.0	347.8	811.4	301.4	1573.2	705.5	8429.0	12171.6
1800	14.6	100.7	625.3	1580.5	1376.5	340.5	3992.9	8030.9
1900	0.4	941.7	9678.2	201.7	2684.3	78.8	5494.6	19079.7
2110	1.9	71087.9	107332.3	446.3	4600.1	1539.8	41329.3	226337.7
2120	0.0	5715.2	12654.5	29.8	433.2	0.0	4841.8	23674.5
2130	2.5	4905.1	8307.3	55.5	68.7	0.0	3453.6	16791.8
2140	0.0	3726.0	21921.3	1252.4	786.6	0.0	5630.4	33313.2
2150	0.0	1726.5	5191.6	32.7	229.1	155.5	14454.0	21789.4
2156	0.0	29118.6	1136.0	0.0	0.0	18178.5	0.0	48433.0
2160	0.0	0.0	82.1	0.0	0.0	0.0	0.0	82.1
2210	0.0	23853.9	61900.2	173.1	0.0	59.2	739.1	86725.5
2220	0.0	0.0	0.0	0.0	0.0	0.0	38.1	38.1
2230	0.0	0.0	168.2	5691.0	19.0	0.0	453.9	6332.1
2410	0.0	696.3	444.2	740.4	0.0	1080.5	920.5	3885.9
2420	0.0	805.6	8215.1	0.0	0.0	0.0	5109.7	14133.1
2430	0.0	64.0	1476.7	640.3	60.0	0.0	1200.6	3445.7
2500	0.0	0.0	198.4	0.0	0.0	42.7	170.8	414.4
2510	0.0	351.6	95.4	0.0	0.0	0.0	60.3	507.3
2520	0.0	233.0	0.0	0.0	0.0	0.0	491.9	724.9
2540	0.0	26.1	87.9	0.0	0.0	0.0	93.7	207.7
2610	0.0	128.5	1085.8	77.3	65.7	0.0	775.7	2133.9
3000	12.4	1233.6	5343.1	766.8	2218.0	69.1	4727.1	14369.9
4000	4.9	752.6	2298.4	328.1	1051.1	34.7	3681.2	8151.0
4400	0.0	2675.1	5879.4	0.0	14.3	0.0	228.3	8797.1
5000	1088.8	142.2	251.1	6500.2	472.5	49.5	491.1	8995.4
6000	3.8	418.5	876.5	338.0	299.2	16.5	595.9	2548.4
7000	0.0	1976.9	2322.5	69.3	472.0	698.6	532.0	6071.3
8100	13.7	1687.3	1468.7	82.0	1111.2	751.4	6075.0	11191.5
8200	0.0	13.2	15.9	0.0	6.6	0.0	27.8	63.6
8300	0.7	257.0	113.3	41.1	261.6	177.5	514.7	1366.5
Grand Total	1359.6	157662.0	277902.6	30481.4	44679.0	32652.3	237011.4	781770.1

Verification Data for Freshwater West

Calculated	277,903 lbs/year 0.158 mg/l
Measured	260,240 lbs/year 0.148 mg/l

Table 18. Net N Loads in Pounds/year to Stream within the Caloosahatchee Watershed

FLUCCS	Caloosahatchee Estuary	Freshwater East	Freshwater West	Nearshore	North Coastal	S-4	Tidal	Grand Total
1100	137.9	21888.9	107948.9	30753.4	174849.8	3978.5	218467.9	558025.4
1200	686.4	4044.5	18564.5	18385.0	19272.0	15903.4	275806.1	352661.8
1300	237.6	934.6	6304.3	15570.7	22714.6	1219.7	134418.2	181415.5
1400	116.2	2773.3	9989.8	6112.9	5575.7	6214.6	98547.2	129315.1
1500	0.0	3115.2	5874.0	79.2	303.6	16684.8	8883.6	34953.6
1600	0.0	5109.7	203.3	27.7	3141.6	628.3	11938.1	21048.7
1700	0.0	970.2	2263.8	840.8	4389.0	1968.1	23515.8	33957.0
1800	101.6	702.2	4361.3	11023.3	9600.4	2374.7	27849.4	56012.9
1900	5.3	12867.4	132248.2	2756.2	36680.2	1077.1	75081.6	260715.8
2110	14.7	539120.3	813991.9	3384.6	34886.4	11677.6	313435.6	1716511.1
2120	0.0	41759.5	92463.4	217.8	3165.4	0.0	35378.0	172984.0
2130	16.2	32060.7	54298.6	362.6	449.2	0.0	22573.5	109755.4
2140	0.0	21384.0	125809.2	7187.4	4514.4	0.0	32313.6	191188.8
2150	0.0	3688.8	11092.6	69.9	489.5	332.2	30882.7	46555.7
2156	0.0	557050.6	21732.5	0.0	0.0	347761.9	0.0	926545.0
2160	0.0	0.0	246.8	0.0	0.0	0.0	0.0	246.8
2210	0.0	298373.5	774269.8	2165.5	0.0	740.5	9245.3	1084794.5
2220	0.0	0.0	0.0	0.0	0.0	0.0	142.6	142.6
2230	0.0	0.0	629.6	21300.8	71.3	0.0	1698.8	23700.6
2410	0.0	2756.2	1758.2	2930.4	0.0	4276.8	3643.2	15380.6
2420	0.0	3433.3	35010.4	0.0	0.0	0.0	21776.0	60231.6
2430	0.0	253.4	5845.0	2534.4	237.6	0.0	4752.0	13638.2
2500	0.0	0.0	834.2	0.0	0.0	179.5	718.1	1742.4
2510	0.0	2956.8	802.6	0.0	0.0	0.0	506.9	4266.2
2520	0.0	475.2	0.0	0.0	0.0	0.0	1003.2	1478.4
2540	0.0	356.4	1201.2	0.0	0.0	0.0	1280.4	2838.0
2610	0.0	1228.9	10385.8	739.2	628.3	0.0	7419.7	20411.2
3000	270.6	26876.0	116412.1	16706.8	48323.7	1504.5	102990.4	313084.2
4000	168.3	25710.3	78516.9	11206.8	35907.3	1184.7	125756.4	278450.7
4400	0.0	52880.9	116225.1	0.0	282.3	0.0	4513.5	173901.8
5000	18746.6	2448.5	4323.1	111916.7	8135.4	851.8	8455.0	154877.2
6000	544.5	60051.4	125755.7	48496.1	42930.4	2362.1	85498.4	365638.7
7000	0.0	17648.4	20734.6	619.1	4213.4	6237.0	4749.4	54201.8
8100	72.9	8998.7	7832.9	437.2	5926.3	4007.5	32400.2	59687.8
8200	0.0	158.4	190.1	0.0	79.2	0.0	332.6	760.3
8300	7.9	3073.0	1354.3	491.0	3128.4	2122.6	6153.8	16339.0
Grand Total	21126.7	1755149.1	2709474.5	316315.7	469895.4	433287.9	1732127.1	7437458.4

Verification

Calculated	2,709,474 lbs/year 1.54 mg/l
Measured	2,468,224 lbs/year 1.41 mg/l

Table 19. Land Use Categories, Unit Load Factors, and P Reduction Factors for the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Unit P Load (lbs/acre/yr)	Estimated Phosphorus Reduction		
				Owner Implemented BMPs	Typical Incentive BMPs	Alternative Practices
Residential Low Density	Residential Low Density ¹	1100	0.68	5%	5%	0%
Residential Medium Density	Residential Medium Density ²	1200	1.93	5%	5%	0%
Residential High Density	Residential High Density ²	1300	4.14	5%	5%	0%
Other Urban	Commercial/Industrial ²	1400-1800	2.05	5%	5%	0%
Improved Pastures	Improved Pastures	2110	1.93	11%	19%	49%
Unimproved Pastures	Unimproved Pastures	2120	0.99	7%	13%	44%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	0.40	4%	6%	35%
Row Crops	Row Crops	2140	3.45	30%	30%	50%
Sugar Cane	Sugar Cane	2156	0.55	10%	23%	52%
Citrus	Citrus	2210	0.90	12%	20%	42%
Sod Farms	Sod Farms	2420	2.79	20%	27%	50%
Ornamentals	Ornamentals	2430	4.00	32%	35%	50%
Horse Farms	Horse Farms	2510	2.51	20%	22%	49%
Dairies	Dairies	2520	12.94	9%	28%	48%
Other Areas	Other Areas	2150-2610	3.20	15%	25%	36%
Tree Plantations	Tree Plantations	4400	0.21	1%	10%	50%
Water	Water	5000	0.07	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	0.11	0%	0%	0%
Transportation	Transportation	8100	2.28	10%	23%	52%
Communication/Utilities	Communication/Utilities	8200/8300	0.66	5%	5%	0%

1 Assumed on Septic

2 Assumed about 70% of Discharge from WWT outside basin

Table 20. Land Use Categories, Unit Load Factors, and Estimated P Reduction Factors Using 2004 Land Use for the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit P Load (lbs/acre/yr)	Total P (MT/yr)	Estimated P Reduction		Annual Cost (\$)
						(percent)	(MT/yr)	
Residential Low Density	Residential Low Density ¹	1100	7.12%	0.68	23.6	10%	2.4	176,305,275
Residential Medium Density	Residential Medium Density ²	1200	3.09%	1.93	29.3	10%	2.9	76,602,409
Residential High Density	Residential High Density ²	1300	1.06%	4.14	21.6	10%	2.2	26,270,433
Other Urban	Commercial/Industrial ²	1400-1800	2.18%	2.05	21.9	10%	2.2	54,061,629
Improved Pastures	Improved Pastures	2110	10.85%	1.93	102.9	30%	30.9	2,078,370
Unimproved Pastures	Unimproved Pastures	2120	2.21%	0.99	10.8	20%	2.2	112,723
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.24%	0.40	14.2	10%	1.4	369,624
Row Crops	Row Crops	2140	0.89%	3.45	15.1	60%	9.1	761,356
Sugar Cane	Sugar Cane	2156	8.13%	0.55	22.0	33%	7.3	3,459,101
Citrus	Citrus	2210	8.95%	0.90	39.4	32%	12.6	8,121,456
Sod Farms	Sod Farms	2420	0.47%	2.79	6.4	47%	3.0	199,880
Ornamentals	Ornamentals	2430	0.08%	4.00	1.6	67%	1.0	67,888
Horse Farms	Horse Farms	2510	0.02%	2.51	0.2	42%	0.1	3,345
Dairies	Dairies	2520	0.01%	12.94	0.3	37%	0.1	65,542
Other Areas	Other Areas	2150-2610	1.01%	3.20	15.9	40%	6.3	193,552
Tree Plantations	Tree Plantations	4400	3.94%	0.21	4.0	11%	0.4	1,204,103
Water	Water	5000	12.07%	0.07	4.1	0%	0.0	0
Natural Areas	Forrests/wetlands/Open	4000/6000	30.03%	0.11	16.3	0%	0.0	0
Transportation	Transportation	8100	0.46%	2.28	5.1	33%	1.7	193,769
Communication/Utilities	Communication/Utilities	8200/8300	0.20%	0.66	0.7	10%	0.1	1,602,248
Total Basin			100%	0.68	334	25%	84	325,402,270

1 Assumed on Septic

2 Assumed about 70% of Discharge from WWT outside basin

Table 21. Land Use Categories, Unit Load Factors, and N Reduction Factors for the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Unit N Load (lbs/acre/yr)	Estimated Nitrogen Reduction		
				Owner Implemented BMPs	Typical Incentive BMPs	Alternative Practices
Residential Low Density	Residential Low Density ¹	1100	7.26	15%	15%	15%
Residential Medium Density	Residential Medium Density ²	1200	10.56	25%	25%	15%
Residential High Density	Residential High Density ²	1300	15.84	30%	25%	15%
Other Urban	Commercial/Industrial ²	1400-1800	11.68	25%	25%	15%
Improved Pastures	Improved Pastures	2110	14.65	17%	10%	30%
Unimproved Pastures	Unimproved Pastures	2120	7.26	11%	8%	30%
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	5.41	4%	6%	20%
Row Crops	Row Crops	2140	19.80	30%	30%	50%
Sugar Cane	Sugar Cane	2156	10.56	10%	23%	52%
Citrus	Citrus	2210	11.22	10%	20%	42%
Sod Farms	Sod Farms	2420	11.88	20%	27%	50%
Ornamentals	Ornamentals	2430	15.84	25%	25%	25%
Horse Farms	Horse Farms	2510	21.12	30%	22%	30%
Dairies	Dairies	2520	26.40	20%	40%	48%
Other Areas	Other Areas	2150-2610	10.18	15%	25%	36%
Tree Plantations	Tree Plantations	4400	4.09	5%	10%	25%
Water	Water	5000	1.19	0%	0%	0%
Natural Areas	Forrests/wetlands/Open	4000/6000	2.96	0%	0%	0%
Transportation	Transportation	8100	12.14	20%	23%	25%
Communication/Utilities	Communication/Utilities	8200/8300	7.92	30%	25%	15%

1 Assumed on Septic

2 Assumed about 70% of Discharge from WWT outside basin

Table 22. Land Use Categories, Unit Load Factors, and Estimated N Reduction Factors Using 2004 Land Use for the Caloosahatchee Watershed

Land Use Category	Land Use Description	FLUCCS	Percent of Basin	Unit N Load (lbs/acre/yr)	Total N (MT/yr)	Estimated N Reduction		Annual Cost (\$)
						(percent)	(MT/yr)	
Residential Low Density	Residential Low Density ¹	1100	7.12%	7.26	253.6	30%	76.1	176,608,300
Residential Medium Density	Residential Medium Density ²	1200	3.09%	10.56	160.3	50%	80.2	76,781,946
Residential High Density	Residential High Density ²	1300	1.06%	15.84	82.5	55%	45.4	26,332,005
Other Urban	Commercial/Industrial ²	1400-1800	2.18%	11.68	125.1	55%	68.8	59,607,170
Improved Pastures	Improved Pastures	2110	10.85%	14.65	780.2	27%	210.7	2,078,370
Unimproved Pastures	Unimproved Pastures	2120	2.21%	7.26	78.6	19%	14.9	101,987
Woodland Pastures/Rangeland	Woodland/Range Pastures	2130/3000	7.24%	5.41	192.2	10%	19.2	369,624
Row Crops	Row Crops	2140	0.89%	19.80	86.9	60%	52.1	761,356
Sugar Cane	Sugar Cane	2156	8.13%	10.56	421.2	33%	139.0	3,484,258
Citrus	Citrus	2210	8.95%	11.22	493.1	30%	147.9	16,979,257
Sod Farms	Sod Farms	2420	0.47%	11.88	27.4	47%	12.9	199,880
Ornamentals	Ornamentals	2430	0.08%	15.84	6.2	50%	3.1	50,663
Horse Farms	Horse Farms	2510	0.02%	21.12	1.9	52%	1.0	3,584
Dairies	Dairies	2520	0.01%	26.40	0.7	60%	0.4	65,542
Other Areas	Other Areas	2150-2610	1.01%	10.18	50.5	40%	20.2	226,788
Tree Plantations	Tree Plantations	4400	3.94%	4.09	79.0	15%	11.9	1,427,933
Water	Water	5000	12.07%	1.19	70.4	0%	0.0	0
Natural Areas	Forrests/wetlands/Open	4000/6000	30.03%	2.96	435.9	0%	0.0	0
Transportation	Transportation	8100	0.46%	12.14	27.1	43%	11.7	256,618
Communication/Utilities	Communication/Utilities	8200/8300	0.20%	7.92	7.8	55%	4.3	3,702,458
Total Basin			100%	6.72	3,298	27%	874	342,705,734

1 Assumed on Septic

2 Assumed about 70% of Discharge from WWT outside basin