Final

2016 Progress Report for the for the Lakes Harney and Monroe, Middle St. Johns River, and Smith Canal Basin Management Action Plan

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

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Tallahassee, FL 32399

Acknowledgments

This *2016 Progress Report for the Lakes Harney and Monroe and Middle St. Johns River Basin Management Action Plan* was prepared as part of a statewide watershed management approach to restore and protect Florida's water quality. It was prepared by the Florida Department of Environmental Protection with participation from the Lakes Harney and Monroe and Middle St. Johns River stakeholders.

For additional information on the watershed management approach in the Lake Harney, Lake Monroe, and Middle St. Johns River Basin, contact:

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List of Acronyms and Abbreviations

BMAP	Basin Management Action Plan
BMP	Best Management Practice
DEP	Florida Department of Environmental Protection
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDOT	Florida Department of Transportation
FYN	Florida Yards and Neighborhood (Program)
I	Interstate
lbs	Pounds
lbs/yr	Pounds Per Year
mg/m^3	Milligrams Per Cubic Meter
mg/L	Milligrams Per Liter
MSJR	Middle St. Johns River
NNC	Numeric Nutrient Criteria
NOI	Notice of Intent
NOx	Nitrate+Nitrite Nitrogen
NPDES	National Pollutant Discharge and Elimination System
OAWP	Office of Agricultural Water Policy
PCU	Platinum Cobalt Units
POR	Period of Record
PSA	Public Service Announcement
R	Correlation Coefficient
RSF	Regional Stormwater Facility
SJRWMD	St. Johns River Water Management District
SR	State Road
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
USJR	Upper St. Johns River Basin
WBID	Waterbody Identification

Section 1: Introduction

1.1 Purpose of the Report

This is the fourth annual progress report for the Lakes Harney and Monroe and Middle St. Johns River (MSJR) Basin Management Action Plan (BMAP). **Section 2** describes the activities that occurred during the period from September 1, 2015, through August 31, 2016. **Section 3** summarizes compliance with the BMAP. **Section 4** describes the water quality and biological monitoring that occurred during the reporting period. **Appendix A** contains a comprehensive list of stakeholder projects and activities that have been completed, continued (i.e., ongoing), or planned since BMAP adoption.

1.2 Total Maximum Daily Loads (TMDLs) for the Lakes Harney and Monroe and MSJR Basin

The Lakes Harney and Monroe and MSJR Basin includes the impaired mainstem segments of the MSJR located between the inlet of Lake Harney and the confluence of the St. Johns River with the Wekiva River. These river segments receive discharges from the Upper St. Johns River and from several major tributaries, including the Econlockhatchee River, Deep Creek, and Lake Jesup. Two major lakes, Lake Monroe and Lake Harney, are also impaired segments of the MSJR mainstem. The basin encompasses portions of Seminole County and Volusia County and portions of the Cities of DeBary, DeLand, Deltona, Lake Helen, Lake Mary, Orange City, and Sanford.

Smith Canal, located in northwest Seminole County, drains an area of 10 square miles. The canal is 6 miles long and flows northwest until it enters the St. Johns River 1.4 miles upstream of the outlet to Lake Monroe. The Smith Canal Watershed includes portions of Seminole County, Lake Mary, and Sanford.

Figure 1 shows the Lakes Harney and Monroe and MSJR Basin and the local governments in the area.

The Florida Department of Environmental Protection (DEP) adopted total nitrogen (TN) and total phosphorus (TP) TMDLs in December 2009 for the Lakes Harney and Monroe and MSJR Basin, and a TP TMDL in September 2009 for Smith Canal. The TMDL documents are available on the DEP website.

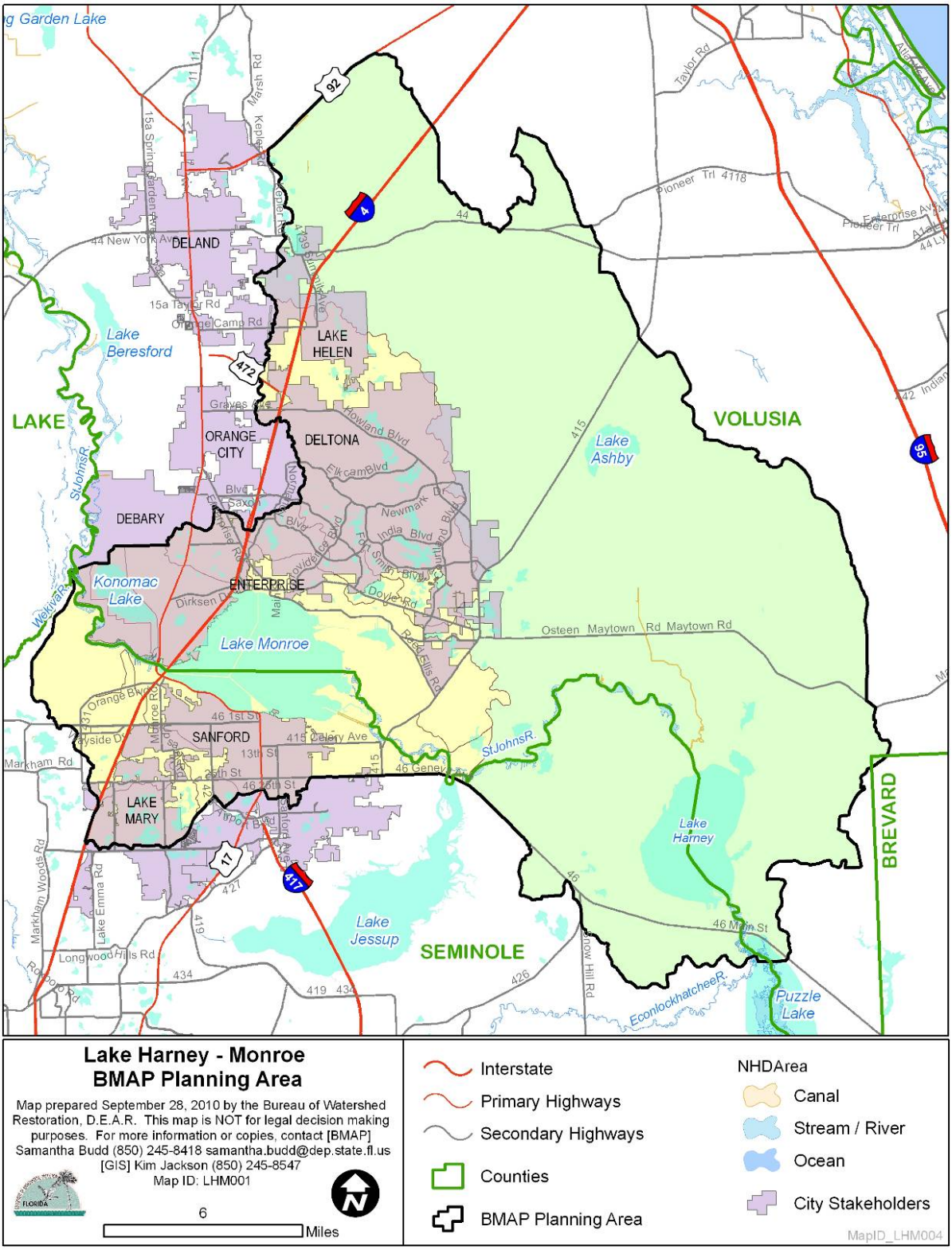


Figure 1. Lakes Harney and Monroe and MSJR Basin

Section 2: Activities During the Reporting Year

Section 2.1 and **Section 2.2** describe the accomplishments in the Lakes Harney and Monroe and MSJR Basin during the reporting year. New projects added to the individual project tables are described below, as are individual projects completed during the reporting period. Ongoing efforts, such as street sweeping, ordinances, and public education efforts, are not specifically described below but must continue each year for the project credit to remain effective. **Appendix A** contains the individual project tables.

2.1 Activities by Entity

2.1.1 Agriculture

As of June 30, 2016, producers throughout the basin (**Figure 2**) submitted 33 agricultural best management practice (BMP) notices of intent (NOIs) representing 9,261 acres or 52 % of the adjusted agricultural acreage in the Lakes Harney and Monroe and MSJR Basin (**Table 1**). This enrollment has a reduction of 10,723 pounds per year (lbs/yr) of TN and 1,903 lbs/yr of TP for the reporting period, and 26,768 lbs/yr of TN and 4,926 lbs/yr of TP to date.

In 2015, the Florida Department of Agriculture and Consumer Services (FDACS) Office of Agricultural Water Policy (OAWP) adopted a revised vegetable and agronomic crop manual that includes specific nutrient and irrigation BMPs for plastic mulch, bare ground, sugar cane, hay/silage, and greenhouse production systems. In early 2016, FDACS adopted a dairy manual targeting dairies without DEP-issued National Pollutant Discharge Elimination System (NPDES) permits. In June 2016, a poultry manual was adopted. To date, FDACS has developed BMP manuals, available on its website, for cow/calf, citrus, vegetable and agronomic crops, nurseries, equine, sod, dairy, poultry, and specialty fruit and nut operations.

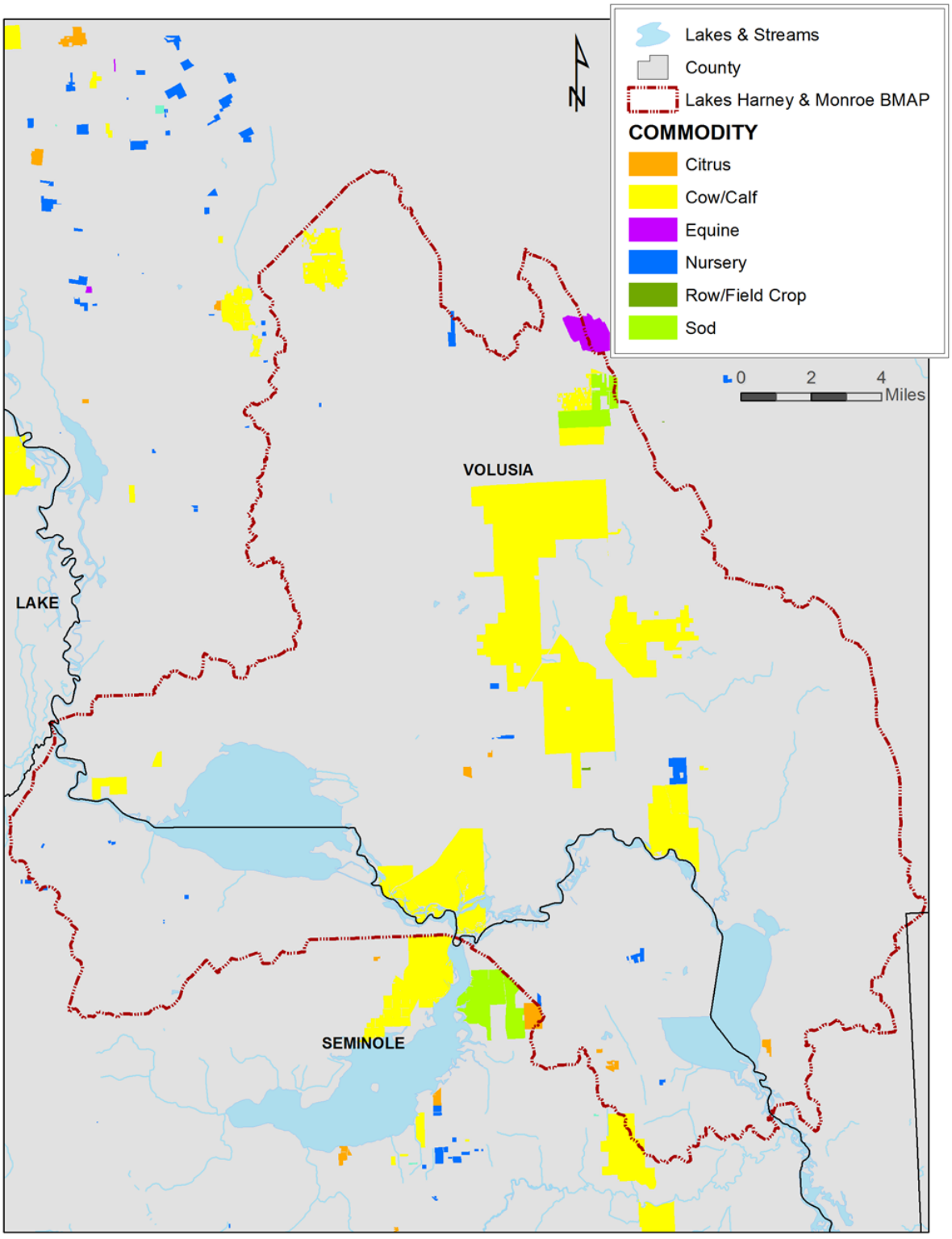


Figure 2. Agricultural operations enrolled in FDACS BMP programs in the Lakes Harney and Monroe and MSJR BMAP area as of June 30, 2016

Table 1. Agricultural acreage, BMP enrollment, and future enrollment goals for the Lakes Harney and Monroe and MSJR Basin as of June 30, 2016

[1] FDACS staff-adjusted acreage for purposes of enrollment is based on a review of more recent aerial imagery in the basin and local staff observations.
[2] Most of these horse farms likely are not commercial agriculture and will be addressed through DEP-developed BMPs.
[3] FDACS staff have observed no active poultry operations in the BMAP area but will be confirming this supposition.
[4] FDACS Division of Aquaculture currently has eight aquaculture facilities in the BMAP area, encompasssing eight acres. These facilities have a current Aquaculture Certificate of Registration and comply with Aquaculture BMPs pursuant to Rule 5L-3, Florida Administrative Code (F.A.C.).
N/A = Not applicable.

2004 SJRWMD Land Use	2004 Acres	FDACS-Adjusted Acres[1]	Related FDACS BMP Programs	Acreage Enrolled	Related NOIs
Pasture	15,901.10	15,901.10	Cow/Calf; Hay;Statewide Sod	7,413.5	14
Row/Field/Mixed Crops	2,862.80	825.60	Vegetable/Agronomic Crops	1,601.7	1
Fallow Cropland (out of production)	1.70	1.70	No enrollment needed	N/A	N/A
Horse Farm[2]	174.10	174.10	Equine	37.5	1
Citrus	450.10	450.10	Citrus	95.1	5
Abandoned Citrus	633.90	0.00	No enrollment needed	N/A	N/A
Tree Crops	13.30	13.30	Specialty Fruit and Nut	0	
Tree Nurseries	76.50	76.50	Nursery; Specialty Fruit/Nut	0	
Ornamentals	243.00	243.00	Container Nursery	81.3	12
Shade Ferns	0.60	0.60	Nursery	0	
Hammock Ferns	2.40	2.40	Nursery	0	
Specialty Farms	2.20	2.20	Conservation Plan Rule	0	
Cattle Feeding	11.30	11.30	Conservation Plan Rule	0	
Poultry Feeding[3]	80.90	80.90	Conservation Plan Rule	12.8	
Other Open Lands – Rural	0.10	0.00	No enrollment needed	N/A	N/A
Aquaculture[4]	12.5	12.5	FDACS Division of Aquaculture	10.1	
Total	20,466.50	17,795.30	N/A	9,260.9	33
5-Year Enrollment Goal (90 %)	N/A	16,015.77	N/A	N/A	N/A
Acreage Enrolled (as of June 2016)	N/A	9,260.9	N/A	N/A	N/A
Remaining Acres To Enroll	N/A	6,754.9	N/A	N/A	N/A

2.1.2 City of Deltona

Deltona completed the Leland Drive Retention Pond Project (Project DEL-7) and held a Florida Stormwater Erosion Control Inspector Certification class that trained 36 individuals on managing onsite stormwater flows, clean discharges, and BMPs that reduce pollutants contained in stormwater runoff.

During the reporting period, the city monitored the Gleason control structure (Project DEL-4) and verified that the structure allows Lake Gleason to provide additional storage and reduced discharges.

The city is also working on a stormwater management system project at Brickell Drive that will help remove pollutants by increasing flow through vegetative wetlands.

2.1.3 City of Orange City

Orange City focused on education, training and outreach in 2016. The U.S. Environmental Protection Agency (EPA) "Stop Pointless Pollution" flyer was attached to utility bills, and the city issued a newsletter focusing on water quality improvement projects. Additionally, an organized activity helped school-aged children collect 27 pounds of garbage from city parks. A Florida-friendly landscaping training class hosted by the city was scheduled for late 2016.

From 2015 to 2016, the city made progress on a number of ongoing projects, including adopting a cooperative agreement on water resource impacts with Volusia County, working to adopt a fertilizer ordinance, issuing a notice to proceed for the Mill Lake Park Stormwater Treatment Center, and the adoption of "Project Blue Spring – A Comprehensive and Fully Integrated Water Resource Protection Program."

2.1.4 City of Sanford

Sanford is developing four new water quality improvement projects to benefit Cloud Branch, Mill Creek, North Star, and Pump Branch Creek.

2.1.5 Florida Department of Transportation (FDOT) District 5

FDOT added and completed two wet detention pond projects (FDOT-43 and FDOT-44). These projects improve drainage and treat stormwater runoff from the new and existing impervious areas along State Road (SR) 400 (from SR 44 to east of Interstate [I]-95).

Several stormwater projects associated with the SR 415 roadway improvements were completed. These included the construction of 3 wet detention ponds (Projects FDOT-36, FDOT-37, and FDOT-39) and 1 exfiltration trench system (Project FDOT-38). FDOT also reduced TN in the basin by 962 pounds (lbs) through fertilizer cessation (Project FDOT-42).

2.1.6 Seminole County

Seminole County conducted biological and ambient water quality monitoring from 2015 to 2016. The county also aired public service announcements (PSAs) on CBS and Seminole Government Television that demonstrated the proper use of fertilizers.

2.1.7 Volusia County

Volusia County added a new ongoing project (Project VC-7) that will result in the removal of sediments and other debris from roadside ditches.

2.1.8 St. Johns River Water Management District (SJRWMD)

The SJRWMD continued to monitor TP trends to determine where to concentrate future efforts as part of the TP reduction planning in the Deep Creek Watershed.

2.2 2.2 Summary of Accomplishments

Table 2 summarizes the projects completed during the fourth annual BMAP reporting period. The projects that were quantified resulted in an estimated reduction of 12,487 lbs/yr of TN and 2,467 lbs/yr of TP.

Table 2. Summary of projects completed in the reporting period (September 1, 2015–August 31, 2016)

N/A = Not applicable

Entity	Project Number	Project Name	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
City of Deltona	DEL-07	Leland Drive Retention Pond	Not quantified	Not quantified
Agriculture	FDACS-03	Agricultural BMP Enrollment	10,723	1,903
FDOT	FDOT-36	SR 415 – Pond A	7	2
FDOT	FDOT-37	SR 415 – Pond B	8	1
FDOT	FDOT-38	SR 415 – Exfiltration Trench	12	0
FDOT	FDOT-39	SR 415 – Pond H	10	2
FDOT	FDOT-42	Fertilizer Cessation	712	N/A
FDOT	FDOT-43	SR 400 Widening (from SR 44 to East of I-95)	52	1
FDOT	FDOT-44	SR 400 Widening (from SR 44 to East of I-95)	59	1
Volusia County	VC-07	Roadside Ditch Cleaning	905	556
Total			**12,487**	**2,467**

Section 3: Compliance

Table 3 lists the number of projects that each entity committed to in the 2012 BMAP and the status of those projects. **Table 4**summarizes the allocations and reductions achieved to date by each entity in the BMAP.

Table 3. Summary of completed projects identified in the BMAP by entity

Entity	Projects Listed in 2012 BMAP	Completed	Canceled	Under Way
City of DeBary	2	2		
City of DeLand	1	1		
City of Deltona	6	6		
City of Lake Helen	1	1		
City of Lake Mary	2	2		
City of Orange City	1	1		
City of Sanford	4	4		
FDOT	41	39		2
Seminole County	6	6		
Turnpike Authority	1	1		
Volusia County	6	6		2
Total	**73**	**71**	**0**	**2**

Table 4. Summary of allocations and reduction status by entity

Note: Entities marked with an "*" indicate entities with *de minimus* load contributions.

Entity	TN Allocation (lbs/yr)	Phase I TN Required Reduction (lbs/yr)	Current TN Reduction (lbs/yr)	TP Allocation (lbs/yr)	Phase I TP Required Reduction (lbs/yr)	Current TP Reduction (lbs/yr)
FDACS	87,886	21,141	43,229	16,200	6,885	8,121
City of DeBary	16,146	1,880	13,562	2,976	86	2,207
City of DeLand*			9			1
City of Deltona	18,182	3,609	7,151	3,352	388	1,230
City of Lake Helen*			31			5
City of Lake Mary*			371			59
City of Orange City*			1			0
City of Sanford	20,678	10,360	14,454	3,812	1,340	5,339
FDOT	7,648	1,232	3,117	1,410	-	627
Seminole County	26,158	3,974	7,638	4,822	155	1,906
Turnpike Authority*			22			14
Volusia County	23,246	1,633	4,486	4,285	0	1,530

Figure 3 and **Figure 4** show the progress towards the TN and TP TMDL load reductions, respectively. The first bar shows the starting load for urban and agricultural stormwater runoff. The second bar shows the current estimated loading based on those projects shown as completed in the BMAP; those completed as part of the 2013, 2014, and 2015 progress reports; and those listed in **Table 2**. The third bar shows the total allocation for stormwater runoff to meet the TMDLs. The horizontal line shows the target (50 % of the total required reductions) for the first BMAP iteration. The TN and TP reductions from completed projects to date are 94,070 and 21,038 lbs/yr, respectively.

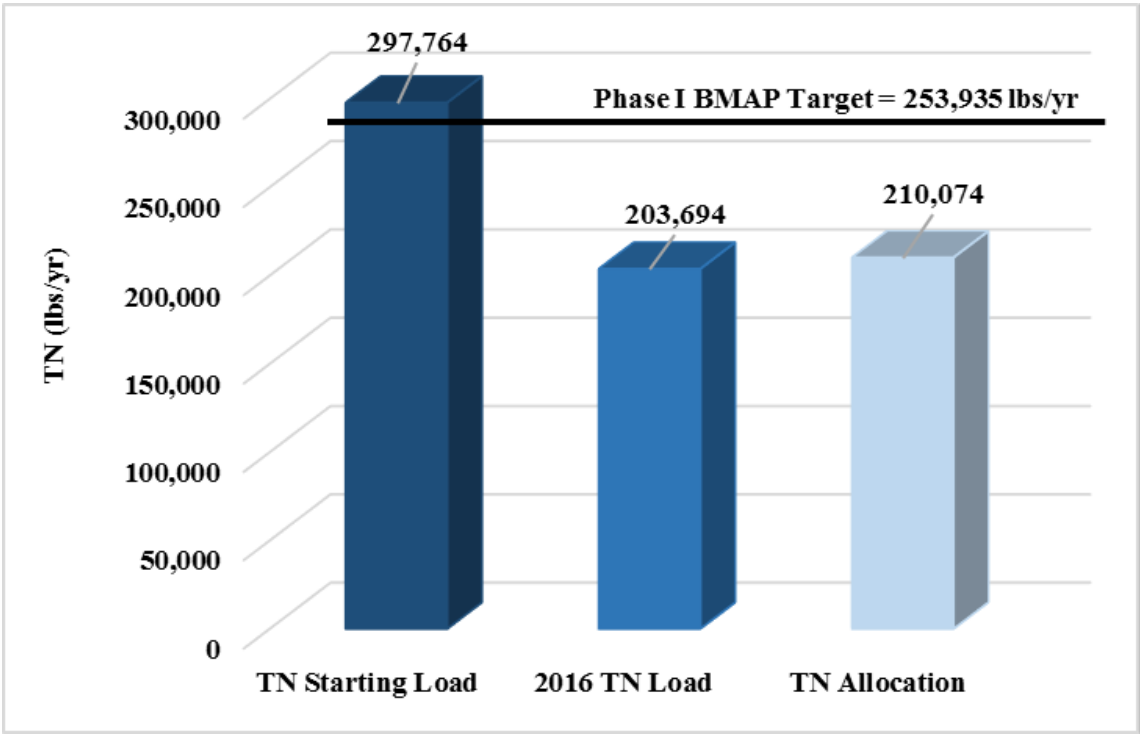


Figure 3. Progress towards the TN TMDL through August 31, 2016

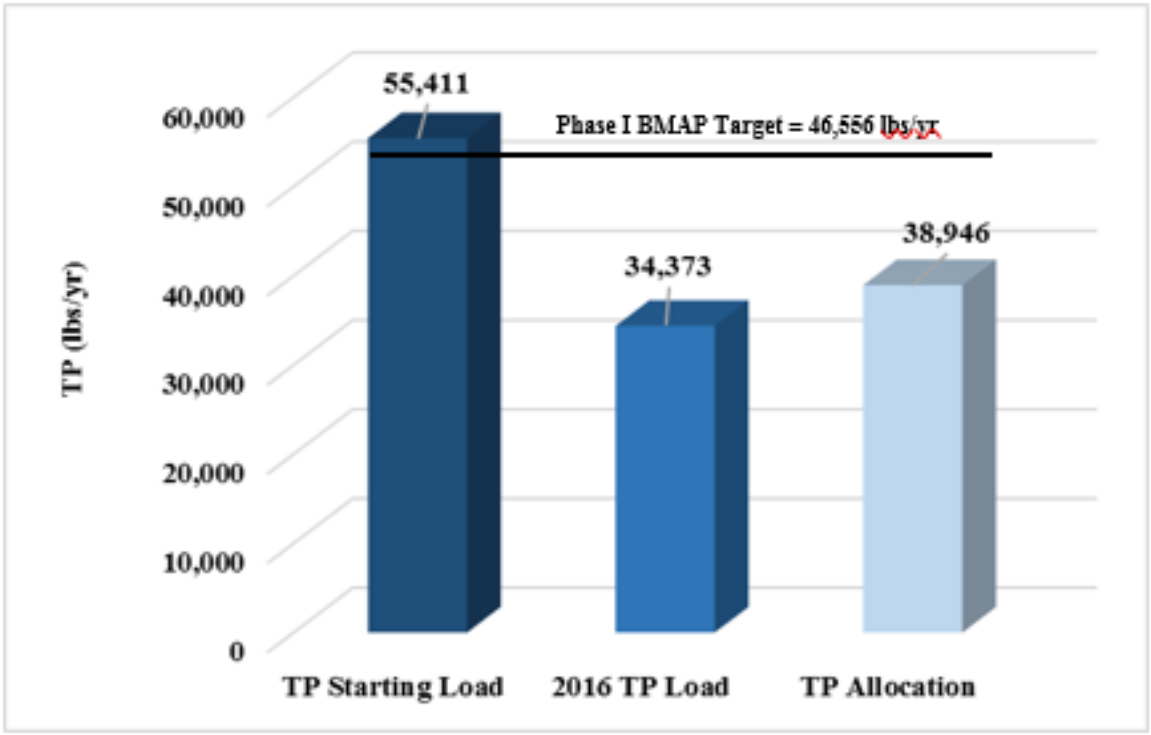

55,411
Phase I BMAP Target = 46,556 lbs/yr
34,373
38,946
60,000
50,000
40,000
30,000
20,000
10,000
0
TP (lbs/yr)
TP Starting Load
2016 TP Load
TP Allocation

Figure 4. Progress towards the TP TMDL through August 31, 2016

Section 4: Water Quality and Biological Monitoring

The Lakes Harney and Monroe and MSJR BMAP monitoring plan was designed to enhance the understanding of basin loads, identify areas with high nutrient concentrations, and track water quality trends. The information gathered through the monitoring plan will measure progress toward achieving the TMDLs and provide a better understanding of the watershed loading. The BMAP monitoring plan consists of ambient water quality sampling and biological and vegetation monitoring.

A detailed water quality evaluation will be conducted after the fourth year of BMAP implementation to determine water quality improvements in the basin from actions included in the first BMAP iteration. All responsible stakeholders participated in the monitoring plan in the fourth year of BMAP implementation. A few highlights of the monitoring efforts are described below.

4.1 SJRWMD

This summary covers the St. Johns River mainstem and includes Lakes Harney and Monroe and the river between the two lakes. A nutrient TMDL for this section of the river (**Figure 5**) (Gao 2009) was completed prior to the adoption of other numeric nutrient criteria (NNC). Brief summaries of three of the primary MSJR Basin tributaries—Econlockhatchee, Deep Creek, and Lake Jesup—are included for a perspective on nutrient loads (**Figure 6**). One upstream site is also included to demonstrate upper basin inputs—the Upper St. Johns River (USJR) Basin at U.S. Highway 50, which is the closest SJRWMD sampling site to the boundary between the USJR Basin and MSJR Basin. **Figure 7** shows the ambient monitoring network used for this report. Sampling sites included in the analysis represent different positions along the downstream flow and are itemized I in **Table 6**.

Table 5. List of water quality stations

Location	Category	Sampling Site Name(s)
Outlet of USJR Basin to MSJR Basin – St. Johns River at the Northern End of the Upper Basin	River Mainstem	SRS
Econlockhatchee River Just Before St. Johns River at SR 426	Tributary to St. John River	ECH
Near Input to Lake Harney at SR 46	River Mainstem	SRN
Lake Harney	Lake on Mainstem	CLH, LH-OW-NE, LH-OW-SE
Deep Creek and Lake Ashby	Tributary with Lake as Headwater	ASH and LA-OW-S, DMR, DCR-MRD
St. Johns River Between Harney and Jesup	River Mainstem	OW-SJR-1
St. Johns River Between Jesup and Monroe	River Mainstem	SJR-415
Lake Monroe	Lake on Mainstem	LM-OW-NE, LM-OW-S, LMAC
Outfall from Lake Monroe and Florida Power and Light Power Plant	River Mainstem	SJR-DPP

The Lake Harney summary results are calculated as the average of Stations LH-OW-NE and LH-OW-SE for the period of record (POR) from 2004 through 2011. The CLH station data are used to represent the remaining POR from 2012 through 2015. Additionally, the Lake Monroe results are calculated as the average of Station LM-OW-NE and LM-OW-S for POR 2014 through 2011. The LMAC station data are used to represent the remaining POR for 2012 through 2015. Lake Ashby results were calculated as the average of Stations ASH and LA-OW-S for POR 2004 through 2013. The ASH station data are used to represent the remaining POR 2014 through 2015.

Although an extensive set of water quality parameters is analyzed monthly or bimonthly at each site, this summary focuses on analytes critical to nutrient TMDLs: TP, TN, chlorophyll *a*, dissolved oxygen (DO), and cyanobacteria where available. TN is calculated as the sum of total Kjeldahl nitrogen (TKN) and nitrate+nitrite nitrogen (NO_x). The POR for water quality parameters is 2004 through 2015.

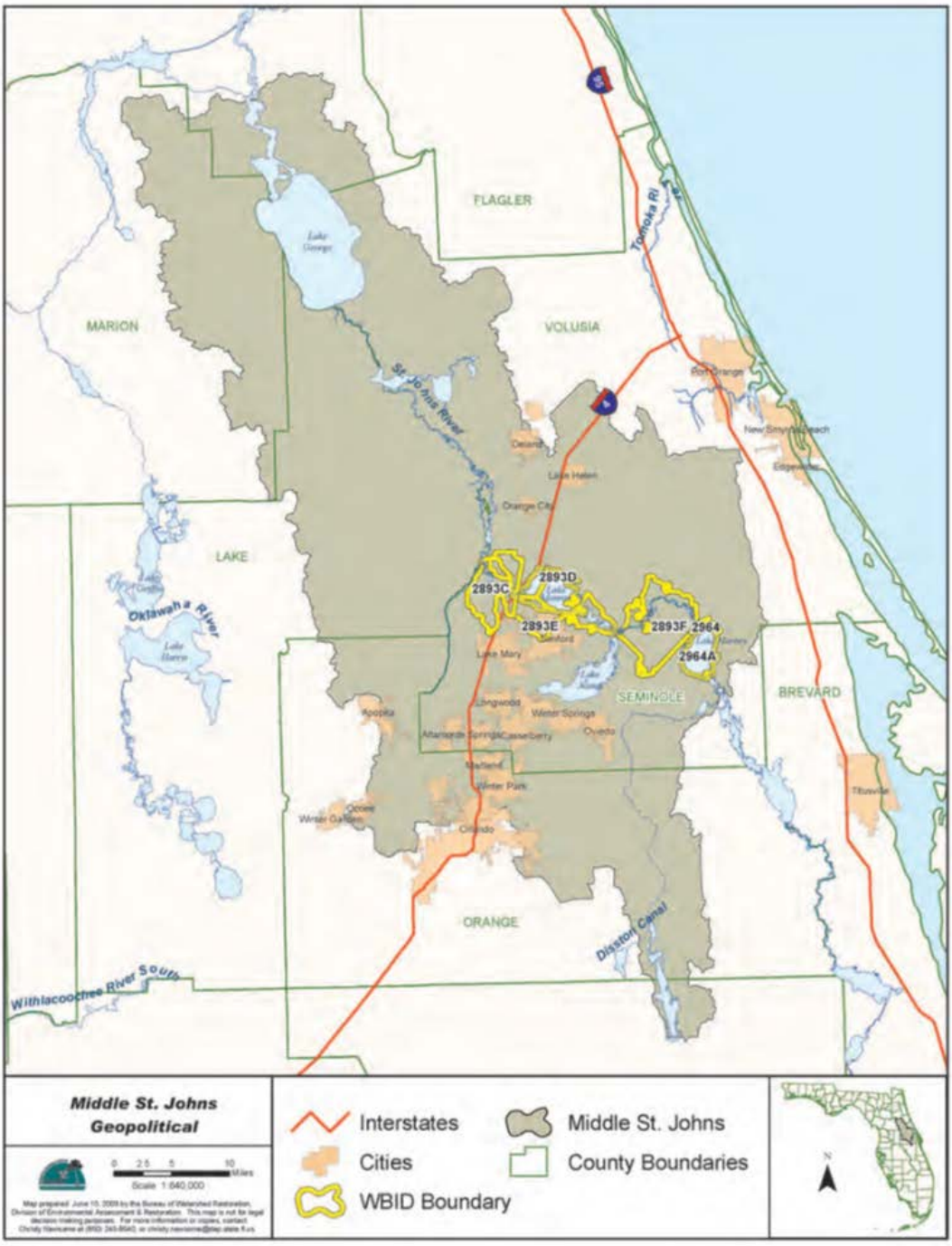


Figure 5. Segments with waterbody identification (WBID) numbers included in the MSJR Basin TMDL (2009)

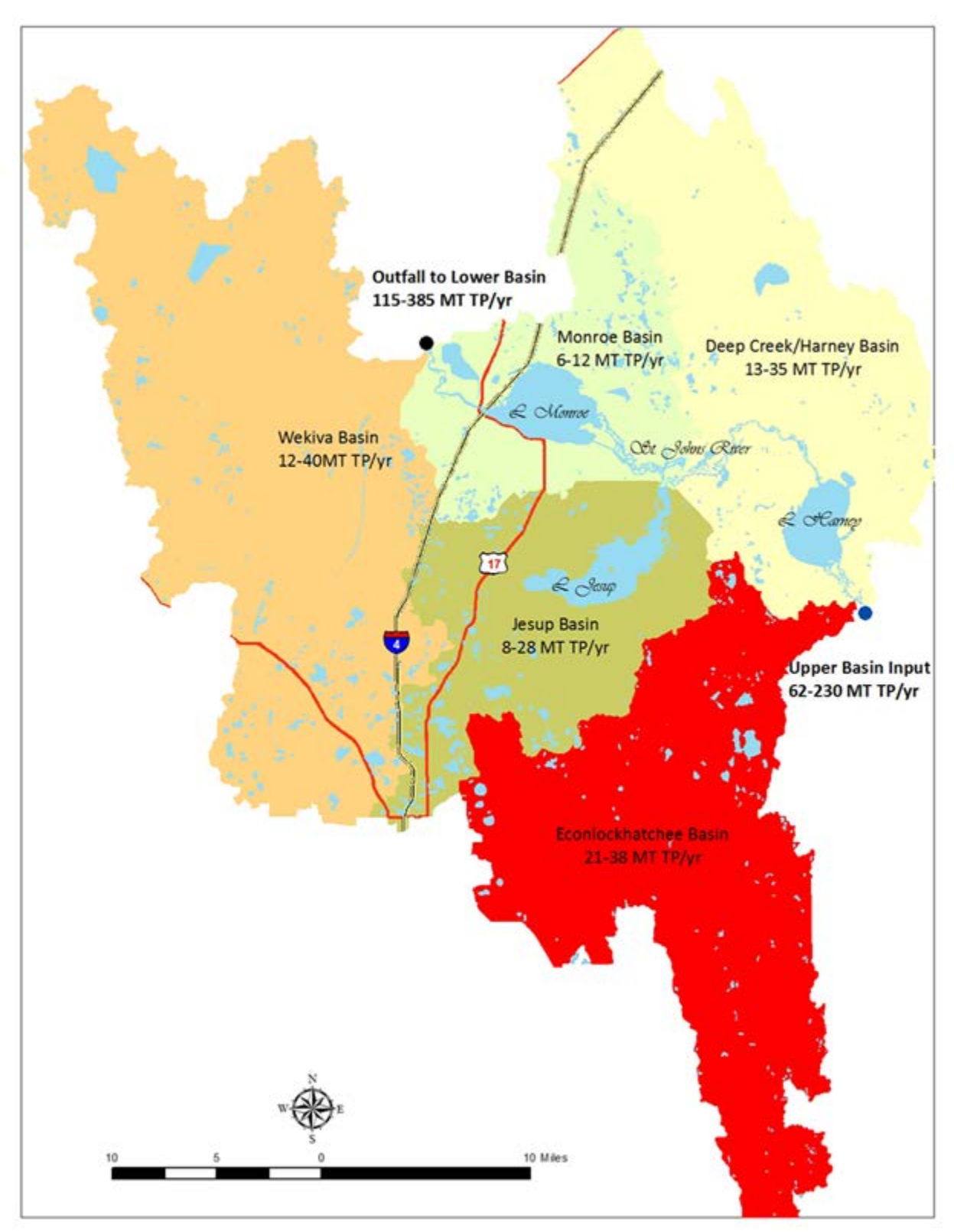


Figure 6. Range of average annual TP loads from the primary planning units in the MSJR Basin, 2004–14

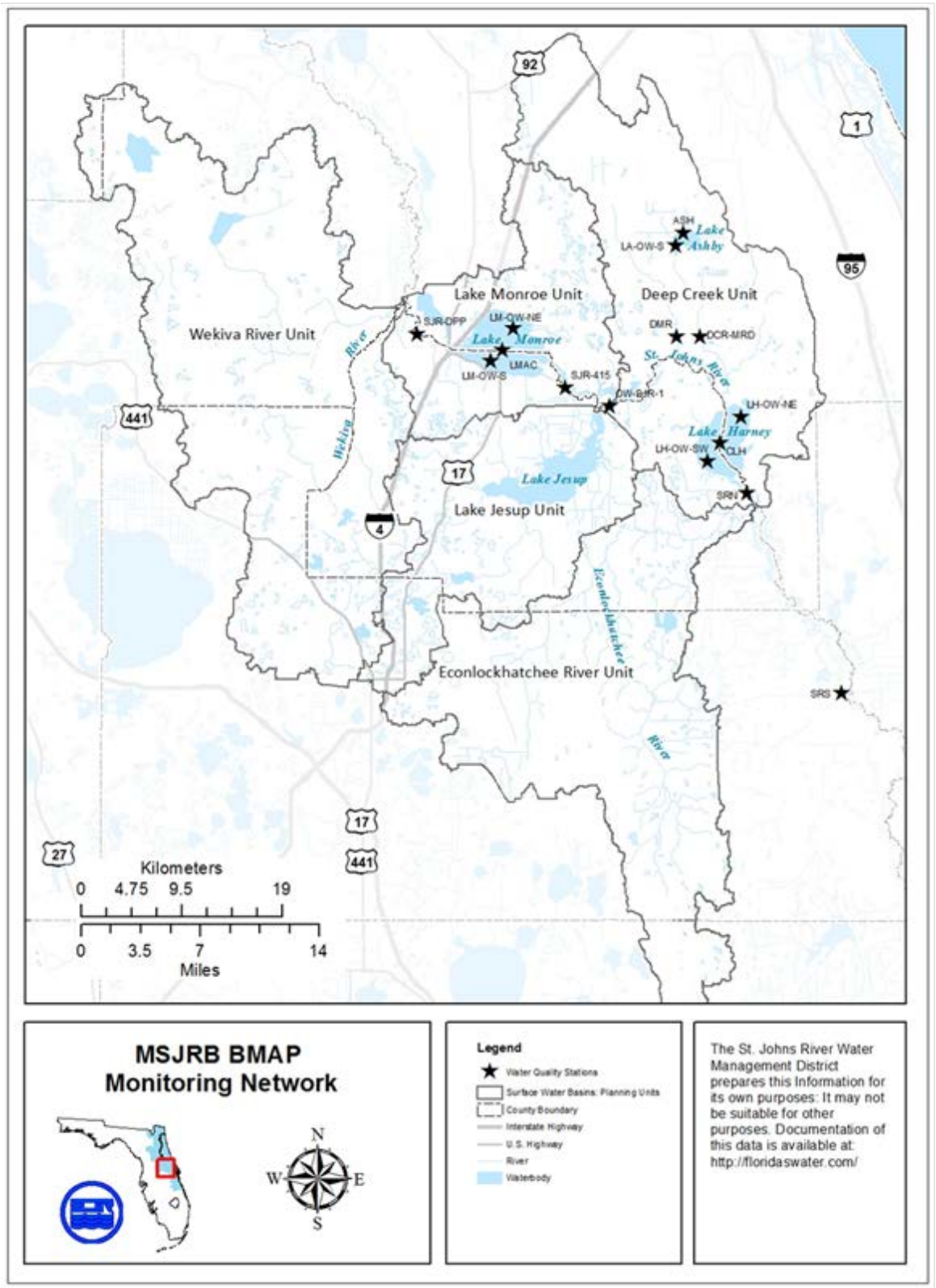


Figure 7. Water quality sampling sites

4.1.1 Mainstem Water Quality

Table 6 and **Table 7** list the annual mean and geometric mean concentrations for nitrogen and phosphorus forms, DO, total suspended solids (TSS), and color, respectively. The reported values in **Table 7** are the more typical averages reported in past reports rather than the geometric mean now used in the new NNC. The bar graphs in **Figure 8, Figure 9**, and **Figure 10** plot the 2004–15 annual mean concentrations for TP, chlorophyll *a*, and TN for monitoring stations from upstream to downstream.

Both TP and chlorophyll *a* concentrations are similar from the USJR Basin to just upstream of Lake Jesup (SRS through OW-SJR-1) (**Figure 8** and **Figure 9**). Both TP and chlorophyll *a* are significantly higher following the outflow from Lake Jesup and through Lake Monroe ($p < 0.05$). Although TP and chlorophyll *a* are not statistically different between Monroe and the site just downstream (SJR-DPP), a downward trend is evident. TN concentrations are similar throughout the basin (**Figure 10**). Time series patterns throughout the mainstem in the graphs for TP, chlorophyll *a*, and TN concentration (**Figure 11, Figure 12,** and **Figure 13**) are similar and demonstrate the strong influence of the St. Johns River (SJR) on water quality. There is no significant change in nutrient concentrations at any site except Monroe and SJR-DPP, which exhibited a slightly lower TP concentration between 2004 and 2015 ($p<0.05$).

Table 6. Geometric mean for key water quality parameters along the MSJR mainstem, 2004–15

Note: Yellow highlighting and boldface type indicate exceedances of the NNC for streams/lakes.
mg/m^3 = Milligrams per cubic meter; PCU = Platinum cobalt units; ft = Feet

Parameter	SRS	SRN	Harney	OW-SJR-1	SJR-415	Monroe	SJR-DPP
TP, mg/L	0.083	0.088	0.081	0.078	0.092	0.093	0.086
TN, mg/L	**1.6**	1.44	1.42	1.42	**1.63**	1.6	1.36
TKN, mg/L	1.74	1.33	1.34	1.33	1.56	1.51	1.37
Chlorophyll *a*, mg/m^3	5.9	3.29	5.24	3.22	10.6	12.4	9.9
DO, mg/L	4.29	5.30	7.20	6.18	5.66	7.02	7.10
TSS, mg/L	7.2	3.65	2.09	1.13	6.4	6.5	3.3
Color, PCU	186	168.96	152.72	150.95	137	133	120
Water Depth, ft	3.13	1.99	2.32	1.93	3.67	2.51	4.16

Table 7. Averages for key water quality parameters along the MSJR mainstem, 2004–15

Parameter	SRS	SRN	Harney	OW-SJR-1	SJR-415	Monroe	SJR-DPP
TP, mg/L	0.092	0.09	0.09	0.09	0.099	0.099	0.092
TN, mg/L	1.85	1.46	1.45	1.46	1.69	1.6	1.48
TKN, mg/L	1.78	1.37	1.36	1.37	1.62	1.55	1.41
Chlorophyll *a*, mg/m^3	9.44	4.88	10.69	7.50	19.61	21.52	17.22
DO, mg/L	5.52	5.89	7.41	6.56	6.18	7.40	7.32
TSS, mg/L	8.76	6.54	4.90	4.70	10.18	10.71	7.34
Color, PCU	202	192.23	173.95	179.22	165	159	147
Water Depth, ft	3.29	2.14	2.40	2.01	3.84	2.55	4.24

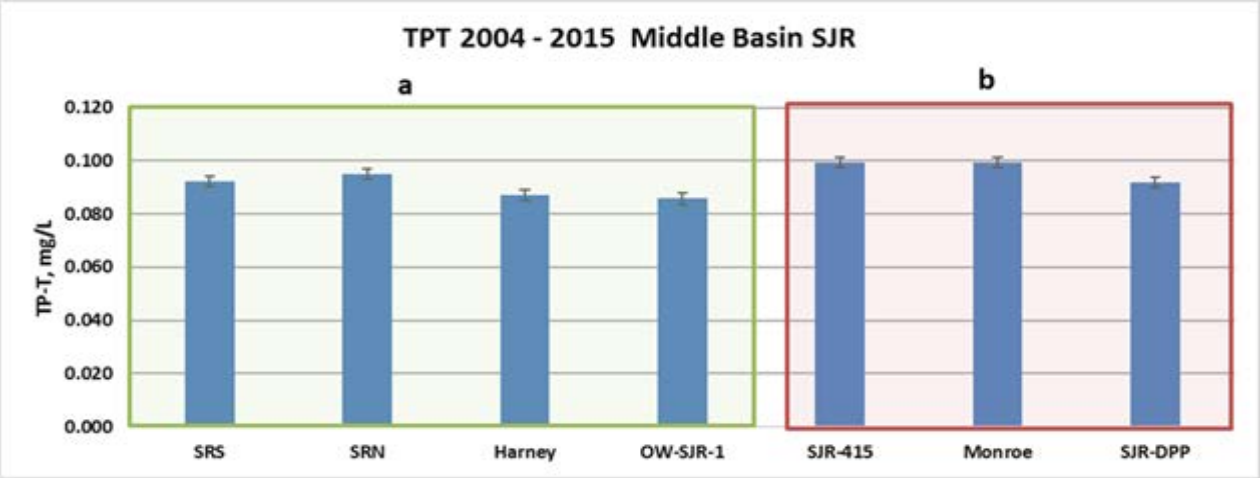


Figure 8. Annual average TP concentrations in the upper half of the MSJR Basin, 2004–15

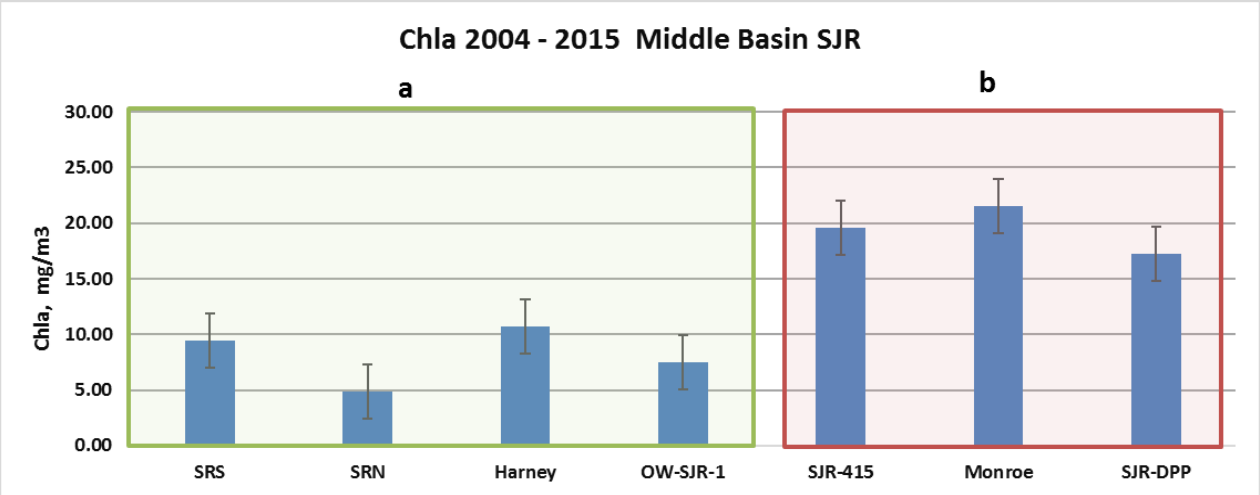


Figure 9. Annual average chlorophyll *a* concentrations in the upper half of the MSJR Basin, 2004–15

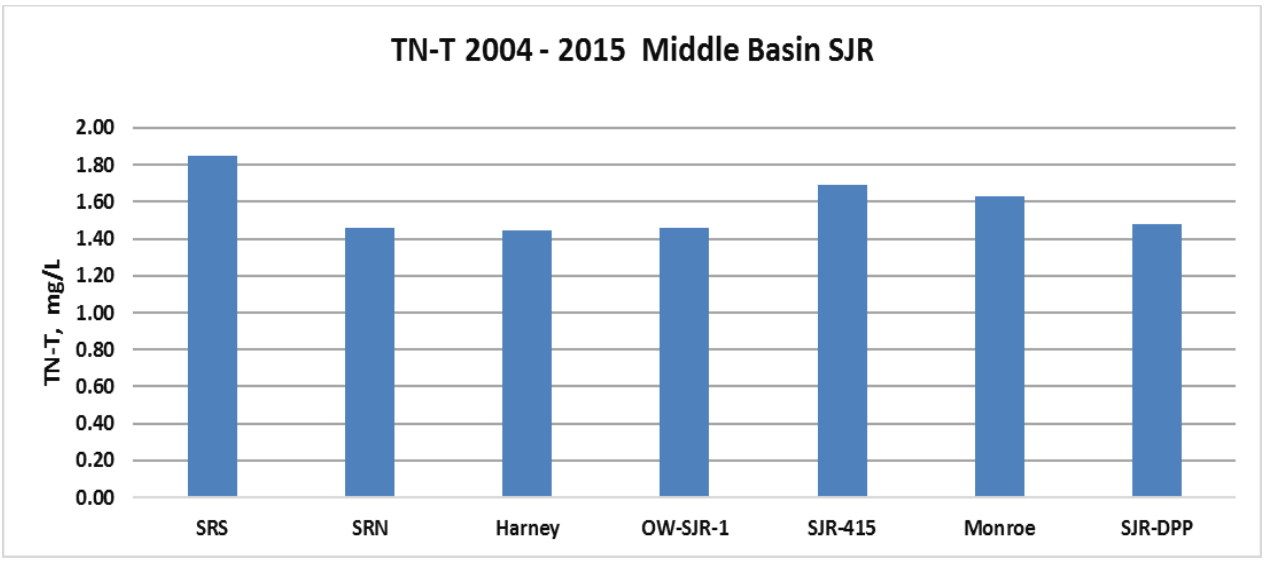
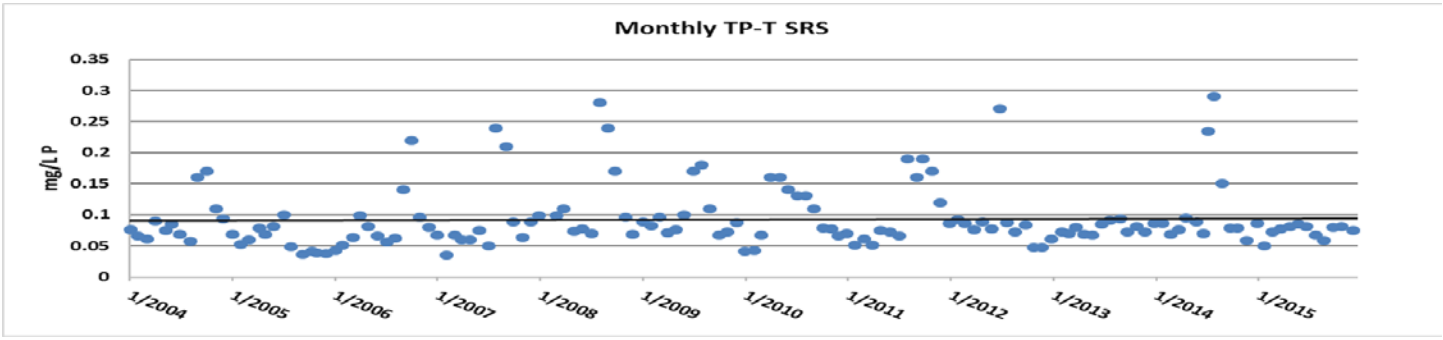
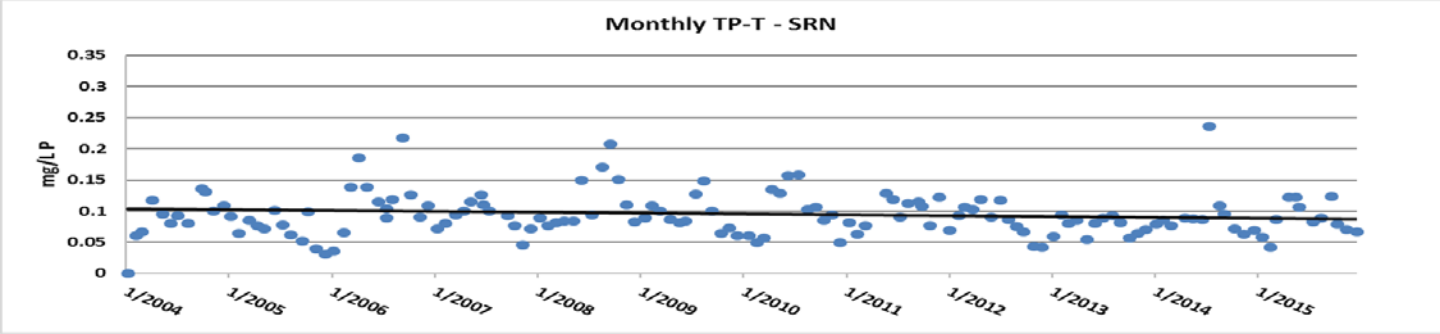
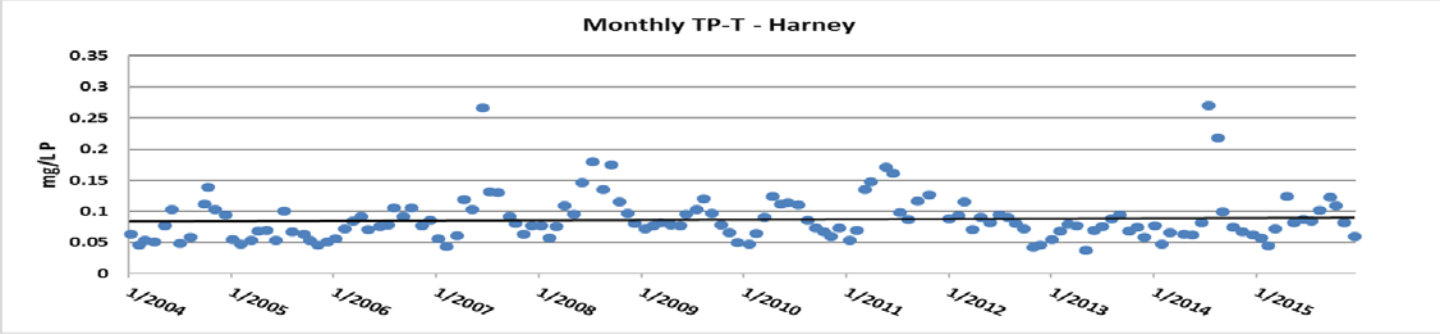
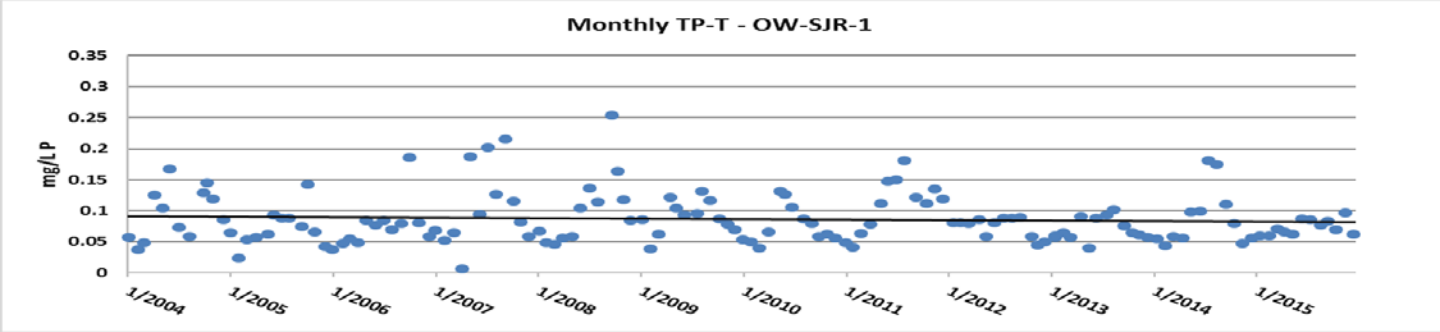


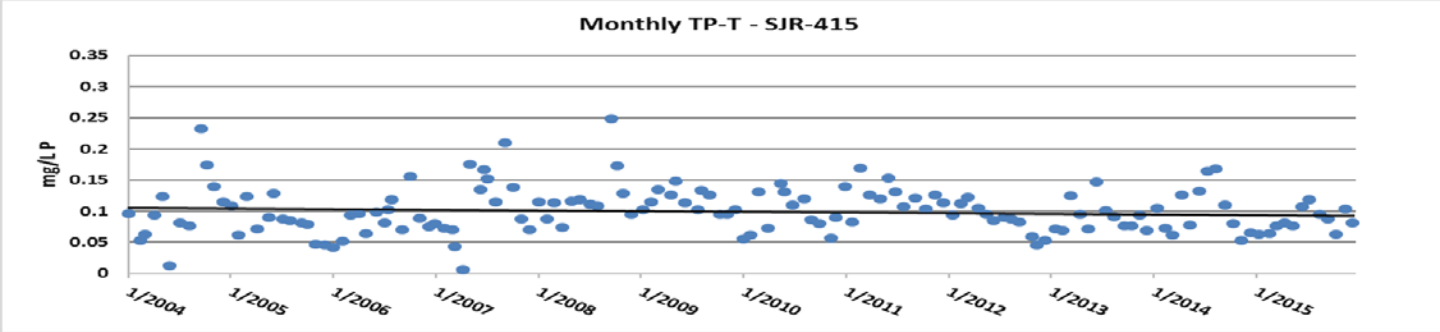
Figure 10. TN concentrations in the MSJR Basin, 2004–15

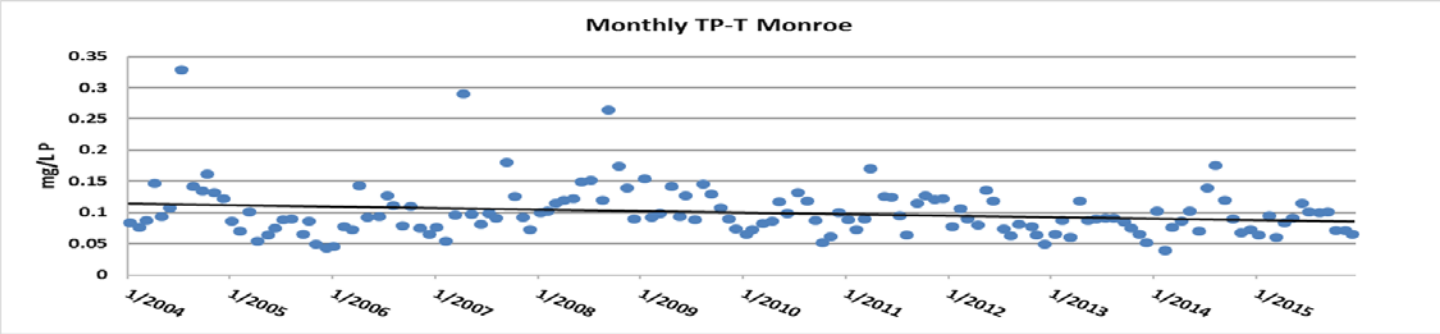



Monthly TP-T - SRN
mg/L P
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly TP-T - Harney
mg/L P
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly TP-T - OW-SJR-1
mg/L P
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly TP-T - SJR-415
mg/L P
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015



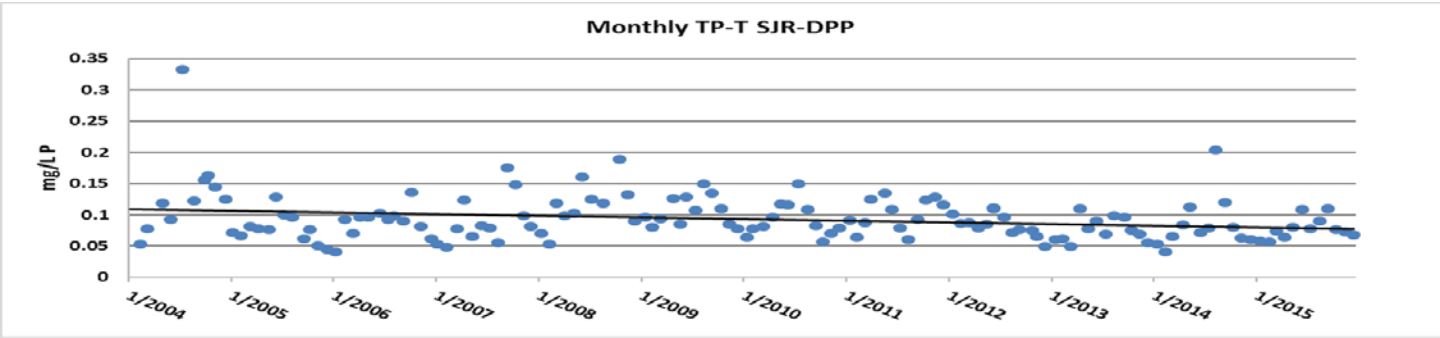
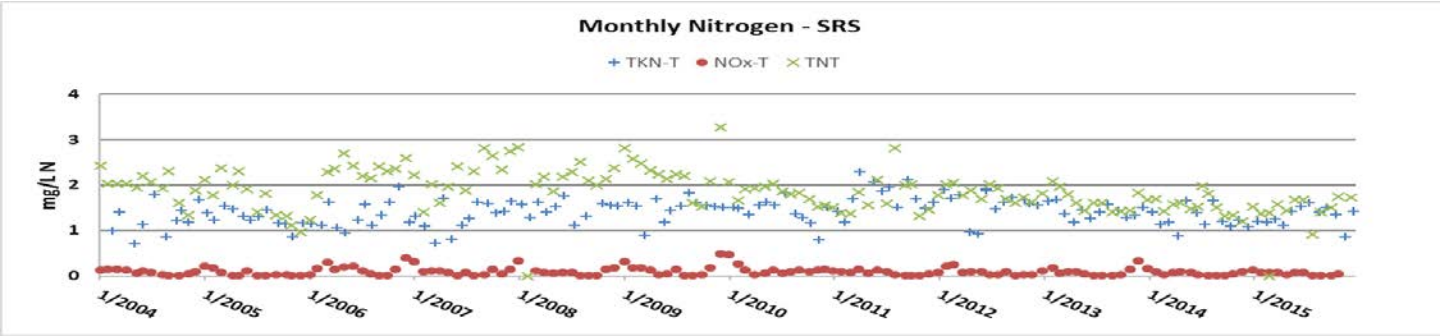
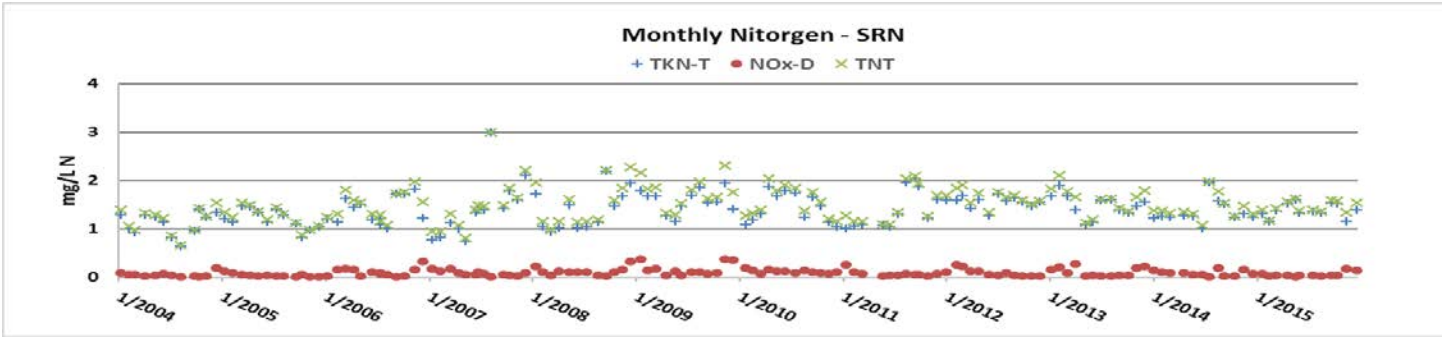
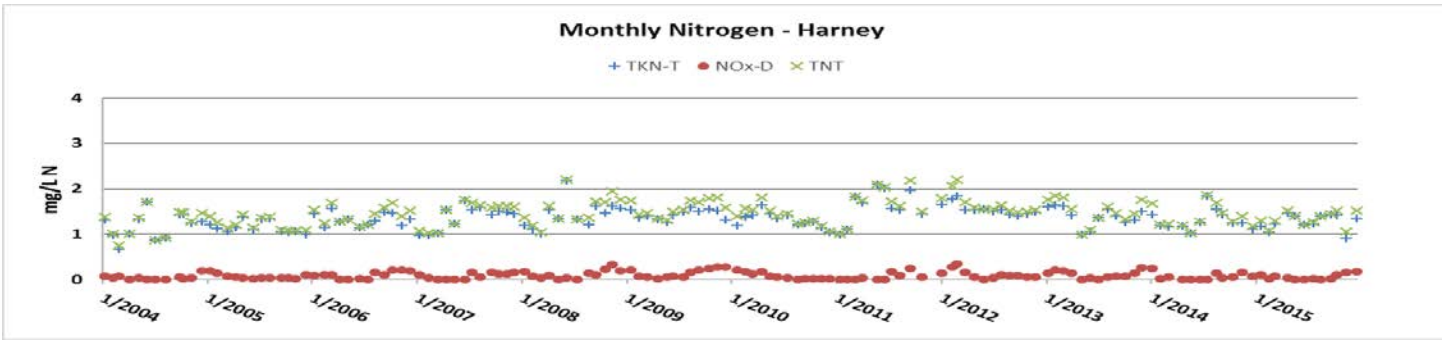
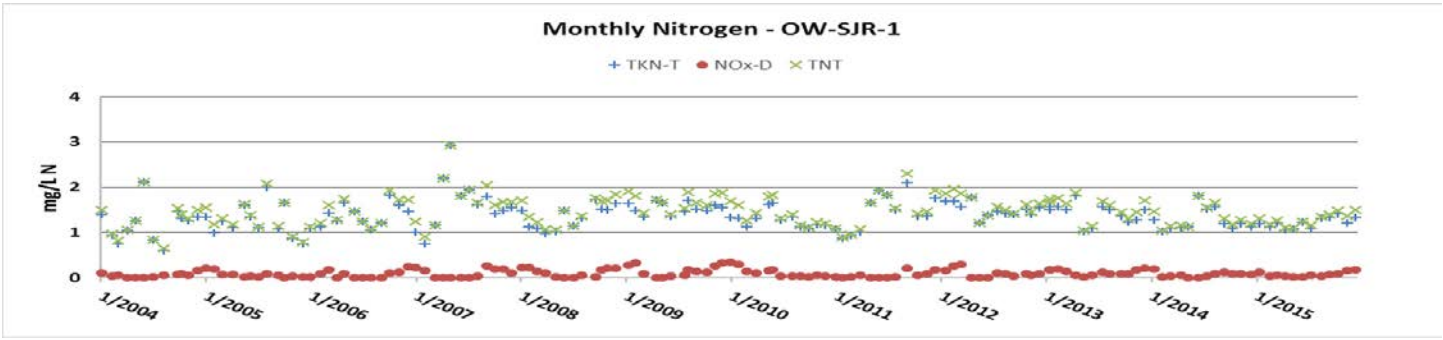


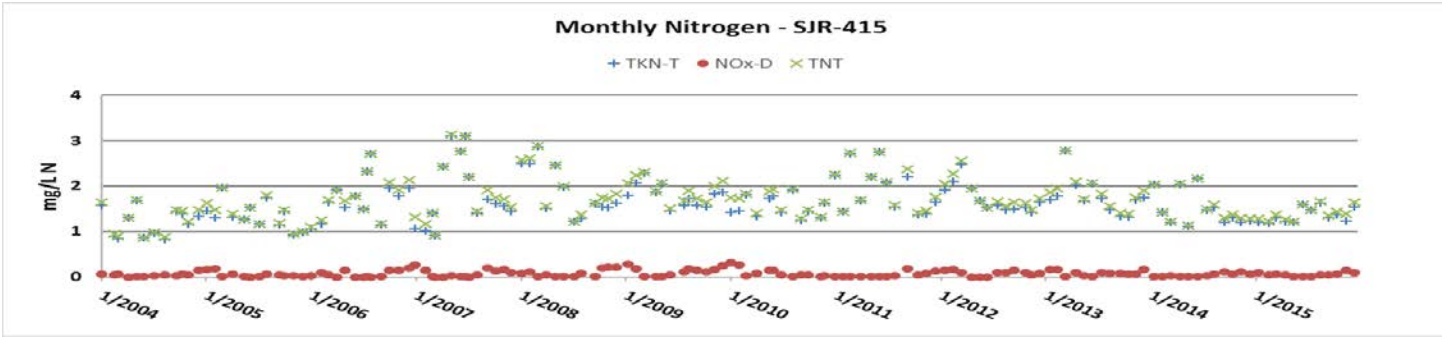
Figure 11. Time series for TP concentration for the MSJR mainstem sampling sites




Monthly Nitorgen - SRN
TKN-T
NOx-D
TNT
mg/L N
0
1
2
3
4
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Nitrogen - Harney
TKN-T
NOx-D
TNT
mg/L N
0
1
2
3
4
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Nitrogen - OW-SJR-1
TKN-T
NOx-D
TNT
mg/L N
0
1
2
3
4
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Nitrogen - SJR-415
TKN-T
NOx-D
TNT
mg/L N
0
1
2
3
4
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015

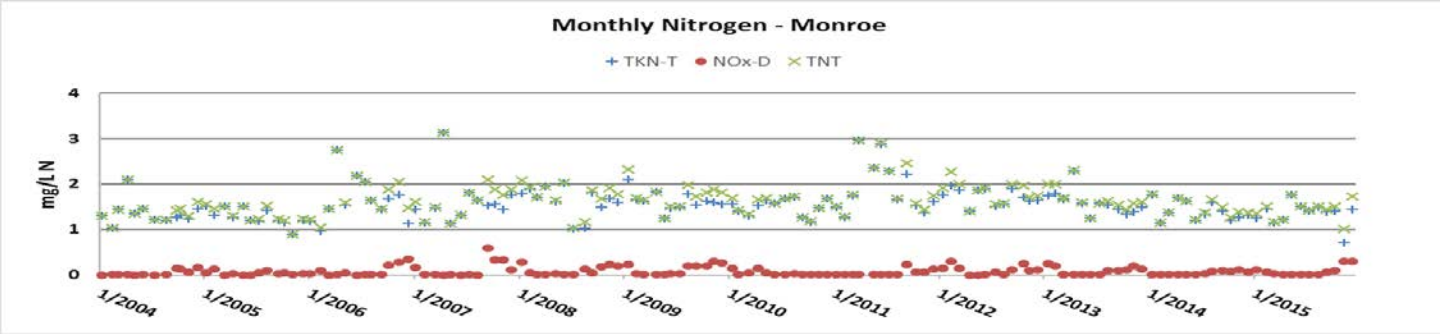
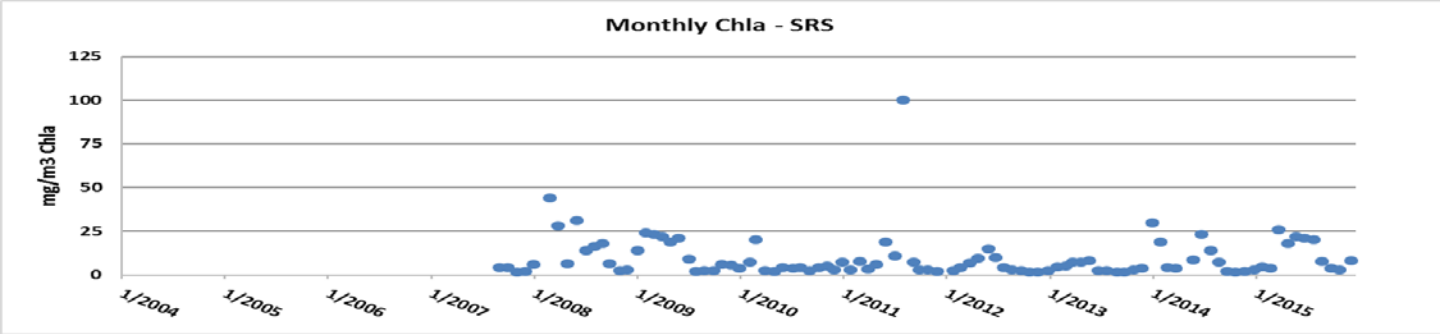
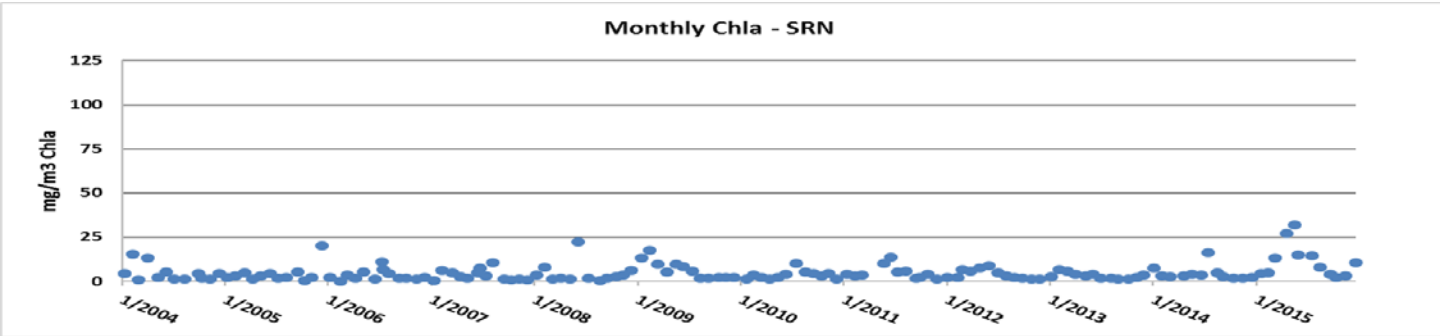
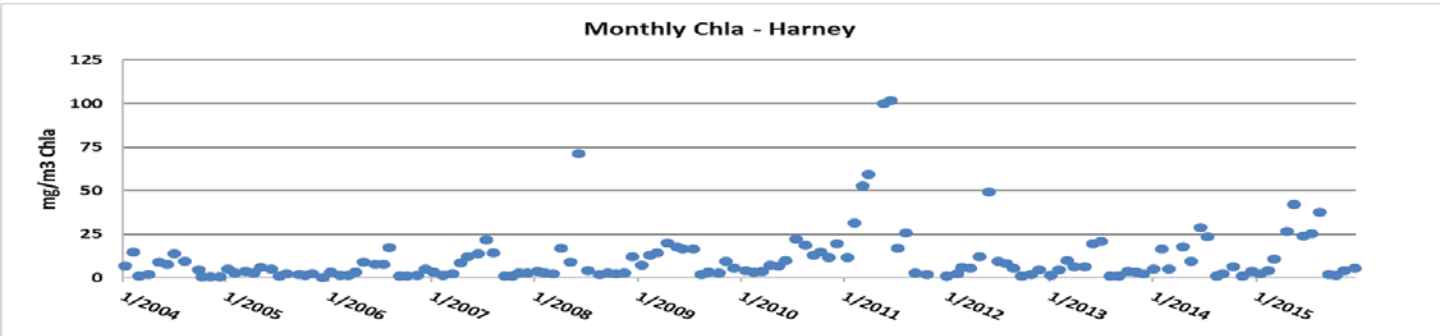
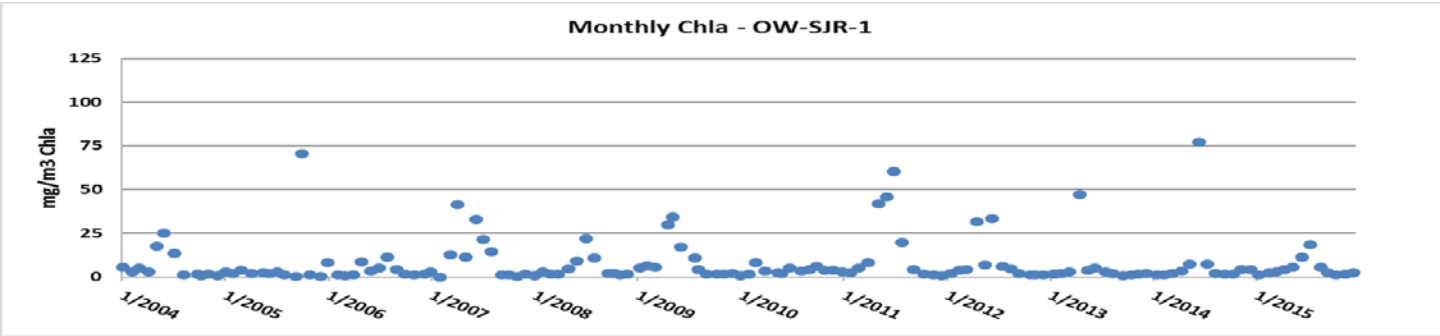


Figure 12. Time series for nitrogen species in the MSJR mainstem sampling sites


Monthly Chla - SRS
mg/m3 Chla
125
100
75
50
25
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Chla - SRN
mg/m3 Chla
125
100
75
50
25
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Chla - Harney
mg/m3 Chla
125
100
75
50
25
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015


Monthly Chla - OW-SJR-1
mg/m3 Chla
125
100
75
50
25
0
1/2004
1/2005
1/2006
1/2007
1/2008
1/2009
1/2010
1/2011
1/2012
1/2013
1/2014
1/2015

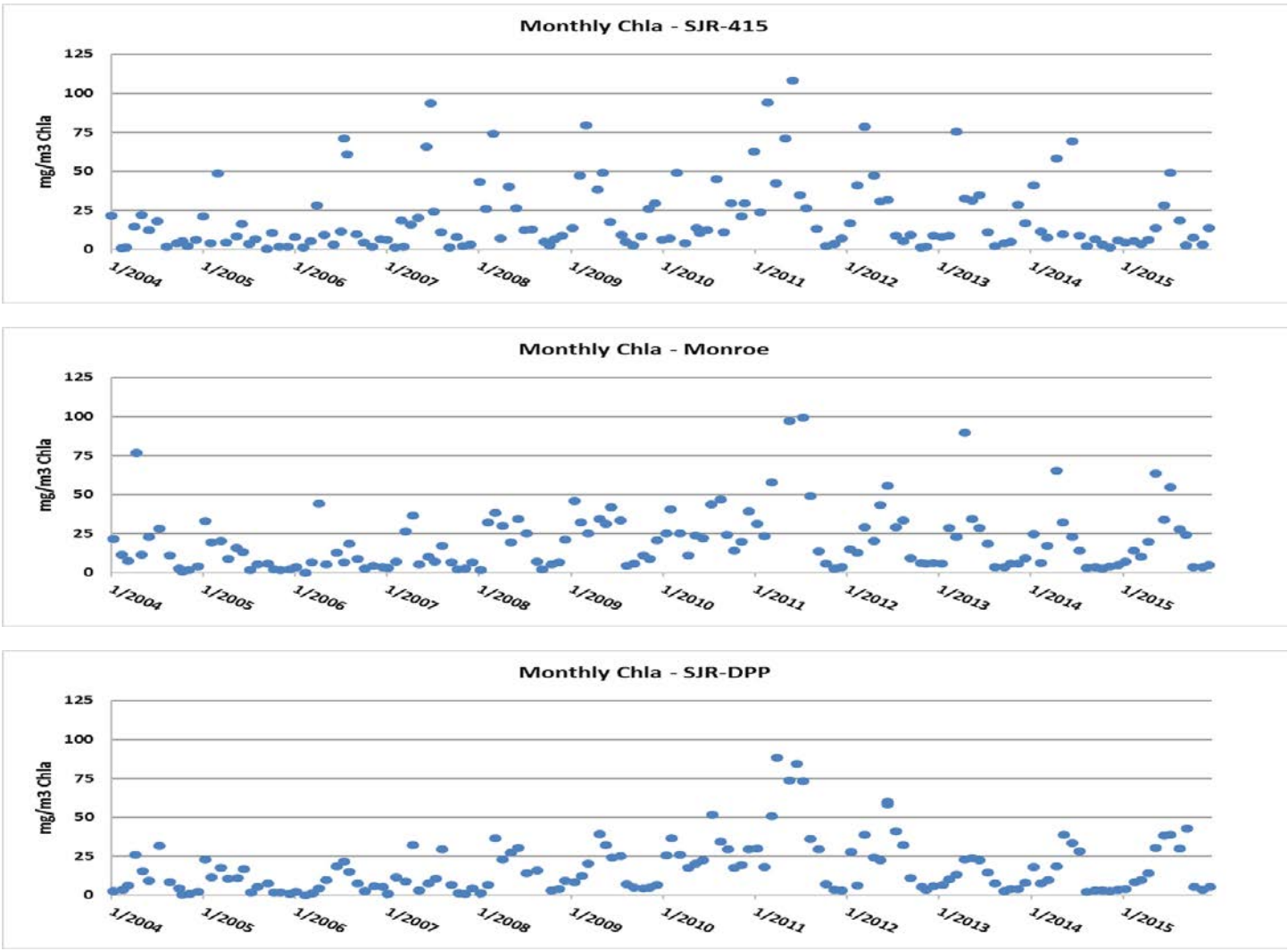


Figure 13. Time series for chlorophyll *a* for the MSJR mainstem sampling sites

Cyanobacteria were the predominant phytoplankton division at most sites in the MSJR Basin, except for the inflows to Lake Harney (Station SRN), where Bacillariophyta (diatoms) were predominant, and in Lake Ashby, where Pyrrophycophyta (dinoflagellates) predominated (**Figure 14**). The average phytoplankton biovolume from 2004 to 2015 was highest at Site SJR-415, probably reflecting the influence of Lake Jesup (its outfall is just upstream of SJR-415). Phytoplankton biovolumes were also relatively high in the downstream sites Lake Monroe and SJR-DPP.

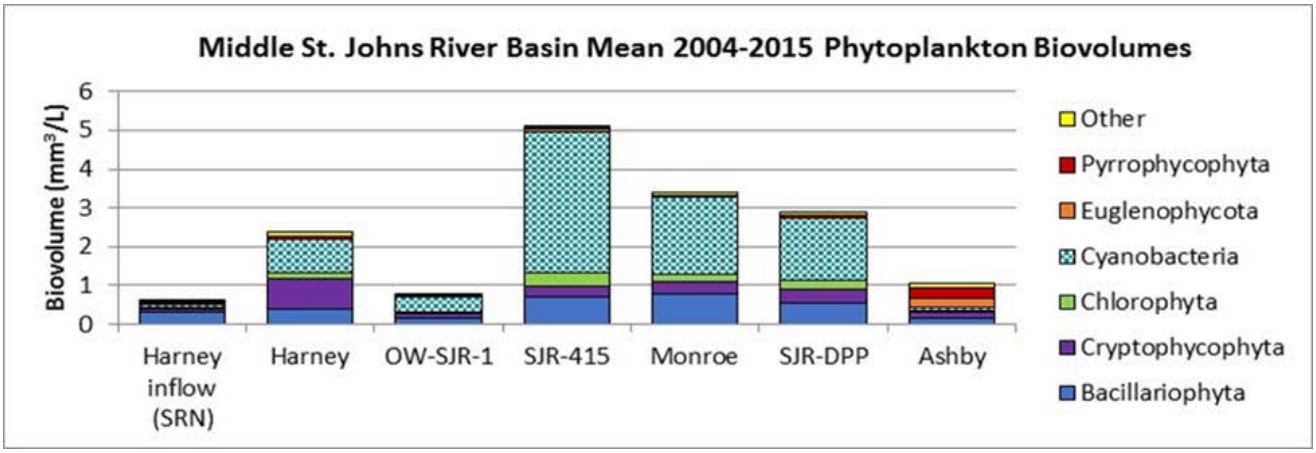


Figure 14. MSJR Basin average phytoplankton biovolumes, 2004–15

Four sites in the basin showed unusually high phytoplankton biovolumes in 2015, including the inflow to Lake Harney (at Sample Station SRN), Lake Harney, Lake Monroe, and SJR-DPP (biovolume data not available for 2011 to 2012). The 2015 increases were primarily because of Cyanobacteria at Lake Harney (**Figure 15**), Lake Monroe (**Figure 16**), and SJR-DPP, but primarily Bacillariophyta at SRN. The primary cyanobacterial genera in 2015 were *Anabaena* and *Anabaenopsis* in Lake Harney. *Planktolyngbya* and *Microcystis* were the primary cyanobacterial genera in Lake Monroe and at SJR-DPP. At SJR-415, the primary cyanobacterial genera in 2015 were *Cylindrospermopsis*, *Planktolyngbya*, and *Microcystis*.

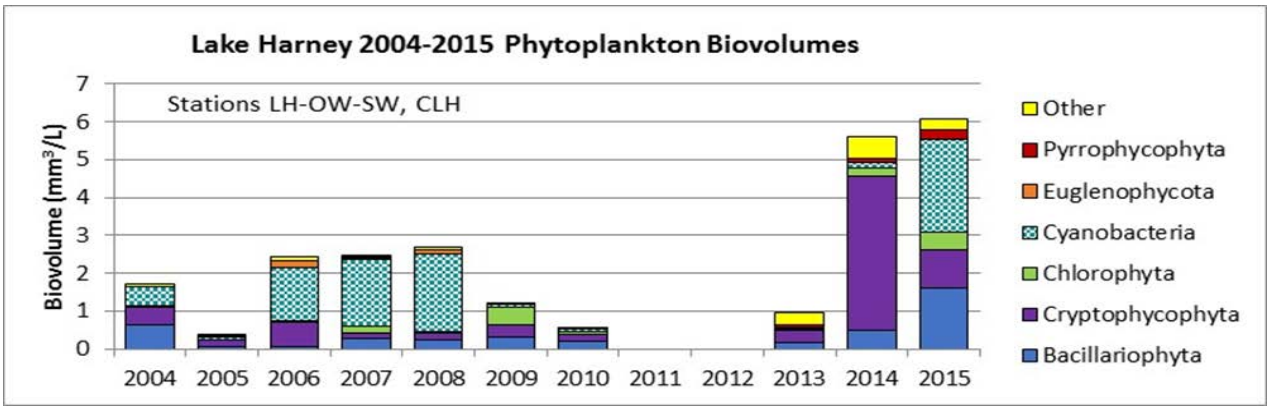


Figure 15. Lake Harney phytoplankton biovolumes (annual averages), 2004–15

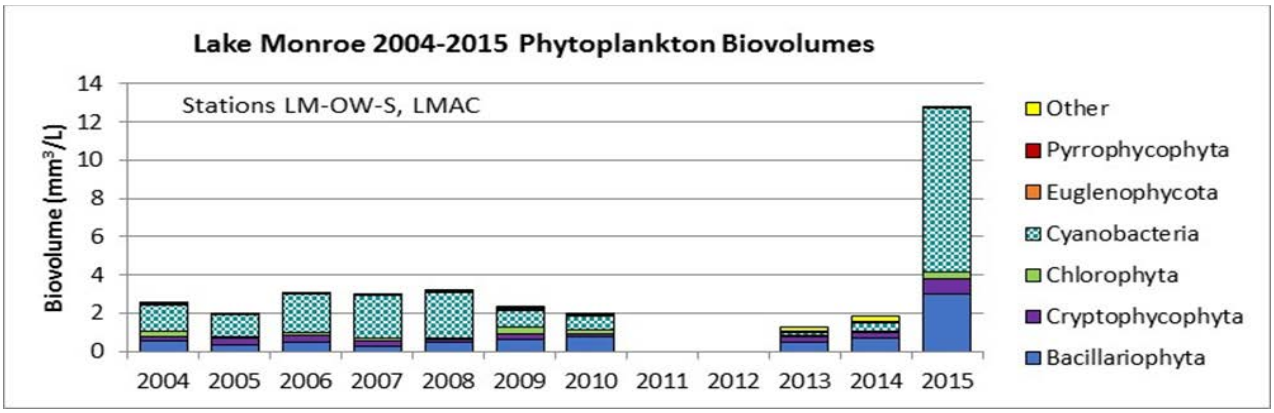


Figure 16. Lake Monroe phytoplankton biovolumes (annual averages), 2004–15

4.1.2 Tributary Water Quality

The Econlockhatchee River (Sample Site ECH) enters the SJR just upstream of Lake Harney (outfall between Sample Sites SRS and SRN). The tributaries to Lake Ashby form the headwaters for the Deep Creek sampling station (DCR-MRD), which enters the SJR just downstream of Lake Harney. The Deep Creek Diversion Canal (DMR) drains the western part of the Deep Creek Planning Unit and enters the SJR downstream of Deep Creek and upstream of Lake Jesup.

The Econlockhatchee enters the SJR at about the same TP concentration as the river, but a significantly lower TN concentration (**Table 8** and **Table 9**). Deep Creek drains into the SJR at a significantly higher TP concentration, but a significantly lower TN concentration ($p < 0.05$). The Deep Creek Diversion had a similar TP concentration but a significantly lower TN than the St. Johns River mainstem. Lake Jesup, covered in a separate summary, had a significantly higher mean TP concentration (0.16 milligrams per liter [mg/L]) than the SJR but lower than Deep Creek. Jesup's TN concentration (2.94 mg/L) is significantly higher than the SJR.

Table 8. Average water quality concentrations using monthly ambient data, 2004–15

Parameter	ECH	SRN	Ashby	DCR-MRD	DMR
TP, mg/L	0.099	0.09	0.100	0.180	0.081
TN, mg/L	0.894	1.46	0.963	1.137	1.270
TKN, mg/L	0.742	1.37	0.923	0.930	1.237
Chlorophyll *a*, mg/m³	1.215	4.88	6.457		

Table 9. Geometric mean nutrient concentrations using monthly ambient data, 2004–15

Note: Yellow highlighting and boldface type indicate exceedances of the NNC for streams/lakes.

Parameter	ECH	SRN	Ashby	DCR-MRD	DMR
TP, mg/L	0.095	0.088	0.092	**0.132**	0.068
TN, mg/L	0.87	1.42	0.94	1.09	1.2
TKN, mg/L	0.72	1.33	0.903	1.01	1.12
Chlorophyll *a*, mg/m^3	0.53	3.29	3.54		

The Econlockhatchee showed no significant increase or decrease in TP or TN between 2004 and 2015 (**Figure 17** and **Figure 18**). Comparing the Econlockhatchee outfall with the sampling site immediately downstream (SRN) indicated a significant correlation between the 2 sites for TP concentration (correlation coefficient [R] = 0.32, $p < 0.0001$), with no significant difference between monthly paired concentrations. Comparing the Econlockhatchee outfall with the sampling site immediately downstream indicated a significant correlation between the 2 sites for TN concentration ($R = 0.34$, $p < 0.0001$) but with a significant difference between monthly paired concentrations ($p < 0.0001$).

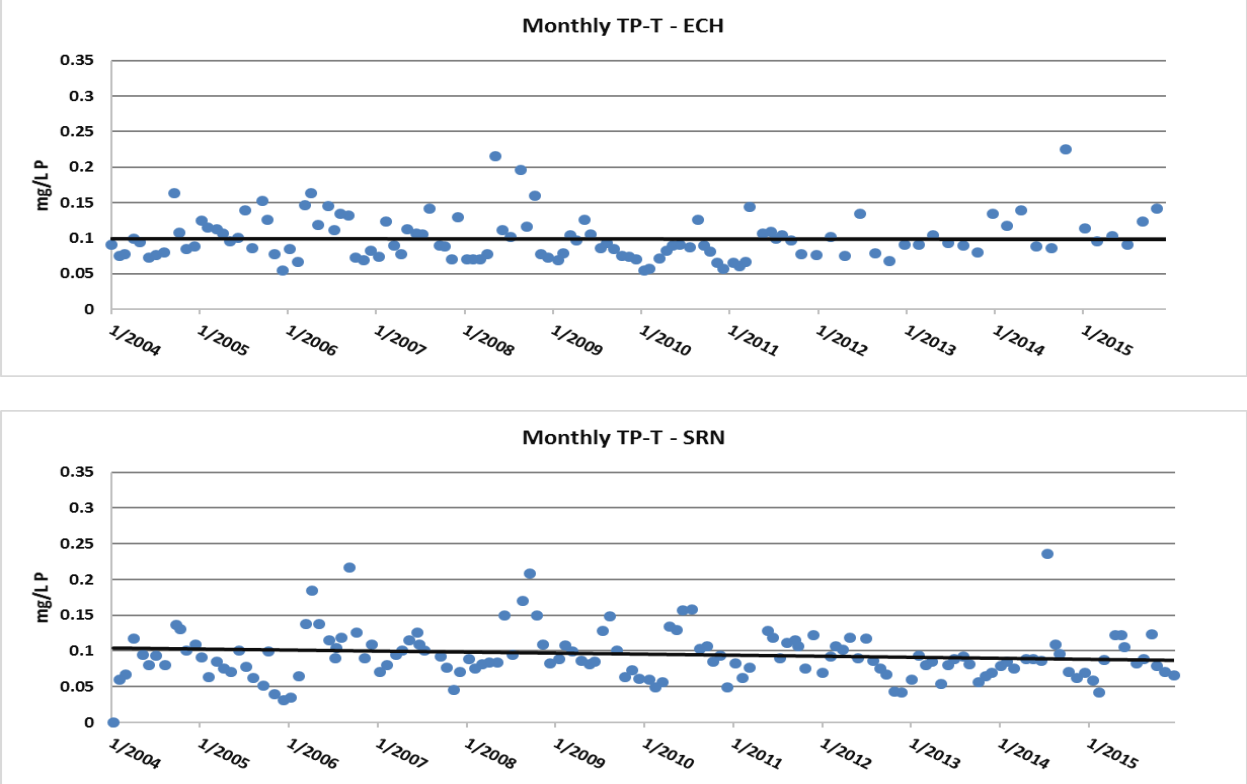


Figure 17. Time series of TP concentration for the Econlockhatchee River (ECH) just before the outfall into the St. Johns River, 2004–15

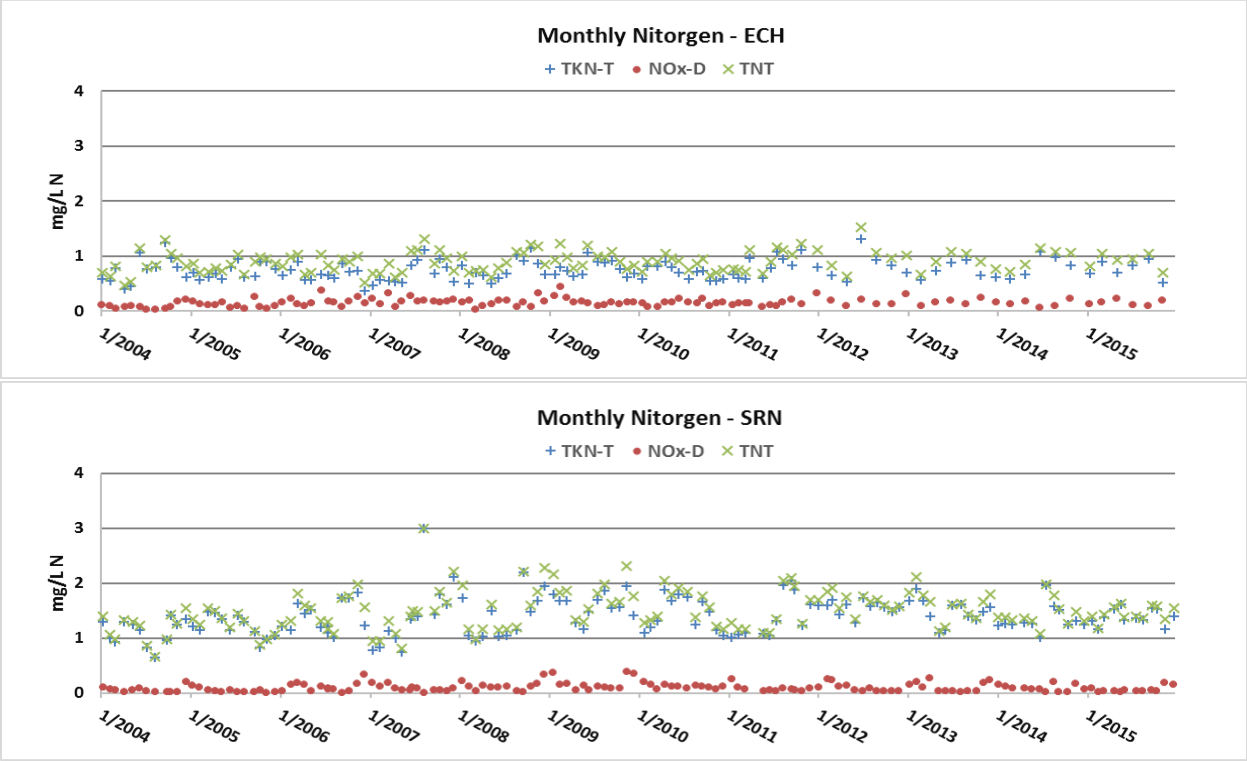


Figure 18. Nitrogen dynamics in the Econlockhatchee (ECH), 2004–15

Lake Ashby TP dynamics influence Deep Creek phosphorus levels most of the time, with higher storm events contributing to higher concentrations (**Figure 19**). However, further investigation shows Deep Creek (DMR-MRD) with highly variable spikes of elevated TP concentrations from 2007 to 2012 and suggests an unusual cause. During this period, Lukas Ranch (**Figure 21**) applied biosolids to pasture as a fertilizer and soil conditioner as a common field practice. When application began, large spikes in TP occurred, likely during large storm events.

Biosolids are high in organic carbon, TN, TP, and several essential metals. The carbon helps condition the soil to hold water and nutrients. The TN is in a slow-release form, which is the most beneficial to the plants. Unfortunately, the TP is at a high concentration relative to TN for what plants need. Adding biosolids to address the TN needs of crops or grasses will greatly overfertilize the field with TP. This excess TP is not absorbed by the plants and may wash off during large storm events when there is surface flow from the fields.

After the cessation of biosolids application at Lukas Ranch, the large spikes occur less frequently and can typically be attributed to the high percentage of agricultural land use in the watershed. Both Lake Ashby and Deep Creek TP concentrations are significantly lower when comparing the 2 periods of analysis: applied biosolids (2004–12) and postbiosolids (2013–15). The TP concentration dropped from 0.108 to 0.07 mg/L and 0.202 to 0.11 mg/L at Lake Ashby and Deep Creek, respectively. The Deep Creek Diversion TP concentrations were unchanged between the 2 periods.

Lake Ashby also influenced TN dynamics in Deep Creek (**Figure 20**), but no change in TN concentration was evident in Lake Ashby or Deep Creek. The Deep Creek Diversion had a higher TN concentration than Deep Creek but exhibited no significant change over the period examined.

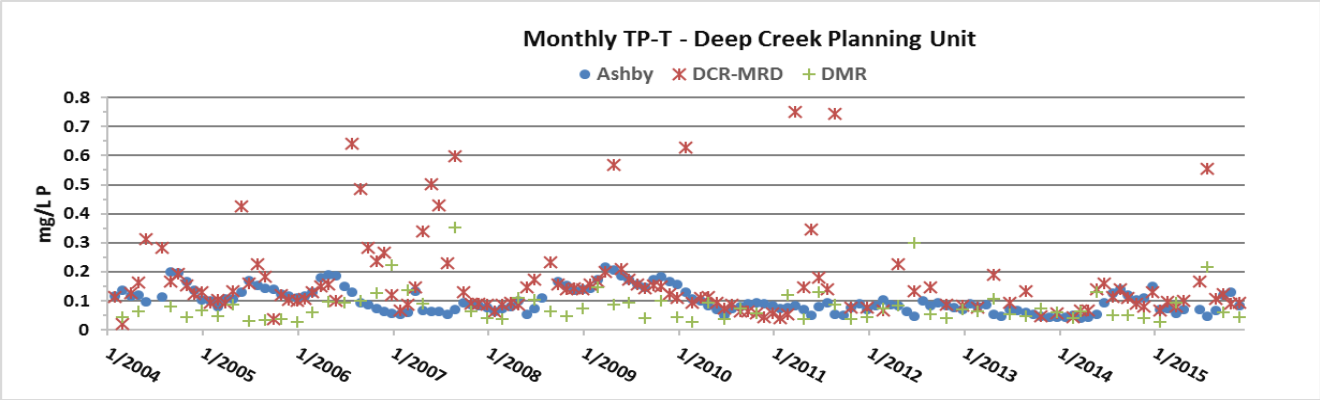


Figure 19. Time series for three waterbodies in the Deep Creek Planning Unit, 2004-–15

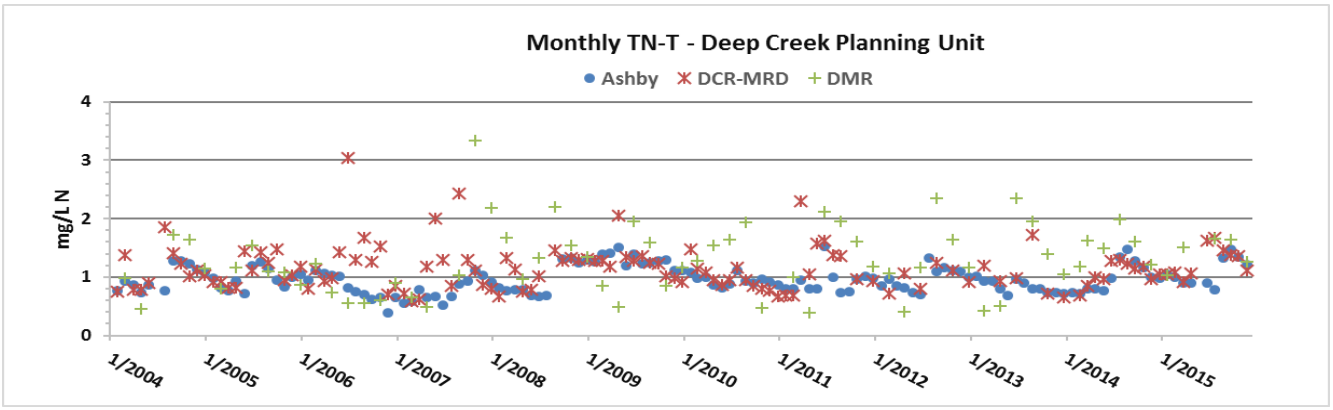


Figure 20. Time series of nitrogen in the Deep Creek system. 2004–15

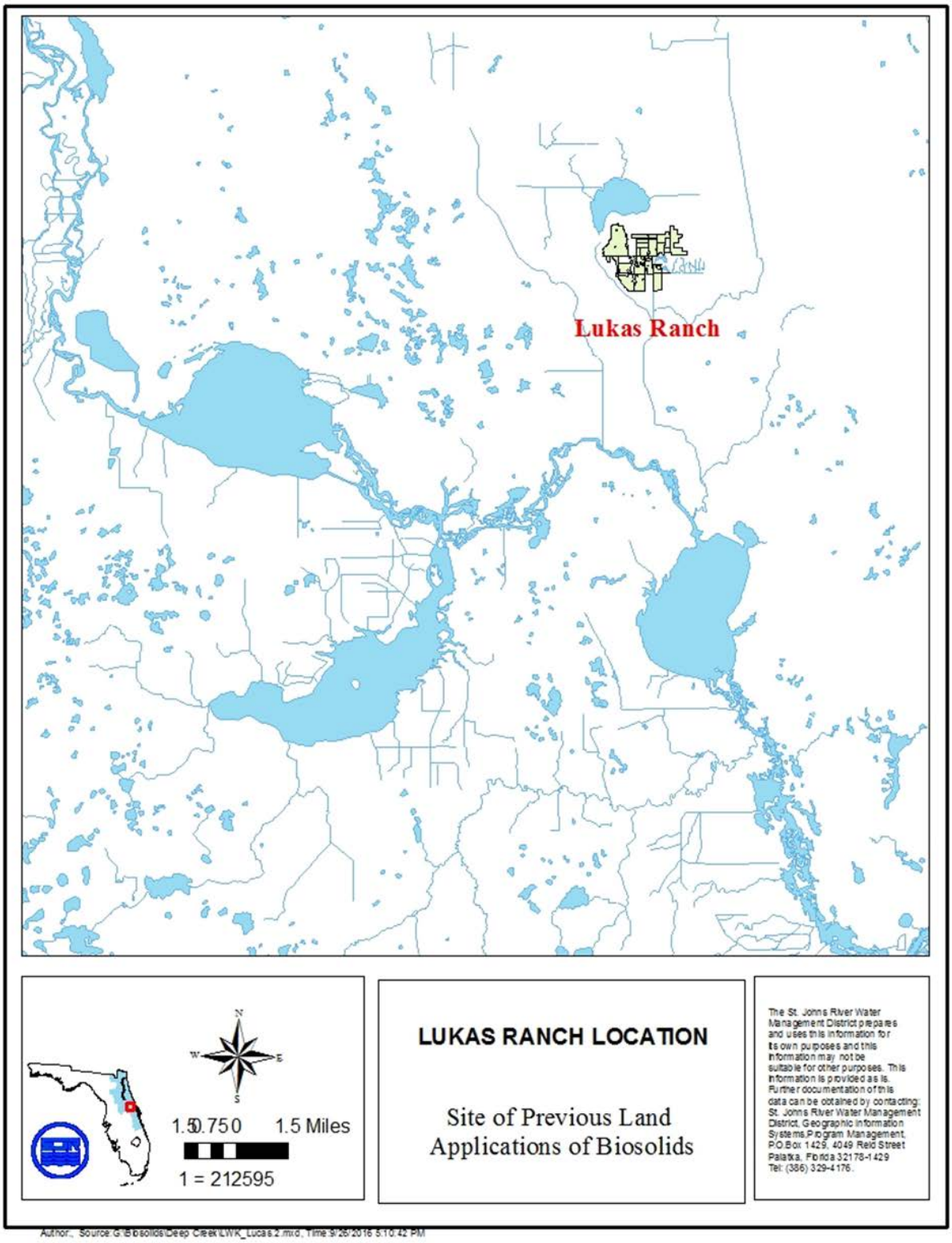


Figure 21. Location of Lukas Ranch

Lake Ashby has high TP concentrations and yet low chlorophyll *a* and phytoplankton abundance. It continues to maintain a healthy population of submerged aquatic vegetation. While this situation was also exhibited during the 2004–15 period, both chlorophyll *a* levels and phytoplankton populations have increased (**Figure 22** and **Figure 23**). Similar to trends throughout the middle basin, Cyanobacteria has become the dominant species in recent years. The primary cyanobacterial genus in 2015 was Anabaena. The SJRWMD will continue to monitor the lake for phytoplankton changes.

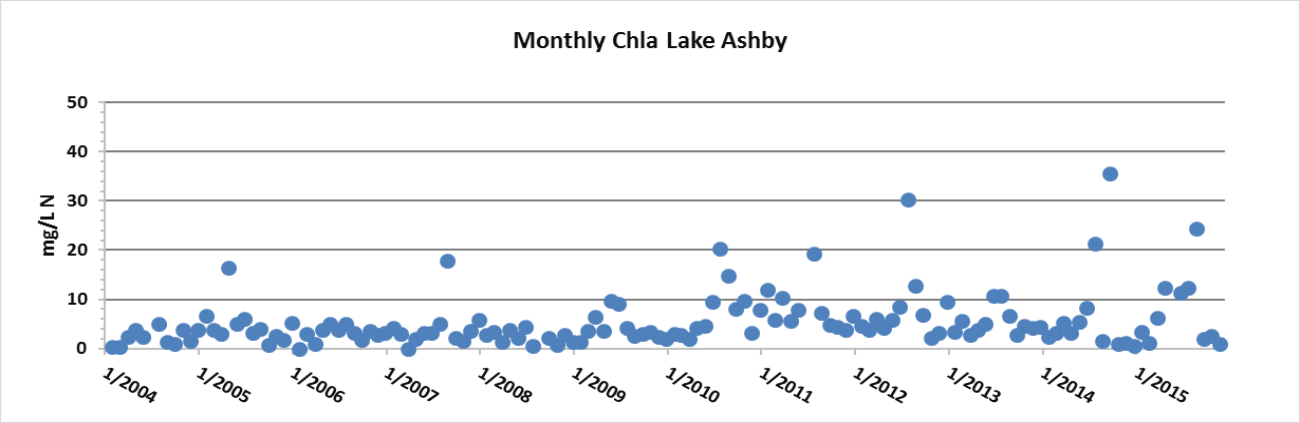


Figure 22. Time series of chlorophyll *a* in Lake Ashby, 2004–15

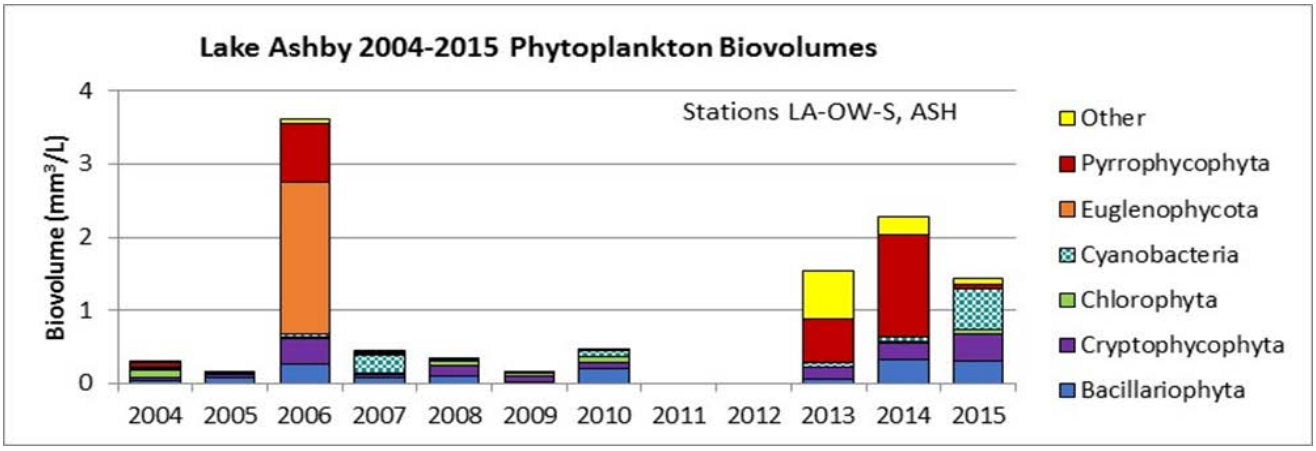


Figure 23. Phytoplankton biovolumes in Lake Ashby, 2004–15

Appendices

Appendix A: BMAP Projects

The BMAP project tables below list the implementation status of the BMAP projects as of August 31, 2016. The tables provide information on the nutrient reduction attributed to each individual project, shown in lbs/yr. These projects were submitted to provide reasonable assurance to DEP that each entity has a plan on how it will meet its allocation. However, this list of projects is meant to be flexible enough to allow for changes that may occur over time, provided that the reduction is still met within the specified period.

Table A-1. City of DeBary projects

* Noncontributing basins are defined in Section 1.4 (Assumptions and Considerations Regarding TMDL Implementation) in the Lakes Harney and Monroe and MSJR BMAP.

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
DB-1	Noncontributing Basin	Noncontributing basin; not included in the TMDL model	Noncontributing Basin	Completed	6,523	1,037
DB-2	Noncontributing Basin	Noncontributing basin; not included in the TMDL model	Noncontributing Basin	Completed	7,039	1,170

Table A-2. City of DeBary summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	13,562	2,207
Total BMAP I Required Reduction	1,880	86
Credit for Future BMAPs	11,682	2,121

Table A-3. City of DeLand projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
DL-1	Education Efforts	Florida Yards and Neighborhoods (FYN) Program, irrigation ordinance, fertilizer ordinance, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	9	1

Table A-4. City of DeLand summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	9	1
Total BMAP I Required Reduction	0	0
Credit for Future BMAPs	9	1

Table A-5. City of Deltona projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
DEL-1	McGarity Kirkhill Regional Stomwater Facility (RSF)	Retrofit project to treat surface water runoff from a residential area in the city	Wet Detention Pond	Completed	345	92
DEL-2	DRA GC-5	Water quality treatment for a residential area	Retention Pond	Completed	26	4
DEL-3	Swales	Swales throughout the city	Swales	Completed	4,820	729
DEL-4	Lake Gleason Control Structure	Proposed control structure to increase storage in Lake Gleason	Wet Detention Pond	Completed	672	188
DEL-5	Education Efforts	FYN, irrigation ordinance, pet waste ordinance, PSAs, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	1,270	206
DEL-6	Catch Basin Maintenance	Catch basin cleanout throughout the city	Catch Basin Maintenance	Ongoing	19	10
DEL-7	Leland Dr. Retention Pond		Retention Pond	Completed	Not quantified	Not quantified
DEL-8	Tivoli/Wheeling Forcemain to Rapid Infiltration Basin Stormwater Retention Ponds		Rapid Infiltration Basin	Completed	Not quantified	Not quantified

Table A-6. City of Deltona summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	7,151	1,230
Total BMAP I Required Reduction	3,609	388
Credit for Future BMAPs	3,543	842

Table A-7. City of Lake Helen projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
LH-1	Education Efforts	Irrigation ordinance, pet waste ordinance, pamphlets, website, stormwater pollution prevent factsheet	Education Efforts	Ongoing	31	5

Table A-8. City of Lake Helen summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	31	5
Total BMAP I Required Reduction	0	0
Credit for Future BMAPs	31	5

Table A-9. City of Lake Mary projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
LM-1	Education Efforts	FYN, landscape ordinance, irrigation ordinance, pet waste ordinance, PSAs, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	362	52
LM-2	Street Sweeping	Sweeping of 53.58 curb miles per year	Street Sweeping	Ongoing	10	6

Table A-10. City of Lake Mary summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	371	59
Total BMAP I Required Reduction	0	0
Credit for Future BMAPs	371	59

Table A-11. City of Orange City projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
OC-1	Education Efforts	Irrigation ordinance, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	1	0

Table A-12. City of Orange City summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	1	0
Total BMAP I Required Reduction	0	0
Credit for Future BMAPs	1	0

Table A-13. City of Sanford projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
S-1	Cloud Branch Phase I	Drainage/water quality improvements	Wet Detention Pond	Completed	647	174
S-2	Cloud Branch Phase II	Drainage/water quality improvements	Wet Detention Pond	Completed	1,390	406
S-3	Street Sweeping	Street sweeping throughout the city	Street Sweeping	Ongoing	8,867	3,993
S-4	Education Efforts	FYN, landscaping ordinance, irrigation ordinance, PSAs, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	2,070	325
S-5	Sanford Avenue Baffle Box	Baffle box on Sanford Avenue	Baffle Box	Completed	6	1
S-6	Mill Creek Wet Detention Pond	Drainage/water quality improvements	Wet Detention Pond	Completed	1,466	434
S-7	Baffle Boxes on 2nd Street	Baffle box on 2nd Street	Baffle Box	Completed	9	7

Table A-14. City of Sanford summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	14,454	5,339
Total BMAP I Required Reduction	10,360	1,340
Credit for Future BMAPs	4,094	3,999

Table A-15. FDOT projects

*Noncontributing areas are defined in Section 1.4 (Assumptions and Considerations Regarding TMDL Implementation) in the Lakes Harney and Monroe and MSJR BMAP.
N/A = Not available.

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
FDOT-1	79070-3547-02 (Pond 2)		Wet Detention Pond	Completed	20	2
FDOT-2	79070-3547-03 (Pond 3)		Wet Detention Pond	Completed	12	1
FDOT-3	79070-3547-04 (Pond 4)		Wet Detention Pond	Completed	16	1
FDOT-4	79070-3547-06 (Pond 6)		Wet Detention Pond	Completed	14	1
FDOT-5	79070-3546-03 (Pond 9)		Wet Detention Pond	Completed	13	9
FDOT-6	79070-3546-02 (Pond 8)		Wet Detention Pond	Completed	25	6
FDOT-7	79070-3547-05 (Pond 5)		Wet Detention Pond	Completed	25	3
FDOT-8	79070-3546-01 (Pond 7)		Wet Detention Pond	Completed	20	1
FDOT-9	79070-3546-04 (Pond 10)		Wet Detention Pond	Completed	4	3
FDOT-10	79110-xxx (Pond 4)		Wet Detention Pond	Completed	8	2
FDOT-11	79110-xxx (Pond 5)		Wet Detention Pond	Completed	27	6
FDOT-12	79110-xxx (Pond 6)		Wet Detention Pond	Completed	14	3
FDOT-13	79110-xxx (Pond 7)		Wet Detention Pond	Completed	38	8
FDOT-14	79110-xxx4-01 & 02 (Pond 1 and 1A)		Wet Detention Pond	Completed	54	11
FDOT-15	79110-xxx4-03 & 04 (Pond 2 and 2A)		Wet Detention Pond	Completed	65	13
FDOT-16	79110-xxx4-05 (Pond 14)		Wet Detention Pond	Completed	44	8
FDOT-17	SR 415–Missing from Model		Swales	Completed	90	28
FDOT-18	SR 44–Missing from Model		Swales	Completed	34	11
FDOT-19	SR 46–Missing from Model		Swales	Completed	33	7
FDOT-20	77160-3404-02		Retention BMPS	Completed	94	13

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
	(Pond 1-Nw)					
FDOT-21	77160-3404-06 (Pond 4-11)		Wet Detention Pond	Completed	103	24
FDOT-22	77160-3404-05 (Pond 4-1)		Wet Detention Pond	Completed	45	12
FDOT-23	77160-3404-07 (Pond 5)		Wet Detention Pond	Completed	47	9
FDOT-24	77160 3436		Swales	Completed	148	20
FDOT-25	77160-3439-01 (Pond 1)		Wet Detention Pond	Completed	7	1
FDOT-26	79110-3404-04 & 05 (Pond Qq-3 and Qq-5)		Wet Detention Pond	Completed	56	12
FDOT-27	79110-3404-06 (Rr-3)		Wet Detention Pond	Completed	68	17
FDOT-28	79110-3404-07 (Pond Ss-2)		Wet Detention Pond	Completed	92	26
FDOT-29	Roadside Swale		Swales	Completed	94	14
FDOT-30	Roadside Swale		Swales	Completed	40	6
FDOT-31	SR 415–Missing from Model		Swales	Completed	39	9
FDOT-32	Education Efforts		Education Efforts	Ongoing	101	13
FDOT-33	Street Sweeping		Street Sweeping	Ongoing	410	263
FDOT-34	Noncontributing Debary		Noncontributing Area	Completed	195	28
FDOT-35	Noncontributing County		Noncontributing Area	Completed	118	19
FDOT-36	SR 415 (Pond A)		Wet Detention Pond	Completed	7	2
FDOT-37	SR 415 (Pond B)		Wet Detention Pond	Completed	8	1
FDOT-38	Sr 415–Exfiltration Trench		Retention BMPS	Completed	12	0
FDOT-39	SR 415 (Pond H)		Wet Detention Pond	Completed	10	2
FDOT-40	SR 46 (Pond 1)		Wet Detention Pond	Under way	26	6
FDOT-41	SR 46 (Pond 2)		Wet Detention Pond	Under way	19	5
FDOT-42	Fertilizer Cessation		Fertilizer Cessation	Completed	712	N/A
FDOT-43	SR 400 Widening (from SR 44 to East of I-95)		Wet Detention Pond	Completed	52	1
FDOT-44	SR 400 Widening (from SR 44 to East of I-95)		Wet Detention Pond	Completed	59	1

Table A-16. FDOT summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	3,117	629
Total BMAP I Required Reduction	1,232	0
Credit for Future BMAPs	1,885	627

Table A-17. Seminole County projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
SC-1	Club RSF	RSF to collect and treat stormwater runoff	Club II RSF	Completed	1,333	396
SC-2	Midway RSF	RSF to collect and treat stormwater runoff	Midway RSF	Completed	408	118
SC-3	Elder RSF	RSF to collect and treat stormwater runoff	Elder Creek RSF	Completed	519	134
SC-4	Lockhart RSF	RSF to collect and treat stormwater runoff	Lockhart-Smith RSF	Completed	3,201	840
SC-5	Street Sweeping	Street sweeping throughout the county	Street Sweeping	Ongoing	300	135
SC-6	Education Efforts	FYN, landscaping ordinance, irrigation ordinance, pet waste ordinance, PSAs, pamphlets, website, illicit discharge program	Education Efforts	Ongoing	1,876	282

Table A-18. Seminole County summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	7,638	1,906
Total BMAP I Required Reduction	3,974	155
Credit for Future BMAPs	3,664	1,750

Table A-19. Turnpike Authority projects

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
T-1	Street Sweeping	Sweep 120 lane miles per year	Street Sweeping	Ongoing	22	14

Table A-20. Turnpike Authority summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	22	14
Total BMAP I Required Reduction	0	0
Credit for Future BMAPs	22	14

Table A-21. Volusia County projects

*Noncontributing basins are defined in Section 1.4 (Assumptions and Considerations Regarding TMDL Implementation) in the Lakes Harney and Monroe and MSJR BMAP.

Project Number	Project Name	Description	Project Type	Project Status	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
VC-1	Education Outreach		Education and Outreach	Ongoing	1,392	201
VC-2	Street Sweeping		Street Sweeping	Ongoing	1,483	668
VC-3	Lemon Bluff Road		Swales	Completed	7	1
VC-4	Lemon Bluff Road Ramp		Swales	Completed	1	0
VC-5	Debary Avenue Expansion		Wet Detention Pond	Completed	41	10
VC-6	Lake Winnemissett Noncontributing Basin		Noncontributing Basin	Completed	658	94
VC-7	Roadside Ditch Cleaning		Ditch Cleaning	Ongoing	905	556

Table A-22. Volusia County summary of reductions

Category	TN Reduction (lbs/yr)	TP Reduction (lbs/yr)
Total Projects Reduction	4,486	1,530
Total BMAP I Required Reduction	1,633	0
Credit for Future BMAPs	2,853	1,530